R&S®NRP
USB and LAN Power Sensors
Specifications

3 year warranty
Extendable to 5 years

Test & Measurement

Data Sheet | 03.00

ROHDE&SCHWARZ

CONTENTS

Definitions

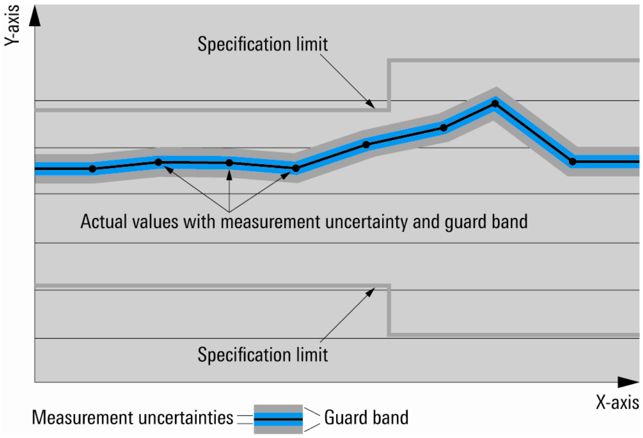
Product data applies under the following conditions:

- 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 **<, ≤, >, ≥, ±,** 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
Multipath power sensors			
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)
Thermal power sensors			
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)
Average power sensors			
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[sk1]**)**	**relative (in dB)**
Multipath power sensors						
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)**
Thermal power sensors						
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)**
Average power sensors						
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.

Frequency range	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	
Impedance matching (SWR)	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**)	
Power measurement range	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) [1]	
	trace	2 nW to 200 mW (–57 dBm to +23 dBm) [2]	
Max. power	average power	1 W (+30 dBm) AVG, max. 10 V DC	
	peak envelope power	2 W (+33 dBm) for max. 10 µs	
Measurement subranges	path 1	–70 dBm to –15 dBm	
	path 2	–53 dBm to +5 dBm	
	path 3	–33 dBm to +23 dBm	
Transition regions	with automatic path selection [3]	(–20 ± 1) dBm to (–14 ± 1) dBm (0 ± 1) dBm to (+6 ± 1) dBm	
Dynamic response	video bandwidth	> 100 kHz (150 kHz)	( ): +15 °C to +35 °C
	rise time 10 %/90 %	< 5 µs (3 µs)	
Acquisition	sample rate (continuous)	2 Msps	
Triggering	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 [4]	0 s to 10 s	
	external	EXTernal[1]: R&S®NRP2 or R&S®NRP-Z5	
		EXTernal2: coaxial trigger I/0	
	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	
Zero offset	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 [5]		
	path 1	< 53 [49] (28) pW	
	path 2	< 2.2 [2.1] (1.3) nW	
	path 3	< 224 [192] (108) nW	
Zero drift [6]	path 1	< 13 [12] (2) pW	
	path 2	< 0.6 [0.5] (0.1) nW	
	path 3	< 54 [47] (8) nW	
Measurement noise [7]	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 [8] 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 °C to +50 °C
0.089	*0.085*	*0.083*	+15 °C to +35 °C
0.055	*0.054*	*0.054*	+20 °C to +25 °C

–70 –20 0 +23

Power level in dBm

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 °C to +50 °C
0.088	*0.089*	*0.088*	+15 °C to +35 °C
0.065	*0.063*	*0.064*	+20 °C to +25 °C

–70 –20 0 +23

Power level in dBm

> 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 °C to +50 °C
0.110	*0.111*	*0.112*	+15 °C to +35 °C
0.092	*0.090*	*0.094*	+20 °C to +25 °C

–70 –20 0 +23

Power level in dBm

> 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 °C to +50 °C
0.131	*0.138*	*0.155*	+15 °C to +35 °C
0.114	*0.114*	*0.134*	+20 °C to +25 °C

