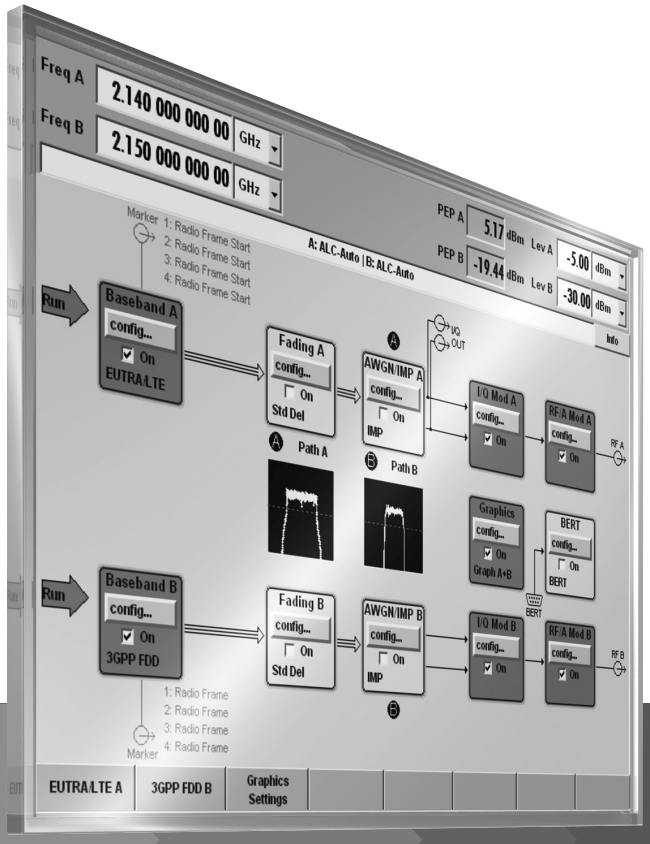
DIGITAL STANDARDS FOR SIGNAL GENERATORS

Specifications

R&S®SMW200A Vector Signal Generator
R&S®SMM100A Vector Signal Generator
R&S®SMBV100B Vector Signal Generator



Specifications
Version 24.00

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Introduction

This document describes the digital standard options of the R&S®SMW200A, R&S®SMM100A and R&S®SMBV100B vector signal generators.

Related documents

This document provides the functional specifications of the digital standards that are running on the instrument.

The digital standards with R&S®WinIQSIM2 are described in the R&S®WinIQSIM2 data sheet (PD 5213.7460.22).

The GNSS options for the R&S®SMW200A are described in the “GNSS and Avionics Simulation for Rohde & Schwarz Signal Generators” data sheet (PD 3607.6896.22).

The options with external R&S®Pulse Sequencer Software are described in the pulse sequencer options data sheet (PD 3607.1388.22).

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

R&S®SMW200A data sheet: PD 3606.8037.22,
R&S®SMM100A data sheet: PD 3608.7680.22,
R&S®SMBV100B data sheet: PD 3607.8201.22.

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. This means that R&S®SMW-K42 is the 3GPP FDD option for the R&S®SMW200A, R&S®SMM-K42 is the 3GPP FDD option for the R&S®SMM100A and R&S®SMBVB-K42 is the 3GPP FDD option for the R&S®SMBV100B. Digital standard functionality is the same for all instruments, unless otherwise stated. Therefore, standard specifications (e.g. 3GPP FDD -K42 option) are valid for all instrument options (in this example R&S®SMW-K42, R&S®SMM-K42, R&S®SMBVB-K42), unless otherwise stated.

Baseband generators and prerequisite for installation

Any digital standard requires a baseband generator installed on the respective Rohde & Schwarz instrument.
The following baseband generators are available:

For the R&S®SMW200A	R&S®SMW-B10	baseband generator with ARB (64 Msample) and digital modulation (real-time), 120 MHz RF bandwidth
	The following enhancement options can be added to the R&S®SMW-B10 options:	
	R&S®SMW-K511	ARB memory extension to 512 Msample
	R&S®SMW-K512	ARB memory extension to 1 Gsample
	R&S®SMW-K522	bandwidth extension to 160 MHz RF bandwidth
	R&S®SMW-B9	wideband baseband generator with ARB (256 Msample), 500 MHz RF bandwidth
	R&S®SMW-B9F	wideband baseband generator for GNSS with high dynamics [1], with ARB (256 Msample), 500 MHz RF bandwidth
	The following enhancement options can be added to the R&S®SMW-B9/-B9F options:	
	R&S®SMW-K515	ARB memory extension to 2 Gsample
	R&S®SMW-K525	bandwidth extension to 1 GHz RF bandwidth
	R&S®SMW-K527	bandwidth extension to 2 GHz RF bandwidth
For the R&S®SMM100A	R&S®SMM-B9	baseband generator with ARB (64 Msample), 120 MHz RF bandwidth
	The following enhancement options can be added to the R&S®SMM-B9 option:	
	R&S®SMM-K511	ARB memory extension to 512 Msample
	R&S®SMM-K512	ARB memory extension to 1 Gsample
	R&S®SMM-K513	ARB memory extension to 2 Gsample
	R&S®SMM-K520	baseband real-time extension
	R&S®SMM-K523	baseband extension to 240 MHz RF bandwidth
	R&S®SMM-K524	baseband extension to 500 MHz RF bandwidth
	R&S®SMM-K525	baseband extension to 1 GHz RF bandwidth
For the R&S®SMBV100B	standard, included in minimum configuration	baseband generator with ARB (64 Msample), 120 MHz RF bandwidth
	The following enhancement options can be added:	
	R&S®SMBVB-K511	ARB memory extension to 512 Msample
	R&S®SMBVB-K512	ARB memory extension to 1 Gsample
	R&S®SMBVB-K513	ARB memory extension to 2 Gsample
	R&S®SMBVB-K520	baseband real-time extension
	R&S®SMBVB-K523	baseband extension to 240 MHz RF bandwidth
	R&S®SMBVB-K524	baseband extension to 500 MHz RF bandwidth

Prerequisite for installation on the R&S®SMW200A

At least one R&S®SMW-B9/-B9F or R&S®SMW-B10 baseband generator must be installed. Which standard is available with which baseband generator is shown in the overview table in the next section.

If two 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®SMW-K40). If only one R&S®SMW-K40 option is installed and GSM/EDGE is selected in one baseband generator, the other baseband generator is disabled for GSM/EDGE. Software options are not tied to a specific baseband generator.

Prerequisite for installation on the R&S®SMM100A

The R&S®SMM-B9 baseband generator and the R&S®SMM-K520 baseband real-time extension must be installed.

Prerequisite for installation on the R&S®SMBV100B

The R&S®SMBVB-K520 baseband real-time extension must be installed.

[1] The R&S®SMW-B9F wideband baseband generator enables high dynamics in line with GNSS standards. For details, see the GNSS simulation for Rohde & Schwarz signal generators data sheet (PD 5213.9434.22). Enhancements of the R&S®SMW-B9 option and software options that run on the R&S®SMW-B9 option run also with the R&S®SMW-B9F option.

Overview of digital standards on the different instruments

The following table gives an overview of the standards that are available for the different instruments and option types. For better readability, option types are abbreviated as follows:

The R&S®SMW-K55 option is referred to as “SMW-K55”, and so on.

For R&S®SMW200A:

Italics: standards that run on the wideband baseband (R&S®SMW-B9) only.
Plain text: standards that run on both the wideband baseband (R&S®SMW-B9) and the standard baseband (R&S®SMW-B10).

	R&S®SMW200A	**R&S®SMM100A**	**R&S®SMBV100B**
Cellular standards			
5G New Radio release 15	SMW-K144	SMM-K144	SMBVB-K144
5G New Radio release 16	SMW-K148	SMM-K148	SMBVB-K148
5G New Radio release 17/18	SMW-K171	SMM-K171	SMBVB-K171
5G NR closed-loop BS tests	SMW-K145	–	–
5G NR sidelink	SMW-K170	SMM-K170	–
Verizon 5GTF signals	SMW-K118	–	–
LTE release 8	SMW-K55	SMM-K55	SMBVB-K55
LTE closed-loop BS test	SMW-K69	–	–
Log file generation	SMW-K81	–	–
U-plane generation	SMW-K175	SMM-K175	SMBVB-K175
LTE release 9	SMW-K84	SMM-K84	SMBVB-K84
LTE release 10 (LTE-Advanced)	SMW-K85	SMM-K85	SMBVB-K85
LTE release 11	SMW-K112	SMM-K112	SMBVB-K112
LTE release 12	SMW-K113	SMM-K113	SMBVB-K113
LTE releases 13/14/15	SMW-K119	SMM-K119	SMBVB-K119
Cellular IoT release 13	SMW-K115	SMM-K115	SMBVB-K115
Cellular IoT release 14	SMW-K143	SMM-K143	SMBVB-K143
Cellular IoT release 15/16/17	SMW-K146	SMM-K146	SMBVB-K146
OneWeb user-defined signal generation	SMW-K130	–	–
OneWeb reference signals	SMW-K355	–	–
3GPP FDD	SMW-K42	SMM-K42	SMBVB-K42
3GPP FDD HSPA/HSPA+, enhanced MS/BS tests	SMW-K83	SMM-K83	SMBVB-K83
GSM/EDGE	SMW-K40	SMM-K40	SMBVB-K40
EDGE Evolution	SMW-K41	SMM-K41	SMBVB-K41
CDMA2000® [2]	SMW-K46	SMM-K46	SMBVB-K46
1xEV-DO	SMW-K47	SMM-K47	SMBVB-K47
1xEV-DO rev. B	SMW-K87	SMM-K87	SMBVB-K87
TD-SCDMA	SMW-K50	SMM-K50	SMBVB-K50
TD-SCDMA enhanced BS/MS tests, including HSDPA	SMW-K51	SMM-K51	SMBVB-K51
TETRA release 2	SMW-K68	–	–
Wireless connectivity standards			
IEEE 802.11a/b/g/n/j/p	SMW-K54	SMM-K54	SMBVB-K54
IEEE 802.11ac	SMW-K86	SMM-K86	SMBVB-K86
IEEE 802.11ax	SMW-K142	SMM-K142	SMBVB-K142
IEEE 802.11be	SMW-K147	SMM-K147	SMBVB-K147
IEEE 802.11ad	*SMW-K141*	–	–
IEEE 802.11ay	*SMW-K177*	–	–
NFC A/B/F [3]	SMW-K89	SMM-K89	SMBVB-K89
HRP UWB	*SMW-K149*	SMM-K149	SMBVB-K149
Bluetooth® [4]	SMW-K60	SMM-K60	SMBVB-K60
Bluetooth® 5.x	SMW-K117	SMM-K117	SMBVB-K117
Bluetooth® 5.4 and channel sounding	SMW-K178	SMM-K178	SMBVB-K178
LoRa®	SMW-K131	SMM-K131	SMBVB-K131

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

[3] NFC Forum and the NFC Forum logo are trademarks of the Near Field Communication Forum.

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

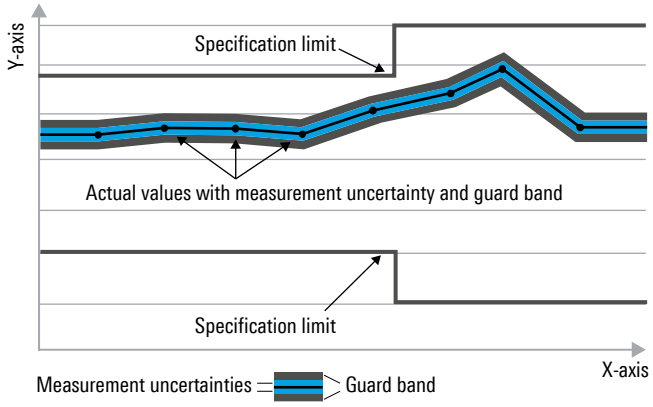
Broadcast standards			
DVB-H/DVB-T	SMW-K52	–	–
DVB-S2/DVB-S2X	SMW-K116	–	–
DVB-S2/DVB-S2X Annex E	SMW-K176	–	–
DVB-RCS2	SMW-K169	–	–
Other standards and modulation systems			
OFDM signal generation	SMW-K114	SMM-K114	SMBVB-K114
Multicarrier CW	SMW-K61	SMM-K61	SMBVB-K61
Baseband power sweep	SMW-K542	–	–

Definitions

General
Product data applies under the following conditions:

- Three hours of storage at ambient temperature followed by 30 minutes of warm-up operation
- Specified environmental conditions met
- Recommended calibration interval adhered to
- All internal automatic adjustments performed, if applicable

Specifications with limits
Represent warranted product performance by means of a range of values for the specified parameter. These specifications are marked with limiting symbols such as <, ≤, >, ≥, ±, or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design. Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.



Non-traceable specifications with limits (n. trc.)
Represent product performance that is specified and tested as described under “Specifications with limits” above. However, product performance in this case cannot be warranted due to the lack of measuring equipment traceable to national metrology standards. In this case, measurements are referenced to standards used in the Rohde & Schwarz laboratories.

Specifications without limits
Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (e.g. dimensions or resolution of a setting parameter). Compliance is ensured by design.

Typical data (typ.)
Characterizes product performance by means of representative information for the given parameter. When marked with <, > or as a range, it represents the performance met by approximately 80 % of the instruments at production time. Otherwise, it represents the mean value.

Nominal values (nom.)
Characterize product performance by means of a representative value for the given parameter (e.g. nominal impedance). In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

Measured values (meas.)
Characterize expected product performance by means of measurement results gained from individual samples.

Uncertainties
Represent limits of measurement uncertainty for a given measurand. Uncertainty is defined with a coverage factor of 2 and has been calculated in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM), taking into account environmental conditions, aging, wear and tear.

Device settings and GUI parameters are designated with the format “parameter: value”.

Non-traceable specifications with limits, typical data as well as nominal and measured values are not warranted by Rohde & Schwarz.

In line with the 3GPP/3GPP2 standard, chip rates are specified in million chips per second (Mcps), whereas bit rates and symbol rates are specified in billion bit per second (Gbps), million bit per second (Mbps), thousand bit per second (kbps), million symbols per second (Msps) or thousand symbols per second (ksps), and sample rates are specified in million samples per second (Msample/s). Gbps, Mcps, Mbps, Msps, kbps, ksps and Msample/s are not SI units.

Cellular standards

5G New Radio

The 5G NR software options implement the physical layer in line with 3GPP releases 15 and 16. The options provide standard-compliant FR1 and FR2 signals for testing components, modules, receivers and base stations. They support all downlink and uplink physical channels and signals, multiple bandwidth parts with mixed numerology as well as important physical layer features such as channel coding, scrambling, multiplexing of data and control information.

3GPP 5G NR digital standard		release 15/16/17 features in line with the following versions of the 3GPP specifications, or newer: • TS 38.211 17.3.0 • TS 38.212 17.3.0 • TS 38.213 17.3.0 • TS 38.214 17.3.0

5G New Radio release 15

For the R&S®SMW-K144, R&S®SMM-K144 and R&S®SMBVB-K144 options.

Key features

General

- In line with 3GPP 5G NR release 15
- All numerologies up to 240 kHz subcarrier spacing
- Normal and extended cyclic prefix
- Channel bandwidth up to 400 MHz
- CP-OFDM in downlink and uplink and optionally DFT-S (transform precoding) in uplink
- BPSK, π/2-BPSK, QPSK, 16QAM, 64QAM, 256QAM modulation
- Carrier aggregation including cross-carrier scheduling
- Intuitive user interface with graphical display of time plan
- Several SS/PBCH simultaneously at multiple frequency positions
- Multi-numerology (mixed numerology)
- Channel coding
- DCI and UCI
- Flexible BWP configuration
- Up to 10 users
- MIMO and multilayer transmission
- Flexible mapping of the antenna ports to the output(s)
- Optional BWP filtering
- Various leveling modes for different use cases
- Time domain windowing/WOLA
- RedCap support

Downlink

- Downlink signals and channels: PSS, SSS, PBCH, PDSCH, CORESET/PDCCH, DMRS, CSIRS, PTRS
- Automatic PDSCH scheduling from DCI
- MIB content coding
- Dynamic spectrum sharing (DSS) for 5G and LTE
- NR-TM presets of TS 38.141 for FR1 and FR2

Uplink

- Uplink signals and channels: PUSCH, PUCCH, PRACH, DMRS, PTRS, SRS
- Assistant for resource block configuration based on TS 38.521-1 table 6.1-1
- Assistant for FRCs of TS 38.141 for FR1 and FR2
- PUSCH frequency hopping

Additional

- Quick settings for simplified 5G NR signal generation
- Test case wizard for 3GPP 38.141 base station conformance testing
- Crest factor reduction (with R&S®SMx-K548 option)
- Logging intermediate results from the signal processing chain (R&S®SMx-K81 required)
- Generating O-RAN U-plane payload data (R&S®SMx-K175 required)
- Channel models for performance testing in line with 3GPP TS 38.141-1/-2 chapter 8 (R&S®SMW-B14/-B15 required)

NR-TM presets		test models with release 15 features in line with the following versions of the 3GPP specifications, or newer: • TS 38.141-1 17.6.0 • TS 38.141-2 17.6.0
Note that given parameter ranges may be additionally restricted due to inter-parameter dependencies.		
General settings		
RF frequency		user-selectable in entire frequency range of Rohde & Schwarz instrument
Sequence length		can be entered in frames (10 ms each); the maximum length depends on the available ARB memory options and the configured 5G NR settings, e.g. the channel bandwidth
Filter mode		channel BW, per BWP, off, fast, user
Suppress subcarrier on output carrier		off/on
Sample rate variation		off/on
Marker		• subframe • radio frame start • restart (ARB) • user period • on/off period • system frame number restart • TDD UL/DL
Link direction		downlink, uplink
Payload data source	for various channels or signals	PN9, PN11, PN15, PN16, PN20, PN21, PN23, All0, All1, pattern (length: 1 bit to 64 bit), data lists
Node settings		
Number of carriers		1 to 16
RF phase compensation		off, manual, auto
Deployment		FR1 ≤ 3 GHz, FR1 > 3 GHz, FR2
Channel bandwidth	per carrier	5 MHz, 10 MHz, 15 MHz, 20 MHz, 25 MHz, 30 MHz, 40 MHz, 50 MHz, 60 MHz, 70 MHz, 80 MHz, 90 MHz, 100 MHz, 200 MHz, 400 MHz
Subcarrier spacing	per carrier, multiple are possible	15 kHz, 30 kHz, 60 kHz, 120 kHz, 240 kHz
Users/BWP settings		
Number of users		1 to 10
Number of DL BWPs or UL BWPs	per carrier and user	1 to 4
Supported RNTIs		C-RNTI, CS-RNTI, MCS-C-RNTI, SP-CSI-RNTI, SFI-RNTI, RA-RNTI, TC-RNTI, INT-RNTI, TPC-PUSCH-RNTI, TPC-PUCCH-RNTI, TPC-SRS-RNTI
Scheduling settings		
DCI formats		0_0, 0_1, 1_0, 1_1, 2_0, 2_1, 2_2, 2_3
Search space		USS, type3 USS
Number of allocations	per carrier and per subframe and per BWP	0 to 64
Content	per carrier and per subframe and per BWP and per allocation	CORESET, PDSCH, PUSCH, PRACH, PUCCH
Modulation	per carrier and per subframe and per BWP and per allocation	BPSK, π/2-BPSK, QPSK, 16QAM, 64QAM, 256QAM
DFT-S (transform precoding)	per carrier and per subframe and per BWP	off/on
PUCCH settings		
Group and sequence hopping		supported
Format		F0 to F4
PRACH settings		
PRACH subcarrier spacing		1.25 kHz, 5 kHz, 15 kHz, 30 kHz, 60 kHz, 120 kHz
Format		0, 1, 2, 3, A1, A2, A3, B1, B2, B3, B4, C0, C2

5G New Radio release 16

For the R&S®SMW-K148, R&S®SMM-K148 and R&S®SMBVB-K148 options. A K144 option must also be installed on the instrument for each K148 option.

