

R&S® NRP-Z22 universal power sensor

Specifications apply when the power sensor is operated together with the RF power attenuator supplied. Please refer to the specifications of the R&S® NRP-Z21 when operating the power sensor section alone.

Frequency range		10 MHz to 18 GHz	
Impedance matching (SWR)	10 MHz to 2.4 GHz	< 1.14	
	> 2.4 GHz to 8.0 GHz	< 1.20	
	> 8.0 GHz to 12.4 GHz	< 1.25	
	> 12.4 GHz to 18.0 GHz	< 1.30	
Power measurement range	Continuous Average	2 nW to 2 W (–57 dBm to +33 dBm)	
	Burst Average	2 µW to 2 W (–27 dBm to +33 dBm)	
	Timeslot/Gate Average	6 nW to 2 W (–52 dBm to +33 dBm) ¹	
	Trace	100 nW to 2 W (–40 dBm to +33 dBm) ²	
Max. power	average power	3 W (+35 dBm), continuous (see diagram)	
	peak envelope power	10 W (+40 dBm) for max. 10 µs	
Measurement subranges	path 1	–57 dBm to –4 dBm	
	path 2	–37 dBm to +16 dBm	
	path 3	–17 dBm to +33 dBm	
Transition regions	with automatic path selection ³	(–9 ± 1.5) dBm to (–3 ± 1.5) dBm (+11 ± 1.5) dBm to (+17 ± 1.5) dBm	
Dynamic response	video bandwidth	> 50 kHz (100 kHz)	(): +15 °C to +35 °C
	single-shot bandwidth	> 50 kHz (100 kHz)	
	rise time 10%/90%	< 8 µs (4 µs)	
Acquisition	sample rate (continuous)	133.358 kHz (default) or 119.467 kHz ⁴	
Triggering	internal		
	threshold level range	–30 dBm to +33 dBm	
	threshold level accuracy	identical to uncertainty for absolute power measurements	
	threshold level hysteresis	0 dB to 10 dB	
	dropout ⁵	0 s to 10 s	
	external	see R&S® NRP2 base unit, R&S® NRP-Z3 USB adapter or R&S® NRP-Z5 USB sensor hub	
	slope (external, internal)	pos./neg.	
	delay	–5 ms to +100 s	
	hold-off	0 s to 10 s	
	resolution (delay, hold-off, dropout)	sample period	
	source	internal, external, immediate, bus, hold	
Zero offset	initial, without zeroing		(): typical at 1 GHz +15 °C to +35 °C
	path 1	< 5.9 (1.2) nW	
	path 2	< 590 (120) nW	
	path 3	< 59 (12) µW	
	after external zeroing ^{6 7}		
	path 1	< 1.3 (0.7) nW	
	path 2	< 120 (60) nW	
path 3	< 12 (6) µW		
Zero drift⁸	path 1	< 0.4 (0) nW	
	path 2	< 40 (0) nW	
	path 3	< 4 (0) µW	
Measurement noise⁹	path 1	< 0.8 (0.4) nW	
	path 2	< 80 (40) nW	
	path 3	< 8 (4) µW	

R&S® NRP-Z22 universal power sensor (continued)

Uncertainty for absolute power measurements¹⁰ in dB

10 MHz to < 100 MHz

0.180	0.237	–	–	
0.180	0.237	0.281	–	
0.180	0.237	0.281	0.316	
0.096	0.124	0.149	0.170	
0.079	0.088	0.104	0.119	
–57	+20	+30	+32	+33

Power level in dBm

100 MHz to < 4 GHz

0.186	0.242	–	–	0 °C to +50 °C
0.186	0.242	0.285	–	0 °C to +40 °C
0.186	0.242	0.285	0.320	0 °C to +35 °C
0.106	0.133	0.157	0.176	+15 °C to +35 °C
0.085	0.098	0.113	0.128	+20 °C to +25 °C
–57	+20	+30	+32	+33

Power level in dBm

4 GHz to < 12.4 GHz

0.203	0.255	–	–	
0.203	0.255	0.296	–	
0.203	0.255	0.296	0.330	
0.133	0.156	0.176	0.194	
0.116	0.125	0.137	0.151	
–57	+20	+30	+32	+33

