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# Signal Analyzer R&S®FSQ

## Specifications



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# Specifications

Specifications are valid under the following conditions:

30 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and total calibration performed. Data without tolerances: typical values only. Data designated 'nominal' applies to design parameters and is not tested.

## Frequency

<b>Frequency range</b>	R&S FSQ3:	DC coupled	20 Hz to 3.6 GHz
		AC coupled	1 MHz to 3.6 GHz
	R&S FSQ8:	DC coupled	20 Hz to 8 GHz
		AC coupled	1 MHz to 8 GHz
	R&S FSQ26:	DC coupled	20 Hz to 26.5 GHz
		AC coupled	10 MHz to 26.5 GHz
	R&S FSQ40:	DC coupled	20 Hz to 40 GHz
<b>Frequency resolution</b>			0.01 Hz

<b>Reference frequency, internal, nominal</b>	<b>standard OCXO</b>	
Aging per day	after 30 days of continuous operation	$1 \times 10^{-9}$
Aging per year	after 30 days of continuous operation	$1 \times 10^{-7}$
Temperature drift	+5 °C to +45 °C	$8 \times 10^{-8}$
Total error	per year	$1.8 \times 10^{-7}$
<b>Reference frequency, internal, nominal</b>	<b>Option R&amp;S FSU-B4</b>	
Aging per day	after 30 days of continuous operation	$2 \times 10^{-10}$
Aging per year	after 30 days of continuous operation	$3 \times 10^{-8}$
Temperature drift	+5 °C to +45 °C	$1 \times 10^{-9}$
Total error	per year	$5 \times 10^{-8}$
<b>External reference frequency</b>		1 MHz to 20 MHz, 1 Hz steps

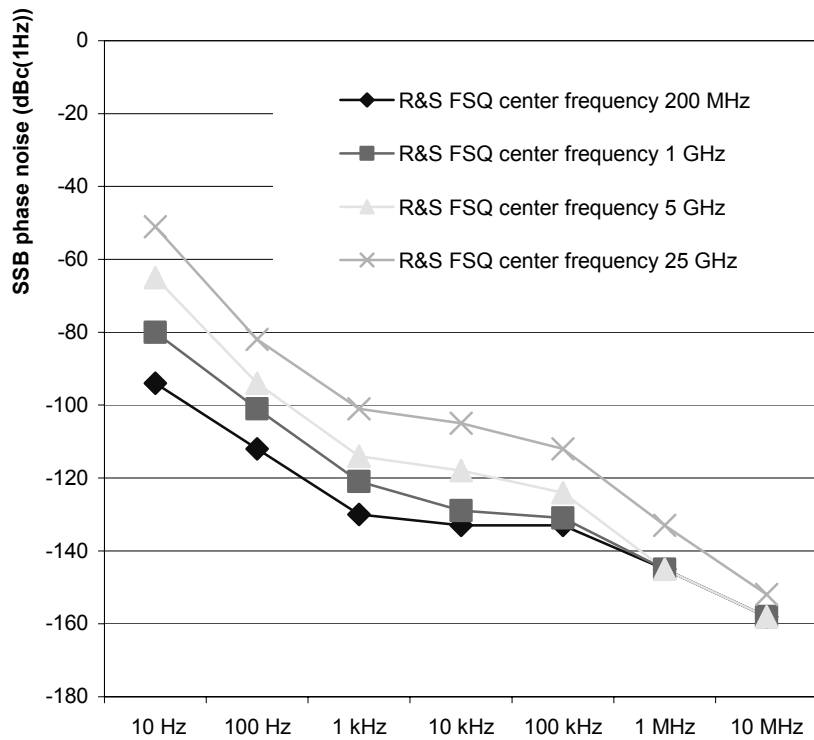
<b>Frequency display</b>		with marker or frequency counter
Marker resolution		span/624
Maximum deviation	sweep time >3 × auto sweep time	$\pm(\text{marker frequency} \times \text{reference error} + 0.5\% \times \text{span} + 10\% \times \text{resolution bandwidth} + \frac{1}{2} \text{ (last digit)})$
Frequency counter resolution	selectable	0.1 Hz to 10 kHz
Count accuracy	S/N >25 dB	$\pm(\text{frequency} \times \text{reference error} + \frac{1}{2} \text{ (last digit)})$
Display range for frequency axis		0 Hz, 10 Hz to max. frequency
Resolution		0.1 Hz
Max. span deviation		1%

<b>Spectral purity, SSB phase noise (1Hz)</b>	f = 640 MHz	
Residual FM	nominal, RBW 10 kHz, RMS	<1 Hz
Carrier offset	10 Hz	- 73 dBc, nominal
	10 Hz with option R&S FSU-B4 fitted	- 86 dBc, nominal
	100 Hz	<-98 dBc <sup>1</sup> , <-90 dBc, typ. -104 dBc <sup>1</sup>
	1 kHz	<-116 dBc <sup>1</sup> , <-112dBc, typ. -124 dBc <sup>1</sup>
	10 kHz	<-128 dBc <sup>1</sup> , <-120 dBc, typ. -133 dBc <sup>1</sup>
	100 kHz	<-128 dBc <sup>1</sup> , <-120 dBc, typ. -133 dBc <sup>1</sup>
	1 MHz	<-140 dBc <sup>1</sup> , <-138 dBc, typ. -146 dBc <sup>1</sup>
	10 MHz	typ. -160 dBc

## Sweep

Sweep time	time sweep, span = 0 Hz	1 μs to 16000 s in 5% steps
	frequency sweep, span ≥10 Hz	2.5 ms to 16000 s in steps ≤10%
Max. deviation of sweep time		3%
Measurement in time domain		with marker and cursor lines (resolution 31.25 ns)

<sup>1</sup> valid as of serial number 200000



## Resolution bandwidths

Sweep filters		
3 dB bandwidths		10 Hz to 20 MHz in 1/2/3/5 sequence, 50 MHz
Bandwidth uncertainty		
	10 Hz to 100 kHz (digital)	<3%
	200 kHz to 5 MHz (analog)	<10%
	10 MHz	-30% to +10%
	20 MHz	-20% to +20%
	50 MHz, $f \leq 3.6$ GHz	-20% to +20%
	50 MHz, $f > 3.6$ GHz	-30% to +100%
Shape factor 60 dB:3 dB		
	$\leq 100$ kHz	<6
	200 kHz to 2 MHz	<12
	3 MHz to 10 MHz	<7
	20 MHz, 50 MHz	<6, nominal

