

Tracking Generators FSE-B8 to -B11

for scalar network analysis with Spectrum Analyzers FSE and FSIQ

- ◆ Frequency range 9 kHz to 3.5/7 GHz
- ◆ Attenuation measurement range >90 dB, 120 dB typ.
- ◆ I/Q modulator in FSE-B9/-B11
- ◆ Output level 0 dBm to -20 dBm, optionally 0 dBm to -90 dBm
- ◆ Versatile measurement functions, e.g:
 - bandwidth measurement
 - shape factor
 - limit lines

Characteristics

Permissible combinations of tracking generators and optional output attenuator with Spectrum Analyzers FSE/FSIQ

• Permissible combination – Cannot be installed

	FSEA30/FSIQ3	FSEB30/FSIQ7	FSEM30/FSIQ26	FSEK30
FSE-B8	•	–	–	–
FSE-B9	•	–	–	–
FSE-B10	–	•	•	•
FSE-B11	–	•	•	•
Output Attenuator FSE-B12 ¹⁾	•	•	•	•

¹⁾ Cannot be fitted together with the 1 dB Attenuator FSE-B13.

Scalar network analysis with wide dynamic range

The optional Tracking Generators FSE-B8, FSE-B9, FSE-B10 and FSE-B11 enhance the Spectrum Analyzers FSE and FSIQ for selective scalar network analysis. They allow gain, frequency response, insertion and return loss (with additional SWR bridge) to be measured in a wide dynamic range. In contrast to measurements with broadband scalar network analyzers, the selective measurement method ensures that harmonics and spurious responses of the generator or device under test have no effect on the measurement.

The Spectrum Analyzers FSE/FSIQ with built-in tracking generators feature a very low noise floor and hence an extremely wide dynamic range for attenuation measurements. They are therefore ideal,

for instance, for measuring shielding effectiveness.

The Tracking Generators FSE-B8 and FSE-B9 are intended for use with the FSEA30 and FSIQ3 and cover the frequency range 9 kHz to 3.5 GHz. FSE-B10 and FSE-B11 are suitable for FSEB30/FSIQ7, FSEM30/FSIQ26 and FSEK30 and cover the frequency range 9 kHz to 7 GHz.

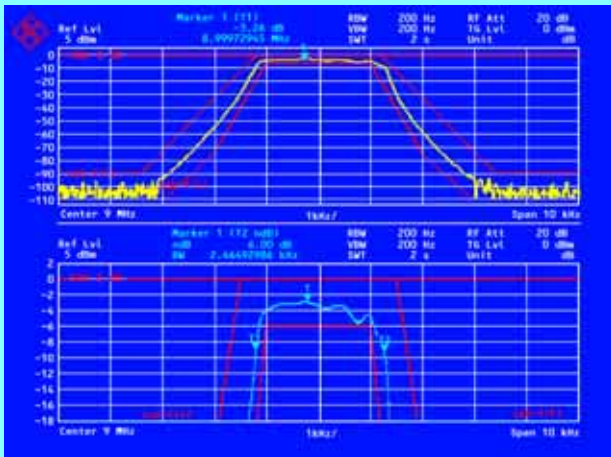
All tracking generators can additionally be fitted with the optional Output Attenuator FSE-B12 (0 dB to 70 dB). With this optional attenuator, the output level can be reduced to –90 dBm and measurements be made on modules with high gain or very low permissible input level.

Versatile measurement functions

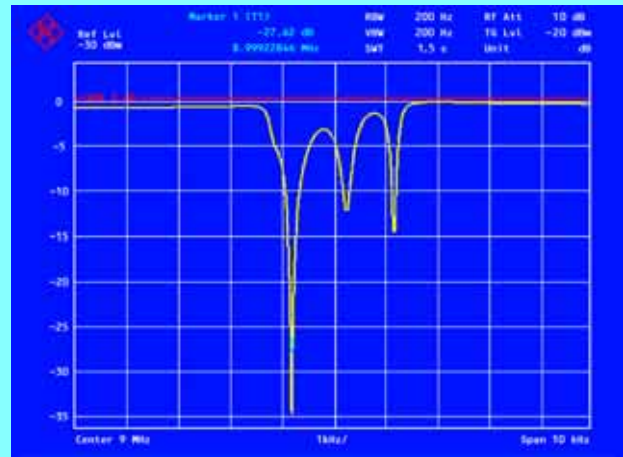
The versatile functions integrated as standard make scalar network measurements extremely easy:

