Microwave Signal Generator R&S® SMP

Excellent signal characteristics through to 40 GHz

◆ Instrument family with three models
  – R&S® SMP02 (10 MHz to 20 GHz)
  – R&S® SMP03 (10 MHz to 27 GHz)
  – R&S® SMP04 (10 MHz to 40 GHz)
◆ High output level
  – R&S® SMP02 >+11.5 dBm
  – R&S® SMP03 >+13 dBm
  – R&S® SMP04 >+10 dBm
◆ Optional pulse modulator and pulse generator
◆ Digital RF, AF and level sweep
◆ Storage of 50 complete instrument setups
◆ Optional phase modulator
◆ ASK/FSK modulation, phase offset settings
◆ Extremely low SSB phase noise at 10 GHz (<–105 dBc (1 Hz) at 10 kHz from carrier)
◆ Very short frequency setting time <11 ms + 5 ms/GHz
◆ Extremely high level accuracy <±0.9 dB at 0 dBm in frequency range 10 MHz to 40 GHz
Microwave signals in the range from 10 MHz to 40 GHz

The basic models of the R&S® SMP cover the following frequency ranges:

- R&S® SMP02 (2 GHz to 20 GHz)
- R&S® SMP03 (2 GHz to 27 GHz)
- R&S® SMP04 (2 GHz to 40 GHz)

The lower frequency limit can be optionally extended to 10 MHz.

A modern frequency synthesis concept with direct digital synthesis (DDS) ensures the following:

- Stable output frequency
- 0.1 Hz frequency resolution
- Fast settling after a frequency change

High, levelled output power

All R&S® SMP models have been designed for high output power without any compromises:

- R&S® SMP02 (>+11.5 dBm)
- R&S® SMP03 (>+13 dBm)
- R&S® SMP04 (>+10 dBm)

The output levels specified are valid for the upper frequency limit.

Excellent spectral purity

High spectral purity is ensured by the use of YIG oscillators — up to 20 GHz without any frequency multiplying:

- Harmonics
typ. <-50 dBc for f >1.8 GHz
- Nonharmonics <-60/54 dBc up to/above 20 GHz
- SSB phase noise at 10 GHz <-105 dBc (1 Hz)
  (10 kHz from carrier)

Versatile modulation capabilities

AM, FM and optional ϕM modulation meet the high standards usually expected of low-frequency generators only. The large variety of options includes a high-speed pulse modulator:

- AM (DC to 100 kHz)
- FM (DC to 5 MHz)
- ϕM (DC to 100 kHz)
- Pulse modulation with on/off ratio >80 dB

Large choice of options for user-specific configuration

A wide selection of options allows the R&S® SMP to be configured economically to meet today's and tomorrow's requirements:

- Pulse generator and pulse modulators
- Frequency extension 0.01 GHz to 2 GHz
- RF attenuator
- Modulation generator up to 500 kHz
- Precision FM/ϕM modulator
- OCXO reference oscillator
- Auxiliary interface
Intelligent menu guidance for maximum ease of operation

- Large-size LC display
- Menu-guided operation with all menu levels being shown at a glance
- Two menu memories to speed up operation

User-friendly details

- Digital RF, AF and level sweep
- Storage of 50 complete instrument setups
- Combination of any modulation modes possible
- Ultra-low RF leakage
- RF control output

Unambiguous results due to high spectral purity

The outstanding features of the R&S® SMP are the extremely low SSB phase noise of $< -105 \, \text{dBc (1 Hz)}$ at 10 GHz (10 kHz from carrier) as well as nonharmonics of $< -60/54 \, \text{dBc}$ up to/above 20 GHz. The high harmonics rejection and the complete absence of subharmonics below 20 GHz cut out time-wasting measurements such as occur with inferior signal generators.

Minimum level error

A highly precise level is required, for example, for measurements and calibration of receivers. A controlled and frequency-response-compensated output level is a basic prerequisite for setting accuracy. In conjunction with a precision attenuator (option R&S® SMP-B15/-B17), an extremely high level accuracy is ensured throughout the setting range ($< \pm 0.9 \, \text{dB at 0 dBm}$ in the frequency range 10 MHz to 40 GHz).

Stable output frequency

The crystal reference built-in as standard ensures an accurate and low-drift output frequency.

The R&S® SMP can also be fitted with an oven-controlled crystal oscillator (option R&S® SMP-B1, OCXO) to meet the most exacting requirements.

Our standard:

0.1 Hz frequency resolution

A high frequency resolution is required especially for scientific applications and in industrial research, e.g., for surface measurements of materials using radar equipment.

Owing to their high output levels, the R&S® SMP models feature sufficient reserves for compensating the attenuation of long cables as well as the losses of power splitters and directional couplers.

High output level eliminates the need for add-on units

A large number of microwave measurements requires mainly one thing: a high output level, which until now has only been possible with expensive add-on amplifiers.

The R&S® SMP is setting standards with a resolution of 0.1 Hz throughout its frequency range, and even above 20 GHz.

FIG 1: SSB phase noise at 10 GHz

FIG 2: Typical maximum level versus frequency
Variety of applications

The R&S® SMP is ideal for the following applications:

- Substitution of local oscillators
- Measurements on nonlinear components such as frequency multipliers or high-level mixers
- Driving of travelling wave tubes (TWTs) and other power stages
- Interconnection of several signal generators for intermodulation measurements
- Tracking generator for spectrum and network analyzers

High-quality shielding

Sensitivity measurements on low-noise satellite receivers can only be made with absolutely RF-leakage-proof signal sources.

The comprehensive shielding of the R&S® SMP ensures extremely low RF leakage.