FFT filters		
3 dB bandwidths		1 Hz to 30 kHz in 1/2/3/5 sequence
Bandwidth uncertainty		5%, nominal
Shape factor 60 dB:3 dB		<3, nominal

EMI filters		
6 dB bandwidths		200 Hz, 9 kHz, 120 kHz
Bandwidth uncertainty		3%, nominal
Shape factor 60 dB:3 dB		<6, nominal



<b>Displayed average noise level</b>		
	0 dB RF attenuation, termination 50 $\Omega$ RBW = 1 kHz, VBW = 3 kHz, zero span, sweep time 50 ms, trace average, sweep count = 20, mean marker, normalized to 10 Hz RBW	
	20 Hz 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz 10 MHz	<-80 dBm <-100 dBm <-110 dBm <-120 dBm <-126 dBm <-136 dBm <-143 dBm
	R&S FSQ3	
	20 MHz $\leq f < 2.0$ GHz 2.0 GHz $\leq f \leq 3.0$ GHz 3.0 GHz $\leq f \leq 3.6$ GHz	<-145 dBm, typ. -148 dBm <-143 dBm, typ. -147 dBm <-142 dBm, typ. -147 dBm
	R&S FSQ8	
	20 MHz $\leq f < 2.0$ GHz 2 GHz $\leq f \leq 3.0$ GHz 3 GHz $\leq f \leq 3.6$ GHz 3.6 GHz $\leq f < 7$ GHz 7 GHz $\leq f < 8$ GHz	<-145 dBm, typ. -148 dBm <-143 dBm, typ. -147 dBm <-142 dBm, typ. -146 dBm <-140 dBm, typ. -142 dBm <-139 dBm, typ. -142 dBm
	R&S FSQ26	
	20 MHz $\leq f < 2$ GHz 2 GHz $\leq f < 3.6$ GHz 3.6 GHz $\leq f < 8$ GHz 8 GHz $\leq f < 13$ GHz 13 GHz $\leq f < 18$ GHz 18 GHz $\leq f < 22$ GHz 22 GHz $\leq f < 26.5$ GHz	<-142 dBm, typ. -146 dBm <-140 dBm, typ. -143 dBm <-141 dBm, typ. -145 dBm <-139 dBm, typ. -143 dBm <-137 dBm, typ. -141 dBm <-135 dBm, typ. -138 dBm <-133 dBm, typ. -136 dBm
	R&S FSQ40	
	20 MHz $\leq f < 2$ GHz 2 GHz $\leq f < 8$ GHz 8 GHz $\leq f < 18$ GHz 18 GHz $\leq f < 22$ GHz 22 GHz $\leq f < 26.5$ GHz 26.5 GHz $\leq f < 40$ GHz	<-142 dBm, typ. -146 dBm <-140 dBm, typ. -143 dBm <-138 dBm, typ. -141 dBm <-135 dBm, typ. -138 dBm <-133 dBm, typ. -136 dBm <-125 dBm, typ. -128 dBm

<b>Maximum dynamic range</b>		
1 dB compression to DANL (1 Hz)		170 dB

<b>Immunity to interference</b>		
Image frequency	$f \leq 3.6$ GHz $f > 3.6$ GHz	>90 dB, typ. >110 dB >70 dB, typ. >100 dB
Intermediate frequency	$f \leq 3.6$ GHz 3.6 GHz $< f \leq 4.2$ GHz $f > 4.2$ GHz	>90 dB, typ. >110 dB typ. 70 dB >70 dB, typ. >90 dB
Spurious response	$f > 1$ MHz, without input signal, 0 dB RF attenuation	<-103 dBm
Other interfering signals	$\Delta f > 100$ kHz mixer level <-10 dBm, $f \leq 2.3$ GHz mixer level <-35 dBm, 2.3 GHz $< f < 4$ GHz mixer level <-10 dBm 4 GHz $\leq f < 8$ GHz 8 GHz $\leq f < 16$ GHz 16 GHz $\leq f < 26$ GHz 26.5 GHz $\leq f < 40$ GHz	<-80 dBc <-70 dBc <-70 dBc <-64 dBc <-58 dBc <-52 dBc

<b>Level display</b>		
Screen		625 × 500 pixel (one diagram), max. 2 diagrams with independent settings
Logarithmic level axis		1 dB to 200 dB, in steps of 1/2/5
Linear level axis		10% of reference level per level division, 10 divisions or logarithmic scaling
Number of traces	1 measurement diagram 2 measurement diagrams	3 6
Trace detector		Max Peak, Min Peak, Auto Peak (Normal), Sample, RMS, Average, Quasi Peak
Number of measurement points	default value range	625 155 to 10001 in steps of about a factor of 2
Trace functions		Clear/Write, Max Hold, Min Hold, Average
Trace update rate	local measurement, display update rate, 625 points, zero span remote measurement, display off: zero span/sweep time 1 ms span = 10 MHz, sweep time 2.5 ms	80 per second  70 per second 50 per second
Setting range of reference level	logarithmic level display	–130 dBm to (+5 dBm + RF attenuation), max. 30 dBm, in steps of 0.1 dB
	linear level display	7.0 nV to 7.07 V in steps of 1%
Units of level axis	logarithmic level display linear level display	dBm, dBμV, dBmV, dBμA, dBpW μV, mV, μA, mA, pW, nW

