

# R&S®NRP POWER METER FAMILY

## Specifications

3  
year  
warranty



Data Sheet  
Version 11.00

**ROHDE & SCHWARZ**

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# CONTENTS

|                                                                                                                                                                                         |           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>Definitions .....</b>                                                                                                                                                                | <b>3</b>  |
| <b>Overview of the R&amp;S®NRP power sensors .....</b>                                                                                                                                  | <b>4</b>  |
| <b>Specifications in brief of the R&amp;S®NRP power sensors .....</b>                                                                                                                   | <b>5</b>  |
| <b>Multipath diode power sensors .....</b>                                                                                                                                              | <b>7</b>  |
| R&S®NRP8S(N)/18S(N)/33S(N) three-path diode power sensors,<br>R&S®NRP33SN-V TVAC-compliant three-path diode power sensor .....                                                          | 7         |
| R&S®NRP40S(N)/50S(N)/67S(N) three-path diode power sensors,<br>R&S®NRP67SN-V TVAC-compliant three-path diode power sensor .....                                                         | 10        |
| R&S®NRP18S-10 high-power three-path diode power sensor .....                                                                                                                            | 14        |
| R&S®NRP18S-20 high-power three-path diode power sensor .....                                                                                                                            | 16        |
| R&S®NRP18S-25 high-power three-path diode power sensor .....                                                                                                                            | 18        |
| Additional characteristics of the R&S®NRPxxS(N)/18S-10/18S-20/18S-25 three-path diode power sensors and<br>the R&S®NRP33SN-V/67SN-V TVAC-compliant three-path diode power sensors ..... | 20        |
| Power rating of the R&S®NRP18S-10/-20/-25 .....                                                                                                                                         | 23        |
| <b>Average power sensors.....</b>                                                                                                                                                       | <b>24</b> |
| R&S®NRP6A(N)/18A(N) average power sensors .....                                                                                                                                         | 24        |
| Additional characteristics of the R&S®NRPxxA(N) average power sensors .....                                                                                                             | 27        |
| <b>Thermal power sensors.....</b>                                                                                                                                                       | <b>29</b> |
| R&S®NRP18T(N)/33T(N)/40T(N)/50T(N)/67T(N) thermal power sensors .....                                                                                                                   | 29        |
| R&S®NRP90T(N)/110T thermal power sensors .....                                                                                                                                          | 30        |
| Additional characteristics of the R&S®NRP18T(N)/33T(N)/40T(N)/50T(N)/67T(N)/90T(N)/110T thermal power sensors .....                                                                     | 31        |
| <b>Thermal waveguide power sensors.....</b>                                                                                                                                             | <b>33</b> |
| R&S®NRP75TWG/90TWG/110TWG thermal waveguide power sensors .....                                                                                                                         | 33        |
| Additional characteristics of the R&S®NRP75TWG/90TWG/110TWG thermal waveguide power sensors .....                                                                                       | 34        |
| <b>Accessories for R&amp;S®NRP power sensors .....</b>                                                                                                                                  | <b>36</b> |
| R&S®NRP-ZKU interface cables .....                                                                                                                                                      | 36        |
| R&S®NRP-ZK6 interface cables .....                                                                                                                                                      | 36        |
| R&S®NRP-ZK8 interface cables .....                                                                                                                                                      | 36        |
| R&S®NRP-ZKVSJR Ethernet cables for TVAC applications .....                                                                                                                              | 37        |
| R&S®NRP-ZKVSMD Ethernet cables for TVAC applications .....                                                                                                                              | 37        |
| R&S®NRP-ZKASMD Ethernet cables (air side cables) .....                                                                                                                                  | 37        |
| <b>General data for R&amp;S®NRP power sensors and accessories.....</b>                                                                                                                  | <b>38</b> |
| <b>R&amp;S®NRX base unit .....</b>                                                                                                                                                      | <b>39</b> |
| <b>Options for the R&amp;S®NRX base unit.....</b>                                                                                                                                       | <b>42</b> |
| <b>Appendix.....</b>                                                                                                                                                                    | <b>43</b> |
| Reading the uncertainty of multipath power sensors for relative power measurements .....                                                                                                | 43        |
| Technical drawings of the R&S®NRP33SN-V/67SN-V TVAC-compliant three-path diode power sensor .....                                                                                       | 44        |
| <b>Ordering information .....</b>                                                                                                                                                       | <b>45</b> |
| <b>Endnotes.....</b>                                                                                                                                                                    | <b>48</b> |

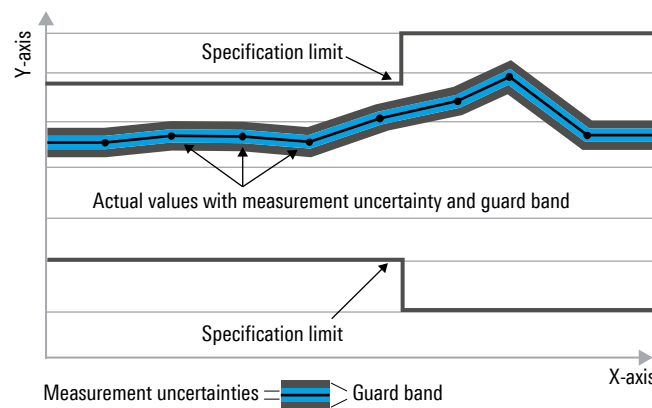
# Definitions

Product data applies under the following conditions:

- Three hours storage at the expected operating temperature followed by 30 minutes warm-up, unless otherwise stated
- Specified environmental conditions met
- Recommended calibration interval adhered to
- All internal automatic adjustments performed, if applicable

## Specifications with limits

Represent warranted product performance by means of a range of values for the specified parameter. These specifications are marked with limiting symbols such as  $<$ ,  $\leq$ ,  $>$ ,  $\geq$ ,  $\pm$ , or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design. Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.



## Specifications without limits

Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (e.g. dimensions or resolution of a setting parameter). Compliance is ensured by design.

## Typical values (typ.)

Characterizes product performance by means of representative information for the given parameter. When marked with  $<$ ,  $>$  or as a range, it represents the performance met by approximately 80 % of the instruments at production time. Otherwise, it represents the mean value.

## Nominal values (nom.)

Characterize product performance by means of a representative value for the given parameter (e.g. nominal impedance). In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

## Measured values (meas.)

Characterize expected product performance by means of measurement results gained from individual samples.

## Uncertainties

Represent limits of measurement uncertainty for a given measurand. Uncertainty is defined with a coverage factor of 2 and has been calculated in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM), taking into account environmental conditions, aging, wear and tear.

Device settings and GUI parameters are indicated as follows: "parameter: value".

Typical data as well as nominal and measured values are not warranted by Rohde & Schwarz.

In line with the 3GPP/3GPP2 standard, chip rates are specified in million chips per second (Mcps), whereas bit rates and symbol rates are specified in billion bits per second (Gbps), million bits per second (Mbps), thousand bits per second (kbps), million symbols per second (Msps) or thousand symbols per second (ksps), and sample rates are specified in million samples per second (Msample/s). Gbps, Mcps, Mbps, Msps, kbps, ksps and Msample/s are not SI units.

## Overview of the R&S®NRP power sensors

| Sensor type<br>R&S®                              | Frequency range   | Power range,<br>max. average power / peak envelope power                     | Connector<br>type |
|--------------------------------------------------|-------------------|------------------------------------------------------------------------------|-------------------|
| <b>Three-path diode power sensors</b>            |                   |                                                                              |                   |
| NRP8S(N)                                         | 10 MHz to 8 GHz   | 100 pW to 200 mW (–70 dBm to +23 dBm)<br>max. 1 W (AVG) / 2 W (PK, 10 µs)    | N (m)             |
| NRP18S(N)                                        | 10 MHz to 18 GHz  | 100 pW to 200 mW (–70 dBm to +23 dBm)<br>max. 1 W (AVG) / 2 W (PK, 10 µs)    | N (m)             |
| NRP33S(N)/<br>NRP33SN-V                          | 10 MHz to 33 GHz  | 100 pW to 200 mW (–70 dBm to +23 dBm)<br>max. 1 W (AVG) / 2 W (PK, 10 µs)    | 3.50 mm (m)       |
| NRP40S(N)                                        | 50 MHz to 40 GHz  | 100 pW to 100 mW (–70 dBm to +20 dBm)<br>max. 200 mW (AVG) / 1 W (PK, 10 µs) | 2.92 mm (m)       |
| NRP50S(N)                                        | 50 MHz to 50 GHz  | 100 pW to 100 mW (–70 dBm to +20 dBm)<br>max. 200 mW (AVG) / 1 W (PK, 10 µs) | 2.40 mm (m)       |
| NRP67S(N)<br>NRP67SN-V                           | 50 MHz to 67 GHz  | 100 pW to 100 mW (–70 dBm to +20 dBm)<br>max. 200 mW (AVG) / 1 W (PK, 10 µs) | 1.85 mm (m)       |
| <b>High-power three-path diode power sensors</b> |                   |                                                                              |                   |
| NRP18S-10                                        | 10 MHz to 18 GHz  | 1 nW to 2 W (–60 dBm to +33 dBm)<br>max. 3 W (AVG) / 20 W (PK, 10 µs)        | N (m)             |
| NRP18S-20                                        | 10 MHz to 18 GHz  | 10 nW to 15 W (–50 dBm to +42 dBm)<br>max. 18 W (AVG) / 100 W (PK, 10 µs)    | N (m)             |
| NRP18S-25                                        | 10 MHz to 18 GHz  | 30 nW to 30 W (–45 dBm to +45 dBm)<br>max. 36 W (AVG) / 300 W (PK, 10 µs)    | N (m)             |
| <b>Average power sensors</b>                     |                   |                                                                              |                   |
| NRP6A(N)                                         | 8 kHz to 6 GHz    | 100 pW to 200 mW (–70 dBm to +23 dBm)<br>max. 1 W (AVG) / 2 W (PK, 10 µs)    | N (m)             |
| NRP18A(N)                                        | 8 kHz to 18 GHz   | 100 pW to 200 mW (–70 dBm to +23 dBm)<br>max. 1 W (AVG) / 2 W (PK, 10 µs)    | N (m)             |
| <b>Thermal power sensors</b>                     |                   |                                                                              |                   |
| NRP18T(N)                                        | DC to 18 GHz      | 300 nW to 100 mW (–35 dBm to +20 dBm)<br>max. 300 mW (AVG) / 20 W (PK, 1 µs) | N (m)             |
| NRP33T(N)                                        | DC to 33 GHz      | 300 nW to 100 mW (–35 dBm to +20 dBm)<br>max. 300 mW (AVG) / 10 W (PK, 1 µs) | 3.50 mm (m)       |
| NRP40T(N)                                        | DC to 40 GHz      | 300 nW to 100 mW (–35 dBm to +20 dBm)<br>max. 300 mW (AVG) / 10 W (PK, 1 µs) | 2.92 mm (m)       |
| NRP50T(N)                                        | DC to 50 GHz      | 300 nW to 100 mW (–35 dBm to +20 dBm)<br>max. 300 mW (AVG) / 10 W (PK, 1 µs) | 2.40 mm (m)       |
| NRP67T(N)                                        | DC to 67 GHz      | 300 nW to 100 mW (–35 dBm to +20 dBm)<br>max. 300 mW (AVG) / 10 W (PK, 1 µs) | 1.85 mm (m)       |
| NRP90T(N)                                        | DC to 90 GHz      | 300 nW to 100 mW (–35 dBm to +20 dBm)<br>max. 300 mW (AVG) / 10 W (PK, 1 µs) | 1.35 mm (m)       |
| NRP110T                                          | DC to 110 GHz     | 300 nW to 100 mW (–35 dBm to +20 dBm)<br>max. 300 mW (AVG) / 10 W (PK, 1 µs) | 1.00 mm (m)       |
| <b>Thermal waveguide power sensors</b>           |                   |                                                                              |                   |
| NRP75TWG                                         | 50 GHz to 75 GHz  | 300 nW to 100 mW (–35 dBm to +20 dBm)<br>max. 300 mW (AVG) / 10 W (PK, 1 µs) | WR15              |
| NRP90TWG                                         | 60 GHz to 90 GHz  | 300 nW to 100 mW (–35 dBm to +20 dBm)<br>max. 300 mW (AVG) / 10 W (PK, 1 µs) | WR12              |
| NRP110TWG                                        | 75 GHz to 110 GHz | 300 nW to 100 mW (–35 dBm to +20 dBm)<br>max. 300 mW (AVG) / 10 W (PK, 1 µs) | WR10              |

# Specifications in brief of the R&S®NRP power sensors

| Sensor type<br>R&S®                       | Impedance matching (SWR)                                                                                                                                                                                                                                                                             |                     | Rise time<br>Video<br>BW | Zero<br>offset<br>(typ.) | Noise<br>(typ.) | Uncertainty for power<br>measurements at +20 °C to +25 °C |                  |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------|--------------------------|-----------------|-----------------------------------------------------------|------------------|
|                                           |                                                                                                                                                                                                                                                                                                      |                     |                          |                          |                 | absolute (in dB)                                          | relative (in dB) |
| Three-path diode power sensors            |                                                                                                                                                                                                                                                                                                      |                     |                          |                          |                 |                                                           |                  |
| NRP8S(N)                                  | 10 MHz to 2.4 GHz: < 1.13<br>> 2.4 GHz to 8.0 GHz: < 1.20                                                                                                                                                                                                                                            | < 5 µs<br>> 100 kHz | 28 pW                    | 20 pW                    | 0.053 to 0.065  | 0.022 to 0.050                                            |                  |
| NRP18S(N)                                 | 10 MHz to 2.4 GHz: < 1.13<br>> 2.4 GHz to 8.0 GHz: < 1.20<br>> 8.0 GHz to 18.0 GHz: < 1.25                                                                                                                                                                                                           |                     |                          |                          | 0.053 to 0.094  | 0.022 to 0.069                                            |                  |
| NRP33S(N)/<br>NRP33SN-V                   | 10 MHz to 2.4 GHz: < 1.13<br>> 2.4 GHz to 8.0 GHz: < 1.20<br>> 8.0 GHz to 18.0 GHz: < 1.25<br>> 18.0 GHz to 26.5 GHz: < 1.30<br>> 26.5 GHz to 33.0 GHz: < 1.35                                                                                                                                       |                     |                          |                          | 0.053 to 0.134  | 0.022 to 0.136                                            |                  |
| NRP40S(N)                                 | 50 MHz to 2.4 GHz: < 1.13<br>> 2.4 GHz to 8.0 GHz: < 1.20<br>> 8.0 GHz to 18.0 GHz: < 1.25<br>> 18.0 GHz to 26.5 GHz: < 1.30<br>> 26.5 GHz to 33.0 GHz: < 1.35<br>> 33.0 GHz to 40.0 GHz: < 1.37                                                                                                     |                     |                          |                          | 0.073 to 0.138  | 0.028 to 0.142                                            |                  |
| NRP50S(N)                                 | 50 MHz to 2.4 GHz: < 1.13<br>> 2.4 GHz to 8.0 GHz: < 1.20<br>> 8.0 GHz to 18.0 GHz: < 1.25<br>> 18.0 GHz to 26.5 GHz: < 1.30<br>> 26.5 GHz to 33.0 GHz: < 1.35<br>> 33.0 GHz to 40.0 GHz: < 1.37<br>> 40.0 GHz to 50.0 GHz: < 1.40                                                                   |                     |                          |                          | 0.073 to 0.183  | 0.028 to 0.184                                            |                  |
| NRP67S(N)<br>NRP67SN-V                    | 50 MHz to 200 MHz: < 1.30<br>> 200 MHz to 2.4 GHz: < 1.13<br>> 2.4 GHz to 8.0 GHz: < 1.20<br>> 8.0 GHz to 18.0 GHz: < 1.25<br>> 18.0 GHz to 26.5 GHz: < 1.30<br>> 26.5 GHz to 33.0 GHz: < 1.35<br>> 33.0 GHz to 40.0 GHz: < 1.37<br>> 40.0 GHz to 50.0 GHz: < 1.40<br>> 50.0 GHz to 67.0 GHz: < 1.68 |                     |                          |                          | 0.073 to 0.255  | 0.028 to 0.266                                            |                  |
| High-power three-path diode power sensors |                                                                                                                                                                                                                                                                                                      |                     |                          |                          |                 |                                                           |                  |
| NRP18S-10                                 | 10 MHz to 2.4 GHz: < 1.14<br>> 2.4 GHz to 8.0 GHz: < 1.20<br>> 8.0 GHz to 12.4 GHz: < 1.25<br>> 12.4 GHz to 18.0 GHz: < 1.30                                                                                                                                                                         | < 5 µs<br>> 100 kHz | 320 pW                   | 230 pW                   | 0.083 to 0.198  | 0.022 to 0.087                                            |                  |
| NRP18S-20                                 | 10 MHz to 2.4 GHz: < 1.14<br>> 2.4 GHz to 8.0 GHz: < 1.25<br>> 8.0 GHz to 12.4 GHz: < 1.30<br>> 12.4 GHz to 18.0 GHz: < 1.41                                                                                                                                                                         |                     | 3.4 nW                   | 2.4 nW                   | 0.083 to 0.198  | 0.022 to 0.087                                            |                  |
| NRP18S-25                                 | 10 MHz to 2.4 GHz: < 1.14<br>> 2.4 GHz to 8.0 GHz: < 1.25<br>> 8.0 GHz to 12.4 GHz: < 1.30<br>> 12.4 GHz to 18.0 GHz: < 1.41                                                                                                                                                                         |                     | 12 nW                    | 8 nW                     | 0.083 to 0.219  | 0.022 to 0.087                                            |                  |
| Average power sensors                     |                                                                                                                                                                                                                                                                                                      |                     |                          |                          |                 |                                                           |                  |
| NRP6A(N)                                  | 8 kHz to < 20 kHz: < 1.25<br>20 kHz to 2.4 GHz: < 1.13<br>> 2.4 GHz to 6.0 GHz: < 1.20                                                                                                                                                                                                               | –                   | 28 pW                    | 20 pW                    | 0.051 to 0.056  | 0.022 to 0.050                                            |                  |
| NRP18A(N)                                 | 8 kHz to < 20 kHz: < 1.25<br>20 kHz to 2.4 GHz: < 1.13<br>> 2.4 GHz to 8.0 GHz: < 1.20<br>> 8.0 GHz to 18.0 GHz: < 1.25                                                                                                                                                                              |                     |                          |                          | 0.051 to 0.094  | 0.022 to 0.069                                            |                  |

| Sensor type<br>R&S®             | Impedance matching (SWR)                                                                                                                                                                                                                                                                                                                                              |   | Rise time<br>Video<br>BW | Zero<br>offset<br>(typ.) | Noise<br>(typ.) | Uncertainty for power measurements<br>at +20 °C to +25 °C |                  |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------|--------------------------|-----------------|-----------------------------------------------------------|------------------|
|                                 |                                                                                                                                                                                                                                                                                                                                                                       |   |                          |                          |                 | absolute (in dB)                                          | relative (in dB) |
| Thermal power sensors           |                                                                                                                                                                                                                                                                                                                                                                       |   |                          |                          |                 |                                                           |                  |
| NRP18T(N)                       | DC to 100 MHz: < 1.03<br>> 100 MHz to 2.4 GHz: < 1.06<br>> 2.4 GHz to 12.4 GHz: < 1.13<br>> 12.4 GHz to 18.0 GHz: < 1.16                                                                                                                                                                                                                                              |   | -                        | 15 nW                    | 15 nW           | 0.040 to 0.082                                            | 0.010            |
| NRP33T(N)                       | DC to 100 MHz: < 1.03<br>> 100 MHz to 2.4 GHz: < 1.06<br>> 2.4 GHz to 12.4 GHz: < 1.13<br>> 12.4 GHz to 18.0 GHz: < 1.16<br>> 18.0 GHz to 26.5 GHz: < 1.22<br>> 26.5 GHz to 33.0 GHz: < 1.28                                                                                                                                                                          |   |                          |                          |                 | 0.040 to 0.101                                            | 0.010            |
| NRP40T(N)                       | DC to 100 MHz: < 1.03<br>> 100 MHz to 2.4 GHz: < 1.06<br>> 2.4 GHz to 12.4 GHz: < 1.13<br>> 12.4 GHz to 18.0 GHz: < 1.16<br>> 18.0 GHz to 26.5 GHz: < 1.22<br>> 26.5 GHz to 40.0 GHz: < 1.28                                                                                                                                                                          |   |                          |                          |                 | 0.040 to 0.108                                            | 0.010            |
| NRP50T(N)                       | DC to 100 MHz: < 1.03<br>> 100 MHz to 2.4 GHz: < 1.06<br>> 2.4 GHz to 12.4 GHz: < 1.13<br>> 12.4 GHz to 18.0 GHz: < 1.16<br>> 18.0 GHz to 26.5 GHz: < 1.22<br>> 26.5 GHz to 40.0 GHz: < 1.28<br>> 40.0 GHz to 50.0 GHz: < 1.30                                                                                                                                        |   |                          |                          |                 | 0.040 to 0.143                                            | 0.010            |
| NRP67T(N)                       | DC to 100 MHz: < 1.03<br>> 100 MHz to 2.4 GHz: < 1.06<br>> 2.4 GHz to 12.4 GHz: < 1.13<br>> 12.4 GHz to 18.0 GHz: < 1.16<br>> 18.0 GHz to 26.5 GHz: < 1.22<br>> 26.5 GHz to 40.0 GHz: < 1.28<br>> 40.0 GHz to 50.0 GHz: < 1.30<br>> 50.0 GHz to 67.0 GHz: < 1.35                                                                                                      |   |                          |                          |                 | 0.040 to 0.209                                            | 0.010            |
| NRP90T(N)                       | DC to 100 MHz: < 1.05<br>> 100 MHz to 2.4 GHz: < 1.08<br>> 2.4 GHz to 12.4 GHz: < 1.18<br>> 12.4 GHz to 18.0 GHz: < 1.23<br>> 18.0 GHz to 26.5 GHz: < 1.28<br>> 26.5 GHz to 40.0 GHz: < 1.38<br>> 40.0 GHz to 50.0 GHz: < 1.46<br>> 50.0 GHz to 67.0 GHz: < 1.56<br>> 67.0 GHz to 80.0 GHz: < 1.60<br>> 80.0 GHz to 90.0 GHz: < 1.66                                  |   |                          |                          |                 | 0.041 to 0.269                                            | 0.010 to 0.014   |
| NRP110T                         | DC to 100 MHz: < 1.05<br>> 100 MHz to 2.4 GHz: < 1.08<br>> 2.4 GHz to 12.4 GHz: < 1.18<br>> 12.4 GHz to 18.0 GHz: < 1.23<br>> 18.0 GHz to 26.5 GHz: < 1.28<br>> 26.5 GHz to 40.0 GHz: < 1.38<br>> 40.0 GHz to 50.0 GHz: < 1.46<br>> 50.0 GHz to 67.0 GHz: < 1.56<br>> 67.0 GHz to 80.0 GHz: < 1.60<br>> 80.0 GHz to 95.0 GHz: < 1.66<br>> 95.0 GHz to 110 GHz: < 1.70 |   |                          |                          |                 | 0.041 to 0.290                                            | 0.010 to 0.014   |
| Thermal waveguide power sensors |                                                                                                                                                                                                                                                                                                                                                                       |   |                          |                          |                 |                                                           |                  |
| NRP75TWG                        | 50 GHz to 75 GHz: < 1.35                                                                                                                                                                                                                                                                                                                                              | - | 20 nW                    | 20 nW                    | 0.190           | 0.014                                                     |                  |
| NRP90TWG                        | 60 GHz to 90 GHz: < 1.35                                                                                                                                                                                                                                                                                                                                              |   |                          |                          | 0.194           | 0.014                                                     |                  |
| NRP110TWG                       | 75 GHz to 110 GHz: < 1.35                                                                                                                                                                                                                                                                                                                                             |   |                          |                          | 0.198           | 0.014                                                     |                  |

# Multipath diode power sensors

## R&S®NRP8S(N)/18S(N)/33S(N) three-path diode power sensors, R&S®NRP33SN-V TVAC-compliant three-path diode power sensor

Specifications from 10 MHz to 8 GHz apply to the R&S®NRP8S(N).

Specifications from 10 MHz to 18 GHz apply to the R&S®NRP18S(N).

