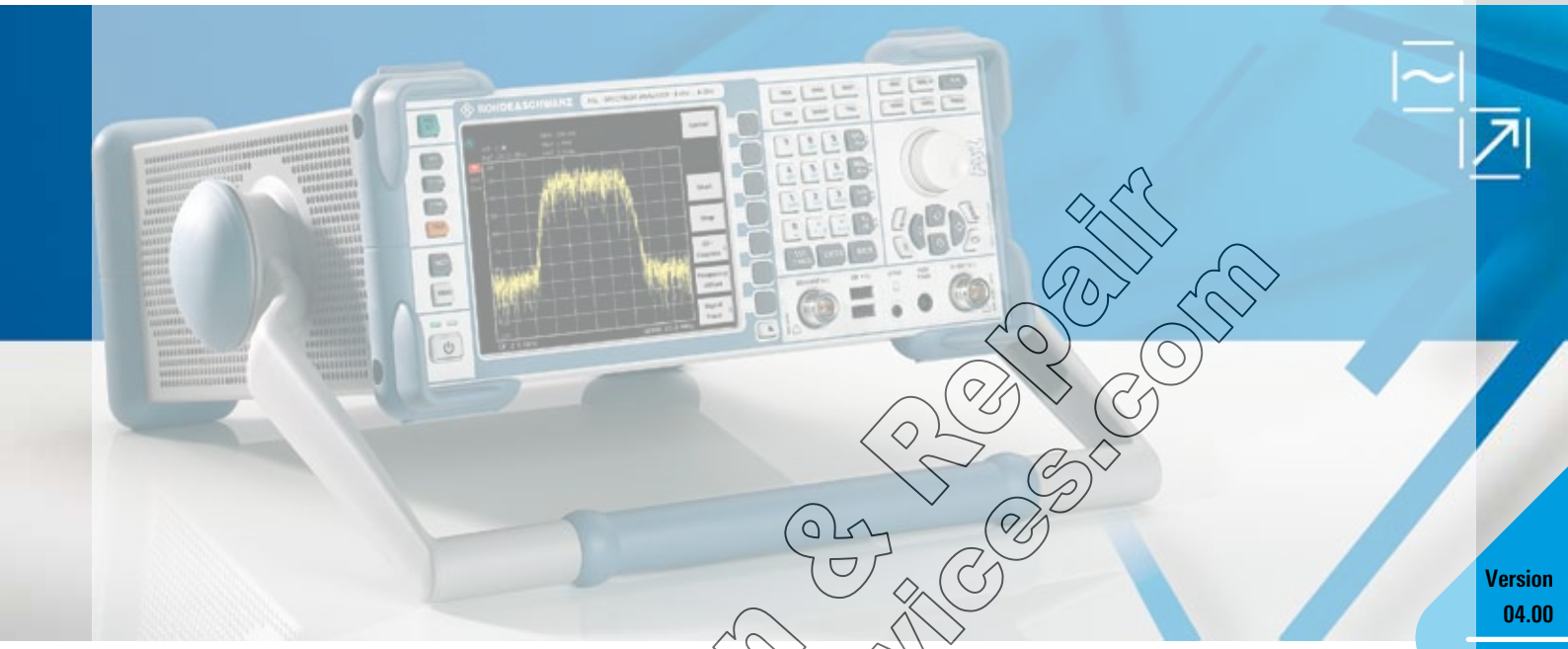
Product brochure



Version 04.00

June 2006

Spectrum Analyzer R&S®FSL

High-end functions in an extremely lightweight, compact package

- Frequency range 9 kHz to 3 GHz/6 GHz, with and without tracking generator
- I/Q demodulation bandwidth 20 MHz
- DANL –152 dBm (1 Hz)
- Total measurement uncertainty <0.5 dB
- Low weight – under 8 kg/18 lbs
- Internal battery option with typ. 1 h operating time
- Extensive measurement routines such as TOI, OBW, time domain power, channel/adjacent channel power

New: Bluetooth® and cable TV measurements

ROHDE&SCHWARZ

You no longer have to make comprises when buying a spectrum analyzer. You can now get high-end features without stretching your budget – the R&S®FSL.

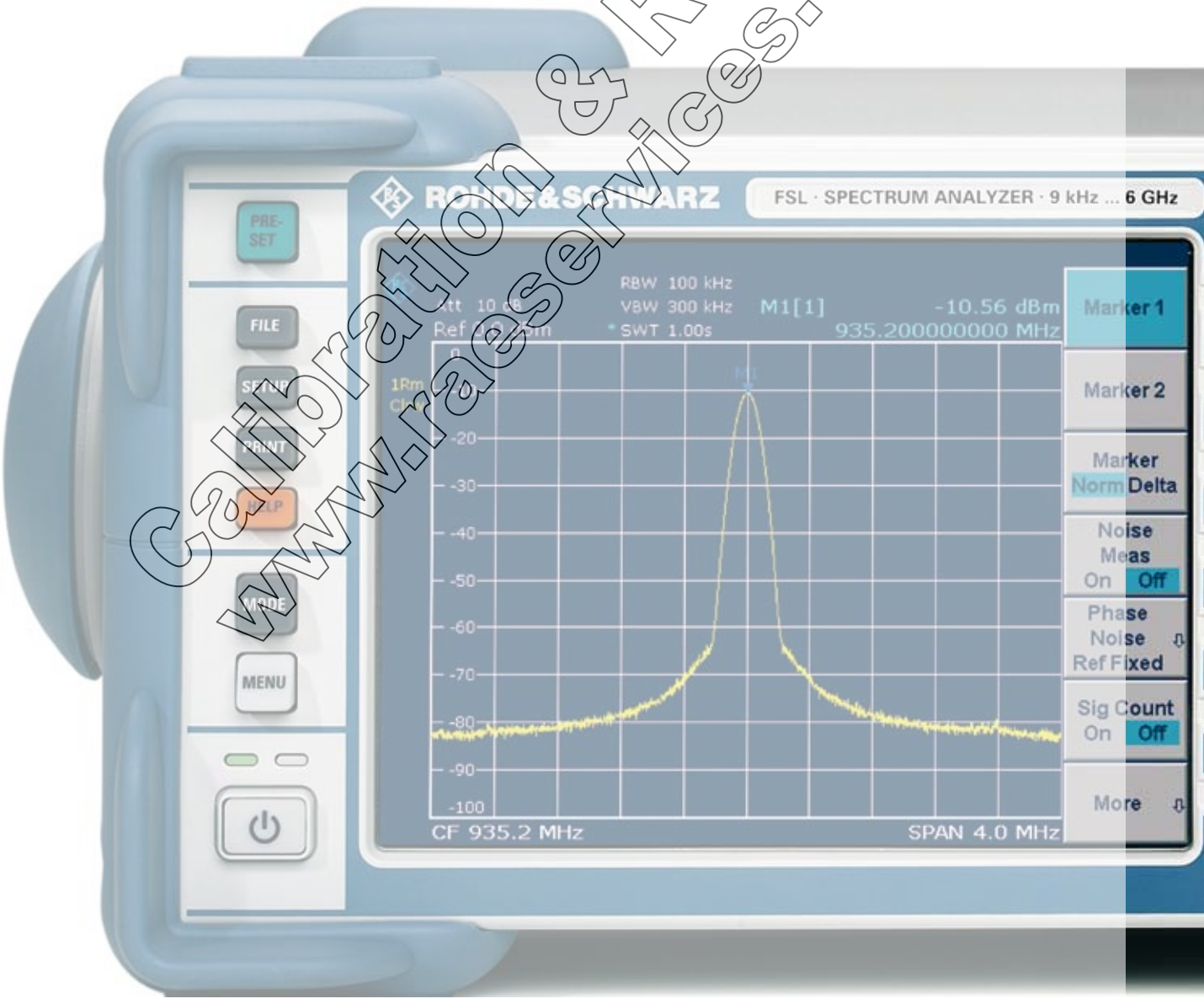
The R&S®FSL is an extremely lightweight and compact spectrum analyzer that is ideal for a large number of applications in development, service and production. Despite its compact size, it offers a wealth of functions more typical of the high-end range, thus ensuring an excellent price/performance ratio. The R&S®FSL is the only instrument in its class that features a tracking generator up to 6 GHz and can I/Q-demodulate signals with a bandwidth of 20 MHz.

Model overview	Frequency range	Tracking generator
R&S®FSL3, model .03	9 kHz to 3 GHz	no
R&S®FSL3, model .13	9 kHz to 3 GHz	1 MHz to 3 GHz
R&S®FSL6, model .06	9 kHz to 6 GHz	no
R&S®FSL6, model .16	9 kHz to 6 GHz	1 MHz to 6 GHz

The high-end approach is also evident in the operating features. As with the R&S®FSP and R&S®FSU, the main functions of the R&S®FSL are directly accessible by fixed-assignment function keys, with additional functions accessed using softkeys and tables. This shortens the learning curve for new users.

Its compact size and low weight, plus its optional battery pack, make the R&S®FSL ideal for mobile use.

The R&S®FSL has unique plug & play upgrade abilities. All options can be added without opening the instrument.



Main characteristics

- Best RF characteristics in its class
- Largest I/Q demodulation bandwidth in its class
- High measurement accuracy
- High resolution filter accuracy owing to all-digital implementation
- Robust and compact
- Carrying handle and low weight (<8 kg/18 lbs) for mobile use
- Optional battery operation
- Wide range of functions, simple operation
- Easy on-site upgradeability

The compact size of the R&S®FSL is illustrated by this nearly-to-scale picture. Yet the R&S®FSL is a full-featured analyzer with the widest range of functions and the best RF characteristics in its class.

Exceptional performance for its class

With phase noise of typ. –103 dBc (1 Hz) at 10 kHz from the carrier, a third order intercept point of typ. +18 dBm, a bandwidth range from 10 Hz to 10 MHz, and a displayed average noise level (DANL) of typ. –162 dBm, the R&S®FSL compares favorably with high-end analyzers. This makes it very useful in production, service, field use and in labs. The RF attenuator, which is adjustable in steps of 5 dB, and the optional preamplifier ensure an optimum usable dynamic range.

Condensed specifications

	R&S®FSL3, model .03	R&S®FSL3, model .13	R&S®FSL6, model .06	R&S®FSL6, model .16
Frequency range	9 kHz to 3 GHz	9 kHz to 3 GHz	9 kHz to 6 GHz	9 kHz to 6 GHz
Frequency accuracy	1×10^{-6}			
With R&S®FSL-B4, OCXO	1×10^{-7}			
Resolution bandwidths				
Standard	100 Hz to 10 MHz in 1/3 sequence, zero span additionally 20 MHz			
With R&S®FSL-B7	10 Hz to 10 MHz in 1/3 sequence, additionally 1 Hz (FFT filter)			
Video bandwidths	10 Hz to 10 MHz			
I/Q demodulation bandwidth	20 MHz			
Phase noise	typ. –103 dBc (1 Hz) at 10 kHz from carrier, 1 GHz			
DANL				
With 300 Hz RBW	typ. –117 dBm			
With 1 Hz FFT RBW and preamplifier (options R&S®FSL-B7, -B22)	500 MHz: typ. –162 dBm 3 GHz: typ. –158 dBm			
TOI	typ. +18 dBm			
Detectors	pos/neg peak/auto peak, RMS, quasi-peak, average, sample			
Level measurement uncertainty	<0.5 dB			
Tracking generator	no	yes	no	yes
Frequency range		1 MHz to 3 GHz		1 MHz to 6 GHz
Output level		–20 dBm to 0 dBm		–20 dBm to 0 dBm

