



# R&S®NRP

## USB and LAN Power Sensors

### Specifications



**3** year  
warranty  
Extendable to 5 years



Test & Measurement

Data Sheet | 03.00



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## Definitions

Product data applies under the following conditions:

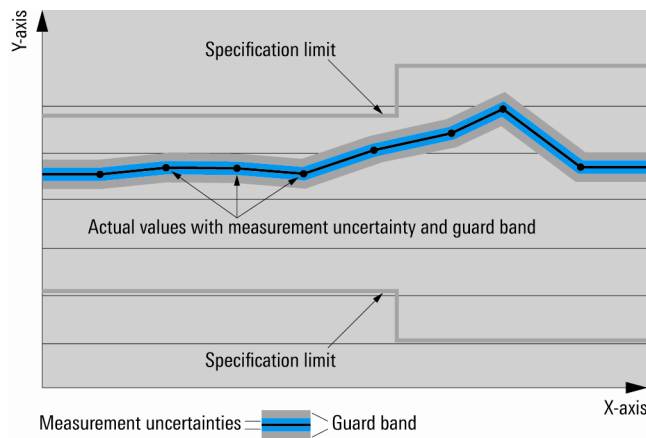
- Three hours storage at the expected operating temperature followed by 30 minutes warm-up, unless otherwise stated
- Specified environmental conditions met
- Recommended calibration interval adhered to
- All internal automatic adjustments performed, if applicable

### Specifications with limits

Describe 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 and minimum.

Specifications in normal print refer to parameters where compliance is ensured by the design or derived from the measurement of related parameters.

Specifications in **bold** print are 100 % tested. Test limits have been narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.



### Specifications without limits

Describe warranted product performance by means of a representative value for the specified parameter. Limits are omitted whenever they are not relevant for the specification (e.g. dimensional data).

### Typical values (typ.)

Represent the population mean for the given parameter, derived from the design and/or production testing. Typical values are not warranted by Rohde & Schwarz.

### Limits of uncertainty

Expanded uncertainties with a coverage factor of 2, calculated from the test assembly specifications and the modeled behavior of the sensor, including environmental conditions, aging, wear and tear, if applicable. The given values represent limits of uncertainty that are met by the Rohde & Schwarz instrument after calibration at a production or service site. Limits of uncertainty (in italics) are defined in EN 60359 and have been determined in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM).

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

Sensor type R&S®	Frequency range	Power range, max. average power / peak envelope power	Connector type
<b>Multipath power sensors</b>			
NRP8S(N)	10 MHz to 8 GHz	100 pW to 200 mW (-70 dBm to +23 dBm) 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) max. 1 W (AVG) / 2 W (PK, 10 µs)	N (m)
NRP33S(N)/ NRP33SN-V	10 MHz to 33 GHz	100 pW to 200 mW (-70 dBm to +23 dBm) 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) 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) max. 200 mW (AVG) / 1 W (PK, 10 µs)	2.40 mm (m)
<b>Thermal power sensors</b>			
NRP18T(N)	DC to 18 GHz	300 nW to 100 mW (-35 dBm to +20 dBm) 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) 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) 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) 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) max. 300 mW (AVG) / 10 W (PK, 1 µs)	1.85 mm (m)
NRP110T	DC to 110 GHz	300 nW to 100 mW (-35 dBm to +20 dBm) max. 300 mW (AVG) / 10 W (PK, 1 µs)	1.00 mm (m)
<b>Average power sensors</b>			
NRP6A(N)	8 kHz to 6 GHz	100 pW to 200 mW (-70 dBm to +23 dBm) 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) max. 1 W (AVG) / 2 W (PK, 10 µs)	N (m)

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

Sensor type R&S®	Impedance matching (SWR)	Rise time Video BW	Zero offset (typ.)	Noise (typ.)	Uncertainty for power measurements at +20 °C to +25 °C	
					absolute (in dB <sub>[sk1]</sub> )	relative (in dB)
<b>Multipath power sensors</b>						
NRP8S(N)	10 MHz to 2.4 GHz: < 1.13 > 2.4 GHz to 8.0 GHz: < 1.20	< 5 µs > 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 > 2.4 GHz to 8.0 GHz: < 1.20 > 8.0 GHz to 18.0 GHz: < 1.25				0.053 to 0.094	0.022 to 0.069
NRP33S(N)/ NRP33SN-V	10 MHz to 2.4 GHz: < 1.13 > 2.4 GHz to 8.0 GHz: < 1.20 > 8.0 GHz to 18.0 GHz: < 1.25 > 18.0 GHz to 26.5 GHz: < 1.30 > 26.5 GHz to 33.0 GHz: < 1.35				0.053 to 0.134	0.022 to 0.136
NRP40S(N)	50 MHz to 2.4 GHz: < 1.13 > 2.4 GHz to 8.0 GHz: < 1.20 > 8.0 GHz to 18.0 GHz: < 1.25 > 18.0 GHz to 26.5 GHz: < 1.30 > 26.5 GHz to 33.0 GHz: < 1.35 > 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 > 2.4 GHz to 8.0 GHz: < 1.20 > 8.0 GHz to 18.0 GHz: < 1.25 > 18.0 GHz to 26.5 GHz: < 1.30 > 26.5 GHz to 33.0 GHz: < 1.35 > 33.0 GHz to 40.0 GHz: < 1.37 > 40.0 GHz to 50.0 GHz: < 1.40				0.073 to 0.183	0.028 to 0.184

