



WLAN 802.11a Application Firmware R&S[®] FSQ-K90

Transmitter measurements on WLAN 802.11a OFDM signals with the Signal Analyzer R&S FSQ

- ◆ Enhances the signal analyzers of the R&S FSQ family by transmitter measurements in accordance with the IEEE 802.11a standard
- ◆ Frequency range from 20 MHz to 3/8/26 GHz, depending on base unit
- ◆ Very low residual EVM of below -44 dB/ -46 dB
- ◆ Automatic or manual setting of modulation format
- ◆ Analysis at the RF or in the baseband (optional)
- ◆ All measurement functions remote-controllable via IEC/IEEE bus or LAN
- ◆ High measurement rate of >2 measurements/s (54 Mbps, 16 payload symbols)
- ◆ Supports 802.11g OFDM

Version
01.00July
2003

General

Application Firmware R&S FSQ-K90 expands the application range of the Signal Analyzers R&S FSQ by spectrum and modulation measurements on OFDM signals in accordance with the WLAN standard IEEE 802.11a. The measurements specified by this standard can thus be performed at a keystroke, for example:

- ◆ Output power (burst power)
- ◆ Spectrum mask with limit lines and PASS/FAIL display (FIG 1a +b)

- ◆ Spectrum flatness (including display of group delay, FIG 4)
- ◆ Constellation error (FIG 2)
- ◆ RF carrier leakage (FIG 2)
- ◆ Carrier frequency and symbol clock error
- ◆ Adjacent channel power

Further analysis and evaluation facilities are often required in the development and verification phase:

- ◆ Constellation diagram for all carriers or a single carrier
- ◆ Constellation overview of all carriers (FIG 6)
- ◆ EVM of single carriers
- ◆ EVM versus symbols or time
- ◆ Group delay
- ◆ Time-gated spectrum (FFT)
- ◆ Time-gated CCDF and crest factor
- ◆ Bit stream
- ◆ Analysis at the RF, IF, inverted IF or in the baseband (option R&S FSQ-B71)
- ◆ Selectable tracking (phase, timing, level)

