

# R&S® FSH4/FSH8 Spectrum Analyzer Specifications



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# 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

<b>Frequency range</b>	R&S®FSH4 model .04/.14	9 kHz to 3.6 GHz
	R&S®FSH8 model .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
<b>Frequency resolution</b>		1 Hz

<b>Reference frequency, internal</b>		
Aging per year		$1 \times 10^{-6}$
Temperature drift	0 °C to +30 °C	$1 \times 10^{-6}$
	+30 °C to +50 °C	$3 \times 10^{-6}$
Achievable initial calibration accuracy		$5 \times 10^{-7}$
Total reference uncertainty		(time since last adjustment × aging rate) + temperature drift + calibration accuracy
<b>Reference frequency, with option R&amp;S®HA-Z240 GPS receiver</b>		
Frequency uncertainty	GPS ON, ≥ 1 minute after satellite lock	$\pm 2.5 \times 10^{-8}$
	up to 30 minutes after losing satellite lock	$\pm 5 \times 10^{-8}$

<b>Frequency readout</b>		
Marker resolution		0.1 Hz
Uncertainty		$\pm(\text{marker frequency} \times \text{reference uncertainty} + 10 \% \times \text{resolution bandwidth} + \frac{1}{2}(\text{span} / (\text{sweep points} - 1) + 1 \text{ Hz}))$
Number of sweep (trace) points		631
Marker tuning frequency step size		span/630
Frequency counter resolution		0.1 Hz
Count uncertainty	S/N > 25 dB	$\pm(\text{frequency} \times \text{reference uncertainty} + \frac{1}{2}(\text{last digit}))$
Frequency span		0 Hz, 10 Hz to 3.6/8 GHz
Span uncertainty		nominal 1 %

<b>Spectral purity SSB phase noise</b>		
Carrier offset	30 kHz	f = 500 MHz < -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)

## Sweep time

Sweep time	span = 0 Hz	200 μs to 100 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	nominal 1 %
	span ≥ 10 Hz	nominal 3 %

## Bandwidths

Resolution bandwidths		
Range	-3 dB bandwidth	1 Hz to 3 MHz in 1/3 sequence
Bandwidth accuracy	$1 \text{ Hz} \leq \text{RBW} \leq 300 \text{ kHz}$	nominal < 5 %
	$\text{RBW} > 300 \text{ kHz}$	nominal < 10 %
Selectivity 60 dB:3 dB		nominal < 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 with RF attenuation $\geq 10$ dB		
DC voltage	model .04/.08/.14/.18	80 V
	model .24/.28	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 $\mu$ s	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 $\mu$ s	1 mWs
Intermodulation		
Third-order intercept (TOI), nominal values	intermodulation-free dynamic range, signal level $2 \times -20$ dBm, RF attenuation = 0 dB, RF preamplifier = OFF	
	$f_{in} < 300 \text{ MHz}$	> 54 dBc (TOI > +7 dBm, typ. +11 dBm)
	$300 \text{ MHz} \leq f_{in} < 3.6 \text{ GHz}$	> 60 dBc (TOI > +10 dBm, typ. +15 dBm)
	$3.6 \text{ GHz} \leq f_{in} \leq 8 \text{ GHz}$	> 46 dBc (TOI > +3 dBm, typ. +10 dBm)
	intermodulation-free dynamic range, signal level $2 \times -40$ dBm, RF attenuation = 0 dB, RF preamplifier = ON	
	$f_{in} < 300 \text{ MHz}$	> 50 dBc (TOI -15 dBm)
$300 \text{ MHz} \leq f_{in} \leq 8 \text{ GHz}$	> 56 dBc (TOI -12 dBm)	
Second harmonic intercept (SHI), nominal values	RF attenuation = 0 dB, RF preamplifier = OFF	
	$f_{in} = 20 \text{ MHz to } 1.5 \text{ GHz}$	+40 dBm
	$f_{in} = 1.5 \text{ GHz to } 3 \text{ GHz}$	+30 dBm
	$f_{in} = 3 \text{ GHz to } 4 \text{ GHz}$	+20 dBm
	RF attenuation 0 dB, RF preamplifier = ON	
$f_{in} = 100 \text{ MHz to } 4 \text{ GHz}$	0 dBm	
Displayed average noise level		
0 dB RF attenuation, termination 50 $\Omega$ , 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 (models .04/.14/.08/.18 only)		< -108 dBm, typ. -118 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 8 GHz		< -136 dBm, typ. -141 dBm
		preamplifier = ON
100 kHz to 1 MHz		< -133 dBm, typ. -143 dBm
1 MHz to 10 MHz		< -157 dBm, typ. -161 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

