WCDMA RF Measurements with the R&S®CMW500 according to 3GPP TS 34.121

Application note

Products:

| R&S[®]CMW500

The 3GPP TS 34.121-1 "Radio transmission and reception" UMTS User Equipment (UE) conformance specification defines the measurement procedures for UMTS (FDD) terminals with regard to their transmitting characteristics, receiving characteristics and performance requirements as part of the 3G standard.

This application note describes how to use the WCDMA measurement functionality provided by the R&S[®]CMW500 wideband radio communication tester to perform WCDMA transmitter and receiver measurements according to this test specification.

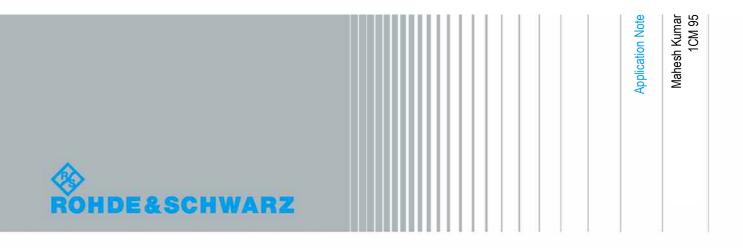


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1 Introduction

Most of the tests specified in Technical Standard 34.121 [1] for 3GPP Rel-99 can be performed with an R&S[®]CMW500. This document provides a step-by-step guide on how to perform Rel-99 measurements on transmitter characteristics and receiver characteristics according to TS 34.121 V9.5.0, clauses 5 and 6, using a standalone R&S[®]CMW500. After each test case description in this application note, a short demo has been added to illustrate how the R&S®CMW500 is used for each type of test. The specification requires this testing to be done on several frequencies; however, the examples in this application note concentrate on one operation band and one channel only. The example screenshots and steps shown are based on testing user equipment that supports Operating Band I and Power Class 3. To test UEs that support other bands and power classes, the user needs to adapt the settings mentioned in the examples.

Test cases that require additional instruments, e.g. a signal generator, a fading simulator (R&S[®]SMU200A or R&S[®]AMU200A) or a spectrum analyzer (R&S[®]FSQ), are not covered in this application note.

A set of *.dfl files based on the R&S[®]CMW500 firmware V2.1.20 for UEs that support Operating Band I and Power Class 3 in the 12.2 kbps downlink/uplink RMC is attached to this application note. In this document, information on these *.dfl files is marked with

this symbol:

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1.1 Tests Supported in Accordance with 3GPP TS 34.121-1

Table 1 shows the Rel-99 tests for transmitter characteristics and receiver characteristics that can be performed with the $R\&S^{\mbox{\ensuremath{\mathbb{R}}}}CMW500$.

Tests of transmitter characteristics and receiver characteristics from 3GPP Rel-99 that the R&S $^{\textcircled{B}}CMW500$ supports						
Test	Clause Test Parameter					
	5.2	Maximum output power				
	5.3	Frequency error				
	5.4.2	Inner loop power control in the uplink				
	5.4.3	Minimum output power				
Transmitter	5.8	Occupied bandwidth (OBW)				
characteristics	5.9	Spectrum emission mask				
	5.10	Adjacent channel leakage power ratio (ACLR)				
	5.13.1	Error vector magnitude (EVM)				
	5.13.2	Peak code domain error				
	5.13.3	UE phase discontinuity				
Receiver	6.2	Reference sensitivity level				
characteristics	6.3	Maximum input level				

Table 1: 3GPP Rel-99 measurement that the R&S®CMW500 supports.

2 Rel-99 Transmitter Characteristics

2.1 Generic Call Setup for Transmitter Characteristics

2.1.1 Configuring the RMC Mode

All transmitter characteristic parameters are defined using the 12.2 kbps uplink (UL) reference measurement channel (RMC), as specified in TS 34.121, Annex C.2.1, unless stated otherwise.

Configuring the R&S[®]CMW500: Config \rightarrow Connection Configuration \rightarrow UE term. Connection \rightarrow RMC Config \rightarrow Connection Configuration \rightarrow RMC \rightarrow Data Rate \rightarrow DL RMC 12.2 kbps UL RMC 12.2 kbps

WCDMA Signaling Configuration		WCDMA
Path: HSDPA		
-Scenario B-RF Settings	Standard Cell -	• Go to
 Physical Downlink Settings Physical Uplink Settings 		Go to
Connection Configuration UE term. Connection	RMC -	
- SRB Data Rate	DL 13.6 kbps 🕶 UL 13.6 kbps	• Go to
Video Single SRB		WCDMA Sig. Config
⊟-RMC —Data Rate	DL RMC 12.2 - UL RMC 12.2	
—Test Mode	Loop Mode 2 💌	
Loop Mode 1 RLC	Transparent 💌	
-Loop Mode 2 Sym. UL	RC 🗆	
DL Ressource in Use	100 %	
-Data Pattern	PRBS9 -	
HSPA Test Mode		
B-HSPA Test Mode		
Network HSDPA		WCDMA-UE
I IIF Maseuromant Panart		Signaling
Connect J	id T	T T T
RMC Unregister SM		Config

Fig. 1: Setting up the dedicated 12.2 kbps RMC.

Users define all transmitter characteristic parameters using the common RF test conditions as specified in 3GPP TS 34.121, Annex E.3.1, except for TS 34.121, clauses 5.3, 5.4.1, 5.4.4 and 5.5.2.

2.1.2 Configuring the Downlink Power

Downlink physical channels transmitted during a connection					
Physical channel	Power				
lor	–93 dBm / 3.84 MHz				
СРІСН	CPICH_Ec / DPCH_Ec = 7 dB				
P-CCPCH	P-CCPCH_Ec / DPCH_Ec = 5 dB				
SCH	SCH_Ec / DPCH_Ec = 5 dB				
PICH	PICH_Ec / DPCH_Ec = 2 dB				
DPCH	–103.3 dBm / 3.84 MHz				

Table 2: Physical WCDMA downlink channels transmitted during a connection (Table E.3.1 of 3GPP TS 34.121 [1]).

Table 2 provides an overview on the base station transmitting power for different physical channels. The corresponding power settings for these channels are configured as shown below.

Configuration in the R&S[®]CMW500:

Config → RF Settings → RF Power Downlink → Output Channel Power (lor) → -93.0 dBm Config → RF Settings → RF Power Uplink → Exp. Nominal Power Mode → According to UL Power Control Settings Config → Physical Downlink Settings → P-CPICH → -3.3 dB Config → Physical Downlink Settings → P-CCPCH → -5.3 dB Config → Physical Downlink Settings → P-SCH → -8.3 dB Config → Physical Downlink Settings → S-SCH → -8.3 dB Config → Physical Downlink Settings → PICH → -8.3 dB Config → Physical Downlink Settings → DPDCH Level Config → -10.3 dB

These settings apply for all transmitter test cases in this application note. For this reason, they will not be repeated unless the specific test case requires a different power level setting.

Remarks:

Setting the *Exp. Nominal Power Mode* to *According to UL Power Control Settings* ensures auto adjustment of the reference level according to the TPC bits sent to the UE to control the UL Tx power.

WCDMA Signaling Configuration		WCDMA
Path. RF Settings/RF Power Downlink/Output	Power (lor)	
Scenario	Standard Cell -	, io to
	Connector: RF1COM Converter: RFTX1 Connector: RF1COM Converter: RFRX1 Converter: RFRX1 Converter: RFRX1	io to
FF Frequency FF Power Downlink Output Power (lor)	-93.00 dBm	VCDMA lig. Config
	-70.00 dBm -93.00 dBm	
□ RF Power Uplink	According to UL Power Control Settings	
→ Margin → Physical Downlink Settings → Accumulated Power	7.40 dB 0.00 dB Adjust to 0dB level"	VCDMA-UE
- OCNS - Code Conflict	No Code Conflict Detected!	ignaling
Disconnect Send RMC SMS	Handover	Config

Fig. 2: Configuring the physical downlink channels – part 1.

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Generic Call Setup for Transmitter Characteristics

th RF Settings/RF Power Downlink/Ou	tput Power (lor)		
Physical Downlink Settings Accumulated Power OCNS Code Conflict Code Domain Diagram	0.00 dB Adjust to 0dB Release 99 No Code Conflict Detect Show	ed!	. Go to Go to
	Level Code	Symbol Rate	Go to
P-CPICH Đ-P-CPICH Enhanced	₩ -3.30 dB 0	15 ksps	
-S-CPICH -S-CPICH Enhanced	□ -3.30 dB 11	15 ksps	WCDMA Sig. Conf
-P-SCH -S-SCH	I⊽ -8.30 dB I⊽ -8.30 dB		
-P-CCPCH -S-CCPCH	I −5.30 dB 1 I −5.30 dB 2	15 ksps 60 ksps	
←PICH ←AICH ⊞-AICH Enhanced	₩ -8.30 dB 2 ₩ -8.30 dB 3	15 ksps 15 ksps	
- DPCH DPCH Enhanced	🔽 −10.30 dB 3	30 ksps	
-2nd Scrambling Code Power Offset Timing Offset	■ 0 hex 0.0 dB 0 * 256 chip		WCDMA-L Signaling

Fig. 3: Configuring the physical downlink channels – part 2.

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Generic Call Setup for Transmitter Characteristics

2.1.3 Establishing a Call

To establish a WCDMA connection, press "Connect RMC" on the R&S $^{\$}$ CMW500 once the UE has registered with the R&S $^{\$}$ CMW500.

😵 WCDMA FDD Signaling		WCDMA
Connection Status	Cell Setup	
Cell HSDPA	Band Band Downlink Uplink	Go to
Circuit Switched Registered	Downlink Uplink Channel 10563 Ch 9613 Ch	
Packet Switched	Frequency 2112.6 MHz 1922.6 MH	do to
CMW Demod. Info	Output Power -56.10 dBm	
UE Info	Total Output -56.10 dBm	Go to
Connection Type Established	Scrambling Code 0 hex 0 he	
Packet Switched	PCPICH • ⊽ -3.3 dB Code	0
Registration Identity Type IMISI	PS Domain 🔽 Reduced Signaling	WCDMA Sig. Config
Registration Identity 001010123456063 IMEI 355921041915396	Connection Setup	}
UE Called Number	UE term. Connect RMC -	
UE Calling Number CTM Text Telephony (TTY)		
Show UE Capabilities	RMC	
UE Measurement Report On UTRA FDD (Current Cell) Lower Upper	Data Rate DL RMC 12.2 VL RMC 12.2	
CPICH RSCP [dBm]		
CPICH Ec/No [dB]	Test Mode Loop Mode 2 -	
Log10(TCH BLER)	HSPA Test Mode	
UE RX-TX Time Difference [Chip]		WCDMA-UE Signaling
Connect RMC Unregister Send SMS	I I I	Config

Fig. 4: Establishing an RMC call.

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S WCDMA FDD Signaling		WCDMA
Connection Status	Cell Setup	
Cell (M) HSDPA	Band Band 1 🗸	Go to
Circuit Switched	Downlink Uplink	
Circuit Switched	Channel 10563 Ch 9613 Ch	1
Packet Switched Attached	Frequency 2112.6 MHz 1922.6 MHz	Go to
CMW Demod. Info Prevent in Politice: Informe	Output Power -56.10 dBm	<u> </u>
UE Info	Total Output -56.10 dBm	Caba
Connection Type Established	Scrambling Code 0 hex 0 hex	Go to
Circuit Switched UE terminated RMC Ca Packet Switched	PCPICH3,3 dB Code 0	
Registration Identity Type IMSI	PS Domain 🔽 Reduced Signaling	WCDMA Sig. Config
Registration Identity 001010123456063	Connection Setup	sig. comig
IMEI 355921041915396 UE Called Number	UE term. Connect RMC	
UE Calling Number		
CTM Text Telephony (TTY)		<u> </u>
Show UE Capabilities	RMC	1
UE Measurement Report	Data Rate DL RMC 12.2 UL RMC 12.2	
On UTRA FDD (Current Cell) Lower Up	The second	<u>├</u>
CPICH RSCP [dBm] -75 -74		
CPICH Ec/No [dB] -3.5 -3	Test Mode Loop Mode 2	
Log10(TCH BLER) 0 0	HSPA Test Mode	<u> </u>
Transmitted UE Power (dBm) -5 -4 UE RX-TX Time Difference (Chip) 1024 1025		WCDMA-UE
		Signaling
UE RX-TX Time Difference [Chip] 1024 1025 Pathloss IdBI 106		ON

Fig. 5: RMC call established.

