R&S®ESR
EMI Test Receiver
Specifications

ROHDE&SCHWARZ

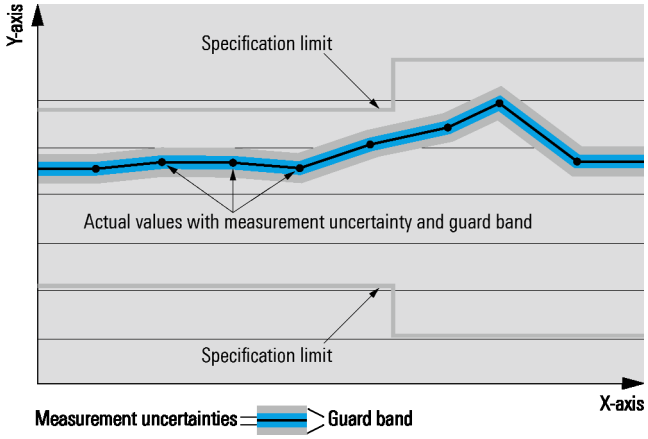
CONTENTS

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 <, ≤, >, ≥, ±, 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.



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”.

Typical data as well as nominal and measured values are not warranted by Rohde & Schwarz.

Specifications

Operating modes		EMI test receiver
		spectrum analyzer
	with R&S®ESR-K55 option	real-time spectrum analyzer

Frequency

Frequency range	R&S®ESR3	
	input 1, AC coupled	10 MHz to 3.6 GHz
	input 1, DC coupled	9 kHz to 3.6 GHz
	input 2, DC coupled	9 kHz to 1 GHz
	R&S®ESR7	
	input 1, AC coupled	10 MHz to 7 GHz
	input 1, DC coupled	9 kHz to 7 GHz
	input 2, DC coupled	9 kHz to 1 GHz
	with R&S®ESR-B29 option, DC coupled	10 Hz to max. frequency
Frequency resolution	receiver mode	0.1 Hz
	analyzer mode	0.01 Hz

Reference frequency, internal		
Accuracy		±((time since last adjustment × aging rate) + temperature drift + calibration accuracy)
Aging per year	standard	$\pm 1 \times 10^{-6}$
	with R&S®FSV-B4 option	$\pm 1 \times 10^{-7}$
Temperature drift (+5 °C to +45 °C)	standard	$\pm 1 \times 10^{-6}$
	with R&S®FSV-B4 option, model .02	$\pm 1 \times 10^{-7}$
	with R&S®FSV-B4 option, model .03	$\pm 1 \times 10^{-8}$
Max. initial calibration accuracy	standard	$\pm 5 \times 10^{-7}$
	with R&S®FSV-B4 option	$\pm 5 \times 10^{-8}$

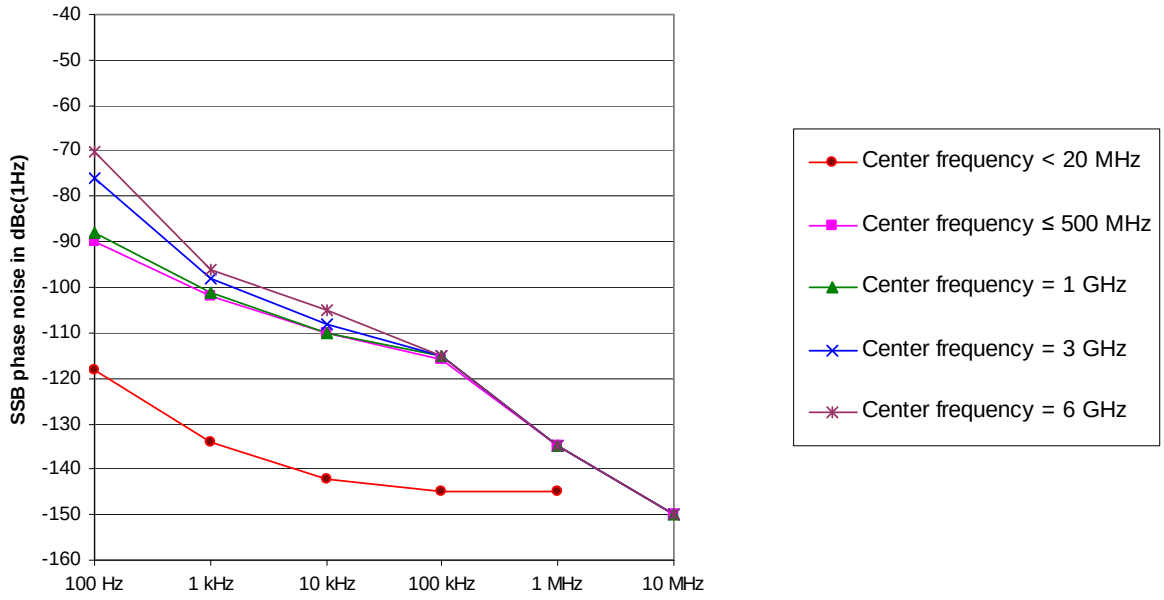
Frequency readout (analyzer mode)		
Marker resolution		1 Hz
Uncertainty		±(marker frequency × reference accuracy + 10 % × resolution bandwidth + ½ (span/(sweep points – 1)) + 1 Hz)
Number of sweep (trace) points	default value	691
	range	
	spectrum analyzer	101 to 32 001
	EMI measurement	101 to 200 001
Marker tuning frequency step size	marker step size = sweep points	span/(sweep points – 1)
	marker step size = standard	span/(default sweep points – 1)
Frequency counter resolution		0.001 Hz
Count accuracy		±(frequency × reference accuracy + ½ (last digit))
Display range for frequency axis		0 Hz, 10 Hz to max. frequency
Resolution		0.1 Hz
Max. span deviation		±0.1 %

Receiver scan		
Scan		scan with max. 10 subranges with different settings
Scan modes		normal scan, time domain scan [1]
Measurement time	normal scan, per frequency	50 µs to 100 s
	time domain scan, per subrange [1]	50 µs to 100 s
Number of trace points		up to 4 000 000
Frequency step size	normal scan	min. 1 Hz
	time domain scan [1]	0.25 × resolution bandwidth
Time domain scan [1]		
Frequency segment processed in parallel	RBW = 200 Hz	0.66 MHz
	RBW = 9 kHz	30 MHz
	RBW = 120 kHz	24.6 MHz
	RBW = 1 MHz	25.6 MHz
FFT overlap factor		≥ 93 %

Spectrum analyzer		
Sweep time range	span = 0 Hz	1 µs to 16 000 s
	span ≥ 10 Hz, swept	1 ms to 16 000 s [2]
	span ≥ 10 Hz, FFT	7 µs to 16 000 s [3]
Sweep time accuracy	span = 0 Hz	±0.1 % (nom.)
	span ≥ 10 Hz, swept	±3 % (nom.)

