R&S®NRP
USB and LAN Power Sensors
Taking power measurements to the next level

R&S®NRPxxS/SN three-path diode power sensors

ROHDE&SCHWARZ

Test & Measurement

Product Brochure | 01.01

R&S®NRP USB and LAN Power Sensors

At a glance

The R&S®NRP2 power meter and associated power sensors have long been recognized for delivering supreme precision and speed. The R&S®NRPxxS and R&S®NRPxxSN power sensors take power measurements to the next level. All R&S®NRPxxS/SN power sensors offer USB capability, plus the R&S®NRPxxSN sensors can be controlled via LAN. This makes the R&S®NRP power meter portfolio unique in the industry.

The R&S®NRPxxS/SN three-path diode power sensors are self-contained, fully characterized instruments. They can be operated with the R&S®NRP2 base unit, with a laptop/PC via USB, and with many Rohde&Schwarz instruments (e.g. signal generators, signal and spectrum analyzers, network analyzers). The R&S®NRPxxSN power sensors additionally offer LAN capability, allowing remote control over large distances.

The R&S®NRPxxS and R&S®NRPxxSN power sensors are based on an enhanced three-path technology. This substantially reduces the sensors' measurement noise, providing a lower measurement limit of –70 dBm and a dynamic range of 93 dB. The result is a significant enhancement in measurement speed and accuracy, especially at low levels. This applies to CW signals as well as to signals of any bandwidth and type of modulation.

Key facts

- Fast and accurate power measurements for CW and modulated signals
- Maximum dynamic range: –70 dBm to +23 dBm
- 10000 triggered measurements/s
- More than 50000 readings/s
- Control and monitoring via LAN and USB
- Web client for operation using a web browser
- Operation with R&S®NRP2 base unit, a laptop/PC and many Rohde&Schwarz instruments
- Built-in trigger I/O port

Operation of R&S®NRPxxSN power sensor via a web browser.

R&S®NRP USB and LAN Power Sensors

Benefits and key features

Functions and performance features

- Fully characterized power sensors
- Minimizing measurement uncertainty
- Versatile measurement functions
- Intelligent averaging function minimizes measurement time
- Easy system integration

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Intelligent, LAN enabled power measurements

- Detachable cables for flexible operation
- Remote monitoring via LAN over any distance
- Built-in trigger I/O port
- Sensor status at a glance with status LED

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R&S®NRPxxS/SN three-path diode power sensors

- 10000 triggered measurements/s
- More than 50000 readings/s
- Unprecedented measurement speed and accuracy even at low levels
- Ideal for universal applications
- 93 dB dynamic range thanks to innovative three-path concept

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Sensor types	
Three-path diode power sensors	
R&S®NRP8S	8 GHz power sensor
R&S®NRP8SN	8 GHz LAN power sensor
R&S®NRP18S	18 GHz power sensor
R&S®NRP18SN	18 GHz LAN power sensor
R&S®NRP33S	33 GHz power sensor
R&S®NRP33SN	33 GHz LAN power sensor

▷ For further sensor types, see the R&S®NRP Power Meter Family product brochure, PD 5213.5539.12

