WCDMA Base Station Performance Tests according to TS25.141 Application Note

Products:

- I R&S[®]SMW200A
- R&S[®]SMU200A
- I R&S[®]AMU200A
- R&S[®]SMATE200A

3GPP TS25.141 defines conformance tests for UTRA base stations (NodeB).

This application note describes how performance tests (TS25.141 Chapter 8) can be performed quickly and easily by using vector signal generators from Rohde & Schwarz.

Examples illustrate the manual operation. A free software program enables and demonstrates remote operation.

The WCDMA base station transmitter (Tx) tests (TS25.141 Chapter 6) are described in Application Note 1MA67.

The WCDMA base station receiver (Rx) tests (TS25.141 Chapter 7) are described in Application Note 1MA114.



Table of Contents

1Introduction 4

2General Performance Tests	6
2.1 Note 6	
2.2Performance Test setup	6
2.3Instruments and Software options	7
3Performance Tests (Chapter 8)	8
3.1Basic operation	8
3.1.1General 3GPP FDD settings (Test Case Wizard)	9
3.1.2General Fading settings	11
3.1.3General AWGN settings	14
3.1.4Demo Program R&S TSrun	16
3.2Demodulation of DCH	20
3.2.1 Demodulation of DCH in static propagation conditions (Clause 8.2.1)	21
3.2.2Demodulation of DCH in multipath fading conditions (Clause 8.3)	24
3.2.3Demodulation of DCH in moving propagation conditions (Clause 8.4)	29
3.2.4Demodulation of DCH in birth/death propagation conditions (Clause 8.5)	32
3.3Verification of the internal BLER calculation (Clause 8.6)	35
3.4RACH performance (Clause 8.8)	38
3.4.1RACH preamble detection in static propagation conditions (Clause 8.8.1)	39
3.4.2RACH preamble detection in multipath fading case 3 (Clause 8.8.2)	42
3.4.3Demodulation of RACH message in static propagation conditions (Clause 8.8.3)	46
3.4.4Demodulation of RACH message in multipath fading case 3 (Clause 8.8.4)	49

4 Appendix 53

4.1R&S TSrun Program	53
4.2 References 58	
4.3Additional Information	58
4.4Ordering Information	59

The following abbreviations are used in this Application Note for Rohde & Schwarz test equipment:

- The R&S®SMW200A vector signal generator is referred to as the SMW.
- I The R&S®SMATE200A vector signal generator is referred to as the SMATE.
- The R&S®SMU200A vector signal generator is referred to as the SMU.
- The R&S®AMU200A baseband signal generator and fading simulator is referred to as the AMU.
- The SMATE, SMU and SMW are referred to as the SMx.
- The software R&S®TSrun is referred to as the TSrun.

1 Introduction

The Wide band code division multiple access (W-CDMA) was first introduced in 3GPP Release 99/4 considering the growing demand for higher capacity and improved data rate. Since then, it has gone through a long process of evolution to ensure high quality experience for customers and maintain market competition.

Evolution of W-CDMA						
3GPP Release	Main Features					
Rel-99/4	W-CDMA					
Rel-5	HSDPA					
Rel-6	HSUPA					
Rel-7	 Downlink MIMO 16 QAM for Uplink and 64 QAM for Downlink 					
Rel-8	Combination of MIMO and 64 QAMDual cell HSDPA					
Rel-9	 Dual cell HSUPA Dual band HSDPA Dual Cell HSDPA + MIMO 					
Rel-10	Four carrier HSDPA					

Table 1-1 gives a brief overview of the evolution of W-CDMA with 3GPP releases.

Table 1-1: Evolution of W-CDMA from 3GPP release 99/4 to release 10

3GPP specification TS 25.141 describes the conformance tests for W-CDMA base stations operating in FDD mode. It includes transmitter (Tx), receiver (Rx) and performance (Px) tests.

The transmitter (Tx) tests (TS25.141 Chapter 6) are described in Application Note 1MA67 and the receiver (Rx) tests (TS25.141 Chapter 7) are covered in Application Note 1MA114.

In this application note the WCDMA Test Case Wizard is used. Please not that this Wizard supports the testcases according to release R99/R4 only.

 Table 1-2 gives an overview of the performance tests defined in line with Chapter 8 of

 TS25.141. The tests can be carried out using instruments from Rohde & Schwarz.

 These tests are individually described in this application note.

