R&S® FSW
SIGNAL AND SPECTRUM ANALYZER

Continuing innovation in RF performance and usability
The high-performance R&S®FSW signal and spectrum analyzer helps engineers accomplish the most demanding tasks. Its wide internal analysis bandwidth allows the characterization of wideband components and communications systems. Its unparalleled phase noise facilitates the development of high-performance oscillators such as those used in radars. A state-of-the-art multitouch display with gesture support ensures straightforward and intuitive operation. An embedded SCPI recorder enables easy creation of executable scripts.

Key facts

- Frequency range from 2 Hz to 90 GHz (up to 500 GHz with external harmonic mixers from Rohde & Schwarz)
- Low phase noise of –140 dBc (1 Hz) at 10 kHz offset, –143 dBc at 100 kHz offset (1 GHz carrier)
- 60 dBc spurious-free dynamic range for 2 GHz internal analysis bandwidth
- Up to 8.3 GHz internal analysis bandwidth
- 800 MHz real-time analysis bandwidth with 2.4 million FFT/s, 0.46 µs POI and 500 MHz I/Q data streaming interface.
- SCPI recorder simplifies code generation
- New flat Windows 10 design and multitouch gesture support
- Multiple measurement applications can be run and displayed in parallel

The R&S®FSW offers up to 8.3 GHz analysis bandwidth for measuring wideband-modulated or frequency agile signals like those used in the new 5G New Radio standard or in automotive and pulsed radars.

The 800 MHz real-time analysis bandwidth allows users to monitor wide portions of the spectrum and trigger on short duration signals.

The R&S®FSW can measure multiple standards simultaneously. Users can quickly and easily detect and eliminate errors caused by interaction between signals.

Featuring a multitouch display and intuitive menu structure, the R&S®FSW offers exceptional ease of operation. Various measurements can be displayed simultaneously in separate windows on the large 12.1” screen, which greatly facilitates result interpretation.
**BENEFITS**

- Outstanding RF performance ► page 4
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OUTSTANDING RF PERFORMANCE

The R&S®FSW redefines the top of the line for signal and spectrum analyzers, offering superior RF performance in terms of phase noise, displayed average noise level, intermodulation suppression and dynamic range for ACLR and harmonic measurements.

Unmatched phase noise – ideal for measuring oscillators for radar and communications applications

Developers of oscillators, synthesizers and transmit systems benefit from the R&S®FSW analyzer’s excellent RF performance for phase noise measurements. At 10 kHz offset from the carrier, the R&S®FSW achieves a phase noise of typ. –140 dBc (1 Hz) for a 1 GHz carrier and typ. –131 dBc (1 Hz) for a 10 GHz carrier. It also has an excellent close-in phase noise of typ. –114 dBc (1 Hz) at 100 Hz offset. Depending on the frequency and offset range, the R&S®FSW outperforms other high-end analyzers by more than 10 dB.

Phase noise at 10 kHz offset from a 10 GHz carrier: typ. –133 dBc (1 Hz)

Harmonic measurement with highpass filter switched on (top) and off (bottom)
Excellent dynamic range for spurious measurements thanks to low DANL
Featuring a low displayed average noise level (DANL) of typ. –159 dBm (1 Hz) at 2 GHz and –150 dBm (1 Hz) at 25 GHz without using a preamplifier, the R&S®FSW measures spurious emissions quickly and reliably over a wide frequency range. A built-in preamplifier reduces the DANL further by over 15 dB and the analyzer’s switch-selected noise cancellation improves the DANL by up to 13 dB. As a result, users can identify even the smallest of spurious emissions that were previously hidden in the noise floor, and effectively optimize transmit systems.

Harmonic measurements made easy thanks to integrated highpass filters
The R&S®FSW can optionally be equipped with switchable highpass filters (R&S®FSW-B13) for carrier frequencies up to 1.5 GHz for harmonic measurements on transmit systems. This preselection clearly improves the dynamic range compared with conventional spectrum analyzers. External filters are no longer needed, which simplifies test system setups.

High sensitivity even at low frequencies
The DANL of the R&S®FSW at low frequencies up to approx. 40 MHz is improved by routing the input signal directly to the A/D converter. Even in the audio and baseband frequency range it offers a high sensitivity of –120 dBm (1 Hz) at 2 Hz, surpassing comparable analyzers by up to 20 dB.

High accuracy
The R&S®FSW offers high level measurement accuracy. It measures signal levels with < 0.37 dB total measurement uncertainty for frequencies ≤ 8 GHz.

Unparalleled dynamic range up to 1 GHz with separate receive path
The R&S®FSW has a separate receive path optimized for frequencies < 1 GHz. This yields a previously unattained dynamic range, for example for measurements on radio systems for public safety and security.

Ultrawideband filters in sweep mode
UWB regulations such as EN 302065 call for a 50 MHz resolution filter to measure the peak power, a measurement easily performed with the R&S®FSW. With its optional resolution bandwidths of 28 MHz, 40 MHz, 50 MHz and 80 MHz, the R&S®FSW offers unique possibilities for wideband signal testing.

Image rejection up to 85 GHz
A YIG preselector at the input of the R&S®FSW ensures that image frequencies are rejected and out-of-band interferers are suppressed.

The R&S®FSW85 signal and spectrum analyzer features a YIG preselector for frequencies between 8 GHz and 85 GHz. It provides image-free spectrum analysis at very high frequencies like those used in automotive radar.
## Scalable Analysis Bandwidth

The demand for analysis bandwidth is constantly increasing. The R&S®FSW with up to 8.3 GHz internal analysis bandwidth is ready to take on this challenge.

### Recommended Signal Analysis Bandwidth Extensions for the Different R&S®FSW Models

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>up to 512 MHz 1</th>
<th>up to 2 GHz 2</th>
<th>4.4 GHz</th>
<th>6.4 GHz 3</th>
<th>8.3 GHz 4</th>
</tr>
</thead>
</table>

1. Available options: 10 MHz standard, 28 MHz, 40 MHz, 80 MHz, 160 MHz, 320 MHz, 512 MHz.
2. Available options: 1.2 GHz and 2 GHz.
3. 6.4 GHz analysis bandwidth available for frequencies above 18 GHz and 18.5 GHz.
4. 8.3 GHz analysis bandwidth available for frequencies from 18.5 GHz to 57 GHz.

