Handheld
Spectrum Analyzer R&S FSH 3

100 kHz to 3 GHz

Third Edition March 2003

ROHDE&SCHWARZ

Spectrum analysis – anywhere, anytime

The R&S FSH3 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.

Power measurement with
Power Sensor R&S FSH-Z1

Handy, robust and portable

The R&S FSH3 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 100 traces and setups
Easy data transfer to PC
High measurement accuracy
Best RF characteristics in this class

■ Trace
■ Memory Trace
■ Clear/Write
■ Max/Min Hold
■ Average
■ View
■ Detectors
   - Auto Peak
   - Sample
   - Max/Min Peak
   - RMS

Function keys   Softkey function

The R&S FSH3 can, of course, also be used on the lab bench. The R&S FSH3 has an adjustable, fold-out stand to position the instrument to an optimal display viewing angle.

Selection of measurement
functions:
- Spectrum analysis
- Scalar network analysis
- Channel power
- TDMA power
- DTF
- Power
- Transducer factors
- Limit lines
- Display line

Selection of following functions:
- Marker
- Delta marker
- Noise marker
- Frequency counter

- Memory for up to 100 traces
  and setups
- Direct printout of measure-
  ment results
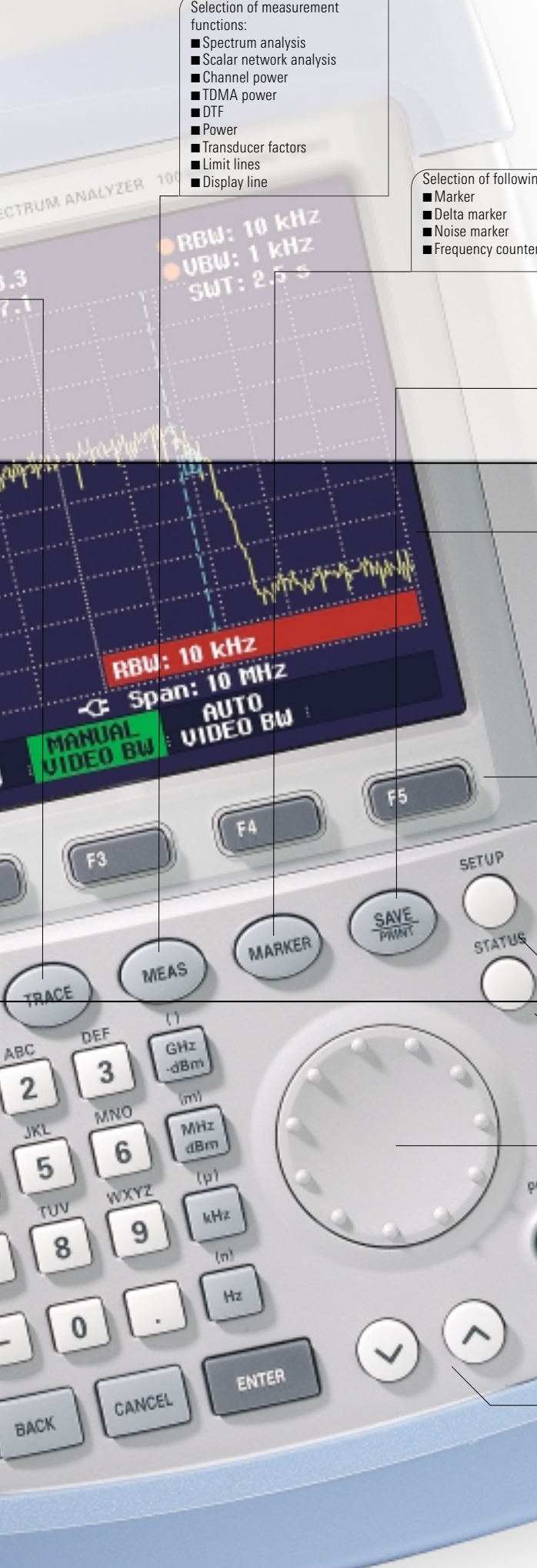
Colour display, 320 x 240 pixels