–70 –20 0 +23

Power level in dBm

Uncertainty for relative power measurements [9] 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 °C to +50 °C
	0.100	*0.096*	*0.026*	+15 °C to +35 °C
+6	*0.045*	*0.041*	*0.026*	+20 °C to +25 °C
0	*0.235*	*0.028*	*0.228*	0 °C to +50 °C
	0.097	*0.024*	*0.096*	+15 °C to +35 °C
–14	*0.043*	*0.023*	*0.041*	+20 °C to +25 °C
–20	*0.022*	*0.235*	*0.242*	0 °C to +50 °C
	0.022	*0.097*	*0.100*	+15 °C to +35 °C
–70	*0.022*	*0.043*	*0.045*	+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

> 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 °C to +50 °C
	0.162	*0.174*	*0.067*	+15 °C to +35 °C
+6	*0.129*	*0.136*	*0.067*	+20 °C to +25 °C
0	*0.252*	*0.047*	*0.288*	0 °C to +50 °C
	0.137	*0.042*	*0.174*	+15 °C to +35 °C
–14	*0.096*	*0.040*	*0.136*	+20 °C to +25 °C
–20	*0.023*	*0.252*	*0.268*	0 °C to +50 °C
	0.023	*0.137*	*0.162*	+15 °C to +35 °C
–70	*0.023*	*0.096*	*0.129*	+20 °C to +25 °C
	–70 –20	–14 0	+6 +23	

Power level in dBm

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).

Frequency range	R&S®NRP40S(N)	50 MHz to 40 GHz	
	R&S®NRP50S(N)	50 MHz to 50 GHz	
Impedance matching (SWR)	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**)	
Power measurement range	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) [1]	
	trace	2 nW to 100 mW (–57 dBm to +20 dBm) [2]	
Max. power	average power	0.2 W (+23 dBm) AVG, max. 10 V DC	
	peak envelope power	1 W (+30 dBm) for max. 10 µs	
Measurement subranges	path 1	–70 dBm to –15 dBm	
	path 2	–53 dBm to +5 dBm	
	path 3	–33 dBm to +20 dBm	
Transition regions	with automatic path selection [3]	(–20 ± 1) dBm to (–14 ± 1) dBm (0 ± 1) dBm to (+6 ± 1) dBm	
Dynamic response	video bandwidth	> 100 kHz (150 kHz)	( ): +15 °C to +35 °C
	rise time 10 %/90 %	< 5 µs (3 µs)	
Acquisition	sample rate (continuous)	2 Msps	
Triggering	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 [4]	0 s to 10 s	
	external	EXTernal[1]: R&S®NRP2 or R&S®NRP-Z5	
		EXTernal2: coaxial trigger I/0	
	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	
Zero offset	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 [5]		
	path 1	< 58 [49] (28) pW	
	path 2	< 5.5 [4.6] (2.7) nW	
	path 3	< 280 [220] (130) nW	
Zero drift [6]	path 1	< 14 [12] (2) pW	
	path 2	< 1.3 [1.1] (0.2) nW	
	path 3	< 67 [53] (9) nW	
Measurement noise [7]	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 [8] 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 [9] 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
	−70 −20	−14 0	+6 +20

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
	−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

