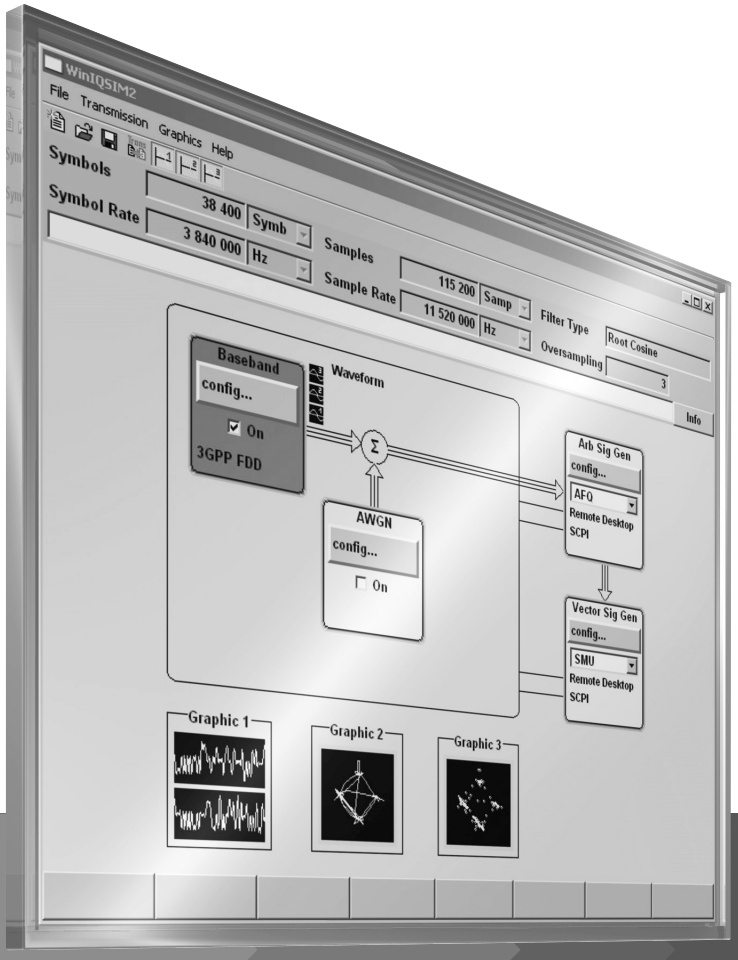
R&S®WinIQSIM2
SIMULATION SOFTWARE

Specifications



Specifications
Version 18.00

ROHDE&SCHWARZ
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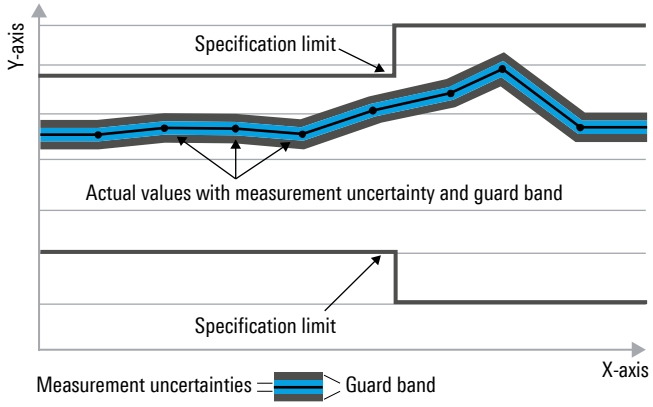
CONTENTS

Definitions

General
Product data applies under the following conditions:

- Three hours storage at ambient temperature followed by 30 minutes 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.



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.

Typical data as well as nominal and measured values are not warranted by Rohde & Schwarz.

In line with the 3GPP 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.

Introduction

R&S®WinIQSIM2 has been especially developed for easily generating digitally modulated signals. The graphical user interface allows intuitive operation, supported by context-sensitive help. By offering a convenient way to create any standard-compliant waveform with all the included standards and to generate multicarrier signals as well as multisegment waveforms, R&S®WinIQSIM2 is suitable for a wide range of applications.

The signals generated with the aid of the R&S®WinIQSIM2 software can be output by the R&S®SMW200A (R&S®SMW-B9/-B10 options), R&S®SMBV100B, R&S®SMM100A (R&S®SMM-B9 option), R&S®SMCV100B, R&S®SGT100A (R&S®SGT-K510 option) vector signal generators and by the R&S®PVT360A performance vector tester. Some standards also work for the R&S®CMW500/R&S®CMW100/R&S®CMW290/R&S®CMP200/R&S®CMP180 radio communication testers, the R&S®CMW270 wireless connectivity tester and the R&S®CMA180 radio test set. R&S®WinIQSIM2 can be downloaded from www.rohde-schwarz.com – search term: WinIQSIM2.

This document describes the capabilities of the R&S®WinIQSIM2 software. Please note that additional hardware limitations of the used Rohde & Schwarz signal generator (especially maximum signal bandwidth, ARB memory size and maximum sample clock rate) apply. For instrument-specific data, see the data sheet of the respective Rohde & Schwarz instrument.

Key features

Large variety of digital standards

- Cellular standards
  - 5G New Radio, incl. Rel. 15, Rel. 16 and Rel. 17
  - LTE, incl. Rel. 8, Rel. 9, Rel. 10, Rel. 11, Rel. 12, Rel. 13, Rel. 14 and Rel. 15
  - Cellular IoT (eMTC and NB-IoT), incl. Rel. 13, Rel. 14 and Rel. 15
  - OneWeb reference signals and OneWeb user-defined signal generation
  - 3GPP FDD with HSDPA, HSUPA and HSPA+ (HSPA Evolution)
  - CDMA2000® with 1xEV-DV
  - 1xEV-DO Rev. A, Rev. B
  - TD-SCDMA
  - GSM/EDGE
  - EDGE Evolution, VAMOS
  - Verizon 5GTF signals
  - TETRA Release 2
- Wireless connectivity standards
  - WLAN IEEE 802.11a/b/g/n/j/p/ac/ax/be/ad/ay
  - IEEE 802.16 WiMAX™ supporting OFDM and OFDMA
  - HRP UWB
  - UWB (ECMA-368)
  - Bluetooth®, up to Release 5.1
  - NFC A/B/F including EMV Type A/B
  - LoRa®
- Broadcast standards
  - DVB-T/DVB-H
  - DAB/T-DMB
  - DVB-S2/DVB-S2X/DVB-S2X Annex E
  - DVB-RCS2
- Navigation standards
  - GPS, GLONASS, Galileo, BeiDou (Compass), NavIC (IRNSS)
- Other standards
  - OFDM signal generation
  - AWGN

Additional systems in R&S®WinIQSIM2

- Custom digital waveforms allow the generation of user-definable digital signals while offering user-selectable modulation parameters
- Multicarrier CW signal generation
- Multicarrier generation allows several digital signals to be combined to form one waveform with different frequency offsets
- Multisegment waveform function makes it possible to have multiple different waveforms in an arbitrary waveform generator's memory and ensures minimum transition times, while even seamless transitions are possible
- AWGN generation and addition to the signal
- Import function to import I/Q samples via a server connection into the R&S®WinIQSIM2 signal generation chain where filtering can be performed and AWGN can be added

Extended graphics

- I and Q versus time
- Absolute value and phase versus time
- Vector diagram
- Constellation diagram
- FFT magnitude showing the spectrum of the signal
- Eye diagram of I and Q
- Complementary cumulative distribution function (CCDF)

Convenient connections

- Waveform transmission via GPIB, USB and LAN
- Waveforms can be locally stored on the PC; a USB memory stick can be used for data transmission
- Control of instruments via remote desktop connection via LAN

Overview of digital standards on the different instruments

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

The R&S®SMW-K255 option is referred to as “SMW-K255”, and so on.

Vector signal generators

	R&S®SMW200A	R&S®SMM100A	R&S®SMBV100B	R&S®SMCV100B	R&S®SGT100A
Cellular standards					
5G New Radio Release15	SMW-K444	SMM-K444	SMBVB-K444	SMCVB-K444	SGT-K444
5G New Radio Release 16	SMW-K448	SMM-K448	SMBVB-K448	SMCVB-K448	SGT-K448
5G New Radio Release 17	SMW-K471	SMM-K471	SMBVB-K471	SMCVB-K471	SGT-K471
5G New Radio sidelink	SMW-K470	SMM-K470	SMBVB-K470	SMCVB-K470	SGT-K470
Verizon 5GTF signals	SMW-K418	–	SMBVB-K418	SMCVB-K418	SGT-K418
LTE Release 8	SMW-K255	SMM-K255	SMBVB-K255	SMCVB-K255	SGT-K255
LTE Release 9	SMW-K284	SMM-K284	SMBVB-K284	SMCVB-K284	SGT-K284
LTE Release 10 (LTE Advanced)	SMW-K285	SMM-K285	SMBVB-K285	SMCVB-K285	SGT-K285
LTE Release 11	SMW-K412	SMM-K412	SMBVB-K412	SMCVB-K412	SGT-K412
LTE Release 12	SMW-K413	SMM-K413	SMBVB-K413	SMCVB-K413	SGT-K413
LTE Releases 13/14/15	SMW-K419	SMM-K419	SMBVB-K419	SMCVB-K419	SGT-K419
Cellular IoT Release 13	SMW-K415	SMM-K415	SMBVB-K415	SMCVB-K415	SGT-K415
Cellular IoT Release 14	SMW-K443	SMM-K443	SMBVB-K443	SMCVB-K443	SGT-K443
Cellular IoT Release 15	SMW-K446	SMM-K446	SMBVB-K446	SMCVB-K446	SGT-K446
OneWeb user-defined signal generation	SMW-K430	–	–	–	–
OneWeb reference signals	SMW-K355	–	–	–	–
3GPP FDD	SMW-K242	SMM-K242	SMBVB-K255	SMCVB-K255	SGT-K255
3GPP FDD HSPA/HSPA+, enhanced MS/BS tests	SMW-K283	SMM-K283	SMBVB-K255	SMCVB-K255	SGT-K255
GSM/EDGE	SMW-K240	SMM-K240	SMBVB-K240	SMCVB-K240	SGT-K240
EDGE Evolution	SMW-K241	SMM-K241	SMBVB-K241	SMCVB-K241	SGT-K241
CDMA2000®	SMW-K246	SMM-K246	SMBVB-K246	SMCVB-K246	SGT-K246
1xEV-DO	SMW-K247	SMM-K247	SMBVB-K247	SMCVB-K247	SGT-K247
1xEV-DO Rev. B	SMW-K287	SMM-K287	SMBVB-K287	SMCVB-K287	SGT-K287
TD-SCDMA	SMW-K250	SMM-K250	SMBVB-K250	SMCVB-K250	SGT-K250
TD-SCDMA enhanced BS/MS tests, including HSDPA	SMW-K251	SMM-K251	SMBVB-K251	SMCVB-K251	SGT-K251
TETRA Release 2	SMW-K268	–	–	–	SGT-K268
Wireless connectivity standards					
IEEE 802.11a/b/g/n/j/p	SMW-K254	SMM-K254	SMBVB-K254	SMCVB-K254	SGT-K254
IEEE 802.11ac	SMW-K286	SMM-K286	SMBVB-K286	SMCVB-K286	SGT-K286
IEEE 802.11ax	SMW-K442	SMM-K442	SMBVB-K442	SMCVB-K442	SGT-K442
IEEE 802.11ad	SMW-K441	–	–	–	–
IEEE 802.11be	SMW-K447	SMM-K447	SMBVB-K447	SMCVB-K447	SGT-K447
IEEE 802.11ay	SMW-K477	–	–	–	–
IEEE 802.16 WiMAX™	SMW-K249	–	–	–	SGT-K249
HRP UWB	SMW-K449	SMM-K449	SMBVB-K449	–	–
Bluetooth®	SMW-K260	SMM-K260	SMBVB-K260	SMCVB-K260	SGT-K260
Bluetooth® 5.x	SMW-K417	SMM-K417	SMBVB-K417	SMCVB-K417	SGT-K417
NFC A/B/F	SMW-K289	SMM-K289	SMBVB-K289	SMCVB-K289	SGT-K289
LoRa®	SMW-K431	SMM-K431	SMBVB-K431	SMCVB-K431	SGT-K431
Broadcast standards					
DVB-H/DVB-T	SMW-K252	SMM-K252	SMBVB-K252	SMCVB-K252	SGT-K252
DAB/T-DMB	SMW-K253	SMM-K253	SMBVB-K253	SMCVB-K253	SGT-K253
DVB-S2/DVB-S2X	SMW-K416	SMM-K416	SMBVB-K416	SMCVB-K416	SGT-K416
DVB-RCS2	SMW-K469	–	–	–	–
DVB-S2X Annex E	SMW-K476	–	–	–	–
Navigation standards					
GPS (1 satellite)	SMW-K244	SMM-K244	SMBVB-K244	SMCVB-K244	SGT-K244
Galileo (1 satellite)	SMW-K266	SMM-K266	SMBVB-K266	SMCVB-K266	SGT-K266
GLONASS (1 satellite)	SMW-K294	SMM-K294	SMBVB-K294	SMCVB-K294	SGT-K294
NavIC (IRNSS) (1 satellite)	SMW-K297	SMM-K297	SMBVB-K297	SMCVB-K297	SGT-K297
Modernized GPS (1 satellite with L2C or L5)	SMW-K298	SMM-K298	SMBVB-K298	SMCVB-K298	SGT-K298

	R&S®SMW200A	R&S®SMM100A	R&S®SMBV100B	R&S®SMCV100B	R&S®SGT100A
BeiDou (1 satellite)	SMW-K407	SMM-K407	SMBVB-K407	SMCVB-K407	SGT-K407
Modernized BeiDou (1 satellite)	SMW-K432	SMM-K432	SMBVB-K432	SMCVB-K432	SGT-K432
Modernized GLONASS (1 satellite)	SMW-K423	SMM-K423	SMBVB-K423	SMCVB-K423	SGT-K423
Other standards and modulation systems					
OFDM signal generation	SMW-K414	SMM-K414	SMBVB-K414	SMCVB-K414	SGT-K414
Multicarrier CW	SMW-K261	SMM-K261	SMBVB-K261	SMCVB-K261	SGT-K261
AWGN	SMW-K262	SMM-K262	SMBVB-K262	SMCVB-K262	SGT-K262

Performance vector testers

A subset of R&S®WinIQSIM2 options is supported for the R&S®PVT360A.

