R&S®FSH HANDHELD SPECTRUM ANALYZER

Specifications

3 year warranty

Data Sheet
Version 29.00

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CONTENTS

Definitions **4**

Specifications **5**

Frequency 5

Sweep time 6

Bandwidths 6

Level 6

Trigger functions 8

Inputs and outputs 9

Vector network analysis/vector voltmeter 11

R&S®FSH4/FSH8 models .24/.28 with R&S®FSH-K42/R&S®FSH-K45 option 11

R&S®FSH13/FSH20 models .23/.30 with or without option R&S®FSH-K45 option 13

Scalar network analysis 15

R&S®FSH4/FSH8 models .24/.28 without R&S®FSH-K42 option 15

Distance-to-fault analysis 16

R&S®FSH4/FSH8/FSH13/FSH20 models .24/.28/.23/.30 with R&S®FSH-K41 option 16

R&S®FSH-K29 pulse measurements with power sensor 16

R&S®FSH-K10 GSM EDGE measurement application 17

R&S®FSH-K44 3GPP WCDMA BTS/NodeB pilot channel and pilot EVM measurement application;
R&S®FSH-K44E 3GPP WCDMA BTS/NodeB code domain power and EVM measurement application with HSDPA/HSPA+ analyzer 18

R&S®FSH-K46 CDMA2000® BTS pilot channel and EVM measurement application;
R&S®FSH-K46E CDMA2000® BTS code domain power measurement application 20

R&S®FSH-K47 1xEV-DO® BTS pilot channel and EVM measurement application;
R&S®FSH-K47E 1xEV-DO® BTS PN scanner and time domain power measurement application 22

R&S®FSH-K48 3GPP TD-SCDMA BTS power and P-CCPCH EVM measurement application;
R&S®FSH-K48E 3GPP TD-SCDMA/HSDPA BTS code domain power and EVM measurement application 23

R&S®FSH-K50/R&S®FSH-K51 LTE FDD/TDD downlink pilot channel and EVM measurement application;
R&S®FSH-K50E/R&S®FSH-K51E LTE FDD/TDD downlink extended channel and modulation measurement application 25

R&S®FSH-K56 NB-IoT measurement application (for FDD LTE) 26

R&S®FSH-K105 EMF measurement application 27

R&S®FSH-K43 receiver mode and channel scan measurement application 28

General data 29

Equivalence of specifications for different R&S®FSH part numbers 30

Accessories 31

R&S®FSH-Z14 directional power sensor 31

R&S®FSH-Z44 directional power sensor 33

R&S®HA-Z240 GPS receiver 34

R&S®FSH-Z114 precision frequency reference 34

Ordering information 35

Options 35

Accessories 36

R&S®NRP power sensors supported by the R&S®FSH4/FSH8/FSH13/FSH20 37

Thermal power sensors 38

Optical power sensors and accessories 38

Recommended extras: directional antenna and accessories 38

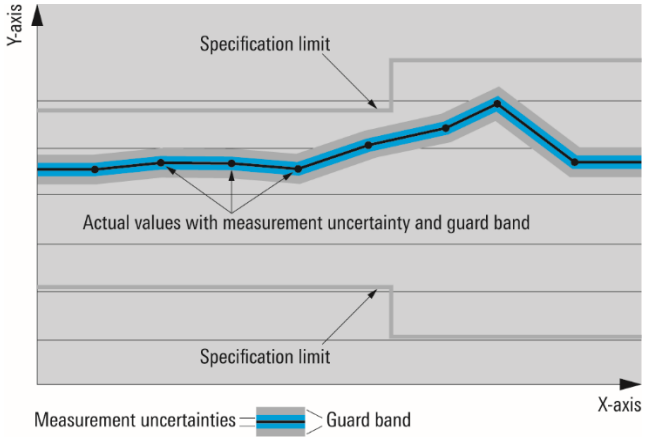
Warranty 39

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.

In line with the 3GPP/3GPP2 standard, chip rates are specified in million chips per second (Mcps), whereas bit rates and symbol rates are specified in billion bits per second (Gbps), million bits per second (Mbps), thousand bits per second (kbps), million symbols per second (Msps) or thousand symbols per second (ksps), and sample rates are specified in million samples per second (Msample/s). Gbps, Mcps, Mbps, Msps, kbps, ksps and Msample/s are not SI units.

Specifications

Specifications apply under the following conditions:
15 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to.
Data without tolerances: typical values only. Data designated as “nominal” applies to design parameters and is not tested.
Data without tolerance limits is not binding.

Frequency

Frequency range	R&S®FSH4, models .04/.14	9 kHz to 3.6 GHz
	R&S®FSH8, models .08/.18	9 kHz to 8 GHz
	R&S®FSH4, model .24	100 kHz to 3.6 GHz
	R&S®FSH8, model .28	100 kHz to 8 GHz
	R&S®FSH13, models .13/.23	9 kHz to 13.6 GHz
	R&S®FSH20, models .20/.30	9 kHz to 20 GHz
Frequency resolution		1 Hz

Reference frequency, internal		
Aging per year		1×10^{-6}
Temperature drift	0 °C to +50 °C [1]	1×10^{-6}
Achievable initial calibration accuracy		5×10^{-7}
Total reference uncertainty		(time since last adjustment × aging rate) + temperature drift + calibration accuracy
Reference uncertainty	+20 °C to +30 °C	$< 2 \times 10^{-6}$ + aging, typ. 1×10^{-6} + aging
Reference frequency, with R&S®HA-Z240 GPS receiver option		
Frequency uncertainty	GPS on, ≥ 1 min after satellite lock	$\pm 2.5 \times 10^{-8}$
	up to 30 min after losing satellite lock	$\pm 5 \times 10^{-8}$
Reference frequency, with R&S®FSH-Z114 precision frequency reference option		
Aging per year		3.6×10^{-9}
Temperature drift	0 °C to +50 °C	4×10^{-10}
Achievable initial calibration accuracy		1×10^{-9}
Total reference uncertainty	R&S®FSH-Z114 connected	
	≥ 30 s after oscillator lock	(time since last adjustment × aging rate) + temperature drift + 3 × calibration accuracy (nominal)
	≥ 2 min after oscillator lock	(time since last adjustment × aging rate) + temperature drift + calibration accuracy

Frequency readout		
Marker resolution		0.1 Hz
Uncertainty		±(marker frequency × reference uncertainty + 10 % × resolution bandwidth + ½ (span/(sweep points – 1) + 1 Hz)
Number of sweep (trace) points		631
Marker tuning frequency step size		span/630
Frequency counter resolution	selectable	0.1 Hz (low), 0.1 mHz (high)
Count uncertainty	SNR > 25 dB	±(frequency × reference uncertainty + ½ (last digit))
Frequency span		0 Hz, 10 Hz to 3.6/8/13.6/20 GHz
Span uncertainty		nom. 1 %

Spectral purity SSB phase noise		f = 500 MHz
Carrier offset	30 kHz	< –95 dBc (1 Hz), typ. –105 dBc (1 Hz)
	100 kHz	< –100 dBc (1 Hz), typ. –110 dBc (1 Hz)
	1 MHz	< –120 dBc (1 Hz), typ. –127 dBc (1 Hz)

[1] Temperature drift for serial number < 115000: +30 °C to +50 °C: 3×10^{-6}.

Sweep time

Sweep time	span = 0 Hz	100 µs to 1000 s
	10 Hz ≤ span ≤ 600 MHz	20 ms to 1000 s
	span > 600 MHz	(20 ms × span/600 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
	zero span [2]	10 MHz, 20 MHz additionally
Bandwidth accuracy	1 Hz ≤ RBW ≤ 300 kHz	nom. < 5 %
	RBW > 300 kHz	nom. < 10 %
Selectivity 60 dB:3 dB	Gaussian type filters	nom. < 5
Video filters		
Range	–3 dB bandwidth	1 Hz to 3 MHz in 1/3 sequence
	zero span [2]	10 MHz additionally

Level

Display range		displayed noise floor to +30 dBm
Maximum rated input level with RF attenuation ≥ 10 dB		
DC voltage	R&S®FSH4/R&S®FSH 8, model .04/.08/.14/.18	80 V
	R&S®FSH4/R&S®FSH 8, models .24/.28, R&S®FSH13, R&S®FSH 20	50 V
CW RF power		30 dBm (= 1 W)
Peak RF power	duration < 3 s	33 dBm (= 2 W)
Max. pulse voltage		150 V
Max. pulse energy	pulse width 10 µs	10 mWs
Maximum rated input level with RF attenuation < 10 dB		
DC voltage		50 V
CW RF power		20 dBm (= 100 mW)
Peak RF power	duration < 3 s	23 dBm (= 200 mW)
Max. pulse voltage		50 V
Max. pulse energy	pulse width 10 µs	1 mWs
Intermodulation		
Third-order intercept (TOI), nominal values	intermodulation-free dynamic range, signal level 2 × –20 dBm, RF attenuation = 0 dB, RF preamplifier = off	
	f_{in} < 300 MHz	> 54 dBc (TOI > +7 dBm, typ. +11 dBm)
	300 MHz ≤ f_{in} < 3.6 GHz	> 60 dBc (TOI > +10 dBm, typ. +15 dBm)
	3.6 GHz ≤ f_{in} ≤ 20 GHz	> 46 dBc (TOI > +3 dBm, typ. +10 dBm)
	intermodulation-free dynamic range, signal level 2 × –40 dBm, RF attenuation = 0 dB, RF preamplifier = on	
	f_{in} < 300 MHz	> 50 dBc (TOI > –15 dBm)
	300 MHz ≤ f_{in} ≤ 20 GHz	> 56 dBc (TOI > –12 dBm)
Second-harmonic intercept (SHI), nominal values	RF attenuation = 0 dB, RF preamplifier = off	
	f_{in} = 20 MHz to 1.5 GHz	+40 dBm
	f_{in} = 1.5 GHz to 3 GHz	+30 dBm
	f_{in} = 3 GHz to 4 GHz	+20 dBm
	f_{in} = 4 GHz to 10 GHz	+60 dBm
	RF attenuation 0 dB, RF preamplifier = on	
	f_{in} = 100 MHz to 4 GHz	0 dBm

[2] Requires instrument with serial number > 105000.

