

# Dual-Channel Arbitrary/Function Generator R&S® AM300

100 Msample/s  
DC to 50 MHz



**R&S Smart Instruments™**  
The new product family  
from  
Rohde & Schwarz

*First edition · February 2004*



**ROHDE & SCHWARZ**

# Dual-Channel Arbitrary/Function Generator

## Sampling rate 100 Msample/s

### Top performance for arbitrary and standard signals

The R&S®AM300 is a dual-channel arbitrary/function generator that offers superb functionality and spectral purity at a favourable price. Due to its high-quality characteristics, the instrument displays digitally generated signals almost distortion-free – even at high output levels and frequencies. The R&S®AM300 thus meets reference signal source requirements for a host of applications.

With a high sampling rate of up to 100 Msample/s, 256k-point waveform memory per channel and the Waveform Composer software, virtually any waveform can be implemented – no matter whether for applications in the lab, in production or service.

The two channels of the instrument are phase-coupled and thus allow the generation of analog I/Q signals that can be used, for example, to modulate the RF Signal Generator R&S®SM300. The upper frequency limit of 35 MHz for sine signals and 50 MHz for square signals leaves sufficient room for future tasks.

### Highlights

**Two channels with individually selectable frequency, waveform and amplitude**

**Phase offset selectable with 0.01° resolution**

**Harmonic suppression for sine signals (1 MHz) typically 70 dB (0.03%)**

**Large color display for displaying waveforms, including zoom function**

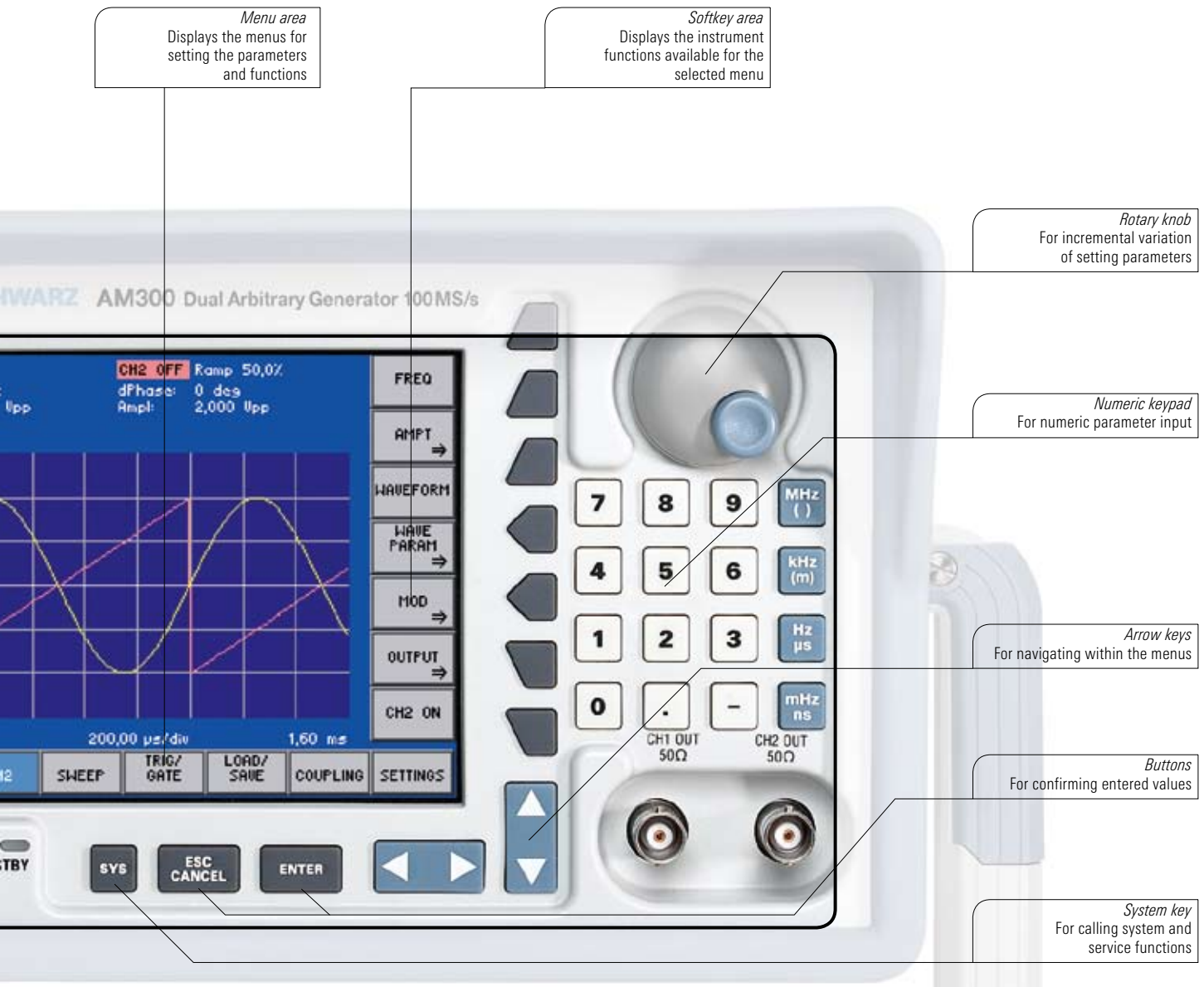
**Highly stable reference frequency (1 ppm/year)**

