R&S®FSH Handheld Spectrum Analyzer

Where mobility counts

ROHDE & SCHWARZ

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 three most important RF analysis functions that an RF service technician or an installation and maintenance team needs to solve daily routine measurement tasks. For example, it can be used for maintaining or installing transmitter systems, checking cables and antennas, assessing signal quality in broadcasting, radiocommunications and service, measuring electric field strength or in simple lab applications. The R&S®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 if it rains? No problem – 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 (base stations)
▯ Power measurements on pulsed signals
▯ Channel power measurements
▯ Adjacent channel power measurements
▯ Measurements of spurious emissions (spectrum emission mask)
▯ Measurements of the modulation spectrum on pulsed signals with gated sweep
▯ Spectrogram measurements
▯ Analysis of transmit signals (connected to BTS or OTA)
 ▪ GSM/GPRS/EDGE
 ▪ WCDMA/HSDPA/HSPA+
 ▪ CDMA2000®
 ▪ 1xEV-DO
 ▪ LTE FDD/TDD
 ▪ 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
▯ Power measurements up to 67 GHz
▯ Directional power measurements up to 4 GHz

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

Measurements of electromagnetic fields
▯ Field strength measurements with directional antennas
▯ Field strength measurements with isotropic antennas

Diagnostic applications in the lab or in service
▯ General spectrum analysis
▯ EMC precompliance measurements and channel scan
▯ AM modulation depth measurements
▯ Measurements of signal distortions caused by harmonics
▯ Location of EMC problems

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 using the R&S®FSH wizard
▯ Setting of frequency via channel tables
▯ Operation in different languages

Documentation and remote control
▯ R&S®FSH4View software for documenting measurement results
▯ Remote control via LAN or USB

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Installation and maintenance of transmitter stations (base 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
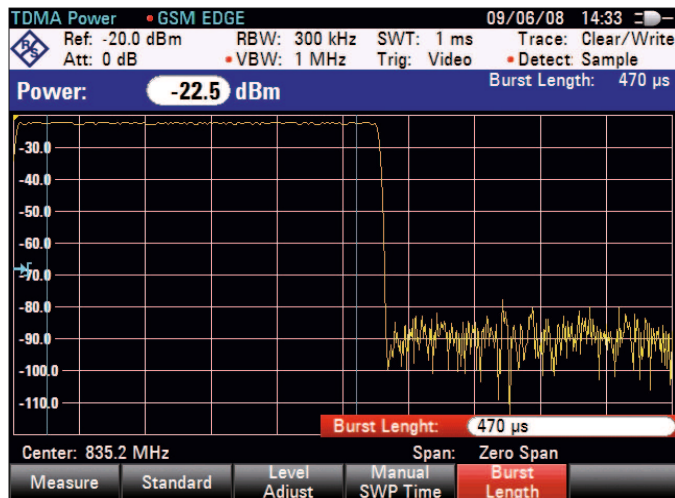- Determination of transmission power using power sensors

Power measurements on pulsed signals

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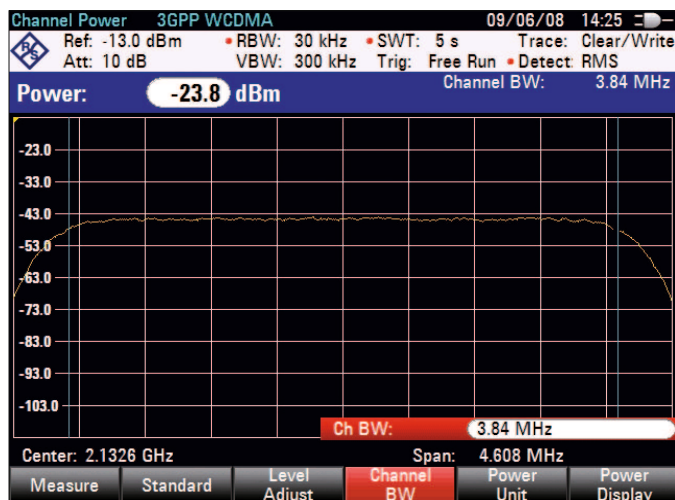
Channel power measurements

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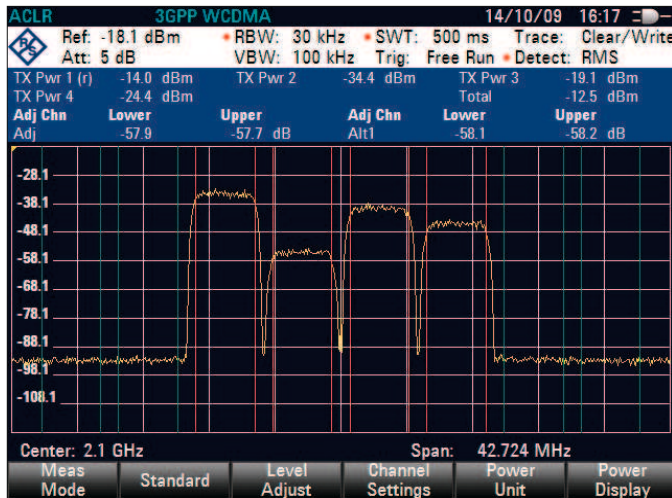
TDMA power measurement.

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).

Adjacent channel power measurements

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

Measurements 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®FSH4View software.
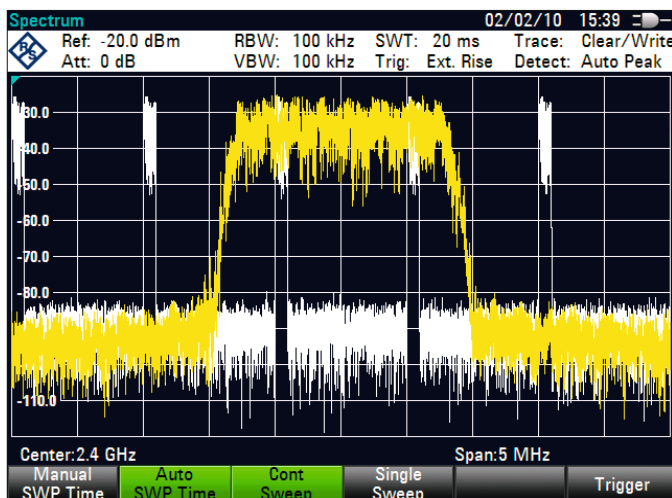
Measurements of the modulation spectrum on pulsed signals with gated sweep

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

Simultaneous display of spectrum and spectrogram.