Spectral purity		
SSB phase noise	frequency = 500 MHz, carrier offset	
	100 Hz	< –84 dBc (1 Hz)
	1 kHz	< –101 dBc (1 Hz)
	10 kHz	< –106 dBc (1 Hz)
	100 kHz	< –115 dBc (1 Hz)
	1 MHz	< –134 dBc (1 Hz)
	10 MHz	< –150 dBc (1 Hz) (nom.)
Residual FM	frequency = 500 MHz, RBW = 1 kHz, sweep time = 100 ms	< 3 Hz (nom.)

[1] Requires R&S®ESR-K53 option.
[2] Net sweep time without additional hardware settling time.
[3] Data acquisition time for FFT calculation.



Typical phase noise at different center frequencies.

Preselection and preamplifier

Preselection		
State	receiver mode	always on
	analyzer mode	on, off (selectable)
Number of preselection filters		16
Bandwidths (–6 dB), nominal	10 Hz to 150 kHz	fixed lowpass filter
	150 kHz to 30 MHz	35 MHz, fixed bandpass filter
	30 MHz to 80 MHz	94 MHz, fixed bandpass filter
	80 MHz to 130 MHz	94 MHz, fixed bandpass filter
	130 MHz to 180 MHz	91 MHz, fixed bandpass filter
	180 MHz to 230 MHz	105 MHz, fixed bandpass filter
	230 MHz to 300 MHz	110 MHz, fixed bandpass filter
	300 MHz to 425 MHz	195 MHz, fixed bandpass filter
	425 MHz to 570 MHz	200 MHz, fixed bandpass filter
	570 MHz to 715 MHz	210 MHz, fixed bandpass filter
	715 MHz to 860 MHz	200 MHz, fixed bandpass filter
	860 MHz to 1005 MHz	200 MHz, fixed bandpass filter
	1005 MHz to 1750 MHz	fixed highpass filter
	1750 MHz to 2850 MHz	fixed highpass filter
	2850 MHz to 4850 MHz	fixed highpass filter
	4850 MHz to 7000 MHz	fixed highpass filter
Preamplifier	switchable	
Location		in the signal path between preselection and 1st mixer
Range		1 kHz to 7 GHz
Gain		20 dB (nom.)

IF and resolution bandwidths

IF and sweep filters		
Resolution bandwidths (–3 dB)	receiver mode or analyzer mode, span ≥ 10 Hz	10 Hz to 10 MHz in 1/2/3/5 sequence
	analyzer mode, span = 0 Hz	20 MHz, 28 MHz, 40 MHz additionally
Bandwidth uncertainty		< 3 %
Shape factor 60 dB:3 dB		< 5
EMI bandwidths (–6 dB)	standard	200 Hz, 9 kHz, 120 kHz, 1 MHz
	with R&S®ESR-B29 option	10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz additionally
Bandwidth uncertainty		< 3 %
Shape factor 60 dB:6 dB		< 4

FFT filters (analyzer mode)		
Resolution bandwidths (–3 dB)	span ≥ 10 Hz	10 Hz to 300 kHz in 1/2/3/5 sequence
Bandwidth uncertainty		< 3 % (nom.)
Shape factor 60 dB:3 dB		< 5 (nom.)

Channel filters (analyzer mode)		
Bandwidths (–3 dB)	standard (RRC = root raised cosine)	100/200/300/500 Hz
		1/1.5/2/2.4/2.7/3/3.4/4/4.5/5/6/8.5/9/10/ 12.5/14/15/16/18 (RRC)/20/21/24.3 (RRC) /25/30/50/100/150/192/200/300/500 kHz
		1/1.228/1.28 (RRC)/1.5/2/3/3.84 (RRC)/ 4.096 (RRC)/5/10/20/28/40 MHz
Bandwidth accuracy		< 2 % (nom.)
Shape factor 60 dB:3 dB		< 2 (nom.)

Video bandwidths (analyzer mode)		1 Hz to 10 MHz in 1/2/3/5 sequence, 20 MHz, 28 MHz, 40 MHz

Level

Display range		displayed noise floor up to +130 dBm

Max. input level		
DC voltage	input 1	
	AC coupled	50 V
	DC coupled	0 V
	input 2	0 V
CW RF power	RF attenuation = 0 dB	
	RF preamplifier = off	20 dBm (= 0.1 W)
	RF preamplifier = on	13 dBm (= 0.02 W)
	RF attenuation ≥ 10 dB	
	RF preamplifier = off	30 dBm (= 1 W)
	RF preamplifier = on	23 dBm (= 0.2 W)
Pulse spectral density	RF attenuation = 0 dB, preselection = on [4], RF preamplifier = off	97 dB µV/MHz
Max. pulse voltage	RF attenuation ≥ 10 dB	
	input 1	150 V
	input 2	450 V
Max. pulse energy	RF attenuation ≥ 10 dB, 10 µs	
	input 1	1 mWs
	input 2	20 mWs

[4] Default setting in receiver mode.

