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.

Application Note
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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: 

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®CMW500.

Tests of transmitter characteristics and receiver characteristics from 3GPP Rel-99 that the R&S®CMW500 supports		
Test	**Clause**	**Test Parameter**
Transmitter characteristics	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
	5.8	Occupied bandwidth (OBW)
	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 characteristics	6.2	Reference sensitivity level
	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 → Connection Configuration → UE term. Connection → RMC
Config → Connection Configuration → RMC → Data Rate → DL RMC 12.2 kbps UL RMC 12.2 kbps

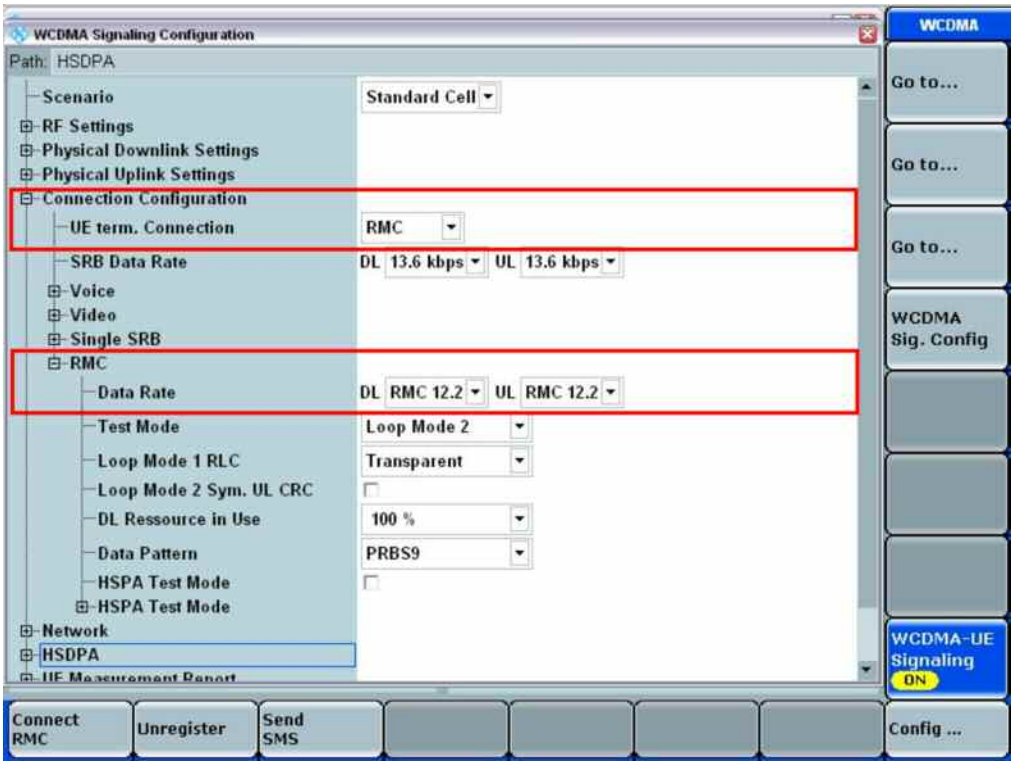


Fig. 1: Setting up the dedicated 12.2 kbps RMC.

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**
Ior	–93 dBm / 3.84 MHz
CPICH	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 (Ior) → –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.

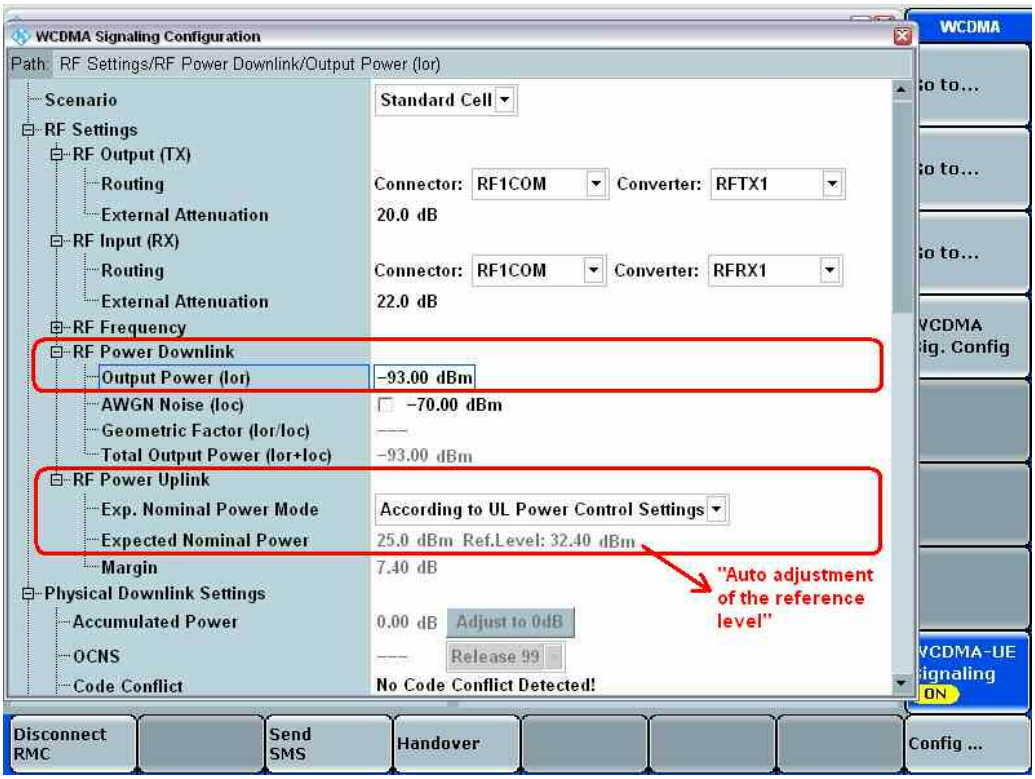


Fig. 2: Configuring the physical downlink channels – part 1.

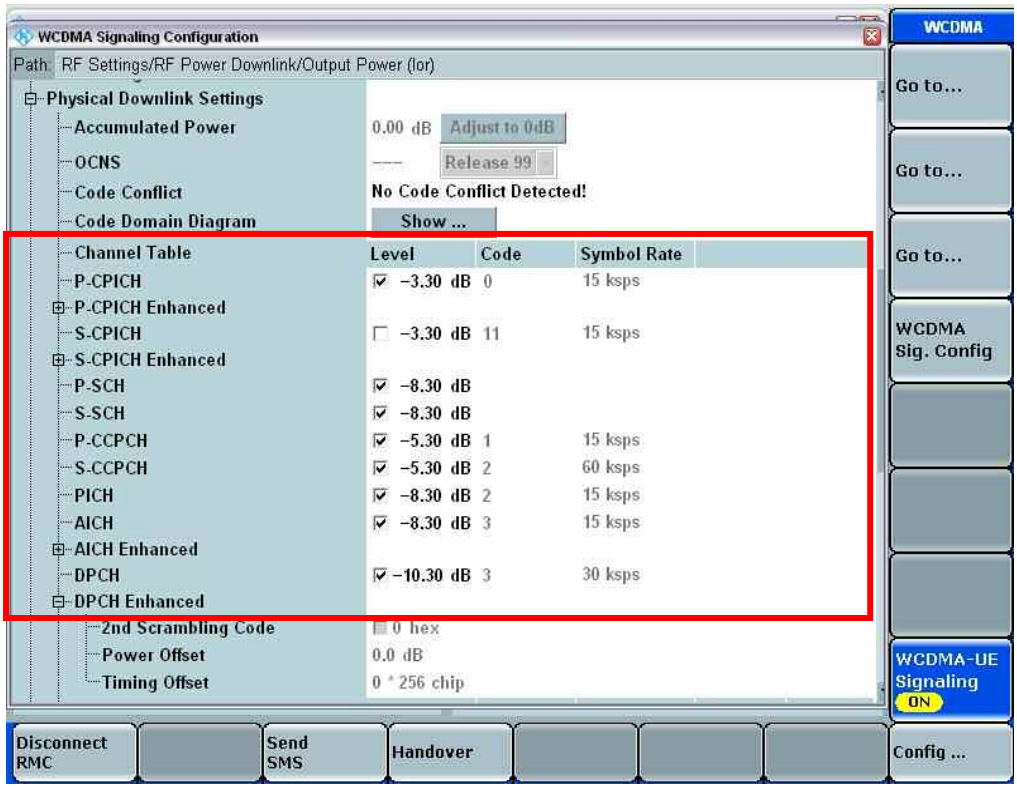


Fig. 3: Configuring the physical downlink channels – part 2.

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.

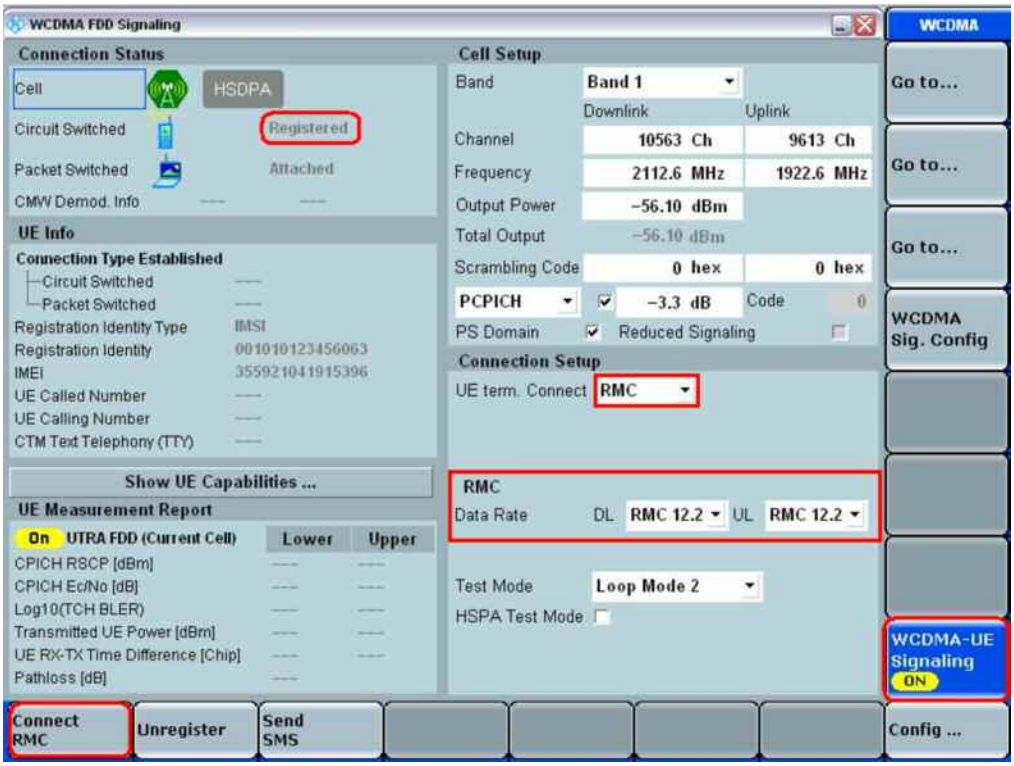


Fig. 4: Establishing an RMC call.

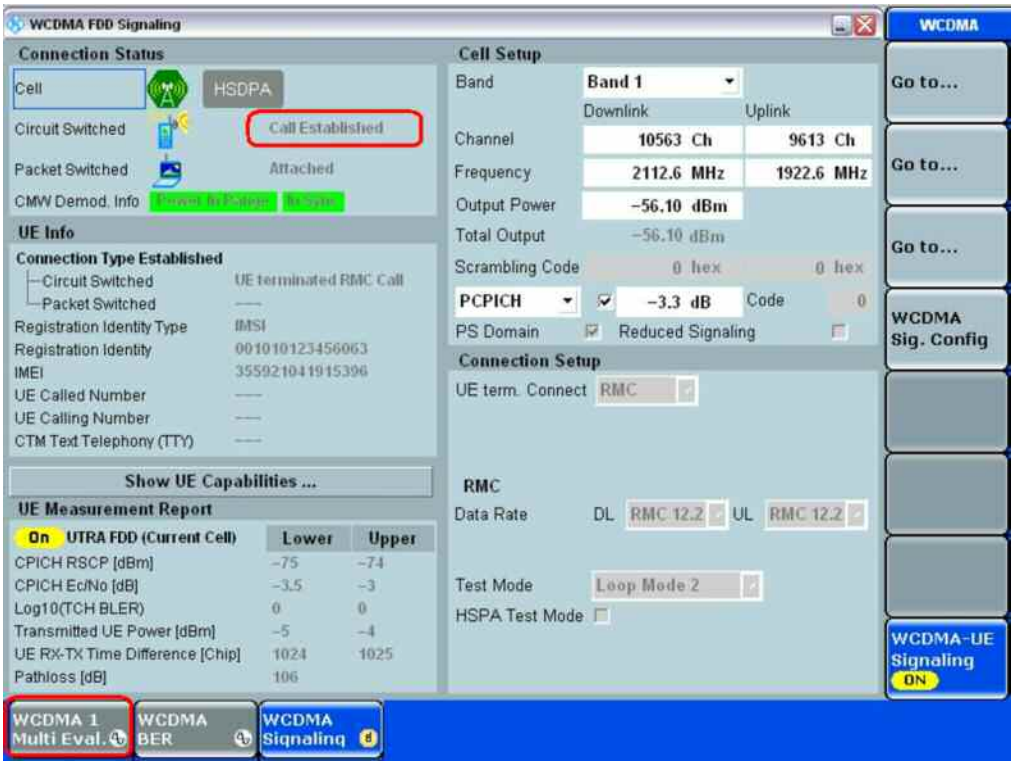


Fig. 5: RMC call established.

