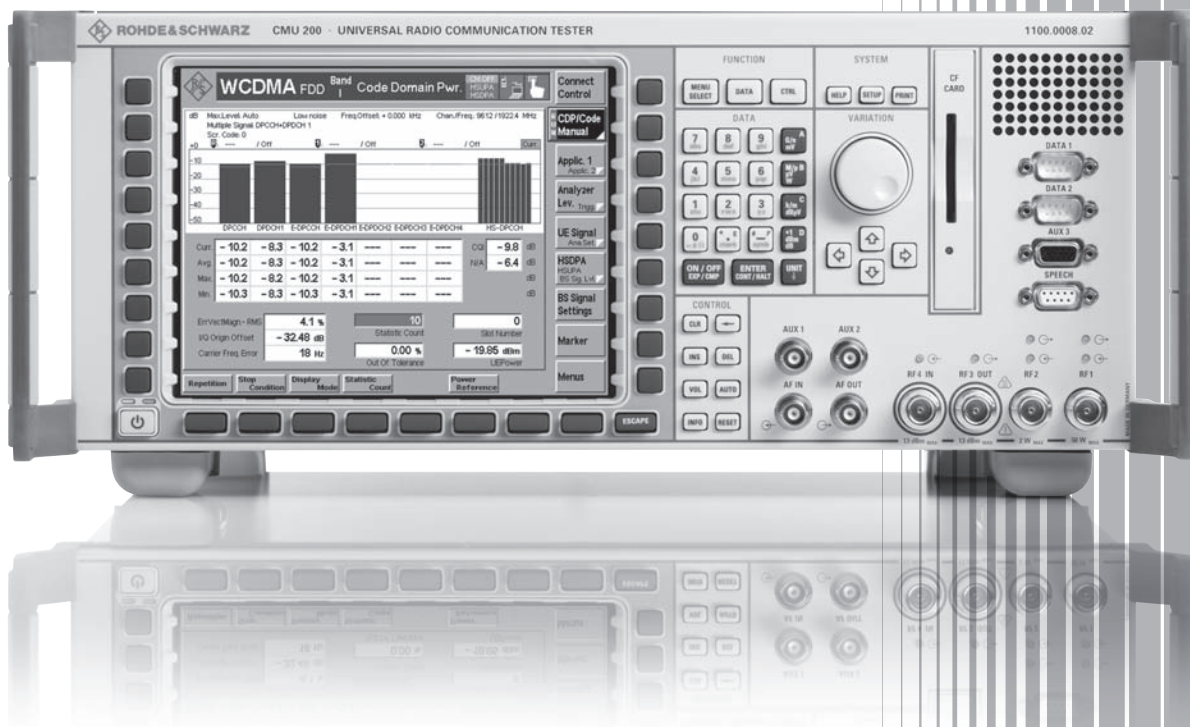




# R&S® CMU200 Universal Radio Communication Tester Specifications

Test & Measurement

Data Sheet | 09.00



**75** Years of  
Driving  
Innovation



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Specifications apply under the following conditions: "Typical values" are designated with the abbreviation "typ." These values are verified during the final test but are not assured by Rohde & Schwarz. "Nominal values" are design parameters that are not assured by Rohde & Schwarz. These values are verified during product development but are not specifically tested during production.

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 kbps (thousand bits per second) or ksps (thousand symbols per second). Mcps, kbps, and ksps are not SI units.

The specifications for the R&S<sup>®</sup>CMU200 (Order No. 1100.0008.02/10/30/53) refer to a fully equipped unit with all relevant options installed.

Data without tolerance limits is not binding.

For more general information about the R&S<sup>®</sup>CMU200, refer to the product brochure PD 0758.0039.12.

CDMA2000<sup>®</sup> is a registered trademark of the Telecommunications Industry Association (TIA - USA).

The Bluetooth<sup>®</sup> word mark and logos are owned by the Bluetooth SIG, Inc. and any use of such marks by Rohde & Schwarz is under license.

# Base unit specifications

## Timebase TCXO

Max. frequency drift	in temperature range +5 °C to +45 °C	$\pm 1 \times 10^{-6}$
Max. aging		$\pm 1 \times 10^{-6}$ /year

## Timebase OCXO – R&S® CMU-B11 option

Max. frequency drift	in temperature range +5 °C to +45 °C	$\pm 1 \times 10^{-7}$
Max. aging	after 30 days of operation	$\pm 2 \times 10^{-7}$ /year $\pm 5 \times 10^{-9}$ /day
Warm-up time	at +25 °C	approx. 5 min

## Timebase OCXO – R&S® CMU-B12 option

Max. frequency drift	in temperature range +5 °C to +45 °C, referenced to +25 °C	$\pm 5 \times 10^{-9}$
	with instrument orientation	$\pm 3 \times 10^{-9}$
	referenced to turn-off frequency after 2 h warm-up time following a 24 h off time at +25 °C	$\pm 5 \times 10^{-9}$
Max. aging	after 30 days of operation	$\pm 3.5 \times 10^{-8}$ /year $\pm 5 \times 10^{-10}$ /day
Warm-up time	at +25 °C	approx. 10 min

## Reference frequency inputs/outputs

<b>Synchronization input</b>		BNC connector REF IN
Frequency	sinewave	1 MHz to 52 MHz, 1 kHz step
	squarewave (TTL level)	10 kHz to 52 MHz, 1 kHz step
Max. frequency variation		$\pm 5 \times 10^{-6}$
Input voltage range		0.5 V to 2 V, rms
Impedance		50 Ω

<b>Synchronization output 1</b>		BNC connector REF OUT 1
Frequency		10 MHz from internal reference or frequency at synchronization input
Output voltage		>1.4 V, peak-peak
Impedance		50 Ω

<b>Synchronization output 2</b>		BNC connector REF OUT 2
Frequency		net-specific frequencies in range 100 kHz to 40 MHz
Output voltage	f ≤ 13 MHz	>1.0 V, peak-peak
Impedance		50 Ω

## RF generator

Frequency range		100 kHz to 2700 MHz
Frequency resolution		0.1 Hz
Frequency uncertainty		same as timebase + frequency resolution
Frequency settling time		<400 $\mu$ s to $\Delta f < 1$ kHz

<b>Output level range</b>		
RF 1	100 kHz to 2200 MHz	-130 dBm to -27 dBm
	2200 MHz to 2700 MHz	-130 dBm to -33 dBm
RF 2	100 kHz to 2200 MHz	-130 dBm to -10 dBm
	2200 MHz to 2700 MHz	-130 dBm to -16 dBm
RF 3 OUT	100 kHz to 2200 MHz	-90 dBm to +13 dBm
	2200 MHz to 2700 MHz	-90 dBm to +5 dBm

<b>Output level uncertainty</b>		
RF 1, RF 2	in temperature range +20 °C to +35 °C	
	output level $\geq -106$ dBm	
	10 MHz to 450 MHz	<0.6 dB
	450 MHz to 2200 MHz	<0.6 dB
	2200 MHz to 2700 MHz	<0.8 dB
	output level > -117 dBm	
	450 MHz to 2200 MHz	<0.6 dB <sup>1</sup>
	2200 MHz to 2700 MHz	<0.8 dB <sup>1</sup>
	output level -117 dBm to -130 dBm	
	450 MHz to 2200 MHz	<1.5 dB <sup>1,2</sup>
	2200 MHz to 2700 MHz	<1.5 dB <sup>1,2</sup>
RF 3 OUT	10 MHz to 450 MHz	
	output level -80 dBm to +10 dBm	<0.8 dB
	450 MHz to 2200 MHz	
	output level -90 dBm to +10 dBm	<0.8 dB
	2200 MHz to 2700 MHz	
	output level -90 dBm to +5 dBm	<1.0 dB

<b>Output level uncertainty</b>		
RF 1, RF 2	in temperature range +5 °C to +45 °C	
	output level $\geq -106$ dBm	
	10 MHz to 450 MHz	<1.0 dB
	450 MHz to 2200 MHz	<1.0 dB
	2200 MHz to 2700 MHz	<1.5 dB
	output level > -117 dBm	
	450 MHz to 2200 MHz	<1.0 dB <sup>1</sup>
	2200 MHz to 2700 MHz	<1.5 dB <sup>1</sup>
	output level -117 dBm to -130 dBm	
	450 MHz to 2200 MHz	<1.5 dB <sup>1,2</sup>
	2200 MHz to 2700 MHz	<1.5 dB <sup>1,2</sup>
RF 3 OUT	10 MHz to 450 MHz	
	output level -80 dBm to +10 dBm	<1.0 dB
	450 MHz to 2200 MHz	
	output level -90 dBm to +10 dBm	<1.0 dB
	2200 MHz to 2700 MHz	
	output level -90 dBm to +5 dBm	<1.5 dB

<b>Output level settling time</b>		<4 $\mu$ s
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<b>Output level resolution</b>		0.1 dB
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<sup>1</sup> Not valid at frequencies of net-clock harmonics.

<sup>2</sup> Valid for RF 1 only.

<b>Generator RF level repeatability</b>	typical values after 1 h warm-up time	
	output level $\geq -80$ dBm	<0.01 dB
	output level < $-80$ dBm	<0.1 dB
<b>VSWR</b>		
RF 1	10 MHz to 2000 MHz	<1.2
	2000 MHz to 2200 MHz	<1.3
	2200 MHz to 2700 MHz	<1.6
RF 2	10 MHz to 2200 MHz	<1.2
	2200 MHz to 2700 MHz	<1.6
RF 3 OUT	10 MHz to 2200 MHz	<1.5
	2200 MHz to 2700 MHz	<1.7

<b>Attenuation of harmonics</b>	up to 7 GHz	
RF 1, RF 2	$f_0 = 10$ MHz to 200 MHz	>20 dB
RF 1, RF 2	$f_0 = 200$ MHz to 2200 MHz	>30 dB
RF 3 OUT	$f_0 = 10$ MHz to 2200 MHz output level $\leq +10$ dBm	>20 dB

<b>Attenuation of nonharmonics</b>	10 MHz to 2200 MHz, at $f > 5$ kHz from carrier	>40 dB
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<b>Phase noise</b>	single sideband, $f < 2.2$ GHz	
Carrier offset	20 kHz to 250 kHz	<-100 dBc, 1 Hz
	$\geq 250$ kHz	<-110 dBc, 1 Hz

<b>Residual FM</b>	$f < 2.2$ GHz	
	30 Hz to 15 kHz	<50 Hz, rms <200 Hz, peak
	ITU-T (formerly CCITT)	<5 Hz, rms

<b>Residual AM</b>	$f < 2.2$ GHz	
	ITU-T (formerly CCITT)	<0.02 %, rms

<b>I/Q modulation</b>		
Carrier suppression	data for frequency offset range 0 Hz to $\pm 135$ kHz	>40 dB

<b>FM modulation</b>		
Deviation range		10 kHz to 440 kHz
Deviation resolution		1 Hz
Modulation frequency range		100 Hz to 50 kHz
Modulation distortion	modulation frequency 1 kHz, deviation 80 kHz	<2 %
Deviation uncertainty		<5 % + resolution + residual FM

## RF analyzer

<b>VSWR</b>		
RF 1	10 MHz to 2000 MHz	<1.2
	2000 MHz to 2200 MHz	<1.3
	2200 MHz to 2700 MHz	<1.6
RF 2	10 MHz to 2200 MHz	<1.2
	2200 MHz to 2700 MHz	<1.6
RF 4 IN	10 MHz to 2200 MHz	<1.5
	2200 MHz to 2700 MHz	<1.6

