Specifications

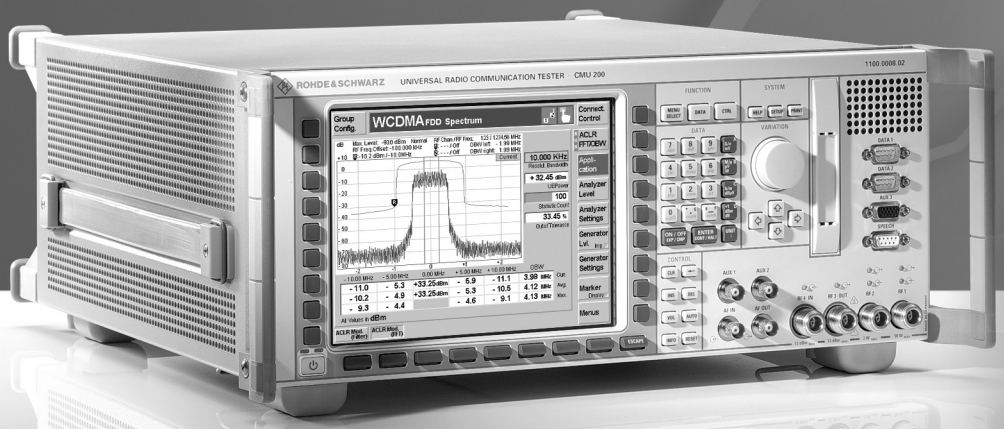
CDMA2000 WCDMA Bluetooth

GSM

1xEV-DO

Analog

TDMA



Version 07.00

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Universal Radio Communication Tester R&S®CMU 200

Specifications

ROHDE&SCHWARZ

CONTENTS

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

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 – option R&S CMU-B11

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
Warmup time	at +25 °C	approx. 5 min

Timebase OCXO – option R&S CMU-B12

Max. frequency drift		
	in temperature range +5°C to +45 °C, referred to +25 °C	$\pm 5 \times 10^{-9}$
	with instrument orientation	$\pm 3 \times 10^{-9}$
	referred to turn-off frequency after 2 h warmup 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
Warmup time	at +25 °C	approx. 10 min

Reference frequency inputs/outputs

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

Synchronization output 1		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

Synchronization output 2		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 µs to ∆f < 1 kHz

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

Output level uncertainty	in temperature range +20 °C to +35 °C	
RF 1, RF 2	output level ≥ –106 dBm 10 MHz to 450 MHz 450 MHz to 2200 MHz 2200 MHz to 2700 MHz output level > –117 dBm 450 MHz to 2200 MHz 2200 MHz to 2700 MHz output level –117 dBm to –130 dBm 450 MHz to 2200 MHz 2200 MHz to 2700 MHz	 <0.6 dB <0.6 dB <0.8 dB <0.6 dB[1] <0.8 dB[1] <1.5 dB[1, 2] <1.5 dB[1, 2]
RF 3 OUT	10 MHz to 450 MHz output level –80 dBm to +10 dBm 450 MHz to 2200 MHz output level –90 dBm to +10 dBm 2200 MHz to 2700 MHz output level –90 dBm to +5 dBm	 <0.8 dB <0.8 dB <1.0 dB

Output level uncertainty	in temperature range +5 °C to +45 °C	
RF 1, RF 2	output level ≥ –106 dBm 10 MHz to 450 MHz 450 MHz to 2200 MHz 2200 MHz to 2700 MHz output level > –117 dBm 450 MHz to 2200 MHz 2200 MHz to 2700 MHz output level –117 dBm to –130 dBm 450 MHz to 2200 MHz 2200 MHz to 2700 MHz	 <1.0 dB <1.0 dB <1.5 dB <1.0 dB[1] <1.5 dB[1] <1.5 dB[1, 2] <1.5 dB[1, 2]
RF 3 OUT	10 MHz to 450 MHz output level –80 dBm to +10 dBm 450 MHz to 2200 MHz output level –90 dBm to +10 dBm 2200 MHz to 2700 MHz output level –90 dBm to +5 dBm	 <1.0 dB <1.0 dB <1.5 dB

Output level settling time		<4 µs

Output level resolution		0.1 dB

[1] Not valid at frequencies of net-clock harmonics.

[2] Valid for RF1 only.

Generator RF level repeatability	typical values after 1 h warmup time output level ≥–80 dBm output level <–80 dBm	 <0.01 dB <0.1 dB
VSWR		
RF 1	10 MHz to 2000 MHz 2000 MHz to 2200 MHz 2200 MHz to 2700 MHz	<1.2 <1.3 <1.6
RF 2	10 MHz to 2200 MHz 2200 MHz to 2700 MHz	<1.2 <1.6
RF 3 OUT	10 MHz to 2200 MHz 2200 MHz to 2700 MHz	<1.5 <1.7

Attenuation of harmonics	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 ≤ +10 dBm	 >20 dB

Attenuation of nonharmonics	10 MHz to 2200 MHz, at f > 5 kHz from carrier	 >40 dB

Phase noise	single sideband, f < 2.2 GHz	
Carrier offset	20 kHz to 250 kHz ≥250 kHz	<–100 dBc, 1 Hz <–110 dBc, 1 Hz

Residual FM	30 Hz to 15 kHz ITU-T (formerly CCITT)	<50 Hz, rms, <200 Hz, peak <5 Hz, rms

Residual AM	ITU-T (formerly CCITT)	<0.02%, rms

I/Q modulation		
Carrier suppression	data for frequency offset range 0 Hz to ±135 kHz	 >40 dB

FM modulation		
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

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

Inherent spurious response	*RF Attenuation → Low Distortion,* 20 MHz to 2200 MHz, except 1816.115 MHz	 <–50 dB

