

# R&S®FSW

## Signal and Spectrum Analyzer

### Setting standards in RF performance and usability



**ROHDE & SCHWARZ**

# R&S®FSW Signal and Spectrum Analyzer At a glance

The high-performance R&S®FSW signal and spectrum analyzer was developed to meet demanding customer requirements. Offering low phase noise, wide analysis bandwidth and straightforward and intuitive operation, the analyzer makes measurements fast and easy.

Users in the aerospace and defense (A&D) sector and developers of future, wideband communications systems will find plenty of reasons why the R&S®FSW is the right solution for their T&M requirements. With phase noise unparalleled among signal and spectrum analyzers, the R&S®FSW facilitates the development of oscillators intended for use in radar systems, for example.

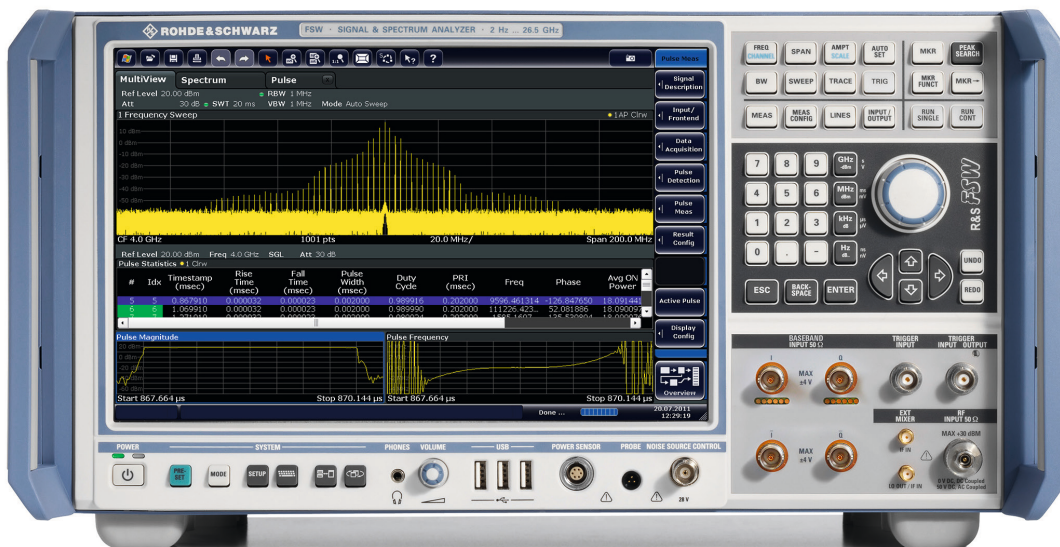
The R&S®FSW offers up to 500 MHz analysis bandwidth for measuring wideband-modulated or frequency-agile signals. Currently, signal and spectrum analyzers measure different standards (GSM, CDMA2000®, WCDMA, LTE) separately. The R&S®FSW takes analysis to the next level, providing capability to measure multiple standards simultaneously. Users can quickly and easily detect and eliminate errors caused by interaction between signals.

Featuring a touchscreen user interface, a flat menu structure and straightforward result representation, 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. The R&S®FSW also scores top marks when it comes to measurement speed. Providing 1000 sweep/s in remote operation and delay-free switching between instrument setups, the R&S®FSW ranks top among the signal and spectrum analyzers available on the market.

Equipped with the R&S®FSW-B71 option, the R&S®FSW can analyze signals in the analog baseband. The R&S®FSW-B17 option allows measurements in the digital baseband.

## Key facts

- Frequency range from 2 Hz to 8/13.6/26.5/43.5/50/67 GHz (with external harmonic mixers from Rohde&Schwarz up to 110 GHz)
- Low phase noise of  $-137$  dBc (1 Hz) at 10 kHz offset (1 GHz carrier)
- $-88$  dBc dynamic range (with noise cancellation) for WCDMA ACLR measurements
- Up to 500 MHz analysis bandwidth
- $< 0.4$  dB total measurement uncertainty up to 8 GHz
- Real-time analysis up to 160 MHz bandwidth
- High-resolution 12.1" (31 cm) touchscreen for convenient operation
- Multiple measurement applications can be run and displayed in parallel



# R&S®FSW Signal and Spectrum Analyzer

## Benefits and key features

### RF performance that meets exacting demands

- Unmatched phase noise – ideal for measuring oscillators for radar and communications applications
- Excellent dynamic range for spurious measurements thanks to low DANL
- Harmonic measurements made easy – due to integrated highpass filters
- High sensitivity even at low frequencies
- High accuracy
- Unparalleled dynamic range up to 1 GHz with separate receive path

▷ [page 4](#)

### Ready for the future

- Up to 500 MHz analysis bandwidth
- High spurious-free dynamic range of > 100 dBc
- Large I/Q memory depth for seamless recording of long signal sequences
- 500 MHz wide IF path with IF output

▷ [page 6](#)

### Designed for convenience – with straightforward result display

- Efficient measurement functions speed up operation
- MultiView: multiple results available at a glance
- Optimum configuration and combination of measurement applications

▷ [page 8](#)

### Ideal for analyzing radar systems

- Fast identification and analysis of spurious emissions
- Low phase noise for oscillator measurements
- Measuring pulse parameters at the touch of a key
- Detection of wideband frequency-hopping signals
- Analyzing short pulse rise and fall times

▷ [page 9](#)

### Identifying interaction between signals

- Multistandard radio analyzer (MSRA)
- Multistandard realtime analyzer (MSRT)

▷ [page 10](#)

### A safe investment

- Keeping pace with technological advancement
- R&S®Legacy Pro – easy replacement of obsolete analyzers
- Firmware updates – always in step with new developments
- Keeping test data confidential

▷ [page 11](#)

### When speed counts

- High measurement rates and fast sweep times with sweep rates of up to 1000 sweep/s
- Fast switchover between instrument setups
- Efficient measurement functions speed up operation
- Integrated support of R&S®NRP-Zxx power sensors

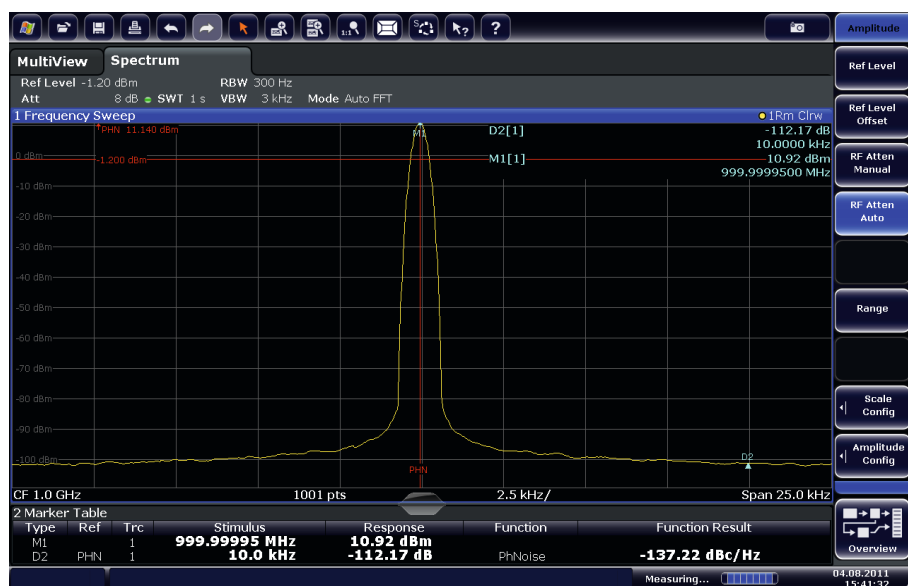
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# RF performance that meets exacting demands