### Recommended Signal Analysis Bandwidth Extensions for the Different Signal Analysis Applications

<table>
<thead>
<tr>
<th>Application</th>
<th>10 MHz</th>
<th>28 MHz</th>
<th>40 MHz</th>
<th>80 MHz</th>
<th>160 MHz</th>
<th>320 MHz</th>
<th>512 MHz</th>
<th>1.2 GHz</th>
<th>2 GHz</th>
<th>4.4 GHz</th>
<th>6.4 GHz</th>
<th>8.3 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTE, WLAN EEE 802.11a/b/g/n signals</td>
<td>•</td>
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<td>5G NR</td>
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<td>WLAN IEEE 802.11n signals</td>
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<tr>
<td>WLAN IEEE 802.11ac and WLAN IEEE 802.11ax signals</td>
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<td>WLAN IEEE 802.11ad signals</td>
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<tr>
<td>Component characterization and linearization (amplifiers, frequency converters, etc.)</td>
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<td>Pulsed radar</td>
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<tr>
<td>Wideband measurements on CW and frequency hopping radar systems</td>
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<td>Automotive radar</td>
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</table>
ADVANCED USER INTERFACE
The R&S®FSW is designed for convenience – with straightforward result display.

SCPI recorder
Simplified code generation for automatic, remote controlled measurements

R&S®MultiView and R&S®Sequencer
► Display all tabs on one screen
► Measure consecutively
► Receive continually updated results

Overview settings
Display and adjust all hardware-related settings on one screen

Toolbar
► Quickly access frequently used functions
► Load and save configurations
► Take screenshots
► Configure displayed items

12.1” high-resolution, multitouch display
► 1280 x 800 pixel resolution
► Multitouch operation

Three USB 2.0 ports
► For storage media
► For connecting accessories
► For power sensors with USB connector

Noise source control
► 28 V DC power for noise sources with BNC DC input
► Control with instrument firmware

Smart port
► For power meters
► For smart noise sources
With its wide internal analysis bandwidth of optionally up to 8.3 GHz, the R&S®FSW-K144 can capture the entire bandwidth of the downlink signal and allows you to evaluate the complete system. Its high-performance digitizer yields a low inherent error vector magnitude (EVM), providing new insight into designs. Another advantage is that the bandwidth option is an internal R&S®FSW option. This reduces both the size of the test setup and the amount of cabling between components and also increases measurement accuracy.

The R&S®FSW-K144 and R&S®FSW-K145 support all specified 5G signal bandwidths from 5 MHz to 400 MHz, with multiple numerologies, multiple bandwidth parts and modulation formats from QPSK to 256QAM.

The R&S®FSW-K145 supports both the OFDMA and the transform precoded modes in the uplink.
To simplify signal analysis, several parameters are automatically detected, which reduces the number of user settings to a minimum.

For out-of-band measurements, a wide range of settings and limit lines are provided for adjacent channel leakage ratio and spectrum emission mask measurements.

The R&S®FSW-K147 enables combined and automated measurement of ACLR, SEM and EVM. Thanks to parallelized calculations and adaptable trigger settings, the feature offers significant speed advantages. This is of particular interest for the over-the-air (OTA) characterization of devices that require a large number of measurements.

**Narrowband IoT (NB-IoT)**
The R&S®FSW-K106 covers all three operating modes (in-band, guard band and out-of-band) for base station testing in line with the 3GPP specification. It delivers signal modulation results as well as out-of-band spectral measurements (ACLR and SEM). The timing alignment measurement is included to be able to easily measure the timing between transmitters in MIMO operation.

To simplify signal analysis, several parameters such as cell ID and modulation formats are automatically detected.

**Wireless connectivity: WLAN IEEE 802.11ac/ax**
The latest WLAN standards such as WLAN IEEE802.11ac aim to significantly increase data rates. To achieve a higher throughput, IEEE802.11ac has several new features, including a channel bandwidth of up to 160 MHz. The IEEE802.11ax standard is an extension of the IEEE802.11ac standard. Its aim is to improve system capacity especially in scenarios that are interference limited due to the high density of WLAN devices. The outstanding performance of the R&S®FSW signal and spectrum analyzer permits the precise signal analysis necessary when characterizing DUTs with the R&S®FSW-K91ac and R&S®FSW-K91ax options. For a 160 MHz bandwidth and 256QAM modulation, the residual EVM is as low as –47 dB.

**WiGig IEEE 802.11ad/ay – very high data rates at 60 GHz**
The IEEE802.11ad standard provides data throughput speeds of up to 7 Gbps with a channel bandwidth of 2.16 GHz bandwidth in the 60 GHz ISM band. IEEE802.11ay bonds up to four of those channels together for transmission rates of 20 Gbit/s to 40 Gbit/s.

The R&S®FSW67 and R&S®FSW85 signal and spectrum analyzers, which are equipped with the R&S®FSW-B2001 and the special measurement option R&S®FSW-K95 for IEEE802.11ad, are the only one-box solutions on the market that cover IEEE802.11ad applications.

In addition, the R&S®FSW85 with the optional bandwidth extensions to 4 GHz, 6.4 GHz or 8.3 GHz (R&S®FSW-B4001/-B6001/-B8001) and a dedicated IEEE802.11ay measurement application (R&S®FSW-K97) allows an easy IEEE802.11ay analysis. Using the 8.3 GHz analysis option, up to four bonded channels can be evaluated at the push of a button.

**The R&S®FSW-K106 NB-IoT measurement application**
EXTENSIVE RADAR ANALYSIS FUNCTIONS

Extensive analysis functions and fast identification of spurious emissions are essential prerequisites when testing modern radar systems with their wideband signals, intrapulse modulation techniques and frequency hopping capabilities.