Frequency and phase modulation

The R&S® SMP is fitted as standard with a broadband FM modulator covering a modulation frequency range up to 5 MHz for deviations up to 10 MHz (20 MHz above 20 GHz).

In addition, a precision FM/ϕM modulator (option R&S® SM-B5) with a modulation frequency range of up to 1 MHz and maximum deviation of up to 1 MHz (2 MHz for f >20 GHz) is available for testing communication receivers and for scientific applications.

FSK modulation

Owing to a special frequency control circuit, the precision FM/ϕM modulator features an extremely high carrier frequency accuracy and stability in the FM DC mode. Digital frequency shift keying (FSK modulation) is also possible. A deviation of up to 1 MHz (2 MHz above 20 GHz) can be selected.

Wide ϕM modulation range

The wide frequency range of the phase modulation extending from DC to 100 kHz allows testing of phase-sensitive circuits.

R&S® SMP for use as a VCO

In DC-coupled FM or ϕM mode, the R&S® SMP can also be used as a voltage-controlled oscillator (VCO) and integrated into an external frequency control loop. The RF control output fitted on the rear panel is very useful for this application.

The RF control output provides signals in the frequency range 2 GHz to 20 GHz and can, for example, be used for monitoring the output frequency with the aid of a frequency counter (FIG 3).

Pulse modulation

Ideal for radar receivers

All data specified for pulse modulation, which is frequently used in the development, production and maintenance of radar receivers, is valid throughout the rated frequency range and also at the important intermediate frequencies of 70 MHz and 140 MHz. The on/off ratio is better than 80 dB, the rise/fall time shorter than 10 ns. Pulse widths of less than 20 ns are possible (FIG 4).

Optional pulse generator

In addition to feeding in external modulation signals, the pulse generator (option R&S® SMP-B14) can also be used to gen-
erate internal single or double pulses with pulse frequencies up to 10 MHz.

The pulse generator can also be triggered externally, pulse width and delay being user-selectable over a wide range.

**Simultaneous modulation modes and their application**

All modulation modes which the R&S®SMP is able to generate can be combined (in the case of the R&S®SMP03/04 with some restrictions regarding pulse and amplitude modulation). Highly complex signals can thus be generated for modern communication and radar systems.

**Doppler effects**

The combination of pulse modulation and FM DC simulates Doppler effects and also chirp signals.

**Pulse radar with rotating antenna**

Combined scan and pulse modulation provides the type of signals occurring in pulse radar applications with rotating antenna.

In the example shown in FIG 5, the external pulse from the pulse generator or radar display is applied to the external pulse input of the R&S®SMP and used as a trigger for the internal pulse generator and modulator.

The main advantage of this kind of trigger is that it can be delayed to simulate distance and direction and to check the values on the display.

**Fading**

Simultaneous frequency and amplitude modulation can be used to study fading effects of FM receivers.

**Sweep capabilities**

**Level sweep**

The 20 dB level sweep of the R&S®SMP is an efficient function for determining power characteristics and for compression measurements.

**Digital frequency sweep**

The digital frequency sweep with steps from 10 ms is a useful facility for measuring the frequency response of microwave modules or antennas.

**Sweep modes**

The digital sweep can be executed automatically in repetitive mode or in single-shot mode with selectable sweep time. Manual sweeping (STEP MODE) within the sweep limits is also possible. Trigger inputs and outputs facilitate synchronous operation in conjunction with other instruments.

**Use in EMC measurements**

Functions qualifying the R&S®SMP for EMC applications include the trigger facility for step-by-step sweeping, marker outputs and, above all, the extension of the frequency range to 10 MHz (option R&S®SMP-B11).

The capability of compensating external frequency responses is also an important feature.

**Frequency hopping in list mode**

One of the very special features of the R&S®SMP is the list mode. Unlike the normal sweep mode with increasing or decreasing frequencies, the list mode can be used for programming frequency hopping. A list editor makes programming extremely easy. Up to 2003 pairs of frequency and level values can be stored in lists.

Of course, the same types of sweep can be executed in the list mode as in the normal sweep mode.

**Frequency response compensation**

Power amplifiers, cables, antennas and TEM cells usually exhibit a relatively large frequency response which has to be compensated to obtain accurate measurement results.

The R&S®SMP provides two excellent tools for the correction of external frequency responses:

- User-defined correction of external frequency responses
- External level control using a power meter

![FIG 5: Radar tests (switch position 1 for testing the distance indicated by radar, switch position 2 for testing the antenna direction indicated by radar)]
User-defined correction of external frequency responses

The user correction function is extremely useful for fast RF sweeps, for example to compensate nonlinearities of an amplifier.

The known frequency response can be compensated by entering level correction values for up to 160 frequency points. The correction values for the frequencies between these points are determined by means of automatic interpolation (FIG 6).

In addition, the R&S®SMP can automatically measure the level correction values at a keystroke with the aid of external power meters such as the R&S®NRVS or R&S®NRVD.

External level control using a power meter

A very simple method is the external level control with high level accuracy (FIG 7).

Scalar network analysis

The Microwave Signal Generator R&S®SMP used as a tracking generator in conjunction with the Spectrum Analyzer R&S®FSP and the option R&S®FSP-B10 provides a unique scalar network analysis function. This application features an extremely wide dynamic range, which allows, for example, filter resonances in the stop band to be displayed at very low levels.

Due to the user-definable frequency offset, measurements on frequency-converting devices can also be performed with this configuration.
Automatic measurement functions for production and test labs

The memory sequence is an extremely useful function. It provides convenient execution of standard test routines or frequently required sequences of different types of single measurements.

Up to 50 complete instrument setups can be stored. After programming the sequence of measurements to be executed, the user can activate the autorun control facility.

