R&S®FSW
Signal and Spectrum Analyzer
Setting standards in RF performance and usability

ROHDE&SCHWARZ

Test & Measurement

Product Brochure | 18.01

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 as well as 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 2 GHz 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 8/13.6/26.5/43.5/50/67/85 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 2 GHz analysis bandwidth
- < 0.4 dB total measurement uncertainty up to 8 GHz
- Real-time analysis up to 512 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
- Ultrawideband filters in sweep mode

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Ready for the future

- Up to 2 GHz analysis bandwidth
- High spurious-free dynamic range of > 100 dBc
- Large I/Q memory depth for seamless recording of long signal sequences

▷ page 6

Designed for convenience – with straightforward result display

- Efficient operation thanks to optimized user guidance
- MultiView: multiple results available at a glance
- Optimum configuration and combination of measurement applications

▷ page 9

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

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Identifying interaction between signals

- Multistandard radio analyzer (MSRA)
- Multistandard real-time analyzer (MSRT)

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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 measurement data confidential

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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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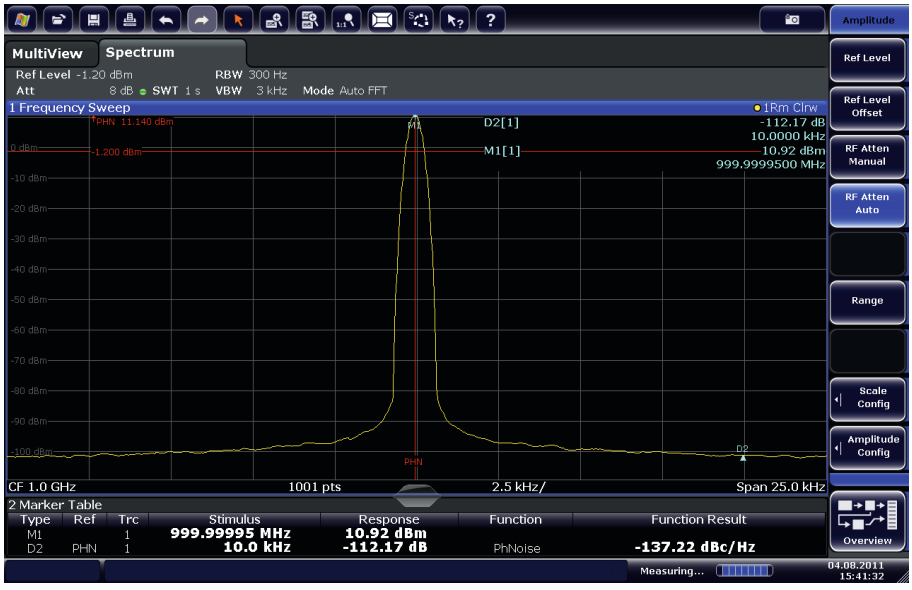
RF performance that meets exacting demands

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 analyzer'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 switched 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. 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 – 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 DANL of the R&S®FSW 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 radio systems for public safety and security.

Ultrawideband filters in sweep mode

UWB standards such as EN 302 065 call for a 50 MHz filter to be used in sweep mode for peak power measurements, a measurement easily performed with the R&S®FSW. With its optional resolution bandwidths of 28 MHz, 50 MHz and 80 MHz, the R&S®FSW offers unique possibilities for wideband signal testing.

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

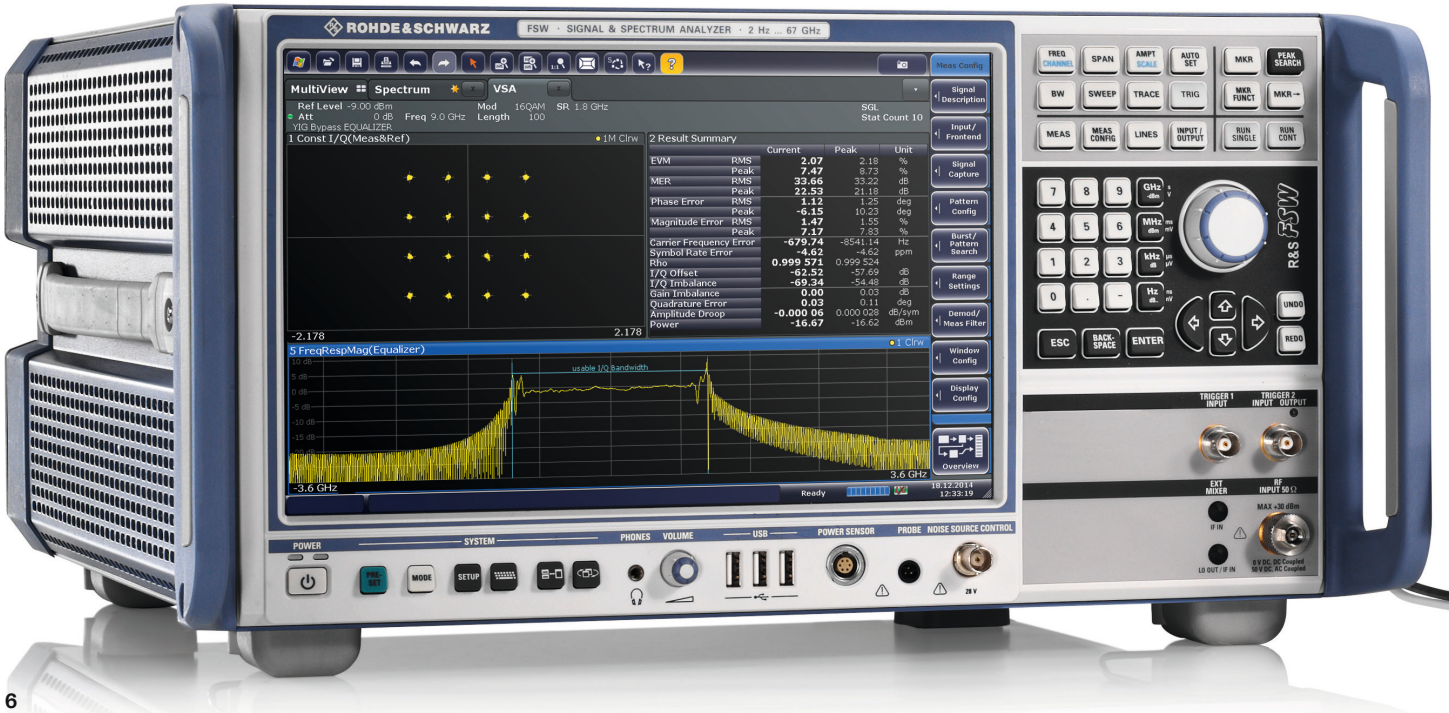
Ready for the future

Up to 2 GHz 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 2 GHz.

