Handheld Spectrum Analyzer R&S®FSH

R&S®FSH3 100 kHz to 3 GHz
R&S®FSH6 100 kHz to 6 GHz

Third Edition June 2006

ROHDE&SCHWARZ

Spectrum analysis anywhere, anytime – on earth and in space

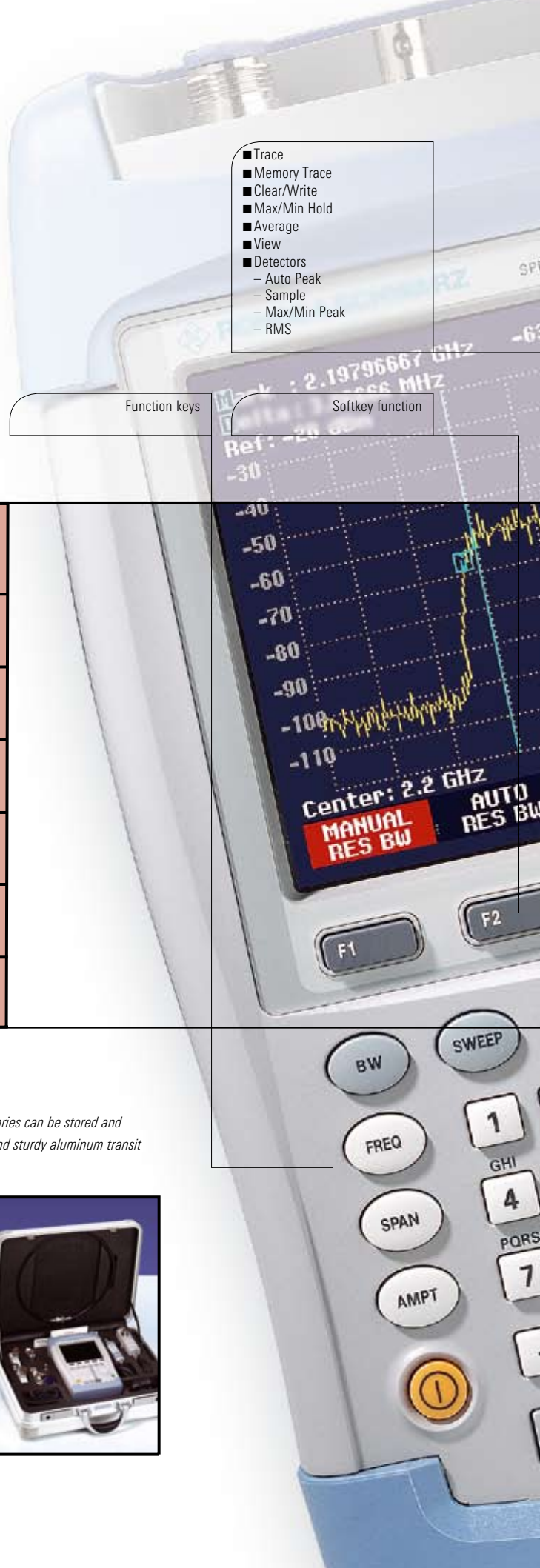
The R&S®FSH is the ideal spectrum analyzer for rapid, high-precision, cost-effective signal investigations. It provides a large number of measurement functions and so can handle anything from the installation or maintenance of a mobile radio base station up to on-site fault location in RF cables as well as development and service – an extensive range of applications.

Due to its excellent characteristics, the R&S®FSH3 is used on board the International Space Station (ISS) for distance-to-fault measurements on RF antenna cables.

Handy, robust and portable

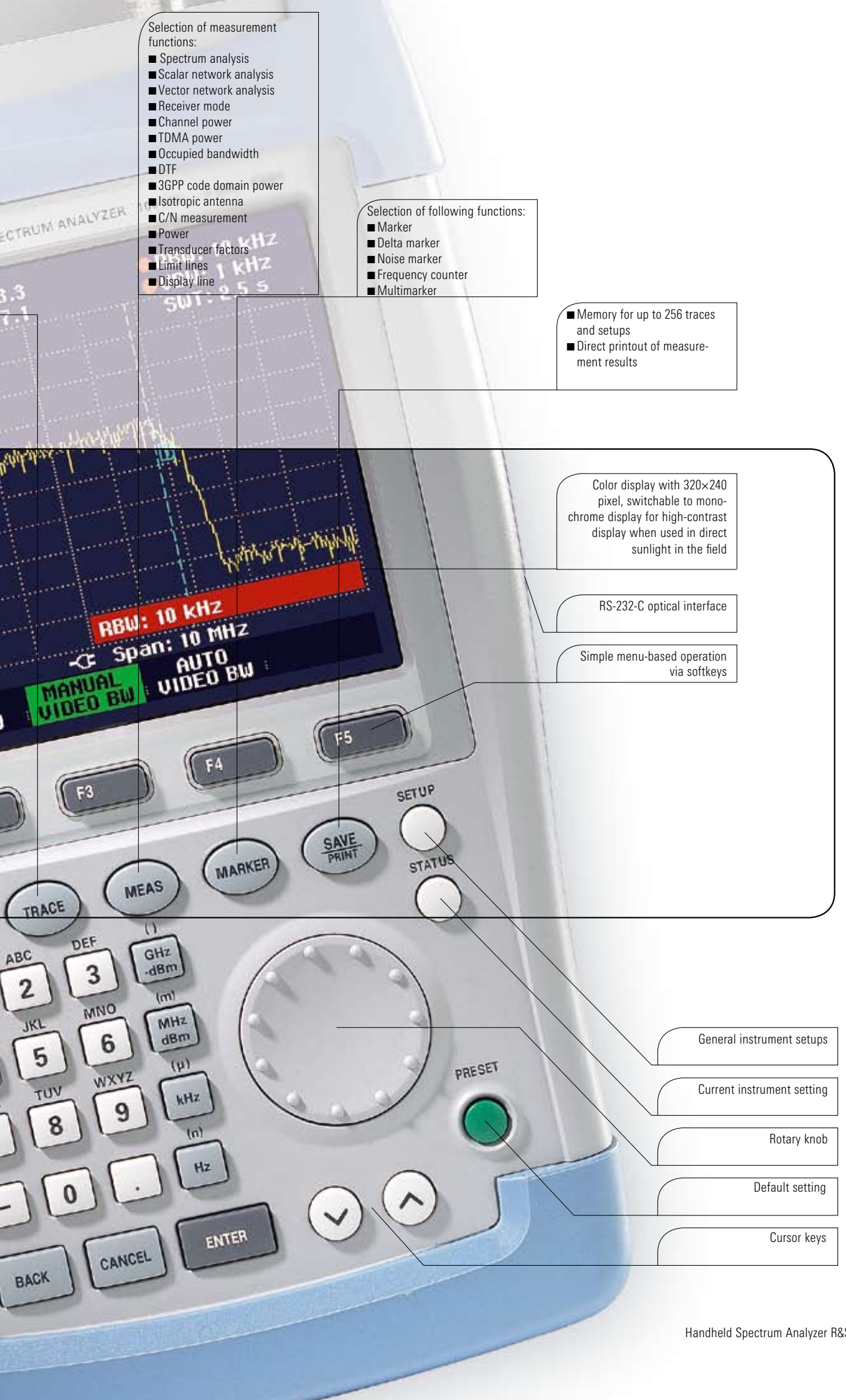
The R&S®FSH has been designed as a robust, portable spectrum analyzer that can be used in the field.

- **Robust edge protection, stable carrying handle**
- **Easy operation**
- **Four hours operating time on battery power**
- **Storage of up to 256 traces and setups**
- **Easy data transfer to PC**
- **High measurement accuracy**
- **Best RF characteristics in its class**



The R&S®FSH can, of course, also be used on the lab bench. The R&S®FSH has an adjustable, fold-out stand to position the instrument to an optimal display viewing angle.

The R&S®FSH and its accessories can be stored and transported in the compact and sturdy aluminum transit case.