RS-232-C optical interface

Simple menu-based operation
via softkeys

General instrument setup

Current instrument settings

Rotary knob

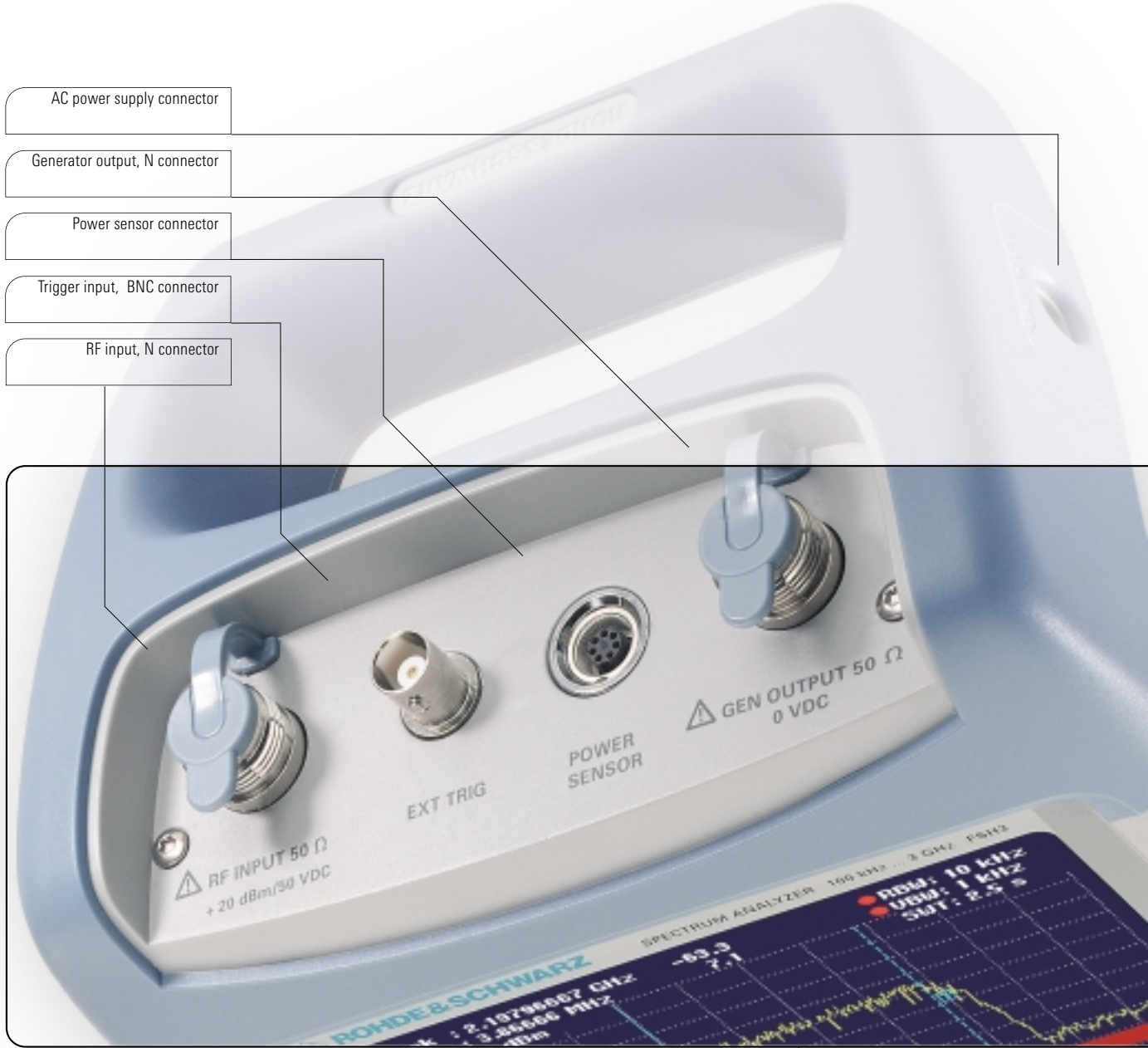Default setting

Cursor keys

AC power supply connector

Generator output, N connector

Power sensor connector

Trigger input, BNC connector

RF input, N connector

RF INPUT 50 Ω
+ 20 dBm/50 VDC

EXT TRIG

POWER
SENSOR

GEN OUTPUT 50 Ω
0 VDC

Headphones connector

Data in brief

Frequency range	100 kHz to 3 GHz
Resolution bandwidths	1 kHz to 1 MHz
Video bandwidths	10 Hz to 1 MHz
Displayed average noise level	–114 dBm (1 kHz) typ.
IP3	15 dBm typ.
SSB phase noise	<–100 dBc (1 Hz) at 100 kHz from carrier
Detectors	sample, max/min peak, auto peak, RMS
Level measurement accuracy	<1.5 dB
Reference level	–80 dBm to +20 dBm
Dimensions	170 mm x 120 mm x 270 mm
Weight	2.5 kg

R&S FSH3 – options and applications

Two versions of the R&S FSH3 are available – one with an internal tracking generator and one without. The tracking generator extends the R&S FSH3's range of applications to cover distance-to-fault (DTF) measurements on cables and scalar network analysis. A power sensor is available as an accessory for high-precision power measurements up to 8 GHz. The table below indicates which configuration is required for each application.

