R&S®Spectrum Rider FPH Handheld Spectrum Analyzer

Specifications

ROHDE&SCHWARZ

Data Sheet | Version 05.00

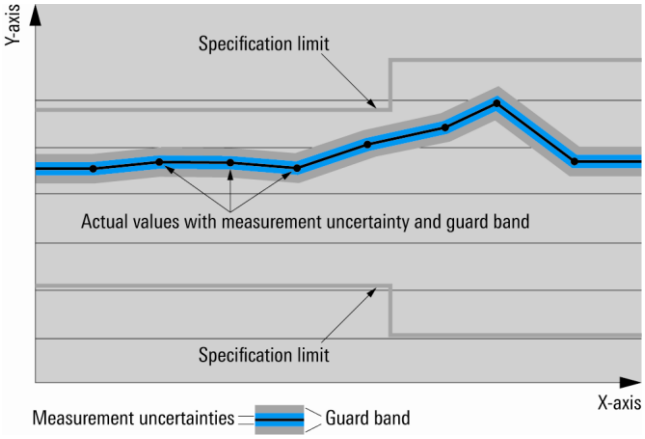
CONTENTS

Definitions

General
Product data applies under the following conditions:

- Three hours storage at ambient temperature followed by 30 minutes warm-up operation
- Specified environmental conditions met
- Recommended calibration interval adhered to
- All internal automatic adjustments performed, if applicable

Specifications with limits
Represent warranted product performance by means of a range of values for the specified parameter. These specifications are marked with limiting symbols such as <, ≤, >, ≥, ±, or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design. Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.



Specifications without limits
Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (e.g. dimensions or resolution of a setting parameter). Compliance is ensured by design.

Typical data (typ.)
Characterizes product performance by means of representative information for the given parameter. When marked with <, > or as a range, it represents the performance met by approximately 80 % of the instruments at production time. Otherwise, it represents the mean value.

Nominal values (nom.)
Characterize product performance by means of a representative value for the given parameter (e.g. nominal impedance). In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

Measured values (meas.)
Characterize expected product performance by means of measurement results gained from individual samples.

Uncertainties
Represent limits of measurement uncertainty for a given measurand. Uncertainty is defined with a coverage factor of 2 and has been calculated in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM), taking into account environmental conditions, aging, wear and tear.

Device settings and GUI parameters are indicated as follows: “parameter: value”.

Typical data as well as nominal and measured values are not warranted by Rohde & Schwarz.

Frequency

Frequency range	R&S®Spectrum Rider FPH model .02	5 kHz to 2 GHz
	with R&S®FPH-B3 option installed	5 kHz to 3 GHz
	with R&S®FPH-B3 and R&S®FPH-B4 options installed	5 kHz to 4 GHz
	R&S®Spectrum Rider FPH model .06	5 kHz to 6 GHz
	with R&S® FPH-B8 option installed	5 kHz to 8 GHz
	R&S®Spectrum Rider FPH model .13	5 kHz to 13.6 GHz
	with R&S® FPH-B20 option installed	5 kHz to 20 GHz
	R&S®Spectrum Rider FPH model .26	5 kHz to 26.5 GHz
	with R&S® FPH-B31 option installed	5 kHz to 31 GHz
Frequency resolution		1 Hz

Reference frequency, internal		
Aging per year		1×10^{-6}
Temperature drift	0 °C to +50 °C	1×10^{-6}
Achievable initial calibration accuracy		5×10^{-7}
Total reference uncertainty		(time since last adjustment × aging rate) + temperature drift + calibration accuracy

Frequency readout		
Marker resolution		1 Hz
Uncertainty		±(marker frequency × reference uncertainty + 10 % × resolution bandwidth + ½ (span/(sweep points – 1) + 1 Hz)
Number of sweep (trace) points		711
Marker tuning frequency step size		span/710
Frequency counter resolution		0.1 Hz
Count uncertainty	SNR > 25 dB	±(frequency × reference uncertainty + ½ (last digit))
Frequency span		0 Hz, 10 Hz to 2/3/4/6/8/13.6/20/26.5/31 GHz
Span uncertainty		nom. 1 %

Spectral purity SSB phase noise		f = 500 MHz
Carrier offset	30 kHz	< –88 dBc (1 Hz), typ. –95 dBc (1 Hz)
	100 kHz	< –98 dBc (1 Hz), typ. –105 dBc (1 Hz)
	1 MHz	< –118 dBc (1 Hz), typ. –125 dBc (1 Hz)

Sweep time

Sweep time	span = 0 Hz	1 ms to 1000 s
	10 Hz ≤ span ≤ 600 MHz	20 ms to 1000 s
	span > 600 MHz	20 ms × span/1600 MHz to 1000 s
Uncertainty	span = 0 Hz	nom. 1 %
	span ≥ 10 Hz	nom. 3 %

Bandwidths

Resolution bandwidths		
Range	–3 dB bandwidth	1 Hz to 3 MHz in 1/3 sequence
Bandwidth accuracy	1 Hz ≤ RBW ≤ 300 kHz	nom. < 5 %
	300 kHz < RBW ≤ 1 MHz	nom. < 10 %
Selectivity 60 dB:3 dB		nom. < 5 (Gaussian type filters)
Video filters		
Range	–3 dB bandwidth	1 Hz to 3 MHz in 1/3 sequence