<b>Adjacent channel leakage power ratio (ACLR)</b>		
Dynamic range	frequency < 3.6 GHz, total power > -20 dBm	
	3GPP WCDMA	
	adjacent channel	nominal > 55 dB
	alternate channel	nominal > 58 dB
	CDMA2000®	
	adjacent channel	nominal > 58 dB
	alternate channel	nominal > 61 dB
<b>Immunity to interference, nominal values</b>		
Image frequencies	serial number < 105000	
	$f_{in} - 2 \times 21.4$ MHz	< -70 dBc, typ. -80 dBc
	$f_{in} - 2 \times 831.4$ MHz	< -70 dBc, typ. -90 dBc
	$f_{in} - 2 \times 4881$ MHz	-60 dBc
	serial number $\geq$ 105000	
	$f_{in} - 2 \times 54.4$ MHz	< -70 dBc, typ. -80 dBc
	$f_{in} - 2 \times 860.8$ MHz	< -70 dBc, typ. -90 dBc
	$f_{in} - 2 \times 4892.8$ MHz	-60 dBc
Intermediate frequencies	serial number < 105000	
	21.4 MHz, 831.4 MHz, 4881.4 MHz	< -60 dBc, typ. -80 dBc
	8931.4 MHz	-50 dBc
	serial number $\geq$ 105000	
	54.4 MHz, 860.8 MHz, 4892.8 MHz	< -60 dBc, typ. -80 dBc
	8924.8 MHz	-50 dBc
Other interfering signals, signal level – RF attenuation < -20 dBm	serial number < 105000	
	$f \leq 3.6$ GHz, spurious at $f_{in} - 2440.7$ MHz	< -60 dBc
	3.6 GHz < $f \leq 8$ GHz, spurious at $f_{in} - 4465.7$ MHz	< -60 dBc
	serial number $\geq$ 105000	
	$f \leq 3.6$ GHz, spurious at $f_{in} - 2446.4$ MHz	< -60 dBc
	3.6 GHz < $f \leq 8$ GHz, spurious at $f_{in} - 4462.4$ MHz	< -60 dBc
Other interfering signals, related to local oscillators	$f \leq 3.6$ GHz	
	$\Delta f < 300$ kHz	-60 dBc
	$\Delta f \geq 300$ kHz	< -60 dBc
	$f > 3.6$ GHz	
	$\Delta f < 300$ kHz	-54 dBc
	$\Delta f \geq 300$ kHz	< -54 dBc
	$f =$ receive frequency	
Residual spurious response	input matched with 50 $\Omega$ , without input signal, RBW $\leq$ 30 kHz, $f \geq 3$ MHz, RF attenuation = 0 dB, tracking generator OFF	< -90 dBm
<b>Level display</b>		
Logarithmic level axis		1/2/5/10/20/50/100 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		-80 dBm to +30 dBm
Units of level axis		dBm, dBmV, dB $\mu$ V, 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)	nominal < 1.5 dB
	100 kHz ≤ f < 10 MHz	nominal < 1.5 dB
	10 MHz ≤ f ≤ 3.6 GHz	< 1 dB
	3.6 GHz < f ≤ 8 GHz	< 1.5 dB
Attenuator uncertainty		< 0.3 dB
Uncertainty of reference level setting		nominal < 0.1 dB
Display nonlinearity	S/N > 16 dB, 0 dB to –50 dB, logarithmic level display	< 0.2 dB
Bandwidth switching uncertainty	reference: RBW = 10 kHz	nominal < 0.1 dB
Total measurement uncertainty	95 % confidence level, +20 °C to +30 °C, S/N > 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 ≤ 8 GHz	< 1.5 dB, typ. 1 dB

## Trigger functions

Trigger		
Trigger source		free run, video, external
External trigger level threshold	low → high transition	
	high → low transition	