In the WCDMA Multi Evaluation application, the user needs to configure the scenario so that the "Combined Signal Path," is controlled by "WCDMA Sig1" in order to automatically align the signal routing and analyzer settings with the signaling configurations.

Figure 6 below shows the settings for the R&S[®]CMW500.

Remarks:

The best way to prepare the WCDMA Multi Evaluation to work with the signaling application is to configure the "Go To..." shortcut for this. Example: The Combined Signal Path is automatically configured when you navigate to the Multi Evaluation application using the "Go to..." tab.

P	ath: Scenario	n 🛍		Evaluation OFF
	-Scenario -Controlled by	Combined Signal Path WCDMA Sig1	Slot	RF Settings
	-RF Routing -External Attenuation (Input) -Band / Channel -Frequency	Connector: RF1COM Converter: RFRX1 0.00 dB Band1 F 1922,6000000 MHz	Skot	Trigger
as	Expected Nominal Power User Margin UL Target Power UE Signal Info Measurement Control Trigger	-20.00 dBm Ref. Level -7.00 dBm 13.00 dB -20.0 dBm	Code	WCDMA Sig. Config
agn	⊕–Limit		Ch kHz	Display
x		· · · · · · · · · · · · · · · · · · ·		WCDMA 1

Fig. 6: Configuring the scenario for signaling tests.

Once all the above mentioned configurations are done, the setup is ready to start with the measurements to obtain test results for different Tx characteristics in accordance with the 3GPP 34.121 specification.

2.2 Maximum Output Power (3GPP TS 34.121, 5.2)

The maximum output power measures the maximum power that the UE can transmit in a bandwidth of at least $(1 + \alpha)$ times the radio access mode's chip rate. If the maximum output power is too high, the device may interfere with other channels or other systems. If the maximum output power is too low, this decreases the coverage area.

Table 3 shows the nominal maximum output power and tolerance.

Operating Band	Power Class 1		Power	Class 2	Power	Power Class 3		Power Class 3bis		Class 4
	Power	Tol	Power	Tol	Power	Tol	Power	Tol	Power	Tol
	(dBm)	(dB)	(dBm)	(dB)	(dBm)	(dB)	(dBm)	(dB)	(dBm)	(dB)
Band I	+33	+1.7/	+27	+1.7/-	+24	+1.7/			+21	+2.7/
		-3.7		3.7		-3.7				-2.7
Band II					+24	+1.7/			+21	+2.7/
<u> </u>						-3.7				-2.7
Band III					+24	+1.7/			+21	+2.7/
5						-3.7				-2.7
Band IV					+24	+1.7/			+21	+2.7/
5						-3.7				-2.7
Band V					+24	+1.7/			+21	+2.7/
						-3.7			. 01	-2.7
Band VI					+24	+1.7/			+21	+2.7/
						-3.7	. 00		. 01	-2.7
Band VII					+24	+1.7/	+23	+2.7/	+21	+2.7/
5						-3.7		-2.7		-2.7
Band VIII					+24	+1.7/	+23	+2.7/	+21	+2.7/
5 1.07						-3.7		-2.7		-2.7
Band IX					+24	+1.7/			+21	+2.7/
						-3.7				-2.7
Band X					+24	+1.7			+21	+2.7/
						/_3.7				-2.7
Band XI					+24	+1.7			+21	+2.7/
						/_3.7				-2.7
Band XII					+24	+1.7/	+23	+2.7/	+21	+2.7/
						-3.7		-2.7		-2.7
Band XIII					+24	+1.7/	+23	+2.7/	+21	+2.7/
5						-3.7		-2.7		-2.7
Band XIV					+24	+1.7/	+23	+2.7/	+21	+2.7/
						-3.7		-2.7		-2.7
Band XIX					+24	+1.7/	+23	+2.7/	+21	+2.7/
						-3.7		-2.7	ļ	-2.7
Band XX					+24	+1.7/	+23	+2.7/	+21	+2.7
						-3.7		-2.7	ļ	-2.7
Band XXI					+24	+1.7/	+23	+2.7/	+21	+2.7/
				1		-3.7		-2.7	1	-2.7

Table 3: Test requirements for nominal maximum output power (Table 5.2.2 of 3GPP TS 34.121 [1]).

A WCDMA call is setup as specified in section 2.1. A continuously UP power control command is sent to the UE until the UE transmission reaches its maximum power and the mean power of the UE is measured. In the R&S[®]CMW500, choose the display to view the UE power in the WCDMA Multi Evaluation. A continuously UP power control command can be configured by setting the *Active TPC Setup* to *All 1* under the "TPC config" tab.

The "TPC config" tab is available as a softkey under the **WCDMA Sig. Config** tab in the WCDMA Multi Evaluation.

Configuration in the R&S[®]CMW500:

Task \rightarrow WCDMA Multi Evaluation \rightarrow Display \rightarrow Select View \rightarrow UE PowerWCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow All 1WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Alg./Stepsize \rightarrow Alg2_1dB



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To find out the mobile device's power class, click on "Show UE capabilities" and scroll to "RF Parameters," when the mobile is "Registered" on the R&S®CMW500

	UE Capabilities			To the stress of the	
Connection Status Cell HSDPA	Physical Channel FDD DPDCH Bits per 10ms	9600 BR	*	Go to	
	RF Parameters				
Circuit Switched	E-Bands	Supported	Power	Go to	
_	Band1	Yes			
CMW Demod. Info	-Band2				
UE Info	-Band3			Go to	
Connection Type Established	-Band4	Yes	3	GU (U	
-Circuit Switched	-Band5			<u> </u>	
Packet Switched	-Band6			WCDMA	
Registration Identity Type IMSI	-Band7		-	Sig. Config	
Registration Identity 001010123456063	Band8 Band9				
IMEI 355921041915396	Bands Band10			1	
UE Called Number	-Bandit				
UE Calling Number	-Band12				
CTM Text Telephony (TTT)	-Band13			<u>}</u>	
Show UE Capabilities	-Band14				
UE Measurement Report	Band 19				
Management of the second s	-Band 20				
	Band 20	-			
CPICH RSCP (dBm)	Multi-Mode				
Log10(TCH BLER)	UTRA FOD/TDD	FDD			
Transmitted UE Power [dBm]	Multi-RAT			An open set of the owner of the	
UE RX-TX Time Difference [Chip]	GSM	Yes		WCDMA-U	
Pathloss [dB]	-Multi-Carrier Mode	Yes	1	Signaling	
	× ×	~			
Connect Unregister Send				Config	

Fig. 7: Determining the mobile device's power class.

S WCDMA FI	00 TX Measurement 1 - M	uiti Evaluation		WCDMA
UL Frequenc UE Power	y 1922.6000000 MHz R	ef Level: 35.40 dBm Connector F Power Steps dB	And a second sec	Multi Evaluation RUN
Phase Disc	sio		Slot Relative CDE	Stot RF Settings
•	Sio Sio	He		Stot
Error Vecto	or Magnitude		L-Signal dB	WCDMA Sig. Config
Phase Erro			nure minist	
Magnitude	Active TPC Setup	All 1		Display
1	Alg. / Step Size User Defined Patt	Alg2_1dB - 00000000001111111111	Chip dB	
TX Meas UE Powe	Precondition Configuration	None 11	34.10 Hz OBW 4.11	MHz WCDMA 1 Signaling
	Physical DL Settings	РС Н	SDPA	Config

Fig. 8: Settings for the maximum output power measurement results.

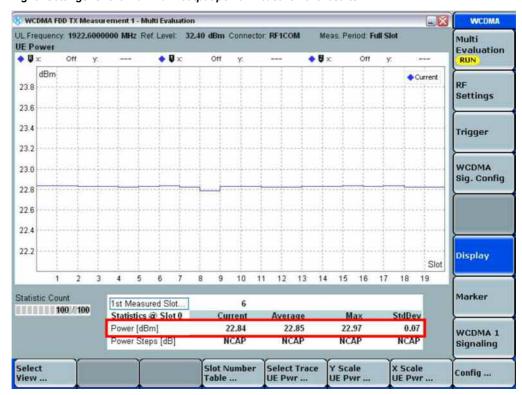


Fig. 9: Results from a maximum output power measurement.

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Fig. **9** shows the maximum output power result for a Power Class 3 mobile device. According to 3GPP TS 34.121-1, Table 5.2.2, the maximum output power for a Power Class 3 UE must be within the range of 24 + 1.7 - 3.7 dBm.

Recall Tx meas.dfl and establish an RMC call:

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WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow All 1

The measurement results are then available at: Tasks \rightarrow WCDMA Multi Evaluation \rightarrow Display \rightarrow Select View \rightarrow UE Power

2.3 Frequency Error (3GPP TS 34.121, 5.3)

The UE transmitter tracks to the RF carrier frequency received from the Node B. The frequency error is the difference between the RF modulated carrier frequency transmitted from the UE and the assigned frequency. Frequency error occurs due to the Node B frequency error and the Doppler shift.

The frequency error must not exceed \pm (0.1 ppm + 10 Hz). An excessive carrier frequency error increases the transmission errors in the uplink's own channel. This test verifies the receiver's ability to derive correct frequency information for the transmitter when locked to the DL carrier frequency.

A 12.2 kbps RMC is setup as shown in Fig. 1.

The physical downlink channels in Table 4 and 5 are to be configured in the R&S $^{\ensuremath{\mathbb{R}}}$ CMW500.

Downlink physical channels transmitted during a connection							
Physical Channel	Power						
СРІСН	CPICH_Ec / DPCH_Ec	= 7 dB					
P-CCPCH	P-CCPCH_Ec / DPCH_Ec	= 5 dB					
SCH	SCH_Ec / DPCH_Ec	= 5 dB					
PICH	PICH_Ec / DPCH_Ec	= 2 dB					
DPCH	Test-dependent power						

 Table 4: Downlink physical channels transmitted during a connection (Table E.3.2.1 of 3GPP TS 34.121 [1]).

Frequency Error (3GPP TS 34.121, 5.3)

eference sensitivi	eference sensitivity level							
Operating Band	Unit	DPCH_Ec <refsens></refsens>	<reflor></reflor>					
Ι	dBm/3.84 MHz	-116.3	-106					
П	dBm/3.84 MHz	-114.3	-104					
Ш	dBm/3.84 MHz	-113.3	-103					
IV	dBm/3.84 MHz	-116.3	-106					
V	dBm/3.84 MHz	-114.3	-104					
VI	dBm/3.84 MHz	-116.3	-106					
VII	dBm/3.84 MHz	-114.3	-104					
VIII	dBm/3.84 MHz	-113.3	-103					
IX	dBm/3.84 MHz	-115.3	-105					
Х	dBm/3.84 MHz	-116.3	-106					
XI	dBm/3.84 MHz	-114.3	-104					
XII	dBm/3.84 MHz	-113.3	-103					
XIII	dBm/3.84 MHz	-113.3	-103					
XIV	dBm/3.84 MHz	-113.3	-103					
XIX	dBm/3.84 MHz	-116.3	-106					
XX	dBm/3.84 MHz	-113.3	-103					
XXI	dBm/3.84 MHz	-116.3	-106					

Table 5: Reference sensitivity level (Table 6.2.2 of TS 3GPP 34.121 [1]).

A WCDMA call is setup as specified in section 2.1. A continuously UP power control command is sent to the UE until the UE transmission reaches its maximum power.

For a UE that supports Operating Band 1, the power levels need to be configured for the following physical downlink channels:

Config \rightarrow RF Settings \rightarrow RF Power Downlink \rightarrow Output Channel Power (Ior) \rightarrow -106 dBm

Config \rightarrow Physical Downlink Settings \rightarrow DPDCH Level Config \rightarrow -10.3 dB [w.r.t lor i.e -106 dBm - 10.3 dB = -116.3 dBm]

The frequency error is measured while the UE transmits at its maximum power.

