

# R&S®CMW100 Communications Manufacturing Test Set Specifications

R&S®CMW100 – model K03



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**Data valid for the R&S®CMW100 model K03 unless otherwise stated.**

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

# Definitions

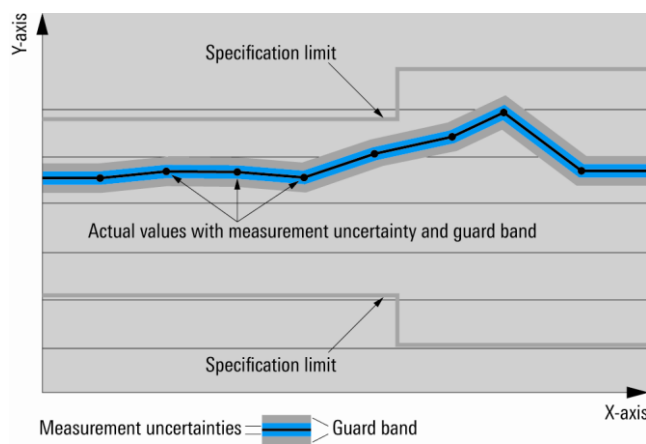
## General

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  $<$ ,  $\leq$ ,  $>$ ,  $\geq$ ,  $\pm$ , or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design. Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.



## 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".

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 Mcps (million chips per second), whereas bit rates and symbol rates are specified in Gbps (billion bits per second), Mbps (million bits per second), kbps (thousand bits per second), Msps (million symbols per second) or ksps (thousand symbols per second), and sample rates are specified in Msample/s (million samples per second). Gbps, Mcps, kbps, Msps, ksps and Msample/s are not SI units.

## General technical specifications

<b>General functions</b>		simultaneous receiver and transmitter testing
	RF generator/analyzer, RF1 to RF8	8 x SnapN, RF input/output to DUT
	RF generator, TX AUX	1 x SnapN, RF output
<b>Receiver test functions</b>		<ul style="list-style-type: none"> <li>RF generator signal is split and forwarded to 8 output ports</li> <li>every output can be switched off separately</li> <li>collective output level setting for connectors RF 1 to RF 8</li> <li>frequency-dependent attenuation (FDA) table for customer-specific corrections, separate for connectors RF1 to RF8</li> </ul>
<b>Transmitter test functions</b>		<ul style="list-style-type: none"> <li>8 input signals to be multiplexed to RF analyzer</li> <li>frequency-dependent attenuation (FDA) tables for customer-specific corrections, separate for connectors RF 1 to RF 8</li> </ul>
<b>Isolation</b>		
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
<b>VSWR</b>		
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

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

<b>Output level range</b>		
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

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

<b>Output level uncertainty</b>	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 <sup>2</sup>
	400 MHz to 2700 MHz	< 1.0 dB <sup>2</sup>
	2700 MHz to 4000 MHz	< 2.0 dB <sup>2</sup>
	4000 MHz to 6000 MHz	< 2.0 dB <sup>2</sup>
TX AUX	output level > -80 dBm	
	70 MHz to 400 MHz	< 2.0 dB <sup>2</sup>
	400 MHz to 2700 MHz	< 1.2 dB <sup>2</sup>
	2700 MHz to 4000 MHz	< 2.0 dB <sup>2</sup>
	4000 MHz to 6000 MHz	< 2.0 dB <sup>2</sup>

<b>Output level imbalance</b>	difference between RF1 to RF8	typ. < 0.6 dB
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<sup>1</sup> Relevant is the internal unit temperature, influenced by natural or forced convection.

<sup>2</sup> Valid for a 12-month calibration interval.

<b>Frequency-dependent attenuation (FDA) setting range</b>		-30 dB to 0 dB
<b>Max. FDA setting range</b>	for specified output level uncertainty	-10 dB to 0 dB
<b>Output level linearity with fixed RF output attenuator setting</b>	in temperature range +20 °C to +30 °C <sup>3</sup> , 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
<b>Output level resolution</b>		0.01 dB
<b>Output level settling time</b>	to within 0.1 dB	< 50 μs <sup>4</sup>
<b>Output level repeatability</b>	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
<b>Attenuation of second harmonic</b>		
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
<b>Attenuation of third harmonic</b>		
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
<b>Attenuation of nonharmonics</b>	> 5 kHz offset from carrier, for output level > -40 dBm, for full-scale CW signal	
	400 MHz to 3300 MHz, except $f_{\text{nonharmonic}} = 3900 \text{ MHz} - f_{\text{carrier}}$ , except $f_{\text{nonharmonic}} = 3900 \text{ MHz}$ , except $f_{\text{carrier}} = (899 \text{ to } 901) \text{ MHz} +$ $n \times 800 \text{ MHz}$ with $n = 1, 2, 3, 4, 5, 6, 7$ , except $f_{\text{nonharmonic}} = 350 \text{ MHz} +$ $n \times 50 \text{ MHz}$ with $n = 1 \text{ to } 12$	> 60 dB
	3300 MHz to 3600 MHz	> 25 dB
	3600 MHz to 6000 MHz, except $f_{\text{nonharmonic}} = 2 \times f_{\text{carrier}} - 6400 \text{ MHz}$	> 40 dB
<b>Phase noise</b>	single sideband, 70 MHz to 3300 MHz	
Carrier offset	≥ 1 MHz	< -120 dBc, 1 Hz
<b>Phase noise</b>	single sideband, 3300 MHz to 6000 MHz	
Carrier offset	≥ 1 MHz	< -117 dBc, 1 Hz
<b>Signal-to-noise ratio</b>	70 MHz to 3300 MHz	
RF 1 to RF 8	5 MHz offset from carrier, for output level > -30 dBm	> 90 dB, typ. > 98 dB, 1 kHz (> 122 dB, typ. > 128 dB, 1 Hz)
<b>Signal-to-noise ratio</b>	3300 MHz to 6000 MHz	
RF 1 to RF 8	5 MHz offset from carrier, for output level > -30 dBm	> 89 dB, 1 kHz

<sup>3</sup> Relevant is the internal unit temperature, influenced by natural or forced convection.

<sup>4</sup> When using list mode.

**Modulation source: arbitrary waveform generator (ARB)**

<b>Memory size</b>		2.048 Gbyte
<b>Word length</b>	I	16 bit
	Q	16 bit
<b>Sample length</b>	with 4-bit marker	up to 400 Msample
<b>Sample rate</b>	minimum	400 Hz
	maximum	100 MHz
<b>Maximum possible RF bandwidth</b>	depends on arbitrary waveform file	80 MHz

**RF analyzer**

<b>Inherent spurious response</b>	without input signal, 70 MHz to 6000 MHz, except 4000, 4800 MHz, 5162.5 MHz, 5600 MHz, 6000 MHz except 100 MHz + $n \times 50$ MHz with $n = 0$ to 62	
	expected nominal power setting $\leq -10$ dBm	< -100 dBm
	expected nominal power setting $> -10$ dBm	< -90 dB below expected nominal power setting

<b>Spurious response</b>	for full-scale single-tone input signal	
	70 MHz to 3300 MHz, except $f_{in} = 1962.5$ MHz and 3925 MHz, except $f_{in} = 1962.5$ MHz + $f_{selected}$	< -55 dB
	3300 MHz to 3700 MHz, except $f_{in} = 6400$ MHz - $f_{selected}$ , except $f_{in} = 6400$ MHz - $0.5 \times f_{selected}$	< -40 dB
	3700 MHz to 6000 MHz, except $f_{in} = 6400$ MHz - $0.5 \times f_{selected}$	< -40 dB

<b>Harmonic response</b>	second harmonic	
RF 1 to RF 8	$f_{in} = 70$ MHz to 1650 MHz, $f_{selected} = 140$ MHz to 3300 MHz	< -30 dB
	$f_{in} = 1650$ MHz to 3000 MHz, $f_{selected} = 3300$ MHz to 6000 MHz	< -30 dB

<b>Harmonic response</b>	third harmonic	
RF 1 to RF 8	$f_{in} = 70$ MHz to 900 MHz, $f_{selected} = 210$ MHz to 2700 MHz	< -50 dB
	$f_{in} = 900$ MHz to 1100 MHz, $f_{selected} = 2700$ MHz to 3300 MHz	< -45 dB
	$f_{in} = 1100$ MHz to 2000 MHz, $f_{selected} = 3300$ MHz to 6000 MHz	< -50 dB

<b>Phase noise</b>	single sideband, 70 MHz to 3300 MHz	
Carrier offset	$\geq 1$ MHz	< -120 dBc, 1 Hz

<b>Phase noise</b>	single sideband, 3300 MHz to 6000 MHz	
Carrier offset	$\geq 1$ MHz	< -117 dBc, 1 Hz

<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>• GPRF: free run</li> <li>• GPRF: IF power</li> <li>• GPRF: Gen</li> </ul>



## Power meter

<b>Frequency range</b>		70 MHz to 4000 MHz, up to 6000 MHz with the R&S®CMW-K046 option
<b>Frequency resolution</b>		0.1 Hz
<b>Resolution bandwidths</b>		Gaussian, 1 kHz to 10 MHz, in 1/3/5 steps, bandpass, 1 kHz to 30 MHz, in 1/3/5 steps, RRC, $\alpha = 0.1$ , 3.84 MHz, RRC, $\alpha = 0.22$ , WCDMA filter, 1.2288 MHz, CDMA filter
<b>Expected nominal power setting range</b>	for ADC full scale	
RF 1 to RF 8	70 MHz to 100 MHz	-37 dBm to +42 dBm <sup>5</sup>
	100 MHz to 3300 MHz	-47 dBm to +42 dBm <sup>5</sup>
	3300 MHz to 6000 MHz	-37 dBm to +42 dBm <sup>5</sup>