Displayed average noise level	0 dB RF attenuation, termination 50 Ω, RBW = 100 Hz, VBW = 10 Hz, sample detector, log scaling, tracking generator off, normalized to 1 Hz	
	frequency	preamplifier = off
	9 kHz to 100 kHz	
	R&S®FSH4, R&S®FSH8 (models .04/.14/.08/.18 only)	< –108 dBm, typ. –118 dBm
	R&S®FSH13/FSH20	< –96 dBm, typ. –106 dBm
	100 kHz to 1 MHz	< –115 dBm, typ. –125 dBm
	1 MHz to 10 MHz	< –136 dBm, typ. –144 dBm
	10 MHz to 2 GHz	< –141 dBm, typ. –146 dBm
	2 GHz to 3.6 GHz	< –138 dBm, typ. –143 dBm
	3.6 GHz to 5 GHz	< –142 dBm, typ. –146 dBm
	5 GHz to 6.5 GHz	< –140 dBm, typ. –144 dBm
	6.5 GHz to 13.6 GHz	< –136 dBm, typ. –141 dBm
	13.6 GHz to 18 GHz	< –134 dBm, typ. –139 dBm
	18 GHz to 20 GHz	< –130 dBm, typ. –135 dBm
	frequency	preamplifier = on
	100 kHz to 1 MHz	< –133 dBm, typ. –143 dBm
	1 MHz to 10 MHz	
	R&S®FSH4, R&S®FSH8	< –157 dBm, typ. –161 dBm
	R&S®FSH13/FSH20	< –155 dBm, typ. –159 dBm
	10 MHz to 1 GHz	< –161 dBm, typ. –165 dBm
	1 GHz to 2 GHz	< –159 dBm, typ. –163 dBm
	2 GHz to 5 GHz	< –155 dBm, typ. –159 dBm
	5 GHz to 6.5 GHz	< –151 dBm, typ. –155 dBm
	6.5 GHz to 8 GHz	< –147 dBm, typ. –150 dBm
	8 GHz to 13.6 GHz	< –158 dBm, typ. –162 dBm
	13.6 GHz to 18 GHz	< –155 dBm, typ. –160 dBm
	18 GHz to 20 GHz	< –150 dBm, typ. –155 dBm

Adjacent channel leakage power ratio (ACLR)		
Dynamic range	frequency < 3.6 GHz, total power > –20 dBm	
	3GPP WCDMA	
	adjacent channel	nom. > 55 dB
	alternate channel	nom. > 58 dB
	CDMA2000®	
	adjacent channel	nom. > 58 dB
	alternate channel	nom. > 61 dB
Immunity to interference		
Image frequencies, nominal values	R&S®FSH4/FSH8 with serial number < 105000	
	f_{in} – 2 × 21.4 MHz	< –70 dBc, typ. –80 dBc
	f_{in} – 2 × 831.4 MHz	< –70 dBc, typ. –90 dBc
	f_{in} – 2 × 4881 MHz	–60 dBc
	R&S®FSH4/FSH8 with serial number ≥ 105000, R&S®FSH13/FSH20	
	f_{in} – 2 × 54.4 MHz	< –70 dBc, typ. –80 dBc
	f_{in} – 2 × 860.8 MHz	< –70 dBc, typ. –90 dBc
	f_{in} – 2 × 4892.8 MHz	–60 dBc
	R&S®FSH13/FSH20	
	f_{in} + 2 × 6342.4 MHz	–60 dBc
	f_{in} – 2 × 6342.4 MHz	–60 dBc
Intermediate frequencies, nominal values	R&S®FSH4/FSH8 with serial number < 105000	
	21.4 MHz, 831.4 MHz, 4881.4 MHz	< –60 dBc, typ. –80 dBc
	8931.4 MHz	–50 dBc
	R&S®FSH4/FSH8 with serial number ≥ 105000, R&S®FSH13/FSH20	
	54.4 MHz, 860.8 MHz, 4892.8 MHz	< –60 dBc, typ. –80 dBc
	8924.8 MHz	–50 dBc
	R&S®FSH13/FSH20	
	3171.2 MHz	–50 dBc

Other interfering signals, signal level – RF attenuation < –20 dBm, nominal values	R&S®FSH4/FSH8 with serial number < 105000	
	f ≤ 3.6 GHz, spurious at f_{in} – 2440.7 MHz	< –60 dBc
	3.6 GHz < f ≤ 8 GHz, spurious at f_{in} – 4465.7 MHz	< –60 dBc
	R&S®FSH4/FSH8 with serial number ≥ 105000, R&S®FSH13/FSH20	
	f ≤ 3.6 GHz, spurious at f_{in} – 2446.4 MHz	< –60 dBc
	3.6 GHz < f ≤ 8 GHz, spurious at f_{in} – 4462.4 MHz	< –60 dBc
	8 GHz < f ≤ 20 GHz,	< –60 dBc
Other interfering signals, related to local oscillators, nominal values	f ≤ 3.6 GHz	
	Δf < 300 kHz	typ. –60 dBc
	Δf ≥ 300 kHz	< –60 dBc
	f > 3.6 GHz	
	Δf < 300 kHz	typ. –54 dBc
	Δf ≥ 300 kHz	< –54 dBc
	f = receive frequency	
Residual spurious response, nominal values	input matched with 50 Ω, without input signal, RBW ≤ 30 kHz, f ≥ 3 MHz, RF attenuation = 0 dB, tracking generator off	< –90 dBm
Level display		
Logarithmic level axis		1/2/5/10/20/50/100/150 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		–200 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)	9 kHz ≤ f < 100 kHz (models .04/.14/.08/.18 only)	nom. < 1.5 dB
	100 kHz ≤ f < 10 MHz	nom. < 1.5 dB
	10 MHz ≤ f ≤ 3.6 GHz	< 1 dB
	3.6 GHz < f ≤ 20 GHz	< 1.5 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	< 0.2 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 ≤ 3.6 GHz	< 1 dB, typ. 0.5 dB
	3.6 GHz < f ≤ 20 GHz	< 1.5 dB, typ. 1 dB

Trigger functions

Trigger		
Trigger source		free run, video, external
	serial number > 121000	internal periodic trigger additionally
Internal periodic trigger, cycle frequency	serial number > 121000	1 Hz to 1 MHz, min. resolution 1 Hz
External trigger level threshold	low → high transition	2.4 V
	high → low transition	0.7 V
Gated trigger		
Gate source		external
Gate delay		10 µs to 100 s, min. resolution 10 µs (or 1 % of delay)
Gate length		10 µs to 100 s, min. resolution 10 µs (or 1 % of gate length)

Inputs and outputs

RF input		
Impedance		50 Ω
Connector		N female
VSWR	100 kHz ≤ f ≤ 1 GHz	nom. < 1.5
	1 GHz < f ≤ 6 GHz	nom. < 2
	6 GHz < f ≤ 20 GHz	nom. < 3
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)		adjustable from 0 V to > 100 mV (RMS)
Power sensor		
Connector		7-contact female (type Binder 712)
Power sensors supported		see accessories
Tracking generator (only models .14/.18/.23/.24/.28/.30)		
Frequency range	models .14/.24	100 kHz to 3.6 GHz
	models .18/.23/.28/.30	100 kHz to 8 GHz
Connector		N female, 50 Ω
VSWR	100 kHz ≤ f ≤ 1 GHz	nom. < 1.5
	1 GHz < f ≤ 6 GHz	nom. < 2
	6 GHz < f ≤ 8 GHz, models .18 and .28	nom. < 3
Output level	tracking generator attenuation = 0 dB	nom. 0 dBm
Tracking generator attenuator		0 dB to 40 dB in 1 dB steps
Dynamic range for isolation measurements	RF attenuation = 0 dB, tracking generator attenuation = 10 dB, RBW = 1 kHz	
	100 kHz ≤ f < 300 kHz	> 60 dB, typ. 80 dB
	300 kHz ≤ f < 6 GHz	> 70 dB, typ. 90 dB
	6 GHz ≤ f < 8 GHz, models .18 and .28	typ. > 50 dB
Reverse power		
DC voltage		50 V
CW RF power		+20 dBm (= 0.1 W)
Max. pulse voltage		50 V
Max. pulse energy (10 µs)		1 mWs
External reference, external trigger, DC bias port 2 (BNC 1)		
Connector		BNC, 50 Ω
Mode	selectable, R&S®FSH4/FSH8, models .24/.28	external reference, external trigger, DC bias port 2
	selectable, R&S®FSH4/FSH8, other models, R&S®FSH13/FSH20	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
DC bias port 2	max. rated input voltage	50 V
	max. rated input current	600 mA

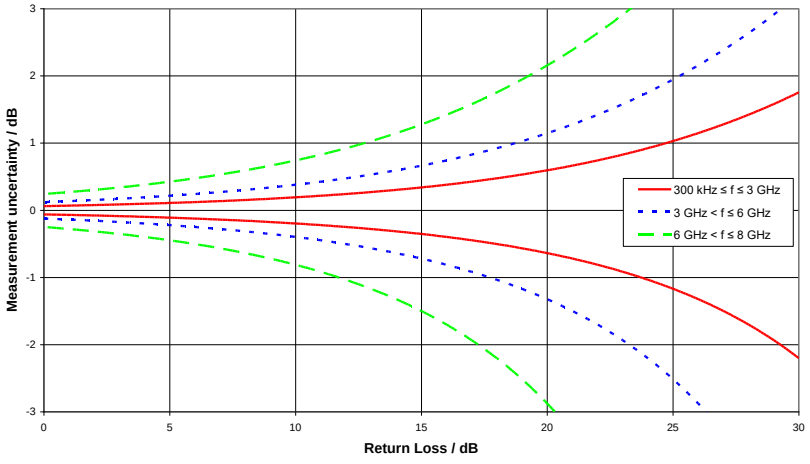
IF out, DC bias port 1 (BNC 2)		
Connector		BNC, 50 Ω
Mode	selectable, R&S®FSH4/FSH8, models .24/.28	IF out, DC bias port 1
	R&S®FSH4/FSH8, models .04/.14/.08/.18, R&S®FSH13/FSH20	IF out
IF out frequency	R&S®FSH4/FSH8, serial number < 105000	21.4 MHz
	R&S®FSH4/FSH8 with serial number ≥ 105000, R&S®FSH13/FSH20	54.4 MHz
DC bias port 1	max. rated input voltage	50 V
	max. rated input current	600 mA
Internal DC bias [3]		
Output port	selectable	port 1 or 2
Output voltage		+12 V to +32 V in 1 V steps
Maximum output power	operated with battery	4 W
	operated with AC mains	10 W
Maximum continuous output current	mode: internal	500 mA

[3] Internal DC bias is available by instruments with serial number ≥ 106292 (model .24) or serial number ≥ 106623 (model .28).

