

# WLAN IEEE 802.11a/b/g/j/p/n/ac/ax/be/bn MEASUREMENT APPLICATION

## Specifications

R&S®FSW3-KM410/-KM411/-KM412/-KM414/-KM417

R&S®FSW-K91/-K91p/-K91n/-K91ac/-K91ax/-K91be/-K91bn

R&S®FSV3-K91/-K91p/-K91n/-K91ac/-K91ax/-K91be/-K91bn

R&S®FPS-K91/-K91p/-K91n/-K91ac

R&S®VSE-K91/-K91p/-K91n/-K91ac/-K91ax/-K91be/-K91bn/-K91X



Specifications  
Version 11.00

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# Definitions

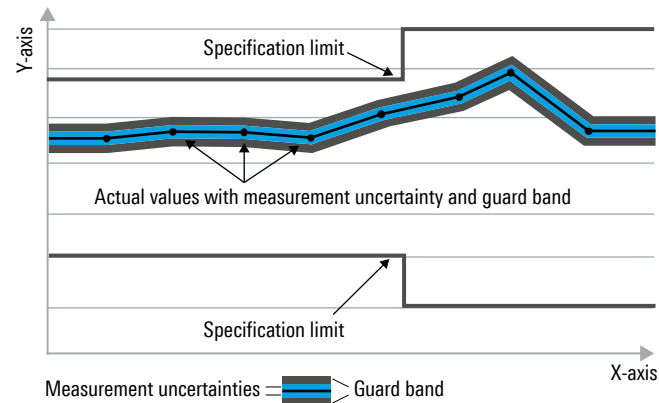
## General

Product data applies under the following conditions:

- Three hours of storage at ambient temperature followed by 30 minutes of 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 designated with the format "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 standard, chip rates are specified in million chips per second (Mcps), whereas bit rates and symbol rates are specified in billion bit per second (Gbps), million bit per second (Mbps), thousand bit per second (kbps), million symbols per second (Msps) or thousand symbols per second (ksps), and sample rates are specified in million samples per second (Msample/s). Gbps, Mcps, Mbps, Msps, kbps, ksps and Msample/s are not SI units.

## Specifications

The specifications of the R&S®FSW3-KM410/-KM411/-KM412/-KM414, R&S®FSx-K91/p/n/ac/ax/be/bn, R&S®FPS-K91/p/n/ac and R&S®VSE-K91/p/n/ac/ax/be/bn WLAN measurement applications are based on the specifications of the FSWX, 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 data

This specifications cover the R&S®FSW3-KM410/-KM411/-KM412/-KM414, R&S®FSW-K91/p/n/ac/ax/be/bn, the R&S®FSV3-K91/p/n/ac/ax/be/bn, the R&S®FPS-K91/p/n/ac and the R&S®VSE-K91/p/n/ac/ax/be/bn.

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

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

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

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

For feature tables the following convention applies:

•	Feature always supported, i.e. with the R&S®VSE-K91/p/n/ac/ax/be/bn connected to the device and with the corresponding R&S®FSx-K91/p/n/ac/ax/be/bn option when running directly on the device.
• (VSE)	Feature supported only with the R&S®VSE-K91/p/n/ac/ax/be/bn connected to the device. Not with the corresponding R&S®FSx-K91/p/n/ac/ax/be/bn option when running directly on the device.
• (FSx-K91/p/n/ac/ax/be/bn)	Feature supported only when running directly on the device with the corresponding R&S®FSx-K91/p/n/ac/ax/be/bn option. Not supported in the R&S®VSE-K91/p/n/ac/ax/be/bn.
• (FSW3-KM410/-KM411/-KM412/-KM414)	Feature supported only when running directly on the device with the corresponding R&S®FSW3-KM410/-KM411/-KM412/-KM414 option. Not supported in the R&S®VSE-K91/p/n/ac/ax/be/bn.
–	Feature not supported with this device.

## Overview

	FSWX	FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
R&S®FSx-K91/p/n/ac/ax/be/bn, resp. R&S®FSW3-KM410/-KM411/-KM412/-KM414, software that runs on device	• (FSW3-KM410/-KM411/-KM412/-KM414)	• (FSW-K91/p/n/ac/ax/be/bn)	• (FSV3-K91/p/n/ac/ax/be/bn)	• (FPS-K91/p/n/ac)
R&S®VSE-K91/p/n/ac/ax/be/bn, PC software that can be connected to a device	•	•	•	•

