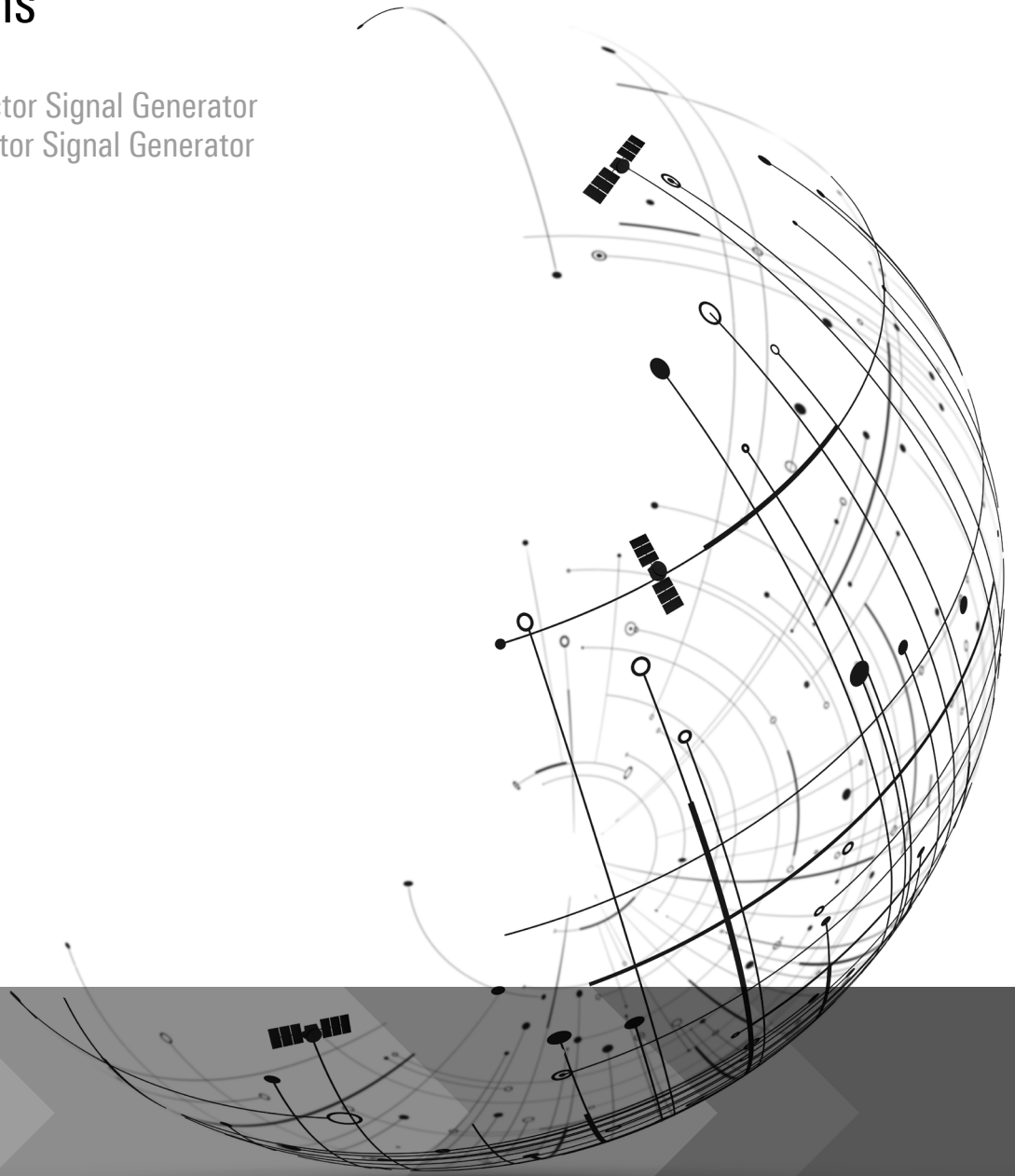


GNSS AND AVIONICS SIMULATION FOR ROHDE & SCHWARZ SIGNAL GENERATORS

Specifications

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



Specifications
Version 17.00

ROHDE & SCHWARZ

Make ideas real



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Definitions

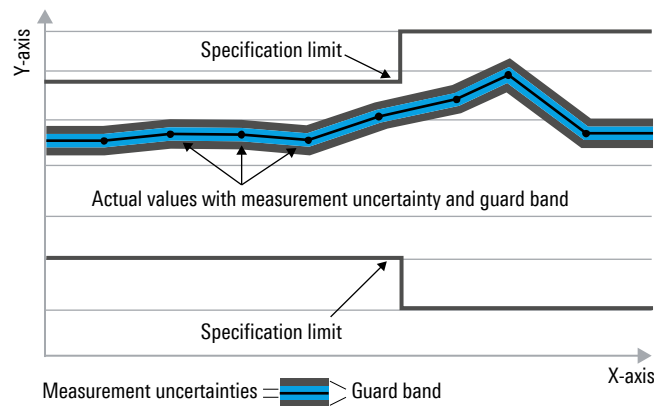
General

Product data applies under the following conditions:

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

Specifications with limits

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



Non-traceable specifications with limits (n. trc.)

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

Specifications without limits

Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value, e.g. dimensions or resolution of a setting parameter. Compliance is ensured by design.

Typical data (typ.)

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

Nominal values (nom.)

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

Measured values (meas.)

Characterize expected product performance by means of measurement results gained from individual samples.

Uncertainties

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

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

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

In line with the 3GPP 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.

Overview

With the GNSS and avionics simulation solutions for the R&S®SMBV100B and the R&S®SMW200A, dynamic scenarios with GPS/SBAS/QZSS, Galileo, GLONASS and BeiDou signals can be generated in real time including moving scenarios, multipath, dynamic power control and atmospheric modeling. For moving scenarios, the effects of antenna pattern and vehicle body mask can be simulated in real time with dynamic variation of the vehicle's attitude. Above and beyond GNSS signal generation, the R&S®SMBV100B and the R&S®SMW200A are flexible vector signal generators with excellent RF performance. They offer options for generating standard-compliant signals for all important digital communications standards (GSM, WCDMA, HSPA+, LTE, WiMAX, WLAN, etc.). This versatility allows mobile phone or car infotainment system manufacturers that integrate GNSS modules into their products to test the GNSS functionality and the normal functionality of their products with only one instrument.

This document contains the functional specifications of the GNSS-related software options for the R&S®SMBV100B and the R&S®SMW200A.

Options	R&S®SMBV100B	R&S®SMW200A
GNSS		
GPS	R&S®SMBVB-K44	R&S®SMW-K44
Modernized GPS	R&S®SMBVB-K98	R&S®SMW-K98
Galileo	R&S®SMBVB-K66	R&S®SMW-K66
GLONASS	R&S®SMBVB-K94	R&S®SMW-K94
NavIC/IRNSS	R&S®SMBVB-K97	R&S®SMW-K97
BeiDou	R&S®SMBVB-K107	R&S®SMW-K107
Modernized GLONASS	R&S®SMBVB-K123	R&S®SMW-K123
Modernized BeiDou	R&S®SMBVB-K132	R&S®SMW-K132
SBAS/QZSS	R&S®SMBVB-K106	R&S®SMW-K106
Real-world scenarios	R&S®SMBVB-K108	R&S®SMW-K108
Real-time GNSS interfaces	R&S®SMBVB-K109	R&S®SMW-K109
P(Y)/M/PRS noise	–	R&S®SMW-K128
Single-satellite GNSS	R&S®SMBVB-K133	–
Virtual RTK reference station	R&S®SMBVB-K122	R&S®SMW-K122
Matched-spectrum GNSS interference test	R&S®SMBVB-K129	R&S®SMW-K129
Upgrade to dual-frequency GNSS	R&S®SMBVB-K134	R&S®SMW-K134
Upgrade to triple-frequency GNSS	R&S®SMBVB-K135	R&S®SMW-K135
Add 6 GNSS channels	R&S®SMBVB-K136	R&S®SMW-K136
Add 12 GNSS channels	R&S®SMBVB-K137	R&S®SMW-K137
Add 24 GNSS channels	–	R&S®SMW-K138
Add 48 GNSS channels	–	R&S®SMW-K139
ERA-GLONASS test suite	R&S®SMBVB-K360	R&S®SMW-K360
eCall test suite	R&S®SMBVB-K361	R&S®SMW-K361
GNSS test suite	R&S®SMBVB-K362	R&S®SMW-K362
Car navigation test suite	R&S®SMBVB-K363	R&S®SMW-K363
China national GNSS test standard	R&S®SMBVB-K364	–
Avionics		
GBAS	R&S®SMBVB-K111	R&S®SMW-K111
ILS	R&S®SMBVB-K151	–
VOR	R&S®SMBVB-K152	–
DME	R&S®SMBVB-K153	–

For information on other digital standards or signal quality such as phase noise or spurious, see the following Rohde & Schwarz documents:

- R&S®SMBV100B specifications, PD 3607.8201.22
- R&S®SMBV100B product brochure, PD 3607.8201.12
- R&S®SMW200A specifications, PD 5214.1114.22
- R&S®SMW200A product brochure, PD 5214.1114.12
- Digital standards for signal generators specifications, PD 5213.9434.22

Abbreviations

The following abbreviations are used in this document:

- The R&S®SMBVB-K44 and the R&S®SMW-K44 are referred to as K44
- The R&S®SMBVB-K98 and the R&S®SMW-K98 are referred to as K98
- The R&S®SMBVB-K66 and the R&S®SMW-K66 are referred to as K66
- The R&S®SMBVB-K94 and the R&S®SMW-K94 are referred to as K94
- The R&S®SMBVB-K97 and the R&S®SMW-K97 are referred to as K97
- The R&S®SMBVB-K107 and the R&S®SMW-K107 are referred to as K107
- The R&S®SMBVB-K132 and the R&S®SMW-K132 are referred to as K132
- The R&S®SMBVB-K106 and the R&S®SMW-K106 are referred to as K106
- The R&S®SMBVB-K108 and the R&S®SMW-K108 are referred to as K108
- The R&S®SMBVB-K109 and the R&S®SMW-K109 are referred to as K109
- The R&S®SMBVB-K122 and the R&S®SMW-K122 are referred to as K122
- The R&S®SMBVB-K123 and the R&S®SMW-K123 are referred to as K123
- The R&S®SMBVB-K129 and the R&S®SMW-K129 are referred to as K129
- The R&S®SMBVB-K133 is referred to as K133
- The R&S®SMW-K128 is referred to as K128
- The R&S®SMBVB-K134 and the R&S®SMW-K134 are referred to as K134
- The R&S®SMBVB-K135 and the R&S®SMW-K135 are referred to as K135
- The R&S®SMBVB-K136 and the R&S®SMW-K136 are referred to as K136
- The R&S®SMBVB-K137 and the R&S®SMW-K137 are referred to as K137
- The R&S®SMW-K138 is referred to as K138
- The R&S®SMW-K139 is referred to as K139
- The R&S®SMBVB-K360 and the R&S®SMW-K360 are referred to as K360
- The R&S®SMBVB-K361 and the R&S®SMW-K361 are referred to as K361
- The R&S®SMBVB-K362 and the R&S®SMW-K362 are referred to as K362
- The R&S®SMBVB-K362 and the R&S®SMW-K362 are referred to as K363
- The R&S®SMBVB-K364 is referred to as K364
- The R&S®SMBVB-K111 and the R&S®SMW-K111 are referred to as K111
- The R&S®SMBVB-K151 is referred to as K151
- The R&S®SMBVB-K152 is referred to as K152
- The R&S®SMBVB-K153 is referred to as K153
- Space vehicle is abbreviated as SV

GNSS testing with the R&S®SMW200A

The R&S®SMW200A can be equipped with two different types of baseband hardware. When equipped with R&S®SMW-B10(F) baseband generators, the maximum RF bandwidth is limited to 160 MHz which prevents the baseband from simultaneously generating GNSS signals from different GNSS frequency bands. This limitation can be overcome by using an R&S®SMW-B9(F) baseband generator. Being able to support a maximum RF bandwidth of 2 GHz, multifrequency GNSS signals can be simulated out of one single baseband module. Compared to the R&S®SMW-B10(F) baseband module, the R&S®SMW-B9(F) also allows to simulate more GNSS channels and the number of channels can even be increased further by adding additional GNSS coder boards (2 × R&S®SMW-B15 or 4 × R&S®SMW-B15). The following table contains a comparison of some important GNSS simulation features when using different instrument configurations.