Vector network analysis/vector voltmeter

R&S®FSH4/FSH8, models .24/.28 with R&S®FSH-K42/R&S®FSH-K45 option

Frequency range	R&S®FSH4, model .24	300 kHz to 3.6 GHz
	R&S®FSH8, model .28	300 kHz to 8 GHz
Frequency resolution		1 Hz
Data points		631
Port power	controlled via tracking generator attenuation	nom. 0 dBm to –40 dBm in 1 dB steps
Reflection measurement		
Result formats	measurement mode = vector	magnitude, phase, magnitude + phase, VSWR, reflection coefficient, Smith chart, cable loss, group delay, electrical length
	measurement mode = vector voltmeter	magnitude + phase, VSWR + reflection
	S-parameters	S_{22}, S_{11}
Return loss		
Range	selectable	1/2/5/10/20/50/100 dB, linear 100 %
Resolution		0.01 dB
Measurement uncertainty		see figure below
One-port phase		
Range	selectable	90/180/360/1000° to 10000° in 1/2/5 steps
Resolution		0.01°
Measurement uncertainty	specifications are based on a matched DUT, RBW = 100 Hz, RF attenuation = 10 dB, nominal source power = 0 dBm, +20 °C to +30 °C	
	300 kHz ≤ f ≤ 3.6 GHz	
	0 dB ≤ return loss < 15 dB	nom. < 3°
	15 dB ≤ return loss < 25 dB	nom. < 6°
	25 dB ≤ return loss < 35 dB	nom. < 20°
	3.6 GHz < f ≤ 8 GHz (R&S®FSH8 only)	
	0 dB ≤ return loss < 15 dB	nom. < 3°
	15 dB ≤ return loss < 25 dB	nom. < 6°
	25 dB ≤ return loss < 35 dB	nom. < 20°
VSWR		
Range	selectable	1 to 1.1, 1.5, 2, 6, 11, 21 or 71
Smith chart		
Range		1, zoom: × 2, × 4, × 8
Reflection coefficient		
mRho	range	1 to 1000 in 1, 2, 5 steps
Corrected directivity	300 kHz ≤ f ≤ 3 GHz	typ. 46 dB
	3 GHz < f ≤ 6 GHz	typ. 43 dB
	6 GHz < f ≤ 8 GHz	typ. 36 dB
Corrected test port match	300 kHz ≤ f ≤ 3 GHz	typ. 30 dB
	3 GHz < f ≤ 6 GHz	typ. 25 dB
	6 GHz < f ≤ 8 GHz	typ. 21 dB

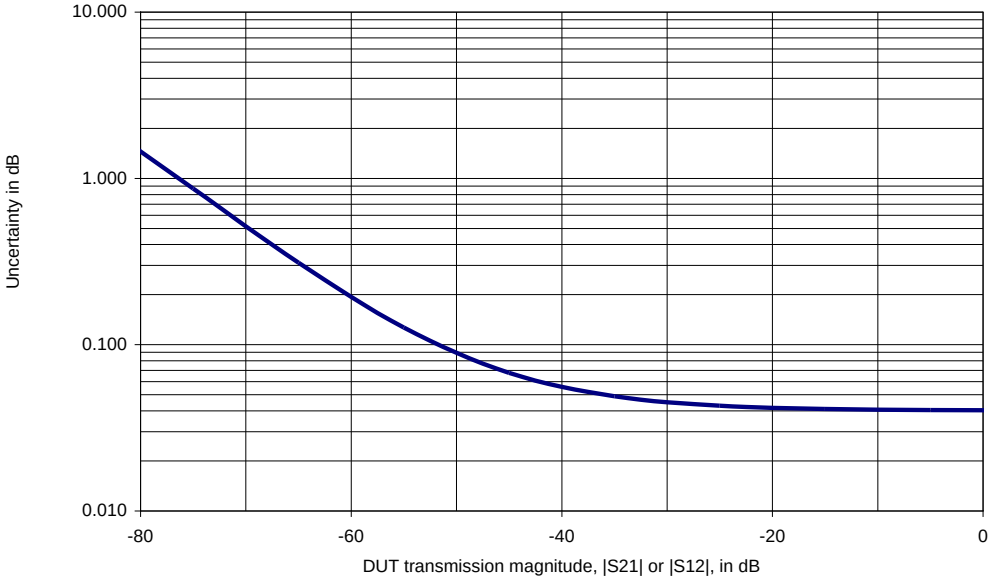


Uncertainty of reflection measurement, R&S®FSH4/FSH8 with the R&S®FSH-K42/R&S®FSH-K45 option

Transmission measurement		
Result formats	measurement mode = vector	magnitude, phase, magnitude + phase, group delay, electrical length
	measurement mode = vector voltmeter (requires R&S®FSH-K45)	magnitude + phase
	S-parameters	S_{12}, S_{21}
Gain		
Measurement range		–120 dB to +80 dB
Display range	selectable	1/2/5/10/20/50/100 dB, linear 100 %
Resolution		0.01 dB
Measurement uncertainty	calibration method = full two port high accuracy	see figure below
Phase		
Range	selectable	90/180/360/1000° to 10000° in 1/2/5 steps
Resolution		0.01°
Measurement uncertainty	specifications are based on a matched DUT, RBW = 100 Hz, RF attenuation = 10 dB, nominal source power = 0 dBm, +20 °C to +30 °C	
	300 kHz ≤ f ≤ 50 MHz	
	0 dB ≤ insertion loss < 40 dB	nom. < 2°
	50 MHz < f ≤ 3.6 GHz	
	0 dB ≤ insertion loss < 50 dB	nom. < 2°
	50 dB ≤ insertion loss < 70 dB	nom. < 3°
	3.6 GHz < f < 6 GHz (R&S®FSH8 only)	
	0 dB ≤ insertion loss < 50 dB	nom. < 2°
	50 dB ≤ insertion loss < 70 dB	nom. < 3°
	6 GHz ≤ f < 8 GHz (R&S®FSH8 only)	
	0 dB ≤ insertion loss < 50 dB	nom. < 3°
	50 dB ≤ insertion loss < 70 dB	nom. < 5°
Dynamic range from port 1 to port 2	RF attenuation = 0 dB, tracking generator attenuation = 10 dB, RBW = 1 kHz	
	100 kHz ≤ f < 300 kHz	typ. 70 dB
	300 kHz ≤ f < 6 GHz	> 70 dB, typ. 90 dB
	6 GHz ≤ f < 8 GHz	typ. > 50 dB
Dynamic range from port 2 to port 1	RF attenuation = 0 dB, tracking generator attenuation = 10 dB, RBW = 1 kHz	
	100 kHz ≤ f < 300 kHz	typ. 80 dB
	300 kHz ≤ f < 6 GHz	> 80 dB, typ. 100 dB
	6 GHz ≤ f < 8 GHz	typ. > 60 dB
Test port match		as specified for tracking generator output/RF input

Transmission magnitude uncertainty R&S®FSH4/FSH8

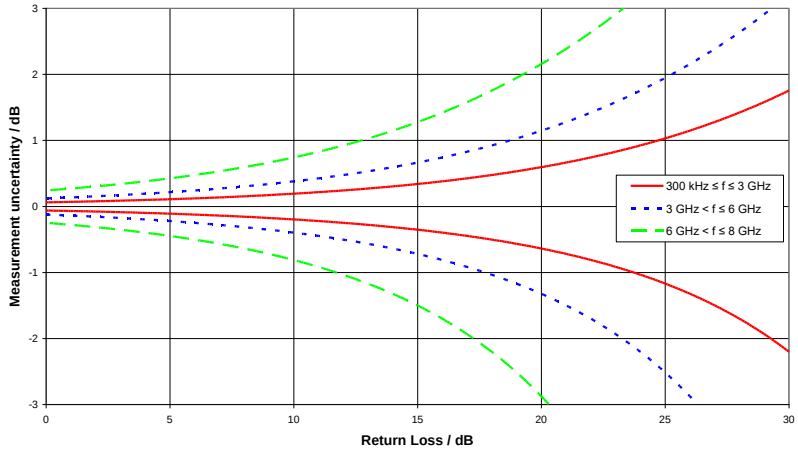
with calibration method “Full two Port High Accuracy”, f = 1 GHz, IF bandwidth = 100 Hz



Transmission magnitude uncertainty, R&S®FSH4/FSH8 with the R&S®FSH-K42/R&S®FSH-K45 option

R&S®FSH13/FSH20, models .23/.30 with or without option R&S®FSH-K45 option [4]

Frequency range		100 kHz to 8 GHz
Frequency resolution		1 Hz
Data points		631
Port power	controlled via tracking generator attenuation	nom. 0 dBm to –40 dBm, in 1 dB steps
Reflection measurement		
Result formats	measurement mode = vector	magnitude, phase, magnitude + phase, VSWR, reflection coefficient, Smith chart, cable loss, group delay, electrical length
	measurement mode = vector voltmeter (requires R&S®FSH-K45)	magnitude + phase, VSWR + reflection
	S-parameter	S_{22}
Return loss		
Input		RF port 2
Range	selectable	1/2/5/10/20/50/100 dB, linear 100 %
Resolution		0.01 dB
Measurement uncertainty		see figure below
One-port phase		
Range	selectable	90/180/360/1000° to 10000° in 1/2/5 steps
Resolution		0.01°
Measurement uncertainty	specifications are based on a matched DUT, RBW = 100 Hz, RF attenuation = 10 dB, nominal source power = 0 dBm, +20 °C to +30 °C	
	300 kHz ≤ f ≤ 3.6 GHz	
	0 dB ≤ return loss < 15 dB	nom. < 3°
	15 dB ≤ return loss < 25 dB	nom. < 6°
	25 dB ≤ return loss < 35 dB	nom. < 20°
	3.6 GHz < f ≤ 8 GHz (R&S®FSH8 only)	
	0 dB ≤ return loss < 15 dB	nom. < 3°
	15 dB ≤ return loss < 25 dB	nom. < 6°
	25 dB ≤ return loss < 35 dB	nom. < 20°
VSWR		
Range	selectable	1 to 1.1, 1.5, 2, 6, 11, 21 or 71
Smith chart		
Range		1, zoom: × 2, × 4, × 8
Reflection coefficient		
mRho	range	1 to 1000 in 1, 2, 5 steps
Corrected directivity	300 kHz ≤ f ≤ 3 GHz	typ. 46 dB
	3 GHz < f ≤ 6 GHz	typ. 43 dB
	6 GHz < f ≤ 8 GHz	typ. 36 dB
Corrected test port match	300 kHz ≤ f ≤ 3 GHz	typ. 30 dB
	3 GHz < f ≤ 6 GHz	typ. 25 dB
	6 GHz < f ≤ 8 GHz	typ. 21 dB



Uncertainty of reflection measurement with the R&S®FSH13, model .23/R&S®FSH20, model .30.