<b>Inherent spurious response</b>	<i>RF Attenuation</i> $\rightarrow$ <i>Low Distortion</i> 20 MHz to 2200 MHz, except 1816.115 MHz	<-50 dB
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<b>Inherent harmonics</b>	$f_{in} = 50$ MHz to 1100 MHz, $f_{selected} = 100$ MHz to 2200 MHz	
RF 1, RF 2		<-30 dB
RF 4 IN		<-20 dB

<b>Phase noise</b>	single sideband, $f < 2.2$ GHz	
Carrier offset	20 kHz to 250 kHz	$<-100$ dBc, 1 Hz
	250 kHz to 400 kHz	$<-110$ dBc, 1 Hz
	$\geq 400$ kHz	$<-118$ dBc, 1 Hz
<b>Residual FM</b>	$f < 2.2$ GHz	
	30 Hz to 15 kHz	$<50$ Hz, rms $<200$ Hz, peak
	ITU-T (formerly CCITT)	$<5$ Hz, rms
<b>Residual AM</b>	$f < 2.2$ GHz	
	ITU-T (formerly CCITT)	$<0.02$ %, rms

## Power meter (wideband)

<b>Frequency range</b>		100 kHz to 2700 MHz
<b>Level range</b>		
RF 1	continuous power <sup>3</sup>	
	10 MHz to 2200 MHz	+6 dBm to +47 dBm (50 W)
	2200 MHz to 2700 MHz	+10 dBm to +47 dBm (50 W)
	peak envelope power <sup>4</sup> (PEP)	+53 dBm (200 W)
RF 2	continuous power	
	10 MHz to 2200 MHz	-8 dBm to +33 dBm (2 W)
	2200 MHz to 2700 MHz	-4 dBm to +33 dBm (2 W)
	peak envelope power <sup>4</sup> (PEP)	+39 dBm (8 W)
RF 4 IN	continuous power and PEP	
	10 MHz to 2200 MHz	-33 dBm to 0 dBm
	2200 MHz to 2700 MHz	-29 dBm to 0 dBm
<b>Level uncertainty</b>		
RF 1	input level +10 dBm to +20 dBm	
	50 MHz to 2700 MHz	$<1.0$ dB <sup>5</sup>
	input level +20 dBm to +47 dBm	
	50 MHz to 2700 MHz	$<0.5$ dB <sup>5,6</sup>
RF 2	input level -4 dBm to +6 dBm	
	50 MHz to 2700 MHz	$<1.0$ dB <sup>5</sup>
	input level +6 dBm to +33 dBm	
	50 MHz to 2700 MHz	$<0.5$ dB <sup>5</sup>
RF 4 IN	input level -29 dBm to -19 dBm	
	50 MHz to 2700 MHz	$<1.5$ dB
	input level -19 dBm to 0 dBm	
	50 MHz to 2700 MHz	$<0.8$ dB
<b>Level resolution</b>	in manual mode	0.1 dB
	in remote control mode	0.01 dB

<sup>3</sup> 50 W in temperature range +5 °C to +30 °C, linear degradation down to 25 W at +45 °C.

<sup>4</sup> Mean value of power versus time must be equal to or less than permissible continuous power.

<sup>5</sup> Temperature range +5 °C to +20 °C or +35 °C to +45 °C and  $f > 2200$  MHz: add 0.2 dB.

<sup>6</sup> Calibrated for input level  $> +33$  dBm only in frequency range 800 MHz to 2000 MHz.



## Power meter (frequency-selective)

<b>Frequency range</b>		10 MHz to 2700 MHz
<b>Frequency resolution</b>		0.1 Hz
<b>Resolution bandwidths</b>		10 Hz to 1 MHz in 1/2/3/5 steps
<b>Level range</b>		
RF 1	continuous power <sup>3</sup>	
	10 MHz to 2200 MHz	-40 dBm to +47 dBm (50 W)
	2200 MHz to 2700 MHz	-34 dBm to +47 dBm (50 W)
	peak envelope power <sup>4</sup> (PEP)	+53 dBm (200 W)
RF 2	continuous power	
	10 MHz to 2200 MHz	-54 dBm to +33 dBm (2 W)
	2200 MHz to 2700 MHz	-48 dBm to +33 dBm (2 W)
	peak envelope power <sup>4</sup> (PEP)	+39 dBm (8 W)
RF 4 IN	continuous power and PEP	
	10 MHz to 2200 MHz	-80 dBm to 0 dBm
	2200 MHz to 2700 MHz	-74 dBm to 0 dBm
<b>Level uncertainty</b>	in temperature range +20 °C to +35 °C	
RF 1, RF 2	50 MHz to 2200 MHz	<0.5 dB
	2200 MHz to 2700 MHz	<0.7 dB
RF 4 IN	50 MHz to 2200 MHz	<0.7 dB
	2200 MHz to 2700 MHz	<0.9 dB
<b>Level uncertainty</b>	in temperature range +5 °C to +45 °C	
RF 1, RF 2	50 MHz to 2200 MHz	<1.0 dB
	2200 MHz to 2700 MHz	<1.0 dB
RF 4 IN	50 MHz to 2200 MHz	<1.0 dB
	2200 MHz to 2700 MHz	<1.1 dB
<b>Level resolution</b>	in manual mode	0.1 dB
	in remote control mode	0.01 dB
<b>RF level measurement repeatability</b>	typical values after 1 h warm-up time	
	input level ≥ -40 dBm	<0.01 dB
	input level < -40 dBm	<0.03 dB

## Spectrum analyzer

<b>Frequency range</b>		10 MHz to 2.7 GHz
<b>Span</b>		zero span to full span
<b>Frequency resolution</b>		0.1 Hz
<b>Resolution bandwidths</b>		10 Hz to 1 MHz in 1/2/3/5 steps
<b>Sweep time</b>	depending on resolution bandwidth (RBW)	≥100 ms
<b>Display</b>		560 dots, horizontal
<b>Marker</b>		up to 3, absolute/relative
<b>Display line</b>		1
<b>Display scale</b>		10 dB/20 dB/30 dB/50 dB/80 dB/100 dB

<b>Level range</b>		
RF 1	continuous power <sup>3</sup>	up to +47 dBm (50 W)
	peak envelope power <sup>4</sup> (PEP)	up to +53 dBm (200 W)
RF 2	continuous power	up to +33 dBm (2 W)
	peak envelope power <sup>4</sup> (PEP)	up to +39 dBm (8 W)
RF 4 IN	continuous power and PEP	up to 0 dBm

<b>Level uncertainty</b>	in temperature range +20 °C to +35 °C	
RF 1, RF 2	50 MHz to 2200 MHz	<0.5 dB
	2200 MHz to 2700 MHz	<0.7 dB
RF 4 IN	50 MHz to 2200 MHz	<0.7 dB
	2200 MHz to 2700 MHz	<0.9 dB

<b>Level uncertainty</b>	in temperature range +5 °C to +45 °C	
RF 1, RF 2	50 MHz to 2200 MHz	<1.0 dB
	2200 MHz to 2700 MHz	<1.0 dB
RF 4 IN	50 MHz to 2200 MHz	<1.0 dB
	2200 MHz to 2700 MHz	<1.1 dB

<b>Reference level for full dynamic range</b>	<i>RF Attenuation</i> → <i>Low Noise</i> logarithmic level display	
RF 1		+10 dBm to +47 dBm
RF 2		-4 dBm to +33 dBm
RF 4 IN		-22 dBm to 0 dBm

<b>Displayed average noise level</b>	<i>RF Attenuation</i> → <i>Low Noise</i> RBW → 1 kHz	
	10 MHz to 2200 MHz	<-100 dBc
	2200 MHz to 2700 MHz	<-95 dBc

<b>Inherent spurious response</b>	<i>RF Attenuation</i> → <i>Low Distortion</i> 20 MHz to 2200 MHz, except 1816.115 MHz	<-50 dB
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<b>Inherent harmonics</b>	$f_{in} = 50 \text{ MHz to } 1100 \text{ MHz}$ $f_{selected} = 100 \text{ MHz to } 2200 \text{ MHz}$	
RF 1, RF 2		<-30 dB
RF 4 IN		<-20 dB

## General data

<b>Operating temperature range</b>		+5 °C to +45 °C, in line with EN 60068-2-1 and -2
<b>Storage temperature range</b>		-25 °C to +60 °C, in line with EN 60068-2-1 and -2
<b>Humidity</b>	+40 °C, non-condensing	80 % relative humidity, in line with EN 60068-2-78
<b>Electromagnetic compatibility</b>		in line with EMC Directive 2004/108/EC, applied standard: EN 61326 (immunity for industrial environment; class B emissions)
<b>Electrical safety</b>		in line with IEC 61010-1: 2001 (ed. 2), EN 61010-1: 2001 (ed. 2), UL 61010-1 (ed. 2), CAN C22.2 No. 61010-1-04
<b>Mechanical resistance</b>	non-operating mode	
Vibration	sinusoidal	in line with EN 60068-2-6, MIL-PRF-28800 F classes 3 and 4, 5 Hz to 150 Hz, max. 2 g at 55 Hz, 55 Hz to 150 Hz, 0.5 g const.
Vibration	random	in line with EN 60068-2-64 10 Hz to 300 Hz, acceleration 1.2 g rms
Shock		in line with MIL-STD-810D 40 g shock spectrum
<b>Power supply</b>		power factor correction, in line with EN 61000-3-2
Input		100 V to 240 V $\pm$ 10 % (AC), max. 500 VA, 50 Hz to 400 Hz -5 % to +10 %
Power consumption	base unit	approx. 130 W
	with typical options	approx. 180 W
<b>Display</b>		21 cm TFT color display (8.4")
Resolution		640 pixel x 480 pixel (VGA resolution)
Pixel failure rate		$<2 \times 10^{-5}$
<b>Dimensions</b>	W x H x D	465.1 mm x 197.3 mm x 517.0 mm (18.31 in x 7.77 in x 20.35 in)
	for rackmounting	19" 1/1, 4 HU, 450
<b>Weight</b>	base unit	approx. 14 kg (approx. 31 lb)
	with typical options	approx. 18 kg (approx. 40 lb)

## Inputs and outputs (rear panel)

<b>IF 3 RX CH1</b>		BNC female
Frequency	WCDMA other networks/RF	7.68 MHz 10.7 MHz
Max. output level		0 dBm
Impedance		50 $\Omega$
<b>Remote control interfaces</b>		
IEC/IEEE bus	IEC 60625-2 (IEEE 488.2)	24-pin Amphenol connector
Serial interface COM 1, COM 2	RS-232-C (COM)	9-pin D-Sub connector
<b>Printer interface LPT</b>	parallel (Centronics compatible)	25-pin D-Sub connector
<b>USB</b>	keyboard only	2 $\times$ USB type A connector
<b>External monitor (VGA)</b>		15-pin D-Sub connector

