

R&S® FE170SR

EXTERNAL FRONTEND

110 GHz to 170 GHz

Specifications



Specifications
Version 06.00

ROHDE & SCHWARZ

Make ideas real



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Definitions

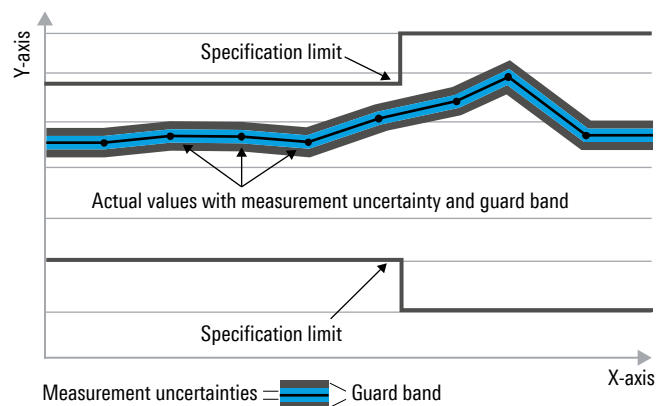
General

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

Unless otherwise noted, all specifications in this section are valid for:

- R&S®FE170SR, in combination with R&S®FSW base unit (see Options needed for the base unit)
- 640 MHz reference signal from R&S®FSW base unit, LO mode internal
- The corresponding R&S®FE170-Z01, R&S®FE170-Z02, R&S®FE170-Z03 waveguide filters within the specified frequency range (see Recommended extras)
- +12 V power supply (see Accessories supplied)
- IF cable, 2.92 mm, length: 1 m (see Accessories supplied)
- Temperature range from +20 °C to +30 °C

Frequency

RF frequency range	R&S®FE170SR	110 GHz to 170 GHz
	overrange	170 GHz to 175 GHz
	R&S®FE170SR with R&S®FE170-Z01 waveguide filter (110 GHz to 136 GHz)	110 GHz to 131 GHz
	R&S®FE170SR with R&S®FE170-Z02 waveguide filter (126 GHz to 153 GHz)	131 GHz to 148 GHz
	R&S®FE170SR with R&S®FE170-Z03 waveguide filter (143 GHz to 170 GHz)	148 GHz to 170 GHz
	R&S®FE170SR with R&S®FE170-Z04 waveguide filter (160 GHz to 175 GHz)	160 GHz to 175 GHz

Reference frequency

This item is specified in the specifications of the base unit which is used as input for the R&S®FE170SR reference frequency.

LO source

Mode	internal	internal synthesizer
	external	external signal generator or LO output of a further R&S®FE170SR/ST with IF mode: shared LO

Setting times

Frequency change	≤ 10 MHz	< 10 ms (nom.)
	> 10 MHz	< 30 ms (nom.)

Analysis bandwidth

Maximum signal analysis bandwidth (equalized)

With R&S®FSW	The signal analysis bandwidth is equal to the analysis bandwidth of the used R&S®FSW base unit. For details about available options, see the R&S®FSW specifications (PD 5215.6749.22).	
With R&S®RTP	with R&S®RTP-K11 and R&S®RTP-K121	10 GHz

Level

Setting range of RF attenuator		0 dB to 30 dB, in 1 dB steps
Maximum safe input level	RF attenuation = 0 dB	-7 dBm
	RF attenuation ≥ 27 dB	+20 dBm

Compression

1 dB compression point	RF attenuation = 30 dB	
	110 GHz ≤ f_m ≤ 170 GHz	> +5 dBm (meas.)

Sensitivity

All noise level data in this section not marked as typical (typ.) or nominal (nom.) are specified values whose compliance is ensured by testing.