Key features

General

- In line with 3GPP 5G NR release 16
- Up to 200 users
- Integrated backhaul access: PUSCH slot aggregation, SSB period, downlink HARQ feedback (with R&S®SMW-K145)

Downlink

- Downlink signals and channels: PRS
- Additional RNTI according to release 16
- Additional DCI formats according to release 16 as well as release 16 extensions of release 15 DCI formats
- Generation of the MIB system frame number independently from the ARB sequence length (only for R&S®SMW200A and R&S®SMM100A equipped with B9 option)
- Shared spectrum access: interlaced resource blocks, SS/PBCH adjustments, cyclic timing extension, CG-UCI, PRACH
- Additional allocation type: RIM-RS

Uplink

- Closed-loop reception of timing adjustment commands (R&S®SMW-K145 required)
- Release 16 updated for FRCs of TS 38.141 for FR1 and FR2

Note that given parameter ranges may be additionally restricted due to inter-parameter dependencies.		
Node settings		
Count full system frame number	only for R&S®SMW200A and R&S®SMM100A equipped with B9 option	off/on
PRS state	per carrier	off/on
Node settings – closed-loop feedback configuration (only available with K145)		
TA state		off/on
Users/BWP settings		
Number of users		1 to 200
Supported RNTIs		as of K144 option, plus CI-RNTI, PS-RNTI
Scheduling settings		
DCI formats		as of K144 option, plus 2_4, 2_6

5G New Radio release 17/18

For the R&S®SMW-K171, R&S®SMM-K171 and R&S®SMBVB-K171 options. A K144 and K148 option must also be installed on the instrument for each K171 option.

Key features

- Extension to 71 GHz
  - Deployment frequency range for FR2-2: up to 71 GHz
  - Channel bandwidths introduced with FR2-2: 800 MHz, 1600 MHz and 2000 MHz
  - Channel bandwidths introduced: 35 MHz and 45 MHz
  - New subcarrier spacings: 480 kHz and 960 kHz
  - FR2-2 adjustments for SS/PBCH and PRACH
- Support of 1024QAM modulation including coding
- Additional DCI formats according to release 17 as well as release 17 extensions of existing DCI formats
- Transport block over multi-slots
- Supports less than 5 MHz
  - Channel bandwidth introduced: 3 MHz
  - SSB and coreset puncturing

5G New Radio sidelink

For the R&S®SMW-K170, R&S®SMM-K170 and R&S®SMBVB-K170 options.

Key features

- Support for PSSCH, PSCCH and S-SS/PSBCH
- Support of SSCH channel coding
- Support of sidelink control information (SCI)
- Support for PSFCH

5G NR closed-loop BS test

For the R&S®SMW-K145 option.

A K144 option must also be installed on the instrument for each K145 option.

Key features

- Reception of HARQ feedback on a serial connection
- Real-time adaptation of PUSCH redundancy versions
- Suitable for performing uplink closed-loop base station tests in line with 3GPP TS 38.141
- Logging of received data is possible
- Optionally supports an HPN (HARQ process number) mode, for easier association of PUSCH transmissions to receive feedback

Closed-loop feedback configuration		
Closed-loop feedback mode	switches on closed-loop feedback processing and selects the mode	off, serial, serial 3 × 8; serial and serial 3 × 8 is only possible if number of carriers is 1
Connector	specifies the connector to be used for the feedback commands	depends on the Rohde & Schwarz instrument
Feedback delay (in slot units)	used for determining the time points when the instrument expects feedback commands	–20.00 to –1.00
Baseband selector	specifies the baseband unit identifier needed if feedback commands for several units are transmitted via one line	0 to 3
Serial rate	specifies the serial transmission bit rate	115.2 kbps, 1.6 Mbps, 1.92 Mbps

Verizon 5GTF signals

For the R&S®SMW-K118 option.

Key features

General

- Supports different predefined configurations in line with V5G.211, V5G.212 and V5G.213
- Cell-specific and UE-specific antenna ports can be configured
- Timeplan of generated signal
- Multi-antenna scenario modes such as TX diversity and spatial multiplexing
- Intuitive user interface with graphical display of time plan

Downlink

- Four predefined downlink configurations comprise xPDCCH, xPDSCH, xPBCH channels, including reference and synchronization signals
- Auto/DCI mode
- CSI-RS settings
- xPBCH, xPDCCH, xPDSCH channels can be generated including DMRS reference signals
- A1, A2, B1, B2 DCI formats can be configured in terms of CCEs/xREGs
- xPDSCHs/CSI-RS are automatically generated from xPDCCH via Auto/DCI mode

Uplink

- Four predefined uplink configurations comprise xPUSCH and xPUCCH channels, including reference signals
- User-specific uplink settings
- Configuration of TX modes of UEs
- LDPC channel coding for xPUSCH
- Flexible configuration of xPUSCH channel including UL PCRS
- Flexible configuration of xPUCCH channel including UL PCRS
- Up to four uplink users can be configured

Predefined configurations		Downlink_Config_{1-4}, Uplink_Config_{1-4}
General settings		
Downlink		
Scheduling		manual, Auto/DCI
Number of antenna ports (BRS)		1, 2, 4 or 8
BRS transmission period		1 slot, 1 subframe, 2 subframes, 4 subframes
Antenna ports		
Antenna ports		AP 0 to 7 (xPBCH), AP 16 to 31 (CSI-RS), AP 300 to 313 (PSS, SSS, ESS)

Frame configuration		
General		
Number of configurable subframes		1 to 48
User configuration		
TX modes		mode 1, mode 2, mode 3
Antenna mapping		AP 8 to 15 (xPDSCH), AP 60/61 (DL PCRS), AP 107/109 (xPDCCH)
Data source		PN9, PN11, PN15, PN16, PN20, PN21, PN23, pattern, data list, All0, All1
Subframe configuration		
Modulation		QPSK, 16QAM, 64QAM, 256QAM
No. RB		4 to 100
No. sym.		1 to 11
Offset RB		0 to 96
Offset sym.		1, 2
Content type		xPDSCH, CSI-RS, xPDCCH, xPBCH
Enhanced settings		
Precoding	TX mode 1	none
	TX mode 2	TX diversity
	TX mode 3	TX diversity, spatial multiplexing
xPDCCH		
Dummy CCE data source		PN9, PN11, PN15, PN16, PN20, PN21, PN23, pattern, data list, All0, All1
User		User1, User2, User3, User4
DCI format		A1, A2, B1, B2
Content	can be set in line with V5G.213 specification	bit data
Uplink		
User configuration		
Data source		PN9, PN11, PN15, PN16, PN20, PN21, PN23, pattern, data list, All0, All1
Channel coding		on/off
Subframe configuration		
Modulation		QPSK, 16QAM, 64QAM, 256QAM
No. RB		4 to 100
No. offset	depends on no. RB	0 to 96
Code rate	xPUSCH, depends on modulation, RBs	$^{1}/_{2}$, $^{2}/_{3}$, $^{3}/_{4}$, $^{5}/_{6}$
Transport block size	xPUSCH, according to V5G.212	see table in V5G.212

LTE

The LTE options implement the physical layer in line with 3GPP releases 8 to 15. These options provide standard-compliant signals for testing components, modules, receivers and base stations. They support all downlink, uplink and sidelink physical channels, all specified channel bandwidths and modulation schemes such as 1024QAM as well as important physical layer features such as channel coding, scrambling, multiplexing of data and control information.

LTE release 8

For the R&S®SMW-K55, R&S®SMM-K55 and R&S®SMBVB-K55 options.

Key features

General

- FDD and TDD
- Downlink (OFDMA) and uplink (SC-FDMA)
- 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 20 MHz channel bandwidth
- QPSK, 16QAM, 64QAM modulation
- Full MIMO and transmit diversity support
- Multiple users
- Intuitive user interface with graphical display of time plan

Downlink

- P-SYNC, S-SYNC and DL reference signal derived from cell ID
- PBCH, PDSCH, PDCCH, PCFICH, PHIC
- PDCCH with full DCI configuration
- Channel coding and scrambling for PDSCH and PBCH (including MIB)
- Automatic PDSCH scheduling from DCI
- Downlink test models (E-TMs) in line with 3GPP TS 36.141

Uplink

- PRACH, PUCCH and PUSCH with channel coding and scrambling
- DMRS and SRS
- Fixed reference channels (FRC) in line with 3GPP TS 36.141

Additional

- Test case wizard in line with 3GPP TS 36.141
- Real-time HARQ feedback (R&S®SMW-K69 required)
- Logging intermediate results from the signal processing chain including FEC (R&S®SMx-K81 required)
- Generating O-RAN U-plane payload data (R&S®SMx-K175 required)
- Channel models for performance testing in line with 3GPP TS 36.141 chapter 8 (R&S®SMW-B14/-B15 required)

EUTRA/LTE digital standard		in line with 3GPP release 8: • TS 36.211 v.15.6.0 • TS 36.212 v.15.6.0 • TS 36.213 v.15.6.0
General settings		
Test case wizard	configuration assistant for easy setup of test cases in line with TS 36.141	
Mode	restricts the user interface to certain LTE/cellular IoT features and enables access to all features of installed options	only available if LTE and cellular IoT option(s) are installed
Duplexing		FDD, TDD
Link direction		downlink, uplink
EUTRA test models (downlink)	in line with 3GPP TS 36.141 v.8.12.0 both FDD and TDD E-TMs are supported	E-TM1.1, E-TM1.2, E-TM2, E-TM3.1, E-TM3.2, E-TM3.3
Physical settings		
Channel bandwidth	determines the channel bandwidth used	1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz, user-defined
Cell-specific settings		
Physical cell ID group	determines cell ID together with physical layer ID	0 to 167
Physical layer ID	determines cell ID together with physical cell ID group	0 to 2
TDD special subframe configuration	only selectable if duplexing mode is set to TDD	0 to 8
TDD uplink/downlink configuration	only selectable if duplexing mode is set to TDD	0 to 6

Cyclic prefix	determines whether a normal or extended cyclic prefix is used for the subframes; Note: It automatically determines the number of symbols per subframe.	normal, extended, user-defined
MIMO		
Global MIMO configuration	simulated cell-specific antenna configuration	1, 2, 4 transmit antennas, SISO + BF
Resource allocation downlink		
Number of configurable subframes	determines the number of configurable subframes; the subframe configurations are used periodically; Note: P/S-SYNC and PBCH are configured globally and therefore not copied here. The use of this function ensures a valid frame configuration.	up to 40 subframes; The actual range depends on the duplex mode, on the sequence length and – in the case of TDD – on the UL/DL configuration.
Behavior in unscheduled resource blocks	determines whether unscheduled resource blocks and subframes are filled with dummy data or left DTX	dummy data, DTX
Allocation table		
Code word	up to 2 code words can be configured for MIMO	1/1, 1/2, 2/2
Modulation	determines modulation scheme used	QPSK, 16QAM, 64QAM
Content type	determines type of selected allocation	PDSCH, PDCCH, PBCH
Precoding scheme	sets multi-antenna mode for selected allocation	none, transmit diversity, spatial multiplexing, TX mode 7
Configuration of PCFICH, PHICH, PDCCH		
DCI format	can be mapped individually to CCEs	0, 1, 1a, 1b, 1c, 1d, 2, 2a, 3, 3a
Configure user		
Transmission mode	selects the downlink transmission mode	user, mode 1 to mode 7
Resource allocation uplink		
Select user equipment	Up to 8 UEs can be configured individually and allocated to the subframes.	
Number of configurable subframes (for FDD), number of configurable uplink subframes (for TDD)	determines the number of configurable uplink subframes	up to 40 subframes
Allocation table		
Content type	UE can be set to PUSCH or PUCCH	PUSCH, PUCCH
Modulation	determines the modulation scheme used if content type is PUSCH or the PUCCH format if content type is PUCCH	QPSK, 16QAM, 64QAM or format 1, 1a, 1b, 2, 2a, 2b
User equipment configuration		
Mode		standard, PRACH
FRC	selects the FRC	A1-1, A1-2, A1-3, A1-4, A1-5, A1-6, A1-7; A2-1, A2-2, A2-3; A3-1, A3-2, A3-3, A3-4, A3-5, A3-6, A3-7; A4-1, A4-2, A4-3, A4-4, A4-5, A4-6, A4-7, A4-8; A5-1, A5-2, A5-3, A5-4, A5-5, A5-6, A5-7; A7-1, A7-2, A7-3, A7-4, A7-5, A7-6; A8-1, A8-2, A8-3, A8-4, A8-5, A8-6; A12-1, A12-2, A12-3, A12-4, A12-5, A12-6; A13-1, A13-2, A13-3, A13-4, A13-5, A13-1
Channel coding mode	selects whether data, control information or both is transmitted on the PUSCH	UL-SCH only, UCI + UL-SCH, UCI only
SRS state	enables sending of sounding reference signals	on/off
Enhanced settings for PUSCH		
Frequency hopping		on/off
Settings for PRACH		
Preamble format	set indirectly by PRACH configuration	0 to 4
Data source init	init value for the data sources	0 to 8388607

LTE release 9

For the R&S®SMW-K84, R&S®SMM-K84 and R&S®SMBVB-K84 options.
A K55 option must also be installed on the instrument for each K84 option.

Key features

Downlink

- Downlink positioning reference signals (PRS)
- Dual-layer beamforming (transmission mode 8)
- MBMS single-frequency network (MBSFN) including MCCH and PMCH channels

Additional

- MIB SFN generation independent from the ARB sequence length (not for R&S®SMBV100B)

General description	This option enhances the K55 option (LTE release 8) to support LTE release 9. Requires K55 option.	
EUTRA/LTE digital standard		in line with 3GPP release 9: • TS 36.211 v.15.6.0 • TS 36.212 v.15.6.0 • TS 36.213 v.15.6.0
Positioning reference signals (PRS)		
PRS state		on/off
Dual-layer beamforming		
This option generates downlink signals dedicated to UE set to transmission mode 8. DCI format 2B has been introduced to support this mode. Mapping of (logical) antenna ports to the (physical) signal generator TX antennas is configurable. This feature allows UE receiver testing in line with the beamforming model in TS 36.101, B.4.		
Transmission mode	selects the downlink transmission mode	transmission mode range is extended by transmission mode 8
DCI format	selects the DCI format	DCI format range is extended by format 2B
MBMS single-frequency network (MBSFN)		
This option generates MBSFN subframes. All different allocation, modification and repetition periods can be set individually within the maximum number of frames that can be generated in line with the sequence length enabled by the K55 option. References to the official 3GPP TS 36.331 v.9.5.0 specification are abbreviated as 36.331.		
MBSFN mode	mixed: 15 kHz subcarrier spacing; dedicated: 7.5 kHz subcarrier spacing [5]	off, mixed, dedicated
MIB SFN generation independent from the ARB sequence length		
SFN restart period (not available for the R&S®SMBVB-K84)	SFN counter is restarted after specified period	sequence length, 3GPP (1024 frames)

[5] The dedicated mode will be supported in a later version.

LTE release 10 (LTE-Advanced)

For the R&S®SMW-K85, R&S®SMM-K85 and R&S®SMBVB-K85 and options.
For each K85 option, a K55 option must also be installed on the instrument.

Key features

Downlink

- Downlink carrier aggregation including cross-carrier scheduling
- Downlink transmission mode 9 for up to 8-layer beamforming
- CSI-RS
- Generation of DCIs with carrier indicator field (CIF)

Uplink

- Enhanced SC-FDMA
- PUCCH format 3
- Simultaneous PUSCH and PUCCH transmission
- Noncontiguous PUSCH transmission (uplink resource allocation type 1)
- PUSCH transmission mode 2 (uplink MIMO)
- Aperiodic SRS (SRS trigger type 1)

General description	This option enhances the K55 option (LTE release 8) to support LTE release 10/LTE-Advanced. Requires K55 option.	
EUTRA/LTE digital standard		in line with 3GPP release 10: • TS 36.211 v.15.6.0 • TS 36.212 v.15.6.0 • TS 36.213 v.15.6.0
Downlink simulation		
CSI reference signals		
This option generates DL CSI reference signals.		
CSI-RS state	enables the transmission of CSI reference signals in the cell	on/off
Number of CSI-RS antenna ports	(from 36.331, CSI-RS-Config) defines the number of antenna ports used for CSI-RS; the antenna ports are mapped to the physically available antennas in the “AP mapping” panel	1, 2, 4, 8
Downlink carrier aggregation settings		
This option generates DL carrier aggregation signals with up to five component carriers (1 × primary cell/PCell and 4 × secondary cells/SCells) in line with EUTRA release 10. The exact number of component carriers that can be generated within one baseband depends on the maximum available baseband generator bandwidth, the bandwidth and the exact frequency offsets of the individual component carriers, or the instrument signal routing and system configuration.		
General CA settings		
Activate carrier aggregation	activates the generation of several component carriers (CC)	on/off
DCI configuration		
Carrier indicator field	part of DCI when CIF is set to be present; defines on which cell UL/DL transmission takes place	0 to 7
DL transmission mode 9 for up to 8-layer beamforming		
This option generates downlink signals dedicated to UE set to transmission mode 9. DCI format 2B has been introduced to support this mode. Mapping of (logical) antenna ports to the (physical) signal generator TX antennas is configurable.		
Transmission mode	selects the downlink transmission mode	transmission mode range is extended by transmission mode 9
DCI format	selects the DCI format	DCI format range is extended by format 2C
Uplink simulation		
General configuration		
This option generates uplink signals in line with EUTRA release 10.		
3GPP release	selects the functionality for a user equipment	release 8/9, LTE-Advanced
PUCCH format 3		
This option generates PUCCH with format 3 for configured LTE-Advanced user equipment.		

