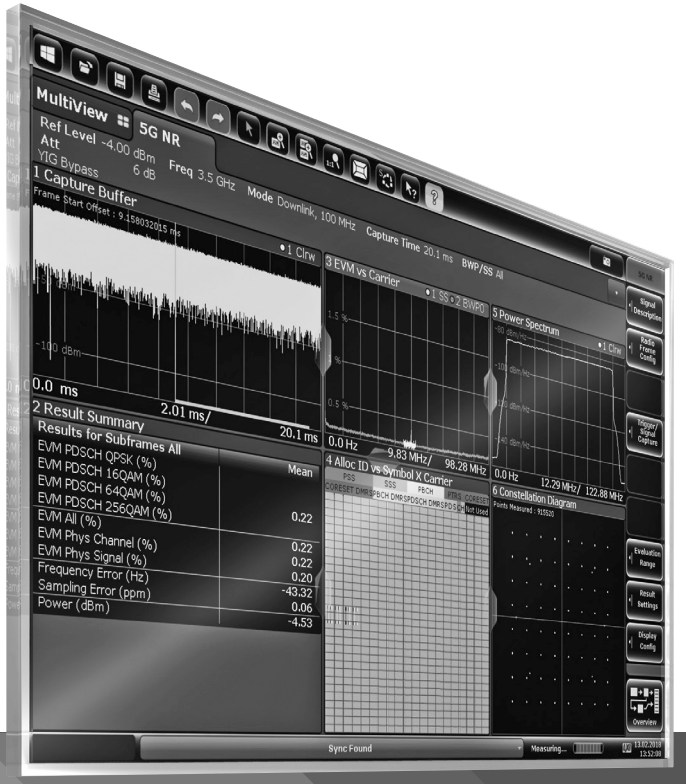
5G NR MEASUREMENT APPLICATION

Specifications

R&S®FSW-K144 5G NR Downlink Measurement Application
R&S®FSW-K145 5G NR Uplink Measurement Application
R&S®FSW-K147 5G NR Combined EVM/SEM/ACLR Measurements
R&S®FSW-K147C 5G NR Combined Multi Carrier EVM/SEM/ACLR Measurements
R&S®FSW-K148 5G NR Extension for Uplink/Downlink
R&S®FSW-K171 5G NR Release 17/18 Extension for Uplink/Downlink
R&S®FSW-K175 O-RAN Measurements
R&S®FSV3-K144 5G NR Downlink Measurement Application
R&S®FSV3-K145 5G NR Uplink Measurement Application
R&S®FSV3-K147 5G NR Combined EVM/SEM/ACLR Measurements
R&S®FSV3-K147C 5G NR Combined Multi Carrier EVM/SEM/ACLR Measurements
R&S®FSV3-K171 5G NR Release 17/18 Extension for Uplink/Downlink
R&S®FSV3-K175 O-RAN Measurements
R&S®FPS-K144 5G NR Downlink Measurement Application
R&S®FPS-K148 5G NR Extension for Downlink
R&S®VSE-K144 5G NR Release 15 Uplink/Downlink Measurements
R&S®VSE-K146 5G NR MIMO Measurement Application
R&S®VSE-K148 5G NR Release 16 Extension for Uplink/Downlink
R&S®VSE-K171 5G NR Release 17 Extension for Uplink/Downlink
R&S®VSE-K175 O-RAN Measurements



Specifications
Version 18.00

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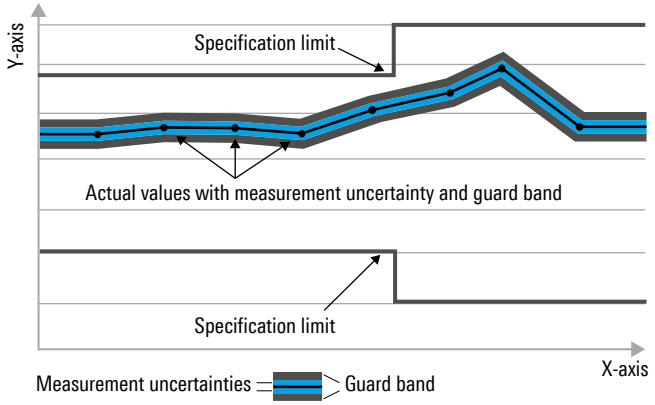
CONTENTS

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 <, ≤, >, ≥, ± 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®FSW-K144/-K145/-K147/-K147C/-K148/-K171/-K175, the R&S®FSV3-K144/-K145/-K147/-K147C/-K148/-K171/-K175, the R&S®FPS-K144/-K148 and the R&S®VSE-K144/-K146/-K148/-K171/-K175 are based on the specifications of the R&S®FSW, R&S®FSVA3000, R&S®FSV3000 and R&S®FPS signal and spectrum analyzers, the R&S®RTO and R&S®RTP oscilloscopes and the R&S®NRQ6 power sensor. 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

The specifications cover the R&S®FSW-K144/-K145/-K147/-K147C /-K148/-K171/-K175, the R&S®FSV3-K144/-K145/-K147/-K147C/-K148/-K171/-K175, R&S®FPS-K144/-K148 and the R&S®VSE-K144/-K146/-K148/-K171/-K175. The R&S®FSW-K144/-K145/-K147/-K147C /-K148/-K171/-K175, the R&S®FSV3-K144/-K145/-K147/-K147C/-K148/-K171/-K175 and the R&S®FPS-K144 are summarized with the term R&S®FSx-K144/-K145/-K147/-K147C/-K148/-K171/-K175.

