R&S®CMW100 COMMUNICATIONS MANUFACTURING TEST SET

Specifications

R&S®CMW100 – model K06

Data Sheet
Version 04.00

ROHDE&SCHWARZ
Make ideas real

CONTENTS

Data valid for the R&S®CMW100 model K06 unless otherwise stated.

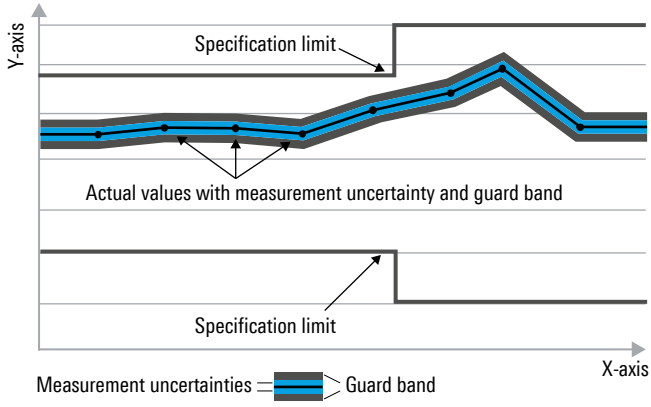
Data sheet values for frequencies above 4000 MHz are only available with the R&S®CMW-K046 option.

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
- Based on a 24-month calibration interval unless otherwise stated
- Recommended calibration interval adhered to
- Internal path correction (IPC) adjustment performed

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.



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”.

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/3GPP2 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.

General technical specifications

General functions		simultaneous receiver and transmitter testing
	RF generator/analyzer, RF1 to RF8	8 × SnapN, RF input/output to DUT
	RF generator, TX AUX	1 × SnapN, RF output

Receiver test functions		• RF generator signal is split and forwarded to 8 output ports • every output can be switched off separately • collective output level setting for connectors RF 1 to RF 8 • frequency-dependent attenuation (FDA) table for user-specific corrections, separate for connectors RF1 to RF8

Transmitter test functions		• 8 input signals to be multiplexed to RF analyzer • frequency-dependent attenuation (FDA) tables for user-specific corrections, separate for connectors RF 1 to RF 8

Isolation		
Power meter, any “OFF” port to active port, RF generator active	900 MHz	typ. > 50 dB
	2400 MHz	typ. > 55 dB
	3800 MHz	typ. > 60 dB
	6000 MHz	typ. > 50 dB
Power meter, any “OFF” port to active port, RF generator off at active port	900 MHz	typ. > 95 dB
	2400 MHz	typ. > 85 dB
	3800 MHz	typ. > 80 dB
	6000 MHz	typ. > 65 dB
RF generator, active port to any “OFF” port	900 MHz	typ. > 80 dB
	2400 MHz	typ. > 70 dB
	3800 MHz	typ. > 65 dB
	6000 MHz	typ. > 50 dB
RF generator, power meter port to RF generator port	900 MHz	typ. > 60 dB
	2400 MHz	typ. > 60 dB
	3800 MHz	typ. > 60 dB
	6000 MHz	typ. > 60 dB
RF generator port to power meter port, RF generator off at power meter port	900 MHz	typ. > 50 dB
	2400 MHz	typ. > 40 dB
	3800 MHz	typ. > 35 dB
	6000 MHz	typ. > 25 dB

VSWR		
RF 1 to RF 8	70 MHz to 3300 MHz	< 1.3
	3300 MHz to 4000 MHz	< 1.5
	4000 MHz to 6000 MHz	< 1.5
TX AUX	70 MHz to 4000 MHz	< 1.8
	4000 MHz to 6000 MHz	< 2.2

RF generator

Frequency range		70 MHz to 4000 MHz, up to 6000 MHz with the R&S®CMW-K046 option
Frequency resolution		0.1 Hz
Frequency uncertainty		same as timebase + frequency resolution

Output level range		
RF 1 to RF 8	70 MHz to 400 MHz	
	continuous wave (CW)	–130 dBm to –8 dBm
	peak envelope power (PEP)	up to –8 dBm
	overranging (PEP)	up to –3 dBm
	400 MHz to 4000 MHz	
	continuous wave (CW)	–130 dBm to –8 dBm
	peak envelope power (PEP)	up to –8 dBm
	overranging (PEP)	up to –3 dBm
	4000 MHz to 6000 MHz	
	continuous wave (CW)	–120 dBm to –15 dBm
	peak envelope power (PEP)	up to –15 dBm
	overranging (PEP)	up to –10 dBm
TX AUX	70 MHz to 400 MHz	
	continuous wave (CW)	– 80 dBm to 8 dBm
	peak envelope power (PEP)	– 80 dBm to 8 dBm
	overranging (PEP)	– 80 dBm to 13 dBm
	400 MHz to 4000 MHz	
	continuous wave (CW)	– 80 dBm to 8 dBm
	peak envelope power (PEP)	– 80 dBm to 8 dBm
	overranging (PEP)	– 80 dBm to 13 dBm
	4000 MHz to 6000 MHz	
	continuous wave (CW)	–80 dBm to 8 dBm
	peak envelope power (PEP)	– 80 dBm to 8 dBm
	overranging (PEP)	– 80 dBm to 13 dBm

Output level uncertainty	in temperature range +20 °C to +30 °C [1]	
RF 1 to RF 8	output level > –120 dBm	
	70 MHz to 400 MHz	< 1.2 dB [2]
	400 MHz to 2700 MHz	< 0.6 dB [2]
	2700 MHz to 4000 MHz	< 1.2 dB [2]
	4000 MHz to 6000 MHz	< 1.2 dB [2]
TX AUX	output level > –80 dBm	
	70 MHz to 400 MHz	< 1.6 dB [2]
	400 MHz to 2700 MHz	< 0.8 dB [2]
	2700 MHz to 4000 MHz	< 1.6 dB [2]
	4000 MHz to 6000 MHz	< 1.6 dB [2]

Output level uncertainty	in temperature range +5 °C to +45 °C	
RF 1 to RF 8	output level > –120 dBm	
	70 MHz to 400 MHz	< 2.0 dB [2]
	400 MHz to 2700 MHz	< 1.0 dB [2]
	2700 MHz to 4000 MHz	< 2.0 dB [2]
	4000 MHz to 6000 MHz	< 2.0 dB [2]
TX AUX	output level > –80 dBm	
	70 MHz to 400 MHz	< 2.0 dB [2]
	400 MHz to 2700 MHz	< 1.2 dB [2]
	2700 MHz to 4000 MHz	< 2.0 dB [2]
	4000 MHz to 6000 MHz	< 2.0 dB [2]

Output level imbalance	difference between RF1 to RF8	typ. < 0.6 dB

[1] Relevant is the internal unit temperature, influenced by natural or forced convection.

[2] Valid for a 12-month calibration interval.

Frequency-dependent attenuation (FDA) setting range		–30 dB to 0 dB
Max. FDA setting range	for specified output level uncertainty	–10 dB to 0 dB

Output level linearity with fixed RF output attenuator setting	in temperature range +20 °C to +30 °C [3], GPRF generator list mode, level range 0 dB to –30 dB	
RF 1 to RF 8	no overranging	< 0.2 dB, typ. < 0.1 dB

Output level resolution		0.01 dB
Output level settling time	to within 0.1 dB	< 50 µs [4]
Output level repeatability	typical values after 1 h warm-up time, always returning to same level and frequency, no temperature change, insignificant time change	
	output level ≥ –80 dBm	< 0.01 dB
	output level < –80 dBm	< 0.05 dB

Attenuation of second harmonic		
RF 1 to RF 8	70 MHz to 6000 MHz, P < –10 dBm	> 30 dB
TX AUX	70 MHz to 6000 MHz, P < 0 dBm	> 30 dB

Attenuation of third harmonic		
RF 1 to RF 8	70 MHz to 6000 MHz, P < –10 dBm	> 40 dB
TX AUX	70 MHz to 6000 MHz, P < 0 dBm	> 40 dB

Attenuation of nonharmonics	> 5 kHz offset from carrier, for output level > –40 dBm, for full-scale CW signal	
	400 MHz to 3300 MHz, except $f_{nonharmonic}$ = 3800 MHz – $f_{carrier}$, except $f_{nonharmonic}$ = abs(3800 MHz – 2 × $f_{carrier}$), except $f_{carrier}$ = (899 to 901) MHz + n × 800 MHz with n = 1, 2, 3, 4, 5, 6, 7, except $f_{nonharmonic}$ = 350 MHz + n × 50 MHz with n = 1 to 12	> 60 dB
	3300 MHz to 3600 MHz	> 25 dB
	3600 MHz to 6000 MHz, except $f_{nonharmonic}$ = 2 × $f_{carrier}$ – 6400 MHz	> 40 dB

Phase noise	single sideband, 70 MHz to 3300 MHz	
Carrier offset	≥ 1 MHz	< –120 dBc, 1 Hz

Phase noise	single sideband, 3300 MHz to 6000 MHz	
Carrier offset	≥ 1 MHz	< –117 dBc, 1 Hz

Signal-to-noise ratio	70 MHz to 6000 MHz	
RF 1 to RF 8	5 MHz offset from carrier, for output level > –30 dBm	> 90 dB, typ. > 98 dB, 1 kHz (> 120 dB, typ. > 128 dB, 1 Hz)

Modulation source: arbitrary waveform generator (ARB)

Memory size		4.096 Gbyte
Word length	I	16 bit
	Q	16 bit
Sample length	with 4-bit marker	up to 800 Msample
Sample rate	minimum	400 Hz
	maximum	200 MHz
Maximum possible RF bandwidth	depends on arbitrary waveform file	160 MHz

[3] Relevant is the internal unit temperature, influenced by natural or forced convection.

[4] When using list mode.

RF analyzer

Inherent spurious response	without input signal, 150 MHz to 6000 MHz, except n × 500 MHz with n = 5 to 12, except 100 MHz + n × 50 MHz with n = 1 to 62, except 562.5 MHz, 750 MHz, 3150 MHz, 4050 MHz, 4800 MHz, 5812.5 MHz	
	expected nominal power setting ≤ –10 dBm	< –100 dBm
	expected nominal power setting > –10 dBm	< –90 dB below expected nominal power setting

Spurious response	for full-scale single-tone input signal	
	150 MHz to 3800 MHz, except f_{in} = 2215.5 MHz and 4425 MHz, except f_{in} = 2212.5 MHz + $f_{selected}$	< –55 dB
	3800 MHz to 4200 MHz, except f_{in} = 7200 MHz – $f_{selected}$, except f_{in} = 7200 MHz – 0.5 × $f_{selected}$	< –40 dB
	4200 MHz to 6000 MHz, except f_{in} = 7200 MHz – 0.5 × $f_{selected}$	< –40 dB

Harmonic response	second harmonic	
RF 1 to RF 8	f_{in} = 150 MHz to 3000 MHz, $f_{selected}$ = 300 MHz to 6000 MHz	< –30 dB

Harmonic response	third harmonic	
RF 1 to RF 8	f_{in} = 150 MHz to 2000 MHz, $f_{selected}$ = 450 MHz to 6000 MHz	< –50 dB

Phase noise	single sideband, 150 MHz to 3800 MHz	
Carrier offset	≥ 1 MHz	< –120 dBc, 1 Hz

Phase noise	single sideband, 3800 MHz to 6000 MHz	
Carrier offset	≥ 1 MHz	< –117 dBc, 1 Hz

Trigger		
Trigger sources		• GPRF: free run • GPRF: IF power • GPRF: Gen

Power meter

Frequency range		150 MHz to 4000 MHz, up to 6000 MHz with the R&S®CMW-K046 option
Frequency resolution		0.1 Hz
Resolution bandwidths		Gaussian, 1 kHz to 10 MHz, in 1/3/5 steps, bandpass, 1 kHz to 30 MHz, in 1/3/5 steps, RRC, α = 0.1, 3.84 MHz, RRC, α = 0.22, WCDMA filter, 1.2288 MHz, CDMA filter
Expected nominal power setting range	for ADC full scale	
RF 1 to RF 8	150 MHz to 3800 MHz	–47 dBm to +42 dBm [5]
	3800 MHz to 6000 MHz	–37 dBm to +42 dBm [5]

[5] The maximum permissible continuous power is +34 dBm due to thermal limits.

Level range		
RF 1 to RF 8	150 MHz to 3800 MHz	
	continuous power (CW)	–84 dBm [6] to +34 dBm
	peak envelope power (PEP)	up to +36 dBm [7]
	3800 MHz to 6000 MHz	
	continuous power (CW)	–74 dBm [6] to +34 dBm
	peak envelope power (PEP)	up to +36 dBm [7]
	maximum input DC level	0 V DC

Level uncertainty	in temperature range +20 °C to +30 °C [8]	
RF 1 to RF 8	150 MHz to 3300 MHz	< 0.5 dB [9]
	3300 MHz to 4000 MHz	< 1.0 dB [9]
	4000 MHz to 6000 MHz	< 1.0 dB [9]

Level uncertainty	in temperature range +5 °C to +45 °C	
RF 1 to RF 8	150 MHz to 3300 MHz	< 0.7 dB [9]
	3300 MHz to 4000 MHz	< 1.2 dB [9]
	4000 MHz to 6000 MHz	< 1.2 dB [9]

Level linearity with fixed expected nominal power setting	in temperature range +20 °C to +30 °C [8]	
RF 1 to RF 8	level range 0 dB to –40 dB	< 0.15 dB, typ. < 0.1 dB

Level resolution		0.01 dB

Level repeatability	typical values after 1 h warm-up time, always returning to same level and frequency, no temperature change, insignificant time change	
	input level ≥ –40 dBm	< 0.01 dB
	input level < –40 dBm	< 0.03 dB

Port switching time	to within 0.1 dB	< 50 µs [10]

Dynamic range	150 MHz to 3800 MHz, RBW: 1 kHz, with fixed expected nominal power setting and mixer level offset ≥ +4 dB	> 100 dB
Expected nominal power setting for full dynamic range		
RF 1 to RF 8		–8 dBm to +42 dBm [7]

Dynamic range	3800 MHz to 6000 MHz, RBW: 1 kHz, with fixed expected nominal power setting and mixer level offset ≥ +4 dB	> 97 dB
Expected nominal power setting for full dynamic range		
RF 1 to RF 8		+2 dBm to +42 dBm [7]

[6] RBW: 1 kHz.

[7] The maximum permissible continuous power is +34 dBm due to thermal limits.

[8] Relevant is the internal unit temperature, influenced by natural or forced convection.

[9] Valid for a 12-month calibration interval.

[10] When using list mode.

