# R&S®FSH
# Handheld Spectrum Analyzer
## The all-in-one handheld platform


ROHDE&SCHWARZ

Test&Measurement

Product Brochure | 19.00

# R&S®FSH Handheld Spectrum Analyzer

## 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 in operation during installation and maintenance of transmitter stations.

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 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®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 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®FSH battery enables uninterrupted operation for up to 4.5 hours. The battery is 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 (< –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)

# R&S®FSH Handheld Spectrum Analyzer

# Benefits and key features

### Installation and maintenance of transmitter stations

- Power measurements on pulsed signals
- Channel power measurements
- Adjacent channel power measurements
- Measurement of spurious emissions (spectrum emission mask)
- Measurement of the modulation spectrum on pulsed signals with gated sweep
- 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
- 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
- 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

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### 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

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

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### Documentation and remote control

- R&S®InstrumentView 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
- Test report in just a few steps with the R&S®FSH wizard
- Setting of frequency via channel tables
- Operation in different languages

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# 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 using power sensors

## 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 the user, all required instrument settings are already predefined for the GSM and EDGE standards.

## Channel power measurements

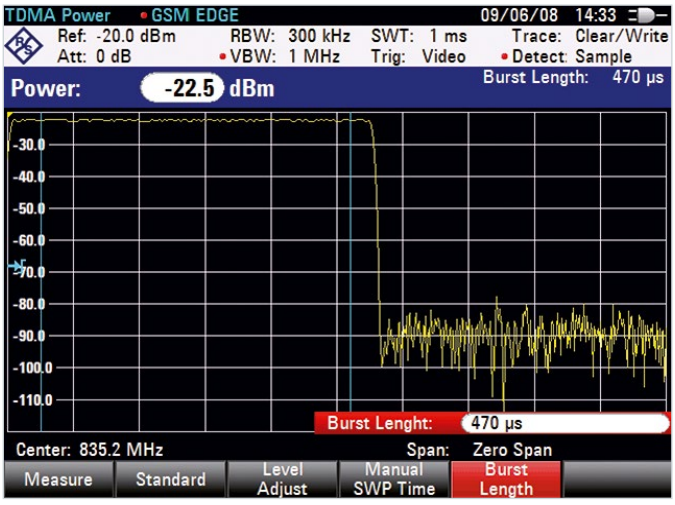
The R&S®FSH uses the channel power measurement function to determine the power of a definable transmission channel. Channel power measurement for the LTE, WCDMA, GSM, TD-SCDMA, cdmaOne, CDMA2000® and 1xEVDO digital mobile communications standards is performed at a keystroke.

## Adjacent channel power measurements

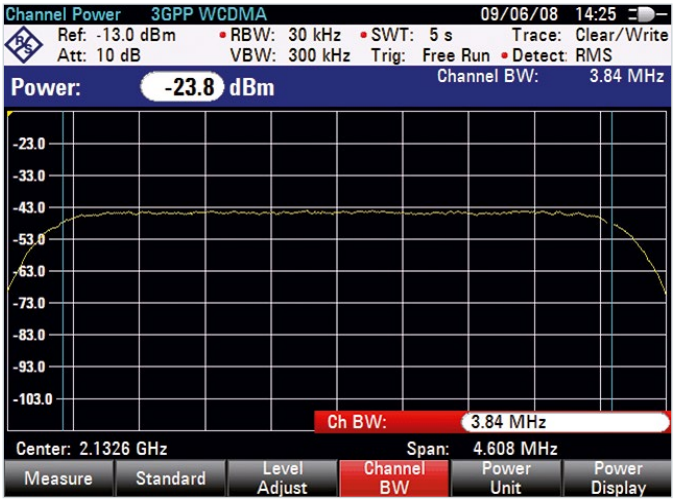
The ACLR measurement function enables the user to test how far a base station carrier signal reaches into the adjacent channel. An ACLR value that is too low indicates poor signal quality and can lead to interference on the adjacent useful signals.

The adjacent channel power can be displayed as an absolute value or relative to the useful carrier. The R&S®FSH offers predefined settings for various transmission standards such as WCDMA, CDMA2000®, 1xEVDO, TD-SCDMA 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.

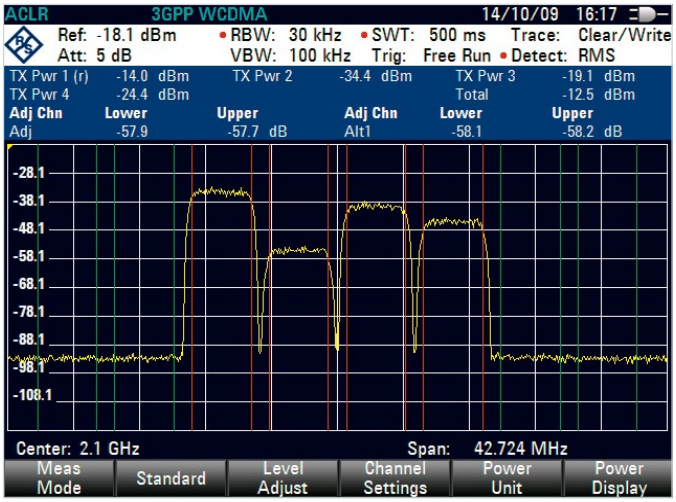
TDMA power measurement.



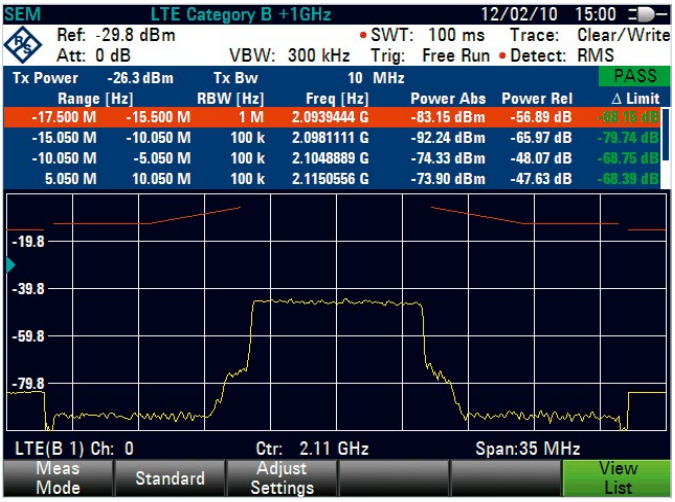

Channel power measurement.



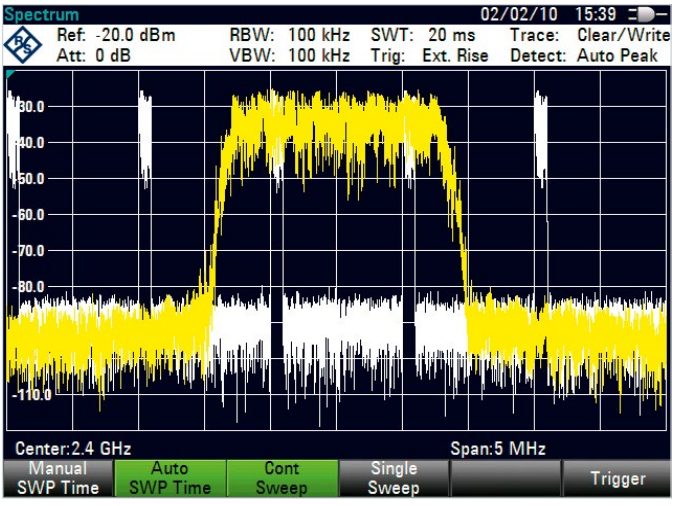

ACLR measurement on a 3GPP WCDMA signal with four carriers.



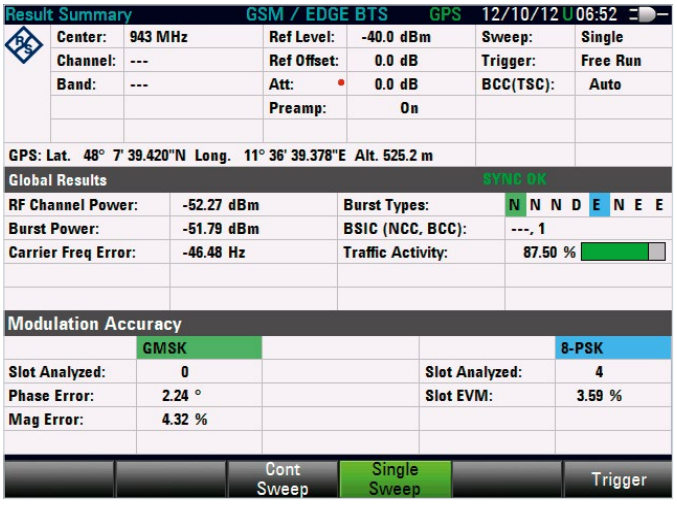
Spectrum emission mask measurement on an LTE signal.




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




Analysis of GSM/GPRS/EDGE transmit signals.




## Measurement of spurious emissions (spectrum emission mask)

The R&S®FSH measures spurious emissions of a 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®FSH tests whether the signal lies within the limits defined by the wireless communications standard. The R&S®FSH 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®InstrumentView software.

