

Chapter 4

Signal generators

Baseband, RF and microwave signal generators from Rohde & Schwarz excel in signal quality, flexibility and usability. Rohde & Schwarz signal generators offer wide frequency ranges up to 43.5 GHz (up to 170 GHz with frequency multipliers), feature modulation bandwidths up to 2 GHz and support all major mobile communications and wireless digital standards.

The portfolio ranges from ultracompact and unexcelled fast analog and digital signal sources, optimized for use in production and automated solutions, to premium class vector signal generators with multichannel and fading simulation capabilities for the most demanding applications.



Type	Designation	Frequency range	Description	Page
RF vector signal generators				
R&S®SMW200A	Vector signal generator	100 kHz to 3/6/12.75/20/31.8/40 GHz	The fine art of signal generation	92
R&S®SMBV100B	Vector signal generator	8 kHz to 3 GHz/6 GHz	Perfect combination of performance and usability	94
R&S®SGS100A	SGMA RF source	1 MHz to 6/12.75 GHz (CW) 80 MHz to 12.75 GHz (I/Q)	Compact – fast – reliable	95
R&S®SGU100A	SGMA upconverter	12 GHz to 20/40 GHz (CW) 12 GHz to 20/40 GHz (I/Q)	High performance up to microwave frequencies	95
R&S®SGT100A	SGMA vector RF source	1 MHz to 3 GHz or 6 GHz	Fast and compact production solution	96
R&S®SZU100A	I/Q upconverter	58.32 GHz to 64.80 GHz	Wideband mmWave vector signal generation	97
RF analog signal generators				
R&S®SMA100B	RF and microwave analog signal generator	8 kHz to 3 GHz/6 GHz/ 12.75 GHz/20 GHz	Performance leadership without compromise	98
R&S®SMB100A	RF and microwave signal generator	9 kHz to 1.1/2.2/3.2/6 GHz 100 kHz to 12.75/20/40 GHz	Versatile, compact solution for signal generation up to 40 GHz	99
R&S®SMB100B	RF signal generator	8 kHz to 1 GHz, 3 GHz or 6 GHz	Perfect combination of performance and usability in a compact size	100
R&S®SMC100A	Signal generator	9 kHz to 1.1 GHz/3.2 GHz	Flexible and universal all-purpose signal generator	101
R&S®SMF100A	Microwave signal generator	100 kHz/1 GHz to 22/31.8/43.5 GHz	Signal generation redefined	102
R&S®SGS100A	SGMA RF source	1 MHz to 6/12.75 GHz (CW) 80 MHz to 12.75 GHz (I/Q)	Compact – fast – reliable	95
R&S®SGU100A	SGMA upconverter	12 GHz to 20 GHz (CW) 12 GHz to 20 GHz (I/Q)	High performance up to microwave frequencies	95
R&S®SMZ	Frequency multiplier	50/60/75/110 GHz to 75/90/110/170 GHz	Precise and adjustable output levels (for R&S®SMZ75, R&S®SMZ90 and R&S®SMZ110)	103
Baseband signal generators				
R&S®AFQ100A	I/Q modulation generator		High-performance baseband signals	105
R&S®AFQ100B	UWB signal and I/Q modulation generator			
R&S®HMF2525	Arbitrary function generators	10 µHz to 25/50 MHz	Accurate, versatile and price convenient	106
R&S®HMF2550				
R&S®HM8150	Arbitrary function generator	10 mHz to 12.5 MHz	Easy to use, multifunctional and a great price	107
Application-specific solutions				
R&S®AREG100A	Automotive radar echo generator	24 GHz to 24.25 GHz 76 GHz to 77 GHz 76 GHz to 81 GHz	Reliable and simple production testing of automotive radar sensors	104
Application firmware packages for Rohde&Schwarz signal generators			Overview	108
Software solutions				
R&S®WinIQSIM2™	Simulation software		Ideal for the generation of digitally modulated signals	121
R&S®Sxx-Kxxx	Pulse sequencing, direction finding, DFS signal generation, extended sequencing		Generation of pulsed signals with basic modulation schemes (for R&S®SMBV100B and R&S®SGT100A)	108

R&S®SMW200A Vector Signal Generator



The fine art of signal generation

The R&S®SMW200A is the ideal generator for the digitally modulated signals required to develop the new wideband communications systems, to verify 3G and 4G base stations or in the aerospace and defense sector.

Key facts

- Frequency range from 100 kHz to 3 GHz, 6 GHz, 12.75 GHz, 20 GHz, 31.8 GHz or 40 GHz
- Optional second RF path with 100 kHz up to 3 GHz, 6 GHz, 12.75 GHz or 20 GHz
- Up to 2 GHz I/Q modulation bandwidth (in RF) with internal baseband
- Options for all important digital communications standards
- Optional integrated fading simulator with up to 160 MHz bandwidth
- Support of all key MIMO modes including 3x3, 4x4, 8x4, 4x8 and 4x2x2
- Intuitive operation via touchscreen with block diagram as key element

Simplify your setup

- Easy generation of complex signals
- Max. eight baseband generators on two internal baseband modules with realtime coder and ARB
- Internal digital adding of baseband signals, even with frequency and level offset

- Wideband baseband and vector signal generator in one box
- Support of all important digital standards such as 5G NR, LTE (up to release 14), 3GPP FDD/HSPA/HSPA+, IoT, WLAN IEEE802.11a/b/g/n/j/p/ac/ad, DVB-S2/S2X and OneWeb
- No separate PC software required for digital standards
- Generation of radar signal scenarios for module, receiver and DFS tests
- LTE and 3GPP test case wizards for easy base station conformance testing in line with 3GPP TS25.141 or 3GPP TS36.141
- Envelope tracking and AM/AM, AM/φM predistortion options for full testing and verification of ET modulator chipsets

Bring reality to your lab

- Optional integrated fading section for channel emulation with up to 160 MHz bandwidth
- All important fading scenarios available as presets
- Installation of up to four fading modules, providing as many as 32 "logical" faders
- Implementation of all key MIMO fading scenarios such as 2x2, 3x3, 4x4, 8x4 and 4x8 using a single instrument
- Support of complex applications such as dual-carrier HSPA, carrier aggregation with MIMO and multi-user scenarios
- Connection of R&S®SGT100A signal generator modules to provide up to eight RF paths

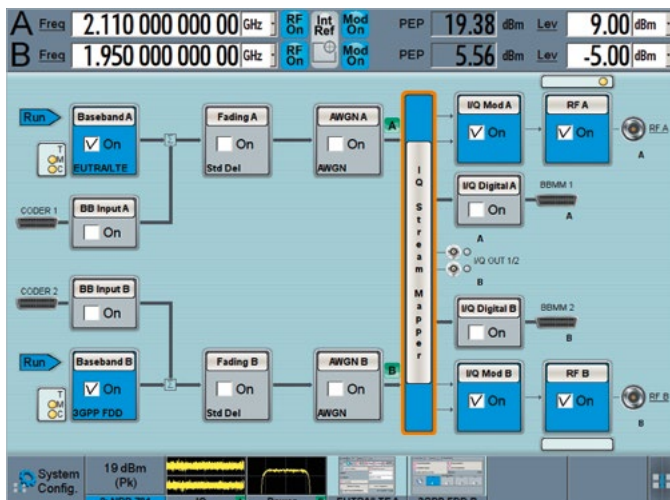
Make your device even better

- Excellent signal quality for high accuracy in spectral and modulation measurements
- Up to 2 GHz I/Q modulation bandwidth (in RF) with internal baseband
- Exceptional modulation frequency response of < 0.4 dB (meas.) over 2 GHz bandwidth
- High-end pulse modulation with on/off ratio > 80 dB and rise/fall time < 10 ns
- Excellent spectral purity (SSB phase noise -139 dBc (typ.) at 1 GHz, 20 kHz offset)
- Phase coherence option, e.g. for beamforming applications
- 3 GHz, 6 GHz and 12.75 GHz RF paths with electronic attenuator

Grows with your needs

- Advanced plug-in system for retrofitting baseband modules without instrument recalibration
- Software upgrades possible at any time, simple and quick activation via key codes

Models	
R&S®SMW200A + R&S®SMW-B103	100 kHz to 3 GHz
R&S®SMW200A + R&S®SMW-B106	100 kHz to 6 GHz
R&S®SMW200A + R&S®SMW-B112	100 kHz to 12.75 GHz
R&S®SMW200A + R&S®SMW-B120	100 kHz to 20 GHz
R&S®SMW200A + R&S®SMW-B131	100 kHz to 31.8 GHz
R&S®SMW200A + R&S®SMW-B140	100 kHz to 40 GHz
R&S®SMW200A + R&S®SMW-B140N	100 kHz to 40 GHz, I/Q modulation bandwidth and minimum pulse width limited



Speed up your development

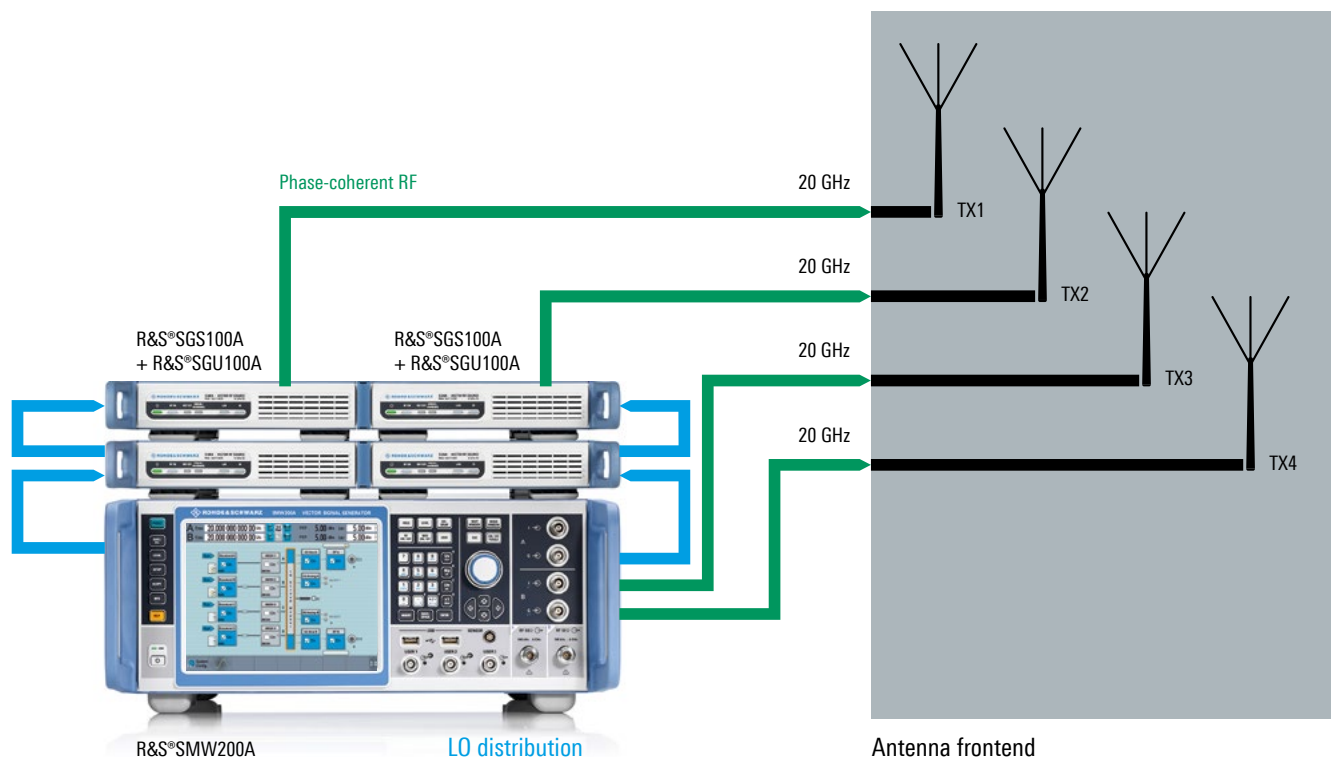
- Intuitive operating concept and clever help functions for quick success
- Block diagram as key operating element to visualize signal flow
- Adaptive GUI for overview of both simple and complex scenarios
- Graphical signal monitoring at practically every point in the signal flow
- Context-sensitive online help system with complete user documentation
- SCPI macro recorder and code generator for generating executable remote control code from manual operating steps (for MATLAB®, CVI, etc.)

4

The R&S®SMW200A can be used together with many other Rohde & Schwarz instruments

R&S®SMW200A function/connection	Related option(s)	Rohde & Schwarz partner instrument	Application example
Digital baseband input	R&S®SMW-B10	e.g. R&S®CMW500 wideband radio communication tester	R&S®CMW500 as external I/Q source, e.g. for signaling
Digital baseband output	R&S®SMW-K18	e.g. R&S®SGT100A signal generator module	provides additional RF paths
Analog I/Q output	R&S®SMW-K16/-K17	e.g. R&S®SGS100A signal generator module	provides additional RF paths
R&S®NRP sensor connector	–	R&S®NRPxxS power sensors, R&S®NRP-Z28/-Z98 level control sensors	high-accuracy power measurement, result display on the R&S®SMW200A

Setup for antenna testing



Setup with a two-path R&S®SMW200A, two R&S®SGS100A and two R&S®SGU100A to generate four phase-coherent CW or modulated signals, for example for antenna testing up to 20 GHz. The setup can be scaled to 40 GHz and duplicated if more RF paths are required.

R&S®SMBV100B Vector Signal Generator

New



Perfect combination of performance and usability

The state-of-the-art R&S®SMBV100B vector signal generator sets new standards in its class. Ultra high output power, fully calibrated wideband signal generation and intuitive touchscreen operation make the R&S®SMBV100B ideal for all kinds of applications.

Key facts

- Frequency range from 8 kHz to 3 GHz or 6 GHz
- Ultra high output power up to +34 dBm
- 500 MHz modulation bandwidth with perfect accuracy
- Excellent EVM and ACPR results up to high power levels

- Easy upgrading of instrument at customer premises via software keycodes
- Convenient operation via 7" touchscreen

Perfect for signal quality

- New realtime, user-defined frequency response correction to compensate for the effect of test fixtures
- Very low single-sideband (SSB) phase noise: < -134 dBc (meas.) at 1 GHz and 20 kHz offset
- Wide modulation bandwidth with perfect accuracy: modulation frequency response of < 0.3 dB (meas.) across 500 MHz bandwidth
- Excellent EVM and ACPR up to high power levels

Perfect for output power

- Ultra high output power: up to +34 dBm at 1 GHz
- Excellent level accuracy for CW and modulated signals: level linearity of < 0.2 dB (meas.)