Selection of measurement functions:
■ Spectrum analysis
■ Scalar network analysis
■ Vector network analysis
■ Receiver mode
■ Channel power
■ TDMA power
■ Occupied bandwidth
■ DTF
■ 3GPP code domain power
■ Isotropic antenna
■ C/N measurement
■ Power
■ Transducer factors
■ Limit lines
■ Display line
Selection of following functions:
■ Marker
■ Delta marker
■ Noise marker
■ Frequency counter
■ Multimarker
■ Memory for up to 256 traces and setups
■ Direct printout of measurement results
Color display with 320×240 pixel, switchable to monochrome display for high-contrast display when used in direct sunlight in the field
RS-232-C optical interface
Simple menu-based operation via softkeys
RBW: 10 kHz
Span: 10 MHz
AUTO
VIDEO BW
MANUAL
VIDEO BW
F5
F4
F3
SETUP
SAVE
PRINT
MARKER
MEAS
TRACE
STATUS
PRESET
ENTER
CANCEL
BACK
General instrument setups
Current instrument setting
Rotary knob
Default setting
Cursor keys

Data in brief

	R&S®FSH3	R&S®FSH6
Frequency range	100 kHz to 3 GHz	100 kHz to 6 GHz
Resolution bandwidths	1 kHz to 1 MHz (model .13) 100 Hz to 1 MHz (models .03 and .23)	100 Hz to 1 MHz
Video bandwidths	10 Hz to 1 MHz	
Displayed average noise level	typ. –114 dBm (1 kHz) (model .13) typ. –135 dBm (100 Hz) (models .03 and .23)	typ. –135 dBm (100 Hz)
TOI	typ. 13 dBm	
SSB phase noise	<–100 dBc (1 Hz) at 100 kHz from carrier	
Detectors	sample, max/min peak, auto peak, RMS	
Level measurement uncertainty	<1.5 dB, typ. 0.5 dB	
Reference level	–80 dBm to +20 dBm	
Dimensions	170 mm × 120 mm × 270 mm	
Weight	2.5 kg	

R&S®FSH – options and applications

The R&S®FSH is available as a 3 GHz or 6 GHz model either with or without an internal tracking generator. When the tracking generator is included, the R&S®FSH can be used for distance-to-fault (DTF) measurements, scalar and vector network analysis, and one-port cable loss measurement. Almost all models come standard with an adjustable preamplifier, making them suitable for measuring very small signals. Power sensors are available as accessories for high-precision terminating power measurements up to 8 GHz or 18 GHz as well as for directional power measurements up to 4 GHz. The following tables show possible configurations for various applications and an overview of available models.

Product \ Application	TDMA power measurements	Channel-power measurements	Field-strength measurements/ measurements with isotropic antenna	C/N measurements	Channel tables	Receiver mode	Code domain power measurements on 3GPP base stations[1]	Power measurements up to 8 GHz/18 GHz	Directional power measurements up to 1 GHz/4 GHz	Measurements on cables (distance-to-fault)	Scalar transmission measurements	Vector transmission measurements[2]	Scalar reflection measurements	Vector reflection measurements[2]	Remote control via RS-232-C interface	One-port cable loss measurements
R&S®FSH (models .03/.06) with preamplifier	■	■	■	■	■	+R&S® FSH-K3	–	+R&S® FSH-Z1/ -Z18	+R&S® FSH-Z14/- Z44	–	–	–	+R&S® FSH-K1	–		
R&S®FSH (model .13) with tracking generator	■	■	■	■	■	+R&S® FSH-K3	–	+R&S® FSH-Z1/ -Z18	+R&S® FSH-Z14/- Z44	+R&S® FSH-Z2/Z3 +R&S® FSH-B1	■	+R&S® FSH-Z2	+R&S® FSH-K1	+R&S® FSH-Z2/Z3 +R&S® FSH-K2		
R&S®FSH (models .23/.26) with tracking generator and preamplifier	■	■	■	■	■	+R&S® FSH-K3	+R&S® FSH-K4	+R&S® FSH-Z1/ -Z18	+R&S® FSH-Z14/- Z44	+R&S® FSH-Z2/Z3 +R&S® FSH-B1	■	+R&S® FSH-Z2/Z3	+R&S® FSH-K1	+R&S® FSH-Z2/Z3 +R&S® FSH-K2		

[1] *For R&S®FSH 3 model .23 with serial number 103500 or later.*

[2] *R&S®FSH-K2 required.*

■ *R&S®FSH standard function*

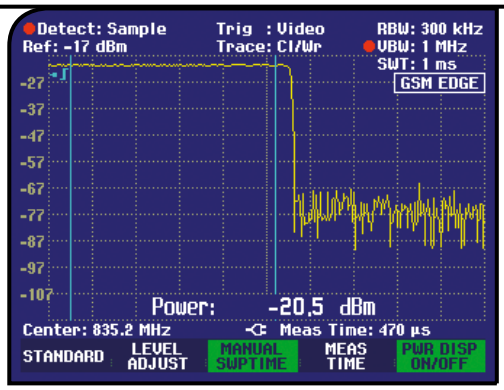
– *Not available*

R&S®FSH – models

	Frequency range	Tracking generator	Output power of tracking generator	Preamplifier	Resolution bandwidth
R&S®FSH3 model .03	100 kHz to 3 GHz	–	–	■	100 Hz to 1 MHz
R&S®FSH3 model .13	100 kHz to 3 GHz	■	–20 dBm	–	1 kHz to 1 MHz
R&S®FSH3 model .23	100 kHz to 3 GHz	■	–20 dBm/0 dBm selectable	■	100 Hz to 1 MHz
R&S®FSH6 model .06	100 kHz to 6 GHz	–	–	■	100 Hz to 1 MHz
R&S®FSH6 model .26	100 kHz to 6 GHz	■	–10 dBm (f < 3 GHz) –20 dBm (f > 3 GHz)	■	100 Hz to 1 MHz

TDMA power measurements

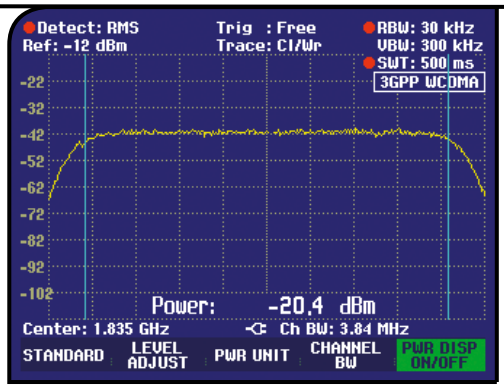
By means of the TDMA POWER function, the R&S®FSH performs time-domain power measurements within a timeslot of TDMA (time division multiple access) methods. All the settings required for the GSM and EDGE standards are predefined on the R&S®FSH to make these measurements easier for the user. In addition, up to five user-definable instrument setups can be loaded into the R&S®FSH using the R&S®FSH View software.

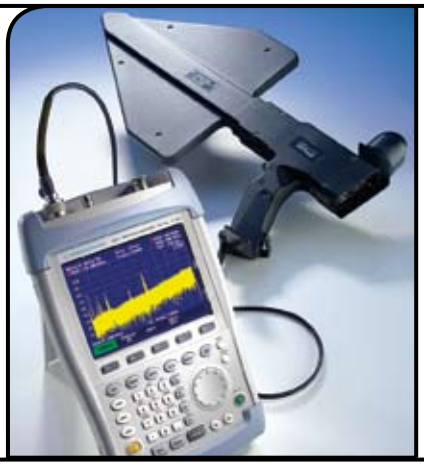


Channel-power measurements

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 digital mobile radio standards 3GPP WCDMA, cdmaOne and CDMA2000® 1x is performed at a keystroke with all the correct instrument settings. With the R&S®FSH View software, the user can quickly and easily define further standards and load them into the R&S®FSH.

CDMA2000® is a registered trademark of the Telecommunications Industry Association (TIA USA)





Field-strength measurements

When measuring electric field strength, the R&S®FSH takes into account the specific antenna factors of the connected antenna. 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 of, for example, a cable or an amplifier can be corrected. For quick and easy result analysis, the R&S®FSH provides two user-definable limit lines with automatic limit monitoring.

R&S®FSH with Active Directional Antenna R&S®HE200 (optional accessory)

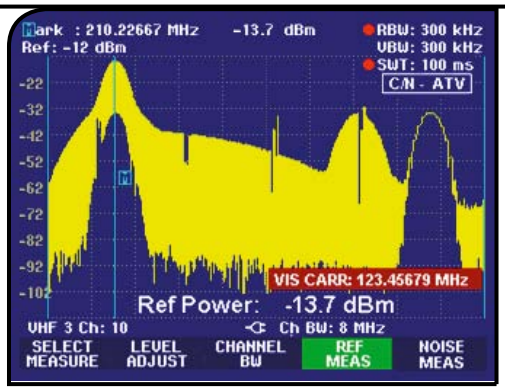
Field-strength measurements with isotropic antenna

When used with the R&S®TS-EMF isotropic antenna, the R&S®FSH can determine the direction-independent resultant field strength in the frequency range from 30 MHz to 3 GHz. For measuring the resultant field strength, the antenna has three orthogonal antenna elements. The R&S®FSH successively triggers the three antenna elements and calculates the resultant field strength. The calculation takes into account the antenna factors for each individual antenna element as well as the cable loss of the connecting cable.