Analysis of GSM/GPRS/EDGE transmit signals.

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

Spectrogram measurements

The R&S®FSH-K14 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.

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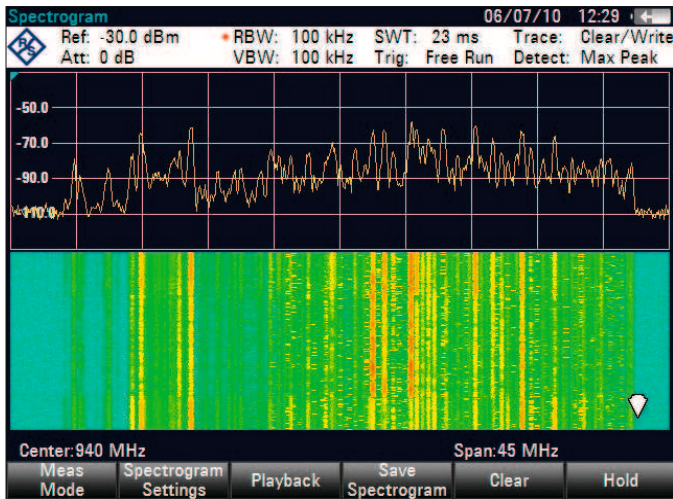
The power versus time display shows the GSM/EDGE bursts in the time domain. It is used to check whether the power and timing of the frame comply with the specifications. Equipped with the R&S®FSH-K10, the R&S®FSH measurement results allow network operators to adjust BTS transmit power and frequency settings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

Analysis of 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

The 3GPP WCDMA code domain power measurement provides an overview of the key signal parameters.
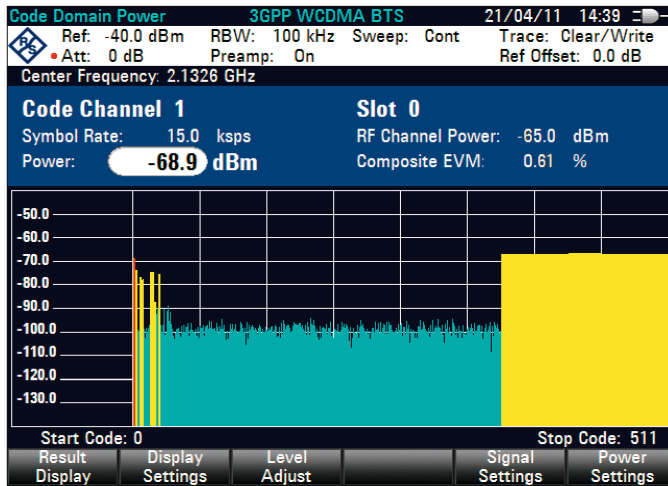
Analysis of a CDMA2000® transmit signal with the R&S®FSH-K46 option.
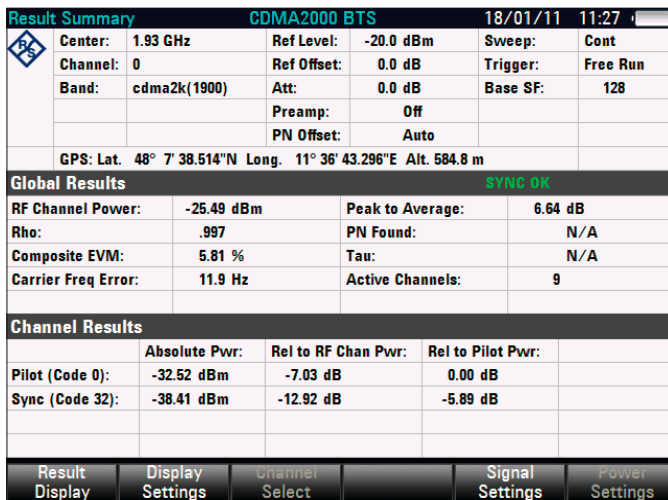
The CDMA2000® code domain power measurement provides an overview of the key signal parameters.
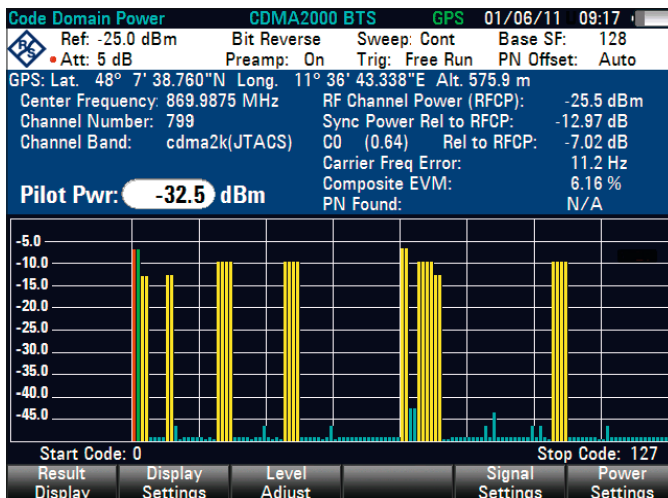
about signal quality. The ratio of the chip energy (E_c) to the power density of the interference signal (I_0) provides information about the signal-to-interference ratio. The scrambling code can be determined at the press of a button and used automatically for decoding the code channels. For a quick 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.