Sensor type		three-path diode power sensor
Measurand		power of incident wave
		power of source (DUT) into 50 Ω [10]
RF connector	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)
Measurement functions	stationary and recurring waveforms	continuous average
		burst average
		timeslot/gate average
		trace
	single events	burst average
		timeslot/gate average
		trace
Continuous average function	measurand	mean power over recurring acquisition interval
	aperture	10 µs to 2.0 s (20 ms default)
	window function	uniform or von Hann [11]
	duty cycle correction [12]	0.001 % to 100.0 %
	capacity of measurement buffer [13]	1 to 8192 results
Burst average function	measurand	mean power over burst portion of recurring signal (trigger settings required)
	detectable burst width [14]	5 µs to 8 s
	minimum gap between bursts	5 µs
	dropout period [15] for burst end detection	1 µs to 300 ms
	exclusion periods [16]	
	start	0 s to 1 s
	end	0 s to 1 s
	resolution (dropout and exclusion periods)	0.5 µs (sample period)
Timeslot/gate average function	measurand	mean power over individual timeslots/gates
	number of timeslots/gates	1 to 32 (consecutive)
	nominal length	10 µs 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 µs (sample period)
Trace function	measurand	mean, random, maximum and minimum power over pixel length
	acquisition	
	length	10 µs to 3.0 s
	start (referenced to delayed trigger)	–3.0 s to 3.0 s
	result	
	pixels	1 to 8192
	resolution	≥ 0.5 µs (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	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	≤ 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 [17] Av: averaging number	continuous average		
	single measurements	2 × (aperture + 100 µs) × Av + t_z	
	buffered measurements without averaging	2 × (aperture + 116 µs) × buffer size + t_z t_z = 2 ms (typ.)	
Zeroing (duration)		5.3 s	
Measurement error due to modulation [18]	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	
Change of input reflection coefficient with respect to power [19]	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 ≤ 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)	

Calibration uncertainty [20]	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*
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		
	permissible total cable length	≤ 5 m		
Ethernet interface 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		
Trigger-I/O EXTernal2	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		
Vacuum-specific characteristics of the R&S®NRP33SN-V	recommended bake-out procedure	vacuum bake for 100 h at +85 °C and P < 10^{-5} mbar		
	typical mass loss during bake-out	70 mg		
Mounting of R&S®NRP33SN-V onto a baseplate 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)		
Dimensions (W × H × L)	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)		
Weight	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).

Frequency range	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		
Impedance matching (SWR)	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**		
	> 50.0 GHz to 67.0 GHz	< **1.35**		
Power measurement range		300 nW to 100 mW (–35 dBm to +20 dBm), continuous, in a single range		
Max. power	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		
Acquisition	sample rate	20.833 kHz (sigma-delta)		
Zero offset	after external zeroing [5]	< **25 nW** (typ. 15 nW at 1 GHz)		
Zero drift [6]		< 8 nW		
Measurement noise [7]		< **25 nW** (typ. 15 nW at 1 GHz)		
Uncertainty for absolute power measurements [21]		+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*
Uncertainty for relative power measurements [22]		*0.010 dB*		

R&S®NRP110T thermal power sensor

Frequency range		DC to 110 GHz		
Impedance matching (SWR)	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**		
Power measurement range		300 nW to 100 mW (–35 dBm to +20 dBm), continuous, in a single range		
Max. power	average power	0.3 W (+25 dBm), continuous		
	peak envelope power	10 W (40 dBm) for max. 1 µs		
Acquisition	sample rate	20.833 kHz (sigma-delta)		
Zero offset	after external zeroing [5]	< **34 nW** (typ. 15 nW at 1 GHz)		
Zero drift [6]		< 11 nW		
Measurement noise [7]		< **34 nW** (typ. 15 nW at 1 GHz)		
Uncertainty for absolute power measurements [21]		+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*
Uncertainty for relative power measurements [22]	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

Sensor type		thermoelectric power sensor
Measurand		power of incident wave
		power of source (DUT) into 50 Ω [10]
RF connector	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®NRP110T	1.00 mm (male)
Measurement function	stationary and recurring waveforms	continuous average
Continuous average function	measurand	mean power over recurring acquisition interval
	aperture	0.5 ms to 300 ms (5 ms default)
	window function	uniform or von Hann [11]
	duty cycle correction [12]	0.001 % to 100.0 %
	capacity of measurement buffer [13]	1 to 8192 results
Averaging filter	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
Attenuation correction	function	corrects the measurement result by means of a fixed factor (dB offset)
	range	–200.000 dB to +200.000 dB
Embedding	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
Gamma correction	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)
Frequency response correction	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
Measurement time [17] Av: averaging number	continuous average single measurements	2 × (aperture + 150 μs) × Av + t_z + t_d t_z : = 4 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)/67T(N)/110T	40 ms
Zeroing (duration)		10 s
Change of input reflection coefficient with respect to power [19]	only for power levels > 15 dBm	< 0.005