To perform ultrawideband measurements up to 2 GHz bandwidth, the R&S®FSW signal and spectrum analyzer can be combined with the R&S®FSW-B2000 analysis bandwidth option and the R&S®RTO1044 digital oscilloscope. The R&S®FSW downconverts the signal to an intermediate frequency of 2 GHz. The signal is then digitized by the R&S®RTO1044. The digital data is transferred to the R&S®FSW via LAN. Various R&S®FSW measurement applications are used to analyze the result. The entire signal path, from the spectrum analyzer's RF input to the oscilloscope's A/D converter, is characterized with respect to amplitude and phase response. The digital data from the oscilloscope is equalized and mixed to the digital baseband; the measurement applications receive equalized I/Q samples.

The connection between the R&S®RTO1044 and the R&S®FSW is completely transparent to the user. The R&S®FSW fully controls the R&S®RTO, transferring, processing and equalizing the digital data. For the user, there is no difference between using the measurement option and extending the bandwidth with an internal A/D converter.



Configuration	Maximum analysis bandwidth	Applications
Standard	10 MHz	▪ Standard applications and measurements on single carriers, e.g. WCDMA, CDMA2000®, TD-SCDMA, TETRA carriers
R&S®FSW-B28	28 MHz	▪ Modulation measurements on WiMAX™, LTE, WLAN IEEE 802.11a/b/g/p signals
R&S®FSW-B40	40 MHz	▪ Amplifier characterization and linearization ▪ Modulation measurements on WLAN IEEE 802.11n signals
R&S®FSW-B80	80 MHz	▪ Amplifier characterization and linearization ▪ Wideband pulse measurements ▪ Modulation measurements on WLAN IEEE 802.11ac signals
R&S®FSW-B160	160 MHz	▪ Amplifier characterization and linearization ▪ Wideband pulse measurements ▪ Modulation measurements on WLAN IEEE 802.11ac signals
R&S®FSW-B320	320 MHz	▪ Amplifier characterization and linearization ▪ Wideband pulse measurements
R&S®FSW-B512	512 MHz	▪ Amplifier characterization and linearization ▪ Wideband pulse measurements
R&S®FSW-B2000	2 GHz	▪ Modulation measurements on WLAN IEEE 802.11ad signals ▪ Wideband pulse measurements ▪ Wideband measurements on CW and frequency hopping radar systems ▪ Wideband modulation measurements for future wireless and satellite communications standards

Signal analysis up to 2 GHz with the R&S®FSW-B2000 analysis bandwidth option and an R&S®RTO1044 digital oscilloscope.

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 at 10 MHz, the R&S®FSW offers unprecedented accuracy when it comes to linearizing amplifiers or measuring EVM.

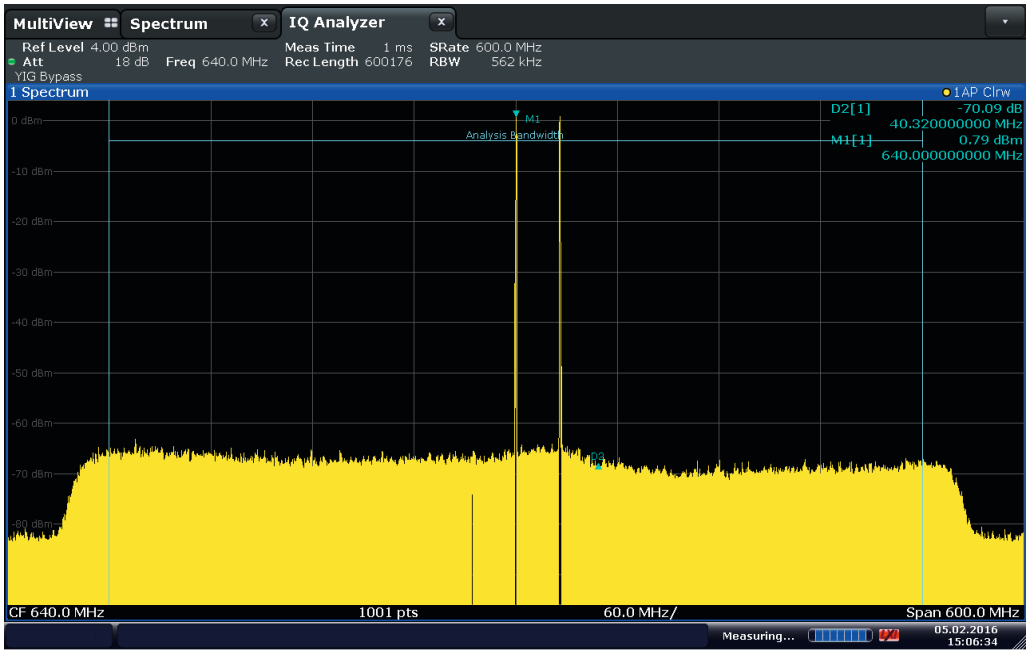
Large I/Q memory depth for seamless recording of long signal sequences

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.