Product	Application	TDMA power measurements	Channel-power measurements	Field-strength measurements	Power measurements up to 8 GHz	Measurements on cables (distance-to-fault)	Scalar transmission measurements / Vector transmission measurements[1]	Scalar reflection measurements / Vector reflection measurements[1]
R&S FSH3		■	■	■				
R&S FSH3 incl. tracking generator		■	■	■			■	
R&S FSH3 incl. tracking generator + VSWR Bridge R&S FSH-Z2 + DTF Function R&S FSH-B1		■	■	■		■	■	■
R&S FSH3 + Power Sensor R&S FSH-Z1		■	■	■	■			
R&S FSH3 incl. tracking generator + Power Sensor R&S FSH-Z1 + VSWR Bridge R&S FSH-Z2 + DTF Function R&S FSH-B1		■	■	■	■	■	■	■

[1] *R&S FSH-K2 required*

*Data transfer between R&S FSH3 and PC (interface cables and software are supplied with the instrument)*

R&S FSH3 with VSWR Bridge and Power Divider R&S FSH-Z2

TDMA power measurements

Basically, when TDMA (time division multiple access) methods are employed, e.g. GSM, several users share a frequency channel. Each user is assigned a single timeslot. The R&S FSH3's TDMA POWER function performs time-domain power measurements in these timeslots. All the settings required for the GSM and EDGE standards are predefined on the R&S FSH3 to make these measurements easier for the user. The R&S FSH3 can use external triggering or video triggering to start power measurements.
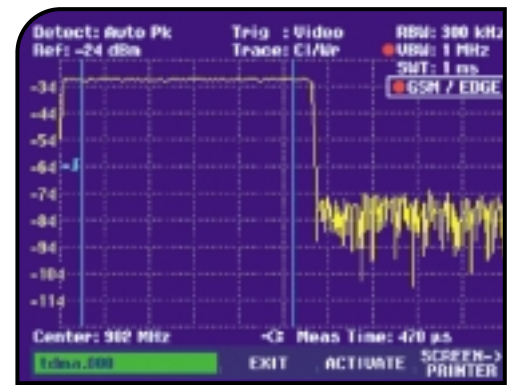
Channel-power measurements