Inherent harmonics	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

Phase noise	single sideband, f < 2.2 GHz	
Carrier offset	20 kHz to 250 kHz 250 kHz to 400 kHz ≥400 kHz	<–100 dBc, 1 Hz <–110 dBc, 1 Hz <–118 dBc, 1 Hz

Residual FM	30 Hz to 15 kHz ITU-T (formerly CCITT)	<50 Hz, rms, <200 Hz, peak <5 Hz, rms

Residual AM	ITU-T (formerly CCITT)	<0.02%, rms

Power meter (wideband)

Frequency range		100 kHz to 2700 MHz

Level range		
RF 1	continuous power[3] 100 kHz to 2200 MHz 2200 MHz to 2700 MHz peak envelope power[4] (PEP)	 +6 dBm to +47 dBm (50 W) +10 dBm to +47 dBm (50 W) +53 dBm (200 W)
RF 2	continuous power 100 kHz to 2200 MHz 2200 MHz to 2700 MHz peak envelope power[4] (PEP)	 –8 dBm to +33 dBm (2 W) –4 dBm to +33 dBm (2 W) +39 dBm (8 W)
RF 4 IN	continuous power and PEP 100 kHz to 2200 MHz 2200 MHz to 2700 MHz	 –33 dBm to 0 dBm –29 dBm to 0 dBm

Level uncertainty		
RF 1	input level +10 dBm to +20 dBm 50 MHz to 2700 MHz input level +20 dBm to +47 dBm 50 MHz to 2700 MHz	 <1.0 dB[5] <0.5 dB[5, 6]
RF 2	input level –4 dBm to +6 dBm 50 MHz to 2700 MHz input level +6 dBm to +33 dBm 50 MHz to 2700 MHz	 <1.0 dB[5] <0.5 dB[5]
RF 4 IN	input level –29 dBm to –19 dBm 50 MHz to 2700 MHz input level –19 dBm to 0 dBm 50 MHz to 2700 MHz	 <1.5 dB <0.8 dB

Level resolution	in manual mode in remote control mode	0.1 dB 0.01 dB

Power meter (frequency-selective)

Frequency range		10 MHz to 2700 MHz

Frequency resolution		0.1 Hz

[3] 50 W in temperature range +5 °C to +30 °C, linear degradation down to 25 W at +45 °C.

[4] Mean value of power vs time must be equal to or less than allowed continuous power.

[5] Temperature range +5 °C to +20 °C or +35 °C to +45 °C and f > 2200 MHz: add 0.2 dB.

[6] Calibrated for input level >+33 dBm only in frequency range 800 MHz to 2000 MHz.

Resolution bandwidths		10 Hz to 1 MHz in 1/2/3/5 steps

Level range		
RF 1	continuous power[3] 10 MHz to 2200 MHz 2200 MHz to 2700 MHz peak envelope power[4] (PEP)	 –40 dBm to +47 dBm (50 W) –34 dBm to +47 dBm (50 W) +53 dBm (200 W)
RF 2	continuous power 10 MHz to 2200 MHz 2200 MHz to 2700 MHz peak envelope power[4] (PEP)	 –54 dBm to +33 dBm (2 W) –48 dBm to +33 dBm (2 W) +39 dBm (8 W)
RF 4 IN	continuous power and PEP 10 MHz to 2200 MHz 2200 MHz to 2700 MHz	 –80 dBm to 0 dBm –74 dBm to 0 dBm

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

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

Level resolution	in manual mode in remote control mode	0.1 dB 0.01 dB

RF level measurement repeatability	typical values after 1 h warmup input level ≥–40 dBm input level <–40 dBm	 <0.01 dB <0.03 dB

Spectrum analyzer

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

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

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

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

Reference level for full dynamic range	*RF Attenuation → Low Noise,* 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

Displayed average noise level	*RF Attenuation → Low Noise,* RBW → 1 kHz, 10 MHz to 2200 MHz 2200 MHz to 2700 MHz	 <–100 dBc <–95 dBc

Inherent spurious response	*RF Attenuation → Low Distortion,* 20 MHz to 2200 MHz, except 1816.115 MHz	 <–50 dB

Inherent harmonics	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

General specifications

Operating temperature range		+5 °C to +45 °C, meets EN60068-2-1 and -2
Storage temperature range		–25 °C to +60 °C, meets EN60068-2-1 and -2
Humidity	+40 °C, non-condensing	80 % relative humidity, meets EN 60068-2-3

Electromagnetic compatibility		meets EMC Directive 89/336/EEC, applied standard: EN 61326 (immunity for industrial environment; class B emissions)

Electrical safety		IEC 61010-1, EN 61010-1, UL3111-1, CAN/CSA-C22.2 No. 1010.1

Mechanical resistance	non-operating mode	
Vibration	sinusoidal	meets EN 60068-2-6, EN 61010-1, MIL-T-28800 D class 5, 5 Hz to 150 Hz, max. 2 g at 55 Hz, 55 Hz to 150 Hz, 0.5 g const
Vibration	random	meets EN 60068-2-64 10 Hz to 300 Hz, acceleration 1.2 g rms
Shock		meets EN 60068-2-27, MIL-STD-810D 40 g shock spectrum

Power supply		power factor correction, meets EN61000-3-2
Input		100 V to 240 V ±10 % (AC), max. 500 VA, 50 Hz to 400 Hz –5 % to +10 %
Power consumption	base unit with typical options	approx. 130 W approx. 180 W

Display		21 cm TFT colour display (8.4”)
Resolution		640 × 480 pixels (VGA resolution)
Pixel failure rate		<2 × 10^{-5}

Dimensions	W × H × D	465.1 mm × 196.5 mm × 517.0 mm (19” 1/1, 4 HU, 450)

Weight	base unit with typical options	approx. 14 kg approx. 18 kg

Inputs and outputs (rear panel)