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.

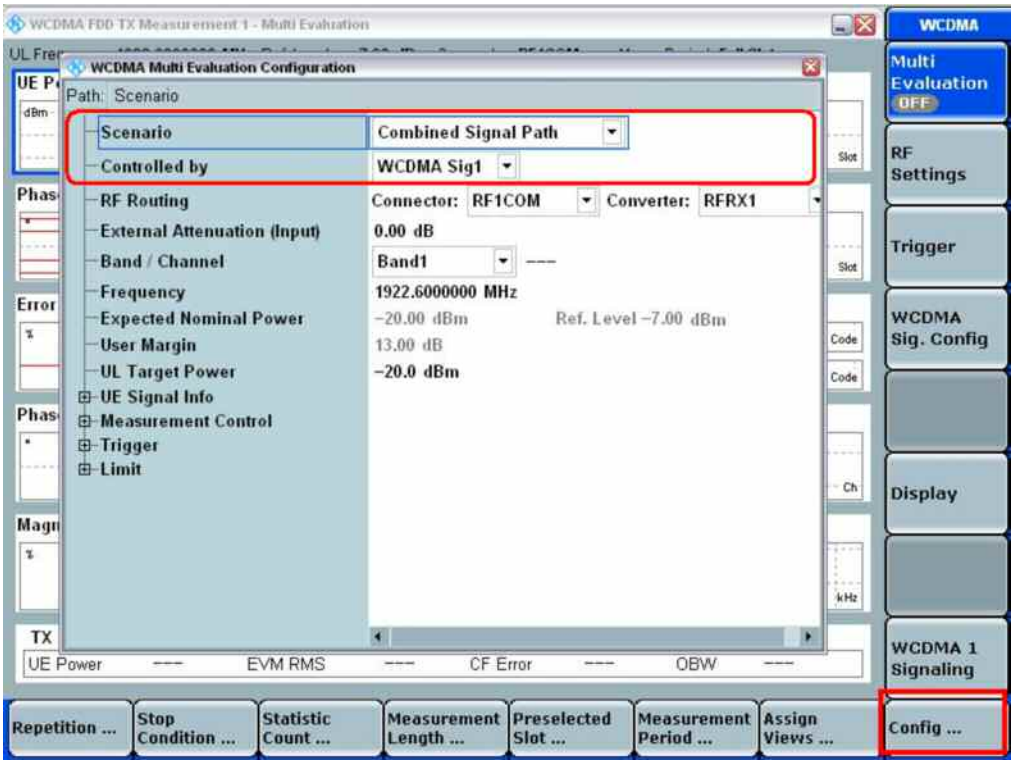


Fig. 6: Configuring the scenario for signaling tests.

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 + α) 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.

Nominal maximum output power										
Operating Band	Power Class 1		Power Class 2		Power Class 3		Power Class 3bis		Power Class 4	
	Power (dBm)	Tol (dB)	Power (dBm)	Tol (dB)	Power (dBm)	Tol (dB)	Power (dBm)	Tol (dB)	Power (dBm)	Tol (dB)
Band I	+33	+1.7/ –3.7	+27	+1.7/– 3.7	+24	+1.7/ –3.7	--	--	+21	+2.7/ –2.7
Band II	--	--	--	--	+24	+1.7/ –3.7	--	--	+21	+2.7/ –2.7
Band III	--	--	--	--	+24	+1.7/ –3.7	--	--	+21	+2.7/ –2.7
Band IV	--	--	--	--	+24	+1.7/ –3.7	--	--	+21	+2.7/ –2.7
Band V	--	--	--	--	+24	+1.7/ –3.7	--	--	+21	+2.7/ –2.7
Band VI	--	--	--	--	+24	+1.7/ –3.7	--	--	+21	+2.7/ –2.7
Band VII	--	--	--	--	+24	+1.7/ –3.7	+23	+2.7/ –2.7	+21	+2.7/ –2.7
Band VIII	--	--	--	--	+24	+1.7/ –3.7	+23	+2.7/ –2.7	+21	+2.7/ –2.7
Band IX	--	--	--	--	+24	+1.7/ –3.7	--	--	+21	+2.7/ –2.7
Band X	--	--	--	--	+24	+1.7 /–3.7	--	--	+21	+2.7/ –2.7
Band XI	--	--	--	--	+24	+1.7 /–3.7	--	--	+21	+2.7/ –2.7
Band XII	--	--	--	--	+24	+1.7/ –3.7	+23	+2.7/ –2.7	+21	+2.7/ –2.7
Band XIII	--	--	--	--	+24	+1.7/ –3.7	+23	+2.7/ –2.7	+21	+2.7/ –2.7
Band XIV	--	--	--	--	+24	+1.7/ –3.7	+23	+2.7/ –2.7	+21	+2.7/ –2.7
Band XIX	--	--	--	--	+24	+1.7/ –3.7	+23	+2.7/ –2.7	+21	+2.7/ –2.7
Band XX	--	--	--	--	+24	+1.7/ –3.7	+23	+2.7/ –2.7	+21	+2.7/ –2.7
Band XXI	--	--	--	--	+24	+1.7/ –3.7	+23	+2.7/ –2.7	+21	+2.7/ –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 → WCDMA Multi Evaluation → Display → Select View → UE Power
WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Active TPC Setup → All 1
WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Alg./Stepsize → Alg2_1dB

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

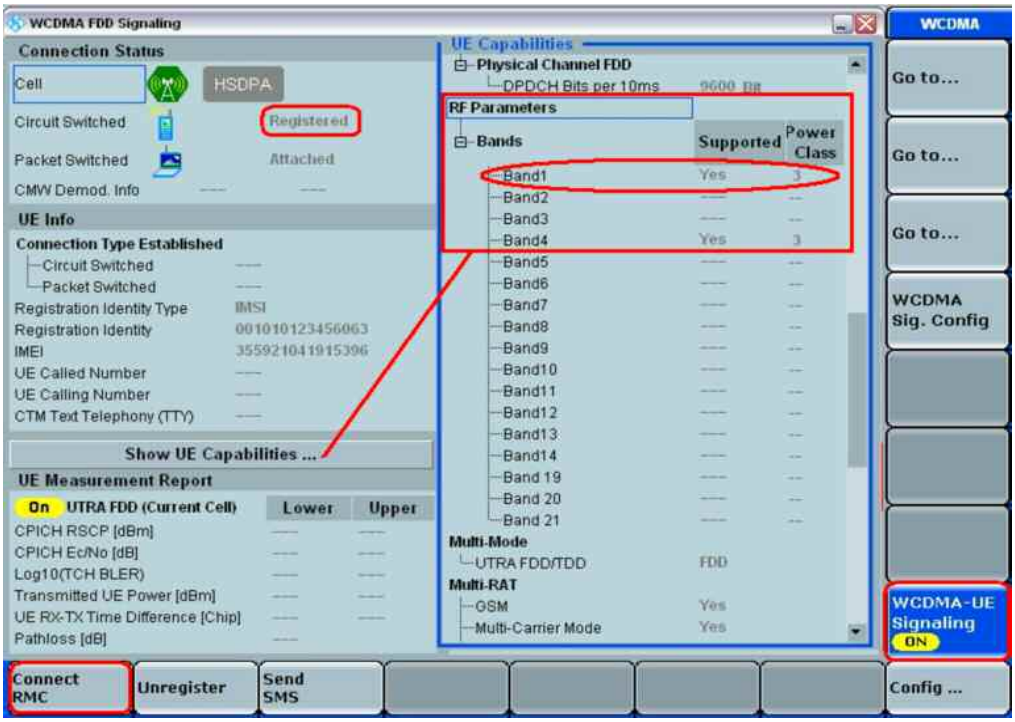


***Fig. 7*: Determining the mobile device's power class.**

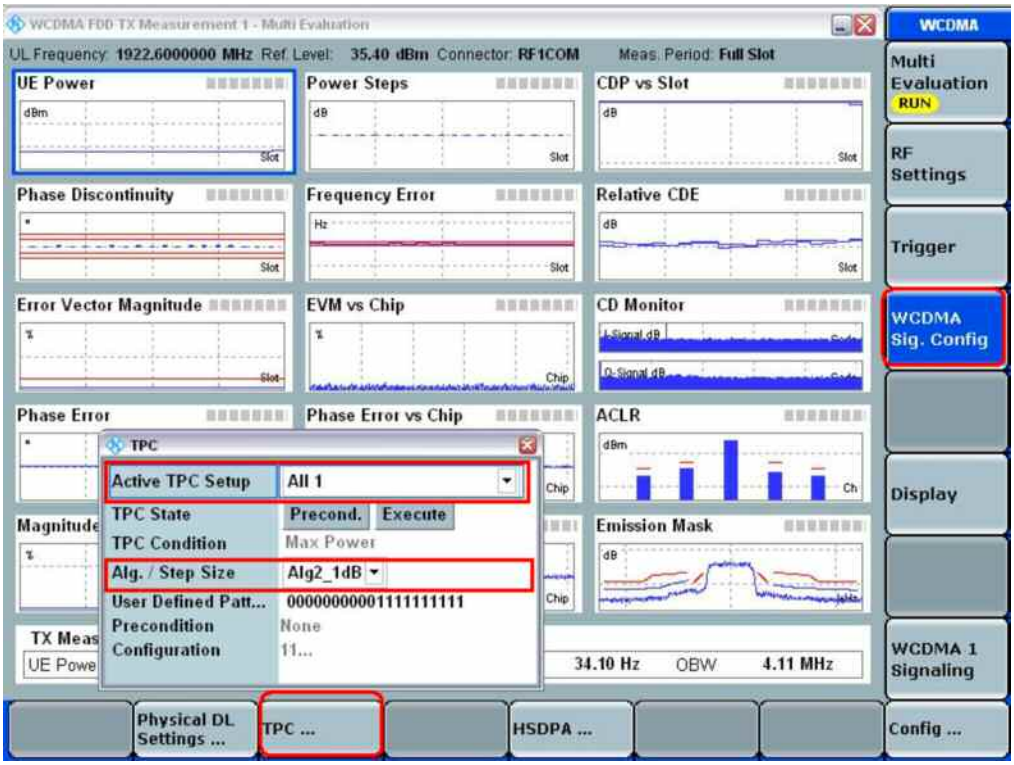


Fig. 8: Settings for the maximum output power measurement results.

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

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:

WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Active TPC Setup → All 1

The measurement results are then available at:
Tasks → WCDMA Multi Evaluation → Display → Select View → 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 ±(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®CMW500.

Downlink physical channels transmitted during a connection	
Physical Channel	**Power**
CPICH	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]).

Reference sensitivity level			
Operating Band	**Unit**	**DPCH_Ec <REFSENS>**	**<REFIor>**
I	dBm/3.84 MHz	–116.3	–106
II	dBm/3.84 MHz	–114.3	–104
III	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
X	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 → RF Settings → RF Power Downlink → Output Channel Power (Ior) → –106 dBm

Config → Physical Downlink Settings → DPDCH Level Config → –10.3 dB [w.r.t Ior 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 → WCDMA Sig. Config → TPC → Active TPC Setup → All 1

WCDMA Multi Evaluation → Display → Select View → Frequency Error

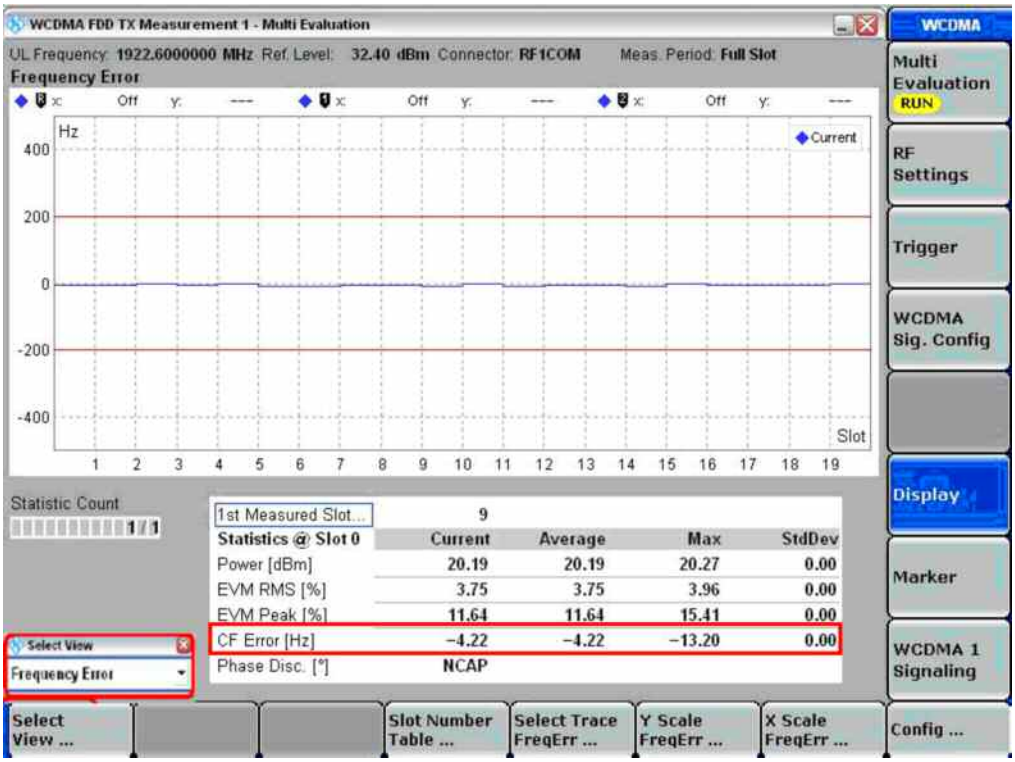


Fig. 10: Frequency error measurement result.