The most extensive set of functions in its class

Channel power measurement (CP)	Highly configurable or standard-compliant predefined functions for precise power measurement of modulated signals
Adjacent channel power and multicarrier adjacent channel power measurement (ACP and MC-ACP)	
Fast ACP	Adjacent channel power measurement in time domain with channel filters, faster than normal ACP measurement
Time domain power measurement	Determines burst power
C/N, C/N_0	Measures carrier-to-noise ratio relative to 1 Hz or the selected channel width
OBW	Measures occupied bandwidth at the press of a button
TOI measurement	Simplifies TOI measurement
Modulation depth measurement (AM%)	Determines modulation depth of AM signals at the press of a button
Complete range of detectors	RMS, quasi-peak, average, auto peak, pos peak, neg peak, sample
Selectable number of trace points	Improves repeatability of channel/adjacent channel power measurement, especially important for spurious measurements over a wide frequency range
Level units	dBm, dBµV, dBmV, dBµA, dBpW, V, W, A
Frequency counter	Fast determination of frequency at the accuracy of the internal or external reference, 1 Hz resolution with 50 ms measurement time
Noise and phase noise markers	dBm (1 Hz) and dBc (1 Hz) including all necessary correction factors
n-dB down marker	Fast filter bandwidth determination
RRC and channel filters	Channel power measurement in time domain and transient adjacent channel power
FFT filters 1 Hz/300 Hz to 30 kHz	Reduce measurement time for values such as spurious or near-carrier
LAN interface	Uses a remote control interface now standard in most PCs, eliminating the need to purchase a separate IEC/IEEE bus card
Limit lines	Simplify the monitoring of limit values with pass/fail evaluation
Transducer factors	For compensating antenna factors or frequency responses of the test setup
20 MHz I/Q demodulation bandwidth	I/Q data of the built-in I/Q demodulator can be transferred blockwise (up to a length of 512 ksample) via the LAN or IEC/IEEE bus interface and processed externally. The bandwidth depends on the selected sampling rate. The maximum bandwidth is 20 MHz, which covers the signal bandwidths of the most common mobile radio standards including WLAN.
USB	Interface for USB memory sticks, e.g. for storing measurement results and plots or for easy firmware updates
Help function	Eliminates the need for manuals
Optional	
Gated sweep	For measuring the modulation spectra of burst signals
Power measurement with R&S®NRP power sensors	Increases level accuracy and eliminates the need for a separate power meter
AM/FM/φM measurement demodulator	Measures analog-modulated signals including total harmonic distortion and displays the spectrum due to modulation
TV trigger	Generates a trigger in response to selectable lines of a TV signal
WLAN modulation and spectrum measurements	Determine the modulation quality (EVM, flatness, constellation diagram), spectrum mask and ACP of WLAN signals
Bluetooth® modulation and spectrum measurements	Measure power, spectrum and modulation quality (DEVM, frequency drift) for Bluetooth® basic rate and enhanced data rate signals in accordance with the Bluetooth® standard
Cable TV measurements	Push-button measurements for analog and digital cable TV networks

Fast and versatile in production

The R&S®FSL is ideal for fast, easy measurements during production. A quick check of the level and frequency is often all that's needed. The R&S®FSL's high speed of >80 sweeps/s in zero span, including remote output of data (or trace data), ensures high production throughput.

Even a simple level calibration can be streamlined and accelerated with the R&S®FSL's integrated complex measurement functions – a special multisummary marker measures different levels in the time domain in a single sweep. This eliminates reset and remote control overhead time. For fast synchronization or triggering, the R&S®FSL-B5 additional interfaces option – which includes a special trigger interface – can be added. The R&S®FSL also features the functionality needed to handle more complex tasks, for example a wide I/Q demodulation bandwidth.

Wireless interfaces such as WLAN are becoming widespread, even in mobile phones. This requires a greater number of modulation measurements on broadband signals during production. With its I/Q demodulation bandwidth of 20 MHz, the R&S®FSL is ready for the challenge.

In addition, the R&S®FSL offers the following functions:

- Fast ACP measurements in the time domain for the major mobile radio standards, with very good repeatability and short measurement times
- List mode: measurements with up to 300 analyzer settings in a single IEC/IEEE bus command
- Fast power measurement in the time domain using channel or RRC filters
- Fast frequency counter with 1 Hz resolution and measurement times <50 ms

Remote control via LAN or IEC/IEEE bus in line with SCPI

The standard remote interface is a 10/100BaseT LAN interface that provides significantly higher speeds than an IEC/IEEE bus for transferring large data volumes. It also offers considerable cost advantages over IEC/IEEE bus wiring. However, IEC/IEEE bus remote control can be added by installing the R&S®FSL-B10 option.

The command set of the R&S®FSL follows SCPI conventions and is thus largely compatible with the R&S®FSP and R&S®FSU analyzers.

The R&S®FSL is immune to reliability problems caused by mechanical switching of the RF attenuator, since its RF attenuator switching mechanism is completely electronic and thus not subject to wear.

Remote control of the R&S®FSL via IEC/IEEE bus in list mode cuts down on measurement time.

Lightweight and compact for on-site installation, maintenance and operation

- Easy portability due to small size and low weight
- Optional internal battery pack for cordless use; operating time can be expanded by simply replacing the battery pack
- Carrying bag with space for extra battery pack and accessories
- Connector for R&S®NRP power sensors; no separate power meter required
- Optional internal tracking generator for directional power measurements
- AM/FM audio demodulator (Mkr Demod) for interference identification
- Extensive functions for power measurements
- Storage of settings and measurement results internally or on USB memory stick

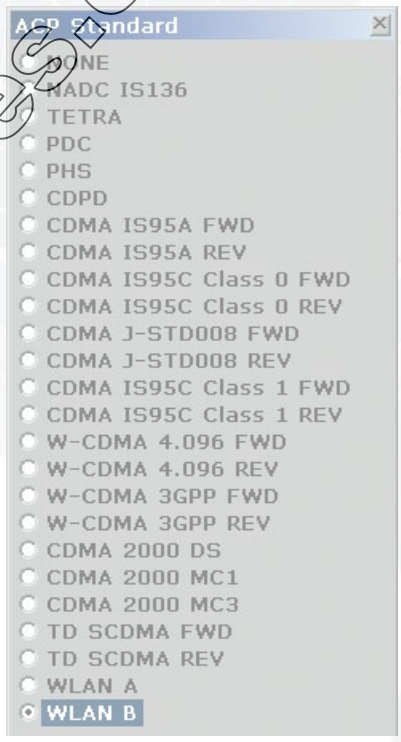
Ideal for service

- Cost-effectiveness
- High measurement accuracy
- Extensive evaluation options
- Wide range of functions
- Built-in frequency counter
- Tracking generator for directional power measurements (for example with the R&S®ZRB 2 or R&S®FSH-Z2 VSWR bridge)
- Easy output of measurement results to USB printer or file

At home in every development lab

The R&S®FSL's excellent price/performance ratio makes it a must for every developer's lab bench, as indispensable as an oscilloscope or multimeter. Its range of functions and operation are largely identical with those of the R&S®FSU class of reference analyzers, simplifying the reproducible verification of measurements.

- Good RF performance at a low price
- Widest I/Q demodulation bandwidth in its class
- Quasi-peak detectors and EMC bandwidths of 200 Hz, 9 kHz and 120 kHz for EMC checks during development and precompliance testing
- Tracking generator for directional power measurements (for example with the R&S®ZRB 2 or R&S®FSH-Z2 VSWR bridge)
- High measurement accuracy
- Easy output of measurement results to USB printer, network printer or file
- Easy remote control via LAN
- Connection to MATLAB®



The R&S®FSL's wide scope of functions also extends to channel/adjacent channel power measurements. To simplify use, many default settings can be selected by pressing a button.

Easy upgrades and a wide range of interfaces

The R&S®FSL has unique plug & play upgrade abilities. All options can be added without opening the instrument. This has several important advantages:

- No extra alignment after installation
- No recalibration
- No need to send in the instrument, thus negligible downtime
- No installation costs
- Easy installation of additional functions

The wide range of additional interfaces provided by the R&S®FSL-B5 option expands the application range of the R&S®FSL:

- IF output/video output for connecting further instruments
- 28 V, switchable for connecting noise sources
- Trigger interface for fast measurement on frequency lists
- Connector for an R&S®NRP power sensor (replaces the USB adapter for the R&S®NRP power sensors)

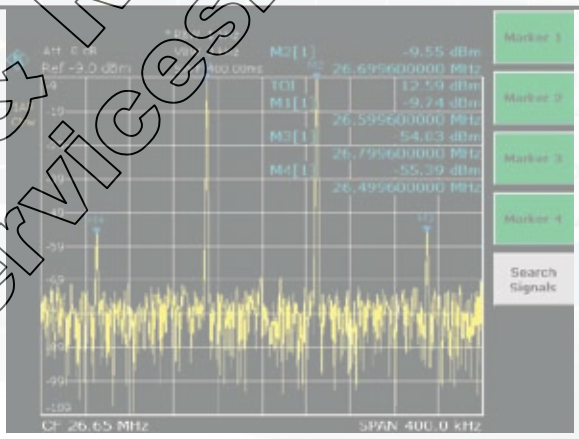
The most extensive set of functions in its class

Scalar network analysis

Models .13 and .16 of the R&S®FSL, which include a tracking generator, can quickly and easily measure frequency response, filters and attenuation. The n-dB down marker determines the 3 dB bandwidth of a bandpass filter at the press of a button, for example. The R&S®FSL measures return loss or matching by using an external VSWR bridge. Precision is enhanced by Through, Short and Open calibration methods.

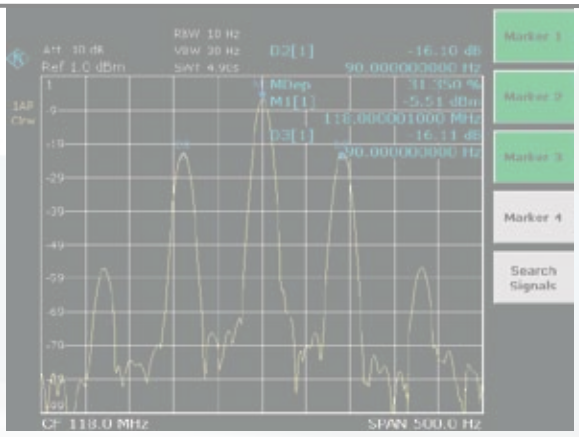
Third order intercept (TOI)

The R&S®FSL can determine the TOI from the spectrum at the press of a button. It automatically detects the useful carriers and thus determines the intermodulation sidebands. The instrument's maximum dynamic range of 95 dB is high for its class. RF attenuation steps of 5 dB further enhance its usefulness.



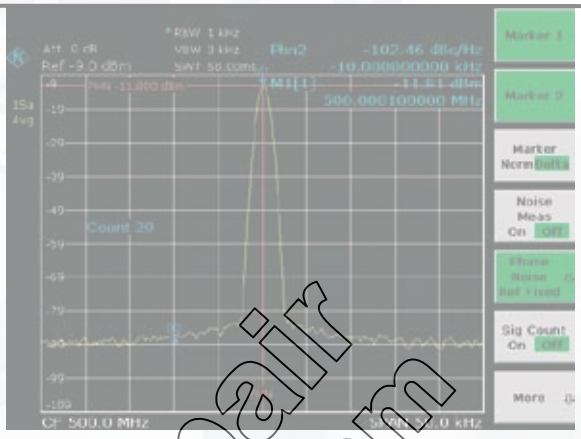
Modulation depth measurement (AM%)

The R&S®FSL measures the modulation depth of an AM signal at the press of a button. The AM% marker function positions three markers – one each on the carrier, the upper sideband, and the lower sideband – and uses the sideband suppression to determine the modulation depth. The modulation depth of a two-tone signal can be determined selectively by predefining the modulation frequency, for example by starting with a 90 Hz sideband and then moving to the 150 Hz sideband of an ILS signal. The high linearity of <0.2 dB ensures a small absolute measurement error.



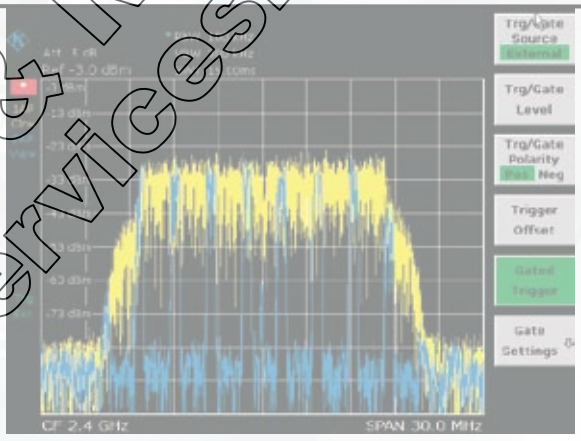
Phase noise measurement with phase noise marker

The phase noise marker provides a quick measurement of the phase noise at a specific carrier offset. The result in dBc (1 Hz) includes all necessary corrections for the noise bandwidth of the filter, the detector used, and averaging. The phase noise of typ. –103 dBc (1 Hz) at 10 kHz from the carrier is sufficient for a number of oscillator measuring tasks.



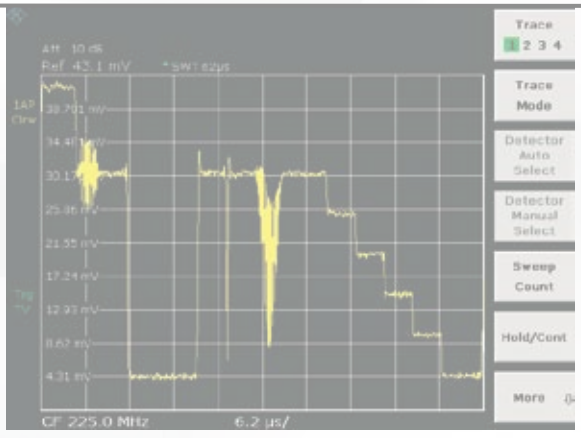
Gated sweep

The R&S®FSL uses the gated sweep function for burst signal measurements. This function can display the modulation spectrum of a GSM signal or a burst WLAN signal (as shown in the example).