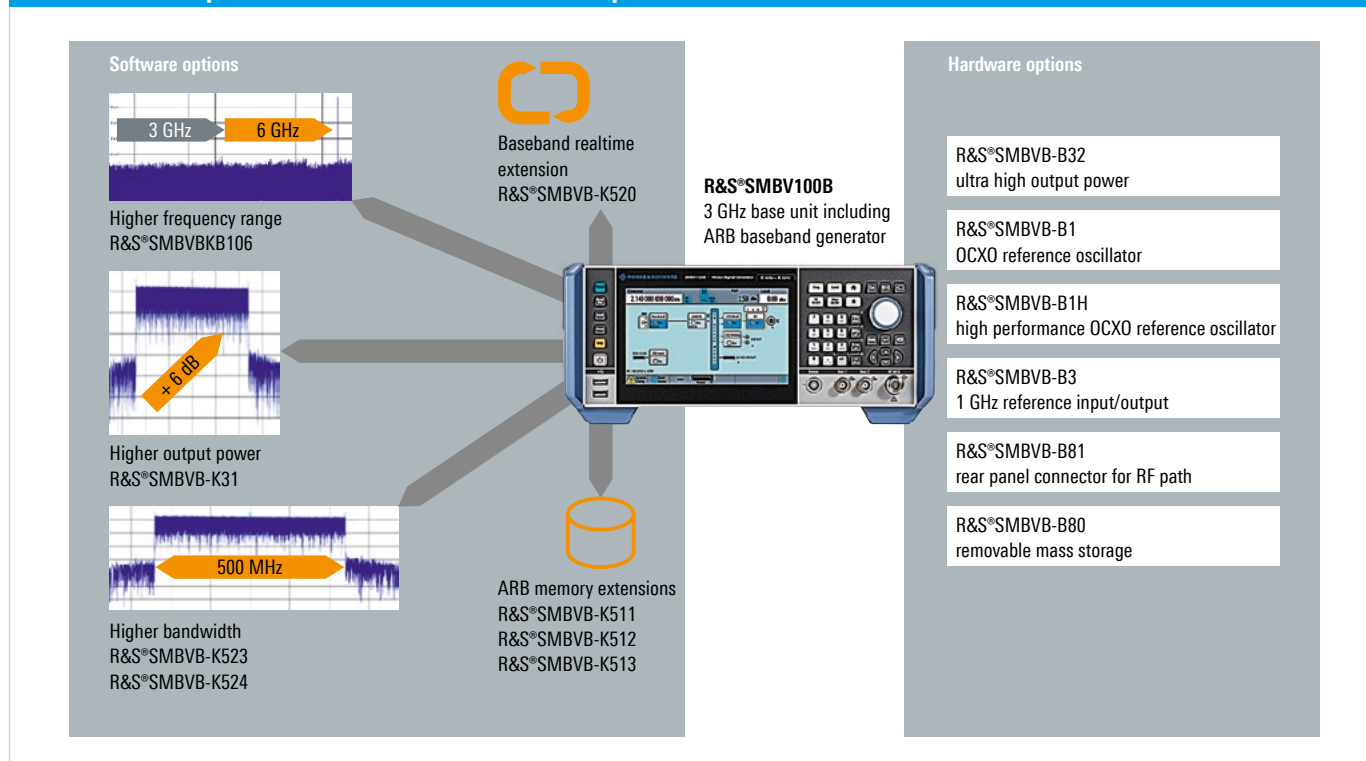
Perfect for use

- Convenient operation via 7" touchscreen
- Automation made easy with context-sensitive help system and SCPI recording
- Internal realtime signal generation
- Protecting user data

Models

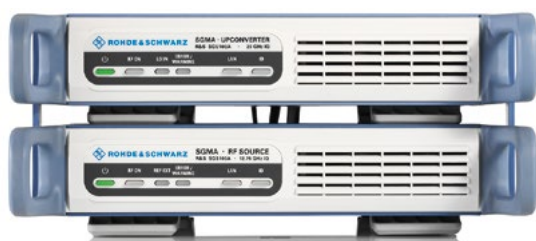
R&S®SMBV100B + R&S®SMBVB-B103	8 kHz to 3 GHz
R&S®SMBV100B + R&S®SMBVB-KB106	8 kHz to 6 GHz

Overview of important software and hardware options



R&S®SGS100A SGMA RF Source

R&S®SGU100A SGMA Upconverter

Configurator
SGS100AProduct site
SGS100AConfigurator
SGU100AProduct site
SGU100A

Compact – fast – reliable

The R&S®SGS100A is an RF source designed to meet the requirements of automated test systems. It is available as a CW source or as a vector signal generator with an integrated I/Q modulator. With its frequency range of up to 12.75 GHz, the vector signal generator version covers the essential digital signals. The CW version can be used as a flexible local oscillator as well as for interference testing against mobile radio standards.

The R&S®SGU100A SGMA upconverter offers a frequency extension to 20 GHz or 40 GHz. When the R&S®SGS100A and the R&S®SGU100A are connected, they act as a single instrument for both remote control and manual operation via the R&S®SGMA-GUI PC software.

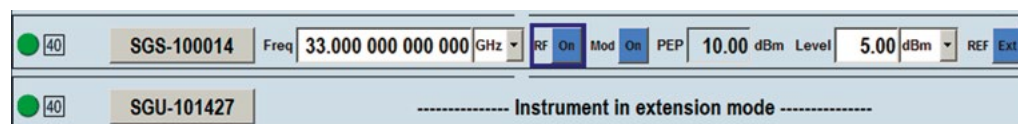
Key facts R&S®SGS100A

- Smallest fully integrated vector signal generator on the market, space-saving design for system integration
- High throughput due to very short frequency and level setting times of typ. 280 µs via PCIe interface
- Excellent RF performance in a compact format
- Maximum output level of typ. +22 dBm for compensating losses in the setup
- Closed ALC loop for CW and I/Q modes for highest level repeatability
- Wear-free electronic attenuator for high reliability up to 12.75 GHz
- Low initial costs and low cost of ownership

Connections between the R&S®SGS100A and the R&S®SGU100A



R&S®SGMA-GUI PC software with the R&S®SGS100A connected to the R&S®SGU100A upconverter



R&S®SGS100A and R&S®SGU100A model overview

R&S®SGS100A alone

CW source as local oscillator

1 MHz to 6 GHz

with R&S®SGS-B106

1 MHz to 12.75 GHz

with R&S®SGS-B106 and
R&S®SGS-B112

Vector signal generator for generating digital signals with an external baseband signal

80 MHz to 6 GHz

with R&S®SGS-B106V

80 MHz to 12.75 GHz

with R&S®SGS-B106V and
R&S®SGS-B112V

R&S®SGS100A together with R&S®SGU100A

CW source as local oscillator

10 MHz to 20 GHz

with R&S®SGS-B106,
R&S®SGS-B112 and
R&S®SGU-B120

10 MHz to 40 GHz

with R&S®SGS-B106,
R&S®SGS-B112,
R&S®SGU-B120 and
R&S®SGU-B140

Vector signal generator for generating digital signals with an external baseband signal

80 MHz to 20 GHz

with R&S®SGS-B106V,
R&S®SGS-B112V and
R&S®SGU-B120V

80 MHz to 40 GHz

with R&S®SGS-B106V,
R&S®SGS-B112V,
R&S®SGU-B120V and
R&S®SGU-B140V

R&S®SGT100A SGMA Vector RF Source



Configurator



Videos



Product site

Fast and compact production solution

The R&S®SGT100A is an RF vector signal generator with an integrated baseband generator. It has been optimized for use in production and automated applications. Designed as a fast and compact, space-saving solution, it provides top speed to ensure optimized throughput and fits into any test system.

Key facts

- Fastest vector signal generator with frequency and level switchover times of typ. 240 µs for optimized throughput in production
- Smallest standalone vector signal generator up to 6 GHz with integrated baseband generator (1 HU ½ 19")
- Integrated baseband generator with I/Q modulation bandwidth of up to 240 MHz (in RF) supporting all advanced digital standards, including 5G NR
- Excellent RF performance for EVM and ACLR
- Easy signal generation for digital standards such as LTE and LTE-Advanced using the R&S®WinQSIM2™ simulation software
- Ideal enhancement for the R&S®SMW200A in MIMO applications with more than two receiving antennas

Optimized for use in production

- Smallest standalone vector signal generator with integrated baseband generator
- Fast frequency and level switchover to optimize production throughput
- High output level to compensate for losses in the test system
- Low power consumption for reduced heat dissipation and simplified thermal management within the system

The right signal performance in the right package

- Excellent modulation accuracy for large test margins
- Outstanding frequency response due to integrated baseband generator
- Low phase noise of typ. -133 dBc at 1 GHz and 20 kHz offset (1 Hz measurement bandwidth)
- Excellent level repeatability and level linearity for outstanding reproducibility of measurements
- Optional high-performance oven-controlled crystal oscillator for easy integration into test system
- Optional analog I/Q outputs enabling full-featured envelope tracking testing capabilities

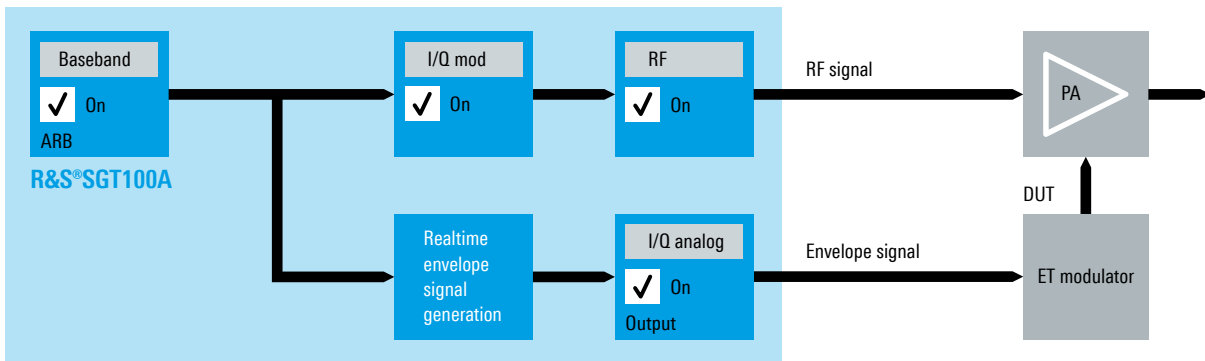
Low cost of ownership

- Low acquisition costs
- Simple modular design for easy servicing
- Easily upgradeable at customer premises
- Waveform package as ideal production solution
- Many remote control interfaces for easy integration into the test setup
- R&S®SGMA-GUI PC software

Models

R&S®SGT100A	1 MHz to 3 GHz
R&S®SGT100A + R&S®SGT-KB106	1 MHz to 6 GHz

Concept of realtime envelope tracking tests with R&S®SGT-K540



Equipped with the R&S®SGT-K540 option, the R&S®SGT100A calculates the envelope signal in realtime. This unique feature offers the advantage of test time reduction since no manual calculation of the envelope waveform is required.

R&S®SZU100A I/Q Upconverter

New



Videos



Product site



Standard WR15



Opt. 1.85 mm (f)



Opt. (HP/A)

Wideband mmWave vector signal generation

The R&S®SZU100A I/Q upconverter extends the R&S®SMW200A vector signal generator into the mmWave range. Its 2 GHz bandwidth, flat frequency response and dynamic range of over 80 dB allows the R&S®SZU100A to generate high-quality test signals in the frequency range from 57.32 GHz to 65.80 GHz for WLAN IEEE802.11ad, 5G or microwave links as well as to test satellite and radar systems. Components, chips, transceivers, mobile devices and the communications infrastructure for these fields of application are conveniently tested using the R&S®SZU100A I/Q upconverter.

Key facts

- Upconversion of R&S®SMW200A generated signals to mmWave frequencies
- Flat frequency response independent of set level and frequency
- Fully characterized in factory; no need for external frequency response correction prior to measurements
- High spectral purity paired with high dynamic range
- Seamless integration into the R&S®SMW200A operating concept for maximum usability

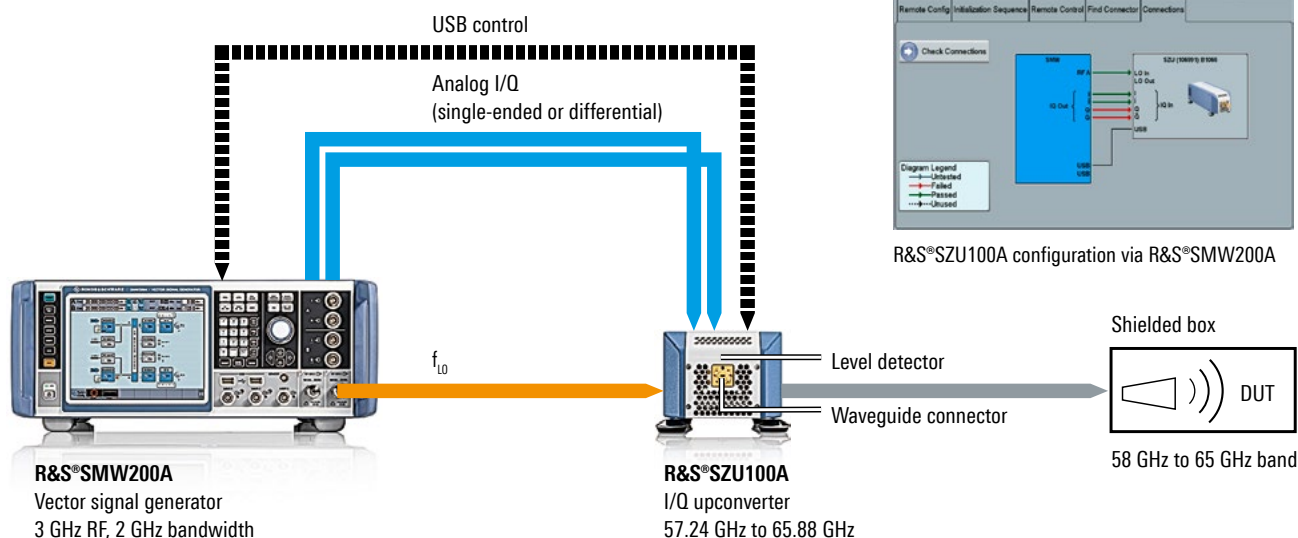
High performance for challenging applications

- Field-proven design as a flexible RF head
 - Waveguide connector WR15
 - Highest output power available close to the DUT
- High frequency and large bandwidth
 - Center frequency from 58.32 GHz to 64.80 GHz
 - RF modulation bandwidth ± 1 GHz around center frequency
- High output power and wide dynamic range from -80 dBm to $+5$ dBm (PEP)
- Easy upgrading of the R&S®SMW200A
- Multichannel operation

Reliable results due to outstanding signal quality

- Automatic frequency response compensation
 - Flat frequency response of < 2.0 dB
 - Fully characterized in factory
 - No need for external frequency response correction
- Harmonics, nonharmonics and subharmonics better than -50 dBc (level > -40 dBm)
- Wideband noise -146 dBm (1 Hz) or better
- Excellent modulation quality: EVM for WLAN IEEE802.11ad at 60.48 GHz better than -32 dB (meas.)

