

Version  
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## WCDMA Base Station Test Set R&S®FSMU-W

Base station testing as easy as it gets

- ◆ Base station tests in accordance with 3GPP TS 25.141
- ◆ Signal analysis up to 3.6 GHz, 8 GHz or 26.5 GHz
- ◆ Signal generation up to 3 GHz
- ◆ Supports HSDPA analysis and generation
- ◆ Extendable to other 2G and 3G standards
- ◆ Interferer simulation
- ◆ Fading simulation
- ◆ Noise generation

**ROHDE & SCHWARZ**

# Base station testing as easy as it gets

The standards of the third mobile radio generation place considerably higher requirements on test and measurement equipment. Because of their good RF characteristics and flexibility, signal generators and spectrum analyzers are the instruments of choice, particularly when base stations are being tested.

The R&S®FSMU-W consists of the Vector Signal Generator R&S®SMU 200A and the Signal Analyzer R&S®FSQ, pre-configured with all the necessary options for WCDMA base station testing.

Both the R&S®SMU 200A and the R&S®FSQ have been designed to meet the high requirements that are needed today in the development and production of WCDMA base stations. For instance, the instruments feature high RF performance, and the user interface has been designed to simplify instrument operation.



# The R&S®FSMU-W consists of ...

## ... the R&S®SMU200A – the art of signal generation

- ◆ Four code channels in realtime for 3GPP FDD
- ◆ Excellent ACLR typ. +70 dB for 3GPP FDD (test model 1, 64 DPCHs)
- ◆ Typ. 64 dB ACLR for 3GPP multicarrier signals (four adjacent carriers)
- ◆ Very high level repeatability 0.05 dB
- ◆ Very low SSB phase noise typ. –135 dBc (f = 1 GHz, 20 kHz carrier offset, 1 Hz measurement bandwidth)
- ◆ Wideband noise typ. –153 dBc (CW, f = 1 GHz, >5 MHz carrier offset, 1 Hz measurement bandwidth)

## ... the R&S®FSQ – the world champion in spectrum analysis

- ◆ 84 dB ACLR for 3GPP with noise correction
- ◆ 77 dB ACLR for 3GPP multicarrier signals (four adjacent carriers)
- ◆ TOI >+20 dBm, typ. +25 dBm
- ◆ 1 dB compression +13 dBm
- ◆ Displayed average noise level (DANL) –158 dBm (1 Hz bandwidth)
- ◆ Phase noise –160 dBc (1 Hz) at 10 MHz carrier offset
- ◆ Phase noise –123 dBc (1 Hz) at 10 kHz carrier offset

In the base configuration, the R&S®FSMU-W consists of the following instruments and options:

R&S®SMU200A	Vector Signal Generator	R&S®FSQ3 (R&S®FSMU3)	Signal Analyzer 3/8/26 GHz
R&S®SMU-B103	RF Path A 100 kHz to 3.0 GHz	R&S®FSQ8 (R&S®FSMU8)	
R&S®SMU-B11	Baseband Generator	R&S®FSQ26 (R&S®FSMU26)	
R&S®SMU-B13	Baseband Main Module	R&S®FSP-B10	External Generator Control
R&S®SMU-K42	Digital Standard 3GPP FDD	R&S®FS-K72	Modulation and Code Domain Power Measurements to 3GPP TS 24.141 on Base Station Signals (Node B)
R&S®SMU-K43	3GPP Enhanced MS/BS Tests incl. HSDPA	R&S®FS-K74	HSDPA Extension for R&S®FS-K72
R&S®SMU-K62	Additive White Gaussian Noise (AWGN)		

The R&S®FSMU-W can be extended for the single test cases by adding the following options:

Option	Description	Consisting of	Description
R&S®FSMU-B1	Package for 2nd Signal Generator RF Path	R&S®SMU-B203 R&S®SMU-B13 R&S®SMU-K62	2nd RF Path (3.0 GHz) Baseband Main Module for 2nd Path Additive White Gaussian Noise for 2nd Path
R&S®FSMU-B2	Package for 2nd Signal Generator Baseband	R&S®SMU-B11 R&S®SMU-K42 R&S®SMU-K43	Baseband Generator for 2nd Path Digital Standard 3GPP FDD for 2nd Path 3GPP Enhanced MS/BS Tests incl. HSDPA for 2nd Path
R&S®FSMU-B3	Package for Fading	R&S®SMU-B14 R&S®SMU-B15 2 × R&S®SMU-K71	Fading Simulator Fading Simulator Extension Dynamic Fading and Enhanced Time Resolution

In addition to the R&S®FSMU options, the R&S®FSMU can be extended with all available R&S®FSQ and R&S®SMU200A options, which makes it possible to use the R&S®FSMU also for user equipment tests or extend the functionality to other standards such as CDMA2000® or GSM/EDGE.

# Extensive test expertise

Section in TS 25.141	Transmitter test	Required configuration
6.2.1	Base station maximum output power	R&S®FSMU
6.2.2	CPICH power accuracy	R&S®FSMU
6.3	Frequency error	R&S®FSMU
6.4.2	Power control steps	R&S®FSMU
6.4.3	Power control dynamic range	R&S®FSMU
6.4.5	Total power dynamic range	R&S®FSMU
6.5.1	Occupied bandwidth	R&S®FSMU
6.5.2.1	Spectrum emission mask	R&S®FSMU
6.5.2.2	Adjacent channel leakage ratio (ACLR)	R&S®FSMU
6.5.3	Spurious emissions	R&S®FSMU
6.6	Transmit intermodulation	R&S®FSMU
6.7.1	Error vector magnitude (EVM)	R&S®FSMU
6.7.2	Peak code domain error	R&S®FSMU
6.7.3	Time alignment error in TX diversity	R&S®FSMU <sup>1)</sup>

The R&S®FSMU-W includes extensive documentation on how to perform the tests required by 3GPP TS 25.141.

For each of the tests listed on this page, the R&S®FSMU-W documentation includes a detailed description of:

- ◆ Objective of the test
- ◆ Test setup
- ◆ Recommended options
- ◆ How to perform the measurement manually
- ◆ C code for automating the measurements (also on CD)

<sup>1)</sup> Measurement can be performed as a two-step measurement.

Section in TS 25.141	Receiver test	Required configuration
7.2	Reference sensitivity level	R&S®FSMU
7.3	Dynamic range	R&S®FSMU
7.4	Adjacent channel selectivity	R&S®FSMU + R&S®FSMU-B1 + R&S®FSMU-B2
7.5 <sup>2)</sup>	Blocking characteristics	R&S®FSMU + R&S®FSMU-B1 + R&S®FSMU-B2
7.6	Intermodulation characteristics	R&S®FSMU + R&S®FSMU-B1 + R&S®FSMU-B2
7.7	Spurious emissions	R&S®FSMU
7.8	Verification of internal BER calculation	R&S®FSMU + R&S®FSMU-B1

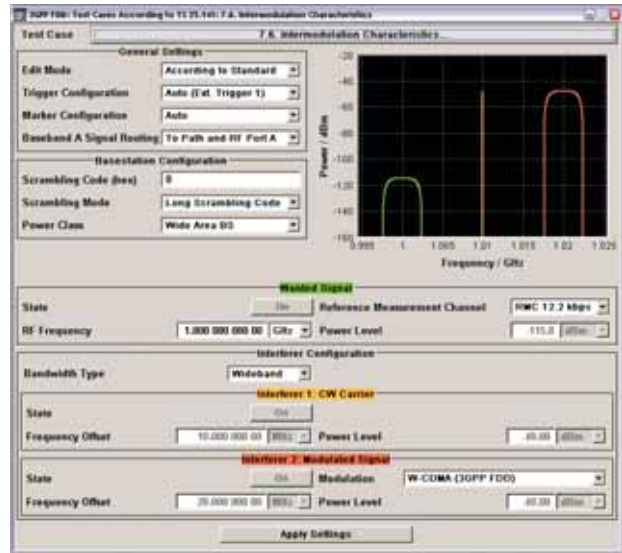
<sup>2)</sup> Test case partly requires large offset frequencies of interfering signal beyond R&S®SMU200A capabilities.