Sensor type R&S®	Impedance matching (SWR)	Rise time Video BW	Zero offset (typ.)	Noise (typ.)	Uncertainty for power measurements at +20 °C to +25 °C	
					absolute (in dB)	relative (in dB)
<b>Thermal power sensors</b>						
NRP18T(N)	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	-	15 nW	15 nW	0.040 to 0.082	0.010
NRP33T(N)	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				0.040 to 0.101	0.010
NRP40T(N)	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 40.0 GHz: < 1.28				0.040 to 0.108	0.010
NRP50T(N)	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 40.0 GHz: < 1.28 > 40.0 GHz to 50.0 GHz: < 1.30				0.040 to 0.143	0.010
NRP67T(N)	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 40.0 GHz: < 1.28 > 40.0 GHz to 50.0 GHz: < 1.30 > 50.0 GHz to 67.0 GHz: < 1.35				0.040 to 0.248	0.010
NRP110T	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 GHz: < 1.70				0.040 to 0.318	0.014

Sensor type R&S®	Impedance matching (SWR)	Rise time Video BW	Zero offset (typ.)	Noise (typ.)	Uncertainty for power measurements at +20 °C to +25 °C	
					absolute (in dB)	relative (in dB)
<b>Average power sensors</b>						
NRP6A(N)	8 kHz to < 20 kHz: < 1.25 20 kHz to 2.4 GHz: < 1.13 > 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 20 kHz to 2.4 GHz: < 1.13 > 2.4 GHz to 8.0 GHz: < 1.20 > 8.0 GHz to 18.0 GHz: < 1.25				0.051 to 0.094	0.022 to 0.069

## Multipath power sensors

### R&S®NRP8S(N)/18S(N)/33S(N) multipath power sensors

### R&S®NRP33SN-V multipath power sensor for use in thermal vacuum

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)/33SN-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)/33SN-V	10 MHz to 33 GHz	
<b>Impedance matching (SWR)</b>	10 MHz to 2.4 GHz	< 1.13 <b>(1.11)</b>	( ): +15 °C to +35 °C
	> 2.4 GHz to 8.0 GHz	< 1.20 <b>(1.18)</b>	
	> 8.0 GHz to 18.0 GHz	< 1.25 <b>(1.23)</b>	
	> 18.0 GHz to 26.5 GHz	< 1.30 <b>(1.28)</b>	
	> 26.5 GHz to 33.0 GHz	< 1.35 <b>(1.33)</b>	
<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>Max. 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 (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	
<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®NRP2 or R&S®NRP-Z5 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 +15 °C to +35 °C  [ ]: at frequencies ≤ 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	
path 3	< 224 [192] (108) nW		
<b>Zero drift <sup>6</sup></b>	path 1	< 13 [12] (2) pW	
	path 2	< 0.6 [0.5] (0.1) nW	
	path 3	< 54 [47] (8) nW	
<b>Measurement noise <sup>7</sup></b>	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
	-70	-20	-14
		0	+6
			+23

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
	-70	-20	-14
		0	+6
			+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**

+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
	0.095	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
	-70	-20	-14
		0	+6
			+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**

+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
	0.109	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
	-70	-20	-14
		0	+6
			+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**

+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
	-70	-20	-14
		0	+6
			+23

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
	-70	-20	-14
		0	+6
			+23

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) multipath power sensors

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).