<b>Level measurement uncertainty</b>		
Absolute level uncertainty at 128 MHz	RBW = 10 kHz, level –30 dBm, reference level –30 dBm, RF attenuation 10 dB	<0.2 dB ( $\sigma = 0.07$ dB)
Frequency response referenced to 128 MHz	DC coupling, RF attenuation $\geq 10$ dB, +20 °C to +30 °C 10 MHz $\leq f < 3.6$ GHz 3.6 GHz $\leq f < 8$ GHz, span < 1 GHz 8 GHz $\leq f < 22$ GHz, span < 1 GHz 22 GHz $\leq f < 26.5$ GHz, span < 1 GHz 26.5 GHz $\leq f < 40$ GHz, span < 1 GHz $f \geq 3.6$ GHz, span $\geq 1$ GHz  +5 °C to +45 °C 10 MHz $\leq f < 3.6$ GHz 3.6 GHz $\leq f < 26.5$ GHz $f \geq 26.5$ GHz	<0.3 dB ( $\sigma = 0.1$ dB) <1.5 dB ( $\sigma = 0.5$ dB) <2 dB ( $\sigma = 0.7$ dB) <2.5 dB ( $\sigma = 0.8$ dB) <2.5 dB ( $\sigma = 0.8$ dB) add 0.5 dB to above values  <0.6 dB ( $\sigma = 0.2$ dB) add 0.5 dB to above values add 1.0 dB to above values
Attenuator switching uncertainty	$f = 128$ MHz 0 dB to 70 dB, referenced to 10 dB attenuation	<0.2 dB ( $\sigma = 0.07$ dB)
Uncertainty of reference level setting	RF attenuation 10 dB, referenced to –10 dBm reference level setting	<0.15 dB ( $\sigma = 0.05$ dB)

<b>Display non linearity</b>		
	+20 °C to +30 °C, mixer level $\leq -10$ dBm)	
Logarithmic level display	RBW $\leq 100$ kHz or channel filters, S/N >20 dB 0 dB to –70 dB –70 dB to –90 dB	<0.1 dB ( $\sigma = 0.03$ dB) <0.3 dB ( $\sigma = 0.1$ dB)
	200 kHz $\leq$ RBW $\leq 10$ MHz, S/N >16 dB 0 dB to –50 dB –50 dB to –70 dB	<0.2 dB ( $\sigma = 0.07$ dB) <0.5 dB ( $\sigma = 0.17$ dB)
	RBW >10 MHz, S/N >16 dB 0 dB to –50 dB	<0.5 dB ( $\sigma = 0.17$ dB)
Linear level display		5% of reference level
Bandwidth switching error	referenced to RBW = 10 kHz 1 Hz to 100 kHz 200 kHz to 3 MHz 5 MHz to 50 MHz FFT filter 1 Hz to 3 kHz	<0.1 dB ( $\sigma = 0.03$ dB) <0.2 dB ( $\sigma = 0.07$ dB) <0.5 dB ( $\sigma = 0.15$ dB) <0.2 dB ( $\sigma = 0.07$ dB)

Total measurement uncertainty		
	0 dB to -70 dB, S/N >20 dB, span/RBW <100, 95% confidence level, 20 °C to 30 °C, mixer level ≤-10 dBm	
	f < 3.6 GHz, RBW ≤100 kHz	0.3 dB
	f < 3.6 GHz, RBW >100 kHz	0.5 dB
	3.6 GHz ≤ f < 8 GHz	2.0 dB
	8 GHz ≤ f < 18 GHz	2.5 dB
	18 GHz ≤ f < 26.5 GHz	3.0 dB
	26.5 GHz ≤ f < 40 GHz	3.0 dB

## I/Q data

General		
Interface		GPIB or LAN interface
Sampling rate		Programmable: 10 kHz to 81.6 MHz in 0.1 Hz steps
ADC resolution		14 bit
I/Q memory		16 Msamples each for I and Q data

RF path		
Max. information bandwidth		28 MHz
Harmonic distortion	full-scale input signal	typ.<-70 dBc
Third order distortion	two input tones 6 dB below full scale	typ.<-80 dBc
LO feedthrough	$f_{I/Q} = 81.6 \text{ MHz} - f_{\text{center}}$ ; mixer level = -10 dBm	typ.<-65 dBfs
Aliased DC offset	$f_{I/Q} = 20.4 \text{ MHz}$ ; within ±10 K temperature change after I/Q or total calibration	typ.<-65 dBfs

Frequency response		
	within 2/3 RBW; RBW = 3, 5, 10, 20, 50 MHz	
	f ≤ 3.6 GHz	typ.0.3 dB
	f > 3.6 GHz, YIG filter off	typ.0.5 dB

Deviation from linear phase		
	within 2/3 RBW; RBW = 3, 5, 10, 20, 50 MHz	
	f ≤ 3.6 GHz	typ.1°
	f > 3.6 GHz, YIG filter off	typ.2°



## Audio demodulation

AF demodulation types		AM and FM
Audio output		loudspeaker and phone jack
Marker stop time in spectrum mode		100 ms to 60 s

## Trigger functions

Trigger		
Trigger source		free run, video, external, IF level (mixer level 10 dBm to -50 dBm)
Trigger offset	span $\geq$ 10 Hz	125 ns to 100 s, resolution 125 ns min. (or 1% of offset)
	span = 0 Hz	$\pm$ (125 ns to 100 s), resolution 125 ns min., dependent on sweep time
Max. deviation of trigger offset		$\pm$ (31.25 ns + (0.1% $\times$ trigger offset))
Gated sweep		
Gate source		external, IF level, video
Gate delay		1 $\mu$ s to 100 s
Gate length		125 ns to 100 s, resolution min. 125 ns or 1% of gate length
Max. deviation of gate length		$\pm$ (31.25 ns + (0.05% $\times$ gate length))

## Inputs and outputs (front panel)

<b>RF input</b>		
Impedance		50 $\Omega$
Connector	R&S FSQ3, R&S FSQ8  R&S FSQ26  R&S FSQ40	N female,  testport adapter APC 3.5 mm/N female, testport adapter 2.92 mm (K)/N female
VSWR	RF attenuation $\geq$ 10 dB, DC coupled f < 3.6 GHz R&S FSQ8: 3.6 GHz $\leq$ f < 8 GHz R&S FSQ26, R&S FSQ40: 3.6 GHz $\leq$ f < 18 GHz 18 GHz $\leq$ f < 26.5 GHz 26.5 GHz $\leq$ f < 40 GHz	< 1.5  < 2  < 1.8 < 2.0 < 2.5
	RF attenuation < 10 dB or AC coupling	typ. 1.5
Setting range of attenuator		0 dB to 75 dB, in 5 dB steps

<b>Probe power supply</b>		
Supply voltages		+15 V DC, -12.6 V DC and ground, max. 150 mA, nominal