Simultaneous PUSCH and PUCCH transmission		
This option generates PUSCH and PUCCH of a configured LTE-Advanced user equipment in the same subframe.		
Noncontiguous PUSCH transmission (uplink resource allocation type 1)		
This option generates PUSCH with noncontiguous frequency allocation (two resource block sets according to uplink resource allocation type 1).		
PUSCH transmission mode 2 (uplink MIMO)		
This option generates PUSCH with transmission mode 2 (uplink MIMO).		
Transmission mode	transmission mode for PUSCH, only available for LTE-Advanced user equipment	1 (spatial multiplexing not possible), 2 (spatial multiplexing possible)
Number of antenna ports for PUSCH		1, 2, 4
Number of antenna ports for SRS		1, 2, 4
Number of antenna ports for PUCCH		1, 2
Number of codewords	for PUSCH	1, 2
Number of layers	for PUSCH	1, 2, 4
This option generates SRS signals according to SRS trigger type 1 (aperiodic SRS).		

LTE release 11

For the R&S®SMW-K112, R&S®SMM-K112 and R&S®SMBVB-K112 options.
A K55 option must also be installed on the instrument for each K112 option.

Key features

Downlink

- TDD special subframe configurations 9 (normal cyclic prefix) and 7 (extended cyclic prefix)
- Mixed TDD settings for downlink carrier aggregation
- Enhanced PDCCH (EPDCCH)
- Transmission mode 10, DCI format 2D, scrambling settings for CoMP/eICIC/feICIC
- Automatic scheduling of downlink transmissions according to long HARQ patterns (“Auto Sequence”)

Uplink

- Uplink carrier aggregation including mixed TDD settings
- PUCCH format 3 for periodic CSI

General description	This option enhances the K55 option (LTE release 8) to support LTE release 11.	
EUTRA/LTE digital standard		in line with 3GPP release 11: • TS 36.211 v.15.6.0 • TS 36.212 v.15.6.0 • TS 36.213 v.15.6.0
Release 11 special subframe configurations		
This option generates TDD signals with special subframe configuration 9 and normal cyclic prefix, as well as of TDD signals with special subframe configuration 7 and extended cyclic prefix.		
TDD special subframe configuration	defines the special subframe configuration for TDD (frame structure type 2)	0 to 9; For values 8 and 9, only the normal cyclic prefix is allowed. For values 0 to 7, the normal and the extended cyclic prefixes are allowed.
PUCCH format 3 for periodic CSI		
This option generates PUCCH format 3 with up to 22 information bits before channel coding, independently of the duplexing mode. This is necessary for transmitting periodic CSI reports by means of PUCCH format 3.		
Number of A/N + SR + CSI bits	defines the number of PUCCH format 3 information bits before channel coding	0 to 22
Uplink carrier aggregation		
This option generates uplink carrier aggregation signals with up to five component carriers (1 × primary cell/PCell and 4 × secondary cells/SCells) in line with EUTRA release 10. The exact number of component carriers that can be generated within one baseband depends on the maximum available baseband generator bandwidth, the bandwidth and the exact frequency offsets of the individual component carriers, or the instrument signal routing and system configuration. References to the official 3GPP TS 36.331 v.10.8.0 specification are abbreviated as 36.331.		
Activate carrier aggregation	activates the generation of several component carriers (CC)	on/off
Mixed TDD settings for downlink carrier aggregation		
This option uses different TDD settings (uplink downlink configuration, special subframe configuration) in individual component carriers for downlink carrier aggregation, in line with EUTRA release 11.		

Auto sequence PDSCH scheduling mode		
This option uses the “Auto Sequence” PDSCH scheduling mode. This mode allows easy configuration of downlink transmissions according to long HARQ patterns. In the “Manual” and “Auto/DCI” scheduling modes, which are also available without the K112 option, the maximum HARQ pattern length is limited by the maximum number of configurable downlink subframes. This limitation does not apply in the “Auto Sequence” scheduling mode.		
PDSCH scheduling	determines the PDSCH scheduling mode	manual, Auto/DCI, auto scheduling
MCS mode	determines the MCS mode	manual, fixed, target code rate
Enhanced PDCCH (EPDCCH)		
This option uses the enhanced PDCCH (EPDCCH) channel in the “Auto/DCI” and “Auto Sequence” PDSCH scheduling modes.		
Parameters in the DCI configuration		
(E)PDCCH	selects whether the DCI is transmitted in the PDCCH or EPDCCH set 1 or EPDCCH set 2	PDCCH, EPDCCH set 1, EPDCCH set 2
Transmission mode 10, DCI format 2D, scrambling settings for CoMP/eICIC/feICIC		
This option uses downlink transmission mode 10, DCI format 2D and scrambling settings for CoMP, eICIC, feICIC.		
Parameters in the user configuration		
Transmission mode	selects the downlink transmission mode	transmission mode range is extended by transmission mode 10
Parameters in the DCI configuration		
DCI format	selects the DCI format	DCI format range is extended by format 2D

LTE release 12

For the R&S®SMW-K113, R&S®SMM-K113 and R&S®SMBVB-K113 options.
A K55 option must also be installed on the instrument for each K113 option.

Key features

General
- Mixed duplexing for uplink and downlink carrier aggregation

Downlink
- 256QAM modulation for PDSCH, downlink dummy resource elements and PMCH
- Downlink test models for 256QAM in line with 3GPP TS 36.141 v.12.9.0
- DCI format 1C for eIMTA RNTI
- Further DL MIMO enhancements (enhanced 4TX codebook)
- UE category 0 assisted configuration for M2M

Sidelink
- Sidelink (D2D) communications, discovery and synchronization
- Sidelink transmission modes 1 and 2
- P-SLSS, S-SLSS, PSCCH, PSSCH, PSDCH, PSBCH
- Scrambling and channel coding for PSSCH, PSDCH
- QPSK, 16QAM modulation for PSSCH/ PSDCH with MCS index (0 to 28)

General description	This option enhances the K55 option (LTE release 8) to support LTE release 12.	
EUTRA/LTE digital standard		in line with 3GPP release 12: • TS 36.211 v.15.6.0 • TS 36.212 v.15.6.0 • TS 36.213 v.15.6.0
256QAM modulation for PDSCH, downlink dummy resource elements and PMCH		
This option generates downlink signals with 256QAM modulation in the PDSCH channel, the PMCH channel and in the dummy OFDM resource elements.		
Downlink test models for 256QAM in line with 3GPP TS 36.141 v.12.9.0		
This option configures and generates 256QAM test models in line with 3GPP TS 36.141 v.12.9.0 for FDD and TDD.		
Parameter	**Condition**	**Range**
EUTRA test models (downlink)	in line with 3GPP TS 36.141 v.12.9.0 both FDD and TDD E-TMs are supported	E-TM1.1, E-TM1.2, E-TM2, E-TM3.1, E-TM3.2, E-TM3.3, E-TM2a, E-TM3.1a
DCI format 1C for eIMTA-RNTI		
This option generates downlink DCI format 1C in case of eIMTA-RNTI.		
Mixed duplexing for uplink and downlink carrier aggregation		
This option uses different duplexing modes (FDD, TDD) in individual component carriers for uplink and downlink carrier aggregation, in line with EUTRA release 12.		
Further DL MIMO enhancements (enhanced 4TX codebook)		
This option uses the enhanced 4TX codebook, in line with EUTRA release 12.		

Sidelink		
This option configures and generates D2D signals in line with EUTRA release 12.		
Mode		communications, discovery
Communications mode		
Synchronization state		off/on
SL TX mode		1, 2
SCI format		0
Content		PSCCH, PSSCH, PSBCH
Discovery mode		
Synchronization state		off/on
Content		PSDCH, PSBCH

LTE releases 13/14/15

For the R&S®SMW-K119, R&S®SMM-K119 and R&S®SMBVB-K119 options.
A K55 option must also be installed on the instrument for each K119 option.

Key features

Downlink
- 1024QAM modulation for PDSCH
- Downlink licensed-assisted access (LAA) (K85 option is also required)
- Frame structure type 3, DRS for LAA, DCI 1C for LAA
- Enhancements for DCI formats 2C/2D (*dmrsAltTable/semiOpenLoop*)
- CSI-RS enhancements for full dimension MIMO
- Support of E-TM2b and E-TM3.1b test models

Uplink
- 256QAM modulation for PUSCH
- PUCCH formats 4 and 5
- Special subframe configuration 10 (PUSCH in special subframe including DMRS)
- SRS enhancements for full dimension MIMO
- Enhanced uplink DMRS (ul-DMRS-IFDMA)
- PRACH restricted set type B
- FRCs according to releases 13, 14 and 15

Sidelink
- Cellular V2X communications and synchronization
- Sidelink transmission modes 3 and 4
- Cellular V2X RMCs in line with 3GPP TS 36.521
- SCI and DCI enhancements for cellular V2X
- Support of 64QAM

Additional
- Support for up to 64 V2X UEs (R&S®SMW-K76 required)
- Graphical display of time plan for V2X Ues
- Test case wizard in line with 3GPP TS 36.141

General description	This option enhances the K55 option (LTE release 8) to support LTE releases 13, 14 and 15.	
EUTRA/LTE digital standard		in line with 3GPP release 13/14/15: • TS 36.211 v.15.6.0 • TS 36.212 v.15.6.0 • TS 36.213 v.15.6.0
256QAM modulation for PUSCH		
This option extends the LTE carrier aggregation feature of the K85 option for generation of uplink signals with 256QAM modulation in the PUSCH channel.		
Modulation	PUSCH allocation	QPSK, 16QAM, 64QAM, 256QAM

FRCs according to releases 13 and 14		
FRC	selects the FRC	A1-1, A1-2, A1-3, A1-4, A1-5, A1-6, A1-7; A2-1, A2-2, A2-3; A3-1, A3-2, A3-3, A3-4, A3-5, A3-6, A3-7; A4-1, A4-2, A4-3, A4-4, A4-5, A4-6, A4-7, A4-8; A5-1, A5-2, A5-3, A5-4, A5-5, A5-6, A5-7; A7-1, A7-2, A7-3, A7-4, A7-5, A7-6; A8-1, A8-2, A8-3, A8-4, A8-5, A8-6; A12-1, A12-2, A12-3, A12-4, A12-5, A12-6; A13-1, A13-2, A13-3, A13-4, A13-5, A13-6; A17-1, A17-2, A17-3, A17-4, A17-5, A17-6
Downlink LAA		
This option configures and generates signals for downlink LAA SCells (frame structure type 3), including DRS for LAA and DCI format 1C for LAA.		
Duplexing	SCells in the downlink carrier aggregation table, in case of “Auto/DCI” or “Auto Sequence” PDSCH scheduling modes	FDD, TDD, LAA
DRS state	only for SCells with duplexing “LAA”	off/on
(e)FD-MIMO		
This option configures and generates CSI-RS for FD-MIMO (release 13) and eFD-MIMO (release 14).		
CSI-RS in DwPTS		off/on
PUCCH formats 4 and 5		
This option configures and generates signals for PUCCH formats 4 and 5.		
Modulation/format		F1, F1a, F1b, F2, F2a, F2b, F3, F4, F5
Special subframe configuration		
TDD special subframe configuration	only selectable if duplexing mode is set to TDD	0 to 10
PUSCH in UpTPS state	only selectable if TDD special subframe configuration is set to 10	on/off
Enhancements for DCI formats 2C/2D		
This option configures the *dmrsAltTable* and *semiOpenLoop* higher layer parameters.		
SRS enhancements		
This option configures and generates SRS enhanced in release 13 (*srs-UpPtsAdd*/*transmissionCombNum*).		
Enhanced uplink DMRS		
This option configures and generates PUSCH transmissions with enhanced DMRS in release 14 (*ul-DMRS-IFDMA*).		
PRACH restricted set type B		
This option configures and generates PRACH signals with restricted set type B in release 14.		
PRACH restricted set		unrestricted set, restricted set type A, restricted set type B
V2X		
This option configures and generates V2X signals in release 14.		
Mode		communications, discovery, V2X communications
V2X communications mode		
SL TX mode		3, 4
SCI format		1
V2X RMCs	in line with TS 36.521	A 8.2.1, A 8.2.2, A 8.2.3

Cellular IoT

Cellular IoT release 13

For the R&S®SMW-K115, R&S®SMM-K115 and R&S®SMBVB-K115 options.

Key features

General

- NB-IoT and eMTC
- UE categories M1 and NB1
- FDD and TDD for eMTC, FDD for NB-IoT
- Downlink and uplink
- Standalone and mixed configuration with LTE (K55 option required)
- NB-IoT modes in-band, guard band and standalone
- eMTC mode in-band
- Coverage enhancement CE modes A and B
- Intuitive user interface with graphical display of time plan

Downlink

- NPSS, NSSS and downlink reference signal derived from cell ID
- PBCH, PDSCH, MPBCH
- NPDCCH and NPDSCH with full DCI configuration
- Channel coding and scrambling for NPDCCH, NPDSCH and NPBCH (including SIB type 1)
- Downlink test models (N-TMs) in line with 3GPP TS 36.141
- Support for one NB-IoT anchor carrier and up to three dummy carriers
- Support for eMTC narrowband hopping and search spaces

Uplink

- NPUSCH with channel coding and scrambling
- NPRACH configuration
- SRS
- NB-IoT fixed reference channels (FRCs) in line with 3GPP TS 36.141

Additional

- Real-time HARQ feedback (R&S®SMW-K69 required)
- Logging intermediate results from the signal processing chain including FEC (K81 option required)
- Channel models for performance testing in line with 3GPP TS 36.141 chapter 8 (R&S®SMW-B14/-B15 required)

General description	This option supports the narrowband IoT (NB-IoT) and enhanced machine type communications (eMTC) LTE release 13 cellular IoT variants, i.e. Cat-NB1 and Cat-M1.	
Cellular IoT standard		in line with 3GPP release 13: • TS 36.211 v.15.6.0 • TS 36.212 v.15.6.0 • TS 36.213 v.15.6.0
Uplink simulation		
Physical settings		
Channel bandwidth	determines the channel bandwidth used	200 kHz, 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
Signals – NB-IoT-DRS		
Group hopping	activates reference signal group hopping	on/off
eMTC-PUSCH settings		
Narrowband hopping	enables or disables the PUSCH hopping between narrowbands	on/off
eMTC-PRACH settings		
CE level	different coverage extension levels are defined	0, 1, 2, 3
NB-IoT-NPRACH settings		
Preamble format		0, 1
NPRACH configuration		0, 1, 2
UE-specific settings for eMTC users		
CE level	coverage extension level	0, 1 or 2, 3
Number of transmissions		1 to 20
PUSCH settings (allocation table of eMTC users)		
Modulation		QPSK, 16QAM and 64QAM

PUCCH settings (allocation table of eMTC users)		
Format	CE level 0, 1	
	FDD	1, 1a, 2, 2a, 2b
	TDD	1, 1a, 1b, 2, 2a, 2b
	CE level 2, 3	
	FDD	1, 1a
	TDD	1, 1a
PRACH settings (for eMTC users in mode PRACH)		
CE level		0 to 3
UE-specific settings for NB-IoT users		
Subcarrier spacing		3.75 kHz and 15 kHz
Mode		in-band, guard band and standalone
NPUSCH settings (allocation table of NB-IoT users)		
NPUSCH format		F1 and F2
Modulation		π/2 BPSK, π/4 QPSK and QPSK
NPRACH settings (for NB-IoT users in mode PRACH)		
NPRACH configuration		0, 1, 2
NB-IoT downlink simulation		
Physical settings		
Channel bandwidth	determines the channel bandwidth used	200 kHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
General NB-IoT settings		
Activate NB-IoT	enables or disables the NB-IoT DL	on/off
LTE cell	enables or disables LTE channels	on/off
Frame configuration general settings		
Users		1 to 4
NB-IoT DCI configuration	DCI configuration	
DCI format	different DCI formats	N0, N1, N2
Search space		UE-specific, type 1 common, type 2 common
NB-IoT allocation		
Content type	supported channels	NPBCH, NPDCCH, NPDSCH, NPDSCH, SIB1-NB
Modulation		QPSK
Uplink FRCs		
Uplink FRC	selects the FRC	36.141: A14-1, A14-2, A14-3, A14-4, A15-1, A15-2, A16-1, A16-2, A16-3, A16-4, A16-5; 36.521: A2.4-1, A2.4-2, A2.4-3, A2.4-4, A2.4-5, A2.4-6, A2.4-7
NB-IoT test models (downlink)		
Test models	in line with 3GPP TS 36.141 release 13	N-TM_Standalone, N-TM_Inband_SamePCI, N-TM_Inband_DifferentPCI, N-TM_Guardband, N-TM_Guardband_With_E_TM1_1, N-TM_Inband_With_E_TM1_1
eMTC uplink SRS settings		
SRS state	enables sounding reference signal transmission	on/off
eMTC downlink simulation		
Physical settings		
Channel bandwidth	determines the channel bandwidth used	1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
Frame configuration general settings		
Users		1 to 4
eMTC DCI configuration	DCI configuration	
DCI format	different DCI formats	3, 3A, 6-0A, 6-0B, 6-1A, 6-1B, 6-2
Search space		UE-specific, type 0 common, type 1 common, type 2 common

eMTC allocation		
Content type	supported channels	PBCH, MPDCCH, PDSCH-SIB1-BR, PDSCH
Modulation		QPSK

Cellular IoT release 14

For the R&S®SMW-K143, R&S®SMM-K143 and R&S®SMBVB-K143 options.
A K115 option must also be installed on the instrument for each K143 option.