Displayed average noise level	RF attenuation = 0 dB, termination = 50 Ω , log. scaling, normalized to 1 Hz RBW, RBW = 1 kHz, trace average = 50, IF cable loss < 3 dB at I/Q analyzer center frequency, analysis bandwidth = 10 MHz	
	110 GHz $\leq f \leq$ 115 GHz	-152 dBm, -155 dBm (typ.)
	115 GHz < f \leq 148 GHz	-156 dBm, -159 dBm (typ.)
	148 GHz < f \leq 166 GHz	-152 dBm, -155 dBm (typ.)
	166 GHz < f \leq 170 GHz	-145 dBm, -150 dBm (typ.)

Level measurement uncertainty

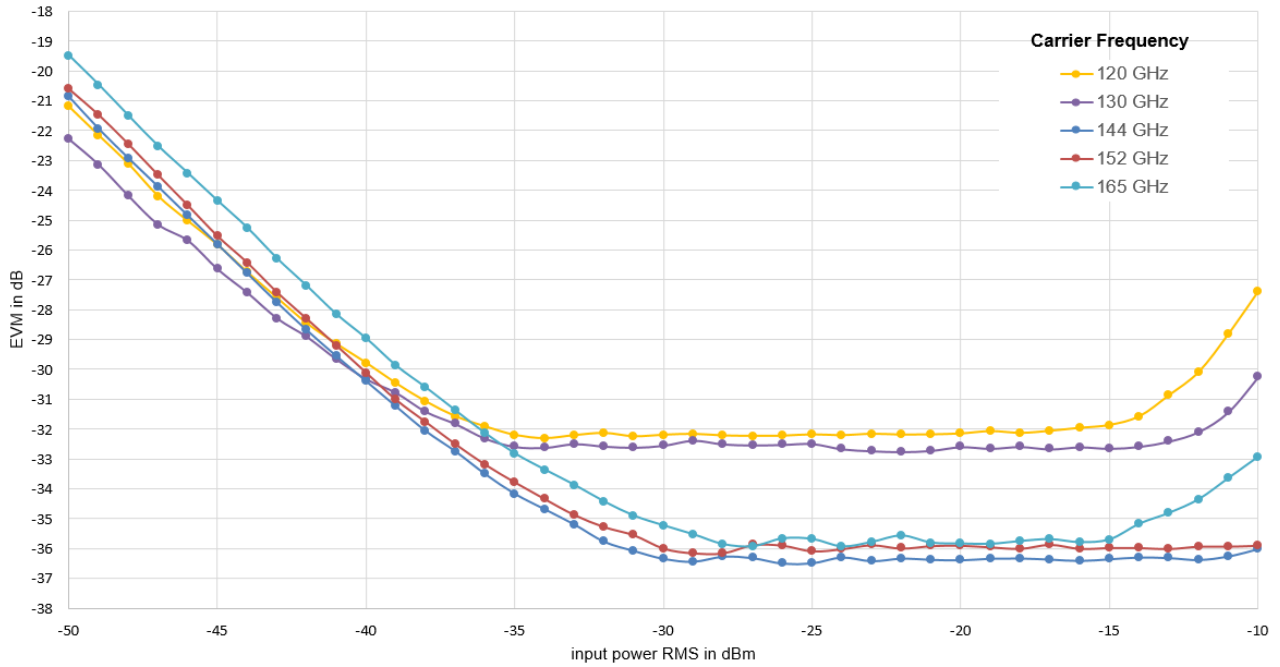
Level measurement uncertainty at center frequency	any RF attenuation, amplitude settings: auto	
	110 GHz $\leq f \leq$ 120 GHz	< 3.5 dB ($\sigma = 0.67$ dB)
	120 GHz < f \leq 165 GHz	< 2.5 dB ($\sigma = 0.67$ dB)
	165 GHz < f \leq 170 GHz	< 3.0 dB ($\sigma = 0.83$ dB)
RF attenuator switching uncertainty	referenced to 10 dB attenuation, $f_{\text{center}} = 140$ GHz and 150 GHz	
	0 dB to 30 dB	< 0.7 dB (typ.)
Amplitude flatness	RF attenuation = 10 dB, amplitude settings: auto	
	analysis bandwidth ≤ 2000 MHz ¹	
	110 GHz $\leq f_{\text{center}} \leq$ 120 GHz	± 3.0 dB (nom.)
	120 GHz < $f_{\text{center}} \leq$ 140 GHz	± 1.5 dB (nom.)
	140 GHz < $f_{\text{center}} \leq$ 170 GHz	± 2.0 dB (nom.)
	analysis bandwidth ≤ 4400 MHz ¹	
	110 GHz $\leq f_{\text{center}} \leq$ 120 GHz	± 3.0 dB (nom.)
	120 GHz < $f_{\text{center}} \leq$ 140 GHz	± 2.0 dB (nom.)
	140 GHz < $f_{\text{center}} \leq$ 170 GHz	± 2.5 dB (nom.)
	analysis bandwidth ≤ 8312 MHz ¹	
	110 GHz $\leq f_{\text{center}} \leq$ 120 GHz	± 3.5 dB (nom.)
	120 GHz < $f_{\text{center}} \leq$ 140 GHz	± 2.5 dB (nom.)
	140 GHz < $f_{\text{center}} \leq$ 170 GHz	± 3.0 dB (nom.)