Spectrum measurements

FFT spectrum analyzer		
Frequency range		150 MHz to 4000 MHz, up to 6000 MHz with the R&S®CMW-K046 option
Frequency span		1.25 MHz, 2.5 MHz, 5 MHz, 10 MHz, 20 MHz, 40 MHz, 80 MHz, 160 MHz
FFT length		1k, 2k, 4k, 8k, 16k
Detector		peak, RMS

Dynamic range	150 MHz to 3800 MHz, for FFT length: 16k and span: 5 MHz (equivalent to RBW: 781 Hz) and mixer level offset ≥ +4 dB	> 100 dB
Expected nominal power setting for full dynamic range		
RF 1 to RF 8		–8 dBm to +42 dBm [11]

Dynamic range	3800 MHz to 6000 MHz, for FFT length: 16k and span: 5 MHz (equivalent to RBW: 781 Hz) and mixer level offset ≥ + 4 dB	> 97 dB
Expected nominal power setting for full dynamic range		
RF 1 to RF 8		+2 dBm to +42 dBm [11]

RF spectrum analyzer (R&S®CMW-KM010 option)		
Frequency range		150 MHz to 4000 MHz, up to 6000 MHz with the R&S®CMW-K046 option
Frequency span	zero span	0 Hz
		500 Hz to 3930 MHz
	with the R&S®CMW-K046 option	up to 5930 MHz
Resolution bandwidth (RBW)		100 Hz to 10 MHz (additional 40 MHz in zero span)
Video bandwidth (VBW)		10 Hz to 10 MHz
Sweep time	frequency sweep, depends on RBW, VBW and span	500 µs to 2000 s
	zero span, depends on RBW and VBW	80 µs to 2000 s
Detector		average, RMS, sample, min. peak, max. peak, auto peak
Trigger	frequency sweep	free run
	zero span	video, BASE: external TRIG IN all R&S®CMW internal trigger sources

Dynamic range	150 MHz to 3800 MHz, RBW: 1 kHz, detector: RMS, mixer level offset ≥ + 4 dB	> 100 dB
Expected nominal power setting for full dynamic range		
RF 1 to RF 8		–8 dBm to +42 dBm [11]

Dynamic range	3800 MHz to 6000 MHz, RBW: 1 kHz, detector: RMS, mixer level offset ≥ + 4 dB	> 97 dB
Expected nominal power setting for full dynamic range		
RF 1 to RF 8		+2 dBm to +42 dBm [11]

Level range		see general technical specifications

[11] The maximum permissible continuous power is +34 dBm due to thermal limits.

Level uncertainty	for center frequency and detector: peak	see general technical specifications
Inherent spurious response		see general technical specifications
Spurious response		see general technical specifications
Harmonic response		see general technical specifications
Phase noise		see general technical specifications

GPRF pathloss measurement (R&S®CMW-KM015 option)

Frequency range		150 MHz to 4000 MHz, up to 6000 MHz with the R&S®CMW-K046 option
Pathloss measurement range		0 dB to 12 dB

Level uncertainty	in temperature range +20 °C to +30 °C [12]	
RF 1 to RF 8	150 MHz to 400 MHz	< 0.9 dB [13] typ < 0.6 [13]
	400 MHz to 2700 MHz	< 0.5 dB [13] typ < 0.3 [13]
	3300 MHz to 6000 MHz	< 0.9 dB [13] typ < 0.6 [13]

Level repeatability	typical values after 1 h warm-up time, always returning to same frequency, no temperature change, insignificant time change	
	attenuation < 6 dB	< 0.10 dB
	attenuation < 12 dB	< 0.15 dB

Timebase

Timebase OCXO

Max. frequency drift	in temperature range +5 °C to +45 °C	$\pm 5 \times 10^{-8}$
Retrace	at +25 °C, after 24 hours power on / 2 hours power off / 1 hour power on	$\pm 2 \times 10^{-8}$
Max. aging	at +25 °C, after 10 days of continuous operation	$\pm 1 \times 10^{-7}$/year, $\pm 1 \times 10^{-9}$/day
Warm-up time	at +25 °C, the frequency is in the range that is 10 times the frequency drift ($\pm 5 \times 10^{-7}$)	approx. 10 min

Reference frequency input/output

Synchronization input		Ref 10 MHz In BNC connector, rear panel
Frequency	sine wave	10 MHz
	square wave (TTL level)	10 MHz
Max. frequency variation		$\pm 7.5 \times 10^{-7}$
Input voltage range		0.5 V to 2 V, RMS
Impedance		50 Ω

Synchronization output		Ref 10 MHz Out BNC connector, rear panel
Frequency		10 MHz from internal reference
Output voltage		> 1.4 V, peak-to-peak
Impedance		50 Ω

[12] Relevant is the internal unit temperature, influenced by natural or forced convection.

[13] Valid for a 12-month calibration interval.

GSM specifications – mobile station test

GSM RF generator

Frequency range	GSM 450 band	460 MHz to 468 MHz
	GSM 480 band	488 MHz to 496 MHz
	GSM 750 band	747 MHz to 762 MHz
	GSM 850 band	869 MHz to 894 MHz
	GSM 900 band	921 MHz to 960 MHz
	GSM 1800 band	1805 MHz to 1880 MHz
	GSM 1900 band	1930 MHz to 1990 MHz

GSM R&S®WinIQSIM2 (R&S®CMW-KW200 option), GSM EDGE Evolution R&S®WinIQSIM2 (R&S®CMW-KW201 option)

Arbitrary waveform files	GMSK, W × D = 0.3, with the R&S®CMW-KW200 option	GSM_GMSK.WV (PAR = 0 dB), GMSKDIGMOD.WV (PAR = 0 dB)
	8PSK, with the R&S®CMW-KW200 option	GSM_EDGE.WV (PAR = 3.23 dB), EDGEDIGMOD.WV (PAR = 3.22 dB)
Arbitrary waveform files	16QAM, with the R&S®CMW-KW200 and R&S®CMW-KW201 options	EDGE_EVO_16QAM_A.WV (PAR = 4.70 dB)
	32QAM, with the R&S®CMW-KW200 and R&S®CMW-KW201 options	EDGE_EVO_32QAM_B.WV (PAR = 5.37 dB)

Output level range	depends on PAR	see general technical specifications
Output level uncertainty	with the R&S®CMW-KW200 option, waveform files used: GMSKDIGMOD.WV or EDGEDIGMOD.WV	see general technical specifications
	with the R&S®CMW-KW200 and R&S®CMW-KW201 options, waveform files used: EDGE_EVO_16QAM_A.WV, EDGE_EVO_32QAM_B.WV	see general technical specifications
Output level resolution		see general technical specifications

Signal quality		
Phase error	GMSK with the R&S®CMW-KW200 option, waveform file used: GSM_GMSK.WV	< 1°, RMS
		< 4°, peak
Error vector magnitude (EVM)	8PSK with the R&S®CMW-KW200 option, waveform file used: GSM_EDGE.WV	< 2 %, RMS
	16QAM / 32QAM level A with the R&S®CMW-KW200 and R&S®CMW-KW201 options, waveform file used: EDGE_EVO_16QAM_A.WV	< 2 %, RMS
	QPSK / 16QAM / 32QAM level B with the R&S®CMW-KW200 and R&S®CMW-KW201 options, waveform file used: EDGE_EVO_32QAM_B.WV	< 2 %, RMS

GSM RF analyzer (R&S®CMW-KM200 option) and GSM EDGE Evolution A analyzer (R&S®CMW-KM201 option)

Frequency range	GSM 450 band	450 MHz to 458 MHz
	GSM 480 band	478 MHz to 486 MHz
	GSM 750 band	777 MHz to 792 MHz
	GSM 850 band	824 MHz to 849 MHz
	GSM 900 band	876 MHz to 915 MHz
	GSM 1800 band	1710 MHz to 1785 MHz
	GSM 1900 band	1850 MHz to 1910 MHz

Trigger		
Trigger sources		• BASE: external TRIG IN • GPRF: Gen • GSM: free run • GSM: IF power • GSM: acquisition

Modulation analysis

Level range		–28 dBm to +36 dBm [14]
Analysis mode	with the R&S®CMW-KW200 option	GMSK, 8PSK
	with the R&S®CMW-KW200 and R&S®CMW-KW201 options	GMSK, 8PSK, 16QAM (level A)
Inherent phase error	GMSK	< 0.6°, RMS; < 2°, peak
Inherent error vector magnitude (inherent EVM)	8PSK, 16QAM (level A)	< 0.8 %, RMS
Frequency measurement uncertainty		< 20 Hz + drift of timebase, see general technical specifications
Inherent I/Q offset		< –50 dB
Filter	GMSK	bandpass, 900 kHz, RRC filter, α = 0.16
	8PSK, 16QAM (level A)	windowed raised-cosine filter in line with 3GPP TS 45.005

Burst power measurement		
Level uncertainty	bandpass, 900 kHz, RRC filter, α = 0.16	see general technical specifications

Power versus time measurement

Filter	selectable	Gaussian, 500 kHz or 1 MHz

Dynamic range	filter: 500 kHz, Gaussian, with fixed expected nominal power setting	
	GMSK	> 72 dB, RMS
	8PSK, 16QAM (level A)	> 69 dB, RMS
Expected nominal power setting for full dynamic range	RF1 to RF8	–8 dBm to +36 dBm [14]

Relative measurement uncertainty	result > –40 dB	typ. < 0.1 dB
	–60 dB ≤ result ≤ –40 dB	typ. < 0.5 dB

Burst power measurement		
Level range		–50 dBm to +36 dBm [14]
Level uncertainty	filter: 500 kHz or 1 MHz, Gaussian	see general technical specifications

[14] The maximum permissible continuous power is +34 dBm due to thermal limits.

Spectrum due to modulation measurement

Expected nominal power setting for full dynamic range	RF1 to RF8	–8 dBm to +36 dBm [15]
Test method		relative measurement, averaging
Filter		Gaussian, 30 kHz, 5 pole
Measurement	at an offset of ±	100/200/250/400/600/800/1000/1200/ 1400/1600/1800 kHz

Dynamic range	offset ≥ 1200 kHz	
	GMSK	> 74 dB
	8PSK, 16QAM (level A)	> 70 dB

Spectrum due to switching measurement

Expected nominal power setting for full dynamic range	RF1 to RF8	–8 dBm to +36 dBm [15]
Test method		absolute measurement, max. hold
Filter		Gaussian, 30 kHz, 5 pole
Measurement	at an offset of ±	400/600/1200/1800 kHz

Dynamic range	offset ≥ 1200 kHz	
	GMSK	> 72 dB
	8PSK, 16QAM (level A)	> 68 dB

[15] The maximum permissible continuous power is +34 dBm due to thermal limits.

NB-IoT specifications – mobile station test

Standard		3GPP NB-IoT HD-FDD

NB-IoT RF generator

Frequency range	NB-IoT operates in the E-UTRA bands 1, 2, 3, 5, 8, 11, 12, 13, 17, 18, 19, 20, 21, 25, 26, 28, 31, 66	see LTE FDD RF generator specifications

NB-IoT WinIQSIM2 (R&S®CMW-KW300 option)

Arbitrary waveform file	NB-IoT HD-FDD	KW300_NB_IOT_64frames_DCI_160ms.wv (PAR = 8.64 dB)

Output level range	depends on PAR	see general technical specifications
Output level uncertainty	waveform file used: KW300_NB_IOT_64frames_DCI_160ms.wv	see general technical specifications
Output level resolution		see general technical specifications

Signal quality		
Error vector magnitude (EVM)	EVM NPDSCH QPSK, bandwidth = 200 kHz waveform file used: KW300_NB_IOT_64frames_DCI_160ms.wv	< 2 %, RMS

NB-IoT HD-FDD RF analyzer (R&S®CMW-KM300 option)

Bandwidth		200 kHz

Frequency range	NB-IoT operates in the E-UTRA bands 1, 2, 3, 5, 8, 12, 13, 17, 18, 19, 20, 26, 28, 66	see LTE FDD RF analyzer specifications
Level setting		manual mode

Statistics		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation

Trigger		
Trigger sources		• BASE: external TRIG IN • GPRF: Gen • NB-IoT: free run • NB-IoT: IF power

Power measurement

Slot power	RMS detector	
Level range		–50 dBm to +30 dBm, RMS
Level uncertainty		see general technical specifications

Modulation analysis

Measured parameters	numeric results	error vector magnitude (EVM), magnitude error (ME), phase error (PE), frequency error, I/Q origin offset, TX power, peak power, subcarrier power (SC power)
	graphical	EVM versus SC-FDMA symbol, ME versus SC-FDMA symbol, PE versus SC-FDMA symbol, in-band emissions, I/Q constellation

Error vector magnitude (EVM)		
Inherent EVM	–38 dBm ≤ input level < +30 dBm, RMS	< 1 %, RMS

Frequency error		
Measurement range	subcarrier spacing = 3.75 kHz	±1.8 kHz
	subcarrier spacing = 15 kHz	±7.0 kHz
Frequency measurement uncertainty		< 20 Hz [16] + drift of timebase, see general technical specifications

I/Q origin offset		
Inherent I/Q offset	for average ≥ 10 measurements	< –45 dB

In-band emissions		
Dynamic range		> 45 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

Spectrum measurements

Adjacent channel leakage ratio		
Filter	NB-IoT, GSM	rectangle 180 kHz
	UTRA	3.84 MHz, RRC, α = 0.22, WCDMA filter
Dynamic range		> 50 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

Spectrum emission mask (SEM)		
Frequency span		4 MHz
		< –45 dBm

[16] For frequency error measurements relative to the downlink signal of the same R&S®CMW100, the uncertainty is in line with 3GPP TS 36.521 V14.3.0.

