

Technical Information

Power Sensor R&S NRP-Z51

Thermoelectric accuracy at its best

The R&S NRP-Z51 is the world's first power sensor to combine the thermal test cell with a complete power meter. The sensor features not only all the advantages of the thermal measuring principle but also a further increase in accuracy since the influence of the base unit is eliminated; it also offers a continuous measurement range from 1 μ W to 100 mW without range switching, *G* correction to reduce matching errors and numerous other assets. The DC-coupled thermal test cell of the predecessor

model R&S NRV-Z51 was adopted, allowing measurements starting at 0 Hz, plus reference to a low-frequency or DC standard. Like the other sensors of this instrument family, the R&S NRP-Z51 sensor can be operated via the R&S NRP base unit or a PC with a USB interface. A virtual user interface is part of the equipment supplied to enable operation from a PC.

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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

Sensor type		Thermoelectric sensor																								
Measurand		Average power of incident wave average power of source into 50Ω ¹⁾																								
Frequency range		DC to 18 GHz																								
Matching (SWR)	DC to 2.4 GHz > 2.4 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz	< 1.10 < 1.15 < 1.20																								
RF connector		N (male)																								
Power measurement range		1 μ W to 100 mW (-30 dBm to +20 dBm) cont., without subranges																								
Max. power	Average Pulse energy	0.3 W (+25 dBm) continuous 10 W μ s																								
Display noise ¹⁴⁾		< 30 nW (20 nW typ.)																								
Zero offset ¹⁷⁾		< 50 nW (33 nW typ.)																								
Zero drift ¹⁸⁾		< 20 nW																								
Linearity uncertainty ^{*)}		< 0.02 dB																								
Calibration uncertainty ^{**)}	10 MHz to < 100 MHz 100 MHz to 4 GHz > 4 GHz to 8 GHz > 8 GHz to 12.4 GHz > 12.4 GHz to 18 GHz	20°C to 25°C <i>0.047 dB</i> <i>0.057 dB</i> <i>0.071 dB</i> <i>0.076 dB</i> <i>0.098 dB</i>																								
Temperature effect		< 0.004 dB/K (0.001 dB/K typ.)																								
Uncertainty for absolute power measurements ^{***)} from -13 dBm to 20 dBm	10 MHz to < 100 MHz 100 MHz to 4 GHz > 4 GHz to 8 GHz > 8 GHz to 12.4 GHz > 12.4 GHz to 18 GHz	<table border="1"> <thead> <tr> <th></th> <th>20°C to 25°C</th> <th>15°C to 35°C</th> <th>0°C to 50°C</th> </tr> </thead> <tbody> <tr> <td>10 MHz to < 100 MHz</td> <td><i>0.052 dB</i></td> <td><i>0.057 dB</i></td> <td><i>0.075 dB</i></td> </tr> <tr> <td>100 MHz to 4 GHz</td> <td><i>0.061 dB</i></td> <td><i>0.066 dB</i></td> <td><i>0.082 dB</i></td> </tr> <tr> <td>> 4 GHz to 8 GHz</td> <td><i>0.074 dB</i></td> <td><i>0.078 dB</i></td> <td><i>0.092 dB</i></td> </tr> <tr> <td>> 8 GHz to 12.4 GHz</td> <td><i>0.078 dB</i></td> <td><i>0.082 dB</i></td> <td><i>0.095 dB</i></td> </tr> <tr> <td>> 12.4 GHz to 18 GHz</td> <td><i>0.100 dB</i></td> <td><i>0.102 dB</i></td> <td><i>0.113 dB</i></td> </tr> </tbody> </table>		20°C to 25°C	15°C to 35°C	0°C to 50°C	10 MHz to < 100 MHz	<i>0.052 dB</i>	<i>0.057 dB</i>	<i>0.075 dB</i>	100 MHz to 4 GHz	<i>0.061 dB</i>	<i>0.066 dB</i>	<i>0.082 dB</i>	> 4 GHz to 8 GHz	<i>0.074 dB</i>	<i>0.078 dB</i>	<i>0.092 dB</i>	> 8 GHz to 12.4 GHz	<i>0.078 dB</i>	<i>0.082 dB</i>	<i>0.095 dB</i>	> 12.4 GHz to 18 GHz	<i>0.100 dB</i>	<i>0.102 dB</i>	<i>0.113 dB</i>
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Measurement window ⁷⁾	Duration Shape	2 × (1 ms to 300 ms) rectangular (integrating behaviour) Von Hann (smoothing filter, for efficient suppression of result variations due to modulation ²⁶⁾)																								
Measurement time ²⁷⁾		N × (duration of measurement window + 0.5 ms) + t_z t_z : < 82 ms																								