R&S®PVT-KW300	GSM (same feature set as xxx-K240 and -K241)
R&S®PVT-KW301	WCDMA (same feature set as xxx-K242 and -K283)
R&S®PVT-KW310	LTE (LTE R8-R15 together with eMTC/Cat M1 feature set of xxx-K415, -K443 and -K446)
R&S®PVT-KW313	NB-IoT (NB-IoT feature set of xxx-K415, -K443 and -K446)
R&S®PVT-KW320	5G NR Release 15/16 (same feature set as xxx-K444 and -K448)
R&S®PVT-KW326	5G NR Release 17 (same feature set as xxx-K471)
R&S®PVT-KW400	Bluetooth® (same feature set as xxx-K260 and -K417)
R&S®PVT-KW410	WLAN IEEE 802.11a/b/g/n/j/ac (same feature set as xxx-K254 and -K286)
R&S®PVT-KW411	WLAN IEEE 802.11ax (same feature set as xxx-K442)
R&S®PVT-KW412	WLAN IEEE 802.11be (same feature set as xxx-K447)

Radio communication testers

A subset of R&S®WinIQSIM2 options is supported for the R&S®CMP200.

R&S®CMP-KW300	HRP UWB (NB-IoT feature set as xxx-K449)
R&S®CMP-KW601	5G NR (same feature set as xxx-K444 and -K448)

A subset of R&S®WinIQSIM2 options is supported for the R&S®CMP180.

R&S®CMP-KW220	GNSS (same feature set as xxx-K244, -K266, -K294, -K297, -K298, -K407 and -K432)
R&S®CMP-KW250	NB-IoT (NB-IoT feature set of xxx-K415, -K443 and -K446)
R&S®CMP-KW280	LP-IoT (same feature set as xxx-K431)
R&S®CMP-KW310	Bluetooth® (same feature set as xxx-K260 and -K417)
R&S®CMP-KW350	WLAN IEEE 802.11a/b/g/n/j/ac (same feature set as xxx-K254 and -K286)
R&S®CMP-KW351	WLAN IEEE 802.11ax (same feature set as xxx-K442)
R&S®CMP-KW352	WLAN IEEE 802.11be (same feature set as xxx-K447)
R&S®CMP-KW601	5G NR (same feature set as xxx-K444 and K448)
R&S®CMP-KW420	GSM (same feature set as xxx-K240 and -K241)
R&S®CMP-KW440	WCDMA (same feature set as xxx-K242 and -K283)
R&S®CMP-KW480	CDMA2000® 1x RTT (same feature set as xxx-K246, -K247 and -K287)
R&S®CMP-KW500	LTE (LTE R8-R15 together with eMTC/Cat M1 feature set of xxx-K415, -K443 and -K446)
R&S®CMP-KW570	LTE C-V2X (V2X feature set of xxx-K419)

A subset of R&S®WinIQSIM2 options is supported for the R&S®CMW500 and R&S®CMW100.

R&S®CMW-KW010	AWGN (same feature set as xxx-K262)
R&S®CMW-KW200	GSM/EDGE (same feature set as xxx-K240)
R&S®CMW-KW201	EDGE Evolution (same feature set as xxx-K241)
R&S®CMW-KW300	LTE NB-IoT (NB-IoT feature set as xxx-K415)
R&S®CMW-KW400	WCDMA (same feature set as xxx-K242)
R&S®CMW-KW401	HSDPA (same feature set as xxx-K243)
R&S®CMW-KW402	HSUPA (same feature set as xxx-K245)
R&S®CMW-KW403	WCDMA Release 7 HSPA+ (same feature set as xxx-K259)
R&S®CMW-KW500	LTE (same feature set as xxx-K255)
R&S®CMW-KW502	LTE Release 10 (same feature set as xxx-K285)
R&S®CMW-KW504	LTE Release 12 (same feature set as xxx-K413)
R&S®CMW-KW514	LTE Release 13 LAA (LAA features set of xxx-K419)
R&S®CMW-KW570	LTE Release 14 C-V2X (V2X feature set of xxx-K419)
R&S®CMW-KW590	LTE MTC (eMTC feature set of xxx-K415)
R&S®CMW-KW6000	5G NR (same feature set as xxx-K444)

R&S®CMW-KW610	Bluetooth® (same feature set as xxx-K260)
R&S®CMW-KW620	GPS (1 satellite, same feature set as xxx-K244 and xxx-K298)
R&S®CMW-KW621	GLONASS (1 satellite, same feature set as xxx-K294)
R&S®CMW-KW622	Galileo (1 satellite, same feature set as xxx-K266)
R&S®CMW-KW623	BeiDou (1 satellite, same feature set as xxx-K407)
R&S®CMW-KW630	DVB (same feature set as xxx-K252)
R&S®CMW-KW632	DAB (same feature set as xxx-K253)
R&S®CMW-KW650	WLAN IEEE 802.11a/b/g/n/j/p (same feature set as xxx-K254)
R&S®CMW-KW656	WLAN IEEE 802.11ac (same feature set as xxx-K286)
R&S®CMW-KW657	WLAN IEEE 802.11ax (same feature set as xxx-K442)
R&S®CMW-KW683	LoRa® (same feature set as xxx-K431)
R&S®CMW-KW750	TD-SCDMA (same feature set as xxx-K250)
R&S®CMW-KW751	TD-SCDMA enhanced (same feature set as xxx-K251)
R&S®CMW-KW800	CDMA2000® (same feature set as xxx-K246)
R&S®CMW-KW880	1xEV-DO Rev. A (same feature set as xxx-K247)

A subset of R&S®WinIQSIM2 options is supported for the R&S®CMW290.

R&S®CMW-KW010	AWGN (same feature set as xxx-K262)
R&S®CMW-KW200	GSM/EDGE (same feature set as xxx-K240)
R&S®CMW-KW201	EDGE Evolution (same feature set as xxx-K241)
R&S®CMW-KW400	WCDMA (same feature set as xxx-K242)
R&S®CMW-KW401	HSDPA (same feature set as xxx-K243)
R&S®CMW-KW402	HSUPA (same feature set as xxx-K245)
R&S®CMW-KW403	WCDMA Release 7 HSPA+ (same feature set as xxx-K259)
R&S®CMW-KW500	LTE (same feature set as xxx-K255)
R&S®CMW-KW610	Bluetooth® (same feature set as xxx-K260)
R&S®CMW-KW620	GPS (1 satellite, same feature set as xxx-K244 and xxx-K298)
R&S®CMW-KW621	GLONASS (1 satellite, same feature set as xxx-K294)
R&S®CMW-KW622	Galileo (1 satellite, same feature set as xxx-K266)
R&S®CMW-KW623	BeiDou (1 satellite, same feature set as xxx-K407)
R&S®CMW-KW630	DVB (same feature set as xxx-K252)
R&S®CMW-KW650	WLAN IEEE 802.11a/b/g/n/j/p (same feature set as xxx-K254)
R&S®CMW-KW656	WLAN IEEE 802.11ac (same feature set as xxx-K286)
R&S®CMW-KW657	WLAN IEEE 802.11ax (same feature set as xxx-K442)
R&S®CMW-KW750	TD-SCDMA (same feature set as xxx-K250)
R&S®CMW-KW751	TD-SCDMA enhanced (same feature set as xxx-K251)
R&S®CMW-KW800	CDMA2000® (same feature set as xxx-K246)
R&S®CMW-KW880	1xEV-DO Rev. A (same feature set as xxx-K247)

A subset of R&S®WinIQSIM2 options is supported for the R&S®CMW270.

R&S®CMW-KW010	AWGN (same feature set as xxx-K262)
R&S®CMW-KW610	Bluetooth® (same feature set as xxx-K260)
R&S®CMW-KW620	GPS (1 satellite, same feature set as xxx-K244 and xxx-K298)
R&S®CMW-KW621	GLONASS (1 satellite, same feature set as xxx-K294)
R&S®CMW-KW622	Galileo (1 satellite, same feature set as xxx-K266)
R&S®CMW-KW623	BeiDou (1 satellite, same feature set as xxx-K407)
R&S®CMW-KW630	DVB (same feature set as xxx-K252)
R&S®CMW-KW650	WLAN IEEE 802.11a/b/g/n/j/p (same feature set as xxx-K254)
R&S®CMW-KW656	WLAN IEEE 802.11ac (same feature set as xxx-K286)
R&S®CMW-KW657	WLAN IEEE 802.11ax (same feature set as xxx-K442)
R&S®CMW-KW683	LoRa® (same feature set as xxx-K431)

A subset of R&S®WinIQSIM2 options is supported for the R&S®CMA180.

R&S®CMA-KW620	GPS test (1 satellite, same feature set as xxx-K244 and xxx-K298)
R&S®CMA-KW621	GLONASS test (1 satellite, same feature set as xxx-K294)
R&S®CMA-KW622	Galileo test (1 satellite, same feature set as xxx-K266)
R&S®CMA-KW668	Tetra Release 2 (same feature set as xxx-K268)

Specifications

I/Q baseband generator

Types of modulation	ASK	
	modulation index	0 % to 100 %
	resolution	0.1 %
	FSK	2FSK, 4FSK, MSK
	deviation	0.1 to 1.5 × f_{sym}
	maximum	10 MHz
	resolution	< 0.1 Hz
	setting uncertainty	< 0.5 %
	variable FSK	4FSK, 8FSK, 16FSK
	deviations	–1.5 × f_{sym} to +1.5 × f_{sym}
	maximum	10 MHz
	resolution	< 0.1 Hz
	PSK	BPSK, QPSK, QPSK 45° offset, QPSK EDGE, AQPSK, OQPSK, π/4-QPSK, π/2-DBPSK, π/4-DQPSK, π/8-D8PSK, 8PSK, 8PSK EDGE
	QAM	16QAM, 16QAM EDGE, 32QAM, 32QAM EDGE, 64QAM, 128QAM, 256QAM, 1024QAM
Coding	Not all coding methods can be used with every type of modulation.	off, differential, diff. phase, diff. + gray, gray, GSM, NADC, PDC, PHS, TETRA, APCO25 (PSK), APCO25(FSK), APCO25(8PSK), PWT, TFTS/TETRA, INMARSAT, VDL, ICO, CDMA2000®, WCDMA
Baseband filter	Any filter can be used with any type of modulation. The bandwidth of the modulation signal depends on the instrument for which the waveform is generated; the signal is clipped if the bandwidth is exceeded.	
	oversampling	2 to 32
	impulse length	1 to 128
	cosine, root cosine	
	filter parameter α	0.05 to 1.00
	Gaussian	
	filter parameter B × T	0.15 to 2.50
	EDGE narrow pulse shape	
	EDGE wide pulse shape	
	cdmaOne, cdmaOne + equalizer	
	cdmaOne 705 kHz	
	cdmaOne 705 kHz + equalizer	
	CDMA2000® 3X	
	EUTRA/LTE	
	APCO25 C4FM	
	rolloff factor	0.05 to 0.99
	APCO25 (H-CPM)	
	APCO25 (LSM)	
	Gauss cut-off frequency	400 Hz to 25 MHz
	lowpass cut-off frequency	400 Hz to 25 MHz
	rectangular	
	split phase	
	filter parameter B × T	0.15 to 2.5
	lowpass (ACP optimized)	
	cut-off frequency factor	0.05 to 2.00
	lowpass (EVM optimized)	
	cut-off frequency factor	0.05 to 2.00
	dirac	(= no filter, only oversampling)
	resolution of filter parameter	0.01
Symbol rate	The symbol rate depends on the selected instrument.	
	resolution	0.001 Hz

Data sources	All0, All1	
	PRBS	9, 11, 15, 16, 20, 21, 23
	sequence length	1 bit to 64 bit
	pattern	
	length	1 bit to 64 bit
	data lists	8 bit to 2 Gbit
Marker outputs	number	4
	operating modes	control list, restart, pulse, pattern, ratio
Level reduction	setting range	0 dB to +60 dB
Burst	operating range	max. 5 MHz
	rise/fall time	
	setting range	0.5 symbol to 16 symbol
	resolution	0.1 symbol
	ramp shape	cosine, linear
Predefined settings	modulation, filter, symbol rate and coding in line with standard	
	standards	APCO phase 1 (C4FM, CQPSK, LSM, WCQPSK), APCO phase 2 (H-CPM, H-DQPSK, H-D8PSK wide, H-D8PSK narrow), Bluetooth®, DECT, ETC, GSM, GSM EDGE, NADC, PDC, PHS, TETRA, TFTS, WCDMA 3GPP, TD-SCDMA, CDMA2000® forward, CDMA2000® reverse, worldspace
Multisegment waveform	number of segments	depending on instrument
Multicarrier waveform	number of carriers	max. 512
	mode	equidistant carrier spacing, arbitrary carrier frequency
	total RF bandwidth	depending on instrument
	crest factor modes	maximize, minimize, off
	clipping	on (with specification of target crest factor and filter cut-off frequency), off
	signal period modes in equidistant carrier spacing mode	longest file, shortest file, user (max. 1 s)
	single carrier gain	–80 dB to 0 dB
	single carrier start phase	0° to 360°
	single carrier delay	0 s to 1 s

Digital modulation systems

The specified data applies together with the parameters of the relevant standard.

