Product Brochure

Version 03.00

November 2005

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: R&S® FSL-K91 for WLAN transmitter 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.

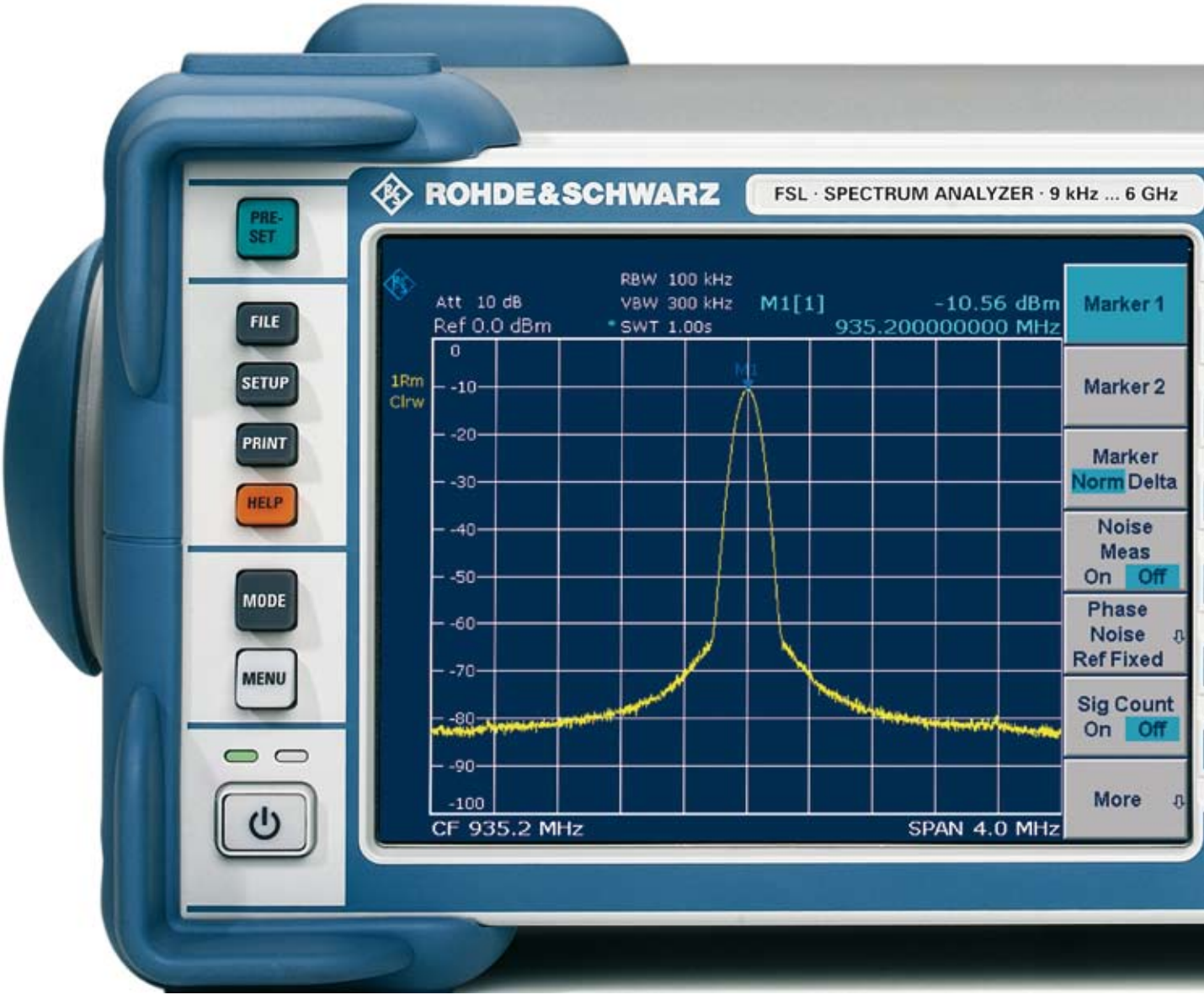
The R&S®FSL is an extremely lightweight and compact spectrum analyzer that is ideal for a large number of applications in development, service and production. Despite its compact size, it offers a wealth of functions more typical of the high-end range, thus ensuring an excellent price/performance ratio. 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. +15 dBm, a bandwidth range from 10 Hz to 10 MHz, and a displayed average noise level (DANL) of –152 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	300 Hz to 10 MHz in 1/3 sequence			
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)	typ. –152 dBm			
TOI	10 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

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.