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

### Level

		<b>FSWX</b>	<b>FSW</b>	<b>R&amp;S®FSVA3000/R&amp;S®FSV3000</b>	<b>R&amp;S®FPS</b>
Level range	RF input	<ul style="list-style-type: none"> <li>RF A (FSW3-KM410/-KM411/-KM412/-KM414)</li> </ul>	-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	<ul style="list-style-type: none"> <li>(FSW3-KM410/-KM411/-KM412/-KM414)</li> </ul>	<ul style="list-style-type: none"> <li>(FSW-K91/p/n/ac/ax/be/bn)</li> </ul>	<ul style="list-style-type: none"> <li>(FSV3-K91/p/n/ac/ax/be/bn)</li> </ul>	<ul style="list-style-type: none"> <li>(FPS-K91/p/n/ac)</li> </ul>
	manual	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>

### Inputs

	<b>FSWX</b>	<b>FSW</b>	<b>R&amp;S®FSVA3000/R&amp;S®FSV3000</b>	<b>R&amp;S®FPS</b>
RF input	<ul style="list-style-type: none"> <li>RF A (FSW3-KM410/-KM411/-KM412/-KM414)</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>
Digital baseband input	–	<ul style="list-style-type: none"> <li>(FSW-K91/p/n/ac/ax/be/bn)<sup>4</sup></li> </ul>	–	–
Analog baseband input	–	<ul style="list-style-type: none"> <li>(FSW-K91/p/n/ac/ax/be/bn)<sup>5</sup></li> </ul>	<ul style="list-style-type: none"> <li>(FSV3-K91/p/n/ac/ax/be/bn)<sup>6</sup></li> </ul>	–
File	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>

<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/-B71E option.

<sup>6</sup> Requires R&S®FSV3-B271 option.

## Signal acquisition

		FSWX	FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS	
Supported standards		IEEE 802.11a, IEEE 802.11g-OFDM, IEEE 802.11j <sup>7</sup> , IEEE 802.11p, IEEE 802.11n, IEEE 802.11ac				
		IEEE 802.11ax				IEEE 802.11ax (VSE-K91ax)
		IEEE 802.11be				IEEE 802.11be (VSE-K91be)
		IEEE 802.11bn				IEEE 802.11bn (VSE-K91bn)
Capture length	IEEE 802.11a/j/g-OFDM/p	24 µs to 400 ms <sup>8</sup> (FSW3-KM410)	24 µs to 400 ms <sup>8</sup> (FSW-K91/p)	24 µs to 200 ms <sup>8</sup> (FSV3-K91/p)	24 µs to 200 ms (FPS-K91/p)	
	IEEE 802.11n	24 µs to 400 ms <sup>8</sup> (FSW3-KM410)	24 µs to 400 ms <sup>8</sup> (FSW-K91n)	24 µs to 200 ms <sup>8</sup> (FSV3-K91n)	24 µs to 200 ms (FPS-K91n)	
	IEEE 802.11ac	24 µs to 200 ms <sup>8</sup> (FSW3-KM410)	24 µs to 200 ms <sup>8</sup> (FSW-K91ac)	24 µs to 200 ms <sup>8</sup> (FSV3-K91ac)	24 µs to 200 ms <sup>8</sup> (FPS-K91ac)	
	IEEE 802.11ax	24 µs to 200 ms <sup>8</sup> (FSW3-KM411)	24 µs to 200 ms <sup>8</sup> (FSW-K91ax)	24 µs to 200 ms <sup>8</sup> (FSV3-K91ax)	–	
	IEEE 802.11be	24 µs to 100 ms <sup>8</sup> (FSW3-KM412)	24 µs to 100 ms <sup>8</sup> (FSW-K91be)	24 µs to 100 ms <sup>8</sup> (FSV3-K91be)	–	
	IEEE 802.11bn	24 µs to 100 ms <sup>8</sup> (FSW3-KM414)	24 µs to 100 ms <sup>8</sup> (FSW-K91bn)	24 µs to 100 ms <sup>8</sup> (FSV3-K91bn)	–	
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	20/40/80/160/320 MHz (VSE-K91ax)	
	IEEE 802.11be	20/40/80/160/320/640 MHz		20/40/80/160/320/640 MHz	20/40/80/160/320 MHz (VSE-K91be)	
	IEEE 802.11bn	20/40/80/160/320/640 MHz		20/40/80/160/320/640 MHz	20/40/80/160/320 MHz (VSE-K91bn)	

<sup>7</sup> Supported for R&S®FSW3-KM410, R&S®FSW-K91, R&S®FSV3-K91 and R&S®FPS-K91 options.

<sup>8</sup> In case of restricted system memory (for example multiple application instances), the max capture length might be reduced.

In case of MIMO analysis, the maximum capture time scales reciprocally proportional to the number of RX antennas and the channel bandwidth (CBW) of the signal to be analyzed.

