

# R&S® FSH4/FSH8

## Spectrum Analyzer

### Where mobility counts



# R&S®FSH4/FSH8 Spectrum Analyzer At a glance

The R&S®FSH4/FSH8 spectrum analyzer is rugged, handy and designed for use in the field. Its low weight, its simple, well-conceived operation concept and the large number of measurement functions make it an indispensable tool for anyone who needs an efficient measuring instrument for outdoor work.

The R&S®FSH4/FSH8 is a spectrum analyzer and – depending on the model and the options installed – a power meter, a cable and antenna tester and a two-port vector network analyzer. It provides the three most important RF analysis functions that an RF service technician or an installation and maintenance team needs to solve daily routine measurement tasks. For example, it can be used for maintaining or installing transmitter systems, checking cables and antennas, assessing signal quality in broadcasting, radiocommunications and service, measuring electric field strength or in simple lab applications. The R&S®FSH4/FSH8 can perform any of these tasks quickly, reliably and with high measurement accuracy.

Weighing only 3 kg, the R&S®FSH4/R&S®FSH8 is a handy instrument. All frequently used functions have their own function keys and are within fingertip reach. The brilliant color display is easy to read even under poor lighting conditions, and it has a monochrome mode for extreme conditions.

The capacity of the R&S®FSH4/FSH8 battery enables uninterrupted operation for up to 4.5 hours. The battery is changed within seconds. And if it rains? No problem – all connectors are splash-proof.

## Key facts

- Frequency range from 9 kHz to 3.6 GHz or 8 GHz
- High sensitivity ( $< -141$  dBm (1 Hz), with preamplifier  $< -161$  dBm (1 Hz))
- 20 MHz demodulation bandwidth for analyzing LTE signals
- Low measurement uncertainty ( $< 1$  dB)
- Measurement functions for all important measurement tasks related to the startup and maintenance of transmitter systems
- Internal tracking generator and VSWR bridge with built-in DC voltage supply (bias)
- Two-port network analyzer
- Rugged, splash-proof housing for rough work in the field
- Easy handling due to low weight (3 kg with battery) and easy-to-reach function keys



Easy-to-replace Li-ion battery for up to 4.5 h of operation.

# R&S®FSH4/FSH8 Spectrum Analyzer Benefits and key features

The R&S®FSH4/FSH8 in operation during installation and maintenance of transmitter stations.



## Installation and maintenance of transmitter stations (base stations)

- ▮ Power measurements on pulsed signals
- ▮ Channel power measurements
- ▮ Adjacent channel power measurements
- ▮ Measurements of spurious emissions (spectrum emission mask)
- ▮ Measurements of the modulation spectrum on pulsed signals with gated sweep
- ▮ Spectrogram measurements
- ▮ Analysis of 3GPP WCDMA transmit signals
- ▮ Analysis of CDMA2000® transmit signals
- ▮ Analysis of 1xEV-DO transmit signals
- ▮ Analysis of LTE FDD/TDD transmit signals
- ▮ Distance-to-fault measurements
- ▮ Two-port vector network analysis
- ▮ Scalar network analysis
- ▮ One-port cable loss measurements
- ▮ Vector voltmeter
- ▮ Position finding and increased measurement accuracy using the GPS receiver
- ▮ Power measurements up to 18 GHz
- ▮ Directional power measurements up to 4 GHz

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## Measurements of electromagnetic fields

- ▮ Field strength measurements with directional antennas
- ▮ Field strength measurements with isotropic antennas

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## Diagnostic applications in the lab or in service

- ▮ General spectrum analysis
- ▮ AM modulation depth measurements
- ▮ Measurements of signal distortions caused by harmonics
- ▮ Location of EMC problems

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## Documentation and remote control

- ▮ R&S®FSH4View software for documenting measurement results
- ▮ Remote control via LAN or USB

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## Easy operation

- ▮ Quick function selection via keypad and rotary knob
- ▮ Optimal reading of measurement results in any situation
- ▮ Setting of frequency via channel tables
- ▮ Operation in different languages
- ▮ Easy-to-access, well-protected connectors

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# Installation and maintenance of transmitter stations (base stations)

The R&S®FSH4/FSH8 is designed for the installation and maintenance of transmitter systems. For this purpose, it provides the following measurement functions:

- ▀ Checking of signal quality in the spectral and time domain with channel power measurements and measurements on pulsed signals
- ▀ Distance-to-fault measurements on cables and one-port cable loss measurements
- ▀ Measuring of antenna match and testing of power amplifiers with vector network analysis
- ▀ Determination of transmission power with power sensors

## Power measurements on pulsed signals

By means of the TDMA POWER function, the R&S®FSH4/FSH8 performs time-domain power measurements within a time division multiple access (TDMA) timeslot. To make work easier for the user, all required instrument settings are already predefined for the GSM and EDGE standards.

## Channel power measurements

The R&S®FSH4/FSH8 determines the power of a definable transmission channel by means of the channel power measurement function. A channel power measurement for the LTE, 3GPP WCDMA, cdmaOne and CDMA2000® 1x digital mobile radio standards is performed at a keystroke.

TDMA power measurement.



Channel power measurement.

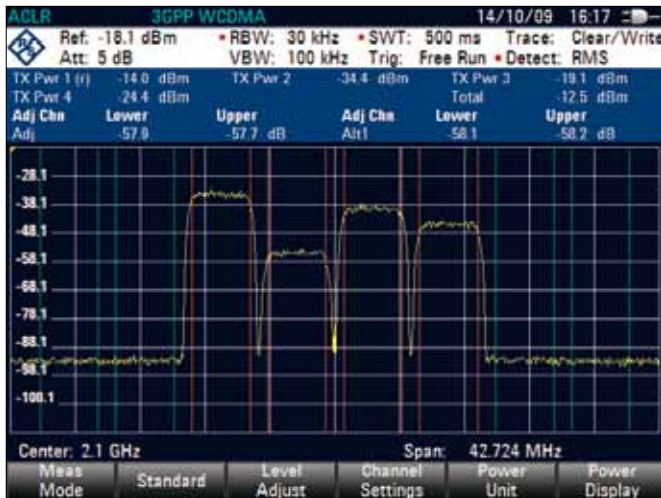




## Adjacent channel power measurements

The ACLR measurement function enables the user to test how far a base station carrier signal reaches into the adjacent channel. An ACLR value that is too low indicates poor signal quality and can lead to the interference of the adjacent useful signals.

ACLR measurement on a 3GPP WCDMA signal with four carriers.



The adjacent channel power can be displayed as an absolute value or relative to the useful carrier. The R&S®FSH4/FSH8 offers predefined settings for various transmission standards such as 3GPP WCDMA, CDMA2000® 1x and LTE, but parameters can also be user-defined. For example, users can enter different channel widths and spacings for up to 12 channels and up to 12 adjacent channels for the measurement of multicarrier signals.

## Measurements of spurious emissions (spectrum emission mask)

The R&S®FSH4/FSH8 measures spurious emissions of a mobile radio base station using the spectrum emission mask (SEM) function. Spurious emissions can interfere with adjacent transmit signals, resulting in reduced signal quality and lower data rates. By means of the SEM function, the R&S®FSH4/FSH8 tests whether the signal lies within the limits defined by the wireless communications standard. The R&S®FSH4/FSH8 offers a wide range of predefined masks, e.g. for 3GPP WCDMA, CDMA2000®, WiMAX™, LTE, TD-SCDMA, WLAN and WiBro. New masks with user-defined settings can be created and utilized quickly and easily with the R&S®FSH4View software.

