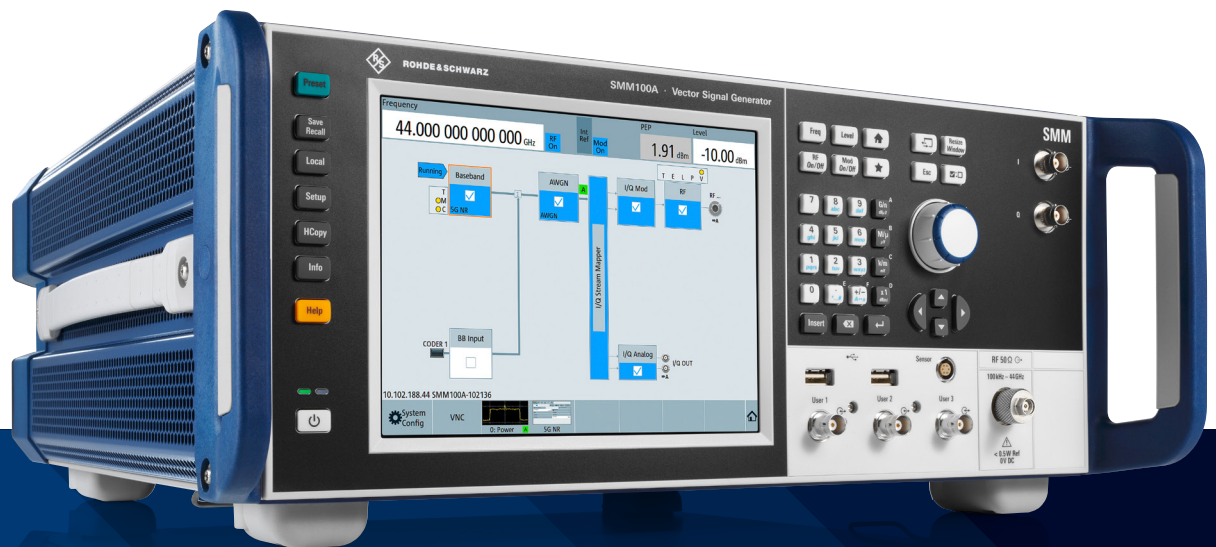


# R&S® SMM100A VECTOR SIGNAL GENERATOR

Redefining midrange



Product Brochure  
Version 12.00

**ROHDE & SCHWARZ**

Make ideas real



# AT A GLANCE

Midrange state-of-the-art vector signal generators face strict requirements. The R&S®SMM100A provides users with a flexible option concept in combination with outstanding signal quality into the mmWave range as well as an excellent price/performance ratio. Discover the R&S®SMM100A, the only vector signal generator with mmWave testing capabilities in its class.

The R&S®SMM100A vector signal generator provides remarkably good RF characteristics across the entire frequency range from 100 kHz to 44 GHz. The instrument covers the bands up to 7.125 GHz used by the wireless standards for 5G NR FR1 and Wi-Fi 8 as well as the 5G NR FR2 bands up to 44 GHz.

The internal baseband generator in the R&S®SMM100A supports a maximum RF modulation bandwidth of 1 GHz. Digitally modulated broadband signal generation is possible in line with the prevalent wireless standards. The R&S®SMM100A is ready for future bandwidth requirements.

Depending on the test requirements, the R&S®SMM100A can be configured for production or development applications. The vector signal generator is an economically attractive solution for the playback of predefined waveforms with an arbitrary waveform generator (ARB). The optional baseband generator makes real-time capabilities available as required. Complex signal settings can be handled directly on the instrument – no external software is needed for signal generation.

Furthermore, the R&S®SMM100A vector signal generator has a flexible concept. Digital baseband standards or upgrades of the RF modulation bandwidth can be easily activated at any time with a keycode. The instrument can easily adapt to future requirements.



# KEY FACTS

- ▶ Frequency range from 100 kHz to 44 GHz
- ▶ High output power up to +18 dBm
- ▶ Internal RF modulation bandwidth up to 1 GHz
- ▶ Excellent modulation frequency response, error vector magnitude (EVM) and adjacent channel power ratio (ACPR)
- ▶ 5G NR signal generation up to 44 GHz
- ▶ Support for WLAN requirements for RF frequency, modulation bandwidth and performance
- ▶ Convenient operation via touchscreen and block diagram

# BENEFITS

Discover excellent signal performance

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Discover baseband capabilities

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Discover scalability

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# APPLICATIONS

Mobile communications standards

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Ready for Wi-Fi 8 testing

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Envelope tracking

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High rate pulse (HRP) ultra-wideband (UWB)

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# STATE-OF-THE-ART USER INTERFACE

## High-resolution touchscreen

With easy-to-use graphical user interface and block diagram

## Context-sensitive help system

## Signal monitoring with graphical result display

For practically every point in the signal flow



### Favorite key

For simplified and fast operation via customizable user menu



### Connector

For an R&S®NRP power sensor

### RF output connector

1.85 mm male<sup>1)</sup>

### User-configurable connectors

E.g. trigger, marker, clock

<sup>1)</sup> Depending on frequency option.

# REAR PANEL CONNECTIONS

Removable solid-state drive (SSD)

Flexible reference input/output  
from 1 MHz to 100 MHz

R&S®SMM-K704 option

1 GHz reference input/output

R&S®SMM-K703 option

LO in/out for phase coherence application

R&S®SMM-B90 option

Remote control via GPIB



Remote control via USB or LAN



Single-ended and differential analog I/Q outputs  
R&S®SMM-K17 option

Input for external pulse modulation signal  
R&S®SMM-K22 option

# DISCOVER EXCELLENT SIGNAL PERFORMANCE

Verification of the performance of a device under test (DUT) requires the use of a signal generator with better signal quality than the DUT itself. Such performance is defined by the SSB phase noise, error vector magnitude (EVM) and adjacent channel power ratio (ACPR). However, amplitude and phase frequency response across the entire signal bandwidth is also important. The R&S®SMM100A excels in all these areas.

## Excellent SSB phase noise and EVM performance with the R&S®SMM-B709 low phase noise option

For the R&S®SMM100A vector signal generator, SSB phase noise of  $< -129$  dBc is specified at an RF frequency of 1 GHz with a 20 kHz offset. The typical value of  $-134$  dBc is even 5 dB lower. Further improved SSB phase noise of  $-139$  dBc is possible with the R&S®SMM-B709 low phase noise option.

## Excellent EVM and ACPR/ACLR performance

The R&S®SMM100A also has outstanding modulation characteristics. The R&S®SMM100A has impressive EVM performance of  $< -58$  dB (0.1%) at an RF frequency of 3.5 GHz for a 100 MHz 5G NR signal in line with 3GPP test model (TM) 3.1.

Special attention was paid to minimizing unwanted distortion for the best possible adjacent channel power ratio (ACPR) when the R&S®SMM100A was developed. A 10 MHz LTE test signal in line with 3GPP TM 1.1 has ACLR performance in the adjacent channel of  $-69$  dBc.

## Improved performance at higher output power with the R&S®SMM-K575 RF linearization option

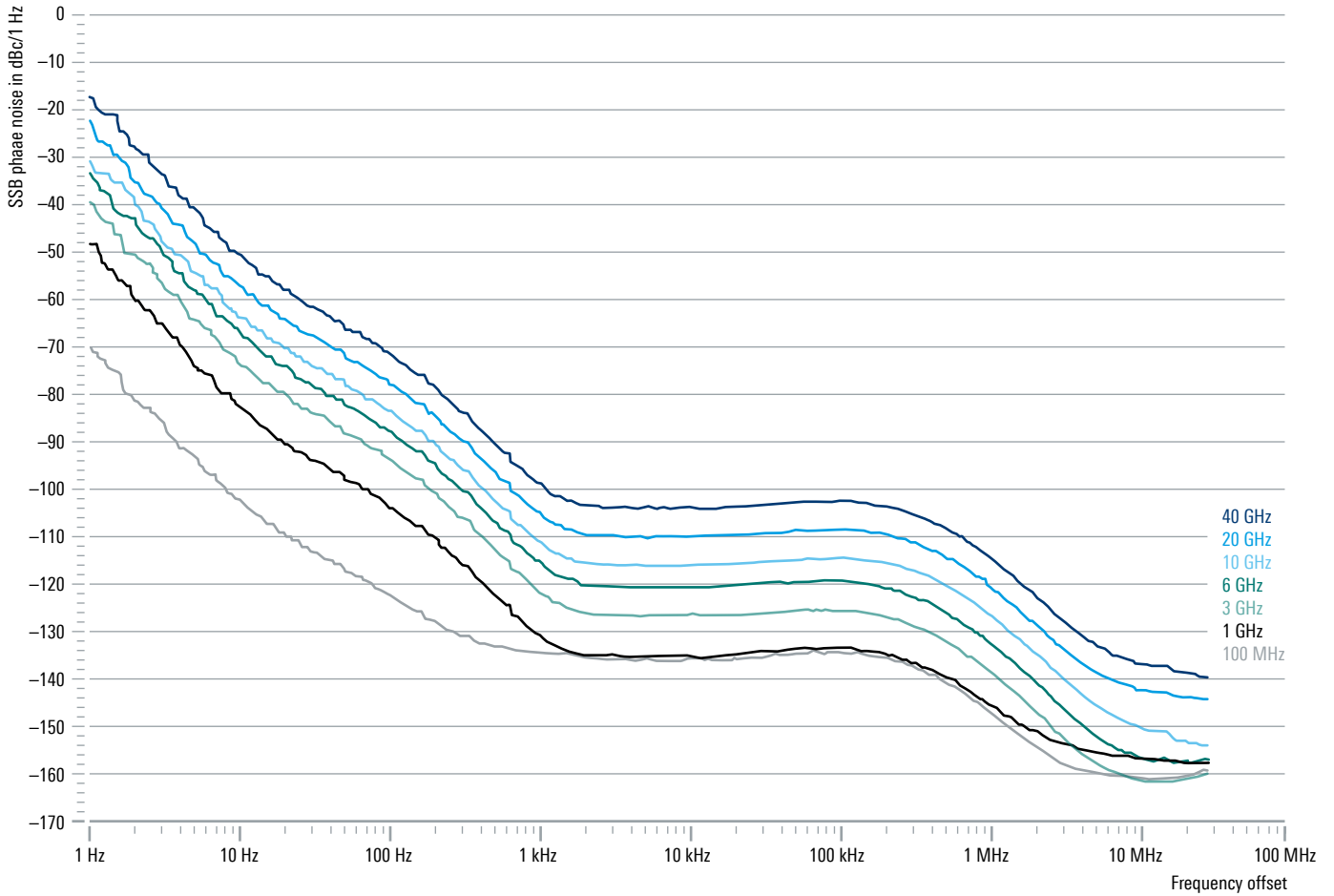
Activating the R&S®SMM-K575 RF linearization option significantly improves EVM performance at higher output power. The EVM performance is improved by 8 dB for 100 MHz 5G NR signals in line with 3GPP TM3.1 at 3.5 GHz and output power of 10 dBm. The same applies to ACLR performance in the adjacent channel.

## Extremely flat frequency response

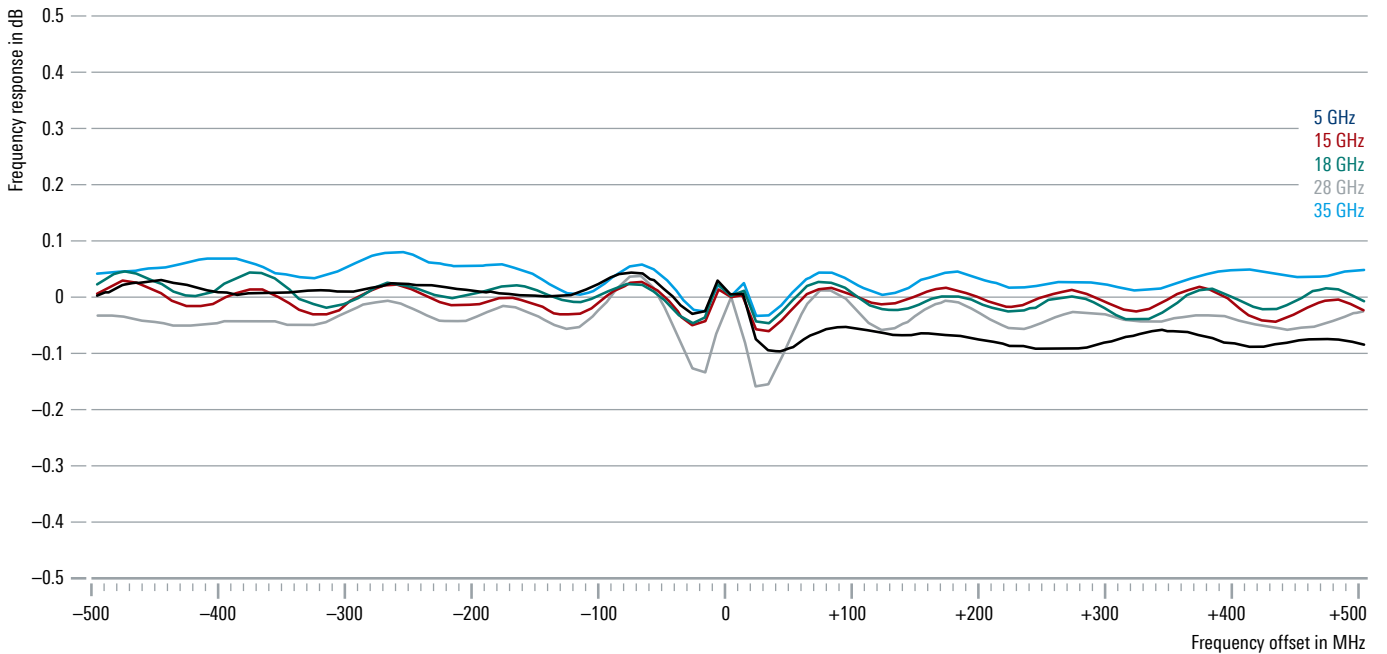
The frequency response of the signal within the modulation bandwidth also has a major influence on the achievable EVM performance for single-carrier signals. The parameter magnitude and phase must be reduced across the entire RF frequency range of the generator.

Intelligent compensation is provided for internal influences of the R&S®SMM100A on the frequency response. The R&S®SMM100A has a measured magnitude frequency response of  $< 0.4$  dB over the entire RF modulation bandwidth of 1 GHz.

### Measured SSB phase noise performance, CW mode



### Measured I/Q modulation frequency response with internal baseband generator



# DISCOVER BASEBAND CAPABILITIES

## Internal real-time signal generation

The internal baseband of the R&S®SMM100A has impressive real-time capabilities. Users can configure and generate standard-compliant signals for all major digital communications standards right on the instrument, including 5G NR, LTE, WLAN, Bluetooth® and others. No external signal generation software is needed. The well-arranged configuration menus make instrument operation simple and help speed up measurement tasks.

## Arbitrary waveform generator

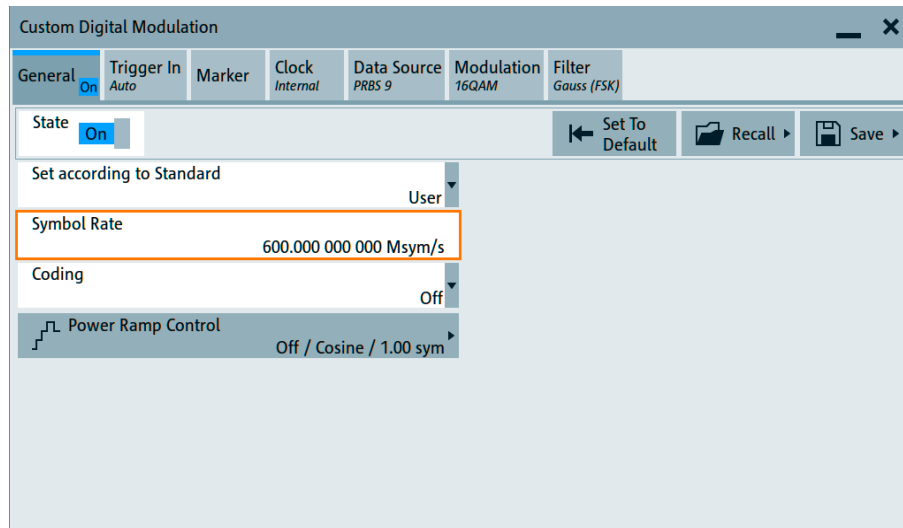
The arbitrary waveform generator is ideal for production applications. Waveforms generated with the R&S®WinIQSIM2 simulation software can be loaded and played back. User-specific waveforms are also supported. The R&S®SMM100A is impressive with its large memory depth of up to 2 Gsample and maximum sampling rate of 1.2 Gsample/s.

Multisegment mode is another ARB function that speeds up test sequences by allowing fast switching between individual baseband signals.

## Custom digital modulation

The R&S®SMM100A also makes it easy to generate customized digitally modulated signals with predefined modulation types and a symbol rate of up to 600 Msymbol/s. Besides standard pseudo noise (PN) data, user-specific data lists can also be loaded and a variety of configurable filters can be applied. Preconfigured settings are also available for various digital standards such as GSM and Bluetooth®.

### Custom digital modulation



# DISCOVER SCALABILITY

## Frequency options

The R&S®SMM100A is available with various frequency options up to a maximum frequency of 44 GHz. Users can precisely configure the R&S®SMM100A to meet actual test requirements. Signals can be generated in the 5G NR frequency ranges FR1 and FR3 up to 24.25 GHz and FR2 up to 44 GHz. The relevant frequency range for Wi-Fi 8 can also be precisely covered with the 7.5 GHz option.

## Keycode extendable bandwidth and ARB memory

In the basic configuration, the R&S®SMM100A supports an RF modulation bandwidth of 120 MHz. Depending on the requirements, this can be extended up to 1 GHz by installing a license key. The ARB memory depth can be extended from 64 Msample up to a maximum of 2 Gsample.

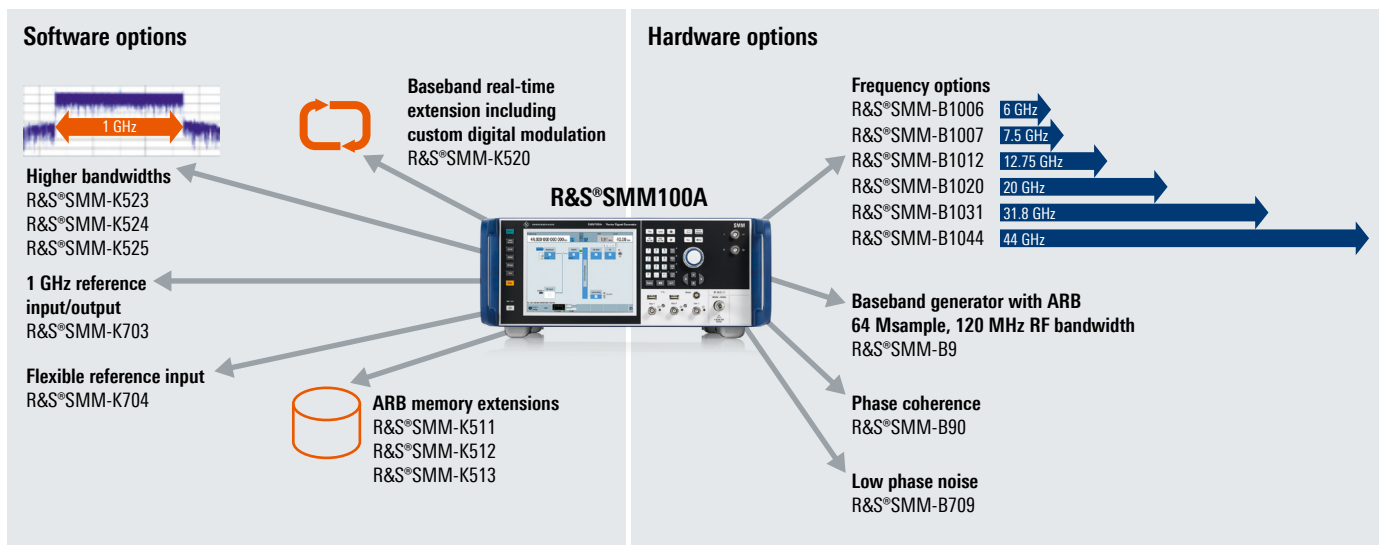
## Timed licenses and waveform packs

In addition to permanent software licenses, time-limited licenses are available for three, six or twelve months to cost-efficiently support smaller projects. Where only a few test signals are needed from various standards, the waveform packages in different sizes are the right choice. Once registered, the waves can be used as often as necessary with no time limitation.

## Floating licenses

In production environments, many test procedures might run in parallel but not always at the same time. Measurement options tied to specific instruments go unused. The license server provides a solution to this problem. All available licenses are stored in a central location on a server. The different instruments simply access the license pool when necessary. This helps reduce the number of necessary licenses while simultaneously cutting costs.

## Overview of important software and hardware options



# DISCOVER USABILITY

## Structured and intuitive user interface

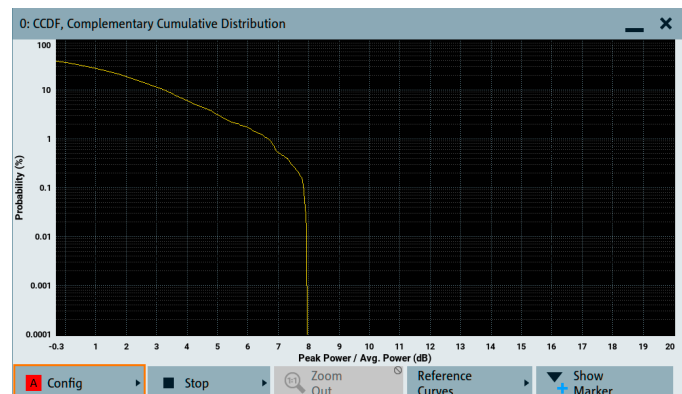
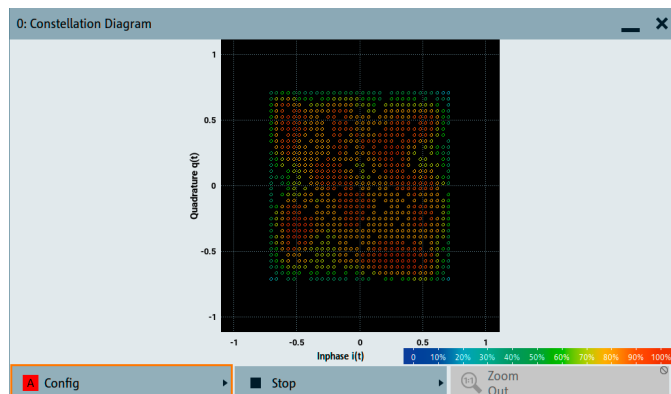
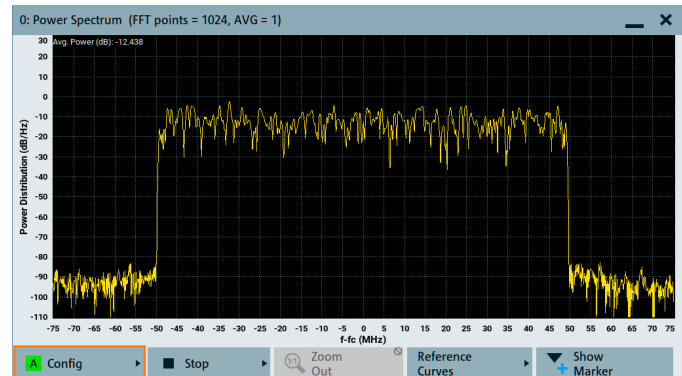
Instrument setups can be configured via a 8.4" touch-screen. The logically structured user interface is presented in the form of a block diagram. The configuration blocks begin with the baseband generator and are followed by the additive white Gaussian noise (AWGN) block, the I/Q modulator and the RF block for signal output. The block diagram represents the signal flow while simultaneously helping users intuitively work through the configuration menus.

The built-in graphical analysis function allows verification of the configured baseband signal at different points within the overall signal flow path. Signals can be displayed in real time either in the time domain or as a spectrum. Additional analysis functions are available for the baseband signal.

## Division of the user interface into configuration blocks



## Graphical signal monitoring in real time

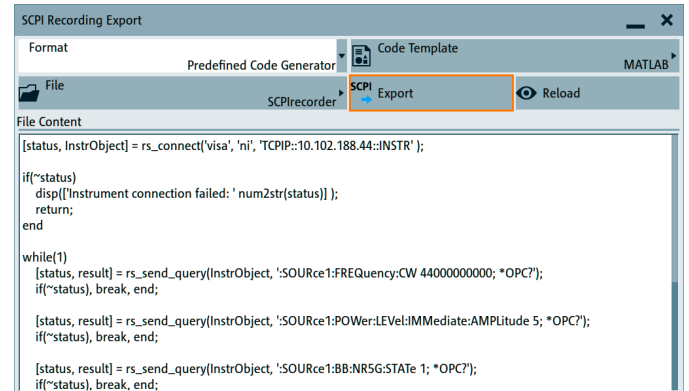
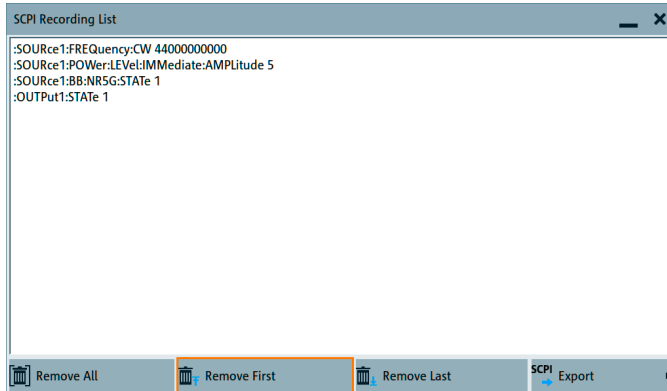


## Automation made easy with context-sensitive help system and SCPI recording

Context-sensitive online help offers comprehensive information that describes each parameter and setup menu in detail, states the setting range and shows the associated remote-control commands. Users can also search for specific parameters in the user manual installed on the instrument.

The R&S®SMM100A helps users quickly and correctly create remote control programs. The built-in SCPI macro recorder with code generator can automatically record all manual settings and create an executable MATLAB or Python script. The scripts can be reused with other Rohde & Schwarz vector signal generators thanks to code compatibility. The R&S®SMM100A therefore helps minimize the time required for test automation, saving development resources.

The built-in SCPI macro recorder and code generator support fast, easy generation of SCPI sequences

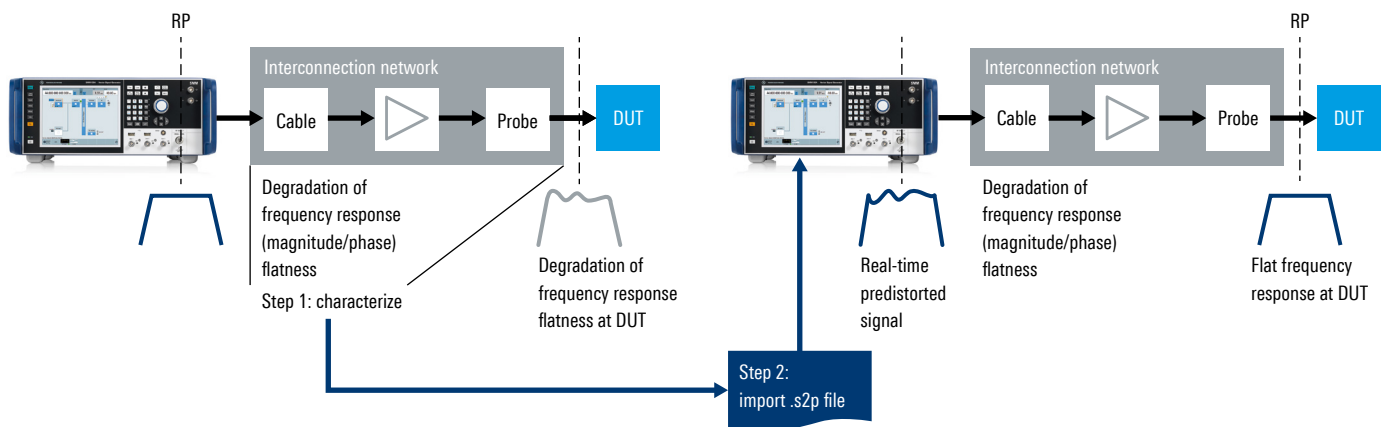


## R&S®SMM-K544 frequency response correction

Various RF components such as cables, adapters, amplifiers and antennas are used to connect the signal generator to the DUT. Of course, all these components influence the RF signal provided by the R&S®SMM100A. The R&S®SMM-K544 frequency response correction option

can be used to automatically compensate for the effect. The frequency response for the components that are used is saved in .s2p files, which can be individually selected as required. The reference plane of the test signal is thus shifted from the RF connector of the R&S®SMM100A to the DUT input.

### Principle of user-defined frequency response correction with R&S®SMM-K544 option

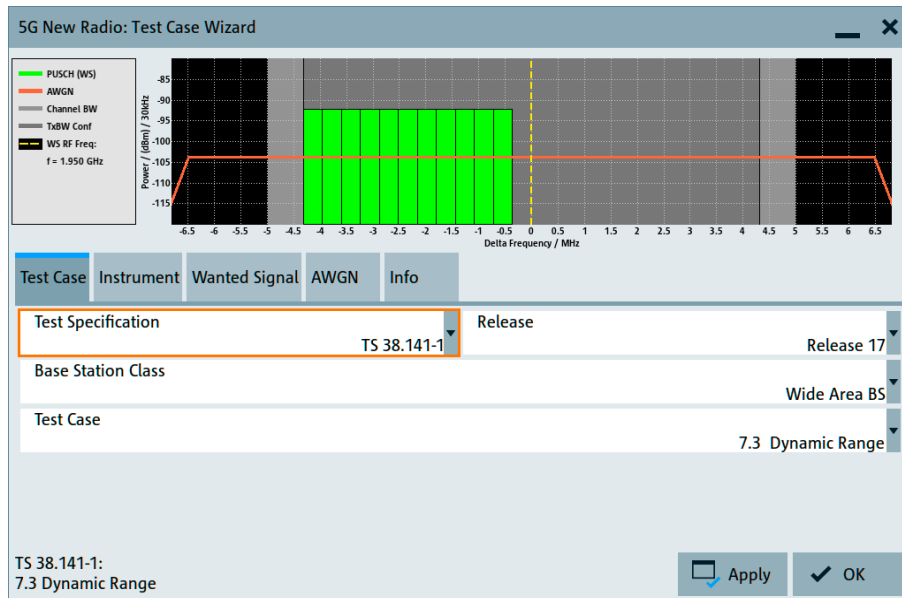


# MOBILE COMMUNICATIONS STANDARDS

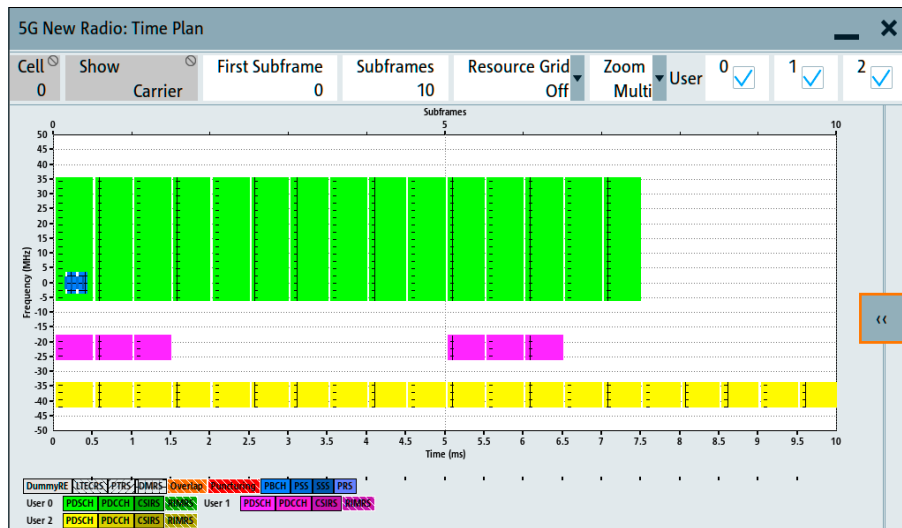
Using a wide range of available signal generation options, the R&S®SMM100A can produce test signals in compliance with the most important wireless communications standards. The instrument is well suited to standard-compliant 5G NR signal generation up to release 18 and beyond 5G (R&S®SMM-K184). When equipped with the R&S®SMM-B1044 frequency option, the instrument covers all frequency ranges for 5G NR up to 44 GHz. Together with the R&S®SMM-K525 bandwidth extension to 1 GHz, the instrument can handle increased signal bandwidth requirements in 5G applications (especially in frequency range FR2 and with carrier aggregation).

The R&S®SMM100A is the idea signal generator for 5G NR base station conformance testing in all frequency ranges – conducted and OTA.

Users benefit from the predefined test models and fixed reference channels (FRC). A test case wizard simplifies instrument configuration for 3GPP-compliant 5G NR and LTE BTS conformance tests. Once the user has selected the desired conformance test case, the wizard automatically configures all signal parameters and other R&S®SMM100A settings.



The 5G NR test case wizard allows the R&S®SMM100A to be conveniently and cleverly configured for BTS tests in line with 3GPP TS38.141



Time plan display in the 5G NR option of the R&S®SMM100A

# READY FOR Wi-Fi 8 TESTING

Previous IEEE802.11ac and IEEE802.11ax WLAN standards use a maximum signal bandwidth of 160 MHz. However, WLAN is also trending toward larger bandwidths and higher frequencies. A signal bandwidth of 320 MHz is specified in the frequency range from 5.8 GHz to 7.125 GHz for IEEE802.11be.

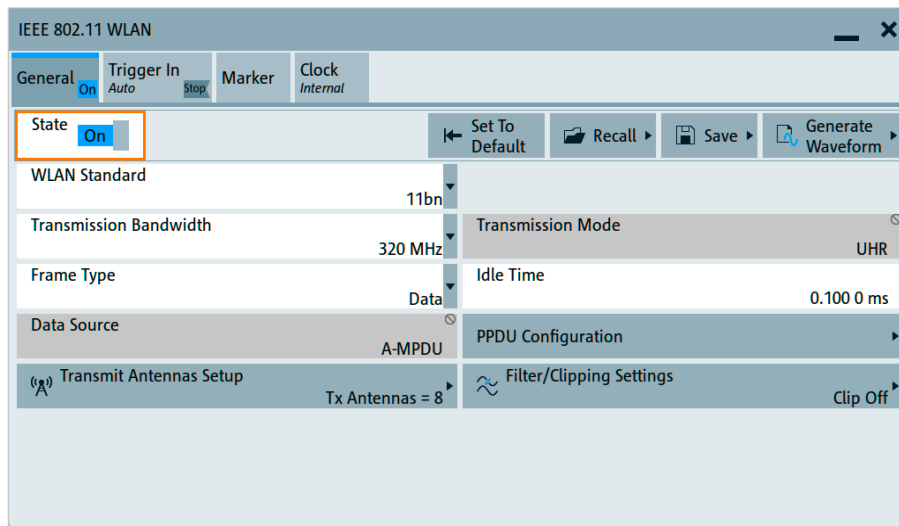
The next improvement is ultra-high reliability (UHR) with Wi-Fi 8, standardized in IEEE802.11bn that focuses on reliability, low latency and optimized spectrum efficiency for reliable augmented reality (AR)/virtual reality (VR) and streaming support along with support for industrial and healthcare applications.

More efficient use of the available resources is achieved with improved coding rates and unequal modulation for better rate adaptation and non-primary channel access for dynamic channel switching.

To increase the coverage, a long-range physical layer protocol data unit (PPDU) is introduced while the distributed resource units (DRU) are specially designed for low-power indoor devices in IoT applications.

With EVM of better than  $-53$  dB for a signal bandwidth of 320 MHz, the R&S®SMM100A satisfies the relevant requirements for signal quality. In combination with the R&S®SMM-B1007 frequency option up to 7.5 GHz, the R&S®SMM-K524 bandwidth extension to 500 MHz and the standard compliant signal generation options up to Wi-Fi 8, the R&S®SMM100A is the ideal signal generator for WLAN testing of components, modules and devices.

User interface for IEEE802.11bn signal configuration



# ENVELOPE TRACKING

More power amplifiers than ever support envelope tracking (ET) to reduce power consumption and improve efficiency in smartphones and tactical radios. Typical test set-ups for measuring power amplifiers include at least one signal generator and one spectrum analyzer. Envelope tracking requires an additional generator for the DC modulator envelope signal.

## RF and envelope signal out of one box

The R&S®SMM-K540 envelope tracking option lets the R&S®SMM100A generate both the RF signal and envelope signal from the baseband signal in real time. Any user specific I/Q signal and any supported wireless communications signal, such as 5G NR or LTE, can be used.

Generating the RF signal and the envelope signal in a single instrument helps precisely adjust the delay between the two signals.

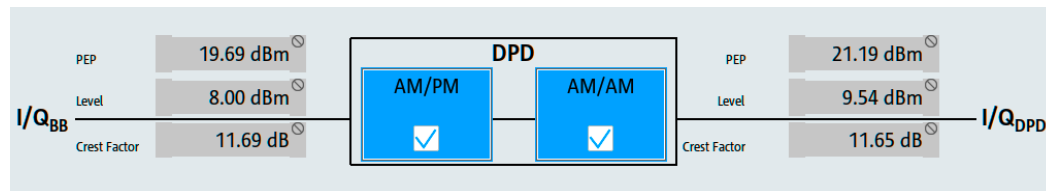
The R&S®SMM100A adjusts the delay in real-time picosecond steps to satisfy strict requirements with accuracy of 1 ns for a 20 MHz LTE signal.

The envelope signal is shaped to optimize the power amplifier for efficiency or linearity. The R&S®SMM100A has various shaping methods, such as look-up table and polynomial, which are applied in real time. The R&S®SMM100A automatically calculates the amplitude of the envelope signal for power sweeps, eliminating time-consuming manual calculations. Additional parameters can also be adjusted, such as the gain and impedance of the DC modulator.

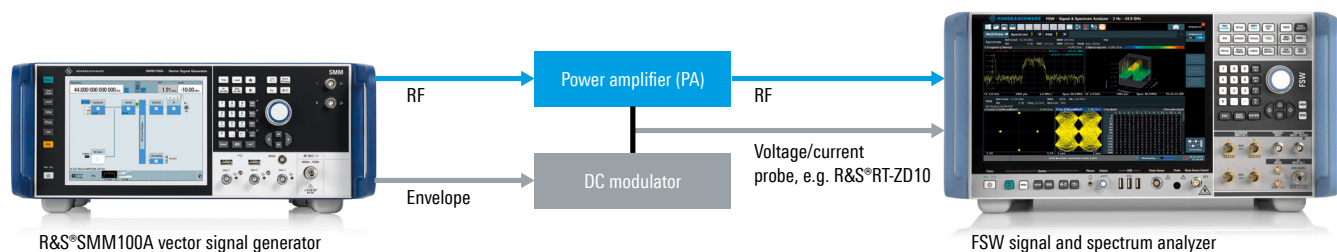
## Real-time digital predistortion

The amplifier is operated close to or even in saturation for envelope tracking and causes distortion at the amplifier output. To compensate, envelope tracking is often combined with digital predistortion (DPD). The R&S®SMM-K541 digital predistortion option lets the R&S®SMM100A apply real-time amplitude and phase correction to each complex I/Q sample for the values in the DPD tables. Users can quickly verify predistortion effects, even for different power levels, without having to manually calculate the original waveform.

Digital predistortion user interface with the R&S®SMM-K541 option



## Compact Rohde & Schwarz setup for power amplifier tests including envelope tracking



# HIGH RATE PULSE (HRP) ULTRA-WIDEBAND (UWB)

In recent years HRP UWB has become more important in many applications because it can determine distances with extremely high precision. The information is used in mobile devices for hands-free access, mobile payments or asset finding. Keyless entry systems that determine the distance between the key and the vehicle are also common in the automotive sector.

The R&S®SMM-K149 HRP UWB baseband option supports signal generation for the three specified modes: HRP UWB in line with IEEE 802.15.4 as well as the base pulse repetition frequency (BPRF) mode and the high pulse repetition frequency (HPRF) mode for enhanced ranging devices (ERDEV) in line with IEEE 802.15.4z.

IEEE 802.15.4 also specifies OQPSK physical layer signals since they are used in IoT base infrastructure. The signal generation mode is available with the R&S®SMM-K180 IEEE 802.15.4 OQPSK option.

The next generation UWB is now specified in the amendment IEEE 802.15.4ab to the IEEE 802.15.4 standard improving existing features and adding new capabilities.

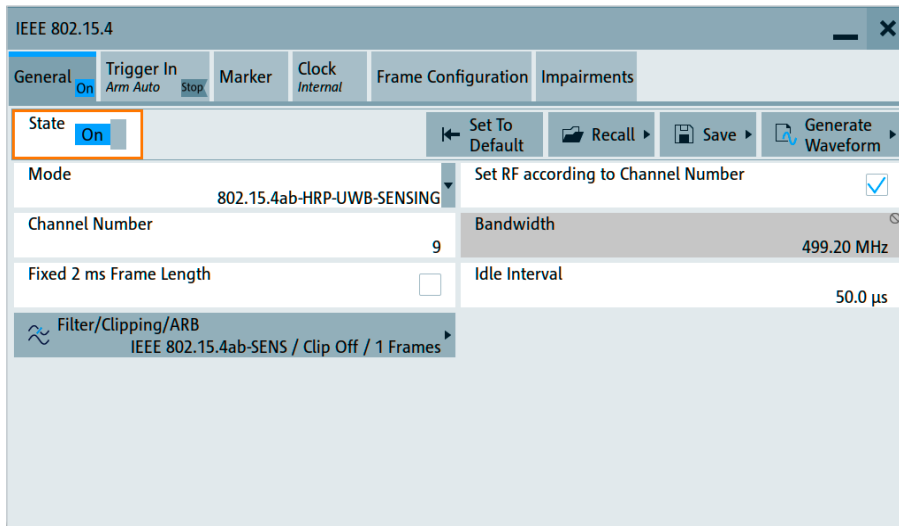
To overcome maximum peak power and power spectrum density (PSD) limitations, next generation UWB introduced the multimillisecond (MMS) ranging fragments for advanced ranging configurable with the R&S®SMM-K181 HRP UWB MMS option.

The new sensing capabilities can be used for intrusion and proximity detection. The R&S®SMM-K182 HRP UWB sensing option supports the corresponding signals with the newly defined sensing PPDU's.

The R&S®SMM100A is ideal for HRP UWB receiver testing. The R&S®SMM100A covers the frequency range used by HRP UWB up to 10.6 GHz with the R&S®SMM-B1012 frequency option up to 12.75 GHz.

Together with the R&S®SMM-K525 baseband extension option for 1 GHz RF bandwidth, signals can be generated on the most important channels with a sample rate of 1 GSamples.

Configuration of an HRP UWB sensing signal



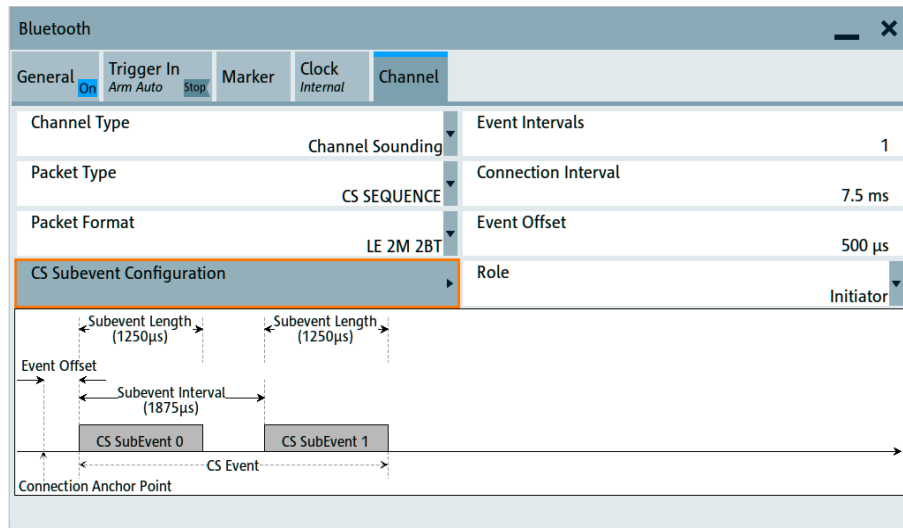
# BLUETOOTH®

Bluetooth® has developed over the years into an indispensable wireless communication standard. The basic transmission mode to peripherals, such as headsets, keyboards and mice, is possible with Bluetooth® basic rate (BR). The next step was Bluetooth® enhanced data rate (EDR) which supports audio devices or file transfer between devices. In a next step Bluetooth® Low Energy helped reduce power consumption and enable longer ranges for modern IoT devices and wearables.

The latest version 6.0 defines a Bluetooth® channel sounding feature with accurate distance measurements for asset tracking and keyless entry.

The R&S®SMM100A and the R&S®SMM-K60 Bluetooth® enhanced data rate, R&S®SMM-K117 Bluetooth® 5.x and R&S®SMM-K178 Bluetooth® 6.0 signal creation options make it possible to test the physical layer in line with the Bluetooth® specifications 4.2, 5.x and 6.0. Beside the configuration of PPDU and test packets, the Bluetooth® user interface enables dirty transmitter settings.

Bluetooth® channel sounding configuration



# SPECIFICATIONS IN BRIEF

Specifications in brief		
<b>Frequency</b>		
Frequency range	with R&S®SMM-B1006 option	100 kHz to 6 GHz
	with R&S®SMM-B1007 option	100 kHz to 7.5 GHz
	with R&S®SMM-B1012 option	100 kHz to 12.75 GHz
	with R&S®SMM-B1020 option	100 kHz to 20 GHz
	with R&S®SMM-B1031 option	100 kHz to 31.8 GHz
	with R&S®SMM-B1044/-B1044N/-B1044O options	100 kHz to 44 GHz
<b>Level</b>		
Specified level range	peak envelope power (PEP)	
	100 kHz ≤ f < 1 MHz	-120 dBm to +3 dBm
	1 MHz ≤ f ≤ 3 MHz	-120 dBm to +8 dBm
	with R&S®SMM-B1006/-B1007/-B1012/-B1020 options	
	3 MHz < f ≤ 20 GHz	-120 dBm to +18 dBm
	with R&S®SMM-B1031/-B1044/-B1044N/-B1044O options	
	3 MHz < f ≤ 3 GHz	-120 dBm to +18 dBm
	3 GHz < f ≤ 14 GHz	-120 dBm to +17 dBm
	14 GHz < f ≤ 20 GHz	
	CW, I/Q modulation, signal bandwidth ≤ 160 MHz	-120 dBm to +15 dBm
	I/Q modulation, signal bandwidth > 160 MHz	-120 dBm to +12 dBm
	20 GHz < f ≤ 29 GHz	-120 dBm to +18 dBm
	29 GHz < f ≤ 33 GHz	-120 dBm to +17 dBm
	33 GHz < f ≤ 40 GHz	-120 dBm to +15 dBm
	40 GHz < f ≤ 42 GHz	-120 dBm to +13 dBm
	42 GHz < f ≤ 44 GHz	-120 dBm to +11 dBm
<b>Spectral purity</b>		
Harmonics	CW, f > 1 MHz	
	with R&S®SMM-B1006 option, level < 10 dBm	< -30 dBc
	with R&S®SMM-B1007/-B1012 options, level < 8 dBm	< -30 dBc
	with R&S®SMM-B1020/-B1031/-B1044/-B1044N/-B1044O options, level < 10 dBm	
	f ≤ 3.5 GHz	< -30 dBc
	f > 3.5 GHz	< -55 dBc
Nonharmonics	CW, I/Q modulation (external wideband I/Q, full-scale DC input), level > -10 dBm, > 10 kHz offset from carrier	
	100 kHz ≤ f ≤ 1.5 GHz	< -80 dBc
	1.5 GHz < f ≤ 3 GHz	< -79 dBc
	3 GHz < f ≤ 6 GHz	< -73 dBc
	6 GHz < f ≤ 12 GHz	< -67 dBc
	12 GHz < f ≤ 24 GHz	< -61 dBc
	24 GHz < f ≤ 44 GHz	< -55 dBc
SSB phase noise	CW, carrier offset = 10 kHz, f = 1 GHz	
	standard	< -129 dBc
	with R&S®SMM-B709 option	< -139 dBc
	CW, carrier offset = 10 kHz, f = 10 GHz	
	standard	< -109 dBc
	with R&S®SMM-B709 option	< -119 dBc
<b>Analog modulation</b>		
Supported analog modulation modes	with R&S®SMM-K720 option	AM, FM, PM
	with R&S®SMM-K22 option	pulse modulation

## Specifications in brief

### I/Q modulation

RF modulation bandwidth	with internal baseband I/Q, I/Q wideband on; with R&S®SMM-B1006/-B1007/-B1012/-B1020/-B1031/-B1044 options	
	1 MHz ≤ f ≤ 300 MHz	±32% of carrier frequency
	300 MHz < f ≤ 1.25 GHz	±40% of carrier frequency
	f > 1.25 GHz	±500 MHz
	with internal baseband I/Q, I/Q wideband on; with R&S®SMM-B1044N option	
	1 MHz ≤ f ≤ 300 MHz	±32% of carrier frequency
	300 MHz < f ≤ 1.25 GHz	±40% of carrier frequency
	1.25 GHz < f ≤ 20 GHz	±500 MHz
	f > 20 GHz	±275 MHz
	with internal baseband I/Q, I/Q wideband on; with R&S®SMM-B1044O option	
	1 MHz ≤ f ≤ 300 MHz	±32% of carrier frequency
	300 MHz < f ≤ 1.25 GHz	±40% of carrier frequency
	1.25 GHz < f ≤ 31.75 GHz	±500 MHz
	31.75 GHz < f ≤ 37.05 GHz	±225 MHz
	f > 37.05 GHz	±500 MHz
Modulation frequency response in specified RF modulation bandwidth	with internal baseband, I/Q wideband on	< 1.0 dB, < 0.4 dB (meas.)

### I/Q baseband generator

Signal bandwidth	standard	120 MHz
	with R&S®SMM-K523 option	240 MHz
	with R&S®SMM-K523/-K524 options	500 MHz
	with R&S®SMM-K523/-K524/-K525 options	1000 MHz
ARB memory depth	standard	64 Msample
	with R&S®SMM-K511 option	512 Msample
	with R&S®SMM-K511/-K512 options	1 Gsample
	with R&S®SMM-K511/-K512/-K513 options	2 Gsample

### Digital standards

Supported standards and modulation systems		5G NR, OFDM signal generation, cellular IoT, LTE, 3GPP FDD/HSPA/HSPA+, GSM/EDGE/EDGE Evolution, CDMA2000, 1xEV-DO Rev. A/B, WLAN IEEE 802.11a/b/g/n/lj/p/ac/ax/be, HRP UWB, AWGN and more
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Service at Rohde & Schwarz

# YOU'RE IN GREAT HANDS

	SERVICE PLANS	ON DEMAND
Calibration	Up to five years <sup>1)</sup>	Pay per calibration
Warranty and repair	Up to five years <sup>1)</sup>	Standard price repair

<sup>1)</sup> For extended periods, contact your Rohde & Schwarz sales office.

## Instrument management made easy

The R&S®InstrumentManager makes it easy to register and manage your instruments. It lets you schedule calibration dates and book services.

Find out more  
about our service  
portfolio under:



**Service at Rohde & Schwarz**  
**You're in great hands**

- ▶ Worldwide
- ▶ Local and personalized
- ▶ Customized and flexible
- ▶ Uncompromising quality
- ▶ Long-term dependability

**Rohde & Schwarz**

The Rohde&Schwarz technology group is among the trail-blazers when it comes to paving the way for a safer and connected world with its leading solutions in test&measurement, technology systems and networks&cybersecurity. Founded more than 90 years ago, the group is a reliable partner for industry and government customers around the globe. The independent company is headquartered in Munich, Germany and has an extensive sales and service network with locations in more than 70 countries.

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