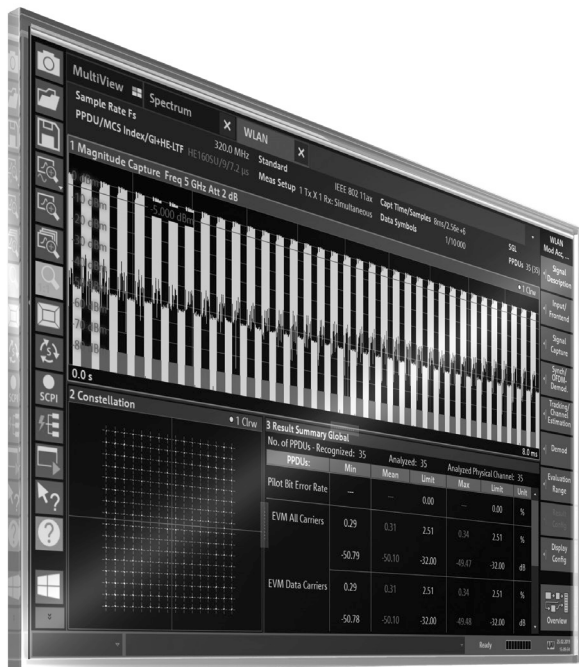


# WLAN IEEE 802.11a/b/g/j/p/n/ac/ax Measurement Application Specifications

R&S®FPS/FSV3/FSW/VSE-K91/K91n/K91ac WLAN IEEE 802.11a/b/g/j/p/n/ac Measurement Application  
R&S®FSV3/FSW-K91ax WLAN IEEE 802.11ax Measurement Application



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# Definitions

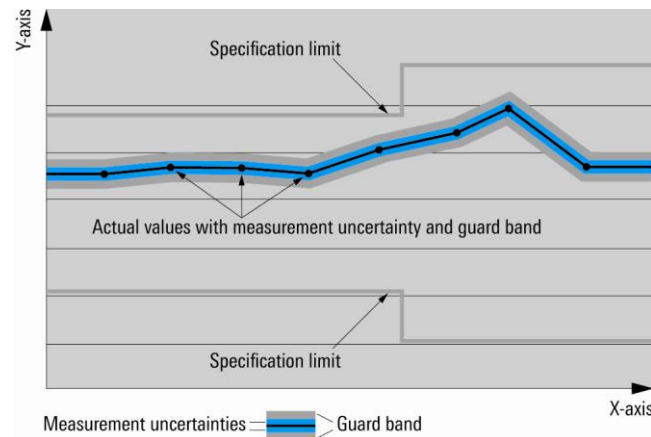
## General

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  $<$ ,  $\leq$ ,  $>$ ,  $\geq$ ,  $\pm$ , 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.



## Non-traceable specifications with limits (n. trc.)

Represent product performance that is specified and tested as described under "Specifications with limits" above. However, product performance in this case cannot be warranted due to the lack of measuring equipment traceable to national metrology standards. In this case, measurements are referenced to standards used in the Rohde & Schwarz laboratories.

## 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 indicated as follows: "parameter: value".

Non-traceable specifications with limits, typical data as well as nominal and measured values are not warranted by Rohde & Schwarz.

In line with the 3GPP/3GPP2 standard, chip rates are specified in Mcps (million chips per second), whereas bit rates and symbol rates are specified in Mbps (million bits per second), kbps (thousand bits per second) or ksps (thousand symbols per second), and sample rates are specified in Msample/s (million samples per second). Mcps, kbps, ksps and Msample/s are not SI units.

## Specifications

The specifications of the R&S®VSE-K91/p/n/ac and R&S®FSx-K91/p/n/ac/ax WLAN measurement applications are based on the data sheet specifications of the R&S®FSW, R&S®FSVA3000, R&S®FSV3000 and R&S®FPS signal and spectrum analyzers. They have not been checked separately and are not verified during instrument calibration. Measurement uncertainties are given as 95 % confidence intervals. The specified level measurement errors do not take into account systematic errors due to reduced signal-to-noise ratio (SNR).

## General remarks

This data sheet covers the R&S®FSW-K91/p/n/ac/ax, the R&S®FSV3-K91/p/n/ac/ax, the R&S®FPS-K91/p/n/ac and the R&S®VSE-K91/p/n/ac.

The R&S®FSW-K91/p/n/ac/ax, R&S®FSV3-K91/p/n/ac/ax and R&S®FPS-K91/p/n/ac are summarized with the term R&S®FSx-K91/p/n/ac/ax.

The R&S®FSx-K91/p/n/ac/ax runs on the device itself.