Level

Display range		displayed noise floor to +30 dBm
Maximum rated input level		
DC voltage		50 V
CW RF power		33 dBm (= 2 W)
Peak RF power	duration < 3 s	36 dBm (= 4 W)
Max. pulse voltage		150 V
Max. pulse energy	pulse width 10 µs	10 mWs
Intermodulation		
Third-order intercept (TOI)	intermodulation-free dynamic range, signal level 2 × –20 dBm, RF attenuation = 0 dB, RF preamplifier = off	
	R&S®Spectrum Rider FPH model .02	
	f = 1 GHz	+7 dBm (meas.)
	f = 2.4 GHz	+10 dBm (meas.)
	R&S®Spectrum Rider FPH models .06/.13/.26	
	f = 1 GHz	+7 dBm (meas.)
	f = 4.5 GHz	+8 dBm (meas.)
	f = 9.5 GHz	+10 dBm (meas.)
	f = 12 GHz	+9 dBm (meas.)
	f = 22 GHz	+8 dBm (meas.)
	f = 26.5 GHz	+10 dBm (meas.)
Second-harmonic intercept (SHI)	RF attenuation = 0 dB, RF preamplifier = off, signal level = –40 dBm	
	R&S®Spectrum Rider FPH model .02	
	f_{in} = 20 MHz to 1.5 GHz	nom. –60 dBc
	f_{in} = 1.5 GHz to 2 GHz	nom. –80 dBc
	R&S®Spectrum Rider FPH models .06/.13/.26	
	f_{in} = 20 MHz to 1.5 GHz	nom. –60 dBc
	f_{in} = 1.5 GHz to 4 GHz	nom. –90 dBc
	f_{in} = 4 GHz to 10 GHz	nom. –90 dBc
	f_{in} = 10 GHz to 14 GHz	nom. –90 dBc
	f_{in} = 14 GHz to 15.4 GHz	nom. –85 dBc
Displayed average noise level (DANL)	0 dB RF attenuation, termination 50 Ω, RBW = 1 kHz, VBW = 10 Hz, sample detector, log scaling, normalized to 1 Hz	
	R&S®Spectrum Rider FPH model .02	
	frequency	preamplifier = off
	1 MHz to 10 MHz	< –135 dBm, typ. –142 dBm
	10 MHz to 1 GHz	< –142 dBm, typ. –146 dBm
	1 GHz to 4 GHz	< –140 dBm, typ. –144 dBm
	frequency	preamplifier = on
	1 MHz to 10 MHz	< –150 dBm, typ. –160 dBm
	10 MHz to 3 GHz	< –158 dBm, typ. –163 dBm
	3 GHz to 4 GHz	< –156 dBm, typ. –161 dBm
	R&S®Spectrum Rider FPH models .06/.13/.26	
	frequency	preamplifier = off
	1 MHz to 10 MHz	< –122 dBm, typ. –130 dBm
	10 MHz to 25 MHz	< –130 dBm, typ. –135 dBm
	25 MHz to 1 GHz	< –140 dBm, typ. –145 dBm
	1 GHz to 4 GHz	< –135 dBm, typ. –140 dBm
	4 GHz to 8 GHz	< –135 dBm, typ. –140 dBm
	8 GHz to 19 GHz	< –135 dBm, typ. –138 dBm
	19 GHz to 20 GHz	< –130 dBm, typ. –138 dBm
	20 GHz to 27 GHz	< –130 dBm, typ. –138 dBm
	27 GHz to 29 GHz	< –125 dBm, typ. –130 dBm
	29 GHz to 31 GHz	< –120 dBm, typ. –123 dBm
	frequency	preamplifier = on
	1 MHz to 20 MHz	< –147 dBm, typ. –152 dBm
	20 MHz to 1 GHz	< –158 dBm, typ. –162 dBm
	1 GHz to 3 GHz	< –158 dBm, typ. –162 dBm
	3 GHz to 4 GHz	< –155 dBm, typ. –158 dBm
	4 GHz to 4.5 GHz	< –155 dBm, typ. –158 dBm
	4.5 GHz to 8 GHz	< –150 dBm, typ. –155 dBm
	8 GHz to 20 GHz	< –150 dBm, typ. –155 dBm
	20 GHz to 27 GHz	< –150 dBm, typ. –155 dBm
	27 GHz to 29 GHz	< –140 dBm, typ. –145 dBm
	29 GHz to 31 GHz	< –130 dBm, typ. –133 dBm

Immunity to interference		
Image frequencies	R&S®Spectrum Rider FPH model .02	
	f_{in} – 2 × 30.15 MHz	nom. < –70 dBc
	f_{in} – 2 × 830.15 MHz	nom. < –70 dBc
	f < 3 GHz , f_{in} – 2 × 830.15 MHz	nom. < –70 dBc
	f < 3 GHz, f_{in} – 2 × 4042.65 MHz	nom. –60 dBc
	f ≥ 3 GHz, f_{in} + 2 × 830.15 MHz	nom. –60 dBc
	R&S®Spectrum Rider FPH model .06/.13/.26	
	f_{in} – 2 × 30.15 MHz	nom. < –70 dBc
	f_{in} – 2 × 830.15 MHz	nom. < –70 dBc
	f < 4 GHz, f_{in} – 2 × 830.15 MHz	nom. < –70 dBc
	f < 4 GHz, f_{in} + 2 × 5582.35 MHz	nom. < –50 dBc
	f < 4 GHz, f_{in} + 2 × 7230.15 MHz	nom. < –50 dBc
	4 GHz ≤ f < 8 GHz, f_{in} – 2 × 830.15 MHz	nom. < –70 dBc
	8 GHz ≤ f < 20 GHz, f_{in} – 2 × 830.15 MHz	nom. < –70 dBc
	8 GHz ≤ f < 20 GHz, f_{in} + 2 × 4030.15 MHz	nom. < –70 dBc
	8 GHz ≤ f < 20 GHz, f_{in} + 2 × 5582.35 MHz	nom. < –70 dBc
	8 GHz ≤ f < 20 GHz, f_{in} + 2 × 7230.15 MHz	nom. < –70 dBc
	20 GHz ≤ f < 26.5GHz, f_{in} – 2 × 4030.15 MHz	nom. < –40 dBc
	26.5 GHz ≤ f < 28.5 GHz, f_{in} – 2 × 7230.15 MHz	nom. < –60 dBc
Intermediate frequencies	R&S®Spectrum Rider FPH model .02	
	30.15 MHz, 830.15 MHz, 4042.65 MHz	nom. < –60 dBc
	R&S®Spectrum Rider FPH models .06/.13/.26	
	30.15 MHz, 830.15 MHz, 4030.15 MHz	nom. < –60 dBc
	5582.35 MHz	nom. < –50 dBc
	7230.15 MHz	nom. < –40 dBc
Other interfering signals, signal level – RF attenuation < –30 dBm	R&S®Spectrum Rider FPH model .02	
	f ≤ 3 GHz, spurious at f_{in} – 2021.325 MHz	nom. < –60 dBc
	R&S®Spectrum Rider FPH models .06/.13/.26	
	f < 4 GHz, spurious at f_{in} + 2015.075 MHz	nom. < –60 dBc
	4 GHz ≤ f < 8 GHz, f_{in} – 415.075 MHz	nom. < –60 dBc
	8 GHz ≤ f < 20 GHz, f_{in} + 2015.075 MHz	nom. < –60 dBc
	8 GHz ≤ f < 20 GHz, f_{in} + 2791.175 MHz	nom. < –60 dBc
	8 GHz ≤ f < 20 GHz, f_{in} + 3615.075 MHz	nom. < –60 dBc
	20 GHz ≤ f < 26.5 GHz, f_{in} – 2015.075 MHz	nom. < –60 dBc
	26.5 GHz ≤ f < 28.5 GHz, f_{in} – 3615.075 MHz	nom. < –60 dBc
Other interfering signals, related to local oscillators	R&S®Spectrum Rider FPH model .02	
	$\Delta f \geq 300$ kHz	nom. < –60 dBc
	R&S®Spectrum Rider FPH models .06/.13/.26	
	$\Delta f \geq 300$ kHz, $\Delta f \leq 1600$ MHz	nom. < –60 dBc except otherwise stated
	$\Delta f \leq -422.5$ MHz, 21440 MHz ≤ f_{in} < 23400 MHz	nom. < –35 dBc
	$\Delta f \geq 1115$ MHz, 23400 MHz ≤ f_{in} < 24400 MHz	nom. < –40 dBc
	f = receive frequency	
Residual spurious response	input matched with 50 Ω, without input signal, RBW ≤ 30 kHz, f ≥ 3 MHz, RF attenuation = 0 dB	nom. < –90 dBm