		FSWX	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 MHz	5/10/20/40 <sup>9</sup> MHz	5/10/20/40 <sup>10</sup> MHz	20/40 <sup>11</sup> MHz
	IEEE 802.11ac	5/10/20/40/80 <sup>12</sup> /160 <sup>13</sup> MHz	5/10/20/40 <sup>9</sup> /80 <sup>14</sup> /160 <sup>15</sup> MHz	5/10/20/40 <sup>10</sup> /80 <sup>16</sup> /160 <sup>16</sup> MHz	20/40 <sup>11</sup> /80 <sup>17</sup> /160 <sup>17</sup> MHz
	IEEE 802.11ax	20/40/80 <sup>12</sup> /160 <sup>13</sup> MHz	20/40 <sup>9</sup> /80 <sup>14</sup> /160 <sup>15</sup> MHz	20/40 <sup>10</sup> /80 <sup>16</sup> /160 <sup>16</sup> MHz	20/40 <sup>11</sup> /80 <sup>17</sup> /160 <sup>17</sup> MHz (VSE-K91ax)
	IEEE 802.11be	20/40/80 <sup>12</sup> /160 <sup>13</sup> /320 <sup>13</sup> MHz	20/40 <sup>9</sup> /80 <sup>14</sup> /160 <sup>15</sup> /320 <sup>18</sup> MHz	20/40 <sup>10</sup> /80 <sup>16</sup> /160 <sup>16</sup> /320 <sup>19</sup> MHz	20/40 <sup>11</sup> /80 <sup>17</sup> /160 <sup>17</sup> MHz (VSE-K91be)
	IEEE 802.11bn	20/40/80 <sup>12</sup> /160 <sup>13</sup> /320 <sup>13</sup> MHz	20/40 <sup>9</sup> /80 <sup>14</sup> /160 <sup>15</sup> /320 <sup>18</sup> MHz	20/40 <sup>10</sup> /80 <sup>16</sup> /160 <sup>16</sup> /320 <sup>19</sup> MHz	20/40 <sup>11</sup> /80 <sup>17</sup> /160 <sup>17</sup> MHz (VSE-K91bn)
Trigger modes	RF input	free run	•	•	•
		external	•	•	•
		IF power <sup>20</sup>	•	•	•
		I/Q power	•	•	–
Optimization	cross-correlation	• <sup>21</sup>	• (VSE-K91/p/n/ac/ax/be/bn) <sup>22</sup>	• (VSE-K91/p/n/ac/ax/be/bn) <sup>22</sup>	• (VSE-K91/p/n/ac/ax/be/bn) <sup>22</sup>
	IQNC	–	• (FSW-K91/p/n/ac/ax/be/bn) <sup>23</sup>	• (FSV3-K91/p/n/ac/ax/be/bn) <sup>24</sup>	–

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

<sup>10</sup> Requires R&S®FSV3-B40 40 MHz analysis bandwidth option or higher.

<sup>11</sup> Requires R&S®FPS-B40 40 MHz analysis bandwidth option or higher.

<sup>12</sup> Requires R&S®FSW31/32-B100 100 MHz analysis bandwidth option or higher.

<sup>13</sup> Requires R&S®FSW31/32-B320 320 MHz analysis bandwidth option or higher.

<sup>14</sup> Requires R&S®FSW-B80 80 MHz analysis bandwidth option or higher.

<sup>15</sup> Requires R&S®FSW-B160 160 MHz analysis bandwidth option or higher.

<sup>16</sup> Requires R&S®FSV3-B200 200 MHz analysis bandwidth option or higher.

<sup>17</sup> Requires R&S®FPS-B160 160 MHz analysis bandwidth option.

<sup>18</sup> Requires R&S®FSW-B320 320 MHz analysis bandwidth option or higher.

<sup>19</sup> Requires R&S®FSV3-B400 400 MHz analysis bandwidth option or higher.

<sup>20</sup> Restricted functionality at carrier frequencies < 50 MHz.

<sup>21</sup> Requires R&S®FSW3-KM417 cross-correlation.

<sup>22</sup> Requires R&S®VSE-K91X cross-correlation.

<sup>23</sup> Requires R&S®FSW-K575 IQ noise cancellation.

<sup>24</sup> Requires R&S®FSV3-K575 IQ noise cancellation.