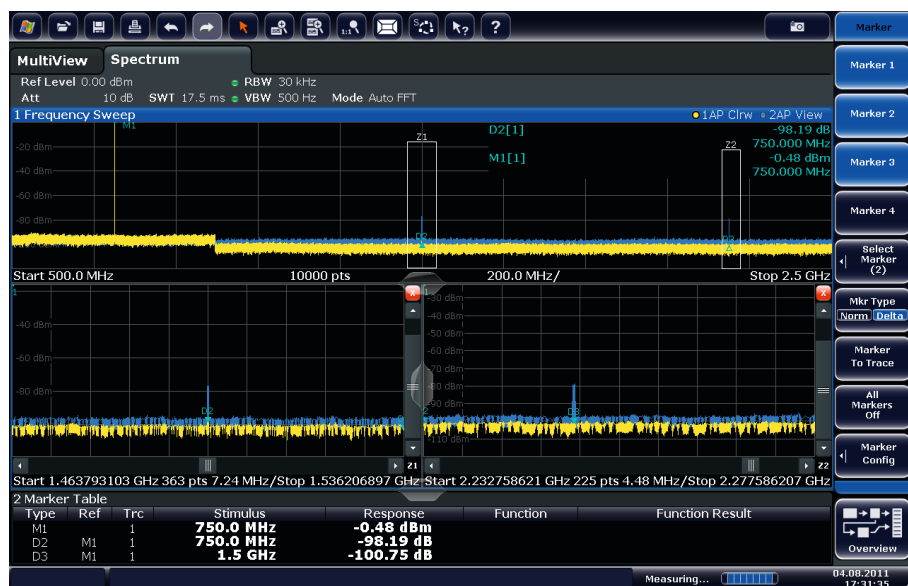
The R&S®FSW redefines the top of the line for signal and spectrum analyzers, offering superior RF performance in terms of phase noise, displayed average noise level (without noise cancellation), intermodulation suppression and dynamic range for ACLR and harmonic measurements.

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

Developers of oscillators, synthesizers or transmit systems benefit from the R&S®FSW's excellent dynamic range for phase noise measurements. At 10 kHz offset from the carrier, the R&S®FSW achieves phase noise of  $-137$  dBc (1 Hz) for a 1 GHz carrier and  $-128$  dBc (1 Hz) for a 10 GHz carrier. At 100 Hz offset from the carrier, values of  $-110$  dBc (1 Hz) and  $-90$  dBc (1 Hz) are attained. The R&S®FSW therefore outperforms previous analyzers by more than 10 dB.



Phase noise at 10 kHz offset from a 1 GHz carrier:  $-137$  dBc (1 Hz).



Harmonic measurement with highpass filter on (yellow trace) and off (blue trace).

### 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. DANL can be further improved by up to 13 dB by means of the analyzer's switch-selected noise cancellation. Users can thus identify even the smallest of spurious that were previously hidden in the noise floor, and effectively optimize transmit systems.

### Harmonic measurements made easy – due 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, resulting in a clear improvement of dynamic range over conventional spectrum analyzers. External filters are no longer needed. This facilitates test system setup for GSM, CDMA2000®, WCDMA, LTE and TETRA systems, for example.

### High sensitivity even at low frequencies

The R&S®FSW's DANL at low frequencies is improved by routing the input signal directly to the A/D converter. This yields high sensitivity of  $-120$  dBm (1 Hz) at 2 Hz even in the audio and baseband frequency range – surpassing comparable analyzers by up to 20 dB.

### High accuracy

The R&S®FSW offers high level measurement accuracy up to 8 GHz. This means that the analyzer measures signal levels with  $< 0.4$  dB total measurement uncertainty, for example in the 5.8 GHz ISM band or in satellite communications or radar bands.

### 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 dynamic range unattained so far, for example for measurements on professional mobile radio (PMR) systems.



Displayed average noise level (DANL) with preamplifier and noise cancellation switched on.

# Ready for the future

## Up to 500 MHz analysis bandwidth

The demand for analysis bandwidth is continuously increasing. This becomes apparent when power amplifiers for multicarrier or wideband applications have to be linearized in order to make them more effective, or when the occupied bandwidth of communications systems themselves increases. The R&S®FSW is ready to take on this challenge – offering analysis bandwidths of up to 500 MHz.

Configuration	Maximum analysis bandwidth	Applications
Standard	10 MHz	<ul style="list-style-type: none"><li>Standard applications and measurements on single carriers, e.g. WCDMA, CDMA2000®, TD-SCDMA, TETRA carriers</li></ul>
R&S®FSW-B28	28 MHz	<ul style="list-style-type: none"><li>Modulation measurements on WiMAX™, LTE, WLAN IEEE802.11a/b/g/p signals</li></ul>
R&S®FSW-B40	40 MHz	<ul style="list-style-type: none"><li>Modulation measurements on WLAN IEEE802.11n signals</li><li>Amplifier characterization and linearization</li></ul>
R&S®FSW-B80	80 MHz	<ul style="list-style-type: none"><li>Amplifier characterization and linearization</li><li>Wideband pulse measurements</li><li>Modulation measurements on WLAN IEEE802.11ac signals</li></ul>
R&S®FSW-B160	160 MHz	<ul style="list-style-type: none"><li>Amplifier characterization and linearization</li><li>Wideband pulse measurements</li><li>Modulation measurements on WLAN IEEE802.11ac signals</li></ul>
R&S®FSW-B320	320 MHz	<ul style="list-style-type: none"><li>Amplifier characterization and linearization</li><li>Wideband pulse measurements</li></ul>
R&S®FSW-B500	500 MHz	<ul style="list-style-type: none"><li>Amplifier characterization and linearization</li><li>Wideband pulse measurements</li></ul>



## High spurious-free dynamic range of > 100 dBc

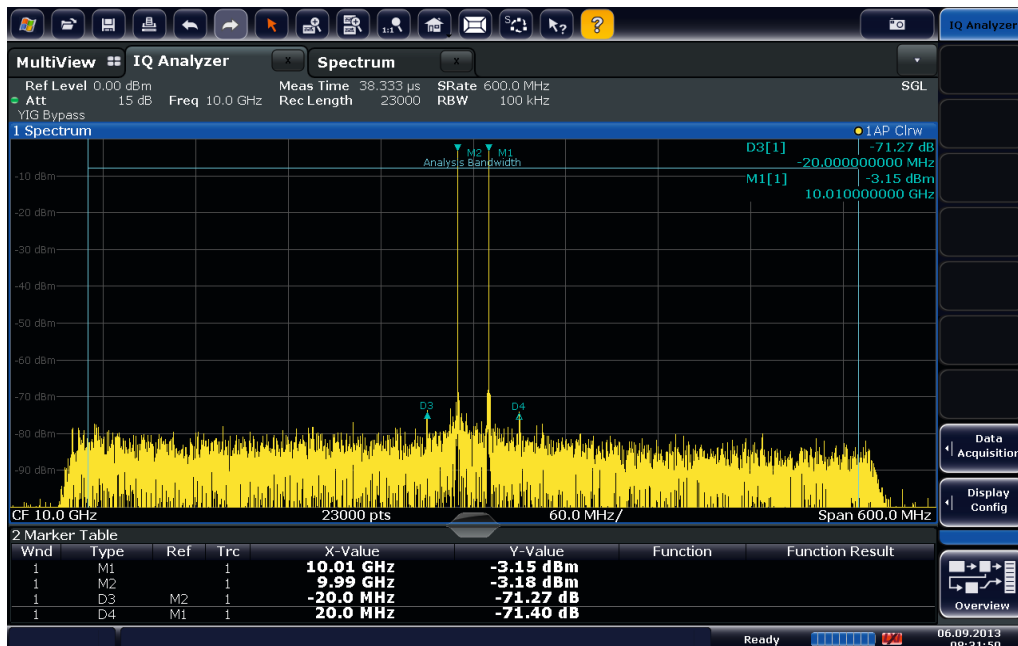
In addition to A/D converter resolution, the available spurious-free dynamic range (SFDR) plays an eminent role when analyzing I/Q data. With an SFDR well over 100 dBc, the R&S®FSW offers unprecedented accuracy when it comes to linearizing amplifiers or measuring EVM.

Analysis bandwidth	SFDR
10 MHz	100 dBc
80 MHz	80 dBc
160 MHz	70 dBc
320 MHz	67 dBc
500 MHz	60 dBc

## Large I/Q memory depth for seamless recording of long signal sequences

The R&S®FSW has a 400 Msample I/Q memory depth. Signals can be recorded over extended periods of time, even when analyzing large bandwidths. This makes it easier to identify and analyze sporadic errors.

