Technical Information

R&S®NRP-Z28/-Z98 USB Level Control Sensors

For feeding precisely calibrated RF and microwave signals

The new USB level control sensors of the R&S®NRP family turn every signal source into a precision power reference. They replace the traditional power splitter/power sensor combination with a unique one-box solution. Since the sensors come fully calibrated, the power incident on the UUT can directly be read off. It goes without saying that the sensors can be used on the R&S®NRP, many other Rohde & Schwarz instruments, and on any PC.

The sensors work precisely on CW and modulated signals from -67 dBm up to +20 dBm. They are available in two models: the R&S®NRP-Z98 for the frequency range 9 kHz to 6 GHz and the R&S®NRP-Z28 for the frequency range 10 MHz to 18 GHz.

Both sensors are equipped with a low-loss microwave cable that allows a distance of up to 1.2 m from the signal source.

ROHDE&SCHWARZ

Preliminary

Level Control Sensors R&S NRP-Z28/-Z98

Specifications

Bold: Parameter 100 % tested.
Italics: Uncertainties calculated from the test assembly specifications and modeled behavior of the sensor.
Normal: Compliance with specifications is achieved via the design or derived from the measurement of related parameters.

Frequency range		9 kHz to 6 GHz (R&S NRP-Z98) 10 MHz to 18 GHz (R&S NRP-Z28)
Matching (SWR)		RF Input / RF output[1]
	9 kHz to 2.4 GHz	< **1.35** / < **1.11**
	> 2.4 GHz to 4.0 GHz	< **1.45** / < **1.15**
	> 4.0 GHz to 8.0 GHz	< **1.75** / < **1.22**
	> 8.0 GHz to 12.4 GHz	< **1.80** / < **1.30**
	> 12.4 GHz to 18.0 GHz	< **1.90** / < **1.30**
Power measurement range (RF output)	Continuous Average Burst Average Timeslot/Gate[2] Trace[3]	200 pW to 100 mW (–67 dBm to +20 dBm) 200 nW to 100 mW (–37 dBm to +20 dBm) 650 pW to 100 mW (–62 dBm to +20 dBm) 10 nW to 200 mW (–50 dBm to +20 dBm)
Max. power (RF input)	Average power	
	9 kHz to 2.4 GHz	0.7 W (+28.5 dBm)
	> 2.4 GHz to 8.0 GHz	0.9 W (+29.5 dBm)
	> 8.0 GHz to 12.4 GHz	1.1 W (+30.5 dBm)
	> 12.4 GHz to 18.0 GHz	1.3 W (+31.0 dBm)
	Peak envelope power (for max. 10 µs)	7.5 dB above max. average power
Insertion loss Between RF input and RF output	9 kHz to 2.4 GHz	< **8.0** dB (typ. 7.0 dB)
	> 2.4 GHz to 4.0 GHz	< **8.5** dB (typ. 7.5 dB)
	> 4.0 GHz to 8.0 GHz	< **9.5** dB (typ. 8.5 dB)
	> 8.0 GHz to 12.4 GHz	< **10.5** dB (typ. 9.0 dB)
	>12.4 GHz to 18.0 GHz	< **11.0** dB (typ. 10.0 dB)
Display noise[4] values in [ ]: 8 GHz to 18 GHz	15 °C to 35 °C, Path 1	< 66 pW [77 pW] (typ. 42 pW)
	15 °C to 35 °C, Path 2	< 6.2 nW [7.2 nW] (typ. 3.8 nW)
	15 °C to 35 °C, Path 3	<0.62 µW [0.72 µW] (typ. 0.38 µW)
	0 °C to 50 °C, Path 1	< 72 pW [83 pW]
	0 °C to 50 °C, Path 2	< 7.0 nW [8.0 nW]
	0 °C to 50 °C, Path 3	< 0.7 µW [0.8 µW]
Zero offset[5] values in [ ]: 8 GHz to 18 GHz	15 °C to 35 °C, Path 1	< 106 pW [122 pW] (typ. 67 pW)
	15 °C to 35 °C, Path 2	< 9.9 nW [11.5 nW] (typ. 6.1 nW)
	15 °C to 35 °C, Path 3	<0.99 µW [1.15 µW] (typ. 0.61 µW)
	0 °C to 50 °C, Path 1	< 114 pW [132 pW]
	0 °C to 50 °C, Path 2	<11.0 nW [12.7 nW]
	0 °C to 50 °C, Path 3	<1.10 µW [1.27 µW]
Zero drift[6] values in [ ]: 8 GHz to 18 GHz	Path 1	< 39 pW [44 pW]
	Path 2	< 3.3 nW [3.8 nW]
	Path 3	<0.33 µW [0.38 µW]