<b>Level range</b>		
RF 1 to RF 8	70 MHz to 100 MHz	
	continuous power (CW)	-74 dBm <sup>6</sup> to +34 dBm
	peak envelope power (PEP)	up to +36 dBm <sup>5</sup>
	100 MHz to 3300 MHz	
	continuous power (CW)	-84 dBm <sup>6</sup> to +34 dBm
	peak envelope power (PEP)	up to +36 dBm <sup>5</sup>
	3300 MHz to 6000 MHz	
	continuous power (CW)	-74 dBm <sup>6</sup> to +34 dBm
	peak envelope power (PEP)	up to +36 dBm <sup>5</sup>
	maximum input DC level	0 V DC

<b>Level uncertainty</b>	in temperature range +20 °C to +30 °C <sup>7</sup>	
RF 1 to RF 8	70 MHz to 100 MHz	< 1.0 dB <sup>8</sup>
	100 MHz to 3300 MHz	< 0.5 dB <sup>8</sup>
	3300 MHz to 4000 MHz	< 1.0 dB <sup>8</sup>
	4000 MHz to 6000 MHz	< 1.0 dB <sup>8</sup>

<b>Level uncertainty</b>	in temperature range +5 °C to +45 °C	
RF 1 to RF 8	70 MHz to 100 MHz	< 1.2 dB <sup>8</sup>
	100 MHz to 3300 MHz	< 0.7 dB <sup>8</sup>
	3300 MHz to 4000 MHz	< 1.2 dB <sup>8</sup>
	4000 MHz to 6000 MHz	< 1.2 dB <sup>8</sup>

<b>Level linearity with fixed expected nominal power setting</b>	in temperature range +20 °C to +30 °C <sup>7</sup>	
RF 1 to RF 8	level range 0 dB to -40 dB	< 0.15 dB, typ. < 0.1 dB

<b>Level resolution</b>		0.01 dB
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<b>Level repeatability</b>	typical values after 1 h warm-up time, always returning to same level and frequency, no temperature change, insignificant time change	
	input level $\geq -40$ dBm	< 0.01 dB
	input level < -40 dBm	< 0.03 dB

<b>Port switching time</b>	to within 0.1 dB	< 50 $\mu$ s <sup>9</sup>
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<sup>5</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

<sup>6</sup> RBW: 1 kHz.

<sup>7</sup> Relevant is the internal unit temperature, influenced by natural or forced convection.

<sup>8</sup> Valid for a 12-month calibration interval.

<sup>9</sup> When using list mode.

<b>Dynamic range</b>	70 MHz to 3300 MHz, RBW: 1 kHz, with fixed expected nominal power setting and mixer level offset $\geq +4$ dB	> 100 dB
<b>Expected nominal power setting for full dynamic range</b>		
RF 1 to RF 8		-8 dBm to +42 dBm <sup>10</sup>
<b>Dynamic range</b>	3300 MHz to 6000 MHz, RBW: 1 kHz, with fixed expected nominal power setting and mixer level offset $\geq +4$ dB	> 97 dB
<b>Expected nominal power setting for full dynamic range</b>		
RF 1 to RF 8		+2 dBm to +42 dBm <sup>10</sup>

## Spectrum measurements

<b>FFT spectrum analyzer</b>		
Frequency range		70 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
FFT length		1k, 2k, 4k, 8k, 16k
Detector		peak, RMS
<b>Dynamic range</b>	70 MHz to 3300 MHz, for FFT length: 16k and span: 5 MHz (equivalent to RBW: 781 Hz) and mixer level offset $\geq +4$ dB	> 100 dB
<b>Expected nominal power setting for full dynamic range</b>		
RF 1 to RF 8		-8 dBm to +42 dBm <sup>10</sup>
<b>Dynamic range</b>	3300 MHz to 6000 MHz, for FFT length: 16k and span: 5 MHz (equivalent to RBW: 781 Hz) and mixer level offset $\geq +4$ dB	> 97 dB
<b>Expected nominal power setting for full dynamic range</b>		
RF 1 to RF 8		+2 dBm to +42 dBm <sup>10</sup>
<b>RF spectrum analyzer (R&amp;S®CMW-KM010 option)</b>		
Frequency range		70 MHz to 4000 MHz, up to 6000 MHz with the R&S®CMW-K046 option
Frequency span	zero span	0 Hz
	with the R&S®CMW-K046 option	500 Hz to 3930 MHz 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 $\mu$ s to 2000 s
	zero span, depends on RBW and VBW	80 $\mu$ s to 2000 s
Detector		average, RMS, sample, min. peak, max. peak, auto peak
Trigger	frequency sweep	free run
	zero span	video, all R&S®CMW internal trigger sources

<sup>10</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

<b>Dynamic range</b>	70 MHz to 3300 MHz, RBW: 1 kHz, detector: RMS, mixer level offset $\geq +4$ dB	> 100 dB
<b>Expected nominal power setting for full dynamic range</b>		
RF 1 to RF 8		-8 dBm to +42 dBm <sup>11</sup>
<b>Dynamic range</b>	3300 MHz to 6000 MHz, RBW: 1 kHz, detector: RMS, mixer level offset $\geq +4$ dB	> 97 dB
<b>Expected nominal power setting for full dynamic range</b>		
RF 1 to RF 8		+2 dBm to +42 dBm <sup>11</sup>
<b>Level range</b>		see general technical specifications
<b>Level uncertainty</b>	for center frequency and detector: peak	see general technical specifications
<b>Inherent spurious response</b>		see general technical specifications
<b>Spurious response</b>		see general technical specifications
<b>Harmonic response</b>		see general technical specifications
<b>Phase noise</b>		see general technical specifications

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

<b>Frequency range</b>		70 MHz to 4000 MHz, up to 6000 MHz with the R&S®CMW-K046 option
<b>Pathloss measurement range</b>		0 dB to 12 dB
<b>Level uncertainty</b>	in temperature range +20 °C to +30 °C <sup>12</sup>	
RF 1 to RF 8	70 MHz to 400 MHz	< 0.9 dB <sup>13</sup> typ < 0.6 <sup>13</sup>
	400 MHz to 2700 MHz	< 0.5 dB <sup>13</sup> typ < 0.3 <sup>13</sup>
	3300 MHz to 6000 MHz	< 0.9 dB <sup>13</sup> typ < 0.6 <sup>13</sup>
<b>Level repeatability</b>	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

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

<sup>11</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

<sup>12</sup> Relevant is the internal unit temperature, influenced by natural or forced convection.

<sup>13</sup> 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, $W \times D = 0.3$ , 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

<b>Signal quality</b>		
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

<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>• GPRF: Gen</li> <li>• GSM: free run</li> <li>• GSM: IF power</li> <li>• GSM: acquisition</li> </ul>

### Modulation analysis

<b>Level range</b>		-28 dBm to +36 dBm <sup>14</sup>
<b>Analysis mode</b>	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)
<b>Inherent phase error</b>	GMSK	< 0.6°, RMS; < 2°, peak
<b>Inherent error vector magnitude (inherent EVM)</b>	8PSK, 16QAM (level A)	< 0.8 %, RMS
<b>Frequency measurement uncertainty</b>		< 20 Hz + drift of timebase, see general technical specifications
<b>Inherent I/Q offset</b>		< -50 dB
<b>Filter</b>	GMSK	bandpass, 900 kHz, RRC filter, $\alpha = 0.16$
	8PSK, 16QAM (level A)	windowed raised-cosine filter in line with 3GPP TS 45.005

<b>Burst power measurement</b>		
Level uncertainty	bandpass, 900 kHz, RRC filter, $\alpha = 0.16$	see general technical specifications

### Power versus time measurement

<b>Filter</b>	selectable	Gaussian, 500 kHz or 1 MHz
<b>Dynamic range</b>	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 <sup>14</sup>
<b>Relative measurement uncertainty</b>	result > -40 dB	typ. < 0.1 dB
	-60 dB ≤ result ≤ -40 dB	typ. < 0.5 dB
<b>Burst power measurement</b>		
Level range		-50 dBm to +36 dBm <sup>14</sup>
Level uncertainty	filter: 500 kHz or 1 MHz, Gaussian	see general technical specifications

<sup>14</sup> 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 <sup>15</sup>
Test method		relative measurement, averaging
Filter		Gaussian, 30 kHz, 5 pole
Measurement	at an offset of $\pm$	100/200/250/400/600/800/1000/1200/ 1400/1600/1800 kHz

Dynamic range	offset $\geq$ 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 <sup>15</sup>
Test method		absolute measurement, max. hold
Filter		Gaussian, 30 kHz, 5 pole
Measurement	at an offset of $\pm$	400/600/1200/1800 kHz

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

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<sup>15</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

## NB-IoT specifications – mobile station test

Standard		3GPP NB-IoT HD-FDD
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### 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
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### 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)
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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

<b>Signal quality</b>		
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
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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

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

<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>• GPRF: Gen</li> <li>• NB-IoT: free run</li> <li>• NB-IoT: IF power</li> </ul>

### Power measurement

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

**Modulation analysis**

<b>Measured parameters</b>	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

<b>Error vector magnitude (EVM)</b>		
Inherent EVM	-38 dBm ≤ input level < +30 dBm, RMS	< 1 %, RMS