Analysis bandwidth	Sampling rate	Maximum recording time
10 MHz	12.5 Msample/s	36.9 s
20 MHz	25 Msample/s	18.4 s
40 MHz	50 Msample/s	9.2 s
80 MHz	100 Msample/s	4.6 s
160 MHz	200 Msample/s	2.3 s
320 MHz	400 Msample/s	0.49 s
500 MHz	600 Msample/s	0.76 s



Third Order Intermodulation Distortion (IM3) of -65 dBc.

# Designed for convenience – with straightforward result display

The R&S®FSW turns into a reality what many users desire: configuration, measurement and analysis that are truly intuitive.

## Efficient operation with optimized user guidance

From block diagrams reflecting the signal flow on the R&S®FSW touchscreen, the user can select a desired element and access all functions via straightforward dialogs. The R&S®FSW uses flat menu structures throughout, making it easy to navigate to a desired function or setting. For example, up to eight traces can be configured in a single dialog. Dialog windows are transparent, so that the signal of interest is always visible.

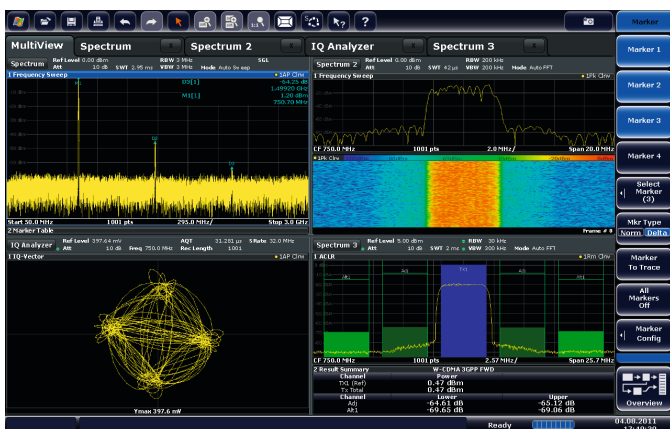
Frequently used control functions are assigned to hard-keys. Via a toolbar, users can quickly access global functions, such as the zoom function or the storage function for saving measurement data and screen content.

## MultiView: multiple results available at a glance

With the MultiView function, the user can display multiple results simultaneously on the R&S®FSW's 12.1" touchscreen.

For example, in one measurement diagram, the user can analyze the wanted spectrum of a radar signal. In a second diagram with separate settings, the signal harmonics can be measured. A third diagram can be activated to measure and statistically evaluate the pulse rise and fall times as well as phase shift keying within a pulse (intrapulse PSK) using the R&S®FSW-K6 application. The desired diagram (measurement application) can be activated by clicking the associated tab. Clicking the MultiView tab will simultaneously display all active measurements.

The multichannel sequencer makes it possible to run multiple measurement applications virtually in parallel. Measuring signals at different frequencies and according to different parameters previously called for a step-by-step approach, i.e. measurements had to be performed one after the other, which was a time-consuming procedure. The new functionality now makes it possible to run different measurement applications virtually simultaneously and view all results at a glance. This provides an enormous speed advantage for signal measurements during development and verification.



MultiView function.



# Ideal for analyzing radar systems

Rapid spurious identification, low phase noise, extensive pulse analysis functions and wide analysis bandwidth make the R&S®FSW signal and spectrum analyzer an essential tool in the development and production of radar systems.

## Fast identification and analysis of spurious emissions

To identify spurious emissions from a transmitter or oscillator, measurements are often carried out over large frequency ranges at narrow analysis bandwidths. Due to its short sweep times, the R&S®FSW delivers results very quickly even for this demanding application.

At 1 kHz resolution bandwidth and a frequency range up to 8 GHz, the R&S®FSW outputs a spectrum with levels down to -100 dBm within 10 s. Using the zoom or the MultiView function, users can investigate detected spurious emissions in greater detail while keeping an eye on the overall spectrum.

## Low phase noise for oscillator measurements

Radar systems are equipped with highly stable oscillators in order to achieve high resolution. They can accurately determine the speed of moving objects, for example. With its outstanding RF performance, the R&S®FSW is the ideal tool for measuring these oscillators (see page 4).

## Measuring pulse parameters at the touch of a key

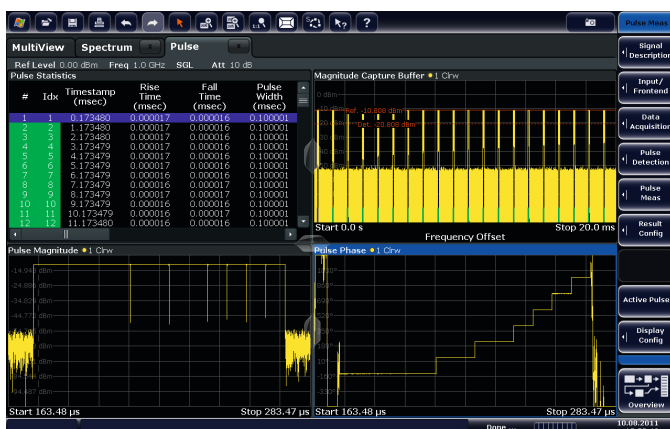
Characterizing radar systems requires numerous pulse parameters to be measured. The R&S®FSW-K6 option measures – at the touch of a key – all relevant parameters such as pulse duration, pulse period, pulse rise and fall times, power drop across a pulse, and intrapulse phase modulation, and produces a trend analysis over many pulses. The user selects the results to be displayed simultaneously on the screen. The R&S®FSW thus delivers a full picture of a radar system within seconds.

## Detection of wideband frequency-hopping signals

The R&S®FSW can also analyze frequency-agile, pulsed signals where the frequency varies within a pulse (chirp) or from pulse to pulse (hopping). In addition to the R&S®FSW-K6 pulse analysis option, the R&S®FSW-K60 transient analysis option is ideal for radar system manufacturers and developers who need to characterize frequency-agile signals, including analysis of hopping sequences (R&S®FSW-K60H) and chirp frequency response (R&S®FSW-K60C). The R&S®FSW-K60C option displays the frequency response and calculates the deviation from the ideal, linear phase, even for non-pulsed FM CW radar signals used in distance radars and fill level measurements. The R&S®FSW-K60H option displays the dwell time, settling time, switching time, frequency offset, power and an automatic analysis of the hopping sequence of fast frequency-hopping, pulsed signals.

## Analyzing short pulse rise and fall times

Analyzing short pulses requires a wide dynamic range and a large analysis bandwidth. The R&S®FSW has both (see page 6).



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

# Identifying interaction between signals

## Multistandard radio analyzer (MSRA)

The constantly growing demand for wireless transmission capacity results in ever more complex signal scenarios. Multistandard transmitters transmit signals to various standards over a common RF path. Measuring RF signal quality and RF signal interaction poses new challenges for signal and spectrum analyzers, both in terms of speed and the ability to measure different signals in parallel.

The R&S®FSW meets this challenge with its new multistandard radio analyzer function. The MSRA simultaneously measures signals of different standards (GSM, WCDMA, LTE, etc.) at different frequencies within its 500 MHz analysis bandwidth.

## Multistandard realtime analyzer (MSRT)

The multistandard realtime analyzer (MSRT) can be used to detect short, sporadic interference signals and their influence on adjacent signals. The MSRT seamlessly acquires the spectrum. As soon as the frequency mask trigger is activated, the recorded I/Q data is transferred to the measurement application and analyzed. The data covers a settable time span before and after the trigger event. As with the MSRA, time-correlated dependencies between signals are retained.

Developers of multistandard transmitters use the MSRT to identify the cause and influence of sporadic spurious emissions on wanted signals.

Equipped with the pulse analysis option (R&S®FSW-K6) and the transient analysis option (R&S®FSW-K60/-K60H/-K60C), the MSRT supports other measurement applications for analyzing pulses and frequency-agile systems, such as hopping sequences of radar systems.



