R&S®ESSENTIALS

R&S®FSH HANDHELD SPECTRUM ANALYZER

The all-in-one handheld platform

3 year warranty

Product Brochure
Version 22.01

ROHDE&SCHWARZ
Make ideas real

AT A GLANCE

The R&S®FSH 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®FSH is a handheld 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 most important RF analysis functions that an RF service technician or an installa- tion 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®FSH can perform any of these tasks quickly, reliably and with high measurement accuracy.

Weighing only 3 kg, the R&S®FSH is a handy instrument. All frequently used functions have their own function keys and are at your fingertips. 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®FSH battery enables uninterrupted operation for up to 4.5 hours. The battery can be changed within seconds and all connectors are splash-proof.

Key facts

- Frequency range from 9 kHz to 3.6/8/13.6/20 GHz
- High sensitivity of < –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 operation thanks to user configurable, automatic test sequences (wizard)

BENEFITS AND KEY FEATURES

Installation and maintenance of transmitter stations

- ► Power measurements on pulsed signals
- ► Channel power measurements
- ► Adjacent channel power measurements
- ► Measuring spurious emissions (spectrum emission mask)
- ► Measuring modulation spectrum on pulsed signals with g ate d swe e p
- ► Analysis of transmit signals (connected to BTS or OTA)
  - – GSM/GPRS/EDGE
  - – WCDMA/HSDPA/HSPA+
  - – CDMA2000®
  - – 1xEV-DO
  - – LTE FDD/TDD
  - – NB-IoT
  - – TD-SCDMA/HSDPA
- ► Vector network analysis
- ► One-port cable loss measurements
- ► Distance-to-fault measurements
- ► Vector voltmeter
- ► Position finding and increased measurement accuracy with GPS receiver
- ► Highly accurate power measurements up to 110 GHz with terminating power sensors
- ► Directional power measurements up to 4 GHz
- ► Channel power meter
- ► Pulse analysis with wideband power sensors
- ► Optical power measurement with optical power sensor

► page 4

Interference analysis, geotagging and indoor mapping

- ► Spectrogram measurements with R&S®FSH-K14 and R&S®FSH-K15
- ► Interference analysis with R&S®FSH-K15 and directional antennas
- ► Geotagging
- ► Indoor mapping

► page 15

Measurements of electromagnetic fields

- ► E a s y - t o - a c c e s s , w e l l - p r o t e c t e
- ► Field strength measurements with isotropic antennas
- ► EMF measurement application (R&S®FSH-K105 option)

► page 18

Diagnostic applications in the lab or in service

- ► EMC precompliance measurements and channel scan
- ► AM modulation depth measurements
- ► Measurement of signal distortions caused by harmonics
- ► Location of EMC problems

► page 20

Documentation and remote control

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

► page 22

Easy operation

- ► Quick function selection via keypad and rotary knob
- ► Optimal reading of measurement results in any situation
- ► Segmented sweep
- ► Test report in just a few steps with the R&S®FSH wizard
- ► Setting of frequency via channel tables
- ► Operation in different languages
- ► Easy-to-access, well-protected connectors

► page 24

System configuration options and applications

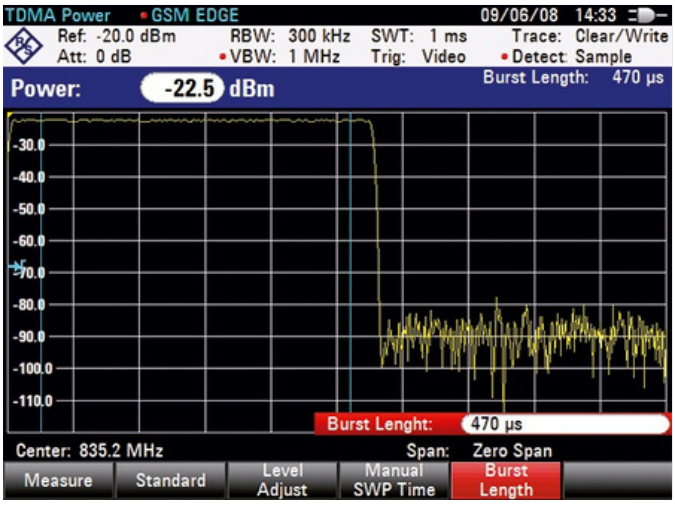
► page 28

INSTALLATION AND MAINTENANCE OF TRANSMITTER STATIONS

The R&S®FSH is designed for the installation and maintenance of transmitter systems. It provides the following measurement functions:

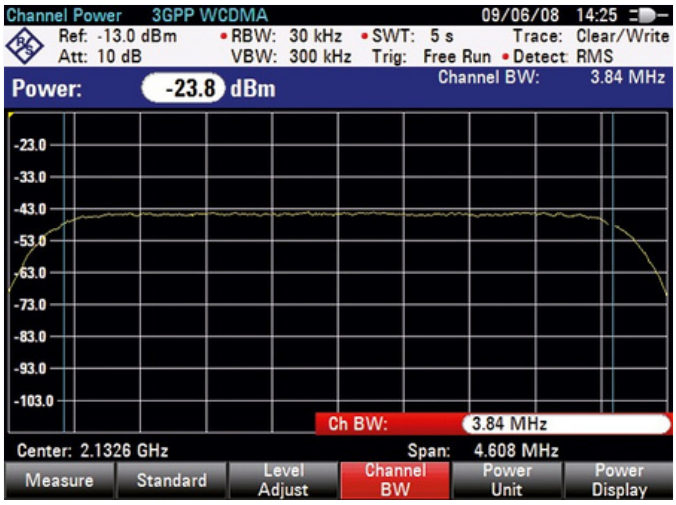
- ► Checking of signal quality in the spectral and time domain using channel power measurements and measurements on pulsed signals
- ► Analysis of GSM/GPRS/EDGE, WCDMA/HSDPA/HSPA+, LTE FDD/TDD, TD-SCDMA/HSDPA, CDMA2000® and 1xEV-DO transmit signals
- ► All measurements on transmit signals can be performed connected to the base station as well as over the air (OTA)
- ► Spectrogram analysis of intermittent faults
- ► Distance-to-fault measurements on cables and one-port cable loss measurements
- ► Measuring of antenna match and testing of power amplifiers using vector network analysis
- ► Determination of transmission power with power sensors

The R&S®FSH in operation during installation and maintenance of transmitter stations



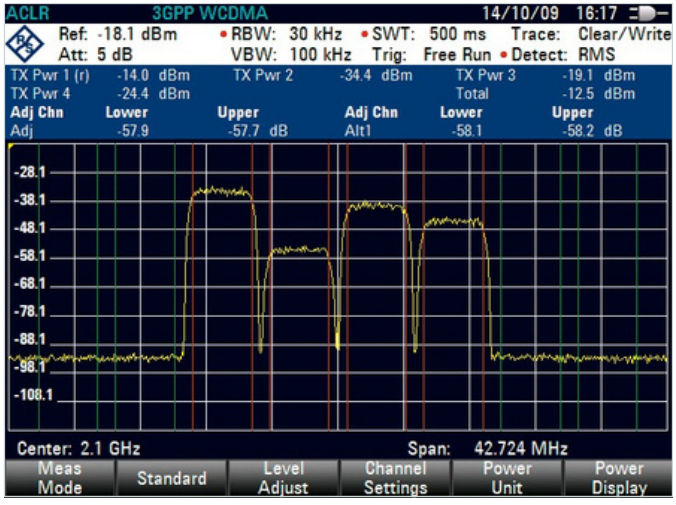
Power measurements on pulsed signals

The R&S®FSH uses the TDMA power function to measure time-domain power within a time division multiple access (TDMA) timeslot. To make work easier for users, all required instrument settings are predefined for the GSM and EDGE standards.



Channel power measurements

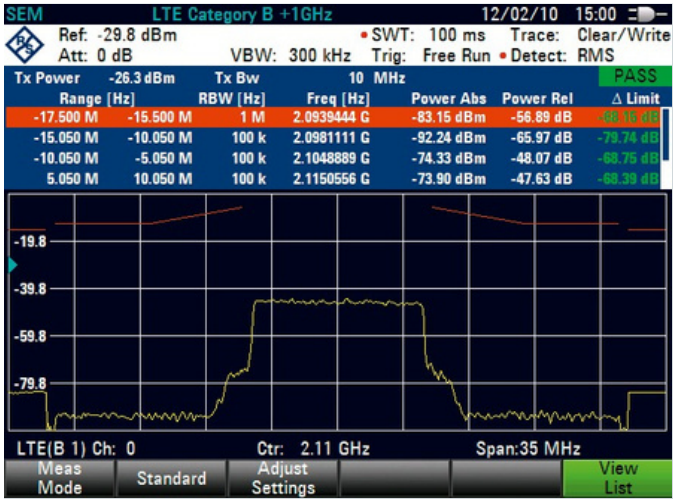
The R&S®FSH uses the channel power measurement function to determine the power of a definable transmission channel. Channel power measurement for the LTE, WCDMA, GSM, TD-SCDMA, cdmaOne, CDMA2000® and 1xEV-DO digital mobile communications standards can be performed at a keystroke.



Adjacent channel power measurements

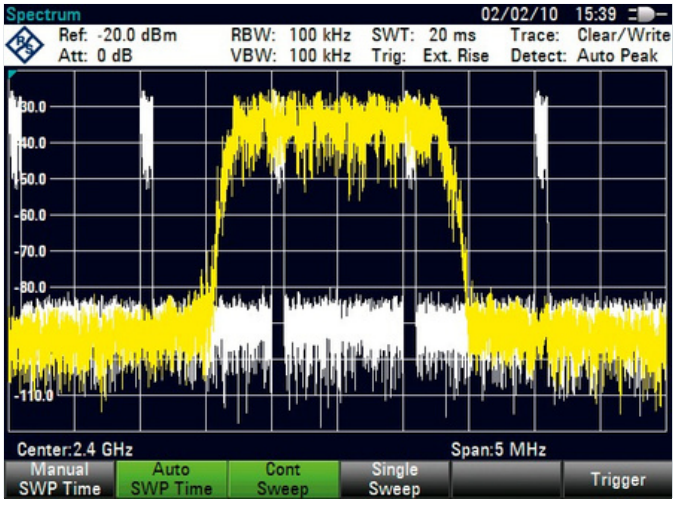
The ACLR measurement function enables users to test how far a base station carrier signal reaches into an adjacent channel. A low ACLR value indicates poor signal quality and can lead to interference in adjacent useful signals.

Adjacent channel power can be displayed as an absolute value or in relation to the useful carrier. The R&S®FSH offers predefined settings for various transmission standards such as WCDMA, CDMA2000®, 1xEV-DO, TD-SCDMA and LTE, but user-defined parameters are also possible. For example, users can enter different channel widths and spacings for up to 12 channels and up to 12 adjacent channels to measure multicarrier signals.



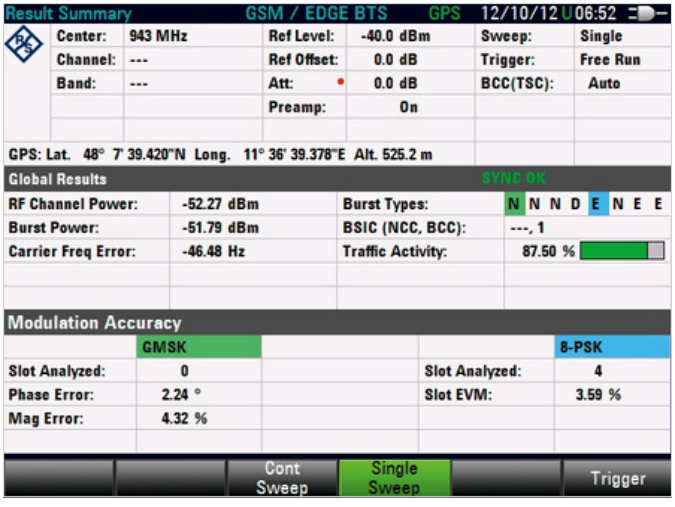
Measuring spurious emissions (spectrum emission mask)

The spectrum emission mask (SEM) function in the R&S®FSH measures spurious emissions from a base station. Spurious emissions can interfere with adjacent transmit signals, reducing signal quality and lowering data rates. The R&S®FSH uses the SEM function to test whether a signal is within the limits defined by a wireless communications standard. The R&S®FSH offers a wide range of predefined masks for 3GPP WCDMA, CDMA2000®, WiMAX™, LTE, TD-SCDMA, WLAN or WiBro. Creating and using new masks with user-defined settings is quick and easy with R&S®InstrumentView software.



Measuring modulation spectrum on pulsed signals with gated sweep

The gated sweep function measures a pulsed signal only when the pulse is active. This method can be used to display the modulation spectrum of a GSM signal, a WLAN signal or a pulsed WiMAX™ signal (as seen in the example).