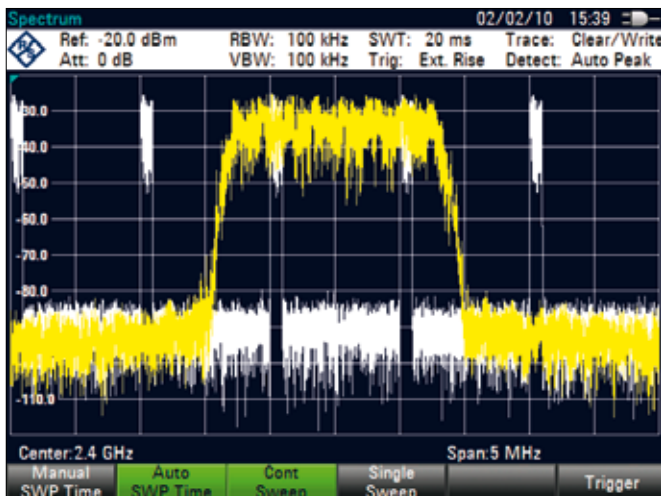
Spectrum emission mask measurement on an LTE signal.



## Measurements of the modulation spectrum on pulsed signals with gated sweep

The gated sweep function is used to measure a pulsed signal only in the time interval in which the pulse is active. This method makes it possible, for instance, to display the modulation spectrum of a GSM signal, a WLAN signal or, as shown in the example, a pulsed WiMAX™ signal.

Modulation spectrum measurement (yellow trace) on a pulsed WiMAX™ signal (white trace).



## Spectrogram measurements

The R&S®FSH-K14 spectrogram measurements application allows the R&S®FSH4/FSH8 to provide a history of the spectrum. As a result, intermittent faults or variations in frequency and level versus time can be analyzed. Specific evaluations can be made by replaying recorded data and setting time lines and markers.

## Analysis of 3GPP WCDMA transmit signals

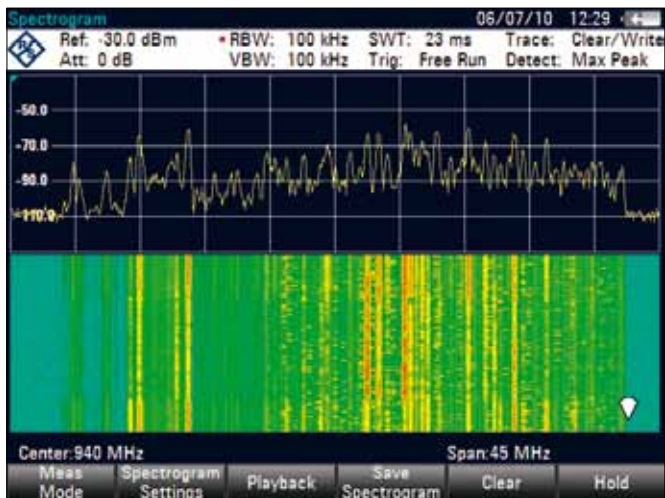
When base stations are put into operation or maintained, a quick overview of the modulation characteristics, the power of the code channels and signal quality is necessary.

The R&S®FSH-K44 option demodulates 3GPP WCDMA base station signals and performs a detailed analysis. In addition to the total power, it measures the power of the most important code channels such as the common pilot channel (CPICH), the primary common control physical channel (P-CCPCH) and the primary and secondary synchronization channels (P-SCH and S-SCH). It also displays the carrier frequency offset and the error vector magnitude (EVM) which is used to draw conclusions about signal quality. The ratio of the chip energy ( $E_c$ ) to the power density of the interference signal ( $I_p$ ) provides information about the signal-to-interference ratio. The scrambling code can be determined at the press of a button and used automatically for decoding the code channels. To get a quick overview of adjacent base stations, the R&S®FSH4/FSH8 provides up to eight scrambling codes with associated CPICH power.

Using the R&S®FSH-K44 option in practice is really easy. Only three operating steps are required to display the measurement results:

- ▮ Select the 3GPP WCDMA function
- ▮ Set the center frequency
- ▮ Start the scrambling code search

Simultaneous display of spectrum and spectrogram.



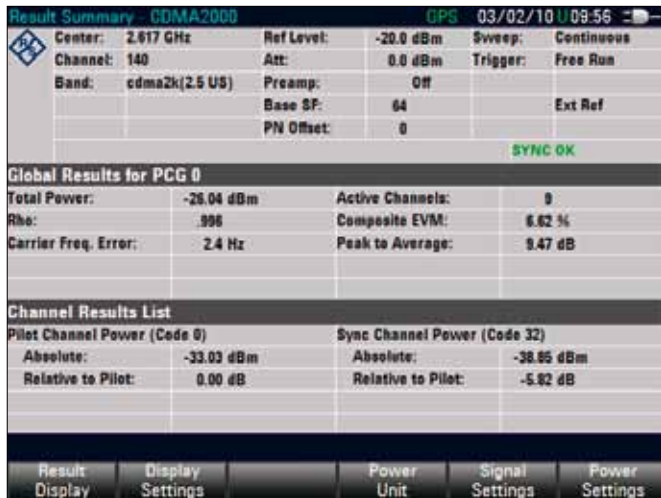
Analysis of a 3GPP WCDMA transmit signal.

Result Summary		3GPP WCDMA BTS		13/07/09 14:21	
Center Frequency	2.2	GHz			
Scrambling Code	0 / 0				
Transducer	---				
Global Results for Frame 0:					
Total Power	-2.8	dBm		SYNC OK	
Carrier Freq Error	137.79	Hz			
Active Channels 2					
Channel Results List:					
CPICH (15 kbps, Code 0)			P-CCPCH (15 kbps, Code 1)		
Power	-13.0	dBm		Power	-13.3
Ec/Io	-10.2	dB		Ec/Io	-10.5
Symbol EVM rms	2.8	%		Symbol EVM rms	3.2
P-SCH Power	-16.0	dBm		S-SCH Power	-15.4
Result Display	Scrambling Code	Signal Settings	Power Settings		

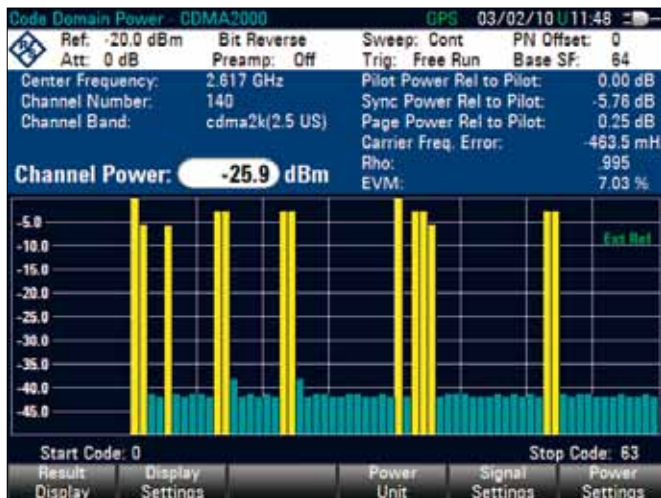
## Analysis of CDMA2000® transmit signals

The R&S®FSH-K46 option ideally equips the R&S®FSH4/FSH8 for CDMA2000® base station transmitter measurements. In addition to total power, the spectrum analyzer determines the power of the pilot channel (F-PICH) and the synchronization channel (F-SYNC) code channels. The carrier frequency offset, the error vector magnitude (EVM) and Rho are also measured and displayed. This allows the user to detect transmitter impairments such as clipping or intermodulation that are difficult to recognize in the spectrum.