¹ Specification is valid for input frequencies in the range from 110 GHz to 170 GHz.

Signal performance for digital standards

Residual EVM	5G NR signal, channel bandwidth: 2 GHz, full allocation, SCS: 960 kHz, modulation: QPSK, measured with R&S®FSW (with R&S®FSW-B4001 option) in combination with R&S®SMW200A (with R&S®SMW-B711 option) and R&S®FE170ST, IF mode: EVM optimized	
	120 GHz $\leq f_{in} \leq$ 134 GHz	
	$-35 \text{ dBm} \leq P_{in} \text{ (RMS)} \leq -15 \text{ dBm}$	< -31 dB (meas.)
	134 GHz < $f_{in} \leq$ 167 GHz	
	$-30 \text{ dBm} \leq P_{in} \text{ (RMS)} \leq -15 \text{ dBm}$	< -34 dB (meas.)

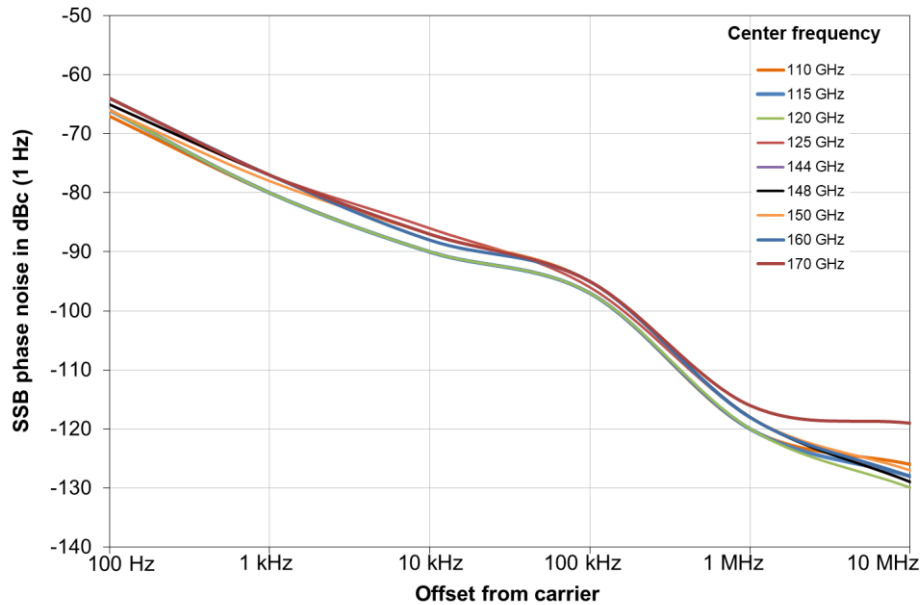
EVM versus input power (5G NR 2 GHz)



EVM values versus input power at different center frequencies with R&S®FSW (with R&S®FSW4001 option) in combination with R&S®FE170ST and R&S®SMW200A (with R&S®SMW-B711 option), IF mode: EVM optimized