Multistandard radio analyzer (MSRA): Signals are captured once, then analyzed according to different standards and at different frequencies in parallel.

# A safe investment

## **Keeping pace with technological advancement**

Fast innovation cycles, new transmission methods, growing data volumes and ever higher bandwidths mean that analyzers have to constantly cope with new T&M requirements during their useful life. The R&S®FSW has a modular design, i.e. subassemblies such as the controller, the power supply and the digital backend are inserted into slots on the rear. Optional modules, such as for extending I/Q demodulation bandwidth, are likewise accommodated on the rear. Measurement applications can be activated with a key code.

## **R&S®Legacy Pro – easy replacement of obsolete analyzers**

In a test system, core elements such as spectrum analyzers may have to be replaced, for example because an analyzer becomes inoperative and repair is not possible, or because the user wants to benefit from the higher measurement speed of a more state-of-the-art instrument. Replacement may be required despite test system software having been validated at substantial cost and effort. The R&S®FSW supports the remote control command sets of other Rohde&Schwarz signal and spectrum analyzers, such as those of the R&S®FSU and R&S®FSQ, as well as those of other manufacturers' instruments (R&S®Legacy Pro). Replacing an obsolete analyzer with an R&S®FSW therefore poses no problems. In most cases it is sufficient to verify the R&S®FSW's response during a measurement sequence. Numerous successful reference projects with the R&S®FSV or R&S®FSU replacing obsolete analyzers prove the efficiency of this approach.

## **Firmware updates – always in step with new developments**

R&S®FSW firmware updates can be downloaded from a USB stick or via LAN. They are available free of charge at [www.rohde-schwarz.com](http://www.rohde-schwarz.com)

## **Keeping test data confidential**

To keep their test data confidential, users can exchange the R&S®FSW's internal solid state disk (SSD) for another, neutral SSD (R&S®FSW-B18 option). The instrument can then be sent in for calibration or any other purpose without any confidential test data leaving the lab. Device-specific alignment data remains in the analyzer, where it is stored separately and independently of user data.

# When speed counts

A wide variety of measurements are needed in order to validate and verify the characteristics of RF ICs, modules and systems under various conditions, for example at different frequencies, temperatures or with different supply voltages.

The R&S®FSW effectively supports these measurements by offering high speed, efficient measurement functions and fast switchover between instrument setups. This speeds up test sequences and reduces the time to the final product.

## High measurement rates and fast sweep times with sweep rates of up to 1000 sweep/s

With a sweep rate of up to 800 sweep/s in manual operation and 1000 sweep/s in remote control, the R&S®FSW offers performance superior to that of comparable signal and spectrum analyzers. The R&S®FSW speeds up measurements that require a high averaging factor, as are frequently stipulated in test specifications for communications standards.

Measurement speed of the R&S®FSW		
Local measurement and display update rate	1001 sweep points	1.25 ms (800/s) (measured)
Remote measurement, average over 1000 sweeps	1001 sweep points	1.0 ms (1000/s) (measured)
Remote measurement including data transfer via LAN		5 ms (200/s) (measured)
Marker peak search		1.7 ms (measured)
Setting of center frequency including data transfer	f ≤ 8 GHz	15 ms (measured)
	f > 8 GHz	65 ms (measured)

### Fast switchover between instrument setups

With the R&S®FSW, different instrument setups can be kept in RAM simultaneously to accommodate measurements requiring different settings. This minimizes the time to switch between instrument setups and operating modes. For example, test routines that involve switchover between spectrum and modulation measurements are performed faster.

### Efficient measurement functions speed up operation

- Frequency list mode: fast measurement on up to 300 frequencies with different analyzer settings triggered by just a single remote control command
- Measurement of different power levels in the time domain in just a single sweep (multisummary marker)
- Frequency counter with 0.1 Hz resolution at < 50 ms measurement time
- Fast ACP measurement in the time domain using channel filters or in the frequency domain using FFT sweep

### Integrated support of R&S®NRP-Zxx power sensors

The R&S®FSW supports the operation of up to four R&S®NRP-Zxx power sensors. This simplifies test system architecture. No extra, separately controlled instruments are needed to connect the sensors, which also speeds up test system control.



R&S®FSW with R&S®NRP-Zxx power sensor.

# R&S®FSW-K70

## option

# Vector signal analysis application

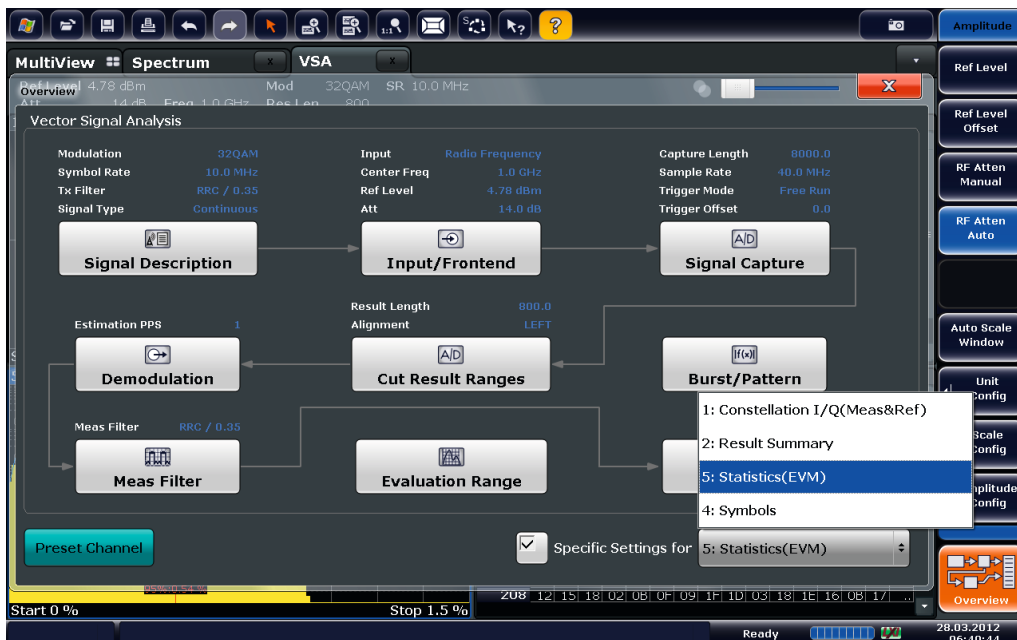
The R&S®FSW-K70 option enables users to flexibly analyze digitally modulated single carriers down to the bit level. The clearly structured operating concept simplifies measurements, despite the wide range of analysis tools.

### Flexible modulation analysis from MSK to 1024QAM

- Modulation formats:
  - 2FSK, 4FSK
  - MSK, GMSK, DMSK
  - BPSK, QPSK, Offset-QPSK, DQPSK, 8PSK, D8PSK,  $\pi/4$ -DQPSK,  $3\pi/8$ -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),  $-\pi/4$ -16QAM (EDGE)
- Analysis length up to 50 000 symbols
- Signal analysis bandwidth 28 MHz (40/80/160/320/500 MHz optional)

### 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



Clearly structured block diagram display.