IF 3 RX CH1		BNC female
Frequency	WCDMA other networks/RF	7.68 MHz 10.7 MHz
Max. output level		0 dBm
Impedance		50 Ω

Remote control interfaces		
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 sub-D connector

Printer interface LPT	parallel (Centronics compatible)	25-pin sub-D connector

Keyboard		PS/2 connector

External monitor (VGA)		15-pin sub-D connector

GSM specifications – mobile station test

RF generator

Modulation		GMSK, B × T = 0.3 8PSK

Frequency range		
	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

Attenuation of inband spurious emissions		>50 dB

Inherent phase error	GMSK	<1°, rms <4°, peak

Inherent EVM	8PSK	<2 %, rms

Frequency settling time	to residual phase of 4°	<500 µs

Output level range	GMSK	
RF 1		–130 dBm to –27 dBm
RF 2		–130 dBm to –10 dBm
RF 3 OUT		–90 dBm to +13 dBm

Output level range	8PSK	
RF 1		–130 dBm to –31 dBm
RF 2		–130 dBm to –14 dBm
RF 3 OUT		–90 dBm to +9 dBm

Output level resolution		0.1 dB

Output level uncertainty	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

Output level uncertainty	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

Option Additional RF Generator R&S CMU-B95

Modulation		GMSK, B × T = 0.3 8PSK

Frequency range		
	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

Frequency resolution		200 kHz

Frequency uncertainty		same as time base, see base unit specifications

Inherent phase error	GMSK	<5°, rms

Output level range	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

Output level range	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

Output level resolution		1 dB

Reduced input level range	if R&S CMU-B95 is installed	
RF 1	continuous input power	max. 2 W

Option Additional RF Generator R&S CMU-B96

Path 1 for GSM

Modulation		GMSK, B × T = 0.3 8PSK

Frequency range		
	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

Frequency resolution		2.5 kHz

Frequency uncertainty		same as time base, see base unit specifications

Inherent phase error	GMSK	<5°, rms

Output level range	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

Output level range	8PSK	
RF 1	without R&S CMU-U99 with R&S CMU-U99	–115 dBm to –76 dBm –103 dBm to –64 dBm
RF 2		–103 dBm to –64 dBm

Output level range	GMSK overrange mode	
RF 1	without R&S CMU-U99 with R&S 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

Output level range	8PSK overrange mode	
RF 1	without R&S CMU-U99 with R&S 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

Output level resolution		1 dB

Influence on RF interface

Reduced input level range	if R&S CMU-B96 is installed	
RF 1	continuous input power	max. 2 W

RF level uncertainty	usage of R&S CMU-B96 in overrange mode may influence all RF signal levels and their quality	

RF analyzer

Frequency range		
	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)

Level range		
RF 1	continuous power[3] peak envelope power[4] (PEP)	–40 dBm to +47 dBm (50 W) +53 dBm (200 W)
RF 2	continuous power peak envelope power[4] (PEP)	–54 dBm to +33 dBm (2 W) +39 dBm (8 W)
RF 4 IN	continuous power and PEP	–80 dBm to 0 dBm

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

Level resolution	in manual mode in remote control mode	0.1 dB 0.01 dB

Measurement bandwidth	selectable	500 kHz or 600 kHz

Modulation analysis

Level range	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

Inherent phase error	GMSK	<0.6°, rms <2°, peak

Inherent EVM	8PSK	≤1.0 %, rms

Frequency measurement uncertainty		≤10 Hz + drift of time base, see base unit specifications

Measurement bandwidth	selectable	500 kHz or 600 kHz

Burst power measurement

Reference level for full dynamic range	GMSK, *RF Attenuation → Low Noise*	
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

Reference level for full dynamic range	8PSK, *RF Attenuation → Low Noise*	
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

Dynamic range	Filter → 500 kHz, rms, *RF Attenuation → Low Noise*	
	GMSK	>72 dB
	8PSK	>69 dB

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

Resolution	in active part of burst	0.1 dB

Measurement bandwidth	selectable	500 kHz or 600 kHz

Spectrum due to modulation

Reference level for full dynamic range	GMSK, *RF Attenuation → Low Noise*	
RF 1		+10 dBm to +47 dBm
RF 2		–4 dBm to +33 dBm
RF 4 IN		–22 dBm to 0 dBm

Test method		relative measurement, averaging

Filter bandwidth		30 kHz resolution filter, 5 pole

Measurement	at an offset of	100, 200, 250, 400, 600, 800, 1000, 1200, 1400, 1600, 1800 kHz

Dynamic range	with offset ≥ 1200 kHz	>74 dB

Spectrum due to switching

Reference level for full dynamic range	GMSK, *RF Attenuation → Low Noise*	
RF 1		+10 dBm to +47 dBm
RF 2		–4 dBm to +33 dBm
RF 4 IN		–22 dBm to 0 dBm

Test method		absolute measurement, max. hold over several measurements

Filter bandwidth		30 kHz resolution filter, 5 pole

Measurement	at an offset of	400, 600, 800, 1200, 1800 kHz

Dynamic range	with offset ≥1200 kHz	>72 dB

Option Speech Codec R&S CMU-B52

Speech decoder output	SPEECH HANDSET OUT	9-pin sub-D connector
Output impedance		<10 Ω
Maximum output current		20 mA, peak
Full-range output level		1 V, peak

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

TDMA specifications – mobile station test

RF generator

Frequency range	signaling mode	
	US Cellular	869 MHz to 894 MHz
	PCS (US)	1930 MHz to 1990 MHz

Frequency range	non-signaling mode	10 MHz to 2200 MHz

Frequency resolution	non-signaling mode	1 Hz

Frequency uncertainty		same as time base, see base unit specifications

Output level range		
RF 1		–130 dBm to –32 dBm
RF 2		–130 dBm to –15 dBm
RF 3 OUT		–90 dBm to +8 dBm