The R&S®FSx-K144/-K145/-K147/-K147C/-K148/-K171/-K175 runs on the analyzer itself.
The R&S®VSE-K144/-K146/-K148/-K171/-K175 runs on a PC that can be connected to the devices as specified below.

If not declared otherwise, the values in these specificationsare device-specific, e.g. the same value applies to the R&S®FSW-K144/-K145 and the R&S®VSE-K144 with connected R&S®FSW.

For feature tables the following convention applies

•	Feature always supported i.e. with the R&S®VSE-K144 connected to the device and with the corresponding R&S®FSx-K144/-K145 option when running directly on the device
• (VSE)	Feature supported only with the R&S®VSE-K144 connected to the device. Not with the corresponding R&S®FSx-K144/-K145 option when running directly on the device
• (FSx-K144/-K145)	Feature supported only when running directly on the device with the corresponding R&S®FSx-K144/-K145 option. Not supported in the R&S®VSE-K144
–	Feature not supported with this device

Overview

Measurement application	Description	R&S®FSW	R&S®FSVA3000/ R&S®FSV3000	R&S®FPS	R&S®RTO/ R&S®RTP	R&S®NRQ6
R&S®FSx-K144/ -K145/-K147/ -K147C/-K148/ -K171/-K175	software that runs on device	• R&S®FSW-K144/ -K145/-K147/-K147C /-K148/ -K171/-K175	• R&S®FSV3-K144/ -K145/-K147/-K147C/ -K148/-K171/-K175	• R&S®FPS-K144/ -K148	–	–
R&S®VSE-K144/ -K146/-K148/-K171/ -K175	PC software that can be connected to device	•	•	•	• [1]	• [2]

[1] R&S®RTO-K11 or R&S®RTP-K11 option required for measurements with R&S®VSE.
[2] R&S®NRQ6-K1 option required for measurements with R&S®VSE.

Application overview

Assignment of option numbers to link modes and access modes

R&S®FSx-K144	5G NR Release 15 downlink measurements
R&S®FSx-K145	5G NR Release 15 uplink measurements
R&S®FSx-K147	5G NR combined EVM/SEM/ACLR measurements
R&S®FSx-K147C	5G NR combined multi carrier EVM/SEM/ACLR measurements
R&S®FSx-K148	5G NR Release 16 extension for uplink/downlink
R&S®FSx-K171	5G NR Release 17/18 extension for uplink/downlink
R&S®FSx-K175	O-RAN measurements
R&S®VSE-K144	5G NR Release 15 uplink/downlink measurements
R&S®VSE-K146	5G NR MIMO measurements
R&S®VSE-K148	5G NR Release 16 extension for uplink/downlink
R&S®VSE-K171	5G NR Release 17 extension for uplink/downlink
R&S®VSE-K175	O-RAN measurements

Supported standards

Supported standards	R&S®FSx-K144/-K145/-K147/-K147C and R&S®VSE-K144/-K146 in line with [1] R&S®FSx-K148 and R&S®VSE-K148 in line with [2] R&S®VSE-K171 in line with [3] R&S®FSx-K171 in line with [4] R&S®FSx-K175 and R&S®VSE-K175 in line with [5]
Supported physical channels and signals	
R&S®FSx-K144, R&S®VSE-K144/-K146	PDSCH, DL PT-RS, PDCCH, PBCH, PSS, SSS, CSI-RS
	support of multi-numerology scenarios
R&S®FSx-K145, R&S®VSE-K144	PUSCH, UL PT-RS, PUCCH (format 0/1/2), PRACH, SRS, support of transform precoding
	support of multi-numerology scenarios
R&S®FSx-K148, R&S®VSE-K148	PRS

References

[1] 3GPP TS 38.211 v15.10.0, 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical Channels and Modulation (Release 15).

[2] 3GPP TS 38.211 v16.8.0, 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical Channels and Modulation (Release 16).

[3] 3GPP TS 38.211 v17.3.0, 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical Channels and Modulation (Release 17).

[4] 3GPP TS 38.211 v18.2.0, 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical Channels and Modulation (Release 18).

[5] O-RAN.WG4.CONF.0-v05.00, O-RAN Fronthaul Working Group; Conformance Test Specification.

5G NR analysis

Inputs

	R&S®FSW	R&S®FSVA3000/ R&S®FSV3000	R&S®FPS	R&S®RTO/ R&S®RTP (VSE)	R&S®NRQ6 (VSE)
RF input	●	●	●	●	●
External frontend	–	● (FSV3-K144/-K145) [3]	–	–	–
Analog baseband input	● (FSW-K144/-K145) [4]	● (FSV3-K144/-K145) [5]	–	●	–
External mixer	●	●	–	–	–
File	●	●	●	●	●

Signal acquisition

		R&S®FSW	R&S®FSVA3000/ R&S®FSV3000	R&S®FPS	R&S®RTO/ R&S®RTP (VSE)	R&S®NRQ6 (VSE)
Capture length	default	1.0 ms to 50.1 ms	1.0 ms to 50.1 ms	1.0 ms to 50.1 ms	1.0 ms to 50.1 ms	1.0 ms to 50.1 ms
	long capture	50.1 ms to 1 s	50.1 ms to 1 s [6]	50.1 ms to 1 s	> 50.1 ms (depending on sampling rate)	> 50.1 ms (depending on sampling rate)
Trigger modes	free run	●	●	●	●	●
	external	●	●	●	●	●

[3] R&S®FE44S and R&S®FE50DTR supported. For details, see R&S®FE44S (PD 3609.5545.22) and R&S®FE50DTR (PD 3609.5551.22) specifications.