R&S®FSH with Isotropic Antenna R&S®TS-EMF (optional accessory)

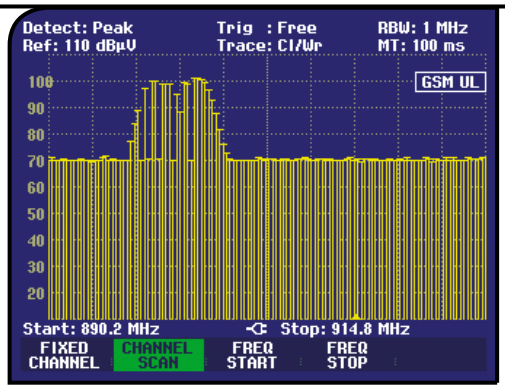
C/N measurements

The R&S®FSH offers a carrier/noise (C/N) measurement for determining the ratio of carrier power to noise power or carrier power to noise power density. The R&S®FSH supports three different modes for carrier power measurement. In the CW TX mode, the R&S®FSH determines the power of an unmodulated carrier. In the digital TX mode, it determines the channel power of a reference channel, as is common with digitally modulated carriers (e.g. the DAB, DVB, DVB-T, DVB-H and J.83/A/B/C standards). Furthermore, the ATSC standard for digital terrestrial television with 8VSB modulation is supported. In the analog TV mode, the R&S®FSH measures the peak power of the vision carrier with amplitude-modulated TV signals.



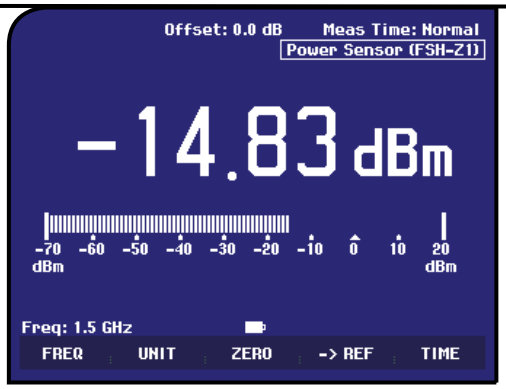
Channel tables

If preferred, the R&S®FSH can be tuned by channel numbers rather than by entering the frequency. The channel number is displayed instead of the center frequency. Users who are accustomed to channel assignments, which are common in TV and mobile radio applications, can operate the R&S®FSH more easily. The channel tables are generated with the R&S®FSH View software and loaded into the R&S®FSH. The R&S®FSH includes TV channel tables for a number of countries



Receiver mode

When equipped with the option R&S®FSH-K3, the R&S®FSH can be operated as a receiver for monitoring and precompliance EMC applications. Measurements are performed at a predefined frequency with a user-selectable measurement time. In the scan mode, the R&S®FSH sequentially measures each level at various frequencies defined in a channel table. The channel tables are generated with the R&S®FSH View software and loaded into the R&S®FSH. For a few TV transmitter and mobile radio standards, the tables are predefined. In addition, the CISPR bandwidths 200 Hz, 9 kHz, 120 kHz and 1 MHz are available for EMI emission measurements. The R&S®FSH offers peak, average, RMS and quasi-peak detectors.

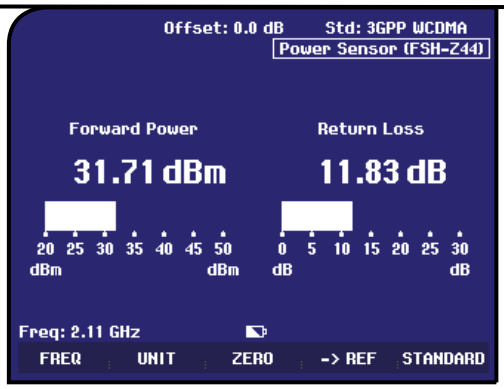


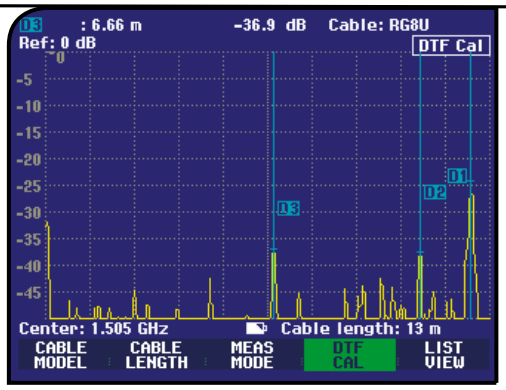
Power measurements

The Power Sensors R&S®FSH-Z1 and R&S®FSH-Z18 expand the R&S®FSH to a high-precision RF power meter up to 8 GHz and 18 GHz respectively. As with thermal sensors, the true RMS value of the measured signal is obtained over the entire measurement range of –67 dBm to +23 dBm irrespective of the signal waveform. In particular with modulated signals, additional measurement errors can thus be prevented, and handling becomes easy.

Directional power measurements

The Directional Power Sensors R&S®FSH-Z14 and R&S®FSH-Z44 turn the R&S®FSH into a full-fledged directional power meter with a frequency range of 25 MHz to 1 GHz and 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 standards GSM/EDGE, 3GPP WCDMA, cdmaOne, CDMA2000® 1x, DVB-T and DAB. Additionally, the peak envelope power (PEP) can be determined up to a maximum of 300 W.





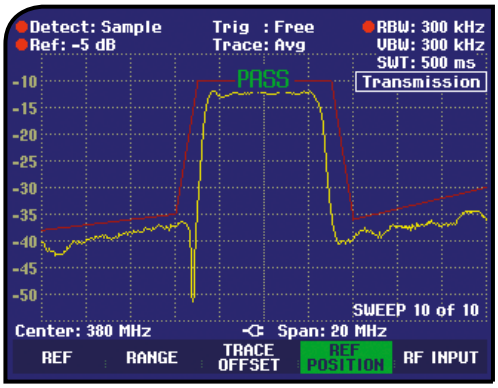
Measurements on cables (distance to fault)

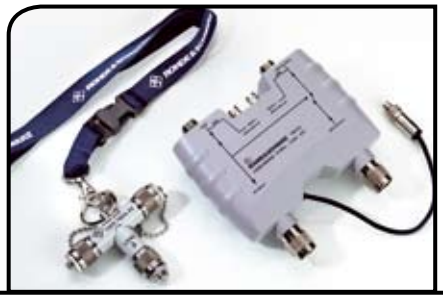
The option R&S®FSH-B1 allows the distance to any faults in an RF cable to be determined rapidly and accurately. Distance-to-fault measurements using the R&S®FSH-Z2/-Z3 VSWR bridge give an immediate overview of the state of the device under test (return loss and distance, see figure). The marker-zoom function allows detailed analysis of faults with a resolution of up to 1024 pixel.

Only applies to the R&S®FSH with tracking generator and options R&S®FSH-B1 (distance-to-fault measurement) and R&S®FSH-Z2/-Z3 (VSWR bridge) installed

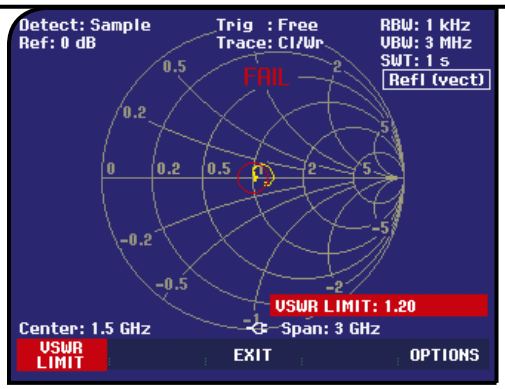
Scalar transmission and reflection measurements with VSWR bridge (R&S®FSH-Z2/-Z3 as accessory)

The R&S®FSH with built-in tracking generator rapidly determines the transmission characteristics of cables, filters, amplifiers, etc, with a minimum of effort. When equipped with the R&S®FSH-Z2/-Z3 VSWR bridge (10 MHz to 3 GHz/6 GHz), the R&S®FSH can also measure the matching (return loss, reflection coefficient or VSWR) of an antenna, for example. The bridge is screwed directly onto the R&S®FSH's RF input and tracking generator output without involving cumbersome, extra cabling. The innovative design of the R&S®FSH-Z3 VSWR Bridge with integrated RF bypass switch allows the user to make spectrum and transmission measurements also with the bridge connected. Active components such as amplifiers can be supplied directly via the RF cable by means of the two integrated bias tees.



