

Vector Signal Generator R&S® SM300

Wide variety of test signals at an excellent price

Like the Spectrum Analyzer

R&S® FS300 [*], the new signal generator is based on the Family 300 platform and has its characteristic design.

The R&S® SM300 offers maximum functionality in a compact unit and excellent specifications at a low price.

Wide variety of functions

Whether in the development lab, in service or remotely controlled in production, the new R&S® SM300 (FIG 1) is an ideal choice if you need a favourably priced signal source. Despite its low price, this signal generator meets virtually every requirement as regards versatility of application: integrated broadband I/Q modulator, pulse modulator, modulation generator, electronic attenuator and a frequency range from 9 kHz to 3 GHz.

Featuring a 5.4" colour display and a user-friendly operating concept – the set parameters are displayed in a clear-cut block diagram – the generator can be configured fast and conveniently.

A universal talent

The new member of the R&S Smart Instruments™ family covers all the important frequency bands, e.g. for WLAN, Bluetooth® and EMC measurements. The R&S® SM300 is the first generator in this price category to deliver digitally modulated signals, as required for mobile radio measurements. All that is needed is an I/Q arbitrary waveform generator, for example the R&S® AMIQ, which is connected to the I/Q inputs of the R&S® SM300. The generator's built-in I/Q modulator has a bandwidth of 40 MHz, which means that the instrument covers all common mobile radio

FIG 1 The Vector Signal Generator R&S® SM300, the new member of the R&S Smart Instruments™ family.



R&S
Smart Instruments™

standards and fully meets the relevant requirements for in-channel measurements.

On top of this, the signal generator offers frequency and level sweeps, versatile analog modulation modes including AM, FM, ϕ M, and high signal quality. This makes the R&S® SM300 a universal tool for all kinds of radio measurements in the lab, in service and in the production test shop. Its frequency range can even be extended down to 20 Hz by means of the AF generator, whose output is next to the RF output.

The built-in squarewave generator and pulse modulator in addition generate bursts with a minimum duration of 100 μ s. The pulse modulator has a rise time of less than 500 ns, which allows bursts as short as a few microseconds to be generated if an external pulse generator is used. Such bursts are needed in radar applications, for example.

The output level can be set between -127 dBm and +13 dBm in steps of 0.1 dB – an important prerequisite for sensitivity measurements on receivers. This feature is enhanced by the extremely low level uncertainty of the R&S® SM300, i.e. less than 1 dB (for levels >-120 dBm) over the entire specified frequency range, which is achieved by means of complex calibration processes. Compared with generators with higher level uncertainty, the R&S® SM300 thus allows greater tolerances in the test setup without any detrimental effect on total measurement uncertainty. This reduces the costs of test setup as well as the error rate.

As far as signal quality is concerned, the new generator is particularly attractive for its low spurious FM and AM. Typical values are as low as 0.01 % or 3 Hz, respectively, weighted to ITU-T – which can by no means be regarded as standard in this price category. These key fig-

ures, which are important for modulation, make the instrument ideally suited for applications where the transmission characteristics of amplifiers and mixers are to be determined.

Elaborate design

A synthesizer with only one loop generates RF frequencies in the range 3.8 GHz to 6.8 GHz (FIG 2). To fulfil the stringent requirements placed, for example, on phase noise and frequency resolution, an ASIC developed by Rohde & Schwarz is used that features a fractional divider as well as direct feed of the FM signal into the control loop. The signal obtained is applied to a mixer and converted, with a fixed frequency of 3.8 GHz, to the useful frequency range of 0 Hz to 3 GHz. Compared with signal generation by way of frequency division, this method not only reduces costs since it eliminates the need for dividers and harmonics filters, but also has the advantage that the maximum possible frequency deviation is ensured across the entire frequency range. The advantages of this method are shown by the very low phase noise of the R&S® SM300 at a warranted value of -95 dBc(1 Hz) at a carrier offset of 20 kHz.

The generator concept also allows the easy implementation of a pulse modulator. The signal at the output is switched on and off by switching a 3.8 GHz VCO on and off. This concept offers the advantages of short switching times of less than 500 ns as well as a wide dynamic range. The pulse modulator can be driven either by means of the internal squarewave generator or an external pulse generator. The internal squarewave generator is purely digital with pulse widths selectable between 100 μ s and 1 s.