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

<b>I/Q origin offset</b>		
Inherent I/Q offset	for average ≥ 10 measurements	< -45 dB

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

**Spectrum measurements**

<b>Adjacent channel leakage ratio</b>		
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

<b>Spectrum emission mask (SEM)</b>		
Frequency span		4 MHz
		< -45 dBm

<sup>16</sup> 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
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### 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

<b>Signal quality</b>		
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)

<b>Frequency range</b>		
	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

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

<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>• GPRF: Gen</li> <li>• WCDMA: free run</li> <li>• WCDMA: free run (fast sync)</li> <li>• WCDMA: IF power</li> <li>• WCDMA: DCCH TTI trigger</li> <li>• WCDMA: frame trigger</li> <li>• WCDMA: HS-DPCCH trigger</li> <li>• WCDMA: slot trigger</li> </ul>

## Modulation analysis

<b>Filter</b>		3.84 MHz, RRC, $\alpha = 0.22$ , WCDMA filter
<b>Level range</b>		-28 dBm to +36 dBm <sup>17</sup>
<b>Analysis modes</b>	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+
<b>Measured parameters</b>	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

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

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

<b>I/Q origin offset</b>		
Inherent I/Q offset	for average $\geq 10$ measurements	< -55 dB

<b>I/Q imbalance</b>		
Inherent I/Q imbalance		< -50 dB

## Spectrum measurements

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

<sup>17</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

**Power meter**

<b>UE power measurement</b>	RMS detector	
Filter		bandpass, 6.3 MHz, RRC, $\alpha = 0.22$
Level range		-55 dBm to +36 dBm <sup>18</sup>
Level uncertainty		see general technical specifications
Measurement length		half-slot, 1 slot
<b>Off power measurement</b>	RMS detector	
Filter		3.84 MHz, RRC, $\alpha = 0.22$ , WCDMA filter
Noise floor		-72 dBm
Level uncertainty		see general technical specifications + uncertainty due to noise floor

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<sup>18</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

# WCDMA specifications – small cell test

## WCDMA RF analyzer (R&S®CMW-KN400)

<b>Frequency range</b>	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	

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

<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>• GPRF: Gen</li> <li>• WCDMA: free run</li> <li>• WCDMA: free run (fast sync)</li> <li>• WCDMA: IF power</li> <li>• WCDMA: DCCH TTI trigger</li> <li>• WCDMA: frame trigger</li> <li>• WCDMA: HS-DPCCH trigger</li> <li>• WCDMA: slot trigger</li> </ul>

## Modulation analysis

<b>Filter</b>		3.84 MHz, RRC, $\alpha = 0.22$ , WCDMA filter
<b>Level range</b>		-28 dBm to +36 dBm <sup>19</sup>

<b>Analysis modes</b>	with the R&S®CMW-KM400 option	QPSK, WCDMA
<b>Measured parameters</b>	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

<sup>19</sup> 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
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<b>Error vector magnitude (EVM)</b>		
Measurement range		up to 25 %, RMS
Inherent EVM		< 2.5 %, RMS
Measurement length		half-slot, 1 slot, multislots (1 to 120)

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

<b>I/Q origin offset</b>		
Inherent I/Q offset	for average ≥ 10 measurements	< -52 dB

<b>I/Q imbalance</b>		
Inherent I/Q imbalance		< -50 dB

## Spectrum measurements

<b>Adjacent channel leakage ratio</b>		
Filter	RMS detector	3.84 MHz, RRC, $\alpha = 0.22$ , 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 <sup>20</sup>
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

<b>UE power measurement</b>		
Filter	RMS detector	bandpass, 6.3 MHz, RRC, $\alpha = 0.22$
Level range		-55 dBm to +36 dBm <sup>20</sup>
Level uncertainty		see general technical specifications
Measurement length		half-slot, 1 slot

<b>Off power measurement</b>		
Filter	RMS detector	3.84 MHz, RRC, $\alpha = 0.22$ , WCDMA filter
Noise floor		-72 dBm
Level uncertainty		see general technical specifications + uncertainty due to noise floor

<sup>20</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

# LTE specifications – mobile station test

Standard	LTE FDD and TDD
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## 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 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)**

<b>Arbitrary waveform file</b>	LTE FDD	LTE_FDD_QPSK_10MHZ.WV (PAR = 11.15 dB)
	LTE TDD	LTE_TDD_64QAM_20MHZ.WV (PAR = 11.10 dB)
<b>Output level range</b>	depends on PAR	see general technical specifications
<b>Output level uncertainty</b>	waveform file used: LTE_FDD_QPSK_10MHZ.WV	see general technical specifications
	waveform file used: LTE_TDD_64QAM_20MHZ.WV	see general technical specifications
<b>Output level resolution</b>		see general technical specifications
<b>Signal quality</b>		
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)**

<b>Bandwidth</b>		1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
<b>Frequency range</b>	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 to 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
	<b>Level setting</b>	



<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation
<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>• GPRF: Gen</li> <li>• LTE: free run (fast sync)</li> <li>• LTE: IF power</li> </ul>

### Power measurement

<b>Slot power</b>	RMS detector	
Level range		-50 dBm to +30 dBm, RMS
Level uncertainty		see general technical specifications

### Modulation analysis

<b>Measured parameters</b>	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

<b>Error vector magnitude (EVM)</b>		
Inherent EVM	allocated resource blocks $\leq 15$	
	-34 dBm $\leq$ input level $<$ +30 dBm, RMS	$< 1 \%$ , RMS
	-38 dBm $\leq$ input level $<$ -34 dBm, RMS	$< 1.5 \%$ , RMS
	allocated resource blocks $\leq 50$	
	-30 dBm $\leq$ input level $\leq$ +30 dBm, RMS	$< 1 \%$ , RMS
	-38 dBm $\leq$ input level $<$ -30 dBm, RMS	$< 2 \%$ , RMS
	allocated resource blocks $\leq 100$	
	-28 dBm $\leq$ input level $\leq$ +30 dBm, RMS	$< 1 \%$ , RMS
	-38 dBm $\leq$ input level $<$ -28 dBm, RMS	$< 2.5 \%$ , RMS

<b>Frequency error</b>		
Measurement range		$\pm 80$ kHz
Frequency measurement uncertainty		$< 20$ Hz <sup>21</sup> + drift of timebase, see general technical specifications

<b>I/Q origin offset</b>		
Inherent I/Q offset	for average $\geq 10$ measurements	$< -50$ dB

<b>In-band emissions</b>		
Dynamic range	allocated resource blocks $\leq 50$ , $f_{RF} < 3300$ MHz	$> 50$ dB
	allocated resource blocks $\leq 50$ , $f_{RF} > 3300$ MHz	$> 47$ dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

<b>Equalizer spectrum flatness</b>		
Level uncertainty	allocated resource blocks $\leq 50$	$< 0.5$ dB

<sup>21</sup> 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 V9.3.0.

**Spectrum measurements**

<b>Adjacent channel leakage ratio</b>		
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, $\alpha = 0.22$ , WCDMA filter
Dynamic range	E-UTRA, $f_{RF} < 3300$ MHz	> 45 dB
	E-UTRA, $f_{RF} > 3300$ MHz	> 42 dB
	UTRA, $f_{RF} < 3300$ MHz	> 52 dB
	UTRA, $f_{RF} > 3300$ MHz	> 49 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

<b>Spectrum emission mask (SEM)</b>		
Frequency span		70 MHz
Noise floor	RBW: 1 MHz, $f_{RF} < 3300$ MHz	< -35 dBm
	RBW: 1 MHz, $f_{RF} > 3300$ MHz	< -32 dBm
	RBW: 100 kHz, $f_{RF} < 3300$ MHz	< -40 dBm
	RBW: 100 kHz, $f_{RF} > 3300$ MHz	< -37 dBm
	RBW: 30 kHz, $f_{RF} < 3300$ MHz	< -45 dBm
	RBW: 30 kHz, $f_{RF} > 3300$ MHz	< -42 dBm

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

<b>Bandwidth</b>		1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
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<b>Frequency range</b>	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
<b>Level setting</b>		manual mode

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

<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>• GPRF: Gen</li> <li>• LTE: free run (fast sync)</li> <li>• LTE: IF power</li> </ul>

**Power measurement**

<b>Slot power</b>	RMS detector	
Level range		-50 dBm to +30 dBm, RMS
Level uncertainty		see general technical specifications

## Modulation analysis

<b>Measured parameters</b>	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
<b>Error vector magnitude (EVM)</b>		
Inherent EVM	allocated resource blocks $\leq 15$	
	$-34 \text{ dBm} \leq \text{input level} < +30 \text{ dBm}$ , RMS	< 1 %, RMS
	$-38 \text{ dBm} \leq \text{input level} < -34 \text{ dBm}$ , RMS	< 1.5 %, RMS
	allocated resource blocks $\leq 50$	
	$-30 \text{ dBm} \leq \text{input level} \leq +30 \text{ dBm}$ , RMS	< 1 %, RMS
	$-38 \text{ dBm} \leq \text{input level} < -30 \text{ dBm}$ , RMS	< 2 %, RMS
	allocated resource blocks $\leq 100$	
	$-28 \text{ dBm} \leq \text{input level} \leq +30 \text{ dBm}$ , RMS	< 1 %, RMS
	$-38 \text{ dBm} \leq \text{input level} < -28 \text{ dBm}$ , RMS	< 2.5 %, RMS
<b>Frequency error</b>		
Measurement range		$\pm 80 \text{ kHz}$
Frequency measurement uncertainty		< 20 Hz <sup>22</sup> + drift of timebase, see general technical specifications
<b>I/Q origin offset</b>		
Inherent I/Q offset		< -50 dB
<b>In-band emissions</b>		
Dynamic range	allocated resource blocks $\leq 50$ , $f_{\text{RF}} < 3300 \text{ MHz}$	> 50 dB
	allocated resource blocks $\leq 50$ , $f_{\text{RF}} > 3300 \text{ MHz}$	> 47 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications
<b>Equalizer spectrum flatness</b>		
Level uncertainty	allocated resource blocks $\leq 50$	< 0.5 dB

<sup>22</sup> 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 V9.3.0.