The R&S®VSE-K91/p/n/ac runs on a PC that can be connected to the analyzers and oscilloscopes as specified below.

If not stated otherwise, the data sheet values are device-specific, e.g. the same value applies to the R&S®FSW-K91/p/n/ac and the R&S®VSE-K91/p/n/ac with connected R&S®FSW.

For feature tables the following convention applies:

•	Feature always supported i.e. with the R&S®VSE-K91/p/n/ac connected to the device and with the corresponding R&S®FSx-K91/p/n/ac option when running directly on the device.
• (VSE)	Feature supported only with the R&S®VSE-K91/p/n/ac connected to the device. Not with the corresponding R&S®FSx-K91/p/n/ac/ax option when running directly on the device.
• (FSx-K91/p/n/ac/ax)	Feature supported only when running directly on the device with the corresponding R&S®FSx-K91/p/n/ac/ax option. Not supported in the R&S®VSE-K91/p/n/ac.
–	Feature not supported with this device.

## Overview

	R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
R&S®FSx-K91/p/n/ac/ax, software that runs on device	• (FSW-K91/p/n/ac/ax)	• (FSV3-K91/p/n/ac/ax)	• (FPS-K91/p/n/ac)
R&S®VSE-K91/p/n/ac, PC software that can be connected to a device	•	• R&S®VSE firmware version 1.62 or higher required	•

## OFDM analysis (IEEE 802.11a, IEEE 802.11g-OFDM, IEEE 802.11j, IEEE 802.11p, IEEE 802.11n, IEEE 802.11ac, IEEE 802.11ax)

### Level

		R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
Level range	RF input	-70 dBm <sup>1</sup> to +30 dBm	-70 dBm <sup>2</sup> to +30 dBm	-70 dBm <sup>3</sup> to +30 dBm
Level setting	auto level	• (FSW-K91/p/n/ac/ax)	–	• (FPS-K91/p/n/ac)
	manual	•	•	•

### Inputs

	R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
RF input	•	•	•
Digital baseband input	• (FSW-K91/p/n/ac/ax) <sup>4</sup>	–	–
Analog baseband input	• (FSW-K91/p/n/ac/ax) <sup>5</sup>	–	–
File	•	•	•

### Signal acquisition

		R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
Supported standards		IEEE 802.11a, IEEE 802.11g-OFDM, IEEE 802.11j <sup>6</sup> , IEEE 802.11p, IEEE 802.11n, IEEE 802.11ac		
		IEEE 802.11ax (FSW-K91ax)	IEEE 802.11ax (FSV3-K91ax)	–
Capture length	IEEE 802.11a/j/g-OFDM/p	24 µs to 200 ms (FSW-K91/p)	24 µs to 200 ms (FSV3-K91/p)	24 µs to 200 ms (FPS-K91/p)
	IEEE 802.11n	24 µs to 200 ms (FSW-K91n)	24 µs to 200 ms (FSV3-K91n)	24 µs to 200 ms (FPS-K91n)
	IEEE 802.11ac	24 µs to 200 ms <sup>7</sup> (FSW-K91ac)	24 µs to 200 ms <sup>7</sup> (FSV3-K91ac)	24 µs to 200 ms <sup>7</sup> (FPS-K91ac)
	IEEE 802.11ax	24 µs to 200 ms <sup>7</sup> (FSW-K91ax)	24 µs to 200 ms <sup>7</sup> (FSV3-K91ax)	–
Sample rate	IEEE 802.11a/g-OFDM/p	5/10/20/40 MHz	5/10/20/40 MHz	5/10/20/40 MHz
	IEEE 802.11n	10/20/40/80 MHz	10/20/40/80 MHz	20/40/80 MHz
	IEEE 802.11ac	10/20/40/80/160/320 MHz	10/20/40/80/160/320 MHz	20/40/80/160/320 MHz
	IEEE 802.11ax	20/40/80/160/320 MHz	20/40/80/160/320 MHz	–

<sup>1</sup> Requires R&S®FSW-B24 RF preamplifier option.

<sup>2</sup> Requires R&S®FSV3-B24 RF preamplifier option.

<sup>3</sup> Requires R&S®FPS-B22 or R&S®FPS-B24 RF preamplifier option.

<sup>4</sup> Requires R&S®FSW-B17 option.

<sup>5</sup> Requires R&S®FSW-B71 option.

<sup>6</sup> Supported for R&S®FSW-K91, R&S®FSV3-K91 and R&S®FPS-K91.