Calibration uncertainty [23]	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*
Temperature effect [24]	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
Linearity [25]	DC to 67.0 GHz	*0.007 dB*
	> 67.0 GHz to 110.0 GHz	*0.010 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
	permissible total cable length	≤ 5 m
Ethernet interface 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
Trigger-I/O EXTernal2	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
Dimensions (W × H × L)	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)
Weight	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).

Frequency range	R&S®NRP6A(N)	8 kHz to 6 GHz	
	R&S®NRP18A(N)	8 kHz to 18 GHz	
Impedance matching (SWR)	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**)	
Power measurement range		100 pW to 200 mW (–70 dBm to +23 dBm)	
Max. power	average power	1 W (+30 dBm) AVG, max. 10 V DC	
	peak envelope power	2 W (+33 dBm) for max. 10 µs	
Measurement subranges	path 1	–70 dBm to –15 dBm	
	path 2	–53 dBm to +5 dBm	
	path 3	–33 dBm to +23 dBm	
Transition regions	with automatic path selection [3]	(–20 ± 1) dBm to (–14 ± 1) dBm (0 ± 1) dBm to (+6 ± 1) dBm	
Dynamic response	rise time 10 %/90 %	< 5 ms	
Acquisition	sample rate (continuous)	2 Msps	
Zero offset	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 [5]		
	path 1	< 49 (28) pW	
	path 2	< 2.1 (1.3) nW	
	path 3	< 192 (108) nW	
Zero drift [6]	path 1	< 12 (2) pW	
	path 2	< 0.5 (0.1) nW	
	path 3	< 47 (8) nW	
Measurement noise [7]	path 1	< 35 (20) pW	
	path 2	< 1.5 (0.9) nW	
	path 3	< 136 (76) nW	

Uncertainty for absolute power measurements [8] 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 [9] 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

Sensor type		three-path diode power sensor
Measurand		power of incident wave
		power of source (DUT) into 50 Ω [10]
RF connector		N (male)
Measurement functions	stationary and recurring waveforms	continuous average
Continuous average function	measurand	mean power over recurring acquisition interval
	aperture	10 µs to 2.0 s (20 ms default)
	window function	uniform or von Hann [11]
	duty cycle correction [12]	0.001 % to 100.0 %
	capacity of measurement buffer [13]	1 to 8192 results
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	
	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	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	≤ 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 time [17]	continuous average	
Av: averaging number	single measurements	2 × (aperture + 5 ms) × Av –5 ms + t_z t_z = 2 ms (typ.)
Zeroing (duration)		6.6 s
Measurement error due to modulation [18]	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 [19]	8 kHz to 2.4 GHz	< 0.02 (0.01)		( ): +15 °C to +35 °C
	> 2.4 GHz	< 0.03 (0.02)		
Calibration uncertainty [20]		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		
	permissible total cable length	≤ 5 m		
Ethernet interface 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		
Trigger-I/O EXTernal2	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		
Dimensions (W × H × L)	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)		
Weight	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.

Connectors	sensor side	8-pin female M12 connector (A-coded)
	host side	USB type A plug
Length	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.

Connectors	sensor side	8-pin female M12 connector (A-coded)
	host side	6-pole circular plug with push-pull locking
Length	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.

OEM manufacturer and type		Zyxel GS1110-8HP
Connectivity	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+
Power consumption		≤ 90 W
Dimensions (W × D × H)	switch	210 mm × 104 mm ×27 mm (8.27 in × 4.09 in × 1.06 in)
Weight	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)
Environmental specifications	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.