The channel-power measurement function is for determining the power in a user-defined transmission channel. After a few preliminary settings have been made, a single keystroke starts the R&S FSH3's spectrum measurement inside the channel, using a resolution bandwidth that is small relative to the channel bandwidth. The R&S FSH3 then integrates the measured values indicated by the trace to obtain and display the total power. All the settings required for the digital mobile radio standards 3GPP WCDMA, cdmaOne, CDMA2000 1x are predefined. The R&S FSH3 also takes into account the characteristics of the selected display mode (lin or log), the selected detector and the resolution bandwidth.
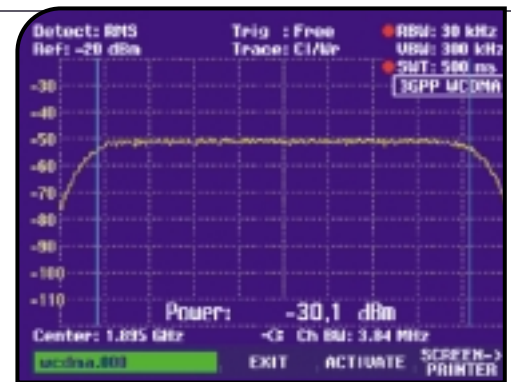
Field-strength measurements

The R&S FSH3 makes field-strength measurements easy. The antenna factor – or its logarithmic equivalent, the antenna transducer factor – is taken into account in the measurements. The R&S FSH3 thus displays electric field strength directly in dBμV/m. In addition, it is possible to correct the frequency-dependent loss or gain of, for example, a cable or an amplifier connected between the device under test and the RF input of the R&S FSH3. For quick and easy result analysis, the R&S FSH3 supports up to two limit lines with automatic limit monitoring that can be defined as upper and lower limits.

R&S FSH 3 with Active
Directional Antenna R&S HE 200
*(optional accessory)*

Power measurements

By means of the Power Sensor R&S FSH-Z1, the R&S FSH3 can be expanded to a high-precision RF power meter up to 8 GHz. As with thermal sensors, the true RMS value of the measured signal is obtained over the whole measurement range irrespective of the signal waveform. This is particularly relevant when measurements are made on modulated signals because no additional measurement errors are introduced. The measurements are straightforward, which is very important for digitally modulated signals such as 3GPP. The large measurement range which covers 200 pW to 200 mW (equivalent to a dynamic range of 90 dB) turns the R&S FSH3 with the R&S FSH-Z1 into a universal RF power meter.

Measurements on cables (distance-to-fault)

Only applies to R&S FSH3 with tracking generator, Order No. 1145.5850.13, with installed option R&S FSH-B1 (distance-to-fault measurement) and R&S FSH-Z2 (VSWR bridge and power divider)

For rapidly and accurately determining the distance to any faults in an RF cable. Distance-to-fault measurements using the VSWR Bridge R&S FSH-Z2 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 pixels.
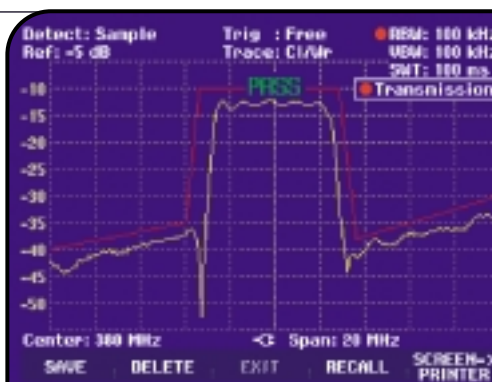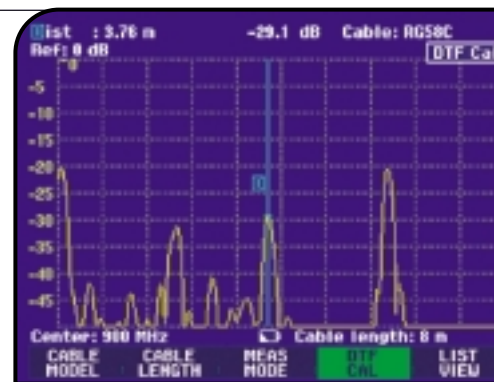
Scalar transmission and reflection measurement with VSWR bridge (R&S FSH-Z2 as accessory)