**Low-jitter clock generator up to 50 MHz**

**USB interface (with file management on USB stick)**

### Condensed data

|                       |  |
|-----------------------|--|
| Standard functions    | sine, square, triangle, ramp, pulse, noise, exponential                |
| Max. frequency ranges | 35 MHz sine, 50 MHz square, 500 kHz for triangle, ramp and exponential |
| Modulation            | AM, FM, φM, FSK, PSK   |
| Arbitrary waveforms   | 100 Msample/s, 16 to 256k points per channel                           |
| Amplitude range       | 1 mV to 10 V (V <sub>pp</sub> ), with 14-bit resolution                |
| Pulse                 | 20 ns to 9999 s, selectable pulse width; rise time <10 ns              |
| Sweep                 | linear and logarithmic   |
| Trigger               | 1 trigger input, 2 sync outputs  |
| Burst                 | 1 to 65535 periods per burst   |



## Ergonomic user interface

Operation is menu-guided so that even untrained users will quickly obtain correct results. Clear structures simplify navigation within the menus.

The bright TFT color display allows settings and results to be read even at odd angles or when the incidence of light is unfavourable.



## Applications

The R&S®AM300 combines the functionality of three instruments:  
arbitrary, function and I/Q generator.

### Dual-channel function generator

Generation of a variety of standard functions such as sine or squarewave with modulation capability and precisely adjustable phase offset between the channels

### Dual-channel arbitrary generator

Generation of virtually any type of waveform

### I/Q baseband source

For digital transmission applications

## Typical applications of the R&S® AM300

- ◆ High-quality modulation signal source
- ◆ Generation of two signals with precisely defined time and phase relationship
- ◆ Testing of control loops (e.g. AGCs)
- ◆ Generation of test signals, e.g. simulation of sensor signals including defined superimposed interference
- ◆ Replay of digitized data for reproduction of real signals
- ◆ I/Q modulation source for generating a wide range of digitally modulated broadband signals
- ◆ Generation of pulses and bursts

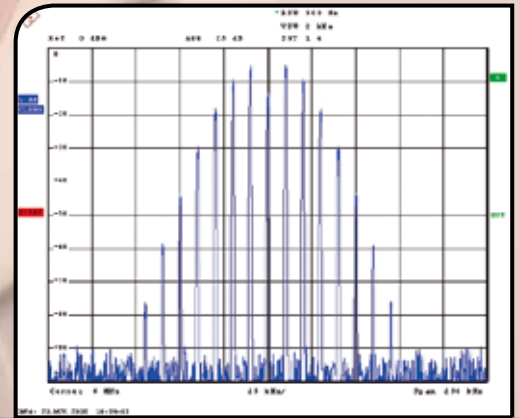
The possible combinations offered by the two channels of the R&S®AM300 further increase the instrument's versatility.