WCDMA specifications – mobile station (UE) test

Standard		3GPP FDD

WCDMA RF generator

Frequency range	WCDMA band 1	2112.4 MHz to 2167.6 MHz
	WCDMA band 2	1932.4 MHz to 1987.6 MHz
	WCDMA band 3	1807.4 MHz to 1877.6 MHz
	WCDMA band 4	2112.4 MHz to 2152.6 MHz
	WCDMA band 5	871.4 MHz to 891.6 MHz
	WCDMA band 6	877.4 MHz to 882.6 MHz
	WCDMA band 7	2622.4 MHz to 2687.6 MHz
	WCDMA band 8	927.4 MHz to 957.6 MHz
	WCDMA band 9	1847.4 MHz to 1877.4 MHz
	WCDMA band 10	2112.4 MHz to 2167.6 MHz
	WCDMA band 11	1478.4 MHz to 1498.4 MHz
	WCDMA band 12	730.4 MHz to 743.6 MHz
	WCDMA band 13	748.4 MHz to 753.6 MHz
	WCDMA band 14	760.4 MHz to 765.6 MHz
	WCDMA band S	2182.4 MHz to 2197.6 MHz
	WCDMA band S170	2180 MHz to 2190 MHz
	WCDMA band S190	2190 MHz to 2200 MHz

WCDMA R&S®WinIQSIM2 (R&S®CMW-KW400 option), WCDMA HSDPA R&S®WinIQSIM2 (R&S®CMW-KW401 option), WCDMA HSUPA R&S®WinIQSIM2 (R&S®CMW-KW402 option), WCDMA HSPA+ R&S®WinIQSIM2 (R&S®CMW-KW403 option)

Arbitrary waveform files	with the R&S®CMW-KW400 option	TM4CPICH.WV (PAR = 8.34 dB), 3GPPDEFAULT.WV (PAR = 10.65 dB)
	with the R&S®CMW-KW400 and R&S®CMW-KW401 options	WCDMA_DL_HSDPA.WV (PAR = 10.08 dB)
	with the R&S®CMW-KW400 and R&S®CMW-KW401 and R&S®CMW-KW402 options	WCDMA_DL_HSUPA.WV (PAR = 10.12 dB)

Output level range	depends on PAR	see general technical specifications
Output level uncertainty	with the R&S®CMW-KW400 option, waveform file used: 3GPPDEFAULT.WV	see general technical specifications
	with the R&S®CMW-KW401 option, waveform file used: WCDMA_DL_HSDPA.WV	see general technical specifications
	with the R&S®CMW-KW402 option, waveform file used: WCDMA_DL_HSUPA.WV	see general technical specifications
	with the R&S®CMW-KW400 and R&S®CMW-KW401 and R&S®CMW-KW402 and R&S®CMW-KW403 options	see general technical specifications
Output level resolution		see general technical specifications

Signal quality		
Error vector magnitude (EVM)	composite EVM, with the R&S®CMW-KW400 option, waveform file used: TM4CPICH.WV	< 2 %, RMS
	composite EVM, with the R&S®CMW-KW401 option, waveform file used: WCDMA_DL_HSDPA.WV	< 2 %, RMS
	composite EVM, with the R&S®CMW-KW402 option, waveform file used: WCDMA_DL_HSUPA.WV	< 2 %, RMS
	with the R&S®CMW-KW400 and R&S®CMW-KW401 and R&S®CMW-KW402 and R&S®CMW-KW403 options	< 2 %, RMS

WCDMA RF analyzer (R&S®CMW-KM400, R&S®CMW-KM401, R&S®CMW-KM403 options)

Frequency range	WCDMA band 1	1922.4 MHz to 1977.6 MHz
	WCDMA band 2	1852.4 MHz to 1907.6 MHz
	WCDMA band 3	1712.4 MHz to 1782.6 MHz
	WCDMA band 4	1712.4 MHz to 1752.6 MHz
	WCDMA band 5	826.4 MHz to 846.6 MHz
	WCDMA band 6	832.4 MHz to 837.6 MHz
	WCDMA band 7	2502.4 MHz to 2567.6 MHz
	WCDMA band 8	882.4 MHz to 912.6 MHz
	WCDMA band 9	1752.4 MHz to 1782.4 MHz
	WCDMA band 10	1712.4 MHz to 1767.6 MHz
	WCDMA band 11	1430.4 MHz to 1450.4 MHz
	WCDMA band 12	700.4 MHz to 713.6 MHz
	WCDMA band 13	779.4 MHz to 784.6 MHz
	WCDMA band 14	790.4 MHz to 795.6 MHz
	WCDMA band S	2002.4 MHz to 2017.6 MHz
	WCDMA band S170	2010 MHz to 2020 MHz
	WCDMA band S190	2000 MHz to 2010 MHz

Statistics		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation

Trigger		
Trigger sources		• BASE: external TRIG IN • GPRF: Gen • WCDMA: free run • WCDMA: free run (fast sync) • WCDMA: IF power • WCDMA: DCCH TTI trigger • WCDMA: frame trigger • WCDMA: HS-DPCCH trigger • WCDMA: slot trigger

Modulation analysis

Filter		3.84 MHz, RRC, α = 0.22, WCDMA filter
Level range		–28 dBm to +36 dBm [17]

Analysis modes	with the R&S®CMW-KM400 option	QPSK, WCDMA
	with the R&S®CMW-KM400 and R&S®CMW-KM401 options	WCDMA + HSDPA, WCDMA + HSUPA, WCDMA + HSPA
	with the R&S®CMW-KM400 and R&S®CMW-KM401 and R&S®CMW-KM403 options	WCDMA + HSPA+
Measured parameters	numeric results and standard deviation	error vector magnitude (EVM), magnitude error (ME), phase error (PE), frequency error, I/Q origin offset, I/Q imbalance, UE power, power steps, phase discontinuity, CDP, CDE
	graphical	EVM versus time, EVM versus chip, ME versus time, ME versus chip, PE versus time, PE versus chip, FE versus time, UE versus time, PS versus slot, PD versus slot, CDP versus slot, CDE versus slot, CD monitor

Error vector magnitude (EVM)		
Measurement range		up to 25 %, RMS
Inherent EVM		< 2.5 %, RMS
Measurement length		half-slot, 1 slot, multislot (1 to 120)

Frequency error		
Measurement range		±3 kHz
Frequency measurement uncertainty		< 20 Hz + drift of timebase, see general technical specifications

I/Q origin offset		
Inherent I/Q offset	for average ≥ 10 measurements	< –55 dB

I/Q imbalance		
Inherent I/Q imbalance		< –50 dB

Spectrum measurements

Adjacent channel leakage ratio	RMS detector	
Filter		3.84 MHz, RRC, α = 0.22, WCDMA filter
Dynamic range	first adjacent channel at ±5 MHz	> 54 dB
	second adjacent channel at ±10 MHz	> 57 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	–4 dBm to +36 dBm [17]
Uncertainty	for –33 dBc first adjacent channel level	< 0.5 dB
	for –43 dBc second adjacent channel level	< 0.5 dB
Measurement length		1 slot (2560 chip)

[17] The maximum permissible continuous power is +34 dBm due to thermal limits.

Power meter

UE power measurement	RMS detector	
Filter		bandpass, 6.3 MHz, RRC, α = 0.22
Level range		–55 dBm to +36 dBm [18]
Level uncertainty		see general technical specifications
Measurement length		half-slot, 1 slot

Off power measurement	RMS detector	
Filter		3.84 MHz, RRC, α = 0.22, WCDMA filter
Noise floor		–72 dBm
Level uncertainty		see general technical specifications + uncertainty due to noise floor

[18] The maximum permissible continuous power is +34 dBm due to thermal limits.

WCDMA specifications – small cell test

WCDMA RF analyzer (R&S®CMW-KN400)

Frequency range	WCDMA band 1	2112.4 MHz to 2167.6 MHz
	WCDMA band 2	1932.4 MHz to 1987.6 MHz
	WCDMA band 3	1807.4 MHz to 1877.6 MHz
	WCDMA band 4	2112.4 MHz to 2152.6 MHz
	WCDMA band 5	871.4 MHz to 891.6 MHz
	WCDMA band 6	877.4 MHz to 882.6 MHz
	WCDMA band 7	2622.4 MHz to 2687.6 MHz
	WCDMA band 8	927.4 MHz to 957.6 MHz
	WCDMA band 9	1847.4 MHz to 1877.4 MHz
	WCDMA band 10	2112.4 MHz to 2167.6 MHz
	WCDMA band 11	1478.4 MHz to 1498.4 MHz
	WCDMA band 12	730.4 MHz to 743.6 MHz
	WCDMA band 13	748.4 MHz to 753.6 MHz
	WCDMA band 14	760.4 MHz to 765.6 MHz
	WCDMA band S	2182.4 MHz to 2197.6 MHz
	WCDMA band S170	2180 MHz to 2190 MHz
	WCDMA band S190	2190 MHz to 2200 MHz

Statistics		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation

Trigger		
Trigger sources		BASE: external TRIG IN GPRF: Gen WCDMA: free run WCDMA: free run (fast sync) WCDMA: IF power WCDMA: DCCH TTI trigger WCDMA: frame trigger WCDMA: HS-DPCCH trigger WCDMA: slot trigger

Modulation analysis

Filter		3.84 MHz, RRC, α = 0.22, WCDMA filter
Level range		–28 dBm to +36 dBm [19]

Analysis modes	with the R&S®CMW-KM400 option	QPSK, WCDMA
Measured parameters	numeric results and standard deviation	error vector magnitude (EVM), magnitude error (ME), phase error (PE), frequency error, I/Q origin offset, I/Q imbalance, UE power, power steps, phase discontinuity, CDP, CDE

[19] The maximum permissible continuous power is +34 dBm due to thermal limits.

	graphical	EVM versus time, EVM versus chip, ME versus time, ME versus chip, PE versus time, PE versus chip, FE versus time, UE versus time, PS versus slot, PD versus slot, CDP versus slot, CDE versus slot, CD monitor

Error vector magnitude (EVM)		
Measurement range		up to 25 %, RMS
Inherent EVM		< 2.5 %, RMS
Measurement length		half-slot, 1 slot, multislot (1 to 120)

Frequency error		
Measurement range		±3 kHz
Frequency measurement uncertainty		< 20 Hz + drift of timebase, see general technical specifications

I/Q origin offset		
Inherent I/Q offset	for average ≥ 10 measurements	< –52 dB

I/Q imbalance		
Inherent I/Q imbalance		< –50 dB

Spectrum measurements

Adjacent channel leakage ratio	RMS detector	
Filter		3.84 MHz, RRC, α = 0.22, WCDMA filter
Dynamic range	first adjacent channel at ±5 MHz	> 52 dB
	second adjacent channel at ±10 MHz	> 52 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	–4 dBm to +36 dBm [20]
Uncertainty	for –33 dBc first adjacent channel level	< 0.5 dB
	for –43 dBc second adjacent channel level	< 0.5 dB
Measurement length		1 slot (2560 chip)

Power meter

UE power measurement	RMS detector	
Filter		bandpass, 6.3 MHz, RRC, α = 0.22
Level range		–55 dBm to +36 dBm [20]
Level uncertainty		see general technical specifications
Measurement length		half-slot, 1 slot

Off power measurement	RMS detector	
Filter		3.84 MHz, RRC, α = 0.22, WCDMA filter
Noise floor		–72 dBm
Level uncertainty		see general technical specifications + uncertainty due to noise floor

[20] The maximum permissible continuous power is +34 dBm due to thermal limits.

LTE specifications – mobile station test

Standard		LTE FDD and TDD

LTE RF generator

Frequency range	E-UTRA band 1, FDD	2110 MHz to 2170 MHz
	E-UTRA band 2, FDD	1930 MHz to 1990 MHz
	E-UTRA band 3, FDD	1805 MHz to 1880 MHz
	E-UTRA band 4, FDD	2110 MHz to 2155 MHz
	E-UTRA band 5, FDD	869 MHz to 894 MHz
	E-UTRA band 6, FDD	875 MHz to 885 MHz
	E-UTRA band 7, FDD	2620 MHz to 2690 MHz
	E-UTRA band 8, FDD	925 MHz to 960 MHz
	E-UTRA band 9, FDD	1844.9 MHz to 1879.9 MHz
	E-UTRA band 10, FDD	2110 MHz to 2170 MHz
	E-UTRA band 11, FDD	1475.9 MHz to 1495.9 MHz
	E-UTRA band 12, FDD	729 MHz to 746 MHz
	E-UTRA band 13, FDD	746 MHz to 756 MHz
	E-UTRA band 14, FDD	758 MHz to 768 MHz
	E-UTRA band 15, FDD	2600 MHz to 2620 MHz
	E-UTRA band 16, FDD	2585 MHz to 2600 MHz
	E-UTRA band 17, FDD	734 MHz to 746 MHz
	E-UTRA band 18, FDD	860 MHz to 875 MHz
	E-UTRA band 19, FDD	875 MHz to 890 MHz
	E-UTRA band 20, FDD	791 MHz to 821 MHz
	E-UTRA band 21, FDD	1495.9 MHz to 1510.9 MHz
	E-UTRA band 22, FDD	3510 MHz to 3590 MHz
	E-UTRA band 23, FDD	2180 MHz to 2200 MHz
	E-UTRA band 24, FDD	1525 MHz to 1559 MHz
	E-UTRA band 25, FDD	1930 MHz to 1995 MHz
	E-UTRA band 26, FDD	859 MHz to 894 MHz
	E-UTRA band 27, FDD	852 MHz to 869 MHz
	E-UTRA band 28, FDD	758 MHz to 803 MHz
	E-UTRA band 29, FDD	717 MHz to 728 MHz
	E-UTRA band 30, FDD	2350 MHz to 2360 MHz
	E-UTRA band 31, FDD	462.5 MHz to 467.5 MHz
	E-UTRA band 87, FDD	420 MHz to 425 MHz
	E-UTRA band 88, FDD	422 MHz to 427 MHz
	E-UTRA band 33, TDD	1900 MHz to 1920 MHz
	E-UTRA band 34, TDD	2010 MHz to 2025 MHz
	E-UTRA band 35, TDD	1850 MHz to 1910 MHz
	E-UTRA band 36, TDD	1930 MHz to 1990 MHz
	E-UTRA band 37, TDD	1910 MHz to 1930 MHz
	E-UTRA band 38, TDD	2570 MHz to 2620 MHz
	E-UTRA band 39, TDD	1880 MHz to 1920 MHz
	E-UTRA band 40, TDD	2300 MHz to 2400 MHz
	E-UTRA band 41, TDD	2496 MHz to 2690 MHz
	E-UTRA band 42, TDD	3400 MHz to 3600 MHz
	E-UTRA band 43, TDD	3600 MHz to 3800 MHz
	E-UTRA band 44, TDD	703 MHz to 803 MHz

LTE R&S®WinIQSIM2 (R&S®CMW-KW500 option)

Arbitrary waveform file	LTE FDD	LTE_FDD_QPSK_10MHZ.WV (PAR = 11.15 dB)
	LTE TDD	LTE_TDD_64QAM_20MHZ.WV (PAR = 11.10 dB)

Output level range	depends on PAR	see general technical specifications
Output level uncertainty	waveform file used: LTE_FDD_QPSK_10MHZ.WV	see general technical specifications
	waveform file used: LTE_TDD_64QAM_20MHZ.WV	see general technical specifications
Output level resolution		see general technical specifications

Signal quality		
Error vector magnitude (EVM)	EVM PDSCH QPSK, bandwidth = 10 MHz, 50 resource blocks, PRB symbol offset = 3, 10 subframes, PCFICH present, waveform file used: LTE_FDD_QPSK_10MHZ.WV	< 2 %, RMS
	EVM PDSCH 64QAM, bandwidth = 20 MHz, 100 resource blocks, PRB symbol offset = 2, uplink/downlink configuration 1, special subframe configuration 7, waveform file used: LTE_TDD_64QAM_20MHZ.WV	< 2 %, RMS