## Measurement parameters

	FSWX	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			
Channel bandwidth (CBW)	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	CBW20, CBW40 <sup>9</sup>	CBW20, CBW40 <sup>10</sup>	CBW20, CBW40 <sup>11</sup>
IEEE 802.11ac	CBW20, CBW40, CBW80 <sup>12</sup> , CBW80+80 <sup>12</sup> , CBW160 <sup>13</sup>	CBW20, CBW40 <sup>9</sup> , CBW80 <sup>14</sup> , CBW80+80 <sup>14</sup> , CBW160 <sup>15</sup>	CBW20, CBW40 <sup>10</sup> , CBW80 <sup>16</sup> , CBW80+80 <sup>16</sup> , CBW160 <sup>16</sup>	CBW20, CBW40 <sup>11</sup> , CBW80 <sup>17</sup> , CBW80+80 <sup>17</sup> , CBW160 <sup>17</sup>
IEEE 802.11ax	CBW20, CBW40, CBW80 <sup>12</sup> , CBW80+80 <sup>12</sup> CBW160 <sup>13</sup>	CBW20, CBW40 <sup>9</sup> , CBW80 <sup>14</sup> , CBW80+80 <sup>14</sup> , CBW160 <sup>15</sup>	CBW20, CBW40 <sup>10</sup> , CBW80 <sup>16</sup> , CBW80+80 <sup>16</sup> , CBW160 <sup>16</sup>	CBW20, CBW40 <sup>11</sup> , CBW80 <sup>17</sup> , CBW80+80 <sup>17</sup> , CBW160 <sup>17</sup> (VSE-K91ax)
IEEE 802.11be	CBW20, CBW40, CBW80 <sup>12</sup> , CBW160 <sup>13</sup> , CBW320 <sup>13</sup>	CBW20, CBW40 <sup>9</sup> , CBW80 <sup>14</sup> , CBW160 <sup>15</sup> , CBW320 <sup>18</sup>	CBW20, CBW40 <sup>10</sup> , CBW80 <sup>16</sup> , CBW160 <sup>16</sup> , CBW320 <sup>19</sup>	CBW20, CBW40 <sup>11</sup> , CBW80 <sup>17</sup> , CBW160 <sup>17</sup> (VSE-K91be)
IEEE 802.11bn	CBW20, CBW40, CBW80 <sup>12</sup> , CBW160 <sup>13</sup> , CBW320 <sup>13</sup>	CBW20, CBW40 <sup>9</sup> , CBW80 <sup>14</sup> , CBW160 <sup>15</sup> , CBW320 <sup>18</sup>	CBW20, CBW40 <sup>10</sup> , CBW80 <sup>16</sup> , CBW160 <sup>16</sup> , CBW320 <sup>19</sup>	CBW20, CBW40 <sup>11</sup> , CBW80 <sup>17</sup> , CBW160 <sup>17</sup> (VSE-K91bn)
Filter out adjacent channels <sup>25</sup>	on/off			
PPDU format				
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			auto, HE SU, HE MU, HE trigger-based, HE extended range (VSE-K91ax)
IEEE 802.11be	auto, EHT MU, EHT non-OFDMA SU, EHT TB			auto, EHT MU, EHT non-OFDMA SU, EHT TB (VSE-K91be)
IEEE 802.11bn	auto, UHR MU, UHR non-OFDMA SU, UHR TB RRU and DRU, UHR ELR PPDU			auto, EHT MU, EHT non-OFDMA SU, EHT TB (VSE-K91bn)
Guard interval				
IEEE 802.11n/ac	auto, short, long			
IEEE 802.11ax	auto, 0.8 $\mu$ s, 1.6 $\mu$ s, 3.2 $\mu$ s			auto, 0.8 $\mu$ s, 1.6 $\mu$ s, 3.2 $\mu$ s (VSE-K91ax)
IEEE 802.11be	auto, 0.8 $\mu$ s, 1.6 $\mu$ s, 3.2 $\mu$ s			auto, 0.8 $\mu$ s, 1.6 $\mu$ s, 3.2 $\mu$ s (VSE-K91be)
IEEE 802.11bn	auto, 0.8 $\mu$ s, 1.6 $\mu$ s, 3.2 $\mu$ s			auto, 0.8 $\mu$ s, 1.6 $\mu$ s, 3.2 $\mu$ s (VSE-K91bn)

<sup>25</sup> Not supported for R&S®FSW-K91b/g-DSSS, R&S®FSV3-K91b/g-DSSS, R&S®FPS-K91b/g-DSSS and R&S®VSE-K91b/g-DSSS.