Section in TS 25.141	Performance test	Required configuration
8.2	Demodulation in static propagation conditions	R&S®FSMU + R&S®FSMU-B1
8.3	Demodulation of DCH in multipath fading conditions	R&S®FSMU + R&S®FSMU-B1 + R&S®FSMU-B3
8.4	Demodulation of DCH in moving propagation conditions	R&S®FSMU + R&S®FSMU-B1 + R&S®FSMU-B3
8.5	Demodulation of DCH in birth/death propagation conditions	R&S®FSMU + R&S®FSMU-B1 + R&S®FSMU-B3
8.6	Verification of internal BLER calculation	R&S®FSMU + R&S®FSMU-B1
8.8.1 <sup>3)</sup>	RACH preamble detection in static propagation conditions	R&S®FSMU + R&S®FSMU-B1
8.8.2 <sup>3)</sup>	RACH preamble detection in multipath fading case 3	R&S®FSMU + R&S®FSMU-B1 + R&S®FSMU-B3
8.8.3	Demodulation of RACH message in static propagation conditions	R&S®FSMU + R&S®FSMU-B1
8.8.4	Demodulation of RACH message in multipath fading case 3	R&S®FSMU + R&S®FSMU-B1 + R&S®FSMU-B3
8.9.1 <sup>3)</sup>	CPCH AP/CD preamble detection in static propagation conditions	R&S®FSMU + R&S®FSMU-B1
8.9.2 <sup>3)</sup>	CPCH AP/CD preamble detection in multipath fading case 3	R&S®FSMU + R&S®FSMU-B1 + R&S®FSMU-B3
8.9.3	Demodulation of CPCH message in static propagation conditions	R&S®FSMU + R&S®FSMU-B1
8.9.4	Demodulation of CPCH msg. in multipath fading case 3	R&S®FSMU + R&S®FSMU-B1 + R&S®FSMU-B3

<sup>3)</sup> Probability of false detection of preamble (Pfa) test is not supported.

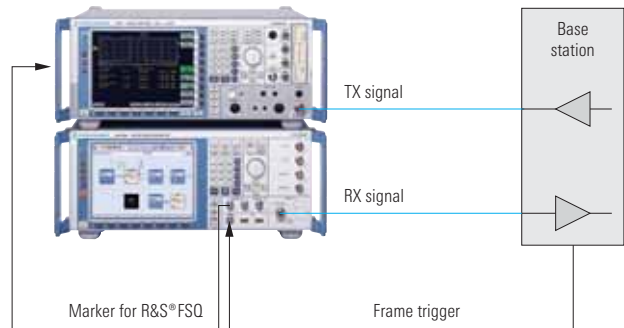
# Ease of operation

The test case wizard of the R&S® SMU 200A allows one-button base station testing. By simply choosing the required test case as defined in TS 25.141, the complete generator will be set up in accordance with the specification. All specific parameters, such as noise level, fading profile, and interfering signals, are set without having to look them up in the standard document. The automatic setup includes the wanted signal, frequency offset and power level as well as interfering signals, noise and fading conditions. To test beyond the specifications, the parameters can also be adjusted.