LTE FDD RF analyzer (R&S®CMW-KM500 option)

Bandwidth		1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz

Frequency range	E-UTRA band 1, FDD	1920 MHz to 1980 MHz
	E-UTRA band 2, FDD	1850 MHz to 1910 MHz
	E-UTRA band 3, FDD	1710 MHz to 1785 MHz
	E-UTRA band 4, FDD	1710 MHz to 1755 MHz
	E-UTRA band 5, FDD	824 MHz to 849 MHz
	E-UTRA band 6, FDD	830 MHz to 840 MHz
	E-UTRA band 7, FDD	2500 MHz to 2570 MHz
	E-UTRA band 8, FDD	880 MHz to 915 MHz
	E-UTRA band 9, FDD	1749.9 MHz 1784.9 MHz
	E-UTRA band 10, FDD	1710 MHz to 1770 MHz
	E-UTRA band 11, FDD	1427.9 MHz to 1447.9 MHz
	E-UTRA band 12, FDD	699 MHz to 716 MHz
	E-UTRA band 13, FDD	777 MHz to 787 MHz
	E-UTRA band 14, FDD	788 MHz to 798 MHz
	E-UTRA band 15, FDD	1900 MHz to 1920 MHz
	E-UTRA band 16, FDD	2010 MHz to 2025 MHz
	E-UTRA band 17, FDD	704 MHz to 716 MHz
	E-UTRA band 18, FDD	815 MHz to 830 MHz
	E-UTRA band 19, FDD	830 MHz to 845 MHz
	E-UTRA band 20, FDD	832 MHz to 862 MHz
	E-UTRA band 21, FDD	1447.9 MHz to 1462.9 MHz
	E-UTRA band 22, FDD	3410 MHz to 3490 MHz
	E-UTRA band 23, FDD	2000 MHz to 2020 MHz
	E-UTRA band 24, FDD	1625.5 MHz to 1660.5 MHz
	E-UTRA band 25, FDD	1850 MHz to 1915 MHz
	E-UTRA band 26, FDD	814 MHz to 849 MHz
	E-UTRA band 27, FDD	807 MHz to 824 MHz
	E-UTRA band 28, FDD	703 MHz to 748 MHz
	E-UTRA band 30, FDD	2305 MHz to 2315 MHz
	E-UTRA band 31, FDD	452.5 MHz to 457.5 MHz
	E-UTRA band 87, FDD	410 MHz to 415 MHz
	E-UTRA band 88, FDD	412 MHz to 417 MHz
Level setting		manual mode

Statistics		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation

Trigger		
Trigger sources		• BASE: external TRIG IN • GPRF: Gen • LTE: free run (fast sync) • LTE: IF power

Power measurement

Slot power	RMS detector	
Level range		–50 dBm to +30 dBm, RMS
Level uncertainty		see general technical specifications

Modulation analysis

Measured parameters	numeric results	error vector magnitude (EVM), magnitude error (ME), phase error (PE), frequency error, I/Q origin offset, TX power, peak power, resource block power (RB power)
	graphical	EVM versus SC-FDMA symbol, ME versus SC-FDMA symbol, PE versus SC-FDMA symbol, EVM versus subcarrier, in-band emissions, spectrum flatness, I/Q constellation

Error vector magnitude (EVM)		
Inherent EVM	allocated resource blocks ≤ 15	
	–34 dBm ≤ input level < +30 dBm, RMS	< 1 %, RMS
	–38 dBm ≤ input level < –34 dBm, RMS	< 1.5 %, RMS
	allocated resource blocks ≤ 50	
	–30 dBm ≤ input level ≤ +30 dBm, RMS	< 1 %, RMS
	–38 dBm ≤ input level < –30 dBm, RMS	< 2 %, RMS
	allocated resource blocks ≤ 100	
	–28 dBm ≤ input level ≤ +30 dBm, RMS	< 1 %, RMS
	–38 dBm ≤ input level < –28 dBm, RMS	< 2.5 %, RMS

Frequency error		
Measurement range		±80 kHz
Frequency measurement uncertainty		< 20 Hz [21] + drift of timebase, see general technical specifications

I/Q origin offset		
Inherent I/Q offset	for average ≥ 10 measurements	< –50 dB

In-band emissions		
Dynamic range	allocated resource blocks ≤ 50	> 50 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

Equalizer spectrum flatness	allocated resource blocks ≤ 50	
Level uncertainty		< 0.5 dB

Spectrum measurements

Adjacent channel leakage ratio		
Filter	E-UTRA	rectangle 1.08 MHz, 2.7 MHz, 4.5 MHz, 9 MHz, 13.5 MHz, 18 MHz
	UTRA	3.84 MHz, RRC, α = 0.22, WCDMA filter
Dynamic range	E-UTRA	> 45 dB
	UTRA	> 52 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

[21] For frequency error measurements relative to the downlink signal of the same R&S®CMW100, the uncertainty is in line with 3GPP TS 36.521-1 V16.3.0.

Spectrum emission mask (SEM)		
Frequency span		70 MHz
Noise floor	RBW: 1 MHz	< –35 dBm
	RBW: 100 kHz	< –40 dBm
	RBW: 30 kHz	< –45 dBm

LTE TDD RF analyzer (R&S®CMW-KM550 option)

Bandwidth		1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz

Frequency range	E-UTRA band 33, TDD	1900 MHz to 1920 MHz
	E-UTRA band 34, TDD	2010 MHz to 2025 MHz
	E-UTRA band 35, TDD	1850 MHz to 1910 MHz
	E-UTRA band 36, TDD	1930 MHz to 1990 MHz
	E-UTRA band 37, TDD	1910 MHz to 1930 MHz
	E-UTRA band 38, TDD	2570 MHz to 2620 MHz
	E-UTRA band 39, TDD	1880 MHz to 1920 MHz
	E-UTRA band 40, TDD	2300 MHz to 2400 MHz
	E-UTRA band 41, TDD	2496 MHz to 2690 MHz
	E-UTRA band 42, TDD	3400 MHz to 3600 MHz
	E-UTRA band 43, TDD	3600 MHz to 3800 MHz
	E-UTRA band 44, TDD	703 MHz to 803 MHz
Level setting		manual mode

Statistics		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation

Trigger		
Trigger sources		• BASE: external TRIG IN • GPRF: Gen • LTE: free run (fast sync) • LTE: IF power

Power measurement

Slot power	RMS detector	
Level range		–50 dBm to +30 dBm, RMS
Level uncertainty		see general technical specifications

Modulation analysis

Measured parameters	numeric results	error vector magnitude (EVM), magnitude error (ME), phase error (PE), frequency error, I/Q origin offset, TX power, peak power, resource block power (RB power)
	graphical	EVM versus SC-FDMA symbol, ME versus SC-FDMA symbol, PE versus SC-FDMA symbol, EVM versus subcarrier, in-band emissions, spectrum flatness, I/Q constellation

Error vector magnitude (EVM)		
Inherent EVM	allocated resource blocks ≤ 15	
	–34 dBm ≤ input level < +30 dBm, RMS	< 1 %, RMS
	–38 dBm ≤ input level < –34 dBm, RMS	< 1.5 %, RMS
	allocated resource blocks ≤ 50	
	–30 dBm ≤ input level ≤ +30 dBm, RMS	< 1 %, RMS
	–38 dBm ≤ input level < –30 dBm, RMS	< 2 %, RMS
	allocated resource blocks ≤ 100	
	–28 dBm ≤ input level ≤ +30 dBm, RMS	< 1 %, RMS
	–38 dBm ≤ input level < –28 dBm, RMS	< 2.5 %, RMS

Frequency error		
Measurement range		±80 kHz
Frequency measurement uncertainty		< 20 Hz [22] + drift of timebase, see general technical specifications

I/Q origin offset		
Inherent I/Q offset		< –50 dB

In-band emissions		
Dynamic range	allocated resource blocks ≤ 50	> 50 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

Equalizer spectrum flatness	allocated resource blocks ≤ 50	
Level uncertainty		< 0.5 dB

Spectrum measurements

Adjacent channel leakage ratio		
Filter	E-UTRA	rectangle 1.08 MHz, 2.7 MHz, 4.5 MHz, 9 MHz, 13.5 MHz, 18 MHz
	UTRA	1.28 MHz, RRC, α = 0.22, WCDMA filter
Dynamic range	E-UTRA	> 45 dB
	UTRA	> 56 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

Spectrum emission mask (SEM)		
Frequency span		70 MHz
Noise floor	RBW: 1 MHz	< –35 dBm
	RBW: 100 kHz	< –40 dBm
	RBW: 30 kHz	< –45 dBm

LTE C-V2X RF analyzer (R&S®CMW-KM570 option)

Bandwidth		1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz

Frequency range	E-UTRA band 47, TDD	5855 MHz to 5925 MHz
Level setting		manual mode

Statistics		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation

Trigger		
Trigger sources		• BASE: external TRIG IN • GPRF: Gen • LTE: free run (fast sync) • LTE: IF power

[22] For frequency error measurements relative to the downlink signal of the same R&S®CMW100, the uncertainty is in line with 3GPP TS 36.521-1 V16.3.0.

Power measurement

Slot power	RMS detector	
Level range		–50 dBm to +30 dBm, RMS
Level uncertainty		see general technical specifications

Modulation analysis

Measured parameters	numeric results	error vector magnitude (EVM), magnitude error (ME), phase error (PE), frequency error, I/Q origin offset, TX power, peak power, resource block power (RB power)
	graphical	EVM versus SC-FDMA symbol, ME versus SC-FDMA symbol, PE versus SC-FDMA symbol, EVM versus subcarrier, in-band emissions, spectrum flatness, I/Q constellation

Error vector magnitude (EVM)		
Inherent EVM	allocated resource blocks ≤ 15	
	–34 dBm ≤ input level < +30 dBm, RMS	< 1 %, RMS
	–38 dBm ≤ input level < –34 dBm, RMS	< 1.5 %, RMS
	allocated resource blocks ≤ 50	
	–30 dBm ≤ input level ≤ +30 dBm, RMS	< 1 %, RMS
	–38 dBm ≤ input level < –30 dBm, RMS	< 2 %, RMS
	allocated resource blocks ≤ 100	
	–28 dBm ≤ input level ≤ +30 dBm, RMS	< 1 %, RMS
	–38 dBm ≤ input level < –28 dBm, RMS	< 2.5 %, RMS

Frequency error		
Measurement range		±80 kHz
Frequency measurement uncertainty		< 35 Hz [23] + drift of timebase, see general technical specifications

I/Q origin offset		
Inherent I/Q offset		< –50 dB

In-band emissions		
Dynamic range	allocated resource blocks ≤ 50	> 50 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

Equalizer spectrum flatness	allocated resource blocks ≤ 50	
Level uncertainty		< 0.5 dB

Spectrum measurements

Adjacent channel leakage ratio		
Filter	E-UTRA	rectangle 1.08 MHz, 2.7 MHz, 4.5 MHz, 9 MHz, 13.5 MHz, 18 MHz
	UTRA	1.28 MHz, RRC, α = 0.22, WCDMA filter
Dynamic range	E-UTRA	> 45 dB
	UTRA	> 56 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

[23] For frequency error measurements relative to the downlink signal of the same R&S®CMW100, the uncertainty is in line with 3GPP TS 36.521-1 V16.3.0.

Spectrum emission mask (SEM)		
Frequency span		70 MHz
Noise floor	RBW: 1 MHz	< –37 dBm
	RBW: 100 kHz	< –42 dBm
	RBW: 30 kHz	< –47 dBm

LTE specifications – small cell test

Standard		LTE FDD and TDD

LTE FDD eNodeB RF analyzer (R&S®CMW-KN500 option)

Bandwidth		1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz

Frequency range	E-UTRA band 1, FDD	2110 MHz to 2170 MHz
	E-UTRA band 2, FDD	1930 MHz to 1990 MHz
	E-UTRA band 3, FDD	1805 MHz to 1880 MHz
	E-UTRA band 4, FDD	2110 MHz to 2155 MHz
	E-UTRA band 5, FDD	869 MHz to 894 MHz
	E-UTRA band 6, FDD	875 MHz to 885 MHz
	E-UTRA band 7, FDD	2620 MHz to 2690 MHz
	E-UTRA band 8, FDD	925 MHz to 960 MHz
	E-UTRA band 9, FDD	1844.9 MHz 1879.9 MHz
	E-UTRA band 10, FDD	2110 MHz to 2170 MHz
	E-UTRA band 11, FDD	1475.9 MHz to 1495.9 MHz
	E-UTRA band 12, FDD	729 MHz to 746 MHz
	E-UTRA band 13, FDD	746 MHz to 756 MHz
	E-UTRA band 14, FDD	758 MHz to 768 MHz
	E-UTRA band 15, FDD	2600 MHz to 2620 MHz
	E-UTRA band 16, FDD	2585 MHz to 2600 MHz
	E-UTRA band 17, FDD	734 MHz to 746 MHz
	E-UTRA band 18, FDD	860 MHz to 875 MHz
	E-UTRA band 19, FDD	875 MHz to 890 MHz
	E-UTRA band 20, FDD	791 MHz to 821 MHz
	E-UTRA band 21, FDD	1495.9 MHz to 1510.9 MHz
	E-UTRA band 22, FDD	3510 MHz to 3590 MHz
	E-UTRA band 23, FDD	2180 MHz to 2200 MHz
	E-UTRA band 24, FDD	1525 MHz to 1559 MHz
	E-UTRA band 25, FDD	1930 MHz to 1995 MHz
	E-UTRA band 26, FDD	859 MHz to 894 MHz
	E-UTRA band 27, FDD	852 MHz to 869 MHz
	E-UTRA band 28, FDD	758 MHz to 803 MHz
	E-UTRA band 29, FDD	717 MHz to 728 MHz
	E-UTRA band 30, FDD	2350 MHz to 2360 MHz
	E-UTRA band 31, FDD	462.5 MHz to 467.5 MHz
Level setting		manual mode

Statistics		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation

Trigger		
Trigger source		BASE: external TRIG IN, GPRF: Gen, LTE: free run (fast sync), LTE: IF power

Power measurement

Slot power	RMS detector	
Level range		–50 dBm to +30 dBm, RMS
Level uncertainty		see general technical specifications

Modulation analysis

Measured parameters	numeric results	error vector magnitude (EVM), magnitude error (ME), phase error (PE), frequency error, I/Q origin offset, TX power, peak power, reference symbol power, OFDM symbol power
	graphical	EVM versus OFDMA symbol, ME versus OFDMA symbol, PE versus OFDMA symbol, OFDM symbol power spectrum flatness, spectrum ACLR I/Q constellation

Error vector magnitude (EVM)		
Inherent EVM	for average ≥ 10 subframes	
	–20 dBm ≤ input level < +30 dBm, RMS	< 1.5 %, RMS

Frequency error		
Measurement range		±80 kHz
Frequency measurement uncertainty		< 20 Hz [24] + drift of timebase, see general technical specifications

Spectrum measurements

Adjacent channel leakage ratio		
Filter	E-UTRA	rectangle 1.08 MHz, 2.7 MHz, 4.5 MHz, 9 MHz, 13.5 MHz, 18 MHz
	UTRA	1.28 MHz, RRC, α = 0.22, WCDMA filter 3.84 MHz, RRC, α = 0.22, WCDMA filter 7.68 MHz, RRC, α = 0.22, WCDMA filter
Dynamic range	E-UTRA	> 50 dB
	UTRA384	> 52 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

Spectrum emission mask (SEM)		
Frequency span		70 MHz
Noise floor	RBW: ≤ 1 MHz, expected nominal power < 12 dBm	< –58 dBm

[24] For frequency error measurements relative to the downlink signal of the same R&S®CMW100, the uncertainty is in line with 3GPP TS 36.521-1 V16.3.0.