## Measurement 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.

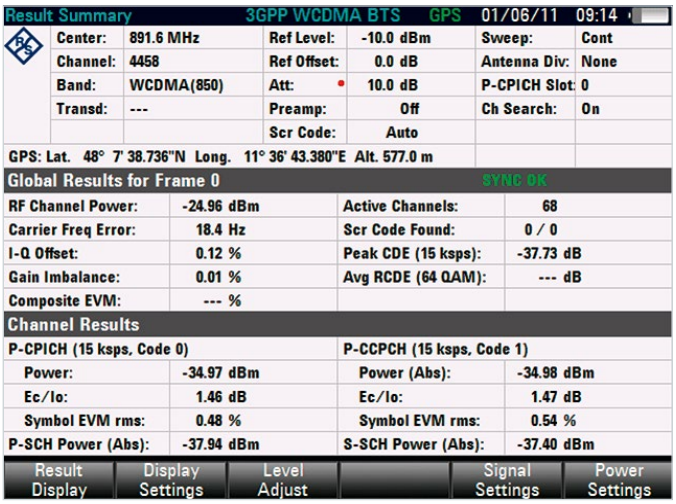
## Analysis of GSM/GPRS/EDGE transmit signals

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. A too high RF channel power would interfere with other base stations.

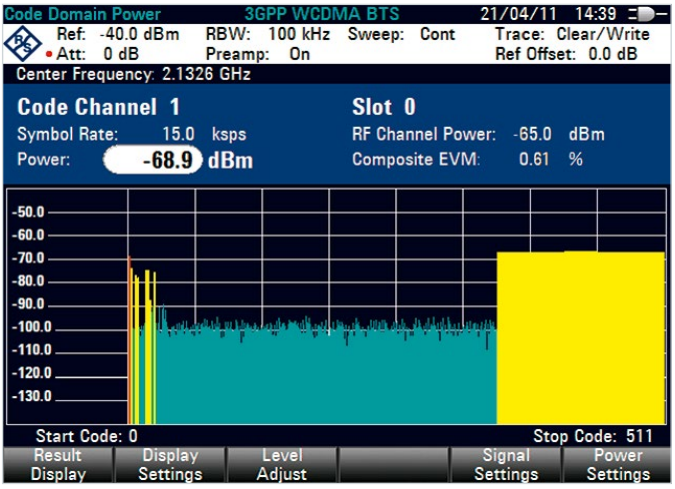
The result summary displays the main signal parameters such as RF channel power, burst power, carrier frequency error, modulation and base station identity code (BSIC). The current traffic activity indicates whether capacity problems or low data rates may be related to an increase in cell traffic. Modulation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

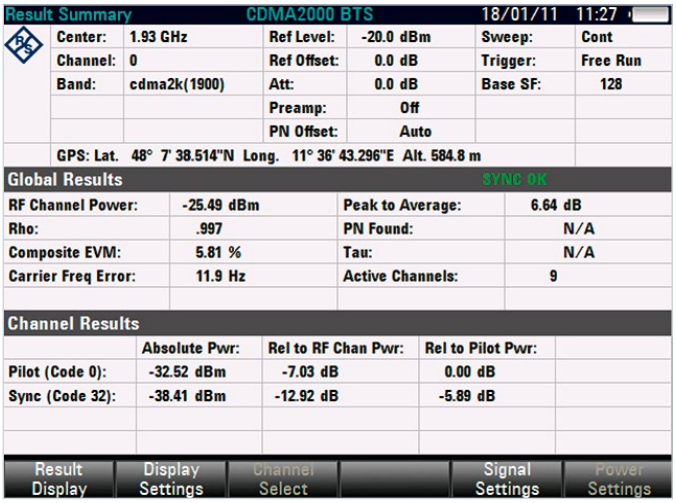
Analysis of a 3GPP WCDMA transmit signal with the R&S®FSH-K44 option.




The 3GPP WCDMA code domain power measurement provides an overview of the key signal parameters.




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




## Analysis of WCDMA/HSDPA/HSPA+ transmit signals

When commissioning and maintaining base stations, users need a quick overview of the modulation characteristics, the power of the code channels 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) 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 ($I_0$) 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. 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:

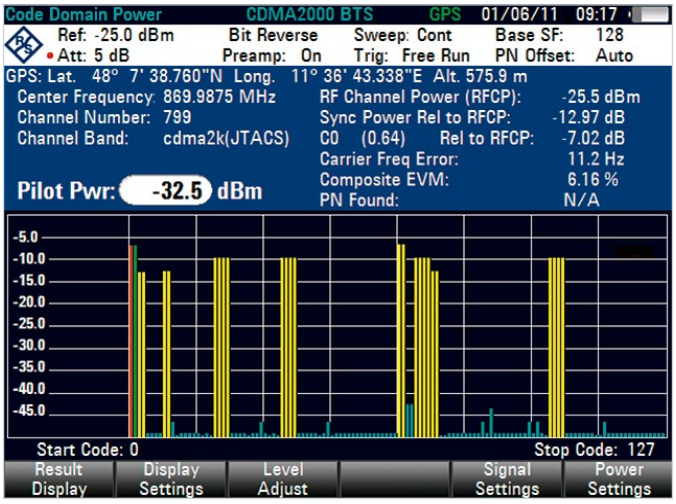
- Select the 3GPP WCDMA function
- Set the center frequency
- Start the scrambling code search

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.

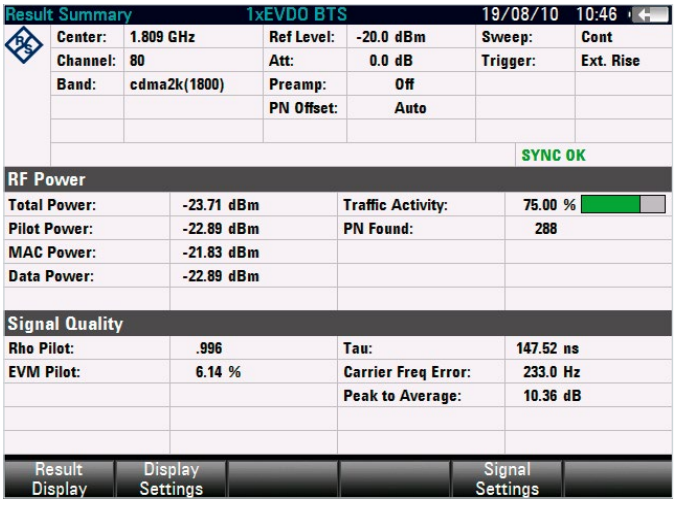
## Analysis of CDMA2000® transmit signals

The R&S®FSH-K46 option ideally equips the R&S®FSH 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). 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.

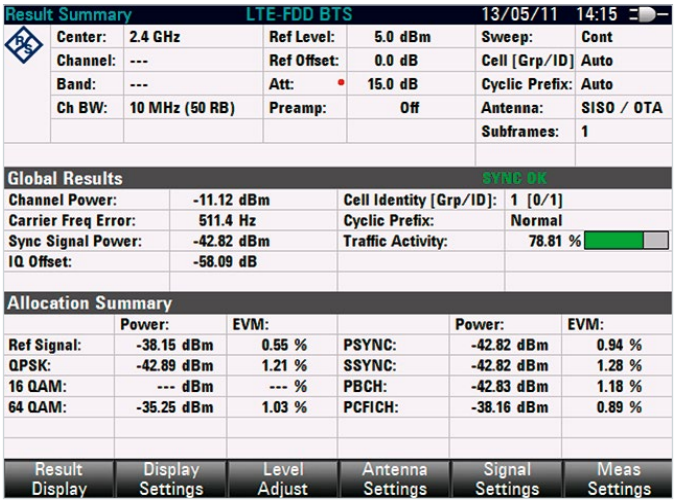
The CDMA2000® code domain power measurement provides an overview of the key signal parameters.




Analysis of a 1xEV-DO transmit signal with the R&S®FSH-K47 option.




Analysis of an LTE FDD transmit signal using the R&S®FSH-K50 option.




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 key signal parameters, e.g. RF channel 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 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 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.

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 is used to check whether the power and timing of the 1xEV-DO frame comply with standard specifications.

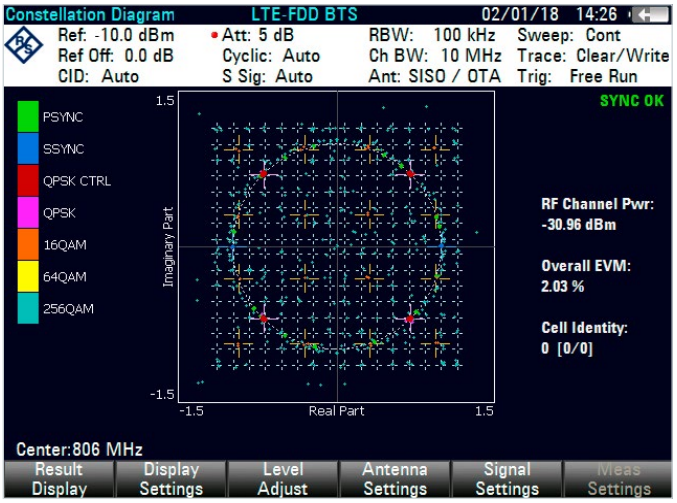
## Analysis of LTE FDD/TDD transmit signals

The R&S®FSH-K50/-K51 [1] option equips the R&S®FSH 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. Both options support all important LTE measurements – from single input single output (SISO) to 4×4 multiple input multiple output (MIMO) transmissions. In addition to the total power, the R&S®FSH-K50/-K51 determines the power of the reference signal, the power of the physical control format indicator channel (PCFICH), the physical broadcast channel (PBCH) and the two synchronization channels PSYNC and SSYNC.

