

R&S® FE170ST

EXTERNAL FRONTEND

110 GHz to 170 GHz

Specifications



Specifications
Version 08.00

ROHDE & SCHWARZ

Make ideas real



CONTENTS

Definitions	3
Specifications.....	4
Frequency	4
Modulation bandwidth.....	4
Level.....	5
Signal performance for digital standards	5
Spectral purity	7
Inputs and outputs	8
General data.....	9
Ordering information	10
Recommended extras.....	10
Supported base units.....	10
Options needed for the base unit	10
Warranty and service.....	11

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®FE170ST, in combination with R&S®SMW200A or R&S®SMM100A base unit (see Options needed for the base unit)
- 1 GHz reference signal from R&S®SMW200A or R&S®SMM100A base unit, LO mode: internal
- The corresponding R&S®FE170-Z01, R&S®FE170-Z02 and 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®FE170ST	110 GHz to 170 GHz
	overrange	170 GHz to 175 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
	R&S®FE170ST 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®FE170ST reference frequency.

LO source

Mode	internal	internal synthesizer
	external	external signal generator or LO output of a further R&S®FE170SR/ R&S®FE170ST with IF mode: shared LO

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 option	4 GHz

Level

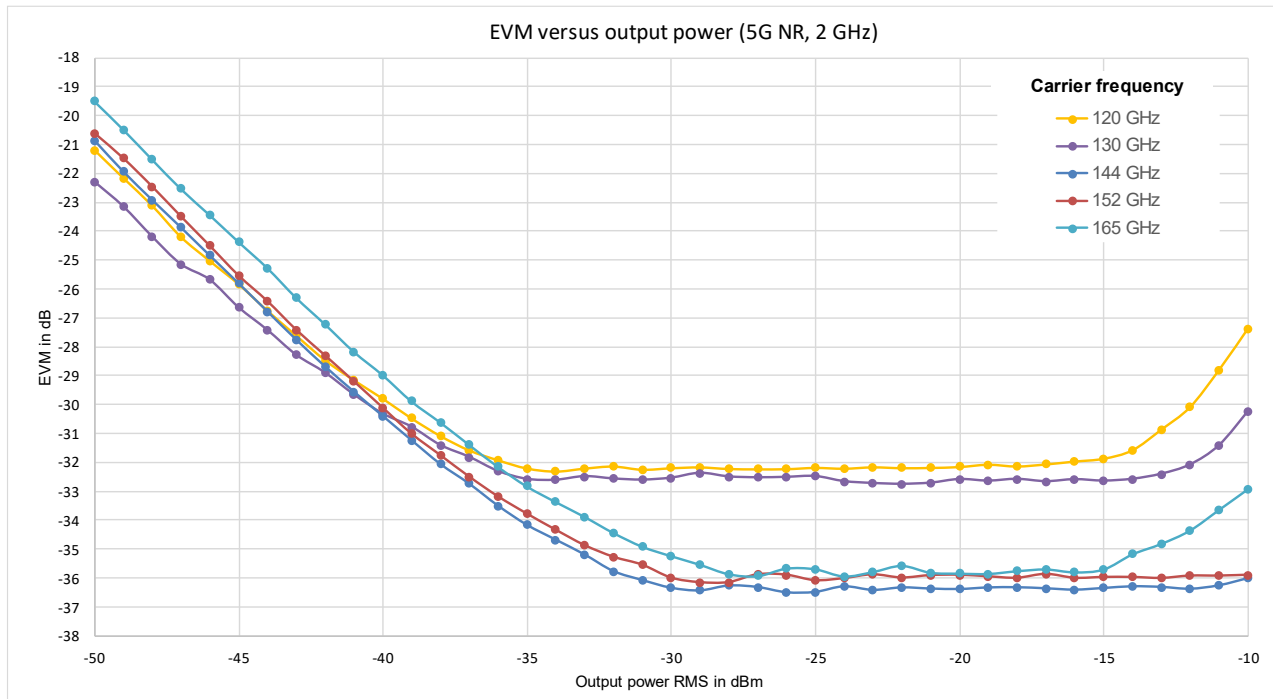
Setting range		–145 dBm to +30 dBm
Specified level range	CW or I/Q modulated signals	
	$110 \text{ GHz} \leq f_{\text{out}} \leq 170 \text{ GHz}$	–40 dBm to –15 dBm (PEP)
Resolution of setting		0.1 dB (nom.)
Setting range of RF attenuator		0 dB to 30 dB, in 1 dB steps
Level error	CW signal, amplitude settings: auto, level range from –30 dBm to –15 dBm	
	$110 \text{ GHz} \leq f_{\text{out}} \leq 118 \text{ GHz}$	< 3.5 dB ¹
	$118 \text{ GHz} < f_{\text{out}} \leq 128 \text{ GHz}$	< 3.5 dB
	$128 \text{ GHz} < f_{\text{out}} \leq 166 \text{ GHz}$	< 3.0 dB
