

R&S® FE170ST

EXTERNAL FRONTEND

110 GHz to 170 GHz

Specifications

Data Sheet
Version 04.00

ROHDE & SCHWARZ

Make ideas real



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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 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®FE170ST, in combination with R&S®SMW200A or R&S®SMM100A base unit (see section Options needed for the base unit)
- 1 GHz reference signal from R&S®SMW200A or R&S®SMM100A base unit
- the corresponding R&S®FE170-Z01, R&S®FE170-Z02 and R&S®FE170-Z03 waveguide filters within the specified frequency range of the waveguide filter (see section Recommended extras)
- +12 V power supply (see section Accessories supplied)
- IF cable, 2.92 mm, length: 1 m (see section Accessories supplied)
- temperature range: +20 °C to +30 °C

Frequency

RF frequency range	R&S®FE170ST	110 GHz to 170 GHz
	R&S®FE170ST with R&S®FE170-Z01 waveguide filter (110 GHz to 136 GHz)	110 GHz to 131 GHz
	R&S®FE170ST with R&S®FE170-Z02 waveguide filter (126 GHz to 153 GHz)	131 GHz to 148 GHz
	R&S®FE170ST with R&S®FE170-Z03 waveguide filter (143 GHz to 170 GHz)	148 GHz to 170 GHz

Reference frequency

This item is specified in the data sheet of the instrument which is used as input for the R&S®FE170ST reference frequency.

Setting times

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

Modulation bandwidth

Maximum signal modulation bandwidth (equalized)	with R&S®SMM100A	1 GHz
	with R&S®SMW200A	2 GHz
	with dual-channel R&S®SMW200A and R&S®SMW-K555 options	4 GHz

