R&S®FSW-K192/-K193 DOCSIS 3.1 OFDM/OFDMA Downstream/Upstream Measurement Application

Specifications

ROHDE & SCHWARZ

CONTENTS

Definitions

General

Product data applies under the following conditions:

- Three hours storage at ambient temperature followed by 30 minutes warm-up operation
- Specified environmental conditions met
- Recommended calibration interval adhered to
- All internal automatic adjustments performed, if applicable

Specifications with limits

Represent warranted product performance by means of a range of values for the specified parameter. These specifications are marked with limiting symbols such as <, ≤, >, ≥, ±, or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design. Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.
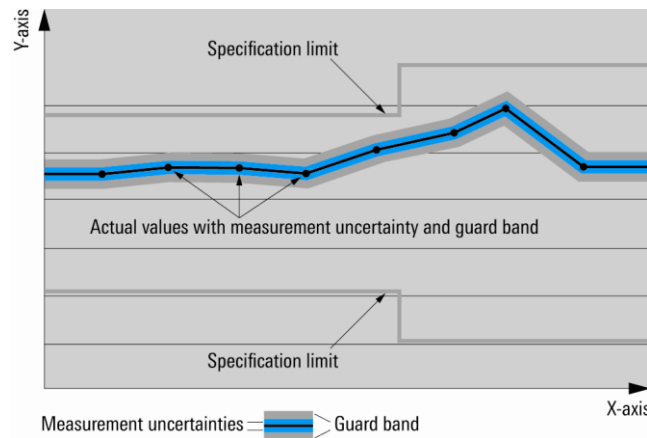
Specifications without limits

Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (e.g. dimensions or resolution of a setting parameter). Compliance is ensured by design.

Typical data (typ.)

Characterizes product performance by means of representative information for the given parameter. When marked with <, > or as a range, it represents the performance met by approximately 80 % of the instruments at production time. Otherwise, it represents the mean value.

Nominal values (nom.)

Characterize product performance by means of a representative value for the given parameter (e.g. nominal impedance). In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

Measured values (meas.)

Characterize expected product performance by means of measurement results gained from individual samples.

Uncertainties

Represent limits of measurement uncertainty for a given measurand. Uncertainty is defined with a coverage factor of 2 and has been calculated in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM), taking into account environmental conditions, aging, wear and tear.

Device settings and GUI parameters are designated with the format "parameter: value".

Typical data as well as nominal and measured values are not warranted by Rohde & Schwarz.

Specifications

The specifications of the R&S®FSW-K192/K193 DOCSIS 3.1 OFDM/OFDMA downstream/upstream measurement applications are based on the specifications in the data sheet for the R&S®FSW signal and spectrum analyzer. They have not been checked separately and are not verified during instrument calibration. Measurement uncertainties are given as 95 % confidence intervals. They apply to the specified symbol rates. The specified level measurement errors do not take into account systematic errors due to reduced signal-to-noise ratio (S/N).

OFDM and OFDMA analysis requirements

- R&S®FSW-B320 320 MHz analysis bandwidth option with order no. 1325.4867.04

Level

Level range	RF input	−50 dBm [1] to +30 dBm
Level setting		manual

R&S®FSW-K192 DOCSIS 3.1 OFDM downstream specifications

Frequency

Frequency range	R&S®FSW8 recommended	108 MHz to 1794 MHz

Signal acquisition

Supported standards		DOCSIS 3.1 OFDM downstream
Input		RF
Result length	result summary: MER data and pilot, MER data, MER pilot, center frequency error, sample/symbol clock error, trigger to PLC time stamp ref point, power signal content summary [3]	1 frame or number of frames to analyze
	spectrum flatness, MER versus carrier, MER versus symbol, group delay, constellation, bitstream, MER versus symbol × carrier, power versus symbol × carrier, signal content detailed, signal content summary	1 frame
	magnitude capture, power spectrum	capture time
Frame length		128 symbol
Triggering	RF input	free run, external

Result display

Result summary		MER data and pilot
		MER data
		MER pilot
		center frequency error
		sample/symbol clock error
		trigger to PLC time stamp ref point
		power
Signal content detailed	pilots, PLC preamble	modulation, MER, power
	PLC data	modulation, MER, power
		LDPC bit err pre, LDPC BER pre
		LDPC CW err post, LDPC BLER post
	NCP	modulation, MER, power
		LDPC bit err pre, LDPC BER pre
		LDPC CW err post, LDPC BLER post
	codeword	modulation, MER, power
		LDPC bit err pre, LDPC BER pre
		LDPC bit err post, LDPC BER post
		LDPC CW err post, LDPC BLER post

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[1] Requires R&S®FSW-B24 RF preamplifier option.

