R&S®NRT
POWER REFLECTION METER FAMILY

R&S®NRT2 and R&S®NRT-Zxx

3 year warranty

Product Brochure
Version 02.01

ROHDE&SCHWARZ
Make ideas real

AT A GLANCE

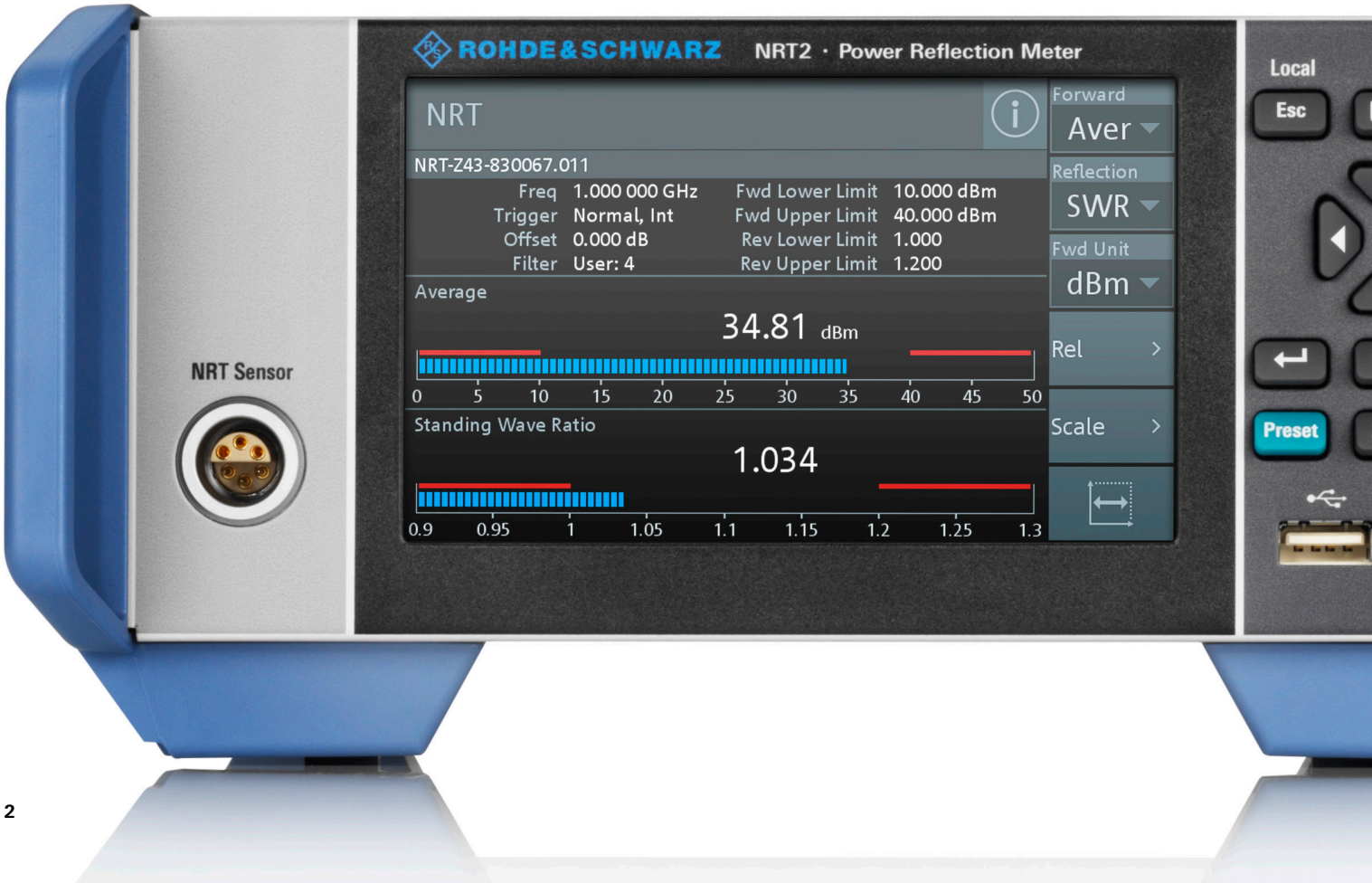
Directional power sensors measure forward and reverse power under operating conditions. These measurements are required when installing, servicing and monitoring transmitters, antennas and RF generators. The R&S®NRT family consists of the R&S®NRT2 power reflection meter and various R&S®NRT-Zxx directional power sensors. Thanks to their wide range of measurement functions and high accuracy, they are suitable for use in research, development and production.

The R&S®NRT-Zxx directional power sensors are self-contained measuring instruments. They can be connected directly to the R&S®NRT2 or, via the R&S®NRT-Z5 USB interface adapter, to the PC (communications via USB).

The compact R&S®NRT2 power reflection meter supports all the measurement functions of the R&S®NRT-Zxx directional power sensors. The large, user-friendly touchscreen simultaneously displays the forward and reverse power. The base unit is exceptionally easy and intuitive to use and can be remotely controlled via LAN, GPIB (R&S®NRT2-B8 option) or USB.

Key facts

- Simultaneous display of forward and reverse power
- Measurement of average power, average burst power, peak power, crest factor, CCDF and mismatch
- 5" color touchscreen
- Direct operation of the R&S®NRT-Zxx directional power sensors from a PC
- Frequency range from 25 MHz to 4 GHz (sensor-dependent)



BENEFITS

R&S®NRT2 power reflection meter

- Simple touchscreen operation
- Simultaneous display of forward and reverse power
- Analog bargraph and autoscale
- Visual limit monitoring
- 100 % code compatibility with predecessor model

► page 4

R&S®NRT-Zxx directional power sensors

- Various sensor models
- Diverse measurement functions
- Direct power monitoring on a PC

► page 5

Versatile applications

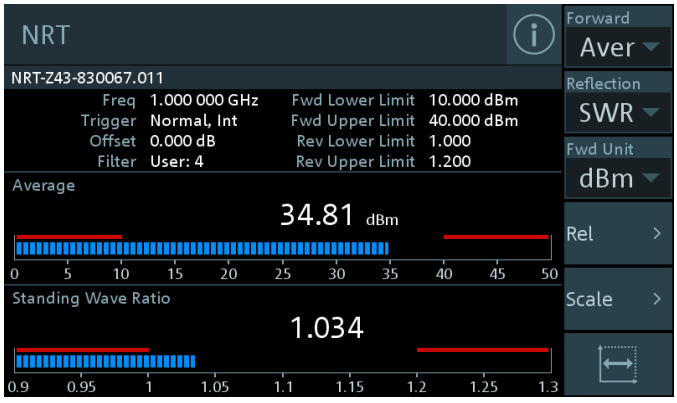
- Continuous monitoring of transmitter systems
- Power measurements with digital modulation