	With R&S®SMW-B10(F)	With 2 × R&S®SMW-B9(F)	With 2 × R&S®SMW-B9(F) and 4 × R&S®SMW-B15
Maximum number of channels per R&S®SMW200A	48	204	612
Maximum number of channels per baseband	24	102	102
Multifrequency GNSS on one baseband	–	•	•
RF OUT	2	2	2

In addition to these different simulation capabilities, the type of baseband hardware being used in the R&S®SMW200A also determines which software options can be installed on the instrument. The following table lists all GNSS options that can be installed on an instrument equipped with an R&S®SMW-B10(F) or a R&S®SMW-B9(F) baseband, respectively.

Options		Available in combination with R&S®SMW-B9(F)	Available in combination with R&S®SMW-B10(F)
GPS	R&S®SMW-K44	•	•
Modernized GPS	R&S®SMW-K98	•	•
Galileo	R&S®SMW-K66	•	•
GLONASS	R&S®SMW-K94	•	•
NavIC/IRNSS	R&S®SMW-K97	•	•
BeiDou	R&S®SMW-K107	•	•
Modernized GLONASS	R&S®SMW-K123	•	–
P(Y)/M/PRS noise	R&S®SMW-K128	•	–
Modernized BeiDou	R&S®SMW-K132	•	•
SBAS/QZSS	R&S®SMW-K106	•	•
Real-world scenarios	R&S®SMW-K108	•	•
Real-time GNSS interfaces	R&S®SMW-K109	•	•
Virtual RTK reference station	R&S®SMW-K122	•	–
Matched-spectrum GNSS interference test	R&S®SMW-K129	•	–
Upgrade to dual-frequency GNSS	R&S®SMW-K134	•	–
Upgrade to triple-frequency GNSS	R&S®SMW-K135	•	–
Add 6 GNSS channels	R&S®SMW-K136	•	–
Add 12 GNSS channels	R&S®SMW-K137	•	–
Add 24 GNSS channels	R&S®SMW-K138	•	–
Add 48 GNSS channels	R&S®SMW-K139	•	–
ERA-GLONASS test suite	R&S®SMW-K360	•	–
eCall test suite	R&S®SMW-K361	•	–
GNSS test suite	R&S®SMW-K362	•	–
Car navigation test suite	R&S®SMW-K363	•	–

Minimum instrument configuration for GNSS testing

The following minimum hardware configuration is required as a prerequisite for testing GNSS functionality.

Required options for R&S®SMBV100B		Required options for R&S®SMW200A	
R&S®SMBV100B	base unit incl. BB generator with ARB (64 Msample, 120 MHz RF bandwidth)	R&S®SMW200A	base unit
R&S®SMBVB-B103	frequency option, 8 kHz to 3 GHz	R&S®SMW-B1003	frequency option, RF path A, 100 kHz to 3 GHz
R&S®SMBVB-K520	real-time extension	R&S®SMW-B13	signal routing and baseband main module, one I/Q path to RF
		R&S®SMW-B10	baseband generator with ARB (64 Msample) and real-time coder, 120 MHz RF bandwidth

Minimum instrument configuration for avionics testing

The following minimum hardware configuration is required as a prerequisite for installing avionics options.

Required options for R&S®SMBV100B		Required options for R&S®SMW200A	
R&S®SMBV100B	base unit incl. BB generator with ARB (64 Msample, 120 MHz RF bandwidth)	–	–
R&S®SMBVB-B103	frequency option, 8 kHz to 3 GHz	–	–
R&S®SMBVB-K520	real-time extension	–	–

Global navigation satellite systems (GNSS)

Addressed GNSS applications

The main difference between the R&S®SMBV100B and the R&S®SMW200A in terms of GNSS testing is that the R&S®SMBV100B has one single RF output whereas the R&S®SMW200A can be equipped with two or even more RF outputs (with additional R&S®SGT100A SGMA vector RF sources or by stacking several R&S®SMW200A vector signal generators). That way, both instruments are able to address different types of GNSS test applications, which are summarized in the following tables.

Midrange GNSS applications with R&S®SMBV100B

Frequency bands	Applications	Tests
L1, L2, L5	single and multifrequency applications	<ul style="list-style-type: none"> • GNSS production testing • standard receiver tests for receiver characterization • standard receiver tests under special conditions (interference, multipath, leap seconds) • RAIM testing

High-end GNSS applications with R&S®SMW200A

Frequency bands	Applications	Tests
L1, L2, L5	single and multifrequency applications	<ul style="list-style-type: none"> • standard receiver tests for receiver characterization • standard receiver tests under special conditions (interference, multipath, leap seconds) • RAIM testing • ionospheric monitoring • atmospheric sounding
	multi-antenna applications	<ul style="list-style-type: none"> • baseline determination • beamforming (CRPA) • attitude determination • multipath direction finding
	multivehicle applications	<ul style="list-style-type: none"> • differential GNSS • collision avoidance • spacecraft formation flying • time and frequency transfer
	advanced interference simulation	<ul style="list-style-type: none"> • simulating of jamming/spoofing attacks • coexistence testing with several interferers

Systems and signals

Systems		Frequency bands	Supported signals	Required options for R&S®SMBVB100B	Required options for R&S®SMW200A
GNSS	GPS	L1	C/A code, P code	R&S®SMBVB-K44	R&S®SMW-K44
		L1	L1C	R&S®SMBVB-K98	R&S®SMW-K98
		L1	P(Y) noise, M noise	–	R&S®SMW-K128
		L2	C/A code, P code	R&S®SMBVB-K44	R&S®SMW-K44
		L2	L2C	R&S®SMBVB-K98	R&S®SMW-K98
		L2	P(Y) noise, M noise	–	R&S®SMW-K128
		L5	L5	R&S®SMBVB-K98	R&S®SMW-K98
	GLONASS	L1	C/A code	R&S®SMBVB-K94	R&S®SMW-K94
		L2	C/A code	R&S®SMBVB-K94	R&S®SMW-K94
	Modernized GLONASS	L1	CDMA L1 ¹	R&S®SMBVB-K123	R&S®SMW-K123
		L2	CDMA L2 ¹	R&S®SMBVB-K123	R&S®SMW-K123
		L5	CDMA L3	R&S®SMBVB-K123	R&S®SMW-K123
	Galileo	E1	OS data/pilot	R&S®SMBVB-K66	R&S®SMW-K66
		E1	E1 PRS noise	–	R&S®SMW-K128
		E5	E5a data/pilot, E5b data/pilot	R&S®SMBVB-K66	R&S®SMW-K66
		E6	E6 data/pilot	R&S®SMBVB-K66	R&S®SMW-K66
		E6	E6 PRS noise	–	R&S®SMW-K128
	BeiDou	B1	B1-I	R&S®SMBVB-K107	R&S®SMW-K107
		B2	B2-I	R&S®SMBVB-K107	R&S®SMW-K107
		B1	B1C	R&S®SMBVB-K132	R&S®SMW-K132
		B2	B2a	R&S®SMBVB-K132	R&S®SMW-K132
B2		B2b_I ²	R&S®SMBVB-K132	R&S®SMW-K132	
B3		B3-I	R&S®SMBVB-K132	R&S®SMW-K132	
RNSS	NavIC/IRNSS	L5	L5 SPS	R&S®SMBVB-K97	R&S®SMW-K97
SBAS	QZSS	L1	C/A code, L1C	R&S®SMBVB-K106	R&S®SMW-K106
	QZSS	L2	L2C	R&S®SMBVB-K106	R&S®SMW-K106
	QZSS	L5	L5	R&S®SMBVB-K106	R&S®SMW-K106
	WAAS	L1	C/A code	R&S®SMBVB-K106	R&S®SMW-K106
	EGNOS	L1	C/A code	R&S®SMBVB-K106	R&S®SMW-K106
	MSAS	L1	C/A code	R&S®SMBVB-K106	R&S®SMW-K106
	GAGAN	L1	C/A code	R&S®SMBVB-K106	R&S®SMW-K106
	WAAS	L5	Exp L5 ²	R&S®SMBVB-K106	R&S®SMW-K106
EGNOS	L5	Exp L5 ²	R&S®SMBVB-K106	R&S®SMW-K106	

In the R&S®SMBVB100B and the R&S®SMW200A, the designators L1, L2 and L5 are used when referring to a specific GNSS frequency band. The following table shows how the supported signals are mapped to these bands.

	L1 frequency band	L2 frequency band	L5 frequency band
GPS	C/A, P, L1C	C/A, P, L2C	L5
Galileo	E1 OS (including OSNMA)	E6	E5a, E5b
GLONASS	C/A, CDMA L1 ¹	C/A, CDMA L2 ¹	CDMA L3
BeiDou	B1I, B1C	B3I	B2I, B2a, B2b_I ²
NavIC/IRNSS	–	–	L5
SBAS	C/A	–	Exp L5 ³
QZSS	C/A, L1C	L2C	L5

¹ 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 warranted.

² B2b_I refers to non-GEO satellites 6 to 58, where only the B2b-I component is defined.

³ Exp L5 signals are experimental and not compliant to any existing or future ICDs. The navigation message is just a copy of the corresponding L1 message. Exp L5 signals are available only for WAAS and EGNOS.

Key features

GNSS features (independent from instrument type)

- Support of all global satellite navigation systems (GPS, GLONASS, Galileo including OSNMA on E1OS, BeiDou)
- Support of satellite based augmentation systems and regional systems (SBAS, QZSS and NavIC)
- Static and dynamic GNSS scenarios
- Moving receiver simulations based on predefined and user-defined waypoints with additional support of NMEA and KML files and waypoint smoothing using vehicle description files
- Support of predefined A-GNSS test scenarios, including generation of A-GNSS assistance data
- Support of predefined Galileo test cases based on OSNMA test vectors (see user manual for further details)
- Realistic GNSS scenarios with consideration of
 - Orbit perturbations and clock errors
 - Tropospheric and ionospheric effects
 - Signal obscuration and multipath
 - Antenna gain and phase patterns
 - User trajectories with consideration of vehicle attitude
 - Pseudorange steps and ramps for RAIM testing
- Interactive power control of individual satellites
- Optional internal noise generator
- Integrated GNSS simulation software with user-friendly simulation configuration, monitoring and interactive control capabilities using the instrument's large touchscreen
- Logging of user motion and satellite-related parameters
- Scenario generation can be fully automated using extensive remote control capabilities via Ethernet, USB or GPIB
- Automatic GNSS performance testing for ERA-GLONASS modules against GOST-R-55534/33471 performance criteria
- Automatic GNSS performance testing for eCall modules against EU2017/79 Annex VI and UNECE2016/07 performance criteria
- Automated and customizable GNSS receiver tests for GNSS receiver characterization
- Hardware-in-the-loop (HIL) real-time feed of vehicle's motion and attitude data (position, velocity, acceleration and jerk)

GNSS features (related to instrument type)

Feature	R&S®SMBV100B	R&S®SMW200A
Multifrequency scenarios	yes	yes
GNSS frequency bands	L1, L2, L5	L1, L2, L5
Number of GNSS channels	6 to 102	24 to 612
Number of RF outputs	1	1 or 2 internal RFs
Maximum number of simulated antennas	1	6
Maximum number of simulated vehicles	1	2
Measured worst case pseudorange accuracy	< 1 cm	< 1 cm
Hardware update rate	100 Hz	100 Hz
Signal dynamics		
Velocity	max. 600 m/s	with R&S®SMW-B10 or R&S®SMW-B9: max. 600 m/s, with R&S®SMW-B10F or R&S®SMW-B9F: max. 10000 m/s
Acceleration	max. 1600 m/s ²	max. 1600 m/s ²
Jerk	max. 400 m/s ³	max. 400 m/s ³
HIL streaming rate	100 Hz	100 Hz
HIL latency	20 ms	20 ms
Interference generation	yes	yes
Interference scenarios	GNSS + CW interference or GNSS + AWGN	<ul style="list-style-type: none"> • GNSS + CW interference • GNSS + AWGN • GNSS + communications signal (coexistence) • GNSS + jamming • spoofing