# GSM specifications – mobile station test

## RF generator

<b>Modulation</b>		GMSK, B × T = 0.3 8PSK
<b>Frequency range</b>	GSM400 band	460 MHz to 468 MHz 488 MHz to 496 MHz
	GSM850 band	869 MHz to 894 MHz
	GSM900 band	921 MHz to 960 MHz
	GSM1800 band	1805 MHz to 1880 MHz
	GSM1900 band	1930 MHz to 1990 MHz
<b>Attenuation of inband spurious emissions</b>		>50 dB
<b>Inherent phase error</b>	GMSK	<1°, rms <4°, peak
<b>Inherent EVM</b>	8PSK	<2 %, rms
<b>Frequency settling time</b>	to residual phase of 4°	<500 µs
<b>Output level range</b>	GMSK	
RF 1		-130 dBm to -27 dBm
RF 2		-130 dBm to -10 dBm
RF 3 OUT		-90 dBm to +13 dBm
<b>Output level range</b>	8PSK	
RF 1		-130 dBm to -31 dBm
RF 2		-130 dBm to -14 dBm
RF 3 OUT		-90 dBm to +9 dBm
<b>Output level resolution</b>		0.1 dB
<b>Output level uncertainty</b>	in temperature range +20 °C to 35 °C	
RF 1, RF 2	output level > -117 dBm	<0.5 dB
RF 3 OUT	-90 dBm to +10 dBm (GMSK) -90 dBm to +6 dBm (8PSK)	<0.7 dB <0.7 dB
<b>Output level uncertainty</b>	in temperature range +5 °C to 45 °C	
RF 1, RF 2	output level > -117 dBm	<0.7 dB
RF 3 OUT	-90 dBm to +10 dBm (GMSK) -90 dBm to +6 dBm (8PSK)	<0.9 dB <0.9 dB

## R&S® CMU-B95 additional RF generator option

<b>Modulation</b>		GMSK, B × T = 0.3 8PSK
<b>Frequency range</b>	GSM400 band	460 MHz to 468 MHz 488 MHz to 496 MHz
	GSM850 band	869 MHz to 894 MHz
	GSM900 band	921 MHz to 960 MHz
	GSM1800 band	1805 MHz to 1880 MHz
	GSM1900 band	1930 MHz to 1990 MHz
<b>Frequency resolution</b>		200 kHz
<b>Frequency uncertainty</b>		same as timebase, see base unit specifications
<b>Inherent phase error</b>	GMSK	<5°, rms
<b>Output level range</b>	GMSK	
RF 1	without R&S® CMU-U99 with R&S® CMU-U99	-122 dBm to -72 dBm -110 dBm to -60 dBm
RF 2		-110 dBm to -60 dBm
<b>Output level range</b>	8PSK	
RF 1	without R&S® CMU-U99 with R&S® CMU-U99	-122 dBm to -76 dBm -110 dBm to -64 dBm
RF 2		-110 dBm to -64 dBm
<b>Output level resolution</b>		1 dB
<b>Reduced input level range</b>	if R&S® CMU-B95 is installed	
RF 1	continuous input power	max. 2 W

## R&S® CMU-B96 additional RF generator option

### Path 1 for GSM

<b>Modulation</b>		GMSK, B × T = 0.3 8PSK
<b>Frequency range</b>	GSM400 band	460 MHz to 468 MHz 488 MHz to 496 MHz
	GSM850 band	869 MHz to 894 MHz
	GSM900 band	921 MHz to 960 MHz
	GSM1800 band	1805 MHz to 1880 MHz
	GSM1900 band	1930 MHz to 1990 MHz
<b>Frequency resolution</b>		2.5 kHz
<b>Frequency uncertainty</b>		same as timebase, see base unit specifications
<b>Inherent phase error</b>	GMSK	<5°, rms
<b>Output level range</b>	GMSK	
RF 1	without R&S® CMU-U99 with R&S® CMU-U99	-115 dBm to -72 dBm -103 dBm to -60 dBm
RF 2		-103 dBm to -60 dBm

<b>Output level range</b>	8PSK	
RF 1	without R&S <sup>®</sup> CMU-U99 with R&S <sup>®</sup> CMU-U99	-115 dBm to -76 dBm -103 dBm to -64 dBm
RF 2		-103 dBm to -64 dBm

<b>Output level range</b>	GMSK overrange mode	
RF 1	without R&S <sup>®</sup> CMU-U99 with R&S <sup>®</sup> CMU-U99	-110 dBm to -28 dBm -90 dBm to -14 dBm
RF 2		-90 dBm to -14 dBm
RF 3 OUT		-70 dBm to +9 dBm

<b>Output level range</b>	8PSK overrange mode	
RF 1	without R&S <sup>®</sup> CMU-U99 with R&S <sup>®</sup> CMU-U99	-110 dBm to -32 dBm -90 dBm to -18 dBm
RF 2		-90 dBm to -18 dBm
RF 3 OUT		-70 dBm to +5 dBm

<b>Output level resolution</b>		1 dB
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### Influence on RF interface

<b>Reduced input level range</b>	if R&S <sup>®</sup> CMU-B96 is installed	
RF 1	continuous input power	max. 2 W

<b>RF level uncertainty</b>	Use of the R&S <sup>®</sup> CMU-B96 in overrange mode may influence all RF signal levels and their quality.	
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### RF analyzer

<b>Frequency range</b>	GSM400 band	450 MHz to 458 MHz 478 MHz to 486 MHz
	GSM850 band	824 MHz to 849 MHz
	GSM900 band	876 MHz to 915 MHz
	GSM1800 band	1710 MHz to 1785 MHz
	GSM1900 band	1850 MHz to 1910 MHz

### Power meter (frequency-selective)

<b>Level range</b>		
RF 1	continuous power <sup>3</sup>	-40 dBm to +47 dBm (50 W)
	peak envelope power <sup>4</sup> (PEP)	+53 dBm (200 W)
RF 2	continuous power	-54 dBm to +33 dBm (2 W)
	peak envelope power <sup>4</sup> (PEP)	+39 dBm (8 W)
RF 4 IN	continuous power and PEP	-80 dBm to 0 dBm

<b>Level uncertainty</b>	in temperature range +20 °C to +35 °C	<0.5 dB
	in temperature range +5 °C to +45 °C	<0.7 dB

<b>Level resolution</b>	in manual mode	0.1 dB
	in remote control mode	0.01 dB

<b>Measurement bandwidth</b>	selectable	500 kHz or 600 kHz
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## Modulation analysis

<b>Level range</b>	peak envelope power (PEP)	
RF 1	see footnote 4	-6 dBm to +53 dBm
RF 2	see footnote 4	-20 dBm to +39 dBm
RF 4 IN		-60 dBm to 0 dBm
<b>Inherent phase error</b>	GMSK	<0.6°, rms <2°, peak
<b>Inherent EVM</b>	8PSK	≤1.0 %, rms
<b>Frequency measurement uncertainty</b>		≤10 Hz + drift of timebase, see base unit specifications
<b>Measurement bandwidth</b>	selectable	500 kHz or 600 kHz

## Burst power measurement

<b>Reference level for full dynamic range</b>	GMSK, <i>RF Attenuation → Low Noise</i>	
RF 1	see footnote 4	+10 dBm to +53 dBm
RF 2	see footnote 4	-4 dBm to +39 dBm
RF 4 IN		-22 dBm to 0 dBm
<b>Reference level for full dynamic range</b>	8PSK, <i>RF Attenuation → Low Noise</i>	
RF 1	see footnote 4	+6 dBm to +49 dBm
RF 2	see footnote 4	-8 dBm to +35 dBm
RF 4 IN		-26 dBm to -4 dBm
<b>Dynamic range</b>	<i>Filter → 500 kHz, rms</i> <i>RF Attenuation → Low Noise</i>	
	GMSK	>72 dB
	8PSK	>69 dB
<b>Relative measurement uncertainty</b>		
	result > -40 dB	<0.1 dB
	-60 dB ≤ result ≤ -40 dB	<0.5 dB
<b>Resolution</b>	in active part of burst	0.1 dB
<b>Measurement bandwidth</b>	selectable	500 kHz or 600 kHz

## Spectrum due to modulation

<b>Reference level for full dynamic range</b>	GMSK, <i>RF Attenuation → Low Noise</i>	
RF 1		+10 dBm to +47 dBm
RF 2		-4 dBm to +33 dBm
RF 4 IN		-22 dBm to 0 dBm
<b>Test method</b>		relative measurement, averaging
<b>Filter bandwidth</b>		30 kHz resolution filter, 5 poles
<b>Measurement</b>	at an offset of ±	100/200/250/400/600/800/1000/1200/ 1400/1600/1800 kHz
<b>Dynamic range</b>	with offset ≥ 1200 kHz	>74 dB



## Spectrum due to switching

<b>Reference level for full dynamic range</b>	GMSK, <i>RF Attenuation</i> → <i>Low Noise</i>	
RF 1		+10 dBm to +47 dBm
RF 2		-4 dBm to +33 dBm
RF 4 IN		-22 dBm to 0 dBm
<b>Test method</b>		absolute measurement, max. hold over several measurements
<b>Filter bandwidth</b>		30 kHz resolution filter, 5 poles
<b>Measurement</b>	at an offset of ±	400/600/1200/1800 kHz
<b>Dynamic range</b>	with offset ≥ 1200 kHz	>72 dB

## R&S® CMU-B52 speech codec option

<b>Speech decoder output</b>	SPEECH HANDSET OUT	9-pin D-Sub connector
Output impedance		<10 Ω
Max. output current		20 mA, peak
Full-range output level		1 V, peak
<b>Speech coder input</b>	SPEECH HANDSET IN	9-pin D-Sub connector
Input impedance		100 kΩ
Full-range input level	low sensitivity	1.4 V, peak
	high sensitivity	0.1 V, peak

# TDMA specifications – mobile station test

## RF generator

<b>Frequency range</b>	signaling mode	
	US Cellular	869 MHz to 894 MHz
	PCS (US)	1930 MHz to 1990 MHz
<b>Frequency range</b>	non-signaling mode	10 MHz to 2200 MHz
<b>Frequency resolution</b>	non-signaling mode	1 Hz
<b>Frequency uncertainty</b>		same as timebase, see base unit specifications
<b>Output level range</b>		
RF 1		-130 dBm to -32 dBm
RF 2		-130 dBm to -15 dBm
RF 3 OUT		-90 dBm to +8 dBm
<b>Output level resolution</b>		0.1 dB
<b>Output level uncertainty</b>		see base unit specifications
<b>Modulation</b>	$\pi/4$ DQPSK or unmodulated (non-signaling mode)	
Uncertainty	EVM	<2.5 %, rms
Carrier suppression		>40 dB

## RF analyzer

<b>Frequency range</b>	signaling mode	
	US Cellular	824 MHz to 849 MHz
	PCS (US)	1850 MHz to 1910 MHz
<b>Frequency range</b>	non-signaling mode	10 MHz to 2200 MHz
<b>Frequency resolution</b>	non-signaling mode	1 Hz
<b>Frequency uncertainty</b>		same as timebase, see base unit specifications

## Modulation analysis

<b>Frequency range</b>	signaling mode	
	US Cellular	824 MHz to 849 MHz
	PCS (US)	1850 MHz to 1910 MHz
<b>EVM</b>	residual	<2.0 %, rms <4 %, peak
<b>I/Q offset</b>	residual	<-50 dB (0.3 %)
<b>I/Q imbalance</b>	residual	<-50 dB (0.3 %)
<b>Frequency measurement range</b>		-2 kHz to +2 kHz
<b>Frequency measurement uncertainty</b>		$\leq 5$ Hz + drift of timebase, see base unit specifications

### Power meter (frequency-selective)

Level range		see base unit specifications
Level uncertainty		see base unit specifications

### Power versus time measurement

Reference level for full dynamic range		
RF 1		+4 dBm to +47 dBm
RF 2		-10 dBm to +33 dBm
RF 4 IN		-28 dBm to -6 dBm
Dynamic range	<i>Filter</i> → 100 kHz, rms <i>RF Attenuation</i> → Low Noise	>74 dB
Relative measurement uncertainty	result > -40 dB	<0.1 dB
	-60 dB ≤ result ≤ -40 dB	<0.5 dB
Residual leakage power level		<-65 dBm