Remote control to SCPI standard

The IEC/IEEE-bus remote control commands are in line with the SCPI guidelines. One of the advantages is that the user can exchange measuring instruments in an automatic system without having to modify the control software.

Intelligent operating concept

Easy-to-follow menus

Neither multifunction keys nor obscure special functions burden the user. All functions are clearly arranged in menus. Menus and functions as well as parameter settings can be conveniently selected with a spinwheel.

Menu memories

Frequently used menu settings can be stored in two memories and recalled at a keystroke.

Easy-to-read screen display

All settings associated with a certain function can be seen at a glance on the large-size, high-contrast LC display.

HELP function

Explanatory remarks can be called up for each individual menu. This does away with wasting time in looking up functions in a manual.

This function also allows synchronous operation with other units through triggering. Step times can be separately programmed for each step.

FIG 9: SAVE and RCL for storing and recalling settings

FIG 10: General settings and menu selection with spinwheel, RETURN, SELECT and arrow keys
Expertise in microwaves

Continuity of progress at Rohde & Schwarz

The name of Rohde & Schwarz is also synonymous with quality in the field of microelectronics.

Large investments have been made in advanced technologies to fully keep up with the ever-increasing demands made on the precision and reliability of microwave modules. Rohde & Schwarz uses ultra-modern clean rooms and systems for the development and production of thin-film circuits.

Airbridges is an ideal technique for implementing PCB crossovers with excellent high-frequency characteristics. The photo above has been taken with a scanning electron microscope and shows such an airbridge which is only 0.05 mm long.
## Specifications

### Frequency

<table>
<thead>
<tr>
<th>Range (standard)</th>
<th>R&amp;S®SMP02</th>
<th>R&amp;S®SMP03</th>
<th>R&amp;S®SMP04</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;S®SMP02</td>
<td>2 GHz to 20 GHz</td>
<td>2 GHz to 27 GHz</td>
<td>2 GHz to 40 GHz</td>
</tr>
<tr>
<td>R&amp;S®SMP03</td>
<td>10 MHz to 20 GHz</td>
<td>10 MHz to 27 GHz</td>
<td>10 MHz to 40 GHz</td>
</tr>
<tr>
<td>R&amp;S®SMP04</td>
<td>10 MHz to 20 MHz</td>
<td>10 MHz to 27 MHz</td>
<td>10 MHz to 40 MHz</td>
</tr>
</tbody>
</table>

### Resolution

0.1 Hz

### Setting time (to within <1 × 10–6) after IEC/IEEE-bus delimiter

<(11 ms + 5 ms/GHz)1)

### Reference frequency

<table>
<thead>
<tr>
<th>Aging (after 30 days of operation)</th>
<th>Standard</th>
<th>Option R&amp;S®SMP-B1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 × 10–6/year</td>
<td>1 × 10–7/year</td>
<td></td>
</tr>
</tbody>
</table>

### Temperature effect (0°C to 55°C)

<1 × 10–10/°C

### Warm-up time

– 10 min

### Output for internal reference

- Frequency: 10 MHz
- Source impedance: 50 Ω

### Input for internal reference

- Frequency: 1 MHz to 16 MHz in 1 MHz steps
- Input level (Vrms): 0.1 V to 2 V
- Source impedance: 200 Ω

### Spectral purity

#### Spurious signals

<table>
<thead>
<tr>
<th>Harmonics2)</th>
<th>R&amp;S®SMP02</th>
<th>R&amp;S®SMP03</th>
<th>R&amp;S®SMP04</th>
</tr>
</thead>
<tbody>
<tr>
<td>f &lt;1.8 GHz</td>
<td>&lt;-30 dBc</td>
<td>&lt;-30 dBc</td>
<td>&lt;-30 dBc</td>
</tr>
<tr>
<td>f ≥1.8 GHz</td>
<td>&lt;-40 dBc</td>
<td>&lt;-40 dBc</td>
<td>&lt;-40 dBc</td>
</tr>
<tr>
<td>Harmonics2)</td>
<td>(with options R&amp;S®SMP-B12/-B13, pulse modulation on)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f &lt;1.8 GHz</td>
<td>&lt;-25 dBc</td>
<td>&lt;-25 dBc</td>
<td>&lt;-25 dBc</td>
</tr>
<tr>
<td>f ≥1.8 GHz</td>
<td>&lt;-25 dBc</td>
<td>&lt;-25 dBc</td>
<td>&lt;-25 dBc</td>
</tr>
</tbody>
</table>

#### Subharmonics

| f ≥10 GHz     | typ. <-60 dBc  | typ. <-60 dBc  | typ. <-60 dBc  |
| f >20 GHz     | <-60 dBc  | <-60 dBc  | <-60 dBc  |

#### Nonharmonics at >10 kHz from carrier

| f <2 GHz       | typ. <-60 dBc  | typ. <-60 dBc  | typ. <-60 dBc  |
| 2 to 20 GHz    | -60 dBc  | -60 dBc  | -54 dBc  |
| f >20 GHz      | -54 dBc  | -54 dBc  | -54 dBc  |

### SSB phase noise, 1 Hz bandwidth, FM off

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Offset from carrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Hz</td>
<td>-110 dBc</td>
</tr>
<tr>
<td>1 kHz</td>
<td>-104 dBc</td>
</tr>
<tr>
<td>10 kHz</td>
<td>-104 dBc</td>
</tr>
<tr>
<td>100 kHz</td>
<td>-104 dBc</td>
</tr>
</tbody>
</table>

### Residual FM, rms, FM off

#### Weighting bandwidth

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Standard</th>
<th>With option R&amp;S®SMP-B15</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 Hz to 3 kHz</td>
<td>&lt;5 Hz</td>
<td>&lt;5 Hz</td>
</tr>
<tr>
<td>30 Hz to 20 kHz</td>
<td>&lt;5 Hz</td>
<td>&lt;5 Hz</td>
</tr>
</tbody>
</table>

