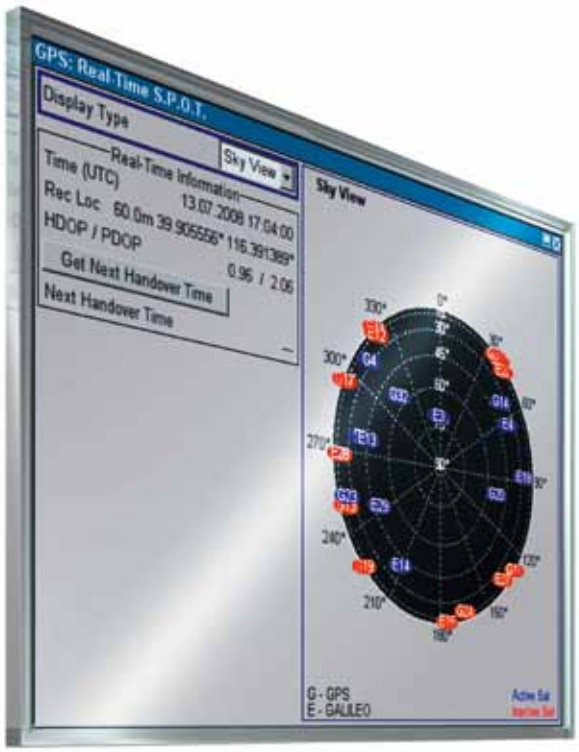
GNSS for the R&S®SMBV100A Vector Signal Generator

The new reference in satellite simulation

Product Brochure | 02.00

Now with

Glonass and GPS P code



ROHDE&SCHWARZ

GNSS for the R&S®SMBV100A Vector Signal Generator

At a glance

Whether in the R&D lab or in production, the global navigation satellite system (GNSS) solution for the R&S®SMBV100A sets new standards in the field of satellite simulation. It supports all possible scenarios, from simple setups with individual, static satellites all the way to flexible scenarios generated in realtime with up to 12 dynamic GPS (C/A and P code), Glonass and Galileo satellites.

A number of standard tests are available for characterizing the performance of a GNSS receiver, e.g. time to first fix (TTFF) and location accuracy. Test runs often include an entire series of tests, each with a different scenario. Therefore, satellite simulators that allow users to simulate a wide variety of scenarios are ideal for this purpose.

This is where the flexibility of the GNSS solution for the R&S®SMBV100A stands out: Only a few keystrokes are needed to generate complex scenarios, unlimited in time, with up to 12 satellites – including hybrid GPS, Glonass and Galileo constellations. Users can select the almanac file as well as the geographic position, and both stationary positions and moving scenarios that simulate the movement of receivers along any custom route are possible. The signal strength of individual satellites can be controlled in realtime in order to simulate conditions of restricted satellite visibility. The GNSS functionality provided by the R&S®SMBV100A also includes the ability to simulate realistic transmission conditions through the use of multipath signal generation and modeling of various atmospheric effects.

The versatility of the R&S®SMBV100A is especially beneficial to mobile phone and car infotainment system manufacturers that integrate GNSS modules in their products, as it allows them to test a range of functions with a single instrument. This is possible because, in addition to GNSS signals, the R&S®SMBV100A also generates communications signals conforming to all conventional standards such as LTE, HSPA+ and WiMAX™ as well as signals for digital radio standards such as DAB, XM Radio or Sirius.

Key facts

- Support of GPS L1/L2 (C/A and P code), Glonass L1/L2 and Galileo E1, including hybrid constellations
- Simulation of realistic constellations with up to 12 satellites in realtime (no precalculated waveforms)
- Flexible scenario generation including moving scenarios (import of NMEA waypoints), multipath, dynamic power control and atmospheric modeling without the need for additional software tools
- Unlimited simulation time with automatic, on-the-fly exchange of satellites
- User mode for full flexibility to select the satellites and to define the navigation data (import of RINEX files)
- Support of predefined as well as user-defined A-GPS (Assisted GPS) test scenarios, including generation of assistance data
- Support of digital communications standards (GSM, WCDMA, HSPA+, LTE, WiMAX™, WLAN, etc.) and radio standards (DAB, Sirius|XM Satellite Radio, HD Radio™, FM stereo) in the same instrument

GNSS for the R&S®SMBV100A Vector Signal Generator

Benefits and key features

GNSS receiver tests made easy

- Flexible scenario generation facilitates receiver testing
- Faster testing with GNSS signal generation in realtime
- Unlimited simulation time with automatic, on-the-fly exchange of satellites
- Receiver testing under real-world conditions
- Support of Assisted GPS (A-GPS) test cases
- Support of GPS P code

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Customized solutions through flexible options

- Instrument configuration tailored to customer needs
- Ready for other GNSS standards
- Ideal for production and R&D alike

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GNSS simulation plus multifaceted vector signal generation

- Support of all important, state-of-the-art digital standards
- Customized internal signal generation
- High performance for all types of applications

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GNSS receiver tests made easy

Whether measuring TTFF, location accuracy, reacquisition time, or sensitivity: With the GNSS simulator solution in the R&S®SMBV100A, the performance of receivers is quickly and easily characterized.