**Spectrum measurements**

<b>Adjacent channel leakage ratio</b>		
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, $\alpha = 0.22$ , WCDMA filter
Dynamic range	E-UTRA, $f_{RF} < 3300$ MHz	> 45 dB
	E-UTRA, $f_{RF} > 3300$ MHz	> 42 dB
	UTRA, $f_{RF} < 3300$ MHz	> 56 dB
	UTRA, $f_{RF} > 3300$ MHz	> 53 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

<b>Spectrum emission mask (SEM)</b>		
Frequency span		70 MHz
Noise floor	RBW: 1 MHz, $f_{RF} < 3300$ MHz	< -35 dBm
	RBW: 1 MHz, $f_{RF} > 3300$ MHz	< -32 dBm
	RBW: 100 kHz, $f_{RF} < 3300$ MHz	< -40 dBm
	RBW: 100 kHz, $f_{RF} > 3300$ MHz	< -37 dBm
	RBW: 30 kHz, $f_{RF} < 3300$ MHz	< -45 dBm
	RBW: 30 kHz, $f_{RF} > 3300$ MHz	< -42 dBm

## LTE specifications – small cell test

Standard	LTE FDD and TDD
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### LTE FDD eNodeB RF analyzer (R&S®CMW-KN500 option)

Bandwidth	1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
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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
Level setting	manual mode	

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

Trigger	
Trigger sources	<ul style="list-style-type: none"> <li>• GPRF: Gen</li> <li>• LTE: free run (fast sync)</li> <li>• LTE: IF power</li> </ul>

### Power measurement

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

**Modulation analysis**

<b>Measured parameters</b>	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

<b>Error vector magnitude (EVM)</b>		
Inherent EVM	for average $\geq 10$ subframes -20 dBm $\leq$ input level < +30 dBm, RMS	< 1.5 %, RMS

<b>Frequency error</b>		
Measurement range		$\pm 80$ kHz
Frequency measurement uncertainty		< 20 Hz <sup>23</sup> + drift of timebase, see general technical specifications

**Spectrum measurements**

<b>Adjacent channel leakage ratio</b>		
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, $\alpha = 0.22$ , WCDMA filter 3.84 MHz, RRC, $\alpha = 0.22$ , WCDMA filter 7.68 MHz, RRC, $\alpha = 0.22$ , WCDMA filter
Dynamic range	E-UTRA, $f_{RF} < 3300$ MHz	> 50 dB
	E-UTRA, $f_{RF} > 3300$ MHz	> 48 dB
	UTRA384, $f_{RF} < 3300$ MHz	> 52 dB
	UTRA384, $f_{RF} > 3300$ MHz	> 52 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

<b>Spectrum emission mask (SEM)</b>		
Frequency span		70 MHz
Noise floor	RBW $\leq 1$ MHz, expected nominal power < 12 dBm, $f_{RF} < 3300$ MHz	< -58 dBm
	RBW $\leq 1$ MHz, expected nominal power < 12 dBm, $f_{RF} > 3300$ MHz	< -55 dBm

<sup>23</sup> 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 V9.3.0.

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

<b>Bandwidth</b>		1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
<b>Frequency range</b>	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, E-UTRA band 43, TDD, E-UTRA band 44, TDD	703 MHz to 803 MHz
<b>Level setting</b>		manual mode
<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation
<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>• GPRF: Gen</li> <li>• LTE: free run (fast sync)</li> <li>• LTE: IF power</li> </ul>

### Power measurement

<b>Slot power</b>	RMS detector	
Level range		-50 dBm to +30 dBm, RMS
Level uncertainty		see general technical specifications

### Modulation analysis

<b>Measured parameters</b>	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
<b>Error vector magnitude (EVM)</b>		
Inherent EVM	for average $\geq 10$ subframes	
	-20 dBm $\leq$ input level < +30 dBm, RMS	< 1.5 %, RMS

<b>Frequency error</b>		
Measurement range		±80 kHz
Frequency measurement uncertainty		< 20 Hz <sup>24</sup> + drift of timebase, see general technical specifications

### Spectrum measurements

<b>Adjacent channel leakage ratio</b>		
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, $\alpha = 0.22$ , WCDMA filter 3.84 MHz, RRC, $\alpha = 0.22$ , WCDMA filter 7.68 MHz, RRC, $\alpha = 0.22$ , WCDMA filter
Dynamic range	E-UTRA, $f_{RF} < 3300$ MHz	> 50 dB
	E-UTRA, $f_{RF} > 3300$ MHz	> 47 dB
	UTRA128, $f_{RF} < 3300$ MHz	> 52 dB
	UTRA384, $f_{RF} < 3300$ MHz	> 52 dB
	UTRA768, $f_{RF} < 3300$ MHz	> 49 dB
	UTRA128, $f_{RF} > 3300$ MHz	> 52 dB
	UTRA384_1, $f_{RF} > 3300$ MHz	> 50 dB
	UTRA384_2, $f_{RF} > 3300$ MHz	> 52 dB
UTRA768, $f_{RF} > 3300$ MHz	> 49 dB	
Expected nominal power setting for full dynamic range	RF1 to RF8	see general technical specifications

<b>Spectrum emission mask (SEM)</b>		
Frequency span		70 MHz
Noise floor	RBW ≤ 1 MHz, expected nominal power < 12 dBm, $f_{RF} < 3300$ MHz	< -58 dBm
	RBW ≤ 1 MHz, expected nominal power < 12 dBm, $f_{RF} > 3300$ MHz	< -55 dBm

<sup>24</sup> 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 V9.3.0.



## Bluetooth® specifications

<b>Standard</b>	standard	Bluetooth® Core Specification Version 5.0
	test standard	Radio Frequency Bluetooth® Test Specification RF.TS.5.0.0, Low Energy RF PHY Bluetooth® Test Specification, RF-PHY.TS.5.0.0

## Bluetooth® RF generator

<b>Frequency range</b>	Bluetooth®	2402 MHz to 2480 MHz
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## Bluetooth® R&S®WinIQSIM2™ (R&S®CMW-KW610 option)

<b>Arbitrary waveform file</b>	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)

<b>Output level range</b>	depends on PAR	see general technical specifications
<b>Output level uncertainty</b>	waveform files used: BLUETOOTH_11110000_DH5.WV, BLUETOOTH_PRBS9_3-DH5.WV	see general technical specifications
<b>Output level resolution</b>		see general technical specifications

<b>Signal quality</b>		
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)

<b>Frequency range</b>	Bluetooth®	2402 MHz to 2480 MHz
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<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, maximum, minimum, standard deviation

<b>Trigger</b>		
Trigger source		Bluetooth®: IF power

## Modulation analysis

<b>Filter</b>	filter bandwidth: wide	2.0 MHz bandpass
	filter bandwidth: narrow	1.3 MHz bandpass
<b>Level range</b>		-35 dBm to +36 dBm <sup>25</sup>
<b>Supported packet types</b>	basic rate	DH1, DH3, DH5
	enhanced data rate (EDR)	2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5
<b>Measured parameters</b>	basic rate, numeric results and standard deviation	$\Delta f_2$ 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
<b>Measured parameters</b>	enhanced data rate (EDR), numeric results and standard deviation	99 % DEVM, frequency stability $\omega_i$ , frequency stability $(\omega_o + \omega_i)_{max}$ , frequency stability $\omega_{o,max}$ , RMS DEVM, peak RMS, nominal power
<b>Total measurement range for frequency accuracy, frequency deviation and frequency drift</b>	basic rate	$\pm 250$ kHz
<b>Frequency accuracy</b>	basic rate	
Measurement range	for nominal deviation of 160 kHz	$\pm 100$ kHz
Uncertainty	for deviation $\leq 160$ kHz	$< 2$ kHz
<b>Frequency deviation</b>	basic rate	
Measurement range	without frequency offset	$\leq 210$ kHz
Uncertainty	for modulation index 0.22 to 0.42	$< 1$ %
<b>Frequency drift</b>	basic rate	
Measurement range		$\pm 50$ kHz
Uncertainty	measured in burst relative to frequency offset in preamble, with 10101010 pattern referenced to measured frequency offset	$< 2$ kHz
	in preamble (relative frequency drift)	$\leq 1$ kHz
<b>Frequency stability <math>\omega_i</math></b>	enhanced data rate	
Measurement range		$\pm 100$ kHz
Uncertainty	for $\omega_i \leq 75$ kHz, for deviation $\leq 160$ kHz	$< 2$ kHz
<b>Frequency stability <math>\omega_{o,max}</math></b>	enhanced data rate	
Measurement range		$\pm 15$ kHz
Uncertainty	for $\omega_o \leq 10$ kHz	$< 1$ kHz
<b>Differential error vector magnitude (DEV M)</b>	enhanced data rate	
Inherent DEV M	for PRBS pattern	$< 1.5$ %, RMS; $< 3.0$ %, peak