The R&S FSH3 with built-in tracking generator can be used to rapidly determine the transmission characteristics (i.e. attenuation or gain) of twoports such as cables, filters, amplifiers, etc, with a minimum of effort. A simple calibration procedure compensates for the attenuation introduced by measurement cables or any attenuators used for amplifier measurements. When the VSWR Bridge R&S FSH-Z2 is fitted, the matching (return loss or VSWR) at the input or output of twoports can be determined as well as their transfer function. The bridge is screwed directly onto the R&S FSH3's RF input and tracking generator output, and no cumbersome, extra cabling is required.
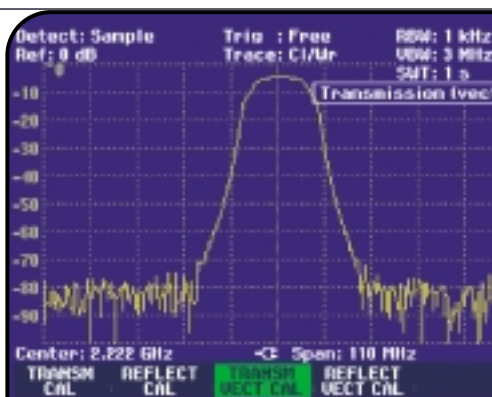

Vector transmission and reflection measurements

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. This allows for a complex correction of system errors. Transmission and reflection results are displayed as magnitude.

Control Software R&S FSH View

The powerful software package for documenting your measurements is supplied with every R&S FSH3.
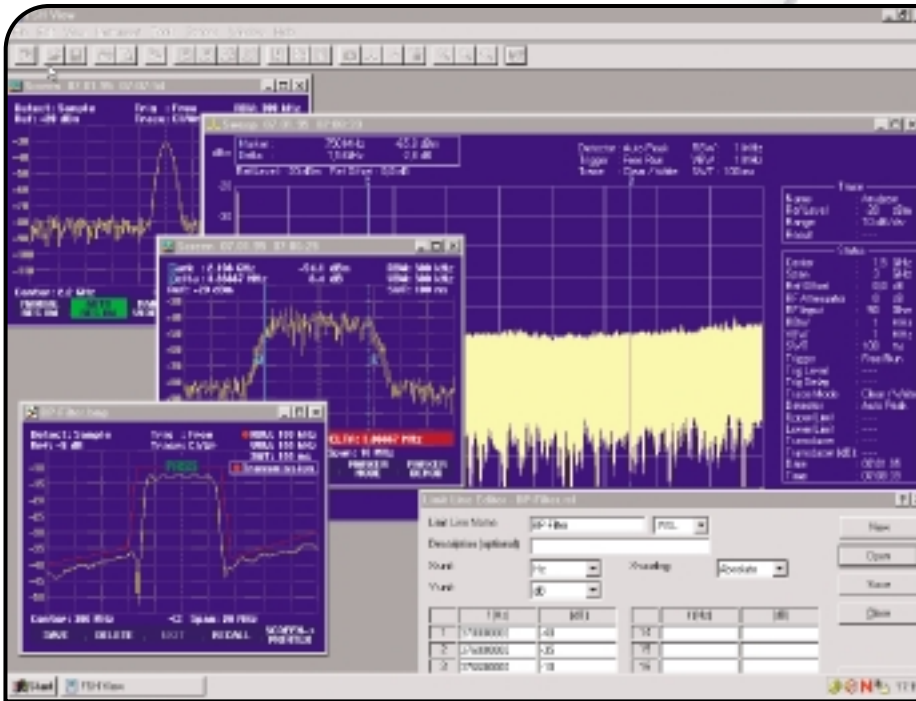
Features:

- Runs under Windows 98/ME/NT/2000/XP

- Rapid and simple transfer of measurement data from the R&S FSH3 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 FSH3 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)

- Unlimited memory capacity for traces and other measurement information; comparison of new and old measurements

- Generation of cable data with a built-in cable editor; downloading to the R&S FSH3 for distance-to-fault measurements

- Editor for the generation of limit lines, transducer factors and correction factors for external attenuators or amplifiers

- Macro function for Word for fast and easy documentation of measurement results

- Connection between PC and R&S FSH3 via interference-free, RS-232-C optical interface