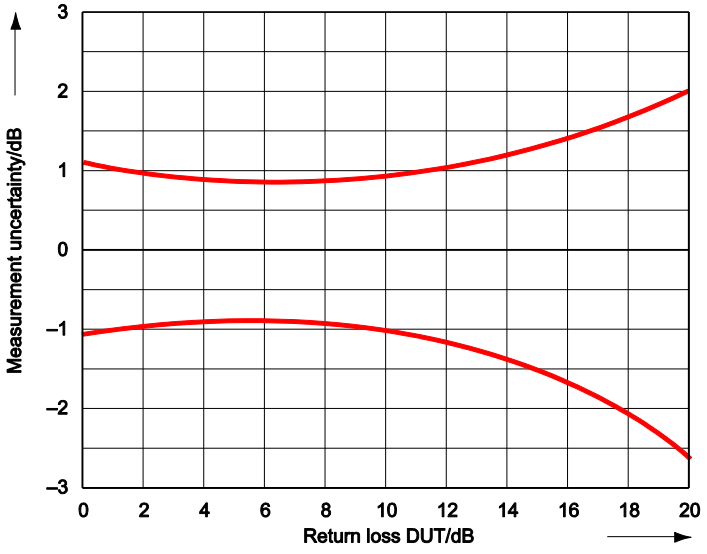
[4] R&S®FSH13, model .23 and R&S®FSH20, model .30, support one port reflection and transmission measurements as standard. For vector voltmeter support the R&S®FSH-K45 option is required.

Transmission measurement		
Result formats	measurement mode = vector	magnitude, phase, magnitude + phase, group delay, electrical length
	measurement mode = vector voltmeter (requires R&S®FSH-K45)	magnitude + phase
	S-parameter	S_{12}
Gain		
Measurement range		–120 dB to +80 dB
Display range	selectable	1/2/5/10/20/50/100 dB, linear 100 %
Resolution		0.01 dB
Phase		
Range	selectable	90/180/360/1000° to 10000° in 1/2/5 steps
Resolution		0.01°
Dynamic range from port 2 to port 1	RF attenuation = 0 dB, tracking generator attenuation = 10 dB, RBW = 1 kHz	
	100 kHz ≤ f < 300 kHz	typ. 80 dB
	300 kHz ≤ f < 6 GHz	> 80 dB, typ. 100 dB
	6 GHz ≤ f < 8 GHz	typ. > 60 dB
Test port match		as specified for tracking generator output/RF input

Scalar network analysis

R&S®FSH4/FSH8, models .24/.28 without R&S®FSH-K42 option [5]

Frequency range	R&S®FSH4, model .24	300 kHz to 3.6 GHz
	R&S®FSH8, model .28	300 kHz to 8 GHz
Frequency resolution		1 Hz
Data points		631
Port power	controlled via tracking generator attenuation	nom. 0 dBm to –40 dBm, in 1 dB steps
Reflection measurement		
Result formats		magnitude, VSWR, reflection coefficient
Return loss	range	1/2/5/10/20/50/100 dB, linear 100 %
	resolution	0.01 dB
VSWR	range	1 to 2, 6, 11, 21 or 71, selectable
Corrected directivity (20° to 30°)	300 kHz ≤ f ≤ 6 GHz	nom. > 25 dB
	6 GHz < f ≤ 8 GHz	nom. > 20 dB
Corrected test port match (20° to 30°)	300 kHz ≤ f ≤ 6 GHz	nom. > 20 dB
	6 GHz < f ≤ 8 GHz	nom. > 15 dB
Transmission measurement		
Result formats		magnitude
Dynamic range from port 1 to port 2	RF attenuation = 0 dB, tracking generator attenuation = 0 dB, RBW = 1 kHz	
	300 kHz ≤ f < 6 GHz	> 60 dB, typ. 80 dB
	6 GHz ≤ f < 8 GHz	typ. > 40 dB
Dynamic range from port 2 to port 1	RF attenuation = 0 dB, tracking generator attenuation = 0 dB, RBW = 1 kHz	
	300 kHz ≤ f < 6 GHz	> 70 dB, typ. 90 dB
	6 GHz ≤ f < 8 GHz	typ. > 50 dB
Test port match		as specified for tracking generator output/RF input



Uncertainty of reflection measurement without the R&S®FSH-K42 option

[5] R&S®FSH13, model .23/R&S®FSH20, model .30 support vector network analysis only.

Distance-to-fault analysis

R&S®FSH4/FSH8/FSH13/FSH20, models .24/.28/.23/.30 with R&S®FSH-K41 option

Return loss	range	1/2/5/10/20/50/100 dB, linear 100 %
	resolution	0.01 dB
VSWR	range	1 to 1.1, 1.5, 2, 6, 11, 21 or 71
	resolution	0.01
Reflection coefficient		
mRho	range	1 to 1000 in 1, 2, 5 steps
Fault resolution in m		(1.5×10^8 × velocity factor/span)
Maximum permissible spurious signal	RF attenuation = 0 dB	nom. 0 dBm
Input	models .24/.28: selectable	RF port 1 or 2
	models .23/.30	RF port 2
Maximum cable length	depending on cable loss	1500 m
Cable type		coaxial, waveguide

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

In combination with one of the power sensors R&S®NRP-Z81, R&S®NRP-Z85 or R&S®NRP-Z86, the R&S®FSH4/FSH8/FSH13/FSH20 supports measurements on pulsed signals [6]. 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®FSH-K29.

Measurements	**R&S®FSH-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	●

[6] The R&S®NRP-Z8x power sensors are supported by instruments with serial number ≥ 105000.
For instruments with serial number < 121000, the R&S®FSH-Z129 adapter cable is required in addition.

R&S®FSH-K10 GSM EDGE measurement application

The specifications below apply to the R&S®FSH4/FSH8/FSH13/FSH20. They are based on the data sheet specifications of the R&S®FSH4/FSH8/FSH13/FSH20, have not been checked separately and are not verified during instrument calibration. Measurement uncertainties are indicated as 95 % confidence intervals. The specified level measurement errors do not take into account systematic errors due to reduced signal-to-noise ratio (SNR).

Measurements	**R&S®FSH-K10**
Spectrum overview	●
RF channel power	●
Occupied bandwidth	●
Power within span	●
Result summary	●
RF channel power	●
Burst power	●
Carrier frequency error	●
Burst type identification	●
BCC (TSC) identification	●
GMSK phase error	●
GMSK magnitude error	●
8PSK EVM	●
Traffic activity	●
Burst power	●
RF channel power	●
Burst power	●
BCC (TSC) identification	●
Burst display (8 bursts)	●
Burst type identification	●

All specifications are given for GMSK and 8PSK modulations, SNR > 30 dB.

Frequency range		15 MHz to 3.0 GHz
Carrier frequency uncertainty, nominal values		
Lock range		±8 kHz
Measurement uncertainty	SNR > 30 dB, Δf_{ref} = uncertainty of reference frequency	< 15 Hz + Δf_{ref}
RF channel power		
Measurement range	frequency > 15 MHz	
	preamplifier = off	–60 dBm < P_{total} < 20 dBm
	preamplifier = on	–75 dBm < P_{total} < 20 dBm
Measurement uncertainty	–75 dBm < P_{total} < 20 dBm, P_{REF_LEV} – 30 dB < P_{total} < P_{REF_LEV} + 3 dB	1 dB, typ. 0.5 dB
Burst power	SNR > 30 dB, nominal	
Measurement range	–40 dBm < P_{total} < 20 dBm	P_{total} – 20 dB < P_{burst} < P_{total}
Measurement uncertainty	P_{total} – 20 dB < P_{burst} < P_{total}	1 dB, typ. 0.5 dB
GMSK modulation quality	SNR > 30 dB, nominal	
Residual phase error		typ. 0.3°
Residual magnitude error		typ. 0.4%
8PSK modulation quality	SNR > 30 dB, nominal	
Residual EVM		typ. 0.5 %

R&S®FSH-K44 3GPP WCDMA BTS/NodeB pilot channel and pilot EVM measurement application; R&S®FSH-K44E 3GPP WCDMA BTS/NodeB code domain power and EVM measurement application with HSDPA/HSPA+ analyzer

The specifications below apply to the R&S®FSH4/FSH8/FSH13/FSH20. They are based on the data sheet specifications of the R&S®FSH4/FSH8/FSH13/FSH20, have not been checked separately and are not verified during instrument calibration. Measurement uncertainties are indicated as 95 % confidence intervals. The specified level measurement errors do not take into account systematic errors due to reduced signal-to-noise ratio (SNR).

Measurements	**R&S®FSH-K44**	**R&S®FSH-K44E**
Spectrum overview	●	●
Scrambling code search	●	●
Isotropic antenna	●	●
Limits screen	●	●
Result summary	●	●
RF channel power	●	●
Carrier frequency error	●	●
Active channels	● (2 channels)	●
Scrambling code found	●	●
Composite EVM	–	●
Peak code domain error	–	●
Average RCDE	–	●
I/Q offset	–	●
Gain imbalance	–	●
P-CPICH power	●	●
P-CPICH E_C/I_0	●	●
P-CPICH symbol EVM	●	●
Sync channel power	●	●
Code domain power	–	●
Code channel power	–	●
Code channel symbol rate	–	●
Channel power	–	●
EVM	–	●
Code domain channel table	–	●
Code channel type	–	●
Channel number/spreading factor	–	●
Code channel symbol rate	–	●
Timing offset	–	●
Pilot bits	–	●
Status	–	●
Power, absolute	–	●
Power, relative to CPICH	–	●
HSDPA channel support	–	●
HSPA+ channel support	–	●

Frequency range		15 MHz to 3.0 GHz
Carrier frequency uncertainty	test case 6.3 in line with 3GPP TS 25.141	
Lock range		±1 kHz
Measurement uncertainty	SNR > 30 dB, Δf_{ref} = uncertainty of reference frequency	< 10 Hz + Δf_{ref}
RF channel power	test case 6.2.1 in line with 3GPP TS 25.141, SNR > 30 dB	
Measurement range	frequency > 15 MHz	
	preamplifier = off	–60 dBm < $P_{RF\ channel}$ < 20 dBm
	preamplifier = on	–80 dBm < $P_{RF\ channel}$ < 20 dBm
Measurement uncertainty	–80 dBm < $P_{RF\ channel}$ < 20 dBm, P_{REF_LEV} – 30 dB < $P_{RF\ channel}$ < P_{REF_LEV} + 3 dB	< 1 dB, typ. 0.5 dB
CPICH power	test case 6.2.2 in line with 3GPP TS 25.141, SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	$P_{RF\ channel}$ – 20 dB < P_{CPICH} < $P_{RF\ channel}$
Measurement uncertainty	$P_{RF\ channel}$ – 20 dBm < P_{CPICH} < $P_{RF\ channel}$	< 1 dB, typ. 0.5 dB
P-CCPCH power	test model 2 in line with 3GPP TS 25.141, SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	$P_{RF\ channel}$ – 20 dB < $P_{P\text{-}CCPCH}$ < $P_{RF\ channel}$
Measurement uncertainty	$P_{RF\ channel}$ – 20 dBm < $P_{P\text{-}CCPCH}$ < $P_{RF\ channel}$	< 1 dB, typ. 0.5 dB
PSCH/SSCH power	test model 2 in line with 3GPP TS 25.141, SNR > 30 dB	

Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	$P_{RF\ channel}$ – 20 dB < P_{SCH} < $P_{RF\ channel}$
Measurement uncertainty	$P_{RF\ channel}$ – 20 dBm < P_{SCH} < $P_{RF\ channel}$	< 2.5 dB, typ. 1.5 dB
Symbol EVM	SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm single channel EVM	1.5 % < EVM < 25 %
Measurement uncertainty	1.5 % < EVM ≤ 10 %	0.5 %
	10 % < EVM < 25 %	2.5 %
Residual EVM		typ. 1.5 %
Composite EVM [7]	test case 6.7.1 in line with 3GPP TS 25.141, test model 4 with P-CPICH, SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	1.5 % < EVM < 25 %
Measurement uncertainty	1.5 % < EVM ≤ 10 %	typ. 2.0 %
	10 % < EVM < 25 %	typ. 2.5 %
Residual EVM		typ. 2.5 %
Scrambling code detection	test model 1.16 in line with 3GPP TS 25.141	
Lock range		±1 kHz
Calculation time		2.5 s
CPICH E_C/I_0		> –21 dB

[7] Requires instrument with serial number ≥ 105000.