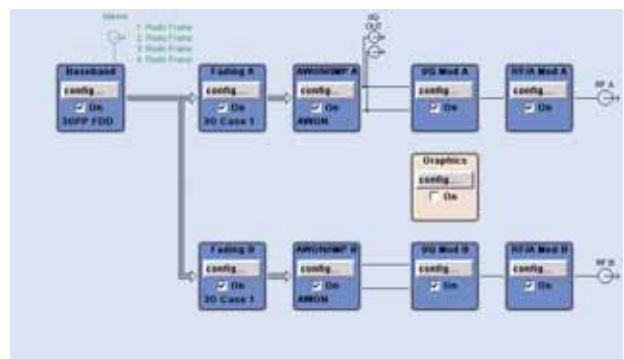
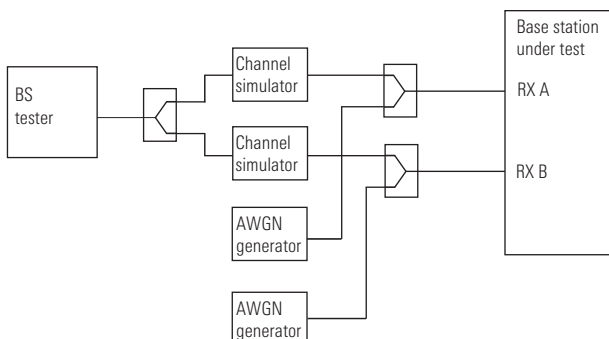
**Test case wizard: intermodulation characteristics with display of signal setup**

The power control step test verifies that the base station adjusts its transmit power in response to the TPC information sent from a mobile phone. In the test setup the R&S® SMU 200A acts as a mobile phone and sends a TPC pattern to the base station. The R&S® FSQ then measures the output signal of the base station and displays the transmitter power control step tolerance and aggregated power control step range.



**Test setup for power control step test**

With the fading simulator and the second RF path installed on the R&S® SMU 200A, the R&S® FSMU-W combines all necessary equipment for performance tests in a single instrument. There is no need for external wiring of generators and faders as well as for synchronization.



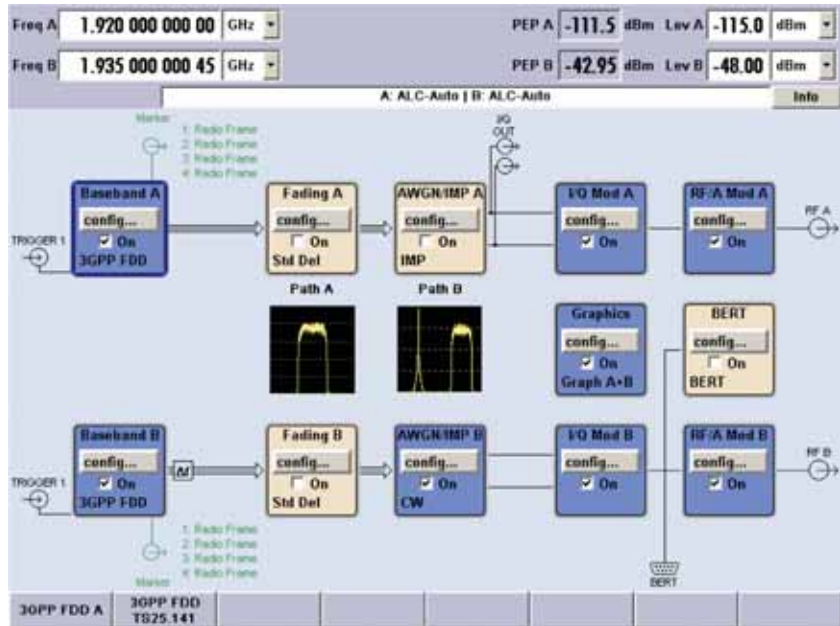
**The R&S® FSMU-W with the options R&S® FSMU-B1 and R&S® FSMU-B3**

**Test setup for performance test as defined in 3GPP TS 25.141**

# The R&S®SMU 200A – the art of signal generation

The Vector Signal Generator R&S®SMU 200A has been designed to meet all requirements encountered in the research and development of modern communications systems as well as in their production. The R&S®SMU 200A is extremely modular and can be equipped with one or two independent RF paths as well as baseband generators.