<b>Frequency range</b>	R&S®NRP40S(N)	50 MHz to 40 GHz		
	R&S®NRP50S(N)	50 MHz to 50 GHz		
<b>Impedance matching (SWR)</b>	50 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)		
	> 33.0 GHz to 40.0 GHz	< 1.37 (1.35)		
	> 40.0 GHz to 50.0 GHz	< 1.40 (1.38)		
<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>Max. 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 (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		
<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®NRP2 or R&S®NRP-Z5 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 +15 °C to +35 °C [ ]: at frequencies ≤ 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		
<b>Zero drift <sup>6</sup></b>	path 1	< 14 [12] (2) pW		
	path 2	< 1.3 [1.1] (0.2) nW		
	path 3	< 67 [53] (9) nW		
<b>Measurement noise <sup>7</sup></b>	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**

0.241	0.196	0.193
0.113	0.098	0.099
0.077	0.073	0.077

-70                      -20                      0                      +20  
Power level in dBm

**200 MHz to 8 GHz**

0.162	0.172	0.171
0.095	0.094	0.097
0.081	0.074	0.078

-70                      -20                      0                      +20  
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**

0.152	0.157	0.157
0.103	0.098	0.101
0.090	0.081	0.086

-70                      -20                      0                      +20  
Power level in dBm

**> 12.4 GHz to 18 GHz**

0.165	0.167	0.168
0.117	0.111	0.114
0.104	0.095	0.100

-70                      -20                      0                      +20  
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**

0.176	0.176	0.180
0.122	0.114	0.120
0.107	0.095	0.103

-70                      -20                      0                      +20  
Power level in dBm

**> 26.5 GHz to 33 GHz**

0.196	0.196	0.203
0.139	0.131	0.140
0.123	0.111	0.122

-70                      -20                      0                      +20  
Power level in dBm

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

**> 33 GHz to 40 GHz**

0.216	0.217	0.229
0.152	0.145	0.159
0.134	0.122	0.138

-70                      -20                      0                      +20  
Power level in dBm

**> 40 GHz to 50 GHz**

0.257	0.260	0.279
0.188	0.184	0.205
0.169	0.160	0.183

-70                      -20                      0                      +20  
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

50 MHz to < 200 MHz				200 MHz to < 8 GHz				
+20	0.285	0.252	0.046	0.214	0.221	0.047	0 °C to +50 °C	
	0.127	0.117	0.045	0.109	0.109	0.047	+15 °C to +35 °C	
+6	0.081	0.077	0.045	0.083	0.077	0.047	+20 °C to +25 °C	
0	0.277	0.040	0.252	0.206	0.040	0.221	0 °C to +50 °C	
	0.121	0.038	0.117	0.102	0.038	0.109	+15 °C to +35 °C	
-14	0.073	0.038	0.077	0.076	0.038	0.077	+20 °C to +25 °C	
-20	0.028	0.277	0.285	0.029	0.206	0.214	0 °C to +50 °C	
	0.028	0.121	0.127	0.029	0.102	0.109	+15 °C to +35 °C	
-70	0.028	0.073	0.081	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				> 12.4 GHz to 18 GHz				
+20	0.195	0.199	0.050	0.203	0.205	0.054	0 °C to +50 °C	
	0.111	0.108	0.049	0.117	0.113	0.054	+15 °C to +35 °C	
+6	0.086	0.080	0.049	0.092	0.085	0.054	+20 °C to +25 °C	
0	0.187	0.041	0.199	0.194	0.043	0.205	0 °C to +50 °C	
	0.104	0.039	0.108	0.109	0.041	0.113	+15 °C to +35 °C	
-14	0.079	0.039	0.080	0.083	0.041	0.085	+20 °C to +25 °C	
-20	0.029	0.187	0.195	0.030	0.194	0.203	0 °C to +50 °C	
	0.029	0.104	0.111	0.030	0.109	0.117	+15 °C to +35 °C	
-70	0.029	0.079	0.086	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				> 26.5 GHz to 33 GHz				
+20	0.226	0.227	0.064	0.252	0.254	0.074	0 °C to +50 °C	
	0.134	0.130	0.064	0.153	0.151	0.074	+15 °C to +35 °C	
+6	0.106	0.099	0.064	0.122	0.117	0.074	+20 °C to +25 °C	
0	0.214	0.048	0.227	0.236	0.054	0.254	0 °C to +50 °C	
	0.122	0.046	0.130	0.135	0.052	0.151	+15 °C to +35 °C	
-14	0.092	0.046	0.099	0.101	0.051	0.117	+20 °C to +25 °C	
-20	0.032	0.214	0.226	0.034	0.236	0.252	0 °C to +50 °C	
	0.032	0.122	0.134	0.034	0.135	0.153	+15 °C to +35 °C	
-70	0.032	0.092	0.106	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				> 40 GHz to 50 GHz				
+20	0.285	0.289	0.088	0.336	0.344	0.110	0 °C to +50 °C	
	0.176	0.179	0.087	0.214	0.224	0.110	+15 °C to +35 °C	
+6	0.141	0.142	0.087	0.174	0.184	0.109	+20 °C to +25 °C	
0	0.263	0.062	0.289	0.304	0.077	0.344	0 °C to +50 °C	
	0.151	0.060	0.179	0.174	0.074	0.224	+15 °C to +35 °C	
-14	0.111	0.059	0.142	0.126	0.073	0.184	+20 °C to +25 °C	
-20	0.036	0.263	0.285	0.040	0.304	0.336	0 °C to +50 °C	
	0.036	0.151	0.176	0.040	0.174	0.214	+15 °C to +35 °C	
-70	0.036	0.111	0.141	0.040	0.126	0.174	+20 °C to +25 °C	
	-70	-20	-14	0	+6	+20		
	Power level in dBm							