Level display		
Logarithmic level axis		1/2/3/5/10/20/30/50/100/120/150 dB, 10 divisions
Linear level axis		0 % to 100 %, 10 divisions
Number of traces		2
Trace detectors		max. peak, min. peak, auto peak, sample, RMS
Trace functions		clear/write, max. hold, min. hold, average, view
Setting range of reference level		–130 dBm to +30 dBm
Units of level axis		dBm, dBmV, dBµV, V, W
Level measurement uncertainty		
Absolute level uncertainty at 100 MHz	+20 °C to +30 °C	< 0.3 dB
Frequency response (+20 °C to +30 °C)	5 kHz ≤ f < 10 MHz	nom. < 1.5 dB
	10 MHz ≤ f < 8 GHz	< 1 dB
	8 GHz ≤ f < 20 GHz	< 1.5 dB
	20 GHz ≤ f ≤ 31 GHz	< 2 dB
Attenuator uncertainty		< 0.3 dB
Uncertainty of reference level setting		nom. < 0.1 dB
Display nonlinearity	SNR > 16 dB, 0 dB to –50 dB, logarithmic level display	< 0.3 dB
Bandwidth switching uncertainty	reference: RBW = 10 kHz	nom. < 0.1 dB
Total measurement uncertainty	95 % confidence level, +20 °C to +30 °C, SNR > 16 dB, 0 dB to –50 dB below reference level, RF attenuation auto	
	10 MHz ≤ f ≤ 31 GHz	< 1.25 dB, typ. 0.5 dB

Trigger functions

Trigger		
Trigger source		free run, video, external
External trigger level threshold	low → high transition	2.4 V
	high → low transition	0.7 V
	maximum	3.0 V

Inputs and outputs

RF input		
Impedance		nom. 50 Ω
Connector	R&S®Spectrum Rider FPH models .02/.06/.13	N female
	R&S®Spectrum Rider FPH model .26	PC 3.5 mm male
VSWR	R&S®Spectrum Rider FPH model .02	
	100 kHz ≤ f ≤ 1 GHz	nom. < 1.5
	1 GHz < f ≤ 4 GHz	nom. < 2
	R&S®Spectrum Rider FPH models .06/.13/.26	
	100 kHz ≤ f ≤ 100 MHz	nom. < 2
	100 MHz ≤ f ≤ 1 GHz	nom. < 1.5
	1 GHz < f ≤ 31 GHz	nom. < 2
Input attenuator	RF input only	0 dB to 40 dB in 5 dB steps
AF output		
AF demodulation types		AM and FM
Connector		3.5 mm mini jack
Output impedance		nom. 32 Ω
Voltage (open circuit)		V (RMS), adjustable from 0 V to > 100 mV
External reference, external trigger		
Connector		BNC, 50 Ω
Mode		external reference, external trigger
External reference	required level	0 dBm
	frequency	10 MHz
External trigger threshold	low → high transition	2.4 V
	high → low transition	0.7 V

General data

Manual operation		
Languages		Chinese, Chinese Traditional, English, French, German, Italian, Hungarian, Japanese, Korean, Portuguese, Russian, Spanish
Remote control		
Command set		SCPI 1997.0
LAN interface		10/100BASE-T, RJ-45
USB		mini B plug, version 2.0
Display		
Resolution		WVGA, 800 × 480 pixel
Audio		
Speaker		internal, external headphone supported
USB interface		type A plug, version 2.0
	number of interfaces	2
Mass memory		
Mass memory		USB stick/micro SD card (not supplied) size ≤ 32 Gbyte, USB version 1.1 or 2.0
Data storage	internal	> 160 instrument settings and traces
	on USB stick or micro SD card, ≥ 1 Gbyte	> 10000 instrument settings and traces
Temperature	operating temperature range	–10 °C to +55 °C
	storage temperature range	–40 °C to +70 °C
	battery charging mode	0 °C to +40 °C
Climatic loading	relative humidity	+25/+55 °C at 95 % relative humidity, in line with EN 60068-2-30
	protection class	IP51
Mechanical resistance		
Vibration	sinusoidal	in line with EN 60068-2-6, MIL-PRF-28800F class 2
	random	in line with EN 60068-2-64, MIL-PRF-28800F class 2
Shock		40 g shock spectrum, in line with MIL-STD-810E, method 516.4 procedure 1, MIL-PRF-28800F
Power supply		
R&S®HA-Z301 AC power supply	input specifications	100 V to 240 V AC, 50 Hz/60 Hz, 1.0 A to 0.5 A
	output specifications	15 V, 2.67 A, max. 40 W
	operating temperature range	–30 °C to +60 °C
	storage temperature range	–40 °C to +85 °C
	test mark	CE, UL, PSE, TUV
External DC voltage		14.65 V to 15.45 V
Battery		lithium-ion battery
Capacity	R&S®HA-Z306	72 Wh
Voltage		nom. 11.25 V
Operating time with new, fully charged battery	R&S®HA-Z306	8 h (R&S®Spectrum Rider FPH model .02)
		7 h (R&S®Spectrum Rider FPH model .06)
		6 h (R&S®Spectrum Rider FPH models .13/.26)
Charging time	instrument switched off or charge with R&S®HA-Z303 battery charger	3.5 h
	instrument switched on	4 h
Life time	charging cycles	> 80 % or more of its initial capacity after 300 charge/discharge
Power consumption		8 W (meas.)
Safety		IEC 61010-1, EN 61010-1, UL 61010-1 (Third Edition), CAN/CSA-C22.2 No. 61010-1-12
Test mark		VDE, CSA, CSA-NRTL

EMC		in line with European EMC Directive 2004/108/EC including
		• EN 61326-1 class B (emission) • CISPR 11/EN 55011/group 1 class B (emission) • EN 61326-1 table 2 (immunity, industrial)
Dimensions	W × H × D	202 mm × 294 mm × 76 mm (8.0 in × 11.6 in × 3 in)
Weight		2.5 kg (5.5 lb)
Recommended calibration interval		1 year

Equivalence of specifications for different R&S®FPH part numbers

- The specifications for part number 1321.1111.02 are equivalent to part number 1321.1111.52.
- The specifications for part number 1321.1111.06 are equivalent to part number 1321.1111.56.
- The specifications for part number 1321.1111.13 are equivalent to part number 1321.1111.63.
- The specifications for part number 1321.1111.26 are equivalent to part number 1321.1111.76.