Key features

General
- UE categories: M2 and NB2
- New TBS sizes for NB-IoT Cat-NB2
- Wider bandwidth in CE mode

Downlink
- New scrambling for NPDSCH-SIB1
- NPRS positioning reference signals
- Two HARQ processes for NB-IoT

Uplink
- Frequency retuning
- PRACH restricted type B

General description	This option enhances the narrowband IoT (NB-IoT) and enhanced machine type communications (eMTC) LTE release 14 cellular IoT variants, i.e. Cat-NB2 and Cat-M2.	
Cellular IoT standard		in line with 3GPP release 14: • TS 36.211 v.15.6.0 • TS 36.212 v.15.6.0 • TS 36.213 v.15.6.0
General settings		
Uplink simulation		
Physical settings		
Wideband configuration	enables or disables the wideband configuration	on/off
Cell-specific settings		
Retuning symbols	retuning symbols between narrowbands/widebands	0, 1, 2
eMTC-PRACH settings		
PRACH restricted set (high speed mode)		unrestricted, restricted type A and restricted type B
UE-specific settings		
NPUSCH settings		
Transport block size index		0 to 13
NB-IoT downlink simulation		
General NB-IoT settings		
NPRS		
NPRS state		on/off
NPRS parameter		PART A/PART B/PART A+B
Antenna port 2006 (AP 2006)	used only when NPRS is enabled	
Frame configuration general settings		
UE category		NB2
Support of two HARQ processes	for NB-IoT user	off/on
NB-IoT allocation		
Enhanced settings – NPDSCH		
Modulation and coding scheme	in-band	0 to 10
	standalone/guard band	0 to 13
eMTC downlink simulation		
Physical settings		
Wideband configuration	enables or disables the wideband configuration	on/off

Cellular IoT release 15/16/17

For the R&S®SMW-K146, R&S®SMM-K146 and R&S®SMBVB-K146 options.
A K115 option must also be installed on the instrument for each K146 option.

Key features

General
- NB-IoT TDD operation

Downlink
- Narrowband wake-up signals (NWUS)

Uplink
- TDD NPUSCH, NPRACH
- NPRACH format 2
- Early data transmission (EDT)
- Scheduling request for NPUSCH format 2
- 16QAM modulation for NPUSCH

General description	This option enhances the narrowband IoT (NB-IoT) and enhanced machine type communications (eMTC) LTE release 15 cellular IoT variants.	
Cellular IoT standard		in line with 3GPP release 17: • TS 36.211 v.17.5.0 • TS 36.212 v.17.5.0 • TS 36.213 v.17.5.0
General uplink settings		
Physical settings		
TDD UL/DL configuration		1 to 5
Cell settings		
NPRACH preamble format FDD		2
NB-IoT-NPRACH settings TDD		
Preamble format		0, 1, 0–A, 1–A
NPRACH configuration		0, 1, 2
TDD-NPUSCH settings		
NPUSCH format		F1 and F2
Modulation		π/2 BPSK, π/4 QPSK, QPSK, 16QAM
Early transmission (EDT) settings		
Early transmission (EDT) support		on/off
NB-IoT downlink TDD		
Physical settings		
TDD UL/DL configuration		1 to 5
NPUSCH F2-FDD		
Scheduling request (SR) support		on/off
Narrowband wake-up signal (NWUS)		
NWUS state		on/off

LTE closed-loop BS test

For the R&S®SMW-K69 option. A K55 or K115 option must also be installed on the instrument for each K69 option.

Key features

- Uplink closed-loop base station tests in line with 3GPP TS 36.141
- Real-time HARQ feedback for LTE and cellular IoT
- Real-time timing adjustment and timing advance
- Serial or binary (LTE HARQ only) feedback commands
- Simulation of block errors for LTE HARQ

Uplink real-time feedback configuration for UE1		
Real-time feedback mode	switches on real-time feedback processing and selects the mode	off, binary, serial, serial 3 × 8
Serial rate (only if serial real-time feedback mode is selected)	specifies the bit rate for serial transmission	115.2 kbps, 1.6 Mbps, 1.92 Mbps
Connector	specifies the connector for the feedback line	
	instrument equipped with R&S®SMW-B10	local (TM3, TM6) or global (user 6)
	instrument equipped with R&S®SMW-B9	local (TM2, TM4)

Log file generation

For the R&S®SMW-K81 option. A K55 and/or K115 option and/or K144 option must also be installed on the instrument for each K81 option.

Key features

- Log file generation for intermediate results of the signal processing chain
- For LTE, cellular IoT and 5G NR
- Channel coding (FEC), precoding, layers and antenna ports
- CRC, code blocks, rate matching, scrambling and interleaving
- Summary log files for allocation and DCI mapping details

General settings		
Logging state		on/off
Output path	The output path for storing log files can be selected by the user.	
Physical channels for LTE, eMTC, NB-IoT		
Downlink	PDSCH, PBCH, PMCH, PCFICH/PHICH/PDCCH	
Uplink	PUSCH including UCI, PUCCH, PUSCH DRS, PUCCH DRS, SRS	
Physical channels for 5G NR		
Downlink	PDSCH, PBCH, PDCCH	
Uplink	PUSCH including UCI, PUCCH, PUSCH DRS, PUCCH DRS, SRS	

U-plane generation

For the R&S®SMW-K175, R&S®SMM-K175 and R&S®SMBVB-K175 options.
A K55 and/or K144 option must also be installed on the respective instrument for each K175 option.

Key features

- Generation of I/Q frequency symbol grid files for O-RAN U-plane payload generation
- For LTE and 5G NR
- Presets for several O-RAN TMs in line with WG4.CONF.0 v09.00

General settings		
U-plane state		on/off
Link directions for LTE		
Downlink		supported
Uplink		not supported
Link directions for 5G NR		
Downlink		supported
Uplink		supported, except PRACH

OneWeb

The OneWeb software options implement the physical layer in line with the OneWeb satellite communications standard for both forward and reverse links.

OneWeb user-defined signal generation

For the R&S®SMW-K130 option.

The R&S®SMW-K130 OneWeb user-defined signal generation option is ideal for physical layer testing with maximum flexibility and access to all standard OneWeb signal parameters.

Key features

- Selected reference signals for OneWeb satellite air interface
- Fully standard-compliant OneWeb signal generation
- Highest flexibility for customized signal design
- Forward link (SC-TDM) and reverse link (SC-FDMA) signal generation
- Define multicarrier scenarios for reverse links
- Single carrier scenarios for forward links

General settings		
Sequence length	Sequence length can be entered in frames (10 ms each). The maximum length depends on the available ARB memory options and the configured OneWeb settings, e.g. the channel bandwidth and the filter settings.	
Mode		predefined and user-defined modes
Baseband filter	standard	root cosine with rolloff 0.085
Link direction		downlink, uplink
Physical layer mode	downlink	SC-TDM
	uplink	SC-FDMA

Downlink simulation		
General settings		
Channel bandwidth		250 MHz
Sampling rate		230.4 MHz
Allocation table		
Code word	up to 2 code words can be configured	1/1, 1/2, 2/2
Modulation	determines modulation scheme used	QPSK, 8PSK, 16QAM
State	sets state of selected allocation	on/off
Transmission mode	selects the downlink transmission mode	1OW mode, 2OW mode
UE category		1 to 5

Uplink simulation		
General settings		
Channel bandwidth	determines the channel bandwidth used	20 MHz
FFT size		2048
Carrier aggregation settings		
Activate carrier aggregation		on/off
Resource allocation uplink		
Select user equipment	Up to 4 UEs can be configured individually and allocated to the subframes.	
Number of configurable subframes	determines the number of configurable uplink subframes; the subframe configurations are used periodically; Note: Sounding reference signals are configured globally and therefore not copied here.	up to 40 subframes
Allocation table		
Content type	UE can be set to PUSCH or PUCCH or PUACH	PUSCH, PUCCH, PUACH
Modulation	determines the modulation scheme used if content type is PUSCH or PUACH or the PUCCH format if content type is PUCCH	QPSK, 8PSK, 16QAM or format 1, 1a, 1b, 2, 2a, 2b, 3

User equipment configuration		
UE ID/n_RNTI	user equipment identifier (n_RNTI) for selected user equipment	0 to 65535
Power	sets power level of selected UE	–80 dB to +10 dB, in steps of 0.001 dB
Mode		standard, PRACH

OneWeb reference signals

For the R&S®SMW-K355 option.

The R&S®SMW-K355 OneWeb reference signal option provides predefined waveforms for basic RF tests without supporting all standard-compliant OneWeb signal parameters. Predefined waveforms are available for developing and testing RF components. Receiver test parameters, such as cell ID, are not present.

Reference waveforms for both R&S®SMW-B9 and R&S®SMW-B10 (wideband and standard baseband)	HY11-H9951-2_2.0_RL_8PSK_1CC_1cl_736371.1831.wv
	HY11-H9951-2_2.0_RL_8PSK_2CC_1cl_736371.1817.wv
	HY11-H9951-2_2.0_RL_16QAM_1CC_1cl_736371.1833.wv
	HY11-H9951-2_2.0_RL_16QAM_2CC_1cl_736371.1823.wv
	HY11-H9951-2_2.0_RL_QPSK_1CC_1cl_736371.1827.wv
	HY11-H9951-2_2.0_RL_QPSK_2CC_1cl_736371.18.wv
	HY11-HA563-1_1.0_RL_8PSK_1CC_2cl_736408.2524.wv
	HY11-HA563-1_1.0_RL_8PSK_2CC_2cl_736408.2531.wv
	HY11-HA563-1_1.0_RL_16QAM_1CC_2cl_736408.2521.wv
	HY11-HA563-1_1.0_RL_16QAM_2CC_2cl_736408.2528.wv
	HY11-HA563-1_1.0_RL_QPSK_1CC_2cl_736408.2518.wv
	HY11-HA563-1_1.0_RL_QPSK_2CC_2cl_736408.2527.wv
	HY11-HA674-1_1.0_RL_8PSK_1CC_TDD_736523.4025.wv
	HY11-HA674-1_1.0_RL_16QAM_1CC_TDD_736523.4179.wv
	HY11-HA674-1_1.0_RL_QPSK_1CC_TDD_736523.4201.wv
	HY11-HA674-2_1.0_RL_8PSK_2CC_TDD_736523.4383.wv
	HY11-HA674-2_1.0_RL_16QAM_2CC_TDD_736523.441.wv
	HY11-HA674-2_1.0_RL_QPSK_2CC_TDD_736523.4217.wv
Reference waveforms for R&S®SMW-B9 only (wideband baseband)	HY11-H9878-2_2.0_FL_8psk_736399.8358.wv
	HY11-H9878-2_2.0_FL_16qam_736399.8052.wv
	HY11-H9878-2_2.0_FL_qpsk_736399.837.wv
	HY11-HA610-1_1.0_FLwvfm736292.5983.8psk.notch.wv
	HY11-HA610-1_1.0_FLwvfm736292.5996.qpsk.notch.wv
	HY11-HA610-1_1.0_FLwvfm736345.2465.16qam.notch.wv
	OneWeb_RL_6Carrier_8PSK_channel1.wv
	OneWeb_RL_6Carrier_8PSK_channel2.wv
	OneWeb_RL_6Carrier_8PSK_channel3.wv
	OneWeb_RL_6Carrier_8PSK_channel4.wv
	OneWeb_RL_6Carrier_8PSK_channel5.wv
	OneWeb_RL_6Carrier_8PSK_channel6.wv
	OneWeb_RL_6Carrier_8PSK_channel7.wv
	OneWeb_RL_6Carrier_8PSK_channel8.wv
	OneWeb_RL_6Carrier_QPSK_channel1.wv
	OneWeb_RL_6Carrier_QPSK_channel2.wv
	OneWeb_RL_6Carrier_QPSK_channel3.wv
	OneWeb_RL_6Carrier_QPSK_channel4.wv
	OneWeb_RL_6Carrier_QPSK_channel5.wv
	OneWeb_RL_6Carrier_QPSK_channel6.wv
	OneWeb_RL_6Carrier_QPSK_channel7.wv
	OneWeb_RL_6Carrier_QPSK_channel8.wv
	OneWeb_RL_48Carrier_8PSK.wv
	OneWeb_RL_48Carrier_QPSK_v4.wv

3GPP WCDMA/HSPA+

3GPP FDD

For the R&S®SMW-K42, R&S®SMM-K42 and R&S®SMBVB-K42 options.

Key features

- Four individually configurable BS/UE
- Real-time generation of P-CCPCH and up to three DPCHs in downlink
- One UE in real time in uplink, up to 128 additional mobile stations via ARB
- Support for compressed mode in downlink and uplink
- Physical layer-only HSDPA channels for use in test models or OCNS
- Test case wizard in line with 3GPP TS 25.141
- Graphical displays such as code domain, frequency spectrum, CCDF and more support fast and easy signal configuration/evaluation

WCDMA 3GPP FDD digital standard		release 99 features in line with the 3GPP 25 series FDD specifications release 11; physical layer-only HSDPA channels in line with the 3GPP 25 series FDD specifications release 11
Signal generation modes		
Signal generation modes	In standard mode, the signal contains precalculated parts that repeat according to the configured ARB sequence length and/or parts that are generated by real-time hardware and therefore do not necessarily repeat according to the configured ARB sequence. In all-offline mode, the signal parts (if configured) that would be generated by real-time hardware in standard mode are still contained (emulated, precalculated) and therefore are also repeated according to the configured ARB sequence length.	On the R&S®SMBV100B, standard mode is used. On the R&S®SMW200A with standard baseband (R&S®SMW-B10), standard mode is used in baseband A and B and all-offline mode is used in baseband C and D. On the R&S®SMW200A with wideband baseband (R&S®SMW-B9), all-offline mode is used. On the R&S®SMM100A with R&S®SMM-B9, all-offline mode is used.
Real-time signal parts and precalculated ARB signal parts	In downlink mode, the P-CCPCH (BCCH with running SFN) and up to three DPCHs can be generated in real time. All other channels (frame-cycle control channels such as SCH, OCNS simulation, other base stations, etc.) repeat according to the configured ARB sequence length. In uplink mode, the DPCCH and one DPDCH of one mobile station can be generated in real time; further channels and mobile stations (three user-configured ones and up to 128 of identical configuration) repeat according to the configured ARB sequence length.	
ARB sequence length	The sequence length of the precalcuated ARB part can be entered in frames (10 ms each); the maximum length depends on the available baseband option.	
Generate waveform file	signal filtered and saved as ARB waveform file	
Enhanced channels		
Special capabilities in up to 4 channels of base station 1 in downlink and in channels of mobile station 1 in uplink: real-time calculation, optional channel coding, simulation of bit and block errors, data lists as sources for data and TPC fields		
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. As a result, externally generated data can 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 DUT power control can also be generated.	
Channel coding	coding of 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	
	channel coding schemes for uplink and downlink	• RMC 12.2 kbps • AMR 12.2 kbps • RMC 64 kbps • RMC 144 kbps • RMC 384 kbps • user
Bit error insertion	deliberate generation of bit errors by impairing the data stream prior to channel coding or at the physical layer	
	bit error rate	0.5 to 10^{-7}

Block error insertion	deliberate generation of block errors by impairing the CRC during coding of enhanced channels	
	block error rate	0.5 to 10^{-4}
Test case wizard		
Configuration assistant for easy setup of test cases in line with TS 25.141	not available for the R&S®SMBVB-K42 option	
Channel and code domain configuration		
Modulation		• BPSK (uplink) • QPSK (downlink) • 16QAM (downlink HS-PDSCH) • 64QAM (downlink HS-PDSCH)
Test models	downlink (in line with TS 25.141)	• test model 1 with 4/8/16/32/64 DPCH • test model 2 • test model 3 with 4/8/16/32 DPCH • test model 4 • test model 5 with 8/4/2 HS-PDSCH channels (in case of 4 HS-PDSCH with 4 or 14 DPCH) • test model 6 with 8/4 HS-PDSCH
	uplink (not standardized)	• DPCCH + 1 DPDCH at 60 ksps • DPCCH + 1 DPDCH at 960 ksps
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.	
Additional user equipment	simulation of up to 128 mobile stations in addition to the 4 user-configurable mobile stations; the additional mobile stations use different scrambling codes	
General settings		
Chip rate	standard	3.840 Mcps
	range	0.4 Mcps to 5 Mcps
Link direction		uplink (reverse link) and downlink (forward link)
Baseband filter	standard	root cosine, α = 0.22
	other filters	root cosine, cos, user filters
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 128 additional MS of identical configuration in each of the following modes: PRACH only, PCPCH only, DPCCH + DPDCHs
Power reference	for uplink only	RMS power, first DPCCH, PRACH message part, last PRACH preamble
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	
Physical channels in uplink		
	physical random access channel (PRACH)	
	physical common packet channel (PCPCH)	
	dedicated physical control channel (DPCCH)	
	dedicated physical data channel (DPDCH)	

3GPP FDD enhanced MS/BS tests including HSDPA, HSUPA and HSPA+

For the R&S®SMW-K83, R&S®SMM-K83 and R&S®SMBVB-K83 options.
A K42 option must also be installed on the instrument for each K83 option.