Note that the given parameter ranges may be additionally restricted due to inter-parameter dependencies.

Cellular standards

5G New Radio

The 5G NR software options implement the physical layer in line with 3GPP Releases 15, 16 and 17. With support for 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, these options provide standard-compliant signals to test components, modules, receivers and base stations for FR1 and FR2.

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 v.17.3.0 • TS 38.212 v.17.3.0 • TS 38.213 v.17.3.0 • TS 38.214 v.17.3.0

5G New Radio Release 15 (xxx-K444, R&S®PVT-KW320, R&S®CMW-KW6000 or R&S®CMP-KW601 option)

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 multi-layer transmission
- Flexible mapping of the antenna ports to the output(s)
- Optional BWP-wise filtering
- Various leveling modes for the 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

NR-TM presets		test models that use Release 15 features are in line with the following versions of the 3GPP specifications, or newer: • TS 38.141-1 v.17.6.0 • TS 38.141-2 v.17.6.0
Note that the given parameter ranges may be additionally restricted due to inter-parameter dependencies.		
General settings		
RF frequency		user-selectable in entire frequency range of respective 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		on/off
Sample rate variation		on/off
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	on/off
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 (xxx-K448 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

- 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
- Shared spectrum access: interlaced resource blocks, SS/PBCH adjustments, cyclic timing extension, CG-UCI, PRACH
- Additional allocation type: RIM-RS

Uplink

- Release 16 updated for FRCs of TS 38.141 for FR1 and FR2

Note that the given parameter ranges may be additionally restricted due to inter-parameter dependencies.		
Node settings		
Count full system frame number	only for R&S®SMW200A equipped with B9 option	on/off
PRS state	per carrier	on/off
Node settings		
TA state		on/off
Users/BWP settings		
Number of users		1 to 50
Supported RNTIs		as of -K444, plus CI-RNTI, PS-RNTI
Scheduling settings		
DCI formats		as of -K444, plus 2_4, 2_6

5G New Radio Release 17 (xxx-K471 or R&S®PVT-KW326 option)

Key features

- Extension to 71 GHz
  - Deployment frequency range (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 slot

5G New Radio sidelink (xxx-K470 option)

Key features

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

Verizon 5GTF signals

Verizon 5GTF (xxx-K418 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 transmit 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
- AutoDCI mode
- CSI-RS settings
- Channels xPBCH, xPDCCH, xPDSCH can be generated including DMRS reference signals
- DCI formats A1, A2, B1, B2 can be configured in terms of CCEs/xREGs
- xPDSCHs/CSI-RS are automatically generated from xPDCCH via AutoDCI mode

Uplink

- Four predefined uplink configurations comprise xPUSCH and xPUCCH channels, including reference signals
- User-specific uplink settings
- Configuration 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

Verizon 5GTF digital standard		in line with V5G.211, V5G.212, and V5G.213
Predefined configurations		downlink_Config_{1-4}, uplink_Config_{1-4}
General settings		
Downlink		
Scheduling		manual, AutoDCI
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 0-7 (xPBCH), AP 16-31 (CSI-RS), AP 300-313 (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 8-15 (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
Number of RB		4 to 100
Number of symbols		1 to 11
Offset RB		0 to 96
Offset symbols		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
Number of RB		4 to 100
Number of offset	depends on no. RB	0 to 96
Code rate	xPUSCH, depends on modulation, RBs	1/2, 2/3, 5/6
Transport block size	xPUSCH, in line with V5G.212	see table in V5G.212

LTE

The LTE options implement the physical layer in line with 3GPP Release 8 to 15. With support for 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, these options provide standard-compliant signals to test components, modules, receivers and base stations.

LTE Release 8 (xxx-K255, R&S®CMW-KW500 or R&S®CMP-KW500 option)

Key features

General

- FDD and TDD
- Downlink (OFDMA) and uplink (SC-FDMA)
- 1.4/3/5/10/20 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

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		
Mode	restricts the user interface to certain LTE/cellular IoT features for simplicity or enables access to all features in line with the installed options	only available if LTE as well as cellular IoT option(s) are installed in the instrument
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 individually mapped 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

LTE Release 9 (xxx-K284 option)

For each K284 option, a K255 option must also be installed.

Key features

Downlink

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

General description	This option enhances the K255 option (LTE Release 8) to support LTE Release 9.	
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 enables the generation of downlink signals dedicated to UE that is set to transmission mode 8. In order to support this mode, the DCI format 2B is introduced. The way that the (logical) antenna ports are mapped to the (physical) TX antennas of the signal generator is configurable. This feature allows UE receiver testing in line with the beamforming model defined 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 enables the generation of 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 TS 36.331.		
MBSFN mode	mixed: 15 kHz subcarrier spacing dedicated: 7.5 kHz subcarrier spacing [1]	off, mixed, dedicated

LTE Release 10 (LTE-Advanced) (xxx-K285 or R&S®CMW-KW502 option)

For each xxx-K285 (R&S®CMW-KW502) option, an xxx-K255 (R&S®CMW-KW500) option must also be installed.

Key features

Downlink

- Downlink carrier aggregation including cross-carrier scheduling
- Downlink transmission mode 9 for up to 8-layear 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)

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

General description	This option enhances the K255 option (LTE Release 8) to support LTE Release 10/LTE-Advanced.	
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 enables the generation of 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 enables the generation of 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 bandwidth of the baseband generator, the bandwidth and the exact frequency offsets of the individual component carriers, or the instrument’s 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 enables the generation of downlink signals dedicated to UE that is set to transmission mode 9. In order to support this mode, the DCI format 2C is introduced. The way that the (logical) antenna ports are mapped to the (physical) TX antennas of the signal generator 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 enables the generation of 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 enables the generation of PUCCH with format 3 for configured LTE-Advanced user equipment.		
Simultaneous PUSCH and PUCCH transmission		
This option enables the generation of PUSCH and PUCCH of a configured LTE-Advanced user equipment in the same subframe.		
Noncontiguous PUSCH transmission (uplink resource allocation type 1)		
This option enables the generation of PUSCH with noncontiguous frequency allocation (two resource block sets in line with uplink resource allocation type 1).		
PUSCH transmission mode 2 (uplink MIMO)		
This option enables the generation of 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 enabled the generation of SRS signals in line with SRS trigger type 1 (aperiodic SRS).		

LTE Release 11 (xxx-K412 option)

For each xxx-K412 option, an xxx-K255 option must also be installed.

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 in line with 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 K255 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 enables the generation of 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 config	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 enables the generation of 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 enables the generation of 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 bandwidth of the baseband generator, the bandwidth and the exact frequency offsets of the individual component carriers, or the instrument’s signal routing and system configuration. References to the official 3GPP TS 36.331 v.10.8.0 specification are abbreviated as TS 36.331.		
Activate carrier aggregation	activates the generation of several component carriers (CC)	on/off
Mixed TDD settings for downlink carrier aggregation		
This option enables the usage of 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 enables the use of the “Auto Sequence” PDSCH scheduling mode. This mode allows easy configuration of downlink transmissions in line with long HARQ patterns. In the “Manual” and “Auto/DCI” scheduling modes, which are also available without the K412 option, the maximum HARQ pattern length is limited by the maximum number of configurable downlink subframes. In the “Auto Sequence” scheduling mode, this limitation does not apply.		
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 enables the use of the Enhanced PDCCH (EPDCCH) channel in the PDSCH scheduling modes “Auto/DCI” and “AutoSequence”		
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 enables the use of 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 (xxx-K413 or R&S®CMW-KW504 option)

For each xxx-K413 (R&S®CMW-KW504) option, an xxx-K255 (R&S®CMW-KW500) option must also be installed on the respective instrument.

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) communication, 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 K255 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 enables the generation of downlink signals with 256QAM modulation in the PDSCH channel, the PMCH channel, as well as in the dummy OFDM resource elements.		
Downlink test models for 256QAM in line with 3GPP TS 36.141 v.12.9.0		
This option enables the configuration and generation of the 256QAM test models in line with 3GPP TS 36.141 v.12.9.0 for FDD as well as 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 enables the generation of downlink DCI format 1C in case of eIMTA-RNTI.		
Mixed duplexing for uplink and downlink carrier aggregation		
This option enables the usage of 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 enables the usage of the enhanced 4TX codebook, in line with EUTRA Release 12.		
Sidelink		
This option enables the configuration and generation of D2D signals in line with EUTRA Release 12.		
Mode		communication, discovery
Communications mode		
Synchronization state		on/off
SL TX mode		1, 2
SCI format		0
Content		PSCCH, PSSCH, PSBCH
Discovery mode		
Synchronization state		on/off
Content		PSDCH, PSBCH

LTE Releases 13/14/15 (xxx-K419, R&S®CMW-KW514, CMW-KW570 or R&S®CMP-KW570 option)

For each xxx-K419 (R&S®CMW-KW514/-KW570) option, an xxx-K255 (R&S®CMW-KW500) option must also be installed on the respective instrument. The R&S®CMW-KW514 option covers the LAA related feature set only. The R&S®CMW-KW570 and the R&S®CMP-KW570 options cover the C-V2X related feature set only.

Key features

Downlink

- 1024QAM modulation for PDSCH
- Downlink licensed-assisted access (LAA) (xxx-K285 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

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 in line with Releases 13, 14 and 15

Sidelink

- Cellular V2X communication 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

Additional

- Graphical display of time plan for V2X UEs

General description	This option enhances the K255 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
1024QAM modulation for PDSCH		
This option extends the LTE carrier aggregation feature of the R&S®SMW-K85 option for generation of downlink signals with 1024QAM modulation in the PDSCH channel.		
256QAM modulation for PUSCH		
This option extends the LTE carrier aggregation feature of the xxx-K285 option for generation of uplink signals with 256QAM modulation in the PUSCH channel.		
Modulation	PUSCH allocation	QPSK, 16QAM, 64QAM, 256QAM
FRCs in line with Releases 13, 14 and 15		
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 A18-1, A18-2, A18-3, A18-4, A18-5, A18-6 A19-1, A19-2, A19-3, A19-4, A19-5, A19-6 A21-1, A21-2, A21-3, A21-4, A21-5, A21-6 A22-1, A22-2, A22-3, A22-4
Downlink LAA		
This option enables the configuration and generation of 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 PDSCH scheduling modes “Auto/DCI” or “Auto Sequence”	FDD, TDD, LAA
DRS state	only for SCells with duplexing “LAA”	on/off

(e)FD-MIMO		
This option enables the configuration and generation of CSI-RS for FD-MIMO (Release 13) and eFD-MIMO (Release 14).		
CSI-RS in DwPTS		on/off
PUCCH formats 4 and 5		
This option enables the configuration and generation of 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 enables the configuration of the higher layer parameters *dmrsAltTable* and *semiOpenLoop*		
SRS enhancements		
This option enables to configure and generate SRS enhanced in Rel. 13 (*srs-UpPtsAdd* /*transmissionCombNum*)		
Enhanced uplink DMRS		
This option enables to configure and generate PUSCH transmissions with enhanced DMRS in Rel. 14 (*ul-DMRS-IFDMA*)		
PRACH restricted set type B		
This option enables to configure and generate PRACH signals with restricted set type B in Rel. 14		
PRACH restricted set		unrestricted set, restricted set type A, restricted set type B
V2X		
This option enables to configure and generate V2X signals in Rel. 14.		
Mode		communication, discovery, V2X communication
V2X communication 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 (xxx-K415, R&S®CMW-KW300, R&S®CMW-KW590 or R&S®CMP-KW250 option)

The R&S®CMW-KW300 and the R&S®CMP-KW250 options cover the NB-IoT related feature set only. The R&S®CMW-KW590 option covers the MTC related feature set only. For R&S®CMW-KW590 option, an R&S®CMW-KW500 option must also be installed on the respective instrument.

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 (R&S®SMx-K55 required)
- NB-IoT modes inband, guard band and standalone
- eMTC mode inband
- 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

General description	This option contains the support for the LTE Release 13 cellular IoT variants NB-IoT (narrowband IoT, Cat-NB1) and eMTC (enhanced machine type communication, 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
Mode		
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 stand alone
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	enable or disable 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 config	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	TS 36.141: A14-1, A14-2, A14-3, A14-4, A15-1, A15-2, A16-1, A16-2, A16-3, A16-4, A16-5; TS 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 sending of sounding reference signals	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 config	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 (xxx-K443 option)

For each xxx-K443 option, an xxx-K415 option must also be installed.

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 LTE cellular IoT variants NB-IoT (narrowband IoT) and eMTC (enhanced machine type communication) in line with Release 14, 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 config	to enable or disable 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 two HARQ processes	for NB-IoT user	on/off
NB-IoT allocation		
Enhanced settings – NPDSCH		
Modulation and coding scheme		inband: 0 to 10, standalone/guardband: 0 to 13
eMTC downlink simulation		
Physical settings		
Wideband config	to enable or disable the wideband configuration	on/off

Cellular IoT Release 15 (xxx-K446 option)

For each xxx-K446 option, an xxx-K415 option must also be installed.