<b>Power supply for antennas etc</b>		
Supply voltages		5-pin connector  $\pm$ 10 V and ground, max. 100 mA, nominal

<b>Keyboard connector</b>		
		PS/2 female for MF-2 keyboard
<b>AF output</b>		
Connector		3.5 mm mini jack
Output impedance		10 $\Omega$
Open-circuit voltage		up to 1.5 V, adjustable
<b>Power supply for noise source</b>		
		BNC female
Output voltage		0 V and 28 V, switchable, nominal

## Inputs and outputs (rear panel)

<b>IF 20.4 MHz</b>		BNC female
Impedance		50 $\Omega$
Bandwidth	RBW $\leq$ 30 kHz	1.67 $\times$ resolution bandwidth, min. 2.6 kHz
	RBW = 50 kHz, 100 kHz	400 kHz
	200 kHz $\leq$ RBW $\leq$ 10 MHz	equal to resolution bandwidth
Level	RBW $\leq$ 100 kHz, FFT filter, mixer level $>$ -70 dBm	-20 dBm at reference level
	RBW = 200 kHz to 10 MHz, mixer level $>$ -50 dBm	0 dBm at reference level
<b>IF 404.4 MHz</b>	active only if RBW $>$ 10 MHz	BNC female
Impedance		50 $\Omega$
Bandwidth	RBW $>$ 10 MHz	equal to resolution bandwidth
Level	mixer level $\leq$ 0 dBm	mixer level typ. -10 dB
<b>Video output</b>		BNC female
Impedance		50 $\Omega$
Output voltage	RBW $\geq$ 200 kHz, logarithmic scaling, full scale	0 V to 1 V (EMF)
<b>Reference output</b>		BNC female
Impedance		50 $\Omega$
Output frequency		10 MHz
Level		$>$ 0 dBm, nominal
<b>Reference Input</b>		BNC female
Impedance		50 $\Omega$
Input frequency range		1 MHz $\leq$ $f_{in}$ $\leq$ 20 MHz, in 1 Hz steps
Required level		$>$ 0 dBm from 50 $\Omega$
<b>Sweep output</b>		BNC female
Output voltage		0 V to 5 V, proportional to displayed frequency
<b>External trigger/gate input</b>		BNC female
Trigger voltage		1.4 V (TTL)
Input impedance		$\geq$ 10 k $\Omega$
<b>IEC/IEEE bus control</b>		interface to IEC 625-2 (IEEE 488.2)
Command set		SCPI 1997.0 or HP8566 compatible
Connector		24-pin Amphenol female
Interface functions		SH1, AH1, T6, L4, SR1, RL1, PP1, DC1,DT1, C0
<b>LAN interface</b>		10/100 BaseT, RJ45
<b>USB interface</b>		type A plug, version 1.1
<b>Serial interface</b>		RS-232-C (COM), 9-pin female connectors
<b>Printer interface</b>		parallel (Centronics compatible)
<b>Mouse interface</b>		PS/2 compatible
<b>Connector for external monitor (VGA)</b>		15-pin sub-D

## General specifications

<b>Display</b>		21 cm LC TFT colour display (8.4")
Resolution		800 × 600 pixel (SVGA resolution)
Pixel failure rate		$<1 \times 10^{-5}$

<b>Mass memory</b>		
Mass memory		1.44 Mbyte 3 ½" disk drive, hard disk, USB flash disk (not supplied)
Data storage		>500 instrument settings and traces

<b>Temperature</b>		
Temperature	operating temperature range permissible temperature range storage temperature range	+5° C to +40 °C +0° C to +50 °C -40°C to +70 °C
Climatic loading		+40 °C at 95% relative humidity (DIN EN 60068-2-30: 2000-02)

<b>Mechanical resistance</b>		
	sinusoidal vibration	5 Hz to 150 Hz, max. 2 g at 55 Hz; 0.5 g from 55 Hz to 150 Hz; meets DIN EN 60068-2-6: 1996-05, DIN EN 60068-2-30: 2000-02, DIN EN 61010-1, MIL-T-28800D, class 5
	random vibration	10 Hz to 100 Hz, acceleration 1 g (rms)
	shock	40 g shock spectrum, meets MIL-STD-810C and MIL-T-28800D, classes 3 and 5
Recommended calibration interval	operation with external reference operation with internal reference	2 years 1 year
RFI suppression		meets EMC directive of EU (89/336/EEC) and German EMC legislation

<b>Power supply</b>		
AC supply		100 V to 240 V, 3.1 A to 1.3 A; 50 Hz to 400 Hz, class of protection I to VDE 411
Power consumption	R&S FSQ3, R&S FSQ8 R&S FSQ26, R&S FSQ40	typ. 130 VA typ. 150 VA
Safety		meets EN 61010-1, UL 3111-1, CSA C22.2 No. 1010-1, IEC 1010-1
Test mark		VDE, GS, CSA, CSA-NRTL
Dimensions	W × H × D in mm	435 × 192 × 460
Weight	R&S FSQ3 R&S FSQ8 R&S FSQ26 R&S FSQ40	14.6 kg 15.4 kg 16.5 kg 16.8 kg

# Tracking Generator R&S FSU-B9, Attenuator R&S FSU-B12 for Tracking Generator

Unless specified otherwise, specifications not valid for frequency range from  $-3 \times \text{RBW}$  to  $+3 \times \text{RBW}$ , however at least not valid from  $-100 \text{ kHz}$  to  $+100 \text{ kHz}$ . Maximum output level  $+5 \text{ dBm}$  (peak modulation in the case of amplitude-modulated signals).