Key features

- Support of 3GPP HSDPA, HSUPA and HSPA+
- HSDPA H-Sets 1 to 12 with channel coding; user-definable H-Set configuration
- HSUPA fixed reference channels with channel coding and HARQ simulation
- Closed-loop HARQ feedback (only for R&S®SMW200A equipped with B10)
- Support of UL-DTX, DC-HSDPA, 4C-HSDPA and 8C-HSDPA
- External dynamic power control of up to three code channels in downlink or one UE in uplink (only for R&S®SMW200A with B10 option)

WCDMA 3GPP FDD digital standard	HSDPA, HSUPA and HSPA+ features in line with the 3GPP 25 series FDD specifications release 11	
Downlink simulation		
HSDPA downlink channels (HS-SCCH, HS-PDSCH and F-DPCH/enhanced F-DPCH) including MIMO and downlink higher order modulation (HOM, 64QAM)		
Enhancements	The K42 option simulates HSDPA/HSPA+ channels in continuous mode for TX measurements in line with TS 25.141 (test models 5 and 6). The K43 option does not support MIMO. The K83 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 and the capability to set start subframe and inter-TTI distance. For HS-PDSCH, modulation schemes up to 64QAM are supported as well as MIMO (double transmit antenna array, D-TXAA). In addition, several F-DPCHs (fractional dedicated physical channel) up to slot format 9 (enhanced F-DPCH) can be generated.	
Ranges	modulation	QPSK, 16QAM or 64QAM; In case of MIMO, the modulation for the two streams can be set independently.
Ranges (valid for F-DPCH)	slot format	0 to 9
Fixed reference channel definition H-Set		
Enhancements	The K83 option allows HSDPA downlink channels with channel coding to be generated in line with the definition of the fixed reference channels (H-Sets 1 to 12) 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. The cases for HS-SCCH-less operation (downlink continuous packet connectivity, CPC), MIMO and downlink higher order modulation (HOM, 64QAM) are also included.	
Ranges	H-Set	H-Set 1 to H-Set 12, user-editable H-Set
	HS-SCCH type	HS-SCCH type 1 to 3, in line with TS 25.212
	HS-PDSCH modulation	QPSK, 16QAM or 64QAM; In case of MIMO, the modulation for the two streams can be configured. Note: Only modulation mode combinations in line with TS 25.212 table 14 are possible.
HSUPA downlink channels (E-AGCH, E-RGCH, E-HICH)		
Enhancements	In downlink, the K83 option simulates the 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.	
Features for type 3i enhanced performance requirements tests		
Enhancements	The K43 option does not support OCNS generation for type 3i enhanced performance requirements tests or generation of H-Sets with varying modulation and number of HS-PDSCH codes. The K83 option expands the functionality to include both features.	

Dynamic power control (not available in all-offline mode)		
Enhancements	The K83 option allows the variation of the output power in real-time mode for up to 3 DPCHs in three submodes:	
	external (not available for the R&S®SMBVB-K83 option)	The UE provides TPC info to the Rohde & Schwarz instrument by an external connector (TTL level).
	by TPC pattern	The 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.
Uplink simulation		
HS-DPCCH (high speed dedicated physical control channel) including MIMO and up to 8C-HSDPA		
Enhancements	The K42 option does not support HSDPA for the uplink. The K83 option now allows the simulation of an HS-DPCCH (high speed dedicated physical control channel) in real-time operation (UE1 in “up to release 7” or “release 8 and later RT” compatibility mode) and arbitrary waveform mode (UE1 in “release 8 and later” compatibility mode, UE2 to UE4, additional mobile stations).	
Ranges	compatibility mode	up to release 7, release 8 and later, release 8 and later RT; Release 8 and later RT is not supported in all-offline mode.
	MIMO mode	off/on
	secondary cell enabled/active	0 to 7
E-DPCCH (E-DCH dedicated physical control channel), E-DPDCH (E-DCH dedicated physical data channel) including uplink higher order modulation (HOM, 4PAM)		
Enhancements	The K83 option simulates one E-DPCCH and up to four E-DPDCHs in each of the mobile stations in the uplink, and for mobile station 1 also with channel coding in line with the defined fixed reference channels in TS 25.104 and TS 25.141 or with user-configured coding chain. Furthermore, a method is provided to control the output of the FRC HARQ processes in real-time using a feedback line (TTL) by which ACKs and NACKs are received in order to fulfill the requirements defined in 3GPP TS 25.141, chapters 8.12 and 8.13. This in not supported in all-offline mode, and also not for the R&S®SMBVB-K83 option.	
E-DPDCH	overall symbol rate (total symbol rate of all uplink E-DPDCHs)	15 ksps, 30 ksps, 60 ksps, 120 ksps, 240 ksps, 480 ksps, 960 ksps, 2 × 960 ksps, 2 × 1920 ksps, 2 × 960 ksps + 2 × 1920 ksps
	modulation	BPSK, 4PAM
HSUPA FRC	channel coding in line with the defined fixed reference channels in TS 25.104 and TS 25.141 or with user-configured coding chain; in addition, a user-configurable virtual HARQ mode or a HARQ feedback mode (not in all-offline mode) and bit/block error insertion are possible	
	fixed reference channel (FRC) (channel coding schemes)	FRC 1 to FRC 8, user
	data source E-DCH	PRBS: 9, 11, 15, 16, 20, 21, 23, All0, All1, pattern (length: 1 bit to 64 bit), data lists
	HARQ feedback simulation (not available for the R&S®SMBVB-K83 option, not available in all-offline mode): feedback (TTL) connected to an input connector	
	maximum number of retransmissions	0 to 20
	ACK definition	high, low
	virtual HARQ mode	
	HARQ ACK/NACK pattern (individual ACK/NACK pattern for each HARQ process)	up to 32 ACK/NACK commands used periodically
Uplink DPCCH with 4 TPC bits		
Enhancements	The K42 option allows the simulation of DPCCH with 2 TPC bits per slot only (slot formats 0 to 3). The K83 option now enables simulation of DPCCH with 4 TPC bits per slot (slot formats 0 to 4).	
Ranges in the uplink DPCCH settings	slot format	0 to 4
	TPC mode	2 bit, 4 bit

UL-DTX CPC feature and uplink user scheduling feature		
Enhancements	The K83 option simulates the UL-DTX CPC feature for mobile station 1. In addition, the K83 option enables flexible uplink transmission scheduling for mobile station 1 by means of a user scheduling file (not available in all-offline mode, and also not for the R&S®SMBVB-K83 option).	
Ranges in the UL-DTX/user scheduling configuration dialog	state	off/on
	mode	UL-DTX, user scheduling; User scheduling is not available in all-offline mode or for R&S®SMBVB-K83.
	E-DCH TTI	2 ms, 10 ms
Additional power reference modes		
Enhancements	additional power reference modes in line with new HDSPA/HSUPA/HSPA+ features	
Ranges	power reference	RMS power, first DPCCH, PRACH message part, last PRACH preamble, first HARQ-ACK, first PCI/CQI, first E-DCH
Dynamic power control (not available in all-offline mode)		
Enhancements	The K83 option allows the variation of the output power in real-time mode for UE1 in three submodes:	
	external (not available for the R&S®SMBVB-K83 option)	NodeB provides TPC info to the Rohde & Schwarz instrument by an external connector (TTL level)
	by TPC pattern	The 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.
	assignment mode for UL-DTX	normal, F-DPCH slot format 0 or 9
Uplink test models (in line with TS 34.121) for the K83 option		
3GPP release 6 test models		TS 34.121, table C.10.1.4, subtests 1 to 6
3GPP release 8 test models		TS 34.121, table C.10.1.4, subtests 1 to 4, TS 34.121, table C.11.1.3, subtests 1 to 5, TS 34.121, table C.11.1.4, subtest 1

GSM/EDGE

GSM/EDGE digital standard

For the R&S®SMW-K40, R&S®SMM-K40 and R&S®SMBVB-K40 options.

GSM/EDGE digital standard		in line with 3GPP: • TS 45.001 v. 9.0.0 • TS 45.002 v. 9.0.0 • TS 45.004 v. 9.0.0
Sequence 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 multi-frame
	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 the 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)
Settable slot attenuation		0.0 dB to +60.0 dB, 8 different levels simultaneously possible (full level and 7 attenuated levels)
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

EDGE Evolution

For the R&S®SMW-K41, R&S®SMM-K41 and R&S®SMBVB-K41 options.
A K40 option must also be installed on the instrument for each K41 option.

General parameters	This option enhances the K40 option (GSM/EDGE digital standard) to support EDGE Evolution (EDGE+) including VAMOS.	
GSM/EDGE/EDGE+ digital standard		in line with 3GPP: • TS 45.001 v. 9.0.0 • TS 45.002 v. 9.0.0 • TS 45.004 v. 9.0.0
Symbol rate mode		normal symbol rate, higher symbol rate
Sequence mode	unframed	normal symbol rate: MSK, AQPSK, 8PSK EDGE, 16QAM EDGE or 32QAM EDGE
		higher symbol rate: QPSK EDGE, 16QAM EDGE or 32QAM EDGE
	framed (single)	configuration of a signal via frame structure (see frame structure below)
	framed (double)	configuration of simple multi-frame
Modulation	normal symbol rate	MSK, FSK, AQPSK, 8PSK EDGE, 16QAM EDGE or 32QAM EDGE
	higher symbol rate	QPSK EDGE, 16QAM EDGE or 32QAM EDGE
Training sequence		set 1; set 2: normal (GMSK), normal (AQPSK)
Symbol rate	standard	normal symbol rate: 270.833 kHz; higher symbol rate: 325 kHz
	range	400 Hz to 325 kHz
Baseband filter	GSM, standard for normal symbol rate	Gaussian with B × T = 0.3
	range	B × T = 0.15 to 2.5
	EDGE, standard for normal symbol rate	Gaussian linearized (EDGE)
	EDGE+ for higher symbol rate	narrow pulse shape, wide pulse shape
Frame structure	change possible from slot to slot and frame to frame	normal symbol rate: GSM, AQPSK, 8PSK EDGE, 16QAM EDGE, 32QAM EDGE; higher symbol rate: QPSK EDGE, 16QAM EDGE, 32QAM EDGE
	additional burst types for normal symbol rate	normal (AQPSK, full rate – full rate), normal (AQPSK, full rate – half rate), normal (AQPSK, half rate – half rate), normal (16QAM), normal (32QAM), all data (16QAM), all data (32QAM)
	additional burst types for higher symbol rate	normal (QPSK), normal (16QAM), normal (32QAM), all data (QPSK), all data (16QAM), all data (32QAM)
Vamos timing offset jitter (for GMSK)	for R&S®SMW200A with R&S®SMW-B14	random timing jitter in range of –1, 0, +1 symbol period
Vamos frequency offset jitter (for GMSK)	for R&S®SMW200A with R&S®SMW-B14	random frequency jitter with settable range
	setting range	μ = 0 Hz to 9999.9 Hz, σ = 0 Hz to 9999.9 Hz

CDMA2000®/1xEV-DO

CDMA2000® digital standard

For the R&S®SMW-K46, R&S®SMM-K46 and R&S®SMBVB-K46 options.

CDMA2000® digital standard	release C	in line with 3GPP2 C.S0002-C
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
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 (depends on radio configuration)
	reverse link	4 mobile stations with a maximum of 8 code channels each (depends on radio configuration)
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 chip (fixed)
	BS2 to BS4	0 chip to 98304 chip
PN offset		0 to 511
Transmit diversity	If this function is activated, the output signal can be generated for either antenna 1 or antenna 2, as defined in the standard.	off, antenna 1, antenna 2
Diversity mode		OTD/STS
Quasi-orthogonal Walsh sets		set 1 to set 3
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
(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.	
	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.	

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.	
Operating mode	simulates MS operating mode and defines available channels	• traffic • access • enhanced access • common control
(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.	
	output power control step	–10 dB to +10 dB
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)	

1xEV-DO digital standard

For the R&S®SMW-K47, R&S®SMM-K47 and R&S®SMBVB-K47 options.

1xEV-DO digital standard	release A	in line with 3GPP2 C.S0024-A 3.0
Chip rates	standard	1.2288 MHz (1X)
	range	1 MHz to 5 MHz
Link direction		forward link and reverse link
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 four independent traffic channels for different users.
	reverse link	Up to four completely independent access terminals can be simulated.
Generate waveform file	filtering of data generated in ARB mode and saving it as waveform file	
Forward link parameters		
Physical layer subtype		0&1 or 2
Control channel	data rate	38.4 kbps or 76.8 kbps
Settings for each forward link traffic channel		
Number of packets to send		0 to 65536 or infinite
Rate index		1 to 12
HARQ mode	subtype 2 only	off, ACK, NAK
Settings for each reverse link access terminal in traffic mode		
Physical layer subtype		0&1 or 2
Data channel	modulation, subtype 0&1	BPSK
	modulation, subtype 2	B4, Q4, Q2, Q4Q2, E4E2
Settings for each reverse link access terminal in access mode		
Physical layer subtype		0&1 or 2
Data channel	data rate	9.6 kbps, 19.2 kbps, 38.4 kbps

1xEV-DO revision B

For the R&S®SMW-K87, R&S®SMM-K87 and R&S®SMBVB-K87 options.
A K47 option must also be installed on the instrument for each K87 option.

General parameters	This option enhances the K47 option (1xEV-DO revision A) to support 1xEV-DO revision B. The K87 option requires the K47 option (1xEV-DO revision A).	
1xEV-DO digital standard	revision B	in line with 3GPP2 C.S0024-B 3.0
Forward link parameters		
Physical layer subtype		0&1, 2 or 3
Settings for each forward link traffic channel		
Rate index	subtype 3	1 to 28
Multicarrier parameters		
	An activated multi-carrier provides up to 16 concurrent carriers. Each carrier is modulated according to the signal configuration settings. Carrier frequencies can be set via the CDMA channel number or by directly specifying the RF center frequency.	
Band class	band class selection defines the CDMA channel number frequencies	• band class 0 (800 MHz band) • band class 1 (1900 MHz band) • band class 2 (TACS band) • band class 3 (JTACS band) • band class 4 (Korean PCS band) • band class 5 (450 MHz band) • band class 6 (2 GHz band) • band class 7 (upper 700 MHz band) • band class 8 (1800 MHz band) • band class 9 (900 MHz band) • band class 10 (secondary 800 MHz band) • band class 11 (400 MHz European PAMR band) • band class 12 (800 MHz PAMR band) • band class 13 (2.5 GHz IMT-2000 extension band) • band class 14 (US PCS 1.9 GHz band) • band class 15 (AWS band) • band class 16 (US 2.5 GHz band) • band class 17 (US 2.5 GHz forward link only band) • band class 18 (700 MHz public safety band) • band class 19 (lower 700 MHz band) • band class 20 (L band) • band class 21 (S band)

TD-SCDMA

TD-SCDMA digital standard (3GPP TDD LCR)

For the R&S®SMW-K50, R&S®SMM-K50 and R&S®SMBVB-K50 options.

Key features

- Downlink cells, slots, pilots and guard period
- Signal generation of P-CCPCH, S-CCPCH and DPCCH, HS-SCCH in downlink
- BCH and DCH transport channels
- PUSCH, PRACH support in uplink
- Data, midamble sequences
- Various graphical displays such as code domain, frequency spectrum and CCDF support fast and easy signal configuration/evaluation

WCDMA 3GPP TDD LCR (TD-SCDMA) digital standard		in line with 3GPP TDD standard for a chip rate of 1.28 Mcps (low chip rate mode)
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	
	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	
General settings		
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	$\sqrt{\cos}$ α = 0.22
	other filters	$\sqrt{\cos}$, cos, user filters
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		
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	
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)	
	high speed shared information channel (HS-SICH)	
	enhanced physical uplink shared channel QPSK (E-PUCH QPSK)	
	enhanced physical uplink shared channel 16QAM (E-PUCH 16QAM)	

TD-SCDMA (3GPP TDD LCR) enhanced BS/MS tests, including HSDPA

For the R&S®SMW-K51, R&S®SMM-K51 and R&S®SMBVB-K51 options.
A K50 option must also be installed on the instrument for each K51 option.

Key features

- HSDPA and HSUPA support
- Predefined and user-defined reference measurement channels for uplink and downlink
- Various graphical displays such as code domain, frequency spectrum and CCDF support fast and easy signal configuration/evaluation

General parameters	This option enhances the K50 option (TD-SCDMA digital standard) to support full channel coding and HSDPA.	
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, 16QAM and 64QAM modulation), HS-SICH, HSDPA and HSUPA	
	bit and block error insertion possible	
Modulation	QPSK, 8PSK, 16QAM and 64QAM	
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 physical downlink shared channel 64QAM (HS-PDSCH 64QAM)	
	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, RMC PLCCH, HSDPA, user
	uplink	RMC 12.2 kbps, RMC 64 kbps, RMC 144 kbps, RMC 384 kbps, RMC HS-SICH, HSUPA, user

TETRA release 2

For the R&S®SMW-K68 option.