Input command

SENSE:LIST:POW
100MHz,-0dBm,10dB,10dB,NORM,1MHz,3MHz,434us,0,
200MHz,-20dBm,10dB,0dB,NORM,30kHz,100kHz,1ms,0,
300MHz,-20dBm,10dB,0dB,NORM,30kHz,100kHz,1ms,0;

Output R&S®FSL
-28.3,
-30.6,
-38.1

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

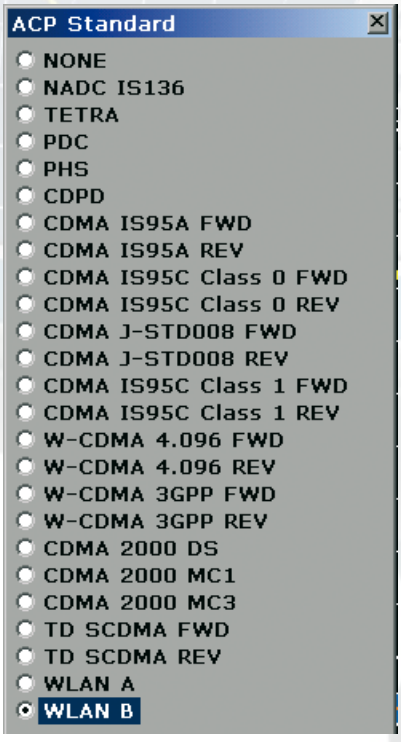
Ideal for service

- 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®ZRB2 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®ZRB2 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®

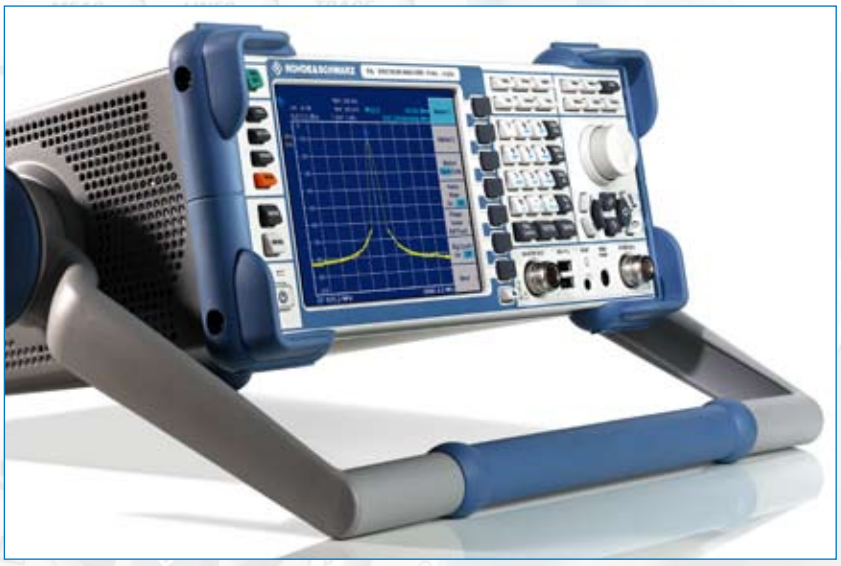


The R&S®FSL's wide scope of functions also extends to channel/adjacent channel power measurements. To simplify use, many default settings can be selected by pressing a button.

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



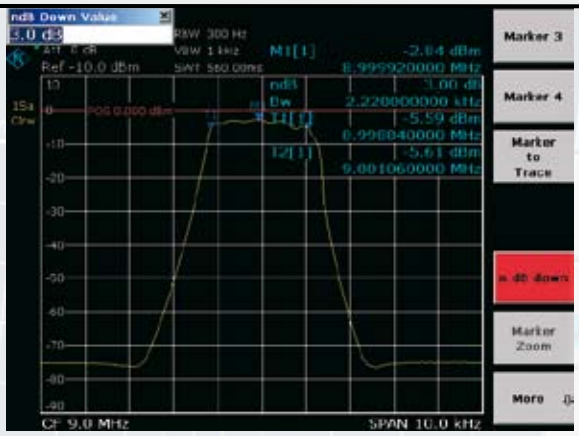
The wide range of additional interfaces provided by the R&S®FSL-B5 option expands the application range of the R&S®FSL:

- 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

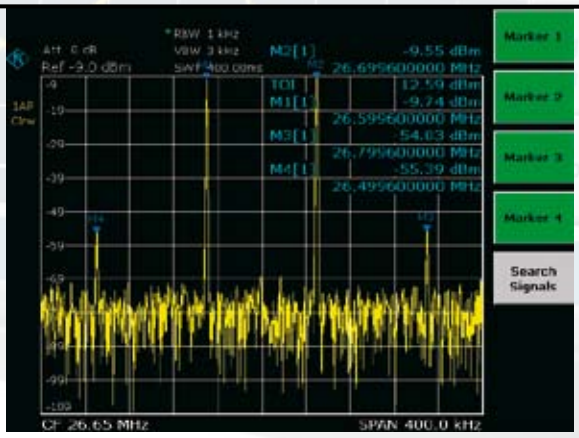
Scalar network analysis

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.



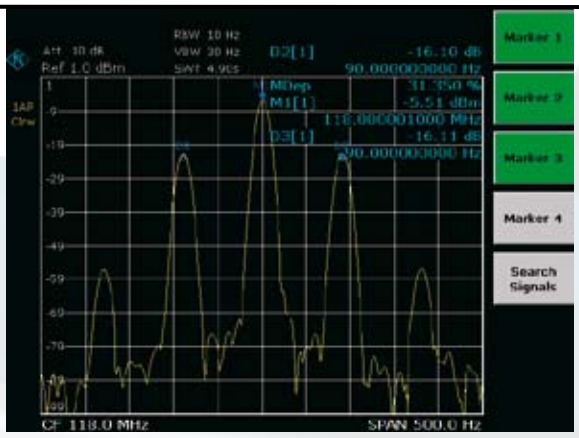
Third order intercept (TOI)

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.



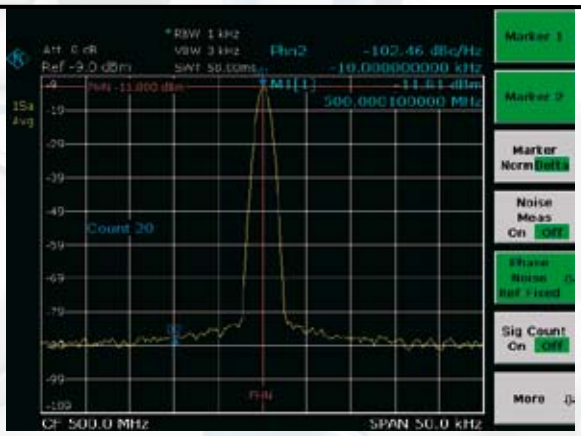
Modulation depth measurement (AM%)

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.



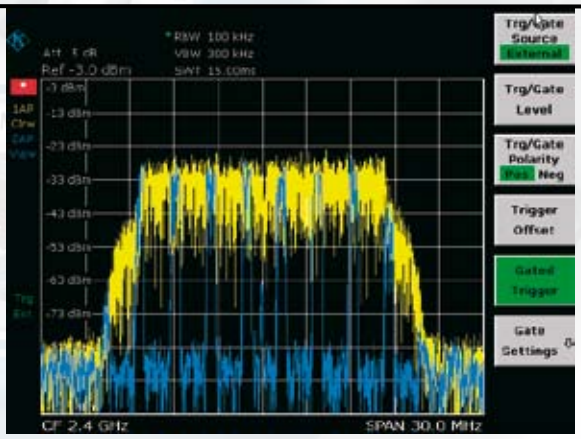
Phase noise measurement with phase noise marker

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.



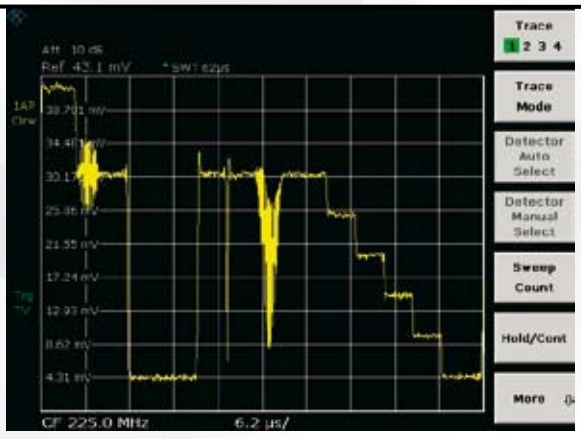
Gated sweep

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).