Specifications from 10 MHz to 33 GHz apply to the R&S®NRP33S(N)/NRP33SN-V.

|                                       |                                            |                                                                           |                                                                              |
|---------------------------------------|--------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------------------|
| <b>Frequency range</b>                | R&S®NRP8S(N)                               | 10 MHz to 8 GHz                                                           |                                                                              |
|                                       | R&S®NRP18S(N)                              | 10 MHz to 18 GHz                                                          |                                                                              |
|                                       | R&S®NRP33S(N)/NRP33SN-V                    | 10 MHz to 33 GHz                                                          |                                                                              |
| <b>Impedance matching (SWR)</b>       | 10 MHz to 2.4 GHz                          | < 1.13 (1.11)                                                             | ( ): +15 °C to +35 °C                                                        |
|                                       | > 2.4 GHz to 8.0 GHz                       | < 1.20 (1.18)                                                             |                                                                              |
|                                       | > 8.0 GHz to 18.0 GHz                      | < 1.25 (1.23)                                                             |                                                                              |
|                                       | > 18.0 GHz to 26.5 GHz                     | < 1.30 (1.28)                                                             |                                                                              |
|                                       | > 26.5 GHz to 33.0 GHz                     | < 1.35 (1.33)                                                             |                                                                              |
| <b>Power measurement range</b>        | continuous average                         | 100 pW to 200 mW (–70 dBm to +23 dBm)                                     |                                                                              |
|                                       | burst average                              | 300 nW to 200 mW (–35 dBm to +23 dBm)                                     |                                                                              |
|                                       | timeslot/gate average                      | 300 pW to 200 mW (–65 dBm to +23 dBm) <sup>1</sup>                        |                                                                              |
|                                       | trace                                      | 2 nW to 200 mW (–57 dBm to +23 dBm) <sup>2</sup>                          |                                                                              |
| <b>Maximum power</b>                  | average power                              | 1 W (+30 dBm) AVG, max. 10 V DC                                           |                                                                              |
|                                       | peak envelope power                        | 2 W (+33 dBm) for max. 10 µs                                              |                                                                              |
| <b>Measurement subranges</b>          | path 1                                     | –70 dBm to –15 dBm                                                        |                                                                              |
|                                       | path 2                                     | –53 dBm to +5 dBm                                                         |                                                                              |
|                                       | path 3                                     | –33 dBm to +23 dBm                                                        |                                                                              |
| <b>Transition regions</b>             | with automatic path selection <sup>3</sup> | (–20 ± 1) dBm to (–14 ± 1) dBm<br>(0 ± 1) dBm to (+6 ± 1) dBm             |                                                                              |
| <b>Dynamic response</b>               | video bandwidth                            | > 100 kHz (150 kHz)                                                       | ( ): +15 °C to +35 °C                                                        |
|                                       | rise time 10 %/90 %                        | < 5 µs (3 µs)                                                             |                                                                              |
| <b>Acquisition</b>                    | sample rate (continuous)                   | 2 Msps                                                                    |                                                                              |
|                                       | accuracy of time base                      | ±5 ppm                                                                    |                                                                              |
| <b>Triggering</b>                     | internal                                   |                                                                           |                                                                              |
|                                       | threshold level range                      | –38 dBm to +23 dBm                                                        |                                                                              |
|                                       | threshold level accuracy                   | identical to uncertainty for absolute power measurements                  |                                                                              |
|                                       | threshold level hysteresis                 | 0 dB to 10 dB                                                             |                                                                              |
|                                       | dropout <sup>4</sup>                       | 0 s to 10 s                                                               |                                                                              |
|                                       | external                                   | EXTernal[1]: R&S®NRX/NRP2 or R&S®NRP-Z5<br>EXTernal2: coaxial trigger I/O |                                                                              |
|                                       | slope (external, internal)                 | pos./neg.                                                                 |                                                                              |
|                                       | delay                                      | –5 s to +10 s                                                             |                                                                              |
|                                       | hold-off                                   | 0 s to 10 s                                                               |                                                                              |
|                                       | resolution (delay, hold-off, dropout)      | 0.5 µs (sample period)                                                    |                                                                              |
|                                       | source                                     | INTernal, EXTernal[1], EXTernal2, IMMEDIATE, BUS, HOLD                    |                                                                              |
| <b>Zero offset</b>                    | initial, without zeroing                   |                                                                           | ( ): typical at 1 GHz<br>+15 °C to +35 °C<br>[ ]: at frequencies<br>≤ 18 GHz |
|                                       | path 1                                     | < 250 [235] (50) pW                                                       |                                                                              |
|                                       | path 2                                     | < 10.5 [10.3] (2.2) nW                                                    |                                                                              |
|                                       | path 3                                     | < 1.10 [0.93] (0.19) µW                                                   |                                                                              |
|                                       | after external zeroing <sup>5</sup>        |                                                                           |                                                                              |
|                                       | path 1                                     | < 53 [49] (28) pW                                                         |                                                                              |
|                                       | path 2                                     | < 2.2 [2.1] (1.3) nW                                                      |                                                                              |
| <b>Zero drift <sup>6</sup></b>        | path 3                                     | < 224 [192] (108) nW                                                      |                                                                              |
|                                       | path 1                                     | < 13 [12] (2) pW                                                          |                                                                              |
|                                       | path 2                                     | < 0.6 [0.5] (0.1) nW                                                      |                                                                              |
| <b>Measurement noise <sup>7</sup></b> | path 3                                     | < 54 [47] (8) nW                                                          |                                                                              |
|                                       | path 1                                     | < 37 [35] (20) pW                                                         |                                                                              |
|                                       | path 2                                     | < 1.6 [1.5] (0.9) nW                                                      |                                                                              |
|                                       | path 3                                     | < 158 [136] (76) nW                                                       |                                                                              |

**Uncertainty for absolute power measurements <sup>8</sup> in dB****10 MHz to < 20 MHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.224              | 0.187 | 0.181 |
| 0.098              | 0.087 | 0.085 |
| 0.058              | 0.053 | 0.053 |
| -70                | -20   | 0     |
| +23                |       |       |
| Power level in dBm |       |       |

**20 MHz to < 100 MHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.195              | 0.177 | 0.172 |
| 0.089              | 0.085 | 0.083 |
| 0.055              | 0.054 | 0.054 |
| -70                | -20   | 0     |
| +23                |       |       |
| Power level in dBm |       |       |

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**100 MHz to 2.4 GHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.161              | 0.168 | 0.163 |
| 0.084              | 0.086 | 0.085 |
| 0.060              | 0.059 | 0.060 |
| -70                | -20   | 0     |
| +23                |       |       |
| Power level in dBm |       |       |

**> 2.4 GHz to 8 GHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.162              | 0.168 | 0.164 |
| 0.088              | 0.089 | 0.088 |
| 0.065              | 0.063 | 0.064 |
| -70                | -20   | 0     |
| +23                |       |       |
| Power level in dBm |       |       |

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**> 8 GHz to 12.4 GHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.166              | 0.172 | 0.166 |
| 0.096              | 0.096 | 0.095 |
| 0.076              | 0.073 | 0.074 |
| -70                | -20   | 0     |
| +23                |       |       |
| Power level in dBm |       |       |

**> 12.4 GHz to 18 GHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.174              | 0.182 | 0.178 |
| 0.110              | 0.111 | 0.112 |
| 0.092              | 0.090 | 0.094 |
| -70                | -20   | 0     |
| +23                |       |       |
| Power level in dBm |       |       |

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**> 18 GHz to 26.5 GHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.178              | 0.194 | 0.196 |
| 0.112              | 0.117 | 0.125 |
| 0.093              | 0.093 | 0.105 |
| -70                | -20   | 0     |
| +23                |       |       |
| Power level in dBm |       |       |

**> 26.5 GHz to 33 GHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.194              | 0.217 | 0.226 |
| 0.131              | 0.138 | 0.155 |
| 0.114              | 0.114 | 0.134 |
| -70                | -20   | 0     |
| +23                |       |       |
| Power level in dBm |       |       |

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

Uncertainty for relative power measurements <sup>9</sup> in dB

**10 MHz to < 20 MHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +23 | 0.267 | 0.239 | 0.027 |
|     | 0.107 | 0.097 | 0.026 |
| +6  | 0.047 | 0.041 | 0.026 |
| 0   | 0.260 | 0.028 | 0.239 |
|     | 0.103 | 0.024 | 0.097 |
| -14 | 0.044 | 0.023 | 0.041 |
| -20 | 0.022 | 0.260 | 0.267 |
|     | 0.022 | 0.103 | 0.107 |
| -70 | 0.022 | 0.044 | 0.047 |

Power level in dBm

**20 MHz to < 100 MHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +23 | 0.242 | 0.228 | 0.027 |
|     | 0.100 | 0.096 | 0.026 |
| +6  | 0.045 | 0.041 | 0.026 |
| 0   | 0.235 | 0.028 | 0.228 |
|     | 0.097 | 0.024 | 0.096 |
| -14 | 0.043 | 0.023 | 0.041 |
| -20 | 0.022 | 0.235 | 0.242 |
|     | 0.022 | 0.097 | 0.100 |
| -70 | 0.022 | 0.043 | 0.045 |

Power level in dBm

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**100 MHz to 2.4 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +23 | 0.213 | 0.217 | 0.027 |
|     | 0.093 | 0.093 | 0.026 |
| +6  | 0.045 | 0.040 | 0.026 |
| 0   | 0.208 | 0.028 | 0.217 |
|     | 0.090 | 0.024 | 0.093 |
| -14 | 0.043 | 0.023 | 0.040 |
| -20 | 0.022 | 0.208 | 0.213 |
|     | 0.022 | 0.090 | 0.093 |
| -70 | 0.022 | 0.043 | 0.045 |

Power level in dBm

**> 2.4 GHz to 8 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +23 | 0.211 | 0.214 | 0.027 |
|     | 0.095 | 0.093 | 0.026 |
| +6  | 0.050 | 0.042 | 0.026 |
| 0   | 0.205 | 0.028 | 0.214 |
|     | 0.092 | 0.024 | 0.093 |
| -14 | 0.047 | 0.023 | 0.042 |
| -20 | 0.022 | 0.205 | 0.211 |
|     | 0.022 | 0.092 | 0.095 |
| -70 | 0.022 | 0.047 | 0.050 |

Power level in dBm

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**> 8 GHz to 12.4 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +23 | 0.212 | 0.215 | 0.029 |
|     | 0.099 | 0.097 | 0.027 |
| +6  | 0.056 | 0.048 | 0.027 |
| 0   | 0.207 | 0.029 | 0.215 |
|     | 0.095 | 0.025 | 0.097 |
| -14 | 0.052 | 0.024 | 0.048 |
| -20 | 0.022 | 0.207 | 0.212 |
|     | 0.022 | 0.095 | 0.099 |
| -70 | 0.022 | 0.052 | 0.056 |

Power level in dBm

**> 12.4 GHz to 18 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +23 | 0.219 | 0.223 | 0.034 |
|     | 0.109 | 0.108 | 0.033 |
| +6  | 0.069 | 0.064 | 0.032 |
| 0   | 0.212 | 0.031 | 0.223 |
|     | 0.102 | 0.027 | 0.108 |
| -14 | 0.061 | 0.026 | 0.064 |
| -20 | 0.022 | 0.212 | 0.219 |
|     | 0.022 | 0.102 | 0.109 |
| -70 | 0.022 | 0.061 | 0.069 |

Power level in dBm

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**> 18 GHz to 26.5 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +23 | 0.242 | 0.254 | 0.049 |
|     | 0.134 | 0.139 | 0.049 |
| +6  | 0.098 | 0.099 | 0.049 |
| 0   | 0.231 | 0.038 | 0.254 |
|     | 0.119 | 0.034 | 0.139 |
| -14 | 0.079 | 0.032 | 0.099 |
| -20 | 0.022 | 0.231 | 0.242 |
|     | 0.022 | 0.119 | 0.134 |
| -70 | 0.022 | 0.079 | 0.098 |

Power level in dBm

**> 26.5 GHz to 33 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +23 | 0.268 | 0.288 | 0.067 |
|     | 0.162 | 0.174 | 0.067 |
| +6  | 0.129 | 0.136 | 0.067 |
| 0   | 0.252 | 0.047 | 0.288 |
|     | 0.137 | 0.042 | 0.174 |
| -14 | 0.096 | 0.040 | 0.136 |
| -20 | 0.023 | 0.252 | 0.268 |
|     | 0.023 | 0.137 | 0.162 |
| -70 | 0.023 | 0.096 | 0.129 |

Power level in dBm

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

## R&S®NRP40S(N)/50S(N)/67S(N) three-path diode power sensors, R&S®NRP67SN-V TVAC-compliant three-path diode power sensor

Specifications from 50 MHz to 40 GHz apply to the R&S®NRP40S(N).

Specifications from 50 MHz to 50 GHz apply to the R&S®NRP50S(N).

Specifications from 50 MHz to 67 GHz apply to the R&S®NRP67S(N)/NRP67SN-V.

|                                 |                                            |                                                                           |
|---------------------------------|--------------------------------------------|---------------------------------------------------------------------------|
| <b>Frequency range</b>          | R&S®NRP40S(N)                              | 50 MHz to 40 GHz                                                          |
|                                 | R&S®NRP50S(N)                              | 50 MHz to 50 GHz                                                          |
|                                 | R&S®NRP67S(N)/NRP67SN-V                    | 50 MHz to 67 GHz                                                          |
| <b>Impedance matching (SWR)</b> | R&S®NRP40S(N), R&S®NRP50S(N)               |                                                                           |
|                                 | 50 MHz to 2.4 GHz                          | < 1.13 (1.11)                                                             |
|                                 | > 2.4 GHz to 8.0 GHz                       | < 1.20 (1.18)                                                             |
|                                 | > 8.0 GHz to 18.0 GHz                      | < 1.25 (1.23)                                                             |
|                                 | > 18.0 GHz to 26.5 GHz                     | < 1.30 (1.28)                                                             |
|                                 | > 26.5 GHz to 33.0 GHz                     | < 1.35 (1.33)                                                             |
|                                 | > 33.0 GHz to 40.0 GHz                     | < 1.37 (1.35)                                                             |
|                                 | > 40.0 GHz to 50.0 GHz                     | < 1.40 (1.38)                                                             |
|                                 |                                            |                                                                           |
|                                 | R&S®NRP67S(N), R&S®NRP67SN-V               |                                                                           |
|                                 | 50 MHz to 200 MHz                          | < 1.30 (1.28)                                                             |
|                                 | > 200 MHz to 2.4 GHz                       | < 1.13 (1.11)                                                             |
|                                 | > 2.4 GHz to 8.0 GHz                       | < 1.20 (1.18)                                                             |
|                                 | > 8.0 GHz to 18.0 GHz                      | < 1.25 (1.23)                                                             |
|                                 | > 18.0 GHz to 26.5 GHz                     | < 1.30 (1.28)                                                             |
|                                 | > 26.5 GHz to 33.0 GHz                     | < 1.35 (1.33)                                                             |
|                                 | > 33.0 GHz to 40.0 GHz                     | < 1.37 (1.35)                                                             |
|                                 | > 40.0 GHz to 50.0 GHz                     | < 1.40 (1.38)                                                             |
|                                 | > 50.0 GHz to 67.0 GHz                     | < 1.68 (1.66)                                                             |
| <b>Power measurement range</b>  | continuous average                         | 100 pW to 100 mW (–70 dBm to +20 dBm)                                     |
|                                 | burst average                              | 300 nW to 100 mW (–35 dBm to +20 dBm)                                     |
|                                 | timeslot/gate average                      | 300 pW to 100 mW (–65 dBm to +20 dBm) <sup>1</sup>                        |
|                                 | trace                                      | 2 nW to 100 mW (–57 dBm to +20 dBm) <sup>2</sup>                          |
| <b>Maximum power</b>            | average power                              | 0.2 W (+23 dBm) AVG, max. 10 V DC                                         |
|                                 | peak envelope power                        | 1 W (+30 dBm) for max. 10 µs                                              |
| <b>Measurement subranges</b>    | path 1                                     | –70 dBm to –15 dBm                                                        |
|                                 | path 2                                     | –53 dBm to +5 dBm                                                         |
|                                 | path 3                                     | –33 dBm to +20 dBm                                                        |
| <b>Transition regions</b>       | with automatic path selection <sup>3</sup> | (–20 ± 1) dBm to (–14 ± 1) dBm<br>(0 ± 1) dBm to (+6 ± 1) dBm             |
| <b>Dynamic response</b>         | video bandwidth                            | > 100 kHz (150 kHz)                                                       |
|                                 | rise time 10 %/90 %                        | < 5 µs (3 µs)                                                             |
| <b>Acquisition</b>              | sample rate (continuous)                   | 2 Msps                                                                    |
|                                 | accuracy of time base                      | ±5 ppm                                                                    |
| <b>Triggering</b>               | internal                                   |                                                                           |
|                                 | threshold level range                      | –38 dBm to +20 dBm                                                        |
|                                 | threshold level accuracy                   | identical to uncertainty for absolute power measurements                  |
|                                 | threshold level hysteresis                 | 0 dB to 10 dB                                                             |
|                                 | dropout <sup>4</sup>                       | 0 s to 10 s                                                               |
|                                 | external                                   | EXTernal[1]: R&S®NRX/NRP2 or R&S®NRP-Z5<br>EXTernal2: coaxial trigger I/O |
|                                 | slope (external, internal)                 | pos./neg.                                                                 |
|                                 | delay                                      | –5 s to +10 s                                                             |
|                                 | hold-off                                   | 0 s to 10 s                                                               |
|                                 | resolution (delay, hold-off, dropout)      | 0.5 µs (sample period)                                                    |
|                                 | source                                     | INTernal, EXTernal[1], EXTernal2,<br>IMMediate, BUS, HOLD                 |

|                                |                                     |                         |                                                                                  |
|--------------------------------|-------------------------------------|-------------------------|----------------------------------------------------------------------------------|
| Zero offset                    | initial, without zeroing            |                         | ( ): typical at 1 GHz<br>+15 °C to +35 °C<br><br>[ ]: at frequencies<br>≤ 18 GHz |
|                                | path 1                              | < 280 [235] (50) pW     |                                                                                  |
|                                | path 2                              | < 26.3 [22.0] (4.8) nW  |                                                                                  |
|                                | path 3                              | < 1.34 [1.06] (0.23) μW |                                                                                  |
|                                | after external zeroing <sup>5</sup> |                         |                                                                                  |
|                                | path 1                              | < 58 [49] (28) pW       |                                                                                  |
|                                | path 2                              | < 5.5 [4.6] (2.7) nW    |                                                                                  |
|                                | path 3                              | < 280 [220] (130) nW    |                                                                                  |
| Zero drift <sup>6</sup>        | path 1                              | < 14 [12] (2) pW        |                                                                                  |
|                                | path 2                              | < 1.3 [1.1] (0.2) nW    |                                                                                  |
|                                | path 3                              | < 67 [53] (9) nW        |                                                                                  |
| Measurement noise <sup>7</sup> | path 1                              | < 41 [35] (20) pW       |                                                                                  |
|                                | path 2                              | < 3.9 [3.3] (1.9) nW    |                                                                                  |
|                                | path 3                              | < 196 [155] (90) nW     |                                                                                  |

### Uncertainty for absolute power measurements <sup>8</sup> in dB

| 50 MHz to < 200 MHz  |       |       | 200 MHz to 8 GHz     |       |       | 0 °C to +50 °C<br>+15 °C to +35 °C<br>+20 °C to +25 °C |     |
|----------------------|-------|-------|----------------------|-------|-------|--------------------------------------------------------|-----|
| 0.241                | 0.196 | 0.193 | 0.162                | 0.172 | 0.171 |                                                        |     |
| 0.113                | 0.098 | 0.099 | 0.095                | 0.094 | 0.097 |                                                        |     |
| 0.077                | 0.073 | 0.077 | 0.081                | 0.074 | 0.078 |                                                        |     |
| -70                  | -20   | 0     | +20                  | -70   | -20   | 0                                                      | +20 |
| Power level in dBm   |       |       | Power level in dBm   |       |       |                                                        |     |
| > 8 GHz to 12.4 GHz  |       |       | > 12.4 GHz to 18 GHz |       |       | 0 °C to +50 °C<br>+15 °C to +35 °C<br>+20 °C to +25 °C |     |
| 0.152                | 0.157 | 0.157 | 0.165                | 0.167 | 0.168 |                                                        |     |
| 0.103                | 0.098 | 0.101 | 0.117                | 0.111 | 0.114 |                                                        |     |
| 0.090                | 0.081 | 0.086 | 0.104                | 0.095 | 0.100 |                                                        |     |
| -70                  | -20   | 0     | +20                  | -70   | -20   | 0                                                      | +20 |
| Power level in dBm   |       |       | Power level in dBm   |       |       |                                                        |     |
| > 18 GHz to 26.5 GHz |       |       | > 26.5 GHz to 33 GHz |       |       | 0 °C to +50 °C<br>+15 °C to +35 °C<br>+20 °C to +25 °C |     |
| 0.176                | 0.176 | 0.180 | 0.196                | 0.196 | 0.203 |                                                        |     |
| 0.122                | 0.114 | 0.120 | 0.139                | 0.131 | 0.140 |                                                        |     |
| 0.107                | 0.095 | 0.103 | 0.123                | 0.111 | 0.122 |                                                        |     |
| -70                  | -20   | 0     | +20                  | -70   | -20   | 0                                                      | +20 |
| Power level in dBm   |       |       | Power level in dBm   |       |       |                                                        |     |
| > 33 GHz to 40 GHz   |       |       | > 40 GHz to 50 GHz   |       |       | 0 °C to +50 °C<br>+15 °C to +35 °C<br>+20 °C to +25 °C |     |
| 0.216                | 0.217 | 0.229 | 0.257                | 0.260 | 0.279 |                                                        |     |
| 0.152                | 0.145 | 0.159 | 0.188                | 0.184 | 0.205 |                                                        |     |
| 0.134                | 0.122 | 0.138 | 0.169                | 0.160 | 0.183 |                                                        |     |
| -70                  | -20   | 0     | +20                  | -70   | -20   | 0                                                      | +20 |
| Power level in dBm   |       |       | Power level in dBm   |       |       |                                                        |     |
| > 50 GHz to 67 GHz   |       |       |                      |       |       | 0 °C to +50 °C<br>+15 °C to +35 °C<br>+20 °C to +25 °C |     |
| 0.318                | 0.327 | 0.357 |                      |       |       |                                                        |     |
| 0.242                | 0.243 | 0.278 |                      |       |       |                                                        |     |
| 0.221                | 0.217 | 0.255 |                      |       |       |                                                        |     |

Uncertainty for relative power measurements <sup>9</sup> in dB

| 50 MHz to < 200 MHz |       |       |       |   |    |     |
|---------------------|-------|-------|-------|---|----|-----|
| +20                 | 0.285 | 0.252 | 0.046 |   |    |     |
|                     | 0.127 | 0.117 | 0.045 |   |    |     |
| +6                  | 0.081 | 0.077 | 0.045 |   |    |     |
| 0                   | 0.277 | 0.040 | 0.252 |   |    |     |
|                     | 0.121 | 0.038 | 0.117 |   |    |     |
| -14                 | 0.073 | 0.038 | 0.077 |   |    |     |
| -20                 | 0.028 | 0.277 | 0.285 |   |    |     |
|                     | 0.028 | 0.121 | 0.127 |   |    |     |
| -70                 | 0.028 | 0.073 | 0.081 |   |    |     |
|                     | -70   | -20   | -14   | 0 | +6 | +20 |
| Power level in dBm  |       |       |       |   |    |     |

| 200 MHz to < 8 GHz |       |       |       |   |    |                  |
|--------------------|-------|-------|-------|---|----|------------------|
| +20                | 0.214 | 0.221 | 0.047 |   |    | 0 °C to +50 °C   |
|                    | 0.109 | 0.109 | 0.047 |   |    | +15 °C to +35 °C |
| +6                 | 0.083 | 0.077 | 0.047 |   |    | +20 °C to +25 °C |
| 0                  | 0.206 | 0.040 | 0.221 |   |    | 0 °C to +50 °C   |
|                    | 0.102 | 0.038 | 0.109 |   |    | +15 °C to +35 °C |
| -14                | 0.076 | 0.038 | 0.077 |   |    | +20 °C to +25 °C |
| -20                | 0.029 | 0.206 | 0.214 |   |    | 0 °C to +50 °C   |
|                    | 0.029 | 0.102 | 0.109 |   |    | +15 °C to +35 °C |
| -70                | 0.029 | 0.076 | 0.083 |   |    | +20 °C to +25 °C |
|                    | -70   | -20   | -14   | 0 | +6 | +20              |
| Power level in dBm |       |       |       |   |    |                  |

| > 8 GHz to 12.4 GHz |       |       |       |   |    |     |
|---------------------|-------|-------|-------|---|----|-----|
| +20                 | 0.195 | 0.199 | 0.050 |   |    |     |
|                     | 0.111 | 0.108 | 0.049 |   |    |     |
| +6                  | 0.086 | 0.080 | 0.049 |   |    |     |
| 0                   | 0.187 | 0.041 | 0.199 |   |    |     |
|                     | 0.104 | 0.039 | 0.108 |   |    |     |
| -14                 | 0.079 | 0.039 | 0.080 |   |    |     |
| -20                 | 0.029 | 0.187 | 0.195 |   |    |     |
|                     | 0.029 | 0.104 | 0.111 |   |    |     |
| -70                 | 0.029 | 0.079 | 0.086 |   |    |     |
|                     | -70   | -20   | -14   | 0 | +6 | +20 |
| Power level in dBm  |       |       |       |   |    |     |

| > 12.4 GHz to 18 GHz |       |       |       |   |    |                  |
|----------------------|-------|-------|-------|---|----|------------------|
| +20                  | 0.203 | 0.205 | 0.054 |   |    | 0 °C to +50 °C   |
|                      | 0.117 | 0.113 | 0.054 |   |    | +15 °C to +35 °C |
| +6                   | 0.092 | 0.085 | 0.054 |   |    | +20 °C to +25 °C |
| 0                    | 0.194 | 0.043 | 0.205 |   |    | 0 °C to +50 °C   |
|                      | 0.109 | 0.041 | 0.113 |   |    | +15 °C to +35 °C |
| -14                  | 0.083 | 0.041 | 0.085 |   |    | +20 °C to +25 °C |
| -20                  | 0.030 | 0.194 | 0.203 |   |    | 0 °C to +50 °C   |
|                      | 0.030 | 0.109 | 0.117 |   |    | +15 °C to +35 °C |
| -70                  | 0.030 | 0.083 | 0.092 |   |    | +20 °C to +25 °C |
|                      | -70   | -20   | -14   | 0 | +6 | +20              |
| Power level in dBm   |       |       |       |   |    |                  |

| > 18 GHz to 26.5 GHz |       |       |       |   |    |     |
|----------------------|-------|-------|-------|---|----|-----|
| +20                  | 0.226 | 0.227 | 0.064 |   |    |     |
|                      | 0.134 | 0.130 | 0.064 |   |    |     |
| +6                   | 0.106 | 0.099 | 0.064 |   |    |     |
| 0                    | 0.214 | 0.048 | 0.227 |   |    |     |
|                      | 0.122 | 0.046 | 0.130 |   |    |     |
| -14                  | 0.092 | 0.046 | 0.099 |   |    |     |
| -20                  | 0.032 | 0.214 | 0.226 |   |    |     |
|                      | 0.032 | 0.122 | 0.134 |   |    |     |
| -70                  | 0.032 | 0.092 | 0.106 |   |    |     |
|                      | -70   | -20   | -14   | 0 | +6 | +20 |
| Power level in dBm   |       |       |       |   |    |     |

| > 26.5 GHz to 33 GHz |       |       |       |   |    |                  |
|----------------------|-------|-------|-------|---|----|------------------|
| +20                  | 0.252 | 0.254 | 0.074 |   |    | 0 °C to +50 °C   |
|                      | 0.153 | 0.151 | 0.074 |   |    | +15 °C to +35 °C |
| +6                   | 0.122 | 0.117 | 0.074 |   |    | +20 °C to +25 °C |
| 0                    | 0.236 | 0.054 | 0.254 |   |    | 0 °C to +50 °C   |
|                      | 0.135 | 0.052 | 0.151 |   |    | +15 °C to +35 °C |
| -14                  | 0.101 | 0.051 | 0.117 |   |    | +20 °C to +25 °C |
| -20                  | 0.034 | 0.236 | 0.252 |   |    | 0 °C to +50 °C   |
|                      | 0.034 | 0.135 | 0.153 |   |    | +15 °C to +35 °C |
| -70                  | 0.034 | 0.101 | 0.122 |   |    | +20 °C to +25 °C |
|                      | -70   | -20   | -14   | 0 | +6 | +20              |
| Power level in dBm   |       |       |       |   |    |                  |