## Additional characteristics of the R&S®NRPxxS(N) multipath power sensors and the R&S®NRP33SN-V multipath power sensor for use in thermal vacuum

<b>Sensor type</b>		three-path diode power sensor	
<b>Measurand</b>		power of incident wave	
		power of source (DUT) into 50 $\Omega$ <sup>10</sup>	
<b>RF connector</b>	R&S®NRP8S(N)/18S(N)	N (male)	
	R&S®NRP33S(N)/33SN-V	3.5 mm (male)	
	R&S®NRP40S(N)	2.92 mm (male)	
	R&S®NRP50S(N)	2.4 mm (male)	
<b>Measurement functions</b>	stationary and recurring waveforms	continuous average	
		burst average	
		timeslot/gate average	
		trace	
	single events	burst average	
		timeslot/gate average	
	trace		
<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>11</sup>	
	duty cycle correction <sup>12</sup>	0.001 % to 100.0 %	
	capacity of measurement buffer <sup>13</sup>	1 to 8192 results	
<b>Burst average function</b>	measurand	mean power over burst portion of recurring signal (trigger settings required)	
	detectable burst width <sup>14</sup>	5 $\mu$ s to 8 s	
	minimum gap between bursts	5 $\mu$ s	
	dropout period <sup>15</sup> for burst end detection	1 $\mu$ s to 300 ms	
	exclusion periods <sup>16</sup>	start	0 s to 1 s
		end	0 s to 1 s
		resolution (dropout and exclusion periods)	0.5 $\mu$ s (sample period)
	<b>Timeslot/gate average function</b>	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)
<b>Trace function</b>		measurand	mean, random, maximum and minimum power over pixel length
		acquisition	length
	start (referenced to delayed trigger)		-3.0 s to 3.0 s
	result		
	pixels	1 to 8192	
	resolution	$\geq$ 0.5 $\mu$ s (sample period)	

<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		
	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		
<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 times</b> <sup>17</sup> Av: averaging number	continuous average		
	single measurements	$2 \times (\text{aperture} + 100 \mu\text{s}) \times Av + t_z$	
	buffered measurements without averaging	$2 \times (\text{aperture} + 116 \mu\text{s}) \times \text{buffer size} + t_z$ $t_z = 2 \text{ ms (typ.)}$	
<b>Zeroing (duration)</b>			5.3 s
<b>Measurement error due to modulation</b> <sup>18</sup>	general		depends on CCDF and RF bandwidth of test signal
	WCDMA (3GPP test model 1-64)		
	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	
<b>Change of input reflection coefficient with respect to power</b> <sup>19</sup>	R&S®NRP8S(N)/18S(N)/33S(N)/33SN-V		
	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)		
	50 MHz to 8.0 GHz	< 0.04 (0.02)	( ): levels $\leq 10$ dBm
	> 8.0 GHz to 18.0 GHz	< 0.06 (0.03)	
	> 18.0 GHz to 33.0 GHz	< 0.07 (0.04)	
	> 33.0 GHz to 50.0 GHz	< 0.09 (0.05)	