	FSWX	FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
HE-LTF, EHT-LTF, UHR-LTF size				
IEEE 802.11ax	auto, 3.2 µs, 6.4 µs, 12.8 µs		auto, 3.2 µs, 6.4 µs, 12.8 µs (VSE-K91ax)	
IEEE 802.11be	auto, 3.2 µs, 6.4 µs, 12.8 µs		auto, 3.2 µs, 6.4 µs, 12.8 µs (VSE-K91be)	
IEEE 802.11bn	auto, 3.2 µs, 6.4 µs, 12.8 µs		auto, 3.2 µs, 6.4 µs, 12.8 µs (VSE-K91bn)	
Modulation format				
IEEE 802.11a/g-OFDM/p/n	BPSK, QPSK, 16QAM, 64QAM			
IEEE 802.11ac	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM			
IEEE 802.11ax	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM, 4096QAM		BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM, 4096QAM (VSE-K91ax)	
IEEE 802.11be	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM, 4096QAM		BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM, 4096QAM (VSE-K91be)	
IEEE 802.11bn	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM, 4096QAM		BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM, 4096QAM (VSE-K91bn)	
Demodulator setting	auto, manual with/without using the signal field			
MIMO	<ul style="list-style-type: none"> <li>(VSE-K91n/ac/ax/be/bn)</li> </ul>	<ul style="list-style-type: none"> <li>(FSW-K91n/ac/ax/be/bn, VSE-K91n/ac/ax/be/bn)</li> </ul>	<ul style="list-style-type: none"> <li>(FSV3-K91n/ac/ax/be/bn, VSE-K91n/ac/ax/be/bn)</li> </ul>	<ul style="list-style-type: none"> <li>(FPS-K91n/ac, VSE-K91n/ac/ax/be/bn)</li> </ul>
Configuration				
IEEE 802.11n	1 TX antenna	1 to 4 TX antennas	1 to 4 TX antennas	1 to 4 TX antennas
IEEE 802.11ac	1 TX antenna	1 to 8 TX antennas	1 to 8 TX antennas	1 to 8 TX antennas
IEEE 802.11ax	1 TX antenna	1 to 8 TX antennas	1 to 8 TX antennas	1 to 8 TX antennas (VSE-K91ax)
IEEE 802.11be	1 TX antenna	1 to 8 TX antennas	1 to 8 TX antennas	1 to 8 TX antennas (VSE-K91be)
IEEE 802.11bn	1 TX antenna	1 to 8 TX antennas	1 to 8 TX antennas	1 to 8 TX antennas (VSE-K91bn)
MIMO antenna signal capture setup	–	simultaneous <sup>26</sup> , sequential		simultaneous <sup>26</sup> , sequential (FPS-K91n/ac, VSE-K91n/ac/ax/be/bn)
	–	sequential, using R&S®OSP open switch and control platform <sup>27</sup> (FSW-K91n/ac/ax/be, FSV3-K91n/ac/ax/be)		–
Spatial mapping	–	direct, spatial expansion, user defined		

<sup>26</sup> Requires an FSW/R&S®FSVA3000/R&S®FSV3000/R&S®FPS for each DUT TX antenna to be measured. In case of R&S®VSE-K91n/ac/ax, the DUT TX antennas can be connected to the input channels of an R&S®RTP oscilloscope.

<sup>27</sup> Requires an R&S®OSP open switch and control platform.

	<b>FSWX</b>	<b>FSW</b>	<b>R&amp;S®FSVA3000/R&amp;S®FSV3000</b>	<b>R&amp;S®FPS</b>
Source of payload length	estimate from signal, take from signal field			estimate from signal, take from signal field (FPS-K91a/g-OFDM/p/n/ac, VSE-K91a/g-OFDM/p/n/ac/ax/be/bn)
Pilot tracking	phase on/off, timing on/off, level on/off			
Channel decoding	off/BCC/LDPC			• (VSE-K91n/ac/ax/be/bn)
Channel estimation Interpolation <sup>28</sup>	preamble, preamble and data none/linear, Wiener			none/linear, Wiener (VSE-K91n/ac/ax/be/bn)
I/Q mismatch compensation <sup>25</sup>	per subcarrier, average subcarrier, off			on/off (FPS-K91n/ac), • (VSE-K91n/ac/ax/be/bn)

<sup>28</sup> For R&S®VSE-K91n/ac/ax/be/bn and R&S®FSx-K91n/ac/ax/be/bn measurement applications.

## Result display

	FSWX	FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
Result summary				
Center frequency error	•	•	•	•
Symbol clock error	•	•	•	•
EVM all carriers	•	•	•	•
EVM pilots <sup>29</sup>	•	•	•	•
EVM payload <sup>29</sup>	•	•	•	•
BER	•	•	•	–
CWER	•	•	•	–
FCS	•	•	•	–
I/Q offset <sup>30</sup>	•	•	•	•
Gain imbalance <sup>30</sup>	•	•	•	•
Quadrature offset <sup>30</sup>	•	•	•	•
Mean PPDU power	•	•	•	•
Crest factor	•	•	•	•
Power versus time				
Magnitude capture	•	•	•	•
Full PPDU	•	•	•	•
Rising/falling PPDU	•	•	•	•
EVM				
EVM versus carrier <sup>29</sup>	•	•	•	•
EVM versus symbol <sup>29</sup>	•	•	•	•
Spectrum				
Spectrum flatness	•	•	•	•
Group delay	•	•	•	•
FFT spectrum	•	•	•	•
Spectrum mask	• (FSW3-KM410/-KM411/-KM412)	• (FSW-K91/n/ac/ax/be)	• (FSV3-K91/n/ac/ax/be)	• (FPS-K91/n/ac)
ACP	• (FSW3-KM410/-KM411/-KM412/KM414)	• (FSW-K91/n/ac/ax/be)	• (FSV3-K91/n/ac/ax/be)	• (FPS-K91/n/ac)
Constellation				
Constellation diagram	•	•	•	•
Constellation versus carrier	•	•	•	•
I/Q <sup>25</sup>				
Gain imbalance versus carrier <sup>30</sup>	•	•	•	• (VSE-K91/n/ac/ax/be/bn)
Quadrature error versus carrier <sup>30</sup>	•	•	•	• (VSE-K91/n/ac/ax/be/bn)
Linearity <sup>25</sup>				
AM/AM	•	•	•	–
AM/PM	•	•	•	–
AM/EVM	•	•	•	–