The R&S®SMU 200A features a modern and intuitive user interface. The signal flow from the baseband to the RF output is shown in the block diagram. Each block represents a functional unit of the instrument. The generated signal can be seen at a glance, including whether it is affected by additive white Gaussian noise or other impairments.

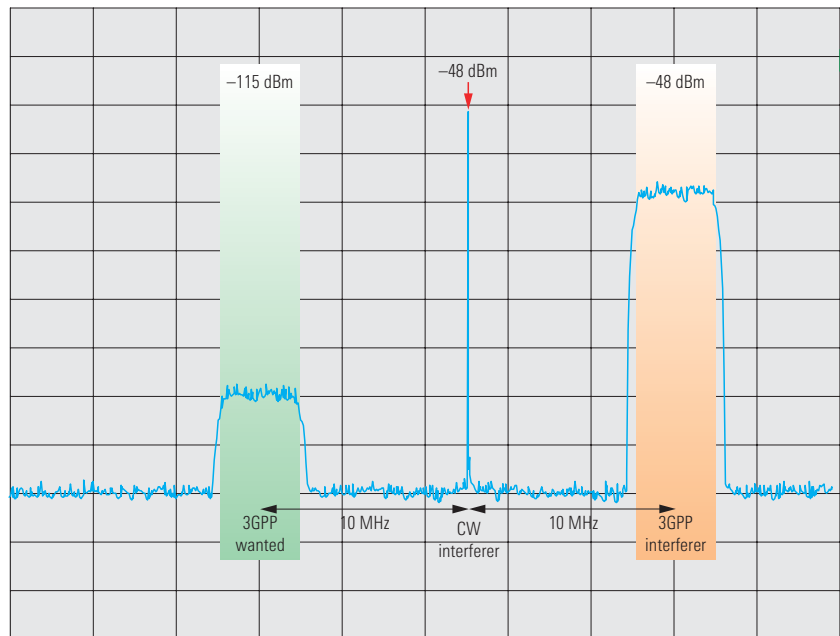


**Block diagram of the R&S®SMU 200A with setup for intermodulation characteristics**

Since the R&S®SMU 200A can accommodate two independent baseband generators as well as two RF signal generators in one instrument in combination with the internal fading and noise solution, it is the instrument of choice for all terms of base station testing. There is no need for external wiring or synchronization.

For 3GPP FDD, up to four user-configurable mobile stations can be simulated simultaneously. In addition, 64 mobile stations can be configured as background traffic. This allows any configuration to be set – from reference measurement channels in line with 3GPP TS 25.141 to complex scenarios for traffic simulation in the mobile radio network. Also, bit errors and block errors can be inserted in the generated signal.

This allows the internal bit error ratio (BER) and block error ratio (BLER) calculations of a base station to be checked in line with 3GPP TS 25.141.



**Intermodulation characteristics test generated by one R&S®SMU 200A (wanted signal on RF path A, CW and 3GPP interferer on RF path B)**

For more information on the R&S®SMU 200A, refer to the R&S®SMU 200A product brochure (PD 0758.0197).

# The R&S®FSQ – the world champion in spectrum analysis

## The R&S®FSQ – the multi-carrier signal analyzer

The R&S®FSQ provides the dynamic range needed for multicarrier measurements or measurements on spurious emissions. These emissions can be measured in a single sweep over the entire frequency range of the instrument. The sweep can be partitioned in up to 20 different segments, each user-configurable.