The frequency error must not exceed ±(0.1 ppm + 10 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 → Display → Frequency Error

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 $\Delta_{RP\text{-}TPC}$, 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.

Transmitter power control range						
TPC_cmd	**Transmitter power control range (all units are in dB)**					
	1 dB step size		**2 dB step 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 power control range after 10 equal TPC_cmd groups (all units are in dB)**				**Transmitter power control range after 7 equal TPC_cmd groups (all units are in dB)**	
	1 dB step size		**2 dB step size**		**3 dB step 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	N/A	N/A	N/A	N/A
0,0,0,0,–1	–5.7	–14.3	N/A	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.

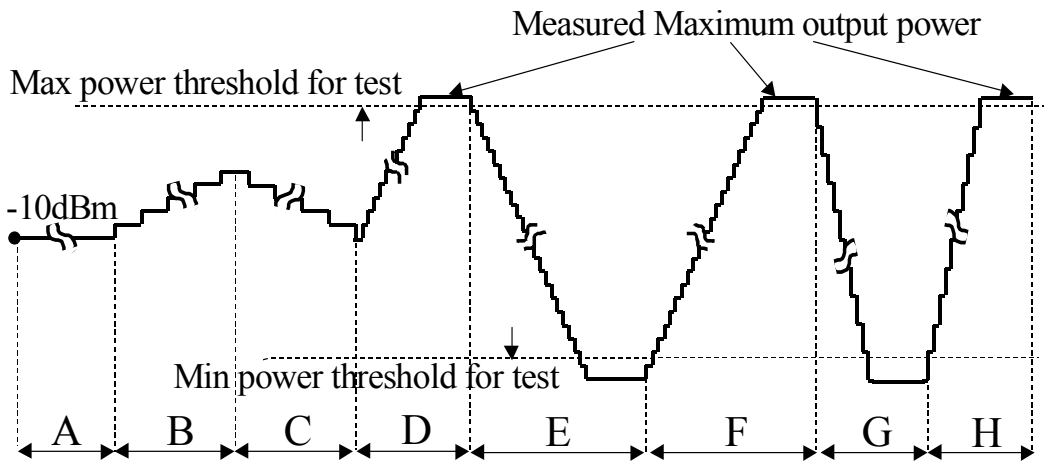


Fig. 11: The inner loop power control test steps (Fig. 5.4.2.4 of 3GPP TS 34.121 [1]).

Summary of the test step conformance requirement		
Test step	**Difference in mean power between adjacent slots**	**Change in mean power over consecutive slots**
A	TPC_cmd = 0	TPC_cmd group = 0 for 10 consecutive slots
B	Every 5th 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
C	Every 5th 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 Algorithm 1 with a TPC step size of 1 dB and measured maximum output power	
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)
H	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

Configuration in the "WCDMA TPC Meas" application:
WCDMA TPC Meas → Config → Scenario → Combined Signal Path
WCDMA TPC Meas → Config → Controlled by → 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 → 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]*

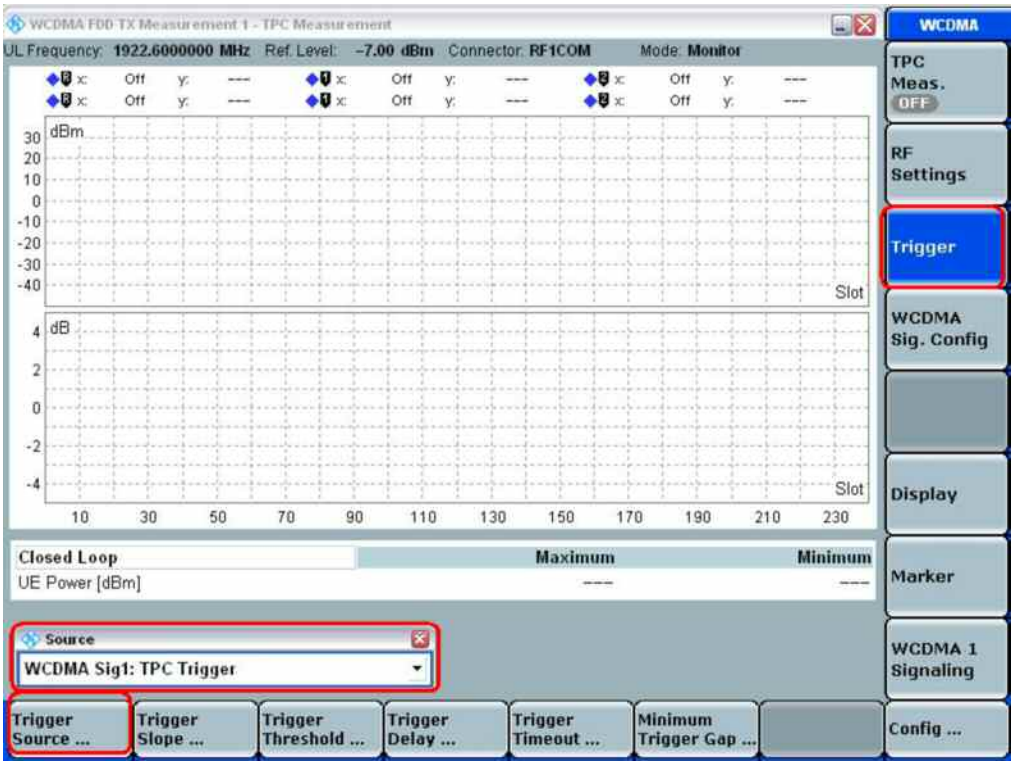


Fig. 12: Configuring the trigger mode.

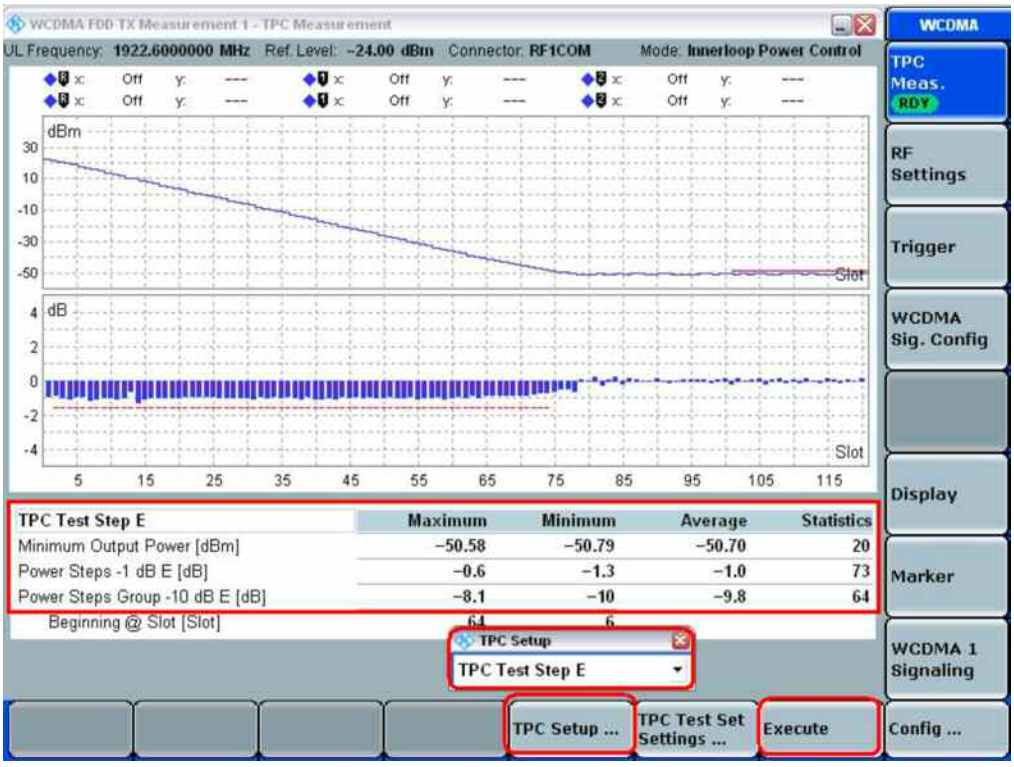
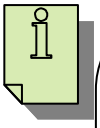


Fig. 13: TPC Measurement results for TPC Pattern E.

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 → WCDMA Multi Evaluation → Display → UE Power
WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Active TPC Setup → All 0
WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Alg. /Step size → Alg2_1dB

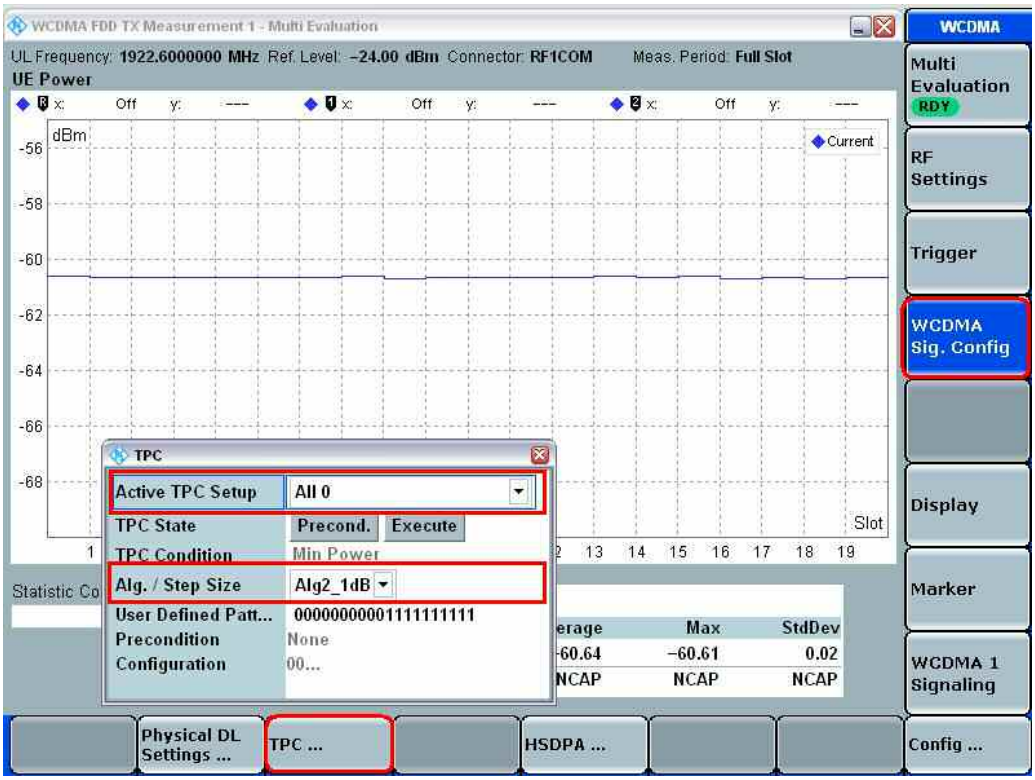


Fig. 14: Settings for the minimum output power measurement result.

Fig. 15 shows the minimum output power measurement results.

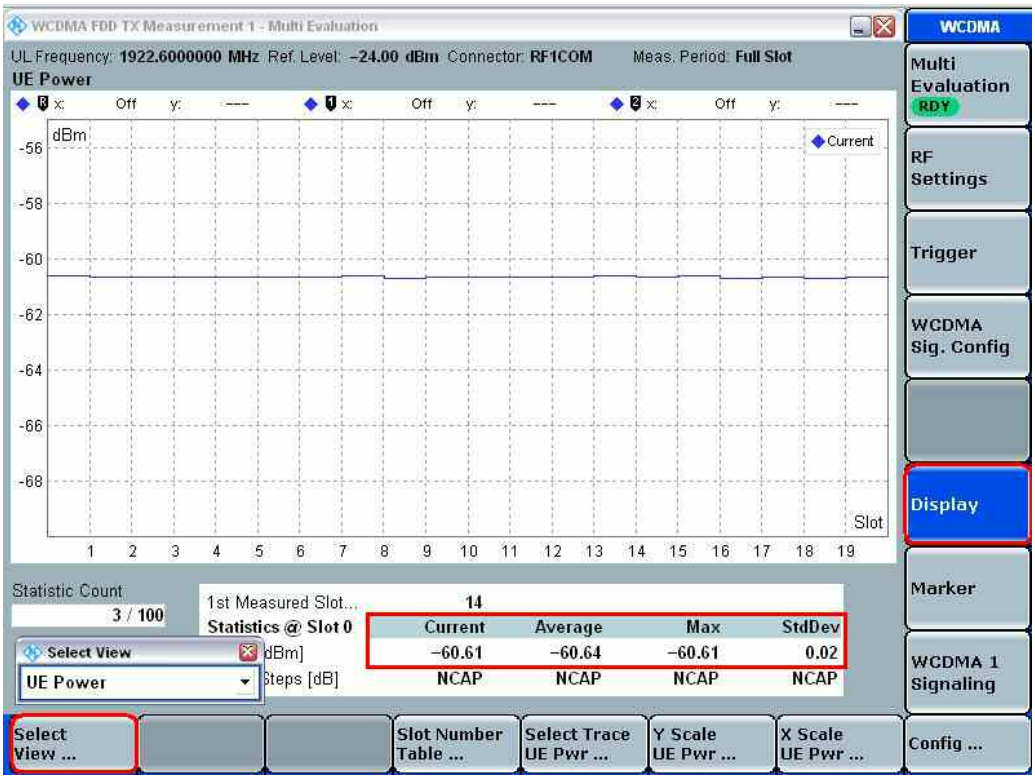


Fig. 15: Minimum output power measurement results.