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

General description	This option enhances the LTE cellular IoT variants NB-IoT (narrowband IoT) and eMTC (enhanced machine type communication) in line with Release 15.	
Cellular IoT standard		in line with 3GPP Release 15: • TS 36.211 v.15.6.0 • TS 36.212 v.15.6.0 • TS 36.213 v.15.6.0
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
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 wakeup signal (NWUS)		
NWUS state		on/off

3GPP WCDMA/HSPA+

3GPP FDD (xxx-K242, R&S®CMW-KW400 or R&S®CMP-KW440 option)

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 usage in test models or OCNS
- Various 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 downlink mode, the P-CCPCH (BCCH with running SFN), several DPCHs and all other channels (frame-cycle control channels such as SCH, OCNS simulation, other base stations, etc.) can be generated. In uplink mode, up to four user-configured mobile stations (PRACH, PCPCH or DPCCH and up to six DPDCHs) together with up to 128 of identical configuration can be simulated.	
ARB sequence length	The sequence length can be entered in frames (10 ms each); the maximum length depends on oversampling and the type of the instrument the waveform file is generated for.	
Generate waveform file	signal filtered and saved as ARB waveform file	
Enhanced channels		
Special capabilities in up to four channels of base station 1 on downlink and in DPDCH channels of mobile station 1 on uplink: channel coding, simulation of bit and block errors		
Enhanced component		
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}
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	$\sqrt{\cos}$, α = 0.22
	other filters	$\sqrt{\cos}$, 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 test including HSDPA, HSUPA and HSPA+ (xxx-K283 or R&S®CMW-KW401/-KW402/-KW403 options)

One xxx-K242 (R&S®CMW-KW400) option must be installed. R&S®CMW-KW401 supports HSDPA, R&S®CMW-KW402 supports HSUPA and R&S®CMW-KW403 supports HSPA+.

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
- Support of UL-DTX, DC-HSDPA, 4C-HSDPA and 8C-HSDPA

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 K242 option supports simulation of HSDPA/HSPA+ channels in a continuous mode needed for TX measurements in line with TS 25.141 (test models 5 and 6). The K283 option supports simulation of HS-SCCH (high speed shared control channel) and HS-PDSCH (high speed physical downlink shared channel) in line with TS 25.211. This implies the correct timing between these channels as well as the capability to set start subframe and inter-TTI distance. 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 K283 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 the combinations of modulation modes in line with TS 25.212 table 14 are possible.
HSUPA downlink channels (E-AGCH, E-RGCH, E-HICH)		
Enhancements	In downlink, the K283 option supports simulation of 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 K283 supports OCNS generation for type 3i enhanced performance requirements tests or generation of H-Sets with varying modulation and number of HS-PDSCH.	
Dynamic power control (not available in all-offline mode)		
Enhancements	The K283 option allows the variation of the output power in real-time mode for up to three DPCHs in three submodes:	
	external (not available for the R&S®SMBVB-K283 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 K242 option does not support HSDPA for the uplink. The K283 option 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	on/off
	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	In uplink, the K283 option supports the simulation of one E-DPCCH and up to four E-DPDCHs in each of the mobile stations, and for mobile station 1 also with channel coding in line with the definition of the fixed reference channels in TS 25.104 and TS 25.141 or with user-configured coding chain.	
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 definition of 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-K283 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 K283 option enables simulation of the UL-DTX CPC feature for mobile station 1. In addition, the K283 option enables flexible scheduling of uplink transmission for mobile station 1 by means of a user-generated user scheduling file (not available in all-offline mode and not available for the R&S®SMBVB-K283 option).	
Ranges in the UL-DTX /user scheduling configuration dialog	state	on/off
	mode	UL-DTX, user scheduling; User scheduling is not available in all-offline mode or for R&S®SMBVB-K283.
	E-DCH TTI	2 ms, 10 ms
Additional power reference modes		
Enhancements	Additional power reference modes in line with the other 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

Uplink test models (in line with TS 34.121) for the R&S®SMW-K283 or the R&S®SMBVB-K283 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 (xxx-K240, R&S®CMW-KW200 or R&S®CMP-KW420 option)

GSM/EDGE digital standard		in line with • 3GPP TS 45.001 v.9.0.0 • 3GPP TS 45.002 v.9.0.0 • 3GPP 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 multiframe
	application: simulation of modulation change in a slot versus time	scenarios by combining two frames (see frame structure below); a repetition factor can be specified for each of the two frames
Modulation		MSK; switchable to FSK with settable deviation for simulating frequency deviation errors 8PSK EDGE
Symbol rate	standard	270.833 kHz
	range	400 Hz to 300 kHz
Baseband filter	GSM, standard	Gaussian with B × T = 0.3
	range	B × T = 0.15 to 2.5
	EDGE, standard	Gaussian linearized (EDGE)
Frame structure	Change between GSM and EDGE possible from slot to slot and frame to frame; half rate and GPRS at the physical layer; slots 0 to 7 of the frames are user-defined for uplink and downlink. In the normal burst half-rate mode, the burst parameters can be defined independently for two users that alternate from frame to frame.	
	burst types	• normal (full rate) • normal (half rate) • EDGE • synchronization • frequency correction (normal + compact) • dummy • access • all data (GSM) • all data (EDGE)
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 (xxx-K241 or R&S®CMW-KW201 option)

One xxx-K240 (R&S®CMW-KW200) option must be installed.

General parameters	This option extends the xxx-K240 (R&S®CMW-KW200) 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 • 3GPP TS 45.002 v.9.0.0 • 3GPP 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 multiframe
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)

CDMA2000®/1xEV-DO

CDMA2000® incl. 1xEV-DV (xxx-K246 or R&S®CMW-KW800 option)

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 Rev. A (xxx-K247, R&S®CMW-KW880 or R&S®CMP-KW480 option)

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 Rev. B (xxx-K287 option)

For each xxx-K287 option, an xxx-K247 option must also be installed on the respective instrument.

General parameters	This option enhances the xxx-K247 option (1xEV-DO Rev. A) to support 1xEV-DO Rev. B.	
1xEV-DO digital standard	Release B	in line with 3GPP2 C.S0024-B 3.0
Frequency	band class 0 to band class 21	410 MHz to 2690 MHz
Forward link parameters		
Physical layer subtype		0&1, 2 or 3
Reverse activity bit (MAC)	MAC index	4 to 127
Other users count	simulates additional MAC users	1 to 360
Settings for each forward link traffic channel		
Rate index	subtype 3	1 to 28
Packet size		128 bit to 12288 bit
Data rate	depending on rate index and packet size	4.8 kbps to 4915.2 kbps
MAC index	subtype 3	4 to 383

DRC lock (MAC)	period, subtype 3	0, 4
	length	1, 4, 8, 16, 32, 64
Multicarrier parameters		
Multicarrier state		on/off
	Activated multicarrier provides up to 16 concurrent carriers. Each carrier is modulated in line with the signal configuration settings. Carrier frequencies can be set by 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 (3GPP TDD LCR) (xxx-K250 or R&S®CMW-KW750 option)

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, mid-amble sequences
- Various graphical displays such as code domain, frequency spectrum, CCDF, and more, 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 test including HSDPA (xxx-K251 or R&S®CMW-KW751 option)

One xxx-K250 (R&S®CMW-KW750) option must be installed.

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, CCDF, and more, support fast and easy signal configuration/evaluation:

General parameters	This option enhances the K250 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	
	insertion of bit and block errors 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 (xxx-K268 or R&S®CMA-KW668 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 multiframes and is highly dependent on the settings made. With default values (T1), 14.28 multiframes/Msample are available. Example: An R&S®SMW200A with 64 Msample can generate 913 multiframes.	
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)
	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 types: • 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

The WLAN software options support standard compliant signal generation in line with IEEE 802.11a/b/g/n/j/p/ac/ax/be/ad/ay. Channel bandwidths of 20 MHz, 40 MHz, 80 MHz, 80+80 MHz, 160 MHz and 320 MHz are supported 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), high efficiency (HE) and extremely high throughput (EHT) 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 (xxx-K254, R&S®CMW-KW650 or R&S®CMP-KW350 option)

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

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 (xxx-K286, R&S®CMW-KW656 or R&S®CMP-KW350 option)

One xxx-K254 (R&S®CMW-KW650) option must be installed.

Key features

- Support of all 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

General parameters	This option enhances the K254 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 (xxx-K442, R&S®CMW-KW657 or R&S®CMP-KW351 option)

One xxx-K254 (R&S®CMW-KW650 or R&S®CMP-KW350) option must be installed.

Key features

- Support of all 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

General parameters	This option enhances the K254 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, 2x996-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 (xxx-K447 or R&S®CMP-KW352 option)

One xxx-K254 (R&S®CMP-KW351) option must be installed.

Key features

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

General parameters	This option enhances the K254 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
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, 2x996-tone, 2x996+484-tone, 3x996-tone, 3x996+484-tone, 4x996-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 (R&S®SMW-K441 option)

Key features

- PHY modes: single carrier and control
- Standard compliant MCS index 0 to 12, π/2-16QAM
- 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	activating and configuring the MAC header with the following parameters: frame control, duration/ID, addresses 1 to 4, sequence control, QoS control
	frame check sequence	activating or deactivating a 32 bit (4 byte) checksum for protecting MAC header and user data (frame body)
	preamble/header active	the preamble/header can be turned on or 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 (R&S®SMW-K477 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
- Up to 4.32 GHz RF modulation bandwidth with channel bonding (R&S®SMW-K555)
- 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/sample rate	standard	1.76 GHz/3.52 GHz for single carrier
	range	400 Hz to 4.8 GHz
Baseband filter		spectral mask in line with IEEE Std 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

WiMAX™

IEEE 802.16 WiMAX™ including IEEE 802.16e (xxx-K249 option)

IEEE 802.16 digital standard		in line with IEEE 802.16 Rev. 2
Link direction		forward link and reverse link
Physical layer modes		OFDM, OFDMA, OFDMA/WiBro
Duplexing		TDD, FDD
Frame durations		2 ms, 2.5 ms, 4 ms, 5 ms, 8 ms, 10 ms, 12.5 ms, 20 ms, continuous, user
Predefined frames	in OFDM mode	short, mid and long test messages for BPSK, QPSK, 16QAM and 64QAM modulation
	in OFDMA mode	predefined setups for all bandwidths and modulations specified in MRCT 1.0.0, appendix 2
Level reference	in OFDM mode	FCH/burst or preamble
	in OFDMA/WiBro mode	preamble or subframe RMS power
Generate waveform file	filtering of data generated in ARB mode and saving it as waveform file	
Parameters in OFDM mode		
Predefined frequency bands		ETSI, MMDS, WCS, U-NII, user
Channel bandwidth		1.25 MHz to 30 MHz, depending on selected frequency band
Modulation and RS-CC rates		BPSK 1/2, QPSK 1/2, QPSK 3/4, 16QAM 1/2, 16QAM 3/4, 64QAM 2/3, 64QAM 3/4
Burst types		data, DL-MAP, UL-MAP, ranging
Parameters in OFDMA mode		
Predefined frequency bands		ETSI, MMDS, WCS, U-NII, WiBro, user
Channel bandwidth		1.25 MHz to 30 MHz, depending on selected frequency band
Space-time coding modes		• off • 2 antennas: matrix A or B • 4 antennas: matrix A, B or C • collaborative spatial multiplexing (CSTD)
Modulation and coding rates		QPSK 1/2, QPSK 3/4, 16QAM 1/2, 16QAM 3/4, 64QAM 1/2, 64QAM 2/3, 64QAM 3/4, 64QAM 5/6
Channel coding modes		off, CC, CTC
Burst types		FCH, DL-MAP, UL-MAP, DCD, UCD, SUB-DL-UL-MAP, HARQ, ranging, fast feedback, data

NFC

NFC is based on RFID technology and makes mobile phones suitable for numerous applications including, for example contactless payment of tickets, downloading of information from a passive RFID tag, use as security ID etc. Other than with RFID, some devices can also act as a reader (poller) and as a listener. There are three types of NFC, all working on the same frequency of 13.56 MHz, but with different data rates and modulation characteristics: NFC-A, NFC-B and NFC-F.

NFC A/B/F (xxx-K289 option)

This option supports all three NFC types and the different command types from the standard. In the sequence configurator, you can easily configure a complete message sequence to do a real test with an NFC device.

Key features

- Signal generation with standard-conform signals for NFC A/B/F
- Sequence generator with all signals from the standard
- 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 technology “NFC-A”, “NFC-B” or “NFC-F”: poll, listen for technology; “EMV Type A” or “EMV Type B”: “PCD to PICC”, “PICC to PCD”
Modulation settings		
Bit rate		depending 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

Bluetooth®

The Bluetooth® software options support standard compliant Bluetooth® signal generation in line with specification Bluetooth® 5.1 plus previous releases on Rohde & Schwarz vector signal generators. The user interface allows to configure Bluetooth® signals for Basic Rate (BR), Enhanced Data Rate (EDR) and Low Energy 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® EDR/Low Energy (xxx-K260, R&S®CMW-KW610 or R&S®CMP-KW310 option)

Key features

- In line with Bluetooth® specification 4.2, including enhanced data rate (EDR) and Low Energy mode
- Support of all three transport modes, in particular ACL+EDR, SCO and eSCO+EDR
- Support of all packet types for basic rate (BR) and enhanced data rate (EDR) modes

Basic rate + EDR		
Bluetooth® version		version 4.2
Transport modes		ACL + EDR, SCO, eSCO + EDR
Supported packet types		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; in all data mode or with packet editor
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
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 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 ms 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		primary, secondary
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 to 255 bytes
Payload CRC		calculated automatically

Bluetooth® 5.x (xxx-K417)

One xxx-K260 option must be installed.