<sup>7</sup> One RX antenna analysis allows up to 200 ms capture time. In case of MIMO analysis, the maximum capture time scales reciprocally proportional to the number of RX antennas and the CBW of the signal to be analyzed. For example, CBW160 signal analysis: two RX antenna analysis up to 100.0 ms capture time; three RX antenna analysis up to 66.66 ms capture time; four RX antenna analysis up to 50.0 ms capture time. For example, CBW80 signal analysis: two RX antenna analysis up to 200.0 ms capture time; three RX antenna analysis up to 133.33 ms capture time; four RX antenna analysis up to 100.0 ms capture time.

		R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
Usable I/Q bandwidth	IEEE 802.11a/g-OFDM/p	5/10/20 MHz	5/10/20 MHz	5/10/20 MHz
	IEEE 802.11n	5/10/20/40 <sup>8</sup> MHz	5/10/20/40 <sup>9</sup> MHz	20/40 <sup>10</sup> MHz
	IEEE 802.11ac	5/10/20/40 <sup>8</sup> /80 <sup>11</sup> /160 <sup>12</sup> MHz	5/10/20/40 <sup>9</sup> /80 <sup>13</sup> /160 <sup>13</sup> MHz	20/40 <sup>10</sup> /80 <sup>14</sup> /160 <sup>14</sup> MHz
	IEEE 802.11ax	20, 40 <sup>8</sup> /80 <sup>11</sup> /160 <sup>12</sup> MHz (FSW-K91ax)	20/40 <sup>9</sup> /80 <sup>13</sup> /160 <sup>13</sup> MHz (FSV3-K91ax)	–
Trigger modes	RF input	free run	•	•
		external	•	•
		IF power <sup>15</sup>	•	•
		I/Q power	•	–

## Measurement parameters

		R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
PPDU statistic count		on/off		
Number of PPDU's to analyze		1 to 10922		
PPDU statistic count off		all PPDU's to be analyzed in one capture memory		
PPDU statistic count on		1 PPDU to 10922 PPDU's		
<b>Channel bandwidth (CBW)</b>		sample rate ( $F_s$ ) and $N_{FFT}$ are set depending on the channel bandwidth		
IEEE 802.11a/g-OFDM/p		CBW5, CBW10, CBW20	CBW5, CBW10, CBW20	CBW5, CBW10, CBW20
IEEE 802.11n		CBW20, CBW40 <sup>8</sup>	CBW20, CBW40 <sup>9</sup>	CBW20, CBW40 <sup>10</sup>
IEEE 802.11ac		CBW20, CBW40 <sup>8</sup> , CBW80 <sup>11</sup> , CBW80+80 <sup>11</sup> , CBW160 <sup>12</sup>	CBW20, CBW40 <sup>9</sup> , CBW80 <sup>13</sup> , CBW80+80 <sup>13</sup> , CBW160 <sup>13</sup>	CBW20, CBW40 <sup>10</sup> , CBW80 <sup>14</sup> , CBW80+80 <sup>14</sup> , CBW160 <sup>14</sup>
IEEE 802.11ax		CBW20, CBW40 <sup>8</sup> , CBW80 <sup>11</sup> , CBW80+80 <sup>11</sup> , CBW160 <sup>12</sup> (FSW-K91ax)	CBW20, CBW40 <sup>9</sup> , CBW80 <sup>13</sup> , CBW80+80 <sup>13</sup> , CBW160 <sup>13</sup> (FSV3-K91ax)	–
Filter out adjacent channels <sup>16</sup>		on/off		
<b>PPDU format</b>				
IEEE 802.11n		auto, HT-MF, HT-GF		
IEEE 802.11ac		auto, VHT		
IEEE 802.11ax		auto, HE SU, HE MU, HE Trigger- Based, HE Extended Range (FSW-K91ax)	auto, HE SU, HE MU, HE Trigger- Based, HE Extended Range (FSV3-K91ax)	–

<sup>8</sup> Requires R&S®FSW-B40 40 MHz analysis bandwidth option or higher.

<sup>9</sup> Requires R&S®FSV3-B40 40 MHz analysis bandwidth option or higher.

<sup>10</sup> Requires R&S®FPS-B40 40 MHz analysis bandwidth option or higher.

<sup>11</sup> Requires R&S®FSW-B80 80 MHz analysis bandwidth option or higher.

<sup>12</sup> Requires R&S®FSW-B160 160 MHz analysis bandwidth option or higher.

<sup>13</sup> Requires R&S®FSV3-B200 200 MHz analysis bandwidth option or higher.

<sup>14</sup> Requires R&S®FPS-B160 160 MHz analysis bandwidth option.

<sup>15</sup> Restricted functionality at carrier frequencies < 50 MHz.

<sup>16</sup> Not supported for K91b/g-DSSS.