<sup>25</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

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

<b>Frequency range</b>	Bluetooth®	2402 MHz to 2480 MHz
<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, maximum, minimum, standard deviation
<b>Trigger</b>		
Trigger source		Bluetooth®: IF power

### Modulation analysis

<b>Filter</b>	filter bandwidth: wide	2.0 MHz bandpass
	filter bandwidth: narrow	1.3 MHz bandpass
<b>Level range</b>		-35 dBm to +36 dBm <sup>26</sup>
<b>Supported packet types</b>		RF PHY test reference packets
<b>Measured parameters</b>	numeric results and standard deviation	$\Delta f_2$ 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
<b>Total measurement range for frequency accuracy, offset, deviation and drift measurements</b>		$\pm 350$ kHz
<b>Frequency accuracy (using preamble)</b>		
Measurement range	for nominal deviation of 250 kHz	$\pm 175$ kHz
Uncertainty	for deviation $\leq 250$ kHz	$< 2$ kHz
<b>Frequency offset</b>		
Measurement range	for nominal deviation of 250 kHz	$\pm 175$ kHz
Uncertainty	for deviation $\leq 250$ kHz	$< 2$ kHz
<b>Frequency deviation</b>		
Measurement range	without frequency offset	$\leq 350$ kHz
Uncertainty	for modulation index 0.40 to 0.60	$< 1.0$ %
<b>Frequency drift</b>		
Measurement range		$\pm 75$ kHz
Uncertainty	measured in burst relative to frequency offset in preamble, with 10101010 pattern referenced to measured frequency offset in preamble (relative frequency drift)	$< 2$ kHz
		$\leq 1$ kHz

<sup>26</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

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

<b>Frequency range</b>	Bluetooth®	2402 MHz to 2480 MHz
<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, maximum, minimum, standard deviation
<b>Trigger</b>		
Trigger source		Bluetooth®: IF power

### Modulation analysis

<b>Filter</b>	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
<b>Level range</b>		-35 dBm to +36 dBm <sup>27</sup>
<b>Supported packet types</b>		RF PHY Test Reference Packets

<b>Measured parameters</b>	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)	$\Delta f2$ 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)	$\Delta f1$ 99.9 %

<b>Total measurement range for frequency accuracy, offset, deviation and drift measurements</b>	LE 2 2 Msymbol/s	$\pm 700$ kHz
	LE long range	$\pm 350$ kHz

<b>Frequency accuracy (using preamble)</b>		
Measurement range	for nominal deviation of 500 kHz (LE 2 Msymbol/s)	$\pm 175$ kHz
	for nominal deviation of 250 kHz (LE long range)	
Uncertainty	for deviation $\leq 500$ kHz (LE 2 Msymbol/s)	< 2 kHz
	for deviation $\leq 250$ kHz (LE long range)	

<b>Frequency offset</b>		
Measurement range	for nominal deviation of 500 kHz (LE 2 Msymbol/s)	$\pm 175$ kHz
	for nominal deviation of 250 kHz (LE long range)	
Uncertainty	for deviation $\leq 500$ kHz (LE 2 Msymbol/s)	< 2 kHz
	for deviation $\leq 250$ kHz (LE long range)	

<sup>27</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

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

<b>Frequency drift</b>		
Measurement range		$\pm 75$ kHz
Uncertainty	measured in burst referenced to frequency offset in preamble	$< 2$ kHz
	referenced to measured frequency offset value in preamble (relative frequency drift)	$\leq 1$ kHz

## GPS specifications

Standard		GPS
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### 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
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### 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_SCRAMBLE_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_SCRAMBLE_16QAM_3SEC_TESTFILE.WV	see general technical specifications
Output level resolution		see general technical specifications

## FM STEREO RADIO specifications

Standard		FM STEREO RADIO
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### FM STEREO RADIO generator

Frequency range	FM	70 MHz to 110 MHz
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### 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

<b>Standard</b>		IEEE 802.11a, IEEE 802.11b, IEEE 802.11g, IEEE 802.11n, IEEE 802.11ac
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## WLAN RF generator

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

## WLAN ABGN R&S®WinIQSIM2™ (R&S®CMW-KW650 option)

<b>Arbitrary waveform files</b>	in line with IEEE 802.11a/g OFDM 64QAM	WLAN_A_G_OFDM_64QAM.WV (PAR = 10.01 dB)
	in line with IEEE 802.11b CCK DQPSK	WLAN_B_CCK_DQPSK.WV (PAR = 1.48 dB)
	in line with IEEE 802.11n 64QAM, code rate 5/6	WLAN_N_64QAM_5_6.WV (PAR = 10.01 dB)

<b>Output level range</b>	depends on PAR	see general technical specifications
<b>Output level uncertainty</b>	waveform files used: WLAN_A_G_OFDM_64QAM.WV, WLAN_B_CCK_DQPSK.WV, WLAN_N_64QAM_5_6.WV	see general technical specifications
<b>Output level resolution</b>		see general technical specifications

<b>Signal quality</b>		
<b>Error vector magnitude (EVM) <sup>28</sup></b>	IEEE 802.11b, EVM, waveform file used: WLAN_B_CCK_DQPSK.WV	< 4 %, peak
	IEEE 802.11g, EVM all carriers, waveform file used: WLAN_A_G_OFDM_64QAM.WV	< -40 dB, RMS
	IEEE 802.11a, EVM all carriers, waveform file used: WLAN_A_G_OFDM_64QAM.WV	< -40 dB, RMS <sup>29</sup>
	IEEE 802.11n, 2.4 GHz band, EVM all carriers, waveform file used: WLAN_N_64QAM_5_6.WV	< -40 dB, RMS
	IEEE 802.11n, 5 GHz band, EVM all carriers, waveform file used: WLAN_N_64QAM_5_6.WV	< -40 dB, RMS <sup>29</sup>

<sup>28</sup> Measured with channel estimation based on payload.

<sup>29</sup> 2 dB less at temperature > +30 °C.

**WLAN AC WinIQSIM2™ (R&S®CMW-KW656 option)**

<b>Arbitrary waveform files</b>	in line with IEEE 802.11ac 256QAM, 20 MHz, code rate 3/4	WLAN_VHT_BW20_MCS8_LEN4096.WV (PAR = 9.57 dB)
	in line with IEEE 802.11ac 256QAM, 40 MHz, code rate 3/4	WLAN_VHT_BW40_MCS8_LEN4096.WV (PAR = 11.23 dB)
	in line with IEEE 802.11ac 256QAM, 80 MHz, code rate 3/4	WLAN_VHT_BW80_MCS8_LEN4096.WV (PAR = 10.24 dB)

<b>Output level range</b>	depends on PAR	see general technical specifications
<b>Output level uncertainty</b>	waveform files used: WLAN_VHT_BW20_MCS8_LEN4096.WV WLAN_VHT_BW40_MCS8_LEN4096.WV WLAN_VHT_BW80_MCS8_LEN4096.WV	see general technical specifications
<b>Output level resolution</b>		see general technical specifications

<b>Signal quality</b>		
Error vector magnitude (EVM) <sup>30</sup>	IEEE 802.11ac, EVM all carriers, waveform file used: WLAN_VHT_BW20_MCS8_LEN4096.WV	< -40 dB, RMS
	WLAN_VHT_BW40_MCS8_LEN4096.WV	< -40 dB, RMS <sup>31</sup>
	WLAN_VHT_BW80_MCS8_LEN4096.WV	< -38 dB, RMS <sup>31</sup>

**WLAN ABG RF analyzer (R&S®CMW-KM650 option)**

<b>Frequency range</b>	WLAN IEEE 802.11b/g	2412 MHz to 2484 MHz
	WLAN IEEE 802.11a, prerequisite: R&S®CMW-K046 option	5000 MHz to 6000 MHz, for frequency exceptions for inherent spurious response, see general technical specifications

<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, maximum, standard deviation

<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>WLAN: free run</li> <li>WLAN: IF power</li> </ul>

**Modulation analysis**

<b>Filter</b>		20 MHz
<b>Level range</b>		-28 dBm to +36 dBm <sup>32</sup>
<b>Payload length</b>		≥ 16 symbol
<b>Analysis modes</b>	DSSS	1 Mbps DBPSK, 2 Mbps DQPSK, 5.5 Mbps CCK, 11 Mbps CCK
	OFDM	6 Mbps BPSK, 9 Mbps BPSK, 12 Mbps QPSK, 18 Mbps QPSK, 24 Mbps 16QAM, 36 Mbps 16QAM, 48 Mbps 64QAM, 54 Mbps 64QAM

<sup>30</sup> Measured with channel estimation based on payload.<sup>31</sup> 2 dB less at temperature > +30 °C.<sup>32</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.



