ROHDE&SCHWARZ

Test and Measurement
Division

Manual

Wideband Power Sensor

R&S® NRP-Z81

50 MHz to 18 GHz / 1 nW to 100 mW

1137.9009.02

Printed in Germany

Dear Customer,

Operation of the R&S NRP-Z81 wideband power sensor on R&S NRP base unit

Dear Customer,

for proper operation of the R&S NRP-Z81 wideband power sensor on a R&S NRP, the right software is required for the base unit:

Main Program (Application)	≥ 5.01
Bootloader	≥ 5.01
Keyboard Controller	≥ 3.22

The revision numbers for the software components installed in the base unit can be displayed under menu item 'System Info', lines 'Main Program', 'Bootloader' and 'Keybd. Ctrl.'. The 'System Info' can be found in the 'System' menu.

Please note, that the statistics capabilities of the sensor are not yet supported by these revisions.

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Tabbed Divider

Technical Information

Wideband Power Sensor R&S NRP-Z81

A selected choice for the analysis of radar and digital communications signals

The new power sensor R&S NRP-Z81 stands for latest power measurement technology. It offers all the functionality of a conventional peak power meter and more within the small housing of a power sensor. It can be operated on the R&S NRP power meter or any Windows PC, e.g. as a cost-effective solution in production systems. No compromise had to be made in terms of accuracy and versatility. Therefore the new member of the R&S NRP family turns out to be a strong candidate for nearly every task in the field of power measurement:

- Analysis of radar and comm signals up to 30 MHz RF bandwidth (sensor risetime < 13 ns)
- Accurate continuous average power measurements on modulated and unmodulated signals from -60 dBm to +20 dBm
- Ultra-fast statistical analysis (1 Mio point CCDF within 25 ms)
- Frequency range: 50 MHz to 18 GHz (from 500 MHz with full video bandwidth)

ROHDE&SCHWARZ

Preliminary

Wideband Power Sensor R&S NRP-Z81

Specifications

Bold: Parameter 100 % tested.

Italics: Limits of uncertainty, calculated from the test assembly specifications and the modeled behavior of the sensor.

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

Sensor type		Wideband diode power sensor
Measurand		envelope power
Frequency range		50 MHz to 18 GHz
Matching (SWR)	50 MHz to 2.4 GHz > 2.4 GHz to 8.0 GHz > 8.0 GHz to 18.0 GHz	< **1.16 (1.11)** < **1.20 (1.18)** < **1.25 (1.23)** values in ( ) for temperature range 15 °C to 35 °C
RF connector		N (male)
Power measurement range	Measurement function Continuous Average Burst Average Trace, Timeslot/Gate Average Statistics	 1 nW to 100 mW (–60 dBm to +20 dBm) 20 µW[1] to 100 mW (–17 dBm[1] to +20 dBm) 20 nW to 100 mW (–47 dBm to +20 dBm) 3 µW[1] to 100 mW (–25 dBm[1] to +20 dBm)
Max. power	Average power Peak envelope power	0.2 W (+23 dBm) continuous 1.0 W (+30 dBm) for max. 1 µs
Dynamic response	Video bandwidth Single shot bandwidth Video bandwidth settings Rise time 10 %/90 % f ≥ 500 MHz < 500 MHz Minimum burst width (f ≥ 500 MHz) Overshoot	≥ 30 MHz ≥ 30 MHz 'Full' 5 MHz 1.5 MHz 0.3 MHz ≤ **13 ns** < 75 ns < 250 ns < 1.2 µs < 40 ns 50 ns ≤ 5 %
Acquisition	Sampling rate (continuous) Capture length Timebase accuracy Timebase jitter	80×10^6 s^{-1} ('Full' video bandwidth) 40×10^6 s^{-1} (5 MHz) 10×10^6 s^{-1} (1.5 MHz) 2.5×10^6 s^{-1} (0.3 MHz) 50 ns to 1 s (depending on meas function) ±50 ppm < 1 ns
Trigger	Internal trigger Range Level accuracy Jitter External trigger input Trigger delay Delay range Delay resolution Source Slope (external, internal) Trigger hold-off Trigger dropout Resolution (hold-off, dropout) Trigger level threshold hysteresis	 -30 dBm to +20 dBm (usable from -22 dBm at full video bandwidth) identical to uncertainty for absolute power measurements ≤ 6.3 ns see specs of R&S NRP and USB Adapter R&S NRP-Z3 -51.2 µs to +10 s 12.5 ns Bus, External, Hold, Immediate, Internal pos./neg. 0 to 10 s 0 to 10 s 12.5 ns ±10 dB
Zero offset [3,5] typical values in ( )	Measurement function Continuous Average Burst/Timeslot/Gate Average Trace, Statistics	 10 µs sampling window other lengths < 400 (220) pW < 5 (2) nW with averaging w/o averaging < 10 (2) nW < 200 (100) nW

Zero drift [3,6]	Continuous Average	10 µs sampling window: < 200 pW; other lengths: < 500 pW
	Burst/Timeslot/Gate Average Trace, Statistics	with averaging: < 2 nW; w/o averaging: < 150 nW
Noise [2,3] typical values in ( )	Measurement function Continuous Average Trace / Statistics noise per sample @ Video Bw 'Full' 5 MHz 1.5 MHz 300 kHz effect of time-gating on noise of average value Burst/Timeslot (Gate) Average	 < 200 (110) pW sampling window set to 10 µs [4] **< 3.0** (2.0) **µW** < 1.5 (1.0) µW < 0.9 (0.6) µW < 0.6 (0.4) µW multiply "noise per sample" specification for 'Full' video bandwidth with noise reduction factors from table B and table C (page 6) A minimum noise value of 5 nW or better can be achieved with adequate averaging, valid for gate lengths ≥ 2 µs see "effect of time-gating" in Trace / Statistics specifications
Uncertainty for absolute power measurements [7] 0 °C to 50 °C	50 MHz to < 100 MHz ≥ 100 MHz to 700 MHz > 700 MHz to 4.0 GHz > 4.0 GHz to 8.0 GHz > 8.0 GHz to 18.0 GHz	*0.18 dB* (*4.0 %*) *0.14 dB* (*3.3 %*) *0.13 dB* (*3.0 %*) *0.15 dB* (*3.5 %*) *0.18 dB* (*4.0 %*)

Additional characteristics of R&S NRP-Z81

Continuous Average function Measurement of average power of stationary signals	Sampling window Window shape Duty cycle correction [9] Capacity of measurement buffer	1 µs to 0.1 s rectangular or 'von Hann' [8] 0.001 % to 100.00 % 1 to 8192 results
Burst Average function Measurement of average burst power with automatic detection of burst	Detectable burst width Minimum gap between bursts Dropout length [10] for burst end detection Exclusion periods [11] Start End Resolution (dropout, exclusion periods)	50 ns to 0.1 s 40 ns 0 to 0.3 s 0 to 0.1 s 0 to 51.2 µs 12.5 ns
Timeslot (Gate) function Measurement of average power in one Gate or several equidistant, successive timeslots	Number of timeslots Timeslot (Gate) nominal width Delay of first timeslot (gate) Exclusion periods [11] Start Fence End Resolution (width, exclusion periods)	1 to 16 50 ns to 0.1 s see Trigger delay 0 to 0.1 s 0 to 0.1 s 0 to 51.2 µs 12.5 ns
Trace function Measurement of envelope power versus time	Trace length (Δ) Pixels (M) Resolution (Δ/M) @ Video Bw 'Full' 5 MHz 1.5 MHz 300 kHz Pixel representation Trace start (referenced to trigger)	50 ns to 1 s 3 to 8192 ≥ 12.5 ns ≥ 25 ns ≥ 100 ns ≥ 400 ns Average, Random, Maximum, Minimum over pixel length $-4096\times\Delta/M$ to 10 s

Statistics functions Measurement of envelope power distribution	Modes Acquisition window Length Delay Exclusion periods [11] Start Fence End Resolution (length, delay, exclusion) Number of classes (*C*) Power span (*S*) Class width (*S/C*)	CCDF and PDF histograms 10 µs to 0.3 s -51.2 µs to 10 s referenced to trigger 0 to 0.3 s 0 to 0.3 s 0 to 51.2 µs see parameter *Δl/M* under 'Trace function' 3 to 8192 0.01 dB to 100 dB ≥ 0.006 dB
Measurement times [12] *N*: averaging factor *T*: number of timeslots	Continuous Average Buffered [13], without averaging Burst Average (burst period – burst width – burst dropout) > 6 µs all other cases Timeslot Average (frame length – *T* × nominal width) > 6 µs all other cases	*2* × *N* × (duration of sampling window + 13 µs) + t_z *2* × buffer size × (duration of sampling window + 13 µs) + t_z ≤ t_z + (*N* + 1) × burst period ≤ t_z + *N* × (burst width + burst dropout + 6 µs + burst period) ≤ t_z + (*N* + 1) × frame length ≤ t_z + *N* × (*T* × nominal width + frame length + 6 µs) t_z : 1.6 ms typical
Zeroing (duration)	For all functions and frequencies Restricted to < 500 MHz, all functions Restricted to ≥ 500 MHz, all functions Restricted to Trace and Statistics, whole frequency range	8 s 4 s 4 s 20 ms
Averaging	Modes AUTO OFF Supported measurement functions Averaging factor N Trace, Statistics other AUTO ON/ONCE Supported measurement functions 'Normal' [14] operating mode 'Fixed Noise' operating mode Result output Moving Rate Repeat	AUTO OFF (fixed averaging factor) AUTO ON (continuously auto-adapted) AUTO ONCE (automatically fixed once) all 2 to 2^{16} 2 to 2^{20} Continuous Average, Burst Average, Timeslot (Gate) Average Averaging factor adapted to resolution setting and power to be measured Averaging factor adapted to specified noise content Continuously, independent from averaging factor Can be limited from 0.1 s^{-1} to 1000 s^{-1} Only final result

Measurement error due to harmonics at $n \times f_0$ of carrier frequency [15]		≤ 4 GHz	4 GHz to 8 GHz	> 8 GHz
N = 2	–60 dBc	<0.001 dB	<0.002 dB	<0.003 dB
	–40 dBc	<0.010 dB	<0.017 dB	<0.025 dB
	–20 dBc	<0.100 dB	<0.170 dB	<0.250 dB
N = 3	–60 dBc	<0.004 dB	<0.003 dB	<0.003 dB
	–40 dBc	<0.035 dB	<0.030 dB	<0.025 dB
	–20 dBc	<0.350 dB	<0.300 dB	<0.250 dB

Susceptibility of matching with respect to power			Change of RCO	
-10 dBm	to	-60 dBm	< 0.015 (0.005)	values in ( ) for temperature range 15 °C to 35 °C and frequencies ≤ 4 GHz
-10 dBm	to	0 dBm	< 0.035 (0.025)	
-10 dBm	to	+10 dBm	< 0.075 (0.050)	
-10 dBm	to	+20 dBm	< 0.090 (0.060)	

Γ correction	Function Parameters Residual SWR	Reducing the influence of mismatched sources Magnitude and phase of reflection coefficient of source < 1.06 within temperature range 15 °C to 35 °C
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 Parameters Number of independently addressable data sets Total number of frequencies (sum of all data sets)	Taking into account a component connected to the sensor input by loading its s-parameter data set into the sensor s_{11}, s_{21}, s_{12} and s_{22} (in s2p format) freely definable 32000
Calibration uncertainty [16] 20 °C to 25 °C	50 MHz to < 100 MHz ≥ 100 MHz to 700 MHz > 700 MHz to 2.0 GHz > 2.0 GHz to 4.0 GHz > 4.0 GHz to 8.0 GHz > 8.0 GHz to 12.5 GHz > 12.5 GHz to 18.0 GHz	*0.120 dB (2.8 %)* *0.075 dB (1.8 %)* *0.065 dB (1.5 %)* *0.070 dB (1.6 %)* *0.085 dB (2.0 %)* *0.090 dB (2.1 %)* *0.120 dB (2.8 %)*

General Specifications

Interface to host	Power supply Remote control Trigger input	+5 V / typ. 500 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 Length incl. connecting cable	48 mm × 31 mm × 170 mm approx. 1.6 m
Weight		< 0.3 kg
Temperature loading		
Operating range and permissible range [17]	permissible range in [ ]	0 °C [–10 °C] to +50 °C [+55 °C] meets IEC 60068
Storage range		–40 °C to +70 °C
Climatic resistance		meets IEC 60068
Damp heat		+25 °C/+40 °C cyclic at 95 % relative humidity without condensation
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
Calibration interval		2 years

Table A Multipliers for noise, zero offset and zero drift specifications

Use these multipliers for the calculation of noise, zero offset and zero drift when operating the sensor outside the square law range, at frequencies below 500 MHz or at temperatures different from 23°C.

	≤ -20 dBm	-10 dBm	-5 dBm	0 dBm	5 dBm	10 dBm	15 dBm	20 dBm
0 °C	**0.8** [0.9]	**0.9** [1.0]	**1.4** [1.5]	**3.2** [3.5]	**7.5** [8.5]			
15 °C	**0.9** [1.0]	**1.1** [1.2]	**1.6** [1.8]	**3.4** [3.6]	**7.5** [8.5]			
23 °C	**1.0** [1.2]	**1.3** [1.5]	**1.8** [2.0]	**3.5** [3.8]	**7.6** [8.7]	**17** [18]	**35** [37]	**65** [70]
35 °C	**1.4** [1.7]	**1.7** [2.1]	**2.3** [2.6]	**3.9** [4.3]	**7.8** [9.0]			
50 °C	**2.5** [3.0]	**2.7** [3.3]	**3.3** [4.0]	**5.2** [5.4]	**8.7** [9.5]			

[ ] at frequencies < 500 MHz

Table B Noise reduction factors for gating and smoothing

Noise reduction factors in this table describe how noise is reduced, if adjacent samples are averaged for the measurement of mean power over a time interval. The time interval can be the length of a gate, timeslot or pixel in trace mode. Without averaging or for single events, use the leftmost column. With activated averaging, use the columns given for the individual repetition rates and additionally apply reduction factors from table B. The repetition rate is identical to the frequency of the measurement being carried out, i.e. the inverse of the trigger period.

Repetition rate → / Gate (point) width	0	10 s^{-1}	100 s^{-1}	10^3 s^{-1}	10^4 s^{-1}	5×10^4 s^{-1}	10^5 s^{-1}
25 ns	**0.7**						
50 ns	**0.5**						
100 ns	**0.4**						
200 ns	**0.3**						
500 ns	**0.2**						
1 µs	**0.16**	**0.15**		**0.14**			
2 µs	**0.14**	**0.13**	**0.12**	**0.11**	**0.10**		
10 µs	**0.11**	**0.1**	**0.09**	**0.08**	**0.07**	**0.06**	
100 µs	**0.10**	**0.09**	**0.07**	**0.06**	**0.04**		
1 ms	**0.10**	**0.07**	**0.06**	**0.035**			
10 ms	**0.10**	**0.06**	**0.035**				

Table C Noise reduction factors for averaging (see footnote [4] for *Continuous Average* function)

averaging no.	2	4	8	16	32	64	128	256	512	1 k	2 k	4 k	8 k
reduction factor	**0.7**	**0.5**	**0.35**	**0.25**	**0.18**	**0.13**	**0.09**	**0.063**	**0.044**	**0.031**	**0.022**	**0.016**	**0.011**

Example: A power measurement on a radar pulse is carried out by means of the Timeslot (Gate) function. Nominal width is set to 1 µs and the averaging factor to 32. The pulse repetition rate equals 100 Hz and the measurement is taken at 15°C ambient temperature. The measured value is about -10 dBm.

Sample noise specification (2σ) under reference conditions is 3 µW maximum. From table A, a multiplier of 1.1 can be taken, resulting in 3.3 µW sample noise under measurement conditions. Gating results in a noise reduction factor of 0.15 (table B), and averaging in a reduction factor of 0.18 (table C). Residual noise can then be calculated to 3.3 µW × 0.15 × 0.18 = 89 nW (approximately 0.1 % of measured value).

[1] With 'Full' video bandwidth setting. Reduce given minimum levels according the reduction of sampling noise at lower bandwidths.

[2] Measured over a one-minute interval, at a constant temperature, two standard deviations

[3] Specifications are valid at 23 °C ambient temperature for power levels below -20 dBm and frequencies ≥ 500 MHz. For measurements at other temperatures, frequencies and/or levels use the multipliers from table A.

[4] 512 k averages taken with the sampling window set to 10 µs (default). Noise with other averaging numbers can be calculated using the multipliers given in the table:

averaging number	512 k	128 k	32 k	8 k	2 k	512	128	32	8
integration time	10.5 s	3.9 s	1.0 s	0.25 s	60 ms	15 ms	3.8 ms	1.0 ms	0.24 ms
noise multiplier	**1**	**2**	**4**	**8**	**16**	**32**	**64**	**128**	**256**

A sampling window length of 10 µs is optimum with respect to noise for a given total integration time. Increasing the length above 10 µs, e.g. for effectively suppressing modulation induced fluctuations of the measurement result, only lowers the noise contribution of the sampling window itself, i.e. 50 % for lengths larger than 100 µs. Since the number of sampling windows is inversely proportional to their length for a given integration time, total noise increases with lengths other than 10 µs.

[5] Specification in terms of an expanded uncertainty with a confidence level of 95 % (two standard deviations). For calculating zero offsets at higher confidence levels, use the properties of the normal distribution (e.g. 99.7 % confidence level for three standard deviations).

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

[7] Expanded uncertainty (k=2) for absolute power measurements on CW signals.

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

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

[10] This parameter enables power measurements on modulated bursts. The parameter must be longer in duration than modulation-induced power drops within the burst.

[11] To exclude unwanted portions at the beginning, at the end or within the measurement window from the measurement result.

[12] 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 IEC625/IEEE488 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.

[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] 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.

[15] Magnitude of measurement error with reference to an ideal thermal power sensor that measures the sum power of carrier and harmonics. For power levels below -10 dBm, the specifications for $2\times f_0$ ($3\times f_0$) can be lowered by a factor of $\sqrt{10}$ (10) per 10 dB below -10 dBm. Example: At 12 GHz / -30 dBm, the influence of the second harmonic, suppressed by 30 dBc will lead to an error of max. 0.025 dB × $\sqrt{10}$ ÷ 10 = 0.008 dB. Standard uncertainties can be assumed to be half the values.

[16] Expanded uncertainty (k=2) for absolute power measurements on CW signals at the calibration level of -10 dBm and at calibration frequencies (50/55/60/68/80/100/200/300/400/499.99/500/600/720/850 MHz; from 1 GHz to 18 GHz in steps of 0.5 GHz). .

[17] 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.

Accessories

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

Ordering information

Description	Type	Order No.
Wideband Power Sensor 1 nW to 100 mW; 50 MHz to 18 GHz	R&S NRP-Z81	1137.9009.02

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Before putting the product into operation for the first time, make sure to read the following

Safety Instructions

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standard of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment required for them are designed and tested in accordance with the relevant safety standards. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for an intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and a basic knowledge of English. It is therefore essential that the product be used exclusively by skilled and specialized staff or thoroughly trained personnel with the required skills. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation.

Symbols and safety labels

							
Observe product documentation	Weight indication for units >18 kg	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Attention! Electrostatic sensitive devices

					
Supply voltage ON/OFF	Standby indication	Direct current (DC)	Alternating current (AC)	Direct/alternating current (DC/AC)	Device fully protected by double/reinforced insulation

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before putting the product into operation. It is also absolutely essential to observe the additional safety instructions on personal safety that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories.

Tags and their meaning

DANGER	This tag indicates a definite hazard carrying a high risk of death or serious injury if not avoided.
WARNING	This tag indicates a possible hazard carrying a medium risk of death or (serious) injury if not avoided.
CAUTION	This tag indicates a hazard carrying a low risk of minor or moderate injury if not avoided.
ATTENTION	This tag indicates the possibility of incorrect use that can cause damage to the product.
NOTE	This tag indicates a situation where the user should pay special attention to operating the product but which does not lead to damage.

These tags are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the tags described here are always used only in connection with the related product documentation and the related product. The use of tags in connection with unrelated products or documentation can result in misinterpretation and thus contribute to personal injury or material damage.

Basic safety instructions

1. The product may be operated only under the operating conditions and in the positions specified by the manufacturer. Its ventilation must not be obstructed during operation. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products:
   prescribed operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only in enclosed spaces, max. operation altitude 2000 m above sea level, max. transport altitude 4500 m above sea level.
   Unless specified otherwise in the data sheet, a tolerance of ±10% shall apply to the nominal voltage and of ±5% to the nominal frequency.
2. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed. The product may be opened only by authorized, specially trained personnel. Prior to performing any work on the product or opening the product, the product must be disconnected from the supply network. Any adjustments, replacements of parts, maintenance or repair must be carried out only by technical personnel authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test).
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens, e.g. nickel) such as aluminum cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties), consult a physician immediately to determine the cause.

4. If products/components are mechanically and/or thermically processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled, e.g. for disposal purposes, by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
5. If handling the product yields hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation.
6. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn life requires increased protection, pregnant women should be protected by appropriate measures. Persons with pacemakers may also be endangered by electromagnetic radiation. The employer/operator is required to assess workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the danger.
7. Operating the products requires special training and intense concentration. Make certain that persons who use the products are physically, mentally and emotionally fit enough to handle operating the products; otherwise injuries or material damage may occur. It is the responsibility of the employer to select suitable personnel for operating the products.
8. Prior to switching on the product, it must be ensured that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
9. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with earthing contact and protective earth connection.
10. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
11. If the product has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases, it must be ensured that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply. If products without power switches are integrated in racks or systems, a disconnecting device must be provided at the system level.
12. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by e.g. tripping over the cable or suffering an electric shock.
13. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
14. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, this can result in sparks, fire and/or injuries.
15. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
16. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
17. Ensure that the connections with information technology equipment comply with IEC 950/EN 60950.
18. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.

19. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a license electrician.
20. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that suitable protection is provided for users and products.
21. Do not insert any objects into the openings in the housing that are not designed for this purpose. Never pour any liquids onto or into the housing. This can cause short circuits inside the product and/or electric shocks, fire or injuries.
22. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a thunderstorm) can reach the product. Otherwise the operating personnel will be endangered by electric shocks.
23. Rohde & Schwarz products are not protected against penetration of water, unless otherwise specified (see also safety instruction 1.). If this is not taken into account, there exists the danger of electric shock for the user or damage to the product, which can also lead to personal injury.
24. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product was moved from a cold to a warm environment.
25. Do not close any slots or openings on the product, since they are necessary for ventilation and prevent the product from overheating. Do not place the product on soft surfaces such as sofas or rugs or inside a closed housing, unless this is well ventilated.
26. Do not place the product on heat-generating devices such as radiators or fan heaters. The temperature of the environment must not exceed the maximum temperature specified in the data sheet.
27. Batteries and storage batteries must not be exposed to high temperatures or fire. Keep batteries and storage batteries away from children. Do not short-circuit batteries and storage batteries.
    If batteries or storage batteries are improperly replaced, this can cause an explosion (warning: lithium cells). Replace the battery or storage battery only with the matching Rohde & Schwarz type (see spare parts list). Batteries and storage batteries must be recycled and kept separate from residual waste. Batteries and storage batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.
28. Please be aware that in the event of a fire, toxic substances (gases, liquids etc.) that may be hazardous to your health may escape from the product.
29. The product can be very heavy. Be careful when moving it to avoid back or other physical injuries.
30. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves).
31. Handles on the products are designed exclusively for personnel to hold or carry the product. It is therefore not permissible to use handles for fastening the product to or on means of transport such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport and for observing the safety regulations of the manufacturer of the means of transport. Noncompliance can result in personal injury or material damage.
32. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. The driver is always responsible for the safety of the vehicle. The manufacturer assumes no responsibility for accidents or collisions.
33. If a laser product (e.g. a CD/DVD drive) is integrated in a Rohde & Schwarz product, do not use any other settings or functions than those described in the product documentation. Otherwise this may be hazardous to your health, since the laser beam can cause irreversible damage to your eyes. Never try to take such products apart, and never look into the laser beam.

Por favor lea imprescindiblemente antes de la primera puesta en funcionamiento las siguientes

Informaciones de seguridad

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estandards de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestra sección de gestión de la seguridad de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el comprobante de conformidad adjunto según las normas de la CE y ha salido de nuestra planta en estado impecable según los estandards técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las informaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto solamente fue elaborado para ser utilizado en la industria y el laboratorio o para fines de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda ser dañada. El uso del producto fuera de sus fines definidos o despreciando las informaciones de seguridad del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado dentro de las instrucciones de la correspondiente documentación de producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos profundos y conocimientos parciales del idioma inglés. Por eso se deberá tener en cuenta de exclusivamente autorizar para el uso del producto a personas peritas o debidamente minuciosamente instruidas con los conocimientos citados. Si fuera necesaria indumentaria de seguridad para el uso de productos de R&S, encontrará la información debida en la documentación del producto en el capítulo correspondiente.

Símbolos y definiciones de seguridad

							
Ver documen-tación de producto	Informaciones para maquinaria con uns peso de > 18kg	Peligro de golpe de corriente	¡Advertencia! Superficie caliente	Conexión a conductor protector	Conexión a tierra	Conexión a masa conductora	¡Cuidado! Elementos de construcción con peligro de carga electroestática

					
potencia EN MARCHA/PARADA	Indicación Stand-by	Corriente continua DC	Corriente alterna AC	Corriente continua/alterna DC/AC	El aparato está protegido en su totalidad por un aislamiento de doble refuerzo

Tener en cuenta las informaciones de seguridad sirve para tratar de evitar daños y peligros de toda clase. Es necesario de que se lean las siguientes informaciones de seguridad concienzudamente y se tengan en cuenta debidamente antes de la puesta en funcionamiento del producto. También deberán ser tenidas en cuenta las informaciones para la protección de personas que encontrarán en el capítulo correspondiente de la documentación de producto y que también son obligatorias de seguir. En las informaciones de seguridad actuales hemos juntado todos los objetos vendidos por el grupo de empresas Rohde & Schwarz bajo la denominación de „producto“, entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Palabras de señal y su significado

PELIGRO	Identifica un peligro directo con riesgo elevado de provocar muerte o lesiones de gravedad si no se toman las medidas oportunas.
ADVERTENCIA	Identifica un posible peligro con riesgo medio de provocar muerte o lesiones (de gravedad) si no se toman las medidas oportunas.
ATENCIÓN	Identifica un peligro con riesgo reducido de provocar lesiones de gravedad media o leve si no se toman las medidas oportunas.
CUIDADO	Indica la posibilidad de utilizar mal el producto y a consecuencia dañarlo.
INFORMACIÓN	Indica una situación en la que deberían seguirse las instrucciones en el uso del producto, pero que no consecuentemente deben de llevar a un daño del mismo.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación de producto y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a malinterpretaciones y tener por consecuencia daños en personas u objetos.

Informaciones de seguridad elementales

1. El producto solamente debe ser utilizado según lo indicado por el fabricante referente a la situación y posición de funcionamiento sin que se obstruya la ventilación. Si no se convino de otra manera, es para los productos R&S válido lo que sigue:
   como posición de funcionamiento se define principialmente la posición con el suelo de la caja para abajo , modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, utilizar solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4.500 m sobre el nivel del mar.
   A menos que se especifique otra cosa en la hoja de datos, se aplicará una tolerancia de ±10% sobre el voltaje nominal y de ±5% sobre la frecuencia nominal.
2. En todos los trabajos deberán ser tenidas en cuenta las normas locales de seguridad de trabajo y de prevención de accidentes. El producto solamente debe de ser abierto por personal perito autorizado. Antes de efectuar trabajos en el producto o abrirlo deberá este ser desconectado de la corriente. El ajuste, el cambio de partes, la manutención y la reparación deberán ser solamente efectuadas por electricistas autorizados por R&S. Si se reponen partes con importancia para los aspectos de seguridad (por ejemplo el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Despues de cada recambio de partes elementales para la seguridad deberá ser efectuado un control de seguridad (control a primera vista, control de conductor protector, medición de resistencia de aislamiento, medición de medición de la corriente conductora, control de funcionamiento).

3. Como en todo producto de fabricación industrial no puede ser excluido en general de que se produzcan al usarlo elementos que puedan generar alergias, los llamados elementos alergénicos (por ejemplo el níquel). Si se producieran en el trato con productos R&S reacciones alérgicas, como por ejemplo urticaria, estornudos frecuentes, irritación de la conjuntiva o dificultades al respirar, se deberá consultar inmediatamente a un médico para averigurar los motivos de estas reacciones.
4. Si productos / elementos de construcción son tratados fuera del funcionamiento definido de forma mecánica o térmica, pueden generarse elementos peligrosos (polvos de sustancia de metales pesados como por ejemplo plomo, berilio, níquel). La partición elemental del producto, como por ejemplo sucede en el tratamiento de materias residuales, debe de ser efectuada solamente por personal especializado para estos tratamientos. La partición elemental efectuada inadecuadamente puede generar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes al tratamiento de materias residuales.
5. En el caso de que se produjeran agentes de peligro o combustibles en la aplicación del producto que debieran de ser transferidos a un tratamiento de materias residuales, como por ejemplo agentes refrigerantes que deben ser repuestos en periodos definidos, o aceites para motores, deberan ser tenidas en cuenta las prescripciones de seguridad del fabricante de estos agentes de peligro o combustibles y las regulaciones regionales para el tratamiento de materias residuales. Cuiden también de tener en cuenta en caso dado las prescripciones de seguridad especiales en la descripción del producto.
6. Ciertos productos, como por ejemplo las instalaciones de radiación HF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. En vista a la protección de la vida en desarrollo deberían ser protegidas personas embarazadas debidamente. También las personas con un bypass pueden correr peligro a causa de la radiación electromagnética. El empresario/usario está comprometido a valorar y señalar areas de trabajo en las que se corra un riesgo aumentado de exposición a radiaciones para evitar riesgos.
7. La utilización de los productos requiere instrucciones especiales y una alta concentración en el manejo. Debe de ponerse por seguro de que las personas que manejen los productos estén a la altura de los requerimientos necesarios referente a sus aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario lleva la responsabilidad de seleccionar el personal usuario apto para el manejo de los productos.
8. Antes de la puesta en marcha del producto se deberá tener por seguro de que la tensión preseleccionada en el producto equivalga a la del la red de distribución. Si es necesario cambiar la preselección de la tensión también se deberán en caso dabo cambiar los fusibles correspondientes del prodcuto.
9. Productos de la clase de seguridad I con alimentación móvil y enchufe individual de producto solamente deberán ser conectados para el funcionamiento a tomas de corriente de contacto de seguridad y con conductor protector conectado.
10. Queda prohibida toda clase de interrupción intencionada del conductor protector, tanto en la toma de corriente como en el mismo producto. Puede tener como consecuencia el peligro de golpe de corriente por el producto. Si se utilizaran cables o enchufes de extensión se deberá poner al seguro, que es controlado su estado técnico de seguridad.
11. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de distribución como interruptor. En estos casos deberá asegurar de que el enchufe sea de fácil acceso y nabejo (según la medida del cable de distribución, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en construciones o instalaciones, se deberá instalar el interruptor al nivel de la instalación.

12. No utilice nunca el producto si está dañado el cable eléctrico. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegure a través de las medidas de protección y de instalación adecuadas de que el cable de eléctrico no pueda ser dañado o de que nadie pueda ser dañado por él, por ejemplo al tropezar o por un golpe de corriente.
13. Solamente está permitido el funcionamiento en redes de distribución TN/TT aseguradas con fusibles de como máximo 16 A (utilización de fusibles de mayor amperaje sólo previa consulta con el grupo de empresas Rohde & Schwarz).
14. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. Si no tiene en consideración estas indicaciones se arriesga a que se originen chispas, fuego y/o heridas.
15. No sobrecargue las tomas de corriente, los cables de extensión o los enchufes de extensión ya que esto pudiera causar fuego o golpes de corriente.
16. En las mediciones en circuitos de corriente con una tensión de entrada de U_{eff} > 30 V se deberá tomar las precauciones debidas para impedir cualquier peligro (por ejemplo medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
17. En caso de conexión con aparatos de la técnica informática se deberá tener en cuenta que estos cumplan los requisitos de la EC950/EN60950.
18. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar heridas, fuego o daños en el producto.
19. Si un producto es instalado fijamente en un lugar, se deberá primero conectar el conductor protector fijo con el conductor protector del aparato antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efecutadas por un electricista especializado.
20. En caso de que los productos que son instalados fijamente en un lugar sean sin protector implementado, autointerruptor o similares objetos de protección, el circuito de suministro de corriente deberá estar protegido de manera que usuarios y productos estén suficientemente protegidos.
21. Por favor, no introduzca ningún objeto que no esté destinado a ello en los orificios de la caja del aparato. No vierta nunca ninguna clase de líquidos sobre o en la caja. Esto puede producir corto circuitos en el producto y/o puede causar golpes de corriente, fuego o heridas.
22. Asegúrese con la protección adecuada de que no pueda originarse en el producto una sobrecarga por ejemplo a causa de una tormenta. Si no se verá el personal que lo utilice expuesto al peligro de un golpe de corriente.
23. Los productos R&S no están protegidos contra el agua si no es que exista otra indicación, ver también punto 1. Si no se tiene en cuenta esto se arriesga el peligro de golpe de corriente para el usario o de daños en el producto lo cual también puede llevar al peligro de personas.
24. No utilice el producto bajo condiciones en las que pueda producirse y se hayan producido líquidos de condensación en o dentro del producto como por ejemplo cuando se desplaza el producto de un lugar frío a un lugar caliente.
25. Por favor no cierre ninguna ranura u orificio del producto, ya que estas son necesarias para la ventilación e impiden que el producto se caliente demasiado. No pongan el producto encima de materiales blandos como por ejemplo sofás o alfombras o dentro de una caja cerrada, si esta no está suficientemente ventilada.
26. No ponga el producto sobre aparatos que produzcan calor, como por ejemplo radiadores o calentadores. La temperatura ambiental no debe superar la temperatura máxima especificada en la hoja de datos.

27. Baterías y acumuladores no deben de ser expuestos a temperaturas altas o al fuego. Guardar baterías y acumuladores fuera del alcance de los niños. No cortocircuitar baterías ni acumuladores. Si las baterías o los acumuladores no son cambiados con la debida atención existirá peligro de explosión (atención celulas de Litio). Cambiar las baterías o los acumuladores solamente por los del tipo R&S correspondiente (ver lista de piezas de recambio). Las baterías y acumuladores deben reutilizarse y no deben acceder a los vertederos. Las baterías y acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de evacuación y reciclaje.
28. Por favor tengan en cuenta que en caso de un incendio pueden desprenderse del producto agentes venenosos (gases, líquidos etc.) que pueden generar daños a la salud.
29. El producto puede poseer un peso elevado. Muévalo con cuidado para evitar lesiones en la espalda u otras partes corporales.
30. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptas para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (por ejemplo paredes y estantes).
31. Las asas instaladas en los productos sirven solamente de ayuda para el manejo que solamente está previsto para personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como por ejemplo grúas, carretillas elevadoras de horquilla, carros etc. El usuario es responsable de que los productos sean sujetados de forma segura a los medios de transporte y de que las prescripciones de seguridad del fabricante de los medios de transporte sean tenidas en cuenta. En caso de que no se tengan en cuenta pueden causarse daños en personas y objetos.
32. Si llega a utilizar el producto dentro de un vehículo, queda en la responsabilidad absoluta del conductor que conducir el vehículo de manera segura. Asegure el producto dentro del vehículo debidamente para evitar en caso de un accidente las lesiones u otra clase de daños. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Siempre queda en la responsabilidad absoluta del conductor la seguridad del vehículo. El fabricante no asumirá ninguna clase de responsabilidad por accidentes o colisiones.
33. Dado el caso de que esté integrado un producto de laser en un producto R&S (por ejemplo CD/DVD-ROM) no utilice otras instalaciones o funciones que las descritas en la documentación de producto. De otra manera pondrá en peligro su salud, ya que el rayo laser puede dañar irreversiblemente sus ojos. Nunca trate de descomponer estos productos. Nunca mire dentro del rayo laser.

Certified Quality System

DIN EN ISO 9001 : 2000
DIN EN 9100 : 2003
DIN EN ISO 14001 : 1996

DQS REG. NO 001954 QM/ST UM

QUALITÄTSZERTIFIKAT

Sehr geehrter Kunde,
Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Managementsystems entwickelt, gefertigt und geprüft.
Das Rohde & Schwarz Managementsystem ist zertifiziert nach:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:1996

CERTIFICATE OF QUALITY

Dear Customer,
you have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.
The Rohde & Schwarz quality management system is certified according to:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:1996

CERTIFICAT DE QUALITÉ

Cher Client,
vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité.
Le système de gestion qualité de Rohde & Schwarz a été homologué conformément aux normes:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:1996

ROHDE&SCHWARZ

1171.0200.11-01.00

ROHDE&SCHWARZ
EC Certificate of Conformity

CE

Certificate No.: 2002-36, page 1

This is to certify that:

Equipment type	Stock No.	Designation
NRP	1143.8500.02	Power Meter
NRP-B1	1146.9008.02	Sensor Check Source
NRP-B2	1146.8801.02	Second Sensor Input
NRP-B3	1146.8501.02	Battery Supply
NRP-B4	1146.9308.02	Ethernet Lan-Interface
NRP-B5	1146.9608.02	3rd und 4th Sensor
NRP-B6	1146.9908.02	Rear-Panel Sensor

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)
- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN61010-1 : 2001-12
EN55011 : 1998 + A1 : 1999, Class B
EN61326 : 1997 + A1 : 1998 + A2 : 2001 + A3 : 2003

For the assessment of electromagnetic compatibility, the limits of radio interference for Class B equipment as well as the immunity to interference for operation in industry have been used as a basis.

Affixing the EC conformity mark as from 2002

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 2006-11-23

Central Quality Management FS-QZ / Radde

ROHDE&SCHWARZ
EC Certificate of Conformity

CE

Certificate No.: 2002-36, page 2

This is to certify that:

Equipment type	Stock No.	Designation
NRP-Z3	1146.7005.02	USB Adapter
NRP-Z4	1146.8001.02/.04	USB Adapter
NRP-Z11	1138.3004.02/.04	Average Power Sensor
NRP-Z21	1137.6000.02	Average Power Sensor
NRP-Z22	1137.7506.02	Average Power Sensor
NRP-Z23	1137.8002.02	Average Power Sensor
NRP-Z24	1137.8502.02	Average Power Sensor
NRP-Z27	1169.4102.02	Power Sensor Module
NRP-Z37	1169.3206.02	Power Sensor Module
NRP-Z51	1138.0005.02	Thermal Power Sensor
NRP-Z55	1138.2008.02	Thermal Power Sensor
NRP-Z81	1137.9009.02	Wideband Power Sensor
NRP-Z91	1168.8004.02/.04	Average Power Sensor

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)
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Munich, 2006-11-23

Central Quality Management FS-QZ / Radde

Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your Rohde & Schwarz equipment always up-to-date,
please subscribe to our electronic newsletter at

http://www.rohde-schwarz.com/www/response.nsf/newsletterpreselection

or request the desired information and upgrades via email from your Customer Support Center (addresses see below).

Feedback

We want to know if we are meeting your support needs. If you have any comments please email us and let us know CustomerSupport.Feedback@rohde-schwarz.com.

USA & Canada

Monday to Friday (except US public holidays)
8:00 AM – 8:00 PM Eastern Standard Time (EST)

Tel. from USA	888-test-rsa (888-837-8772) (opt 2)
From outside USA	+1 410 910 7800 (opt 2)
Fax	+1 410 910 7801
E-mail	Customer.Support@rsa.rohde-schwarz.com

East Asia

Monday to Friday (except Singaporean public holidays)
8:30 AM – 6:00 PM Singapore Time (SGT)

Tel.	+65 6 513 0488
Fax	+65 6 846 1090
E-mail	Customersupport.asia@rohde-schwarz.com

Rest of the World

Monday to Friday (except German public holidays)
08:00 – 17:00 Central European Time (CET)

Tel. from Europe	+49 (0) 180 512 42 42
From outside Europe	+49 89 4129 13776
Fax	+49 (0) 89 41 29 637 78
E-mail	CustomerSupport@rohde-schwarz.com

ROHDE&SCHWARZ

1171.0200.22-01.00

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- National Websites

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1 Putting into Operation

Follow the instructions below precisely to prevent damage to the sensor – particularly when you are putting it into operation for the first time.

Unpacking the sensor

Remove the sensor from its packing and check that nothing is missing. Inspect all items for damage. If you discover any damage, inform the carrier responsible immediately and keep the packing to support any claims for compensation.

It is also best to use the original packing if the sensor is to be shipped or transported at a later date.

The sensor contains components which can be destroyed by electrostatic discharges. To prevent this happening, never touch the inner conductor of the RF connector and never open the sensor.

Connecting the sensor

To prevent EMI, the sensor must never be operated with its enclosure wholly or partially removed. Only use shielded cables that meet the relevant EMC standards.

Never exceed the maximum RF power limit. Even brief overloads can destroy the sensor.

In many cases, the RF connector only requires manual tightening. However, for maximal measurement accuracy, the RF connector must be tightened using a torque wrench with a nominal torque of 1.36 Nm (12" lbs.).

Operation with the R&S NRP basic unit

Connecting the sensor to the R&S NRP basic unit

The sensor can be connected to the R&S NRP basic unit when it is in operation. The interface connector must be inserted, red marking upwards, into one of the R&S NRP basic unit's sensor connectors. When the sensor is connected, it is detected by the R&S NRP basic unit and initialized.

Connecting the sensor to the DUT

The Sensor R&S NRP-Z81 has a male N connector and so can be connected to any standard female N connector. Using light pressure, and keeping the male N connector perpendicular, insert it into the female N connector and tighten the N connector locking nut (right-hand thread).

PC control

Hardware and software requirements

The following requirements must be met if the sensor is to be controlled by a PC via an interface adapter:

- The PC must have a USB port.
- The PC's operating system must support the USB port. This is the case with Windows™ 98, Windows™ ME, Windows™ 2000, Windows™ XP and more recent versions of the Windows™ operating system.
- The USB device drivers in the supplied *NRP Toolkit* software package must be installed.

If these requirements are met, the sensor can be controlled using a suitable application program such as the NrpFlashup program contained in the NRP Toolkit (includes the modules Power Viewer, USB Terminal, Firmware Update and Update S-Parameters).

When you insert the CD-ROM supplied with the R&S NRP, the NRP Toolkit is automatically installed on your PC. The rest of the procedure is self-explanatory.

The sensor can be powered in two ways:

- *Self-powered* from a separate power supply via the Active USB Adapter R&S NRP-Z3.
- *Bus-powered* from the PC or a USB hub with its own power supply (*self-powered hub*) via the Active USB Adapter R&S NRP-Z3 or via the Passive USB Adapter R&S NRP-Z4.