► page 7

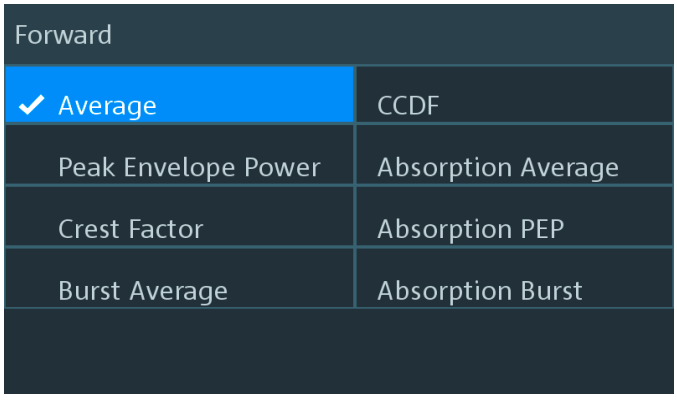
R&S®NRT2 POWER REFLECTION METER

Simple touchscreen operation

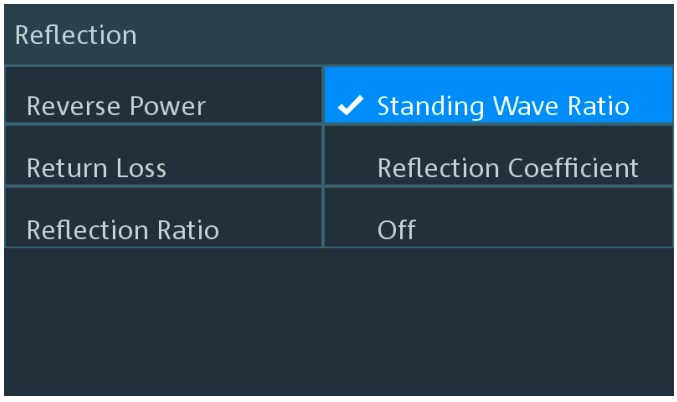
Thanks to intelligent menus, the compact R&S®NRT2 base unit with a state-of-the-art 5" touchscreen is extremely easy to operate. On the top menu level, users can switch between the most important measurements. Additional parameters can be set in clearly structured submenus. Important functions such as setting frequencies, zeroing and creating screenshots can be accessed at the push of a button.



Analog bar graph with configurable limits



Forward measurement function



Reflection measurement function

Simultaneous display of forward and reverse power

The R&S®NRT-Zxx directional power sensors simultaneously measure forward and reverse power and calculate additional parameters such as load matching. The R&S®NRT2 power reflection meter then displays one forward and one reverse parameter at the same time.

The forward measurement function shows the average power, average burst power, peak envelope power (PEP) and the peak-to-average power ratio (crest factor). The calculated absorption average power (forward minus reverse), absorption burst power, absorption PEP and amplitude distribution (CCDF) for modulated signals can also be displayed.

The reflection measurement function displays the average power, return loss, SWR, reflection coefficient and reflection ratio in %.

Analog bargraph and autoscale

Measurements can be shown as numeric values or in an analog bargraph. To define the analog measuring range, the user starts the autoscale function by simply pressing a button. The scale of the analog bargraph is optimally adjusted to the measured signal.

Visual limit monitoring

Each measurement can be visually monitored. Values outside the defined limits are highlighted in red. The analog bargraph additionally graphically displays the defined limits in red.

100 % code compatibility with predecessor model

The remote commands of the R&S®NRT2 are 100 % code compatible with the command set of the previous R&S®NRT model. This simplifies device replacement and integration into existing systems (no additional programming required). The R&S®NRT2 power reflection meter can be remote controlled via USB or LAN. The R&S®NRT2-B8 option adds remote control via GPIB (IEEE 488).

R&S®NRT-ZXX DIRECTIONAL POWER SENSORS

Various sensor models

The R&S®NRT-Z43 and R&S®NRT-Z44 power sensors are tailor-made to meet the requirements of all common radiocommunications standards:

- The wide frequency range from 200/400 MHz to 4 GHz covers all relevant frequency bands
- The measurement method is compatible with all common analog and digital modulation standards

The R&S®NRT-Z14 directional power sensor (25 MHz to 1 GHz) can be used in traditional analog radio and broadcast frequency bands.

Diverse measurement functions

The R&S®NRT-Z14, R&S®NRT-Z43 and R&S®NRT-Z44 power sensors support the following measurement functions.

Average power (RMS value)

This function returns the average value of the power for any type of test signal (modulated, unmodulated or several carriers). It features a measurement range of 35 dB to 40 dB and high measurement accuracy.

Peak envelope power (PEP) and crest factor

Both parameters provide information on the peak power of a modulated envelope and describe the overdrive characteristics of transmitter output stages. The result of the crest factor measurement is referenced to the average power and displayed in dB. Measurements are performed using a video bandwidth that is adjustable in several steps, so that even short-time and high-power peaks can be determined.

Average burst power

This function can be used to measure modulated and unmodulated bursts based on the average power and the duty cycle. Both can be defined by the user or determined automatically by the power sensor.

Complementary cumulative distribution function (CCDF)

This function measures the probability of the peak envelope power exceeding a preset threshold so that the amplitude distribution of signals with an unknown envelope can be determined.

Direct power monitoring on a PC

The R&S®NRT-Zxx directional power sensors are fully calibrated, independent measuring instruments that can also be used without the base unit. The R&S®NRT-Z5 USB interface adapter enables direct connection to a laptop/PC.

The R&S®NRT-Z14, R&S®NRT-Z43 and R&S®NRT-Z44 power sensors make high-precision power and reflection measurements extremely cost-effective. Direct monitoring on a PC is very useful in applications where data needs to be collected (e.g. in development labs and for maintenance of base stations) as well as for purely remote controlled applications such as power monitoring in transmitter stations and EMC test systems. The R&S®V-NRT Windows user interface (supplied with the sensors) allows users to define measurement functions and also display and store individual results and series of measurements.