Configuration in the R&S[®]CMW500:

WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow All 1 WCDMA Multi Evaluation \rightarrow Display \rightarrow Select View \rightarrow Frequency Error

Frequency Error (3GPP TS 34.121, 5.3)

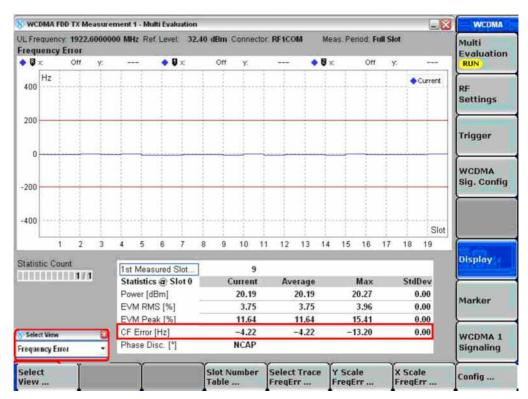


Fig. 10: Frequency error measurement result.

The frequency error must not exceed $\pm (0.1 \text{ ppm} + 10 \text{ Hz})$.

Recall TX_meas.dfl, modify the following configurations and establish a CS call:

Config → RF Power Downlink → Output Channel Power (Ior) → -106.0 dBm WCDMA Sig. Config → TPC → Active TPC Setup → All 1

The measurement results are available at: WCDMA Multi Evaluation \rightarrow Display \rightarrow Frequency Error

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2.4 Inner Loop Power Control in the Uplink (3GPP TS 34.121, 5.4.2)

The inner loop power control in the uplink measurement determines the UE transmitter's ability to adjust its output power in accordance with one or more TPC commands received in the downlink. The power control step is the change in the UE transmitter output power in response to a single TPC command, TPC_cmd, which is derived at the UE. The UE transmitter shall change the output power with a step size of 1 dB, 2 dB and 3 dB according to the value of Δ TPC or Δ RP-TPC, in the slot immediately after the TPC_cmd can be derived. An excess error of the inner loop power control decreases the system capacity.

Tables 6 and 7 show the transmitter power control range and the transmitter aggregate power control tolerance respectively. The 3 dB inner loop power control steps are only used in compressed mode; its test procedure is not covered in 3GPP TS 34.121, 5.4.2.

Transmitte	Transmitter power control range									
TPC_cmd	Transmitter power control range (all units are in dB)									
	1 dB st	ep size	2 dB st	ep size	3 dB step size					
	Lower	Upper	Lower	Upper	Lower	Upper				
+1	+0.4	+1.6	+0.85	+3.15	+1.3	+4.7				
0	-0.6	+0.6	-0.6	+0.6	-0.6	+0.6				
-1	-0.4	-1.6	-0.85	-3.15	-1.3	-4.7				

Table 6: Transmitter power control range (Table 5.4.2.5.1 of 3GPP TS 34.121 [1]).

	Transmitter aggregate power control tolerance									
TPC_cmd group	Transmitter p TPC_cmd gro (all units are	•	Transmitter p control range equal TPC_ct (all units are	e after 7 md groups						
3	1 dB st	ep size	2 dB st	ep size	3 dB st	ep size				
	Lower	Upper	Lower	Upper	Lower	Upper				
+1	+7.7	+12.3	+15.7	+24.3	+15.7	+26.3				
0	-1.1	+1.1	-1.1	+1.1	-1.1	+1.1				
-1	-7.7	-12.3	-15.7	-24.3	-15.7	-26.3				
0,0,0,0,+1	+5.7 +14.3		1 +5.7 +14.3 N/A N/A		N/A	N/A	N/A			
0,0,0,0,-1	-5.7	-14.3	N/A	N/A	N/A					

Table 7: Transmitter aggregate power control tolerance (Table 5.4.2.5.2 of 3GPP TS 34.121 [1])

Fig. 11 shows the inner loop power control test steps. Table 8 summarizes the test step conformance requirement.

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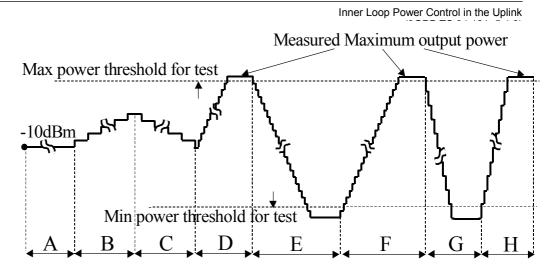


Fig. 11: The inner loop power control test steps (Fig. 5.4.2.4 of 3GPP TS 34.121 [1]).

Inner Loop Power Control in the Uplink (3GPP TS 34.121, 5.4.2)

Summ	nary of the test step conformance r	equirement
Test step	Difference in mean power between adjacent slots	Change in mean power over consecutive slots
А	TPC_cmd = 0	TPC_cmd group = 0 for 10 consecutive slots
В	Every 5 th TPC command should have TPC_cmd = +1 with a step size = 1 dB; all others should have TPC_cmd = 0	TPC_cmd group = {0, 0, 0, 0, +1} for 50 consecutive slots
С	Every 5 th TPC command should have TPC_cmd = -1 with step size = 1 dB; all others should have TPC_cmd = 0	TPC_cmd group = {0, 0, 0, 0, -1} for 50 consecutive slots
D	The power control algorithm is set to Algorith maximum output power	m 1 with a TPC step size of 1 dB and measured
E	TPC_cmd = -1 with step size = 1 dB between the min power threshold and the max power threshold derived from the measured maximum output power in Test Step D (Note 1)	TPC_cmd group = -1 with step size = 1 dB for 10 consecutive slots between the min power threshold and the max power threshold derived from the measured maximum output power in Test Step D (Note 2)
F	TPC_cmd = +1 with step size = 1 dB between the min power threshold and the max power threshold derived from the measured maximum output power in Test Step F (Note 1)	TPC_cmd group = +1 with step size = 1 dB for 10 consecutive slots between the min power threshold and the max power threshold derived from the measured maximum output power in Test Step F (Note 2)
G	TPC_cmd = -1 with step size = 2 dB between the min power threshold and the max power threshold derived from the measured maximum output power in Test Step F (Note 1)	TPC_cmd group = -1 with step size = 2 dB for 10 consecutive slots between the min power threshold and the max power threshold derived from the measured maximum output power in Test Step F (Note 2)
Н	TPC_cmd = +1 with step size = 2 dB between the min power threshold and the max power threshold derived from the measured maximum output power in Test Step G (Note 1)	TPC_cmd group = +1 with step size = 2 dB for 10 consecutive slots between the min power threshold and the max power threshold derived from the measured maximum output power in Test Step G (Note 2)

Notes:

1. The lower step size requirement does not apply for the power step adjacent to the min or max power threshold for the test.

2. The power step adjacent to the min or max power threshold for the test should not be part of the 10 consecutive slots.

Table 8: Summary of test step conformance requirement (summary of 5.4.2.5 in 3GPP TS 34.121 [1]).

Set up a WCDMA call as specified in section 2.1.

The measurement results for the inner-loop TPC in the uplink are available in the "WCDMA TPC Meas" measurement application in the R&S[®]CMW500. This application can be activated by pressing the "Measure" hardkey.

Configuration in the R&S[®]CMW500: Tasks → WCDMA TPC Meas

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Inner Loop Power Control in the Uplink (3GPP TS 34.121, 5.4.2)

Configuration in the "WCDMA TPC Meas" application: WCDMA TPC Meas \rightarrow Config \rightarrow Scenario \rightarrow Combined Signal Path WCDMA TPC Meas \rightarrow Config \rightarrow Controlled by \rightarrow WCDMA Sig.

For the "WCDMA TPC Meas" application, the trigger source is automatically set to "TPC Trigger," which is required for the TPC measurement.

The required TPC pattern to be tested and the related settings can be set under the "Measurement Control" item available in the "Config" menu. The following example shows configurations made for Test Step E.

Configuration in the R&S[®]CMW500: WCDMA TPC Meas \rightarrow Config \rightarrow Measurement Control \rightarrow Inner Loop Power \rightarrow TPC

Auto Execute [\land] WCDMA TPC Meas \rightarrow TPC Setup \rightarrow TPC Test Step E WCDMA TPC Meas \rightarrow Press the **ON/OFF** hardkey [to initiate the measurement]

Inner Loop Power Control in the Uplink (3GPP TS 34.121, 5.4.2)

Frequency:	1922.6	000000	MHz	Ref. Level:	-7.00 dBm	Conne	ector. RF1C	OM	Mode: Me	onitor		TPC
◆Ũ ×: ◆Ũ ×:	Off Off	y: y:		◆0 × ◆0 ×		y: y:		◆♥ x ◆♥ x	Off	у. У.		Meas.
30 dBm												RF Settings
10 0 10												
20 30 40											Slot	Trigger
4 dB												WCDMA Sig. Confi
0												
4	30		0	70	90 110		30 15	0 17	0 19	0 21	Slot	Display
Josed Loo JE Power [c	р		ių.	10				dimum	0 13	2	Minimun	Marker
Source WCDMA S	ig1: TP	C Trigg	let		8							WCDMA 1 Signaling
rigger	Tri	ager		Trigger	Trigge		Trigge	r	Minimur	'nΥ		Config

Fig. 12: Configuring the trigger mode.

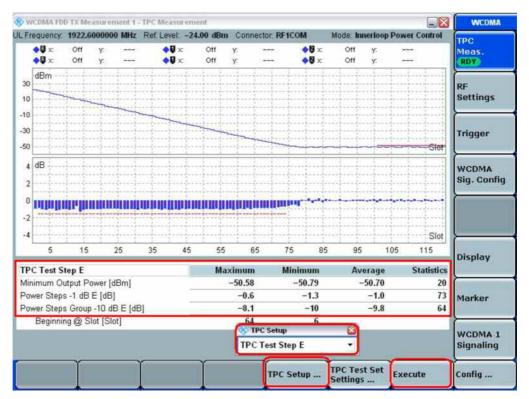


Fig. 13: TPC Measurement results for TPC Pattern E.

For TPC Test Step E, the difference in mean power between adjacent slots shall be within the prescribed range given in Table 6 for a TPC_cmd of -1 and a step size of 1 dB.

Furthermore, the change in mean power over 10 consecutive slots shall be within the prescribed range for a TPC_cmd group of -1, and a step size of 1 dB as specified in Table 7.

Recall TX_meas.dfl and establish a CS call. Modify the following configurations:
Tasks → WCDMA TPC Meas
WCDMA TPC Meas → Config → Scenario → Combined Signal Path WCDMA TPC Meas → Config → Controlled by → WCDMA Sig.
WCDMA TPC Meas → Config → Measurement Control → Inner Loop Power → TPC Auto Execute [\]
WCDMA TPC Meas → TPC Setup → TPC Test Step E
WCDMA TPC Meas → Press the ON/OFF hardkey [to initiate the measurement]

2.5 Minimum Output Power (3GPP TS 34.121, 5.4.3)

The UE's minimum output power arises when the power control setting is set to a minimum value, i.e. when both the inner-loop and open-loop power control indicate that a minimum transmit output power is required. An excess minimum output power increases interference with other channels and decreases the system capacity. The minimum output power is defined as the mean power in one timeslot. The minimum transmit power shall be less than –49 dBm.

A WCDMA call is setup as specified in section 2.1. A continuously DOWN power control command is sent to the UE, and the UE's mean power is measured. In the R&S[®]CMW500, continuously DOWN power control commands can be configured by setting the "Active TPC Setup" to "All 0" in the TPC tab available in the "WCDMA Sig. Config" tab.