Fast and comprehensive radar signal analysis
The R&S®FSW-K6 pulse measurement application measures all relevant pulse parameters such as pulse duration, pulse period, pulse rise and fall times, power drop across a pulse and intrapulse phase modulation at the touch of a button. It produces a trend analysis over many pulses. The user selects which results to display simultaneously on the screen. The R&S®FSW delivers a full picture of a radar system within seconds. The segmented I/Q capture function ensures that I/Q data is timestamped and stored in memory only when a pulse is detected. This feature significantly increases the analysis period – by a factor of nearly 1000 for pulse lengths less than 1 µs and a 1 kHz pulse repetition interval (PRI). With up to 8.3 GHz internal analysis bandwidth, the R&S®FSW is ready to support the design of ultra wideband radar.

Detailed pulse compression radar measurements
The R&S®FSW-K6S time sidelobe measurement option measures the pulse compression parameters and helps you evaluate the degradation of radar performance caused, for example, by modulators and exciters. You can import any I/Q-based reference waveform in I/Q data file format, allowing the use of confidential, proprietary waveforms. The R&S®FSW-K6S also supports reference waveforms captured with the R&S®FSW and stored in I/Q data file format as well as built-in waveforms such as Barker and polynomial FM.

Characterization of transient chirp and hop signals
The R&S®FSW-K60/-K60C transient analysis option/chirp measurement option characterizes FMCW signals such as those used in car radar sensors.

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Equipped with the R&S®FSW-K6 pulse measurements option, the R&S®FSW delivers pulse parameters at the touch of a button.

Pulse compression parameters and correlated magnitude display of a chirped pulse are shown with the R&S®FSW-K6S option.
The R&S®FSW automatically calculates the chirp rate and the deviation from the ideal FMCW chirp to enable efficient radar sensor optimization.

The R&S®FSW-K60 with the R&S®FSW-K60H transient hop measurement option is a convenient tool for analyzing signals with fast channel-switching characteristics such as those that occur in frequency hopping radios. Results include dwell time/hop, switching time, frequency, deviation and much more.

### Fast and reliable detection of spurious emissions

In order to measure the low levels of spurious emissions, it is often necessary to reduce the resolution bandwidth, which increases the measurement time. The R&S®FSW-K50 spurious measurement option automates spurious searches, which are performed faster than the standard spurious search measurements available in spectrum analyzers. You only need to enter the frequency range and the desired spur detection level. The application calculates the optimum resolution bandwidth (RBW) for measuring at each frequency. The R&S®FSW-K50 spurious search option is significantly faster than conventional spurious search methods for measurements at –120 dBm or below.
### IDEAL FOR SATELLITE RF TESTING

Satellite communications must cover a diverse set of user requirements in broadcasting, wireless communications and remote sensing for both commercial and government systems. Rohde & Schwarz offers fast and reliable high-performance measurement solutions for designing, developing and testing satellite payloads, payload subsystems and components.

**Multicarrier group delay measurements**

The R&S®FSW spectrum analyzer and the R&S®SMW200A signal generator along with the R&S®FSW-K17 option can be used to measure absolute and relative group delay (GD) within milliseconds on satellite transponders, frequency converters and other components. The R&S®FSW-K17 offers 1 ns measurement accuracy for relative GD measurements on frequency converters and 300 ps measurement accuracy in non-frequency-converting measurements.

**Relative group delay measurement on a bandpass filter**

It is designed to handle signal degradations that occur during in-orbit testing and achieves an extremely low noise floor due to multicarrier reference signals. No reference mixer or golden device is required for frequency converting measurements.

The R&S®FSW-K17S option is an extension of the R&S®FSW-K17. It supports broadband signal analysis to improve the overall signal-to-noise (S/N) ratio and speed of the measurement by analyzing subspans of the overall signal.

With this option, small parts of the overall signal can be output sequentially on the R&S®SMW200A and analyzed by the R&S®FSW.

In satellite applications, repeatability and accuracy of the measurement are extremely important. In these applications, having a good dynamic range is critical. This is especially important when testing the system level of a satellite in an environment with high gain (approx. 120 dB), high noise level and high intermodulation. One way to improve the dynamic range is to use narrower stimulus signals.

**Gain transfer curve measurement (AM/AM) of an amplifier.** For the curve above, a CW signal with a linear power ramp has been used as the stimulus. As expected, the AM/AM curve is a line. The curve on the right was measured using a digitally modulated signal generated by the R&S®SMW200A. The AM/AM is a cloud-like curve; the line width is due to amplifier memory effects.
Linearity and gain transfer measurements
A combination of the R&S®SMW200A vector signal generator and the R&S®FSW signal and spectrum analyzer equipped with the R&S®FSW-K18 option can be used to characterize two-port devices such as satellite transponders, power amplifiers and converters. The R&S®FSW-K18 can use either a CW power sweep or a digitally modulated stimulus signal to determine how the DUT will perform when tested under real-world conditions using a signal with the same modulation, bandwidth and crest factor as in the intended application. Typical measurements include gain compression, AM/AM, AM/PM, distortion and ACLR. The R&S®FSW-K18D option provides direct digital predistortion that linearizes the DUT based on an iterative approach. It minimizes EVM and ACLR without being limited to a certain DPD algorithm. It is therefore the ideal tool for comparing PAs under linearization conditions. The R&S®FSW-K18F option measures the frequency response of the DUT and displays magnitude, phase, and group delay versus frequency.

Noise power ratio (NPR)
Equipped with the R&S®FSW-K19 option, the R&S®FSW offers a convenient and straightforward way to measure the NPR over a maximum of 25 notches.

DVB-S2X modulation analysis
The R&S®FSW-K70M multicarrier modulation analysis application (R&S®FSW-K70 option required) allows DVB-S2X signals to be analyzed. The R&S®FSW-K70M detects the start of frame, demodulates both the header and payload parts of the signal and displays the constellation diagram and relevant modulation analysis parameters.