	R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
<b>Guard interval</b>			
IEEE 802.11n/ac	auto, short, long		
IEEE 802.11ax	auto, 0.8 μs, 1.6 μs, 3.2 μs (FSW-K91ax)	auto, 0.8 μs, 1.6 μs, 3.2 μs (FSV3-K91ax)	–
<b>HE-LTF size</b>			
IEEE 802.11ax	auto, 3.2 μs, 6.4 μs, 12.8 μs (FSW-K91ax)	auto, 3.2 μs, 6.4 μs, 12.8 μs (FSV3-K91ax)	–
<b>Modulation format</b>			
IEEE 802.11a/g-OFDM/p/n/ac	BPSK, QPSK, 16QAM, 64QAM		
IEEE 802.11ac	256QAM, 1024QAM		
IEEE 802.11ax	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM (FSW-K91ax)	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM (FSV3-K91ax)	–
<b>Demodulator setting</b>			
<b>MIMO</b>	auto, manual with/without using the signal field		
Configuration	• (FSW-K91n/ac/ax)	• (FSV3-K91n/ac/ax)	• (FPS-K91n/ac)
IEEE 802.11n	1 to 4 TX antennas	1 to 4 TX antennas	1 to 4 TX antennas
IEEE 802.11ac	1 to 8 TX antennas	1 to 8 TX antennas	1 to 8 TX antennas
IEEE 802.11ax	1 to 8 TX antennas (FSW-K91ax)	1 to 8 TX antennas (FSV3-K91ax)	–
MIMO antenna signal capture setup	simultaneous <sup>17</sup> , sequential using R&S®OSP open switch and control platform <sup>18</sup> , sequential		
Spatial mapping	direct, spatial expansion, user defined		
<b>Source of payload length</b>	estimate from signal, take from signal field (-K91a/g-OFDM/p/n/ac, FSW-K91ax)	estimate from signal, take from signal field (-K91a/g-OFDM/p/n/ac, FSV3-K91ax)	estimate from signal, take from signal field (-K91a/g-OFDM/p/n/ac)
<b>Pilot tracking</b>	phase on/off, timing on/off, level on/off		
<b>Channel estimation</b>	preamble, preamble and data		
<b>I/Q mismatch compensation</b> <sup>19</sup>	on/off		

<sup>17</sup> Requires an R&S®FSW/FPS/FSV for each TX antenna to be measured.

<sup>18</sup> Requires an R&S®OSP open switch and control platform from Rohde & Schwarz.

<sup>19</sup> Not supported for K91b/g-DSSS.



## Result display

	R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
<b>Result summary</b>			
Center frequency error	•	•	•
Symbol clock error	•	•	•
EVM all carriers	•	•	•
EVM pilots	•	•	•
EVM payload	•	•	•
I/Q offset <sup>20</sup>	•	•	•
Gain imbalance <sup>20</sup>	•	•	•
Quadrature offset <sup>20</sup>	•	•	•
Mean PPDU power	•	•	•
Crest factor	•	•	•
<b>Power versus time</b>			
Magnitude capture	•	•	•
Full PPDU	•	•	•
Rising falling PPDU	•	•	•
<b>EVM</b>			
EVM versus carrier	•	•	•
EVM versus symbol	•	•	•
<b>Spectrum</b>			
Spectrum flatness	•	•	•
Group delay	•	•	•
FFT spectrum	•	•	•
Spectrum mask	• (FSW-K91/n/ac/ax)	• (FSV3-K91/n/ac/ax)	• (FPS-K91/n/ac)
ACP	• (FSW-K91/n/ac/ax)	• (FSV3-K91/n/ac/ax)	• (FPS-K91/n/ac)
<b>Constellation</b>			
Constellation diagram	•	•	•
Constellation versus carrier	•	•	•
<b>Statistics/miscellaneous</b>			
CCDF	•	•	•
Signal field	•	•	•
Bit stream	• (K91/n/ac)	• (K91/n/ac)	•

<sup>20</sup> HE OFDMA PPDU's require symmetrical subcarrier usage around the DC.

