R&S®NRP
Power Sensor Family
Specifications

ROHDE&SCHWARZ

Test & Measurement

Data Sheet | 01.01

CONTENTS

Definitions

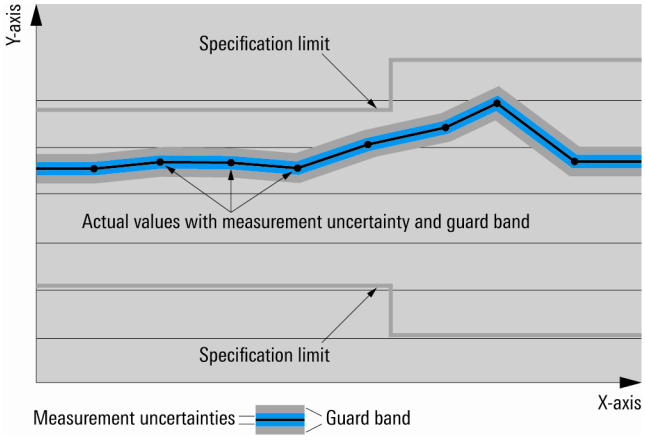
Product data applies under the following conditions:

- 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®NRPxxS(N) 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
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
NRP33S(N)	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

Specifications in brief of the R&S®NRPxxS(N) 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	relative
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 dB to 0.065 dB*	*0.022 dB to 0.050 dB*
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 dB to 0.094 dB*	*0.022 dB to 0.069 dB*
NRP33S(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 > 18.0 GHz to 26.5 GHz: < 1.30 > 26.5 GHz to 33.0 GHz: < 1.35				*0.053 dB to 0.134 dB*	*0.022 dB to 0.136 dB*

Rohde & Schwarz multipath power sensors

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

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).

Frequency range	R&S®NRP8S(N)	10 MHz to 8 GHz	
	R&S®NRP18S(N)	10 MHz to 18 GHz	
	R&S®NRP33S(N)	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*
0.089	*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 [9] in dB

10 MHz to < 20 MHz

	–70	–20	–14	0	+6	+23	
+23	0.267	0.239				0.027	0 °C to +50 °C
	0.107	0.097				0.026	+15 °C to +35 °C
+6	0.047	0.041				0.026	+20 °C to +25 °C
0	0.260	0.028				0.239	0 °C to +50 °C
	0.103	0.024				0.097	+15 °C to +35 °C
–14	0.044	0.023				0.041	+20 °C to +25 °C
–20	0.022	0.260				0.267	0 °C to +50 °C
	0.022	0.103				0.107	+15 °C to +35 °C
–70	0.022	0.044				0.047	+20 °C to +25 °C

Power level in dBm

20 MHz to < 100 MHz

	–70	–20	–14	0	+6	+23	
+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

Power level in dBm

100 MHz to 2.4 GHz

	–70	–20	–14	0	+6	+23	
+23	0.213	0.217				0.027	0 °C to +50 °C
	0.093	0.093				0.026	+15 °C to +35 °C
+6	0.045	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				0.045	+20 °C to +25 °C

Power level in dBm

> 2.4 GHz to 8 GHz

	–70	–20	–14	0	+6	+23	
+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

Power level in dBm

> 8 GHz to 12.4 GHz

	–70	–20	–14	0	+6	+23	
+23	0.212	0.215				0.029	0 °C to +50 °C
	0.099	0.097				0.027	+15 °C to +35 °C
+6	0.056	0.048				0.027	+20 °C to +25 °C
0	0.207	0.029				0.215	0 °C to +50 °C
	0.095	0.025				0.097	+15 °C to +35 °C
–14	0.052	0.024				0.048	+20 °C to +25 °C
–20	0.022	0.207				0.212	0 °C to +50 °C
	0.022	0.095				0.099	+15 °C to +35 °C
–70	0.022	0.052				0.056	+20 °C to +25 °C

Power level in dBm

> 12.4 GHz to 18 GHz

	–70	–20	–14	0	+6	+23	
+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

Power level in dBm

> 18 GHz to 26.5 GHz

	–70	–20	–14	0	+6	+23	
+23	0.242	0.254				0.049	0 °C to +50 °C
	0.134	0.139				0.049	+15 °C to +35 °C
+6	0.098	0.099				0.049	+20 °C to +25 °C
0	0.231	0.038				0.254	0 °C to +50 °C
	0.119	0.034				0.139	+15 °C to +35 °C
–14	0.079	0.032				0.099	+20 °C to +25 °C
–20	0.022	0.231				0.242	0 °C to +50 °C
	0.022	0.119				0.134	+15 °C to +35 °C
–70	0.022	0.079				0.098	+20 °C to +25 °C