<b>Measured parameters</b>	DSSS, numeric results and standard deviation	burst power, error vector magnitude (EVM) peak, error vector magnitude (EVM) RMS, center frequency error, chip clock error, I/Q offset, gain imbalance, quadrature error
	DSSS, graphical	EVM versus chip, I/Q constellation
	OFDM, numeric results and standard deviation	burst power, EVM all carriers, EVM data carriers, EVM pilot carriers, center frequency error, symbol clock error, I/Q offset, gain imbalance, quadrature error
	OFDM, graphical	EVM versus symbol, EVM versus carrier, I/Q constellation, spectrum flatness

<b>Error vector magnitude (EVM)</b>		
Inherent EVM <sup>33</sup>	DSSS, IEEE 802.11b/g	< 5 %, peak < 2 %, RMS
	OFDM, IEEE 802.11g	< -40 dB, RMS
	OFDM, IEEE 802.11a	
	-18 dBm ≤ input level ≤ +36 dBm <sup>34</sup> , RMS	< -40 dB, RMS
Measurement length	DSSS	1000 samples
	OFDM	entire PPDU

<b>Center frequency error</b>		
Frequency measurement uncertainty	DSSS, IEEE 802.11b/g	< 20 Hz + drift of timebase, see general technical specifications
	OFDM, IEEE 802.11g, for ≥ 100 symbol (400 μs)	< 20 Hz + drift of timebase, see general technical specifications
	OFDM, IEEE 802.11a, for ≥ 100 symbol (400 μs)	< 35 Hz + drift of timebase, see general technical specifications

<b>Chip clock error</b>	DSSS	
Uncertainty		< 1 ppm

<b>Symbol clock error</b>	OFDM	
Uncertainty		< 1 ppm

<b>I/Q offset</b>		
Inherent I/Q offset	DSSS, for average ≥ 10 measurements	< -50 dB
	OFDM, for average ≥ 10 measurements	< -45 dB

<b>Spectrum flatness</b>		
Level uncertainty	OFDM, IEEE 802.11g (2.4 GHz band)	< 0.5 dB
	OFDM, IEEE 802.11a (5 GHz band)	< 0.8 dB

<sup>33</sup> Measured with channel estimation based on payload.

<sup>34</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

**Spectrum measurements**

<b>Transmit spectrum mask</b>		
Frequency span		80 MHz
Dynamic range	DSSS	in line with IEEE 802.11b
	OFDM	in line with IEEE 802.11a/g
Expected nominal power setting for full dynamic range	RF1 COM, RF2 COM	
	IEEE 802.11g (2.4 GHz band)	+2 dBm to +36 dBm <sup>35</sup>
	IEEE 802.11a (5 GHz band)	+12 dBm to +36 dBm <sup>35</sup>

**WLAN N RF analyzer (R&S®CMW-KM651 option)**

<b>Frequency range</b>	WLAN IEEE 802.11n (2.4 GHz band)	2412 MHz to 2484 MHz
	WLAN IEEE 802.11n (5 GHz band), prerequisite: R&S®CMW-K046 option	5000 MHz to 6000 MHz, for frequency exceptions for inherent spurious response, see general technical specifications

<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, maximum, standard deviation

<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>WLAN: free run</li> <li>WLAN: IF power</li> </ul>

<b>High throughput (HT)</b>		
PPDU format		legacy mode, mixed mode, greenfield mode

**Modulation analysis**

<b>Bandwidth</b>		20 MHz, 40 MHz
<b>Level range</b>		-28 dBm to +36 dBm <sup>35</sup>
<b>Payload length</b>		≥ 16 symbol
<b>Analysis modes</b>		BPSK code rate 1/2 (MCS0), BPSK code rate 3/4, QPSK code rate 1/2 (MCS1), QPSK code rate 3/4 (MCS2), 16QAM code rate 1/2 (MCS3), 16QAM code rate 3/4 (MCS4), 64QAM code rate 1/2, 64QAM code rate 2/3 (MCS5), 64QAM code rate 3/4 (MCS6), 64QAM code rate 5/6 (MCS7)
	for optional 40 MHz MCS format	BPSK code rate 1/2 (MCS32)

<b>Measured parameters</b>	numeric results and standard deviation	burst power, EVM all carriers, EVM data carriers, EVM pilot carriers, center frequency error, symbol clock error, I/Q offset, gain imbalance, quadrature error
	graphical	EVM versus symbol, EVM versus carrier, spectrum flatness

<sup>35</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

<b>Error vector magnitude (EVM)</b>		
Inherent EVM <sup>36</sup>	IEEE 802.11n (2.4 GHz band)	
	-28 dBm ≤ input level ≤ +36 dBm <sup>37</sup> , RMS	< -40 dB, RMS
	IEEE 802.11n (5 GHz band)	
	-18 dBm ≤ input level ≤ +36 dBm <sup>37</sup> , RMS	< -40 dB, RMS
Measurement length		entire PPDU
<b>Center frequency error</b>		
Frequency measurement uncertainty	IEEE 802.11n (2.4 GHz band), for ≥ 100 symbol (400 μs)	< 20 Hz + drift of timebase, see general technical specifications
	IEEE 802.11n (5 GHz band), for ≥ 100 symbol (400 μs)	< 35 Hz + drift of timebase, see general technical specifications
<b>Symbol clock error</b>		
Uncertainty		< 1 ppm
<b>I/Q offset</b>		
Inherent I/Q offset	for average ≥ 10 measurements	< -45 dB
<b>Spectrum flatness</b>		
Level uncertainty	IEEE 802.11n (2.4 GHz band)	
	bandwidth 20 MHz	< 0.5 dB
	bandwidth 40 MHz	< 0.8 dB
	IEEE 802.11n (5 GHz band)	
	bandwidth 20 MHz	< 0.8 dB
	bandwidth 40 MHz	< 1.0 dB

## Spectrum measurements

<b>Transmit spectrum mask</b>		
Frequency span		up to 160 MHz
Dynamic range		in line with IEEE 802.11n
Expected nominal power setting for full dynamic range	RF1 COM, RF2 COM	
	IEEE 802.11n (2.4 GHz band)	+2 dBm to +36 dBm <sup>37</sup>
	IEEE 802.11n (5 GHz band)	+12 dBm to +36 dBm <sup>37</sup>

## WLAN N AC CMIMO RF analyzer (R&S®CMW-KM652 option)

<b>Frequency range</b>	WLAN IEEE 802.11n (2.4 GHz band)	2412 MHz to 2484 MHz
	WLAN IEEE 802.11n/ac (5 GHz band), prerequisite: R&S®CMW-K046 option	5000 MHz to 6000 MHz, for frequency exceptions for inherent spurious response, see general technical specifications
<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, maximum, standard deviation
<b>Trigger</b>		
Trigger source		WLAN: IF power
<b>High throughput</b>		
PPDU format	IEEE 802.11n	mixed mode, greenfield mode
	IEEE 802.11ac	mixed mode

<sup>36</sup> Measured with channel estimation based on payload.

<sup>37</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

**Modulation analysis**

<b>Bandwidth</b>	IEEE 802.11n	20 MHz, 40 MHz
	IEEE 802.11ac	20 MHz, 40 MHz, 80 MHz, 80+80 MHz, 160 MHz
<b>Level range</b>		-28 dBm to +36 dBm <sup>38</sup>
<b>Payload length</b>		≥ 1 symbol (max. 1024)
<b>Analysis modes</b> <sup>39</sup>	IEEE 802.11n	MCS0 to MCS7: data and pilot, MCS8 to MCS31: pilot only, MCS33 to MCS76: pilot only
	IEEE 802.11ac	MCS0 to MCS9: data and pilot
<b>Measured parameters</b>	numeric results and standard deviation	total power, STS1 to STS4 power, EVM all carriers, EVM data carriers, EVM pilot carriers, center frequency error

<b>Error vector magnitude (EVM)</b>		
Inherent EVM <sup>40</sup>	IEEE 802.11n (2.4 GHz band) -28 dBm ≤ input level ≤ +36 dBm <sup>38</sup> RMS	< -40 dB, RMS
	IEEE 802.11n/ac (5 GHz band), bandwidth 20 MHz, 40 MHz -18 dBm ≤ input level ≤ +36 dBm <sup>38</sup> , RMS	< -40 dB, RMS
Measurement length		entire PPDU

<b>Center frequency error</b>		
Frequency measurement uncertainty	IEEE 802.11n (2.4 GHz band), for ≥ 100 symbol (400 μs)	< 20 Hz + drift of timebase, see general technical specifications
	IEEE 802.11n/ac (5 GHz band), for ≥ 100 symbol (400 μs)	< 35 Hz + drift of timebase, see general technical specifications

**WLAN N AC switched MIMO RF analyzer (R&S<sup>®</sup>CMW-KM653 option)**

<b>Frequency range</b>	WLAN IEEE 802.11n (2.4 GHz band)	2412 MHz to 2484 MHz
	WLAN IEEE 802.11n/ac (5 GHz band), prerequisite: R&S <sup>®</sup> CMW-K046 option	5000 MHz to 6000 MHz, for frequency exceptions for inherent spurious response, see general technical specifications

<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, maximum, standard deviation

<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>• GPRF: Gen</li> <li>• WLAN: IF power</li> </ul>

<b>High throughput (HT)</b>		
PPDU format	IEEE 802.11n	mixed mode, greenfield mode
	IEEE 802.11ac	mixed mode

**Modulation analysis**

<b>Bandwidth</b>	IEEE 802.11n	20 MHz, 40 MHz
	IEEE 802.11ac	20 MHz, 40 MHz, 80 MHz, 80+80 MHz, 160 MHz
<b>Level range</b>		-28 dBm to +36 dBm <sup>38</sup>
<b>Payload length</b>		≥ 1 symbol (max. 1024)

<sup>38</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.<sup>39</sup> Modulation analysis on data possible after initial acquisition of training data.<sup>40</sup> Measured with channel estimation based on payload.