Output level resolution		0.1 dB

Output level uncertainty		see base unit specifications

Modulation	π/4 DQPSK or unmodulated (non-signaling mode)	
Uncertainty	EVM	<2.5 %, rms
Carrier suppression		>40 dB

RF analyzer

Frequency range	signaling mode	
	US Cellular	824 MHz to 849 MHz
	PCS (US)	1850 MHz to 1910 MHz

Frequency range	non-signaling mode	10 MHz to 2200 MHz

Frequency resolution	non-signaling mode	1 Hz

Frequency uncertainty		same as time base, see base unit specifications

Modulation analysis

Frequency range	signaling mode	
	US Cellular	824 MHz to 849 MHz
	PCS (US)	1850 MHz to 1910 MHz

EVM		
	residual	<2.0 %, rms
	residual	<4 %, peak

I/Q offset	residual	<–50 dB (0.3%)

I/Q imbalance	residual	<–50 dB (0.3%)

Frequency measurement range		–2 kHz to +2 kHz

Frequency measurement uncertainty		≤5 Hz + drift of time base, 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	*Filter → 100 kHz*, rms, *RF Attenuation → 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

Frequency range	signaling mode	
	US Cellular	869 MHz to 894 MHz

Frequency range	non-signaling mode	10 MHz to 2200 MHz

Frequency resolution	non-signaling mode	1 Hz

Frequency uncertainty		same as time base, see base unit specifications

Output level range		
RF 1		–130 dBm to –27 dBm
RF 2		–130 dBm to –10 dBm
RF 3 OUT		–99 dBm to +13 dBm

Output level resolution		0.1 dB

Output level uncertainty		see base unit specifications and add 0.1 dB

FM modulation		
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, BW 30 Hz to 15 kHz	≥40 dB
Residual FM	BW 300 Hz to 3 kHz	<10 Hz, rms
Deviation uncertainty	modulation frequency 1 kHz, deviation 8 kHz, BW 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

Frequency range	signaling mode	
	US Cellular	824 MHz to 849 MHz

Frequency range	non-signaling mode	10 MHz to 2200 MHz

Frequency resolution	non-signaling mode	1 Hz

Frequency uncertainty		same as time base, see base unit specifications

Power meter (frequency-selective)

Max. level range		
RF 1		0 dBm to +53 dBm
RF 2		–14 dBm to +39 dBm
RF 4 IN		–37 dBm to +0 dBm

Level uncertainty		see base unit specifications

Level resolution		0.1 dB

FM measurement

Dynamic range		30 dB below max. level

RF bandwidth	2 × deviation + 4 × modulation frequency	136 kHz

Deviation range		0 Hz to 47 kHz

Resolution		1 Hz

Modulation frequency range		100 Hz to 18 kHz

Residual FM		
	BW 300 Hz to 3 kHz	<5 Hz, rms
	BW 6 Hz to 20 kHz	<18 Hz, rms

Deviation uncertainty	BW 6 Hz to 20 kHz	<1 % of reading + residual FM

Carrier frequency error		
Measurement range		–47 kHz to +47 kHz
Measurement uncertainty		≤2 kHz + drift of time base, see base unit specifications

AF generator

See specifications of Option Audio Generator/Analyzer R&S CMU-B41		

AF analyzer

See specifications of Option Audio Generator/Analyzer R&S CMU-B41		

CDMA2000® specifications – mobile station test

Standards	CDMA2000® standards CDMA2000® test standards CDMA2000® is a registered trademark of the Telecommunications Industry Association (TIA -- USA)	TIA/EIA IS-2000 Rev. 0 TIA/EIA IS-98-E

RF generator

Frequency range		
	NMT-450 (band class 5)	421.675 MHz to 494.480 MHz
	US / Korean Cellular (band class 0)	869.025 MHz to 893.985 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
	North American 700 MHz Cellular Band (band class 7)	746.000 MHz to 764.000 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
	North American PCS (band class 1)	1930.000 MHz to 1990.000 MHz
	Korean PCS (band class 4)	1840.000 MHz to 1870.000 MHz
	1800 MHz Band (band class 8)	1805.000 MHz to 1879.950 MHz
	IMT-2000 (band class 6)	2110.000 MHz to 2169.950 MHz

Frequency resolution	channel spacing in line with standard	

Frequency uncertainty		same as time base, see base unit specifications

Output level range	modulated signal	
RF 1		–120 dBm to –33 dBm
RF 2		–120 dBm to –16 dBm
RF 3 OUT		–99 dBm to +5 dBm

Output level resolution	modulated signal	0.1 dB

Output level uncertainty	in temperature range +20 °C to +35 °C	
RF 1, RF 2	output level ≥ –108 dBm	<0.5 dB
RF 3 OUT	–80 dBm to +4 dBm	<0.7 dB

Output level uncertainty	in temperature range +5 °C to +45 °C	
RF 1, RF 2	output level ≥ –108 dBm	<0.7 dB
RF 3 OUT	–80 dBm to +4 dBm	<0.9 dB

Modulation		
Dual BPSK, multiple QPSK		1.2288 Mcps
AWGN		see AWGN generator
Carrier suppression		>35 dB
Waveform quality factor (ρ)		>0.985
Code channel level uncertainty	relative to the total CDMA power F-PICH, F-PCH, F-FCH, F-SCH1, F-SCH2 all other channels	 approx. 0.1 dB approx. 0.25 dB
Code channel resolution		0.1 dB

AWGN generator		
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

Supported service options		
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 teleservice option		SO 6, 14