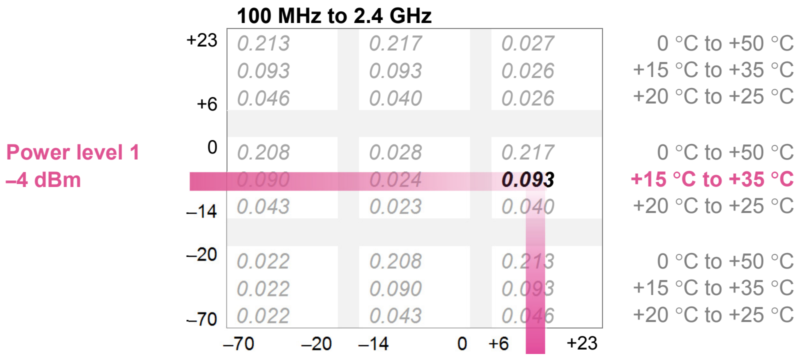
Temperature [26]	R&S®NRPxxS(N), R&S®NRPxxT(N), R&S®NRPxxA(N), R&S®NRP-ZKx	
	operating temperature range	0 °C to +50 °C
	permissible temperature range	–10 °C to +55 °C
	storage temperature range	–40 °C to +85 °C
	R&S®NRP33SN-V	
	operating temperature range	0 °C to +50 °C
	permissible temperature range	–10 °C to +60 °C
	storage temperature range	–40 °C to +85 °C
Climatic resistance	damp heat	+25 °C/+55 °C cyclic at 95 % relative humidity with restrictions: noncondensing, in line with EN 60068-2-30
Mechanical resistance	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
Air pressure	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 [27]	0 hPa to 1060 hPa
	transport	0 hPa to 1060 hPa
Electromagnetic compatibility		applied harmonized standards: EN 61326-1 EN 61326-2-1 EN 55011 (class B)
Calibration interval	recommended	2 years

Warranty	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.

