Spectrum Analyzer FSP

The new medium-class standard:

Unparalleled range of functions

High measurement speed

Maximum in precision

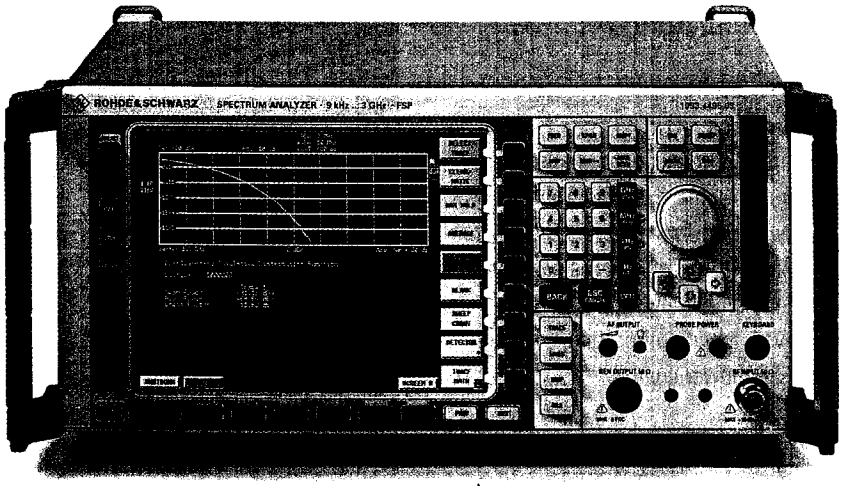

Photo 43389-2

Brief description

With the new FSP family, the well-known advantages of high-end Analyzers FSE and FSIQ have been systematically integrated into the medium class of analyzers. FSP sets the standard for the medium class regarding the vital criteria of functionality, measurement speed and accuracy. The use of innovative techniques such as an highly integrated front-end and fully digital signal processing in the back end, together with ASICs developed by Rohde & Schwarz, has resulted in a product of top-class specifications and high reliability.

The FSP option list is short – all important functions and interfaces are implemented as standard. FSP features future-oriented characteristics such as an RMS detector and a CCDF routine for fast statistical measurements on digitally modulated signals not offered by any other medium-class spectrum analyzer.

Main features

The new FSP Spectrum Analyzers from Rohde & Schwarz are outstanding for their innovative measurements and a host of standard functions.
Instead of a wide choice of options, FSP offers as standard all the functions and interfaces you may expect from a state-of-the art spectrum analyzer:

- Largest colour display in its class
- Resolution bandwidths from 1 Hz to 10 MHz
- Highly selective digital and FFT filters
- Quasi-peak detector and EMI bandwidths
- Convenient documentation of results as a hardcopy or file in PC-compatible formats
- Interfaces: GPIB, Centronics, RS232
- Automatic test routines for measuring TOI, OBW, phase noise and ACP(R)
- Split screen with separate settings and up to 3 traces per screen
- Editable limit lines including PASS/FAIL indication
- Fast measurements in the time domain: minimum sweep time 1 µs
- Gated sweep for measurements on TDMA signals

On top of this, FSP features as standard the following unique attributes:

- RMS detector for fast and reproducible power measurements on digitally modulated signals in frequency and time domain
- Statistical measurement functions for determining crest factor and CCDF (complementary cumulative distribution function)

Featuring such a wealth of functions, FSP offers state-of-the-art spectrum analysis at an extremely attractive price-performance ratio.

Speed

Time is a finite resource – so high measurement speed is indispensable for competitiveness and cost-effective testing. Here, too, the new FSP offers characteristics that make it top of the class:

- Up to 30 measurements/s on GPIB interface including trace transfer of 501 binary data
- 70 measurements/s on GPIB interface in zero span mode including trace transfer of 501 binary data
- Minimum sweep time of 2.5 ms
- 1 µs time domain measurements
- Unique fast ACP mode for high-speed ACPR measurements in time domain using the standard-stipulated test filters

With 30 measurements/s in manual operation and digital filters with sweep time 2.5 times faster than comparable analog filters, FSP will also help in your day-to-day work to develop your product much faster.