Option	Analysis bandwidth	SFDR
Standard	10 MHz	100 dBc
R&S®FSW-B80	80 MHz	80 dBc
R&S®FSW-B160	160 MHz	78 dBc
R&S®FSW-B320	320 MHz	72 dBc
R&S®FSW-B512 [1)]	512 MHz	70 dBc
R&S®FSW-B2000 [2)]	2 GHz	45 dBc

[1)] Not available together with the R&S®FSW-U160, R&S®FSW-B160, R&S®FSW-U320, R&S®FSW-B320, R&S®FSW-U160R and R&S®FSW-B160R options.
[2)] R&S®RTO1044 digital oscilloscope required. Not available for the R&S®FSW8 and R&S®FSW13.

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
512 MHz	600 Msample/s	0.76 s
2 GHz	2.5 Gsample/s	79 ms



Third-order intermodulation distortion (IM3) of < –70 dBc, measured with the R&S®FSW-B512 option.

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 thanks to 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.

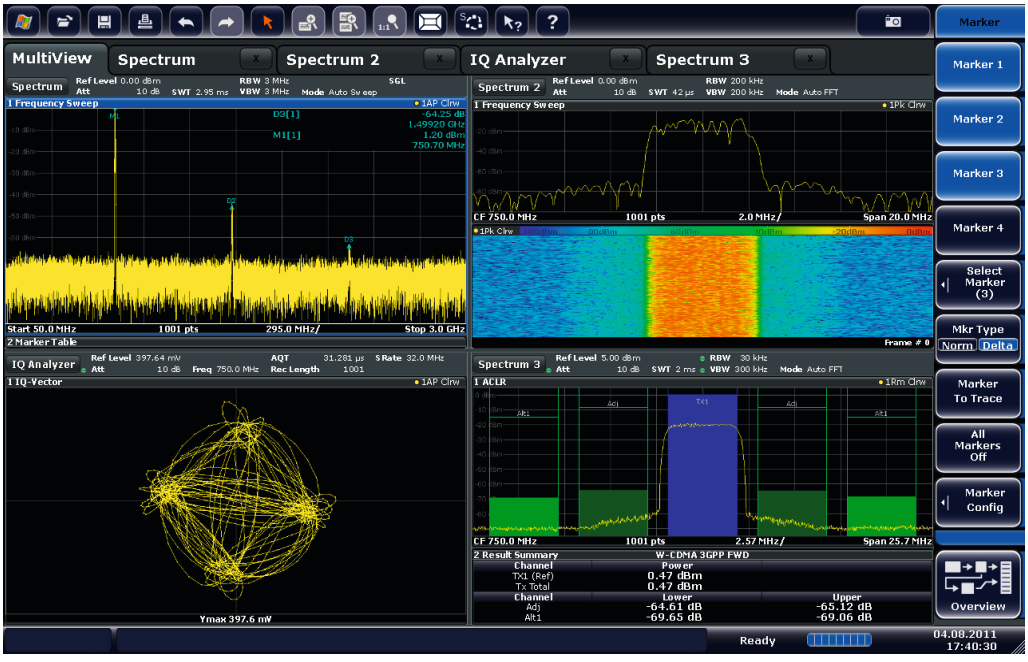
Frequently used control functions are assigned to hardkeys. Via a toolbar, users can quickly access global functions, such as the zoom function or the storage function for saving measurement data and screen content.

MultiView: multiple results available at a glance

The MultiView function enables the user to display multiple results simultaneously on the 12.1" touchscreen of the R&S®FSW.

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.

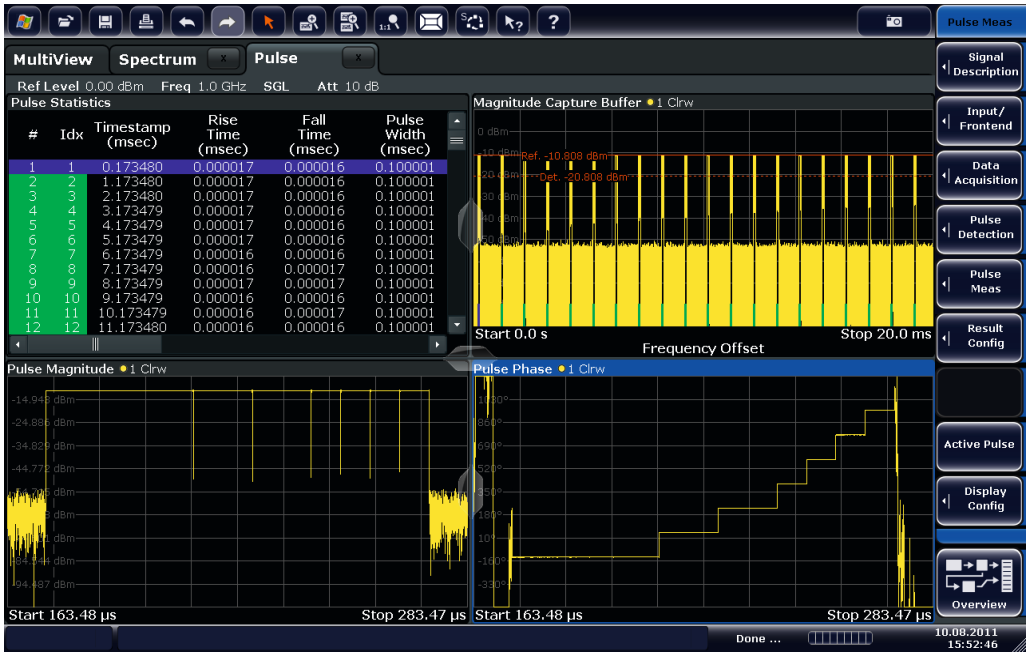
Ideal for analyzing radar systems

Rapid identification of spurious emissions, 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.



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

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 delivers a full picture of a radar system within seconds.

The R&S®FSW-K6 option can be upgraded with the R&S®FSW-K6S option to automatically measure the compression parameters of modulated pulses. Results such as the mainlobe vs. sidelobe level and the time differences between the mainlobe and the sidelobes are displayed in the results summary table. The user can upload reference pulse waveforms in I/Q format and compare phase and frequency within a pulse with the measured values.