### Adjacent channel power measurement

Dynamic range	first adjacent channel	>45 dB
	second and third adjacent channel	>55 dB

# AMPS specifications – mobile station test

## RF generator

<b>Frequency range</b>	signaling mode	
	US Cellular	869 MHz to 894 MHz
<b>Frequency range</b>	non-signaling mode	10 MHz to 2200 MHz
<b>Frequency resolution</b>	non-signaling mode	1 Hz
<b>Frequency uncertainty</b>		same as timebase, see base unit specifications
<b>Output level range</b>		
RF 1		-130 dBm to -27 dBm
RF 2		-130 dBm to -10 dBm
RF 3 OUT		-99 dBm to +13 dBm
<b>Output level resolution</b>		0.1 dB
<b>Output level uncertainty</b>		see base unit specifications and add 0.1 dB
<b>FM modulation</b>		
Deviation range		100 Hz to 20 kHz
Deviation resolution		1 Hz
Modulation frequency range		100 Hz to 15.999 kHz
Modulation distortion	SINAD, modulation frequency 1 kHz, deviation 8 kHz, bandwidth 30 Hz to 15 kHz	≥40 dB
Residual FM	bandwidth 300 Hz to 3 kHz	<10 Hz, rms
Deviation uncertainty	modulation frequency 1 kHz, deviation 8 kHz, bandwidth 30 Hz to 15 kHz	<2 % of setting + residual FM
Deviation frequency response	modulation frequency 300 Hz to 15.999 kHz	≤1 dB

## RF analyzer

<b>Frequency range</b>	signaling mode	
	US Cellular	824 MHz to 849 MHz
<b>Frequency range</b>	non-signaling mode	10 MHz to 2200 MHz
<b>Frequency resolution</b>	non-signaling mode	1 Hz
<b>Frequency uncertainty</b>		same as timebase, see base unit specifications

## Power meter (frequency-selective)

<b>Max. level range</b>		
RF 1		0 dBm to +53 dBm
RF 2		-14 dBm to +39 dBm
RF 4 IN		-37 dBm to +0 dBm
<b>Level uncertainty</b>		see base unit specifications
<b>Level resolution</b>		0.1 dB

## FM measurement

<b>Dynamic range</b>		30 dB below max. level
<b>RF bandwidth</b>	$2 \times \text{deviation} + 4 \times \text{modulation frequency}$	136 kHz
<b>Deviation range</b>		0 Hz to 47 kHz
<b>Resolution</b>		1 Hz
<b>Modulation frequency range</b>		100 Hz to 18 kHz
<b>Residual FM</b>	bandwidth 300 Hz to 3 kHz	<5 Hz, rms
	bandwidth 6 Hz to 20 kHz	<18 Hz, rms
<b>Deviation uncertainty</b>	bandwidth 6 Hz to 20 kHz	<1 % of reading + residual FM
<b>Carrier frequency error</b>		
Measurement range		-47 kHz to +47 kHz
Measurement uncertainty		$\leq 2$ kHz + drift of timebase, see base unit specifications

## AF generator

See specifications of R&S® CMU-B41 audio generator/analyzer option		
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## AF analyzer

See specifications of R&S® CMU-B41 audio generator/analyzer option		
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# CDMA2000<sup>®</sup> specifications – mobile station test

Standards	CDMA2000 <sup>®</sup> standards	TIA/EIA IS-2000 Rev. 0
	CDMA2000 <sup>®</sup> test standards	TIA/EIA IS-98-F

## RF generator

Frequency range	US/Korean Cellular (band class 0)	860.025 MHz to 893.985 MHz
	North American PCS (band class 1)	1930.000 MHz to 1990.000 MHz
	TACS band (band class 2)	917.0125 MHz to 959.9875 MHz
	JTACS band (band class 3)	832.0125 MHz to 869.9875 MHz
	Korean PCS (band class 4)	1840.000 MHz to 1870.000 MHz
	NMT-450 (band class 5)	421.675 MHz to 493.480 MHz
	IMT-2000 (band class 6)	2110.000 MHz to 2169.950 MHz
	North American 700 MHz Cellular band (band class 7)	746.000 MHz to 764.000 MHz
	1800 MHz band (band class 8)	1805.000 MHz to 1879.950 MHz
	900 MHz band (band class 9)	925.000 MHz to 958.750 MHz
	secondary 800 MHz band (band class 10)	851.000 MHz to 939.975 MHz
	400 MHz European PAMR (band class 11)	421.675 MHz to 493.475 MHz
	800 MHz PAMR band (band class 12)	915.0125 MHz to 920.9875 MHz
	2.5 GHz IMT-2000 extension (band class 13)	2620.000 MHz to 2690 MHz
	US PCS 1.9 GHz band (band class 14)	1930.000 MHz to 1995.000 MHz
	AWS band (band class 15)	2110.000 MHz to 2155.000 MHz
	US 2.5 GHz band (band class 16)	2624.000 MHz to 2690.000 MHz
US 2.5 GHz forward link only band (band class 17)	2624.000 MHz to 2690.000 MHz	

Frequency resolution	channel spacing in line with standard	
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Frequency uncertainty		same as timebase, see base unit specifications
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Output level range	modulated signal	
RF 1	f < 2200 MHz	-120 dBm to -33 dBm
	f ≥ 2200 MHz	-120 dBm to -39 dBm
RF 2	f < 2200 MHz	-120 dBm to -16 dBm
	f ≥ 2200 MHz	-120 dBm to -22 dBm
RF 3 OUT	f < 2200 MHz	-99 dBm to +5 dBm
	f ≥ 2200 MHz	-99 dBm to -1 dBm

Output level resolution	modulated signal	0.1 dB
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Output level uncertainty	in temperature range +20 °C to +35 °C	
RF 1, RF 2	output level ≥ -108 dBm	
	f < 2200 MHz	<0.5 dB
	f ≥ 2200 MHz	<0.7 dB
RF 3 OUT	-80 dBm to +4 dBm	
	f < 2200 MHz	<0.7 dB
	f ≥ 2200 MHz	<0.9 dB
RF 1, RF 2	in temperature range +5 °C to +45 °C	
	output level ≥ -108 dBm	
	f < 2200 MHz	<0.7 dB
RF 3 OUT	-80 dBm to +4 dBm	
	f < 2200 MHz	<0.9 dB
	f ≥ 2200 MHz	<1.5 dB

<b>Modulation</b>		
Dual BPSK, multiple QPSK		1.2288 Mcps
AWGN		see AWGN generator
Carrier suppression		>35 dB
Waveform quality ( $\rho$ ) factor		>0.985
Code channel level uncertainty	relative to total CDMA output power F-PICH, F-PCH, F-FCH, F-SCH1, F-SCH2	approx. 0.1 dB
	all other channels	approx. 0.25 dB
Code channel resolution		0.1 dB
Code channel level range	relative to total CDMA output power	
	PICH, SYNC, FCH, SCH0, SCH1, PCH	-20 dB to -1 dB
	QPCH (relative to PICH level)	-5 dB to +2 dB

<b>AWGN generator</b>		
Bandwidth		>1.8 MHz
Output level resolution		0.1 dB
Output level uncertainty	bandwidth 1.23 MHz	approx. 0.2 dB
Output level range	relative to total CDMA output power	-20 dB to +4 dB

<b>Supported service options</b>		
	in signaling mode	
Loopback service options		SO 2, 9, 55
Speech service options		SO 1, 3, 17, 0x8000
Test data service option		SO 32
Packet data service option		SO 33
Messaging tele service option		SO 6, 14

## RF analyzer

<b>Frequency range</b>	US/Korean Cellular (band class 0)	815.025 MHz to 848.985 MHz
	North American PCS (band class 1)	1850.000 MHz to 1910.000 MHz
	TACS band (band class 2)	872.0125 MHz to 914.9875 MHz
	JTACS band (band class 3)	887.0125 MHz to 924.9875 MHz
	Korean PCS (band class 4)	1750.000 MHz to 1780.000 MHz
	NMT-450 (band class 5)	411.675 MHz to 483.480 MHz
	IMT-2000 (band class 6)	1920.000 MHz to 1979.950 MHz
	North American 700 MHz Cellular band (band class 7)	776.000 MHz to 794.000 MHz
	1800 MHz band (band class 8)	1710.000 MHz to 1784.950 MHz
	900 MHz band (band class 9)	880.000 MHz to 913.750 MHz
	secondary 800 MHz band (band class 10)	806.000 MHz to 900.975 MHz
	400 MHz European PAMR (band class 11)	411.675 MHz to 483.475 MHz
	800 MHz PAMR band (band class 12)	870.0125 MHz to 875.9875 MHz
	2.5 GHz IMT-2000 extension (band class 13)	2500.000 MHz to 2570.000 MHz
	US PCS 1.9 GHz band (band class 14)	1850.000 MHz to 1915.000 MHz
	AWS band (band class 15)	1710.000 MHz to 1755.000 MHz
US 2.5 GHz band (band class 16)	2502.000 MHz to 2568.000 MHz	
<b>Measurement filter</b>	in line with standard	bandwidth 1.23 MHz
<b>Frequency resolution</b>	channel spacing in line with standard	
<b>Frequency uncertainty</b>		same as timebase, see base unit specifications

## Power meter (frequency-selective)

<b>Level range</b>	HPSK, O-QPSK signal	
RF 1	f < 2200 MHz	-40 dBm to +44 dBm
	f ≥ 2200 MHz	-34 dBm to +44 dBm
RF 2	f < 2200 MHz	-54 dBm to +30 dBm
	f ≥ 2200 MHz	-48 dBm to +30 dBm
RF 4 IN	f < 2200 MHz	-80 dBm to -9 dBm
	f ≥ 2200 MHz	-74 dBm to -9 dBm
<b>Level uncertainty</b>		
RF 1, RF 2, RF 4 IN	in temperature range +20 °C to +35 °C	
	f < 2200 MHz	<0.5 dB
	f ≥ 2200 MHz	<0.7 dB
	in temperature range +5 °C to +45 °C	
	f < 2200 MHz	<0.7 dB
	f ≥ 2200 MHz	<0.9 dB
<b>Level resolution</b>		0.1 dB



## Modulation analyzer

<b>Level range</b>	HPSK, O-QPSK signal	
RF 1	f < 2200 MHz	-40 dBm to +44 dBm
	f ≥ 2200 MHz	-34 dBm to +44 dBm
RF 2	f < 2200 MHz	-54 dBm to +30 dBm
	f ≥ 2200 MHz	-48 dBm to +30 dBm
RF 4 IN	f < 2200 MHz	-80 dBm to -9 dBm
	f ≥ 2200 MHz	-74 dBm to -9 dBm

<b>RC1, RC2 (O-QPSK)</b>	waveform quality, error vector magnitude, magnitude error, phase error	
Waveform quality (ρ) uncertainty	for ρ 0.9 to 1	<0.003
Frequency measurement range		-3 kHz to +3 kHz
Frequency measurement uncertainty	f < 2200 MHz	<10 Hz + drift of timebase see base unit specifications
	f ≥ 2200 MHz	<15 Hz + drift of timebase see base unit specifications

<b>RC3, RC4 (HPSK)</b>	waveform quality, error vector magnitude, magnitude error, phase error, channel power, code domain power, peak code domain error power	
Waveform quality (ρ) uncertainty	for ρ 0.9 to 1	<0.003
Frequency measurement range		-3 kHz to +3 kHz
Frequency measurement uncertainty		<10 Hz + drift of timebase, see base unit specifications
Relative measurement uncertainty	result > -33 dB	<0.1 dB