Spectral purity

Image response	$f_{in} = f - 2 \times$ (first IF), $110 \text{ GHz} \leq f_{in} \leq 170 \text{ GHz}$, input level $\leq -15 \text{ dBm}$, IF mode: spur optimized	
	$122 \text{ GHz} \leq f \leq 126 \text{ GHz}$	$< -50 \text{ dBc}$
	$126 \text{ GHz} < f \leq 155 \text{ GHz}$	$< -65 \text{ dBc}$
	$155 \text{ GHz} < f \leq 165 \text{ GHz}$	$< -55 \text{ dBc (nom.)}$
	f = receive frequency	
Residual spurious response	RF attenuation = 0 dB, RF input termination = 50 Ω , analysis bandwidth $\leq 8.312 \text{ GHz}$	
	$110 \text{ GHz} \leq f \leq 170 \text{ GHz}$	$< -90 \text{ dBc (nom.)}$
	f = receive frequency	
SSB phase noise	RF center frequency = 144 GHz, measured with an R&S®FE170ST as signal source on the used IF frequency of the R&S®FE170SR	
	100 Hz	-64 dBc (1 Hz) (meas.)
	1 kHz	-77 dBc (1 Hz) (meas.)
	10 kHz	-87 dBc (1 Hz) (meas.)
	100 kHz	-95 dBc (1 Hz) (meas.)
	1 MHz	-118 dBc (1 Hz) (meas.)
	10 MHz	-129 dBc (1 Hz) (meas.)



Measured single sideband phase noise in combination with an R&S®FE170ST

Inputs and outputs

RF input		
Connector		WM-1651/WR6.5
Impedance		50 Ω

IF output		
Connector		SMA female
Impedance		50 Ω (nom.)
Output frequency		5 GHz to 15 GHz
Level		-40 dBm to +10 dBm

Reference input 10 MHz, 640 MHz, 1 GHz		
Connector		SMA female
Impedance		50 Ω (nom.)
Input frequency range		10 MHz, 640 MHz, 1 GHz
Required level		0 dBm to +20 dBm

LO input		
Connector		SMA female
Impedance		50 Ω (nom.)
Input frequency		8 GHz to 16.4 GHz
Level		+5 dBm to +20 dBm

LO output		
Connector		SMA female
Impedance		50 Ω (nom.)
Output frequency		8 GHz to 16.4 GHz
Level		+5 dBm to +20 dBm

Power supply		
Connector		2-pin LEMOSA
Supply voltage		+12 V DC, max. 2.5 A (nom.)

LAN interface		
Connector		10BASE-T/100BASE-T
PoE support		RJ-45 jack PoE++ (max. 52 W)

External modules		
Connector		ix Industrial [®] , type B

USB interface		
	for service use only	1 port, type B plug, version 2.0

General data

Temperature		
Temperature range	operating	+5 °C to +40 °C
	storage	−40 °C to +70 °C

Altitude		
Maximum operating altitude	above sea level	4600 m (approx. 15100 ft)

Mechanical resistance		
Vibration	sinusoidal	5 Hz to 55 Hz, displacement: 0.3 mm, constant amplitude (1.8 g at 55 Hz), in line with EN 60068-2-6
		55 Hz to 150 Hz, acceleration: 0.5 g constant, in line with EN 60068-2-6
	random	8 Hz to 500 Hz, acceleration 1.2 g (RMS), in line with EN 60068-2-64
Shock		40 g shock spectrum, in line with MIL-STD-810G, method 516.6, procedure I

EMC		
		<ul style="list-style-type: none"> • IEC/EN 61326-1 ^{2,3} • IEC/EN 61326-2-1 • CISPR 11/EN 55011 ² • IEC/EN 61000-3-2 • IEC/EN 61000-3-3

Recommended calibration interval		2 years
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External power supply		
DC output voltage range		+12 V
Maximum output current		5 A
Power consumption		max. 60 W
Safety		in line with IEC/UL/EN 62368-1, CE, CB
Test marks		UL, GS, CE, FCC

Dimensions and weight		
Dimensions (nom.)	W x H x D (overall)	150 mm x 57 mm x 190 mm (5.90 in x 2.24 in x 7.48 in)
Net weight (nom.)		1.66 kg (3.66 lb)

² Emission limits for class A equipment applied.