The R&S®FSW-K6 option offers especially efficient memory management for analyzing trends over very long periods. The Segmented I/Q Capture function ensures that I/Q data is only timestamped and stored in memory when a pulse is detected. This feature significantly increases the analysis period – by nearly a factor of 1000 for pulse lengths less than 1 µs and a 1 kHz pulse repetition interval.

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 nonpulsed 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).

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 according 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 multistandard radio analyzer (MSRA) function. The MSRA simultaneously measures signals of different standards (GSM, WCDMA, LTE, etc.) at different frequencies within its 512 MHz analysis bandwidth.

Multistandard real-time analyzer (MSRT)

The multistandard real-time 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 a transient analysis option (R&S®FSW-K60/-K60C/-K60H), 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 the R&S®FSU and R&S®FSQ, as well as those of other manufacturers' legacy 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 response of the R&S®FSW during a measurement sequence. Numerous successful reference projects with the R&S®FSV or R&S®FSU prove the efficiency of this replacement approach.

Firmware updates – always in step with new developments

R&S®FSW firmware updates can be downloaded from a USB flash drive or via LAN. Updates are available free of charge at www.rohde-schwarz.com

Keeping measurement data confidential

To keep their measurement data confidential, users can exchange the internal solid state disk (SSD) of the R&S®FSW 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 measurement 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) (meas.)
Remote measurement, average over 1000 sweeps	1001 sweep points	1.0 ms (1000/s) (meas.)
Remote measurement including data transfer via LAN		5 ms (200/s) (meas.)
Marker peak search		1.7 ms (meas.)
Setting of center frequency including data transfer	f ≤ 8 GHz	15 ms (meas.)
	f > 8 GHz	65 ms (meas.)

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 base units 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

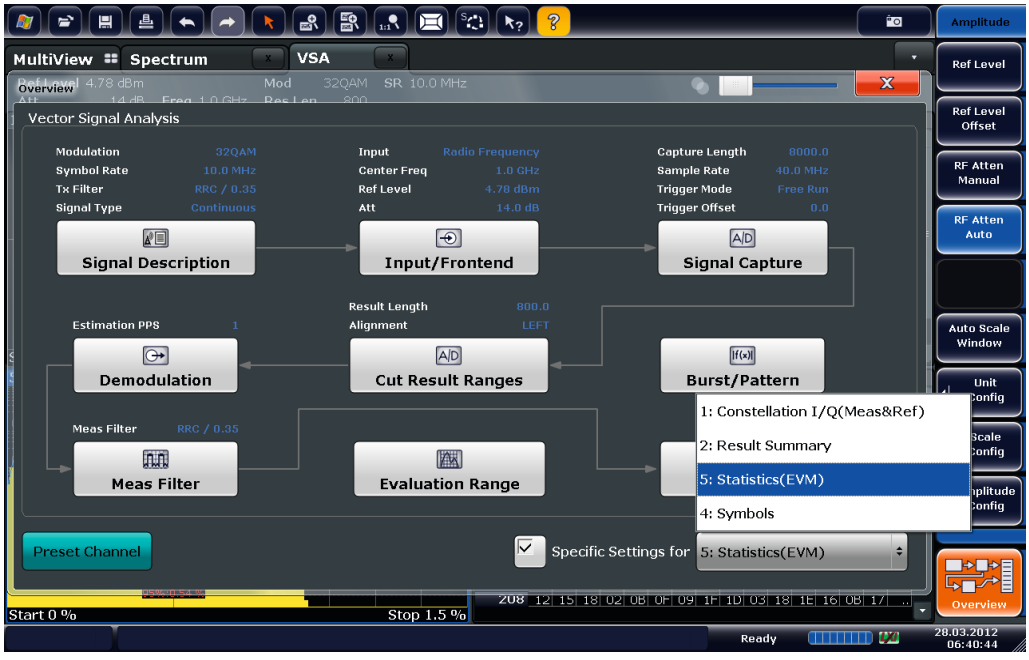
The R&S®FSW-K70 option enables users to flexibly analyze digitally modulated single carriers down to the bit level. The clearly structured operating concept simplifies measurements, despite the wide range of analysis tools.

Flexible modulation analysis from MSK to 4096QAM

- Modulation formats:
  - 2FSK, 4FSK
  - MSK, GMSK, DMSK
  - BPSK, QPSK, Offset-QPSK, DQPSK, 8PSK, D8PSK, π/4-DQPSK, 3π/8-8PSK, π/8-D8PSK
  - 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 512QAM, 1024QAM, 2048QAM, 4096QAM
  - 16APSK (DVB-S2), 32APSK (DVB-S2), 2ASK, 4ASK, π/4-16QAM (EDGE), –π/4-16QAM (EDGE), SOQPSK
- Analysis length up to 64 000 symbols
- 10 MHz signal analysis bandwidth (optionally 40/80/160/320/512 MHz and 2 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



Clearly structured block diagram display.