Power level in dBm

12.4 GHz to < 18 GHz

0.223	0.271	–	–	0 °C to +50 °C
0.223	0.271	0.310	–	0 °C to +40 °C
0.223	0.271	0.310	0.343	0 °C to +35 °C
0.163	0.182	0.199	0.215	+15 °C to +35 °C
0.147	0.155	0.165	0.178	+20 °C to +25 °C
–57	+20	+30	+32	+33

Power level in dBm

Uncertainty for relative power measurements^{11 12} in dB

10 MHz to < 100 MHz

+30	0.286	0.298	0.031	
	0.108	0.109	0.022	
+18	0.052	0.045	0.022	
+10	0.283	0.031	0.298	
	0.108	0.022	0.109	
–2	0.051	0.022	0.045	
–10	0.023	0.283	0.286	
	0.022	0.108	0.108	
–57	0.022	0.051	0.052	
–57	–10/–2	+10/+18	+30	

Power level in dBm

100 MHz to 4 GHz

+30	0.272	0.289	0.041	0 °C to +50 °C
	0.112	0.113	0.032	+15 °C to +35 °C
+18	0.060	0.053	0.031	+20 °C to +25 °C
+10	0.268	0.032	0.289	0 °C to +50 °C
	0.108	0.022	0.113	+15 °C to +35 °C
–2	0.054	0.022	0.053	+20 °C to +25 °C
–10	0.024	0.268	0.272	0 °C to +50 °C
	0.022	0.108	0.112	+15 °C to +35 °C
–57	0.022	0.054	0.060	+20 °C to +25 °C
–57	–10/–2	+10/+18	+30	

Power level in dBm

> 4 GHz to 12.4 GHz

+30	0.284	0.299	0.066	
	0.131	0.130	0.061	
+18	0.087	0.081	0.060	
+10	0.277	0.037	0.299	
	0.118	0.027	0.130	
–2	0.068	0.025	0.081	
–10	0.024	0.277	0.284	
	0.022	0.118	0.131	
–57	0.022	0.068	0.087	
–57	–10/–2	+10/+18	+30	

Power level in dBm

> 12.4 GHz to 18 GHz

+30	0.300	0.310	0.088	0 °C to +50 °C
	0.152	0.148	0.084	+15 °C to +35 °C
+18	0.112	0.106	0.083	+20 °C to +25 °C
+10	0.288	0.043	0.310	0 °C to +50 °C
	0.131	0.035	0.148	+15 °C to +35 °C
–2	0.082	0.033	0.106	+20 °C to +25 °C
–10	0.024	0.288	0.300	0 °C to +50 °C
	0.022	0.131	0.152	+15 °C to +35 °C
–57	0.022	0.082	0.112	+20 °C to +25 °C
–57	–10/–2	+10/+18	+30	

Power level in dBm

Additional characteristics of the R&S® NRP-Z11/-Z21/-Z31/-Z211/-Z221/-Z22/-Z23/-Z24 universal power sensors