Zeroing (duration)	Depends on setting of averaging filter AUTO ON AUTO OFF Integration time ¹⁶⁾ < 4 s 4 s... 16 s > 16 s	4 s 4 s integration time ¹⁶⁾ 16 s
Averaging filter	Modes Normal operating mode ²³⁾ Resolution Fixed Noise operating mode Noise content Max. measurement time ²⁴⁾ Averaging factor N Result output Moving Average Repeat	AUTO OFF (fixed averaging factor) AUTO ON (continuously auto-adapted) AUTO ONCE (automatically fixed once) setting of filter depends on power to be measured and resolution 1 (1 dB), 2 (0.1 dB), 3 (0.01 dB), 4 (0.001 dB) filter set to specified noise content 0.0001 dB to 1 dB 0.01 s to 1000 s 1 to 2 ¹⁶ (number of averaged measurement windows) continuous with every newly evaluated measurement window (e.g. in case of manual operation via R&S NRP) only final result (e.g. in case of remote control of R&S NRP)
Duty cycle correction ⁸⁾		0.001 % to 99.999 %
Capacity of measurement buffer ⁹⁾		1 to 1024 results
Triggering	Source Slope (external, internal) Level Internal External Delay Holdoff Hysteresis	Bus, External, Hold, Immediate, Internal pos./neg. -16 dBm to +20 dBm see specs of R&S NRP and USB Adapter R&S NRP-Z3 0 s to +100 s 0 s to 10 s 0 dB to 10 dB
Attenuation correction	Function Range	Correcting the measurement result by means of a fixed factor (dB offset) -100.000 dB to +100.000 dB
S-parameter-correction	Function Number of frequencies Parameters Download	taking into account a component connected ahead of the sensor by loading ist s-parameter data set into the sensor 1 to 1000 S ₁₁ , S ₂₁ , S ₁₂ and S ₂₁ (in s2p format) with R&S NRP Toolkit (supplied with sensor) via USB Adapter R&S NRP-Z3 or R&S NRP-Z4.

G correction	Function Parameters Download	reducing the influence of mismatched sources ²⁹⁾ magnitude and phase of reflection coefficient of source see under S-parameter correction
Frequency response correction	Function Parameter Permissible deviation from actual value	taking into account the calibration factors relevant for the test frequency Carrier frequency (center frequency) 100 MHz (0.1 × f below 1GHz) for specified measurement uncertainty
Interface to host	Power supply Remote control Trigger input	+5 V / 100 mA typ. (USB Low-power device) as a USB device (function) in full-speed mode, compatible with USB 1.0/1.1/2.0 specifications differential (0 / +3.3 V)
Dimensions (W × H × L)		48 mm × 31 mm × 170 mm length incl. connecting cable: approx. 1.6 m
Weight		< 0.3 kg

*) For relative measurements referenced to 0 dBm.

**) Expanded uncertainty (k=2) for absolute power measurements at the calibration level (0 dBm) and the calibration frequencies (10 MHz, 50 MHz, 100 MHz; from 500 MHz to 18 GHz in increments of 500 MHz). Specifications include zero offset and display noise (up to a 2 σ value of 0.004 dB).

***) Includes the effects of calibration uncertainty, linearity, zero offset, temperature and display noise (up to a value of 0.004 dB). For power levels below -13 dBm the effect of zero set must be calculated separately.

General specifications

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

Accessories and numerical footnotes

see the R&S NRP data sheet (PD 0757.7023.21)

Ordering information

Description	Type	Order No.
Power Sensor 1 μW to 100 mW; DC to 18 GHz	R&S NRP-Z51	1138.0005.02