### Residual AM, rms, AM off4)

#### Weighting bandwidth

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Standard</th>
<th>With options R&amp;S®SMP-B12/-B13</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>&lt;-0.1%</td>
<td>&lt;-0.2%</td>
</tr>
<tr>
<td>2 GHz to 20 GHz</td>
<td>&lt;-0.05%</td>
<td>&lt;-0.1%</td>
</tr>
</tbody>
</table>

### Maximum level4) R&S®SMP02 (without options R&S®SMP-B12/-B13)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Standard</th>
<th>With option R&amp;S®SMP-B15</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>+17 dBm</td>
<td>+11.5 dBm</td>
</tr>
</tbody>
</table>

### Maximum level6) R&S®SMP02 (with options R&S®SMP-B12/-B13)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Pulse modulation on</th>
<th>Pulse modulation off</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>+13 dBm</td>
<td>+17 dBm</td>
</tr>
</tbody>
</table>

### Maximum level6) R&S®SMP03/04 (without options R&S®SMP-B12/-B13)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Standard</th>
<th>With option R&amp;S®SMP-B15</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>+13 dBm</td>
<td>+17 dBm</td>
</tr>
<tr>
<td>2 GHz to 20 GHz</td>
<td>-8.5 dBm</td>
<td>-8.5 dBm</td>
</tr>
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</table>

### Maximum level6) R&S®SMP03/04 (with options R&S®SMP-B12/-B13)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Standard</th>
<th>With option R&amp;S®SMP-B15</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>+13 dBm</td>
<td>+17 dBm</td>
</tr>
<tr>
<td>2 GHz to 20 GHz</td>
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<td>-8.5 dBm</td>
</tr>
<tr>
<td>18 GHz to 20 GHz</td>
<td>-4.5 dBm</td>
<td>-4.5 dBm</td>
</tr>
<tr>
<td>&gt;20 to 27/33 GHz</td>
<td>-11 dBm</td>
<td>-11 dBm</td>
</tr>
<tr>
<td>&gt;33 GHz to 40 GHz</td>
<td>-10 dBm</td>
<td>-10 dBm</td>
</tr>
</tbody>
</table>

### Level

#### Maximum level6) R&S®SMP02 (without options R&S®SMP-B12/-B13)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Standard</th>
<th>With option R&amp;S®SMP-B15</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>+17 dBm</td>
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</table>

### SSB phase noise, 1 Hz bandwidth, FM off

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<tr>
<th>Frequency range</th>
<th>Offset from carrier</th>
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<tbody>
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<td>100 Hz</td>
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<td>-104 dBc</td>
</tr>
<tr>
<td>100 kHz</td>
<td>-104 dBc</td>
</tr>
</tbody>
</table>

### Residual FM, rms, FM off

#### Weighting bandwidth

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Standard</th>
<th>With option R&amp;S®SMP-B15</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 Hz to 3 kHz</td>
<td>&lt;5 Hz</td>
<td>&lt;5 Hz</td>
</tr>
<tr>
<td>30 Hz to 20 kHz</td>
<td>&lt;5 Hz</td>
<td>&lt;5 Hz</td>
</tr>
</tbody>
</table>

### Residual AM, rms, AM off4)

#### Weighting bandwidth

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Standard</th>
<th>With options R&amp;S®SMP-B12/-B13</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>&lt;-0.1%</td>
<td>&lt;-0.2%</td>
</tr>
<tr>
<td>2 GHz to 20 GHz</td>
<td>&lt;-0.05%</td>
<td>&lt;-0.1%</td>
</tr>
</tbody>
</table>

### Maximum level4) R&S®SMP02 (without options R&S®SMP-B12/-B13)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Standard</th>
<th>With option R&amp;S®SMP-B15</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>+17 dBm</td>
<td>+11.5 dBm</td>
</tr>
</tbody>
</table>

### Maximum level6) R&S®SMP02 (with options R&S®SMP-B12/-B13)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Pulse modulation on</th>
<th>Pulse modulation off</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>+13 dBm</td>
<td>+17 dBm</td>
</tr>
</tbody>
</table>

### Maximum level6) R&S®SMP03/04 (without options R&S®SMP-B12/-B13)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Standard</th>
<th>With option R&amp;S®SMP-B15</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>+13 dBm</td>
<td>+17 dBm</td>
</tr>
<tr>
<td>2 GHz to 20 GHz</td>
<td>-8.5 dBm</td>
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</tr>
<tr>
<td>18 GHz to 20 GHz</td>
<td>-4.5 dBm</td>
<td>-4.5 dBm</td>
</tr>
<tr>
<td>&gt;20 to 27/33 GHz</td>
<td>-11 dBm</td>
<td>-11 dBm</td>
</tr>
<tr>
<td>&gt;33 GHz to 40 GHz</td>
<td>-10 dBm</td>
<td>-10 dBm</td>
</tr>
</tbody>
</table>

### Maximum level6) R&S®SMP03/04 (with options R&S®SMP-B12/-B13)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Standard</th>
<th>With option R&amp;S®SMP-B15</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>+13 dBm</td>
<td>+17 dBm</td>
</tr>
<tr>
<td>2 GHz to 20 GHz</td>
<td>-8.5 dBm</td>
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</tr>
<tr>
<td>&gt;20 to 27/33 GHz</td>
<td>-11 dBm</td>
<td>-11 dBm</td>
</tr>
<tr>
<td>&gt;33 GHz to 40 GHz</td>
<td>-10 dBm</td>
<td>-10 dBm</td>
</tr>
</tbody>
</table>
## Maximum level\(^\text{R&S\textsuperscript{TM}}\) R&S\textsuperscript{TM}MP03/R&S\textsuperscript{TM}MP04 (with options R&S\textsuperscript{TM}MP-B12/-B13)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>R&amp;S\textsuperscript{TM}MP03</th>
<th>R&amp;S\textsuperscript{TM}MP04</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>-10 dBm</td>
<td>&lt;10 dBm</td>
</tr>
<tr>
<td>2 to 20/27/40 GHz</td>
<td>same as max. level without options R&amp;S\textsuperscript{TM}MP-B12/-B13</td>
<td></td>
</tr>
</tbody>
</table>