Performance Requirement (Chapter 8) Release R99/R4								
Chapter (TS25.14	Chapter Test TS25.141)							
8.2.1 Der	8.2.1 Demodulation of DCH in static propagation conditions							
8.2	1 Demodulation of DCH							
8.3 Demo	dulation of DCH in multipath fading conditions							
8.3	1 Multipath fading Case 1							
8.3	2 Multipath fading Case 2							
8.3	3 Multipath fading Case 3							
8.3	4 Multipath fading Case 4							
8.4 Demo	dulation of DCH in moving propagation conditions							
8.5 Demo	dulation of DCH in birth/death propagation conditions							
8.6 Verifi	ation of the internal BLER calculation							
8.8 RACH	performance							
8.8	1 RACH preamble detection in static propagation conditions							
8.8	2 RACH preamble detection in multipath fading case 3							
8.8	3 Demodulation of RACH message in static propagation conditions							
8.8	8.8.4 Demodulation of RACH message in multipath fading case 3							

Table 1-2: Covered Tests according to Release R99/R4

2 General Performance Tests

2.1 Note



Very high power occurs on base stations! Be sure to use suitable attenuators in order to prevent damage to the test equipment.

2.2 Performance Test setup

Fig. 2-1 shows the general test setup for performance tests. A SMx is used to perform the test. The second RF path is used for diversity tests.



Fig. 2-1: Px Test Setup

2.3 Instruments and Software options

Several different vector signal generators can be used for the tests described here:

- I SMW
- I SMU
- SMATE + AMU

The W-CDMA **3GPP FDD** software option is available for each of the listed generators. The following are needed for the Px tests:

■ SMx-K42 3GPP FDD

The instrument needs the following general options:

- ∎ SMx-B14 Fading
- ∎ SMx-K62 AWGN

For diversity tests the SMx need a second RF path.

3 Performance Tests (Chapter 8)

Performance tests are for the receiver of the basestation. The basestation typically measures the bit error rate (BER) or the block error rate (BLER on the DCH) or the ability to detect certain signals (RACH preamble) under static or multipath channel conditions.

Reference Measurement Channels (RMC)

For the performance tests RMC are defined. They contain W-CDMA channel parameters as bit rate, spreading factor etc. They are named according to [1], annex A and split in different subsets:

- RMC 12.2
- RMC 64
- RMC 144
- RMC 384

For more details refer to [1], annex A.

All RMCs are implemented as predefined settings in the signal generator family SMx.

Channels

According to [1] the channels to be tested are at the bottom (B), in the middle (M) and at the top (T) of the supported frequency range of the base station.

3.1 Basic operation

For most of the following measurements the first operating steps are the same. They are described only once.

The SMx simulates a UE and the channel with fading and noise (if applicable). Before starting with the described steps perform a preset of the device (green button in left upper corner). In principle four main parts are necessary:

- Signal routing
- W-CDMA settings for a UE in the baseband block
- Channel simulation / Fading
- I AWGN / SNR

The SMx provides a **Test Case Wizard** which simplifies necessary settings according to TS25.141. All necessary settings (the four mentioned steps) are handled automatically according to the standard. In addition manual edition of certain parameters is possible.

3.1.1 General 3GPP FDD settings (Test Case Wizard)

1. In the block diagram click the **Baseband** block (typically A). Select **3GPP FDD...**

TDMA Standards
GSM/EDGE
Bluetooth
TETRA
CDMA Standards
3GPP FDD
CDMA2000
TD-SCDMA
1xEV-DO
WLAN Standards
IEEE 802.11
Beyond 3G Standards
IEEE 802.16 WIMAX
EUTRA/LTE

Fig. 3-1: Selecting of WCDMA (3GPP FDD) in the baseband

The 3GPP FFD A dialog opens (Fig. 3-2)



Fig. 3-2: 3GPP FDD main dialog. Use the Test Case Wizard-

3GPP FDD: Test Case Wizard (TS 25.141)	-	×
Wanted Signal AWGN Fading ⁵ -120 -140	Faded	
1.94	1.945 1.95 1.955 1.96 Frequency / GHz	
General Base Station OWanted Signal	AWGN Fading	
Test Case 8.9.4 Demodulation of CPCH Mes	ssage in Multipath Fading Case 3	•
Edit Mode 6 Transmitter	8.2 Demodulation in Static Propagation Conditions	•
7 Receiver Characteristics	8.3 Demodulation of DCH in Multipath Fading Conditions	
Baseband A Signal Routing	8.4 Demodulation of DCH in Moving Propagation Conditions	
	8.5 Demodulation of DCH in Birth/Death Propagation Conditions	
8.9.4 Demodulation of CPCH Message in Mult	8.6 Verification of Internal BLER	у
	8.8 RACH Performance	
Config.	8.9 CPCH Performance	

2. Press Test Case Wizard.

Fig. 3-3: The Test Case Wizard according to TS25.141: Available cases are shown under 8 Performance Requirement.