R&S®FPH-K7 analog modulation analysis AM/FM

Measurement of analog modulation signals		
Center frequency	R&S®Spectrum Rider FPH model .02	10 MHz to 2 GHz
	with R&S®FPH-B3 option installed	10 MHz to 3 GHz
	with R&S®FPH-B3 and R&S®FPH-B4 options installed	10 MHz to 4 GHz
	R&S®Spectrum Rider FPH model .06	10 MHz to 6 GHz
	with R&S®FPH-B8 option installed	10 MHz to 8 GHz
	R&S®Spectrum Rider FPH model .13	10 MHz to 13.6 GHz
	with R&S®FPH-B20 option installed	10 MHz to 20 GHz
	R&S®Spectrum Rider FPH model .26	10 MHz to 26.5 GHz
	with R&S®FPH-B31 option installed	10 MHz to 31 GHz
Demodulation bandwidth		2 MHz, 1 MHz, 500 kHz, 300 kHz, 200 kHz, 100 kHz, 50 kHz, 30 kHz, 20 kHz, 10 kHz (nom.)
Bandwidth accuracy		nom. < ±5%
Display	AM	carrier power, carrier frequency offset, AM modulation depth, modulation frequency, THD, SINAD
	FM	carrier power, carrier frequency offset, FM deviation, modulation frequency, THD, SINAD

Carrier power		
Carrier power measurement accuracy		add 0.2 dB, see section Level measurement uncertainty
Display resolution		0.1 dB

AF (modulation frequency) [1]		
Range	AM	nom. 20 Hz to 100 kHz
	FM	nom. 20 Hz to 200 kHz
Resolution		1 Hz
Measurement uncertainty	1 kHz ≤ AF ≤ 200 kHz	nom. ±(1 % of measured value)
	20 Hz ≤ AF < 1 kHz	nom. ±1 Hz
AF filters		
Lowpass	audio decimation	bypass, 1/10, 1/30, 1/100 (nom.)
De-emphasis	FM demodulation and demodulation bandwidth 200 kHz and 300 kHz	off, 50 µs, 75 µs (nom.)

AM demodulation [2]		
Measurement range	modulation depth	nom. 5 % to 95 %
Modulation depth uncertainty		nom. ±(4 %)

FM demodulation [3]		
Measurement range	frequency deviation	nom. 10 kHz to 400 kHz , max. 0.4 × demodulation bandwidth
Deviation uncertainty		nom. ±(0.04 × (AF + deviation))

Modulation distortion [1, 2, 3]		
Measurement functions		THD, SINAD
Measurement range		–50 dB to 0 dB (THD)
		0 dB to 50 dB (SINAD, AM)
		0 dB to 40 dB (SINAD, FM)
Display resolution		0.1 dB
Measurement uncertainty		nom. 1 dB
AF frequency range		nom. 20 Hz to 100 kHz

[1] Min. and max. detectable audio frequency and harmonics depend on the demodulation bandwidth and audio filter settings.

[2] Modulation frequency 1 kHz sine, AM modulation depth 50 %, carrier level 0 dBm, center frequency = 499 MHz, reference level 6 dBm, demodulation bandwidth = 20 kHz, SNR > 60 dB, audio filter = bypass.

[3] Modulation frequency 1 kHz sine, FM deviation = 75 kHz, carrier level 0 dBm, center frequency = 499 MHz, reference level 6 dBm, demodulation bandwidth = 300 kHz, SNR > 60 dB, audio filter = 1/10, de-emphasis = off.

R&S®FPH-K19 channel power meter

Frequency range	R&S®Spectrum Rider FPH model .02	5 kHz to 2 GHz
	with R&S®FPH-B3 option installed	5 kHz to 3 GHz
	with R&S®FPH-B3 and R&S®FPH-B4 options installed	5 kHz to 4 GHz
	R&S®Spectrum Rider FPH model .06	5 kHz to 6 GHz
	with R&S®FPH-B8 option installed	5 kHz to 8 GHz
	R&S®Spectrum Rider FPH model .13	5 kHz to 13.6 GHz
	with R&S®FPH-B20 option installed	5 kHz to 20 GHz
	R&S®Spectrum Rider FPH model .26	5 kHz to 26.5 GHz
	with R&S®FPH-B31 option installed	5 kHz to 31 GHz
Channel bandwidth		100 kHz to 1 GHz
Amplitude		offset, dB relative, zeroing
Unit		dBm, W
Limits		on/off, upper limit, lower limit, beep on fail
Measurement range		–120 dBm to +30 dBm
Level measurement uncertainty		
Absolute level uncertainty at 100 MHz	+20 °C to +30 °C	< 0.3 dB
Frequency response (+20 °C to +30 °C)	100 kHz ≤ f < 10 MHz	nom. < 1.5 dB
	10 MHz ≤ f ≤ 4 GHz	< 1.25 dB

R&S®FPH-K29 pulse measurements with power sensor

In combination with one of the R&S®NRP-Z81, -Z85 or -Z86 power sensors, the R&S®Spectrum Rider FPH supports measurements on pulsed signals. The achievable RF performance is documented in the data sheet specifications of the R&S®NRP-Z81/-Z85/-Z86 power sensors. The list below shows which measurements are supported by the R&S®FPH-K29.

Measurements	**R&S®FPH-K29**
Pulse power parameters	●
Peak power	●
Pulse top power	●
Average power	●
Base power	●
Minimum power	●
Positive overshoot	●
Negative overshoot	●
Pulse timing parameters	●
Pulse duration	●
Pulse period	●
Pulse start/stop time	●
Rise/fall time	●
Duty cycle	●

R&S®FPH-K43 receiver mode and channel scan measurement application

The specifications below apply to the R&S®Spectrum Rider FPH. They are based on the data sheet specifications of the R&S®Spectrum Rider FPH, have not been checked separately and are not verified during instrument calibration.

Measurements	**R&S®FSH-K43**
Fixed frequency	●
Frequency scan	●
Channel scan	●
User defined channel list	●
EMI precompliance	●
CISPR bandwidths	●
CISPR detectors	●

Frequency range		see basic instrument
Measurement modes		fixed frequency, frequency scan, channel scan
Frequency scan stepsize		
Scan stepsize		100 Hz to max. frequency
Max. number of steps		10000
Channel scan		
Channel spacing		user definable
Max. number of channels		10000

Resolution bandwidths		
Range	–3 dB bandwidth	1 Hz to 3 MHz in 1/3 sequence
Detectors	CISPR bandwidths (–6 dB)	200 Hz, 9 kHz, 120 kHz, 1 MHz
		max. peak, average, RMS, quasi-peak
Level		see basic instrument

R&S®HA-Z350 log-periodic OEM antenna

Frequency range		700 MHz to 4 GHz
Gain		typ. 4 dBi
Impedance		50 Ω
VSWR		nom. < 1:2
Connector type		SMA (f)
Dimensions	W × H × D	340 mm × 200 mm × 25 mm (13.3 in × 7.9 in × 1 in)
Weight		270 g (0.6 lb)
Accessories supplied	hardcase with foam, typical calibration data in 10 MHz steps, pistol grip with mini-tripod function, one set of SMA toolset	