[4] R&S®FSW-B71 or R&S®FSW-B2071 option required.

[5] R&S®FSV-B271 option required.

[6] With R&S®FSV3-B200 or R&S®FSV3-B400 installed, value only valid up to 40 MHz carrier bandwidth.

Measurement parameters

	R&S®FSW	R&S®FSVA3000/ R&S®FSV3000	R&S®FPS	R&S®RTO/ R&S®RTP (VSE)	R&S®NRQ6 (VSE)
Resource allocation					
Channel bandwidth	5/10/15/20/25/30/ 35 [7]/40/45 [7]/50/60/ 70/80/90/100/200/ 400/800 [7]/1600 [7]/ 2000 [7] MHz [8]	3 [7]/5/10/15/20/25/30/35 [7]/40/ 45 [7]/50/60/70/80/90/100/200/ 400/800 [7] MHz [8]	5/10/15/20/25/30/40/50/60/70 /80/90/ 100 MHz [8]	5/10/15/20/25/30/35 [7]/ 40/45 [7]/50/60/70/80/ 90/100/200/400 MHz	5/10/15/20/25/30/35 [7]/40/ 45 [7]/50/60/70/80/90/100 MHz
Number of component carriers	16	16	16	16	16
Switchable multicarrier filter	●	●	●	●	●
Number of frames to be allocated (per capture)	5	5	5	5	5
Modulation types	π/2-BPSK (uplink TP only), QPSK, 16QAM, 64QAM, 256QAM, 1024QAM [7]				
MIMO					
Configuration	1 to 8 RX antennas (VSE-K146, DL only)				
Number of input sources	1 to 8 (VSE-K146, DL only)				
Spectrum emission mask/adjacent channel leakage power ratio (ACLR)					
Measurements available	● [9]	● [9]	● [10]	–	–
Frequency range	FR1/FR2			–	–
Base station type	1-C, 1-H, 1-O, 2-O (FSx-K144/-K147/-K147C, VSE-K144)		1-C, 1-H, 1-O, 2-O (FSx-K144, VSE-K144)	–	–
Category (SEM)	A, B (option 1, option 2), local area, home (FSx-K144/-K147/-K147C, VSE-K144); general SEM (FSx-K145/-K147/-K147C, VSE-K144)		A, B (option 1, option 2), local area, home (FSx-K144, VSE-K144); general SEM (VSE-K144)	–	–
Adjacent channel (ACLR)	NR of same bandwidth, 5 MHz E-UTRA (FSx-K144/-K147/-K147C, VSE-K144); 3.84 MHz UTRA (FSx-K145/-K147/-K147C, VSE-K144)		NR of same bandwidth, 5 MHz E-UTRA (FSx-K144, VSE-K144); 3.84 MHz UTRA (VSE-K144)	–	–
ACLR noise correction	● (FSW-K144/-K145)	● (FSV3-K144/-K145)	● (FPS-K144)	–	–
Auto gating	● (FSW-K144/-K145/ -K147/-K147C)	● (FSV3-K144/-K145/ -K147/-K147C)	● (FPS-K144)	–	–

[7] Only available with R&S®FSx-K171 or R&S®VSE-K171.

[8] Matching bandwidth option required. For example, R&S®FSW-B512/R&S®FSV3-B400/R&S®FSV-B160/R&S®FPS-B160 required for the respective analyzer to support all given 5G NR channel bandwidths.

[9] As defined in section 6.6 of 3GPP TS 38.141-1/2 v17.5.0 or in section 6.5 of TS 38.521-1/2 v17.5.0/v16.12.0.

[10] As defined in section 6.6 of 3GPP TS 38.141-1/2 v16.4.0 or in section 6.5 of TS 38.521-1/2 v16.4.0.

Result displays downlink

	R&S®FSW	R&S®FSVA3000/ R&S®FSV3000	R&S®FPS	R&S®RTO/ R&S®RTP (VSE)	R&S®NRQ6 (VSE)
Result summary					
EVM PDSCH QPSK	•	•	•	•	•
EVM PDSCH 16QAM	•	•	•	•	•
EVM PDSCH 64QAM	•	•	•	•	•
EVM PDSCH 256QAM	•	•	•	•	•
EVM PDSCH 1024QAM	• [7]	–	–	–	–
EVM physical channel	•	•	•	•	•
EVM physical signal	•	•	•	•	•
EVM all	•	•	•	•	•
EVM peak	•	•	•	•	•
Center frequency error	•	•	•	•	•
Sampling error	•	•	•	•	•
Time alignment error	•	•	•	•	•
I/Q offset	•	•	•	•	•
I/Q gain imbalance	•	•	•	•	•
I/Q quadrature error	•	•	•	•	•
OFDM symbol TX power (OSTP)	•	•	•	•	•
RSTP	•	•	•	•	•
CSI-RSRP	•	•	•	•	•
SS-RSRP	•	•	•	•	•
Power	•	•	•	•	•
Crest factor	•	•	•	•	•
Frame start offset	•	•	•	–	–
Throughput	•	•	• (VSE-K175)	• (VSE-K175)	• (VSE-K175)
BLER	•	•	• (VSE-K175)	• (VSE-K175)	• (VSE-K175)
Combined EVM/ACLR/SEM result (in addition to result summary parameters)					
Meas ID	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
Time stamp	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
Time stamp delta	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
Sync state	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
ACLR pass/fail	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
ACLR absolute pass/fail	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
ACLR relative pass/fail	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–