VERSATILE APPLICATIONS

Continuous monitoring of transmitter systems

Many applications need continuous monitoring of power and reflection, e.g. to enable fast reaction times when an antenna is damaged. This requires a highly accurate measuring instrument that does not influence the SWR and attenuation of the antenna feeder and does not generate any interfering signals. The R&S®NRT-Z14, R&S®NRT-Z43 and R&S®NRT-Z44 directional power sensors feature good matching, low insertion loss and excellent intermodulation characteristics. When a multicarrier signal is applied, the sum power is displayed – a feature rarely found in conventional directional power sensors. Since data is digitally transferred, the length of the connecting cable is not critical and the R&S®NRT-Z14, R&S®NRT-Z43 and R&S®NRT-Z44 directional power sensors can be installed where they measure most accurately – at the antenna feed point.

Power measurements with digital modulation

Conventional directional power meters only measure RF and microwave signals that have an unmodulated envelope. The R&S®NRT-Z14, R&S®NRT-Z43 and R&S®NRT-Z44 directional power sensors have been designed to also meet the requirements of digitally modulated signals. The key factor is their ability to correctly measure the average power (RMS value) of a signal irrespective of its envelope. The sensors behave like a thermal power meter and offer the best accuracy and measurement range (35 dB to 40 dB).

For TDMA systems, the average burst power function makes it possible to measure transmitter power in an active timeslot. If several timeslots are active (e.g. base stations), the average power function can determine the average power over all timeslots. The peak envelope power function can measure overshoots at the beginning of a timeslot or peak values caused by modulation down to a minimum duration of 200 ns (R&S®NRT-Z43/-Z44) or 1.5 µs (R&S®NRT-Z14).

When measuring CDMA signals with the R&S®NRT-Z43/-Z44 directional power sensors, both the peak envelope power function and the average power function can be used. The peak envelope power function measures the short-time peak values that are approx. 10 dB above the average value. This provides information about the overdrive capability of the transmitter output stage. The peak envelope power can be displayed as an absolute value in W or dBm or as a relative value in dB referenced to the average value (crest factor).

SPECIFICATIONS

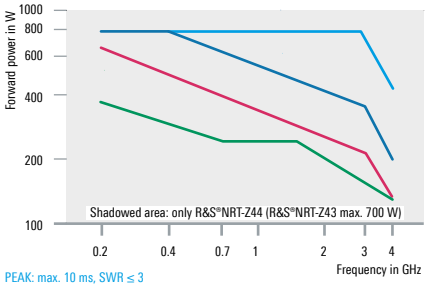
R&S®NRT-Z14/-Z43/-Z44 directional power sensors			
	R&S®NRT-Z14	**R&S®NRT-Z43**	**R&S®NRT-Z44**
General data (max. power, see diagram)			
Power measurement range [1]	0.006 W to 120 W (average), 300 W (peak)	0.0007 W to 30 W (average), 75 W (peak)	0.003 W to 120 W (average), 300 W (peak)
Frequency range	25 MHz to 1 GHz	400 MHz to 4 GHz	200 MHz to 4 GHz
SWR (referenced to 50 Ω)	max. 1.06	► 0.4 GHz to 3 GHz: max. 1.07 ► 3 GHz to 4 GHz: max. 1.12	► 0.2 GHz to 3 GHz: max. 1.07 ► 3 GHz to 4 GHz: max. 1.12
Insertion loss	max. 0.06 dB	► 0.4 GHz to 1.5 GHz: max. 0.06 dB ► 1.5 GHz to 4 GHz: max. 0.09 dB	► 0.2 GHz to 1.5 GHz: max. 0.06 dB ► 1.5 GHz to 4 GHz: max. 0.09 dB
Directivity [2]	min. 30 dB	► 0.4 GHz to 3 GHz: min. 30 dB ► 3 GHz to 4 GHz: min. 26 dB	► 0.2 GHz to 3 GHz: min. 30 dB ► 3 GHz to 4 GHz: min. 26 dB
Average power measurement [3, 4]			
Definition	mean value of carrier power, averaged over several modulation cycles (thermal equivalent, true RMS value in case of voltage measurement)		
Power measurement range [5] CF (crest factor): peak-to-average ratio	► CW, FM, φM, FSK or GMSK: 0.03 [0.006] W to 300 W ► other modulation modes: 0.03 [0.006] W to 300 [50] W/CF [6]	► CW, FM, φM, FSK, GMSK or equivalent: 0.007 [0.0007] W to 75 W ► (W)CDMA, DAB/DVB-T: 0.007 [0.0007] W to 30 [3] W [6] ► other modulation modes: 0.007 [0.0007] W to 75 [7.5] W/CF [6]	► CW, FM, φM, FSK or GMSK: 0.03 [0.006] W to 300 W ► other modulation modes: 0.03 [0.006] W to 300 [50] W/CF [6]
Modulation	for all types of analog and digital modulation; lowest frequency component of signal envelope should exceed 7 Hz for steady indication		
Measurement uncertainty [7] from +18 °C to +28 °C, CW signal	► from 40 MHz to 1 GHz: 3.2 % of rdg (0.14 dB) [8] ► from 25 MHz to 40 MHz: 4.0 % of rdg (0.17 dB) [8] plus zero offset	3.2 % of rdg (0.14 dB) [9] plus zero offset	► from 0.3 GHz to 4 GHz: 3.2 % of rdg (0.14 dB) [9] ► from 0.2 GHz to 0.3 GHz: 4.0 % of rdg (0.17 dB) [9] plus zero offset
Modulated signal	same as CW signal, plus errors due to modulation		
Zero offset	±0.004 [±0.0008] W [10]	±0.001 [±0.0001] W [10]	±0.004 [±0.0004] W [10]
Typical errors due to modulation [11]	► FM, φM, FSK, GMSK: ±0 % of rdg (0 dB) ► AM (80 %): ±3 % of rdg (±0.13 dB) ► EDGE, TETRA [12]: ±0.5 % of rdg (±0.02 dB) ► 2 CW carriers: ±2.0 % of rdg (±0.09 dB)	► FM, φM, FSK, GMSK: ±0 % of rdg (0 dB) ► AM (80 %): ±3 % of rdg (±0.13 dB) ► cdmaOne, DAB [12]: ±1 % of rdg (±0.04 dB) ► CDMA2000® (3X) [13]: ±2 % of rdg (±0.09 dB) ► EDGE [12]: ±0.5 % of rdg (±0.02dB) ► WCDMA [14]: ±2 % of rdg (±0.09 dB) ► DVB-T [12]: ±2 % of rdg (±0.09 dB) ► π/4 DQPSK: ±2 % of rdg (±0.09 dB) ► 2 CW carriers: ±2 % of rdg (±0.09 dB)	
Temperature coefficient [15]	► 40 MHz to 1 GHz: 0.25 %/K (0.011 dB/K) ► 25 MHz to 40 MHz: 0.40 %/K (0.017 dB/K)	0.4 GHz to 4 GHz: 0.25 %/K (0.011 dB/K)	► 0.3 GHz to 4 GHz: 0.25 %/K (0.011 dB/K) ► 0.2 GHz to 0.3 GHz: 0.40 %/K (0.017 dB/K)
Measurement time/averaging factor [16] Values in ( ) for high resolution setting	► 0 W to 0.2 W: 1.40 (4.9) s/32 (128) ► 0.2 W to 2 W: 0.37 (1.4) s/4 (32) ► 2 W to 300 W: 0.26 (0.4) s/1 (4)	► 0 W to 0.05 W: 1.4 (4.9) s/32 (128) ► 0.05 W to 0.5 W: 0.37 (1.4) s/4 (32) ► 0.5 W to 75 W: 0.26 (0.4) s/1 (4)	► 0 W to 0.2 W: 1.4 (4.9) s/32 (128) ► 0.2 W to 2 W: 0.37 (1.4) s/4 (32) ► 2 W to 300 W: 0.26 (0.4) s/1 (4)
Average burst power measurement [3, 4] Video bandwidth settings in { }			
Definition	average power value of periodic RF bursts based on the measurement of the average power under consideration of burst width t and repetition rate 1/T: average burst power = average power × T/t t and T can be predefined (calculate mode) or measured (measure mode)		
Power measurement range			
Calculate mode [5]	0.03 [0.006] W × (T/t) up to specified upper limit of average power measurement	0.007 [0.0007] W × (T/t) up to specified upper limit of average power measurement	0.03 [0.003] W × (T/t) up to specified upper limit of average power measurement