³ Immunity test requirement for industrial environment (EN 61326 table 2).

Ordering information

Designation	Type	Order No.
External frontend 110 GHz to 170 GHz	R&S®FE170SR	1347.9090.02
Internal low noise amplifier, 110 GHz to 170 GHz (included in R&S®FE170SR)	R&S®FE170-B221	1347.9578.02
Accessories supplied		
+12 V power supply, IF cable (2.92 mm, length: 1 m), reference cable (SMA, length: 2 m)		

Recommended extras

Designation	Type	Order No.
Torque wrench, for 3.5/2.92/2.4/1.85 mm connectors, 0.9 Nm coupling torque	R&S®ZN-ZTW	1328.8534.35
Torque wrench for waveguide flanges, 0.58 Nm	R&S®ZCTW	1175.2014.02
Waveguide filter, 110 GHz to 136 GHz	R&S®FE170-Z01	1347.9532.02
Waveguide filter, 126 GHz to 153 GHz	R&S®FE170-Z02	1347.9549.02
Waveguide filter, 143 GHz to 170 GHz	R&S®FE170-Z03	1347.9555.02
Waveguide filter, 160 GHz to 175 GHz	R&S®FE170-Z04	1348.7656.02
WR6.5 waveguide-to-waveguide adapter	R&S®FE170-Z20	1347.9655.02
Height adjustment, for external frontends	R&S®ZZA-FE01	1348.5330.02
Horn antenna, 110 GHz to 170 GHz	R&S®SGH170G20	1537.3327.02
LANCOM PoE++ injector (compatible with IEEE 802.3af/at/bt, up to 100 m distance)		4044144617799 (LANCOM order number)

Supported base units

Designation	Type	Order No.
Signal and spectrum analyzers		
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
Oscilloscope		
Oscilloscope 16 GHz, 100 Mpoints memory	R&S®RTP164B	1803.7000.16

Options needed for the base unit

Designation	Type	Order No.
Signal and spectrum analyzer		
External frontend control, for R&S®FSW	R&S®FSW-K553	1350.6118.02
Oscilloscopes		
External frontend control	R&S®RTP-K553	1803.6890.02
I/Q software interface	R&S®RTP-K11	1800.6683.02
Deembedding base option	R&S®RTP-K121	1326.3064.02

Supported applications

Designation	Type	Order No.
Pulse measurements	R&S®FSW-K6	1313.1322.02
Amplifier measurements	R&S®FSW-K18	1325.2170.02
Noise figure measurements	R&S®FSW-K30	1313.1380.02
Transient measurement application	R&S®FSW-K60	1313.7495.02
Vector signal analysis	R&S®FSW-K70	1313.1416.02
WLAN 802.11ad measurements	R&S®FSW-K95	1313.1639.02
OFDM signal analysis	R&S®FSW-K96	1313.1539.02
WLAN 802.11ay measurements	R&S®FSW-K97	1338.4902.02
5G NR Rel. 15 downlink measurements	R&S®FSW-K144	1338.3606.02
5G NR Rel. 15 uplink measurements	R&S®FSW-K145	1338.3612.02

Warranty and service

Warranty		
Base unit		1 year
All other items		1 year
Service options		
	Service plans	On demand
Calibration	up to five years ⁴	pay per calibration
Warranty and repair	up to five years ⁴	standard price repair
Contact your Rohde & Schwarz sales office for further details.		

⁴ For extended periods, contact your Rohde & Schwarz sales office.

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Sustainable product design

- ▶ Environmental compatibility and eco-footprint
- ▶ Energy efficiency and low emissions
- ▶ Longevity and optimized total cost of ownership

Certified Quality Management

ISO 9001

Certified Environmental Management

ISO 14001

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