Common specifications for all GNSS options

Simulation configuration

		R&S®SMBV100B	R&S®SMW200A
Simulation time	flexible date and time (UTC) or GNSS system time configuration	resolution of 1 ms	
	leap second simulation		
Simulation modes/test modes	tracking	signal generation with constant or custom Doppler profiles for individual satellites	
	navigation	simulation of receiver positioning with realistic Doppler profiles relative to the motion of satellites and simulated user receiver	
	single satellite per system	simulation of one single satellite for the following systems: GPS, GLONASS, Galileo, BeiDou, NavIC	–
Coordinate systems for configuring static locations or user trajectories (ECEF WGS84 PZ-90.11)			
	altitude	–10 000 m to +50 000 000 m, in steps of 0.1 m	
	latitude	–90° to +90°, in steps of 0.000001°	
	longitude	–180° to +180°, in steps of 0.000001°	
Trajectory configuration	waypoint files with multiple formats	XTD (proprietary trajectory format, see user manual for format description), KML, TLE, NMEA formats	
	possibility to smooth the trajectory depending on vehicle dynamics		
Constellation configuration and navigation data sources	default constellations available that will be internally extrapolated for different simulation start times		
	data can be imported from multiple publicly available file formats	RINEX, YUMA, SEM, AGL, XML	
Channel selection criteria	satellite visibility time	<ul style="list-style-type: none"> automatic exchange of invisible satellites with visible ones, with preference to those with longest visibility duration at the current position visible satellites can be turned off and on without interrupting the simulation 	
	satellite elevation	same as above, with preference on satellites of higher elevation	
	manual	satellites can be arbitrarily turned on and off without any automatic exchange	
Elevation mask	earth tangent, local horizon	excludes satellites below a specific elevation, range: –10° to +90°	
Tropospheric models	none	possibility of removing troposphere errors	
	STANAG	STANAG Doc. 4294	
	MOPS 229D	minimum operational performance standard for GPS/SBAS airborne equipment	
Ionospheric models	none	possibility of removing ionosphere errors	
	STANAG	STANAG Doc. 4294	
	NeQuick	NeQuick ionosphere model	
	MOPS 229D	minimum operational performance standard for GPS/SBAS airborne equipment	
Satellite vehicle parameters	state	switch satellites on/off, modifiable on-the-fly	

		R&S®SMBV100B	R&S®SMW200A
Power configuration	reference power	received power per signal assuming all offsets are zero (setting range: -145 dBm to -20 dBm)	
	satellite vehicle power offset	attenuation for all signals transmitted from a single satellite, modifiable on-the-fly	
	free space path loss	automatically calculated attenuation due to the line of sight distance between transmit and receive antenna	
	signal power offset	additional attenuation of a specific signal (-21 dB to 0 dB, updated in real-time without restarting the simulation)	
	pseudorange errors in navigation mode	<ul style="list-style-type: none"> constant bias, modifiable on-the-fly profile (steps, ramps): suitable for testing receiver autonomous integrity monitoring (RAIM) synchronized with corrections broadcasted in SBAS: The ionosphere errors will match the MOPS grid broadcasted by SBAS. Moreover, for GPS satellite, the deviation between the simulated orbits and clock and those broadcasted by the satellites will match the amount of differential correction broadcasted in SBAS message about the individual GPS SVs 	
	constant signal dynamics in tracking mode	<ul style="list-style-type: none"> pseudorange (0 km to 119900 km) pseudorange rate (-100 km/s to 100 km/s) carrier doppler is coupled with pseudorange rate initial carrier phase: 0π rad to 2π rad 	
	high order signal dynamics in tracking mode	periodic profiles with acceleration, constant velocity and deceleration	
	marker	<ul style="list-style-type: none"> 1 PPS 1 PP2S 10 PPS pulse pattern on/off ratio trigger 	
Connectivity	triggering	see R&S®SMBV100B specifications, section: I/Q baseband generator	see R&S®SMW200A specifications, section: I/Q baseband generator

Simulation monitoring

		R&S®SMBV100B	R&S®SMW200A
Sky view	in navigation test mode	shows the distribution of GNSS satellites in the sky	
Power view	in navigation and tracking test modes	bar plot visualizing the signals' power levels	
Satellite vehicle trajectory	in navigation test mode	azimuth/elevation of individual SVs over 24 h relative to simulation start	
World map	in navigation test mode	shows the simulated user position on a world map	
Map view	in navigation test mode	shows the currently simulated user position along with a preview of the full trajectory	
Vehicle dynamics	in navigation test mode	visualizes position, velocity and attitude information (heading, elevation and bank) in the form of an artificial horizon	
Hardware channels view	in navigation and tracking test modes	<ul style="list-style-type: none"> visualizes the assignment of each GNSS signal in the hardware channels and its corresponding power (in dBm) each signal represents a unique combination of: vehicle/antenna/band/multipath-ray/signal type 	

Simulation data logging

		R&S®SMBV100B	R&S®SMW200A
Logging mode ⁴	real-time log, offline log	<ul style="list-style-type: none"> logs simulation data during the currently running simulation simulation run is performed as fast as possible without producing an RF signal for fast generation of logging data 	
Log types	satellite data	<ul style="list-style-type: none"> elapsed time, UTC date and time, system/SVID, elevation, azimuth, ECEF XYZ position (in m), ECEF XYZ velocity (in m/s), ECEF XYZ acceleration in (in m/s²), clock bias (in m) signal level (in dBm) range, pseudorange (in m) range, pseudorange rates (in m/s) pseudorange bias (in m) pseudorange bias rate (in m/s) doppler shift (in Hz) carrier phase (in deg) tropospheric, ionospheric delays (in m) 	
	vehicle motion	<ul style="list-style-type: none"> elapsed time, UTC date and time latitude (in deg) longitude (in deg) altitude (in m) position XYZ (in m) velocity XYZ (in m/s) acceleration XYZ (in m/s²) jerk XYZ (in m/s³) position east, north, upper (in m) velocity east, north, upper (in m/s) ground speed (in m/s) attitude rate yaw, pitch, roll (in deg) attitude rate yaw, pitch, roll (in deg/s) attitude acceleration yaw, pitch, roll (in deg/s²) attitude jerk yaw, pitch, roll (in deg/s³) GDOP, PDOP, HDOP, VDOP, TDOP visible SVs 	

⁴ Not available in HIL operation mode.

Specifications for GNSS options

GPS (R&S®SMBVB/R&S®SMW-K44 option)

Can be installed once on the R&S®SMBV100B and twice on the R&S®SMW200A.

	R&S®SMBV100B	R&S®SMW200A
GPS	in line with ICD-GPS-200 revision H	
Simulation configuration, monitoring, logging	see section Common specifications for all GNSS options	
Channel budget	see section Channel allocation	
Frequency bands	L1, L2	L1, L2
Center frequencies	1575.42 MHz, 1227.60 MHz	1575.42 MHz, 1227.60 MHz
Signals	C/A code, P code	C/A code, P code
Number of GNSS channels	6	24
Channel extension options	K136/K137	K136/K137/K138/K139, in combination with B9(F)
Navigation data format	LNAV, data list, pattern, All0, All1, PRBS	
SVs	PRNs 1 to 37	

Modernized GPS (R&S®SMBVB/R&S®SMW-K98 option)

Can be installed once on the R&S®SMBV100B and twice on the R&S®SMW200A.

	R&S®SMBV100B	R&S®SMW200A
GPS	in line with ICD-GPS-200 revision H and ICD-GPS-705 revision E	
Simulation configuration, monitoring, logging	see section Common specifications for all GNSS options	
Channel budget	see section Channel allocation	
Frequency bands	L2, L5	L2, L5
Center frequencies	1227.60 MHz, 1176.45 MHz	1227.60 MHz, 1176.45 MHz
Signals	L2C, L5	L2C, L5
Number of GNSS channels	6	24
Channel extension options	K136/K137	K136/K137/K138/K139, in combination with B9(F)
Navigation data format	CNAV, data list, pattern, All0, All1, PRBS	
SVs	PRNs 1 to 37	

Galileo (R&S®SMBVB/R&S®SMW-K66 option)

Can be installed once on the R&S®SMBV100B and twice on the R&S®SMW200A.

		R&S®SMBV100B	R&S®SMW200A
Galileo		in line with OS SIS ICD, E1/E5 band	in line with OS SIS ICD, E1/E5 band, OSNMA for E1, in line with OSNMA SIS ICD, Issue 1.1, October 2023
Simulation configuration, monitoring, logging		see section Common specifications for all GNSS options	
Channel budget		see section Channel allocation	
Frequency bands		E1, E5, E6	E1, E5, E6
Center frequencies		1575.42 MHz, 1176.45 MHz, 1207.14 MHz, 1278.75 MHz	1575.42 MHz, 1176.45 MHz, 1207.14 MHz, 1278.75 MHz
Signals		E1 open service, E5a, E5b, E6	E1 open service, E5a, E5b, E6
Number of GNSS channels		6	24
Channel extension options		K136/K137	K136/K137/K138/K139, in combination with B9(F)
Navigation data format		I/NAV for E1/E5b, F/NAV for E5a, data list, pattern, All0, All1, PRBS	
SVs		PRNs 1 to 30	
OSNMA test vectors			predefined scenarios with limited simulation time, in line with OSNMA Receiver Guidelines for the Test Phase, Issue 1.1, October 2022 and with OSNMA Receiver Guidelines, Issue 1.1, October 2023

GLONASS (R&S®SMBVB/R&S®SMW-K94 option)

Can be installed once on the R&S®SMBV100B and twice on the R&S®SMW200A.

		R&S®SMBV100B	R&S®SMW200A
GLONASS		in line with GLONASS ICD version 5.0	
Simulation configuration, monitoring, logging		see section Common specifications for all GNSS options	
Channel budget		see section Channel allocation	
Frequency bands		L1, L2	L1, L2
Center frequencies		1602.0 MHz, 1246.0 MHz	1602.0 MHz, 1246.0 MHz
Signals		C/A code	C/A code
Number of GNSS channels		6	24
Channel extension options		K136/K137	K136/K137/K138/K139, in combination with B9(F)
Navigation data format		GLONASS NAV, data list, pattern, All0, All1, PRBS	
SVs		PRNs 1 to 24	

Modernized GLONASS (R&S®SMBVB/R&S®SMW-K123 option)

Can be installed once on the R&S®SMBV100B and twice on the R&S®SMW200A.

	R&S®SMBV100B	R&S®SMW200A
Modernized GLONASS	in line with GLONASS ICD CDMA open service navigation signal in L3 frequency band	
Simulation configuration, monitoring, logging	see section Common specifications for all GNSS options	
Channel budget	see section Channel allocation	
Frequency bands	L1, L2, L3	L1, L2, L3
Center frequencies	1600.995 MHz, 1248.06 MHz, 1202.025 MHz	1600.995 MHz, 1248.06 MHz, 1202.025 MHz
Signals	C/A code, CDMA L1 ⁵ , CDMA L2 ⁵ , CDMA L3	C/A code, CDMA L1 ⁵ , CDMA L2 ⁵ , CDMA L3
Number of GNSS channels	6	24
Channel extension options	K136/K137	K136/K137/K138/K139, in combination with B9(F)
Navigation data format	GLONASS NAV, data list, pattern, All0, All1, PRBS	
SVs	PRNs 1 to 24	

NavIC/IRNSS (R&S®SMBVB/R&S®SMW-K97 option)

Can be installed once on the R&S®SMBV100B and twice on the R&S®SMW200A.

	R&S®SMBV100B	R&S®SMW200A
NavIC/IRNSS	in line with ISRO-IRNSS-ICD-SPS version 1.1	
Simulation configuration, monitoring, logging	see section Common specifications for all GNSS options	
Channel budget	see section Channel allocation	
Frequency bands	L5	L5
Center frequencies	1176.45 MHz	1176.45 MHz
Signals	L5 SPS	L5 SPS
Number of GNSS channels	6	24
Channel extension options	K136/K137	K136/K137/K138/K139, in combination with B9(F)
Navigation data format	SPS, data list, pattern, All0, All1, PRBS	
SVs	PRNs 1 to 14	

BeiDou (R&S®SMBVB/R&S®SMW-K107 option)

Can be installed once on the R&S®SMBV100B and twice on the R&S®SMW200A.

	R&S®SMBV100B	R&S®SMW200A
BeiDou	in line with BDS-SIS-ICD-BI-2.0	
Simulation configuration, monitoring, logging	see section Common specifications for all GNSS options	
Channel budget	see section Channel allocation	
Frequency bands	B1, B2	B1, B2
Center frequencies	1561.098 MHz, 1207.14 MHz	1561.098 MHz, 1207.14 MHz
Orbits	GSO, IGSO, MEO	
Signals	B1 I (GSO), B1 I (non-GSO), B2 I (GSO), B2 I (non-GSO),	
Number of GNSS channels	6	24
Channel extension options	K136/K137	K136/K137/K138/K139, in combination with B9(F)
Navigation data format	D1 NAV, D2 NAV, data list, pattern, All0, All1, PRBS	
SVs	PRNs 1 to 35	

⁵ 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 warranted.