R&S®NRT-Z14/-Z43/-Z44 directional power sensors			
	R&S®NRT-Z14	**R&S®NRT-Z43**	**R&S®NRT-Z44**
Measure mode (only with forward direction 1 ▷ 2) Values in ( ) for "FULL" video bandwidth setting	same as calculate mode, but at least 2 (4) W	same as calculate mode, but at least 0.5 (1.25) W	same as calculate mode, but at least 2 (5) W
Burst width (t)			
Calculate mode	0.2 µs to 150 ms	0.2 µs to 150 ms	
Measure mode	► 500 µs to 150 ms {4 kHz} ► 10 µs to 150 ms {200 kHz} ► 2 µs to 150 ms {"FULL"}	► 500 µs to 150 ms {4 kHz} ► 10 µs to 150 ms {200 kHz} ► 1 µs to 150 ms {"FULL"}	
Repetition rate (1/T)	min. 7/s		
Duty cycle t/T			
Calculate mode	as defined by burst width and repetition rate		
Measure mode	0.01 to 1		
Measurement uncertainty from +18 °C to +28 °C			
Calculate mode	same as for average power measurement; stated zero offset multiplied by T/t		
Measure mode	same as for calculate mode plus 2 % of rdg (0.09 dB) at 0.1 duty cycle [17]		
Temperature coefficient	same as for average power measurement		
Measurement time/averaging factor [16]			
Calculate mode	see average power measurement with corresponding average power value (average burst power multiplied by t/T)		
Measure mode with 0.1 duty cycle Values in ( ) for high resolution setting	► 2 W to 20 W: 1.6 (9.5) s/4 (32) ► 20 W to 300 W: 0.75 (1.6) s/1 (4)	► 0.5 W to 5 W: 1.6 (9.5) s/4 (32) ► 5 W to 75 W: 0.75 (1.6) s/1 (4)	► 2 W to 20 W: 1.6 (9.5) s/4 (32) ► 20 W to 300 W: 0.75 (1.6) s/1 (4)
Crest factor measurement			
Definition	ratio of peak envelope power to average power in dB (only with 1 ▷ 2 forward direction)		
Power measurement range	see average power and peak envelope power specifications		
Measurement uncertainty	approx. 4.3 dB × (measurement error of peak hold circuit in W divided by peak envelope power)		
Measurement time/averaging factor	see specifications for peak envelope power measurement with simultaneous reflection measurement		
Peak envelope measurement (PEP) [3] Video bandwidth settings in { }			
Definition	peak value of carrier power (only with 1 ▷ 2 forward direction)		
Power measurement range			
Burst signals (repetition rate min. 20/s)	► from 100 µs width {4 kHz}: 0.4 W to 300 W ► from 2 µs width {200 kHz}: 1 W to 300 W ► from 1.5 µs width {"FULL"}: 2 W to 300 W	► from 100 µs width {4 kHz}: 0.1 W to 75 W ► from 2 µs width {200 kHz}: 0.25 W to 75 W ► from 0.2 µs width {"FULL"}: 0.5 W to 75 W	► from 100 µs width {4 kHz}: 0.4 W to 300 W ► from 2 µs width {200 kHz}: 1 W to 300 W ► from 0.2 µs width {"FULL"}: 2 W to 300 W
cdmaOne, WCDMA, CDMA2000®, DAB, DVB-T		1 W to 75 W {"FULL" with modulation correction switched on}	4 W to 300 W {"FULL" with modulation correction switched on}
Other signal type	see burst signal of equivalent burst width		
Measurement uncertainty from +18 °C to +28 °C	same as for average power measurement, plus measurement error of peak hold circuit		
Measurement error limits of peak hold circuit for burst signals with specified burst width, repetition rate > 100/s, duty cycle from 0.1 to 1	► from 200 µs {4 kHz}: ±(3 % of rdg + 0.05 W) [10] ► from 4 µs {200 kHz}: ±(3 % of rdg + 0.2 W) [10] ► from 2 µs {"FULL"}: ±(7 % of rdg + 0.4 W) [10]	► from 200 µs {4 kHz}: ±(3 % of rdg + 0.012 W) [10] ► from 4 µs {200 kHz}: ±(3 % of rdg + 0.05 W) [10] ► from 1 µs {"FULL"}: ±(7 % of rdg + 0.1 W) [10]	► from 200 µs {4 kHz}: ±(3 % of rdg + 0.05 W) [10] ► from 4 µs {200 kHz}: ±(3 % of rdg + 0.2 W) [10] ► from 1 µs {"FULL"}: ±(7 % of rdg + 0.4 W) [10]
At repetition rates from 20/s to 100/s	add ±(1.6 % of rdg + 0.15 W)	add ±(1.6 % of rdg + 0.04 W)	add ±(1.6 % of rdg + 0.15 W)
At duty cycles from 0.001 to 0.1	► add ±0.10 W {200 kHz, "FULL"} ► add ±0.05 W {4 kHz}	► add ±0.025 W {200 kHz, "FULL"} ► add ±0.013 W {4 kHz}	► add ±0.10 W {200 kHz, "FULL"} ► add ±0.05 W {4 kHz}