<b>Measurements</b>		
Modulation		overview EVM versus time, graphical ME versus time, graphical PE versus time, graphical I/Q analyzer
Power		standby/access-probe power open loop time response gated output power max. output power min. output power power versus frame smart alignment narrowband power
Spectrum		adjacent channel power
Code domain power		code domain power code domain error power channel power time/phase offset relative to pilot
Receiver		FER for FCH, SCH RLP/throughput statistics forward power control

## R&S® CMU-B85 speech codec option

<b>Speech decoder output</b>	SPEECH HANDSET OUT	9-pin D-Sub connector
Output impedance		<10 Ω
Max. output current		20 mA, peak
Full-range output level		1 V, peak

<b>Speech coder input</b>	SPEECH HANDSET IN	9-pin D-Sub connector
Input impedance		100 kΩ
Full-range input level	low sensitivity	1.4 V, peak
	high sensitivity	0.1 V, peak

# 1xEV-DO specifications – access terminal test

Standards	1xEV-DO standards	TIA/EIA IS-856-2
	1xEV-DO test standards (access terminal)	TIA/EIA IS-866-A

## RF generator

Frequency range	US/Korean Cellular (band class 0)	860.025 MHz to 893.985 MHz
	North American PCS (band class 1)	1930.000 MHz to 1990.000 MHz
	public safety bands (PSB)	772.000 MHz to 802.000 MHz
	TACS band (band class 2)	917.0125 MHz to 959.9875 MHz
	JTACS band (band class 3)	832.0125 MHz to 869.9875 MHz
	Korean PCS (band class 4)	1840.000 MHz to 1870.000 MHz
	NMT-450 (band class 5)	421.675 MHz to 493.480 MHz
	IMT-2000 (band class 6)	2110.000 MHz to 2169.950 MHz
	North American 700 MHz Cellular band (band class 7)	746.000 MHz to 764.000 MHz
	1800 MHz band (band class 8)	1805.000 MHz to 1879.950 MHz
	900 MHz band (band class 9)	925.000 MHz to 958.750 MHz
	secondary 800 MHz band (band class 10)	851.000 MHz to 939.975 MHz
	400 MHz European PAMR (band class 11)	421.675 MHz to 493.475 MHz
	800 MHz PAMR band (band class 12)	915.0125 MHz to 920.9875 MHz
	2.5 GHz IMT-2000 extension (band class 13)	2620.000 MHz to 2690 MHz
	US PCS 1.9 GHz band (band class 14)	1930.000 MHz to 1995.000 MHz
	AWS band (band class 15)	2110.000 MHz to 2155.000 MHz
US 2.5 GHz band (band class 16)	2624.000 MHz to 2690.000 MHz	
US 2.5 GHz forward link only band (band class 17)	2624.000 MHz to 2690.000 MHz	

Frequency resolution	channel spacing in line with standard	
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Frequency uncertainty		same as timebase, see base unit specifications
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<b>Statistics</b>		
Statistic count		1 to 1000
Values		current, average, min./max.

<b>Trigger</b>		
Trigger sources		free run, internal, external, IF power, RF power
Trigger output	24-pin D-Sub connector AUX 3	super frame, power control frame, paging frame, sync frame, PP2S

<b>Output level range</b>	modulated signal	
RF 1	f < 2200 MHz	-120 dBm to -33 dBm
	f ≥ 2200 MHz	-120 dBm to -39 dBm
RF 2	f < 2200 MHz	-120 dBm to -16 dBm
	f ≥ 2200 MHz	-120 dBm to -22 dBm
RF 3 OUT	f < 2200 MHz	-99 dBm to +5 dBm
	f ≥ 2200 MHz	-99 dBm to -1 dBm

Output level resolution	modulated signal	0.1 dB
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<b>Output level uncertainty</b>	in temperature range +20 °C to +35 °C	
RF 1, RF 2	output level $\geq -108$ dBm	
	f < 2200 MHz	<0.5 dB
	f $\geq$ 2200 MHz	<0.7 dB
RF 3 OUT	-80 dBm to +4 dBm	
	f < 2200 MHz	<0.7 dB
	f $\geq$ 2200 MHz	<0.9 dB

<b>Output level uncertainty</b>	in temperature range +5 °C to +45 °C	
RF 1, RF 2	output level $\geq -108$ dBm	
	f < 2200 MHz	<0.7 dB
	f $\geq$ 2200 MHz	<1.5 dB
RF 3 OUT	-80 dBm to +4 dBm	
	f < 2200 MHz	<0.9 dB
	f $\geq$ 2200 MHz	<1.5 dB

<b>Modulation</b>		
Dual BPSK		1.2288 Mcps
AWGN		see AWGN generator
Carrier suppression		>35 dB
Waveform quality ( $\rho$ ) factor		>0.985
Code channel level uncertainty	relative to total 1xEV-DO output power	approx. 0.1 dB
Code channel resolution		0.1 dB
Code channel level range	relative to total 1xEV-DO output power	
	PICH, SYNC, FCH, SCH0, SCH1, PCH	-20 dB to -1 dB
	QPCH (relative to PICH level)	-5 dB to +2 dB

<b>AWGN generator</b>		
Bandwidth		>1.8 MHz
Output level resolution		0.1 dB
Output level uncertainty	bandwidth 1.23 MHz	approx. 0.2 dB
Output level range	relative to total 1xEV-DO output power	-20 dB to +4 dB

<b>Supported applications</b>	in signaling mode	
Test applications		FTAP/RTAP, FETAP/RETAP
Default signaling application		
Default packet application		

## RF analyzer

<b>Frequency range</b>	US/Korean Cellular (band class 0)	815.025 MHz to 848.985 MHz
	North American PCS (band class 1)	1850.000 MHz to 1910.000 MHz
	public safety bands (PSB)	742.000 MHz to 772.000 MHz
	TACS band (band class 2)	872.0125 MHz to 914.9875 MHz
	JTACS band (band class 3)	887.0125 MHz to 924.9875 MHz
	Korean PCS (band class 4)	1750.000 MHz to 1780.000 MHz
	NMT-450 (band class 5)	411.675 MHz to 483.480 MHz
	IMT-2000 (band class 6)	1920.000 MHz to 1979.950 MHz
	North American 700 MHz Cellular band (band class 7)	776.000 MHz to 794.000 MHz
	1800 MHz band (band class 8)	1710.000 MHz to 1784.950 MHz
	900 MHz band (band class 9)	880.000 MHz to 913.750 MHz
	secondary 800 MHz band (band class 10)	806.000 MHz to 900.975 MHz
	400 MHz European PAMR (band class 11)	411.675 MHz to 483.475 MHz
	800 MHz PAMR band (band class 12)	870.0125 MHz to 875.9875 MHz
	2.5 GHz IMT-2000 extension (band class 13)	2500.000 MHz to 2570.000 MHz

<b>Measurement filter</b>	in line with standard	bandwidth 1.23 MHz
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<b>Frequency resolution</b>	channel spacing in line with standard	
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<b>Frequency uncertainty</b>		same as timebase, see base unit specifications
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<b>Statistics</b>		
Statistic count		1 to 1000
Values		current, average, min./max.

<b>Trigger</b>		
Trigger sources		free run, internal, external, IF power, RF power
Trigger output	24-pin D-Sub connector AUX 3	ControlSlot, ControlChannel, slot, PP2S

## Power meter (frequency-selective)

<b>Level range</b>	modulated signal	
RF 1	f < 2200 MHz	-40 dBm to +44 dBm
	f ≥ 2200 MHz	-34 dBm to +44 dBm
RF 2	f < 2200 MHz	-54 dBm to +30 dBm
	f ≥ 2200 MHz	-48 dBm to +30 dBm
RF 4 IN	f < 2200 MHz	-80 dBm to -9 dBm
	f ≥ 2200 MHz	-74 dBm to -9 dBm

<b>Level uncertainty</b>		
RF 1, RF 2, RF 4 IN	in temperature range +20 °C to +35 °C	
	f < 2200 MHz	<0.5 dB
	f ≥ 2200 MHz	<0.7 dB
	in temperature range +5 °C to +45 °C	
	f < 2200 MHz	<0.7 dB
	f ≥ 2200 MHz	<0.9 dB

<b>Level resolution</b>		0.1 dB
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## Modulation analyzer

<b>Level range</b>	modulated signal	
RF 1	f < 2200 MHz	-40 dBm to +44 dBm
	f ≥ 2200 MHz	-34 dBm to +44 dBm
RF 2	f < 2200 MHz	-54 dBm to +30 dBm
	f ≥ 2200 MHz	-48 dBm to +30 dBm
RF 4 IN	f < 2200 MHz	-80 dBm to -9 dBm
	f ≥ 2200 MHz	-74 dBm to -9 dBm

<b>Waveform quality (p) uncertainty</b>	for p 0.9 to 1	<0.003
<b>Frequency measurement range</b>		-3 kHz to +3 kHz
<b>Frequency measurement uncertainty</b>		<10 Hz + drift of timebase, see base unit specifications
<b>Relative measurement uncertainty</b>	result > -33 dB	<0.1 dB

<b>Measurements</b>		
Modulation		overview EVM versus time, graphical ME versus time, graphical PE versus time, graphical I/Q analyzer
Power		standby/access-probe power open loop time response narrowband power
Spectrum		adjacent channel power
Code domain power		code domain power code domain error power channel power
Receiver	in signaling mode	FTAP/RTAP, FETAP/RETAP

## WCDMA specifications – mobile station (UE) test

<b>Standard</b>		3GPP FDD
<b>Symbol rate</b>		3.84 MHz

<b>Synchronization output 2</b>		BNC connector REF OUT 2
Frequency		30.72 MHz/n, n = 1 to 32

### RF generator

<b>Channels</b>	non-signaling mode	
	P-CPICH, P-SCH, S-SCH, P-CCPCH, PICH, DPCH, up to 4 HS-SCCHs, HS-PDSCH, E-AGCH, E-RGCH/E-HICH	
	OCNS R99	16-channel orthogonal channel noise
	OCNS R5	6-channel orthogonal channel noise
	AWGN	bandwidth $\geq$ 5.76 MHz
	reference measurement channels (RMC) in line with 3GPP TS 34.121	12.2 kbit/s, 64 kbit/s, 144 kbit/s, 384 kbit/s

<b>Channels</b>	signaling mode; codes selectable until conflict in code space occurs	
	P-CPICH, P-SCH, S-SCH, P-CCPCH, S-CCPCH, AICH, PICH, up to 4 HS-SCCHs, HS-PDSCH, E-AGCH, E-RGCH/E-HICH	
	OCNS R99	16-channel orthogonal channel noise
	OCNS R5	6-channel orthogonal channel noise
	AWGN	bandwidth $\geq$ 5.76 MHz
	DPCH signaling radio bearer (SRB)	1.7 kbit/s, 2.5 kbit/s, 3.4 kbit/s, 13.6 kbit/s
	DPCH reference measurement channels (RMC) in line with 3GPP TS 34.121	
	DL and UL	12.2 kbit/s, 64 kbit/s, 144 kbit/s, 384 kbit/s
	DL/UL	144 kbit/s/64 kbit/s, 384 kbit/s/64 kbit/s, 384 kbit/s/144 kbit/s
	BTFD	1.95 kbit/s, 4.75 kbit/s, 5.15 kbit/s, 5.9 kbit/s, 6.7 kbit/s, 7.4 kbit/s, 7.95 kbit/s, 10.2 kbit/s, 12.2 kbit/s
	DPCH voice (echo or speech codec) NB-AMR	4.75 kbit/s, 5.15 kbit/s, 5.9 kbit/s, 6.7 kbit/s, 7.4 kbit/s, 7.95 kbit/s, 10.2 kbit/s, 12.2 kbit/s
	DPCH voice (echo or speech codec) WB-AMR	6.6 kbit/s, 8.85 kbit/s, 12.65 kbit/s, 14.25 kbit/s, 15.85 kbit/s, 18.25 kbit/s, 19.85 kbit/s, 23.05 kbit/s, 23.85 kbit/s