TETRA release 2 digital standard		in line with ETSI EN 300392-2 digital standard (V3.2.1) and TETRA conformance testing specification ETSI EN 300394-1 (V3.1.1)
General settings		
Link direction	not available in T3 mode	downlink, uplink
Channel type	test channel (NOT logical channel) only in T1 and T4 mode	see test modes
Sequence length	The sequence length can be entered in multi-frames and depends on the settings. With default values (T1), 14.28 multi-frames/Msample are available. Example: An R&S®SMW200A with 64 Msample can generate 913 multi-frames.	
Baseband filter	default	root raised cosine (rolloff factor 0.2)
	others	available
Test modes		
T1	downlink channels	0, 1, 2, 3, 4, 21, 22, 24
	uplink channels	7, 8, 9, 10, 11, 21, 23, 24
T2	TETRA interferer	phase modulation, QAM
T3	CW interferer	
T4	downlink channels	27
	uplink channels	25, 26
User-defined		see "User-defined mode"
Frame configuration		
Frames 1 to 17	slots	configurable as specified by test mode (logical channel, etc.), see "User-defined mode"; different slot levels (off, attenuated, full)
Frame 18	slots	configurable as specified by test mode (logical channel, etc.), see "User-defined mode"; different slot levels (off, attenuated, full)
User-defined mode		
In user-defined mode, the slots can be configured without restrictions. In all other test modes, the settings are limited by the test mode specification.		
Modulation type		phase modulation, QAM
Downlink burst type	only with phase modulation	continuous, discontinuous
Slot settings		
Slot level	full	not attenuated
	attenuated	1 of 4 attenuation levels
	off	inactive
Slot attenuation	A1 to A4	1 of 4 attenuation levels
Logical channel type (burst types are controlled by the logical channels)	downlink, phase modulation available burst types: • normal continuous downlink • synchronization continuous downlink • normal discontinuous downlink • synchronization discontinuous downlink	TCH/7,2 (π/4-DQPSK), TCH/4,8 (π/4-DQPSK), TCH/2,4 (π/4-DQPSK), TCH/F (π/4-DQPSK), TCH/H (π/4-DQPSK), STCH+TCH (π/4-DQPSK), STCH+STCH (π/4-DQPSK), SCH/F (π/4-DQPSK), TCH-P8/10,8/F (π/8-DQPSK), SCH-P8/F (π/8-DQPSK), SCH/HD | SCH/HD (π/4-DQPSK), BSCH | SCH/HD (π/4-DQPSK), SCH/HD | BNCH (π/4-DQPSK), BSCH | BNCH (π/4-DQPSK), SCH-P8/HD | SCH-P8/HD (π/8-DQPSK)

Logical channel type (continued) (burst types are controlled by the logical channels)	uplink, phase modulation available burst types: • normal uplink • control uplink	TCH/7,2 (π/4-DQPSK), TCH/4,8 (π/4-DQPSK), TCH/2,4 (π/4-DQPSK), TCH/F (π/4-DQPSK), TCH/H (π/4-DQPSK), STCH+TCH (π/4-DQPSK), STCH+STCH (π/4-DQPSK), SCH/F (π/4-DQPSK), TCH-P8/10,8/F (π/8-DQPSK), SCH-P8/F (π/8-DQPSK), SCH/HU | SCH/HU (π/4-DQPSK), SCH-P8/HU | SCH-P8/HU (π/8-DQPSK), SCH/HU (π/4-DQPSK) | SCH-P8/HU (π/8-DQPSK), SCH-P8/HU (π/8-DQPSK) | SCH/HU (π/4-DQPSK)
	downlink, QAM available burst type: • normal downlink	SCH-Q/D-4H (4QAM, high protection), SCH-Q/D-16H, SCH-Q/D-64H, SCH-Q/D-64M (64QAM, mid-protection), SCH-Q/D-16U (16QAM, unprotected), SCH-Q/D-64U, BNCH-Q/4H, BNCH-Q/16H, BNCH-Q/64H, BNCH-Q/64M, BNCH-Q/16U, BNCH-Q/64U
	uplink, QAM available burst types: • normal uplink • control uplink • random access	SCH-Q/U-4H, SCH-Q/U-16H, SCH-Q/U-64H, SCH-Q/U-64M, SCH-Q/U-16U, SCH-Q/U-64U, SCH-Q/HU-4H | SCH-Q/HU-4H, SCH-Q/HU-16H | SCH-Q/HU-16H, SCH-Q/HU-64H | SCH-Q/HU-64H, SCH-Q/HU-64M | SCH-Q/HU-64M, SCH-Q/HU-16U | SCH-Q/HU-16U, SCH-Q/HU-64U | SCH-Q/HU-64U, SCH-Q/RA | SCH-Q/RA

Wireless connectivity standards

WLAN IEEE 802.11

WLAN software options generate standard-compliant signals in line with IEEE 802.11a/b/g/n/j/p/ac/ax/ad/ay. They support channel bandwidths of 20 MHz, 40 MHz, 80 MHz, 80 + 80 MHz,160 MHz and 320 MHz, and even 4.32 GHz bandwidth with the R&S®SMW200A for IEEE 802.11ay. The options support high throughput (HT), very high throughput (VHT) and high efficiency (HE) modes including MIMO capabilities (generation of up to eight spatial streams and up to eight TX antennas).

IEEE 802.11a/b/g/n/j/p

For the R&S®SMW-K54, R&S®SMM-K54 and R&S®SMBVB-K54 options.

Key features

- Support of all standard-compliant transmission modes
- Support of all three operating modes: legacy, mixed mode, green field
- Standard-compliant MCS, 256QAM
- Up to four spatial streams/antennas
- Simulation of real-time MIMO channel conditions

IEEE 802.11a/b/g/n/j/p digital standard		in line with IEEE 802.11-2016
General settings		
Bandwidth		20 MHz, 40 MHz
Baseband filter		spectral mask in line with IEEE 802.11-2016 transmit spectrum mask definitions
Transmit antenna setup	number of antennas	1 to 4
Frame block configuration		
Frame blocks (rows in table)		1 to 100
Type		DATA, SOUNDING
Physical mode	type = DATA	LEGACY, MIXED MODE, GREEN FIELD
	type = SOUNDING	GREEN FIELD, MIXED MODE
Transmit mode	physical mode = LEGACY	L-10 MHz, L-20 MHz, L-Duplicate, L-Upper, L-Lower, CCK, PBCC
	physical mode = MIXED MODE or GREEN FIELD	HT-20 MHz, HT-40 MHz, HT-Duplicate, HT-Upper, HT-Lower
PSDU parameters	MAC header	fields: frame control, duration/ID, addresses 1 to 4, sequence control
	frame check sequence	32-bit CRC
	PLCP preamble and header format	long PLCP and short PLCP
	preamble/header	on/off
	data length	0 byte to 4095 byte
	scrambling	on/off
Settings for CCK	PSDU modulation	DBPSK, DQPSK, CCK
Settings for PBCC	PSDU modulation	DBPSK, DQPSK, PBCC
Settings for OFDM	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	on/off
	PSDU modulation/space stream	BPSK, QPSK, 16QAM, 64QAM
	data length	1 byte to 4061 byte for LEGACY frames, 1 byte to 65495 byte for HT frames; 0 is permissible only with sounding frames
	guard interval	short, long
	scrambling	on/off
	coding	BCC or off
	interleaver	on/off
	time domain windowing (transition times)	0 s to 1000 ns
	spatial mapping	off, direct, indirect and spatial expansion

IEEE 802.11ac

For the R&S®SMW-K86, R&S®SMM-K86 and R&S®SMBVB-K86 options.
A K54 option must also be installed on the instrument for each K86 option.

Key features

- Support of all IEEE 802.11ac VHT transmission modes
- Standard-compliant MCS index 0 to 9, 1024QAM
- Up to eight spatial streams/antennas
- Multi-user MIMO, space time block coding (STBC), spatial multiplexing
- Simulation of real-time MIMO channel conditions

General parameters	This option enhances the K54 option (IEEE 802.11a/b/g/n/j/p) to support IEEE 802.11ac modes.	
IEEE 802.11ac digital standard		in line with IEEE 802.11ac-2013
General settings		
Bandwidth		20 MHz, 40 MHz, 80 MHz, 80 + 80 MHz, 160 MHz
Baseband filter		spectral mask in line with IEEE 802.11ac-2013
Transmit antenna setup	number of antennas	1 to 8
Frame block configuration		
Transmit mode	physical mode = MIXED MODE	VHT-20 MHz, VHT-40 MHz, VHT-80 MHz, VHT-80+80 MHz, VHT-160 MHz
Settings for OFDM		
PSDU parameters	multi-user MIMO	supported
	MAC header	fields: frame control, duration/ID, addresses 1 to 4, sequence control, QoS control and VHT control
	number of spatial streams	1 to 8
	number of space time streams	1 to 8
	PSDU modulation/space stream	BPSK, QPSK, 16QAM, 64QAM, 256QAM
	MCS	0 to 11
	channel coding	off, BCC, LDPC
	code rate	1/2, 2/3, 3/4, 5/6
	data source type	All0, All1, PRBS 9 to PRBS 23, pattern, data list, A-MPDU
	PN seed value	default/user

IEEE 802.11ax

For the R&S®SMW-K142, R&S®SMM-K142 and R&S®SMBVB-K142 options.
A K54 option must also be installed on the instrument for each K142 option.

Key features

- Support of all IEEE 802.11ax HE transmission modes
- Standard-compliant MCS index 0 to 11 and MCS 12/13, 1024QAM and 4096QAM
- MIMO modes with up to eight transmit antennas
- Multi-user MIMO, space time block coding (STBC), spatial multiplexing
- Simulation of real-time MIMO channel conditions

General parameters	This option enhances the K54 option (IEEE 802.11a/b/g/n/j/p) to support IEEE 802.11ax modes.	
IEEE 802.11ax digital standard		in line with IEEE P802.11ax
General settings		
Bandwidth		20 MHz, 40 MHz, 80 MHz, 80 + 80 MHz,160 MHz
Baseband filter		spectral mask in line with IEEE P802.11ax
Transmit antenna setup	number of antennas	1 to 8
Frame block configuration		
Transmit mode	physical mode = MIXED MODE	HE-20 MHz, HE-40 MHz, HE-80 MHz, HE-80+80 MHz, HE-160 MHz
Settings for OFDM/OFDMA		
PPDU parameters	number of spatial streams	1 to 8
	number of space time streams	1 to 8
	link direction	downlink, uplink
	PPDU format	HE SU, HE MU, HE trigger based, HE extended range SU
	guard	0.8 µs, 1.6 µs, 3.2 µs
	HE-LTF symbol duration	3.2 µs, 6.4 µs, 12.8 µs
	number of MU-MIMO users	1 to 8
	maximum total number of users	138
	RU type	26-tone, 52-tone, 106-tone, 242-tone, 484-tone, 996-tone, 2 × 996-tone
	MCS	0 to 11, 12 and 13
	PPDU modulation	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM and 4096QAM
	channel coding	off, BCC, LDPC
	code rate	1/2, 2/3, 3/4, 5/6
	DCM	on/off
	number of MPDUs per A-MPDU	1 to 64

IEEE 802.11be

For the R&S®SMW-K147, R&S®SMM-K147 and R&S®SMBVB-K147 options.
A K54 option must also be installed on the respective instrument for each K147 option.

Key features

- Support of all IEEE 802.11be EHT transmission modes
- Standard compliant MCS index 0 to 13, up to 4096 QAM
- MIMO modes with up to eight transmit antennas
- Multi-user MIMO, space time block coding (STBC), spatial multiplexing
- Simulation of real-time MIMO channel conditions

General parameters	This option enhances the K54 option (IEEE 802.11a/b/g/n/j/p) to support IEEE 802.11be modes.	
IEEE 802.11be digital standard		in line with IEEE P802.11be
General settings		
Bandwidth		20 MHz, 40 MHz, 80 MHz, 80 + 80 MHz, 160 MHz, 320 MHz
Baseband filter		spectral mask in line with IEEE P802.11be
Transmit antenna setup	number of antennas	1 to 8
Frame block configuration		
Transmit mode	physical mode = MIXED MODE	EHT-20 MHz, EHT-40 MHz, EHT-80 MHz, EHT-160 MHz, EHT-320 MHz
Frame type	type = trigger	EHT common info, special user info, EHT user info
Settings for OFDM/OFDMA		
PPDU parameters	number of spatial streams	1 to 8
	number of space-time streams	1 to 8
	link direction	downlink, uplink
	PPDU format	EHT MU, EHT trigger based
	guard	0.8 µs, 1.6 µs, 3.2 µs
	EHT-LTF symbol duration	3.2 µs, 6.4 µs, 12.8 µs
	number of MU-MIMO users	1 to 8
	maximum total number of users	138
	RU type	26-tone, 52-tone, 52+26-tone, 106-tone, 106+26-tone, 242-tone, 484-tone, 484+242-tone, 996-tone, 996+484-tone, 996+484+242-tone, 2 × 996-tone, 2 × 996+484-tone, 3 × 996-tone, 3 × 996+484-tone, 4 × 996-tone
	MCS	0 to 13
	PPDU modulation	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM and 4096QAM
	channel coding	off, BCC, LDPC
	code rate	1/2, 2/3, 3/4, 5/6
	DCM	on/off
	number of MPDUs per A-MPDU	1 to 96

IEEE 802.11ad

For the R&S®SMW-K141 option.

Key features

- PHY modes: single carrier and control
- Support of 2.16 GHz channels
- Standard-compliant MCS index 0 to 12, π/2-16QAM
- Extraordinary flat frequency response over 2 GHz bandwidth
- Baseband, IF and RF signal generation with R&S®SMW200A

IEEE 802.11ad digital standard		in line with IEEE 802.11ad-2012
General settings		
Frame type		data
DMG phy mode		control, single carrier
Chip/sample rate	standard	1.76 GHz for control, single carrier
	range	400 Hz to 3 GHz
Baseband filter		spectral mask in line with IEEE 802.11ad-2012, chapter 21.3.2
PPDU parameters	MAC header	fields: frame control, duration/ID, addresses 1 to 4, sequence control, QoS control
	frame check sequence	32-bit CRC
	preamble/header active	on/off
Settings for PHY mode single carrier		
MCS	modulation and coding scheme	1 to 12
Modulation		π/2-BPSK, π/2-QPSK, π/2-16QAM
Channel coding		LDPC
Code rate		1/2, 3/4, 5/8, 13/16
Scrambler		on/off
Training length		0 to 16
Turnaround		on/off
Last RSSI		–68 dBm to –42 dBm
Settings for PHY mode control		
MCS	modulation and coding scheme	0
Modulation		DBPSK
Channel coding		LDPC
Code rate		3/4
Scrambler		on/off
Training length		0 to 16
Turnaround		on/off

IEEE 802.11ay

For the R&S®SMW-K177 option.

Key features

- PHY modes: single carrier
- Standard-compliant MCS index 1 to 21
- π/2-BPSK, π/2-QPSK, π/2-16QAM, π/2-64QAM, π/2-8PSK, π/2-64NUC
- Support of 4.32 GHz channels with bandwidth extension (R&S®SMW-K555 option)
- Baseband, IF and RF signal generation with R&S®SMW200A

IEEE 802.11ay digital standard		in line with IEEE 802.11ay-2021
General settings		
Frame type		data
EDMG phy mode		single carrier
Chip rate	standard	1.76 GHz/3.52 GHz for single carrier
Sample rate		2.4 GHz/4.8 GHz for single carrier
Baseband filter		spectral mask in line with IEEE 802.11ay-2021, chapter 28.3.5
PPDU parameters	MAC header	fields: frame control, duration/ID, addresses 1 to 4, sequence control, QoS control
	frame check sequence	32-bit CRC
	preamble/header active	on
Settings for PHY mode single carrier		
MCS	modulation and coding scheme	1 to 21
Modulation		π/2-BPSK, π/2-QPSK, π/2-16QAM, π/2-64QAM, π/2-8PSK, π/2-64NUC
Channel coding		LDPC
Code rate		1/2, 5/8, 2/3, 3/4, 13/16, 5/6, 7/8
Scrambler		on/off
Training length		0 to 255
Turnaround		on/off
type of GI		short GI, normal GI, long GI
SISO		yes

NFC A/B/F

For the R&S®SMW-K89 R&S®SMM-K89 and R&S®SMBVB-K89 options.

NFC is based on RFID technology and makes mobile phones suitable for numerous applications such as contactless payment of tickets, downloading of information from passive RFID tags and security ID use. Other than with RFID, some devices can also act as readers (poller) and listeners. There are three NFC types, all working on the same 13.56 MHz frequency, but with different data rates and modulation characteristics: NFC-A, NFC-B and NFC-F. This option supports all three NFC types and standard command types. The sequence configurator makes it easy to configure complete message sequences for realistic NFC device testing.

Key features

- Signal generation with standard-conform NFC A/B/F signals
- Sequence generator with all standard signals
- Predefined sequences for polling applications
- Flexible pulse form definition

NFC A/B/F digital standard	If “Technology” is set to “NFC-A”, “NFC-B” or “NFC-F”, signals are generated in line with the NFC Forum™ specifications “NFCForum-TS-DigitalProtocol-1.0” and “NFCForum-TS-Analog-1.0”. If “Technology” is set to “EMV type A” or “EMV type B”, signals are generated in line with “Book D: Contactless Communication Protocol”, version 2.2, from EMVCo, LLC.	
General settings		
Technology		NFC-A, NFC-B, NFC-F, EMV type A, EMV type B
Transmission mode		for “NFC-A”, “NFC-B” or “NFC-F”: poll, listen; for “EMV type A” or “EMV type B”: “PCD to PICC”, “PICC to PCD”
Modulation settings		
Bit rate		depends on technology and divisor: NFC-A and EMV type A: 105.938 kbit/s, NFC-B and EMV type B: 105.938 kbit/s, NFC-F with divisor 2: 211.875 kbit/s, NFC-F with divisor 4: 423.750 kbit/s
Inverse modulation	only for NFC-B listen mode and NFC-F listen mode and EMV type B PICC to PCD	on/off

Bluetooth®

Bluetooth® software options support standard-compliant Bluetooth® signal generation in line with Bluetooth® 5.1 specification plus previous releases on Rohde & Schwarz vector signal generators. The user interface makes it possible to configure Bluetooth® signals for Bluetooth® Basic Rate (BR), Bluetooth® Enhanced Data Rate (EDR) and Bluetooth® Low Energy (LE) with all the different channel types, packet types and packet formats including AoA/AoD. Packet content can be modified with user-specific data using the intuitive packet editor. Additional dirty transmitter configuration is possible for receiver sensitivity tests.

Bluetooth® Enhanced Data Rate/Bluetooth® Low Energy

For the R&S®SMW-K60, R&S®SMM-K60 and R&S®SMBVB-K60 options.