Functions and performance features

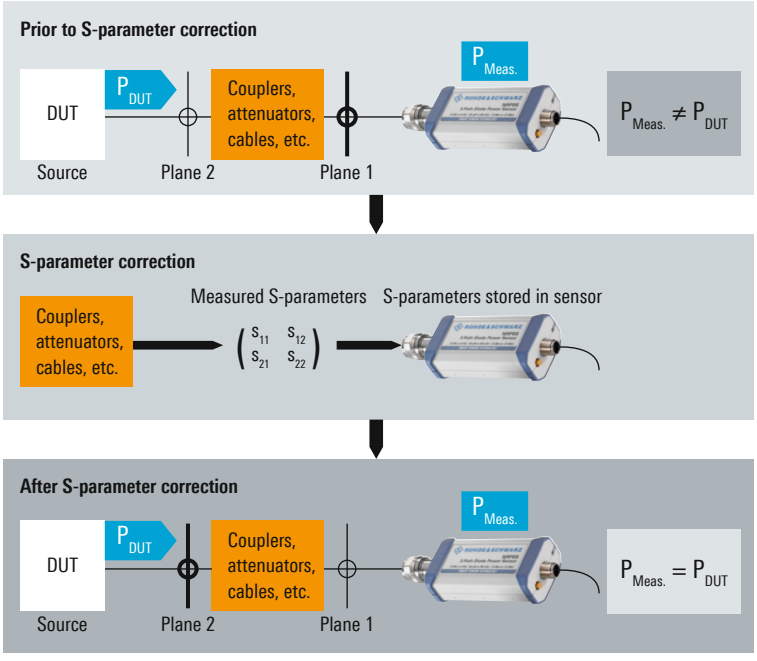
Fully characterized power sensors

The R&S®NRPxxS/SN power sensors are immediately ready for use. In contrast to conventional power sensors, no calibration is required prior to making measurements since the sensors are fully characterized over frequency, level and temperature and feature long-term stability. All calibration data is stored in the sensors, so they function as independent measuring instruments. Usually, no zeroing is required. Users can plug in a sensor and simply start measuring.

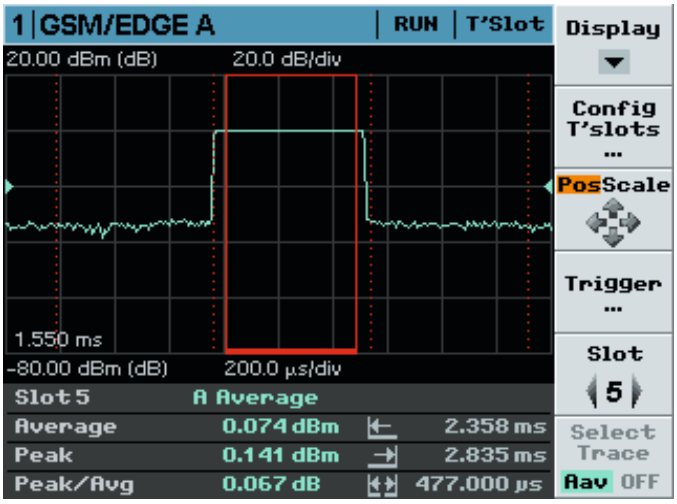
Minimizing measurement uncertainty

Even complex test setups represent no challenge for the R&S®NRPxxS/SN power sensors. Unwanted effects such as cable losses and reflections can be compensated using offset, S-parameter and Γ correction. Offset correction is used to take into account frequency-independent attenuation. S-parameter correction is used to mathematically shift the reference plane to the device under test (DUT) by taking into account the S-parameters for any components connected upstream of the sensor. Γ correction compensates for the effects of impedance mismatch.

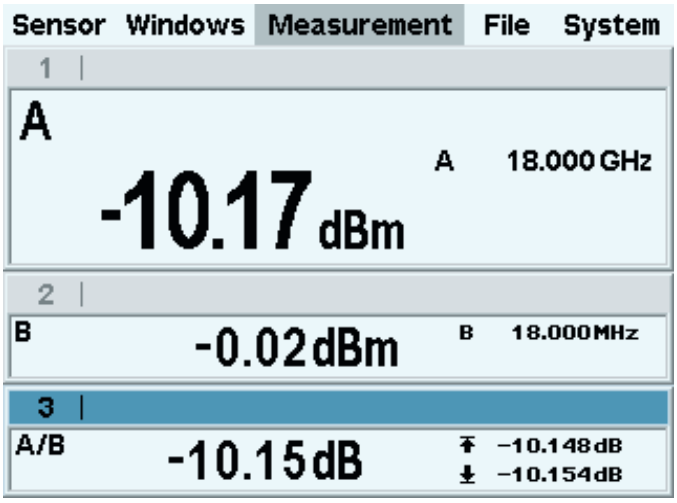
Shifting the measurement plane from 1 to 2 by using S-parameter correction; the influence of upstream components is compensated