Intermodulation		
1 dB compression of input mixer	RF attenuation = 0 dB, preselection and preamplifier = off [5]	+3 dBm (nom.)
Third-order intercept point (TOI)	RF attenuation = 0 dB, level = 2 × –15 dBm, Δf > 5 × RBW or 10 kHz, whichever is larger, preselection = off [5], with R&S®FSV-B22 option: RF preamplifier = off	
	10 MHz ≤ f_{in} < 100 MHz	> 12 dBm, typ. 15 dBm
	100 MHz ≤ f_{in} < 3.6 GHz	> 13 dBm, typ. 16 dBm
	3.6 GHz ≤ f_{in} ≤ 7 GHz	> 15 dBm, typ. 18 dBm
	preselection = on [6], preamplifier = off, RF attenuation = 0 dB, level = 2 × –20 dBm, Δf > 5 × RBW or 10 kHz, whichever is larger	
	10 MHz ≤ f_{in} < 100 MHz	> 5 dBm, typ. 8 dBm
	100 MHz ≤ f_{in} < 4.5 GHz	> 8 dBm, typ. 11 dBm
	4.5 GHz ≤ f_{in} ≤ 7 GHz	> 5 dBm, typ. 8 dBm
	preselection = on [6], preamplifier = on, RF attenuation = 0 dB, level = 2 × –45 dBm, Δf > 5 × RBW or 10 kHz, whichever is larger	
	10 MHz ≤ f_{in} < 100 MHz	> –16 dBm, typ. –13 dBm
	100 MHz ≤ f_{in} < 3.6 GHz	> –14 dBm, typ. –11 dBm
	3.6 GHz ≤ f_{in} ≤ 7 GHz	> –10 dBm, typ. –7 dBm
	with R&S®FSV-B22 option, preselection = off [5], RF preamplifier = on, RF attenuation = 0 dB, level = 2 × –45 dBm, Δf > 5 × RBW or 10 kHz, whichever is larger	
	10 MHz ≤ f_{in} < 100 MHz	–3 dBm (nom.)
	100 MHz ≤ f_{in} < 3.6 GHz	–2 dBm (nom.)
	3.6 GHz ≤ f_{in} ≤ 7 GHz	0 dBm (nom.)
Second harmonic intercept (SHI)	RF attenuation = 0 dB, level = –10 dBm, preselection = off [5], with R&S®FSV-B22 option: RF preamplifier = off	
	100 MHz < f_{in} ≤ 3.5 GHz	45 dBm (nom.)
	RF attenuation = 0 dB, level = –15 dBm, preselection = on [6], preamplifier = off	
	100 MHz < f_{in} ≤ 3.5 GHz	50 dBm (nom.)
	RF attenuation = 0 dB, level = –10 dBm, preselection = on [6], preamplifier = on	
	100 MHz < f_{in} ≤ 3.5 GHz	35 dBm (nom.)
	with R&S®FSV-B22 option, preselection = off [5], RF preamplifier = on, RF attenuation = 0 dB, level = –40 dBm	
	100 MHz < f_{in} ≤ 3.5 GHz	25 dBm (nom.)

[5] Preselection = off is only available in analyzer mode. In receiver mode the preselection is permanently on.
[6] Default setting in receiver mode.

Displayed average noise level (analyzer mode)		
	RF attenuation = 0 dB, preselection = off/on, preamplifier = off, termination = 50 Ω, log. scaling, normalized to 1 Hz RBW, RBW = 1 kHz, VBW = 3 kHz, zero span, sweep time = 50 ms, sample detector, trace average, sweep count = 20, mean marker	
	R&S®ESR3, R&S®ESR7	
	9 kHz ≤ f < 100 kHz	< –130 dBm, typ. –140 dBm
	100 kHz ≤ f < 1 MHz	< –145 dBm, typ. –150 dBm
	1 MHz ≤ f < 1 GHz	< –152 dBm, typ. –155 dBm
	1 GHz ≤ f < 3.6 GHz	< –150 dBm, typ. –151 dBm
	R&S®ESR7	
	3.6 GHz ≤ f < 6 GHz	< –148 dBm, typ. –151 dBm
	6 GHz ≤ f ≤ 7 GHz	< –146 dBm, typ. –149 dBm
	with R&S®ESR-B29 option, RF attenuation = 0 dB, preselection = off/on, preamplifier = off, termination = 50 Ω, log. scaling, normalized to 1 Hz RBW, RBW = 10 Hz, VBW = 10 Hz, zero span, sweep time = 500 ms, sample detector, trace average, sweep count = 20, mean marker	
	R&S®ESR3, R&S®ESR7	
	10 Hz	< –90 dBm, typ. –100 dBm
	20 Hz	< –100 dBm, typ. –110 dBm
	100 Hz	< –110 dBm, typ. –120 dBm
	1 kHz	< –120 dBm, typ. –130 dBm
	RF attenuation = 0 dB, preselection = on, preamplifier = on, termination = 50 Ω, log. scaling, normalized to 1 Hz RBW, RBW = 1 kHz, VBW = 3 kHz, zero span, sweep time = 50 ms, sample detector, trace average, sweep count = 20, mean marker	
	R&S®ESR3, R&S®ESR7	
	9 kHz ≤ f < 100 kHz	< –150 dBm, typ. –155 dBm
	100 kHz ≤ f < 1 MHz	< –155 dBm, typ. –160 dBm
	1 MHz ≤ f < 1 GHz	< –165 dBm, typ. –168 dBm
	1 GHz ≤ f < 3.6 GHz	< –162 dBm, typ. –165 dBm
	R&S®ESR7	
	3.6 GHz ≤ f < 6 GHz	< –160 dBm, typ. –163 dBm
	6 GHz ≤ f ≤ 7 GHz	< –158 dBm, typ. –161 dBm
	with R&S®ESR-B29 option, RF attenuation = 0 dB, preselection = on, preamplifier = on, termination = 50 Ω, log. scaling, normalized to 10 Hz RBW, RBW = 10 Hz, VBW = 5 Hz, zero span, sweep time = 500 ms, sample detector, trace average, sweep count = 20, mean marker	
	R&S®ESR3, R&S®ESR7	
	1 kHz	< –140 dBm, typ. –150 dBm
	with R&S®FSV-B22 option, RF attenuation = 0 dB, preselection = off, RF preamplifier = on, termination = 50 Ω, log. scaling, normalized to 1 Hz RBW, RBW = 1 kHz, VBW = 3 kHz, zero span, sweep time = 50 ms, sample detector, trace average, sweep count = 20, mean marker	
	R&S®ESR3, R&S®ESR7	
	100 kHz ≤ f < 1 MHz	< –150 dBm, typ. –155 dBm
	1 MHz ≤ f < 1 GHz	< –162 dBm, typ. –165 dBm
	1 GHz ≤ f < 3.6 GHz	< –160 dBm, typ. –163 dBm
	R&S®ESR7	
	3.6 GHz ≤ f < 6 GHz	< –158 dBm, typ. –161 dBm
	6 GHz ≤ f ≤ 7 GHz	< –156 dBm, typ. –159 dBm