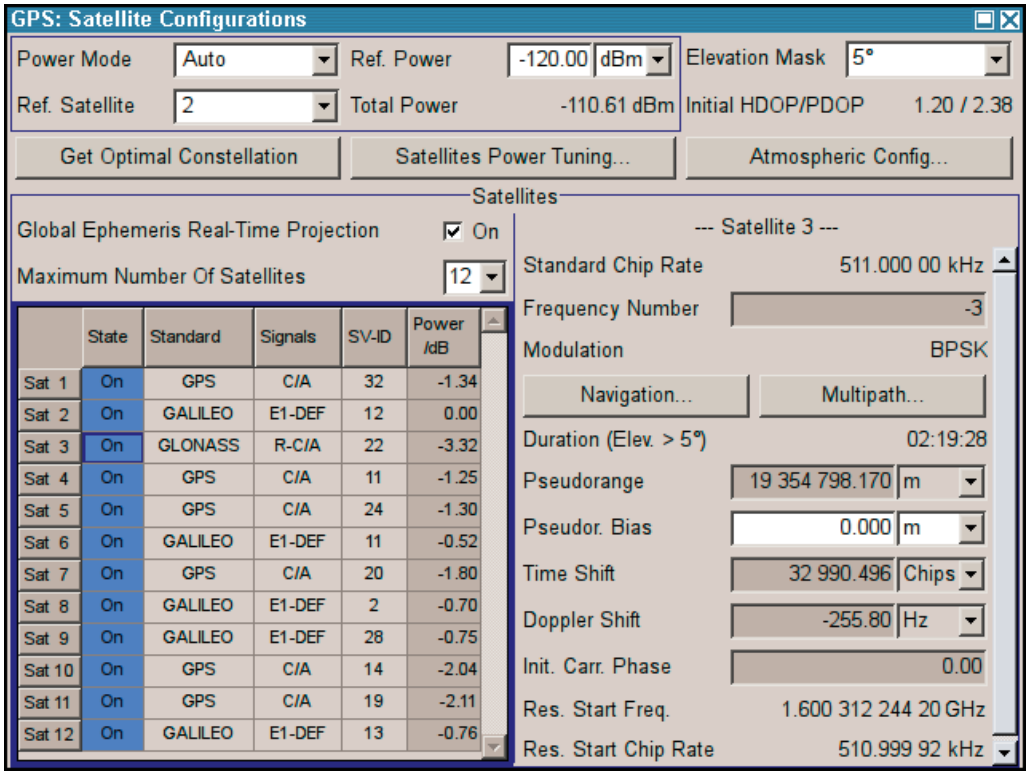
Flexible scenario generation facilitates receiver testing

A number of standard tests are available for characterizing the performance of a GNSS receiver, including TTFF, location accuracy and sensitivity. Entire test series are usually required before statistically solid statements can be made about the characteristics of a receiver. Each test in the series can have a different scenario, i.e. different conditions under which the test takes place. For example, the number of visible satellites or the satellite signal strength can be varied in order to simulate scenarios where satellite visibility is restricted. Even the geographic position can be changed from test to test. While one scenario is based on a stationary position, another might be based on movement along a defined route (moving scenario).

Many GNSS simulators offer users only a defined number of precalculated scenarios for playback. But this usually does not meet the requirements and conditions described above. In contrast, the R&S®SMBV100A allows users to generate unlimited customized scenarios, making it easy to perform receiver tests under varying conditions.

Only a few keystrokes are needed in the R&S®SMBV100A user interface to generate complex scenarios with up to 12 satellites. In the future, multistandard receivers will continue to increase in importance. This is why the R&S®SMBV100A was designed to simultaneously generate GPS, Glonass and Galileo signals in hybrid constellations.

The R&S®SMBV100A simulates the movement of satellites in orbits according to a real almanac file containing actual Doppler shifts and real navigation data. Any SEM or YUMA almanac file can be loaded into the R&S®SMBV100A for this purpose. The user can define any start time or date as well as any geographic position for either a stationary or a moving scenario. A moving scenario can be defined as any route, such as a drive through downtown Rome. The path trajectory is specified either with a simple txt file or by importing NMEA files.



The R&S®SMBV100A generates hybrid GPS, Glonass and Galileo satellite constellations with minimum position dilution of precision (PDOP).

Faster testing with GNSS signal generation in realtime

While other GNSS simulators in this performance and price category can merely play back precalculated signals, the R&S®SMBV100A actually generates signals in realtime. All parameters can be set internally in the instrument, effectively eliminating the need for time-intensive recalculation of the signal using external PC software. As a result, users can change settings on the fly, which allows them to quickly and easily test the performance of a receiver under varying conditions.

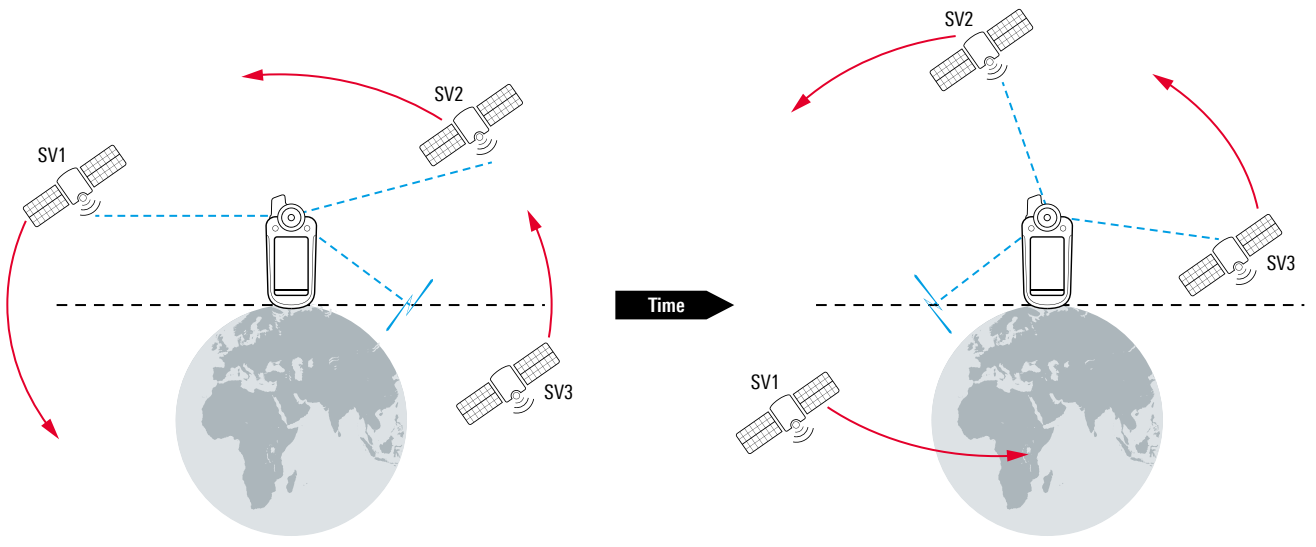
Unlimited simulation time with automatic, on-the-fly exchange of satellites

