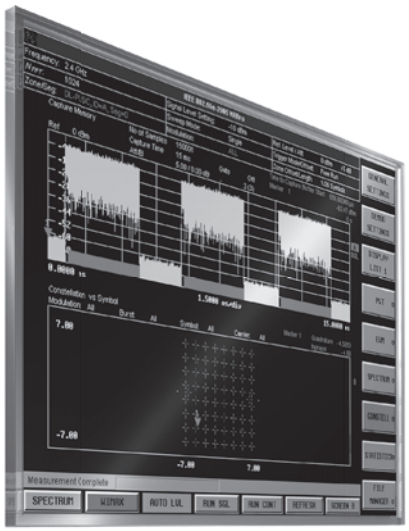
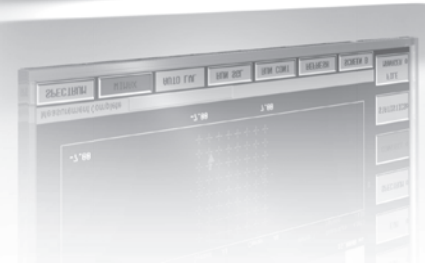
R&S®FSQ-K92/K93/K94 WiMAX, WiBro Application Firmware Specifications





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CONTENTS

WiMAX 802.16 OFDM analysis (IEEE 802.16-2004/802.16-2005)

Frequency

Frequency range	RF input	
	R&S®FSQ3	50 MHz [1] to 3.6 GHz
	R&S®FSQ8	50 MHz [1] to 8 GHz
	R&S®FSQ26	50 MHz [1] to 26.5 GHz
	R&S®FSQ40	50 MHz [1] to 40 GHz
	I/Q baseband inputs (R&S®FSQ-B71)	DC to 36 MHz
Frequency setting		frequency, channel number
Nominal channel bandwidth		1.25 MHz to 28 MHz

Level

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

Signal acquisition

Supported standards		IEEE 802.16-2004 OFDM, IEEE 802.16e-2005 OFDM, P802.16Rev2/D3 OFDM
Capture length	sampling rate (F_s) 1.44 MHz to sampling rate (F_s) 32 MHz	24 µs to 694.44 ms upper limit decreases linearly 24 µs to 35.71 ms
Gate length		24 µs to capture length
Number of analyzed bursts		1 to 10922 bursts
Result length	power versus time, EVM versus symbol, EVM versus carrier, frequency error versus preamble, phase error versus preamble, constellation versus symbol, constellation versus carrier, spectrum flatness, spectrum flatness difference, group delay, bit stream, burst summary	capture length [2]
	FFT spectrum, CCDF	capture length or gate length
	result summary	capture length [2] or 1 to 10922 bursts
Burst length	number of data symbols is automatically detected, manually adjustable	1 to 2425 data symbols
Sweep time	spectrum mask	15 ms to 16000 s, auto
	ACPR (adjacent channel power ratio)	15 ms to 16000 s
Sweep count		1 to 32767
Trigger modes	RF input	free run, IF power, external
	I/Q baseband input	free run, I/Q voltage envelope, external

[1] 5 MHz to 50 MHz with restricted functionality dependent on bandwidth (IF power trigger, auto level, IF overload). Digital downconverting can also be performed in the baseband [requires R&S®FSQ-B71] in order to analyze if applications with center frequency ≥ nominal channel bandwidth (BW)/2.

[2] Max. 200 bursts per capture buffer.

Measurement parameters

Input		RF
	R&S®FSQ-B71	I and Q baseband, balanced-to-unbalanced switchover
Frequency band	predefined bands	offers preset combinations of sampling rate (F_s) and nominal channel bandwidth (BW) in line with the standard
	unspecified	offers F_s/BW ratios in line with the standard or user-defined
Sampling rate (F_s), channel bandwidth (BW)		If one of the parameters is set, the other is automatically set as required for the selected 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 (DL), uplink (UL)
Modulation detection		none, first symbol, user, all (auto demod.)
Modulation format		BPSK, QPSK, 16QAM, 64QAM
Subchannelization	uplink	ON/OFF
Subchannel index	uplink	1 to 31
UL physical modifier	uplink	0 to 255
Pilot tracking		phase ON/OFF, timing ON/OFF, level ON/OFF
Channel estimation		preamble, preamble and payload
Spectrum emission mask	standard	IEEE, ETSI
	user	spectrum emission mask measurement is performed in line with the user setting files