R&S®FSH-K46 CDMA2000® BTS pilot channel and EVM measurement application; R&S®FSH-K46E CDMA2000® BTS code domain power measurement application

The specifications below apply to the R&S®FSH4/FSH8/FSH13/FSH20. They are based on the data sheet specifications of the R&S®FSH4/FSH8/FSH13/FSH20, have not been checked separately and are not verified during instrument calibration. Measurement uncertainties are indicated as 95 % confidence intervals. The specified level measurement errors do not take into account systematic errors due to reduced signal-to-noise ratio (SNR).

Measurements	**R&S®FSH-K46**	**R&S®FSH-K46E**
Spectrum overview	●	●
Result summary	●	●
RF channel power	●	●
Rho	●	●
Carrier frequency error	●	●
Active channels	●	●
Composite EVM	●	●
Peak to average	●	●
Pilot channel power (Cd 0)	●	●
Sync channel power (Cd 32)	●	●
Code domain power	–	●
RF channel power	–	●
Pilot power	–	●
Sync power (rel. to RF ch. pwr./pilot)	–	●
Code power (rel. to RF ch. pwr./pilot)	–	●
Carrier frequency error	–	●
Rho	–	●
Composite EVM	–	●
PN offset found	–	●
Code domain channel table	–	●
Channel type	–	●
Walsh code/spreading factor	–	●
Symbol rate (ksps)	–	●
RC	–	●
Status	–	●
Power absolute (dBm)	–	●
Power relative (rel. to RF ch. pwr./pilot)	–	●
PN scanner	–	●
Detected PN offset	–	●
Power per detected PN offset	–	●

All specifications are valid for RC3, one traffic channel, SNR > 30 dB.

Frequency range		15 MHz to 3.0 GHz
Carrier frequency uncertainty, nominal values		
Lock range		±10 kHz
Measurement uncertainty	SNR > 30 dB, Δf_{ref} = uncertainty of reference frequency	< 10 Hz + Δf_{ref}
RF channel power		
Measurement range	frequency > 15 MHz	
	preamplifier = off	–60 dBm < $P_{RF\ channel}$ < 20 dBm
	preamplifier = on	–75 dBm < $P_{RF\ channel}$ < 20 dBm
Measurement uncertainty	–75 dBm < $P_{RF\ channel}$ < 20 dBm, ref. level adjusted to RF channel power	< 1 dB, typ. 0.5 dB
PICH power	SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	$P_{RF\ channel}$ – 20 dB < P_{PICH} < $P_{RF\ channel}$
Measurement uncertainty	$P_{RF\ channel}$ – 20 dBm < P_{CPICH} < $P_{RF\ channel}$	< 1 dB, typ. 0.5 dB
F-SYNC power	SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	$P_{RF\ channel}$ – 20 dB < P_{SYNC} < $P_{RF\ channel}$
Measurement uncertainty	$P_{RF\ channel}$ – 20 dBm < P_{SYNC} < $P_{RF\ channel}$	< 1 dB, typ. 0.5 dB

Composite EVM	SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	1.5 % < EVM < 25 %
Measurement uncertainty	1.5 % < EVM ≤ 10%	typ. 2.0 %
	10 % < EVM < 25 %	typ. 2.5 %
Residual EVM		typ. 2.5 %
Rho	SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	0.9 < rho < 1
Measurement uncertainty	0.97 < rho ≤ 1.0	typ. 0.005
	0.90 < rho ≤ 0.97	typ. 0.02

R&S®FSH-K47 1xEV-DO® BTS pilot channel and EVM measurement application; R&S®FSH-K47E 1xEV-DO® BTS PN scanner and time domain power measurement application

The specifications below apply to the R&S®FSH4/FSH8/FSH13/FSH20. They are based on the data sheet specifications of the R&S®FSH4/FSH8/FSH13/FSH20, have not been checked separately and are not verified during instrument calibration. Measurement uncertainties are indicated as 95 % confidence intervals. The specified level measurement errors do not take into account systematic errors due to reduced signal-to-noise ratio (SNR).

Measurements	**R&S®FSH-K47**	**R&S®FSH-K47E**
Spectrum overview	●	●
Result summary	●	●
RF channel power	●	●
Pilot Rho	●	●
Carrier frequency error	●	●
Traffic activity	●	●
Pilot EVM	●	●
PN timing (tau)	●	●
Peak to average	●	●
Pilot power	●	●
MAC power	●	●
Data power	●	●
PN scanner	–	●
Detected PN offset	–	●
Power per detected PN offset	–	●
Burst power	–	●
RF channel power	–	●
Pilot power	–	●

All specifications are valid for RC3, one traffic channel, SNR > 30 dB.

Frequency range		15 MHz to 3.0 GHz
Carrier frequency uncertainty, nominal values		
Lock range		±5 kHz
Measurement uncertainty	SNR > 30 dB, Δf_{ref} = uncertainty of reference frequency	< 100 Hz + Δf_{ref}
RF channel power		
Measurement range	frequency > 15 MHz	
	preamplifier = off	–60 dBm < $P_{RF\ channel}$ < 20 dBm
	preamplifier = on	–75 dBm < $P_{RF\ channel}$ < 20 dBm
Measurement uncertainty	–75 dBm < $P_{RF\ channel}$ < 20 dBm, ref. level adjusted to RF channel power	< 1 dB, typ. 0.5 dB
Pilot power	SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	$P_{RF\ channel}$ – 20 dB < P_{PICH} < $P_{RF\ channel}$
Measurement uncertainty	$P_{RF\ channel}$ – 20 dBm < P_{CPICH} < $P_{RF\ channel}$	< 1 dB, typ. 0.5 dB
MAC power	SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	$P_{RF\ channel}$ – 20 dB < P_{SYNC} < $P_{RF\ channel}$
Measurement uncertainty	$P_{RF\ channel}$ – 20 dBm < P_{SYNC} < $P_{RF\ channel}$	< 1 dB, typ. 0.5 dB
Data power	SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	$P_{RF\ channel}$ – 20 dB < P_{SYNC} < $P_{RF\ channel}$
Measurement uncertainty	$P_{RF\ channel}$ – 20 dBm < P_{SYNC} < $P_{RF\ channel}$	< 1 dB, typ. 0.5 dB
Pilot EVM	SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	1.5 % < EVM < 25 %
Measurement uncertainty	1.5 % < EVM ≤ 10 %	typ. 2.0 %
	10 % < EVM < 25 %	typ. 2.5 %
Residual EVM		typ. 2.5 %
Pilot Rho	SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	0.9 < rho < 1
Measurement uncertainty	0.97 < rho ≤ 1.0	typ. 0.005
	0.90 < rho ≤ 0.97	typ. 0.02

R&S®FSH-K48 3GPP TD-SCDMA BTS power and P-CCPCH EVM measurement application; R&S®FSH-K48E 3GPP TD-SCDMA/HSDPA BTS code domain power and EVM measurement application

The specifications below apply to the R&S®FSH4/FSH8/FSH13/FSH20. They are based on the data sheet specifications of the R&S®FSH4/FSH8/FSH13/FSH20, have not been checked separately and are not verified during instrument calibration. Measurement uncertainties are indicated as 95 % confidence intervals. The specified level measurement errors do not take into account systematic errors due to reduced signal-to-noise ratio (SNR).

Measurements	R&S®FSH-K48	R&S®FSH-K48E
Spectrum overview	●	●
Time domain power	–	●
Slot 0 to 6 power	–	●
DwPTS power	–	●
UpPTS power	–	●
Slot 0 to 6 composite EVM	–	●
Slot 0 to 6 C/I	–	●
Sync ID	–	●
Sync ID #	–	●
Sync ID power	–	●
Sync ID delay	–	●
Code domain power	–	●
Code #/SF (spreading factor)	–	●
Modulation type (QPSK, 8PSK, 16QAM, 64QAM)	–	●
Symbol EVM	–	●
Code power	–	●
RF channel power	–	●
Composite EVM	–	●
Code domain channel table	–	●
Code #/SF (spreading factor)	–	●
Modulation type (QPSK, 8PSK, 16QAM, 64QAM)	–	●
Symbol EVM	–	●
Code power abs/rel	–	●
Limits screen	–	●
Result summary	●	●
RF channel power	●	●
Carrier frequency error	●	●
Composite EVM	–	●
Peak code domain error	–	●
Average RCDE	–	●
I-Q offset	–	●
Gain imbalance	–	●
Active channels	–	●
Scrambling code found	●	●
P-CCPCH symbol EVM	●	●
P-CCPCH Ec/Io	●	●
Data power abs/rel	●	●
Data 1/2 power abs/rel	●	●
Midamble power abs/rel	●	●

Frequency range		15 MHz to 3.0 GHz
Carrier frequency uncertainty	test case 6.3 in line with 3GPP TS 25.142	
Lock range		±5 kHz
Measurement uncertainty	SNR > 30 dB, Δf_{ref} = uncertainty of reference frequency	< 10 Hz + Δf_{ref}
RF channel power	test case 6.2 in line with 3GPP TS 25.142, SNR > 30 dB	
Measurement range	frequency > 15 MHz	
	preamplifier = off	–60 dBm < $P_{RF\ channel}$ < 20 dBm
	preamplifier = on	–75 dBm < $P_{RF\ channel}$ < 20 dBm
Measurement uncertainty	–75 dBm < $P_{RF\ channel}$ < 20 dBm, P_{REF_LEV} – 30 dB < $P_{RF\ channel}$ < P_{REF_LEV} + 3 dB	< 1 dB, typ. 0.5 dB
P-CCPCH symbol EVM	SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm single channel EVM	1.5 % < EVM < 25 %
Measurement uncertainty	1.5 % < EVM ≤ 10 %	typ. 0.5 %
	10 % < EVM < 25 %	typ. 2.5 %
Residual EVM		typ. 0.8 %
Data power, data 1/2 power, midamble power	SNR > 30 dB	
Measurement range		–60 dBm < $P_{data,\ midamble}$ < 20 dBm
Measurement uncertainty	–40 dBm < $P_{data,\ midamble}$ < 20 dBm	< 1 dB, typ. 0.5 dB
Composite EVM	test case 6.8.1 in line with 3GPP TS 25.142, SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	1.5 % < EVM < 25 %
Measurement uncertainty	1.5 % < EVM ≤ 10 %	typ. 1.0 %
	10 % < EVM < 25 %	typ. 2.5 %
Residual EVM		typ. 1.0 %
Code domain power	SNR > 30 dB	
Measurement range	–40 dBm < $P_{RF\ channel}$ < 20 dBm	$P_{RF\ channel}$ – 20 dB < P_{code} < $P_{RF\ channel}$
Measurement uncertainty	$P_{RF\ channel}$ – 20 dBm < P_{Code} < $P_{RF\ channel}$	< 1 dB, typ. 0.5 dB
Sync ID detection		
Lock range		±5 kHz