Noise indication (receiver mode), nominal, calculated from DANL data		
	RF attenuation = 0 dB, preamplifier = off, termination = 50 Ω, average detector (AV)	
	R&S®ESR3, R&S®ESR7	
	9 kHz ≤ f < 100 kHz, BW = 200 Hz	< 0 dBµV
	100 kHz ≤ f < 150 kHz, BW = 200 Hz	< –15 dBµV
	150 kHz ≤ f < 1 MHz, BW = 9 kHz	< 2 dBµV
	1 MHz ≤ f < 30 MHz, BW = 9 kHz	< –5 dBµV
	30 MHz ≤ f < 1 GHz, BW = 120 kHz	< 6 dBµV
	1 GHz ≤ f < 3.6 GHz, BW = 1 MHz	< 17 dBµV
	R&S®ESR7	
	3.6 GHz ≤ f < 6 GHz, BW = 1 MHz	< 19 dBµV
	6 GHz ≤ f ≤ 7 GHz, BW = 1 MHz	< 21 dBµV
	with R&S®ESR-B29 option, RF attenuation = 0 dB, preamplifier = off, termination = 50 Ω, average detector (AV)	
	R&S®ESR3, R&S®ESR7	
	10 Hz, BW = 10 Hz	< 27 dBµV
	20 Hz, BW = 10 Hz	< 17 dBµV
	100 Hz, BW = 10 Hz	< 7 dBµV
	1 kHz, BW = 100 Hz	< 7 dBµV
	RF attenuation = 0 dB, preamplifier = on, termination = 50 Ω, average detector (AV)	
	R&S®ESR3, R&S®ESR7	
	9 kHz ≤ f < 100 kHz, BW = 200 Hz	< –20 dBµV
	100 kHz ≤ f < 150 kHz, BW = 200 Hz	< –25 dBµV
	150 kHz ≤ f < 1 MHz, BW = 9 kHz	< –8 dBµV
	1 MHz ≤ f < 30 MHz, BW = 9 kHz	< –18 dBµV
	30 MHz ≤ f < 1 GHz, BW = 120 kHz	< –7 dBµV
	1 GHz ≤ f < 3.6 GHz, BW = 1 MHz	< 5 dBµV
	R&S®ESR7	
	3.6 GHz ≤ f < 6 GHz, BW = 1 MHz	< 7 dBµV
	6 GHz ≤ f ≤ 7 GHz, BW = 1 MHz	< 9 dBµV
	with R&S®ESR-B29 option, RF attenuation = 0 dB, preamplifier = on, termination = 50 Ω, average detector (AV)	
	R&S®ESR3, R&S®ESR7	
	1 kHz, BW = 100 Hz	< –13 dBµV

Spurious responses		
Image response	30 MHz ≤ f ≤ 7 GHz	
	f_{in} – 2 × 8409.9 MHz (1st IF)	< –80 dBc (nom.)
	f_{in} – 2 × 729.9 MHz (2nd IF)	< –80 dBc
	f_{in} – 2 × 89.9 MHz (3rd IF)	< –80 dBc
Intermediate frequency response	30 MHz ≤ f ≤ 7 GHz	
	1st IF (8409.9 MHz)	< –70 dBc (nom.)
	2nd IF (729.9 MHz)	< –80 dBc
	3rd IF (89.9 MHz)	< –80 dBc
Residual spurious response	RF attenuation = 0 dB	
	f ≤ 1 MHz	< –90 dBm
	f > 1 MHz	< –103 dBm
Local oscillator related spurious	30 MHz ≤ f ≤ 7 GHz	
	1 kHz ≤ offset from carrier ≤ 10 MHz	< –70 dBc
	offset from carrier > 10 MHz	< –80 dBc
Other interfering signals		
Subharmonic of 1st LO	20 MHz ≤ f < 7 GHz, spurious at 8410 MHz – 2 × f_{in}	< –70 dBc
Harmonic of 1st LO	mixer level < –25 dBm, spurious at f_{in} –4205 MHz	< –70 dBc

Level display (analyzer mode)		
Logarithmic level axis		1 dB to 200 dB, in steps of 1/2/5
Linear level axis		10 % of reference level per level division, 10 divisions or logarithmic scaling
Number of traces		6
Trace detector		max. peak, min. peak, auto peak (normal), sample, RMS, average, quasi-peak, CISPR-average, RMS-average
Trace functions		clear/write, max. hold, min. hold, average, view
Setting range of reference level		–130 dBm to (–10 dBm + RF attenuation – RF preamplifier gain), in steps of 0.01 dB
Units of level axis	logarithmic level display	dBm, dBµV, dBmV, dBµA, dBpW
	linear level display	µV, mV, µA, mA, pW, nW

Level display (receiver mode)		
Level display	analog	bargraph display, separately for each detector
	digital	numeric; 0.01 dB resolution
Detectors	max. 4 selectable	max. peak, min. peak, RMS, average, quasi-peak, CISPR-average, RMS-average
Units of level axis		dBm, dBµV, dBmV, dBµA, dBpW, dBpT
RF spectrum		
Logarithmic level axis		10 dB to 200 dB, in steps of 10
Frequency axis		linear or logarithmic
Number of traces		6
Detectors	normal scan	max. peak, min. peak, RMS, average, quasi-peak, CISPR-average, RMS-average
	time domain scan [7]	max. peak, min. peak, average, quasi-peak, CISPR-average, RMS-average

Spectrogram display (analyzer mode)		
Result display		color-graded bitmap
Spectrogram bitmap color depth		240 colors
Dynamic range covered by bitmap colors		selectable, up to 200 dB (nom.)
History depth		max. 100 000 frames
Recording mode		single trace, continuous, frame count
Trace detector		max. peak, min. peak, sample, RMS, average
Number of markers		16
Marker readout		frequency, time/frame number, level

[7] Requires R&S®ESR-K53 option.