## High-quality modulation signal source

Available modulation modes include AM, FM,  $\phi$ M, FSK and PSK. The desired signal can be selected from a variety of standard waveforms or defined by the user. Owing to its diverse modulation capabilities, the R&S®AM300 can be used in test labs, training centers and at universities as well as in R&D, service and production.

*FM signal  
Carrier: 6 MHz sine  
Modulation: 10 kHz sine, 20 kHz deviation*



## Precisely defined time and phase relationship

Generation of signals with defined time and phase relationship for testing the behaviour of detector circuits (e.g. phase detector).

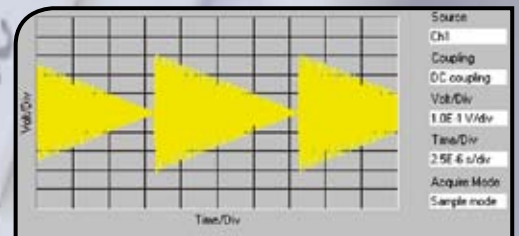
*Two sine waves  
with 90° phase offset*



## Complex test signals

The comprehensive range of waveforms plus the capability of combining them with modulation and burst functionality allow signals for circuit testing to be generated. To test the transient response of automatic gain control (AGC) circuits, for example, level steps or defined ramps can be created conveniently. The R&S®AM300 meets all relevant requirements commonly encountered in electronics labs.

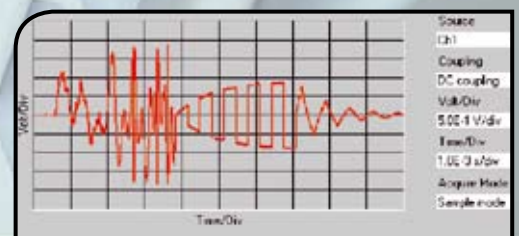
*Carrier: 35 MHz sine  
AM: negative ramp with 100 kHz*



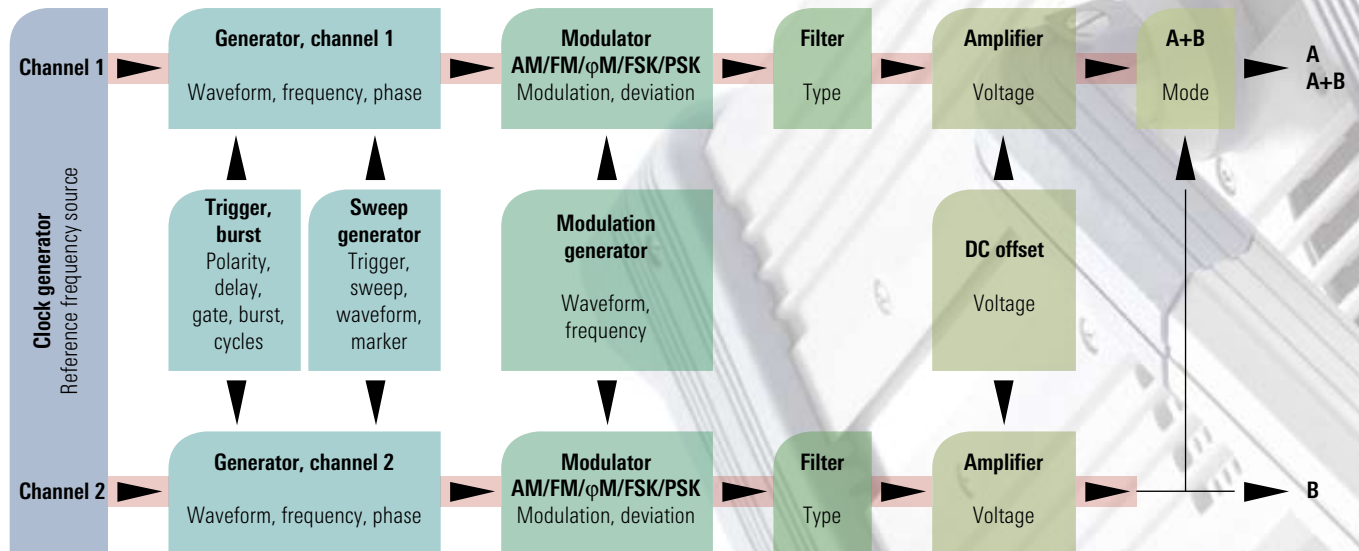
## Arbitrary signals

Using the Waveform Composer software, you can generate nearly all conceivable waveforms. Plus, a large number of data formats can be imported and combined with user-defined signals. Waveform Composer also supports file formats such as used with oscilloscopes, for example. Synchronization to recorded signals can be supported by markers.