R&S®SZU100A I/Q upconverter test setup



R&S®SMA100B

RF and Microwave Signal Generator

New



Configurator



Videos



Product site

Performance leadership without compromise

The R&S®SMA100B RF and microwave signal generator delivers maximum performance without compromise. It provides purest output signals while maintaining the highest output power level, far outpacing the competition. As the world's leading signal generator, it can handle the most demanding component, module and system T&M tasks in the RF semiconductor, wireless communications and aerospace and defense industries. The same signal generator can provide a second, independent and extremely pure clock signal output for ADC testing.

First-class devices thanks to first-class signals

- Purest signals
 - Excellent SSB phase noise in base unit:
typ. -119 dBc for 10 GHz at an offset of 20 kHz

- Outstanding SSB phase noise with option:
typ. -132 dBc for 10 GHz at an offset of 10 kHz
- Lowest close-in SSB phase noise:
typ. -83 dBc; f = 10 GHz, offset = 10 Hz
- Virtually no wideband noise:
-162 dBc (meas.) at 10 GHz and an offset of 30 MHz
- Lowest harmonic and nonharmonic signal components
 - Very low harmonic signal components over the entire frequency range (< -63 dBc) even at very high output power
 - Very low nonharmonic signal components of -90 dBc (meas.) at 10 GHz

Very high output power without compromise

- Exceptionally high output level
 - Ultra high output power up to 38 dBm with the 6 GHz instrument
 - Over 30 dBm at 18 GHz and 28 dBm at 20 GHz
 - First stage high power upgrade via keycode
- Excellent level accuracy and repeatability for CW signals, narrow pulses and modulated signals

User friendly in every detail

- Flexible 2 HU or 3 HU housing
- 3 HU with larger 7" display and multiple front panel connectors
- Ergonomic operation thanks to state-of-the-art GUI with touch display

Models

R&S®SMA100B + R&S®SMAB-B103	8 kHz to 3 GHz, 2 HU/3 HU
R&S®SMA100B + R&S®SMAB-B106	8 kHz to 6 GHz, 2 HU/3 HU
R&S®SMA100B + R&S®SMAB-B112	8 kHz to 12.75 GHz, 2 HU/3 HU
R&S®SMA100B + R&S®SMAB-B120	8 kHz to 20 GHz, 2 HU/3 HU

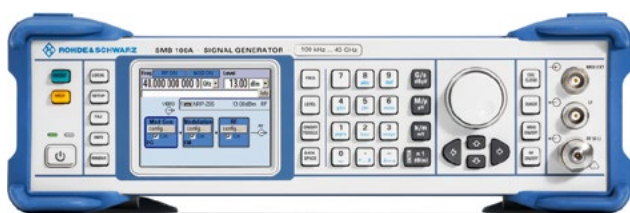
Size of the 2 HU instrument versus the 3 HU instrument with its additional front panel connectors



The microwave signal generator can provide a second, independent and extremely pure clock signal output for ADC testing.

R&S®SMB100A

RF and Microwave Signal Generator



Configurator



Product site

Versatile, compact solution for signal generation up to 40 GHz; 170 GHz with upconverter

The compact, versatile R&S®SMB100A RF and microwave signal generator with a frequency range up to 40 GHz provides outstanding spectral purity and high output power. In addition, it features easy operation, comprehensive functionality and low cost of ownership.

For even higher frequencies, the frequency range of the R&S®SMB100A can be easily extended with the R&S®SMZ frequency multiplier. The R&S®SMB100A plus R&S®SMZ solution combines easy handling with precise, adjustable output levels in the frequency range from 50 GHz to 110 GHz (adjustable output levels are not possible with R&S®SMZ170).

Wide frequency range, high output power and a variety of modulations make the R&S®SMB100A a flexible signal source for a broad scope of applications.

Key facts

- Wide frequency range from 9 kHz to 6 GHz or from 100 kHz to 40 GHz
- Excellent signal characteristics with low SSB phase noise of typ. -128 dBc (at 1 GHz, 20 kHz offset)
- High output power of up to $+27$ dBm (meas.)
- All important analog modulations with AM, FM/PM and pulse modulation supported
- Optional internal low harmonic filters for the 20 GHz and 40 GHz model to lower the harmonics to less than -50 dBc for frequencies above 150 MHz

Benefits and key features

- All-purpose signal source
- Best signal quality in the mid-range
- High output power and wide level range
- Ideal for production
- Testing of FM stereo and RDS receivers
- Ready for aerospace and defense applications
- Flexible service concept

Models

R&S®SMB100A + R&S®SMB-B101	9 kHz to 1.1 GHz
R&S®SMB100A + R&S®SMB-B102	9 kHz to 2.2 GHz
R&S®SMB100A + R&S®SMB-B103	9 kHz to 3.2 GHz
R&S®SMB100A + R&S®SMB-B106	9 kHz to 6 GHz
R&S®SMB100A + R&S®SMB-B112	100 kHz to 12.75 GHz, with electronic step attenuator
R&S®SMB100A + R&S®SMB-B112L	100 kHz to 12.75 GHz, without step attenuator
R&S®SMB100A + R&S®SMB-B120	100 kHz to 20 GHz, with mechanical step attenuator



R&S®SMB100B RF Signal Generator

New



Perfect combination of performance and usability in a compact size

The new R&S®SMB100B RF signal generator is all about performance and versatility in a small footprint. Outstanding spectral purity and very high output power combined with comprehensive functionality and very simple operation are some of the impressive features of the R&S®SMB100B.

Key facts

- Frequency range from 8 kHz to 1 GHz, 3 GHz or 6 GHz
- Outstanding single sideband (SSB) phase noise of –134 dBc (meas.) at 1 GHz and an offset of 20 kHz
- Very low wideband noise of typ. –153 dBc at 15 MHz < f ≤ 6 GHz and an offset of 30 MHz
- Ultra high output power of 34 dBm (meas.) at 1 GHz
- Compact form factor with 2 HU and ¾ 19" width
- Large, state-of-the-art 5" GUI with touchscreen

Perfect for signal quality

- Very low SSB phase noise of –134 dBc (meas.) at 1 GHz and an offset of 20 kHz
- Very low close-in SSB phase noise of –94 dBc (meas.) at 1 GHz and offset of 10 Hz
- Very low wideband noise of typ. –153 dBc at 15 MHz < f ≤ 6 GHz and an offset of 30 MHz
- Very low nonharmonic signal components of < –76 dBc (spec.) at 1 GHz

Perfect for output power

- The R&S®SMBB-K31 high output power option provides 28 dBm at 1 GHz and 24 dBm at 6 GHz (measured values) – easy keycode activation
- Ultra high output power of 34 dBm at 1 GHz and 31 dBm at 6 GHz with additional R&S®SMBB-B32 ultra high output power option (measured values)

Perfect for use

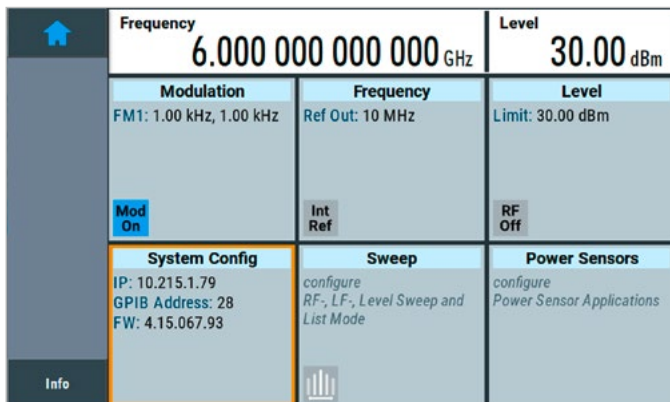
- Ergonomic operation thanks to state-of-the-art GUI with touchscreen
- Support of R&S®NRP power sensors and display of measured power on the generator display
- Easy integration into existing test environments using versatile reference frequency inputs and outputs
- Sanitizing of user data for secured areas

R&S®LegacyPro: refresh your T&M equipment

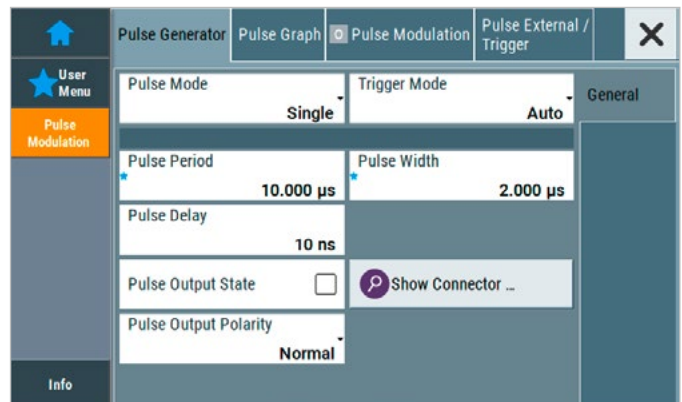
- R&S®Legacy Pro program: replacement and emulation of obsolete signal generators using the R&S®SMB100B in an automated test environment without modifying the control software

Models	
R&S®SMB100B + R&S®SMBB-B101	8 kHz to 1 GHz
R&S®SMB100B + R&S®SMBB-B103	8 kHz to 3 GHz
R&S®SMB100B + R&S®SMBB-B106	8 kHz to 6 GHz

The main screen with all important parameters and information



Individual menu items can be added to the user menu. Added items are marked with a blue star



R&S®SMC100A Signal Generator



Flexible and universal all-purpose signal generator

The R&S®SMC100A offers outstanding signal quality at an attractive price. It covers the frequency range from 9 kHz to 1.1 GHz or 3.2 GHz. Output power is typ. > +17 dBm. All important functions (AM, FM, ϕ M, PM) are already integrated in the instrument. This makes the R&S®SMC100A signal generator a flexible and versatile instrument.

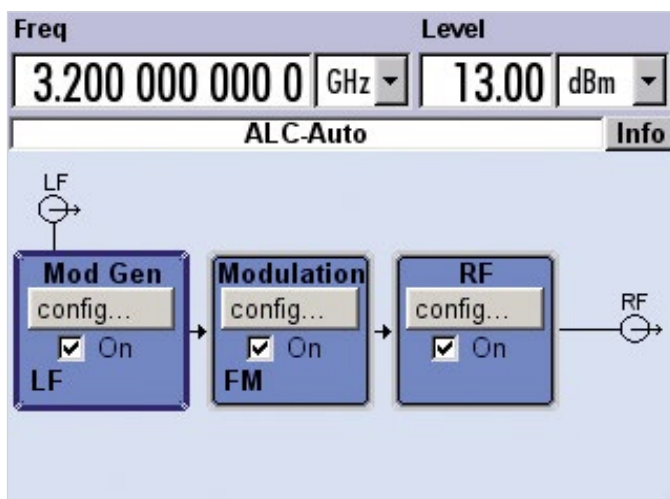
Key facts

- Smallest size and best price/performance ratio in its class
- Frequency range from 9 kHz to 1.1 GHz/3.2 GHz
- Maximum output level of typ. > +17 dBm
- AM/FM/ ϕ M/PM provided as standard
- Integrated overvoltage protection
- Wear-free electronic attenuator
- Minimized total cost of ownership

Ideal tool for many application fields

- Service and maintenance
- Research and education
- Field use
- Secure areas
- Simple production applications

R&S®SMC100A graphical user interface



High performance at an attractive price

- Low SSB phase noise of typ. -111 dBc (f = 1 GHz, 20 kHz carrier offset, 1 Hz measurement bandwidth)
- Wideband noise of typ. < -146 dBc (f > 1 MHz, carrier offset > 10 MHz, 1 Hz measurement bandwidth)
- Nonharmonics of typ. < -72 dBc (f ≤ 1600 MHz, carrier offset > 10 kHz)
- Level error < 0.9 dB
- Frequency and level setting times < 5 ms
- Optional high-stability reference oscillator

Flexible and universal all-purpose signal generator

- Frequency range 9 kHz to 1.1 GHz or 3.2 GHz
- Typical maximum level of > +17 dBm
- Analog modulation modes (AM/FM/ ϕ M/pulse modulation) integrated as standard
- Remote control compatibility with other signal generators
- Multiple language support (nine selectable GUI languages)
- Integrated overvoltage protection
- Wear-free electronic attenuator

Space-saving operation due to small dimensions

- Smallest signal generator in the economy class: ½ 19", 2 height units
- Lightweight

Minimized total cost of ownership

- Attractive initial cost
- Long calibration interval
- Simplified error diagnostics through built-in selftests
- Repair by users by means of precalibrated replacement modules
- Optimization of level accuracy through level correction with R&S®NRP sensors

Models

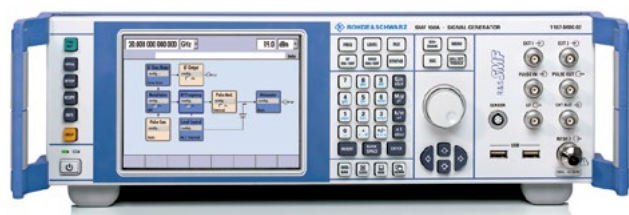
R&S®SMC100A + R&S®SMC-B101	9 kHz to 1.1 GHz
R&S®SMC100A + R&S®SMC-B101	9 kHz to 3.2 GHz

R&S®SMC100A rear view with optional R&S®SMC-K4 GPIB interface



R&S®SMF100A

Microwave Signal Generator



Signal generation redefined

Signal quality, speed and flexibility are decisive properties for a signal generator in the microwave range.

The R&S®SMF100A microwave signal generator is a first-rate, state-of-the-art microwave signal generator that sets new standards. It covers the numerous fields of application encountered in R&D, production, service, maintenance and repair.

The R&S®SMF100A operates in the wide frequency range from 100 kHz to 43.5 GHz with specific configurations. In addition to CW signals, all common types of analog modulation (AM, FM, ϕ M, PM) or combinations thereof can be generated.

The R&S®SMF100A signal generator offers a modern graphical user interface for fast and intuitive operation. The settings – which, for the first time in a microwave signal generator, can be controlled via a block diagram – and the signal flow can be seen at a glance.