R&S®FSH-K50/R&S®FSH-K51 LTE FDD/TDD downlink pilot channel and EVM measurement application [8];
R&S®FSH-K50E/R&S®FSH-K51E LTE FDD/TDD downlink extended channel and modulation measurement application [8]

The specifications below apply to the R&S®FSH4/FSH8/FSH13/FSH20. They are based on the data sheet specifications of the R&S®FSH4/FSH8/FSH13/FSH20, have not been checked separately and are not verified during instrument calibration. Measurement uncertainties are indicated as 95 % confidence intervals. The specified level measurement errors do not take into account systematic errors due to reduced signal-to-noise ratio (SNR).

Measurements	R&S®FSH-K50/R&S®FSH-K51	R&S®FSH-K50E/R&S®FSH-K51E
Spectrum overview	●	●
Result summary	●	●
RF channel power	●	●
Carrier frequency error	●	●
I/Q offset	●	●
Cell identity	●	●
Cyclic prefix	●	●
Reference signal power	●	●
PSYNC power	●	●
SSYNC power	●	●
PBCH power	●	●
PCFICH power	●	●
PDSCH power	●	●
Reference signal EVM	●	●
PSYNC EVM	●	●
SSYNC EVM	●	●
PBCH EVM	●	●
PCFICH EVM	●	●
PDSCH EVM	●	●
Isotropic antenna	●	●
Limits screen	●	●
Constellation diagram	–	●
PSYNC	–	●
SSYNC	–	●
QPSK	–	●
16QAM	–	●
64QAM	–	●
256QAM	–	●
BTS scanner	–	●
Cell identity	–	●
PSYNC power	–	●
SSYNC power	–	●
Resource allocations	–	●

All specifications are valid for SNR > 30 dB.

Frequency range		15 MHz to 4.0 GHz
Supported channel bandwidths		1.4/3/5/10/15/20 MHz
Carrier frequency uncertainty		
Lock range		±10 kHz
Measurement uncertainty	SNR > 30 dB, Δf_{ref} = uncertainty of reference frequency	< 10 Hz + Δf_{ref}
RF channel power		
Measurement range	frequency > 15 MHz	
	preamplifier = off	–60 dBm < $P_{RF\ channel}$ < 20 dBm
	preamplifier = on	–75 dBm < $P_{RF\ channel}$ < 20 dBm
Measurement uncertainty	–75 dBm < $P_{RF\ channel}$ < 20 dBm, ref. level adjusted to RF channel power	< 1 dB, typ. 0.5 dB
EVM		
Measurement range	–50 dBm < $P_{RF\ channel}$ < 10 dBm, 860 MHz < frequency < 4.0 GHz, E-UTRA test model 3.1, bandwidth 10 MHz, reference signal and PDSCH	
Residual EVM		< 2.5 %, typ. 2.0 %

[8] R&S®FSH-K50/-K51/-K50E/-K51E/-K56 options require instruments with serial number ≥ 105000.

R&S®FSH-K56 NB-IoT measurement application (for FDD LTE) [8]

The specifications below apply to the R&S®FSH4/FSH8/FSH13/FSH20. They are based on the data sheet specifications of the R&S®FSH4/FSH8/FSH13/FSH20, have not been checked separately and are not verified during instrument calibration. Measurement uncertainties are indicated as 95 % confidence intervals. The specified level measurement errors do not take into account systematic errors due to reduced signal-to-noise ratio (SNR).

Measurements	**R&S®FSH-K56**
Spectrum overview	●
Result summary	●
NB-IoT channel power	●
NB-IoT carrier frequency error	●
NB-IoT cell identity	●
NB-IoT reference signal power	●
NPSYNC power	●
NSSYNC power	●
NPBCH power	●
Reference signal EVM	●
NPSYNC EVM	●
NSSYNC EVM	●
NPBCH EVM	●
Constellation diagram	●
NPSYNC	●
NSSYNC	●
QPSK	●

All specifications are valid for SNR > 30 dB.

Frequency range		15 MHz to 4.0 GHz
Supported channel bandwidths		3/5/10/15/20 MHz
Carrier frequency uncertainty		
Lock range		±10 kHz
Measurement uncertainty	SNR > 30 dB, Δf_{ref} = uncertainty of reference frequency	< 10 Hz + Δf_{ref}
RF channel power		
Measurement range	frequency > 15 MHz	
	preamplifier = off	–60 dBm < $P_{RF\ channel}$ < 20 dBm
	preamplifier = on	–75 dBm < $P_{RF\ channel}$ < 20 dBm
Measurement uncertainty	–75 dBm < $P_{RF\ channel}$ < 20 dBm, ref. level adjusted to RF channel power	< 1 dB, typ. 0.5 dB
EVM		
Measurement range	–50 dBm < $P_{RF\ channel}$ < 10 dBm, 860 MHz < frequency < 4.0 GHz,	
Residual EVM [9]	E-UTRA test model 3.1, bandwidth 10 MHz, reference signal and PDSCH, embedded NB-IoT signal, NCellID = 1, CRS = 19, punctuate LTE at NB-IoT carriers	< 2.5 %, typ. 2.0 %

Deployment		in-band, guard band, standalone
NB-IoT sequence info		CRS sequence info, PRB index
NB-IoT filter	dedicated for standalone mode with adjacent channels	on/off

[9] For deployment in-band: NB-IoT cell identity must be identical to LTE cell identity.

R&S®FSH-K105 EMF measurement application

The specifications below apply to the R&S®FSH4/FSH8/FSH13/FSH20. They are based on the data sheet specifications of the R&S®FSH4/FSH8/FSH13/FSH20, have not been checked separately and are not verified during instrument calibration.

EMF measurements	**R&S®FSH-K105**
Sequence of measurements	●
Fixed frequency	●
Set of frequencies	●
Digital networks	
3GPP WCDMA BTS	● [10]
LTE FDD BTS	● [10]
LTE TDD BTS	● [10]
Spectrum measurements	
LTE channel power (10 MHz)	●
Spectrum overview (10 MHz)	●
Results	
Extrapolation factor (LTE, WCDMA)	●
Table of field strengths	●
Total field strength	●
Calculation of exposition	●
EMF limit check	●
ISO antenna measurement	●

Frequency range, measurement range		see definitions in the basic instrument and the digital network options
EMF measurement modes		
LTE	BTS scanner	SSYNC, RSRP, RSPWR [11]
3GPP WCDMA	scrambling code	P-CPICH
Spectrum		LTE channel power (10 MHz)

The setup of the EMF measurement sequence and the detailed result evaluation is carried out with the PC application R&S®InstrumentView.

Required options for digital network measurements

	Designation	**Required option**	**Remarks**
1	3GPP WCDMA BTS	R&S®FSH-K44	
2	LTE FDD BTS	R&S®FSH-K50 and R&S®FSH-K50E	only for R&S®FSH4/FSH8 with serial number ≥ 105000, R&S®FSH13/FSH20
3	LTE TDD BTS	R&S®FSH-K51 and R&S®FSH-K51E	only for R&S®FSH4/FSH8 with serial number ≥ 105000, R&S®FSH13/FSH20

[10] See required options.

[11] RSPWR is the sum of the detected power of the BTS antenna 1 and/or 2 (dependent on the instrument configuration).

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

The specifications below apply to the R&S®FSH4/FSH8/FSH13/FSH20. They are based on the data sheet specifications of the R&S®FSH4/FSH8/FSH13/FSH20, 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
	CISPR bandwidths (–6 dB)	200 Hz, 9 kHz, 120 kHz, 1 MHz
Detectors		max. peak, average, RMS, quasi-peak
Level		see basic instrument

General data

Manual operation		
Languages		Chinese, English, French, German, Italian, Hungarian, Japanese, Korean, Portuguese, Russian, Spanish
Remote control (R&S®FSH-K40 option)		
Command set		SCPI 1997.0
LAN interface		10/100BASE-T, RJ-45
USB		mini B plug, version 1.1
Display		
Resolution		640 × 480 pixel
Audio		
Speaker		internal
USB interface	R&S®FSH4/FSH8 with serial number ≥ 105000, R&S®FSH13/FSH20	type A plug, version 1.1
Memory		
Mass memory		flash memory (internal), SD card (not supplied), size ≤ 32 Gbyte
	R&S®FSH4/FSH8 with serial number ≥ 105000, R&S®FSH13/FSH20	memory stick (not supplied), USB version 1.1 or 2.0
Data storage	internal	> 256 instrument settings and traces
	on SD card/memory stick, ≥ 1 Gbyte	> 5000 instrument settings and traces
Temperature	operating temperature range	–10 °C to +55 °C
	storage temperature range	–40 °C to +70 °C
	battery charging mode	+10 °C to +45 °C
Climatic loading	relative humidity	+25 °C/+40 °C at 85 % relative humidity, in line with EN 60068-2-30
	protection class	IP51
	with R&S®HA-Z222 carrying holster and rain cap	IP54
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-810F, method 516.4 procedure 1, EN 60068-2-27, MIL-PRF-28800F class 2

Power supply		
R&S®HA-Z201 plug-in AC power supply	input specifications	100 V to 240 V AC, 50 Hz to 60 Hz, 700 mA
	output specifications	15 V DC, 2 A
	operating temperature range	0 °C to +40 °C
	storage temperature range	–40 °C to +70 °C
	test mark	VDE or SIQ, CE, UL, PSE
External DC voltage		14 V to 16 V
Internal battery		Lithium-ion battery
Capacity	R&S®HA-Z204 (standard)	4.2 Ah
	R&S®HA-Z206 (option)	6.3 Ah
Voltage		nom. 7.2 V
Operating time with new, fully charged battery	R&S®HA-Z204 (standard)	3 h
	R&S®HA-Z206 (option)	4.5 h
Charging time	instrument switched off or R&S®HA-Z203 battery charger	
	R&S®HA-Z204 (standard)	2.5 h
	R&S®HA-Z206 (option)	3.5 h
	instrument switched on	
	R&S®HA-Z204 (standard)	3.5 h
	R&S®HA-Z206 (option)	4.5 h
Life time	charging cycles	> 500
Power consumption		typ. 12 W
Safety		IEC 61010-1, EN 61010-1, UL 61010-1, CAN/CSA-C22.2 No. 61010.1-04
Test mark		VDE or SIQ, GS, CSA, CSA-NRTL
EMC	in line with European EMC Directive 2004/108/EC including	EN 61326 class B (emission)
		CISPR 11/EN 55011/group 1 class B (emission)
		EN 61326 table 2 (immunity, industrial) field strength: 30 V/m: 30 MHz to 2 GHz 3 V/m: 2 GHz to 2.7 GHz
Dimensions (W × H × D)	with handle	194 mm × 300 mm × 144 mm (7.6 in × 11.8 in × 5.7 in)
	without handle	194 mm × 300 mm × 69 mm (7.6 in × 11.8 in × 2.7 in)
Weight		< 3 kg (< 6.6 lb)
Recommended calibration interval		1 year

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

The specifications for part number 1309.6000.54 are equivalent to part number 1309.6000.04.