## Inputs and outputs

<b>RF input</b>		
Impedance		50 $\Omega$
Connector		N female
VSWR	100 kHz $\leq f \leq$ 1 GHz	nominal < 1.5
	1 GHz < f $\leq$ 6 GHz	nominal < 2
	6 GHz < f $\leq$ 8 GHz	nominal < 3
Input attenuator	RF input only	0 dB to 40 dB in 5 dB steps
<b>AF output</b>		
AF demodulation types		AM and FM
Connector		3.5 mm mini jack
Output impedance		nominal 32 $\Omega$
Voltage (open circuit)		V <sub>RMS</sub> adjustable from 0 V to > 100 mV
<b>Power sensor</b>		
Connector		7-contact female (type Binder 712)
Power sensors supported		see accessories
<b>Tracking generator (models .14 and .24 only)</b>		
Frequency range		100 kHz to 3.6 GHz
Connector		N female, 50 $\Omega$
VSWR	100 kHz $\leq f \leq$ 1 GHz	nominal < 1.5
	1 GHz < f $\leq$ 3.6 GHz	nominal < 2
Output level	tracking generator attenuation = 0 dB	nominal 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 $\leq f <$ 300 kHz	> 60 dB, typ. 80 dB
	300 kHz $\leq f <$ 3.6 GHz	> 70 dB, typ. 90 dB
Reverse power		
DC voltage		50 V
CW RF power		+20 dBm (= 0.1 W)
Max. pulse voltage		50 V
Max. pulse energy (10 $\mu$ s)		1 mWs
<b>Tracking generator (models .18 and .28 only)</b>		
Frequency range		100 kHz to 8 GHz
Connector		N female, 50 $\Omega$
VSWR	100 kHz $\leq f \leq$ 1 GHz	nominal < 1.5
	1 GHz < f $\leq$ 6 GHz	nominal < 2
	6 GHz < f $\leq$ 8 GHz	nominal < 3
Output level	tracking generator attenuation = 0 dB	nominal 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 $\leq f <$ 300 kHz	> 60 dB, typ. 80 dB
	300 kHz $\leq f <$ 6 GHz	> 70 dB, typ. 90 dB
	6 GHz $\leq f <$ 8 GHz	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 $\mu$ s)		1 mWs
<b>External reference, external trigger, DC bias port 2 (BNC 1)</b>		
Connector		BNC, 50 $\Omega$
Mode	selectable	ext. reference, ext. trigger, DC bias port 2
External reference	required level	0 dBm
	frequency	10 MHz
External trigger threshold	low $\rightarrow$ high transition	2.4 V
	high $\rightarrow$ low transition	0.7 V
DC bias port 2	max. rated input voltage	50 V
	max. rated input current	600 mA
<b>IF out, DC bias port 1 (BNC 2)</b>		
Connector		BNC, 50 $\Omega$
Mode	selectable	IF out, DC bias port 1
IF out frequency	serial number < 105000	21.4 MHz
	serial number $\geq$ 105000	54.4 MHz
DC bias port 1	max. rated input voltage	50 V
<b>AUX</b>		
Connector		7-contact female (type Binder 712)

## Vector network analysis/vector voltmeter

### Model .24/.28 with R&S®FSH-K42/R&S®FSH-K45 option

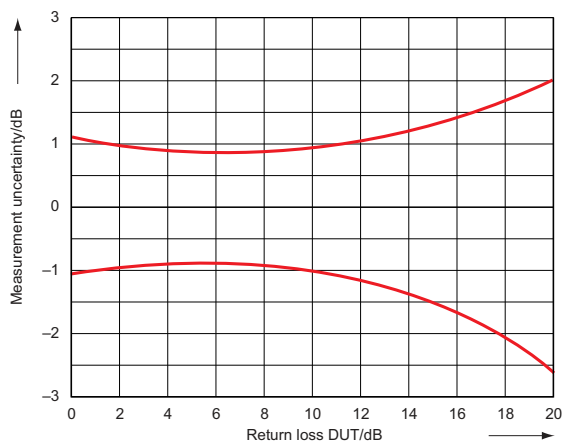
<b>Frequency range</b>	R&S®FSH4 model .24	300 kHz to 3.6 GHz
	R&S®FSH8 model .28	300 kHz to 8 GHz
<b>Frequency resolution</b>		1 Hz
<b>Data points</b>		631
<b>Port power</b>	controlled via tracking generator attenuation	nominal 0 dBm to -40 dBm in 1 dB steps
<b>Reflection measurement</b>		
Result formats	meas. mode = vector	magnitude, phase, magnitude + phase, VSWR, reflection coefficient, Smith chart, cable loss, group delay, electrical length
	meas. mode = vector voltmeter	magnitude + phase, Smith chart
Return loss		
Range	selectable	1/2/5/10/20/50/100 dB, linear 100 %
Resolution		0.01 dB
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	nominal < 3°
	15 dB ≤ return loss < 25 dB	nominal < 6°
	25 dB ≤ return loss < 35 dB	nominal < 20°
	3.6 GHz < f ≤ 8 GHz (R&S®FSH8 only)	
	0 dB ≤ return loss < 15 dB	nominal < 3°
15 dB ≤ return loss < 25 dB	nominal < 6°	
25 dB ≤ return loss < 35 dB	nominal < 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	nominal > 43 dB
	3 GHz < f ≤ 6 GHz	nominal > 37 dB
	6 GHz < f ≤ 8 GHz	nominal > 31 dB
Corrected test port match	300 kHz ≤ f ≤ 3 GHz	nominal > 40 dB
	3 GHz < f ≤ 6 GHz	nominal > 37 dB
	6 GHz < f ≤ 8 GHz	nominal > 30 dB