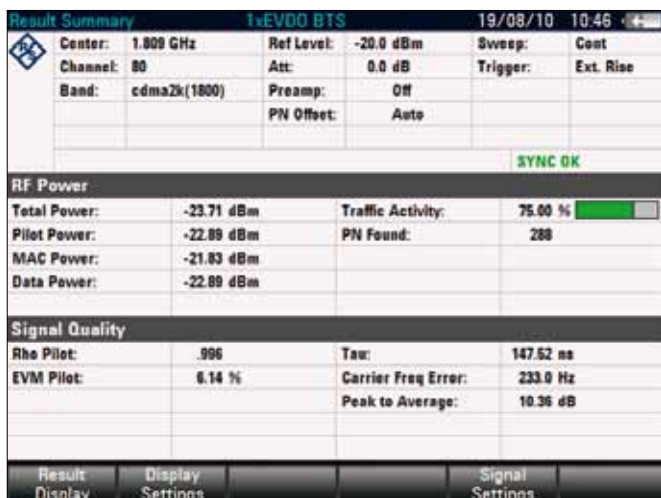
Analysis of a CDMA2000® transmit signal with the R&S®FSH-K46 option.



The code domain power measurement provides an overview of the key signal parameters.



Analysis of a 1xEV-DO transmit signal.



For in-depth analysis, the R&S®FSH-K46E option is available for code domain power measurements. This option permits the graphical display of the channel power of occupied and unoccupied channels. The resulting summary provides an overview of the key signal parameters, e.g. total power, channel power, Rho and EVM. Channel power is displayed relative to the total power or relative to the power of the pilot channel.

The code domain channel list contains additional information such as symbol rate and channel number with the associated Walsh code.

## Analysis of 1xEV-DO transmit signals

The R&S®FSH-K47 option equips the R&S®FSH4/FSH8 for 1xEV-DO base station transmitter measurements. The analyzer measures all key parameters that provide useful information about the signal quality and the power distribution of various code channels. These include the total power, the ratio of peak power to average power, the power of the pilot, MAC and data as well as the carrier frequency offset, the EVM and Rho. This allows the user to detect transmitter impairments such as clipping or intermodulation that are difficult to recognize in the spectrum. In addition, current traffic activity is displayed. This value shows whether connection problems or low data rates are caused by high traffic activity.



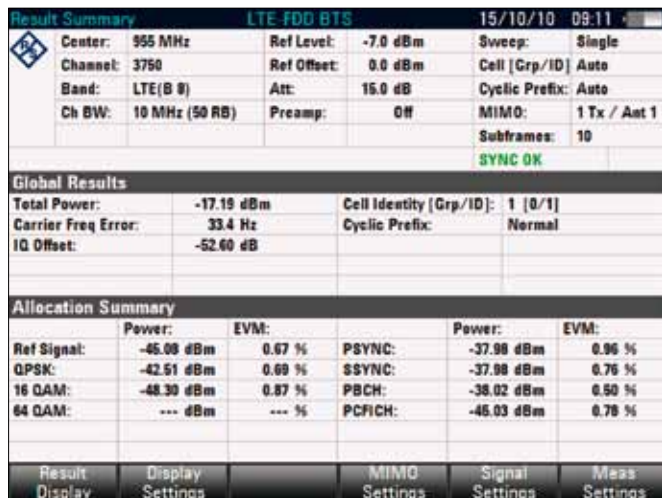
## Analysis of LTE FDD/TDD transmit signals

The R&S®FSH-K50/-K51 <sup>1)</sup> option equips the R&S®FSH4/FSH8 for measurements on LTE FDD and LTE TDD eNodeB transmitters. It can analyze all signal bandwidths up to 20 MHz that are defined in the LTE standard. In addition to the total power, the R&S®FSH-K50/-K51 determines the power of the reference signal as well as the power of the physical control format indicator channel (PCFICH), the physical broadcast channel (PBCH) and the two synchronization channels PSYNC and SSYNC. It also measures and displays the carrier frequency offset and the EVM value of the reference signal and the useful data. The user can now detect transmitter impairments such as clipping or intermodulation that are difficult to recognize in the spectrum.

## Distance-to-fault measurements

The distance-to-fault, caused by a pinched cable or by loose or corroded cable connections, is determined quickly and precisely. The built-in threshold function ensures that only true cable faults, i.e. faults that exceed a tolerance limit, are displayed in a list. This considerably simplifies measurement evaluation.

Analysis of an LTE FDD transmit signal.



<sup>1)</sup> The R&S®FSH-K50/-K51 options are available for R&S®FSH4/FSH8 analyzers with serial numbers  $\geq 105000$ .

Distance-to-fault (DTF) measurement.

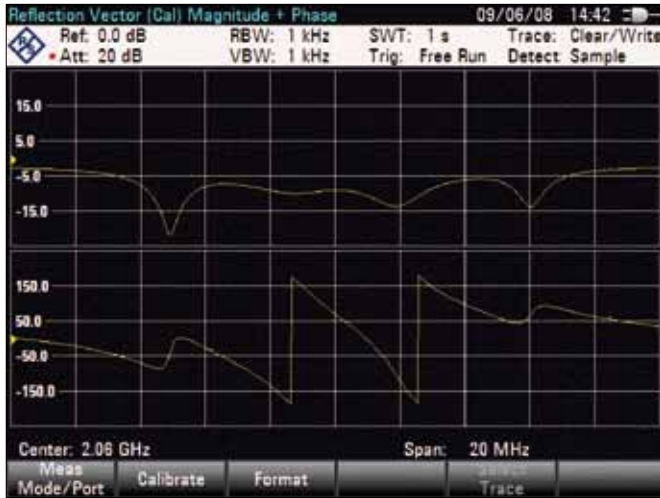




## Two-port vector network analysis

The "vector measurements" option transforms the R&S®FSH models with built-in tracking generator and internal VSWR bridge into a two-port vector network analyzer. Matching and transmission characteristics of filters, amplifiers, etc., can be determined quickly and with high accuracy in the forward and reverse direction with only one test setup. The built-in DC bias supplies power to active DUTs, such as amplifiers, via the RF cable. This function is especially useful for mast-mounted amplifiers of a mobile radio base station.

Vector network analysis: display of magnitude and phase.



Vector network analysis: measurement with Smith chart.



Scalar transmission measurement.



- ▮ Increased measurement accuracy due to vector system error correction
- ▮ Measurement of magnitude and phase of S-parameters  $S_{11}$ ,  $S_{21}$ ,  $S_{12}$  and  $S_{22}$
- ▮ Simultaneous display of magnitude and phase in split-screen mode
- ▮ Simultaneous display of two different S-parameters
- ▮ Smith chart with zoom function
- ▮ Support of all conventional marker formats
- ▮ Input of a reference impedance for DUTs with an impedance other than 50  $\Omega$
- ▮ Electrical length measurement
- ▮ Determination of group delay

## Scalar network analysis

If you do not need the advantages of vector network analysis for reflection and transmission measurements, the R&S®FSH models featuring a built-in tracking generator are a more cost-effective solution for determining the transmission characteristics of cables, filters and amplifiers. The R&S®FSH models with a built-in VSWR bridge (models .24 and .28) can additionally measure the matching (return loss, reflection coefficient or VSWR), e.g. of an antenna.