Result display

Result summary	min./mean/max. values	EVM all carriers, EVM data carriers, EVM pilot carriers, I/Q offset, gain imbalance, quadrature error, frequency error, clock error, burst power, crest factor, RSSI, RSSI standard deviation, CINR, CINR standard deviation
Power versus time		full burst, start/end, burst view depends on selected burst
EVM	min./mean/max. values	EVM versus symbol, EVM versus carrier
Error versus preamble	min./mean/max. values	frequency error versus preamble, phase error versus preamble
Spectrum	min./mean/max. values	spectrum flatness, spectrum flatness difference
	min./mean/max. values	group delay
	clear write, max. hold	spectrum mask IEEE [3], ETSI [4], user
	clear write, max. hold	ACPR (absolute/relative)
	clear write	FFT spectrum
Constellation		constellation versus symbol, constellation versus carrier
Statistics		CCDF
		bit stream
		burst summary list modulation format, burst length in symbols, power, EVM

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

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

Limit check	values in line with the standard	result list EVM, I/Q offset, frequency error, clock error, spectrum flatness, spectrum flatness difference, spectrum mask IEEE [5], ETSI [6], user

Measurement uncertainty (nominal)

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	–45 dB
	channel estimation: preamble	–44 dB
Frequency error		
Max. measurement frequency window		16 ppm
Uncertainty		1 Hz + reference frequency uncertainty
Level uncertainty	spectrum mask measurement	0.1 dB
	output power	
	f < 3.6 GHz	0.5 dB
	3.6 GHz ≤ f ≤ 8 GHz	1.5 dB
	ACPR (adjacent channel power ratio)	0.5 dB
Spectrum flatness	f < 3.6 GHz	0.3 dB
	f > 3.6 GHz	0.5 dB

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

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

WiMAX/WiBro 802.16 OFDMA SISO analysis (IEEE 802.16-2004, 802.16-2004/Cor1-2005, 802.16e2005, P802.16Rev2/D3 WiMAX and WiBro)

Frequency

Frequency range	RF input	
	R&S®FSQ3	50 MHz [7] to 3.6 GHz
	R&S®FSQ8	50 MHz [7] to 8 GHz
	R&S®FSQ26	50 MHz [7] to 26.5 GHz
	R&S®FSQ40	50 MHz [7] to 40 GHz
	I/Q baseband inputs (R&S®FSQ-B71)	DC to 36 MHz
Nominal channel bandwidth		1.25 MHz to 28 MHz

Level

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

Signal acquisition

Supported standards		IEEE 802.16-2004 OFDMA SISO, IEEE 802.16-2004/Cor1-2005 OFDMA SISO, IEEE 802.16e-2005 OFDMA SISO, P802.16Rev2/D3 OFDMA SISO, IEEE 802.16e-2005-based WiBro
Capture length	sampling rate (F_s) 1.44 MHz to sampling rate (F_s) 32 MHz	24 µs to 714.2857 ms upper limit decreases linearly 24 µs to 31.25ms
Gate length		24 µs to capture length
Number of analyzed subframes		1 to 10922 subframes
Result length	EVM versus symbol, burst summary list, constellation versus symbol, bit stream	capture length [8]
	spectrum FFT, CCDF	capture length or gate length
	result summary, power versus time, EVM versus carrier, spectrum flatness, spectrum flatness difference, group delay, frequency error versus sample, phase error versus sample	capture length [8] or 1 to 10922 subframes
Frame length		2 ms to 20 ms
Sweep time	spectrum mask,	15 ms to 16000 s, auto
	ACPR (adjacent channel power ratio)	15 ms to 16000 s
Sweep count		1 to 32767
Trigger modes	RF input	free run, IF power, external
	I/Q baseband input	free run, I/Q voltage envelope, external

[7] 5 MHz to 50 MHz with restricted functionality dependent on bandwidth (IF power trigger, auto level, IF overload). Digital downconverting can also be performed in the baseband [requires R&S®FSQ-B71] in order to analyze if applications with center frequency ≥ nominal channel bandwidth (BW)/2.

[8] Max. 100 subframes per capture buffer.