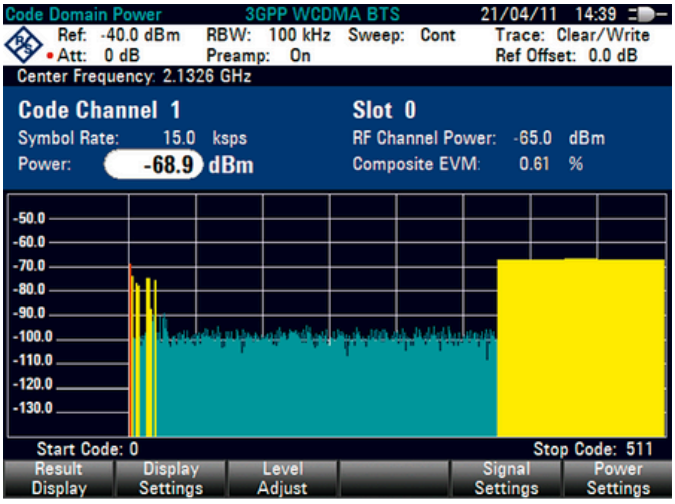


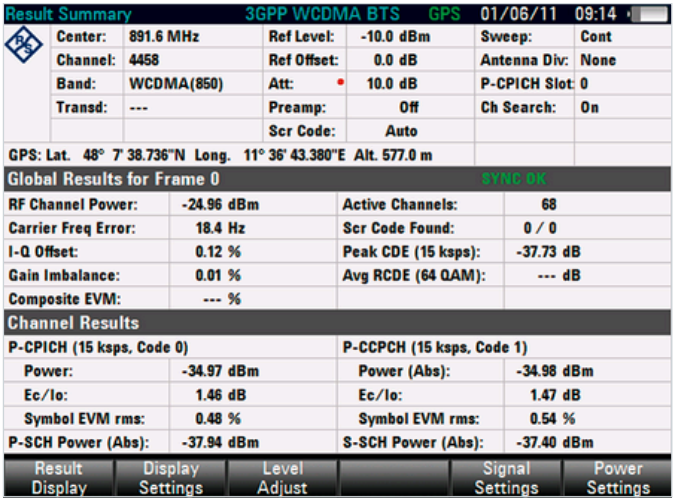
Analysis of GSM/GPRS/EDGE transmit signals

The R&S®FSH-K10 option demodulates GSM, GPRS and EDGE base station signals. A fast and accurate signal analysis is performed, allowing the user to easily check and troubleshoot base stations. The spectrum overview displays the RF channel power and occupied bandwidth of the signal. If the received power is below the specified limit, it indicates poor link performance. Too high RF channel power would interfere with other base stations.

The result summary displays the main signal parameters such as RF channel power, burst power, carrier frequency error, modulation and base station identity code (BSIC). The current traffic activity indicates whether capacity problems or low data rates may be related to an increase in cell traffic. Modulation accuracy measurements on GMSK and 8PSK modulated bursts are performed as required in standard specifications. Poor modulation accuracy indicates problems in the BTS transmitter components.

The power versus time display shows the GSM/EDGE bursts in the time domain and can help check whether the power and timing of the frame comply with the specifications. Equipped with the R&S®FSH-K10, the R&S®FSH measurement results allow network operators to adjust BTS transmit power and frequency settings accurately, improving signal quality and out-of-channel emissions. The result is less interference, higher data rates and more network capacity.





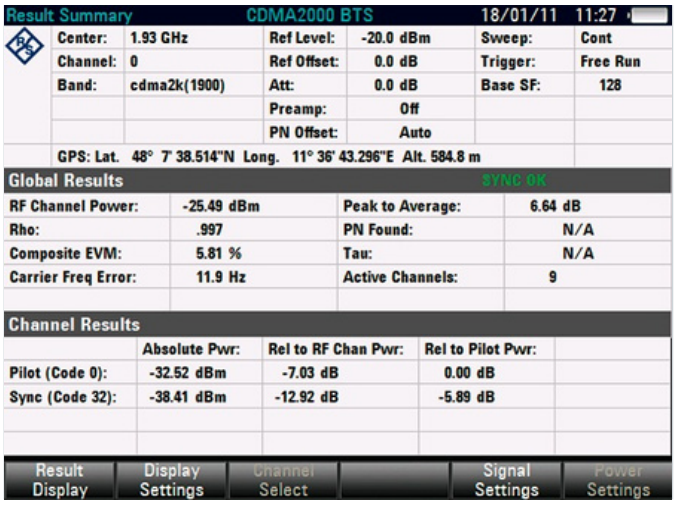
Analysis of WCDMA/HSDPA/HSPA+ transmit signals

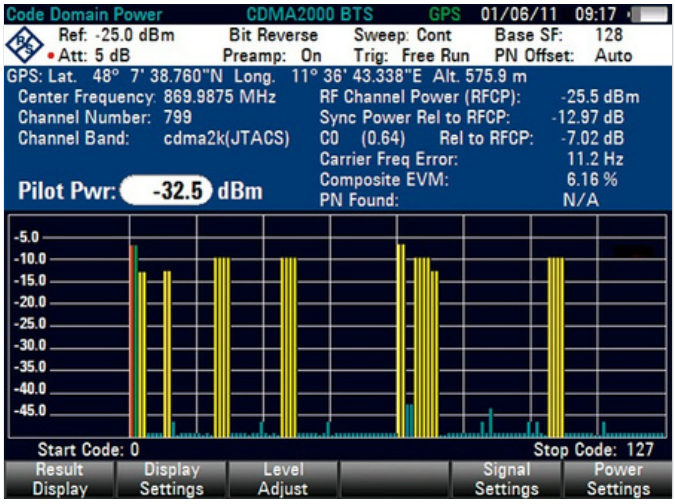
When commissioning and maintaining base stations, users need a quick overview of the modulation characteristics, the code channel power and the signal quality. The R&S®FSH-K44 option demodulates 3GPP WCDMA base station signals and performs a detailed analysis. In addition to the total power, it measures 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) helping draw conclusions about signal quality. The ratio of the chip energy (E C) to the interference signal (I0) power density indicates the signal-to-interference ratio. The scrambling code can be determined at the press of a button and used to automatically decode the channels. For a quick overview of adjacent base stations, the R&S®FSH provides up to eight scrambling codes with associated CPICH power. Equipped with the isotropic antennas of the R&S®TS-EMF measurement system, the R&S®FSH-K44 can also measure the electrical field strength of the WCDMA signal.

The R&S®FSH-K44 option is easy to use. 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

The R&S®FSH-K44E option provides code domain power measurements for in-depth WCDMA/HSDPA/HSPA+ analyses. This option allows the channel power of occupied and unoccupied code channels to be graphically displayed. The resulting summary provides an overview of key signal parameters such as RF channel power, code channel power and composite EVM. The code domain channel table contains additional information such as symbol rate, channel number with the associated spreading factor and automatic detection and display of the channel type.



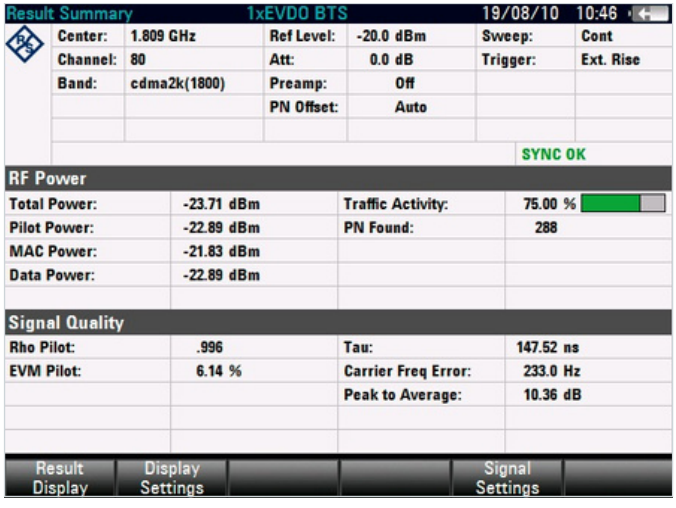


Analysis of CDMA2000® transmit signals

The R&S®FSH-K46 option helps the R&S®FSH make 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). The carrier frequency offset, the error vector magnitude (EVM) and Rho are also measured and displayed. The user can detect transmitter impairments such as clipping or intermodulation that are difficult to recognize in the spectrum.

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

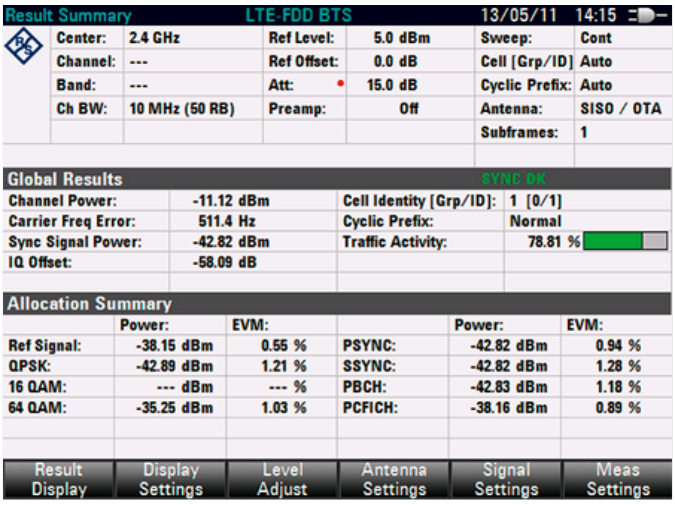
The code domain channel table contains additional information such as the symbol rate and the channel number with its Walsh code.

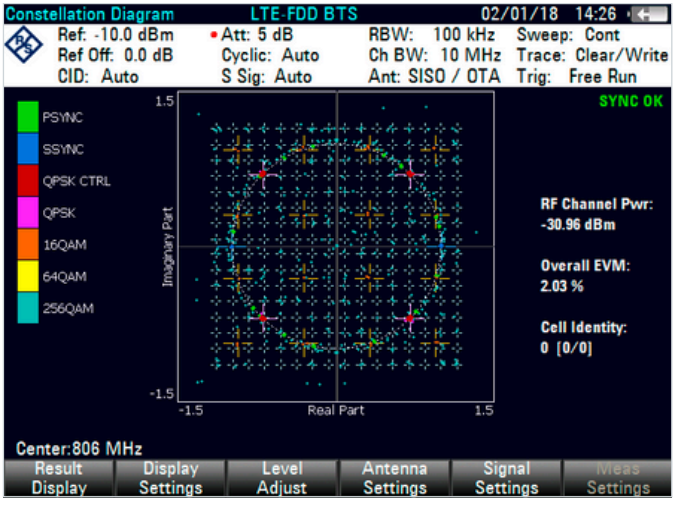


Analysis of 1xEV-DO transmit signals

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

The R&S®FSH-K47E option enables in-depth 1xEV-DO measurements. For a quick overview of adjacent base stations, the R&S®FSH provides up to eight PN offsets with corresponding power. The burst power measurement in the time domain checks whether the 1xEV-DO frame power and timing are standard compliant.





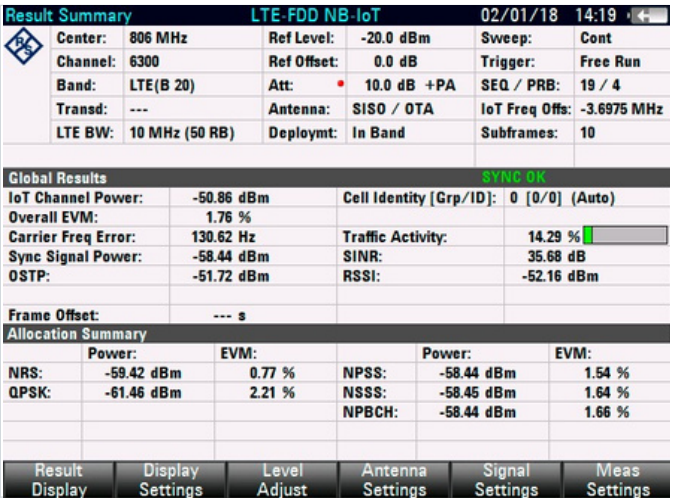
Analysis of LTE FDD/TDD transmit signals

The R&S®FSH-K50/-K51[1] option equips the R&S®FSH for LTE FDD and LTE TDD eNodeB transmitter measurements. It can analyze all signal bandwidths defined in the LTE standard up to 20 MHz. Both options support all important LTE measurements – from single input single output (SISO) to 4x4 multiple input multiple out- put (MIMO) transmissions. In addition to total power, the R&S®FSH-K50/-K51 determines the power for the reference signal, the physical control format indicator channel (PCFICH), the physical broadcast channel (PBCH) and the two PSYNC and SSYNC synchronization channels.

It also measures and displays the carrier frequency offset and EVM value of the reference signal and the useful data. Users can now detect transmitter impairments such as clipping or intermodulation that are difficult to recognize in the spectrum.

The R&S®FSH also supports LTE-Advanced carrier aggregation. Measurement results of up to three LTE carriers are displayed simultaneously. A simple pass/ fail indication helps the user detect errors in the antenna and cable installation. Using the isotropic antennas of the R&S®TS-EMF measurement system, the R&S®FSH-K50/-K51 can also measure the LTE signal electric field strength. The R&S®FSH-K50E/-K51E options are available for in-depth LTE analysis. In addition to displaying the EVM value, the option includes a constellation diagram that graphically displays LTE signal quality. The different modulation types and LTE signal components can be displayed separately. An LTE BTS scanner for measurements of the OTA interface. The scanner measures power for the eight strongest LTE signals and provides a quick overview of all LTE base stations in the surrounding area.

