# R&S®AFQ100A
# I/Q Modulation Generator
# R&S®AFQ100B
# UWB Signal and
# I/Q Modulation Generator
# High-performance
# baseband signals



75 Years of Driving Innovation

**ROHDE & SCHWARZ**

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

# At a glance

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.

The R&S®AFQ100A and the R&S®AFQ100B from Rohde&Schwarz are two state-of-the-art, self-contained and flexible baseband sources that perfectly meet those requirements.

Featuring a maximum clock rate of 300 MHz, a bandwidth of 200 MHz (RF) and a waveform memory of up to 1 Gsample, the R&S®AFQ100A provides the functionality and flexibility that is required for development and production tests on receivers and components of modern digital communications standards such as WiMAX and LTE.

The R&S®AFQ100B with a bandwidth of 528 MHz (RF), a clock rate of 600 MHz and a waveform memory of up to 1 Gsample is perfectly suited for applications that require more bandwidth. Examples are the support of broadband digital communications systems like UWB (ultra wideband) or radar applications where signals with extremely short pulses and short rise and fall times might be needed.

Both R&S®AFQ family members combine flexibility with outstanding signal quality. Their spurious suppression, for example, is first-rate and their frequency response extremely linear.

All these essential features combined with a wealth of other functions make the R&S®AFQ100A and the R&S®AFQ100B very versatile baseband generators.

# R&S®AFQ100A I/Q Modulation Generator
# R&S®AFQ100B UWB Signal and I/Q Modulation Generator
# Key features

**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 (MCPA)
▪ 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.

▷ page 5

**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)
▪ Almost all R&S®AFQ100A features included

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# R&S®AFQ100A I/Q Modulation Generator R&S®AFQ100B UWB Signal and I/Q Modulation Generator
# Key features

## Aerospace and defense applications
- High bandwidth for generating very short pulses with short rise and fall times
- Pulse Sequencer Software for generating complex pulse patterns (R&S®AFQ-K6 option)
- Accuracy <20 ps when starting several instruments simultaneously for phased-array antenna development and testing
- Removable hard disk to meet high security requirements
▷ page 8

## 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
▷ page 9

## Broad scope of applications
- Analog I/Q outputs (balanced and unbalanced) and optional digital outputs, e.g. for D/A and A/D converter tests
- Multisegment waveform for reducing switching time between different test signals and thus improving test throughput
- Numerous trigger and marker capabilities, e.g. for synchronization with a DUT
- Optional BER measurements for characterizing receivers
▷ page 10

## Easy creation of test signals
- Digital standards using R&S®WinIQSIM2™
- Pulsed signals with Pulse Sequencer Software
- MATLAB Transfer Toolbox for easy interoperability with MATLAB®
- ARB Toolbox for converting numeric I/Q data into R&S®AFQ waveform files
▷ page 12

## Easy operation
- Remote control via GPIB, USB and LAN
- User interface via external monitor or Windows XP Remote Desktop
- USB connectors for USB equipment (keyboard, mouse, memory stick)
▷ page 13

# R&S®AFQ100A – fit for digital communications systems

Digital communications systems are rapidly evolving today, calling for test equipment that can meet the new challenges they present.

## Flexibility whenever needed

An important component of test equipment is a flexible baseband source that allows development and production tests to be performed on state-of-the-art receivers for a variety of standards. A self-contained baseband source must fulfill a wide range of signal requirements. Plus, it needs variable digital and analog outputs in order to directly operate the DUT. All this is offered by the R&S®AFQ100A. When used as a modulation source for vector signal generators, for example, the R&S®AFQ100A provides I/Q signals that offer all the sophistication of modern communications standards for generating the required RF signal. Featuring a maximum clock rate of 300 MHz and a waveform memory of up to 1 Gsample, the R&S®AFQ100A allows long sequences to be generated. Moreover, its high clock rate provides the necessary bandwidth for supporting wireless communications systems such as WiMAX, LTE and HSPA+. The R&S®WinIQSIM2™ software enables the user to control the generator and to easily create test signals in line with different standards.