[1] Equivalent source reflection coefficient

[2] Specifications apply to timeslots/gates with a duration of 12.5 % referenced to the signal period (duty cycle 1:8). For other waveforms the following equation applies: lower measurement limit = 200 pW × √(measurement time/integration time). For measurement time, see specifications. For integration time, see footnote 18

[3] With a resolution of 256 points.

[4] Two standard deviations, 10.24 s integration time (see footnote 18**Error! Bookmark not defined.**). Multiplying noise specifications by √(10.24 s/integration time) yields the noise contribution at other integration times. Smoothing (see under Measurement window) increases noise by 22 %.

[5] Expanded uncertainty (k = 2) after zeroing (for 4 s). Zeroing for more than 4 s lowers uncertainty correspondingly (half values for 16 s).

[6] Within 1 hour after zeroing, permissible temperature change ±1 °C, following 2-hour warm-up of power sensor.

Calibration uncertainty [7] in dB

Frequency values in ( ) apply to R&S NRP-Z98 only

10 MHz (9 kHz) **to <100 MHz**

Path 1	Path 2	Path 3	
0.056	*0.047*	*0.048*	20 °C to 25 °C

100 MHz to <4 GHz

Path 1	Path 2	Path 3	
0.066	*0.057*	*0.058*	20 °C to 25 °C

>4 GHz to 8 GHz (6 GHz)

Path 1	Path 2	Path 3	
0.083	*0.072*	*0.072*	20 °C to 25 °C

>8 GHz to 12.4 GHz

Path 1	Path 2	Path 3	
0.095	*0.077*	*0.077*	20 °C to 25 °C

>12.4 GHz to 18 GHz

Path 1	Path 2	Path 3	
0.124	*0.100*	*0.101*	20 °C to 25 °C

Uncertainty for absolute power measurements[8] in dB - frequency values in ( ) apply to R&S NRP-Z98 only

10 MHz to <20 MHz (9 kHz to <20 kHz)

0.174	*0.175*	*0.175*	0 °C to 50 °C
0.075	*0.070*	*0.071*	15 °C to.35 °C
0.056	*0.047*	*0.048*	20 °C to.25 °C
–40 to –19	to +1	to +20 dBm	

20 MHz (20 kHz) **to <100 MHz**

0.147	*0.160*	*0.160*	0 °C to 50 °C
0.073	*0.069*	*0.069*	15 °C to 35 °C
0.056	*0.047*	*0.048*	20 °C to 25 °C
–40 to –19	to +1	to +20 dBm	

100 MHz to 4 GHz

0.159	*0.170*	*0.172*	0 °C to 50 °C
0.084	*0.080*	*0.084*	15 °C to.35 °C
0.066	*0.058*	*0.064*	20 °C to.25 °C
–40 to –19	to +1	to +20 dBm	

>4 GHz to 8 GHz (6 GHz)

0.176	*0.185*	*0.189*	0 °C to 50 °C
0.101	*0.095*	*0.102*	15 °C to.35 °C
0.083	*0.073*	*0.083*	20 °C to.25 °C
–40 to –19	to +1	to +20 dBm	

>8 GHz to 12.4 GHz

0.191	*0.198*	*0.205*	0 °C to 50 °C
0.114	*0.104*	*0.117*	15 °C to.35 °C
0.095	*0.080*	*0.097*	20 °C to.25 °C
–40 to –19	to +1	to +20 dBm	

>12.4 GHz to 18 GHz

0.218	*0.224*	*0.237*	0 °C to 50 °C
0.142	*0.130*	*0.151*	15 °C to.35 °C
0.124	*0.105*	*0.130*	20 °C to.25 °C
–40 to –19	to +1	to +20 dBm	

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[7] Expanded uncertainty (k = 2) for absolute power measurements on CW signals at calibration levels (–20 dBm for path 1, 0 dBm for paths 2 and 3) and the calibration. Specifications include zero offset and display noise (up to a 2 σ value of 0.004 dB). Calibration frequencies:
R&S NRP-Z98: 9 kHz, 14 kHz, 20 kHz, 30 kHz, 50 kHz, 100 kHz, 200 kHz, 500 kHz, 1 MHz, 2 MHz, 5 MHz
R&S NRP-Z28 & R&S NRP-Z98: 10 MHz, 15 MHz, 20 MHz, 30 MHz, 50 MHz, 100 MHz; from 250 MHz to 18 GHz in increments of 250 MHz.