<b>Transmission measurement</b>		
Result formats	meas. mode = vector	magnitude, phase, magnitude + phase, group delay, electrical length
	meas. mode = vector voltmeter	magnitude + phase
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°
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	nominal < 2°
	50 MHz < f ≤ 3.6 GHz	
	0 dB ≤ insertion loss < 50 dB	nominal < 2°
	50 dB ≤ insertion loss < 70 dB	nominal < 3°
	3.6 GHz < f < 6 GHz (R&S®FSH8 only)	
	0 dB ≤ insertion loss < 50 dB	nominal < 2°
	50 dB ≤ insertion loss < 70 dB	nominal < 3°
	6 GHz ≤ f < 8 GHz (R&S®FSH8 only)	
0 dB ≤ insertion loss < 50 dB	nominal < 3°	
50 dB ≤ insertion loss < 70 dB	nominal < 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

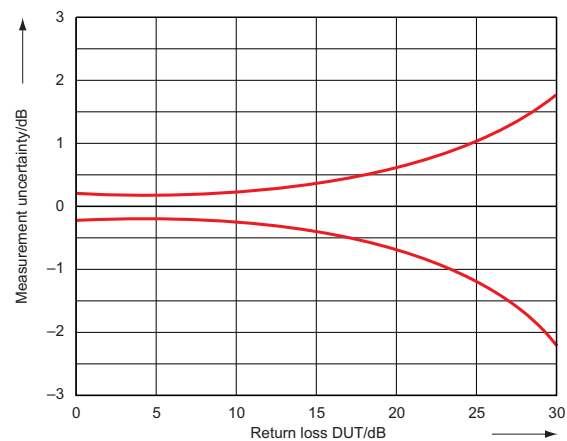
## Scalar network analysis

### Model .24/.28 without R&S®FSH-K42 option

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



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



Uncertainty of reflection measurement with R&S®FSH-K42 option.

## Distance-to-fault analysis

### Model .24/.28 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		$(1.5^8 \times \text{velocity factor/span})$
Maximum permissible spurious signal	RF attenuation = 0 dB	nominal 0 dBm

## 3GPP WCDMA BTS/Node B pilot channel and EVM measurement application R&S®FSH-K44

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

<b>Frequency range</b>		15 MHz to 3.0 GHz
<b>Carrier frequency uncertainty</b>	test case 6.3 in line with 3GPP TS 25.141	
Lock range		±1 kHz
Measurement uncertainty	SNR > 30 dB, $\Delta f_{\text{ref}}$ = uncertainty of reference frequency	< 10 Hz + $\Delta f_{\text{ref}}$
<b>Total power</b>	test case 6.2.1 in line with 3GPP TS 25.141, SNR > 30 dB, +15 °C to +35 °C	
Measurement range	frequency > 15 MHz	
	preamplifier = OFF	-60 dBm < $P_{\text{total}}$ < 20 dBm
	preamplifier = ON	-80 dBm < $P_{\text{total}}$ < 20 dBm
Measurement uncertainty	-80 dBm < $P_{\text{total}}$ < 20 dBm, $P_{\text{REF\_LEV}} - 30 \text{ dB} < P_{\text{total}} < P_{\text{REF\_LEV}} + 3 \text{ dB}$	1 dB, typ. 0.5 dB
<b>CPICH power</b>	test case 6.2.2 in line with 3GPP TS 25.141, SNR > 30 dB	
Measurement range	-40 dBm < $P_{\text{total}}$ < 20 dBm	$P_{\text{total}} - 20 \text{ dB} < P_{\text{CPICH}} < P_{\text{total}}$
Measurement uncertainty	$P_{\text{total}} - 20 \text{ dBm} < P_{\text{CPICH}} < P_{\text{total}}$	1 dB, typ. 0.5 dB
<b>P-CCPCH power</b>	test model 2 in line with 3GPP TS 25.141, SNR > 30 dB	
Measurement range	-40 dBm < $P_{\text{total}}$ < 20 dBm	$P_{\text{total}} - 20 \text{ dB} < P_{\text{P-CCPCH}} < P_{\text{total}}$
Measurement uncertainty	$P_{\text{total}} - 20 \text{ dBm} < P_{\text{P-CCPCH}} < P_{\text{total}}$	1 dB, typ. 0.5 dB
<b>PSCH/SSCH power</b>	test model 2 in line with 3GPP TS 25.141, SNR > 30 dB	
Measurement range	-40 dBm < $P_{\text{total}}$ < 20 dBm	$P_{\text{total}} - 20 \text{ dB} < P_{\text{SCH}} < P_{\text{total}}$
Measurement uncertainty	$P_{\text{total}} - 20 \text{ dBm} < P_{\text{SCH}} < P_{\text{total}}$	2.5 dB, typ. 1.5 dB
<b>Symbol EVM</b>	SNR > 30 dB	
Measurement range	-40 dBm < $P_{\text{total}}$ < 20 dBm	1.5 % < EVM < 25 %
	single channel EVM	
Measurement uncertainty	1.5 % < EVM ≤ 10%	0.5 %
	10 % < EVM < 25 %	2.5 %
Residual EVM		typ. 1.5 %
<b>Scrambling code detection</b>	test model 1.16 in line with 3GPP TS 25.141	
Lock range		±1 kHz
Single scrambling code detection		
Calculation time		2.5 s
CPICH $E_c/I_0$		> -21 dB
Multiple scrambling code detection		
Max. number of scrambling codes		8
Calculation time		5 s
CPICH $E_c/I_0$		> -21 dB