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 → WCDMA Sig. Config → TPC → Active TPC Setup → All 0

The measurement results are available here:
Tasks → WCDMA Multi Evaluation → Display → 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 → Display → Select View → Emission Mask
WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Alg./Step size → Alg2_1dB
Config → WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Active TPC Setup → All 1
Fig. 16 shows results from an occupied bandwidth measurement.

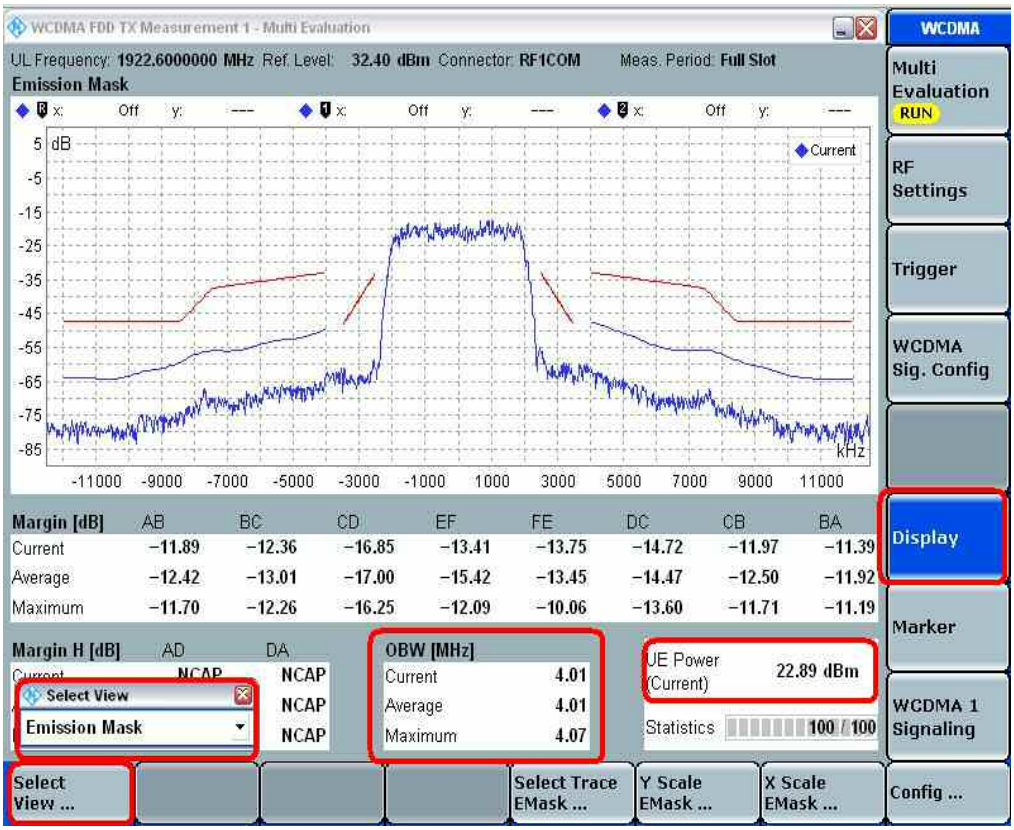


Fig. 16: Occupied bandwidth measurement results.

The measured OBW must not exceed 5 MHz.

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

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

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 emission mask requirement			
Δf in MHz	**Minimum requirement**		**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 filter center frequency, f_offset**	**Additional requirements Bands II, IV, X**	**Measurement bandwidth**
2.5 MHz ≤ Δf < 3.5 MHz	2.515 MHz ≤ f_offset < 3.485 MHz	–15 dBm	30 kHz
3.5 MHz ≤ Δf ≤ 12.5 MHz	4.0 MHz ≤ 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	**Frequency offset of measurement filter center frequency, f_offset**	**Additional requirements Band V**	**Measurement bandwidth**
2.5 MHz ≤ Δf < 3.5 MHz	2.515 MHz ≤ f_offset < 3.485 MHz	–15 dBm	30 kHz
3.5 MHz ≤ Δf ≤ 12.5 MHz	3.55 MHz ≤ 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 filter center frequency, f_offset**	**Additional requirements Band XII, XIII, XIV**	**Measurement bandwidth**
2.5 MHz ≤ Δf < 2.6 MHz	2.515 MHz ≤ f_offset < 2.585 MHz	–13 dBm	30 kHz
2.6 MHz ≤ Δf ≤ 12.45 MHz	2.65 MHz ≤ 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])

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 → WCDMA Multi Evaluation → Display → Select View → Emission Mask

Fig. 17 shows the spectrum emission mask measurement results.

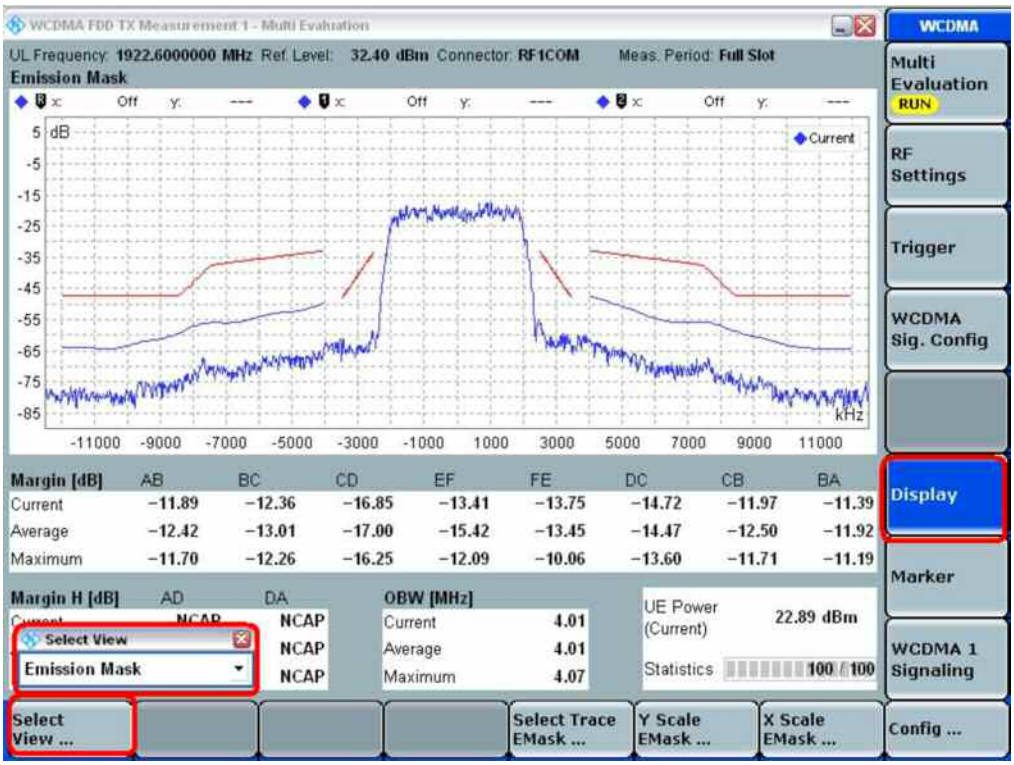


Fig. 17: Spectrum emission mask measurement results.

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

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

The measurement results are available here:
Menus → Spectrum → Application → 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		
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 → WCDMA Multi Evaluation → Display → Select View → ACLR
WCDMA Multi Evaluation → Select Unit ACLR… → dB

Fig. 18 shows the ACLR measurement results.

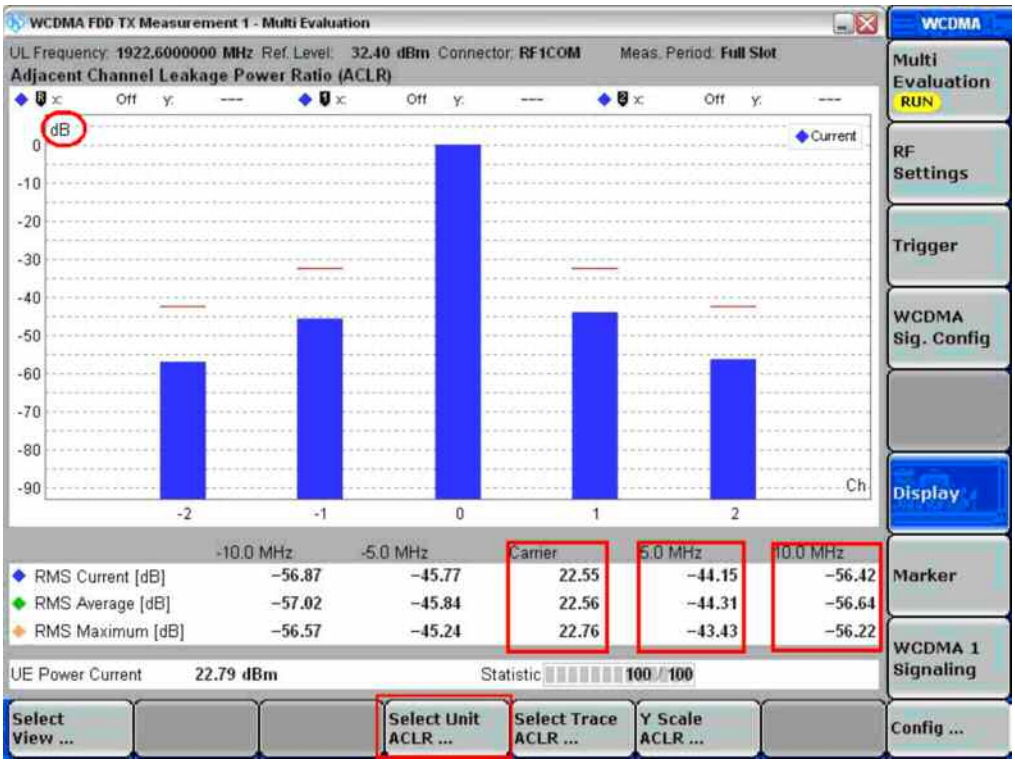


Fig. 18: Measurement results for the UE's ACLR.

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 → WCDMAMulti Evaluation → WCDMA Sig. Config → Active TPC Setup → All 1

The measurement results are available here:
Tasks → WCDMA Multi Evaluation → Display → Select View → 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 α = 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])

Case (i):

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 → WCDMA Multi Evaluation → Display → Select View → EVM
WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Active TPC Setup → 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 → WCDMA Sig. Config → TPC → Active TPC Setup → Closed Loop
WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Alg. Step Size → Alg 1_1dB

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

WCDMA Multi Evaluation → Display → Select View → EVM

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

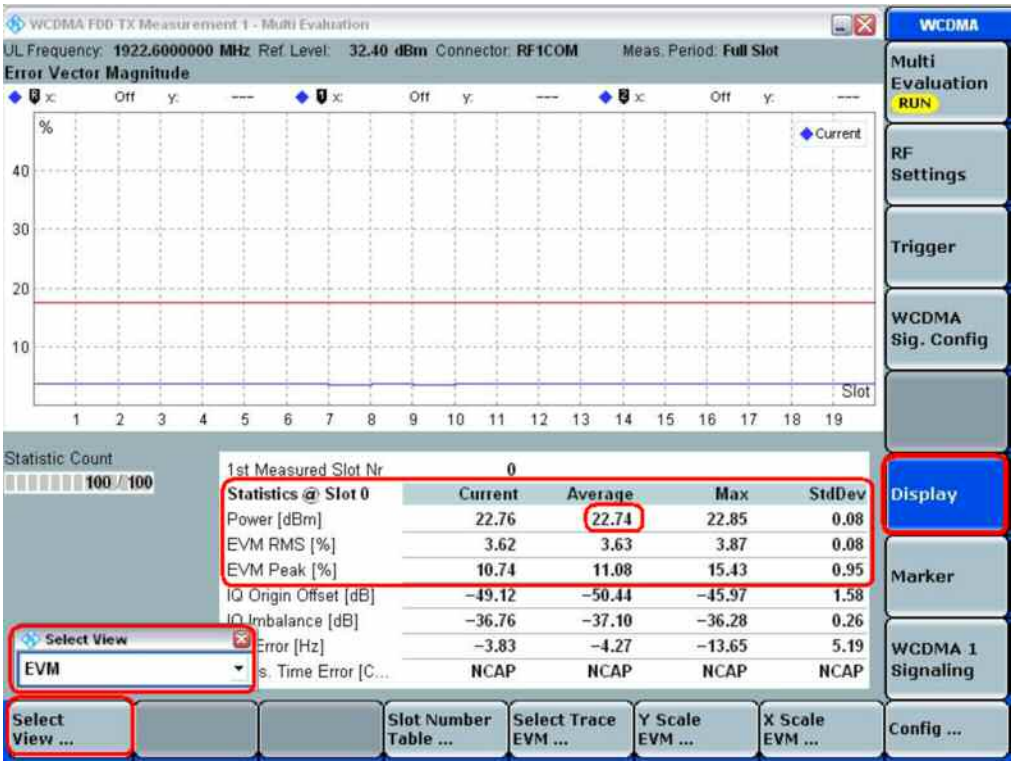


Fig. 19: EVM measurement results for a UE transmitting at its maximum power.