In addition, the R&S®AFQ100A makes it possible to work with any kind of customized waveforms: Easy interoperability with MATLAB® is ensured by the free-of-charge MATLAB Transfer Toolbox. The ARB Toolbox, which is free of charge, converts I/Q data in numeric format into a waveform file and transfers it automatically to the instrument. And last but not least the Pulse Sequencer Software allows flexible generation of any kind of pulsed signals commonly used in radar applications (R&S®AFQ-K6 option required).
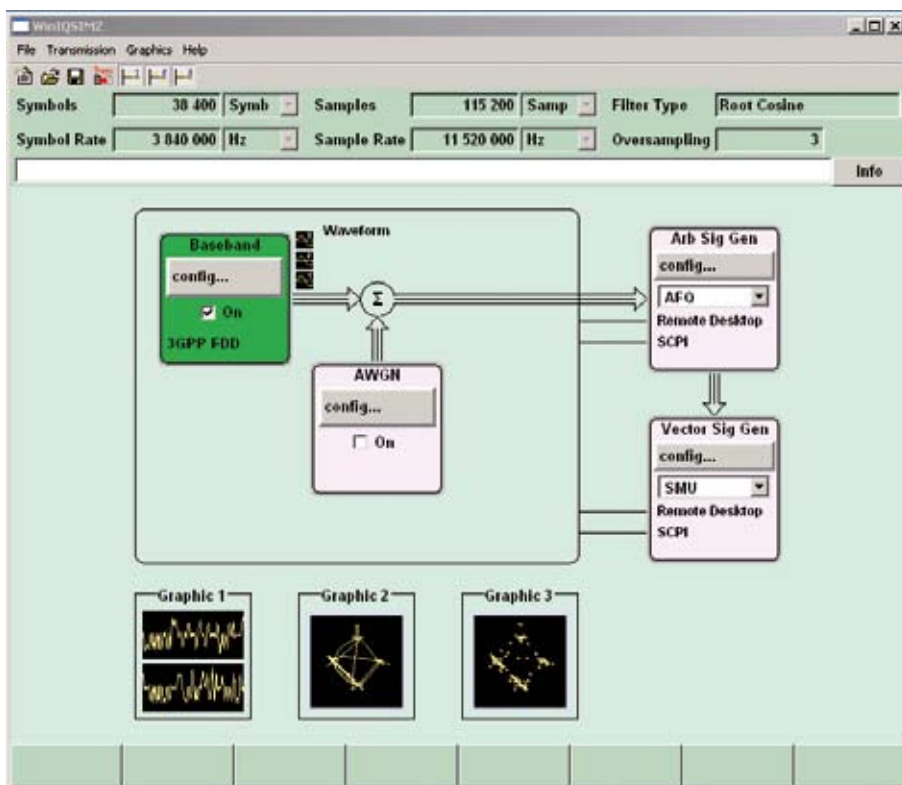


R&S®WinIQSIM2™ screenshot

# R&S®AFQ100A – fit for digital communications systems
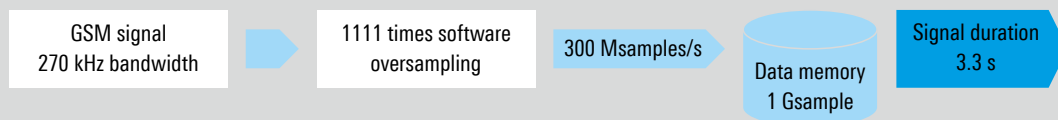
## Performance at any time

The R&S®AFQ100A combines flexibility with outstanding signal quality. Its spurious suppression, for example, is first-rate and its frequency response extremely linear. All these essential features combined with a host of other functions make the R&S®AFQ100A a versatile baseband generator that can easily be adapted to changes.
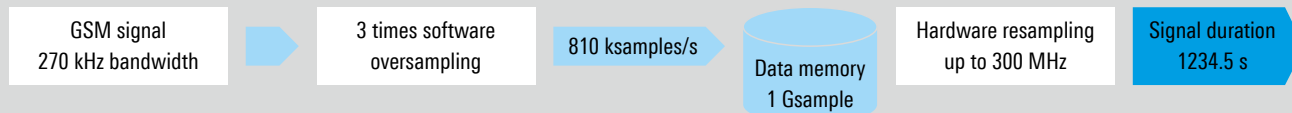
## Automatic resampling

The readout speed of data from the internal memory is user-selectable and can be optimally adapted to the useful signal internally. The R&S®AFQ100A digitally converts the I/Q samples to the higher clock rate of the converter in realtime. This loss-free resampling makes it possible to implement a fixed clock rate for the D/A converter and an optimally adapted anti-aliasing filter, providing ideal signal characteristics. Furthermore, resampling allows you to read out data at a theoretical minimum clock rate, an advantage that means maximum signal duration using a specific memory depth.