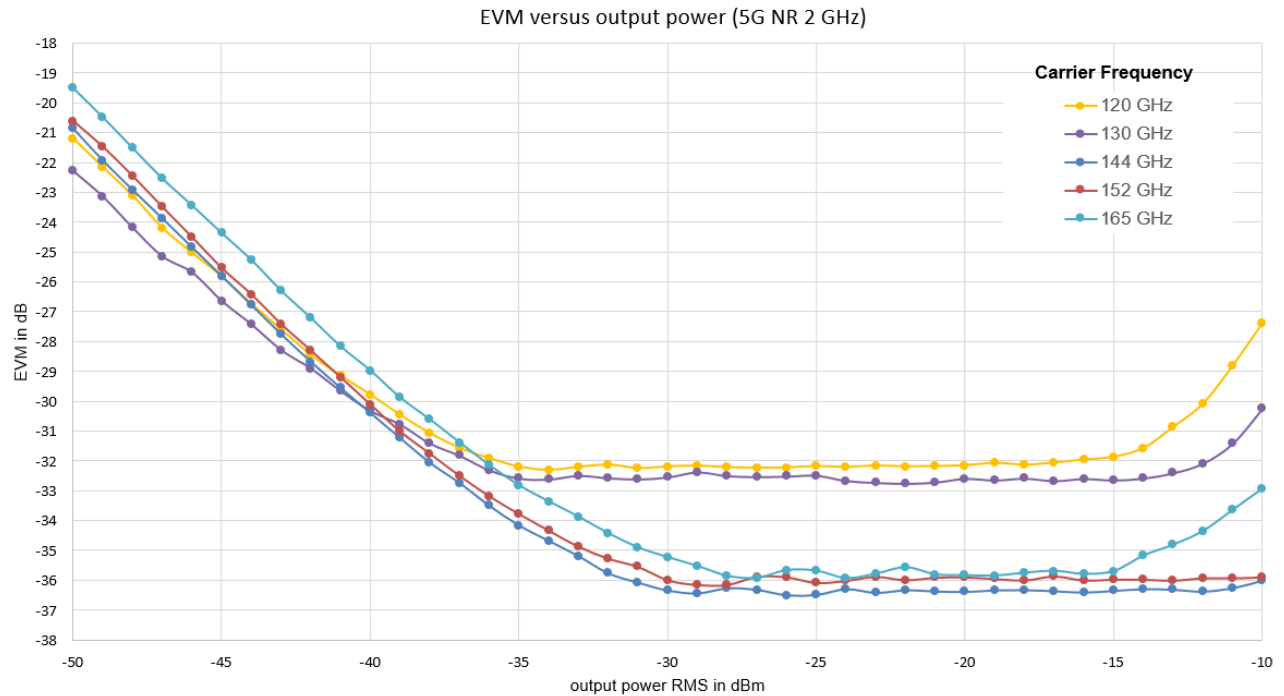
Level

Setting range		–145 dBm to +30 dBm
Specified level range	CW or I/Q modulated signals, coupled settings	
	$110\text{ GHz} \leq f_{\text{out}} \leq 170\text{ GHz}$	–40 dBm to –15 dBm (PEP)
Resolution of setting		0.1 dB (nom.)
Setting range of RF attenuator		0 dB to 30 dB, in 1 dB steps
Level error	CW signal, coupled settings, level range –30 dBm to –15 dBm	
	$110\text{ GHz} \leq f_{\text{out}} \leq 128\text{ GHz}$	< 3.5 dB
	$128\text{ GHz} < f_{\text{out}} \leq 170\text{ GHz}$	< 3.0 dB
	I/Q modulated signal, level range –30 dBm to –15 dBm	
	$110\text{ GHz} \leq f_{\text{out}} \leq 170\text{ GHz}$	add 0.5 dB
	for any other level setting	
Amplitude flatness	$110\text{ GHz} \leq f_{\text{out}} \leq 170\text{ GHz}$	add 1.0 dB (meas.)
	with internal baseband I/Q (R&S®SMW-B13XT wideband baseband main module option), optimization mode: high quality	
	modulation bandwidth $\leq 500\text{ MHz}$ ¹	
	$110\text{ GHz} \leq f_{\text{out}} \leq 115\text{ GHz}$	±2.7 dB (meas.)
	$115\text{ GHz} < f_{\text{out}} \leq 128\text{ GHz}$	±2.5 dB (nom.)
	$128\text{ GHz} < f_{\text{out}} \leq 150\text{ GHz}$	±1.5 dB (nom.)
	$150\text{ GHz} < f_{\text{out}} \leq 170\text{ GHz}$	±2.3 dB (nom.)
	modulation bandwidth $\leq 1000\text{ MHz}$ ¹	
	$110\text{ GHz} \leq f_{\text{out}} \leq 115\text{ GHz}$	±3.0 dB (meas.)
	$115\text{ GHz} < f_{\text{out}} \leq 128\text{ GHz}$	±2.8 dB (nom.)
	$128\text{ GHz} < f_{\text{out}} \leq 150\text{ GHz}$	±2.0 dB (nom.)
	$150\text{ GHz} < f_{\text{out}} \leq 170\text{ GHz}$	±2.3 dB (nom.)
	modulation bandwidth $\leq 2000\text{ MHz}$ ¹	
	$110\text{ GHz} \leq f_{\text{out}} \leq 115\text{ GHz}$	±3.2 dB (meas.)
	$115\text{ GHz} < f_{\text{out}} \leq 128\text{ GHz}$	±3.0 dB (nom.)
	$128\text{ GHz} < f_{\text{out}} \leq 150\text{ GHz}$	±2.2 dB (nom.)
	$150\text{ GHz} < f_{\text{out}} \leq 170\text{ GHz}$	±2.5 dB (nom.)
Maximum rated reverse power		0 dBm