<b>Analysis modes</b>	IEEE 802.11n	MCS0 to MCS7, MCS32, all data and pilot
	IEEE 802.11ac	MCS0 to MCS9, all data and pilot
<b>Measured parameters</b>	numeric results and standard deviation	total power, EVM all carriers, EVM data carriers, EVM pilot carriers, center frequency error, symbol clock error,
	numeric results for each spatial stream	EVM all carriers, EVM data carriers, EVM pilot carriers power I/Q offset

## WLAN P RF analyzer (R&S®CMW-KM655 option)

<b>Frequency range</b>	WLAN IEEE 802.11p, prerequisite: R&S®CMW-K046 option	5000 MHz to 6000 MHz, for frequency exceptions for inherent spurious response, see general technical specifications
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<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, maximum, standard deviation

<b>Trigger</b>		
Trigger sources		WLAN: IF power

## Modulation analysis

<b>Filter</b>		5 MHz, 10 MHz, 20 MHz
<b>Level range</b>		-28 dBm to +36 dBm <sup>41</sup>
<b>Payload length</b>		≥ 16 symbol
<b>Analysis modes</b>	OFDM 5 MHz channel spacing	1.5 Mbps BPSK, 2.25 Mbps BPSK, 3 Mbps QPSK, 4.5 Mbps QPSK, 6 Mbps 16QAM, 9 Mbps 16QAM, 12 Mbps 64QAM, 13.5 Mbps 64QAM
	OFDM 10 MHz channel spacing	3 Mbps BPSK, 4.5 Mbps BPSK, 6 Mbps QPSK, 9 Mbps QPSK, 12 Mbps 16QAM, 18 Mbps 16QAM, 24 Mbps 64QAM, 27 Mbps 64QAM
	OFDM 20 MHz channel spacing	6 Mbps BPSK, 9 Mbps BPSK, 12 Mbps QPSK, 18 Mbps QPSK, 24 Mbps 16QAM, 36 Mbps 16QAM, 48 Mbps 64QAM, 54 Mbps 64QAM

<sup>41</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

<b>Measured parameters</b>	OFDM, numeric results and standard deviation	burst power, EVM all carriers, EVM data carriers, EVM pilot carriers, center frequency error, symbol clock error, I/Q offset, gain imbalance, quadrature error
	OFDM, graphical	EVM versus symbol, EVM versus carrier, I/Q constellation, spectrum flatness

<b>Error vector magnitude (EVM)</b>		
Inherent EVM <sup>42</sup>	-18 dBm ≤ input level ≤ +36 dBm <sup>43</sup> , RMS	< -40 dB, RMS
Measurement length		entire PPDU

<b>Center frequency error</b>		
Frequency measurement uncertainty	for ≥ 100 symbol (400 μs)	< 35 Hz + drift of timebase, see general technical specifications

<b>Symbol clock error</b>		
Uncertainty		< 1 ppm

<b>I/Q offset</b>		
Inherent I/Q offset	for average ≥ 10 measurements	< -45 dB

<b>Spectrum flatness</b>		
Level uncertainty		< 0.8 dB

## Spectrum measurements

<b>Transmit spectrum mask</b>		
Frequency span		up to 80 MHz
Dynamic range		in line with IEEE 802.11p up to class B
Expected nominal power setting for full dynamic range	RF1 COM, RF2 COM	+12 dBm to +36 dBm <sup>43</sup>

## WLAN AC RF analyzer (R&S®CMW-KM656 option)

<b>Frequency range</b>	WLAN IEEE 802.11ac (5 GHz band), prerequisite: R&S®CMW-K046 option	5000 MHz to 6000 MHz, for frequency exceptions for inherent spurious response, see general technical specifications
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<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, maximum, standard deviation

<b>Trigger</b>		
Trigger source		WLAN: IF power

<b>High throughput (HT)</b>		
PPDU format		mixed mode

<sup>42</sup> Measured with channel estimation based on payload.

<sup>43</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

## Modulation analysis

<b>Bandwidth</b>		20 MHz, 40 MHz, 80 MHz, 80+80 MHz, 160 MHz
<b>Level range</b>		-28 dBm to +36 dBm <sup>44</sup>
<b>Payload length</b>		≥ 1 symbol
<b>Analysis modes</b>		BPSK code rate 1/2 (MCS0), BPSK code rate 3/4, QPSK code rate 1/2 (MCS1), QPSK code rate 3/4 (MCS2), 16QAM code rate 1/2 (MCS3), 16QAM code rate 3/4 (MCS4), 64QAM code rate 1/2, 64QAM code rate 2/3 (MCS5), 64QAM code rate 3/4 (MCS6), 64QAM code rate 5/6 (MCS7) 256QAM code rate 3/4 (MCS8) 256QAM code rate 5/6 (MCS9)
<b>Measured parameters</b>	numeric results and standard deviation	burst power, EVM all carriers, EVM data carriers, EVM pilot carriers, center frequency error, symbol clock error, I/Q offset
	graphical	EVM versus symbol, spectrum flatness, I/Q constellation, transmit spectrum mask
<b>Error vector magnitude (EVM)</b>		
Inherent EVM <sup>45</sup>	bandwidth 20 MHz, 40 MHz -18 dBm ≤ input level ≤ +36 dBm <sup>44</sup> , RMS	< -40 dB, RMS
	bandwidth 80 MHz -18 dBm ≤ input level ≤ +36 dBm <sup>44</sup> , RMS	< -38 dB, RMS
	bandwidth 160 MHz -15 dBm ≤ input level ≤ +36 dBm <sup>44</sup> , RMS	typ. < -38 dB, RMS
	Measurement length	entire PPDU
<b>Center frequency error</b>		
Frequency measurement uncertainty	for ≥ 100 symbol (400 μs)	< 35 Hz + drift of timebase, see general technical specifications
<b>Symbol clock error</b>		
Uncertainty	for ≥ 100 symbol (400 μs)	< 1 ppm
<b>I/Q offset</b>		
Inherent I/Q offset	for average ≥ 10 measurements	< -45 dB
<b>Spectrum flatness</b>		
Level uncertainty	bandwidth 20 MHz	< 0.8 dB
	bandwidth 40 MHz	< 1.0 dB
	bandwidth 80 MHz	< 1.5 dB
	bandwidth 160 MHz	typ. < 1.5 dB

<sup>44</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

<sup>45</sup> Measured with channel estimation based on payload.

## Spectrum measurements

<b>Transmit spectrum mask</b>		
Frequency span		up to 640 MHz
Dynamic range		in line with IEEE 802.11ac
Expected nominal power setting for full dynamic range	RF1 COM, RF2 COM	+12 dBm to +36 dBm <sup>46</sup>

## LR-WPAN specifications

<b>Standard</b>	low-rate wireless personal area networks	IEEE 802.15.4™ – 2011
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## LR-WPAN RF generator

<b>Frequency range</b>	2450 MHz O-QPSK PHY	2405 MHz to 2480 MHz
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## LR-WPAN waveforms (R&S®CMW-KV680 option)

<b>Arbitrary waveform file</b>	2450 MHz O-QPSK PHY	LRWPAN_2450MHz_OQPSK_127Bytes_PRBS9.WV (PAR = 0.06 dB)
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<b>Output level range</b>	depends on PAR	see general technical specifications
<b>Output level uncertainty</b>	waveform file used: LRWPAN_2450MHz_OQPSK_127Bytes_PRBS9.WV	see general technical specifications
<b>Output level resolution</b>		see general technical specifications

<b>Signal quality</b>		
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)

<b>Frequency range</b>	2450 MHz O-QPSK PHY	2405 MHz to 2480 MHz
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<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, maximum, minimum, standard deviation

<b>Trigger</b>		
Trigger source		LRWPAN: IF power

## Modulation analysis

<b>Level range</b>		–35 dBm to +36 dBm <sup>46</sup>
<b>Supported PHYs</b>		2450 MHz O-QPSK PHY
<b>Measured parameters</b>	2450 MHz O-QPSK PHY	frequency accuracy, symbol rate error, offset RMS EVM PSDU, offset peak EVM PSDU

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

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

<sup>46</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.



## TD-SCDMA specifications – mobile station (UE) test

Standard	TD-SCDMA CWTS
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### TD-SCDMA RF generator

Frequency range <sup>47</sup>	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
<b>Signal quality</b>		
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 <sup>47</sup>	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
<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation
<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>• GPRF: Gen</li> <li>• TD-SCDMA: free run</li> <li>• TD-SCDMA: IF power</li> </ul>

<sup>47</sup> Bands A, E, F in line with the CCSA standard.