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

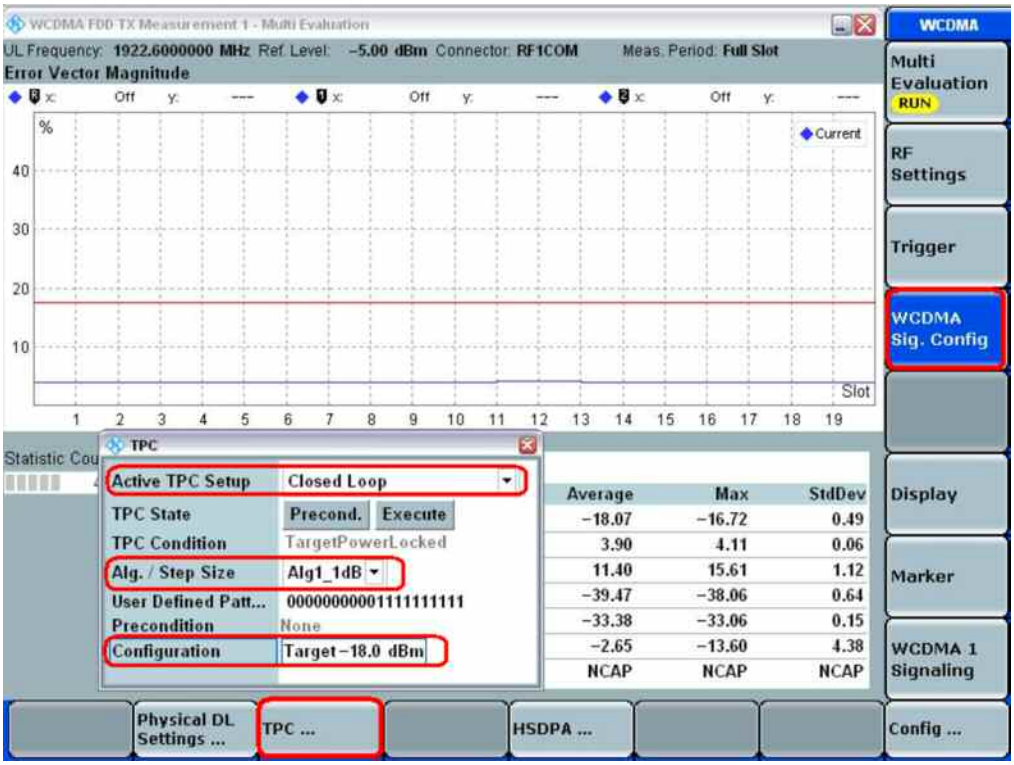


Fig. 20: EVM measurement results for a UE transmitting at –18 dBm.

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 → Display → Select View → Tx Measurement (Scalar)

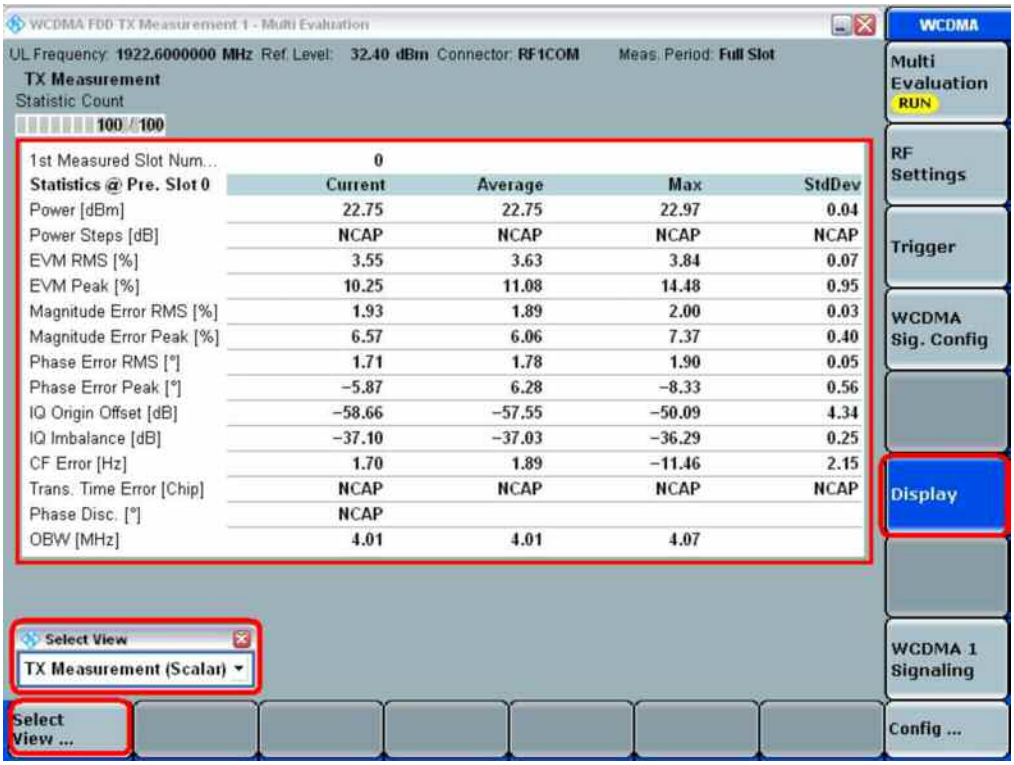


Fig. 21: Results of a scalar Tx measurement.

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 → TPC → Active TPC Setup → All 1

For UE output power = –18 dBm, recall TX_meas.sav and establish a CS call. Modify the following configurations:
WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Active TPC Setup → Closed Loop
WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Alg. Step Size → Alg 1_1dB

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

The measurement results are available here:
WCDMA Multi Evaluation → Display → Select View → 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 → Connection Setup → UE term Connect → RMC
*WCDMA-UE Signaling → Connection Setup → RMC Data rate → 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 → TPC → Active TPC Setup → 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:

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

WCDMA Multi Evaluation → Config → Measurement Control → Modulation / CDP → CDP Spreading Factor → 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 → WCDMA Sig. Config → TPC → Active TPC Setup → Closed loop

WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Alg. Step size → Alg2_1dB

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

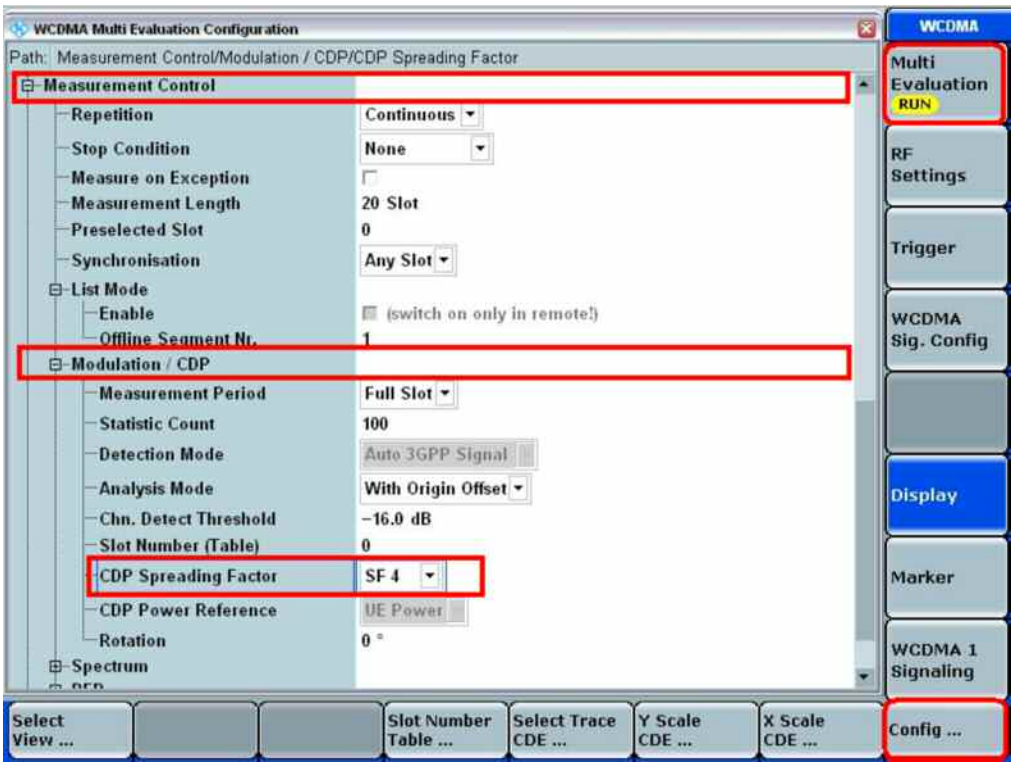


Fig. 22: Configuring the peak code domain measurement.

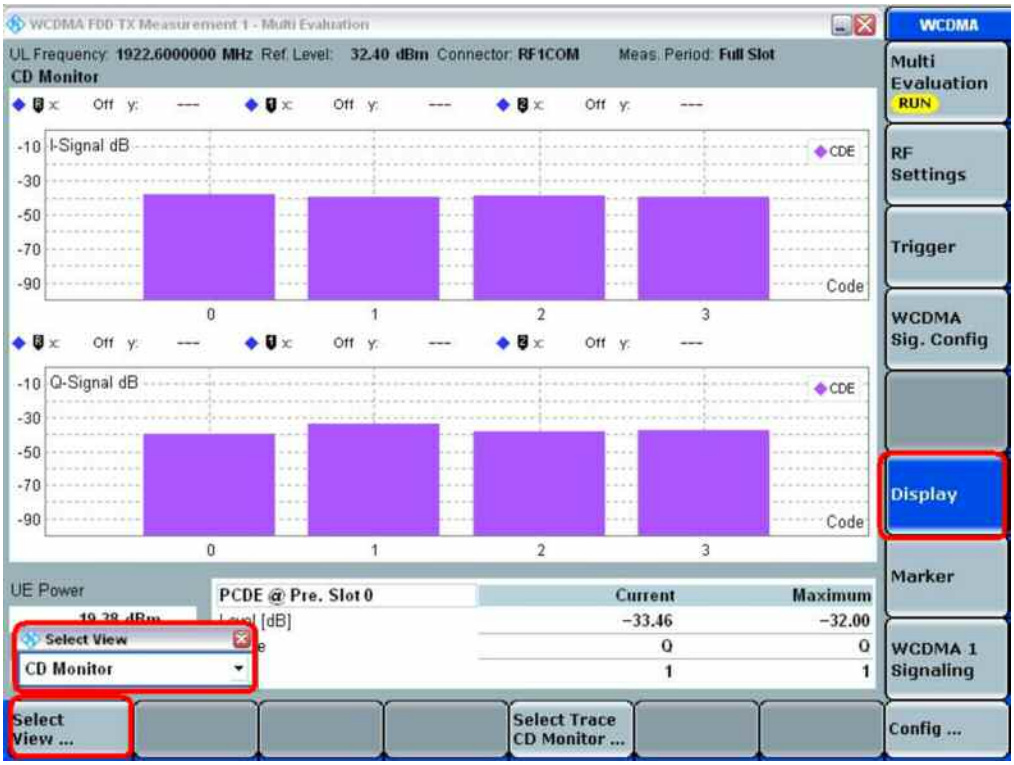


Fig. 23: ACLR test results.

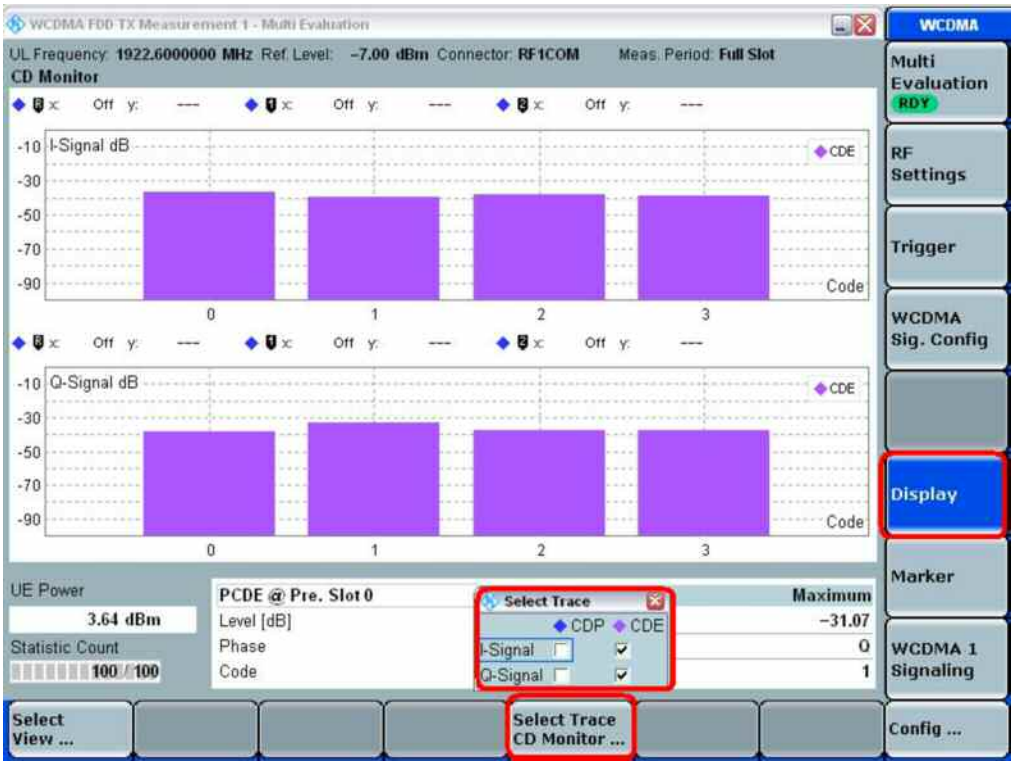


Fig. 24: Display mode configuration.