Modernized BeiDou (R&S®SMBVB/R&S®SMW-K132 option)

Can be installed once on the R&S®SMBV100B and twice on the R&S®SMW200A.

	R&S®SMBV100B	R&S®SMW200A
Modernized BeiDou	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	
Simulation configuration, monitoring, logging	see section Common specifications for all GNSS options	
Channel budget	see section Channel allocation	
Frequency bands	B1, B2, B3	B1, B2, B3
Center frequencies	1575.42 MHz, 1176.45 MHz, 1207.14 MHz, 1268.52 MHz	1575.42 MHz, 1176.45 MHz, 1207.14 MHz, 1268.52 MHz
Signals	B1C, B2a, B3I (GSO, non-GSO), B2b_I ⁶ (non-GEO)	B1C, B2a, B3I (GSO, non-GSO), B2b_I ⁶ (non-GEO)
Number of GNSS channels	6	24
Channel extension options	K136/K137	K136/K137/K138/K139, in combination with B9(F)
Navigation data format	CNAV, D1 NAV, D2 NAV, data list, pattern, All0, All1, PRBS	
SVs	PRNs 1 to 35	

P(Y)/M/PRS noise (R&S®SMW-K128 option)

Can be installed twice on the R&S®SMW200A.

	R&S®SMBV100B	R&S®SMW200A
Simulation configuration, monitoring, logging	–	see section Common specifications for all GNSS options
Channel budget	–	see section Channel allocation
Frequency bands	–	L1, L2
Center frequencies	–	1575.42 MHz, 1278.75 MHz, 1227.6 MHz
Signals	–	P(Y) noise, M noise, E1-PRS noise, E6-PRS noise ⁷
Number of GNSS channels	–	GPS: 37, Galileo: 30
Channel extension options	–	K136/K137/K138/K139, in combination with B9(F)
Navigation data format	–	GPS: LNAV, Galileo: I/NAV; data list, pattern, All0, All1, PRBS
SVs	–	GPS: PRNs 1 to 37, Galileo: PRNs 1 to 30

⁶ B2b_I refers to non-GEO satellites 6 to 58, where only the B2b-I component is defined.

⁷ The noise signals P(Y) noise, M noise, E1-PRS noise and E6-PRS noise are pure random signals simulating spectral interference. The signals cannot be used for position calculations.

SBAS/QZSS (R&S®SMBVB/R&S®SMW-K106 option)

Requires the R&S®SMBVB/SMW-K44 option. Can be installed once on the R&S®SMBV100B and twice on the R&S®SMW200A.

		R&S®SMBV100B	R&S®SMW200A
SBAS		in line with DO-229D, minimum operational performance standard for global positioning system/wide area augmentation system airborne equipment	
Simulation configuration, monitoring, logging		see section Common specifications for all GNSS options	
Channel budget		see section Channel allocation	
Frequency bands		L1, L5 for WAAS/EGNOS ⁸	L1, L5 for WAAS/EGNOS ⁸
Center frequencies		1547.42 MHz, 1176.45 MHz,	1547.42 MHz, 1176.45 MHz,
Signals		C/A code, experimental signal Exp L5 ⁸	C/A code, experimental signal Exp L5 ⁸
Number of channels		5	5
Navigation data format		SBAS-L1-NAV, data list, pattern, All0, All1, PRBS	
Regional systems		<ul style="list-style-type: none"> • WAAS • EGNOS • MSAS • GAGAN 	
SVs		PRNs: 120, 124, 126, 131, 136, 122, 133, 134, 135, 138, 129, 137	
Differential corrections	automatically generated	The broadcasted corrections reflect the simulated errors in the GNSS constellation: Ionosphere model, pseudorange error, orbit and clock deviations.	
	replay of historical data with possibility to edit	loading of downloaded daily data from EGNOS and WAAS FTP servers: <ul style="list-style-type: none"> • EGNOS message server EMS format and WAAS real-time data NSTB format • EGNOS message server EMS format and WAAS real-time data NSTB format; optionally the ionosphere model pseudorange error GPS satellite can be synchronized to the imported data 	
Message types	<ul style="list-style-type: none"> • almanac • ephemeris • time conversion to UTC • ionosphere corrections • PRN mask • fast corrections • long-term corrections • degradation parameters • clock and ephemeris covariance matrix 	<ul style="list-style-type: none"> • MT 17 • MT 9 • MT 12 • MT 18, 26 • MT 1 • MT 2, 3, 4, 5, 6, 24 • MT 24, 25 • MT 7, 10 • MT 28 	

		R&S®SMBV100B	R&S®SMW200A
QZSS		in line with: <ul style="list-style-type: none"> • IS-QZSS V1.6 for L1 • IS-QZSS-PNT-003 for L1C, L2C, L5 	
Simulation configuration, monitoring, logging		see section Common specifications for all GNSS options	
Channel budget		see section Channel allocation	
Frequency bands		L1, L2, L5	L1, L2, L5
Center frequencies		1547.42 MHz, 1227.60 MHz, 1176.45 MHz	1547.42 MHz, 1227.60 MHz, 1176.45 MHz
Signals		C/A code, L1C, L2C, L5	C/A code, L1C, L2C, L5
Number of channels		5	5
Navigation data format		QZSS-L1-NAV, CNAV, data list, pattern, All0, All1, PRBS	
SVs		PRNs: 193, 194, 195, 196, 197, 199	

⁸ Exp L5 signals are experimental and not compliant to any existing or future ICDs. The navigation message is just a copy of the corresponding L1 message. The Exp L5 signals are available only for WAAS and EGNOS.

Single-satellite GNSS (R&S®SMBVB-K133 option)

This option allows for single-frequency production testing. It provides one single satellite for each of the systems GPS, GLONASS, Galileo, NavIC/IRNSS and BeiDou and generates signals in one of the frequency bands L1, L2 or L5 (selectable). Upgrades to dual- or triple-frequency production testing are possible by adding the R&S®SMBVB-K134 and R&S®SMBVB-K135 options.

		R&S®SMBV100B
GPS		in line with ICD-GPS-200 revision H
Simulation configuration, monitoring, logging		see section Common specifications for all GNSS options
Frequency bands		L1, L2, L5
Center frequencies		1575.42 MHz, 1227.60 MHz, 1191.795 MHz
Signals		L1 C/A code, L1 P code, L1C, L2C, L5, P(Y) noise ⁹ , M noise ⁹
Maximum number of SVs		1
Navigation data format		LNAV, CNAV, data list, pattern, All0, All1, PRBS
SVs		PRNs 1 to 37

		R&S®SMBV100B
Galileo		in line with OS SIS ICD, E1/E5/E6 band
Simulation configuration, monitoring, logging		see section Common specifications for all GNSS options
Frequency bands		E1, E5, E6
Center frequencies		1575.42 MHz, 1191.795 MHz, 1278.75 MHz
Signals		E1 open service, E5a, E5b, E6, E1-PRS noise ⁹ , E6-PRS noise ⁹
Maximum number of SVs		1
Navigation data format		I/NAV for E1/E5b, F/NAV for E5a, data list, pattern, All0, All1, PRBS
SVs		PRNs 1 to 30

		R&S®SMBV100B
GLONASS		in line with GLONASS ICD version 5.0
Simulation configuration, monitoring, logging		see section Common specifications for all GNSS options
Frequency bands		L1, L2
Center frequencies		1602.0 MHz, 1246.0 MHz
Signals		C/A code
Maximum number of SVs		1
Navigation data format		GLONASS NAV, data list, pattern, All0, All1, PRBS
SVs		PRNs 1 to 24

		R&S®SMBV100B
NavIC/IRNSS		in line with ISRO-IRNSS-ICD-SPS-1.1
Simulation configuration, monitoring, logging		see section Common specifications for all GNSS options
Frequency bands		L5
Center frequencies		1176.45 MHz
Signals		SPS
Maximum number of SVs		1
Navigation data format		SPS, data list, pattern, All0, All1, PRBS
SVs		PRNs 1 to 14

⁹ The noise signals P(Y) noise, M noise, E1-PRS noise and E6-PRS noise are pure random signals simulating spectral interference. The signals cannot be used for position calculations.

		R&S®SMBV100B
BeiDou		in line with BDS-SIS-ICD-B1I-2.0, BDS-SIS-ICD-B3I-1.0, BDS-SIS-ICD-B2a-1.0, BDS-SIS-ICD-B2b-1.0, BDS-SIS-ICD-B1C-1.0
Simulation configuration, monitoring, logging		see section Common specifications for all GNSS options
Frequency bands		B1, B2, B3
Center frequencies		1561.098 MHz, 1207.140 MHz, 1268.52 MHz, 1176.45 MHz, 1575.42 MHz
Orbits		GSO, IGSO, MEO
Signals		B1 I (GSO), B1 I (non-GSO), B2 I (GSO), B2 I (non-GSO), B3 I (GSO), B3 I (non-GSO), B2a, B1C, B2b_I ⁶ (non-GEO)
Maximum number of SVs		1
Navigation data format		D1 NAV, D2 NAV, CNAV, data list, pattern, All0, All1, PRBS
SVs		PRNs 1 to 35

Upgrade to dual-frequency GNSS (R&S®SMBVB/R&S®SMW-K134 option)

Allows to configure dual-frequency GNSS scenarios. Requires at least one GNSS option (K44, K98, K66, K94, K97, K107, K123, K128, K132 or K133). The option allows the user to generate signals simultaneously in two of the three GNSS frequency bands (L1 + L2 or L1 + L5 or L2 + L5). The option can be installed once on the R&S®SMBV100B and twice on the R&S®SMW200A (once per RF output).

Upgrade to triple-frequency GNSS (R&S®SMBVB/R&S®SMW-K135 option)

Allows to configure triple-frequency GNSS scenarios. Requires the K134 option. The option allows the user to generate signals simultaneously in all three GNSS frequency bands (L1 + L2 + L5). The option can be installed once on the R&S®SMBV100B and twice on the R&S®SMW200A (once per RF output).

Add 6 GNSS channels (R&S®SMBVB/R&S®SMW-K136 option)

Extends the number of available GNSS channels by 6. Requires at least one GNSS option (K44, K98, K66, K94, K97, K107, K123, K128 or K132). Can be installed several times. The maximum number of available GNSS channels is 102 on the R&S®SMBV100B and 612 on the R&S®SMW200A.

Add 12 GNSS channels (R&S®SMBVB/R&S®SMW-K137 option)

Extends the number of available GNSS channels by 12. Requires at least one GNSS option (K44, K98, K66, K94, K97, K107, K123, K128 or K132). Can be installed several times. The maximum number of available GNSS channels is 102 on the R&S®SMBV100B and 612 on the R&S®SMW200A.

Add 24 GNSS channels (R&S®SMW-K138 option)

Extends the number of available GNSS channels by 24. Requires at least one GNSS option (K44, K98, K66, K94, K97, K107, K123, K128 or K132). Can be installed several times. The maximum number of available GNSS channels is 612 on the R&S®SMW200A.

Add 48 GNSS channels (R&S®SMW-K139 option)

Extends the number of available GNSS channels by 48. Requires at least one GNSS option (K44, K98, K66, K94, K97, K107, K123, K128 or K132). Can be installed several times. The maximum number of available GNSS channels on the R&S®SMW200A is 612.

Matched-spectrum GNSS interference test (R&S®SMBVB/R&S®SMW-K129 option)

The matched-spectrum GNSS interference test option extends the number of available GNSS channels to the maximum number possible on the hardware platform, but for all these GNSS channels the navigation data generation is disabled. This special test option allows generation of GNSS signals with correct PRN sequences and modulation for all installed GNSS options. It is possible to simulate all signals based on a realistic satellite constellation and user motion. The generated signals can be used for GNSS interference tests, but a PVT can not be calculated based on the generated signals.

Requires at least one GNSS option (K44, K98, K66, K94, K97, K107, K123, K128 or K132). For R&S®SMW200A additionally an R&S®SMW-B9(F) is needed. The maximum number of available GNSS channels on the R&S®SMW200A depends on physical hardware installed and may be up to 612. The maximum number of available GNSS channels is 102 on the R&S®SMBVB100.

Real-world scenarios (R&S®SMBVB/R&S®SMW-K108 option)

This option adds the following simulation features to the basic options K44, K98, K66, K94, K97, K107, K123, K128, K132 or K106 (can be installed once).