*Arbitrary signal: 1000 points,  
sampling rate 7.5 MHz*



# The R&S® AM300 can be used as an arbitrary, function or I/Q baseband generator



## Function generator

### Characteristics

- ◆ Two channels with separately selectable frequency, amplitude, waveform and phase
- ◆ Signals can be summed and output on one channel (addition)
- ◆ Variety of modulation modes

### Advantages

- ◆ Two function generators in a single unit simplify test setups
- ◆ Precise, adjustable phase offset between the channels
- ◆ Creation of flexible test scenarios with individually selectable signal parameters, e.g. sine in channel 1 and noise with variable amplitude in channel 2

## Arbitrary generator

### Characteristics

- ◆ High signal quality
- ◆ Two channels with synchronous sampling
- ◆ Waveform Composer PC software for waveform generation
- ◆ Import filters for different waveform formats

### Advantages

- ◆ True reproduction of digitally generated signals
- ◆ Generation of two-channel test scenarios with precisely defined time relationship
- ◆ Versatile applications based on PC software, e.g. replay of waveforms recorded with an oscilloscope
- ◆ High flexibility through user-programmable settings

## I/Q source for digitally modulated signals

### Characteristics

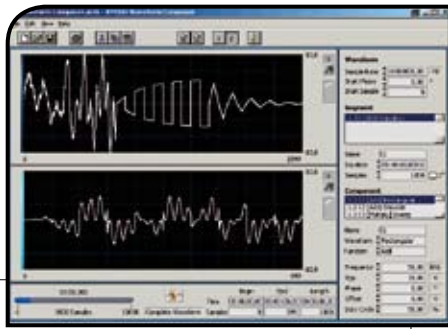
- ◆ Reading and replay of I/Q data
- ◆ Support of common mathematical programs such as Matlab or Mathcad

### Advantages

- ◆ Use of the R&S®AM300 in digital transmission applications
- ◆ Economical I/Q baseband signal source, e.g. for training purposes







## File formats

The built-in import filters allow user-calculated waveforms to be loaded from other programs by means of Waveform Composer. The following formats are supported:

|                  |          |                      |          |
|------------------|----------|----------------------|----------|
| ADS ASCII Single | *.asg    | LeCroy               | *.trc    |
| ADS ASCII Mixed  | *.asg    | Mathcad Single       | *.i, *.q |
| AM300 Binary     | *.amb    | Mathcad Mixed        | *.dat    |
| AM300 ASCII      | *.ama    | Matlab ASCII Single  | *.dat    |
| AWG 2000         | *.wfm    | Matlab ASCII Mixed   | *.dat    |
| COSSAP Single    | *.i, *.q | Matlab Binary Single | *.mat    |
| COSSAP Mixed     | *.dat    | Matlab Binary Mixed  | *.mat    |
| DAB-K1           | *.sym    | SPW ASCII Single     | *.acsig  |
| DaDisp Single    | *.i, *.q | SPW ASCII Mixed      | *.acsig  |
| DaDisp Mixed     | *.dsp    | SPW Binary Mixed     | *.sig    |
| IQSIM            | *.i, *.q | Uint16               | *.i, *.q |
| IQW Mixed        | *.iqw    | WAV                  | *.wav    |

## Simple downloading of waveforms via USB stick

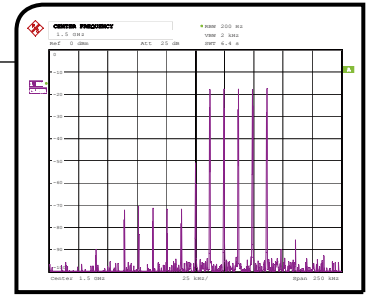
In remote operation, waveforms generated with Waveform Composer can be loaded on the instrument via the USB cable. For mobile applications, up to 1000 waveforms can be stored on a USB stick (256 Mbyte) and downloaded from the instrument to the waveform memory when required.