RF analyzer

Frequency range		
	NMT-450 (band class 5)	411.675 MHz to 483.480 MHz
	US/Korean Cellular (band class 0)	824.025 MHz to 848.985 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
	North American 700 MHz Cellular Band (band class 7)	776.000 MHz to 794.000 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
	North American PCS (band class 1)	1850.000 MHz to 1910.000 MHz
	Korean PCS (band class 4)	1750.000 MHz to 1780.000 MHz
	1800 MHz Band (band class 8)	1710.000 MHz to 1784.950 MHz
	IMT-2000 (band class 6)	1920.000 MHz to 1979.950 MHz

Measurement filter	in line with standard	bandwidth 1.23 MHz

Frequency resolution	channel spacing in line with standard	

Frequency uncertainty		same as time base, see base unit specifications

Power meter (frequency-selective)

Level range	HPSK, O-QPSK signal	
RF 1		–40 dBm to +44 dBm
RF 2		–54 dBm to +30 dBm
RF 4 IN		–80 dBm to –9 dBm

Level uncertainty		
RF 1, RF 2, RF 4 IN	in temperature range +20 °C to +35 °C	<0.5 dB
	in temperature range +5 °C to +45 °C	<0.7 dB

Level resolution		0.1 dB

Modulation analyzer

Level range	HPSK, O-QPSK signal	
RF 1		–40 dBm to +44 dBm
RF 2		–54 dBm to +30 dBm
RF 4 IN		–80 dBm to –9 dBm

RC1, RC2 (O-QPSK)	waveform quality, error vector magnitude, magnitude error, phase error	
ρ uncertainty	for ρ 0.9 to 1	<0.003
Frequency measurement range		–3 kHz to +3 kHz
Frequency measurement uncertainty		<30 Hz + drift of time base, see base unit specifications

RC3, RC4 (HPSK)	waveform quality, error vector magnitude, magnitude error, phase error, channel power, code domain power, peak code domain error power,	
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 time base, see base unit specifications
Relative measurement uncertainty	result >–33 dB	<0.1 dB

Option Speech Codec R&S CMU-B85

Speech decoder output	SPEECH HANDSET OUT	9-pin sub-D connector
Output impedance		<10 Ω
Maximum output current		20 mA, peak
Full-range output level		1 V, peak

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

1xEV-DO specifications – access terminal test

Standards	1xEV-DO standards 1xEV-DO test standards	TIA/EIA IS-856-2 TIA/EIA IS-866

RF generator

Frequency range		
	US / Korean Cellular (band class 0)	869.025 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 494.480 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

Frequency resolution	channel spacing in line with standard	

Frequency uncertainty		same as time base, see base unit specifications

Output level range	modulated signal	
RF 1		–120 dBm to –33 dBm
RF 2		–120 dBm to –16 dBm
RF 3 OUT		–99 dBm to +5 dBm

Output level resolution	modulated signal	0.1 dB

Output level uncertainty	in temperature range +20 °C to +35 °C	
RF 1, RF 2	output level ≥–108 dBm	<0.5 dB
RF 3 OUT	–80 dBm to +4 dBm	<0.7 dB

Output level uncertainty	in temperature range +5 °C to +45 °C	
RF 1, RF 2	output level ≥–108 dBm	<0.7 dB
RF 3 OUT	–80 dBm to +4 dBm	<0.9 dB

Modulation		
Dual BPSK		1.2288 Mcps
AWGN		see AWGN generator
Carrier suppression		>35 dB
Waveform quality factor (ρ)		>0.985
Code channel level uncertainty	relative to total CDMA power	approx. 0.1 dB
Code channel resolution		0.1 dB
Code channel level range		–25.0 dB to –7.0 dB

AWGN generator		
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

RF analyzer

Frequency range		
	US / Korean Cellular (band class 0)	824.025 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

Measurement filter	in line with standard	bandwidth 1.23 MHz

Frequency resolution	channel spacing in line with standard	

Frequency uncertainty		same as time base, see base unit specifications

Power meter (frequency-selective)

Level range	modulated signal	
RF 1		–40 dBm to +44 dBm
RF 2		–54 dBm to +30 dBm
RF 4 IN		–80 dBm to –9 dBm

Level uncertainty		
RF 1, RF 2, RF 4 IN	in temperature range +20 °C to +35 °C	<0.5 dB
	in temperature range +5 °C to +45 °C	<0.7 dB

Level resolution		0.1 dB

Modulation analyzer

Level range	modulated signal	
RF 1		–40 dBm to +44 dBm
RF 2		–54 dBm to +30 dBm
RF 4 IN		–80 dBm to –9 dBm

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 time base, see base unit specifications
Relative measurement uncertainty	result >–33 dB	<0.1 dB

WCDMA specifications – mobile station (UE) test

Standard		3GPP FDD
Symbol rate		3.84 MHz

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

RF generator

Channels	non-signaling mode	
	P-CPICH, P-SCH, S-SCH, P-CCPCH, PICH, DPCH	
	OCNS	16-channel orthogonal channel noise
	reference measurement channels (RMC) in line with 3GPP TS 34.121	12.2 kbit/s, 64 kbit/s, 144 kbit/s, 384 kbit/s

Channels	signaling mode, codes selectable until conflict in code space occurs	
	P-CPICH, P-SCH, S-SCH, P-CCPCH, S-CCPCH, AICH, PICH	
	OCNS	16-channel orthogonal channel noise
	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 DL/UL BTFD	 12.2 kbit/s, 64 kbit/s, 144 kbit/s, 384 kbit/s 144 kbit/s / 64 kbit/s, 384 kbit/s / 64 kbit/s, 384 kbit/s / 144 kbit/s 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)	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

Frequency range	non-signaling mode	 869 MHz to 894 MHz 921 MHz to 960 MHz 1805 MHz to 1880 MHz 1930 MHz to 1990 MHz 2110 MHz to 2170 MHz