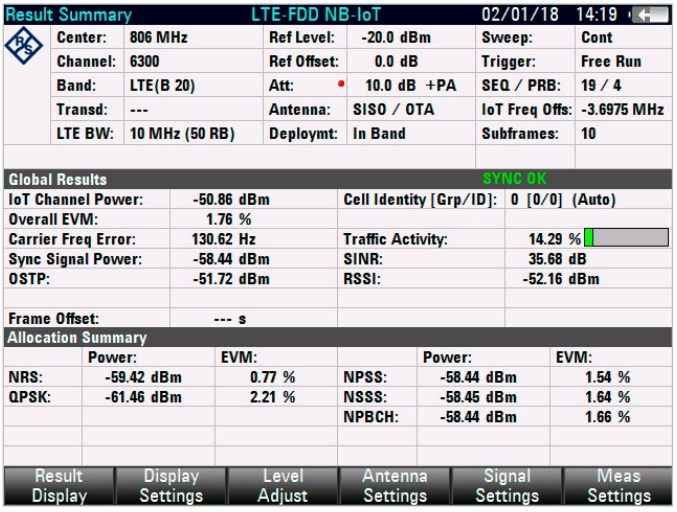
It also measures and displays the carrier frequency offset and EVM value of the reference signal and the useful data. Users can now detect transmitter impairments such as clipping or intermodulation that are difficult to recognize in the spectrum.

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

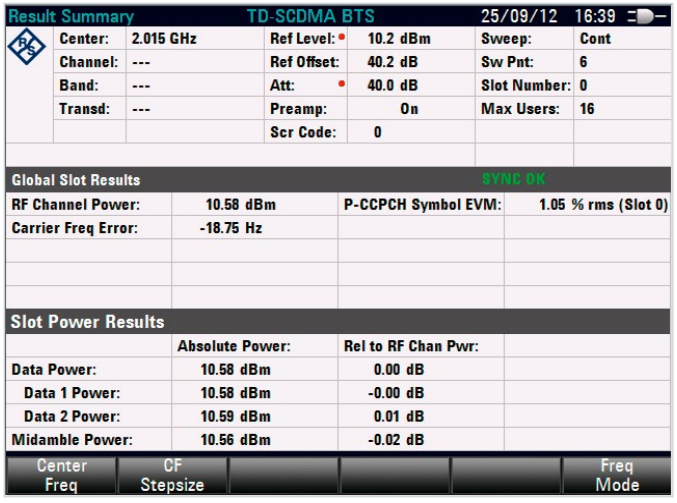
The constellation diagram of the R&S®FSH-K50E option provides a graphical overview of the LTE transmit signal quality.




Analysis of NB-IoT downlink signals with the R&S®FSH-K56 option.




Analysis of TD-SCDMA transmit signals with the R&S®FSH-K48/-K48E option.

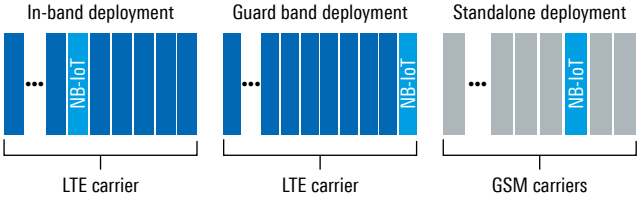



The R&S®FSH also supports LTE-Advanced carrier aggregation. Measurement results of up to 3 LTE carriers are displayed simultaneously. A simple pass/fail indication helps the user detect errors in the antenna and cable installation. Using the isotropic antennas of the R&S®TS-EMF measurement system, the R&S®FSH-K50/-K51 can also measure the electric field strength of the LTE signal. The R&S®FSH-K50E/-K51E options are available for in-depth LTE analysis. In addition to displaying the EVM value, this option includes a constellation diagram that graphically displays the quality of the LTE signal. The different modulation types and LTE signal components can be displayed separately. An LTE BTS scanner is provided for measurements over the air interface. This scanner shows the power of the up to eight strongest LTE signals and provides a quick overview of all LTE base stations in the surrounding area.

## 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, which corresponds to one resource block in LTE transmission. 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

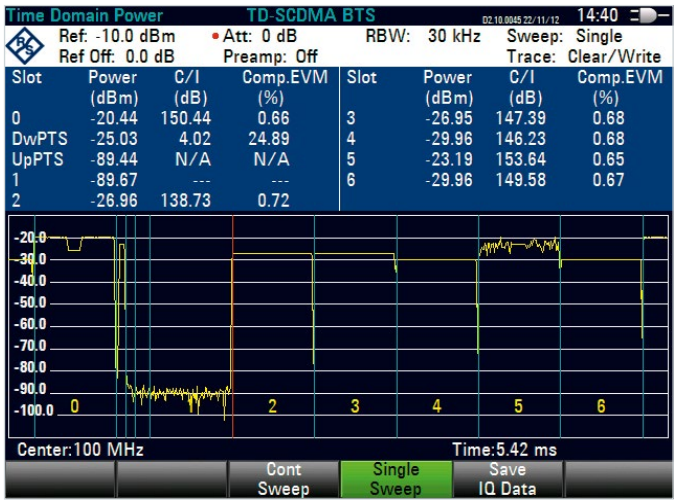



The error vector magnitude (EVM) and frequency error shown on the result summary page are important parameters for determining the quality of the transmitted signal. Other NB-IoT downlink physical signal parameters (NPSS, NSSS and NPBCH) are also measured and displayed. The constellation diagram graphically shows the quality of the NB-IoT signals.

## Analysis of TD-SCDMA/HSDPA transmit signals

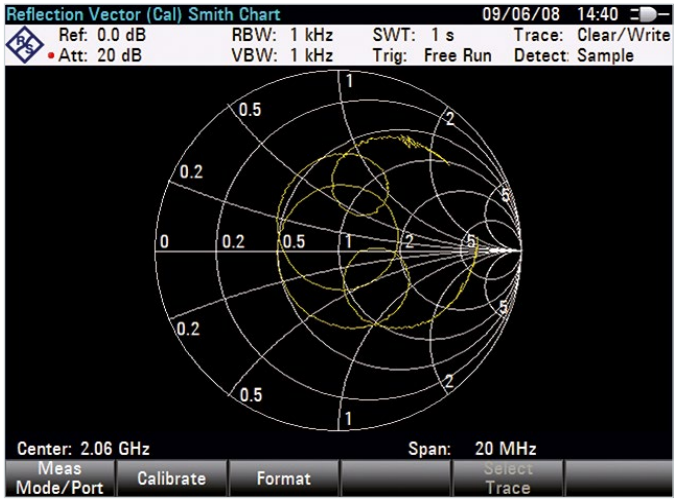
Equipped with the R&S®FSH-K48/-K48E measurement applications, the R&S®FSH provides the user with a quick overview of the main parameters needed for commissioning and maintaining TD-SCDMA/HSDPA base stations. The result summary display is available with the R&S®FSH-K48 measurement application. It shows the carrier frequency error (CFE) and the PCCPCH symbol error vector magnitude (EVM), which indicate signal quality. The absolute channel power and the channel power in relation to the total signal power of the data parts and midamble parts of a selected timeslot are measured. These measurements provide information about the signal-to-interference ratio.

TD-SCDMA time domain power display is available with the R&S®FSH-K48E option.




Vector network analysis: simultaneous display of four S-parameters.


Vector network analysis: measurement with Smith chart.




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 meet 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.

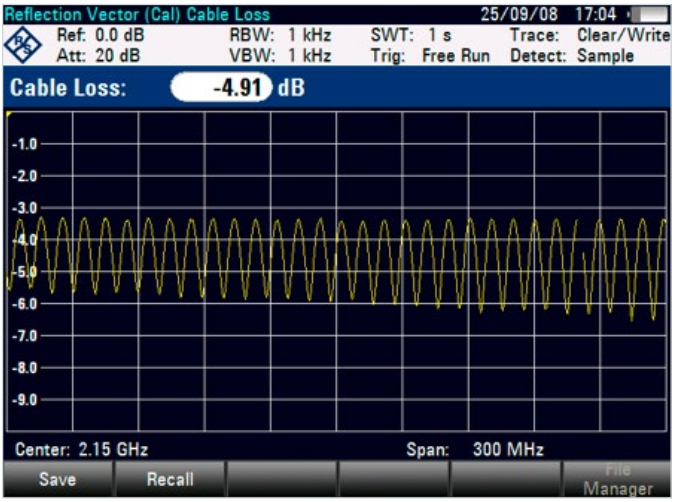
## Vector network analysis

The vector measurements option adds a built-in tracking generator and an internal VSWR bridge, transforming the R&S®FSH models 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 in a base station.