Key facts

- Max. frequency range from 100 kHz to 22/31.8/43.5 GHz
- Excellent SSB phase noise of typ. -120 dBc (at 10 GHz with 10 kHz carrier offset)
- Very high output power of typ. $+25$ dBm
- Optional pulse modulator with excellent data: > 80 dB on/off ratio, < 10 ns rise/fall time, < 20 ns pulse width
- Optional pulse generator

Models	
R&S®SMF100A + R&S®SMF-B122	1 GHz to 22 GHz
R&S®SMF100A + R&S®SMF-B131	1 GHz to 31.8 GHz
R&S®SMF100A + R&S®SMF-B144	1 GHz to 43.5 GHz
R&S®SMF100A + R&S®SMF-B144N	1 GHz to 43.5 GHz, minimum pulse width limited

- Optional removable compact flash disk to meet high security requirements
- Connector for R&S®NRP power sensors for precise power measurement
- Usable for scalar network analysis with R&S®NRP power sensors connected
- Remote control via GPIB, Ethernet or USB

Excellent signal quality

- Exceptionally low single sideband phase noise: typ. -120 dBc (at 10 GHz; 10 kHz carrier offset; 1 Hz measurement bandwidth)
- Very low wideband noise: typ. < -148 dBc at 10 GHz (> 10 MHz carrier offset; 1 Hz measurement bandwidth; at $+10$ dBm)
- Very low harmonics: typ. < -55 dBc at 10 GHz ($+10$ dBm)
- High suppression of nonharmonics: typ. < -62 dBc at 10 GHz (> 3 kHz carrier offset; at $+10$ dBm)

Ideal for use in production

- Very short level and frequency setting times across entire level and frequency range: < 4 ms (frequency), < 3 ms (level), < 700 μ s (List mode; frequency and level)
- Very high output power of up to typ. $+25$ dBm
- Outstanding absolute level accuracy and repeatability
- Selection of interfaces for remote control
- Low space requirement in rack: only three height units

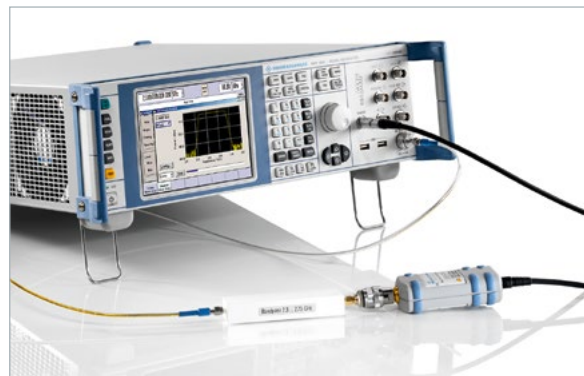
Aerospace and defense applications

- Optional pulse modulator with excellent data: > 80 dB on/off ratio, < 10 ns rise/fall time, < 20 ns pulse width
- Optional pulse generator

All-purpose applications

- Frequency range 100 kHz to 43.5 GHz
- Frequency, level, and LF sweeps
- AM, broadband FM, ϕ M, pulse modulation
- Two multifunction generators up to 10 MHz
- Usable for scalar network analysis with R&S®NRP power sensor connected

Scalar network analysis on a external bandpass filter (with R&S®SMF-K28 power analysis option plus R&S®NRP power sensor)



R&S®SMZ Frequency Multiplier



Videos



Product site

Precise output levels from 50 GHz to 170 GHz

The R&S®SMZ family of frequency multipliers combines easy handling and precise output levels in the frequency range from 50 GHz to 170 GHz. It can be used in diverse applications, e.g. in the automotive sector with distance radars, in astronomy with sophisticated telescopes and in radar interferometry for analyzing the earth's surface.

The family of frequency multipliers consists of four models R&S®SMZ75/90/110/170 as well as optional attenuators (the attenuator is not available for R&S®SMZ170). The attenuator is integrated into the same housing as the frequency multiplier, which simplifies handling. The R&S®SMZ can be controlled via USB in different ways. The most convenient way is to use the R&S®SMZ together with the R&S®SMF100A or R&S®SMB100A microwave signal generator.

Key facts

- Wide frequency range
- Wide dynamic range
- Convenient easy handling
- High signal quality

Wide frequency range

- Frequency ranges from 50 GHz to 75 GHz, 60 GHz to 90 GHz, 75 GHz to 110 GHz and 110 GHz to 170 GHz
- Two models (R&S®SMZ75 and R&S®SMZ110) cover the wide frequency range from 50 GHz to 110 GHz

Wide dynamic range

- Mechanically controlled attenuator with a dynamic range of 25 dB
- Electronically controlled attenuator with a dynamic range of 15 dB

Easy handling

- Automatic detection and control of the R&S®SMZ by means of the R&S®SMF100A or R&S®SMB100A microwave signal generator via USB
- Easy setups with the one-box solution consisting of the R&S®SMF100A or R&S®SMB100A, the R&S®SMZ plus an optional mechanically or electronically controlled attenuator (the attenuators are not available for the R&S®SMZ170)
- Frequency setting on the R&S®SMF100A or R&S®SMB100A taking the connected R&S®SMZ into consideration
- Level setting on the R&S®SMF100A or R&S®SMB100A taking the connected R&S®SMZ into consideration (only for built-in attenuator)¹⁾
- Automatic frequency response correction of the precalibrated R&S®SMZ including attenuator by means of the R&S®SMF100A or R&S®SMB100A¹⁾
- Use of the R&S®SMZ also possible with any microwave signal generator that meets the level and frequency requirements; for the convenient operation of this setup the external PC software (R&S®SMZ-K1) can be used
- For frequency-, phase- and pulse-modulated signals

High signal quality

- Very low single sideband phase noise when the R&S®SMF100A is used as a source
- High accuracy of the set output level
- Excellent matching

¹⁾ With the mechanical attenuator, users must set the setting screw to the value displayed on the R&S®SMF100A or R&S®SMB100A

Models	
R&S®SMZ75	Frequency multiplier, 50 GHz to 75 GHz
R&S®SMZ-B75M	Mechanically controlled attenuator
R&S®SMZ-B75E	Electronically controlled attenuator (via USB)
R&S®SMZ90	Frequency multiplier, 60 GHz to 90 GHz
R&S®SMZ-B90M	Mechanically controlled attenuator
R&S®SMZ-B90E	Electronically controlled attenuator (via USB)
R&S®SMZ110	Frequency multiplier, 75 GHz to 110 GHz
R&S®SMZ-B110M	Mechanically controlled attenuator
R&S®SMZ-B110E	Electronically controlled attenuator (via USB)
R&S®SMZ170	Frequency multiplier, 110 GHz to 170 GHz

The R&S®SMZ110 with the mechanically controlled attenuator (R&S®SMZ-B110M option)



R&S®AREG100A

Automotive Radar Echo Generator

New



Configurator



Videos



Product site

Reliable and simple production testing of automotive radar sensors

The R&S®AREG100A automotive radar echo generator is a smart and robust solution for testing automotive radar sensors in production. The R&S®AREG100A gives engineers the advantage of test case flexibility combined with simple and robust operation.

Key facts

- Supports 24 GHz, 77 GHz and 79 GHz automotive radar sensors
- Future-proof frontend with instantaneous bandwidth up to 4 GHz¹⁾
- 4 m minimum object distance short-range radar testing
- Individually controllable radial velocity for each object¹⁾

¹⁾ Under development.

²⁾ Radio Equipment Directive (RED)

Reliable and flexible echo generation

- Simulate up to four artificial objects at fixed distances at the same time
- Simulate echoes with minimum delay for SRR sensor tests and for LRR sensor tests
- Select additional Doppler offsets to simulate radial velocity¹⁾

Test today's and tomorrow's radar sensors

- Choose a 24 GHz ISM band frontend or an E-band frontend from 76 GHz to 77 GHz
- Wideband E-band frontend with 4 GHz instantaneous bandwidth for short range radar sensor tests with any FMCW or I/Q modulated radar signal¹⁾

Ready for RED²⁾

- Measure the sensor's equivalent radiated isotropic power (EIRP) in line with the applicable standards – with a connected R&S®NRP8S(N) power sensor
- Verify robustness of radar sensors to in-band interferers – with a connected analog or vector signal generator
- Measure occupied bandwidth and unwanted emissions – with a connected signal and spectrum analyzer

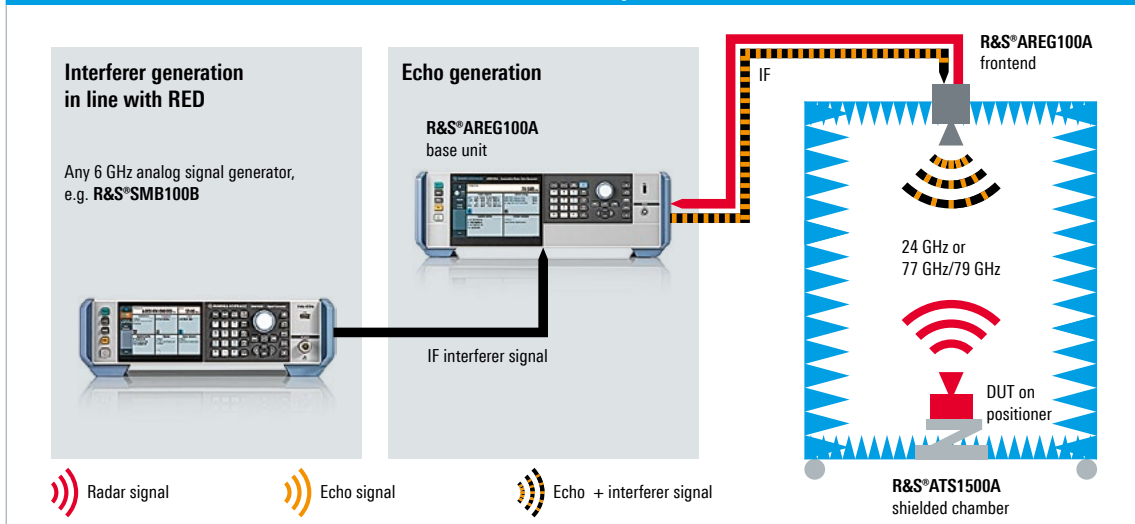
Simple and stable operation

- Linux-based operating system for maximum software stability
- Optimized for minimal footprint of just 3 HU
- SCPI macro recorder with automatic code generator
- Intuitive GUI for user-friendly operation

Models

R&S®AREG100A	Automotive radar echo generator (base unit)
+ R&S®AREG-B124S	24 GHz to 24.25 GHz, single antenna
+ R&S®AREG-B177S	76 GHz to 77 GHz, single antenna
+ R&S®AREG-B181S ¹⁾	76 GHz to 81 GHz, single antenna

Rohde & Schwarz reference solution for reliably testing the robustness of automotive radar sensors to in-band interferers as defined by RED²⁾



R&S®AFQ100A I/Q Modulation Generator, R&S®AFQ100B UWB Signal and I/Q Modulation Generator



High-performance baseband signals

Whether in the commercial or aerospace and defense field, customers require excellent signal quality, speed and high flexibility when selecting a signal source. Besides, there is a growing need for development and testing in the digital baseband domain. The signals to be created are increasingly complex and dynamic. They use complex modulation schemes and demand more and more bandwidth.

R&S®AFQ100A – fit for digital communications systems

- Variable memory clock rate (1 kHz to 300 MHz) can optimally be adjusted to the useful signal
- RF bandwidth of 200 MHz, e.g. for compensating higher-order non-linearities of multicarrier power amplifiers
- Long signal duration of up to 1 Gsample (R&S®AFQ-B11 option). Long signals are needed e.g. for bit error ratio (BER) measurements
- R&S®WinIQSIM2™ options for communications standards such as WiMAX, LTE, HSPA, etc.

R&S®AFQ100B – tailored to UWB applications

- Memory clock rate:
 - Standard mode (mode 1): variable clock rate (1 kHz to 300 MHz) can optimally be adjusted to the useful signal
 - Broadband mode (mode 2): very high clock rate of 600 MHz
- RF bandwidth:
 - Standard mode (mode 1): 200 MHz
 - Broadband mode (mode 2): 528 MHz (especially suited for UWB applications)
- Long signal duration of up to 1 Gsample (R&S®AFQ-B11 option). Long signals are needed, for example, when using multisegment waveforms to reduce switching times between different test signals
- R&S®WinIQSIM2™ option for flexible UWB (ECMA-368) signal generation (R&S®AFQ-K264)

R&S®AFQ100A and R&S®AFQ100B shared features

Aerospace and defense applications

- High bandwidth for generating very short pulses with short rise and fall times
- Accuracy < 20 ps when starting several instruments simultaneously for phased-array antenna development and testing
- Removable hard disk to meet high security requirements

Outstanding signal quality

- Excellent spurious-free dynamic range (SFDR) of up to typ. 83 dBc
- Frequency response of typ. 0.1 dB across 100 MHz I/Q bandwidth
- Frequency response compensation
- Very pure sine-wave source

Broad scope of applications

- Analog I/Q outputs (balanced and unbalanced), e.g. for D/A and A/D converter tests
- Multisegment waveform for reducing switching time between different test signals
- Numerous trigger and marker capabilities
- Optional BER measurements for characterizing receivers

Easy creation of test signals

- Digital standards using R&S®WinIQSIM2™
- MATLAB Transfer Toolbox for easy interoperability with MATLAB®
- ARB Toolbox for converting numeric I/Q data into R&S®AFQ waveform files

R&S®AFQ100A and R&S®AFQ100B can be remote-controlled via GPIB (IEC/IEEE bus), USB and LAN (Gigabit Ethernet)



Models

R&S®AFQ100A	I/Q Modulation Generator
+ R&S®AFQ-B10	Waveform memory 256 Msample
+ R&S®AFQ-B11	Waveform memory 1 Gsample
R&S®AFQ100B	UWB Signal and I/Q Modulation Generator
+ R&S®AFQ-B11	Waveform memory 1 Gsample
+ R&S®AFQ-B12	Waveform Memory 512 Msample

R&S®HMF2525/R&S®HMF2550

Arbitrary Function Generators



Accurate, versatile and affordable

- Two models: R&S®HMF2525 with 25 MHz and R&S®HMF2550 with 50 MHz maximum frequency
- 14-bit resolution and 8 ns rise time
- As well as standard waveforms such as sine, rectangle and triangle, the instruments provide powerful arbitrary signal functionality. In addition to predefined signal shapes such as sin(x)/x, white or pink noise, they can also output customer-specific, arbitrary curve shapes with a signal length of up to 256 ksample
- The burst, sweep, gating, internal and external triggering operating modes and the AM, FM, PM, PWM and FSK modulation functions (in each case internal and external) can be applied on all signals

Key facts

- Frequency range: 10 µHz to 25/50 MHz
- Triangle waveforms up to 10 MHz
- Output voltage: 5 mV to 10 V (V_{pp}) (into 50 Ω)
- Total harmonic distortion of 0.04 % (f < 100 kHz)
- Waveforms: sine, square, triangle/ramp, pulse, arbitrary (incl. predefined waveforms such as white/pink noise, cardinal sine, exponential rise/fall)
- Modulation modes: AM, FM, PWM, FSK (internal and external)
- External connectors: TRIGGER (I/O), SWEEP (O), MODULATION (I)
- External reference input/output (10 MHz) via BNC connector
- Arbitrary waveform generator: 250 Msample/s, 14 bit, 256 kpoints
- Oscillographic signal display in realtime
- Front USB connector to easily save and recall waveforms and settings
- USB/RS-232 dual interface for remote control
- Fanless design

Rear view with R&S®HO720 dual-interface, alternatively with optional R&S®HO740 IEEE-488 (GBIP) interface