As the sensor is a *high-power device*, there is no guarantee that it can be powered from all types of laptop or notebook in the *bus-powered* mode. To be sure, you should determine the current at the USB connectors beforehand:

- *In the Windows™ start menu, select **Settings – Control Panel***
- *Select the **System** icon*
- *Select the **Hardware** tab*
- *By clicking on the button with that name, start the **Device Manager***
- *Open **USB Controller** (all USB controllers, hubs and USB devices are listed here)*
- *Double-click on **USB Root Hub** or select **Properties*** in the context menu *(use the right-hand mouse button)*
- *Select the **Power** tab (Fig. 1-1). If the hub is self-powered and the total power available is, as indicated by **Hub Information,** 500 mA per port, high-power devices can be connected.*

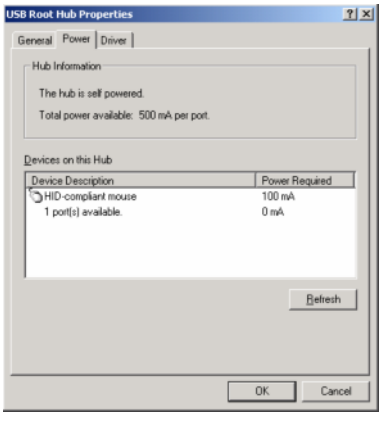

Fig. 1-1 Displaying the total available power of a USB port

If you have any doubts, ask the manufacturer if the USB port on your laptop or notebook can handle *high-power devices*.

Operation via the Active USB Adapter R&S NRP-Z3

Figure 1-2 shows the configuration with the Active USB Adapter R&S NRP-Z3, which also makes it possible to feed in a trigger signal for the *Timeslot* and *Scope* modes. The order in which the cables are connected is not critical.

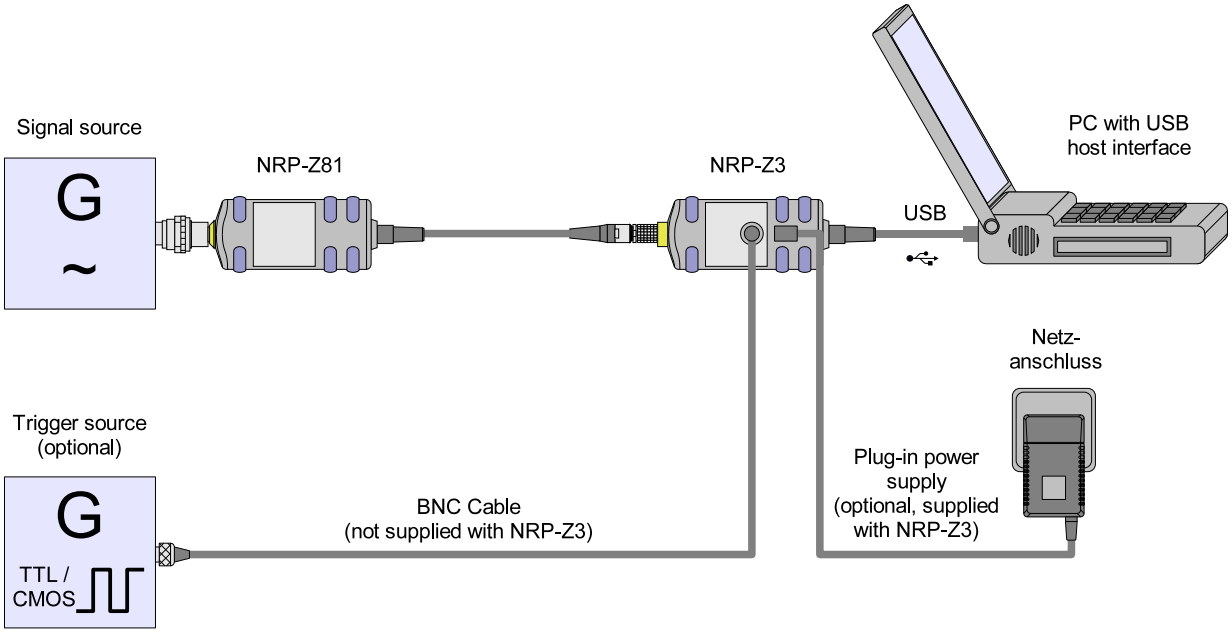

Fig. 1-2 Configuration with Active USB Adapter R&S NRP-Z3

The plug-in power supply for the R&S NRP-Z3 can be powered from a single-phase AC source with a nominal voltage range of 100 V to 240 V and a nominal frequency between 50 Hz and 60 Hz. The plug-in power supply autosets to the applied AC voltage. No manual voltage selection is required.

The plug-in power supply comes with four primary adapters for Europe, the UK, the USA and Australia. No tools of any kind are required to change the primary adapter. The adapter is pulled out manually and another adapter inserted until it locks (Fig. 1-3).

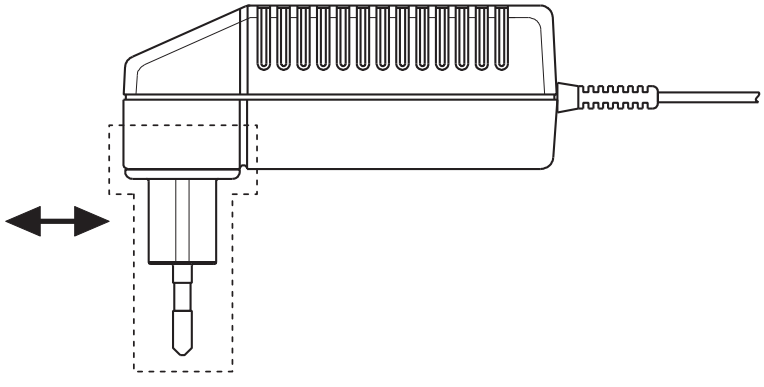

Fig. 1-3 Changing the primary adapter

The plug-in power supply is short-circuit-proof and has an internal fuse. It is not possible to replace this fuse or open the plug-in power supply.

The plug-in power supply is not intended for outdoor use.

Keep within the temperature range of 0°C to 50°C.

If there is any condensation on the plug-in power supply, dry it off before connecting it to the AC supply.

Operation via the Passive USB Adapter R&S NRP-Z4

Fig. 1-4 is a schematic of the measurement setup. The order in which the cables are connected is not critical.

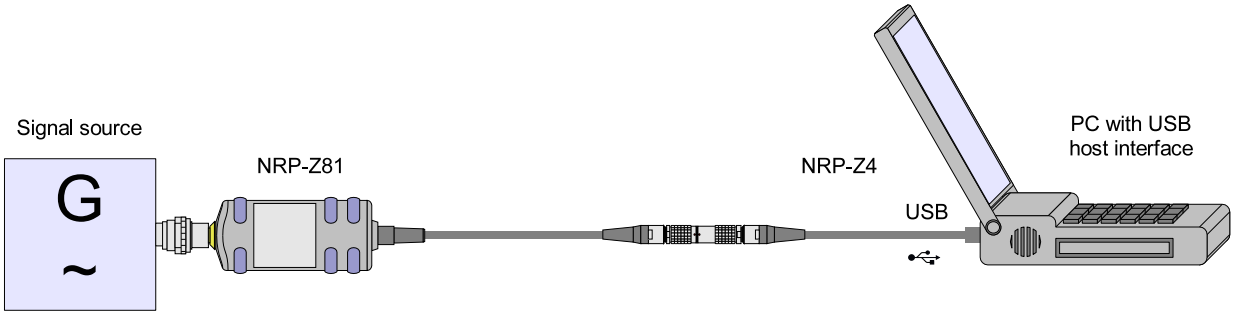

Fig. 1-4 Configuration with Passive USB Adapter R&S NRP-Z4

Connecting the sensor to the DUT

See the section “Operation with the R&S NRP basic unit” for information on how to connect the sensor to the DUT.

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2 Virtual Power Meter

You will find the **NrpFlashup** program for controlling sensors with a PC under Windows™ on the CD-ROM that accompanies the sensor. The program comprises several modules which can be started centrally via the Windows™ start-menu entry **NRP Toolkit**.

This section describes the **Power Viewer** program module. This is a virtual power meter which only uses a cut-down set of the sensor's functions. This means that after an extremely brief familiarization period, the user can measure the average power of modulated signals.

The other modules in **NrpFlashup** are described in Chapter 3 of the operating manual (**Terminal** and **Update S-Parameters** modules) or in the service manual (**Firmware Update** module).

Overview

Start the virtual power meter using the **NRP Toolkit** – **Power Viewer** start-menu entry. The **Power Viewer** program window is displayed (Fig. 2-1).

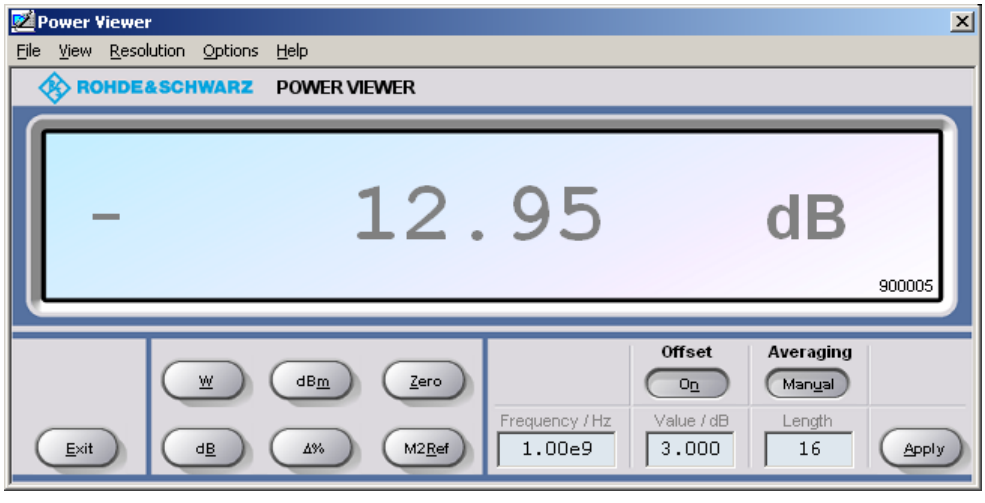


Fig. 2-1 **Power Viewer –** virtual power meter

The result display occupies most of the program window. The result, unit and additional sensor status information are displayed. The serial number of the sensor is displayed in the bottom right. The program window also contains animated buttons and entry fields (see Table 2-1 and Table 2-2).

Table 2-1 Virtual power meter keys

Button	Function	Key combination
Exit	Terminates the program. The current settings are saved and recalled the next time the program is started.	Alt + E
W	Selects Watt as the display unit.	Alt + W
dBm	Selects dBm as the display unit.	Alt + M
Zero	Zeroes the sensor.	Alt + Z
dB	Selects dB as the display unit. This is the log of the ratio of the measured value to the reference value.	Alt + B
Δ%	Selects % as the display unit. The difference between the measured value and the reference value is expressed as a percentage.	Alt + %
M2Ref	Makes the current measured value the reference value for the relative display units dB and %.	Alt + R
Offset On/Off	Turns the offset correction for the sensor on or off. If the offset correction is Off, the **Offset/dB** entry field has a grey background.	Alt + N
Averaging Man/Auto	Turns auto-averaging on or off. When auto-averaging is on, the **Length** entry field has a grey background; the current averaging factor is displayed.	Alt + T
Apply	Accepts edited numerical values in the **Frequency/Hz**, **Value/dB** and **Length** entry fields and transfers them to the sensor.	Alt + A or Enter key

Table 2-2 Virtual power meter entry fields

Entry field	Function
Frequency/Hz	Frequency of the RF carrier in Hertz.
Value/dB	Attenuation in dB of the twoport connected to the sensor. The valid range is –100 to 100. The offset correction must be activated beforehand with the **Offset On/Off** button if this entry field is to be edited.
Length	Length of the averaging filter (= averaging factor). The valid range is 1 to 65536. Averaging must be set to manual with the **Averaging Man/Auto** button if this entry field is to be edited.

Scientific notation can also be used for the entry fields. If an invalid entry is made, an error message is output. An edited numerical value will not be transferred to the sensor unless you use the **Apply** button or the Enter key to terminate the entry.

Menus

The menu bar can be used to call less frequently used functions.

File

Start Log ...

Opens a file-selection dialog to specify the path and name of the log file. Clicking the **Save** button starts the recording. All displayed values are written line-by-line to the log file with the date (format: YY/MM/DD) and time (format: hh:mm:ss.ms). Example:

```
-22.51 dBm (03/02/25 15:37:25.310)
```

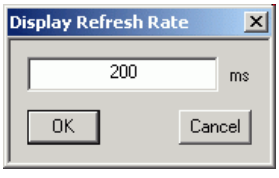
Stop Log

Ends the log-file recording.

View

Display Refresh Rate

Opens a dialog box to adjust the display refresh rate. The time in milliseconds between two refresh operations is entered. The default setting is 200 ms.



Colours

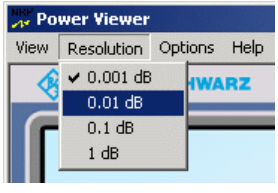
Result
Unit
Edit
Button

Opens a dialog box to select the background colour for

- the result,
- the unit,
- the text in the number fields or
- the key labelling.

Resolution

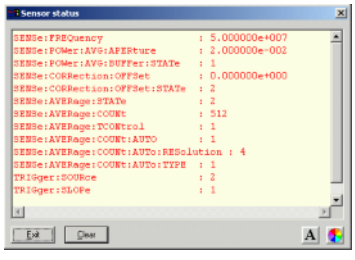
For setting the result resolution. If auto-averaging has been selected, a higher resolution leads to a greater averaging factor, which means a longer result settling time.



Options

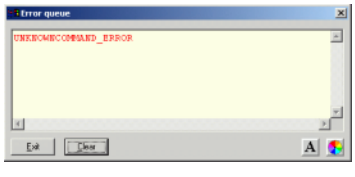
Read Sensor Status …

Reads the current sensor status. A parameter list is output.

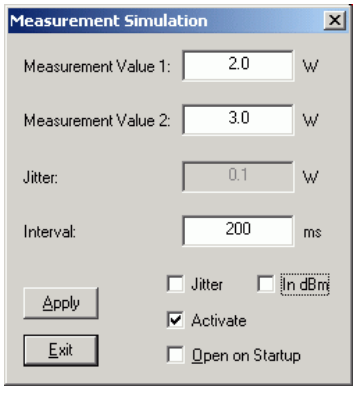


Read Error Queue …

Reads the error queue. All the error messages that have been issued since the last call are read line-by-line. A tick before this menu entry indicates that an error has occurred.



	Simulation …	For trying out the functions of the virtual power meter without actually connecting a sensor. The display alternates between **Measurement Value 1** & **Measurement Value 2** with a period given by **Interval**. Simulation can be activated immediately with the **Activate** check box.
	Reset Sensor	Initializes the sensor. Any previous zeroing remains valid.
Help	**Contents**	Opens the table of contents for the online-help facility.
	About	Displays information about the program version used, etc.



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3 Manual Operation

The previous section describes the Power Viewer program module supplied with the instrument. This module simplifies the most frequently used function of a power meter – measuring the average power of an RF signal of almost any modulation. Other program modules are also part of the supplied equipment and can be selected in the Start menu:

- **Power Viewer**: A detailed description of this virtual power meter module is provided in section 2.
- **Terminal**: Program module for sending commands and command sequences to the sensor and for displaying measurement results, status information and other data from the sensor
- **Firmware Update**: Program module for updating the sensor firmware
- **Update S-Parameters**: Program module for loading an s-parameter table into the sensor

Program module "Terminal"

Main control elements

With the USB terminal, commands and command sequences can be sent to the sensor in two different ways:

- Commands are entered in the **Input** field (Fig. 3-1). Consecutive commands can be entered as separate lines, one below the other. The buttons associated with the **Input** field are described in Table 3-1.
- Commands or command sequences are stored in *command files*. Command files are created with a text editor, for instance, and then stored. They can be called as often as required (Fig. 3-2). The buttons of the **Command File** field are described in Table 3-2.

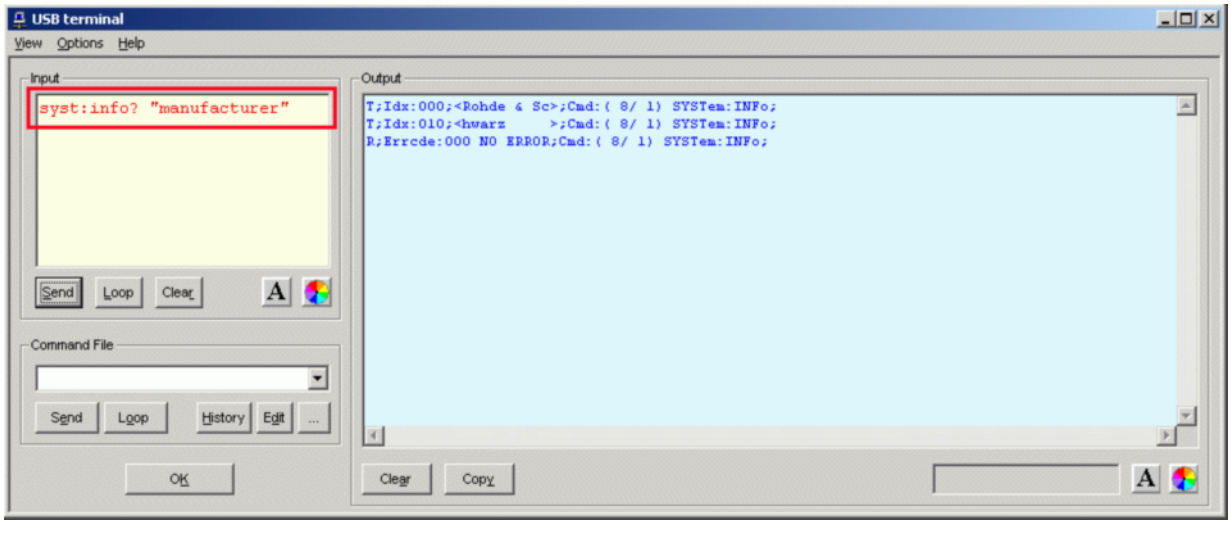


Fig. 3-1 Sending commands using the **Input** field

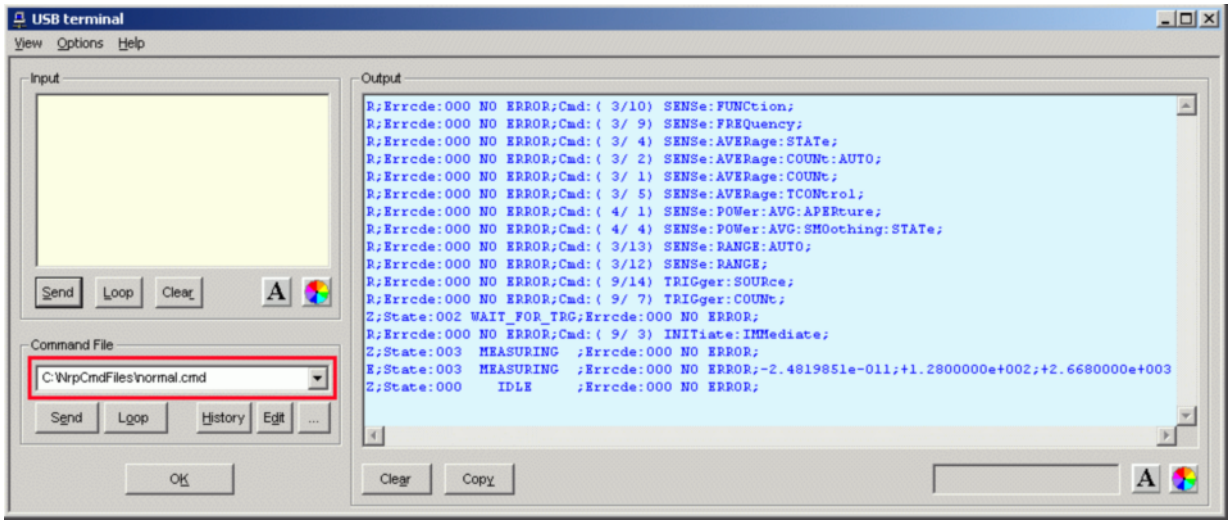


Fig. 3-2 Sending commands using command files

Table 3-1 Buttons assigned to the **Input** field

Button	**Function**	**Key combination**
Send	Sends the content of the **Input** entry field to the sensor.	Alt + S
Loop	With **Loop** the command or command sequence is cyclically sent. Pressing the button again terminates the cyclic transmission. The repetition rate is set in a dialog window that can be opened with **View - Loop...**	Alt + L
Clear	Clears the content of the **Input** field.	Alt + R
Font key	Opens a dialog window where the font for the **Input** field can be selected.	
Colour key	Opens a dialog window where the background colour of the **Input** field can be selected.	

Table 3-2 Buttons assigned to the **Command File** field

Button	**Function**	**Key combination**
Send	Sends the content of the command file to the sensor.	Alt + E
Loop	With **Loop** the command or command sequence is cyclically sent. Pressing the button again terminates the cyclic transmission. The repetition rate is set in a dialog window that can be opened with **View - Loop...**	Alt + O
History	Opens a window for editing the command file name in the **Command File** field.	Alt + H
Edit	Opens the selected command file in the Windows™ text editor.	Alt + D
…	Opens a file opening dialog for selecting the command file.	

A command line starting with a tab, a blank or a special character is considered a comment and not forwarded to the sensor.

Measurement results, parameters and status information returned by the sensor are displayed in the **Output** field.