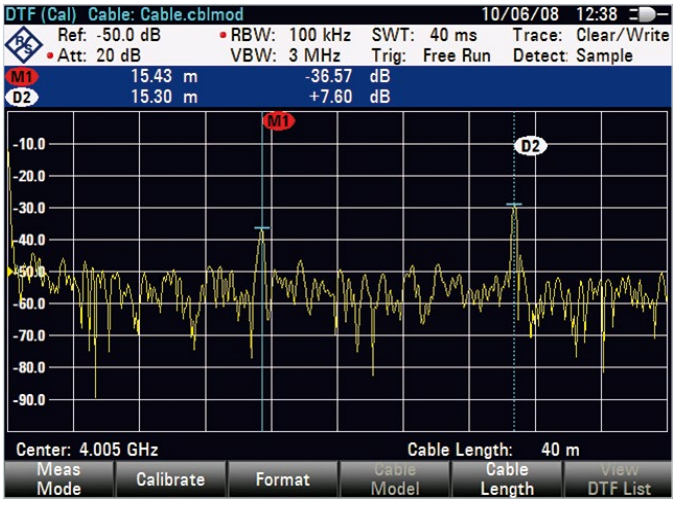
- Higher measurement accuracy due to vector system error correction
- Measurement of magnitude and phase of S-parameters $S_{11}$ [2], $S_{21}$ [2], $S_{12}$ and $S_{22}$
- Simultaneous display of magnitude and phase in split-screen mode
- Simultaneous display of four different S-parameters
- Smith chart 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
- Measure the 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).

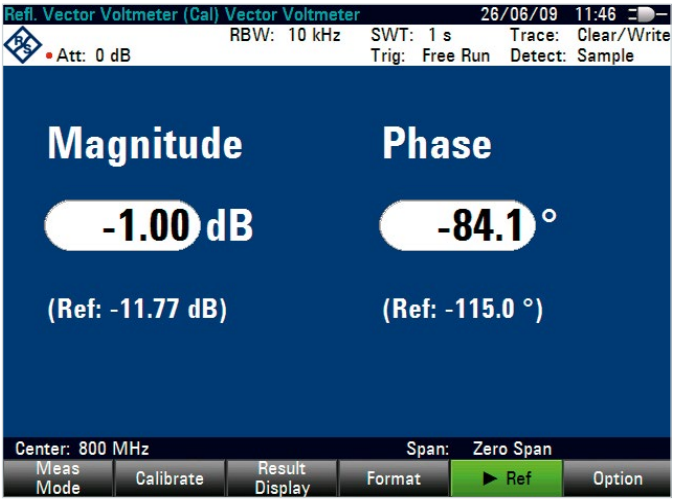
Cable loss measurement.




Distance-to-fault measurements (DTF).




Vector voltmeter display.




## One-port cable loss measurements

The R&S®FSH can determine the cable loss of installed cables without much effort. Simply connect one end of the 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, 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 listed. This considerably simplifies measurement evaluation.

## Vector voltmeter

The R&S®FSH-K45 vector voltmeter option displays the magnitude and phase of a DUT at a fixed frequency. Therefore, the R&S®FSH (models .23/.24/.28/.30) can replace a conventional vector voltmeter for many applications. Because the required signal source and bridge are already available in the R&S®FSH, 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:

- Adjustment of electrical cable length
- Checking of phase-controlled antennas such as used in an instrument landing system (ILS) in air traffic control

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

Using the R&S®HA-Z240 GPS receiver, the R&S®FSH 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®FSH 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.

## 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.

## 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.

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

## Channel power meter

This standard function enables the R&S®FSH to measure channel power without an external power sensor at 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

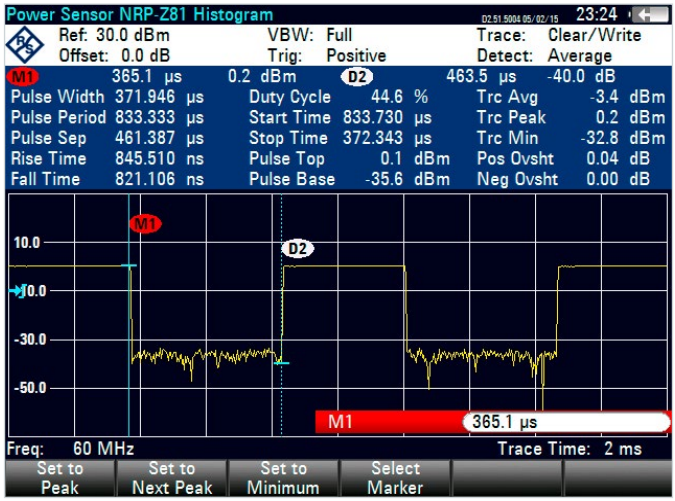
When equipped with the R&S®FSH-K29 option and a R&S®NRP-Z81/-Z85/-Z86 wideband power sensor, the R&S®FSH can measure peak power and the main pulse parameters up to 44 GHz.

## Optical power measurement with optical power sensor

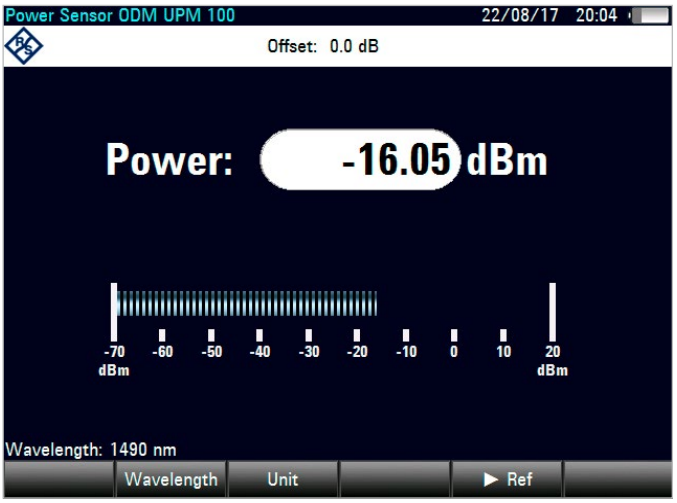
When attached with an R&S®HA-Z360/Z361 optical power sensor, R&S®FSH power meter mode reads out optical absolute power in dBm as well as relative power in dB.

R&S®NRP power sensors.

Pulse analysis with R&S FSH-K29 and R&S NRP-Z81 wideband power sensors.




Optical power measurement.



# 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.

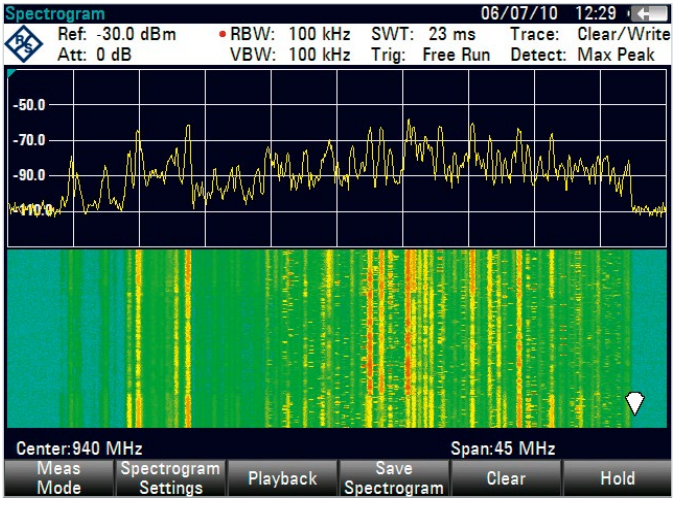
A rugged, lightweight, handheld spectrum analyzer such as the R&S®FSH is the optimum tool for interference analysis in the field.

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

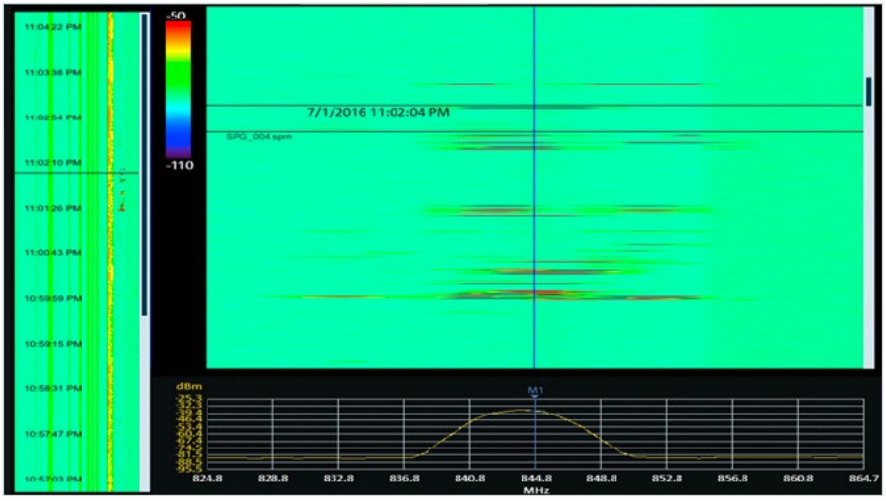
The spectrogram measurements application allows the R&S®FSH to provide a history of the spectrum. As a result, intermittent faults or variations in frequency and level versus time can be analyzed. Specific evaluations can be made by replaying recorded data and setting time lines and markers.