TV trigger option

The TV Trigger R&S®FSL-B6 generates a trigger in response to selectable lines and the horizontal or vertical blanking interval. Video formats with 525 or 625 lines with positive or negative modulation are covered.



Channel power measurements

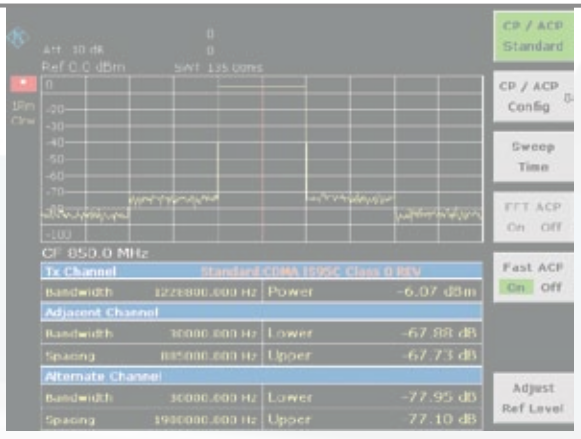
Channel power measurements use integration to determine the power within a defined channel bandwidth. The full-featured RMS detector is used to measure the correct power independent of the signal, which ensures good repeatability and accuracy. The channel width can be defined by the user or selected from an extensive list of transmission standards.

Adjacent channel power (ACP, MC-ACP) measurements, for example cdmaOne

The ACP measurement function determines the adjacent channel power as an absolute value or relative to the useful carrier. The R&S®FSL offers predefined settings for many transmission standards, but parameters can also be user-defined, with channel widths and spacings for up 12 channels and up to 3 adjacent channels.

Fast ACP in time domain with standard-compliant channel filters

The fast ACP function measures the adjacent channel power in the time domain using standard-compliant channel filters. This reduces the measurement time necessary for a specific repeatability by a factor of 10. It also provides an easy way to determine transient, time-dependent adjacent channel power.



Burst power measurement: time domain power

This feature allows the burst power to be measured in the time domain. Display lines delimit the evaluation area, thus making it possible to determine the power during the 147 useful bits of a GSM burst, for example.

Occupied bandwidth (OBW)

OBW is a measure of the bandwidth occupied by the signal. The R&S®FSL determines this value from the total power within the span and the individual external power values, for example 0.5% of the power. The remaining value then corresponds to 99% of the bandwidth. The fully synchronous frequency sweep and the high number of trace points make this measurement very precise.

AM/FM/φM Measurement Demodulator R&S®FSL-K7

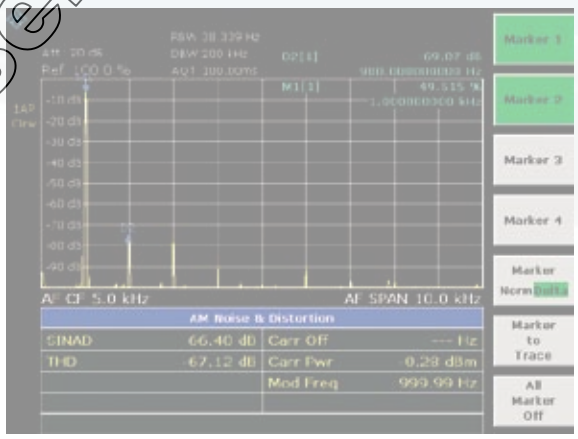
The AM/FM/φM Measurement Demodulator R&S®FSL-K7 converts the R&S®FSL into an analog modulation analyzer for amplitude-, frequency- or phase-modulated signals. It measures not only characteristics of the useful modulation, but also factors such as residual FM or synchronous modulation.

Display and evaluation capabilities:

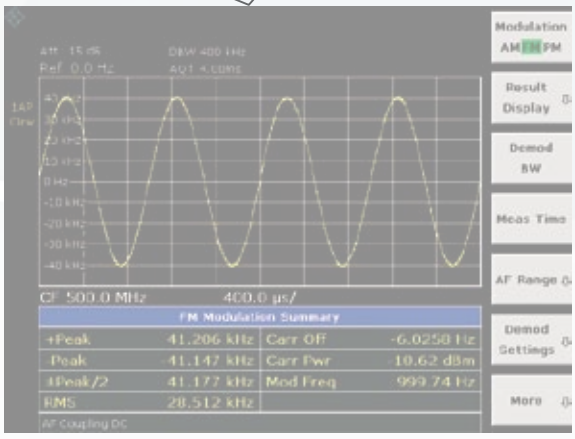
- Modulation signal versus time
- Spectrum of modulation signal (FFT)
- RF signal power versus time
- Spectrum of RF signal (FFT versus max. 18 MHz)
- Table with numeric display of
  - Deviation or modulation depth, +Peak, –Peak, ± Peak/2 and RMS weighted
  - Modulation frequency
  - Carrier frequency offset
  - Carrier power
  - Total harmonic distortion (THD) and SINAD

Condensed data

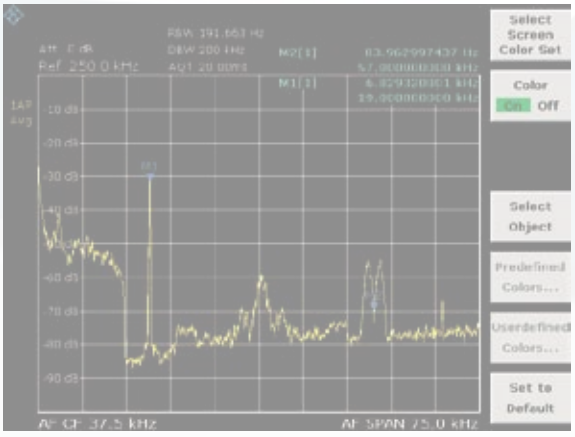
Demodulation bandwidth	100 Hz to 18 MHz
Recording time (depends on demodulation bandwidth)	12.5 ms to 3276 s
AF filters	
Highpass filter	50 Hz, 300 Hz
Lowpass filter	3 kHz, 15 kHz, 150 kHz and 5%, 10% or 25% of demodulation bandwidth
Deemphasis	25/50/75/750 µs
Modulation frequency	≤5 MHz, max. 0.5 × demodulation bandwidth
Measurement uncertainty (deviation or modulation depth)	3%



THD measurement on an amplitude-modulated signal: The first harmonic of the modulation signal is well suppressed by 69 dB. This corresponds to a THD (D2) of less than 0.1 %.



Frequency deviation measurement: Display of modulation signal together with peak and RMS deviation, carrier frequency offset and carrier power.



AF spectrum of an FM stereo signal: The 19 kHz pilot carrier, the stereo signal on the 38 kHz subcarrier and the RDS subcarrier at 57 kHz are clearly distinguishable. The pilot deviation is selected using the marker.

Option R&S®FSL-K8, transmitter measurements for Bluetooth® V2.0 and EDR

Application Firmware R&S®FSL-K8 enhances the range of applications of the Spectrum Analyzer R&S®FSL to include measurements on Bluetooth® transmitters. All measurements are carried out in line with the Bluetooth® RF Test Specification (Bluetooth® SIG) Rev. 2.0+EDR and cover the basic rate as well as EDR.

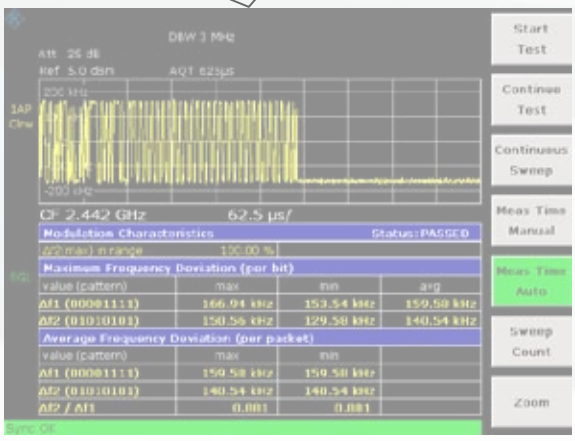
Integrated limit value monitoring is provided for all measurements and allows analysis of the results in the development and production of Bluetooth® modules.

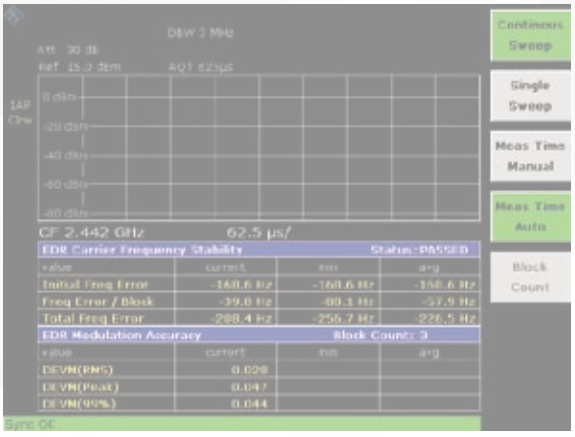
Basic rate measurements
Output power
ACP over up to 79 channels
Modulation characteristics
Initial carrier frequency tolerance
Carrier frequency drift
EDR measurements
Output power and relative transmit power
Inband spurious emissions, gated
Carrier frequency stability and modulation accuracy (DEVM)
Differential phase encoding

Relative transmit power: EDR relative transmit power determines the power of the GFSK-modulated and the DPSK-modulated part and the power difference.

Adjacent channel power (ACP): This measurement determines the power of all adjacent channels. The power of up to 79 channels in total can be measured. For EDR inband spurious the measurement can be gated.

Modulation characteristics: This measurement determines the maximum frequency deviation of all 8-bit test sequences of the payload. In addition, the average value of the maximum frequency deviations per packet is calculated and displayed.





Carrier frequency stability and modulation accuracy: This measurement determines the frequency accuracy within the packet header, the frequency drift within the DPSK part, as well as the DEVM metrics.

Option R&S®FSL-K20, analog and digital cable TV measurements

The R&S®FSL-K20 CATV option provides easy-to-use push-button measurements for analog and digital cable TV networks as well as for analog TV transmitters.

TV standards

Selectable analog TV standards	Selectable digital cable TV standards
B/G, D/K, I, K1, L, M, N	QAM J.83/A (EU), J.83/B (US), J.83/C (Japan)
PAL, NTSC, SECAM	4QAM to 1024QAM
	Symbol rate 0.1 Msymbol/s to 7.45 Msymbol/s

Measurements

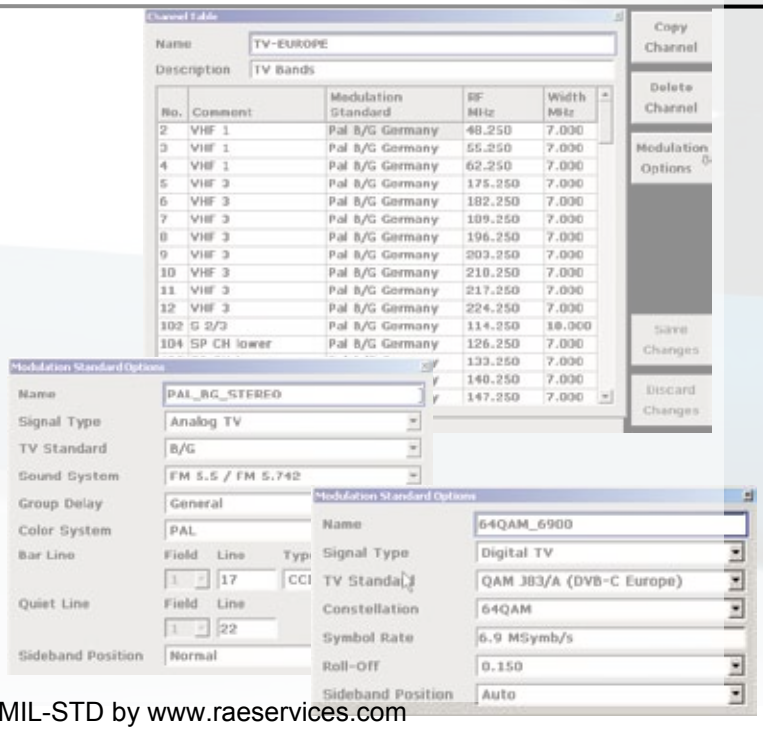
Analog TV	Digital TV
Carrier levels (picture and sound carriers	Channel power
C/N (in-service, off-service, quiet line)	Modulation parameters and errors: carrier frequency offset, symbol frequency offset, MER, EVM, phase jitter, carrier suppression, quadrature offset, imbalance
CTB (composite triple beat) and CSO (composite second order), off-service or during quiet line	Constellation diagram
Vision modulation	Echo pattern
Hum	Signal statistics/CCDF, APD
Video scope function for detailed line analysis	
Tilt: determines the frequency response of the cable TV network by measuring the channel power of every channel	

Channel tables

Channel tables make it possible to preconfigure the R&S®FSL for a specific network:

- Channel numbers can be assigned to frequencies
- The signal type for each channel can be defined (analog TV signal, digital TV signal) as well as even more detailed properties such as the position of test lines

Thus the R&S®FSL is set up correctly just by entering the channel number. Channel tables can be easily copied and multiplied between different instruments.