	R&S®FSW	R&S®FSVA3000/ R&S®FSV3000	R&S®FPS	R&S®RTO/ R&S®RTP (VSE)	R&S®NRQ6 (VSE)
SEM pass/fail	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
OVLD	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
Power versus time					
Capture buffer	•	•	•	•	•
On/off power	•	•	–	–	–
Power versus symbol and carrier	•	•	•	•	•
EVM					
EVM versus carrier	•	•	•	•	•
EVM versus symbol	•	•	•	•	•
EVM versus symbol and carrier	•	•	•	•	•
EVM versus resource block	•	•	•	•	•
Frequency error versus symbol	•	•	•	•	•
Frequency error versus subframe	•	•	•	•	•
Spectrum					
Power spectrum	•	•	•	•	•
Channel flatness	•	•	•	•	•
Spectrum mask	•	•	•	–	–
ACLR	•	•	•	–	–
Constellation					
Constellation diagram	•	•	•	•	•
Statistics/miscellaneous					
CCDF	•	•	•	•	•
Allocation summary list	•	•	•	•	•
Bit stream	•	•	•	•	•
Allocation ID versus symbol and carrier	•	•	•	•	•
Channel decoder results (PBCH only)	•	•	•	•	•
Beamforming					
Reference signal phase versus carrier	•	•	•	•	•
Reference signal phase difference versus carrier	•	•	•	•	•
Reference signal magnitude	•	•	•	•	•
Beamforming summary	•	•	•	•	•

Result displays uplink

	R&S®FSW	R&S®FSVA3000/ R&S®FSV3000	R&S®FPS (VSE)	R&S®RTO/ R&S®RTP (VSE)	R&S®NRQ6 (VSE)
Result summary					
EVM PUSCH π/2-BPSK (TP only)	•	•	•	•	•
EVM PUSCH QPSK	•	•	•	•	•
EVM PUSCH 16QAM	•	•	•	•	•
EVM PUSCH 64QAM	•	•	•	•	•
EVM PUSCH 256QAM	•	•	•	•	•
EVM PUSCH 1024QAM	• [7]	–	–	–	–
EVM DMRS PUSCH π/2-BPSK (TP only)	•	•	•	•	•
EVM DMRS PUSCH QPSK	•	•	•	•	•
EVM DMRS PUSCH 16QAM	•	•	•	•	•
EVM DMRS PUSCH 64QAM	•	•	•	•	•
EVM DMRS PUSCH 256QAM	•	•	•	•	•
EVM DMRS PUSCH 1024QAM	• [7]	–	–	–	–
EVM PUCCH	•	•	•	•	•
EVM DMRS PUCCH	•	•	•	•	•
EVM physical channel	•	•	•	•	•
EVM physical signal	•	•	•	•	•
EVM all	•	•	•	•	•
EVM peak	•	•	•	•	•
Center frequency error	•	•	•	•	•
Sampling error	•	•	•	•	•
I/Q offset	•	•	•	•	•
I/Q gain imbalance	•	•	•	•	•
I/Q quadrature error	•	•	•	•	•
Power	•	•	•	•	•
Crest factor	•	•	•	•	•
Frame start offset	•	•	•	–	–
Throughput	•	•	• (VSE-K175)	• (VSE-K175)	• (VSE-K175)
BLER	•	•	• (VSE-K175)	• (VSE-K175)	• (VSE-K175)
Combined EVM/ACLR/SEM result (in addition to result summary parameters)					
Meas ID	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
Time stamp	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
Time stamp delta	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–

	R&S®FSW	R&S®FSVA3000/ R&S®FSV3000	R&S®FPS (VSE)	R&S®RTO/ R&S®RTP (VSE)	R&S®NRQ6 (VSE)
Sync state	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
ACLR pass/fail	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
ACLR absolute pass/fail	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
ACLR relative pass/fail	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
SEM pass/fail	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
OVLD	• (FSW-K147/-K147C)	• (FSV3-K147/-K147C)	–	–	–
Power versus time					
Capture buffer	•	•	•	•	•
Power versus symbol and carrier	•	•	•	•	•
EVM					
EVM versus carrier	•	•	•	•	•
EVM versus symbol	•	•	•	•	•
EVM versus symbol and carrier	•	•	•	•	•
EVM versus resource block	•	•	•	•	•
Frequency error versus symbol	•	•	•	•	•
Frequency error versus subframe	•	•	•	•	•