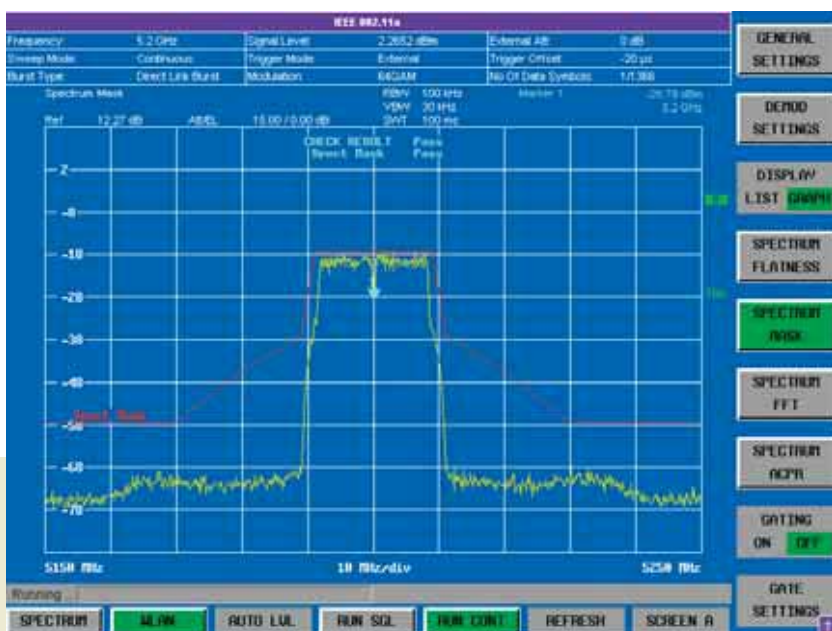


FIG 1a: Spectrum mask with standard-compliant limit lines

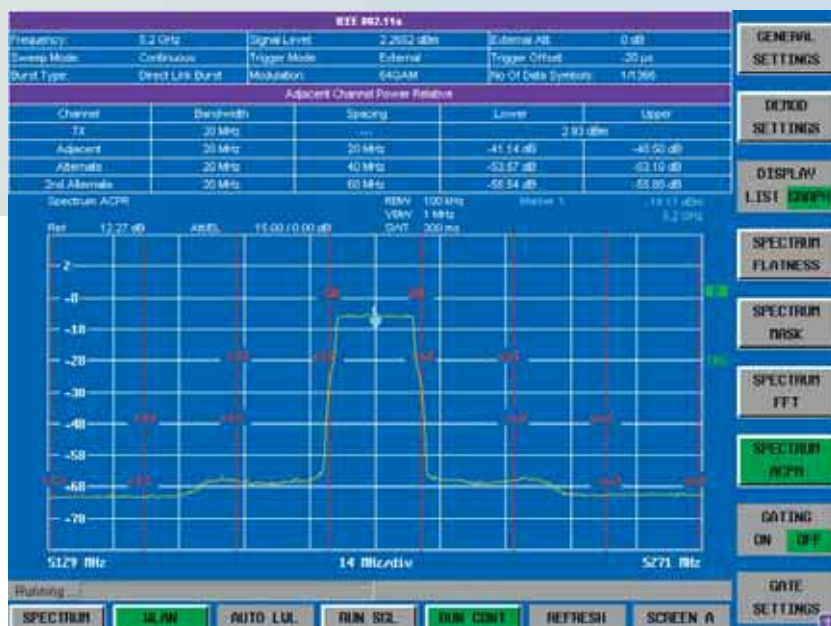


FIG 1b: ACP measurement

The usual spectrum analysis functions of the base unit further expand measurement functionality, making the instrument even more versatile.

Other typical development tasks can be performed with the following measurement functions:

- ◆ Channel and user-configurable adjacent channel power measurement
- ◆ Multicarrier adjacent channel power measurement
- ◆ TOI marker for automatic determination of third-order intercept
- ◆ Noise measurements (with R&S FS-K3) or phase noise measurement (with R&S FS-K4)

The Signal Analyzer R&S FSQ26 covers the entire frequency range to be measured for spurious emissions.

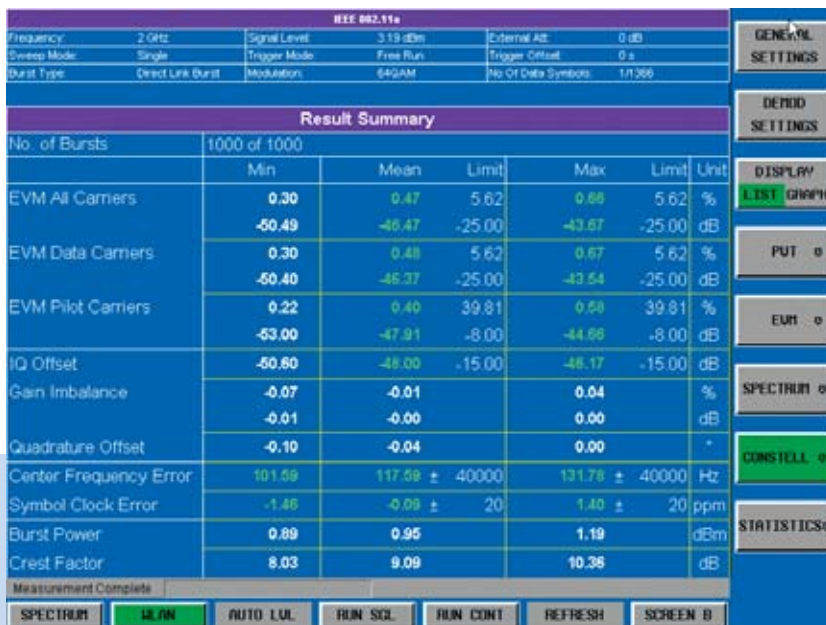


FIG 2: Display of the main modulation parameters in the Result Summary: The measurement covering 20 bursts shows an EVM of -46.7 dB for the best burst (min. peak) and -45.09 dB for the worst burst (max. peak) as well as an average EVM of -46.09 dB for all bursts. Output power (with regard to burst) and crest factor are also displayed. Quick and easy determination, for example, of the EVM dependence on the output power of an amplifier is thus possible. Owing to its auto level function, the analyzer follows these level changes without requiring any manual settings.