3. In the tab **Base Station**, set the **scrambling code** and **mode** and select the **Power Class**.

General Base Station O Wanted Sign	nal OAWGN OFading
Scrambling Code (hex)	0000 00
Scrambling Mode	Long Scrambling Code
Power Class	Wide Area BS -

- 4. Press Apply.
- 5. Switch ON the RF paths.

Trigger

In default mode the SMx starts the WCDMA signal immediately.

 To align the start of the LTE signal to the basestation under test, set Trigger In Mode to Armed Auto. (Fig. 3-4)

EUTRA/LTE A	_ ×				
General Story Trigger In Arm Auto Marker	lock ternal Info				
Trigger Settings C	ommon to all Basebands				
Mode Armed Auto					
	Stopped				
Source External Global Trigger 1					
Sync. Output To Ext. Trigger	⊘ On				
External Inhibit	0 Samples				
External Delay Unit	Samples				
External Delay	0.00 Samples				

Fig. 3-4: Trigger In settings. The SMx waits for an external trigger signal to align the WCDMA signal.

3.1.2 General Fading settings

The SMx provides channels simulators in the baseband via the block **Fading**. It allows the fast and easy configuration with predefined settings according to the different mobile radio specifications (e.g. in WCDMA 3G CASE 3). Additionally individual fading settings can be applied.

The **Test Case Wizard** applies the correct fading settings automatically. To change settings:

1. Click on the block Fading and Fading Settings (Fig. 3-5)

Fading	
Fading Settings.	÷.
Signal Routing (non-M	IIMO)
✓ A-► A	B - ► B
A−►A	B – ► A
A-► B	B → B
A → A and B	B −► (open)
A - ► (open)	B —► A and B
A –► A and B	B →► A and B
Signal Routing (MIMO))
System Configu	ation
Summation Ratio A / E	}
0.0 dB	

Fig. 3-5: Fading Settings

- 2. Select a profile via Standard (e.g. 3GPP Case 3 (UE/BS)) (Fig. 3-6 and Fig. 3-7)
- 3. Switch the fading block **On**. (Fig. 3-6)

Fading A								_	×	٢
General Standard/Fine Delay	Restart Auto	Insertion Loss Config. / Coupled Parameters	Path	Table	Path Graph					
Off On					C S	et To efault	P Reca		Save	•
Standard	3GPP (Case 3 (UE/BS)	i.							
Configuration	Standar	[.] d/Fine Delay	•	Fadin	ng Clockrate	200) MHz			
Signal Dedicated To	Auto D	etect Output		Dedic	cated Freq		1.950 000	000 00	GHz	•
				Dedic	cated Connect	or RfA	L			•
Ignore RF Changes	< 5%	(On	Freq.	Hopping	Off				•

Fig. 3-6: Overview General Fading settings. Select a predefined setting in Standard

	User		3GPP Case 1 (UE/BS)
	CDMA	۲	3GPP Case 2 (UE/BS)
	GSM	۲	3GPP Case 3 (UE/BS)
	NADC	۲	3GPP Case 4 (BS)
	PCN	۲	3GPP Case 4 (UE)
	TETRA	۲	3GPP Case 5 (UE)
	3GPP	Þ	3GPP Case 6 (UE)
ľ	WLAN	۲	3GPP Case 7 (UE-Sector)
	DAB	۲	3GPP Case 7 (UE-Beam)
	WIMAX	۲	3GPP Case 8 (UE)
	WIMAX-MIMO	۲	3GPP PA 3
	LTE	۲	3GPP PB 3
	LTE-MIMO	۲	3GPP VA 3
	1xEVDO	۲	3GPP VA 30
Ì	WATTERSON	۲	3GPP VA 120
	802.11n-SISO	۲	3GPP MBSFN (18Path)
i	-		-

Fig. 3-7: Predefined Fading profiles for 3GPP

- 4. Repeat the settings in other paths. If special MIMO modes are used, this is done automatically
- 5. The path settings are shown as a table and as graph. Individual settings can be handled in the tables. (Fig. 3-8 and Fig. 3-9)

Fading A					_ :
General Standard/Fine Delay	estart _{Jto}	Insertion Loss Config Coupled Parameters	g. / Path Table Path	n Graph	
Table Settings		Copy Path Group	1 To	o	2 Copy
	Unit	1 1	1 2	1 3	1 4
State		On	On	On	On
Profile		Rayleigh	Rayleigh	Rayleigh	Rayleigh
Path Loss /dB		0.00	1.50	1.40	3
Basic Delay /µs	μs	0.000 000	0.000 000	0.000 000	0.000 (
Additional Delay /µs	μs	0.000 000	0.030 000	0.150 000	0.310 (
Resulting Delay /µs	μs	0.000 000	0.030 000	0.150 000	0.310 (
Power Ratio /dB					

Fig. 3-8: Fading Path table



Fig. 3-9: Fading Path graph

3.1.3 General AWGN settings

The SMx provides noise via the block AWGN. The power levels in [1] are always set via a noise power and a relative signal-to-noise (SNR) requirement.