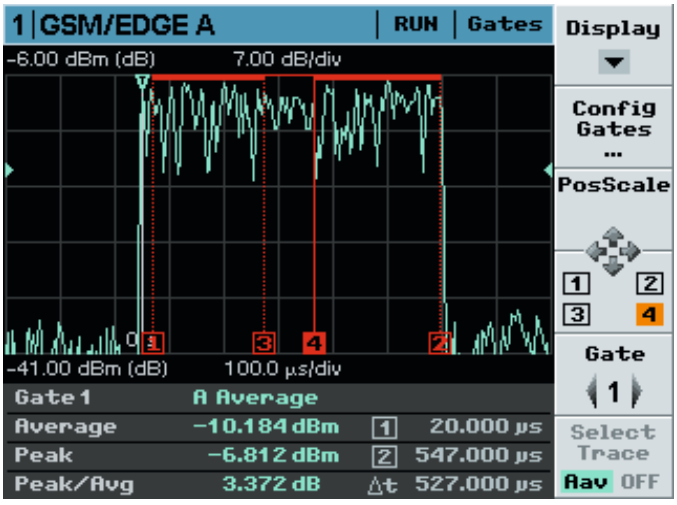
Timeslot measurement of a GSM signal with exclude times at the edges of the timeslot.



Numerical display of two continuous average measurements and their ratio.



Determination of power of an EDGE burst using an R&S®NRPxxS/SN three-path diode power sensor and the gate function; exclusion of training sequence in the center of the signal.



Versatile measurement functions

- Continuous average mode: reliable average power measurements on CW and modulated signals
- Burst average mode: burst average power measurements; sensors automatically detect start and end of a burst
- Trace mode: display of envelope power versus time
- Timeslot mode: timeslot average power measurements on TDMA signals (e.g. GSM/EDGE)
- Time gate mode: average power measurements in up to four independent time gates with user-defined position and length

Intelligent averaging function minimizes measurement time

With fixed noise averaging (an enhanced auto averaging function), any measurement can be optimized with respect to measurement time and accuracy. The averaging filter is dynamically set to the optimum averaging value to achieve a user-defined maximum noise content. This helps to minimize measurement time and maximize production throughput for a user-specified accuracy, and to simplify programming of remotely controlled measurement sequences.

Easy system integration

The R&S®NRPxxS/SN power sensors are USBTMC devices and can be easily integrated into automated test setups without needing to install additional drivers.

R&S®NRPxxS/SN power sensors can be used to replace R&S®NRP-Zxx legacy power sensors with 100% code compatibility for remote operation.

Intelligent, LAN enabled power measurements

LAN interface, trigger I/O port and detachable cable for the R&S®NRPxxSN sensors.