Some receiver tests require particularly long simulation times – for example, a moving scenario that simulates a drive from Frankfurt to Munich, or a stationary scenario that runs over several hours or even days in order to characterize the long-term stability of the receiver.

In Auto Localization mode, the R&S®SMBV100A dynamically exchanges the satellites so that the GNSS signal remains valid for as long as needed. This simulates the behavior of GNSS receivers which evaluate only those signals that originate from satellites at a specific minimum elevation above the horizon. Satellites move in orbits around the earth which means that over time some satellites drop below the horizon from the standpoint of the receiver while others rise into view.

The R&S®SMBV100A continually calculates the time of the next satellite handover based on two criteria. The first is the visibility of the satellites above the horizon. The user can set this parameter via the elevation mask. The second criterion is the geometrically optimum satellite constellation with minimum position dilution of precision (PDOP).

From the receiver standpoint, some satellites drop below the horizon, while others rise into view



Receiver testing under real-world conditions

To create real-world conditions, it is not sufficient to generate ideal GNSS satellite signals. Interferences such as multipath propagation, atmospheric effects, and shadowing make it necessary to test the behavior of the receiver under non-ideal transmission conditions.

Satellite signals reach the receiver via the direct, line-of-sight path, and often via additional paths when they are reflected off obstacles such as buildings or mountains. These reflected signals are delayed compared to the direct path and have different attenuations. To test the performance of receivers under these conditions, the R&S®SMBV100A can generate separate multipath scenarios for each satellite.

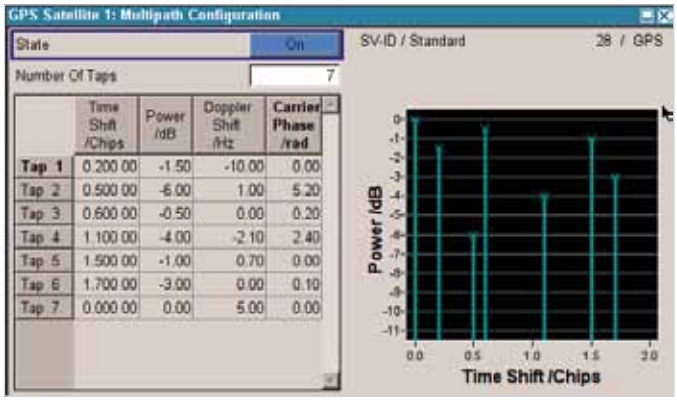
The R&S®SMBV100A is able to simulate atmospheric effects that affect receivers and could lead to decreased accuracy when fixing a position. And it can also simulate reduced satellite visibility, as can occur in street canyons or when driving through a tunnel. The R&S®SMBV100A controls the signal strength of individual satellites in real-time in order to determine the reacquisition time of a receiver. It is even possible to switch some satellites off and back on again to emulate scenarios in which the signal is interrupted for short periods of time.

The R&S®SMBV100A includes an optional AWGN generator that makes it possible to superimpose noise on the GNSS signals.

Support of Assisted GPS (A-GPS) test cases

Many modern mobile phones are equipped with A-GPS functionality. To allow the integrated GPS receiver to get a faster position fix when it is turned on, A-GPS capable mobile phones retrieve their navigation data simultaneously from the satellite and from the mobile radio network, which is much faster. This can reduce the TTFF from a worst case of several minutes to just a few seconds. This speed advantage is utilized for emergency functions, for example.

To simulate multipath propagation, such as occurs in street canyons, the R&S®SMBV100A supports separate multipath scenarios for each satellite.



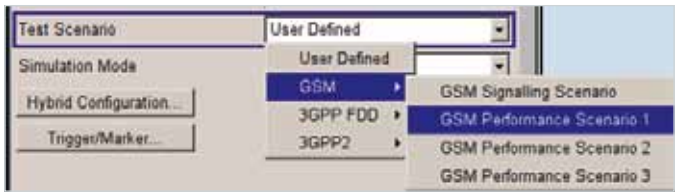
The R&S®SMBV100A supports all GPS scenarios for A-GPS test cases currently defined for GSM, 3GPP FDD, and 3GPP2 (CDMA2000®). All necessary settings in the generator are made automatically. In addition to these predefined scenarios, custom scenarios can also be generated for user-defined A-GPS test cases. In both cases, the associated assistance data can be generated at the push of a button. The assistance data contains all navigation data needed by the A-GPS capable mobile phone for faster position fixing. In reality, nearby base stations transfer the assistance data to the mobile phone. This is why a complete A-GPS test setup includes the satellite simulator plus a radiocommunications tester like the R&S®CMW500 for simulating the role of the mobile radio network. The assistance data generated by the R&S®SMBV100A can be transmitted to the radiocommunications tester, so that it can in turn be made available to the DUT via a mobile radio connection.