# CDMA2000<sup>®</sup> BTS pilot channel and EVM measurement application R&S<sup>®</sup> FSH-K46 and CDMA2000<sup>®</sup> BTS code domain power measurement application R&S<sup>®</sup> FSH-K46E

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

Measurements	R&S <sup>®</sup> FSH-K46	R&S <sup>®</sup> FSH-K46E
Spectrum overview	✓	✓
Result summary	✓	✓
Total 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	–	✓
Channel power	–	✓
Pilot power (rel. to total)	–	✓
Sync power (rel. to total)	–	✓
Page power (rel. to total)	–	✓
Carrier frequency error	–	✓
Rho	–	✓
EVM	–	✓
Code domain channel table	–	✓
Channel type	–	✓
Walsh code/spreading factor	–	✓
Symbol rate (ksps)	–	✓
RC	–	✓
Status	–	✓
Power abs. (dBm)	–	✓
Power rel. (dB)	–	✓

All specifications are given for RC3, one traffic channel, SNR > 30 dB, +15 °C to +35 °C.

<b>Frequency range</b>		15 MHz to 3.0 GHz
<b>Carrier frequency uncertainty, nominal values</b>		
Lock range		±10 kHz
Measurement uncertainty	SNR > 30 dB, $\Delta f_{ref}$ = uncertainty of reference frequency	< 10 Hz + $\Delta f_{ref}$
<b>Total power</b>		
Measurement range	frequency > 15 MHz preamplifier = OFF preamplifier = ON	– 60 dBm < $P_{total}$ < 20 dBm – 75 dBm < $P_{total}$ < 20 dBm
Measurement uncertainty	–75 dBm < $P_{total}$ < 20 dBm, reference level adjusted to channel power	< 1 dB, typ. 0.5 dB
<b>PICH power</b>		
Measurement range	SNR > 30 dB, nominal –40 dBm < $P_{total}$ < 20 dBm	$P_{total} - 20$ dB < $P_{PICH}$ < $P_{total}$
Measurement uncertainty	$P_{total} - 20$ dBm < $P_{CPICH}$ < $P_{total}$	< 1 dB, typ. 0.5 dB
<b>F-SYNC power</b>		
Measurement range	SNR > 30 dB, nominal –40 dBm < $P_{total}$ < 20 dBm	$P_{total} - 20$ dB < $P_{SYNC}$ < $P_{total}$
Measurement uncertainty	$P_{total} - 20$ dBm < $P_{SYNC}$ < $P_{total}$	< 1 dB, typ. 0.5 dB
<b>Composite EVM</b>		
Measurement range	SNR > 30 dB, nominal –40 dBm < $P_{total}$ < 20 dBm	1.5 % < EVM < 25 %
Measurement uncertainty	1.5 % < EVM ≤ 10 % 10 % < EVM < 25 %	typ. 2.0 % typ. 2.5 %
Residual EVM		typ. 2.5 %
<b>Rho</b>		
Measurement range	SNR > 30 dB, nominal –40 dBm < $P_{total}$ < 20 dBm	0.9 < Rho < 1
Measurement uncertainty	0.97 < Rho ≤ 1.0 0.90 < Rho ≤ 0.97	typ. 0.005 typ. 0.02

## General data

<b>Manual operation</b>		
Languages		Chinese, English, French, German, Italian, Hungarian, Japanese, Korean, Portuguese, Russian, Spanish
<b>Remote control (R&amp;S®FSH-K40 option)</b>		
Command set		SCPI 1997.0
LAN interface		10/100BaseT, RJ-45
USB		mini B plug, version 1.1
<b>Display</b>		
Resolution		640 × 480 pixel
<b>Audio</b>		
Speaker		internal
<b>USB interface</b>		
	serial number ≥ 105000	type A plug, version 1.1
<b>Mass memory</b>		
Mass memory		flash memory (internal), SD card (not supplied), size ≤ 4 Gbyte
	serial number ≥ 105000	memory stick (not supplied), size ≤ 4 Gbyte, 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
<b>Temperature</b>		
	operating temperature range	0 °C to +50 °C
	permissible temperature range	-10 °C to +55 °C
	storage temperature range	-40 °C to +70 °C
	battery charging mode	0 °C to +40 °C
<b>Climatic loading</b>		
	relative humidity	+25/+40 °C at 85 % relative humidity (EN 60068-2-30)
	IP class of protection	51
	with R&S®HA-Z222 carrying holster and rain cap	54
<b>Mechanical resistance</b>		
Vibration	sinusoidal	EN 60068-2-6
	random	EN 60068-2-64
Shock		40 g shock spectrum, in line with MIL-STD-810F, method 516.4 procedure 1, EN 60068-2-27