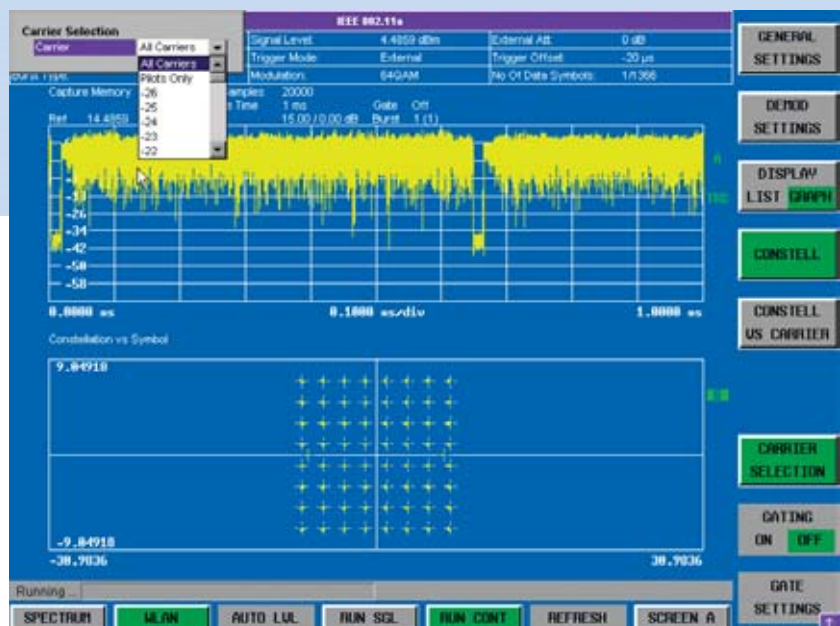


FIG 3: Constellation diagram of all or (selectable) single carriers

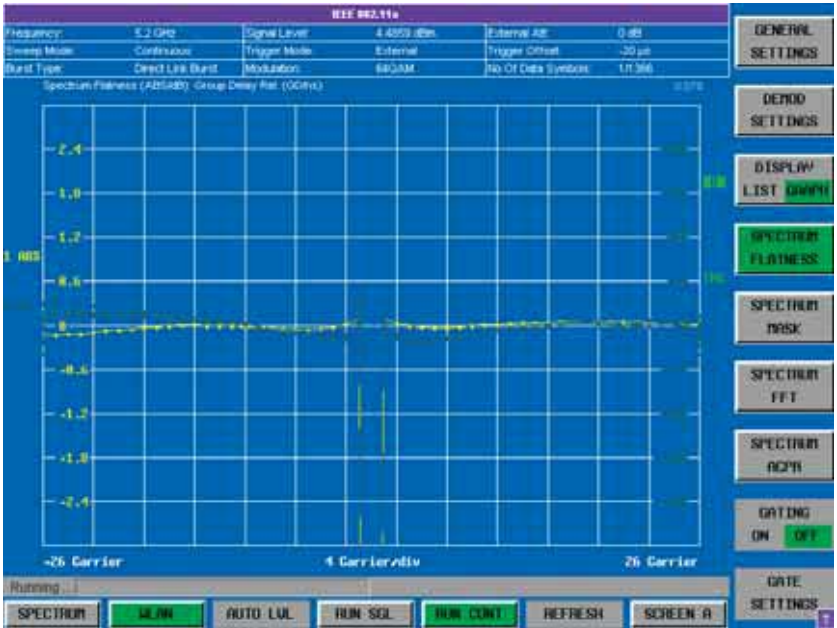


FIG 4: Group delay and spectrum flatness are determined via the channel estimation of the preamble or (user-selectable) for the entire burst including payload. Frequency responses of filters, distortions due to time offsets or different I and Q signal delays (skew) are clearly visible.

General Settings

Signal Characteristics

Standard	IEEE 802.11a
Frequency	5.2 GHz
Channel No	40
Auto Level	<input checked="" type="checkbox"/>
Ext Att	0 dB
Signal Level (RF)	-30 dBm
Signal Level (Baseband)	1 V

Data Capture Settings

Capture Time	1 ms
Overall Burst Count	<input type="checkbox"/>
No of Bursts to Analyze	1

Trigger Settings

Trigger Mode	Free Run
Trigger Offset	Free Run
Power Level (RF)	External
Power Level (Baseband)	Power
Auto Power Trigger Level	<input type="checkbox"/>

IQ Settings

Swap IQ	<input type="checkbox"/>
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Input Settings

Baseband Input	<input type="checkbox"/>
IQ Input	50 Ohm
Balanced	<input checked="" type="checkbox"/>
Low Pass	<input checked="" type="checkbox"/>
Dither	<input type="checkbox"/>

Demod Settings

Burst To Analyze

Use Signal Field Content	<input type="checkbox"/>
Burst Type	Direct Link Burst
Demodulator	64QAM
Equal Burst Length	BPSK
Min No of Data Symbols	QPSK
Max No of Data Symbols	16QAM
Improved Channel Estimation	64QAM
Improved Channel Estimation	<input type="checkbox"/>