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.




Simultaneous display of spectrum and spectrogram.




Long time spectrogram recording analysis with R&S®InstrumentView.

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.

## 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.

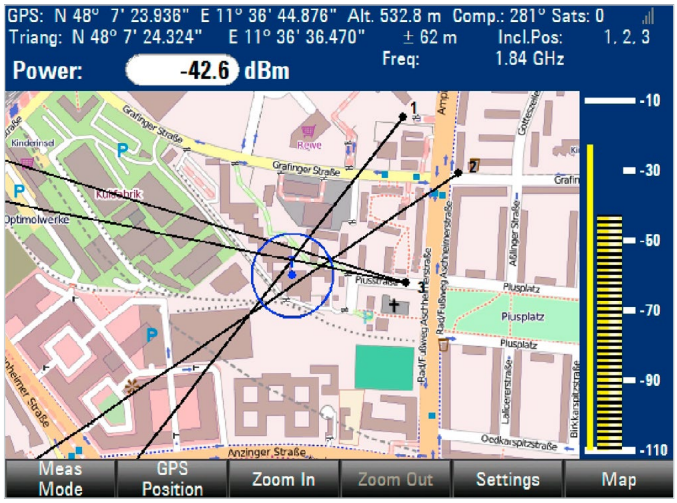
The mapping feature uses the triangulation technique to locate the interferer. Using the R&S®OSM wizard, Open Street Maps (OSM) can be easily downloaded for use with the R&S®FSH.

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 is 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 screen shot 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.



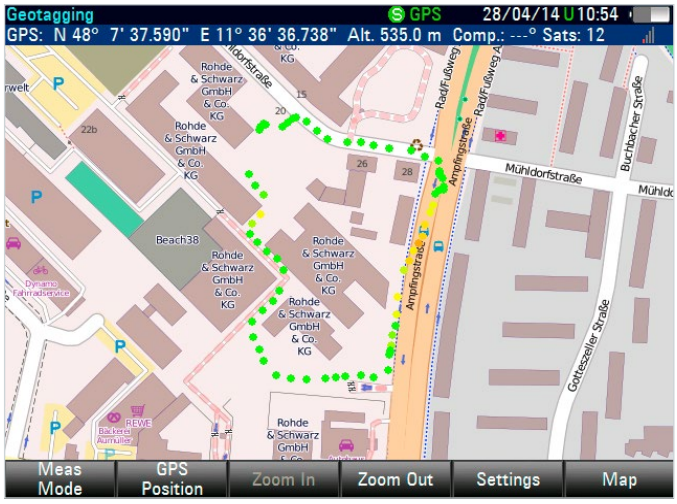

## Geotagging

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´s 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.



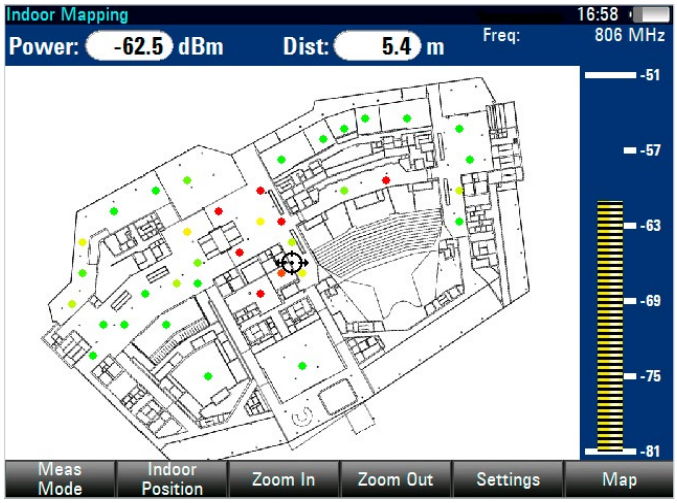

## Indoor mapping

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 MS 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:
http://www.openstreetmap.org/

OSM is a wiki project in which users can participate by uploading and editing geographical information such as GPS tracking data or the course of a road or river. This world map is growing daily. OpenStreetMap data can be used freely 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.

The R&S®FSH with isotropic antennas.

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

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.

# 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

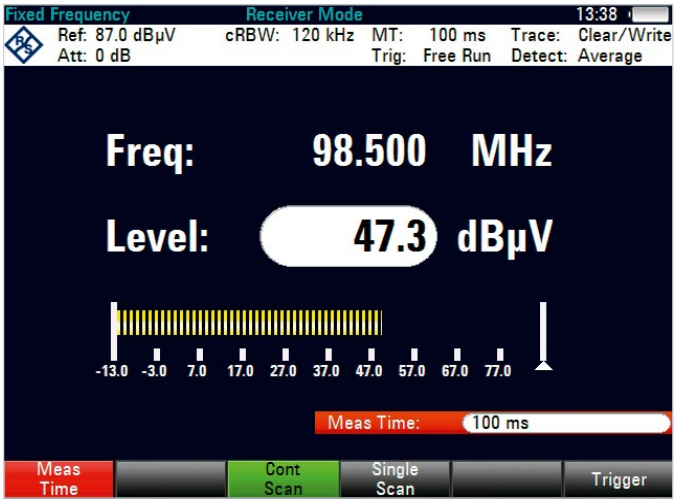
## EMC precompliance measurements and channel scan

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.

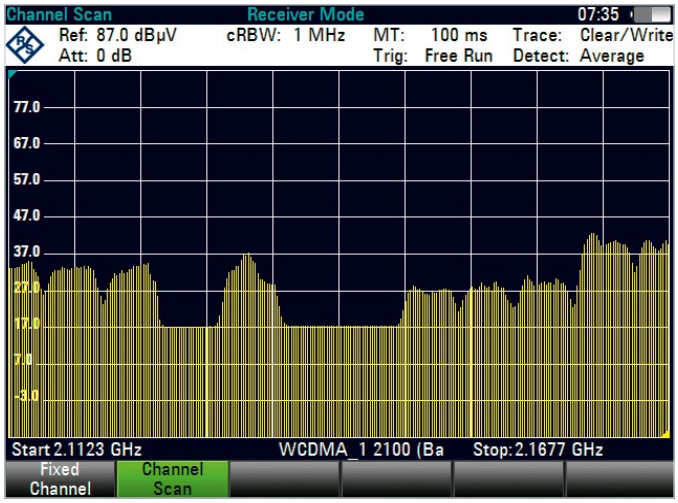
In the channel scan mode, the R&S®FSH sequentially measures the levels at various frequencies defined in a channel table. The channel tables are generated with the R&S®InstrumentView software and loaded into the R&S®FSH. There are predefined tables for a large number of mobile communications standards 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.

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

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, e.g. 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/-17 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/-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 combination 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 through Multi Transfer (continuous sweep retrieval with interval) with session AutoSave
- Subsequent analysis of measurement results by displaying/hiding and shifting markers
- Generation of cable data using an cable models editor and file transfer to downloading to the R&S®FSH for distance-to-fault measurement

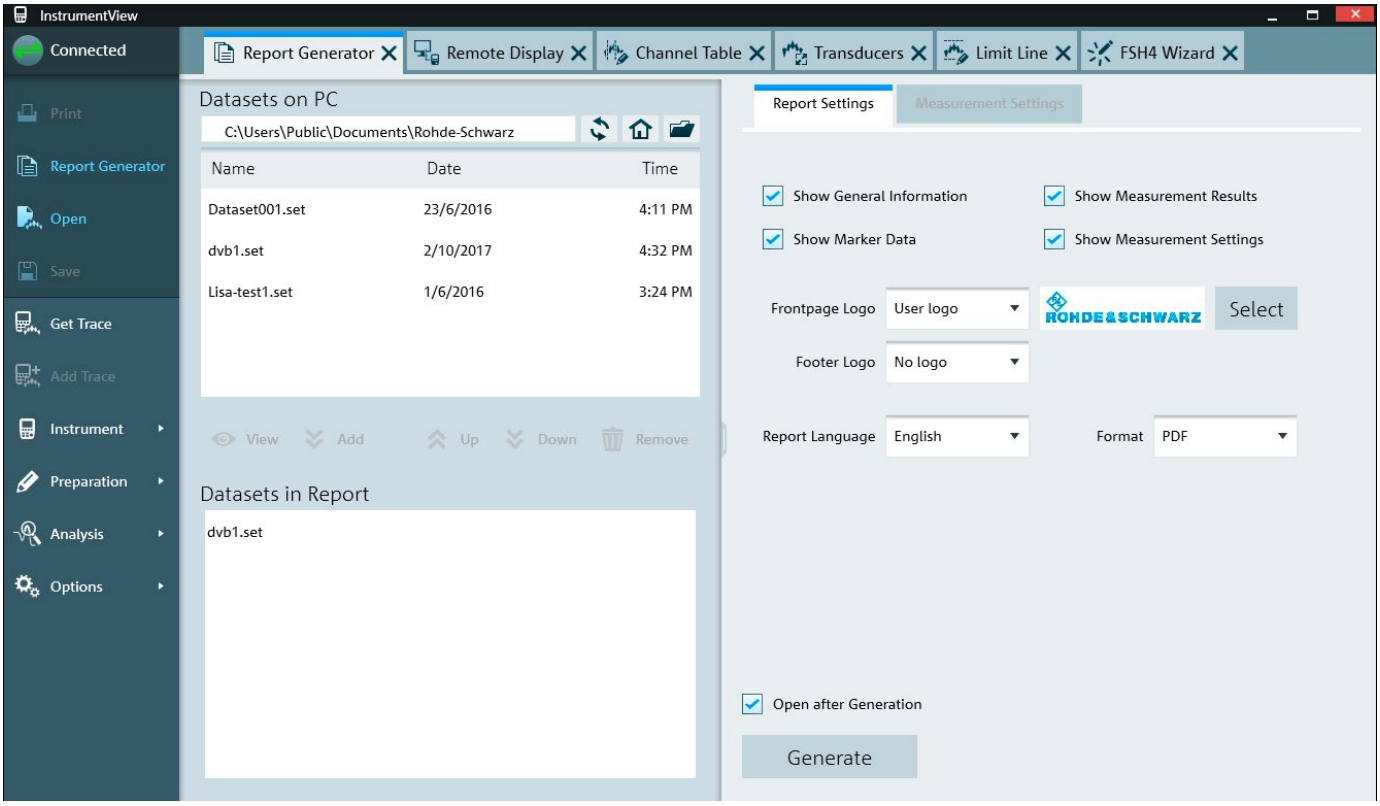
The R&S®FSH with laptop.