[1] Available for R&S®FSH with serial numbers ≥ 105000.

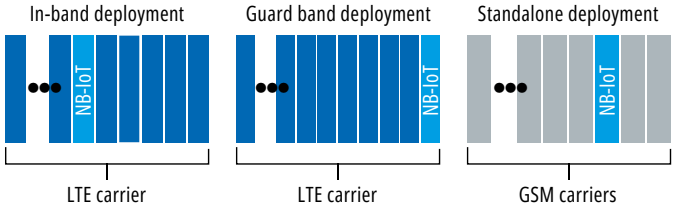


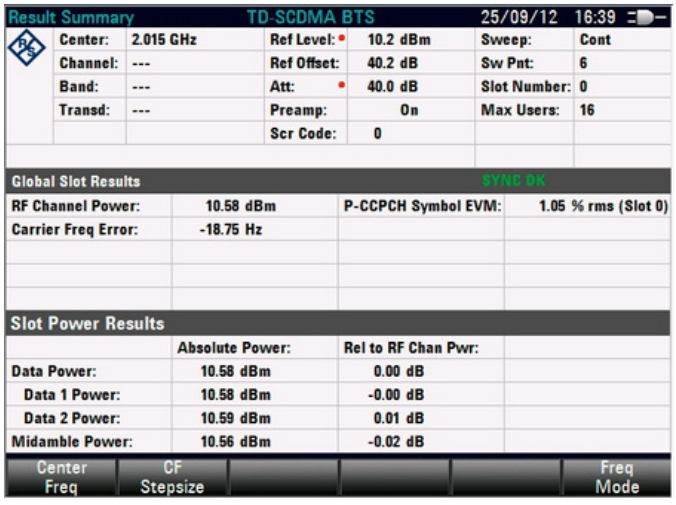
Analysis of NB-IoT transmit signals

The R&S®FSH-K56 option enables the R&S®FSH to measure NB-IoT transmit signals. NB-IoT occupies a bandwidth of 180 kHz or one resource block in LTE transmissions. The error vector magnitude (EVM) and frequency error shown on the result summary page are important parameters for determining the quality of the transmitted signal. Other NB-IoT downlink physical signal parameters (NPSS, NSSS and NPBCH) are also measured and displayed. The constellation diagram graphically shows the quality of the NB-IoT signals.

The R&S®FSH-K56 option supports analysis of an NB-IoT downlink signal in three deployment modes – in-band, guard band and standalone.

Deployment modes for NB-IoT

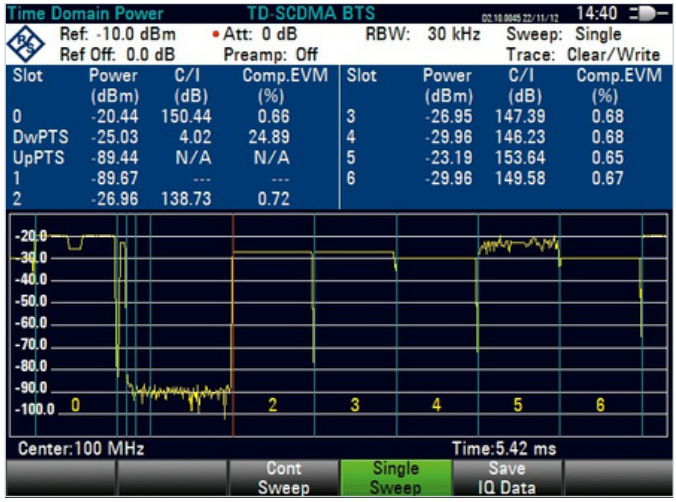




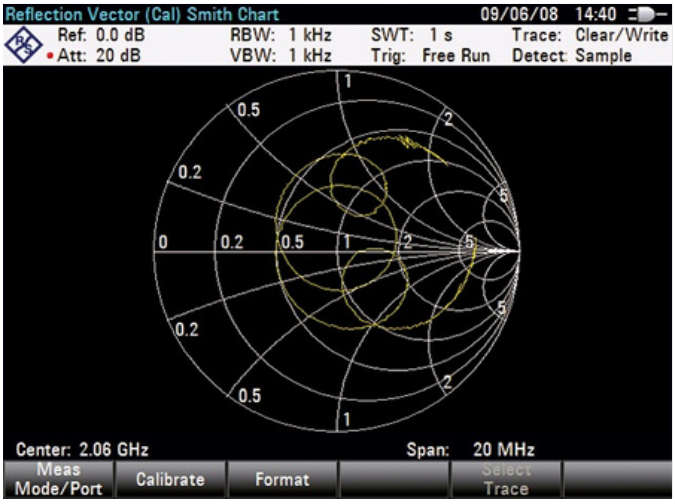
Analysis of TD-SCDMA/HSDPA transmit signals

With the R&S®FSH-K48/-K48E measurement applications, the R&S®FSH provides a quick overview of the main parameters needed for commissioning and maintaining TD-SCDMA/HSDPA base stations. The R&S®FSH-K48 measurement application displays a summary of the results. The carrier frequency error (CFE) and PCCPCH symbol error vector magnitude (EVM) are also provided to indicate signal quality. The absolute channel power and the channel power relative to the total signal power of the data parts and midamble parts of a selected timeslot are measured, providing information about the signal-to-interference ratio.

The R&S®FSH-K48E measurement application enables fast and reliable in-depth analysis of TD-SCDMA/HSDPA signals. The time domain power display shows the received power, C/I and composite EVM of each active slot within the TD-SCDMA subframe. The results are simultaneously displayed in a table and in a diagram. Display lines and numbering help the user easily check whether the power and timing of each subframe comply with specifications.



The code domain power display shows the active and inactive TD-SCDMA codes within the selected frequency channel. The channel table display shows the main parameters of the TD-SCDMA and HSDPA channels. The Sync ID display shows the signals coming from different base stations.

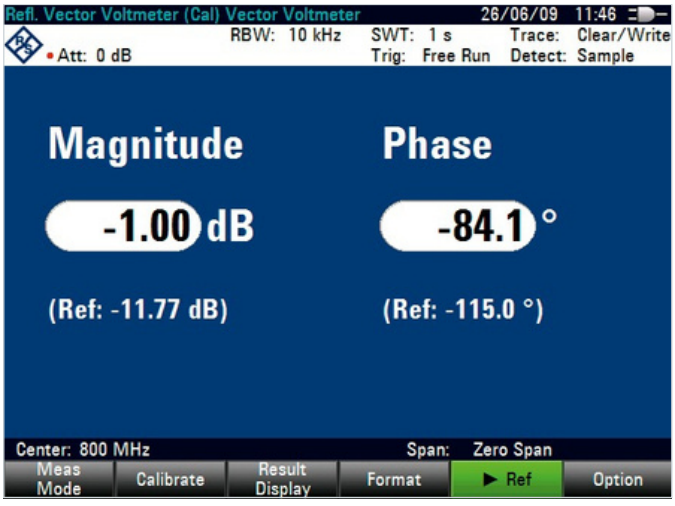


Vector network analysis

The vector measurements option adds a built-in tracking generator and an internal VSWR bridge allowing the R&S®FSH to act as a two-port vector network analyzer. Matching and transmission characteristics for filters, amplifiers, etc. can be determined quickly and accurately in the forward and reverse directions in a single test setup. The built-in DC bias supplies power to active DUTs through the RF cable, which is especially useful for mast-mounted amplifiers in base stations.

- ► Higher measurement accuracy due to vector system error correction
- ► Measurement of magnitude and phase of S-parameters S_{11} 2), S_{21} 2), S12 and S22
- ► Simultaneous display of magnitude and phase in split-screen mode
- ► Simultaneous display of four 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 Ω
- ► Electrical length measurement
- ► Determination of group delay
- ► Measurement of matching characteristic of the antenna (return loss, reflection coefficient or VSWR) 3)

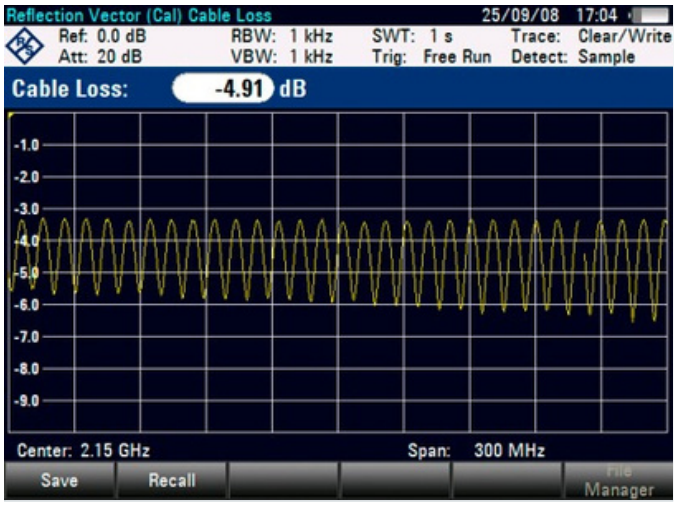
2) Not applicable to R&S®FSH13 and R&S®FSH20.
3) Applicable only to R&S®FSH models with built-in VSWR bridge (models .23/.24/.28/.30).



Vector voltmeter

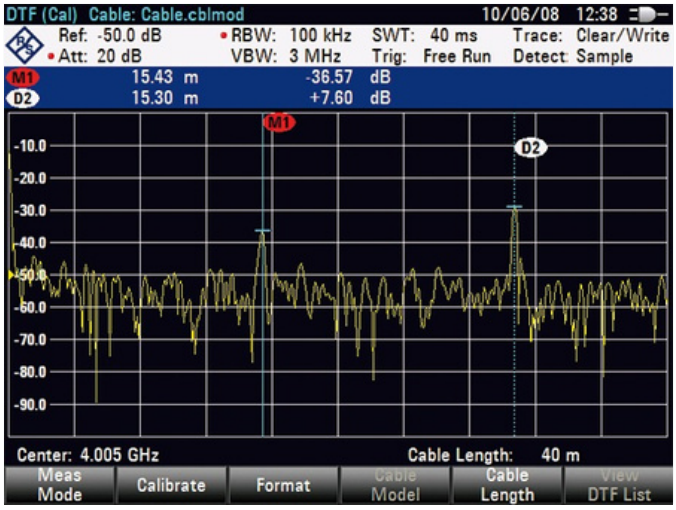
The R&S®FSH-K45 vector voltmeter option displays DUT magnitude and phase at a fixed frequency. The R&S®FSH (models .23/.24/.28/.30) can replace conventional vector voltmeters in many applications. The required signal source and bridge are available in the R&S®FSH, saving costs and simplifying the test setup, making the R&S®FSH-K45 ideal for field use. The measurement results for a reference DUT can be stored at the press of a button and used later for a relative measurement. Comparison measurements such as between different RF cables and a reference cable (golden device) are quick and easy. Typical applications:

- ► Adjusting electrical cable length
- ► Checking phase-controlled antennas used in an instrument landing system (ILS) for air traffic control



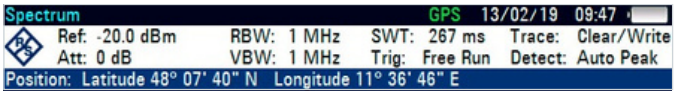
One-port cable loss measurements

The R&S®FSH can determine the cable loss of installed cables with little effort. Simply connect one end of cable to the R&S®FSH measurement port. The other end of the cable is terminated with a short circuit or left open.



Distance-to-fault measurements

The distance-to-fault from a pinched, loose or corroded cable connection 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 listed. This considerably simplifies measurement evaluation.



Position finding and increased measurement accuracy with GPS receiver

The R&S®FSH uses R&S®HA-Z240 GPS receiver to document 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 after position finding, the frequency accuracy of the R&S®FSH is 25 ppb (25 × 10–9). To fasten the GPS receiver on the roof of a car the GPS receiver is equipped with a magnet and a 5 m cable.

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

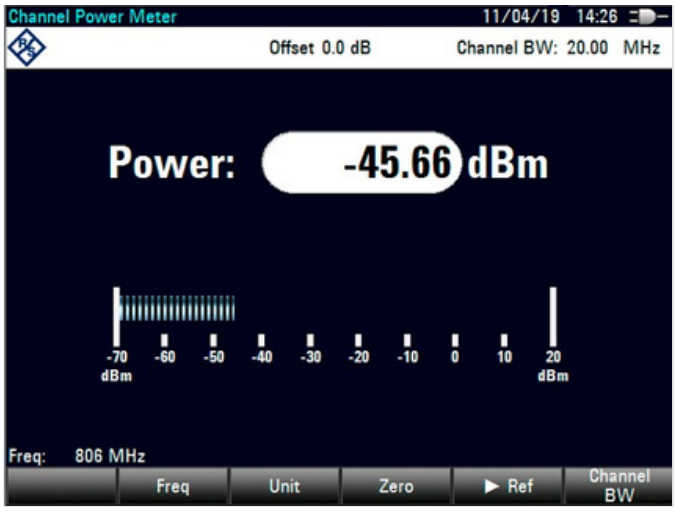
Directional power measurements up to 4 GHz

The R&S®FSH-Z14 and R&S®FSH-Z44 directional power sensors transform the R&S®FSH 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®FSH 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.