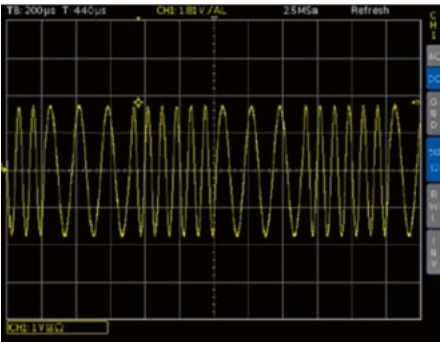


Model overview

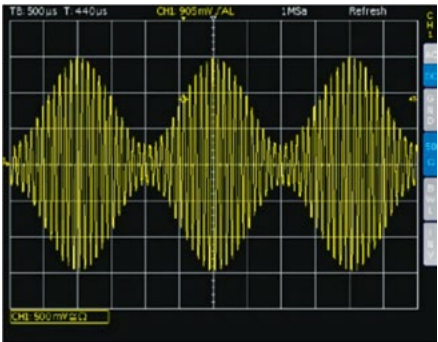
Model	Frequency range	Output voltage	Total harmonic distortion	Arbitrary waveform vertical resolution	Arbitrary waveform signal memory length	Interface
R&S®HMF2525	10 µHz to 25 MHz	5 mV to 10 V (V _{pp}) (into 50 Ω) 10 mV to 20 V (V _{pp}) (open circuit)	typ. 0.04 % (f ≤ 100 kHz)	14 bit	up to 256k points	dual-interface USB/RS-232, opt. LAN/USB or GPIB
R&S®HMF2550	10 µHz to 50 MHz	5 mV to 10 V (V _{pp}) (into 50 Ω) 10 mV to 20 V (V _{pp}) (open circuit)	typ. 0.04 % (f ≤ 100 kHz)	14 bit	up to 256k points	dual-interface USB/RS-232, opt. LAN/USB or GPIB

Signal examples

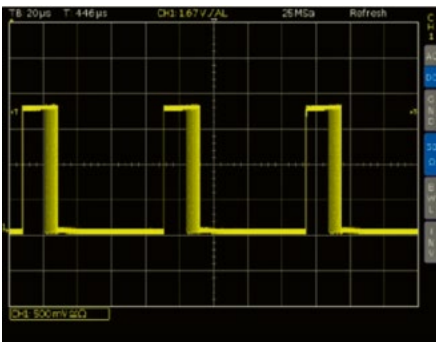
Frequency shift keying (FSK).



Amplitude modulation (AM).



Pulse width modulation (PWM).



R&S®HM8150

Arbitrary Function Generator



Product site

Versatile and price convenient

- Waveforms: sine wave, square wave, triangle, pulse, sawtooth, arbitrary
- Rise and fall time: < 10 ns
- Pulse width adjustment: 100 ns to 80 s
- Arbitrary waveform generator: 40 Msample/s
- Burst, gating, external triggering, sweep
- Free of charge software for creation of arbitrary waveforms
- External amplitude modulation (bandwidth 20 kHz)
- Intuitive operation with one touch of a button – quick change of signals

Key facts

- Frequency range: 10 mHz to 12.5 MHz
- Output voltage: 10 mV to 10 V (V_{pp}) (into 50 Ω)
- Waveforms: sine wave, square wave, triangle, pulse, sawtooth, arbitrary
- Rise and fall time: < 10 ns
- Pulse width adjustment: 100 ns to 80 s
- Arbitrary waveform generator: 40 MSample/s
- Burst, gating, external triggering, sweep
- External amplitude modulation (bandwidth 20 kHz)
- Intuitive operation with one touch of a button – quick change of signals
- USB/RS-232 dual-interface, optional IEEE-488 (GPIB) interface

Rear view with R&S®HO720 Dual-Interface, alternatively with optional R&S®HO880 IEEE-488 (GPIB) interface



Options

R&S®HO880	IEEE-488 (GPIB) interface
R&S®HZ42	19" rack adapter, 2 HU

Models overview

Model	Frequency range	Voltage output	Total harmonic distortion	DC offset	Arbitrary waveform resolution
R&S®HM8150	10 mHz to 12.5 MHz	<ul style="list-style-type: none"> ■ 10 mV to 10 V (V_{pp}) (into 50 Ω) ■ 20 mV to 20 V (V_{pp}) (open circuit) 	typ. 0.05% (f < 100 kHz)	± 75 mV to ± 7.5 V	12 bit

Application firmware packages for Rohde & Schwarz signal generators

The tables provide an overview of the digital modulation systems supported by Rohde & Schwarz signal generators and show the wide range of applications covered.

Digital standards and options for Rohde & Schwarz signal generators (internal signal generation)				
Option R&S®SMW R&S®SMBVB		R&S®SMW200A	R&S®SMBV100B	Page
-K40	GSM/EDGE	•	•	112
-K41	EDGE Evolution (incl. VAMOS)	•	•	112
-K42	3GPP FDD ¹⁾	•	•	112
-K44	GPS ¹⁾	•	•	113
-K46	CDMA2000®	•	•	114
-K47	1xEV-DO Rev. A	•	•	114
-K49	IEEE802.16	•	–	114
-K50	TD-SCDMA ¹⁾	•	•	114
-K51	TD-SCDMA enhanced BS/MS tests ¹⁾	•	•	114
-K52	DVB-H/DVB-T	•	–	115
-K54	IEEE802.11 (a/b/g/n/j/p)	•	•	115
-K59	HSPA+	–	–	112
-K60	Bluetooth® 4.2 (incl. EDR, low energy)	•	•	116
-K61	Multicarrier CW signal generation	•	•	–
-K62	Additive white Gaussian noise (AWGN)	•	–	–
-K66	Galileo	•	•	113
-K68	TETRA Release 2	•	–	117
-K69	LTE closed-loop BS test	•	–	–
-K71	Dynamic fading and enhanced resolution	•	–	–
-K72	Extended statistics functions	•	–	–
-K73	OTA-MIMO fading enhancements	•	–	–
-K74	MIMO fading	•	–	–
-K75	Higher order MIMO	•	–	–
-K76	Multiple entities	•	–	–
-K78	Radar echo generation	•	–	–
-K80	Bit error rate tester	•	–	–
-K81	LTE log file generation	•	–	112
-K83	3GPP FDD HSPA/HSDPA+, enhanced BS/MS tests	•	•	112
-K84	LTE Release 9 and enhanced features	•	•	116
-K85	LTE Release 10 (LTE-Advanced)	•	•	116
-K86	IEEE802.11ac	•	•	115
-K87	1xEV-DO Rev. B	•	•	114
-K89	NFC A/B/F	•	–	117
-K94	GLONASS	•	•	113
-K98	Modernized GPS	•	•	113
-K99	Extension to 48 channels per baseband	•	•	–
-K106	SBAS/QZSS	•	•	113
-K107	BeiDou	•	•	113
-K108	Real world scenarios	•	•	–
-K109	GNSS realtime interfaces (RT remote control)	•	•	–
-K111	GBAS	–	•	113
-K112	LTE Release 11 and enhanced features	•	•	116
-K113	EUTRA/LTE Release 12	•	•	116
-K114	OFDM signal generation	•	•	118
-K115	Cellular IoT	•	•	118
-K116	DVB-S2/DVB-S2X	•	–	119

Digital standards and options for Rohde&Schwarz signal generators (internal signal generation)				
Option R&S®SMW R&S®SMBVB		R&S®SMW200A	R&S®SMBV100B	Page
-K117	Bluetooth® 5.0	•	•	116
-K118	Verizon 5GTF signals	•	–	–
-K119	LTE Release 13 and 14	•	•	119
-K120	Advanced GNSS applications	•	–	–
-K130	OneWeb user-defined signal generation	•	–	119
-K141	IEEE 802.11ad	•	–	120
-K142	IEEE 802.11ax	•	•	115
-K143	Cellular IoT enhancements	•	–	–
-K144	5G New Radio	•	•	120
-K151	ILS	–	•	–
-K152	VOR	–	•	–
-K153	DME	–	•	–
-K355	OneWeb reference signals	•	–	–
-K360	ERA-GLONASS test suite	–	•	–
-K361	eCall test suite	–	•	–
-K362	GNSS test suite	–	•	–
-K542	Baseband power sweep	•	–	–
-K550	Stream extender	•	–	–
-K820	Customized dynamic fading	•	–	–
-K821	MIMO subsets for higher-order MIMO	•	–	–

¹⁾ Functionality is instrument-specific.

• Available – Not usable

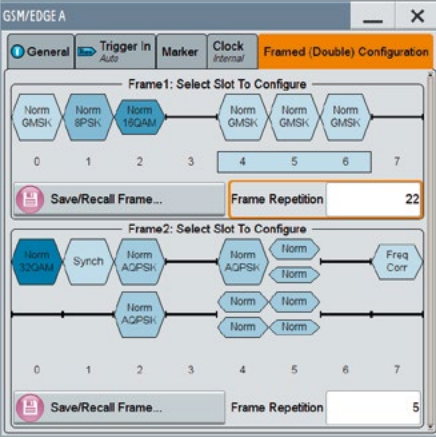
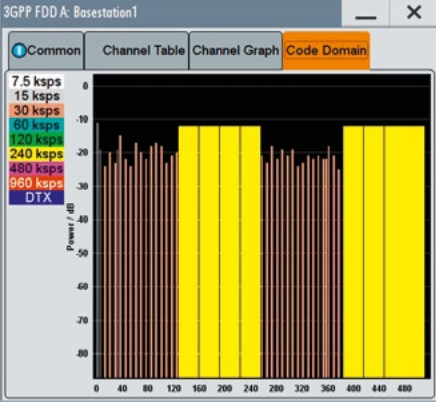
Digital standards and options for Rohde & Schwarz signal generators (R&S®WinIQSIM2™ – see page 121)							
Option R&S®SMW R&S®SMBVB R&S®SGT R&S®AFQ		R&S®SMW200A	R&S®SMBV100B	R&S®SGT100A	R&S®AFQ100A	R&S®AFQ100B	Page
-K240	GSM/EDGE	•	•	•	•	•	112
-K241	EDGE Evolution (incl. VAMOS)	•	•	•	•	•	112
-K242	3GPP FDD	•	•	•	•	•	112
-K243	3GPP enhanced BS/MS tests incl. HSDPA	–	–	–	•	•	–
-K244	GPS ²⁾	•	•	•	•	•	113
-K245	3GPP FDD HSUPA	–	–	–	•	•	112
-K246	CDMA2000®	•	•	•	•	•	114
-K247	1xEV-DO Rev. A	•	•	•	•	•	114
-K248	IEEE802.11 (a/b/g)	–	–	–	•	•	–
-K249	IEEE802.16	•	–	•	•	•	114
-K250	TD-SCDMA	•	•	•	•	•	114
-K251	TD-SCDMA enhanced BS/MS test	•	•	•	•	•	114
-K252	DVB-H/DVB-T	•	•	•	•	•	115
-K253	DAB/T-DMB	•	•	•	•	•	–
-K254	IEEE802.11 (a/b/g/n/j/p)	•	•	•	•	•	115
-K255	EUTRA/LTE	•	•	•	•	•	119
-K259	HSPA+	–	–	–	•	•	112
-K260	Bluetooth® (incl. EDR, low energy)	•	•	•	•	•	–
-K261	Multicarrier CW	•	•	•	•	•	–
-K262	Additive white Gaussian noise (AWGN)	•	•	•	•	•	–
-K264	ECMA-368 IEEE 802.15.3a (UWB)	–	–	–	–	•	–
-K266	Galileo ²⁾	•	•	•	•	•	113
-K268	TETRA release 2	•	–	•	•	•	117
-K283	3GPP FDD HSPA/HSDPA+, enhanced BS/MS tests	•	•	•	–	–	112
-K284	LTE release 9 and enhanced features	•	•	•	•	•	116
-K285	LTE release 10/LTE-Advanced	•	•	•	•	•	116
-K286	IEEE802.11ac	•	•	•	•	•	115
-K287	1xEV-DO Rev. B	•	•	•	•	•	114
-K289	NFC A/B/F	•	•	•	•	•	117
-K294	GLONASS ²⁾	•	•	•	•	•	113
-K298	Modernized GPS ²⁾	•	–	–	–	–	113
-K407	BeiDou ²⁾	•	•	–	–	–	113
-K412	LTE release 11 and enhanced features	•	•	•	•	•	116
-K413	EUTRA/LTE release 12	•	•	•	•	•	–
-K414	OFDM signal generation	•	•	•	–	–	118
-K415	Cellular IoT	•	•	•	•	•	118
-K416	DVB-S2/DVB-S2X	•	•	•	–	–	119
-K417	Bluetooth® 5.0	•	•	•	–	–	116
-K418	Verizon 5GTF	•	•	•	•	•	–
-K419	LTE release 13/14	•	•	•	•	•	119
-K430	OneWeb user-defined signal generation	•	–	–	–	–	119
-K441	IEEE 802.11ad	•	–	–	–	–	120
-K442	IEEE 802.11ax	•	•	•	•	•	–
-K443	Cellular IoT enhancements	–	•	•	–	–	–
-K444	5G New Radio	•	•	•	–	–	120

Digital standards and options for Rohde & Schwarz signal generators (external PC software or waveforms)							
Option R&S®SMW R&S®SMBVB R&S®SGT R&S®AFQ		R&S®SMW200A	R&S®SMBV100B	R&S®SGT100A	R&S®AFQ100A	R&S®AFQ100B	Page
-K256	Playback of XM radio waveforms	–	•	–	•	•	115
-K300	Pulse sequencer	•	•	•	–	–	121
-K301	Enhanced pulse sequencer	•	•	•	–	–	121
-K304	Moving emitters and receivers	•	–	–	–	–	–
-K306	Multiple emitters	•	–	–	–	–	–
-K308	Direction finding	•	•	•	–	–	122
-K350	DFS signal generation	•	•	•	–	–	122
-K352	Playback of HD Radio™ waveforms	–	•	–	•	•	115
-K353	DAB+ streams	–	•	–	–	–	115
-K354	T-DMB/DAB streams	–	•	–	–	–	115
-K355	OneWeb Reference Signals	•	–	–	–	–	119
-K501	Extended sequencing	•	–	–	–	–	123
-K502	Wideband extended sequencing	•	–	–	–	–	123
-K503	Realtime control interface	•	–	–	–	–	123
-K504	Extended pulse rate	•	–	–	–	–	123

²⁾ One satellite only.

