

Technical Information

Power Sensor Modules R&S NRP-Z27, -Z37

For accurate absolute power measurements with the R&S FSMR

The new power sensor modules for the frequency ranges DC to 18 GHz (R&S NRP-Z27) and DC to 26.5 GHz (R&S NRP-Z37) turn the R&S FSMR measuring receivers into precision power meters with a dynamic range as large as -115 dBm to +30 dBm. The sensor modules feature not only all the advantages of the thermal measuring principle, but also reliable and repeatable operation due to the use of a power splitter for signal separation.

Excellent isolation from the receiver input is achieved by means of hardware and by numeric precorrection of the splitter, which yields high total accuracy.

Like all other power sensors of the R&S NRP family, the sensor modules are fully self-contained power meters that are remote-controlled from the R&S FSMR via USB.



Preliminary

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Specifications

Bold: Parameter 100% tested.

Italics: Uncertainties calculated from the test assembly specifications and modeled behavior of the sensor.

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

Sensor type		thermoelectric power sensor with RF signal output														
Measurand		average power of incident wave														
Frequency range		DC to 18 GHz (R&S NRP-Z27) DC to 26.5 GHz (R&S NRP-Z37)														
Input SWR ³⁹⁾	DC to 2.0 GHz > 2.0 GHz to 4.2 GHz > 4.2 GHz to 8.0 GHz > 8.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;">R&S NRP-Z27</td> <td style="width: 50%; border: none;">R&S NRP-Z37</td> </tr> <tr> <td style="border: none;">< 1.15</td> <td style="border: none;">< 1.15</td> </tr> <tr> <td style="border: none;">< 1.18</td> <td style="border: none;">< 1.18</td> </tr> <tr> <td style="border: none;">< 1.23</td> <td style="border: none;">< 1.23</td> </tr> <tr> <td style="border: none;">< 1.25</td> <td style="border: none;">< 1.25</td> </tr> <tr> <td style="border: none;">< 1.35</td> <td style="border: none;">< 1.30</td> </tr> <tr> <td style="border: none;"></td> <td style="border: none;">< 1.45</td> </tr> </table>	R&S NRP-Z27	R&S NRP-Z37	< 1.15	< 1.15	< 1.18	< 1.18	< 1.23	< 1.23	< 1.25	< 1.25	< 1.35	< 1.30		< 1.45
R&S NRP-Z27	R&S NRP-Z37															
< 1.15	< 1.15															
< 1.18	< 1.18															
< 1.23	< 1.23															
< 1.25	< 1.25															
< 1.35	< 1.30															
	< 1.45															
RF connector		N (male) for R&S NRP-Z27 3.5 mm (male) for R&S NRP-Z37														
Power measurement range		4 µW to 400 mW (-24 dBm to +26 dBm) cont., without subranges														
Max. power	average pulse energy	0.5 W (+27 dBm) continuous 1.0 W (+30 dBm) short-term 30 Wµs														
Display noise ¹⁴⁾		< 240 nW (typ. 120 nW)														
Zero offset ¹⁷⁾		< 400 nW (typ. 200 nW)														
Zero drift ¹⁸⁾		< 160 nW														
Linearity uncertainty ³⁶⁾		< 0.02 dB														
Temperature effect ³⁷⁾	DC to 4.2 GHz > 4.2 GHz to 8.0 GHz > 8.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz	< 0.004 dB/K (typ. 0.0014 dB/K) < 0.005 dB/K (typ. 0.0015 dB/K) < 0.005 dB/K (typ. 0.0017 dB/K) < 0.006 dB/K (typ. 0.0019 dB/K) < 0.009 dB/K (typ. 0.0027 dB/K)														
Isolation ³⁸⁾	DC to 2.0 GHz > 2.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz	> 23 (51) dB > 25 (37) dB > 26 (35) dB > 26 (32) dB														
Coupling from input to RF output	DC to 2.0 GHz > 2.0 GHz to 4.2 GHz > 4.2 GHz to 8.0 GHz > 8.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz	< 14 dB (typ. 12.5 dB) < 15 dB (typ. 13.5 dB) < 16 dB (typ. 14.0 dB) < 17 dB (typ. 14.5 dB) < 18 dB (typ. 15.5 dB) < 19 dB (typ. 16.5 dB)														
SWR of RF output	DC to 8.0 GHz > 8.0 GHz to 26.5 GHz	> 13 dB > 9.5 dB														
Calibration uncertainty ³⁹⁾	DC to < 100 MHz 100 MHz to 4.2 GHz > 4.2 GHz to 8.0 GHz > 8.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz	<i>0.063 dB</i> <i>0.070 dB</i> <i>0.082 dB</i> <i>0.088 dB</i> <i>0.109 dB</i> <i>0.118 dB</i>														