<b>Frequency range</b>	non-signaling mode	
		728 MHz to 768 MHz 869 MHz to 894 MHz 925 MHz to 960 MHz 1475.9 MHz to 1500.9 MHz 1805 MHz to 1880 MHz 1930 MHz to 1990 MHz 2110 MHz to 2170 MHz 2180 MHz to 2200 MHz 2620 MHz to 2690 MHz

<b>Frequency range</b>	signaling mode	
	band 1	2110 MHz to 2170 MHz
	band 2	1930 MHz to 1990 MHz
	band 3	1805 MHz to 1880 MHz
	band 4	2110 MHz to 2155 MHz
	band 5	869 MHz to 894 MHz
	band 6	875 MHz to 885 MHz
	band 7	2620 MHz to 2690 MHz
	band 8	925 MHz to 960 MHz
	band 9	1844.9 MHz to 1879.9 MHz
	band 10	2110 MHz to 2170 MHz
	band 11	1475.9 MHz to 1500.9 MHz
	band 12	728 MHz to 746 MHz
	band 13	746 MHz to 756 MHz
	band 14	758 MHz to 768 MHz
band S	2180 MHz to 2200 MHz	

<b>Frequency offset</b>		-100 kHz to +100 kHz
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<b>Frequency resolution</b>		0.1 Hz
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<b>Frequency setting</b>		by channel number or frequency
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<b>Output level range</b>	depending on PAR	
RF 1	PAR ≤ 10 dB	-120 dBm to -37 dBm
RF 2	PAR ≤ 10 dB	-120 dBm to -20 dBm
	overranging	up to -15 dBm
RF 3 OUT	PAR ≤ 10 dB	-100 dBm to 0 dBm
	overranging	up to +3 dBm

<b>Output level resolution</b>	manual mode	0.1 dB
	remote mode	0.01 dB
<b>Output level uncertainty</b>	in temperature range +20 °C to +35 °C, no overranging	
RF 1, RF 2	output level $\geq -120$ dBm	
	f < 2200 MHz	<0.6 dB
	f $\geq$ 2200 MHz	<0.8 dB
RF 3 OUT	output level $\geq -80$ dBm	
	f < 2200 MHz	<0.8 dB
	f $\geq$ 2200 MHz	<1.0 dB
<b>Output level uncertainty</b>	in temperature range +5 °C to +45 °C, no overranging	
RF 1, RF 2	output level $\geq -120$ dBm	
	f < 2200 MHz	<0.9 dB
	f $\geq$ 2200 MHz	<1.5 dB
RF 3 OUT	output level $\geq -80$ dBm	
	f < 2200 MHz	<1.0 dB
	f $\geq$ 2200 MHz	<1.5 dB
<b>Output level setting</b>	setting reference	relative to CPICH or total output power
<b>Channel levels</b>	non-signaling mode	
	P-CPICH, P-SCH, S-SCH, P-CCPCH, PICH, DPCH, OCNS, HS-SCCH, HS-PDSCH, E-AGCH	-35 dB to +15 dB relative to CPICH
	E-RGCH/E-HICH	-35 dB to +12 dB relative to CPICH
<b>Channel levels</b>	signaling mode	
	P-CPICH, P-SCH, S-SCH, P-CCPCH, S-CCPCH, PICH, AICH, DPCH, OCNS, HS-SCCH, HS-PDSCH, E-AGCH	-35 dB to +15 dB relative to CPICH
	E-RGCH/E-HICH	-35 dB to +12 dB relative to CPICH
<b>Signal quality</b>		
Error vector magnitude (EVM)	global EVM for DL RMC in line with 3GPP TS 34.121 C3.1 to C3.4 with DPCH/CPICH = 0 dB	<8 %, rms
<b>Signal quality</b>	16QAM	
Error vector magnitude (EVM)	global EVM for 16QAM reference setup: 3GPP TS34.121 FRC H-Set3 for 16QAM	<8 %, rms



# R&S® CMU-B96 additional RF generator option

## Path 2 for WCDMA

<b>Standard</b>		3GPP FDD
<b>Frequency range</b>	non-signaling mode	728 MHz to 768 MHz 869 MHz to 894 MHz 925 MHz to 960 MHz 1475.9 MHz to 1500.9 MHz 1805 MHz to 1880 MHz 1930 MHz to 1990 MHz 2110 MHz to 2170 MHz 2180 MHz to 2200 MHz
<b>Frequency range</b>	WCDMA signaling mode	
	band 1	2110 MHz to 2170 MHz
	band 2	1930 MHz to 1990 MHz
	band 3	1805 MHz to 1880 MHz
	band 4	2110 MHz to 2155 MHz
	band 5	869 MHz to 894 MHz
	band 6	875 MHz to 885 MHz
	band 8	925 MHz to 960 MHz
	band 9	1844.9 MHz to 1879.9 MHz
	band 10	2110 MHz to 2170 MHz
	band 11	1475.9 MHz to 1500.9 MHz
	band 12	728 MHz to 746 MHz
	band 13	746 MHz to 756 MHz
	band 14	758 MHz to 768 MHz
	band S	2180 MHz to 2200 MHz
<b>Frequency resolution</b>		2.5 kHz
<b>Frequency uncertainty</b>		same as timebase, see base unit specifications
<b>Error vector magnitude (EVM)</b>	global EVM for DL RMC in line with 3GPP TS 34.121 C3.1 to C3.4 with DPCH/CPICH = 0 dB	<8 %, rms
<b>Output level range</b>		
RF 1	without R&S® CMU-U99	-115 dBm to -82 dBm
	with R&S® CMU-U99	-103 dBm to -70 dBm
RF 2		-103 dBm to -70 dBm
<b>Output level resolution</b>	RF 1 and RF 2	0.1 dB
<b>Output level range</b>	overrange mode	
RF 1	without R&S® CMU-U99	-110 dBm to -38 dBm
	with R&S® CMU-U99	-90 dBm to -24 dBm
RF 2		-90 dBm to -24 dBm
RF 3 OUT		-70 dBm to -1 dBm
<b>Output level resolution</b>	for overrange mode	1 dB

## Influence on RF interface

<b>Reduced input level range</b>	if R&S®CMU-B96 is installed	
RF 1	continuous input power	max. 2 W
<b>RF level uncertainty</b>	Use of the R&S®CMU-B96 in overrange mode may influence all RF signal levels and quality.	

## RF analyzer (TX measurements)

<b>Frequency range</b>	non-signaling mode	
		698 MHz to 716 MHz 777 MHz to 798 MHz 824 MHz to 849 MHz 880 MHz to 915 MHz 1427.9 MHz to 1452.9 MHz 1710 MHz to 1785 MHz 1850 MHz to 1910 MHz 1920 MHz to 1980 MHz 2000 MHz to 2020 MHz 2500 MHz to 2570 MHz

<b>Frequency range</b>	signaling mode	
	band 1	1920 MHz to 1980 MHz
	band 2	1850 MHz to 1910 MHz
	band 3	1710 MHz to 1785 MHz
	band 4	1710 MHz to 1755 MHz
	band 5	824 MHz to 849 MHz
	band 6	830 MHz to 840 MHz
	band 7	2500 MHz to 2570 MHz
	band 8	880 MHz to 915 MHz
	band 9	1749.9 MHz to 1784.9 MHz
	band 10	1710 MHz to 1770 MHz
	band 11	1427.9 MHz to 1452.9 MHz
	band 12	698 MHz to 716 MHz
	band 13	777 MHz to 787 MHz
	band 14	788 MHz to 798 MHz
	band S	2000 MHz to 2020 MHz

<b>Frequency offset</b>		-100 kHz to +100 kHz
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<b>Frequency resolution</b>		1 Hz
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<b>Frequency setting</b>		by channel number or frequency
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<b>Level setting</b>		by autoranging or manual mode
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<b>Max. level setting range</b>		
RF 1	peak envelope power <sup>4</sup> (PEP)	-38 dBm to +53 dBm
RF 2	peak envelope power <sup>4</sup> (PEP)	-52 dBm to +39 dBm
RF 4 IN	peak envelope power (PEP)	-77 dBm to +0 dBm

<b>Statistics</b>		
Statistic count		1 to 1000
Values		current, average, min./max.

<b>Trigger</b>	non-signaling mode	
Trigger sources		free run, internal, external, IF power, slot, frame, TPC, HSDPCCH, auto
Trigger input	15-pin D-Sub connector AUX 3, pin 8	external
Trigger slot delay		0 to 14 slots
Trigger delay offset		-10239 to + 10239 × 1/4 chip
Trigger output	15-pin D-Sub connector AUX 3, pins 2 to 5	frame, slot, TPC, HSDPCCH

<b>Trigger</b>	signaling mode	
Trigger sources		free run, external, slot, frame, signaling, IF power, TPC, preamble, PRACH-MSG part, compressed mode, change of TFC, HSDPCCH, auto
Trigger input	15-pin D-Sub connector AUX 3, pin 8	external
Trigger slot delay		0 to 14 slots
Trigger delay offset		-10239 to + 10239 x 1/4 chip
Trigger output	15-pin D-Sub connector AUX 3, pins 2 to 4 15-pin D-Sub connector AUX 3, pin 5, depending on signaling state and trigger source	frame, slot, TPC preamble, PRACH-MSG part, compressed mode, change of TFC, HSDPCCH

## Modulation analysis

<b>Measurement filter</b>	receiver filter in line with standard	3.84 MHz, RRC, $\alpha = 0.22$
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<b>Analysis modes</b>		QPSK, WCDMA uplink
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<b>Input level range</b>		
RF 1	continuous power <sup>3</sup> peak envelope power <sup>4</sup> (PEP)	-21 dBm to +47 dBm -16 dBm to +53 dBm
RF 2	continuous power peak envelope power <sup>4</sup> (PEP)	-35 dBm to +33 dBm -30 dBm to +39 dBm
RF 4 IN	continuous power and PEP	-50 dBm to 0 dBm

<b>Error vector magnitude (EVM)</b>		
Measurement range		up to 25 %
Applications		overview EVM versus time, graphical ME versus time, graphical PE versus time, graphical
	non-signaling mode	I/Q analyzer
Measured parameters		error vector magnitude magnitude error phase error I/Q origin offset I/Q imbalance peak code domain error waveform quality
Inherent EVM	<i>RF Attenuation</i> → <i>Low Noise</i> <i>RF Attenuation</i> → <i>Low Noise</i> with R&S <sup>®</sup> CMU-Z6 calibration and $f < 2200$ MHz	<2.5 %, rms <1.5 %, rms
	<i>RF Attenuation</i> → <i>Low Noise</i> with R&S <sup>®</sup> CMU-Z6 calibration and $f \geq 2200$ MHz	<2.5 %, rms
Resolution		0.1 %
Measurement length	QPSK mode	1 timeslot (2560 chips) 1/4 timeslot (640 chips)
	WCDMA mode	1 timeslot
Marker	in graphical menus	reference, Abs1, Abs2, D-line