Frequency range	signaling mode band 1 band 2 band 3	 2110 MHz to 2170 MHz 1930 MHz to 1990 MHz 1805 MHz to 1880 MHz

Frequency offset		–100 kHz to +100 kHz

Frequency resolution		0.1 Hz

Frequency setting		by channel number or frequency

Output level range		
RF 1		–120 dBm to –37 dBm
RF 2		–120 dBm to –20 dBm
RF 3 OUT		–100 dBm to 0 dBm

Output level resolution	manual mode remote mode	0.1 dB 0.01 dB

Output level uncertainty	in temperature range +20 °C to +35 °C	
RF 1, RF 2	output level ≥–120 dBm	<0.6 dB
RF 3 OUT	output level ≥–80 dBm	<0.8 dB

Output level uncertainty	in temperature range +5 °C to +45 °C	
RF 1, RF 2	output level ≥–120 dBm	<0.9 dB
RF 3 OUT	output level ≥–80 dBm	<1.0 dB

Output level setting	setting reference	relative to CPICH or total output power

Channel levels	non-signaling mode	
	P-CPICH, P-SCH, S-SCH, P-CCPCH, PICH, DPCH, OCNS	–30 dB to +15 dB relative to CPICH

Channel levels	signaling mode	
	P-CPICH, P-SCH, S-SCH, P-CCPCH, S-CCPCH, PICH, AICH, DPCH, OCNS	–30 dB to +15 dB relative to CPICH

Signal quality		
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

Signal quality	16QAM	
Error vector magnitude (EVM)	global EVM for 16QAM reference setup: 3GPP TS34.121 FRC H-Set3 for 16 QAM	<8 %, rms

Option Additional RF Generator R&S CMU-B96

Path 2 for WCDMA

Standard		3GPP FDD

Frequency range	non-signaling mode	
		869 MHz to 894 MHz 1805 MHz to 1880 MHz 1930 MHz to 1990 MHz 2110 MHz to 2170 MHz

Frequency range	WCDMA signaling mode	
	band 1 band 2 band 3 band 4 band 5 band 6	2110 MHz to 2170 MHz 1930 MHz to 1990 MHz 1805 MHz to 1880 MHz 2110 MHz to 2170 MHz 869 MHz to 894 MHz 875 MHz to 885 MHz

Frequency resolution		2.5 kHz

Frequency uncertainty		same as time base, see base unit specifications

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

Output level range		
RF 1	without R&S CMU-U99 with R&S CMU-U99	–115 dBm to –82 dBm –103 dBm to –70 dBm
RF 2		–103 dBm to –70 dBm

Output level resolution	RF1 and RF2	0.1 dB

Output level range	overrange mode	
RF 1	without R&S CMU-U99 with R&S CMU-U99	–110 dBm to –38 dBm –90 dBm to –24 dBm
RF 2		–90 dBm to –24 dBm
RF 3 OUT		–70 dBm to –1 dBm

Output level resolution	for overrange mode	1 dB

Influence on RF interface

Reduced input level range	if R&S CMU-B96 is installed	
RF 1	continuous input power	max. 2 W

RF level uncertainty	the usage of R&S CMU-B96 in overrange mode may influence all RF signal levels and quality	

RF analyzer (TX measurements)

Frequency range	non-signaling mode	 824 MHz to 849 MHz 876 MHz to 915 MHz 1710 MHz to 1785 MHz 1850 MHz to 1910 MHz 1920 MHz to 1980 MHz

Frequency range	signaling mode band 1 band 2 band 3	 1920 MHz to 1980 MHz 1850 MHz to 1910 MHz 1710 MHz to 1785 MHz

Frequency offset		–100 kHz to +100 kHz

Frequency resolution		1 Hz

Frequency setting		by channel number or frequency

Level setting		by autoranging or manual mode

Max. level setting range		
RF 1	peak envelope power[4] (PEP)	–38 dBm to +53 dBm
RF 2	peak envelope power[4] (PEP)	–52 dBm to +39 dBm
RF 4 IN	peak envelope power (PEP)	–77 dBm to +0 dBm

Statistics		
Statistic count		1 to 1000
Values		current, average, min/max

Trigger		
Trigger sources		free run, internal, external, IF power
Trigger slot delay		0 to 14 slots
Trigger delay offset		–10239 to + 10239 × 1/4 chip
Trigger output	24-pin sub-D connector AUX 3	downlink frame, downlink slot, TPC trigger

Modulation analysis

Measurement filter	receiver filter in line with standard	3.84 MHz, RRC, α = 0.22

Analysis modes		QPSK, WCDMA uplink

Input level range		
RF 1	continuous power[3] peak envelope power[4] (PEP)	–21 dBm to +47 dBm –16 dBm to +53 dBm
RF 2	continuous power peak envelope power[4] (PEP)	–35 dBm to +33 dBm –30 dBm to +39 dBm
RF 4 IN	continuous power and PEP	–50 dBm to 0 dBm

Error vector magnitude (EVM)		
Measurement range		up to 25%
Applications	non-signaling mode	overview EVM versus time, graphical ME versus time, graphical PE versus time, graphical 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	*RF Attenuation → Low Noise* *RF Attenuation → Low Noise,* with R&S CMU-Z6 calibration	<2.5 %, rms <1.5 %, rms
Resolution		0.1%
Measurement length	QPSK mode WCDMA mode	1 timeslot (2560 chips) 1/4 timeslot (640 chips) 1 timeslot
Marker	in graphical menus	reference , Abs1, Abs2, D-line

Frequency error		
Measurement range		±3 kHz
Uncertainty		<10 Hz + drift of time base, see base unit specifications
Resolution		1 Hz