**> 33 GHz to 40 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +20 | 0.285 | 0.289 | 0.088 |
|     | 0.176 | 0.179 | 0.087 |
| +6  | 0.141 | 0.142 | 0.087 |
| 0   | 0.263 | 0.062 | 0.289 |
|     | 0.151 | 0.060 | 0.179 |
| -14 | 0.111 | 0.059 | 0.142 |
| -20 | 0.036 | 0.263 | 0.285 |
|     | 0.036 | 0.151 | 0.176 |
| -70 | 0.036 | 0.111 | 0.141 |

Power level in dBm

**> 40 GHz to 50 GHz**

|     |       |       |       |                  |
|-----|-------|-------|-------|------------------|
| +20 | 0.336 | 0.344 | 0.110 | 0 °C to +50 °C   |
|     | 0.214 | 0.224 | 0.110 | +15 °C to +35 °C |
| +6  | 0.174 | 0.184 | 0.109 | +20 °C to +25 °C |
| 0   | 0.304 | 0.077 | 0.344 | 0 °C to +50 °C   |
|     | 0.174 | 0.074 | 0.224 | +15 °C to +35 °C |
| -14 | 0.126 | 0.073 | 0.184 | +20 °C to +25 °C |
| -20 | 0.040 | 0.304 | 0.336 | 0 °C to +50 °C   |
|     | 0.040 | 0.174 | 0.214 | +15 °C to +35 °C |
| -70 | 0.040 | 0.126 | 0.174 | +20 °C to +25 °C |

Power level in dBm

**> 50 GHz to 67 GHz**

|     |       |       |       |                  |
|-----|-------|-------|-------|------------------|
| +20 | 0.419 | 0.436 | 0.152 | 0 °C to +50 °C   |
|     | 0.280 | 0.307 | 0.151 | +15 °C to +35 °C |
| +6  | 0.233 | 0.266 | 0.151 | +20 °C to +25 °C |
| 0   | 0.365 | 0.109 | 0.436 | 0 °C to +50 °C   |
|     | 0.210 | 0.105 | 0.307 | +15 °C to +35 °C |
| -14 | 0.150 | 0.103 | 0.266 | +20 °C to +25 °C |
| -20 | 0.047 | 0.365 | 0.419 | 0 °C to +50 °C   |
|     | 0.047 | 0.210 | 0.280 | +15 °C to +35 °C |
| -70 | 0.047 | 0.150 | 0.233 | +20 °C to +25 °C |

## R&S®NRP18S-10 high-power three-path diode power sensor

Specifications apply when the power sensor is operated together with the RF power attenuator supplied. Please refer to the specifications of the R&S®NRP18S when operating the power sensor section alone.

|                                       |                                            |                                                                           |
|---------------------------------------|--------------------------------------------|---------------------------------------------------------------------------|
| <b>Frequency range</b>                |                                            | 10 MHz to 18 GHz                                                          |
| <b>Impedance matching (SWR)</b>       | 10 MHz to 2.4 GHz                          | < 1.14                                                                    |
|                                       | > 2.4 GHz to 8.0 GHz                       | < 1.20                                                                    |
|                                       | > 8.0 GHz to 12.4 GHz                      | < 1.25                                                                    |
|                                       | > 12.4 GHz to 18.0 GHz                     | < 1.30                                                                    |
| <b>Power measurement range</b>        | continuous average                         | 1 nW to 2 W (–60 dBm to +33 dBm)                                          |
|                                       | burst average                              | 3 µW to 2 W (–25 dBm to +33 dBm)                                          |
|                                       | timeslot/gate average                      | 3 nW to 2 W (–55 dBm to +33 dBm) <sup>1</sup>                             |
|                                       | trace                                      | 20 nW to 2 W (–47 dBm to +33 dBm) <sup>2</sup>                            |
| <b>Maximum power</b>                  | average power                              | 3 W (+35 dBm) AVG                                                         |
|                                       | peak envelope power                        | 20 W (+43 dBm) for max. 10 µs                                             |
| <b>Measurement subranges</b>          | path 1                                     | –60 dBm to –5 dBm                                                         |
|                                       | path 2                                     | –43 dBm to +15 dBm                                                        |
|                                       | path 3                                     | –23 dBm to +33 dBm                                                        |
| <b>Transition regions</b>             | with automatic path selection <sup>3</sup> | (–10 ± 1.5) dBm to (–4 ± 1.5) dBm<br>(10 ± 1.5) dBm to (+16 ± 1.5) dBm    |
| <b>Dynamic response</b>               | video bandwidth                            | > 100 kHz (150 kHz)                                                       |
|                                       | rise time 10 %/90 %                        | < 5 µs (3 µs)                                                             |
| <b>Acquisition</b>                    | sample rate (continuous)                   | 2 Msps                                                                    |
|                                       | accuracy of time base                      | ±5 ppm                                                                    |
| <b>Triggering</b>                     | internal                                   |                                                                           |
|                                       | threshold level range                      | –27 dBm to +33 dBm                                                        |
|                                       | threshold level accuracy                   | identical to uncertainty for absolute power measurements                  |
|                                       | threshold level hysteresis                 | 0 dB to 10 dB                                                             |
|                                       | dropout <sup>4</sup>                       | 0 s to 10 s                                                               |
|                                       | external                                   | EXTErnal[1]: R&S®NRX/NRP2 or R&S®NRP-Z5<br>EXTErnal2: coaxial trigger I/O |
|                                       | slope (external, internal)                 | pos./neg.                                                                 |
|                                       | delay                                      | –5 s to +10 s                                                             |
|                                       | hold-off                                   | 0 s to 10 s                                                               |
|                                       | resolution (delay, hold-off, dropout)      | 0.5 µs (sample period)                                                    |
|                                       | source                                     | INTernal, EXTErnal[1], EXTErnal2, IMMEDIATE, BUS, HOLD                    |
| <b>Zero offset</b>                    | initial, without zeroing                   |                                                                           |
|                                       | path 1                                     | < 2.9 (0.6) nW                                                            |
|                                       | path 2                                     | < 120 (25) nW                                                             |
|                                       | path 3                                     | < 12.3 (2.2) µW                                                           |
|                                       | after external zeroing <sup>5</sup>        |                                                                           |
|                                       | path 1                                     | < 600 (320) pW                                                            |
|                                       | path 2                                     | < 26 (14) nW                                                              |
| <b>Zero drift <sup>6</sup></b>        | path 3                                     | < 2.6 (1.2) µW                                                            |
|                                       | path 1                                     | < 145 (23) pW                                                             |
|                                       | path 2                                     | < 6.0 (1.0) nW                                                            |
| <b>Measurement noise <sup>7</sup></b> | path 3                                     | < 615 (90) nW                                                             |
|                                       | path 1                                     | < 425 (230) pW                                                            |
|                                       | path 2                                     | < 18 (10) nW                                                              |
|                                       | path 3                                     | < 1.8 (0.9) µW                                                            |

( ): typical at 1 GHz  
+15 °C to +35 °C

**Uncertainty for absolute power measurements <sup>8</sup> in dB****10 MHz to < 100 MHz**

|       |       |       |       |
|-------|-------|-------|-------|
| 0.238 | 0.218 | 0.244 | 0.268 |
| 0.117 | 0.140 | 0.179 | 0.210 |
| 0.083 | 0.120 | 0.163 | 0.198 |

-60      +20      +30      +32      +33  
Power level in dBm

**100 MHz to 2.4 GHz**

|       |       |       |       |
|-------|-------|-------|-------|
| 0.186 | 0.195 | 0.212 | 0.228 |
| 0.108 | 0.127 | 0.153 | 0.174 |
| 0.085 | 0.109 | 0.138 | 0.162 |

-60      +20      +30      +32      +33  
Power level in dBm

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**> 2.4 GHz to 12.4 GHz**

|       |       |       |       |
|-------|-------|-------|-------|
| 0.193 | 0.205 | 0.221 | 0.237 |
| 0.128 | 0.145 | 0.168 | 0.188 |
| 0.103 | 0.124 | 0.150 | 0.176 |

-60      +20      +30      +32      +33  
Power level in dBm

**> 12.4 GHz to 18 GHz**

|       |       |       |       |
|-------|-------|-------|-------|
| 0.208 | 0.219 | 0.234 | 0.249 |
| 0.147 | 0.162 | 0.183 | 0.201 |
| 0.123 | 0.140 | 0.164 | 0.190 |

-60      +20      +30      +32      +33  
Power level in dBm

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**Uncertainty for relative power measurements <sup>9, 10</sup> in dB****10 MHz to < 100 MHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +30 | 0.356 | 0.316 | 0.028 |
|     | 0.162 | 0.147 | 0.026 |
| +16 | 0.076 | 0.069 | 0.026 |
| +10 | 0.347 | 0.032 | 0.316 |
|     | 0.157 | 0.025 | 0.147 |
| -4  | 0.073 | 0.024 | 0.069 |
| -10 | 0.022 | 0.347 | 0.356 |
|     | 0.022 | 0.157 | 0.162 |
| -60 | 0.022 | 0.073 | 0.076 |

-60      -10      -4      +10      +16      +30  
Power level in dBm

**100 MHz to < 2.4 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +30 | 0.273 | 0.278 | 0.028 |
|     | 0.136 | 0.138 | 0.026 |
| +16 | 0.068 | 0.067 | 0.026 |
| +10 | 0.266 | 0.032 | 0.278 |
|     | 0.133 | 0.025 | 0.138 |
| -4  | 0.066 | 0.024 | 0.067 |
| -10 | 0.022 | 0.266 | 0.273 |
|     | 0.022 | 0.133 | 0.136 |
| -60 | 0.022 | 0.066 | 0.068 |

-60      -10      -4      +10      +16      +30  
Power level in dBm

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**> 2.4 GHz to 12.4 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +30 | 0.269 | 0.274 | 0.030 |
|     | 0.139 | 0.140 | 0.028 |
| +16 | 0.076 | 0.072 | 0.027 |
| +10 | 0.262 | 0.033 | 0.274 |
|     | 0.136 | 0.026 | 0.140 |
| -4  | 0.073 | 0.024 | 0.072 |
| -10 | 0.022 | 0.262 | 0.269 |
|     | 0.022 | 0.136 | 0.139 |
| -60 | 0.022 | 0.073 | 0.076 |

-60      -10      -4      +10      +16      +30

**> 12.4 GHz to 18 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +30 | 0.275 | 0.280 | 0.034 |
|     | 0.148 | 0.150 | 0.033 |
| +16 | 0.087 | 0.085 | 0.033 |
| +10 | 0.266 | 0.035 | 0.280 |
|     | 0.142 | 0.028 | 0.150 |
| -4  | 0.080 | 0.026 | 0.085 |
| -10 | 0.022 | 0.266 | 0.275 |
|     | 0.022 | 0.142 | 0.148 |
| -60 | 0.022 | 0.080 | 0.087 |

-60      -10      -4      +10      +16      +30

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

## R&S®NRP18S-20 high-power three-path diode power sensor

Specifications apply when the power sensor is operated together with the RF power attenuator supplied. Please refer to the specifications of the R&S®NRP18S when operating the power sensor section alone.

|                                       |                                            |                                                                           |
|---------------------------------------|--------------------------------------------|---------------------------------------------------------------------------|
| <b>Frequency range</b>                |                                            | 10 MHz to 18 GHz                                                          |
| <b>Impedance matching (SWR)</b>       | 10 MHz to 2.4 GHz                          | < 1.14                                                                    |
|                                       | > 2.4 GHz to 8.0 GHz                       | < 1.25                                                                    |
|                                       | > 8.0 GHz to 12.4 GHz                      | < 1.30                                                                    |
|                                       | > 12.4 GHz to 18.0 GHz                     | < 1.41                                                                    |
| <b>Power measurement range</b>        | continuous average                         | 10 nW to 15 W (–50 dBm to +42 dBm)                                        |
|                                       | burst average                              | 30 µW to 15 W (–15 dBm to +42 dBm)                                        |
|                                       | timeslot/gate average                      | 30 nW to 15 W (–45 dBm to +42 dBm) <sup>1</sup>                           |
|                                       | trace                                      | 200 nW to 15 W (–37 dBm to +42 dBm) <sup>2</sup>                          |
| <b>Maximum power</b>                  | average power                              | 18 W (+42.5 dBm) AVG                                                      |
|                                       | peak envelope power                        | 100 W (+50 dBm) for max. 10 µs                                            |
| <b>Measurement subranges</b>          | path 1                                     | –50 dBm to +5 dBm                                                         |
|                                       | path 2                                     | –33 dBm to +25 dBm                                                        |
|                                       | path 3                                     | –13 dBm to +42 dBm                                                        |
| <b>Transition regions</b>             | with automatic path selection <sup>3</sup> | (0 ± 1.75) dBm to (+6 ± 1.75) dBm<br>(20 ± 1.75) dBm to (+26 ± 1.75) dBm  |
| <b>Dynamic response</b>               | video bandwidth                            | > 100 kHz (150 kHz)                                                       |
|                                       | rise time 10 %/90 %                        | < 5 µs (3 µs)                                                             |
| <b>Acquisition</b>                    | sample rate (continuous)                   | 2 Msps                                                                    |
|                                       | accuracy of time base                      | ±5 ppm                                                                    |
| <b>Triggering</b>                     | Internal                                   |                                                                           |
|                                       | threshold level range                      | –17 dBm to +42 dBm                                                        |
|                                       | threshold level accuracy                   | identical to uncertainty for absolute power measurements                  |
|                                       | threshold level hysteresis                 | 0 dB to 10 dB                                                             |
|                                       | dropout <sup>4</sup>                       | 0 s to 10 s                                                               |
|                                       | external                                   | EXTErnal[1]: R&S®NRX/NRP2 or R&S®NRP-Z5<br>EXTErnal2: coaxial trigger I/O |
|                                       | slope (external, internal)                 | pos./neg.                                                                 |
|                                       | delay                                      | –5 s to +10 s                                                             |
|                                       | hold-off                                   | 0 s to 10 s                                                               |
|                                       | resolution (delay, hold-off, dropout)      | 0.5 µs (sample period)                                                    |
|                                       | source                                     | INTernal, EXTErnal[1], EXTErnal2, IMMEDIATE, BUS, HOLD                    |
| <b>Zero offset</b>                    | initial, without zeroing                   |                                                                           |
|                                       | path 1                                     | < 30 (6) nW                                                               |
|                                       | path 2                                     | < 1.30 (0.26) µW                                                          |
|                                       | path 3                                     | < 130 (23) µW                                                             |
|                                       | after external zeroing <sup>5</sup>        |                                                                           |
|                                       | path 1                                     | < 6.3 (3.4) nW                                                            |
|                                       | path 2                                     | < 270 (150) nW                                                            |
| <b>Zero drift <sup>6</sup></b>        | path 3                                     | < 27 (13) µW                                                              |
|                                       | path 1                                     | < 1.5 (0.24) nW                                                           |
|                                       | path 2                                     | < 63 (11) nW                                                              |
| <b>Measurement noise <sup>7</sup></b> | path 3                                     | < 6.5 (1.0) µW                                                            |
|                                       | path 1                                     | < 4.5 (2.4) nW                                                            |
|                                       | path 2                                     | < 190 (110) nW                                                            |
|                                       | path 3                                     | < 19 (9) µW                                                               |

( ): typical at 1 GHz  
+15 °C to +35 °C

**Uncertainty for absolute power measurements <sup>8</sup> in dB****10 MHz to < 100 MHz**

|       |       |       |       |
|-------|-------|-------|-------|
| 0.256 | 0.223 | 0.244 | 0.276 |
| 0.124 | 0.123 | 0.157 | 0.204 |
| 0.083 | 0.090 | 0.133 | 0.186 |

-50      +30      +36      +40      +42

Power level in dBm

**100 MHz to 2.4 GHz**

|       |       |       |       |
|-------|-------|-------|-------|
| 0.208 | 0.208 | 0.226 | 0.253 |
| 0.116 | 0.121 | 0.149 | 0.188 |
| 0.085 | 0.093 | 0.127 | 0.172 |

-50      +30      +36      +40      +42

Power level in dBm

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**> 2.4 GHz to 12.4 GHz**

|       |       |       |       |
|-------|-------|-------|-------|
| 0.218 | 0.221 | 0.237 | 0.264 |
| 0.140 | 0.145 | 0.169 | 0.204 |
| 0.107 | 0.113 | 0.143 | 0.183 |

-50      +30      +36      +40      +42

Power level in dBm

**> 12.4 GHz to 18 GHz**

|       |       |       |       |
|-------|-------|-------|-------|
| 0.236 | 0.239 | 0.254 | 0.279 |
| 0.165 | 0.169 | 0.189 | 0.222 |
| 0.130 | 0.135 | 0.160 | 0.198 |

-50      +30      +36      +40      +42

Power level in dBm

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**Uncertainty for relative power measurements <sup>9, 10</sup> in dB****10 MHz to < 100 MHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +40 | 0.356 | 0.316 | 0.028 |
|     | 0.162 | 0.147 | 0.026 |
| +26 | 0.076 | 0.069 | 0.026 |
| +20 | 0.347 | 0.032 | 0.316 |
|     | 0.157 | 0.025 | 0.147 |
| +6  | 0.073 | 0.024 | 0.069 |
| 0   | 0.022 | 0.347 | 0.356 |
|     | 0.022 | 0.157 | 0.162 |
| -50 | 0.022 | 0.073 | 0.076 |

-50      0      +6      +20      +26      +40

Power level in dBm

**100 MHz to < 2.4 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +40 | 0.273 | 0.278 | 0.028 |
|     | 0.136 | 0.138 | 0.026 |
| +26 | 0.068 | 0.067 | 0.026 |
| +20 | 0.266 | 0.032 | 0.278 |
|     | 0.133 | 0.025 | 0.138 |
| +6  | 0.066 | 0.024 | 0.067 |
| 0   | 0.022 | 0.266 | 0.273 |
|     | 0.022 | 0.133 | 0.136 |
| -50 | 0.022 | 0.066 | 0.068 |

-50      0      +6      +20      +26      +40

Power level in dBm

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**> 2.4 GHz to 12.4 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +40 | 0.269 | 0.274 | 0.030 |
|     | 0.139 | 0.140 | 0.028 |
| +26 | 0.076 | 0.072 | 0.027 |
| +20 | 0.262 | 0.033 | 0.274 |
|     | 0.136 | 0.026 | 0.140 |
| +6  | 0.073 | 0.024 | 0.072 |
| 0   | 0.022 | 0.262 | 0.269 |
|     | 0.022 | 0.136 | 0.139 |
| -50 | 0.022 | 0.073 | 0.076 |

-50      0      +6      +20      +26      +40

**> 12.4 GHz to 18 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +40 | 0.275 | 0.280 | 0.034 |
|     | 0.148 | 0.150 | 0.033 |
| +26 | 0.087 | 0.085 | 0.033 |
| +20 | 0.266 | 0.035 | 0.280 |
|     | 0.142 | 0.028 | 0.150 |
| +6  | 0.080 | 0.026 | 0.085 |
| 0   | 0.022 | 0.266 | 0.275 |
|     | 0.022 | 0.142 | 0.148 |
| -50 | 0.022 | 0.080 | 0.087 |

-50      0      +6      +20      +26      +40

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

## R&S®NRP18S-25 high-power three-path diode power sensor

Specifications apply when the power sensor is operated together with the RF power attenuator supplied. Please refer to the specifications of the R&S®NRP18S when operating the power sensor section alone.

|                                       |                                            |                                                                           |
|---------------------------------------|--------------------------------------------|---------------------------------------------------------------------------|
| <b>Frequency range</b>                |                                            | 10 MHz to 18 GHz                                                          |
| <b>Impedance matching (SWR)</b>       | 10 MHz to 2.4 GHz                          | < 1.14                                                                    |
|                                       | > 2.4 GHz to 8.0 GHz                       | < 1.25                                                                    |
|                                       | > 8.0 GHz to 12.4 GHz                      | < 1.30                                                                    |
|                                       | > 12.4 GHz to 18.0 GHz                     | < 1.41                                                                    |
| <b>Power measurement range</b>        | continuous average                         | 30 nW to 30 W (–45 dBm to +45 dBm)                                        |
|                                       | burst average                              | 100 µW to 30 W (–10 dBm to +45 dBm)                                       |
|                                       | timeslot/gate average                      | 100 nW to 30 W (–40 dBm to +45 dBm) <sup>1</sup>                          |
|                                       | trace                                      | 600 nW to 30 W (–32 dBm to +45 dBm) <sup>2</sup>                          |
| <b>Maximum power</b>                  | average power                              | 36 W (+45.5 dBm) AVG                                                      |
|                                       | peak envelope power                        | 300 W (+55 dBm) for max. 10 µs                                            |
| <b>Measurement subranges</b>          | path 1                                     | –45 dBm to +10 dBm                                                        |
|                                       | path 2                                     | –28 dBm to +30 dBm                                                        |
|                                       | path 3                                     | –8 dBm to +45 dBm                                                         |
| <b>Transition regions</b>             | with automatic path selection <sup>3</sup> | (+5 ± 2) dBm to (+11 ± 2) dBm<br>(25 ± 2) dBm to (+31 ± 2) dBm            |
| <b>Dynamic response</b>               | video bandwidth                            | > 100 kHz (150 kHz)                                                       |
|                                       | rise time 10 %/90 %                        | < 5 µs (3 µs)                                                             |
| <b>Acquisition</b>                    | sample rate (continuous)                   | 2 Msps                                                                    |
|                                       | accuracy of time base                      | ±5 ppm                                                                    |
| <b>Triggering</b>                     | Internal                                   |                                                                           |
|                                       | threshold level range                      | –12 dBm to +45 dBm                                                        |
|                                       | threshold level accuracy                   | identical to uncertainty for absolute power measurements                  |
|                                       | threshold level hysteresis                 | 0 dB to 10 dB                                                             |
|                                       | dropout <sup>4</sup>                       | 0 s to 10 s                                                               |
|                                       | external                                   | EXTErnal[1]: R&S®NRX/NRP2 or R&S®NRP-Z5<br>EXTErnal2: coaxial trigger I/O |
|                                       | slope (external, internal)                 | pos./neg.                                                                 |
|                                       | delay                                      | –5 s to +10 s                                                             |
|                                       | hold-off                                   | 0 s to 10 s                                                               |
|                                       | resolution (delay, hold-off, dropout)      | 0.5 µs (sample period)                                                    |
|                                       | source                                     | INTernal, EXTErnal[1], EXTErnal2, IMMEDIATE, BUS, HOLD                    |
| <b>Zero offset</b>                    | initial, without zeroing                   |                                                                           |
|                                       | path 1                                     | < 100 (20) nW                                                             |
|                                       | path 2                                     | < 4.2 (0.9) µW                                                            |
|                                       | path 3                                     | < 430 (80) µW                                                             |
|                                       | after external zeroing <sup>5</sup>        |                                                                           |
|                                       | path 1                                     | < 21 (12) nW                                                              |
|                                       | path 2                                     | < 880 (500) nW                                                            |
|                                       | path 3                                     | < 90 (44) µW                                                              |
| <b>Zero drift <sup>6</sup></b>        | path 1                                     | < 5.1 (0.8) nW                                                            |
|                                       | path 2                                     | < 210 (35) nW                                                             |
|                                       | path 3                                     | < 22 (3) µW                                                               |
| <b>Measurement noise <sup>7</sup></b> | path 1                                     | < 15 (8) nW                                                               |
|                                       | path 2                                     | < 620 (350) nW                                                            |
|                                       | path 3                                     | < 64 (31) µW                                                              |

( ): typical at 1 GHz  
+15 °C to +35 °C

**Uncertainty for absolute power measurements <sup>8</sup> in dB****10 MHz to < 100 MHz**

|       |       |       |       |
|-------|-------|-------|-------|
| 0.268 | 0.242 | 0.264 | 0.303 |
| 0.129 | 0.135 | 0.171 | 0.227 |
| 0.083 | 0.101 | 0.146 | 0.209 |

-45      +35      +40      +43      +45

Power level in dBm

**100 MHz to 2.4 GHz**

|       |       |       |       |
|-------|-------|-------|-------|
| 0.224 | 0.227 | 0.247 | 0.282 |
| 0.122 | 0.133 | 0.165 | 0.214 |
| 0.087 | 0.102 | 0.141 | 0.196 |

-45      +35      +40      +43      +45

Power level in dBm

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**> 2.4 GHz to 12.4 GHz**

|       |       |       |       |
|-------|-------|-------|-------|
| 0.233 | 0.239 | 0.258 | 0.292 |
| 0.145 | 0.155 | 0.183 | 0.228 |
| 0.108 | 0.121 | 0.155 | 0.207 |

-45      +35      +40      +43      +45

Power level in dBm

**> 12.4 GHz to 18 GHz**

|       |       |       |       |
|-------|-------|-------|-------|
| 0.250 | 0.255 | 0.273 | 0.305 |
| 0.169 | 0.177 | 0.202 | 0.244 |
| 0.131 | 0.141 | 0.171 | 0.219 |

-45      +35      +40      +43      +45

Power level in dBm

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**Uncertainty for relative power measurements <sup>9, 10</sup> in dB****10 MHz to < 100 MHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +43 | 0.356 | 0.316 | 0.028 |
|     | 0.162 | 0.147 | 0.026 |
| +31 | 0.076 | 0.069 | 0.026 |
| +25 | 0.347 | 0.032 | 0.316 |
|     | 0.157 | 0.025 | 0.147 |
| +11 | 0.073 | 0.024 | 0.069 |
| +5  | 0.022 | 0.347 | 0.356 |
|     | 0.022 | 0.157 | 0.162 |
| -45 | 0.022 | 0.073 | 0.076 |

-45      +5      +11      +25      +31      +43

Power level in dBm

**100 MHz to < 2.4 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +43 | 0.273 | 0.278 | 0.028 |
|     | 0.136 | 0.138 | 0.026 |
| +31 | 0.068 | 0.067 | 0.026 |
| +25 | 0.266 | 0.032 | 0.278 |
|     | 0.133 | 0.025 | 0.138 |
| +11 | 0.066 | 0.024 | 0.067 |
| +5  | 0.022 | 0.266 | 0.273 |
|     | 0.022 | 0.133 | 0.136 |
| -45 | 0.022 | 0.066 | 0.068 |

-45      +5      +11      +25      +31      +43

Power level in dBm

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**> 2.4 GHz to 12.4 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +43 | 0.269 | 0.274 | 0.030 |
|     | 0.139 | 0.140 | 0.028 |
| +31 | 0.076 | 0.072 | 0.027 |
| +25 | 0.262 | 0.033 | 0.274 |
|     | 0.136 | 0.026 | 0.140 |
| +11 | 0.073 | 0.024 | 0.072 |
| +5  | 0.022 | 0.262 | 0.269 |
|     | 0.022 | 0.136 | 0.139 |
| -45 | 0.022 | 0.073 | 0.076 |