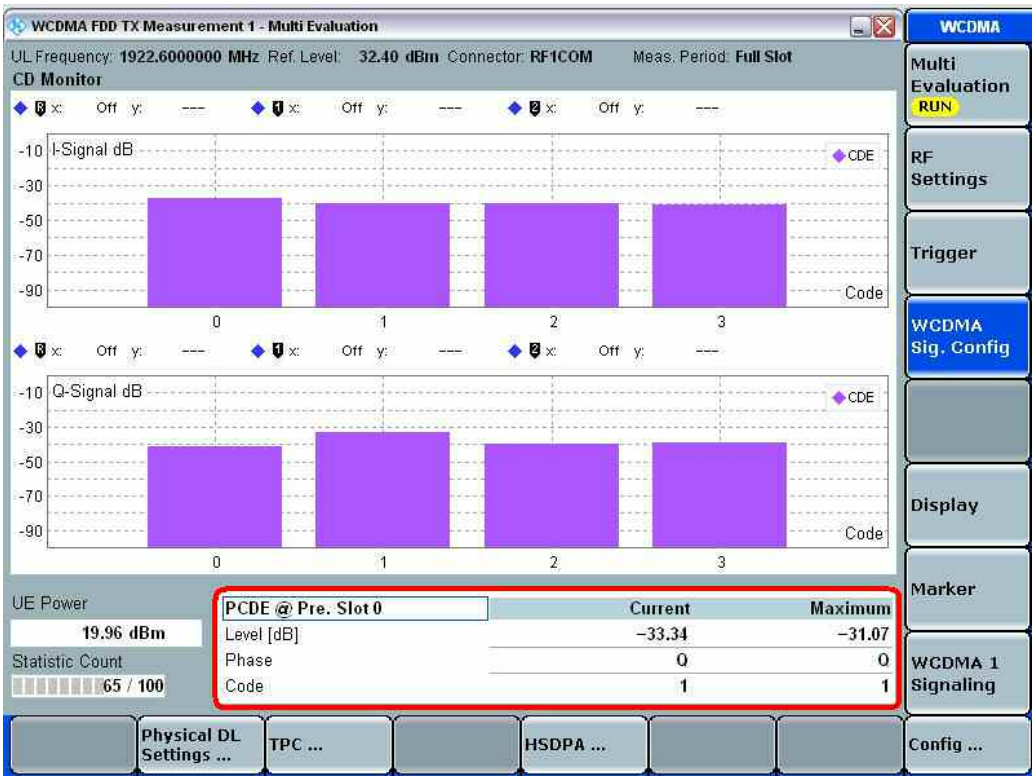


Fig. 25: Peak code domain error result for UE transmitting at its maximum power.

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

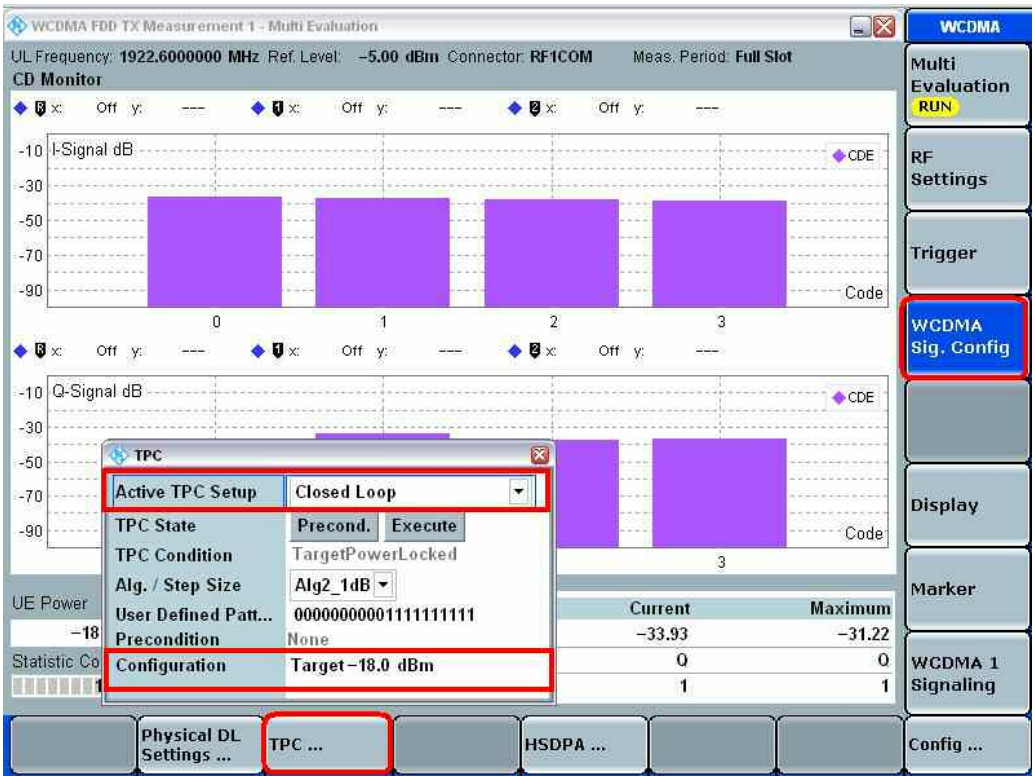
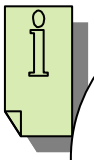


Fig. 26: Peak code domain error measurement results at –18 dBm.

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



To determine the UE's maximum output power, recall TX_meas.dfl, modify the following configurations and establish a CS call:
WCDMA-UE Signaling → Connection Setup → UE term Connect → RMC
*WCDMA-UE Signaling → Connection Setup → RMC Data rate → 384 kbps DL / UL**
WCDMA-UE Signaling → WCDMA Sig Config → TPC → Active TPC Setup → All 1

For UE output power = –18 dBm, recall TX_meas.dfl, modify the following configurations, and establish a CS call:
WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Active TPC Setup → Closed loop

WCDMA Multi Evaluation → WCDMA Sig. Config → TPC → Alg. Step size → Alg2_1dB

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

The measurement results are available here:
WCDMA Multi Evaluation → Display → Select View → CD Monitor
WCDMA Multi Evaluation → Display → Select Trace CD Monitor → CDE (I-signal and Q-signal)

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

* Option KS410 required. This setting must be made before establishing the call.

2.11 UE Phase Discontinuity (3GPP TS 34.121, 5.13.3)

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 ±(0.1 ppm + 10 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.

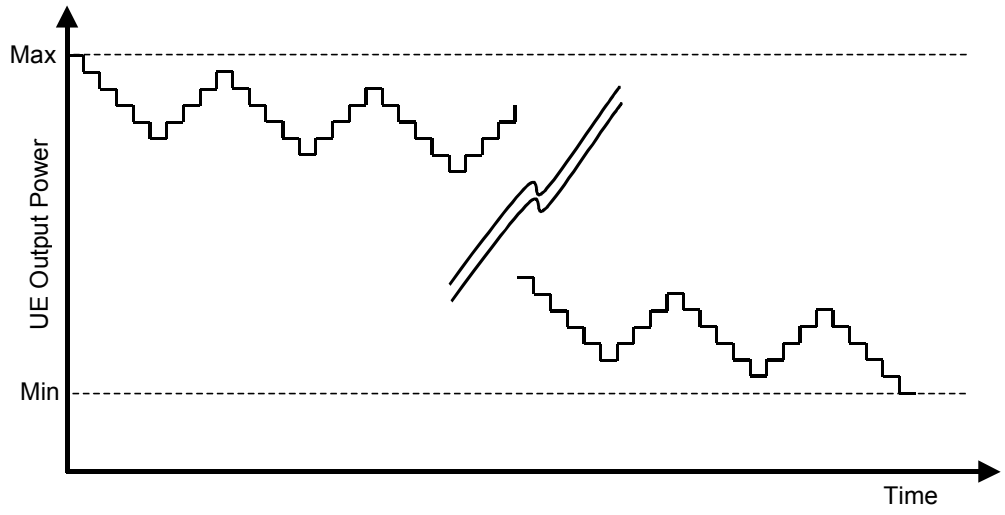


Fig. 27: Five down, four up hysteresis test pattern (Fig. 5.13.3.4 of 3GPP TS 34.121 [1]).

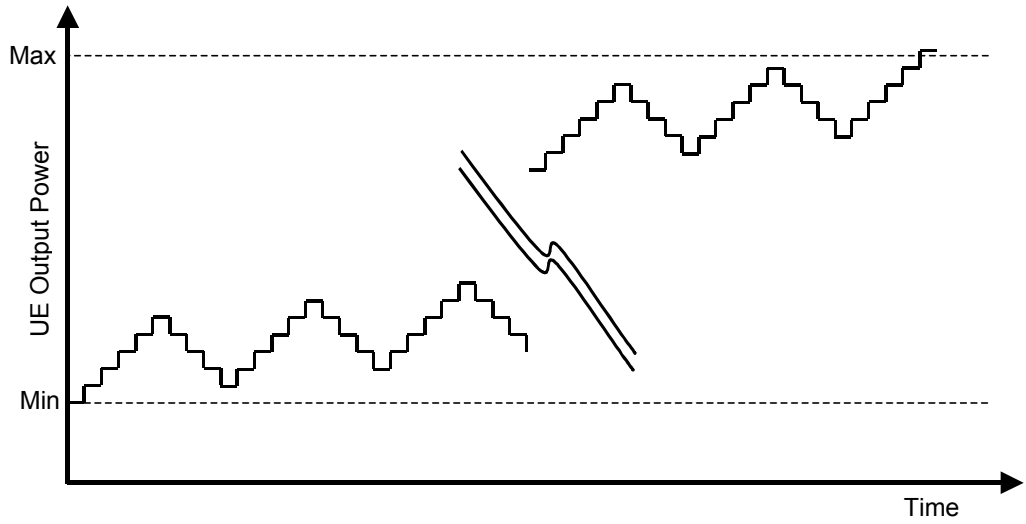


Fig. 28: Five up, four down hysteresis test pattern (Fig. 5.13.3.5 of 3GPP TS 34.121 [1]).

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

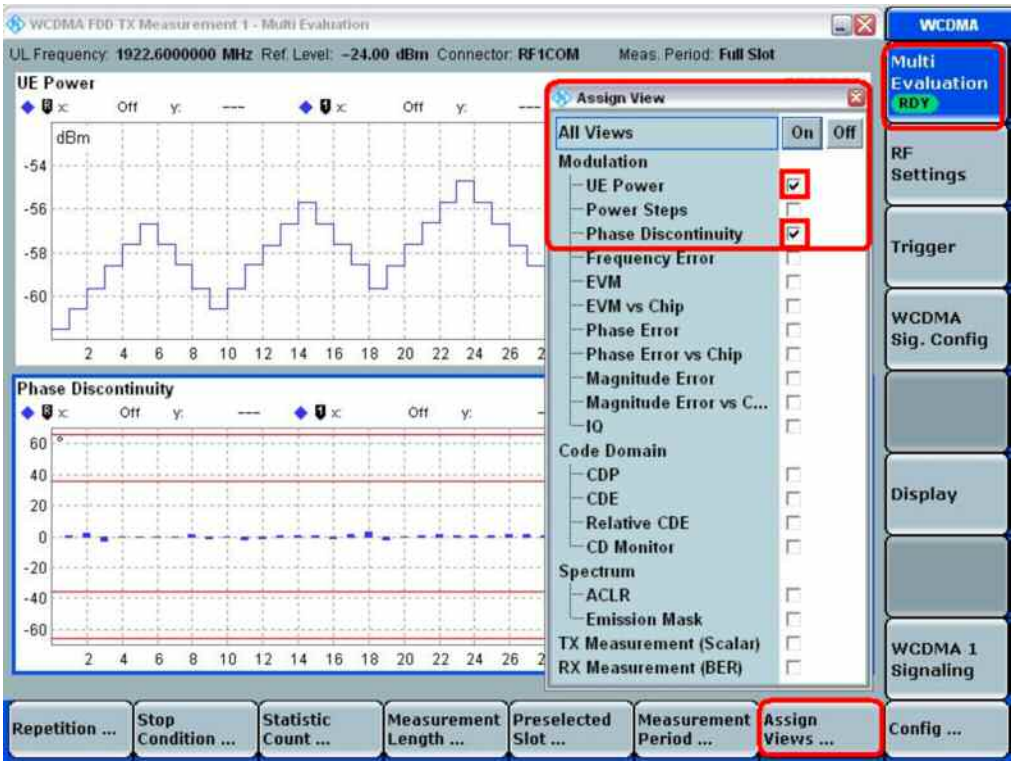


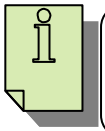
Fig. 29: Configuring the display mode.

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

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.