**Measurement uncertainty (nominal)**

Signal level at -10 dBm

	<b>R&amp;S®FSW8</b>	<b>R&amp;S®FSVA3000</b>	<b>R&amp;S®FSV3000</b>	<b>R&amp;S®FPS</b>
<b>Residual EVM in dB</b>	level -10 dBm <sup>21</sup> , average of 20 PPDU	level -10 dBm <sup>22</sup> , average of 20 PPDU		level -10 dBm <sup>23</sup> , average of 20 PPDU
<b>Input = RF, f<sub>center</sub> = 2.4 GHz</b>				
Channel estimation = preamble and data				
IEEE 802.11a/g-OFDM/j/p signal				
5 MHz	-56.0	-55.5	-55.0	-55.0
10 MHz	-56.1	-55.6	-55.1	-55.0
20 MHz	-56.1	-55.6	-55.1	-55.0
IEEE 802.11n signal				
20 MHz	-55.5	-55.0	-55.0	-55.0
40 MHz	-54.2	-54.0	-53.8	-53.5
Channel estimation = preamble				
IEEE 802.11a/p signal				
5 MHz	-55.5	-55.3	-55.1	-55.0
10 MHz	-55.6	-55.3	-55.1	-55.0
20 MHz	-55.5	-55.3	-55.1	-55.0
IEEE 802.11n signal				
20 MHz	-53.6	-52.0	-52.0	-53.0
40 MHz	-51.6	-51.2	-51.1	-50.8
<b>Input = RF, f<sub>center</sub> = 5.8 GHz</b>				
Channel estimation = preamble and data				
IEEE 802.11a/p signal				
5 MHz	-	-	-	-
10 MHz	-	-	-	-
20 MHz	-	-	-	-
IEEE 802.11n signal				
20 MHz	-54.7	-53.2	-52.7	-52.5
40 MHz	-53.8	-53.3	-52.8	-50.9
IEEE 802.11ac signal				
20 MHz	-53.5	-52.1	-52.1	-52.1
40 MHz	-52.4	-51.9	-51.4	-50.0
80 MHz	-53.2 <sup>24</sup>	-52.7	-52.2	-45.5
	-49.0			
160 MHz	-51.8 <sup>24</sup>	-51.3	-50.8	-44.8
	-46.3			

<sup>21</sup> Requires R&S®FSW-B24 RF preamplifier and R&S®FSW-B25 electronic attenuator, 1 dB step options.

<sup>22</sup> Requires R&S®FSV3-B24 RF preamplifier option.

<sup>23</sup> Requires R&S®FPS-B22 or R&S®FPS-B24 RF preamplifier option and R&S®FPS-B25 electronic attenuator option.

<sup>24</sup> Requires R&S®FSW-B320 320 MHz analysis bandwidth option with order no. 1325.4867.04.

	R&S®FSW8	R&S®FSVA3000	R&S®FSV3000	R&S®FPS
Channel estimation = preamble				
IEEE 802.11a/p signal				
5 MHz	–	–	–	–
10 MHz	–	–	–	–
20 MHz	–	–	–	–
IEEE 802.11n signal				
20 MHz	–52.3	–50.4	–50.4	–50.4
40 MHz	–50.7	–50.7	–50.7	–50.7
IEEE 802.11ac signal				
20 MHz	–51.9	–50.5	–50.2	–50.0
40 MHz	–50.8	–50.3	–50.0	–48.2
80 MHz	–50.5 <sup>24</sup>	–50.0	–49.7	–43.3
	–46.5			
160 MHz	–49.0 <sup>24</sup>	–48.5	–48.2	–41.5
	–43.7			

	R&S®FSW8 <sup>25</sup>	R&S®FSVA3000	R&S®FSV3000	R&S®FPS
<b>Residual EVM in dB</b>	level –10 dBm <sup>26</sup> , average of 20 PPDU	level –10 dBm, average of 20 PPDU		–
<b>Input = RF, f<sub>center</sub> = 2.4 GHz</b>				
Channel estimation = preamble and data				
IEEE 802.11ax HE SU signal <sup>27</sup>				
20 MHz	–55.4	–53.0	–52.5	–
40 MHz	–55.3	–54.8	–54.3	–
80 MHz	–54.1	–53.6	–53.1	–
160 MHz	–52.1 <sup>24</sup>	–51.6	–51.1	–
Channel estimation = preamble				
IEEE 802.11ax HE SU signal				
20 MHz	–54.2	–51.5	–51.0	–
40 MHz	–54.3	–53.8	–53.3	–
80 MHz	–53.2	–52.7	–52.2	–
160 MHz	–51.1 <sup>24</sup>	–50.6	–50.1	–
<b>Input = RF, f<sub>center</sub> = 5.8 GHz</b>				
Channel estimation = preamble and data				
IEEE 802.11ax HE SU signal				
20 MHz	–54.2	–51.5	–51.0	–
40 MHz	–54.1	–53.6	–53.1	–
80 MHz	–53.0	–52.5	–52.0	–
160 MHz	–51.2 <sup>24</sup>	–50.5	–50.0	–

<sup>25</sup> Frontend board order no. 1312.8046 Rev08.26 or newer.

<sup>26</sup> Requires R&S®FSW-B24 RF preamplifier and R&S®FSW-B25 electronic attenuator, 1 dB step options.

<sup>27</sup> HE SU with MCS 9.