R&S®NRT-Z14/-Z43/-Z44 directional power sensors			
	R&S®NRT-Z14	**R&S®NRT-Z43**	**R&S®NRT-Z44**
At burst width from 0.5 µs to 1 µs 0.2 µs to 0.5 µs		► add ±5% of rdg ► add 10% of rdg	
Typical measurement errors of peak hold circuit with spread-spectrum signals [18]		► cdmaOne, DAB [12]: ±(5% of rdg + 0.1 W) ► CDMA2000® (3X) [13], WCDMA [14], DVB-T: ±(15% of rdg + 0.1 W)	► cdmaOne, DAB [12]: ±(5% of rdg + 0.4 W) ► CDMA2000® (3X) [13], WCDMA [14], DVB-T: ±(15% of rdg + 0.4 W)
Temperature coefficient [15]	► 40 MHz to 1 GHz: 0.35%/K (0.015 dB/K) ► 25 MHz to 40 MHz: 0.50%/K (0.022 dB/K)	0.4 GHz to 4 GHz: 0.35%/K (0.015 dB/K)	► 0.3 GHz to 4 GHz: 0.35%/K (0.015 dB/K) ► 0.2 GHz to 0.3 GHz: 0.50%/K (0.022 dB/K)
Measurement time/averaging factor [16] Values in ( ) for high resolution setting	PEP measurement only (not possible in combination with the R&S®NRT2): ► 0.28 (0.40) s/1 (4) {4 kHz, 200 kHz} ► 0.40 (0.55) s/4 (8) {"FULL"} with simultaneous reflection measurement: ► 0.7 (1.5) s/1 (4) {4 kHz, 200 kHz} ► 1.5 (2.7) s/4 (8) {"FULL"}		
Complementary cumulative distribution function measurement (CCDF)			
Definition	probability in % of forward power envelope exceeding a specified threshold (only with 1 ▷ 2 forward direction)		
Measurement range	0% to 100%		
Measurement uncertainty from +18°C to +28°C	0.2% [20]		
Threshold level range	1 W to 300 W	0.25 W to 75 W	1 W to 300 W
Accuracy of threshold level at +18°C to +28°C	±(5% of threshold level in W + 0.5 W)	±(5% of threshold level in W + 0.13 W)	±(5% of threshold level in W + 0.5 W)
Measurement time/averaging factor [16] Values in ( ) for high resolution setting	CCDF measurement only [19]: 0.26 (0.37) s/1 (4) with simultaneous reflection measurement (not possible in combination with the R&S®NRT2): 0.7 (1.6) s/1 (4)		
Reflection measurement [4] Values in { }: 3 GHz to 4 GHz			
Definition	measurement of load match in terms of SWR, return loss, or reflection coefficient		
Reflection measurement range			
Return loss	0 to 23 dB	0 dB to 23 {20} dB	
SWR	1.15 to ∞	1.15 {1.22} to ∞	
Reflection coefficient	0.07 to 1	0.07 {0.10} to 1	
Min. forward power	0.06 [0.3] W (specs met from 0.4 [2] W)	0.007 [0.07] W (specs met from 0.05 [0.5] W)	0.03 [0.3] W (specs met from 0.2 [2] W)
Measurement uncertainty	see diagram		
Measurement time/averaging factor	same as measurement time of selected power measurement function, lowest with average power measurement		

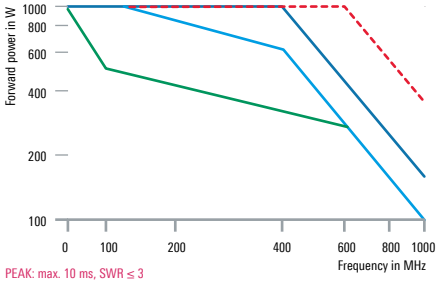
Figures

Maximum forward power of the R&S®NRT-Z43 and R&S®NRT-Z44 directional power sensors (for both directions)



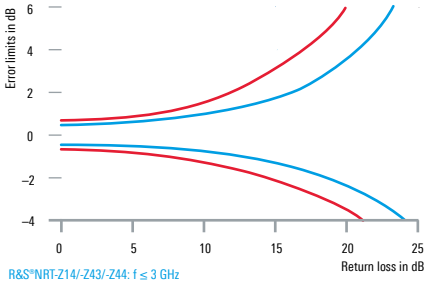
PEAK: max. 10 ms, SWR ≤ 3
AVG: –10 °C to + 35 °C, SWR ≤ 1.5
AVG: –10 °C to + 35 °C, SWR ≤ 3
AVG: +35 °C to + 50 °C, SWR ≤ 3

Maximum forward power of the R&S®NRT-Z14 directional power sensor (for both directions)



PEAK: max. 10 ms, SWR ≤ 3
AVG: –10 °C to + 35 °C, SWR ≤ 1.5
AVG: –10 °C to + 35 °C, SWR ≤ 3
AVG: +35 °C to + 50 °C, SWR ≤ 3

Measurement error limits (two standard deviations) for reflection measurements with the R&S®NRT-Z14/-Z43/-Z44 directional power sensors