R&S®NRP power sensors

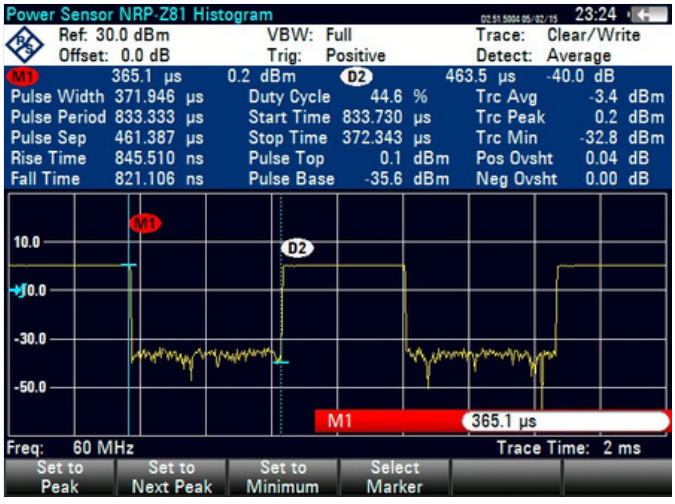
Highly accurate power measurements up to 110 GHz with terminating power sensors

Equipped with the R&S®NRP USB power sensors, the R&S®FSH becomes a highly accurate RF power meter up to 110 GHz with a dynamic range from –70 dBm to +45 dBm.



Channel power meter

This standard function enables the R&S®FSH to measure channel power without an external power sensor with the same accuracy as in spectrum analyzer mode. The measurement amplitude range goes up to +30 dBm. The frequency range depends on the R&S®FSH spectrum analyzer model. The channel bandwidth can be set up to 1 GHz and allows measuring all types of signals, including modulated signals such as LTE, WCDMA, etc.



Pulse analysis with wideband power sensors

When equipped with the R&S®FSH-K29 option and a R&S®NRP-Z81/-Z85/-Z86 wideband power sensor, the R&S®FSH can measure peak power and the main pulse parameters up to 44 GHz.

Optical power measurement with optical power sensor

When connected to an R&S®HA-Z360/-Z361 optical power sensor, R&S®FSH power meter mode reads out optical absolute power in dBm as well as relative power in dB.

INTERFERENCE ANALYSIS, GEOTAGGING AND INDOOR MAPPING

In wireless systems, interference causes low data rates, dropped calls and poor voice quality, often making it impossible to establish or maintain a connection.

A rugged, lightweight, handheld spectrum analyzer such as the R&S®FSH is the optimum tool for interference analysis in the field.

Spectrogram measurements with R&S®FSH-K14 and R&S®FSH-K15

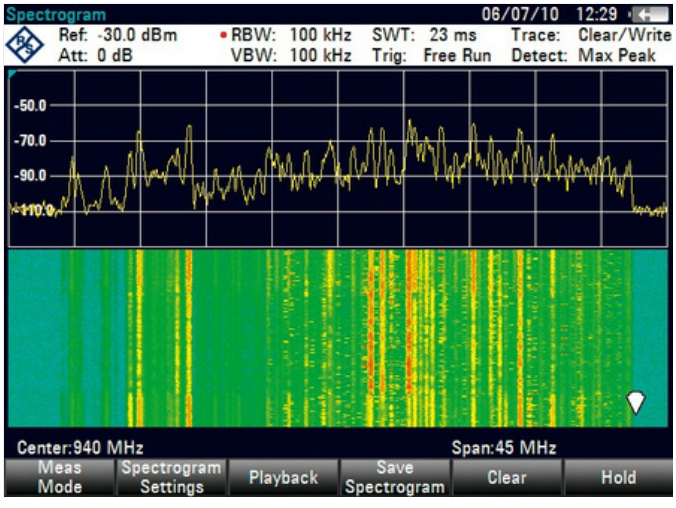
The spectrogram measurements application allows the R&S®FSH to provide a history of the spectrum. As a result, intermittent faults or variations in frequency and level versus time can be analyzed. Specific evaluations can be made by replaying recorded data and setting time lines and markers.

The R&S®FSH can record up to 999 hours. The recording interval is adjustable. A short recording interval results in an increasing capturing rate, which is suitable for capturing very short intermittent signals.

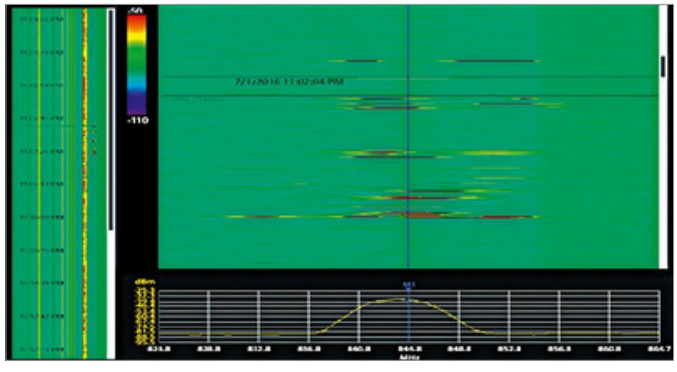
Recording can be initiated manually, with predefined start and stop date and time, or triggered by events. Using R&S®InstrumentView, the compressed view on the left allows fast search of ambiguous signals and the spectrum display on the right bottom can be zoomed in for further analysis.

Time and frequency markers can be added during the post-analysis stage and for documentation. This long time recording spectrogram allows unmanned recording, collection of activities over a long period and facilitates post-analysis, which is useful for interference hunting and spectrum observation.

Simultaneous display of spectrum and spectrogram



Long time spectrogram recording analysis with R&S®InstrumentView



Interference analysis with R&S®FSH-K15 and directional antennas

Equipped with the R&S®FSH-K15 option and a directional antenna such as the R&S®HE400, the R&S®FSH helps network operators and regulatory bodies to successfully detect and characterize interfering signals and find interference sources.

In addition to the spectrogram and standard spectrum analyzer measurements, interference specific measurements such as carrier to noise (C/N), carrier to interference (C/I) and trace mathematics (diff mode) help users to easily find, monitor and characterize interfering signals.

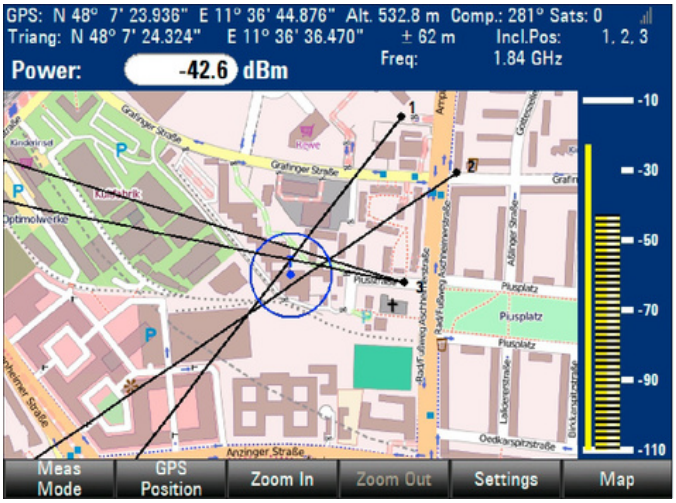
The mapping feature uses the triangulation technique to locate the interferer. Using the R&S®OSM wizard, Open Street Maps (OSM) can be easily downloaded for use with the R&S®FSH.

The tone feature helps users acoustically find the direction where the interference is coming from without needing to constantly look at the map or watch the signal levels.

The R&S®HE400 is the perfect handheld antenna for interference hunting with the R&S®FSH. The antenna modules cover frequencies between 8.3 kHz and 8 GHz and are equipped with GPS and an electronic compass. There is a toggle button on top of the R&S®HE400 handle to switch on the R&S®FSH preamplifier, and a trigger button that can be used to save the screenshot or position coordinates and bearing information. The R&S®HE400 weighs only 1 kg and has a small footprint, which makes it very handy for interference hunting in the field together with the R&S®FSH.

R&S®FSH with R&S®HE400 antenna

Display of map triangulation lines with R&S®FSH-K15



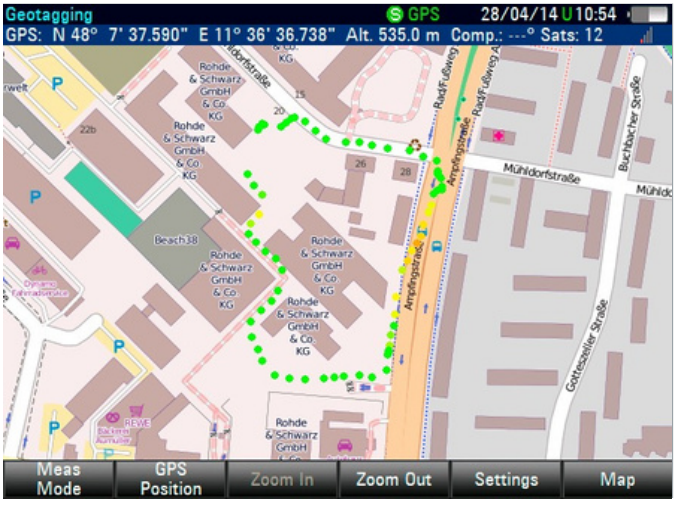
Geotagging

When equipped with the R&S®FSH-K16, the R&S®HA-Z240 GPS receiver and an antenna, the R&S®FSH can analyze the geographical distribution of the received signal strength, enabling network operators to analyze the coverage conditions around the base station coverage area.

The R&S®FSH-K16 geotagging option can also be used by base station maintenance technicians to document and report on the map the site location where the measurements were performed.

The measured data can be displayed on Google Earth for postprocessing, making it easier to recognize areas with poor coverage or high levels of interference.

Geotagging results display with R&S®FSH-K16



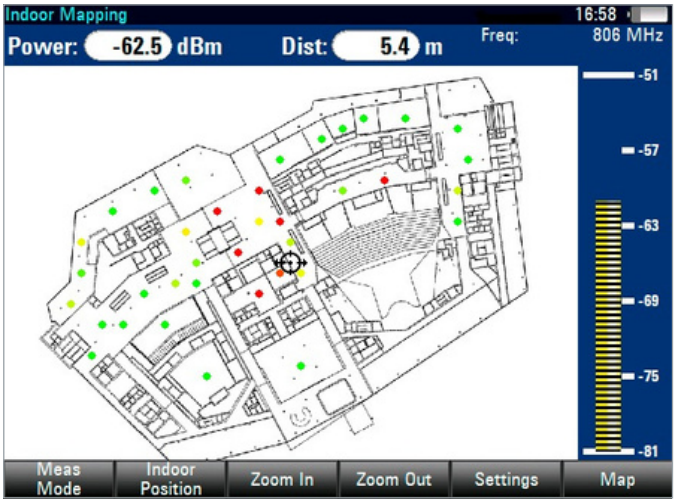
Indoor mapping

The indoor mapping function helps users measure indoor coverage in a simple and reliable way.

With the indoor mapping option (R&S®FSH-K17), the user can easily import indoor maps into the R&S®FSH and record the signal strength distribution in environments where a GPS signal is not available, such as buildings or tunnels, while keeping the information of the location where measurements have been done.

Measured data can be converted to .csv format for analysis with Microsoft Excel. Export to the .kmz format is also possible, to analyze the data and superimpose the indoor map in Google Earth.

Indoor mapping with R&S®FSH-K17



OpenStreetMap (OSM)

OpenStreetMap (OSM) is a user-editable world map that is available at the following internet address: www.openstreetmap.org/

OSM is a wiki project in which users upload and edit geographical information such as GPS tracking data or the course of a road or river. This world map is growing daily.

OpenStreetMap data is available for free under the terms of the Creative Commons Attribution-ShareAlike 2.0 license.

MEASUREMENTS OF ELECTROMAGNETIC FIELDS

The R&S®FSH can reliably determine the effects of electromagnetic fields (EMF) caused by transmitter systems.

Due to its large frequency range of up to 20 GHz, the R&S®FSH covers all common wireless communications services, including GSM, CDMA, WCDMA, LTE, DECT, Bluetooth®, WLAN (IEEE 802.11a, b, g, n), WiMAX™, broadcasting and television.

The R&S®FSH 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®FSH takes into account the specific antenna factors of the connected antenna. The field strength is displayed directly in dBµV/m. If W/m2 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®FSH provides two user-definable limit lines with automatic limit monitoring.