Uncertainty for absolute power measurements on R&S FSMR26 ⁴⁰⁾ From -10 dBm to +26 dBm	DC to < 100 MHz 100 MHz to 4.2 GHz > 4.2 GHz to 8.0 GHz > 8.0 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz	20°C to 25°C <i>0.104 dB</i> <i>0.116 dB</i> <i>0.163 dB</i> <i>0.183 dB</i> <i>0.226 dB</i>	15°C to 35°C <i>0.109 dB</i> <i>0.120 dB</i> <i>0.166 dB</i> <i>0.187 dB</i> <i>0.235 dB</i>	0°C to 50°C <i>0.128 dB</i> <i>0.138 dB</i> <i>0.181 dB</i> <i>0.207 dB</i> <i>0.269 dB</i>
	After numerical isolation correction DC to < 100 MHz 100 MHz to 4.2 GHz > 4.2 GHz to 8.0 GHz > 8.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz	<i>0.067 dB</i> <i>0.077 dB</i> <i>0.092 dB</i> <i>0.099 dB</i> <i>0.122 dB</i> <i>0.154 dB</i>	<i>0.074 dB</i> <i>0.083 dB</i> <i>0.099 dB</i> <i>0.107 dB</i> <i>0.130 dB</i> <i>0.167 dB</i>	<i>0.101 dB</i> <i>0.107 dB</i> <i>0.123 dB</i> <i>0.135 dB</i> <i>0.159 dB</i> <i>0.212 dB</i>
Measurement window ⁷⁾	duration shape	2 × (1 ms to 300 ms) rectangular (integrating behavior) 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 %		
Attenuation correction	function range	correcting the measurement result by means of a fixed factor (dB offset) -100.000 dB to +100.000 dB		
Γ correction	function parameters	reducing the influence of mismatched sources ²⁹⁾ magnitude and phase of reflection coefficient of source		

Frequency response correction	function parameter	taking into account the calibration factors relevant for the test frequency carrier frequency (center frequency)
Isolation correction	function parameter	taking into account the reflection coefficient of the load on the RF signal output magnitude and phase of reflection coefficient of the load
Interface to host	power supply remote control trigger input	typ. +5 V / 100 mA (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 × 50 mm × 250 mm length incl. connecting cable: approx. 1.75 m
Weight		< 0.7 kg

1)

... See the R&S NRP data sheet (PD 0757.7023.21).
35)

36) For relative measurements referenced to 0 dBm.

37) Taking into consideration change of sensitivity for power sensor, drift of insertion loss for power splitter and phase change of RF cable (with the R&S FSMR26 connected to the RF signal output).

38) Between RF signal output and input of the integrated power sensor. It can be expressed by $20 \text{ dB} \log |s_{21} / (s_{23} \cdot s_{31})|$, where s_{xy} are S parameters of the power splitter (including cable). Port 1 denotes the input of the power sensor module, port 2 the input of the internal power sensor and port 3 the RF signal output. The power measurement error introduced due to mismatch of an R&S FSMR26 does not exceed 0.06 dB from DC to 2 GHz, 0.10 dB up to 18 GHz, and 0.14 dB up to 26.5 GHz.

Values in parentheses represent effective isolation, which can be achieved after numerical isolation correction of the measurement result inside the sensor. Isolation correction requires the complex reflection coefficient of the load on the RF signal output to be sent to the sensor. Residual power measurement error introduced by an R&S FSMR26 after isolation correction does not exceed 0.01 dB from DC to 2 GHz, 0.025 dB up to 8 GHz, 0.04 dB up to 18 GHz, and 0.07 dB up to 26.5 GHz.

39) Expanded uncertainty (k=2) for absolute power measurements at the calibration level (0 dBm) and the calibration frequencies at 20°C to 25°C. Specifications include zero offset and display noise (up to a 2σ value of 0.01 dB). The load on the RF signal output must be a low-reflection type (SWR < 1.05) or isolated by numerical correction (see footnote 38).

Calibration frequencies: 0.1/0.5/1/3/5/10/50/100 MHz; from 250 MHz to the upper frequency limit in increments of 250 MHz.

40) Includes the effects of calibration uncertainty, linearity, zero offset and drift, temperature, display noise (up to a value of 0.01 dB) and mismatch of the R&S FSMR26. For power levels below -10 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

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

Ordering information

Description	Type	Order No.
Power Sensor Module 4 μ W to 400 mW; DC to 18 GHz	R&S NRP-Z27	1169.4102.02
Power Sensor Module 4 μ W to 400 mW; DC to 26.5 GHz	R&S NRP-Z37	1169.3206.02