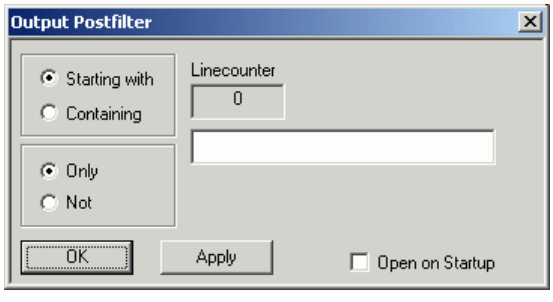
Table 3-3 Buttons assigned to the **Output** field

Button	**Function**	**Key combination**
Clear	Clears the content of the **Output** field	Alt + A
Copy	Copies the content of the **Output** field to the clipboard. (Another possiblity: mark the desired information in the output window with the mouse cursor, press the right mouse key or Ctrl+C and then copy the selected text to the clipboard using the menu item **Copy** in the opened context menu.)	Alt + Y
Font button	Opens a dialog window where the font for the **Output** field can be selected.	
Colour button	Opens a dialog window where the background colour of the **Output** field can be selected.	

Close the USB terminal with OK.

Menus

View **Post Filter …** Opens the **Output Postfilter** dialog window where the lines stored in the input buffer can be filtered according to different criteria.



Filter criteria:

Only + **Starting with**: Only lines starting with the entered character string are displayed.

Not + **Starting with**: Only lines not starting with the entered character string are displayed.

Only + **Containing**: Only lines containing the entered character string are displayed.

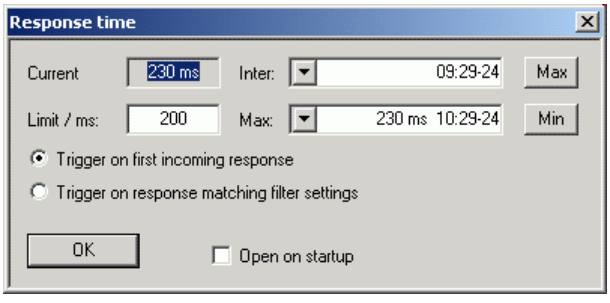
Not + **Containing**: Only lines not containing the entered character string are displayed.

Lines not matching the specific filter criterion are blanked but not cleared.

Filtering is started with **Apply**. The number of lines matching the filter criterion is displayed in the **Linecounter** field. If **Open on startup** is active, the **Output Postfilter** dialog is automatically opened when the terminal is started. The dialog window is closed with **OK**.

Response Time …

Opens the **Response time** dialog window where the response time of the sensor can be set.



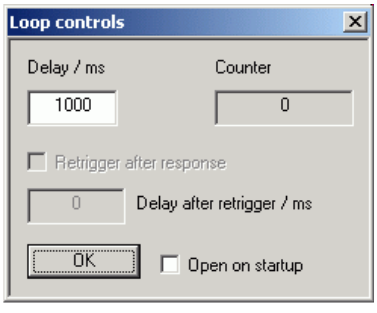
Current indicates the time elapsed between dispatch of the last command and receipt of an acknowledgement from the sensor. When the **Max** button is clicked, the response times exceeding the value in the **limit / ms** field are recorded. When the **Min** button is clicked, the response times within the value in the **limit / ms** field are recorded.

If **Trigger on first incoming response** is active, the time measurement is terminated as soon as the first response arrives after a command is sent. If **Trigger on response matching filter settings** is active, the time measurement is terminated as soon as the first response matching the filter criterion in the **Output Postfilter** dialog window is received.

If **Open on startup** is active, the **Response Time** dialog is automatically displayed when the Terminal module is started. The dialog window is closed with **OK**.

Loop …

Opens the **Loop controls** dialog window where the cyclic transfer of commands and command sequences can be controlled.



In the **Delay / ms** field, the time interval for the cyclic transfer is specified in milliseconds.

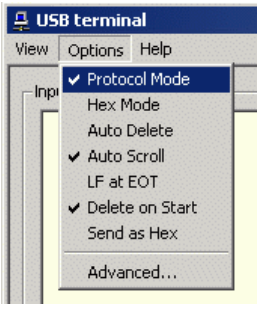
The number of completed transfer cycles is displayed in the **Counter** field. If **Open on startup** is active, the **Response time** dialog is automatically opened when the Terminal module is started. The dialog window is closed with **OK**.

Options

Protocol Mode In this mode, a time stamp is added to each response block.

Hex Mode In this mode, the response blocks from the sensor are displayed in hexadecimal format.

Auto Delete With this option active, the **Output** field is automatically cleared when the **Send** button is pressed.



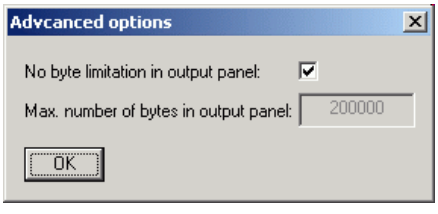
Auto Scroll With this option active, older items in the **Output** field are automatically shifted upward and off the display if space is required for new values.

LF at EOT With this option active, a line feed is appended to each response block from the sensor.

Delete on Start With this option active, the **Output** field is automatically cleared when the Terminal module is started.

Send as Hex With this option active, the text in the **Input** field is interpreted as a hexadecimal character sequence.

Advanced … Opens a dialog window where the buffer size for the **Output** field can be set.



Help

Contents Opens the table of contents for the online help.

About Displays information about the program version, etc.

Program module "Firmware Update"

A detailed description of the program module for firmware updates is provided in the Service Manual.

Program module "Update S-Parameters"

Fundamentals

With the Sensor R&S NRP-Z81 the influence of any twoport connected to the input on the measurement result can be corrected by way of calculation. A precondition is that a complete set of s-parameters of the twoport is available in the frequency range in question. The set of calibration data in the R&S NRP-Z81 therefore includes an s-parameter table with up to about 10 000 measurement frequencies. The real and the imaginary part as well as the uncertainty of the s-parameters s_{11}, s_{12}, s_{21} and s_{22} can be stored for each frequency. Since the measurement frequencies in the s-parameter table are independent of the calibration frequencies, they can be set so that the twoport frequency range of interest is optimally covered. The real and the imaginary parts between these measurement frequencies are linearly interpolated, while the more substantial measurement uncertainty at the two neighbouring frequency points is used for calculating the uncertainty of the measurement result. Below the first and above the last measurement frequency, the values of the first and the last measurement frequency are used, respectively.

The NrpFlashup program (menu item **Update S-Parameters**) is used for loading an s-parameter table. To ensure compatibility with a great number of network analyzers, NrpFlashup can process measurement data files in S2P format. All standard frequency units (Hz, kHz, MHz, GHz) and display formats (real and imaginary part, linear magnitude and phase, magnitude in dB and phase) are supported. The only restriction is that a reference impedance of 50 Ω must be used for the s-parameters. Additional noise parameters in the measurement data file are ignored.

Structure of the S2P measurement data file:

1. The *option line* has the following format:
   # [<frequency unit>] [<parameter>] [<format>] [<R n>]
   # identifies the *option line*.
   The <frequency unit> may be Hz, kHz, MHz or GHz. If a frequency unit is not specified, GHz is implicitly assumed.
   If a parameter is specified, S must be used in <parameter> for s-parameter files. If a parameter is not specified, S is implicitly assumed.
   The <format> may be MA (linear magnitude and phase in degree), DB (magnitude in dB, phase in degree) or RI (real and imaginary part). If a format is not specified, MA is implicitly assumed.
   R is optional and followed by the reference impedance in Ω. If an entry is made for R, R50 must be specified. If no entry is made, R50 is implicitly assumed.
   The *option line* should therefore read:
   # [HZ | KHZ | MHZ | GHZ] [S] [MA | DB | RI] [R 50]

2. The measurement frequencies in ascending order are specified as follows:
   $f_i \;\; s_{11}(f_i) \;\; s_{21}(f_i) \;\; s_{12}(f_i) \;\; s_{22}(f_i)$,
   where $s_{jk}(f_i)$ is the display format as specified in the *option line*:

   $|s_{jk}(f_i)| \;\; \arg s_{jk}(f_i)$ (display format for linear magnitude and phase in degree) or

   $20 \cdot \lg |s_{jk}(f_i)| \;\; \arg s_{jk}(f_i)$ (display format for magnitude in dB and phase in degree)

   $\mathrm{Re}\,[s_{jk}(f_i)] \;\; \mathrm{Im}\,[s_{jk}(f_i)]$ (display format for real and imaginary part)

3. Comments: Any line starting with an exclamation mark (!) is interpreted as a comment line.

To characterize the measurement uncertainty of the s-parameter test system, another data file can optionally be created. Without this file, the measurement uncertainty cannot be correctly calculated in the sensor. The syntax of the uncertainty data file is similar to that of the S2P data file but U is specified as <Parameter> in the *option line* so that the *option line* reads # Hz U for frequencies in Hz.
The measurement frequencies must not be identical to those of the S2P measurement data files. In most cases a few entries will be sufficient to characterize the measurement uncertainty of the s-parameter test system. An s-parameter uncertainty as high as that of the neighbouring measurement frequencies of the uncertainty data file is then selected. If different values are available, the higher one is chosen. This is illustrated in the example below:

Table 3-4 Uncertainties of the s-parameter test system (example)

***f* in GHz**	**unc [$s_{ik}(f)$]**
0.1	0.01
1.0	0.01
1.1	0.005
10.0	0.005
10.1	0.01
40.0	0.01

Table 3-5 Interpolated uncertainties of measurement frequencies for s-parameters (example)

***f* in GHz**	**unc [$s_{ik}(f)$]**
0.9	0.01
0.95	0.01
1.0	0.01
1.05	0.01
1.1	0.005
1.15	0.005
1.2	0.005

At 1.05 GHz, the higher uncertainty of the two adjacent 1.0 GHz and 1.1 GHz measurement frequencies is entered in the s-parameter table. If an uncertainty of 0.005 is desired for all frequencies above 1.0 GHz, the first measurement frequency in the uncertainty data file must above 1.0 GHz, e.g. 1.000001 GHz.

Structure of the uncertainty data file:

1. The *option line* has the following format:
   # [<frequency unit>] <parameter> [<format>] [<R n>]
   # identifies the *option line*.
   The <frequency unit> may be Hz, kHz, MHz or GHz. If a frequency unit is not specified, GHz is implicitly assumed.
   U must be specified for <parameter> in uncertainty data files. If a parameter is not specified, S is implicitly assumed and as a result an error message is triggered.
   <format> is ignored in uncertainty measurement files; the entry is therefore irrelevant.
   R is optional and followed by the reference impedance in Ω. If an entry is made for R, R50 must be specified. If no entry is made, R50 is implicitly assumed.
   The *option line* should therefore read:
   # [HZ | KHZ | MHZ | GHZ] U [MA | DB | RI] [R 50]

2. Measurement frequencies in ascending order are specified in the following form:
   $f_i \quad \mathrm{unc}\left[s_{11}(f_i)\right] \quad \mathrm{unc}\left[s_{21}(f_i)\right] \quad \mathrm{unc}\left[s_{12}(f_i)\right] \quad \mathrm{unc}\left[s_{22}(f_i)\right]$.
   The s-parameters uncertainties are forwarded as follows:
   - as extended absolute uncertainties ($k = 2$) for the magnitude of reflection parameters s_{11} and s_{22}, for instance 0.015,
   - as extended uncertainties ($k = 2$) in dB for the magnitude of transmission parameters s_{21} and s_{12}, for instance 0.015.

3. Comments: Any line starting with an exclamation mark (!) is interpreted as a comment line.

Two additional values must be specified when the s-parameters are loaded: the lower and the upper nominal measurement limit of the sensor-twoport combination. If s-parameter correction is active, these values are transferred by the sensor in response to SYSTem:INFO? The values cannot always be derived from the lower or upper measurement limit of the sensor alone and from the loss or gain of the preconnected twoport. The upper measurement limit of the sensor-twoport combination may also be limited by the twoport's maximum power-handling capacity. Furthermore, the lower measurement limit may be raised not only by the loss but also by the inherent noise of the twoport. For this reason, NrpFlashup allows these values to be entered.

The upper nominal measurement limit of the sensor-twoport combination entered when loading the s-parameters should be carefully specified, as automatic test systems may evaluate it and an incorrect value may cause the sensor and/or the twoport to be overloaded.

Procedure

To load an s-parameter table into the calibration set of the sensor, proceed as follows:

1. Connect the sensor to the USB port of the PC and start the program module **Update S-Parameters**. The corresponding dialog window is opened (Fig. 3-3).
2. Make sure **Keep Current S-Parameter Data** is deactivated.
3. Under **S-Parameter File** enter the search path and the name of the S2P file containing the parameters. Press the **Browse**... button to open a file-opening dialog where the S2P measurement data file can be easily selected.
4. Under **Uncertainty File** enter the search path and the name of the measurement uncertainty file containing the measurement uncertainty of the s-parameter test system. Press the **Browse**... button to open a file-opening dialog where the measurement uncertainty file can be easily selected.
5. Enter the upper and lower nominal measurement limit of the sensor-twoport combination in the **Lower Power Limit** and **Upper Power Limit** fields**.**
6. Enter a name for the loaded s-parameter set in the **S-Parameter Device Mnemonic** field. This name can later be queried with *SYSTem:INFO? "SPD Mnemonic"* and is displayed on the NRP basic unit when s-parameter correction is switched on.
7. Activate **S-Parameter Correction on by Default** if the *SENSe:CORRection:SPDevice:STATe* switch should be automatically set to *ON* when the sensor is put into operation.
8. Press **Start** for loading. (The dialog is closed with **OK** and the set parameters are retained. When the dialog is exited with **Cancel**, all parameter modifications are ignored.)

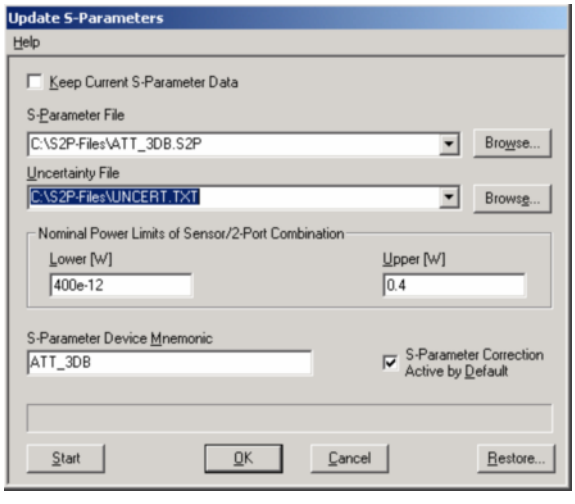


Fig. 3-3 Dialog window for loading an s-parameter table

During loading, the current calibration data set of the sensor is overwritten. To be on the safe side, a backup copy of the current calibration data set is therefore automatically stored before s-parameters are loaded. The names of the backup files have the structure <batch number>_<date><time>.bak, where <batch number> is the batch number of the sensor, <date> the date of the s-parameter update in yymmdd format and <time> the time of the s-parameter update in the format hhmmss.

Store the automatically created backup files on a separate data medium (e.g. diskette, CD-ROM or network drive) and, if required, assign a meaningful name to them to simplify reloading. With the aid of these files, a previously used calibration data set of the sensor can be restored.

To reload the backup file of a calibration data set into the sensor, proceed as follows:

1. Press the **Restore...** button. The **Restore S-Parameters** window is opened (Fig. 3-4).
2. Enter the search path and the name of the backup file in the **Backup File** field. Press the **Browse**... button to open a dialog where the backup file can be easily selected.
3. Press **OK** to start the restore procedure. (With **Cancel** the dialog window is exited without data being restored).

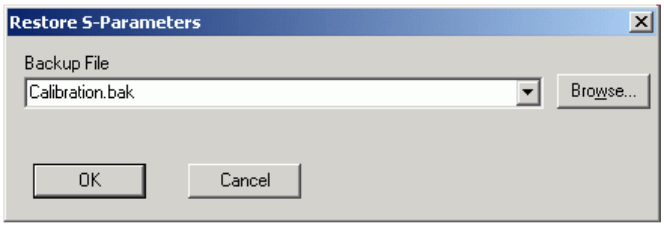


Fig. 3-4 Dialog window for loading the backup file of a calibration data set

To be able to determine if the s-parameter correction is active after plugging in or resetting the sensor, proceed as follows:

1. Connect the sensor to the USB port of the PC and start the program module **Update S-Parameters**.
2. Make sure **Keep Current S-Parameter Data** is activated (Fig. 3-5).
3. Activate **S-Parameter Correction on by Default** if the *SENSe:CORRection:SPDevice:STATe* switch should be automatically set to *ON* when the sensor is put into operation, otherwise deactivate it.
4. Press **Start** for loading.

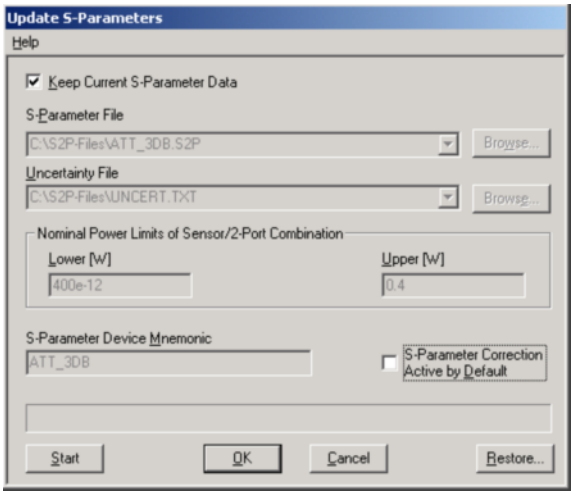


Fig. 3-5 Subsequently changing the default behaviour of the s-parameter correction

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5 Remote Control – Fundamentals

Rohde & Schwarz recommends to utilize the VXI Plug & Play Driver for the remote control of R&S NRP power sensors. This driver can be found on the CD-ROM supplied with the sensor or downloaded in its most recent version via the internet (http://rohde-schwarz.com/).

The old remote control interface provided by the *Dynamic Link Library NrpControl.dll* is not developed further, but remains on the CD-ROM and can be downloaded via the internet.

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6 Remote Control – Commands

Notation

In the following sections, all commands implemented in the sensor are first listed in a table according to command systems and are then described in detail. The notation is largely in line with the SCPI standard.

Command tables For a quick overview of available commands, the commands are listed in a table before they are described. These tables contain the following four columns:

Command: Commands and their tree structure
Parameters: Possible parameters
Unit: The basic unit of the physical parameters (must not be sent with parameters)
Remarks: Identification of all commands
- that have no query form
- that are available as query only

Indentations The various levels of the SCPI command hierarchy are shown in the table by right indentations. The lower the level, the greater the indentation to the right. It should be noted that the complete notation of the command includes the higher levels too.

Example:
SENSe:AVERage:COUNt is represented in the table as follows:
SENSe first level
:AVERage second level
:COUNt third level

In the individual description, the command is shown full length. An example of the command is given at the end of the description.

[?]
? A question mark in square brackets at the end of a command indicates that this command can either be used as a setting command (without question mark) or as a query (with question mark). If the question mark is not in square brackets, the command is a query only.

Example:
SENSe:POWer:AVG:APERture[?]
SENSe:POWer:AVG:APERture 1e-3 sets the length of the sampling window to 1 ms.

SENSe:POWer:AVG:APERture? returns the currently set length as a response.
**IDN?* queries the sensor identification string which, of course, cannot be changed. For this reason, this command is only available as a query.

Special character | between parameters A vertical bar between parameters is used to separate alternative options (ORing).

Example:
NITiate:CONTinuous OFF | ON
Either *OFF* or *ON* can be entered.

{numeric expression} A numeric expression in curly brackets means that it has been rounded to the nearest integer.

<parameter>
<variable> The current value of a parameter or variable is represented by placing the parameter or variable in triangular brackets.

Commands as per IEEE 488.2

The sensor supports a subset of the possible setting commands and queries *(common commands and queries)* in line with IEEE 488.2.

*IDN? – Identification Query

**IDN?* returns a string identifying the sensor (device identification code). The version number of the installed firmware is indicated. The string for a sensor of type R&S NRP-Z81 has the following structure:

ROHDE&SCHWARZ,NRP-Z81,<serial number>,<firmware version>

<serial number>: serial number in ASCII
<firmware version>: firmware version number in ASCII

*RST – Reset

**RST* sets the sensor to the default state, i.e. the default settings for all test parameters are loaded.

*TRG – Trigger

**TRG* triggers a measurement. For this purpose, the sensor must be in the *WAIT_FOR_TRIGGER* state and the source for the trigger event must be set to *BUS* (*TRIGger:SOURce BUS*).

*TST? – Self Test Query

**TST?* starts a selftest and returns 0 (no error found) or 1 (an error has occurred). The selftest comprises the following functions:

- RAM test
- Operating voltages
- Temperature measurement
- Calibration data set
- Noise
- Zero-point offsets

SCPI Commands

The R&S NRP-Z81 power sensor is controlled via the command groups

- CALibration (zeroing)
- SENSe (measurement configurations)
- SYSTem
- TRIGger
- SERVice

CALibration

Table 6-1 Commands of the *CALibration* group

Command	Parameter	Unit	Remarks
CALibration			
:DATA[?]	<calibration data set as definite length block>		
:LENGth?		Bytes	Query only
:ZERO			
:AUTO[?]	LFR | UFR | ONCE		
:FAST:AUTO[?]	ONCE		Only in Trace or Statistics mode

CALibration:DATA[?] <calibration data set as *definite length block*>

CALibration:DATA is used to write a calibration data set to the sensor's flash memory.

The query returns the calibration data set currently stored in the flash memory as a *definite length block*.

CALibration:DATA:LENGth?

CALibration:DATA:LENGth? returns the length in bytes of the calibration data set currently stored in the flash memory. Programs that read out the calibration data set can use this information to determine the capacity of the buffer memory required.

CALibration:ZERO:AUTO[?] LFR | UFR | ONCE

These commands zero the sensor. For this purpose, the test signal must be deactivated or the sensor disconnected from the signal source. The sensor automatically detects the presence of any significant power to be measured. This causes zeroing to be aborted and the error message *NRPERROR_CALZERO* to be output.