Frequency		
Frequency range		100 kHz to 3.6 GHz
Resolution		1 Hz
Frequency offset		
Setting range		$\pm 200 \text{ MHz}$
Resolution		1 Hz

Spectral purity		
SSB phase noise	f = 500 MHz, carrier offset 10 kHz normal mode with frequency offset with FM modulation on	typ. $-120 \text{ dBc}$ (1 Hz) typ. $-110 \text{ dBc}$ (1 Hz) typ. $-110 \text{ dBc}$ (1 Hz)

Level		
Level setting range	with option R&S FSU-B12	$-30 \text{ dBm}$ to $+5 \text{ dBm}$ in steps of $0.1 \text{ dB}$ $-100 \text{ dBm}$ to $+5 \text{ dBm}$ in steps of $0.1 \text{ dB}$

Max. deviation of output level		
Absolute	f = 128 MHz, output level $-20 \text{ dBm}$ to $0 \text{ dBm}$	$<1 \text{ dB}$ ( $\sigma = 0.34 \text{ dB}$ )
Frequency response	referenced to level at 128 MHz, sweep time $>100 \text{ ms}$ , $+5 \text{ }^\circ\text{C}$ to $+45 \text{ }^\circ\text{C}$	
	output level $-20 \text{ dBm}$ to $0 \text{ dBm}$ , 100 kHz to 3.6 GHz output level $-30 \text{ dBm}$ to $-20 \text{ dBm}$ , f = 100 kHz to 3.6 GHz additional deviation with R&S FSU-B12, 100 kHz to 3.6 GHz	$<3 \text{ dB}$ , typ. $1.9 \text{ dB}$ $3 \text{ dB}$ $<1 \text{ dB}$

Dynamic range		
Attenuation measurement range	RBW = 1 kHz, f $> 10 \text{ MHz}$	100 dB
Harmonics	output level $-10 \text{ dBm}$	typ. $-30 \text{ dBc}$
Spurious, nonharmonics	output level $0 \text{ dBm}$	typ. $-30 \text{ dBc}$

Modulation		
Modulation format	external	I/Q, AM, FM
Input Voltage	full scale AM, FM, $V_{pp}$ I/Q	1 V $\sqrt{U_i^2 + U_q^2} = 0.5 \text{ V}$
<b>AM</b>	$f_{\text{Center}} > f_{\text{Mod}}$ , span = 0 Hz	
Modulation depth		0% to 99%
Modulation frequency response	0 Hz to 5 MHz 0 Hz to 30 MHz	1 dB 3 dB
<b>FM</b>	$f_{\text{Center}} > f_{\text{Mod}}$ , span = 0 Hz	
Frequency deviation		full range: 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz
Modulation frequency range	deviation = 10 MHz deviation $\leq 1 \text{ MHz}$	0 Hz to 1 kHz 0 Hz to 100 kHz
Modulation frequency response	0 kHz to 100 kHz	1 dB
<b>I/Q modulation</b>	$f_{\text{Center}} > f_{\text{Mod}}$ , span = 0 Hz	
Modulation frequency response	0 Hz to 5 MHz 0 Hz to 30 MHz	1 dB 3 dB

Modulation deviation of tracking generator	I/Q modulation, typical values, baseband signals generated by the R&S AMIQ	
EVM	NADC/TETRA/PDC	
	RMS	2%
	peak	4%
	PHS	
	RMS	2%
	peak	5%
Phase error	GSM/DCS1800/PCS1900	
	RMS	1.5°
	peak	5°
Rho factor	IS-95 CDMA	
		0.997

Inputs and outputs (front panel)		
RF output		N female, 50 Ω
VSWR	100 kHz ≤ f ≤ 2 GHz	1.2
	2 GHz ≤ f ≤ 3.6 GHz	1.5

Inputs and outputs (rear panel)		
TG I/AM IN		BNC female
Impedance		50 Ω
Input voltage	V <sub>pp</sub>	1 V
TG Q/FM IN		BNC female
Impedance		50 Ω,
Input voltage	V <sub>pp</sub>	1 V

## LO/IF Ports for External Mixers R&S FSU-B21 (for R&S FSQ26 and R&S FSQ40 only)

LO signal		
Frequency range		7.0 GHz to 15.5 GHz
Level	+20 °C to +30 °C	+15.0 dBm ±1 dB
	+5 °C to +45 °C	+15.0 dBm ±3 dB

IF input		
IF frequency		404.4 MHz
Full scale level	2-port mixer (LO output / IF input, front panel)	-20 dBm
	3-port mixer (IF input, front panel)	-20 dBm
Level uncertainty	IF input level -30 dBm, RBW 30 kHz, 2-port mixer, LO output / IF input (front panel)	+20 °C to +30 °C
		+5 °C to +45 °C
	3-port mixer, IF input (front panel)	+20 °C to +30 °C
		+5 °C to +45 °C

### Inputs and outputs (front panel)

Option R&S FSU-B21		
LO output/IF input		SMA-female, 50 Ω
IF input		SMA-female, 50 Ω

**RF Preamplifier R&S FSQ-B23  
(for R&S FSQ26 only, requires option R&S FSU-B25)**

Level measurement uncertainty		
Frequency response	preamplifier = on 3.6 GHz to 8 GHz 8 GHz to 22 GHz 22 GHz to 26.5 GHz	<2.0 dB ( $\sigma = 0.7$ dB) <2.5 dB ( $\sigma = 0.8$ dB) <3.0 dB ( $\sigma = 1$ dB)

Displayed average noise level		
	0 dB RF attenuation, termination 50 $\Omega$ RBW = 1 kHz, VBW = 3 kHz, zero span, sweep time 50 ms, trace average, sweep count = 20, mean marker, normalized to 10 Hz RBW	
	preamplifier = off	
	3.6 GHz to 8 GHz 8 GHz to 26.5 GHz	R&S FSQ26 specifications + 2 dB R&S FSQ26 specifications + 3 dB
	preamplifier = on	
	3.6 GHz to 8 GHz	<-152 dBm, typ. -155 dBm
	8 GHz to 13 GHz	<-149 dBm, typ. -152 dBm
	13 GHz to 18 GHz	<-147 dBm, typ. -150 dBm
	18 GHz to 22 GHz	<-144 dBm, typ. -149 dBm
	22 GHz to 26.5 GHz	<-140 dBm, typ. -145 dBm

## Electronic Attenuator R&S FSU-B25

Frequency		
Frequency range	R&S FSQ3	100 kHz <sup>2</sup> , 10 MHz to 3.6 GHz
	R&S FSQ8	100 kHz <sup>2</sup> , 10 MHz to 8 GHz
	R&S FSQ26	100 kHz <sup>2</sup> , 10 MHz to 3.6 GHz
	R&S FSQ40	100 kHz <sup>2</sup> , 10 MHz to 3.6 GHz

Setting range		
Electronic attenuator		0 dB to 30 dB, in 5 dB steps
Preamplifier		20 dB, switchable