<b>Calibration uncertainty</b> <sup>20</sup>	R&S®NRP8S(N)/18S(N)/33S(N)/33SN-V	path 1	path 2	path 3
	10 MHz to < 100 MHz	0.058 dB	0.052 dB	0.053 dB
	100 MHz to 2.40 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)	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	
<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> only for R&S®NRPxxSN types and the R&S®NRP33SN-V	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 or 50 Ω		
	output	50 Ω		
	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</b>	recommended bake-out procedure	vacuum bake for 100 h at +85 °C and P < 10 <sup>-5</sup> mbar		
	typical mass loss during bake-out	70 mg		
<b>Mounting of R&amp;S®NRP33SN-V onto a baseplate</b> 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 (1.89 in × 1.18 in × 5.43 in)		
	R&S®NRPxxSN, R&S®NRP33SN-V	73 mm × 26 mm × 146 mm (2.87 in × 1.02 in × 5.75 in)		
<b>Weight</b>	R&S®NRPxxS	< 0.20 kg (0.44 lb)		
	R&S®NRPxxSN, R&S®NRP33SN-V	< 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	< <b>1.03</b>		
	> 100 MHz to 2.4 GHz	< <b>1.06</b>		
	> 2.4 GHz to 12.4 GHz	< <b>1.13</b>		
	> 12.4 GHz to 18.0 GHz	< <b>1.16</b>		
	> 18.0 GHz to 26.5 GHz	< <b>1.22</b>		
	> 26.5 GHz to 33.0 GHz	< <b>1.28</b>		
	> 33.0 GHz to 40.0 GHz	< <b>1.28</b>		
	> 40.0 GHz to 44.0 GHz	< <b>1.30</b>		
<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>Max. power</b>	average power	0.3 W (+25 dBm), continuous		
	peak envelope power			
	R&S®NRP18T(N)	20 W (43 dBm) for max. 1 µs		
	R&S®NRP33T(N)/40T(N)/50T(N)/67T(N)	10 W (40 dBm) for max. 1 µs		
<b>Acquisition</b>	sample rate	20.833 kHz (sigma-delta)		
<b>Zero offset</b>	after external zeroing <sup>5</sup>	< <b>25 nW</b> (typ. 15 nW at 1 GHz)		
<b>Zero drift <sup>6</sup></b>		< 8 nW		
<b>Measurement noise <sup>7</sup></b>		< <b>25 nW</b> (typ. 15 nW at 1 GHz)		
<b>Uncertainty for absolute power measurements <sup>21</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	0.248 dB	0.250 dB	0.260 dB	
<b>Uncertainty for relative power measurements <sup>22</sup></b>		0.010 dB		

**R&S®NRP110T thermal power sensor**

<b>Frequency range</b>		DC to 110 GHz		
<b>Impedance matching (SWR)</b>	DC to 100 MHz	< <b>1.05</b>		
	> 100 MHz to 2.4 GHz	< <b>1.08</b>		
	> 2.4 GHz to 12.4 GHz	< <b>1.18</b>		
	> 12.4 GHz to 18.0 GHz	< <b>1.23</b>		
	> 18.0 GHz to 26.5 GHz	< <b>1.28</b>		
	> 26.5 GHz to 40.0 GHz	< <b>1.38</b>		
	> 40.0 GHz to 50.0 GHz	< <b>1.46</b>		
	> 50.0 GHz to 67.0 GHz	< <b>1.56</b>		
	> 67.0 GHz to 80.0 GHz	< <b>1.60</b>		
	> 80.0 GHz to 95.0 GHz	< <b>1.66</b>		
	> 95.0 GHz to 110.0 GHz	< <b>1.70</b>		
<b>Power measurement range</b>		300 nW to 100 mW (–35 dBm to +20 dBm), continuous, in a single range		
<b>Max. 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	20.833 kHz (sigma-delta)		
<b>Zero offset</b>	after external zeroing <sup>5</sup>	< <b>34 nW</b> (typ. 15 nW at 1 GHz)		
<b>Zero drift <sup>6</sup></b>		< 11 nW		
<b>Measurement noise <sup>7</sup></b>		< <b>34 nW</b> (typ. 15 nW at 1 GHz)		
<b>Uncertainty for absolute power measurements <sup>21</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	0.265 dB	0.268 dB	0.280 dB
	> 67.0 GHz to 80.0 GHz	0.283 dB	0.286 dB	0.299 dB
> 80.0 GHz to 95.0 GHz	0.298 dB	0.302 dB	0.317 dB	
> 95.0 GHz to 110.0 GHz	0.318 dB	0.321 dB	0.337 dB	
<b>Uncertainty for relative power measurements <sup>22</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)/110T thermal power sensors

<b>Sensor type</b>		thermoelectric power sensor
<b>Measurand</b>		power of incident wave power of source (DUT) into 50 Ω <sup>10</sup>
<b>RF connector</b>	R&S®NRP18T(N) R&S®NRP33T(N) R&S®NRP40T(N) R&S®NRP50T(N) R&S®NRP67T(N) R&S®NRP110T	N (male) 3.50 mm (male) 2.92 mm (male) 2.40 mm (male) 1.85 mm (male) 1.00 mm (male)
<b>Measurement function</b>	stationary and recurring waveforms	continuous average
<b>Continuous average function</b>	measurand aperture window function duty cycle correction <sup>12</sup> capacity of measurement buffer <sup>13</sup>	mean power over recurring acquisition interval 0.5 ms to 300 ms (5 ms default) uniform or von Hann <sup>11</sup> 0.001 % to 100.0 % 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
	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 Ω 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>17</sup> Av: averaging number	continuous average single measurements	$2 \times (\text{aperture} + 150 \mu\text{s}) \times A_v + t_z + t_d$ $t_z : = 4 \text{ ms (typ.)}$ $t_d$ 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)/	40 ms
	67T(N)/110T	
<b>Zeroing (duration)</b>		10 s
<b>Change of input reflection coefficient with respect to power</b> <sup>19</sup>	only for power levels > 15 dBm	< 0.005