• Available – Not usable

Application-specific solutions

General measurement applications		
R&S®SMW/R&S®SMBVB-K40/-K41/-K240/-K241 GSM/EDGE/EDGE Evolution		
		
GSM/EDGE signal generation With the R&S®SMW/R&S®SMBVB-K40 option, GSM/EDGE signals can be generated in realtime, whereas the type of modulation can be changed from slot to slot. In addition, eight different power levels can be defined for the timeslots. All necessary burst types (e.g. normal (full and half rate), EDGE, synchronization, access) are supported.		The R&S®SMW/R&S®SMBVB-K41 option adds EDGE Evolution and VAMOS features such as: <ul style="list-style-type: none"> ■ Higher symbol rate (325 kHz) ■ Higher-order modulation types: 16QAM, 32QAM ■ Mixed frames with GSM, EDGE and EGPRS2 slots in one frame (with same symbol rate per frame) ■ “Framed double” sequence mode for generation of realistic test scenarios with changing frame content ■ Adaptive QPSK (AQPSK) modulation scheme
R&S®SMW/R&S®SMBVB-K42/-K59/-K83/-K242/-K259/-K283 3GPP FDD/HSPA/HSPA+		
		
3GPP signal generation These options provide signal generation capabilities in line with 3GPP FDD Release 11, including HSDPA, HSUPA and HSPA+. The R&S®SMW/R&S®SMBVB options combine realtime operation and arbitrary waveform mode for realtime generation of the P-CCPCH and up to three DPCHs in the downlink, for example. In the uplink, one UE can be simulated in realtime; up to 128 UEs can be simulated via the ARB and added to the realtime signal.		The R&S®SMBVB-K59 HSPA+ option supports higher-order modulation (64QAM) for higher data rates, multiple input multiple output (MIMO) for higher data throughput in the downlink and continuous packet connectivity (CPC) for reduction of latency and control information overhead. The R&S®SMW-K83 combines the functionality of the R&S®SMBVB-K43/-K45 and R&S®SMBVB-K59 in one option for the R&S®SMW200A

General measurement applications

R&S®SMW-K44/-K66/-K94/-K98/-K106/-K107/-K244/-K266/-K294/-K298/-K407

GNSS Simulation with GPS, Galileo, GLONASS, BeiDou including Augmentation Systems (QZSS, SBAS, GBAS)



GNSS simulation

The R&S®SMW200A can be turned into a powerful and feature-rich GNSS simulator. With its capability to simulate multi-constellation and multi-frequency (MCMF), multi-antenna and multi-vehicle scenarios, the R&S®SMW200A is able to cover a variety of high-end GNSS applications. Hybrid GNSS satellite constellations with up to 24 satellites per baseband in combination with options R&S®SMW-K44, R&S®SMW-K66, R&S®SMW-K94, R&S®SMW-K98, R&S®SMW-K106 and/or R&S®SMW-K107.

R&S®SMW-K44/-K244 for GPS

The R&S®SMW-K44 allows to simulate up to 24 GPS satellites in the frequency bands L1 and/or L2.

R&S®SMW-K66/-K266 for Galileo

The R&S®SMW-K66 allows to simulate up to 24 Galileo satellites in the E1 frequency band.

R&S®SMW-K94/-K244 for GLONASS

The R&S®SMW-K94 allows to simulate up to 24 Glonass satellites in the frequency bands L1 and/or L2.

R&S®SMW-K98/-K244 for Galileo

The R&S®SMW-K98 allows to simulate up to 24 satellites transmitting modernized GPS signals in the L2 frequency band.

R&S®SMW-K106 for SBAS/QZSS

The R&S®SMW-K106 allows to simulate SBAS and QZSS satellites in the L1 frequency band.

R&S®SMW-K107/-K244 for BeiDou

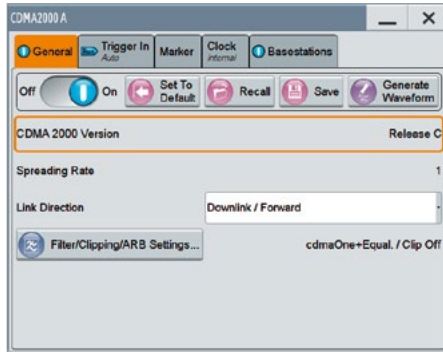
The R&S®SMW-K107 allows to simulate up to 24 BeiDou satellites in the frequency bands B1 and/or B2.

Key facts

- Support of GPS L1/L2 (C/A and P code), GLONASS L1/L2, Galileo E1, BeiDou B1/B2 and QZSS/SBAS L1, including hybrid constellations
- Realtime simulation of realistic constellations with up to 24 satellites and unlimited simulation time
- Flexible scenario generation including moving scenarios, dynamic power control and atmospheric modeling
- Configuration of realistic user environments, including obscuration and multipath, antenna characteristics and vehicle attitude
- Static mode for basic receiver testing using signals with zero or constant Doppler shift
- Support of Assisted GNSS (A-GNSS) test scenarios, including generation of assistance data for GPS, GLONASS, Galileo, BeiDou and QZSS/SBAS
- Realtime external trajectory feed for hardware in the loop (HIL) applications
- Logging of simulation data
- High signal dynamics, simulation of spinning vehicles and precision code (P code) simulations to support aerospace and defense applications
- Enhanced simulation capabilities for aerospace applications by supporting ground-based augmentation systems (GBAS)
- Support of other digital communications and radio standards in the same instrument

General measurement applications

R&S®SMW/R&S®SMBVB-K46/-K47/-K87 CDMA2000® incl. 1xEV-DV and 1xEV-DO



CDMA2000®, 1xEV-DV and 1xEV-DO signal generation

The R&S®SMW/R&S®SMBVB-K46 option generates signals for CDMA2000®, the North American standard for the third mobile radio generation including IS-95 as a subset. Even signals for 1xEV-DV can be generated using R&S®SMW/R&S®SMBVB-K46.

R&S®SMW/R&S®SMBVB-K46 option for generating CDMA2000® signals

- Configuration of up to four base stations or four mobile stations
- All special channels and up to 78 channels in the downlink (depending on radio configuration)
- Packet channel in line with 1xEV-DV in the downlink
- Operating modes in the uplink: traffic, access, enhanced access and common control
- Simulation of up to 64 additional mobile stations
- All channel coding modes included in IS-2000 (frame quality indicator, convolutional encoder, turbo encoder, symbol puncture, interleaver, etc.)

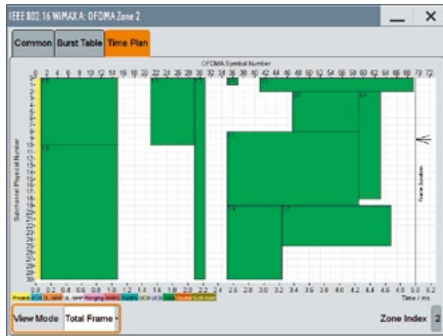
R&S®SMW/R&S®SMBVB-K47 option for generating signals for 1xEV-DO (Rev. A)

- Simulation of up to four users in the downlink and up to four terminals in the uplink
- Physical layer subtypes 0 and 1 or 2 selectable
- Downlink data rate selectable through rate index and packet size
- Matrix for reverse power control (RPC) allowing flexible testing of power control
- Traffic and access mode in the uplink; automatic setting of different data rates and modulations by selected payload size

R&S®SMW/R&S®SMBVB-K87 option for generating signals for 1xEV-DO (Rev. B)

- Independent configuration of up to four traffic channels in the downlink or four access terminals in the uplink
- Support of physical layer subtypes 0, 1, 2 and 3
- Support of multicarrier operation with up to 16 simultaneous carriers
- Operating modes in the uplink: traffic and access
- Simulation of up to 360 additional MAC users
- Supports configuration of public data as defined in the standard, such as long code masks for I and Q channel, preamble length, DRC length

R&S®SMW/R&S®SMBVB-K49 WiMAX™ Signal Generation



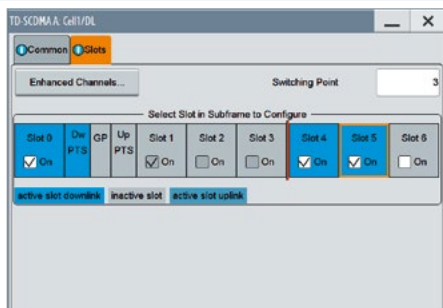
WiMAX™ signal generation

The R&S®SMW/R&S®SMBVB-K49 option allows convenient generation of OFDM and OFDMA signals in line with WiMAX™ IEEE802.16 Rev. 2 (incl. WiBro) as well as WiMAX™ IEEE802.16-2004 and IEEE802.16e-2005 standards. It covers uplink and downlink as well as SISO and MIMO signal generation.

Key facts

- Full CC and CTC channel coding
- FCH, DL-MAP and UL-MAP, either automatic or user-defined
- DCD, UCD, submaps
- HARQ, ranging and fast feedback bursts
- Optional generic MAC headers and CRC for each burst
- Predefined frames for receiver tests
- Subchannelization modes
- Space time coding for up to four antennas (matrix A, B, C, collaborative spatial multiplexing, CSTD)
- Multiple zones and segments

R&S®SMW/R&S®SMBVB-K50/-K51 TD-SCDMA Signal Generation



TD-SCDMA signal generation

The combination of the R&S®SMW/R&S®SMBVB-K50 and -K51 options offers easy, flexible configuration of realtime, fully coded (transport and physical layer) TD-SCDMA (3GPP TDD LCR) test signals for evaluating components, power amplifiers, digital baseband receiver chips and RF receivers in user equipment and base stations. The TD-SCDMA signal generation is in accordance with 3GPP TDD LCR with a chip rate of 1.28 Mcps (low chip rate mode) and contains the HSDPA and HSUPA functionality for TD-SCDMA.

R&S®SMW/R&S®SMBVB-K50 TD-SCDMA functionality

- Simulation of up to four TD-SCDMA cells with variable switching point of uplink and downlink
- User-configurable channel table for each slot and simulation of downlink and uplink pilot timeslot
- PRACH can be generated in the uplink

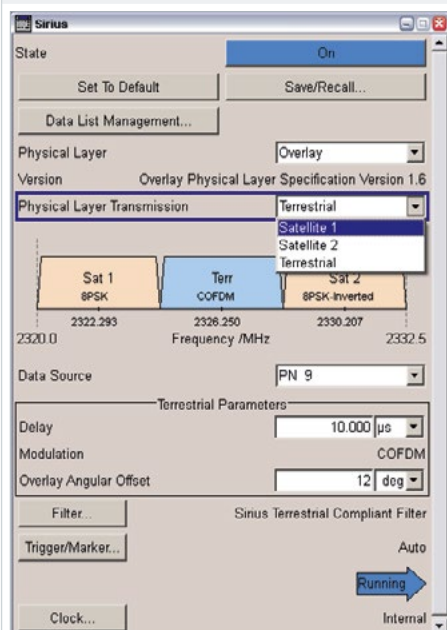
R&S®SMW/R&S®SMBVB TD-SCDMA enhanced functionality

- Enhancing R&S®SMW/R&S®SMBVB-K50 to support full channel coding in fixed coding schemes and user-defined coding schemes, HSDPA and HSUPA
- Simulation of up to four TD-SCDMA cells with generation of the coded P-CCPCH (BCH with running SFN) in the downlink
- Fixed reference measurement channels RMC 12.2 kbps to RMC 384 kbps in both uplink and downlink; user configuration supported
- Simulation of HSDPA channels HS-SCCH, HS-PDSCH, HS-SICH and H-RMC 0.5 Mbps, 1.1 Mbps, 1.6 Mbps, 2.2 Mbps, 2.8 Mbps (QPSK and 16QAM), H-RMC 64QAM; user configuration supported
- Simulation of HSUPA channels E-DCH FRC from 1 to 4 (QPSK and 16QAM); user configuration supported

General measurement applications

R&S®SMBVB-K52/-K57/-K58/-K256/-K352/-K353/-K354

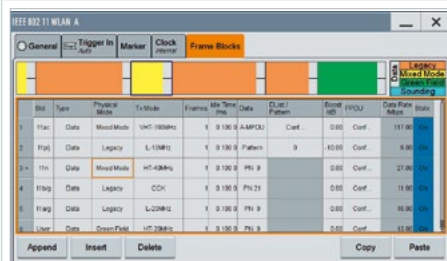
DVB-H/DVB-T, DAB/T-DMB, XM Radio, FM Stereo/RDS, Sirius, HD Radio™



Signal generation options for radio and video standards

- Testing mobile communications standards (such as WCDMA 3GPP FDD, TD-SCDMA, GSM/EDGE) and video standards with only one signal generator
- Realtime signal generation for the XM Radio and Sirius standards
- Solution tested and approved by Sirius for software testing and for manufacturing
- R&S®SMBVB-K352 option for playback of all test vectors as supplied by iBiquity (iBiquity license required)
- Realtime generation of FM stereo signals; closed-loop testing with R&S®UPV or R&S®UPP audio analyzers possible

R&S®SMW/R&S®SMBVB-K54/-K86/-K142 IEEE 802.11a/b/g/n/j/p/ac/ax



WLAN signal generation

The R&S®SMW/SMBV/SMBVB-K54 option allows the generation of signals in line with the IEEE 802.11a/b/g/n/j/p WLAN standards.

The options R&S®SMW/SMBV/SMBVB-K86 and R&S®SMW/SMBV-K142 enable the signal generation for IEEE 802.11ac and 802.11ax (both options require R&S®SMW/SMBV/SMBVB-K54). The integrated frame block sequencer allows to generate a sequence of cascaded frame blocks with different WLAN modes, configurations and data rates for realistic WLAN scenario simulation. Simple diversity and static MIMO tests are possible without additional channel simulator. Simulation of realtime MIMO channel condition is possible for instruments equipped with the R&S®SMW-B14 (2x or 4x)/R&S®SMW-K74 fading options. The number of spatial streams, space time streams and additional spatial streams is configurable as well as the modulation type per spatial stream.

R&S®SMW/R&S®SMBVB-K54 for IEEE 802.11a/b/g/j/p

- Physical layer modes: OFDM (IEEE 802.11a/g/j/p) and CCK/PBCC (IEEE 802.11b/g)
- Data scrambling can be activated or deactivated (CCK/PBCC), and initial scrambler state can be set randomly or to a user-defined value (OFDM)

R&S®SMW/R&S®SMBVB-K54 for IEEE 802.11n

- Support of all mandatory physical layer modes: HT-20 MHz, HT-40 MHz, HT-Duplicate, HT-Upper, HT-Lower
- BPSK, QPSK, 16QAM and 64QAM modulation
- Additional support of the CCK and PBCC frames in accordance with IEEE 802.11a/b/g standard

R&S®SMW/R&S®SMBVB-K86 for IEEE 802.11ac

- Support of all mandatory physical layer modes: VHT-20 MHz, VHT-40 MHz, VHT-80 MHz, VHT-80+80 MHz and VHT-160 MHz
- BPSK, QPSK, 16QAM, 64QAM and 256QAM modulation

R&S®SMW/R&S®SMBVB-K142 for IEEE 802.11ax

- Support of all mandatory physical layer modes: HE-20 MHz, HE-40 MHz, HE-80 MHz, HE-80+80 MHz and HE-160 MHz
- BPSK, QPSK, 16QAM, 64QAM, 256QAM and 1024QAM modulation

General measurement applications

R&S®SMW/R&S®SMBVB-K55/-K69/-K81/-K84/-K85/-K112/-K113 LTE Signal Generation

R&S®SMBVB-K55/-K81/-K84/-K85/-K112/-K113 LTE Signal Generation



LTE receiver and performance testing

The LTE signal generation options allow comprehensive LTE testing of base stations, mobile devices, modules and components.