Specifications

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

Frequency

Frequency range	100 kHz to 3 GHz
Reference frequency	
Aging	2 ppm / year
Temperature drift	2 ppm (0 °C to +30 °C),
	plus 2 ppm/10 °C from +30 °C to +50 °C
Frequency counter	
Resolution	1 Hz
Span	10 kHz to 3 GHz, 0 Hz
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 ≥10 kHz	100 ms to 1000 s
Span = 0 Hz	1 ms to 100 s
Bandwidths	
Resolution bandwidths (-3 dB)	1 kHz to 1 MHz in 1, 3 steps
Tolerance	±5 %
Video bandwidths	10 Hz to 1 MHz in 1, 3 steps

Amplitude

Display range	average noise floor displayed to +20 dBm
Maximum permitted DC voltage at RF input	50 V
Maximum power	20 dBm, 30 dBm (1 W) for max. 3 min
Intermodulation-free range	
2 x -20 dBm, reference level = -10 dBm	70 dB (+15 dBm IP3)
(0 dB RF attenuation)	
Displayed average noise floor, resolution bandwidth 1 kHz	
Video bandwidth 10 Hz, 10 MHz to 3 GHz,	<−105 dBm, −114 dBm typ.
Reference level ≤ -30 dBm	
Spurious response	
Reference level ≤ -10 dBm, f >30 MHz,	<−80 dBm
RBW ≤100 kHz	
Input related spurious	
Carrier offset >1 MHz	<−70 dBc (nominal)
Level display	
Reference level	−80 dBm to +20 dBm in 1 dB steps
RF attenuation	0 dB to 30 dB in 10 dB steps, automatically
	coupled to the reference level
Display range	100 dB, 50 dB, 20 dB, linear
Display units	
Logarithmic	dBm, dBμV, dBmV
Linear	μV, mV, V, nW, μW, mW, W
Traces	1 trace and 1 memory trace
Level display error	
At reference level down to -50 dB	<1.5 dB (+20 °C to +30 °C)
Trace detector	auto peak, max/min peak, sample, RMS
Markers	1 marker and 1 delta marker
Marker functions	peak, next peak, marker to center
Marker displays	normal (level), noise marker, frequency counter
	(count)
Trigger	free-running, video trigger, external trigger
Audio demodulation	AM (video voltage without AGC) and FM

Inputs

RF input	N connector, female
Input impedance	50 Ω
VSWR (10 MHz to 3 GHz)	1.5 typ.
Trigger input	BNC connector, female
Trigger voltage	TTL

Outputs

Headphones output	3.5 mm mini jack
Output impedance	100 Ω
Open-circuit voltage	adjustable up to 1.5 V
Tracking generator (only model 1145.5850.13)	N connector, female
Frequency range	10 MHz to 3 GHz
Output level	−20 dBm (nominal)
Output impedance	50 Ω, nominal

Interfaces

RS-232-C optical interface	
Baud rates	1200, 2400, 9600, 19200, 38400, 57600, 115200 baud
Power sensor	7-contact connector (Binder 712)

Accessories

Power Sensor R&S FSH-Z1	
Frequency range	10 MHz to 8 GHz
VSWR (+18 °C to +28 °C)	
10 MHz to 30 MHz	<1.15
30 MHz to 2.4 GHz	<1.13
2.4 GHz to 8 GHz	<1.20
Maximum input power	400 mW (+26 dBm), average power
	1 W (+30 dBm), peak power (<10 µs, 1% duty cycle)
Measurement range	200 pW to 200 mW (−67 dBm to +23 dBm)
Signal weighting	average power
Effect of harmonics	<0.5 % (0.02 dB) at harmonic ratio of 20 dB
Effect of modulation	<1.5 % (0.07 dB) for continuous digital modulation
Absolute measurement uncertainty (sine signals, no zero offset)	
+18 °C to +28 °C	<2.5 % (0.11 dB)
0 °C to +50 °C	<4.5 % (0.19 dB)

Accessories (continued)