The implementation of digital modulation is somewhat more complex. For

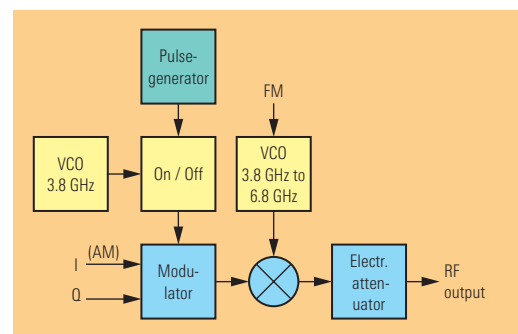


FIG 2 Block diagram of the R&S® SM300.

this, an I/Q modulator is needed, which becomes more expensive or more restricted with respect to technical data as the range it covers widens. The I/Q modulator of the R&S® SM300 operates at a fixed frequency only, which reduces broadband requirements, and for the first time allows excellent modulation characteristics to be achieved at an unprecedented price.

Due to the use of a finely stepped electronic attenuator, the new generator even withstands continuous operation under the harshest conditions in production. On top of this, the generator comes with an excellent VSWR of <1.6 (9 kHz to 3 GHz) – an important prerequisite for low level uncertainty at the DUT.

I/Q modulator

The R&S® SM300 is the only signal generator in this price range that offers as standard a built-in I/Q modulator and thus opens up, as an entry-level model, the world of digitally modulated signals such as used in digital mobile radio or in WLANs. The I/Q signals required as an input to the modulator are supplied, for example, by the I/Q Modulation Generator R&S® AMIQ from Rohde & Schwarz or, alternatively, by the Function/Arbitrary Waveform Generator R&S® AM300 (FIG 5), which will soon be available as a new member of the Family 300. ▶

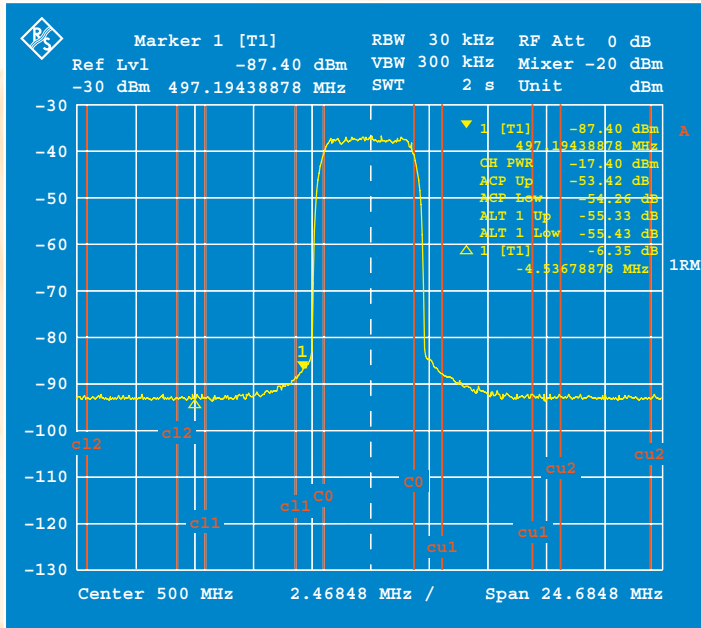
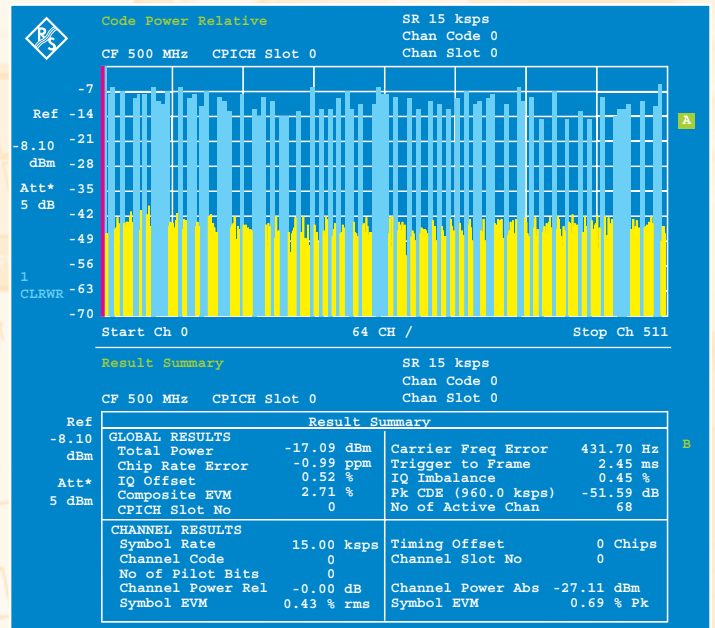


FIG 3 3GPP signal, test model 1 with 64 channels: ACLR typically 54 dBc.