R&S®SMW/R&S®SMBVB-K55, general features

- In line with 3GPP LTE Release 8
- FDD and TDD
- Downlink (OFDMA) and uplink (SC-FDMA)

R&S®SMW/R&S®SMBVB-K55 LTE downlink functionality

- PBCH, PDSCH, PDCCH, PCFICH, PHICH
- Full MIMO and TX diversity support
- P-SYNC, S-SYNC and DL reference signals
- Channel coding and scrambling for PDSCH/PBCH
- Predefined test models
- LTE test case wizard

R&S®SMW/R&S®SMBVB-K55 LTE uplink functionality

- PUSCH incl. channel coding, scrambling and multiplexing
- PUCCH, PRACH
- Demodulation and sounding reference signals
- PUSCH frequency hopping type 1 and type 2
- Group and sequence hopping

R&S®SMW-K69 (together with R&S®SMW-K55)

- Support of uplink closed-loop base station tests in line with 3GPP TS 36.141
- Realtime processing of feedback commands for HARQ feedback, timing adjustment and timing advance

R&S®SMW-K81 (together with R&S®SMW-K55)

- Output of log files with intermediate results (bits/symbols) from the signal generation chain
- Generation of summary log files with LTE signal description

R&S®SMW/R&S®SMBVB-K84 (together with R&S®SMW/R&S®SMBVB-K55)

- In line with 3GPP LTE Release 9
- MBMS/MBSFN subframes including PMCH
- Downlink positioning reference signals (PRS)
- Dual-layer beamforming (TX mode 8)
- Mapping of logical antenna ports to physical TX antennas

R&S®SMW/R&S®SMBVB-K85 (together with R&S®SMW/R&S®SMBVB-K55)

- In line with 3GPP LTE Release 10/ LTE-Advanced
- Carrier aggregation
- Enhanced SC-FDMA
- PUSCH/PUCCH synchronous transmission
- Clustered PUSCH
- PUCCH format 3
- Generation of CSI reference signals
- Eight-layer transmission (TX mode 9)
- UL-MIMO

R&S®SMW/R&S®SMBVB-K112 (together with R&S®SMW/R&S®SMBVB-K55)

- In line with 3GPP LTE Release 11
- TDD special subframe configurations
- DL auto sequence (enhanced Auto DCI)

R&S®SMW/R&S®SMBVB-K113 (together with R&S®SMW/R&S®SMBVB-K55)

- In line with 3GPP LTE Release 12
- LTE FDD and TD-LTE support
- Uplink and downlink signal generation
- 256QAM in downlink

R&S®SMW/R&S®SMBVB-K60/-K117 Bluetooth® V 4.2 incl. EDR and LE / V 5.0



Bluetooth® 4.2 including EDR and LE and Bluetooth® 5.0

The R&S®SMW/R&S®SMBVB-K60 option enables the signal generator to generate Bluetooth® signals in accordance with Bluetooth® specification 4.2 including enhanced data rate (EDR) and low energy (LE).

The option R&S®SMW/R&S®SMBVB-K117 (requires option R&S®SMW/R&S®SMBVB-K60), covers all improvements compared to Bluetooth® 4.2.

R&S®SMW/R&S®SMBVB-K60 for Bluetooth® 4.2

- In line with Bluetooth® specification 4.2, including enhanced data rate (EDR) and low energy (LE) mode
- Support of all three transport modes, in particular ACL+EDR, SCO and eSCO+EDR
- Support of all packet types for basic rate and enhanced data rate (EDR) modes
- Automatic selection of modulation type according to chosen packet type

R&S®SMW/R&S®SMBVB-K117 for Bluetooth® 5.0

- Further improvements of several low energy characteristics for IoT applications
- Quadruple the range (LE long range)
- Double the speed (2 Msps)
- Increase data broadcasting capacity by 800% (LE advertising extensions)

General measurement applications

R&S®SMW-B14/-K62/-K71/-K72/-K73/-K74/-K75/-K76 Multipath and Channel Simulation



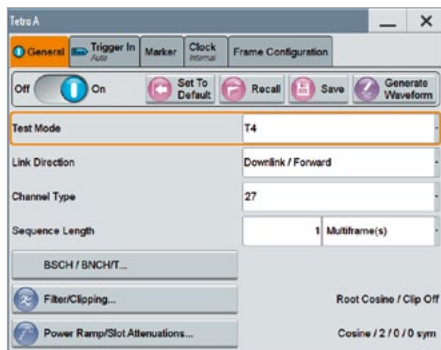
Multichannel, fading and interference simulation with the R&S®SMW200A

The multipath R&S®SMW200A can simulate up to 8 SISO channels as well as sophisticated MIMO channels. It is a cost-effective and powerful solution for testing the behavior of products under realistic transmission conditions. The R&S®SMW200A fading simulator allows emulation of both static and dynamically changing fading conditions ones. Complex correlation between the fading paths, geometric antenna setup definition (via AoA/AoD) as well as channel matrix inversion and user defined antenna patterns for OTA-MIMO are supported. Together with the AWGN simulation capability, the signal generator is ideal for performance tests in line with all important digital communications standards as well as multistandard radio (MSR) test scenarios.

Channel simulation options

- R&S®SMW-B14: Fading simulator
- R&S®SMW-K62: AWGN
- R&S®SMW-K71: Dynamic fading and enhanced resolution
- R&S®SMW-K72: Extended statistics functions
- R&S®SMW-K73: OTA-MIMO enhancements
- R&S®SMW-K74: MIMO fading
- R&S®SMW-K75: Higher order MIMO
- R&S®SMW-K76: Multiple entities

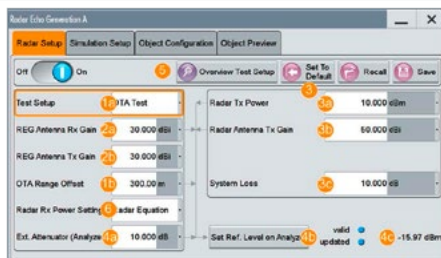
R&S®SMW/R&S®SMBVB-K68 TETRA Release 2 Signal Generation



TETRA Release 2 digital standard

- In line with ETSI EN 300392-2 digital standard (V3.2.1) and TETRA conformance testing specification ETSI EN300394-1 (V3.1.1)
- Link direction: downlink and uplink (not for T3)
- T1 downlink channels 0, 1, 2, 3, 4, 21, 22, 24
- T1 uplink channels 7, 8, 9, 10, 11, 21, 23, 24
- T2 TETRA interferer phase modulation, QAM
- T3 CW interferer
- T4 downlink channel 27
- T4 uplink channels 25, 26

R&S®SMW-K78 Radar Echo Generation



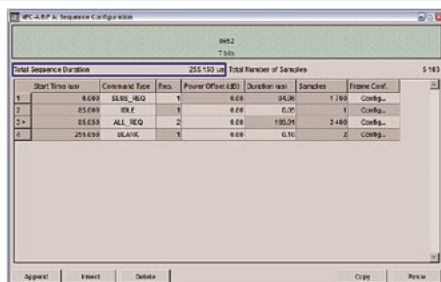
Radar echo generation

The R&S®SMW-K78 radar echo generation option, in conjunction with the R&S®SMW200A vector signal generator and the R&S®FSW spectrum and signal analyzer, makes it possible to artificially generate radar signal echoes. These tests can be performed via a wired connection (conducted test) or via the air interface (over the air test), eliminating much of the need for time-consuming and costly field tests.

Key facts

- Realtime capability for echo generation
- Simulation of up to 24 independent virtual static or moving objects
- 160 MHz RF bandwidth throughout the entire frequency range up to 40 GHz
- Possibility to add interferers and noise
- Internal generator solution, no need for external PC
- Intuitive and easy-to-use graphical user interface

R&S®SMW/R&S®SMBVB-K89 NFC A/B/F Digital Standard



NFC A/B/F signal generation

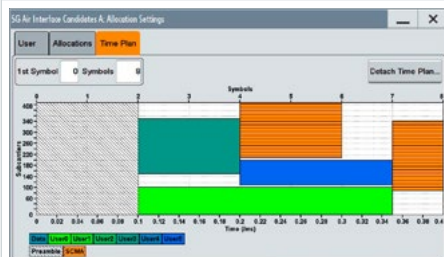
NFC is based on RFID technology and makes mobile phones suitable for numerous applications including, for example, contactless payment of tickets, downloading of information from a passive RFID tag, use as security ID, etc. Other than with RFID, some devices can also act as a reader (poller) and as a listener. There are three types of NFC, all working on the same frequency of 13.56 MHz but with different data rates and modulation characteristics: NFC-A, NFC-B and NFC-F. The R&S®SMW/SMBV-K89 supports all three.

Key facts

- Standard-conforming signals for NFC A/B/F
- Sequence generator with all signals from standard
- Predefined sequences for polling applications
- Flexible definition for pulse forms
- Support for EMV type A and EMV type B

General measurement applications

R&S®SMW-K114 OFDM Signal Generation



OFDM signal generation

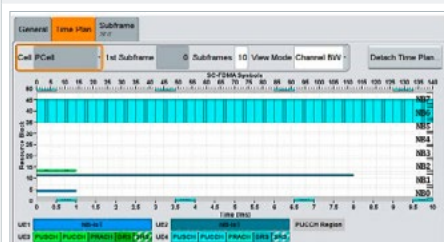
The R&S®SMW200A vector signal generator is the ideal tool for early 5G physical layer testing. Using the R&S®SMW-K114 option, the R&S®SMW200A flexibly generates customized 5G air interface candidate signals. The user can choose from various waveform types such as GFDM, FBMC, UFMC or f-OFDM and parameterize the signals as desired. Pulse shaping filters, subcarrier spacing and the number of carriers can be set. Preamble generation, a configurable cyclic prefix length and support for sparse code multiple access (SCMA) allow the testing of components or receivers with realistic pre-5G physical layer signals. Direct internal signal generation – without the need for any external PC software – helps to speed up the signal creation process.

Optionally, the R&S®SMW200A can also be equipped with a second signal generation path. This allows simultaneous generation of a 5G candidate signal and a legacy LTE signal from a single signal generator without complicated synchronization of multiple separate signal sources. Interdependencies between LTE and 5G are hence quickly simulated. And interference that occurs in the device under test (DUT) due to the simultaneous presence of 5G and LTE are easily discovered.

Key facts

- Create customized 5G signals
- GFDM, UFMC, FBMC, f-OFDM
- Sparse code multiple access (SCMA)
- Easy waveform parameterization
- Allocation time plan for visualization
- PN sequences, data patterns or user data lists
- BPSK, QPSK, 16QAM, 64QAM, 256QAM

R&S®SMW-K115 Cellular IOT



Cellular IOT

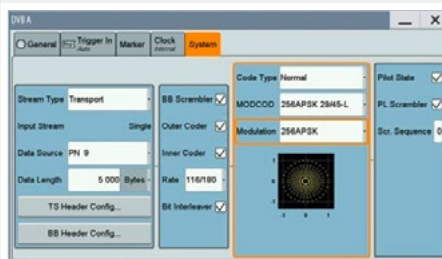
The R&S®SMW-K115 option cellular IOT enhances the R&S®SMW200A vector signal generator with the capability to generate Cat-M1 and Cat-NB1 uplink signals.

Key facts

- Generation of eMTC and NB-IoT uplink signals
- eMTC mode: in-band
- SCFDMA 15 kHz tone spacing
- NB-IoT mode
 - In-band; guard band; standalone
 - Single tone, 15 kHz/3.75 kHz
 - SCFDMA 15 kHz tone spacing
- Frequency hopping

General measurement applications

R&S®SMW-K116 DVB-S2/DVB-S2X



DVB-S2/DVB-S2X physical layer testing

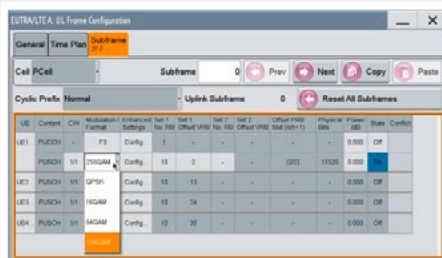
The R&S®SMW200A vector signal generator is the ideal tool for DVB-S2/DVB-S2X physical layer testing. By means of the R&S®SMW-K116 option, the R&S®SMW200A flexibly generates customized DVB-S2/DVB-S2X signals.

DVB-S2 is the common standard for providing TV program from satellites to millions of homes. The physical parameters of the signals are defined to ideally fit the satellite to ground links. Thus the DVB-S2 modulation scheme is not only used for TV broadcast but also for many other professional satellite data services for enterprises, in-flight entertainment, maritime, military and government applications. With DVB-S2X as the newest version higher order modulation schemes are added to increase the data rate in a given frequency band. The standard TV transmission is in the Ku band and other satellite links using the same physical layer are typically in the Ka band. Both are directly addressed with the microwave frequency options of the R&S®SMW200A up to 40 GHz.

Key facts

- Fully encoded DVB-S2 and DVB-S2X signal generation
- Support of transport stream (TS), generic packetized (GP), generic continuous (GC), generic stream encapsulated high efficiency mode
- Signal generation from arbitrary data sources and TS or GSE files
- Maximum symbol rate of up to 600 MHz
- Channel coding according to the standard, incl. scrambling, interleaving, outer code (BCH), inner code (LDPC) with varying code rates from 1/4 to 31/45
- Support of all specified Walsh-Hadamard sequences for VL-SNR (very low signal-to-noise ratio) mode
- Configurable header information, incl. baseband (BB) header, VL-SNR header, TS header, GSE header
- Supported modulation schemes:
 - For DVB-S2: QPSK, 8PSK, 16APSK, 32APSK
 - For DVB-S2X: QPSK, 8APSK, 8PSK, 16APSK, 32APSK, 64APSK, 128APSK, 256APSK
 - For VL-SNR: QPSK, $\pi/2$ BPSK
- Pilot insertion and configuration
- Signals suitable for testing of satellite transponders, components and ground modems

R&S®SMW-K119 EUTRA/LTE Release 13/14



EUTRA/LTE release 13/14

The additions in 3GPP LTE Releases 13 and 14 – also referred to as “LTE-Advanced Pro” – further enhance the LTE standard to improve its overall efficiency. The releases incorporate important technological steps on the evolution path from LTE to 5G, such as further carrier aggregation enhancements, licensed assisted access (LAA) or 256QAM in uplink direction.

By means of the R&S®SMW-K119 option the Vector Signal Generator R&S®SMW200A generates physical layer signals in line with 3GPP LTE Releases 13 and 14.

The R&S®SMW-K119 option requires the R&S®SMW-K55 LTE option. Downlink SCell LAA functionality additionally requires R&S®SMW-K85 option.