Key features

- In line with Bluetooth® 4.2 specification, including Bluetooth® Enhanced Data Rate (EDR) and Bluetooth® Low Energy (LE) mode
- Support of all three transport modes, in particular ACL+EDR, SCO and eSCO+EDR
- Support of all packet types for Bluetooth® Basic Rate (BR) and Bluetooth® Enhanced Data Rate (EDR) modes

Bluetooth® Basic Rate and Bluetooth® Enhanced Data Rate		
Bluetooth® version		version 4.2
Transport modes		ACL + EDR, SCO, eSCO + EDR
Supported packet types	in all data mode or with packet editor	ID, NULL, POLL, FHS, DM1, DM3, DM5, DH1, DH3, DH5, AUX1, 2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5, HV1, HV2, HV3, DV, EV3, EV4, EV5, 2-EV3, 2-EV5, 3-EV3, 3-EV5
Data sources		All0, All1, PRBS 7 to PRBS 23, pattern, data list
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 CRC	calculated automatically
Power ramping	ramp function	$\cos^2$, linear
	ramp time	1 symbol to 32 symbol
	rise offset, fall offset	–32 symbol to 32 symbol
Modulation	default settings	preset in line with Bluetooth® standard, 2FSK, 160 kHz deviation, 1 MHz symbol rate, π/4-DQPSK/8DPSK, 1 MHz symbol rate for EDR packets
	2FSK frequency deviation	100 kHz to 200 kHz
	2FSK symbol rate	400 Hz to 15 MHz
Filter	filter function	Gaussian, root cosine (others available)
	B × T (for Gaussian filter)	0.15 to 2.5
Dirty transmitter test	frequency drift rate	1.6 kHz
	start phase	0° to 359°
	frequency drift deviation	–100 kHz to +100 kHz
	carrier frequency offset	–150 kHz to +150 kHz
	symbol timing error	–150 ppm to +150 ppm
	modulation index	0.28 to 0.35
Bluetooth® Low Energy		
Bluetooth® Low Energy version		version 4.2
Channel types		advertising, data
Supported packet types		ADV_IND, ADV_DIRECT_IND, ADV_NONCONN_IND, ADV_DISCOVER_IND, SCAN_REQ, SCAN_RSP, CONNECT_REQ, DATA, CONTROL_DATA, TEST PACKET
Sequence length		depends on available ARB memory
Power ramping	ramp function	$\cos^2$, linear
	ramp time	1 symbol to 32 symbol
	rise offset, fall offset	–32 symbol to +32 symbol

Modulation	default settings	preset in line with Bluetooth® Low Energy (LE) standard, 2FSK, 250 kHz deviation, 1 MHz symbol rate
	2FSK frequency deviation	200 kHz to 300 kHz
	2FSK symbol rate	400 Hz to 15 MHz
Filter	filter function	Gaussian (others available)
	B × T (for Gaussian filter)	0.15 to 2.5
Dirty transmitter test	frequency drift rate	0 Hz or 625 Hz
	start phase	0° to 359°
	frequency drift deviation	–100 kHz to +100 kHz
	carrier frequency offset	–150 kHz to +150 kHz
	symbol timing error	–150 ppm to +150 ppm
	modulation index	0.45 to 0.55
Settings for advertising channel		
Advertising event interval		0.9 ms to 6.4 s
Advertising event delay		0 to 10 ms
Scan window		2.5 ms to 10.24 s
Scan interval		2.5 ms to 6.4 s
Data whitening		supported
Settings for data channel		
Bluetooth® controller role		central/peripheral
Number of TX packets per event		1 to 3
Connection event interval		7.5 ms to 6.4 s
LL connection mode		unencrypted, encrypted
Data whitening		supported
Settings for test packets		
Packet interval		625 µs to 12.5 ms, in steps of 625 µs
Payload type		PRBS 9, PRBS 15, pattern: 11110000, 10101010, 11111111, 00000000, 00001111, 01010101
Payload length		37 byte to 255 byte
Payload CRC		calculated automatically

Bluetooth® 5.x

For the R&S®SMW-K117, R&S®SMM-K117 and R&S®SMBVB-K117 options.
A K60 option must also be installed on the instrument for each K117 option.

Key features

- Further improvements of several Bluetooth® Low Energy (LE) characteristics for IoT applications
- Bluetooth® Low Energy (LE) long range to quadruple the range
- Double the speed up to 2 Msymbol/s
- Bluetooth® Low Energy (LE) advertising extensions to increase data broadcasting capacity by 800 %
- Direction finding with AoA/AoD

Bluetooth® Low Energy		
Bluetooth® Low Energy version		version 5.2
Channel types		advertising, data
Supported packet types		ADV_IND, ADV_DIRECT_IND, ADV_NONCONN_IND, ADV_SCAN_IND, SCAN_REQ, SCAN_RSP, CONNECT_IND, ADV_EXT_IND, AUX_ADV_IND, AUX_CHAIN_IND, AUX_SYNC_IND, AUX_SCAN_REQ, AUX_SCAN_RSP, AUX_CONNECT_REQ, AUX_CONNECT_RSP, DATA, CONTROL_DATA, TEST PACKET
Packet format		LE 1M, LE 2M, LE coded
Power ramping	ramp function	$\cos^2$, linear
	ramp time	1 symbol to 32 symbol
	rise offset, fall offset	–32 symbol to +32 symbol

Modulation	default settings	preset in line with Bluetooth® Low Energy (LE) standard, 2FSK, 250 kHz deviation, 1 MHz symbol rate for LE 1M and LE coded modes, 2FSK, 500 kHz deviation, 2 MHz symbol rate for LE 2M mode
	2FSK frequency deviation	200 kHz to 300 kHz for LE 1M and LE coded modes, 400 kHz to 600 kHz for LE 2M mode
	2FSK symbol rate	400 Hz to 15 MHz
Filter	filter function	Gaussian (others available)
	B × T (for Gaussian filter)	0.15 to 2.5
Dirty transmitter test	frequency drift rate	0 Hz or 1250 Hz
	start phase	0° to 359°
	frequency drift deviation	–100 kHz to +100 kHz
	carrier frequency offset	–150 kHz to +150 kHz
	symbol timing error	–150 ppm to +150 ppm
	modulation index	0.45 to 0.55
	modulation index modes	standard, stable
Settings for advertising channel		
Corrupted CRC every packet		off/on
Advertising event interval		0.9 ms to 6.4 s
Advertising event delay		0 ms to 10 ms
Data whitening		supported
Settings for data channel		
Bluetooth® controller role		central/peripheral
Corrupted CRC every second packet		off/on
Number of TX packets per event		1 to 3
Connection event interval		7.5 ms to 6.4 s
LL connection mode		unencrypted, encrypted
Data whitening		supported
Symbols per a bit		S = 2, S = 8 for LE coded mode
Settings for test packets		
Packet interval		625 µs to 12.5 ms, in steps of 625 µs for LE 1M and LE 2M modes; 1.875 ms to 15 ms, in steps of 625 µs for LE coded mode
Symbols per a bit		S = 2, S = 8 for LE coded mode
Payload type		PRBS 9, PRBS 15, pattern: 11110000, 10101010, 11111111, 00000000, 00001111, 01010101
Payload length		37 byte to 255 byte

Bluetooth® 5.4 and channel sounding

For the R&S®SMW-K178, R&S®SMM-K178 and R&S®SMBVB-K178 options.
A K60 and K117 options must also be installed on the instrument for each K178 option.

Key features

- Further improvements of several Bluetooth® Low Energy (LE) characteristics for channel sounding (CS)
- Support new packet format LE 2M 2BT
- Support of full channel hopping scenarios
- Support of all CS step modes for both initiator and responder
- Support of all event, sub event parameters
- Support of generation of companion signal

Bluetooth® Low Energy		
Bluetooth® Low Energy version		version 5.4 and channel sounding
Channel types		channel sounding
Supported packet types		CS SEQUNCE, CS_CONTROL_DATA, TEST PACKET
Packet format		LE 1M, LE 2M, LE 2M 2BT
Power ramping	ramp function	$\cos^2$, linear
	ramp time	1 symbol to 32 symbol
	rise offset, fall offset	–32 symbol to +32 symbol

Modulation	default settings	preset in line with Bluetooth® Low Energy (LE) standard, 2FSK, 250 kHz deviation, 1 MHz symbol rate for LE 1M, 2FSK, 500 kHz deviation, 2 MHz symbol rate for LE 2M mode and LE 2M 2BT
	2FSK frequency deviation	200 kHz to 300 kHz for LE 1M and LE coded modes, 400 kHz to 600 kHz for LE 2M mode
	2FSK symbol rate	400 Hz to 15 MHz
Filter	filter function	Gaussian (others available)
	B × T (for Gaussian filter)	0.15 to 2.5
Dirty transmitter test	frequency drift rate	0 Hz or 1250 Hz
	start phase	0° to 359°
	frequency drift deviation	–100 kHz to +100 kHz
	carrier frequency offset	–150 kHz to +150 kHz
	symbol timing error	–150 ppm to +150 ppm
	modulation index	0.45 to 0.55
	modulation index modes	standard, stable
Settings for channel sounding channel		
Event interval		0.9 ms to 6.4 s
Connection interval		7.5 ms to 4 s
Data whitening		supported
Role		initiator/reflector
Settings for CS subevent		
Step scheduling		auto/manual
Number of subevents		1 to maximum value that depends on event interval and connection interval
Subevent length	minimum	1250 µs, in steps of 625 µs
Subevent interval	minimum	1875 µs, in steps of 625 µs
T_FCS		15 µs, 20 µs, 30 µs, 40 µs, 50 µs, 60 µs, 80 µs,100 µs, 120 µs,150 µs
Mode-0 steps		1 to 3
Mode-0 configuration		T_IP1 = {10, 20, 30, 40, 50, 60, 80,145} µs
Mode-1 configuration		T_IP1 = {10, 20, 30, 40, 50, 60, 80, 145} µs, sounding sequence or random sequence, sequence length = {32, 64, 96, 128} bit
Mode-2 configuration		T_PM = {10, 20, 40} µs, T_IP2 = {10, 20, 30, 40, 50, 60, 80, 145} µs
Mode-3 configuration		T_IP2 = {10, 20, 30, 40, 50, 60, 80, 145} µs, T_PM = {10, 20, 40} µs, sounding sequence or random sequence, sequence length = {32, 64, 96, 128} bit
Setting for CS step configuration		
Main mode		mode-1, mode-2, mode-3
Sub_mode		mode-1, mode-2, mode-3, none
Main_mode_max_steps		2 to 255
Main_mode_min_steps		2 to 255
Main_mode_repetition		0 to 3
Setting for channel selection		
Channel table		each channel is individually allowed or not
ChSel		algorithm #3b, algorithm #3c
ChM_repetition		1 to 3
Ch3cShape		hat shape or X shape
Ch3cJump		2, 3, 4, 5, 6, 7, 8
Settings for test packets		
User payload pattern		PRBS 9, PRBS 15, pattern: 11110000, 10101010, 11111111, 00000000, 00001111, 01010101; CS_SYNC_user_payload for random sequence of mode-1 configuration and mode-3 configuration

LoRa®

For the R&S®SMW-K131, R&S®SMM-K131 and R&S®SMBVB-K131 options.

LoRa® (long range) is a digital wireless communications technology owned by Semtech that enables long range transmissions (> 10 km in rural areas) with low power consumption. This makes it a perfect fit for internet of things (IoT) applications in rural areas. The option helps generate LoRa® physical layer signals with Rohde & Schwarz signal generators in line with specifications, including impaiments for symbol timing error, frequency offset and frequency drift.

Key features

- Chirped spread spectrum (125 kHz, 250 kHz, 500 kHz)
- Individual idle time
- Supporting all specified coding rates and spreading factors
- Configurable payload data
- Symbol timing error, frequency offset, frequency drift

LoRaWAN®		
LoRaWAN® version		version 1.1
General settings		
Bandwidth		7.8125 kHz, 10.4167 kHz, 15.625 kHz, 20.8333 kHz, 31.25 kHz, 41.667 kHz, 62.5 kHz, 125 kHz, 250 kHz, 500 kHz
Modulation, coding, header and payload parameters		
Conding rate		0, 1, 2, 3, 4
Spreading factor		6 to 12
Encoder state		on/off
Interleaver state		on/off
Payload data source		All0, All1, PRBS 9 to PRBS 23, pattern, data list
Payload CRC		on/off
Sync mode		public, private
Unmodulated preamble length		6 to 8
Impairments		
State		on/off
Symbol timing error		–300 ppm to +300 ppm
Frequency offset		–200 kHz to +200 kHz
Frequency drift		
State		on/off
Type		linear, sine
Deviation		–200 kHz to +200 kHz
Rate		160 Hz to 1600 Hz

HRP-UWB

For the R&S®SMW-K149, R&S®SMM-K149 and R&S®SMBVB-K149 options.

Key features

- IEEE 802.15.4, 802.15.4z-BPRF and 802.15.4z-HPRF
- Channel bandwidth: 499.2 MHz, 1081.6 MHz, 1331.2 MHz, 1354.97 MHz
- Individual idle time
- Support of all specified coding rates and data rates
- Configurable payload data
- Scrambled timestamp sequence (STS) coding
- Impairments: chip clock error and frequency offset

General description	This option supports IEEE 802.15.4,802.15.4z-BPRFand HPRF.	
General settings		
Channel bandwidth	depends on baseband generator bandwidth (see data sheet of Rohde & Schwarz instrument)	
	R&S®SMW200A	499.2 MHz, 1081.6 MHz, 1331.2 MHz and 1354.97 MHz
	R&S®SMM100A and R&S®SMBV100B	499.2 MHz
Idle interval		0 to 1×10^3 µs
Frame configuration		
Code index		1 to 24
STS configuration		0, 1, 2, 3
Synchronization length		16, 24, 32, 48, 64, 98, 128, 256, 1024, 4096
SFD		0 to 4
Payload data source		All0, All1, PRBS 9 to PRBS 23, pattern, data list
Payload CRC (FCS)		on/off
STS active segment length		16, 32, 64, 128, 256, 512, 1024, 2048
STS number of active segments		1 to 4
Additional gap between payload and STS		0 to 127
STS source		on/off
Convolutional code constraint length		CL3, CL7
MAC header		on/off
MAC FCS		on/off
Impairments		
State		on/off
Chip clock error		–300 ppm to +300 ppm
Frequency offset		–200 kHz to +200 kHz
Baseband filter		IEEE 802.15.4z and root cosine with rolloff = 0.5

Broadcast standards

DVB-H/DVB-T

For the R&S®SMW-K52 option.

DVB-H/DVB-T digital standard		in line with ETSI EN 300 744 V1.5.1
General settings		
Frequency		settable, default: 212.5 MHz VHF
Hierarchy mode		nonhierarchical
Sequence length	number of superframes	minimum: 1, maximum: depends on baseband generator memory
Baseband filter		cosine, α = 0.1
Signal path parameters		
Input data	null packets are generated and filled with the wanted data	All0, All1, PN15, PN23
	transport stream format	.GTS, .TS, .TRP
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	interleaving	bit, symbol
	state	on/off
	symbol interleaving block size	1512 bit (2k mode), 3024 bit (4k mode), 6048 bit (8k mode)
	symbol interleaving modes	native, in-depth
Modulation		QPSK, 16QAM, 64QAM
Transmission modes		2k, 4k, 8k
Guard interval		1/4, 1/8, 1/16, 1/32
Framing and signaling		
Superframe size		4 frames
Frame size		68 OFDM symbols
TPS settings	cell ID	0000 to FFFF (settable)
	time slicing	on/off
	MPE-FEC	on/off

DVB-S2/DVB-S2X

For the R&S®SMW-K116 option.

DVB-S2/DVB-S2X digital standard		in line with: • ETSI EN 302 307-1 V1.4.1 • ETSI EN 302 307-2 V1.1.1
General settings		
Number of frames		minimum: 1, maximum: depends on baseband generator memory
VL-SNR mode		on/off
Baseband filter	standard	root cosine
	rolloff range	low, high
	rolloff factor	0.05, 0.1, 0.15, 0.2, 0.25, 0.35
Symbol rate		100 symbol/s up to 600 Msymbol/s (depends on baseband generator bandwidth)
Signal path parameters		
Stream type		MPEG-2 TS, GP, GC, GSE-HEM
Input data		All0, All1, pattern, PN 9, PN 11, PN 15, PN 16, PN 20, PN 21, PN 23, data list, data from file (see below)
	MPEG-2 TS format	.GTS, .TS, .TRP
	GSE-HEM format	GSE
BB scrambler	state	on/off
Outer coder	state	on/off
Inner coder	state	on/off
Code type		normal, medium, short
MODCOD		
DVB-S2	QPSK	1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10
	8PSK	3/5, 2/3, 3/4, 5/6, 8/9, 9/10
	16APSK	2/3, 3/4, 4/5, 5/6, 8/9, 9/10
	32APSK	3/4, 4/5, 5/6, 8/9, 9/10
DVB-S2X	QPSK	13/45, 9/20, 11/20
	8PSK	23/36, 25/36, 13/18
	8APSK-L	5/9, 26/45
	16APSK	26/45, 3/5, 28/45, 23/36, 25/36, 13/18, 7/9, 77/90
	16APSK-L	5/9, 8/15, 1/2, 3/5, 2/3
	32APSK	32/45, 11/15, 7/9
	32APSK-L	2/3
	64APSK	11/15, 7/9, 4/5, 5/6
	64APSK-L	32/45
	128APSK	3/4, 7/9
	256APSK	32/45, 3/4
	256APSK-L	29/45, 2/3, 31/45, 11/15
	QPSK (short)	11/45, 4/15, 14/45, 7/15, 8/15, 32/45
	8PSK (short)	7/15, 8/15, 26/45, 32/45
	16APSK (short)	7/15, 8/15, 26/45, 3/5, 32/45,
	32APSK (short)	2/3, 32/45
Pilot state		on/off
PL scrambler		on/off
Scrambler sequence		0 to 6

DVB-S2/DVB-S2X Annex E

For the R&S®SMW-K176 option. A K116 option must also be installed on the instrument for each K176 option.

Key features

- Generating DVB-S2X Annex E signals
- Support of super frame formats 4, 5, 6, 7
- Physical layer header (PLH) in line with the DVB-S2X specification ETSI EN 302 307-2 V1.3.1 Annex E
- Support SF pilot and special VL-SNR pilots
- Support of two-way scrambling
- Support of beam-hopping with configurable dwell time

DVB-S2/DVB-S2X digital standard		in line with ETSI EN 302 307-2 V1.3.1
Note that given parameter ranges may be additionally restricted due to inter parameter dependencies.		
SF configuration		
SF common		
Super frame active	state	on/off
SFFI (super frame format indicator)		4, 5, 6, 7
SOSF WH (start of super frame)		0 to 255
n ref (SF scrambler, two-way)		0 to 1048574
N pay (SF scrambler, two-way)		0 to 1048574
SF pilot state	state	on/off
SF pilot WH	state	on/off
TSN		0 to 255
SF-specific		
SFL (super frame length)		up to 612540 symbol
PLI (PLH protection level index)		standard, robust, very robust, high efficiency
ST WH (super frame trailer)		0 to 63
BH configuration		
Beam hopping active	state	on/off
Zero beam switching signal	state	on/off
Number of dwells		1 to 24
Attenuate other dwell	state	on/off
Beam hopping cycle		0 to 2047974660
Fill other dwells	fills automatically other dwells with DT0	
DT configuration		
Dwell length	minimum	0 symbol
	maximum	depends on baseband generator memory
SFFI (super frame format indicator)	same as SFFI of SF configuration	
Number of super frames		1 to 25
Number of PL frames		The value is calculated.
Postamble length	same as postamble length of SF configuration	
Beam switching time		1 symbol to 50000 symbol

DVB-RCS2

For the R&S®SMW-K169 option.