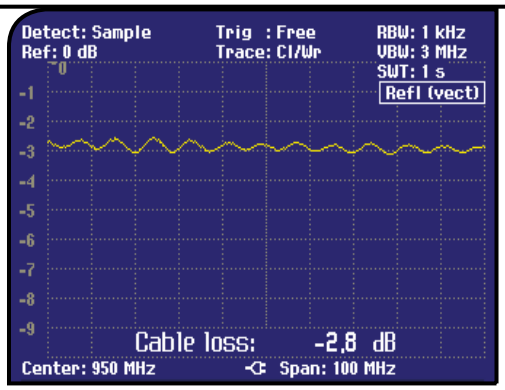


R&S®FSH-Z3 VSWR bridge



Vector transmission and reflection measurements

Compared to scalar measurements, the optional R&S®FSH-K2 vector measurement significantly increases measurement accuracy and dynamic range for transmission and reflection measurements. This is possible because the receive signal is analyzed with respect to magnitude and phase. After calibration, complex correction of the system errors can be effected by the R&S®FSH. To allow detailed analysis of the matching of, for example, an antenna, the magnitude and phase are displayed in a Smith chart. A user-definable limit line comes in handy when evaluating the measurement results.

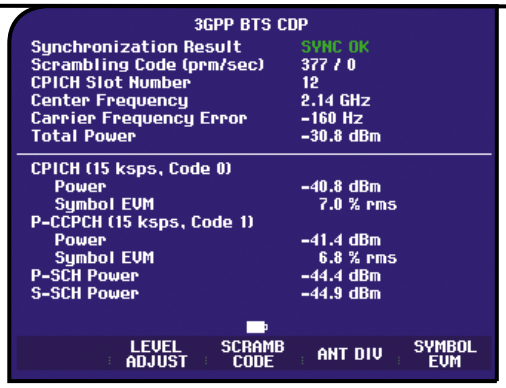


One-port cable loss measurements

The R&S®FSH with tracking generator and VSWR bridge can determine the cable loss of previously installed long cables without much effort. One end of the cable is connected to the VSWR bridge, and the other end is terminated with a short circuit or simply left open. The calculated cable loss represents the average value within the displayed frequency range. The loss at specific frequencies is determined via markers. The one-port cable loss measurement is only available with the option R&S®FSH-K2.

3GPP FDD code domain power measurements on base stations

The R&S®FSH-K4 option allows the code domain power measurements on a 3GPP base station. It measures the total power and the power of the most important code channels, such as the common pilot channel (CPICH), primary common control physical channel (P-CCPCH), primary synchronization channel (P-SCH) and secondary synchronization channel (S-SCH). In addition, the frequency offset of the carrier frequency and the error vector magnitude (EVM) are measured and displayed. R&S®FSH-K4 provides an automatic function for fast and optimal setting of the reference level. In the case of base stations with two antennas, the user can select which antenna the spectrum analyzer should synchronize to (antenna diversity).



Available for the R&S®FSH 3 (11145.5850.23) with serial number 103500 or later

Locating EMC weak spots

The Near-Field Probe Set R&S®HZ-15 is a diagnostic tool for locating EMC weak spots on printed boards, integrated circuits, cables, shieldings and other trouble spots. The Near-Field Probe Set R&S®HZ-15 can handle emission measurements from 30 MHz to 3 GHz. Its sensitivity can be enhanced by adding the Preamplifier R&S®HZ-16, which has a frequency range of up to 3 GHz, a gain of approx. 20 dB 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 sources of interference during development.

R&S®FSH with near-field probe set and DUT

R&S®FSH with Directional Power Sensor R&S®FSH-Z44

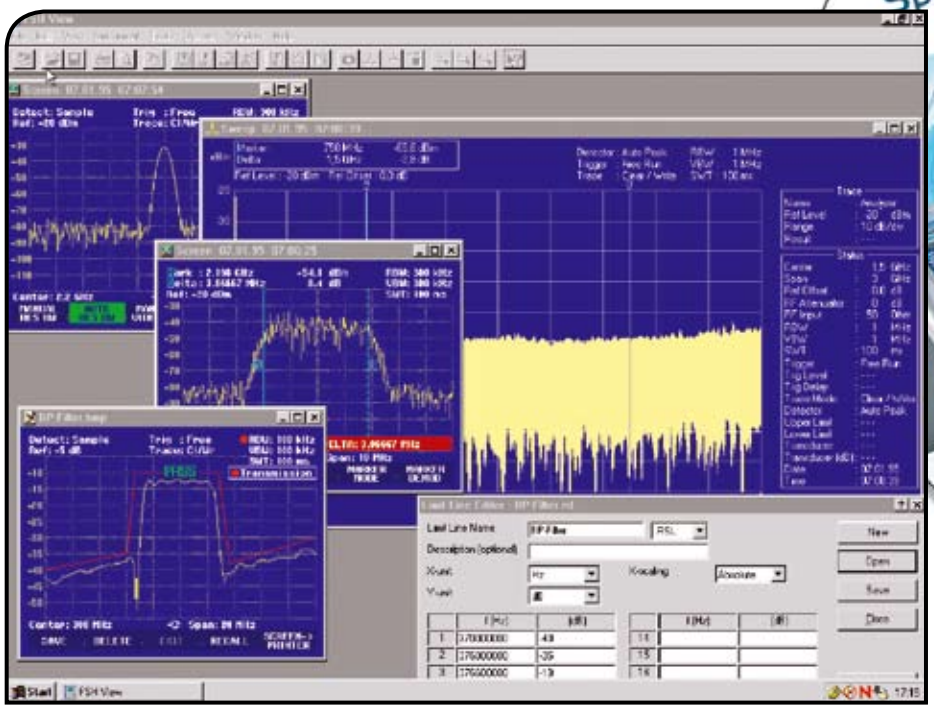
Data transfer between R&S®FSH and PC (interface cables and software are supplied with the instrument)

The R&S®FSH-Z29 calibration standard is designed for field use;. it is a combination of a 50 Ω load, open and short

R&S®FSH with R&S®FSH-Z2 VSWR bridge

Control Software R&S®FSH View

The powerful software package for documenting your measurements is supplied with every R&S®FSH.



Features

- Runs under Windows 98/ME/NT/2000/XP
- Rapid and simple transfer of measurement data from the R&S®FSH to a PC and vice versa
- Data export in ASCII or MS Excel format
- Printout of all relevant data via Windows (screenshot of the R&S®FSH display for documentation)
- Graphics data stored in standard formats (.bmp, .pcx, .png, .wmf)
- Permanent and continuous transfer of sweeps to the PC; facilities for subsequent analysis (markers, zoom, etc)
- Storage space for traces and measurement data as well as for comparisons of current and previous measurements (available space is limited only by the size of the hard disk of the controlling PC)
- Automatic storage of measurement results at selectable intervals
- Generation of cable data with a built-in cable editor; downloading to the R&S®FSH for distance-to-fault measurements (R&S®FSH-B1)
- Editor for generating limit lines, user-definable standards (measurement of occupied bandwidth, channel power and TDMA power), transducer factors and correction factors for taking into account external attenuators or amplifiers, as well as channel lists
- Macro function for Word for fast and easy documentation of measurement results
- Connection between PC and R&S®FSH via interference-free, RS-232-C optical interface

Specifications

Specifications apply under the following conditions: 15 minutes warm-up time at ambient temperature, specified environmental conditions met and calibration cycle adhered to. Data without tolerances: typical values. Data designated as "nominal": design parameters, i. e. not tested.

