

GSM Measurements Specifications

R&S®FSW-K10 GSM/EDGE/EDGE Evolution/VAMOS Measurements
 R&S®FSV3-K10 Analysis of GSM, EDGE and EDGE Evolution Signals
 R&S®FSV-K10 Analysis of GSM, EDGE and EDGE Evolution Signals
 R&S®FPS-K10 GSM/EDGE/EDGE Evolution/VAMOS Measurements
 R&S®VSE-K10 GSM Measurements



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Definitions

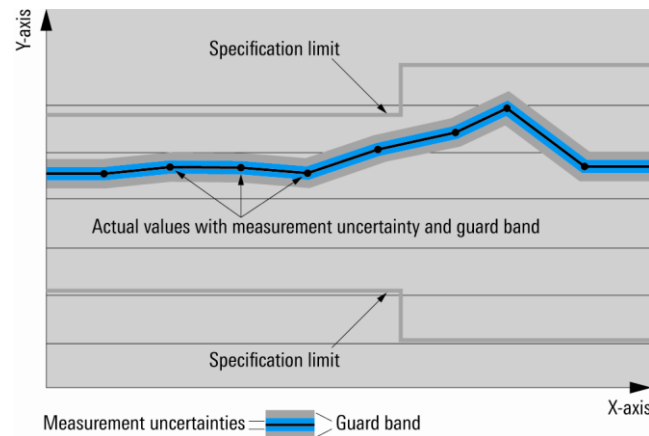
General

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".

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 Gbps (billion bits per second), Mbps (million bits per second), kbps (thousand bits per second), Msps (million symbols per second) or ksps (thousand symbols per second), and sample rates are specified in Msample/s (million samples per second). Gbps, Mcps, Mbps, Msps, kbps, ksps and Msample/s are not SI units.

Specifications

The specifications of the R&S®VSE-K10/R&S®FSx-K10 GSM measurements are based on the data sheet specifications of the R&S®FSW, R&S®FSVA3000, R&S®FSV3000, R&S®FSVA, R&S®FSV and R&S®FPS signal and spectrum analyzers in the default operating mode (signal and spectrum analyzer mode). They have not been checked separately and are not verified during instrument calibration. Measurement uncertainties are given as 95 % confidence intervals at a center frequency of 935 MHz. 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-K10, R&S®FSV3-K10, R&S®FSV-K10, R&S®FPS-K10 and the R&S®VSE-K10.

The R&S®FSW-K10, R&S®FSV3-K10, R&S®FSV-K10 and R&S®FPS-K10 are summarized with the term R&S®FSx-K10.

The R&S®FSx-K10 runs on the device itself.

The R&S®VSE-K10 runs on a PC that can be connected to the following analyzers: R&S®FSW, R&S®FSVA, R&S®FSV, R&S®FPS and for R&S®VSE; firmware version 1.62 or higher also to R&S®FSVA3000 and R&S®FSV3000.

If not stated otherwise, the data sheet values are device-specific, e.g. the same value applies to the R&S®FSW-K10 and the R&S®VSE-K10 with connected R&S®FSW.

For feature tables, the following convention applies:

•	Feature always supported, i.e. with the R&S®VSE-K10 connected to the device and with the corresponding R&S®FSx-K10 option when running directly on the device.
• (VSE)	Feature supported only with the R&S®VSE-K10 connected to the device. Not with the R&S®FSx-K10 option when running directly on the device.
• (FSx-K10)	Feature supported only when running directly on the device with the R&S®FSx-K10 option. Not supported in the R&S®VSE-K10.
–	Feature not supported with this device.

GSM measurements

Supported measurements

Measurement mode ¹	R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FSVA/R&S®FSV	R&S®FPS
I/Q measurements ²	•	•	•	•
MCWN measurements ³	• (FSW-K10), only RF input	• (FSV3-K10), only RF input	–	• (FPS-K10), only RF input
Wide modulation spectrum measurements ⁴	• ²	• ²	• (FSV-K10)	• ²

Inputs

Measurement mode	R&S®FSW		R&S®FSVA3000/R&S®FSV3000		R&S®FSVA/R&S®FSV		R&S®FPS	
	I/Q	MCWN	I/Q	MCWN	I/Q	Wide modulation spectrum	I/Q	MCWN
RF input	•	• (FSW-K10)	•	• (FSV3-K10)	•	• (FSV-K10)	•	• (FPS-K10)
Frequency range	frequency range same as R&S®FSW ⁵		frequency range same as R&S®FSVA3000/FSV3000		frequency range same as R&S®FSVA/FSV ⁵		frequency range same as R&S®FPS ⁵	
Digital baseband input	• (FSW-K10) ⁶	–	–	–	• (FSV-K10) ⁷	–	–	–
Analog baseband input	• (FSW-K10) ⁸	–	–	–	–	–	–	–
File	•	–	•	–	• (VSE)	–	•	–

Frequency

Frequency bands	T-GSM380, T-GSM410, GSM450, GSM480, GSM710, GSM750, T-GSM810, GSM850, P-GSM900, E-GSM900, R-GSM900, T-GSM900, DCS1800, PCS1900		
Frequency setting	frequency band		frequency and ARFCN up to 16 carriers frequencies carrier allocation: • contiguous • noncontiguous ¹⁰
	single carrier		
	multicarrier ⁹		

¹ R&S®FSW/FSV3/FPS-K10: MEAS hardkey switches between multicarrier wideband noise measurement and single carrier I/Q based measurement. R&S®FSV-K10: Softkeys switch between single carrier I/Q based measurements and the wide modulation spectrum measurement.

² Modulation spectrum measurements are covered by the MCWN (R&S®FSW/FSV3-K10/FPS-K10) or the I/Q measurement (R&S®FSW/FSV3/FPS/VSE-K10) mode. No separate measurement mode available.

³ Measurement in line with 3GPP TS 51.021, chapter 6.12: Wideband noise and intra-BSS intermodulation attenuation in multicarrier operation.

⁴ Gated zero span modulation spectrum measurements for offset frequencies up to 6 MHz.