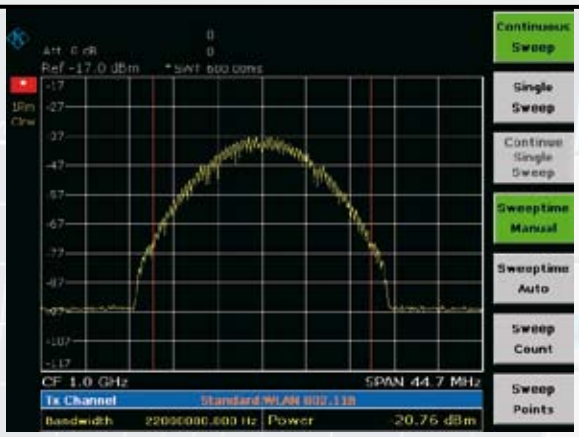
TV trigger option

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.



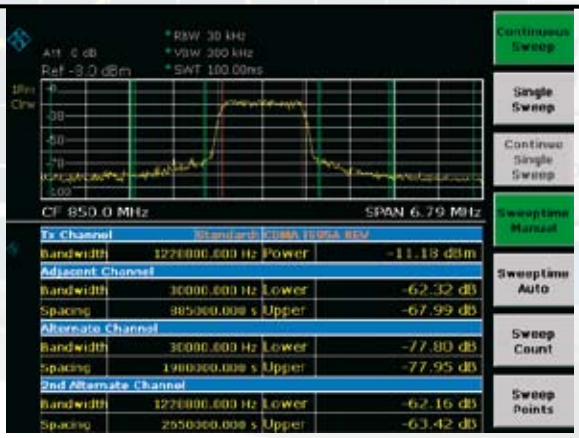
Channel power measurements

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.

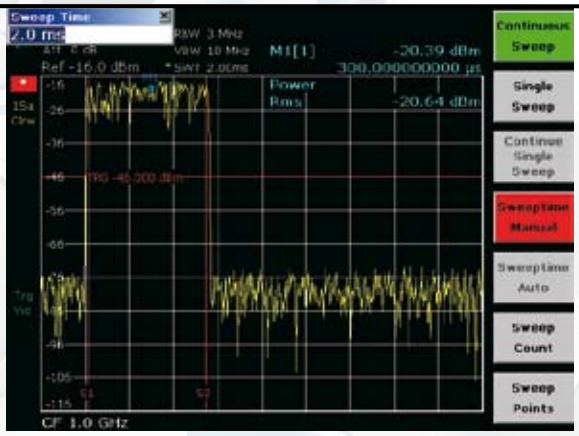


Fast ACP in time domain with standard-compliant channel filters

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.

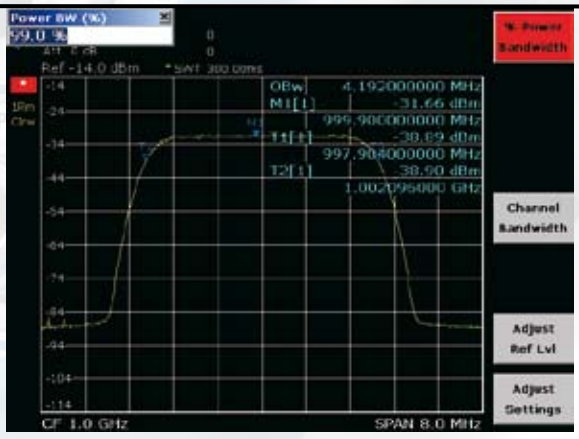
Burst power measurement: time domain power