		R&S®SMBV100B	R&S®SMW200A
Receiver antenna pattern and body mask	maximum of one active antenna per option	four configurable antennas, one of them can be simulated	six (B9(F)) or four (B10(F)) configurable antennas, all of them can be activated
	antenna to vehicle attitude offsets	e.g. if the antenna frame is not aligned with the vehicle body frame; Note: antenna to vehicle position offsets are available in the basic options	
	separate files can be used for antenna patterns and body masks	XML file format with a resolution down to 1° (see user manual for format description)	
Receiver attitude (heading, elevation and bank)	constant	The vehicle will remain in the same orientation with respect to the earth-fixed-earth-centered (ECEF) frame.	
	from file	The vehicle will change attitude with a resolution up to the hardware update rate. The values are imported from an external file.	
	spinning	The vehicle will change bank at constant rate defined by the user (max. 50 Hz).	
Receiver environment	static multipath	user-defined initial code phase, code phase drift, power offset, initial carrier phase, Doppler shift, elevation/azimuth angles of arrival	
	additional obscuration and multipath models	<ul style="list-style-type: none"> • vertical obstacles • roadside planes • full obscuration • ground and sea reflection 	

Real-time GNSS interfaces (R&S®SMBVB/R&S®SMW-K109 option)

This option adds the following simulation features to the basic options K44, K98, K66, K94, K97, K107, K123, K128, K132 or K106 (can be installed once).

		R&S®SMBV100B	R&S®SMW200A
Real-time trajectory feed		real-time feed of vehicle motion data (position, velocity, acceleration and jerk) for hardware in the loop applications	
Real-time attitude feed		real-time feed of vehicle attitude data (yaw, pitch and roll) for hardware in the loop applications	
Streaming rate		up to 100 Hz	up to 100 Hz
Latency		down to 20 ms	down to 20 ms

Virtual RTK reference station (R&S®SMBVB/R&S®SMW-K122 option)

This option adds the following simulation features to the basic options K44, K98, K66, K94, K107, K123 or K132 (can be installed once).

		R&S®SMBV100B	R&S®SMW200A
Number base stations		1	
Supported GNSS systems		GPS, Galileo, GLONASS, BeiDou	
Protocol		NTRIP 1.0 (HTTP) via IP	
Correction format		RTCM 3.3 (10403.3)	
Message update rate	1 Hz	1077, 1087, 1097, 1127	
	10 Hz	1006, 1013, 1033	

ERA-GLONASS test suite (R&S®SMBVB/R&S®SMW-K360 option)

Automatic GNSS performance testing against GOST-R-55534/33471 performance criteria. The supported test cases and the required R&S®SMBVB/SMW options are listed in the following table.

Test case	Performance tests	Required options	
		Minimum instrument configuration	To add for full test coverage
5.1	Availability of position/velocity for GLONASS L1	K44, K94, K137 ¹⁰	–
5.2	Availability of position/velocity for GPS L1		–
5.3	Availability of position/velocity for combined GPS/GLONASS L1 processing		–
5.4	Verify NMEA transmission from DUT		–
5.5	Functional RAIM test		–
5.6	Use of different reference systems (PZ-90/WGS-84)		–
5.7	Location accuracy (static receiver)		–
5.8	Location accuracy (moving receiver)		K108 ¹¹
5.9	Minimum update rate of NMEA stream		–
5.10	Reacquisition time		–
5.11	Time to first fix (TTFF) under cold start conditions		–
5.12	Tracking and acquisition sensitivity		–
5.13	Change update rate of NMEA stream		–
5.14	Check cutoff angle settings for navigation satellites		–
5.15	Check power-off time of navigation module (GNSS navigation receiver)		
5.16	Performance tests with consideration of CW interference	not covered by K360, because not specified in GOST-R-33471	
5.17	Performance tests with consideration of pulse interference	not covered by K360, because not specified in GOST-R-33471	

eCall test suite (R&S®SMBVB/R&S®SMW-K361 option)

Automatic GNSS performance testing against EU2017/79, Annex VI and UNECE 2016/07 performance criteria. The supported test cases and the required R&S®SMBVB/SMW options are listed in the following table.

Test case	Performance tests	Required options	
		Minimum instrument configuration	To add for full test coverage
2.1	NMEA-0183 messages output test	K44, K66, K106, K137 ¹⁰	K94 ¹² , K136 ¹
2.2	Positioning accuracy in autonomous static mode		K94 ¹² , K136 ¹
2.3	Positioning accuracy in autonomous dynamic mode		K94 ¹² , K136 ¹
2.4	Movement in shadow areas, areas of intermittent reception of navigation signals and urban canyons		K108 ¹¹ , K94 ¹² , K136 ¹
2.5	Cold start time to first fix test		K94 ¹² , K136 ¹
2.6	Test of reacquisition time of tracking signals after block out of 60 s		K94 ¹⁰ , K136 ¹
2.7	Test of GNSS receiver sensitivity in cold start mode, tracking mode and reacquisition scenario		K94 ¹² , K136 ¹

¹⁰ K136, K137 only required for R&S®SMBV100B.

¹¹ Required for poor reception test mode; if K108 is not installed, the dynamic location accuracy test (5.8) can still be performed, but not under poor reception conditions.

¹² K94 required for testing against UNECE specification, not required for testing against EU specification.

GNSS test suite (R&S®SMBVB/R&S®SMW-K362 option)

Automated and customizable GNSS receiver tests for GNSS receiver characterization. Requires at least one of the following options: K44, K66, K94, K97, K98, K107 or K132. The supported test cases are listed in the following table.

Test case	Performance tests	Test description
1	Verify NMEA transmission from DUT	checks for compliance of the NMEA messages coming from the DUT against the NMEA specification, and detects missing or corrupts NMEA sentences
2	Location accuracy (static receiver)	measures the accuracy of the position obtained by the DUT relative to the actual (simulated, static) position
3	Location accuracy (moving receiver)	measures the accuracy of the position obtained by the DUT relative to the actual (simulated, moving) position
4	Time-to-first fix (TTFF) under cold start conditions	measures the time from switching on the DUT to the availability of the first valid location fix
5	Reacquisition time	measures how long it takes for the DUT to restore its position information after having lost the GNSS signals for a certain period of time
6	Tracking and acquisition sensitivity	determines the minimum required signal level that allows the receiver to successfully perform or maintain a position fix
7	Functional RAIM test	determines the DUT ability to detect and exclude faulty GNSS signals

The K362 allows to configure automated GNSS tests for the following signals and systems.

	L1 frequency band	L2 frequency band	L5 frequency band
GPS	C/A, P	C/A, P, L2C	L5
Galileo	E1 OS	E6	E5a, E5b
GLONASS	C/A	C/A	
BeiDou	B1-I, B1c	B3-I	B2a, B2-I, B2b_I (non-GEO)
QZSS	C/A		
SBAS	L1		

Car navigation test suite (R&S®SMBVB/R&S®SMW-K363 option)

Automatic GNSS performance testing against “Technical specification for on board satellite positioning system” (Chinese version) performance criteria. The supported test cases and the required R&S®SMBVB100B/SMW200A options are listed in the following table.

Within “Technical specification for on board satellite positioning system”, the test cases are not numbered but the naming conventions are pretty similar to the below test case list.

Several of the independent BeiDou tests need additional licenses for GPS, Galileo and GLONASS because of the cold start state definitions of Annex B in the technical specification definition.

Test case	Performance tests	Required options	
		Basic instrument configuration	Additionally needed options on instrument
1	Output	K107, K108	K44, K66, K94, K136 + K137 ¹³
2	Supporting satellite signal consistency		K44, K66, K94, K136 + K137 ¹³
3	Independent BeiDou static positioning accuracy open sky		K44, K66, K94, K136 + K137 ¹³
4	Static positioning accuracy open sky		K44, K66, K94, K136 + K137 ¹³
5	Independent BeiDou static positioning accuracy urban canyon		K44, K66, K94, K136 + K137 ¹³
6	Static positioning accuracy urban canyon		K44, K66, K94, K136 + K137 ¹³
7	Independent BeiDou dynamic positioning accuracy open sky		K44, K66, K94, K136 + K137 ¹³
8	Dynamic positioning accuracy open sky		K44, K66, K94, K136 + K137 ¹³
9	Independent BeiDou dynamic positioning accuracy urban canyon		K44, K66, K94, K136 + K137 ¹³
10	Dynamic positioning accuracy urban canyon		K44, K66, K94, K136 + K137 ¹³
11	Independent BeiDou velocity accuracy open sky		K44, K66, K94, K136 + K137 ¹³
12	Velocity accuracy open sky		K44, K66, K94, K136 + K137 ¹³
13	Independent BeiDou velocity accuracy urban canyon		K44, K66, K94, K136 + K137 ¹³
14	Velocity accuracy urban canyon		K44, K66, K94, K136 + K137 ¹³
15	Independent BeiDou cold start time to first fix		K44, K66, K94, K136 + K137 ¹³
16	Cold start time to first fix		K44, K66, K94, K136 + K137 ¹³
17	Independent BeiDou hot start time to first fix		–
18	Hot start time to first fix		K44, K66, K94, K136 + K137 ¹³
19	Independent BeiDou reacquisition time		–
20	Reacquisition time		K44, K66, K94, K136 + K137 ¹³
21	Independent BeiDou acquisition sensitivity		K44, K66, K94, K136 + K137 ¹³
22	Acquisition sensitivity		K44, K66, K94, K136 + K137 ¹³
23	Independent BeiDou reacquisition sensitivity		–
24	Reacquisition sensitivity		K44, K66, K94, K136 + K137 ¹³
25	Independent BeiDou tracking sensitivity		–
26	Tracking sensitivity		K44, K66, K94, K136 + K137 ¹³
27	Independent BeiDou timing performance open sky		see Note below
28	Timing performance open sky		K44, K66, K94, K136 + K137 ¹³ see Note below
29	Independent BeiDou timing performance urban canyon		see Note below
30	Timing performance urban canyon		K44, K66, K94, K136 + K137 ¹³ see Note below

Note: For timing related tests 27 to 30, additional hardware equipment is needed to test the full timing specifications including hardware PPS output of the DUT. For this purpose, the K363 test suite option supports seamless integration of the R&S®RTM3002 and R&S®RTM3004 oscilloscopes. Without an oscilloscope, only a simplified version of the timing tests can be executed for the DUT and therefore, the PPS output cannot be verified.

¹³ K136, K137 only required for R&S®SMBV100B.

China national GNSS test standard (R&S®SMBVB-K364 option)

Automatic GNSS performance testing against “Technical Requirements and Test Methods for On-board Positioning System - Part 1: Satellite Positioning” performance criteria. The supported test cases and the required R&S®SMBVB100B options are listed in the following table.

Several of the independent BeiDou tests need additional licenses for GPS, Galileo and GLONASS because of the cold start state definitions of Annex B in the technical specification definition. Furthermore, the cold start state according to Annex B indirectly requires additional hardware (power supply) for fast automated testing.

Test case	Performance test	Basic instrument configuration	Additionally needed options on instrument	
1	Output	K44, K66, K94, K107, K108, K132, K134, K135, 3 x K137		
2	Switching to BeiDou single-mode			
3	Satellite signal consistency			
4	BeiDou independence			
5	BeiDou priority			
6	BeiDou single-mode			
7	Independent BeiDou static positioning accuracy open sky			
8	Static positioning accuracy open sky			
9	Independent BeiDou static positioning accuracy urban canyon			
10	Static positioning accuracy urban canyon			
11	Independent BeiDou dynamic positioning accuracy open sky			
12	Dynamic positioning accuracy open sky			
13	Independent BeiDou Dynamic positioning accuracy urban canyon			
14	Dynamic positioning accuracy urban canyon			
15	Independent BeiDou velocity accuracy open sky			
16	Velocity accuracy open sky			
17	Independent BeiDou velocity accuracy urban canyon			
18	Velocity accuracy urban canyon			
19	Independent BeiDou cold start time to first fix			
20	Cold start time to first fix			
21	Independent BeiDou hot start time to first fix			
22	Hot start time to first fix			
23	Independent BeiDou reacquisition time			
24	Reacquisition time			
25	Independent BeiDou acquisition sensitivity			
26	Acquisition sensitivity			
27	Independent BeiDou reacquisition sensitivity			
28	Reacquisition sensitivity			
29	Independent BeiDou tracking sensitivity			
30	Tracking sensitivity			
31	Independent BeiDou timing performance open sky			see Note below
32	Timing performance open sky			see Note below
33	Independent BeiDou timing performance urban canyon			see Note below
34	Timing performance urban canyon			see Note below
35	Week count zeroing of GPS system			
36	Satellite constellation system perturbation			
37	BeiDou single-mode: satellite constellation system perturbation			
38	Second count zeroing of BeiDou system			
39	BeiDou single-mode: second count zeroing of BeiDou system			
40	Abnormal indication signal of health word			
41	BeiDou single-mode: abnormal indication signal of health word			
42	Leap second event			
43	BeiDou single-mode: leap second event			
44	Single-satellite pseudorange mutation			
45	BeiDou single-mode: single-satellite pseudorange mutation			
46	RF signal coordination			K62

Note: The GNSS scenarios that correspond to the test cases listed above are configured to meet the minimum requirements in terms of simulated satellites. The standard states with a minimum of six satellites must be simulated per system; simulation of more satellites is also allowed. Based on the list of required instrument options, only six satellites per system will be simulated in multiconstellation scenarios. When users want to simulate more satellites, additional K137 options can be purchased. The timing test cases (tests 31 to 34) include the verification of the receiver's timing performance. Whenever a 1PPS signal is used as a timing source for other components in the car's navigation system, the 1PPS signal must be analyzed with an oscilloscope. For this, the K364 test suite option supports seamless integration of the R&S®RTM3002 and R&S®RTM3004 oscilloscopes. If a 1PPS output is not available or not used within the the car's navigation system, it is allowed to do a simplified timing test without using an oscilloscope.