⁵ Restricted dynamic range, IF overload, IF power trigger and auto level functionality depending on carrier frequency and bandwidth at carrier frequencies < 90 MHz.

⁶ Only with R&S®FSW-B17 option.

⁷ Only with R&S®FSV-B17 option.

⁸ Only with R&S®FSW-B71 option.

⁹ R&S®FSV-K10: Only up to 12 active carriers. Configuration of carrier allocation and carrier frequencies not supported.

¹⁰ Noncontiguous frequency allocation is defined as an allocation where two sub-blocks are separated by at least 5 MHz (cf. 3GPP TS 51.021, chapter 4.10.10. multicarrier BTS).

Level

		R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FSVA/R&S®FSV	R&S®FPS
Level range	RF input	up to +30 dBm	up to +30 dBm	up to +30 dBm	up to +30 dBm
	auto level	•	•	•	•
	manual	•	•	•	•

Signal acquisition

	R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FSVA/R&S®FSV	R&S®FPS
Implemented standard versions	3GPP TS 45.002 V12.2.0 (2014-08)		3GPP TS 45.002 V9.4.0 (2010-09)	3GPP TS 45.002 V12.2.0 (2014-08)
	3GPP TS 45.004 V12.0.0 (2014-09)		3GPP TS 45.004 V9.5.0 (2010-11)	3GPP TS 45.004 V12.0.0 (2014-09)
	3GPP TS 45.005 V12.5.0 (2015-04)		3GPP TS 45.005 V9.4.0 (2010-09)	3GPP TS 45.005 V12.5.0 (2015-04)
	3GPP TS 51.010-1 V12.4.0 (2015-06)		3GPP TS 51.010-1 V9.2.0 (2010-06)	3GPP TS 51.010-1 V12.4.0 (2015-06)
	3GPP TS 51.021 V12.3.0 (2014-12)		3GPP TS 51.021 V9.3.0 (2010-09)	3GPP TS 51.021 V12.3.0 (2014-12)

Device types	base transceiver station (BTS)	normal
		micro
		pico
multicarrier base transceiver station ¹¹	wide area	
	medium range	
	local area	
mobile station (MS)	normal	
	small	
Standards	GSM	
	EDGE (EGPRS)	
	EDGE Evolution level A (EGPRS2-A)	
	EDGE Evolution level B (EGPRS2-B)	
	VAMOS ¹²	
Burst types and modulation formats	access burst (AB)	GMSK
	normal burst (NB)	GMSK
		AQPSK
		$3\pi/8$ -8PSK
		$\pi/4$ -16QAM
		$-\pi/4$ -32QAM
	higher symbol rate burst (HSR)	$3\pi/4$ -QPSK
	$\pi/4$ -16QAM	
	$-\pi/4$ -32QAM	
Symbol rates	NB and AB	normal (270.833 ksps)
	HSR	higher (325 ksps)
VAMOS ¹² SCPIR ¹³		-15 dB to +15 dB (NB-AQPSK only)

¹¹ R&S®FSV-K10: Only basic support for multicarrier BTS (multicarrier filter; the limit of the modulation spectrum measurement is changed by $10 \cdot \log(N)$, where N corresponds to the number of active carriers).

¹² VAMOS: voice services over adaptive multi-user channels on one slot.

¹³ SCPIR: subchannel power imbalance ratio.

Training sequence codes (TSC)	NB-8PSK, 16QAM and 32QAM	TSC 0 to TSC 7 user-definable TSC
	NB-GMSK	TSC 0 (set 1) to TSC 7 (set 1)
		TSC 0 (set 2) to TSC 7 (set 2)
		user-definable TSC
	NB-AQPSK	subchannel 1
		TSC 0 (set 1) to TSC 7 (set 1)
		user-definable TSC
		subchannel 2
		TSC 0 (set 1) to TSC 7 (set 1)
	HSR	TSC 0 to TSC 7
user-definable TSC		
TS 0 to TS 2		
AB	user-definable TS	
Filter	NB-AQPSK, 8PSK, 16QAM and 32QAM	linearized GMSK pulse
	NB-GMSK and AB	GMSK pulse
	HSR	narrow pulse
		wide pulse
Power versus time filter		1 MHz Gauss
		500 kHz Gauss
		600 kHz
		400 kHz (multicarrier)
		300 kHz (multicarrier)
Multicarrier filter		optional channel filter for suppressing neighboring channels prior to synchronization and demodulation
Timeslot	length	NB
		157 symbol, 156 symbol
		156.25 symbol
		HSR
	188.4 symbol, 187.2 symbol	
	187.5 symbol	
	power versus time, limit line, time alignment	alignment with respect to reference slot (slot to measure) measured TSC position per slot
Number of slots to measure	1 slot	modulation accuracy table
		EVM versus time graph
		phase error versus time graph
		magnitude error versus time graph
		modulation spectrum table
		modulation spectrum graph
		trigger to sync graph
		trigger to sync table

Number of slots to measure	1 slot to 8 slots	power versus slot table
		power versus time graph
		transient spectrum table
		transient spectrum graph
Triggering	RF input	free run
		IF power
		I/Q power ¹⁴
		RF power ¹⁴
		external

	R&S®FSW	R&S®FSVA3000/R&S®FSV3000	R&S®FSVA/R&S®FSV	R&S®FPS
Auto set				
Auto freq: detects number of active carriers, their frequencies, predominant modulation, allocation mode	• (FSW-K10), only for RF input	• (FSV3-K10), only for RF input	–	• (FPS-K10), only for RF input
Auto level: automatic setting of reference level	•	•	•	•
Auto frame config: per slot, detects state, burst type, modulation scheme, TSC and filter	•	•	•	•
Auto trigger offset: detects trigger offset for external and IF power trigger	•	•	• ¹⁵	•
Capture time				
Minimum	866 µs (FSW-K10), 10 ms (VSE)	866 µs (FSV3-K10), 10 ms (VSE)	10 ms	866 µs (FPS-K10), 10 ms (VSE)
Maximum	1 s (up to 200 GSM frames)	1 s (up to 200 GSM frames)	1 s (up to 200 GSM frames)	1 s (up to 200 GSM frames)
Manual	•	•	•	•
Auto	•	•	• (VSE)	•

¹⁴ Not supported in R&S®FSV-K10.