- 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 realtime 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.

All operating elements are within fingertip reach.

## 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 within fingertip reach. 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.

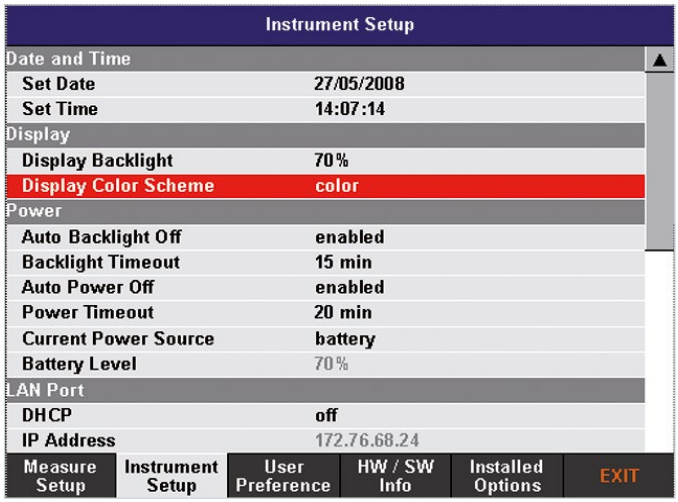
The USER key allows frequently required measurements to be collected in a single menu. User-defined instrument setups are assigned to softkeys under a user-definable name.

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

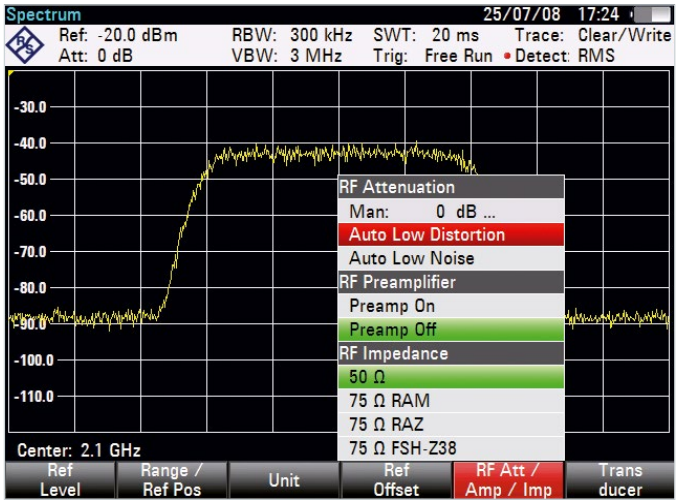
The measurement results are easy to read on the brilliant, clearly laid out 6.5" VGA color display. The backlighting of the display can be adjusted to the ambient lighting conditions. For use in extremely strong sunlight, a special monochrome mode provides optimal contrast.

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

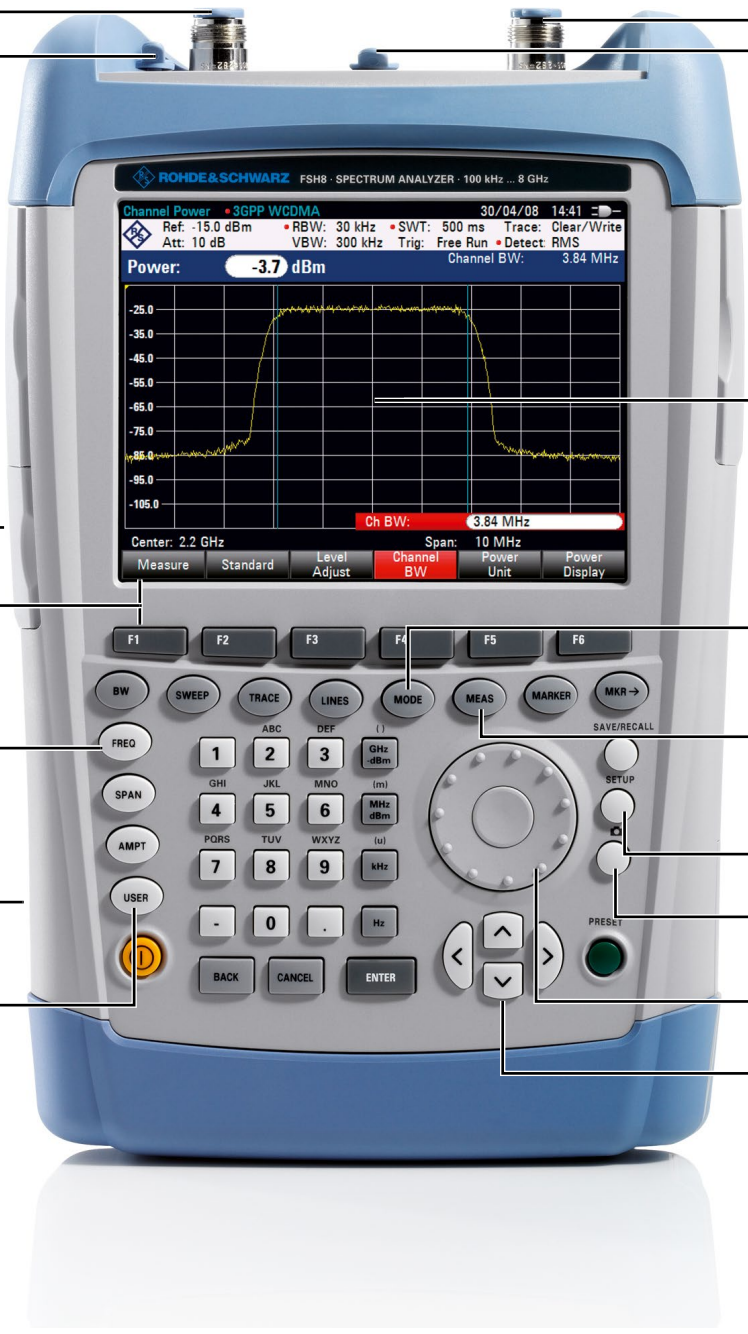
The user interface of the R&S®FSH is available in various languages. Almost all of the softkeys, operating instructions and messages will then be displayed in the selected language. The R&S®FSH supports the following languages: English, German, Korean, Japanese, Chinese, Russian, Italian, Spanish, Portuguese, 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) are protected by hinged covers.

## Front view




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

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.

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

## R&S®FSH standard functions

| | Models .04/.08/.13/.20 | Models .14/.18 | Models .24/.28 | Models .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 ($S_{12}$) and reflection ($S_{22}$) measurements | – | – | • | • |
| One-port cable loss measurements | – | – | – | • |
| Channel power meter | • | • | • | • |