The **Test Case Wizard** applies the correct AWGN settings automatically. To change settings:

- 1. Click on the block AWGN
- 2. Switch the state ON and set the Mode to Additive Noise. (Fig. 3-10, Fig. 3-11)
- 3. Set the **System Bandwidth** to **3.840 MHz** (Fig. 3-10).
- 4. Set the **Ratio** to 2 (Fig. 3-10).

1	AWGN Setting	s A		_	×
	OGeneral	Noise Power / Output Results			
ĺ	State		Off		On
	Mode		Additive Noise		•
	System Bandwidth		3.840 0	MHz	•
	Min Noise/System Bandwidth Ratio				2

Fig. 3-10: General AWGN settings. The system bandwidth is 3.840 MHz.

- 5. Set the **Reference Mode** to **Noise**.
- Set the Noise Power and the Carrier to Noise Ratio (SNR) (e.g. power = -80.5 dB, SNR = 4 dB) (Fig. 3-11). Please note that for certain testcases an additional SNR correction factor applies.
- 7. For the SMU each AWGN block has to be set separately.
- 8. For the SMW the referenced RF port has to be set (e.g. RF A)

AWGN Settings A		_	×
General Noise Power / Output Results			
Show Powers For Output	RF A		·
Set Noise Power Via	C/N		•
Reference Mode	Noise		·
Bit Rate	100.000 000	kbps	
Carrier/Noise Ratio	-4.00	dB	
Eb/N0	15.54	dB	•
Carrier Power	-84.50	dB	•
Noise Power (System Bandwidth)	-80.50	dB	·
Noise Power (Total Bandwidth)	-76.99	dB	•

Fig. 3-11: AWGN settings. Set the noise power and the SNR. The effective Carrier Power is shown.

3.1.4 Demo Program R&S TSrun

This Application Note comes with a demonstration program module called **WCDMA BS Performance Tests** for the software **R&S TSrun** which is free of charge. The module covers all required tests (with the exceptions in Table 1-2).

The **WCDMA BS Performance Tests** module represents a so called test for the TSrun software. See Section 4.1 for some important points on the basic operation of TSrun.

Each test described in this application note can be executed quickly and easily using the module. Additional individual settings can be applied.

The program offers a straightforward user interface, and SCPI remote command sequence export functions for integrating the necessary SCPI commands into any user-specific test environment. A measurement report will be generated on each run. It can be saved to a file in different formats including PDF and HTML.

Following SCPI resources are needed:

I SMx

Getting started

This section describes only the module for the WCDMA BS Px tests. Double-click the test to open the window for entering parameters.

The test consists of two independent testcases:

WCDMA_BS_Px_Tests							
÷	UCDMA_BS_Px_Tests						
	T Reset All						
	Measurement						

- The testcase **ResetAll** resets all instruments (SMx)
- The testcase Measurement is the main part.

WCDMA BS Performance	e Test	-		B	-	
ROHDE&SCH	WARZ					Help
Test Case: 8.2.1 Der	modulation of DCH in S	tatic Pro	opagation Conditions			Reset Device Ext. Ref.
-General Parameters RF Frequency	1950.00	MHz	- Test Specific Parameters Wanted Signal	S		Comments: 8.2.1 Demodulation of DCH in Static Propagation Conditions:
Power Level	-100.28	dBm	Ref. Measurement Ch. Block Error Rate	RMC 12.2	kbps	Generates a DCH signal of 1 UE with different RMC's in static channel conditions (AW(GN)
Diversity			Transport Block Size	168	Bits	Note: For diversity the second RF path is necessary.
Base Station			- AWGN	-84.00	dBm	
Power Class Scrambling Mode	Wide Area Long Scrambling		Required BLER	< 0.01	·	Tutota
Scrambling Code	000000	HEX	Required Pd	>= 0.99		BS Contractions
Generator Attenuation	on	رن <u>۔۔۔۔</u>	Eb/N0	8.70) dB	Charnel AWGN
Path A	0.00	dB	Fading			
Path B	0.00	dB	State	Off		SMx
						OK Cancel

Fig. 3-12: Full overview: setting parameters for the WCDMA BS Performance tests.