<b>Frequency error</b>		
Measurement range		$\pm 3$ kHz
Uncertainty	$f < 2200$ MHz and max. value of 10 slots $f \geq 2200$ MHz and average value of 10 slots	<10 Hz + drift of timebase, see base unit specifications <10 Hz + drift of timebase, see base unit specifications
Resolution		1 Hz

<b>I/Q offset</b>		
Inherent I/Q offset		<-55 dB
Resolution		0.01 dB

<b>I/Q imbalance</b>		
Inherent I/Q imbalance		<-30 dB
Resolution		0.01 dB

<b>Peak code domain error (PCDE)</b>		
Inherent PCDE	for SF = 4	<-40 dB
Resolution		0.01 dB

<b>I/Q analyzer</b>		
Display	non-signaling mode	
	QPSK mode and WCDMA mode	graphical display
	waveform type	constellation diagram, vector diagram, eye diagram I, Q, I/Q
	zoom	1, 2, 5, 10, 20
	rotation	0°, 45°
	measurement length	1 timeslot (2560 chips) 1/4 timeslot (640 chips)

## Spectrum measurements

<b>Reference level for full dynamic range</b>		
RF 1	rms	+14 dBm to +47 dBm
	peak envelope power <sup>4</sup> (PEP)	up to +53 dBm
RF 2	rms	+0 dBm to +33 dBm
	peak envelope power <sup>4</sup> (PEP)	up to +39 dBm
RF 4 IN	rms	-18 dBm to 0 dBm
	peak envelope power (PEP)	up to 0 dBm

<b>Adjacent channel leakage ratio (ACLR filter application)</b>		
Measurement filter	receiver filter in line with standard	3.84 MHz, RRC, $\alpha = 0.22$
Display		bargraphs of rms and peak values, numeric values rms and peak of current, average and max. values
Frequency offsets	first adjacent channel second adjacent channel	$\pm 5$ MHz $\pm 10$ MHz
Uncertainty	for -33 dBc first adjacent channel level for -43 dBc second adjacent channel level	<0.5 dB <0.5 dB
Dynamic range (High Dynamic Mode → On)	first adjacent channel second adjacent channel	>54 dB >64 dB
Resolution		0.1 dB
Measurement length		1 timeslot (2560 chips) 1/2 timeslot (1280 chips) 1/4 timeslot (640 chips) 1/8 timeslot (320 chips)

<b>Adjacent channel leakage ratio (ACLR FFT/OBW application)</b>		
Measurement filter	receiver filter in line with standard	3.84 MHz, RRC, $\alpha = 0.22$
Display		continuous spectrum with 25 MHz bandwidth, numeric values rms and peak of current, average and max. values
Frequency offsets	first adjacent channel second adjacent channel	$\pm 5$ MHz $\pm 10$ MHz
Resolution bandwidth		20 kHz 3.84 MHz
Dynamic range (High Dynamic Mode → On)	first adjacent channel second adjacent channel	>54 dB >64 dB
Occupied bandwidth	measurement range	1 MHz to 6 MHz
	measurement uncertainty	<50 kHz
	measurement resolution	20 kHz
Measurement length		$\geq 1$ timeslot (2560 chips) $\geq 1/2$ timeslot (1280 chips) $\geq 1/4$ timeslot (640 chips) $\geq 1/8$ timeslot (320 chips)

<b>Spectrum emission mask (SEM application)</b>		
Measurement filter	receiver filter in line with standard	3.84 MHz, RRC, $\alpha = 0.22$
Display		graphical and numeric values of current, average and max. values
Resolution bandwidth	frequency offset	
	2.5 MHz to 3.5 MHz	30 kHz
	3.5 MHz to 7.5 MHz	1 MHz
	7.5 MHz to 8.5 MHz	1 MHz
Measurement interval	8.5 MHz to 12.5 MHz	1 MHz
		$\geq 1$ timeslot (2560 chips) $\geq 1/2$ timeslot (1280 chips) $\geq 1/4$ timeslot (640 chips) $\geq 1/8$ timeslot (320 chips)

### Power meter (frequency-selective) <sup>7</sup>

<b>Measurement applications</b>	max. power, min. power	bandwidth approx. 7 MHz
	off power	3.84 MHz, RRC, $\alpha = 0.22$
	power versus slot	bandwidth approx. 7 MHz
	inner loop power	3.84 MHz, RRC, $\alpha = 0.22$

<b>Power versus slot</b>	measurement width	0.25, 0.5, 1 slot
	step width	1 slot to 30 slots
	step count	1 to 100
	step delay	0 to 100

<b>Level range</b>		
RF 1	continuous power <sup>3</sup>	-52 dBm to +47 dBm
	peak envelope power <sup>4</sup> (PEP)	-42 dBm to +53 dBm
RF 2	continuous power	-66 dBm to +33 dBm
	peak envelope power <sup>4</sup> (PEP)	-56 dBm to +39 dBm
RF 4 IN	continuous power <sup>8</sup>	-89 dBm to 0 dBm
	peak envelope power (PEP)	-79 dBm to 0 dBm

<b>Level uncertainty</b>	in temperature range +20 °C to +35 °C	
RF 1	-10 dBm to +47 dBm, rms	
	f < 2200 MHz	<0.5 dB
	f $\geq$ 2200 MHz	<0.7 dB
	-44 dBm to -10 dBm, rms	
	f < 2200 MHz	<0.7 dB
	f $\geq$ 2200 MHz	<0.9 dB
RF 2	-24 dBm to +33 dBm, rms	
	f < 2200 MHz	<0.5 dB
	f $\geq$ 2200 MHz	<0.7 dB
	-60 dBm to -24 dBm, rms	
	f < 2200 MHz	<0.7 dB
	f $\geq$ 2200 MHz	<0.9 dB
RF 4 IN	-24 dBm to 0 dBm, rms	
	f < 2200 MHz	<0.5 dB
	f $\geq$ 2200 MHz	<0.7 dB
	-85 dBm to -24 dBm, rms	
	f < 2200 MHz	<0.7 dB
	-83 dBm to -24 dBm, rms	
	f < 2200 MHz	<0.7 dB
	f $\geq$ 2200 MHz	<0.9 dB

<sup>7</sup> The specified data is valid for *RF Attenuation* set to *Low Noise*.

<sup>8</sup> Upper limit depends on crest factor.

<b>Level uncertainty</b>	in temperature range +5 °C to +45 °C	
RF 1	-10 dBm to +47 dBm, rms	
	f < 2200 MHz	<0.7 dB
	f ≥ 2200 MHz	<0.9 dB
	-44 dBm to -10 dBm, rms	
RF 2	-24 dBm to +33 dBm, rms	
	f < 2200 MHz	<0.7 dB
	f ≥ 2200 MHz	<0.9 dB
	-60 dBm to -24 dBm, rms	
RF 4 IN	-24 dBm to 0 dBm, rms	
	f < 2200 MHz	<0.7 dB
	f ≥ 2200 MHz	<0.9 dB
	-85 dBm to -24 dBm, rms	
	f < 2200 MHz	<0.9 dB
	-83 dBm to -24 dBm, rms	
	f ≥ 2200 MHz	<1.1 dB

<b>Level resolution</b>		0.01 dB
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### Code domain power <sup>7</sup>

<b>Measurement filter</b>	receiver filter in line with standard	3.84 MHz, RRC, $\alpha = 0.22$
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<b>Display modes</b>		CDP/code auto
		CDP/code manual
		CDP/code Rho auto
		CDP/code Rho manual

<b>Spreading factor (SF)</b>	auto mode	
	manual setting	4, 8, 16, 32, 64, 128, 256

<b>Level range</b>		
RF 1		-8 dBm to +47 dBm
RF 2		-22 dBm to +33 dBm
RF 4 IN		-45 dBm to 0 dBm

<b>Level uncertainty</b>		<0.5 dB
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<b>Level resolution</b>		0.01 dB
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### Receiver quality (bit error rate measurements)

<b>Measurement types</b>		BER, BLER, DBLER, FDR
Measurement method		loopback mode 2, loopback mode 1 with RLC transparent
Number of transport blocks		1 to 50000
DL/UL transport block size		symmetric, asymmetric
DL/UL timing		876 chips to 1172 chips

### R&S<sup>®</sup> CMU-B52 speech codec option

<b>Speech decoder output</b>	SPEECH HANDSET OUT	9-pin D-Sub connector
Output impedance		<10 $\Omega$
Max. output current		20 mA, peak
Full-range output level		1 V, peak

<b>Speech coder input</b>	SPEECH HANDSET IN	9-pin D-Sub connector
Input impedance		100 k $\Omega$
Full-range input level	low sensitivity	1.4 V, peak
	high sensitivity	0.1 V, peak

# Bluetooth® specifications

Standards		Bluetooth® Core Specifications Version 1.1
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## RF generator

RF channel definition		2402 MHz + k × 1 MHz, k = 0 to 93
Frequency range		2402 MHz to 2495 MHz
Frequency resolution	channel spacing in line with standard	1 MHz
Frequency offset range		±500 kHz
Frequency offset resolution		1 kHz
Frequency uncertainty		±1 Hz + drift of timebase, see base unit specifications
Hopping scheme	modes in line with standard	Europe (except France), USA France RX/TX single frequency reduced hopping
Output level range	modulated signal	
RF 1		-106 dBm to -33 dBm
RF 2		-106 dBm to -12 dBm
RF 3 OUT		-90 dBm to +5 dBm
Output level uncertainty	in temperature range +20 °C to +35 °C	
RF 1, RF 2		<0.9 dB
RF 3 OUT		<1.1 dB
Output level uncertainty	in temperature range +5 °C to +45 °C	
RF 1, RF 2		<1.6 dB
RF 3 OUT		<1.6 dB
Output level resolution		0.1 dB
Modulation		
GFSK	AC coupling cut-off frequency 100 Hz	1 Mbps, B × T = 0.5
Modulation index	11110000 pattern, frequency deviation 160 kHz	0.32
Modulation index range	frequency deviation 100 kHz to 220 kHz	0.20 to 0.44
Modulation index resolution		0.01
Modulation index uncertainty	11110000 pattern, frequency deviation 160 kHz	±5 %

## RF analyzer

RF channel definition		2402 MHz + k × 1 MHz, k = 0 to 93
Frequency range		2402 MHz to 2495 MHz
Frequency resolution	channel spacing in line with standard	1 MHz
Frequency uncertainty		±1 Hz + drift of timebase, see base unit specifications
Hopping scheme	modes in line with standard	Europe (except France), USA France RX/TX single frequency reduced hopping

## Power meter (frequency-selective) and power versus time

<b>Measurement bandwidth</b>	filter definition: passband	
	<i>Filter Bandwidth</i> → wide	2.0 MHz
	<i>Filter Bandwidth</i> → narrow	1.3 MHz
<b>Reference level for full dynamic range</b>	GFSK signal	
RF 1		0 dBm to +41 dBm
RF 2		-14 dBm to +33 dBm
RF 4 IN		-32 dBm to 0 dBm
<b>Dynamic range</b>	<i>Filter Bandwidth</i> → wide	>55 dB, rms
<b>Level uncertainty</b>	in temperature range +20 °C to +35 °C	
RF 1, RF 2	from full scale setting down to -25 dB	<0.7 dB
RF 4 IN	from full scale setting down to -25 dB	<0.9 dB
<b>Level uncertainty</b>	in temperature range +5 °C to +45 °C	
RF1, RF2	from full scale setting down to -25 dB	<1.0 dB
RF4IN	from full scale setting down to -25 dB	<1.1 dB
<b>Level resolution</b>	in manual mode	0.1 dB
	in remote control mode	0.01 dB