Sensor type	R&S® NRP-Z11/-Z21/-Z31	three-path diode power sensor
	R&S® NRP-Z211/-Z221	two-path diode power sensor
	R&S® NRP-Z22/-Z23/-Z24	three-path diode power sensor with preceding RF power attenuator
Measurand		power of incident wave power of source (DUT) into 50 Ω ¹³
RF connector	R&S® NRP-Z11/-Z21/-Z211/-Z221/-Z22/-Z23/-Z24	N (male)
	R&S® NRP-Z31	3.5 mm (male)
RF attenuation ¹⁴	R&S® NRP-Z11/-Z21/-Z211/-Z221/-Z31	not applicable
	R&S® NRP-Z22	10 dB
	R&S® NRP-Z23	20 dB
	R&S® NRP-Z24	25 dB
Measurement functions	stationary and recurring waveforms	Continuous Average Burst Average Timeslot/Gate Average Trace
	single events	Trace
Continuous Average function	measurand	mean power over recurring acquisition interval
	aperture	10 μs to 300 ms (20 ms default)
	window function	uniform or von Hann ¹⁵
	duty cycle correction ¹⁶	0.001 % to 99.999 %
	capacity of measurement buffer ¹⁷	1 to 1024 results
Burst Average function	measurand	mean power over burst portion of recurring signal (trigger settings required)
	detectable burst width	
	R&S® NRP-Z11/-Z21/-Z31 /-Z22/-Z23/-Z24	20 μs to 50 ms
	R&S® NRP-Z211/-Z221	25 μs to 50 ms
	minimum gap between bursts	10 μs
	dropout period ¹⁸ for burst end detection	0 to 3 ms
	exclusion periods ¹⁹	
	start	0 to burst width
	end	0 s to 3 ms
	resolution (dropout and exclusion periods)	sample period (≈ 8 μs)
Timeslot/Gate Average function	measurand	mean power over individual timeslots/gates of recurring signal
	number of timeslots/gates	1 to 128 (consecutive)
	nominal length	10 μs to 0.1 s
	start of first timeslot/gate	at delayed trigger event
	exclusion periods ¹⁹	
	start	0 to nominal length
	end	0 s to 3 ms
resolution (nominal length and exclusion periods)	sample period (≈ 8 μs)	
Trace function	measurand	mean power over pixel length
	acquisition	
	length (Δ)	100 μs to 300 ms
	start (referenced to delayed trigger)	-5 ms to +100 s
	result	
	pixels (M)	1 to 1024
	resolution (Δ/M)	
non-recurring or internally triggered	≥ 10 μs	
recurring and externally triggered	≥ 2.5 μs	

Additional characteristics of the R&S® NRP-Z11/-Z21/-Z31/-Z211/-Z221/-Z22/-Z23/-Z24 universal power sensors (continued)

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	2^N ; $N = 0$ to 16 (13 for Trace function)
	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 rate	continuous, independent of averaging number can be limited to 0.1 s^{-1}
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 ²⁰	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	1 to 1000
Gamma correction	function	removes the influence of impedance mismatch from the measurement result so that the power of the source (DUT) into 50Ω can be read
	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 ²¹	Continuous Average	$2 \times (\text{aperture} + 105 \mu\text{s}) \times 2^N + t_z$
	buffered ¹⁷ , without averaging	$2 \times (\text{aperture} + 250 \mu\text{s}) \times \text{buffer size} + t_z$
	Timeslot/Gate Average	
	signal period – $T \times w > 100 \mu\text{s}$	$\leq 2 \times \text{signal period} \times (2^N + \frac{1}{2}) + t_z$
	all other cases	$\leq 4 \times \text{signal period} \times (2^N + \frac{1}{4}) + t_z$ $t_z : < 1.6 \text{ ms}$ (0.9 ms, typical)
Zeroing (duration)	depends on setting of averaging filter	
	AUTO ON	4 s
	AUTO OFF, integration time ²²	
	< 4 s	4 s
	4 s to 16 s	integration time
	> 16 s	16 s

Additional characteristics of the R&S®NRP-Z11/-Z21/-Z31/-Z211/-Z221/-Z22/-Z23/-Z24 universal power sensors (continued)