Video scope function (video line analysis) and vision modulation

A dedicated video line trigger allows selected lines of the video signals to be displayed for detailed analysis. The vision modulation measurement further determines the modulation depth and residual picture carrier level.

Digital TV signals

A table provides a quick overview of the most important modulation quality parameters such as MER, EVM (both peak and RMS), carrier frequency offset and symbol frequency offset.

Typical I/Q modulator impairments such as quadrature offset, gain imbalance can be evaluated from the modulation error table (see picture). A constellation diagram enables further analysis of faults and their cause.

Carrier-to-noise ratio

The ratio of carrier power to noise ratio can be determined in different ways:

- In-service and off-service modes determine the C/N from the spectrum, with the noise measured in a channel that is switched off (off-service) or in between channels (in-service). The reference power can be measured from the signal or be set manually.
- In a third mode, the S/N is determined in the video signal from the quiet line.

An automatic limit check with editable limits allows fast recognition of pass or fail condition. The pass/fail limit check with editable limits is a standard function for all measured parameters.

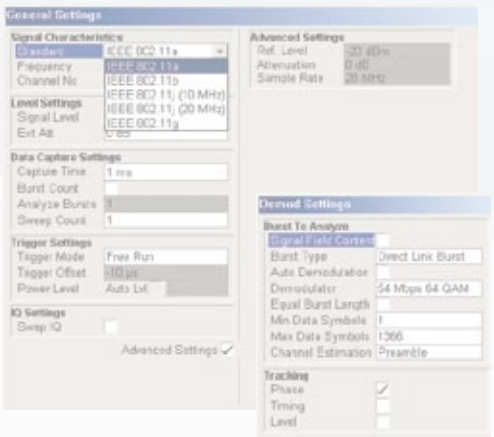
Option R&S®FSL-K91, WLAN transmitter measurements

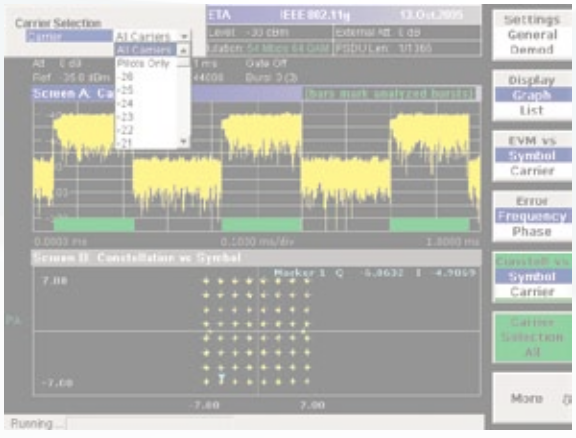
WLAN Application Firmware R&S®FSL-K91 expands the application range of the Spectrum Analyzer R&S®FSL by spectrum and modulation measurements on signals in line with the WLAN standards IEEE 802.11a/b/g/j. The excellent price/performance ratio, the compact size and the capability to be remote-controlled make the R&S®FSL an ideal WLAN tester in manufacturing and production. The R&S®FSL's analysis and evaluation capabilities, which enable measurements beyond the scope of the standard, make it indispensable for applications in development and troubleshooting. Functions, operation and remote control commands are essentially identical to those of the Signal Analyzer R&S®FSQ with the option R&S®FSQ-K91.

Measurement	IEEE 802.11a, IEEE 802.11g (OFDM)	IEEE 802.11b, IEEE 802.11g-CCK/ DSSS, PBCC
Output power	✓, 17.3.9.1	✓, 18.4.7.1
Spectrum mask with limit lines and pass/fail indication	✓, 17.3.9.2	✓, 18.4.7.3
Spectrum flatness with limit lines and pass/fail indication	✓, 17.3.9.6.2	–
Adjacent channel power	✓	✓
Rise and fall times of the burst	✓	✓, 18.4.7.8
EVM	✓, 17.3.9.6.3	✓, 18.4.7.8
EVM display	versus carrier or versus time	versus time
Constellation diagram	✓ (carrierspecific or all carriers)	✓
Constellation overview	✓	–
Selectable tracking: phase, level, timing	✓	✓
RF carrier leakage	✓, 17.3.9.6.1	✓, 18.4.7.7
Carrier frequency and symbol clock error	✓, 17.3.9.4, 17.3.9.5	✓, 18.4.7.4, 18.4.7.5
CCDF and crest factor	✓	✓
Bit stream	✓	✓
Header information	✓	✓
Automatic modulation selection	✓	✓

Result summary provides a quick overview of the most important measurement values.

Setup tables provide a quick overview of the selected settings and quick access to the setting parameters.





OFDM allows you to display the constellation diagram for all or for selected carriers.

Benefit from the advantages of networking

Versatile documentation and networking capabilities

The Windows XP Embedded operating system coupled with a wide variety of interfaces makes it easy to insert measurement results into documentation. Simply save the screen contents as a BMP or WMF file and import the file into your word processing system. To process trace data, save it as an ASCII file (CSV format), together with the main instrument settings.

Make use of the advantages offered by networking

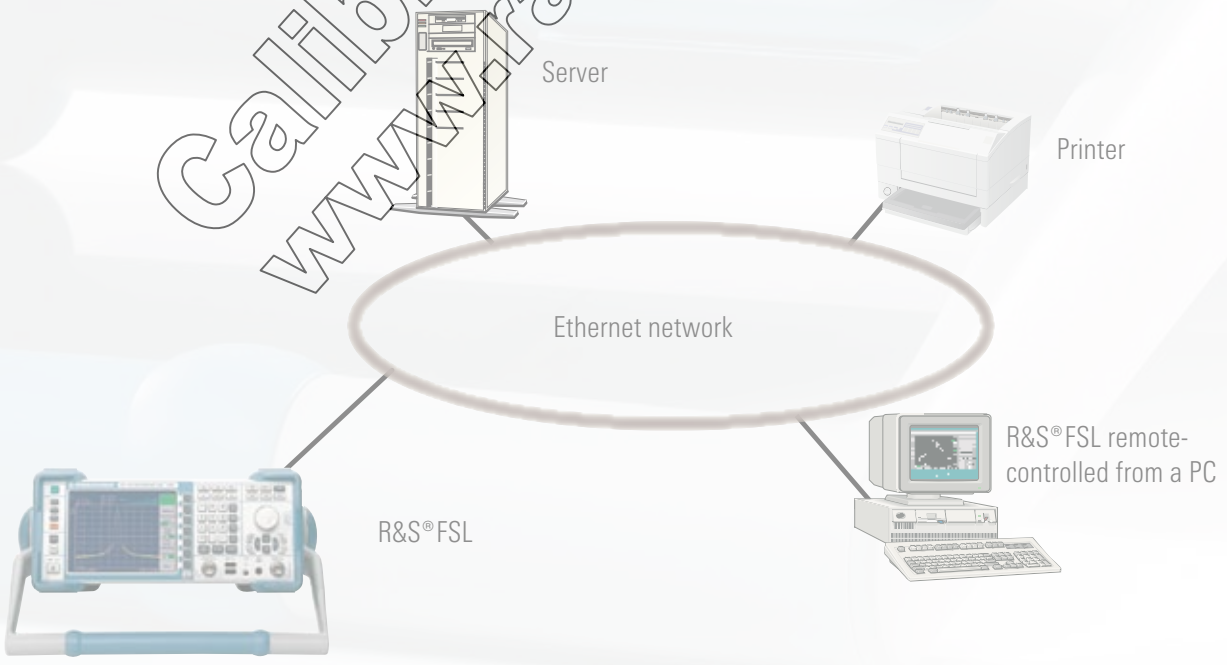
The standard LAN interface opens up versatile networking capabilities:

- Link to standard network (Ethernet 10/100BaseT)
- Running under Windows XP Embedded, the R&S®FSL can be configured for network operation. Applications such as data output to a central network printer or saving results on a central server can easily be implemented. The R&S®FSL can thus be optimally matched to any work environment.
- You can import screen contents directly into MS Word for Windows or, by using an MS Excel macro, into your documentation programs and thus immediately create data sheets for your products or documents for quality assurance

The standard USB host interface allows functions such as the following:

- Quick firmware update from a USB flash memory stick or a USB CD-ROM drive
- Connection of PC peripheral devices (mouse, keyboard)
- Simple file transfer, including large volumes of data via a USB flash memory stick

Remote control by Ethernet is even simpler with the built-in VXI11 compatibility: It links your application to the TCP/IP protocol and acts like an IEC/IEEE bus driver. VXI11 is supported by commercial VISA libraries. The R&S®FSL can be programmed and remote-controlled via this interface just like on the familiar IEC/IEEE bus.



Ordering information

Order designation	Type	Order No.
Spectrum Analyzer, 9 kHz to 3 GHz	R&S®FSL3	1300.2502.03
Spectrum Analyzer, 9 kHz to 3 GHz, with tracking generator	R&S®FSL3	1300.2502.13
Spectrum Analyzer, 9 kHz to 6 GHz	R&S®FSL6	1300.2502.06
Spectrum Analyzer, 9 kHz to 6 GHz, with tracking generator	R&S®FSL6	1300.2502.16

Options

Order designation	Type	Order No.	Comments
OCXO Reference Frequency, aging 1×10^{-7}/year	R&S®FSL-B4	1300.6008.02	
Additional Interfaces	R&S®FSL-B5	1300.6108.02	video out, IF out, noise source control, AUX port, connector for R&S®NRP power sensors
TV Trigger	R&S®FSL-B6	1300.5201.02	
Narrow Resolution Filters	R&S®FSL-B7	1300.5601.02	
Gated Sweep	R&S®FSL-B8	1300.5701.02	
GPIB Interface	R&S®FSL-B10	1300.6208.02	
RF Preamplifier	R&S®FSL-B22	1300.5953.02	
DC Power Supply, 12 V to 28 V	R&S®FSL-B30	1300.6308.02	
NiMH Battery Pack	R&S®FSL-B31	1300.6408.02	requires R&S®FSL-B30
Firmware/options			
AM/FM/φM Measurement Demodulator	R&S®FSL-K7	1300.9246.02	
Transmitter Measurements for Bluetooth® V2.0 and EDR	R&S®FSL-K8	1301.9398.02	
Power Sensor Support	R&S®FSL-K9	1301.9530.02	requires R&S®FSL-B5 or R&S®NRP-Z3/4 and R&S®NRP power sensor
Cable TV Measurements	R&S®FSL-K20	1301.9675.02	
WLAN Transmitter Measurements for IEEE 802.11a, b, g, j	R&S®FSL-K91	1302.0094.02	

Recommended extras

Order designation	Type	Order No.
19'' Rackmount Adapter	R&S®ZZA-S334	1109.4487.00
Soft Carrying Bag	R&S®FSL-Z3	1300.5401.00
Additional Charger Unit	R&S®FSL-Z4	1300.5430.02
Matching Pad 75 Ω, L section	R&S®RAM	0358.5414.02
Matching Pad 75 Ω, series resistor 25 Ω	R&S®RAZ	0358.5714.02
Matching Pad 75 Ω, L section, N to BNC	R&S®FSH-Z38	1300.7740.02
SWR Bridge 5 MHz to 3 GHz	R&S®ZRB2	0373.9017.52
SWR Bridge 40 kHz to 4 GHz	R&S®ZRC	1039.9492.52
SWR Bridge 10 MHz to 3 GHz (incl. Open, Short, Load calibration standards)	R&S®FSH-Z2	1145.5767.02