Full zeroing, covering all measurement modes and the entire frequency range, can be carried out with the *ONCE* parameter. Usually, this takes eight seconds. There are a number of ways to reduce the time taken. Zeroing can be limited to the frequency range <500 MHz or ≥500 MHz by using the parameters

LFR (lower frequency range) and *UFR* (upper frequency range), cutting the zeroing time by half. Zeroing is even faster if performed only in the *Trace* mode and the *Statistics* modes (20 ms – see the command group *CALibration:ZERO:FAST:AUTO*).

The query always returns *1*.

Default setting
After a power-on reset, the zero offsets stored in the data memory of the sensor are used as corrections. Since they were determined after sensor warm-up during factory calibration, only moderate zero errors are to be expected if no zeroing is performed. After initialization of the sensor by means of **RST* or *SYSTem:INITialize*, the current zero setting remains unchanged.

Repeat zeroing

- *during warm-up after switching on the R&S NRP or connecting the sensor*
- *after a substantial change in the ambient temperature*
- *after connecting the sensor to an RF connector if the ambient temperature is high*
- *after several hours in operation*
- *when very low-power signals are to be measured, e.g. less than 10 dB above the lower measurement limit of the sensor*

When zeroing, preferably switch off the test signal and do not remove the sensor from the signal source. Apart from keeping the thermal balance, this has the advantage that the noise superimposed on the test signal (e.g. from a broadband amplifier) can be detected on zeroing and does not impair the measurement result.

CALibration:ZERO:FAST:AUTO[?] ONCE

The command *CALibration:ZERO:FAST:AUTO ONCE* performs fast zeroing, but can be called only in the sensor's *Trace* mode and *Statistics* modes. In any other measurement mode, the error message *NRPERROR_CALZERO* is output. Even though the execution time is shorter than that for standard zeroing by a factor of 100 or more, measurement accuracy is not affected. Fast zeroing is available for the entire frequency range.

The query always returns *1*.

Default setting
After a power-on reset, the zero offsets stored in the data memory of the sensor are used as corrections. Since they were determined after sensor warm-up during factory calibration, only moderate zero errors are to be expected if no zeroing is performed. After initialization of the sensor by means of **RST* or *SYSTem:INITialize*, the current zero setting remains unchanged.

SENSe (Sensor Configuration)

The sensor is configured by means of the commands in the *SENSe* and *TRIGger* groups.

Table 6-2 Commands of the *SENSe* system

Command	Parameter	Unit	Remarks
SENSe			
:AUXiliary[?]	NONE | MINMAX | RNDMAX		
:AVERage			
:COUNt[?]	1 to 2^{20}		
:AUTO[?]	OFF | ON | ONCE		
:MTIMe[?]	1.0 to 999.99	s	
:NSRatio[?]	0.0001 to 1.0	dB	
:RESolution[?]	1 to 4		
:SLOT[?]	1 to <SENSe:POWer:TSLot:AVG:COUNt>		
:TYPE[?]	RESolution | NSRatio		
:RESet			No query
:STATe[?]	OFF | ON		
:TCONtrol[?]	MOVing | REPeat		
:BWIDth			
:VIDeo[?]	"300 kHz" | "1.5 MHz" | "5 MHz" | "FULL"		
:LIST?			Query only
:CORRection			
:DCYCle[?]	0.001 to 99.999	%	
:STATe[?]	OFF | ON		
:OFFSet[?]	-200.0 to 200.0	dB	
:STATe[?]	OFF | ON		
:SPDevice			
:LIST?			Query only
:SELect[?]	1 to x		
:STATe[?]	OFF | ON		
:FREQuency[?]	50.0e6 to 18.0e9	Hz	

Command	Parameter	Unit	Remarks
:FUNCtion[?]	"POWer:AVG" | "POWer:BURSt:AVG" | "POWer:TGATe:AVG" | "POWer:TSLot:AVG" | "XTIME:POWer" | "XPOWer:CCDFunction" | "XPOWer:PDFunction"		
:POWer			
:AVG			
:APERture[?]	1.0e-6 to 0.1	s	
:BUFFer			
:SIZE[?]	1 to 8192		
:STATe[?]	OFF | ON		
:SMOothing:STATe[?]	OFF | ON		
:BURSt			
:DTOLerance[?]	0.0 to 0.3	s	
:TSLot[:AVG]			
:COUNt[?]	1 to 16		
[:EXCLUDE]:MID			
:OFFSet[:TIME][?]	0.0 to 0.1	s	
:TIME[?]	0.0 to 0.1	s	
:WIDTh[?]	50e-9 to 0.1	s	
:SGAMma			
:CORRection:STATe[?]	OFF | ON		
:MAGNitude[?]	0.0 to 1.0		
:PHASe[?]	-360.0 to 360.0	degree	
:STATistics			
[:EXCLude]:MID			
:OFFSet[:TIME][?]	0 to 0.3	s	
:TIME[?]	0 to 0.3	s	
:OFFSet:TIME[?]	0 to 10.0	s	
:SCALe:X			
:MPWidth?			Query only

Command	Parameter	Unit	Remarks
:POINts[?]	3 to 8192		
:RANGe[?]	0.01 to 100.0	dB	
:RLEVel[?]	–80 to +20	dBm	
:TIME[?]	10.0e-6 to 0.3	s	
:TIMing			
:EXCLude			
:STARt[?]	0.0 to 10.0	s	
:STOP[?]	0.0 to 51.2e-6	s	
:TRACe			
:AVERage			
:COUNt[?]	1 to 65536		
:STATe[?]	OFF | ON		
:TCONtrol[?]	MOVing | REPeat		
:MPWidth?		s	Query only
:OFFSet:TIME[?]	x to 10.0	s	
:POINts[?]	3 to 8192		
:FPGA?			Query only
:TIME[?]	50e-9 to 1	s	
:FPGA?		s	Query only

SENSe:AUXiliary[?] NONE | MINMAX | RNDMAX

This command group is used to define which measurement results are to be made available in the Trace mode. For every pixel, *SENSe:AUXiliary NONE* provides only the average power of the associated samples. *MINMAX* provides the maximum and minimum as well, while RNDMAX provides the maximum and a random sample.

The query returns
- *1 for NONE,*
- *2 for MINMAX*
- *4 for RNDMAX*

Default setting: *RNDMAX*

SENSe:AVERage:COUNt[?] 1 to 2^{20}

SENSe:AVERage:COUNt sets the number of measured values that have to be averaged to form the measurement result in the modes *Continuous Average*, *Burst Average* and *Timeslot Average*. The greater this averaging factor, the less the measured values fluctuate and the longer the measurement time. The parameter is rounded to the nearest power-of-two. If an averaging factor of two ore more has been chosen, the measurement is performed with chopper-stabilization in the *Burst Average* and *Timeslot Average* modes. Chopper stabilization is always activated in the *Continuous Average* mode.

The query returns the averaging factor that has been set.

The averaging function must be activated with SENSe:AVERage:STATe ON *so that the set averaging factor becomes effective.*

Default setting: *1024*

SENSe:AVERage:COUNt:AUTO[?] OFF | ON | ONCE

SENSe:AVERage:COUNt:AUTO ON activates auto-averaging in the modes *Continuous Average*, *Burst Average* and *Timeslot Average. SENSe:AVERage:COUNt :AUTO OFF* deactivates it. If auto-averaging is activated, the averaging factor is continuously determined and set according to the power level and other parameters. On deactivation, the previous, automatically determined averaging factor is used in the fixed-filter mode. The *SENSe:AVERage:COUNt:AUTO ONCE* command ensures that a new averaging factor is determined by the automatic filter function under the current measurement conditions and is used in the fixed-filter mode.

In the *Burst Average* and *Timeslot Average* modes, a minimum value of two is selected for the averaging factor. This prevents implicit deactivation of chopper stabilization in course of automatic averaging.

The query returns
- *1* for *OFF*
- *2* for *ON*

Default setting: *OFF*

SENSe:AVERage:COUNt:AUTO:MTIMe[?] 1.0 to 999.99

SENSe:AVERage:COUNt:AUTO:MTIMe sets an upper limit for the settling time of the auto-averaging filter in the *NSRatio* mode and thus limits the length of the filter.

The query returns the time that has been set.

Default setting: *4 [s]*

SENSe:AVERage:COUNt:AUTO:NSRatio[?] 0.0001 to 1.0

SENSe:AVERage:COUNt:AUTO:NSRatio sets an upper limit for the relative noise content of the measurement result in the *NSRatio* auto-averaging mode. The relative noise content is defined as the magnitude in dB of the level variation caused by the inherent noise of the sensor (two standard deviations).

The query returns the set relative noise content.

Default setting: *0.01 [dB]*

SENSe:AVERage:COUNt:AUTO:RESolution[?] 1 to 4

SENSe:AVERage:COUNt:AUTO:RESolution sets the resolution index for the automatic averaging filter if it is operated in the *RESolution* mode. The resolution index is greater by a value of 1 than the number of decimal places that have to be taken into account to further process the measurement result in dBm, dBµV or dB. The design of the *RESolution* mode is similar to that of its predecessors R&S NRVS and R&S NRVD or other commercial power meters. The higher the selected index, the better the measurement result is filtered. However, it cannot be ensured that the least significant digit (e.g. 0.01 dB with an index of 3) remains stable. The NSRatio setting is recommended instead.

The query returns the set resolution index.

Default setting: *3*

SENSe:AVERage:COUNt:AUTO:SLOT[?] 1 to <SENSe:POWer:TSLot:AVG:COUNt>

SENSe:AVERage:COUNt:AUTO:SLOT defines a timeslot whose power is used as a reference for the auto-averaging filter in the *Timeslot* mode. The reference timeslot is addressed via a number, the numbers starting at 1. This number must not exceed the total number of timeslots which can be set with the *SENSe:POWer:TSLot[:AVG]:COUNt* command. If the total number is reduced to a value that is smaller than the reference-timeslot number, then the timeslot with the highest number is automatically chosen as a reference.

The query returns the reference-timeslot number.

Default setting: *1*

SENSe:AVERage:COUNt:AUTO:TYPE[?] RESolution | NSRatio

SENSe:AVERage:COUNt:AUTO:TYPE defines the operating mode of the automatic averaging filter in the *Continuous Average*, *Burst Average* and *Timeslot Average* modes. The *RESolution* parameter sets an operating mode that is usually implemented in power meters; *NSRatio* ensures that the noise content of the measurement result does not exceed a predefined limit.

The query returns
- *1* for *RESolution*
- *2* for *NSRatio*

Default setting: *RESolution*

SENSe:AVERage:RESet

SENSe:AVERage:RESet initializes the averaging filter in the *Continuous Average*, *Burst Average* or *Timeslot Average* measurement modes. This is useful if the averaging filter is operated in the *SENSe:AVERage :TCONtrol MOVing* filter mode and a high averaging factor has been set. In this case, rapid changes in the measured power will be delayed to such an extent that the advantage of the *MOVing* filter mode is lost. The *SENSe:AVERage:RESet* command solves this problem by initially setting the length of averaging filter to a minimum value and filling it with the current measured value. The averaging factor is then automatically increased to its final value which is determined by the *SENSe:AVERage:COUNt* command. In this way, changes in the measurement result become quickly apparent and fluctuations in the measurand are still filtered out in accordance with the set averaging factor. However, this procedure does not reduce the time required to obtain a fully settled reading.

SENSe:AVERage:STATe[?] OFF | ON

SENSe:AVERage:STATe switches the averaging filter for the *Continuous Average*, *Burst Average* and *Timeslot Average* modes on or off. If an averaging factor of two ore more has been chosen, the measurement is performed with chopper-stabilization in the *Burst Average* and *Timeslot Average* modes. Chopper stabilization is always activated in the *Continuous Average* mode.

The query returns
- *1* for *OFF*
- *2* for *ON*

Default setting: *ON*

SENSe:AVERage:TCONtrol[?] MOVing | REPeat

SENSe:AVERage:TCONtrol (terminal control) defines the behavior of the averaging filter in the *Continuous Average*, *Burst Average* and *Timeslot Average* modes.

When the *REPeat* parameter is included, a measurement result is output after the averaging filter has been completely filled with new measured values. This ensures that a settled result is output. Very long measurement times may be the consequence of large averaging factors.

When the *MOVing* parameter is used in a setting command, a moving average is formed, which means that with every new measured value, a new output value is also available. This is advantageous if a large averaging factor has been selected, as trends emerge quickly and there is no need to wait for the full settling time to elapse. The output rate can be varied over a wide range to prevent an intermediate result overload (see the *SYStem:RUTime command*).

The query returns
- *1* for *MOVing*
- *2* for *REPeat*

Default setting: *REPeat*

SENSe:BWIDth:VIDEo[?] "300 kHz" | "1.5 MHz" | "5 MHz" | "FULL"

This command can be used to reduce the video bandwidth for the *Trace* and *Statistics* modes. As a result, trigger sensitivity is increased and the display noise reduced. To prevent signals from being corrupted, the selected video bandwidth should not be smaller than the RF bandwidth of the measurement signal. The "FULL" setting corresponds to a video bandwidth of at least 30 MHz if there is an associated frequency setting (*SENSe:FREQuency* command) greater than or equal to 500 MHz. If a frequency below 500 MHz is set and the video bandwidth is set to "FULL", the video bandwidth is automatically reduced to approx. 7.5 MHz.

If the video bandwidth is limited with the *SENSe:BWIDth:VIDEo* command, the sampling rate is also automatically reduced, i.e. the effective time resolution in the *Trace* mode is reduced accordingly. In the *Statistics* modes, the measurement time must be increased appropriately if the required sample size is to be maintained:

Table 6-3 Video bandwidth and resulting sampling rate and interval

Video bandwidth	Sampling rate	Sampling interval
"Full"	8×10^7 s^{-1}	12.5 ns
"5 MHz"	4×10^7 s^{-1}	25 ns
"1.5 MHz"	1×10^7 s^{-1}	100 ns
"300 kHz"	$2{,}5\times10^6$ s^{-1}	400 ns

The sampling interval can be queried with the *SENSe:TRACe:MPWidth?* command.

Default setting: *"FULL"*

SENSe:BWIDth:VIDeo:LIST?

This query command outputs all available video-bandwidth settings.

SENSe:CORRection:DCYCle[?] 0.001 to 99.999

SENSe:CORRection:DCYCle sets the duty cycle as a percentage when pulse-modulated signals are corrected. With the correction activated, the sensor calculates pulse power from the duty cycle and average power. The duty cycle is only evaluated in the *Continuous Average* mode.

The query returns the current duty cycle in percent.

Default setting: *1.0 [%]*

SENSe:CORRection:DCYCle:STATe[?] OFF | ON

SENSe:CORRection:DCYCle:STATe ON activates duty cycle correction and thus pulse-power measurement, whereas *SENSe:CORRection:DCYCle:STATe OFF* deactivates it.

The query returns
- *1* for *OFF*
- *2* for *ON*

Default setting: *OFF*

SENSe:CORRection:OFFSet[?] –200.0 to 200.0

SENSe:CORRection:OFFSet defines a fixed offset in dB which is used to correct the measured value. (When a log scale is used, the offset is added to the measured value; this is the reason why the command has this name.)

The attenuation of an attenuator located ahead of the sensor or the coupling attenuation of a directional coupler is taken into account with a positive offset, i.e. the sensor calculates the power at the input of the attenuator or directional coupler. A negative offset can be used to correct the influence of an amplifier connected ahead.

The query returns the set offset in dB.

Default setting: *0.0 [dB]*

SENSe:CORRection:OFFSet:STATe[?] OFF | ON

SENSe:CORRection:OFFSet:STATe ON activates the offset correction and *SENSe:CORRection:OFFSet:STATe OFF* deactivates it.

The query returns
- *1* for *OFF*
- *2* for *ON*

Default setting: *OFF*

SENSe:CORRection:SPDevice:LIST?

Several S-parameter data sets can be loaded onto the R&S NRP-Z81 power sensor. This query command outputs a list of the data sets that have been loaded; the list indicates the consecutive number and mnemonic of each data set.

SENSe:CORRection:SPDevice:SELect[?] <device_number>

Several S-parameter data sets can be loaded onto the R&S NRP-Z81 power sensor. The *SENSe:CORRection:SPDevice:SELect* command can be used to select a loaded data set for S-parameter correction. This data set is accessed by means of a consecutive number, starting with 1 for the first data set. If an invalid data set consecutive number is entered, an error message is output.

The query command returns the consecutive number of the selected S-parameter data set.

Default setting:
When the S-parameter data sets are being loaded, the user can specify the S-parameter data set to be used as default setting.

SENSe:CORRection:SPDevice:STATe[?] OFF | ON

SENSe:CORRection:SPDevice:STATe ON activates S-parameter correction by setting the selected S-parameter data set (see the *SENSe:CORRection:SPDevice:SELect* command). The *OFF* parameter deactivates S-parameter correction.

S-parameter correction is used to compensate for a component (attenuator, directional coupler) connected ahead of the sensor by means of its S-parameter data set. The use of S-parameters instead of a fixed offset (see *SENSe:CORRection :OFFSet* command group) allows more precise measurements because the interaction between the sensor and the component can be taken into account. The R&S NRP-Z81 wideband sensor contains no factory-set S-parameter data set. As a result, the *SENSe:CORRection:SPDevice:STATe ON* command generates an error message, if no user-defined data set is available. For detailed information on loading S-parameter data sets, see section 3.

The query returns
- *1* for *OFF*
- *2* for *ON*

Default setting:
The sensor's factory-set default setting is *OFF*. The default setting can be redefined when an S-parameter table is loaded (see section 3).

SENSe:FREQuency[?] 50.0e6 to 18.0e9

SENSe:FREQuency transfers the carrier frequency of the RF signal to be measured to the sensor; this frequency is used for various corrections of the measurement result. When the R&S NRP-Z81 power sensor is used, it is essential that the current carrier frequency is set. Otherwise, non-linearities or temperature dependencies considerably greater than those stated in the data sheet can occur. If the frequency that is entered is below 500 MHz, the video bandwidth of the sensor is automatically reduced (see *SENSe:BWIDth:VIDEo* command). The center frequency is set for broadband signals (*spread-spectrum* signals, multicarrier signals), if there is no explicit carrier.

The query returns the set carrier frequency in Hz.

Default setting: *1.0e9 [Hz]*

SENSe:FUNCtion[?] <sensor_function>

SENSe:FUNCtion <sensor_function> sets the sensor to one of the following measurement modes:

Table 6-4 Measurement modes

<sensor_function>	Measurement mode designation
"POWer:AVG"	Continuous Average
"POWer:BURSt:AVG"	Burst Average
"POWer:TSLot:AVG"	Timeslot Average
"XTIMe:POWer"	Trace
"XPOWer:PDFunction"	Statistics (PDF)
"XPOWer:CCDFunction"	Statistics (CCDF)

The query returns a string indicating the set measurement mode.

Default setting: *"POWer:AVG"*

Short description of the measurement modes

Continuous Average

In this mode, the average power of the measurement signal is asynchronously measured within definable time intervals (sampling windows). The width of a sampling window is set with the *SENSe:POWer:AVG:APERture* command. The measurements are performed with chopper stabilization to obtain more accurate results with reduced noise and zero offset. Therefore, a measurement is always performed over two sampling windows, the polarity of the detector output signal being reversed for the second window. By taking the difference of the output signals, the influence of the video path on noise and zero drift is minimized.

When the averaging function is activated, the averaging factor determines how often the described measurement cycle is repeated.

A measurement should be started with the command *INITiate:IMMediate* (once) or *INITiate:CONTinuous:ON* (continuously), the trigger source being set to *Immediate* with the *TRIGger:SOURce* command (asynchronous measurement).

Burst Average

This mode is used to measure the average power of bursts. The time interval in which power is measured starts when the power exceeds the trigger level and stops when the trigger logic detects the end of the pulse. To prevent power drops due to modulation being erroneously interpreted as an end of a pulse, the user must define a dropout tolerance with the *SENSe:POWer:BURSt:DTOLerance* command.

When the averaging function is activated (*SENSe:AVERage:STATe ON*), and an averaging factor of two ore more has been chosen, measurements are performed with chopper stabilization to obtain more accurate results with reduced noise and zero offset. The same holds true for activated automatic averaging. Chopper stabilization involves that the polarity of the detector output signal is reversed from burst to burst. By taking the difference of the output signals, the effect of the video path on noise and zero drift is minimized.

In the Burst Average mode, only internal trigger events (from the signal) are evaluated, irrespective of the setting of the *TRIGger:SOURce* parameter. The *TRIGger:DELay* setting is also ignored so that the measurement interval starts the instant the signal crosses the trigger threshold. A measurement is initiated with the command *INITiate:IMMediate* (once, irrespective of the number of repetitions required for chopper stabilization and averaging) or *INITiate:CONTinuous:ON* (continuously).

Time intervals that are to be excluded from measurement can be set at the beginning and at the end of the measurement interval (see commands *SENSe:TIMing:EXCLude:STARt* and *SENSe:TIMing:EXCLude:STOP*).

Timeslot Average

The average power of a definable number of successive timeslots within a frame structure with equal spacing is measured. The width of one slot must be defined with *SENSe:POWer:TSLot:WIDTh*, the number of slots must be defined with *SENSe:POWer:TSLot:COUNt.* The limit is 16 for the R&S NRP-Z81 wideband power sensor. It is essential to define the *TRIGger:DELay* parameter to ensure that the beginning of the first slot to be measured coincides with the delayed trigger point. The measurement result is an array with the same number of elements as timeslots. Each element represents the average power in a particular timeslot.