	R&S®FSW	R&S®FSVA3000/ R&S®FSV3000	R&S®FPS (VSE)	R&S®RTO/ R&S®RTP (VSE)	R&S®NRQ6 (VSE)
Spectrum					
Power spectrum	•	•	•	•	•
Relative in-band emissions	•	•	•	•	•
In-band emission summary	•	•	•	•	•
Spectrum flatness	•	•	•	•	•
Spectrum mask	•	•	•	–	–
ACLR	•	•	•	–	–
Constellation					
Constellation diagram	•	•	•	•	•
Statistics/miscellaneous					
CCDF	•	•	•	•	•
Allocation summary list	•	•	•	•	•
Bit stream	•	•	•	•	•
Allocation ID versus symbol and carrier	•	•	•	•	•

Measurement uncertainty

Specifications apply under the following conditions:

- Specifications are nominal values
- Temperature range from +20 °C to +30 °C
- Reference level properly adjusted
- External reference frequency applied
- R&S®FSW device serial number larger than 104019/101423

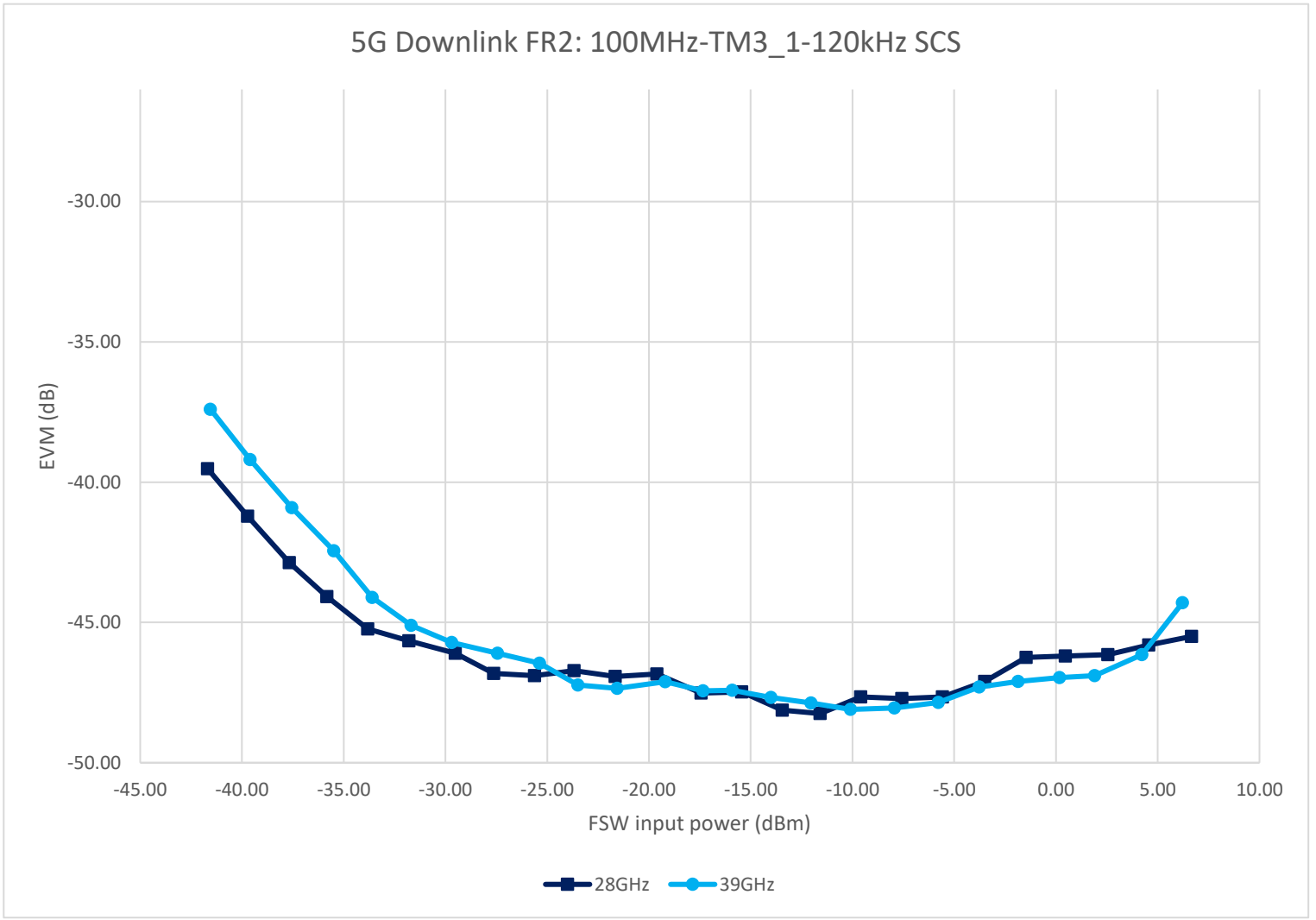
Output power

Output power	
Level uncertainty	same as R&S®FSW/R&S®FSVA3000/R&S®FSV3000/R&S®FPS (see R&S®FSW/R&S®FSVA3000/R&S®FSV3000/R&S®FPS total measurement uncertainty)