VSWR Bridge and Power Divider R&S FSH-Z2

Frequency range	10 MHz to 3 GHz
Impedance	50 Ω
VSWR bridge	
Directivity, 10 MHz to 1 GHz	30 dB
Directivity, 1 GHz to 3 GHz	25 dB
Directivity, corrected (option R&S FSH-K2)	43 dB
Return loss at test port	20 dB
Return loss, corrected (option R&S FSH-K2)	35 dB
Insertion loss	9 dB
Power divider	
Return loss, test port	20 dB
Connectors	
Generator input/RF output	N connector, male
Test port	N connector, female
Control interface	7-pin connector (Binder)
Calibration standards	
Short circuit/open circuit	
Connector	N connector, male
50 Ω load	
Impedance	50 Ω
Return loss, up to 3 GHz	>46 dB
Power-handling capacity	1 W
Connector	N connector, male
General data	
Power consumption	500 mW (nominal)
Dimensions (W x H x D)	169 mm x 116 mm x 30 mm
Weight	485 g

Distance-to-Fault Measurement R&S FSH-B1 (optional)

Display	301 pixels
Maximum resolution distance	cable length/1023 pixels (maximum zoom)
Display range of return loss	0 dB to 100 dB, scalable
Cable length	3 m to 1000 m max. (depending on cable attenuation)
Maximum permissible spurious signal	1st mixer 1 dB compression point +10 dBm typ.
	IF overload with reference level +8 dB typ.

Transmission measurement (possible only with R&S FSH 3 with tracking generator)

Frequency range	10 MHz to 3 GHz
Dynamic range	
10 MHz to 2.2 GHz	60 dB (scalar measurement)
	80 dB (vector measurement, option R&S FSH-K2)
2.2 GHz to 3 GHz	50 dB (scalar measurement)
	65 dB (vector measurement, option R&S FSH-K2)

Accessories (continued)

Reflection measurement (possible only with R&S FSH 3 with tracking generator and option R&S FSH-Z2)

Frequency range	10 MHz to 3 GHz
Display range of return loss	10 dB, 20 dB, 50 dB, 100 dB, selectable
VSWR display range	1 to 2 and 1 to 6, selectable
Measurement uncertainty, see diagram ▼	
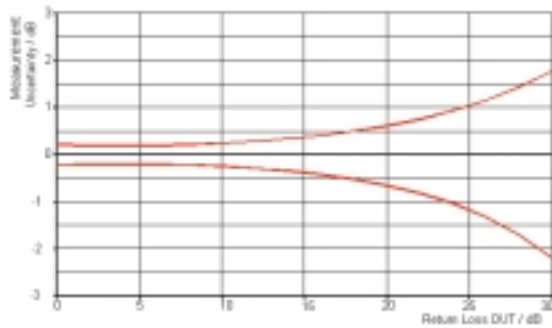
Measurement uncertainty with vector measurements,
directivity 43 dB (option R&S FSH-K2)
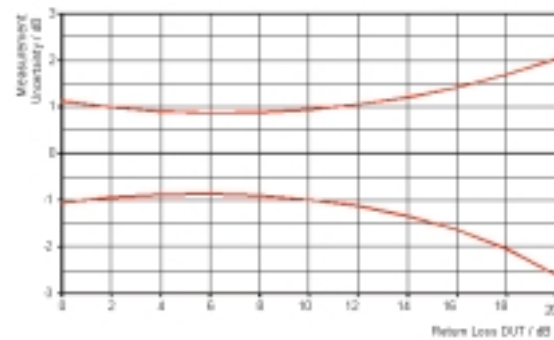
Measurement uncertainty with scalar measurements,
directivity 30 dB