Key features

- Generating DVB-RCS2 signals in line with ETSI EN 301 545-2
- Energy dispersal with predefined scrambling sequence CRC16 and CRC32
- Support of turbo FEC encoder linear modulation and Pi/2-BPSK, QPSK, 8PSK, 16QAM modulation schemes
- Support of linear modulation and spread spectrum linear modulation bursts
- Support of predefined waveforms in line with ETSI EN 301 545-2 Annex A
- Support of user-defined waveforms
- Support of multi-carrier and multi-section configuration.

DVB-RCS2		in line with ETSI EN 301 545-2 V1.3.1
Note that given parameter ranges may be additionally restricted due to inter-parameter dependencies.		
SF configuration		
Number of super frames		1
Number of frames		1 up to 10
Frame start time/tick		0 to 1048575
Frame central frequency offset		–199.999950 MHz to 199.999950 MHz
Frame bandwidth		100 Hz to 400 MHz
TX format class		“Linear Modulation” and “SS Linear Modulation” (spread spectrum)
Frame structure settings		
BTU configuration		
BTU duration		1 tick to 58000 tick
BTU bandwidth		100 Hz up to frame bandwidth
BTU symbol rate		same as BTU bandwidth
Time unit count		dynamic value which depends on BTU duration and BTU bandwidth
Grid configuration		
Number of grids		1 up to 10
Grid offset	relative to the frame center frequency	dynamic value which depends on other grids
Section configuration		
Number of sections		1 up to 10
Mode		predefined, user defined
Waveform ID	linear modulation	1 to 49
	SS linear modulation	1 to 19
Start BTU		0 to (max. BTU number – 1)
Repeat count		0 to (max. BTU number – 1)
Timeslot size		1 to time unit count
Burst start offset		0 tick to 1048575 tick
Modulation		BPSK, QPSK, 8PSK, 16QAM
Burst length		1 symbol/chip to 10000 symbol/chip
Content type		logon, control, traffic and control, traffic
Payload length (including CRC)		1 to 1000
Data source		PN9, PN11, PN15, PN16, PN20, PN21, PN23, pattern, data list, All0, All1
P	predefined waveform ID	0 to 255, settable
Q0, Q1, Q2, Q3	predefined waveform ID	0 to 255, settable
Y puncturing pattern	predefined waveform ID	settable
W puncturing pattern	predefined waveform ID	settable
Unique word (UW)		1 bit to 512 bit
UW length	predefined waveform ID	preamble length + postamble length + pilot block length (in symbol/chip)
Preamble length	predefined waveform ID	8 symbol/chip to 155 symbol/chip, settable
Postamble length	predefined waveform ID	0 symbol/chip to 41 symbol/chip, settable
Pilot period	predefined waveform ID	0 symbol/chip to 768 symbol/chip, settable
Pilot block length	predefined waveform ID	0 symbol/chip to 24 symbol/chip, settable
Number of pilot	predefined waveform ID	0 symbol/chip to 12968 symbol/chip, settable

Other standards and modulation systems

OFDM signal generation

For the R&S®SMW-K114, R&S®SMM-K114 and R&S®SMBVB-K114 options.

Key features

- Supported modulation types: OFDM, f-OFDM, UFMC, FBMC, GFDM
- Optional discrete Fourier transformation spread OFDM (DFT-s-OFDM) for data allocations
- Flexible physical parameterization of sequence length, total/occupied number of subcarriers, subcarrier spacing, cyclic prefix
- Custom parameters can be set for each individual modulation type
- Customization of predefined filters such as RC, RRC, dirichlet, rectangular, soft truncation
- Support of user-defined filters designed by a numeric toolbox, e.g. MATLAB®
- Different users can be configured, each allocated a different data source (e.g. PRBS sequence, data list/pattern)
- Allocation table for flexible assignment of users or individual allocations (each with a different modulation type, data source, power offset and time-frequency resources)
- Custom I/Q sources can be used as an allocation source
- Visualization of resource grid assignments in a global time plan graphic
- Multiple access scheme SCMA to multiplex different users to the same allocation
- OFDM/f-OFDM: allocations can be defined to be used as pilots
- OFDM/f-OFDM: XML configuration file for automatic R&S®FSW-K96 settings configuration is automatically exported

Modulation type		OFDM, f-OFDM, UFMC, FBMC, GFDM, DFT-s-OFDM
General settings		
Total number of subcarriers		64 to 16384
Occupied number of subcarriers		1 to 0.86 × total number of subcarriers
Sequence length	OFDM, f-OFDM	1 symbol to 2400 symbols
	UFMC, FBMC, GFDM	1 symbol to 150 symbols
Subcarrier spacing		1 to x Hz, x is calculated as follows: total number of subcarriers / max. sampling rate (depends on baseband options of the Rohde & Schwarz instrument)
Cyclic prefix length		1 to total number of subcarriers
Cyclic prefix number of symbols	OFDM, f-OFDM	0 to sequence length
Alternative cyclic prefix length	OFDM, f-OFDM	1 to total number of subcarriers
Alternative cyclic prefix number of symbols	OFDM, f-OFDM	0 to (sequence length – cyclic prefix number of symbols)
Filter settings		
Filter type	OFDM	none, user
	f-OFDM	soft truncation, user, none
	UFMC	Dolph-Chebyshev, user
	FBMC	root raised cosine, user
	GFDM	raised cosine, root raised cosine, Dirichlet, rectangular, user
Filter length	OFDM, f-OFDM, UFMC	1 to 2048
Stopband attenuation	UFMC	–80 dB to +10 dB
Rolloff factor	GFDM	0.0 to 1.0
Windowing method	f-OFDM	none, Hanning, Hamming
Load user filter	OFDM, f-OFDM, UFMC selected filter type: user	.dat/.iqw filter coefficient file
Modulation-specific configuration		
Number of subbands	OFDM, f-OFDM, UFMC	1 to occupied number of subcarriers
Datablock size	GFDM	1 to sequence length, must be a common divisor of sequence length

Allocation settings		
User		
Data source		PN9, PN11, PN15, PN16, PN20, PN21, PN23, pattern, data list, All0, All1, Zadoff-Chu
Relative power ρ		–80 dB to +10 dB
Allocations		
Number of allocations		500
Modulation		BPSK, QPSK, 16QAM, 64QAM, 256QAM, SCMA, custom I/Q, custom constellation
Number of allocated subcarriers		1 to occupied number of subcarriers
Number of symbols		1 to sequence length
Offset of subcarriers		0 to (occupied number of subcarriers – number of subcarriers)
Offset of symbols		0 to (sequence length – number of symbols)
Data source		PN9, PN11, PN15, PN16, PN20, PN21, PN23, pattern, data list, All0, All1, I/Q source
Relative power ρ		–80 dB to +10 dB
Content type		data
Content type	OFDM, f-OFDM	data, pilot, reserved
SCMA configuration		
Spreading factor K		4 (fixed)
Codebook size M		4 (fixed)
Number of layers J		6 (fixed)
SCMA layer mapping		
LayerX		User0 to User5, one user can be allocated to multiple layers
Relative power ρ		0.0 dB (fixed)
Export path for XML settings	Sets the path for saving OFDM settings in XML format. These files can be used for measurements with a Rohde & Schwarz signal analyzer or analysis software, for example R&S®VSE-K96.	

Multicarrier CW signal generation

For the R&S®SMW-K61, R&S®SMM-K61 and R&S®SMBVB-K61 options.

Signal generation		simulation of unmodulated multicarrier signals in arbitrary waveform mode
Number of carriers		1 to 160001
Total RF bandwidth	depends on baseband generator bandwidth (see data sheet of Rohde & Schwarz instrument)	
Carrier spacing	user-settable, maximum spacing depends on number of carriers and baseband generator bandwidth	
Parameters of each carrier		state, power, start phase
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 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

Baseband power sweep

For the R&S®SMW-K542 option.

State		on/off
Shape		linear ramp, stair step, triangle, constant
Slope		ascending, descending
Sweep power range		
Total setting range	range plus pre-sweep	0 dB to +50.00 dB
Sweep setting range		0 dB to +50.00 dB
Pre-sweep setting range		0 dB to +15.00 dB
Setting resolution		0.01 dB
Sweep time range		
Setting range		1 µs to 20 s
Setting resolution		1 µs
RF blanking time		
Setting range		1 µs to 1 ms
Setting resolution		depends on derived sampling rate, possible minimum: 5 ns
Fall time range		
Setting range		5 ns to 1 s
Setting resolution		depends on derived sampling rate, possible minimum: 5 ns

Ordering information

Digital standards for the R&S®SMW200A vector signal generator

Designation	Type	Order No.
GSM/EDGE	R&S®SMW-K40	1413.3684.02
EDGE Evolution	R&S®SMW-K41	1413.3732.02
3GPP FDD	R&S®SMW-K42	1413.3784.02
CDMA2000®	R&S®SMW-K46	1413.3884.02
1xEV-DO rev. A	R&S®SMW-K47	1413.3932.02
TD-SCDMA	R&S®SMW-K50	1413.4039.02
TD-SCDMA enhanced BS/MS tests	R&S®SMW-K51	1413.4080.02
DVB-H/DVB-T	R&S®SMW-K52	1413.6090.02
IEEE 802.11(a/b/g/n/j/p)	R&S®SMW-K54	1413.4139.02
LTE release 8	R&S®SMW-K55	1413.4180.02
Bluetooth® Enhanced Data Rate (EDR)	R&S®SMW-K60	1413.4239.02
Multicarrier CW signal generation	R&S®SMW-K61	1413.4280.02
TETRA release 2	R&S®SMW-K68	1413.4439.02
LTE closed-loop BS test	R&S®SMW-K69	1413.4480.02
EUTRA/LTE, 5G NR log file generation	R&S®SMW-K81	1413.4539.02
3GPP FDD HSPA/HSPA+, enhanced BS/MS tests	R&S®SMW-K83	1413.4580.02
LTE release 9	R&S®SMW-K84	1413.5435.02
LTE release 10 (LTE-Advanced)	R&S®SMW-K85	1413.5487.02
IEEE 802.11ac	R&S®SMW-K86	1413.5635.02
1xEV-DO rev. B	R&S®SMW-K87	1413.6519.02
NFC A/B/F	R&S®SMW-K89	1413.6619.02
LTE release 11	R&S®SMW-K112	1413.8505.02
LTE release 12	R&S®SMW-K113	1414.1933.02
OFDM signal generation	R&S®SMW-K114	1414.1985.02
Cellular IoT	R&S®SMW-K115	1414.2723.02
DVB-S2/DVB-S2X	R&S®SMW-K116	1414.2630.02
Bluetooth® 5.x	R&S®SMW-K117	1414.3336.02
Verizon 5GTF signals	R&S®SMW-K118	1414.3465.02
LTE release 13/14/15	R&S®SMW-K119	1414.3542.02
OneWeb user-defined signal generation	R&S®SMW-K130	1414.3788.02
LoRa®	R&S®SMW-K131	1414.6464.02
IEEE 802.11ad	R&S®SMW-K141	1414.1333.02
IEEE 802.11ax	R&S®SMW-K142	1414.3259.02
Cellular IoT release 14	R&S®SMW-K143	1414.6064.02
5G New Radio release 15	R&S®SMW-K144	1414.4990.02
5G NR closed-loop BS test	R&S®SMW-K145	1414.6506.02
Cellular IoT release 15/16/17	R&S®SMW-K146	1414.6564.02
IEEE 802.11be	R&S®SMW-K147	1413.6677.02
5G NR release 16	R&S®SMW-K148	1414.6664.02
HRP UWB	R&S®SMW-K149	1414.6912.02
DVB-RCS2	R&S®SMW-K169	1413.8711.02
5G NR sidelink	R&S®SMW-K170	1413.8640.02
5G NR release 17/18	R&S®SMW-K171	1413.7280.02
U-plane generation	R&S®SMW-K175	1413.3261.02
DVB-S2/DVB-S2X Annex E	R&S®SMW-K176	1413.8686.02
IEEE 802.11ay	R&S®SMW-K177	1434.8191.02
Bluetooth® 5.4 and channel sounding	R&S®SMW-K178	1434.8279.02
OneWeb reference signals	R&S®SMW-K355	1414.3742.02
Baseband power sweep	R&S®SMW-K542	1413.9876.02

Digital standards for the R&S®SMM100A vector signal generator

Designation	Type	Order No.
GSM/EDGE	R&S®SMM-K40	1441.2020.02
EDGE Evolution	R&S®SMM-K41	1441.2014.02
3GPP FDD	R&S®SMM-K42	1441.2008.02
CDMA2000®	R&S®SMM-K46	1441.1999.02
1xEV-DO rev. A	R&S®SMM-K47	1441.1982.02
TD-SCDMA	R&S®SMM-K50	1441.1960.02
TD-SCDMA enhanced BS/MS tests	R&S®SMM-K51	1441.1953.02
IEEE 802.11(a/b/g/n/j/p)	R&S®SMM-K54	1441.1930.02
LTE release 8	R&S®SMM-K55	1441.1924.02
Bluetooth® Enhanced Data Rate (EDR)	R&S®SMM-K60	1441.1918.02
Multicarrier CW signal generation	R&S®SMM-K61	1441.1901.02
3GPP FDD HSPA/HSPA+, enhanced BS/MS tests	R&S®SMM-K83	1441.1899.02
LTE release 9	R&S®SMM-K84	1441.1882.02
LTE release 10 (LTE-Advanced)	R&S®SMM-K85	1441.1876.02
IEEE 802.11ac	R&S®SMM-K86	1441.1860.02
1xEV-DO rev. B	R&S®SMM-K87	1441.1853.02
NFC A/B/F	R&S®SMM-K89	1441.1160.02
LTE release 11	R&S®SMM-K112	1441.1847.02
LTE release 12	R&S®SMM-K113	1441.1830.02
OFDM signal generation	R&S®SMM-K114	1441.1824.02
Cellular IoT	R&S®SMM-K115	1441.1818.02
Bluetooth® 5.x	R&S®SMM-K117	1441.1799.02
Verizon 5GTF signals	R&S®SMM-K118	1414.3465.02
LTE release 13/14/15	R&S®SMM-K119	1441.1776.02
LoRa®	R&S®SMM-K131	1441.1760.02
IEEE 802.11ax	R&S®SMM-K142	1441.1753.02
Cellular IoT release 14	R&S®SMM-K143	1441.1747.02
5G New Radio release 15	R&S®SMM-K144	1441.1730.02
Cellular IoT release 15/16/17	R&S®SMM-K146	1441.1247.02
IEEE 802.11be	R&S®SMM-K147	1441.1053.02
5G NR release 16	R&S®SMM-K148	1441.2166.02
HRP UWB	R&S®SMM-K149	1441.1099.02
5G NR sidelink	R&S®SMM-K170	1441.1076.02
5G NR release 17/18	R&S®SMM-K171	1441.1018.02
U-plane generation	R&S®SMM-K175	1441.1030.02
Bluetooth® 5.4 and channel sounding	R&S®SMM-K178	1441.0886.02

Digital standards for the R&S®SMBV100B vector signal generator

Designation	Type	Order No.
GSM/EDGE	R&S®SMBVB-K40	1423.7724.02
EDGE Evolution	R&S®SMBVB-K41	1423.7730.02
3GPP FDD	R&S®SMBVB-K42	1423.7747.02
CDMA2000®	R&S®SMBVB-K46	1423.7760.02
1xEV-DO rev. A	R&S®SMBVB-K47	1423.7776.02
TD-SCDMA	R&S®SMBVB-K50	1423.7782.02
TD-SCDMA enhanced BS/MS tests	R&S®SMBVB-K51	1423.7799.02
IEEE 802.11(a/b/g/n/j/p)	R&S®SMBVB-K54	1423.7824.02
LTE release 8	R&S®SMBVB-K55	1423.7830.02
Bluetooth® Enhanced Data Rate (EDR)	R&S®SMBVB-K60	1423.7853.02
Multicarrier CW signal generation	R&S®SMBVB-K61	1423.7860.02
3GPP FDD HSPA/HSPA+, enhanced BS/MS tests	R&S®SMBVB-K83	1423.7899.02
LTE release 9	R&S®SMBVB-K84	1423.7901.02
LTE release 10 (LTE-Advanced)	R&S®SMBVB-K85	1423.7918.02
IEEE 802.11ac	R&S®SMBVB-K86	1423.7924.02
1xEV-DO rev. B	R&S®SMBVB-K87	1423.7930.02
NFC A/B/F	R&S®SMBVB-K89	1423.7947.02
LTE release 11	R&S®SMBVB-K112	1423.8037.02
LTE release 12	R&S®SMBVB-K113	1423.8043.02
OFDM signal generation	R&S®SMBVB-K114	1423.8050.02
Cellular IoT	R&S®SMBVB-K115	1423.8066.02
Bluetooth® 5.x	R&S®SMBVB-K117	1423.8089.02
LTE release 13/14/15	R&S®SMBVB-K119	1423.8108.02
LoRa®	R&S®SMBVB-K131	1423.8720.02
IEEE 802.11ax	R&S®SMBVB-K142	1423.8114.02
Cellular IoT release 14	R&S®SMBVB-K143	1423.8637.02
5G New Radio	R&S®SMBVB-K144	1423.8608.02
Cellular IoT release 15	R&S®SMBVB-K146	1423.8808.02
IEEE 802.11be	R&S®SMBVB-K147	1423.8950.02
5G NR release 16	R&S®SMBVB-K148	1423.8843.02
HRP UWB	R&S®SMBVB-K149	1423.8889.02
5G NR release 17/18	R&S®SMBVB-K171	1423.9085.02
U-plane generation	R&S®SMBVB-K175	1423.8989.02
Bluetooth® 5.4 and channel sounding	R&S®SMBVB-K178	1423.9310.02

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