Level measurement uncertainty		
Absolute level uncertainty at 64 MHz	RBW = 10 kHz, CW signal, level = –10 dBm, reference level = –10 dBm, RF attenuation = 10 dB	
	+20 °C to +30 °C	
	preselection = off [8]	< 0.2 dB (σ = 0.07 dB)
	preselection = on [9]	< 0.3 dB (σ = 0.1 dB)
	+5 °C to +40 °C	
	preselection = off [8]	< 0.35 dB (σ = 0.12 dB)
	preselection = on [9]	< 0.45 dB (σ = 0.15 dB)
Frequency response referenced to 64 MHz	DC coupling, RF attenuation = 10 dB, 20 dB, 30 dB, 40 dB, preselection = off [8], with R&S®FSV-B22 option: RF preamplifier = off , +20 °C to +30 °C	
	9 kHz ≤ f < 10 MHz	< 0.5 dB (σ = 0.17 dB)
	10 MHz ≤ f < 3.6 GHz	< 0.3 dB (σ = 0.1 dB)
	3.6 GHz ≤ f ≤ 7 GHz	< 0.5 dB (σ = 0.17 dB)
	DC coupling, RF attenuation = 10 dB, 20 dB, 30 dB, 40 dB, preselection = on [9], +20 °C to +30 °C	
	9 kHz ≤ f < 3.6 GHz	< 0.6 dB (σ = 0.2 dB)
	3.6 GHz ≤ f ≤ 7 GHz	< 0.8 dB (σ = 0.27 dB)
	any setting for RF attenuation, preselection and preamplifier, +5 °C to +40 °C	
	9 kHz ≤ f < 3.6 GHz	< 1 dB (σ = 0.33 dB)
	3.6 GHz ≤ f ≤ 7 GHz	< 1.5 dB (σ = 0.5 dB)
	with R&S®ESR-B29 option, DC coupling, preamplifier = off, +5 °C to +40 °C	
	10 Hz ≤ f < 9 kHz	< 1 dB (σ = 0.33 dB)
Attenuator switching uncertainty	f = 64 MHz, 0 dB to 70 dB, referenced to 10 dB attenuation	< 0.2 dB (σ = 0.07 dB)
Uncertainty of reference level setting		0 dB [10] (nom.)
Bandwidth switching uncertainty	referenced to RBW = 10 kHz	
	sweep filters	< 0.1 dB (σ = 0.04 dB)
	FFT filters	< 0.2 dB (σ = 0.07 dB)
Quasi-peak display		in line with CISPR 16-1-1

Nonlinearity of displayed level		
Logarithmic level display	S/N > 16 dB	
	0 dB to –50 dB	< 0.1 dB (σ = 0.04 dB)
	–50 dB to –60 dB	< 0.15 dB (σ = 0.05 dB)
	–60 dB to –70 dB	< 0.2 dB (σ = 0.07 dB)
Linear level display	S/N > 16 dB, 0 dB to –70 dB	< 5 % of reference level (nom.)

Total measurement uncertainty		
	CW signal, level = 0 dB to –70 dB below reference level, S/N > 20 dB, sweep time = auto, sweep type = sweep, RF attenuation = 10 dB, 20 dB, 30 dB, 40 dB, preselection = off [8], with R&S®FSV-B22 option: RF preamplifier = off, span/RBW < 100, 95 % confidence level, +20 °C to +30 °C	
	9 kHz ≤ f < 10 MHz	0.4 dB
	10 MHz ≤ f < 3.6 GHz	0.31 dB
	3.6 GHz ≤ f ≤ 7 GHz	0.4 dB
	CW signal, level = 0 dB to –70 dB below reference level, S/N > 20 dB, sweep time = auto, sweep type = sweep, RF attenuation = 10 dB, 20 dB, 30 dB, 40 dB, preselection = on [9], span/RBW < 100, 95 % confidence level, +20 °C to +30 °C	
	9 kHz ≤ f < 3.6 GHz	0.47 dB
	3.6 GHz ≤ f ≤ 7 GHz	0.57 dB

[8] Preselection = off is only available in analyzer mode. In receiver mode the preselection is permanently on.

[9] Default setting in receiver mode.

[10] The setting of the reference level affects only the graphical representation of the measurement result on the display, not the measurement itself. Therefore, the reference level setting causes no additional uncertainty in measurement results.

Measurement speed

Receiver mode		
Time domain scan [11]	CISPR band B, 150 kHz to 30 MHz, RBW = 9 kHz, measurement time = 100 ms, peak detector	110 ms (meas.)
	CISPR band B, 150 kHz to 30 MHz, RBW = 9 kHz, measurement time = 1 s, quasi-peak detector	2 s (meas.)
	CISPR band C/D, 30 MHz to 1000 MHz, RBW = 120 kHz, measurement time = 10 ms, peak detector	520 ms (meas.)
	CISPR band C/D, 30 MHz to 1000 MHz, RBW = 9 kHz, measurement time = 10 ms, peak detector	820 ms (meas.)
	CISPR band C/D, 30 MHz to 1000 MHz, RBW = 120 kHz, measurement time = 1 s, quasi-peak detector	80 s (meas.)
Analyzer mode		
Local measurement and display update rate		1.1 ms (900/s) (meas.)
Remote measurement, 1000 sweep averages [12]		1 ms (1000/s) (meas.)
Remote measurement and LAN transfer [12]		3 ms (333/s) (meas.)
Marker peak search		1.5 ms (meas.)
Center frequency tune and transfer [12]		15 ms (meas.)

Trigger functions

Trigger		
Trigger source	analyzer mode	free run, video, external, IF power
	receiver mode	free run, video, external
Trigger offset	analyzer mode, span ≥ 10 Hz	31.25 ns to 30 s, min. resolution = 31.25 ns (or 1 % of offset)
	analyzer mode, span = 0 Hz	(–sweep time) to 30 s, min. resolution = 31.25 ns (or 1 % of offset)
Max. deviation of trigger offset	analyzer mode	±(7.8125 ns + (0.1 % × trigger offset))
IF power trigger (analyzer mode)		
Sensitivity	min. signal power	–60 dBm + RF attenuation – RF pre-amplifier gain (nom.)
	max. signal power	–10 dBm + RF attenuation – RF pre-amplifier gain (nom.)
IF power trigger bandwidth	RBW > 500 kHz, swept	40 MHz (nom.)
	RBW > 20 kHz, FFT	
	RBW ≤ 500 kHz, swept	6 MHz (nom.)
	RBW ≤ 20 kHz, FFT	
Gated sweep (analyzer mode)		
Gate source		video, external, IF power
Gate delay		31.25 ns to 30 s, min. resolution = 31.25 ns (or 1 % of delay)
Gate length		31.25 ns to 30 s, min. resolution = 31.25 ns (or 1 % of gate length)
Max. deviation of gate length		±(7.8125 ns + (0.1 % × gate length))

[11] Requires R&S®ESR-K53 option.