[3] The individual signal content summary measurements are listed under result display in this document.

Signal content summary	pilots, PLC preamble	modulation, MER
	PLC data, NCP all, profiles	modulation, MER
		LDPC bit err pre, LDPC BER pre
		LDPC bit err post, LDPC BER post
		LDPC CW err post, LDPC BLER post
Power		magnitude capture
		power versus symbol × carrier
MER		MER versus symbol
		MER versus carrier
		MER versus symbol × carrier
Spectrum		power spectrum
		spectrum flatness
		group delay
Constellation		constellation diagram
Bitstream		raw bits, raw bits descrambled, input bits LDPC, output bits LDPC, info bits: decoded payload data

Measurement parameters

Stream direction		downstream
Data capture settings	capture time	24 µs to 470 ms
	frame statistic count	on/off
	number of frames to analyze [4]	
	frame statistic count off	all frames to be analyzed in one capture memory
	frame statistic count on	1 frame to 10 000 frames
Channel bandwidth		24 MHz to 192 MHz
FFT size		4k, 8k
Cyclic prefix		192, 256, 512, 768, 1024 samples
		auto
Windowing		0, 64, 128, 192, 256 samples
		auto max. roll-off
Modulation mode		16QAM, 64QAM, 128QAM, 256QAM, 512QAM, 1024QAM, 2048QAM, 4096QAM, 8192QAM, 16384QAM
Demodulation	continuous pilots	auto
		user defined
	frame configuration (NCP content)	auto
		user defined
	PLC content	auto detection
		user defined
Tracking		phase on/off
		time on/off

Residual MER [5]	R&S®FSW8, single channel 192 MHz bandwidth, center frequency 600 MHz, mixer level [6] = –8 dBm, preamplifier = off	57 dB (nom.)
Level uncertainty	power	same as R&S®FSW (see R&S®FSW total measurement uncertainty)

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[4] Statistic over multiple frames is only available for the result summary and signal content summary measurements.

[5] Requires R&S®FSW-B320 option with order no. 1325.4867.04.

[6] Level of a tone at the input mixer (also abbreviated as mixer level) = signal level – RF attenuation + preamplifier gain.

R&S®FSW-K193 DOCSIS 3.1 OFDMA upstream specifications

Frequency

Frequency range	R&S®FSW8 recommended	5 MHz to 204 MHz

Signal acquisition

Supported standards		DOCSIS 3.1 OFDMA upstream
Input		RF
Result length	result summary: MER data and pilot, MER data, MER pilot, center frequency error, sample/symbol clock error, trigger to frame, power	1 frame or number of frames to analyze
	spectrum flatness, power versus carrier, MER versus carrier, MER versus symbol, group delay, constellation, MER versus symbol × carrier, power versus symbol × carrier, signal content detailed	1 frame
	magnitude capture, power spectrum	capture time
Symbols per frame (K)	N_{FFT}: 2k	6, 7 to 36
	N_{FFT}: 4k	6, 7 to 18
Triggering	RF input	free run, external, if power

Result display

Result summary		MER data and pilot
		MER data
		MER pilot
		center frequency error
		sample/symbol clock error
		trigger to frame
		power
Signal content detailed	pilots	modulation, MER, power
	minislot set	modulation, MER, power
	complementary pilots	modulation, MER, power
Power		magnitude capture
		power versus symbol × carrier
MER		MER versus symbol
		MER versus carrier
		MER versus symbol × carrier
Spectrum		power versus carrier
		power spectrum
		spectrum flatness
		group delay
Constellation		constellation diagram