General data

Power supply

AC supply	external 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
Battery voltage	6 V to 9 V
Operating time with fully charged battery	4 h without tracking generator
	3.5 h with tracking generator
Battery charging time	4 h
Battery life	300 to 500 charging cycles
Power consumption	7 W (typ.)
Safety	to EN 61010-1, UL 3111-1, CSA C22.2 No. 1010-1
Test marks	VDE, GS, CSA, CSA-NRTL
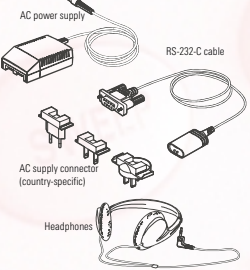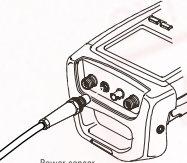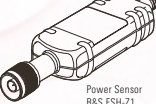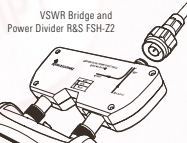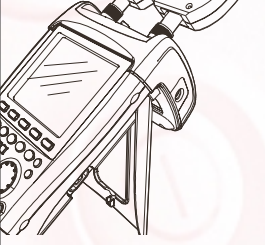
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General data (continued)

Display	14 cm (5.7") colour LCD
Resolution	320 x 240 pixels
Memory	CMOS RAM
Setups and traces	100
Temperature	
Operating temperature range	
R&S FSH3 powered from battery	0 °C to +50 °C
R&S FSH3 powered from AC power supply	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 (IEC 60068)
IP class of protection	51
Mechanical resistance	
Sinusoidal vibration	to EN 60068-2-1, EN61010-1
	5 Hz to 55 Hz: max. 2 g, 55 Hz to 150 Hz: 0.5 g constant,
	12 minutes per axis
Random vibration	to EN60068-2-64
	10 Hz to 500 Hz, 1.9 g, 30 minutes per axis
Shock	to EN 60068-2-27
	40 g shock spectrum
RFI suppression	to EMC directive of EU (89/336/EEC)
	and German EMC legislation
Immunity to radiated interference	10 V/m
Level display at 10 V/m (ref. level ≤-10 dBm)	
Input frequency	<−75 dBm (nominal)
IF	<−85 dBm (nominal)
Other frequencies	< noise display
Dimensions (W x H x D)	170 mm x 120 mm x 270 mm
Weight	2.5 kg

Accessories and ordering information

Handheld Spectrum Analyzer R&S FSH3

Description	Designation	Order No.
Handheld Spectrum Analyzer, 100 kHz to 3 GHz	R&S FSH3	1145.5850.03
Handheld Spectrum Analyzer, 100 kHz to 3 GHz, with tracking generator	R&S FSH3	1145.5850.13
Accessories supplied		
External AC power supply, battery pack (integrated), RS-232-C optical cable, headphones, CD-ROM with Control Software R&S, FSH View and documentation, Quick Start Manual		

Options

Description	Designation	Order No.
Distance-to-Fault Measurement for R&S FSH3, includes 1 m cable and license key, R&S FSH-Z2 required	R&S FSH-B1	1145.5750.02
Vector Transmission and Reflection Measurements for R&S FSH3	R&S FSH-K2	1157.3387.02

Optional accessories

Description	Designation	Order No.
Power Sensor for R&S FSH3	R&S FSH-Z1	1155.4505.02
VSWR Bridge and Power Divider, 10 MHz to 3 GHz, for R&S FSH3, incl. calibration standards (open, short, 50 Ω load)	R&S FSH-Z2	1145.5767.02
Matching Pad 50/75 Ω, 0 MHz to 2700 MHz	R&S RAZ	0358.5714.02
12 V Cigarette-Lighter Adapter for R&S FSH3	R&S FSH-Z21	1145.5873.02
Serial/Parallel Converter for R&S FSH3	R&S FSH-Z22	1145.5880.02
Carrying Bag for R&S FSH3	R&S FSH-Z25	1145.5896.02
Additional RF Cable, 1 m, N connectors for R&S FSH-B1	R&S FSH-Z20	1145.5867.02
Spare Short/Open Calibration Standards 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 for R&S FSH3	R&S FSH-Z32	1145.5796.02
Spare AC Power Supply for R&S FSH3	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
Active Directional Antenna for Field-Strength Measurements	R&S HE200	4050.3509.02

AC power supply

RS-232-C cable

AC supply connector (country-specific)

Headphones

Power sensor connector on R&S FSH3

Power Sensor R&S FSH-Z1

VSWR Bridge and Power Divider R&S FSH-Z2

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