- ◆ Easy to operate normalization with interpolation
- ◆ Normalization for reflection measurements with open or short, or both
- ◆ Automatic filter bandwidth measurement ("n dB down" function)
- ◆ Shape factor 60/6 dB or 60/3 dB
- ◆ Tolerance limits with PASS/FAIL evaluation
- ◆ Display range up to 200 dB for compensation of frequency responses of even large amplitude variation
- ◆ Frequency range settable down to 3 kHz with reduced output level

Applications



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I/Q modulation

The Tracking Generators FSE-B9 and FSE-B11 contain an I/Q modulator for generating any analog or digital modulation. A suitable signal source, for instance, is the I/Q Modulation Generator AMIQ from Rohde & Schwarz. The I/Q simulation software WinIQSIM available for the AMIQ generates the arbitrary data for the I and Q modulation signals. With this software and the optional Computer Function FSE-B15¹⁾ as well as the optional 2nd IEC/IEEE-Bus Interface FSE-B17, the analyzer can drive the generator with arbitrary data. In this way, a variety of signals in line with the different mobile radio communication standards GSM, TETRA, NADC or DECT can be generated. If the FSE is fitted with the vector signal analyzer option, a complete compact system is obtained which provides convenient

¹⁾ Included in the FSIQ as standard.

analysis functions and allows, for instance, investigation of the effect of amplifiers, IF stages or filters on the modulation quality.

Frequency offset up to ± 200 MHz

A frequency offset adjustable by up to ± 200 MHz between tracking generator signal and analyzer receive frequency is ideal for measurements on frequency-converting modules. A negative frequency offset also allows measurements on modules with inverted frequency conversion. Frequency offset and I/Q modulation cannot be used simultaneously.

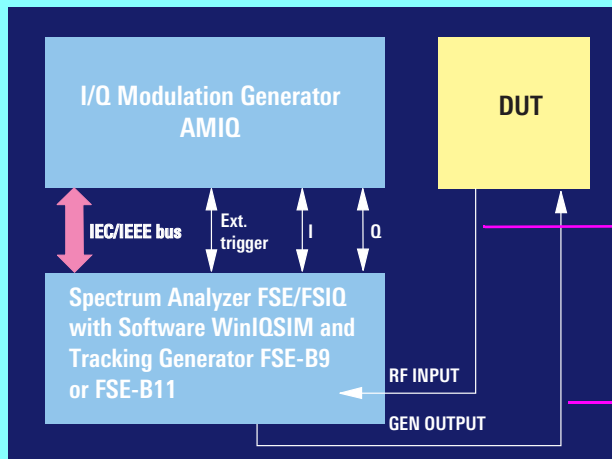
Applications

Measuring the passband and stopband attenuation of a filter (1)

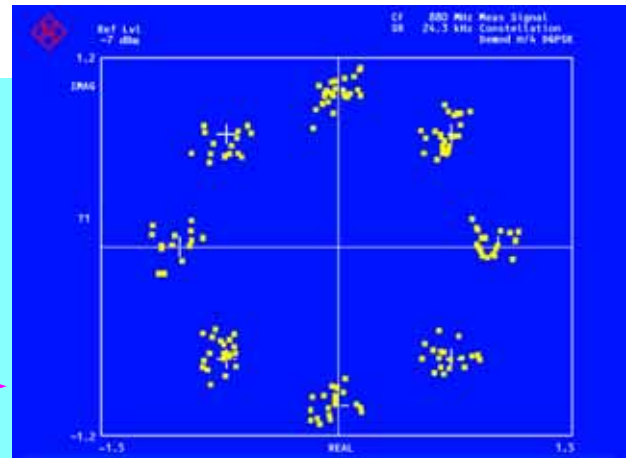
The split-screen function allows simultaneous measurement of the stopband attenuation in a wide dynamic range and the passband characteristic with high resolution. The marker directly indicates the passband attenuation or 6 dB bandwidth. Adjustable limit lines are provided to check for compliance with specified tolerance values.