Measurement parameters

Stream direction		upstream
Data capture settings	capture time	24 µs to 470 ms
	frame statistic count	on/off
	number of frames to analyze [8]	
	frame statistic count off	all frames to be analyzed in one capture memory
	frame statistic count on	1 frame to 10 000 frames
Channel bandwidth		up to 96 MHz
FFT size (N_{FFT})		2k, 4k
Cyclic prefix		96, 128, 160, 192, 224, 256, 288, 320, 384, 512, 640 samples
		auto
Windowing		0, 32, 64, 96, 128, 160, 192, 224 samples
		auto max. roll-off
Modulation mode		Zero valued, BPSK, QPSK, 8QAM, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 512QAM, 1024QAM, 2048QAM, 4096QAM
Pilot pattern	N_{FFT}: 2k	1, 2 to 7
	N_{FFT}: 4k	8, 9 to 14
Number of minislots		1, 2 to 237
Channel estimation		equalized MER
		unequalized MER
		partial equalization
Tracking		time on/off

Residual MER [9]	R&S®FSW8, single channel 96 MHz bandwidth, center frequency 100 MHz, mixer level [10] = –8 dBm, preamplifier = off	
	5% grant	63 dB (nom.)
	100% grant	57 dB (nom.)
Level uncertainty	power	same as R&S®FSW (see R&S®FSW total measurement uncertainty)

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[8] Statistic over multiple frames is only available for the result summary and signal content summary measurements.

[9] Requires R&S®FSW-B320 option with order no. 1325.4867.04.

[10] Level of a tone at the input mixer (also abbreviated as mixer level) = signal level – RF attenuation + preamplifier gain.

Ordering information

Designation	Type	Order No.	Retrofittable	Remarks
DOCSIS 3.1 OFDM Downstream Measurement Application	R&S®FSW-K192	1325.4138.02	yes	user-retrofittable
DOCSIS 3.1 OFDMA Upstream Measurement Application	R&S®FSW-K193	1325.4144.02	yes	user-retrofittable
Signal and Spectrum Analyzer, 2 Hz to 8 GHz	R&S®FSW8	1312.8000.08		
Signal and Spectrum Analyzer, 2 Hz to 13.6 GHz	R&S®FSW13	1312.8000.13		
Signal and Spectrum Analyzer, 2 Hz to 26.5 GHz	R&S®FSW26	1312.8000.26		
Signal and Spectrum Analyzer, 2 Hz to 43.5 GHz	R&S®FSW43	1312.8000.43		
Signal and Spectrum Analyzer, 2 Hz to 50 GHz	R&S®FSW50	1312.8000.50		
Signal and Spectrum Analyzer, 2 Hz to 67 GHz	R&S®FSW67	1312.8000.67		
Mandatory options and extras				
320 MHz Analysis Bandwidth	R&S®FSW-B320	1325.4867.04	yes	contact service center
Recommended options and extras				
RF Preamplifier, 100 kHz to 13.6 GHz	R&S®FSW-B24	1313.0832.13	yes	contact service center
RF Preamplifier, 100 kHz to 26.5 GHz	R&S®FSW-B24	1313.0832.26	yes	contact service center
RF Preamplifier, 100 kHz to 43.5 GHz	R&S®FSW-B24	1313.0832.43	yes	for R&S®FSW43/50/67 (no export license required); contact service center
RF Preamplifier, 100 kHz to 50 GHz	R&S®FSW-B24	1313.0832.50	yes	for R&S®FSW50; export license required; contact service center
RF Preamplifier, 100 kHz to 67 GHz	R&S®FSW-B24	1313.0832.67	yes	for R&S®FSW67; export license required; contact service center
Electronic Attenuator, 1 dB steps	R&S®FSW-B25	1313.0990.02	yes	for R&S®FSW8/13/26; contact service center

See also R&S®FSW signal and spectrum analyzer data sheet (PD 5214.5984.22).

For R&S®FSW product brochure, see PD 5214.5984.12 and www.rohde-schwarz.com

About Rohde & Schwarz

The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, radiomonitoring and radiolocation. Founded more than 80 years ago, this independent company has an extensive sales and service network and is present in more than 70 countries. The electronics group is among the world market leaders in its established business fields. The company is headquartered in Munich, Germany. It also has regional headquarters in Singapore and Columbia, Maryland, USA, to manage its operations in these regions.

Sustainable product design

ı Environmental compatibility and eco-footprint
ı Energy efficiency and low emissions
ı Longevity and optimized total cost of ownership

Certified Quality Management
ISO 9001

Certified Environmental Management
ISO 14001

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