Power sensors supported by R&S®FSL-K9

Order designation	Type	Order No.
Average Power Sensor 10 MHz to 8 GHz, 200 mW	R&S®NRP-Z11	1138.3004.02
Average Power Sensor 10 MHz to 18 GHz, 200 mW	R&S®NRP-Z21	1137.6000.02
Average Power Sensor 10 MHz to 18 GHz, 2 W	R&S®NRP-Z22	1137.7506.02
Average Power Sensor 10 MHz to 18 GHz, 15 W	R&S®NRP-Z23	1137.8002.02
Average Power Sensor 10 MHz to 18 GHz, 30 W	R&S®NRP-Z24	1137.8502.02
Average Power Sensor 9 kHz to 6 GHz, 200 mW	R&S®NRP-Z91	1168.8004.02
Thermal Power Sensor 0 Hz to 18 GHz, 100 mW	R&S®NRP-Z51	1138.0005.02
Thermal Power Sensor 0 Hz to 40 GHz, 100 mW	R&S®NRP-Z55	1138.2008.02

For specifications, see PD 0758.2790.22
and www.rohde-schwarz.com
(search term: FSL)

ROHDE&SCHWARZ

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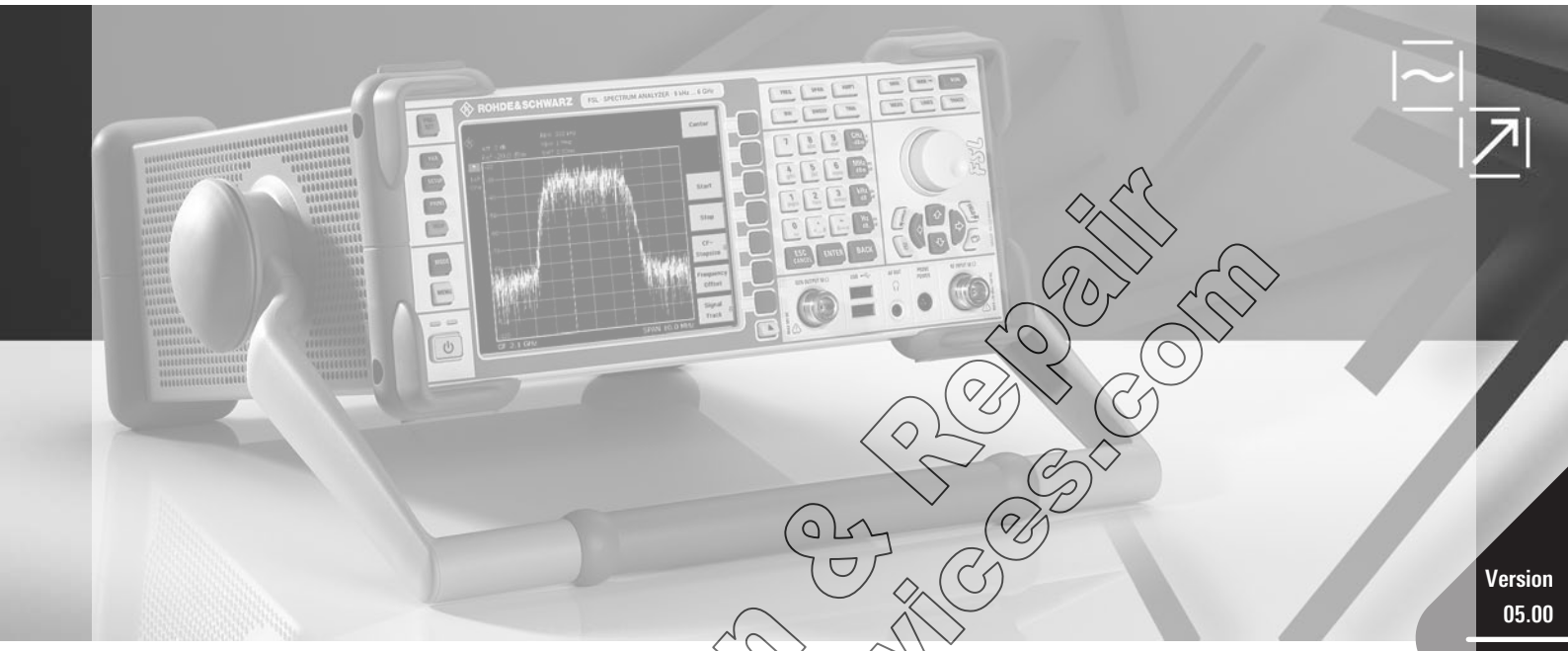

Version 05.00

June 2007

Spectrum Analyzer R&S®FSL

Data Sheet

ROHDE&SCHWARZ

CONTENTS

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

Frequency

Frequency range	R&S®FSL3	9 kHz to 3 GHz
	R&S®FSL6	9 kHz to 6 GHz
Frequency resolution		1 Hz

Reference frequency, internal, nominal		
Aging per year		1×10^{-6}
Temperature drift	0 °C to +50 °C	1×10^{-6}

Reference frequency, internal, nominal	R&S®FSL-B4 OCXO reference frequency option	
Aging per year		1×10^{-7}
Temperature drift	0 °C to +50 °C	1×10^{-7}

Frequency readout		with marker or frequency counter
Marker resolution		span/500
Uncertainty		±(marker frequency × reference uncertainty + 2 % × span +10 % × resolution bandwidth + ½ (last digit))
Frequency counter resolution		1 Hz
Count uncertainty	S/N > 25 dB	±(frequency × reference uncertainty + ½ (last digit))
Frequency span		0 Hz, 10 Hz to 3 GHz/6 GHz
Span uncertainty		3 %

Spectral purity SSB phase noise		f = 500 MHz
Carrier offset	1 kHz	typ. –95 dBc (1 Hz)
	10 kHz	<–98 dBc (1 Hz), typ. –103 dBc (1 Hz)
	100 kHz	<–98 dBc (1 Hz), typ. –105 dBc (1 Hz)
	1 MHz	<–115 dBc (1 Hz), typ. –120 dBc (1 Hz)

Sweep time

Sweep time	span = 0 Hz	1 µs to 5 µs in 125 ns steps 5 µs to 16000 s in 5 % steps
	10 Hz ≤ span ≤ 3.2 kHz	2.5 ms to 5 s/Hz × span
	3.2 kHz < span ≤ 1.5 GHz	2.5 ms to 16000 s
	1.5 GHz < span ≤ 3 GHz	5 ms to 16000 s
	span > 3 GHz	10 ms to 16000 s
Uncertainty	span = 0 Hz	nominal 0.1 %
	span ≥ 10 Hz	nominal 3 %

Resolution bandwidths

Sweep filters		
Resolution bandwidths		300 Hz to 10 MHz (–3 dB) in 1/3 sequence
	R&S®FSL-B7 option	10 Hz to 10 MHz (–3 dB) in 1/3 sequence
	zero span	20 MHz (–3 dB) additionally
Resolution bandwidth uncertainty		nominal <3 %
Resolution filter shape factor 60 dB : 3 dB		nominal <5 (Gaussian type filters)

EMI filters		
6 dB bandwidths		9 kHz, 120 kHz, 1MHz
	R&S®FSL-B7 option	200 Hz, 9 kHz, 120 kHz, 1MHz
Bandwidth uncertainty		nominal <3 %
Shape factor 60 dB : 3 dB		nominal <6

FFT filters	analyzer mode	
3 dB bandwidths		300 Hz to 30 kHz in 1/3 sequence
	R&S®FSL-B7 option	1 Hz to 30 kHz in 1/3 sequence
Bandwidth uncertainty		nominal 5 %
Shape factor 60 dB : 3 dB		nominal 2.5

Channel filters		
Bandwidths	300; 500 Hz; 1; 1.5; 2; 2.4; 2.7; 3; 3.4; 4; 4.5; 5; 6; 8.5; 9 kHz 10; 12.5; 14; 15; 16; 18 (RRC); 20; 21; 24.3 (RRC); 25; 30; 50; 100; 150; 192; 200; 300; 500 kHz 1; 1.228; 1.28 (RRC); 1.5; 2; 3;3.84 (RRC); 4.096 (RRC); 5 MHz (RRC = root raised cosine)	
	R&S®FSL-B7 option	100 Hz, 200 Hz additionally

Video bandwidths	(1-pole lowpass RC filters)	1 Hz to 10 MHz in 1/3 sequence
Demodulation bandwidth		nominal 20 MHz

Level

Display range		displayed noise floor to +20 dBm

Maximum rated input level		
DC voltage		50 V
CW RF power		30 dBm (= 1 W)
Peak RF power		36 dBm (= 4 W) < 3 s
Max. pulse voltage		150 V
Max. pulse energy	10 µs	10 mWs
1 dB compression of input mixer	0 dB RF attenuation, f > 200 MHz	nominal +5 dBm

Intermodulation		
Third-order intermodulation	intermodulation-free dynamic range, level 2 × –20 dBm, reference level –10 dBm	
	f_{in} < 30 MHz	>54 dBc (TOI +7 dBm, typ. +12 dBm)
	f_{in} ≥ 30 MHz	>60 dBc (TOI +10 dBm, typ +18 dBm)
Second harmonic intercept (SHI)	f_{in} = 20 MHz to 3 GHz	nominal 35 dBm

Displayed average noise level		
	0 dB RF attenuation, termination 50 Ω, RBW = 1 kHz, VBW = 1 Hz, sample detector, log scaling, tracking generator OFF, normalized to 1 Hz	
	frequency, preamplifier = OFF	
	9 kHz to 1 MHz	<–100 dBm (1 Hz)
	1 MHz to 10 MHz	<–115 dBm (1 Hz)
	10 MHz to 50 MHz	<–130 dBm (1 Hz)
	50 MHz to 3 GHz	<–140 dBm (1 Hz)
	3 GHz to 5 GHz	<–136 dBm (1 Hz)
	5 GHz to 6 GHz	<–130 dBm (1 Hz)
	frequency, preamplifier = ON	
	9 kHz to 1 MHz	<–115 dBm (1 Hz)
	1 MHz to 10 MHz	<–130 dBm (1 Hz)
	10 MHz to 50 MHz	<–145 dBm (1 Hz)
	50 MHz to 3 GHz	<–152 dBm (1 Hz)
	3 GHz to 5 GHz	<–148 dBm (1 Hz)
	5 GHz to 6 GHz	<–140 dBm (1 Hz)
	frequency, preamplifier = ON, typical values	
	500 MHz	–162 dBm (1 Hz)
	1 GHz	–160 dBm (1 Hz)
	3 GHz	–158 dBm (1 Hz)
	6 GHz	–147 dBm (1 Hz)

Immunity to interference		
Image frequency	f_{in} – 2 × 48.375 MHz	<–60 dBc, typ. –80 dBc
	f_{in} – 2 × 838.375 MHz	<–60 dBc, typ. –80 dBc
	f_{in} – 2 × 7158.375 MHz	typ. –60 dBc
Intermediate frequency	48.375 MHz, 838.375 MHz, 7158.375 MHz	<–60 dBc, typ. –80 dBc
Spurious response, inherent	f > 30 MHz, without input signal, RF attenuation = 0 dB, RBW < 1 MHz	<–90 dBm
Spurious response	referenced to local oscillators	<–60 dBc
Spurious response	referenced to A/D conversion	typ. <–70 dBc
Spurious response	referenced to subharmonic of first LO (spur at 7158.375 MHz – 2 × f_{in})	typ. –60 dBc
Spurious response at mixer level <–10 dBm	referenced to harmonic of first LO (spur at f_{in} – 3579.1875 MHz)	typ. <–60 dBc

Level display		
Logarithmic level axis		10 dB to 100 dB
Linear level axis		0 % to 100 %/10 divisions
Number of traces		4
Trace detectors		max peak, min peak, auto peak, sample, RMS, quasi peak, average
Number of measurement points	default value	501
	range	125 to 32001 in steps of about a factor of 2
Trace functions		clear/write, max hold, average, min hold, view
Setting range of reference level	logarithmic level display	–80 dBm to 20 dBm in steps of 2 dB, 5 dB or 10 dB
	linear level display	–80 dBm to 20 dBm, 0 % to 100 %
Units of level axis	logarithmic level display	dBm, dBmV, dBµV, dBµA, dBpW
	linear level display	µV, mV, V, µA, mA, A, pW, nW, µW, mW, W

Level measurement uncertainty		
	95 % confidence level, +20 °C to +30 °C, S/N > 16 dB, 0 dB to –50 dB from reference level	
	10 MHz < f ≤ 3 GHz	<0.5 dB
	3 GHz < f ≤ 6 GHz	<0.8 dB
Absolute uncertainty at reference frequency		<0.3 dB
Frequency response (+20 °C to +30 °C)	f ≤ 3 GHz	<0.5 dB, typ. 0.3 dB
	3 GHz < f ≤ 6 GHz	<0.8 dB, typ. 0.3 dB
Attenuator uncertainty		<0.3 dB
Uncertainty of reference level setting		<0.1 dB nominal

Display nonlinearity		
Logarithmic level display	S/N > 16 dB 0 dB to –50 dB	<0.2 dB
Bandwidth switching uncertainty	reference: RBW = 10 kHz	<0.1 dB nominal