## One-port cable loss measurements

The R&S®FSH4/FSH8 can determine the cable loss of installed cables without much effort. Simply connect one end of the cable to the R&S®FSH4/FSH8 measurement port. The other end of the cable is terminated with a short circuit or left open.

## Vector voltmeter

The R&S®FSH-K45 vector voltmeter option displays the magnitude and phase of a DUT on a fixed frequency. Therefore, the R&S®FSH4/FSH8 (models .24 and .28) can replace a conventional vector voltmeter for many applications. Because the required signal source and bridge are already available in the R&S®FSH4/FSH8, costs are saved and the test setup is significantly simplified, making the R&S®FSH-K45 the right choice for field use. For relative measurements, the measurement results of a reference DUT are stored at the press of a button. Comparison measurements, e.g. between different RF cables and a reference cable (golden device), can be quickly and easily performed.

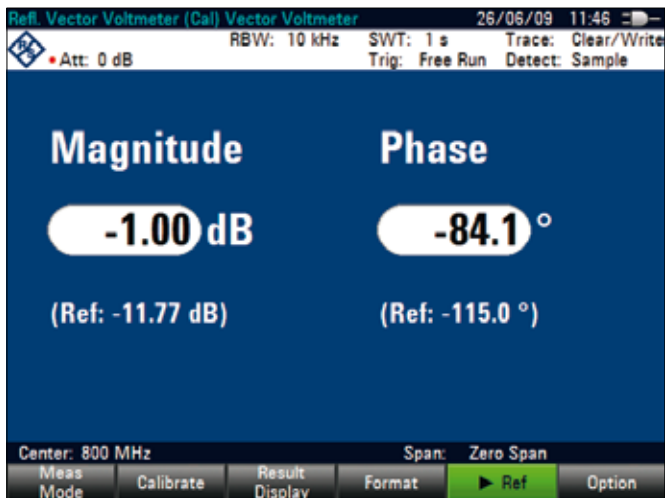
Typical applications are as follows:

- ▀ Adjustment of electrical cable length
- ▀ Checking of phase-controlled antennas as used, for example, in air traffic control with an instrument landing system (ILS)

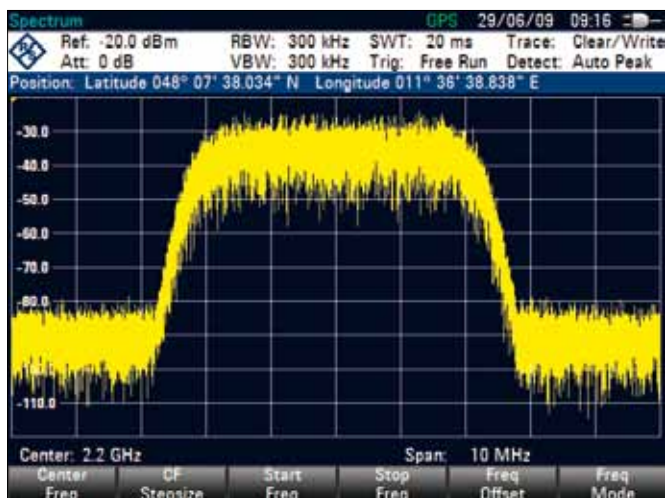
## Position finding and increased measurement accuracy using the GPS receiver

Using the R&S®HA-Z240 GPS receiver, the R&S®FSH4/FSH8 documents where a measurement is carried out. The longitude, latitude and altitude of the position are shown on the display. If required, the position can be stored together with the measurement results. Moreover, the GPS receiver increases the frequency measurement accuracy by synchronizing the internal reference oscillator to the GPS frequency reference. One minute following position finding, the frequency accuracy of the R&S®FSH4/FSH8 is 25 ppb ( $25 \times 10^{-9}$ ). To fasten the GPS receiver on the roof of a car, for example, the GPS receiver is equipped with a magnet and a 5 m cable.

Vector voltmeter display.



Display of the current position with the R&S®HA-Z240 GPS receiver connected.



### Power measurements up to 18 GHz

Equipped with the R&S®FSH-Z1 and the R&S®FSH-Z18 power sensors, the R&S®FSH4/FSH8 becomes a highly accurate RF power meter up to 8 GHz or 18 GHz with a measurement range from  $-67$  dBm to  $+23$  dBm.

### Directional power measurements up to 4 GHz

The R&S®FSH-Z14 and R&S®FSH-Z44 directional power sensors transform the R&S®FSH4/FSH8 into a full-featured directional power meter for the frequency ranges from 25 MHz to 1 GHz and from 200 MHz to 4 GHz. The R&S®FSH4/FSH8 can then simultaneously measure the output power and the matching of transmitter system antennas under operating conditions. The power sensors measure average power up to 120 W and normally eliminate the need for any extra attenuators. They are compatible with the common GSM/EDGE, 3GPP WCDMA, cdmaOne, CDMA2000® 1x, DVB-T and DAB standards. In addition, the peak envelope power (PEP) up to max. 300 W can be determined.

The R&S®FSH8 and the R&S®FSH-Z1 terminating power sensor.



The R&S®FSH8 and the R&S®FSH-Z44 directional power sensor.



# Measurements of electromagnetic fields

The effects of electromagnetic fields (EMF) caused by transmitter systems can be reliably determined by the R&S®FSH4/FSH8. Due to its large frequency range of up to 8 GHz, the R&S®FSH4/FSH8 covers all common wireless communications services, including mobile radio (GSM, CDMA, WCDMA, LTE), DECT, Bluetooth®, WLAN (IEEE 802.11a, b, g, n), WiMAX™, broadcasting and television.

The R&S®FSH8 with the R&S®HE300 antenna.



The R&S®FSH4/FSH8 is ideally suited for the following measurements:

- Determination of maximum field strength using directional antennas
- Direction-independent field strength measurements using an isotropic antenna
- Determination of electric field strength in a transmission channel with defined bandwidth (channel power measurement)

## Field strength measurements with directional antennas

When measuring electric field strength, the R&S®FSH4/FSH8 takes into account the specific antenna factors of the connected antenna. The field strength is displayed directly in dB $\mu$ V/m. If W/m<sup>2</sup> is selected, the power flux density is calculated and displayed. In addition, frequency-dependent loss or gain, e.g. of a cable or amplifier, can be corrected. For simple result analysis, the R&S®FSH4/FSH8 provides two user-definable limit lines with automatic limit monitoring.

## Field strength measurements with isotropic antennas

Equipped with the isotropic antennas of the R&S®TS-EMF measurement system, the R&S®FSH4/FSH8 can determine the direction-independent resultant field strength in the frequency range from 9 kHz to 6 GHz. The antenna includes three orthogonally arranged antenna elements for measuring the resultant field strength. The R&S®FSH4/FSH8 sequentially activates the three antenna elements and calculates the resultant field strength, taking into account the antenna factors for each antenna element as well as the cable loss of the connection cable.

The R&S®FSH8 with isotropic antennas.





# Diagnostic applications in the lab or in service

The fold-out stand turns the R&S®FSH4/FSH8 into a desktop analyzer for work in the lab or in service.