		R&S®FSH3	R&S®FSH6
Frequency			
Frequency range		100 kHz to 3 GHz	100 kHz to 6 GHz
Reference frequency			
Aging		1 ppm/year	
Temperature drift	0 °C to +30 °C +30 °C to +50 °C	2 ppm in addition 2 ppm/10 °C	
Frequency counter			
Resolution		1 Hz	
Counter accuracy	S/N > 25 dB	± (frequency × reference frequency error)	
Frequency span	model .03/.23, model .06/.26 model .13	0 Hz, 100 Hz to 3 GHz 0 Hz, 10 kHz to 3 GHz	0 Hz, 100 Hz to 6 GHz –
Spectral purity			
SSB phase noise	f = 500 MHz, +20 °C to +30 °C		
30 kHz from carrier		<85 dBc (1 Hz)	
100 kHz from carrier		<100 dBc (1 Hz)	
1 MHz from carrier		<120 dBc (1 Hz)	
Sweep time	span = 0 Hz	1 ms to 100 s	
	span > 0 Hz	20 ms to 1000 s, min. 20 ms/600 MHz	
Bandwidths			
Resolution bandwidths (–3 dB)	model .13	1, 3, 10, 30, 100, 200, 300 kHz, 1 MHz	
	model .03/.23, model .06/.26	in addition 100 Hz, 300 Hz	
Tolerance	≤300 kHz	±5 %, nominal	
	1 MHz	±10 %, nominal	
Resolution bandwidths (–6 dB)	with option R&S®FSH-K3 installed	in addition 200 Hz, 9 kHz, 120 kHz, 1 MHz	
Video bandwidths		10 Hz to 1 MHz in 1, 3 steps	

		R&S®FSH3	R&S®FSH6
Amplitude			
Display range		average noise level displayed to +20 dBm	
Maximum permissible DC voltage at RF input		50 V/80 V [1]	
Maximum power		20 dBm, 30 dBm (1 W) for max. 3 minutes	
Intermodulation-free dynamic range	third-order IM products, 2 × –20 dBm, reference level = –10 dBm at signal offset ≤2 MHz at signal offset >2 MHz	typ. 66 dB (typ. +13 dBm third-order intercept, TOI) 60 dB (+10 dBm TOI) 66 dB (typ. +13 dBm TOI)	
Displayed average noise level 10 MHz to 3 GHz 3 GHz to 5 GHz 5 GHz to 6 GHz	resolution bandwidth 1 kHz, video bandwidth 10 Hz, reference level ≤–30 dBm	 <–105 dBm, typ. –114 dBm – –	 <–105 dBm, typ. –112 dBm <–103 dBm, typ. –108 dBm <–96 dBm, typ. –102 dBm
With preamplifier 10 MHz to 2.5 GHz 2.5 GHz to 3 GHz 3 GHz to 5 GHz 5 GHz to 6 GHz	only models .03[2], .23, .06 and .26	 <–120 dBm, typ. –125 dBm <–115 dBm, typ. –120 dBm – –	 <–120 dBm, typ. –125 dBm <–115 dBm, typ. –120 dBm <–115 dBm, typ. –120 dBm <–105 dBm, typ. –110 dBm
Inherent spurious	reference level ≤–20 dBm, f > 30 MHz, RBW ≤ 100 kHz	 <–80 dBm	 <–80 dBm
Input related spurious Up to 3 GHz 3 GHz to 6 GHz Signal frequency minus –2.0156 GHz for signal frequencies 2 GHz to 3.2 GHz	mixer level –40 dBm, carrier offset >1 MHz	 <–70 dBc (nominal) – typ. <–55 dBc	 <–70 dBc (nominal) <–64 dBc (nominal) typ. <–55 dBc
2nd harmonic	mixer level –40 dBm	typ. <–60 dBc	typ. <–60 dBc
Level display			
Reference level		–80 dBm to +20 dBm in steps of 1 dB	
Display range		100 dB, 50 dB, 20 dB, 10 dB, linear	
Display units Logarithmic Linear		 dBm, dBµV, dBmV with transducer also dBµV/m and dBµA/m µV, mV, V, nW, µW, mW, W with transducer also V/m, mV/m, µV/m and W/m²	
Traces		1 trace and 1 memory trace	
Trace mathematics		A-B and B-A (trace – memory trace and memory trace – trace)	
Detectors		auto peak, maximum peak, minimum peak, sample, RMS	
	with option R&S®FSH-K3 installed	in addition average and quasi-peak	
Level measurement error	frequency >1 MHz, at reference level down to –50 dB, +20 °C to +30 °C	<1.5 dB, typ. 0.5 dB	

[1] *80 V valid as of serial number 100900 (model 1145.5850.03) or 101600 (model 1145.5850.13); models 1145.5850.23, 1145.5850.06 and 1145.5850.26 all serial numbers.*

[2] *As of serial number 101362.*

		R&S®FSH3	R&S®FSH6
Markers			
Number of markers or delta markers		max. 6	
Marker functions		peak, next peak, minimum, center = marker frequency, reference level = marker level, all markers to peak	
Marker displays		normal (level), noise marker, frequency counter (count)	
Trigger		free-running, video, external	
Audio demodulation		AM (video voltage without AGC) and FM	
Inputs			
RF input		N female	
Input impedance		50 Ω	
VSWR	10 MHz to 3 GHz 10 MHz to 6 GHz	typ. 1.5 –	– typ. 1.5
Trigger/external reference input		BNC female, selectable	
Trigger voltage		TTL	
Reference frequency		10 MHz	
Required level	from 50 Ω	10 dBm	
Outputs			
AF output		3.5 mm mini jack	
Output impedance Open-circuit voltage		100 Ω adjustable up to 1.5 V	
Tracking generator	only models .13, .23, .26		
Frequency range		5 MHz to 3 GHz	5 MHz to 6 GHz
Output level	model .13 model .23 model .26 f < 3 GHz f > 3 GHz	–20 dBm (nominal) 0 dBm/–20 dBm, selectable	 –10 dBm (nominal) –20 dBm (nominal)
Step attenuator	model .26[3] model .23[4]	20 dB step attenuator is adjustable in 1 dB steps	
Output impedance		50 Ω, nominal	
Interfaces			
RS-232-C optical interface[5]			
Baud rate		1200, 2400, 9600, 19200, 38400, 57600, 115200 baud	
Power sensor		7-contact female connector (type Binder 712)	

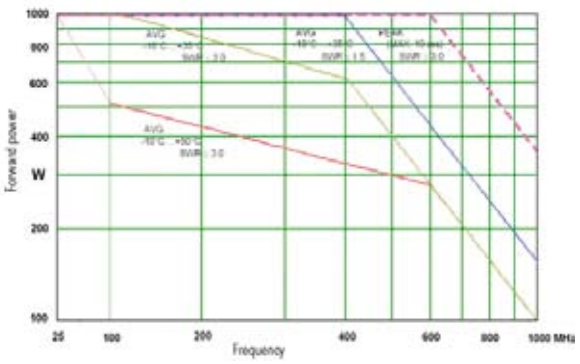
[3] *As of serial no. 100500.*

[4] *As of serial no. 102314.*

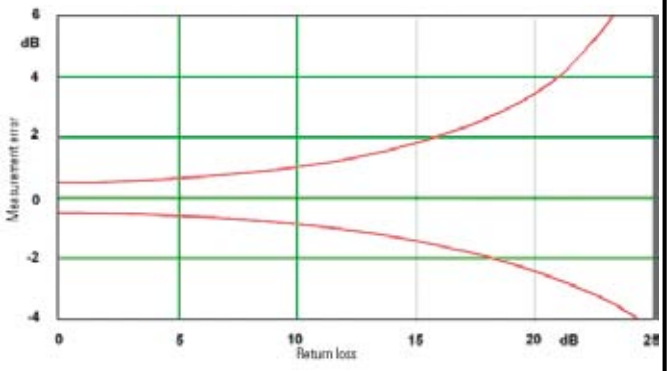
[5] *Standard accessory: optical USB cable.*