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

Signal performance for digital standards

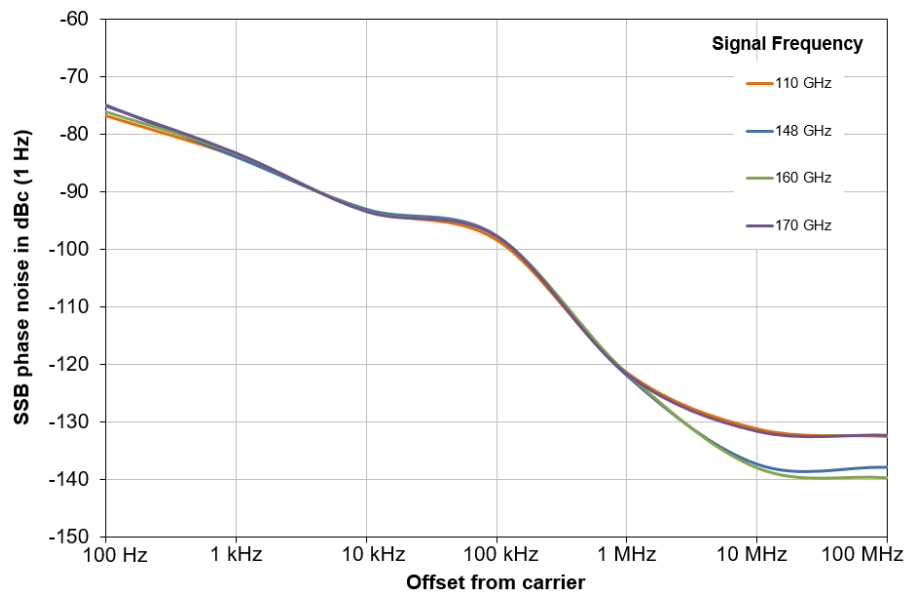
Residual EVM	5G NR signal, channel bandwidth: 2 GHz, full allocation, SCS: 960 kHz, modulation: QPSK, measured with R&S®SMW200A (with R&S®SMW-B711/-B721 options) in combination with R&S®FE170SR	
	120 GHz $\leq f_{in} \leq 134$ GHz	
	$-35 \text{ dBm} \leq P_{out} \text{ (RMS)} \leq -15 \text{ dBm}$	$< -31 \text{ dB (meas.)}$
	134 GHz $< f_{in} \leq 167$ GHz	
	$-30 \text{ dBm} \leq P_{out} \text{ (RMS)} \leq -15 \text{ dBm}$	$< -34 \text{ dB (meas.)}$



EVM values versus output power at different center frequencies with R&S®SMW200A (with R&S®SMW-B711/-B721 options) in combination with R&S®FE170SR, IF mode = EVM optimized

Spectral purity

Image suppression	-15 dBm CW output signal, observed frequency range 110 GHz to 170 GHz, IF mode = spur optimized	
	$110 \text{ GHz} \leq f_{\text{out}} \leq 129 \text{ GHz}$	< -80 dBc (nom.)
	$129 \text{ GHz} < f_{\text{out}} \leq 146 \text{ GHz}$	< -70 dBc (nom.)
	$146 \text{ GHz} < f_{\text{out}} \leq 170 \text{ GHz}$	< -70 dBc (meas.)
Wideband noise	-15 dBm CW output signal, carrier offset 100 MHz, measurement bandwidth = 1 Hz	
	$110 \text{ GHz} \leq f_{\text{out}} \leq 170 \text{ GHz}$	< -132 dBc (meas.)
LO suppression	-15 dBm CW output signal, observed frequency range 110 GHz to 170 GHz, IF mode = spur optimized	
	$110 \text{ GHz} \leq f_{\text{out}} \leq 131 \text{ GHz}$	< -55 dBc (nom.)
	$131 \text{ GHz} < f_{\text{out}} \leq 148 \text{ GHz}$	< -50 dBc (nom.)
	$148 \text{ GHz} < f_{\text{out}} \leq 170 \text{ GHz}$	< -55 dBc (meas.)
Harmonics, subharmonics and other mixing products of the RF and LO signal	-15 dBm CW output signal, within 8.4 GHz bandwidth, IF mode = EVM optimized	
	$110 \text{ GHz} \leq f_{\text{out}} \leq 170 \text{ GHz}$	< -50 dBc (meas.)
	-15 dBm CW output signal, observed frequency range 110 GHz to 170 GHz, IF mode = spur optimized	
	$110 \text{ GHz} \leq f_{\text{out}} \leq 136 \text{ GHz}$	< -30 dBc (meas.)
	$136 \text{ GHz} < f_{\text{out}} \leq 151 \text{ GHz}$	< -45 dBc (meas.)
	$151 \text{ GHz} < f_{\text{out}} \leq 170 \text{ GHz}$	< -30 dBc (meas.)
SSB phase noise	RF center frequency = 148 GHz, measured in combination with an R&S®SMW200A (with R&S®SMW-B711 option)	
	100 Hz	-75 dBc (1 Hz) (meas.)
	1 kHz	-84 dBc (1 Hz) (meas.)
	10 kHz	-93 dBc (1 Hz) (meas.)
	100 kHz	-97 dBc (1 Hz) (meas.)
	1 MHz	-122 dBc (1 Hz) (meas.)
	10 MHz	-137 dBc (1 Hz) (meas.)