I/Q offset		
Inherent I/Q offset		<–55 dB
Resolution		0.01 dB

I/Q imbalance		
Inherent I/Q imbalance		<–30 dB
Resolution		0.01 dB

Peak code domain error (PCDE)		
Inherent PCDE	for SF = 4	<–40 dB
Resolution		0.01 dB

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

Spectrum measurements

Reference level for full dynamic range		
RF 1	rms peak envelope power[4](PEP)	+14 dBm to +47 dBm up to +53 dBm
RF 2	rms peak envelope power[4](PEP)	+0 dBm to +33 dBm up to +39 dBm
RF 4 IN	rms peak envelope power (PEP)	–18 dBm to 0 dBm up to 0 dBm

Adjacent channel leakage ratio (ACLR filter application)		
Measurement filter	receiver filter in line with standard	3.84 MHz, RRC, α = 0.22
Display		bar graphs of rms and peak values, numerical values rms and peak of current, average and max. values
Frequency offsets	first adjacent channel second adjacent channel	±5 MHz ±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)

Adjacent channel leakage ratio (ACLR FFT/OBW application)		
Measurement filter	receiver filter in line with standard	3.84 MHz, RRC, α = 0.22
Display		continuous spectrum with 25 MHz bandwidth, numerical values rms and peak of current, average and max. values
Frequency offsets	first adjacent channel second adjacent channel	±5 MHz ±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		1 timeslot (2560 chips) 1/2 timeslot (1280 chips) 1/4 timeslot (640 chips) 1/8 timeslot (320 chips)

Spectrum emission mask (SEM application)		
Measurement filter	receiver filter in line with standard	3.84 MHz, RRC, α = 0.22
Display		graphical and numerical values of current, average and max values

Resolution bandwidth	frequency offset 2.5 MHz to 3.5 MHz 3.5 MHz to 7.5 MHz 7.5 MHz to 8.5 MHz 8.5 MHz to 12.5 MHz	 30 kHz 1 MHz 1 MHz 1 MHz
Measurement interval		1 timeslot (2560 chips) 1/2 timeslot (1280 chips) 1/4 timeslot (640 chips) 1/8 timeslot (320 chips)

Power meter (frequency-selective)[7]

Measurement applications	maximum power, minimum power off power power versus slot inner loop power	bandwidth approx. 7 MHz 3.84 MHz, RRC, α = 0.22 bandwidth approx. 7 MHz 3.84 MHz, RRC, α = 0.22

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

Level range		
RF 1	continuous power[3] peak envelope power[4] (PEP)	–52 dBm to +47 dBm –42 dBm to +53 dBm
RF 2	continuous power peak envelope power[4] (PEP)	–66 dBm to +33 dBm –56 dBm to +39 dBm
RF 4 IN	continuous power[8] peak envelope power (PEP)	–89 dBm to 0 dBm –79 dBm to 0 dBm

Level uncertainty	in temperature range +20 °C to +35 °C	
RF 1	–10 dBm to +47 dBm, rms –44 dBm to –10 dBm, rms	<0.5 dB <0.7 dB
RF 2	–24 dBm to +33 dBm, rms –60 dBm to –24 dBm, rms	<0.5 dB <0.7 dB
RF 4 IN	–24 dBm to 0 dBm, rms –85 dBm to –24 dBm, rms	<0.5 dB <0.7 dB

Level uncertainty	in temperature range +5 °C to +45 °C	
RF 1	–10 dBm to +47 dBm, rms –44 dBm to –10 dBm, rms	<0.7 dB <0.9 dB
RF 2	–24 dBm to +33 dBm, rms –60 dBm to –24 dBm, rms	<0.7 dB <0.9 dB
RF 4 IN	–24 dBm to 0 dBm, rms –85 dBm to –24 dBm, rms	<0.7 dB <0.9 dB

Level resolution		0.01 dB

[7] The specified data is valid for *RF Attenuation* set to *Low Noise*.

[8] Upper limit depends on crest factor.

Code domain power[7]

Measurement filter	receiver filter in line with standard	3.84 MHz, RRC, α = 0.22

Display modes		CDP/Code Auto CDP/Code Manual CDP/Code Rho Auto CDP/Code Rho Manual

Spreading Factor (SF)	auto mode manual setting	 4, 8, 16, 32, 64, 128, 256

Level range		
RF 1		–8 dBm to +47 dBm
RF 2		–22 dBm to +33 dBm
RF 4 IN		–45 dBm to 0 dBm

Level uncertainty		<0.5 dB

Level resolution		0.01 dB

Receiver quality (bit error rate measurements)

Measurement types		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

Option Speech Codec R&S CMU-B52

Speech decoder output	SPEECH HANDSET OUT	9-pin sub-D connector
Output impedance		<10 Ω
Maximum output current		20 mA, peak
Full-range output level		1 V, peak

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

Bluetooth specifications

Standards		Bluetooth Core Specifications Version 1.1

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 time base, 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 time base, 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

Measurement bandwidth	filter definition: passband	
	Filter Bandwidth → wide *Filter Bandwidth → narrow*	2.0 MHz 1.3 MHz

Reference level for full dynamic range	GFSK signal	
RF 1		0 dBm to +41 dBm
RF 2		–14 dBm to +33 dBm
RF 4 IN		–32 dBm to 0 dBm

Dynamic range	*Filter Bandwidth → wide*	>55 dB, rms

Level uncertainty	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

Level uncertainty	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

Level resolution	in manual mode in remote control mode	0.1 dB 0.01 dB

Modulation analyzer

Measurement bandwidth	filter definition: passband	
	Filter Bandwidth → wide *Filter Bandwidth → narrow*	2.0 MHz 1.3 MHz

Level range	GFSK signal	
RF 1, RF 2, RF 4 IN		from full scale setting down to –25 dB

Total measurement range for frequency offset and frequency deviation		–250 kHz to +250 kHz