## Modulation analyzer

<b>Measurement bandwidth</b>	filter definition: passband	
	<i>Filter Bandwidth</i> → wide	2.0 MHz
	<i>Filter Bandwidth</i> → narrow	1.3 MHz
<b>Level range</b>	GFSK signal	
RF 1, RF 2, RF 4 IN		from full scale setting down to -25 dB
<b>Total measurement range for frequency offset and frequency deviation</b>		-250 kHz to +250 kHz
<b>Frequency offset uncertainty in preamble</b>	for deviation ≤ 160 kHz	≤2 kHz
<b>Frequency deviation uncertainty in payload</b>	for 100 kHz < deviation ≤ 200 kHz	
	11110000 pattern	≤2 %
	10101010 pattern	≤4 %
<b>Frequency drift uncertainty</b>	measured in burst related to frequency offset value in preamble	
	10101010 pattern	
	max.	≤2 kHz
	typ.	≤1 kHz
<b>Frequency resolution</b>	in manual mode	1 kHz
	in remote control mode	1 Hz

## Timing measurement

<b>Range</b>		±20 µs
<b>Resolution</b>		≤0.25 µs
<b>Uncertainty</b>		≤0.25 µs + resolution



## R&S® CMU-B52 speech codec option

<b>Speech decoder output</b>	SPEECH HANDSET OUT	9-pin D-Sub connector
Output impedance		<10 $\Omega$
Max. output current		20 mA, peak
Full-range output level		1 V, peak

<b>Speech coder input</b>	SPEECH HANDSET IN	9-pin D-Sub connector
Input impedance		100 k $\Omega$
Full-range input level	low sensitivity	1.4 V, peak
	high sensitivity	0.1 V, peak

# R&S® CMU-B17 I/Q/IF interface option

## I/Q interface

<b>Analog I/Q outputs</b>	IF → I/Q; TX and RX paths, analog I/Q output	connector I/Q CH1
I/Q bandwidth		0 MHz to 2.5 MHz
Max. output voltage range	EMF	-1 V to +1 V, peak $\sqrt{I^2 + Q^2} = 1 \text{ V, peak}$
Output impedance		50 Ω
I and Q amplitude imbalance		<2 %
	for WCDMA function group	<2.5 %
Offset voltage	in temperature range +20 °C to +35 °C	<4 mV
	in temperature range +20 °C to +35 °C for WCDMA function group	<5 mV
	in temperature range +5 °C to +45 °C	<8 mV

<b>Analog I/Q inputs</b>	I/Q → IF; TX path, analog I/Q input	connector I/Q CH1
I/Q bandwidth		0 MHz to 2.5 MHz
Max. input voltage range		-0.5 V to +0.5 V, peak $\sqrt{I^2 + Q^2} = 0.5 \text{ V, peak}$
Input impedance		50 Ω
Carrier suppression	in temperature range +20 °C to +35 °C	>40 dB
	in temperature range +5 °C to +45 °C	>35 dB
Sideband suppression	$f_{I/Q} < 1 \text{ MHz}$	>45 dB
	$1 \text{ MHz} < f_{I/Q} < 2.5 \text{ MHz}$	>40 dB

<b>Analog I/Q inputs</b>	I/Q → IF; RX path, analog I/Q input	connector I/Q CH1
I/Q bandwidth		0 MHz to 2.5 MHz
Max. input voltage range		-0.5 V to +0.5 V, peak $\sqrt{I^2 + Q^2} = 0.5 \text{ V, peak}$
Input impedance		50 Ω
Carrier suppression	in temperature range +20 °C to +35 °C	>35 dB <sup>9</sup>
	in temperature range +5 °C to +45 °C	>35 dB <sup>9</sup>
Sideband suppression	$f_{I/Q} < 1 \text{ MHz}$	>45 dB
	$1 \text{ MHz} < f_{I/Q} < 2.5 \text{ MHz}$	>40 dB

## Influence on RF interface

<b>GSM/EDGE measurements</b>		
Additional influence on signal quality	analog I/Q input and output considered; for TX and RX paths	
Phase error	GMSK	<3°, peak <1°, rms
EVM	8PSK	<5 %, rms

<b>WCDMA measurements</b>	3GPP FDD, UE test	
Additional influence on signal quality	analog I/Q input and output considered; for TX and RX paths	
EVM		<5 %, rms

<b>RF level uncertainty</b>	bypass with I/Q IF OUT, I/Q IN/OUT, IF IN/OUT	
Output level uncertainty	at RF 1, RF 2, RF 3 OUT	add 0.3 dB to R&S®CMU200 base unit specifications
Input level uncertainty of frequency-selective power meter	at RF 1, RF 2, RF 4 IN	add 0.3 dB to R&S®CMU200 base unit specifications

<sup>9</sup> For GMSK modulation and max. input voltage at I/Q inputs.

## IF interface

<b>IF inputs, TX path</b>		connector IF3 TX CH1 IN
IF level range		up to -5 dBm, PEP
Standard IF frequencies	RF/GSM (GMSK and 8PSK)/ TDMA/CDMA2000®	13.85 MHz
	WCDMA	15.36 MHz

<b>IF inputs, RX path</b>		connector IF3 RX CH1 IN
IF level range		up to +2 dBm, PEP
Standard IF frequencies	RF/GSM (GMSK and 8PSK)/ TDMA/CDMA2000®	10.7 MHz
	WCDMA	7.68 MHz

<b>IF outputs, TX path</b>		connector IF3 TX CH1 OUT
IF level range		up to -5 dBm, PEP
Standard IF frequencies	RF/GSM (GMSK and 8PSK)/ TDMA/CDMA2000®	13.85 MHz
	WCDMA	15.36 MHz

<b>IF outputs, RX path</b>		connector IF3 RX CH1 OUT
IF level range		up to +6 dBm, PEP
Standard IF frequencies	RF/GSM (GMSK and 8PSK)/ TDMA/CDMA2000®	10.7 MHz
	WCDMA	7.68 MHz

## Remarks

- Due to the modulation schemes used Bluetooth® and AMPS standards will not be supported.
- The R&S®CMU-B17 and R&S®CMU-B73 options use the same mainboard connector of the R&S®CMU200. Therefore, either the R&S®CMU-B17 or the R&S®CMU-B73 can be ordered for a single instrument.

### Additional information for GSM:

To avoid influences on the fading profile, the following is highly recommended:

- To set all timeslots to the same level.
- To use for the TX signal of the R&S®CMU200 the same RF frequencies and RF levels for both TCH and BCCH.
- To switch off hopping.

### Aspects to be considered if TX or RX signal paths are interrupted:

The RF frequency of the R&S®CMU200 influences the rotating direction of the I/Q vector. The direction is inverted for  $f < 1200.1$  MHz; this can be compensated for by changing I and Q.

	R&S®CMU200 generator or analyzer RF frequency	
	100 kHz to 1200.0999999 MHz	1200.1 MHz to 2700.0 MHz
R&S®CMU200 I/Q output vector	inverted rotation swap I output for Q output for proper operation	normal rotation
R&S®CMU200 I/Q input vector	inverted rotation swap I input for Q input for proper operation	normal rotation

The rotating direction must be considered if the R&S®CMU200 signal path from the link handler board to the frontend and vice versa is interrupted, i.e. if the signal is not returned to the same R&S®CMU200 block after external handling.

Examples:

- The rotating direction need **not** be taken into account if the transmitted signal is routed from the I/Q output of the R&S®CMU-B17 to an external fading simulator and then returned to the R&S®CMU200 I/Q input (the R&S®CMU200 in combination with the R&S®ABFS fading simulator or the R&S®SMIQ/SMIQB14, with the R&S®CMU200 providing the faded RF signal).
- The rotating direction must be considered if the transmitted signal is forwarded to an external fading simulator and is not returned to the I/Q input of the R&S®CMU200 (the R&S®CMU200 in combination with the R&S®SMIQ, with the R&S®SMIQ providing the faded RF signal).

### Notes for measuring I/Q/IF signals applied to inputs of the R&S®CMU-B17 option on the R&S®CMU200 RX path:

- The RF spectrum analyzer function (RF function group) cannot be used.
- The displayed RF power levels are not related directly to the applied I/Q/IF voltages. The analyzer settings of the R&S®CMU200 RF interface (RF 1, RF 2, RF 4 IN) must also be considered (*Analyzer Level* → *RF Max. Level*).
- I/Q inputs have a fixed attenuation of 2 dB, e.g. the RF power meter readout for an applied 500 mV I/Q peak voltage will be 2 dB below the value set in *RF Max. Level*.
- IF inputs do not have a fixed attenuation. The max. IF input level is 2 dBm. The RF power meter readout for the specified max. IF signal level (2 dBm) will be 2 dB below the value set in *RF Max. Level*.
- We recommend switching off the autoranging function.
- RF and IF trigger functions are not possible.
- The WCDMA RF compensation filter is switched off (I/Q IN/OUT, IF IN/OUT, IFIN\_I/Q IN/OUT).
- WCDMA UE test: ACLR/SEM measurement is not applicable.

# R&S<sup>®</sup> CMU-B41 audio generator/analyzer option

## AF generator

Output impedance		<4 Ω
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Max. output current		20 mA, peak
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<b>AF sine generator</b>		
Frequency range		20 Hz to 20 kHz
Frequency uncertainty		same as timebase + half resolution, see base unit specifications
Frequency resolution		0.1 Hz
Output level range		10 μV to 5 V
Output level resolution	level < 10 mV	10 μV
	level ≥ 10 mV	0.1 %
Output level uncertainty	level ≥ 1 mV and frequency ≤ 10 kHz	≤1.5 % + resolution
THD+N <sup>10</sup>	level ≥ 100 mV into load ≥ 600 Ω	≤0.05 %
THD <sup>10</sup>	level ≥ 100 mV into load ≥ 600 Ω	≤0.025 %

## AF analyzer

Input impedance		1 MΩ   100 pF
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<b>AF voltmeter</b>		
Frequency range		50 Hz to 20 kHz
Level range		50 μV to 30 V
Level resolution	level < 1 mV	1 μV
	level ≥ 1 mV	0.1 %
Level uncertainty	1 mV ≤ level ≤ 2 V	<1 % + resolution
	2 V < level ≤ 20 V	<2 % + resolution

<b>THD+N meter</b>		
Measurement bandwidth		21 kHz
Frequency range		100 Hz to 10 kHz
Level range		10 mV to 30 V
Resolution		0.01 % THD+N
Inherent distortion	100 mV ≤ level ≤ 20 V	<0.05 % THD+N
Uncertainty	100 mV ≤ level ≤ 2 V	<1 % + inherent resolution
	2 V < level ≤ 20 V	<2 % + inherent resolution

## R&S<sup>®</sup> CMU-U99/B99 RF1 level range identical to RF2 option

With the R&S<sup>®</sup> CMU-U99/B99 option installed, the input/output level range and the input/output level uncertainty for RF 1 are the same as for RF 2.

With the R&S<sup>®</sup> CMU-U99/B99 option installed, the VSWR of the RF generator and analyzer at RF 1 is as follows:

<b>VSWR</b>	RF generator and RF analyzer	
RF1	10 MHz to 2000 MHz	<1.2
	2000 MHz to 2200 MHz	<1.4
	2200 MHz to 2700 MHz	<1.6

<sup>10</sup> Measurement bandwidth 21.9 kHz.





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