The R&S®FSH4/FSH8 is suitable, for example, for the following measurements:

- Frequency and level measurements
- Power measurements up to 18 GHz with the accuracy of a power meter
- Measurements on amplifiers, filters, etc., using vector network analysis
- Automated generation of test sequences by remote control via LAN or USB

## AM modulation depth measurements

The R&S®FSH4/FSH8 measures the modulation depth of an AM-modulated signal at the push of a button. The AM modulation depth measurement function positions one marker each on the carrier, the upper sideband and the lower sideband, and uses sideband suppression to determine the modulation depth. The modulation frequency can be predefined to selectively determine the modulation depth of a two-tone signal, for example by starting with the 90 Hz sideband and then moving to the 150 Hz sideband of an ILS signal.

## Measurements of signal distortions caused by harmonics

The R&S®FSH4/FSH8 determines the harmonics of a device under test, e.g. an amplifier, with the harmonic distortion measurement function. In addition to the graphical display of the harmonics, the R&S®FSH4/FSH8 also calculates and displays the total harmonic distortion (THD).

## Location of EMC problems

The R&S®HZ-15 near-field probes are used as diagnostic tools for locating EMC problems, e.g. on circuit boards, integrated circuits, cables and shielding. The R&S®HZ-15 near-field probe set is adequate for emission measurements from 30 MHz to 3 GHz. The R&S®HZ-16 preamplifier improves measurement sensitivity up to 3 GHz, with approx. 20 dB gain and a noise figure of 4.5 dB. In combination with the R&S®FSH4/FSH8, the preamplifier and near-field probe set are a cost-effective means of analyzing and locating disturbance sources during development.

The R&S®FSH8 with near-field probes and DUT.



# Documentation and remote control

The supplied R&S®FSH4View software makes it easy to document measurement results and manage instrument settings.

The R&S®FSH8 with laptop.



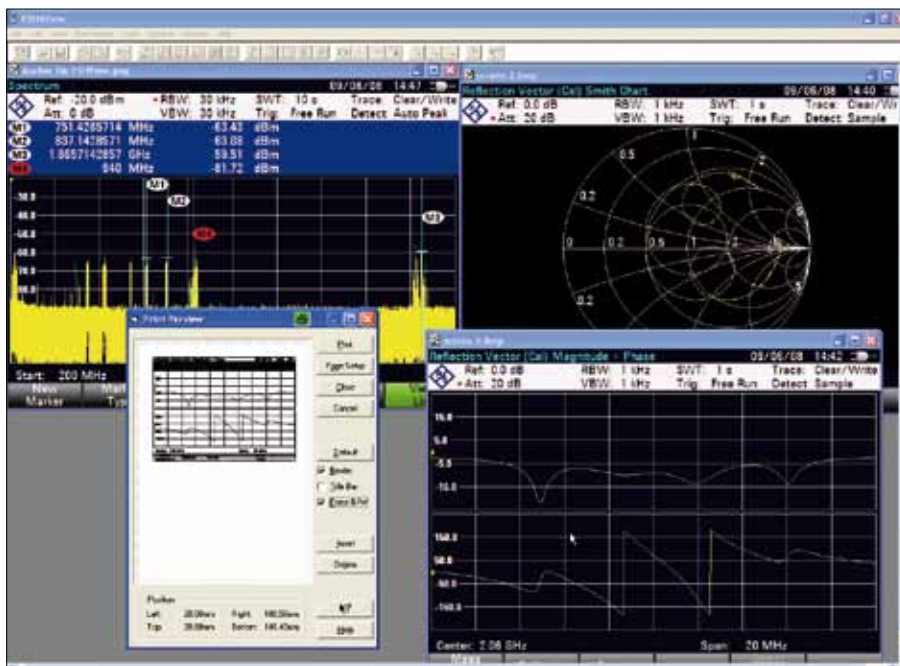
## R&S®FSH4View software for documenting measurement results

- ▮ Fast data exchange via a USB or LAN connection between the R&S®FSH4/FSH8 and a PC
- ▮ Easy processing of measurement results due to data export in ASCII or MS Excel format
- ▮ Storage of graphics data in .bmp, .pcx, .png and .wmf format
- ▮ Printout of all relevant data via Windows PC
- ▮ Remote signal monitoring via LAN by means of permanent and continuous transfer of sweeps
- ▮ Simple comparison of measurement results
- ▮ Automatic storage of measurement results at selectable intervals
- ▮ Subsequent analysis of measurement results by displaying/hiding and shifting markers
- ▮ Subsequent display of limit lines
- ▮ Generation of cable data using an integrated cable editor and downloading to the R&S®FSH4/FSH8 for distance-to-fault measurement
- ▮ Editor for generating limit lines, antenna factors and transducer factors for external attenuators and amplifiers as well as channel lists
- ▮ Compatible with Windows XP and Vista (32/64 bit version) and Windows 7 (32/64 bit version)

## Remote control via LAN or USB

The R&S®FSH4/FSH8 can be remote controlled via the USB or LAN interface and integrated into user-specific programs. The SCPI-compatible remote control commands are activated by the R&S®FSH-K40 option.

The R&S®FSH4View software.



# Easy operation

All frequently used functions such as reference level, bandwidths, frequency, etc., can be set directly via keys.

All operating elements are within fingertip reach.



## Quick function selection via keypad and rotary knob

The R&S®FSH4/FSH8 is operated via the keypad and rotary knob. The selected function can be activated directly using the Enter button integrated in the rotary knob. Thanks to the vertical design, all operating elements are within fingertip reach. The MODE key is used to switch between the various operating modes such as "spectrum analyzer", "vector network analyzer" or "power meter".

All basic settings can be conveniently set in a straightforward list. Measurement results, including instrument settings, are saved to the internal memory or the replaceable SD memory card. Predefined instrument settings can be locked to prevent them from being changed unintentionally. This reduces the risk of incorrect measurements.

Frequently required measurements can be summarized in a single menu using the USER key. User-defined instrument setups are then assigned to the softkeys under an individually selectable name.

For documentation purposes, the contents of a screenshot can be saved as a graphics file – with a single keystroke.

## Optimal reading of measurement results in any situation

The measurement results are easy to read on the brilliant, clearly laid out 6.5" VGA color display. The backlighting of the display can be adjusted to the ambient lighting conditions. For use in extremely strong sunlight, a special monochrome mode provides optimal contrast.

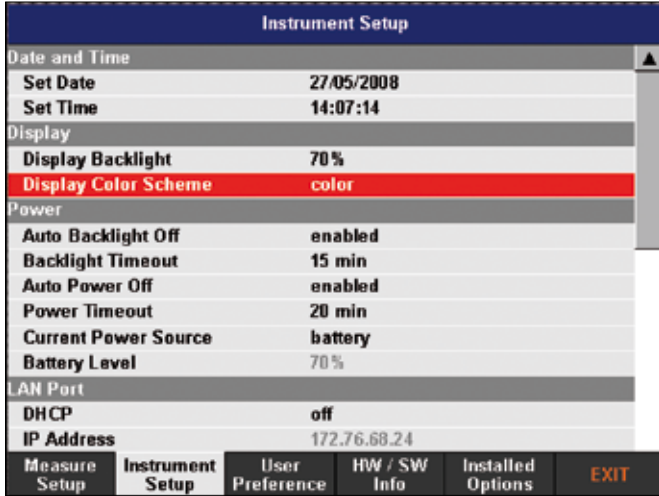
## Setting of frequency via channel tables

As an alternative to entering a frequency, the R&S®FSH4/FSH8 can be tuned using channel numbers. The channel number is displayed instead of the center frequency. Users who are familiar with the channel assignments commonly used in wireless communications or TV/broadcast applications can operate the R&S®FSH4/FSH8 even more easily. TV channel tables for a large number of countries are supplied with the R&S®FSH4/FSH8.