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 an unoccupied channels. The resulting summary provides and 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.
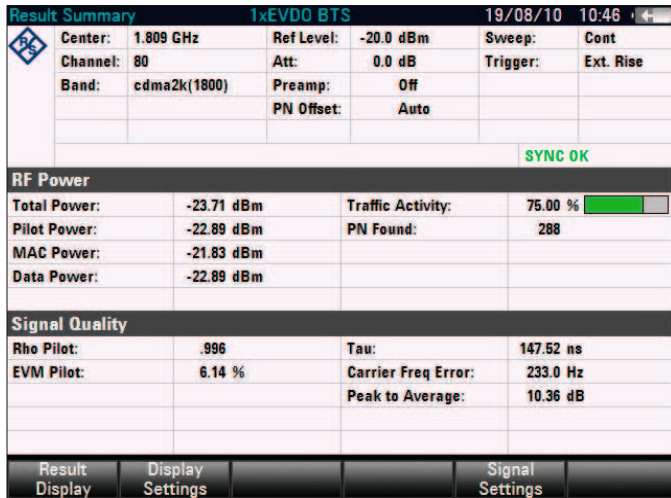
The code domain channel table contains additional information such as the symbol rate and the channel number with its Walsh code.

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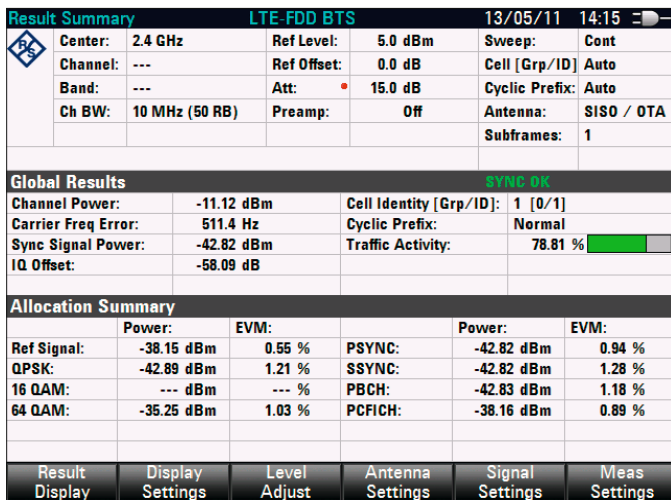
Analysis of 1xEV-DO transmit signals

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

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 4x4 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.

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

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

[1] The R&S®FSH-K50/-K51 options are available for R&S®FSH analyzers with serial numbers ≥ 105000.

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Result Summary		TD-SCDMA BTS		25/09/12	16:39
Center:	2.015 GHz	Ref Level: *	10.2 dBm	Sweep:	Cont
Channel:	---	Ref Offset:	40.2 dB	Sw Pnt:	6
Band:	---	Att: *	40.0 dB	Slot Number:	0
Transd:	---	Preamp:	On	Max Users:	16
		Scr Code:	0		

Global Slot Results				SYNC OK
RF Channel Power:	10.58 dBm	P-CCPCH Symbol EVM:	1.05 % rms (Slot 0)
Carrier Freq Error:	-18.75 Hz		

Slot Power Results		
	Absolute Power:	Rel to RF Chan Pwr:
Data Power:	10.58 dBm	0.00 dB
Data 1 Power:	10.58 dBm	-0.00 dB
Data 2 Power:	10.59 dBm	0.01 dB
Midamble Power:	10.56 dBm	-0.02 dB

Center Freq	CF Stepsize				Freq Mode

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

Time Domain Power			TD-SCDMA BTS		02.10.0045 22/11/12	14:40
Ref: -10.0 dBm	• Att: 0 dB		RBW: 30 kHz		Sweep:	Single
Ref Off: 0.0 dB	Preamp: Off				Trace:	Clear/Write

Slot	Power (dBm)	C/I (dB)	Comp.EVM (%)	Slot	Power (dBm)	C/I (dB)	Comp.EVM (%)
0	-20.44	150.44	0.66	3	-26.95	147.39	0.68
DwPTS	-25.03	4.02	24.89	4	-29.96	146.23	0.68
UpPTS	-89.44	N/A	N/A	5	-23.19	153.64	0.65
1	-89.67	---	---	6	-29.96	149.58	0.67
2	-26.96	138.73	0.72				

Center:100 MHz   Time:5.42 ms

			Cont Sweep	Single Sweep	Save IQ Data	

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

S11,S22 + S21,S12 Vector						11:34
• Ref: 1.0 dB		RBW: 10 kHz	SWT: Auto		Trace:	Clear/Write
• Att: 10 dB			TG Att: 10 dB		Suppr:	Off
M1	2.22 GHz	-26.39 dB	-18.85 dB	-4.77 dB		-4.90 dB
M2	2.22 GHz	-10.06 dB	-9.87 dB	-6.02 dB		-6.06 dB
Upper Limit:	Threshold		-1.00 dB		Trace 1	PASS
Lower Limit:	Threshold		-25.00 dB		Trace 1	FAIL
Upper Limit:	Threshold		-3.00 dB		Trace 2	PASS

S11 S22 (interp HA) Mag

S21 S12 (interp HA) Mag

Center:2.22 GHz   Trace: 1   Span: 25 MHz

Spectrum	Network Analyzer	Dig Mod Analyzer	Distance to Fault	Power Meter	Receiver / Interference

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 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.

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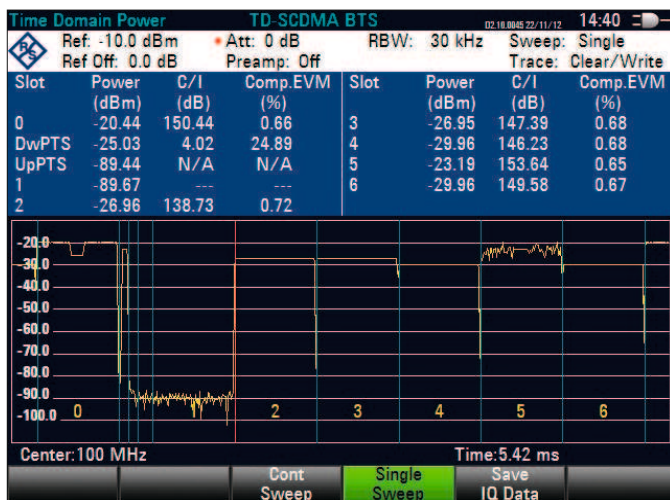
The code domain power display shows the active and inactive TD-SCDMA codes within the selected frequency channel. The channel table display shows the main parameters of the TD-SCDMA and HSDPA channels. The Sync ID display shows the signals coming from different base stations.

Two-port 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}, S_{21}, 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

Vector network analysis: measurement with Smith chart.