### Minimum level of all models
- Without option R&S\textsuperscript{TM}MP-B15/-B17: -20 dBm
- With option R&S\textsuperscript{TM}MP-B15/-B17: -130 dBm

### Resolution
- Without option R&S\textsuperscript{TM}MP-B15/-B17: -20 dBm
- With option R&S\textsuperscript{TM}MP-B15/-B17: -130 dBm

### Total accuracy\(^\text{R&S\textsuperscript{TM}}\) (frequency response and temperature effect included)

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Level</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>+10 dBm</td>
<td>&lt;±1.2 dB</td>
</tr>
<tr>
<td>2 GHz to 20 GHz</td>
<td>+10 dBm</td>
<td>&lt;±2.0 dB</td>
</tr>
<tr>
<td>&gt;20 GHz to 27/40 GHz</td>
<td>+10 dBm</td>
<td>&lt;±3.0 dB</td>
</tr>
</tbody>
</table>

### Output impedance
50 Ω

### VSWR
- f ≤ 20 GHz: <2.2, typ. <1.8
- f > 20 GHz: <2.2, typ. <1.6

### Setting time
- After IEC/IEEE-bus delimiter: <10 ms
- With option R&S\textsuperscript{TM}MP-B15/-B17, with switching in attenuator set: <25 ms

### Non-interrupting level setting (ATTENUATOR MODE FIXED)
0 dB to 20 dB

### Simultaneous modulation
Any combination of AM (scan modulation), FM (pM) and pulse modulation

### Linear amplitude modulation

#### Operating modes
- Internal, external AC/DC

#### Modulation depth\(^\text{R&S\textsuperscript{TM}}\)
0% to 90%

#### Resolution
0.1%

#### Setting accuracy at AF = 1 kHz
(m = 80%)\(^\text{R&S\textsuperscript{TM}}\): <(4% of reading + 1%)\(^\text{R&S\textsuperscript{TM}}\)

#### AM distortion at AF = 1 kHz
(m = 60%): <2%, typ. <1%

#### Modulation frequency range
- For frequency response <1 dB:
  - f < 2 GHz: DC to 100 kHz
  - f ≥ 2 GHz: DC to 10 kHz
- For frequency response >1 dB:
  - f < 2 GHz: DC to 50 kHz
  - f ≥ 2 GHz: DC to 50 kHz

#### Modulation input EXT1
- Input impedance: 600 Ω or 100 kΩ
- Input voltage (peak value): 1 V (HIGH/LOW warning if variation >3%)

### Logarithmic amplitude modulation (scan modulation)

#### Operating modes
- Internal, external AC/DC, locked/unlocked, two-tone with two separate channels FM1 and FM2

#### Dynamic range
>30 dB

#### Sensitivity
0.1 dB/V to 10 dB/V

#### Resolution
0.01 dB/V

#### Rise/fall time (10%\%/90%)
<10 μs

#### Modulation input EXT1
- Input impedance: 600 Ω or 100 kΩ
- Input voltage: 600 V or 100 kΩ

### Frequency modulation

#### Standard FM (without option R&S\textsuperscript{TM}SM-B5)
- Maximum deviation
  - f ≤ 20 GHz: 10 MHz
  - f > 20 GHz: 20 MHz
- Resolution
  - f ≤ 20 GHz: <1%, min. 10 Hz
  - f > 20 GHz: <1%, min. 20 Hz
- Setting accuracy at AF = 1 kHz and deviation >1 kHz
  - FM distortion at AF = 1 kHz and 90 kHz deviation
  - Modulation frequency range
  - Locked mode
  - Unlocked mode
  - Carrier frequency offset with FM
  | Locked mode | Unlocked mode |
  | carrier frequency drift with FM DC | 10 kHz to 5 MHz |
  | typ. | <1 MHz, <1% |
  | typ. | <10 kHz, <10% |
  | typ. | <20 kHz, <10% |

#### FM (with option R&S\textsuperscript{TM}SM-B5\textsuperscript{R&S\textsuperscript{TM}})
- Maximum deviation
  - f ≤ 20 GHz: 1 MHz
  - f > 20 GHz: 2 MHz
- Resolution
  - f ≤ 20 GHz: <1%, min. 10 Hz
  - f > 20 GHz: <1%, min. 20 Hz
- Setting accuracy at AF = 1 kHz and deviation >1 kHz
  - FM distortion at AF = 1 kHz and 90 kHz deviation
- Modulation frequency range
  - Locked mode
  - Unlocked mode
  - Carrier frequency offset with FM
  | Locked mode | Unlocked mode |
  | carrier frequency drift with FM DC | 1 MHz to 5 MHz |
  | typ. | <10 Hz, <1% |
  | typ. | <25 kHz, <1% |
  | typ. | <100 kHz, <1% |

### AM distortion at AF = 1 kHz and 500 kHz deviation
<2%, typ. <1%

### Modulation frequency range
- Locked mode
  - Deviation = 100 kHz
  - 10 kHz to 5 MHz
  - 1 kHz to 5 MHz
- Unlocked mode
  - Deviation = 1 MHz
  - 10 Hz (DC) to 100 kHz
  - 100 kHz to 1 MHz
  - 1 kHz to 1 MHz