Support of GPS P code

Many applications, especially US military applications require the precision code in addition to the coarse/acquisition code (C/A) commercially used in GPS receivers. The P code uses a higher sampling rate, which significantly improves localization accuracy.

The R&S®SMBV100A supports up to 8 satellites generating both the C/A and the P code signal. The generator automatically makes the necessary settings for the different rates. All receiver tests in all modes, such as user and auto localization, as well as moving receiver tests are fully supported in conjunction with P code simulation. The R&S®SMBV100A also supports pure P code signals for testing the different sections of military GPS receivers.

All currently defined GPS scenarios for A-GPS test cases are implemented in the R&S®SMBV100A.



Customized solutions through flexible options

6 or 12 satellites? GPS, Glonass and/or Galileo? GPS C/A code or P code? With or without moving scenarios? The GNSS solution for the R&S®SMBV100A makes it possible: Users can completely customize their solution.

Instrument configuration tailored to customer needs

Users of the R&S®SMBV100A don't have to pay for features that they might never use. The instrument configuration can be expanded to include specific features as test requirements change. Because additional functionality is released via software license keys, there are no downtimes for time-consuming hardware installations. Users can continue working without interruption.

Ready for other GNSS standards

The market for GNSS has risen steadily over the last few years. The variety of supported satellite systems and applications continues to grow.

To take this development into account, the R&S®SMBV100A is ready to support other satellite standards above and beyond GPS, Glonass and Galileo. This is made possible by the powerful R&S®SMBV100A hardware platform coupled with the very generic software architecture of the GNSS solution, making the R&S®SMBV100A a very safe investment for the future.

Ideal for production and R&D alike

The flexible GNSS options allow the R&S®SMBV100A to be configured differently so that it can be used both in production and in the R&D lab. Users don't have to learn to work with a number of different solutions; the remote control commands are the same. This makes work easier and ensures reproducible measurements.

One test frequently performed on GNSS receivers during production is the sensitivity test. This test determines whether the minimum level is sufficient for a receiver to recognize a static satellite signal.

The GPS, Glonass and the Galileo base options (R&S®SMBV-K44, R&S®SMBV-K94 and R&S®SMBV-K66) already support a number of R&D applications. For example, when integrating GNSS modules into mobile phones, these options allow complete receiver tests, such as TTFF (under cold, warm, or hot start conditions), location accuracy, and reacquisition time, with up to 6 dynamic satellites. Installing the GPS, Glonass and/or Galileo base options together in a single instrument permits hybrid constellations with up to 6 satellites for easily carrying out tests on multistandard receivers.

By adding the R&S®SMBV-K92 software option, the existing solution can be expanded to handle the above tests in a moving scenario instead of a static scenario, or to perform the tests under less-than-ideal transmission conditions (multipath). The R&S®SMBV-K91 software option allows the number of satellites to be increased up to 12.

GNSS simulation plus multifaceted vector signal generation

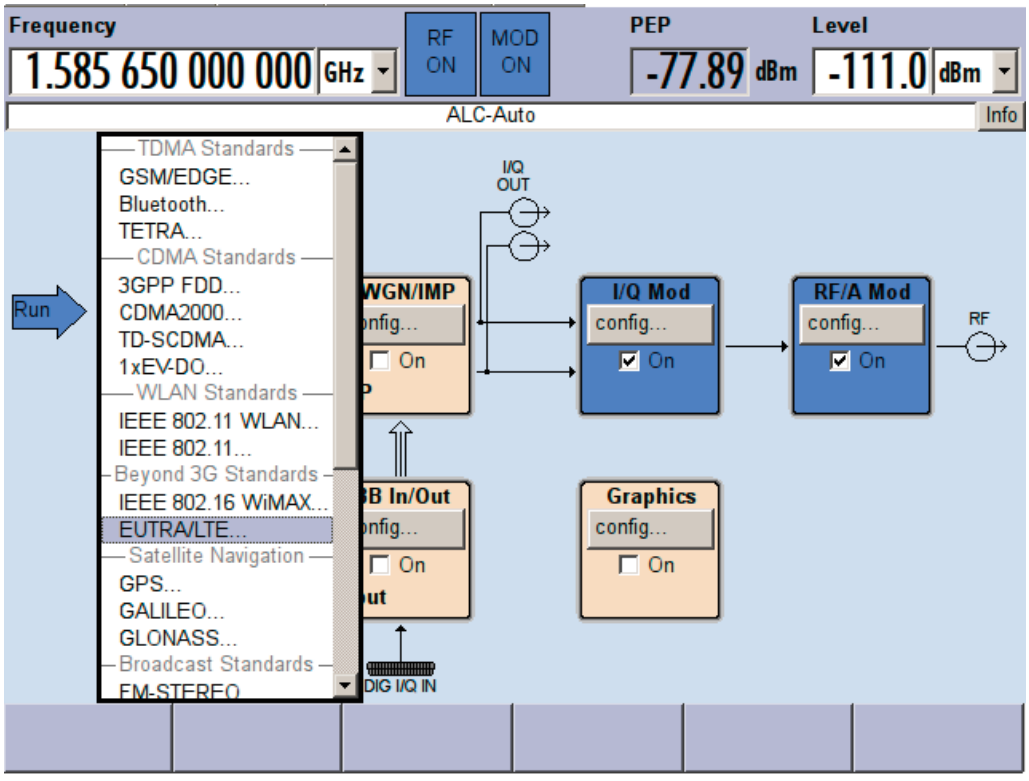
The R&S®SMBV100A is not just a satellite simulator, it is also a flexible vector signal generator with outstanding RF performance. This makes it possible for manufacturers of mobile phones or car infotainment systems to test both the main functionality of their products as well as the GNSS functionality with a single instrument.