R&S®NRT-Z14/-Z43/-Z44: f ≤ 3 GHz
R&S®NRT-Z43/-Z44: 3 GHz < f ≤ 4 GHz

Min. forward power (forward direction 1 ▷ 2): R&S®NRT-Z14: 0.4 W; R&S®NRT-Z43: 0.05 W; R&S®NRT-Z44: 0.2 W

R&S®NRT-Z14/-Z43/-Z44 directional power sensors		
Measurement channels		2 (for forward and reverse power)
Forward direction	1 ▷ 2	standard for all measurement functions
	2 ▷ 1	only for measurement of average power and average burst power (at lower levels)
Measurement functions		forward power and reflection
Power parameters		average power, average burst power, peak envelope power, peak-to-average ratio, complementary cumulative distribution function
Reflection parameters		return loss, SWR, reflection coefficient, reverse-to-forward power ratio in %, reverse power
Range selection		automatic
Video bandwidth		4 kHz, 200 kHz and "FULL" (600 kHz for the R&S®NRT-Z14, 4 MHz for the R&S®NRT-Z43/-Z44) for all power parameters except for the measurement of the average power
Frequency response correction		on input of RF frequency, the stored correction factors are taken into account
Zero adjustment		on remote command with RF power switched off, duration approx. 5 s
RF connectors		N (female) on both ends
Remote control		
RS-422 serial interface		4.8/9.6/19.2 kbit/s or 38.4 kbit/s, 1 start bit, 8 data bits, 1 stop bit, no parity, XON/XOFF handshake
Command set		proprietary (not SCPI-compliant)
Environmental conditions		
Temperature	operating temperature range	0 °C to +50 °C (unless otherwise stated)
	permissible temperature range	–10 °C to +55 °C
	storage temperature range	–40 °C to +70 °C
Damp heat		+25 °C/+40 °C, 95 % rel. humidity, cyclic, in line with EN 60068-2-30 with restrictions: noncondensing
Altitude	operating or nonoperating	max. 4600 m
Mechanical resistance		
Vibration	sinusoidal	5 Hz to 55 Hz, 0.15 mm amplitude const., 55 Hz to 150 Hz, acceleration 0.5 g const., in line with EN 60068-2-6
	random	10 Hz to 500 Hz, acceleration 1.9 g (RMS), in line with EN 60068-2-64
Shock		40 g shock spectrum, in line with MIL STD-810E, method 516.4, procedure I
Product conformity		
Electromagnetic compatibility	EU: in line with EMC Directive 2014/30/EU	applied harmonized standards: ▶ EN 61326-1 (industrial environment) ▶ EN 61326-2-1 ▶ EN 55011 (class B) ▶ EN 61000-3-2 ▶ EN 61000-3-3
General data		
Power supply		6.5 V to 28 V, approx. 1.5 W
Length of connecting cable		1.5 m
Maximum length of extension cable	operation via R&S®NRT2	500 m (approx. 1640 ft) [21)]
	operation via R&S®NRT-Z5	30 m (approx. 100 ft)
Cable plug		LEMO S series, FFP model, size 2, 6-pole plug (1: RXD+, 2: RXD–, 3: V_{SUPPLY}, 4: GND, 5: TXD–, 6: TXD+)
Dimensions	W × H × D	120 mm × 95 mm × 39 mm (4.72 in × 3.74 in × 1.54 in)
Weight		0.65 kg (1.43 lb)
Calibration interval		2 years

R&S®NRT2 power reflection meter		
Application		power reflection meter
Sensors		R&S®NRT-Z14, R&S®NRT-Z43, R&S®NRT-Z44
Sensor input		one sensor input on front panel
	connector	LEMO S series, ERA model, size 2, 6-pole receptacle (1: RXD+, 2: RXD–, 3: V_{SUPPLY}, 4: GND, 5: TXD–, 6: TXD+)
Frequency range		25 MHz to 4 GHz (sensor-dependent)
Power measurement range		0.0007 W to 120 W (average), max. 300 W (peak) (sensor-dependent)
Measurement functions		
Power		forward power or power absorbed by the load
Forward power	parameters	average power, average burst power, peak envelope power, peak-to-average ratio (crest factor), complementary cumulative distribution function
	display	
	absolute	in W, dBm and dBµV
	relative	in dB, as change in percent (Δ %) or as quotient
Reflection	parameters	SWR, return loss, reflection coefficient, reverse-to-forward power ratio in %, reverse power
Measurement conditioning and filtering		
Frequency response correction		on input of RF frequency, the stored correction factors are taken into account
Zero adjustment		selectable with RF power switched off, duration approx. 5 s
Averaging filter		automatic or user-selectable
	automatic	dependent on selected resolution of the measurement result and characteristics of the sensor
	user-selectable	1, 2, 4, 8, 16, 32, 64, 128, 256
Maximum/minimum		display of current maximum, minimum or difference (max. – min.)
Measurement uncertainty		see sensor specifications
Display		127 mm (5") TFT color display
	resolution	800 × 480 pixel (WVGA)
Manual operation		via capacitive touch panel and/or keypad
Remote control		
Systems		► IEC 60625.1 (IEEE 488.1) ► IEC 60625.2 (IEEE 488.2)
Command set		SCPI-1999.0
IEC/IEEE bus (R&S®NRT2-B8 option)	interface functions	SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0
	connector	24-pin Amphenol (female)
USB		USB 2.0 high-speed
	connector	USB type B receptacle
	supported protocols	USBTMC via VISA
LAN		10/100/1000BASE-T
	connector	RJ-45 modular socket
	supported protocols	VXI-11, HiSLIP, SCPI-RAW
Measurement time		add 50 ms to sensor specifications
Analog outputs and trigger I/O		
Out 1/Trig Out	Out 1 (analog output 1)	recorder output; user-definable linear relationship to measurement result
	output voltage range	0 V to 2.5 V (no load)
	output resistance	600 Ω (nom.)
	accuracy of no-load output voltage	±(0.4 % of output voltage + 4 mV)
	resolution	16 bit
	update rate	same as result rate of sensor