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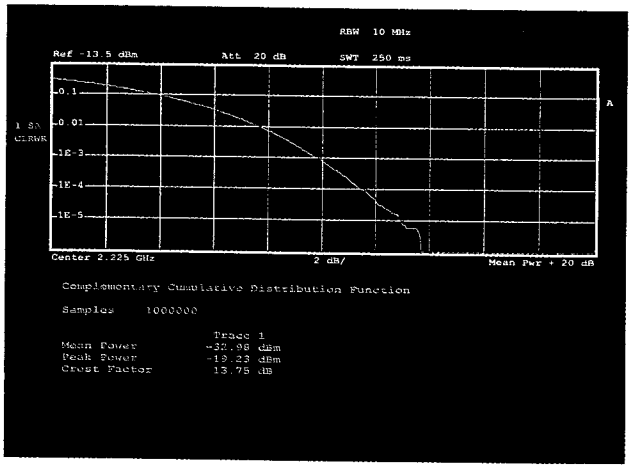
Performance

Modern communication systems are required to achieve optimum spectral efficiency at high data rates. For the 3rd generation of CDMA mobile radio systems currently under development this is achieved, among other things, by high-precision power control.

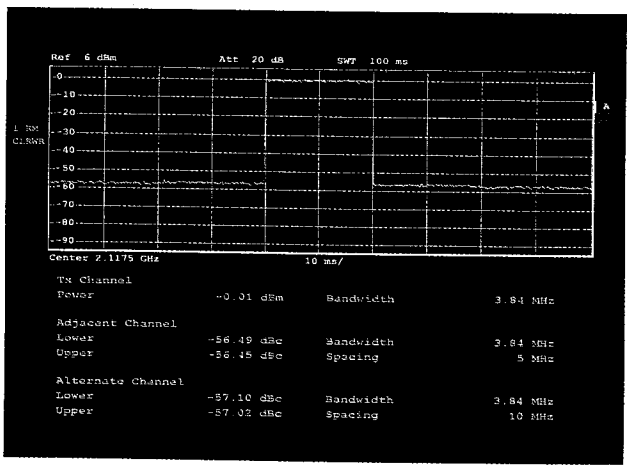
FSP is the ideal partner in development and production, featuring the smallest level measurement uncertainty of all spectrum analyzers on the market, as well as excellent RF characteristics:

- 0.5 dB total measurement uncertainty allows higher tolerances for the DUT, thus increasing production yield
- 0.07 dB linearity uncertainty (1 σ) is ideal for precise measurements, for example of gain control and ACPR
- RMS detector with 100 dB dynamic range measures power fast and accurately irrespective of the signal shape – almost like a thermal power sensor
- The displayed average noise level of typ. –155 dBm (1 Hz) is attained without the use of preamplifiers and thus without any reduction in dynamic range.
- Typ. –145 dBc (1 Hz) phase noise at 10 MHz offset offers optimum conditions for ACPR measurements on W-CDMA systems.

Resolution bandwidths of up to 100 kHz are fully digital and provide – in addition to high selectivity – an ideal basis for accurate (adjacent-) channel measurements thanks to a maximum bandwidth deviation of 3%.



FSP is the first spectrum analyzer to offer statistical analysis of signals by means of the complementary cumulative distribution function (CCDF) as standard and at an impressively high speed. FSP furnishes in only 250 ms the exact CCDF characteristic, average and peak power as well as the crest factor over 1 million measured values



Adjacent-channel power ratio (ACPR) measurements, which many mobile radio standards stipulate for components and units, are implemented in FSP by means of automatic test routines. All settings, measurements and filters required for a selected standard are activated at a keystroke

Open for the PC world ...