R&S®FSH-Z14 directional power sensor [4]

Frequency range		25 MHz to 1 GHz
Power measurement range		30 mW to 300 W
VSWR referenced to 50 Ω		< 1.06
Power handling capacity	depending on temperature and matching (see diagram on page 13)	100 W to 1000 W
Insertion loss		< 0.06 dB
Directivity		> 30 dB

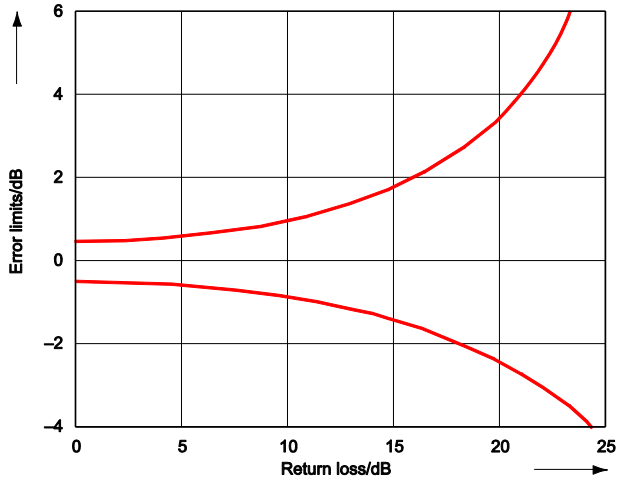
Average power		
Power measurement range		
CW, FM, PM, FSK, GMSK	CF: ratio of peak envelope	30 mW to 300 W
Modulated signals	power to average power	30 mW to 300 W/CF
Measurement uncertainty		
25 MHz to 40 MHz	sine signal	4.0 % of measured value (0.17 dB)
40 MHz to 1 GHz	+18 °C to +28 °C, no zero offset	3.2 % of measured value (0.14 dB)
Zero offset	after zeroing	±4 mW
Range of typical measurement error with modulation	FM, PM, FSK, GMSK	0 % of measured value (0 dB)
	AM (80 %)	±3 % of measured value (±0.13 dB)
	two CW carriers with identical power	±2 % of measured value (±0.09 dB)
	EDGE, TETRA	±0.5 % of measured value (±0.02 dB) [5]
Temperature coefficient	25 MHz to 40 MHz	0.40 %/K (0.017 dB/K)
	40 MHz to 1 GHz	0.25 %/K (0.011 dB/K)

Max. peak envelope power		
Power measurement range		
Video bandwidth	4 kHz	0.4 W to 300 W
	200 kHz	1 W to 300 W
	600 kHz	2 W to 300 W
Measurement uncertainty	same as for average power plus effect of peak hold circuit	+18 °C to +28 °C
Error limits of peak hold circuit for burst signals	duty cycle ≥ 0.1 and repetition rate ≥ 100/s	
	video bandwidth 4 kHz	±(3 % of measured value + 0.05 W) starting from a burst width of 200 µs
	video bandwidth 200 kHz	±(3 % of measured value + 0.20 W) starting from a burst width of 4 µs
	video bandwidth 600 kHz	±(7 % of measured value + 0.40 W) starting from a burst width of 2 µs
	20/s ≤ repetition rate < 100/s	plus ±(1.6 % of measured value + 0.15 W)
	0.001 ≤ duty cycle < 0.1	plus ±0.10 W
Temperature coefficient	25 MHz to 40 MHz	0.50 %/K (0.022 dB/K)
	40 MHz to 1 GHz	0.35 %/K (0.015 dB/K)

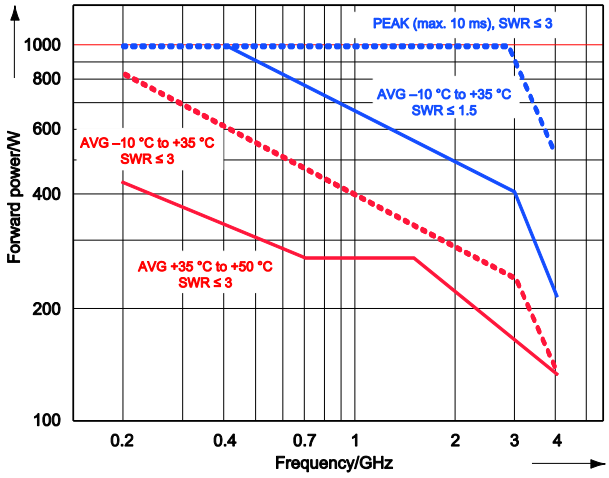
[4] Requires R&S®FSH-Z144 adapter cable.

[5] If standard is selected on the R&S®Spectrum Rider FPH.

Load matching		
Matching measurement range		
Return loss		0 dB to 23 dB
VSWR		> 1.15
Minimum forward power	specifications complied with ≥ 0.4 W	0.06 W
Dimensions (W × H × D)		120 mm × 95 mm × 39 mm (4.72 in × 3.74 in × 1.53 in)
	connecting cable	1.5 m (59 in)
Weight		0.65 kg (1.43 lb)



Error limits for matching measurements.



Power handling capacity.

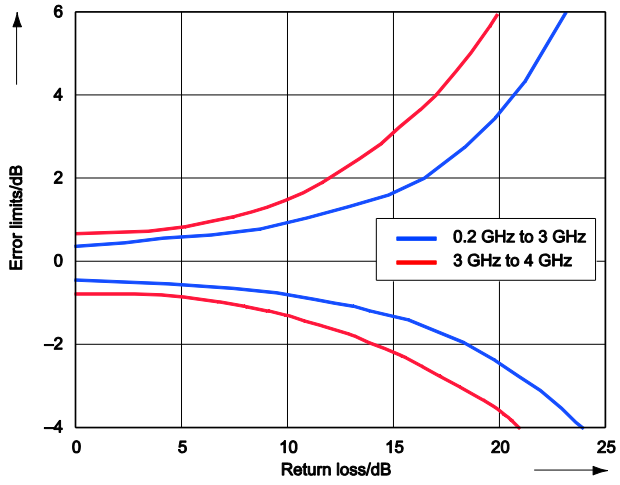
R&S®FSH-Z44 directional power sensor [6]

