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 radio-communication. 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

ROHDE&SCHWARZ

Preliminary

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) Level-dependent matching change [2)]	9 kHz to 2.4 GHz > 2.4 GHz to 6.0 GHz 9 kHz to 2.4 GHz > 2.4 GHz to 6.0 GHz	< 1.13 (**1.11**) values in ( ) for < 1.20 (**1.18**) temperature range 15°C to 35°C < 0.05 (0.02) < 0.08 (0.05)
Power measurement range		200 pW to 200 mW (-67 dBm to +23 dBm)
Max. power	Average Peak envelope power	0.4 W (+26 dBm) continuous 1 W (+30 dBm) for max. 10 µs
Measurement subranges	Path 1 Path 2 Path 3	-67 dBm to - 14 dBm -47 dBm to + 6 dBm -27 dBm to +23 dBm
Transition ranges	With automatic path selection, user def'd crossover[5]) set to 0 dB	(-19±1) dBm to (-13±1) dBm (+ 1±1) dBm to (+7±1) dBm
Display noise[14)]	15°C to 35°C Path 1 2 3 0°C to 50°C Path 1 2 3	< 60 pW (40 pW typ.) < 5.6 nW (3.6 nW typ.) < 0.56 µW (0.36 µW typ.) < 65 pW < 6.3 nW < 0.63 µW
Display noise, relative [15)]	Measurement window 2 × 1 ms, without averaging Measurement window 2 × 20 ms, averaging factor 32 (measure-ment time approx. 1 s)	< 0.05 dB (0.03 dB typ.) < 0.002 dB (0.001 dB typ.)
Zero offset[17)]	15°C to 35°C Path 1 2 3 0°C to 50°C Path 1 2 3	< 96 pW (64 pW typ.) < 9.0 nW (5.8 nW typ.) < 0.90 µW (0.58 µW typ.) < 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 Slope (external, internal) Level Internal External Delay Holdoff Hysteresis	Bus, External, Hold, Immediate, Internal pos./neg. -40 dBm to +23 dBm See specs for R&S NRP and USB Adapter R&S NRP-Z3 -5 ms to +100 s 0 s to 10 s 0 dB to 10 dB

Uncertainty for absolute power measurements[31)] in dB

9 kHz to < 20 kHz

0.174 0.075 0.056	0.175 0.070 0.047	0.175 0.071 0.048	(0...50) °C (15...35) °C (20...25) °C

-40[37)] to -19 to +1 to +23 dBm

20 kHz to < 100 MHz

0.147 0.072 0.056	0.159 0.069 0.047	0.159 0.069 0.048	(0...50) °C (15...35) °C (20...25) °C

-40[37)] to -19 to +1 to +23 dBm

100 MHz to 4 GHz

0.150 0.081 0.066	0.162 0.077 0.058	0.164 0.081 0.063	(0...50) °C (15...35) °C (20...25) °C

-40[37)] to -19 to +1 to +23 dBm

> 4 GHz to 6 GHz

0.160 0.096 0.083	0.170 0.089 0.072	0.174 0.097 0.082	(0...50) °C (15...35) °C (20...25) °C

-40[37)] to -19 to +1 to +23 dBm

Uncertainty for relative power measurements [32), 33), 36)] in dB

9 kHz to < 20 kHz

+23	0.226 0.084 0.046	0.229 0.080 0.044	0.027 0.022 0.022
+7 / +1	0.226 0.083 0.045	0.027 0.022 0.022	0.229 0.080 0.044
-13 / -19	0.023 0.022 0.022	0.226 0.083 0.045	0.226 0.084 0.046
-40[37)]			

dBm -40[37)] -19 / -13 ±0 / +8 +23

20 kHz to < 100 MHz

+23	0.206 0.082 0.046	0.215 0.078 **0.044**	0.027 0.022 0.022
+7 / +1	0.205 0.081 **0.044**	0.027 0.022 **0.022**	0.215 0.078 **0.044**
-13 / -19	0.023 0.022 0.022	0.205 0.081 **0.044**	0.206 0.082 0.046
-40[37)]			

(0...50) °C
(15...35) °C
(20...25) °C

dBm -40[37)] -19 / -13 ±0 / +8 +23

100 MHz to 4 GHz

+23	0.209 0.088 0.055	0.218 0.085 0.047	0.038 0.032 0.031
+7 / +1	0.206 0.083 0.048	0.028 0.022 0.022	0.218 0.085 0.047
-13 / -19	0.023 0.022 0.022	0.206 0.083 0.048	0.209 0.088 0.055
-40[37)]			

dBm -40[37)] -19 / -13 ±0 / +8 +23

> 4 GHz to 6 GHz

+23	0.215 0.097 0.066	0.223 0.093 0.059	0.049 0.044 0.043
+7 / +1	0.210 0.088 0.054	0.030 0.022 0.022	0.223 0.093 0.059
-13 / -19	0.024 0.022 0.022	0.210 0.088 0.054	0.215 0.097 0.066
-40[37)]			