General settings

The basic parameters are set at the top right:

- Reset Devices: Sends a reset command to all connected instruments
- Ext. Ref: Uses an external reference

Reset Device	Ext. Ref.
--------------	-----------



The **Attenuation** section is used to enter compensations for external path attenuations.

- Generator Attenuation				
Path A	0.00	dB		
Path B	0.00	dB		

Fig. 3-14: Attenuation settings.

Test cases

This is the main parameter. Select the wanted test case here. All other remaining parameters in the window are grayed out or set active based on the requirements for the selected test case. These parameters are described in detail in the individual sections below.

8.2.1 Demodulation of DCH in Static Propagation Conditions
8.2.1 Demodulation of DCH in Static Propagation Conditions
8.3.1 Demodulation of DCH in Multipath Fading Conditions Case 1
8.3.2 Demodulation of DCH in Multipath Fading Conditions Case 2
8.3.3 Demodulation of DCH in Multipath Fading Conditions Case 3
8.3.4 Demodulation of DCH in Multipath Fading Conditions Case 4
8.4 Demodulation of DCH in Moving Propagation Conditions
8.5 Demodulation of DCH in Birth/Death Propagation Conditions
8.6 Verification of Internal BLER Calculation
8.8.1 RACH Preamble Detection in Static Propagation Conditions
8.8.2 RACH Preamble Detection in Multipath Fading Case 3
8.8.3 Demodulation of RACH Message in Static Propagation Conditions
8.8.4 Demodulation of RACH Message in Multipath Fading Case 3
olo.+ Demodulation of rotort message in manipatin rading oase o



Based on the selected test case, helpful hints are provided in the Comments section and an illustration of the basic test setup is displayed.

Comments:
8.2.1 Demodulation of DCH in Static Propagation Conditions:
Generates a DCH signal of 1 UE with different RMC's in static channel conditions (AWGN).
Note: For diversity the second RF path is necessary.

Fig. 3-16: Brief notes are provided in the Comments section (top right) based on the selected test case.



Fig. 3-17: The Test Setup section (bottom right) displays a basic setup for the selected test case.

General settings for the signal

Use this section to define the basic parameters for the LTE signal:

- **RF Frequency** for the center frequency
- Power Level: the wanted level
- **Trigger Mode:** typically External trigger provided by the basestation under test
- Diversity: switches on the RX diversity
- The section **Base Station** defines the general BS settings:
 - Power Class
 - Scrambling Mode
 - Scrambling Code

More advanced settings for specific tests cases are described in the corresponding sections below.

General Parameters					
RF Frequency	1950.00	MHz			
Power Level	-100.28	dBm			
Trigger Mode	Armed Auto (Ext.) 👻				
Diversity					
Base Station					
Power Class	Wide Area 🔹				
Scrambling Mode	Long Scrambling -				
Scrambling Code	000000	HEX			

Fig. 3-18: Main parameter settings.

3.2 Demodulation of DCH

The Dedicated Channel (DCH) is a transport channel for dedicated user and control data. For reproducible testing, so called Reference Measurement Channels (RMC) has been defined in the specification.

The performance requirement for DCH is determined by the maximum Block Error Ratio (BLER) allowed when the receiver input signal is at a specified E_b/N_0 limit. The BLER is calculated for each of the measurement channels supported by the base station [1].

If external BLER measurement is not used then the internal BLER calculation shall be used instead. When internal BLER calculation is used, the requirements of the verification test according to 8.6 shall be met in advance [1].

DCH tests and data rates						
Reference Measurement Channel data rate (kbit/s)	8.2	8.3	8.4	8.5		
12.2	V	V	V	V		
64	V	V	V	V		
144	V	V	-	-		
384	V	Ø	-	-		
Table 3-1: different data rates in DCH tests						

Table 5-1. different data fates in Dorn tes

The AWGN is for all DCH tests:

AWGN settings					
Base Station	AWGN (dBm)				
Wide Area	- 84				
Medium Range	- 74				
Local Area / Home BS	- 70				

Table 3-2: AWGN settings for DCH tests

The resulting RF level is calculated:

$$Level = AWGN + 10 \times log_{10} \frac{RMC}{3.84 \times 10^6} + \frac{E_b}{N_0}$$

Example for a wide area BS with a RMC of 64 kbit/s and Eb/N0 of 5.5 dB: Level = -84 dBm - 17.78 dB + 5.5 dB = -96.28 dBm.

3.2.1 Demodulation of DCH in static propagation conditions (Clause 8.2.1)

In this test the BLER is determined in static propagation conditions (AWGN) at certain $E_{\rm b}/N_{\rm 0.}$

The test shall verify the receiver's ability to receive the test signal under static propagation conditions with a BLER not exceeding a specified limit [1].

