Brief description

FSEA, FSEB, FSEM and FSEK are advanced, high-speed and high-performance analyzers tailored to the requirements of modern digital communication systems. They can also be used as general-purpose analyzers for many applications. High measurement speed, modular design and excellent technical features make for an excellent price/performance ratio.

In addition to measurement functions for digital communication systems, such as 2 μs sweep time in ZERO SPAN mode, pretrigger and trigger delay, gated sweep and adjacent-channel power measurement, these spectrum analyzers feature a wide dynamic range, a very low measurement uncertainty of 1 dB and a low-noise synthesizer.

FSE analyzers have low inherent noise and a wide dynamic range, so that for instance measurement of GSM power ramps is no problem.

An extremely wide intermodulation-free dynamic range of 110 dB (with 10 Hz resolution bandwidth) ensures reliable measurements on highly linear amplifiers as well as correct analysis of broadband complex signals.

From the available frequency ranges, the basic models 20 and the high-performance models 30 the right instrument can be chosen for every application. Models 20 can easily be upgraded to give the full range of functions of models 30.

To ensure correct measurement of time variants or pulse-modulated signals, the FSE features digital resolution filters (10 Hz to 1 kHz) with a response corresponding to that of analog filters. It additionally provides FFT bandwidths down to 1 Hz (models 30).

Main features

- Resolution bandwidths 1 Hz (up to 10 MHz), adjustable in steps of 1/2/3/5/10
- Displayed noise floor down to –160 dBm (FSEA)
- 3rd-order intercept point >+15 dBm
- 1 dB compression point of RF input >+10 dBm
- Phase noise at 20 kHz from carrier: down to –123 dBc (FSEA)
- Intermodulation-free dynamic range 110 dB
- Measurement uncertainty up to 1 GHz: 1 dB
- Headphones connector and built-in loudspeaker for AM/FM
- Internal RF trigger for GATED SWEEP measurements
- Speed records:
  - Shortest FULL SPAN sweep time is 5 ms (for 3.5 and 7 GHz span) with a fully synchronized sweep – added speed is not at the expense of frequency accuracy but even enhances it
  - Shortest ZERO SPAN sweep time is 1 μs (100 ns/div) – ideal for high-resolution measurements on pulse edges
  - More than 20 sweeps/s – an optimal prerequisite for fast alignments or applications in production
Spectrum Analyzers FSEA, FSEB, FSEM, FSEK

From AF to microwave

FSEM/K21/31 (corresponding to FSEM/K20/30 with option FSE-B21) allow frequency range extension by means of external mixers. Continuous automatic signal identification, which is used to suppress unwanted image frequency bands and mixture products, ensures fast and easy measurements. Due to the built-in diplexer, three-port as well as two-port mixers can be used.

The external mixer measurement function features great ease of operation:

- Definition of frequency range and harmonics by selection of a waveguide band
- Definition of all important parameters for each waveguide band separately
- Frequency-dependent consideration of mixer conversion loss
- Storage of parameters on hard disk

Measurement functions

- Up to 8 markers
- Marker functions for the direct measurement of
  - phase noise and phase power density
  - NEXT MIN/PEAK, NEXT MIN/PEAK RIGHT, NEXT MIN/PEAK LEFT
- Frequency counter with selectable resolution
- LOW NOISE, NORMAL and LOW DISTORTION modes to cater for low-intermodulation and low-noise operation
- Plotting or printout in background operation or file saving in standard graphic format
- Simultaneous display of four traces
- Selectable colour setup
- Numerous level and frequency lines
- Split-screen display with independent windows
- Quasi-analog display
- Frequency zoom

- Limit lines
- User-configurable menu and keyboard macros
- Adjacent-channel power measurement for up to 7 channels
- RMS detector

Operation

A combination of hardkeys and softkeys makes for extremely fast and easy operation. The operating convenience based on a wide variety of evaluation routines and marker functions can be accessed via the menus. Complicated tree structures could be avoided by using menus of lateral structure and fixed control keys. Complete setups and traces, limit lines as well as macros can be stored on the hard disk or on floppy disks.