Scalar transmission measurement.

Distance-to-fault measurements (DTF).

Scalar network analysis

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

One-port cable loss measurements

The R&S®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.
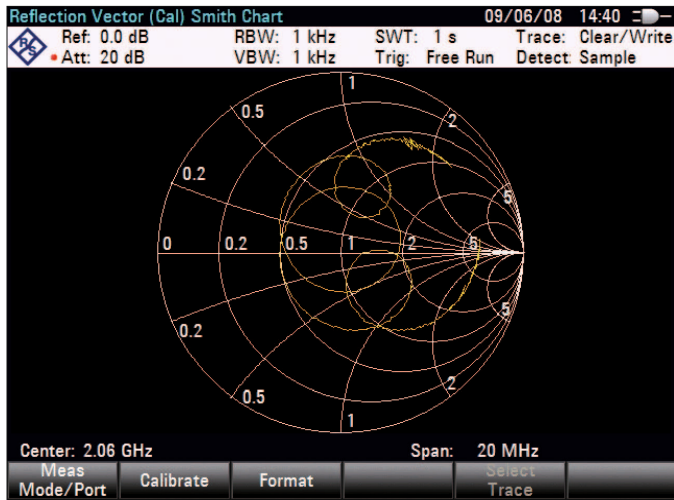
Vector voltmeter

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 .24 and .28) can replace a conventional vector voltmeter for many applications. Because the required signal source and bridge are already available in the R&S®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.
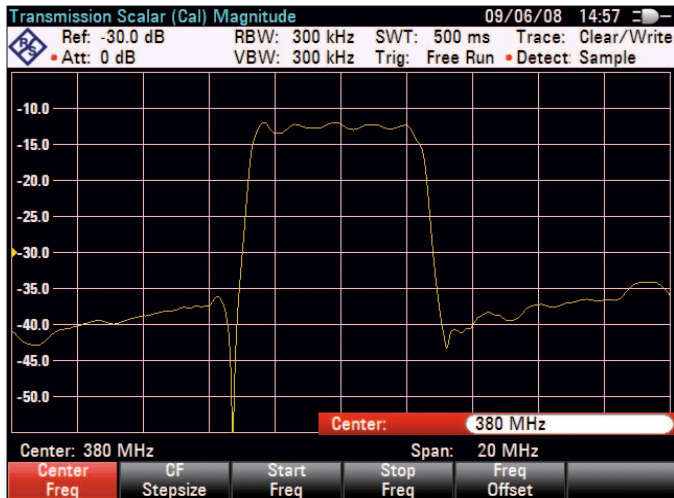
Typical applications:
❙ Adjustment of electrical cable length
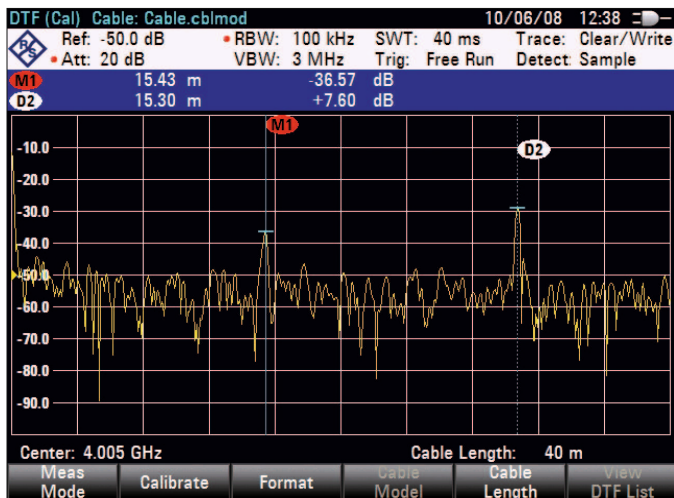❙ Checking of phase-controlled antennas such as used in an instrument landing system (ILS) in air traffic control

Position finding and increased measurement accuracy using the GPS receiver
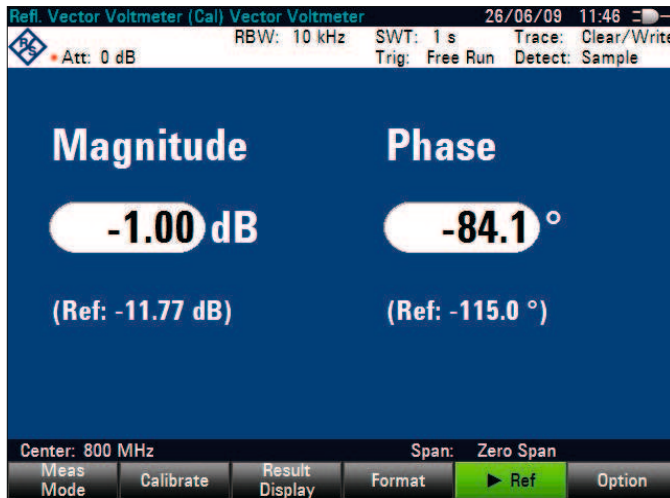
Using the R&S®HA-Z240 GPS receiver, the R&S®FSH documents where a measurement is carried out. The longitude, latitude and altitude of the position are shown on the display. If required, the position can be stored together with the measurement results. Moreover, the GPS receiver increases the frequency 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 (25×10^{-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.

Power measurements up to 67 GHz

Equipped with the R&S®FSH-Z1 and the R&S®FSH-Z18 power sensors or the R&S®NRP-Zxx USB power sensors, the R&S®FSH becomes a highly accurate RF power meter up 67 GHz with a measurement range from –67 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.

Interference analysis and geotagging

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.

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®HL300, the R&S®FSH helps network operators and regulatory bodies to successfully detect and characterize interfering signals and find interference sources.

The RSSI, C/I, C/N and signal strength measurement displays help users to easily find, monitor and characterize interfering signals.

With the "save on event function", thresholds can be defined to detect short duration or intermittent signals.

The spectrogram display shows frequency, time and level information, allowing the time pattern of the interfering signal to be analyzed using the recording and replay functions.

R&S®FSH with R&S®HL300 antenna.