Trigger functions

Trigger		
Trigger source		free run, video, external, IF power
External trigger level		TTL level

I/Q data

Interface		LAN
	R&S®FSL-B10	LAN or GPIB
Memory length		max. 512 ksample I and Q
Sample rate		10 kHz to 65.8 MHz
Signal bandwidth	sample rate 65.8 MHz	20 MHz

Inputs and outputs

RF input		
Impedance		50 Ω
Connector		N female
VSWR	RF attenuation ≥ 10 dB	
	10 MHz ≤ f ≤ 1 GHz	nominal 1.2
	1 GHz < f ≤ 6 GHz	nominal 1.5
Input attenuator		0 dB to 30 dB in 5 dB steps

AF output		
Connector		3.5 mm mini jack
Output impedance		<100 Ω
Open-circuit voltage		up to 1.5 V, adjustable

Tracking generator		
Tracking generator	models .13 and .16 only	N female, 50 Ω
Output level		–20 dBm to 0 dBm in 1 dB steps
Frequency range		1 MHz to 3 GHz/6 GHz
Dynamic range	RF attenuation = 0 dB, source power 0 dBm	
	10 MHz to 2 GHz	nominal 80 dB
	2 GHz to f_{max}	nominal 60 dB
Reverse power		
DC voltage		50 V
CW RF power		30 dBm (= 1 W)
Max. pulse voltage		150 V
Max. pulse energy (10 µs)		10 mWs

External reference		
Connector		BNC female, 50 Ω
Input level		0 dBm to +10 dBm
Output level	with R&S®FSL-B4	typ. 0 dBm
Frequency		10 MHz ±5 ppm

External trigger/gate input		
Connector		BNC female, 50 Ω
Input level		TTL compatible

Probe power		
		+15 V DC, –12.6 V DC and ground, max. 150 mA nominal

General specifications

Remote control		
LAN interface		10/100BaseT, RJ-45
IEC/IEEE bus (GPIB)	R&S®FSL-B10	SCPI 1997.0

Display		
Resolution		640 × 480 pixels
Pixel failure rate		$<2 \times 10^{-5}$

Mass memory		
Mass memory		flash disk (internal), USB memory stick (not supplied)
Data storage		>500 instrument settings and traces

Temperature		
Operating temperature range		+0 °C to +50 °C
Permissible temperature range		+0 °C to +55 °C
Storage temperature range		-40 °C to +70 °C
Climatic loading		+25 °C/+40 °C at 95 % relative humidity (IEC 60068-2-30)

Mechanical resistance		
Vibration	sinusoidal	IEC 60068-2-6
	random	IEC 60068-2-64
Shock		40 g shock spectrum, in line with MIL-STD-810E, method 516.4 procedure 1, IEC 60068-2-27

Power supply		
Input voltage range, AC, nominal		100 V to 240 V
AC supply frequency		50 Hz to 400 Hz
Input current, AC		0.9 A to 0.3 A
Input voltage range, DC, nominal	R&S®FSL-B30	10 V to 28 V
Input current, DC	R&S®FSL-B30	8.0 A to 2.2 A
Power consumption		typ. 45 W, max. 65 W with all options
Safety		IEC 61010-1, EN 61010-1, UL 61010B-1, CSA C22.2 No. 1010-1
Test mark		VDE, GS, CSA, CSA-NRTL
EMC		in line with European EMC Directive 89/336/EEC and the new EMC Directive 2004/108/EC including: - IEC/EN 61326 class B (emission) - CISPR 11/EN 55011/group 1 Class B (emission) - IEC/EN 61326 Table A.1 (immunity, industrial)
Dimensions (W × H × D)	with handle	408.8 mm × 158.1 mm × 465.3 mm (16.09 in × 6.22 in × 18.32 in)
	without handle	342.3 mm × 158.1 mm × 367.0 mm (13.48 in × 6.22 in × 14.45 in)
Weight	without options	<7 kg (<15.43 lb)
	with battery pack	<8 kg (<17.64 lb)

Recommended calibration interval		1 year
	operation with external reference	2 years

R&S®FSL-B5 additional interfaces

User port		
Connector		9-pin D-Sub male
Output		TTL compatible, 0 V/5 V max. 15 mA
Input		TTL compatible, max. 5 V

Noise source control		
Connector		BNC female
Output		0 V/28 V, max. 100 mA, switchable, supply for noise source

IF/video out		
Connector		BNC female, 50 Ω
Bandwidth	IF and video out	typ. 20 MHz
Output level	video out	typ. 1 V full scale (open circuit), linear scaling
IF frequency	IF out	typ. 10 MHz
Power sensor		
Connector		6-pin LEMOSA female for supported R&S®NRP-Zxx power sensors

IF/video out		
Connector		BNC female, 50 Ω
IF out		
Bandwidth		approx. 10 MHz (3 dB) approx. 20 MHz (10 dB)
IF frequency	RBW 20 MHz, center frequency >20 MHz, span 0 Hz	17.45833 MHz (nominal) ±2 MHz, dependent on center frequency
Output level (gain versus RF input)	RF attenuation 0 dB, RF preamplifier = OFF, span 0 Hz, RBW 20 MHz	
	center frequency	
	100 MHz	approx. +3 dB
	3 GHz	approx. –1 dB
	6 GHz	approx. –7 dB
Video out		
Bandwidth		equal to VBW setting, max RBW/2
Firmware version ≥1.50		
Output scaling		log scaling with display scale set to log, lin scaling with display scale set to lin
Output level	center frequency >10 MHz, span 0 Hz, signal at reference level and center frequency	
	video 1 V	1 V ±10 % (open circuit) (nominal)
	video 200 mV	200 mV ±10 % (open circuit) (nominal)
Firmware version <1.50		
Output scaling		linear
Output level	center frequency 65.8333 MHz, span 0 Hz, resolution bandwidth 300 kHz, reference level –10 dBm, RF attenuation 0 dB, RF preamplifier = OFF	approx. 170 mV (open circuit),
Power sensor		
Connector		6-pin LEMOSA female for supported R&S®NRP-Zxx power sensors

R&S®FSL-K7 AM/FM/φM measurement demodulator

Measurement of analog modulation signals		
Demodulation bandwidth		100 Hz to 6.4 kHz, binary steps 12.5 kHz to 1.6 MHz, binary steps 3 MHz, 5 MHz, 8 MHz, 10 MHz, 18 MHz
Recording length	maximum	512 ksample
Recording time	demodulation bandwidth	
	100 Hz	3276.8 s
	6.4 kHz	51.2 s
	12.5 kHz	26.6 s
	1.6 MHz	200 ms
	3 MHz	100 ms
	5 MHz	50 ms
	8 MHz	25 ms
	10 MHz	12.5 ms
	18 MHz	12.5 ms
Display	frequency versus time (FM), amplitude versus time (AM), phase versus time (φM), RF power versus time, RF spectrum (FFT), AF spectrum (FFT), table with numeric values for: modulation deviation (peak, RMS), modulation frequency, carrier offset, carrier power (power of unmodulated carrier), THD, SINAD	

AF (modulation frequency)		
Range		≤9 MHz max. 0.5 × demodulation bandwidth
Resolution		5 digits
Measurement uncertainty		0.1 %
AF filters		
Lowpass		3 kHz, 15 kHz, 150 kHz, 5 %, 10 %, 25 % of demodulation bandwidth
Highpass		50 Hz, 300 Hz
Deemphasis		25 µs, 50 µs, 75 µs, 750 µs

AM demodulation		
Measurement range	modulation depth	0 % to 100 %
Modulation depth uncertainty	AF ≤ 1 MHz	<3 % of reading + residual AM
Residual AM	demodulation bandwidth ≤ 200 kHz, RMS, RF ≤ 3 GHz, RF input level ≥ (RF attenuation/dB – 30) dBm	0.2 %
Distortion	10 Hz ≤ AF ≤ 100 kHz	0.3 %
FM rejection	AF ≤ 1 MHz and AF + deviation ≤ 0.5 × demodulation bandwidth	typ. 1 % + residual AM

FM demodulation		
Measurement range	frequency deviation	≤9 MHz
Deviation uncertainty	AF ≤ 1 MHz and AF + deviation ≤ 0.5 × demodulation bandwidth	<3 % of reading + residual FM
Residual FM	demodulation bandwidth ≤ 100 kHz, RMS, RF input level ≥ (RF attenuation/dB –30) dBm	
	RF ≤ 1 GHz	150 Hz
	RF = 3 GHz	200 Hz
Distortion	10 Hz ≤ AF ≤ 100 kHz, deviation < 400 kHz	0.3 %
AM rejection	100 Hz ≤ AF ≤ 1 kHz, modulation depth 50 %	30 Hz

φM demodulation		
AF		≤5 MHz, max. 0.5 × demodulation bandwidth
Measurement range	phase deviation	<1000 rad
Residual φM	demodulation bandwidth ≤ 100 kHz, RMS, RF = 1 GHz, highpass 300 Hz, RF input level ≥ (RF attenuation/dB – 30 dBm)	5 mrad

Carrier power versus time		
Display range		noise floor to +20 dBm
Measurement uncertainty	unmodulated carrier, S/N > 16 dB, RF: 50 kHz to 3 GHz	typ. 1 dB
Maximum dynamic range	demodulation bandwidth 200 kHz	typ. 75 dB
Display linearity	S/N > 16 dB	typ. 0.2 dB

AF spectrum		
Span		≤9 MHz
Resolution bandwidth		1 Hz to 10 MHz

RF spectrum		
Span		≤18 MHz
Resolution bandwidth		1 Hz to 10 MHz
Shape factor	60 dB/3 dB	2.5, nominal

Modulation distortion		
Measurement functions		THD, SINAD
Measurement range		–100 dB to 0 dB
Resolution		0.01 dB
Measurement uncertainty		typ. 0.5 dB
AF frequency range		10 Hz to 5 MHz

Trigger		
Trigger functions		RF level, AM, FM, φM demodulation

R&S®FSL-K8 Bluetooth® TX measurements

The specifications below are based on the data sheet specifications of the R&S®FSL spectrum analyzer and have not been checked separately. Specifications apply under the following conditions: Unless otherwise stated, these specifications are with RF input level +20 dBm to –40 dBm within the Bluetooth® band (ISM) 2400 MHz to 2483.5 MHz and default settings.

Output power		
Measurements		average and peak power in line with Bluetooth® RF test specification 2.0.E.3, 5.1.3
Level range		–40 dBm to + 20 dBm
Level uncertainty		<0.7 dB
Packet type		longest supported (DH1, DH3, DH5)
Payload		PRBS9
Synchronization		RF burst, access code
Trigger		IF power, external, free run

Modulation characteristics		
Measurements		FM deviation in line with Bluetooth® RF test specification 2.0.E.3, 5.1.9 Δf_{1max}, Δf_{2max}, Δf_{1avg}, Δf_{2avg} and $\Delta f_{2avg}/\Delta f_{1avg}$
Deviation range		±250 kHz
Deviation uncertainty	signal level >–25 dBm, 10 averages	<6 kHz
Packet type		all supported (DH1, DH3, DH5)
Payload		10101010 and 11110000, auto detect
Synchronization		access code
Trigger		IF power, external, free run

Initial carrier frequency tolerance (ICFT)		
Measurements		ICFT in line with Bluetooth® RF test specification 2.0.E.3, 5.1.10
Measurement range		±250 kHz
Measurement uncertainty	signal level >–30 dBm	<3 kHz + carrier frequency × reference error
Packet type		DH1 and all supported (DH1, DH3, DH5)
Payload		PRBS9
Synchronization		access code
Trigger		IF power, external, free run

Carrier frequency drift		
Measurements		carrier frequency drift in line with Bluetooth® RF test specification 2.0.E.3, 5.1.11 drift/packet and drift/50 µs
Measurement range		±250 kHz
Uncertainty	signal level >–30 dBm	<5 kHz
Packet type		all supported (DH1, DH3, DH5)
Payload		10101010
Synchronization		access code
Trigger		IF power, external, free run

Adjacent channel power (ACP)		
Measurements		adjacent channel power in line with Bluetooth® RF test specification 2.0.E.3, 5.1.8
Level range		max. +20 dBm
Packet type		DH1
Payload		PRBS9
Synchronization		none
Trigger		external, free run

EDR relative TX power		
Measurements		GFSK and DPSK power in line with Bluetooth® RF test specification 2.0.E.3, 5.1.12
Measurement range		–40 dBm to +20 dBm
Level uncertainty		<0.7 dB
Packet type		2-DHx, 3-DHx, 2-EVx, 3-EVx
Payload		PRBS9
Synchronization		GFSK access code and DPSK synchronization sequence
Trigger		IF power, external, free run