Frequency range		200 MHz to 4 GHz
Power measurement range		30 mW to 300 W
VSWR referenced to 50 Ω	200 MHz to 3 GHz	< 1.07
	3 GHz to 4 GHz	< 1.12
Power handling capacity	depending on temperature and matching (see diagram on page 15)	120 W to 1000 W
Insertion loss	200 MHz to 1.5 GHz	< 0.06 dB
	1.5 GHz to 4 GHz	< 0.09 dB
Directivity	200 MHz to 3 GHz	> 30 dB
	3 GHz to 4 GHz	> 26 dB
Average power		
Power measurement range	CF: ratio of peak envelope power to average power	
	CW, FM, PM, FSK, GMSK	30 mW to 300 W
	LTE, 3GPP WCDMA, cdmaOne, CDMA2000®, DAB, DVB-T	30 mW to 120 W
	other modulated signals	30 mW to 300 W/CF
Measurement uncertainty	sine signal, +18 °C to +28 °C, no zero offset	
	200 MHz to 300 MHz	4.0 % of measured value (0.17 dB)
	300 MHz to 4 GHz	3.2 % of measured value (0.14 dB)
Zero offset	after zeroing	±4 mW
Range of typical measurement error with modulation	FM, PM, FSK, GMSK	0 % of measured value (0 dB)
	AM (80 %)	±3 % of measured value (±0.13 dB)
	two CW carriers with identical power	±2 % of measured value (±0.09 dB)
	π/4-DQPSK	±2 % of measured value (±0.09 dB)
	EDGE	±0.5 % of measured value (±0.02 dB) [7]
	cdmaOne, DAB	±1 % of measured value (±0.04 dB) [7]
	3GPP WCDMA, CDMA2000®	±2 % of measured value (±0.09 dB) [7]
	DVB-T	±2 % of measured value (±0.09 dB) [7]
Temperature coefficient	200 MHz to 300 MHz	0.40 %/K (0.017 dB/K)
	300 MHz to 4 GHz	0.25 %/K (0.011 dB/K)
Max. peak envelope power		
Power measurement range		
DAB, DVB-T, cdmaOne, CDMA2000®, 3GPP WCDMA		4 W to 300 W
Other signals at video bandwidth	4 kHz	0.4 W to 300 W
	200 kHz	1 W to 300 W
	4 MHz	2 W to 300 W
Measurement uncertainty	+18 °C to +28 °C	same as for average power plus effect of peak hold circuit
Error limits of peak hold circuit for burst signals	duty cycle ≥ 0.1 and repetition rate ≥ 100/s	
	video bandwidth 4 kHz	±(3 % of measured value + 0.05 W) starting from a burst width of 100 µs
	video bandwidth 200 kHz	±(3 % of measured value + 0.20 W) starting from a burst width of 4 µs
	video bandwidth 4 MHz	±(7 % of measured value + 0.40 W) starting from a burst width of 1 µs
	20/s ≤ repetition rate < 100/s	plus ±(1.6 % of measured value + 0.15 W)
	0.001 ≤ duty cycle < 0.1	plus ±0.10 W
	burst width ≥ 0.5 µs	plus ±5 % of measured value
	burst width ≥ 0.2 µs	plus ±10 % of measured value
Range of typical measurement error of peak hold circuit	video bandwidth 4 MHz and standard selected on the R&S®FSH4/8/13/20	
	cdmaOne, DAB	±(5 % of measured value + 0.4 W)
	DVB-T, CDMA2000®, 3GPP WCDMA	±(15 % of measured value + 0.4 W)
Temperature coefficient	200 MHz to 300 MHz	0.50 %/K (0.022 dB/K)
	300 MHz to 4 GHz	0.35 %/K (0.015 dB/K)

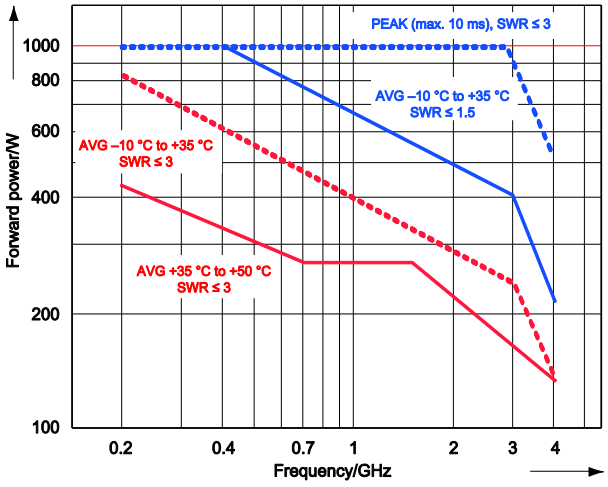
[6] Requires R&S®FSH-Z144 adapter cable.

[7] If standard is selected on the R&S®Spectrum Rider FPH.

Load matching		
Matching measurement range		
Return loss	200 MHz to 3 GHz	0 dB to +23 dB
VSWR	3 GHz to 4 GHz	0 dB to +20 dB
VSWR	200 MHz to 3 GHz	> 1.15
	3 GHz to 4 GHz	> 1.22
Minimum forward power	specifications complied with ≥ 0.2 W	0.03 W
Dimensions (W × H × D)		120 mm × 95 mm × 39 mm (4.72 in × 3.74 in × 1.53 in)
	connecting cable	1.5 m (59 in)
Weight		0.65 kg (1.43 lb)



Error limits for matching measurements.



Power handling capacity.

Ordering information

Designation	Type	Order No.
Handheld spectrum analyzer, 5 kHz to 2 GHz	R&S®Spectrum Rider FPH	1321.1111.02
Handheld spectrum analyzer, 5 kHz to 6 GHz	R&S®Spectrum Rider FPH	1321.1111.06
Handheld spectrum analyzer, 5 kHz to 13.6 GHz	R&S®Spectrum Rider FPH	1321.1111.13
Handheld spectrum analyzer, 5 kHz to 26.5 GHz	R&S®Spectrum Rider FPH	1321.1111.26
Accessories supplied		
Lithium-ion battery pack, USB cable, AC power supply with country specific adapters for EU, GB, US, AUS, CH, CD-ROM with R&S®InstrumentView software and documentation, quick start guide, side strap		

Options

Designation	Type	Order No.
Spectrum analyzer frequency upgrade, 2 GHz to 3 GHz [8]	R&S®FPH-B3	1321.0667.02
Spectrum analyzer frequency upgrade, 3 GHz to 4 GHz [8] (requires R&S®FPH-B3)	R&S®FPH-B4	1321.0673.02
Spectrum analyzer frequency upgrade, 6 GHz to 8 GHz [9]	R&S®FPH-B8	1321.0767.02
Spectrum analyzer frequency upgrade, 13.6 GHz to 20 GHz [10]	R&S®FPH-B20	1321.0773.02
Spectrum analyzer frequency upgrade, 26.5 GHz to 31 GHz [11]	R&S®FPH-B31	1321.0780.02
Spectrum analyzer preamplifier, 5 kHz to 4 GHz [8]	R&S®FPH-B22	1321.0680.02
Spectrum analyzer preamplifier, 5 kHz to 8 GHz [9]	R&S®FPH-B23	1321.0867.02
Spectrum analyzer preamplifier, 5 kHz to 20 GHz [10]	R&S®FPH-B24	1321.0850.02
Spectrum analyzer preamplifier, 5 kHz to 31 GHz [11]	R&S®FPH-B25	1321.0873.02
Analog modulation analysis AM/FM	R&S®FPH-K7	1321.0696.02
Power sensor support	R&S®FPH-K9	1321.0709.02
Interference analysis	R&S®FPH-K15	1321.0715.02
Signal strength mapping	R&S®FPH-K16	1321.0615.02
Channel power meter	R&S®FPH-K19	1321.0721.02
Pulse measurements with power sensor	R&S®FPH-K29	1321.0738.02
Receiver mode and channel scanner	R&S®FPH-K43	1321.0621.02