[8] Expanded uncertainty (k = 2) for absolute power measurements on CW signals with automatic path selection. Specifications include display noise with a 2 σ value up to 0.01 dB and zero offset. Higher display noise and the effect of zero offset at lower levels must be considered separately.

Example: Power to be measured is 3.2 nW (–55 dBm) at 1.9 GHz; ambient temperature is 29 °C; automatic path selection is set. Typical absolute uncertainty due to zero offset equals 67 pW, corresponding to a relative measurement uncertainty of

$$10 \times \lg\left(\frac{3.2\text{nW} + 67\text{pW}}{3.2\text{nW}}\right) = 0.09\,\text{dB}$$

Combined with the specified value of 0.084 dB for the uncertainty of absolute power measurements, the total uncertainty is

$$\sqrt{0.090^2 + 0.084^2}\ \text{dB} = 0.123\ \text{dB}$$

Display noise exceeding 0.01 dB should be considered in the same way.

Uncertainty for relative power measurements[9] [10] **in dB**

10 MHz to <20 MHz

	–40	–19/–13	±0/+8	+20	
+20	*0.226*	*0.229*	*0.027*		
	0.084	*0.080*	*0.022*		0 °C to 50 °C
+8	*0.046*	*0.044*	*0.022*		15 °C to 35 °C
±0	*0.226*	*0.027*	*0.229*		20 °C to 25 °C
	0.083	*0.022*	*0.080*		0 °C to 50 °C
–13	*0.045*	*0.022*	*0.044*		15 °C to 35 °C
–19	*0.023*	*0.226*	*0.226*		20 °C to 25 °C
	0.022	*0.083*	*0.084*		0 °C to 50 °C
–40	*0.022*	*0.045*	*0.046*		15 °C to 35 °C
					20 °C to 25 °C

Power level in dBm

20 MHz to <100 MHz

	–40	–19/–13	±0/+8	+20	
+20	*0.206*	*0.215*	*0.027*		
	0.082	*0.078*	*0.022*		0 °C to 50 °C
+8	*0.046*	**0.044**	*0.022*		15 °C to 35 °C
±0	*0.205*	*0.027*	*0.215*		20 °C to 25 °C
	0.081	*0.022*	*0.078*		0 °C to 50 °C
–13	**0.044**	**0.022**	**0.044**		15 °C to 35 °C
–19	*0.023*	*0.205*	*0.206*		20 °C to 25 °C
	0.022	*0.081*	*0.082*		0 °C to 50 °C
–40	*0.022*	**0.044**	*0.046*		15 °C to 35 °C
					20 °C to 25 °C

Power level in dBm

100 MHz to 4 GHz

	–40	–19/–13	+1/+7	+20	
+20	*0.209*	*0.218*	*0.038*		
	0.088	*0.085*	*0.032*		0 °C to 50 °C
+7	*0.055*	*0.047*	*0.031*		15 °C to 35 °C
+1	*0.206*	*0.028*	*0.218*		20 °C to 25 °C
	0.083	*0.022*	*0.085*		0 °C to 50 °C
–13	*0.048*	*0.022*	*0.047*		15 °C to 35 °C
–19	*0.023*	*0.206*	*0.209*		20 °C to 25 °C
	0.022	*0.083*	*0.088*		0 °C to 50 °C
–40	*0.022*	*0.048*	*0.055*		15 °C to 35 °C
					20 °C to 25 °C

Power level in dBm

>4 GHz to 8 GHz

	–40	–19/–13	+1/+7	+20	
+20	*0.215*	*0.223*	*0.049*		
	0.097	*0.093*	*0.044*		0 °C to 50 °C
+7	*0.066*	*0.059*	*0.043*		15 °C to 35 °C
+1	*0.210*	*0.030*	*0.223*		20 °C to 25 °C
	0.088	*0.022*	*0.093*		0 °C to 50 °C
–13	*0.054*	*0.022*	*0.059*		15 °C to 35 °C
–19	*0.024*	*0.210*	*0.215*		20 °C to 25 °C
	0.022	*0.088*	*0.097*		0 °C to 50 °C
–40	*0.022*	*0.054*	*0.066*		15 °C to 35 °C
					20 °C to 25 °C