Requirements for DCH in AWGN channel					
Measurement channel (kbit/s)	BLER	E _b /N₀ With Rx Diversity (dB)	E _b /N₀ Without Rx Diversity (dB)		
40.0	0.1	n.a.	n.a.		
12.2	0.01	5.5	8.7		
	0.1	1.9	5.1		
64	0.01	2.1	5.2		
	0.1	1.2	4.2		
144	0.01	1.3	4.4		
004	0.1	1.3	4.4		
384	0.01	1.4	4.5		

Table 3-3: Requirements for 8.2.1

Test Setup

Fig. 3-19 shows the test setup.

For diversity the wanted signal generated by SMx baseband A is split up in two paths. AWGN is added.

The SMU needs an external trigger at input TRIGGER1, the SMW at USER3.



Fig. 3-19: Test setup for DCH test 8.2.1

Test Procedure

As an example the settings for diversity, wide area BS and a BLER of 0.01 are shown.

- 1. For the basic steps see section 3.1.1.
- 2. Select **8.2.1 Demodulation of DCH** and switch **Diversity ON.** (both in tab **General**)

General	Base Station	○ Wanted Signa	○ Fading			
Test Case	8.2.1 Democ	dulation of DCH				-
Edit Mode			Accordir	ng to Standard -	Marker Configuration	Auto
Trigger Configuration			Auto (Ex	t. Trigger 1) -	Diversity	On -

3. Select the **Reference Measurement Channel** and set the **RF Frequency**. In addition the resulting **Power Level** is displayed. (example: RMC 12.2 kbps, 1.95 GHz)

General Base Station O War	nted Signal 🔘 AWGN 🔘	Fading	
State	Off On	Reference Measurement Channel	RMC 12.2 kbps -
RF Frequency	1.950 000 000 00 GHz ·	Power Level	-103.5 dBm 🕞

4. Set the required **BLER** (example **0.01**). In addition the **AWGN level** (depends on the Base station power class) and the **Eb/No** is displayed

3GPP FDD: T	est Case Wizard	(TS 25.141)					_	×
Wante AWGN Fading	d Signal I 9	.70 .80 .90 .100 .100 .120 .130 .140						
		1.94	1.945	Freq	1.95 Juency / GHz	1.955	1.9	96
General	Base Station	O Wanted Signal) Fading				
State		Off	On	Required BI	LER		< 0).01 -
Power Le	vel (within 3.84	MHz BW)	-84.00 dBm -	Eb/N0			5.5	0 dB -
8.2.1 Dem	odulation of D	сн					Ap	ply

5. Measure the BLER at the base station.

Demo Program

Fig. 3-20 shows the parameters of the test. Select the wanted **Ref Measurement Ch.** and the **Required BLER**. When selecting a particular test all settings are default according to the specification. The setting of the **Eb/N0** depends on the RMC and the required BLER and diversity. The level depends also on the base station power class. For this test the fading is Off.

Test Specific Parameters								
Wanted Signal								
Ref. Measurement Ch.	RMC 12.2 -	kbps						
Block Error Rate	0.01 -							
Transport Block Size	168 👻	Bits						
AWGN								
Power Level	-84.00	dBm						
Required BLER	< 0.01 ▼							
Required Pd	>= 0.99 👻							
Eb/N0	8.70	dB						
Fading								
State	Off							

Fig. 3-20: Parameter for DCH test 8.2.1

Fig. 3-21 shows the report.

WCDMA Base Station Performance Test Test Case: 8.2.1 Demodulation of DCH in Static Propagation Conditions Generator Settings: Trigger Configuration: Armed Auto (Ext.) Diversity: On Attenuation (Path A): 1.23 dB Attenuation (Path B): 2.34 dB Base Station Configuration: Power Class: Wide Area Scrambling Mode: Long Scrambling Scrambling Code: 000000 HEX Settings Item and Configuration Value Unit Status Wanted Signal **RF Frequency** 1950.00 MHz ------Power Level ____ -103.48 dBm RMC 12.2 kbps Reference Measurement Channel AWGN Power Level within 3.84 MHz BW -84.00 dBm ---Required BLER ____ < 0.01 -/-Eb/N0 5.50 dB Fading Off -/-State ____

Settings in compliance with TS 25.141!