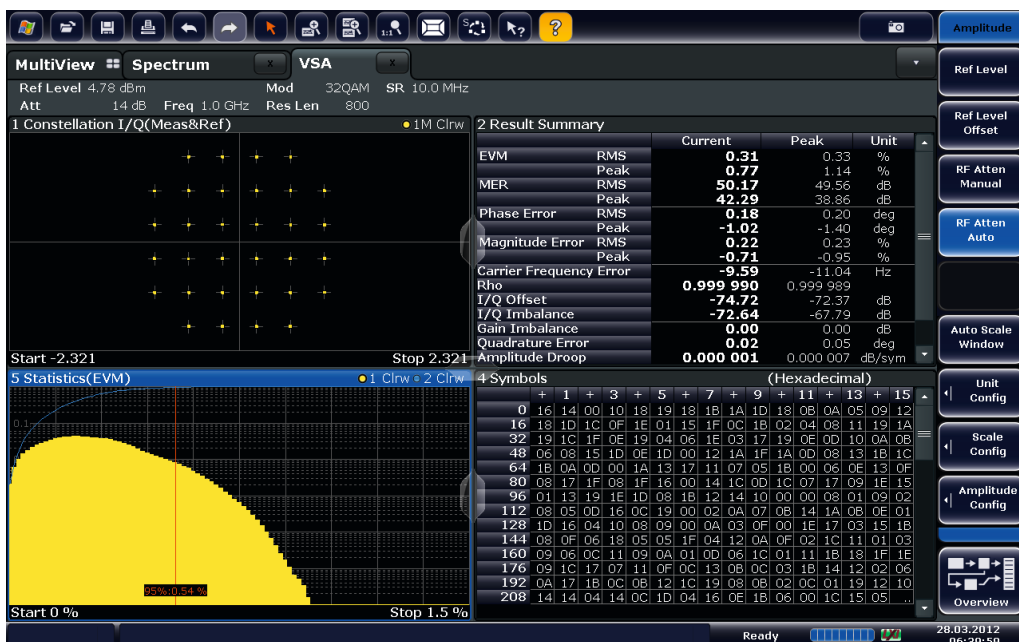
## Easy operation with graphical support

The visualization of the demodulation stages and the associated settings is so clear that even beginners and infrequent users can find the correct settings. The combination of touchscreen and block diagram simplifies operation and representation.

Based on the description of the signal to be analyzed (e.g. modulation format, continuous or with bursts, symbol rate, transmit filtering), the R&S®FSW-K70 option supports users in automatically finding useful settings.

## Flexible analysis tools for detailed signal analysis make troubleshooting really easy

- Display choices for amplitude, frequency, phase, I/Q, eye diagram; amplitude, phase or frequency error; constellation or vector diagram
- Analysis of RF signals or analog and digital baseband signals
- Statistical evaluations
  - Histogram representation
  - Standard deviation and 95th percentile in the result summary
- Spectrum analyses of the measurement and error signal considerably support users in finding signal errors such as incorrect filtering or spurious
- Flexible burst search for the analysis of complex signal combinations, short bursts or signal mix – capabilities that go beyond the scope of many signal analyzers
- Bit error calculation on known data sequences
- Equalizer helps in finding the optimum filter design
- Multicarrier filter for measuring under conditions where several signals are present



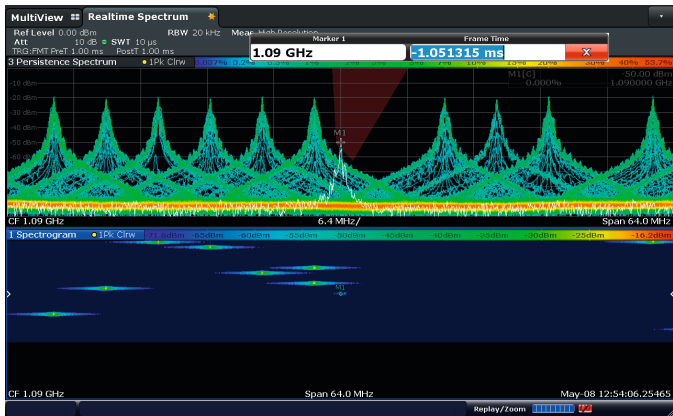
32QAM with four screens.

# R&S®FSW-K160R

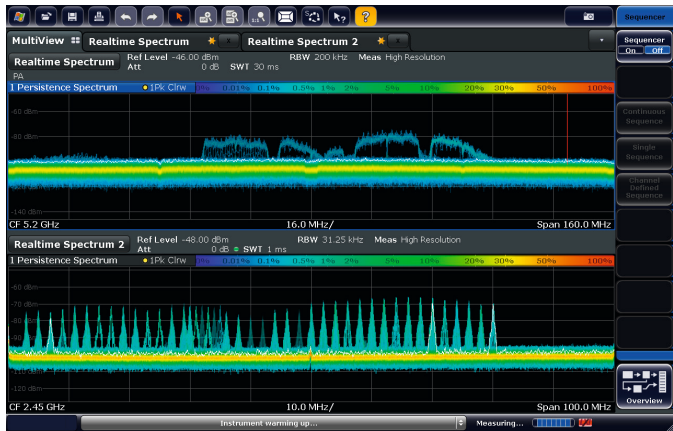
## option

## Realtime analysis

Using the frequency mask trigger (FMT) function, an identification friend or foe (IFF) signal can be detected in the hopping spectrum of a frequency-agile communications system.



Using the MultiView function of the R&S®FSW, the persistence spectra for the 2.4 GHz and 5.8 GHz ISM radio bands can be displayed simultaneously.



Equipped with the R&S®FSW-K160R 160 MHz realtime spectrum analyzer option, the R&S®FSW displays RF spectra seamlessly and in realtime. With nearly 600 000 spectra generated per second, the FFT windows overlap by 67% or more in the time domain even at an analysis bandwidth of 160 MHz. This is essential in order to measure the level correctly, mitigate signal loss at the edges of the FFT windows, and provide higher time resolution.

For visual assessment, the R&S®FSW with the R&S®FSW-K160R offers a realtime spectrogram in addition to the instantaneous spectrum and, in persistence mode, a realtime spectrum with the signal amplitudes shown in different colors according to their frequency of occurrence (persistence spectrum). Frequency-dependent masks help the user reliably detect sporadic signals in the spectrum, as the R&S®FSW will activate a trigger whenever a spectrum violates a mask. While realtime analysis functionality previously required an extra device, it can now be provided by simply configuring or retrofitting the R&S®FSW signal and spectrum analyzer with the R&S®FSW-K160R option. The R&S®FSW-K160R option adds realtime analysis capability to the full-featured R&S®FSW signal and spectrum analyzer.

The R&S®FSW-K160R measurement application helps RF design engineers detect short and sporadic interference signals and identify their causes (e.g. interference originating from digital circuits or produced during synthesizer frequency switching). Seamless spectrum display is necessary, for example, to analyze existing frequency-hopping algorithms and create alternative ones to prevent collisions between signals of different standards operating in the same frequency band (e.g. WLAN and Bluetooth®). Aerospace and defense (A&D) engineers will primarily focus on seamlessly analyzing frequency-agile radar signals and detecting unwanted spurious emissions. They will also find the R&S®FSW an attractive instrument when validating tactical, frequency-agile communications systems.

Regulatory authorities also need to seamlessly monitor frequency bands and reliably detect unwanted or unlicensed signals. The R&S®FSW with the R&S®FSW-K160R realtime spectrum analyzer option meets this challenge.

Key parameters in realtime analysis	
FFT length	selectable from 32 to 16k
Realtime analysis bandwidth	up to 160 MHz
Signal duration for 100% POI	1.87 µs
FFT rate	max. 585 938 FFT/s