Tracking

Phase	<input checked="" type="checkbox"/>
Timing	<input type="checkbox"/>
Level	<input type="checkbox"/>

FIGs 5a + b: Setup; tables permit a quick overview of the selected settings and immediate access to the setting parameters

The optional Vector Signal Analyzer R&S FSQ-K70 enhances the R&S FSQ by universal demodulation and analysis functions for digitally modulated signals up to a symbol rate of 25 Msps. Thus, the AM/AM and AM/φM distortion curves of an amplifier, for example, can be determined directly from a digitally modulated signal, i.e. very realistically.

For analysis down to the chip layer, the option R&S FSQ-B71 has selectable balanced or unbalanced I and Q base-band inputs.

Measurements in the 2.4 GHz range already support 802.11g OFDM.

Specifications for R&S FSQ-K90 see PD 0758.0200.



FIG 6: Constellation overview of all carriers; single-carrier constellation is vertical; I and Q values have different colours. This diagram gives a quick overview of all carriers.

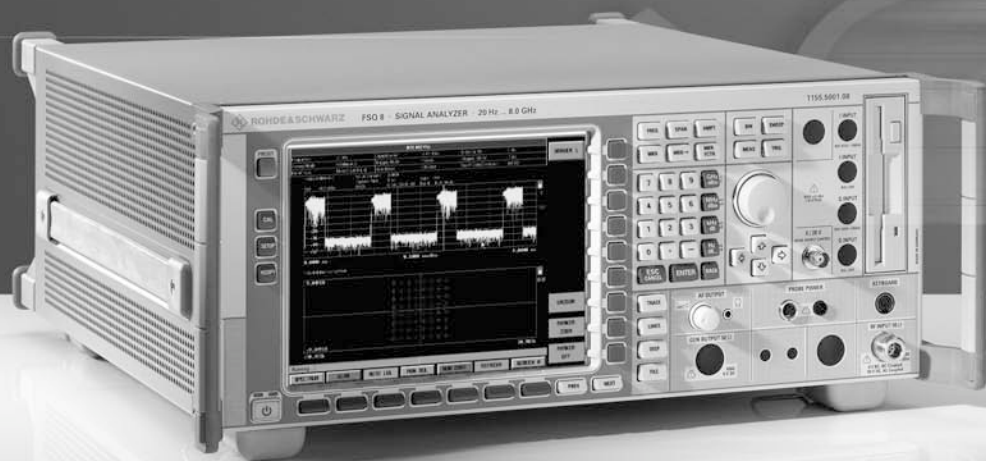


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Rohde & Schwarz GmbH & Co. KG · Mühlendorfstraße 15 · 81671 München · Germany · P.O.B. 80 14 69 · 81614 München · Germany · Telephone +49 89 4129-0
www.rohde-schwarz.com · Customer Support: Telephone +49 1805124242, Fax +49 89 4129-13777, E-mail: CustomerSupport@rohde-schwarz.com

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WLAN 802.11a Application Firmware R&S® FSQ-K90

Specifications



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The specifications of R&S FSQ-K90 are based on the data sheet specifications of the Signal Analyzer R&S FSQ and have not been checked separately. They are valid under the following conditions:
 15 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to and internal calibration performed. Data with tolerance limits: measurement uncertainties with a confidence level of 95%. Data without tolerance limits: typical values. The specified level measurement errors do not take into account systematic errors due to reduced S/N ratio.

Frequency

Frequency range	RF input R&S FSQ3 R&S FSQ8 R&S FSQ26 I/Q baseband input (R&S FSQ-B71)	10 MHz to 3.6 GHz 10 MHz to 8 GHz 10 MHz to 26.5 GHz DC to 36 MHz
Frequency setting		frequency channel number

Level

Level range	RF input I/Q baseband input (R&S FSQ-B71)	-50 dBm to +30 dBm 31.6 mV to 5.62 V
Level setting		autorange manual