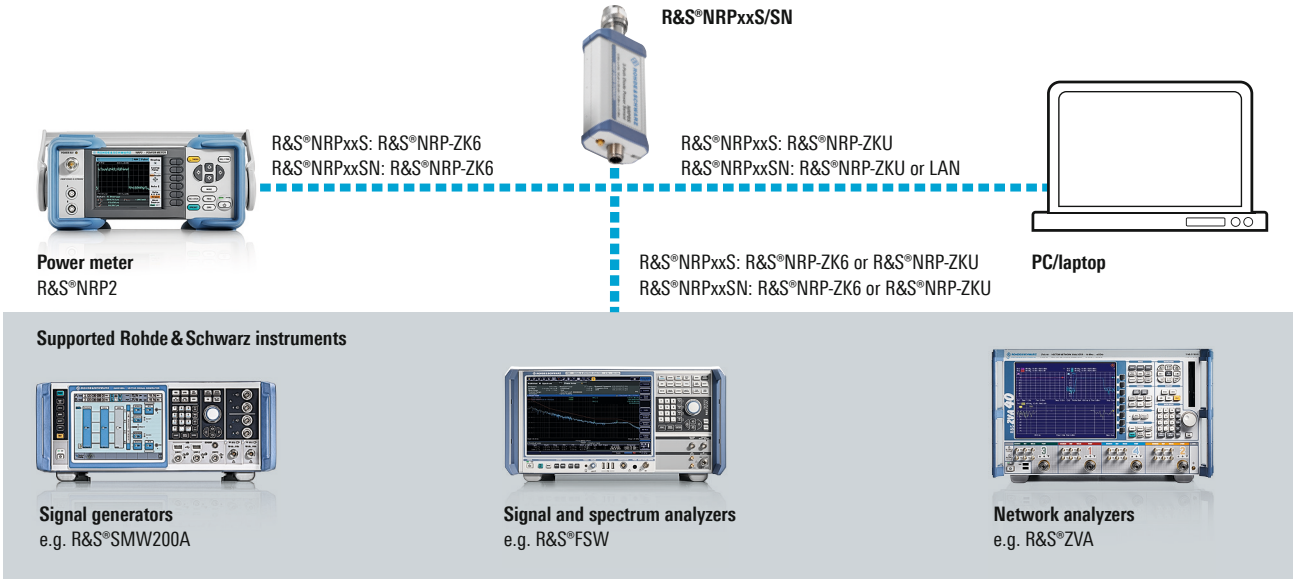
Detachable cables for flexible operation

The power sensors come with various, detachable cables for connection to diverse display units. A screw connection is provided on the sensor end to prevent accidental loosening of the cable.

The R&S®NRP-ZKU USB interface cable can be used to connect a power sensor to a laptop/PC via the USB interface. This is an extremely space-saving and also cost-efficient solution that does not require a base unit. Two software tools – R&S®Power Viewer Plus and R&S®NRPV virtual power meter – are available to simplify sensor operation from a laptop/PC. These tools support all measurement functions implemented in the sensors.

The R&S®NRP-ZK6 interface cable is intended for operating a power sensor on the R&S®NRP2 base unit. It can also be used for connecting the power sensor to diverse Rohde&Schwarz signal generators and signal and spectrum analyzers to enhance these instruments with a high-performance power meter.

Multiple options to operate the R&S®NRPxxS/SN power sensors



Remote monitoring via LAN over any distance

The R&S®NRPxxSN LAN power sensors are ideal for remote monitoring applications, e.g. for satellite systems or particle accelerators, where sensors need to be placed at different points in the system. After connecting the sensors to a LAN using power-over-Ethernet (PoE) switches (R&S®NRP-ZAP1), the system can be remotely monitored from a control center.

Using an Internet connected PC, the R&S®NRPxxSN sensors can be conveniently controlled via a web browser – no additional software needs to be installed.

Built-in trigger I/O port

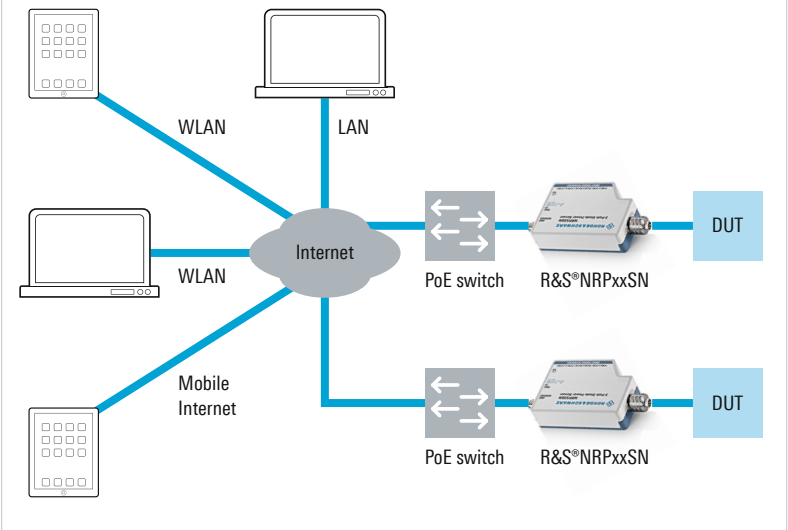
The R&S®NRPxxS/SN power sensors have integrated trigger capability. To measure power levels below the minimum trigger threshold, an external trigger signal is required. Such signals can be conveniently supplied via the built-in trigger port, which can also be used as a trigger source. In the trigger master mode, a trigger signal is derived from the measured signal inside the power sensor and output via the trigger port. This feature can be used for determining the input and output power levels of a power amplifier when the level at the amplifier input is too low for an internally triggered measurement, yet the level at the amplifier output is sufficiently high. In this case, the R&S®NRPxxS/SN used for measuring the output level acts as the trigger master to trigger the input level measurement.