Support of all important, state-of-the-art digital standards

Manufacturers who integrate GNSS modules into mobile phones or car infotainment systems have to test GNSS functionality in addition to their product's main functionality. Even increasing numbers of chips in GNSS standalone devices are being designed to handle multiple standards. At the very least, they often support Wi-Fi and Bluetooth® for updating maps or swapping route data.

This is where users profit in particular from the versatility of the R&S®SMBV100A. It allows them to test a range of functions with a single instrument because, in addition to GNSS signals, the R&S®SMBV100A can optionally generate standard-compliant signals for all significant digital communications standards (LTE, HSPA+, WCDMA, WiMAX™, GSM, WLAN) and radio standards (DAB, Sirius|XM Satellite Radio, HD Radio™). With the internal baseband generator (R&S®SMBV-B10), all settings can be made directly on the instrument with no external software. This is particularly advantageous in R&D applications where users need quick access to parameters without time-intensive recalculation of waveforms.

The R&S®SMBV100A can also play back precalculated signals, which are often used in production applications. For all of the standards listed above, the external R&S®WinIQSIM2™ software provides options that allow standard-compliant waveforms to be generated with only a few keystrokes.



The R&S®SMBV100A optionally supports a number of digital communications standards and analog/digital radio standards.

Customized internal signal generation

In addition to signal generation in accordance with digital standards, the baseband generator (R&S®SMBV-B10) provided by the R&S®SMBV100A also generates user-defined, digitally modulated signals. Again, signals can be generated either in realtime directly in the instrument, or they can be generated as a precalculated waveform using the R&S®WinIQSIM2™ software. In the integrated ARB, the R&S®SMBV100A can also play back proprietary signals and special test vectors (e.g. generated with MATLAB®).

High performance for all types of applications

In addition to its flexibility with respect to signal generation, the R&S®SMBV100A also offers excellent RF performance, which is a prerequisite for pure signals and reproducible measurements.

For example, a key parameter for RF quality is SSB phase noise. This parameter is important for CW applications as well as for digital signals because it directly affects the error vector magnitude (EVM). The R&S®SMBV100A not only exhibits excellent SSB phase noise, it also boasts outstanding values for harmonic and non-harmonic suppression, which is also a significant factor in the quality of GNSS signals.

When testing GNSS receivers, one key parameter is the level range of the generator. This range must support the low levels required for sensitivity tests which determine the minimum level at which a receiver can get or maintain a position fix. The R&S®SMBV100A allows a level of down to –145 dBm to be set with a resolution of 0.01 dB. This high resolution is needed to determine the sensitivity of the receiver as precisely as possible. The R&S®SMBV100A also offers excellent level accuracy for ensuring the reproducibility of the measurement results.

On the other hand, a powerful signal generator like the R&S®SMBV100A should also exhibit a sufficiently high output power for general applications, such as component tests. This makes it possible to compensate for loss between the generator and the DUT resulting from complex test setups (cables, switches, couplers, etc.) without having to use an external amplifier. As standard, the R&S®SMBV100A offers a specified output power of +18 dBm (PEP), and of more than +24 dBm in overrange.

GNSS options – overview in brief

The R&S®SMBV100A offers options related to the GNSS standard, such as the R&S®SMBV-K44 GPS base option and the R&S®SMBV-K66 Galileo base option, as well as standard-independent options that provide receiver-related features. An example is the R&S®SMBV-K91 option which does not change the features of an individual satellite, but rather increases to 12 the number of GNSS satellites that can be simulated.

The following is a detailed overview of the available options and the functionality they provide.

GPS (R&S®SMBV-K44 option)

- Simulation of up to 6 GPS satellites with C/A code at frequencies L1 and L2
- Static mode and localization mode
- User-definable almanac file (SEM/YUMA) with real navigation data
- User-definable location and start time
- Automatic setup of GPS scenario with optimum satellite constellation
- Unlimited simulation time with automatic, on-the-fly exchange of satellites based on configurable elevation masks
- Dynamic power control of individual satellites in realtime
- Hybrid GPS and Galileo satellite constellations with up to 6 satellites (requires additional R&S®SMBV-K66 Galileo option and/or R&S®SMBV-K94 Glonass option)

Assisted GPS (R&S®SMBV-K65 option)

- Support of predefined and user-defined A-GPS test scenarios
- Generation of A-GPS assistance data for predefined and user-defined scenarios
- Full user-defined configuration of the navigation message (manually or via import of RINEX ephemeris files)
- Requires the R&S®SMBV-K44 option

GPS P code (R&S®SMBV-K93 option)

- Simulation of up to 6 GPS satellites with P codes or combined civilian C/A and military P codes
- Requires the R&S®SMBV-K44 option
- Static mode and localization mode
- User-definable almanac file (SEM/YUMA) with real navigation data
- User-definable location and start time
- Automatic setup of GPS scenarios with optimum satellite constellation
- Unlimited simulation time with automatic, on-the-fly exchange of satellites based on configurable elevation masks
- Dynamic power control of individual satellites in realtime
- Hybrid GNSS satellite constellations with up to 6 satellites (requires additional R&S®SMBV-K66 Galileo option and/or R&S®SMBV-K94 Glonass option)

Galileo (R&S®SMBV-K66 option)