<b>Calibration uncertainty</b> <sup>23</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	0.235 dB
	R&S®NRP110T	
	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	0.253 dB
> 67.0 GHz to 80.0 GHz	0.256 dB	
> 80.0 GHz to 95.0 GHz	0.273 dB	
> 95.0 GHz to 110.0 GHz	0.294 dB	
<b>Temperature effect</b> <sup>24</sup>	DC to 100 MHz	< 0.002 dB/K
	> 100 MHz to 50.0 GHz	< 0.004 dB/K
	> 50.0 GHz to 110.0 GHz	< 0.006 dB/K
<b>Linearity</b> <sup>25</sup>	DC to 67.0 GHz	0.007 dB
	> 67.0 GHz to 110.0 GHz	0.010 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
	permissible total cable length	≤ 5 m
	<b>Ethernet interface</b> only for R&S®NRPxxTN types	mechanical
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 or 50 Ω
	output	50 Ω
	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 (1.89 in × 1.18 in × 5.43 in)
	R&S®NRPxxTN	73 mm × 26 mm × 146 mm (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)

## 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>Max. 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 (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	
<b>Zero offset</b>	initial, without zeroing		( ): typical at 1 GHz +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 Ω <sup>10</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 μs to 2.0 s (20 ms default)
	window function	uniform or von Hann <sup>11</sup>
	duty cycle correction <sup>12</sup>	0.001 % to 100.0 %
	capacity of measurement buffer <sup>13</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 <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
<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 Ω
	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>17</sup> Av: averaging number	continuous average	
	single measurements	2 × (aperture + 5 ms) × Av – 5 ms + t <sub>z</sub> t <sub>z</sub> = 2 ms (typ.)
<b>Zeroing (duration)</b>		6.6 s
<b>Measurement error due to modulation</b> <sup>18</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	



<b>Change of input reflection coefficient with respect to power</b> <sup>19</sup>	8 kHz to 2.4 GHz	< 0.02 (0.01)			( ): +15 °C to +35 °C
	> 2.4 GHz	< 0.03 (0.02)			
<b>Calibration uncertainty</b> <sup>20</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	
<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> only for R&S®NRPxxAN 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 or 50 Ω			
	output	50 Ω			
	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>Dimensions (W × H × L)</b>	R&S®NRPxxA	48 mm × 30 mm × 138 mm (1.89 in × 1.18 in × 5.43 in)			
	R&S®NRPxxAN	73 mm × 26 mm × 146 mm (2.87 in × 1.02 in × 5.75 in)			
<b>Weight</b>	R&S®NRPxxA	< 0.20 kg (0.44 lb)			
	R&S®NRPxxAN	< 0.35 kg (0.77 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®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-ZAP1 Gigabit Ethernet switch with Power-over-Ethernet (PoE) capability

The R&S®NRP-ZAP1 Gigabit Ethernet switch with Power-over-Ethernet (PoE) capability can be used to connect up to four R&S®NRPxxSN power sensors to a local area network (LAN) and provide them with operating power.

<b>OEM manufacturer and type</b>		Zyxel GS1110-8HP	
<b>Connectivity</b>	LAN ports (PoE)	4 Ethernet RJ-45 ports with PoE power sourcing capability (up to 30 W per port, up to 75 W overall power budget)	
	LAN ports (non-PoE)	4 Ethernet RJ-45 ports	
	standard conformance		IEEE 802.3 10BASE-T Ethernet
			IEEE 802.3u 100BASE-TX Ethernet
			IEEE 802.3ab 1000BASE-T Ethernet
		IEEE 802.3af PoE	
		IEEE 802.3at PoE+	
<b>Power consumption</b>		≤ 90 W	
<b>Dimensions (W × D × H)</b>	switch	210 mm × 104 mm × 27 mm (8.27 in × 4.09 in × 1.06 in)	
<b>Weight</b>	switch	0.55 kg (1.20 lb)	
	external power supply and power cord	0.60 kg (1.30 lb)	
	switch including power supply, power cord and packing	1.47 kg (3.20 lb)	
<b>Environmental specifications</b>	operating temperature range	0 °C to +50 °C	
	storage temperature range	-40 °C to +70 °C	
	operation humidity range	10 % to 95 % relative humidity, noncondensing	