	R&S®FSW8 <sup>25</sup>	R&S®FSVA3000	R&S®FSV3000	R&S®FPS
Channel estimation = preamble				
IEEE 802.11ax HE SU signal				
20 MHz	-53.4	-50.2	-49.7	-
40 MHz	-53.1	-52.6	-52.1	-
80 MHz	-52.4	-51.9	-51.4	-
160 MHz	-50.3 <sup>24</sup>	-49.5	-49.0	-

## Signal level at -25/-20/-15/-10/-5/0 dBm

	R&S®FSW8/13/26 <sup>28</sup>	R&S®FPS <sup>29</sup>
<b>Residual EVM in dB</b>	average of 20 PPDUs	average of 20 PPDUs
<b>Input = RF, f<sub>center</sub> = 2.4 GHz</b>		
Channel estimation = preamble and data		
IEEE 802.11a/g-OFDM/j/p signal		
5 MHz	-55.4	-55.0
10 MHz	-55.4	-55.0
20 MHz	-55.2	-54.7
IEEE 802.11n signal		
20 MHz	-54.8	-54.3
40 MHz	-52.0	-51.5
Channel estimation = preamble		
IEEE 802.11a/p signal		
5 MHz	-54.5	-54.0
10 MHz	-54.6	-54.0
20 MHz	-54.5	-54.0
IEEE 802.11n signal		
20 MHz	-52.6	-52.1
40 MHz	-49.2	-48.7
<b>Input = RF, f<sub>center</sub> = 5 GHz</b>		
Channel estimation = preamble and data		
IEEE 802.11a/p signal		
5 MHz	-52.8	-52.3
10 MHz	-52.5	-52.0
20 MHz	-52.8	-52.3
IEEE 802.11n signal		
20 MHz	-52.3	-52.0
40 MHz	-49.8	-49.0
IEEE 802.11ac signal		
20 MHz	-51.4	-51.0
40 MHz	-48.3	-48.0
80 MHz	-47.0	-45.7

<sup>28</sup> Requires R&S®FSW-B24 RF preamplifier and R&S®FSW-B25 electronic attenuator, 1 dB step options.

<sup>29</sup> Requires R&S®FPS-B22 or R&S®FPS-B24 RF preamplifier option and R&S®FPS-B25 electronic attenuator option.

	R&S®FSW8/13/26 <sup>28</sup>	R&S®FPS <sup>29</sup>
160 MHz	-43.5	-43.0
Channel estimation = preamble		
IEEE 802.11a/p signal		
5 MHz	-51.6	-51.1
10 MHz	-51.8	-51.3
20 MHz	-51.8	-51.3
IEEE 802.11n signal		
20 MHz	-50.4	-49.9
40 MHz	-47.7	-47.2
IEEE 802.11ac signal		
20 MHz	-50.1	-49.5
40 MHz	-47.6	-47.1
80 MHz	-44.9	-43.6
160 MHz	-40.5	-40.0

	R&S®FSW8/13/26	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
<b>Frequency error</b>			
Lock range	40 ppm <sup>30</sup>		
Uncertainty	1 Hz + R&S®FSx reference frequency uncertainty (see R&S®FSx reference frequency in the respective data sheet)		
<b>Level uncertainty</b>			
Power	same as R&S®FSx (see R&S®FSx total measurement uncertainty in the respective data sheet)		

<sup>30</sup> For IEEE 802.11a CBW5 signals at 5 GHz: 30 ppm.

## DSSS analysis (IEEE 802.11b, IEEE 802.11g-DSSS)

IEEE 802.11b and IEEE 802.11g-DSSS modulation analysis requires R&S®FSW-B28 28 MHz analysis bandwidth option or higher.

Note: Exclusively one instance of this measurement option is supported.

### Level

		R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
Level range	RF input	-70 dBm <sup>31</sup> to +30 dBm	-70 dBm <sup>32</sup> to +30 dBm	-70 dBm <sup>33</sup> to +30 dBm
Level setting	auto level	• (FSW-K91)	–	• (FPS-K91)
	manual	•	•	•

### Inputs

	R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
RF input	•	•	•

### Signal acquisition

		R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
Supported standards		IEEE 802.11b, IEEE 802.11g-DSSS		
Capture length	IEEE 802.11b/g-DSSS	24 µs to 100 ms		
Sample rate	IEEE 802.11b/g-DSSS	44 MHz		
Usable I/Q bandwidth	IEEE 802.11b/g-DSSS	35.2 MHz		
Trigger modes	RF input	free run	•	•
		external	•	•
		IF power <sup>34</sup>	•	•
		I/Q power	•	–

### Measurement parameters

		R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
<b>Data capture settings</b>				
PPDU statistic count		on/off		
	PPDU statistic count off	all PPDU to be analyzed in one capture memory		
	PPDU statistic count on	1 PPDU to 10922 PPDU		
<b>PPDU format</b>				
<b>Modulation format</b> <sup>35</sup>		short PPDU, long PPDU		
<b>Demodulator settings</b>		DBPSK, DQPSK, CCK, PBCC		
<b>Source of payload length</b>		auto, manual with/without using the PLCP header		
<b>Tracking</b>		take from PLCP header		
		phase on/off, timing on/off, level on/off		

<sup>31</sup> Requires R&S®FSW-B24 RF preamplifier option.