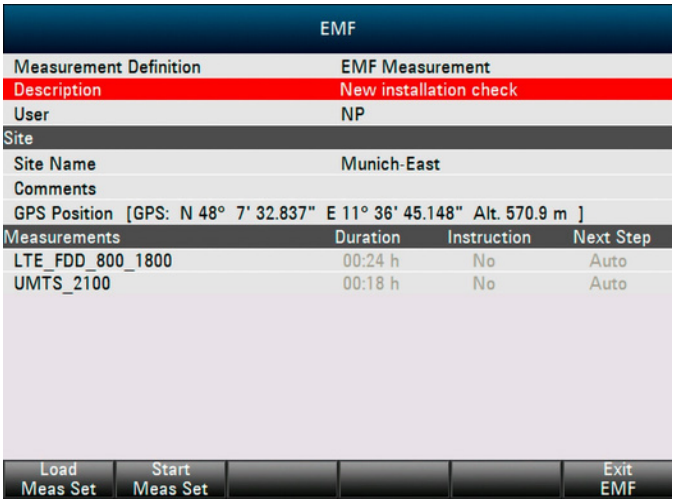
Field strength measurements with isotropic antennas

Equipped with the isotropic antennas of the R&S®TS-EMF measurement system, the R&S®FSH 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®FSH 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®FSH with isotropic antennas

The R&S®FSH with the R&S®HE400 antenna

Measurement test sequences in the R&S®FSH-K105 EMF measurement application

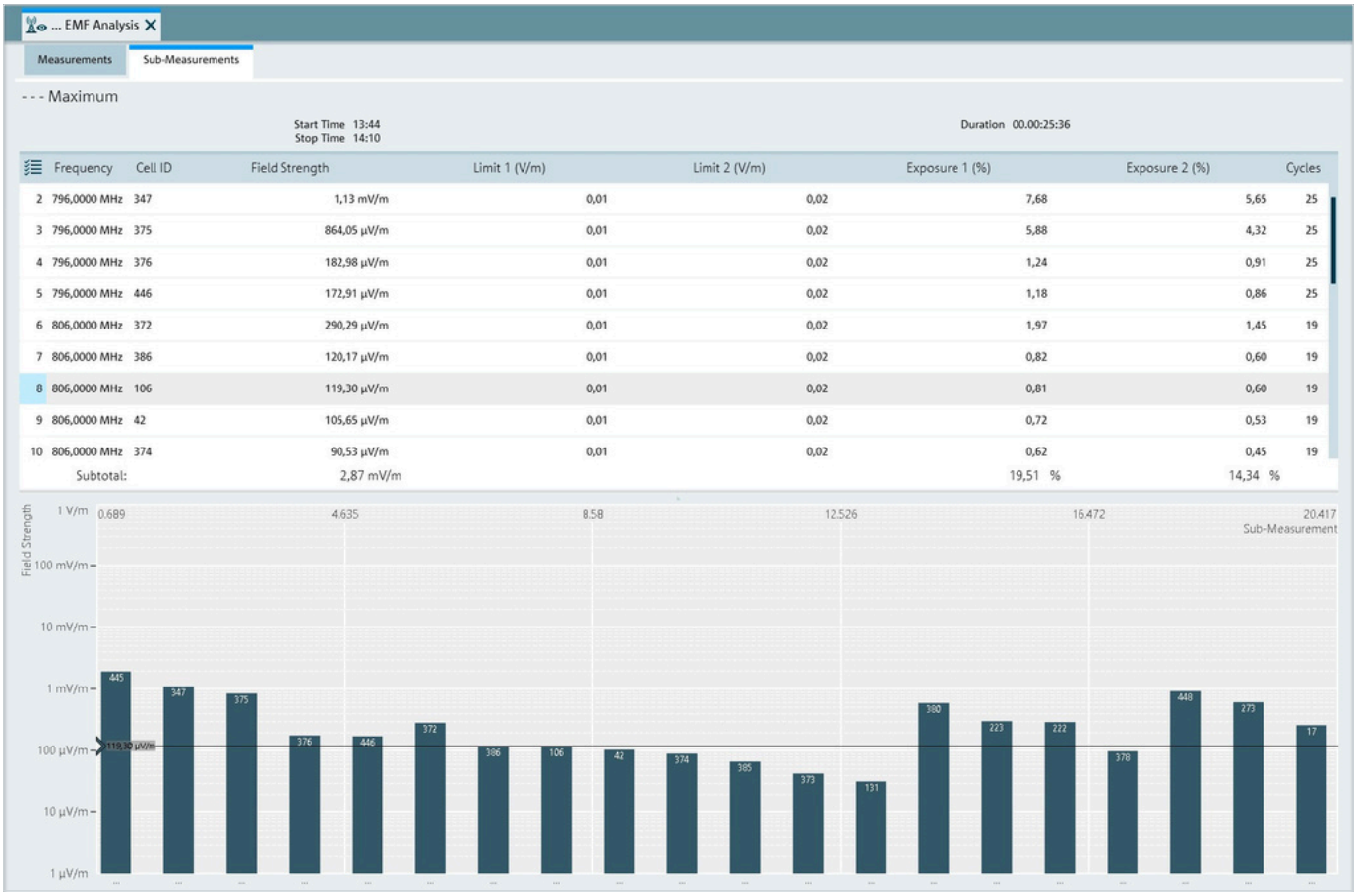


EMF measurement application (R&S®FSH-K105 option)

The R&S®FSH-K105 option supports automated test sequences to perform frequency selective measurements. The measurement is conveniently configured using the R&S®InstrumentView software. The configuration setup covers one or several sub-measurements on various frequencies or channels. It can include setting the limits of the EMF emissions in line with national and international standards during the configuration step or after the measurement. This provides a quick overview of whether the transmitter system complies with the applicable safety exposure limits.

Preconfiguration is performed in the lab. This saves time and effort in the field. With just a few clicks, all test sequences are executed automatically. The result can be previewed on the analyzer or using the R&S®InstrumentView software where the results can be analyzed and documented.

Measurement results of the R&S®FSH-K105 EMF measurement application



DIAGNOSTIC APPLICATIONS IN THE LAB OR IN SERVICE

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

The R&S®FSH is suitable, for example, for the following measurements:

- ► Frequency and level measurements
- ► Power measurements up to 110 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

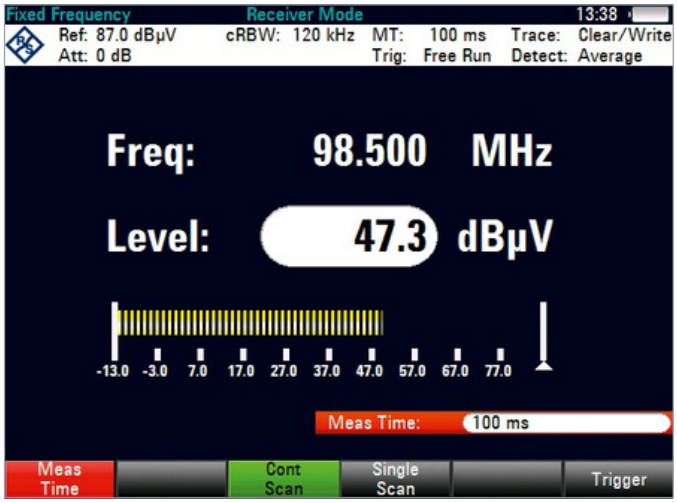
The R&S®FSH with fold-out stand for desktop use

EMC precompliance measurements and channel scan

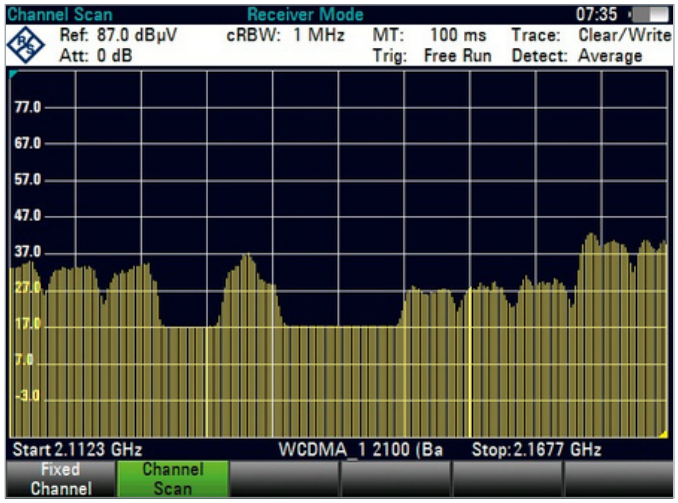
Equipped with the R&S®FSH-K43 option, the R&S®FSH can be operated as a receiver for precompliance EMC applications and monitoring tasks. Measurements are performed at a predefined frequency with adjustable measurement time.

In the channel scan mode, the R&S®FSH sequentially measures the levels at various frequencies defined in a channel table. The channel tables are generated with the R&S®InstrumentView software and loaded into the R&S®FSH. There are predefined tables for a large number of mobile communications standards and TV transmitters. CISPR bandwidths of 200 Hz, 9 kHz, 120 kHz and 1 MHz are available for EMI emission measurements. Peak, average, RMS and quasi-peak detectors can be selected.

EMC precompliance measurement at a fixed frequency with adjustable measurement time



Channel scan of a 3GPP WCDMA frequency band



AM modulation depth measurements

The R&S®FSH 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.

Measurement of signal distortions caused by harmonics

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

Location of EMC problems

The R&S®HZ-15/HZ-17 near-field probes are used as diagnostic tools for locating EMC problems on circuit boards, integrated circuits, cables and shielding. The R&S®HZ-15/HZ-17 near-field probe set is ideal 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 com- bination with the R&S®FSH, the preamplifier and near- field probe set are a cost-effective means of analyzing and locating disturbance sources during development.

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

DOCUMENTATION AND REMOTE CONTROL

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

R&S®InstrumentView software for documenting measurement results

- Large data exchange between the R&S®FSH and a PC via a USB or LAN connection
- Easy processing of measurement results thanks to data export in Excel format (.csv)
- Storage of graphics data in .jpg, .tiff, .jpg, .png and .bmp format
- Generation of user-defined test sequences (wizard)
- Easy creation of test reports in .pdf, .html and .rtf format
- Printout of all relevant data via Windows PC
- Remote signal monitoring via USB/LAN by means of remote display and lab display
- Simple comparison of measurement results within the same workspace by using the “Add Trace” function
- Automatic storage of measurement results with "Multi Transfer" (continuous sweep retrieval with interval) in AutoSave session
- Subsequent analysis of measurement results by displaying/hiding and shifting markers
- Generation of cable data using a cable model editor and file transfer to download to the R&S®FSH for distance-to-fault measurement

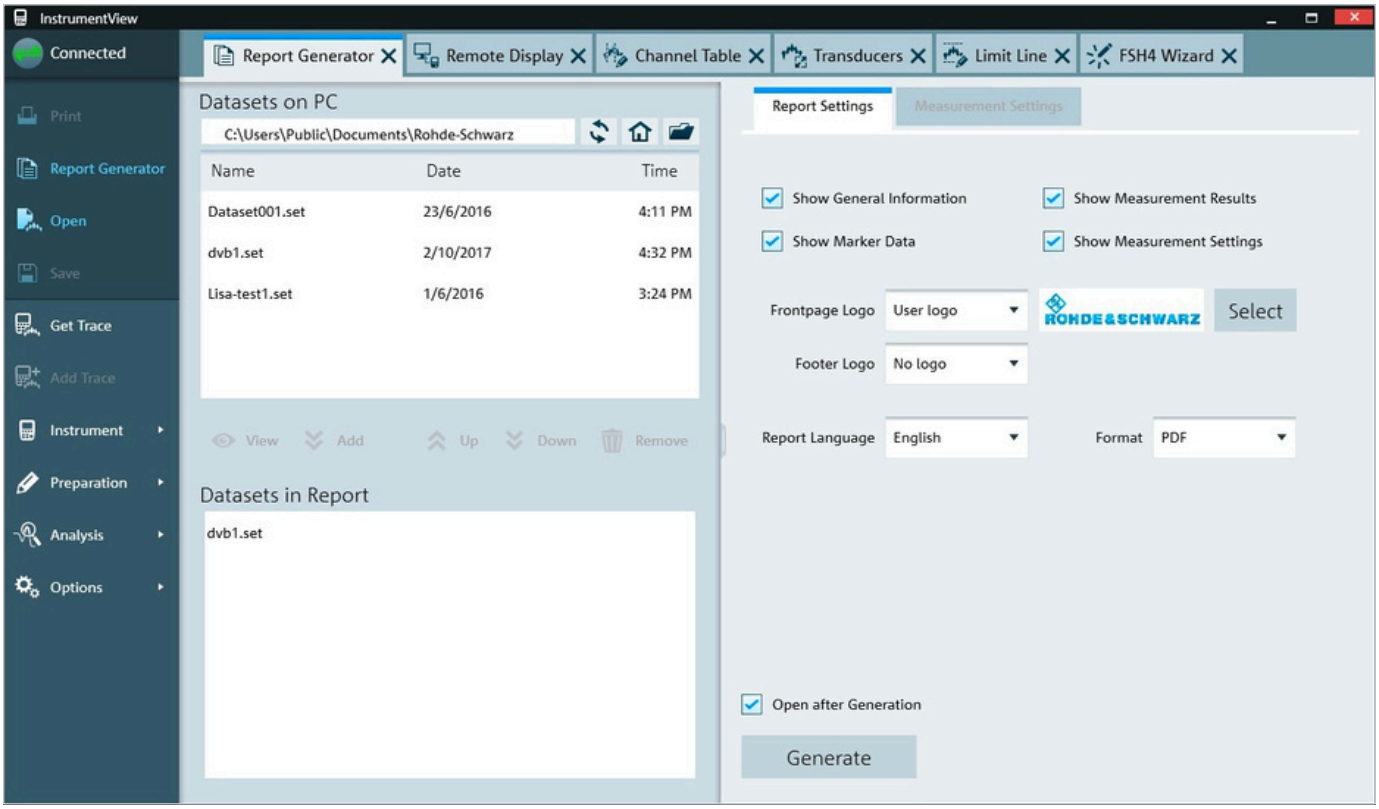
The R&S®FSH with laptop

- R&S®InstrumentView supports the following editors:
  - Transducers
  - Cable models
  - Calibration kits
  - Limit lines
  - Channel tables
  - Standards
  - Quick name tables
  - AM/FM limits
  - Wizard sets
  - (Indoor) Maps
- Compatible with
  - Windows Vista (32/64 bit)
  - Windows 7 (32/64 bit)
  - Windows 8 (32/64 bit)
  - Windows 10 (32/64 bit)

Remote control via LAN or USB

The R&S®FSH can be remotely 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 remote display included with the R&S®InstrumentView software shows the R&S®FSH screen in real time and allows users to operate the instrument remotely via USB or LAN for training and presentation purposes.