Measurement error due to harmonics ²³	R&S®NRP-Z11/-Z2x: all paths R&S®NRP-Z31: paths 1 and 2 R&S®NRP-Z211/-Z221: all paths	<i>n</i> = 2	<i>n</i> = 3	<i>n</i> : multiple of carrier frequency
	-30 dBc	< 0.001 dB	< 0.003 dB	
	-20 dBc	< 0.002 dB	< 0.010 dB	
	-10 dBc	< 0.010 dB	< 0.040 dB	
	R&S®NRP-Z31: path 3	<i>n</i> = 2	<i>n</i> = 3	
	-40 dBc	< 0.001 dB	< 0.010 dB	
	-30 dBc	< 0.002 dB	< 0.040 dB	
Measurement error due to modulation ²⁴	general	depends on CCDF and RF bandwidth of test signal		
	WCDMA (3GPP test model 1-64)			
	worst case	-0.02 dB to +0.07 dB		
	typical	-0.01 dB to +0.03 dB		
Change of input reflection coefficient with respect to power ²⁵	10 MHz to 2.4 GHz	< 0.02 (0.01)	(): +15 °C to +35 °C	
	> 2.4 GHz	< 0.03 (0.02)		
Calibration uncertainty ²⁶	R&S®NRP-Z11/-Z21	path 1	path 2	path 3
	10 MHz to < 100 MHz	0.056 dB	0.047 dB	0.048 dB
	100 MHz to 4.0 GHz	0.066 dB	0.057 dB	0.057 dB
	> 4.0 GHz to 8.0 GHz	0.083 dB	0.071 dB	0.072 dB
	> 8.0 GHz to 12.4 GHz	0.094 dB	0.076 dB	0.076 dB
	> 12.4 GHz to 18.0 GHz	0.123 dB	0.099 dB	0.099 dB
	R&S®NRP-Z31	path 1	path 2	path 3
	10 MHz to < 100 MHz	0.051 dB	0.053 dB	0.053 dB
	100 MHz to 4.0 GHz	0.061 dB	0.062 dB	0.062 dB
	> 4.0 GHz to 8.0 GHz	0.063 dB	0.063 dB	0.063 dB
	> 8.0 GHz to 12.4 GHz	0.070 dB	0.069 dB	0.069 dB
	> 12.4 GHz to 18.0 GHz	0.088 dB	0.087 dB	0.087 dB
	> 18.0 GHz to 26.5 GHz	0.088 dB	0.085 dB	0.087 dB
	> 26.5 GHz to 33.0 GHz	0.116 dB	0.113 dB	0.117 dB
	R&S®NRP-Z211/-Z221	path 1	path 2	
	10 MHz to < 100 MHz	0.052 dB	0.053 dB	
	100 MHz to 4.0 GHz	0.061 dB	0.062 dB	
	> 4.0 GHz to 8.0 GHz	0.075 dB	0.076 dB	
	> 8.0 GHz to 12.4 GHz	0.080 dB	0.080 dB	
	> 12.4 GHz to 18.0 GHz	0.101 dB	0.102 dB	
R&S®NRP-Z22/-Z23/-Z24 ²⁷	path 1	path 2	path 3	
10 MHz to < 100 MHz	0.078 dB	0.072 dB	0.073 dB	
100 MHz to 4.0 GHz	0.084 dB	0.077 dB	0.077 dB	
> 4.0 GHz to 12.4 GHz	0.110 dB	0.095 dB	0.095 dB	
> 12.4 GHz to 18.0 GHz	0.139 dB	0.118 dB	0.118 dB	

Additional characteristics of the R&S® NRP-Z11/-Z21/-Z31/-Z211/-Z221/-Z22/-Z23/-Z24 universal power sensors (continued)

Interface to host	power supply	+5 V/0.2 A (USB high-power device)
	remote control	as a USB device (function) in full-speed mode, compatible with USB 1.0/1.1/2.0 specifications
	trigger input	differential (0 V/+3.3 V)
	connector type	ODU Mini-Snap® L series, six-pole cylindrical straight plug
	permissible total cable length	≤ 10 m (see also tables on page 55)
Dimensions (W × H × L)	R&S® NRP-Z11/-Z21/-Z31/-Z211/-Z221	48 mm × 31 mm × 170 mm (1.89 in × 1.22 in × 6.69 in)
	R&S® NRP-Z22	48 mm × 31 mm × 214 mm (1.89 in × 1.22 in × 8.42 in)
	R&S® NRP-Z23	60 mm × 54 mm × 285 mm (2.36 in × 2.13 in × 11.22 in)
	R&S® NRP-Z24	60 mm × 54 mm × 344 mm (2.36 in × 2.13 in × 13.54 in)
	length including connecting cable model .02 model .04 (R&S® NRP-Z11 only)	approx. 1.6 m (62.99 in) approx. 0.6 m (23.62 in)
Weight	R&S® NRP-Z11/-Z21/-Z31/-Z211/-Z221	< 0.30 kg (0.66 lb)
	R&S® NRP-Z22	< 0.37 kg (0.82 lb)
	R&S® NRP-Z23	< 0.48 kg (1.06 lb)
	R&S® NRP-Z24	< 0.63 kg (1.39 lb)

Power rating of the R&S® NRP-Z22/-Z23/-Z24

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