Configuration in the R&S[®]CMW500: Tasks \rightarrow WCDMA Multi Evaluation \rightarrow Display \rightarrow UE Power WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow All 0 WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Alg. /Step size \rightarrow Alg2_1dB

	equenc ower	y: 1922,	600000	0 MHz	Ref. Le	/el: -2-	4.00 dBn	I Connec	tor: RF1CO	M	Mea	as. Pei	riod. F	ull Sic	ot		Multi Evaluation
Q	x:	Off	y:	Passaro	٠	0×	Off	- Y:	12902	- 7	• 0 ×	8	Off	Y:) P	anare	RDY
56	dBm									-				-	•••	urrent	RF Settings
58																	Sectings
60																	Trigger
62																	WCDMA Siq. Confid
64	(*****						44		<u> </u>	-			-				oig. comi
- 1	1	ŝ.	- (8 8	1 1	1	- 24	9 9	8	R 8 -	- 81			÷.	1	18	1	ſ
66		TPC							8								
57.65		-	e TPC 1	Setup	All	0											Display
57.65		-	e TPC S	Setup	1.000	0 econd.	Exec	ute								Slot	Display
2722	1	Activ TPC 9 TPC 0	e TPC S State Conditi	on	Pre	econd. Powe		ute		13	14	15	16	17	18	Slot 19	
68	1 stic Co	Active TPC 9 TPC 0 Alg. /	e TPC S State Conditi Step S	on Size	Pro Min Alg	econd. Powe 2_1dB	er T			13	14	15	16	17		Post-row 6	Display
66 68		Activ TPC TPC Alg. /	e TPC State State Conditi Step S Defined	on Size d Patt	Pre Min Alg	econd. Powe 2_1dB			· · · · · · · · · · · · · · · · · · ·	13 13	14	100817	16 ax		18 StdDev	19	
68		Activ TPC 9 TPC 9 Alg. / User Preco	e TPC S State Conditi Step S Defined ondition	on Size d Patt n	Pre Min Alg 000 Non	econd. Powe 2_1dB 000000	er T		2 2 era -60	nge .64	14	M -60.	ax 61		StdDev 0.02	19	
68		Activ TPC 9 TPC 9 Alg. / User Preco	e TPC State State Conditi Step S Defined	on Size d Patt n	Pre Min Alg	econd. Powe 2_1dB 000000	er T		2 era	nge .64	14	M	ax 61		StdDev	19	Marker

Fig. 14: Settings for the minimum output power measurement result.

Fig. 15 shows the minimum output power measurement results.

Occupied Bandwidth (3GPP TS 34.121, 5.8)

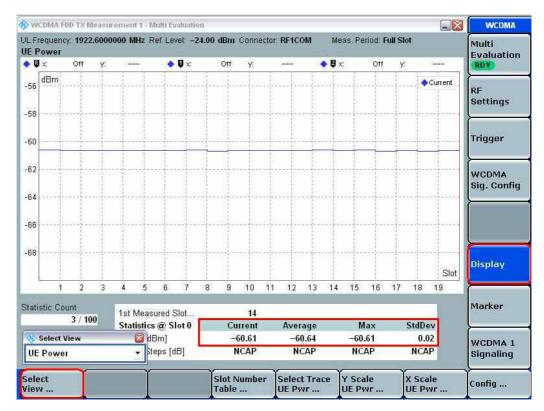


Fig. 15: Minimum output power measurement results.

The measured mean power must be less than -49 dBm.

Recall Tx_meas.dfl and establish a CS call. Change the Active TPC Setup to "All 0": WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow All 0

The measurement results are available here: Tasks \rightarrow WCDMA Multi Evaluation \rightarrow Display \rightarrow UE Power

2.6 Occupied Bandwidth (3GPP TS 34.121, 5.8)

The occupied bandwidth (OBW) measurement determines the bandwidth containing 99% of the total integrated power of the transmitted spectrum, centered on the assigned channel frequency. The measured occupied bandwidth shall not exceed 5 MHz. Excess occupied channel bandwidth increases interference with other channels or with other systems.

A WCDMA call is setup as specified in section 2.1. A continuously UP power control command is sent to the UE until the UE output power is at the maximum level, as shown in Fig. 8.

The measurement results for the occupied bandwidth is available in the Emission Mask view in the WCDMA Multi Evaluation application.

Configuration in the R&S[®]CMW500:

WCDMA Multi Evaluation \rightarrow Display \rightarrow Select View \rightarrow Emission Mask WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Alg./Step size \rightarrow Alg2_1dB Config \rightarrow WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow All 1

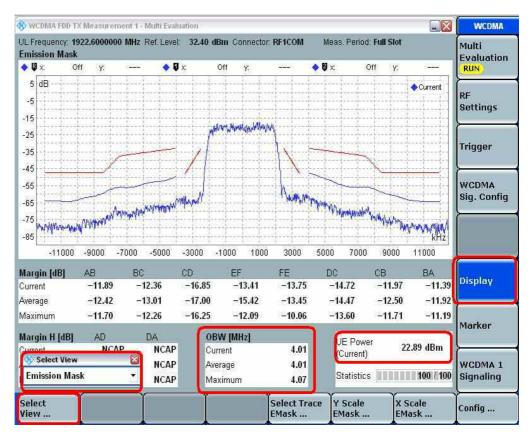


Fig. 16 shows results from an occupied bandwidth measurement.

Fig. 16: Occupied bandwidth measurement results.

The measured OBW must not exceed 5 MHz.

Recall TX_meas.dfl and establish a CS call. Modify the following configurations: $WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow All 1$ $WCDMA Sig. Config \rightarrow TPC \rightarrow Alg. /Step size \rightarrow Alg2_1dB$

The measurement results are available here: Menus \rightarrow Spectrum \rightarrow Application \rightarrow ACLR FFT/OBW

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2.7 Spectrum Emission Mask (3GPP TS 34.121, 5.9)

The spectrum emission mask measures the out-of-channel emissions relative to the UE carrier's RRC filtered mean power between 2.5 MHz and 12.5 MHz away from the UE's center carrier frequency. Excess emission increases the interference with other channels or with other systems. Tables 9, 10, 11 and 12 show the spectrum emission mask requirements and additional spectrum emission limits. Δf is the separation between the carrier frequency and the center of the measurement bandwidth.

Spectrum e	Spectrum emission mask requirement								
Δf in MHz	Minimum requirem	ent	Measurement bandwidth						
	Relative requirement	Absolute requirement							
2.5 to 3.5	$\left\{-33.5 - 15 \cdot \left(\frac{\Delta f}{MHz} - 2.5\right)\right\} dBc$	–69.6 dBm	30 kHz						
3.5 to 7.5	$\left\{-33.5 - 1 \cdot \left(\frac{\Delta f}{MHz} - 3.5\right)\right\} dBc$	–54.3 dBm	1 MHz						
7.5 to 8.5	$\left\{-37.5 - 10 \cdot \left(\frac{\Delta f}{MHz} - 7.5\right)\right\} dBc$	–54.3 dBm	1 MHz						
8.5 to 12.5	-47.5 dBc	–54.3 dBm	1 MHz						

Table 9: Spectrum emission mask requirements (Table 5.9.2 of 3GPP TS 34.121 [1]).

Additional spectrum emission limits for Bands II, IV, X						
Δf in MHz	Frequency offset of measurement Additional requirements Measurement bandwid filter center frequency, f_offset Bands II, IV, X Measurement bandwid					
$2.5 \text{ MHz} \leq \Delta f < 3.5 \text{ MHz}$	2.515 MHz \leq f_offset < 3.485 MHz	–15 dBm	30 kHz			
$3.5 \text{ MHz} \leq \Delta f \leq 12.5 \text{ MHz}$	4.0 MHz \leq f_offset < 12.0 MHz	–13 dBm	1 MHz			

Table 10: Additional spectrum emission limits for Bands II, IV, X (Table 5.9.2A of 3GPP TS 34.121 [1])

Additional spectrum emission limits for Band V							
Δf in MHz	Δf in MHz Frequency offset of measurement Additional requirements Measurement bandw filter center frequency, f_offset Band V Band V						
2.5 MHz $\leq \Delta f$ < 3.5 MHz	2.515 MHz \leq f_offset < 3.485 MHz	–15 dBm	30 kHz				
$3.5 \text{ MHz} \leq \Delta f \leq 12.5 \text{ MHz}$	3.55 MHz \leq f_offset < 12.45 MHz	–13 dBm	100 kHz				

Table 11: Additional spectrum emission limits for Band V (Table 5.9.2B of 3GPP TS 34.121 [1])

Additional spectrum emission limits for Bands XII, XIII, XIV							
Δf in MHz	Frequency offset of measurement Additional requirements Measurement bandwidth filter center frequency, f_offset Band XII, XII, XIV						
$2.5 \text{ MHz} \le \Delta f < 2.6 \text{ MHz}$							
$2.6 \text{ MHz} \leq \Delta f \leq 12.45 \text{ MHz}$	2.65 MHz \leq f_offset < 12.45 MHz	–13 dBm	100 kHz				

 Table 12: Additional spectrum emission limits for Bands XII, XIII, XIV (Table 5.9.2C of 3GPP TS 34.121

 [1])

Spectrum Emission Mask (3GPP TS 34.121, 5.9)

A WCDMA call is setup as specified in section 2.1. A continuously UP power control command is sent to the UE until the UE output power reaches the maximum level as shown in Fig. 8.

The measurement results for the spectrum emission mask are available in the Emission Mask view under "WCDMA Multi Evaluation."

Configuration in the R&S[®]CMW500:

Config → WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Active TPC Setup → All 1 Config → WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Alg./Step size → Alg2_1dB

Tasks \rightarrow WCDMA Multi Evaluation \rightarrow Display \rightarrow Select View \rightarrow Emission Mask

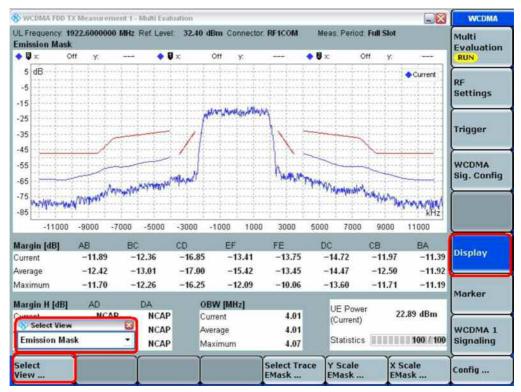


Fig. 17 shows the spectrum emission mask measurement results.

Fig. 17: Spectrum emission mask measurement results.

The spectrum measured for the UL Tx signal from the UE must meet the requirements specified in Table 9.

Adjacent Channel Leakage Power Ratio (3GPP TS 34.121, 5.10)

Recall TX_meas.dfl and establish a CS call. Modify the following configurations: Config \rightarrow WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow All 1

The measurement results are available here: Menus \rightarrow Spectrum \rightarrow Application \rightarrow Emission Mask

2.8 Adjacent Channel Leakage Power Ratio (3GPP TS 34.121, 5.10)

The adjacent channel leakage power ratio (ACLR) is defined as the ratio of the RRC filtered mean power centered on the assigned channel frequency to the RRC filtered mean power centered on an adjacent channel frequency. Excess ACLR increases interference with other channels or with other systems.

If the measured first and second adjacent channel RRC filtered mean power is greater than –50.0 dBm, the ratio of the power between the RRC filtered mean power centered on the assigned channel frequency to the RRC filtered mean power centered on an adjacent channel frequency must be higher than the limits specified in Table 13.

UE ACLR	UE ACLR							
Power Class	UE channel	ACLR limit						
3	+5 MHz or –5 MHz	32.2 dB						
3	+10 MHz or -10 MHz	42.2 dB						
4	+5 MHz or –5 MHz	32.2 dB						
4	+10 MHz or –10 MHz	42.2 dB						

Table 13: UE ACLR (Table 5.10.2 of 3GPP TS 34.121 [1])

A WCDMA call is setup as specified in section 2.1. A continuously UP power control command is sent to the UE until the UE output power reaches the maximum level as shown in Fig. 8.

The ACLR measurement results are available in the ACLR View in the WCDMA Multi Evaluation measurement. By default, the R&S[®]CMW500 reads the absolute power values for the "adj" and "alt" channels. By changing the unit, the displayed value can be changed to read relative power to the carrier.

Configuration in R&S[®]CMW500: Tasks \rightarrow WCDMA Multi Evaluation \rightarrow Display \rightarrow Select View \rightarrow ACLR WCDMA Multi Evaluation \rightarrow Select Unit ACLR... \rightarrow dB

Fig. 18 shows the ACLR measurement results.

Adjacent Channel Leakage Power Ratio (3GPP TS 34.121, 5.10)

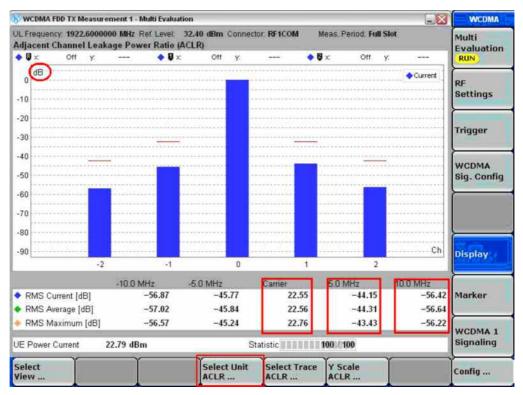


Fig. 18: Measurement results for the UE's ACLR.