When the averaging function is activated (*SENSe:AVERage:STATe ON*), and an averaging factor of two ore more has been chosen, measurements are performed with chopper stabilization to obtain more accurate results with reduced noise and zero offset. The same holds true for activated automatic averaging. Chopper stabilization involves that the polarity of the detector output signal is reversed from frame to frame. By taking the difference of the output signals, the effect of the video path on noise and zero drift is minimized.

Time intervals that are to be excluded from the measurement can be set at the beginning, in the middle and at the end of each timeslot (see commands *SENSe:TIMing:EXCLude:STARt, SENSe:POWer:TSLot[:AVG][:EXCLUDE]:MID* and *SENSe:TIMing:EXCLude:STOP*).

A measurement is initiated with the command *INITiate:IMMediate* (once, irrespective of the number of repetitions required for averaging) or *INITiate:CONTinuous:ON* (continuously). The trigger source must be set to *INTernal* or *EXTernal* with the *TRIGger:SOURce* command. After each occurrence of the trigger event, a measurement is performed in all timeslots. A trigger event must be available for each frame when averaging is being performed.

Trace (XTIMe:POWer)

In the Trace mode, the envelope power can be recorded as a function of time. This is done by sampling power over a time interval that can be specified by the user (*SENSe:TRACe:OFFSet:TIME* and *SENSe:TRACe:TIME* commands) and then assigning the power values that have been determined to a number of pixels that are largely user-selectable (S*ENSe:TRACe:POINts* command). The time interval represented by a pixel is obtained by dividing the trace length by N–1, where N is the number of pixels.

In the simplest case, each pixel is assigned a single sample value which fully characterizes it. If several sample values are assigned to a pixel, the following quantities can be determined for each time interval:

- Average power
- Maximum power
- Minimum power
- A randomly selected sample value

The *SENSe:AUXiliary* command is used to make the selection. Individual sample values cannot be accessed.

When the averaging function is deactivated (*SENSe:TRACe:AVERage:STATe OFF*) or an averaging factor of one has been selected, measurements are performed without chopper stabilization, i.e. a measurement consists of a single sampling sequence activated by a trigger event. Otherwise, the detector's output-voltage polarity is reversed automatically for alternate sampling sequences. This suppresses low-frequency noise and increases the accuracy with which the average power is measured at each pixel. Averaging has no effect on the randomly selected samples; the largest values for each averaging sequence are output as peak values.

In the *Trace* mode, the video bandwidth can be reduced step-by-step (*SENSe:BWIDth:VIDeo* command) to cut noise and increase trigger sensitivity.

Statistics (CCDF, PDF)

In both *Statistics* modes, either the complementary cumulative distribution function (*CCDF*) or the probability density function (*PDF*) of the envelope power can be measured The following measurement parameters can be set:

- Start of analysis window (*STATistics:OFFSet:TIME* command)
- Length of analysis window (*STATistics:TIME* command)
- Exclusion period within analysis window (*STATistics[:EXCLude]:MID* command group)
- Number of analysis window repetitions (*SENSe:TRACe:AVERage:COUNt* command)
- Video bandwidth (*SENSe:BWIDth:VIDeo* command group)

Statistical analysis can either be triggered by a signal (*TRIGger:SOURce INTernal | EXTernal* command) or is performed continuously (*TRIGger:SOURce IMMediate* command). In the first case, analysis is synchronized to the signal characteristic, but not in the second case, i.e. a sequence of analysis windows is used. Analysis is terminated when the specified number of repetitions has been reached. Statistical analysis can be performed only when chopper stabilization is deactivated.

The sample size, i.e. the number of samples analyzed, equals the product of the analysis-window length, the number of repetitions and the sampling rate. In turn, the sampling rate is a function of the video bandwidth that has been set (*SENSe:BWIDth:VIDeo* command).

Before the analysis result can be output, the user must specify a level range and its resolution in pixels. For each pixel, either the value of the complementary cumulative distribution function or the value of the probability density function (in W^{-1}) is output. The following output parameters can be set:

- Lower limit of level range in dBm (*STATistics:SCALe:X:RLEVel* command)
- Width of level range in dB (*STATistics:SCALe:X:RANGe* command)
- Resolution in pixels (*STATistics:SCALe:X:POINts* command)

The size of the level interval represented by each pixel is determined by dividing the width of the level range by the number of pixels minus one. The smallest possible interval size for the R&S NRP-Z81 power sensor is specified as 0.006 dB. It can be queried with the *SENSe:STATistics:SCALe:X :MPWidth?* command.

SENSe:POWer:AVG:APERture[?] 1.0e-6 … 0.1

SENSe:POWer:AVG:APERture defines the length of the time interval used to measure the average signal power in the *Continuous Average* mode (sampling window). For an unmodulated signal, the default setting of 10 µs in conjunction with chopper stabilization provides optimum noise suppression. For a specified measurement-result noise-content, the minimum measurement time can therefore be obtained with this setting. Due to the narrow sampling window, averaging factors up to 2^{20} may be required at the lower end of the measurement range (–60 dBm).

Wider sampling windows are required when the measurement result exhibits variations due to modulation. In this case, it is beneficial to set the sampling-window length so that it is exactly equal to the modulation period; this provides a display with optimum stability. If the modulation period varies, or is not exactly known, smoothing (see command group *SENSe:POWer:AVG:SMOothing*) should also be activated. Approx. five periods within one sampling window are sufficient to reduce variations due to modulation to an acceptable level; variations with more than nine periods are no longer perceptible. With smoothing deactivated, the situation is significantly worse. In this case, 300 periods instead of five are required and variations completely disappear with 3000 or more periods.

The query returns the currently set length of the sampling window in seconds.

Default setting: 10.0e-6 *[s]*

SENSe:POWer:AVG:BUFFer:SIZE[?] 1 to 8192

SENSe:POWer:AVG:BUFFer:SIZE sets the buffer size for the buffered *Continuous Average* mode.

The query returns the current buffer size for the buffered *Continuous Average* mode.

Default setting: *1*

SENSe:POWer:AVG:BUFFer:STATe[?] OFF | ON

The buffered *Continuous Average* mode is activated with *ON* and deactivated with *OFF*. In the buffered mode, measurement results generated by trigger events are buffered in the sensor until the buffer is full. All results are then transferred as block data. The effective measurement rate obtained is thus higher than in the non-buffered *Continuous Average* mode. The maximum measurement rate is obtained by combining the buffered mode with multiple triggering (see parameter *TRIGger:COUNt*). The size of the result buffer is set with the *SENSe:POWer:AVG:BUFFer:SIZE* command.

The query returns
- *1* for *OFF*
- *2* for *ON*

Default setting: *OFF*

SENSe:POWer:AVG:SMOothing:STATe[?] OFF | ON

The *ON* parameter activates a smoothing filter for modulated signals in the *Continuous Average* mode and *OFF* deactivates it. The smoothing filter is a steep-slope digital lowpass filter used to suppress result variations due to modulation. This parameter should be activated to reduce result variations due to modulation when the size of the sampling window cannot, or should not, be set to exactly equal the modulation period. If the selected sampling window is 5 to 9 times larger than a modulation period, the display variations are usually sufficiently reduced. With smoothing deactivated, 300 to 3000 periods are required to obtain the same effect.

When smoothing is deactivated, the sampling values are considered to be equivalent and averaged in a sampling window, which means that the measuring instrument acts as an integrator. As described above, optimum suppression of result variations is obtained when the size of the sampling window exactly equals the modulation period. Otherwise, modulation can have a considerable influence, even if

the sampling window is much larger than the modulation period. The response can be considerably improved by weighting samples (raised von Hann window), which is equivalent to video filtering. This is exactly what happens when smoothing is activated.

Since the smoothing filter increases the inherent noise of the sensor by approx. 20%, it should always be deactivated if not required.

The query returns
- *1* for *OFF*
- *2* for *ON*

Default setting: *ON*

SENSe:POWer:BURSt:DTOLerance[?] 0.0 to 0.3

SENSe:POWer:BURSt:DTOLerance defines the dropout tolerance, a parameter for reliably detecting the end of the burst in the *Burst Average* mode when signals are modulated (e. g. with digital standards NADC, PDC, PHS, etc). The dropout tolerance should be selected to be larger than the greatest amplitude drop and smaller than the gap between two consecutive bursts. The default value is sufficient for all common digital communications standards.

The query returns the dropout tolerance for the *Burst Average* mode.

Default setting: 1.0e-6 *[s]*

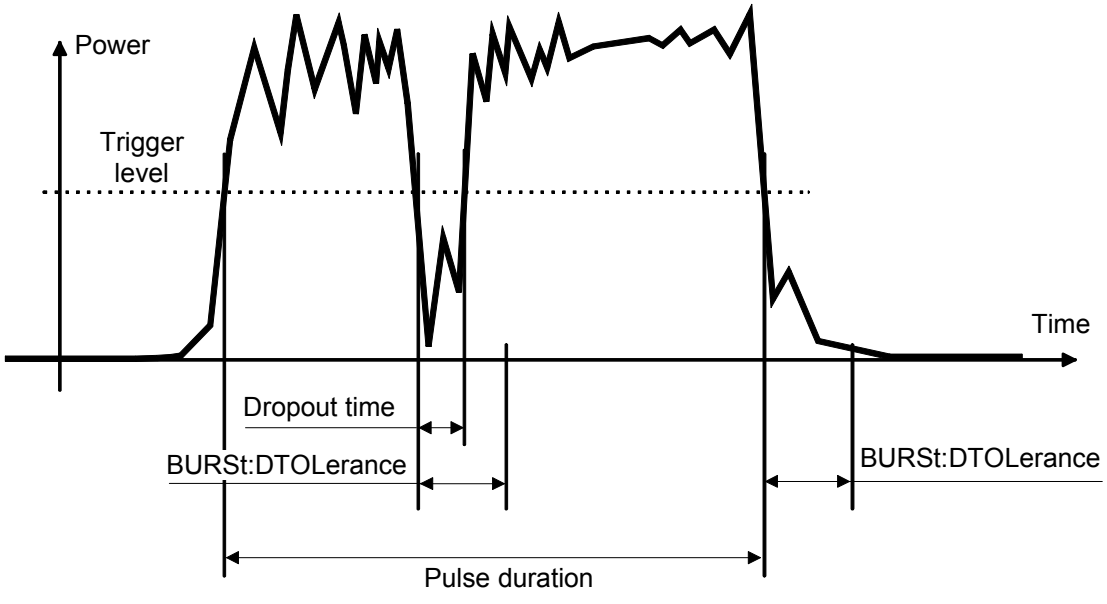

Fig. 6-1 Effect of SENSe:POWer:BURSt:DTOLerance

SENSe:POWer:TSLot[:AVG]:COUNt[?] 1 to 16

For the *Timeslot Average* mode, *SENSe:POWer:TSLot:AVG:COUNt* sets the number of consecutive timeslots that are to be processed after each trigger event.

The query returns the number of consecutive timeslots.

Default setting: *1*

SENSe:POWer:TSLot[:AVG][:EXCLude]:MID:OFFSet[:TIME][?] 0.0 to 0.1

In the *Timeslot Average* mode, *SENSe:POWer:TSLot[:AVG][:EXCLude]:MID:OFFSet[:TIME]* is used to set the start of an exclusion interval in a timeslot. In conjunction with the command *SENSe:POWer:TSLot[:AVG][:EXCLude]:MID:TIME,* it is possible to exclude, for example, a midamble from the measurement. The start of the timeslot is used as the reference point for defining the start of the exclusion interval and this applies to each of the timeslots. In Fig. 6-2, this parameter is designated as T_{OFFSET}.

If the specified value is greater than the length of a timeslot, it is ignored. No error message is output.

The query command returns the start of the exclusion interval in a timeslot in seconds.

Default setting: *0 [s]*

SENSe:POWer:TSLot[:AVG][:EXCLude]:MID:TIME[?] 0.0 to 0.1

In the *Timeslot Average* mode, *SENSe:POWer:TSLot[:AVG][:EXCLude]:MID:TIME* is used to specify the length of an exclusion interval in a timeslot. In conjunction with the command *SENSe:POWer:TSLot[:AVG][:EXCLude]:MID:OFFSET[:TIME],* it can be used, for example, to exclude a midamble from the measurement. The parameter applies to each individual timeslot. In Fig. 6-2, this parameter is designated as T_{LENGTH}.

Even if the exclusion interval exceeds the timeslot because, for example, its right limit is outside the timeslot, correct results are obtained. In the extreme case, where the interval length has been set to a value greater than the timeslot length, 0 W is output as the measured power. No error message is output.

The query command returns the length of the exclusion interval in seconds in a timeslot.

Default setting: *0 [s]*

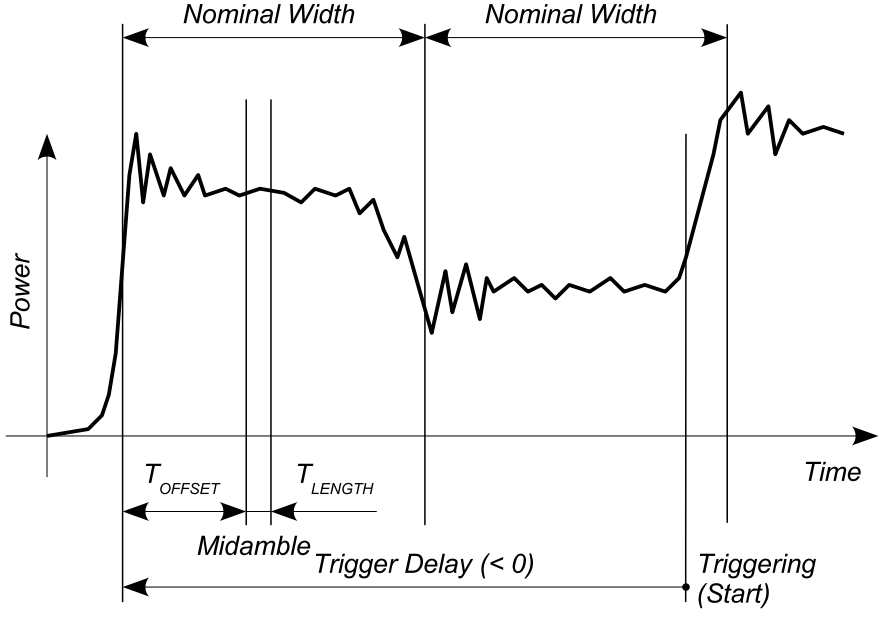

Fig. 6-2 Effect of an exclusion interval in the Timeslot mode

SENSe:POWer:TSLot[:AVG]:WIDTh[?] 50e-9 to 0.1

SENSe:POWer:TSLot[:AVG]:WIDTh sets the length of a timeslot for the *Timeslot Average* mode.

The query returns the length of a timeslot in seconds.

Default setting: *0.0001 [s]*

SENSe:SGAMma:CORRection:STATe[?] OFF | ON

SENSe:SGAMma:CORRection:STATe ON activates the complex reflection coefficient of the source defined with *SENSe:SGAMma:MAGNitude* and *SENSe:SGAMma:PHASe* to correct interactions between the source and the input of the power sensor. The input is either defined by the sensor itself or by any device ahead of the sensor that has been activated by *SENSe:CORRection:SPDevice:STATe ON*. This compensates for mismatch which often makes a major contribution to measurement uncertainty.

The query returns
- *1* for *OFF*
- *2* for *ON*

Default setting: *OFF*

SENSe:SGAMma:MAGNitude[?] 0.0 to 1.0

SENSe:SGAMma:MAGNitude defines the magnitude of the complex reflection coefficient of the source. A value of *0.0* corresponds to an ideal matched source and a value of 1.0 to total reflection.

The query returns the set magnitude.

Default setting: *0.0*

SENSe:SGAMma:PHASe[?] –360.0 to 360.0

SENSe:SGAMma:MAGNitude defines the phase angle (in degrees) of the complex reflection coefficient of the source.

The query returns the set phase angle.

Default setting: *0.0 [°]*

SENSe:STATistics[:EXCLude]:MID:OFFSet[:TIME][?] 0.0 to 0.3

For both *Statistics* modes, this command is used to specify the start of an exclusion interval in the analysis window. The start time is referenced to the start of the analysis window. All other details are the same as for the *Timeslot Average* mode
(see *SENSe:POWer:TSLot[:AVG][:EXCLude]:MID:OFFSet[:TIME][?]* command)**.**

Default setting: *0 [s]*

SENSe:STATistics[:EXCLude]:MID:TIME[?] 0.0 to 0.3

For both *Statistics* modes, this command is used to specify the length of an exclusion interval in the analysis window. All other details are the same as for the *Timeslot Average* mode
(see *SENSe:POWer:TSLot[:AVG][:EXCLude]:MID:TIME][?]* command*).*

Default setting: *0 [s]*

SENSe:STATistics:OFFSet:TIME[?] 0.0 to 10.0

In both *Statistics* modes, *SENSe:STATistics:OFFSet:TIME* is used to specify the start of the analysis window for recording measured values. The start time is referenced to the delayed trigger point (*TRIGger:DELay* command). Only positive values are valid. If the analysis window starts before the physical trigger point, the trigger delay must be set to a negative value with a suitably large magnitude (minimum magnitude -51.2 µs).

The query command returns the set time in seconds.

Default setting: *0.0 [s]*

SENSe:STATistics:SCALe:X:MPWidth?

In both *Statistics* modes, this command is used to query the greatest attainable level resolution. For the R&S NRP-Z81 power sensor, this value is fixed at 0.006 dB per pixel. If this value is exceeded, a "Settings conflict" message is output. The reason for the conflict may be that the number of pixels that has been selected is too great or that the width chosen for the level range is too small (*SENSe:STATistics:SCALe:X:POINts* und *SENSe:STATistics:SCALe:X:RANGe* commands).

SENSe:STATistics:SCALe:X:POINts[?] 3 to 8192

SENSe:STATistics:SCALe:X:POINts is used to set the measurement-result resolution in both *Statistics* modes. This command specifies the number of pixels that are to be assigned to the logarithmic level range (*SENSe:STATistics:SCALe:X:RANGe* command) for measured value output. The width of the level range divided by N–1, where N is the number of pixels, must not be less than the value which can be read out with *SENSe:STATistics:SCALe:X:MPWidth?*.

The query command returns the number of pixels for both *Statistics* modes.

Default setting: *200*

SENSe:STATistics:SCALe:X:RANGe[?] 0.01 to 100

SENSe:STATistics:SCALe:X:RANGe is used to specify the width of the level range for the analysis result in both *Statistics* modes.

The query returns the set level range in dB.

Default setting: *50 [dB]*

SENSe:STATistics:SCALe:X:RLEVel[?] –80 to +20

SENSe:STATistics:SCALe:X:RLEVel is used to define the lower limit of the level range for the analysis result in both *Statistics* modes. This level can be assigned to the first pixel. The level assigned to the last pixel is equal to the level of the first pixel plus the level range.

The query returns the lower limit of the level range for the *Statistics* modes.

Default setting: *–30 [dBm]*

SENSe:STATistics:TIME[?] 10.0e-6 to 0.3

SENSe:STATistics:TIME is used to set the duration of the analysis window for both *Statistics* modes.

The query command returns the time-window duration in seconds.

Default setting: *0.01 [s]*

SENSe:TIMing:EXCLude:STARt[?] 0.0 to 10

SENSe:TIMing:EXClude:STARt defines an exclusion time at the beginning of the measurement window in the *Burst Average* and *Timeslot Average* modes. It is referred to as "T_{START}" in Fig. 6-3 and Fig. 6-4.

The query returns the exclusion time at the beginning of the measurement window.

Default setting: *0.0 [s]*

SENSe:TIMing:EXCLude:STOP[?] 0.0 to 51.2e-6

SENSe:TIMing:EXClude:STOP defines an exclusion time at the end of the measurement window in the *Burst Average* (Fig. 6-3) and *Timeslot Average* (Fig. 6-4) modes. It is referred to as "T_{STOP}" in Fig. 6-3 and Fig. 6-4.

The query returns the exclusion time at the end of the measurement window.

Default setting: *0.0 [s]*

If the exclusion times defined with EXCLude:STARt and EXCLude:STOP overlap, a "Settings conflict" message is output.