Key facts

- In line with 3GPP LTE Release 13 and 14
- LTE FDD and TD-LTE support
- Uplink and downlink signal generation
- 256QAM in uplink for PUSCH
- Frame structure type 3 for downlink licensed assisted access (LAA)
- Discovery reference signal (DRS) for downlink licensed assisted access (LAA)
- DCI format 1C support for downlink licensed assisted access (LAA)

R&S®SMW-K130 OneWeb User-Defined Signal Generation



OneWeb user-defined signal generation

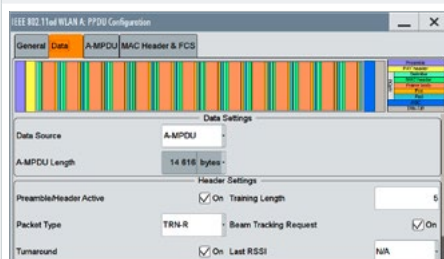
The R&S®SMW-K130 option allows users to easily generate standard-compliant OneWeb signals. This option support both forward link and reverse link. Users have access to all relevant setting parameters for these transmission links. It supports a single-carrier scenario for the forward link with an occupied bandwidth of 250 MHz. For the reverse link, users can configure single-carrier scenarios with a 20 MHz carrier. Multi-carrier scenarios for the reverse link can be generated by using carrier aggregation.

Key facts

- Fully standard-compliant OneWeb signal generation
- Highest flexibility for customized signal design
- Signal generation for forward link (SC-TDM) and reverse link (SC-FDMA)
- Support of forward link and reverse link parameter settings
- Define multicarrier scenarios for reverse link
- Single carrier scenarios for forward link
- Test of receivers in user terminal, ground station and satellite payload
- Test of RF components, ground stations, satellite payloads and user terminals

General measurement applications

R&S®SMW-K141 IEEE802.11ad

**Physical layer signals in line with IEEE802.11ad**

The R&S®SMW-K141 option enables the R&S®SMW200A with R&S®SMW-B9 wideband baseband option to generate physical layer signals in line with the IEEE802.11ad standard.

The R&S®SMW200A excels with extraordinary flat frequency response over 2 GHz bandwidth – and that without the need for a special external calibration procedure. Baseband signals or IF signals at frequencies up to 40 GHz (depending on the R&S®SMW frequency option) are directly available at high quality out of a single instrument.

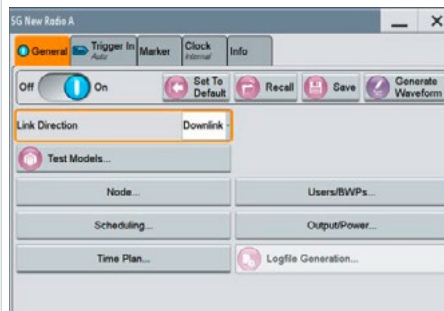
As a result, the R&S®SMW200A instantly delivers outstanding EVM performance for IEEE802.11ad signals. The user has full control over the IEEE802.11ad signal configuration and does not need to run any tedious calibration of the test setup – not when setting up the signal scenario the first time nor when changing signal parameters, signal content, level or frequency while working.

Key facts

- PHY modes: single carrier and control
- Modulation and coding schemes (MCS) 0 to 12
- DBPSK, $\pi/2$ -BPSK, $\pi/2$ -QPSK, $\pi/2$ -16QAM
- LDPC channel coding and scrambling
- MAC header and FCS support
- Data source: All 1, All 0, pattern, PN sequences, data list
- A-MPDU support (up to 64 MDPUs)
- Settable last RSSI value (for single carrier signal)
- Support for training sequences TRN-T and TRN-R with settable length

R&S®SMW/R&S®SMBVB-K144 5G New Radio

R&S®SMW/R&S®SMBVB/R&S®SGT-K444 5G New Radio

**5G New Radio**

The 5G NR software option (-K144, -K444) simplifies uplink and downlink 5G NR signal configuration. It supports all waveforms, channel bandwidths, modulation schemes and numerology options specified in the standards. The intuitive GUI allows configuring these and many other parameters, such as bandwidth parts, directly on the instrument.

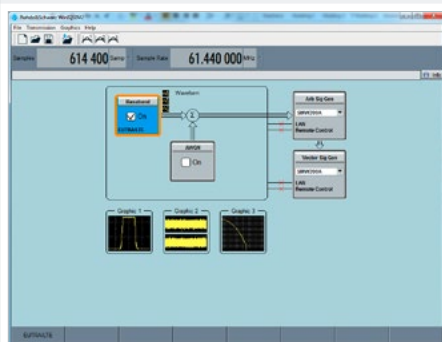
Predefined settings are also available to configure specific test signals quickly.

Key facts

- All supported features are in line with 3GPP Release 15
- Downlink and uplink (CP-OFDM and DFT-S-OFDM)
- All numerologies
- All channel bandwidths
- Sync (SS/PBCH)
- Support of multi-bandwidth part (BWP)
- PBCH with channel coding
- PDSCH with DMRS and all modulation formats
- CORESETs with DMRS
- Time plan
- Filtering per carrier or per BWP

General measurement applications

R&S®WinIQSIM2™ Simulation Software

**Ideal for the generation of digitally modulated signals**

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

Signals generated with the aid of the R&S®WinIQSIM2™ software can be output by the R&S®AFQ100A and R&S®AFQ100B arbitrary waveform generators as well as by the R&S®SMW200A (R&S®SMW-B9/-B10 options), R&S®SMBV100A (R&S®SMBVB-B10/-B50/-B51 options), R&S®SMBV100B and R&S®SGT100A (R&S®SGT-K510 option) vector signal generators. Some standards also work for the R&S®CMW500/R&S®CMW280 wideband radio communication tester, the R&S®CMW270 wireless connectivity tester, the R&S®CMA180 radio test set and the R&S®EX-IQ-Box digital signal interface module. R&S®WinIQSIM2™ is delivered with these arbitrary waveform generators free of charge; it is also available on the Rohde&Schwarz website.

Large variety of digital standards

- 5G New Radio
- Verizon 5GTF signals
- OFDM signal generation
- EUTRA/LTE incl. Rel. 9, Rel. 10, Rel. 11, Rel. 12, Rel. 13 and Rel. 14
- Cellular IoT (eMTC and NB-IoT)
- GSM/EDGE
- EDGE Evolution, VAMOS
- 3GPP FDD with HSDPA, HSUPA and HSPA+ (HSPA Evolution)
- CDMA2000® with 1xEV-DV
- 1xEV-DO Rev. A, Rev. B
- TD-SCDMA
- WLAN IEEE 802.11a/b/g/n/j/p/ac/ax/ad
- IEEE 802.16 WiMAX™ supporting OFDM and OFDMA
- DVB-T/DVB-H
- DAB/T-DMB
- UWB (ECMA-368)
- GPS, GLONASS, Galileo, BeiDou (Compass)
- OneWeb
- Bluetooth®, up to release 5.0
- TETRA Release 2
- NFC A/B/F including EMV Type A/B 1

R&S®SMW/R&S®SMBVB/R&S®SGT-K300 Pulse Sequencing**R&S®SMW/R&S®SMBVB/R&S®SGT-K301 Enhanced Pulse Sequencing****R&S®Pulse Sequencer software**

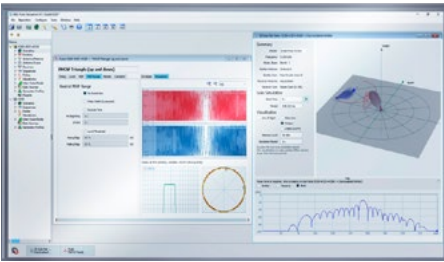
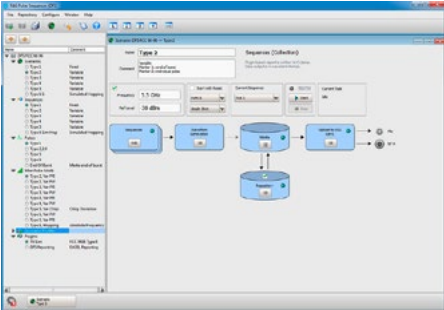
The R&S®Pulse Sequencer software together with the R&S®SMW/SMBV/SMBVB/SGT-K300 option makes it possible to generate pulsed signals with basic modulation schemes. Signals with simple pulses, pulse trains and repetition of pulses can be generated. In addition, pulse trains with different pulses and pulse breaks can be generated sequentially. All major modulation formats for modulation on pulse are available with internal and external data sources. Typical pulse parameters such as rise and fall time, ripple, droop and overshoot, etc. can be defined. Only deterministic interpulse modulation with frequency hops, staggered pulse repetition intervals and user-defined lists can be used. Instead of pulses, waveform files can be used in the sequencer with a repetition count.

Enhanced pulse sequencing

The R&S®Pulse Sequencer software together with the R&S®SMW/SMBV/SMBVB/SGT-K301 option enhances the capabilities of the R&S®SMW/SMBV/SMBVB/SGT-K300 option. The R&S®SMW/SMBV/SMBVB/SGT-K301 option allows users to utilize various control elements like loops, nested loops, overlays, fillers and subsequences for sequencing applications. The -K301 option can only be used together with the -K300 option.

Key facts

- ARB-based signal generation and multisegment waveform sequencing
- Single pulse and pulse train generation with repetition count per pulse
- Powerful sequencing tool with loops, nested loops, subsequences and overlays
- Antenna diagram definition and antenna scan definition
- Antenna diagrams such as pencil beams, cosecant beams, Gaussian diagrams, user-defined antenna diagrams, phased array antenna diagrams
- Antenna scan types such as helical scans, circular scans, conical scans
- Emitter definition based on waveforms, antenna diagram, antenna scan, attitude information, EIRP and carrier frequency
- Receiver definition based on antenna diagram, antenna scan and attitude information
- Calculation of signal taking into account one-way free space propagation according to emitter and receiver location on the 2D map
- Import of R&S®WinIQSIM2™ or customer waveforms for interference generation

General measurement applications		
R&S®SMW/R&S®SMBVB/R&S®SGT-K308 Direction Finding		
	<p>Configure test scenarios for multichannel receivers in direction finding applications</p> <p>The R&S®Pulse Sequencer software together with R&S®SMW/SMBV/SMBVB/SGT-K308 option enhances the capabilities of R&S®SMW/SMBV/SMBVB/SGT-K300 and R&S®SMW/SMBV/SMBVB/SGT-K301 options. The R&S®SMW/SMBV/SMBVB/SGT-K308 option allows the user to configure test scenarios for multichannel receivers in direction finding applications. This option provides a receiver as a new simulation component. The receiver can store individual antenna patterns for each channel. Each antenna can be assigned a position, an antenna pattern and a pointing direction. The ensemble of all individual antennas is an antenna system.</p> <p>On the 2D map, the antenna system itself can be assigned attitude and height information. In combination with an emitter placed on the 2D map, the R&S®Pulse Sequencer software automatically calculates the individual power levels at the output of each individual receiver antenna taking into consideration free space propagation and the attitude information.</p>	<p>Key facts</p> <ul style="list-style-type: none">■ Direction finding with a single emitter■ Up to 20 individual antenna elements■ Predefined antenna patterns or user-defined antenna patterns■ Consideration of attitude information of receiver and emitter■ Consideration of co- and cross-polarization
R&S®SMW/R&S®SMBVB/R&S®SGT-K350 DFS Signal Generation		
	<p>Generation of radar signals</p> <p>The R&S®Pulse Sequencer (DFS) software and its respective software option for the Rohde&Schwarz signal generators have been especially developed for generation of radar signals as specified by the FCC, ETSI or the Telec T403 standards.</p>	<p>Supported standards</p> <ul style="list-style-type: none">■ United States: FCC 06-96, FCC 13-22A1), FCC KDB 905462 D02■ Europe: ETSI EN301893 V1.8.5 (2017-06), ETSI EN302502 V2.0.8 (2017-06)■ Japan: MIC-W53 (2016-06)■ Australia/New Zealand: AS/NZS 4268:2008■ Korea (06-2016)■ China: YD/T 2950-2015 (11-2017)

General measurement applications

R&S®SMW-K501 Extended Sequencing

R&S®SMW-K502 Wideband Extended Sequencing

**Reduces memory requirements to a minimum and increases playtime enormously**

The R&S®SMW-K501/-K502 extended sequencing option can be used manually via sequencing lists and waveform segments or via the R&S®Pulse Sequencer software and its R&S®SMW-K300 and R&S®SMW-K301 options. In both cases, memory requirements are reduced to a minimum and playtime is increased enormously.

In manual user mode, the R&S®SMW-K501/-K502 option allows sequencing of waveforms. It supports loops, nested loops and repetitions, enabling ultralong playtimes.

If used with the R&S®Pulse Sequencer software and its options, the software calculates all required signals and required sequencing lists and transfers them to the signal generator. Continuous wave signals, unmodulated rectangular CW pulses and pulses with linear frequency modulation or Barker codes are calculated in real-time inside the R&S®SMW200A.

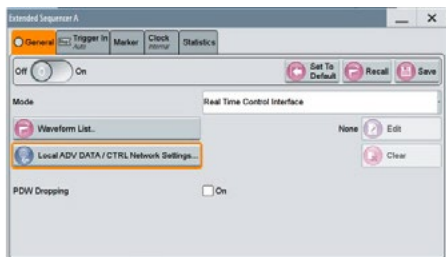
Changes in amplitude, offset frequency, offset phase and off time are always applied in real-time as defined by the sequencing list.

Key facts

- Sequencing of arbitrary waveform files
- Support of loops, nested loops and repetitions
- Realtime change of amplitude, offset frequencies, relative phase and off times for waveform files instead of many individual segments
- Realtime signal generation of CW, unmodulated rectangular CW pulses and pulses with linear frequency modulation or Barker codes with the R&S®Pulse Sequencer software together with the R&S®SMW-K300 and R&S®SMW-K301 options
- Ultralong playtimes
- Can be used manually via sequencing lists and waveform segments or via the R&S®Pulse Sequencer software and R&S®SMW-K300 and R&S®SMW-K301 options

R&S®SMW-K503 Realtime Control Interface

R&S®SMW-K504 Extended Pulse Rate

**Realtime control interface for PDW streaming**

With the option R&S®SMW-K503 the vector signal generator R&S®SMW200A gets ready to directly receive streamed PDWs via Ethernet and TCP/IP from a customer simulator. Customers can generate highly dense radar scenarios.

Key facts

- Streaming of PDWs via LAN to R&S®SMW200A
- R&S®SMW-K503 generates realtime pulses with a maximum rate of up to 1 Mpulse/s per installed option on one baseband
- R&S®SMW-K504 allows you to upgrade to up to 2 Mpulses/s per installed option on one baseband
- One-box solution for PDW streaming including I/Q waveform segments
- Integrate the vector signal generator R&S®SMW200A into the most modern and flexible radar simulators