Sensor status at a glance with status LED

A status LED on the sensors allows the sensor status to be viewed from different angles. This is especially advantageous in the case of production racks with many sensors. The LED lights green to indicate error-free measurements. System-related errors, e.g. the absence of a trigger signal, are also indicated by dedicated colors. This allows users to immediately see the operating status of all sensors and quickly respond to problems.

By assigning the same color (RGB value) to a measured trace and the LED of the associated sensor, users can more easily attribute a trace to a specific sensor. This is beneficial when using multiple sensors at the same time.

Simultaneous, location-independent remote monitoring of multiple R&S®NRPxxSN power sensors using a web browser



R&S®NRPxxS/SN three-path diode power sensors

10 000 triggered measurements/s

In fast continuous average mode, the R&S®NRPxxS/SN power sensors are able to perform up to 10 000 triggered measurements/s with a minimum trigger resolution of 100 µs without losing any measurement. This measurement speed can be achieved by using the buffer mode. In buffer mode, all measured data is collected inside the sensor and transmitted in one block to the sensor's host. By exploiting the maximum buffer size, the R&S®NRPxxS/SN sensors are able to collect measured data for up to 8192 triggered measurements within 0.81 s.

More than 50 000 readings/s

With more than 50 000 readings/s, the R&S®NRPxxS/SN power sensors are currently the fastest sensors on the market. In trace mode, they can transmit up to 8192 equidistant measured values per block using a time resolution configurable within 10 µs. This corresponds to a continuous acquisition time of 81.92 ms. Any sporadic interference will be reliably detected.

Unprecedented measurement speed and accuracy even at low levels

The measurement speed is not only a function of the sampling rate. It depends to a substantial degree on the level to be measured and the desired measurement accuracy. To increase measurement accuracy, especially at low levels, it is necessary to average multiple measured values. While averaging reduces the noise component and thus increases measurement accuracy, it slows down the measurement at the same time. The R&S®NRPxxS/SN power sensors have therefore been designed with an extremely low measurement noise in mind.

As a basic rule, it can be said that a 50 % reduction in the measurement noise will reduce the measurement time by a factor of four while maintaining the same accuracy.

With a typical measurement noise of 20 pW, the R&S®NRPxxS/SN power sensors can perform measurements to a lower limit of –70 dBm with the highest speed and accuracy currently available on the market.

Sensor type	Frequency range	Level range	Connector type
R&S®NRP8S	10 MHz to 8 GHz	–70 dBm to +23 dBm	N (m)
R&S®NRP8SN	10 MHz to 8 GHz	–70 dBm to +23 dBm	N (m)
R&S®NRP18S	10 MHz to 18 GHz	–70 dBm to +23 dBm	N (m)
R&S®NRP18SN	10 MHz to 18 GHz	–70 dBm to +23 dBm	N (m)
R&S®NRP33S	10 MHz to 33 GHz	–70 dBm to +23 dBm	3.5 mm (m)
R&S®NRP33SN	10 MHz to 33 GHz	–70 dBm to +23 dBm	3.5 mm (m)

Ideal for universal applications

Three-path diode power sensors are suitable for numerous applications since they support continuous average, burst average, timeslot average, gate average and trace measurements. Featuring outstanding performance and unprecedented measurement speed and accuracy, the sensors can be used to perform precise average power measurements on wireless signals such as GSM and 3GPP as well as on higher bandwidth signals such as LTE and LTE-Advanced. For detailed analysis, the sensors offer additional measurement functions such as timeslot mode and trace mode with a video bandwidth of 100 kHz.

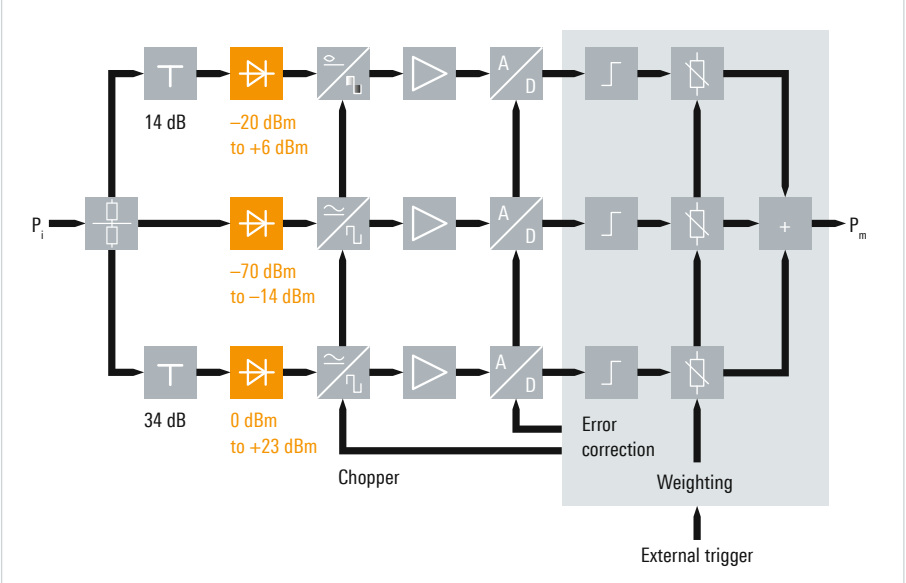
Offering a frequency range of up to 33 GHz, the R&S®NRP33S/SN is ideal for use in the automotive sector, for example in the development and production of long-range and short-range anti-collision radars (24 GHz). It is also a perfect choice for installation, maintenance and remote monitoring of ground stations for satellite systems (up to 33 GHz).

93 dB dynamic range thanks to innovative three-path concept

The R&S®NRPxxS/SN power sensors use three separate diode paths, each operated in the optimum detector range. As a result, the average power can be determined with high accuracy independent of the modulation type. Measurement results are hardly affected by interfering signals or harmonics. The R&S®NRPxxS/SN power sensors therefore behave in a way similar to thermal power sensors but offer significantly higher speed. They provide up to 93 dB dynamic range with an excellent lower measurement limit of –70 dBm.

In contrast to conventional multipath technology, adjacent diode paths in the R&S®NRPxxS/SN power sensors overlap by 6 dB. All paths are continuously and simultaneously measured. The final measurement result is achieved by appropriately weighting the measurement results of all paths. This innovative approach ensures a smooth transition between measurement paths. Problems due to hard switching between the measurement paths, such as hysteresis effects, additional measurement delays and differential nonlinearity, are eliminated. The patented sensor architecture also improves the signal-to-noise ratio and increases measurement speed in the transition region.