		R&S®FSH3	R&S®FSH6
Accessories			
Power Sensors R&S®FSH-Z1 and R&S®FSH-Z18			
Frequency range			
R&S®FSH-Z1		10 MHz to 8 GHz	
R&S®FSH-Z18		10 MHz to 18 GHz	
VSWR 10 MHz to 30 MHz 30 MHz to 2.4 GHz 2.4 GHz to 8 GHz 8 GHz to 18 GHz		 <1.15 <1.13 <1.20 <1.25	
Maximum input power	average power peak power (<10 µs, 1 % duty cycle)	400 mW (+26 dBm) 1 W (+30 dBm)	
Measurement range		200 pW to 200 mW (–67 dBm to +23 dBm)	
Signal weighting		average power	
Effect of harmonics Effect of modulation		<0.5 % (0.02 dB) at harmonic ratio of 20 dBc <1.5 % (0.07 dB) for continuous digital modulation	
Absolute measurement uncertainty	sine signals, no zero offset		
10 MHz to 8 GHz 8 GHz to 18 GHz	+15 °C to +35 °C 0 °C to +50 °C +15 °C to +35 °C 0 °C to +50 °C	<2.5 % (0.11 dB) <4.5 % (0.19 dB) <3.5 % (0.15 dB) <5.2 % (0.22 dB)	
Zero offset after zeroing		<150 pW	
Dimensions (W × H × D)		48 mm × 31 mm × 170 mm, connecting cable 1.5 m	
Weight		<0.3 kg	
Directional Power Sensor R&S®FSH-Z14			
Frequency range		25 MHz to 1 GHz	
Power measurement range		30 mW to 300 W	
VSWR referenced to 50 Ω		<1.06	
Power-handling capacity	depending on temperature and matching (see diagram on page 15)	100 W to 1000 W	
Insertion loss		<0.06 dB	
Directivity		>30 dB	
Average power			
Power measurement range CW, FM, PM, FSK, GMSK Modulated signals	 CF: ratio of peak envelope power to average power	 30 mW to 300 W 30 mW to 300 W/CF	
Measurement uncertainty 25 MHz to 40 MHz 40 MHz to 1 GHz	sine signal, +18 °C to +28 °C, no zero offset	 4.0 % (0.17 dB) of measured value 3.2 % (0.14 dB) of measured value	
Zero offset	after zeroing	±4 mW	
Range of typical measurement error with modulation FM, PM, FSK, GMSK AM (80 %) 2 equal-power CW carriers EDGE, TETRA	if standard is selected on the R&S®FSH	 0 % of measured value (0 dB) ±3 % of measured value (±0.13 dB) ±2 % of measured value (±0.09 dB) ±0.5 % of measured value (±0.02 dB)	

		R&S®FSH3	R&S®FSH6
Temperature coefficient 25 MHz to 40 MHz 40 MHz to 1 GHz		 0.40 %/K (0.017 dB/K) 0.25 %/K (0.011 dB/K)	
Peak envelope power			
Power measurement range for video bandwidth 4 kHz 200 kHz 600 kHz		 0.4 W to 300 W 1 W to 300 W 2 W to 300 W	
Measurement uncertainty	+18 °C to +28 °C	same as for average power plus effect of peak hold circuit	
Accuracy of peak hold circuit for burst signals Duty cycle ≤ 0.1 and repetition rate ≤ 100/s 20/s ≤ repetition rate < 100/s 0.001 ≤ duty cycle < 0.1	 video bandwidth 4 kHz 200 kHz 600 kHz	 ±(3 % of measured value + 0.05 W) at burst width > 200 µs ±(3 % of measured value + 0.20 W) at burst width > 4 µs ±(7 % of measured value + 0.40 W) at burst width > 2 µs ±(1.6 % of measured value + 0.15 W) ±0.10 W	
Temperature coefficient 25 MHz to 40 MHz 40 MHz to 1 GHz		 0.50 %/K (0.022 dB/K) 0.35 %/K (0.015 dB/K)	
Load matching			
Matching measurement range Return loss VSWR		 0 dB to 23 dB >1.15	
Minimum forward power	specs met at ≥ 0.4 W	0.06 W	



Power-handling capacity

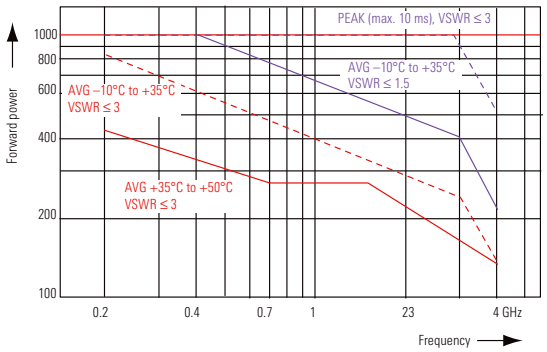


Limits of measurement uncertainty for matching measurements

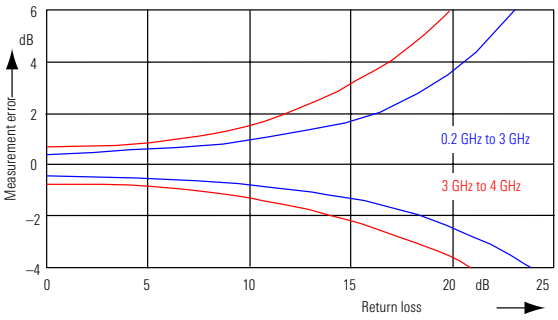
Dimensions (W × H × D)		120 mm × 95 mm × 39 mm, connecting cable 1.5 m
Weight		0.65 kg

		R&S®FSH3	R&S®FSH6
Directional Power Sensor R&S®FSH-Z44			
Frequency range		200 MHz to 4 GHz	
Power measurement range		30 mW to 120 W (300 W with unmodulated envelope)	
VSWR referenced to 50 Ω 200 MHz to 3 GHz 3 GHz to 4 GHz		 <1.07 <1.12	
Power-handling capacity	depending on temperature and matching (see diagram below)	120 W to 1000 W	
Insertion loss 200 MHz to 1.5 GHz 1.5 GHz to 4 GHz		 <0.06 dB <0.09 dB	
Directivity 200 MHz to 3 GHz 3 GHz to 4 GHz		 >30 dB >26 dB	
Signal weighting		average power	
Measurement uncertainty 200 MHz to 300 MHz 300 MHz to 4 GHz	sine signals, +18 °C to +28 °C, no zero offset	 4 % of measured value (0.17 dB) 3.2 % of measured value (0.14 dB)	
Zero offset	after zeroing	±4 mW	
Range of typical measurement error with modulation FM, PM, FSK, GMSK AM (80 %) cdmaOne, DAB 3GPP WCDMA, CDMA2000® DVB-T π/4-DQPSK	if standard is selected on R&S®FSH	 0 % of measured value (0 dB) ±3 % of measured value (±0.13 dB) ±1 % of measured value (±0.04 dB) ±2 % of measured value (±0.09 dB) ±2 % of measured value (±0.09 dB) ±2 % of measured value (±0.09 dB	
Temperature coefficient 200 MHz to 300 MHz 300 MHz to 4 GHz		 0.40 %/K (0.017 dB/K) 0.25 %/K (0.011 dB/K)	
Peak envelope power			
Power measurement range DAB, DVB-T, cdmaOne, CDMA2000®, 3GPP WCDMA Video bandwidth 4 kHz 200 kHz 4 MHz		 4 W to 300 W 0.4 W to 300 W 1 W to 300 W 2 W to 300 W	
Measurement uncertainty	+18 °C to +28 °C	same as for average power plus effect of peak hold circuit	
Accuracy of peak hold circuit for burst signals Duty cycle ≥ 0.1 and repetition rate ≥ 100/s 20/s ≤ repetition rate < 100/s 0.001 ≤ duty cycle < 0.1 Burst width ≥ 0.5 µs Burst width ≥ 0.2 µs	video bandwidth 4 kHz 200 kHz 4 MHz	 ±(3 % of measured value + 0.05 W) at burst width ≥100 µs ±(3 % of measured value + 0.20 W) at burst width ≥4 µs ±(7 % of measured value + 0.40 W) at burst width ≥1 µs ±(1.6 % of measured value + 0.15 W) ±0.10 W ±5 % of measured value ±10 % of measured value	
Range of typical measurement error of peak hold circuit for cdmaOne, DAB DVB-T, CDMA2000®, 3GPP WCDMA	video bandwidth 4 MHz and standard selected on the R&S®FSH	±(5 % of measured value + 0.4 W) ±(15 % of measured value + 0.4 W)	
Temperature coefficient 200 MHz to 300 MHz 300 MHz to 4 GHz		 0.50 %/K (0.022 dB/K) 0.35 %/K (0.015 dB/K)	

Load matching		
Return loss		
200 MHz to 3 GHz		0 dB to 23 dB
3 GHz to 4 GHz		0 dB to 20 dB
VSWR		
200 MHz to 3 GHz		>1.15
3 GHz to 4 GHz		>1.22