### Incidental AF = 1 kHz and 40 kHz deviation
<1%, typ. <1%
### Phase modulation with option R&S®SM-B5

<table>
<thead>
<tr>
<th>Operating modes</th>
<th>internal, external AC/DC, two-tone with two separate channels $\varphi M_1$ and $\varphi M_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum deviation</td>
<td></td>
</tr>
<tr>
<td>$f \leq 20$ GHz</td>
<td>10 rad</td>
</tr>
<tr>
<td>$f &gt; 20$ GHz</td>
<td>20 rad</td>
</tr>
<tr>
<td>Resolution</td>
<td></td>
</tr>
<tr>
<td>$f \leq 20$ GHz</td>
<td>&lt;1%, min. 0.001 rad</td>
</tr>
<tr>
<td>$f &gt; 20$ GHz</td>
<td>&lt;1%, min. 0.002 rad</td>
</tr>
<tr>
<td>Setting accuracy at AF = 1 kHz</td>
<td></td>
</tr>
<tr>
<td>$f \leq 20$ GHz</td>
<td>&lt;(3% of reading + 0.01 rad)</td>
</tr>
<tr>
<td>$f &gt; 20$ GHz</td>
<td>&lt;(3% of reading + 0.02 rad)</td>
</tr>
<tr>
<td>$\varphi M$ distortion at AF = 1 kHz and 5 rad deviation</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Modulation frequency range</td>
<td>DC to 100 kHz</td>
</tr>
<tr>
<td>Modulation frequency response 10 Hz (DC to 100 kHz</td>
<td>&lt;3 dB</td>
</tr>
<tr>
<td>Modulation inputs EXT1, EXT2</td>
<td></td>
</tr>
<tr>
<td>Input impedance</td>
<td>600 $\Omega$ or 100 k$\Omega$</td>
</tr>
<tr>
<td>Input voltage (peak value) for selected deviation</td>
<td>1 V (HIGH/LOW warning if variation &gt;3%)</td>
</tr>
</tbody>
</table>

#### ASK modulation

<table>
<thead>
<tr>
<th>Operating mode</th>
<th>external</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum modulation depth$^1$</td>
<td>90%</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1%</td>
</tr>
<tr>
<td>Data rate$^5$</td>
<td>0 Hz to 200 kHz</td>
</tr>
<tr>
<td>Rise/fall time (10%/90%)</td>
<td>&lt;10 $\mu$s</td>
</tr>
<tr>
<td>Modulation input EXT1</td>
<td></td>
</tr>
<tr>
<td>Input impedance</td>
<td>600 $\Omega$ or 100 k$\Omega$</td>
</tr>
<tr>
<td>Input level</td>
<td>TTL/HCT signal, selectable polarity</td>
</tr>
</tbody>
</table>

#### FSK modulation

<table>
<thead>
<tr>
<th>Operating mode</th>
<th>external</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum shift</td>
<td></td>
</tr>
<tr>
<td>Standard FM</td>
<td></td>
</tr>
<tr>
<td>$f \leq 20$ GHz</td>
<td>10 MHz</td>
</tr>
<tr>
<td>$f &gt; 20$ GHz</td>
<td>20 MHz</td>
</tr>
<tr>
<td>With option R&amp;S®SM-B5</td>
<td></td>
</tr>
<tr>
<td>$f \leq 20$ GHz</td>
<td>1 MHz</td>
</tr>
<tr>
<td>$f &gt; 20$ GHz</td>
<td>2 MHz</td>
</tr>
<tr>
<td>Resolution</td>
<td></td>
</tr>
<tr>
<td>$f \leq 20$ GHz</td>
<td>&lt;1%, min. 10 Hz</td>
</tr>
<tr>
<td>$f &gt; 20$ GHz</td>
<td>&lt;1%, min. 20 Hz</td>
</tr>
<tr>
<td>Data rate</td>
<td></td>
</tr>
<tr>
<td>Standard FM</td>
<td></td>
</tr>
<tr>
<td>Locked mode</td>
<td>20 kHz to 2 MHz</td>
</tr>
<tr>
<td>Unlocked mode</td>
<td>0 Hz to 2 MHz</td>
</tr>
<tr>
<td>With option R&amp;S®SM-B5</td>
<td></td>
</tr>
<tr>
<td>$f \leq 20$ GHz</td>
<td>0 Hz to 2 MHz</td>
</tr>
<tr>
<td>$f &gt; 20$ GHz</td>
<td>0 Hz to 2 MHz</td>
</tr>
<tr>
<td>Modulation input EXT1</td>
<td></td>
</tr>
<tr>
<td>Input impedance</td>
<td>600 $\Omega$ or 100 k$\Omega$</td>
</tr>
<tr>
<td>Input level</td>
<td>TTL/HCT signal, selectable polarity</td>
</tr>
</tbody>
</table>