EDR frequency stability		
Measurements		frequency error initial (ω_i), per block (ω_0) and total ($\omega_i + \omega_0$) in line with Bluetooth® RF test specification 2.0.E.3, 5.1.13
Measurement range		±250 kHz
Uncertainty	frequency error initial, signal level > –25 dBm	<1 kHz + carrier frequency × reference error
	frequency error per block, signal level > –25 dBm	<1 kHz
Packet type		2-DHx, 3-DHx, 2-EVx, 3-EVx
Payload		PRBS9
Synchronization		
Trigger		IF power, external, free run

EDR modulation accuracy		
Measurements		RMS, peak and 99% DEVM in line with Bluetooth® RF test specification 2.0.E.3, 5.1.13
Uncertainty	RMS, signal level > –25 dBm	<3 %
	peak, signal level > –25 dBm	<8 %
Packet type		2-DHx, 3-DHx, 2-EVx, 3-EVx
Payload		PRBS9
Synchronization		GFSK access code and DPSK synchronization sequence
Trigger		IF power, external, free run

EDR differential phase encoding		
Measurements		bit error detection in line with Bluetooth® RF test specification 2.0.E.3, 5.1.14
Packet type		2-DHx, 3-DHx, 2-EVx, 3-EVx
Payload		PRBS9
Synchronization		GFSK access code and DPSK synchronization sequence
Trigger		IF power, external, free run

EDR in-band spurious emissions		
Measurements		adjacent channel power and power between 1 MHz and 1.5 MHz from carrier in line with Bluetooth® RF test specification 2.0.E.3, 5.1.15
Level range		max. +10 dBm
Packet type		2-DHx, 3-DHx, 2-EVx, 3-EVx
Payload		PRBS9
Synchronization		gated measurement
Trigger		IF power, external,

R&S®FSL-K20 cable TV measurements

The R&S®FSL-K20 option for the R&S®FSL spectrum analyzer makes it possible to perform measurements on analog and digital modulated TV signals in cable networks and also simplifies such measurements.

The option includes a software demodulator for analyzing digital TV signals and an internal TV trigger for analyzing analog TV signals.

General

Frequency		
Range	vision carrier frequency with analog modulation or carrier frequency with digital modulation	5 MHz to 1.5 GHz
Selection of measurement frequency	a channel table is used	selection of a channel and/or direct input of frequency
	no channel table is used	direct input of frequency
Channel tables		
Characteristics	The number of channel tables that can be saved is limited only by the memory capacity of the instrument. Max. 400 channels in each channel table. Channel bandwidths from 0.1 MHz to 10 MHz. Max. 50 modulation standards, i.e. signal characteristic sets, can be present in each channel table. The modulation standard assigned to the active channel automatically configures each measurement. Channel tables can be generated and edited on the instrument at any time. The most important standard channel tables and modulation standards are included.	
Manual measurements	Operation is also possible without channel tables, in which case the user must select the measurement parameters.	

Analog TV

TV standards	B/G, D/K, I, K1, L, M, N	
Color system	PAL / SECAM / NTSC	
Sound systems	B/G	FM 5.5 MONO FM 5.5 / FM 5.742 FM 5.5 / NICAM 5.85
	D/K/K1	FM 6.5 MONO FM 6.5 / FM 6.742 FM 6.5 / FM 6.258 FM 6.5 / NICAM 5.85
	I	FM 6.0 MONO FM 6.0 / NICAM 6.552
	L	AM 6.5 MONO AM 6.5 / NICAM 5.85
	M, N	FM 4.5 MONO FM 4.5 / FM 4.724 FM 4.5 BTSC FM 4.5 EIA-J

Measurements		
Spectrum	active channel/signal spectrum	
Carriers	vision carrier	frequency and level absolute; display of deviation from nominal values
	one or two sound carriers	frequency and level relative to vision carrier; display of deviation from nominal values
C/N	carrier to noise; peak level of vision carrier relative to noise in selectable bandwidth; noise floor correction can be activated	
	channel switched ON	in-service mode, measurement next to signal
	channel switched OFF	off-service mode
	channel switched ON, no scrambling	quiet-line mode, measurement during unmodulated line
CSO	composite second order (beat); peak level of vision carrier relative to second-order intermodulation product; noise floor correction can be activated	
	channel switched OFF	off-service mode
	channel switched ON, no scrambling, unmodulated video line present	quiet-line mode, measurement during unmodulated line
CTB	composite triple beat; channel switched OFF; peak level of vision carrier relative to third-order intermodulation product; noise floor correction can be activated	
Video scope	no scrambling, SWT = 25 µs to 100 µs, offset = –50 µs to +50 µs	luminance signal of a selectable video line versus time
Vision modulation	white-reference test line, no scrambling	modulation depth and residual carrier of vision carrier
Hum	no scrambling	modulation depth of unwanted AM, modulation frequency <1 kHz

Analog TV measurement ranges and measurement uncertainty

Standards	All specified tolerances refer to a modulated TV signal in line with the PAL B/G standard. FM carriers are at 5.5 MHz and 5.742 MHz relative to the vision carrier, each modulated with 3 kHz. Vision carrier frequency range: 10 MHz < f ≤ 1.5 GHz.	
Measurements		
Carriers		
Vision carrier power, absolute	S/N (vision carrier) > 16 dB	typ. <0.5 dB
Vision carrier frequency offset	|frequency offset| < 10 kHz	±(vision carrier frequency × reference uncertainty + 0.5 Hz)
Sound carrier 1 power, relative	S/N (sound carrier 1) > 16 dB	typ. <0.7 dB
Intercarrier 1 frequency offset	|intercarrier 1 frequency offset| < 100 Hz S/N (sound carrier 1) > 25 dB	±(intercarrier 1 frequency offset × reference uncertainty + 0.5 Hz)
Sound carrier 2 power, relative	S/N (sound carrier 2) > 16 dB	typ. <0.7 dB
Intercarrier 2 frequency offset	|intercarrier 2 frequency offset| < 100 Hz S/N (sound carrier 2) > 25 dB	±(intercarrier 2 frequency offset × reference uncertainty + 0.5 Hz)
C/N	channel with vision carrier peak power –2 dBm; noise-reference bandwidth = 4 MHz; carrier and noise with 0 dB attenuation	
C/N (off-service)	preamp = OFF	C/N < 54 dB, typ. <1 dB
		C/N < 59 dB, typ. <3 dB
	preamp = ON for noise measurement	C/N < 69 dB, typ. <1 dB
		C/N < 74 dB, typ. <3 dB

Digital TV

QAM demodulator	user-configurable, block-based, open-loop software demodulator	
Standards	J.83/A (DVB-C Europe)	
	J.83/B (US cable)	
	J.83/C (Japanese cable)	
Measurements		
Spectrum	active channel/signal spectrum	
Overview	result table, zoom of individual parameters possible	
	modulation error rate (peak and RMS value)	
	error vector magnitude (peak and RMS value)	
	frequency offset	
	symbol rate offset	
Constellation	color constellation diagram with zoom capability	
Modulation errors	result table, zoom of individual parameters possible	
	amplitude imbalance	
	quadrature error	
	carrier suppression	
	phase jitter	
	modulation error rate (peak and RMS value)	
	error vector magnitude (peak and RMS value)	
Channel analysis	–20 × symbol duration to +100 × symbol duration	magnitude of channel impulse response, zoom
Channel power	measurement of channel power	
APD	amplitude probability distribution, special channel filters (5 MHz, 6 MHz, 7 MHz, 8 MHz, 10 MHz)	
CCDF	complementary cumulative distribution function, special channel filters (5 MHz, 6 MHz, 7 MHz, 8 MHz, 10 MHz)	

Digital TV measurement ranges and measurement uncertainty

Demodulator		
Adjustable symbol rate	0.1 Hz steps	0.1 MHz to 7.15 MHz
Permissible symbol rate error	referenced to symbol rate	typ. ±0.1 %
Permissible frequency error		typ. ±30 kHz
Modulation formats	QAM	4/16/32/64/128/256/512/1024
Equalizer	ON/OFF/freeze/reset; fractionally spaced; taps from –5 symbols to +25 symbols	
Receive filter	root raised cosine	roll-off factor = 0.12/0.13/0.15/0.18
Measurements		
Overview		
MER	64QAM, roll-off factor = 0.15, symbol rate = 6.9 MHz, equalizer OFF, R&S®FSL-B4 OCXO option	typ. residual MER rms greater (95 %) than
	at 200 MHz, 400 MHz, 600 MHz, 800 MHz	42.0 dB, 39.2 dB, 38.6 dB, 41.6 dB
	256QAM, roll-off factor = 0.12, symbol rate = 5.3605369 MHz, equalizer OFF, R&S®FSL-B4 OCXO option	typ. residual MER rms greater (95 %) than
	at 200 MHz, 400 MHz, 600 MHz, 800 MHz	42.3 dB, 40.8 dB, 39.3 dB, 41.9 dB

TV analyzer

Standards	see “Analog TV” and “Digital TV”
Measurements	
Tilt	Display of the power of many channels versus frequency allows level differences/tilt to be detected. Channels are selected by specifying the frequency range and/or modulation characteristics.

R&S®FSL-K30 application firmware for noise figure and gain measurements

Frequency

Frequency range	R&S®FSL3	100 kHz to 3 GHz
	R&S®FSL6	100 kHz to 6 GHz

Measurement bandwidth	R&S®FSL3/6	300 Hz to 10 MHz (–3 dB) in 1/3 sequence
	R&S®FSL3/6 with R&S®FSL-B7 option	10 Hz to 10 MHz (–3 dB) in 1/3 sequence

Noise figure and gain measurement

Noise figure		
Measurement range		0 dB to 35 dB
Resolution		0.01 dB
Accuracy	instrument uncertainty (95 % confidence level)	0.05 dB
	frequency range 100 kHz to 10 MHz	
	measurement with external preamplifier (gain 50 dB, noise figure <5 dB), RBW <10 kHz, DUT noise figure 1 dB to 10 dB and gain >10 dB	0.3 dB
	frequency range 10 MHz to 6 GHz	
	measurement with external preamplifier (gain 30 dB, noise figure <5 dB), RBW 1 MHz, DUT noise figure 1 dB to 10 dB and gain >10 dB	0.3 dB
	R&S®FSL-B22 (internal preamplifier) active, measurement with external preamplifier (gain 20 dB, noise figure <5 dB), RBW 1 MHz, DUT noise figure 1 dB to 10 dB and gain >10 dB	0.3 dB

Gain		
Measurement range		0 dB to 60 dB
Resolution		0.01 dB
Accuracy	frequency range 100 kHz to 10 MHz	
	measurement with preamplifier (gain 50 dB, noise figure <5 dB), RBW <10 kHz	0.2 dB
	frequency range 10 MHz to 6 GHz	
	measurement with preamplifier (gain 30 dB, noise figure <5 dB), RBW 1 MHz	0.2 dB

Required hardware

Spectrum analyzer		
Noise source supply	via 28 V connector on rear panel of R&S®FSL	R&S®FSL-B5
Noise source	recommendation	noisecom NC346
Preamplifier , external	frequency range 100 kHz to 3/6 GHz	gain approx. 30 dB, noise figure max. 5 dB

R&S®FSL-K91 WLAN 802.11a/b/g/j OFDM analysis (IEEE 802.11a, IEEE 802.11g OFDM, IEEE 802.11j)

Frequency

Frequency range		
RF input	R&S®FSL3	10 MHz to 3 GHz
	R&S®FSL6	10 MHz to 6 GHz
Frequency setting		frequency channel number

Level

Level range	RF input	–60 dBm to +30 dBm
Level setting		autorange manual

Signal acquisition

Supported standards		IEEE 802.11a, IEEE 802.11g (OFDM), IEEE 802.11j (10 MHz), IEEE 802.11j (20 MHz)
Modulation format		BPSK, QPSK, 16QAM, 64QAM
Demodulator setting		auto, manual with/without test of signal field
Capture length	continuous	
	IEEE 802.11a, j	24 µs to 15 ms
	IEEE 802.11g	24 µs to 11.9 ms
Number of bursts that can be analyzed	manual	1 to 10922
Result length	PVT, spectrum FFT, CCDF	capture length, 1 to 10922 bursts or gate length
	EVM versus symbol and versus carrier, constellation versus symbol versus carrier spectrum flatness, bitstream, signal field	capture length, 1 to 10922 bursts
Burst length	automatic detection of number of data symbols manual	1 to 1366 data symbols
Triggering		free run, IF power, external