LTE TDD eNodeB RF analyzer (R&S®CMW-KN550 option)

Bandwidth		1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz

Frequency range	E-UTRA band 33, TDD	1900 MHz to 1920 MHz
	E-UTRA band 34, TDD	2010 MHz to 2025 MHz
	E-UTRA band 35, TDD	1850 MHz to 1910 MHz
	E-UTRA band 36, TDD	1930 MHz to 1990 MHz
	E-UTRA band 37, TDD	1910 MHz to 1930 MHz
	E-UTRA band 38, TDD	2570 MHz to 2620 MHz
	E-UTRA band 39, TDD	1880 MHz to 1920 MHz
	E-UTRA band 40, TDD	2300 MHz to 2400 MHz
	E-UTRA band 41, TDD	2496 MHz to 2690 MHz
	E-UTRA band 42, TDD,	3400 MHz to 3600 MHz
	E-UTRA band 43, TDD,	3600 MHz to 3800 MHz
	E-UTRA band 44, TDD	703 MHz to 803 MHz
Level setting		manual mode

Statistics		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation

Trigger		
Trigger source		BASE: external TRIG IN GPRF: Gen, LTE: free run (fast sync), LTE: IF power

Power measurement

Slot power	RMS detector	
Level range		–50 dBm to +30 dBm, RMS
Level uncertainty		see general technical specifications

Modulation analysis

Measured parameters	numeric results	error vector magnitude (EVM), magnitude error (ME), phase error (PE), frequency error, I/Q origin offset, TX power, peak power, reference symbol power, OFDM symbol power
	graphical	EVM versus OFDMA symbol, ME versus OFDMA symbol, PE versus OFDMA symbol, OFDM symbol power spectrum flatness, spectrum ACLR, I/Q constellation

Error vector magnitude (EVM)		
Inherent EVM	for average ≥ 10 subframes	
	–20 dBm ≤ input level < +30 dBm, RMS	< 1.5 %, RMS

Frequency error		
Measurement range		±80 kHz
Frequency measurement uncertainty		< 20 Hz [25] + drift of timebase, see general technical specifications

Spectrum measurements

Adjacent channel leakage ratio		
Filter	E-UTRA	rectangle 1.08 MHz, 2.7 MHz, 4.5 MHz, 9 MHz, 13.5 MHz, 18 MHz
	UTRA	1.28 MHz, RRC, α = 0.22, WCDMA filter; 3.84 MHz, RRC, α = 0.22, WCDMA filter; 7.68 MHz, RRC, α = 0.22, WCDMA filter
Dynamic range	E-UTRA	> 50 dB
	UTRA128	> 52 dB
	UTRA384	> 52 dB
	UTRA768	> 49 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

Spectrum emission mask (SEM)		
Frequency span		70 MHz
Noise floor	RBW: ≤ 1 MHz, expected nominal power < 12 dBm	< –58 dBm

[25] For frequency error measurements relative to the downlink signal of the same R&S®CMW100, the uncertainty is in line with 3GPP TS 36.521-1 V16.3.0.

Bluetooth® specifications

Standard	standard	Bluetooth® Core Specification Version 5.0, 5.1, 5.2 [26], 5.3
	test standard	Radio Frequency Bluetooth® Test Specification RF.TS.p32, Low Energy RF PHY Bluetooth® Test Specification, RF-PHY.TS.p17

Bluetooth® RF generator

Frequency range	Bluetooth®	2402 MHz to 2480 MHz

Bluetooth® R&S®WinIQSIM2 (R&S®CMW-KW610 option)

Arbitrary waveform file	basic rate	BLUETOOTH_11110000_DH5.WV LAP: 123456, (PAR = 0.00 dB)
	enhanced data rate (EDR)	BLUETOOTH_PRBS9_3-DH5.WV LAP: 123456, (PAR = 3.20 dB)

Output level range	depends on PAR	see general technical specifications
Output level uncertainty	waveform files used: BLUETOOTH_11110000_DH5.WV, BLUETOOTH_PRBS_3-DH5.WV	see general technical specifications
Output level resolution		see general technical specifications

Signal quality		
Modulation index uncertainty	basic rate, frequency deviation $\Delta f_{1\ max.}$ = 160 kHz, waveform file used: BLUETOOTH_11110000_DH5.WV	< 1 %
Differential error vector magnitude (DEVM)	enhanced data rate, waveform file used: BLUETOOTH_PRBS9_3-DH5.WV	< 1.5 %, RMS

Bluetooth® RF analyzer (R&S®CMW-KM610 option)

Frequency range	Bluetooth®	2402 MHz to 2480 MHz

Statistics		
Statistical count		1 to 1000
Values		current, average, maximum, minimum, standard deviation

Trigger		
Trigger source		Bluetooth®: IF power

Modulation analysis

Filter	filter bandwidth: wide	2.0 MHz bandpass
	filter bandwidth: narrow	1.3 MHz bandpass
Level range		–35 dBm to +36 dBm [27]
Supported packet types	basic rate	DH1, DH3, DH5
	enhanced data rate (EDR)	2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5

[26] Support of Bluetooth® 5.2 Isochronous PDU type.

[27] The maximum permissible continuous power is +34 dBm due to thermal limits.

Measured parameters	basic rate, numeric results and standard deviation	Δf_2 99.9 %, frequency accuracy, frequency drift, maximum drift rate, frequency deviation $\Delta f_{1\ average}$, frequency deviation $\Delta f_{1\ minimum}$, frequency deviation $\Delta f_{1\ maximum}$, frequency deviation $\Delta f_{2\ average}$, frequency deviation $\Delta f_{2\ minimum}$, frequency deviation $\Delta f_{2\ maximum}$, nominal power
Measured parameters	enhanced data rate (EDR), numeric results and standard deviation	99 % DEVM, frequency stability ω_i, frequency stability $(\omega_o + \omega_i)_{max}$, frequency stability $\omega_{o\ max}$, RMS DEVM, peak RMS, nominal power

Total measurement range for frequency accuracy, frequency deviation and frequency drift	basic rate	±250 kHz

Frequency accuracy	basic rate	
Measurement range	for nominal deviation of 160 kHz	±100 kHz
Uncertainty	for deviation ≤ 160 kHz	< 2 kHz

Frequency deviation	basic rate	
Measurement range	without frequency offset	≤ 210 kHz
Uncertainty	for modulation index 0.22 to 0.42	< 1 %

Frequency drift	basic rate	
Measurement range		±50 kHz
Uncertainty	measured in burst relative to frequency offset in preamble, with 10101010 pattern	< 2 kHz
	referenced to measured frequency offset in preamble (relative frequency drift)	≤ 1 kHz

Frequency stability ω_i	enhanced data rate	
Measurement range		±100 kHz
Uncertainty	for ω_i ≤ 75 kHz, for deviation ≤ 160 kHz	< 2 kHz

Frequency stability $\omega_{o\ max}$	enhanced data rate	
Measurement range		±15 kHz
Uncertainty	for ω_o ≤ 10 kHz	< 1 kHz

Differential error vector magnitude (DEVM)	enhanced data rate	
Inherent DEVM	for PRBS pattern	< 1.5 %, RMS; < 3.0 %, peak

Bluetooth® RF analyzer (R&S®CMW-KM611 option)

Frequency range	Bluetooth®	2402 MHz to 2480 MHz

Statistics		
Statistical count		1 to 1000
Values		current, average, maximum, minimum, standard deviation

Trigger		
Trigger source		Bluetooth®: IF power

Modulation analysis

Filter	filter bandwidth: wide	2.0 MHz bandpass
	filter bandwidth: narrow	1.3 MHz bandpass
Level range		–35 dBm to +36 dBm [28]
Supported packet types		RF PHY Test Reference Packets

Measured parameters	numeric results and standard deviation	Δf_2 99.9 %, frequency accuracy, frequency offset, initial frequency drift, frequency drift, max drift rate, frequency deviation $\Delta f_{1\ average}$, frequency deviation $\Delta f_{1\ minimum}$, frequency deviation $\Delta f_{1\ maximum}$, frequency deviation $\Delta f_{2\ average}$, frequency deviation $\Delta f_{2\ minimum}$, frequency deviation $\Delta f_{2\ maximum}$, nominal power

Total measurement range for frequency accuracy, offset, deviation and drift measurements		±350 kHz

Frequency accuracy (using preamble)		
Measurement range	for nominal deviation of 250 kHz	±175 kHz
Uncertainty	for deviation ≤ 250 kHz	< 2 kHz

Frequency offset		
Measurement range	for nominal deviation of 250 kHz	±175 kHz
Uncertainty	for deviation ≤ 250 kHz	< 2 kHz

Frequency deviation		
Measurement range	without frequency offset	≤ 350 kHz
Uncertainty	for modulation index 0.40 to 0.60	< 1.0 %

Frequency drift		
Measurement range		±75 kHz
Uncertainty	measured in burst relative to frequency offset in preamble, with 10101010 pattern	< 2 kHz
	referenced to measured frequency offset in preamble (relative frequency drift)	≤ 1 kHz

[28] The maximum permissible continuous power is +34 dBm due to thermal limits.

Bluetooth® RF analyzer (R&S®CMW-KM721 option)

Frequency range	Bluetooth®	2402 MHz to 2480 MHz

Statistics		
Statistical count		1 to 1000
Values		current, average, maximum, minimum, standard deviation

Trigger		
Trigger source		Bluetooth®: IF power

Modulation analysis

Filter	filter bandwidth: wide (LE 2 Msymbol/s)	4.0 MHz bandpass
	filter bandwidth: wide (LE long range)	2.0 MHz bandpass
	filter bandwidth: narrow (LE 2 Msymbol/s)	2.6 MHz bandpass
	filter bandwidth: narrow (LE long range)	1.3 MHz bandpass
Level range		–35 dBm to +36 dBm [29]
Supported packet types		RF PHY Test Reference Packets

Measured parameters	numeric results and standard deviation (common)	frequency accuracy, frequency offset, initial frequency drift, frequency drift, max drift rate, frequency deviation $\Delta f1_{average}$, frequency deviation $\Delta f1_{minimum}$, frequency deviation $\Delta f1_{maximum}$, nominal power
	numeric results and standard deviation (LE 2 Msymbol/s)	Δf2 99.9 % frequency deviation $\Delta f2_{average}$, frequency deviation $\Delta f2_{minimum}$, frequency deviation $\Delta f2_{maximum}$,
	numeric results and standard deviation (LE long range)	Δf1 99.9 %

Total measurement range for frequency accuracy, offset, deviation and drift measurements	LE 2 2 Msymbol/s	±700 kHz
	LE long range	±350 kHz

Frequency accuracy (using preamble)		
Measurement range	for nominal deviation of 500 kHz (LE 2 Msymbol/s)	±175 kHz
	for nominal deviation of 250 kHz (LE long range)	
Uncertainty	for deviation ≤ 500 kHz (LE 2 Msymbol/s)	< 2 kHz
	for deviation ≤ 250 kHz (LE long range)	

Frequency offset		
Measurement range	for nominal deviation of 500 kHz (LE 2 Msymbol/s)	±175 kHz
	for nominal deviation of 250 kHz (LE long range)	
Uncertainty	for deviation ≤ 500 kHz (LE 2 Msymbol/s)	< 2 kHz
	for deviation ≤ 250 kHz (LE long range)	

[29] The maximum permissible continuous power is +34 dBm due to thermal limits.