The R&S®InstrumentView software



EASY OPERATION

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

Quick function selection via keypad and rotary knob

The R&S®FSH is operated via the keypad and rotary knob. The selected function can be activated directly using the Enter button integrated into the rotary knob. The vertical design puts all operating elements at your fingertips. The MODE key is used to switch between the various operating modes such as “spectrum analyzer“, “ vector network analyzer“, “digital modulation analysis“ and “power meter“.

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

All operating elements within fingertip reach

The USER key allows frequently required measurements to be collected in a single menu. User-defined instrument setups are assigned to softkeys under a user-definable name.

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

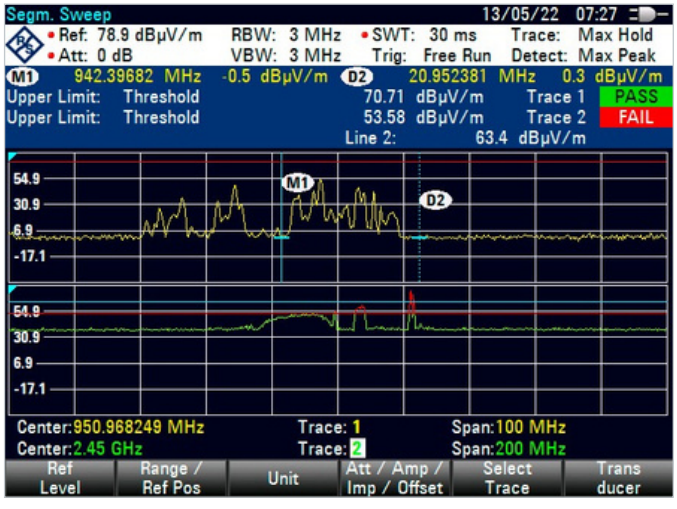
Optimal reading of measurement results in any situation

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.

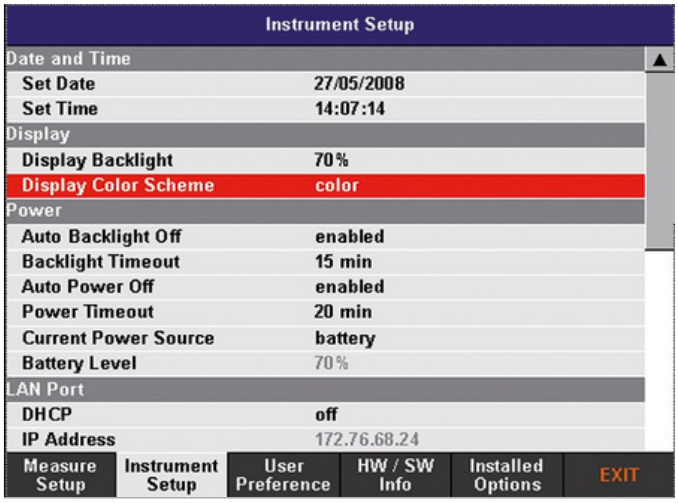
Segmented sweep

The R&S®FSH-K20 segmented sweep option turns on the second display segment in spectrum mode and is like having two handheld spectrum analysers. The segmented sweep option enables measurements on the second spectrum display with independent settings such as frequency range, detectors, attenuator and preamplifier. This flexibility allows signal behaviour comparisons with different detectors selected, observing and measuring the signal of interest in one display and checking for harmonics or interference in the other. If the signals are located far apart, two different frequency ranges can be set without cluttering the signals in a single display with a wide span setting. The signals shape visibility is clearer on both intended ranges.

R&S®FSH-K20 segmented sweep option

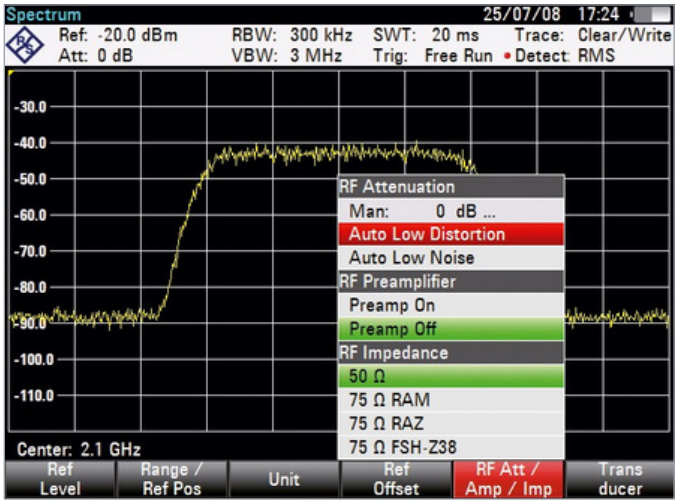


Easy configuration of instrument setup



Selecting the channel table

Straightforward menus for easy selection of functions



Test report in just a few steps with the R&S®FSH wizard

When an antenna is installed or a transmit station is commissioned, the customer usually requests a test report. The required measurements are defined in test instructions. The R&S®FSH wizard makes this procedure easy for the user and eliminates the need to consult the installation instructions. The dialog based wizard guides the user through the measurements and automatically saves the results.

The advantages for the user:

- ► Easy creation of test sequences using the wizard
- ► Incorrect measurements are prevented thanks to predefined test sequences
- ► No need to consult test instructions
- ► Reproducible measurement results
- ► Time is saved by speeding up the installation process
- ► All members of an installation team use the same test sequence
- ► Uniform test report format

Setting of frequency via channel tables

As an alternative to entering a frequency, the R&S®FSH 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®FSH even more easily. TV channel tables for a large number of countries are supplied with the R&S®FSH.

Operation in different languages

The user interface of the R&S®FSH 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®FSH supports the following languages: English, German, Korean, Japanese, Chinese, Russian, Italian, Spanish, Portuguese, French and Hungarian.

Easy-to-access, well-protected connectors

Additional inputs/outputs such as the DC voltage supply (bias), LAN and USB 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) protected by hinged covers

OPERATING ELEMENTS

RF input

Connector for power sensor

Connector for headphones

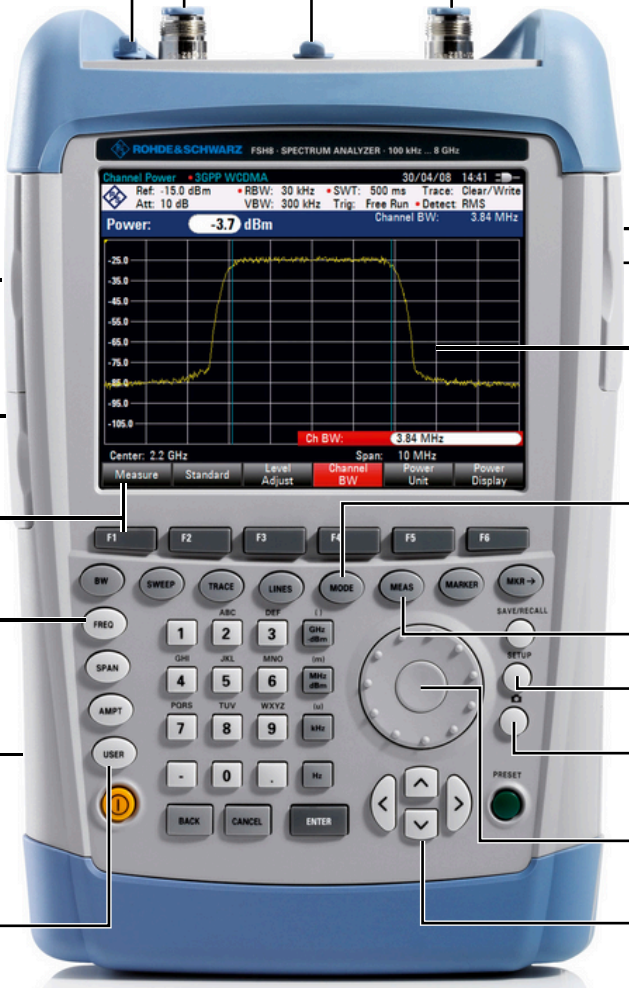
Tracking generator output

USB interface, type A 4)

- Ext. trigger input
- Ext. reference input
- IF output
- Bias input
- Connector for accessories

SD memory card

Color LCD (640 × 480 pixel), can be switched to high-contrast monochrome display in extreme sunlight



LAN/USB interface

Selection between different operating modes (spectrum analyzer, vector network analyzer, power meter, etc.)

Simple menu based operation via softkeys

Selection of the measurement function (channel power, occupied bandwidth, etc.)

Function keys

General instrument setup

Kensington lock

Screenshot

Rotary knob with Enter button

Call-up of user-defined settings

Cursor keys

4) Interface integrated into instruments with serial numbers ≥ 105000.
For connecting R&S®NRP-Zxx power sensors and USB sticks.

SYSTEM CONFIGURATION OPTIONS AND APPLICATIONS

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

Altogether ten R&S®FSH models for different applications and frequency ranges are available (models .04/.08/.14/.18/.24/.28/.13/.23/.20/.30). The R&S®FSH can perform measurements up to an upper frequency limit of 3.6 GHz, 8 GHz, 13.6 GHz or 20 GHz. 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.

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 110 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.

Models

	Frequency range	Preamplifier	Tracking generator	Built-in VSWR bridge	DC voltage supply (bias) for port 1/2
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	•	•	•	•
R&S®FSH13, model .13	9 kHz to 13.6 GHz	•	–	–	–
R&S®FSH13, model .23	9 kHz to 13.6 GHz	•	•	•	–
R&S®FSH20, model .20	9 kHz to 20 GHz	•	–	–	–
R&S®FSH20, model .30	9 kHz to 20 GHz	•	•	•	–

Standard functions

Models	.04/.08/.13/.20	.14 /.18	.24/.28	.23/.30
TDMA power measurements Channel	•	•	•	•
power measurements	•	•	•	•
Field strength measurements/ measurements with isotropic antennas	•	•	•	•
Occupied bandwidth measurements	•	•	•	•
Frequency settings via channel tables	•	•	•	•
Scalar transmission measurements	–	•	•	–
Scalar reflection measurements	–	–	•	–
Vector transmission (S12) and reflection (S22) measurements	–	–	–	•
One-port cable loss measurements	–	–	–	•
Channel power meter	•	•	•	•