**Modulation analysis**

<b>Filter</b>		1.28 MHz, RRC, $\alpha = 0.22$ , TD-SCDMA filter
<b>Level range</b>		-28 dBm to +36 dBm <sup>48</sup>
<b>Analysis modes</b>	TD-SCDMA uplink	QPSK, DPCH, QPSK, DPCH + HSDPA, 16QAM, DPCH + HSUPA
<b>Measured parameters</b>	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

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

<b>Frequency error</b>		
Measurement range		$\pm 3$ kHz
Frequency measurement uncertainty		< 20 Hz + drift of timebase, see general technical specifications

<b>I/Q origin offset</b>		
Inherent I/Q offset	for average $\geq 10$ measurements	< -55 dB

<b>I/Q imbalance</b>		
Inherent I/Q imbalance		< -50 dB

**Code domain**

<b>Filter</b>		1.28 MHz, RRC, $\alpha = 0.22$ , TD-SCDMA filter
<b>Level range</b>		-28 dBm to +36 dBm <sup>48</sup>
<b>Analysis modes</b>	TD-SCDMA uplink	QPSK, DPCH, QPSK, DPCH + HSDPA, 16QAM, DPCH + HSUPA
<b>Measured parameters</b>	numeric results and standard deviation	code domain error (CDE)
	graphical	code domain power versus code

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

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

<sup>48</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

**Spectrum measurements**

<b>Adjacent channel leakage ratio</b>	RMS detector	
Filter		1.28 MHz, RRC, $\alpha = 0.22$ , TD-SCDMA filter
Dynamic range	first adjacent channel at $\pm 1.6$ MHz	> 53 dB
	second adjacent channel at $\pm 3.2$ MHz	> 61 dB
Expected nominal power setting for full dynamic range	RF1 to RF8	-3 dBm to +36 dBm <sup>49</sup>
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

**Power meter**

<b>Measured parameters</b>	numeric current RMS values	UE power
<b>UE power</b>	RMS detector	
Filter		bandpass, 2.1 MHz, RRC, $\alpha = 0.22$
Level range		-55 dBm to +36 dBm <sup>49</sup>
Level uncertainty		see general technical specifications
Measurement length		1 slot

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<sup>49</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

## CDMA2000® 1xRTT specifications – mobile station test

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

### CDMA2000® 1xRTT RF generator

<b>Frequency range</b>	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)

<b>Arbitrary waveform files</b>		CDMA_OQPSK.WV (PAR = 5.54 dB) or CDMA_HPSK.WV (PAR = 6.97 dB)
<b>Output level range</b>	depends on PAR	see general technical specifications
<b>Output level uncertainty</b>	waveform file used: CDMA_OQPSK.WV or CDMA_HPSK.WV	see general technical specifications
<b>Output level resolution</b>		see general technical specifications
<b>Signal quality</b>		
Waveform quality (rho)	waveform file used: CDMA_OQPSK.WV or CDMA_HPSK.WV	> 0.99

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

<b>Frequency range</b>	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	

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

<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>• GPRF: Gen</li> <li>• C2K: free run</li> <li>• CDMA2000® signaling: superframe (80 ms)</li> </ul>

### Modulation analysis

<b>Filter</b>		1.23 MHz, RRC, $\alpha = 0.22$ , CDMA filter
<b>Level range</b>		-28 dBm to +36 dBm <sup>50</sup>
<b>Analysis modes</b>		OQPSK, HPSK
<b>Measured parameters</b>	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

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

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

<sup>50</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

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

<b>Carrier feedthrough</b>		
Inherent carrier feedthrough	for average $\geq 10$ measurements	< -55 dB

<b>I/Q imbalance</b>		
Inherent I/Q imbalance		< -50 dB

## Code domain

<b>Filter</b>		1.23 MHz, RRC, $\alpha = 0.22$ , CDMA filter
<b>Level range</b>		-28 dBm to +36 dBm <sup>51</sup>
<b>Measured parameters</b>	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

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

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

## Spectrum measurements

<b>Adjacent channel power</b>	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 <sup>51</sup>
Uncertainty	for -43 dBc adjacent channel level	< 0.5 dB
Measurement length	one power control group	1536 chip (1.25 ms)

## Power meter

<b>MS power</b>		
Filter	narrowband	bandpass, 1.25 MHz
Filter	wideband	bandpass, 8 MHz
Level range		-55 dBm to +36 dBm <sup>51</sup>
Level uncertainty		see general technical specifications
Measurement length		616 chip (0.5 ms)

<sup>51</sup> 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
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	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	

<b>Statistics</b>		
Statistical count		1 to 1000
Values		current, average, minimum/maximum, standard deviation
<b>Trigger</b>		
Trigger sources		<ul style="list-style-type: none"> <li>• GPRF: Gen</li> <li>• 1xEV-DO: free run</li> <li>• 1xEV-DO signaling: superframe (80 ms)</li> </ul>

## Modulation analysis

<b>Filter</b>		1.23 MHz, RRC, $\alpha = 0.22$ , CDMA filter
<b>Level range</b>		-28 dBm to +36 dBm <sup>52</sup>
<b>Analysis modes</b>		dual BPSK
<b>Multicarrier</b>		single carrier or 3 carriers within -8 MHz to +8 MHz
<b>Measured parameters</b>	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

<b>Waveform quality (rho)</b>		
Uncertainty	for rho 0.9 to 1	< 0.003
Measurement length	half-slot	1024 chip (833.33 $\mu$ s)

<b>Error vector magnitude (EVM)</b>		
Measurement range		up to 25 %, RMS
Inherent EVM		< 2.5 %, RMS
Measurement length	half-slot	1024 chip (833.33 $\mu$ s)

<b>Frequency error</b>		
Measurement range		$\pm 3$ kHz
Frequency measurement uncertainty		< 20 Hz + drift of timebase, see general technical specifications

<b>Carrier feedthrough</b>		
Inherent carrier feedthrough	for average $\geq 10$ measurements	< -55 dB

<b>I/Q imbalance</b>		
Inherent I/Q imbalance		< -50 dB

<sup>52</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.



**Code domain**

<b>Filter</b>		1.23 MHz, RRC, $\alpha = 0.22$ , CDMA filter
<b>Level range</b>		-28 dBm to +36 dBm <sup>53</sup>
<b>Measured parameters</b>	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

<b>Code domain power versus code</b>		
Uncertainty		< 0.4 dB
Measurement length	half-slot	1024 chip (833.33 $\mu$ s)

<b>Code domain error versus code</b>		
Measurement uncertainty		< 0.4 dB
Measurement length	half-slot	1024 chip (833.33 $\mu$ s)

**Spectrum measurements**

<b>Adjacent channel power</b>	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 <sup>53</sup>
Uncertainty	for -43 dBc adjacent channel level	< 0.5 dB
Measurement length	half-slot	1024 chip (833.33 $\mu$ s)

**Power meter**

<b>MS power</b>		
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 <sup>53</sup>
Level uncertainty		see general technical specifications
Measurement length	half-slot	1024 chip (833.33 $\mu$ s)

<sup>53</sup> The maximum permissible continuous power is +34 dBm due to thermal limits.

## General data

<b>RF connectors (front panel)</b>		SnapN female, 50 $\Omega$ , compatible with N female connectors
RF 1 TO RF 8		combined RF input and RF output
TX AUX		RF output
<b>Control interface (rear panel)</b>		
USB	max. length 3 m	USB 3.0 type B connector
<b>Power input (rear panel)</b>		DC socket
Rated voltage	For safety reasons, the instrument is only to be used with the Rohde & Schwarz AC adapter (order no. 1210.7812.00).	24 V DC ( $\pm 10\%$ )
Rated current		max. 3 A
Power consumption		max. 72 W
<b>Environmental conditions</b>		
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
<b>Product conformity</b>		
Electromagnetic compatibility	EU: in line with EMC Directive 2014/30/EC	applied harmonized standards: <ul style="list-style-type: none"> <li>EN 61326-1 (industrial environment)</li> <li>EN 61326-2-1</li> <li>EN 55011 (class A)</li> </ul>
Electrical safety	EU	applied harmonized standard: EN 61010-1
	USA/Canada	applied harmonized standards: <ul style="list-style-type: none"> <li>UL 61010-1</li> <li>CAN C22.2 No. 61010-1</li> </ul>
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
<b>Mechanical resistance</b>		
Vibration	nonoperating mode	
	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
<b>Dimensions</b>	W x H x D, overall	354 mm x 112 mm x 389 mm (14.0 in x 4.4 in x 15.3 in)
<b>Weight</b>		approx. 6.8 kg (15 lb)
<b>Calibration interval</b>		recommended for highest accuracy, see specified RF generator and RF analyzer level uncertainty
	12 months	
	24 months	add 0.2 dB to specified RF generator and RF analyzer level uncertainty

## Accessories delivered with R&S®CMW-PS10 (1210.7606.02)

### 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.

<b>Power rating</b>		
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

<b>Environmental conditions</b>		
Temperature	operating temperature range	see general data
	storage temperature range	see general data
Damp heat		see general data

<b>Product conformity</b>		
Electromagnetic compatibility	EU: in line with EMC Directive 2014/30/EC	applied harmonized standards: <ul style="list-style-type: none"> <li>• EN 61000</li> <li>• EN 55032 class B</li> </ul>
Electrical safety	EU: in line with Low Voltage Directive 2014/35/EC	applied harmonized standard: <ul style="list-style-type: none"> <li>• EN 60950-1</li> </ul>
	USA/Canada/Japan	applied standards: <ul style="list-style-type: none"> <li>• UL/CAN/CSA-C22.2 No. 60950-1</li> <li>• J60950-1</li> </ul>
	Korea	applied standard: <ul style="list-style-type: none"> <li>• Korea KC</li> </ul>

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

### USB 3.0 cable

The 3 m USB 3.0 cable (type A to type B) 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	1201.0002K03
R&S®CMW100 hardware kit	R&S®CMW-PS10	1210.7606.02
Documentation of calibration values	R&S®DCV-2	0240.2193.08
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 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 accessory R&S®CMW100-Z31.

### Recommended accessories

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

### Computer requirements

The computer to be connected to the radio 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 <sup>54</sup>	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 radio test head	1 × USB 3.0; Use a socket mounted to the motherboard, not a socket connected to the motherboard via a cable. Typically, sockets on the front of the PC are not suitable.	

<sup>54</sup> 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 <sup>55</sup>. 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 <sup>55</sup> 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 <sup>55</sup> and accredited calibration at the recommended intervals as well as any accredited calibration carried out during repairs or option upgrades.

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<sup>55</sup> 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
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- | Uncompromising quality
- | Long-term dependability

## Rohde & Schwarz

The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

[www.rohde-schwarz.com](http://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**

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**ISO 14001**

## Rohde & Schwarz training

[www.training.rohde-schwarz.com](http://www.training.rohde-schwarz.com)

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