### Pulse modulation

<table>
<thead>
<tr>
<th>Operating modes</th>
<th>external, internal with option R&amp;S®SMP-B14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard [without options R&amp;S®SMP-B12/-B13]</td>
<td></td>
</tr>
<tr>
<td>Frequency range</td>
<td></td>
</tr>
<tr>
<td>On/off ratio</td>
<td></td>
</tr>
<tr>
<td>Rise/fall time (10%/90%)</td>
<td></td>
</tr>
<tr>
<td>Minimum pulse width</td>
<td></td>
</tr>
<tr>
<td>Maximum pulse pause</td>
<td></td>
</tr>
<tr>
<td>With level control switched on (ALC ON)</td>
<td></td>
</tr>
<tr>
<td>With level control switched off (ALC OFF)</td>
<td></td>
</tr>
<tr>
<td>Minimum pulse/pause ratio</td>
<td></td>
</tr>
<tr>
<td>With level control switched on (ALC ON)</td>
<td></td>
</tr>
<tr>
<td>With level control switched off (ALC OFF)</td>
<td></td>
</tr>
<tr>
<td>Frequency range</td>
<td></td>
</tr>
<tr>
<td>With option R&amp;S®SMP-B13</td>
<td></td>
</tr>
<tr>
<td>With option R&amp;S®SMP-B12</td>
<td></td>
</tr>
<tr>
<td>10 MHz to &lt;2 GHz</td>
<td>&gt;50 dB (level &gt;0 dBm)</td>
</tr>
<tr>
<td>&gt;20 GHz</td>
<td>&lt;1.5 $\mu$s</td>
</tr>
<tr>
<td>Data rate$^5$</td>
<td>0 Hz to 2 MHz</td>
</tr>
<tr>
<td>Rise/fall time (10%/90%)</td>
<td>&lt;10 ns</td>
</tr>
<tr>
<td>Minimum pulse width</td>
<td>20 ns (R&amp;S®SMP-02/1 kHz (R&amp;S®SMP03/04)</td>
</tr>
<tr>
<td>Pulse repetition frequency</td>
<td>any</td>
</tr>
<tr>
<td>Pulse delay</td>
<td>any</td>
</tr>
<tr>
<td>Video feedthrough</td>
<td>any (R&amp;S®SMP02/1 kHz (R&amp;S®SMP03/04)</td>
</tr>
</tbody>
</table>

#### Internal modulation generator

<table>
<thead>
<tr>
<th>Frequency</th>
<th>0.4/1/3/15 kHz ± 3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open-circuit voltage at LF connector</td>
<td>1 V ± 1% ($R_{\text{Ext}} = 10 \Omega$, $R_{\text{load}} &gt;200 \Omega$) (peak value)</td>
</tr>
</tbody>
</table>
### LF generator option R&S®SM-B2

<table>
<thead>
<tr>
<th>Waveforms</th>
<th>sinewave, triangular, squarewave, noise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range</td>
<td>Sinewave, noise: 0.1 Hz to 500 kHz; Triangular, squarewave: 0.1 Hz to 50 kHz</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1 Hz</td>
</tr>
<tr>
<td>Frequency accuracy</td>
<td>&lt;1 × 10⁻⁴</td>
</tr>
<tr>
<td>Frequency response (sinewave)</td>
<td>Up to 100 kHz: &lt;0.3 dB; Up to 500 kHz: &lt;0.5 dB</td>
</tr>
<tr>
<td>Distortion (20 Hz to 100 kHz)</td>
<td>&lt;0.1% (for level &gt;0.5 V)</td>
</tr>
<tr>
<td>Open-circuit voltage at LF connector</td>
<td>Resolution: 1 mV to 4 V (R&lt;sub&gt;out&lt;/sub&gt; = 10 Ω, R&lt;sub&gt;load&lt;/sub&gt; &gt;200 Ω); Setting accuracy at 1 kHz: 1 mV ±1% + 1 mV</td>
</tr>
<tr>
<td>Frequency setting time (after IEC/IEEE-bus delimiter)</td>
<td>&lt;10 ms</td>
</tr>
</tbody>
</table>

### Pulse generator option R&S®SM-B14

| Operating modes | single pulse, delayed pulse, double pulse |
| Active trigger edge | positive or negative |
| Pulse repetition period | Resolution: 100 ns to 85 s; Accuracy: 5 digits, min. 20 ns |
| Pulse width | Resolution: 40 ns to 1 s; Accuracy: 4 digits, min. 20 ns |
| Pulse delay | Resolution: 40 ns to 1 s; Accuracy: 4 digits, min. 20 ns |
| Double pulse | Resolution: 60 ns to 1 s; Accuracy: 4 digits, min. 20 ns |
| Trigger delay | <50 ns |
| PULSE modulation input | Input level: TTL (HCT), 50 Ω or 10 kΩ |

---

The pulse generator option enables the pulse delay PD, pulse width PW and pulse repetition period PP to be set with high accuracy and resolution.

### RF control output

| Frequency output | 2 GHz to 20 GHz |
| Level | approx. 0 dBm |

### Sweep

| RF sweep, AF sweep | Operating modes | AF sweep with option R&S®SM-B2 automatic, single-shot, manual or externally triggered; Linear or logarithmic user-selectable 0.01% to 50% |

### Level sweep | Operating modes | automatic, single-shot, manual or externally triggered; Logarithmic 0.1 dB to 20 dB 0.1 dB to 20 dB |
| Step width | Resolution: 10 ms to 1 s; Accuracy: 0.1 ms |

### Markers | 3, user-selectable |

### MARKER output | TTL/HC logic signal, selectable polarity |

### X output | 0 V to 10 V |

### BLANK output | TTL/HC logic signal, selectable polarity |

### TRIGGER input | TTL/HCT logic signal, polarity of active trigger edge selectable |

### STOP input | TTL/HCT logic signal, selectable polarity |

### LIST mode

| frequency and level values can be stored and read out fast; permissible level variation range: 20 dB |

### Operating modes | automatic, single-shot, manual or externally triggered |

### Max. length of list | 2003 pairs of frequency and level values |

### Step time | (1 ms to 1 s) + the lesser of 5 ms/GHz or 50 ms; Accuracy: 0.1 ms |

### Memory for instrument settings

| Storable settings | 50 |

| Memory sequence modes | Operating modes | automatic, single-shot, manual or externally triggered |