Frequency deviation		
Measurement range	without frequency offset (LE 2 Msymbol/s)	≤ 700 kHz
	without frequency offset (LE long range)	≤ 350 kHz
Uncertainty	for modulation index 0.40 to 0.60	< 0.5 %

Frequency drift		
Measurement range		±75 kHz
Uncertainty	measured in burst referenced to frequency offset in preamble	< 2 kHz
	referenced to measured frequency offset value in preamble (relative frequency drift)	≤ 1 kHz

GPS specifications

Standard		GPS

GPS RF generator

Frequency range	GPS band	
	L1	1575.42 MHz
	L2	1227.6 MHz

GPS R&S®WinIQSIM2 (R&S®CMW-KW620 option)

Arbitrary waveform file		GPS_DEFAULT.WV (PAR = 3.66 dB)

Output level range	depends on PAR	see general technical specifications
Output level uncertainty	waveform file used: GPS_DEFAULT.WV	see general technical specifications
Output level resolution		see general technical specifications

DVB specifications

Standard		DVB-T

DVB RF generator

Frequency range	VHF band III	
	channels 5 to 12	174 MHz to 230 MHz
	UHF band IV	
	channels 21 to 34	470 MHz to 582 MHz
	UHF band V	
	channels 35 to 69	582 MHz to 862 MHz

DVB WinIQSIM2 (R&S®CMW-KW630 option)

Arbitrary waveform file		DVB-T_SCRAMBLED_16QAM_3SEC_ TESTFILE.WV (PAR = 13.23 dB)

Output level range	depends on PAR	see general technical specifications
Output level uncertainty	waveform file used: DVB-T_SCRAMBLED_16QAM_3SEC_ TESTFILE.WV	see general technical specifications
Output level resolution		see general technical specifications

FM STEREO RADIO specifications

Standard		FM STEREO RADIO

FM STEREO RADIO generator

Frequency range	FM	70 MHz to 110 MHz

FM STEREO RADIO waveforms (R&S®CMW-KV645 option)

Arbitrary waveform file		FM_M_M1K0_D75K0.WV (PAR = 0.00 dB)

Output level range	depends on PAR	see general technical specifications
Output level uncertainty	waveform file used: FM_M_M1K0_D75K0.WV	see general technical specifications
Output level resolution		see general technical specifications

Signal quality	RMS detector *SQRT(2)	
Deviation error	waveform file used: FM_M_M1K0_D75K0.WV	< 1 %

WLAN specifications

WLAN RF generator

Standards	IEEE 802.11a/g/p/n OFDM	R&S®CMW-KW650 option
	IEEE 802.11b/g DSSS	R&S®CMW-KW650 option
	IEEE 802.11ac	R&S®CMW-KW656 option
	IEEE 802.11ax	R&S®CMW-KW657 option

Bandwidth		up to 160 MHz

Frequency range	2.4 GHz band, IEEE 802.11b/g/p/n	2412 MHz to 2484 MHz
	5 GHz band, IEEE 802.11a/n/ac/ax, prerequisite: R&S®CMW-K046 option	5000 MHz to 6000 MHz

Output level range	depends on PAR	see general technical specifications
Output level uncertainty		see general technical specifications
Output level resolution		see general technical specifications

Signal quality		
Error vector magnitude (EVM)	IEEE 802.11 a/g/p/n/ac	
	bandwidth: 5 MHz	< –42 dB RMS
	bandwidth: 10 MHz, 20 MHz, 40 MHz	< –44 dB RMS
	bandwidth: 80 MHz, 80+80 MHz	< –42 dB RMS
	bandwidth: 160 MHz	< –40 dB RMS
	IEEE 802.11 ax	
	bandwidth: 20 MHz, 40 MHz	< –42 dB RMS
	bandwidth: 80 MHz, 80+80 MHz	< –40 dB RMS
	bandwidth: 160 MHz	< –38 dB RMS
	IEEE 802.11 b/g DSSS	< 4 %, peak
Prerequisites	channel estimation (OFDM)	based on payload

Arbitrary waveform files	IEEE 802.11a/g OFDM	WLAN_A_G_OFDM_64QAM.WV (PAR = 10.01 dB)
	IEEE 802.11b DSSS	WLAN_B_CCK_DQPSK.WV (PAR = 1.48 dB)
	IEEE 802.11n	WLAN_N_64QAM_5_6.WV (PAR = 10.01 dB)
	IEEE 802.11ac 20 MHz	WLAN_VHT_BW20_MCS8_LEN4096.WV (PAR = 9.57 dB)
	IEEE 802.11ac 40 MHz	WLAN_VHT_BW40_MCS8_LEN4096.WV (PAR = 11.23 dB)
	IEEE 802.11ac 80 MHz	WLAN_VHT_BW80_MCS8_LEN4096.WV (PAR = 10.24 dB)
	IEEE 802.11ac 160 MHz	WLAN_VHT_BW160_MCS9_SYM20.WV (PAR = 10.45 dB)
	IEEE 802.11ax 20 MHz	WLAN_HE_SU_BW20_4xLTF_GI32_MCS11_SYM16.WV (PAR = 9.59 dB)
	IEEE 802.11ax 40 MHz	WLAN_HE_SU_BW40_4xLTF_GI32_MCS11_SYM16.WV (PAR = 9.89 dB)
	IEEE 802.11ax 80 MHz	WLAN_HE_SU_BW80_4xLTF_GI32_MCS11_SYM16.WV (PAR = 9.88 dB)
	IEEE 802.11ax 160 MHz	WLAN_HE_SU_BW160_4xLTF_GI32_MCS11_SYM16.WV (PAR = 11.03 dB)

WLAN OFDM RF analyzer

Standards	IEEE 802.11a/g	R&S®CMW-KM650 option
	IEEE 802.11n	R&S®CMW-KM651 option
	IEEE 802.11p	R&S®CMW-KM655 option
	IEEE 802.11ac	R&S®CMW-KM656 option
	IEEE 802.11ax	R&S®CMW-KM657 option

Receive modes	SISO	requires above options for standards
	composite MIMO	R&S®CMW-KM652 option
	switched MIMO	R&S®CMW-KM653 option

Bandwidth	IEEE 802.11a/g	20 MHz
	IEEE 802.11n	20 MHz, 40 MHz
	IEEE 802.11p	5 MHz, 10 MHz, 20 MHz
	IEEE 802.11ac/ax	20 MHz, 40 MHz, 80 MHz, 80+80 MHz, 160 MHz
		80+80 MHz can be measured simultaneously on same or on separate antenna ports with any channel spacing
Frequency range	2.4 GHz band, IEEE 802.11g/p/n	2412 MHz to 2484 MHz
	5 GHz band, IEEE 802.11a/n/ac/ax, prerequisite: R&S®CMW-K046 option	5000 MHz to 6000 MHz, for frequency exceptions for inherent spurious response, see general technical specifications

Statistics		
Statistical count		1 to 1000
Values		current, average, maximum, minimum, standard deviation

Trigger		
Trigger sources		WLAN: IF power, BASE: external TRIG IN, GPRF: Gen

Modulation analysis

Level range		–28 dBm to +36 dBm [30]
Payload length		1 to 1377 data symbols
Modulations		BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM
Burst types	IEEE 802.11a/g/p	non HT
	IEEE 802.11n	HT mixed-format, HT Greenfield
	IEEE 802.11ac	VHT mixed-format
	IEEE 802.11ax	HE single user (HE_SU), HE trigger based (HE_TRIG) HEmMultiuser (HE_MU)
MIMO	switched and composite	up to 8 × 8

[30] The maximum permissible continuous power is +34 dBm due to thermal limits.

Measured results	scalar SISO results	burst and signal field information, burst power, peak power, crest factor, EVM all carriers, EVM data carriers, EVM pilot carriers, center frequency error, symbol clock error, I/Q offset, DC power, gain imbalance, quadrature error timing error
	additional scalar results for IEEE 802.11ax	EVM per user (HE_MU), unused tone error (HE_TRIG)
	graphical SISO results	EVM versus symbol, EVM versus carrier, I/Q constellation, spectrum flatness, power versus time
	additional graphical results for IEEE 802.11ax	EVM versus user (HE_MU), unused tone error (HE_TRIG)
	switched MIMO results	same as SISO results, SISO results per antenna or stream
	composite MIMO results	EVM all carriers, EVM data carriers, EVM pilot carriers, total power, total peak power, power per space time stream, center frequency error symbol clock error

Error vector magnitude (EVM)		
Inherent EVM (RMS)	IEEE 802.11 a/g/p/n/ac	
	bandwidth: 5 MHz	< –44 dB
	bandwidth: 10 MHz, 20 MHz, 40 MHz	< –46 dB
	bandwidth: 80 MHz, 80+80 MHz	< –44 dB
	bandwidth: 160 MHz	< –42 dB
	IEEE 802.11 ax	
	bandwidth: 20 MHz, 40 MHz	< –44 dB
	bandwidth: 80 MHz, 80+80 MHz	< –42 dB
	bandwidth: 160 MHz	< –40 dB
Prerequisites	expected nominal power setting	≥ –8 dBm for 2.4 GHz band
		≥ +2 dBm for 5 GHz band
	channel estimation	based on payload
	burst length	> 16 symbols
	average	> 20 packets

Center frequency error		
Frequency measurement uncertainty	2.4 GHz band	< 20 Hz + drift of timebase, see general technical specifications
	5 GHz band	< 35 Hz + drift of timebase, see general technical specifications
Prerequisites	measurement length	≥ 100 symbols

Symbol clock error		
Uncertainty		< 1 ppm

I/Q offset		
Inherent I/Q offset	for average ≥ 10 measurements	< –45 dB

Spectrum flatness		
Level uncertainty	bandwidth: 5 MHz, 10 MHz, 20 MHz	≤ 0.8 dB
	bandwidth: 40 MHz, 80 MHz, 160 MHz	≤ 1.0 dB

Spectrum measurements

Transmit spectrum mask		
Frequency span	4 × of used WLAN bandwidth	40 MHz to 640 MHz
Limit masks		IEEE, ETSI, ARIB
Resolution bandwidth	IEEE, ARIB	100 kHz
	ETSI	1 MHz
Dynamic range		in line with IEEE standard
Expected nominal power setting for full dynamic range	2.4 GHz band	+2 dBm to +42 dBm [31]
	5 GHz band	+12 dBm to +42 dBm [31]

WLAN DSSS RF analyzer

Standards	IEEE 802.11b/g	R&S®CMW-KM650 option

Frequency range	2.4 GHz band	2412 MHz to 2484 MHz

Statistics		
Statistical count		1 to 1000
Values		current, average, maximum, standard deviation

Trigger		
Trigger sources		WLAN: IF power, BASE: external TRIG IN, GPRF: Gen

Modulation analysis

Level range		–28 dBm to +36 dBm [31]
Payload length		1000 to 362472 chips
Modulations		1 Mbps DBPSK, 2 Mbps DQPSK, 5.5 Mbps CCK, 11 Mbps CCK
Measured parameters	scalar results	burst and signal field information, burst power, EVM peak, EVM RMS, center frequency error, chip clock error, I/Q offset, gain imbalance, quadrature error, rise/fall time
	graphical results	EVM versus chip, I/Q constellation, power versus time

Error vector magnitude (EVM)		
Inherent EVM		< 5 %, peak
		< 2 %, RMS
Prerequisites	input level	–18 dBm ≤ input level ≤ +36 dBm [31], RMS
	measurement length	1000 chips

Center frequency error		
Frequency measurement uncertainty		< 20 Hz + drift of timebase, see general technical specifications

Chip clock error		
Uncertainty		< 1 ppm

I/Q offset		
Inherent I/Q offset	OFDM, for average ≥ 10 measurements	< –45 dB

[31] The maximum permissible continuous power is +34 dBm due to thermal limits.

Spectrum measurements

Transmit spectrum mask		
Frequency span		80 MHz
Resolution bandwidth	IEEE	100 kHz
Dynamic range		in line with IEEE standard
Limit masks		IEEE
Expected nominal power setting for full dynamic range		+2 dBm to +42 dBm [32]

[32] The maximum permissible continuous power is +34 dBm due to thermal limits.

LR-WPAN specifications

Standard	low-rate wireless personal area networks	IEEE 802.15.4™ - 2011

LR-WPAN RF generator

Frequency range	2450 MHz O-QPSK PHY	2405 MHz to 2480 MHz

LR-WPAN waveforms (R&S®CMW-KV680 option)

Arbitrary waveform file	2450 MHz O-QPSK PHY	LRWPAN_2450MHz_OQPSK_127Bytes_PRBS9.WV (PAR = 0.06 dB)

Output level range	depends on PAR	see general technical specifications
Output level uncertainty	waveform file used: LRWPAN_2450MHz_OQPSK_127Bytes_PRBS9.WV	see general technical specifications
Output level resolution		see general technical specifications

Signal quality		
Offset error vector magnitude	measured over the PHY service data unit (PSDU), waveform files used: LRWPAN_2450MHz_OQPSK_127Bytes_PRBS9.WV	< 2 %, RMS

LR-WPAN RF analyzer (R&S®CMW-KM680 option)

Frequency range	2450 MHz O-QPSK PHY	2405 MHz to 2480 MHz

Statistics		
Statistical count		1 to 1000
Values		current, average, maximum, minimum, standard deviation

Trigger		
Trigger sources		LRWPAN: IF power

Modulation analysis

Level range		–35 dBm to +36 dBm [33]
Supported PHYs		2450 MHz O-QPSK PHY
Measured parameters	2450 MHz O-QPSK PHY	frequency accuracy, symbol rate error, offset RMS EVM PSDU, offset peak EVM PSDU

Frequency accuracy	2450 MHz O-QPSK PHY	
Measurement range		±800 kHz
Uncertainty		< 20 Hz + drift of timebase, see general technical specifications

Offset EVM PSDU	2450 MHz O-QPSK PHY	
Inherent EVM	for PRBS pattern	< 2 %, RMS

[33] The maximum permissible continuous power is +34 dBm due to thermal limits.

TD-SCDMA specifications – mobile station (UE) test

Standard		TD-SCDMA CWTS

TD-SCDMA RF generator

Frequency range [34]	TD-SCDMA band A	
	channels 10054 to 10121	2010.8 MHz to 2024.2 MHz
	TD-SCDMA band E	
	channels 11504 to 11996	2300.8 MHz to 2399.2 MHz
	TD-SCDMA band F	
	channels 9404 to 9596	1880.8 MHz to 1919.2 MHz

TD-SCDMA R&S®WinIQSIM2 (R&S®CMW-KW750 option) and TD-SCDMA Enhanced R&S®WinIQSIM2 (R&S®CMW-KW751 option)

Arbitrary waveform files	with the R&S®CMW-KW750 option	TD-SCDMA_DEFAULT.WV (PAR = 3.14 dB), TD-SCDMA_PTWLOW.WV (PAR = 2.67 dB)
	with the R&S®CMW-KW750 and R&S®CMW-KW751 options	TD-SCDMA-DL_12K2.WV (PAR = 5.41 dB)

Output level range	depends on PAR	see general technical specifications
Output level uncertainty	waveform file used: TD-SCDMA_PTWLOW.WV	see general technical specifications
Output level resolution		see general technical specifications

Signal quality		
Error vector magnitude (EVM)	composite EVM, waveform file used: TD-SCDMA_DEFAULT.WV	< 4 %, RMS

TD-SCDMA RF analyzer (R&S®CMW-KM750 option)

Frequency range [34]	TD-SCDMA band A	
	channels 10054 to 10121	2010.8 MHz to 2024.2 MHz
	TD-SCDMA band E	
	channels 11504 to 11996	2300.8 MHz to 2399.2 MHz
	TD-SCDMA band F	
	channels 9404 to 9596	1880.8 MHz to 1919.2 MHz

Statistics		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation

Trigger		
Trigger sources		• BASE: external TRIG IN • GPRF: Gen • TD-SCDMA: free run • TD-SCDMA: IF power

Modulation analysis

Filter		1.28 MHz, RRC, α = 0.22, TD-SCDMA filter
Level range		–28 dBm to +36 dBm [35]
Analysis modes	TD-SCDMA uplink	QPSK, DPCH, QPSK, DPCH + HSDPA, 16QAM, DPCH + HSUPA

[34] Bands A, E, F in line with the CCSA standard.

[35] The maximum permissible continuous power is +34 dBm due to thermal limits.