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

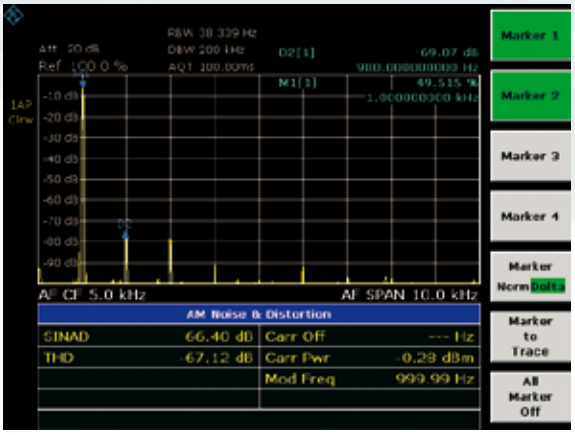
The AM/FM/φM Measurement Demodulator R&S®FSL-K7 converts the R&S®FSL into an analog modulation analyzer for amplitude-, frequency- or phase-modulated signals. It measures not only characteristics of the useful modulation, but also factors such as residual FM or synchronous modulation.

Display and evaluation capabilities:

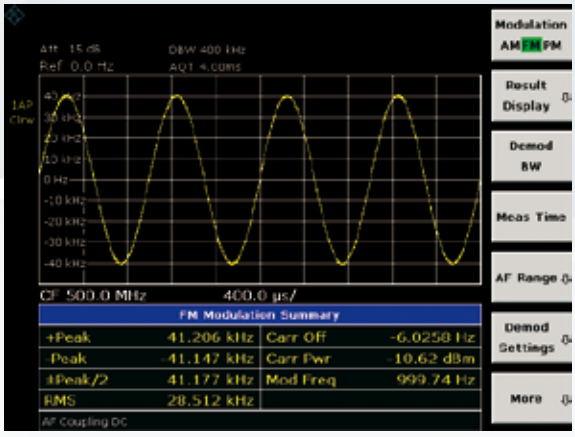
- Modulation signal versus time
- Spectrum of modulation signal (FFT)
- RF signal power versus time
- Spectrum of RF signal (FFT versus max. 18 MHz)
- Table with numeric display of
  - Deviation or modulation depth, +Peak, –Peak, ± Peak/2 and RMS weighted
  - Modulation frequency
  - Carrier frequency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

Condensed data

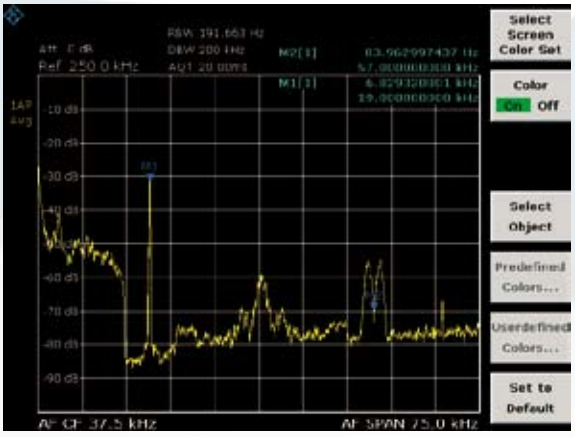
Demodulation bandwidth	100 Hz to 18 MHz
Recording time (depends on demodulation bandwidth)	12.5 ms to 3276 s
AF filters	
Highpass filter	50 Hz, 300 Hz
Lowpass filter	3 kHz, 15 kHz, 150 kHz and 5%, 10% or 25% of demodulation bandwidth
Deemphasis	25/50/75/750 µs
Modulation frequency	<5 MHz, max. 0.5 ×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



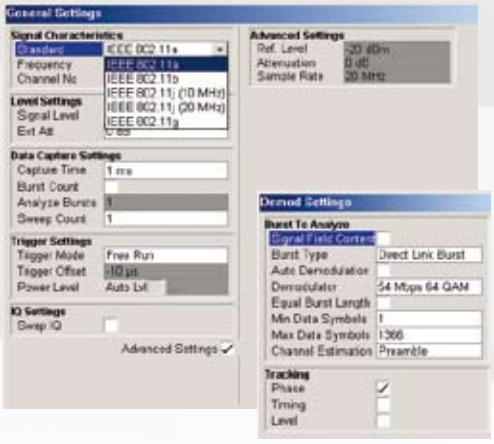
AF spectrum of an FM stereo signal: The 19 kHz pilot carrier, the stereo signal on the 38 kHz subcarrier and the RDS subcarrier at 57 kHz are clearly distinguishable. The pilot deviation is selected using the marker.