- PC-compatible screenshots, no conversion software needed
- Windows™ printer support
- LabWindows driver
- LabView driver
- Software
- SCPI-compatible
- FSE/FSIQ-compatible GPIB command set
- GPIB command set with search function on CD-ROM

Electronic attenuator for high production throughput

The optional Electronic Attenuator FSP-B25 (only for FSP3 and FSP7) supplements the standard mechanical attenuator and provides a wear-and-tear-free setting range of 30 dB in 5 dB steps. The option does away with frequent switching of the mechanical attenuator as called for in high production throughput and so increases the availability and reliability of the measurement facility. The integrated switchable 20 dB preamplifier allows high-sensitivity measurements in the useful frequency range from 10 MHz to 7000 MHz.

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LAN interface

With the aid of the optional LAN Interface FSP-B16, FSP can be connected to common networks such as 100Base-T so that functions like file logging on network drives or documentation of measurement results via network printer are available. In addition, FSP can be remote-controlled via LAN.

Support

- After-sales service
- 3-year warranty
- 2-year calibration cycle
- Customized training
- Pre-sales support
- Solution-oriented consulting
- Leasing

Specifications in brief

Specifications are guaranteed under the following conditions:
15 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and total calibration performed.
Data without tolerances: typical values only.
Data designated "nominal" apply to design parameters and are not tested.
Data designated "σ = xx dB" are shown as standard deviation.

Frequency		**FSP3**	**FSP7**	**FSP13**	**FSP30**
Frequency range	9 kHz to	3 GHz	7 GHz	13.6 GHz	30 GHz
Frequency resolution			0.01 Hz		
Reference frequency internal (nominal)					
Aging per year[1]			1×10^{-6}		
Temperature drift			1×10^{-6}		
with option FSP-B4 (OCXO)					
Aging per year[1]			1×10^{-7}		
Temperature drift			1×10^{-8}		
External reference frequency			10 MHz		
Frequency display		with marker or frequency counter			
Marker resolution		span/500			
Max. deviation (sweep time >3 x auto sweep time)		± (frequency x reference error + 0.5% x span + 10% x resolution bandwidth + ½ (last digit))			
Frequency counter resolution		0.1 Hz to 10 kHz (selectable)			
Count accuracy (S/N >25 dB)		±(frequency x reference error + ½ (last digit))			
Frequency span	0 Hz, 10 Hz to	3 GHz	7 GHz	13.6 GHz	30 GHz
Max. span deviation			0.1%		

Spectral purity (dBc (1 Hz))

SSB phase noise, f = 500 MHz		
Carrier offset	100 Hz	<–84, typ. –90
	1 kHz	<–100, typ. –108
	10 kHz	<–106, typ. –113
	100 kHz[2]	<–110, typ. –113
	1 MHz[2]	<–120, typ. –125
	10 MHz	typ. –145
Residual FM f = 500 MHz, RBW 1 kHz, Sweep time 100 ms		typ. 3 Hz

[1] After 30 days of operation.

[2] Valid for span >100 kHz.

Sweep time

Span ≥10 Hz	2.5 ms to 16000 s in steps of 10%
Error	1%
Span 0 Hz	1 µs to 16000 s in steps of 5%
Resolution	125 ns

Typical values for SSB phase noise (referred to 1 Hz bandwidth)

Offset	**f_{in}= 3 GHz**	**f_{in}= 7 GHz**	**f_{in}= 13 GHz**	**f_{in}= 22 GHz**	**f_{in}= 26 GHz**
100 Hz	–74 dBc	–67 dBc	–61 dBc	–57 dBc	–55 dBc
1 kHz	–100 dBc	–94 dBc	–88 dBc	–84 dBc	–82 dBc
10 kHz	–108 dBc	–104 dBc	–98 dBc	–94 dBc	–92 dBc
100 kHz	–108 dBc	–106 dBc	–100 dBc	–96 dBc	–94 dBc
1 MHz	–118 dBc	–118 dBc	–112 dBc	–108 dBc	–106 dBc

Resolution bandwidths

Bandwidths	10 Hz to 10 MHz (–3 dB), in 1, 3 sequence
EMI bandwidths	200 Hz, 9 kHz, 120 kHz (–6 dB)

Bandwidth accuracy

≤100 kHz	<3%
300 kHz to 3 MHz	<10%
10 MHz	+10%, –30%

Shape factor -60 dB:-3 dB

≤100 kHz	<5:1 (Gaussian filter)
300 kHz to 3 MHz	<15:1 (4-pole synchronously tuned filters)
10 MHz	<7:1

Shape factor -60 dB:-6 dB

EMI bandwidths	<5:1
Video bandwidths	1 Hz to 10 MHz in 1, 3 sequence

FFT filter

Bandwidths	1 Hz to 30 kHz (–3 dB) in 1, 3 sequence
Bandwidth accuracy	5%, nominal
Shape factor -60 dB:-3 dB	2.5:1 nominal

Level

Display range	displayed average noise level to 30 dBm

Maximum input level

RF attenuation 0 dB	
DC voltage	50 V (FSP3, FSP7), 0 V (FSP13, FSP30)
CW RF power	20 dBm
Pulse spectral density	97 dBµV (1 MHz)
RF attenuation ≥10 dB	
CW RF power	30 dBm
Max. pulse voltage	150 V (FSP3, FSP7), 50V (FSP13, FSP30)
Max. pulse energy (10 µs)	1 mWs (FSP3, FSP7), 0.5 mWs (FSP13, FSP30)

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1 dB compression of input mixer
RF attenuation 0 dB, f>200 MHz 0 dBm nominal

Intermodulation
3rd-order intermodulation

Intermodulation-free dynamic range, level 2 x -30 dBm, Δf > 5 x RBW or 10 kHz, whichever the greater value

	FSP3	FSP7	FSP13	FSP30
20 MHz to 200 MHz	>70 dBc, TOI >5 dBm			
200 MHz to 3 GHz	>74 dBc, TOI >7 dBm (typ. 10 dBm)			
3 GHz to 7 GHz	–	>80 dBc, TOI >10 dBm (typ. 15 dBm)		
7 GHz to 20 GHz	–	–	>80 dBc, TOI >10 dBm	
20 GHz to 30 GHz	–	–	–	>76 dBc, TOI>8 dBm

with optional Electronic Attenuator FSP-B25 switched on

20 MHz to 200 MHz	>74 dBc, TOI >7 dBm	–	
200 MHz to 3 GHz	>80 dBc, TOI >10 dBm	–	
3 GHz to 7 GHz	>84 dBc, TOI >12 dBm	–	

Second harmonic intercept point (SHI)

<100 MHz	>25 dBm			
100 MHz to 3 GHz	>35 dBm			
3 GHz to 7 GHz	–	>45 dBm		
7 GHz to 13.6 GHz	–	–	typ. 45 dBm	
13.6 GHz to 30 GHz	–	–	–	typ. 45 dBm

	FSP3	FSP7	FSP13	FSP30
Displayed average noise level				
(0 dB RF attenuation, RBW 10 Hz, VBW 1 Hz, 20 averages, trace average, span 0 Hz, termination 50 Ω)				
9 kHz	<–95 dBm			
100 kHz	<–100 dBm			
1 MHz	<–120 dBm, typ. –125 dBm			
10 MHz to 1 GHz	<–142 dBm, typ. –145 dBm	<–140 dBm, typ. –145 dBm		
1 GHz to 3 GHz	<–140 dBm, typ. –145 dBm	<–138 dBm, typ. –143 dBm		
3 GHz to 7 GHz	–	<–138 dBm, typ. –143 dBm	<–135 dBm, typ. –145 dBm	
7 GHz to 13.6 GHz	–	–	<–132 dBm, typ. –138 dBm	
13.6 GHz to 22 GHz	–	–	–	<–120 dBm, typ. –130 dBm
22 GHz to 30 GHz	–	–	–	<–115 dBm, typ. –123 dBm

Displayed average noise level with preamplifier on (option FSP-B25)

10 MHz to 2 GHz	<–152 dBm	–
2 GHz to 7 GHz	<–150 dBm	–

Immunity to interference

Image frequency	>70 dB
Intermediate frequency (f <3 GHz)	>70 dB
Spurious response (f >1 MHz, without input signal, 0 dB attenuation))	<–103 dBm
Other spurious (with input signal, (mixer level <–10 dBm, Δf >100 kHz)	f <7 GHz: <-70 dBc f <13.6 GHz: <-64 dBc f <30 GHz: <-56 dBc

Level display

Screen	501 × 400 pixels (one diagram), max. 2 diagrams with independent settings
Log level scale	10 dB to 200 dB, in steps of 10 dB
Linear level scale	10% of reference level per level division, 10 divisions
Traces	max. 3, with two diagrams on screen max. 3 per diagram
Trace detector	Max peak, Min Peak, Auto Peak, Sample, Quasi-Peak, Average, RMS
Trace functions	Clear/Write, Max Hold, Min Hold, Average

Setting range of reference level

Logarithmic level display	–130 dBm to 30 dBm, in steps of 0.1 dB
Linear level display	70.71 nV to 7.07 V in steps of 1%
Units of level scale	dBm, dBmV, dBμV, dBμA, dBpW (log level display), mV, μV, mA, μA, pW, nW (linear level display)

Max. uncertainty of level measurement

at 128 MHz, –30 dBm (RF attenuation 10 dB, RBW 10 kHz, ref. level –20 dBm)	<0.2 dB (σ = 0.07 dB)

Frequency response

<50 kHz	<+0.5/–1.0 dB
50 kHz to 3 GHz	<0.5 dB (σ = 0.17 dB)
3 GHz to 7 GHz	<2 dB (σ = 0.7 dB)
7 GHz to 13.6 GHz	<2.5 dB (RF attenuation 10 dB, sweep time >1 s/1 GHz) (FSP13, FSP30)
13.6 GHz to 30 GHz	<3 dB (RF attenuation 10 dB, sweep time >1 s/1 GHz) (FSP30)
Attenuator	<0.2 dB (σ = 0.07 dB)
Reference level switching	<0.2 dB (σ = 0.07 dB)

Display nonlinearity LOG/LIN (S/N >16 dB)

RBW ≤100 kHz	
0 dB to –70 dB	<0.2 dB (σ = 0.07 dB)
–70 dB to –90 dB	<0.5 dB (σ = 0.17 dB)
RBW ≥300 kHz	
0 dB to –50 dB	<0.2 dB (σ = 0.07 dB)
–50 dB to –70 dB	<0.5 dB (σ = 0.17 dB)

Bandwidth switching uncertainty (ref. to RBW = 10 kHz)

10 Hz to 100 kHz	<0.1 dB (σ = 0.03 dB)
300 kHz to 10 MHz	<0.2 dB (σ = 0.07 dB)
1 Hz to 3 kHz, FFT	<0.2 dB (σ = 0.03 dB)

Trigger functions

Span ≥10 Hz

Trigger source	free run, video, external, IF level
Trigger offset	125 ns to 100 s, resolution 125 ns min. (or 1% of offset)

Span = 0 Hz

Trigger source	free run, video, external, IF level
Trigger offset	±125 ns to 100 s, resolution 125 ns min., dependent on sweep time
Max. deviation of trigger offset	±(125 ns + (0.1% x delay time))

Gated sweep

Trigger source	external, IF level, video
Gate delay	1 μs to 100 s
Gate length	125 ns to 100 s, resolution min. 125 ns or 1% of gate length
Max. deviation of gate length	±(125 ns + (0.05% x gate length))

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Inputs and outputs (front panel)