Measured parameters	numeric results and standard deviation	error vector magnitude (EVM), magnitude error (ME), phase error (PE), frequency error, I/Q origin offset, I/Q imbalance, UE power
	graphical	EVM versus time, ME versus time, PE versus time

Error vector magnitude (EVM)		
Measurement range		up to 25 %, RMS
Inherent EVM		< 2.5 %, RMS
Measurement length		1 slot, multislot (1 to 112)

Frequency error		
Measurement range		± 3 kHz
Frequency measurement uncertainty		< 20 Hz + drift of timebase, see general technical specifications

I/Q origin offset		
Inherent I/Q offset	for average ≥ 10 measurements	< –55 dB

I/Q imbalance		
Inherent I/Q imbalance		< –50 dB

Code domain

Filter		1.28 MHz, RRC, α = 0.22, TD-SCDMA filter
Level range		–28 dBm to +36 dBm [36]
Analysis modes	TD-SCDMA uplink	QPSK, DPCH, QPSK, DPCH + HSDPA, 16QAM, DPCH + HSUPA
Measured parameters	numeric results and standard deviation	code domain error (CDE)
	graphical	code domain power versus code

Code domain power versus code		
Uncertainty		< 0.4 dB
Measurement length		1 slot

Code domain error (CDE)		
Uncertainty		< 0.4 dB
Measurement length		1 slot

Spectrum measurements

Adjacent channel leakage ratio	RMS detector	
Filter		1.28 MHz, RRC, α = 0.22, TD-SCDMA filter
Dynamic range	first adjacent channel at ±1.6 MHz	> 53 dB
	second adjacent channel at ±3.2 MHz	> 61 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	–3 dBm to +36 dBm [36]

Uncertainty	for –33 dBc first adjacent channel level	< 0.5 dB
	for –43 dBc second adjacent channel level	< 0.5 dB
Measurement length		1 slot

[36] The maximum permissible continuous power is +34 dBm due to thermal limits.

Power meter

Measured parameters	numeric current RMS values	UE power

UE power	RMS detector	
Filter		bandpass, 2.1 MHz, RRC, α = 0.22
Level range		–55 dBm to +36 dBm [37]
Level uncertainty		see general technical specifications
Measurement length		1 slot

[37] The maximum permissible continuous power is +34 dBm due to thermal limits.

CDMA2000® 1xRTT specifications – mobile station test

Standard	CDMA2000® standards	TIA/EIA IS-2000 Rev. 0
	CDMA2000® test standards	TIA/EIA IS-98-F
Symbol rate		1.2288 Mcps

CDMA2000® 1xRTT RF generator

Frequency range	band class 0	860.025 MHz to 893.985 MHz
	band class 1	1930.000 MHz to 1990.000 MHz
	band class 2	917.0125 MHz to 959.9875 MHz
	band class 3	832.0125 MHz to 869.9875 MHz
	band class 4	1840.000 MHz to 1870.000 MHz
	band class 5	421.675 MHz to 493.480 MHz
	band class 6	2110.000 MHz to 2169.950 MHz
	band class 7	746.000 MHz to 764.000 MHz
	band class 8	1805.000 MHz to 1879.950 MHz
	band class 9	925.000 MHz to 958.750 MHz
	band class 10	851.000 MHz to 939.975 MHz
	band class 11	421.675 MHz to 493.475 MHz
	band class 12	915.0125 MHz to 920.9875 MHz
	band class 13	2620.000 MHz to 2690 MHz
	band class 14	1930.000 MHz to 1995.000 MHz
	band class 15	2110.000 MHz to 2155.000 MHz
	band class 16	2624.000 MHz to 2690.000 MHz
	band class 17	2624.000 MHz to 2690.000 MHz
	band class 18	757.000 MHz to 769.000 MHz
	band class 19	728.000 MHz to 746.000 MHz
	band class 20	1525.000 MHz to 1559.000 MHz
	band class 21	2190.000 MHz to 2200.000 MHz

CDMA2000® R&S®WinIQSIM2 (R&S®CMW-KW800 option)

Arbitrary waveform files		CDMA_OQPSK.WV (PAR = 5.54 dB) or CDMA_HPSK.WV (PAR = 6.97 dB)

Output level range	depends on PAR	see general technical specifications
Output level uncertainty	waveform file used: CDMA_OQPSK.WV or CDMA_HPSK.WV	see general technical specifications
Output level resolution		see general technical specifications

Signal quality		
Waveform quality (rho)	waveform file used: CDMA_OQPSK.WV or CDMA_HPSK.WV	> 0.99

CDMA2000® RF analyzer (R&S®CMW-KM800 option)

Frequency range	band class 0	815.025 MHz to 848.985 MHz
	band class 1	1850.000 MHz to 1910.000 MHz
	band class 2	872.0125 MHz to 914.9875 MHz
	band class 3	887.0125 MHz to 924.9875 MHz
	band class 4	1750.000 MHz to 1780.000 MHz
	band class 5	411.675 MHz to 483.480 MHz
	band class 6	1920.000 MHz to 1979.950 MHz
	band class 7	776.000 MHz to 794.000 MHz
	band class 8	1710.000 MHz to 1784.950 MHz
	band class 9	880.000 MHz to 913.750 MHz
	band class 10	806.000 MHz to 900.975 MHz
	band class 11	411.675 MHz to 483.475 MHz
	band class 12	870.0125 MHz to 875.9875 MHz
	band class 13	2500.000 MHz to 2570.000 MHz
	band class 14	1850.000 MHz to 1915.000 MHz
	band class 15	1710.000 MHz to 1755.000 MHz
	band class 16	2502.000 MHz to 2568.000 MHz
	band class 17	2502.000 MHz to 2567.950 MHz
	band class 18	787.000 MHz to 700.000 MHz
	band class 19	698.000 MHz to 716.000 MHz
	band class 20	1626.500 MHz to 1660.500 MHz
	band class 21	2000.000 MHz to 2029.950 MHz

Statistics		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation

Trigger		
Trigger sources		• BASE: external TRIG IN • GPRF: Gen • C2K: free run • CDMA2000® signaling: superframe (80 ms)

Modulation analysis

Filter		1.23 MHz, RRC, α = 0.22, CDMA filter
Level range		–28 dBm to +36 dBm [38]
Analysis modes		OQPSK, HPSK
Measured parameters	numeric results and standard deviation	error vector magnitude (EVM), magnitude error (ME), phase error (PE), frequency error, rho, carrier feedthrough, I/Q imbalance, power, wideband power (8 MHz), narrowband power (1.23 MHz)
	graphical	EVM versus time, ME versus time, PE versus time

Waveform quality (rho)		
Uncertainty	for rho 0.9 to 1	< 0.003
Measurement length		616 chip (0.5 ms)

Error vector magnitude (EVM)		
Measurement range		up to 25 %, RMS
Inherent EVM		< 2.5 %, RMS
Measurement length		0.5 ms

[38] The maximum permissible continuous power is +34 dBm due to thermal limits.

Frequency error		
Measurement range		±3 kHz
Frequency measurement uncertainty		< 20 Hz + drift of timebase, see general technical specifications

Carrier feedthrough		
Inherent carrier feedthrough	for average ≥ 10 measurements	< –55 dB

I/Q imbalance		
Inherent I/Q imbalance		< –50 dB

Code domain

Filter		1.23 MHz, RRC, α = 0.22, CDMA filter
Level range		–28 dBm to +36 dBm [39]
Measured parameters	numeric values of current, average, max. and min. values	code domain power (CDP), code domain error (CDE)
	graphical	code domain power versus code, code domain error versus code

Code domain power versus code		
Uncertainty		< 0.4 dB
Measurement length		616 chip (0.5 ms)

Code domain error versus code		
Measurement uncertainty		< 0.4 dB
Measurement length		616 chip (0.5 ms)

Spectrum measurements

Adjacent channel power	RMS detector, at the selected frequency offsets	
Filter	Gaussian	1 kHz, 6.25 kHz, 10 kHz, 12.5 kHz, 25 kHz, 30 kHz, 50 kHz
	Nyquist	100 kHz, 1 MHz, 1.23 MHz
Frequency offset interval	up to 20 adjacent channels on each side	–4 MHz to +4 MHz
Dynamic range		> 70 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	+1 dBm to +36 dBm [39]
Uncertainty	for –43 dBc adjacent channel level	< 0.5 dB
Measurement length	one power control group	1536 chip (1.25 ms)

Power meter

MS power		
Filter	narrowband	bandpass, 1.25 MHz
Filter	wideband	bandpass, 8 MHz
Level range		–55 dBm to +36 dBm [39]
Level uncertainty		see general technical specifications
Measurement length		616 chip (0.5 ms)

[39] The maximum permissible continuous power is +34 dBm due to thermal limits.

CDMA2000® 1xEV-DO specifications – access terminal test

Standard	CDMA2000® 1xEV-DO standards	TIA/EIA 856-2
	CDMA2000® 1xEV-DO test standards	TIA/EIA 866-A, TIA/EIA 866-B
Symbol rate		1.2288 Mcps

CDMA2000® 1xEV-DO RF generator

Frequency range	band class 0	860.025 MHz to 893.985 MHz
	band class 1	1930.000 MHz to 1990.000 MHz
	band class 2	917.0125 MHz to 959.9875 MHz
	band class 3	832.0125 MHz to 869.9875 MHz
	band class 4	1840.000 MHz to 1870.000 MHz
	band class 5	421.675 MHz to 493.480 MHz
	band class 6	2110.000 MHz to 2169.950 MHz
	band class 7	746.000 MHz to 764.000 MHz
	band class 8	1805.000 MHz to 1879.950 MHz
	band class 9	925.000 MHz to 958.750 MHz
	band class 10	851.000 MHz to 939.975 MHz
	band class 11	421.675 MHz to 493.475 MHz
	band class 12	915.0125 MHz to 920.9875 MHz
	band class 13	2620.000 MHz to 2690 MHz
	band class 14	1930.000 MHz to 1995.000 MHz
	band class 15	2110.000 MHz to 2155.000 MHz
	band class 16	2624.000 MHz to 2690.000 MHz
	band class 17	2624.000 MHz to 2690.000 MHz
	band class 18	757.000 MHz to 769.000 MHz
	band class 19	728.000 MHz to 746.000 MHz
	band class 20	1525.000 MHz to 1559.000 MHz
	band class 21	2190.000 MHz to 2200.000 MHz

1xEV-DO R&S®WinIQSIM2 (R&S®CMW-KW880 option)

Arbitrary waveform file		EVDO_DEFAULT.WV (PAR = 4.85 dB)

Output level range	depends on PAR	see general technical specifications
Output level uncertainty	waveform file used: EVDO_DEFAULT.WV	see general technical specifications
Output level resolution		see general technical specifications

Signal quality		
Waveform quality (rho)	waveform file used: EVDO_DEFAULT.WV	> 0.99

CDMA2000® 1xEV-DO RF analyzer (R&S®CMW-KM880 option)

Frequency range	band class 0	815.025 MHz to 848.985 MHz
	band class 1	1850.000 MHz to 1910.000 MHz
	band class 2	872.0125 MHz to 914.9875 MHz
	band class 3	887.0125 MHz to 924.9875 MHz
	band class 4	1750.000 MHz to 1780.000 MHz
	band class 5	411.675 MHz to 483.480 MHz
	band class 6	1920.000 MHz to 1979.950 MHz
	band class 7	776.000 MHz to 794.000 MHz
	band class 8	1710.000 MHz to 1784.950 MHz
	band class 9	880.000 MHz to 913.750 MHz
	band class 10	806.000 MHz to 900.975 MHz
	band class 11	411.675 MHz to 483.475 MHz
	band class 12	870.0125 MHz to 875.9875 MHz
	band class 13	2500.000 MHz to 2570.000 MHz
	band class 14	1850.000 MHz to 1915.000 MHz
	band class 15	1710.000 MHz to 1755.000 MHz
	band class 16	2502.000 MHz to 2568.000 MHz
	band class 17	2502.000 MHz to 2567.950 MHz
	band class 18	787.000 MHz to 700.000 MHz
	band class 19	698.000 MHz to 716.000 MHz
	band class 20	1626.500 MHz to 1660.500 MHz
	band class 21	2000.000 MHz to 2029.950 MHz

Statistics		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation
Trigger		
Trigger sources		• BASE: external TRIG IN • GPRF: Gen • 1xEV-DO: free run • 1xEV-DO signaling: superframe (80 ms)

Modulation analysis

Filter		1.23 MHz, RRC, α = 0.22, CDMA filter
Level range		–28 dBm to +36 dBm [40]
Analysis modes		dual BPSK
Multicarrier		single carrier or 3 carriers within –8 MHz to +8 MHz
Measured parameters	numeric results and standard deviation	error vector magnitude (EVM), magnitude error (ME), phase error (PE), frequency error, rho, carrier feedthrough, I/Q imbalance, power, wideband power (8 MHz for single carrier or 16 MHz for multicarrier), narrowband power (1.23 MHz)
	graphical	EVM versus time, ME versus time, PE versus time

Waveform quality (rho)		
Uncertainty	for rho 0.9 to 1	< 0.003
Measurement length	half-slot	1024 chip (833.33 µs)

Error vector magnitude (EVM)		
Measurement range		up to 25 %, RMS
Inherent EVM		< 2.5 %, RMS
Measurement length	half-slot	1024 chip (833.33 µs)

Frequency error		
Measurement range		±3 kHz
Frequency measurement uncertainty		< 20 Hz + drift of timebase, see general technical specifications

Carrier feedthrough		
Inherent carrier feedthrough	for average ≥ 10 measurements	< –55 dB

I/Q imbalance		
Inherent I/Q imbalance		< –50 dB

[40] The maximum permissible continuous power is +34 dBm due to thermal limits.

Code domain

Filter		1.23 MHz, RRC, α = 0.22, CDMA filter
Level range		–28 dBm to +36 dBm [41]
Measured parameters	numeric values of current, average, max. and min. values	code domain power (CDP), code domain error (CDE)
	graphical	code domain power versus code, code domain error versus code

Code domain power versus code		
Uncertainty		< 0.4 dB
Measurement length	half-slot	1024 chip (833.33 µs)

Code domain error versus code		
Measurement uncertainty		< 0.4 dB
Measurement length	half-slot	1024 chip (833.33 µs)

Spectrum measurements

Adjacent channel power	RMS detector, at the selected frequency offsets	
Filter	Gaussian	1 kHz, 6.25 kHz, 10 kHz, 12.5 kHz, 25 kHz, 30 kHz, 50 kHz
	Nyquist	100 kHz, 1 MHz, 1.23 MHz
Frequency offset interval	up to 20 adjacent channels on each side	–4 MHz to +4 MHz to each carrier
Dynamic range		> 70 dB
Expected nominal power setting for full dynamic range	RF1 COM, RF2 COM	+1 dBm to +36 dBm [41]
Uncertainty	for –43 dBc adjacent channel level	< 0.5 dB
Measurement length	half-slot	1024 chip (833.33 µs)

Power meter

MS power		
Filter	narrowband	bandpass, 1.25 MHz
Filter	wideband	bandpass, 8 MHz for single carrier or 16 MHz for multicarrier
Level range		–55 dBm to +36 dBm [41]
Level uncertainty		see general technical specifications
Measurement length	half-slot	1024 chip (833.33 µs)

[41] The maximum permissible continuous power is +34 dBm due to thermal limits.