Fig. 3-21: Report 8.2.1

3.2.2 Demodulation of DCH in multipath fading conditions (Clause 8.3)

In this test the BLER is determined in multipath fading conditions and additional AWGN at certain E_{b}/N_{0}

The test is split in four different tests with different fading conditions. Pleas also note the applicability for the different BS power classes:

Test	Fading	BS class
8.3.1	Case 1	All
8.3.2	Case 2	Not Home BS
8.3.3	Case 3	Not Home BS
8.3.4	Case 4	Wide Area only

Table 3-4: Four tests with different fading conditions for 8.3

The tests shall verify the receiver's ability to receive the test signal

- under slow multipath fading propagation conditions (8.3.1)
- that has a large time dispersion (8.3.2)
- under fast fading propagation conditions (8.3.3 and 8.3.4)

with a BLER not exceeding a specified limit [1].

Requirements for DCH in multipath case 1 channel (8.3.1)									
Measurement channel (kbit/s)	BLER	E _b /N₀ With Rx Diversity (dB)	E _b /N₀ Without Rx Diversity (dB)						
10.0	0.1	n.a.	n.a.						
12.2	0.01	12.5	19.7						
	0.1	6.8	12.2						
64	0.01	9.8	16.5						
	0.1	6.0	11.4						
144	0.01	9.0	15.6						
	0.1	6.4	11.8						
384	0.01	9.4	16.1						

The tables Table 3-5 to Table 3-8 show the different test requirements.

Table 3-5: Requirements for 8.3.1

Requirements for DCH in multipath case 2 channel (8.3.2)									
Measurement channel BLER (kbit/s)		E _b /N₀ With Rx Diversity (dB)	E _b /N₀ Without Rx Diversity (dB)						
40.0	0.1	n.a.	n.a.						
12.2	0.01	9.6	15.6						
	0.1	4.9	9.8						
64	0.01	7.0	12.9						
	0.1	4.3	8.8						
144	0.01	6.2	12.1						
384	0.1	4.7	9.3						
	0.01	6.7	12.7						

Table 3-6: Requirements for 8.3.2

Requirements for DCH in multipath case 3 channel (8.3.3)									
Measurement channel (kbit/s)	BLER	E _b /N₀ With Rx Diversity (dB)	E _b /N₀ Without Rx Diversity (dB)						
	0.1	n.a.	n.a.						
12.2	0.01	7.8	11.4						
	0.001	8.6	12.3						
	0.1	4.0	7.7						
64	0.01	4.4	8.3						
	0.001	4.7	9.1						
	0.1	3.4	6.6						
144	0.01	3.8	7.3						
	0.001	4.2	7.8						
	0.1	3.8	7.1						
384	0.01	4.2	7.8						
	0.001	4.8	8.5						

Table 3-7: Requirements for 8.3.3

Requirements for DCH in multipath case 4 channel (8.3.4)								
Measurement channel (kbit/s)	BLER	E _b /N₀ With Rx Diversity (dB)	E _b /N₀ Without Rx Diversity (dB)					
	0.1	n.a.	n.a.					
12.2	0.01	10.8	14.4					
	0.001	11.6	15.3					
	0.1	7.0	10.7					
64	0.01	7.4	8.3					
	0.001	7.7	12.1					
	0.1	6.4	9.6					
144	0.01	6.8	10.3					
	0.001	7.2	10.8					
	0.1	6.8	10.1					
384	0.01	7.2	10.8					
	0.001	7.8	11.5					

Table 3-8: Requirements for 8.3.4

Test Setup

Fig. 3-22 shows the test setup.

For diversity the wanted signal generated by SMx baseband A is split up in two paths. The channel is simulated and AWGN is added.



The SMU needs an external trigger at input TRIGGER1, the SMW at USER3.

Fig. 3-22: Test setup for DCH test 8.3

Test Procedure

As an example the settings for diversity, Medium Range BS , RMC 384 and a BLER of 0.001 for fading case 3 are shown.

- 1. For the basic steps see section 3.1.1.
- 2. Select **8.3.3 Demodulation of DCH** and switch **Diversity ON.** (both in tab **General**)

General	Base Station	Wanted Signal	O AWGN	O Fading			
Test Case	e 8.3.3 Multipa	th Fading Case 3					
Edit Mode	•			Accordin	ng to Standard -	Marker Configuration	Auto
Trigger C	onfiguration			Auto (Ex	t. Trigger 1)	Diversity	On

 Select the Reference Measurement Channel and set the RF Frequency. In addition the resulting Power Level is displayed. (example: RMC 384 kbps, 1.95 GHz)

General	Base Station	Wanted Signal	O AWGN	0	Fading	
State		Off(On	Reference Measurement Channel RMC 384 kbps	; •
RF Frequ	ency	1.950 000	000 00 GH	۰z	Power Level -79.80 dBm	

4. Set the required **BLER** (example **0.001**). In addition the **AWGN level** (depends on the Base station power class) and the **Eb/No** is displayed. Note that **Fading** is switched On.