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®HL300 is the perfect handheld antenna for interference hunting with the R&S®FSH. It covers frequencies between 450 MHz and 8 GHz and is equipped with GPS and an electronic compass. There is a switch on top of the R&S®HL300 handle that can be used to trigger a measurement or switch on the R&S®FSH preamplifier. The R&S®HL300 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.

Geotagging

When equipped with the R&S®FSH-K16, a GPS receiver (i.e. R&S®HA-Z240) 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.

Display of map triangulation lines with R&S®FSH-K15
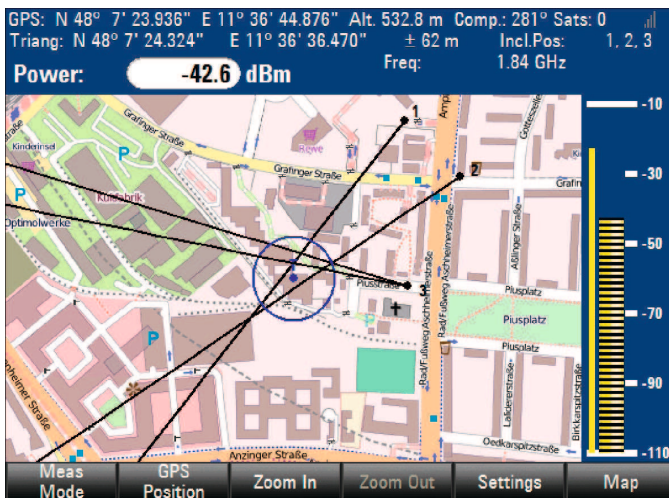
Site location display with R&S®FSH-K16
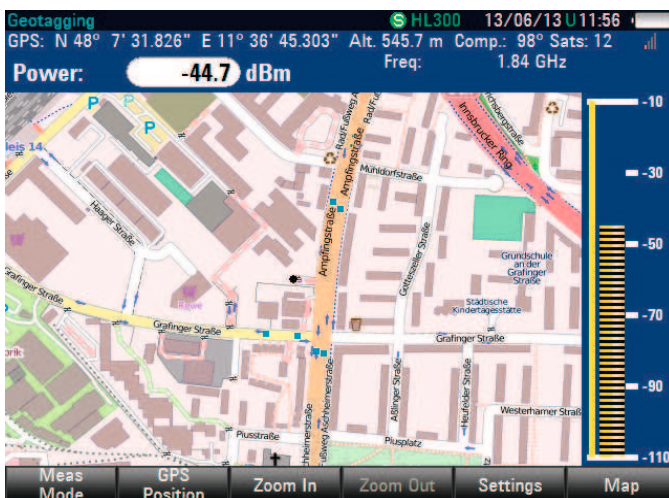
Measurements of electromagnetic fields

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

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

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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/m^2 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.

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 67 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®FSH4 View 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.
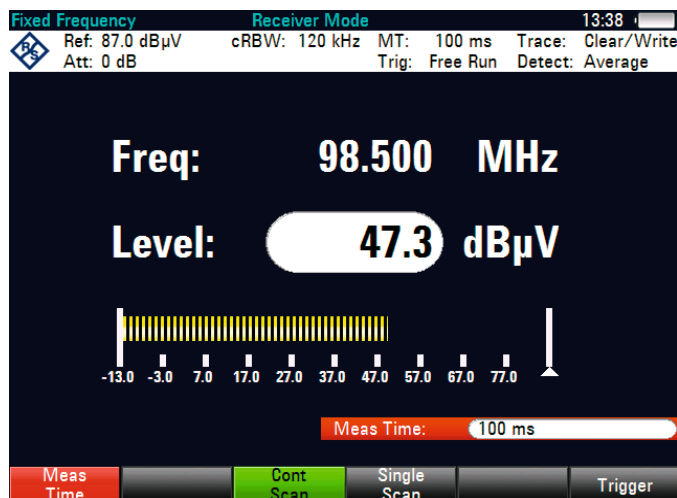
Channel scan of a 3GPP WCDMA frequency band.
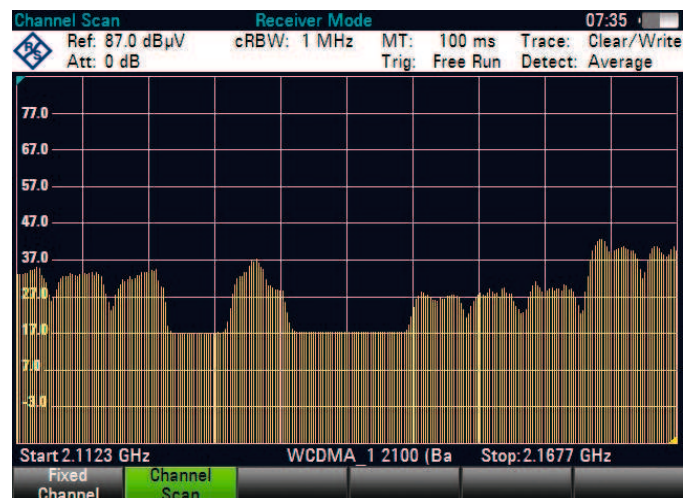
AM modulation depth measurements

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.