Signal acquisition

Supported standards		802.11a, 802.11g (OFDM)
Modulation format		BPSK, QPSK, 16QAM, 64QAM
Demodulator setting		manual with/without test of signal field
Capture length	continuous	24 μ s to 50 ms
Number of bursts that can be analyzed	manual	1 to 10922
Result length	PVT, spectrum FFT, CCDF EVM vs. symbol and vs. carrier, constellation vs. symbol and vs. carrier spectrum flatness, bit stream	capture length, 1 to 10922 bursts or gate length capture length, 1 to 10922 bursts
Sweep time	spectrum mask ACPR	100 ms 300 ms
Burst length	automatic detection of number of data symbols manual	1 to 1366 data symbols
Triggering	RF input I/Q baseband input	free run, IF power, external free run, envelope of I/Q voltage, external

Adjustable parameters

Input	R&S FSQ-B71	RF I and Q baseband, unbalanced, balanced
Pilot tracking		phase on/off timing on/off level on/off
Channel estimation		preamble and data preamble

Measurement uncertainty

Residual EVM	level -23 dBm to +30 dBm average of 20 bursts input = RF (f = 2.4 GHz or 5 GHz) channel estimation = preamble and data channel estimation = preamble input = I and Q baseband channel estimation = preamble and data channel estimation = preamble	-46 dB -44 dB -47 dB -45 dB
Frequency error Lock range Uncertainty		40 ppm 1 Hz + reference frequency uncertainty
Level uncertainty	test of spectrum mask output power f <3.6 GHz 3.6 GHz ≤ f ≤ 8 GHz ACPR (adjacent channel power ratio)	0.1 dB 0.5 dB 1.5 dB 0.5 dB
Spectrum flatness	f <3.6 GHz f >3.6 GHz	0.3 dB 0.5 dB

Ordering information

Application Firmware for WLAN 802.11a TX Measurements with the R&S FSQ	R&S FSQ-K90	1157.3064.02
Signal Analyzer 20 Hz to 3.6 GHz	R&S FSQ3	1155.5001.03
Signal Analyzer 20 Hz to 8 GHz	R&S FSQ8	1155.5001.08
Signal Analyzer 20 Hz to 26 GHz	R&S FSQ26	1155.5001.26
Recommended options and extras	see also data sheet Signal Analyzer R&S FSQ	
I/Q Baseband Inputs for the Signal Analyzer R&S FSQ	R&S FSQ-B71	1157.0113.02

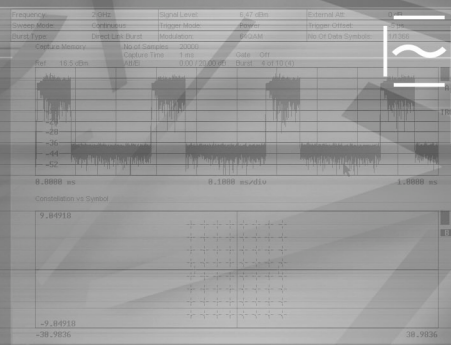


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Rohde & Schwarz GmbH & Co. KG · Mühlendorfstr. 15 · 81671 München · Germany · P.O.B. 801469 · 81614 München · Telephone +49 89 4129-0
www.rohde-schwarz.com · CustomerSupport: Telephone +49 1805 124242, Fax +49 89 4129-13777, E-Mail: CustomerSupport@rohde-schwarz.com

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Specifications

The specifications of R&S FSQ-K91 are based on the data sheet specifications of the Signal Analyzer R&S FSQ and have not been checked separately. They are valid under the following conditions:

15 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to and internal calibration performed. Data with tolerance limits: measurement uncertainties with a confidence level of 95%. Data without tolerance limits: typical values. The specified level measurement errors do not take into account systematic errors due to reduced S/N ratio.

OFDM analysis (802.11a, 802.11g OFDM, 802.11j)

Frequency

Frequency range	RF input R&S FSQ3 R&S FSQ8 R&S FSQ26 I/Q baseband input (R&S FSQ-B71)	10 MHz to 3.6 GHz 10 MHz to 8 GHz 10 MHz to 26.5 GHz DC to 36 MHz
Frequency setting		frequency channel number

Level

Level range	RF input I/Q baseband input (R&S FSQ-B71)	-70 dBm to +30 dBm 31.6 mV to 5.62 V
Level setting		autorange manual

Signal acquisition

Supported standards		802.11a, 802.11g (OFDM), 802.11j (10 MHz), 802.11j (20 MHz)
Modulation format		BPSK, QPSK, 16QAM, 64QAM
Demodulator setting		auto manual with/without test of signal field
Capture length	continuous	24 µs to 50 ms
Number of bursts that can be analyzed	manual	1 to 10922
Result length	PVT, spectrum FFT, CCDF EVM versus symbol and versus carrier, constellation versus symbol/versus carrier spectrum flatness, bit stream, signal field	capture length, 1 to 10922 bursts or gate length capture length, 1 to 10922 bursts
Sweep time	spectrum mask ACPR	100 ms 300 ms
Burst length	automatic detection of number of data symbols manual	1 to 1366 data symbols
Triggering	RF input I/Q baseband input	free run, IF power, external free run, envelope of I/Q voltage, external