NR specifications – mobile station test

Standard		NR sub6 GHz

NR sub6G RF analyzer (R&S®CMW-KM6000 and R&S®CMW-KM6002 options, carrier aggregation)

Bandwidth		5 MHz, 10 MHz, 15 MHz, 20 MHz, 25 MHz, 30 MHz, 35 MHz, 40 MHz, 45 MHz, 50 MHz, 60 MHz, 70 MHz, 80 MHz, 90 MHz, 100 MHz

Frequency range	NR band n1, FDD	1920 MHz to 1980 MHz
	NR band n2, FDD	1850 MHz to 1910 MHz
	NR band n3, FDD	1710 MHz to 1785 MHz
	NR band n5, FDD	824 MHz to 849 MHz
	NR band n7, FDD	2500 MHz to 2570 MHz
	NR band n8, FDD	880 MHz to 915 MHz
	NR band n12, FDD	699 MHz to 716 MHz
	NR band n13, FDD	777 MHz to 787 MHz
	NR band n14, FDD	788 MHz to 798 MHz
	NR band n18, FDD	815 MHz to 830 MHz
	NR band n20, FDD	832 MHz to 862 MHz
	NR band n24, FDD	1626.5 MHz to 1660.5 MHz
	NR band n25, FDD	1850 MHz to 1915 MHz
	NR band n26, FDD	814 MHz to 849 MHz
	NR band n28, FDD	703 MHz to 748 MHz
	NR band n30, FDD	2305 MHz to 2315 MHz
	NR band n34, TDD	2010 MHz to 2025 MHz
	NR band n38, TDD	2570 MHz to 2620 MHz
	NR band n39, TDD	1880 MHz to 1920 MHz
	NR band n40, TDD	2300 MHz to 2400 MHz
	NR band n41, TDD	2496 MHz to 2690 MHz
	NR band n46, TDD	5150 MHz to 5925 MHz
	NR band n47, TDD	5855 MHz to 5925 MHz
	NR band n48, TDD	3550 MHz to 3700 MHz
	NR band n50, TDD	1432 MHz to 1517 MHz
	NR band n51, TDD	1427 MHz to 1432 MHz
	NR band n53, TDD	2483.5 MHz to 2495 MHz
	NR band n65, FDD	1920 MHz to 2010 MHz
	NR band n66, FDD	1710 MHz to 1780 MHz
	NR band n70, FDD	1695 MHz to 1710 MHz
	NR band n71, FDD	663 MHz to 698 MHz
	NR band n74, FDD	1427 MHz to 1470 MHz
	NR band n77, TDD	3300 MHz to 4200 MHz
	NR band n78, TDD	3300 MHz to 3800 MHz
	NR band n79, TDD	4400 MHz to 5000 MHz
	NR band n80, SUL	1710 MHz to 1785 MHz
	NR band n81, SUL	880 MHz to 915 MHz
	NR band n82, SUL	832 MHz to 862 MHz
	NR band n83, SUL	703 MHz to 748 MHz
	NR band n84, SUL	1920 MHz to 1980 MHz
	NR band n85, FDD	698 MHz to 716 MHz
	NR band n86, SUL	1710 MHz to 1780 MHz
	NR band n89, SUL	824 MHz to 849 MHz
	NR band n90, TDD	2496 MHz to 2690 MHz
	NR band n91, FDD	832 MHz to 862 MHz
	NR band n92, FDD	832 MHz to 862 MHz
	NR band n93, FDD	880 MHz to 915 MHz
	NR band n94, FDD	880 MHz to 915 MHz
	NR band n95, SUL	2010 MHz to 2025 MHz
	NR band n97, SUL	2300 MHz to 2400 MHz
	NR band n98, SUL	1880 MHz to 1920 MHz
	NR band n99, SUL	1626.5 MHz to 1660.5 MHz

Statistics		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation

Trigger		
Trigger sources		• BASE: external TRIG IN • GPRF: Gen • NR: free run (fast sync) • NR: IF power

Power measurement

Slot power	RMS detector	
Level range		–50 dBm to +30 dBm, RMS
Level uncertainty		see general technical specifications

Modulation analysis

Measured parameters	numeric results	error vector magnitude (EVM), magnitude error (ME), phase error (PE), frequency error, I/Q origin offset, TX power, peak power, resource block power (RB power)
	graphical	EVM vs OFDM symbol, ME vs OFDM symbol, PE vs OFDM symbol, EVM vs Subcarrier, Inband Emissions, Equalizer Spectrum Flatness, I/Q Constellation

Error vector magnitude (EVM)		
Inherent EVM	transmission bandwidth ≤ 25 MHz	
	–31 dBm ≤ input level < +30 dBm, RMS	< 1 %, RMS
	–39 dBm ≤ input level < –31 dBm, RMS	< 2 %, RMS
	transmission bandwidth ≤ 50 MHz	
	–28 dBm ≤ input level ≤ +30 dBm, RMS	< 1 %, RMS
	–36 dBm ≤ input level < –28 dBm, RMS	< 2 %, RMS
	transmission bandwidth ≤ 100 MHz	
	–25 dBm ≤ input level ≤ +30 dBm, RMS	< 1 %, RMS
	–33 dBm ≤ input level < –25 dBm, RMS	< 2 %, RMS

Frequency error		
Measurement range		±80 kHz
Frequency measurement uncertainty	< 3.3 GHz	< 20 Hz [42] + drift of timebase, see general technical specifications
	< 6 GHz	< 35 Hz + drift of timebase, see general technical specifications

I/Q origin offset		
Inherent I/Q offset	for average ≥ 10 measurements	< – 50 dBc

In-band emissions		
Dynamic range	transmission bandwidth ≤ 50 %	> 40 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

Equalizer spectrum flatness		
Level uncertainty	transmission bandwidth ≤ 100 MHz	< 1 dB

[42] For frequency error measurements relative to the downlink signal of the same R&S®CMW100, the uncertainty is in line with 3GPP TS 38.521-1 V16.3.0.

Spectrum measurements

Adjacent channel leakage ratio		
Filter	NR	rectangle filters, 4.515 MHz, 9.375 MHz, 14.235 MHz, 19.095 MHz, 23.955 MHz, 38.895 MHz, 48.615 MHz, 58.35 MHz, 78.15 MHz, 98.31 MHz
	UTRA	3.84 MHz, RRC, α = 0.22, WCDMA filter
Dynamic range	NR	> 38 dB
	UTRA	> 50 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

Spectrum emission mask (SEM)		
Frequency span	100 MHz channel bandwidth	310 MHz
Noise floor	RBW: 1 MHz	< –35 dBm
	RBW: 30 kHz	< –45 dBm

General data

RF connectors (front panel)		SnapN female, 50 Ω, compatible with N female connectors
RF 1 TO RF 8		combined RF input and RF output
TX AUX		RF output

Control interface (rear panel)		
USB	max. length 3 m	USB 3.0 type B connector

Trigger interface (rear panel)	trigger input/output	2 × BNC connector
	output trigger sources	standard-specific internal trigger sources

Power input (rear panel)	For safety reasons, the instrument is only to be used with the Rohde & Schwarz AC adapter (order no. 1210.7812.00).	DC socket
Rated voltage		24 V DC (± 10 %)
Rated current		max. 5 A
Power consumption		max. 80 W

Environmental conditions		
Temperature	operating temperature range	+5 °C to +45 °C
	storage temperature range	–25 °C to +60 °C
Damp heat		+40 °C, 80 % rel. humidity, steady state, in line with EN 600068-2-78

Product conformity		
Electromagnetic compatibility	EU: in line with EMC Directive 2014/30/EC	applied harmonized standards: • EN 61326-1 (industrial environment) • EN 61326-2-1 • EN 55011 (class A)
Electrical safety	EU	applied harmonized standard: EN 61010-1
	USA/Canada	applied harmonized standards: • UL 61010-1 • CAN C22.2 No. 61010-1
RoHS	EU: in line with Directive 2011/65/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment	EN 50581

Mechanical resistance	nonoperating mode	
Vibration	sinusoidal	5 Hz to 55 Hz, 0.3 mm double amplitude const., 55 Hz to 150 Hz, 0.5 g const., in line with EN 60068-2-6
Vibration	random	10 Hz to 300 Hz, acceleration 1.2 g RMS, in line with EN 60068-2-64
Shock		40 g shock spectrum, in line with MIL-STD-810, method 516, procedure I

Dimensions	W × H × D, overall	354 mm × 112 mm × 394 mm (14.0 in × 4.4 in × 15.5 in)
Weight		approx. 6.8 kg (15 lb)

Calibration interval	12 months	recommended for highest accuracy, see specified RF generator and RF analyzer level uncertainty
	24 months	add 0.2 dB to specified RF generator and RF analyzer level uncertainty

Accessories delivered with R&S®CMW-PS16 (1210.7629.03/13)

External Rohde & Schwarz AC adapter (1210.7812.00)

The external Rohde & Schwarz AC adapter is required to connect the R&S®CMW100 to AC mains.

Power rating		
Rated voltage		100 V to 240 V AC (± 10 %)
Rated frequency		50 Hz to 60 Hz (± 5 %)
Rated current		max. 1.4 A
Output voltage		24 V DC (± 3 %)
Output current		max. 5 A
Power consumption	with R&S®CMW100 load	see general data
	with no load	approx. 0.15 W

Environmental conditions		
Temperature	operating temperature range	see general data
	storage temperature range	see general data
Damp heat		see general data

Product conformity		
Electromagnetic compatibility	EU: in line with EMC Directive 2014/30/EC	applied harmonized standards: • EN 61000 • EN 55032 class B
Electrical safety	EU: in line with Low Voltage Directive 2014/35/EC	applied harmonized standard: • EN 60950-1
	USA/Canada/Japan	applied standards: • UL/CAN/CSA-C22.2 No. 60950-1 • J60950-1
	Korea	applied standard: • Korea KC

Dimensions	W × H × D, overall	167 mm × 67 mm × 35 mm (6.57 in × 2.64 in × 1.38 in)
Weight		approx. 0.62 kg (1.37 lb)

USB 3.0 cable

The 3 m USB 3.0 cable (type A to type B, included in order no. 1210.7629.03) or the 2 m USB 3.0 cable (type A to type B, included in order no. 1210.7629.13) is required to connect the R&S®CMW100 to a computer.

Ordering information

R&S®CMW100 communications manufacturing test set

Designation	Type	Order No.
Communications manufacturing test set	R&S®CMW100	1201.0002K06
R&S®CMW100 hardware kit 1	R&S®CMW-PS16	1210.7629.03
R&S®CMW100 hardware kit 2	R&S®CMW-PS16	1210.7629.13
Documentation of calibration values	R&S®DCV-2	0240.2193.08
Printout of DCV	R&S®DCV-ZP	1173.6506.02
R&S®CMW100 extended frequency range, 4 GHz to 6 GHz	R&S®CMW-PK461	1210.7129.02
R&S®CMW100 GSM WCDMA, TX measurements, UL	R&S®CMW-PKM121	1210.7164.02
R&S®CMW100 LTE, TX measurements, UL	R&S®CMW-PKM151	1210.7187.02
R&S®CMW100 TD-SCDMA, TX measurements, UL	R&S®CMW-PKM171	1210.7206.02
R&S®CMW100 CDMA2000® 1xEV-DO, TX measurements, DL	R&S®CMW-PKM181	1210.7229.03
R&S®CMW100 Bluetooth® BR EDR LE, TX measurements (SL)	R&S®CMW-PKM611	1210.7264.02
R&S®CMW100 WLAN 802.11 a/b/g/n/ac, TX measurements (SL)	R&S®CMW-PKM651	1210.7287.02
R&S®CMW100 waveforms for ARB generator	R&S®CMW-PKV191	1210.7306.03
R&S®CMW100 waveforms for ARB generator	R&S®CMW-PKV191	1210.7306.05

The R&S®CMW100 communications manufacturing test set can be operated only in combination with a standard computer, which is not included. The required R&S®CMW100 software must be installed on the computer. It can be downloaded free of charge or ordered as an accessory (R&S®CMW100-Z31).

Recommended accessories

Designation	Type	Order No.
19" rackmounting kit for R&S®CMW100	R&S®CMW100-Z19	1210.7470.02
R&S®CMW100 software and manual on USB stick	R&S®CMW100-Z31	1210.7570.02

Computer requirements

The computer to be connected to the wireless test head must fulfill the minimum requirements stated in the following table.

	Minimum requirements	Recommended
Processor (CPU)	Intel Core i3, third generation	Intel Core i7, quad-core, fourth generation
Memory (RAM)	8 Gbyte	16 Gbyte
Storage medium [43]	64 Gbyte free space, HDD or SSD	128 Gbyte free space, SSD
Graphics	minimum resolution 1024 × 768 pixel	
Operating system	Windows 7 Professional, 64 bit or higher Windows versions, 64 bit, supporting English language; The compatibility of other Windows versions cannot be guaranteed.	
USB socket for connecting the wireless test head	1 × USB 3.0; Use a socket mounted to the motherboard, not a socket connected to the motherboard via a cable. Typically, the sockets on the front of the PC are not suitable.	

[43] The free disk space on the storage medium is used, for example, for installation of test software, storage of measurement results and ARB files.

Service options

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 accredited calibration coverage, one year	R&S®AW1	
Extended warranty with accredited calibration coverage, two years	R&S®AW2	
Extended warranty with accredited calibration coverage, three years	R&S®AW3	
Extended warranty with accredited calibration coverage, four years	R&S®AW4	

Extended warranty with a term of one to four years (WE1 to WE4)
Repairs carried out during the contract term are free of charge [44]. 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 [44] and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

Extended warranty with accredited calibration (AW1 to AW4)
Enhance your extended warranty by adding accredited calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated under accreditation, inspected and maintained during the term of the contract. It includes all repairs [44] and accredited calibration at the recommended intervals as well as any accredited calibration carried out during repairs or option upgrades.

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

Service that adds value

- ► 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 more than 85 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

PD 5214.8348.22 | Version 04.00 | March 2022 (ch)
R&S®CMW100 Communications Manufacturing Test Set
Data without tolerance limits is not binding | Subject to change

5214834822
5214.8348.22 04.00 PDP/PDW 1 en