## Operation in different languages

The user interface of the R&S®FSH4/FSH8 is available in various languages. Almost all of the softkeys, operating instructions and messages will then be displayed in the selected language. The R&S®FSH4/FSH8 supports the following languages: English, Korean, Japanese, Chinese, Russian, Italian, Spanish, Portuguese, French, Hungarian and German.

Easy configuration of instrument setup.



Selecting the channel table.



Straightforward menus for easy selection of functions.





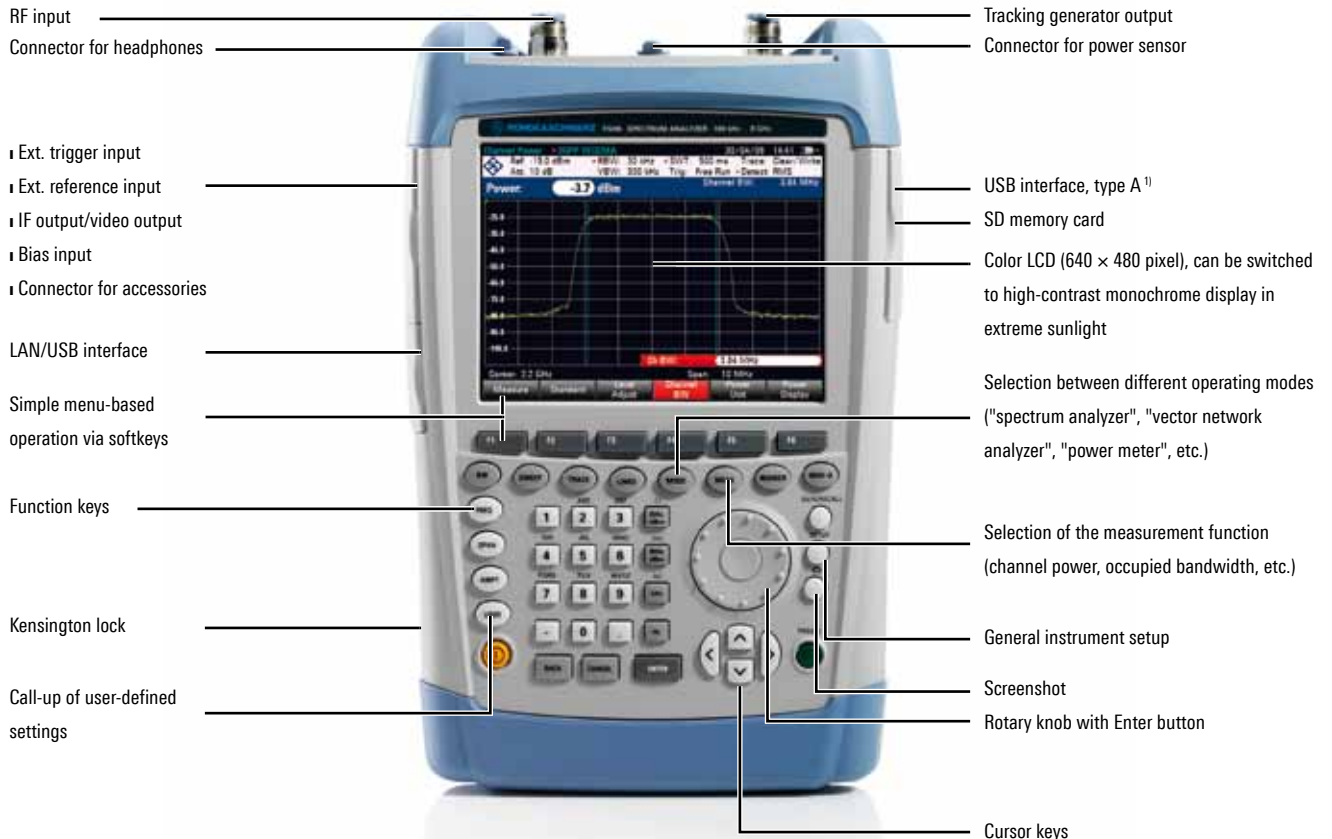
### Easy-to-access, well-protected connectors

Additional inputs/outputs such as the DC voltage supply (bias), interfaces and the SD memory card are easily accessible under dust-proof hinged covers on the side of the instrument.

Additional connectors (e.g. for LAN and USB) are protected by hinged covers.



### Front view



<sup>1)</sup> Interface integrated into instruments with serial numbers  $\geq 105000$ .  
For connecting the R&S®NRP-Zxx power sensors and USB sticks.

# System configuration

## Options and applications

Altogether six R&S®FSH models for different applications and frequency ranges are available (models .04/.08/.14/.18/.24/.28). The R&S®FSH4 and R&S®FSH8 can perform measurements up to an upper frequency limit of 3.6 GHz and 8 GHz, respectively. Models featuring a built-in tracking generator can also be used to determine the transmission characteristics of cables, filters, amplifiers, etc.

Additional models with built-in tracking generator and internal VSWR bridge are available for distance-to-fault (DTF) measurements, matching measurements and vector network analysis.

### R&S®FSH4/FSH8 standard functions

	TDMA power measurements	Channel power measurements	Field strength measurements/measurements with isotropic antennas
Models .04/.08	•	•	•
Models .14/.18	•	•	•
Models .24/.28	•	•	•

### R&S®FSH4/FSH8 options

	Spectrogram measurements	Analysis of 3GPP WCDMA transmit signals	Analysis of CDMA2000® signals	Analysis of 1xEV-DO signals	Analysis of LTE FDD signals	Analysis of LTE TDD signals
Models .04/.08	R&S®FSH-K14	R&S®FSH-K44	R&S®FSH-K46/ R&S®FSH-K46E	R&S®FSH-K47	R&S®FSH-K50 <sup>1)</sup>	R&S®FSH-K51 <sup>1)</sup>
Models .14/.18	R&S®FSH-K14	R&S®FSH-K44	R&S®FSH-K46/ R&S®FSH-K46E	R&S®FSH-K47	R&S®FSH-K50 <sup>1)</sup>	R&S®FSH-K51 <sup>1)</sup>
Models .24/.28	R&S®FSH-K14	R&S®FSH-K44	R&S®FSH-K46/ R&S®FSH-K46E	R&S®FSH-K47	R&S®FSH-K50 <sup>1)</sup>	R&S®FSH-K51 <sup>1)</sup>

<sup>1)</sup> Available for R&S®FSH4/FSH8 analyzers with serial numbers ≥ 105000.

### Models

	Frequency range	Preamplifier	Tracking generator
R&S®FSH4, model .04	9 kHz to 3.6 GHz	•	–
R&S®FSH4, model .14	9 kHz to 3.6 GHz	•	•
R&S®FSH4, model .24	100 kHz to 3.6 GHz	•	•
R&S®FSH8, model .08	9 kHz to 8 GHz	•	–
R&S®FSH8, model .18	9 kHz to 8 GHz	•	•
R&S®FSH8, model .28	100 kHz to 8 GHz	•	•

All models have an adjustable preamplifier, making them suitable for measuring very small signals. Two power sensors are available as accessories – for precise terminating power measurements up to 18 GHz and for directional power measurements up to 4 GHz.