Measuring the return loss of a filter (2)

The return loss of a crystal filter can easily be measured in conjunction with a SWR bridge (e.g. ZRC or ZRB2 from Rohde & Schwarz). Short and/or open is used for normalization.



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The selective method also allows convenient measurement of the VSWR of antennas while they are in operation.

Measurement on an amplifier (3 to 5)

The effect of an amplifier operated close to the 1 dB compression point on the modulation accuracy of a digitally modulated signal can easily be determined (in the example for $\pi/4$ DQPSK).

The following instruments and options are required for this measurement:

- ◆ Tracking Generator FSE-B9 or -B11
- ◆ Vector Signal Analyzer FSE-B7²⁾
- ◆ Computer Function FSE-B15²⁾
- ◆ 2nd IEC/IEEE-Bus Interface FSE-B17
- ◆ I/Q Modulation Generator AMIQ
- ◆ Software WinIQSIM

The Vector Signal Analyzer Option FSE-B7 for the FSE allows among others measurement of the phase error, error vector, amplitude error (rms and peak). For more information about the versatile analysis functions see the FSE-B7 data sheet, Order No. PD 757.2167.12.

The illustrations above show:

- (3) Test setup
- (4) Signal at amplifier output
- (5) Signal at amplifier input

²⁾ Not necessary for the FSIO..

Specifications

Specifications are guaranteed under the following conditions:
5 minutes warmup time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and total calibration performed. Data without tolerances: typical values. Data designated "nominal" apply to design parameters and have not been checked.

Frequency

Frequency range

FSE-B8, FSE-B9	9 kHz to 3.5 GHz
FSE-B10, FSE-B11	9 kHz to 7 GHz
Min. start frequency	3 kHz typ.
Frequency offset	±200 MHz

Spurious responses

Harmonics (f > 50 MHz)	25 dB
Others	30 dB

Level

Output level

Without optional Output Attenuator FSE-B12	-20 dBm to 0 dBm
With option FSE-B12	-90 dBm to 0 dBm (can be set in 0.1 dB steps)

Level accuracy

Frequency response referred to 120 MHz, for sweep time >100 ms and start frequency >2 × RBW and start frequency >SPAN/1000	
Absolute error at 120 MHz, 0 dBm	<1 dB
Without FSE-B12:	
9 kHz to 1 GHz	<2.0 dB
1 GHz to 3.5 GHz	<3.0 dB
3.5 GHz to 7 GHz	<3 dB typ.
Additional frequency response with option FSE-B12:	
9 kHz to 3.5/7 GHz	<1.0 dB

Level control

internal, external (external with negative detector voltage 0 V to 0.5 V)

Dynamic and measurement range

Gain measurement range

Without option FSE-B12	50 dB
With option FSE-B12	120 dB

Attenuation measurement range

f > 10 MHz, RBW = 1 kHz	>90 dB, 120 dB typ.
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Modulation

Modulation modes (external)

Modulation modes (external)	AM, FM, I/Q (cannot be used simultaneously)
Start frequency	>200 kHz

Modulation inputs

AM, FM	BNC, >10 kΩ
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Amplitude modulation

Operating mode	EXTERN AM
Modulation depth	0% to 80%
Modulation frequency range	1 kHz to 20 kHz

Frequency modulation

Operating mode	EXTERN FM
Deviation	max. 1 MHz
Modulation frequency range	1 kHz to 100 kHz with modulation index <2π × 75

I/Q modulation (with FSE-B9 and -B11 only)

Modulation inputs I and Q

Modulation inputs I and Q	BNC
Input impedance	50 Ω
VSWR	<1.4 typ.
Input voltage for 100% modulation	±0.5 V

Modulation frequency response

f _{mod} = DC to 5 MHz	<1 dB
f _{mod} = DC to 10 MHz	typ. <1 dB

Vector DC error

Referred to 100% modulation at I or Q input, input voltage: $\sqrt{I^2 + Q^2} \leq 0.5$ V	
120 MHz	<1.5% (25°C ±5°C), <3% (5°C to 40°C)
10 MHz to 3.5/7 GHz	<1.5% (25°C ±5°C) typ., <3% (5°C to 40°C) typ.