The specifications for part number 1309.6000.64 are equivalent to part number 1309.6000.14.

The specifications for part number 1309.6000.74 are equivalent to part number 1309.6000.24.

The specifications for part number 1309.6000.58 are equivalent to part number 1309.6000.08.

The specifications for part number 1309.6000.68 are equivalent to part number 1309.6000.18.

The specifications for part number 1309.6000.78 are equivalent to part number 1309.6000.28.

The specifications for part number 1314.2000.63 are equivalent to part number 1314.2000.13.

The specifications for part number 1314.2000.70 are equivalent to part number 1314.2000.20.

The specifications for part number 1314.2000.73 are equivalent to part number 1314.2000.23.

The specifications for part number 1314.2000.80 are equivalent to part number 1314.2000.30.

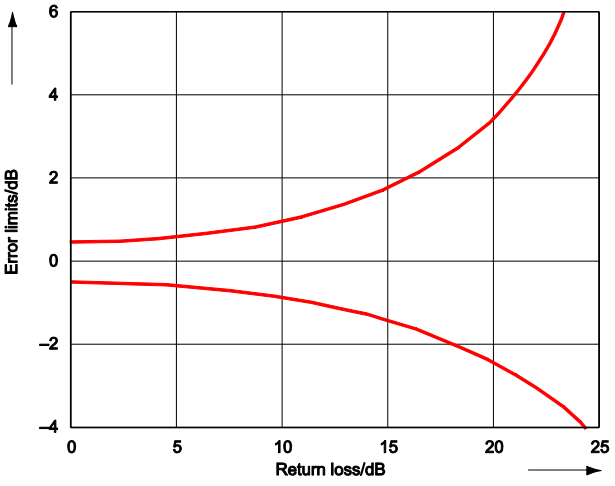
Accessories

R&S®FSH-Z14 directional power sensor

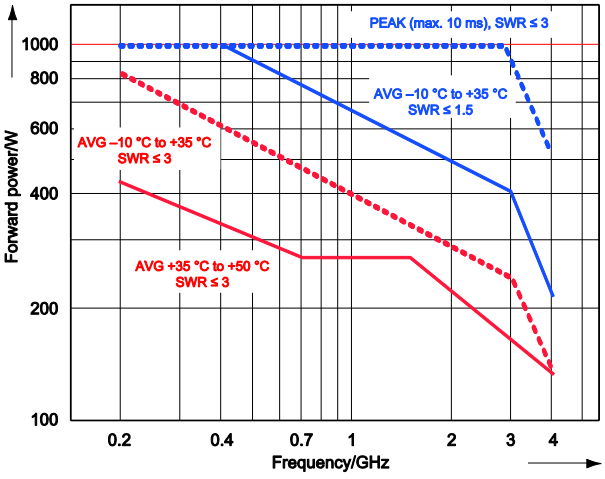
Frequency range		25 MHz to 1 GHz
Power measurement range		30 mW to 300 W
VSWR	referenced to 50 Ω	< 1.06
Power-handling capacity	depending on temperature and matching (see diagram on page 32)	100 W to 1000 W
Insertion loss		< 0.06 dB
Directivity		> 30 dB
Average power		
Power measurement range		
CW, FM, 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) [12]
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)

[12] If standard is selected on the R&S®FSH4/FSH8.

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)
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



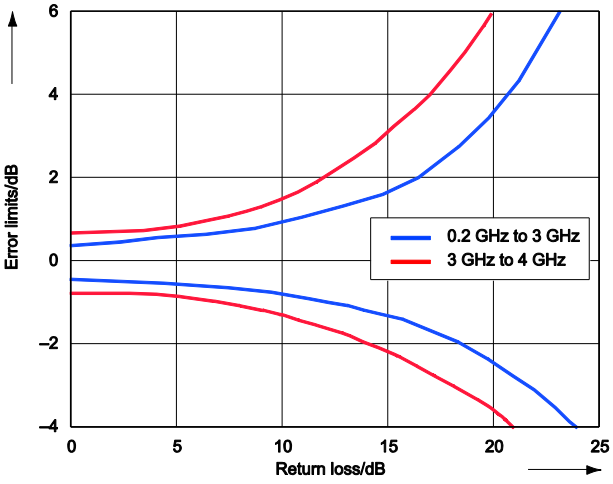
Power-handling capacity

R&S®FSH-Z44 directional power sensor

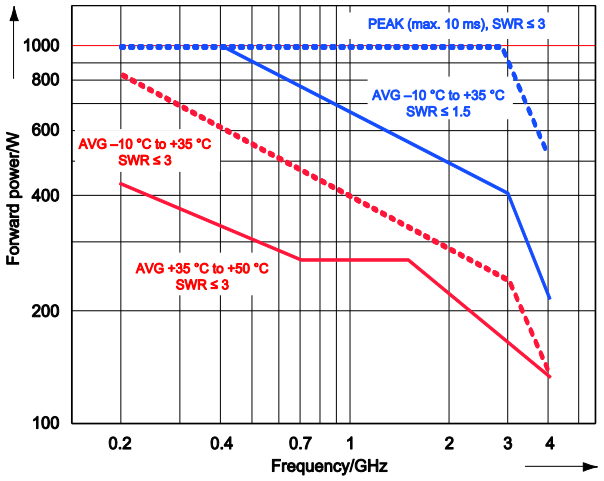
Frequency range		200 MHz to 4 GHz
Power measurement range		30 mW to 300 W
VSWR referenced to 50 Ω	200 MHz to 3 GHz	< 1.07
	3 GHz to 4 GHz	< 1.12
Power-handling capacity	depending on temperature and matching (see diagram on page 34)	120 W to 1000 W
Insertion loss	200 MHz to 1.5 GHz	< 0.06 dB
	1.5 GHz 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) [13]
	cdmaOne, DAB	±1 % of measured value (±0.04 dB) [13]
	3GPP WCDMA, CDMA2000®	±2 % of measured value (±0.09 dB) [13]
	DVB-T	±2 % of measured value (±0.09 dB) [13]
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/FSH8/FSH13/FSH20	
	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)

[13] If standard is selected on the R&S®FSH4/FSH8/FSH13/FSH20.

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

R&S®HA-Z240 GPS receiver

GPS location indication		latitude, longitude
Reference frequency uncertainty	GPS on, ≥ 1 min after satellite lock	$\pm 2.5 \times 10^{-8}$
	up to 30 min after losing satellite lock	$\pm 5 \times 10^{-8}$
Temperature	operating temperature range	–20 °C to +55 °C
	storage temperature range	–40 °C to +70 °C
Climatic loading	GPS receiver module	IPX7 level, in line with IEC 60529
Connector		7-contact male (type: Binder 712)
Power consumption		0.45 W
Test marks		FCC, CE
Dimensions	diameter × height	61 mm × 19.5 mm (2.4 in × 0.8 in)
	cable length	5 m (16.4 ft)
Weight		200 g (0.4 lb)

R&S®FSH-Z114 precision frequency reference

Temperature	operating temperature range	–10 °C to +55 °C
	storage temperature range	–55 °C to +90 °C
Climatic loading	relative humidity	+25 °C/+55 °C at 95 % relative humidity, in line with EN 60068-2-30
	protection class	IP51
Connector		7-contact male (type: Binder 712)
Power consumption		0.20 W
Dimensions	diameter × height	88 mm × 94 mm × 26.0 mm (3.5 in × 3.5 in × 0.8 in)
	cable length	0.25 m (0.82 ft)
Weight		250 g (0.6 lb)

Ordering information

Designation	Type	Order No.
Spectrum analyzer, 9 kHz to 3.6 GHz, with preamplifier	R&S®FSH4	1309.6000.04
Spectrum analyzer, 9 kHz to 3.6 GHz, with preamplifier and tracking generator	R&S®FSH4	1309.6000.14
Spectrum analyzer, 100 kHz to 3.6 GHz, with preamplifier, tracking generator and internal VSWR bridge	R&S®FSH4	1309.6000.24
Spectrum analyzer, 9 kHz to 8 GHz, with preamplifier	R&S®FSH8	1309.6000.08
Spectrum analyzer, 9 kHz to 8 GHz, with preamplifier and tracking generator	R&S®FSH8	1309.6000.18
Spectrum analyzer, 100 kHz to 8 GHz, with preamplifier, tracking generator and internal VSWR bridge	R&S®FSH8	1309.6000.28
Spectrum analyzer, 9 kHz to 13.6 GHz, with preamplifier	R&S®FSH13	1314.2000.13
Spectrum analyzer, 9 kHz to 20 GHz, with preamplifier	R&S®FSH20	1314.2000.20
Spectrum analyzer, 9 kHz to 13.6 GHz, with preamplifier, tracking generator and internal VSWR bridge	R&S®FSH13	1314.2000.23
Spectrum analyzer, 9 kHz to 20 GHz, with preamplifier, tracking generator and internal VSWR bridge	R&S®FSH20	1314.2000.30
Accessories supplied		
Lithium-ion battery pack, USB cable, LAN cable, AC power supply, CD-ROM with R&S®FSH4View software and documentation, quick start guide		