Innovative three-path concept



Specifications in brief

Specifications in brief						
Sensor type, connector type	**Frequency range**	**Power measurement range**	**Impedance matching (SWR)**	**Rise time, video bandwidth**	**Uncertainty for power measurements at +20 °C to +25 °C**	
					absolute (in dB)	**relative (in dB)**
Three-path diode power sensors						
R&S®NRP8S/SN N (m)	10 MHz to 8 GHz	100 pW to 200 mW (–70 dBm to +23 dBm)	10 MHz to 2.4 GHz: < 1.13 > 2.4 GHz to 8.0 GHz: < 1.20	< 5 µs > 100 kHz	0.053 to 0.065	0.022 to 0.050
R&S®NRP18S/SN N (m)	10 MHz to 18 GHz	100 pW to 200 mW (–70 dBm to +23 dBm)	10 MHz to 2.4 GHz: < 1.13 > 2.4 GHz to 8.0 GHz: < 1.20 > 8.0 GHz to 18.0 GHz: < 1.25		0.053 to 0.094	0.022 to 0.069
R&S®NRP33S/SN 3.5 mm (m)	10 MHz to 33 GHz	100 pW to 200 mW (–70 dBm to +23 dBm)	10 MHz to 2.4 GHz: < 1.13 > 2.4 GHz to 8.0 GHz: < 1.20 > 8.0 GHz to 18.0 GHz: < 1.25 > 18.0 GHz to 26.5 GHz: < 1.30 > 26.5 GHz to 33.0 GHz: < 1.35		0.053 to 0.134	0.022 to 0.136

Ordering information

Designation	Type	Order No.
Three-Path Diode Power Sensor		
100 pW to 200 mW, 10 MHz to 8 GHz	R&S®NRP8S	1419.0006.02
100 pW to 200 mW, 10 MHz to 8 GHz, LAN version	R&S®NRP8SN	1419.0012.02
100 pW to 200 mW, 10 MHz to 18 GHz	R&S®NRP18S	1419.0029.02
100 pW to 200 mW, 10 MHz to 18 GHz, LAN version	R&S®NRP18SN	1419.0035.02
100 pW to 200 mW, 10 MHz to 33 GHz	R&S®NRP33S	1419.0064.02
100 pW to 200 mW, 10 MHz to 33 GHz, LAN version	R&S®NRP33SN	1419.0070.02
Accessories (cables, additional equipment, etc.)		
USB Interface Cable, length: 0.75 m	R&S®NRP-ZKU	1419.0658.02
USB Interface Cable, length: 1.5 m	R&S®NRP-ZKU	1419.0658.03
USB Interface Cable, length: 3 m	R&S®NRP-ZKU	1419.0658.04
USB Interface Cable, length: 5 m	R&S®NRP-ZKU	1419.0658.05
6-pole Interface Cable, length: 1.5 m	R&S®NRP-ZK6	1419.0664.02
6-pole Interface Cable, length: 3 m	R&S®NRP-ZK6	1419.0664.03
6-pole Interface Cable, length: 5 m	R&S®NRP-ZK6	1419.0664.04
Sensor Hub	R&S®NRP-Z5	1146.7740.02
Power-over-Ethernet (PoE) Switch	R&S®NRP-ZAP1	1419.0829.00
Accredited Calibration, for R&S®NRPxxS/SN power sensors	R&S®NRP-ACA	1419.0812.00

Service options		
Extended Warranty, one year	R&S®WE1	Please contact your local Rohde&Schwarz sales office.
Extended Warranty, two years	R&S®WE2	
Extended Warranty, three years	R&S®WE3	
Extended Warranty, four years	R&S®WE4	
Extended Warranty with Calibration Coverage, one year	R&S®CW1	
Extended Warranty with Calibration Coverage, two years	R&S®CW2	
Extended Warranty with Calibration Coverage, three years	R&S®CW3	
Extended Warranty with Calibration Coverage, four years	R&S®CW4	

For data sheet, see PD 3607.0852.22 and www.rohde-schwarz.com

Your local Rohde&Schwarz expert will help you determine the optimum solution for your requirements.
To find your nearest Rohde&Schwarz representative, visit www.sales.rohde-schwarz.com

Service that adds value

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

About Rohde&Schwarz

The Rohde&Schwarz electronics group is a leading supplier of solutions in the fields of test and measurement, broadcast and media, secure communications, cybersecurity, and radiomonitoring and radiolocation. Founded more than 80 years ago, this independent global company has an extensive sales network and is present in more than 70 countries. The company is headquartered in Munich, Germany.

Sustainable product design

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

Certified Quality Management
ISO 9001

Certified Environmental Management
ISO 14001

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