<sup>29</sup> Not available for cross-correlation on.<sup>30</sup> HE/EHT/UHR OFDMA PPDU require symmetrical subcarrier usage around the DC.

	<b>FSWX</b>	<b>FSW</b>	<b>R&amp;S®FSVA3000/R&amp;S®FSV3000</b>	<b>R&amp;S®FPS</b>
Tracking <sup>25</sup>				
Phase tracking	•	•	•	• (VSE-K91/n/ac/ax/be/bn)
Amplitude tracking	•	•	•	–
Statistics/miscellaneous				
Signal field	•	•	•	•
Bit stream <sup>31</sup>	• (FSW3-KM410/411/412/414, VSE-K91/n/ac/ax/be/bn)	• (FSW-K91/n/ac/be/bn, VSE-K91/n/ac/ax/be/bn)	• (FSV3-K91/n/ac/bn, VSE-K91/n/ac/ax/be/bn)	• (FPS-K91/n/ac, VSE-K91/n/ac/ax/be/bn)

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<sup>31</sup> For the standards IEEE802.11ax/be/bn the bit stream result is only available for SU respective non-OFDMA.

**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>32</sup> , average of 20 PPDU	level -10 dBm <sup>33</sup> , average of 20 PPDU		level -10 dBm <sup>34</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	-54.8	-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	-51.8	-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	-51.8	-52.1
40 MHz	-52.4	-51.9	-51.4	-50.0
80 MHz	-53.2	-52.7	-52.2	-45.5
160 MHz	-51.8 <sup>35</sup>	-51.3	-50.8	-44.8

<sup>32</sup> Requires R&S®FSW-B24 RF preamplifier option.<sup>33</sup> Requires R&S®FSV3-B24 RF preamplifier option.<sup>34</sup> Requires R&S®FPS-B22 or R&S®FPS-B24 RF preamplifier option and R&S®FPS-B25 electronic attenuator option.<sup>35</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	–50.0	–49.7	–43.3
160 MHz	–49.0 <sup>35</sup>	–48.5	–48.2	–41.5

	R&S®FSW8 <sup>36</sup>	R&S®FSVA3000	R&S®FSV3000	R&S®FPS
<b>Residual EVM in dB</b>	level -10 dBm <sup>37</sup> , average of 20 PPDUs	level -10 dBm, average of 20 PPDUs		-
<b>Input = RF, f<sub>center</sub> = 2.4 GHz</b>				
Channel estimation = preamble and data				
IEEE 802.11ax HE SU signal with MCS 9				
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>35</sup>	-51.6	-51.1	-
Channel estimation = preamble				
IEEE 802.11ax HE SU signal with MCS 9				
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>35</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 with MCS 9				
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>35</sup>	-50.5	-50.0	-
Channel estimation = preamble				
IEEE 802.11ax HE SU signal with MCS 9				
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>35</sup>	-49.5	-49.0	-

<sup>36</sup> Frontend board order no. 1312.8046 Rev. 08.26 or newer.

<sup>37</sup> Requires R&S®FSW-B24 RF preamplifier option.