- Simulation of up to 6 Galileo satellites at frequency E1
- Static mode and localization mode
- User-definable almanac file (SEM/YUMA) with real navigation data
- User-definable location and start time
- Automatic setup of Galileo scenario with optimum satellite constellation
- Unlimited simulation time with automatic, on-the-fly exchange of satellites based on configurable elevation masks
- Dynamic power control of individual satellites in realtime
- Hybrid GPS and Galileo satellite constellations with up to 6 satellites (requires additional R&S®SMBV-K66 Galileo option and/or R&S®SMBV-K94 Glonass option)

Glonass (R&S®SMBV-K94 option)

- Simulation of up to 6 Glonass satellites (FDMA) with civilian codes at frequencies L1 and L2
- Static mode and localization mode
- User-definable almanac file (.agl) with real navigation data
- User-definable location and start time
- Automatic setup of Glonass scenario with optimum satellite constellation
- Unlimited simulation time with automatic, on-the-fly exchange of satellites based on configurable elevation masks
- Dynamic power control of individual satellites in realtime
- Hybrid GNSS satellite constellations with up to 6 satellites (requires additional R&S®SMBV-K66 Galileo option and/or R&S®SMBV-K94 Glonass option)

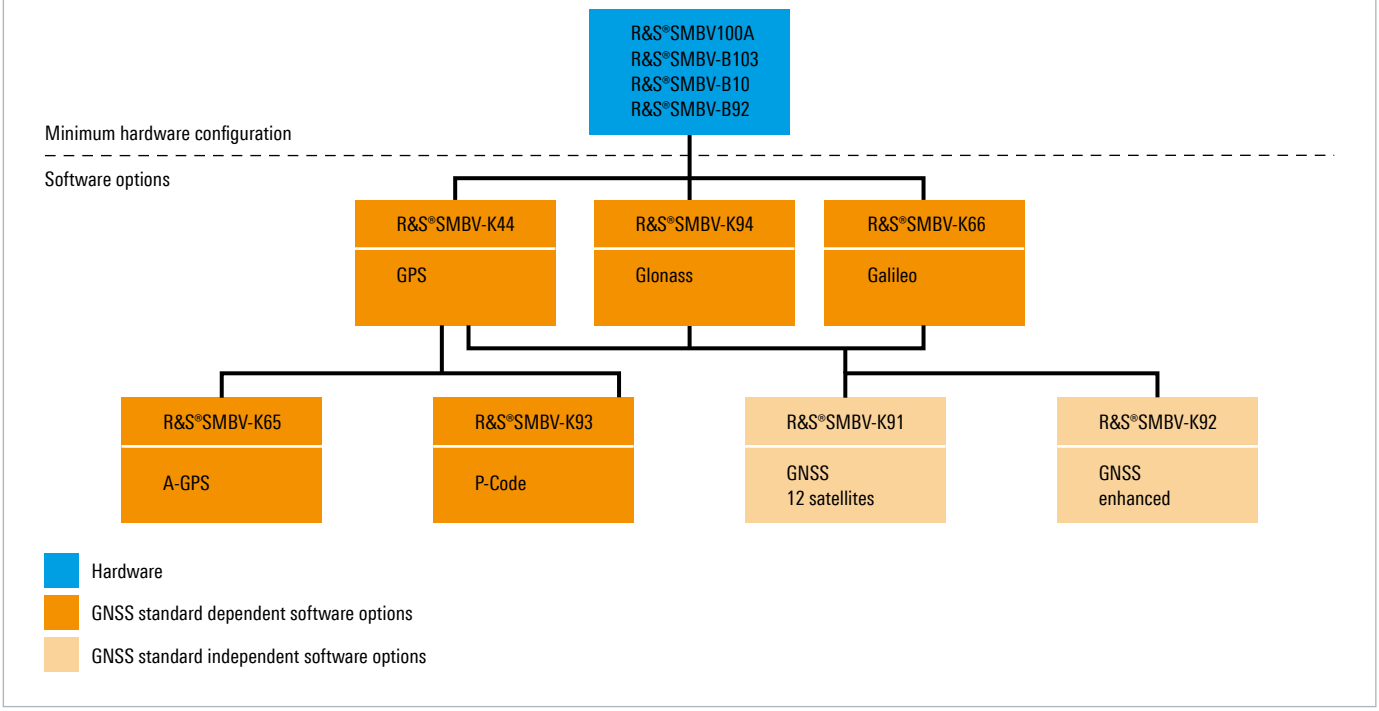
GNSS extension to 12 satellites (R&S®SMBV-K91 option)

- Simulation of civilian signals from up to 12 GNSS satellites (8 to 12 satellites depending on the configuration, if GPS P-Code is active)
- Simulation of up to 12 GNSS satellites
- Requires the R&S®SMBV-K44 option or the R&S®SMBV-K66 option

GNSS enhanced (e.g. moving scenarios, multipath) (R&S®SMBV-K92 option)

- Moving scenarios (import of NMEA waypoints)
- User-definable multipath
- Configurable atmospheric models
- Configurable system time transformation parameters
- Configurable leap second simulation
- Requires the R&S®SMBV-K44, R&S®SMBV-K94 or the R&S®SMBV-K66 option