Transmitted signal quality base station

EVM	• all SS/PBCH blocks transmitted were not overlapping PDSCH DMRS • one bandwidth part occupying full carrier bandwidth (no CSI-RS) • one full bandwidth PDSCH allocation, 64QAM, configuration type 1, mapping type A, DMRS additional position 1 (no PT-RS) • CORESET in first symbol • one component carrier • input: RF, input level > –10 dBm	
Residual EVM		
450 MHz to 3 GHz	20 MHz carrier bandwidth, 15 kHz subcarrier spacing	
	R&S®FSW43	< 0.11 % (–59.1 dB)
	R&S®FSW67	< 0.13 % (–57.7 dB)
	R&S®FSVA3000	< 0.13 % (–57.9 dB)
	R&S®FSV3000	< 0.14 % (–57.1 dB)
	R&S®FPS40	< 0.38 % (–48.4 dB)
3 GHz to 6 GHz	100 MHz carrier bandwidth, 30 kHz subcarrier spacing	
	R&S®FSW43-B512	< 0.27 % (–51.3 dB)
	R&S®FSW43-B1200/-B2001	< 0.37 % (–48.6 dB)
	R&S®FSW67-B1200/-B2001	< 0.37 % (–48.6 dB)
	R&S®FSVA3000-B200	< 0.40 % (–48.0 dB)
	R&S®FSV3000-B200	< 0.45 % (–46.9 dB)
	R&S®FPS40-B160	< 0.67 % (–43.4 dB)
28 GHz	100 MHz carrier bandwidth, 120 kHz subcarrier spacing	
	R&S®FSW43-B512	< 0.69 % (–43.3 dB)
	R&S®FSW43-B1200/-B2001	< 0.71 % (–43.0 dB)
	R&S®FSW67-B1200/-B2001	< 0.75 % (–42.5 dB)
	R&S®FSVA3000-B200	< 0.80 % (–41.9 dB)
	R&S®FSV3000-B200	< 0.85 % (–41.4 dB)
	R&S®FPS40-B160	< 1.09 % (–39.3 dB)

39 GHz	100 MHz carrier bandwidth, 120 kHz subcarrier spacing	
	R&S®FSW43-B512	< 0.88 % (–41.1 dB)
	R&S®FSW43-B1200/-B2001	< 0.91 % (–40.8 dB)
	R&S®FSW67-B1200/-B2001	< 0.91 % (–40.8 dB)
	R&S®FSVA3000-B200	< 1.10 % (–39.2 dB)
	R&S®FSV3000-B200	< 1.20 % (–38.4 dB)
	R&S®FPS40-B160	< 1.56 % (–36.1 dB)
Time alignment between transmitter branches	• all SS/PBCH blocks transmitted • one bandwidth part occupying full carrier bandwidth (no CSI-RS) • one full bandwidth PDSCH allocation, QPSK, configuration type 2, mapping type A, DMRS length 2, DMRS additional position 1 • one component carrier	
Uncertainty	10 MHz carrier bandwidth, 30 kHz subcarrier spacing	
	R&S®FSW	< 2.5 ns
	R&S®FSVA3000	< 2.5 ns
	R&S®FSV3000	< 2.5 ns
	R&S®FPS	< 2.5 ns