Measurement parameters

Input		RF
	R&S®FSQ-B71	I and Q baseband, balanced-to-unbalanced switchover
Frequency band	predefined bands	offer preset combinations of sampling rate (F_s) and nominal channel bandwidth (BW) in line with the standard
	unspecified	offers F_s/BW ratios in line with the standard or user-defined
Sampling rate (F_s), channel bandwidth (BW)		If one of the parameters is set, the other is automatically set as required for the selected 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
N_{FFT}		128, 512, 1024, 2048
Zones	downlink (DL)	DL-PUSC, DL-FUSC, DL-AMC 2x3
	uplink (UL)	UL-PUSC, UL-AMC 2x3
Signal analysis	DL	in line with DL-MAP signal (auto demod.) normal DL-MAP, compressed DL-MAP
	DL, UL	in line with user-defined frame configuration
IDcell		0 to 31
Segments	DL-PUSC	0, 1, 2
Preamble	preamble mode auto	derived from IDcell and segment setting in line with the standard
	preamble mode user	defined by the preamble index in line with the standard
Subchannel bitmap used	DL-PUSC	6-bit mask allocating subchannel groups to a segment
Burst modulation format		BPSK (pilots only), QPSK, 16QAM, 64QAM
Pilot tracking	DL, UL	phase ON/OFF, timing ON/OFF, level ON/OFF
	DL, UL	use pilots in line with the standard [9] use detected pilots [10]
Channel estimation range	DL	preamble only, preamble and payload, payload only
	UL	payload only
Zone editor		
Zone/segment list	DL, UL	zone type, segment, length in symbols, offset in symbols, PermBase
	DL	PRBS_ID
Zone/segment map		graphical display of frame content defined by zone/segment list
Max. number of zones/segments per subframe/frame		26
Burst editor		
Burst list	DL	modulation, number of subchannels, number of symbols, offset in subchannels, offset in symbols, boosting, burst type: FCH, DL-MAP, data, restricted HARQ
	UL	modulation, duration in slots, offset in subchannels, offset in symbols burst type: data, restricted fast feedback
Burst map		graphical display of zone/segment content defined by burst list

[9] The application computes the pilot modulation sequence used for tracking in line with the standard.

[10] The application detects the pilot modulation sequence used for tracking from the signal to be analyzed.

Max. number of bursts per zone/segment		32
Spectrum emission mask	standard	IEEE, ETSI, TTA
	user	spectrum emission mask is performed in line with the user setting files

Result display

Frame config	auto demod	burst map according to the decoded signal map
Result summary	analyzed subframes min./mean/max. values	center frequency error, clock error, TD power DL preamble, TD power subframe, TD power zone, crest factor, RSSI, RSSI standard deviation, CINR, CINR standard deviation
	analyzed zones/segments min./mean/max. values	BER pilots, EVM data and pilots, EVM data, EVM pilots, unmodulated subcarrier error, I/Q offset, gain imbalance, quadrature error, power DL preamble, power data and pilots, power data, power pilots
Power versus time	min./mean/max. values	full subframe, rising/falling
EVM	min./mean/max. values	EVM versus symbol, EVM versus carrier
Error versus sample	min./mean/max. values	frequency error versus sample, phase error versus sample
Spectrum	min./mean/max. values	spectrum flatness, spectrum flatness difference
	min./mean/max. values	group delay
	clear write, max hold	spectrum mask IEEE [11], ETSI [12], TTA, user
	clear write, max hold	ACP (absolute/relative)
	clear write	spectrum FFT
Constellation		constellation diagram versus symbol
Statistics		CCDF
		bit stream
	downlink, uplink	erroneous pilots are highlighted [13]
		burst summary: modulation format, burst area in slots, power, EVM
Limit check	values in line with the standard	result list center frequency error, clock error, EVM data and pilots, EVM data, I/Q offset, spectrum flatness, spectrum flatness difference, spectrum mask IEEE [14], ETSI [15], TTA, user-definable

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

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

[13] The detected pilot sequence is compared with the pilot sequence in line with the standard. The pilot sequence in line with the standard depends on the IDcell, frame number [UL], PRBS_ID [DL], PermBase [DL] user settings.

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

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

Measurement uncertainty (nominal)

Residual EVM [16]	level 0 dBm, average of 20 bursts	
	f = 2.4 GHz	
	channel estimation: preamble and payload	–55 dB
Residual EVM [16]	level –30 dBm to +15 dBm, average of 20 bursts	
	f = 2.4 GHz or 5 GHz	
	channel estimation: preamble and payload	–46 dB
Frequency error		
Max. measurement frequency window	DL	30 ppm
Uncertainty		1 Hz + reference frequency uncertainty
Spectrum flatness	f < 3.6 GHz	0.3 dB
	f > 3.6 GHz	0.5 dB

[16] This result is based on the following signal: BW = 7 MHz, N_{FFT} = 2048, all 60 subchannels assigned to segment 0. The segment contains one burst of 60 subchannels and 20 OFDMA symbols using a QPSK modulation format.