Uncoded bit error rate
The R&S®FSW-K70P is an extension of the R&S®FSW-K70 vector signal analysis option that allows the measurement of raw bit error rate (BER) on PRBS data up to PRBS23. In addition, the R&S®FSW-K70 offers the ability to measure BER based on user-defined bit sequences.
DO NOT MISS A THING WITH THE REAL-TIME SPECTRUM ANALYSIS OPTION

Equipped with the high-performance R&S®FSW-K161R, R&S®FSW-B512R and R&S®FSW-B800R real-time options, the R&S®FSW displays RF spectra seamlessly and in real time. Level-controlled detection of signals takes less than 0.5 µs (R&S®FSW-B800R).

Full-featured signal and spectrum analyzer
The R&S®FSW-K161R, R&S®FSW-B512R and R&S®FSW-B800R options make the R&S®FSW a full-featured signal and spectrum analyzer with built-in real-time analyzer. If level-controlled detection of signals with a length > 15 µs is sufficient, the R&S®FSW-K512RE and R&S®FSW-K800RE firmware options can be activated with a keycode (if the necessary bandwidth option is installed).

This enables the R&S®FSW to perform measuring tasks for a wide range of applications. Aerospace and defense (A&D) engineers will primarily focus on seamlessly analyzing frequency agile radar signals and detecting unwanted spurious emissions or validating tactical, frequency agile communications systems.

Regulatory authorities also need to seamlessly monitor frequency bands and reliably detect unwanted or unlicensed signals.
Detection of extremely short or frequency agile signals
The R&S®FSW real-time options allow users to reliably detect extremely short sporadic interference in the nanosecond range even in close proximity to powerful carriers – in a bandwidth up to 800 MHz.

Detection is supported by the instantaneous spectrum, a real-time spectrogram and, in persistence mode, a real-time spectrum with the signal amplitudes shown in different colors according to their frequency of occurrence (persistence spectrum).

This seamless spectrum display enables users, for example, to analyze existing frequency hopping algorithms or create alternative ones to prevent collisions between signals of different standards operating in the same frequency band (e.g. WLAN and Bluetooth®).

Saving spectra for subsequent more detailed analysis
Using frequency-dependent masks, the R&S®FSW can also trigger on extremely short transient events that typical spectrum analyzers cannot detect. The spectrum or the I/O data in the time domain can be saved for more detailed analysis at a later date.

Users can, for example, determine the cause of interference or what is hindering a base station’s data throughput. Interference originating from digital circuits or produced during synthesizer frequency switching can also be easily detected using this method.

For correct level measurements and to mitigate signal loss at the edges of the FFT window or to achieve higher time resolution, the R&S®FSW performs measurements with up to 67% spectral overlap in the time domain (R&S®FSW-K161R) at an analysis bandwidth of 160 MHz. The maximum FFT rate of almost 2.4 million spectra/s allows 16% overlap at an analysis bandwidth of 800 MHz.

<table>
<thead>
<tr>
<th>Key parameters in real-time analysis</th>
<th>R&amp;S®FSW-K161R 1)</th>
<th>R&amp;S®FSW-B512R</th>
<th>R&amp;S®FSW-K512RE 2)</th>
<th>R&amp;S®FSW-B800R</th>
<th>R&amp;S®FSW-K800RE 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFT length</td>
<td>1024 to 16k</td>
<td>1024 to 32k</td>
<td>1024 to 32k</td>
<td>512 to 32k</td>
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<tr>
<td>Max. realtime bandwidth</td>
<td>160 MHz</td>
<td>512 MHz</td>
<td>512 MHz</td>
<td>800 MHz</td>
<td>800 MHz</td>
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<tr>
<td>Max. streaming bandwidth</td>
<td>160 MHz</td>
<td>512 MHz</td>
<td>512 MHz</td>
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<td>Demodulation bandwidth</td>
<td>320 MHz</td>
<td>512 MHz</td>
<td>512 MHz</td>
<td>2 GHz</td>
<td>2 GHz</td>
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<tr>
<td>Max. FFT rate (FFT/s)</td>
<td>585938</td>
<td>1171875</td>
<td>71022</td>
<td>2343750</td>
<td>71022</td>
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<tr>
<td>POI</td>
<td>1.87 µs</td>
<td>0.91 µs</td>
<td>&gt; 15 µs</td>
<td>0.46 µs</td>
<td>&gt; 15 µs</td>
</tr>
<tr>
<td>User-configurable resolution bandwidth (RBW) for span/RBW ratio</td>
<td>6.35 to 3200</td>
<td>6.25 to 6400</td>
<td>51.2 to 6400</td>
<td>6.25 to 6400</td>
<td>80 to 6400</td>
</tr>
</tbody>
</table>

1) Only with R&S®FSW-B160/-B320 bandwidth upgrade.
2) Only with R&S®FSW-B512.
3) Only with R&S®FSW-B1200/-B2001 bandwidth upgrade.
POWERFUL VECTOR SIGNAL ANALYSIS APPLICATION

The R&S®FSW-K70 vector signal analysis option allows users to flexibly analyze digitally modulated single carriers down to the bit level. The clearly structured operating concept simplifies measurements, despite the wide range of analysis tools.

Flexible modulation analysis from MSK to 4096QAM
- Modulation formats
  - 2FSK, 4FSK to 64FSK
  - MSK, GMSK, DMSK
  - BPSK, \(\pi/2\)-BPSK, \(\pi/2\)-DBPSK, QPSK, offset QPSK, DQPSK, \(3\pi/4\)-QPSK, 8PSK, D8PSK, 3\(\pi/8\)-8PSK, \(\pi/8\)-D8PSK
  - 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 512QAM, 1024QAM, 2048QAM, 4096QAM
  - 16APSK (DVB-S2), 32APSK (DVB-S2), 2ASK, 4ASK
  - \(\pi/4\)-16QAM (EDGE), \(-\pi/4\)-32QAM (EDGE), SOQPSK
- Analysis length up to 128,000 symbols
- 10 MHz signal analysis bandwidth (optionally 40/80/160/320/512 MHz and 1.2/2/4/6.4/8.3 GHz)

Numerous standard-specific default settings
- User-definable constellations and mappings
- GSM, GSM/EDGE
- 3GPP WCDMA, EUTRA/LTE, CDMA2000®
- TETRA, APCO25
- Bluetooth®, ZigBee
- DECT, DVB-S2(X), DOCSIS 3.0

Easy operation with graphical support
The visualization of the demodulation stages and the associated settings is so clear that even inexperienced and infrequent users can find the correct settings. The combination of touchscreen and block diagram simplifies operation and readability. The R&S®FSW-K70 option helps users automatically find useful settings based on the description of the signal to be analyzed (e.g. modulation format, continuous or with bursts, symbol rate, transmit filtering).