Cold start requirements:

Annex B "Method for Setting Cold Start Status of On-board Satellite Positioning System" defines two methods for cold starts: an off time of the device for seven days or a full power on/off step. This is a prerequisite for most of the single tests.

For fast automatic testing, the K364 test suite option supports the switchable R&S®NGC101 single-channel power supply. This power supply is fully integrated in the automated testing and automatically delivers power on/off for all affected tests. This allows test cycles without manual interaction.

Channel allocation

For R&S®SMBV100B

One channel is equivalent to a single signal component transmitted by a single satellite, e.g. GPS-L1C/A of SVID 1 requires one channel. This means for an SV transmitting two signals (such as GPS L1 C/A and GPS L2 C/A) two GNSS channels are required.

Six channels will be available when one of the following basic GNSS options is installed: K44, K97, K98, K66, K94, K107, K123, K128, K132.

When more than one basic option is installed, the total number of channels does not increase. Example: when licenses for GPS, GLONASS, Galileo and BeiDou are installed, the total number of available GNSS channels is still six.

The number of available channels can be increased by installing one of the channel extension options: R&S®SMBV-K136 and R&S®SMBV-K137. That way, the channel budget can be extended from six to max. 102 channels.

For a given instrument configuration, the number of available SVs per system depends on what constellations are active and what signals are to be simulated. Example: If GPS is the only active constellation, all available channels can be used for generating GPS L1 C/A signals. In this case, the number of available SVs equals the number of available channels. When simulating GPS L1 C/A and GPS P code (P(Y) noise, M noise, E1-PRS noise and E6-PRS noise at the same time, the number of available SVs decreases as two channels per SVs are needed.

Simulating E5a and E5b simultaneously requires two separate channels per Galileo SV.

During multipath simulations, each additional echo requires the same number of channels as the corresponding line of sight signal.

The maximum number of available GNSS channels per instrument is 102.

For R&S®SMW200A with R&S®SMW-B10(F)

One channel is equivalent to a single signal component transmitted by a single satellite, e.g. GPS-L1C/A of SVID 1. This means for an SV transmitting two signals (such as GPS L1 C/A and GPS L2 C/A), two GNSS channels are required.

24 channels will be available when one of the following basic GNSS options is installed: K44, K97, K98, K66, K94, K107, K123, K128, K132.

All basic GNSS options can be installed twice (two R&S®SMW-B10(F) options need to be available on the R&S®SMW200A). If installed twice, the signals from that GNSS options can be used in RF path 1 and RF path 2. 24 GNSS channels are available in path 1, other 24 channels can be generated on path 2.

When more than one basic option is installed, the total number of channels does not increase. Example: when licenses for GPS, GLONASS, Galileo and BeiDou are installed in one single RF path, the total number of available GNSS channels is still 24.

The number of available channels per baseband cannot be increased. There are no channel extension options available for instruments equipped with R&S®SMW-B10(F) baseband generators.

For a given instrument configuration, the number of available SVs per system depends on what constellations are active and what signals are to be simulated. Example: If GPS is the only active constellation, all available channels can be used for generating GPS L1 C/A signals. In this case, the number of available SVs equals the number of available channels. When simulating GPS L1 C/A and GPS P code (P(Y) noise, M noise, E1-PRS noise and E6-PRS noise at the same time, the number of available SVs decreases as two channels per SVs are needed.

Simulating E5a and E5b simultaneously requires two separate channels per Galileo SV.

During multipath simulations, each additional echo requires the same number of channels as the corresponding line of sight signal.

For R&S®SMW200A with R&S®SMW-B9(F)

One channel is equivalent to a single signal component transmitted by a single satellite, e.g. GPS-L1C/A or SVID 1. This means for an SV transmitting two signals (such as GPS L1 C/A and GPS L2 C/A), two GNSS channels are required.

24 channels will be available when one of the following basic GNSS options is installed: K44, K97, K98, K66, K94, K107, K123, K128, K132.

All basic GNSS options can be installed twice (two R&S®SMW-B9(F) options need to be available on the R&S®SMW200A). If installed twice, the total amount of available channels increases to 48. These 48 channels can be used anywhere on the R&S®SMW200A and freely distributed among the signal paths.

When more than one basic option is installed, the total number of channels does not increase. Example: when licenses for GPS, GLONASS, Galileo and BeiDou are installed in one single RF path, the total number of available GNSS channels is still 24.

For a given instrument configuration, the number of available channels per instrument can be increased by installing one of the channel extension options: R&S®SMW-K136, R&S®SMW-K137, R&S®SMW-K138 and/or R&S®SMW-K138. That way, the channel budget can be extended to max. 612 channels. Please note that increasing the number of channels beyond 204 requires installation of additional hardware modules (R&S®SMW-B15) (see table below).

For a given instrument configuration, the number of available SVs per system depends on what constellations are active and what signals are to be simulated. Example: If GPS is the only active constellation, all available channels can be used for generating GPS L1 C/A signals. In this case, the number of available SVs equals the number of available channels. When GPS L1 C/A and GPS P code (P(Y) noise, M noise, E1-PRS noise and E6-PRS noise at the same time, the total number of available SVs decreases as two channels per SVs are needed.

Simulating E5a and E5b simultaneously requires two separate channels per Galileo SV.

During multipath simulations, each additional echo requires the same number of channels as the corresponding line of sight signal.

One RF path can generate a max. 102 channels, so that a dual-path R&S®SMW200A equipped with 2 × B9(F) is able to simulate up to 204 GNSS channels. To further increase the channel count, the R&S®SMW200A can be upgraded with wideband fading modules (R&S®SMW-B15), that can be used to simulate additional GNSS signals. To simulate a dedicated number of GNSS channels, the following minimum hardware configuration is needed.

Minimum hardware configuration	R&S®SMW200A base unit, R&S®SMW-B13XT, R&S®SMW-B1003, N × R&S®SMW-B9(F), M × R&S®SMW-B15	
Number of GNSS channels	N (no. of B9(F))	M (no. of B15)
24 to 102	1	0
103 to 204	2	0
205 to 408	2	2
409 to 612	2	4

The maximum number of simulated channels depends on the simulated signals. As an example, 102 GPS P code channels (P(Y) noise, M noise, E1-PRS noise and E6-PRS noise) on a single board are not supported. One R&S®SMW-B9(F) or R&S®SMW-B15 board consists of three channel banks and several subbanks used to generate GNSS signals. Each bank can simulate only one L1, L2 or L5 frequency band at a time. The frequency band is assigned automatically, so that a maximum number of hardware resources from the channel banks is used. The channel capacity on each B9(F) or B15 board is described in following table:

Channel bank	Subbank	Signal	Channel capacity
0	0_A	C/A, E1 OS, B1I, B2I, B3I	12
	0_B	C/A, L1C, E1 OS, B1I, L5, E5a, E5b, B1I, B2I, B3I, B1C	12
	0_C	C/A, L1C, E1 OS, B1I, P, P(Y) noise, M noise, E1-PRS noise, E6-PRS noise, L5, E5a, E5b, B1I, B2I, B3I, B1C	18
	all subbanks	all signals except L2C	42
1	1_A	C/A, L1C, E1 OS, B1I, L2C, L5, E5a, E5b, B1I, B2I, B3I, B1C	16
	1_B	C/A, L1C, E1 OS, B1I, P, P(Y) noise, M noise, E1-PRS noise, E6-PRS noise, L2C, L5, E5a, E5b, B1I, B2I, B3I, B1C	16
	all subbanks	all signals	32
2	2_A	C/A, L1C, E1 OS, B1I, L2c, L5, E5a, E5b, B1I, B2I, B3I, B1C	28

	all subbanks	all signals except P, P(Y) noise, M noise, E1-PRS noise, E6-PRS noise	28
All banks			102

Single-channel GNSS signals with R&S®WinIQSIM2

Overview

The following table lists the GNSS standards available for the different instruments and the respective options.

	R&S®SMW200A	R&S®SMM100A	R&S®SMBV100B	R&S®SMCV100B	R&S®SGT100A
GPS	R&S®SMW-K244	R&S®SMM-K244	R&S®SMBVB-K244	R&S®SMCVB-K244	R&S®SGT-K244
Modernized GPS	R&S®SMW-K298	R&S®SMM-K298	R&S®SMBVB-K298	R&S®SMCVB-K298	R&S®SGT-K298
Galileo	R&S®SMW-K266	R&S®SMM-K266	R&S®SMBVB-K266	R&S®SMCVB-K266	R&S®SGT-K266
GLONASS	R&S®SMW-K294	R&S®SMM-K294	R&S®SMBVB-K294	R&S®SMCVB-K294	R&S®SGT-K294
Modernized GLONASS	R&S®SMW-K423	R&S®SMM-K423	R&S®SMBVB-K423	R&S®SMCVB-K423	R&S®SGT-K423
BeiDou	R&S®SMW-K407	R&S®SMM-K407	R&S®SMBVB-K407	R&S®SMCVB-K407	R&S®SGT-K407
Modernized BeiDou	R&S®SMW-K432	R&S®SMM-K432	R&S®SMBVB-K432	R&S®SMCVB-K432	R&S®SGT-K432
NavIC	R&S®SMW-K297	R&S®SMM-K297	R&S®SMBVB-K297	R&S®SMCVB-K297	R&S®SGT-K297

A subset of R&S®WinIQSIM2 GNSS options is also supported by the R&S®CMW500, the R&S®CMW270, R&S®CMW100 and the R&S®CMA180:

- R&S®CMW-KW620: GPS (one satellite, same feature set as R&S®Sxx-K244 and R&S®xxx-K298)
- R&S®CMW-KW621: GLONASS (one satellite, same feature set as R&S®Sxx-K294)
- R&S®CMW-KW622: Galileo (one satellite, same feature set as R&S®Sxx-K266)
- R&S®CMW-KW623: BeiDou (one satellite, same feature set as R&S®Sxx-K407)
- R&S®CMA-KW620: GPS test (one satellite, same feature set as R&S®Sxx-K244 and R&S®xxx-K298)
- R&S®CMA-KW621: GLONASS test (one satellite, same feature set as R&S®Sxx-K294)
- R&S®CMA-KW622: Galileo test (one satellite, same feature set as R&S®Sxx-K266)

GPS (R&S®Sxx-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		<ul style="list-style-type: none"> • 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 chips to 20459.99 chips in steps of 0.01 chips; precision error depends on configurable sample rate
SV ID		C/A codes: 37 gold codes, 1023 chips 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 (R&S®Sxx-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		L2C: L2, 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		<ul style="list-style-type: none"> • 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		L2C: BPSK, L5: QPSK
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; precision error depends on configurable sample rate
SV 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		L2C: 50 Hz, L5: 100 Hz
Number of ephemeris pages		1

Galileo (R&S®Sxx-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		<ul style="list-style-type: none"> • 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		E1: CBOC(6,1), E5a/E5b, E6: QPSK
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; precision error depends on configurable sample rate
SV ID		E1: 36 memory codes, 4092 chips each; E5a/E5b: 36 memory codes, 10230 chips each; E6: 36 memory codes, 5115 chips 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		E1 and E5b: 250 Hz, E5a: 50 Hz, E6: 1 kHz
Number of ephemeris pages		1

GLONASS (R&S®Sxx-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		<ul style="list-style-type: none"> • 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 chips to 20459.99 chips in steps of 0.01 chips; precision error depends on configurable sample rate
SV ID		1 CDMA code shared by all GLONASS satellites, 511 chips 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 (R&S®Sxx-K423 option)

GLONASS digital standard		in line with GLONASS ICD CDMA open service navigation signal in L3 frequency ¹⁴
General settings		
RF bands		CDMA L1 ¹⁴ : L1, CDMA L2 ¹⁴ : L2, CDMA L3: L5, 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
Marker		<ul style="list-style-type: none"> • 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 ¹⁴ : 1.023 MHz, CDMA L2 ¹⁴ : 1.023 MHz, CDMA L3: 10.23 MHz
Modulation		CDMA L1 ¹⁴ : BPSK/BOC (TDM), CDMA L2 ¹⁴ : BPSK/BOC (TDM), CDMA L3: QPSK
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; precision error depends on configurable sample rate
SV ID		24 CDMA codes for CDMA L1 ¹⁴ , CDMA L2 ¹⁴ 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 ¹⁴)
Data rate		CDMA L1 ¹⁴ : 250 Hz CDMA L3: 200 Hz
Number of ephemeris pages		1

¹⁴ 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 warranted.