Power level in dBm

> 26.5 GHz to 33 GHz

	–70	–20	–14	0	+6	+23	
+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

Power level in dBm

Additional characteristics of the R&S®NRPxxS(N) multipath power sensors

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)	3.5 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 co-efficient with respect to power	10 MHz to 2.4 GHz	< 0.02 (0.01)	( ): +15 °C to +35 °C	
	> 2.4 GHz	< 0.03 (0.02)		
Calibration uncertainty [19]		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*
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	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®NRP8S/18S/33S	48 mm × 30 mm × 138 mm (1.89 in × 1.18 in × 5.43 in)		
	R&S®NRP8SN/18SN/33SN	73 mm × 26 mm × 146 mm (2.87 in × 1.02 in × 5.75 in)		
Weight	R&S®NRP8S/18S/33S	< 0.20 kg (0.44 lb)		
	R&S®NRP8SN/18SN/33SN	< 0.35 kg (0.77 lb)		

Accessories for sensors

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

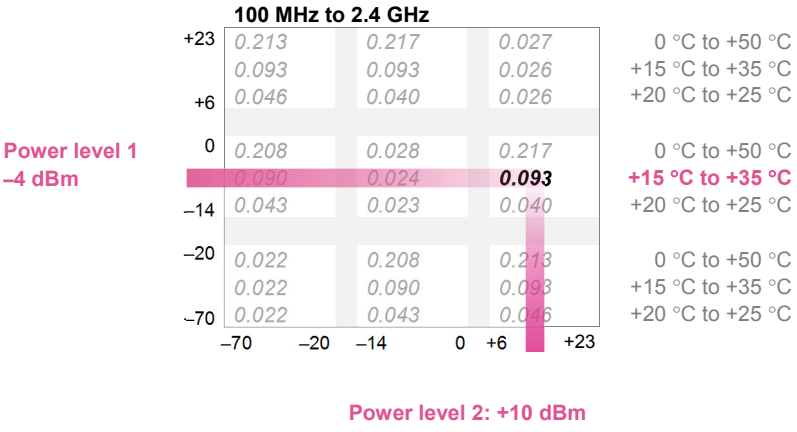
Specifications do not apply to the R&S®NRP-ZAP1 Gigabit Ethernet switch.

Temperature loading [20]	operating temperature range	0 °C to +50 °C, in line with EN 60068
	permissible temperature range	–10 °C to +55 °C, in line with EN 60068
	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	10 Hz to 500 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 16.516.4, procedure I
	air pressure	
	operation	795 hPa (2000 m) to 1060 hPa
	transport	566 hPa (4500 m) to 1060 hPa
Electromagnetic compatibility		in line with EN 61326-1:2013, EN 61326-2:2013 and EN55011:2009+A1:2010
Safety		in line with EN 61010-1; IEC 61010-1; CAN/CSA-C22.2 No. 61010-1-04; UL Std. No. 61010-1
Calibration interval		2 years

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.



Ordering information

Designation	Type	Order No.
Multipath Power Sensors		
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	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	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	R&S®NRP33SN	1419.0070.02
Recommended extras		
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
R&S®NRP Interface Cable, length: 1.50 m	R&S®NRP-ZK6	1419.0664.02
R&S®NRP Interface Cable, length: 3.00 m	R&S®NRP-ZK6	1419.0664.03
R&S®NRP Interface Cable, length: 5.00 m	R&S®NRP-ZK6	1419.0664.04
Gigabit Ethernet switch with Power-over-Ethernet (PoE) capability	R&S®NRP-ZAP1	1419.0829.00
External trigger cable, SMB plug/BNC plug, length: 1.50 m		1419.0641.00

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

Extended warranty with a term of one to four years (WE1 to WE4)
Repairs carried out during the contract term are free of charge [21]. Necessary calibration and adjustments carried out during repairs are also covered. Simply contact the forwarding agent we name; your product will be picked up free of charge and returned to you in top condition a couple of days later.

Extended warranty with calibration (CW1 to CW4)
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 [21] 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

[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

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

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

Combined with the uncertainty of 0.088 dB for absolute power measurements under the given conditions, the total expanded uncertainty is

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

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

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

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

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

[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.

[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] 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.

[20] 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.

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

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

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Certified Quality Management
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