	R&S®FSW8 <sup>38</sup>	R&S®FSVA3000	R&S®FSV3000	R&S®FPS
<b>Residual EVM in dB</b>	level -10 dBm <sup>39</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 802.11be EHT non-OFDMA SU signal with MCS 9				
20 MHz	-55.6	-55.0	-	-
40 MHz	-55.6	-55.0	-	-
80 MHz	-55.4	-55.0	-	-
160 MHz	-53.0 <sup>35</sup>	-52.5	-	-
320 MHz	-50.5 <sup>35</sup>	-50.0	-	-
Channel estimation = preamble				
IEEE 802.11be EHT non-OFDMA SU signal with MCS 9				
20 MHz	-54.6	-54.0	-	-
40 MHz	-54.7	-54.0	-	-
80 MHz	-53.0	-52.5	-	-
160 MHz	-51.3 <sup>35</sup>	-50.7	-	-
320 MHz	-49.5 <sup>35</sup>	-49.0	-	-
<b>Input = RF, f<sub>center</sub> = 5.8 GHz</b>				
Channel estimation = preamble and data				
IEEE 802.11be EHT non-OFDMA SU signal with MCS 9				
20 MHz	-57.6	-57.0	-	-
40 MHz	-56.2	-55.7	-	-
80 MHz	-53.2	-52.8	-	-
160 MHz	-53.0 <sup>35</sup>	-51.7	-	-
320 MHz	-50.3 <sup>35</sup>	-49.0	-	-
Channel estimation = preamble				
IEEE 802.11be EHT non-OFDMA SU signal with MCS 9				
20 MHz	-56.5	-56.0	-	-
40 MHz	-55.0	-54.5	-	-
80 MHz	-53.2	-52.7	-	-
160 MHz	-51.6 <sup>35</sup>	-50.6	-	-
320 MHz	-49.5 <sup>35</sup>	-48.0	-	-

<sup>38</sup> Frontend board order no. 1312.8046 Rev08.26 or newer.

<sup>39</sup> Requires R&S®FSW-B24 RF preamplifier option.

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

	R&S®FSW8/13/26 <sup>40</sup>	R&S®FPS <sup>41</sup>
<b>Residual EVM in dB</b>	average of 20 PPDUs	average of 20 PPDUs
<b>Input = RF, <math>f_{\text{center}} = 2.4 \text{ GHz}</math></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, <math>f_{\text{center}} = 5 \text{ GHz}</math></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
160 MHz	-43.5	-43.0

<sup>40</sup> Requires R&S®FSW-B24 RF preamplifier option.

<sup>41</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>40</sup>	R&S®FPS <sup>41</sup>
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
Frequency error				
Lock range	40 ppm <sup>42</sup>			
Uncertainty	1 Hz + R&S®FSx reference frequency uncertainty (see R&S®FSx reference frequency in the respective specifications)			
Level uncertainty				
Power	same as R&S®FSx (see R&S®FSx total measurement uncertainty in the respective specifications)			

<sup>42</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

		FSWX	FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
Level range	RF input	• RF A (FSW3-KM410)	–70 dBm <sup>43</sup> to +30 dBm	–70 dBm <sup>44</sup> to +30 dBm	–70 dBm <sup>45</sup> to +30 dBm
Level setting	auto level	• (FSW3-KM410)	• (FSW-K91)	–	• (FPS-K91)
	manual	•	•	•	•

### Inputs

	FSWX	FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
RF input	• RF A (FSW3-KM410)	•	•	•

### Signal acquisition

		FSWX	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>46</sup>	•	•	•
		I/Q power	•	•	–

### Measurement parameters

		FSWX	FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
Data capture settings					
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			
PPDU format		short PPDU, long PPDU			
Modulation format <sup>47</sup>		DBPSK, DQPSK, CCK, PBCC			
Demodulator settings		auto, manual with/without using the PLCP header			
Source of payload length		take from PLCP header			
Tracking		phase on/off, timing on/off, level on/off			

<sup>43</sup> Requires R&S®FSW-B24 RF preamplifier option.

<sup>44</sup> Requires R&S®FSV3-B24 RF preamplifier option.

<sup>45</sup> Requires R&S®FPS-B22 or R&S®FPS-B24 RF preamplifier option.

<sup>46</sup> Restricted functionality at carrier frequencies < 50 MHz.

<sup>47</sup> Corresponds to the data rates: 1 Mbps, 2 Mbps, 5.5 Mbps and 11 Mbps.

## Result display

	FSWX	FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FPS
Result list				
Center frequency error	•	•	•	•
Chip clock error	•	•	•	•
Peak vector error	•	•	•	•
PPDU EVM	• <sup>48</sup>	•	•	•
I/Q offset	•	•	•	•
I/Q gain imbalance	•	•	•	•
I/Q quadrature error	•	•	•	•
Rise time	–	–	–	–
Fall time	–	–	–	–
Mean power	•	•	•	•
Peak power	–	–	–	–
Crest factor	•	•	•	•
Power versus time				
Magnitude capture	•	•	•	•
PvT full PPDU	•	•	•	•
Up ramp/down ramp	–	–	–	–
EVM				
Vector error IEEE	•	•	•	•
EVM versus chip	•	•	•	•
Spectrum				
FFT spectrum	•	•	•	•
Spectrum mask	• (FSW3-KM410)	• (FSW-K91)	• (FSV3-K91)	• (FPS-K91)
ACP	• (FSW3-KM410)	• (FSW-K91)	• (FSV3-K91)	• (FPS-K91)
Constellation				
Constellation diagram	•	•	•	•
Statistics/miscellaneous				
PLCP header	•	•	•	•
Bit stream	•	•	•	•

<sup>48</sup> Not supported by R&S®FSW3-KM417 WLAN cross-correlation.

