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Technical Information

Power Sensor R&S NRP-Z91

Universal power measurement from 9 kHz to 6 GHz

The Power Sensor R&S NRP-Z91 is designed for measuring average power in a very wide frequency range. In particular, it covers the frequency bands relevant for terrestrial radiocommunication. It is thus ideal not only for EMC applications but also as a truly universal power sensor.

The sensor can be operated on the R&S NRP base unit and also as a standalone device on a PC or a PC-based measuring instrument.

- 90 dB dynamic range
- Able to handle signals with any type of modulation
- Very low measurement uncertainty
- Excellent matching
- Low sensitivity to harmonics
- Operable on a PC without power meter base unit





Specifications

Bold: Parameter 100% tested

Italics: Uncertainties calculated from the test assembly specifications and the modelled behaviour of the sensor.

Normal: Compliance with specifications is ensured by the design or derived from the measurement of related parameters

Power Sensor R&S NRP-Z91

Frequency range			9 kHz to 6 GHz	
Matching (SWR)	9 kHz to 2.4 GHz > 2.4 GHz to 6.0 GHz		< 1.13 (1.11) < 1.20 (1.18)	values in () for temperature range 15°C to 35°C
Level-dependent matching change ²⁾	9 kHz to 2.4 GHz > 2.4 GHz to 6.0 GHz		< 0.05 (0.02) < 0.08 (0.05)	
Power measurement range			200 pW to 200 m (-67 dBm to +23 d	W dBm)
Max. power	Average		0.4 W (+26 dBm)	continuous
	Peak envelope power		1 W (+30 dBm) fo	or max. 10 µs
Measurement subranges		Path 1 Path 2 Path 3	-67 dBm to - 14 d -47 dBm to + 6 d -27 dBm to +23 d	Bm Bm Bm
Transition ranges	With automatic path se user def'd crossover ⁵) s	election, set to 0 dB	(-19±1) dBm to (- (+ 1±1) dBm to (+	13±1) dBm ⊦7±1) dBm
Display noise ¹⁴⁾	15°C to 35°C	Path 1 2 3	< 60 pW (40 < 5.6 nW (3.6 < 0.56 µW (0.36	pW typ.) nW typ.) μW typ.)
	0°C to 50°C	Path 1 2 3	< 65 pW < 6.3 nW < 0.63 μW	
Display noise, relative ¹⁵⁾	Measurement window 2×1 ms, without averaging		< 0.05 dB (0.03 d	B typ.)
	Measurement window 2 averaging factor 32 (mo ment time approx. 1 s)	2 × 20 ms, easure-	< 0.002 dB (0.001	I dB typ.)
Zero offset ¹⁷⁾	15°C to 35°C	Path 1 2 3	< 96 pW (64 < 9.0 nW (5.8 < 0.90 µW (0.58	pΨ typ.) nW typ.) μW typ.)
	0°C to 50°C	Path 1 2 3	< 104 pW < 10.0 nW < 1.00 µW	
Zero drift ¹⁸⁾		Path 1 Path 2 Path 3	< 35 pW < 3 nW < 0.3 µW	
Triggering	Source		Bus, External, Ho	ld, Immediate, Internal
	Slope (external, interna	al)	pos./neg.	
	Level Internal External		-40 dBm to +23 d See specs for R& Adapter R&S NR	Bm :S NRP and USB P-Z3
	Delay		-5 ms to +100 s	
	Holdoff		0 s to 10 s	
	Hysteresis		0 dB to 10 dB	

Power Sensor R&S NRP-Z91 (continued)

Uncertainty for absolute power measurements³¹⁾ in dB

9 kHz to < 20 kHz

	0.1 0.0 0.0	174 075 056		0.17 0.07 0.04	75 70 47		0.17 0.07 0.04	75 71 8	(0. (15. (20.	50) °C 35) °C 25) °C
-4	0 ³⁷⁾	to	-19) to)	+1	to	+23	dBm	