<sup>32</sup> Requires R&S®FSV3-B24 RF preamplifier option.

<sup>33</sup> Requires R&S®FPS-B22 or R&S®FPS-B24 RF preamplifier option.

<sup>34</sup> Restricted functionality at carrier frequencies < 50 MHz.

<sup>35</sup> Corresponds to the data rates 1 Mbps, 2 Mbps, 5.5 Mbps and 11 Mbps.

**Result display**

	R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
<b>Result list</b>			
Center frequency error	•	•	•
Chip clock error	•	•	•
Peak vector error	•	•	•
PPDU EVM	•	•	•
I/Q offset	•	•	•
I/Q gain imbalance	•	•	•
I/Q quadrature error	•	•	•
Rise time	–	–	–
Fall time	–	–	–
Mean power	•	•	•
Peak power	–	–	–
Crest factor	•	•	•
<b>Power versus time</b>			
Magnitude capture	•	•	•
PVT full PPDU	•	•	•
Up ramp/down ramp	–	–	–
<b>EVM</b>			
Vector error IEEE	•	•	•
EVM versus chip	•	•	•
<b>Spectrum</b>			
FFT spectrum	•	•	•
Spectrum mask	• (FSW-K91)	• (FSV3-K91)	• (FPS-K91)
ACP	• (FSW-K91)	• (FSV3-K91)	• (FPS-K91)
<b>Constellation</b>			
Constellation diagram	•	•	•
<b>Statistics/miscellaneous</b>			
PLCP header	•	•	•
Bit stream	•	•	•

**Measurement uncertainty (nominal)**

	<b>R&amp;S®FSW8/13/26</b>	<b>R&amp;S®FSVA3000</b>	<b>R&amp;S®FSV3000</b>	<b>R&amp;S®FPS</b>
<b>Residual PDU EVM</b>	$f_{\text{center}} = 2.442 \text{ GHz}$ , level $-30 \text{ dBm}^{36}$ to $+30 \text{ dBm}$ , average of 20 PDUs <sup>37</sup>	$f_{\text{center}} = 2.4 \text{ GHz}$ , level $-10 \text{ dBm}^{38}$ , average of 20 PDUs		$f_{\text{center}} = 2.442 \text{ GHz}$ , level $-30 \text{ dBm}^{39}$ to $+30 \text{ dBm}$ , average of 20 PDUs <sup>37</sup>
Input = RF	0.45 %	0.45 %	0.47 %	0.6 %
<b>Frequency error</b>				
Lock range	1.3 MHz			
Uncertainty	1 Hz + R&S®FSx reference frequency uncertainty (see R&S®FSx reference frequency in the respective data sheet)			
<b>Level uncertainty</b>				
Power	same as R&S®FSx (see R&S®FSx total measurement uncertainty in the respective data sheet)			

<sup>36</sup> Requires R&S®FSW-B24 RF preamplifier option.

<sup>37</sup> 11 Mbps CCK with short PLCP.

<sup>38</sup> Requires R&S®FSV3-B24 RF preamplifier option.

<sup>39</sup> Requires R&S®FPS-B22 or R&S®FPS-B24 RF preamplifier option and R&S®FPS-B25 electronic attenuator option.