WiMAX/WiBro 802.16 OFDMA MIMO analysis (IEEE 802.16-2004, 802.16-2004/Cor1-2005, 802.16e-2005, P802.16Rev2/D3 WiMAX and WiBro)

Frequency

Frequency range	RF input	
	R&S®FSQ3	50 MHz [17] to 3.6 GHz
	R&S®FSQ8	50 MHz [17] to 8 GHz
	R&S®FSQ26	50 MHz [17] to 26.5 GHz
	R&S®FSQ40	50 MHz [17] to 40 GHz
	I/Q baseband inputs (R&S®FSQ-B71)	DC to 36 MHz
Nominal channel bandwidth		1.25 MHz to 28 MHz

Level

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

Signal acquisition

Supported standards		IEEE 802.16-2004 OFDMA MIMO, IEEE 802.16-2004/Cor1-2005 OFDMA MIMO, IEEE 802.16e-2005 OFDMA MIMO, P802.16Rev2/D3 OFDMA MIMO, IEEE 802.16e-2005-based WiBro
Capture length	support of 1 RX antenna sampling rate (F_s) 1.44 MHz to sampling rate (F_s) 32 MHz	 24 µs to 228.57 ms upper limit decreases linearly 24 µs to 10 ms
Gate length		24 µs to capture length
Number of analyzed subframes		1 to 10922 subframes
Result length	EVM versus symbol, burst summary list	capture length [18]
	spectrum FFT, CCDF	capture length or gate length
	result summary, power versus time, EVM versus carrier, spectrum flatness, spectrum flatness difference, group delay	capture length [18] or 1 to 10922 subframes
Frame length		2 ms to 20 ms [19]
Sweep time	spectrum mask	15 ms to 16000 s, auto
	ACPR (adjacent channel power ratio)	15 ms to 16000 s
Sweep count		1 to 32767
Trigger modes	RF input	free run, IF power, external
	I/Q baseband input	free run, I/Q voltage envelope, external

[17] 5 MHz to 50 MHz with restricted functionality dependent on bandwidth (IF power trigger, auto level, IF overload). Digital downconverting can also be performed in the baseband [requires R&S®FSQ-B71] in order to analyze if applications with center frequency ≥ nominal channel bandwidth (BW)/2.

[18] Max. 100 subframes per capture buffer.

[19] Supported frame length is restricted by capture length.

Measurement parameters

Input		RF
	R&S®FSQ-B71	I and Q baseband, balanced-to-unbalanced switchover
Frequency band	predefined bands	offer preset combinations of sampling rate (F_s) and nominal channel bandwidth (BW) in line with the standard
	unspecified	offers F_s/BW ratios in line with the standard or user-defined
Sampling rate (F_s), channel bandwidth (BW)		If one of the parameters is set, the other is automatically set as required for the selected 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
N_{FFT}		128, 512, 1024, 2048
Number of supported DUT TX antennas		1,2
Number of supported RX antennas		1
MIMO measurement setup	matrix A	A_0, A_1, $A_0 + A_1$
	matrix B	A_0, A_1
Zones	downlink (DL)	DL-PUSC
Signal analysis	DL	in line with user-defined frame configuration
IDcell		0 to 31
Segments	DL-PUSC	0, 1, 2
Preamble	preamble mode auto	derived from IDcell and segment setting in line with the standard
	preamble mode user	defined by the preamble index in line with the standard
Subchannel bitmap used	DL-PUSC	6-bit mask allocating subchannel groups to a segment
Burst modulation format		BPSK (pilots only), QPSK, 16QAM, 64QAM
Pilot tracking	DL	phase ON/OFF, timing ON/OFF, level ON/OFF
	DL	use pilots in line with the standard [20], use detected pilots [21]
Channel estimation range	DL	preamble only, preamble and payload, payload only
Zone editor		
Zone/segment list	DL	zone type, segment, length in symbols, offset in symbols, PermBase, STC/MIMO config: no STC, 2 TX antennas matrix indicator: matrix A, matrix B, burst defined
	DL	PRBS_ID
Zone/segment map		graphical display of frame content defined by zone/segment list
Max. number of zones/segments per subframe/frame		26
Burst editor		
Burst list	DL	modulation, number of subchannels, number of symbols, offset in subchannels, offset in symbols, boosting, burst type: FCH, DL-MAP, data matrix indicator: matrix A, matrix B
Burst map		graphical display of zone/segment content defined by burst list

[20] The application computes the pilot modulation sequence used for tracking in line with the standard.