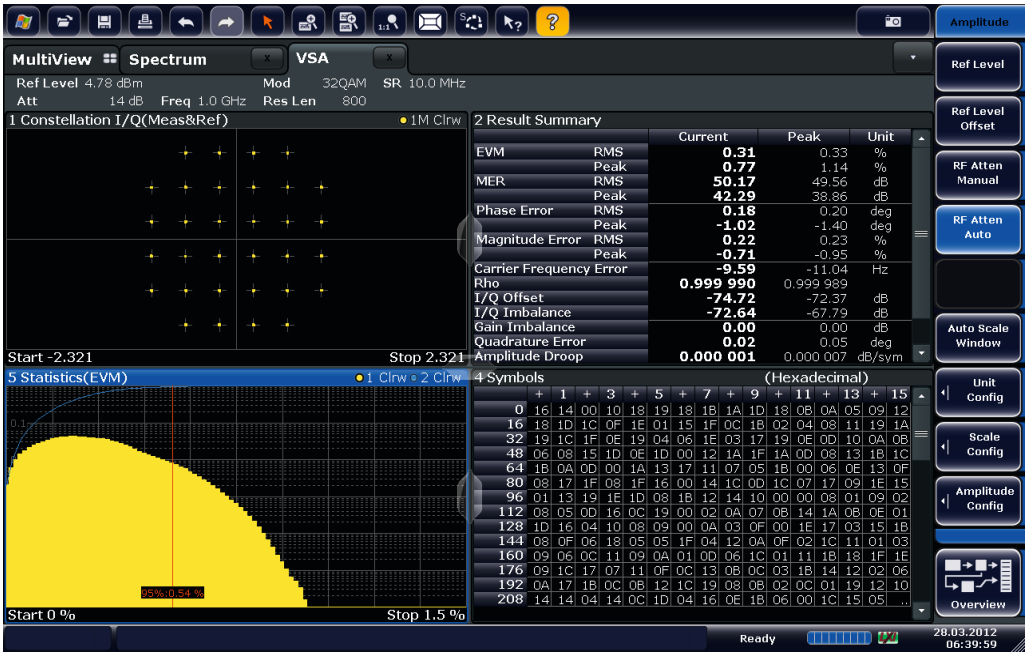
Easy operation with graphical support

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 helps users automatically find 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 emissions
- 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



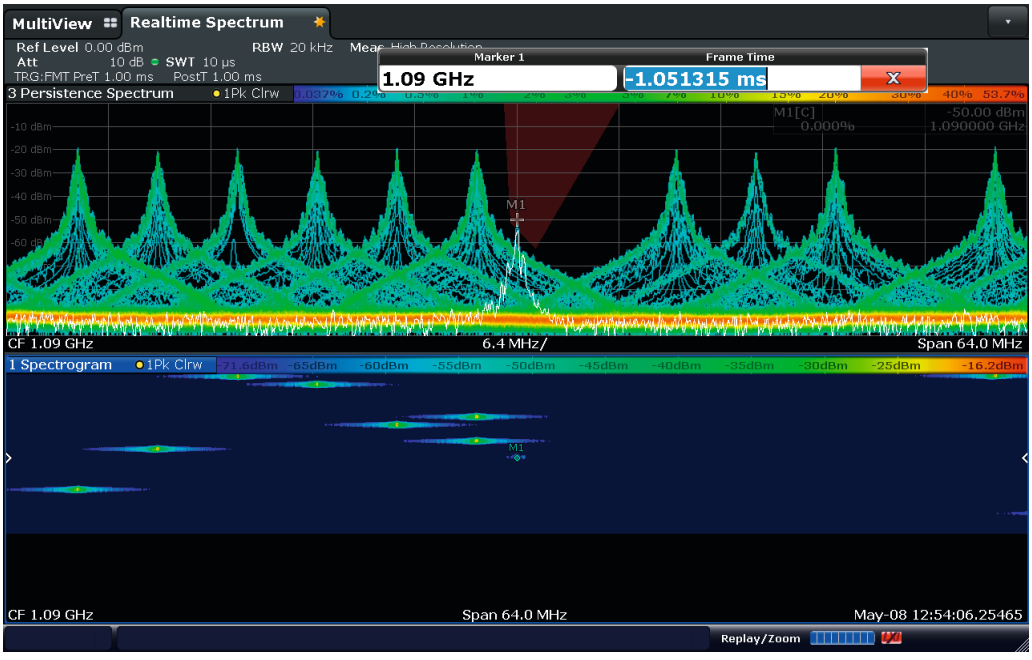
32QAM with four screens.

R&S®FSW-B160R/ -B512R option

Real-time spectrum analyzer

Equipped with the R&S®FSW-B512R/-B160R real-time spectrum analyzer option, the R&S®FSW displays RF spectra seamlessly and in real time. 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% overlap in the time domain (R&S®FSW-B160R) at an analysis bandwidth of 160 MHz. The maximum FFT rate of almost 1.2 million spectra/s allows 50% overlap at an analysis bandwidth of 512 MHz. For visual assessment, the R&S®FSW offers a real-time spectrogram in addition to the instantaneous spectrum and, in persistence mode, a real-time 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. These very rarely occurring sporadic signals produce negligible interference and only have a negative effect when they occur more frequently. The trigger can be adapted in a such a way that it only responds to a defined probability of occurrence and displays or records the spectral data only if a specific signal exceeds a defined occurrence frequency threshold.



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.

Without requiring extra equipment the R&S®FSW signal and spectrum analyzer can be configured or retrofitted for the detection of sporadic signals. The R&S®FSW-B160R or R&S®FSW-B512R option makes the R&S®FSW a full-featured signal and spectrum analyzer with built-in real-time analyzer.

The real-time spectrum analyzer included in the R&S®FSW-B160R/-B512R options 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 or 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 or 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-B160R or R&S®FSW-B512R real-time spectrum analyzer option meets this challenge.

When real-time analysis is required and only signals > 15 µs need to be fully and accurately detected, then the R&S®FSW-K160RE option can be installed alongside the R&S®FSW-B160 option.

Key parameters in real-time analysis

	R&S®FSW-B512R	R&S®FSW-B160R	R&S®FSW-K160RE [1]
FFT length	1024 to 32k	1024 to 16k	1024 to 16k
Max. real-time analysis bandwidth	512 MHz	160 MHz	160 MHz
Max. FFT rate	1 171 875	585 938	58 824
POI	0.91 µs	1.87 µs	> 15 µs
RBW freely configurable for Span/RBW ratio	6.25 to 6400	6.35 to 3200	6.25 to 3200

[1] Not available together with the R&S®FSW-B512 option. R&S®FSW-B160/-B320/-U160 or R&S®FSW-U320 option required.

The persistence spectra 512 MHz above the ISM band at 2.4 GHz and below can be simultaneously displayed thanks to the MultiView function of the R&S®FSW.