3GPP FDD: 1	Fest Case Wizard	(TS 25.141)					_	×
Wante AWGN Fadin	:d Signal I 9	-60 -70 -70 -70 -70 -70 -70 -70 -70 -70 -7		Faded	2		$\langle \rangle$	
		1.94	1.945	1.95 Frequency	r / GHz	1.955	1.9	96
General	Base Station	Wanted Signal		Fading				
State		Off	On	Required BLER			< 0).001 -
Power Le	vel (within 3.84	MHz BW)	-74.00 dBm	Eb/N0			4.8	10 dB -
8.3.3 Multi	path Fading C	ase 3					Ap	ply

5. Measure the BLER at the base station.

Demo Program

Fig. 3-23 shows the parameters of the test. Select the wanted **Ref Measurement Ch.** and the **Required BLER**. When selecting a particular test all settings are default according to the specification. The setting of the **Eb/N0** depends on the RMC and the required BLER and diversity. The level depends also on the base station power class. For this test the fading is **On**, the settings depend on the testcase (case 1...4).

Test Specific Parameters			
Wanted Signal			
Ref. Measurement Ch.	RMC 64 -	kbps	
Block Error Rate	0.01 -]	
Transport Block Size	168 -	Bits	
AWGN			
Power Level	-84.00	dBm	
Required BLER	< 0.1 ▼]	
Required Pd	>= 0.99 👻		
Eb/N0	12.20	dB	
Fading			
State	On		

Fig. 3-23: Parameter for DCH test 8.3.1

Fig. 3-24 shows the report.

WCDMA Base Station Performance Test Test Case: 8.3.1 Demodulation of DCH in Multipath Fading Conditions Case 1 Generator Settings: Trigger Configuration: Armed Auto (Ext.) Diversity: Off Attenuation (Path A): 1.23 dB Base Station Configuration: Power Class: Wide Area Scrambling Mode: Long Scrambling Scrambling Code: 000000 HEX Settings Item and Configuration Value Unit Status Wanted Signal **RF Frequency** 1950.00 MHz _ Power Level -89.58 dBm ____ ____ **Reference Measurement Channel** RMC 64 kbps AWGN Power Level within 3.84 MHz BW -84.00 dBm Required BLER < 0.1 -/---------Eb/N0 12.20 dB _ ___ Fading State --------On -/-

Settings in compliance with TS 25.141!

Fig. 3-24: Report 8.3.1

3.2.3 Demodulation of DCH in moving propagation conditions (Clause 8.4)

In this test the BLER is determined in moving propagation conditions and additional AWGN at certain $E_{\rm b}/N_{0}$

The test shall verify the receiver's ability to receive and track the test signal with a BLER not exceeding a specified limit [1].

Requirements for DCH in moving channel				
Measurement channel (kbit/s)	BLER	E _♭ /N₀ With Rx Diversity (dB)	E _b /N₀ Without Rx Diversity (dB)	
40.0	0.1	n.a.	n.a.	
12.2	0.01	6.3	9.3	
	0.1	2.7	5.9	
64	0.01	2.8	6.1	

Table 3-9: Requirements for 8.4

Test Setup

Fig. 3-25 shows the test setup.

For diversity the wanted signal generated by SMx baseband A is split up in two paths. AWGN is added.



The SMU needs an external trigger at input TRIGGER1, the SMW at USER3.

Fig. 3-25: Test setup for DCH test 8.4

Test Procedure

As an example the settings for diversity, wide area BS, RMC 64 and a BLER of 0.01 are shown.

- 1. For the basic steps see section 3.1.1.
- 2. Select **8.4 Demodulation of DCH in Moving Propagation Conditions** and switch **Diversity ON.** (both in tab **General**)

General	Base Station	Wanted Signal	O AWGN	• Fading			
Test Case	8.4 Demodu	lation of DCH in Mo	ving Propag	ation Condition	s		·
Edit Mode	1			According to	o Standard -	Marker Configuration	Auto -
Trigger C	onfiguration			Auto (Ext. T	rigger 1) -	Diversity	On ·

 Select the Reference Measurement Channel and set the RF Frequency. In addition the resulting Power Level is displayed. (example: RMC 64 kbps, 1.95 GHz)

General Base	Station	OWanted Signal		10	Fading			
State		Off(0	On	Referenc	e Measurement Chann	el R	MC 64 kbps
RF Frequency		1.950 000	000 00 G	Hz •	Power Le	evel		-98.98 dBm

4. Set the required **BLER** (example **0.01**). In addition the **AWGN level** (depends on the Base station power class) and the **Eb/No** is displayed. