R&S®SZU100A
I/Q Upconverter
Wideband mmWave vector signal generation

ROHDE&SCHWARZ

Product Brochure | Version 02.00

R&S®SZU100A I/Q Upconverter

At a glance

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 IEEE 802.11ad, 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.

Millimeter applications in the 60 GHz band are manifold: WLAN, 5G, microwave links, airborne radar, tank radar, radio astronomy, earth surface imaging and inter-satellite communications. The R&S®SZU100A extends the R&S®SMW200A vector signal generator into these fields of application. The R&S®SMW200A supplies a wideband baseband signal (analog I/Q) and an LO signal (RF) to the upconverter, which converts the input signal into an output frequency in the range from 57.32 GHz to 65.80 GHz. An integrated amplifier, electronic attenuator and internal level detector permit precise setting of the output power in the range of –80 dBm to +5 dBm (PEP).

In combination with the R&S®SMW200A, the upconverter generates signals with an RF bandwidth of up to 2 GHz. Factory adjustment of the R&S®SZU100A together with automatic on-the-fly correction in the R&S®SMW200A produces a flat frequency response of < 2 dB over 2 GHz bandwidth – regardless of signal form, level and frequency. The upconverter generates wideband-modulated mmWave signals with excellent modulation quality, e.g. < –32 dB EVM for WLAN IEEE 802.11ad at 60.48 GHz, without requiring time-consuming external calibration prior to every measurement.

The R&S®SZU100A upconverter fits seamlessly into the R&S®SMW200A operating concept and transforms the R&S®SMW200A into a vector signal generator for mmWave applications in the 60 GHz band. User operation of the R&S®SMW200A vector signal generator remains the same, with convenient access to baseband and RF features as well as interfaces and remote control functions.

The R&S®SMW200A and R&S®SZU100A combo is a one-of-a-kind generator solution for all mmWave applications requiring outstanding signal quality and efficiency. Set. Measure. Done.

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

R&S®SZU100A I/Q Upconverter

Benefits and key features

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

▷ page 4

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
- Exceptional spectral purity
  - 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 IEEE 802.11ad at 60.48 GHz better than –32 dB (meas.)

▷ page 6

Fast and convenient operation

- Easy operation
  - Seamlessly integrated into the R&S®SMW200A operating concept
- Remote operation and automation
- Turbo speed for the development process
  - Internal level detector for automatic leveling supersedes external recalibration during operation

▷ page 8

High performance for challenging applications

Field-proven design as a flexible RF head

The R&S®SZU100A I/Q upconverter is designed as a remote RF head for the R&S®SMW200A vector signal generator. Signals generated with the R&S®SMW-B9 wideband baseband option are supplied to the R&S®SZU100A via analog I/Q (single-ended or differential). At the same time, the R&S®SMW200A also supplies the LO signal for the I/Q upconverter via its RF output. A USB connection is used to control the R&S®SZU100A.

Its design as an RF head allows the R&S®SZU100A to be positioned close to the DUT, minimizing the need for RF feed lines and the associated line losses. The shorter feed lines also reduce the level ripple over the frequency. Versatile mounting points and adjustable feet provide flexibility when positioning the R&S®SZU100A in the test setup. The WR15 waveguide connector permits direct mounting of the DUT or an antenna for over-the-air measurements.

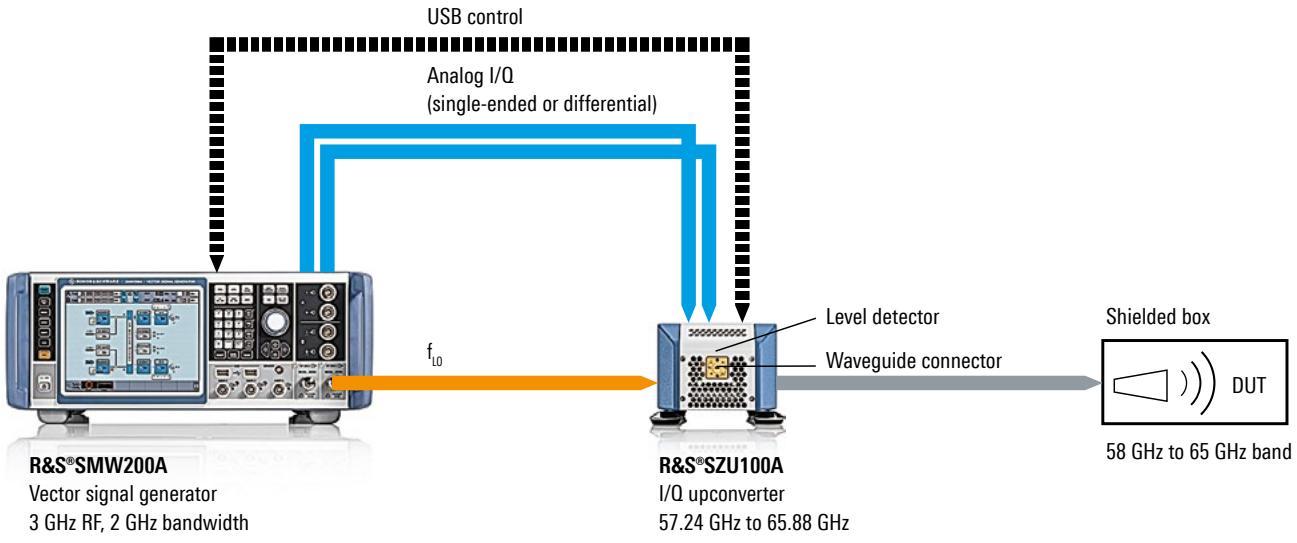
High frequency and large bandwidth

With an adjustable center frequency of 58.32 GHz to 64.80 GHz and ±1 GHz RF modulation bandwidth, the R&S®SZU100A is suited to a number of applications in the mmWave range. When the upconverter is used together with the R&S®SMW200A, users can generate up to 2 GHz wide test signals, e.g. for airborne radar or tank radar, for inter-satellite links or terrestrial point-to-point communciations (backhaul/fronthaul) or for 5G or WLAN IEEE 802.11ad.

High output power and wide dynamic range

The R&S®SZU100A comes equipped with an integrated amplifier and an integrated electronic attenuator. With a specified maximum output power of +5 dBm (PEP) but typically greater than +10 dBm (PEP), the power reserve is sufficient to compensate for the increased cable or over-the-air path loss in test setups in the 60 GHz band. The electronic attenuator precisely sets the level to even less than –80 dBm. The solid-state design is synonymous with high level repeatability, fast setting times and exceptional reliability. When using the R&S®SZU100A, test engineers can perform sensitivity measurements without changing the test setup. The integrated level detector at the output of the R&S®SZU100A, which is based on the same technology as the precision power sensors from Rohde&Schwarz, ensures a clearly defined output level.

R&S®SZU100A I/Q upconverter test setup



Easy upgrading of the R&S®SMW200A

The R&S®SZU100A is an easy upgrade that transforms the R&S®SMW200A into a mmWave vector signal generator. Any R&S®SMW200A equipped with the R&S®SMW-B9 wideband baseband option can operate the R&S®SZU100A. The 3 GHz variant of the signal generator is a cost-effective basis for a complete mmWave test solution.

RF connector options on the R&S®SZU100A.

Standard WR15 connector.

Optional WR15 to 1.85 mm (f) adapter.

Optional WR15 test port adapter, HP/A compatible (as test port saver).

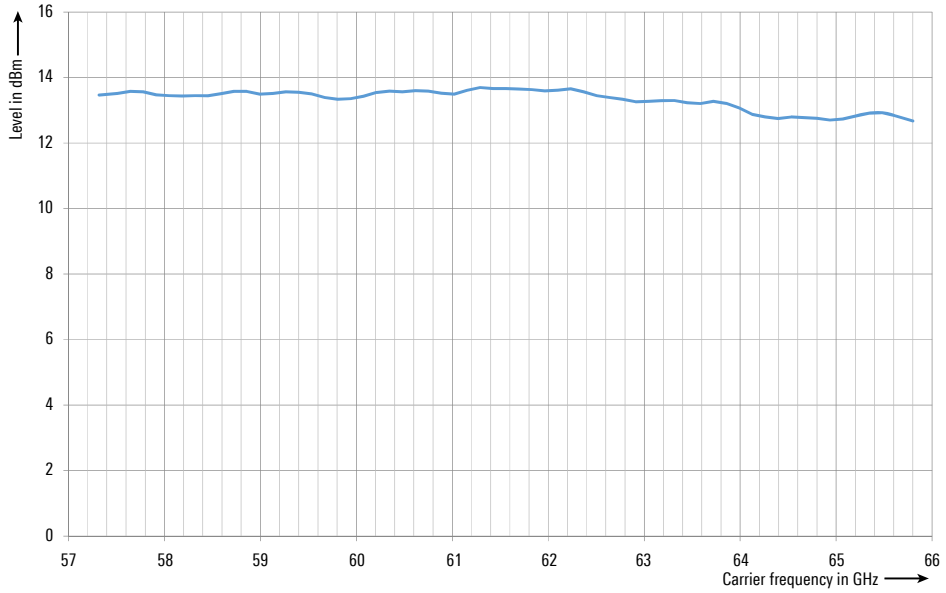
Multichannel operation

The R&S®SMW200A vector signal generator can optionally be equipped with two channels. This makes it possible to conveniently test frequency-converting components and modules using a single instrument. With an additionally connected R&S®SZU100A I/Q upconverter, the dual-channel R&S®SMW200A simultaneously supplies the high-frequency mmWave signal (via the connected R&S®SZU100A) as well as a low-frequency IF or LO signal (up to 20 GHz) via its second, synchronized channel.

Furthermore, the R&S®SMW200A and R&S®SZU100A combo is a perfect solution for multichannel applications such as beamforming or MIMO in the mmWave range. Whenever required, a dual-channel R&S®SMW200A operates two R&S®SZU100A upconverters in parallel via single-ended I/Q, saving test station space while offering maximum usability.

Here, too, the two signal paths can be precisely synchronized in time, frequency and phase. The internal trigger system of the R&S®SMW200A ensures a stable time reference. Via the internal 10 MHz reference of the R&S®SMW200A, the two paths are coupled. The R&S®SMW-B90 phase coherence option synchronizes the phase of the two connected R&S®SZU100A units, if necessary.

Measured maximum available output level vs. frequency of R&S®SMW200A and R&S®SZU100A



Reliable results due to outstanding signal quality

With the R&S®SZU100A, users have a measuring instrument that provides excellent signal quality and conclusive results.

Automatic frequency response compensation

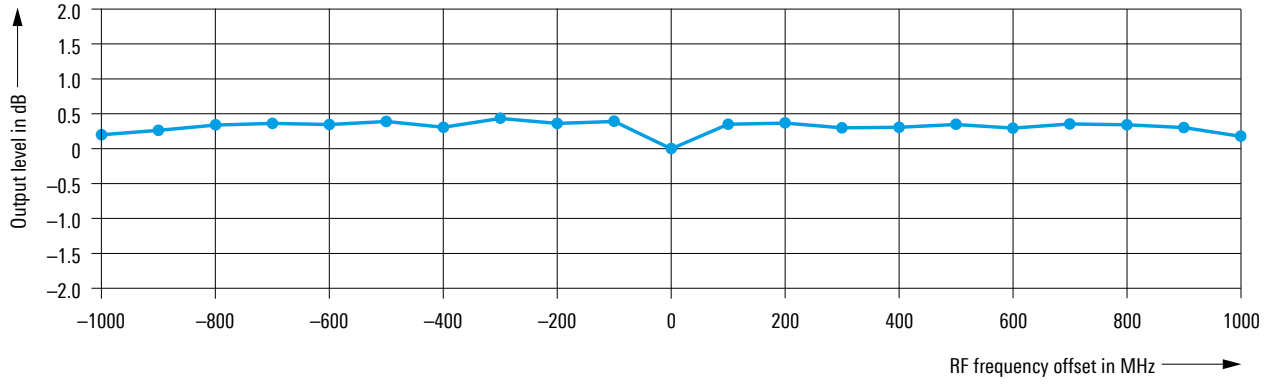
Rohde&Schwarz fully characterizes every R&S®SZU100A I/Q upconverter during the production process and programs it with appropriate correction values. During measurements, the R&S®SMW200A applies these corrections automatically without requiring any special user interaction. At every level and every frequency, the R&S®SZU100A always offers a flat frequency response of < 2.0 dB over 2 GHz bandwidth, although typically the R&S®SZU100A is even better (see diagram below). This eliminates the need for time-consuming external calibration procedures that are required prior to every measurement with conventional mixer setups.

Exceptional spectral purity

The sophisticated synthesizer design developed by Rohde&Schwarz ensures that both image sidebands and spurs are effectively suppressed across the entire wanted frequency band. Harmonics and nonharmonics are attenuated with more than 50 dBc.

When using an R&S®SMW200A equipped with the R&S®SMW-B22 enhanced phase noise performance option, the phase noise at 60.48 GHz with 20 kHz offset is exceptionally low with a typical value of just –102 dBc (1 Hz). With the amplifier turned off, the wideband noise lies in the thermal noise range of about –174 dBm (1 Hz) and therefore does not influence even complex sensitivity measurements.

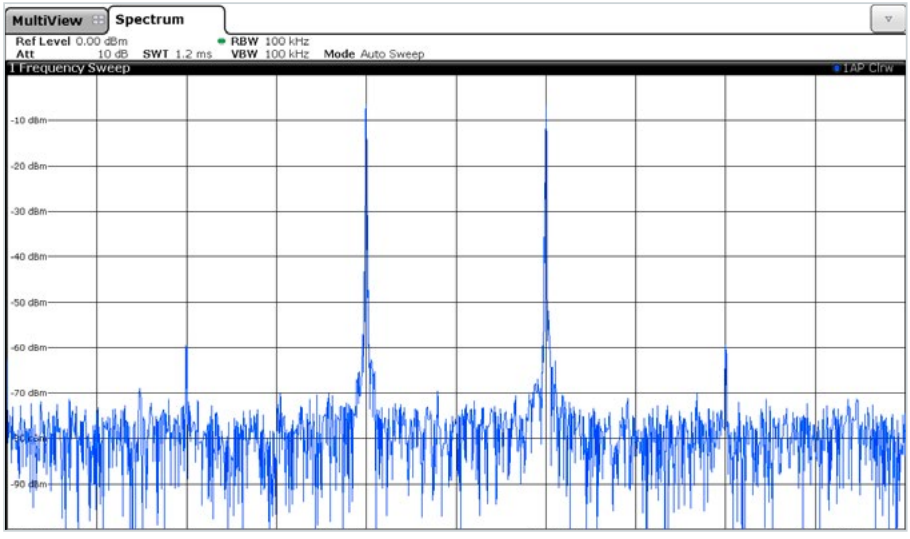
Measured frequency response of the R&S®SMW200A/R&S®SZU100A combo at 60.48 GHz carrier frequency and +0 dBm output level



Excellent modulation quality

High-quality, wideband-modulated test signals are essential, especially for communications standards such as 5G or WLAN IEEE 802.11ad. This is the only way to reliably assess receiver performance.

The R&S®SZU100A upconverter excels thanks to its outstanding modulation quality. For example, 16QAM-modulated WLAN IEEE 802.11ad signals are generated at a carrier frequency of 60.48 GHz with an EVM of better than –32 dB (meas.). The electronic attenuator on the R&S®SZU100A provides a consistently good signal-to-noise ratio even at low power levels. As a result, the excellent modulation quality is maintained almost without change – also at low levels.



Two-tone measurement at 60.48 GHz with 20 MHz carrier spacing.

EVM of a WLAN IEEE 802.11ad signal (MCS12) at 60.48 GHz; measured with the R&S®FSW67 signal and spectrum analyzer.

Fast and convenient operation

A short time to market is the key to the commercial success of a product. The R&S®SZU100A makes everyday measurement tasks simpler, effectively speeding up the development process.

Easy operation

The R&S®SZU100A fits seamlessly into the operating concept of the R&S®SMW200A. As soon as the upconverter is connected to the R&S®SMW200A via the USB, I/Q and RF connectors, the R&S®SMW200A is converted into a vector signal generator for mmWave applications.

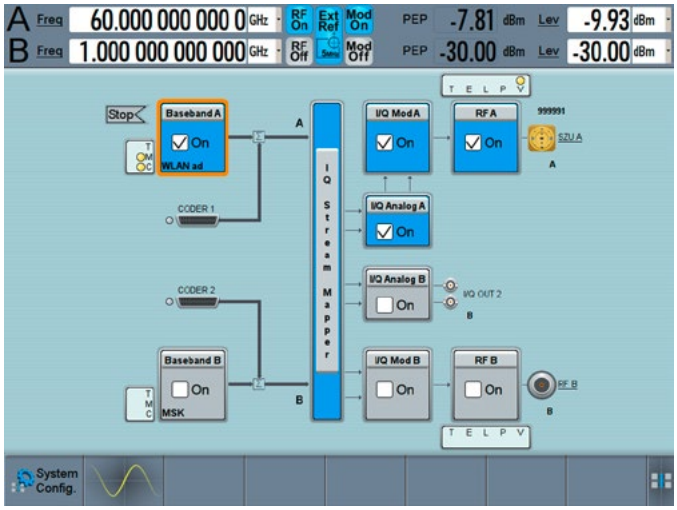
An integrated connection test ensures that all cables are connected correctly. All functions are controlled directly via the graphical user interface on the R&S®SMW200A that is familiar to users of vector signal generators. Standard functions such as the direct signal configuration on the R&S®SMW200A, the context-sensitive help and the graphical display of the generated signal support users in their tasks. All this makes the R&S®SZU100A especially easy to use.

Remote operation and automation

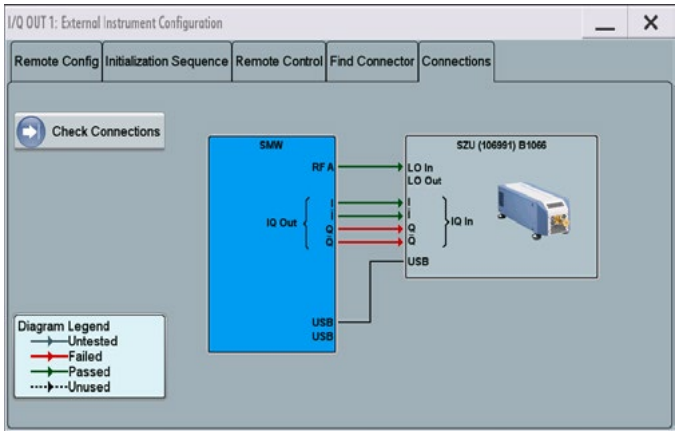
The R&S®SMW200A, and therefore the R&S®SZU100A upconverter, can be controlled via all common remote control interfaces.

R&S®SZU100A users benefit from the versatile remote control functions of the R&S®SMW200A vector signal generator such as the built-in SCPI macro recorder and the function for highlighting any changes to the preset state. Drivers for all key programming environments (MATLAB®, CVI, LabView, VXI plug&play, IVI) are available. With almost no additional effort, remote control programs for the R&S®SMW200A also support the upconverter, minimizing the automation effort for the R&S®SZU100A.

R&S®SMW200A GUI with seamlessly integrated R&S®SZU100A



Internal connection test for checking the correct cabling of the R&S®SMW200A and R&S®SZU100A

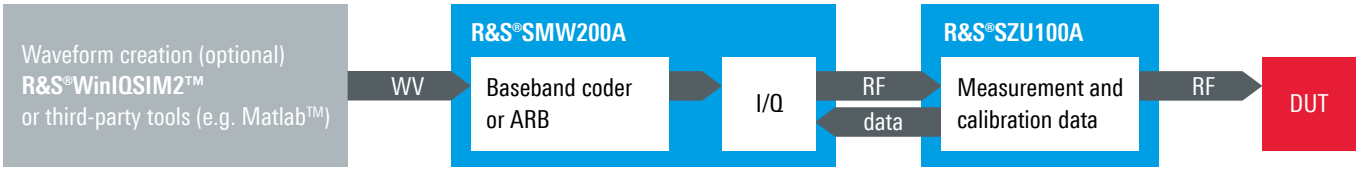


Turbo speed for the development process

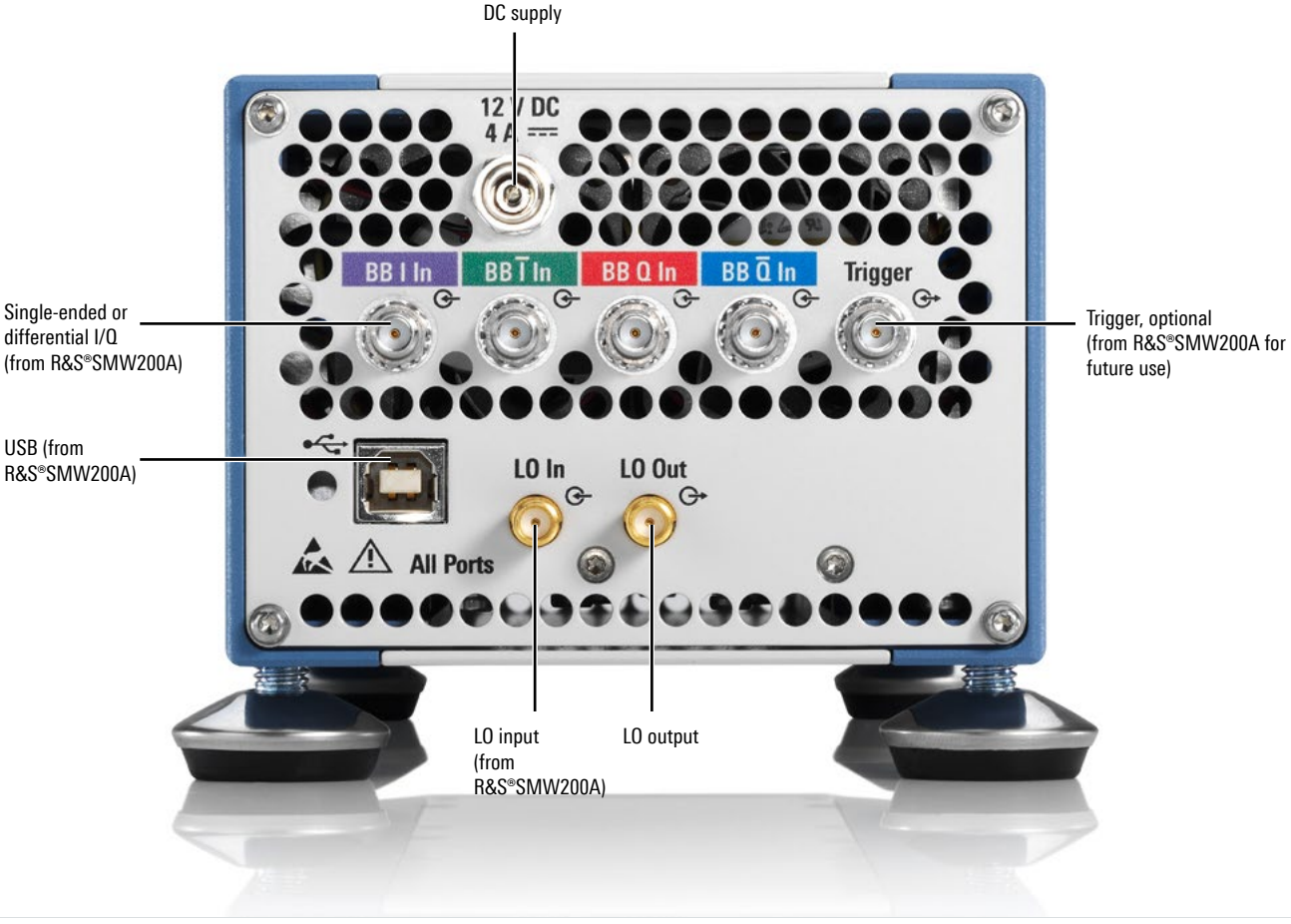
The R&S®SZU100A is fully calibrated at the factory and its frequency response is automatically corrected by the R&S®SMW200A on the fly during operation. This eliminates the need for an external calibration of the test setup before a measurement, such as is typically required by other solutions. The automatic frequency response correction is independent of the wanted signal, level and frequency, eliminating the need for time-consuming calibrations and computational precorrection of waveforms in day-to-day operation.

With on-the-fly compensation, there is also no need to maintain a separate waveform library for each test setup. This ensures that exactly the same signal is used at each test station, permitting work to be performed in parallel. All together, these features help users to perform measurement tasks quickly and purposefully, speeding up the development process.

R&S®SZU100A: on-the-fly frequency response compensation for fast and easy measurements



Rear view of the R&S®SZU100A with color coding on the back panel for easy cable connection



Specifications in brief

Specifications in brief		
Frequency		
Range	R&S®SZU-B1066	58.32 GHz to 64.80 GHz ± ½ occupied modulation bandwidth
Level		
Setting range		–100 dBm to +15 dBm
Specified range		–80 dBm to +5 dBm (PEP) –90 dBm to +10 dBm (PEP, typ.)
Level error	level setting characteristic: auto, less than 5 degree temperature drift after internal adjustment	< 2 dB
Interruption-free level setting range	level setting characteristic: uninterrupted level setting	> 10 dB (nom.)
Spectral purity		
Harmonics		< –50 dBc
Nonharmonics		< –50 dBc
Subharmonics	level > –40 dBm	< –50 dBc
Wideband noise	carrier offset > 30 MHz, measurement bandwidth = 1 Hz, CW, level = 10 dBm	
	PA switched on	–146 dBm (1 Hz) (meas.)
	PA switched off	thermal noise floor (approx. –174 dBm (1 Hz) (meas.))
SSB phase noise with R&S®SMW-B22 option installed in the R&S®SMW200A	I/Q, carrier offset = 20 kHz, measurement bandwidth = 1 Hz	
	f = 60.48 GHz	< –98 dBc, –102 dBc (typ.)
I/Q modulation performance		
RF modulation bandwidth	f_c = 58.32 GHz to 64.80 GHz	2 GHz
RF frequency response in specified RF modulation bandwidth		< 2.0 dB
Carrier leakage	referenced to full-scale baseband input	< –45 dBc
Suppression of image sideband for entire instrument in modulation bandwidth		> 30 dB, > 45 dB (nom.)
Two-tone IMD (2 carriers)	PEP = 0 dBm up to 2000 MHz carrier spacing	< –34 dBc (typ.)
EVM with BPSK, QPSK, 16QAM	60.48 GHz, WLAN IEEE802.11ad signal, 1.76 GHz bandwidth	
With R&S®SMW-B22 option installed in the R&S®SMW200A	time domain power = 0 dBm	
	MCS 5 (BPSK)	< –31 dB, < –34 dB (meas.)
	MCS 9 (QPSK)	< –31 dB, < –34 dB (meas.)
	MCS 12 (16QAM)	< –31 dB, < –34 dB (meas.)

Ordering information

Designation	Type	Order No.
I/Q upconverter, base unit, including combined differential I/Q-USB cable	R&S®SZU100A	1425.3003.02
Frequency option 57 GHz to 66 GHz, WR15	R&S®SZU-B1066	1425.3110.02
Recommended extras		
USB and I/Q cable for R&S®SZU100A, length: 2 m, combined differential I/Q-trigger-USB cable	R&S®SZU-Z1	1425.4851.02
WR15 waveguide-to-waveguide adapter, HP/A compatible, as test port saver		1314.5780.00
WR15 to 1.85 mm waveguide-to-coax adapter	R&S®WCA70	1324.5001.02

Warranty		
Base unit		3 years
All other items		1 year
Options		
Extended warranty, one year	R&S®WE1	Please contact your local Rohde&Schwarz sales office.
Extended warranty, two years	R&S®WE2	
Extended warranty with calibration coverage, one year	R&S®CW1	
Extended warranty with calibration coverage, two years	R&S®CW2	

Service that adds value

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

Rohde&Schwarz

The Rohde&Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

Sustainable product design

- Environmental compatibility and eco-footprint
- Energy efficiency and low emissions
- Longevity and optimized total cost of ownership

Certified Quality Management
ISO 9001

Certified Environmental Management
ISO 14001

Rohde&Schwarz GmbH&Co. KG
www.rohde-schwarz.com

Rohde&Schwarz training
www.training.rohde-schwarz.com

Regional contact

- Europe, Africa, Middle East | +49 89 4129 12345
  customersupport@rohde-schwarz.com
- North America | 1 888 TEST RSA (1 888 837 87 72)
  customer.support@rsa.rohde-schwarz.com
- Latin America | +1 410 910 79 88
  customersupport.la@rohde-schwarz.com
- Asia Pacific | +65 65 13 04 88
  customersupport.asia@rohde-schwarz.com
- China | +86 800 810 82 28 | +86 400 650 58 96
  customersupport.china@rohde-schwarz.com

PD 3607.6038.12 | Version 02.00 | January 2019 (GK)
R&S®SZU100A I/Q Upconverter
Data without tolerance limits is not binding | Subject to change

3607603812

3607.6038.12 02.00 PDP 1 en