Power level in dBm

>8 MHz to 12.4 GHz

	–40	–19/–13	±0/+8	+20	
+20	*0.224*	*0.231*	*0.064*		
	0.111	*0.106*	*0.061*		0 °C to 50 °C
+7	*0.084*	*0.077*	*0.060*		15 °C to 35 °C
+1	*0.216*	*0.034*	*0.231*		20 °C to 25 °C
	0.096	*0.027*	*0.106*		0 °C to 50 °C
–13	*0.063*	*0.025*	*0.077*		15 °C to 35 °C
–19	*0.024*	*0.216*	*0.224*		20 °C to 25 °C
	0.022	*0.096*	*0.111*		0 °C to 50 °C
–40	*0.022*	*0.063*	*0.084*		15 °C to 35 °C
					20 °C to 25 °C

Power level in dBm

>12.4 GHz to 18 GHz

	–40	–19/–13	±0/+8	+20	
+20	*0.244*	*0.245*	*0.086*		
	0.135	*0.128*	*0.084*		0 °C to 50 °C
+7	*0.110*	*0.102*	*0.083*		15 °C to 35 °C
+1	*0.230*	*0.040*	*0.245*		20 °C to 25 °C
	0.112	*0.034*	*0.128*		0 °C to 50 °C
–13	*0.079*	*0.033*	*0.102*		15 °C to 35 °C
–19	*0.024*	*0.230*	*0.244*		20 °C to 25 °C
	0.022	*0.112*	*0.135*		0 °C to 50 °C
–40	*0.022*	*0.079*	*0.110*		15 °C to 35 °C
					20 °C to 25 °C

Power level in dBm

[9] Expanded uncertainty (k = 2) for relative power measurements on CW signals with automatic path selection. Specifications include display noise with a 2 σ value up to 0.01 dB for both the measurement and the reference level as well as zero offsets. Below –40 dBm, the effect of increased relative zero offset must be taken into account (only for the lower level, if both levels are below –40 dBm). See example in footnote 8. Display noise exceeding 0.01 dB must be considered separately for both the measurement level and the reference level (if applicable).

[10] For reading the measurement uncertainty refer to chapter “Appendix”.

Additional characteristics of the R&S NRP-Z28/-Z98

Shaded areas apply to R&S NRP-Z28 only

Sensor type		3-path diode sensor combined with a resistive power splitter (see application diagram on page 9)
Measurand		power of emanating wave
RF connectors		N (male)
Measurement functions	Stationary and periodically modulated signals Non-recurring waveforms	Continuous Average Burst Average Timeslot / Gate Trace Trace
Continuous Average function Continuous measurement of average power	Measurement window[11] R&S NRP-Z28 R&S NRP-Z98 Duty cycle correction[12] Smoothing Capacity of measurement buffer[13]	 2 × (10 µs to 300 ms) 2 × (1 ms to 300 ms) 0.001 % to 100.00 % See under Measurement window 1 to 1024 results
Burst Average function Measurement of average burst power with automatic detection of burst	Detectable burst width Minimum gap between bursts Dropout tolerance[14] Exclusion periods[15] Exclude from Start Exclude from End Measurement window[11]	20 µs to 100 ms 10 µs 0 to 3 ms 0 to burst width 0 to burst width 2 × (burst width – Excl. from Start – Excl. from End)
Timeslot / Gate function Measurement of average power in one or more equidistant, successive timeslots	Duration (nominal width) Number of timeslots Exclusion periods[15] Excluded from Start Excluded from End Measurement window (per timeslot)[11]	10 µs to 100 ms 1 to 128 (26 in case of operation from R&S NRP base unit) 0 to nominal width 0 to nominal width 2 × (nominal width – Excl. from Start – Excl. from End)
Trace function Measurement of power versus time	Measurement window (trace length) Δ[16] Realtime OFF Realtime ON Number of pixels M Pixel length Δ/M Non-recurring waveform or internally triggered Recurring plus externally triggered Beginning of trace (referenced to trigger)	 (100 µs to 300 ms) × 2 100 µs to 300 ms 1 to 1024 ≥10 µs ≥2.5 µs –5 ms to 100 s
Dynamic behavior of video path Values in ( ) for temperature range 15 °C to 35 °C	Bandwidth Rise time 10 %/90 %	>50 kHz (100 kHz) R&S NRP-Z28 <8 µs (4 µs) R&S NRP-Z28 <5 ms R&S NRP-Z98

[11] Portion of signal that is the subject of measurement (sampling). The factor of 2 is due to the measurement being performed chopper stabilized, i.e. a measurement window consisting of two consecutive, equal periods of time (with opposite polarity of the output signal of the RF detector). If averaging is activated, the averaging factor determines the number of measurement windows to be averaged.