## R&S®FSH options

| | Models .04/.08/.13/.20 | Models .14/.18 | Models .24/.28 | Models .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<br>R&S®FSH-K44E | R&S®FSH-K44<br>R&S®FSH-K44E | R&S®FSH-K44/<br>R&S®FSH-K44E | R&S®FSH-K44<br>R&S®FSH-K44E |
| Analysis of CDMA2000® signals | R&S®FSH-K46<br>R&S®FSH-K46E | R&S®FSH-K46<br>R&S®FSH-K46E | R&S®FSH-K46<br>R&S®FSH-K46E | R&S®FSH-K46<br>R&S®FSH-K46E |
| Analysis of 1xEV-DO signals | R&S®FSH-K47<br>R&S®FSH-K47E | R&S®FSH-K47<br>R&S®FSH-K47E | R&S®FSH-K47<br>R&S®FSH-K47E | R&S®FSH-K47<br>R&S®FSH-K47E |
| Analysis of TD-SCDMA/HSDPA signals | R&S®FSH-K48<br>R&S®FSH-K48E | R&S®FSH-K48<br>R&S®FSH-K48E | R&S®FSH-K48<br>R&S®FSH-K48E | R&S®FSH-K48<br>R&S®FSH-K48E |
| Analysis of LTE FDD signals | R&S®FSH-K50[5]<br>R&S®FSH-K50E | R&S®FSH-K50[5]<br>R&S®FSH-K50E | R&S®FSH-K50[5]<br>R&S®FSH-K50E | R&S®FSH-K50[5]<br>R&S®FSH-K50E |
| Analysis of LTE TDD signals | R&S®FSH-K51[5]<br>R&S®FSH-K51E | R&S®FSH-K51[5]<br>R&S®FSH-K51E | R&S®FSH-K51[5]<br>R&S®FSH-K51E | R&S®FSH-K51[5]<br>R&S®FSH-K51E |
| Analysis of NB-IoT downlink signals | R&S®FSH-K56[5] | R&S®FSH-K56[5] | R&S®FSH-K56[5] | R&S®FSH-K56[5] |
| Distance-to-fault (DTF) measurements | – | – | R&S®FSH-K41 | R&S®FSH-K41 |
| Vector reflection and transmission measurements ($S_{11}$, $S_{22}$, $S_{21}$, $S_{12}$) | – | – | R&S®FSH-K42 | – |
| One-port cable loss measurements | – | – | R&S®FSH-K42 | – |
| Vector voltmeter | – | – | R&S®FSH-K45 | R&S®FSH-K45 |
| Power measurements up to 110 GHz | see power sensors on page 25 | | | |
| Directional power measurements up to 1 GHz/4 GHz | R&S®FSH-Z14<br>R&S®FSH-Z44 | R&S®FSH-Z14<br>R&S®FSH-Z44 | R&S®FSH-Z14<br>R&S®FSH-Z44 | R&S®FSH-Z14<br>R&S®FSH-Z44 |
| 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 |

## 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 | • | • | • | – |

[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, typ. 0.5 dB | | | |
| | 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, 4.5 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) [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 | models .24/.28/.23/.30 | 300 kHz to 3.6 GHz | 300 kHz to 8 GHz | 100 kHz to 8 GHz |
| Output power (port 1) | | 0 dBm to –40 dBm | | – |
| Output power (port 2) | | 0 dBm to –40 dBm | | 0 dBm to –40 dBm |
| **Reflection measurements ($S_{11}$, $S_{22}$)** | | | | |
| Directivity | 300 kHz to 3 GHz | > 43 dB nominal | > 43 dB nominal | > 43 dB nominal [4] |
| | 3 GHz to 3.6 GHz | > 37 dB nominal | > 37 dB nominal | > 37 dB nominal [4] |
| | 3.6 GHz to 6 GHz | – | > 37 dB nominal | > 37 dB nominal [4] |
| | 6 GHz to 8 GHz | – | > 31 dB nominal | > 31 dB nominal [4] |
| Display modes | vector reflection and transmission measurement (R&S®FSH-K42) | magnitude, phase, magnitude + phase, Smith chart, VSWR, reflection coefficient, mρ, 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 | 70 dB typ. | 70 dB typ. | – |
| | 300 kHz to 3.6 GHz | > 70 dB, 90 dB typ. | > 70 dB, 90 dB typ. | – |
| | 3.6 GHz to 6 GHz | – | > 70 dB, 90 dB typ. | – |
| | 6 GHz to 8 GHz | – | 50 dB typ. | – |
| Dynamic range ($S_{12}$) | 100 kHz to 300 kHz | 80 dB typ. | typ. 80 dB | typ. 80 dB |
| | 300 kHz to 3.6 GHz | > 80 dB, 100 dB typ. | > 80 dB, 100 dB typ. | > 80 dB, 100 dB typ. |
| | 3.6 GHz to 6 GHz | – | > 80 dB, 100 dB typ. | > 80 dB, 100 dB typ. |
| | 6 GHz to 8 GHz | – | 60 dB typ. | 60 dB typ. |
| 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 | | |

[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.

**For data sheet, see PD 5214.0482.22 and www.rohde-schwarz.com**

# 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 | 1314.2000.13 |
| 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 | 1314.2000.23 |
| Handheld Spectrum Analyzer, 9 kHz to 20 GHz, with preamplifier | R&S®FSH20 | 1314.2000.20 |
| Handheld Spectrum Analyzer, 9 kHz to 20 GHz, with preamplifier, tracking generator 300 kHz to 8 GHz and internal VSWR-Bridge | R&S®FSH20 | 1314.2000.30 |
| **Accessories supplied** | | |
| Li-ion battery pack, USB cable, LAN cable, AC power supply, CD-ROM with R&S®InstrumentView software and documentation, quick start guide | | |
| **Hardware option** | | |
| Li-Ion Battery Pack, 6.75 Ah (installed at factory; upgrade of the battery from 4.5 Ah to 6.75 Ah) | R&S®FSH-B106 | 1304.5958.02 |
| Precision Frequency Reference, aging: < $3.6 \times 10^{-9}$ /year | R&S®FSH-Z114 | 1304.5935.02 |
| **Software options (usually firmware)** | | |
| Spectrogram Measurement Application | R&S®FSH-K14 | 1304.5770.02 |
| Interference Analysis Measurement Application (software license) | R&S®FSH-K15 | 1309.7488.02 |
| Geotagging Measurement Application (software license) | R&S®FSH-K16 | 1309.7494.02 |
| Indoor Mapping Measurement Application (software license) | R&S®FSH-K17 | 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 | 1304.5993.02 |
| 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 | 1304.5612.02 |
| Vector Reflection and Transmission Measurements (for models .24/.28/.23/.30 only, requires R&S®FSH-Z28 or R&S®FSH-Z29) | R&S®FSH-K42 | 1304.5629.02 |
| Vector Voltmeter (for models .24/.28/.23/.30 only, requires R&S®FSH-Z28 or R&S®FSH-Z29) | R&S®FSH-K45 | 1304.5658.02 |
| GSM, EDGE Measurement Application | R&S®FSH-K10 | 1304.5864.02 |
| 3GPP WCDMA BTS/NodeB Pilot Channel and EVM Measurement Application | R&S®FSH-K44 | 1304.5641.02 |
| 3GPP WCDMA BTS/NodeB Code Domain Power Measurement Application (R&S®FSH-K44 required) | R&S®FSH-K44E | 1304.5758.02 |
| CDMA2000® BTS Pilot Channel and EVM Measurement Application | R&S®FSH-K46 | 1304.5729.02 |
| CDMA2000® BTS Code Domain Power Measurement Application (R&S®FSH-K46 required) | R&S®FSH-K46E | 1304.5764.02 |
| 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 |
| Receiver Mode and Channel Scan Measurement Application | R&S®FSH-K43 | 1304.5635.02 |