<b>Power supply</b>		
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, CE, UL, PSE
External DC voltage		14 V to 16 V
Internal battery		Li-ion battery
Capacity	R&S®HA-Z204 (standard)	4.5 Ah
	R&S®HA-Z206 (option)	6.75 Ah
Voltage		nominal 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 61010B-1, CSA C22.2 No. 1010-1
Test mark		VDE, 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 A.1 (immunity, industrial) field strength: 30 V/m	
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)
<b>Recommended calibration interval</b>		1 year

## Accessories

### R&S®FSH-Z1 and R&S®FSH-Z18 power sensors

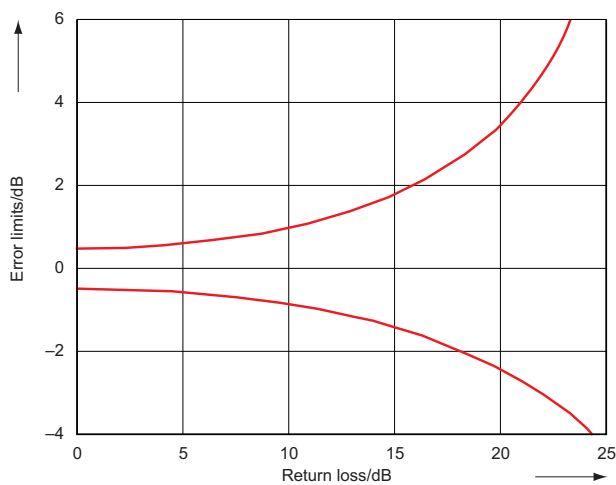
Frequency range	R&S®FSH-Z1	10 MHz to 8 GHz
	R&S®FSH-Z18	10 MHz to 18 GHz
VSWR	10 MHz to 30 MHz	< 1.15
	30 MHz to 2.4 GHz	< 1.13
	2.4 GHz to 8 GHz	< 1.20
	8 GHz to 18 GHz	< 1.25
Maximum input power	average power	400 mW (+26 dBm)
	peak power (< 10 $\mu$ s, 1 % duty cycle)	1 W (+30 dBm)
Measurement range		200 pW to 200 mW (-67 dBm to +23 dBm)
Signal weighting		average power
Effect of harmonics		< 0.5 % (0.02 dB) at harmonic ratio of 20 dB
Effect of modulation		< 1.5 % (0.07 dB) for continuous digital modulation
Absolute measurement uncertainty	sine signals, no zero offset	
	10 MHz to 8 GHz	+15 °C to +35 °C 0 °C to +50 °C
8 GHz to 18 GHz	+15 °C to +35 °C	< 3.5 % (0.15 dB)
	0 °C to +50 °C	< 5.0 % (0.21 dB)
Zero offset after zeroing		< 110 pW
Dimensions (W × H × D)		48 mm × 31 mm × 170 mm (1.9 in × 1.22 in × 6.7 in)
	connecting cable	1.5 m (59 in)
Weight		< 0.3 kg (0.66 lb)

### R&S®FSH-Z14 directional power sensor

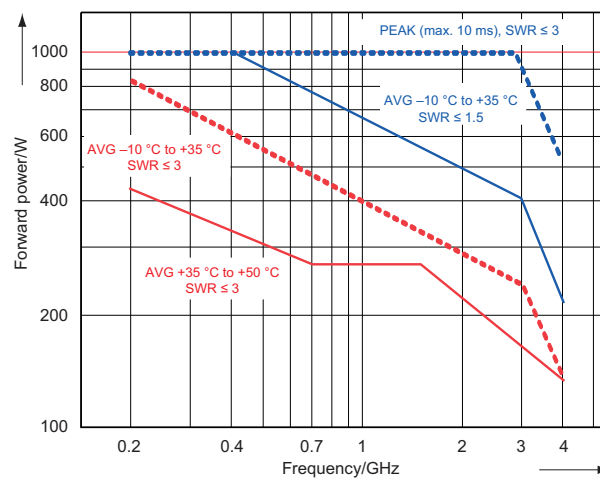
Frequency range		25 MHz to 1 GHz
Power measurement range		30 mW to 300 W
VSWR referenced to 50 $\Omega$		< 1.06
Power-handling capacity	depending on temperature and matching (see diagram on page 15)	100 W to 1000 W
Insertion loss		< 0.06 dB
Directivity		> 30 dB
<b>Average power</b>		
Power measurement 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	$\pm$ 4 mW
Range of typical measurement error with modulation	FM, PM, FSK, GMSK	0 % of measured value (0 dB)
	AM (80 %)	$\pm$ 3 % of measured value ( $\pm$ 0.13 dB)
	two CW carriers with identical power	$\pm$ 2 % of measured value ( $\pm$ 0.09 dB)
	EDGE, TETRA	$\pm$ 0.5 % of measured value ( $\pm$ 0.02 dB) <sup>1</sup>
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)