Key features

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

Bluetooth® Low Energy		
Bluetooth® Low Energy version		version 5.1
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		Low Energy 1M, Low Energy 2M, Low Energy Coded
Sequence length		depending 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 standard; 2FSK, 250 kHz deviation, 1 MHz symbol rate for Low Energy 1M and Low Energy Coded modes; 2FSK, 500 kHz deviation, 2 MHz symbol rate for Low Energy 2M mode
	2FSK frequency deviation	200 kHz to 300 kHz for Low Energy 1M and Low Energy Coded modes; 400 kHz to 600 kHz for Low Energy 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 second packet		on/off
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		master, slave
Corrupted CRC every second packet		on/off
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 Low Energy coded mode
Settings for test packets		
Packet interval		625 µs to 12.5 ms in steps of 625 µs for Low Energy 1M and Low Energy 2M modes; 1.875 ms to 15 ms in steps of 625 µs for Low Energy coded mode
Symbols per a bit		S = 2, S = 8 for Low Energy Coded mode
Payload type		PRBS 9, PRBS 15, pattern 11110000, 10101010, 11111111, 00000000, 00001111, 01010101
Payload length		37 byte to 255 byte
Payload CRC		calculated automatically

LoRa®

LoRa® (long range) is a digital wireless communications technology owned by Semtech that enables very-long-range transmission (> 10 km in rural areas) with low power consumption. This fits perfectly to internet of things (IoT) applications in rural areas. With this option it is possible to generate LoRa® physical layer signals with the signal generators from Rohde & Schwarz in line with the specification including impairments for symbol timing error, frequency offset and frequency drift.

LoRa® (xxx-K431, R&S®CMW-KW683 or R&S®CMP-KW280 option)

Key features

- Chirped spread spectrum (125/250/500 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		
Coding rate		0, 1, 2, 3, 4
Spreading factor		6 to 12
Encoder state		on/off
Interleaver state		on/off
Payload data length		1 byte to 255 bytes
Payload data source		PRBS 9 to PRBS 23, All0, All1, pattern (length: 1 bit to 64 bit) and data list
Payload CRC		on/off
Payload reduced coding mode		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

UWB

HRP-UWB (xxx-K449 or R&S®CMP-KW300 option)

Key features

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

General description	This option contains the support for the IEEE 802.15.4, IEEE 802.15.4z BPRF and HPRF	
General settings		
Channel bandwidth		499.2 MHz, 1 MHz, 1081.6 MHz, 1331.2 MHz and 1354.97 MHz
Idle interval		0 to 1e6 us
Frame configuration		
Code index		1 to 24
STS configuration		0, 1, 2, 3
Sync length		16, 64, 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		32, 64, 128, 256
STS number of active segments		1 to 4
Impairments		
State		on/off
Symbol timing error		–300 ppm to +300 ppm
Frequency offset		–200 kHz to +200 kHz

Broadcast and SatCom standards

DVB

DVB-T/DVB-H (xxx-K252 or R&S®CMW-KW630 option)

DVB-T/DVB-H digital standard		in line with ETSI EN 300 744 v1.5.1
General settings		
Hierarchy mode		non-hierarchical
Sequence length	The sequence length can be entered in superframes. With an oversampling of 2, a guard interval of 1/8 and TX mode 2, the user has 0.82 superframes/Msample. Example: If an R&S®SMU200A with 64 Msample memory is selected and the above values are applied, R&S®WinIQSIM2 can generate 53 superframes.	
Baseband filter	standard	cosine, α = 0.1
Signal path parameters		
Input data	null packets are generated and filled with desired data	PN 15, PN 23, All0, All1
	transport stream	transport stream file (.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		bit interleaving, symbol interleaving
	state	on/off
	symbol interleaving block size	1512 bit in 2K mode, 3024 bit in 4K mode, 6048 bit in 8K mode
	symbol interleaving modes	native, in-depth
Modulation		QPSK, 16QAM, 64QAM
Transmission modes		2k, 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 (user-defined)
	time slicing	on/off
	MPE-FEC	on/off

DVB-S2/DVB-S2X (xxx-K416 option)

DVB-S2/DVB-S2X digital standard		in line with ETSI EN 302 307-1 V1.4.1 and 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 (R&S®SMW-K476 option)

One xxx-K416 option must be installed.

Key features

- Generating DVB-S2X Annex E signals
- Support of superframe format 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 ways 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		
Superframe active	state	on/off
Superframe format indicator (SFFI)		4, 5, 6, 7
SOSF WH (start of superframe)		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
SF-specific		
SFL (superframe length)		up to 612540 symbol
PLH protection level index (PLI)		standard, robust, very robust, high efficiency
ST WH (superframe 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
Superframe format indicator (SFFI) (same as SFFI of SF configuration)	maximum	depends on baseband generator memory
Number of superframes		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
Dwell length	minimum	0 symbol

DVB-RCS2 (R&S®SMW-K469 option)

Key features

- Generating DVB-RCS2 signals in line with to ETSI EN 301 545-2
- Energy dispersal with predefined scrambling sequence CRC16 and CRC32
- Support of turbo FEC encoder linear modulation and π/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 superframes		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 (spread spectrum) linear modulation
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

DAB

DAB/T-DMB (xxx-K253 or R&S®CMW-KW632 option)

DAB/T-DMB digital standard		in line with ETSI EN 300 401 v.1.3.3 (with restrictions, see below)
Ensemble transport interface		in line with ETSI ETS 300 799 (with restrictions, see below)
General settings		
Source data	FIC and CIFs, each filled with	All0, All1, PN 15, PN 23
	ETI frames, number of ETI frames to process	ETI file (.ETI); This number depends on the number and size of streams contained in the ETI file and on the free space on the hard disk.
Transport mode	for sources other than ETI file	I, II, III, IV
	ETI file	specified by ETI frames
Baseband filter	standard	cosine, α = 0.1
Signal path parameters		
PN scrambler state	affects all channels	on/off
Convolutional coder state	affects all channels; if off, missing bits are taken from source	on/off
Time interleaver state	affects all channels	on/off
DAB-related constraints		
Maximum number of streams/channels		FIC + 15 streams
ETI-related constraints		
ETI type		ETI (NI, G.703)
Stream configuration	must not change within the frames	• multiplex configuration • number of streams • size of streams • protection of streams
Frame length		24 ms
Sample rate		48 kHz

OneWeb

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

OneWeb user-defined signal generation (R&S®SMW-K430 option)

The R&S®SMW-K430 OneWeb user-defined signal generation option is the preferred choice for physical layer testing with highest flexibility and access to all parameters of a standard compliant OneWeb signal.

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

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	mode 1OW, mode 2OW
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 (R&S®SMW-K355 option)

The R&S®SMW-K355 OneWeb reference signals option provides predefined waveforms for a basic RF test without supporting all parameters of a complete standard compliant OneWeb signal. Predefined waveforms are fitting for the development and test of RF components. Parameters like the cell ID are not present which are required to perform e.g. a receiver test.

Reference waveforms can be played on both R&S®SMW-B9 and -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 played only on R&S®SMW-B9 (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

Navigation standards

GPS

GPS (xxx-K244, R&S®CMW-KW620 or R&S®CMA-KW620 option)

GPS digital standard		in line with ICD-GPS-200 revision D
General settings		
RF bands		L1/E1, L2, default: L1/E1
Simulation modes		
Static mode		generation of a GPS ARB satellite signal defined in time with user-definable initial code phase and Doppler, e.g. for sensitivity measurements; signal is continuously repeated on the machine
Configurable sample rate		as a multiple integer factor of the GPS coarse acquisition chip rate
Duration of satellite simulation		maximum simulation time depends on configurable sample rate, Doppler value and size of ARB memory available on the signal generator
System time basis		GPS, UTC, default: GPS
Simulation time		flexible date and time or GPS time configuration with 1 ms resolution
Current leap seconds		automated
Marker		• restart • 1 PPS • 1 PP2S • 10 PPS • pulse • pattern • on/off ratio
Navigation data source		All0, All1, pattern (up to 64 bit), PN 9 to PN 23, data lists; real navigation data: almanac file as source for ephemeris and almanac subframes; ephemeris subframes are projected from the almanac subframes
Use of spreading code		on/off
GPS satellite configuration		
Signals (chip rates)		coarse acquisition C/A (1.023 MHz)
Modulation		BPSK (CDMA)
State		on/off
Initial code phase	configurable in the absence of real navigation data	0 chip to 20459.99 chip in steps of 0.01 chip; precision error depends on configurable sample rate
Space vehicle ID		C/A codes: 37 Gold codes, 1023 chip each
Doppler shift		–100 kHz to +100 kHz in steps of 0.01 Hz
Navigation data format		GPS NAV
Data rate		50 Hz
Number of ephemeris pages		1

Modernized GPS (xxx-K298, R&S®CMW-KW620 or R&S®CMA-KW620 option)

GPS digital standard		in line with ICD-GPS-200 revision J (L2C), IS-GPS-705E (L5)
General settings		
RF bands		L2 for L2C, L5, default: L2
Simulation modes		
Static mode		generation of a GPS ARB satellite signal defined in time with user-definable initial code phase and Doppler, e.g. for sensitivity measurements; signal is continuously repeated on the instrument
Configurable sample rate		as a multiple integer factor of the GPS signal chip rate
Duration of satellite simulation		maximum simulation time depends on configurable sample rate, Doppler value and size of ARB memory available on the signal generator
System time basis		GPS, UTC, default: GPS
Simulation time		flexible date and time or GPS time configuration with 1 ms resolution
Current leap seconds		automated
Marker		• restart • 1 PPS • 1 PP2S • 10 PPS • pulse • pattern • on/off ratio
Navigation data source		All0, All1, pattern (up to 64 bit), PN 9 to PN 23, data lists; real navigation data: almanac file as source for ephemeris and almanac subframes; ephemeris subframes are projected from the almanac subframes
Use of spreading code		on/off
GPS satellite configuration		
Signals (chip rates)		L2C (1.023 MHz), L5 (10.23 MHz)
Modulation		BPSK for L2C, QPSK for L5
State		on/off
Initial code phase	configurable in the absence of real navigation data	0 chip to 20459.99 chip in steps of 0.01 chip; precision error depends on configurable sample rate
Space vehicle ID		37 L2 CM-/L2 CL codes
Doppler shift		–100 kHz to +100 kHz in steps of 0.01 Hz
Navigation data format		GPS CNAV
Data rate		50 Hz for L2C, 100 Hz for L5
Number of ephemeris pages		1

Galileo

Galileo (xxx-K266, R&S®CMW-KW622 or R&S®CMA-KW622 option)

Galileo digital standard		in line with OD SIS ICD, E1 band, E5a, E5b and E6
General settings		
RF bands		L1/E1, E5a, E5b, E6
Simulation modes		
Static mode		generation of a Galileo ARB satellite signal defined in time with user-definable initial code phase and Doppler, e.g. for sensitivity measurements; signal is continuously repeated on the machine
Configurable sample rate		as a multiple integer factor of the Galileo minimum required sample rate 12.276 MHz with CBOC(6,1) and 20.46 MHz with E5a/E5b or E6

Duration of satellite simulation		maximum simulation time depends on configurable sample rate, Doppler value and size of ARB memory available on the signal generator
System time basis		GST, UTC, default: GST
Simulation time		flexible date and time or GST time configuration with 1 ms resolution
Current leap seconds		automated
Marker		• restart • 1 PPS • 1 PP2S • 10 PPS • pulse • pattern • on/off ratio
Navigation data source		All0, All1, pattern (up to 64 bit), PN 9 to PN 23, data lists; real navigation data (except for E6): almanac file as source for ephemeris and almanac subframes; ephemeris subframes are projected from the almanac subframes
Use of spreading code		on/off
Galileo satellite configuration		
Signals (chip rates)		E1 default (1.023 MHz), E5a/E5b, E6 (10.23 MHz)
Modulation		CBOC(6,1) for E1, QPSK for E5a/E5b, E6
State		on/off
Initial code phase	configurable in the absence of real navigation data	0 chip to 20459.99 chip in steps of 0.01 chip; precision error depends on configurable sample rate
Space vehicle ID		E1: 36 memory codes, 4092 chip each; E5a/E5b: 36 memory codes, 10230 chip each; E6: 36 memory codes, 5115 chip each
Doppler shift		–100 kHz to +100 kHz in steps of 0.01 Hz
Navigation data format		Galileo INAV for E1 and E5b, FNAV for E5a, All0, All1, pattern, PNx and data list for E6
Data rate		250 Hz for for E1 and E5b, 50 Hz for E5a, 1 kHz for E6
Number of ephemeris pages		1

GLONASS

GLONASS (xxx-K294, R&S®CMW-KW621 or R&S®CMA-KW621 option)

GLONASS digital standard		in line with ICD-GLONASS version 5.0
General settings		
RF bands		L1/E1, L2, default: L1/E1
Simulation modes		
Static mode		generation of a GLONASS ARB satellite signal defined in time with user-definable initial code phase and Doppler, e.g. for sensitivity measurements; signal is continuously repeated on the machine
Configurable sample rate		as a multiple integer factor of the GLONASS coarse acquisition chip rate
Duration of satellite simulation		maximum simulation time depends on configurable sample rate, Doppler value, satellite frequency number and size of ARB memory available on the signal generator
System time basis		GLO, UTC, default: GLO
Simulation time		flexible date and time or GLO time configuration with 1 ms resolution
Current leap seconds		automated

UTC-UTC(SU)		allows the configuration of UTC-UTC(SU) phase shift and frequency drift
Marker		• restart • 1 PPS • 1 PP2S • 10 PPS • pulse • pattern • on/off ratio
Navigation data source		All0, All1, pattern (up to 64 bit), PN 9 to PN 23, data lists; real navigation data: almanac file as source for ephemeris and almanac subframes; ephemeris automatically generated from almanac file
Use of spreading code		on/off
GLONASS satellite configuration		
Signals (chip rates)		coarse acquisition R-C/A (511 kHz)
Frequency number	configurable in the absence of real navigation data	–7 to +13
Modulation		BPSK (CDMA)
State		on/off
Initial code phase	configurable in the absence of real navigation data	0 chip to 20459.99 chip in steps of 0.01 chip; precision error depends on configurable sample rate
Space vehicle ID		1 CDMA code shared by all GLONASS satellites, 511 chip per repetition
Doppler shift		–100 kHz to +100 kHz in steps of 0.01 Hz
Navigation data format		GLONASS NAV
Data rate		50 Hz, 100 Hz (after applying the meander code)
Number of ephemeris pages		1

Modernized GLONASS (xxx-K423 option)

GLONASS digital standard		in line with GLONASS ICD CDMA open service navigation signal in L3 frequency [2]
General settings		
RF bands		L1 for CDMA L1 [2], L2 for CDMA L2 [2], L5 for CDMA L3, default: CDMA L3
Simulation modes		
Static mode		generation of a GLONASS ARB satellite signal defined in time with user-definable initial code phase and Doppler, e.g. for sensitivity measurements; signal is continuously repeated on the machine
Configurable sample rate		as a multiple integer factor of the GLONASS signal chip rate
Duration of satellite simulation		maximum simulation time depends on configurable sample rate, Doppler value, satellite frequency number and size of ARB memory available on the signal generator
System time basis		GLO, UTC, default: GLO
Simulation time		flexible date and time or GLO time configuration with 1 ms resolution
Current leap seconds		automated
UTC-UTC(SU)		allows the configuration of UTC-UTC(SU) phase shift and frequency drift

[2] The modernized GLONASS signals CDMA L1 and CDMA L2 are experimental. Any compliance to GLONASS ICD CDMA open service navigation signal in L1 frequency band or GLONASS ICD CDMA open service navigation signal in L2 frequency band is not guaranteed.