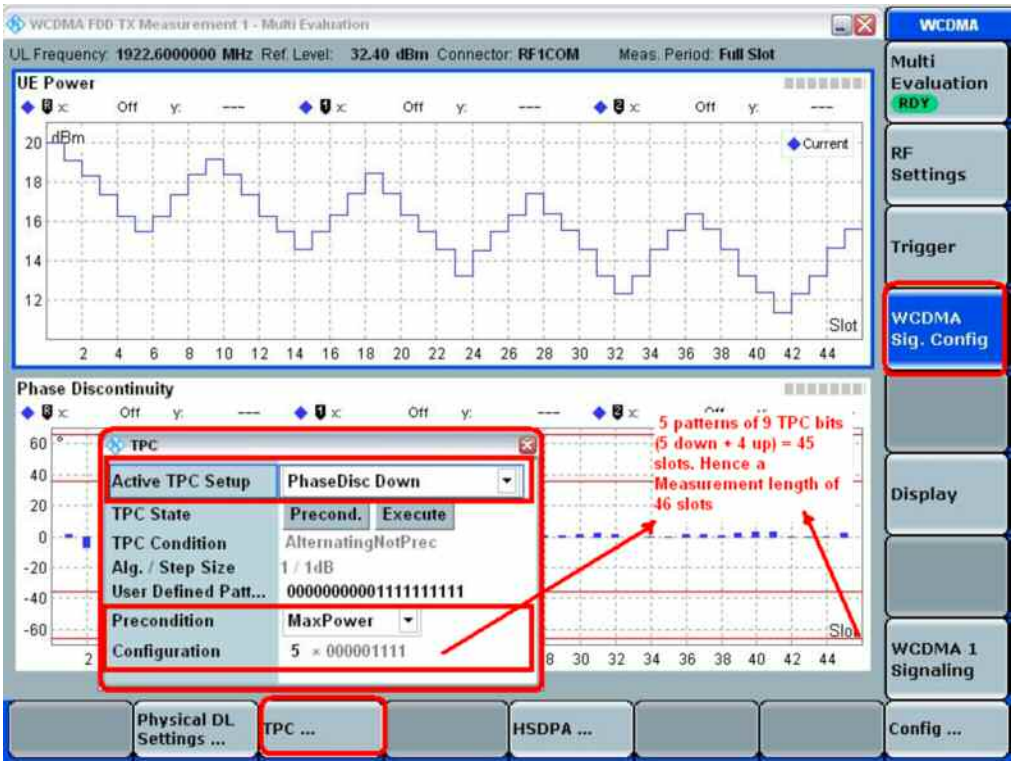


Fig. 31: Configuring the display mode configuration for the "phase discontinuity down" measurement.

WCDMA Multi Evaluation → WCDMA Sig Config → TPC → Precondition → Max Power

Here, setting the Precondition → "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 → Select View → Phase Discontinuity

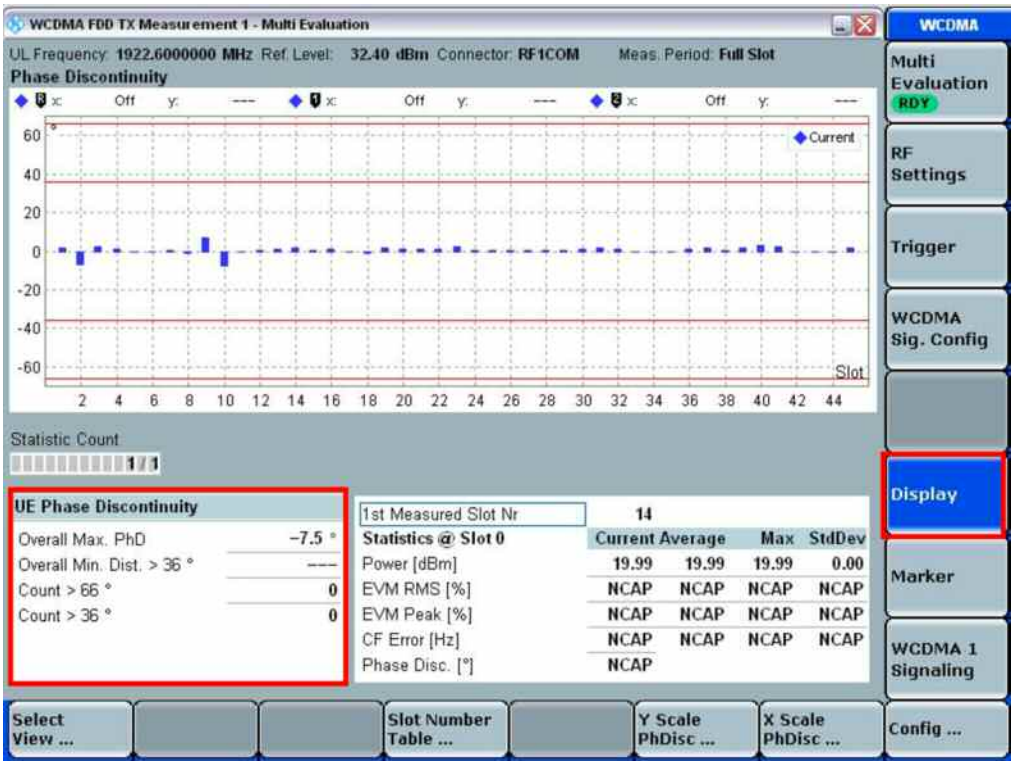


Fig. 32: Results from a phase discontinuity measurement.

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.

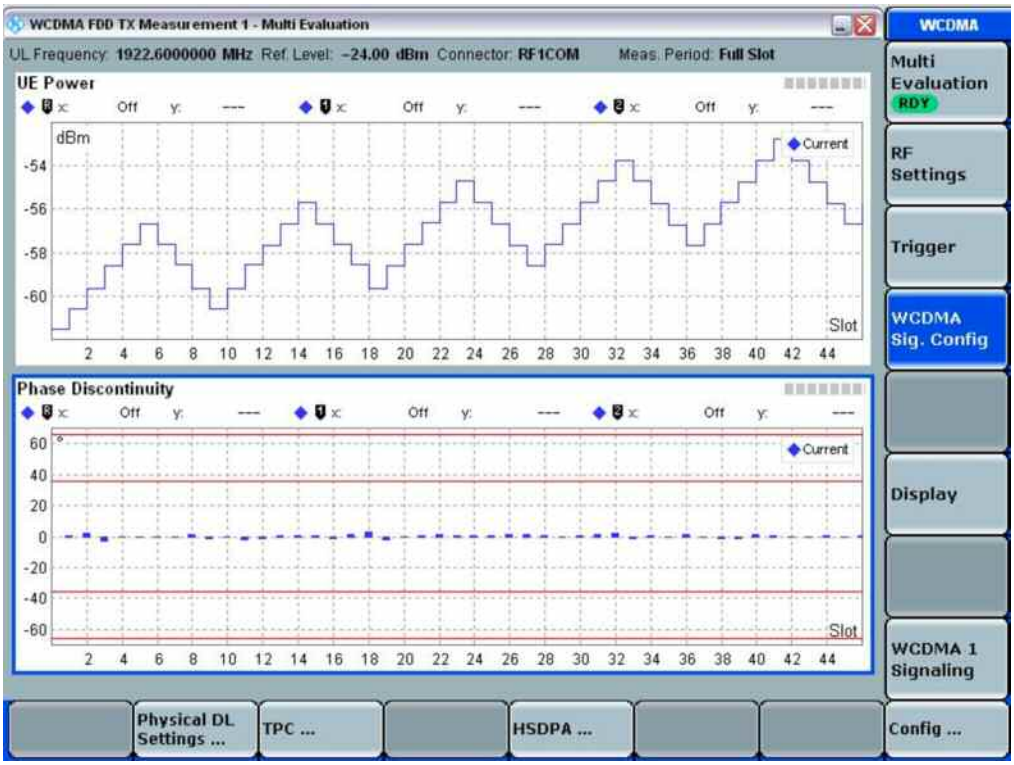


Fig. 34: UE phase discontinuity measurement results.

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.

3 Rel-99 Receiver Characteristics

3.1 Generic Call Setup for Receiver Characteristics

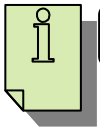
All parameters for receiver characteristics are defined using the DL reference measurement channel (12.2 kbps) as specified in 3GPP TS 34.121, Annex C.3.1, unless stated otherwise.

Configuration in the R&S®CMW500:
WCDMA-UE Signaling → Connection Setup → UE term Connect → DCH (Dedicated Chn.) Type → RMC
BS Signal → Circuit Switched → RMC Settings → Reference Channel Type → 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 Ior 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 Ior are setup according to Table 5 (reference sensitivity level, Table 6.2.2 of 3GPP TS 34.121[1]), and the BER is measured.

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

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

Configuration in the R&S®CMW500:
WCDMA-UE Signaling → Config → RF Settings → RF Downlink Power (Ior) → –106 dBm
WCDMA-UE Signaling → Config → Physical Downlink Settings → P-CPICH → –3.9 dB
WCDMA-UE Signaling → Config → Physical Downlink Settings → P-CCPCH → –8.3 dB
WCDMA-UE Signaling → Config → Physical Downlink Settings → S-CCPCH → –5.3 dB
WCDMA-UE Signaling → Config → Physical Downlink Settings → P-SCH → –11.3 dB
WCDMA-UE Signaling → Config → Physical Downlink Settings → S-SCH → –11.3 dB
WCDMA-UE Signaling → Config → Physical Downlink Settings → PICH → –8.3 dB
WCDMA-UE Signaling → Config → Physical Downlink Settings → DPDCH Level Config → –10.3 dB

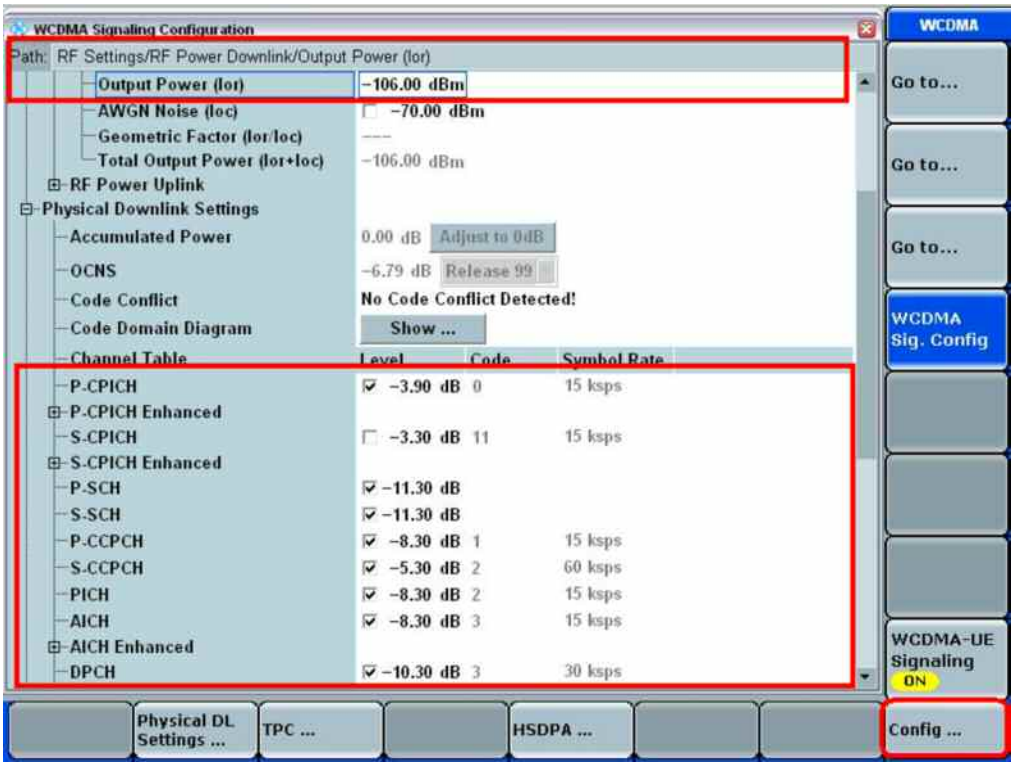


Fig. 35: Configuring downlink physical channels for the Rx sensitivity test.

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

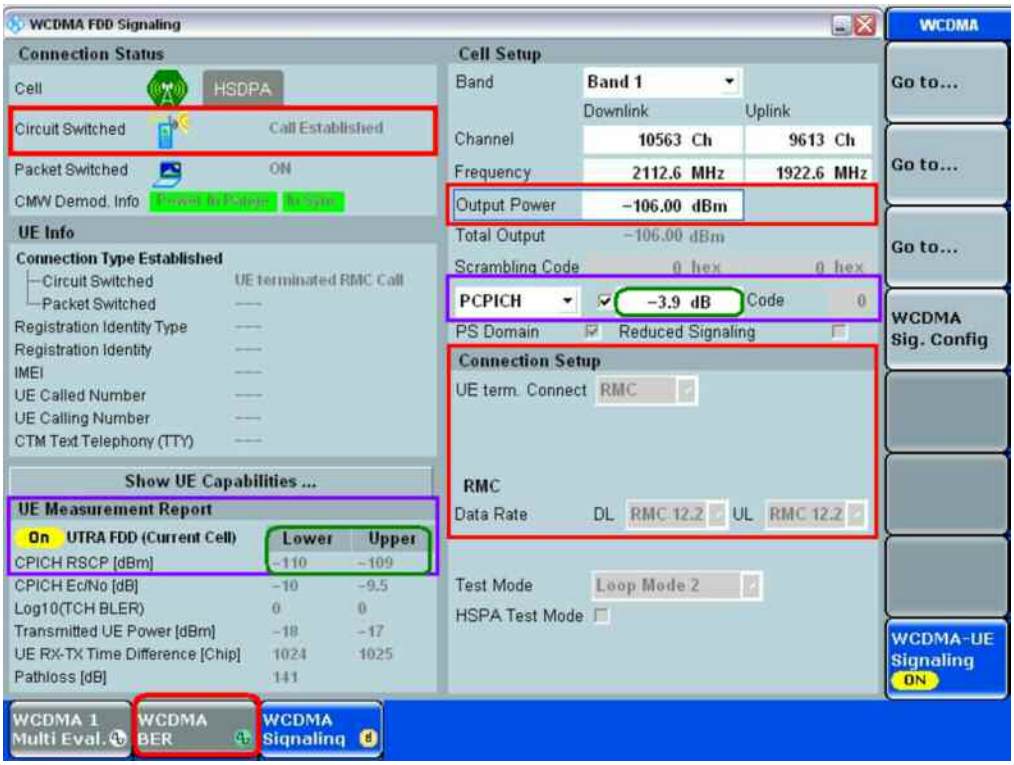


Fig. 36: Configuring the RMC and establishing a call.