Result display

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

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

Adjustable parameters

Input	R&S FSQ-B71	RF I and Q baseband, unbalanced, balanced
Pilot tracking		phase on/off timing on/off level on/off
Channel estimation		preamble and data preamble

Measurement uncertainty

Residual EVM	level -23 dBm to +30 dBm average of 20 bursts input = RF (f = 2.4 GHz or 5 GHz) channel estimation = preamble and data channel estimation = preamble input = I and Q baseband channel estimation = preamble and data channel estimation = preamble	-46 dB -44 dB -47 dB -45 dB
Frequency error Lock range Uncertainty		40 ppm 1 Hz + reference frequency uncertainty
Level uncertainty	test of spectrum mask output power f < 3.6 GHz 3.6 GHz ≤ f ≤ 8 GHz ACPR	0.1 dB 0.5 dB 1.5 dB 0.5 dB
Spectrum flatness	f < 3.6 GHz f > 3.6 GHz	0.3 dB 0.5 dB

DSSS/CCK analysis (802.11b)

Frequency

Frequency range	RF input R&S FSQ3 R&S FSQ8 R&S FSQ26 I/Q baseband input (R&S FSQ-B71)	20 MHz to 3.6 GHz 20 MHz to 8 GHz 20 MHz to 26.5 GHz DC to 36 MHz
Frequency setting		frequency channel number

Level

Level range	RF input I/Q baseband input (R&S FSQ-B71)	-65 dBm to +30 dBm 31.6 mV to 5.62 V
Level setting		autorange manual

Signal acquisition

Supported standards		802.11b
Modulation format		DBPSK, DQPSK, CCK, short PLCP, long PLCP
Demodulator setting		auto manual with/without test of signal field
Capture length	continuous	24 μ s to 66 ms
Number of bursts that can be analyzed	manual	1 to 10922
Result length	PVT, spectrum FFT, CCDF EVM versus symbol and versus carrier, constellation versus symbol bit stream PLCP header	capture length, 1 to 10922 bursts or gate length capture length, 1 to 10922 bursts
Sweep time	spectrum mask ACPR	200 ms 200 ms
Burst length	automatic detection of number of data symbols manual	1 to 4095 bytes
Triggering	RF input I/Q baseband input	free run, IF power, external free run, envelope of I/Q voltage, external

Result display

Result list	min/mean/max min/mean/max	peak vector error burst EVM I/Q offset gain imbalance quadrature error center freq 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
Spectrum		spectrum mask, ACPR, spectrum FFT
Constellation		constellation diagram
Statistics		bit stream PLCP header CCDF
Limit check	values according to standard	result list, power versus time, EVM, spectrum mask, ACP

Adjustable parameters

Input	R&S FSQ-B71	RF I and Q baseband, unbalanced, balanced
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 input = RF (f = 2.442 GHz) input = I and Q baseband	0.7% 0.4%
Frequency error Lock range Uncertainty		1.3 MHz 1 Hz + reference frequency uncertainty
Level uncertainty	test of spectrum mask output power f < 3.6 GHz 3.6 GHz ≤ f ≤ 8 GHz ACPR	0.1 dB 0.5 dB 1.5 dB 0.5 dB

Ordering information

WLAN 802.11a/b/g/j Application Firmware	R&S FSQ-K91	1157.3129.02
Upgrade from R&S FSQ-K90 to R&S FSQ-K91	R&S FSQ-K90U	1300.8000.02
Signal Analyzer 20 Hz to 3.6 GHz	R&S FSQ3	1155.5001.03
Signal Analyzer 20 Hz to 8 GHz	R&S FSQ8	1155.5001.08
Signal Analyzer 20 Hz to 26 GHz	R&S FSQ26	1155.5001.26
Recommended options and extras	see also data sheet Signal Analyzer R&S FSQ	
I/Q Baseband Inputs for the Signal Analyzer R&S FSQ	R&S FSQ-B71	1157.0113.02



Product brochure see PD 0758.0945.12
and at www.rohde-schwarz.com
(search term: FSQ)



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