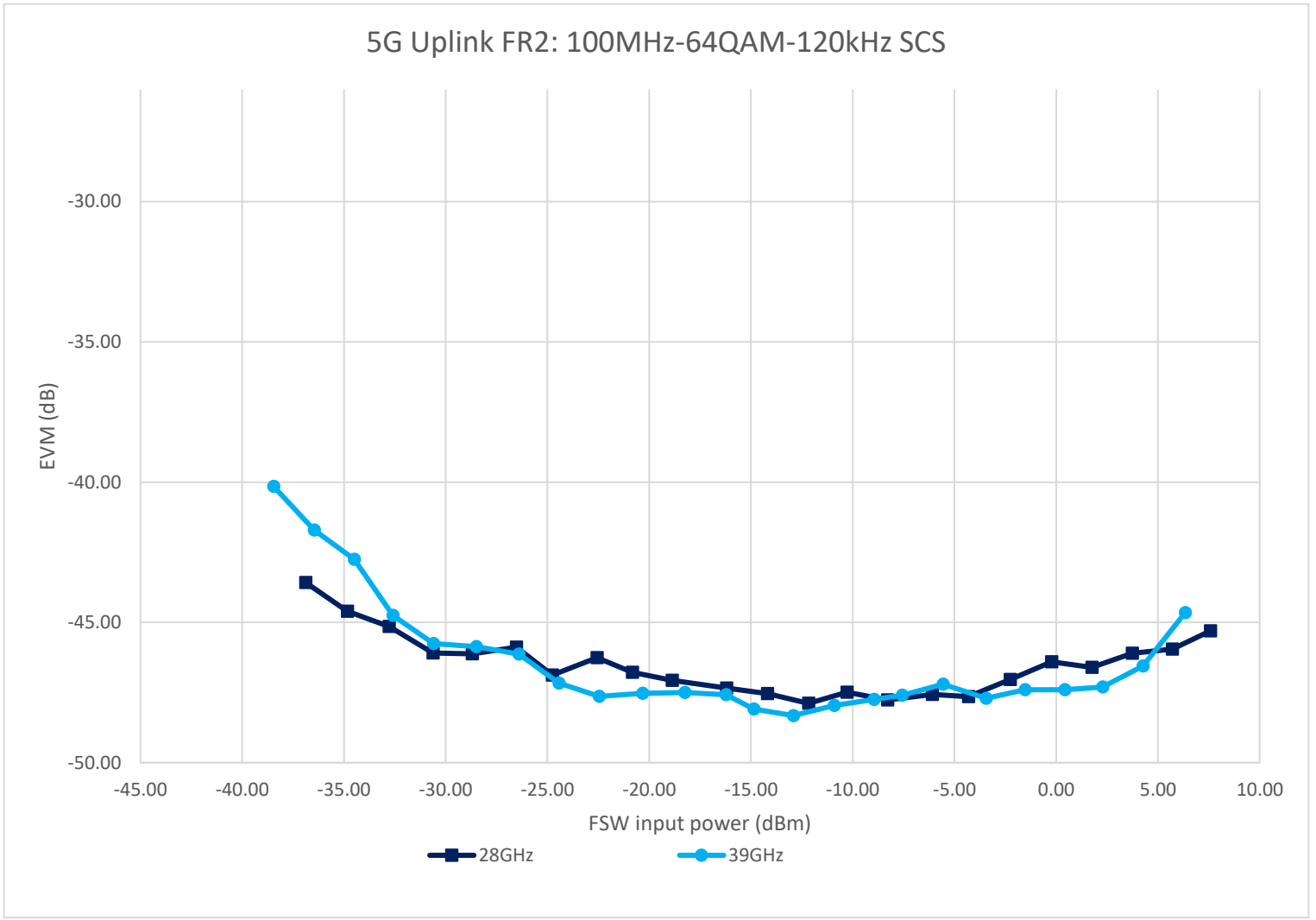


EVM (meas.) for different input power selections measured with the R&S®FSW50-B4001 [11]

[11] R&S®FSW-B24U enhanced dynamic range preamplifier required. For instruments starting from the following serial numbers R&S®FSW43: 102224, R&S®FSW50: 101676, R&S®FSW67: 101721, the enhanced dynamic range preamplifier is included in the R&S®FSW-B24 option. For more details, see the R&S®FSW signal and spectrum analyzer specifications (PD 5215.6749.22).

Transmitted signal quality UE

EVM	• one bandwidth part occupying full carrier bandwidth (no PUCCH, no SRS) • one full bandwidth PUSCH allocation, 64QAM, configuration type 1, mapping type A, DMRS additional position 1 (no PT-RS) • one component carrier • input: RF, input level > –10 dBm	
Residual EVM		
450 MHz to 3 GHz	20 MHz carrier bandwidth, 15 kHz subcarrier spacing	
	R&S®FSW43	< 0.11 % (–59.1 dB)
	R&S®FSW67	< 0.12 % (–58.2 dB)
	R&S®FSVA3000	< 0.12 % (–58.2 dB)
	R&S®FSV3000	< 0.14 % (–57.4 dB)
3 GHz to 6 GHz	100 MHz carrier bandwidth, 30 kHz subcarrier spacing	
	R&S®FSW43-B512	< 0.28 % (–51.2 dB)
	R&S®FSW43-B1200/-B2001	< 0.37 % (–48.6 dB)
	R&S®FSW67-B1200/-B2001	< 0.37 % (–48.6 dB)
	R&S®FSVA3000-B200	< 0.40 % (–48.0 dB)
	R&S®FSV3000-B200	< 0.45 % (–46.9 dB)
28 GHz	100 MHz carrier bandwidth, 120 kHz subcarrier spacing	
	R&S®FSW43-B512	< 0.71 % (–43.0 dB)
	R&S®FSW43-B1200/-B2001	< 0.71 % (–43.0 dB)
	R&S®FSW67-B1200/-B2001	< 0.79 % (–42.0 dB)
	R&S®FSVA3000-B200	< 0.80 % (–41.9 dB)
	R&S®FSV3000-B200	< 0.85 % (–41.4 dB)
39 GHz	100 MHz carrier bandwidth, 120 kHz subcarrier spacing	
	R&S®FSW43-B512	< 0.89 % (–41.0 dB)
	R&S®FSW43-B1200/-B2001	< 0.88 % (–41.1 dB)
	R&S®FSW67-B1200/-B2001	< 0.88 % (–41.1 dB)
	R&S®FSVA3000-B200	< 1.10 % (–39.2 dB)
	R&S®FSV3000-B200	< 1.20 % (–38.4 dB)



EVM (meas.) for different input power selections measured with the R&S®FSW50-B4001 [11]

Ordering information

Designation	Type	Order No.
5G NR measurement applications		
R&S®FSW		
5G NR Release 15 downlink measurements	R&S®FSW-K144	1338.3606.02
5G NR Release 15 uplink measurements	R&S®FSW-K145	1338.3612.02
5G NR combined EVM/SEM/ACLR measurements	R&S®FSW-K147	1338.6486.02
5G NR combined multi carrier EVM/SEM/ACLR measurements	R&S®FSW-K147C	1351.1355.02
5G NR Release 16 extension for uplink/downlink	R&S®FSW-K148	1350.6624.02
5G NR Release 17 extension for uplink/downlink	R&S®FSW-K171	1350.7108.02
O-RAN measurements	R&S®FSW-K175	1353.2642.02
R&S®FSVA3000, R&S®FSV3000		
5G NR Release 15 downlink measurements	R&S®FSV3-K144	1330.7219.02
5G NR Release 15 uplink measurements	R&S®FSV3-K145	1330.7225.02
5G NR combined EVM/SEM/ACLR measurements	R&S®FSV3-K147	1346.4250.02
5G NR combined multi carrier EVM/SEM/ACLR measurements	R&S®FSV3-K147C	1346.6498.02
5G NR Release 16 extension for uplink/downlink	R&S®FSV3-K148	1346.4914.02
5G NR Release 17/18 extension for uplink/downlink	R&S®FSV3-K171	1346.5362.02
O-RAN measurements	R&S®FSV3-K175	1346.6452.02
R&S®FPS		
5G NR Release 15 downlink measurements	R&S®FPS-K144	1321.4979.02
5G NR Release 16 extension for downlink	R&S®FPS-K148	1331.3298.02
R&S®VSE		
5G NR Release 15 downlink/uplink measurements	R&S®VSE-K144	1309.9574.02
5G NR MIMO measurements	R&S®VSE-K146	1345.1305.02
5G NR Release 16 extension for uplink/downlink	R&S®VSE-K148	1345.1392.02
5G NR Release 17 extension for uplink/downlink	R&S®VSE-K171	1345.1663.02
O-RAN measurements	R&S®VSE-K175	1350.7020.02
Signal and spectrum analyzers		
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	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		
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