-45      +5      +11      +25      +31      +43

**> 12.4 GHz to 18 GHz**

|     |       |       |       |
|-----|-------|-------|-------|
| +43 | 0.275 | 0.280 | 0.034 |
|     | 0.148 | 0.150 | 0.033 |
| +31 | 0.087 | 0.085 | 0.033 |
| +25 | 0.266 | 0.035 | 0.280 |
|     | 0.142 | 0.028 | 0.150 |
| +11 | 0.080 | 0.026 | 0.085 |
| +5  | 0.022 | 0.266 | 0.275 |
|     | 0.022 | 0.142 | 0.148 |
| -45 | 0.022 | 0.080 | 0.087 |

-45      +5      +11      +25      +31      +43

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

## Additional characteristics of the R&S®NRPxxS(N)/18S-10/18S-20/18S-25 three-path diode power sensors and the R&S®NRP33SN-V/67SN-V TVAC-compliant three-path diode power sensors

|                                |                                                      |                                                                               |
|--------------------------------|------------------------------------------------------|-------------------------------------------------------------------------------|
| Sensor type                    | R&S®NRPxxS(N)                                        | three-path diode power sensor                                                 |
|                                | R&S®NRP18S-10/-20/-25                                | three-path diode power sensor with preceding RF power attenuator              |
|                                | R&S®NRP33SN-V<br>R&S®NRP67SN-V                       | three-path diode power sensor for use in thermal vacuum                       |
| Measurand                      |                                                      | power of incident wave                                                        |
|                                |                                                      | power of source (DUT) into 50 $\Omega$ <sup>11</sup>                          |
| RF connector                   | R&S®NRP8S(N)/NRP18S(N)<br>R&S®NRP18S-10/-20/-25      | N (male)                                                                      |
|                                | R&S®NRP33S(N)<br>R&S®NRP33SN-V                       | 3.5 mm (male)                                                                 |
|                                | R&S®NRP40S(N)                                        | 2.92 mm (male)                                                                |
|                                | R&S®NRP50S(N)                                        | 2.4 mm (male)                                                                 |
|                                | R&S®NRP67S(N)<br>R&S®NRP67SN-V                       | 1.85 mm (male)                                                                |
| RF attenuation <sup>12</sup>   | R&S®NRPxxS(N)<br>R&S®NRP33SN-V<br>R&S®NRP67SN-V      | not applicable                                                                |
|                                | R&S®NRP18S-10                                        | 10 dB                                                                         |
|                                | R&S®NRP18S-20                                        | 20 dB                                                                         |
|                                | R&S®NRP18S-25                                        | 25 dB                                                                         |
|                                |                                                      |                                                                               |
| Measurement functions          | stationary and recurring waveforms                   | continuous average                                                            |
|                                |                                                      | burst average                                                                 |
|                                |                                                      | timeslot/gate average                                                         |
|                                |                                                      | trace                                                                         |
|                                | single events                                        | burst average                                                                 |
|                                |                                                      | timeslot/gate average                                                         |
| Continuous average function    | measurand                                            | mean power over recurring acquisition interval                                |
|                                | aperture                                             | 10 $\mu$ s to 2.0 s (20 ms default)                                           |
|                                | window function                                      | uniform or von Hann <sup>13</sup>                                             |
|                                | duty cycle correction <sup>14</sup>                  | 0.001 % to 100.0 %                                                            |
|                                | capacity of measurement buffer <sup>15</sup>         | 1 to 8192 results                                                             |
|                                |                                                      |                                                                               |
| Burst average function         | measurand                                            | mean power over burst portion of recurring signal (trigger settings required) |
|                                | detectable burst width <sup>16</sup>                 | 5 $\mu$ s to 8 s                                                              |
|                                | minimum gap between bursts                           | 5 $\mu$ s                                                                     |
|                                | dropout period <sup>17</sup> for burst end detection | 1 $\mu$ s to 300 ms                                                           |
|                                | exclusion periods <sup>18</sup>                      |                                                                               |
|                                | start                                                | 0 s to 1 s                                                                    |
|                                | end                                                  | 0 s to 1 s                                                                    |
|                                | resolution (dropout and exclusion periods)           | 0.5 $\mu$ s (sample period)                                                   |
|                                |                                                      |                                                                               |
| Timeslot/gate average function | measurand                                            | mean power over individual timeslots/gates                                    |
|                                | number of timeslots/gates                            | 1 to 32 (consecutive)                                                         |
|                                | nominal length                                       | 10 $\mu$ s to 0.1 s                                                           |
|                                | start of first timeslot/gate                         | at delayed trigger event                                                      |
|                                | exclusion periods                                    |                                                                               |
|                                | start                                                | 0 s to 1 s                                                                    |
|                                | end                                                  | 0 s to 1 s                                                                    |
|                                | resolution (nominal length and exclusion periods)    | 0.5 $\mu$ s (sample period)                                                   |
|                                |                                                      |                                                                               |
| Trace function                 | measurand                                            | mean, random, maximum and minimum power over pixel length                     |
|                                | acquisition                                          |                                                                               |
|                                | length                                               | 10 $\mu$ s to 3.0 s                                                           |
|                                | start (referenced to delayed trigger)                | -3.0 s to 3.0 s                                                               |
|                                | result                                               |                                                                               |
|                                | pixel                                                | 1 to 100 000                                                                  |
|                                | resolution                                           | $\geq$ 0.5 $\mu$ s (sample period)                                            |

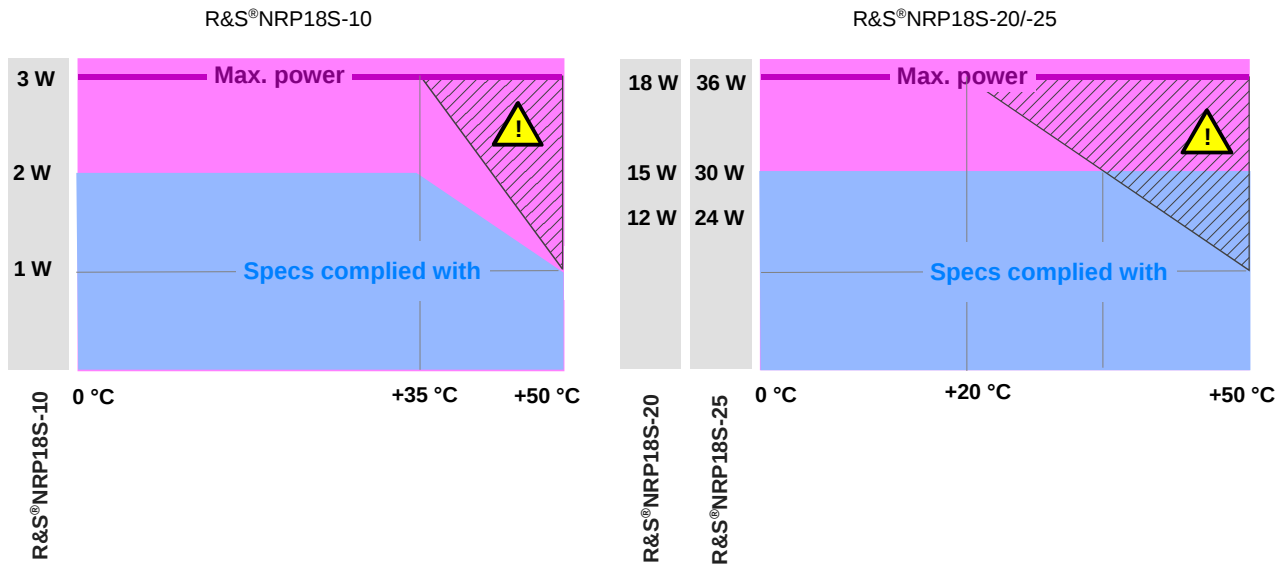
|                                                                            |                                                        |                                                           |                                                                                                                                                      |                       |
|----------------------------------------------------------------------------|--------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Averaging filter                                                           | modes                                                  |                                                           | auto off (fixed averaging number)                                                                                                                    |                       |
|                                                                            |                                                        |                                                           | auto on (continuously auto-adapted)                                                                                                                  |                       |
|                                                                            |                                                        |                                                           | auto once (automatically fixed once)                                                                                                                 |                       |
|                                                                            | auto off                                               |                                                           |                                                                                                                                                      |                       |
|                                                                            | supported measurement functions                        |                                                           | all                                                                                                                                                  |                       |
|                                                                            | averaging number                                       |                                                           | 1, 2, 4, 6, 8, 10 to 65536 (1 or all even numbers between 2 and 65536)                                                                               |                       |
|                                                                            | auto on/once                                           |                                                           |                                                                                                                                                      |                       |
|                                                                            | supported measurement functions                        |                                                           | continuous average, burst average, timeslot/gate average                                                                                             |                       |
|                                                                            | normal operating mode                                  |                                                           | averaging number adapted to resolution setting and power to be measured                                                                              |                       |
|                                                                            | fixed noise operating mode                             |                                                           | averaging number adapted to specified noise content                                                                                                  |                       |
|                                                                            | result output                                          |                                                           |                                                                                                                                                      |                       |
| moving mode                                                                |                                                        | continuous result output, independent of averaging number |                                                                                                                                                      |                       |
| repeat mode                                                                |                                                        | only final result                                         |                                                                                                                                                      |                       |
| Attenuation correction                                                     | function                                               |                                                           | corrects the measurement result by means of a fixed factor (dB offset)                                                                               |                       |
|                                                                            | range                                                  |                                                           | −200.000 dB to +200.000 dB                                                                                                                           |                       |
| Embedding <sup>19</sup>                                                    | function                                               |                                                           | incorporates a two-port device at the sensor input so that the measurement plane is shifted to the input of this device                              |                       |
|                                                                            | parameters                                             |                                                           | S <sub>11</sub> , S <sub>21</sub> , S <sub>12</sub> and S <sub>22</sub> of device                                                                    |                       |
|                                                                            | number of devices                                      |                                                           | 0 to 999                                                                                                                                             |                       |
|                                                                            | total number of frequencies                            |                                                           | ≤ 80000                                                                                                                                              |                       |
| Gamma correction                                                           | function                                               |                                                           | removes the influence of impedance mismatch from the measurement result so that the measurand corresponds to the power of the source (DUT) into 50 Ω |                       |
|                                                                            | parameters                                             |                                                           | magnitude and phase of reflection coefficient of source (DUT)                                                                                        |                       |
| Frequency response correction                                              | function                                               |                                                           | takes the frequency response of the sensor section and of the RF power attenuator into account (if applicable)                                       |                       |
|                                                                            | parameter                                              |                                                           | center frequency of test signal                                                                                                                      |                       |
|                                                                            | residual uncertainty                                   |                                                           | see specification of calibration uncertainty and uncertainty for absolute and relative power measurements                                            |                       |
| Measurement times <sup>20</sup><br>Av: averaging number                    | continuous average                                     |                                                           |                                                                                                                                                      |                       |
|                                                                            | single measurements                                    |                                                           | 2 × (aperture + 100 μs) × Av + t <sub>z</sub>                                                                                                        |                       |
|                                                                            | buffered measurements                                  |                                                           | 2 × (aperture + 116 μs) × buffer size + t <sub>z</sub>                                                                                               |                       |
|                                                                            | without averaging                                      |                                                           | t <sub>z</sub> = 2 ms (typ.)                                                                                                                         |                       |
| Zeroing (duration)                                                         |                                                        |                                                           | 5.3 s                                                                                                                                                |                       |
| Measurement error due to modulation <sup>21</sup>                          | general                                                |                                                           | depends on CCDF and RF bandwidth of test signal                                                                                                      |                       |
|                                                                            | WCDMA (3GPP test model 1 to 64)                        |                                                           |                                                                                                                                                      |                       |
|                                                                            | worst case                                             |                                                           | −0.02 dB to +0.05 dB                                                                                                                                 |                       |
|                                                                            | typical                                                |                                                           | −0.01 dB to +0.03 dB                                                                                                                                 |                       |
|                                                                            | E-UTRA test model 1.1 (E-TM1.1), 20 MHz                |                                                           |                                                                                                                                                      |                       |
|                                                                            | worst case                                             |                                                           | −0.03 dB to +0.08 dB                                                                                                                                 |                       |
|                                                                            | typical                                                |                                                           | −0.02 dB to +0.05 dB                                                                                                                                 |                       |
| Change of input reflection coefficient with respect to power <sup>22</sup> | R&S®NRP8S(N)/18S(N)/33S(N)/33SN-V/18S-10/18S-20/18S-25 |                                                           |                                                                                                                                                      |                       |
|                                                                            | 10 MHz to 2.4 GHz                                      |                                                           | < 0.02 (0.01)                                                                                                                                        | ( ): +15 °C to +35 °C |
|                                                                            | > 2.4 GHz                                              |                                                           | < 0.03 (0.02)                                                                                                                                        |                       |
|                                                                            | R&S®NRP40S(N)/50S(N) /67S(N)/67SN-V                    |                                                           |                                                                                                                                                      |                       |
|                                                                            | 50 MHz to 8.0 GHz                                      |                                                           | < 0.04 (0.02)                                                                                                                                        | ( ): levels ≤ 10 dBm  |
|                                                                            | > 8.0 GHz to 18.0 GHz                                  |                                                           | < 0.06 (0.03)                                                                                                                                        |                       |
|                                                                            | > 18.0 GHz to 26.5 GHz                                 |                                                           | < 0.07 (0.04)                                                                                                                                        |                       |
|                                                                            | > 26.5 GHz to 33.0 GHz                                 |                                                           | < 0.08 (0.05)                                                                                                                                        |                       |
|                                                                            | > 33.0 GHz to 40.0 GHz                                 |                                                           | < 0.09 (0.06)                                                                                                                                        |                       |
|                                                                            | > 40.0 GHz to 50.0 GHz                                 |                                                           | < 0.11 (0.07)                                                                                                                                        |                       |
| > 50.0 GHz to 67.0 GHz                                                     |                                                        | < 0.12 (0.08)                                             |                                                                                                                                                      |                       |

|                                                                                      |                                              |                                                                                                                          |          |          |
|--------------------------------------------------------------------------------------|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|----------|----------|
| <b>Calibration uncertainty</b> <sup>23</sup>                                         | R&S®NRP8S(N)/18S(N)/33S(N)<br>R&S®NRP33SN-V  | path 1                                                                                                                   | path 2   | path 3   |
|                                                                                      | 10 MHz to < 100 MHz                          | 0.058 dB                                                                                                                 | 0.052 dB | 0.053 dB |
|                                                                                      | 100 MHz to 2.4 GHz                           | 0.060 dB                                                                                                                 | 0.058 dB | 0.058 dB |
|                                                                                      | > 2.4 GHz to 8.0 GHz                         | 0.065 dB                                                                                                                 | 0.062 dB | 0.063 dB |
|                                                                                      | > 8.0 GHz to 12.4 GHz                        | 0.075 dB                                                                                                                 | 0.071 dB | 0.072 dB |
|                                                                                      | > 12.4 GHz to 18.0 GHz                       | 0.092 dB                                                                                                                 | 0.088 dB | 0.089 dB |
|                                                                                      | > 18.0 GHz to 26.5 GHz                       | 0.093 dB                                                                                                                 | 0.089 dB | 0.090 dB |
|                                                                                      | > 26.5 GHz to 33.0 GHz                       | 0.113 dB                                                                                                                 | 0.108 dB | 0.109 dB |
|                                                                                      | R&S®NRP40S(N)/50S(N)/67S(N)<br>R&S®NRP67SN-V | path 1                                                                                                                   | path 2   | path 3   |
|                                                                                      | 50 MHz to < 200 MHz                          | 0.076 dB                                                                                                                 | 0.070 dB | 0.071 dB |
|                                                                                      | 200 MHz to 8.0 GHz                           | 0.080 dB                                                                                                                 | 0.071 dB | 0.072 dB |
|                                                                                      | > 8.0 GHz to 12.4 GHz                        | 0.089 dB                                                                                                                 | 0.079 dB | 0.080 dB |
|                                                                                      | > 12.4 GHz to 18.0 GHz                       | 0.104 dB                                                                                                                 | 0.093 dB | 0.094 dB |
|                                                                                      | > 18.0 GHz to 26.5 GHz                       | 0.107 dB                                                                                                                 | 0.092 dB | 0.093 dB |
|                                                                                      | > 26.5 GHz to 33.0 GHz                       | 0.123 dB                                                                                                                 | 0.107 dB | 0.108 dB |
|                                                                                      | > 33.0 GHz to 40.0 GHz                       | 0.133 dB                                                                                                                 | 0.115 dB | 0.117 dB |
|                                                                                      | > 40.0 GHz to 50.0 GHz                       | 0.168 dB                                                                                                                 | 0.150 dB | 0.152 dB |
|                                                                                      | > 50.0 GHz to 67.0 GHz                       | 0.220 dB                                                                                                                 | 0.199 dB | 0.202 dB |
|                                                                                      | R&S®NRP18S-10/-20/-25 <sup>24</sup>          | path 1                                                                                                                   | path 2   | path 3   |
|                                                                                      | 10 MHz to < 100 MHz                          | 0.083 dB                                                                                                                 | 0.078 dB | 0.079 dB |
|                                                                                      | 100 MHz to 2.4 GHz                           | 0.084 dB                                                                                                                 | 0.083 dB | 0.083 dB |
|                                                                                      | > 2.4 GHz to 8.0 GHz                         | 0.088 dB                                                                                                                 | 0.086 dB | 0.087 dB |
|                                                                                      | > 8.0 GHz to 12.4 GHz                        | 0.096 dB                                                                                                                 | 0.093 dB | 0.094 dB |
|                                                                                      | > 12.4 GHz to 18.0 GHz                       | 0.111 dB                                                                                                                 | 0.108 dB | 0.109 dB |
| <b>Host interface</b>                                                                | mechanical                                   | 8-pin male M12 connector (A-coded)                                                                                       |          |          |
|                                                                                      | power supply                                 | +5 V/0.5 A (USB high-power device)                                                                                       |          |          |
|                                                                                      | speed                                        | supports high-speed and full-speed modes according to the specification                                                  |          |          |
|                                                                                      | remote control protocols                     | supports USB test and measurement device class (USBTMC) and legacy mode for compatibility with R&S®NRP-Zxx power sensors |          |          |
|                                                                                      | trigger input EXTERNAL[1]                    | differential (0 V/+3.3 V)                                                                                                |          |          |
|                                                                                      | reference clock                              |                                                                                                                          |          |          |
|                                                                                      | signal level                                 | LVDS                                                                                                                     |          |          |
|                                                                                      | frequency                                    | 20 MHz                                                                                                                   |          |          |
| <b>Ethernet interface</b><br>only for R&S®NRPxxSN types and the R&S®NRP33SN-V/67SN-V | permissible total cable length               | ≤ 5 m                                                                                                                    |          |          |
|                                                                                      | mechanical                                   | RJ-45 jack                                                                                                               |          |          |
|                                                                                      | power supply                                 | power over Ethernet (PoE) class 1 device                                                                                 |          |          |
|                                                                                      | speed                                        | 10/100/1000 Mbit/s                                                                                                       |          |          |
|                                                                                      | remote control protocols                     | VXI11, HiSLIP (high-speed LAN instrument protocol), SCPI-RAW (port 5025)                                                 |          |          |
| <b>Trigger-I/O EXTERNAL2</b>                                                         | permissible cable length                     | ≤ 100 m                                                                                                                  |          |          |
|                                                                                      | mechanical                                   | SMB built-in jack                                                                                                        |          |          |
|                                                                                      | impedance                                    |                                                                                                                          |          |          |
|                                                                                      | input                                        | 10 kΩ (nom.) or 50 Ω (nom.) selectable                                                                                   |          |          |
|                                                                                      | output                                       | 50 Ω (nom.)                                                                                                              |          |          |
|                                                                                      | signal level                                 |                                                                                                                          |          |          |
|                                                                                      | input                                        | compatible with 3 V or 5 V logic, max. –1 to +6 V                                                                        |          |          |
|                                                                                      | output                                       | ≥ 2 V into 50 Ω load, max. 5.3 V                                                                                         |          |          |

|                                                                                              |                                      |                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Vacuum-specific characteristics of the R&amp;S®NRP33SN-V/67SN-V</b>                       | recommended bake-out procedure       | vacuum bake for 100 h at +85 °C and $P < 10^{-5}$ mbar                                                                                                                         |
|                                                                                              | typical mass loss during bake-out    | 85 mg                                                                                                                                                                          |
| <b>Mounting of R&amp;S®NRPxxSN-V onto a baseplate</b><br>for technical drawings see Appendix | general data                         | Two threaded through-holes are provided for mounting the sensor to a baseplate. Using a low-outgassing thermal interface material such as graphite foil is highly recommended. |
|                                                                                              | distance between mounting holes      | 2" (50.8 mm)                                                                                                                                                                   |
|                                                                                              | thread standard                      | UNC 8-32                                                                                                                                                                       |
|                                                                                              | thread length                        | ¼ " (6.35 mm)                                                                                                                                                                  |
|                                                                                              |                                      |                                                                                                                                                                                |
| <b>Dimensions (W × H × L)</b>                                                                | R&S®NRPxxS                           | 48 mm × 30 mm × 138 mm<br>(1.89 in × 1.18 in × 5.43 in)                                                                                                                        |
|                                                                                              | R&S®NRPxxSN,<br>R&S®NRP33SN-V/67SN-V | 73 mm × 26 mm × 146 mm<br>(2.87 in × 1.02 in × 5.75 in)                                                                                                                        |
|                                                                                              | R&S®NRP18S-10                        | 48 mm × 30 mm × 184 mm<br>(1.89 in × 1.18 in × 7.25 in)                                                                                                                        |
|                                                                                              | R&S®NRP18S-20                        | 53 mm × 46 mm × 252 mm<br>(2.09 in × 1.82 in × 9.93 in)                                                                                                                        |
|                                                                                              | R&S®NRP18S-25                        | 53 mm × 46 mm × 310 mm<br>(2.09 in × 1.82 in × 12.21 in)                                                                                                                       |
| <b>Weight</b>                                                                                | R&S®NRPxxS                           | < 0.20 kg (0.44 lb)                                                                                                                                                            |
|                                                                                              | R&S®NRPxxSN,<br>R&S®NRP33SN-V/67SN-V | < 0.35 kg (0.77 lb)                                                                                                                                                            |
|                                                                                              | R&S®NRP18S-10                        | < 0.27 kg (0.59 lb)                                                                                                                                                            |
|                                                                                              | R&S®NRP18S-20                        | < 0.37 kg (0.81 lb)                                                                                                                                                            |
|                                                                                              | R&S®NRP18S-25                        | < 0.47 kg (1.02 lb)                                                                                                                                                            |

## Power rating of the R&S®NRP18S-10/-20/-25

Hatched area: The maximum surface temperatures permitted by IEC 1010-1 are exceeded. Provide protection against inadvertent contacting or apply only a short-term load to the power sensor.



## Average power sensors

### R&S®NRP6A(N)/18A(N) average power sensors

Specifications from 8 kHz to 6 GHz apply to the R&S®NRP6A(N).

Specifications from 8 kHz to 18 GHz apply to the R&S®NRP18A(N).

|                                       |                                            |                                                               |                                           |
|---------------------------------------|--------------------------------------------|---------------------------------------------------------------|-------------------------------------------|
| <b>Frequency range</b>                | R&S®NRP6A(N)                               | 8 kHz to 6 GHz                                                |                                           |
|                                       | R&S®NRP18A(N)                              | 8 kHz to 18 GHz                                               |                                           |
| <b>Impedance matching (SWR)</b>       | 8 kHz to < 20 kHz                          | < 1.25 (1.23)                                                 | ( ): +15 °C to +35 °C                     |
|                                       | 20 kHz to 2.4 GHz                          | < 1.13 (1.11)                                                 |                                           |
|                                       | > 2.4 GHz to 8.0 GHz                       | < 1.20 (1.18)                                                 |                                           |
|                                       | > 8.0 GHz to 18.0 GHz                      | < 1.25 (1.23)                                                 |                                           |
| <b>Power measurement range</b>        |                                            | 100 pW to 200 mW (–70 dBm to +23 dBm)                         |                                           |
| <b>Maximum power</b>                  | average power                              | 1 W (+30 dBm) AVG, max. 10 V DC                               |                                           |
|                                       | peak envelope power                        | 2 W (+33 dBm) for max. 10 µs                                  |                                           |
| <b>Measurement subranges</b>          | path 1                                     | –70 dBm to –15 dBm                                            |                                           |
|                                       | path 2                                     | –53 dBm to +5 dBm                                             |                                           |
|                                       | path 3                                     | –33 dBm to +23 dBm                                            |                                           |
| <b>Transition regions</b>             | with automatic path selection <sup>3</sup> | (–20 ± 1) dBm to (–14 ± 1) dBm<br>(0 ± 1) dBm to (+6 ± 1) dBm |                                           |
| <b>Dynamic response</b>               | rise time 10 %/90 %                        | < 5 ms                                                        |                                           |
| <b>Acquisition</b>                    | sample rate (continuous)                   | 2 Msps                                                        |                                           |
|                                       | accuracy of time base                      | ±5 ppm                                                        |                                           |
| <b>Zero offset</b>                    | initial, without zeroing                   |                                                               | ( ): typical at 1 GHz<br>+15 °C to +35 °C |
|                                       | path 1                                     | < 235 (50) pW                                                 |                                           |
|                                       | path 2                                     | < 10.3 (2.2) nW                                               |                                           |
|                                       | path 3                                     | < 0.93 (0.19) µW                                              |                                           |
|                                       | after external zeroing <sup>5</sup>        |                                                               |                                           |
|                                       | path 1                                     | < 49 (28) pW                                                  |                                           |
|                                       | path 2                                     | < 2.1 (1.3) nW                                                |                                           |
|                                       | path 3                                     | < 192 (108) nW                                                |                                           |
| <b>Zero drift <sup>6</sup></b>        | path 1                                     | < 12 (2) pW                                                   |                                           |
|                                       | path 2                                     | < 0.5 (0.1) nW                                                |                                           |
|                                       | path 3                                     | < 47 (8) nW                                                   |                                           |
| <b>Measurement noise <sup>7</sup></b> | path 1                                     | < 35 (20) pW                                                  |                                           |
|                                       | path 2                                     | < 1.5 (0.9) nW                                                |                                           |
|                                       | path 3                                     | < 136 (76) nW                                                 |                                           |

**Uncertainty for absolute power measurements <sup>8</sup> in dB****8 kHz to < 20 kHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.238              | 0.229 | 0.223 |
| 0.093              | 0.093 | 0.089 |
| 0.052              | 0.052 | 0.051 |
| -70                | -20   | 0     |
|                    |       | +23   |
| Power level in dBm |       |       |

**20 kHz to < 100 MHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.166              | 0.171 | 0.166 |
| 0.080              | 0.082 | 0.081 |
| 0.054              | 0.053 | 0.054 |
| -70                | -20   | 0     |
|                    |       | +23   |
| Power level in dBm |       |       |

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**100 MHz to 2.4 GHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.161              | 0.168 | 0.163 |
| 0.081              | 0.083 | 0.082 |
| 0.054              | 0.054 | 0.054 |
| -70                | -20   | 0     |
|                    |       | +23   |
| Power level in dBm |       |       |

**> 2.4 GHz to 8 GHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.158              | 0.165 | 0.160 |
| 0.082              | 0.083 | 0.081 |
| 0.056              | 0.055 | 0.055 |
| -70                | -20   | 0     |
|                    |       | +23   |
| Power level in dBm |       |       |

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

**> 8 GHz to 12.4 GHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.166              | 0.172 | 0.166 |
| 0.096              | 0.096 | 0.095 |
| 0.076              | 0.073 | 0.074 |
| -70                | -20   | 0     |
|                    |       | +23   |
| Power level in dBm |       |       |

**> 12.4 GHz to 18 GHz**

|                    |       |       |
|--------------------|-------|-------|
| 0.174              | 0.182 | 0.178 |
| 0.110              | 0.111 | 0.112 |
| 0.092              | 0.090 | 0.094 |
| -70                | -20   | 0     |
|                    |       | +23   |
| Power level in dBm |       |       |

0 °C to +50 °C  
+15 °C to +35 °C  
+20 °C to +25 °C

Uncertainty for relative power measurements <sup>9</sup> in dB

| 8 kHz to < 20 kHz  |       |       |       |   |    |     |
|--------------------|-------|-------|-------|---|----|-----|
| +23                | 0.299 | 0.292 | 0.027 |   |    |     |
|                    | 0.107 | 0.105 | 0.026 |   |    |     |
| +6                 | 0.046 | 0.041 | 0.026 |   |    |     |
| 0                  | 0.293 | 0.029 | 0.292 |   |    |     |
|                    | 0.104 | 0.024 | 0.105 |   |    |     |
| -14                | 0.044 | 0.023 | 0.041 |   |    |     |
| -20                | 0.022 | 0.293 | 0.299 |   |    |     |
|                    | 0.022 | 0.104 | 0.107 |   |    |     |
| -70                | 0.022 | 0.044 | 0.046 |   |    |     |
|                    | -70   | -20   | -14   | 0 | +6 | +23 |
| Power level in dBm |       |       |       |   |    |     |

| 20 kHz to < 100 MHz |       |       |       |   |    |                  |
|---------------------|-------|-------|-------|---|----|------------------|
| +23                 | 0.220 | 0.222 | 0.027 |   |    | 0 °C to +50 °C   |
|                     | 0.094 | 0.093 | 0.026 |   |    | +15 °C to +35 °C |
| +6                  | 0.044 | 0.040 | 0.026 |   |    | +20 °C to +25 °C |
| 0                   | 0.214 | 0.028 | 0.222 |   |    | 0 °C to +50 °C   |
|                     | 0.091 | 0.024 | 0.093 |   |    | +15 °C to +35 °C |
| -14                 | 0.042 | 0.023 | 0.040 |   |    | +20 °C to +25 °C |
| -20                 | 0.022 | 0.214 | 0.220 |   |    | 0 °C to +50 °C   |
|                     | 0.022 | 0.091 | 0.094 |   |    | +15 °C to +35 °C |
| -70                 | 0.022 | 0.042 | 0.044 |   |    | +20 °C to +25 °C |
|                     | -70   | -20   | -14   | 0 | +6 | +23              |
| Power level in dBm  |       |       |       |   |    |                  |

| 100 MHz to 2.4 GHz |       |       |       |   |    |     |
|--------------------|-------|-------|-------|---|----|-----|
| +23                | 0.213 | 0.217 | 0.027 |   |    |     |
|                    | 0.093 | 0.093 | 0.026 |   |    |     |
| +6                 | 0.045 | 0.040 | 0.026 |   |    |     |
| 0                  | 0.208 | 0.028 | 0.217 |   |    |     |
|                    | 0.090 | 0.024 | 0.093 |   |    |     |
| -14                | 0.043 | 0.023 | 0.040 |   |    |     |
| -20                | 0.022 | 0.208 | 0.213 |   |    |     |
|                    | 0.022 | 0.090 | 0.093 |   |    |     |
| -70                | 0.022 | 0.043 | 0.045 |   |    |     |
|                    | -70   | -20   | -14   | 0 | +6 | +23 |
| Power level in dBm |       |       |       |   |    |     |

| > 2.4 GHz to 8 GHz |       |       |       |   |    |                  |
|--------------------|-------|-------|-------|---|----|------------------|
| +23                | 0.211 | 0.214 | 0.027 |   |    | 0 °C to +50 °C   |
|                    | 0.095 | 0.093 | 0.026 |   |    | +15 °C to +35 °C |
| +6                 | 0.050 | 0.042 | 0.026 |   |    | +20 °C to +25 °C |
| 0                  | 0.205 | 0.028 | 0.214 |   |    | 0 °C to +50 °C   |
|                    | 0.092 | 0.024 | 0.093 |   |    | +15 °C to +35 °C |
| -14                | 0.047 | 0.023 | 0.042 |   |    | +20 °C to +25 °C |
| -20                | 0.022 | 0.205 | 0.211 |   |    | 0 °C to +50 °C   |
|                    | 0.022 | 0.092 | 0.095 |   |    | +15 °C to +35 °C |
| -70                | 0.022 | 0.047 | 0.050 |   |    | +20 °C to +25 °C |
|                    | -70   | -20   | -14   | 0 | +6 | +23              |
| Power level in dBm |       |       |       |   |    |                  |

| > 8 GHz to 12.4 GHz |       |       |       |   |    |     |
|---------------------|-------|-------|-------|---|----|-----|
| +23                 | 0.212 | 0.215 | 0.029 |   |    |     |
|                     | 0.099 | 0.097 | 0.027 |   |    |     |
| +6                  | 0.056 | 0.048 | 0.027 |   |    |     |
| 0                   | 0.207 | 0.029 | 0.215 |   |    |     |
|                     | 0.095 | 0.025 | 0.097 |   |    |     |
| -14                 | 0.052 | 0.024 | 0.048 |   |    |     |
| -20                 | 0.022 | 0.207 | 0.212 |   |    |     |
|                     | 0.022 | 0.095 | 0.099 |   |    |     |
| -70                 | 0.022 | 0.052 | 0.056 |   |    |     |
|                     | -70   | -20   | -14   | 0 | +6 | +23 |
| Power level in dBm  |       |       |       |   |    |     |

| > 12.4 GHz to 18 GHz |       |       |       |   |    |                  |
|----------------------|-------|-------|-------|---|----|------------------|
| +23                  | 0.219 | 0.223 | 0.034 |   |    | 0 °C to +50 °C   |
|                      | 0.109 | 0.108 | 0.033 |   |    | +15 °C to +35 °C |
| +6                   | 0.069 | 0.064 | 0.032 |   |    | +20 °C to +25 °C |
| 0                    | 0.212 | 0.031 | 0.223 |   |    | 0 °C to +50 °C   |
|                      | 0.102 | 0.027 | 0.108 |   |    | +15 °C to +35 °C |
| -14                  | 0.061 | 0.026 | 0.064 |   |    | +20 °C to +25 °C |
| -20                  | 0.022 | 0.212 | 0.219 |   |    | 0 °C to +50 °C   |
|                      | 0.022 | 0.102 | 0.109 |   |    | +15 °C to +35 °C |
| -70                  | 0.022 | 0.061 | 0.069 |   |    | +20 °C to +25 °C |
|                      | -70   | -20   | -14   | 0 | +6 | +23              |
| Power level in dBm   |       |       |       |   |    |                  |

## Additional characteristics of the R&S®NRPxxA(N) average power sensors

|                                                          |                                              |                                                                                                                                                             |
|----------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Sensor type</b>                                       |                                              | three-path diode power sensor                                                                                                                               |
| <b>Measurand</b>                                         |                                              | power of incident wave                                                                                                                                      |
|                                                          |                                              | power of source (DUT) into 50 $\Omega$ <sup>11</sup>                                                                                                        |
| <b>RF connector</b>                                      |                                              | N (male)                                                                                                                                                    |
| <b>Measurement functions</b>                             | stationary and recurring waveforms           | continuous average                                                                                                                                          |
| <b>Continuous average function</b>                       | measurand                                    | mean power over recurring acquisition interval                                                                                                              |
|                                                          | aperture                                     | 10 $\mu$ s to 2.0 s (20 ms default)                                                                                                                         |
|                                                          | window function                              | uniform or von Hann <sup>13</sup>                                                                                                                           |
|                                                          | duty cycle correction <sup>14</sup>          | 0.001 % to 100.0 %                                                                                                                                          |
|                                                          | capacity of measurement buffer <sup>15</sup> | 1 to 8192 results                                                                                                                                           |
| <b>Averaging filter</b>                                  | modes                                        | auto off (fixed averaging number)                                                                                                                           |
|                                                          |                                              | auto on (continuously auto-adapted)                                                                                                                         |
|                                                          |                                              | auto once (automatically fixed once)                                                                                                                        |
|                                                          | auto off                                     |                                                                                                                                                             |
|                                                          | supported measurement functions              | all                                                                                                                                                         |
|                                                          | averaging number                             | 1, 2, 4, 6, 8, 10 to 65536 (1 or all even numbers between 2 and 65536)                                                                                      |
|                                                          | auto on/once                                 |                                                                                                                                                             |
|                                                          | normal operating mode                        | averaging number adapted to resolution setting and power to be measured                                                                                     |
|                                                          | fixed noise operating mode                   | averaging number adapted to specified noise content                                                                                                         |
|                                                          | result output                                |                                                                                                                                                             |
|                                                          | moving mode                                  | continuous result output, independent of averaging number                                                                                                   |
|                                                          | repeat mode                                  | only final result                                                                                                                                           |
| <b>Attenuation correction</b>                            | function                                     | corrects the measurement result by means of a fixed factor (dB offset)                                                                                      |
|                                                          | range                                        | –200.000 dB to +200.000 dB                                                                                                                                  |
| <b>Embedding</b>                                         | function                                     | incorporates a two-port device at the sensor input so that the measurement plane is shifted to the input of this device                                     |
|                                                          | parameters                                   | $S_{11}$ , $S_{21}$ , $S_{12}$ and $S_{22}$ of device                                                                                                       |
|                                                          | number of devices                            | 0 to 999                                                                                                                                                    |
|                                                          | total number of frequencies                  | $\leq 80000$                                                                                                                                                |
| <b>Gamma correction</b>                                  | function                                     | removes the influence of impedance mismatch from the measurement result so that the measurand corresponds to the power of the source (DUT) into 50 $\Omega$ |
|                                                          | parameters                                   | magnitude and phase of reflection coefficient of source (DUT)                                                                                               |
| <b>Frequency response correction</b>                     | function                                     | takes the frequency response of the sensor section and of the RF power attenuator into account (if applicable)                                              |
|                                                          | parameter                                    | center frequency of test signal                                                                                                                             |
|                                                          | residual uncertainty                         | see specification of calibration uncertainty and uncertainty for absolute and relative power measurements                                                   |
| <b>Measurement time</b> <sup>20</sup>                    | continuous average                           |                                                                                                                                                             |
| Av: averaging number                                     | single measurements                          | $2 \times (\text{aperture} + 5 \text{ ms}) \times \text{Av} - 5 \text{ ms} + t_z$<br>$t_z = 2 \text{ ms (typ.)}$                                            |
| <b>Zeroing (duration)</b>                                |                                              | 6.6 s                                                                                                                                                       |
| <b>Measurement error due to modulation</b> <sup>21</sup> | general                                      | depends on CCDF and RF bandwidth of test signal                                                                                                             |
|                                                          | WCDMA (3GPP test model 1 to 64)              |                                                                                                                                                             |
|                                                          | worst case                                   | –0.02 dB to +0.05 dB                                                                                                                                        |
|                                                          | typical                                      | –0.01 dB to +0.03 dB                                                                                                                                        |
|                                                          | E-UTRA test model 1.1 (E-TM1.1), 20 MHz      |                                                                                                                                                             |
|                                                          | worst case                                   | –0.03 dB to +0.08 dB                                                                                                                                        |
|                                                          | typical                                      | –0.02 dB to +0.05 dB                                                                                                                                        |

|                                                                            |                                |                                                                                                                          |                                                         |                       |
|----------------------------------------------------------------------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|-----------------------|
| Change of input reflection coefficient with respect to power <sup>22</sup> | 8 kHz to 2.4 GHz               | < 0.02 (0.01)                                                                                                            |                                                         | ( ): +15 °C to +35 °C |
|                                                                            | > 2.4 GHz                      | < 0.03 (0.02)                                                                                                            |                                                         |                       |
| Calibration uncertainty <sup>23</sup>                                      |                                | path 1                                                                                                                   | path 2                                                  | path 3                |
|                                                                            | 8 kHz to < 20 kHz              | 0.052 dB                                                                                                                 | 0.050 dB                                                | 0.050 dB              |
|                                                                            | 20 kHz to < 100 MHz            | 0.055 dB                                                                                                                 | 0.052 dB                                                | 0.053 dB              |
|                                                                            | 100 MHz to 2.40 GHz            | 0.054 dB                                                                                                                 | 0.052 dB                                                | 0.053 dB              |
|                                                                            | > 2.4 GHz to 8.0 GHz           | 0.056 dB                                                                                                                 | 0.053 dB                                                | 0.053 dB              |
|                                                                            | > 8.0 GHz to 12.4 GHz          | 0.065 dB                                                                                                                 | 0.062 dB                                                | 0.062 dB              |
|                                                                            | > 12.4 GHz to 18.0 GHz         | 0.076 dB                                                                                                                 | 0.073 dB                                                | 0.075 dB              |
| Host interface                                                             | mechanical                     | 8-pin male M12 connector (A-coded)                                                                                       |                                                         |                       |
|                                                                            | power supply                   | +5 V/0.5 A (USB high-power device)                                                                                       |                                                         |                       |
|                                                                            | speed                          | supports high-speed and full-speed modes according to the specification                                                  |                                                         |                       |
|                                                                            | remote control protocols       | supports USB test and measurement device class (USBTMC) and legacy mode for compatibility with R&S®NRP-Zxx power sensors |                                                         |                       |
|                                                                            | trigger input EXternal[1]      | differential (0 V/+3.3 V)                                                                                                |                                                         |                       |
|                                                                            | reference clock                |                                                                                                                          |                                                         |                       |
|                                                                            | signal level                   | LVDS                                                                                                                     |                                                         |                       |
|                                                                            | frequency                      | 20 MHz                                                                                                                   |                                                         |                       |
| Ethernet interface<br>only for R&S®NRPxxAN types                           | permissible total cable length | ≤ 5 m                                                                                                                    |                                                         |                       |
|                                                                            | mechanical                     | RJ-45 jack                                                                                                               |                                                         |                       |
|                                                                            | power supply                   | power over Ethernet (PoE) class 1 device                                                                                 |                                                         |                       |
|                                                                            | speed                          | 10/100/1000 Mbit/s                                                                                                       |                                                         |                       |
|                                                                            | remote control protocols       | VXI11, HiSLIP (high-speed LAN instrument protocol), SCPI-RAW (port 5025)                                                 |                                                         |                       |
|                                                                            | permissible cable length       | ≤ 100 m                                                                                                                  |                                                         |                       |
|                                                                            | Trigger-I/O EXternal2          | mechanical                                                                                                               | SMB built-in jack                                       |                       |
| impedance                                                                  |                                |                                                                                                                          |                                                         |                       |
| input                                                                      |                                | 10 kΩ (nom.) or 50 Ω (nom.) selectable                                                                                   |                                                         |                       |
| output                                                                     |                                | 50 Ω (nom.)                                                                                                              |                                                         |                       |
| signal level                                                               |                                |                                                                                                                          |                                                         |                       |
| input                                                                      |                                | compatible with 3 V or 5 V logic, max. –1 to +6 V                                                                        |                                                         |                       |
| output                                                                     |                                | ≥ 2 V into 50 Ω load, max. 5.3 V                                                                                         |                                                         |                       |
| Dimensions (W × H × L)                                                     |                                | R&S®NRPxxA                                                                                                               | 48 mm × 30 mm × 138 mm<br>(1.89 in × 1.18 in × 5.43 in) |                       |
|                                                                            | R&S®NRPxxAN                    | 73 mm × 26 mm × 146 mm<br>(2.87 in × 1.02 in × 5.75 in)                                                                  |                                                         |                       |
| Weight                                                                     | R&S®NRPxxA                     | < 0.20 kg (0.44 lb)                                                                                                      |                                                         |                       |
|                                                                            | R&S®NRPxxAN                    | < 0.35 kg (0.77 lb)                                                                                                      |                                                         |                       |

# Thermal power sensors

## R&S®NRP18T(N)/33T(N)/40T(N)/50T(N)/67T(N) thermal power sensors

Specifications from DC to 18 GHz apply to the R&S®NRP18T(N).

Specifications from DC to 33 GHz apply to the R&S®NRP33T(N).

Specifications from DC to 40 GHz apply to the R&S®NRP40T(N).

Specifications from DC to 50 GHz apply to the R&S®NRP50T(N).

Specifications from DC to 67 GHz apply to the R&S®NRP67T(N).

|                                                                  |                                     |                                                                      |                  |                |
|------------------------------------------------------------------|-------------------------------------|----------------------------------------------------------------------|------------------|----------------|
| <b>Frequency range</b>                                           | R&S®NRP18T(N)                       | DC to 18 GHz                                                         |                  |                |
|                                                                  | R&S®NRP33T(N)                       | DC to 33 GHz                                                         |                  |                |
|                                                                  | R&S®NRP40T(N)                       | DC to 40 GHz                                                         |                  |                |
|                                                                  | R&S®NRP50T(N)                       | DC to 50 GHz                                                         |                  |                |
|                                                                  | R&S®NRP67T(N)                       | DC to 67 GHz                                                         |                  |                |
| <b>Impedance matching (SWR)</b>                                  | DC to 100 MHz                       | < 1.03                                                               |                  |                |
|                                                                  | > 100 MHz to 2.4 GHz                | < 1.06                                                               |                  |                |
|                                                                  | > 2.4 GHz to 12.4 GHz               | < 1.13                                                               |                  |                |
|                                                                  | > 12.4 GHz to 18.0 GHz              | < 1.16                                                               |                  |                |
|                                                                  | > 18.0 GHz to 26.5 GHz              | < 1.22                                                               |                  |                |
|                                                                  | > 26.5 GHz to 33.0 GHz              | < 1.28                                                               |                  |                |
|                                                                  | > 33.0 GHz to 40.0 GHz              | < 1.28                                                               |                  |                |
|                                                                  | > 40.0 GHz to 44.0 GHz              | < 1.30                                                               |                  |                |
|                                                                  | > 44.0 GHz to 50.0 GHz              | < 1.30                                                               |                  |                |
| <b>Power measurement range</b>                                   |                                     | 300 nW to 100 mW (–35 dBm to +20 dBm), continuous, in a single range |                  |                |
|                                                                  |                                     | 0.3 W (+25 dBm), continuous                                          |                  |                |
| <b>Maximum power</b>                                             | average power                       |                                                                      |                  |                |
|                                                                  | peak envelope power                 |                                                                      |                  |                |
|                                                                  | R&S®NRP18T(N)                       | 20 W (43 dBm) for max. 1 µs                                          |                  |                |
| <b>Acquisition</b>                                               | R&S®NRP33T(N)/40T(N)/50T(N)/67T(N)  | 10 W (40 dBm) for max. 1 µs                                          |                  |                |
|                                                                  | sample rate                         | 50 ksps (sigma-delta)                                                |                  |                |
|                                                                  | accuracy of time base               | ±5 ppm                                                               |                  |                |
| <b>Zero offset</b>                                               | after external zeroing <sup>5</sup> | < 25 nW (typ. 15 nW at 1 GHz)                                        |                  |                |
| <b>Zero drift <sup>6</sup></b>                                   |                                     | < 8 nW                                                               |                  |                |
| <b>Measurement noise <sup>7</sup></b>                            |                                     | < 25 nW (typ. 15 nW at 1 GHz)                                        |                  |                |
| <b>Uncertainty for absolute power measurements <sup>25</sup></b> |                                     | +20 °C to +25 °C                                                     | +15 °C to +35 °C | 0 °C to +50 °C |
|                                                                  | DC to 100 MHz                       | 0.040 dB                                                             | 0.046 dB         | 0.067 dB       |
|                                                                  | > 100 MHz to 2.4 GHz                | 0.048 dB                                                             | 0.053 dB         | 0.072 dB       |
|                                                                  | > 2.4 GHz to 8.0 GHz                | 0.054 dB                                                             | 0.059 dB         | 0.079 dB       |
|                                                                  | > 8.0 GHz to 12.4 GHz               | 0.063 dB                                                             | 0.068 dB         | 0.085 dB       |
|                                                                  | > 12.4 GHz to 18.0 GHz              | 0.082 dB                                                             | 0.086 dB         | 0.100 dB       |
|                                                                  | > 18.0 GHz to 26.5 GHz              | 0.086 dB                                                             | 0.086 dB         | 0.102 dB       |
|                                                                  | > 26.5 GHz to 33.0 GHz              | 0.101 dB                                                             | 0.105 dB         | 0.121 dB       |
|                                                                  | > 33.0 GHz to 40.0 GHz              | 0.108 dB                                                             | 0.112 dB         | 0.127 dB       |
|                                                                  | > 40.0 GHz to 44.0 GHz              | 0.138 dB                                                             | 0.141 dB         | 0.155 dB       |
|                                                                  | > 44.0 GHz to 50.0 GHz              | 0.143 dB                                                             | 0.146 dB         | 0.159 dB       |
|                                                                  | > 50.0 GHz to 59.0 GHz              | 0.206 dB                                                             | 0.208 dB         | 0.220 dB       |
|                                                                  | > 59.0 GHz to 67.0 GHz              | 0.209 dB                                                             | 0.212 dB         | 0.223 dB       |
| <b>Uncertainty for relative power measurements <sup>26</sup></b> |                                     | 0.010 dB                                                             |                  |                |

## R&S®NRP90T(N)/110T thermal power sensors

Specifications from DC to 90 GHz apply to the R&S®NRP90T(N).

Specifications from DC to 110 GHz apply to the R&S®NRP110T.

|                                                                      |                                     |                                                                      |                  |                |
|----------------------------------------------------------------------|-------------------------------------|----------------------------------------------------------------------|------------------|----------------|
| <b>Frequency range</b>                                               | R&S®NRP90T(N)                       | DC to 90 GHz (calibrated up to 98 GHz <sup>27</sup> )                |                  |                |
|                                                                      | R&S®NRP110T                         | DC to 110 GHz                                                        |                  |                |
| <b>Impedance matching (SWR)</b>                                      | DC to 100 MHz                       | < 1.05                                                               |                  |                |
|                                                                      | > 100 MHz to 2.4 GHz                | < 1.08                                                               |                  |                |
|                                                                      | > 2.4 GHz to 12.4 GHz               | < 1.18                                                               |                  |                |
|                                                                      | > 12.4 GHz to 18.0 GHz              | < 1.23                                                               |                  |                |
|                                                                      | > 18.0 GHz to 26.5 GHz              | < 1.28                                                               |                  |                |
|                                                                      | > 26.5 GHz to 40.0 GHz              | < 1.38                                                               |                  |                |
|                                                                      | > 40.0 GHz to 50.0 GHz              | < 1.46                                                               |                  |                |
|                                                                      | > 50.0 GHz to 67.0 GHz              | < 1.56                                                               |                  |                |
|                                                                      | > 67.0 GHz to 80.0 GHz              | < 1.60                                                               |                  |                |
|                                                                      | > 80.0 GHz to 95.0 GHz              | < 1.66                                                               |                  |                |
|                                                                      | > 95.0 GHz to 110.0 GHz             | < 1.70                                                               |                  |                |
| <b>Power measurement range</b>                                       |                                     | 300 nW to 100 mW (–35 dBm to +20 dBm), continuous, in a single range |                  |                |
| <b>Maximum power</b>                                                 | average power                       | 0.3 W (+25 dBm), continuous                                          |                  |                |
|                                                                      | peak envelope power                 | 10 W (40 dBm) for max. 1 µs                                          |                  |                |
| <b>Acquisition</b>                                                   | sample rate                         | 50 ksps (sigma-delta)                                                |                  |                |
|                                                                      | accuracy of time base               | ±5 ppm                                                               |                  |                |
| <b>Zero offset</b>                                                   | after external zeroing <sup>5</sup> | < 34 nW (typ. 15 nW at 1 GHz)                                        |                  |                |
| <b>Zero drift <sup>6</sup></b>                                       |                                     | < 11 nW                                                              |                  |                |
| <b>Measurement noise <sup>7</sup></b>                                |                                     | < 34 nW (typ. 15 nW at 1 GHz)                                        |                  |                |
| <b>Uncertainty for absolute power measurements <sup>25, 27</sup></b> |                                     | +20 °C to +25 °C                                                     | +15 °C to +35 °C | 0 °C to +50 °C |
|                                                                      | DC to 100 MHz                       | 0.041 dB                                                             | 0.047 dB         | 0.068 dB       |
|                                                                      | > 100 MHz to 2.4 GHz                | 0.051 dB                                                             | 0.057 dB         | 0.074 dB       |
|                                                                      | > 2.4 GHz to 12.4 GHz               | 0.074 dB                                                             | 0.078 dB         | 0.093 dB       |
|                                                                      | > 12.4 GHz to 18.0 GHz              | 0.098 dB                                                             | 0.101 dB         | 0.113 dB       |
|                                                                      | > 18.0 GHz to 26.5 GHz              | 0.099 dB                                                             | 0.103 dB         | 0.115 dB       |
|                                                                      | > 26.5 GHz to 40.0 GHz              | 0.118 dB                                                             | 0.122 dB         | 0.135 dB       |
|                                                                      | > 40.0 GHz to 50.0 GHz              | 0.166 dB                                                             | 0.169 dB         | 0.182 dB       |
|                                                                      | > 50.0 GHz to 59.0 GHz              | 0.226 dB                                                             | 0.229 dB         | 0.244 dB       |
|                                                                      | > 59.0 GHz to 67.0 GHz              | 0.231 dB                                                             | 0.235 dB         | 0.249 dB       |
|                                                                      | > 67.0 GHz to 80.0 GHz              | 0.251 dB                                                             | 0.255 dB         | 0.270 dB       |
|                                                                      | > 80.0 GHz to 95.0 GHz              | 0.269 dB                                                             | 0.273 dB         | 0.289 dB       |
|                                                                      | > 95.0 GHz to 110.0 GHz             | 0.290 dB                                                             | 0.294 dB         | 0.311 dB       |
| <b>Uncertainty for relative power measurements <sup>26</sup></b>     | DC to 67.0 GHz                      | 0.010 dB                                                             |                  |                |
|                                                                      | > 67.0 GHz to 110.0 GHz             | 0.014 dB                                                             |                  |                |

## Additional characteristics of the R&S®NRP18T(N)/33T(N)/40T(N)/50T(N)/67T(N)/90T(N)/110T thermal power sensors

|                                                                                   |                                                |                                                                                                                                            |
|-----------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Sensor type</b>                                                                |                                                | thermoelectric power sensor                                                                                                                |
| <b>Measurand</b>                                                                  |                                                | power of incident wave                                                                                                                     |
|                                                                                   |                                                | power of source (DUT) into 50 $\Omega$ <sup>11</sup>                                                                                       |
| <b>RF connector</b>                                                               | R&S®NRP18T(N)                                  | N (male)                                                                                                                                   |
|                                                                                   | R&S®NRP33T(N)                                  | 3.50 mm (male)                                                                                                                             |
|                                                                                   | R&S®NRP40T(N)                                  | 2.92 mm (male)                                                                                                                             |
|                                                                                   | R&S®NRP50T(N)                                  | 2.40 mm (male)                                                                                                                             |
|                                                                                   | R&S®NRP67T(N)                                  | 1.85 mm (male)                                                                                                                             |
|                                                                                   | R&S®NRP90T(N)                                  | 1.35 mm (male)                                                                                                                             |
|                                                                                   | R&S®NRP110T                                    | 1.00 mm (male)                                                                                                                             |
| <b>Measurement function</b>                                                       | stationary and recurring waveforms             | continuous average                                                                                                                         |
| <b>Continuous average function</b>                                                | measurand                                      | mean power over recurring acquisition interval                                                                                             |
|                                                                                   | aperture                                       | 0.5 ms to 300 ms (5 ms default)                                                                                                            |
|                                                                                   | window function                                | uniform or von Hann <sup>13</sup>                                                                                                          |
|                                                                                   | duty cycle correction <sup>14</sup>            | 0.001 % to 100.0 %                                                                                                                         |
|                                                                                   | capacity of measurement buffer <sup>15</sup>   | 1 to 8192 results                                                                                                                          |
| <b>Averaging filter</b>                                                           | modes                                          | auto off (fixed averaging number)                                                                                                          |
|                                                                                   |                                                | auto on (continuously auto-adapted)                                                                                                        |
|                                                                                   |                                                | auto once (automatically fixed once)                                                                                                       |
|                                                                                   | auto off                                       |                                                                                                                                            |
|                                                                                   | averaging number                               | 1, 2, 4, 6, 8, 10 to 65536 (1 or all even numbers between 2 and 65536)                                                                     |
|                                                                                   | auto on/once                                   |                                                                                                                                            |
|                                                                                   | normal operating mode                          | averaging number adapted to resolution setting and power to be measured                                                                    |
|                                                                                   | fixed noise operating mode                     | averaging number adapted to specified noise content                                                                                        |
|                                                                                   | result output                                  |                                                                                                                                            |
|                                                                                   | moving mode                                    | continuous result output, independent of averaging number                                                                                  |
| <b>Attenuation correction</b>                                                     | repeat mode                                    | only final result                                                                                                                          |
|                                                                                   | function                                       | corrects the measurement result by means of a fixed factor (dB offset)                                                                     |
| <b>Embedding</b>                                                                  | range                                          | –200.000 dB to +200.000 dB                                                                                                                 |
|                                                                                   | function                                       | incorporates a two-port device at the sensor input so that the measurement plane is shifted to the input of this device                    |
|                                                                                   | parameters                                     | $S_{11}$ , $S_{21}$ , $S_{12}$ and $S_{22}$ of device                                                                                      |
| <b>Gamma correction</b>                                                           | frequencies                                    | 0 to 999                                                                                                                                   |
|                                                                                   | function                                       | removes the influence of impedance mismatch from the measurement result so that the power of the source (DUT) into 50 $\Omega$ can be read |
|                                                                                   | parameters                                     | magnitude and phase of reflection coefficient of source (DUT)                                                                              |
| <b>Frequency response correction</b>                                              | function                                       | takes the frequency response of the power sensor into account                                                                              |
|                                                                                   | parameter                                      | center frequency of test signal                                                                                                            |
|                                                                                   | residual uncertainty                           | see specification of calibration uncertainty and uncertainty for absolute and relative power measurements                                  |
| <b>Measurement time</b> <sup>20</sup><br>Av: averaging number                     | continuous average                             | $2 \times (\text{aperture} + 300 \mu\text{s}) \times \text{Av} + t_z + t_d$                                                                |
|                                                                                   | single measurements                            | $t_z : = 4 \text{ ms (typ.)}$<br>$t_d$ must be taken into account when auto delay is active                                                |
|                                                                                   | delay time $t_d$                               |                                                                                                                                            |
|                                                                                   | R&S®NRP18T(N)                                  | 80 ms                                                                                                                                      |
|                                                                                   | R&S®NRP33T(N)/40T(N)/50T(N)/67T(N)/90T(N)/110T | 40 ms                                                                                                                                      |
| <b>Zeroing (duration)</b>                                                         |                                                | 10 s                                                                                                                                       |
| <b>Change of input reflection coefficient with respect to power</b> <sup>22</sup> | only for power levels > 15 dBm                 | < 0.005                                                                                                                                    |

|                                                         |                                           |                                                                                                                          |
|---------------------------------------------------------|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <b>Calibration uncertainty</b> <sup>28</sup>            | R&S®NRP18T(N)/33T(N)/40T(N)/50T(N)/67T(N) |                                                                                                                          |
|                                                         | DC to 100 MHz                             | 0.040 dB                                                                                                                 |
|                                                         | > 100 MHz to 2.4 GHz                      | 0.047 dB                                                                                                                 |
|                                                         | > 2.4 GHz to 8.0 GHz                      | 0.054 dB                                                                                                                 |
|                                                         | > 8.0 GHz to 12.4 GHz                     | 0.063 dB                                                                                                                 |
|                                                         | > 12.4 GHz to 18.0 GHz                    | 0.082 dB                                                                                                                 |
|                                                         | > 18.0 GHz to 26.5 GHz                    | 0.085 dB                                                                                                                 |
|                                                         | > 26.5 GHz to 33.0 GHz                    | 0.101 dB                                                                                                                 |
|                                                         | > 33.0 GHz to 40.0 GHz                    | 0.108 dB                                                                                                                 |
|                                                         | > 40.0 GHz to 44.0 GHz                    | 0.138 dB                                                                                                                 |
|                                                         | > 44.0 GHz to 50.0 GHz                    | 0.143 dB                                                                                                                 |
|                                                         | > 50.0 GHz to 59.0 GHz                    | 0.190 dB                                                                                                                 |
|                                                         | > 59.0 GHz to 67.0 GHz                    | 0.193 dB                                                                                                                 |
|                                                         | R&S®NRP90T(N)/110T                        |                                                                                                                          |
|                                                         | DC to 100 MHz                             | 0.041 dB                                                                                                                 |
|                                                         | > 100 MHz to 2.4 GHz                      | 0.051 dB                                                                                                                 |
|                                                         | > 2.4 GHz to 12.4 GHz                     | 0.074 dB                                                                                                                 |
|                                                         | > 12.4 GHz to 18.0 GHz                    | 0.098 dB                                                                                                                 |
|                                                         | > 18.0 GHz to 26.5 GHz                    | 0.099 dB                                                                                                                 |
|                                                         | > 26.5 GHz to 40.0 GHz                    | 0.118 dB                                                                                                                 |
|                                                         | > 40.0 GHz to 50.0 GHz                    | 0.166 dB                                                                                                                 |
|                                                         | > 50.0 GHz to 59.0 GHz                    | 0.211 dB                                                                                                                 |
|                                                         | > 59.0 GHz to 67.0 GHz                    | 0.217 dB                                                                                                                 |
|                                                         | > 67.0 GHz to 80.0 GHz                    | 0.220 dB                                                                                                                 |
|                                                         | > 80.0 GHz to 95.0 GHz                    | 0.240 dB                                                                                                                 |
|                                                         | > 95.0 GHz to 110.0 GHz                   | 0.263 dB                                                                                                                 |
| <b>Linearity</b> <sup>29</sup>                          | DC to 67.0 GHz                            | 0.007 dB                                                                                                                 |
|                                                         | > 67.0 GHz to 110.0 GHz                   | 0.010 dB                                                                                                                 |
| <b>Temperature effect</b> <sup>30</sup>                 | DC to 100 MHz                             | < 0.002 dB/K                                                                                                             |
|                                                         | > 100 MHz to 50.0 GHz                     | < 0.003 dB/K                                                                                                             |
|                                                         | > 50.0 GHz to 110.0 GHz                   | < 0.004 dB/K                                                                                                             |
| <b>Host interface</b>                                   | mechanical                                | 8-pin male M12 connector (A-coded)                                                                                       |
|                                                         | power supply                              | +5 V/0.5 A (USB high-power device)                                                                                       |
|                                                         | speed                                     | supports high-speed and full-speed modes according to the specification                                                  |
|                                                         | remote control protocols                  | supports USB test and measurement device class (USBTMC) and legacy mode for compatibility with R&S®NRP-Zxx power sensors |
|                                                         | trigger input EXTERNAL[1]                 | differential (0 V/+3.3 V)                                                                                                |
|                                                         | reference clock                           |                                                                                                                          |
|                                                         | signal level                              | LVDS                                                                                                                     |
|                                                         | frequency                                 | 20 MHz                                                                                                                   |
|                                                         | permissible total cable length            | ≤ 5 m                                                                                                                    |
|                                                         |                                           |                                                                                                                          |
| <b>Ethernet interface</b><br>only for R&S®NRPxxTN types | mechanical                                | RJ-45 jack                                                                                                               |
|                                                         | power supply                              | power over Ethernet (PoE) class 1 device                                                                                 |
|                                                         | speed                                     | 10/100/1000 Mbit/s                                                                                                       |
|                                                         | remote control protocols                  | VXI11, HiSLIP (high-speed LAN instrument protocol), SCPI-RAW (port 5025)                                                 |
|                                                         | permissible cable length                  | ≤ 100 m                                                                                                                  |
|                                                         |                                           |                                                                                                                          |
| <b>Trigger-I/O EXTERNAL2</b>                            | mechanical                                | SMB built-in jack                                                                                                        |
|                                                         | impedance                                 |                                                                                                                          |
|                                                         | input                                     | 10 kΩ (nom.) or 50 Ω (nom.) selectable                                                                                   |
|                                                         | output                                    | 50 Ω (nom.)                                                                                                              |
|                                                         | signal level                              |                                                                                                                          |
|                                                         | input                                     | compatible with 3 V or 5 V logic, max. -1 V to +6 V                                                                      |
|                                                         | output                                    | ≥ 2 V into 50 Ω load, max. 5.3 V                                                                                         |
| <b>Dimensions (W × H × L)</b>                           | R&S®NRPxxT                                | 48 mm × 30 mm × 138 mm<br>(1.89 in × 1.18 in × 5.43 in)                                                                  |
|                                                         | R&S®NRPxxTN                               | 73 mm × 26 mm × 146 mm<br>(2.87 in × 1.02 in × 5.75 in)                                                                  |
| <b>Weight</b>                                           | R&S®NRPxxT                                | < 0.20 kg (0.44 lb)                                                                                                      |
|                                                         | R&S®NRPxxTN                               | < 0.35 kg (0.77 lb)                                                                                                      |

# Thermal waveguide power sensors

## R&S®NRP75TWG/90TWG/110TWG thermal waveguide power sensors

Specifications from 50 GHz to 75 GHz apply to the R&S®NRP75TWG.

Specifications from 60 GHz to 90 GHz apply to the R&S®NRP90TWG.

Specifications from 75 GHz to 110 GHz apply to the R&S®NRP110TWG.

|                                                                  |                                     |                                                                      |                  |                |
|------------------------------------------------------------------|-------------------------------------|----------------------------------------------------------------------|------------------|----------------|
| <b>Frequency range</b>                                           | R&S®NRP75TWG                        | 50 GHz to 75 GHz                                                     |                  |                |
|                                                                  | R&S®NRP90TWG                        | 60 GHz to 90 GHz                                                     |                  |                |
|                                                                  | R&S®NRP110TWG                       | 75 GHz to 110 GHz                                                    |                  |                |
| <b>Impedance matching (SWR)</b>                                  |                                     | < 1.35                                                               |                  |                |
| <b>Power measurement range</b>                                   |                                     | 300 nW to 100 mW (–35 dBm to +20 dBm), continuous, in a single range |                  |                |
| <b>Maximum power</b>                                             | average power                       | 0.3 W (+25 dBm), continuous                                          |                  |                |
|                                                                  | peak envelope power                 | 10 W (40 dBm) for max. 1 µs                                          |                  |                |
| <b>Acquisition</b>                                               | sample rate                         | 50 ksps (sigma-delta)                                                |                  |                |
|                                                                  | accuracy of time base               | ±5 ppm                                                               |                  |                |
| <b>Zero offset</b>                                               | after external zeroing <sup>5</sup> | < 28 nW (typ. 20 nW)                                                 |                  |                |
| <b>Zero drift <sup>6</sup></b>                                   |                                     | < 10 nW                                                              |                  |                |
| <b>Measurement noise <sup>7</sup></b>                            |                                     | < 28 nW (typ. 20 nW)                                                 |                  |                |
| <b>Uncertainty for absolute power measurements <sup>25</sup></b> |                                     | +20 °C to +25 °C                                                     | +15 °C to +35 °C | 0 °C to +50 °C |
|                                                                  | R&S®NRP75TWG, 50 GHz to 75 GHz      | 0.190 dB                                                             | 0.193 dB         | 0.204 dB       |
|                                                                  | R&S®NRP90TWG, 60 GHz to 90 GHz      | 0.194 dB                                                             | 0.197 dB         | 0.208 dB       |
|                                                                  | R&S®NRP110TWG, 75 GHz to 110 GHz    | 0.198 dB                                                             | 0.201 dB         | 0.212 dB       |
| <b>Uncertainty for relative power measurements <sup>26</sup></b> |                                     | 0.014 dB                                                             |                  |                |

## Additional characteristics of the R&S®NRP75TWG/90TWG/110TWG thermal waveguide power sensors

|                                                                                   |                                              |                                                                                                                                            |
|-----------------------------------------------------------------------------------|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Sensor type</b>                                                                |                                              | thermoelectric power sensor                                                                                                                |
| <b>Measurand</b>                                                                  |                                              | power of incident wave<br>power of source (DUT) into matched waveguide <sup>11</sup>                                                       |
| <b>RF connector</b>                                                               | R&S®NRP75TWG                                 | WR15                                                                                                                                       |
|                                                                                   | R&S®NRP90TWG                                 | WR12                                                                                                                                       |
|                                                                                   | R&S®NRP110TWG                                | WR10                                                                                                                                       |
| <b>Measurement function</b>                                                       | stationary and recurring waveforms           | continuous average                                                                                                                         |
| <b>Continuous average function</b>                                                | measurand                                    | mean power over recurring acquisition interval                                                                                             |
|                                                                                   | aperture                                     | 0.5 ms to 300 ms (5 ms default)                                                                                                            |
|                                                                                   | window function                              | uniform or von Hann <sup>13</sup>                                                                                                          |
|                                                                                   | duty cycle correction <sup>14</sup>          | 0.001 % to 100.0 %                                                                                                                         |
|                                                                                   | capacity of measurement buffer <sup>15</sup> | 1 to 8192 results                                                                                                                          |
| <b>Averaging filter</b>                                                           | modes                                        | auto off (fixed averaging number)<br>auto on (continuously auto-adapted)<br>auto once (automatically fixed once)                           |
|                                                                                   | auto off                                     |                                                                                                                                            |
|                                                                                   | averaging number                             | 1, 2, 4, 6, 8, 10 to 65536 (1 or all even numbers between 2 and 65536)                                                                     |
|                                                                                   | auto on/once                                 |                                                                                                                                            |
|                                                                                   | normal operating mode                        | averaging number adapted to resolution setting and power to be measured                                                                    |
|                                                                                   | fixed noise operating mode                   | averaging number adapted to specified noise content                                                                                        |
|                                                                                   | result output                                |                                                                                                                                            |
|                                                                                   | moving mode                                  | continuous result output, independent of averaging number                                                                                  |
|                                                                                   | repeat mode                                  | only final result                                                                                                                          |
| <b>Attenuation correction</b>                                                     | function                                     | corrects the measurement result by means of a fixed factor (dB offset)                                                                     |
|                                                                                   | range                                        | –200.000 dB to +200.000 dB                                                                                                                 |
| <b>Embedding</b>                                                                  | function                                     | incorporates a two-port device at the sensor input so that the measurement plane is shifted to the input of this device                    |
|                                                                                   | parameters                                   | $S_{11}$ , $S_{21}$ , $S_{12}$ and $S_{22}$ of device                                                                                      |
|                                                                                   | frequencies                                  | 0 to 999                                                                                                                                   |
| <b>Gamma correction</b>                                                           | function                                     | removes the influence of impedance mismatch from the measurement result so that the power of the source (DUT) into 50 $\Omega$ can be read |
|                                                                                   | parameters                                   | magnitude and phase of reflection coefficient of source (DUT)                                                                              |
| <b>Frequency response correction</b>                                              | function                                     | takes the frequency response of the power sensor into account                                                                              |
|                                                                                   | parameter                                    | center frequency of test signal                                                                                                            |
|                                                                                   | residual uncertainty                         | see specification of calibration uncertainty and uncertainty for absolute and relative power measurements                                  |
| <b>Measurement time</b> <sup>20</sup><br>Av: averaging number                     | continuous average                           | $2 \times (\text{aperture} + 300 \mu\text{s}) \times \text{Av} + t_z + t_d$                                                                |
|                                                                                   | single measurements                          | $t_z : = 4 \text{ ms (typ.)}$<br>$t_d$ must be taken into account when auto delay is active                                                |
|                                                                                   | delay time $t_d$                             | 150 ms                                                                                                                                     |
| <b>Zeroing (duration)</b>                                                         |                                              | 10 s                                                                                                                                       |
| <b>Change of input reflection coefficient with respect to power</b> <sup>22</sup> | only for power levels > 15 dBm               | < 0.005                                                                                                                                    |

|                                                         |                                                         |                                                                                                                          |
|---------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <b>Calibration uncertainty</b> <sup>28</sup>            | R&S®NRP75TWG                                            |                                                                                                                          |
|                                                         | 50 GHz to 75 GHz                                        | 0.180 dB                                                                                                                 |
|                                                         | R&S®NRP90TWG                                            |                                                                                                                          |
|                                                         | 60 GHz to 90 GHz                                        | 0.184 dB                                                                                                                 |
|                                                         | R&S®NRP110TWG                                           |                                                                                                                          |
|                                                         | 75 GHz to 110 GHz                                       | 0.188 dB                                                                                                                 |
| <b>Linearity</b> <sup>29</sup>                          | 0.010 dB                                                |                                                                                                                          |
| <b>Temperature effect</b> <sup>30</sup>                 | < 0.004 dB/K                                            |                                                                                                                          |
| <b>Host interface</b>                                   | mechanical                                              | 8-pin male M12 connector (A-coded)                                                                                       |
|                                                         | power supply                                            | +5 V/0.5 A (USB high-power device)                                                                                       |
|                                                         | speed                                                   | supports high-speed and full-speed modes according to the specification                                                  |
|                                                         | remote control protocols                                | supports USB test and measurement device class (USBTMC) and legacy mode for compatibility with R&S®NRP-Zxx power sensors |
|                                                         | trigger input EXTERNAL[1]                               | differential (0 V/+3.3 V)                                                                                                |
|                                                         | reference clock                                         |                                                                                                                          |
|                                                         | signal level                                            | LVDS                                                                                                                     |
|                                                         | frequency                                               | 20 MHz                                                                                                                   |
|                                                         | permissible total cable length                          | ≤ 5 m                                                                                                                    |
|                                                         | mechanical                                              | RJ-45 jack                                                                                                               |
| <b>Ethernet interface</b><br>only for R&S®NRPxxTN types | power supply                                            | power over Ethernet (PoE) class 1 device                                                                                 |
|                                                         | speed                                                   | 10/100/1000 Mbit/s                                                                                                       |
|                                                         | remote control protocols                                | VXI11, HiSLIP (high-speed LAN instrument protocol), SCPI-RAW (port 5025)                                                 |
|                                                         | permissible cable length                                | ≤ 100 m                                                                                                                  |
|                                                         | mechanical                                              | SMB built-in jack                                                                                                        |
| <b>Trigger-I/O EXTERNAL2</b>                            | impedance                                               |                                                                                                                          |
|                                                         | input                                                   | 10 kΩ (nom.) or 50 Ω (nom.) selectable                                                                                   |
|                                                         | output                                                  | 50 Ω (nom.)                                                                                                              |
|                                                         | signal level                                            |                                                                                                                          |
|                                                         | input                                                   | compatible with 3 V or 5 V logic, max. -1 V to +6 V                                                                      |
|                                                         | output                                                  | ≥ 2 V into 50 Ω load, max. 5.3 V                                                                                         |
| <b>Dimensions (W × H × L)</b>                           | 48 mm × 30 mm × 128 mm<br>(1.89 in × 1.18 in × 5.04 in) |                                                                                                                          |
| <b>Weight</b>                                           | < 0.20 kg (0.44 lb)                                     |                                                                                                                          |

## Accessories for R&S®NRP power sensors

Accessories are not approved for the usage in thermal vacuum chambers.

### R&S®NRP-ZKU interface cables

The R&S®NRP-ZKU interface cables are used to connect Rohde & Schwarz power sensors described in this data sheet to any standard-conforming USB downstream port (type A receptacle), e.g. on a PC, USB hub or a Rohde & Schwarz instrument.

|                   |             |                                      |
|-------------------|-------------|--------------------------------------|
| <b>Connectors</b> | sensor side | 8-pin female M12 connector (A-coded) |
|                   | host side   | USB type A plug                      |
| <b>Length</b>     | model .02   | 0.75 m                               |
|                   | model .03   | 1.50 m                               |
|                   | model .04   | 3.00 m                               |
|                   | model .05   | 5.00 m                               |

The R&S®NRP-ZKU interface cables must not be combined with passive USB extension cables as well as commercially available M12 extension cables. Using such extension cables can affect the reliability of the high-speed data transfer.

### R&S®NRP-ZK6 interface cables

The R&S®NRP-ZK6 interface cables are used to connect Rohde & Schwarz power sensors described in this data sheet to an R&S®NRX power meter, R&S®NRP2 power meter, R&S®NRP-Z5 sensor hub or a Rohde & Schwarz instrument providing a 6-pole circular receptacle for R&S®NRP power sensors.

|                   |             |                                             |
|-------------------|-------------|---------------------------------------------|
| <b>Connectors</b> | sensor side | 8-pin female M12 connector (A-coded)        |
|                   | host side   | 6-pole circular plug with push-pull locking |
| <b>Length</b>     | model .02   | 1.50 m                                      |
|                   | model .03   | 3.00 m                                      |
|                   | model .04   | 5.00 m                                      |

The R&S®NRP-ZK6 interface cables must not be combined with the R&S®NRP-Z2/-Z3/-Z4 cables as well as commercially available M12 extension cables. Using such extension or adapter cables can affect the reliability of the high-speed data transfer.

### R&S®NRP-ZK8 interface cables

The R&S®NRP-ZK8 interface cables are used to connect Rohde & Schwarz power sensors described in this data sheet to an R&S®NRX power meter. Compared to R&S®NRP-ZK6, they contain an additional signal pair for routing the common time base clock provided by the NRX to sensors A, B, C and D.

|                   |             |                                             |
|-------------------|-------------|---------------------------------------------|
| <b>Connectors</b> | sensor side | 8-pin female M12 connector (A-coded)        |
|                   | host side   | 8-pole circular plug with push-pull locking |
| <b>Length</b>     | model .02   | 1.50 m                                      |
|                   | model .03   | 3.00 m                                      |
|                   | model .04   | 5.00 m                                      |

The R&S®NRP-ZK8 interface cables must not be combined with commercially available M12 extension cables. Using such extension cables can affect the reliability of the high-speed data transfer.