Measurements 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 near-field probes are used as diagnostic tools for locating EMC problems, e.g. on circuit boards, integrated circuits, cables and shielding. The R&S®HZ-15 near-field probe set is 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.
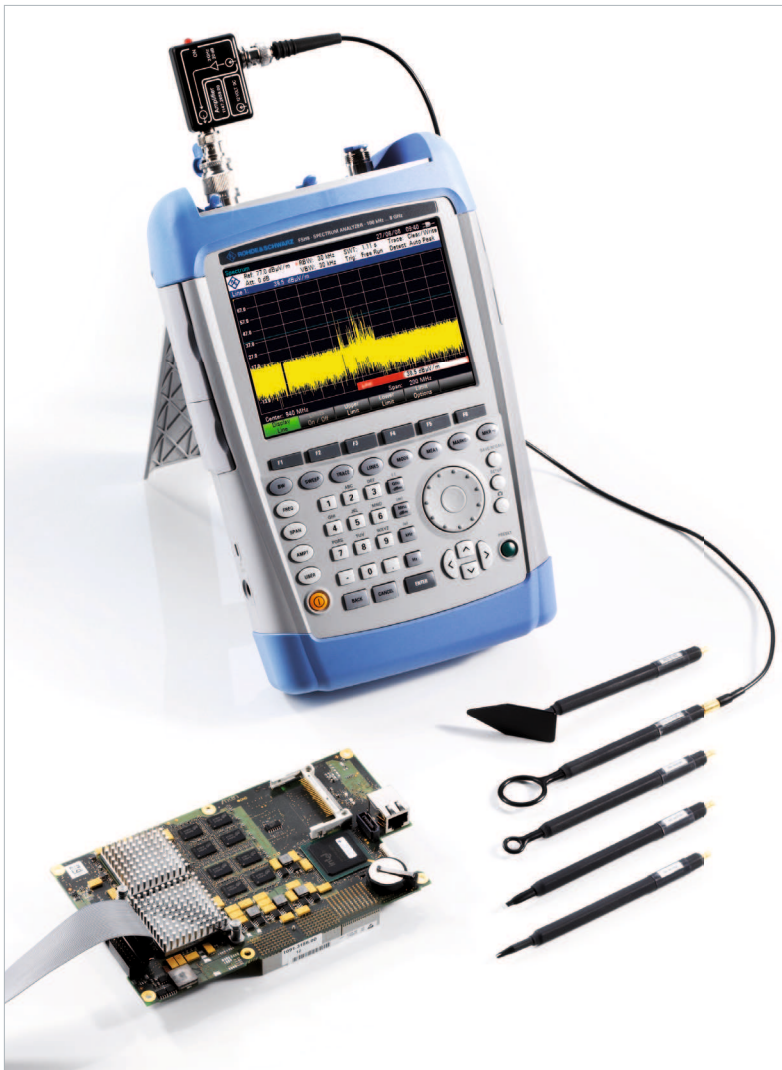
The R&S®FSH with near-field probes and DUT.

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.

Test report in just a few steps using 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

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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 configuration of instrument setup.

Selecting the channel table.

Straightforward menus for easy selection of functions.
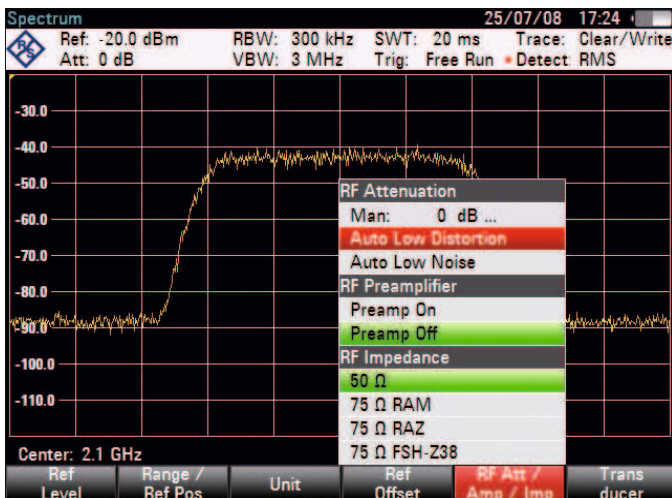
Easy-to-access, well-protected connectors

Additional inputs/outputs such as the DC voltage supply (bias), 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

RF input

Connector for headphones

Ext. trigger input
Ext. reference input
IF output/video output
Bias input
Connector for accessories

LAN/USB interface

Simple menu-based operation via softkeys

Function keys

Kensington lock

Call-up of user-defined settings

Tracking generator output

Connector for power sensor

USB interface, type A [1]

SD memory card

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

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

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

General instrument setup

Screenshot

Rotary knob with Enter button

Cursor keys

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

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Documentation and remote control

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

The R&S®FSH with laptop.

The R&S®FSH4View software.
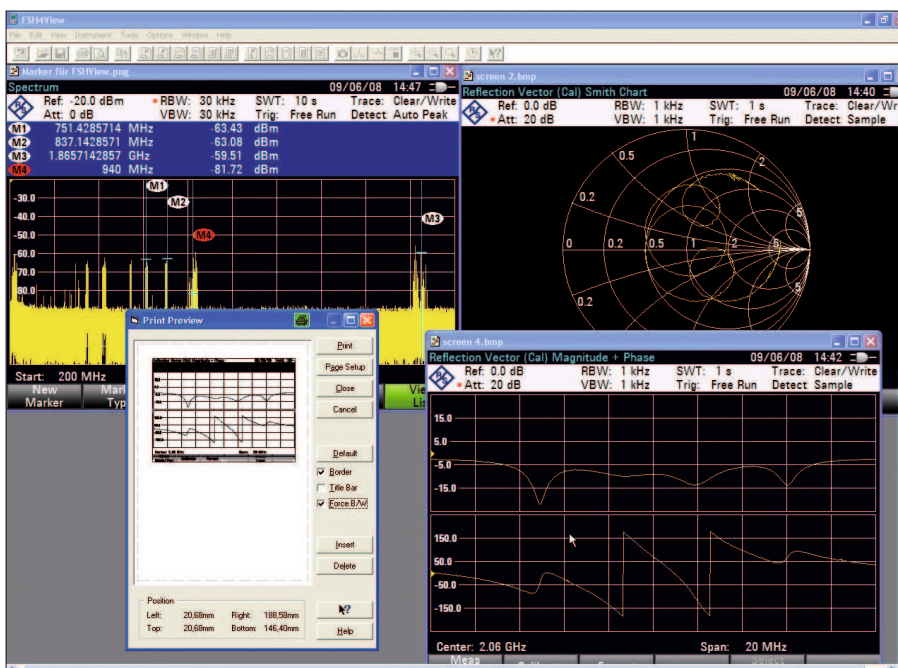
R&S®FSH4View software for documenting measurement results

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

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.

System configuration
Options and applications

Altogether eight R&S®FSH models for different applications and frequency ranges are available (models .04/.08/.14/.18/.24/.28/.13/.20). 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 18 GHz and for directional power measurements up to 4 GHz.