Level measurement uncertainty		
Frequency response	with preamplifier or electronic attenuator	
	10 MHz to 50 MHz	<1 dB ( $\sigma = 0.34$ dB)
	50 MHz to 3.6 GHz	<0.6 dB ( $\sigma = 0.2$ dB)
	3.6 MHz to 8 GHz	<2.0 dB ( $\sigma = 0.7$ dB)
Reference error	at 128 MHz, RBW $\leq$ 100 kHz, reference level -30 dBm, RF attenuation 10 dB	
	electronic attenuator	<0.3 dB ( $\sigma = 0.1$ dB)
	preamplifier	<0.3 dB ( $\sigma = 0.1$ dB)

Displayed average noise level		
	0 dB RF attenuation, termination 50 $\Omega$ RBW = 1 kHz, VBW = 3 kHz, zero span, sweep time 50 ms, trace average, sweep count = 20, mean marker, normalized to 10 Hz RBW	
	preamplifier on	
	R&S FSQ3, R&S FSQ8, R&S FSQ26 10 MHz to 2.0 GHz 2.0 GHz to 3.6 GHz	<-152 dBm <-150 dBm
	R&S FSQ8 3.6 GHz to 8 GHz	<-147 dBm
	R&S FSQ40 10 MHz to 40 MHz 40 MHz to 2 GHz 2 GHz to 3.6 GHz	<-150 dBm <-152 dBm <-150 dBm
	with the R&S FSU-B25 built in, the average noise level values displayed by the base units degrade by (R&S FSU-B25 off):	
	20 Hz to 3.6 GHz	1 dB
	R&S FSQ8, 3.6 GHz to 8 GHz	2 dB
	preamplifier off, electronic attenuator 0 dB	
	20 Hz to 3.6 GHz	typ. 2.5 dB
	R&S FSQ8, 3.6 GHz to 8 GHz	typ. 3.5 dB

Intermodulation		
Third-order intercept point (TOI)	electronic attenuator on, $\Delta f > 5 \times$ RBW or 10 kHz	
	10 MHz to 300 MHz	>17 dBm
	300 MHz to 3.6 GHz	>20 dBm
	3.6 GHz to 8 GHz	>18 dBm

<sup>2</sup> Valid as of R&S FSU-B25 serial number 200000.

## I/Q Baseband Inputs R&S FSQ-B71

I/Q baseband inputs for unbalanced and balanced signals. Input impedance selectable 50 Ω/1 MΩ. All data specified with 1 MΩ input impedance setting apply to 50 Ω source impedance. Specifications are guaranteed under the following conditions: 30 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and baseband calibration performed. Data without tolerances: typical values only. Data designated "nominal" apply to design parameters and are not tested.

### Frequency

<b>Sampling</b>		
ADC sampling rate		81.6 MHz
ADC resolution		14 Bit
<b>Frequency range</b>		
Useful bandwidth with specified frequency response	$f_s$ = output data rate $f_s$ = 40.8 MHz to 81.6 MHz $f_s$ > 20.4 MHz to < 40.8 MHz $f_s$ = 10 kHz to 20.4 MHz	DC to $0.441 \times f_s$ DC to $0.34 \times f_s$ DC to $0.40 \times f_s$

### Spectral purity

Phase noise at $f_{in} = 20$ MHz	1 kHz offset	typ. -135 dBc/Hz
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### Amplitude

<b>Maximum safe input level</b>		
	50 Ω, power from 50 Ω source	+30 dBm (1 Watt)
	1 MΩ, peak voltage	±5 V
<b>Input level range (full scale)</b>		
	with balanced setting: differential voltage	
	50 Ω	±31.6 mV to ±5.62 V (5 dB steps)
	1 MΩ	±31.6 mV to ±1.78 V (5 dB steps)
<b>Max. common mode input voltage</b>		
	50 Ω	±2 × range, max. ±5 V
	1 MΩ, any range	-2.5 V to +3.5 V
<b>Level uncertainty</b>		
Level uncertainty	at 1 MHz (full scale)	<0.25 dB
	I/Q imbalance at 1 MHz	<0.1 dB
<b>Frequency response</b>		
	50 Ω, $f_s = 81.6$ MHz	
	DC to 30 MHz, filter on	<0.3 dB
	DC to 36 MHz, filter off	<0.3 dB
	I/Q imbalance, DC to 30 MHz, filter on	<0.15 dB
	I/Q imbalance, DC to 36 MHz, filter off	<0.15 dB
<b>Frequency response</b>		
	1 MΩ	
	DC to 10 MHz	<0.30 dB
	I/Q imbalance, DC to 10 MHz	<0.15 dB
<b>Amplitude linearity</b>		
	0 dB to -90 dB with dither on	typ. 0.1 dB
<b>I/Q offset</b>		
	50 Ω balanced setting	<0.15 % of range ±0.2 mV
	50 Ω unbalanced setting	<2 mV
	1 MΩ	<2 mV



## Dynamic range

<b>Noise level</b>		
Signal to noise ratio	range = 1 V, signal level equal to range	typ. 143 dBc (1 Hz)
Noise floor	range = 31.6 mV, RMS voltage in 1 Hz bandwidth	
	50 Ω, unbalanced setting	typ. <4 nV
	50 Ω, balanced setting	typ. <6 nV
	1 MΩ, unbalanced setting	typ. <16 nV
	1 MΩ, balanced setting	typ. <16 nV
<b>Spurious &amp; harmonics</b>		
	Single signal, level equal to range 50 Ω: DC to 36 MHz 1 MΩ: DC to 10 MHz, range ≤ 1 V	typ. -60 dBc
<b>Intermodulation distortion 2<sup>nd</sup> order and 3<sup>rd</sup> order</b>		
	Two signals, level equal to range -6 dB	
	50 Ω: DC to 20 MHz	typ. -75 dBc
	50 Ω: 20 MHz to 36 MHz	typ. -70 dBc
	1 MΩ: DC to 10 MHz, range ≤ 1 V	typ. -75 dBc
<b>Image rejection</b>	aliasing into useful bandwidth from single out of band signal equal to range	typ. -75 dB
<b>I/Q crosstalk</b>	DC to 36 MHz	typ. -70 dB