¹⁵ Also detects the trigger level of the IF power trigger.

Result display

I/Q measurements ^{1, 16, 17}		
Power versus slot	numerical results: table	average and peak power versus slot crest factor versus slot delta to sync (slot timing) versus slot per slot limit check of power versus time mask (not for R&S®FSV-K10)
Power versus time	graphical results: minimum/average/maximum/current	1 slot to 8 slots full burst view (with zooming ¹⁸) limit check
Modulation accuracy	numerical results: table	EVM: RMS, peak and 95th percentile phase error: RMS, peak and 95th percentile magnitude error: RMS, peak and 95th percentile origin offset suppression I/Q imbalance frequency error slot power amplitude droop
EVM	graphical results: minimum/average/maximum/current	error vector magnitude versus time
Phase error	graphical results: minimum/average/maximum/current	phase error versus time
Magnitude error	graphical results: minimum/average/maximum/current	magnitude error versus time
Modulation spectrum graph	graphical results: current/average	power versus frequency limit check
Modulation spectrum table	numerical results: table	power versus offset frequency offset frequencies up to 6 MHz ¹⁹ limit check
Transient spectrum graph	graphical results: current/maximum	power versus frequency limit check
Transient spectrum table	numerical results: table	power versus offset frequency limit check
Trigger to sync graph	graphical results: histogram/PDF ²⁰ of average	probability versus trigger to sync time
Trigger to sync table	numerical results: table	trigger to sync time: minimum/average/maximum/current/standard deviation

¹⁶ R&S®FSV-K10 supports a multiple measurement mode for fast and simultaneous I/Q based measurements of power versus time, modulation accuracy, EVM/phase error/magnitude error versus time, modulation spectrum and transient spectrum. With R&S®FSW/FSV3/FPS/VSE-K10, all I/Q based measurements can be setup and measured simultaneously.

¹⁷ For availability of this feature, see Supported measurements.

¹⁸ R&S®FSV-K10 does not support arbitrary zooming. Zooming can be achieved by means of the dedicated rising/falling/rising and falling/top high resolution views.

¹⁹ R&S®FSV-K10: only up to 1.8 MHz.

²⁰ Probability density function.

Multicarrier wideband noise measurements (MCWN) ^{3, 17}		
Spectrum graph	graphical results: average trace, 100 kHz and 300 kHz RBW combined, narrowband noise bars, carrier power bars, limit line	power versus frequency wideband noise intermodulation products narrowband noise carrier powers limit check, check maximum number of limit exceptions
Carrier power table	numerical results: table	power level per carrier, 30 kHz, 100 kHz, 300 kHz reference power per carrier, reference carrier indication
Outer intermodulation table Inner intermodulation table ²¹	numerical results: table	power at intermodulation product frequency relative to closest outermost carrier intermodulation product order (up to 5th) limit check
Outer wideband table Inner wideband table ²¹	numerical results: table	worst distance to limit per limit line segment wideband noise power, absolute and relative frequency, absolute and relative to closest outermost carrier limit check
Outer narrowband table, Inner narrowband table ²¹	numerical results: table	narrowband noise power, absolute and relative frequency, absolute and relative to closest outermost carrier limit check
Wide modulation spectrum measurements ¹⁷		
Wide modulation spectrum	numerical results: table	power versus offset frequency gated zero span measurement offset frequencies up to 6 MHz limit check

²¹ Only available for noncontiguous carrier allocation of a multicarrier BTS.

Measurement uncertainty (nominal)

Measurement uncertainties only apply for these signal and spectrum analyzer models:

- R&S®FSW8, R&S®FSW13, R&S®FSW26
- R&S®FSVA3004, R&S®FSVA3007 and R&S®FSVA3013, R&S®FSV3004, R&S®FSV3007, R&S®FSV3013
- R&S®FSVA4, R&S®FSVA7, R&S®FSVA13, R&S®FSV4, R&S®FSV7, R&S®FSV13, R&S®FSV30
- R&S®FPS4, R&S®FPS7, R&S®FPS13, R&S®FPS30

Demodulation – GSM, EGPRS (EDGE) and VAMOS ¹²

	R&S®FSW	R&S®FSVA3000/R&S®FSVA	R&S®FSV3000/R&S®FSV ²²	R&S®FPS	AUME ²³
EVM ²⁴	(SNR > 40 dB)				
RMS value, error floor NB 3π/8-8PSK NB π/2-AQPSK ²⁵	< 0.25 % < 0.25 %	< 0.25 % < 0.25 %	< 0.5 % < 0.5 %	< 0.4 % < 0.4 %	
RMS value, uncertainty NB 3π/8-8PSK NB π/2-AQPSK ²⁵	< 0.2 % < 0.2 %	< 0.2 % < 0.2 %	< 0.25 % < 0.25 %	< 0.25 % < 0.25 %	
Peak value, error floor NB 3π/8-8PSK NB π/2-AQPSK ²⁵	< 0.75 % < 1 %	< 1 % < 1 %	< 1.5 % < 2.0 %	< 1.2 % < 1.5 %	
Peak value, uncertainty NB 3π/8-8PSK NB π/2-AQPSK ²⁵	< 0.75 % < 0.75 %	< 0.75 % < 0.75 %	< 1 % < 1 %	< 1 % < 1 %	
95th percentile value, error floor NB 3π/8-8PSK NB π/2-AQPSK ²⁵	< 0.4 % < 0.4 %	< 0.5 % < 0.75 %	< 0.5 % < 1.0 %	< 0.5 % < 0.75 %	
Phase error ²⁴	(SNR > 40 dB)				
RMS value, error floor NB GMSK	< 0.2°	< 0.3°	< 0.3°	< 0.3°	1.5°
RMS value, uncertainty NB GMSK	< 0.15°	< 0.15°	< 0.2°	< 0.2°	
Peak value, error floor NB GMSK	< 0.7°	< 1°	< 1.5°	< 1.2°	5°
Peak value, uncertainty NB GMSK	< 0.6°	< 0.7°	< 0.7°	< 0.7°	

²² Values apply only for R&S®FSV-K10 and not for R&S®VSE-K10 with an R&S®FSV.