	$166 \text{ GHz} < f_{\text{out}} \leq 170 \text{ GHz}$	< 3.0 dB ¹
	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 $\leq 500 \text{ MHz}$ ²	
	$110 \text{ GHz} \leq f_{\text{out}} \leq 115 \text{ GHz}$	$\pm 2.7 \text{ dB}$ (meas.)
	$115 \text{ GHz} < f_{\text{out}} \leq 118 \text{ GHz}$	$\pm 2.5 \text{ dB}$ (nom.) ¹
	$118 \text{ GHz} < f_{\text{out}} \leq 128 \text{ GHz}$	$\pm 2.5 \text{ dB}$ (nom.)
	$128 \text{ GHz} < f_{\text{out}} \leq 150 \text{ GHz}$	$\pm 1.5 \text{ dB}$ (nom.)
	$150 \text{ GHz} < f_{\text{out}} \leq 166 \text{ GHz}$	$\pm 2.3 \text{ dB}$ (nom.)
	$166 \text{ GHz} < f_{\text{out}} \leq 170 \text{ GHz}$	$\pm 2.3 \text{ dB}$ (nom.) ¹
	modulation bandwidth $\leq 1000 \text{ MHz}$ ²	
	$110 \text{ GHz} \leq f_{\text{out}} \leq 115 \text{ GHz}$	$\pm 3.0 \text{ dB}$ (meas.)
	$115 \text{ GHz} < f_{\text{out}} \leq 118 \text{ GHz}$	$\pm 2.8 \text{ dB}$ (nom.) ¹
	$118 \text{ GHz} < f_{\text{out}} \leq 128 \text{ GHz}$	$\pm 2.8 \text{ dB}$ (nom.)
	$128 \text{ GHz} < f_{\text{out}} \leq 150 \text{ GHz}$	$\pm 2.0 \text{ dB}$ (nom.)
	$150 \text{ GHz} < f_{\text{out}} \leq 166 \text{ GHz}$	$\pm 2.3 \text{ dB}$ (nom.)
	$166 \text{ GHz} < f_{\text{out}} \leq 170 \text{ GHz}$	$\pm 2.3 \text{ dB}$ (nom.) ¹
	modulation bandwidth $\leq 2000 \text{ MHz}$ ²	
	$110 \text{ GHz} \leq f_{\text{out}} \leq 115 \text{ GHz}$	$\pm 3.2 \text{ dB}$ (meas.)
	$115 \text{ GHz} < f_{\text{out}} \leq 118 \text{ GHz}$	$\pm 3.0 \text{ dB}$ (nom.) ¹
	$118 \text{ GHz} < f_{\text{out}} \leq 128 \text{ GHz}$	$\pm 3.0 \text{ dB}$ (nom.)
	$128 \text{ GHz} < f_{\text{out}} \leq 150 \text{ GHz}$	$\pm 2.2 \text{ dB}$ (nom.)
	$150 \text{ GHz} < f_{\text{out}} \leq 166 \text{ GHz}$	$\pm 2.5 \text{ dB}$ (nom.)
	$166 \text{ GHz} < f_{\text{out}} \leq 170 \text{ GHz}$	$\pm 2.5 \text{ dB}$ (nom.) ¹
Maximum rated reverse power		0 dBm