## Phase

<b>Group delay variation versus frequency</b>		
	aliasing filter on, DC to 30 MHz	typ. 1 ns
	aliasing filter off, DC to 36 MHz	typ. 1 ns
<b>Differential phase between I and Q</b>		
	DC to 10 MHz	typ. 1°
	aliasing filter on, >10 MHz to 30 MHz	typ. 2°
	aliasing filter off, >10 MHz to 36 MHz	typ. 2°

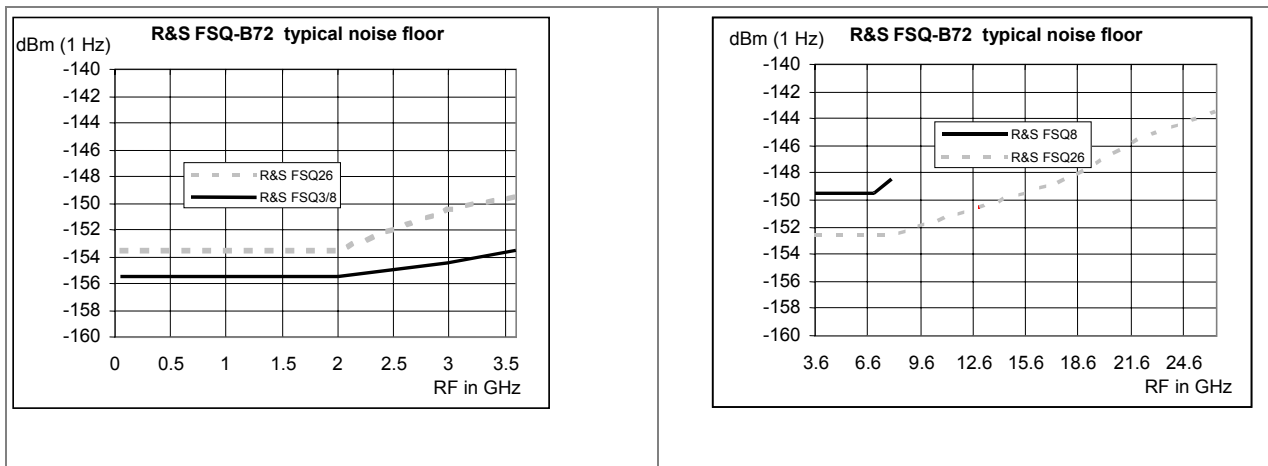
## Input ports

<b>Channels</b>		2 (I & Q)
Connector	each channel balanced or unbalanced	4 × BNC female
<b>Input impedance</b>		
	unbalanced setting common mode	50 Ω/1 MΩ nominal
	balanced setting common mode differential	50 Ω / 1 MΩ nominal 100 Ω / 2 MΩ nominal
<b>Return loss</b>	50 Ω input impedance	
	DC to 10 MHz	typ. 30 dB
	>10 MHz to 36 MHz	typ. 20 dB
<b>Input capacitance</b>	with 1 MΩ input impedance setting, common mode	typ. 9 pF



## Dynamic

<b>Spurious response</b>		
Without input signal	0 dB RF attenuation	<-80 dBm, typ. -100 dBm
With full scale input signal	mixer level $\leq$ -10 dBm	<-50 dBc, typ. -58 dBc
<b>Third order intermodulation</b>	two signals, level equal to reference level -6 dB mixer level $\leq$ -20 dBm (each signal)	<-50 dBc, typ. -58 dBc,
<b>Rejection of out of band signals</b>	$\leq$ 3.6 GHz > 3.6 GHz up to $\pm$ 750 MHz offset > $\pm$ 750 MHz offset	typ. 100 dB typ. 60 dB typ. 0 dB
<b>Signal to noise ratio</b>	mixer level $\geq$ -20 dBm signal level equal to reference level	>125 dBc (1 Hz), typ. 128 dBc (1 Hz)
<b>Noise floor</b>	RF attenuator 0 dB, reference level $\leq$ -30 dBm R&S FSQ3/R&S FSQ8 1 GHz R&S FSQ8 5 GHz R&S FSQ26/R&S FSQ40 1 GHz R&S FSQ26/R&S FSQ40 5 GHz	<-153 dBm (1 Hz) <-148 dBm (1 Hz) <-150 dBm (1 Hz) <-150 dBm (1 Hz)



<b>Susceptibility to radiated emission</b>	relative to full scale, RF attenuation 0 dB, reference level $\leq$ -10 dBm, field strengths 10 V/m  IF frequency band 348 MHz to 468 MHz image frequency 837.6 MHz to 957.6 MHz other frequencies	typ. <-55 dB typ. <-60 dB typ. <-75 dB
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## General data

Interface		GPIO or LAN interface
I/Q memory		16 Msample each for I and Q data
Sampling rate		programmable >20.4 MHz to 326.4 MHz in 0.1 Hz steps
IF pre-filter 3 dB bandwidth	$\leq$ 3.6 GHz	typ. 55 MHz
	>3.6 GHz YIG filter switched off	typ. 125 MHz

# Ordering information

Order designation	Type	Order No.
Signal Analyzer 20 Hz to 3.6 GHz	R&S FSQ3	1155.5001.03
Signal Analyzer 20 Hz to 8 GHz	R&S FSQ8	1155.5001.08
Signal Analyzer 20 Hz to 26.5 GHz	R&S FSQ26	1155.5001.26
Signal Analyzer 20 Hz to 40 GHz	R&S FSQ40	1155.5001.40
<b>Accessories supplied</b>		
Power cable, operating manual, service manual, R&S FSQ26: test port adapter with 3.5 mm female (1021.0512.00) and N female (1021.0535.00) connector R&S FSQ40: test port adapter with K female (10366.4790.00) and N female (1036.4777.00) connector		