R&S®NRT2 power reflection meter		
Out 1/Trig Out (cont.)	Trig Out (trigger output)	signaling output; user-definable logic levels for the PASS and FAIL states in the case of limit monitoring
	high-level output voltage	► (5.1 ± 0.2) V (≥ 10 kΩ load) ► 2.6 V (nom.) (50 Ω load)
	low-level output voltage	0 V to 0.4 V (meas.) (5 mA sink current)
	output impedance	50 Ω (nom.)
	connector	BNC (female)
Trig In/Out 2	Trig In (trigger input)	input for trigger signals to sensor (rising edge is translated to RTRG command)
	input impedance	10 kΩ/50 Ω (nom.) selectable
	absolute minimum voltage	–3 V
	absolute maximum voltage	► 6 V (with 10 kΩ input impedance) ► 4 V (with 50 Ω input impedance)
	low-to-high input threshold	(1.8 ± 0.3) V
	high-to-low input threshold	(1.15 ± 0.25) V
	Out 2 (analog output 2)	recorder output; user-definable linear relationship to measurement result
	electrical characteristics	see Out 1
	connector	BNC (female)
USB host ports		two USB 2.0 high-speed host ports (one on front panel, one on rear panel)
	connector	USB type A receptacle
Firmware update		from the R&S®NRP toolkit via LAN or USBTMC using a Windows program; VISA installation is required
Environmental conditions		
Temperature	operating temperature range	0 °C to +50 °C (unless otherwise stated)
	permissible temperature range	–10 °C to +55 °C
	storage temperature range	–40 °C to +70 °C
Damp heat		+25 °C/+55 °C, 95 % rel. humidity, cyclic, in line with EN 60068-2-30 with restrictions: noncondensing
Altitude	operating or nonoperating	max. 4600 m
Mechanical resistance		
Vibration	sinusoidal	5 Hz to 55 Hz, 0.15 mm amplitude const., 55 Hz to 150 Hz, acceleration 0.5 g const., in line with EN 60068-2-6
	random	10 Hz to 500 Hz, acceleration 1.9 g (RMS), in line with EN 60068-2-64
Shock		40 g shock spectrum, in line with MIL-STD-810E, method 516.4, procedure I
Power rating		
Rated voltage	nominal voltage	100 V to 240 V
	voltage range	90 V to 264 V
Rated frequency	nominal frequency	50 Hz to 60 Hz or 400 Hz
	frequency range	47 Hz to 63 Hz or 380 Hz to 420 Hz
Rated current (including options, connected sensors, and connected USB devices)	at 100 V AC	max. 1.7 A
	at 240 V AC	max. 0.8 A

R&S®NRT2 power reflection meter		
Product conformity		
Electromagnetic compatibility	EU: in line with EMC Directive 2014/30/EU	applied harmonized standards: ► EN 61326-1 (industrial environment) ► EN 61326-2-1 ► EN 55011 (class B) ► EN 61000-3-2 ► EN 61000-3-3
Electrical safety	EU: in line with Low Voltage Directive 2006/95/EC	applied harmonized standard: EN 61010-1
	USA	UL 61010-1
	Canada	CAN/CSA-C22.2 No. 61010-1
Dimensions	W × H × D	234 mm × 106 mm × 272 mm (9.21 in × 4.17 in × 10.71 in)
Weight	without any options installed	2.35 kg (5.18 lb)

R&S®NRT-Z5 USB interface adapter		
Application		for connecting an R&S®NRT power sensor to a PC via USB
Sensor input		one sensor input
	connector	LEMO S series, EBC model, size 2, 6-pole receptacle (1: RXD+, 2: RXD–, 3: V_{SUPPLY}, 4: GND, 5: TXD–, 6: TXD+)
Environmental conditions		
Temperature	operating temperature range	0 °C to +60 °C
	storage temperature range	–40 °C to +70 °C
Damp heat		max. 90 % rel. humidity, with restrictions: noncondensing
Altitude	operating or nonoperating	max. 4600 m
Product conformity		
Electromagnetic compatibility	EU: in line with EMC Directive 2014/30/EU	applied harmonized standards: ► EN 55022 (class B) ► EN 55024
Dimensions	W × H × D (without protruding sensor connector)	60 mm × 35 mm × 89 mm (2.36 in × 1.38 in × 3.50 in)
Weight		0.30 kg (0.66 lb)

ORDERING INFORMATION

Designation	Type	Order No.
Base unit		
Power reflection meter	R&S®NRT2	1430.0509.02
Options		
GPIB/IEEE488 interface	R&S®NRT2-B8	1430.0105.02
Directional power sensors		
120 (300) W, 25 MHz to 1 GHz	R&S®NRT-Z14	1120.5505.02
30 (75) W, 0.4 GHz to 4 GHz	R&S®NRT-Z43	1081.2905.02
120 (300) W, 0.2 GHz to 4 GHz	R&S®NRT-Z44	1081.1309.02
Acessories		
Extension cable for R&S®NRT-Zxx power sensors, length: 10 m	R&S®NRT-Z2	1081.2505.10
Extension cable for R&S®NRT-Zxx power sensors, length: 30 m	R&S®NRT-Z2	1081.2505.30
USB interface adapter	R&S®NRT-Z5	1400.6909.02
19" rack adapter (for one R&S®NRT2 power reflection meter and one empty casing)	R&S®ZZA-KNA22	1177.8184.00
19" rack adapter (for two R&S®NRT2 power reflection meters)	R&S®ZZA-KNA24	1177.8149.00

Warranty		
Base unit and power sensors		3 years
All other items [1]		1 year
Options		
Extended warranty, one year	R&S®WE1	Please contact your local Rohde&Schwarz sales office.
Extended warranty, two years	R&S®WE2	
Extended warranty with calibration coverage, one year	R&S®CW1	
Extended warranty with calibration coverage, two years	R&S®CW2	
Extended warranty with accredited calibration coverage, one year	R&S®AW1	
Extended warranty with accredited calibration coverage, two years	R&S®AW2	

[1] For options that are installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1 year warranty.