**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>
Residual PPDU EVM	$f_{\text{center}} = 2.442 \text{ GHz}$ , level $-30 \text{ dBm}$ <sup>49</sup> to $+30 \text{ dBm}$ , average of 20 PPDUs <sup>50</sup>	$f_{\text{center}} = 2.4 \text{ GHz}$ , level $-10 \text{ dBm}$ <sup>51</sup> , average of 20 PPDUs		$f_{\text{center}} = 2.442 \text{ GHz}$ , level $-30 \text{ dBm}$ <sup>52</sup> to $+30 \text{ dBm}$ , average of 20 PPDUs <sup>49</sup>
Input = RF	0.45 %	0.45 %	0.47 %	0.6 %
Frequency error				
Lock range	1.3 MHz			
Uncertainty	1 Hz + R&S®FSx reference frequency uncertainty (see R&S®FSx reference frequency in the respective specifications)			
Level uncertainty				
Power	same as R&S®FSx (see R&S®FSx total measurement uncertainty in the respective specifications)			

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<sup>49</sup> Requires R&S®FSW-B24 RF preamplifier option.

<sup>50</sup> 11 Mbps CCK with short PLCP.

<sup>51</sup> Requires R&S®FSV3-B24 RF preamplifier option.

<sup>52</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>		
FSWX		
WLAN 802.11a/b/g/n/p/ac measurement application <sup>53</sup>	R&S®FSW3-KM410	1347.7881.02
WLAN 802.11ax measurement application <sup>54</sup>	R&S®FSW3-KM411	1347.7917.02
WLAN 802.11be measurement application <sup>54</sup>	R&S®FSW3-KM412	1347.7923.02
WLAN 802.11bn measurement application <sup>54</sup>	R&S®FSW3-KM414	1349.2287.02
WLAN cross-correlation	R&S®FSW3-KM417	1347.7900.02
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>54</sup>	R&S®FSW-K91n	1313.1516.02
IEEE 802.11ac measurements <sup>54</sup>	R&S®FSW-K91ac	1313.4209.02
IEEE 802.11ax measurements <sup>54</sup>	R&S®FSW-K91ax	1331.6345.02
IEEE 802.11be measurements <sup>54</sup>	R&S®FSW-K91be	1350.6730.02
IEEE 802.11bn measurements <sup>54</sup>	R&S®FSW-K91bn	1353.4374.02
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>54</sup>	R&S®FSV3-K91n	1330.5139.02
IEEE 802.11ac measurements <sup>54</sup>	R&S®FSV3-K91ac	1330.5116.02
IEEE 802.11ax measurements <sup>54</sup>	R&S®FSV3-K91ax	1346.3399.02
IEEE 802.11be measurements <sup>54</sup>	R&S®FSV3-K91be	1346.4966.02
IEEE 802.11bn measurements <sup>54</sup>	R&S®FSV3-K91bn	3740.3306.02
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>54</sup>	R&S®FPS-K91n	1321.4204.02
IEEE 802.11ac measurements <sup>54</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	1320.7680.06
IEEE 802.11n measurements <sup>54</sup>	R&S®VSE-K91n	1320.7600.06
IEEE 802.11ac measurements <sup>54</sup>	R&S®VSE-K91ac	1320.7616.06
IEEE 802.11ax measurements <sup>54</sup>	R&S®VSE-K91ax	1345.1411.06
IEEE 802.11be measurements <sup>54</sup>	R&S®VSE-K91be	1345.1428.06
IEEE 802.11bn measurements <sup>54</sup>	R&S®VSE-K91bn	1345.3043.06
WLAN cross-correlation	R&S®VSE-K91X	1345.2724.06

<sup>53</sup> In order to measure WLAN signals with a given channel bandwidth (CBW)  $\in$  {5, 10, 20, 40, 80, 160, 320} MHz, the R&S®FSx requires an analysis bandwidth option greater or equal to this CBW. I.e. the CBW of the WLAN signal to be measured  $\leq$  max. fitted R&S®FSx analysis bandwidth option.

Designation	Type	Order No.
<b>Analyzers</b>		
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	1331.5003.13
Signal and spectrum analyzer, 2 Hz to 26.5 GHz	R&S®FSW26	1331.5003.26
Signal and spectrum analyzer, 2 Hz to 43.5 GHz	R&S®FSW43	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
R&S®FSVA3000, R&S®FSV3000		
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
R&S®FPS		
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







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