[12] For calculating the pulse power of periodic bursts from an average power measurement.

[13] To increase measurement speed, the power sensor can be operated in buffered mode. In this mode, measurement results are stored in a buffer of user-definable size and then output as a block of data when the buffer is full. To enhance measurement speed even further, the sensor can be set to record the entire series of measurements when triggered by a single event. In this case the power sensor automatically starts a new measurement as soon as it completes the preceding one.

[14] This parameter enables power measurements on modulated bursts. The parameter must be longer in duration than modulation-induced power drops within the burst, but at least 10 µs shorter than the gap between the end of one burst and the beginning of the next one.

[15] To exclude unwanted portions at the beginning or end of the measurement window from the measurement result.

[16] Portion of signal that is the subject of measurement (sampling). When switching the "Realtime" parameter OFF, measurements are performed chopper stabilized, i.e. a measurement window consists of two consecutive, equal periods of time (with opposite polarity of the output signal of the RF detector). If averaging is activated (only after "Realtime" has been switched OFF), the averaging factor determines the number of measurement windows to be averaged.

Sampling frequencies	Frequency 1 (default)		134.400 kHz
	Frequency 2[17]		119.467 kHz
Zeroing (duration)	Depends on setting of averaging filter		
	AUTO ON		4 s
	AUTO OFF		
	Integration time[18]	<4 s	4 s
		4 s to 16 s	integration time[18]
		>16 s	16 s
Measurement error due to harmonics[19] (*H* : order of harmonic) values in [ ]: typ. standard uncertainty	*H* = 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]
	H = 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 defined crossover <–6 dB	General		measurement errors in subranges are proportional to power and depend on the modulation bandwidth of the test signal and the distribution function of its envelope.
	WCDMA (3-GPP Test Model 1-64)		
	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]
Averaging filter	Modes		AUTO OFF (fixed averaging factor) AUTO ON (continuously auto-adapted) AUTO ONCE (automatically fixed once)
	AUTO ON/ONCE		available for all functions except Trace
	Normal operating mode[22]		filter setting depends on power to be measured and resolution
	Resolution		1 dB / 0.1 dB / 0.01 dB / 0.001 dB
	Fixed Noise operating mode		filter setting derived from expected relative noise content of measurement result
	Relative noise content		0.0001 dB to 1 dB
	Max. measurement time[23]		0.01 s to 999 s
	Averaging factor *N* (number of measurement windows)		1 to 2^{13} (Trace function) 1 to 2^{16} (all other functions)
	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)

[17] A selection can be made, to prevent aliasing in the case of signals with discrete modulation frequencies between 100 kHz and 1 MHz.

[18] Integration time is defined as the total time used for sampling the signal. It can be calculated by multiplying the duration of the measurement window by the averaging factor.

[19] Magnitude of measurement error with reference to an ideal thermal power sensor which measures the sum power of carrier and harmonics. Specified values apply to automatic path selection (User defined crossover deactivated or set to 0 dB) and power levels up to +20 dBm. Within a measurement subrange, errors (uncertainties) are proportional to the measured power in W. The specified values refer to 10 µW (–20 dBm) for path 1, 1 mW (0 dBm) for path 2 and 100 mW (20 dBm) for path 3.

[20] Adhering to specified error limits implies that harmonics above 25 GHz (R&S NRP-Z98) and 56 GHz (R&S NRP-Z28) are at least 20 dB lower than required at other frequencies.

[21] Measurement error with reference to CW signal of equal power and frequency. Specified values apply to automatic path selection and power levels up to (+20 dBm + User defined crossover). Above this level, specified values must be multiplied by a factor of 1.25 per 1 dB rise in power level. In the measurement subranges, the specified values apply to –20 dBm for path 1, 0 dBm for path 2 and +20 dBm for path 3.