# Other general purpose measurement applications

Measurement application	Measurement parameters	Measurement functions	Remarks
<b>R&amp;S®FSW-K6</b> Pulse measurement	<ul style="list-style-type: none"> <li>Pulse parameters: pulse width, pulse repetition rate, pulse repetition interval, duty cycle, rise/fall time, settling time</li> <li>Frequency: carrier frequency, pulse-to-pulse frequency difference, chirp rate, frequency deviation, frequency error</li> <li>Power: peak power, average power, peak-to-average power, pulse-to-pulse power</li> <li>Phase: carrier phase, pulse-to-pulse phase difference, phase deviation, phase error</li> <li>Amplitude droop, ripple, overshoot width</li> </ul>	<ul style="list-style-type: none"> <li>Point-in-pulse measurements: frequency, amplitude, phase versus pulse, trends and histograms for all parameters</li> <li>Pulse statistics: standard deviation, average, maximum, minimum</li> <li>Pulse tables</li> <li>User-defined measurement parameters</li> </ul>	
<b>R&amp;S®FSW-K7</b> Modulation analysis for AM/FM/φM modulated single carriers	<ul style="list-style-type: none"> <li>Modulation depth (AM)</li> <li>Frequency deviation (FM)</li> <li>Phase deviation (φM)</li> <li>Modulation frequency</li> <li>THD and SINAD</li> <li>Carrier power</li> </ul>	<ul style="list-style-type: none"> <li>AF spectrum</li> <li>RF spectrum</li> <li>AF scope display</li> <li>AF filters (lowpass and highpass)</li> <li>Weighting filters (CCITT)</li> <li>Squelch</li> </ul>	
<b>R&amp;S®FSW-K17</b> Multicarrier group delay measurements	<ul style="list-style-type: none"> <li>Group delay (absolute and relative)</li> <li>Magnitude</li> <li>Phase</li> </ul>	<ul style="list-style-type: none"> <li>Up to 160 MHz signal capture bandwidth</li> <li>Calibration (load and save calibration data) for measurement of components and frequency converters</li> <li>Configurable multicarrier scenarios</li> </ul>	
<b>R&amp;S®FSW-K30</b> Noise figure and gain measurements based on Y-factor method	<ul style="list-style-type: none"> <li>Noise figure</li> <li>Noise temperature</li> <li>Gain</li> <li>Y factor</li> </ul>	<ul style="list-style-type: none"> <li>Analyzer noise correction (2nd stage correction)</li> <li>Measurements on frequency-converting DUTs</li> <li>Control of a generator as an LO in frequency-converting measurements</li> <li>SSB and DSB</li> </ul>	Requires external noise source, e.g. Noisecom NC346
<b>R&amp;S®FSW-K40</b> Phase noise measurements	<ul style="list-style-type: none"> <li>SSB phase noise</li> <li>Residual FM and residual φM</li> <li>Jitter</li> </ul>	<ul style="list-style-type: none"> <li>1 Hz to 10 GHz offset range</li> <li>Selection of resolution bandwidth and number of averages for each offset range</li> <li>Definable evaluation ranges for residual FM/φM</li> <li>Signal tracking</li> <li>Optional suppression of spurious emissions</li> </ul>	
<b>R&amp;S®FSW-K54</b> EMC diagnosis and precompliance measurements in line with commercial and military standards	<ul style="list-style-type: none"> <li>Disturbance voltage</li> <li>Disturbance power</li> <li>Disturbance radiation</li> </ul>	<ul style="list-style-type: none"> <li>Detectors and resolution bandwidths in line with CISPR 16-1-1 and MIL-STD/DO160</li> <li>Up to 16 independent measurement markers; linkable to various EMI detectors and measurement times</li> <li>Limit lines and correction factors for typical measurement tasks</li> <li>Choice of linear or logarithmic scale on frequency axis</li> <li>Marker demodulation (AM/FM) for signal identification</li> </ul>	
<b>R&amp;S®FSW-K60/-K60C/-K60H</b> Transient analysis	<ul style="list-style-type: none"> <li>Frequency-hopping signals: dwell time, settling time, switching time, frequency offset, power</li> <li>Chirp linearity: frequency deviation</li> </ul>	<ul style="list-style-type: none"> <li>Spectrogram and section of the spectrogram, tabular display, frequency, frequency error, phase and amplitude versus time, FFT spectrum</li> </ul>	

# Measurement applications for wireless communications systems

Measurement application/technology	Power	Modulation quality	Spectrum measurements	Miscellaneous	Special features
<b>R&amp;S®FSW-K10</b> GSM/EDGE/ EDGE Evolution	<ul style="list-style-type: none"> <li>Power measurement in time domain including carrier power</li> </ul>	<ul style="list-style-type: none"> <li>EVM</li> <li>Phase/frequency error</li> <li>Origin offset suppression</li> <li>Constellation diagram</li> </ul>	<ul style="list-style-type: none"> <li>Modulation spectrum</li> <li>Transient spectrum</li> </ul>	–	<ul style="list-style-type: none"> <li>Single burst and multi burst</li> <li>Automatic detection of modulation</li> </ul>
<b>R&amp;S®FSW-K72/-K73</b> 3GPP FDD (WCDMA)	<ul style="list-style-type: none"> <li>Code domain power</li> <li>Code domain power versus time</li> <li>CCDF</li> </ul>	<ul style="list-style-type: none"> <li>EVM</li> <li>Peak code domain error</li> <li>Constellation diagram</li> <li>I/Q offset</li> <li>Residual code domain error</li> <li>I/Q imbalance</li> <li>Gain imbalance</li> <li>Center frequency error (chip rate error)</li> </ul>	<ul style="list-style-type: none"> <li>Spectrum mask</li> <li>ACLR</li> <li>Power measurement</li> </ul>	<ul style="list-style-type: none"> <li>Channel table with channels used on base station</li> <li>Timing offset</li> <li>Power versus time</li> </ul>	<ul style="list-style-type: none"> <li>Automatic detection of active channels and decoding of useful information</li> <li>Automatic detection of encryption code</li> <li>Automatic detection of HSDPA modulation format</li> <li>Support of compressed mode signals</li> <li>Support of HSPA and HSPA+ (HSDPA+ and HSUPA+)</li> </ul>
<b>R&amp;S®FSW-K76/-K77</b> TD-SCDMA	<ul style="list-style-type: none"> <li>Code domain power</li> <li>Code domain power versus time</li> <li>CCDF</li> </ul>	<ul style="list-style-type: none"> <li>EVM</li> <li>Peak code domain error</li> <li>Constellation diagram</li> <li>I/Q offset</li> <li>Residual code domain error</li> <li>Gain imbalance</li> <li>Center frequency error (chip rate error)</li> </ul>	<ul style="list-style-type: none"> <li>Spectrum mask</li> <li>ACLR</li> <li>Power measurement</li> </ul>	<ul style="list-style-type: none"> <li>Channel table with channels used on base station</li> <li>Timing offset</li> <li>Power versus time</li> </ul>	<ul style="list-style-type: none"> <li>Automatic detection of active channels and decoding of useful information</li> <li>Automatic detection of HSDPA modulation format</li> <li>Support of HSPA+ (HSDPA+ and HSUPA+)</li> </ul>
<b>R&amp;S®FSW-K82/-K83</b> CDMA2000®	<ul style="list-style-type: none"> <li>Carrier power</li> <li>Code domain power</li> <li>Code domain power versus time</li> <li>CCDF</li> </ul>	<ul style="list-style-type: none"> <li>RHO</li> <li>EVM</li> <li>Constellation diagram</li> <li>I/Q offset</li> <li>I/Q imbalance</li> <li>Center frequency error</li> </ul>	<ul style="list-style-type: none"> <li>Spectrum mask</li> <li>ACLR</li> <li>Power measurement</li> </ul>	<ul style="list-style-type: none"> <li>Channel table with summary of channels used on base station</li> <li>Timing offset</li> </ul>	<ul style="list-style-type: none"> <li>Automatic detection of active channels and decoding of user information</li> <li>Robust demodulation algorithms for reliable measurement of multicarrier signals</li> </ul>
<b>R&amp;S®FSW-K84/-K85</b> 1xEV-DO	<ul style="list-style-type: none"> <li>Carrier power</li> <li>Code domain power</li> <li>Code domain power versus time</li> <li>CCDF</li> </ul>	<ul style="list-style-type: none"> <li><math>RHO_{Pilot}</math> (R&amp;S®FSW-K84)</li> <li><math>RHO_{Data}</math> (R&amp;S®FSW-K84)</li> <li><math>RHO_{MAC}</math> (R&amp;S®FSW-K84)</li> <li><math>RHO_{Overall}</math></li> <li>EVM</li> <li>Constellation diagram</li> <li>I/Q offset</li> <li>I/Q imbalance</li> <li>Center frequency error</li> </ul>	<ul style="list-style-type: none"> <li>Spectrum mask</li> <li>ACLR</li> <li>Power measurement</li> </ul>	<ul style="list-style-type: none"> <li>Channel table with summary of channels used on base station</li> <li>Timing offset</li> </ul>	<ul style="list-style-type: none"> <li>Automatic detection of active channels and decoding of user information</li> <li>Robust demodulation algorithms for reliable measurement of multicarrier signals</li> </ul>