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1CM71_2E

The measurement results obtained for UE Power Class 3 are shown in Fig. 18. The results must not exceed the limits specified in Table 13.

Recall TX_meas.dfl and establish a CS call. Modify the following configurations: Config \rightarrow WCDMAMulti Evaluation \rightarrow WCDMA Sig. Config \rightarrow Active TPC Setup

 \rightarrow All 1

The measurement results are available here: Tasks \rightarrow WCDMA Multi Evaluation \rightarrow Display \rightarrow Select View \rightarrow ACLR

2.9 Error Vector Magnitude (3GPP TS 34.121, 5.13.1)

The error vector magnitude (EVM) measures the difference between the reference waveform and the measured waveform. Both waveforms pass through a matched root raised cosine filter with a bandwidth of 3.84 MHz and a roll-off of $\alpha = 0.22$. They are further modified by selecting the frequency, absolute phase, absolute amplitude and chip clock timing so as to minimize the error vector. The EVM result is defined as the square root of the ratio of the mean error vector power to the mean reference power, expressed as a percentage. An excess EVM increases transmission errors in the uplink channel.

The test needs to be carried out at two test points:

- i) When the UE transmits at its maximum power
- ii) When the UE transmits at -18 dBm

The EVM shall not exceed 17.5 % for the parameters specified in Table 14.

Test parameters for EVM								
Parameter	Level / Status	Unit						
Output power	≥-20	dBm						
Operating conditions	Normal conditions							
Power control step size	1	dB						

Table 14: Test parameters for EVM (Table 5.13.1 of 3GPP TS 34.121 [1])

<u>Case (i):</u>

A WCDMA call is setup as specified in section 2.1. A continuously UP power control command is sent to the UE until the UE output power reaches its maximum level as shown in Fig. 8. Then the EVM is measured.

Configuration in the R&S[®]CMW500:

Tasks \rightarrow WCDMA Multi Evaluation \rightarrow Display \rightarrow Select View \rightarrow EVM WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow All 1

Case (ii):

The EVM measurement should be repeated at the UE power level of -18 dBm.

Configuration in the R&S[®]CMW500:

WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow Closed Loop WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Alg. Step Size \rightarrow Alg 1_1dB

WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Configuration \rightarrow Target –18.0 dBm

WCDMA Multi Evaluation \rightarrow Display \rightarrow Select View \rightarrow EVM

Error Vector Magnitude (3GPP TS 34.121, 5.13.1)

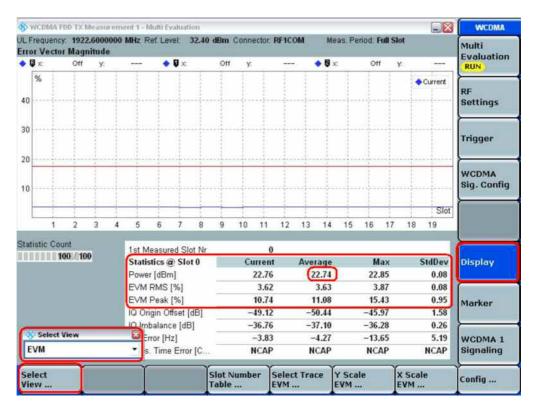


Fig. 19 shows the EVM measurement results for a UE transmitting at its maximum power.

Fig. 19: EVM measurement results for a UE transmitting at its maximum power.

Fig. 20 shows the EVM measurement result for a UE transmitting at -18 dBm.

Error Vector Magnitude (3GPP TS 34.121, 5.13.1)

v			N. La Contraction	ment 1 - M	Contra no	e anne art.								_					WCDMA
				0 MHz Re	f Level:	-5.00) dBm	Conn	ector: I	RF1C	MO		Mea	s.Pe	riod. F	ull Sk	ĸ		Multi
• 🖗		Off	y:		• 0	×	011	y.		- 177	•	٠	Ø×		Of	r y	¢	: जनक	Evaluation RUN
40	%	-																Current	RF Settings
30		-																	Trigger
0																			WCDMA Sig. Config
t	1	2	3 4	5	6 7	8	9	10	11	12	13		14	15	16	17	18	Slot 19	
atis	stic Cour	🚯 TP	¢						1	×								-	<u> </u>
		Activ	e TPC	Setup	Close	d Loop	,		•		Are					ax		StdDev	Display
		TPC	State		Precond. Execute					Average M -18.07 -16						bispiay			
		TPC Condition TargetPowerLocked							3.9		3.90 4.1		11	0.06					
		Alg.	Step 9	Size	Alg1_	1dB ▼					11.40					1.12	Marker		
		User Defined Patt 00000000001111111111								-39.47 -33.38		-38.06			0.64				
			onditio iguratio		None	t – 18.0	dBm				-33.56		27.0		-33.06			4.38	WCDMA
		Com	iguraud	20	rarge	(-10.0	uom	J				NCAP		NCAP			NCAP	Signaling	
			hysical ettings		РС				ļ	ISDF	PA		Y			Ť			Config

Fig. 20: EVM measurement results for a UE transmitting at –18 dBm.

In addition to the EVM results, one can have a complete summary of all the Tx characteristics – such as the magnitude error, phase error, frequency error, IQ imbalance, OBW, etc. – at once, in the Tx Measurement (scalar) view.

Configuration in the R&S[®]CMW500:

WCDMA Multi Evaluation \rightarrow Display \rightarrow Select View \rightarrow Tx Measurement (Scalar)

Error Vector Magnitude (3GPP TS 34.121, 5.13.1)

1st Measured Slot Num 0								
Statistics @ Pre. Slot 0	Current	Average	Max	StdDev	Settings			
Power [dBm]	22.75	22.75	22.97	0.04				
Power Steps [dB]	NCAP	NCAP	NCAP	NCAP	Trigger			
EVM RMS [%]	3.55	3.63	3.84	0.07	rigger			
EVM Peak [%]	10.25	11.08	14.48	0.95				
Magnitude Error RMS [%]	1.93	1.89	2.00	0.03	WCDMA			
Magnitude Error Peak [%]	6.57	6.06	7.37	0.40	Sig. Config			
Phase Error RMS [°]	1.71	1.78	1.90	0.05				
Phase Error Peak [°]	-5.87	6.28	-8.33	0.56				
IQ Origin Offset [dB]	-58.66	-57.55	-50.09	4.34				
Q Imbalance [dB]	-37.10	-37.03	-36.29	0.25	L			
CF Error [Hz]	1.70	1.89	-11.46	2.15	-			
Trans. Time Error [Chip]	NCAP	NCAP	NCAP	NCAP	Display			
Phase Disc. [°]	NCAP		In call Marcola					
OBW [MHz]	4.01	4.01	4.07		1			

Fig. 21: Results of a scalar Tx measurement.

The measured EVM must not exceed 17.5 %

For UE maximum output power, recall TX_meas.dfl and establish a CS call. Modify the following configurations: $WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow All 1$ For UE output power = -18 dBm, recall TX_meas.sav and establish a CS

call. Modify the following configurations: $WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow Closed Loop$ $WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Alg. Step Size \rightarrow Alg 1_1dB$

WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Configuration \rightarrow Target –18.0 dBm

The measurement results are available here: WCDMA Multi Evaluation \rightarrow Display \rightarrow Select View \rightarrow Tx Measurement (Scalar)

2.10 Peak Code Domain Error (3GPP TS 34.121, 5.13.2)

The peak code domain error is computed by projecting the power of the error vector onto the code domain with a specific spreading factor. The code domain error for every code in the domain is defined as the ratio of the mean power of the projection onto that code to the mean power of the composite reference waveform, expressed in dB. The peak code domain error is defined as the maximum value for the code domain error for all codes. An excess peak code domain error increases transmission errors in the uplink channel.

The peak code domain error shall not exceed -14 dB for the parameters specified in Table 15. The requirements and this test apply only to the UE in which the multi-code DPDCH transmission is provided.

Test parameters for peak code domain error							
Parameter	Level / Status	Unit					
Operating conditions	Normal conditions						
Uplink signal	Multi-code						
Information bit rate	2*384	Kbps					
Power control step size	1	dB					

Table 15: Test parameters for peak code domain error (Table 5.13.4 of 3GPP TS 34.121 [1]).

The R&S[®]CMW500 supports a single DPDCH code.

A WCDMA call needs to be set up with a 384 kbps UL RMC. The test shall be carried out at two test points:

i) UE transmitting at its maximum power

ii) UE transmitting at -18 dBm

Case (i):

Configuration in the R&S[®]CMW500: WCDMA-UE Signaling \rightarrow Connection Setup \rightarrow UE term Connect \rightarrow RMC WCDMA-UE Signaling \rightarrow Connection Setup \rightarrow RMC Data rate \rightarrow 384 kbps DL / UL*

As specified in section 2.1, physical downlink channels can be configured in the R&S[®]CMW500 by referring to Fig. 3.

To establish a WCDMA connection, press "Connect UE (CS)" on the R&S[®]CMW500 once the UE has registered with the R&S[®]CMW500.

A continuously UP power control command is sent to the UE until the UE output power reaches its maximum level as shown in Fig. 8. Then the peak code domain error is measured.

Configuration in the R&S[®]CMW500: WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow All 1

The measurements result for the peak code domain error are available in the "CD Monitor" view under "WCDMA Multi Evaluation."

Configuration in the R&S[®]CMW500:

Peak Code Domain Error (3GPP TS 34.121, 5.13.2)

WCDMA Multi Evaluation \rightarrow Display \rightarrow Select View \rightarrow CD Monitor WCDMA Multi Evaluation \rightarrow Display \rightarrow Select Trace CD Monitor \rightarrow CDE (I-signal and Q-signal)

WCDMA Multi Evaluation \rightarrow Config \rightarrow Measurement Control \rightarrow Modulation / CDP \rightarrow CDP Spreading Factor \rightarrow SF4

Case (ii):

The peak code domain error measurement shall be repeated at a UE power level of -18 dBm.

Configuration in the R&S[®]CMW500:

WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow Closed loop

WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Alg. Step size \rightarrow Alg2_1dB

WCDMA Multi Evaluation \rightarrow WCDMA Sig. Config \rightarrow TPC \rightarrow Configuration \rightarrow Target –18.0 dBm

🚸 WCDMA Multi Evaluation Configuration 🛛 🛛											
Path: Measurement Control/Modulation / CDP/CDP Spreading Factor											
₽-Measurement Control				1	Evaluation RUN						
Repetition	-Repetition Continuous -										
-Stop Condition	None 🔻	None 👻									
Measure on Exception	0				RF Settings						
	20 Slot										
Preselected Slot	0										
Synchronisation	Any Slot -				Trigger						
⊟-List Mode	and the second s				<u> </u>						
Enable											
Offline Segment Nr. 1											
B-Modulation / CDP					<u> </u>						
-Measurement Period	Full Slot -										
-Statistic Count	100										
-Detection Mode	Auto 3GPP Signa	1 T 100			<u> </u>						
-Analysis Mode	With Origin Offset				Plantan.						
-Chn. Detect Threshold	-16.0 dB	<u> </u>			Display						
- Slot Number (Table)	0										
CDP Spreading Factor	SF 4 -				Marker						
CDP Power Reference	UE Power										
Rotation	0 *										
⊕-Spectrum				-	WCDMA 1 Signaling						
m oro					orginaling						
Select View	Slot Number Table	Select Trace CDE	Y Scale CDE	X Scale CDE	Config						

Fig. 22: Configuring the peak code domain measurement.

Peak Code Domain Error (3GPP TS 34.121, 5.13.2)

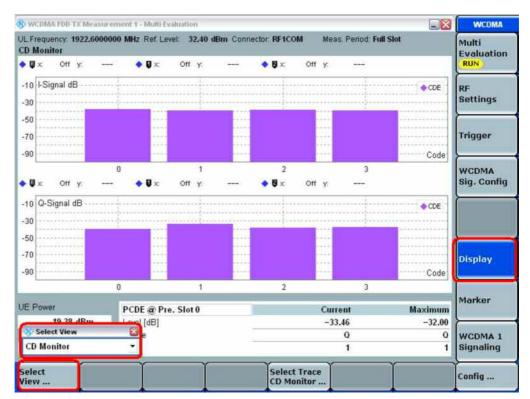


Fig. 23: ACLR test results.