Result display

Result list	min/mean/max	EVM all carriers
	min/mean/max	EVM pilots
	min/mean/max	EVM payload I/Q offset GAIN imbalance quadrature error center frequency error symbol clock error mean burst power crest factor
Power versus time		full burst rising/falling edge
EVM		EVM versus symbol EVM versus carrier
Error versus preamble		frequency error versus preamble phase error versus preamble
Spectrum		spectrum mask (IEEE & ETSI), ACP (IEEE 802.11j: abs/rel), spectrum FFT spectrum flatness

Constellation		constellation diagram constellation versus carrier
Statistics		bit stream signal field CCDF
Limit check	values in line with standard	result list EVM spectrum mask ACP

Adjustable parameters

Pilot tracking		phase ON/OFF timing ON/OFF level ON/OFF
Channel estimation		data preamble

Measurement uncertainty

Residual EVM	level –23 dBm to +30 dBm average of 20 bursts f = 2.4 GHz or 5 GHz	
	channel estimation = data	–35 dB
	channel estimation = preamble	–38 dB
Frequency error		
Lock range		±40 ppm
Uncertainty		1 Hz + reference frequency uncertainty
Level uncertainty	test of spectrum mask	0.2 dB
	output power	
	f < 3 GHz	0.5 dB
	3 GHz ≤ f ≤ 6 GHz	0.8 dB
	ACPR	0.5 dB
Spectrum flatness		0.5 dB

DSSS/CCK/PBCC analysis (IEEE 802.11b, IEEE 802.11g CCK)

Frequency

Frequency range		
RF input	R&S®FSL3	20 MHz to 3 GHz
	R&S®FSL6	20 MHz to 6 GHz
Frequency setting		frequency channel number

Level

Level range	RF input	–60 dBm to +30 dBm
Level setting		autorange manual

Signal acquisition

Supported standards		IEEE 802.11b, IEEE 802.11g (CCK)
Modulation format		DBPSK, DQPSK, CCK short PLCP, long PLCP 5.5 Mbps, 11 Mbps PBCC
Demodulator setting		auto manual with/without test of signal field
Capture length	continuous	24 µs to 11.9 ms
Number of bursts that can be analyzed	manual	1 to 10922
Result length	PVT, spectrum FFT, CCDF	capture length, 1 to 10922 bursts or gate length
	EVM versus symbol and versus carrier, constellation versus symbol bit stream PLCP header	capture length, 1 to 10922 bursts
Burst length	automatic detection of number of data symbols manual	1 to 4095 bytes
Triggering		free run, IF power, external

Result display

Result list	min/mean/max	peak vector error
	min/mean/max	burst EVM I/Q offset gain imbalance quadrature error center frequency error chip clock error rise time fall time mean burst power peak burst power crest factor
Power versus time		up ramp/down ramp
EVM		EVM versus symbol
Error versus preamble		frequency error versus preamble phase error versus preamble
Spectrum		spectrum mask, ACPR, spectrum FFT
Constellation		constellation diagram
Statistics		bit stream PLCP header CCDF
Limit check	values in line with standard	result list, power versus time, EVM, spectrum mask, ACP

Adjustable parameters

Tracking		phase ON/OFF timing ON/OFF level ON/OFF

Measurement uncertainty

Residual EVM	level: -23 dBm to +30 dBm average of 20 bursts, 11 Mbps CCK with short PLCP, burst EVM	
	f = 2.442 GHz	1.8 %
Frequency error		
Lock range		±0.6 MHz
Uncertainty		1 Hz + reference frequency uncertainty
Level uncertainty	test of spectrum mask	0.2 dB
	output power	
	f ≤ 3 GHz	0.5 dB
	3 GHz ≤ f ≤ 6 GHz	0.8 dB
	ACPR	0.5 dB

R&S®FSL-K92 WiMAX IEEE 802.16 OFDM analysis (IEEE 802.16-2004, 802.16-2004/Cor1-2005)

Frequency

Frequency range	RF input	
	R&S®FSL3	15 MHz to 3 GHz
	R&S®FSL6	15 MHz to 6 GHz
Frequency setting		frequency, channel number
Sampling rate f_s		1.44 MHz to 20 MHz

Level

Level range	RF input	–60 dBm to +30 dBm
Level setting		auto, manual

Signal acquisition

Supported standards		IEEE 802.16-2004/Cor1-2005, OFDM physical layer
Capture length		24 µs to 15.6 ms, continuously adjustable
Number of bursts that can be analyzed	manual	1 to 10922
Result length	result summary	capture length, 1 to 10922 bursts
	PVT, spectrum FFT, CCDF	capture length or gate length
	EVM versus symbol, EVM versus carrier, constellation versus symbol/versus carrier, spectrum flatness, spectrum flatness difference, group delay, bit stream	capture length
Burst length	automatic detection of number of data symbols manual	1 to 2425 data symbols
Trigger modes		free run, IF power, external

Result display

Result list	min/mean/max	EVM all carriers
	min/mean/max	EVM data carrier
	min/mean/max	EVM pilot carrier, I/Q offset, gain imbalance, quadrature error, frequency error, clock error, mean burst power, crest factor, RSSI, RSSI standard deviation, CINR, CINR standard deviation
Power versus time		full burst, start/end, burst view depending on burst selection
EVM		EVM versus symbol, EVM versus carrier
Error versus preamble		frequency error versus preamble phase error versus preamble
Spectrum		spectrum mask (IEEE[1] and ETSI[2]), ACP (abs./rel.), spectrum FFT, spectrum flatness, spectrum flatness difference, group delay
Constellation		constellation versus symbol, constellation versus carrier
Statistics		CCDF, bit stream burst summary modulation format, burst length [symbols], power, EVM

[1] In line with [1] IEEE 802.16-2004.

[2] In line with [10] ETSI EN 301 021 V1.6.1 (2003-07).

Limit check	values in line with standard	result list EVM, I/Q offset, frequency error, clock error spectrum mask IEEE[3], ETSI[4]

Adjustable parameters

Frequency band		predefined bands: offer preset combinations of sampling rate (f_s) and nominal channel bandwidth (BW) in line with the standard unspecified: enable f_s/BW ratios in line with the standard
Sampling rate (F_s), Channel bandwidth (BW)		If one of the parameters is set, the other one is automatically set in line with the standard. The frequency band setting is taken into account.
Guard period ratio $G = T_g / T_b$		1/4, 1/8, 1/16, 1/32
Link mode		downlink, uplink
Modulation detection		none, first symbol, user, all
Modulation format		BPSK, QPSK, 16QAM, 64QAM
Subchannelization	UL	ON/OFF
Subchannel index		1 to 31
UL physical modifier	UL	0 to 252
Pilot tracking		phase ON/OFF, timing ON/OFF, level ON/OFF
Channel estimation		preamble, payload

Measurement uncertainty

Residual EVM	level –23 dBm to +12 dBm, average of 20 bursts, f = 2.4 GHz or 5 GHz	
	channel estimation = preamble	–34 dB
	channel estimation = payload	–35 dB
Frequency error		
Lock range		30 ppm
Uncertainty		1 Hz + reference frequency uncertainty
Level uncertainty	test of spectrum mask	0.2 dB
	output power	
	f < 3 GHz	0.5 dB
	3 GHz ≤ f ≤ 6 GHz	0.8 dB
	ACPR	0.5 dB
Spectrum flatness		0.5 dB

References

[1] IEEE 802.16-2004, IEEE Standard for Local and Metropolitan Area Networks. 1 October 2004.

[2] IEEE 802.16e-2005 and IEEE 802.16-2004/Cor1-2005. 28 February 2006.
Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands and Corrigendum 1.

[10] ETSI EN 301 021 V1.6.1 (2003-07). Fixed radio systems; point-to-multipoint equipment; time division multiple access (TDMA); Point-to-multipoint digital radio systems in frequency bands in the range 3 GHz to 11 GHz.

[3] In line with [1] IEEE 802.16-2004.

[4] In line with [10] ETSI EN 301 021 V1.6.1 (2003-07).

Ordering information

Designation	Type	Order No.
Spectrum Analyzer, 9 kHz to 3 GHz	R&S®FSL3	1300.2502.03
Spectrum Analyzer, 9 kHz to 3 GHz, with tracking generator	R&S®FSL3	1300.2502.13
Spectrum Analyzer, 9 kHz to 6 GHz	R&S®FSL6	1300.2502.06
Spectrum Analyzer, 9 kHz to 6 GHz, with tracking generator	R&S®FSL6	1300.2502.16
Accessories supplied		
Power cable, quick start guide and CD-ROM (with operating manual and service manual)		
Recommended extras		
Printed manual (includes operating manual and service manual)		1300.3338.32

Options

Designation	Type	Order No.	Retrofittable	Remarks
Options				
OCXO Reference Frequency	R&S®FSL-B4	1300.6008.02	yes	
Additional Interfaces	R&S®FSL-B5	1300.6108.02	yes	video out, IF out, noise source control, AUX port, R&S®NRP power sensor
TV Trigger	R&S®FSL-B6	1300.5901.02	yes	
Narrow Resolution Filters	R&S®FSL-B7	1300.5601.02	yes	
Gated Sweep	R&S®FSL-B8	1300.5701.02	yes	
GPIB Interface	R&S®FSL-B10	1300.6208.02	yes	
RF Preamplifier	R&S®FSL-B22	1300.5953.02	yes	
DC Power Supply	R&S®FSL-B30	1300.6308.02	yes	
NiMH Battery Pack	R&S®FSL-B31	1300.6408.02	yes	requires R&S®FSL-B30
Firmware/Software				
AM/FM/φM Measurement Demodulator	R&S®FSL-K7	1301.9246.02		
Bluetooth® TX Measurements (1.1 and 2.0+EDR)	R&S®FSL-K8	1301.9398.02		
Power Sensor Support	R&S®FSL-K9	1301.9530.02		requires R&S®FSL-B5 or R&S®NRP-Z3/4
Spectrogram Measurements	R&S®FSL-K14	1302.0913.02		
Cable TV and TV Measurements	R&S®FSL-K20	1301.9675.02		
Application Firmware for Noise Figure and Gain Measurements	R&S®FSL-K30	1301.9817.02		requires R&S®FSL-B5 and preamplifier
3GPP FDD BTS Application Firmware	R&S®FSL-K72	1302.0620.02		see separate specifications
WLAN IEEE 802.11a/b/g/j Application Firmware	R&S®FSL-K91	1302.0094.02		
WiMAX IEEE 802.16 OFDM Application Firmware	R&S®FSL-K92	1302.0236.02		
WiMAX IEEE 802.16 OFDM/OFDMA Application Firmware	R&S®FSL-K93	1302.0736.02		see separate specifications
Upgrade from R&S®FSL-K92 to R&S®FSL-K93	R&S®FSL-K92U	1302.0307.02		

Recommended extras

Order designation	Type	Order No.
19'' Rackmount Adapter	R&S®ZZA-S334	1109.4487.00
Soft Carrying Bag	R&S®FSL-Z3	1300.5401.00
Additional Charger Unit	R&S®FSL-Z4	1300.5430.02
Matching Pad 75 Ω, L section	R&S®RAM	0358.5414.02
Matching Pad 75 Ω, series resistor 25 Ω	R&S®RAZ	0358.5714.02
Matching Pad 75 Ω, L section, N to BNC	R&S®FSH-Z38	1300.7740.02
SWR Bridge 5 MHz to 3 GHz	R&S®ZRB2	0373.9017.52
SWR Bridge 40 kHz to 4 GHz	R&S®ZRC	1039.9492.52
SWR Bridge 10 MHz to 3 GHz (incl. open, short, load calibration standards)	R&S®FSH-Z2	1145.5767.02

Power sensors supported by the R&S®FSL-K9

Order designation	Type	Order No.
Average Power Sensor 10 MHz to 8 GHz, 200 mW	R&S®NRP-Z11	1138.3004.02
Average Power Sensor 10 MHz to 18 GHz, 200 mW	R&S®NRP-Z21	1137.6000.02
Average Power Sensor 10 MHz to 18 GHz, 2 W	R&S®NRP-Z22	1137.7506.02
Average Power Sensor 10 MHz to 18 GHz, 15 W	R&S®NRP-Z23	1137.8002.02
Average Power Sensor 10 MHz to 18 GHz, 30 W	R&S®NRP-Z24	1137.8502.02
Average Power Sensor 9 kHz to 6 GHz, 200 mW	R&S®NRP-Z91	1168.8004.02
Thermal Power Sensor 0 Hz to 18 GHz, 100 mW	R&S®NRP-Z51	1138.0005.02
Thermal Power Sensor 0 Hz to 40 GHz, 100 mW	R&S®NRP-Z55	1138.2008.02
Wideband Power Sensor 50 MHz to 18 GHz, 100 mW	R&S®NRP-Z81	1137.9009.02

For product brochure, see PD 0758.2790.12
and www.rohde-schwarz.com
(search term: FSL)

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