[12] Measured with personal computer equipped with Intel Core2 Duo 2.13 GHz and Gbit LAN interface.

Audio demodulation

AF demodulation types		AM and FM
Audio output		loudspeaker and phone jack
Marker stop time in spectrum mode		100 ms to 60 s

Inputs and outputs

RF input		
Impedance		50 Ω
Connector		N female
VSWR	RF attenuation ≥ 10 dB, DC coupled	
	10 Hz ≤ f ≤ 1 GHz	< 1.2
	1 GHz < f < 3.6 GHz	< 1.5, typ. 1.3
	3.6 GHz ≤ f ≤ 7 GHz	< 2, typ. 1.8
	RF attenuation < 10 dB, DC coupled	
	10 Hz ≤ f ≤ 1 GHz	<2
	1 GHz < f ≤ 7 GHz	<3
	RF attenuation ≥ 10 dB, AC coupled	
	10 MHz ≤ f ≤ 1 GHz	< 1.2
	1 GHz < f < 3.6 GHz	< 1.5, typ. 1.3
	3.6 GHz ≤ f ≤ 7 GHz	< 2, typ. 1.8
Setting range of attenuator	RF input 1	0 dB to 75 dB, in 5 dB steps
	RF input 2	10 dB to 75 dB, in 5 dB steps
Preamplifier gain		20 dB (nom.)

Probe power supply		
Supply voltages	3-pin connector	+15 V DC, –12.6 V DC and ground, max. 150 mA (nom.)
	5-pin connector	±10 V DC and ground, max. 100 mA, (nom.)

Noise source drive		
Connector		BNC female
Output voltage		0 V/28 V, max. 100 mA, switchable (nom.)

AF output		
Connector		3.5 mm mini jack
Output impedance		10 Ω (nom.)
Open-circuit voltage		up to 1.5 V, adjustable

USB interface	front panel	2 ports, type A plug, version 2.0
	rear panel	2 ports, type A plug, version 2.0

Reference output		
Connector		BNC female
Impedance		50 Ω (nom.)
Output frequency	internal reference	10 MHz
	external reference	same as reference input signal
Level		> 0 dBm (nom.)

Reference input		
Connector		BNC female
Impedance		50 Ω (nom.)
Input frequency range		1 MHz ≤ f_{in} ≤ 20 MHz, in 100 kHz steps
Required level		> 0 dBm into 50 Ω (nom.)

External trigger/gate input		
Connector		BNC female
Trigger voltage		0.5 V to 3.5 V (nom.)
Input impedance		10 kΩ (nom.)

IEC/IEEE bus control		interface in line with IEC 625-2 (IEEE 488.2)
Command set		SCPI 1997.0
Connector		24-pin Amphenol female
Interface functions		SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0

LAN interface		10/100/1000BaseT
Connector		RJ-45

External monitor		
Connector		VGA-compatible, 15-pin mini D-Sub

User port		
Connector		9-pin D-Sub male
Output		TTL-compatible, 0 V/5 V (nom.), max. 15 mA (nom.)
Input		TTL-compatible, max. 5 V (nom.)

IF/video out (analyzer mode)		
Connector		BNC female, 50 Ω (nom.)
IF out		
Bandwidth		= RBW setting
IF frequency		32 MHz (nom.)
Output level (gain versus RF input)	RF attenuation = 0 dB, RF preamplifier = off, span = 0 Hz	0 dB (nom.)
Video out		
Bandwidth		= VBW setting
Output scaling	log. display scale	logarithmic
	lin. display scale	linear
Output level	center frequency > 10 MHz, span = 0 Hz, signal at reference level and center frequency	1 V, open circuit (nom.)

Trigger out		
Connector		BNC female
Output		TTL-compatible, 0 V/5 V (nom.)

General data

Display		21 cm LC TFT color display (8.4")
Resolution		800 × 600 pixel (SVGA resolution)
Pixel failure rate		< 1 × 10^{-5}

Data storage		
Internal	standard	hard disk ≥ 40 Gbyte
	with R&S®ESR-B18 option	solid state disk ≥ 8 Gbyte
External		supports USB 2.0 compatible memory devices

Temperature		
Temperature	operating temperature range	+5 °C to +40 °C
	permissible temperature range	0 °C to +50 °C
	storage temperature range	–40 °C to +70 °C
Climatic loading		+40 °C at 90 % rel. humidity, in line with EN 60068-2-30

Mechanical resistance		
Vibration	sinusoidal	5 Hz to 150 Hz, max. 2 g at 55 Hz; 0.5 g from 55 Hz to 150 Hz; in line with EN 60068-2-6
	random	10 Hz to 130 Hz, acceleration 1.2 g (RMS), in line with EN 60068-2-64
Shock		40 g shock spectrum, in line with MIL-T-28800F, class 3, MIL-STD-810E, method 516.4, procedure I

EMC		in line with EMC Directive 2004/108/EC including: IEC/EN 61326-1 [13, 14] IEC/EN 61326-2-1 CISPR 11/EN 55011 [13] IEC/EN 61000-3-2 IEC/EN 61000-3-3

Recommended calibration interval		1 year

Power supply		
AC input voltage range		100 V to 240 V, ±10 % (nom.)
AC supply frequency		50 Hz to 400 Hz, +10 %/–6 % (nom.)
Max. input current		5.2 A (100 V) to 2.2 A (240 V) (nom.)
Power consumption		150 W, max. 250 W with all options (meas.)
Safety		in line with IEC 61010-1, EN 61010-1, CAN/CSA-C22.2 No. 61010-1-04, UL 61010-1
Test mark		VDE-GS, $_{C}$CSA$_{US}$

Weight and dimensions		
Dimensions (nom.)	W × H × D	412 mm × 197 mm × 517 mm (16.22 in × 7.76 in × 20.35 in)
Net weight without options (nom.)		12.8 kg (28.22 lb)

[13] Emission limits for class B equipment.
[14] Immunity test requirement for industrial environment (EN 61326 table 2).