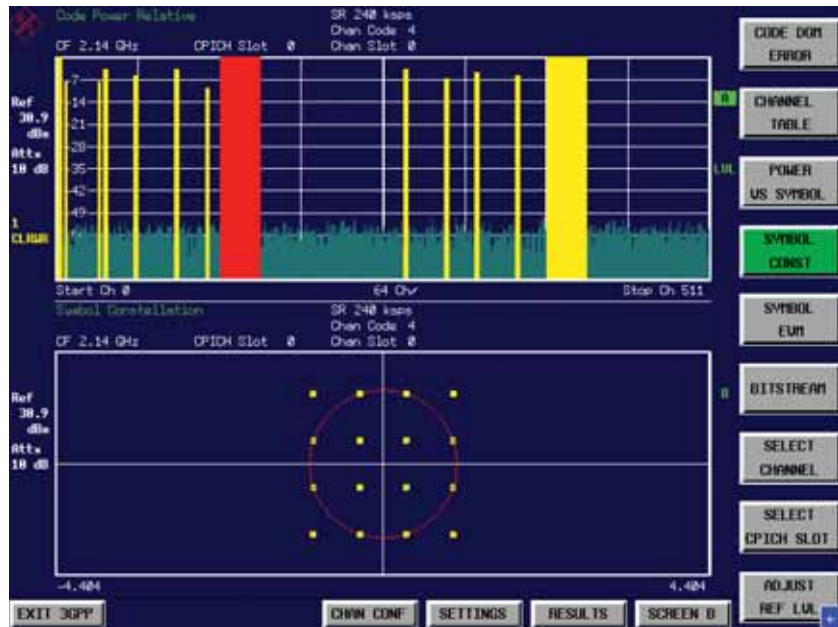
SWEEP LIST				
	Range 1	Range 2	Range 3	Range 4
Range Start	9 kHz	150 kHz	30 MHz	1 GHz
Range Stop	150 kHz	30 MHz	1 GHz	8 GHz
Filter Type	NORMAL	NORMAL	NORMAL	NORMAL
RBW	1 kHz	10 kHz	100 kHz	1 MHz
VBW	3 kHz	30 kHz	300 kHz	3 MHz
Sweep time mode	AUTO	AUTO	AUTO	AUTO
Sweep time	145 ms	300 ms	125 ms	125 ms
Detector	RMS	RMS	RMS	RMS
REF-Level	-10 dBm	-10 dBm	-10 dBm	-10 dBm
RF-Att. mode	AUTO	AUTO	AUTO	AUTO
RF-Attenuator	15 dB	15 dB	15 dB	15 dB
PRE-AMP	OFF	OFF	OFF	OFF
Sweep Points	625	10001	30001	30001
Stop after sweep	OFF	OFF	OFF	OFF
Transd. factor	<NONE>	<NONE>	<NONE>	<NONE>

*R&S®FSQ setup for spurious measurement (the measurement consists of more than 70 000 points with four different resolution bandwidths and is completed in less than one second)*

## Spectrum measurements over wide dynamic range

The RMS detector integrated as standard allows precise transmitter power measurements irrespective of the waveform.

Owing to its extremely wide dynamic range, the R&S®FSQ is the ideal analyzer for out-of-band emissions that have to be detected, for instance, by means of adjacent-channel power measurements. Noise correction yields a value of 84 dB in the adjacent channel, which far exceeds specification values.



*Constellation diagram of HS-DPSCH with 16QAM transmission*

## Code domain analysis

The main application of code domain analysis is to test the quality of the signal from the base station. In the 3GPP test specifications, two difference measures are stipulated:

- ◆ Error vector magnitude (EVM)
- ◆ Peak code domain analysis

To perform these measurements, the R&S®FSQ must look at all permissible signal combinations and detect the active codes (users) as well as their timing and power. All active codes are demod-

ulated down to bit level in order to generate a reference signal. From the demodulation process, additional information from the signal is acquired. This information can be displayed to verify, for instance, the accuracy of power control, constellation diagrams or the demodulated bits. The 16 Msample I&Q memory enables the R&S®FSQ to capture and analyze up to 100 consecutive frames.

For more information on the R&S®FSQ, refer to the R&S®FSQ product brochure (PD 0758.0945).