Signal performance for digital standards

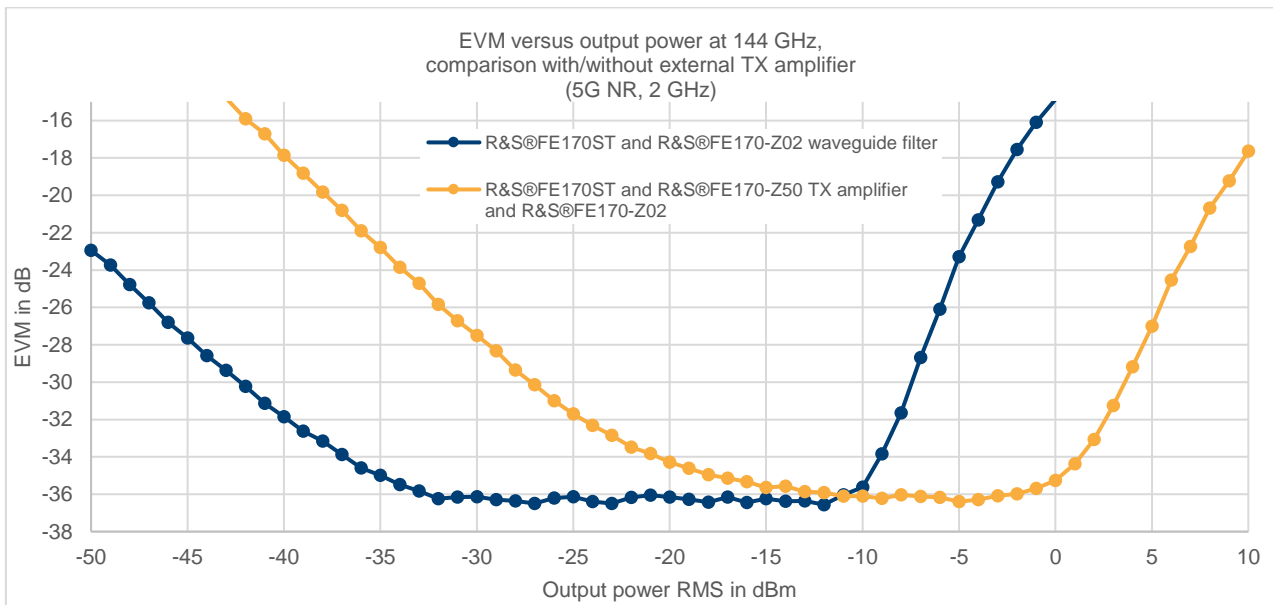
Residual EVM	5G NR signal, channel bandwidth: 2 GHz, full allocation, SCS: 960 kHz, modulation: QPSK, measured with R&S®SMW200A (with R&S®SMW-B711 option) in combination with R&S®FE170SR and R&S®FSW (with R&S®FSW-B4001 option), IF mode: EVM optimized	
	$120 \text{ GHz} \leq f_{\text{out}} \leq 134 \text{ GHz}$	
	$-35 \text{ dBm} \leq P_{\text{out}} (\text{RMS}) \leq -15 \text{ dBm}$	< –31 dB (meas.)
	$134 \text{ GHz} < f_{\text{out}} \leq 167 \text{ GHz}$	
	$-30 \text{ dBm} \leq P_{\text{out}} (\text{RMS}) \leq -15 \text{ dBm}$	< –34 dB (meas.)

¹ For IF mode: shared LO, specification is only valid as measured (meas.).

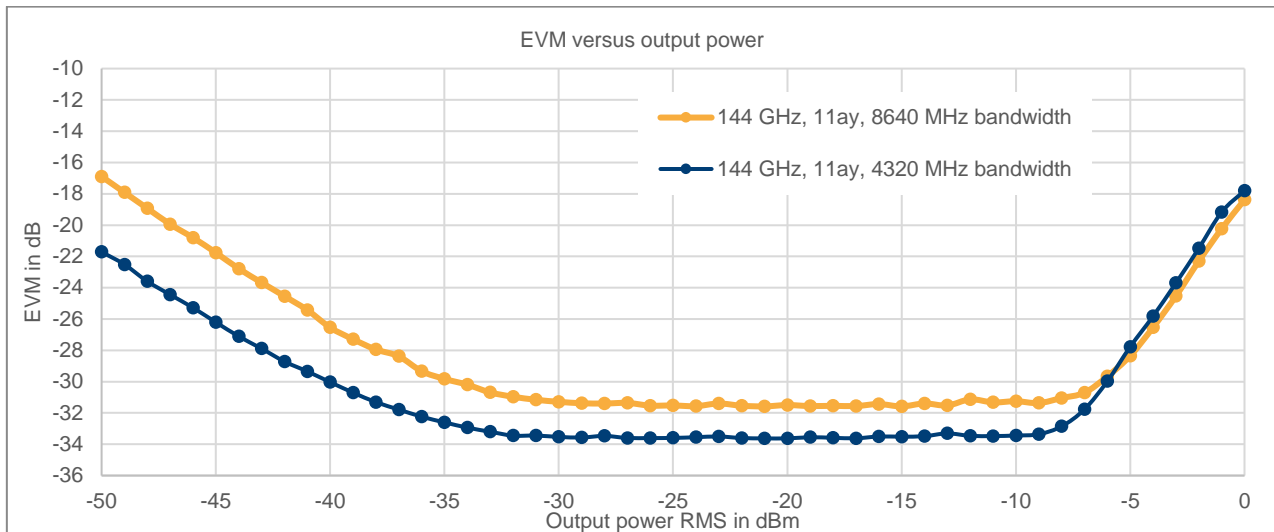
² Specification is valid for output frequencies in the range from 110 GHz to 170 GHz.