## R&S®NRP-ZKVSJR Ethernet cables for TVAC applications

The R&S®NRP-ZKVSJR Gigabit Ethernet cables are used to connect the R&S®NRP33SN-V and R&S®NRP67SN-V power sensors to a PoE-capable Ethernet switch, a PoE injector or to the vacuum side of an RJ-45 vacuum feedthrough.

|                                       |                                           |                                                                                                  |
|---------------------------------------|-------------------------------------------|--------------------------------------------------------------------------------------------------|
| <b>Connectors</b>                     |                                           | 2 × RJ-45                                                                                        |
| Length                                | model .02                                 | 1.50 m                                                                                           |
|                                       | model .03                                 | 3.00 m                                                                                           |
|                                       | model .05                                 | 5.00 m                                                                                           |
|                                       | model .15                                 | 15.00 m                                                                                          |
|                                       | model .30                                 | 30.00 m                                                                                          |
|                                       | model .60                                 | 60.00 m                                                                                          |
| <b>Electrical specifications</b>      | cable category                            | Cat. 6                                                                                           |
|                                       | conductor type                            | 26 AWG (stranded)                                                                                |
| <b>Temperature range</b>              | operating and non-operating               | –40 °C to +120 °C                                                                                |
| <b>Vacuum-specific specifications</b> | insulation and sheath material            | FEP                                                                                              |
|                                       | bake-out procedure (performed in factory) | vacuum bake for 72 h at (100 ± 10) °C and $P < 5 \cdot 10^{-4}$ mbar, in line with MSFC-SPEC-684 |
|                                       | packaging                                 | metalized polyester foil, vacuum welded                                                          |

## R&S®NRP-ZKVSMD Ethernet cables for TVAC applications

The R&S®NRP-ZKVSMD Gigabit Ethernet cables are used to connect the R&S®NRP33SN-V and R&S®NRP67SN-V power sensors to the vacuum side of a 9-pole Micro-D (f) vacuum feedthrough. They are complemented by the R&S®NRP-ZKASMD air side cables.

|                                       |                                           |                                                                                                  |
|---------------------------------------|-------------------------------------------|--------------------------------------------------------------------------------------------------|
| <b>Connectors</b>                     |                                           | 1 × RJ-45<br>1 × Micro-D (m), in line with MIL-DTL-83513                                         |
| Length                                | model .02                                 | 1.50 m                                                                                           |
|                                       | model .03                                 | 3.00 m                                                                                           |
|                                       | model .05                                 | 5.00 m                                                                                           |
|                                       | model .15                                 | 15.00 m                                                                                          |
|                                       | model .30                                 | 30.00 m                                                                                          |
|                                       | model .60                                 | 60.00 m                                                                                          |
| <b>Electrical specifications</b>      | cable category                            | Cat. 6                                                                                           |
|                                       | conductor type                            | 26 AWG (stranded)                                                                                |
| <b>Temperature range</b>              | operating and non-operating               | –40 °C to +120 °C                                                                                |
| <b>Vacuum-specific specifications</b> | insulation and sheath material            | FEP                                                                                              |
|                                       | bake-out procedure (performed in factory) | vacuum bake for 72 h at (100 ± 10) °C and $P < 5 \cdot 10^{-4}$ mbar, in line with MSFC-SPEC-684 |
|                                       | packaging                                 | metalized polyester foil, vacuum welded                                                          |

## R&S®NRP-ZKASMD Ethernet cables (air side cables)

The R&S®NRP-ZKASMD Gigabit Ethernet cables are used to connect the air side of a 9-pole Micro-D (f) vacuum feedthrough to a PoE-capable Ethernet switch, a PoE injector, etc. The pinout of the Micro-D connector matches the R&S®NRP-ZKVSMD vacuum side cables.

|                                       |                                           |                                                          |
|---------------------------------------|-------------------------------------------|----------------------------------------------------------|
| <b>Connectors</b>                     |                                           | 1 × Micro-D (m), in line with MIL-DTL-83513<br>1 × RJ-45 |
| Length                                | model .02                                 | 1.50 m                                                   |
|                                       | model .03                                 | 3.00 m                                                   |
|                                       | model .05                                 | 5.00 m                                                   |
|                                       | model .15                                 | 15.00 m                                                  |
|                                       | model .30                                 | 30.00 m                                                  |
|                                       | model .60                                 | 60.00 m                                                  |
| <b>Electrical specifications</b>      | cable category                            | Cat. 6                                                   |
|                                       | conductor type                            | 26 AWG (stranded)                                        |
| <b>Temperature range</b>              | operating and non-operating               | –20 °C to +120 °C                                        |
| <b>Vacuum-specific specifications</b> | insulation and sheath material            | FEP                                                      |
|                                       | bake-out procedure (performed in factory) | none                                                     |

The R&S®NRP-ZKASMD cables have a visible marking that identifies them as air side cables. Though they are not designed for vacuum use and are not vacuum baked in factory, their FEP insulation and sheathing prevents serious contamination of the vacuum chamber through inadvertent vacuum-side use.

## General data for R&S®NRP power sensors and accessories

|                                      |                                                                                                                                                       |                                                                                                                       |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| <b>Temperature</b> <sup>31</sup>     | R&S®NRPxxS(N), R&S®NRP18S-10/-20/-25<br>R&S®NRPxxT(N), R&S®NRPxxA(N), R&S®NRP-ZKx                                                                     |                                                                                                                       |
|                                      | operating temperature range                                                                                                                           | 0 °C to +50 °C                                                                                                        |
|                                      | permissible temperature range                                                                                                                         | –10 °C to +55 °C                                                                                                      |
|                                      | storage temperature range                                                                                                                             | –40 °C to +85 °C                                                                                                      |
|                                      | R&S®NRP33SN-V/67SN-V                                                                                                                                  |                                                                                                                       |
|                                      | operating temperature range                                                                                                                           | 0 °C to +50 °C                                                                                                        |
|                                      | permissible temperature range                                                                                                                         | –10 °C to +60 °C                                                                                                      |
|                                      | storage temperature range                                                                                                                             | –40 °C to +85 °C                                                                                                      |
| <b>Climatic resistance</b>           | damp heat                                                                                                                                             | +25 °C/+55 °C cyclic at 95 % relative humidity<br>with restrictions: noncondensing,<br>in line with EN 60068-2-30     |
| <b>Mechanical resistance</b>         | vibration                                                                                                                                             |                                                                                                                       |
|                                      | sinusoidal                                                                                                                                            | 5 Hz to 55 Hz, 0.15 mm amplitude,<br>1.8 g at 55 Hz,<br>55 Hz to 150 Hz, 0.5 g constant,<br>in line with EN 60068-2-6 |
|                                      | random                                                                                                                                                | 8 Hz to 650 Hz, 1.9 g (RMS),<br>in line with EN 60068-2-64                                                            |
|                                      | shock                                                                                                                                                 | 45 Hz to 2 kHz, max. 40 g shock spectrum,<br>in line with MIL-STD-810E, method 516.4,<br>procedure I                  |
| <b>Altitude</b>                      | R&S®NRPxxS(N), R&S®NRP18S-10/-20/-25<br>R&S®NRPxxT(N), R&S®NRPxxA(N), R&S®NRP-ZKx                                                                     |                                                                                                                       |
|                                      | operating                                                                                                                                             | max. 2000 m                                                                                                           |
|                                      | transport                                                                                                                                             | max. 15000 m                                                                                                          |
| <b>Air pressure</b>                  | R&S®NRP33SN-V/67SN-V                                                                                                                                  |                                                                                                                       |
|                                      | operating <sup>32</sup>                                                                                                                               | 0 hPa to 1060 hPa                                                                                                     |
|                                      | transport                                                                                                                                             | 0 hPa to 1060 hPa                                                                                                     |
| <b>Electromagnetic compatibility</b> | applied harmonized standards:<br><ul style="list-style-type: none"> <li>• EN 61326-1</li> <li>• EN 61326-2-1</li> <li>• EN 55011 (class B)</li> </ul> |                                                                                                                       |
| <b>Calibration interval</b>          | recommended                                                                                                                                           | 2 years                                                                                                               |

## R&S®NRX base unit

|                                                                     |                                                           |                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Application</b>                                                  |                                                           | universal power meter                                                                                                                                                                                                                                                    |
| <b>Sensors</b>                                                      |                                                           | R&S®NRPxxS(N), R&S®NRPxxA(N),<br>R&S®NRPxxT(N), R&S®NRPxxTWG,<br>R&S®NRP-Zxx and R&S®NRQ6                                                                                                                                                                                |
| <b>Sensor connectors</b>                                            | standard                                                  | two sensor connectors (A and B) on front panel                                                                                                                                                                                                                           |
|                                                                     | with R&S®NRX-B4 option                                    | two additional sensor connectors (C and D) on rear panel                                                                                                                                                                                                                 |
|                                                                     | connector                                                 | 8-pole receptacle; mates with R&S®NRP-ZK8,<br>R&S®NRP-ZK6 and 6-pole push-pull plug of<br>R&S®NRP-Zxx series sensors                                                                                                                                                     |
| <b>Measurement channels</b>                                         | standard                                                  | one measurement channel                                                                                                                                                                                                                                                  |
|                                                                     | with R&S®NRX-K2 option                                    | two measurement channels                                                                                                                                                                                                                                                 |
|                                                                     | with R&S®NRX-K2 and R&S®NRX-K4 options                    | four measurement channels                                                                                                                                                                                                                                                |
| <b>Frequency range</b>                                              |                                                           | DC to 110 GHz (sensor-dependent)                                                                                                                                                                                                                                         |
| <b>Power measurement range</b>                                      |                                                           | 0.1 fW to 30 W (average)<br>(sensor-dependent)                                                                                                                                                                                                                           |
| <b>Measurement functions</b>                                        |                                                           |                                                                                                                                                                                                                                                                          |
| Single channel                                                      |                                                           | see sensor specifications, plus:<br>relative measurement referenced to result or user-selectable reference value, storage of minima and maxima (max., min., max. – min.), limit monitoring                                                                               |
|                                                                     | display                                                   |                                                                                                                                                                                                                                                                          |
|                                                                     | absolute                                                  | in W, dBm and dBμV                                                                                                                                                                                                                                                       |
|                                                                     | relative                                                  | in dB, as change in percent ( $\Delta$ %) or as quotient                                                                                                                                                                                                                 |
| Multichannel                                                        |                                                           | simultaneous measurement in up to 4 channels; individual results, ratios, relative ratios <sup>33</sup> , or difference of results of 2 channels can be displayed                                                                                                        |
|                                                                     | display                                                   |                                                                                                                                                                                                                                                                          |
|                                                                     | ratio                                                     | in dB, as change in percent ( $\Delta$ %), as quotient or as one of the following impedance matching parameters:<br>SWR, return loss, reflection coefficient                                                                                                             |
|                                                                     | relative ratio <sup>33</sup>                              | in dB, as change in percent ( $\Delta$ %) or as quotient                                                                                                                                                                                                                 |
| <b>Measurement uncertainty</b>                                      |                                                           | see sensor specifications                                                                                                                                                                                                                                                |
| <b>Accuracy of common time base clock for sensors A, B, C and D</b> |                                                           | ±5 ppm<br>(R&S®NRP-ZK8 required)                                                                                                                                                                                                                                         |
| <b>Display</b>                                                      |                                                           |                                                                                                                                                                                                                                                                          |
| Physical characteristics                                            | type                                                      | 127 mm (5") TFT color display                                                                                                                                                                                                                                            |
|                                                                     | resolution                                                | 800 × 480 pixel (WVGA)                                                                                                                                                                                                                                                   |
| Result representation                                               | numeric measurements                                      | up to four results can simultaneously be displayed in separate windows using selectable layouts: <ul style="list-style-type: none"> <li>• full-size</li> <li>• 2 × half-size</li> <li>• half-size + 2 × 1/4-size</li> <li>• half-size + 3 × 1/6-size</li> </ul>          |
|                                                                     | format                                                    | digital, digital + bargraph                                                                                                                                                                                                                                              |
|                                                                     | resolution                                                |                                                                                                                                                                                                                                                                          |
|                                                                     | digital values                                            | selectable in four steps: <ul style="list-style-type: none"> <li>• 1 dB/1.0 %/2 ½ digits (W, quotient)</li> <li>• 0.1 dB/1.0 %/2 ½ digits (W, quotient)</li> <li>• 0.01 dB/0.1 %/3 ½ digits (W, quotient)</li> <li>• 0.001 dB/0.01 %/4 ½ digits (W, quotient)</li> </ul> |
|                                                                     | bargraph                                                  | depending on user-definable scale end values                                                                                                                                                                                                                             |
|                                                                     | auxiliary values (optional in full- or half-size windows) |                                                                                                                                                                                                                                                                          |
|                                                                     | extremes                                                  | maximum, minimum, maximum – minimum                                                                                                                                                                                                                                      |
|                                                                     | statistical parameters                                    | mean, standard deviation, measurement count                                                                                                                                                                                                                              |
|                                                                     | measurement of power versus time                          | one or two traces can be displayed in one window: <ul style="list-style-type: none"> <li>• absolute power</li> <li>• ratio of two channels</li> <li>• sum of two channels</li> <li>• difference of two channels</li> </ul>                                               |
|                                                                     | additional information                                    | <ul style="list-style-type: none"> <li>• marker measurements</li> <li>• gate and timeslot measurements</li> </ul>                                                                                                                                                        |

|                                       |                                              |                                                                                                                                                                                                                                                                                               |
|---------------------------------------|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                       | power envelope statistics                    | versus absolute power in dBm or versus relative power referenced to the average power level: <ul style="list-style-type: none"> <li>• CCDF</li> <li>• CDF</li> <li>• PDF</li> </ul>                                                                                                           |
|                                       | additional information                       | marker measurements                                                                                                                                                                                                                                                                           |
| <b>Manual operation</b>               |                                              | via capacitive touch panel and/or keypad                                                                                                                                                                                                                                                      |
| <b>Remote control</b>                 |                                              |                                                                                                                                                                                                                                                                                               |
| Systems                               |                                              | IEC 60625.1 (IEEE 488.1),<br>IEC 60625.2 (IEEE 488.2)                                                                                                                                                                                                                                         |
| Command set                           |                                              | SCPI-1999.0                                                                                                                                                                                                                                                                                   |
| IEC/IEEE bus (R&S®NRX-B8 option)      | interface functions                          | SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0                                                                                                                                                                                                                                                 |
| USB                                   | connector                                    | 24-pin Amphenol (female)                                                                                                                                                                                                                                                                      |
|                                       |                                              | USB 2.0 high-speed                                                                                                                                                                                                                                                                            |
|                                       | connector                                    | USB type B receptacle                                                                                                                                                                                                                                                                         |
| Ethernet                              | supported protocols                          | USBTMC via VISA                                                                                                                                                                                                                                                                               |
|                                       |                                              | 10/100/1000BASE-T                                                                                                                                                                                                                                                                             |
|                                       | connector                                    | RJ-45 modular socket                                                                                                                                                                                                                                                                          |
| Measurement times                     | supported protocols                          | VXI-11, HiSLIP, SCPI-RAW                                                                                                                                                                                                                                                                      |
|                                       | single continuous average measurements, with | add 2 ms (meas.) to sensor specifications                                                                                                                                                                                                                                                     |
|                                       | SYSTem:SPEEd FAST                            |                                                                                                                                                                                                                                                                                               |
| <b>Analog outputs and trigger I/O</b> |                                              |                                                                                                                                                                                                                                                                                               |
| Out 1/Trig Out                        | Out 1 (analog output 1)                      | recorder output; user-definable linear relation to measurement result                                                                                                                                                                                                                         |
|                                       | output voltage range                         | 0 V to 2.5 V (no load)                                                                                                                                                                                                                                                                        |
|                                       | output resistance                            | 600 $\Omega$ (nom.)                                                                                                                                                                                                                                                                           |
|                                       | accuracy of no-load output voltage           | $\pm(0.4\%$ of output voltage + 4 mV)                                                                                                                                                                                                                                                         |
|                                       | resolution                                   | 16 bit                                                                                                                                                                                                                                                                                        |
|                                       | update rate                                  | same as result rate of sensor                                                                                                                                                                                                                                                                 |
|                                       | Trig Out (trigger output)                    | signaling output; user-definable logic levels for the PASS and FAIL states in the case of limit monitoring                                                                                                                                                                                    |
|                                       | high-level output voltage                    | $(5.1 \pm 0.2)$ V ( $\geq 10$ k $\Omega$ load),<br>2.6 V (nom.) (50 $\Omega$ load)                                                                                                                                                                                                            |
|                                       | low-level output voltage                     | 0 V to 0.4 V (meas.) (5 mA sink current)                                                                                                                                                                                                                                                      |
|                                       | output impedance                             | 50 $\Omega$ (nom.)                                                                                                                                                                                                                                                                            |
| Trig In/Out 2                         | connector                                    | BNC (female)                                                                                                                                                                                                                                                                                  |
|                                       | Trig In (trigger input)                      | input for trigger signals to sensors<br>(routed internally to ports Sensor A–D; translated to *TRG command for sensors operated on standard USB ports and via network)                                                                                                                        |
|                                       | input impedance                              | 10 k $\Omega$ (nom.) or 50 $\Omega$ (nom.) selectable                                                                                                                                                                                                                                         |
|                                       | absolute minimum voltage                     | –3 V                                                                                                                                                                                                                                                                                          |
|                                       | absolute maximum voltage                     | 6 V (with 10 k $\Omega$ input impedance),<br>4 V (with 50 $\Omega$ input impedance)                                                                                                                                                                                                           |
|                                       | low-to-high input threshold                  | $(1.8 \pm 0.3)$ V                                                                                                                                                                                                                                                                             |
|                                       | high-to-low input threshold                  | $(1.15 \pm 0.25)$ V                                                                                                                                                                                                                                                                           |
|                                       | Out 2 (analog output 2)                      | recorder output; user-definable linear relation to measurement result                                                                                                                                                                                                                         |
|                                       | electrical characteristics                   | see Out 1                                                                                                                                                                                                                                                                                     |
|                                       | connector                                    | BNC (female)                                                                                                                                                                                                                                                                                  |
| <b>USB host ports</b>                 |                                              | two USB 2.0 high-speed host ports<br>(one on front panel, one on rear panel)                                                                                                                                                                                                                  |
|                                       | connector                                    | USB type A receptacle                                                                                                                                                                                                                                                                         |
| <b>Firmware update</b>                |                                              | <ul style="list-style-type: none"> <li>• from a USB flash memory stick (copy .rsu file to root directory and connect to either USB host port of R&amp;S®NRX)</li> <li>• from the R&amp;S®NRP toolkit via Ethernet or USBTMC using a Windows program; VISA installation is required</li> </ul> |
| <b>Environmental conditions</b>       |                                              |                                                                                                                                                                                                                                                                                               |
| Temperature                           | operating temperature range                  | 0 °C to +50 °C                                                                                                                                                                                                                                                                                |
|                                       | permissible temperature range                | –10 °C to +55 °C                                                                                                                                                                                                                                                                              |
|                                       | storage temperature range                    | –40 °C to +70 °C                                                                                                                                                                                                                                                                              |
| Damp heat                             | noncondensing                                | +25 °C/+55 °C, 95 % rel. humidity, cyclic,<br>in line with EN 60068-2-30                                                                                                                                                                                                                      |
| Altitude                              | operating or nonoperating                    | max. 4600 m                                                                                                                                                                                                                                                                                   |

|                                                                                      |                                                                 |                                                                                                                                                                                                                                                           |
|--------------------------------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Mechanical resistance</b>                                                         |                                                                 |                                                                                                                                                                                                                                                           |
| Vibration                                                                            | sinusoidal                                                      | 5 Hz to 55 Hz, 0.15 mm amplitude const.,<br>55 Hz to 150 Hz, acceleration 0.5 g const.,<br>in line with EN 60068-2-6                                                                                                                                      |
|                                                                                      | random                                                          | 10 Hz to 500 Hz, acceleration 1.9 g (RMS),<br>in line with EN 60068-2-64                                                                                                                                                                                  |
| Shock                                                                                |                                                                 | 40 g shock spectrum, in line with MIL-STD-810E,<br>method 516.4, procedure I                                                                                                                                                                              |
| <b>Power rating</b>                                                                  |                                                                 |                                                                                                                                                                                                                                                           |
| Rated voltage                                                                        | nominal voltage                                                 | 100 V to 240 V                                                                                                                                                                                                                                            |
|                                                                                      | voltage range                                                   | 90 V to 264 V                                                                                                                                                                                                                                             |
| Rated frequency                                                                      | nominal frequency                                               | 50 Hz to 60 Hz or 400 Hz                                                                                                                                                                                                                                  |
|                                                                                      | frequency range                                                 | 47 Hz to 63 Hz or 380 Hz to 420 Hz                                                                                                                                                                                                                        |
| Rated current (including options,<br>connected sensors and connected<br>USB devices) | at 100 V AC                                                     | max. 1.7 A                                                                                                                                                                                                                                                |
|                                                                                      | at 240 V AC                                                     | max. 0.8 A                                                                                                                                                                                                                                                |
| <b>Product conformity</b>                                                            |                                                                 |                                                                                                                                                                                                                                                           |
| Electromagnetic compatibility                                                        | EU: in line with EMC Directive<br>2014/30/EU                    | applied harmonized standards: <ul style="list-style-type: none"> <li>• EN 61326-1 (industrial environment)</li> <li>• EN 61326-2-1</li> <li>• EN 55011 (class B)</li> <li>• EN 55022 (class B)</li> <li>• EN 61000-3-2</li> <li>• EN 61000-3-3</li> </ul> |
| Electrical safety                                                                    | EU: in line with Low Voltage Directive<br>2006/95/EC            | applied harmonized standard:<br>EN 61010-1                                                                                                                                                                                                                |
|                                                                                      | USA                                                             | UL 61010-1                                                                                                                                                                                                                                                |
|                                                                                      | Canada                                                          | CAN/CSA-C22.2 No. 61010-1                                                                                                                                                                                                                                 |
| <b>Dimensions</b>                                                                    | W × H × D                                                       | 234 mm × 106 mm × 272 mm<br>(9.21 in × 4.17 in × 10.71 in)                                                                                                                                                                                                |
| <b>Weight</b>                                                                        | without any options installed                                   | 2.35 kg (5.18 lb)                                                                                                                                                                                                                                         |
|                                                                                      | with R&S®NRX-B1, R&S®NRX-B4 and<br>R&S®NRX-B8 options installed | 2.58 kg (5.69 lb)                                                                                                                                                                                                                                         |

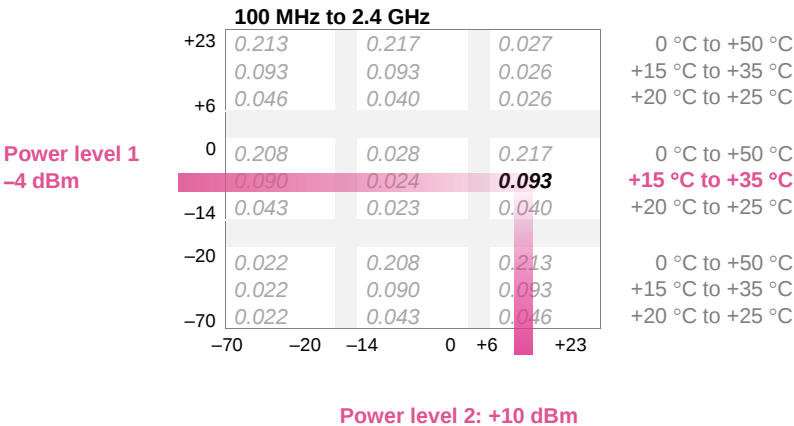
## Options for the R&S®NRX base unit

|                                                                 |                                  |                                                                                                                                             |
|-----------------------------------------------------------------|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| <b>R&amp;S®NRX-B1 sensor check source</b>                       | application                      | as a power reference for testing sensors                                                                                                    |
|                                                                 | mutually exclusive with          | R&S®NRX-B9                                                                                                                                  |
|                                                                 | frequency                        | 50 MHz (nom.) or 1 GHz (nom.) selectable                                                                                                    |
|                                                                 | power                            |                                                                                                                                             |
|                                                                 | CW and pulses                    | –20 dBm (10 µW)<br>–10 dBm (100 µW)<br>0 dBm (1 mW)<br>+10 dBm (10 mW)                                                                      |
|                                                                 | CW only                          | +20 dBm (100 mW)                                                                                                                            |
|                                                                 | uncertainty                      |                                                                                                                                             |
|                                                                 | +20 °C to +25 °C                 | 0.85 % at 50 MHz<br>1.00 % at 1 GHz                                                                                                         |
|                                                                 | +15 °C to +35 °C                 | 1.00 % at 50 MHz<br>1.20 % at 1 GHz                                                                                                         |
|                                                                 | 0 °C to +50 °C                   | 1.00 % at 50 MHz, 0 dBm<br>1.30 % at 50 MHz, –20 dBm, –10 dBm,<br>+10 dBm, +20 dBm<br>1.50 % at 1 GHz                                       |
|                                                                 | pulse repetition frequency       | 10 kHz ± 5 ppm <sup>34</sup>                                                                                                                |
|                                                                 | duty cycle                       | (50 ± 0.02) %                                                                                                                               |
|                                                                 | on/off ratio                     | 60 dB (typ.)                                                                                                                                |
|                                                                 | rise/fall time                   | 5 ns (typ.) at 1 GHz,<br>20 ns (typ.) at 50 MHz                                                                                             |
|                                                                 | SWR                              | < 1.05 (typ.)                                                                                                                               |
|                                                                 | RF connector                     | N (female) on front panel                                                                                                                   |
|                                                                 | source impedance                 | 50 Ω (nom.)                                                                                                                                 |
| <b>R&amp;S®NRX-B4 third (C) and fourth (D) sensor connector</b> | weight                           | 0.155 kg                                                                                                                                    |
|                                                                 | recommended calibration interval | 2 years                                                                                                                                     |
| <b>R&amp;S®NRX-B8 GPIB/IEEE488 interface</b>                    | application                      | provides two additional sensor connectors on rear panel                                                                                     |
|                                                                 | weight                           | 0.025 kg                                                                                                                                    |
| <b>R&amp;S®NRX-B9 interface for R&amp;S®NRT-Z sensors</b>       | application                      | provides a GPIB/IEEE488 interface                                                                                                           |
|                                                                 | weight                           | 0.055 kg                                                                                                                                    |
| <b>R&amp;S®NRX-B9 interface for R&amp;S®NRT-Z sensors</b>       | application                      | provides an additional connector for R&S®NRT-Z14, R&S®NRT-Z43 or R&S®NRT-Z44 directional power sensors                                      |
|                                                                 | mutually exclusive with          | R&S®NRX-B1                                                                                                                                  |
|                                                                 | connector                        | LEMO S series, ERA model, size 2, 6-pole receptacle on front panel<br>(1: RXD+, 2: RXD–, 3: V <sub>SUPPLY</sub> , 4: GND, 5: TXD–, 6: TXD+) |
| <b>R&amp;S®NRX-K2 second measurement channel</b>                | weight                           | 0.135 kg                                                                                                                                    |
|                                                                 | application                      | allows using up to two sensors simultaneously                                                                                               |
| <b>R&amp;S®NRX-K4 third and fourth measurement channel</b>      | application                      | allows using up to four sensors simultaneously (R&S®NRX-K2 required)                                                                        |

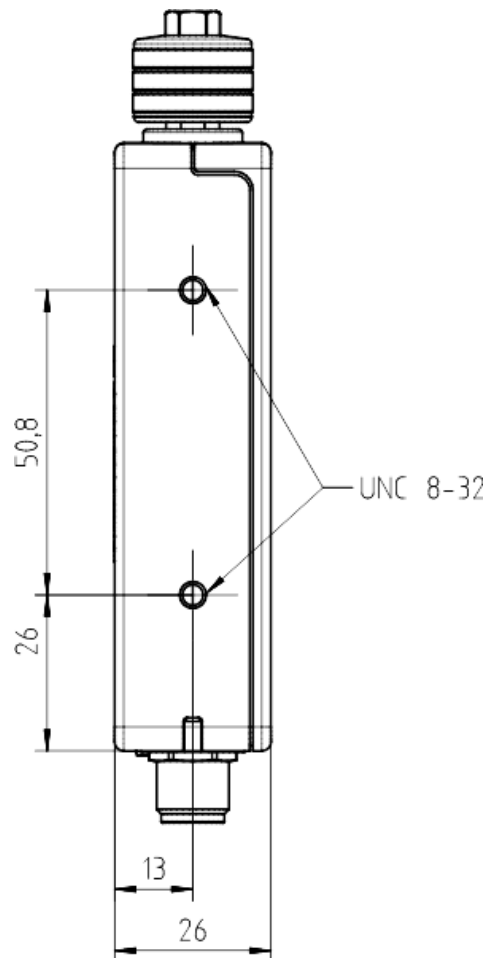
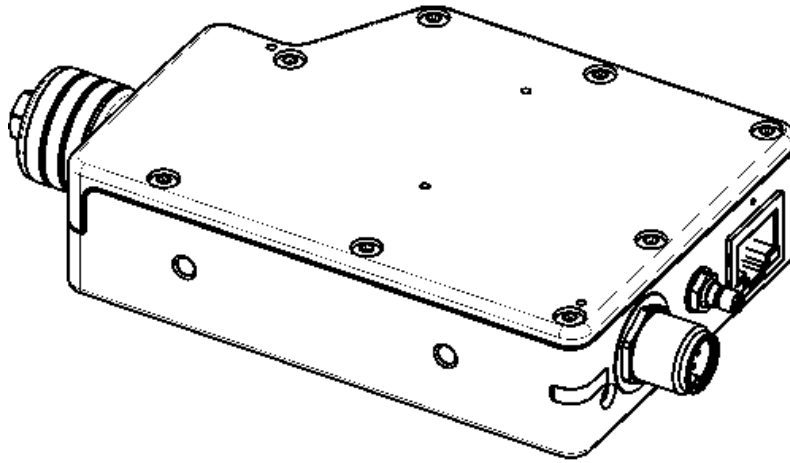
# Appendix

## Reading the uncertainty of multipath power sensors for relative power measurements

The example shows a level step of approx. 14 dB (−4 dBm → +10 dBm) at 1.9 GHz and an ambient temperature of +28 °C for an R&S®NRP8S power sensor. The expanded uncertainty for relative power measurements in this example is 0.093 dB.