## General data

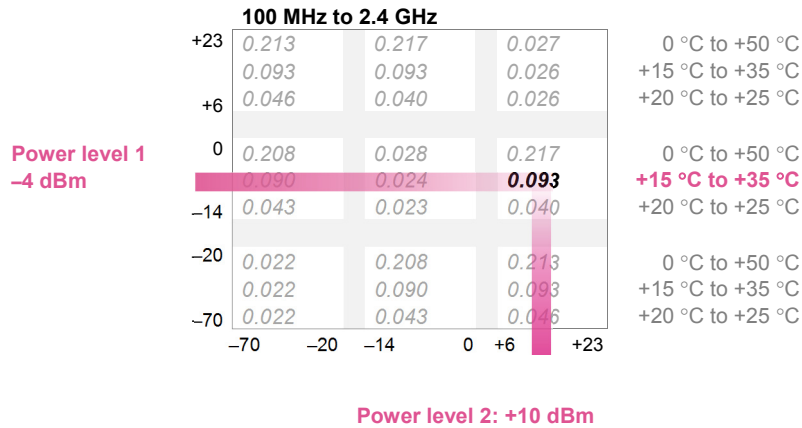
Specifications do not apply to the R&S®NRP-ZAP1 Gigabit Ethernet switch.

<b>Temperature</b> <sup>26</sup>	R&S®NRPxxS(N), 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	
	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 with restrictions: noncondensing, in line with EN 60068-2-30
<b>Mechanical resistance</b>	Vibration	
	sinusoidal	5 Hz to 55 Hz, 0.15 mm amplitude, 1.8 g at 55 Hz, 55 Hz to 150 Hz, 0.5 g constant, in line with EN 60068-2-6
	random	8 Hz to 650 Hz, 1.9 g (RMS), in line with EN 60068-2-64
	shock	45 Hz to 2 kHz, max. 40 g shock spectrum, in line with MIL-STD-810E, method 516.4, procedure I
<b>Air pressure</b>	R&S®NRPxxS(N), R&S®NRPxxT(N), R&S®NRPxxA(N), R&S®NRP-ZKx	
	operating	795 hPa (2000 m) to 1060 hPa
	transport	566 hPa (4500 m) to 1060 hPa
	R&S®NRP33SN-V	
	operating <sup>27</sup>	0 hPa to 1060 hPa
	transport	0 hPa to 1060 hPa
<b>Electromagnetic compatibility</b>		applied harmonized standards: EN 61326-1 EN 61326-2-1 EN 55011 (class B)
<b>Calibration interval</b>	recommended	2 years
<b>Warranty</b>	power sensors and R&S®NRP-Z5	3 years
	all other items	1 year

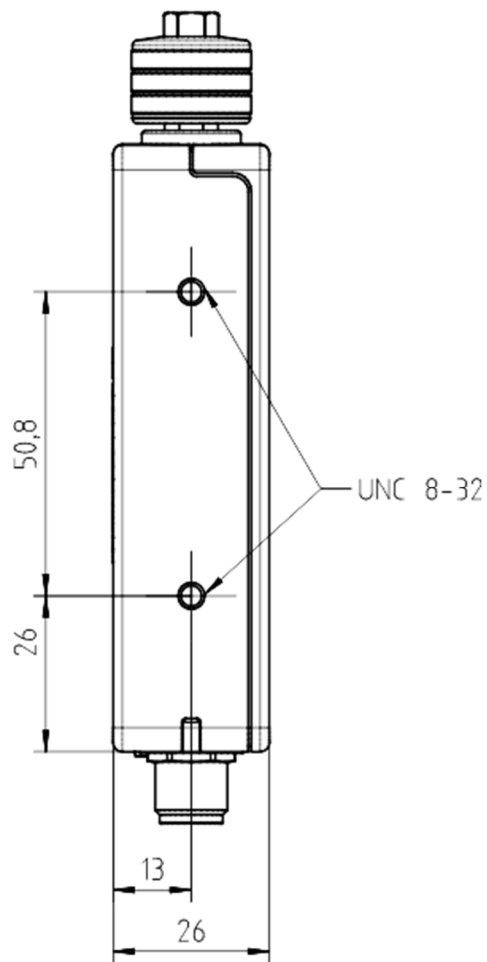
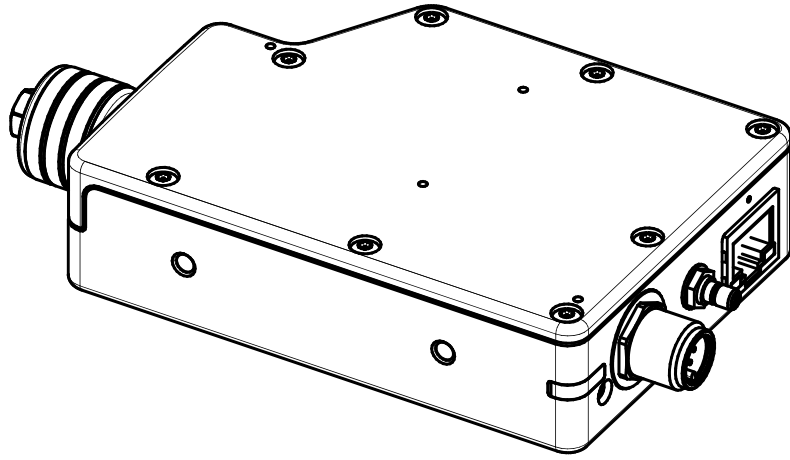
## Appendix