[22] Characteristics like for a conventional power meter. The averaging factor increases continuously as power decreases, but not to the extent that would be necessary to keep the relative noise content at the same level.

[23] Limits the averaging factor when measuring very low powers or when the noise content is set to a very small value (status information available).

Display noise, relative[24]	Measurement window 2 × 100 µs, without averaging Measurement window 2 × 1 ms, without averaging Measurement window 2 × 20 ms, averaging factor 32 (measurement time approx. 1 s)	<0.160 dB (typ. 0.1 dB) < 0.05 dB (typ. 0.03 dB) <0.002 dB (typ. 0.001 dB
Measurement subranges	Path 1 Path 2 Path 3	-67 dBm to -14 dBm -47 dBm to +6 dBm -27 dBm to +20 dBm
Transition ranges	With automatic path selection, user defined crossover[25] set to 0 dB	$-19\,^{+2}_{-1}$ dBm to $-13\,^{+2}_{-1}$ dBm $+1\,^{+2}_{-1}$ dBm to $+7\,^{+2}_{-1}$ dBm
Measurement window	Duration Shape	as specified for the individual measurement functions rectangular (integrating behavior; available for all measurement functions) Von Hann (smoothing filter, for efficient suppression of result variations due to modulation[26]; only for Continuous Average function)
Measurement times[27]	R&S NRP-Z28 Continuous Average Buffered, w/o averaging Burst Average Timeslot / Gate, Trace R&S NRP-Z98 Continuous Average	 N × (duration of measurement window[11] + 0.2 ms) + t_z buffer size × (duration of measurement window[11] + 0.5 ms) + t_z 2 × N[28] × burst period + t_z 2 × N[29] × trigger period + t_z t_z : <1.6 ms (0.9 ms on average) N × (duration of measurement window[11] + 10ms) –3.4 ms+ t_d t_d must be considered with activated auto delay (1ms to 20 ms dependent from temperature)
Auto delay	R&S NRP-Z98 only	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)
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 between the sensor output and the UUT by loading its s-parameter data set into the sensor 1 to 1000 s_{11}, s_{21}, s_{12} and s_{22} (in s2p format) With R&S NRP tool kit (supplied with sensor) via USB Adapter R&S NRP-Z3 or R&S NRP-Z4

[24] Two standard deviations, for power levels greater than 500 nW (–33 dBm) in Continuous Average mode with automatic path selection (User defined crossover deactivated or set to 0 dB). Within a measurement subrange, relative measurement uncertainty due to noise is inversely proportional to the measured power. The specified values refer to 500 nW (–33 dBm) and the lower limits of paths 2 and 3 at 50 µW (–13 dBm) and 5 mW (+7 dBm) respectively.

[25] Transition regions can be shifted up to –20 dB by entry of 'User defined crossover' value.

[26] Preferably used with determined modulation, when the duration of the measurement window cannot be matched to the modulation period. Compared to a rectangular window, display noise is about 22 % higher.

[27] Valid for Repeat mode, extending from the beginning to the conclusion of all transfers via the USB interface of the power sensor. Measurement times under remote control of the R&S NRP base unit via IEC/IEEE bus are approximately 2.5 ms longer, extending from the start of the measurement until the measurement result is supplied to the output buffer of the R&S NRP.

[28] For calculation of measurement time, *N* must be set to twice the averaging factor if the expression (burst width + 100 µs) exceeds the burst period.

[29] For calculation of measurement time, *N* must be set to twice the averaging factor if the expression (number of timeslots(pixels) x nominal width(pixel length) + 100 µs + trigger delay) exceeds the trigger period.

Γ correction	Function Parameters Download	Reducing mismatch uncertainty[30] Magnitude and phase of reflection coefficient of load (UUT) 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) 50 MHz (0.05 × *f* below 1 GHz) for specified measurement uncertainty
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 of 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
Interface to host	Power supply Remote control Trigger input	typ. +5 V/200 mA (USB high-power device) As a USB device (function) in full-speed mode, compatible with USB 1.0/1.1/2.0 specifications differential (0 V/+3.3 V)
Dimensions (W × H × L)		48 mm × 50 mm × 250 mm length incl. cable: approx. 1.75 m
Weight		<0.6 kg