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 (Ior), i.e. –106 – 3.9 = –109.9 dBm
The CPICH RSCP power reported by the UE is –109 dBm to –110 dBm.

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

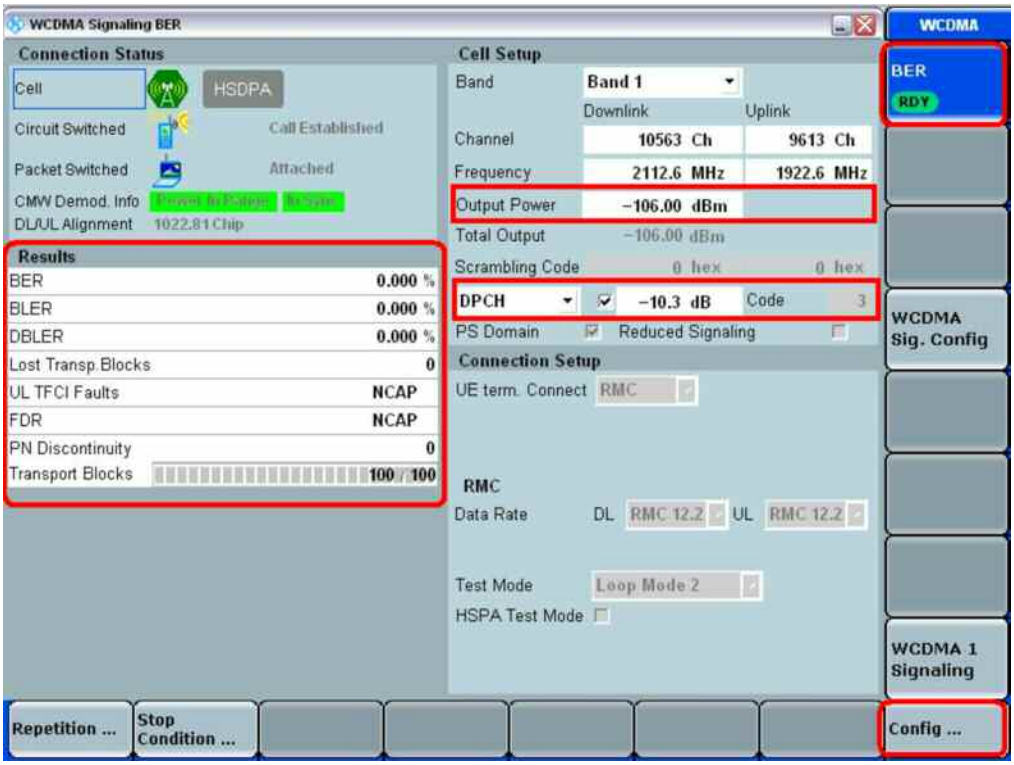


Fig. 37: Reference sensitivity measurement results.

The measured BER shall not exceed 0.001.

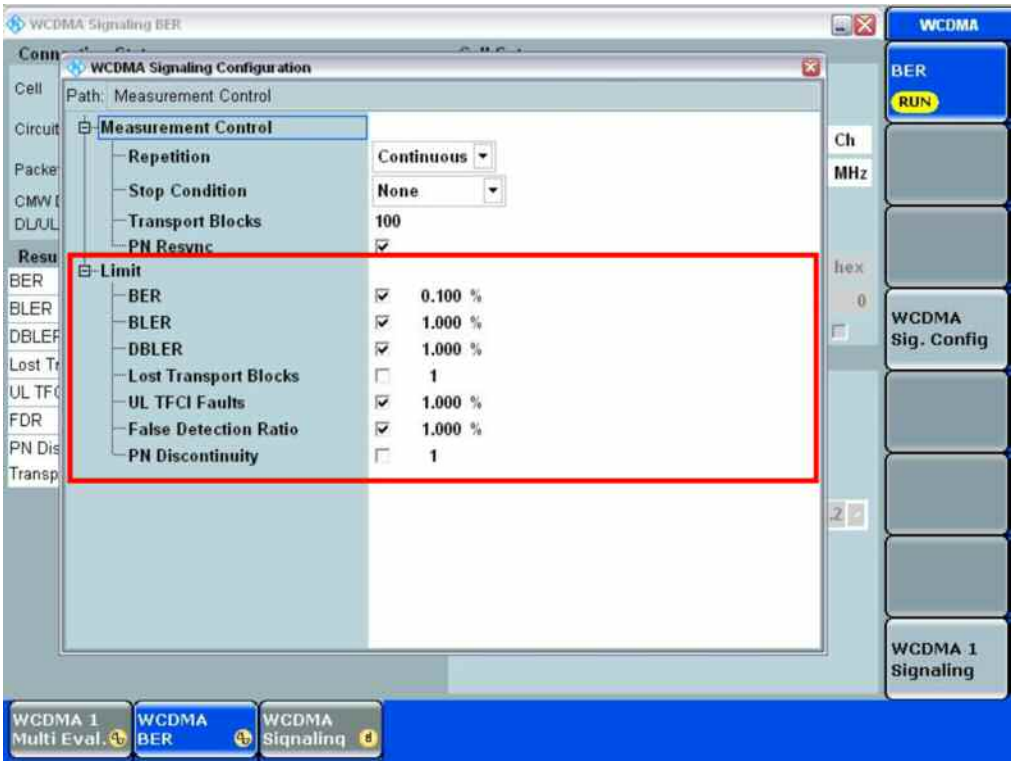


Fig. 38: The user can define tolerance limits for BER measurements.

Recall RX_meas.dfl. Modify the following configurations, and establish a CS call.
BS Signal → Node-B Settings → Output Channel Power (Ior) → –106 dBm
BS Signal → Downlink Physical Channels → P-CPICH → –3.9 dB
BS Signal → Downlink Physical Channels → P-CCPCH → –8.3 dB
BS Signal → Downlink Physical Channels → S-CCPCH → –5.3 dB
BS Signal → Downlink Physical Channels → P-SCH → –11.3 dB
BS Signal → Downlink Physical Channels → S-SCH → –11.3 dB

The measurement results are available here:
Menus → Receiver Quality → Applic. 1 → BER

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.

Test requirements for the maximum input level		
Parameter	**Level / Status**	**Unit**
I_{or}	–25.7	dBm / 3.84 MHz
DPCH_Ec / Ior	–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 / Ior = –10 dB
S-CPICH	S-CPICH_Ec / Ior = –10 dB (Note)
P-CCPCH	P-CCPCH_Ec / Ior = –12 dB
SCH	SCH_Ec / Ior = –12 dB
PICH	PICH_Ec / Ior = –15 dB
DPCH	Test-dependent power
OCNS	Power required in order for the total transmit power spectral density of Node B (Ior) 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 → Config → RF Settings → RF Power Downlink → Output

Power (Ior) → –25.7 dBm
WCDMA-UE Signaling → Config → Physical Downlink Settings → –25.7 dBm
WCDMA-UE Signaling → Config → Physical Downlink Settings → P-CPICH → –10.0 dB
WCDMA-UE Signaling → Config → Physical Downlink Settings → S-CPICH → Off
WCDMA-UE Signaling → Config → Physical Downlink Settings → P-CCPCH → –12.0 dB
WCDMA-UE Signaling → Config → Physical Downlink Settings → P-SCH → –15.0 dB
WCDMA-UE Signaling → Config → Physical Downlink Settings → S-SCH → –15.0 dB
WCDMA-UE Signaling → Config → Physical Downlink Settings → PICH → –15.0 dB
WCDMA-UE Signaling → Config → Physical Downlink Settings → DPDCH Level Config → –19.0 dB

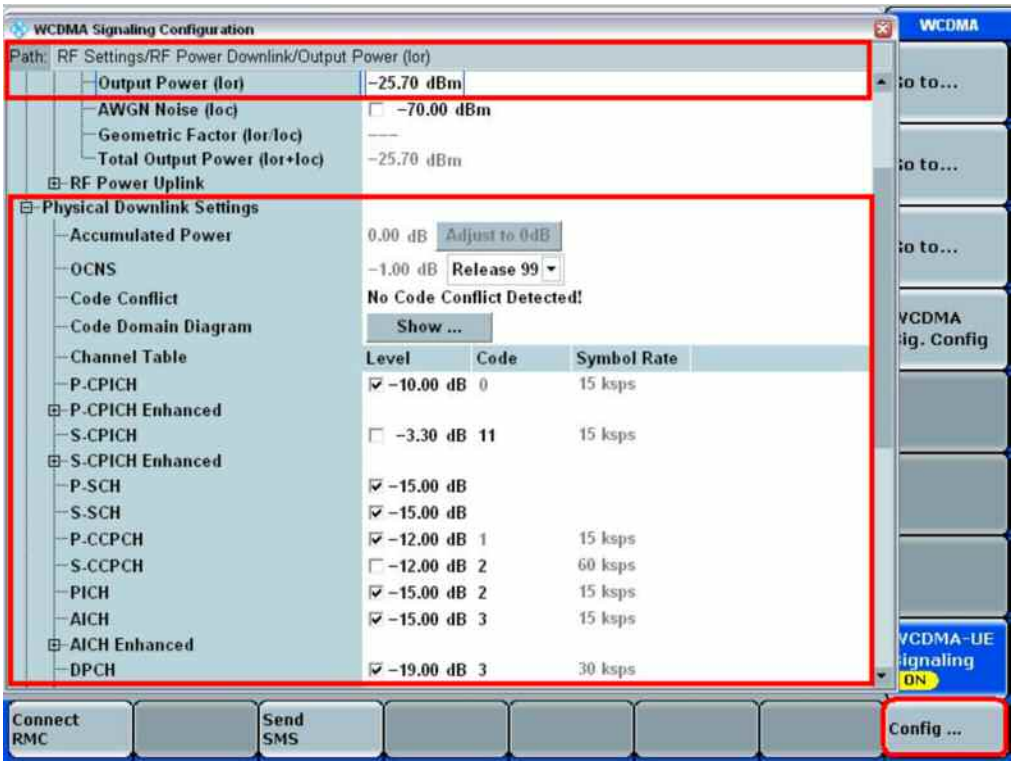


Fig. 39: Configuring physical downlink channels.

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 ±1 dB tolerance.

Configuration in the R&S®CMW500:
WCDMA Sig. Config → TPC → Active TPC Setup → Closed Loop
WCDMA Sig. Config → TPC → Alg./Step Size → Alg2_1dB
WCDMA Sig. Config → TPC → Configuration → 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 → WCDMA BER

Fig. 40 below shows the BER measurement results.

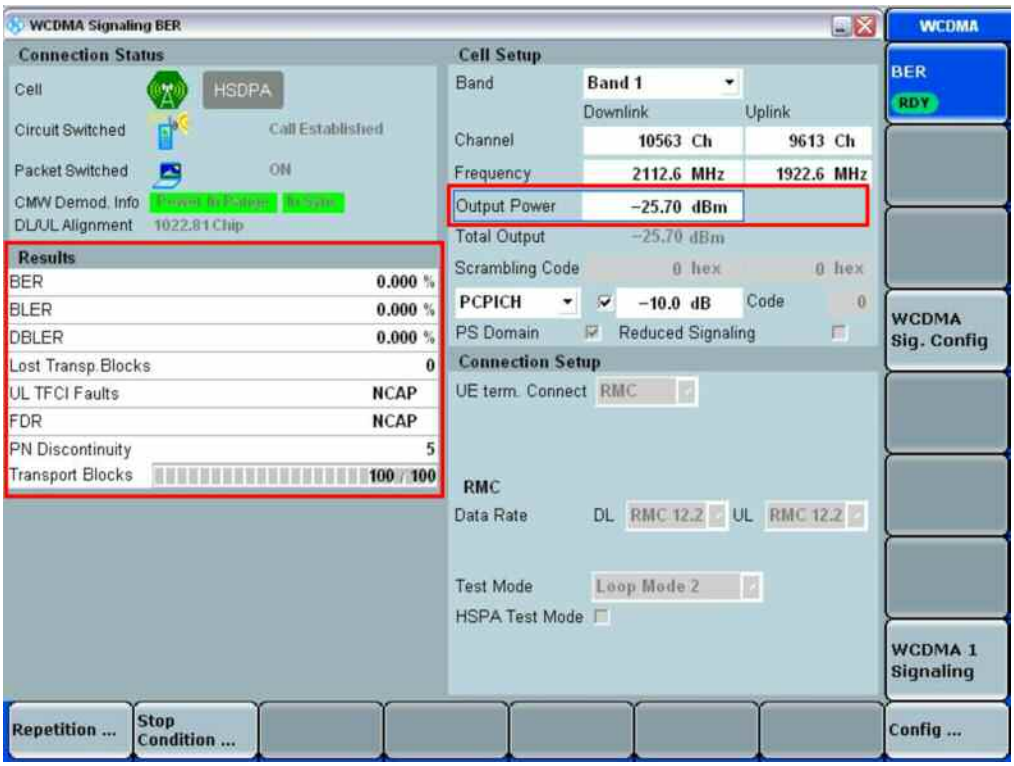


Fig. 40: BER results for the maximum input level.

The measured BER must not exceed 0.001.

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

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

Table19 below summarizes the available *.dfl files based on R&S®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

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		
Type	**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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