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

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
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	–	–	•

R&S®FSH options

	Models .04/.08/.13/.20	Models .14/.18	Models .24/.28
Spectrogram measurements	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
Geotagging	R&S®FSH-K16	R&S®FSH-K16	R&S®FSH-K16
Receiver mode and channel scan measurements	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
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
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
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
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
Analysis of LTE FDD signals	R&S®FSH-K50 [1]/ R&S®FSH-K50E	R&S®FSH-K50 [1]/ R&S®FSH-K50E	R&S®FSH-K50 [1]/ R&S®FSH-K50E
Analysis of LTE TDD signals	R&S®FSH-K51 [1]/ R&S®FSH-K51E	R&S®FSH-K51 [1]/ R&S®FSH-K51E	R&S®FSH-K51 [1]/ R&S®FSH-K51E
Distance-to-fault (DTF) measurements	–	–	R&S®FSH-K41
Vector reflection and transmission measurements	–	–	R&S®FSH-K42
One-port cable loss measurements	–	–	R&S®FSH-K42
Vector voltmeter	–	–	R&S®FSH-K45
Power measurements up to 67 GHz	see power sensors on page 26		
Directional power measurements up to 1 GHz/4 GHz	R&S®FSH-Z14/ R&S®FSH-Z44	R&S®FSH-Z14/ R&S®FSH-Z44	R&S®FSH-Z14/ R&S®FSH-Z44
Remote control via LAN or USB	R&S®FSH-K40	R&S®FSH-K40	R&S®FSH-K40

Models

	Frequency range	Preamplifier	Tracking generator	Built-in VSWR bridge
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®FSH20, model .20	9 kHz to 20 GHz	•	–	–

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

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Specifications in brief

Spectrum analysis

		R&S®FSH4	R&S®FSH8	R&S®FSH13	R&S®FSH20
Frequency range	models .04/.14/.08/.18	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		10 Hz to 3 MHz			
Displayed average noise level	without preamplifier, RBW = 1 Hz (normalized)				
	9 kHz to 100 kHz (models .04/.14/.08/.18 only)	< –108 dBm, –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/vector voltmeter (models .24/.28 with R&S®FSH-K42/R&S®FSH-K45 only)		R&S®FSH4	R&S®FSH8
Frequency range	models .24/.28	300 kHz to 3.6 GHz	300 kHz to 8 GHz
Output power (port 1, port 2)		0 dBm to –40 dBm	
Reflection measurements (S_{11}, S_{22})			
Directivity	300 kHz to 3 GHz	nominal > 43 dB	nominal > 43 dB
	3 GHz to 3.6 GHz	nominal > 37 dB	nominal > 37 dB
	3.6 GHz to 6 GHz	–	nominal > 37 dB
	6 GHz to 8 GHz	–	nominal > 31 dB
Display modes	vector reflection and transmission measurement (R&S®FSH-K42)	magnitude, phase, magnitude + phase, Smith chart, VSWR, reflection coefficient, 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
	300 kHz to 3.6 GHz	> 80 dB, 100 dB typ.	> 80 dB, 100 dB typ.
	3.6 GHz to 6 GHz	–	> 80 dB, 100 dB typ.
	6 GHz to 8 GHz	–	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	

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

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

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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 20 GHz, with preamplifier	R&S®FSH20	1314.2000.20
Accessories supplied		
Li-ion battery pack, USB cable, LAN cable, AC power supply, CD-ROM with R&S®FSH4View software and documentation, quick start guide		
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
Remote Control via LAN or USB	R&S®FSH-K40	1304.5606.02
Distance-to-Fault Measurement (for models .24 and .28 only, requires R&S®FSH-Z320 or R&S®FSH-Z321 and R&S®FSH-Z28 or R&S®FSH-Z29)	R&S®FSH-K41	1304.5612.02
Vector Reflection and Transmission Measurements (for models .24 and .28 only, requires R&S®FSH-Z28 or R&S®FSH-Z29)	R&S®FSH-K42	1304.5629.02
Vector Voltmeter (for models .24 and .28 only, requires R&S®FSH-Z28 or R&S®FSH-Z29)	R&S®FSH-K45	1304.5658.02
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
Receiver Mode and Channel Scan Measurement Application	R&S®FSH-K43	1304.5635.02
Accessories		
Power Sensor, 10 MHz to 8 GHz	R&S®FSH-Z1	1155.4505.02
Power Sensor, 10 MHz to 18 GHz	R&S®FSH-Z18	1165.1909.02
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
USB Adapter Cable for R&S FSH-Z1/-Z18, length: 1.8 m	R&S FSH-Z101	1164.6242.02
Precision Frequency Reference, aging: < 3.6 × 10⁻⁹ /year	R&S®FSH-Z114	1304.5935.02
USB Adapter Cable for R&S®FSH-Z14/-Z44, length: 1.8 m	R&S®FSH-Z144	1145.5909.02
Universal Power Sensor, 200 pW to 200 mW, 10 MHz to 8 GHz [1][2]	R&S®NRP-Z11	1138.3004.02
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, 200 pW to 200 mW, 10 MHz to 18 GHz [1][2]	R&S®NRP-Z21	1137.6000.02
Universal Power Sensor, 1 nW to 100 mW, 10 MHz to 18 GHz [1][2]	R&S®NRP-Z221	1417.0309.02
Universal Power Sensor, 2 nW to 2 W, 10 MHz to 18 GHz [1][2]	R&S®NRP-Z22	1137.7506.02
Universal Power Sensor, 20 nW to 15 W, 10 MHz to 18 GHz [1][2]	R&S®NRP-Z23	1137.8002.02
Universal Power Sensor, 60 nW to 30 W, 10 MHz to 18 GHz [1][2]	R&S®NRP-Z24	1137.8502.02
Universal Power Sensor, 200 pW to 200 mW, 10 MHz to 33 GHz [1][2]	R&S®NRP-Z31	1169.2400.02
Wideband Power Sensor, 1 nW to 100 mW, 50 MHz to 18 GHz [1][2]	R&S®NRP-Z81	1137.9009.02