### 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 multipath power sensor for use in thermal vacuum**



*Dimensions in mm*

## Ordering information

Designation	Type	Order No.
<b>Three-Path Diode Power Sensor</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 200 mW, 10 MHz to 33 GHz, LAN version, TVAC-compliant	R&S®NRP33SN-V	1419.0129.02
<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 110 GHz	R&S®NRP110T	1424.6215.02
<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
<b>Accessories (cables, additional equipment, etc.)</b>		
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
Six-Pole Interface Cable, length: 1.50 m	R&S®NRP-ZK6	1419.0664.02
Six-Pole Interface Cable, length: 3.00 m	R&S®NRP-ZK6	1419.0664.03
Six-Pole Interface Cable, length: 5.00 m	R&S®NRP-ZK6	1419.0664.04
Sensor Hub	R&S®NRP-Z5	1146.7740.02
Power over Ethernet (PoE) Switch	R&S®NRP-ZAP1	1419.0829.00
<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®NRPxxS(N), R&S®NRPxxT(N) and R&S®NRPxxA(N) power sensors	R&S®NRP-ACA	1419.0812.00

<b>Service options</b>		
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 a term of one and two years (WE1 and WE2)**

Repairs carried out during the contract term are free of charge <sup>28</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>28</sup> and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

For product brochure, see PD 3607.0852.12 and [www.rohde-schwarz.com](http://www.rohde-schwarz.com)

## Footnotes

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- <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 pixels.
- <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 0.088 dB for absolute power measurements under the given conditions, the total expanded uncertainty is

$$\sqrt{0.038^2 + 0.076^2 + 0.088^2} \text{ dB} = 0.122 \text{ dB.}$$

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> Gamma correction activated.
- <sup>11</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>12</sup> For measuring the power of periodic bursts based on an average power measurement.



- <sup>13</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>14</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>15</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>16</sup> To exclude unwanted portions of the signal from the measurement result.
- <sup>17</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. Measurement times under remote control of the R&S®NRP2 base unit via IEC/IEEE bus are approximately 2.5 ms longer, extending from the start of the measurement up to when the measurement result has been supplied to the output buffer of the R&S®NRP2. For R&S®NRPxxT(N) sensors the specified measurement time is valid for an aperture time less than 100 ms.
- <sup>18</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>19</sup> Change of the reflection coefficient (error vector magnitude) referenced to 0 dBm.
- <sup>20</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 2σ value of 0.004 dB). The calibration level is –20 dBm for path 1 and 0 dBm for paths 2 and 3.
- <sup>21</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

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

Using the formula in footnote 7, the absolute noise contribution is 25 nW × √(10.24 s/(64 × 2 × 0.005 s)) = 100 nW, which corresponds to a relative measurement uncertainty of

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

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

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

- <sup>22</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>23</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 2σ value of 0.004 dB).
- <sup>24</sup> Error of an absolute power measurement with respect to temperature.
- <sup>25</sup> Expanded uncertainty for relative power measurements referenced to the calibration level (0 dBm), excluding zero offset, zero drift and measurement noise.
- <sup>26</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>27</sup> To operate the R&S®NRP33SN-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>28</sup> Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.







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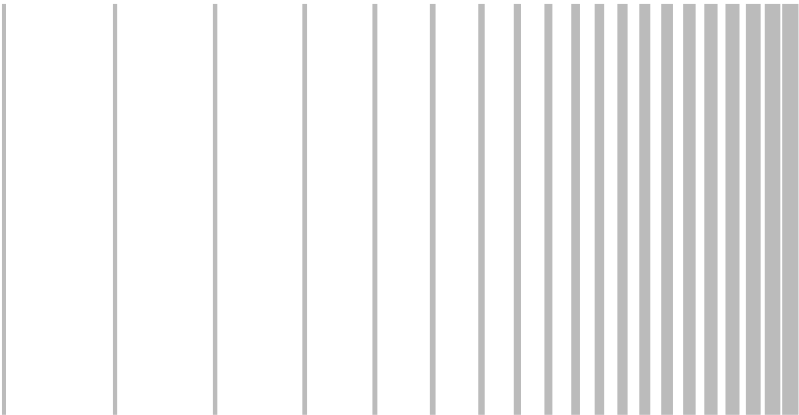
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