| Designation | Type | Order No. |
|---|---|---|
| **Recommended extras: power sensors** | | |
| 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 |
| Universal Power Sensor, 1 nW to 100 mW, 10 MHz to 8 GHz [1), 2)] | R&S®NRP-Z211 | 1417.0409.02 |
| Universal Power Sensor, 1 nW to 100 mW, 10 MHz to 18 GHz [1), 2)] | R&S®NRP-Z221 | 1417.0309.02 |
| Wideband Power Sensor, 1 nW to 100 mW, 50 MHz to 18 GHz [1), 2)] | R&S®NRP-Z81 | 1137.9009.02 |
| Wideband Power Sensor, 1 nW to 100 mW, 50 MHz to 40 GHz (2.92 mm) [1), 2)] | R&S®NRP-Z85 | 1411.7501.02 |
| Wideband Power Sensor, 1 nW to 100 mW, 50 MHz to 40 GHz (2.40 mm) [1), 2)] | R&S®NRP-Z86 | 1417.0109.40 |
| Wideband Power Sensor, 1 nW to 100 mW, 50 MHz to 44 GHz (2.40 mm) [1), 2)] | R&S®NRP-Z86 | 1417.0109.44 |
| Three-Path Diode Power Sensor, 100 pW to 200 mW, 10 MHz to 8 GHz | R&S®NRP8S | 1419.0006.02 |
| Three-Path Diode Power Sensor, 100 pW to 200 mW, 10 MHz to 18 GHz | R&S®NRP18S | 1419.0029.02 |
| Three-Path Diode Power Sensor, 100 pW to 200 mW, 10 MHz to 33 GHz | R&S®NRP33S | 1419.0064.02 |
| Three-Path Diode Power Sensor, 100 pW to 200 mW, 50 MHz to 40 GHz | R&S®NRP40S | 1419.0041.02 |
| Three-Path Diode Power Sensor, 100 pW to 200 mW, 50 MHz to 50 GHz | R&S®NRP50S | 1419.0087.02 |
| Thermal Power Sensor, 300 nW to 100 mW, DC to 18 GHz | R&S®NRP18T | 1424.6115.02 |
| Thermal Power Sensor, 300 nW to 100 mW, DC to 33 GHz | R&S®NRP33T | 1424.6138.02 |
| Thermal Power Sensor, 300 nW to 100 mW, DC to 40 GHz | R&S®NRP40T | 1424.6150.02 |
| Thermal Power Sensor, 300 nW to 100 mW, DC to 50 GHz | R&S®NRP50T | 1424.6173.02 |
| Thermal Power Sensor, 300 nW to 100 mW, DC to 67 GHz | R&S®NRP67T | 1424.6196.02 |
| Thermal Power Sensor, 300 nW to 100 mW, DC to 110 GHz | R&S®NRP110T | 1424.6215.02 |
| Average Power Sensor, 100 pW to 200 mW, 8 kHz to 6 GHz | R&S®NRP6A | 1424.6796.02 |
| Average Power Sensor, 100 pW to 200 mW, 8 kHz to 18 GHz | R&S®NRP18A | 1424.6815.02 |
| **Recommended extras: adapter cables for power sensors** | | |
| USB Adapter (passive), for connecting R&S®NRP-Zxx power sensors to the R&S®FSH | R&S-NRP-Z4 | 1146.8001.02 |
| USB Interface Cable, length: 1.5 m (59 in), to connect R&S®NRP sensors to the R&S®FSH | R&S®NRP-ZKU | 1419.0658.03 |
| Adapter Cable for R&S®NRP-Z8x power sensors and R&S®FSH-Z29 option | R&S®FSH-Z129 | 1304.5887.00 |
| USB Adapter Cable for R&S®FSH-Z14/-Z44, length: 1.8 m | R&S®FSH-Z144 | 1145.5909.02 |
| **Optical power sensor and accessories** | | |
| OEM USB Optical Power Meter (Germanium) | R&S®HA-Z360 | 1334.5162.00 |
| OEM USB Optical Power Meter (filtered InGaAs) | R&S®HA-Z361 | 1334.5179.00 |
| SC Adapter for Optical Power Meter | R&S®HA-Z362 | 1334.5185.00 |
| LC Adapter for Optical Power Meter | R&S®HA-Z363 | 1334.5191.00 |
| 2.5 mm Universal Adapter for Optical Power Meter | R&S®HA-Z364 | 1334.5204.00 |
| 1.25 mm Universal Adapter for Optical Power Meter | R&S®HA-Z365 | 1334.5210.00 |
| Patch Cord SC-LC SM, SX, length: 1 m | R&S®HA-Z366 | 1334.5227.00 |
| Patch Cord SC-SC SM, SX, length: 1 m | R&S®HA-Z367 | 1334.5233.00 |
| **Recommended extras for calibration** | | |
| Combined Open/Short/50 Ω Load Calibration Standard, for calibrating 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 VSWR and DTF measurements, DC to 8 GHz | R&S®FSH-Z28 | 1300.7810.03 |
| Calibration Kit, 3.5 mm male, Open/Short/50 Ω Load/Through combination, 0 Hz to 15 GHz | R&S®ZV-Z135 | 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 | 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 | 0358.5714.02 |
| Matching Pad, 50 Ω/75 Ω, bidirectional, 0 Hz to 2.7 GHz, N female/N male, load capacity 2 W | R&S®RAM | 0358.5414.02 |
| Matching Pad, 50 Ω/75 Ω, bidirectional, 0 Hz to 1 GHz, BNC female/N male, load capacity 1 W | R&S®FSH-Z38 | 1300.7740.02 |
| Adapter, N male/BNC female | | 0118.2812.00 |
| Adapter, N male/N male | | 0092.6581.00 |
| Adapter, N male/SMA female | | 4012.5837.00 |
| Adapter, N male/7/16 female | | 3530.6646.00 |
| Adapter, N male/7/16 male | | 3530.6630.00 |
| Adapter, N male/FME female | | 4048.9790.00 |
| Adapter, BNC male/banana female | | 0017.6742.00 |
| Attenuator, 50 W, 20 dB, 50 Ω, DC to 6 GHz, N female/N male | R&S®RDL50 | 1035.1700.52 |
| Attenuator, 100 W, 20 dB, 50 Ω, DC to 2 GHz, N female/N male | R&S®RBU100 | 1073.8495.20 |
| Attenuator, 100 W, 30 dB, 50 Ω, DC to 2 GHz, N female/N male | R&S®RBU100 | 1073.8495.30 |
| RF Cable (1 m), N male/N female, for R&S®FSH-K41 option, DC to 8 GHz | R&S®FSH-Z320 | 1309.6600.00 |
| RF Cable (3 m), N male/N female, for R&S®FSH-K41 option, DC to 8 GHz | R&S®FSH-Z321 | 1309.6617.00 |
| **Recommended extras: mobile radio test antenna and EMC test equipment** | | |
| GSM/UMTS/CDMA Antenna, with magnetic mount 850/900/1800/1900/2100 band, N connector | R&S®TS95A16 | 1118.6943.16 |
| 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 |
| Compact Probe Set for E and H near-field measurements, 30 MHz to 3 GHz | R&S®HZ-15 | 1147.2736.02 |
| 3 GHz, 20 dB Preamplifier, 100 V to 230 V, for R&S®HZ-15 | R&S®HZ-16 | 1147.2720.02 |
| **Recommended extras: directional antenna and accessories** | | |
| Handheld Directional Antenna (antenna handle) | R&S®HE400 | 4104.6000.02 |
| HF Antenna Module, 8.3 kHz to 30 MHz | R&S®HE400HF | 4104.8002.02 |
| VHF Antenna Module, 20 MHz to 200 MHz | R&S®HE400VHF | 4104.8202.02 |
| UWB Antenna Module, 30 MHz to 6 GHz | R&S®HE400UWB | 4104.6900.02 |
| Log-Periodic Antenna Module, 450 MHz to 8 GHz | R&S®HE400LP | 4104.8402.02 |
| Cellular Antenna Module, 700 MHz to 2500 MHz | R&S®HE400CEL | 4104.7306.02 |
| Cable Set for R&S®HE400 and R&S®PR100 or R&S®FSH | R&S®HE400-K | 4104.7770.02 |
| Transport Case for R&S®HE400 | R&S®HE400Z1 | 4104.9009.02 |
| Transport Bag (small) for R&S®HE400 (recommended for one or two antenna modules) | R&S®HE400Z2 | 4104.9050.02 |
| Transport Bag (large) for R&S®HE400 (recommended for three or four antenna modules) | R&S®HE400Z3 | 4104.9080.02 |
| Tripod for R&S®HE400 | R&S®HE400Z4 | 4104.9109.02 |
| **Recommended extras for power supply** | | |
| 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 |
| Battery Charger, for Li-ion battery pack, 4.5 Ah/6.75 Ah[3)] | R&S®HA-Z203 | 1309.6123.00 |
| 12 V Car Adapter | R&S®HA-Z202 | 1309.6117.00 |
| **Recommended extras for transport of the R&S®FSH handheld spectrum analyzer** | | |
| Soft Carrying Bag (W × H × D: 260 mm × 360 mm × 280 mm; 10.2 in × 14.2 in × 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 |
| Shoulder Strap for Carrying Holster | R&S®HA-Z223 | 1309.6075.00 |
| **Recommended extras: others** | | |
| SD Memory Card, 8 Gbyte[4)] | R&S®HA-Z232 | 1309.6223.00 |
| GPS Receiver | R&S®HA-Z240 | 1309.6700.03 |
| Headphones | R&S®FSH-Z36 | 1145.5838.02 |

| Designation | Type | Order No. |
|---|---|---|
| **Spare parts** | | |
| Spare USB Cable | R&S®HA-Z211 | 1309.6169.00 |
| Spare LAN Cable | R&S®HA-Z210 | 1309.6152.00 |
| Spare AC Adapter | R&S®HA-Z201 | 1309.6100.00 |
| Spare CD-ROM, with R&S®InstrumentView software and R&S®FSH documentation | R&S®FSH-Z45 | 1309.6246.00 |
| Quick Start Manual for R&S®FSH, printed version, English | R&S®FSH-Z46 | 1309.6269.12 |
| Quick Start Manual for R&S®FSH, printed version, German | R&S®FSH-Z47 | 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 | | 3 years |
| All other items | | 1 year |
| **Options** | | |
| Extended Warranty, one year | R&S®WE1 | Please contact your local Rohde&Schwarz sales office. |
| Extended Warranty, two years | R&S®WE2 | |
| Extended Warranty with Calibration Coverage, one year | R&S®CW1 | |
| Extended Warranty with Calibration Coverage, two years | R&S®CW2 | |

## Service that adds value

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

**Rohde&Schwarz**

The Rohde&Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

**Sustainable product design**

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

Certified Quality Management
ISO 9001

Certified Environmental Management
ISO 14001


**Rohde&Schwarz GmbH&Co. KG**
www.rohde-schwarz.com

**Rohde&Schwarz training**
www.training.rohde-schwarz.com

**Regional contact**

- Europe, Africa, Middle East | +49 89 4129 12345
  customersupport@rohde-schwarz.com
- North America | 1 888 TEST RSA (1 888 837 87 72)
  customer.support@rsa.rohde-schwarz.com
- Latin America | +1 410 910 79 88
  customersupport.la@rohde-schwarz.com
- Asia Pacific | +65 65 13 04 88
  customersupport.asia@rohde-schwarz.com
- China | +86 800 810 82 28 | +86 400 650 58 96
  customersupport.china@rohde-schwarz.com




PD 5214.0482.12 | Version 19.00 | January 2018 (GK)
R&S®FSH Handheld Spectrum Analyzer



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