Options

Models	.04/.08/.13/.20	.14 /.18	.24/.28	.23/.30
Spectrogram measurements	R&S®FSH-K14	R&S®FSH-K14	R&S®FSH-K14	R&S®FSH-K14
Interference analysis	R&S®FSH-K15	R&S®FSH-K15	R&S®FSH-K15	R&S®FSH-K15
Geotagging	R&S®FSH-K16	R&S®FSH-K16	R&S®FSH-K16	R&S®FSH-K16
Indoor mapping	R&S®FSH-K17	R&S®FSH-K17	R&S®FSH-K17	R&S®FSH-K17
Receiver mode and channel scan measurements	R&S®FSH-K43	R&S®FSH-K43	R&S®FSH-K43	R&S®FSH-K43
Analysis of GSM/GPRS/EDGE transmit signals	R&S®FSH-K10	R&S®FSH-K10	R&S®FSH-K10	R&S®FSH-K10
Analysis of WCDMA/HSDPA/HSPA+ transmit signals	R&S®FSH-K44, R&S®FSH-K44E	R&S®FSH-K44, R&S®FSH-K44E	R&S®FSH-K44, R&S®FSH-K44E	R&S®FSH-K44, R&S®FSH-K44E
Analysis of CDMA2000® signals	R&S®FSH-K46, R&S®FSH-K46E	R&S®FSH-K46, R&S®FSH-K46E	R&S®FSH-K46, R&S®FSH-K46E	R&S®FSH-K46, R&S®FSH-K46E
Analysis of 1xEV-DO signals	R&S®FSH-K47, R&S®FSH-K47E	R&S®FSH-K47, R&S®FSH-K47E	R&S®FSH-K47, R&S®FSH-K47E	R&S®FSH-K47, R&S®FSH-K47E
Analysis of TD-SCDMA/HSDPA signals	R&S®FSH-K48, R&S®FSH-K48E	R&S®FSH-K48, R&S®FSH-K48E	R&S®FSH-K48, R&S®FSH-K48E	R&S®FSH-K48, R&S®FSH-K48E
Analysis of LTE FDD signals	R&S®FSH-K50 5), R&S®FSH-K50E	R&S®FSH-K50	R&S®FSH-K50	R&S®FSH-K50
Analysis of LTE TDD signals	R&S®FSH-K51 5), R&S®FSH-K51E	5), R&S®FSH-K50E R&S®FSH-K51	5), R&S®FSH-K50E R&S®FSH-K51	5), R&S®FSH-K50E R&S®FSH-K51
Analysis of NB-IoT downlink signals	R&S®FSH-K56 5)			
Distance-to-fault (DTF) measurements	–	5), R&S®FSH-K51E R&S®FSH-K56 5)	5), R&S®FSH-K51E R&S®FSH-K56	5), R&S®FSH-K51E R&S®FSH-K56
Vector reflection and transmission measurements (S11, S22, S21, S12)	–	–	R&S®FSH-K42 5)	• (S 12, S22 only) 5)
One-port cable loss measurements	–	–	R&S®FSH-K42	R&S®FSH-K41
Vector voltmeter	–	–	R&S®FSH-K45	R&S®FSH-K45
Power measurements up to 110 GHz	see power sensors on page 33			
Directional power measurements up to 1 GHz	R&S®FSH-Z14	R&S®FSH-Z14	R&S®FSH-Z14	R&S®FSH-Z14
Directional power measurements up to 4 GHz	R&S®FSH-Z44	R&S®FSH-Z44	R&S®FSH-Z44	R&S®FSH-Z44
Segmented sweep	R&S®FSH-K20	R&S®FSH-K20	R&S®FSH-K20	R&S®FSH-K20
Pulse measurements with power sensor 6)	R&S®FSH-K29	R&S®FSH-K29	R&S®FSH-K29	R&S®FSH-K29
Remote control via LAN or USB	R&S®FSH-K40	R&S®FSH-K40	R&S®FSH-K40	R&S®FSH-K40
EMF measurement application	R&S®FSH-K105	R&S®FSH-K105	R&S®FSH-K105	R&S®FSH-K10 5

[5] Available for R&S®FSH analyzers with serial numbers ≥ 105000.
[6] R&S®FSH-Z129 required for R&S®FSH4/8/13/20 with serial numbers as indicated in the data sheet.

SPECIFICATIONS IN BRIEF

Spectrum analysis

		R&S®FSH4	R&S®FSH8	R&S®FSH13	R&S®FSH20
Frequency range	models .04/.14/.08/.18/.13/.23/.20/.30	9 kHz to 3.6 GHz	9 kHz to 8 GHz	9 kHz to 13.6 GHz	9 kHz to 20 GHz
	models .24/.28	100 kHz to 3.6 GHz	100 kHz to 8 GHz	–	–
Resolution bandwidths		1 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, –118 dBm (typ.)		< –96 dBm, –106 dBm (typ.)	
	100 kHz to 1 MHz	< –115 dBm, –125 dBm (typ.)			
	1 MHz to 10 MHz	< –136 dBm, –144 dBm (typ.)			
	10 MHz to 2 GHz	< –141 dBm, –146 dBm (typ.)			
	2 GHz to 3.6 GHz	< –138 dBm, –143 dBm (typ.)			
	3.6 GHz to 5 GHz	–	< –142 dBm, –146 dBm (typ.)		
	5 GHz to 6.5 GHz	–	< –140 dBm, –144 dBm (typ.)		
	6.5 GHz to 13.6 GHz	–	< –136 dBm, –141 dBm (typ.)		
	13.6 GHz to 18 GHz	–	–	–	< –134 dBm, –139 dBm (typ.)
	18 GHz to 20 GHz	–	–	–	< –130 dBm, –135 dBm (typ.)
	with preamplifier, RBW = 1 Hz (normalized)				
	100 kHz to 1 MHz	< –133 dBm, –143 dBm (typ.)		–	
	1 MHz to 10 MHz	< –157 dBm, –161 dBm (typ.)		< –155 dBm, –160 dBm (typ.)	
	10 MHz to 2 GHz	< –161 dBm, –165 dBm (typ.)		–	
	2 GHz to 3.6 GHz	< –159 dBm, –163 dBm (typ.)		–	
	3.6 GHz to 5 GHz	–	< –155 dBm, –159 dBm (typ.)		
	5 GHz to 6.5 GHz	–	< –151 dBm, –155 dBm (typ.)		
	6.5 GHz to 8 GHz	–	< –147 dBm, –150 dBm (typ.)		
	8 GHz to 13.6 GHz	–	–	< –158 dBm, –162 dBm (typ.)	
	13.6 GHz to 18 GHz	–	–	< –155 dBm, –160 dBm (typ.)	
	18 GHz to 20 GHz	–	–	–	< –150 dBm, –155 dBm (typ.)
Third-order intercept (IP3)	300 MHz to 3.6 GHz	> 10 dBm, +15 dBm (typ.)			
	3.6 GHz to 20 GHz	–	> 3 dBm, +10 dBm (typ.)		
Phase noise	frequency 500 MHz				
	30 kHz carrier offset	< –95 dBc (1 Hz), –105 dBc (1 Hz) (typ.)			
	100 kHz carrier offset	< –100 dBc (1 Hz), –110 dBc (1 Hz) (typ.)			
	1 MHz carrier offset	< –120 dBc (1 Hz), –127 dBc (1 Hz) (typ.)			
Detectors		sample, max. peak, min. peak, auto peak, RMS			
Level measurement uncertainty	10 MHz < f ≤ 3.6 GHz	< 1 dB, 0.5 dB (typ.)			
	3.6 GHz < f ≤ 20 GHz	–	< 1.5 dB, 1 dB (typ.)		
Display		6.5" color LCD with VGA resolution			
Battery operating time (without tracking generator)	R&S®HA-Z204, 4.2 Ah	up to 3 h			
	R&S®HA-Z206, 6.3 Ah	up to 4.5 h			
Dimensions	W × H × D	194 mm × 300 mm × 69 mm (144 mm) 1) 7.6 in × 11.8 in × 2.7 in (5.7 in)			
Weight		3 kg (6.6 lb)			

1) With carrying handle.

Vector network analysis 2)/vector voltmeter 3)				
		R&S®FSH4	R&S®FSH8	R&S®FSH13/20
Frequency range Output	models .24/.28/.23/.30	300 kHz to 3.6 GHz	300 kHz to 8 GHz	100 kHz to 8 GHz
power (port 1) Output		0 dBm to –40 dBm		–
power (port 2)		0 dBm to –40 dBm		0 dBm to –40 dBm
Reflection measurements				
Directivity	300 kHz to 3 GHz	> 43 dB nominal	> 43 dB nominal	> 43 dB nominal
	3 GHz to 3.6 GHz	> 37 dB nominal	> 37 dB nominal	4) > 37 dB
	3.6 GHz to 6 GHz	– –	> 37 dB nominal	nominal 4) >
	6 GHz to 8 GHz		> 31 dB nominal	37 dB nominal 4)
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		> 31 dB nominal 4)
	vector voltmeter (R&S®FSH-K45)	magnitude + phase, VSWR + reflection		
	S-parameter	S11, S22	S11, S22	S22
Transmission measurements				
Dynamic range (S 21)	100 kHz to 300 kHz	70 dB (typ.) > 70 dB,	70 dB (typ.) > 70 dB,	– – – – 80 dB (typ.) >
	300 kHz to 3.6 GHz	90 dB (typ.) – – 80 dB	90 dB (typ.) > 70 dB,	80 dB, 100 dB (typ.) >
	3.6 GHz to 6 GHz	(typ.) > 80 dB, 100 dB	90 dB (typ.) 50 dB	80 dB, 100 dB (typ.)
	6 GHz to 8 GHz	(typ.) – –	(typ.) 80 dB (typ.) >	60 dB (typ.)
Dynamic range (S 12)	100 kHz to 300 kHz		80 dB, 100 dB (typ.) >	
	300 kHz to 3.6 GHz		80 dB, 100 dB (typ.)	
	3.6 GHz to 6 GHz		60 dB (typ.)	
	6 GHz to 8 GHz			
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		
	S-parameter	S12, S21	S12, S21	S12

[2] Available for models .24/.28/.23/.30 only; models .24/.28 require R&S®FSH-K42 additionally.
[3] For models .24/.28/.23/.30 only, requires R&S®FSH-K45.
[4] Only S 22 measurements.

ORDERING INFORMATION

Designation	Type	Order No.
Base unit		
Handheld spectrum analyzer, 9 kHz to 3.6 GHz, with preamplifier	R&S®FSH4	1309.6000.04
Handheld spectrum analyzer, 9 kHz to 3.6 GHz, with preamplifier and tracking generator	R&S®FSH4	1309.6000.14
Handheld spectrum analyzer, 100 kHz to 3.6 GHz, with preamplifier, tracking generator and internal VSWR bridge	R&S®FSH4	1309.6000.24
Handheld spectrum analyzer, 9 kHz to 8 GHz, with preamplifier	R&S®FSH8	1309.6000.08
Handheld spectrum analyzer, 9 kHz to 8 GHz, with preamplifier and tracking generator	R&S®FSH8	1309.6000.18
Handheld spectrum analyzer, 100 kHz to 8 GHz, with preamplifier, tracking generator and internal VSWR bridge	R&S®FSH8	1309.6000.28
Handheld spectrum analyzer, 9 kHz to 13.6 GHz, with preamplifier	R&S®FSH13	1309.6000.03
Handheld spectrum analyzer, 9 kHz to 13.6 GHz, with preamplifier, tracking generator 300 kHz to 8 GHz and internal VSWR bridge	R&S®FSH13	1309.6000.13
Handheld spectrum analyzer, 9 kHz to 20 GHz, with preamplifier	R&S®FSH20	1309.6000.07
Handheld spectrum analyzer, 9 kHz to 20 GHz, with preamplifier, tracking generator 300 kHz to 8 GHz and internal VSWR bridge	R&S®FSH20	1309.6000.17
		1309.6000.27
Accessories supplied		
Lithium-ion battery pack, USB cable, LAN cable, AC power supply, CD-ROM with R&S®InstrumentView software and documentation, quick start guide		1314.2000.13
Hardware options		
Lithium-ion battery pack, 6.3 Ah (installed at factory; upgrade of the battery from 4.2 Ah to 6.3 Ah)	R&S®FSH-B106 R&S®FSH-Z114	1304.5958.02 1314.2000.02
Precision frequency reference, aging: < 3.6 × 10−9/year		1304.5935.03
Software options (usually firmware)		
GSM, EDGE measurement application	R&S®FSH-K10	1304.5864.02
Spectrogram measurement application	R&S®FSH-K14	1304.5770.02
Interference analysis measurement application (software license)	R&S®FSH-K15	1314.2000.32
Geotagging measurement application (software license)	R&S®FSH-K16	1309.7488.02
Indoor mapping measurement application (software license)	R&S®FSH-K17	1309.7494.02
Segmented sweep	R&S®FSH-K20	1304.5893.02
Pulse measurements with power sensor (software license), (requires R&S®FSH-Z129 for R&S®FSH4/8/13/20 with serial numbers < 121000)	R&S®FSH-K29	1318.6660.02
Remote control via LAN or USB	R&S®FSH-K40	1304.5629.02
Distance-to-fault measurement (for models .24/.28/.23/.30 only, R&S®FSH-Z320 or R&S®FSH-Z321 and R&S®FSH-Z28 or R&S®FSH-Z29 recommended)	R&S®FSH-K41	1304.5658.02
Vector reflection and transmission measurements (for models .24/.28 only, requires R&S®FSH-Z28 or R&S®FSH-Z29)	R&S®FSH-K42	1304.5993.02
Vector voltmeter (for models .24/.28/.23/.30 only, requires R&S®FSH-Z28 or R&S®FSH-Z29)	R&S®FSH-K45	1304.5635.02
Receiver mode and channel scan measurement application	R&S®FSH-K43	1304.5641.02
3GPP WCDMA BTS/NodeB pilot channel and EVM measurement application	R&S®FSH-K44	1304.5758.02
3GPP WCDMA BTS/NodeB code domain power measurement application (R&S®FSH-K44 required)	R&S®FSH-K44E	1304.5729.02
CDMA2000® BTS pilot channel and EVM measurement application	R&S®FSH-K46	1304.5764.02
CDMA2000® BTS code domain power measurement application (R&S®FSH-K46 required)	R&S®FSH-K46E	1304.5612.02
1xEV-DO BTS pilot channel and EVM measurement application	R&S®FSH-K47	1304.5787.02
1xEV-DO BTS PN scanner and time domain power measurement application (R&S®FSH-K47 required)	R&S®FSH-K47E	1304.5806.02
TD-SCDMA BTS power and EVM measurements	R&S®FSH-K48	1304.5841.02
TD-SCDMA/HSDPA BTS power and EVM measurements (R&S®FSH-K48 required)	R&S®FSH-K48E	1304.5858.02
LTE FDD downlink pilot channel and EVM measurement application 1)	R&S®FSH-K50	1304.5735.02
LTE FDD downlink extended channel and modulation measurement application 1) (R&S®FSH-K50 required)	R&S®FSH-K50E	1304.5793.02
LTE TDD downlink pilot channel and EVM measurement application 1)	R&S®FSH-K51	1304.5812.02
LTE TDD downlink extended channel and modulation measurement application 1) (R&S®FSH-K51 required)	R&S®FSH-K51E	1304.5829.02
NB-IoT measurement application 1)	R&S®FSH-K56	1318.6100.02
EMF measurement application	R&S®FSH-K105	1318.6200.02