## I/Q modulation with the R&S® AM300

The R&S®AM300 can replay I/Q data formats synchronously on the two channels and can therefore be used as an I/Q baseband generator for digital signals. Waveform Composer supports a wide range of I/Q data formats created by means of common mathematical development tools such as Matlab, Mathcad, etc. Using the RF Signal Generator R&S®SM300, the I/Q signals thus generated can be converted to a higher frequency.



## USB interfaces

The standard USB interface connects the instrument to the PC world. USB ensures high data transmission rates at low cost. Peripheral equipment, e.g. a printer or a USB memory stick, can also be addressed via a second USB interface.

Waveforms generated on a PC with Waveform Composer, for example, can easily be loaded on the instrument using a USB memory stick.

## Identical housing



All instruments based on the Family 300 concept have an almost identical “face”, including a 5.4-inch VGA TFT display, front-panel control elements, protective guards and a handle that can be adjusted to different positions. Only the connectors on the front and rear panels vary depending on the instrument type. If the protective guards and the handle are removed, the R&S®AM300 can be installed in a 19-inch rack. Owing to their slim design, two instruments of the Family 300 can be placed next to each other.



## Uniform operating concept

All instruments of the Family 300 are similarly operated on the basis of the high-end devices from Rohde & Schwarz. Most operations are menu-controlled so that no device-specific keys are required. Only the four unit keys for confirming entered values are configured separately.

# Specifications

**Important:** As a highly innovative company, we continuously refine our products. Please check our homepage [www.smart.rohde-schwarz.com](http://www.smart.rohde-schwarz.com) for new applications and features.

| Channels           |                   |
|--------------------|-------------------|
| Number of channels | 2                 |
| Phase              |                   |
| Setting range      | -180° to +180°    |
| Resolution         | 0.01°             |
| Operating modes    | CH1, CH2, CH1+CH2 |

| Waveforms        |   |
|------------------|---|
| <b>Standard</b>  | sine, triangle, ramp, square, pulse, exponential rise,<br>exponential fall, noise |
| <b>Arbitrary</b> |   |
| Waveform length  | 16 to 262144 (256k) points per channel  |
| Level resolution | 14 bit  |

| Modulation       |                            |
|------------------|----------------------------|
| Modulation modes | AM, FM, $\phi$ M, FSK, PSK |

| Frequency                           |                                       |
|-------------------------------------|---------------------------------------|
| Sine                                | 10 $\mu$ Hz to 35 MHz                 |
| Triangle, ramp, square, exponential | 10 $\mu$ Hz to 500 kHz                |
| Low-jitter square <sup>1)</sup>     | 10 $\mu$ Hz to 50 MHz                 |
| Noise                               | 35 MHz bandwidth                      |
| Pulse                               | 10 $\mu$ Hz to 14.285 MHz (= 1/70 ns) |
| Arbitrary                           |                                       |
| Repetition rate                     | max. 6.25 MHz (16 points)             |
| Sampling rate                       | 10 $\mu$ Hz to 100 MHz                |
| Resolution                          | 10 $\mu$ Hz                           |

| Output parameters                                |  |
|--|--|
| Output voltage (into 50 $\Omega$ )               |  |
| Setting range                                    | 1 mV to 10 V ( $V_{pp}$ ); with AM: 1 mV to 5 V ( $V_{pp}$ ) |
| Resolution                                       | 0.1 mV (4 digits)  |
| Uncertainty                                      | $\pm 2\%$  |
| Frequency response (relative to 10 kHz sinewave) |  |
| 10 $\mu\text{Hz} \leq f \leq 30 \text{ MHz}$     | $\pm 0.1 \text{ dB}$   |
| 30 MHz < f $\leq 35 \text{ MHz}$                 | $\pm 0.25 \text{ dB}$  |
| Units  | V ( $V_{pp}$ ), dBm  |