FIG 4 WCDMA signal, test model 1 with 64 channels: EVM: 2.7 %; peak CDE: -51.5 dB.



Condensed data of the R&S® SM 300

- Frequency range RF: 9 kHz to 3 GHz; AF: 20 Hz to 80 kHz
- Frequency resolution 0.1 Hz
- Modulation modes AM, FM, φM, pulse, I/Q
- Level resolution 0.1 dB
- Level uncertainty <1 dB (for levels >-120 dBm)
- Level range -127 dBm to 13 dBm
- Setting times for frequency and level <10 ms
- Single-sideband (SSB) phase noise <-95 dBc(1 Hz) at f = 1 GHz, Δf = 20 kHz
- Internal modulation generator 20 Hz to 80 kHz



FIG 5 R&S Smart Instruments™ – A strong trio (left to right): the Spectrum Analyzer R&S® FS300, the Vector Signal Generator R&S® SM300, and the new Function/Arbitrary Waveform Generator R&S® AM300, which will soon be available.

► An important amplifier test in digital mobile radio applications is adjacent-channel power measurement based on the WCDMA (3GPP) standard. The R&S® SM300's dynamic range allows measurements on WCDMA mobiles, for which the standard specifies an adjacent channel leakage ratio (ACLR) of 35 dBc in the first adjacent channel. Manufacturers of mobile phones stipulate a value of typically 5 dB to 8 dB better than the standard in order to be reliably below the permissible limit. Taking into account the required signal-to-noise ratio of 10 dB, a dynamic range of 50 dB to 53 dB is obtained for the signal generator. The R&S® SM300 has an ACLR typically as high as 54 dBc (FIG 3).

Another important parameter to be measured on digitally modulated signals is the error vector magnitude (EVM), which likewise provides information about the transmission characteristics of the components used. The EVM expresses the deviation of the signal at the DUT output from the ideal signal and is thus a measure of the transmission quality. The crucial requirement for the signal generator with respect to this measurement is a low inherent error value to avoid distortion of results. For a WCDMA signal in line with the 3GPP standard, for example, the R&S® SM300 has an inherent EVM of less than 3% and is thus far below the permissible limit value (FIG 4).

In the case of GSM signals, the phase error is measured instead of the EVM. The GSM Specification 05.05 defines a limit value of 5° for the root-mean-square (rms) phase error. With a static phase error of typically 1.1°, the R&S® SM300 here too remains far below the permissible limit.

Remote control via the USB

The R&S® SM300 can be remotely controlled from a PC via its USB interface implemented as standard. Software drivers are available for LabView and LabWindows/CVI; a dynamic link library (DLL) exists for all common development languages (Visual Basic, C++, Delphi, MATLAB, etc). The command structure used for the drivers is the same as in other Rohde & Schwarz signal generators and is designed for fast programming of the instrument. The software drivers can be downloaded from the Internet and are continuously updated for all Rohde & Schwarz instruments.

In addition to the software drivers, a free program is available for the R&S® SM300 that allows convenient remote control of the instrument from a PC without any programming expertise required on the part of the user. This application supports all generator commands; in addition, all instrument settings can be stored on hard disk.

The program can be started separately for each instrument of the Family 300 connected to the PC, which means that several different units of this family can be controlled simultaneously. Measurement tasks involving several units can thus be controlled from a single PC. Commercial USB cables are used for connection to the PC, so that no extra hardware such as expensive IEC/IEEE bus cards is needed.

Summary

The R&S® SM300 is available from € 6500¹⁾. In addition to a frequency range from 20 Hz to 3 GHz, it features a wide variety of modulation capabilities and setting options not available at this price from any other supplier. Unprecedented in this price category is the standard I/Q modulator, which opens up a wide range of applications including digital mobile radio measurements.

And, of course, the R&S® SM300 offers the well-known advantages of the Family 300 platform concept: wide range of functions, compact design, 5.4" colour display, effective RF shielding, universal carrying handle and a user-friendly operating concept – all of which makes it easier for the user to solve complex measurement tasks.

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More information and data sheet at
www.rohde-schwarz.com
(search term: SM300)



REFERENCES

- [*] Spectrum Analyzer R&S® FS300 – Favourably priced and universal for laboratory, service and production. News from Rohde & Schwarz (2003) No. 177, pp 20–23

1) Recommended sales price within the EU.