[21] The application detects the pilot modulation sequence used for tracking from the signal to be analyzed.

Max. number of bursts per zone/segment		32
Spectrum emission mask	standard	IEEE, ETSI, TTA
	user	spectrum emission mask is performed in line with the user setting files

Result display

Result summary	analyzed subframes min./mean/max. values	center frequency error, clock error, TD power DL preamble, TD power subframe, TD power zone, crest factor
	analyzed zones/segments min./mean/max. values	BER pilots, EVM data and pilots, EVM data, EVM pilots, unmodulated subcarrier error, I/Q offset, gain imbalance, quadrature error, power DL preamble, power data and pilots, power data, power pilots, power null pilots
Power versus time	min./mean/max. values	full subframe, rising/falling
EVM	min./mean/max. values	EVM versus symbol, EVM versus carrier
Spectrum	min./mean/max. values	spectrum flatness, spectrum flatness difference
	min./mean/max. values	group delay
	clear write, max hold	spectrum mask IEEE [22], ETSI [23], TTA, user
	clear write, max hold	ACP (absolute/relative)
	clear write	spectrum FFT
Statistics		CCDF, burst summary modulation format, burst area in slots, power, burst power null pilots, EVM
Limit check	values in line with the standard	result list center frequency error, clock error, EVM data and pilots, EVM data, I/Q offset, spectrum flatness, spectrum flatness difference, spectrum mask IEEE [24], ETSI [25], TTA, user-definable

Measurement uncertainty (nominal)

Residual EVM [26]	level 0 dBm, average of 20 bursts	
	f = 2.4 GHz	
	channel estimation: preamble and payload	–50 dB
Residual EVM [26]	level –30 dBm to +10 dBm, average of 20 bursts	
	f = 2.4 GHz or 5 GHz	
	channel estimation: payload	–46 dB
Frequency error		
Max. measurement frequency window	DL	30 ppm
Uncertainty		1 Hz + reference frequency uncertainty
Spectrum flatness	f < 3.6 GHz	0.3 dB
	f > 3.6 GHz	0.5 dB

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

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

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

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

[26] This result is based on the following MIMO DL signal: BW = 8.75 MHz, N_{FFT} = 1024, all 30 subchannels assigned to segment 0. The second MIMO matrix B PUSC zone contains one QPSK burst using all 30 subchannels over 16 OFDMA symbols.

Ordering information

Designation	Type	Order No.
WiMAX 802.16e MIMO Application Firmware	R&S®FSQ-K94	1308.9770.02
IEEE 802.16-2004/Cor1-2005, IEEE 802.16e-2005 OFDMA, WiMAX, WiBro Application Firmware	R&S®FSQ-K93	1300.8600.02
Upgrade R&S®FSQ-K92 to R&S®FSQ-K93	R&S®FSQ-K92U	1300.8500.02
WiMAX 802.16-2004 Application Firmware	R&S®FSQ-K92	1300.7410.02
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 26.5 GHz	R&S®FSQ26	1155.5001.26
Signal Analyzer 20 Hz to 40 GHz	R&S®FSQ40	1155.5001.40
Recommended options and extras	**see also specifications for the R&S®FSQ signal analyzer (PD 0758.0945.22)**	
I/Q Baseband Inputs	R&S®FSQ-B71	1157.0113.03
I/Q Bandwidth Extension	R&S®FSQ-B72	1157.0336.02

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.

[3] P802.16Rev2/D2 (December 2007) (Revision of IEEE Std 802.16-2004 and consolidates material from IEEE Std 802.16e-2005, IEEE Std 802.16-2004/Cor1-2005, IEEE Std 802.16f-2005 and IEEE Std 802.16g-2007)

[4] P802.16Rev2/D3 (February 2008) (Revision of IEEE Std 802.16-2004 and consolidates material from IEEE Std 802.16e-2005, IEEE Std 802.16-2004/Cor1-2005, IEEE Std 802.16f-2005 and IEEE Std 802.16g-2007)

[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.

The specifications of the R&S®FSQ-K92/K93/K94 WIMAX, WiBro application firmware are based on the data sheet of the R&S®FSQ signal analyzer. Specifications apply under the following conditions: 30 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and all internal automatic adjustments performed. "Typical values" are designated with the abbreviation "typ." These values are verified during the final test but are not assured by Rohde & Schwarz. "Nominal values" are design parameters that are not assured by Rohde & Schwarz. These values are verified during product development but are not specifically tested during production.

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