²³ AUME: acceptable uncertainty of measurement equipment (in line with 3GPP TS 51.021, chapter 4.7, base station requirements); if there is more than one limit, the strictest limit applies.

²⁴ Reference level set to 0 dBm, average of 200 bursts, measurement synchronized using training sequence.

²⁵ NB π/2-AQPSK: For SCPIR from -10 dB to +10 dB.

	R&S®FSW	R&S®FSVA3000/R&S®FSVA	R&S®FSV3000/R&S®FSV ²²	R&S®FPS	AUME ²³
Frequency error ²⁴					
Frequency lock range (referenced to RF carrier frequency)	±30 kHz	±30 kHz	±30 kHz	±30 kHz	
Uncertainty (excluding Δf_{REF})					
NB GMSK	< 1.5 Hz	< 2 Hz	< 3 Hz	< 2 Hz	10 Hz ²⁶
NB 3 π /8-8PSK	< 1.5 Hz	< 2 Hz	< 3 Hz	< 2 Hz	16 Hz
NB π /2-AQPSK ²⁵	< 1.5 Hz	< 2 Hz	< 3 Hz	< 2 Hz	6 Hz
I/Q origin offset suppression (OOS)					
Measurement range					35 dB
NB 3 π /8-8PSK	15 dB to 50 dB	15 dB to 50 dB	15 dB to 50 dB	15 dB to 50 dB	
NB π /2-AQPSK ²⁵	20 dB to 50 dB	20 dB to 50 dB	20 dB to 50 dB	20 dB to 50 dB	
Uncertainty (SNR > 60 dB, OOS < 45 dB)					±1.5 dB
NB 3 π /8-8PSK	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	
NB π /2-AQPSK ²⁵	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	

²⁶ GSM400: 5 Hz.

Demodulation – EGPRS2-A

	R&S®FSW	R&S®FSVA3000/R&S®FSVA	R&S®FSV3000/R&S®FSV ²²	R&S®FPS	AUME ²³
EVM ²⁴	(SNR > 40 dB)				
RMS value, error floor NB $\pi/4$ -16QAM NB $-\pi/4$ -32QAM	< 0.25 % < 0.25 %	< 0.25 % < 0.25 %	< 0.5 % < 0.5 %	< 0.4 % < 0.4 %	
RMS value, uncertainty NB $\pi/4$ -16QAM NB $-\pi/4$ -32QAM	< 0.2 % < 0.2 %	< 0.2 % < 0.2 %	< 0.25 % < 0.25 %	< 0.25 % < 0.25 %	
Peak value, error floor NB $\pi/4$ -16QAM NB $-\pi/4$ -32QAM	< 0.75 % < 0.75 %	< 1 % < 1 %	< 2 % < 2 %	< 1.5 % < 1.5 %	
Peak value, uncertainty NB $\pi/4$ -16QAM NB $-\pi/4$ -32QAM	< 0.75 % < 0.75 %	< 0.75 % < 0.75 %	< 1 % < 1 %	< 1 % < 1 %	
95th percentile value, error floor NB $\pi/4$ -16QAM NB $-\pi/4$ -32QAM	< 0.4 % < 0.4 %	< 0.75 % < 0.75 %	< 1 % < 1 %	< 0.6 % < 0.6 %	
Frequency error ²⁴					
Frequency lock range (referenced to RF carrier frequency)	±30 kHz	±30 kHz	±30 kHz	±30 kHz	
Uncertainty (excluding Δf_{REF}) NB $\pi/4$ -16QAM NB $-\pi/4$ -32QAM	< 1.5 Hz < 1.5 Hz	< 2 Hz < 2 Hz	< 3 Hz < 3 Hz	< 2 Hz < 2 Hz	6 Hz
I/Q origin offset suppression (OOS)					
Measurement range NB $\pi/4$ -16QAM NB $-\pi/4$ -32QAM	25 dB to 50 dB 25 dB to 50 dB	25 dB to 50 dB 25 dB to 50 dB	25 dB to 50 dB 25 dB to 50 dB	25 dB to 50 dB 25 dB to 50 dB	35 dB
Uncertainty (SNR > 60 dB, OOS < 45 dB) NB $\pi/4$ -16QAM NB $-\pi/4$ -32QAM	±1.5 dB ±1.5 dB	±1.5 dB ±1.5 dB	±1.5 dB ±1.5 dB	±1.5 dB ±1.5 dB	±1.5 dB