Options

Designation	Type	Order No.	Remarks
Hardware option			
Lithium-ion battery pack, 6.3 Ah installed in factory	R&S®FSH-B106	1304.5958.02	upgrade the battery (from 4.2 Ah to 6.3 Ah) that comes with the device
Software options			
Spectrogram measurement application	R&S®FSH-K14	1304.5770.02	
Interference analysis measurement application	R&S®FSH-K15	1309.7488.02	
Geotagging measurement application	R&S®FSH-K16	1309.7494.02	
Indoor mapping measurement application	R&S®FSH-K17	1304.5893.02	
Pulse measurements with power sensor	R&S®FSH-K29	1304.5993.02	requires a power sensor R&S®NRP-Z81/-Z85 or -Z86 [14]
Remote control via LAN or USB	R&S®FSH-K40	1304.5606.02	
Distance-to-fault analysis	R&S®FSH-K41	1304.5612.02	for models .23/.24/.28/.30 only, R&S®FSH-Z320 or R&S®FSH-Z321 and R&S®FSH-Z28 or R&S®FSH-Z29 recommended
Vector network analysis	R&S®FSH-K42	1304.5629.02	for models .24/.28 only, standard for models .23/.30
Vector voltmeter	R&S®FSH-K45	1304.5658.02	for models .23/.24/.28/.30 only
GSM edge measurement application	R&S®FSH-K10	1304.5864.02	
3GPP WCDMA BTS/NodeB pilot channel and EVM measurement application	R&S®FSH-K44	1304.5641.02	
3GPP WCDMA BTS/NodeB code domain power and EVM measurement application	R&S®FSH-K44E	1304.5758.02	R&S®FSH-K44 required
CDMA2000® BTS pilot channel and EVM measurement application	R&S®FSH-K46	1304.5729.02	
CDMA2000® BTS code domain power measurement application	R&S®FSH-K46E	1304.5764.02	R&S®FSH-K46 required
1xEV-DO BTS pilot channel and EVM measurement application	R&S®FSH-K47	1304.5787.02	
1xEV-DO BTS PN scanner and time domain power measurement application	R&S®FSH-K47E	1304.5806.02	R&S®FSH-K47 required
3GPP TD-SCDMA BTS power and P-CCPCH EVM measurement application	R&S®FSH-K48	1304.5841.02	
3GPP TD-SCDMA/HSDPA BTS code domain power and EVM measurement application	R&S®FSH-K48E	1304.5858.02	R&S®FSH-K48 required

[14] The R&S®NRP-Z8x power sensors are supported by instruments with serial number ≥ 105000.
For instruments with serial number < 121000, the R&S®FSH-Z129 adapter cable is required in addition.

Designation	Type	Order No.	Remarks
LTE FDD downlink pilot channel and EVM measurement application	R&S®FSH-K50	1304.5735.02	only for R&S®FSH4/FSH8 with serial number ≥ 105000, R&S®FSH13/FSH20
LTE TDD downlink pilot channel and EVM measurement application	R&S®FSH-K51	1304.5812.02	only for R&S®FSH4/FSH8 with serial number ≥ 105000, R&S®FSH13/FSH20
LTE FDD downlink extended channel and modulation measurement application	R&S®FSH-K50E	1304.5793.02	only for R&S®FSH4/FSH8 with serial number ≥ 105000, R&S®FSH13/FSH20, R&S®FSH-K50 required
LTE TDD downlink extended channel and modulation measurement application	R&S®FSH-K51E	1304.5829.02	only for R&S®FSH4/FSH8 with serial number ≥ 105000, R&S®FSH13/FSH20, R&S®FSH-K51 required
Receiver mode and channel scan measurement application	R&S®FSH-K43	1304.5635.02	
NB-IoT measurement application	R&S®FSH-K56	1318.6100.02	only for R&S®FSH4/FSH8 with serial number ≥ 105000, R&S®FSH13/FSH20
EMF measurement application	R&S®FSH-K105	1318.6200.02	see required options according to page 27

Accessories

Designation	Type	Order No.
RF cable, DC to 8 GHz, armored, N male/N female connectors, length: 1 m	R&S®FSH-Z320	1309.6600.00
RF cable, DC to 8 GHz, armored, N male/N female connectors, length: 3 m	R&S®FSH-Z321	1309.6617.00
Precision frequency reference	R&S®FSH-Z114	1304.5935.02
Combined open/short/50 Ω load calibration standard, DC to 3.6 GHz	R&S®FSH-Z29	1300.7510.03
Combined open/short/50 Ω load calibration standard, DC to 8 GHz	R&S®FSH-Z28	1300.7810.03
Combined open/short/50 Ω load/through calibration standard, DC to 15 GHz, 3.5 mm male	R&S®ZV-Z135	1317.7677.02
Combined open/short/50 Ω load/through calibration standard, DC to 15 GHz, 3.5 mm female	R&S®ZV-Z135	1317.7677.03
Combined open/short/50 Ω load/through calibration standard, DC to 9 GHz, N male	R&S®ZV-Z170	1317.7683.02
Combined open/short/50 Ω load/through calibration standard, DC to 9 GHz, N female	R&S®ZV-Z170	1317.7683.03
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
12 V car adapter for cigarette lighter [15]	R&S®HA-Z202	1309.6117.00
Lithium-ion battery pack, 4.2 Ah	R&S®HA-Z204	1309.6130.00
Lithium-ion battery pack, 6.3 Ah	R&S®HA-Z206	1309.6146.00
Battery charger for R&S®HA-Z204 and R&S®HA-Z206 lithium-ion battery pack [16]	R&S®HA-Z203	1309.6123.00
Soft carrying bag	R&S®HA-Z220	1309.6175.00
Hard case for handhelds	R&S®HA-Z321	1321.1357.02
Carrying holster, including chest harness and rain cover	R&S®HA-Z222	1309.6198.00
Shoulder strap for R&S®HA-Z222 carrying holster	R&S®HA-Z223	1309.6075.00
SD memory card, 4 Gbyte [17]	R&S®HA-Z232	1309.6223.00
Headphones	R&S®FSH-Z36	1145.5838.02
GSM/UMTS/CDMA antenna magnetic mount 850/900/1800/1900/2100 band, N connector	R&S®TS95A16	1118.6943.16

[15] The car adapter is suitable for both the instrument and the R&S®HA-Z203 external battery charger.

[16] The battery charger is dedicated for charging an additional battery outside the instrument. The internal battery is charged by the instrument itself.

[17] Firmware update is installed from SD memory card.

Designation	Type	Order No.
Near-field probe set	R&S®HZ-15	1147.2736.02
Preamplifier for R&S®HZ-15	R&S®HZ-16	1147.2720.02
Spare USB cable	R&S®HA-Z211	1309.6169.00
Spare Ethernet cable	R&S®HA-Z210	1309.6152.00
Spare power supply, incl. mains plug for EU, GB, US	R&S®HA-Z201	1309.6100.00
Power cord + adapter for R&S®HA-Z201 power supply (changes the power supply to laptop style)		
Power cord EU	R&S®HA-Z209	1309.7465.02
Power cord GB	R&S®HA-Z209	1309.7465.03
Power cord US/JP	R&S®HA-Z209	1309.7465.04
Power cord AUS	R&S®HA-Z209	1309.7465.05
GPS receiver	R&S®HA-Z240	1309.6700.03
Spare CD-ROM, including R&S®FSH4View software and operating manual for R&S®FSH4/FSH8/FSH13/FSH20	R&S®FSH-Z45	1309.6246.00
Spare printed quick start guide for R&S®FSH4/FSH8/FSH13/FSH20, English	R&S®FSH-Z46	1318.5332.02
Spare printed quick start guide for R&S®FSH4/FSH8/FSH13/FSH20, German	R&S®FSH-Z47	1318.5332.03
Portable system for EMVU measurements		
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
Calibration unit, 2 MHz to 4 GHz, for R&S®FSH .23/.24/.28/.30 models	R&S®ZN-Z103	1321.1828.02
Calibration unit, 1 MHz to 6 GHz, for R&S®FSH .23/.24/.28/.30 models	R&S®ZN-Z103	1321.1828.12

R&S®NRP power sensors supported by the R&S®FSH4/FSH8/FSH13/FSH20 [18, 19, 20]

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, 2-path	R&S®NRP-Z211	1417.0409.02
Universal power sensor, 10 MHz to 18 GHz, 100 mW, 2-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 sensors, 100 pW to 200 mW, 10 MHz to 8 GHz	R&S®NRP8S	1419.0006.02
Three-path diode power sensors, 100 pW to 200 mW, 10 MHz to 18 GHz	R&S®NRP18S	1419.0029.02
Three-path diode power sensors, 100 pW to 200 mW, 10 MHz to 33 GHz	R&S®NRP33S	1419.0064.02
Three-path diode power sensors, 100 pW to 200 mW, 50 MHz to 40 GHz	R&S®NRP40S	1419.0041.02
Three-path diode power sensors, 100 pW to 200 mW, 50 MHz to 50 GHz	R&S®NRP50S	1419.0087.02
Average power sensors, 100 pW to 200 mW, 8 kHz to 6 GHz	R&S®NRP6A	1424.6796.02
Average power sensors, 100 pW to 200 mW, 8 kHz to 18 GHz	R&S®NRP18A	1424.6815.02

R&S®NRP power sensors require the following adapter cable for operation on the R&S®FSH		
Passive USB adapter to connect R&S®NRP power sensors to the R&S®FSH	R&S®NRP-Z4	1146.8001.02

R&S®FSH power sensors require the following adapter cable for connection to a PC		
USB adapter cable for R&S®FSH-Z14/R&S®FSH-Z44	R&S®FSH-Z144	1145.5909.02

R&S®NRP-Z8x power sensors require the following adapter cable for operation on the R&S®FSH		
Adapter cable for R&S®NRP-Z8x	R&S®FSH-Z129	1304.5887.00

R&S®NRP power sensors require the following adapter cable for operation on the R&S®FSH		
USB interface cable, length: 1.5 m, to connect R&S®NRP power sensors to the R&S®FSH	R&S®NRP-ZKU	1419.0658.03

[18] For average power measurements only.

[19] R&S®NRP power sensors are supported by instruments with serial number ≥ 105000.

[20] Wideband power sensors require the R&S®FSH-Z129 adapter cable for instruments with serial number < 121000. Otherwise, R&S®NRP-Z4 is suitable.

Thermal power sensors

Designation	Type	Order No.
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

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

Recommended extras: directional antenna and accessories

Designation	Type	Order No.
Handheld directional antenna (antenna handle)	R&S®HE400	4104.6000.02
HF antenna module, 8.3 kHz to 30 MHz	R&S®HE400HF	4104.8002.02
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
Cable set for R&S®HE400 and R&S®PR100 or R&S®FSH	R&S®HE400-K	4104.7770.02
Transport case for R&S®HE400	R&S®HE400Z1	4104.9009.02
Transport bag (small) for R&S®HE400 (recommended for one or two antenna modules)	R&S®HE400Z2	4104.9050.02
Transport bag (large) for R&S®HE400 (recommended for three or four antenna modules)	R&S®HE400Z3	4104.9080.02
Tripod for R&S®HE400	R&S®HE400Z4	4104.9109.02

Warranty

Base unit		3 years
All other items [21]		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 [22]. 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 [22] 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 [22] and accredited calibration at the recommended intervals as well as any accredited calibration carried out during repairs or option upgrades.

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

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

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