Measured single sideband phase noise in combination with an R&S®SMW200A (with R&S®SMW-B711/-B721 options)

Inputs and outputs

RF output		
Connector		WM1651/WR6.5
Impedance		50 Ω

IF input		
Connector		2.92 mm female
Impedance		50 Ω (nom.)
Input frequency range	IF mode = spur optimized	
	dependent on RF frequency	5 GHz to 31 GHz
	IF mode = EVM optimized	
	dependent on RF frequency	4.8 GHz to 18.9 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 (currently not supported)		
Connector		SMA female

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		RJ-45 jack
PoE support		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
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General data

Temperature		
Temperature range	operating	+5 °C to +40 °C
	storage	−40 °C to +70 °C
Climatic loading		+40 °C at 95 % relative humidity, in line with EN 60068-2-30, without condensation

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
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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 60950-1/62368-1, CE, CB
Test marks		UL, GS, CE, FCC

Dimensions and weight		
Dimensions (nom.)	W × H × D (overall)	150 mm × 57 mm × 190 mm (5.90 in × 2.24 in × 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 from 110 GHz to 170 GHz	R&S®FE170ST	1347.9190.02
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
Angled wrench, 3/32"	R&S®ZCAW	1175.1960.00
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
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

Supported base units

Designation	Type	Order No.
Vector signal generator	R&S®SMW200A	1412.0000.02
Vector signal generator	R&S®SMM100A	1440.8002.02

Options needed for the base unit

Designation	Type	Order No.
Minimum needed frequency option, for R&S®SMW200A	R&S®SMW-B1020	1428.5107.02
Frequency option needed for IF mode = spur optimized, for R&S®SMW200A	R&S®SMW-B1031	1428.5307.02
External frontend control, for R&S®SMW200A	R&S®SMW-K553	1414.6758.02
Minimum needed frequency option, for R&S®SMM100A	R&S®SMM-B1020	1440.9309.02
Frequency option needed for IF mode = spur optimized, for R&S®SMM200A	R&S®SMM-B1031	1440.9409.02
External frontend control, for R&S®SMM100A	R&S®SMM-K553	1441.1147.02

Service options

Warranty		
Base unit		1 year
Service options		
Extended warranty, one year	R&S®WE1	Please contact your local Rohde & Schwarz sales office.
Extended warranty, two years	R&S®WE2	
Extended warranty, three years	R&S®WE3	
Extended warranty, four years	R&S®WE4	
Extended warranty with calibration coverage, one year	R&S®CW1	
Extended warranty with calibration coverage, two years	R&S®CW2	
Extended warranty with calibration coverage, three years	R&S®CW3	
Extended warranty with calibration coverage, four years	R&S®CW4	

Extended warranty with a term of one to four years (WE1 to WE4)

Repairs carried out during the contract term are free of charge ⁴. Necessary calibration and adjustments carried out during repairs are also covered.

Extended warranty with calibration (CW1 to CW4)

Enhance your extended warranty by adding calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated, inspected and maintained during the term of the contract. It includes all repairs ⁴ and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

⁴ Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.

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- ▶ Customized and flexible
- ▶ Uncompromising quality
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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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