Demodulation – EGPRS2-B narrow pulse

	R&S®FSW	R&S®FSVA3000/R&S®FSVA	R&S®FSV3000/R&S®FSV ²²	R&S®FPS	AUME ²³
EVM ²⁴	(SNR > 40 dB)				
RMS value, error floor					
HSR 3π/4-QPSK	< 0.4 %	< 0.4 %	< 0.5 %	< 0.5 %	
HSR π/4-16QAM	< 0.4 %	< 0.4 %	< 0.5 %	< 0.5 %	
HSR -π/4-32QAM	< 0.4 %	< 0.4 %	< 0.5 %	< 0.5 %	
RMS value, uncertainty					
HSR 3π/4-QPSK	< 0.2 %	< 0.2 %	< 0.25 %	< 0.25 %	
HSR π/4-16QAM	< 0.2 %	< 0.2 %	< 0.25 %	< 0.25 %	
HSR -π/4-32QAM	< 0.2 %	< 0.2 %	< 0.25 %	< 0.25 %	
Peak value, error floor					
HSR 3π/4-QPSK	< 0.75 %	< 1 %	< 2 %	< 1.5 %	
HSR π/4-16QAM	< 0.75 %	< 1 %	< 2 %	< 1.5 %	
HSR -π/4-32QAM	< 1 %	< 1 %	< 2 %	< 1.5 %	
Peak value, uncertainty					
HSR 3π/4-QPSK	< 0.5 %	< 0.75 %	< 1 %	< 1 %	
HSR π/4-16QAM	< 0.5 %	< 0.75 %	< 1 %	< 1 %	
HSR -π/4-32QAM	< 0.5 %	< 0.75 %	< 1 %	< 1 %	
95th percentile value, error floor					
HSR 3π/4-QPSK	< 0.4 %	< 0.75 %	< 1 %	< 0.75 %	
HSR π/4-16QAM	< 0.4 %	< 0.75 %	< 1 %	< 0.75 %	
HSR -π/4-32QAM	< 0.4 %	< 0.75 %	< 1 %	< 0.75 %	
Frequency error ²⁴					
Frequency lock range (referenced to RF carrier frequency)	±30 kHz	±30 kHz	±30 kHz	±30 kHz	
Uncertainty (excluding Δf _{REF})					6 Hz
HSR 3π/4-QPSK	< 1.5 Hz	< 2 Hz	< 3 Hz	< 2 Hz	
HSR π/4-16QAM	< 1.5 Hz	< 2 Hz	< 3 Hz	< 2 Hz	
HSR -π/4-32QAM	< 1.5 Hz	< 2 Hz	< 3 Hz	< 2 Hz	
I/Q origin offset suppression (OOS)					
Measurement range					35 dB
HSR 3π/4-QPSK	25 dB to 50 dB	25 dB to 50 dB	25 dB to 50 dB	25 dB to 50 dB	
HSR π/4-16QAM	30 dB to 50 dB	30 dB to 50 dB	30 dB to 50 dB	30 dB to 50 dB	
HSR -π/4-32QAM	30 dB to 50 dB	30 dB to 50 dB	30 dB to 50 dB	30 dB to 50 dB	
Uncertainty (SNR > 60 dB, OOS < 45 dB)					±1.5 dB
HSR 3π/4-QPSK	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	
HSR π/4-16QAM	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	
HSR -π/4-32QAM	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	

Demodulation – EGPRS2-B wide pulse

	R&S®FSW	R&S®FSVA3000/R&S®FSVA	R&S®FSV3000/R&S®FSV 22	R&S®FPS	AUME 23
EVM 24	(SNR > 40 dB)				
RMS value, error floor					
HSR 3π/4-QPSK	< 0.2 %	< 0.3 %	< 0.5 %	< 0.5 %	
HSR π/4-16QAM	< 0.2 %	< 0.3 %	< 0.5 %	< 0.5 %	
HSR -π/4-32QAM	< 0.2 %	< 0.3 %	< 0.5 %	< 0.5 %	
RMS value, uncertainty					
HSR 3π/4-QPSK	< 0.2 %	< 0.2 %	< 0.25 %	< 0.25 %	
HSR π/4-16QAM	< 0.2 %	< 0.2 %	< 0.25 %	< 0.25 %	
HSR -π/4-32QAM	< 0.2 %	< 0.2 %	< 0.25 %	< 0.25 %	
Peak value, error floor					
HSR 3π/4-QPSK	< 0.4 %	< 1 %	< 2 %	< 1.5 %	
HSR π/4-16QAM	< 0.5 %	< 1 %	< 2 %	< 1.5 %	
HSR -π/4-32QAM	< 0.5 %	< 1 %	< 2 %	< 1.5 %	
Peak value, uncertainty					
HSR 3π/4-QPSK	< 0.5 %	< 0.75 %	< 1 %	< 1 %	
HSR π/4-16QAM	< 0.5 %	< 0.75 %	< 1 %	< 1 %	
HSR -π/4-32QAM	< 0.5 %	< 0.75 %	< 1 %	< 1 %	
95th percentile value, error floor					
HSR 3π/4-QPSK	< 0.4 %	< 0.75 %	< 1 %	< 0.75 %	
HSR π/4-16QAM	< 0.4 %	< 0.75 %	< 1 %	< 0.75 %	
HSR -π/4-32QAM	< 0.4 %	< 0.75 %	< 1 %	< 0.75 %	
Frequency error 24					
Frequency lock range (referenced to RF carrier frequency)	±30 kHz	±30 kHz	±30 kHz	±30 kHz	
Uncertainty (excluding Δf _{REF})					6 Hz
HSR 3π/4-QPSK	< 1.5 Hz	< 2 Hz	< 3 Hz	< 2 Hz	
HSR π/4-16QAM	< 1.5 Hz	< 2 Hz	< 3 Hz	< 2 Hz	
HSR -π/4-32QAM	< 1.5 Hz	< 2 Hz	< 3 Hz	< 2 Hz	
I/Q origin offset suppression (OOS)					
Measurement range					35 dB
HSR 3π/4-QPSK	20 dB to 50 dB	20 dB to 50 dB	20 dB to 50 dB	20 dB to 50 dB	
HSR π/4-16QAM	25 dB to 50 dB	25 dB to 50 dB	25 dB to 50 dB	25 dB to 50 dB	
HSR -π/4-32QAM	25 dB to 50 dB	25 dB to 50 dB	25 dB to 50 dB	25 dB to 50 dB	
Uncertainty (SNR > 60 dB, OOS < 45 dB)					±1.5 dB
HSR 3π/4-QPSK	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	
HSR π/4-16QAM	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	
HSR -π/4-32QAM	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	

Power versus slot, for all modulations ²⁵

	R&S®FSW	R&S®FSVA3000/R&S®FSVA	R&S®FSV3000/R&S®FSV	R&S®FPS	AUME ²³
Absolute level uncertainty	see R&S®FSW data sheet: total measurement uncertainty, YIG preselector off	see R&S®FSVA3000/FSVA data sheet: total measurement uncertainty	see R&S®FSV3000/FSV data sheet: total measurement uncertainty	see R&S®FPS data sheet: total measurement uncertainty	1.0 dB ²⁷
Relative level uncertainty	see R&S®FSW data sheet: display nonlinearity	see R&S®FSVA3000/FSVA data sheet: nonlinearity of displayed level	see R&S®FSV3000/FSV data sheet: display nonlinearity	see R&S®FPS data sheet: display nonlinearity	0.7 dB ²⁸