Marker		• restart • 1 PPS • 1 PP2S • 10 PPS • pulse • pattern • on/off ratio
Navigation data source		All0, All1, pattern (up to 64 bit), PN 9 to PN 23, data lists; real navigation data (except for CDMA L2): almanac file as source for ephemeris and almanac subframes; ephemeris automatically generated from almanac file
Use of spreading code		on/off
GLONASS satellite configuration		
Signals (chip rates)		CDMA L1 [2] (1.023 MHz), CDMA L2 [2] (1.023 MHz), CDMA L3 (10.23 MHz)
Modulation		BPSK/BOC (TDM) for CDMA L1 [2], BPSK/BOC (TDM) for CDMA L2 [2], QPSK for CDMA L3
State		on/off
Initial code phase	configurable in the absence of real navigation data	0 chip to 20459.99 chip in steps of 0.01 chip; precision error depends on configurable sample rate
Space vehicle ID		24CDMA codes for CDMA L1 [2], CDMA L2 [2] and CDMA L3
Doppler shift		–100 kHz to +100 kHz in steps of 0.01 Hz
Navigation data format		GLONASS NAV (except for CDMA L2 [2])
Data rate		250 Hz for CDMA L1 [2], 200 Hz for CDMA L3
Number of ephemeris pages		1

BeiDou

BeiDou (xxx-K407 or R&S®CMW-KW623 option)

BeiDou digital standard		in line with BDS-SIS-ICD-B1I-1.0
General settings		
RF bands		B1I on L1/E1, B2I on L5
Simulation modes		
Static mode		generation of a BeiDou ARB satellite signal defined in time with user-definable initial code phase and Doppler, e.g. for sensitivity measurements; signal is continuously repeated on the machine
Configurable sample rate		as a multiple integer factor of the BeiDou B1I/B2I chip rate
Duration of satellite simulation		maximum simulation time depends on configurable sample rate, Doppler value and size of ARB memory available on the signal generator
System time basis		BDT, UTC, default: BDT
Simulation time		flexible date and time or BDT time configuration with a resolution of 1 ms
Current leap seconds		automated
Marker		• restart • 1 PPS • 1 PP2S • 10 PPS • pulse • pattern • on/off ratio

Navigation data source		All0, All1, pattern (up to 64 bit), PN 9 to PN 23, data lists; real navigation data: almanac file as source for ephemeris and almanac subframes; ephemeris subframes are projected from the almanac subframes
Use of spreading code		on/off
BeiDou satellite configuration		
Signals (chip rates)		coarse acquisition B1I/B2I-C/A (2.046 MHz)
Modulation		BPSK (CDMA)
State		on/off
Initial code phase	configurable in the absence of real navigation data	0 chips to 20459.99 chips in steps of 0.01 chips
Space vehicle ID		B1I/B2I-C/A codes: 1 to 5: GEO, 6 to 37: MEO/IGSO; 2046 chips each
Doppler shift		–100 kHz to +100 kHz in steps of 0.01 Hz
Navigation data format		BeiDou D1 and D2
Data rate		50 Hz and 500 Hz for D1 and D2, respectively
Number of ephemeris pages		1

Modernized BeiDou (xxx-K432 or R&S®CMW-KW623 option)

BeiDou digital standard		in line with • BDS-SIS-ICD-B3I-1.0 • BDS-SIS-ICD-B2a-1.0 • BDS-SIS-ICD-B1C-1.0 • BDS-SIS-ICD-B2b-1.0 [3]
General settings		
RF bands		B1C on L1, B2a and B2b [3] on L5, B3I on L2
Simulation modes		
Static mode		generation of a BeiDou ARB satellite signal defined in time with user-definable initial code phase and Doppler, e.g. for sensitivity measurements; signal is continuously repeated on the machine
Configurable sample rate		as a multiple integer factor of the BeiDou B2a/B2b [3]/B3I chip rate and B1C minimum sample rate (12.276 MHz)
Duration of satellite simulation		maximum simulation time depends on configurable sample rate, Doppler value and size of ARB memory available on the signal generator
System time basis		BDT, UTC, default: BDT
Simulation time		flexible date and time or BDT time configuration with a resolution of 1 ms
Current leap seconds		automated
Marker		• restart • 1 PPS • 1 PP2S • 10 PPS • pulse • pattern • on/off ratio
Navigation data source		All0, All1, pattern (up to 64 bit), PN 9 to PN 23, data lists; real navigation data (except for B2b [3] GEO satellites): almanac file as source for ephemeris and almanac subframes; ephemeris subframes are projected from the almanac subframes

[3] B2b refers to non-geo satellites 6 to 58, where only the B2b-I component is defined.

Use of spreading code		on/off
BeiDou satellite configuration		
Signals (chip rates)		coarse acquisition B3I-C/A (10.23 MHz), B1C (1.023 MHz), B2a/B2b [3] (10.23 MHz)
Modulation		BPSK for B3I and B2b [3], QPSK for B2a, BOC for B1C
State		on/off
Initial code phase	configurable in the absence of real navigation data	0 chips to 20459.99 chips in steps of 0.01 chips
Space vehicle ID		1 to 5: GEO, 6 to 37: MEO/IGSO; 10230 chips each
Doppler shift		–100 kHz to +100 kHz in steps of 0.01 Hz
Navigation data format		BeiDou D1 and D2
Data rate		50 Hz and 500 Hz for D1 and D2, respectively; 100 Hz for B1C, 200 Hz for B2a and 1kHz for B2b [3]
Number of ephemeris pages		1

NavIC (IRNSS)

NavIC (IRNSS) (xxx-K297)

BeiDou digital standard		in line with ISRO-IRNSS-ICD-SPS-1.1
General settings		
RF bands		L5
Simulation modes		
Static mode		generation of an ARB satellite signal defined in time with user-definable initial code phase and Doppler, e.g. for sensitivity measurements; signal is continuously repeated on the machine
Configurable sample rate		as a multiple integer factor of the chip rate
Duration of satellite simulation		maximum simulation time depends on configurable sample rate, Doppler value and size of ARB memory available on the signal generator
System time basis		UTC, NavIC, default: UTC
Simulation time		flexible date and time or BDT time configuration with a resolution of 1 ms
Current leap seconds		automated
Marker		• restart • 1 PPS • 1 PP2S • 10 PPS • pulse • pattern • on/off ratio
Navigation data source		All0, All1, pattern (up to 64 bit), PN 9 to PN 23, data lists; real navigation data: almanac file as source for ephemeris and almanac subframes; ephemeris subframes are projected from the almanac subframes
Use of spreading code		on/off
NavIC satellite configuration		
Signals (chip rates)		coarse acquisition (1.023 MHz)
Modulation		BPSK (CDMA)
State		on/off
Initial code phase	configurable in the absence of real navigation data	0 chips to 20459.99 chips in steps of 0.01 chips
Space vehicle ID		1 to 14; 1023 chips each
Doppler shift		–100 kHz to +100 kHz in steps of 0.01 Hz
Navigation data format		IRNSS master frame
Data rate		50 Hz
Number of ephemeris pages		1

Other standards and modulation systems

OFDM

OFDM signal generation (xxx-K414 option)

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 that were 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

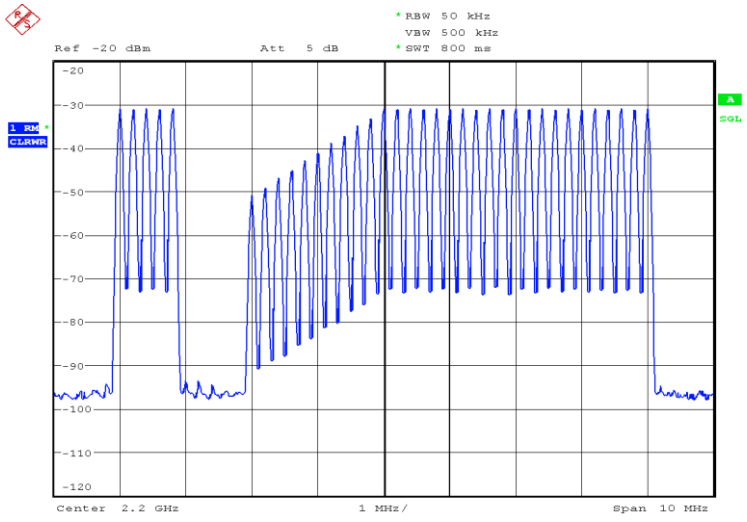
Modulation type		OFDM, f-OFDM, UFMC, FBMC, GFDM, DFT-s-OFDM
General settings		
Physical settings		
Total number of subcarriers		64 to 16384
Occupied number of subcarriers		1 to 0.83 × total number of subcarriers
Sequence length	2400 in case of OFDM, f-OFDM	1 to 150
Subcarrier spacing		1 to x Hz, x is calculated as follows: total number of subcarriers / max. sampling rate (depends on R&S®SMW200A baseband options)
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
Cut transient response	f-OFDM, FBMC	on/off
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		All0, All1, pattern, PNx, data list and 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 subcarriers		1 to occupied number of subcarriers

Number of symbols		1 to sequence length
Offset number of subcarriers		0 to (occupied number of subcarriers – number of subcarriers)
Offset of symbols		0 to (sequence length – number of symbols)
Data source		All0, All1, pattern, PNx, data list and 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 dB (fixed)
Export path for XML settings	Sets the path for saving OFDM settings in XML format. These files can be used for for measurements, e.g. with the R&S®VSE-K96 OFDM vector signal analysis application.	

Multicarrier CW

Multicarrier CW signal generation (xxx-K261 option)

Signal generation	simulation of unmodulated multicarrier signals in arbitrary waveform mode	
Number of carriers		1 to 8192
Carrier spacing	user-selectable, maximum spacing depending on number of carriers and used Rohde & Schwarz instrument	1 Hz to 160 MHz
Parameters of each carrier	state	on/off
	power	–80 dB to 0 dB
	start phase	0° to +360°
Crest factor	optimization of crest factor by varying the start phases of the carrier; available modes:	
	off	no optimization, manual entry of phase possible
	chirp	The phases of each carrier are set such that a chirp signal is obtained for the I and Q components.
	target crest	iterative variation of carrier start phases until a presettable crest factor is attained
Marker		• unchanged • restart • pulse • pattern • ratio



Example spectrum of multicarrier CW signal

Noise

Additive white Gaussian noise (AWGN, xxx-K262 or R&S®CMW-KW010 option)

Addition of an AWGN signal of settable bandwidth and settable C/N ratio or E_b/N_0 to a wanted signal.

Noise	distribution density	Gaussian, statistical, separate for I and Q
	crest factor	> 18 dB
C/N, E_b/N_0	setting range	–50 dB to +30 dB
	resolution	0.01 dB
System bandwidth	bandwidth for determining noise power	
	range (depending on Rohde & Schwarz instrument)	1 kHz to 2.4 GHz
	resolution	1 kHz

General data

Supported operating systems

Administrator rights are necessary for installation.