## Technical drawings of the R&S®NRP33SN-V/-67SN-V TVAC-compliant three-path diode power sensor



*Dimensions in mm*

# Ordering information

| Designation                                                     | Type          | Order No.    |
|-----------------------------------------------------------------|---------------|--------------|
| <b>Base unit</b>                                                |               |              |
| Power meter                                                     | R&S®NRX       | 1424.7005.02 |
| <b>Options for the R&amp;S®NRX base unit</b>                    |               |              |
| Second measurement channel                                      | R&S®NRX-K2    | 1424.9208.02 |
| Third and fourth measurement channel                            | R&S®NRX-K4    | 1424.9308.02 |
| Sensor check source                                             | R&S®NRX-B1    | 1424.7805.02 |
| Third (C) and fourth (D) sensor connector for R&S®NRP           | R&S®NRX-B4    | 1424.8901.02 |
| GPIO/IEEE488 interface                                          | R&S®NRX-B8    | 1424.8301.02 |
| Sensor interface, for R&S®NRT                                   | R&S®NRX-B9    | 1424.8601.02 |
| <b>Three-path diode power sensors</b>                           |               |              |
| 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 |
| 100 pW to 100 mW, 50 MHz to 40 GHz                              | R&S®NRP40S    | 1419.0041.02 |
| 100 pW to 100 mW, 50 MHz to 40 GHz, LAN version                 | R&S®NRP40SN   | 1419.0058.02 |
| 100 pW to 100 mW, 50 MHz to 50 GHz                              | R&S®NRP50S    | 1419.0087.02 |
| 100 pW to 100 mW, 50 MHz to 50 GHz, LAN version                 | R&S®NRP50SN   | 1419.0093.02 |
| 100 pW to 100 mW, 50 MHz to 67 GHz                              | R&S®NRP67S    | 1424.6396.02 |
| 100 pW to 100 mW, 50 MHz to 67 GHz, LAN version                 | R&S®NRP67SN   | 1424.6409.02 |
| <b>High-power three-path diode power sensors</b>                |               |              |
| 1 nW to 2 W, 10 MHz to 18 GHz                                   | R&S®NRP18S-10 | 1424.6721.02 |
| 10 nW to 15 W, 10 MHz to 18 GHz                                 | R&S®NRP18S-20 | 1424.6738.02 |
| 30 nW to 30 W, 10 MHz to 18 GHz                                 | R&S®NRP18S-25 | 1424.6744.02 |
| <b>TVAC-compliant three-path diode power sensor</b>             |               |              |
| 100 pW to 200 mW, 10 MHz to 33 GHz, LAN version, TVAC-compliant | R&S®NRP33SN-V | 1419.0129.02 |
| 100 pW to 100 mW, 50 MHz to 67 GHz, LAN version, TVAC-compliant | R&S®NRP67SN-V | 1424.6415.02 |
| <b>Thermal power sensors</b>                                    |               |              |
| 300 nW to 100 mW, DC to 18 GHz                                  | R&S®NRP18T    | 1424.6115.02 |
| 300 nW to 100 mW, DC to 18 GHz, LAN version                     | R&S®NRP18TN   | 1424.6121.02 |
| 300 nW to 100 mW, DC to 33 GHz                                  | R&S®NRP33T    | 1424.6138.02 |
| 300 nW to 100 mW, DC to 33 GHz, LAN version                     | R&S®NRP33TN   | 1424.6144.02 |
| 300 nW to 100 mW, DC to 40 GHz                                  | R&S®NRP40T    | 1424.6150.02 |
| 300 nW to 100 mW, DC to 40 GHz, LAN version                     | R&S®NRP40TN   | 1424.6167.02 |
| 300 nW to 100 mW, DC to 50 GHz                                  | R&S®NRP50T    | 1424.6173.02 |
| 300 nW to 100 mW, DC to 50 GHz, LAN version                     | R&S®NRP50TN   | 1424.6180.02 |
| 300 nW to 100 mW, DC to 67 GHz                                  | R&S®NRP67T    | 1424.6196.02 |
| 300 nW to 100 mW, DC to 67 GHz, LAN version                     | R&S®NRP67TN   | 1424.6209.02 |
| 300 nW to 100 mW, DC to 90 GHz                                  | R&S®NRP90T    | 1424.6473.02 |
| 300 nW to 100 mW, DC to 90 GHz, LAN version                     | R&S®NRP90TN   | 1424.6480.02 |
| 300 nW to 100 mW, DC to 110 GHz                                 | R&S®NRP110T   | 1424.6215.02 |
| <b>Thermal waveguide power sensors</b>                          |               |              |
| 300 nW to 100 mW, 50 GHz to 75 GHz                              | R&S®NRP75TWG  | 1700.2529.02 |
| 300 nW to 100 mW, 60 GHz to 90 GHz                              | R&S®NRP90TWG  | 1700.2312.02 |
| 300 nW to 100 mW, 75 GHz to 110 GHz                             | R&S®NRP110TWG | 1173.8709.02 |
| <b>Average power sensors</b>                                    |               |              |
| 100 pW to 200 mW, 8 kHz to 6 GHz                                | R&S®NRP6A     | 1424.6796.02 |
| 100 pW to 200 mW, 8 kHz to 6 GHz, LAN version                   | R&S®NRP6AN    | 1424.6809.02 |
| 100 pW to 200 mW, 8 kHz to 18 GHz                               | R&S®NRP18A    | 1424.6815.02 |
| 100 pW to 200 mW, 8 kHz to 18 GHz, LAN version                  | R&S®NRP18AN   | 1424.6821.02 |

| Designation                                                              | Type            | Order No.    |
|--------------------------------------------------------------------------|-----------------|--------------|
| <b>Recommended extras for R&amp;S®NRX</b>                                |                 |              |
| 19" rack adapter (for one R&S®NRX power meter and one empty casing)      | R&S®ZZA-KNA22   | 1177.8184.00 |
| 19" rack adapter (for two R&S®NRX power meters)                          | R&S®ZZA-KNA24   | 1177.8149.00 |
| <b>Recommended extras for R&amp;S®NRPxxS(N)/T(N)/A(N)</b>                |                 |              |
| A minimum of one interface cable is required for power sensor operation. |                 |              |
| USB interface cable, length: 0.75 m                                      | R&S®NRP-ZKU     | 1419.0658.02 |
| USB interface cable, length: 1.50 m                                      | R&S®NRP-ZKU     | 1419.0658.03 |
| USB interface cable, length: 3.00 m                                      | R&S®NRP-ZKU     | 1419.0658.04 |
| USB interface cable, length: 5.00 m                                      | R&S®NRP-ZKU     | 1419.0658.05 |
| 6-pole interface cable, length: 1.50 m                                   | R&S®NRP-ZK6     | 1419.0664.02 |
| 6-pole interface cable, length: 3.00 m                                   | R&S®NRP-ZK6     | 1419.0664.03 |
| 6-pole interface cable, length: 5.00 m                                   | R&S®NRP-ZK6     | 1419.0664.04 |
| 8-pole interface cable, length: 1.50 m                                   | R&S®NRP-ZK8     | 1424.9408.02 |
| 8-pole interface cable, length: 3.00 m                                   | R&S®NRP-ZK8     | 1424.9408.03 |
| 8-pole interface cable, length: 5.00 m                                   | R&S®NRP-ZK8     | 1424.9408.04 |
| Ethernet cable for TVAC applications, 2 × RJ-45, length: 1.50 m          | R&S®NRP-ZKVS RJ | 1425.2407.02 |
| Ethernet cable for TVAC applications, 2 × RJ-45, length: 3.00 m          | R&S®NRP-ZKVS RJ | 1425.2407.03 |
| Ethernet cable for TVAC applications, 2 × RJ-45, length: 5.00 m          | R&S®NRP-ZKVS RJ | 1425.2407.05 |
| Ethernet cable for TVAC applications, 2 × RJ-45, length: 15.00 m         | R&S®NRP-ZKVS RJ | 1425.2407.15 |
| Ethernet cable for TVAC applications, 2 × RJ-45, length: 30.00 m         | R&S®NRP-ZKVS RJ | 1425.2407.30 |
| Ethernet cable for TVAC applications, 2 × RJ-45, length: 60.00 m         | R&S®NRP-ZKVS RJ | 1425.2407.60 |
| Ethernet cable for TVAC applications, RJ-45 to Micro-D, length: 1.50 m   | R&S®NRP-ZKVS MD | 1425.2413.02 |
| Ethernet cable for TVAC applications, RJ-45 to Micro-D, length: 3.00 m   | R&S®NRP-ZKVS MD | 1425.2413.03 |
| Ethernet cable for TVAC applications, RJ-45 to Micro-D, length: 5.00 m   | R&S®NRP-ZKVS MD | 1425.2413.05 |
| Ethernet cable for TVAC applications, RJ-45 to Micro-D, length: 15.00 m  | R&S®NRP-ZKVS MD | 1425.2413.15 |
| Ethernet cable for TVAC applications, RJ-45 to Micro-D, length: 30.00 m  | R&S®NRP-ZKVS MD | 1425.2413.30 |
| Ethernet cable for TVAC applications, RJ-45 to Micro-D, length: 60.00 m  | R&S®NRP-ZKVS MD | 1425.2413.60 |
| Ethernet cable (air side cable), Micro-D to RJ-45, length: 1.50 m        | R&S®NRP-ZKAS MD | 1425.2420.02 |
| Ethernet cable (air side cable), Micro-D to RJ-45, length: 3.00 m        | R&S®NRP-ZKAS MD | 1425.2420.03 |
| Ethernet cable (air side cable), Micro-D to RJ-45, length: 5.00 m        | R&S®NRP-ZKAS MD | 1425.2420.05 |
| Ethernet cable (air side cable), Micro-D to RJ-45, length: 15.00 m       | R&S®NRP-ZKAS MD | 1425.2420.15 |
| Ethernet cable (air side cable), Micro-D to RJ-45, length: 30.00 m       | R&S®NRP-ZKAS MD | 1425.2420.30 |
| Ethernet cable (air side cable), Micro-D to RJ-45, length: 60.00 m       | R&S®NRP-ZKAS MD | 1425.2420.60 |
| Sensor hub                                                               | R&S®NRP-Z5      | 1146.7740.02 |
| <b>Recommended extras for waveguide connectors</b>                       |                 |              |
| Torque wrench SW 3/32 (for waveguide screws)                             | R&S®ZCTW        | 1175.2014.02 |
| <b>Recommended extras for R&amp;S®NRP110T</b>                            |                 |              |
| Waveguide bracket for R&S®NRP110T                                        | R&S®NRP-ZBW     | 1700.2141.02 |
| WR15 to 1 mm (f) adapter                                                 | R&S®WCA75       | 3626.1044.02 |
| WR12 to 1 mm (f) adapter                                                 | R&S®WCA90       | 3626.1050.02 |
| WR10 to 1 mm (f) adapter                                                 | R&S®WCA110      | 3626.1067.02 |

| Designation                                                                                         | Type        | Order No.    |
|-----------------------------------------------------------------------------------------------------|-------------|--------------|
| <b>Documentation</b>                                                                                |             |              |
| Documentation of calibration values                                                                 | R&S®DCV-1   | 0240.2187.06 |
| Printout of DCV (in combination with DCV only)                                                      | R&S®DCV-ZP  | 1173.6506.02 |
| Accredited calibration for R&S®NRX-B1, R&S®NRPxxS(N), R&S®NRPxxA(N), R&S®NRPxxT(N) and R&S®NRPxxTWG | R&S®NRP-ACA | 1419.0812.00 |

| <b>Warranty</b>                                                   |         |                                                         |
|-------------------------------------------------------------------|---------|---------------------------------------------------------|
| R&S®NRX base unit, power sensors and R&S®NRP-Z5                   |         | 3 years                                                 |
| All other items <sup>35</sup>                                     |         | 1 year                                                  |
| 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 with calibration coverage, one year             | R&S®CW1 |                                                         |
| Extended warranty with calibration coverage, two years            | R&S®CW2 |                                                         |
| Extended warranty with accredited calibration coverage, one year  | R&S®AW1 |                                                         |
| Extended warranty with accredited calibration coverage, two years | R&S®AW2 |                                                         |

**Extended warranty with a term of one and two years (WE1 and WE2)**

Repairs carried out during the contract term are free of charge <sup>36</sup>. Necessary calibration and adjustments carried out during repairs are also covered.

**Extended warranty with calibration (CW1 and CW2)**

Enhance your extended warranty by adding calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated, inspected and maintained during the term of the contract. It includes all repairs <sup>36</sup> and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

**Extended warranty with accredited calibration (AW1 and AW2)**

Enhance your extended warranty by adding accredited calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated under accreditation, inspected and maintained during the term of the contract. It includes all repairs <sup>36</sup> and accredited calibration at the recommended intervals as well as any accredited calibration carried out during repairs or option upgrades.

For product brochure, see PD 5213.5539.12 and [www.rohde-schwarz.com](http://www.rohde-schwarz.com)

# Endnotes

- <sup>1</sup> Specifications apply to timeslots/gates with a duration of 12.5 % referenced to the signal period (duty cycle 1:8). For other waveforms, the following equation applies: lower measurement limit = lower measurement limit for continuous average mode /  $\sqrt{\text{duty cycle}}$ .
- <sup>2</sup> With a resolution of 256 pixel.
- <sup>3</sup> Specifications apply to the default transition setting of 0 dB. The transition regions can be shifted by as much as –20 dB using an adequate offset.
- <sup>4</sup> Time span prior to triggering, where the trigger signal must be entirely below the threshold level in the case of a positive slope and vice versa in the case of a negative slope.
- <sup>5</sup> Specifications expressed as an expanded uncertainty with a confidence level of 95 % (two standard deviations). For calculating zero offsets at higher confidence levels, use the properties of the normal distribution (e.g. 99.7 % confidence level for three standard deviations).
- <sup>6</sup> Within one hour after zeroing, permissible temperature change  $\pm 1$  °C, following a two-hour warm-up of the power sensor.
- <sup>7</sup> Two standard deviations at 10.24 s integration time in continuous average mode, with aperture time set to default value.  
The integration time is defined as the total time used for signal acquisition, i.e. the product of twice the aperture time and the averaging number. Multiplying the noise specifications by  $\sqrt{(10.24 \text{ s}/\text{integration time})}$  yields the noise contribution at other integration times. Using a von Hann window function increases noise by a factor of 1.22.
- <sup>8</sup> Expanded uncertainty ( $k = 2$ ) for absolute power measurements on CW signals with automatic path selection and the default transition setting of 0 dB. Specifications include calibration uncertainty, linearity and temperature effect. Zero offset, zero drift and measurement noise must additionally be taken into account when measuring low powers. As a rule of thumb, the contribution of zero offset can be neglected for power levels above –40 dBm. The contribution of measurement noise depends on power and integration time and can be neglected below 0.01 dB.

Example: The uncertainty of a power measurement at 3.2 nW (–55 dBm) and 1.9 GHz is to be determined for an R&S®NRP8S. The ambient temperature is +29 °C and the averaging number is set to 32 in the continuous average mode with an aperture time of 20 ms.

Since path 1 is used for the measurement, the typical absolute uncertainty due to zero offset is 28 pW (typical) after external zeroing, which corresponds to a relative measurement uncertainty of

$$10 \lg \frac{3.2 \text{ nW} + 28 \text{ pW}}{3.2 \text{ nW}} \text{ dB} = 0.038 \text{ dB}.$$

Using the formula in footnote 7, the absolute noise contribution of path 1 is typically  $20 \text{ pW} \times \sqrt{(10.24 \text{ s}/(32 \times 2 \times 0.02 \text{ s}))} = 56.6 \text{ pW}$ , which corresponds to a relative measurement uncertainty of

$$10 \lg \frac{3.2 \text{ nW} + 56.6 \text{ pW}}{3.2 \text{ nW}} \text{ dB} = 0.076 \text{ dB}.$$

Combined with the uncertainty of 0.084 dB for absolute power measurements under the given conditions, the total expanded uncertainty is

$$\sqrt{0.038^2 + 0.076^2 + 0.084^2} \text{ dB} = 0.119 \text{ dB}.$$

The contribution of zero drift has been neglected in this case. It must be treated like zero offset if it is relevant for total uncertainty.

- <sup>9</sup> Expanded uncertainty ( $k = 2$ ) for relative power measurements on CW signals of the same frequency with automatic path selection and a default transition setting of 0 dB. For reading the measurement uncertainty diagrams of universal, average and level control sensors, see the Appendix.

Specifications include calibration uncertainty (only if different paths are affected), linearity and temperature effect. Zero offset, zero drift and measurement noise must additionally be taken into account when measuring low powers. As a rule of thumb, the contribution of zero offset can be neglected for power levels above –40 dBm. The contribution of measurement noise depends on power and integration time and can be neglected below 0.01 dB.

Example: The uncertainty of a power step from 0.5 mW (–3 dBm) to 10 nW (–50 dBm) at 5.4 GHz is to be determined for an R&S®NRP8S. The ambient temperature is +20 °C and the averaging number is set to 16 for both measurements in the continuous average mode with an aperture time of 20 ms. For the calculation of total uncertainty, the relative contribution of noise, zero offset and zero drift must be taken into account for both measurements. In this example, all contributions at –3 dBm and the effect of zero drift at –50 dBm have been neglected.

Since path 1 is used for the –50 dBm measurement, the typical absolute uncertainty due to zero offset is 28 pW after external zeroing, which corresponds to a relative measurement uncertainty of

$$10 \lg \frac{10 \text{ nW} + 28 \text{ pW}}{10 \text{ nW}} \text{ dB} = 0.012 \text{ dB}.$$

Using the formula in footnote 7, the absolute noise contribution of path 1 is typically  $20 \text{ pW} \times \sqrt{(10.24 \text{ s}/(16 \times 2 \times 0.02 \text{ s}))} = 80 \text{ pW}$ , which corresponds to a relative measurement uncertainty of

$$10 \lg \frac{10 \text{ nW} + 80 \text{ pW}}{10 \text{ nW}} \text{ dB} = 0.035 \text{ dB}.$$

Combined with the uncertainty of 0.050 dB for relative power measurements under the given conditions, the total expanded uncertainty is

$$\sqrt{0.012^2 + 0.035^2 + 0.050^2} \text{ dB} = 0.062 \text{ dB}.$$

- <sup>10</sup> Specifications are based on the assumption that the measurements follow each other so fast (at intervals of no more than 10 s) that the temperature of the power attenuator does not change significantly. In the case of the R&S®NRP18S-10, the average power must not exceed 1 W to be compliant with accuracy specifications for relative power measurements. For the R&S®NRP18S-20, the maximum average power is 10 W. For the R&S®NRP18S-20, maximum average power is 20 W for compliance with the specifications for relative power measurements.
- <sup>11</sup> Gamma correction activated.
- <sup>12</sup> Preceding sensor section (nominal value).

- <sup>13</sup> Preferably used with determined modulation when the aperture time cannot be matched to the modulation period. Compared to a uniform window, measurement noise is about 22 % higher.
- <sup>14</sup> For measuring the power of periodic bursts based on an average power measurement.
- <sup>15</sup> To increase measurement speed, the power sensor can be operated in buffered mode. In this mode, measurement results are stored in a buffer of user-definable size and then output as a block of data when the buffer is full. To enhance measurement speed even further, the sensor can be set to record the entire series of measurements when triggered by a single event. In this case, the power sensor automatically starts a new measurement as soon as it has completed the previous one.
- <sup>16</sup> For moving mode, the maximum burst width of a single burst is 8 s. For repeat mode the mean burst length is limited to 8 s/averaging number.
- <sup>17</sup> This parameter enables power measurements on modulated bursts. The parameter must be longer in duration than modulation-induced power drops within the burst.
- <sup>18</sup> To exclude unwanted portions of the signal from the measurement result.
- <sup>19</sup> If embedding is used in conjunction with the R&S®NRP18S-10/-20/-25, the data of the RF power attenuator preceding the sensor section is taken into account (automatically upon power-up of the sensor).
- <sup>20</sup> Specifications are valid for repeat mode, extending from the beginning to the end of all transfers. The actual values depend on the host system, therefore typical values are specified. They have been measured with a USB connection including one USB hub using the USBTMC protocol and an Ethernet network including one PoE switch using the HiSLIP protocol. For R&S®NRPxxT(N) sensors the specified measurement time is valid for an aperture time less than 100 ms.
- <sup>21</sup> Measurement error referenced to a CW signal of equal power and frequency. Specifications apply up to +20 dBm for automatic path selection or within a subrange to the maximum level of the subrange minus 3 dB.
- <sup>22</sup> Change of the reflection coefficient (error vector magnitude) referenced to 0 dBm. Applies to the R&S®NRPxxS(N) and the sensor section of the R&S®NRP18S-10/-20/-25.
- <sup>23</sup> Expanded uncertainty ( $k = 2$ ) for absolute power measurements on CW signals at the calibration level within a temperature range from +20 °C to +25 °C and at the calibration frequencies. Specifications include zero offset and measurement noise (up to a  $2\sigma$  value of 0.004 dB). The calibration level is -20 dBm for path 1 and 0 dBm for paths 2 and 3 and the sensor section of the R&S®NRP18S-10/-20/-25.
- <sup>24</sup> Specifications include sensor section and RF power attenuator.
- <sup>25</sup> Expanded uncertainty ( $k = 2$ ) for absolute power measurements. Specifications include calibration uncertainty, linearity and temperature effect. Zero offset and measurement noise must additionally be taken into account when measuring low powers, whereas zero drift is negligible over the entire measurement range. As a rule of thumb, the contribution of zero offset can be neglected for power levels above -20 dBm if external zeroing has been applied. The contribution of measurement noise can be neglected below 0.01 dB.

Example: The power to be measured with an R&S®NRP50TN is 5 µW (-23 dBm) at 48 GHz; ambient temperature +29 °C; averaging number set to 64 in continuous average mode with an aperture time of 5 ms (default).

The absolute uncertainty due to zero offset (after external zeroing) is 25 nW, which corresponds to a relative measurement uncertainty of

$$10 \lg \frac{5 \mu\text{W} + 25 \text{ nW}}{5 \mu\text{W}} \text{ dB} = 0.022 \text{ dB}.$$

Using the formula in footnote 7, the absolute noise contribution is  $25 \text{ nW} \times \sqrt{(10.24 \text{ s}/(64 \times 2 \times 0.005 \text{ s}))} = 100 \text{ nW}$ , which corresponds to a relative measurement uncertainty of

$$10 \lg \frac{5 \mu\text{W} + 100 \text{ nW}}{5 \mu\text{W}} \text{ dB} = 0.086 \text{ dB}.$$

Combined with the value of 0.149 dB specified for the uncertainty of absolute power measurements at 48 GHz and +29 °C ambient temperature, the total expanded uncertainty is

$$\sqrt{0.149^2 + 0.022^2 + 0.086^2} \text{ dB} = 0.173 \text{ dB}.$$

- <sup>26</sup> Expanded uncertainty ( $k = 2$ ) for relative power measurements on CW signals of the same frequency. Specifications include linearity and temperature effect. Zero offset and measurement noise must additionally be taken into account when measuring low powers, whereas zero drift is negligible over the entire measurement range. As a rule of thumb, the contribution of zero offset can be neglected for power levels above -20 dBm if external zeroing has been applied. The contribution of measurement noise can be neglected below 0.01 dB. See also the example in footnote 9 for taking into account zero offset and noise with relative measurements.
- <sup>27</sup> For R&S®NRP90T(N) absolute accuracy is calibrated up to 98 GHz. Reflection of the sensors is calibrated up to 90 GHz. The specified absolute uncertainty for R&S®NRP90T(N) is valid up to 90 GHz. The uncertainty from 90 GHz to 98 GHz is approximately 0.45 dB.
- <sup>28</sup> Expanded uncertainty ( $k = 2$ ) for absolute power measurements at the calibration level (0 dBm) within a temperature range from +20 °C to +25 °C and at the calibration frequencies. Specifications include zero offset and measurement noise (up to a  $2\sigma$  value of 0.004 dB).
- <sup>29</sup> Expanded uncertainty for relative power measurements referenced to the calibration level (0 dBm), excluding zero offset, zero drift and measurement noise.
- <sup>30</sup> Error of an absolute power measurement with respect to temperature.
- <sup>31</sup> The operating temperature range defines the span of ambient temperature in which the instrument complies with specifications. In the permissible temperature range, the instrument is still functioning but compliance with specifications is not warranted.
- <sup>32</sup> To operate the R&S®NRP33SN-V/67SN-V at an air pressure below 795 hPa the sensor has to be mounted onto a temperature-controlled baseplate. In this case the temperature of the baseplate is regarded as the ambient temperature of the sensor.
- <sup>33</sup> Quotient of a measured and a stored power ratio, e.g. for measuring gain compression of amplifiers.

<sup>34</sup> Guaranteed by design and the specifications of the internal oscillator.

<sup>35</sup> For options installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1 year warranty.

<sup>36</sup> Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.



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