| Spectral purity (sinewave)                          |                   |                                 |                  |
|---|-------------------|---------------------------------|------------------|
| <b>Harmonic distortion</b>                          | <3 V ( $V_{pp}$ ) | $\geq 3 \text{ V}$ ( $V_{pp}$ ) | (output voltage) |
| 20 Hz $\leq f \leq 1 \text{ MHz}$                   | <-65 dBc          | <-60 dBc                        |                  |
| 1 MHz < f $\leq 5 \text{ MHz}$                      | <-55 dBc          | <-55 dBc                        |                  |
| 5 MHz < f $\leq 35 \text{ MHz}$                     | <-40 dBc          | <-35 dBc                        |                  |
| <b>Nonharmonic distortion</b>                       |                   |                                 |                  |
| 10 $\mu\text{Hz} \leq f \leq 5 \text{ MHz}$         | <-60 dBc          | typ. (-70 dBc)                  |                  |
| 5 MHz < f $\leq 25 \text{ MHz}$                     | <-45 dBc          | typ. (-55 dBc)                  |                  |
| 25 MHz < f $\leq 35 \text{ MHz}$                    | <-40 dBc          | typ. (-50 dBc)                  |                  |
| <b>SSB phase noise</b> (10 kHz offset from carrier) |                   |                                 |                  |
| 10 MHz  | -118 dBc (1 Hz)   |                                 |                  |
| 35 MHz  | -117 dBc (1 Hz)   |                                 |                  |

| Signal characteristics                       |                            |
|--|----------------------------|
| <b>Square</b>                                |                            |
| Duty cycle                                   |                            |
| $\leq 500 \text{ kHz}$                       | 1% to 99% (selectable)     |
| 10 $\mu\text{Hz}$ to 50 MHz                  | 50% (fixed)                |
| Rise/fall time                               |                            |
| 10 $\mu\text{Hz} \leq f \leq 10 \text{ MHz}$ | <10 ns                     |
| 10 MHz < f $\leq 50 \text{ MHz}$             | <5 ns                      |
| Overshoot                                    | <5%                        |
| <b>Pulse</b>                                 |                            |
| Period                                       | 70 ns to 9999 s            |
| Pulse width                                  | 20 ns to 9999 s            |
| Rise time                                    | <10 ns                     |
| Overshoot                                    | <5%                        |
| <b>Ramp/triangle</b>                         |                            |
| Symmetry                                     | 0% to 100%                 |
| Linearity                                    | $\pm 0.1\%$ (f < 10 kHz)   |
| <b>Exponential</b>                           |                            |
| Type   | rise or fall               |
| <b>Arbitrary</b>                             |                            |
| Rise time                                    | <10 ns                     |
| Linearity                                    | $\pm 0.1\%$ (f < 10 kHz)   |
| Loading time via USB                         | 16 s (binary, 256k points) |



| <b>Output characteristics</b>         |   |
|---------------------------------------|---|
| <b>DC offset</b> (into 50 $\Omega$ )  |   |
| Setting range                         | $\pm 5$ V,  signal level + offset  $\leq 5$ V           |
| Uncertainty                           | $\pm 1$ % of setting $\pm 2$ mV + 0.5 % of signal level |
| <b>Signal output</b>                  |   |
| Impedance                             | 50 $\Omega$ nominal                                     |
| Protection                            | short-circuit-protected                                 |
| <b>Filters</b>                        |   |
| Internal                              |   |
| Operating modes                       | manual, automatic                                       |
| Cutoff frequencies of lowpass filters | 35 MHz, 37 MHz, 75 MHz                                  |
| Filter types                          | 9th order Bessel, 9th order Cauer                       |
| External filter connector             |   |
| Impedance (output and input)          | 50 $\Omega$ nominal                                     |
| Output voltage                        | 2 V ( $V_{pp}$ )  |