Power-handling capacity

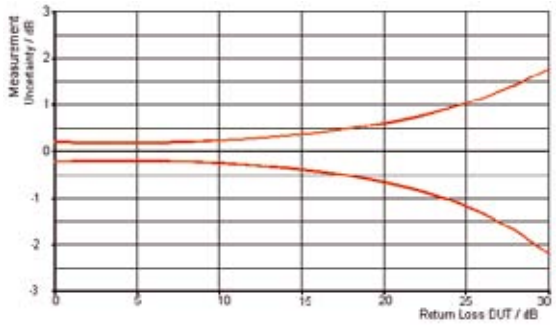


Limits of measurement uncertainty for matching measurements

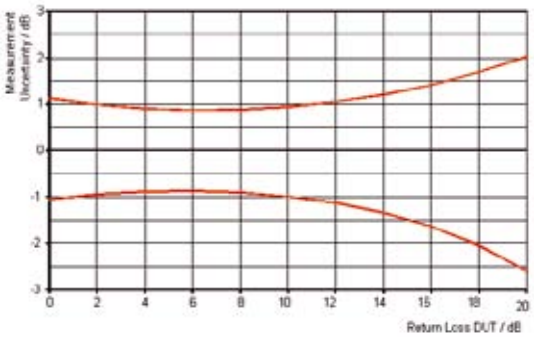
Dimensions (W × H × D)		120 mm × 95 mm × 39 mm, connecting cable 1.5 m
Weight		0.65 kg

		R&S®FSH-Z2	R&S®FSH-Z3
R&S®FSH-Z2/R&S®FSH-Z3 VSWR bridge			
Frequency range		10 MHz to 3 GHz	10 MHz to 6 GHz
Impedance		50 Ω	
VSWR bridge			
Directivity			
10 MHz to 30 MHz		typ. 30 dB	typ. 16 dB
30 MHz to 1 GHz		typ. 30 dB	>20 dB, typ. 28 dB
1 GHz to 3 GHz		typ. 25 dB	>20 dB, typ. 28 dB
3 GHz to 6 GHz		–	>18 dB, typ. 25 dB
Directivity, corrected	option R&S®FSH-K2		
2 MHz to 10 MHz		typ. 40 dB	typ. 40 dB
10 MHz to 3 GHz		typ. 43 dB	typ. 40 dB
3 GHz to 6 GHz		–	typ. 37 dB
Return loss at test port			
10 MHz to 50 MHz		typ. 20 dB	>12 dB, typ. 18 dB
50 MHz to 3 GHz		typ. 20 dB	>16 dB, typ. 22 dB
3 GHz to 6 GHz		–	>16 dB, typ. 22 dB
Return loss at test port, corrected	option R&S®FSH-K2		
2 MHz to 3 GHz		typ. 35 dB	typ. 40 dB
3 GHz to 6 GHz		–	typ. 37 dB
Insertion loss			
Test port		typ. 9 dB	typ. 9 dB
Bypass		–	typ. 4 dB
DC bias			
Max. input voltage		–	50 V
Max. input current		–	300 mA
Type of connector		–	BNC female
Connectors			
Generator input/RF output		N male	
Test port		N female	
Control interface		7-contact connector (type Binder)	
Calibration standards		**R&S®FSH-Z29/-Z30/-Z31**	**R&S®FSH-Z28**
Short/open		N male	
50 Ω load		N male	
Impedance		50 Ω	
Return loss			
DC to 3 GHz		>43 dB	>40 dB, typ. 46 dB
3 GHz to 6 GHz		–	>37 dB, typ. 43 dB
Power-handling capacity		1 W	1 W
General data			
Power consumption		–	3 mW (nominal)
Dimensions (W × H × D)		169 mm × 116 mm × 30 mm	149 mm × 144 mm × 45 mm
Weight		485 g	620 g
Distance-to-Fault Measurement	**option R&S®FSH-B1 only with R&S®FSH3 models .13/.23/.26 and R&S®FSH-Z2/-Z3 VSWR bridges**		
Display		301 pixel	
Maximum resolution, distance to fault	maximum zoom	cable length/1023 pixel	
Display range			
Return loss		10, 5, 2, 1 dB/div, linear	
VSWR		1 to 2 and 1 to 6,	
	with option R&S®FSH-K2	in addition 1 to 1.2 and 1 to 1.5	
Reflection factor (ρ)		0 to 1, 0 to 0.1, 0 to 0.01, 0 to 0.001	
milliRHO (mρ)		0 to 1000, 0 to 100, 0 to 10, 0 to 1	
Cable length	depending on cable loss	3 m to max. 1000 m	
Maximum permissible spurious signal		1st mixer 1 dB compression point typ. +10 dBm IF overload at reference level typ. +8 dB	

		R&S®FSH3	R&S®FSH6
Transmission measurements (only with R&S®FSH3 models .13, .23 and R&S®FSH6 model .26)			
Frequency range		5 MHz to 3 GHz	5 MHz to 6 GHz
Dynamic range			
10 MHz to 2.2 GHz	scalar mode	typ. 60 dB	typ. 80 dB
	vector mode, option R&S®FSH-K2	typ. 80 dB	typ. 90 dB
2.2 GHz to 3 GHz	scalar mode	typ. 50 dB	typ. 70 dB
	vector mode, option R&S FSH-K2	typ. 65 dB	typ. 85 dB
3 GHz to 5 GHz	scalar mode	–	typ. 40 dB
	vector mode, option R&S®FSH-K2	–	typ. 55 dB
5 GHz to 6 GHz	scalar mode	–	typ. 35 dB
	vector mode, option R&S®FSH-K2	–	typ. 50 dB
Reflection measurements (only with R&S®FSH3 model .13 or .23, R&S®FSH6 model .26 and R&S®FSH-Z2)			
Frequency range		10 MHz to 3 GHz	10 MHz to 3 GHz
Display range of return loss		10, 20, 50, 100 dB, selectable	
VSWR display range		1 to 2, 1 to 6, , 1 to 10 , 1 to 20 selectable with option R&S®FSH-K2 also 1 to 1.2 and 1 to 1.5	
Reflection factor (ρ) display range		0 to 1, 0 to 0.1, 0 to 0.01, 0 to 0.001	
milliRHO (mρ) display range		0 to 1000, 0 to 100, 0 to 10, 0 to 1	
Measurement uncertainty		see diagrams	



Measurement uncertainty with vector measurements (option R&S®FSH-K2)



Measurement uncertainty with scalar measurements

		R&S®FSH3	R&S®FSH6
3GPP FDD code domain power BTS/Node B measurement (only with R&S®FSH-K4 1300.7633.02 and R&S®FSH3 model .23)[6]			
Frequency range		10 MHz to 3 GHz	–
Carrier frequency uncertainty		(test case 6.3 in line with 3GPP 25.141)	–
Measurement range		±1 kHz	–
Measurement uncertainty	SNR > 30 dB	< 50 Hz + Δf_{ref} [7] (σ = 20 Hz)	–
Total power	SNR > 30 dB	(test case 6.2.1 in line with 3GPP 25.141)	–
Measurement range	frequency > 1 MHz +20 °C to +30 °C	–60 dBm < P_{total} < 20 dBm	–
Measurement uncertainty	–40 dBm < P_{total} < 20 dBm P_{REF_LEV} – 30 dB < P_{total} < P_{REF_LEV} + 3 dB	±1.5 dB, typ. 0.5 dB	–
CPICH power	SNR > 30 dB	(test case 6.2.2 in line with 3GPP 25.141)	–
Measurement range	–40 dBm < P_{total} < 20 dBm	P_{total} – 20 dB < P_{CPICH} < P_{total}	–
Measurement uncertainty	– P_{total} –20 dBm < P_{CPICH} < P_{total}	±1.5 dB, typ. 0.5 dB	–
P-CCPCH power	SNR > 30 dB		
Measurement range	–40 dBm < P_{total} < 20 dBm	P_{total} – 40 dB < P_{PCCPCH} < P_{total}	–
Measurement uncertainty	P_{total} –20 dBm < P_{PCCPCH} < P_{total}	±1.5 dB, typ. 0.5 dB	–
PSCH/SSCH power	SNR > 30 dB		–
Measurement range	–40 dBm < P_{total} < 20 dBm	P_{total} – 30 dB < P_{SCH} < P_{total}	–
Measurement uncertainty	P_{total} –20 dBm < P_{PSCH} < P_{total}	±2.5 dB, typ. 1.5 dB	–
Symbol EVM			
Measurement range		3 % < EVM_{symbol} < 25 %	–
Measurement uncertainty	3 % < EVM_{symbol} < 10 %	typ. ±2.5 %	–
	10 % < EVM_{symbol} < 20 %	typ. ±3 %	
Residual EVM_{symbol}		typ. 3 %	