<sup>1</sup> If standard is selected on the R&S®FSH.

<b>Max. peak envelope power</b>		
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 $\geq 0.1$ and repetition rate $\geq 100/s$	video bandwidth 4 kHz	$\pm(3\%$ of measured value + 0.05 W) starting from a burst width of 200 $\mu s$
	video bandwidth 200 kHz	$\pm(3\%$ of measured value + 0.20 W) starting from a burst width of 4 $\mu s$
	video bandwidth 600 kHz	$\pm(7\%$ of measured value + 0.40 W) starting from a burst width of 2 $\mu s$
20/s $\leq$ repetition rate < 100/s		plus $\pm(1.6\%$ of measured value + 0.15 W)
0.001 $\leq$ duty cycle < 0.1		plus $\pm 0.10$ 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	specs met from 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



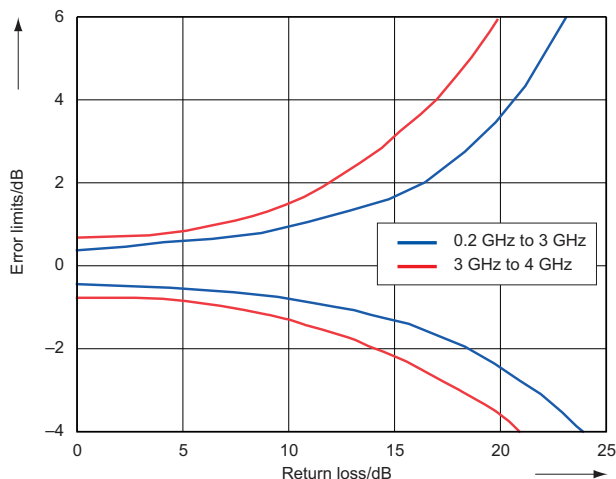
Power-handling capacity

**R&S® FSH-Z44 directional power sensor**

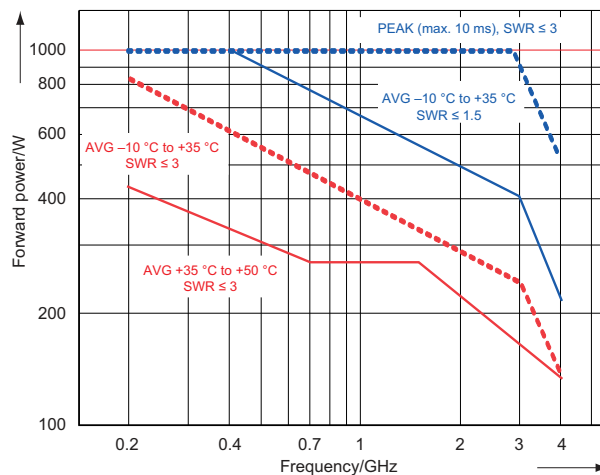
Frequency range		200 MHz to 4 GHz	
Power measurement range		30 mW to 300 W	
VSWR referenced to 50 Ω	200 MHz to 3 GHz	< 1.07	
	3 GHz to 4 GHz	< 1.12	
Power-handling capacity	depending on temperature and matching (see diagram on page 17)	120 W to 1000 W	
Insertion loss	200 MHz to 1.5 GHz	< 0.06 dB	
	1.5 GHz to 4 GHz	< 0.09 dB	
Directivity	200 MHz to 3 GHz	> 30 dB	
	3 GHz to 4 GHz	> 26 dB	
<b>Average power</b>			
Power measurement range	CF: ratio of peak envelope power to average power		
	CW, FM, PM, FSK, GMSK	30 mW to 300 W	
	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) <sup>2</sup>	
	cdmaOne, DAB	±1 % of measured value (±0.04 dB) <sup>2</sup>	
	3GPP WCDMA, CDMA2000®, DVB-T	±2 % of measured value (±0.09 dB) <sup>2</sup>	
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)	
<b>Max. peak envelope power</b>			
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®FSH		
	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)	

<sup>2</sup> If standard is selected on the R&S®FSH.