Other general purpose measurement applications

Measurement application	Measurement parameters	Measurement functions
R&S®FSW-K6 Pulse measurements	▮ Pulse parameters: pulse width, pulse repetition rate, pulse repetition interval, duty cycle, rise/fall time, settling 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	▮ 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
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) ▮ 30/9960 Hz AM modulation depth ▮ 30 Hz FM deviation (subcarrier) ▮ 30/9960 Hz AM/30 Hz FM: frequency, K2, K3, THD ▮ Identifier: modulation depth, frequency, code **ILS:** ▮ DDM, SDM ▮ 90/150 Hz AM modulation depth ▮ 90/150 Hz AM: frequency, K2, K3, THD, phase ▮ Identifier: modulation depth, frequency, code	▮ Reference measurements for calibrating navigation receivers ▮ Production test measurements of 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	▮ Up to 160 MHz signal capture bandwidth ▮ Calibration (load and save calibration data) for measurement of components and frequency converters ▮ Configurable multicarrier scenarios
R&S®FSW-K18 Amplifier measurements [1]	▮ 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	▮ General amplifier measurements ▮ Digital predistortion ▮ Control and synchronization of the R&S®SMW200A vector signal generator
R&S®FSW-K30 Noise figure and gain measurements based on Y-factor method [2]	▮ Noise figure ▮ Noise temperature ▮ Gain ▮ Y factor	▮ Analyzer noise correction (2nd stage correction) ▮ Measurements on frequency-converting DUTs ▮ Control of a generator as an LO in frequency-converting measurements ▮ SSB and DSB

Measurement application	Measurement parameters	Measurement functions
R&S®FSW-K40 Phase noise measurements	▮ SSB phase noise ▮ Residual FM and residual φM ▮ Jitter	▮ 1 Hz to 10 GHz offset range ▮ Selection of resolution bandwidth and number of averages for each offset range ▮ Definable evaluation ranges for residual FM/φM ▮ Signal tracking ▮ Optional suppression of spurious emissions
R&S®FSW-K54 EMC diagnosis and precompliance measurements in line with commercial and military standards	▮ Disturbance voltage ▮ Disturbance power ▮ Disturbance radiation	▮ Detectors and resolution bandwidths in line with CISPR 16-1-1 and MIL-STD/DO160 ▮ Up to 16 independent measurement markers; linkable to various EMI detectors and measurement times ▮ Limit lines and correction factors for typical measurement tasks ▮ Choice of linear or logarithmic scale on frequency axis ▮ Marker demodulation (AM/FM) for signal identification
R&S®FSW-K60/-K60C/-K60H Transient analysis	▮ Frequency hopping signals: dwell time, settling time, switching time, frequency offset, power ▮ Chirp linearity: frequency deviation	▮ Spectrogram and section of spectrogram, tabular display, frequency, frequency error, phase and amplitude versus time, FFT spectrum

[1] Requires the R&S®SMW200A vector signal generator.
[2] Requires an external noise source, e.g. Noisecom NC346.

Measurement applications for wireless and wire-connected communications systems

Measurement applications for wireless communications systems

Measurement application/ technology	Power	Modulation quality	Spectrum measurements	Miscellaneous	Special features
R&S®FSW-K10 GSM/EDGE/ EDGE Evolution	▪ Power measurement in time domain including carrier power	▪ EVM ▪ Phase/frequency error ▪ Origin offset suppression ▪ Constellation diagram	▪ Modulation spectrum ▪ Transient spectrum	–	▪ Single burst and multiburst ▪ Automatic detection of modulation
R&S®FSW-K72/-K73 3GPP FDD (WCDMA)	▪ Code domain power ▪ Code domain power versus time ▪ CCDF	▪ EVM ▪ Peak code domain error ▪ Constellation diagram ▪ I/Q offset ▪ Residual code domain error ▪ I/Q imbalance ▪ Gain imbalance ▪ Center frequency error (chip rate error)	▪ Spectrum mask ▪ ACLR ▪ Power measurement	▪ Channel table with channels used on base station ▪ Timing offset ▪ Power versus time	▪ Automatic detection of active channels and decoding of useful information ▪ Automatic detection of encryption code ▪ Automatic detection of HSDPA modulation format ▪ Support of compressed mode signals ▪ Support of HSPA and HSPA+ (HSDPA+ and HSUPA+)
R&S®FSW-K76/-K77 TD-SCDMA	▪ Code domain power ▪ Code domain power versus time ▪ CCDF	▪ EVM ▪ Peak code domain error ▪ Constellation diagram ▪ I/Q offset ▪ Residual code domain error ▪ Gain imbalance ▪ Center frequency error (chip rate error)	▪ Spectrum mask ▪ ACLR ▪ Power measurement	▪ Channel table with channels used on base station ▪ Timing offset ▪ Power versus time	▪ Automatic detection of active channels and decoding of useful information ▪ Automatic detection of HSDPA modulation format ▪ Support of HSPA+ (HSDPA+ and HSUPA+)
R&S®FSW-K82/-K83 CDMA2000®	▪ Carrier power ▪ Code domain power ▪ Code domain power versus time ▪ CCDF	▪ RHO ▪ EVM ▪ Constellation diagram ▪ I/Q offset ▪ I/Q imbalance ▪ Center frequency error	▪ Spectrum mask ▪ ACLR ▪ Power measurement	▪ Channel table with channels used on base station ▪ Timing offset	▪ Automatic detection of active channels and decoding of useful information ▪ Robust demodulation algorithms for reliable measurement of multicarrier signals
R&S®FSW-K84/-K85 1xEV-DO	▪ Carrier power ▪ Code domain power ▪ Code domain power versus time ▪ CCDF	▪ RHO_{Pilot} (R&S®FSW-K84) ▪ RHO_{Data} (R&S®FSW-K84) ▪ RHO_{MAC} (R&S®FSW-K84) ▪ $RHO_{Overall}$ ▪ EVM ▪ Constellation diagram ▪ I/Q offset ▪ I/Q imbalance ▪ Center frequency error	▪ Spectrum mask ▪ ACLR ▪ Power measurement	▪ Channel table with channels used on base station ▪ Timing offset	▪ Automatic detection of active channels and decoding of useful information ▪ Robust demodulation algorithms for reliable measurement of multicarrier signals
R&S®FSW-K91 WLAN IEEE 802.11a/b/g **R&S®FSW-K91P** WLAN IEEE 802.11p **R&S®FSW-K91N** WLAN IEEE 802.11n **R&S®FSW-K91AC** WLAN IEEE 802.11ac	▪ Power versus time ▪ Burst power ▪ Crest factor	▪ EVM (pilot, data) ▪ EVM versus carrier ▪ EVM versus symbol ▪ Constellation diagram ▪ I/Q offset ▪ I/Q imbalance ▪ Gain imbalance ▪ Center frequency error ▪ Symbol clock error ▪ Group delay	▪ Spectrum mask ▪ ACLR ▪ Power measurement ▪ Spectrum flatness	▪ Bitstream ▪ Signal field ▪ Constellation versus carrier	▪ Automatic detection of burst type ▪ Automatic detection of MCS index ▪ Automatic detection of bandwidth ▪ Automatic detection of guard interval ▪ Estimation of payload length from burst