## Ordering information

<b>WCDMA Base Station Test Set</b>		
Based on the Signal Analyzer R&S®FSQ3, 3 GHz	R&S®FSMU-W3	1166.1554.03
Based on the Signal Analyzer R&S®FSQ8, 8 GHz	R&S®FSMU-W8	1166.1554.08
Based on the Signal Analyzer R&S®FSQ26, 26 GHz	R&S®FSMU-W26	1166.1554.26
<b>Options for the R&amp;S®FSMU-W</b>		
Package for 2nd RF Path	R&S®FSMU-B1	1404.2008.02
Package for 2nd Baseband	R&S®FSMU-B2	1404.2308.02
Package for Fading	R&S®FSMU-B3	1404.2608.02
<b>Extension to the following standards</b>		
GSM/EDGE	R&S®FS-K5 R&S®SMU-K40	1141.1496.02 1160.7609.02
CDMA2000®	R&S®FS-K82 R&S®SMU-K46	1157.2316.02 1160.9876.02
1xEV-DO	R&S®FS-K84 R&S®SMU-K17 <sup>1)</sup>	1157.2851.02 1160.7009.02
TD-SCDMA	R&S®FS-K76 R&S®SMU-K14 <sup>1)</sup>	1300.7291.02 1160.6202.02
<b>Options for the R&amp;S®SMU200A</b>		
Multicarrier CW Signal Generation	R&S®SMU-K61	1160.8505.02
Digital Standard CDMA2000® incl. 1xEV-DV	R&S®SMU-K46	1160.9876.02
Digital Standard IS-95	R&S®SMU-K11 <sup>1)</sup>	1160.5335.02
Digital Standard 3GPP TDD	R&S®SMU-K13 <sup>1)</sup>	1160.5906.02
Digital Standard TD-SCDMA	R&S®SMU-K14 <sup>1)</sup>	1160.6202.02
Digital Standard IEEE 802.11 (a/b/g)	R&S®SMU-K19 <sup>1)</sup>	1160.8805.02
User-Defined OFDM Signals	R&S®SMU-K15 <sup>1)2)</sup>	1160.6402.02
Digital Standard 3GPP FDD incl. HSDPA	R&S®SMU-K20 <sup>1)</sup>	1160.9460.02
<b>Options for the R&amp;S®FSQ</b>		
Noise Measurement Software (Windows software)	R&S®FS-K3	1057.3028.02
Phase Noise Measurements (Windows software)	R&S®FS-K4	1108.0088.02
AM/FM/φM Measurement Demodulator with measurement of modulation frequency, THD, SINAD, and spectrum (FFT) of the demodulated signal	R&S®FS-K7	1141.1796.02
Bluetooth® <sup>3)</sup> Transmitter Measurements	R&S®FS-K8	1157.2568.02
Power Sensor Measurements (supports R&S®NRP-Z11/-Z21 with R&S®NRP-Z4 USB adapter)	R&S®FS-K9	1157.3006.02
Noise Figure and Gain Measurements	R&S®FS-K30	1300.6508.02
Modulation and Code Domain Power Measurements to 3GPP TS 25.141 on Mobile Station Signals (UE)	R&S®FS-K73	1154.7252.02
Modulation and Code Domain Power Measurements on TD-SCDMA Mobile Station Signals (UE)	R&S®FS-K77	1300.8100.02
Modulation and Code Domain Power Measurements on CDMA2000®/1xEV-DV Mobile Station Signals (UE)	R&S®FS-K83	1157.2416.02
Modulation and Code Domain Power Measurements to 1xEV-DO on Mobile Station Signals	R&S®FS-K85	1300.6689.02
Universal Vector Signal Analysis	R&S®FSQ-K70	1161.8038.02
Modulation and Spectrum Measurements on WLAN Signals to 802.11a/b/g/j	R&S®FSQ-K91	1157.3129.02

<sup>1)</sup> With WinIQSIM™.

<sup>2)</sup> With WinIQOFDM.

<sup>3)</sup> The Bluetooth® word mark and logos are owned by the Bluetooth SIG, Inc. and any use of such marks by Rohde & Schwarz is under licence.

For specifications, see PD 0758.2448.22  
and [www.rohde-schwarz.com](http://www.rohde-schwarz.com)  
(search term: FSMU-W)



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