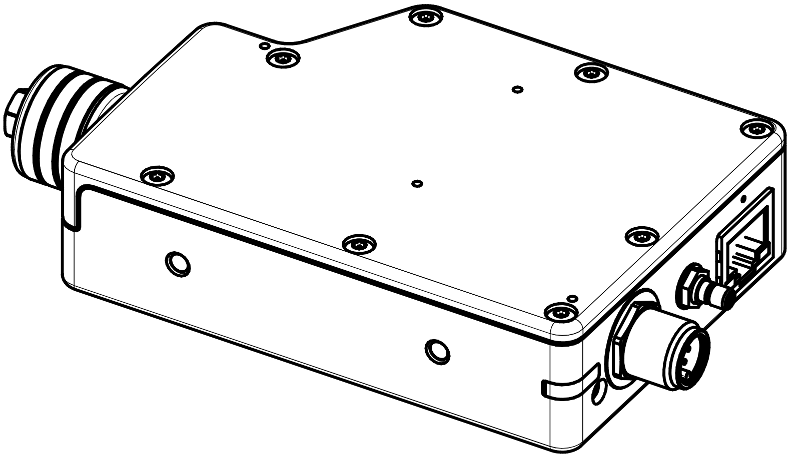


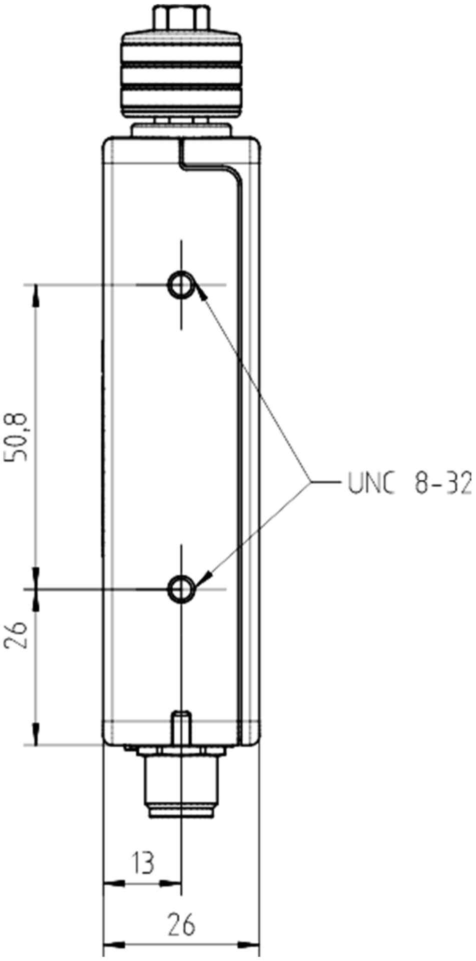
100 MHz to 2.4 GHz

+23	0.213	0.217	0.027	0 °C to +50 °C
	0.093	0.093	0.026	+15 °C to +35 °C
+6	0.046	0.040	0.026	+20 °C to +25 °C
0	0.208	0.028	0.217	0 °C to +50 °C
	0.090	0.024	**0.093**	**+15 °C to +35 °C**
–14	0.043	0.023	0.040	+20 °C to +25 °C
–20	0.022	0.208	0.213	0 °C to +50 °C
	0.022	0.090	0.093	+15 °C to +35 °C
–70	0.022	0.043	0.046	+20 °C to +25 °C
	–70 –20	–14 0	+6 +23	

Power level 2: +10 dBm

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.
Three-Path Diode Power Sensor		
100 pW to 200 mW, 10 MHz to 8 GHz	R&S®NRP8S	1419.0006.02
100 pW to 200 mW, 10 MHz to 8 GHz, LAN version	R&S®NRP8SN	1419.0012.02
100 pW to 200 mW, 10 MHz to 18 GHz	R&S®NRP18S	1419.0029.02
100 pW to 200 mW, 10 MHz to 18 GHz, LAN version	R&S®NRP18SN	1419.0035.02
100 pW to 200 mW, 10 MHz to 33 GHz	R&S®NRP33S	1419.0064.02
100 pW to 200 mW, 10 MHz to 33 GHz, LAN version	R&S®NRP33SN	1419.0070.02
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
Thermal Power Sensors		
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
Average Power Sensors		
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
Accessories (cables, additional equipment, etc.)		
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
Documentation		
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

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 a term of one and two years (WE1 and WE2)
Repairs carried out during the contract term are free of charge [28]. 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 [28] 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

Footnotes

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[1] 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 / √(duty cycle).

[2] With a resolution of 256 pixels.

[3] 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.

[4] 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.

[5] 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).

[6] Within one hour after zeroing, permissible temperature change ±1 °C, following a two-hour warm-up of the power sensor.

[7] 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 √(10.24 s/integration time) yields the noise contribution at other integration times. Using a von Hann window function increases noise by a factor of 1.22.

[8] 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 ºC 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 pW × √(10.24 s/(32 × 2 × 0.02 s)) = 56.6 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.

[9] 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 ºC 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 pW × √(10.24 s/(16 × 2 × 0.02 s)) = 80 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

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

[10] Gamma correction activated.

[11] 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.

[12] For measuring the power of periodic bursts based on an average power measurement.

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[13] 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.

[14] 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.

[15] This parameter enables power measurements on modulated bursts. The parameter must be longer in duration than modulation-induced power drops within the burst.

[16] To exclude unwanted portions of the signal from the measurement result.

[17] 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.

[18] 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.

[19] Change of the reflection coefficient (error vector magnitude) referenced to 0 dBm.

[20] 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.

[21] 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 ºC; 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

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

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

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

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

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

[22] 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.

[23] 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).

[24] Error of an absolute power measurement with respect to temperature.

[25] Expanded uncertainty for relative power measurements referenced to the calibration level (0 dBm), excluding zero offset, zero drift and measurement noise.

[26] 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.

[27] 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.

[28] Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.

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