Options

R&S®FSV-B9 tracking generator (spectrum analyzer mode)

Frequency		
Frequency range	R&S®ESR3	100 kHz to 3.6 GHz
	R&S®ESR7	100 kHz to 7 GHz

Frequency offset		
Setting range		±1 GHz
Setting resolution		1 Hz

Spectral purity		
SSB phase noise	frequency = 1000 MHz, carrier offset = 100 kHz	typ. –90 dBc (1 Hz)

Level		
Setting range	normal mode	–60 dBm to 0 dBm, in 0.1 dB steps
	with AM, I/Q	–60 dBm to –10 dBm, in 0.1 dB steps
Max. deviation of output level	frequency = 64 MHz, +20 °C to +30 °C, output level = –10 dBm, frequency offset = 0 Hz, modulation = off	< 1 dB
Frequency response	output level = –10 dBm, referenced to level at 64 MHz, 100 kHz ≤ f ≤ 7 GHz, frequency offset = 0 Hz, modulation = off	< 3 dB

Dynamic range	RBW = 1 kHz, f > 10 MHz	110 dB

Harmonics, non-harmonic spurious	output level = –10 dBm	–30 dBc

Modulation		
Modulation format	external	I/Q, AM, FM
AM	f > 10 MHz	
Modulation depth		0 % to 100 %
Modulation frequency range		0 Hz to 1 MHz
FM	f > 10 MHz	
Frequency deviation		0 Hz to 10 MHz
Modulation frequency range		0 Hz to 10 kHz

RF output		
Connector		N female, 50 Ω
VSWR		1.3, nominal

TG I/AM IN		
Connector		BNC female, 50 Ω
Input voltage		1 V (pp)

TG Q/FM IN		
Connector		BNC female, 50 Ω
Input voltage		1 V (pp)

R&S®ESR-K55 real-time spectrum analyzer mode

The specifications are based on the specifications of the spectrum analyzer mode.
Therefore, these specifications also apply for the real-time spectrum analyzer mode unless otherwise stated.

Span		
Range	preselection = off	10 kHz to 40 MHz
Resolution		1 Hz

Frequency readout		
Number of sweep (trace) points		801
Marker resolution		0.01 Hz
Uncertainty		±(marker frequency × reference uncertainty + 10 % × resolution bandwidth + ½ (span/(sweep points –1)) + 1 Hz)
Marker tuning frequency step size		span/800

Sweep time		
Range	real-time spectrum, real-time spectrogram, free run or stop on trigger	52 µs to 1 s [15]
	auto rearm trigger	5.2 µs to 1 s
Resolution		5.2 µs

Data acquisition		
A/D converter		
Sampling rate		128 Msample/s
Resolution		16 bit
FFT length		1024/2048/4096/8192/16 384
FFT window		Gaussian
FFT overlap factor		≥ 80 %
Spectrum (FFT) processing rate	span = 40 MHz	250 000/s
Minimum detectable signal duration	span = 40 MHz, SNR > 60 dB	25 ns (nom.)

Resolution bandwidths		
Range	Res BW 6 dB = off	2 Hz to 128 kHz, fixed span/RBW ratio
	Res BW 6 dB = on	3 Hz to 192 kHz, fixed span/RBW ratio
Span/RBW ratio	Res BW 6 dB = off	312/625/1250/2500/5000
	Res BW 6 dB = on	208/416/833/1666/3333
Bandwidth uncertainty		< 3 % (nom.)

Video bandwidths		none

Channel bandwidths		none

[15] Time period during which individual FFTs contribute to the results of the selected trace detector.

Level

Amplitude flatness	f_{center} ≥ (1.25 × signal analysis bandwidth)	±0.8 dB (nom.)

Spurious-free dynamic range	span = 40 MHz	< –70 dBc (nom.)

Minimum signal duration necessary for specified level measurement uncertainty [16]	Res BW 6dB = off, span/RBW ratio = 312, trace detector = max. peak, span =	nominal values
	40 MHz	24 µs
	20 MHz	45 µs
	10 MHz	86 µs
	5 MHz	168 µs
	2 MHz	414 µs
	1 MHz	824 µs
	500 kHz	1.7 ms
	200 kHz	4.1 ms
	100 kHz	8.2 ms
	50 kHz	16.4 ms
	20 kHz	41 ms
	10 kHz	82 ms

Result display

Display modes		full screen, split screen
Max. number of screens	display mode = split screen	4
Result display types	with or without active frequency mask trigger, or any combination if display mode = split screen	real-time spectrum, persistence spectrum, real-time spectrogram

Real-time spectrum		
Number of traces		4
Trace detector		max. peak, min. peak, average
Trace functions		clear/write, max. hold, min. hold, view
Number of markers		16
Marker readout		frequency, level
Maximum sweep update rate [17]		10 000/s

Persistence spectrum		
Persistence bitmap resolution		801 × 600 points
Persistence bitmap color depth		256 colors
Probability range covered by bitmap colors		selectable, 0 % to 100 %
Persistence duration		0 s to 8 s
Number of markers		16
Marker readout		frequency, level, hit probability
Number of real-time traces	in addition to persistence spectrum display	1
Real-time trace detector		max. peak, min. peak, sample, average
Real-time trace functions		clear/write, max. hold, min. hold, view

[16] Events lasting shorter than the minimum event duration specification will result in degraded level accuracy.

[17] Sweep update rate includes FFT overlap and trace detector processing.