Clearly structured block diagram display
Flexible analysis tools for detailed signal analysis make troubleshooting really easy

► Display options for amplitude, frequency and phase
  – I/Q, eye diagram; amplitude, phase and frequency errors
  – Constellation or vector diagram
► Analysis of RF signals or analog and digital baseband signals

► Statistical analysis
  – Histogram
  – Standard deviation and 95th percentile in the result summary
► Spectrum analysis of the measurement and error signal considerably help users find signal errors such as incorrect filtering and interferers
► Flexible burst search for analyzing complex signal combinations, short bursts and signal mixes – capabilities that go beyond the scope of many signal analyzers
► Equalizer helps users find the optimum filter design

Analysis of a 1024QAM modulated signal: constellation diagram, result table, symbol table and EVM distribution

Identifying EG interferer with density mode
# WIDE RANGE OF MEASUREMENT APPLICATIONS

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<thead>
<tr>
<th>Measurement application</th>
<th>Measurement parameters</th>
<th>Measurement functions</th>
</tr>
</thead>
</table>
| **R&S®FSW-K6** Pulse measurements | ► Pulse parameters:  
  - Timing: pulse width, pulse repetition interval, duty cycle, rise/fall time, settling time, timestamp, off time  
  - Frequency: carrier frequency, pulse-to-pulse frequency difference, chirp rate, frequency deviation, frequency error  
  - Power: peak power, average power, peak-to-average power, pulse-to-pulse power  
  - Phase: carrier phase, pulse-to-pulse phase difference, phase deviation, phase error  
  - Amplitude: droop, ripple, overshoot width, top/base power, average on power, average transmitted power, minimum/peak power, peak-to-average/peak-to-min power ratio, pulse-to-pulse power ratio | ► Point-in-pulse measurements: frequency, amplitude, phase versus pulse, trends and histograms for all parameters  
  - Pulse statistics: standard deviation, average, maximum, minimum  
  - Pulse tables  
  - User-defined measurement parameters  
  - Segmented data capturing  
  - Time sidelobe analysis (R&S®FSW-K6S option required) |
| **R&S®FSW-K6S** Time sidelobe 1) | ► Time sidelobe: peak-to-sidelobe level, integrated sidelobe level, mainlobe 3 dB width, sidelobe delay, compression ratio, mainlobe power/phase/ frequency, peak correlation | |
| **R&S®FSW-K7** Modulation analysis for AM/FM/φM modulated single carriers | ► Modulation depth (AM)  
  - Frequency deviation (FM)  
  - Phase deviation (φM)  
  - Modulation frequency  
  - THD and SINAD  
  - Carrier power | ► AF spectrum  
  - RF spectrum  
  - AF scope display  
  - AF filters (lowpass and highpass)  
  - Weighting filters (CCITT)  
  - Squelch |
| **R&S®FSW-K15** VOR/ILS measurements | VOR:  
  - Bearing (VOR phase)  
  - 30 Hz/9660 Hz AM modulation depth  
  - 30 Hz FM deviation (subcarrier)  
  - 30 Hz/9660 Hz AM / 30 Hz FM: frequency, K2, K3, THD  
  - Identifier: modulation depth, frequency, code  
  - DDM, SDM  
  - 90 Hz/150 Hz AM modulation depth  
  - 90 Hz/150 Hz AM: frequency, K2, K3, THD, phase  
  - Identifier: modulation depth, frequency, code | ► Reference measurements for calibrating navigation receivers  
  - Production test measurements on ILS/VOR ground stations  
  - Measurement and calibration of ramp testers |
| **R&S®FSW-K17** Multicarrier group delay measurements | ► Group delay (absolute and relative)  
  - Magnitude  
  - Phase | ► Calibration (load and save calibration data) for measurement of components and frequency converters  
  - Configurable multicarrier scenarios |
| **R&S®FSW-K17S** Subspan measurement for group delay 2) | | |
| **R&S®FSW-K18** Amplifier measurements 3) | ► AM/AM, AM/PM, EVM  
  - Width of AM/PM and AM/AM curves  
  - Synchronous measurement of RF signal and amplifier current and voltage  
  - Power-added efficiency (PAE) on amplifiers with envelope tracking  
  - Magnitude, phase, and group delay versus frequency | ► General amplifier measurements  
  - Polynomial-based digital predistortion (R&S®FSW-K18)  
  - Direct digital predistortion (R&S®FSW-K18D)  
  - Control and synchronization of the R&S®SMW200A vector signal generator  
  - Characterization of dynamic behavior of two port devices |
| **R&S®FSW-K18D** Direct DPD measurements 4) | | |
| **R&S®FSW-K18F** Frequency response | ► Noise power ratio  
  - Noise figure  
  - Noise temperature  
  - Gain  
  - Y factor | ► Noise power ratio measures the intermodulation and noise floor of RF transponders and components in satellite systems  
  - Analyzer noise correction (second stage correction)  
  - Measurements on frequency-converting DUTs  
  - Control of a generator as an LO in frequency-converting measurements  
  - SSB and DSB |
| **R&S®FSW-K19** Noise power ratio measurements | | |
| **R&S®FSW-K30** Noise figure and gain measurements based on Y-factor method 5) | | |

1) Requires R&S®FSW-K6.
3) Requires the R&S®SMW200A vector signal generator.
4) Requires R&S®FSW-K18.
5) Requires an external noise source, e.g. Noisecom NC346.
### General-purpose measurement applications