Designation	Type	Order No.
Recommended extras: power sensors		
Directional power sensor, 25 MHz to 1 GHz	R&S®FSH-Z14	1120.6001.0
Directional power sensor, 200 MHz to 4 GHz	R&S®FSH-Z44	2
Universal power sensor, 1 nW to 100 mW, 10 MHz to 8 GHz 1), 2)	R&S®NRP-	1165.2305.0
Universal power sensor, 1 nW to 100 mW, 10 MHz to 18 GHz 1), 2)	Z211	2
Wideband power sensor, 1 nW to 100 mW, 50 MHz to 18 GHz 1), 2)	R&S®NRP-	1417.0409.0
Wideband power sensor, 1 nW to 100 mW, 50 MHz to 40 GHz (2.92 mm) 1), 2)	Z221	2
Wideband power sensor, 1 nW to 100 mW, 50 MHz to 40 GHz (2.40 mm) 1), 2)	R&S®NRP-Z81	1417.0309.0
Wideband power sensor, 1 nW to 100 mW, 50 MHz to 44 GHz (2.40 mm) 1), 2)	R&S®NRP-Z85	2
Three-path diode power sensor, 100 pW to 200 mW, 10 MHz to 8 GHz	R&S®NRP-Z86	1137.9009.0
Three-path diode power sensor, 100 pW to 200 mW, 10 MHz to 18 GHz	R&S®NRP-Z86	2
Three-path diode power sensor, 100 pW to 200 mW, 10 MHz to 33 GHz	R&S®NRP8S	1411.7501.0
Three-path diode power sensor, 100 pW to 200 mW, 50 MHz to 40 GHz	R&S®NRP18S	2
Three-path diode power sensor, 100 pW to 200 mW, 50 MHz to 50 GHz	R&S®NRP33S	1417.0109.4
Thermal power sensor, 300 nW to 100 mW, DC to 18 GHz	R&S®NRP40S	0
Thermal power sensor, 300 nW to 100 mW, DC to 33 GHz	R&S®NRP50S	1417.0109.4
Thermal power sensor, 300 nW to 100 mW, DC to 40 GHz	R&S®NRP18T	4
Thermal power sensor, 300 nW to 100 mW, DC to 50 GHz	R&S®NRP33T	1419.0006.0
Thermal power sensor, 300 nW to 100 mW, DC to 67 GHz	R&S®NRP40T	2
Thermal power sensor, 300 nW to 100 mW, DC to 110 GHz	R&S®NRP50T	1419.0029.0
Average power sensor, 100 pW to 200 mW, 8 kHz to 6 GHz	R&S®NRP67T	2
Average power sensor, 100 pW to 200 mW, 8 kHz to 18 GHz	R&S®NRP110T	1419.0064.0
Recommended extras: adapter cables for power sensors	R&S®NRP6A	2
USB adapter (passive), for connecting R&S®NRP-Zxx power sensors to the R&S®FSH	R&S®NRP-Z4	1419.0001.0
USB interface cable, length: 1.5 m (59 in), for connecting R&S®NRP sensors to the R&S®FSH	R&S®NRP-ZKU	2
Adapter cable for R&S®NRP-Z8x power sensors and R&S®FSH-Z29 option	R&S®FSH-	1419.0058.0
USB adapter cable for R&S®FSH-Z14/-Z44, length: 1.8 m	Z129	3
Optical power sensor and accessories	R&S®FSH-	1424.6337.0
OEM USB optical power meter (Germanium)	Z44 R&S®HA-Z360	2 2334.5162.0
OEM USB optical power meter (filtered InGaAs)	R&S®HA-Z361	1424.6308.0
SC adapter for optical power meter	R&S®HA-Z362	2 2334.5179.0
LC adapter for optical power meter	R&S®HA-Z363	0 0424.6150.0
2.5 mm universal adapter for optical power meter	R&S®HA-Z364	2 2334.5185.0
1.25 mm universal adapter for optical power meter	R&S®HA-Z365	0 0424.6173.0
Patch cord SC-LC SM, SX, length: 1 m	R&S®HA-Z366	2 2334.5191.0
Patch cord SC-SC SM, SX, length: 1 m	R&S®HA-Z367	0 0424.6196.0
Recommended extras for calibration (for R&S®FSH models .23/.24/.28/.30)		2 2334.5204.0
Combined open/short/50 Ω load calibration standard, for calibrating VSWR and DTF measurements, DC to 3.6 GHz	R&S®FSH-Z29	0 0424.6215.0 1300.7510.03
Combined open/short/50 Ω load calibration standard, for calibrating VSWR and DTF measurements, DC to 8 GHz	R&S®FSH-Z28	2 2334.5210.0 1300.7510.03
Calibration unit, 2 MHz to 4 GHz	R&S®ZN-Z103	2 2334.5227.0 1321.1828.02
Calibration unit, 1 MHz to 6 GHz	R&S®ZN-Z103	0 0424.6815.0 1321.1828.12
Calibration kit, 3.5 mm male, open/short/50 Ω load/through combination, 0 Hz to 15 GHz	R&S®ZV-Z135	2 2334.5233.0 1317.7677.02
Calibration kit, 3.5 mm female, open/short/50 Ω load/through combination, 0 Hz to 15 GHz	R&S®ZV-Z135	0 1317.7677.03
Calibration kit, N male, open/short/50 Ω load/through combination, 0 Hz to 9 GHz	R&S®ZV-Z170	1164.0496.02
Calibration kit, N female, open/short/50 Ω load/through combination, 0 Hz to 9 GHz	R&S®ZV-Z170	1164.0496.03

Designation	Type	Order No.
Recommended extras for testing		
Matching pad, 50 Ω/75 Ω, bidirectional, 0 Hz to 2.7 GHz, N female/N male, load capacity 2 W	R&S®RAZ	0358.5714.0
Matching pad, 50 Ω/75 Ω, bidirectional, 0 Hz to 2.7 GHz, N female/N male, load capacity 2 W	R&S®RAM	2
Matching pad, 50 Ω/75 Ω, bidirectional, 0 Hz to 1 GHz, BNC female/N male, load capacity 1 W	R&S®FSH-Z38	0358.5414.0
Adapter, N male/BNC female		2
Adapter, N male/N male		1300.7740.0
Adapter, N male/SMA female		2
Adapter, N male/7/16 female		0118.2812.0
Adapter, N male/7/16 male		0
Adapter, N male/FME female		0092.6581.0
Adapter, BNC male/banana female		0
Attenuator, 50 W, 20 dB, 50 Ω, DC to 6 GHz, N female/N male	R&S®RDL50	4012.5837.0
Attenuator, 100 W, 20 dB, 50 Ω, DC to 2 GHz, N female/N male	R&S®RBU100	0
Attenuator, 100 W, 30 dB, 50 Ω, DC to 2 GHz, N female/N male	R&S®RBU100	3530.6646.0
RF cable (1 m), N male/N female, for R&S®FSH-K41 option, DC to 8 GHz	R&S®FSH-Z320	0
RF cable (3 m), N male/N female, for R&S®FSH-K41 option, DC to 8 GHz	R&S®FSH-Z321	3530.6630.0
Recommended extras: mobile radio test antenna and EMC test equipment		0
GSM/UMTS/CDMA antenna, with magnetic mount 850/900/1800/1900/2100 band, N connector	R&S®TS95A16	1048.8740.0
Isotropic antenna, 30 MHz to 3 GHz, for R&S®TS-EMF	R&S®TSEMF-B1	0
Isotropic antenna, 700 MHz to 6 GHz, for R&S®TS-EMF	R&S®TSEMF-B2	1074.5742.0
Isotropic antenna, 9 kHz to 200 MHz, for R&S®TS-EMF	R&S®TSEMF-B3	0
Compact probe set for E and H near-field measurements, 30 MHz to 3 GHz	R&S®HZ-15	1035.5702.0
3 GHz, 20 dB preamplifier, 100 V to 230 V, for R&S®HZ-15	R&S®HZ-16	2
Recommended extras: directional antenna and accessories		1073.8690.0
Handheld directional antenna (antenna handle)	R&S®HE400	4104.6000.0
Microwave handheld directional antenna (antenna handle)	R&S®HE400MW	1073.8796.0
Cable set, for R&S®HE400 and R&S®HE400MW	R&S®HE400-K	4104.6000.0
Basic handheld directional antenna (antenna handle)	R&S®HE400BC	1309.8620.0
Cable set, for R&S®HE400BC	R&S®HE400-KB	4104.7770.0
HF antenna module, 8.3 kHz to 30 MHz	R&S®HE400HF	2309.6617.0
VHF antenna module, 20 MHz to 200 MHz	R&S®HE400VHF	4104.6000.0
UWB antenna module, 30 MHz to 6 GHz	R&S®HE400UWB	4
Log-periodic antenna module, 450 MHz to 8 GHz	R&S®HE400LP	4104.7770.0
Cellular antenna module, 700 MHz to 2500 MHz	R&S®HE400CEL	4
SHF antenna module, 5 GHz to 20 GHz	R&S®HE400SHF	4104.8002.0
S/C band antenna module, 1.7 GHz to 6 GHz	R&S®HE400SCB	2
Transport case, for R&S®HE400	R&S®HE400Z1	4104.8202.0
Transport bag (small), for R&S®HE400 (recommended for one or two antenna modules)	R&S®HE400Z2	2
Transport bag (large), for R&S®HE400 (recommended for three or four antenna modules)	R&S®HE400Z3	4104.6900.0
Tripod, for R&S®HE400	R&S®HE400Z4	2
Recommended extras for power supply		4104.8402.0
Lithium-ion battery pack, 4.2 Ah	R&S®HA-Z204	2309.6130.0
Lithium-ion battery pack, 6.3 Ah		4104.7306.0
Battery charger, for lithium-ion battery pack, 4.2 Ah/6.3 Ah 3)	R&S®HA-Z206	2309.6146.0
12 V car adapter		4104.8602.0
Recommended extras for transport of the R&S®FSH handheld spectrum analyzer	R&S®HA-Z220	2309.6123.0
Soft carrying bag (W × H × D: 260 mm × 360 mm × 280 mm; 10.2 in × 14.2 in × 11.0 in)	R&S®HA-Z221	4104.8602.0
Hard case	R&S®HA-Z222	2309.6117.0
Carrying holster, including chest harness and rain cover	R&S®HA-Z262	4104.9009.0
Shoulder strap for carrying holster	Z321	2
Recommended extras: others	R&S®HA-Z322	4104.9096.0
SD memory card, 8 Gbyte 4)	R&S®HA-Z232	2309.6223.0
GPS receiver	R&S®HA-Z240	4104.9080.0
Headphones	R&S®FSH-Z36	2309.6700.0
		4104.9109.0
		2145.5838.0
		2

Designation	Type	Order No.
Spare parts		
Spare USB cable Spare LAN cable Spare AC adapter Spare CD-ROM, with R&S®InstrumentView software and R&S®FSH documentation Quick start manual for R&S®FSH, printed version, English Quick start manual for R&S®FSH, printed version, German	R&S®HA-Z211 R&S®HA-Z210 R&S®HA-Z201 R&S®FSH-Z45 R&S®FSH-Z46 R&S®FSH-Z47	1309.6169.0 0 1309.6152.0 0 1309.6100.0 0 1309.6246.0 0 1309.6269.12 1309.6269.11

[1] Only for R&S®FSH analyzers with serial numbers ≥ 105000.
[2] For the R&S®NRP-Zxx power sensors, the R&S®NRP-Z4 USB adapter is also required.
[3] Required to charge the battery pack outside the R&S®FSH.
[4] R&S®FSH analyzers with serial numbers ≤ 105000 require an SD memory card for a firmware update.

Warranty		
Base unit All other items		3 years
Service options		1 year
Extended warranty, one year Extended warranty, two years		
Extended warranty with calibration coverage, one year Extended warranty with calibration coverage, two years Extended warranty with accredited calibration coverage, one year Extended warranty with accredited calibration coverage, two years	R&S®WE1 R&S®WE2 R&S®CW1 R&S®CW2 R&S®AW1 R&S®AW2	Please contact your local Rohde & Schwarz sales office.