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, R&S NRP or any Windows PC via USB.

ROHDE&SCHWARZ

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.

Module 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)
Matching (SWR)	input 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 RF signal output DC to 8.0 GHz > 8.0 GHz to 26.5 GHz	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** < **1.6** / < **1.6** < **2.0** / < **2.0**
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) for max. 10 minutes 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)]	input power < 0.1 W > 0.1 W	< 0.02 dB < 0.03 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
Insertion loss between input and RF signal 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 power coefficient	< **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) ± (0.02 + 0.002 *f* / GHz)) dB/W
RF connectors	input RF signal output	N (male) for R&S NRP-Z27 3.5 mm (male) for R&S NRP-Z37 3.5 mm (male)

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	*0.063 dB* *0.070 dB* *0.082 dB* *0.088 dB* *0.109 dB* *0.118 dB*		
Uncertainty for absolute power measurements with matched load (SWR < 1.05) [40] From -10 dBm to +26 dBm		20°C to 25°C	15°C to 35°C	0°C to 50°C
	DC to < 100 MHz	*0.070 dB*	*0.077 dB*	*0.103 dB*
	100 MHz to 4.2 GHz	*0.075 dB*	*0.082 dB*	*0.106 dB*
	> 4.2 GHz to 8.0 GHz	*0.087 dB*	*0.094 dB*	*0.119 dB*
	> 8.0 GHz to 12.4 GHz	*0.093 dB*	*0.101 dB*	*0.130 dB*
	> 12.4 GHz to 18.0 GHz	*0.112 dB*	*0.121 dB*	*0.151 dB*
	> 18.0 GHz to 26.5 GHz	*0.122 dB*	*0.137 dB*	*0.190 dB*
Uncertainty for absolute power measurements on R&S FSMR26 [40] From -10 dBm to +26 dBm		20°C to 25°C	15°C to 35°C	0°C to 50°C
	DC to < 100 MHz	*0.104 dB*	*0.109 dB*	*0.128 dB*
	100 MHz to 4.2 GHz	*0.116 dB*	*0.120 dB*	*0.138 dB*
	> 4.2 GHz to 8.0 GHz	*0.163 dB*	*0.166 dB*	*0.181 dB*
	> 8.0 GHz to 18.0 GHz	*0.183 dB*	*0.187 dB*	*0.207 dB*
	> 18.0 GHz to 26.5 GHz	*0.226 dB*	*0.235 dB*	*0.269 dB*
After numerical isolation correction	DC to < 100 MHz	*0.067 dB*	*0.074 dB*	*0.101 dB*
	100 MHz to 4.2 GHz	*0.077 dB*	*0.083 dB*	*0.107 dB*
	> 4.2 GHz to 8.0 GHz	*0.092 dB*	*0.099 dB*	*0.123 dB*
	> 8.0 GHz to 12.4 GHz	*0.099 dB*	*0.107 dB*	*0.135 dB*
	> 12.4 GHz to 18.0 GHz	*0.122 dB*	*0.130 dB*	*0.159 dB*
	> 18.0 GHz to 26.5 GHz	*0.154 dB*	*0.167 dB*	*0.212 dB*
Measurement window [7]	duration	2 × (1 ms to 300 ms)		
	shape	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 averaging filter			
	AUTO ON	4 s		
	AUTO OFF			
	Integration time [16] < 4 s	4 s		
	4 s...16 s	integration time [16]		
	> 16 s	16 s		
Averaging filter	modes	AUTO OFF (fixed averaging factor) AUTO ON (continuously auto-adapted) AUTO ONCE (automatically fixed once)		
	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	0.0001 dB to 1 dB		
	max. measurement time [24]	0.01 s to 1000 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)		

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

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

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 $20\,dB\log|s_{21}/(s_{23}\cdot s_{31})|$, 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 2 σ 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 100 MHz to the upper frequency limit in increments of 100 MHz.

40) At calibration frequencies. 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 load on the RF signal output. For power levels below -10 dBm, the effect of zero offset 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 µW to 400 mW; DC to 18 GHz	R&S NRP-Z27	1169.4102.02
Power Sensor Module 4 µW to 400 mW; DC to 26.5 GHz	R&S NRP-Z37	1169.3206.02

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