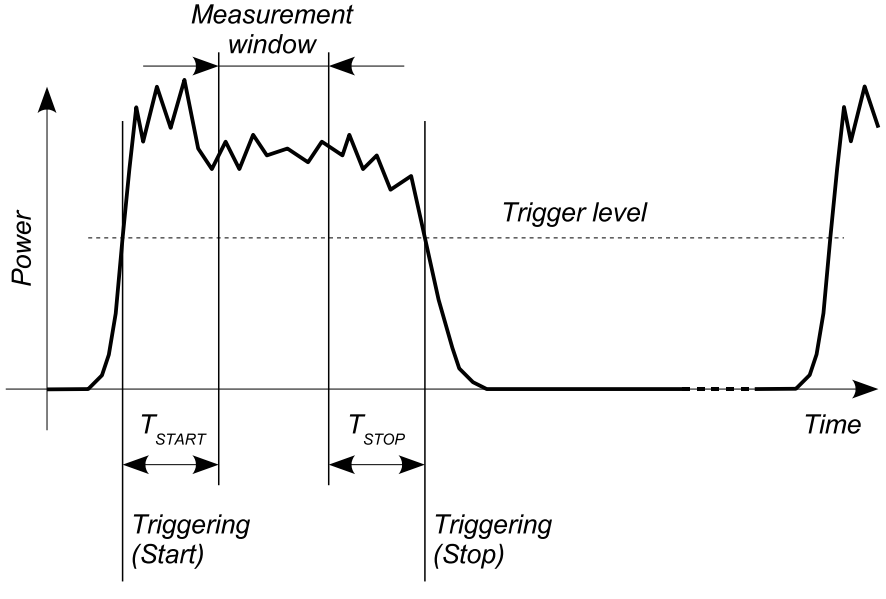

Fig. 6-3 Effect of *SENSe:TIMing:EXCLude:STARt* and *:STOP* in the *Burst Average* mode

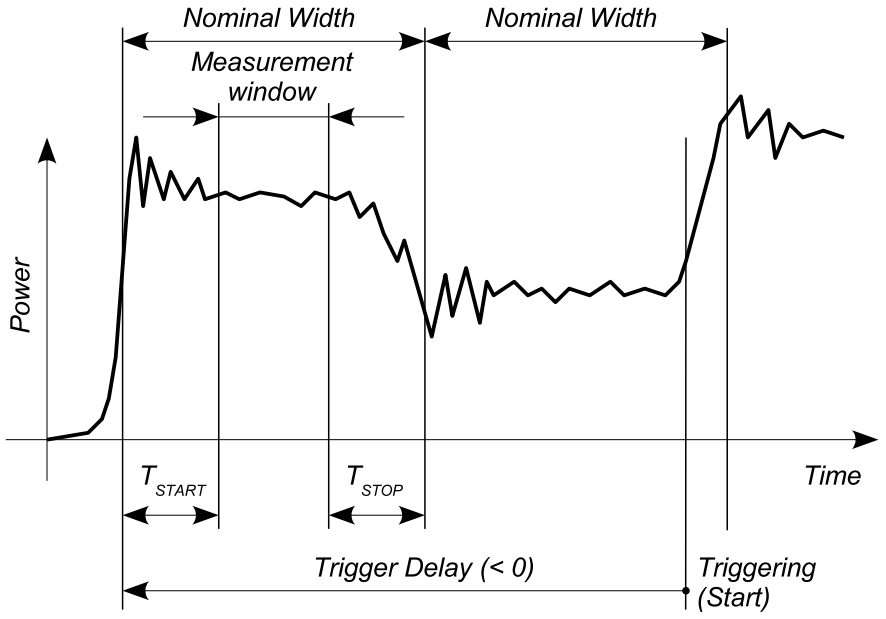

Fig. 6-4 Effect of *SENSe:TIMing:EXCLude:STARt* and *:STOP* in the *Timeslot* mode

SENSe:TRACe:AVERage:COUNt[?] 1 to 65536

SENSe:TRACe:AVERage:COUNt is used to set the averaging factor, i. e. the number of traces to be evaluated in the *Trace* mode and the number of timegates to be analyzed in the *Statistics* modes. In the *Trace* mode, the type of evaluation depends on the measurement result required for a pixel (*SENSe:AUXiliary* command):

Average power: The power values of identical measurement points, i.e. points at the same distance from the trigger point, are averaged. This reduces noise, the noise reduction being proportional to the square root of the averaging factor.

Max./min. values: The maximum and minimum of all samples taken at identical measurement points, i.e. points at the same distance from the trigger point, are found and output.

Random values: The random values are obtained from the first measurement cycle. Repetition of the measurement cycle has no effect on the result.

In the *Statistics* modes, the averaging factor is used to define sample size. For example, a sample size of 10^6 is required and the analysis window has a length of 100 µs. If the sampling rate is 80 Msamples/s, at least 125 analysis windows will be required. As the averaging factor can only be set in powers of two on the sensors, 128 should be chosen.

The general rule is: The higher the averaging factor, the less the fluctuations in the measured values (with the exception of the random samples in the *Trace* mode) and the longer the total measurement time.

The averaging factor set by this command is rounded to the nearest power-of-two by the sensor.

The query returns the averaging factor set by the sensor

Averaging factors greater than one must be activated with the SENSe:TRACe:AVERage:STATe ON command.

Default setting: *1*

SENSe:TRACe:AVERage:STATe[?] OFF | ON

SENSe:TRACe:AVERage:STATe ON enables evaluation of several traces in the *Trace* mode or of several windows in the *Statistics* modes. The number of traces / windows (*averaging factor*) is defined by the *SENSe:TRACe:AVERage:COUNt* command.

The query returns
- *1* for *OFF*
- *2* for *ON*

Default setting: *ON*

SENSe:TRACe:AVERage:TCONtrol[?] MOVing | REPeat

SENSe:TRACe:AVERage:TCONtrol (terminal control) defines how the measurement results are to be output in the *Trace* or *Statistics* modes if an averaging factor greater than one has been activated.

The *REPeat* parameter specifies that a measurement result is output only after the whole measurement has been completed. This means that the number of measurement cycle repetitions is equal to the set averaging factor. If the averaging factor is large, the measurement time can be very long.

When settings are made with the *MOVing* parameter, intermediate values are output to facilitate early detection of changes in the measured quantity. In the settled state - i.e. the number of measurements specified by the averaging factor has been carried out - a moving average is output in the *Trace* mode. In the *Statistics* modes, every measurement output is based on a sample size that has been previously defined. The *SYStem:RUTime* command can be used to vary the output rate over a wide range so that some intermediate results can be ignored.

The query returns
- *1* for *MOVing*
- *2* for *REPeat*

Default setting: *REPeat*

SENSe:TRACe:MPWidth?

This query returns the sampling interval for the *Trace* mode and the *Statistics* modes. It is equal to the reciprocal of the sampling rate and determines the effective time resolution when the measurement signal is sampled. The sampling rate and the sampling interval change when the video-bandwidth setting is changed (*SENSe:BWIDth:VIDeo* command).

SENSe:TRACe:OFFSet:TIME[?] –x to 10.0

SENSe:TRACe:OFFSet:TIME is used to specify the start of recording for the *Trace* mode. It is identical with the first pixel. The time associated with the last pixel is the time associated with the first pixel plus the trace length. The start of recording is referenced to the delayed trigger point (settable with the *TRIGger:DELay* command). Negative values indicate that the start of recording occurs before the delayed trigger point.

Due to the hardware limitations of the R&S NRP-Z81 power sensor, the recording cannot start at any point in time before the physical trigger event, i. e. the sum of the parameters *TRIGger:DELay* and *SENSe:TRACe:OFFSet:TIME* must be limited at the negative end. This limit corresponds to a length of 4096 pixels – in other words, it depends on the trace length and the number of points. Therefore, x may not exceed the following limit:

$$-x/s \le -\left[Trigger\,delay/s + 4096 \times \frac{\text{Trace length/s}}{\text{Number of points}} \right]$$

Example: The trace length is 10 µs for 200 points, the trigger delay being set to -5 µs. This means that the start of recording can be set to occur max. 199.8 µs before the delayed trigger point.
The formula above is exact only when the trace length and the number of points used to measure the signal can be queried with the *SENSe:TRACe:TIME:FPGA?* and *SENSe:TRACe:POINTs:FPGA?* commands. They always differ to some extent from the values obtained from the commands *SENSe:TRACe:TIME* and *SENSe:TRACe:POINTs*.

The query command returns the start of recording in seconds, referenced to the delayed trigger.

Default setting: *0.0 [s]*

SENSe:TRACe:POINts[?] 3 to 8192

This command defines the time resolution for the measurement result in the *Trace* mode. Each point represents a time interval whose length is equal to the trace length (command *SENSe:TRACe:TIME*) divided by N-1, where N is the number of points. If this time interval is not an integer multiple of the sampling interval used internally by the sensor (*SENSe:TRACe:MPWidth?* query command), or is less than the internal sampling interval, all output values are obtained by linear interpolation, i.e. they are not based on an actual measurement. This processing step is performed automatically so that measurement result output can be defined without taking internal signal processing into account. All the same, this step is time-consuming and time resolution is not increased as a result.

Measurement times can always be minimized if the trace length and the number of points for the measurement result are chosen to match the internal values. The trace length and the number of points for the measurement result must first be set with the commands *SENSe:TRACe:TIME* and *SENSe:TRACe:POINTs*. The query commands *SENSe:TRACe:TIMe:FPGA?* and *SENSe:TRACe:POINts:FPGA?* are then used to obtain the values used internally so that the input values can be corrected accordingly.

The measurement result for a point comprises the average power plus max and min power or a random power sample, if selected with the command *SENSe:AUXiliary*.

The query returns the number of set points.

Default setting: *200*

SENSe:TRACe:POINts:FPGA?

SENSe:TRACe:POINts:FPGA? can be used to query the number of points for the *Trace* mode used internally by the signal processing FPGA.

SENSe:TRACe:TIME[?] 50e-9 to 1

SENSe:TRACe:TIME sets the (trace length in the *Trace* mode.

The query returns the set time (in seconds).

Default setting: *0.01 [s]*

SENSe:TRACe:TIME:FPGA?

SENSe:TRACe:TIME:FPGA? can be used to query the trace length for the *Trace* mode used internally by the signal processing FPGA.

SYSTem

SYSTem commands can be used to define and query administrative device settings. This includes detailed information about the sensor and its initialization and the transfer of available commands and their parameter limits.

Table 6-5 *SYSTem* command group

Command	Parameter	Unit	Remarks
SYSTem			
:INFO? [Item]			Query only
:INITialize			No query
:MINPower?		W	Query only
:RUTime	0.001 to 10.0	s	
:SUTime	0.001 to 10.0	s	
:TRANsaction			
:BEGin			No query
:END			No query

SYSTem:INFO? [Item]

SYSTem:INFO? returns a string containing information that is more detailed than the identification string output by the sensor in response to **IDN?*. If no *Item* is specified, the response string is a sequence with the format *Item:Information string* separated by *CR* and *LF* (in C notation: *\r\n*). The information associated with a particular item can be obtained by appending the appropriate *Item* option. The response string is zero-terminated, i.e. its end identifier is a zero byte (in C notation: *\0*).

Table 6-6 Meaning of *Item* in the *SYSTem:INFO?* command

Item	Information string	Remarks
"MANUFACTURER"	"Rohde & Schwarz GmbH & Co. KG"	Manufacturer
"TYPE"	"NRP-Z81"	Type designation
"STOCK NUMBER"	"1137.9009.02"	Material number
"SERIAL"	"<serial number>"	6-digit serial number
"HWVERSION"	"000000000"	Hardware version (standard)

Item	Information string	Remarks
"HWVARIANT"	"000000000"	Hardware model (standard)
"SW BUILD"	"<build number>"	Version number of sensor firmware
"FPGA BUILD"	"<build number>"	Version number of FPGA firmware
"TECHNOLOGY"	"Diode"	Detector technology used
"FUNCTION"	"Power Terminating"	The R&S NRP-Z81 is a terminating power sensor.
"MINPOWER"	"<nominal lower test limit in W>"	The nominal lower test limit of the R&S NRP-Z81 is 1 nW, i.e. with S-parameter correction deactivated, the sensor returns the information string "1e-09" in response to *SYSTem:INFo? "MINPOWER"*. With S-parameter correction activated, the information string depends on the nominal lower limit of the sensor/twoport combination.
"MAXPOWER"	"<nominal upper test limit in W>"	The nominal upper test limit of the R&S NRP-Z81 is 100 mW, i.e. with S-parameter correction deactivated, the sensor returns the information string "0.1" in response to *SYSTem:INFo? "MAXPOWER"*. With S-parameter correction activated, the information string depends on the nominal upper limit of the sensor/twoport combination.
"MINFREQ"	"5e+07"	The minimum measurement frequency of the R&S NRP-Z81 is 50 MHz.
"MAXFREQ"	"1.8e+10"	The maximum measurement frequency of the R&S NRP-Z81 is 18 GHz.
"RESOLUTION"	“12.5ns”	The maximum time resolution in the Trace mode is 12.5 ns.
"IMPEDANCE"	"50"	The R&S NRP-Z81 RF input has a nominal input impedance of 50 Ω.
"COUPLING"	"AC"	The RF input of the R&S NRP-Z81 is AC-coupled.
"CAL. ABS."	"<date>"	Date of absolute calibration in the format YYYY-MM-DD. "Invalid Calibration Date" is returned if an invalid date is entered.
"CAL. REFL."	"<date>"	Date of reflection-coefficient calibration in the format YYYY-MM-DD. "Invalid Calibration Date" is returned if an invalid date is entered.
"CAL. S PARA."	"<date>"	Date of S-parameter calibration in the format YYYY-MM-DD. If no S-parameter set is loaded, the sensor returns the string "not applicable". "Invalid Calibration Date" is returned if an invalid date is entered.
"CAL. MISC."	"<date>"	Date of calibration of other parameters in the format YYYY-MM-DD. "Invalid Calibration Date" is returned if an invalid date is entered.
"CAL. TEMP."	"<date>"	Date of detector characterization in the format YYYY-MM-DD. "Invalid Calibration Date" is returned if an invalid date is entered.
"CAL. LIN."	"<date>"	Date of linearity calibration in the format YYYY-MM-DD. "Invalid Calibration Date" is returned if an invalid date is entered.
"SPD MNEMONIC"	"<mnemonic string>"	Clear-text designation of the components connected ahead of the sensor.

SYSTem:INITialize

SYSTem:INITialize sets the sensor to the standard state, i.e. the loading of default settings for all test parameters is the same as that for **RST*. The sensor then outputs a complete list of all supported commands and parameters. The command can be used to automatically adapt the remote-control software to the features of different types of sensor with different functionalities.

SYSTem:MINPower?

SYSTem:MINPower? returns the lower test limit of the sensor, or of the sensor and the components connected ahead of it, if the *SENSe:CORRection:SPDevice* parameter has the value *ON*. This query can be used to determine an effective resolution for the result display near the lower test limit.

SYSTem:RUTime 0.001 to 10.0

This command is used to limit the output rate when measurements are performed with continuous result output (setting *INITiate:CONTinuous ON*). This is useful if the measurement time is very short or if measurements are made with intermediate result output (*SENSe:AVERage:TCONtrol MOVing* or *SENSe:TRACe:AVERage:TCONtrol MOVing* command). If this limit is not set, the controlling host becomes overloaded very quickly or overly occupied with handling the output of measured values.

The parameter in the *SYSTem:RUTime* command is chosen to equal the required minimum interval between two consecutive measured value outputs. This equals the reciprocal of the output rate. If a measurement is known to take a long time, the output rate is cut accordingly.

SYSTem:SUTime 0.001 to 10.0

This command is used to reduce the frequency of the messages that are output when the sensor changes state from *WAIT_FOR_TRIGGER to MEASURING*.

Usually, the control unit is informed about this change of state. However, if measurement times are very short and/or trigger events occur very frequently, the data flows on the remote control connection can be very heavy and the control unit (or host) may not be able to handle them. The parameter *SUTime* can be used to define how long the power sensor shall remain in the *WAIT_FOR_TRIGGER* state without the associated status message being output.

Usually, *SUTime* is set to a value that is slightly less than the response time of the control system. This means that trigger events that have not occurred can still be detected in good time. At high trigger frequencies, this means that only the first transition to the *WAIT_FOR_TRIGGER* state and the subsequent transition into the *MEASURING* state are indicated by messages after the measurement is started. The next message will only indicate the return to the IDLE state on completion of the measurement.

SYSTem:TRANsaction:BEGin

SYSTEM:TRANsaction:BEGin marks the beginning of a sequence of setting commands whose parameter limits do not have to be checked. This prevents error messages from being displayed when a setting command causes a conflict that is resolved by a subsequent setting command. See *SYSTEM:TRANsaction:END*.

SYSTem:TRANsaction:END

SYSTEM:TRANsaction:END marks the end of a sequence of setting commands whose parameter limits do not have to be checked. This command reactivates parameter limit checks.

TEST

Table 6-7 T*EST* command group

Command	Parameter	Unit	Remarks
TEST:SENSor?			Query only

TEST:SENSor?

TEST:SENSor? triggers a sensor selftest. Unlike **TST*, this command returns detailed information which is useful for troubleshooting.

No signal may be applied to the sensor while the selftest is running.

If the selftest is carried out with a signal connected, error messages may erroneously be output for the test steps "Offset Voltages" and/or "Noise Voltage".

TRIGger

Table 6-8 *TRIGger* command group

Command	Parameter	Unit	Remarks
ABORt			No query
INITiate			
:CONTinuous[?]	OFF | ON		
:IMMediate			No query
TRIGger			
:ALEVel:STATe[?]	OFF | ON		
:ATRigger:STATe[?]	OFF | ON		
:COUNt[?]	1 to 2×10^9		
:DELay[?]	–51.2e-6 to 10.0	s	
:DTIMe[?]	0.0 to 10.0	s	
:HOLDoff[?]	0.0 to 10.0	s	
:HYSTeresis[?]	0.0 to 10.0	dB	
:IMMediate			No query
:LEVel[?]	1.0e-6 to 0.1	W	
:MASTer:STATe[?]	OFF | ON		
:SLOPe[?]	POSitive | NEGative		
:SOURce[?]	HOLD | IMMediate | INTernal | BUS | EXTernal		
:SYNChronisation:STATe[?]	OFF | ON		

ABORt

ABORt interrupts the current measurement and sets the sensor to the *IDLE* state (normal case). However, if the sensor is in the continuous measurement mode (setting *INITiate:CONTinuous ON*), the *IDLE* state is immediately exited and the sensor enters the *WAIT_FOR_TRIGGER* state.

INITiate:CONTinuous[?] OFF | ON

INITiate:CONTinuous ON activates the continuous measurement mode. In this mode, a new measurement cycle is automatically started after the preceding one has been terminated. The sensor first enters the *WAIT_FOR_TRIGGER* state and begins the measurement as soon as the trigger condition is fulfilled. Depending on the number of trigger events that are required, e.g. for averaging, the *WAIT_FOR_TRIGGER* state can be entered several times. Once the whole measurement cycle is

completed, a measurement result is available and the sensor enters the *WAIT_FOR_TRIGGER* state again. The sensor will continue measuring if there are continuous trigger events.

If the continuous measurement mode is switched off by means of the *INITiate:CONTinuous OFF* command, single measurements can be started with the *INITiate:IMMediate* command (see below).

The query returns
- *1* for *OFF*
- *2* for *ON*

Default setting: *OFF*

INITiate:IMMediate

INITiate:IMMediate starts a single measurement cycle. The sensor first changes from the *IDLE* state to the *WAIT_FOR_TRIGGER* state and begins the measurement as soon as the trigger condition is fulfilled. Depending on the number of trigger events that are required, e.g. for averaging, the *WAIT_FOR_TRIGGER* state can be entered several times. Once the whole measurement is completed, a measurement result is available and the sensor enters the *IDLE* state again. The *INITiate :IMMediate* command should only be used after the continuous measurement mode has been switched off with the *INITiate:CONTinuous OFF* command.

TRIGger:ALEVel:STATe[?] OFF | ON

In the *Trace* mode, *TRIGger:ALEVel:STATe ON* activates the automatic setting of the trigger threshold for internal triggering (*TRIGger:SOURce INTernal*). This involves determining the smallest and the largest sample value within the trace length and setting the trigger threshold so that it lies exactly at the midpoint between these two values. If there are no trigger events for more than 0.3 seconds, an automatic search phase lasting 1 second is activated and then the trigger threshold is reset.

TRIGger:ALEVel:STATe OFF is used to reactivate the trigger threshold defined with the *TRIGger:LEVel* command.

The query command returns
- *1* for *OFF*
- *2* for *ON*

Default setting: *OFF*

TRIGger:ATRigger:STATe[?] OFF | ON

TRIGger:ATRigger:STATe ON generates an artificial trigger if more than 300 ms have elapsed after the start of measurement and no trigger event has been recorded. The command is only evaluated in the *Trace* mode and, irrespective of the set averaging factor, only one trace will be recorded. *TRIGger:ATRigger:STATe OFF* deactivates the automatic trigger function.

The query returns
- *1* for *OFF*
- *2* for *ON*

Default setting: *OFF*

TRIGger:COUNt[?] 1 to 2×10^9

This setting is designed for applications where several consecutive measurements are performed by sending the *INITiate:IMMediate* command only once, e.g. to obtain higher measurement speed. The gap between a single measurement and the continuous measurement mode is thus closed. The number of measurements is defined by the parameter associated with the *TRIGger:COUNt* command. This number equals the number of results obtained by the sensor at the end of the measurement. One result may contain several numerical values, e.g. power values for the trace points.

The TRIGger:COUNt command does not define the number of trigger events required to perform the entire measurement task. This number is either identical or an integer multiple if averaging has been activated.

A further increase in the measurement speed can be obtained by entering the buffered mode as well (see command group SENSe:POWer:AVG:BUFFer). In this mode, the results are not made available immediately, but as a block at the end of the measurement cycle.

The query returns the number of measurements to be performed after a measurement is started with the *INIT:IMMediate* command.

Default setting: *1*

TRIGger:DELay[?] –x to 10.0

This command is used to set a trigger delay for all measurements in sync with the signal except in the *Burst Average* mode. It provides a time offset to the physical trigger event equal to the entered value. The trigger can thus be shifted to a point in time of the measurement signal that is significant for the measurement, for example to the start of the first timeslot for the *Timeslot Average* mode. If external triggering is used, delay differences between the external trigger signal and the measurement signal can be compensated for with a trigger delay.

It is possible to set negative trigger delays, i.e. the trigger point can occur before the physical trigger event. No matter which measurement mode is selected, the negative limit is –51.2 µs. If the trigger delay is entered in the *Trace* mode, an additional condition must be met: the sum of the start of recording and the trigger delay must not exceed the length of –4096 pixels (see notes on the *SENSe.TRACe:OFFSet:TIME* command). If full use is to be made of this value, it depends on the order in which the trigger delay and the start of recording are entered whether a trigger delay down to –51.2 µs can be set. When a different measurement mode is selected, the full –51.2 µs become immediately available again. When switching (back) to the *Trace* mode, the trigger delay that has been set is retained and, if there is a conflict, the start of recording is adjusted automatically.