The following tables show possible configurations for different standard functions and applications as well as an overview of available models.

Occupied bandwidth measurements	Frequency settings via channel tables	Scalar transmission measurements	Scalar reflection measurements
•	•	–	–
•	•	•	–
•	•	•	•

Distance-to-fault (DTF) measurements	Vector reflection and transmission measurements	One-port cable loss measurements	Vector voltmeter	Power measurements up to 8 GHz/18 GHz	Directional power measurements up to 1 GHz/4 GHz	Remote control via LAN or USB
–	–	–	–	R&S®FSH-Z1/ R&S®FSH-Z18	R&S®FSH-Z14/ R&S®FSH-Z44	R&S®FSH-K40
–	–	–	–	R&S®FSH-Z1/ R&S®FSH-Z18	R&S®FSH-Z14/ R&S®FSH-Z44	R&S®FSH-K40
R&S®FSH-K41	R&S®FSH-K42	R&S®FSH-K42	R&S®FSH-K45	R&S®FSH-Z1/ R&S®FSH-Z18	R&S®FSH-Z14/ R&S®FSH-Z44	R&S®FSH-K40

Built-in VSWR bridge
–
–
•
–
–
•

# Specifications in brief

Spectrum analysis		R&S®FSH4	R&S®FSH8
Frequency range	models .04/.14/.08/.18	9 kHz to 3.6 GHz	9 kHz to 8 GHz
	models .24/.28	100 kHz to 3.6 GHz	100 kHz to 8 GHz
Resolution bandwidths		10 Hz to 3 MHz	
Displayed average noise level	without preamplifier, RBW = 1 Hz (normalized)		
	9 kHz to 100 kHz (models .04/.14/.08/.18 only)	< -108 dBm, typ. -118 dBm	< -108 dBm, typ. -118 dBm
	100 kHz to 1 MHz	< -115 dBm, typ. -125 dBm	< -115 dBm, typ. -125 dBm
	1 MHz to 10 MHz	< -136 dBm, typ. -144 dBm	< -136 dBm, typ. -144 dBm
	10 MHz to 2 GHz	< -141 dBm, typ. -146 dBm	< -141 dBm, typ. -146 dBm
	2 GHz to 3.6 GHz	< -138 dBm, typ. -143 dBm	< -138 dBm, typ. -143 dBm
	3.6 GHz to 5 GHz	–	< -142 dBm, typ. -146 dBm
	5 GHz to 6.5 GHz	–	< -140 dBm, typ. -144 dBm
	6.5 GHz to 8 GHz	–	< -136 dBm, typ. -141 dBm
	with preamplifier, RBW = 1 Hz (normalized)		
	100 kHz to 1 MHz	< -133 dBm, typ. -143 dBm	< -133 dBm, typ. -143 dBm
	1 MHz to 10 MHz	< -157 dBm, typ. -161 dBm	< -157 dBm, typ. -161 dBm
	10 MHz to 2 GHz	< -161 dBm, typ. -165 dBm	< -161 dBm, typ. -165 dBm
	2 GHz to 3.6 GHz	< -159 dBm, typ. -163 dBm	< -159 dBm, typ. -163 dBm
	3.6 GHz to 5 GHz	–	< -155 dBm, typ. -159 dBm
	5 GHz to 6.5 GHz	–	< -151 dBm, typ. -155 dBm
	6.5 GHz to 8 GHz	–	< -147 dBm, typ. -150 dBm
Third-order intercept (IP3)	300 MHz to 3.6 GHz	> 10 dBm, typ. +15 dBm	> 10 dBm, typ. +15 dBm
	3.6 GHz to 8 GHz	–	> 3 dBm, typ. +10 dBm
Phase noise	frequency 500 MHz		
	30 kHz carrier offset	< -95 dBc (1 Hz), typ. -105 dBc (1 Hz)	
	100 kHz carrier offset	< -100 dBc (1 Hz), typ. -110 dBc (1 Hz)	
	1 MHz carrier offset	< -120 dBc (1 Hz), typ. -127 dBc (1 Hz)	
Detectors	sample, max peak, min peak, auto peak, RMS		
Level measurement uncertainty	10 MHz < f ≤ 3.6 GHz	< 1 dB, typ. 0.5 dB	< 1 dB, typ. 0.5 dB
	3.6 MHz < f ≤ 8 GHz	–	< 1.5 dB, typ. 1 dB
Display	6.5" color LCD with VGA resolution		
Battery operating time (without tracking generator)	R&S®HA-Z204, 4.5 Ah	up to 3 h	
	R&S®HA-Z206, 6.75 Ah	up to 4.5 h	
Dimensions (W × H × D)	194 mm × 300 mm × 69 mm (144 mm) <sup>1)</sup> 7.6 in × 11.8 in × 2.7 in (5.7 in) <sup>1)</sup>		
Weight	3 kg (6.6 lb)		

<sup>1)</sup> With carrying handle.



Vector network analysis/vector voltmeter (models .24/.28 with R&S®FSH-K42/R&S®FSH-K45 only)			
	models .24/.28	R&S®FSH4	R&S®FSH8
Frequency range	models .24/.28	300 kHz to 3.6 GHz	300 kHz to 8 GHz
Output power (port 1, port 2)		0 dBm to -50 dBm	
Reflection measurements ( $S_{11}$ , $S_{22}$ )			
Directivity	300 kHz to 3 GHz	nominal > 43 dB	nominal > 43 dB
	3 GHz to 3.6 GHz	nominal > 37 dB	nominal > 37 dB
	3.6 GHz to 6 GHz	–	nominal > 37 dB
	6 GHz to 8 GHz	–	nominal > 31 dB
Display modes	vector reflection and transmission measurement (R&S®FSH-K42)	magnitude, phase, magnitude + phase, Smith chart, VSWR, reflection coefficient, mp, one-port cable loss, electrical length, group delay	
	vector voltmeter (R&S®FSH-K45)	magnitude + phase, Smith chart	
Transmission measurements			
Dynamic range ( $S_{21}$ )	100 kHz to 300 kHz	typ. 70 dB	typ. 70 dB
	300 kHz to 3.6 GHz	> 70 dB, typ. 90 dB	> 70 dB, typ. 90 dB
	3.6 GHz to 6 GHz	–	> 70 dB, typ. 90 dB
	6 GHz to 8 GHz	–	typ. 50 dB
Dynamic range ( $S_{12}$ )	100 kHz to 300 kHz	typ. 80 dB	typ. 80 dB
	300 kHz to 3.6 GHz	> 80 dB, typ. 100 dB	> 80 dB, typ. 100 dB
	3.6 GHz to 6 GHz	–	> 80 dB, typ. 100 dB
	6 GHz to 8 GHz	–	typ. 60 dB
Display modes	vector reflection and transmission measurement (R&S®FSH-K42)	magnitude (attenuation, gain), phase, magnitude + phase, electrical length, group delay	
	vector voltmeter (R&S®FSH-K45)	magnitude + phase	

The R&S®FSH4/FSH8 with fold-out stand for desktop use.