EVM values versus output power at different center frequencies with R&S®SMW200A (with R&S®SMW-B711 option) in combination with R&S®FE170SR and R&S®FSW (with R&S®FSW-B4001 option), IF mode: EVM optimized



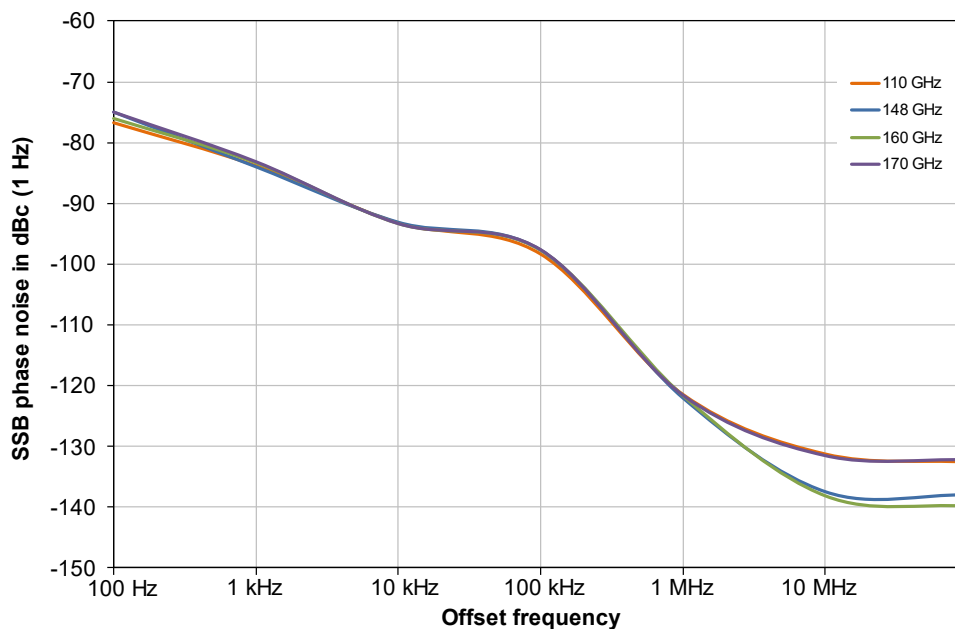
EVM values versus output power with R&S®SMW200A (with R&S®SMW-B711 option) in combination with R&S®FE170SR and R&S®FSW (with R&S®FSW-B4001 option), IF mode: EVM optimized



*EVM values versus output power with R&S®SFI100A
in combination with R&S®FE170SR and R&S®FSW (with R&S®FSW-B8001 option), IF mode: EVM optimized*

Spectral purity

Image suppression	-15 dBm CW output signal, observed frequency range from 110 GHz to 170 GHz, IF mode: spur optimized	
	110 GHz $\leq f_{out} \leq 129$ GHz	< -80 dBc (nom.)
	129 GHz < $f_{out} \leq 146$ GHz	< -70 dBc (nom.)
	146 GHz < $f_{out} \leq 170$ GHz	< -70 dBc (meas.)
Wideband noise	-15 dBm CW output signal, carrier offset = 100 MHz, measurement bandwidth = 1 Hz	
	110 GHz $\leq f_{out} \leq 170$ GHz	< -132 dBc (meas.)
LO suppression	-15 dBm CW output signal, observed frequency range from 110 GHz to 170 GHz, IF mode: spur optimized	
	110 GHz $\leq f_{out} \leq 131$ GHz	< -55 dBc (nom.)
	131 GHz < $f_{out} \leq 148$ GHz	< -50 dBc (nom.)
	148 GHz < $f_{out} \leq 170$ 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, observed frequency range from 110 GHz to 170 GHz, IF mode: EVM optimized	
	110 GHz $\leq f_{out} \leq 170$ GHz	< -50 dBc (meas.)
	-15 dBm CW output signal, observed frequency range from 110 GHz to 170 GHz, IF mode: spur optimized	
	110 GHz $\leq f_{out} \leq 136$ GHz	< -30 dBc (meas.)
	136 GHz < $f_{out} \leq 151$ GHz	< -45 dBc (meas.)
	151 GHz < $f_{out} \leq 170$ 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/-B721 options)	
	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		WM-1651/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
	IF mode: shared LO	9.93 GHz fixed
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 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