Overview of configurations and options

The analyzers of the FSE family are of modular design throughout. In the table below the right solution tailored to the needs of the various applications can be found. Except for the Colour Display FSE-B1 all options can easily be retrofitted. Cannot be retrofitted, factory-fitted only. 

**Note:** max. two of the options -B4, -B7 can be fitted in FSEM20

<table>
<thead>
<tr>
<th>Designation, characteristics (hardware)</th>
<th>Type</th>
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<th>FSB 20</th>
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(1) Cannot be retrofitted, factory-fitted only.
### Spectrum Analyzers FSEA, FSEB, FSEM, FSEK

#### Designation, characteristics (hardware)

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1) Factory-fitted only

#### Designation, characteristics (software)

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● Fitted in basic model  ○ Option
Model-dependent specifications in brief

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<th>FSEM 20/21</th>
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<th>FSEK 20/21</th>
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**Spectral purity**

SSB phase noise, referred to 1 Hz bandwidth, ≤500 MHz

- 1 kHz: ≤-85 dBc
- 10 kHz: ≤-96 dBc
- 100 kHz: ≤-119 dBc
- 1 MHz: ≤-135 dBc

**Resolution bandwidths**

- 10 Hz to 100 MHz: 10 Hz to 100 MHz
- 1 MHz to 3.5 GHz: 10 Hz to 100 MHz
- 3.5 GHz to 40 GHz: 10 Hz to 100 MHz

**Steps**

- 1/2/3/5/10 MHz
- 1/2/3/5/10 kHz
- 1/2/3/10/20 kHz

**Shape factor 60:3 dB**

<table>
<thead>
<tr>
<th>(1 kHz to 2 MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video bandwidths</td>
</tr>
<tr>
<td>1 MHz</td>
</tr>
<tr>
<td>1/2/3/5</td>
</tr>
<tr>
<td>1/2/3/5</td>
</tr>
<tr>
<td>1/2/3/5</td>
</tr>
</tbody>
</table>

**Displayed noise floor, average level in dBm**

- 20 Hz: ≤-80 dBm
- 1 kHz: ≤-110 dBm
- 10 kHz: ≤-125 dBm
- 100 kHz: ≤-145 dBm
- 1 MHz: ≤-165 dBm

**Max. dynamic range**

- Displayed noise floor at 1 dB compression

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>50 MHz to 3.5 GHz</th>
<th>100 MHz to 26.5 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 MHz</td>
<td>155 dB</td>
<td>105 dB</td>
</tr>
<tr>
<td>3.5 GHz</td>
<td>165 dB</td>
<td>115 dB</td>
</tr>
<tr>
<td>100 MHz to 26.5 GHz</td>
<td>105 dB</td>
<td>115 dB</td>
</tr>
</tbody>
</table>

1) Valid at ≤10 kHz for average control loop bandwidth. Automatic setting of this bandwidth at span ≤50 kHz and resolution filter <1 kHz; other bandwidths can be switched manually to "medium". Value at 10 kHz valid for span/sweep time <0.4 MHz/ms with FSEB/M/K20/21.

2) Valid for span >100 kHz.
## Common specifications in brief

### Frequency
- **Frequency display** with marker
- **Resolution** 0.1 Hz to 10 kHz (depending on span)
- **Frequency counter** measures the frequency marker
- **Display range of frequency axis** 0 Hz, 10 Hz to full span
- **Sweep time**
  - **Display range** 0 Hz, 1 s to 1000 s
  - **Picture refresh rate** >15 updates/s with 1 trace
  - **Sampling rate** 50 ns (20 MHz A/D converter)
  - **Sweep trigger** free run, single, line, video, gated, delayed, external
  - **Zero span** additionally pretrigger, posttrigger, trigger delay