# Ordering information

Designation	Type	Order No.
<b>Base unit</b>		
Spectrum Analyzer, 9 kHz to 3.6 GHz, with preamplifier	R&S®FSH4	1309.6000.04
Spectrum Analyzer, 9 kHz to 3.6 GHz, with preamplifier and tracking generator	R&S®FSH4	1309.6000.14
Spectrum Analyzer, 100 kHz to 3.6 GHz, with preamplifier, tracking generator and internal VSWR bridge	R&S®FSH4	1309.6000.24
Spectrum Analyzer, 9 kHz to 8 GHz, with preamplifier	R&S®FSH8	1309.6000.08
Spectrum Analyzer, 9 kHz to 8 GHz, with preamplifier and tracking generator	R&S®FSH8	1309.6000.18
Spectrum Analyzer, 100 kHz to 8 GHz, with preamplifier, tracking generator and internal VSWR bridge	R&S®FSH8	1309.6000.28
<b>Accessories supplied</b>		
Li-ion battery pack (4.5 Ah), USB cable, LAN cable, AC power supply, CD-ROM with R&S®FSH4View software and documentation, quick start guide		
<b>Software options (usually firmware)</b>		
Spectrogram Measurement Application (software license)	R&S®FSH-K14	1304.5770.02
Remote control via LAN or USB	R&S®FSH-K40	1304.5606.02
Distance-to-Fault Measurement (for models .24 and .28 only, requires R&S®FSH-Z320 or R&S®FSH-Z321 and R&S®FSH-Z28 or R&S®FSH-Z29)	R&S®FSH-K41	1304.5612.02
Vector Reflection and Transmission Measurements (for models .24 and .28 only, requires R&S®FSH-Z28 or R&S®FSH-Z29)	R&S®FSH-K42	1304.5629.02
3GPP WCDMA, BTS/NodeB Pilot Channel and EVM Measurement Application	R&S®FSH-K44	1304.5641.02
Vector Voltmeter (for models .24 and .28 only, requires R&S®FSH-Z28 or R&S®FSH-Z29)	R&S®FSH-K45	1304.5658.02
CDMA2000® BTS Application for Pilot Channel and EVM Measurements	R&S®FSH-K46	1304.5729.02
CDMA2000® BTS Application for Code Domain Power Measurements (requires R&S®FSH-K46)	R&S®FSH-K46E	1304.5764.02
1xEV-DO BTS Application for Pilot Channel and EVM Measurements	R&S®FSH-K47	1304.5787.02
LTE FDD Downlink Application for Pilot Channel and EVM Measurements <sup>1)</sup>	R&S®FSH-K50	1304.5735.02
LTE TDD Downlink Application for Pilot Channel and EVM Measurements <sup>1)</sup>	R&S®FSH-K51	1304.5812.02
<b>Accessories</b>		
Power Sensor, 10 MHz to 8 GHz	R&S®FSH-Z1	1155.4505.02
Power Sensor, 10 MHz to 18 GHz	R&S®FSH-Z18	1165.1909.02
USB Adapter Cable for R&S®FSH-Z14/-Z18, length 1.8 m	R&S®FSH-Z101	1164.6242.02
Directional Power Sensor, 25 MHz to 1 GHz	R&S®FSH-Z14	1120.6001.02
Directional Power Sensor, 200 MHz to 4 GHz	R&S®FSH-Z44	1165.2305.02
RF Cable (length 1 m), N male/N female connectors for R&S®FSH-K41 option, DC to 8 GHz	R&S®FSH-Z320	1309.6600.00
RF Cable (length 3 m), N male/N female connectors for R&S®FSH-K41 option, DC to 8 GHz	R&S®FSH-Z321	1309.6617.00
Combined Open/Short/50 Ω Load Calibration Standard, for calibrating the VSWR and DTF measurements, DC to 3.6 GHz	R&S®FSH-Z29	1300.7510.03
Combined Open/Short/50 Ω Load Calibration Standard, for calibrating the VSWR and DTF measurements, DC to 8 GHz	R&S®FSH-Z28	1300.7810.03
Matching Pad, 50 Ω/75 Ω, bidirectional, 0 Hz to 2.7 GHz, N female/N male connectors, load capacity 2 W, series resistor 25 Ω	R&S®RAZ	0358.5714.02
Matching Pad, 50 Ω/75 Ω, bidirectional, 0 Hz to 2.7 GHz, N female/N male connectors, load capacity 2 W, L connector	R&S®RAM	0358.5414.02
Matching Pad, 50 Ω/75 Ω, bidirectional, 0 Hz to 1 GHz, BNC female/N male connectors, load capacity 1 W	R&S®FSH-Z38	1300.7740.02
Li-Ion Battery Pack, 4.5 Ah	R&S®HA-Z204	1309.6130.00
Li-Ion Battery Pack, 6.75 Ah	R&S®HA-Z206	1309.6146.00

Designation	Type	Order No.
Battery Charger for Li-ion battery pack, 4.5 Ah/6.75 Ah <sup>2)</sup>	R&S®HA-Z203	1309.6123.00
12 V Car Adapter	R&S®HA-Z202	1309.6117.00
Soft Carrying Bag (W x H x D: 260 mm x 360 mm x 280 mm (10.2 in x 14.2 in x 11.0 in))	R&S®HA-Z220	1309.6175.00
Hard Case	R&S®HA-Z221	1309.6181.00
Carrying Holster including chest harness and rain cover	R&S®HA-Z222	1309.6198.00
SD Memory Card, 2 Gbyte <sup>3)</sup>	R&S®HA-Z232	1309.6223.00
GPS Receiver	R&S®HA-Z240	1309.6700.03
Headphones	R&S®FSH-Z36	1145.5838.02
Active Directional Antenna, 20 MHz to 7.5 GHz	R&S®HE300	4067.5900.02
Loop Antenna for R&S®HE300, 9 kHz to 20 MHz	R&S®HE300-HF	4067.6806.02
Portable EMF Measurement System, case	R&S®TS-EMF	1158.9295.05
Isotropic Antenna, 30 MHz to 3 GHz, for R&S®TS-EMF	R&S®TSEMF-B1	1074.5719.02
Isotropic Antenna, 700 MHz to 6 GHz, for R&S®TS-EMF	R&S®TSEMF-B2	1074.5702.02
Isotropic Antenna, 9 kHz to 200 MHz, for R&S®TS-EMF	R&S®TSEMF-B3	1074.5690.02
Near-Field Probe Set	R&S®HZ-15	1147.2736.02
Preamplifier for R&S®HZ-15	R&S®HZ-16	1147.2720.02
Spare USB Cable	R&S®HA-Z211	1309.6169.00
Spare LAN Cable	R&S®HA-Z210	1309.6152.00
Spare AC Power Supply	R&S®HA-Z201	1309.6100.00

<sup>1)</sup> Battery charger only for R&S®FSH4/FSH8 analyzers with serial numbers  $\geq 105000$ .

<sup>2)</sup> SD memory card is required to charge the battery pack outside the R&S®FSH4/FSH8.

<sup>3)</sup> R&S®FSH4/FSH8 analyzers with serial numbers  $\leq 105000$  require an SD memory card for a firmware update.

Service options		
Two-Year Calibration Service	R&S®CO2FSH	Please contact your local Rohde & Schwarz sales representative.
Three-Year Calibration Service	R&S®CO3FSH	
Five-Year Calibration Service	R&S®CO5FSH	
One-Year Repair Service following the warranty period	R&S®RO2FSH	
Two-Year Repair Service following the warranty period	R&S®RO3FSH	
Four-Year Repair Service following the warranty period	R&S®RO5FSH	

**For data sheet, see PD 5214.0482.22 and [www.rohde-schwarz.com](http://www.rohde-schwarz.com).**

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PD 5214.0482.12 | Version 04.00 | November 2010 | R&S®FSH4/FSH8  
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