Measurement applications for wireless communications systems

Measurement application/ technology	Power	Modulation quality	Spectrum measurements	Miscellaneous	Special features
R&S®FSW-K95 WLAN IEEE 802.11ad	▪ Power versus time ▪ PPDU power ▪ Crest factor	▪ EVM (pilot, data) ▪ Constellation diagram ▪ I/Q offset ▪ I/Q imbalance ▪ Gain imbalance ▪ Symbol clock error ▪ Center frequency error ▪ Time skew ▪ Phase error versus symbol ▪ Phase tracking versus symbol	▪ Spectrum mask ▪ Power spectrum ▪ Channel frequency response	▪ Bit error rate ▪ Header information ▪ Bitstream (encoded and decoded)	▪ Automatic detection of PPDU type ▪ Automatic detection of MCS index
R&S®FSW-K100/ -K101/-K104/-K105 EUTRA/LTE TDD and FDD UL and DL	▪ Power measurement in time and frequency domains ▪ CCDF	▪ EVM ▪ Constellation diagram ▪ I/Q offset ▪ Gain imbalance ▪ Quadrature error ▪ Center frequency error (symbol clock error)	▪ Spectrum mask ▪ ACLR ▪ Power measurement ▪ Spectrum flatness	▪ Bitstream ▪ Allocation summary list ▪ Averaging over multiple measurements	Automatic detection of modulation, cyclic prefix length and cell ID
R&S®FSW-K102 EUTRA/LTE MIMO		▪ See R&S®FSW-K100/ -K104 modulation quality measurements for each individual MIMO path			▪ MIMO time alignment for R&S®FSW-K100/-K104 ▪ Interband carrier aggregation time alignment
R&S®FSW-K103 EUTRA/ LTE-Advanced UL			▪ Multicarrier ACLR for FDD and TDD ▪ SEM for contiguously aggregated component carriers		
R&S®FS-K100PC/ -K101PC/-K102PC/ -K103PC/-K104PC/ -K105PC LTE FDD, TDD and MIMO	▪ Power measurement in time and frequency domains ▪ CCDF	▪ EVM ▪ Constellation diagram ▪ I/Q offset ▪ Gain imbalance ▪ Quadrature error ▪ Center frequency error (symbol clock error)	▪ Spectrum flatness ▪ Power spectrum ▪ ACLR ▪ Spectrum mask	▪ Bitstream ▪ Allocation summary list ▪ Signal flow diagram ▪ Averaging over multiple measurements	▪ Automatic detection of modulation, cyclic prefix length and cell ID ▪ MIMO measurements (R&S®FS-K102PC/-K103PC) ▪ Windows based analysis software, to be installed on the R&S®FSW or a separate PC

Measurement application for wire-connected communications systems

Measurement application/ technology	Power	Modulation quality	Spectrum measurements	Miscellaneous	Special features
R&S®FSW-K192 DOCSIS 3.1 Downstream	▪ Power ▪ Power versus time ▪ Power versus symbol × carrier	▪ MER versus carrier ▪ MER versus symbol ▪ MER versus symbol × carrier ▪ MER (pilot, data) ▪ Constellation diagram ▪ Center frequency error ▪ Symbol clock error ▪ Group delay	▪ Power measurement ▪ Spectrum flatness	Decoding ▪ LDPC BER ▪ LDPC CWER ▪ Trigger to frame	Automatic detection of ▪ Cyclic prefix ▪ Rolloff ▪ PLC start index ▪ Continuous pilots ▪ NCP ▪ Profile A ▪ N_{FFT}
R&S®FSW-K193 DOCSIS 3.1 Upstream	▪ Power ▪ Power versus time ▪ Power versus symbol × carrier	▪ MER versus carrier ▪ MER versus symbol ▪ MER versus symbol × 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

Specifications in brief

Specifications in brief		
Frequency		
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
	R&S®FSW85	2 Hz to 85 GHz
Aging of frequency reference		1×10^{-7}/year
	with R&S®FSW-B4 option	3×10^{-8}/year
Bandwidths		
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-B512 option	512 MHz
	with R&S®FSW-B2000 option	2 GHz [1]
Displayed average noise level (DANL)	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.)
	80 GHz	–126 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.)
Intermodulation		
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.)
WCDMA ACLR dynamic range	with noise cancellation	88 dB
Phase noise		
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.)
Total measurement uncertainty	8 GHz	< 0.4 dB

[1] 2 GHz demodulation bandwidth for frequencies > 8 GHz. R&S®RTO1044 digital oscilloscope required. Not available for the R&S®FSW8 and R&S®FSW13.