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
	random	55 Hz to 150 Hz, acceleration: 0.5 g constant, in line with EN 60068-2-6
		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^{3, 4} • IEC/EN 61326-2-1 • CISPR 11/EN 55011³ • IEC/EN 61000-3-2 • IEC/EN 61000-3-3
Recommended calibration interval		
		2 years
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 × 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)

³ Emission limits for class A equipment applied.

⁴ 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®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
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
Waveguide filter, 110 GHz to 126 GHz	R&S®FE170-Z10	1347.9661.02
Waveguide filter, 116 GHz to 132 GHz	R&S®FE170-Z11	1347.9678.02
Waveguide filter, 122 GHz to 138 GHz	R&S®FE170-Z12	1347.9684.02
Waveguide filter, 128 GHz to 145 GHz	R&S®FE170-Z13	1347.9690.02
Waveguide filter, 135 GHz to 151 GHz	R&S®FE170-Z14	1348.7610.02
Waveguide filter, 141 GHz to 157 GHz	R&S®FE170-Z15	1348.7627.02
Waveguide filter, 147 GHz to 163 GHz	R&S®FE170-Z16	1348.7633.02
Waveguide filter, 153 GHz to 170 GHz	R&S®FE170-Z17	1348.7640.02
WR6.5 waveguide-to-waveguide adapter	R&S®FE170-Z20	1347.9655.02
Full D band power amplifier	R&S®FE170-Z50	1347.9584.02
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
Tunable attenuator, 110 GHz to 170 GHz	R&S®WTA110-170	3660.9667.02
Fixed attenuator (0 dB to 40 dB, due to customer specification)	WFA 110-170	04710031 (RPG part number)
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.
Vector signal generator	R&S®SMW200A	1412.0000.02
Vector signal generator	R&S®SMM100A	1440.8002.02
Wideband IF vector signal generator	R&S®SFI100A	1444.4001.02

Options needed for the base unit

Designation	Type	Order No.
R&S®SMW200A		
Minimum needed frequency option	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	R&S®SMW-K553	1414.6758.02
Reference input/output, 1 GHz (recommended)	R&S®SMW-K703	1413.7380.02
R&S®SMM100A		
Minimum needed frequency option	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	R&S®SMM-K553	1441.1147.02
Reference input/output, 1 GHz (recommended)	R&S®SMM-K703	1441.1301.02
R&S®SFI100A		
IF frequency, 16 GHz	R&S®SFI-B1016	1444.3892.02
Baseband generator, 4 GHz, RF bandwidth	R&S®SFI-K510	1444.3257.02
External frontend control	R&S®SFI-K553	1444.3311.02
Reference input/output, 1 GHz	R&S®SFI-K703	1444.3405.02

Warranty and service

Warranty		
Base unit		1 year
All other items		1 year
Service options	Service plans	On demand
Calibration	up to five years ⁵	pay per calibration
Warranty and repair	up to five years ⁵	standard price repair
Contact your Rohde & Schwarz sales office for further details.		

⁵ For extended periods, contact your Rohde & Schwarz sales office.

Service at Rohde & Schwarz You're in great hands

- ▶ Worldwide
- ▶ Local and personalized
- ▶ Customized and flexible
- ▶ Uncompromising quality
- ▶ Long-term dependability

Rohde & Schwarz

The Rohde & Schwarz technology group is among the trailblazers when it comes to paving the way for a safer and connected world with its leading solutions in test & measurement, technology systems and networks & cybersecurity. Founded 90 years ago, the group is a reliable partner for industry and government customers around the globe. The independent company is headquartered in Munich, Germany and has an extensive sales and service network with locations in more than 70 countries.

www.rohde-schwarz.com

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

Rohde & Schwarz training

www.training.rohde-schwarz.com

Rohde & Schwarz customer support

www.rohde-schwarz.com/support