Measurement application/ technology	Power	Modulation quality	Spectrum measurements	Miscellaneous	Special features
<b>R&amp;S®FSW-K91</b> WLAN IEEE 802.11a <b>R&amp;S®FSW-K91P</b> WLAN IEEE 802.11p <b>R&amp;S®FSW-K91N</b> WLAN IEEE 802.11n <b>R&amp;S®FSW-K91AC</b> WLAN IEEE 802.11ac	<ul style="list-style-type: none"> <li>Power versus time</li> <li>Burst power</li> <li>Crest factor</li> </ul>	<ul style="list-style-type: none"> <li>EVM (pilot, data)</li> <li>EVM versus carrier</li> <li>EVM versus symbol</li> <li>Constellation diagram</li> <li>I/Q offset</li> <li>I/Q imbalance</li> <li>Gain imbalance</li> <li>Center frequency error</li> <li>Symbol clock error</li> <li>Group delay</li> </ul>	<ul style="list-style-type: none"> <li>Spectrum mask</li> <li>ACLR</li> <li>Power measurement</li> <li>Spectrum flatness</li> </ul>	<ul style="list-style-type: none"> <li>Bitsstream</li> <li>Signal field</li> <li>Constellation versus carrier</li> </ul>	<ul style="list-style-type: none"> <li>Automatic detection of burst type</li> <li>Automatic detection of MCS index</li> <li>Automatic detection of bandwidth</li> <li>Automatic detection of guard interval</li> <li>Estimation of payload length from burst</li> </ul>
<b>R&amp;S®FSW-K100/-K101/-K104/K-105</b> EUTRA/LTE TDD and FDD UL and DL	<ul style="list-style-type: none"> <li>Power measurement in time and frequency domains</li> <li>CCDF</li> </ul>	<ul style="list-style-type: none"> <li>EVM</li> <li>Constellation diagram</li> <li>I/Q offset</li> <li>Gain imbalance</li> <li>Quadrature error</li> <li>Center frequency error (symbol clock error)</li> </ul>	<ul style="list-style-type: none"> <li>Spectrum mask</li> <li>ACLR</li> <li>Power measurement</li> <li>Spectrum flatness</li> </ul>	<ul style="list-style-type: none"> <li>Bit stream</li> <li>Allocation summary list</li> <li>Averaging over multiple measurements</li> </ul>	<ul style="list-style-type: none"> <li>Automatic detection of modulation, cyclic prefix length and cell ID</li> </ul>
<b>R&amp;S®FSW-K102</b> EUTRA/LTE MIMO		<ul style="list-style-type: none"> <li>See R&amp;S®FSW-K100/-K104 modulation quality measurements for each individual MIMO path</li> </ul>			<ul style="list-style-type: none"> <li>MIMO time alignment for R&amp;S®FSW-K100/-K104</li> <li>Interband carrier aggregation time alignment</li> </ul>
<b>R&amp;S®FS-K100PC/-K101PC/-K102PC/-K103PC/-K104PC/-K105PC</b> LTE FDD, TDD and MIMO	<ul style="list-style-type: none"> <li>Power measurement in time and frequency domain</li> <li>CCDF</li> </ul>	<ul style="list-style-type: none"> <li>EVM</li> <li>Constellation diagram</li> <li>I/Q offset</li> <li>Gain imbalance</li> <li>Quadrature error</li> <li>Center frequency error (symbol clock error)</li> </ul>	<ul style="list-style-type: none"> <li>Power spectrum</li> <li>ACLR</li> <li>Spectrum mask</li> <li>Spectrum flatness</li> </ul>	<ul style="list-style-type: none"> <li>Bit stream</li> <li>Allocation summary list</li> <li>Signal flow diagram</li> <li>Averaging over multiple measurements</li> </ul>	<ul style="list-style-type: none"> <li>Automatic detection of modulation, cyclic prefix length and cell ID</li> <li>MIMO measurements (R&amp;S®FS-K102PC/-K103PC)</li> <li>Windows based analysis software, to be installed on the R&amp;S®FSW or a separate PC</li> </ul>

# Specifications in brief

Specifications in brief		
<b>Frequency</b>		
Frequency range	R&S®FSW8	2 Hz to 8 GHz
	R&S®FSW13	2 Hz to 13.6 GHz
	R&S®FSW26	2 Hz to 26.5 GHz
	R&S®FSW43	2 Hz to 43.5 GHz
	R&S®FSW50	2 Hz to 50 GHz
	R&S®FSW67	2 Hz to 67 GHz
Aging of frequency reference		$1 \times 10^{-7}$ /year
	with R&S®FSW-B4 option	$3 \times 10^{-8}$ /year
<b>Bandwidths</b>		
Resolution bandwidths	standard filter	1 Hz to 10 MHz, 80 MHz (with R&S®FSW-B8 option)
	RRC filter	18 kHz (NADC), 24.3 kHz (TETRA), 3.84 MHz (3GPP)
	channel filter	100 Hz to 5 MHz
	video filter	1 Hz to 10 MHz
I/Q demodulation bandwidth		10 MHz
	with R&S®FSW-B28 option	28 MHz
	with R&S®FSW-B40 option	40 MHz
	with R&S®FSW-B80 option	80 MHz
	with R&S®FSW-B160 option	160 MHz
	with R&S®FSW-B320 option	320 MHz
	with R&S®FSW-B500 option	500 MHz
<b>Displayed average noise level (DANL)</b>	2 GHz	-156 dBm (1 Hz) (typ.)
	with R&S®FSW-B13 option	-159 dBm (1 Hz) (typ.)
	8 GHz	-156 dBm (1 Hz) (typ.)
	20 GHz	-150 dBm (1 Hz) (typ.)
	40 GHz	-144 dBm (1 Hz) (typ.)
DANL with preamplifier (R&S®FSW-B24 option)	8 GHz	-169 dBm (1 Hz) (typ.)
	20 GHz	-166 dBm (1 Hz) (typ.)
	40 GHz	-165 dBm (1 Hz) (typ.)
DANL with noise cancellation, preamplifier off, 2 GHz		-169 dBm (1 Hz) (typ.)
<b>Intermodulation</b>		
Third-order intercept (TOI)	$f < 1$ GHz	+30 dBm (typ.)
	$f < 3$ GHz	+25 dBm (typ.)
	8 GHz to 26 GHz	+17 dBm (typ.)
	13.6 GHz to 40 GHz	+15 dBm (typ.)
<b>WCDMA ACLR dynamic range</b>	with noise cancellation	88 dB
<b>Phase noise</b>		
10 kHz offset from carrier	500 MHz carrier	-140 dBc (1 Hz) (typ.)
	1 GHz carrier	-137 dBc (1 Hz) (typ.)
	10 GHz carrier	-128 dBc (1 Hz) (typ.)
<b>Total measurement uncertainty</b>	8 GHz	< 0.4 dB

For data sheet, see PD 5214.5984.22 and [www.rohde-schwarz.com](http://www.rohde-schwarz.com)