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

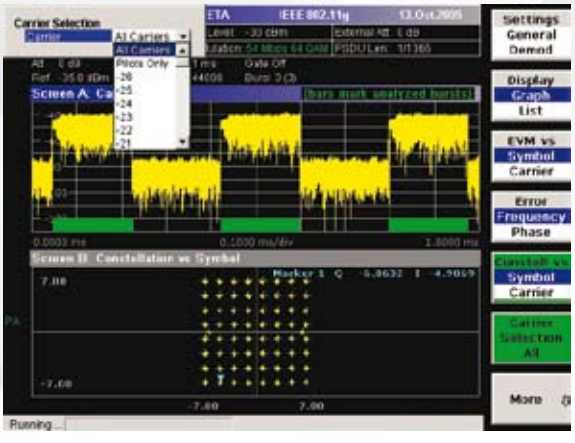
WLAN Application Firmware R&S®FSL-K91 expands the application range of the Spectrum Analyzer R&S®FSL by spectrum and modulation measurements on signals in line with the WLAN standards IEEE 802.11a/b/g/j. The excellent price/performance ratio, the compact size and the capability to be remote-controlled 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 802.111g-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	✓ (for specific 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

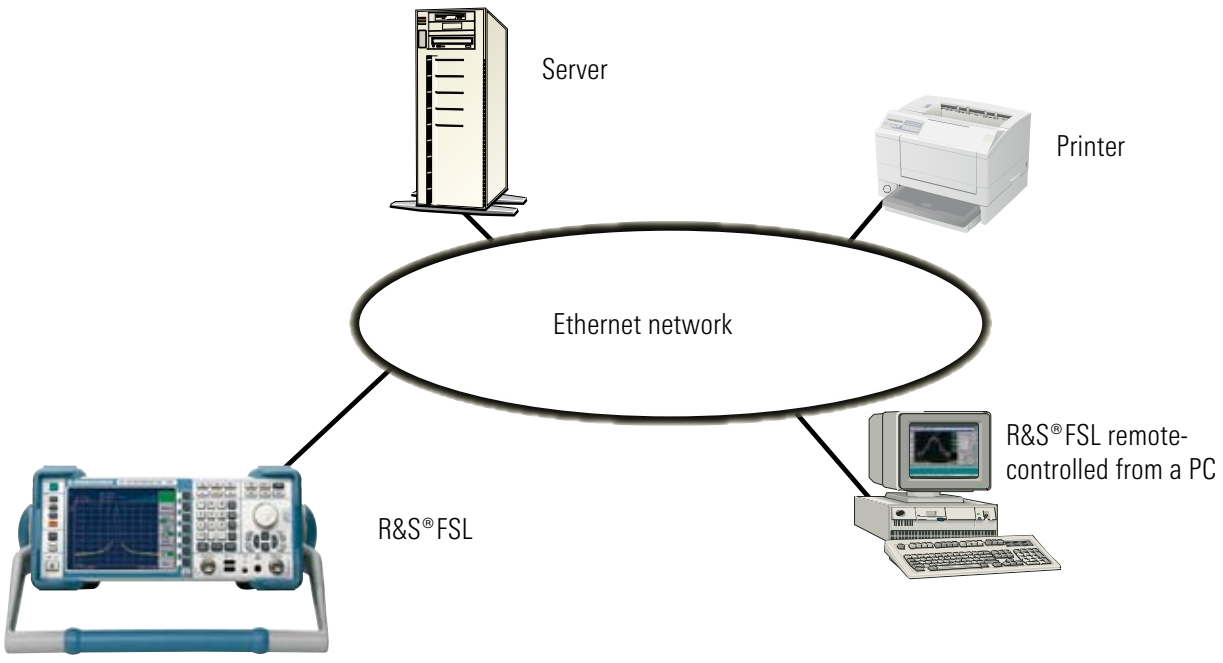
The standard LAN interface opens up versatile networking capabilities:

- 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, R&S®NRP power sensor
TV Trigger	R&S®FSL-B6	1300.5901.02	
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 expansions/options			
AM/FM/φM Measurement Demodulator	R&S®FSL-K7	1300.9246.02	
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
Transmitter measurements for WLAN 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
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