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<tr>
<td>R&amp;S®FSW-K40 Phase noise measurements</td>
<td>- SSB phase noise&lt;br&gt;- Residual FM and residual qM&lt;br&gt;- Jitter</td>
<td>- 1 Hz to 10 GHz offset range&lt;br&gt;- Selection of resolution bandwidth and number of averages for each offset range&lt;br&gt;- Definable evaluation ranges for residual FM/qM&lt;br&gt;- Signal tracking&lt;br&gt;- Optional suppression of spurious emissions</td>
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<tr>
<td>R&amp;S®FSW-K50 Spurious measurements</td>
<td>- List with true spurious emissions that violate a predefined threshold&lt;br&gt;- A second threshold can be defined as a hard limit; spurious emissions that violate this threshold are shown in red</td>
<td>- Detection of spurious emissions with optimized resolution bandwidth in line with a predefined S/N ratio&lt;br&gt;- At least three times faster than standard measurement due to optimal configuration of test parameters&lt;br&gt;- Spot search for further optimization of S/N ratio&lt;br&gt;- Targeted search for spurious emissions&lt;br&gt;- Suppression of internal spurious emissions</td>
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<tr>
<td>R&amp;S®FSW-K54 EMC diagnosis and precompliance measurements in line with commercial and military standards</td>
<td>- Disturbance voltage&lt;br&gt;- Disturbance power&lt;br&gt;- Disturbance radiation</td>
<td>- Detectors and resolution bandwidths in line with CISPR 16-1-1 and MIL-STD/DO160&lt;br&gt;- Up to 16 independent measurement markers; linkable to various EMI detectors and measurement times&lt;br&gt;- Limit lines and correction factors for typical measurement tasks&lt;br&gt;- Choice of linear or logarithmic scale on frequency axis&lt;br&gt;- Marker demodulation (AM/FM) for signal identification</td>
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<tr>
<td>R&amp;S®FSW-K544 Frequency response correction</td>
<td>- SnP file in Touchstone file format</td>
<td>- Corrects frequency response (amplitude and phase) of the measurement setup</td>
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<td>R&amp;S®FSW-K60/-K60C/-K60H Transient analysis</td>
<td>- Frequency hopping signals: dwell time, settling time, switching time, frequency deviation, power, phase deviation, power ripple&lt;br&gt;- Chirp signals: frequency deviation, chirp begin, chirp length, chirp rate, chirp state deviation, phase deviation, power, power ripple</td>
<td>- Spectrogram and section of spectrogram, tabular display, frequency, frequency error, phase and amplitude versus time, FFT spectrum&lt;br&gt;- Pan and zoom functions to select analysis region using touch gestures; supported in spectrogram, spectrum and time domain trace displays&lt;br&gt;- Trends and histograms for all parameters&lt;br&gt;- Hop/chirp statistics: standard deviation, average, maximum, minimum&lt;br&gt;- User-defined measurement parameters</td>
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### Measurement applications for wireless communications systems

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<tr>
<th>Measurement application/technology</th>
<th>Power</th>
<th>Modulation quality</th>
<th>Spectrum measurements</th>
<th>Miscellaneous</th>
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<td>R&amp;S®FSW-K10 GSM/EDGE/EDGE Evolution</td>
<td>- Power measurement in time domain, including carrier power</td>
<td>- EVM&lt;br&gt;- Phase/frequency error&lt;br&gt;- Origin offset&lt;br&gt;- Constellation diagram</td>
<td>- Modulation spectrum&lt;br&gt;- Transient spectrum</td>
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<td>- Single burst and multiburst&lt;br&gt;- Automatic detection of modulation</td>
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<td>R&amp;S®FSW-K72/-K73 3GPP FDD (WCDMA)</td>
<td>- Code domain power&lt;br&gt;- Code domain power versus time&lt;br&gt;- CCDF</td>
<td>- EVM&lt;br&gt;- Peak code domain error&lt;br&gt;- Constellation diagram&lt;br&gt;- I/Q offset&lt;br&gt;- Residual code domain error&lt;br&gt;- I/Q imbalance&lt;br&gt;- Gain imbalance&lt;br&gt;- Center frequency error (chip rate error)</td>
<td>- Spectrum mask&lt;br&gt;- ACLR&lt;br&gt;- Power measurement</td>
<td>- Channel table with channels used on base station&lt;br&gt;- Timing offset&lt;br&gt;- Power versus time</td>
<td>- Automatic detection of active channels and decoding of useful information&lt;br&gt;- Automatic detection of encryption code&lt;br&gt;- Automatic detection of HSUPA modulation format&lt;br&gt;- Support of compressed mode signals&lt;br&gt;- Support of HSPA and HSPA+ (HSDPA+ and HSUPA+)</td>
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<td>R&amp;S®FSW-K76/-K77 TD-SCDMA</td>
<td>- Code domain power&lt;br&gt;- Code domain power versus time&lt;br&gt;- CCDF</td>
<td>- EVM&lt;br&gt;- Peak code domain error&lt;br&gt;- Constellation diagram&lt;br&gt;- I/Q offset&lt;br&gt;- Residual code domain error&lt;br&gt;- Gain imbalance&lt;br&gt;- Center frequency error (chip rate error)</td>
<td>- Spectrum mask&lt;br&gt;- ACLR&lt;br&gt;- Power measurement</td>
<td>- Channel table with channels used on base station&lt;br&gt;- Timing offset&lt;br&gt;- Power versus time</td>
<td>- Automatic detection of active channels and decoding of useful information&lt;br&gt;- Automatic detection of HSUPA modulation format&lt;br&gt;- Support of HSPA+ (HSDPA+ and HSUPA+)</td>
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### Measurement applications for wireless communications systems

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<td>► Robust demodulation algorithms for reliable measurement of multicarrier signals</td>
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<td>► MIMO time alignment for R&amp;S®FSW-K100/-K104</td>
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<td>► Interband carrier aggregation time alignment</td>
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<td>R&amp;S®FSW-K103</td>
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<td>EUTRA/ LTE-Advanced UL</td>
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<td></td>
<td>► Multicarrier ACLR for FDD and TDD</td>
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<td>► SEM for contiguously aggregated component carriers</td>
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## Measurement applications for wireless communications systems