20 kHz to < 100 MHz

> 4 GHz to 6 GHz

0.072	0.009	0.009	(1335) °C (2025) °C
0.147	0.159	0.159	(050) °C

100 MHz to 4 GHz

+23

+7 +1

-13 -19

-40³⁷⁾

dBm -40³⁷⁾

0.226

0.084

0.046

0.226

0.083

0.045

0.023

0.022

0.022

	0.150 0.081 0.066	0.162 0.077 0.058	0.164 0.081 0.063	(050) °C (1535) °C (2025) °C	0.160 0.096 0.083	0.170 0.089 0.072	0.174 0.097 0.082	(1
-4	40 ³⁷⁾ to -	19 to +	1 to +23	dBm	-40 ³⁷⁾ to	-19 to +1	to +23	י dBm

Uncertainty for relative power measurements ^{32), 33), 36)} in dB

0.027

0.022

0.022

0.229

0.080

0.044

0.226 0.084

0.046

+23

9 kHz to < 20 kHz

0.229

0.080

0.044

0.027

0.022

0.022

0.226

0.083

0.045

±0 /+8

-19./ -13

20 kHz to < 100 MHz

(0...50) °C

(15...35) °C

(20...25) °C

+23 +7	0.206 0.082 0.046	0.215 0.078 0.044	0.027 0.022 0.022	(050) °C (1535) °C (2025) °C
+1 -13	0.205 0.081 0.044	0.027 0.022 0.022	0.215 0.078 0.044	(050) °C (1535) °C (2025) °C
-19	0.023	0 205	0 206	(0 50) °C
-40 ³⁷⁾	0.022	0.081 0.044	0.082 0.046	(030) °C (1535) °C (2025) °C
dBm	-40 ³⁷⁾ -19	/ -13 ±0	/ +8 +23	





+23 +7	0.215 0.097 0.066	0.223 0.093 0.059	0.049 0.044 0.043	(050) °C (1535) °C (2025) °C
+1 -13	0.210 0.088 0.054	0.030 0.022 0.022	0.223 0.093 0.059	(050) °C (1535) °C (2025) °C
-19 -40 ³⁷⁾	0.024 0.022 0.022	0.210 0.088 0.054	0.215 0.097 0.066	(050) °C (1535) °C (2025) °C
dBm	-40 ³⁷⁾ -19	/ -13 ±0	/ +8 +23	

Additional characteristics of R&S NRP-Z91

Sensor type			3-path diode sensor		
Measurand			average power average power	of incident wa	ve 50 Ω ¹)
RF connector			N (male)		
Calibration uncertainty ³⁰⁾			Path 1	Path 2	Path 3
in dB	9 kHz to <	< 100 MHz	0.056	0.047	0.048
(20 to 25) °C	0.1 GHz to	4.0 GHz	0.066	0.057	0.057
	> 4 GHz	z to 6 GHz	0.083	0.071	0.072
Measurement function			Continuous Av	verage	
	Measurement windo	w ⁷⁾	2 × (1 ms to 30	00 ms)	
	Duty cycle correction Smoothing	⁸⁾	0.001% to 100 See under Me	0.00% asurement win	dow
Dynamic behaviour of video path	Rise time 10% / 90%		< 5 ms		
Sampling frequency			133.358 kHz		
Zeroing (duration)	Depends on setting of filter	of averaging			
	AUTO ON		4 s		
	Integration time ¹⁶)	< 4 s	4 s		
	:	4 s to 16 s >16 s	Integration time 16 s	e ¹⁶)	
Measurement error due to	$N = 3, 5, 7, \dots^{20}$	-30 dBc	<0.003 dB [0.0	015 dB]	
of carrier frequency ¹⁹⁾		-20 dBc -10 dBc	<0.010 dB [0.0	15 dB]	
values in []:	$N = 2, 4, 6, \dots^{20}$	-30 dBc	<0.001 dB [0.0	003 dB]	
typ. standard uncertainty		-20 dBc -10 dBc	<0.002 dB [0.0 <0.010 dB [0.0	01 dB] 03 dB]	
Modulation influence ²¹⁾	General		measurement	errors in subrar	nges are pro-
values in []:			portional to pov modulation bar	wer and depend adwidth of test	d on CCDF and signal
User def'd crossover ≤ -6 dB	WCDMA (3-GPP Tes AM (80 %)	st Model 1-64)			
	Worst case Typical		-0.02 dB to +0. -0.01 dB to +0.	07 dB [-0.02 dl 03 dB [-0.01 dl	B to +0.02 dB] B to +0.01 dB]
Measurement window	Duration		as specified for	r the measuren	nent function
	Shape		rectangular (int	tegrating behav	viour)
			Von Hann (smo pression of res tion ²⁶⁾	oothing filter, fo ult variations d	or efficient sup- ue to modula-
Measurement times ²⁷⁾			N × (duration of $-3.4 \text{ ms} + t_d$	f meas. windov	v ⁷⁾ +10ms)
			<i>t</i> _d must be con delay (1ms to 2 perature)	sidered with ac 20 ms depende	ctivated auto nt from tem-
Auto delay			If activated, the is delayed so, to power step up ± 0.005 dB).	e beginning of a that settled rea to ±10 dB are o	a measurement dings for a obtained (to