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	specs met from 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 minute after satellite lock	$\pm 2.5 \times 10^{-8}$
	up to 30 minutes after loosing 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	IEC 60529 IPX7 level
Connector		7-contact male (type Binder 712)
Power consumption		0.45 W
Test marks		FCC, CE
Dimensions	diameter × height	Ø 61 mm × 19.5 mm (Ø 2.4 in × 0.8 in)
	cable length	5 m (16.4 ft)
Weight		200 g (0.4 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
<b>Accessories supplied</b>		
Li-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.
Remote Control via LAN or USB	R&S®FSH-K40	1304.5606.02
Distance-to-Fault Analysis (for models .24 and .28 only, requires R&S®FSH-Z320 or R&S®FSH-Z321 and R&S®FSH-Z28 or R&S®FSH-Z29)	R&S®FSH-K41	1304.5612.02
Vector Network Analysis (for models .24 and .28 only)	R&S®FSH-K42	1304.5629.02
Vector Voltmeter (for models .24 and .28 only)	R&S®FSH-K45	1304.5658.02
3GPP WCDMA BTS/Node B Pilot Channel and EVM Measurement Application	R&S®FSH-K44	1304.5641.02
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-K46 required)	R&S®FSH-K46E	1304.5764.02

## Accessories

Designation	Type	Order No.
Power Sensor, 10 MHz to 8 GHz	R&S®FSH-Z1	1155.4505.02
Power Sensor, 10 MHz to 18 GHz	R&S®FSH-Z18	1165.1909.02
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
USB Adapter Cable for R&S®FSH-Z44 (for connection to a PC)	R&S®FSH-Z144	1145.5905.02
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
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
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
Li-Ion Battery Pack, 4.5 Ah	R&S®HA-Z204	1309.6130.00
Li-Ion Battery Pack, 6.75 Ah	R&S®HA-Z206	1309.6146.00
Battery Charger for Li-ion battery pack R&S®HA-Z204 and R&S®HA-Z206 <sup>3</sup>	R&S®HA-Z203	1309.6123.00
12 V Car Adapter for cigarette lighter <sup>4</sup>	R&S®HA-Z202	1309.6117.00
Soft Carrying Bag	R&S®HA-Z220	1309.6175.00
Hardcase	R&S®HA-Z221	1309.6181.00
Carrying Holster with rain cap	R&S®HA-Z222	1309.6198.00
SD Memory Card, 2 Gbyte <sup>5</sup>	R&S®HA-Z232	1309.6223.00
Headphones	R&S®FSH-Z36	1145.5838.02
Active Directional Antenna, 20 MHz to 7.5 GHz	R&S®HE300	4067.5900.02
Loop Antenna for R&S®HE300, 9 kHz to 20 MHz	R&S®HE300HF	4067.6806.02
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
GPS Receiver	R&S®HA-Z240	1309.6700.02
Spare CDROM including R&S®FSH4View Software and Operating Manual for R&S®FSH4/FSH8	R&S®FSH-Z45	1309.6246.00
Spare printed Quickstart Manual for R&S®FSH4/FSH8 English	R&S®FSH-Z46	1309.6269.12
Spare printed Quickstart Manual for R&S®FSH4/FSH8 German	R&S®FSH-Z47	1309.6269.11
Portable system for EMVU measurements		
Hardcase	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

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For product brochure, see PD 5214.0482.12 and [www.rohde-schwarz.com](http://www.rohde-schwarz.com).

<sup>3</sup> Note: The battery charger is dedicated for charging an additional battery outside the instrument. The internal battery is charged by the instrument itself.

<sup>4</sup> Note: The car adapter is suitable for both the instrument and the R&S®HA-Z203 external battery charger.

<sup>5</sup> Note: Firmware update is installed from SD memory card.







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- | Local and personalized
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- | Long-term dependability

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- | Energy-efficient products
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## Rohde & Schwarz GmbH & Co. KG

[www.rohde-schwarz.com](http://www.rohde-schwarz.com)

## Regional contact

- | Europe, Africa, Middle East  
+49 89 4129 137 74  
[customersupport@rohde-schwarz.com](mailto:customersupport@rohde-schwarz.com)
- | North America  
1 888 TEST RSA (1 888 837 87 72)  
[customer.support@rsa.rohde-schwarz.com](mailto:customer.support@rsa.rohde-schwarz.com)
- | Latin America  
+1 410 910 79 88  
[customersupport.la@rohde-schwarz.com](mailto:customersupport.la@rohde-schwarz.com)
- | Asia/Pacific  
+65 65 13 04 88  
[customersupport.asia@rohde-schwarz.com](mailto:customersupport.asia@rohde-schwarz.com)

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