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<th>Modulation quality</th>
<th>Spectrum measurements</th>
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</thead>
</table>
| **R&S®FSW-K106**  
NB-IoT DL measurements | ▶ Power measurement in time and frequency domains 
▶ CCDF | ▶ EVM  
▶ Constellation diagram  
▶ Frequency error  
▶ Sampling error | ▶ Spectrum flatness, ACLR, SEM | ▶ Allocation summary list | ▶ Standalone, guard band and in-band operation  
▶ Automatic detection of cell ID |
| **R&S®FSW-K201**  
OneWeb reverse link measurement application | ▶ Power measurement in time and frequency domains | ▶ EVM  
▶ Constellation diagram  
▶ I/Q offset  
▶ I/Q imbalance  
▶ Gain imbalance  
▶ Quadrature error  
▶ Center frequency error (symbol clock error) | ▶ Spectrum mask  
▶ ACLR  
▶ Power measurement  
▶ Spectrum flatness | ▶ Automatic detection of modulation and cyclic prefix length |
| **R&S®FSW-K118**  
Verizon 5GTF downlink | ▶ Power versus time  
▶ CCDF | ▶ EVM  
▶ EVM xPDSCH  
▶ Constellation diagram  
▶ I/Q offset  
▶ I/Q imbalance  
▶ Gain imbalance  
▶ Center frequency error | ▶ Allocation summary  
▶ Multicarrier filter  
▶ Automatic detection of Cell ID |
| **R&S®FSW-K119**  
Verizon 5GTF uplink | ▶ Power versus time  
▶ CCDF | ▶ EVM  
▶ EVM xPUSCH  
▶ Constellation diagram  
▶ I/Q offset  
▶ I/Q imbalance  
▶ Gain imbalance  
▶ Center frequency error | ▶ Allocation summary  
▶ Multicarrier filter |
| **R&S®FSW-K144**  
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▶ EVM xPDSCH  
▶ Constellation diagram  
▶ I/Q offset  
▶ I/Q imbalance  
▶ Gain imbalance  
▶ Center frequency error | ▶ ACLR  
▶ SEMI  
▶ Allocation summary  
▶ Channel table with channels used on base station  
▶ Automatic detection of Cell ID  
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| **R&S®FSW-K145**  
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▶ MER versus symbol  
▶ MER versus symbol x carrier  
▶ MER (pilot, data)  
▶ Constellation diagram  
▶ Center frequency error  
▶ Symbol clock error  
▶ Group delay | ▶ Power measurement  
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▶ Decoding: LDPC BER  
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▶ Rolloff  
▶ PLC start index  
▶ Continuous pilots  
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▶ N_{PT} |
| **R&S®FSW-K147**  
5G NR combined ACLR/SEM/EVM | ▶ Power versus time  
▶ Power versus symbol x carrier | ▶ MER versus carrier  
▶ MER versus symbol  
▶ MER versus symbol x carrier  
▶ MER (pilot, data)  
▶ Constellation diagram  
▶ Center frequency error  
▶ Symbol clock error  
▶ Group delay | ▶ Power spectrum  
▶ Power versus carrier (synchronous ACP)  
▶ Spectrum flatness  
▶ Individual results for frame objects  
▶ Trigger to frame  
▶ Automatic detection of:  
▶ Cyclic prefix  
▶ Rolloff |

1) Requires R&S®FSW-K144.
# SPECIFICATIONS IN BRIEF

## Specifications in brief

### Frequency

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<th>Model</th>
<th>Frequency range</th>
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<tr>
<td>R&amp;S®FSW8</td>
<td>2 Hz to 8 GHz</td>
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<tr>
<td>R&amp;S®FSW13</td>
<td>2 Hz to 13.6 GHz</td>
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<tr>
<td>R&amp;S®FSW26</td>
<td>2 Hz to 26.5 GHz</td>
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<tr>
<td>R&amp;S®FSW43</td>
<td>2 Hz to 43.5 GHz</td>
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<tr>
<td>R&amp;S®FSW50</td>
<td>2 Hz to 50 GHz</td>
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<tr>
<td>R&amp;S®FSW67</td>
<td>2 Hz to 67 GHz</td>
</tr>
<tr>
<td>R&amp;S®FSW85</td>
<td>2 Hz to 85 GHz, up to 90 GHz with R&amp;S®FSW-B90G option, YIG preselector = off</td>
</tr>
</tbody>
</table>

### Aging of frequency reference

- 1 × 10⁻⁷/year with R&S®FSW-B4 option
- 3 × 10⁻⁸/year

### Bandwidths

#### Resolution bandwidths

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<th>Filter Type</th>
<th>Bandwidth Range</th>
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<tr>
<td>Standard filter</td>
<td>1 Hz to 10 MHz, 40 MHz with R&amp;S®FSW-BB8 option (without export license), 80 MHz with R&amp;S®FSW-BB8 option</td>
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<tr>
<td>RRC filter</td>
<td>18 kHz (NADC), 24.3 kHz (TETRA), 3.84 MHz (3GPP)</td>
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<tr>
<td>Channel filter</td>
<td>100 Hz to 5 MHz</td>
</tr>
<tr>
<td>Video filter</td>
<td>1 Hz to 10 MHz</td>
</tr>
</tbody>
</table>

#### I/O demodulation bandwidth

- 10 MHz
- 28 MHz with R&S®FSW-B28 option
- 40 MHz with R&S®FSW-B40 option
- 80 MHz with R&S®FSW-B80 option
- 160 MHz with R&S®FSW-B160 option
- 320 MHz with R&S®FSW-B320 option
- 512 MHz with R&S®FSW-B512 option
- 1.2 GHz ¹ with R&S®FSW-B1200 option
- 2 GHz ² with R&S®FSW-B2001 option
- 2 GHz ² with R&S®FSW-B2000 option
- 4.4 GHz ³ with R&S®FSW-B4001 option
- 5 GHz ⁴ with R&S®FSW-B5000 option
- 6.4 GHz ⁵ with R&S®FSW-B6001 option
- 8.3 GHz ⁵ with R&S®FSW-B8001 option

### Phase noise

- 10 kHz offset from carrier
  - 500 MHz carrier: $-141$ dBc (1 Hz) (typ.)
  - 1 GHz carrier: $-140$ dBc (1 Hz) (typ.)
  - 10 GHz carrier: $-133$ dBc (1 Hz) (typ.)