BeiDou (R&S®Sxx-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		<ul style="list-style-type: none"> • 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
SV 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 (R&S®Sxx-K432 or R&S®CMW-KW623 option)

BeiDou digital standard		in line with: <ul style="list-style-type: none"> • BDS-SIS-ICD-B3I-1.0 • BDS-SIS-ICD-B2a-1.0 • BDS-SIS-ICD-B1C-1.0 • BDS-SIS-ICD-B2b-1.0¹⁵
General settings		
RF bands		B1C on L1, B2a and B2b ¹⁵ 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 ¹⁵ /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		<ul style="list-style-type: none"> • 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 ¹⁵ GEO satellites): 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 B3I-C/A (10.23 MHz), B1C (1.023 MHz), B2a/B2b ¹⁵ (10.23 MHz)
Modulation		B3I and B2b ¹⁵ : BPSK, B2a: QPSK, B1C : BOC
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
SV 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		D1 and D2: 50 Hz and 500 Hz (respectively), B1C: 100 Hz, B2A: 200 Hz, B2b ¹⁵ : 1 kHz
Number of ephemeris pages		1

¹⁵ B2b refers to non-GEO satellites 6 to 58, where only the B2b-I component is defined.

NavIC/IRNSS (R&S®Sxx-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		<ul style="list-style-type: none"> • 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
SV 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

Avionics systems

Key features

GBAS (R&S®SMBVB/SMW-K111 option)

- Provision of GBAS messages via VHF link
- Simultaneous simulation of up to 11 GBAS frequency channels emulating multiple VHF data broadcast (VDB) towers
- Generation of message types 1, 2, 4, 11
- Support of real GBAS data generation based on user-configurable waypoint file and differential GNSS data
- Flexible message type scheduling

ILS (R&S®SMBV-K151 option)

- Emulation of instrument landing system (ILS)
- Generation of ILS localizer signal
- Generation of ILS glideslope signal
- Generation of marker beacons

VOR (R&S®SMBV-K152 option)

- Emulation of VHF omnidirectional radio range (VOR)
- Four different operating modes (NORM, VAR, subcarrier, subcarrier + FM)
- VOR bearing angle at a resolution of 0.01°

DME (R&S®SMBV-K153 option)

- Emulation of distance measuring equipment (DME)
- Interrogator mode and reply mode
- Testing of DME ground stations and DME aircraft equipment
- DME signal analysis in combination with R&S®NRP-Z81 power sensor

Specifications for avionics options

GBAS (R&S®SMBVB/R&S®SMW-K111 option)

GBAS		in line with RTCA DO-246D
General settings		
Frequency mode	single-frequency channel	allows simulation of one frequency band at a certain time
	multiple frequency channels	simulation of up to 11 adjacent frequency bands simultaneously, each with 25 kHz bandwidth
Gated power mode	available only with single-frequency mode	synchronization of the absolute power to the nominal level of one assigned timeslots
VHF data broadcast (VDB) tower configuration		
Number of VDB transmitters		generation of up to 8 VDB tower signals simultaneously; a tower is allocated on one frequency band and is allocated up to 8 timeslots as scheduled by the user
GBAS ID		configures the ID of the ground station
SSID		station slot identifier; A-H indicating the index of the first allocated timeslot
Frequency number		-5 to +5; references up to 11 adjacent frequency bands out of the 398 standard ones; frequency number 0 corresponds to the band as configured in the generator frequency field
Data source	identical for each VDB	<ul style="list-style-type: none"> • All0 • All1 • pattern (up to 64 bit) • PN 9 to PN 23 • data lists • real GBAS data: generation of GBAS message types 1, 2, 4, 11 based on user configuration including waypoint file for TAP configuration and differential GNSS file for messages 1 and 11
Number of frames	R&S®SMBV-B55/-K511 not available	1 to 6095 in single-frequency mode, 1 to 121 in multiple frequency mode
	R&S®SMBV-B55/-K511 available	1 to 48761 in single-frequency mode, 1 to 975 in multiple frequency mode
	R&S®SMBV-K512 available	1 to 195044 in single-frequency mode, 1 to 3900 in multiple frequency mode
Timeslot configuration		
Scheduling	a timeslot on one frequency band can be allocated to one VDB only	allows the user to reserve up to 8 timeslots on a specific frequency band; the allocated timeslots will be used in modulating the tower signal
State		activates or deactivates a specific timeslot for the VDB modulation
Relative power		sets the relative power of the timeslot of a specific VDB: -21 dB to 0 dB, -INF for inactive timeslot

GBAS message configuration		
Message types	all messages can be modulated simultaneously if needed	<ul style="list-style-type: none"> message type 1: differential corrections (100 s smoothed pseudoranges) message type 2: GBAS related data message type 4: final approach segment (FAS) and terminal area path (TAP) data message type 11: differential corrections (30 s smoothed pseudoranges)
Waypoint file		used to load the TAP waypoint data modulated with GBAS message 4
Differential GNSS file		used to transmit differential GNSS corrections for GPS, GLONASS and GBAS satellites in view; pseudorange correction (PRC) and range rate correction (RRC) among others are modulated in messages 1 and 11
Marker		1 PPS
		restart
		pulse
		pattern
		on/off ratio
Triggering		trigger
Triggering		see R&S®SMBV100A specifications, section I/Q baseband generator
Filter		cosine filter with 0.6 rolloff factor, symbol rate at 10.5 kHz
Clipping		standard R&S®SMBV100A functionality
Modulation/coding	available in static mode	differential 8PSK, FEC encoding and bit scrambling

ILS modulation (R&S®SMBVB-K151 option)

Attenuator mode: low distortion, level (PEP) within 0 dBm to -70 dBm. ILS-LOC specification valid for carrier frequency range from 108 MHz to 118 MHz. ILS-GS specification valid for carrier frequency range from 329 MHz to 335 MHz.

ILS modulation	generation of ILS localizer signal, COM/ID tone possible	ILS-LOC
	generation of ILS glideslope signal	ILS-GS
ILS operating modes	NORM	90 Hz + 150 Hz + COM/ID tone (ILS-LOC)
	90 Hz	suppression of 150 Hz modulation tone
	150 Hz	suppression of 90 Hz modulation tone
ILS modulation tones	If the frequency of the 90 Hz or 150 Hz tone is varied, the other tone is automatically changed in proportion.	
Frequency		
Error		< 0.02 Hz (meas.)
Setting range	90 Hz tone	60 Hz to 120 Hz
	150 Hz tone	100 Hz to 200 Hz
	COM/ID tone	0.1 Hz to 20 kHz
Setting resolution	90 Hz tone	0.3 Hz
	150 Hz tone	0.5 Hz
	COM/ID tone	0.1 Hz
External AM tone	input connectors at front	I and Q
Modulation depth	sum of modulation depths of 90 Hz, 150 Hz, COM/ID and external AM signal must not exceed 100 %	
Setting range	SDM of 90 Hz, 150 Hz, COM/ID tone	0 % to 100 %
	ILS-LOC default setting	40 %
	ILS-GS default setting	80 %
Setting resolution	SDM and COM/ID depth	0.1 %
AM depth error	SDM = 40 %	< 1.3 % AM depth (meas.)
	SDM = 80 %	< 0.8 % AM depth (meas.)
	SDM full range	< 1.3 % AM depth (meas.)
	COM/ID, tone = 1020 Hz	< 0.5 % AM depth (meas.)
External AM tone	sensitivity	0.01 V/%
Difference in depth of modulation (DDM)		
Setting range		0 to ±SDM
Setting resolution		0.0001
Error	SDM = 20 %	< 0.03 % AM depth (meas.)
	SDM = 40 %	< 0.01 % AM depth (meas.)
	SDM = 60 %	< 0.03 % AM depth (meas.)
	SDM = 80 %	< 0.03 % AM depth (meas.)
	SDM = 100 %	< 0.03 % AM depth (meas.)
ILS phase		
Setting range		0° to 120°
Setting resolution		0.01°
Error		< 0.2°(meas.)
Marker beacon modulation tones		
Marker frequencies		400 Hz, 1300 Hz, 3000 Hz
COM/ID tone frequency setting range		0.1 Hz to 20 kHz
COM/ID tone frequency setting resolution		0.1 Hz
Marker beacon modulation depth	sum of modulation depths of marker tone and COM/ID signal must not exceed 100 %	
AM depth		
Setting range		0 % to 100 %
	marker tone default setting	95 %
Setting resolution		0.1 %
Error	marker tone	< 0.5 % AM depth
	COM/ID, tone = 1020 Hz	< 0.5 % AM depth (meas.)

VOR modulation (R&S®SMBVB-K152 option)

Attenuator mode: low distortion, level (PEP) within 0 dBm to -70 dBm. VOR specification valid for carrier frequency range from 108 MHz to 118 MHz.

VOR operating modes	generation of VOR signal	NORM
	30 Hz VAR tone	VAR
	9.96 kHz carrier, unmodulated	subcarrier
	9.96 kHz carrier, modulated	subcarrier + FM
Modulation tones		
Frequency		
Error	30 Hz (VAR, REF)	< 0.003 Hz (meas.)
Setting range	30 Hz REF	10 Hz to 60 Hz
	9.96 kHz FM carrier	5 kHz to 15 kHz
	COM/ID tone	0.1 Hz to 20 kHz
Setting resolution		0.1 Hz
FM deviation		
Setting range	9.96 kHz FM carrier	0 Hz to 960 Hz
Setting resolution	9.96 kHz FM carrier	1 Hz
Error	9.96 kHz FM carrier at 480 Hz deviation	< 0.5 Hz (meas.)
External AM tone	input connectors at front	I and Q
Modulation depth	sum of modulation depths of 30 Hz (VAR) signal, 9.96 kHz FM carrier, COM/ID and external AM signal must not exceed 100 %	
AM depth		
Setting range		0 % to 100 %
Setting resolution		0.1 %
Error	30 Hz (VAR, REF), 30 % AM depth	< 0.5 % AM depth (meas.)
	30 Hz (VAR, REF), AM depth: whole range	< 0.8 % AM depth (meas.)
	9.96 kHz FM carrier, 30 % AM depth	< 0.2 % AM depth (meas.)
	9.96 kHz FM carrier, AM depth: whole range	< 1 % AM depth (meas.)
	COM/ID, tone = 1020 Hz	< 0.3 % AM depth (meas.)
External AM tone	sensitivity	0.01 V/%
Bearing angle		
Setting range		0° to 360°
	default setting	0.00°
Setting resolution		0.01°
Error		< 0.05° (meas.)

DME modulation (R&S®SMBVB-K153 option)

Specifications valid for carrier frequency range from 960 MHz to 1215 MHz, attenuator mode: auto, ALC state: auto, level (PEP) within specified level range and DME default settings.