General Specifications

Temperature loading[31]		
Operating range and permissible range	(in [ ] if different)	meets IEC 60068 0 °C [–10 °C] to +50 °C [+55 °C]
Storage range		–40 °C to +70 °C
Climatic resistance		meets IEC 60068
Damp heat		+25°C/+40 °C cyclic at 95 % relative humidity, non-condensing
Mechanical resistance		
Vibration, sinusoidal		meets IEC 60068 5 Hz to 55 Hz, max. 2 g 55 Hz to 150 Hz, 0.5 g constant
Vibration, random		meets IEC 60068 10 Hz to 500 Hz, 1.9 g (rms)
Shock		meets IEC 60068; 40 g shock spectrum
Air pressure	Operation Transport	795 hPa (2000 m) to 1060 hPa 566 hPa (4500 m) to 1060 hPa
Electromagnetic compatibility		meets EN 61326, EN 55011
Safety		meets EN 61010-1
Recommended calibration interval		2 years

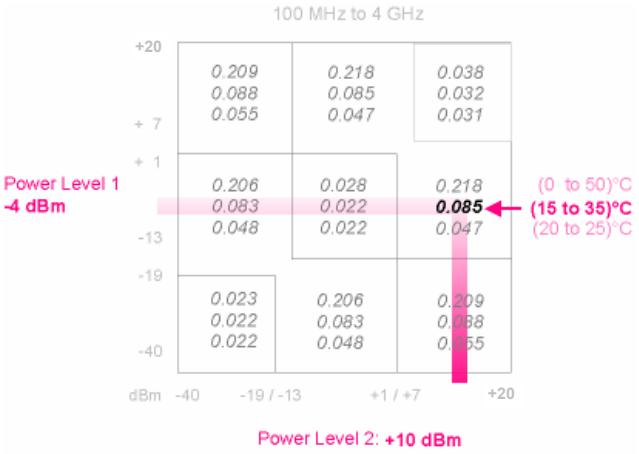
[30] This function can be used to counteract interactions between the load (UUT) and the output of the level control sensor. By using this function, the power incident on the UUT can be measured (without this correction: nominal power dissipated by a 50 Ω load).

[31] The operating temperature range defines the span of ambient temperature in which the instrument complies with specifications. In the permissible temperature range, the instrument is still functioning but adherence to specifications is not warranted.

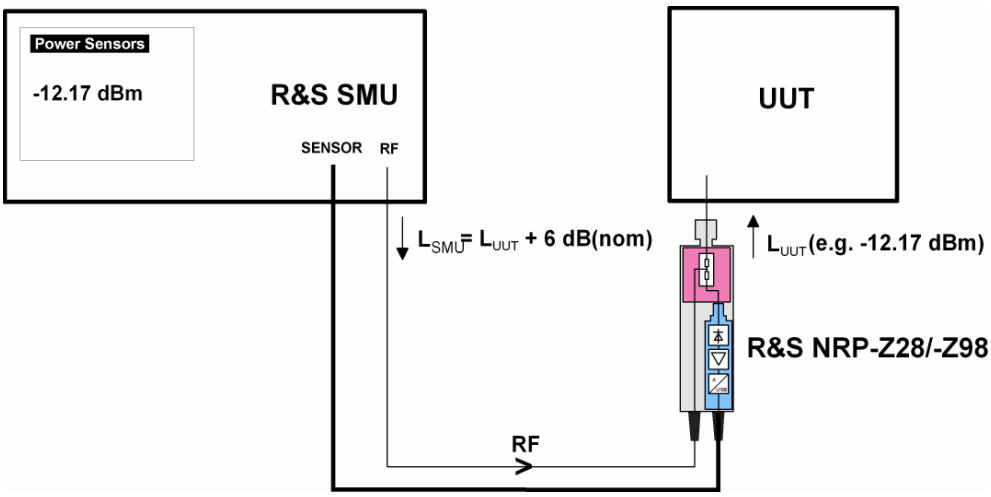
Appendix

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.



Application



Typical measurement setup with an R&S NRP-Z28/-Z98 level control sensor and an R&S SMU signal generator. The power level incident on the UUT can directly be read off from the "Power Sensors" menu.

Accessories

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

Ordering information

Description	Type	Order No.
Level Control Sensor 200 pW to 100 mW; 9 kHz to 6 GHz	R&S NRP-Z98	1170.8508.02
Level Control Sensor 200 pW to 100 mW; 10 MHz to 18 GHz	R&S NRP-Z28	1170.8008.02

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