Frequency offset uncertainty in preamble	for deviation ≤160 kHz	≤2 kHz

Frequency deviation uncertainty in payload	for 100 kHz < deviation ≤ 200 kHz	
	11110000 pattern	≤2 %
	10101010 pattern	≤4 %

Frequency drift uncertainty	measured in burst related to frequency offset value in preamble	
	10101010 pattern maximum typically	 ≤2 kHz ≤1 kHz

Frequency resolution	in manual mode in remote control mode	1 kHz 1 Hz

Timing measurement

Range		±20 µs
Resolution		≤0.25 µs
Uncertainty		≤0.25 µs + resolution

Speech codec

Speech decoder output	SPEECH HANDSET OUT	9-pin sub-D connector
Output impedance		<10 Ω
Maximum output current		20 mA, peak
Full-range output level		1 V, peak

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

Option I/Q/IF Interface R&S CMU-B17

I/Q interface

Analog I/Q outputs	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 V, peak
Output impedance		50 Ω
I and Q amplitude imbalance	 for WCDMA function group	<2 % <2.5 %
Offset voltage	in temperature range +20 °C to +35 °C in temperature range +20 °C to +35 °C for WCDMA function group in temperature range +5 °C to +45 °C	<4 mV <5 mV <8 mV

Analog I/Q inputs	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 V, peak
Input impedance		50 Ω
Carrier suppression	in temperature range +20 °C to +35 °C in temperature range +5 °C to +45 °C	>40 dB >35 dB
Sideband suppression	$f_{I/Q}$ < 1 MHz 1 MHz < $f_{I/Q}$ < 2.5 MHz	>45 dB >40 dB

Analog I/Q inputs	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 V, peak
Input impedance		50 Ω
Carrier suppression	in temperature range +20 °C to +35 °C in temperature range +5 °C to +45 °C	>35 dB[9] >35 dB[9]
Sideband suppression	$f_{I/Q}$ < 1 MHz 1 MHz < $f_{I/Q}$ < 2.5 MHz	>45 dB >40 dB

Influence on RF interface

GSM/EDGE measurements		
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

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

[9] For GSMK modulation and max. input voltage at I/Q inputs.

RF level uncertainty	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

IF interface

IF inputs, TX path		connector IF3 TX CH1 IN
IF level range		up to –5 dBm, PEP
Standard IF frequencies	RF/GSM (GMSK and 8PSK)/ TDMA/cdma2000 WCDMA	 13.85 MHz 15.36 MHz

IF inputs, RX path		connector IF3 RX CH1 IN
IF level range		up to +2 dBm, PEP
Standard IF frequencies	RF/GSM (GMSK and 8PSK)/ TDMA/cdma2000 WCDMA	 10.7 MHz 7.68 MHz

IF outputs, TX path		connector IF3 TX CH1 OUT
IF level range		up to –5 dBm, PEP
Standard IF frequencies	RF/GSM (GMSK and 8PSK)/ TDMA/cdma2000 WCDMA	 13.85 MHz 15.36 MHz

IF outputs, RX path		connector IF3 RX CH1 OUT
IF level range		up to +6 dBm, PEP
Standard IF frequencies	RF/GSM (GMSK and 8PSK)/ TDMA/cdma2000 WCDMA	 10.7 MHz 7.68 MHz

Remarks

- Due to the modulation schemes used Bluetooth and AMPS standards will not be supported.
- The options R&S CMU-B17 and R&S CMU-B73 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 hopping off.

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 with Q output for proper operation	normal rotation
R&S CMU200 I/Q input vector	inverted rotation swap I input with 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 must **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 Fading Simulator R&S ABFS or R&S SMIQ/SMIQB14, 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, 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) have to be considered additionally (*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 mentioned 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.

Option Audio Generator/Analyzer R&S CMU-B41

AF generator

Output impedance		<4 Ω

Maximum output current		20 mA, peak

AF sine generator		
Frequency range		20 Hz to 20 kHz
Frequency uncertainty		same as time base + half resolution, see base unit specifications
Frequency resolution		0.1 Hz
Output level range		10 µV to 5 V
Output level resolution	at level <10 mV at level ≥10 mV	10 µV 0.1 %
Output level uncertainty	at level ≥1 mV and frequency ≤10 kHz	≤1.5 % + resolution
THD+N[10]	at level ≥100 mV into load ≥600 Ω	≤0.05 %
THD[10]	at level ≥100 mV into load ≥600 Ω	≤0.025 %

AF analyzer

Input impedance		1 MΩ ‖ 100 pF

AF voltmeter		
Frequency range		50 Hz to 20 kHz
Level range		50 µV to 30 V
Level resolution	at level <1 mV at level ≥1 mV	1 µV 0.1 %
Level uncertainty	at 1 mV ≤ level ≤ 2 V at 2 V < level ≤ 20 V	<1 % + resolution <2 % + resolution

THD+N meter		
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	at 100 mV ≤ level ≤ 20 V	<0.05 % THD+N
Uncertainty	at 100 mV ≤ level ≤ 2 V at 2 V < level ≤ 20 V	<1 % + inherent resolution <2 % + inherent resolution

Option RF1 Level Range Identical to RF2 R&S CMU-U99/B99

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

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

[10] Measurement bandwidth 21.9 kHz

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

Specifications are valid under the following conditions:

Data without tolerance limits is not binding.

In compliance 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.

For more general information about the R&S CMU200 please refer to the product brochure PD 0758.0039.12, version ≥06.00.

Certified Quality System
ISO 9001
DQS REG. NO 1954 QM

Certified Environmental System
ISO 14001
DQS REG. NO 1954 UM

For product brochure, see PD 0758.0039.12
and www.rohde-schwarz.com
(search term: CMU200)

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