### Example: automatic resampling

For a fixed clock rate of 300 MHz

| GSM signal 270 kHz bandwidth | → | 1111 times software oversampling | 300 Msamples/s | Data memory 1 Gsample | Signal duration 3.3 s |

For a variable clock rate of 1 kHz to 300 MHz with hardware resampling

| GSM signal 270 kHz bandwidth | → | 3 times software oversampling | 810 ksamples/s | Data memory 1 Gsample | Hardware resampling up to 300 MHz | Signal duration 1234.5 s |

# R&S®AFQ100B – tailored to UWB applications

The ECMA-368 UWB standard is designed to enable fast wireless connections. It will be used in the next Bluetooth® generation and for wireless USB, for example.

The R&S®AFQ100B is the right choice for developing and testing UWB components and receivers in the baseband. Its bandwidth of 528 MHz is suitable for one UWB band signal that can conveniently be generated in accordance with the ECMA-368 standard using the R&S®WinIQSIM2™ software tool (R&S®AFQ-K264 option).

Besides being tailored to UWB and other broadband applications, the R&S®AFQ100B in Standard Mode (Mode 1) covers nearly all the functionalities and applications of the R&S®AFQ100A.

When loading a waveform, the R&S®AFQ100B automatically selects the mode to be used. If the clock rate is less than or equal to 300 MHz, Standard Mode (Mode 1) is selected and hardware resampling is automatically performed to achieve a maximum clock rate of 300 MHz. In this mode, the I/Q bandwidth of the instrument is 100 MHz, which corresponds to an RF bandwidth of 200 MHz.

If the clock rate is higher than 300 MHz, Broadband Mode (Mode 2) is selected and a software resampling of the clock rate to 600 MHz is performed. In this mode, the I/Q bandwidth of the instrument is 264 MHz, which corresponds to an RF bandwidth of 528 MHz.

R&S®AFQ-K264 option for UWB (ECMA-368)

# R&S®AFQ100A and R&S®AFQ100B shared features
# Aerospace and defense applications
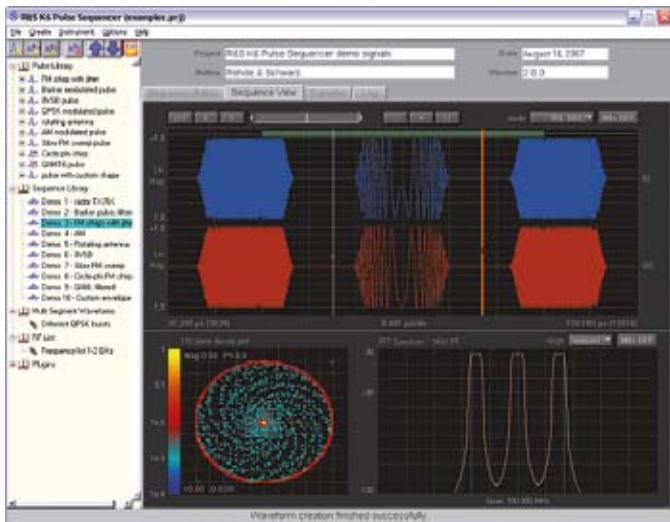
The aerospace and defense (A&D) market is increasingly making use of digital baseband signals, e.g. in modern radar systems and in beamforming phased-array antenna systems. Especially the broadband R&S®AFQ100B meets the requirements of many A&D applications.

## R&S®AFQ100B in pulsed applications
The R&S®AFQ100B RF bandwidth of 528 MHz and a memory depth of up to 1 Gsample make it possible to generate complex pulsed signal scenarios with narrow pulses and very short rise and fall times, which are commonly needed for radar applications. For generating such pulsed signals, the Pulse Sequencer Software (R&S®AFQ-K6 option) is a powerful and flexible tool with an intuitive user interface and integrated waveform display including analysis capabilities. Plug-ins allow the user to add proprietary/classified pulse contents that meet the high demands of A&D customers for data security. The Pulse Sequencer Software makes it possible to conveniently remote-control the R&S®AFQ. In addition to the Pulse Sequencer Software, there are applications available that allow the user to transfer customized waveforms to the R&S®AFQ. The MATLAB Transfer Toolbox ensures easy interoperability with MATLAB®. The ARB Toolbox converts I/Q data in numeric format into a waveform file and transfers it automatically to the instrument.

## R&S®AFQ100A and R&S®AFQ100B in phased-array applications
For developing and testing phased-array antennas, the R&S®AFQ100A and R&S®AFQ100B offer an accuracy of less than 20 ps when starting several instruments synchronously. This is very important, as additional delay would deteriorate the phase relation between the different signals. These phase relations are essential in phased-array applications.
Moreover, the instruments allow flexible and easy generation of the necessary waveform data.

## Meeting security requirements
To meet the high security requirements demanded in aerospace&defense applications, the internal hard disk can be removed whenever necessary. Thus, sensitive data can always remain in a secured area.

Pulse Sequencer Software



Removable hard disk

# R&S®AFQ100A and R&S®AFQ100B shared features
## Outstanding signal quality

## Analog signal output with unsurpassed specifications

A universal I/Q source must provide high signal quality. With their optimized design and state-of-the-art components, the R&S®AFQ100A and R&S®AFQ100B achieve a spurious-free dynamic range (SFDR) of typ. 83 dBc (R&S®AFQ100A) and typ. 78 dBc (R&S®AFQ100B). For broadband and multicarrier signals, one main aspect is the frequency response flatness of the signal generator. This is where the R&S®AFQ100A and R&S®AFQ100B really excel, since they feature a very high linear frequency response of typ. 0.1 dB across 100 MHz I/Q bandwidth.

## Very pure sine-wave source

Both R&S®AFQ generators can create very pure sine wave test signals in the baseband. The R&S®AFQ100A can generate a sine-wave of up to 100 MHz. The R&S®AFQ100B can even generate a sinewave with a frequency up to 264 MHz. Such a pure sine-wave signal can be used for developing and testing A/D converters or mixers, for example.
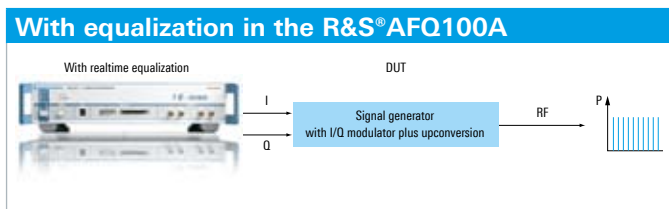
## System equalization

The R&S®AFQ100A and R&S®AFQ100B provide unrivaled baseband performance in terms of frequency response. But the components connected between the R&S®AFQ output and the DUT (cables, filters, amplifiers) and in some cases the DUT itself can deteriorate the frequency response of the setup as a whole. For such cases, the R&S®AFQ100A and R&S®AFQ100B feature a variety of functions to minimize the effect of these impairments, including their capability to compensate the magnitude and phase of a non-ideal frequency response (e.g. of an external I/Q modulator) by means of settable filters. The frequency response of the complete setup can be measured by an external program and transferred to the R&S®AFQ100A and R&S®AFQ100B. During output, a matching inverse filter is taken into account in the signal, achieving linear frequency response and optimum sideband suppression for the entire system.
The R&S®AFQ100A and R&S®AFQ100B also provide I and Q compensation capabilities for each channel for level offset, delay and gain. In addition to being able to compensate delays and effects due to external cables or other elements, you can vary them as required in order to test receiver performance.



### Without equalization in the R&S®AFQ100A
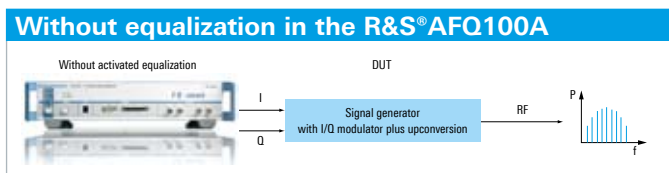
Without equalization in the R&S®AFQ100A: At the R&S®AFQ output, the signal has a very good frequency response, but at the output of the DUT (e.g. a signal generator), the frequency response is degraded due to effects in the cables and the DUT itself.



### With equalization in the R&S®AFQ100A

With equalization in the R&S®AFQ100A: Inverse filters compensate the effects of cables and DUT (in this example for both: the I/Q- and RF-domain) achieving a very linear frequency response at the DUT output.

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

# Broad scope of applications

## Balanced and unbalanced I/Q outputs

Since modern baseband components are often equipped with balanced inputs, the R&S®AFQ100A and R&S®AFQ100B also come with balanced outputs as standard. Of course, it is also possible to use the classic unbalanced I/Q output with 50 Ω terminations connected at I BAR and Q BAR. In addition, the generator allows a DC voltage (bias) of up to ±2.5 V to be added to the balanced output signal.

Both operating modes – balanced and unbalanced – permit flexible level setting. If lower levels are needed, a good signal-to-noise ratio can be achieved by using switchable attenuators in the R&S®AFQ100A and R&S®AFQ100B. The instruments thus provide high signal quality not only at an ideal level value but also across a wide level range.

## Digital I/Q outputs

In addition to the flexible analog outputs, the R&S®AFQ100A and R&S®AFQ100B can optionally be equipped with two digital I/Q output ports. The first output (port 1) provides the digital signals in a multiplexed LVDS data format, which allows the R&S®AFQ100A and R&S®AFQ100B to ideally interface with other equipment from Rohde&Schwarz. This Rohde&Schwarz internal digital interface is suited for clock rates of up to 100 MHz. To digitally connect any DUT with its proprietary I/Q protocol to the R&S®AFQ100A and R&S®AFQ100B, the R&S®EX-IQ-Box can be used. This configurable digital signal interface module provides parallel or serial signal transmission in a programmable format from Rohde&Schwarz instruments to external devices and vice versa. Higher data rates are supported by the second output (port 2), which is a 68-pin HD-SCSI connector. Digital I and Q signals are output in a common LVDS format at a maximum resolution of 16 bit each. This output supplies the data, including the clock signal, directly from the memory.

## Multisegment waveforms

Due to their large memory depth, the R&S®AFQ100A and R&S®AFQ100B enable other useful applications such as the multisegment waveform function. In many cases, testing requires multiple test signals, for example when measuring the distortion of amplifiers. The multisegment waveform function enables high-speed operation by providing rapid switching between different test signals. A multisegment waveform combines several completely independent waveforms in a single waveform file that is entirely loaded into the ARB memory. That means switching between different signals no longer results in delays due to loading operations.

Various output modes support very fast switching times and seamless transition between the different segments of the multisegment waveform.

## Balanced and unbalanced analog I/Q outputs



## Multisegment waveform concept
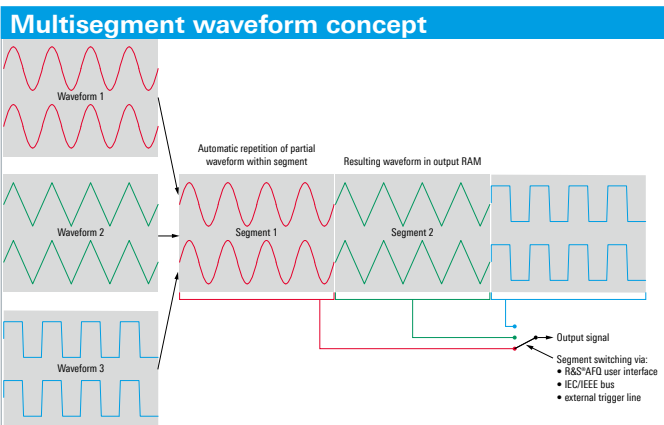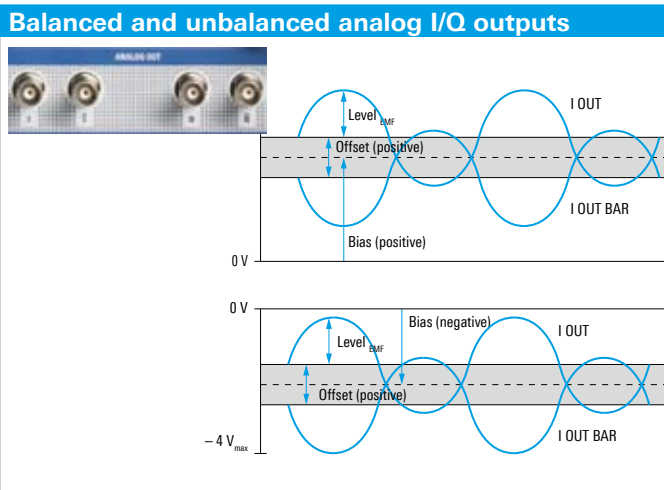
## Numerous trigger and marker capabilities

An important function of an I/Q modulation generator is to control the signal output for synchronization with an external setup. For this purpose, the R&S®AFQ100A and R&S®AFQ100B offer numerous trigger capabilities:
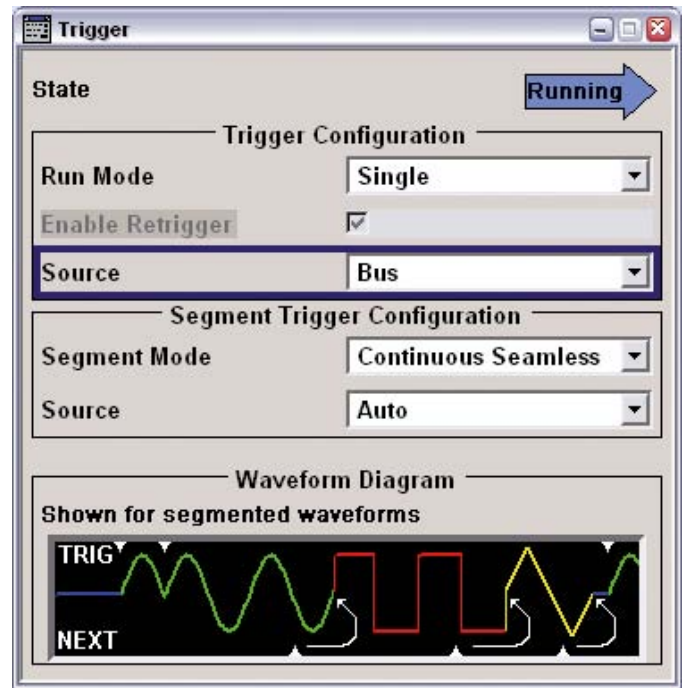
▮ Triggering via remote control
▮ Two external trigger inputs (BNC)
▮ Manual trigger button on the front panel

This is particularly important when multisegment waveforms are used. The two external trigger inputs – TRIG for starting the current segment and NEXT for switching to the next segment – provide the flexibility required to make optimum use of this mode.
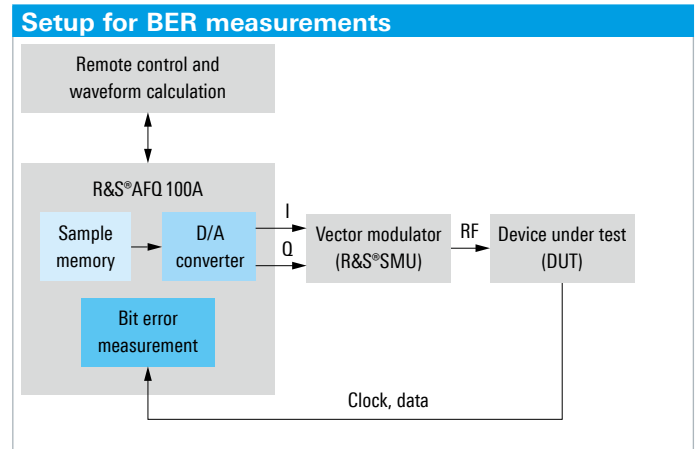In addition, both R&S®AFQ generators supply four independent marker signals, which can be used, for example, to mark a burst in a pulsed signal, to start a receiver or to synchronize with other measurement instruments.
For precise adjustments during signal output, the marker outputs can be delayed without interrupting the I/Q output signal. Thus, time-consuming receiver resynchronization can be avoided while the marker delay is adjusted to the test setup.



Trigger settings for multisegment waveform (MSW) for continuous seamless output

## BER measurements

When testing modules for digital communications standards, measuring bit error ratios is a common quality characteristic for determining receiver sensitivity or selectivity. However, when components are tested that cannot measure bit errors, the R&S®AFQ100A and R&S®AFQ100B handle this task using the R&S®AFQ-K80 BER option. The DUT must provide the demodulated useful data (as PRBS sequence) and – if possible – the associated clock. If the DUT does not provide a clock, the R&S®AFQ100A and the R&S®AFQ100B supply the required clock signal via a marker output.

# R&S®AFQ100A and R&S®AFQ100B shared features
# Easy creation of test signals

## Digital standards with R&S®WinIQSIM2™

The R&S®WinIQSIM2™ simulation software is state-of-the-art software for manual operation. It lets the user create waveforms in accordance with a variety of standards such as WLAN 11n, WiMAX or LTE. For the R&S®AFQ100B with its higher bandwidth, an R&S®WinIQSIM2™ option for UWB (ECMA-368) is also available (R&S®AFQ-K264). Of course, the instruments can be remote-controlled by R&S®WinIQSIM2™.

## Pulsed signals with Pulse Sequencer Software

The Pulse Sequencer Software makes it possible to generate complex pulsed signals for A&D applications (R&S®AFQ-K6 option). It is a powerful and flexible tool with an intuitive user interface and integrated waveform display including analysis capabilities. Any pulse parameter can easily be set, and modulation such as AM, FM, PM, digital modulation, chirps, etc. can be added to the pulses. Plug-ins even allow the user to add proprietary/classified pulse contents that meet the high data security demands of A&D customers.

## Customized signals

The R&S®AFQ100A and R&S®AFQ100B allow the user to work with any kind of customized waveforms:
❙ Easy interoperability with MATLAB® is ensured by the free-of-charge MATLAB Transfer Toolbox (download the Application Note 1GP60 from www.rohde-schwarz.com)
❙ The ARB Toolbox, which is also free of charge, converts I/Q data in numeric format into a waveform file and transfers it automatically to the instrument (download the Application Note 1GP62 from www.rohde-schwarz.com)

# R&S®AFQ100A and R&S®AFQ100B shared features
## Easy operation

The R&S®AFQ100A as well as the R&S®AFQ100B are easy to operate and control. To access the modern graphical user interface (GUI), the instruments are equipped with a video output for an external display. To control the instruments, simply connect a USB keyboard and/or mouse (two USB connectors are available on the front panel and two on the rear panel).

Remote Desktop, a software solution integrated in Windows XP, conveniently allows the instruments to be operated from any workstation worldwide.

The instruments can be remote-controlled via GPIB (IEC/IEEE bus), USB and LAN (Gigabit Ethernet). The two high-speed USB and LAN connectors are suitable for transferring larger waveforms. The generators come with an internal 160 Gbyte hard disk, enough space to hold a large number of signals, which eliminates the need to additionally retransmit waveforms into the R&S®AFQ100A and R&S®AFQ100B.

# Specifications in brief

| Output memory | | |
|---|---|---|
| Memory clock of the R&S®AFQ100A | | 1 kHz to 300 MHz |
| Memory clock of the R&S®AFQ100B | | 1 kHz to 300 MHz (mode 1) |
| | | 600 MHz (mode 2) |
| Waveform length (data and markers) | waveform memory (R&S®AFQ-B10)[1] | up to 256 Msample |
| | waveform memory (R&S®AFQ-B11) | up to 1 Gsample |
| | waveform memory (R&S®AFQ-B12)[2] | up to 512 Msample |
| Amplitude resolution of data words | | 16 bit analog and digital |

| System bandwidth (RF) | | |
|---|---|---|
| System bandwidth (RF) of the R&S®AFQ100A | | 200 MHz |
| System bandwidth (RF) of the R&S®AFQ100B | | 200 MHz (mode 1) |
| | | 528 MHz (mode 2) |

| Signal output | | |
|---|---|---|
| Number of outputs | | 2 (I and Q) |
| Output (unbalanced) | | 1 V ($V_{pp}$) |
| | level range | 0 V to 1.5 V ($V_{pp}$) |
| | resolution | 14 bit |
| | frequency response | ±0.1 dB up to 100 MHz |
| Output (balanced) of the R&S®AFQ100A | | 2 V ($V_{pp}$) |
| | level range | 0 V to 3 V ($V_{pp}$) |
| | resolution | 14 bit |
| | frequency response | ±0.1 dB up to 100 MHz |
| Output (balanced) of the R&S®AFQ100B | | 1 V ($V_{pp}$) |
| | level range | 0 V to 1.4 V ($V_{pp}$) |
| | resolution | 14 bit |
| | frequency response | ±2.5 dB up to 264 MHz |
| Spurious-free dynamic range | | typ. 83 dBc for the R&S®AFQ100A |
| | | typ. 78 dBc for the R&S®AFQ100B |

| Digital outputs | | |
|---|---|---|
| Port 1 | | multiplexed I/Q data stream, compatible with other Rohde&Schwarz equipment |
| Port 2 | | parallel I/Q interface |

| General data | | |
|---|---|---|
| Mass storage | | 160 GByte, removable hard disk |
| Interfaces | | USB 2.0 (master and slave), Gigabit Ethernet, IEC 625 (IEEE 488) |

[1] Only R&S®AFQ100A.
[2] Only R&S®AFQ100B.