Accessories

Designation	Type	Order No.
Battery charger for R&S®HA-Z306 [12]	R&S®HA-Z303	1321.1328.02
Lithium-ion battery pack, 6.4 Ah	R&S®HA-Z306	1321.1334.02
Spare power supply, incl. mains plug for EU, GB, US, AUS, CH	R&S®HA-Z301	1321.1386.02
Car adapter	R&S®HA-Z302	1321.1340.02
Carrying holster	R&S®HA-Z322	1321.1370.02
Rainproof carrying holster	R&S®HA-Z322	1321.1370.03
Soft carrying bag	R&S®HA-Z220	1309.6175.00
Hardcase	R&S®HA-Z321	1321.1357.02
Hard shell protective carrying case	R&S®RTH-Z4	1326.2774.02
Headphones	R&S®FSH-Z36	1145.5838.02
Spare USB cable	R&S®HA-Z211	1309.6169.00
Spare Ethernet cable	R&S®HA-Z210	1309.6152.00

Antennas and antenna accessories

Designation	Type	Order No.
Yagi antenna, 1710 MHz to 1990 MHz	R&S®HA-Z1900	1328.6825.02
Yagi antenna, 824 MHz to 960 MHz	R&S®HA-Z900	1328.6283.02
RF cable (length: 1 m), DC to 6 GHz, N male/N male connectors	R&S®HA-Z901	3626.2757.02
Carrying bag, for R&S®HA-Z900 or R&S®HA-Z1900 Yagi antenna	R&S®HA-Z902	1328.6883.02
Handheld directional antenna (antenna handle)	R&S®HE400BC	4104.6000.04
Cable set for R&S®HE400BC (required R&S®HE300USB)	R&S®HE400-KB	4104.7770.04
Handheld directional antenna (antenna handle)	R&S®HE400	4104.6000.02
Cable set for R&S®HE400 (required R&S®HE300USB)	R&S®HE400-K	4104.7770.02
HF antenna module, 8.3 kHz to 30 MHz	R&S®HE400HF	4104.8002.02

[8] Applicable only to base unit with order no. 1321.1111.02.
[9] Applicable only to base unit with order no. 1321.1111.06.
[10] Applicable only to base unit with order no. 1321.1111.13.
[11] Applicable only to base unit with order no. 1321.1111.26.
[12] The battery charger is dedicated for charging an additional battery outside the instrument. The battery can be charged via the instrument as well.

Designation	Type	Order No.
VHF antenna module, 20 MHz to 200 MHz	R&S®HE400VHF	4104.8202.02
UWB antenna module, 30 MHz to 6 GHz	R&S®HE400UWB	4104.6900.02
Log-periodic antenna module, 450 MHz to 8 GHz	R&S®HE400LP	4104.8402.02
Cellular antenna module, 700 MHz to 2500 MHz	R&S®HE400CEL	4104.7306.02
USB adapter, for R&S®HE300/R&S®HL300	R&S®HE300USB	4080.9440.02
Log-periodic OEM antenna, 700 MHz to 4 GHz	R&S®HA-Z350	1321.1405.02
RF cable (length: 1 m), DC to 8 GHz, armored, N male/N female connectors	R&S®FSH-Z320	1309.6600.00
RF cable (length: 3 m), DC to 8 GHz, armored, N male/N female connectors	R&S®FSH-Z321	1309.6617.00
GPS receiver for R&S®Spectrum Rider FPH	R&S®HA-Z340	1321.1392.02
Portable EMF measurement system, hard case	R&S®TS-EMF	1158.9295.05
Isotropic antenna, 30 MHz to 3 GHz for R&S®TS-EMF	R&S®TSEMF-B1	1074.5719.02
Isotropic antenna, 700 MHz to 6 GHz for R&S®TS-EMF	R&S®TSEMF-B2	1074.5702.02
Isotropic antenna, 9 kHz to 200 MHz for R&S®TS-EMF	R&S®TSEMF-B3	1074.5690.02
Converter cable	R&S®TSEMF-CV	1158.9250.02
Matching pad, 50/75 Ω, L section	R&S®RAM	0358.5414.02
Matching pad, 50/75 Ω, series resistor 25 Ω	R&S®RAZ	0358.5714.02
Matching pad, 50/75 Ω, L section, N to BNC	R&S®FSH-Z38	1300.7740.02
Adapter N (m) – BNC (f)		0118.2812.00
Adapter N (m) – N (m)		0092.6581.00
Adapter N (m) – SMA (f)		4012.5837.00
Adapter N (m) – 7/16 (f)		3530.6646.00
Adapter N (m) – 7/16 (m)		3530.6630.00
Adapter N (m) – FME (f)		4048.9790.00
Adapter BNC (m) – Banana (f)		0017.6742.00
Attenuator, 50 W, 20 dB, 50 Ω, DC to 6 GHz, N(f) – N(m)	R&S®RDL50	1035.1700.52
Attenuator, 100 W, 20 dB, 50 Ω, DC to 2 GHz, N(f) – N(m)	R&S®RBU100	1073.8495.20
Attenuator, 100 W, 30 dB, 50 Ω, DC to 2 GHz, N(f) – N(m)	R&S®RBU100	1073.8495.30
Compact probe set for E and H near-field measurements, 30 MHz to 3 GHz	R&S®HZ-15	1147.2736.02
Near-field probe set H-field	R&S®HZ-17	1339.4141.02
Preamplifier (3 GHz, 20 dB), power adapter (100 V to 230 V), for R&S®HZ-15	R&S®HZ-16	1147.2720.02
Omnidirectional antenna for circular right-hand polarization, 18 GHz to 26.5 GHz	R&S®AC004R1	0749.3000.03
Omnidirectional antenna for circular left-hand polarization, 18 GHz to 26.5 GHz	R&S®AC004L1	4078.4000.02
Omnidirectional antenna for circular right-hand polarization, 26.5 GHz to 40 GHz	R&S®AC004R2	0749.3251.03
Omnidirectional Antenna for circular left-hand polarization, 26.5 GHz to 40 GHz	R&S®AC004L2	4078.5006.02
Standard gain horn antenna, 26 to 40 GHz, mid band bain 20 dB, WR 28	R&S®FH-SG-40	3629.2393.02
Standard gain horn antenna adapter	R&S®HA-Z370	1334.8432.02
Mast and tripod adapter	R&S®KM011Z8	4090.4006.02
Wooden tripod	R&S®HZ-1	0837.2310.02
Test port cable, 0 Hz to 26.5 GHz 3.5 mm female to 3.5 mm male, length: 635 mm	R&S®ZV-Z93	1301.7595.25
Test port cable, 0 Hz to 26.5 GHz 3.5 mm female to 3.5 mm male, length: 965 mm	R&S®ZV-Z93	1301.7595.38
Test port cable, 0 Hz to 26.5 GHz 3.5 mm female to 3.5 mm male, length: 610 mm	R&S®ZV-Z193	1306.4520.24
Test port cable, 0 Hz to 26.5 GHz 3.5 mm female to 3.5 mm male, length: 914 mm	R&S®ZV-Z193	1306.4520.36
Test port cable, 0 Hz to 26.5 GHz 3.5 mm female to 3.5 mm male, length: 1524 mm	R&S®ZV-Z193	1306.4520.60
Test port cable, 0 Hz to 40 GHz 2.92 mm female to 2.92 mm male, length: 635 mm	R&S®ZV-Z95	1301.7608.25
Test port cable, 0 Hz to 40 GHz 2.92 mm female to 2.92 mm male, length: 965 mm	R&S®ZV-Z95	1301.7608.38
Test port cable, 0 Hz to 40 GHz 2.92 mm female to 2.92 mm male, length: 610 mm	R&S®ZV-Z195	1306.4536.24
Test port cable, 0 Hz to 40 GHz 2.92 mm female to 2.92 mm male, length: 914 mm	R&S®ZV-Z195	1306.4536.36