DME operating modes	DME/N	DME interrogation DME reply
DME channel		X, Y
Single pulse	generation of a single pulse instead of a pulse pair	on/off
Squitter pulses	randomly distributed pulse repetition rate, in line with EUROCAE ED-54	on/off
Level error	attenuator mode: auto, temperature range: +18 °C to +33 °C	
	pulse peak power uncertainty	< 0.8 dB
	pulse-to-pulse level difference	< 0.2 dB, < 0.1 dB (typ.)
On/off ratio		> 50 dB (meas.)
Pulse		
Shaping	shape for rising and falling edge	cos ²
	shape for rising edge; shape for falling edge	cos; cos ²
	linear shape for rising and falling edge	linear
	gauss shaped for rising and falling edge	gauss
Rise/fall time setting range	10 %/90 % of RF amplitude	0.5 µs to 20 µs
Width setting range	50 %/50 % of RF amplitude	1 µs to 100 µs
Spacing setting range	50 %/50 % of RF amplitude	1 µs to 100 µs
Parameter setting resolution	rise/fall time, pulse width, pulse spacing	0.01 µs
Rise/fall time error		< 0.05 µs (meas.)
Width error		< 0.05 µs (meas.)
Spacing error		< 0.05 µs (meas.)
Repetition rate setting rate	squitter off	10 pp/s to 6000 pp/s
	squitter on (mean pulse repetition rate)	10 pp/s to 6000 pp/s (nom.)
Repetition setting resolution	squitter off	1 pp/s
	squitter on (mean pulse repetition rate)	100 pp/s
Efficiency setting range		0 % to 100 %
Efficiency setting resolution		1 %
Range distance setting range		-2 NM to 400 NM
Range distance setting resolution		0.01 NM
Propagation simulation, only in DME reply mode		
Echo simulation	state	on (when squitter pulses are off), off
	delay	pulse width + pulse spacing + 0.5 × pulse rise time to 204 µs
	attenuation	0 dB to 50 dB
Velocity simulation	doppler offset due to movement (velocity)	-10000 kn to 10000 kn, when echo simulation is off, else 0 kn
Flight Simulation	straight line movement simulation via startpoint, endpoint and velocity	
	start distance	-400 NM to 400 NM
	stop distance	-400 NM to 400 NM
	controls	start/restart/stop/pause
Identification pulses, only in DME reply mode		
ID code		user-selectable four-character code
ID rate setting range		100 pp/s to 10000 pp/s
ID period setting range		10 s to 120 s
ID dot, dash, symbol space and letter space length setting range		50 ms to 500 ms
Monitor output	output connectors at back	I and Q
DME analysis		
Peak level range		-10 dBm to 20 dBm
Reply delay range		0 µs to 300 µs
Reply efficiency range		0 % to 100 %
Pulse repetition rate range		2 Hz to 10 kHz

Ordering information

R&S®SMBV100B

R&S®SMBVB-Bxxx = hardware option, R&S®SMBVB-Kxxx = software/key code option

Designation	Type	Order No.
Vector signal generator, including baseband generator with ARB (64 Msample, 120 MHz RF bandwidth), power cable and quick start guide	R&S®SMBV100B	1423.1003.02
Minimum instrument configuration for GNSS		
Frequency option, 8 kHz to 3 GHz	R&S®SMBVB-B103	1423.6270.02
Real-time extension	R&S®SMBVB-K520	1423.7676.02
Additional configuration options for GNSS		
Phase coherence	R&S®SMBVB-K90	1423.7601.02
Additive white Gaussian noise (AWGN)	R&S®SMBVB-K62	1423.7876.02
Software options for GNSS		
GPS	R&S®SMBVB-K44	1423.7753.02
Modernized GPS	R&S®SMBVB-K98	1423.7960.02
Galileo	R&S®SMBVB-K66	1423.7882.02
GLONASS	R&S®SMBVB-K94	1423.7953.02
NavIC/IRNSS	R&S®SMBVB-K97	1423.8708.02
BeiDou	R&S®SMBVB-K107	1423.7999.02
Modernized BeiDou	R&S®SMBVB-K132	1423.8789.02
SBAS/QZSS	R&S®SMBVB-K106	1423.7982.02
Real-world scenarios	R&S®SMBVB-K108	1423.8008.02
Real-time GNSS interfaces	R&S®SMBVB-K109	1423.8014.02
Virtual RTK reference station	R&S®SMBVB-K122	1423.8914.02
Modernized GLONASS	R&S®SMBVB-K123	1423.9104.02
Matched-spectrum GNSS interference test	R&S®SMBVB-K129	1423.9362.02
Single-satellite GNSS	R&S®SMBVB-K133	1423.8743.02
Upgrade to dual-frequency GNSS	R&S®SMBVB-K134	1423.8750.02
Upgrade to triple-frequency GNSS	R&S®SMBVB-K135	1423.8766.02
Add 6 GNSS channels	R&S®SMBVB-K136	1423.8772.02
Add 12 GNSS channels	R&S®SMBVB-K137	1423.8795.02
GNSS waveforms, generated by R&S®WinIQSIM2		
GPS	R&S®SMBVB-K244	1423.8195.02
NavIC/IRNSS, 1 satellite	R&S®SMBVB-K297	1423.8695.02
Modernized GPS	R&S®SMBVB-K298	1423.8408.02
Galileo	R&S®SMBVB-K266	1423.8320.02
GLONASS	R&S®SMBVB-K294	1423.8395.02
BeiDou	R&S®SMBVB-K407	1423.8489.02
Modernized GLONASS	R&S®SMBVB-K423	1423.9110.02
Modernized BeiDou	R&S®SMBVB-K432	1423.8837.02
GNSS test automation		
ERA-GLONASS test suite	R&S®SMBVB-K360	1423.8650.02
eCall test suite	R&S®SMBVB-K361	1423.8666.02
GNSS test suite	R&S®SMBVB-K362	1423.8672.02
Car navigation test suite	R&S®SMBVB-K363	1423.9285.02
China national GNSS test standard	R&S®SMBVB-K364	1423.9356.02
Avionics options		
GBAS	R&S®SMBVB-K111	1423.8020.02
ILS	R&S®SMBVB-K151	1423.8120.02
VOR	R&S®SMBVB-K152	1423.8137.02
DME	R&S®SMBVB-K153	1423.8143.02
Recommended extras		
19" rack adapter	R&S®ZZA-KNA33	1177.8090.00
USB serial adapter, for RS-232 remote control	R&S®TS-USB1	6124.2531.00

R&S®SMW200A

R&S®SMW-Bxxx = hardware option, R&S®SMW-Kxxx = software/key code option

Designation	Type	Order No.
Vector signal generator, including power cable and quick start guide	R&S®SMW200A	1412.0000.02
Minimum hardware configuration for GNSS		
Frequency option, RF path A, 100 kHz to 3 GHz	R&S®SMW-B1003	1428.4700.02
Signal routing and baseband main module, one I/Q path to RF	R&S®SMW-B13	1413.2807.02
Baseband generator with ARB (64 Msample) and real-time coder, 120 MHz RF bandwidth	R&S®SMW-B10	1413.1200.02
Recommended hardware configuration for multifrequency GNSS		
Frequency option, RF path A, 100 kHz to 3 GHz	R&S®SMW-B1003	1428.4700.02
Signal routing and wideband baseband main module, two I/Q paths to RF	R&S®SMW-B13XT	1413.8005.02
Wideband baseband generator, with ARB (256 Msample), 500 MHz RF bandwidth	R&S®SMW-B9	1413.7350.02
Additional configuration option for GNSS		
Wideband baseband generator with ARB (256 Msample), 500 MHz RF bandwidth, high signal dynamics	R&S®SMW-B9(F)	1434.7808.02
Additional GNSS coder board	R&S®SMW-B15	1414.4710.02
Phase coherence	R&S®SMW-B90	1413.5841.02
Additive white Gaussian noise (AWGN)	R&S®SMW-K62	1413.3484.02
Multiple entities, for coexistence tests, only in combination with R&S®SMW-B10(F)	R&S®SMW-K76	1413.9624.02
Software options for GNSS		
GPS	R&S®SMW-K44	1413.3832.02
Modernized GPS	R&S®SMW-K98	1414.1533.02
Galileo	R&S®SMW-K66	1413.4380.02
GLONASS	R&S®SMW-K94	1414.1485.02
NavIC/IRNSS	R&S®SMW-K97	1414.6258.02
BeiDou	R&S®SMW-K107	1414.1585.02
Modernized GLONASS	R&S®SMW-K123	1413.3310.02
Modernized BeiDou	R&S®SMW-K132	1414.6606.02
SBAS/QZSS	R&S®SMW-K106	1414.2923.02
Real-world scenarios	R&S®SMW-K108	1414.2975.02
Real-time GNSS interfaces	R&S®SMW-K109	1414.3013.02
Virtual RTK reference station	R&S®SMW-K122	1414.6993.02
P(Y)/M/PRS noise	R&S®SMW-K128	1413.3361.02
Matched-spectrum GNSS interference test	R&S®SMW-K129	1434.8410.02
Upgrade to dual-frequency GNSS	R&S®SMW-K134	1414.6770.02
Upgrade to triple-frequency GNSS	R&S®SMW-K135	1414.6793.02
Add 6 GNSS channels	R&S®SMW-K136	1414.6812.02
Add 12 GNSS channels	R&S®SMW-K137	1414.6835.02
Add 24 GNSS channels	R&S®SMW-K138	1414.6858.02
Add 48 GNSS channels	R&S®SMW-K139	1414.6935.02
GNSS waveforms, generated by R&S®WinIQSIM2		
GPS	R&S®SMW-K244	1413.4880.02
NavIC/IRNSS	R&S®SMW-K297	1414.6287.02
Modernized GPS	R&S®SMW-K298	1414.3171.02
Galileo	R&S®SMW-K266	1413.7015.02
GLONASS	R&S®SMW-K294	1413.7067.02
BeiDou	R&S®SMW-K407	1413.7115.02
Modernized GLONASS	R&S®SMW-K423	1413.3410.02
Modernized BeiDou	R&S®SMW-K432	1414.6629.02
GNSS test automation		
ERA-GLONASS test suite	R&S®SMW-K360	1414.2800.02
eCall test suite	R&S®SMW-K361	1414.2846.02
GNSS test suite	R&S®SMW-K362	1414.6406.02
Car navigation test suite	R&S®SMW-K363	1434.8179.02
Avionics options		
GBAS	R&S®SMW-K111	1414.3059.02

R&S®SMM100A

Designation	Type	Order No.
GPS, 1 satellite	R&S®SMM-K244	1441.1699.02
Galileo, 1 satellite	R&S®SMM-K266	1441.1547.02
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
Modernized GLONASS, 1 satellite	R&S®SMM-K423	1441.0928.02
Modernized BeiDou, 1 satellite	R&S®SMM-K432	1441.1176.02

R&S®SMCV100B

Designation	Type	Order No.
GPS, 1 satellite	R&S®SMCVB-K244	1434.4215.02
Galileo, 1 satellite	R&S®SMCVB-K266	1434.4450.02
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
Modernized GLONASS, 1 satellite	R&S®SMCVB-K423	1434.5911.02
Modernized BeiDou, 1 satellite	R&S®SMCVB-K432	1434.5740.02
Waveform libraries (available for download at customer web)		
GPS predefined waveforms	R&S®SMCVB-KV50	1434.5770.02
Galileo predefined waveforms	R&S®SMCVB-KV51	1434.5792.02
GLONASS predefined waveforms	R&S®SMCVB-KV52	1434.5811.02
BeiDou predefined waveforms	R&S®SMCVB-KV53	1434.5834.02

R&S®SGT100A

Designation	Type	Order No.
GPS, 1 satellite	R&S®SGT-K244	1419.6104.02
Galileo, 1 satellite	R&S®SGT-K266	1419.7000.02
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
BeiDou 1, satellite	R&S®SGT-K407	1419.7452.02
Modernized GLONASS, 1 satellite	R&S®SGT-K423	1426.3407.02
Modernized BeiDou, 1 satellite	R&S®SGT-K432	1426.3394.02

R&S®CMW500/CMW 270/CMW 100

Designation	Type	Order No.
GPS	R&S®CMW-KW620	1203.6008.02
GLONASS	R&S®CMW-KW621	1207.8305.02
Galileo	R&S®CMW-KW622	1207.8357.02
BeiDou	R&S®CMW-KW623	1208.8280.02

R&S®CMA180

Designation	Type	Order No.
GPS	R&S®CMA-KW620	1209.6222.02
GLONASS	R&S®CMA-KW621	1209.6245.02
Galileo	R&S®CMA-KW622	1209.6268.02
Recommended extras		
19" rack adapter	R&S®ZZA-KN4	1175.3033.00
Cable, for connecting Rohde & Schwarz digital baseband interfaces	R&S®SMU-Z6	1415.0201.02
USB serial adapter, for RS-232 remote control	R&S®TS-USB1	6124.2531.00

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