# Ordering information

| Designation | Type | Order No. |
|---|---|---|
| **Base unit** | | |
| I/Q Modulation Generator [1] | R&S®AFQ100A | 1401.3003.02 |
| UWB Signal and I/Q Modulation Generator [2] | R&S®AFQ100B | 1410.9000.02 |
| Including power cable, Quick Start Guide, CD-ROM (with operating and service manual) and two 50 Ω terminations | | |
| **Baseband hardware** | | |
| Waveform Memory 256 Msample [3] | R&S®AFQ-B10 | 1401.5106.02 |
| Waveform Memory 1 Gsample | R&S®AFQ-B11 | 1401.5206.02 |
| Waveform Memory 512 Msample [4] | R&S®AFQ-B12 | 1411.0007.02 |
| Digital I/Q Output | R&S®AFQ-B18 | 1401.5306.02 |
| **Baseband software** | | |
| Bit Error Ratio Tester | R&S®AFQ-K80 | 1401.5006.02 |
| Pulse Sequencer | R&S®AFQ-K6 | 1401.5606.02 |
| **R&S®WinIQSIM2™ software** | | |
| Digital Standard GSM/EDGE | R&S®AFQ-K240 | 1401.6302.02 |
| Digital Standard 3GPP FDD | R&S®AFQ-K242 | 1401.6354.02 |
| Digital Standard 3GPP FDD Enhanced MS/BS Tests, incl. HSDPA | R&S®AFQ-K243 | 1401.6402.02 |
| Digital Standard GPS | R&S®AFQ-K244 | 1401.6454.02 |
| Digital Standard HSUPA | R&S®AFQ-K245 | 1401.6504.02 |
| Digital Standard CDMA2000® incl. 1xEV-DV | R&S®AFQ-K246 | 1401.6554.02 |
| Digital Standard 1xEV-DO Rev. A | R&S®AFQ-K247 | 1401.5958.02 |
| Digital Standard IEEE 802.11 (a/b/g) | R&S®AFQ-K248 | 1401.6602.02 |
| Digital Standard IEEE 802.16 | R&S®AFQ-K249 | 1401.6654.02 |
| Digital Standard TD-SCDMA | R&S®AFQ-K250 | 1401.6702.02 |
| Digital Standard TD-SCDMA Enhanced | R&S®AFQ-K251 | 1401.6754.02 |
| Digital Standard DVB-H | R&S®AFQ-K252 | 1401.5858.02 |
| Digital Standard IEEE 802.11n | R&S®AFQ-K254 | 1401.5806.02 |
| Digital Standard EUTRA | R&S®AFQ-K255 | 1401.5906.02 |
| Digital Standard XM Radio | R&S®AFQ-K256 | 1401.6002.02 |
| Digital Standard HSPA+ | R&S®AFQ-K259 | 1401.5658.02 |
| Multicarrier CW Signal Generation | R&S®AFQ-K261 | 1401.6802.02 |
| Additive White Gaussian Noise | R&S®AFQ-K262 | 1401.6854.02 |
| Digital Standard ECMA-368 (UWB) | R&S®AFQ-K264 | 1410.8504.02 |
| **Recommended extras** | | |
| Hardcopy manuals (in English, UK) for the R&S®AFQ100A | | 1401.3084.32 |
| Hardcopy manuals (in English, US) for the R&S®AFQ100A | | 1401.3084.39 |
| Hardcopy manuals (in English, UK) for the R&S®AFQ100B | | 1410.9069.32 |
| Hardcopy manuals (in English, US) for the R&S®AFQ100B | | 1410.9069.39 |
| 19" Rack Adapter | R&S®ZZA-211 | 1096.3260.00 |
| Keyboard with USB Interface (US character set) | R&S®PSL-Z2 | 1157.6870.04 |
| Mouse with USB Interface, optical | R&S®PSL-Z10 | 1157.7060.03 |
| External USB DVD Drive | R&S®PSP-B6 | 1134.8201.22 |

[1] The base unit must be ordered together with the R&S®AFQ-B10 or R&S®AFQ-B11 option.
[2] The base unit must be ordered together with the R&S®AFQ-B11 or R&S®AFQ-B12 option.
[3] Only for an R&S®AFQ100A.
[4] Only for an R&S®AFQ100B.