In the *Timeslot Average* mode, the time resolution of the trigger delay is always 12.5 ns; in the *Statistics* modes, it depends on the video bandwidth (see the *SENSe:BWIDth:VIDeo* command). In the *Trace* mode, it equals the length of a pixel as used for internal signal processing (see the *SENSe:TRACe:TIME:FPGA?* and *SENSe:TRACe:POINts:FPGA?* query commands).

Any trigger delay that is set comes into effect irrespective of the defined trigger source, but this is only useful with the *Internal a*nd *External* settings.

Default setting: *0.0 [s]*

TRIGger:DTIME[?] 0.0 to 10.0

TRIGger:DTIMe is used to set the dropout time in seconds. With a positive (negative) trigger slope, the dropout time is the minimum time for which the signal must be below (above) the power level defined by *TRIGger:LEVel* and *TRIGger:HYSTeresis* before triggering can occur again. As with the *Holdoff* parameter, unwanted trigger events can be excluded. The set dropout time only affects the *INTernal* trigger source.

The *dropout time* parameter is useful when dealing with, for example, GSM signals with several active slots (Fig. 6-5). When performing a measurement in sync with the signal, a trigger event is to be produced at A, but not at B or C. As the RF power between the slots is below the threshold defined by *TRIGger:LEVel* and *TRIGger:HYSTeresis*, the trigger hysteresis alone cannot prevent triggering at B or at C. This is why the *dropout time* parameter is selected to be greater than the time elapsed between points E and B and between F and C, but less than the time elapsed between G and A. This ensures that triggering will take place at A.

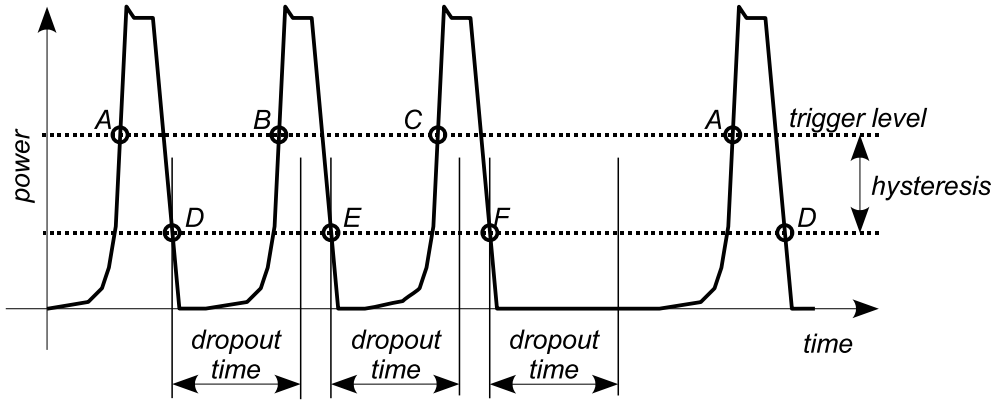

Fig. 6-5 Effect of the *dropout time* parameter

As the mechanism associated with the *dropout time* parameter is reactivated whenever the trigger threshold is crossed, unambiguous triggering can also be obtained for many complex signals. By contrast, all triggering is suppressed during the hold-off time. For the example described, this would mean that although stable triggering conditions could be obtained with a suitable hold-off time (regular triggering at the same point), it would not be possible to set exclusive triggering at A.

The query command returns the dropout time in seconds.

Default setting: *200.0e-9 [s]*

TRIGger:HOLDoff[?] 0.0 to 10.0

TRIGger:HOLDoff suppresses trigger events within the set hold-off time (in seconds), starting from the time of the last successful triggering.

The query returns the set hold-off time (in seconds).

Default setting: *0.0 [s]*

TRIGger:HYSTeresis[?] 0.0 to 10.0

TRIGger:HYSTeresis sets the hysteresis of the internal trigger threshold (parameter *TRIGger:LEVel*). Hysteresis is the magnitude (in dB) the trigger signal level must drop below the trigger threshold (positive trigger slope) before triggering can occur again. Exactly the opposite is the case with a negative trigger slope. The trigger hysteresis setting only applies to the *INTernal* trigger source.

The query returns the trigger hysteresis in dB.

Default setting: *0.0 [dB]*

TRIGger:IMMediate

TRIGger:IMMediate triggers a generic trigger event that causes the sensor to immediately exit the *WAIT_FOR_TRIGGER* state irrespective of the trigger source and the trigger delay and start the measurement. The command is the only means of starting a measurement when the trigger source is set to *HOLD*. Only one measurement cycle is executed irrespective of the averaging factor.

TRIGger:LEVel[?] 1.0e-6 to 0.1

TRIGger:LEVel sets the trigger threshold (in W) for internal triggering derived from the test signal. This setting is irrelevant to all other trigger sources. If an S-parameter device has been activated, the trigger level setting is always referenced to the input of this device. When switching the S-parameter device on or off, the set trigger level and the entry limits are automatically adjusted.

The query returns the trigger threshold in W.

Default setting: 0.0001

TRIGger:MASTer:STATe[?] OFF | ON

TRIGger:MASTer:STATe ON can be used to configure an R&S NRP-Z81 power sensor as the trigger master, enabling it to output a digital trigger signal in sync with its own trigger event. This makes it possible to synchronize several sensors (see the *TRIGger:SYNChronisation:STATe* command) and to perform measurements in sync with a signal at very low power, which normally would not allow signal triggering. The trigger signal which is output has a length of 1µs and the positive slope coincides with the physical trigger point. At present, it can be distributed to other R&S NRP-Zxx sensors only via the R&S NRP base unit and not via the R&S NRP-Z3/-Z4 interface adapter.

Generally, the trigger master is set to internal triggering (signal triggering) (the BUS and IMMEDIATE settings can also be used); the sensors acting as trigger slaves (*TRIGger:MASTer:STATe OFF, TRIGger:SOURce:EXTernal*) must be set to external triggering and positive trigger slope.

With the R&S NRP-Z81 power sensor, digital trigger signals are sent and received via a single differential line pair, the trigger bus. Only one instrument on the trigger bus can act as the trigger master. If the application is time-critical, the trigger-signal delay from the master to a slave must be taken into account. Using the R&S NRP, the delay is about 30 ns.

The query returns
- *1* for *OFF*,
- *2* for *ON*.

Default setting: *OFF*

TRIGger:SLOPe[?] POSitive | NEGative

TRIGger:SLOPe defines the slope of the triggering signal to be evaluated with internal or external triggering. *Positive* means increasing envelope power (with internal triggering) or increasing voltage (with external triggering). This command has no effect in the *Burst Average* mode and when used with the *BUS*, *HOLD* and *IMMediate* trigger sources.

The query returns
- *1* for *POSitive*
- *2* for *NEGative*

Default setting: *POSitive*

TRIGger:SOURce[?] HOLD | IMMediate | INTernal | BUS | EXTernal

TRIGger:SOURce sets the trigger source.

- *HOLD*: Triggering only with the command *TRIGger:IMMediate.*
- *IMMediate*: Automatic triggering without explicit event.
- *INTernal*: Triggering by the measurement signal. Relevant parameters: *TRIGger:LEVel, TRIGger:HYSTeresis, TRIGger:DTIMe, TRIGger:DELay, TRIGger:HOLDoff* and *TRIGger:SLOPe*.
- *BUS*: Triggering with the command **TRG* or *TRIGger:IMMediate*.
- *EXTernal*: Triggering via a hardware trigger bus, i.e. R&S NRP-Z3 USB adapter or another power sensor, configured as a trigger master (currently only with the R&S NRP). Relevant parameters: *TRIGger:DELay, TRIGger:SLOPe, TRIGger:DTIMe, TRIGger:HOLDoff* and *TRIGger:SYNChronisation:STATe*

The query returns
- *1* for *HOLD*
- *2* for *IMMediate*
- *4* for *INTernal*
- *8* for *BUS*
- *16* for *EXTernal*

Default setting: *IMMediate*

TRIGger:SYNChronisation:STATe OFF | ON

TRIGger:SYNChronisation:STATe ON can be used to synchronize the sensors connected to the trigger bus (must currently be connected via the R&S NRP). Synchronization is achieved by enabling the trigger signal only when all the sensors are in the *WAIT_FOR_TRIGGER* state (wired-OR). This ensures that the measurements are started simultaneously and also that repetitions due to averaging start at the same time. It must be ensured that the number of repetitions is the same for all the sensors involved in the measurement. Otherwise, the trigger bus will be blocked by any sensor that has completed its measurements before the others and has returned to the *IDLE* state.

The synchronization function is turned off with *TRIGger:SYNChronisation:STATe OFF*.

Default setting: *OFF*

List of Remote-Control Commands

The syntax of the R&S NRP-Z81's remote-control commands is based to a limited extent on the SCPI 1999.0 standard.

Table 6-9 List of remote-control commands

Command	Parameter	Unit	Default setting	Page
*** Commands**				
*IDN?				6.2
*RST				6.2
*TRG				6.2
*TST?				6.2
CALibration Commands				
CALibration:DATA[?]	<calibration data set as definite length block>			6.3
CALibration:DATA:LENGth?		Bytes		6.3
CALibration:ZERO:AUTO[?]	LFR | UFR | ONCE			6.3
CALibration:ZERO:FAST:AUTO[?]	ONCE			6.4
SENSe Commands				
SENSe:AUXiliary[?]	NONE | MINMAX | RNDMAX		RNDMAX	6.7
SENSe:AVERage:COUNt[?]	1 to 2^{20}		1024	6.7
SENSe:AVERage:COUNt:AUTO[?]	OFF | ON | ONCE		ON	6.8
SENSe:AVERage:COUNt:AUTO:MTIMe[?]	1.0 to 999.99	s	4	6.8
SENSe:AVERage:COUNt:AUTO:NSRatio[?]	0.0001 to 1.0	dB	0.01	6.8
SENSe:AVERage:COUNt:AUTO:RESolution[?]	1 to 4		3	6.9
SENSe:AVERage:COUNt:AUTO:SLOT[?]	1 to <SENSe:POWer:TSLot :AVG :COUNt>		1	6.9
SENSe:AVERage:COUNt:AUTO:TYPE[?]	RESolution | NSRatio		RESolution	6.9
SENSe:AVERage:RESet				6.9
SENSe:AVERage:STATe[?]	OFF | ON		ON	6.9
SENSe:AVERage:TCONtrol[?]	MOVing | REPeat		REPeat	6.10

Command	Parameter	Unit	Default setting	Page
SENSe:BWIDth:VIDEo[?]	"300 kHz" | "1.5 MHz" | "5 MHz" | "FULL"		"FULL"	6.10
SENSe:BWIDth:VIDEo:LIST?				6.10
SENSe:CORRection:DCYCle[?]	0.001 to 99.999	%	1.0	6.10
SENSe:CORRection:DCYCle:STATe[?]	OFF | ON		OFF	6.11
SENSe:CORRection:OFFSet[?]	-200.0 to 200.0	dB	0.0	6.11
SENSe:CORRection:OFFSet:STATe[?]	OFF | ON		OFF	6.12
SENSe:CORRection:SPDevice:LIST?				6.12
SENSe:CORRection:SPDevice:SELect[?]	Consecutive number of the S-parameter device		1 (can be modified by the user)	6.12
SENSe:CORRection:SPDevice:STATe[?]	OFF | ON		OFF (can be modified by the user)	6.12
SENSe:FREQuency[?]	50.0e6 to 18.0e9	Hz	1.0e9	6.13
SENSe:FUNCtion[?]	"POWer:AVG" | "POWer:BURSt:AVG" | "POWer:TGATe:AVG" | "POWer:TSLot:AVG" | "XTIME:POWer" | "XPOWer:CCDFunction" | "XPOWer:PDFunction"		"POWer:AVG"	6.13
SENSe:POWer:AVG:APERture[?]	1.0e-6 to 0.1	s	10.0e-6	6.16
SENSe:POWer:AVG:BUFFer:SIZE[?]	1 to 8192		1	6.16
SENSe:POWer:AVG:BUFFer:STATe[?]	OFF | ON		OFF	6.16
SENSe:POWer:AVG:SMOothing:STATe[?]	OFF | ON		ON	6.16
SENSe:POWer:BURSt:DTOLerance[?]	0.0 to 0.3	s	1.0e-6	6.17
SENSe:POWer:TSLot[:AVG]:COUNt[?]	1 to 16		8	6.17
SENSe:POWer:TSLot[:AVG][:EXCLude]:MID:OFFSet [:TIME][?]	0.0 to 0.1	s	0.0	6.18
SENSe:POWer:TSLot[:AVG][:EXCLude]:MID:TIME[?]	0.0 to 0.1	s	0.0	6.18
SENSe:POWer:TSLot[:AVG]:WIDTh[?]	50e-9 to 0.1	s	0.0001	6.18
SENSe:SGAMma:CORRection:STATe[?]	OFF | ON		OFF	6.19
SENSe:SGAMma:MAGNitude[?]	0.0 to 1.0		0.0	6.19
SENSe:SGAMma:PHASe[?]	–360.0 to 360.0	degree	0.0	6.19
SENSe:STATistics[:EXCLude]:MID:OFFSet[:TIME][?]	0.0 to 0.3	s	0.0	6.19
SENSe:STATistics[:EXCLude]:MID:TIME[?]	0.0 to 0.3	s	0.0	6.19

Command	Parameter	Unit	Default setting	Page
SENSe:STATistics:OFFSet:TIME[?]	0 to 10.0	s	0.0	6.19
SENSe:STATistics:SCALe:X:MPWidth?		dB		6.20
SENSe:STATistics:SCALe:X:POINts[?]	3 to 8192		200	6.20
SENSe:STATistics:SCALe:X:RANGe[?]	0.01 to 100.0	dB	50	6.20
SENSe:STATistics:SCALe:X:RLEVel[?]	–80 to +20	dBm	–30	6.20
SENSe:STATistics:TIME[?]	10.0e-6 to 0.3	s	0.01	6.21
SENSe:TIMing:EXCLude:STARt[?]	0.0 to 10.0	s	0.0	6.21
SENSe:TIMing:EXCLude:STOP[?]	0.0 to 51.2e-6	s	0.0	6.21
SENSe:TRACe:AVERage:COUNt[?]	1 to 65536		1	6.22
SENSe:TRACe:AVERage:STATe[?]	OFF | ON		ON	6.23
SENSe:TRACe:AVERage:TCONtrol[?]	MOVing | REPeat		REPeat	6.23
SENSe:TRACe:MPWidth?		s		6.23
SENSe:TRACe:OFFSet:TIME[?]	x to 10.0	s	0.0	6.23
SENSe:TRACe:POINts[?]	3 to 8192		200	6.24
SENSe:TRACe:POINts:FPGA?				6.24
SENSe:TRACe:TIME[?]	50e-9 to 1	s	0.01	6.24
SENSe:TRACe:TIME:FPGA?		s		6.25
SYSTem Commands				
SYSTem:INFO? [Item]				6.25
SYSTem:INITialize				6.27
SYSTem:MINPower?		W		6.27
SYSTem:RUTime	0.001 to 10.0	s		6.27
SYSTem:SUTime	0.001 to 10.0	s	1e-4	6.27
SYSTem:TRANsaction:BEGin				6.27
SYSTem:TRANsaction:END				6.28
Test Commands				
TEST:SENSor?				6.28
Triggersystem Commands				

Command	Parameter	Unit	Default setting	Page
ABORt				6.29
INITiate:CONTinuous[?]	OFF | ON		OFF	6.29
INITiate:IMMediate				6.30
TRIGger:ALEVel:STATe[?]	OFF | ON		OFF	6.30
TRIGger:ATRigger:STATe[?]	OFF | ON		OFF	6.30
TRIGger:COUNt[?]	1 to 2e9		1	6.31
TRIGger:DELay[?]	–51.2e-6 to 10.0	s	0.0	6.31
TRIGger:DTIMe[?]	0.0 to 10.0	s	200.0e-9	6.32
TRIGger:HOLDoff[?]	0.0 to 10.0	s	0.0	6.32
TRIGger:HYSTeresis[?]	0.0 to 10.0	dB	0.0	6.32
TRIGger:IMMediate				6.33
TRIGger:LEVel[?]	1.0e-6 to 0.1	W	1e-4	6.33
TRIGger:MASTer:STATe[?]	OFF | ON		OFF	6.33
TRIGger:SLOPe[?]	POSitive | NEGative		POSitive	6.33
TRIGger:SOURce[?]	HOLD | IMMediate | INTernal | BUS | EXTernal		IMMediate	6.34
TRIGger:SYNChronisation:STATe	OFF | ON		OFF	6.34

ROHDE&SCHWARZ

Test and Measurement
Division

Service Instructions R&S NRP-Z81

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Table of Contents

4 Firmware Update

Chapter 4 provides information on the firmware update. Descriptions enclosed with the firmware update can be filed here.

Installation of New R&S NRP-Z81 Firmware

Use the Firmware Update program module to load new firmware for the Power Sensor R&S NRP-Z81. The module is part of the R&S NRP Toolkit that is supplied on a CD-ROM together with the power sensors and enables you to update the boot loader and the application firmware.

The current firmware versions can be downloaded from the R&S homepage on the Internet, since the CD-ROM accompanying the power sensors contains the firmware status at the time of delivery.

Hardware and software requirements

The system requirements for a firmware update are the same as for the operation of the power sensor on a PC (an update via the power meter is not possible):

- PC with free USB port.
- USB Interface Adapter R&S NRP-Z3 or R&S NRP-Z4.
- Operating system Windows™ 98, Windows™ ME, Windows™ 2000, or Windows™ XP.
- **The R&S NRP Toolkit software must already be installed on your PC.**
- One of the following files must be selected (depending on the software component to be updated):
  - `<Type>_Sensor<Version Number>.nrp` Application
  - `Bootloader_<Version Number>.nrp`, Boot loader

  The files are available in the \software\firmware\sensors directory of the CD-ROM.

Preparation

- Connect the R&S NRP power sensor to the PC using one of the two USB interface adapters.
- If a second R&S NRP-Z power sensor or an R&S NRP is connected to the PC, unplug these devices from the PC.
- Shortly afterwards, the PC should have identified the new USB hardware and assigned the appropriate driver from the **R&S NRP Toolkit** to the power sensor (brief message in a small window).

If you forgot to install the R&S NRP Toolkit beforehand, Windows will try in vain to find a USB driver for the power sensor. If this happens, the R&S NRP-Zxx is highlighted by a yellow exclamation mark in the Windows device manager. In this case, proceed as follows:

- *Abort the dialog for driver installation.*
- *Install the R&S NRP Toolkit from the CD-ROM.*
  Then manually assign the USB driver from the toolkit to the power sensor.
- *Go to Control Panel – Add/Remove Hardware and start the hardware assistant to search for new components.*
- *Mark the R&S NRP-Zxx in the list of hardware components and complete the driver installation.*
- *Unplug the power sensor and reconnect it.*

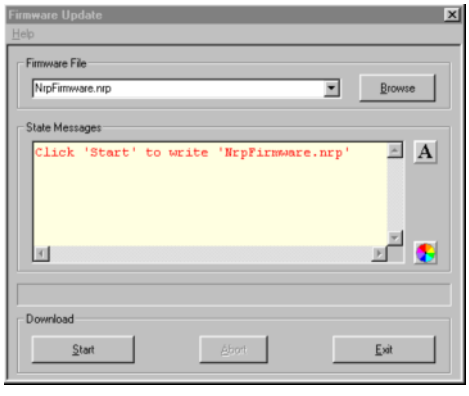
Updating the application firmware

The update can be started as follows:

➢ Either double-click the icon of the update file named `<Type>_Messkopf_<Version Number>.nrp`

➢ Or start **NRP Toolkit – Firmware Update** from the Windows Start menu.

The dialog box on the left is displayed next.

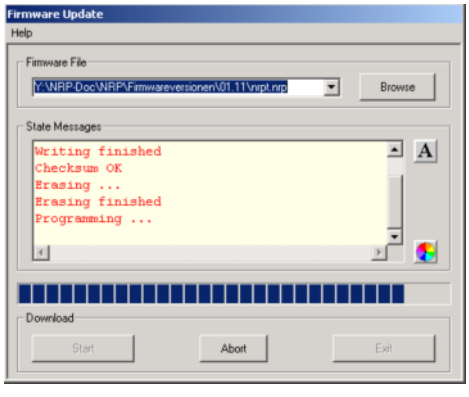


➢ If the update was started via the Windows Start menu, enter the file name of the application firmware in the **Firmware File** box (or search for the name by using the **Browse** button).

➢ Click the **Start** button to start the file transfer, which is performed automatically.

➢ Observe the following:

- *Do not disconnect the power sensor from the PC.*
- *Neither connect nor disconnect the power supply for the R&S NRP-Z3 adapter.*
- *Exit the Firmware Update program only after it has been completely executed.*



➢ During the update, the State Messages box informs you of the progress. The update has been completed successfully if the message `'Device <Type Designation><Serial Number> is active'` appears.

➢ You can then use the power sensor for measuring.

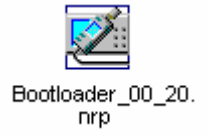
Potential problems

- Error in the compatibility and consistency checks.

  In this case, the update is aborted and an error message is output.

➢ Unplug the power sensor, reconnect it and start the update again.

Updating the boot loader



The boot loader update is similar to the update of the application firmware (see above).

➢ Instead of the application, however, you must load the new boot loader named

`Bootloader_<Version Number>.nrp`

Strictly observe the warnings under "Updating the application firmware", since the destruction of the boot loader will generally require a repair of the power sensor.

Potential problems

- The power sensor cannot be accessed after the update (error message).

➢ Exit the Firmware Update program, unplug the power sensor from the PC and reconnect it. The power sensor is now ready for operation.