R&S®NRP-Zxx power sensors supported by the R&S®Spectrum Rider FPH [13]

Designation	Type	Order No.
Directional power sensor, 25 MHz to 1 GHz	R&S®FSH-Z14	1120.6001.02
Directional power sensor, 200 MHz to 4 GHz	R&S®FSH-Z44	1165.2305.02
Universal power sensor, 10 MHz to 8 GHz, 100 mW, two-path	R&S®NRP-Z211	1417.0409.02
Universal power sensor, 10 MHz to 18 GHz, 100 mW, two-path	R&S®NRP-Z221	1417.0309.02
Wideband power sensor, 50 MHz to 18 GHz, 100 mW	R&S®NRP-Z81	1137.9009.02
Wideband power sensor, 50 MHz to 40 GHz, 100 mW (2.92 mm)	R&S®NRP-Z85	1411.7501.02
Wideband power sensor, 50 MHz to 40 GHz, 100 mW (2.40 mm)	R&S®NRP-Z86	1417.0109.40
Wideband power sensor, 50 MHz to 44 GHz, 100 mW (2.40 mm)	R&S®NRP-Z86	1417.0109.44
Three-path diode power sensor, 100 pW to 200 mW, 10 MHz to 8 GHz	R&S®NRP8S	1419.0006.02
Three-path diode power sensor, 100 pW to 200 mW, 10 MHz to 18 GHz	R&S®NRP18S	1419.0029.02
Three-path diode power sensor, 100 pW to 200 mW, 10 MHz to 33 GHz	R&S®NRP33S	1419.0064.02
Three-üath diode power sensor, 100 pW to 200 mW, 10 MHz to 40 GHz	R&S®NRP40S	1419.0041.02
Three-path diode power sensor, 100 pW to 200 mW, 10 MHz to 50 GHz	R&S®NRP50S	1419.0087.02
Thermal power sensor, 300 nW to 100 mW, DC to 18 GHz	R&S®NRP18T	1424.6115.02
Thermal power sensor, 300 nW to 100 mW, DC to 33 GHz	R&S®NRP33T	1424.6138.02
Thermal power sensor, 300 nW to 100 mW, DC to 40 GHz	R&S®NRP40T	1424.6150.02
Thermal power sensor, 300 nW to 100 mW, DC to 50 GHz	R&S®NRP50T	1424.6173.02
Thermal power sensor, 300 nW to 100 mW, DC to 67 GHz	R&S®NRP67T	1424.6196.02
Thermal power sensor, 300 nW to 100 mW, DC to 110 GHz	R&S®NRP110T	1424.6215.02
Average power sensor, 100 pW to 200 mW, 8 kHz to 6 GHz	R&S®NRP6A	1424.6796.02
Average power sensor, 100 pW to 200 mW, 8 kHz to 18 GHz	R&S®NRP18A	1424.6815.02
R&S®NRP-Zxx power sensors require the following adapter cable for operation on the R&S®Spectrum Rider FPH		
USB adapter cable for R&S®FSH-Z14/ R&S®FSH-Z44 power sensors	R&S®FSH-Z144	1145.5909.02
USB adapter cable (passive), length: 2 m, to connect R&S®NRP-Zxx S/SN power sensors to the R&S®Spectrum Rider FPH	R&S®NRP-Z4	1146.8001.02
R&S®NRP power sensors require the following adapter cable for operation on the R&S®Spectrum Rider FPH		
USB interface cable, length: 1.5 m, to connect R&S®NRP sensors to the R&S®Spectrum Rider FPH	R&S®NRP-ZKU	1419.0658.03

Optical power sensors and accessories

Designation	Type	Order No.
OEM USB optical power meter (Germanium)	R&S®HA-Z360	1334.5162.00
OEM USB optical power meter (filtered InGaAs)	R&S®HA-Z361	1334.5179.00
SC adapter for optical power meter	R&S®HA-Z362	1334.5185.00
LC Adapter for optical power meter	R&S®HA-Z363	1334.5191.00
2.5 mm universal adapter for optical power meter	R&S®HA-Z364	1334.5204.00
1.25 mm universal adapter for optical power meter	R&S®HA-Z365	1334.5210.00
Patch cord SC-LC SM, SX, length: 1 m	R&S®HA-Z366	1334.5227.00
Patch cord SC-SC SM, SX, length: 1 m	R&S®HA-Z367	1334.5233.00

[13] For average power measurements only.

Service options

Warranty		
Base unit		3 years
All other items [14]		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	

Extended warranty with a term of one and two years (WE1 and WE2)
Repairs carried out during the contract term are free of charge [15]. Necessary calibration and adjustments carried out during repairs are also covered.

Extended warranty with calibration coverage (CW1 and CW2)
Enhance your extended warranty by adding calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated, inspected and maintained during the term of the contract. It includes all repairs [15] and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

Extended warranty with accredited calibration (AW1 and AW2)
Enhance your extended warranty by adding accredited calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated under accreditation, inspected and maintained during the term of the contract. It includes all repairs [15] and accredited calibration at the recommended intervals as well as any accredited calibration carried out during repairs or option upgrades.

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

[15] Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.

Service that adds value

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