Amplitude error

at 25°C ±5°C	$\leq 20 \log \left(\frac{\sqrt{I^2 + Q^2} \pm 5 \text{ mV}}{\sqrt{I^2 + Q^2}} \right) \text{ dB} + 0.25 \text{ dB}$
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at 5°C to 40°C	$\leq 20 \log \left(\frac{\sqrt{I^2 + Q^2} \pm 10 \text{ mV}}{\sqrt{I^2 + Q^2}} \right) \text{ dB} + 0.3 \text{ dB}$
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Phase error

at 25°C ±5°C	$\leq 0.5^\circ + \arctan \left(\frac{5 \text{ mV}}{\sqrt{I^2 + Q^2}} \right)^\circ$
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at 5°C to 40°C	$\leq 1^\circ + \arctan \left(\frac{10 \text{ mV}}{\sqrt{I^2 + Q^2}} \right)^\circ$
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(I and Q: voltages in mV at the I and Q outputs)

Modulation error caused by tracking generators with I/Q modulation, typical values

Standard	Error vector		Phase error	
	RMS	Peak	RMS	Peak
GSM 900/1800/1900	—	—	1.5°	5°
NADC/TETRA/PDC	2%	4%	—	—
PHS	2%	5%	—	—
CDMA	0.995 (rho factor)			

Residual carrier

with 0 V at I and Q (referred to 100% modulation)	
120 MHz	<0.5% (25°C ±5°C)
10 MHz to 3.5/7 GHz	<0.5% (5°C to 40°C) typ.

Inputs and outputs (front panel)

RF output

RF output	N female, 50 Ω
VSWR (output attenuator set to -20 dBm)	<2.0 : 1 typ.

Inputs and outputs (rear panel)

TG-IN I/AM/ALC	BNC female
TG IN Q/FM	BNC female

Ordering information

Tracking Generator 9 kHz to 3.5 GHz for FSEA30/FSIQ3	FSE-B8	1066.4469.02
Tracking Generator 9 kHz to 3.5 GHz for FSEA30/FSIQ3 with I/Q modulator	FSE-B9	1066.4617.02
Tracking Generator 9 kHz to 7 GHz for FSEB30/FSIQ7, FSEM30/FSIQ26, FSEK30	FSE-B10	1066.4769.02
Tracking Generator 9 kHz to 7 GHz for FSEB30/FSIQ7, FSEM30/FSIQ26, FSEK30 with I/Q modulator	FSE-B11	1066.4917.02
Output Attenuator for Tracking Generators	FSE-B12 ¹⁾	1066.5065.02

¹⁾ Cannot be fitted together with the 1 dB attenuator FSE-B13.

Recommended extras

SWR Bridge 40 kHz to 4 GHz	ZRC	1032.9492.52/55
SWR Bridge 50 MHz to 3 GHz	ZRB2	0373.9017.5x
N Calibration Kit, 0 GHz to 3 GHz, termination, short/open	ZCAN	0800.8515.52/72
Matching Pad 75 Ω , L-section	RAM	0358.5414.02
Matching Pad 75 Ω , series resistor 25 Ω	RAZ	0358.5714.02

Recommended extras for I/Q modulation

I/Q Modulation Generator including Software WiniQSIM for generation of I/Q signals in conjunction with AMIQ	AMIQ	1110.2003.03/04
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Certified Environmental System

ISO 14001

REG. NO 1954

Certified Quality System

ISO 9001

DQS REG. NO 1954



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