### Step time | Resolution: 50 ms to 60 s; Accuracy: 1 ms |
### Auxiliary interface with option R&S®SMP-B18

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>V/GHz output</td>
<td>Output voltage proportional to frequency; 0.5 V/GHz² or 1 V/GHz selectable</td>
</tr>
<tr>
<td>Z output</td>
<td>User-selectable level range –10 V to +10 V</td>
</tr>
</tbody>
</table>

### Remote control

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>IEC625 (IEEE488)</td>
</tr>
<tr>
<td>Command set</td>
<td>SCPI 1992.0</td>
</tr>
<tr>
<td>Connector</td>
<td>24-contact Amphenol</td>
</tr>
<tr>
<td>IEC/IEEE-bus address</td>
<td>0 to 30</td>
</tr>
<tr>
<td>Interface functions</td>
<td>SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, CO</td>
</tr>
</tbody>
</table>

### General data

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>90 V to 132 V (AC), 47 Hz to 440 Hz; 180 V to 285 V (AC), 47 Hz to 440 Hz autoranging; max. 400 VA safety class I to VDE 0411 (IEC348)</td>
</tr>
<tr>
<td>Electromagnetic compatibility</td>
<td>postal regulation 243/1991 EN55011 (VDE 0875 T11), class B VDE 0875; suppression level K MIL-STD-461B – RE02 radiated emissions – CE03 conducted emissions – CS01/OZ conducted susceptibility</td>
</tr>
<tr>
<td>RF leakage (f &lt;1 GHz)</td>
<td>&lt;0.1 μV (induced in a two-turn coil 2.5 cm in diameter held 2.5 cm away from the surface of the case)</td>
</tr>
<tr>
<td>Radiated susceptibility</td>
<td>3 V/m</td>
</tr>
</tbody>
</table>

### Ambient conditions

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature range</td>
<td>0°C to 55°C¹⁰</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>–40°C to +70°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>IEC68-2-30, +40°C</td>
</tr>
</tbody>
</table>

### Mechanical stress

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock</td>
<td>to MIL-STD-810D, 40 g shock spectrum</td>
</tr>
<tr>
<td>Vibration</td>
<td>Sinusoidal to IEC68-2-6, 5 Hz to 55 Hz 10 m/s² rms, 10 Hz to 300 Hz</td>
</tr>
<tr>
<td>Dimensions (W × H × D)</td>
<td>435 mm × 192 mm × 570 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>27 kg, when fully equipped</td>
</tr>
</tbody>
</table>

1) For frequency changes beyond the 2 GHz and 20 GHz frequency limit the setting time is max. 50 ms longer.
2) Specifications for harmonics above 20 GHz (R&S®SMP02), 27 GHz (R&S®SMP03) and 40 GHz (R&S®SMP04) only typical.
3) Without optional Attenuator R&S®SMP-B15/-B17 specifications apply to levels >–5 dBm only.
4) The maximum level is reduced by up to 2 dB in the temperature range 35°C to 55°C.
5) The specified accuracy only applies to temperatures from 15°C to 35°C. Outside this range the accuracy may be degraded by max. 0.7 dB.
6) The modulation depth adjustable within the AM specifications continuously decreases from 6 dB below the maximum level up to the maximum level.
7) This specification does not apply to a) non-interrupting level setting (ATTENUATOR MODE FIXED) if option R&S®SMP-B15/-B17 is used, b) levels below –5 dBm without option R&S®SMP-B15/-B17, c) external level control mode (EXT ALC). The functions of the standard FM remain available.
8) Above 20 GHz (R&S®SMP03/04) only 0.5 V/GHz available.
9) The contrast of the LC display is degraded at high temperatures.
## Ordering information

<table>
<thead>
<tr>
<th>Designation</th>
<th>Type</th>
<th>Order No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microwave Signal Generator</td>
<td>R&amp;S*SMP02</td>
<td>1035.5005.02</td>
</tr>
<tr>
<td>Microwave Signal Generator</td>
<td>R&amp;S*SMP03</td>
<td>1035.5005.03</td>
</tr>
<tr>
<td>Microwave Signal Generator</td>
<td>R&amp;S*SMP04</td>
<td>1035.5005.04</td>
</tr>
</tbody>
</table>

### Accessories supplied

- Power cable, operating manual
- Female adapter 3.5 mm
- Female adapter 2.9 mm
- Female adapter N
- Male adapter N

### Options

- **OCXO Reference Oscillator**: R&S*SMP-B1, 1036.5109.02
- **Frequency Extension 0.01 GHz to 2 GHz**: R&S*SMP-B11, 1036.6240.02
- **Pulse Modulator**: R&S*SMP-B12, 1036.5750.02
- **RF Attenuator**: R&S*SMP-B15, 1036.5250.02
- **Pulse Generator**: R&S*SMP-B14, 1036.7347.02
- **LF Generator**: R&S*SMP-B2, 1036.7947.02
- **FM/Φ Modulator**: R&S*SMP-B5, 1036.8489.02
- **Auxiliary Interface**: R&S*SMP-B18, 1036.8920.02

### Extras

- **Service Kit**: R&S*SMP-Z3, 1085.2500.02
- **Trolley**: R&S*SZK-1, 1014.0510.00
- **Transit Case**: R&S*SZK-94, 1013.9372.00

### Adapter (R&S*SMP02, R&S*SMP03)

- 3.5 mm, female: 1021.0512.02
- 3.5 mm, male: 1021.0529.00
- N, female: 1021.0535.00
- N, male: 1021.0541.00

### Adapter (R&S*SMP04)

- 2.9 mm, female: 1036.4790.00
- 2.9 mm, male: 1036.4802.00
- N, female: 1036.4777.00
- N, male: 1036.4783.00

### Notes

1) Factory-fitted option.

More information at [www.rohde-schwarz.com](http://www.rohde-schwarz.com) (search term: SMP)