| <b>Modulation<sup>2)</sup></b> |   |
|--------------------------------|---|
| <b>AM</b>                      |   |
| Carrier waveforms              | sine, triangle, ramp, square, exponential, pulse, arbitrary |
| Modulation waveforms           | sine, square, triangle, ramp, exponential, noise            |
| Modulation frequency           | 10 mHz to 100 kHz   |
| Modulation depth               | 0 % to 100 %  |
| Resolution                     | 0.1 %   |
| Source                         | internal  |
| <b>FM</b>                      |   |
| Carrier waveforms              | sine, triangle, ramp, square, exponential, arbitrary        |
| Modulation waveforms           | sine, square, triangle, ramp, exponential, noise            |
| Modulation frequency           | 10 mHz to 100 kHz   |
| Frequency deviation            | 100 mHz to 17.5 MHz   |
| Source                         | internal  |
| <b><math>\phi</math>M</b>      |   |
| Carrier waveforms              | sine, triangle, ramp, square, exponential, arbitrary        |
| Modulation waveforms           | sine, square, triangle, ramp, exponential, noise            |
| Modulation frequency           | 10 mHz to 100 kHz   |
| Phase deviation                | $-180^\circ$ to $+180^\circ$                                |
| Source                         | internal  |
| <b>FSK</b>                     |   |
| Carrier waveforms              | sine, triangle, ramp, square, exponential, arbitrary        |
| Modulation waveform            | square  |
| Modulation frequency           | 0.1 mHz to 2 MHz  |
| Frequency deviation            | 10 $\mu$ Hz to 500 kHz (sine: 35 MHz)                       |
| Source                         | internal, external  |
| <b>PSK</b>                     |   |
| Carrier waveforms              | sine, triangle, ramp, square, exponential, arbitrary        |
| Modulation waveform            | square  |
| Modulation frequency           | 0.1 mHz to 2 MHz  |
| Phase deviation                | $-180^\circ$ to $+180^\circ$                                |
| Source                         | internal, external  |

| <b>Gate/burst</b>          |  |
|----------------------------|--|
| Waveforms                  | sine, triangle, ramp, square, exponential, arbitrary |
| Gate settings              | block end, sample & hold, burst                      |
| Number of cycles per burst | 1 to 65535   |
| Start phase                | -180° to +180°                                       |
| Gate length (internal)     | 100 ns to 9999 s                                     |
| Gate source                | internal, external                                   |

| <b>Sweep</b>         |  |
|----------------------|--|
| Waveforms            | sine, triangle, ramp, square, exponential, arbitrary |
| Type                 | linear, logarithmic                                  |
| Direction            | upward   |
| Start/stop frequency | 10 mHz to max. signal frequency (sine: 35 MHz)       |
| Sweep time           | 1 ms to 999 s  |
| Marker               | frequency marker                                     |

| <b>Trigger</b>                |  |
|-------------------------------|--|
| Source                        | manual, internal, external                       |
| Delay                         |  |
| Setting range                 | 0 ns or 150 ns to 9999 s                         |
| Resolution                    | 10 ns  |
| <b>Internal trigger</b>       |  |
| Repetition cycle              | 500 ns to 9901 s (2 MHz to 101 $\mu$ Hz)         |
| Resolution                    | 10 ns  |
| <b>External trigger input</b> |  |
| Input voltage                 | TTL-compatible                                   |
| Edge                          | rising or falling, selectable                    |
| Pulse width                   | >100 ns  |
| Input impedance               | >1 k $\Omega$ (DC-coupled)                       |
| Latency (burst, sweep)        | typ. 100 ns                                      |
| <b>Sync outputs</b>           |  |
| Number of outputs             | 2  |
| Voltage                       | TTL-compatible                                   |
| Pulse width                   | $\geq$ 50 ns                                     |
| Polarity                      | selectable                                       |
| Impedance                     | 50 $\Omega$                                      |
| Sources                       | comparator, phase accumulators, marker, triggers |