[1] Depends on measurement function.
[2] Ratio of measured forward and reverse power in dB with perfectly matched load.
[3] Specifications apply to measurement of forward power.
[4] Values in [ ]: 2 ▷ 1 forward direction (if different from 1 ▷ 2 forward direction).
[5] Power measurement below the specified limits is possible at the expense of increased influence of zero offset.
[6] Measurement of average power up to the CW limits is possible at the expense of increased measurement errors.
[7] Increased uncertainty with a coverage factor of k = 2. For normal distribution, this coverage factor has a coverage probability of 95%.
[8] With matched load (SWR max. 1.2) under consideration of the carrier frequency which must be input for an accuracy of 1%; measurement results referenced to the load end of the sensor, averaging filter set to automatic mode (high resolution). The influence of the carrier harmonics can be ignored provided they are below –30 dBc up to 5 GHz. With an SWR of more than 1.2 on the load end, the influence of directivity on the measured forward power is to be considered. The associated increased uncertainty with a coverage factor of k = 2 is equal to 6% of rdg (0.25 dB) × the load reflection coefficient. Example: a mismatched load with 3.0 SWR yields a 0.5 reflection coefficient, producing an additional uncertainty of 3% of rdg (0.13 dB). The overall measurement uncertainty will be increased to 4.4% of rdg (0.19 dB).
[9] With matched load (SWR max. 1.2) under consideration of the carrier frequency which must be input for an accuracy of 1%; measurement results referenced to the load end of the sensor, averaging filter set to automatic mode (high resolution). The influence of harmonics of the carrier can be neglected provided they are below –30 dBc up to 4 GHz, –35 dBc from 4 GHz to 10 GHz and –60 dBc above 10 GHz. With an SWR of more than 1.2 on the load end, the influence of directivity on measured forward power is to be considered. The associated increased uncertainty with a coverage factor of k = 2 equals 6% of rdg (0.25 dB) × load reflection coefficient for carrier frequencies up to 3 GHz and 10% of rdg (0.4 dB) × load reflection coefficient from 3 GHz to 4 GHz. Example: a mismatched load with 3.0 SWR yields a 0.5 reflection coefficient leading to an additional uncertainty of 3% of rdg (0.13 dB) in the frequency range up to 3 GHz. Overall measurement uncertainty will be increased to 4.4% of rdg (0.19 dB).
[10] After zero adjustment.
[11] In the temperature range from +18°C to +28°C; relative to a CW signal. The error depends on the modulation parameters for each case, e.g. the modulation frequency with AM and the individual sensor characteristics. The specified tolerances refer to 1 ▷ 2 forward direction and a power of 30 W (R&S®NRT-Z43) or 120 W (R&S®NRT-Z44). With burst signals, the specified errors refer to an average burst power of 30 W (R&S®NRT-Z43) or 120 W (R&S®NRT-Z14/-Z44). Since errors due to modulation are proportional to power, they become smaller the lower the power: a WCDMA signal with an average power of 30 W, for example, will only cause a very small error of about ±0.5% of the R&S®NRT-Z44 sensor with modulation correction switched on.
[12] With modulation correction switched on.
[13] With modulation correction switched on (same as WCDMA); chip rate set to 3.6864 Mchip/s.
[14] Signal similar to test model 1 with 64 channels for downlink with 3.84 Mchip/s in line with 3GPP standard 3G TS 25.141 V3.1.0 (2000-03); modulation correction switched on, chip rate set according to test signal.
[15] Statistically distributed with a mean value of 0%/K, the stated temperature coefficients correspond to approximately two standard deviations. Temperature coefficients must be considered for calculation of measurement uncertainty below +18°C and above +28°C. Example: at +5°C and 1 GHz, a temperature drift of (18 – 5) × 0.25% = 3.25% of rdg (0.14 dB) for average power measurement can be expected relative to +18°C. Combined with the measurement uncertainty of 3.2% from +18°C to +28°C, the overall uncertainty will be 4.6% of rdg (0.19 dB).
[16] Typical values; may be prolonged by 0.22 s by background temperature measurement. Measurement results settled with power-dependent (automatic) averaging. Each measurement time is defined as the time from the input of the trigger command up to the termination of the return string (baud rate 38.4 kbit/s). All measurement results consist of two measured values: one for the forward power measurement function and one for the selected reflection parameter (SWR, return loss, reflection coefficient or reflected power).
[17] After zero adjustment, unmodulated burst signal with rectangular envelope. The burst power must be at least 1 W for the R&S®NRT-Z43 and at least 4 W for the R&S®NRT-Z14 and the R&S®NRT-Z44. For the R&S®NRT-Z43 and the R&S®NRT-Z44, the burst width must be > 2 ms {4 kHz}, > 40 µs {200 kHz} and > 5 µs {"FULL"}. For the R&S®NRT-Z14, the burst width must be > 2 ms {4 kHz}, > 40 µs {200 kHz} and > 10 µs {"FULL"}. Since the measurement uncertainty is inversely proportional to the burst width and the power, it may be smaller or higher for other waveforms.
[18] In the temperature range from +18°C to +28°C; video bandwidth "FULL", PEP defined as power with a CCDF value < 10^{-6}.
[19] Setting must be initiated with a "rev:pow" command in addition to the setting command for the forward measurement function via the remote interface of the sensor. Since the sensor measures average reverse power with this setting (a parameter normally not of interest in combination with any function other than average power measurement), the setting is denoted as "PEP measurement only" or "CCDF measurement only".
[20] After zero adjustment, unmodulated burst signal with rectangular envelope, threshold value set to half the burst power. The burst power must be at least 1 W for the R&S®NRT-Z43 and at least 4 W for the R&S®NRT-Z44. For the R&S®NRT-Z43 and the R&S®NRT-Z44, the repetition rate must be < 50/s {4 kHz}, < 2500/s {200 kHz}, and < 20000/s {"FULL"}. For the R&S®NRT-Z14, the repetition rate must be < 50/s {4 kHz}, < 2500/s {200 kHz} and < 10000/s {"FULL"}. Since the measurement uncertainty is proportional to the repetition rate and inversely proportional to the power, it may be smaller or higher for other waveforms. For spread spectrum signals such as cdmaOne, CDMA2000®(3x), WCDMA, DAB and DVB-T, the measurement uncertainty is optimally described by an uncertainty for the threshold setting. This uncertainty is taken into account in addition to the specified value. With modulation correction switched on, this additional uncertainty is approx. 5% of the power value in W for the aforementioned standards.
[21] Using double-shielded twisted pair cable with a characteristic impedance of 100 Ω and a cross section of ≥ 0.22 mm^2 (24 AWG) for the data lines is recommended to achieve the advertised performance and electromagnetic immunity. Minimizing voltage drop can require a larger cross section of e.g. 0.5 mm^2 (20 AWG) for the power supply lines.

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