RF input	N female, 50 Ω
FSP3/7/13	N female, 50 Ω
FSP30	test port system 50 Ω, N female, 3.5 mm female
VSWR (RF attenuation>0 dB)	
f <3 GHz/7 GHz/13 GHz/30 GHz	1.5:1/2.0:1/2.5:1/3.0:1
Input attenuator	0 dB to 70 dB in 10 dB steps
Probe power supply	+15 V DC, –12.6 V DC and ground, max. 150 mA
Keyboard connector	PS/2 female for MF2 keyboard
AF output (optional)	3.5 mm mini jack, 10 Ω
Open-circuit voltage	up to 1.5 V, adjustable

Inputs and outputs (rear panel)

IF 20.4 MHz		Z_{out} = 50 Ω, BNC female
Level	RBW ≤100 kHz, FFT	–10 dBm at reference level, mixer level >–60 dBm
	RBW ≥300 kHz	0 dBm at reference level, mixer level >–60 dBm
Reference frequency output		BNC, 10 MHz, 0 dBm nominal
Reference frequency input		BNC, 10 MHz, min. 0 dBm, 50 Ω
Power supply for noise source		BNC, 0 V and 28 V, selectable
External trigger/gate input		BNC, >10 kΩ, TTL level
IEC/IEEE-bus control		interface to IEC-625-2 (IEEE 488.2), command set SCPI 1997.0
Serial interface		RS-232-C (COM), 9-pin sub-D
Printer interface		parallel (Centronics)
Mouse connector		PS/2 female
Connector for ext. monitor (VGA)		15-pin sub-D

Tracking Generator FSP-B9

Unless specified otherwise, specifications are not valid for the frequency range from –3 x RBW to +3 x RBW, however at least not valid from –9 kHz to +9 kHz.

Frequency

Frequency range	9 kHz to 3000 MHz
Frequency offset setting range	±150 MHz
Resolution	1 Hz

Spectral purity

SSB phase noise, f = 500 MHz, carrier offset 100 kHz

Normal mode	typ. –90 dBc (1 Hz)
With FM modulation switched on	typ. –70 dBc (1 Hz)

Level

Level range	–30 dBm to 0 dBm in 0.1 dB steps
Level range with AM	–30 dBm to –6 dBm in 0.1 dB steps
Max. deviation of output level, 128 MHz, 0 dBm	<1 dB

Frequency response

Output level 0 dBm, 100 kHz to 2 GHz	<1 dB
Output level 0 dBm to –25 dBm, 9 kHz to 3 GHz	<3 dB

Dynamic range

Attenuation measurement range, RBW=1 kHz, f >10 MHz	120 dB

Spurious

Harmonics, output level –10 dBm	typ.–30 dBc
Nonharmonics, output level 0 dBm	typ.–30 dBc

Electronic Attenuator FSP-B25 (only for FSP3 and FSP7)

Frequency

Frequency range	10 MHz to 7000 MHz
Input attenuator range (mechanical)	0 dB to 75 dB in 5 dB steps
Electronic attenuation range	0 dB to 30 dB in 5 dB steps
Preamplifier	20 dB, switchable

Displayed average noise level with preamplifier on

(0 dB RF attenuation, RBW 10 Hz, VBW 1 Hz, 20 averages, trace average, span 0 Hz, termination 50 Ω)

10 MHz to 2 GHz	<–152 dBm
2 GHz to 7 GHz	<–150 dBm

Intermodulation with electronic attenuator on

3rd-order intermodulation, intermodulation-free dynamic range, level 2 x –30 dBm, Δf > 5 x RBW or 10 kHz, whichever the greater value

Frequency	
20 MHz to 200 MHz	>74 dBc, TOI >7 dBm
200 MHz to 3 GHz	>80 dBc, TOI >10 dBm
3 GHz to 7 GHz	>84 dBc, TOI >12 dBm

Max. deviation of level measurement

128 MHz, –30 dBm

(RF attenuation 10 dB, RBW 10 kHz, reference level –20 dBm),

preamplifier on	<0.2 dB (σ = 0.07 dB)
Electronic attenuator	<0.2 dB (σ = 0.07 dB)