# Ordering information

Designation	Type	Order No.
<b>Base unit</b>		
Signal and Spectrum Analyzer, 2 Hz to 8 GHz	R&S®FSW8	1312.8000K08
Signal and Spectrum Analyzer, 2 Hz to 13.6 GHz	R&S®FSW13	1312.8000K13
Signal and Spectrum Analyzer, 2 Hz to 26.5 GHz	R&S®FSW26	1312.8000K26
Signal and Spectrum Analyzer, 2 Hz to 43.5 GHz	R&S®FSW43	1312.8000K43
Signal and Spectrum Analyzer, 2 Hz to 50 GHz	R&S®FSW50	1312.8000K50
Signal and Spectrum Analyzer, 2 Hz to 67 GHz	R&S®FSW67	1312.8000K67
<b>Hardware options</b>		
OCXO Precision Reference Frequency	R&S®FSW-B4	1313.0703.02
Resolution Bandwidths > 10 MHz (for R&S®FSW8/13/26)	R&S®FSW-B8	1313.2464.26
Resolution Bandwidths > 10 MHz (for R&S®FSW43/50/67) <sup>1)</sup>	R&S®FSW-B8	1313.2464.02
External Generator Control	R&S®FSW-B10	1313.1622.02
Highpass Filters for Harmonic Measurements	R&S®FSW-B13	1313.0761.02
Digital Baseband Interface	R&S®FSW-B17	1313.0784.02
Analog Baseband Inputs (for R&S®FSW8/13)	R&S®FSW-B71	1313.1651.13
Analog Baseband Inputs (for R&S®FSW26/43/50)	R&S®FSW-B71	1313.1651.26
Analog Baseband Inputs (for R&S®FSW67)	R&S®FSW-B71	1313.1651.67
80 MHz Bandwidth for Analog Baseband Inputs	R&S®FSW-B71E	1313.6547.02
Spare Solid State Disk (removable hard drive)	R&S®FSW-B18	1313.0790.02/1.06
LO/IF Ports for External Mixers (for R&S®FSW26)	R&S®FSW-B21	1313.1100.26
LO/IF Ports for External Mixers (for R&S®FSW43/50/67)	R&S®FSW-B21	1313.1100.43
Preamplifier, 100 kHz to 8 GHz/13 GHz (for R&S®FSW8/13)	R&S®FSW-B24	1313.0832.13
Preamplifier, 100 kHz to 26 GHz (for R&S®FSW26)	R&S®FSW-B24	1313.0832.26
Preamplifier, 100 kHz to 43 GHz (for R&S®FSW43/50/67)	R&S®FSW-B24	1313.0832.43
Preamplifier, 100 kHz to 50 GHz (for R&S®FSW50)	R&S®FSW-B24	1313.0832.49
Preamplifier, 100 kHz to 50 GHz (for R&S®FSW50) <sup>1)</sup>	R&S®FSW-B24	1313.0832.51
Preamplifier, 100 kHz to 67 GHz (for R&S®FSW67) <sup>1)</sup>	R&S®FSW-B24	1313.0832.67
Electronic Attenuator, 1 dB steps	R&S®FSW-B25	1313.0990.02
USB Mass Memory Write Protection	R&S®FSW-B33	1313.3602.02
28 MHz Analysis Bandwidth	R&S®FSW-B28	1313.1645.02
40 MHz Analysis Bandwidth	R&S®FSW-B40	1313.0861.02
80 MHz Analysis Bandwidth	R&S®FSW-B80	1313.0878.02
160 MHz Analysis Bandwidth	R&S®FSW-B160	1313.1668.02
320 MHz Analysis Bandwidth	R&S®FSW-B320	1313.7172.02
500 MHz Analysis Bandwidth <sup>2)</sup>	R&S®FSW-B500	1313.4296.02
<b>Firmware/software</b>		
Pulse Measurements	R&S®FSW-K6	1313.1322.02
Analog Modulation Analysis AM/FM/φM	R&S®FSW-K7	1313.1339.02
GSM, EDGE, EDGE Evolution and VAMOS Measurements	R&S®FSW-K10	1313.1368.02
Multicarrier Group Delay Measurements	R&S®FSW-K17	1313.4150.02
Noise Figure Measurements	R&S®FSW-K30	1313.1380.02
Phase Noise Measurements	R&S®FSW-K40	1313.1397.02
EMI Measurements	R&S®FSW-K54	1313.1400.02
Transient Measurement Application	R&S®FSW-K60	1313.7495.02
Transient Chirp Measurement <sup>3)</sup>	R&S®FSW-K60C	1322.9745.02
Transient Hop Measurement <sup>3)</sup>	R&S®FSW-K60H	1322.9916.02
Vector Signal Analysis	R&S®FSW-K70	1313.1416.02
3GPP FDD (WCDMA) BS Measurements (incl. HSDPA and HSDPA+)	R&S®FSW-K72	1313.1422.02
3GPP FDD (WCDMA) MS Measurements (incl. HSUPA and HSUPA+)	R&S®FSW-K73	1313.1439.02
3GPP TDD (TD-SCDMA) BS Measurements	R&S®FSW-K76	1313.1445.02
3GPP TDD (TD-SCDMA) UE Measurements	R&S®FSW-K77	1313.1451.02

Designation	Type	Order No.
CDMA2000® BS Measurements	R&S®FSW-K82	1313.1468.02
CDMA2000® MS Measurements	R&S®FSW-K83	1313.1474.02
1xEV-DO BS Measurements	R&S®FSW-K84	1313.1480.02
1xEV-DO MS Measurements	R&S®FSW-K85	1313.1497.02
IEEE802.11a/b/g Measurements	R&S®FSW-K91	1313.1500.02
IEEE802.11p Measurements	R&S®FSW-K91P	1321.5646.02
IEEE802.11n Measurements	R&S®FSW-K91N	1313.1516.02
IEEE802.11ac Measurements	R&S®FSW-K91AC	1313.4209.02
EUTRA/LTE FDD BS Measurements	R&S®FSW-K100	1313.1545.02
EUTRA/LTE FDD UE Measurements	R&S®FSW-K101	1313.1551.02
EUTRA/LTE BS MIMO Measurements	R&S®FSW-K102	1313.1568.02
EUTRA/LTE TDD BS Measurements	R&S®FSW-K104	1313.1574.02
EUTRA/LTE TDD UE Measurements	R&S®FSW-K105	1313.1580.02
OFDM Vector Signal Analysis Software	R&S®FS-K96	1310.0202.06
OFDM Vector Signal Analysis Software	R&S®FS-K96PC	1310.0219.06
EUTRA/LTE FDD Downlink PC Software	R&S®FS-K100PC	1309.9916.06
EUTRA/LTE Uplink FDD PC Software	R&S®FS-K101PC	1309.9922.06
EUTRA/LTE Downlink MIMO PC Software (incl. LTE-Advanced)	R&S®FS-K102PC	1309.9939.06
EUTRA/LTE Uplink MIMO PC Software (incl. LTE-Advanced)	R&S®FS-K103PC	1309.9945.06
EUTRA/LTE TDD Downlink PC Software	R&S®FS-K104PC	1309.9951.06
EUTRA/LTE TDD Uplink PC Software	R&S®FS-K105PC	1309.9968.06
Distortion Analysis PC Software	R&S®FS-K130PC	1310.0090.06
160 MHz Real-Time Spectrum Analyzer <sup>4)</sup>	R&S®FSW-K160R	1313.5340.02
Analysis Bandwidth Upgrade from 28 MHz to 40 MHz	R&S®FSW-U40	1313.5205.02
Analysis Bandwidth Upgrade from 40 MHz to 80 MHz	R&S®FSW-U80	1313.5211.02
Analysis Bandwidth Upgrade from 80 MHz to 160 MHz	R&S®FSW-U160	1313.3754.02
Analysis Bandwidth Upgrade from 160 MHz to 320 MHz	R&S®FSW-U320	1313.7189.02
Analysis Bandwidth Upgrade from 80 MHz to 500 MHz <sup>2)</sup>	R&S®FSW-U500	1321.6320.02

<sup>1)</sup> Export license required.

<sup>2)</sup> Not available together with the R&S®FSW-U160, R&S®FSW-B160, R&S®FSW-B320 and R&S®FSW-K160R options.

<sup>3)</sup> Requires R&S®FSW-K60.

<sup>4)</sup> Requires R&S®FSW-B160.

Service options		
Extended Warranty, one year	R&S®WE1	Please contact your local Rohde&Schwarz sales office.
Extended Warranty, two years	R&S®WE2	
Extended Warranty, three years	R&S®WE3	
Extended Warranty, four years	R&S®WE4	
Extended Warranty with Calibration Coverage, one year	R&S®CW1	
Extended Warranty with Calibration Coverage, two years	R&S®CW2	
Extended Warranty with Calibration Coverage, three years	R&S®CW3	
Extended Warranty with Calibration Coverage, four years	R&S®CW4	

Your local Rohde&Schwarz expert will help you determine the optimum solution for your requirements. To find your nearest Rohde&Schwarz representative, visit [www.sales.rohde-schwarz.com](http://www.sales.rohde-schwarz.com)

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**ISO 9001**

Certified Environmental Management

**ISO 14001**

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R&S®FSW Signal and Spectrum Analyzer

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