(0...50) °C
(15...35) °C
(20...25) °C

dBm -40[37)] -19 / -13 ±0 / +8 +23

Additional characteristics of R&S NRP-Z91

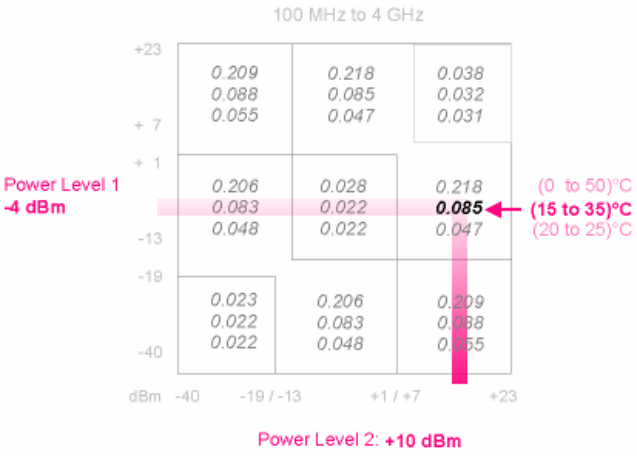
Sensor type		3-path diode sensor		
Measurand		average power of incident wave average power of source into 50 Ω[1])		
RF connector		N (male)		
Calibration uncertainty[30)] in dB (20 to 25) °C		Path 1	Path 2	Path 3
	9 kHz to < 100 MHz	*0.056*	*0.047*	*0.048*
	0.1 GHz to 4.0 GHz	*0.066*	*0.057*	*0.057*
	> 4 GHz to 6 GHz	*0.083*	*0.071*	*0.072*
Measurement function		Continuous Average		
	Measurement window[7)]	2 × (1 ms to 300 ms)		
	Duty cycle correction[8)]	0.001% to 100.00%		
	Smoothing	See under Measurement window		
Dynamic behaviour of video path	Rise time 10% / 90%	< 5 ms		
Sampling frequency		133.358 kHz		
Zeroing (duration)	Depends on setting of averaging filter			
	AUTO ON	4 s		
	AUTO OFF			
	Integration time[16]) < 4 s	4 s		
	4 s to 16 s	Integration time[16])		
	>16 s	16 s		
Measurement error due to harmonics $n \times f_0$ of carrier frequency[19)] values in [ ]: typ. standard uncertainty	*N* = 3, 5, 7, ... [20]) -30 dBc	<0.003 dB [0.0015 dB]		
	-20 dBc	<0.010 dB [0.005 dB]		
	-10 dBc	<0.040 dB [0.015 dB]		
	N = 2, 4, 6, ... [20]) -30 dBc	<0.001 dB [0.0003 dB]		
	-20 dBc	<0.002 dB [0.001 dB]		
	-10 dBc	<0.010 dB [0.003 dB]		
Modulation influence[21)] values in [ ]: User def'd crossover ≤ -6 dB	General	measurement errors in subranges are proportional to power and depend on CCDF and modulation bandwidth of test signal		
	WCDMA (3-GPP Test Model 1-64) AM (80 %)			
	Worst case	-0.02 dB to +0.07 dB [-0.02 dB to +0.02 dB]		
	Typical	-0.01 dB to +0.03 dB [-0.01 dB to +0.01 dB]		
Measurement window	Duration	as specified for the measurement function		
	Shape	rectangular (integrating behaviour)		
		Von Hann (smoothing filter, for efficient suppression of result variations due to modulation[26)]		
Measurement times[27)]		N × (duration of meas. window[7)]+10ms) -3.4 ms+ t_d		
		t_d must be considered with activated auto delay (1ms to 20 ms dependent from temperature)		
Auto delay		If activated, the beginning of a measurement is delayed so, that settled readings for a power step up to ±10 dB are obtained (to ±0.005 dB) .		

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 windows)
	Result output Moving Average	continuous with every newly evaluated measurement window (e.g. in case of manual operation via R&S NRP)
	Repeat	only final result (e.g. in case of remote control 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
Γ correction	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 correction	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 × 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	W x H x L	48 mm × 31 mm × 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 → +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	Type	Order No.
Average Power Sensor 200 pW to 200 mW; 9 kHz to 6 GHz	R&S NRP-Z91	1168.8004.02

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