Designation	Type	Order No.
Thermal Power Sensor, 1 µW to 100 mW, DC to 18 GHz [1] [2]	R&S®NRP-Z51	1138.0005.02
Thermal Power Sensor, 1 µW to 100 mW, DC to 40 GHz [1] [2]	R&S®NRP-Z55	1138.2008.02
Thermal Power Sensor, 300 nW to 100 mW, DC to 50 GHz [1] [2]	R&S®NRP-Z56	1171.8201.02
Thermal Power Sensor, 300 nW to 100 mW, DC to 67 GHz [1] [2]	R&S®NRP-Z57	1171.8401.02
Average Power Sensor, 200 pW to 200 mW, 9 kHz to 6 GHz [1] [2]	R&S®NRP-Z91	1168.8004.02
Average Power Sensor, 2 nW to 2 W, 9 kHz to 6 GHz [1] [2]	R&S®NRP-Z92	1171.7005.02
USB Adapter (passive), for connecting R&S®NRP-Zxx power sensors to the R&S®ZVH	R&S-NRP-Z4	1146.8001.02
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
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
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
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
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
SD Memory Card, 4 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
GSM/UMTS/CDMA Antenna, with magnetic mount 850/900/1800/1900/2100 band, N connector	R&S®TS95A16	1118.6943.16
Active Directional Antenna, 20 MHz to 7.5 GHz	R&S®HE300	4067.5900.02
Loop Antenna for R&S®HE300, 9 kHz to 20 MHz	R&S®HE300-HF	4067.6806.02
Handheld Directional Antenna R&S®HL300, 450 MHz to 8 GHz	R&S®HL300	4097.3005.02
Isotropic Antenna, 30 MHz to 3 GHz, for R&S®TS-EMF	R&S®TSEMF-B1	1074.5719.02
Isotropic Antenna, 700 MHz to 6 GHz, for R&S®TS-EMF	R&S®TSEMF-B2	1074.5702.02
Isotropic Antenna, 9 kHz to 200 MHz, for R&S®TS-EMF	R&S®TSEMF-B3	1074.5690.02
Near Field Probe Set	R&S®HZ-15	1147.2736.02
Preamplifier for R&S®HZ-15	R&S®HZ-16	1147.2720.02

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Designation	Type	Order No.
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®FSH4View 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.
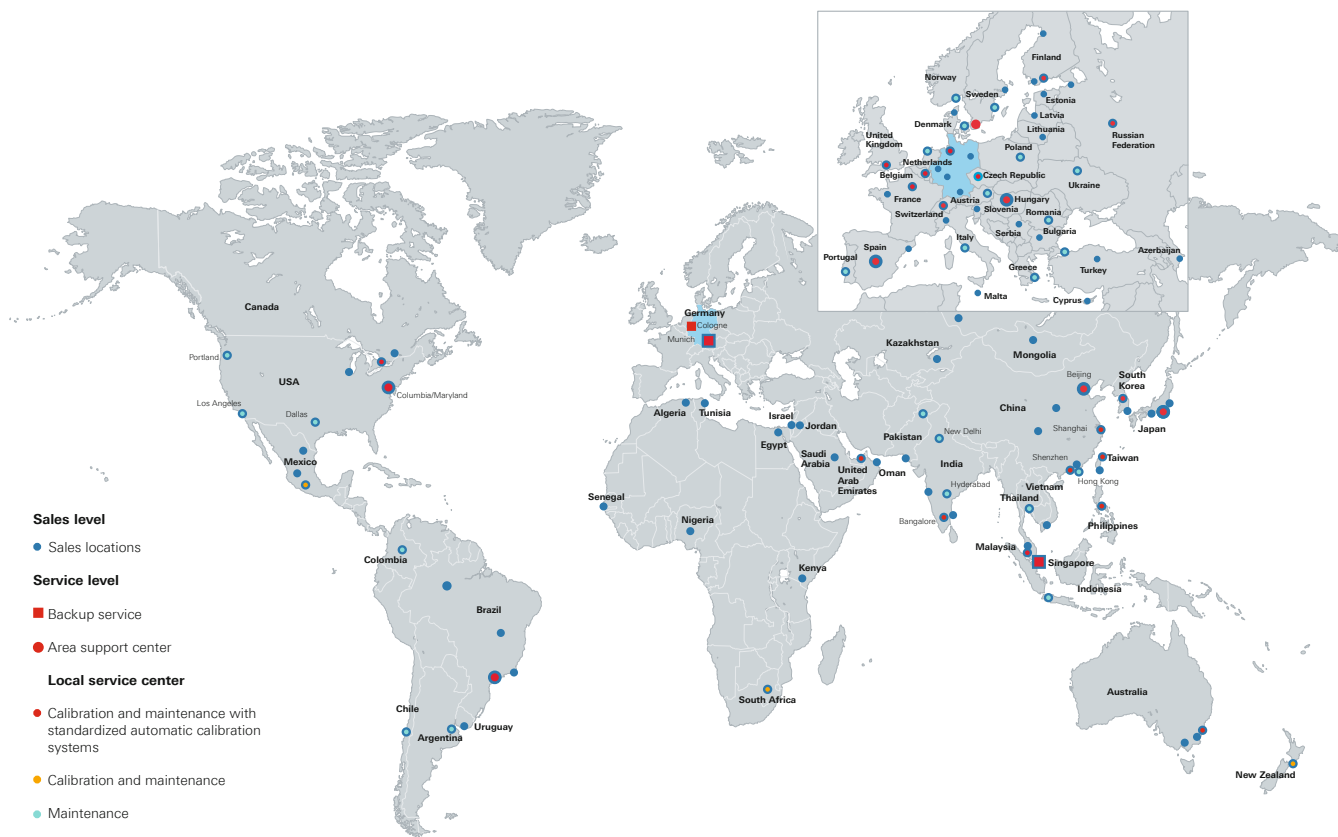[3] Required to charge the battery pack outside the R&S®FSH.
[4] R&S®FSH analyzers with serial numbers ≤ 105000 require an SD memory card for a firmware update.

Service options		
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Extended Warranty, three years	R&S®WE3FSH	
Extended Warranty, four years	R&S®WE4FSH	
Extended Warranty with Calibration Coverage, one year	R&S®CW1FSH	
Extended Warranty with Calibration Coverage, two years	R&S®CW2FSH	
Extended Warranty with Calibration Coverage, three years	R&S®CW3FSH	
Extended Warranty with Calibration Coverage, four years	R&S®CW4FSH	

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