Power versus time, for all modulations ²⁵

	R&S®FSW	R&S®FSVA3000/R&S®FSVA	R&S®FSV3000/R&S®FSV ²²	R&S®FPS	AUME ²³
Absolute level uncertainty	see R&S®FSW data sheet: total measurement uncertainty, YIG preselector off	see R&S®FSVA3000/FSVA data sheet: total measurement uncertainty	see R&S®FSV3000/FSV data sheet: total measurement uncertainty	see R&S®FPS data sheet: total measurement uncertainty	1.0 dB
Dynamic range (PvT filter = 1 MHz)					
average detector	> 76 dB	> 64 dB	> 67 dB	> 66 dB	
peak hold detector	> 71 dB	> 62 dB	> 62 dB	> 64 dB	

²⁷ For static power step = 0.²⁸ For power steps other than 0.

Spectrum due to modulation and noise

	R&S®FSW	R&S®FSVA3000/R&S®FSVA	R&S®FSV3000/R&S®FSV ²²	R&S®FPS	AUME ²³
Level measurement uncertainty	all modulations				
Absolute	see R&S®FSW data sheet: total measurement uncertainty, YIG preselector off	see R&S®FSVA3000/FSVA data sheet: total measurement uncertainty	see R&S®FSV3000/FSV data sheet: total measurement uncertainty	see R&S®FPS data sheet: total measurement uncertainty	1.0 dB
Relative					
$\Delta f \leq 0.1$ MHz	see R&S®FSW data sheet: display nonlinearity, bandwidth switching uncertainty and amplitude flatness	see R&S®FSVA3000/FSVA data sheet: nonlinearity of displayed level, bandwidth switching uncertainty and amplitude flatness	see R&S®FSV3000/FSV data sheet: display nonlinearity, bandwidth switching uncertainty and amplitude flatness	see R&S®FPS data sheet: display nonlinearity, bandwidth switching uncertainty and amplitude flatness	0.5 dB
0.1 MHz $\leq \Delta f \leq 1.8$ MHz					0.7 dB ²⁹
$\Delta f > 1.8$ MHz					2.0 dB
Dynamic range at offset frequency (carrier power = 0 dBm)	NB GMSK NB $\pi/8$-8PSK				
100 kHz ³⁰ , RBW = 30 kHz	> 42.0 dB	> 42.0 dB	–	> 42.0 dB	
200 kHz ³⁰ , RBW = 30 kHz	> 70.0 dB	> 69.5 dB	> 66.0 dB	> 70.0 dB	
250 kHz ³⁰ , RBW = 30 kHz	> 78.2 dB	> 76.5 dB	–	> 78.0 dB	
400 kHz ³⁰ , RBW = 30 kHz	> 82.5 dB	> 82.0 dB	> 77.0 dB	> 78.0 dB	
600 kHz, RBW = 30 kHz	> 79.5 dB	> 78.0 dB	> 76.0 dB	> 78.0 dB	
1.2 MHz, RBW = 30 kHz	> 86.0 dB	> 84.0 dB	> 80.0 dB	> 82.0 dB	
1.8 MHz, RBW = 30 kHz	> 87.0 dB	> 86.0 dB	> 82.0 dB	> 83.0 dB	
1.8 MHz, RBW = 100 kHz	> 81.8 dB	> 80.8 dB	> 76.8 dB	> 77.8 dB	
3.0 MHz, RBW = 100 kHz	> 83.0 dB	> 81.0 dB	> 78.5 dB	> 80.0 dB	
6.0 MHz, RBW = 100 kHz	> 83.0 dB	> 81.0 dB	> 78.5 dB	> 81.0 dB	
Dynamic range at offset frequency (carrier power = 0 dBm)	NB $\pi/2$-AQPSK²⁵ HSR $3\pi/4$-QPSK, narrow pulse				
100 kHz ³⁰ , RBW = 30 kHz	> 42.0 dB	> 42.0 dB	–	> 42.0 dB	
200 kHz ³⁰ , RBW = 30 kHz	> 70.0 dB	> 69.5 dB	> 66.0 dB	> 70.0 dB	
250 kHz ³⁰ , RBW = 30 kHz	> 78.2 dB	> 76.5 dB	–	> 78.0 dB	
400 kHz ³⁰ , RBW = 30 kHz	> 82.5 dB	> 82.0 dB	> 75.0 dB	> 78.0 dB	
600 kHz, RBW = 30 kHz	> 78.5 dB	> 78.0 dB	> 75.0 dB	> 78.0 dB	
1.2 MHz, RBW = 30 kHz	> 85.5 dB	> 84.0 dB	> 79.5 dB	> 81.5 dB	
1.8 MHz, RBW = 30 kHz	> 86.0 dB	> 85.0 dB	> 81.0 dB	> 83.0 dB	
1.8 MHz, RBW = 100 kHz	> 80.8 dB	> 79.8 dB	> 75.8 dB	> 77.8 dB	
3.0 MHz, RBW = 100 kHz	> 82.5 dB	> 81.0 dB	> 77.0 dB	> 80.0 dB	
6.0 MHz, RBW = 100 kHz	> 82.5 dB	> 81.0 dB	> 77.0 dB	> 81.0 dB	

²⁹ < 50 dBc: 0.7 dB; otherwise: 1.5 dB.³⁰ Due to the nominal GSM signal bandwidth, the dynamic range cannot be measured directly; it is computed from phase noise measurements with CW carriers.