[6] *As of serial no. 103500.*

[7] *Δf_{ref} = uncertainty of reference frequency.*

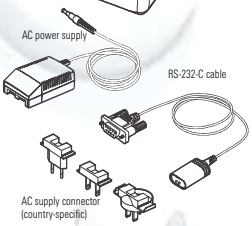
General data

Display	14 cm (5.7") LC color display
Resolution	320 × 240 pixel
Memory Settings and traces	CMOS RAM up to 256
Environmental conditions	
Temperature	
Operating temperature range R&S®FSH powered from internal battery R&S®FSH powered from AC power supply	 0 °C to +50 °C 0 °C to +40 °C
Storage temperature range	–20 °C to +60 °C
Battery charging mode	0 °C to +40 °C
Climatic conditions	
Relative humidity	95 % at +40 °C (EN 60068)
IP class of protection	51
Mechanical resistance	
Vibration, sinusoidal	meets EN 60068-2-1, EN 61010-1 5 Hz to 55 Hz: max 2 g, 55 Hz to 150 Hz: 0.5 g constant, 12 minutes per axis
Vibration, random	meets EN 60068-2-64, 10 Hz to 500 Hz, 1.9 g, 30 minutes per axis
Shock	meets EN 60068-2-27, 40 g shock spectrum
RFI suppression	meets EMC directive of EU (89/336/EEC) and German EMC legislation
Immunity to radiated interference Level display at 10 V/m (reference level ≤–10 dBm) Input frequency IF Other frequencies	10 V/m <–75 dBm (nominal) <–85 dBm (nominal) < displayed noise level

Power supply

AC supply	plug-in AC power supply (R&S®FSH-Z33) 100 V AC to 240 V AC, 50 Hz to 60 Hz, 400 mA
External DC voltage	15 V to 20 V
Internal battery	NiMH battery, type Fluke BP190 (R&S®FSH-Z32)
Battery voltage	6 V to 9 V
Operating time with fully-charged battery	4 h with tracking generator off, 3 h with tracking generator on
Lifetime	300 to 500 charging cycles
Power consumption	typ. 7 W
Safety	meets EN 61010-1, UL 3111-1, CSA C22.2 No. 1010-1
Test mark	VDE, GS, CSA, CSA-NRTL
Dimensions (W × H × D)	170 mm × 120 mm × 270 mm
Weight	2.5 kg

Accessories and ordering information



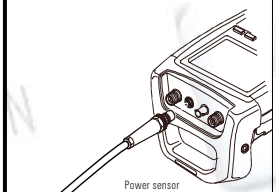
Ordering information

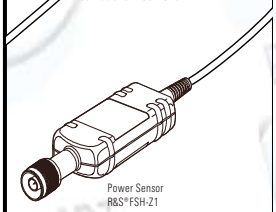
Designation	Type	Order No.
Handheld Spectrum Analyzer, 100 kHz to 3 GHz, with preamplifier	R&S®FSH3	1145.5850.03
Handheld Spectrum Analyzer, 100 kHz to 3 GHz, with tracking generator	R&S®FSH3	1145.5850.13
Handheld Spectrum Analyzer, 100 kHz to 3 GHz, with tracking generator and preamplifier	R&S®FSH3	1145.5850.23
Handheld Spectrum Analyzer, 100 kHz to 6 GHz, with preamplifier	R&S®FSH6	1145.5850.06
Handheld Spectrum Analyzer, 100 kHz to 6 GHz, with tracking generator and preamplifier	R&S®FSH6	1145.5850.26

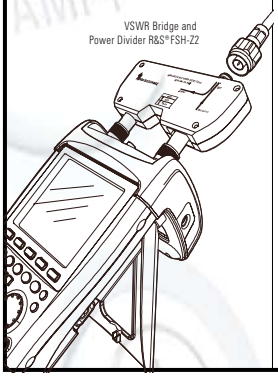
Accessories supplied
External power supply, battery pack (built-in), USB optical cable, headphones, Quick Start manual, CD-ROM with Control Software R&S®FSH View and documentation

Options

Designation	Type	Order No.
Distance-to-Fault Measurement (includes 1 m cable, R&S®FSH-Z2 required)	R&S®FSH-B1	1145.5750.02
Remote Control via RS-232-C	R&S®FSH-K1	1157.3458.02
Vector Transmission and Reflection Measurements	R&S®FSH-K2	1157.3387.02
Receiver Mode	R&S®FSH-K3	1157.3429.02
3GPP FDD Code Domain Power BTS/Node B Measurement for R&S®FSH3 model .23	R&S®FSH-K4 [8)]	1300.7633.02

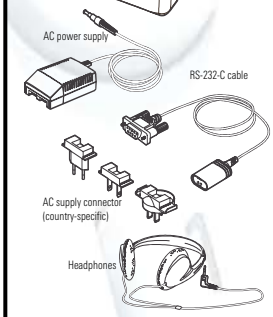


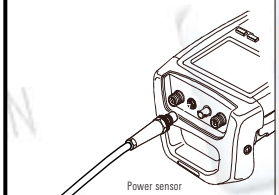


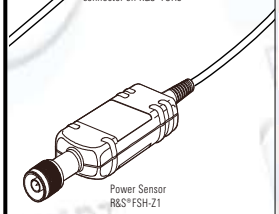


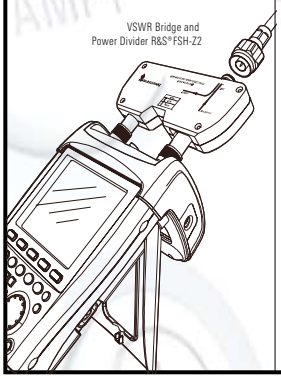
[8)] *For R&S®FSH3 only (1145.5850.23), as of serial no 103500.*

Accessories and ordering information









Optional accessories

Designation	Type	Order No.
Power Sensor, 10 MHz to 8 GHz	R&S®FSH-Z1	1155.4505.02
VSWR Bridge and Power Divider, 10 MHz to 3 GHz (open, short, 50 Ω load)	R&S®FSH-Z2	1145.5767.02
VSWR Bridge with DC Bias and Bypass Connector for the R&S®FSH, 10 MHz to 6 GHz (incl. calibration standards open, short, 50 Ω load)	R&S®FSH-Z3	1300.7756.02
Directional Power Sensor, 25 MHz to 1 GHz	R&S®FSH-Z14	1120.6001.02
Power Sensor, 10 MHz to 18 GHz	R&S®FSH-Z18	1165.1909.02
Directional Power Sensor, 200 MHz to 4 GHz	R&S®FSH-Z44	1165.2305.02
Matching Pad 50/75 Ω, 0 Hz to 2700 MHz	R&S®RAZ	0358.5714.02
Spare RF Cable (1 m), connectors N male/N female for R&S®FSH-B1	R&S®FSH-Z20	1145.5867.02
12 V Car Adapter	R&S®FSH-Z21	1300.7579.02
Serial/Parallel Converter	R&S®FSH-Z22	1145.5880.02
Carrying Bag	R&S®FSH-Z25	1145.5896.02
Transit Case	R&S®FSH-Z26	1300.7627.02
Combined Short/Open and 50 Ω Load for VSWR and DTF calibration	R&S®FSH-Z29	1300.7504.02
Spare Short/Open Calibration Standard for R&S®FSH-Z2 for VSWR calibration	R&S®FSH-Z30	1145.5773.02
Spare 50 Ω Load Standard for R&S®FSH-Z2 for VSWR and DTF calibration	R&S®FSH-Z31	1145.5780.02
Spare Battery Pack	R&S®FSH-Z32	1145.5796.02
Spare AC Power Supply	R&S®FSH-Z33	1145.5809.02
Spare RS-232-C Optical Cable	R&S®FSH-Z34	1145.5815.02
Spare CD-ROM with Control Software R&S®FSH View and documentation	R&S®FSH-Z35	1145.5821.02
Spare Headphones	R&S®FSH-Z36	1145.5838.02
Spare USB Optical Cable	R&S®FSH-Z37	1300.7733.02
Matching Pad 50/75 Ω, 0 Hz to 1000 MHz	R&S®FSH-Z38	1300.7740.02
Active Directional Antenna	R&S®HE200	4050.3509.02
Isotropic Antenna, 30 MHz to 3 GHz for R&S®FSH 3	R&S®TS-EMF	1158.9295.13
Near-Field Probe Set	R&S®HZ-15	1147.2736.02
Preamplifier for R&S®HZ-15	R&S®HZ-16	1147.2720.02