Frequency response with preamplifier, electronic attenuator

10 MHz to 3 GHz	<1.0 dB (σ = 0.33 dB)
3 GHz to 7 GHz	<2 dB (σ = 0.7 dB)

General data

Display	21 cm TFT colour display (8.4")
Resolution	640 x 480 pixels (VGA resolution)
Pixel failure rate	$<2 \times 10^{-5}$
Mass memory	1.44 Mbyte 3 ½" disk drive (built-in), hard disk
Data storage	>500 instrument settings and traces
Temperature ranges	
Rated temperature range	+ 5 °C to +40 °C
Limit temperature range	+ 5 °C to +45 °C
Power supply	
AC supply	100 V AC to 240 V AC, 50 Hz to 400 Hz, 3.1 A to 1.3 A
Typical power consumption	
FSP3	70 VA
FSP7	120 VA
FSP13, FSP30	150 VA
Dimensions in mm (W x H x D)	412 x 197 x 417
Weight	
FSP3	10.5 kg
FSP7	11.3 kg
FSP13, FSP30	12 kg

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Ordering information

Spectrum Analyzer		
9 kHz to 3 GHz	FSP 3	1093.4495.03
9 kHz to 7 GHz	FSP 7	1093.4495.07
9 kHz to 7 GHz	FSP 13	1093.4495.13
9 kHz to 7 GHz	FSP 30	1093.4495.30
Accessories supplied		
Power cable, operating manual, service manual		
Options		
Delete Manuals	FSP-B0	1129.8394.02
Rugged case, carrying handle (factory-fitted)	FSP-B1	1129.7998.02
AM/FM Audio Demodulator	FSP-B3	1129.6491.02
OCXO Reference Frequency	FSP-B4	1129.6740.02
TV Trigger/RF Power Trigger	FSP-B6	1129.859.4.02
internal Tracking Generator 9 kHz to 3 GHz, IQ modulator, for all FSP models	FSP-B9	1129.6991.02
External Generator Control for all FSP models	FSP-B10	1129.7246.02
LAN Interface 100BT for all FSP models (factory-fitted	FSP-B16	1129.8042.02
Electronic Attenuator, 0 dB to 30 dB, 5 dB steps, integrated preamplifier for FSP3 and FSP7	FSP-B25	1129.7746.02
Software		
Noise Measurement Software	FS-K3	1057.3028.02
Phase Noise Measurement Software	FS-K4	1108.0088.02
GSM/EDGE Application Firmware, Mobile	FS-K5	1141.1496.02
AM/FM Measurement Demodulator	FS-K7	1141.1796.02
Extras		
Headphones	–	0708.9010.00
US Keyboard with trackball	PSP-Z2	1091.4100.02
PS/2 Mouse	FSE-Z2	1084.7043.02
Colour Monitor, 15", 230 V	PMC3	1082.6004.02
IEC/IEEE-Bus Cable, 1 m	PCK	0292.2013.10
IEC/IEEE-Bus Cable, 2 m	PCK	0292.2013.20
19" Rack Adapter	ZZA 478	1096.3248.00
Trolley	ZZK-1	1014.0510.00
Transit bag	ZZT473	1109.5048.00
Matching Pads, 75 Ω		
L Section	RAM	0358.5414.02
Series Resistor, 25 Ω[1]	RAZ	0358.5714.02
SWR Bridge, 5 MHz to 3000 MHz	ZRB2	0373.9017.52
SWR Bridge, 40 kHz to 4 GHz	ZRC	1039.9492.52
High-Power Attenuators, 100 W 3/6/10/20/30 dB	RBU 100 (XX=03/06/10/20/ 30)	1073.8820.XX
High-Power Attenuators, 50 W 3/6/10/20/30 dB	RBU 50 (XX=03/06/10/20/ 30)	1073.8695.XX
For FSP30		
Test port Adapter, 3.5 mm male	–	1021.0529.00
Test port Adapter, N male	–	1021.0541.00

[1] Taken into account in device function RF INPUT 75 Ω