	R&S®FSW	R&S®FSVA3000/R&S®FSVA	R&S®FSV3000/R&S®FSV ²²	R&S®FPS	AUME ²³
Dynamic range at offset frequency (carrier power = 0 dBm)	NB $\pi/4$-16QAM NB $-\pi/4$-32QAM HSR $\pi/4$-16QAM, narrow pulse HSR $-\pi/4$-32QAM, narrow pulse				
100 kHz ³⁰ , RBW = 30 kHz	> 42.0 dB	> 42.0 dB	–	> 42.0 dB	
200 kHz ³⁰ , RBW = 30 kHz	> 70.0 dB	> 69.5 dB	> 66.0 dB	> 70.0 dB	
250 kHz ³⁰ , RBW = 30 kHz	> 78.2 dB	> 76.5 dB	–	> 78.0 dB	
400 kHz ³⁰ , RBW = 30 kHz	> 82.5 dB	> 82.0 dB	> 74.5 dB	> 78.0 dB	
600 kHz, RBW = 30 kHz	> 78.5 dB	> 78.0 dB	> 74.5 dB	> 78.0 dB	
1.2 MHz, RBW = 30 kHz	> 82.5 dB	> 82.0 dB	> 77.0 dB	> 80.0 dB	
1.8 MHz, RBW = 30 kHz	> 84.0 dB	> 84.0 dB	> 78.5 dB	> 81.2 dB	
1.8 MHz, RBW = 100 kHz	> 78.8 dB	> 78.8 dB	> 73.3 dB	> 76.0 dB	
3.0 MHz, RBW = 100 kHz	> 79.5 dB	> 79.0 dB	> 74.5 dB	> 77.0 dB	
6.0 MHz, RBW = 100 kHz	> 79.5 dB	> 79.0 dB	> 75.5 dB	> 78.0 dB	
Dynamic range at offset frequency, (carrier power = 0 dBm)	HSR $3\pi/4$-QPSK, wide pulse HSR $\pi/4$-16QAM, wide pulse HSR $-\pi/4$-32QAM, wide pulse				
100 kHz ³⁰ , RBW = 30 kHz	> 42.0 dB	> 42.0 dB	–	> 42.0 dB	
200 kHz ³⁰ , RBW = 30 kHz	> 70.0 dB	> 69.5 dB	> 66.0 dB	> 70.0 dB	
250 kHz ³⁰ , RBW = 30 kHz	> 78.2 dB	> 76.5 dB	–	> 78.0 dB	
400 kHz ³⁰ , RBW = 30 kHz	> 82.5 dB	> 82.0 dB	> 72.0 dB	> 78.0 dB	
600 kHz, RBW = 30 kHz	> 74.0 dB	> 73.0 dB	> 72.0 dB	> 73.0 dB	
1.2 MHz, RBW = 30 kHz	> 79.5 dB	> 78.0 dB	> 76.0 dB	> 77.0 dB	
1.8 MHz, RBW = 30 kHz	> 82.5 dB	> 81.0 dB	> 78.0 dB	> 80.2 dB	
1.8 MHz, RBW = 100 kHz	> 77.3 dB	> 75.8 dB	> 72.8 dB	> 75.0 dB	
3.0 MHz, RBW = 100 kHz	> 78.5 dB	> 78.0 dB	> 73.5 dB	> 76.0 dB	
6.0 MHz, RBW = 100 kHz	> 78.5 dB	> 78.0 dB	> 74.0 dB	> 77.0 dB	

Spectrum due to switching transients

	R&S®FSW	R&S®FSVA3000/R&S®FSVA	R&S®FSV3000/R&S®FSV ²²	R&S®FPS	AUME ²³
Level measurement uncertainty	all modulations²⁵				
Absolute	see R&S®FSW data sheet: total measurement uncertainty, YIG preselector off	see R&S®FSVA3000/FSVA data sheet: total measurement uncertainty	see R&S®FSV3000/FSV data sheet: total measurement uncertainty	see R&S®FPS data sheet: total measurement uncertainty	1.5 dB
Relative					
0 dBc to 50 dBc	see R&S®FSW data sheet: display nonlinearity, bandwidth switching uncertainty and amplitude flatness	see R&S®FSVA3000/FSVA data sheet: nonlinearity of displayed level, bandwidth switching uncertainty and amplitude flatness	see R&S®FSV3000/FSV data sheet: display nonlinearity, bandwidth switching uncertainty and amplitude flatness	see R&S®FPS data sheet: display nonlinearity, bandwidth switching uncertainty and amplitude flatness	0.7 dB
> 50 dBc					1.5 dB
Dynamic range at offset frequency, (carrier power = 0 dBm, RBW = 30 kHz, VBW = 100 kHz)	NB GMSK NB $\pi/8$-8PSK				
400 kHz ³⁰	> 69.5 dB	> 69.5 dB	> 67.0 dB	> 69.5 dB	
600 kHz	> 74.5 dB	> 74.5 dB	> 69.0 dB	> 73.0 dB	
1.2 MHz	> 81.5 dB	> 81.5 dB	> 75.0 dB	> 77.0 dB	
1.8 MHz	> 82.0 dB	> 82.0 dB	> 76.0 dB	> 78.0 dB	
Dynamic range at offset frequency, (carrier power = 0 dBm, RBW = 30 kHz, VBW = 100 kHz)	NB $\pi/4$-16QAM NB $-\pi/4$-32QAM HSR $\pi/4$-16QAM, narrow pulse HSR $-\pi/4$-32QAM, narrow pulse				
400 kHz ³⁰	> 69.5 dB	> 69.5 dB	> 67.0 dB	> 69.5 dB	
600 kHz	> 71.0 dB	> 70.0 dB	> 69.0 dB	> 70.0 dB	
1.2 MHz	> 80.0 dB	> 78.0 dB	> 75.0 dB	> 76.0 dB	
1.8 MHz	> 81.0 dB	> 80.0 dB	> 76.0 dB	> 77.0 dB	
Dynamic range at offset frequency (carrier power = 0 dBm, RBW = 30 kHz, VBW = 100 kHz)	NB $\pi/2$-AQPSK²⁵ HSR $3\pi/4$-QPSK, narrow pulse HSR $3\pi/4$-QPSK, wide pulse HSR $\pi/4$-16QAM, wide pulse HSR $-\pi/4$-32QAM, wide pulse				
400 kHz ³⁰	> 69.5 dB	> 69.5 dB	> 67.0 dB	> 69.5 dB	
600 kHz	> 71.0 dB	> 70.0 dB	> 69.0 dB	> 70.0 dB	
1.2 MHz	> 77.5 dB	> 77.0 dB	> 75.0 dB	> 75.0 dB	
1.8 MHz	> 76.5 dB	> 76.5 dB	> 76.0 dB	> 77.0 dB	