Windows 10		version 1607 “Anniversary Edition” and later

Remote control of R&S®WinIQSIM2

Systems	remote control via Ethernet	local host, Ethernet
Command set		SCPI 1999.5

Remote control of instruments from R&S®WinIQSIM2

Interfaces		Ethernet, USB, IEC/IEEE bus
VISA runtime library	required, depending on the manufacturer of the instrument to be controlled	
	National Instruments	v3.4 or higher
	Agilent Technologies/ Keysight Technologies	v14.0 or higher
Command set		SCPI 1999.5
IEC/IEEE bus address		0 to 30

Ordering information

Designation	Type	Order No.
Simulation software	R&S®WinIQSIM2	1405.7061.00
VISA driver (already included in the R&S®SMW-B10/-B9, R&S®SMM-B9, R&S®SMBVB-K520 and R&S®SGT-K510 device options)	VISA I/O library	1161.8473.02
Digital standards and options for the R&S®SMW200A		
GSM/EDGE	R&S®SMW-K240	1413.4739.02
EDGE Evolution	R&S®SMW-K241	1413.4780.02
3GPP FDD	R&S®SMW-K242	1413.4839.02
GPS, 1 satellite	R&S®SMW-K244	1413.4880.02
CDMA2000®	R&S®SMW-K246	1413.4939.02
1xEV-DO Rev. A	R&S®SMW-K247	1413.4980.02
IEEE 802.16	R&S®SMW-K249	1413.5035.02
TD-SCDMA	R&S®SMW-K250	1413.5087.02
TD-SCDMA enhanced BS/MS tests	R&S®SMW-K251	1413.5135.02
DVB-T/DVB-H	R&S®SMW-K252	1413.6190.02
DAB/T-DMB	R&S®SMW-K253	1413.6248.02
IEEE 802.11a/b/g/n/j/p	R&S®SMW-K254	1413.5187.02
LTE Release 8	R&S®SMW-K255	1413.5235.02
Bluetooth® EDR	R&S®SMW-K260	1413.5287.02
Multicarrier CW signal generation	R&S®SMW-K261	1413.5335.02
AWGN	R&S®SMW-K262	1413.6460.02
Galileo, 1 satellite	R&S®SMW-K266	1413.7015.02
TETRA Release 2	R&S®SMW-K268	1413.5387.02
3GPP FDD HSPA/HSPA+, enhanced BS/MS tests	R&S®SMW-K283	1413.6290.02
LTE Release 9	R&S®SMW-K284	1413.5535.02
LTE Release 10 (LTE-Advanced)	R&S®SMW-K285	1413.5587.02
IEEE 802.11ac	R&S®SMW-K286	1413.5687.02
1xEV-DO Rev. B	R&S®SMW-K287	1413.6560.02
NFC A/B/F	R&S®SMW-K289	1413.6654.02
GLONASS, 1 satellite	R&S®SMW-K294	1413.7067.02
NavIC (IRNSS), 1 satellite	R&S®SMW-K297	1414.6287.02
Modernized GPS, 1 satellite	R&S®SMW-K298	1414.3171.02
OneWeb reference signals	R&S®SMW-K355	1414.3742.02
BeiDou, 1 satellite	R&S®SMW-K407	1413.7115.02
LTE Release 11	R&S®SMW-K412	1413.8557.02
LTE Release 12	R&S®SMW-K413	1414.2030.02
OFDM signal generation	R&S®SMW-K414	1414.4961.02
Cellular IoT Release 13	R&S®SMW-K415	1414.2769.02
DVB-S2/DVB-S2X	R&S®SMW-K416	1414.2681.02
Bluetooth® 5.x	R&S®SMW-K417	1414.3371.02
Verizon 5GTF	R&S®SMW-K418	1414.3507.02
LTE Release 13/14/15	R&S®SMW-K419	1414.3588.02
Modernized GLONASS, 1 satellite	R&S®SMW-K423	1413.3410.02
OneWeb user-defined signal generation	R&S®SMW-K430	1414.3820.02
LoRa®	R&S®SMW-K431	1414.6441.02
Modernized BeiDou, 1 satellite	R&S®SMW-K432	1414.6629.02
IEEE 802.11ad	R&S®SMW-K441	1414.1385.02
IEEE 802.11ax	R&S®SMW-K442	1414.3294.02
Cellular IoT Release 14	R&S®SMW-K443	1414.6093.02
5G NR Release 15	R&S®SMW-K444	1414.5022.02
Cellular IoT Release 15	R&S®SMW-K446	1414.6587.02
IEEE 802.11be	R&S®SMW-K447	1413.6683.02
5G NR Release 16	R&S®SMW-K448	1414.6687.02
HRP UWB	R&S®SMW-K449	1414.6958.02
DVB-RCS2	R&S®SMW-K469	1413.9130.02
5G NR sidelink	R&S®SMW-K470	1413.8663.02
5G NR Release 17	R&S®SMW-K471	1413.7296.02
DVB-S2X Annex E	R&S®SMW-K476	1413.9076.02
IEEE 802.11ay	R&S®SMW-K477	1434.8210.02

Designation	Type	Order No.
Digital standards and options for the R&S®SMM100A		
GSM/EDGE	R&S®SMM-K240	1441.1724.02
EDGE Evolution	R&S®SMM-K241	1441.1718.02
3GPP FDD	R&S®SMM-K242	1441.1701.02
GPS, 1 satellite	R&S®SMM-K244	1441.1699.02
CDMA2000®	R&S®SMM-K246	1441.1682.02
1xEV-DO Rev. A	R&S®SMM-K247	1441.1676.02
IEEE 802.16	R&S®SMM-K249	1441.1653.02
TD-SCDMA	R&S®SMM-K250	1441.1647.02
TD-SCDMA enhanced BS/MS tests	R&S®SMM-K251	1441.1630.02
DVB-T/DVB-H	R&S®SMM-K252	1441.1624.02
DAB/T-DMB	R&S®SMM-K253	1441.1618.02
IEEE 802.11a/b/g/n/j/p	R&S®SMM-K254	1441.1601.02
LTE Release 8	R&S®SMM-K255	1441.1599.02
Bluetooth® EDR	R&S®SMM-K260	1441.1582.02
Multicarrier CW signal generation	R&S®SMM-K261	1441.1576.02
AWGN	R&S®SMM-K262	1441.1560.02
Galileo, 1 satellite	R&S®SMM-K266	1441.1547.02
3GPP FDD HSPA/HSPA+, enhanced BS/MS tests	R&S®SMM-K283	1441.1530.02
LTE Release 9	R&S®SMM-K284	1441.1524.02
LTE Release 10 (LTE-Advanced)	R&S®SMM-K285	1441.1518.02
IEEE 802.11ac	R&S®SMM-K286	1441.1501.02
1xEV-DO Rev. B	R&S®SMM-K287	1441.1499.02
NFC A/B/F	R&S®SMM-K289	1441.1482.02
GLONASS, 1 satellite	R&S®SMM-K294	1441.1199.02
NavIC (IRNSS), 1 satellite	R&S®SMM-K297	1441.1476.02
Modernized GPS, 1 satellite	R&S®SMM-K298	1441.1724.02
BeiDou, 1 satellite	R&S®SMM-K407	1441.1460.02
LTE Release 11	R&S®SMM-K412	1441.1453.02
LTE Release 12	R&S®SMM-K413	1441.1447.02
OFDM signal generation	R&S®SMM-K414	1441.1430.02
Cellular IoT Release 13	R&S®SMM-K415	1441.1424.02
DVB-S2/DVB-S2X	R&S®SMM-K416	1441.1418.02
Bluetooth® 5.x	R&S®SMM-K417	1441.1401.02
LTE Release 13/14/15	R&S®SMM-K419	1441.1382.02
Modernized GLONASS, 1 satellite	R&S®SMM-K423	1441.0928.02
LoRa®	R&S®SMM-K431	1441.1182.02
Modernized BeiDou, 1 satellite	R&S®SMM-K432	1441.1176.02
IEEE 802.11ax	R&S®SMM-K442	1441.1376.02
Cellular IoT Release 14	R&S®SMM-K443	1441.1253.02
5G NR Release 15	R&S®SMM-K444	1441.1360.02
Cellular IoT Release 15	R&S®SMM-K446	1441.1230.02
IEEE 802.11be	R&S®SMM-K447	1441.1060.02
5G NR Release 16	R&S®SMM-K448	1441.2172.02
HRP UWB	R&S®SMM-K449	1441.1101.02
5G NR sidelink	R&S®SMM-K470	1441.1082.02
5G NR Release 17	R&S®SMM-K471	1441.1024.02
Digital standards and options for the R&S®SMBV100B		
GSM/EDGE	R&S®SMBVB-K240	1423.8166.02
EDGE Evolution	R&S®SMBVB-K241	1423.8172.02
3GPP FDD	R&S®SMBVB-K242	1423.8189.02
GPS, 1 satellite	R&S®SMBVB-K244	1423.8195.02
CDMA2000®	R&S®SMBVB-K246	1423.8208.02
1xEV-DO Rev. A	R&S®SMBVB-K247	1423.8214.02
TD-SCDMA	R&S®SMBVB-K250	1423.8220.02
TD-SCDMA enhanced BS/MS test	R&S®SMBVB-K251	1423.8237.02
DVB-T/DVB-H	R&S®SMBVB-K252	1423.8243.02
DAB/T-DMB	R&S®SMBVB-K253	1423.8250.02
IEEE 802.11a/b/g/n/j/p	R&S®SMBVB-K254	1423.8266.02
LTE Release 8	R&S®SMBVB-K255	1423.8272.02
Bluetooth® EDR	R&S®SMBVB-K260	1423.8295.02
Multicarrier CW signal generation	R&S®SMBVB-K261	1423.8308.02
AWGN	R&S®SMBVB-K262	1423.8314.02
Galileo, 1 satellite	R&S®SMBVB-K266	1423.8320.02
3GPP FDD HSPA/HSPA+, enhanced BS/MS tests	R&S®SMBVB-K283	1423.8337.02

Designation	Type	Order No.
LTE Release 9	R&S®SMBVB-K284	1423.8343.02
LTE Release 10	R&S®SMBVB-K285	1423.8350.02
IEEE 802.11ac	R&S®SMBVB-K286	1423.8366.02
1xEV-DO Rev. B	R&S®SMBVB-K287	1423.8372.02
NFC A/B/F	R&S®SMBVB-K289	1423.8389.02
GLONASS, 1 satellite	R&S®SMBVB-K294	1423.8395.02
NavIC (IRNSS), 1 satellite	R&S®SMBVB-K297	1423.8695.02
Modernized GPS, 1 satellite	R&S®SMBVB-K298	1423.8408.02
BeiDou, 1 satellite	R&S®SMBVB-K407	1423.8489.02
LTE Release 11	R&S®SMBVB-K412	1423.8495.02
LTE Release 12	R&S®SMBVB-K413	1423.8508.02
OFDM signal generation	R&S®SMBVB-K414	1423.8595.02
Cellular IoT Release 13	R&S®SMBVB-K415	1423.8514.02
DVB-S2/DVB-S2X	R&S®SMBVB-K416	1423.8520.02
Bluetooth® 5.x	R&S®SMBVB-K417	1423.8537.02
Verizon 5GTF	R&S®SMBVB-K418	1423.8543.02
LTE Release 13/14/15	R&S®SMBVB-K419	1423.8550.02
Modernized GLONASS, 1 satellite	R&S®SMBVB-K423	1423.9110.02
LoRa®	R&S®SMBVB-K431	1423.8737.02
Modernized BeiDou, 1 satellite	R&S®SMBVB-K432	1423.8837.02
IEEE 802.11ax	R&S®SMBVB-K442	1423.8566.02
Cellullar IoT Release 14	R&S®SMBVB-K443	1423.8643.02
5G NR Release 15	R&S®SMBVB-K444	1423.8614.02
Cellular IoT Release 15	R&S®SMBVB-K446	1423.8814.02
IEEE 802.11be	R&S®SMBVB-K447	1423.8966.02
5G NR Release 16	R&S®SMBVB-K448	1423.8850.02
HRP UWB	R&S®SMBVB-K449	1423.8895.02
5G NR sidelink	R&S®SMBVB-K470	1423.8943.02
5G NR Release 17	R&S®SMBVB-K471	1423.9091.02
Digital standards and options for the R&S®SMCV100B		
GSM/EDGE	R&S®SMCVB-K240	1434.4150.02
EDGE Evolution	R&S®SMCVB-K241	1434.4173.02
3GPP FDD	R&S®SMCVB-K242	1434.4196.02
GPS, 1 satellite	R&S®SMCVB-K244	1434.4215.02
CDMA2000®	R&S®SMCVB-K246	1434.4238.02
1xEV-DO Rev. A	R&S®SMCVB-K247	1434.4250.02
TD-SCDMA	R&S®SMCVB-K250	1434.4273.02
TD-SCDMA enhanced BS/MS test	R&S®SMCVB-K251	1434.4296.02
DVB-T/DVB-H	R&S®SMCVB-K252	1434.4315.02
DAB/T-DMB	R&S®SMCVB-K253	1434.4338.02
IEEE 802.11a/b/g/n/j/p	R&S®SMCVB-K254	1434.4350.02
LTE Release 8	R&S®SMCVB-K255	1434.4373.02
Bluetooth® EDR	R&S®SMCVB-K260	1434.4396.02
Multicarrier CW signal generation	R&S®SMCVB-K261	1434.4415.02
AWGN	R&S®SMCVB-K262	1434.4438.02
Galileo, 1 satellite	R&S®SMCVB-K266	1434.4450.02
3GPP FDD HSPA/HSPA+, enhanced BS/MS tests	R&S®SMCVB-K283	1434.4473.02
LTE Release 9	R&S®SMCVB-K284	1434.4496.02
LTE Release 10	R&S®SMCVB-K285	1434.4515.02
IEEE 802.11ac	R&S®SMCVB-K286	1434.4538.02
1xEV-DO Rev. B	R&S®SMCVB-K287	1434.4550.02
NFC A/B/F	R&S®SMCVB-K289	1434.4573.02
GLONASS, 1 satellite	R&S®SMCVB-K294	1434.4596.02
NavIC (IRNSS), 1 satellite	R&S®SMCVB-K297	1434.5734.02
Modernized GPS, 1 satellite	R&S®SMCVB-K298	1434.4615.02
BeiDou, 1 satellite	R&S®SMCVB-K407	1434.4638.02
LTE Release 11	R&S®SMCVB-K412	1434.4650.02
LTE Release 12	R&S®SMCVB-K413	1434.4673.02
OFDM signal generation	R&S®SMCVB-K414	1434.4696.02
Cellular IoT Release 13	R&S®SMCVB-K415	1434.4738.02
DVB-S2/DVB-S2X	R&S®SMCVB-K416	1434.4715.02
Bluetooth® 5.x	R&S®SMCVB-K417	1434.4750.02
Verizon 5GTF	R&S®SMCVB-K418	1434.4773.02
LTE Release 13/14/15	R&S®SMCVB-K419	1434.4796.02
Modernized GLONASS, 1 satellite	R&S®SMCVB-K423	1434.5911.02