Averaging filter	Modes	AUTO OFF(fixed averaging factor)AUTO ON(continuously auto-adapted)AUTO ONCE(automatically fixed once)
	AUTO mode	
	Normal operating mode ²³⁾	setting of filter depends on power to be measured and resolution
	Resolution	1 (1 dB), 2 (0.1 dB), 3 (0.01 dB), 4 (0.001 dB)
	Fixed Noise operating mode	filter set to specified noise content
	Noise content Max. measurement time ²⁴⁾	0.0001 dB to 1 dB 0.01 s to 999 s
	Averaging factor N	1 to 2 ¹⁶ (number of averaged measurement
	Result output	windows)
	Moving Average	measurement window (e.g. in case of man- ual operation via R&S NRP)
	Repeat	only final result (e.g. in case of remote con- trol of R&S NRP)
Attenuation correction	Function	correcting the measurement result by means of a fixed factor (dB offset)
	Range	-100.000 dB to +100.000 dB
S-parameter correction	Function	Taking into account a component connected to the sensor input by loading its s-parameter data set into the sensor
	Number of frequencies Parameters	1 to 1000 s_{11} , s_{21} , s_{12} and s_{22} (in s2p format)
	Download	With R&S NRP tool kit (supplied with sensor) via USB Adapter R&S NRP-Z3 or R&S NRP- Z4
Гcorrection	Function	Reducing the influence of mismatched sources ²⁹⁾
	Parameters	Magnitude and phase of reflection coefficient of source
	Download	see under S-parameter correction
Frequency response cor- rection	Function	taking into account the calibration factors relevant for the test frequency
	Parameter	carrier frequency (center frequency)
	Permissible deviation from actual value	50 MHz (0.05 \times f below 1 GHz) for specified measurement uncertainty
Interface to host	Power supply	+5 V / 200 mA typ. (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 / +3.3 V)
Dimensions	WxHxL	48 mm \times 31 mm \times 170 mm Length incl. connecting cable: approx. 1.6 m
Weight		< 0.3 kg

Footnotes

Please refer to the R&S NRP data sheet for footnotes not mentioned below.

³³) Reading the uncertainty for relative power measurements. The example shows a level step of approx. 14 dB (-4 dBm \rightarrow +10 dBm) at 1.9 GHz and an ambient temperature of 28°C.



³⁷) For measurements at even lower levels the influence of zero offset and zero drift must be added to the specifications on an RSS basis. The same applies to noise exceeding a two-sigma value of 0.01 dB.

General specifications

See the R&S NRP data sheet (PD 0757.7023.21), sensors R&S NRP-Z11/-Z21.

Accessories

See the R&S NRP data sheet (PD 0757.7023.21).

Ordering information

Description	Туре	Order No.
Average Power Sensor		
200 pW to 200 mW; 9 kHz to 6 GHz	R&S NRP-Z91	1168.8004.02