### Level
- **Display range** noise floor displayed to 30 dBm
- **Max. input level**
  - **RF attenuation** 0 dB/10 GHz
  - **DC voltage** 0 V
  - **CW RF power** 20 dBm (= 0.1 W)/30 dBm (= 1 W)
  - **DC voltage** 0 V
  - **Max. pulse energy** (10 ms) 1 mWs (FSEM: 0.5 mWs)
  - **Max. pulse voltage** 150 V (RF attenuation >10 dB)

### Inputs and outputs (front panel)
- **RF input**
  - **VSWR** (RF attenuation >0 dB), f <3.5 GHz
  - **Attenuator**
  - **Probe power**
  - **Power supply and coding connector**
  - **AF output**

### Spectrum and Network Analysis

#### Demodulation
- **Modulation modes** AM and FM
- **Audio output** loudspeaker and headphones output
- **Markert stop time** 100 ms to 60 s
- **Squelch** adjustable by means of level line

#### External Mixer FSE-821
- **LO output/IF input**
  - **LO signal**
  - **Amplitude**
  - **IF signal**
  - **Max. reference level**
  - **IF input (front panel)**
  - **Frequency**
  - **Max. reference level**

#### Inputs and outputs (rear panel)
- **RF input**
  - **VSWR** (RF attenuation >0 dB), f <3.5 GHz
- **Supply voltages**
  - **DC voltage** 0 V
- **Power supply and coding connector**
  - **AF output**

#### General data
- **Display** [640 x 480] Models 20
  - **Models** 20
  - **30
  - **Mass memory**
  - **Power supply, AC**
  - **Power consumption**
  - **Dimensions** (W x H x D; 5 HU)
  - **Weight**

#### Sample data
- **Max. harmonics suppression** 90 dB (f >50 MHz)
- **1 dB compression of input mixer**
  - **IP3, or**
  - **Pulse spectral density** 97 dB (CW RF power 20 dBm (= 0.1 W)/30 dBm (= 1 W)
  - **DC voltage** 0 V
  - **Max. pulse energy** (10 ms) 1 mWs (FSEM: 0.5 mWs)
  - **Max. pulse voltage** 150 V (RF attenuation >10 dB)
  - **Picture refresh rate**
  - **Display range** 0 Hz to 100 s, 10 divisions
  - **Resolution** 0.1 Hz to 10 kHz (depending on span)
  - **Trigger function**
  - **Trigger**
  - **Delayed sweep**
  - **Trigger source** external
  - **Gate position** 1 ms to 10 s
  - **Gate length** 1 ms to 100 s, resolution 1 μs

### Reference
- **FSEM**
  - **Gate length** 1
  - **Trigger source external
  - **Gate position** 1 ms to 10 s
  - **Gate length** 1 ms to 100 s, resolution 1 μs

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**Note:** The above text is a summary of the document, focusing on key specifications and features of the analyzer. For detailed specifications, please refer to the full document.
Spectrum and Network Analysis

Ordering information

**Spectrum Analyzer**

- **FSEA20**: 1066.6000.20
- **FSEA30**: 1066.6000.30
- **FSEB20**: 1066.3010.20
- **FSEB30**: 1066.3010.30
- **FSEM20**: 1080.1505.20
- **FSEM21**: 1080.1505.21
- **FSEM30**: 1079.8500.30
- **FSEM31**: 1079.8500.31
- **FSEK20**: 1088.1491.20
- **FSEK21**: 1088.1491.21
- **FSEK30**: 1079.8500.30
- **FSEK31**: 1079.8500.31