Designation	Type	Order No.
LoRa®	R&S®SMCVB-K431	1434.4815.02
Modernized BeiDou, 1 satellite	R&S®SMCVB-K432	1434.5740.02
IEEE 802.11ax	R&S®SMCVB-K442	1434.4838.02
Cellular IoT Release 14	R&S®SMCVB-K443	1434.4850.02
5G NR Release 15	R&S®SMCVB-K444	1434.4873.02
Cellular IoT Release 15	R&S®SMCVB-K446	1434.5705.02
IEEE 802.11be	R&S®SMCVB-K447	1434.5870.02
5G NR Release 16	R&S®SMCVB-K448	1434.5686.02
5G NR sidelink	R&S®SMCVB-K470	1434.5857.02
5G NR Release 17	R&S®SMCVB-K471	1434.4880.02
Digital standards and options for the R&S®SGT100A		
GSM/EDGE	R&S®SGT-K240	1419.5950.02
EDGE Evolution	R&S®SGT-K241	1419.6004.02
3GPP FDD	R&S®SGT-K242	1419.6056.02
GPS, 1 satellite	R&S®SGT-K244	1419.6104.02
CDMA2000®	R&S®SGT-K246	1419.6156.02
1xEV-DO Rev. A	R&S®SGT-K247	1419.6204.02
IEEE 802.16	R&S®SGT-K249	1419.6504.02
TD-SCDMA	R&S®SGT-K250	1419.6556.02
TD-SCDMA enhanced BS/MS test	R&S®SGT-K251	1419.6604.02
DVB-T/DVB-H	R&S®SGT-K252	1419.6656.02
DAB/T-DMB	R&S®SGT-K253	1419.6704.02
IEEE 802.11 (a/b/g/n/j/p)	R&S®SGT-K254	1419.6756.02
LTE Release 8	R&S®SGT-K255	1419.6804.02
Bluetooth® EDR	R&S®SGT-K260	1419.6856.02
Multicarrier CW signal generation	R&S®SGT-K261	1419.6904.03
AWGN	R&S®SGT-K262	1419.6956.02
Galileo, 1 satellite	R&S®SGT-K266	1419.7000.02
3GPP FDD HSPA/HSPA+, enhanced BS/MS tests	R&S®SGT-K283	1419.7100.02
LTE Release 9	R&S®SGT-K284	1419.7152.07
LTE Release 10 (LTE-Advanced)	R&S®SGT-K285	1419.7200.02
IEEE 802.11ac	R&S®SGT-K286	1419.7252.07
1xEV-DO Rev. B	R&S®SGT-K287	1419.7300.02
NFC A/B/F	R&S®SGT-K289	1419.7352.02
GLONASS, 1 satellite	R&S®SGT-K294	1419.7400.02
NavIC (IRNSS), 1 satellite	R&S®SGT-K297	1426.3388.02
Modernized GPS, 1 satellite	R&S®SGT-K298	1419.5766.02
LTE Release 11	R&S®SGT-K412	1419.7600.02
LTE Release 12	R&S®SGT-K413	1419.8159.02
OFDM signal generation	R&S®SGT-K414	1419.8188.02
Cellular IoT Release 13	R&S®SGT-K415	1426.3607.02
DVB-S2/DVB-S2X	R&S®SGT-K416	1426.3707.02
Bluetooth® 5.x	R&S®SGT-K417	1426.3759.02
Verizon 5GTF	R&S®SGT-K418	1419.7781.02
LTE Release 13/14/15	R&S®SGT-K419	1426.3859.02
Modernized GLONASS, 1 satellite	R&S®SGT-K423	1426.3407.02
LoRa®	R&S®SGT-K431	1419.7881.02
Modernized BeiDou, 1 satellite	R&S®SGT-K432	1426.3394.02
IEEE 802.11ax	R&S®SGT-K442	1426.3807.02
Cellular IoT Release 14	R&S®SGT-K443	1419.7752.02
5G NR Release 15	R&S®SGT-K444	1419.5908.02
Cellular IoT Release 15	R&S®SGT-K446	1419.8171.02
IEEE 802.11be	R&S®SGT-K447	1419.7775.02
5G NR Release 16	R&S®SGT-K448	1419.8036.02
5G NR Sidelink	R&S®SGT-K470	1419.7075.02
5G NR Release 17	R&S®SGT-K471	1426.3165.02
Digital standards and options for the R&S®PVT360A		
GSM WinIQSIM2, waveforms for ARB	R&S®PVT-KW300	1214.0393.02
WCDMA WinIQSIM2, waveforms for ARB	R&S®PVT-KW301	1214.0406.02
LTE WinIQSIM2, waveforms for ARB, LTE/eMTC/cat. M1	R&S®PVT-KW310	1214.0412.02
NB-IoT WinIQSIM2, waveforms for ARB	R&S®PVT-KW313	1214.0429.02
5G NR WinIQSIM2 waveforms for ARB generator, Rel. 15/16	R&S®PVT-KW320	1214.0435.02
5G NR WinIQSIM2, waveforms for ARB generator, Release 17 extension	R&S®PVT-KW326	1214.0441.02
Bluetooth® WinIQSIM2 waveforms for ARB, BT CI, BLE to 5.3	R&S®PVT-KW400	1214.0458.02

Designation	Type	Order No.
WLAN WinIQSIM2 waveforms for ARB, IEEE 802.11a/b/g/n/j/ac	R&S®PVT-KW410	1214.0464.02
WLAN WinIQSIM2 waveforms for ARB, IEEE 802.11ax	R&S®PVT-KW411	1214.0470.02
WLAN WinIQSIM2 waveforms for ARB, IEEE 802.11be	R&S®PVT-KW412	1214.0487.02
Options for the R&S®CMP200		
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, HRP UWB	R&S®CMP-KW300	1212.1892.02
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, 5G NR	R&S®CMP-KW601	1212.1163.02
Options for the R&S®CMP180		
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, GNSS	R&S®CMP-KW220	1212.2460.02
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, NB-IoT	R&S®CMP-KW250	1212.2482.02
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, LP-IoT	R&S®CMP-KW280	1212.2499.02
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, Bluetooth®	R&S®CMP-KW310	1212.2501.02
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, IEEE 802.11a/b/g/n/j/ac	R&S®CMP-KW350	1212.2518.02
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, IEEE 802.11ax	R&S®CMP-KW351	1212.2524.02
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, IEEE 802.11be	R&S®CMP-KW352	1212.2530.02
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, GSM	R&S®CMP-KW420	1212.2547.02
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, WCDMA	R&S®CMP-KW440	1212.2553.02
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, CDMA2000® 1x RTT	R&S®CMP-KW480	1212.2753.02
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, LTE	R&S®CMP-KW500	1212.2560.02
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, LTE C-V2X	R&S®CMP-KW570	1212.2576.02
Permanent R&S®CMP license: enabling R&S®WinIQSIM2 waveform, 5G NR	R&S®CMP-KW601	1212.1163.02
Options for the R&S®CMW500 and R&S®CMW100		
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, AWGN	R&S®CMW-KW010	1204.9000.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, GSM/EDGE	R&S®CMW-KW200	1203.0951.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, EDGE Evolution extension of R&S®CMW-KW200	R&S®CMW-KW201	1204.8456.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, LTE NB-IoT	R&S®CMW-KW300	1211.0686.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WCDMA	R&S®CMW-KW400	1203.1006.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WCDMA, HSDPA extension of R&S®CMW-KW400	R&S®CMW-KW401	1203.1058.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WCDMA, HSUPA extension of R&S®CMW-KW401	R&S®CMW-KW402	1203.1106.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WCDMA, HSPA+ extension of R&S®CMW-KW401 and/or R&S®CMW-KW402	R&S®CMW-KW403	1203.9059.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, LTE	R&S®CMW-KW500	1203.5553.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, LTE Rel. 10 extension of R&S®CMW-KW500	R&S®CMW-KW502	1208.5780.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, LTE Rel. 12 extension of R&S®CMW-KW500	R&S®CMW-KW504	1211.1082.02

Designation	Type	Order No.
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, LTE Rel. 13 LAA extension of R&S®CMW-KW500	R&S®CMW-KW514	1211.2743.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, LTE Rel. 14 C-V2X extension of R&S®CMW-KW500	R&S®CMW-KW570	1211.3033.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, LTE MTC	R&S®CMW-KW590	1211.0705.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, 5G NR	R&S®CMW-KW6000	1211.2914.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, Bluetooth®	R&S®CMW-KW610	1203.6408.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, GPS	R&S®CMW-KW620	1203.5953.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, GLONASS	R&S®CMW-KW621	1207.8305.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, Galileo	R&S®CMW-KW622	1207.8357.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, BeiDou	R&S®CMW-KW623	1208.8280.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, DVB	R&S®CMW-KW630	1203.6050.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, DAB	R&S®CMW-KW632	1208.8280.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WLAN IEEE 802.11a/b/g/n/j/p	R&S®CMW-KW650	1203.1258.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WLAN IEEE 802.11ac	R&S®CMW-KW656	1207.9001.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WLAN IEEE 802.11ax	R&S®CMW-KW657	1211.0805.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, Low Rate WAN (LoRaWAN™)	R&S®CMW-KW683	1211.4081.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, TD-SCDMA	R&S®CMW-KW750	1203.1406.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, TD-SCDMA enhancements, extension of R&S®CMW-KW750	R&S®CMW-KW751	1203.1458.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, CDMA2000®	R&S®CMW-KW800	1203.1506.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, 1xEV-DO	R&S®CMW-KW880	1203.1558.02
Options for the R&S®CMW290		
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, AWGN	R&S®CMW-KW010	1204.9000.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, GSM/EDGE	R&S®CMW-KW200	1203.0951.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, EDGE evolution extension of R&S®CMW-KW200	R&S®CMW-KW201	1204.8456.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WCDMA	R&S®CMW-KW400	1203.1006.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WCDMA, HSDPA extension of R&S®CMW-KW400	R&S®CMW-KW401	1203.1058.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WCDMA, HSUPA extension of R&S®CMW-KW401	R&S®CMW-KW402	1203.1106.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WCDMA, HSPA+ extension of R&S®CMW-KW401 and/or R&S®CMW-KW402	R&S®CMW-KW403	1203.9059.02

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Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, LTE	R&S®CMW-KW500	1203.5553.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, Bluetooth®	R&S®CMW-KW610	1203.6408.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, GPS	R&S®CMW-KW620	1203.5953.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, GLONASS	R&S®CMW-KW621	1207.8305.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, Galileo	R&S®CMW-KW622	1207.8357.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, BeiDou	R&S®CMW-KW623	1208.8280.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, DVB	R&S®CMW-KW630	1203.6050.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WLAN IEEE 802.11a/b/g/n/j/p	R&S®CMW-KW650	1203.1258.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WLAN IEEE 802.11ac	R&S®CMW-KW656	1207.9001.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WLAN IEEE 802.11ax	R&S®CMW-KW657	1211.0805.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, TD-SCDMA	R&S®CMW-KW750	1203.1406.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, TD-SCDMA enhancements, extension of R&S®CMW-KW750	R&S®CMW-KW751	1203.1458.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, CDMA2000®	R&S®CMW-KW800	1203.1506.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, 1xEV-DO	R&S®CMW-KW880	1203.1558.02
Options for the R&S®CMW270		
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, AWGN	R&S®CMW-KW010	1204.9000.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, Bluetooth®	R&S®CMW-KW610	1203.6408.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, GPS	R&S®CMW-KW620	1203.5953.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, GLONASS	R&S®CMW-KW621	1207.8305.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, Galileo	R&S®CMW-KW622	1207.8357.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, Beidou	R&S®CMW-KW623	1208.8280.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WLAN IEEE 802.11a/b/g/n/j/p	R&S®CMW-KW650	1203.1258.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WLAN IEEE 802.11ac	R&S®CMW-KW656	1207.9001.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, WLAN IEEE 802.11ax	R&S®CMW-KW657	1211.0805.02
Permanent R&S®CMW license: enabling R&S®WinIQSIM2 waveform, Low Rate WAN (LoRaWAN™)	R&S®CMW-KW683	1211.4081.02

Designation	Type	Order No.
Options for the R&S®CMA180		
Permanent R&S®CMA license: enabling R&S®WinIQSIM2 waveform, GPS	R&S®CMA-KW620	1209.6222.02
Permanent R&S®CMA license: enabling R&S®WinIQSIM2 waveform, GLONASS	R&S®CMA-KW621	1209.6245.02
Permanent R&S®CMA license: enabling R&S®WinIQSIM2 waveform, Galileo	R&S®CMA-KW622	1209.6268.02
Permanent R&S®CMA license: enabling R&S®WinIQSIM2 waveform, Tetra Release 2	R&S®CMA-KW668	1209.6874.02
Related product		
Cadence® AWR® VSS integration for digital signal creation and analysis with R&S®WinIQSIM2 and R&S®VSE	R&S®VSESIM-VSS	1345.1511.22

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