## Options

Order designation	Type	Order No.	Retrofittable	Remarks
<b>Options</b>				
OCXO, low aging/improved phase noise at 10 Hz carrier offset	R&S FSU-B4	1144.9000.02	yes	
Tracking Generator, 100 kHz to 3.6 GHz	R&S FSU-B9	1142.8994.02	yes	
External Generator Control	R&S FSP-B10	1129.7246.02	yes	
Output Attenuator, 0 dB to 70 dB, for R&S FSU-B9	R&S FSU-B12	1142.9349.02	yes	requires R&S FSU-B9
Removable Hard Disk	R&S FSQ-B18	1145.0242.05	no	
Second Hard Disk for R&S FSQ-B18	R&S FSQ-B19	1145.0394.05		requires R&S FSU-B18
LO/IF ports for external mixers	R&S FSU-B21	1157.1090.02	yes	only for R&S FSQ26 and R&S FSQ40
20 dB Preamplifier, 3.6 GHz to 26.5 GHz, for R&S FSQ26	R&S FSQ-B23		no	only for R&S FSQ26, requires R&S FSU-B25
Electronic Attenuator, 0 dB to 30 dB, and 20 dB Preamplifier (3.6 GHz)	R&S FSU-B25	1044.9298.02	yes	
Analog Baseband Inputs	R&S FSQ-B71	1157.0113.03	yes	
I/Q Bandwidth Extension	R&S FSQ-B72	1157.0336.02	no	
<b>Firmware/Software</b>				
Noise Measurement Software	R&S FS-K3	1057.3028.02		preamplifier (e.g. R&S FSU-B25) recommended
Phase Noise Measurement Software	R&S FS-K4	1108.0088.02		
GSM/EDGE Application Firmware	R&S FS-K5	1141.1496.02		
FM Measurement Demodulator	R&S FS-K7	1141.1796.02		
Bluetooth Application Firmware	R&S FS-K8	1157.2568.02		
Power Sensor Measurements	R&S FS-K9	1157.3006.02		
Application firmware for Noise Figure and Gain Measurements	R&S FS-K30	1300.6508.02		preamplifier (e.g. R&S FSU-B25) recommended
Application Firmware for Phase Noise Measurement	R&S FS-K40	1161.8138.02		
3GPP BTS/Node B FDD Application Firmware	R&S FS-K72	1154.7000.02		
3GPP UE FDD Application Firmware	R&S FS-K73	1154.7252.02		
3 GPP HSDPA BTS Application Firmware	R&S FS-K74	1300.7156.02		requires R&S FS-K72
3 GPP TD-SCDMA BTS Application Firmware	R&S FS-K76	1300.7291.02		
3 GPP TD-SCDMA UE Application Firmware	R&S FS-K77	1300.8100.02		
CDMA2000/IS-95 (cdma one)/1xEV-DV BTS Application Firmware	R&S FS-K82	1157.2316.02		
CDMA2000/1xEV-DV MS Application Firmware	R&S FS-K83	1157.2416.02		
CDMA2000 1xEV-DO BTS Application Firmware	R&S FS-K84	1157.2851.02		
cdma2000 1xEV-DO MS Application Firmware	R&S FS-K85	1300.6689.02		
Vector Signal Analysis	R&S FSQ-K70	1161.8038.02		
WLAN 802.11a Application Firmware	R&S FSQ-K90	1157.3064.02		
WLAN 802.11a/b/g/j Application Firmware	R&S FSQ-K91	1157.3129.02		
Upgrade from R&S FSQ-K90 to R&S FSQ-K91	R&S FSQ-K90U	1300.8000.02		
WiMAX 802.16-2004 OFDM Application Firmware	R&S FSQ-K92	1300.7410.02		

## Recommended extras

Order designation	Type	Order No.
Headphones		0708.9010.00
US Keyboard with trackball	R&S PSP-Z2	1091.4100.02
IEC/IEEE Bus Cable, 1 m	R&S PCK	0292.2013.10
IEC/IEEE Bus Cable, 2 m	R&S PCK	0292.2013.20
19" Rack Adapter	R&S ZZA-411	1096.3283.00
Adapter for mounting on telescopic rails (only with 19" Adapter R&S ZZA-411)	R&S ZZA-T45	1109.3774.00
<b>Matching pads, 50/75 Ω</b>		
L Section, matching at both ends	R&S RAM	0358.5414.02
Series Resistor, 25 Ω, matching at one end (taken into account in instrument function RF INPUT 75 Ω)	R&S RAZ	0358.5714.02
<b>SWR Bridges, 50 Ω</b>		
SWR Bridge, 5 MHz to 3 GHz	R&S ZRB2	0373.9017.5X
SWR Bridge, 40 kHz to 4 GHz	R&S ZRC	1039.9492.5X
<b>High power attenuators</b>		
100 W, 3/6/10/20/30 dB, 1 GHz	R&S RBU100	1073.8495.XX (XX = 03/06/10/20/30)
50 W, 3/6/10/20/30 dB, 2 GHz	R&S RBU50	1073.8695.XX (XX = 03/06/10/20/30)
50 W, 20 dB, 6 GHz	R&S RDL50	1035.1700.52
<b>Connectors and cables</b>		
Probe power connector, 3 pin		1065.9480.02
<b>DC blocks</b>		
DC Block, 10 kHz to 18 GHz (Type N)	R&S FSE-Z4	1084.7443.02
<b>External harmonic mixers (for R&amp;S FSQ26, R&amp;S FSQ40 with option R&amp;S FSU-B21)</b>		
Harmonic Mixer 40 GHz to 60 GHz	R&S FS-Z60	1089.0799.02
Harmonic Mixer 50 GHz to 75 GHz	R&S FS-Z75	1089.0847.02
Harmonic Mixer 60 GHz to 90 GHz	R&S FS-Z90	1089.0899.02
Harmonic Mixer 90 GHz to 110 GHz	R&S FS-Z110	1089.0976.02
<b>For R&amp;S FSQ26 only:</b>		
Test port adapter N male for R&S FSU26		1021.0541.00
Test port adapter 3.5 mm male for R&S FSU26		1021.0529.00
Microwave Measurement Cable with test port adapter set N male and 3.5 mm male for R&S FSQ26 and R&S FSU26	R&S FSE-Z15	1046.2002.02
<b>For R&amp;S FSQ40 only:</b>		
Test port adapter N male for R&S FSQ40		1036.4783.00
Test port adapter K male for R&S FSQ40		1036.4802.00
Test port adapter 2.4 mm female for R&S FSQ40	R&S FSE-Z5	1088.1627.02



For product brochure, see PD 0758.0945.12  
and [www.rohde-schwarz.com](http://www.rohde-schwarz.com)  
(search term: FSQ)



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