| <b>Reference</b>                       |                             |
|--|-----------------------------|
| <b>Reference oscillator</b> (internal) |                             |
| Frequency                              | 10 MHz                      |
| Stability                              | <1 ppm                      |
| Aging                                  | <1 ppm/year                 |
| <b>Reference input</b>                 |                             |
| Frequency                              | 10 MHz, 5 MHz, 2 MHz        |
| Frequency error                        | $<5 \times 10^{-6}$         |
| Input voltage                          | 0.5 V to 2 V (50 $\Omega$ ) |
| Input impedance                        | 50 $\Omega$                 |
| <b>Reference output</b>                |                             |
| Frequency                              | 10 MHz                      |
| Output voltage                         | >0.5 V (50 $\Omega$ )       |
| Impedance                              | 50 $\Omega$                 |

| <b>Interfaces</b> |                                 |
|-------------------|---------------------------------|
| <b>USB host</b>   |                                 |
| Connector         | B plug                          |
| Protocol          | version 1.1                     |
| Command set       | device-specific, remote control |
| <b>USB device</b> |                                 |
| Connector         | A plug                          |
| Protocol          | version 1.1                     |
| Additional memory | USB memory stick <sup>3)</sup>  |

| <b>Power supply</b> |   |
|---------------------|---|
| Input voltage range | 100 V to 240 V AC (autoranging), 50 Hz to 60 Hz |
| Power consumption   | <35 VA  |

<sup>1)</sup> Sampling on edge of square, therefore low jitter, fixed duty cycle of 50%.

<sup>2)</sup> Modulation possible only in coupled-frequency mode, i.e. frequency CH1 = frequency CH2.

<sup>3)</sup> Not supplied as standard.



| <b>General data</b>                  |  |
|--------------------------------------|--|
| <b>Display</b>                       |  |
| Type                                 | 5.4" active color TFT display  |
| Number of pixels                     | 320 × 240  |
| <b>Memory locations</b>              |  |
| Device setups                        | 8  |
| <b>Ambient conditions</b>            |  |
| Operating temperature range          | +5 °C to +45 °C, meets DIN EN 60068-2-1/2  |
| Storage temperature range            | −20 °C to +70 °C   |
| Relative humidity                    | 95% at +40 °C, meets DIN EN 60068-2-3 (no moisture condensation)   |
| <b>Mechanical resistance</b>         |  |
| Vibration, sinusoidal                | 5 Hz to 150 Hz, max. 2 g at 55 Hz, meets DIN EN 60068-2-6;<br>55 Hz to 150 Hz, 0.5 g constant, meets DIN EN 61010-1 and MIL-T-28800D class 5 |
| Vibration, random                    | 10 Hz to 500 Hz, 1.9 g, meets DIN EN 60068-2-64  |
| Shock                                | shock spectrum, meets DIN EN 60068-2-27 and MIL-STD-810  |
| <b>Electromagnetic compatibility</b> | meets EN 55011 class B and EN 61326 (EMC Directive 89/336/EEC)   |
| <b>EMI field strength</b>            | <10 V/m  |
| <b>Protection class</b>              | DIN EN 61010-1 / IEC61010-1 UL3111-1; CSA22.2 No:1010.1  |
| <b>Dimensions (W × H × D)</b>        | 219 mm × 147 mm × 350 mm   |
| <b>Weight</b>                        | 6.2 kg   |

## Ordering information

| <b>Dual-Channel Arbitrary/Function Generator R&amp;S® AM300</b>                   |              |                  |
|---|--------------|------------------|
| <b>Designation</b>  | <b>Type</b>  | <b>Order No.</b> |
| Dual-Channel Arbitrary/Function Generator<br>(including PC software R&S®AM300-K1) | R&S®AM300    | 1147.1998.03     |
| Waveform Composer (software, licensed for 5 instruments)                          | R&S®AM300-K2 | 1147.2013.02     |
| Rack Adapter  | R&S®ZZA-300  | 1147.1281.00     |



**ROHDE & SCHWARZ**

**[www.am300.rohde-schwarz.com](http://www.am300.rohde-schwarz.com) · R&S direct: Tel. (+49 2203) 807-800, Fax (+49 2203) 807-66, E-Mail: [Direct@rohde-schwarz.com](mailto:Direct@rohde-schwarz.com)**

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG · Trade names are trademarks of the owners · Printed in Germany (ch)

PD 0758.0897.32 · R&S® AM300 · Version 01.02 · April 2010 · Data without tolerance limits is not binding · Subject to change