## Ordering information

Designation	Type	Order No.
<b>WLAN measurement applications</b>		
R&S®FSW		
IEEE 802.11a/b/g/j measurements	R&S®FSW-K91	1313.1500.02
IEEE 802.11p measurements	R&S®FSW-K91p	1321.5646.02
IEEE 802.11n measurements <sup>40</sup>	R&S®FSW-K91n	1313.1516.02
IEEE 802.11ac measurements <sup>40</sup>	R&S®FSW-K91ac	1313.4209.02
IEEE 802.11ax measurements <sup>40</sup>	R&S®FSW-K91ax	1331.6345.02
R&S®FSVA3000, R&S®FSV3000		
IEEE 802.11a/b/g/j measurements	R&S®FSV3-K91	1330.5100.02
IEEE 802.11p measurements	R&S®FSV3-K91p	1330.5122.02
IEEE 802.11n measurements <sup>40</sup>	R&S®FSV3-K91n	1330.5139.02
IEEE 802.11ac measurements <sup>40</sup>	R&S®FSV3-K91ac	1330.5116.02
IEEE 802.11ax measurements <sup>40</sup>	R&S®FSV3-K91ax	1346.3399.02
R&S®FPS		
IEEE 802.11a/b/g/j measurements	R&S®FPS-K91	1321.4191.02
IEEE 802.11p measurements	R&S®FPS-K91p	1321.4391.02
IEEE 802.11n measurements <sup>40</sup>	R&S®FPS-K91n	1321.4204.02
IEEE 802.11ac measurements <sup>40</sup>	R&S®FPS-K91ac	1321.4210.02
R&S®VSE		
IEEE 802.11a/b/g measurements	R&S®VSE-K91	1320.7597.06
IEEE 802.11p measurements	R&S®VSE-K91p	1320.7680.02
IEEE 802.11n measurements <sup>40</sup>	R&S®VSE-K91n	1320.7600.06
IEEE 802.11ac measurements <sup>40</sup>	R&S®VSE-K91ac	1320.7616.06
<b>Analyzers</b>		
R&S®FSW		
Signal and spectrum analyzer, 2 Hz to 8 GHz	R&S®FSW8	1331.5003.08
Signal and spectrum analyzer, 2 Hz to 13.6 GHz	R&S®FSW13.6	1331.5003.13
Signal and spectrum analyzer, 2 Hz to 26.5 GHz	R&S®FSW26.5	1331.5003.26
Signal and spectrum analyzer, 2 Hz to 43.5 GHz	R&S®FSW43.5	1331.5003.43
Signal and spectrum analyzer, 2 Hz to 50 GHz	R&S®FSW50	1331.5003.50
Signal and spectrum analyzer, 2 Hz to 67 GHz	R&S®FSW67	1331.5003.67
Signal and spectrum analyzer, 2 Hz to 85 GHz	R&S®FSW85	1331.5003.85

<sup>40</sup> In order to measure WLAN signals with a given channel bandwidth  $\in \{5, 10, 20, 40, 80, 160\}$  MHz, the R&S®FSx requires an analysis bandwidth option greater or equal to this CBW. I.e. the channel bandwidth (CBW) of the WLAN signal to be measured  $\leq$  max. fitted R&S®FSx analysis bandwidth option.

<b>Designation</b>	<b>Type</b>	<b>Order No.</b>
<b>R&amp;S®FSVA3000, R&amp;S®FSV3000</b>		
Signal and spectrum analyzer, 10 Hz to 4 GHz	R&S®FSVA3004	1330.5000.05
Signal and spectrum analyzer, 10 Hz to 7.5 GHz	R&S®FSVA3007	1330.5000.08
Signal and spectrum analyzer, 10 Hz to 13.6 GHz	R&S®FSVA3013	1330.5000.14
Signal and spectrum analyzer, 10 Hz to 30 GHz	R&S®FSVA3030	1330.5000.31
Signal and spectrum analyzer, 10 Hz to 44 GHz	R&S®FSVA3044	1330.5000.44
Signal and spectrum analyzer, 10 Hz to 4 GHz	R&S®FSV3004	1330.5000.04
Signal and spectrum analyzer, 10 Hz to 7.5 GHz	R&S®FSV3007	1330.5000.07
Signal and spectrum analyzer, 10 Hz to 13.6 GHz	R&S®FSV3013	1330.5000.13
Signal and spectrum analyzer, 10 Hz to 30 GHz	R&S®FSV3030	1330.5000.30
Signal and spectrum analyzer, 10 Hz to 44 GHz	R&S®FSV3044	1330.5000.43
<b>R&amp;S®FPS</b>		
Signal and spectrum analyzer, 9 kHz to 4 GHz	R&S®FPS4	1319.2008.04
Signal and spectrum analyzer, 9 kHz to 7 GHz	R&S®FPS7	1319.2008.07
Signal and spectrum analyzer, 9 kHz to 13.6 GHz	R&S®FPS13	1319.2008.13
Signal and spectrum analyzer, 9 kHz to 30 GHz	R&S®FPS30	1319.2008.30
Signal and spectrum analyzer, 9 kHz to 40 GHz	R&S®FPS40	1319.2008.40
<b>Vector signal explorer</b>		
R&S®VSE basic edition	R&S®VSE	1345.1011.06
R&S®VSE enterprise edition	R&S®VSE Enterprise Edition	1345.1105.06
R&S®VSE software maintenance	R&S®VSE-SWM	1320.7622.81