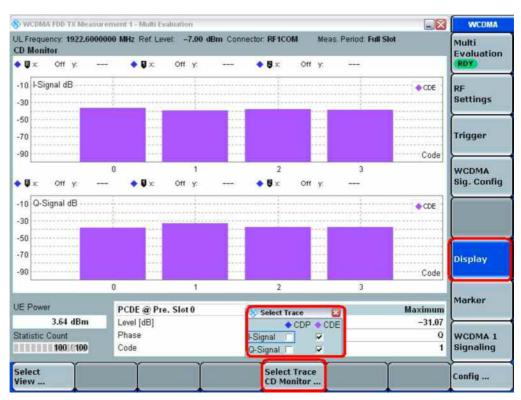
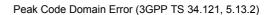


Fig. 24: Display mode configuration.



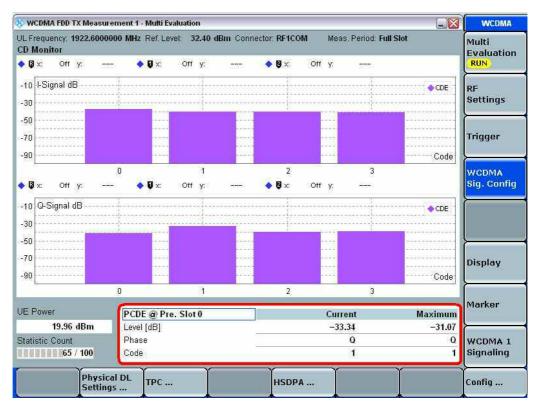


Fig. 25: Peak code domain error result for UE transmitting at its maximum power.

Fig. 25 shows the peak code domain error measurement results for a UE transmitting at its maximum power.

Peak Code Domain Error (3GPP TS 34.121, 5.13.2)

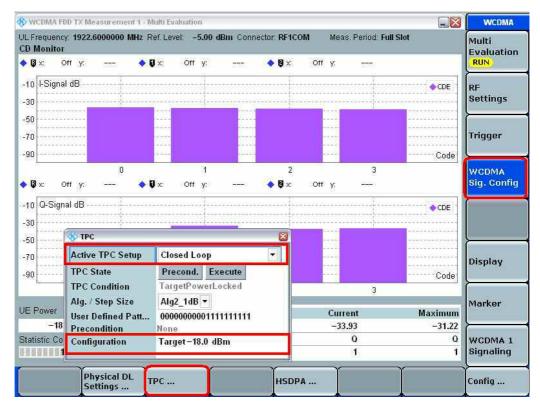
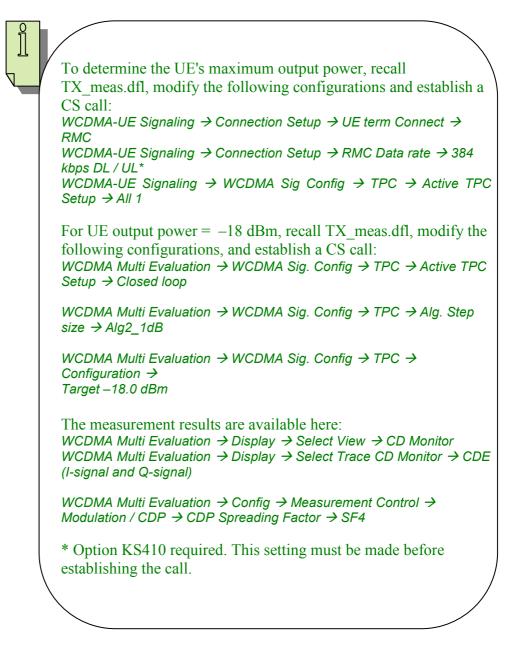


Fig. 26: Peak code domain error measurement results at –18 dBm.

The peak code domain error measured as described above must not exceed -14 dB.

Peak Code Domain Error (3GPP TS 34.121, 5.13.2)



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Phase discontinuity is the change in phase between any two adjacent timeslots. It is defined as the difference between the absolute phase used to calculate the EVM for the preceding timeslot and the absolute phase used to calculate the EVM for the succeeding timeslot.

For this test, any timeslot used to calculate a phase discontinuity result must also meet the requirements for the frequency error and the EVM. None of the EVMs for any measured slot that is greater than or equal to -20 dBm is allowed to exceed 17.5 %. None of the frequency errors for any measured slot is allowed to exceed $\pm(0.1 \text{ ppm} + 10 \text{ Hz})$. The phase discontinuity measurements made between any two adjacent slots must be less than or equal to 36 degrees. If a phase discontinuity measurement is greater than 36 degrees and less than or equal to 66 degrees, the next four measurements shall be less than or equal to 36 degrees. No measurement may exceed 66 degrees.

First, a WCDMA call is setup as specified in section 2.1. Then a continuously UP power control command is sent to the UE until the UE output power reaches its maximum level as shown in Fig. 8. A sequence of TPC commands in a five-down, four-up pattern (as shown in Fig. 27) is sent until the UE has reached the minimum power specified in section 2.5 with a ± 2 dB tolerance. The EVM for each slot and the phase discontinuity to the next slot are measured. A sequence of five up and four down TPC commands (as shown in Fig. 28) is sent until the UE has reached its maximum power as specified in section 2.2, with ± 2 dB tolerance.

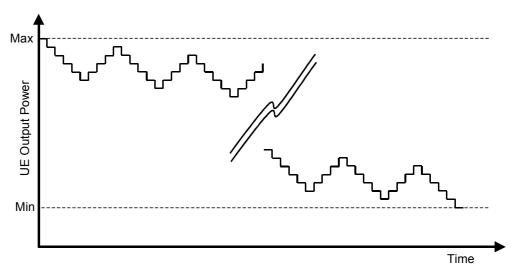


Fig. 27: Five down, four up hysteresis test pattern (Fig. 5.13.3.4 of 3GPP TS 34.121 [1]).

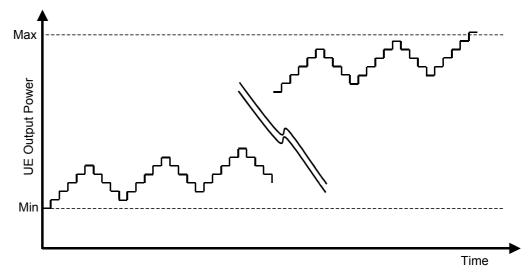


Fig. 28: Five up, four down hysteresis test pattern (Fig. 5.13.3.5 of 3GPP TS 34.121 [1]).

In order to measure the entire dynamic range between the min power threshold and max power threshold, power control sequences can be segmented into smaller subsequences. Except when within 5 dB of the upper and lower thresholds, segmentation will require sufficient overlap so that every power step in one direction is followed by four steps in the other direction.

As shown in the example below for measuring the down-phase discontinuity, sequence of 9 TPC bits (5 down and 4 up) is used in a single measurement and then repeated until the UE reaches its minimum power. The measurement shall be restarted, and then triggered each time by pressing the "Execute" tab.

The measurement results for UE phase discontinuity are available in the WCDMA Multi Evaluation application's "Phase Discont." view.

Here is the basic configuration before starting the test:

Tasks → WCDMA Multi Evaluation → Assign Views → Select UE Power and Phase Discontinuity WCDMA Multi Evaluation → Repetition → Single Shot WCDMA Multi Evaluation → Statistic Count → Modulation → 1 WCDMA Multi Evaluation → Measurement Length → 46 slots (up to 120 slots) WCDMA Multi Evaluation → Trigger → Trigger Source → WCDMA TPC Trigger

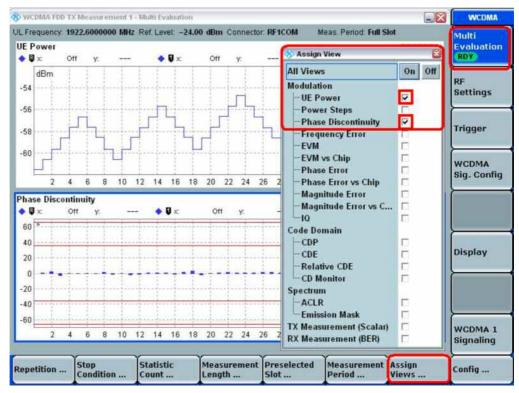


Fig. 29: Configuring the display mode.



Fig. 30: Configuring the display mode for phase discontinuity.

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The phase discontinuity test pattern can be activated by performing the steps listed below.

- Step 1: Tasks → WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Active TPC Setup → Phas Disc Down
- Step 2: WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Alg./Step Size → Alg2_1dB
- Step 3: WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Precondition → Max Power
- Step 4: WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Configuration → 5 x 000001111
- Step 5: WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → TPC State → Execute
- Step 6: Change the precondition to alternating: WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Precondition → Alternating.
- Step 7: Reinitiate the measurement by pressing the "Restart/Stop" hardkey.
- Step 8: Press "Execute" as mentioned in Step 5.

Repeat steps 7 and 8 until the UE reaches its minimum power.



The measurement needs to be restarted by pressing the **Restart/Stop** hardkey. Then press the **Execute** tab in order to activate the selected pattern.

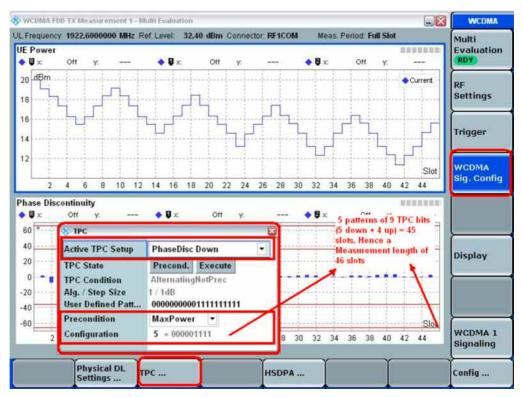


Fig. 31: Configuring the display mode configuration for the "phase discontinuity down" measurement.

WCDMA Multi Evaluation \rightarrow WCDMA Sig Config \rightarrow TPC \rightarrow Precondition \rightarrow Max Power

Here, setting the Precondition \rightarrow "Max Power" for the phase discontinuity down test ensures that the UE is stimulated to reach its maximum power before the "Phase Disc Down" test begins.

Change the precondition to "Min Power" for a "Phase Disc Up"

You can choose the Phase Discontinuity view to get numeric results and simultaneously monitor the EVM and frequency error results for the selected slots.

Display \rightarrow Select View \rightarrow Phase Discontinuity

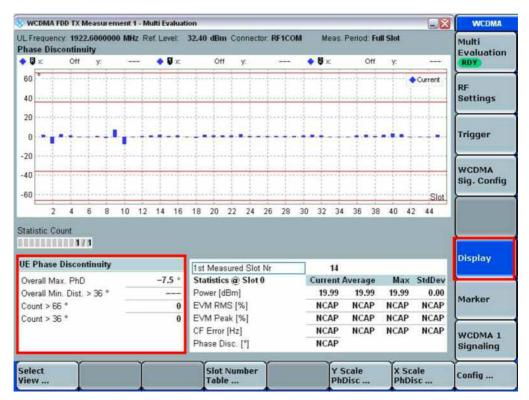


Fig. 32: Results from a phase discontinuity measurement.

The test described above is repeated for "Phase Disc Up" by making the following changes:

- Step 1: Tasks → WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Active TPC Setup → Phas Disc Up
- Step 2: WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Alg./Step Size → Alg1_1dB
- Step 3: WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Precondition → Min Power
- Step 4: WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Configuration → 5 x 000001111
- Step 5: WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → TPC State → Execute
- Step 6: Change the precondition to alternating: WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Precondition → Alternating
- Step 7: Reinitiate the measurement by pressing the "Restart" hardkey.
- Step 8: Press "Execute" as described in Step 5.

Repeat steps 7 and 8 until the UE reaches its maximum power.

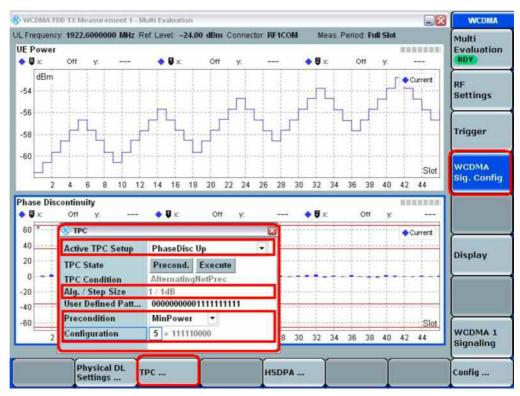


Fig. 33: Configuring a "phase discontinuity up" measurement.