Ordering information

Designation	Type	Order No.
GSM measurements		
GSM/EDGE/EDGE Evolution/VAMOS measurements	R&S®FSW-K10	1313.1368.02
Analysis of GSM, EDGE and EDGE Evolution signals	R&S®FSV3-K10	1330.5039.02
Analysis of GSM, EDGE and EDGE Evolution signals	R&S®FSV-K10	1310.8055.02
GSM/EDGE/EDGE Evolution/VAMOS measurements	R&S®FPS-K10	1321.4091.02
GSM measurements ³¹	R&S®VSE-K10	1313.1368.06
Signal and spectrum analyzers		
R&S®FSW		
Spectrum and signal analyzer, 2 Hz to 8 GHz	R&S®FSW8	1331.5003.08
Spectrum and signal analyzer, 2 Hz to 13.6 GHz	R&S®FSW13	1331.5003.13
Spectrum and signal analyzer, 2 Hz to 26.5 GHz	R&S®FSW26	1331.5003.26
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 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
R&S®FSVA, R&S®FSV		
Signal and spectrum analyzer, 10 Hz to 4 GHz	R&S®FSVA4	1321.3008.05
Signal and spectrum analyzer, 10 Hz to 7 GHz	R&S®FSVA7	1321.3008.08
Signal and spectrum analyzer, 10 Hz to 13.6 GHz	R&S®FSVA13	1321.3008.14
Signal and spectrum analyzer, 10 Hz to 4 GHz	R&S®FSV4	1321.3008.04
Signal and spectrum analyzer, 10 Hz to 7 GHz	R&S®FSV7	1321.3008.07
Signal and spectrum analyzer, 10 Hz to 13.6 GHz	R&S®FSV13	1321.3008.13
Signal and spectrum analyzer, 10 Hz to 30 GHz	R&S®FSV30	1321.3008.30
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
Vector signal explorer		
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
License dongle	R&S®FSPC	1310.0090.03

³¹ Requires R&S®VSE and R&S®FSPC.

Designation	Type	Order No.
Recommended options and extras		
R&S®FSW		
RF preamplifier, 100 kHz to 13.6 GHz ³²	R&S®FSW-B24	1313.0832.13
RF preamplifier, 100 kHz to 26.5 GHz ³³	R&S®FSW-B24	1313.0832.26
Electronic attenuator, 1 dB steps ³⁴	R&S®FSW-B25	1313.0990.02
Digital baseband interface ³⁵	R&S®FSW-B17	1313.0784.02
Analog baseband inputs, 40 MHz analysis bandwidth ³²	R&S®FSW-B71	1313.1651.13
Analog baseband inputs, 40 MHz analysis bandwidth ³⁶	R&S®FSW-B71	1313.1651.26
Analog baseband inputs, 80 MHz analysis bandwidth ³⁷	R&S®FSW-B71E	1313.6547.02
R&S®FSVA3000, R&S®FSV3000		
OCXO frequency reference	R&S®FSV3-B4	1330.3794.02
YIG preselector bypass ³⁸	R&S®FSV3-B11	1330.3865.02
40 MHz analysis bandwidth ³⁵	R&S®FSV3-B40	1330.4103.02
200 MHz analysis bandwidth ³⁹	R&S®FSV3-B200	1330.4132.02
400 MHz analysis bandwidth ³⁹	R&S®FSV3-B400	1330.7154.02
Enhanced computing power	R&S®FSV3-B114	1330.4910.02
R&S®FSVA, R&S®FSV		
Digital baseband interface ⁴⁰	R&S®FSV-B17	1310.9568.02
RF preamplifier, 9 kHz to 7 GHz ³⁵	R&S®FSV-B22	1310.9600.02
RF preamplifier, 9 kHz to 13.6 GHz	R&S®FSV-B24	1310.9616.13
RF preamplifier, 9 kHz to 30 GHz	R&S®FSV-B24	1310.9616.30
RF preamplifier, 9 kHz to 40 GHz	R&S®FSV-B24	1310.9616.40
Electronic attenuator, 1 dB steps ³⁵	R&S®FSV-B25	1310.9622.02
R&S®FPS		
RF preamplifier, 9 kHz to 7 GHz ³⁵	R&S®FPS-B22	1321.4027.02
RF preamplifier, 9 kHz to 13.6 GHz	R&S®FPS-B24	1321.4279.13
RF preamplifier, 9 kHz to 30 GHz	R&S®FPS-B24	1321.4279.30
RF preamplifier, 9 kHz to 40 GHz	R&S®FPS-B24	1321.4279.40
Electronic attenuator, 1 dB steps ³⁵	R&S®FPS-B25	1321.4033.02

³² Retrofittable, for R&S®FSW8 and R&S®FSW13 contact service center.

³³ Retrofittable, for R&S®FSW26 contact service center.

³⁴ Retrofittable, for R&S®FSW8, R&S®FSW13 and R&S®FSW26 contact service center.

³⁵ User-retrofitable.

³⁶ Retrofittable, for R&S®FSW26, R&S®FSW43 and R&S®FSW50 contact service center.

³⁷ User-retrofitable, R&S®FSW-B71 required.

³⁸ User-retrofitable (license key), for R&S®FSVA3013, R&S®FSVA3030 and R&S®FSVA3044.

³⁹ For frequencies > 7.5 GHz: R&S®FSV3-B11 required.

⁴⁰ User-retrofitable, for details ask service center, not available for R&S®FSV40, model .39.