### Displayed average noise level (DANL)

- 2 GHz: $-169$ dBm (1 Hz) (typ.)
- 8 GHz with R&S®FSW-B13 option: $-195$ dBm (1 Hz) (typ.)

### Intermodulation

- Third order intercept (TOI)
  - $f < 1$ GHz: $+30$ dBm (typ.)
  - $f < 3$ GHz: $+25$ dBm (typ.)
  - 19 GHz to 26.5 GHz: $+23$ dBm (typ.)

### Total measurement uncertainty

- 8 GHz: $< 0.37$ dB

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¹ Not available for the R&S®FSW8 and R&S®FSW13.
² 2 GHz demodulation bandwidth for frequencies > 5.5 GHz. R&S®RTO2044 digital oscilloscope required. Not available for the R&S®FSW8 and R&S®FSW13.
³ Available for the R&S®FSW43 and R&S®FSW50, R&S®FSW67 and R&S®FSW85.
⁴ Available for the R&S®FSW43 and R&S®FSW85. 5 GHz demodulation bandwidth for frequencies > 9.5 GHz. R&S®RTO2064 digital oscilloscope required.
⁵ Available for the R&S®FSW43, R&S®FSW50, R&S®FSW67 and R&S®FSW85.
## ORDERING INFORMATION

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<th>Designation</th>
<th>Type</th>
<th>Order No.</th>
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</thead>
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<td><strong>Base unit</strong></td>
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<tr>
<td>Signal and spectrum analyzer, 2 Hz to 8 GHz</td>
<td>R&amp;S®FSW8</td>
<td>1331.5003.08</td>
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<tr>
<td>Signal and spectrum analyzer, 2 Hz to 13.6 GHz</td>
<td>R&amp;S®FSW13</td>
<td>1331.5003.13</td>
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<td>Signal and spectrum analyzer, 2 Hz to 26.5 GHz</td>
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<td>Signal and spectrum analyzer, 2 Hz to 85 GHz</td>
<td>R&amp;S®FSW85</td>
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<td><strong>Hardware options</strong></td>
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<td>OCXO precision frequency reference</td>
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<td>Resolution bandwidth up to 80 MHz</td>
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<td>Resolution bandwidth up to 40 MHz</td>
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<td>Highpass filter for harmonic measurements</td>
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<td>Spare solid state drive (removable hard drive)</td>
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<td>LOAF connections for external mixers</td>
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<td>RF preamplifier, 100 kHz to 26.5 GHz</td>
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<td>RF preamplifier, 100 kHz to 43.5 GHz</td>
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<td>RF preamplifier, 100 kHz to 50 GHz</td>
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<td>8.3 GHz analysis bandwidth</td>
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<td>Analog baseband inputs, 40 MHz analysis bandwidth (for R&amp;S®FSW26, R&amp;S®FSW43 and R&amp;S®FSW50)</td>
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1) Frequency range for R&S®FSW85 with R&S®FSW-B90G option: 2 Hz to 80 GHz (YIG preselector off).
2) For R&S®FSW8, R&S®FSW13 and R&S®FSW26.
3) For R&S®FSW43, R&S®FSW50, R&S®FSW67 and R&S®FSW85. Export license required.
4) For R&S®FSW26, R&S®FSW43, R&S®FSW50 and R&S®FSW67.
5) For R&S®FSW85.
6) For R&S®FSW8 and R&S®FSW13.
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8) For R&S®FSW26.
9) For R&S®FSW43 and R&S®FSW67.
10) For R&S®FSW50.
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12) For R&S®FSW85. Export license required.
13) For R&S®FSW67. Export license required.
16) For R&S®FSW43, R&S®FSW50, R&S®FSW67 and R&S®FSW85.
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<td>R&amp;S®FSW-K40</td>
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<td>R&amp;S®FSW-K54CAL</td>
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<td>Transient measurement application</td>
<td>R&amp;S®FSW-K60</td>
<td>1313.7495.02</td>
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<td>Transient hop measurement</td>
<td>R&amp;S®FSW-K60H</td>
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<td>Transient chirp measurement</td>
<td>R&amp;S®FSW-K60C</td>
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<td>Multi-modulation analysis</td>
<td>R&amp;S®FSW-K70M</td>
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<td>BER PRBS measurements</td>
<td>R&amp;S®FSW-K70P</td>
<td>1338.3893.02</td>
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<td>3GPP FDD (WCDMA) BS measurements (incl. HSDPA and HSDPA+)</td>
<td>R&amp;S®FSW-K72</td>
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<td>3GPP FDD (WCDMA) MS measurements (incl. HSUPA and HSUPA+)</td>
<td>R&amp;S®FSW-K73</td>
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<td>TD-SCDMA BS measurements</td>
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<td>TD-SCDMA UE measurements</td>
<td>R&amp;S®FSW-K77</td>
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<td>CDMA2000® BS measurements</td>
<td>R&amp;S®FSW-K82</td>
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18 For R&S®FSW26, R&S®FSW43, R&S®FSW50, R&S®FSW67 and R&S®FSW85.
19 For R&S®FSW85, without preselection for f > 85 GHz.
20 Requires R&S®FSW-B160 or R&S®FSW-B320.
21 Requires R&S®FSW-B1200 or R&S®FSW-B2001 or R&S®FSW-B800R.
22 Requires R&S®FSW-B4001, R&S®FSW-B6001 or R&S®FSW-B8001.
23 Requires R&S®FSW-K6.
25 Requires R&S®FSW-K18.
26 Requires R&S®FSW-K60.
27 Requires R&S®FSW-K70.
28 Requires R&S®FSW-K91.
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**Shelter front cover 5 HU**

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**License dongle**

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**Service option**

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