The option tree below shows the dependencies among the GNSS options



Specifications in brief

Specifications in brief [1]		
General settings		
Frequency		based on the RF band and GNSS hybrid configuration
		user-selectable in entire frequency range
Output level		based on the power mode and the individual satellite power parameters
		user-selectable in entire output level range of the R&S®SMBV100A
GNSS hybrid configuration		hybrid GNSS constellation, e.g. 2 GPS satellites, 2 Glonass and 2 Galileo satellites possible if R&S®SMBV-K44, R&S®SMBV-K94 and R&S®SMBV-K66 are installed
Simulation modes		static mode, auto localization mode, user localization mode
Dynamics		
Pseudorange error (RMS)		±0.01 m
Max. relative velocity		10 000 m/s
Max. relative acceleration		300 m/s^2
Max. relative jerk		45 m/s^3 (as impulse)
GPS (R&S®SMBV-K44)		
GPS		6 satellites, in line with ICD-GPS-200 revision D
RF bands		L1/E1, L2
GPS satellite configuration (separately settable for each satellite)		
Signals (chip rates)		coarse acquisition C/A (1.023 MHz)
Modulation		BPSK (CDMA)
Assisted GPS (R&S®SMBV-K65)		
A-GPS test scenarios		pre-defined test scenarios for GSM, 3GPP FDD and 3GPP2
		user-definable
Generation of assistance data		almanac file
		ionospheric file
		navigation file
		UTC file
		acquisition file
		in comma separated values (CSV) format, for navigation file also in standard RINEX format
Import RINEX		ephemeris subframes can be configured manually or imported from a GPS RINEX file
GPS P-Code (R&S®SMBV-K93)		
GPS		6 satellites, in line with ICD-GPS-200 revision D (antis-spoofing disabled)
RF bands		L1/E1, L2
GPS satellite configuration (separately settable for each satellite)		
Signals (chip rates)		coarse/acquisition C/A (1.023 MHz) and P (10.23 MHz)
Modulation		BPSK (CDMA)
Galileo (R&S®SMBV-K66)		
Galileo		6 satellites, in line with OD SIS ICD, E1 band
RF bands		L1/E1
Galileo satellite configuration (separately settable for each satellite)		
Signals (chip rates)		E1 default (1.023 MHz)
Modulation		CBOC (6.1) + CDMA

Specifications in brief [1]		
Glonass (R&S®SMBV-K94)		
Glonass		6 satellites, in line with ICD-GLONASS Version 5.0
RF bands		L1/E1, L2
Glonass satellite configuration (separately settable for each satellite)		
Signals (chip rates)		coarse/acquisition R-C/A (511 KHz)
Modulation		BPSK (CDMA)
GNSS extension to 12 satellites (R&S®SMBV-K91)		
GNSS extension to 12 satellites	GPS P code not activated	simulation of up to 12 GNSS satellites, also in hybrid mode
	GPS P code activated (R&S®SMBV-44 and R&S®SMBV-K93 required)	at least 8 satellites can be configured, e.g. 8 (C/A+P) GPS satellites; 12 can be reached depending on the configuration, e.g. 4 (C/A+P) GPS and 8 Glonass satellites (R&S®SMBV-K94 required) or 2 (C/A+P) GPS, 2 Galileo E1 and 8 Glonass satellites on L1/E1 (R&S®SMBV-K66 and R&S®SMBV-K94 required)
GNSS enhanced (e.g. moving scenarios, multipath) (R&S®SMBV-K92)		
Moving scenario		minimum duration of 12 hours before waypoint repetition, up to 4 days if R&S®SMBV-B55 is installed
	supported formats	comma separated waypoints
		movement script
		NMEA
Atmospheric configuration		configuration of the ionospheric navigation parameters as they will be transmitted in the navigation message
		ionospheric and tropospheric models used in channel simulation
Multipath (satellite taps can be defined separately for each satellite; additional time shift, power, Doppler shift and carrier phase can be defined separately for each satellite tap)		
Channel budget	GPS	16 channels
	Glonass	16 channels
	Galileo	12 channels
	hybrid constellations	12 channels to 16 channels
Number of taps		1 to 10 depending on remaining channel budget

[1] These specifications in brief relate to the GNSS functionality of the R&S®SMBV100A. For specifications on the general performance of the R&S®SMBV100A or on the functionality of other digital standards, see the R&S®SMBV100A data sheet (PD 5214.1114.22) and the Digital Standards for Signal Generators data sheet (PD 5213.9434.22).

For data sheet, see PD 5214.5284.22 and www.rohde-schwarz.com

Ordering information

Designation	Type	Order No.
Base unit (including power cable, Quick Start Guide and CD-ROM, with operating and service manual)		
Vector Signal Generator [2]	R&S®SMBV100A	1407.6004.02
Hardware options (GNSS-related configuration) [3]		
Frequency Range 9 kHz to 3.2 GHz	R&S®SMBV-B103	1407.9603.02
Baseband Generator with Digital Modulation (realtime) and ARB (32 Msample), 120 MHz RF bandwidth	R&S®SMBV-B10	1407.8607.02
Hard Disk (removable)	R&S®SMBV-B92	1407.9403.02
ARB Memory Extension to 256 Msample (requires the R&S®SMBV-B92 option)	R&S®SMBV-B55	1407.9203.02
Software options (GNSS-related only) [3]		
GPS	R&S®SMBV-K44	1415.8060.02
Assisted GPS	R&S®SMBV-K65	1415.8560.02
Galileo	R&S®SMBV-K66	1415.8590.02
GNSS Extension to 12 Satellites	R&S®SMBV-K91	1415.8577.02
GNSS Enhanced (e.g. moving scenarios, multipath)	R&S®SMBV-K92	1415.8583.02
GPS P code	R&S®SMBV-K93	1415.8660.02
Glonass	R&S®SMBV-K94	1415.8677.02
Recommended extras		
Hardcopy Manuals (in English, UK)		1407.6062.32
Hardcopy Manuals (in English, US)		1407.6062.39
19" Rack Adapter	R&S®ZZA-S334	1109.4487.00
Power Sensor, 9 kHz to 6 GHz	R&S®NRP-Z92	1171.7005.02
Keyboard with USB Interface (US character set)	R&S®PSL-Z2	1157.6870.04
Mouse with USB Interface, optical	R&S®PSL-Z10	1157.7060.03
USB Serial Adapter for RS-232-C remote control	R&S®TS-USB1	6124.2531.00
Accessories		
Documentation of Calibration Values	R&S®DCV-2	0240.2193.18
R&S®SMBV DKD (ISO 17025) Calibration including ISO 9000 calibration	R&S®SMBV-DKD	1415.8448.02

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

[3] For further options, see R&S®SMBV100A product brochure (PD 5214.1114.12), data sheet (PD 5214.1114.22) and www.rohde-schwarz.com.