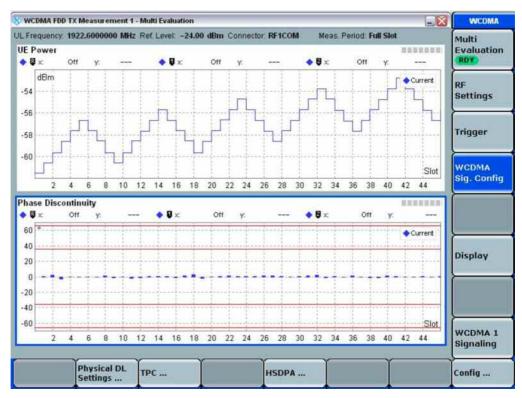


Fig. 34: UE phase discontinuity measurement results.

Fig. 34 shows the measurement results for phase discontinuity that does not exceed the limit of 36 degrees.

Remarks:

Test requirements for phase discontinuity measurements:

1) No EVM for any measured slot that is greater than or equal to -20 dBm may exceed 17.5 %.

2) No frequency error for any measured slot may exceed (0.1 ppm + 10 Hz).
3) The phase discontinuity measurements made between any two adjacent slots must be less than or equal to 36 degrees. If a phase discontinuity measurement is greater than 36 degrees and less than or equal to 66 degrees, the next four measurements must be less than or equal to 36 degrees. No measurement may exceed 66 degrees.

Generic Call Setup for Receiver Characteristics

3 Rel-99 Receiver Characteristics

3.1 Generic Call Setup for Receiver Characteristics

All parameters for receiver characteristics are defined using the DL reference measurement channel (12.2 kbps) as specified in 3GPP TS 34.121, Annex C.3.1, unless stated otherwise.

Configuration in the R&S[®]CMW500: WCDMA-UE Signaling \rightarrow Connection Setup \rightarrow UE term Connect \rightarrow DCH (Dedicated Chn.) Type \rightarrow RMC BS Signal \rightarrow Circuit Switched \rightarrow RMC Settings \rightarrow Reference Channel Type \rightarrow 12.2 kbps Downlink/Uplink

All receiver characteristic parameters are defined using the common RF receiver test conditions as specified in 3GPP TS 34.121, Annex E.3.2, unless stated otherwise. Table 4 (physical downlink channels transmitted during a connection, Table E.3.2.1 of 3GPP TS 34.121[1]) shows the common RF receiver test conditions.

Configuration in the R&S[®]CMW500:

```
BS Signal → Downlink Physical Channels → P-CPICH → -3.3 dB
BS Signal → Downlink Physical Channels → P-CCPCH → -5.3 dB
BS Signal → Downlink Physical Channels → P-SCH → -8.3 dB
BS Signal → Downlink Physical Channels → S-SCH → -8.3 dB
BS Signal → Downlink Physical Channels → PICH → -8.3 dB
```

These downlink physical channels can be configured in the R&S[®]CMW500 by referring to Fig. 3.

Recall RX meas.dfl and establish a CS call.

3.2 Reference Sensitivity Level (3GPP TS 34.121, 6.2)

The reference sensitivity level <REFSENS> is the minimum mean power received at the UE antenna port at which the bit error ratio (BER) shall not exceed 0.001. A lack of reception sensitivity decreases the coverage area at the far side from Node B.

A DL reference measurement channel (12.2 kbps) is setup as specified in section 3.1. The power level of downlink physical channels relative to lor are set up according to Table 16 (downlink physical channels transmitted without dedicated connection, Table E.2.2 of 3GPP TS 34.121[1]). The UE is switched on and a call is setup.

DPCH and lor are setup according to Table 5 (reference sensitivity level, Table 6.2.2 of 3GPP TS 34.121[1]), and the BER is measured.

Reference Sensitivity Level (3GPP TS 34.121, 6.2)

Downlink physical channels transmitted without a dedicated connection					
Physical channel	Power				
lor	Test-dependent power				
CPICH	CPICH_Ec / Ior = -3.9 dB				
P-CCPCH	P-CCPCH_Ec / lor = -8.3 dB				
SCH	SCH_Ec / lor = -8.3 dB				
PICH	PICH_Ec / Ior = -8.3 dB				
SCCPCH	SCCPCh_Ec/lor = -5.3 dB				

Table 16: Downlink physical channels transmitted without a dedicated connection.

Configuration in the R&S[®]CMW500:

WCDMA-UE Signaling \rightarrow Config \rightarrow RF Settings \rightarrow RF Downlink Power (lor) \rightarrow -106 dBm WCDMA-UE Signaling \rightarrow Config \rightarrow Physical Downlink Settings \rightarrow P-CPICH \rightarrow -3.9 dB WCDMA-UE Signaling \rightarrow Config \rightarrow Physical Downlink Settings \rightarrow P-CCPCH \rightarrow -8.3 dB WCDMA-UE Signaling \rightarrow Config \rightarrow Physical Downlink Settings \rightarrow S-CCPCH \rightarrow -5.3 dB WCDMA-UE Signaling \rightarrow Config \rightarrow Physical Downlink Settings \rightarrow P-SCH \rightarrow -11.3 dB WCDMA-UE Signaling \rightarrow Config \rightarrow Physical Downlink Settings \rightarrow S-SCH \rightarrow -11.3 dB WCDMA-UE Signaling \rightarrow Config \rightarrow Physical Downlink Settings \rightarrow P-SCH \rightarrow -11.3 dB WCDMA-UE Signaling \rightarrow Config \rightarrow Physical Downlink Settings \rightarrow PICH \rightarrow -8.3 dB WCDMA-UE Signaling \rightarrow Config \rightarrow Physical Downlink Settings \rightarrow DPDCH Level Config \rightarrow -10.3 dB

WCDMA Signaling Configuration th: RF Settings/RF Power Downlink/Output	it Power (lor)			WCDMA
Output Power (lor)	-106.00 dBm			Go to
AWGN Noise (loc)	-70.00 dBm			
Geometric Factor (lor/loc)				
Total Output Power (lor+loc)	-106.00 dBm			Go to
RF Power Uplink Physical Downlink Settings				
- Accumulated Power	0.00 dB Adjust to 0d	ID		(
				Go to
-OCNS	-6.79 dB Release 99	Sector Contraction of		
-Code Conflict	No Code Conflict Det	ected!		WCDMA
—Code Domain Diagram	Show			Sig. Confi
- Channel Table	Level Code	Symbol Rate		
-P-CPICH	🔽 −3.90 dB 0	15 ksps		
P-CPICH Enhanced				
-S-CPICH	□ -3.30 dB 11	15 ksps		
B-S-CPICH Enhanced	100 000 000 000			ſ
-P-SCH	IZ −11.30 dB			
-S-SCH	IZ −11.30 dB	100 C		(
-P-CCPCH	▼ -8.30 dB 1	15 ksps		
-S-CCPCH	I −5.30 dB 2	60 ksps		
PICH	▼ -8.30 dB 2	15 ksps		
- AICH - AICH Enhanced	₩ -8.30 dB 3	15 ksps		WCDMA-U
-DPCH	▽ -10.30 dB 3	30 ksps		Signaling
	(e) - 10100 UD - 5	an naha		ON
Physical DL TPC	Y Y	SDPA	Ϋ́ Υ	Config

Fig. 35: Configuring downlink physical channels for the Rx sensitivity test.

Set the UE to transmit UL max power, as as shown in Fig. 8, before starting the BER measurement.

The measurement results for the reference sensitivity level is measured in the WCDMA BER application on the R&S[®]CMW500.

Configuration in the R&S[®]CMW500:

Tasks → WCDMA BER

Tasks \rightarrow WCDMA BER \rightarrow Config \rightarrow Limit [To set the limit values for BER as specified in the technical standard]

😽 WCDMA FDD Signaling				WCDMA
Connection Status	Cell Setup Band	Band 1 •		Go to
Cell HSDPA	Dand	Downlink	Uplink	GO TO
Circuit Switched	Channel	10563 Ch	9613 Ch	<u>}</u>
Packet Switched ON	Frequency	2112.6 MHz	1922.6 MHz	Go to
CMW Demod, Info Power In Politice Incom	Output Power	-106.00 dBm		<u> </u>
UE Info	Total Output	-106.00 dBm		Go to
Connection Type Established —Circuit Switched UE terminated RMC Call	Scrambling Cod	de 0 hex	0 hex	
-Packet Switched	PCPICH •	-3.9 dB	Code 0	WCDMA
Registration Identity Type	PS Domain	PS Domain 🔛 Reduced Signaling 🗐		
Registration Identity IMEI	Connection S			
UE Called Number	UE term. Conne	ect RMC		
UE Calling Number CTM Text Telephony (TTY)				
Show UE Capabilities	-			
UE Measurement Report	RMC Data Rate	DL RMC 12.2	B DMC 12.2	
On UTRA FDD (Current Cell) Lower Upper	Second Second Second Second	OL NING TESE	A RANG TELE	<u> </u>
CPICH RSCP (dBm) -109	1			
CPICH Ec/No (dB) -10 -9.5 Log10(TCH BLER) 0 0	Test Mode	Loop Mode 2		
Transmitted UE Power [dBm] -18 -17	HSPA Test Mo	de 🗖		WCDMA-UE
UE RX-TX Time Difference [Chip] 1024 1025 Pathloss [dB] 141				Signaling
WCDMA 1 WCDMA WCDMA Multi Eval. 🚯 BER 🚯 Signaling 🕑				

Fig. 36: Configuring the RMC and establishing a call.

Remarks:

The difference between the PCPICH power value that is set on the R&S[®]CMW500 and the from UE reported value (CPICH RSCP) indicates if the DL pathloss is properly compensated.

This is required in order to ensure accurate measurement results for receiver characteristics such as reference sensitivity.

In the above example, the PCPICH power set on the R&S[®]CMW is –3.9 dB relative to Total Output power (lor), i.e. -106 - 3.9 = -109.9 dBm The CPICH RSCP power reported by the UE is -109 dBm to -110 dBm.

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Reference Sensitivity Level (3GPP TS 34.121, 6.2)

S WCDMA Signaling BER							WCDMA
Connection Status		Cell Setup					
Cell (M) HSDPA		Band	Band 1	•			BER
	and the second second		Downlink		Uplink		RDY
Circuit Switched	II Established	Channel	10563	Ch	9613	3 Ch	
Packet Switched 📩 Att	ached	Frequency	2112.6	MHz	1922.6	5 MHz	
CMW Demod. Info Provet In Patient	11 Some	Output Power	-106.00	dBm			}
		Total Output	-106,00	dBm			
Results BER	0.000 %	Scrambling Cod	le 0	hex	0	hex.	
BLER	0.000 %	DPCH -	· 🛩 −10.3	dB	Code	3	
DBLER	0.000 %	PS Domain 🛛 Reduced Signaling			WCDMA Sig. Config		
Lost Transp. Blocks	0	Connection Se	etup				
UL TFCI Faults	NCAP	UE term. Conne	ect RMC				
FDR	NCAP						
PN Discontinuity	0						<u> </u>
Transport Blocks	100 / 100	RMC					
		Data Rate	DL RMC 1	2.2 1	L RMC 1	2.2	
							<u>}</u>
		2000 C		-			
		Test Mode	Loop Mode	2	12		_
		HSPA Test Mod	ie 🗖				
							WCDMA 1 Signaling
Repetition Stop Condition	Ť	Ť	Ť		Ť		Config

Fig. 37 shows measurement results for a reference sensitivity measurement.

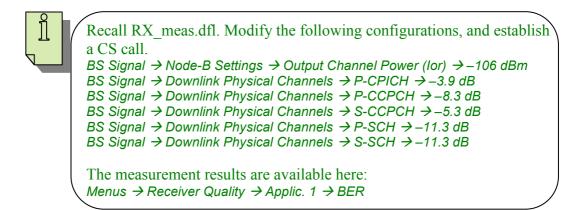
Fig. 37: Reference sensitivity measurement results.

The measured BER shall not exceed 0.001.

Maximum Input Level (3GPP TS 34.121, 6.3)

WCDMA Signaling BER			WCDMA
onn Stranger Strang	2 U.S 2		BER
Acker Stop Condition None Transport Blocks 100 PN Resvnc V 0.1	us 🕶 💌 20 %	Ch MHz hex 0	WCDMA
TFC UL TFCI Faults I 1.0	00 % 00 % 00 %	2 2	Sig. Config
			WCDMA 1 Signaling

Fig. 38: The user can define tolerance limits for BER measurements.