For data sheet, see PD 5214.5984.22 and www.rohde-schwarz.com

Ordering information

Designation	Type	Order No.
Base unit		
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
Signal and Spectrum Analyzer, 2 Hz to 85 GHz	R&S®FSW85	1312.8000K85
Hardware options		
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®FSW43/50/67/85) [1]	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
Analog Baseband Inputs (for R&S®FSW85)	R&S®FSW-B71	1313.1651.85
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/.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
LO/IF Ports for External Mixers (for R&S®FSW85)	R&S®FSW-B21	1313.1100.85
Preamplifier, 100 kHz to 13.6 GHz (for R&S®FSW8/13)	R&S®FSW-B24	1313.0832.13
Preamplifier, 100 kHz to 26.5 GHz (for R&S®FSW26)	R&S®FSW-B24	1313.0832.26
Preamplifier, 100 kHz to 43.5 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) [1]	R&S®FSW-B24	1313.0832.51
Preamplifier, 100 kHz to 67 GHz (for R&S®FSW67)	R&S®FSW-B24	1313.0832.66
Preamplifier, 100 kHz to 67 GHz (for R&S®FSW67) [1]	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
Real-Time Spectrum Analyzer, 160 MHz [1], [2]	R&S®FSW-B160R	1325.4850.06
Real-Time Spectrum Analyzer, 512 MHz [1], [2]	R&S®FSW-B512R	1325.4296.06
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 [3]	R&S®FSW-B160	1325.4850.04
320 MHz Analysis Bandwidth [3]	R&S®FSW-B320	1325.4867.04
512 MHz Analysis Bandwidth [4]	R&S®FSW-B512	1313.4296.04
2 GHz Analysis Bandwidth [5]	R&S®FSW-B2000	1325.4750.02

Designation	Type	Order No.
Firmware/software		
Pulse Measurements	R&S®FSW-K6	1313.1322.02
Time Sidelobe Measurement[6]	R&S®FSW-K6S	1325.3783.02
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
VOR/ILS Measurements	R&S®FSW-K15	1331.4388.02
Multicarrier Group Delay Measurements	R&S®FSW-K17	1313.4150.02
Amplifier Measurements	R&S®FSW-K18	1325.2170.02
Noise Figure Measurements	R&S®FSW-K30	1313.1380.02
Security Write Protection of solid state drive	R&S®FSW-K33	1322.7936.02
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[7]	R&S®FSW-K60C	1322.9745.02
Transient Hop Measurement[7]	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) UE 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
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
IEEE 802.11a/b/g Measurements	R&S®FSW-K91	1313.1500.02
IEEE 802.11p Measurements	R&S®FSW-K91P	1321.5646.02
IEEE 802.11n Measurements	R&S®FSW-K91N	1313.1516.02
IEEE 802.11ac Measurements	R&S®FSW-K91AC	1313.4209.02
IEEE 802.11ad Measurements	R&S®FSW-K95	1313.1639.02
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 UL Advanced UL Measurements[8]	R&S®FSW-K103	1313.2487.02
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 FDD Uplink 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)[9]	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 Measurement Application, POI > 15 µs[10]	R&S®FSW-K160RE	1313.7766.02
DOCSIS 3.1 OFDM Downstream	R&S®FSW-K192	1325.4138.02
DOCSIS 3.1 OFDM Upstream	R&S®FSW-K193	1325.4144.02

Designation	Type	Order No.
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 [11]	R&S®FSW-U160	1325.5357.04
Analysis Bandwidth Upgrade from 160 MHz to 320 MHz	R&S®FSW-U320	1313.7189.02
Analysis Bandwidth Upgrade from 80 MHz to 512 MHz [4], [11]	R&S®FSW-U512	1321.6320.04
Analysis Bandwidth Upgrade from 500 MHz to 512 MHz	R&S®FSW-U512A	1321.6320.14
Real-Time Spectrum Analyzer, including analysis bandwidth upgrade from 80 MHz to 160 MHz [2]	R&S®FSW-U160R	1325.5357.06
Real-Time Spectrum Analyzer, including analysis bandwidth upgrade from 80 MHz to 512 MHz [1], [2], [11]	R&S®FSW-U512R	1321.6320.06

[1] Export license required.
[2] Cannot be combined with the R&S®FSW-B160, R&S®FSW-U160 or R&S®FSW-B320 options.
[3] Not available with option R&S®FSW-B512, R&S®FSW-U512, R&S®FSW-U512A, R&S®FSW-B512R, R&S®FSW-U512R, R&S®FSW-B160R, R&S®FSW-U160R.
[4] Not available together with the R&S®FSW-U160, R&S®FSW-B160, R&S®FSW-U320, R&S®FSW-B320, R&S®FSW-U160R and R&S®FSW-B160R options.
[5] R&S®RTO1044 digital oscilloscope required. Not available for the R&S®FSW8 and R&S®FSW13.
[6] R&S®FSW-K6 required.
[7] R&S®FSW-K60 required.
[8] R&S®FSW-K101 or R&S®FSW-K105 required.
[9] R&S®FS-K101PC or R&S®FS-K105PC required.
[10] R&S®FSW-B160, R&S®FSW-U160, R&S®FSW-B320 or R&S®FSW-U320 required.
[11] R&S®FSW-B80 or R&S®FSW-U80 required.

Warranty		
Base unit		3 years
All other items		1 year
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 with Calibration Coverage, one year	R&S®CW1	
Extended Warranty with Calibration Coverage, two years	R&S®CW2	

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

Service that adds value

- Worldwide
- Local and personalized
- Customized and flexible
- Uncompromising quality
- Long-term dependability

About Rohde&Schwarz

The Rohde&Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, radiomonitoring and radiolocation. Founded more than 80 years ago, this independent company has an extensive sales and service network and is present in more than 70 countries. The electronics group is among the world market leaders in its established business fields. The company is headquartered in Munich, Germany. It also has regional headquarters in Singapore and Columbia, Maryland, USA, to manage its operations in these regions.

Sustainable product design

- Environmental compatibility and eco-footprint
- Energy efficiency and low emissions
- Longevity and optimized total cost of ownership

Certified Quality Management
ISO 9001

Certified Environmental Management
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