Spectrogram		
Result display		color-graded bitmap
Spectrogram bitmap color depth		240 colors
Dynamic range covered by bitmap colors		selectable, up to 200 dB (nom.)
History depth		max. 100 000 frames [18]
Recording mode		single trace, continuous, frame count
Trace detector		max. peak, min. peak, sample
Number of markers		16
Marker readout		frequency, time/frame number, level
Maximum sweep update rate [19]		10 000/s

Trigger

Trigger source		free run, frequency mask, external

Frequency mask trigger		
Trigger level resolution		0.5 dB
Minimum required mask distance to noise floor		30 dB (nom.)
Dynamic range	frequency mask – reference level	0 dB to –80 dB (nom.)
Trigger level accuracy	frequency mask > reference level – 50 dB	±(frequency response + 1.0 dB) (nom.)
	frequency mask > reference level – 70 dB	±(frequency response + 2.5 dB) (nom.)
Trigger uncertainty	span = 40 MHz	±12 µs (nom.)
Trigger conditions		enter mask area, leave mask area
Trigger modes		auto rearm trigger, stop on trigger
Trigger mask		
Mask length		3 to 801 frequency points
Mask frequency resolution		span/800
Mask shape generation		manual, auto set (mask derived from the measured spectrum)
Minimum signal duration for 100 % probability of trigger (nominal values) [20]		see minimum signal duration required for specified level measurement uncertainty

Trigger out		
Connector		BNC female
Output		TTL-compatible, 0 V/5 V (nom.)

[18] A frame is the measurement result displayed in one row of the spectrogram. It may consist of one or more traces, depending on the set sweep count. For example, a sweep count of 2 means that two traces will be combined to one row in the spectrogram using the set trace detector.

[19] Sweep update rate includes FFT overlap and trace detector processing.

[20] Events lasting shorter than the minimum event duration specification will result in degraded frequency mask trigger accuracy.

R&S®ESR-K56 IF analysis

Level display (receiver mode)		
IF spectrum		
Span		max. 10 MHz
Resolution bandwidths		10 Hz to 100 kHz in 1/2/3/5 sequence
Detector		sample
Logarithmic level axis		10 dB to 200 dB in steps of 10 dB
Frequency axis		linear
Number of traces		3

Ordering information

Designation	Type	Order No.
EMI Test Receiver	R&S®ESR3	1316.3003.03
EMI Test Receiver	R&S®ESR7	1316.3003.07
Accessories supplied		
Power cable, probe power cable, quick start guide and CD-ROM (with operating manual and service manual)		

Options

Designation	Type	Order No.	Retrofittable	Remarks
OCXO Reference Frequency	R&S®FSV-B4	1310.9522.02	yes	user-retrofittable
OCXO Extended Frequency Stability	R&S®FSV-B4	1310.9522.03	yes	user-retrofittable
Tracking Generator (100 kHz to 7 GHz)	R&S®FSV-B9	1310.9545.02	yes	retrofit in service center
Solid State Drive (removable hard drive)	R&S®ESR-B18	1316.3555.02	yes	user-retrofittable
Spare Hard Drive (removable hard drive)	R&S®ESR-B19	1316.3561.02	yes	user-retrofittable
RF Preamplifier (100 kHz to 7 GHz)	R&S®FSV-B22	1310.9600.02	yes	user-retrofittable
Frequency Extension 10 Hz and MIL bandwidths	R&S®ESR-B29	1316.3578.02	yes	user-retrofittable
DC Power Supply for 12 V supply voltage	R&S®FSV-B30	1310.9897.02	yes	user-retrofittable
Hardware for Time Domain and Real-Time Analysis	R&S®ESR-B50	1316.3584.02	yes	retrofit in service center
Firmware/software				
Time Domain Scan	R&S®ESR-K53	1316.3590.02		requires R&S®ESR-B50
Real-Time Analysis	R&S®ESR-K55	1316.3603.02		requires R&S®ESR-B50
IF Analysis	R&S®ESR-K56	1316.3610.02		

Recommended extras

Designation	Type	Order No.
Headphones		0708.9010.00
IEC/IEEE Bus Cable, 1 m	R&S®PCK	0292.2013.10
IEC/IEEE Bus Cable, 2 m	R&S®PCK	0292.2013.20
19" Rack Adapter	R&S®ZZA-478	1096.3248.00
Matching pads, 50/75 Ω		
Matching Pad, 50/75 Ω, L Section, matching at both ends	R&S®RAM	0358.5414.02
Matching Pad, 50/75 Ω, series resistor, 25 Ω, matching at one end (taken into account in instrument function RF INPUT 75 Ω)	R&S®RAZ	0358.5714.02
SWR bridges, 50 Ω		
SWR Bridge, 50 Ω, 5 MHz to 3 GHz	R&S®ZRB2	0373.9017.5X
SWR Bridge, 50 Ω, 40 kHz to 4 GHz	R&S®ZRC	1039.9492.5X
High-power attenuators		
High-Power Attenuator, 100 W, 3/6/10/20/30 dB, 1 GHz	R&S®RBU100	1073.8495.xx (xx = 03/06/10/20/30)
High-Power Attenuator, 50 W, 3/6/10/20/30 dB, 2 GHz	R&S®RBU50	1073.8695.xx (xx = 03/06/10/20/30)
High-Power Attenuator, 50 W, 20 dB, 6 GHz	R&S®RDL50	1035.1700.52
Connectors and cables		
Probe Power Connector, 3-pin		1065.9480.00
DC block		
DC Block, 10 kHz to 18 GHz (type N)	R&S®FSE-Z4	1084.7443.02

Service options		
Extended Warranty, one year	R&S®WE1ESR	Please contact your local Rohde & Schwarz sales office.
Extended Warranty, two years	R&S®WE2ESR	
Extended Warranty, three years	R&S®WE3ESR	
Extended Warranty, four years	R&S®WE4ESR	
Extended Warranty with Calibration Coverage, one year	R&S®CW1ESR	
Extended Warranty with Calibration Coverage, two years	R&S®CW2ESR	
Extended Warranty with Calibration Coverage, three years	R&S®CW3ESR	
Extended Warranty with Calibration Coverage, four years	R&S®CW4ESR	

Extended warranty with a term of one to four years (WE1 to WE4)
Repairs carried out during the contract term are free of charge [21]. Necessary calibration and adjustments carried out during repairs are also covered. Simply contact the forwarding agent we name; your product will be picked up free of charge and returned to you in top condition a couple of days later.

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 [21] and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

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

Service you can rely on

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

About Rohde&Schwarz

Rohde&Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde&Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Certified Quality System
ISO 9001