**Options**

- **7 GHz Frequency Extension for FSEA**: FSE-B2 1073.5044.02
- **TV Demodulator**: FSE-B3 1073.5244.02
- **Low Phase Noise and OCXO (for models 20)**: FSE-B4 1073.5396.02
- **FFT Filter 1 Hz to 1 kHz (for models .20)**: FSE-B5 1073.5544.02
- **Vector Signal Analyzer**: FSE-B7 1066.4317.02
- **Tracking Generator 3.5 GHz**: FSE-B8 1066.4469.02
- **Tracking Generator 3.5 GHz with I/Q Modulator**: FSE-B9 1066.4617.02
- **Tracking Generator 7 GHz**: FSE-B10 1066.4769.02
- **Controller for FSE (mouse and keyboard included)**: FSE-B11 1066.4917.02
- **Switchable Attenuator for Tracking Generator**: FSE-B12 1066.5065.02
- **Ethernet Interface 15-contact AUI connector**: FSE-B16 1073.5973.02
- **IEC/IEEE-Bus Interface for FSE**: FSE-B17 1066.4017.02
- **Removable Hard Disk**: FSE-B18 1088.6993.02
- **Second Hard Disk for FSE-B18 (firmware included)**: FSE-B19 1088.7348.02
- **Software**: FSE-K3 1057.2996.02
- **Phase Noise Measurement Software, Windows**: FSE-K4 1108.0088.02
- **GSM Application Firmware, BTS**: FSE-K10 1057.3092.02
- **GSM Application Firmware, BTS**: FSE-K11 1057.3392.02

**Recommended extras**

- **Service Kit**: FSE-Z1 1066.3862.02
- **DC Block, 5 to 7000 MHz (Type N)**: FSE-Z3 1040.3895.00
- **DC Block, 10 kHz to 1 GHz, Type N**: FSE-Z4 1084.7443.02
- **MicroWave Measurement Cables and Adapter Set for FSEM**: FSE-Z5 1046.2002.02
- **Service Manual**: 1066.6016.24
- **Headphones**: 0708.9010.00
- **German Keyboard**: FSE-Z2 1007.3091.31
- **American Keyboard**: FSE-Z2 1007.3091.02
- **PS/2 Mouse**: FSE-Z2 1084.7043.02
- **Colour Monitor, 15", 230 V**: FSE-Z3 1082.6004.02
- **Printer, 24-pin printer head**: PCK 0381.4512.04
- **IEC/IEEE-Bus Cable, 1 m**: PCK 0292.2013.04
- **IEC/IEEE-Bus Cable, 2 m**: PCK 0292.2013.20
- **19" Rack Adapter**
  - **with front handles**: ZZA-95 0358.4911.00
  - **without front handles**: ZZA-95 0396.4988.00
- **Set of Front Handles**: ZZA-95 0396.4988.00
- **SWR Bridge, 5 MHz to 3000 MHz**: ZRB2 1033.9017.52
- **SWR Bridge, 40 kHz to 4 GHz**: ZRC 1039.4992.52
- **High-Power Attenuators, 100 W, 3/6/10/20/30 dB**: RBU 100 1073.8820.xx
- **High-Power Attenuators, 50 W**: RBU 50 1073.8895.xx
- **Preamplifier, 9 kHz to 30 MHz**: ESH3-Z3 0827.8016.52
- **Preamplifier, 20 MHz to 1000 MHz**: ESV3 0397.7014.52
- **Preamplifier**: ESH3-Z3 0827.8016.52
- **SWR Bridge**: ZRB2 1033.9017.52
- **SWR Bridge**: ZRC 1039.4992.52
- **High-Power Attenuators, 100 W**: RBU 100 1073.8820.xx
- **High-Power Attenuators, 50 W**: RBU 50 1073.8895.xx
- **Test Port Adapter, N (male)**: -- 1021.0541.00
- **Test Port Adapter, 3.5 mm (male)**: -- 1021.0529.00
- **Test Port Adapter, K (male)**: -- 1036.4783.00
- **Test Port Adapter, K (male)**: -- 1036.4802.00

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1) Options FSE-B16 and FSE-B17 require option FSE-B15.

2) Cannot be retrofitted, factory-fitted only.