Service options		
Extended warranty, one year	R&S®WE1SMBV100A	Please contact your local Rohde&Schwarz sales office.
Extended warranty, two years	R&S®WE2SMBV100A	
Extended warranty, three years	R&S®WE3SMBV100A	
Extended warranty, four years	R&S®WE4SMBV100A	
Extended warranty with calibration coverage, one year	R&S®CW1SMBV100A	
Extended warranty with calibration coverage, two years	R&S®CW2SMBV100A	
Extended warranty with calibration coverage, three years	R&S®CW3SMBV100A	
Extended warranty with calibration coverage, four years	R&S®CW4SMBV100A	

Your local Rohde&Schwarz expert will help you determine the optimum solution for your requirements.
To find your nearest Rohde&Schwarz representative, visit
www.sales.rohde-schwarz.com

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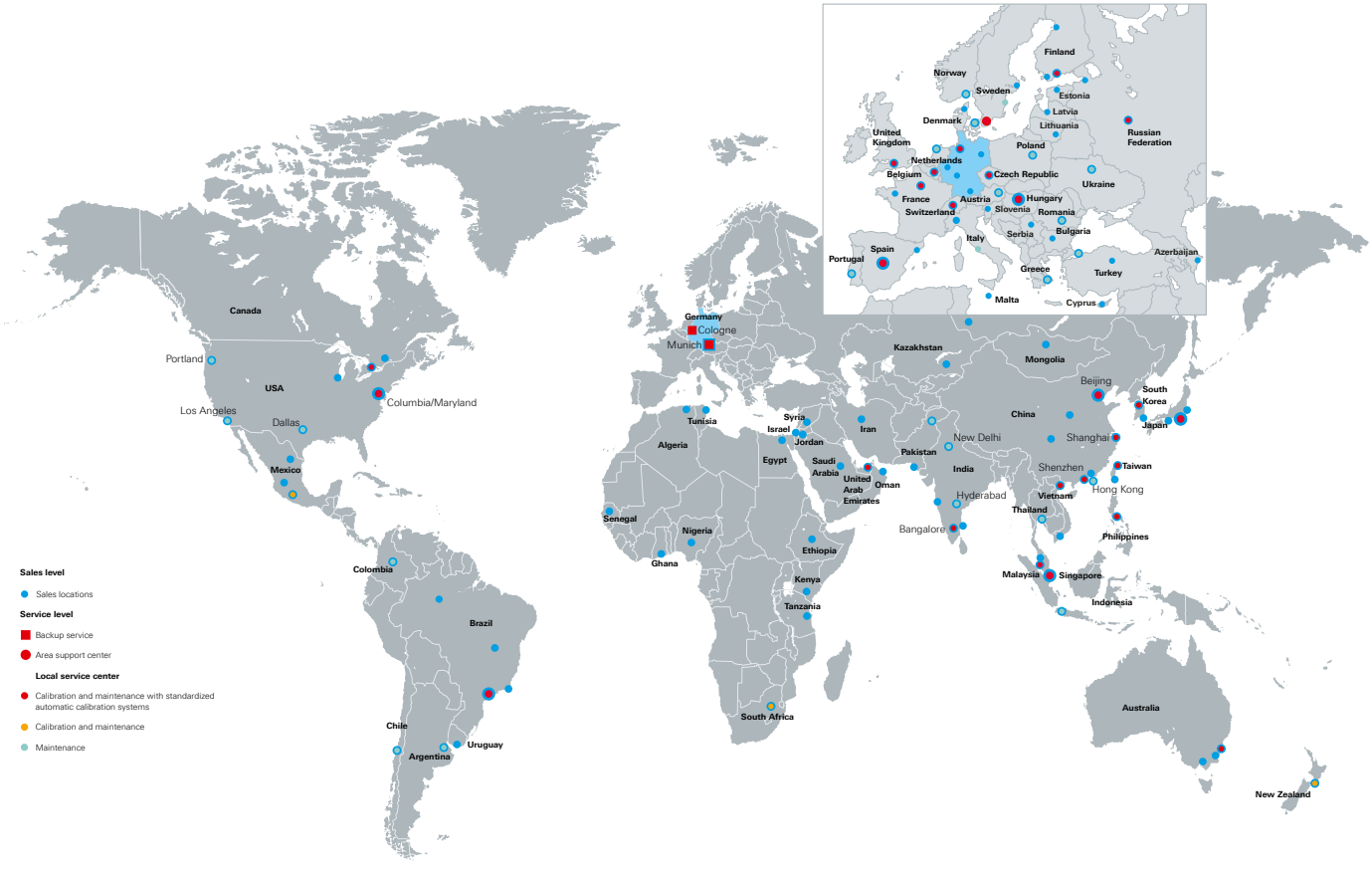
- Solution finding/purchase
- Technical start-up/application development/integration
- Training
- Operation/calibration/repair



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- Long-term dependability

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

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- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Certified Quality System
ISO 9001

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PD 5214.5284.12 | Version 02.00 | November 2011 | GNSS for the R&S®SMBV100A

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