3.3 Maximum Input Level (3GPP TS 34.121, 6.3)

The maximum input level is defined as the maximum mean power received at the UE antenna port, for which BER shall not exceed 0.001. An insufficient maximum input level causes loss of coverage near Node B.

A DL reference measurement channel (12.2 kbps) is setup as described in section 3.1. Tables 17 and 18 show the test requirements for the maximum input level and downlink physical channels transmitted during a connection respectively.

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Maximum Input Level (3GPP TS 34.121, 6.3)

Test requirements for the maximum input level				
Parameter	Level / Status	Unit		
lor	-25.7	dBm / 3.84 MHz		
DPCH_Ec / lor	-19	dB		
UE transmitted mean power	20 (for Power class 3 and 3bis) 18 (for Power class 4)	dBm		

Table 17: Test requirement for maximum input level (Table 6.3.3 of 3GPP TS 34.121 [1])

Downlink physical channels transmitted during a connection				
Physical channel	Power			
P-CPICH	P-CPICH_Ec / lor = -10 dB			
S-CPICH	S-CPICH_Ec / lor = -10 dB (Note)			
P-CCPCH	$P-CCPCH_Ec / lor = -12 dB$			
SCH	$SCH_Ec / lor = -12 dB$			
PICH	PICH_Ec / lor = -15 dB			
DPCH	Test-dependent power			
OCNS	Power required in order for the total transmit power spectral density of Node B (lor) adds up to one			

Note: When S-CPICH is the phase reference in a test condition, the phase of S-CPICH shall be offset by 180 degrees from the P-CPICH's phase. When S-CPICH is not the phase reference, it is not transmitted.

Table 18: Downlink physical channels transmitted during a connection (Table E.3.3 of 3GPP *TS* 34.121 [1])

Configuration in the R&S[®]CMW500:

WCDMA-UE Signaling \rightarrow Config \rightarrow RF Settings \rightarrow RF Power Downlink \rightarrow Output

Maximum Input Level (3GPP TS 34.121, 6.3)

```
Power (lor) \rightarrow -25.7 \text{ dBm}

WCDMA-UE Signaling \rightarrow \text{Config} \rightarrow \text{Physical Downlink Settings} \rightarrow -25.7 \text{ dBm}

WCDMA-UE Signaling \rightarrow \text{Config} \rightarrow \text{Physical Downlink Settings} \rightarrow \text{P-CPICH}

\rightarrow -10.0 \text{ dB}

WCDMA-UE Signaling \rightarrow \text{Config} \rightarrow \text{Physical Downlink Settings} \rightarrow \text{S-CPICH} \rightarrow \text{Off}

WCDMA-UE Signaling \rightarrow \text{Config} \rightarrow \text{Physical Downlink Settings} \rightarrow \text{P-CCPCH}

\rightarrow -12.0 \text{ dB}

WCDMA-UE Signaling \rightarrow \text{Config} \rightarrow \text{Physical Downlink Settings} \rightarrow \text{P-SCH} \rightarrow -15.0 \text{ dB}

WCDMA-UE Signaling \rightarrow \text{Config} \rightarrow \text{Physical Downlink Settings} \rightarrow \text{S-SCH} \rightarrow -15.0 \text{ dB}

WCDMA-UE Signaling \rightarrow \text{Config} \rightarrow \text{Physical Downlink Settings} \rightarrow \text{PICH} \rightarrow -15.0 \text{ dB}

WCDMA-UE Signaling \rightarrow \text{Config} \rightarrow \text{Physical Downlink Settings} \rightarrow \text{PICH} \rightarrow -15.0 \text{ dB}

WCDMA-UE Signaling \rightarrow \text{Config} \rightarrow \text{Physical Downlink Settings} \rightarrow \text{PICH} \rightarrow -15.0 \text{ dB}

WCDMA-UE Signaling \rightarrow \text{Config} \rightarrow \text{Physical Downlink Settings} \rightarrow \text{PICH} \rightarrow -15.0 \text{ dB}

WCDMA-UE Signaling \rightarrow \text{Config} \rightarrow \text{Physical Downlink Settings} \rightarrow \text{PICH} \rightarrow -15.0 \text{ dB}

WCDMA-UE Signaling \rightarrow \text{Config} \rightarrow \text{Physical Downlink Settings} \rightarrow \text{PICH} \rightarrow -15.0 \text{ dB}

WCDMA-UE Signaling \rightarrow \text{Config} \rightarrow \text{Physical Downlink Settings} \rightarrow \text{DPDCH Level}

Config \rightarrow -19.0 \text{ dB}
```

Construct Provident Report	25 70 10			wint .	
Output Power (lor)	-25.70 dBm				io to
-AWGN Noise (loc)	□ -70.00 d	Bm			
Geometric Factor (lor/loc)	-25.70 dBm				
RF Power Uplink	-25.70 dBm				io to
Physical Downlink Settings	_				
-Accumulated Power	0.00 dB Ad	ljust to 0dE	3		io to
-OCNS	-1.00 dB R	elease 99	T		10 10
Code Conflict	No Code Co	nflict Dete	cted!		
Code Domain Diagram	Show				VCDMA lig. Confi
Channel Table	Level	Code	Symbol Rate		ig. com
-P-CPICH	₩ -10.00 dB	0	15 ksps		
P-CPICH Enhanced					
-S-CPICH	□ -3.30 dB	3 11	15 ksps		
S-CPICH Enhanced					
-P-SCH	₩ -15.00 dB				
-S-SCH	₩ -15.00 dB		CARGO TO F.		
-P-CCPCH	₩ -12.00 dB		15 ksps		
-S-CCPCH	□ -12.00 dB		60 ksps		
-PICH	▼ -15.00 dB	-	15 ksps		
-AICH AICH Enhanced	₹ -15.00 dB	5 3	15 ksps		VCDMA-L
-DPCH	₩ -19.00 dB	1 3	30 ksps		ignaling
RC MI	15.00 db		as nata		ON

Fig. 39: Configuring physical downlink channels.

These physical channels for the downlink can be configured in the R&S[®]CMW500 by referring to Fig. 39.

This example uses a Power Class 3 UE. Consequently, the device shall be configured to transmit at a mean power of +20 dBm. Power Control Algorithm 2 with step size 1 dB shall be used to keep the UE output power at the specified output power level with a \pm 1 dB tolerance.

Configuration in the R&S[®]CMW500:

WCDMA Sig. Config \rightarrow TPC \rightarrow Active TPC Setup \rightarrow Closed Loop WCDMA Sig. Config \rightarrow TPC \rightarrow Alg./Step Size \rightarrow Alg2_1dB WCDMA Sig. Config \rightarrow TPC \rightarrow Configuration \rightarrow Target 20.0 dBm The measurement results for the maximum input level are available in the BER application of the $R\&S^{@}CMW500$.

Configuration in the R&S[®]CMW500: Tasks \rightarrow WCDMA BER

Fig. 40 below shows the BER measurement results.

S WCDMA Signaling BER				WCDMA
Connection Status	Cell Setup			(here)
Cell (M) HSDPA	Band	Band 1 🔹		BER
		Downlink	Uplink	RDY
Circuit Switched Call Established	Channel	10563 Ch	9613 Ch	
Packet Switched 🔼 ON	Frequency	2112.6 MHz	1922.6 MHz	
CMW Demod. Info	Output Power	-25.70 dBm		<u>}</u>
DL/UL Alignment 1022.81 Chip	Total Output	-25,70 dBm		
Results	Scrambling Code	0 hex	0 hex	_
BER 0.000 % BLER 0.000 %	РСРІСН 🝷	✓ -10.0 dB	Code 0	<u> </u>
DBLER 0.000 %	PS Domain	Reduced Signali	ng 🗐	WCDMA Sig. Config
Lost Transp Blocks 0	Connection Se			sig. coning
UL TFCI Faults NCAP	UE term. Conner	t RMC		
FDR NCAP				
PN Discontinuity 5				
Transport Blocks 100 / 100	RMC			(
	Data Rate	DL RMC 12.2	PMC 12.2	
	Data Mats	OC INTERACIÓN DE C	THIS LESS	<u>}</u>
	Test Mode	Loop Mode 2	12	
	HSPA Test Mod	e 🗖		<u>├</u>
				WCDMA 1 Signaling
Repetition Stop Condition	Ĩ		Ĭ.	Config

Fig. 40: BER results for the maximum input level.

The measured BER must not exceed 0.001.



Recall MaxInput.dfl and establish a CS call. The measurement results are available here: Menus \rightarrow Receiver Quality \rightarrow Applic. 1 \rightarrow BER

Reference Dataset for the R&S®CMW500

4 Summary of the R&S®CMW500 *.dfl Files

Table19 below summarizes the available *.dfl files based on $R\&S^{\textcircled{B}}CMW500$ firmware V2.1.20 for UEs that support Operating Band I with Power Class 3 in the 12.2 kbps RMC downlink/uplink.

4.1 Reference Dataset for the R&S[®]CMW500

Summa 3)	Summary of *.dfl files (Firmware V2.1.20, UE Operating Band I and Power Class 3)				
Clause	Test parameter	*.dfl filename			
5.2	Maximum output power	TX_meas.dfl			
5.3	Frequency error	TX_meas.dfl			
5.4.2	Inner loop power control in the uplink	TX_meas.dfl			
5.4.3	Minimum output power	TX_meas.dfl			
5.8	Occupied bandwidth (OBW)	TX_meas.dfl			
5.9	Spectrum emission mask	TX_meas.dfl			
5.10	Adjacent channel leakage power ratio (ACLR)	TX_meas.dfl			
5.12	Transmit intermodulation	TX_meas.dfl			
5.13.1	Error vector magnitude (EVM)	TX_meas.dfl			
5.13.2	Peak code domain error	TX_meas.dfl			
5.13.3	UE phase discontinuity	TX_meas.dfl			
6.2	Reference sensitivity level	RX_meas.dfl			
6.3	Maximum input level	MaxInput.dfl			

Table 19: Summary of the .dfl files required for each test case.

5 References

[1] Technical Specification Group Radio Access Network; User Equipment (UE) Conformance Specification; 3GPP TS 34.121-1 V 9.5.0 (2011-02)

[2] Technical Specification Group Radio Access Network; Common Test Environments for User Equipment (UE); 3GPP TS 34.108 V 9.5.0, (2011-02)

[3] Rohde & Schwarz; Application Note: Measurements on 3GPP WCDMA User Equipment According to Standard TS 34.121, 1CM71

[4] Rohde & Schwarz; Reiner Stuhlfauth; Wideband Code Division Multiple Access, WCDMA – RF measurement with CMW500 radio communication tester

6 Ordering Information

Ordering information				
Туре	Description	Order no.		
R&S [®] CMW500	Wideband Radio Communication Tester	1201.0002K50		
R&S [®] CMW500-PS502	CMW500 Basic Assembly (mainframe), including one RF Converter Module and one Baseband Measurement Unit, 70 MHz to 3.3 GHz (selection)	1202.5408.02		
R&S [®] CMW500-S550B	Baseband Interconnection, flexible link, for signaling and IQ access	1202.4801.03		
R&S [®] CMW500-S590D	RF Frontend	1202.5108.03		
R&S [®] CMW500-S600B	CMW500 Frontpanel With Display/Keypad	1201.0102.03		
R&S [®] CMW-B300A	Signaling Unit Wideband (SUW), for WCDMA/LTE	1202.6304.02		
R&S [®] CMW500-B612A	IEEE Bus Interface, single interface	1202.5608.02		
R&S [®] CMW500-B620A	Digital Video Interface (DVI), only required for units with display/keypad	1202.5808.02		
R&S [®] CMW500-B690A	OCXO Module, basic stability	1202.5908.02		
R&S [®] CMW500-KM400	WCDMA Release 99, TX measurement, uplink	1203.0700.02		
R&S [®] CMW500-KS400	WCDMA Release 99, signaling/network emulation, basic functionality	1203.0751.02		
R&S [®] CMW500-K410	WCDMA Release 99, signaling/network emulation, advanced functionality	1203.9807.02		

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Certified Quality System ISO 9001 DQS REG NO 1954 QM

Certified Environmental System ISO 14001 DQS REG. NO 1954 UM

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