R&S®FSV3000		
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, 10 Hz to 4 GHz	R&S®FPS4	1319.2008.04
Signal and spectrum analyzer, 10 Hz to 7 GHz	R&S®FPS7	1319.2008.07
Signal and spectrum analyzer, 10 Hz to 13.6 GHz	R&S®FPS13	1319.2008.13
Signal and spectrum analyzer, 10 Hz to 30 GHz	R&S®FPS30	1319.2008.30
Signal and spectrum analyzer, 10 Hz to 40 GHz	R&S®FPS40	1319.2008.40
Oscilloscopes		
R&S®RTO		
Oscilloscope, 6 GHz, 4 channels	R&S®RTO2064	1329.7002.64
R&S®RTP		
Oscilloscope, 6 GHz, 4 channels	R&S®RTP064	1320.5007.06
Power sensor		
R&S®NRQ6		
Frequency selective power sensor, 50 MHz to 6 GHz	R&S®NRQ6	1421.3509K02
Vector signal explorer software		
R&S®VSE basic edition	R&S®VSE	1345.1011.06
R&S®VSE enterprise edition	R&S®VSE	1345.1105.06
R&S®VSE software maintenance	R&S®VSE-SWM	1320.7622.81
Recommended options and extras		
R&S®FSW		
LO/IF connections for external mixers for R&S®FSW26/R&S®FSW43/R&S®FSW50/R&S®FSW67	R&S®FSW-B21	1313.1100.28
LO/IF connections for external mixers for R&S®FSW85	R&S®FSW-B21	1313.1100.86
28 MHz analysis bandwidth	R&S®FSW-B28	1313.1645.02
40 MHz analysis bandwidth	R&S®FSW-B40	1313.0861.02
80 MHz analysis bandwidth	R&S®FSW-B80	1313.0878.02
160 MHz analysis bandwidth	R&S®FSW-B160	1325.4850.04
320 MHz analysis bandwidth	R&S®FSW-B320	1325.4867.04
512 MHz analysis bandwidth	R&S®FSW-B512	1313.4296.04
1.2 GHz analysis bandwidth	R&S®FSW-B1200	1331.6400.04
2 GHz analysis bandwidth	R&S®FSW-B2001	1331.6916.04
R&S®FSVA3000, R&S®FSV3000		
YIG preselector bypass	R&S®FSV3-B11	1330.3865.02
LO/IF connections for external mixers	R&S®FSV3-B21	1330.4010.02
40 MHz analysis bandwidth	R&S®FSV3-B40	1330.4103.02
200 MHz analysis bandwidth	R&S®FSV3-B200	1330.4132.02
400 MHz analysis bandwidth	R&S®FSV3-B400	1330.7154.02
600 MHz analysis bandwidth	R&S®FSV3-B600	1346.5004.02
Upgrade from 600 MHz to 1 GHz analysis bandwidth	R&S®FSV3-U1006	1346.5027.02
1 GHz analysis bandwidth	R&S®FSV3-B1000	1346.3699.02

R&S®FPS		
YIG preselector bypass for R&S®FPS30	R&S®FPS-B11	1326.5467.30
YIG preselector bypass for R&S®FPS40	R&S®FPS-B11	1326.5467.40
160 MHz analysis bandwidth for R&S®FPS4/R&S®FPS7	R&S®FPS-B160	1321.4285.02
160 MHz analysis bandwidth for R&S®FPS13	R&S®FPS-B160	1321.4285.13
160 MHz analysis bandwidth for R&S®FPS30/R&S®FPS40	R&S®FPS-B160	1321.4285.40
R&S®RTO		
OCXO 10 MHz	R&S®RTO-B4	1304.8305.02
I/Q software interface	R&S®RTO-K11	1329.7360.02
R&S®RTP		
I/Q software interface	R&S®RTP-K11	1800.6683.02
R&S®NRQ6		
I/Q data interface	R&S®NRQ6-K1	1421.4705.02
Phase coherent measurements	R&S®NRQ6-K3	1421.4770.02
External frontends		
External frontend from 24 GHz to 44 GHz	R&S®FE44S	1338.7001.02
External frontend from 36 GHz to 50 GHz	R&S®FE50DTR	1347.4099.02

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ISO 9001

Certified Environmental Management
ISO 14001

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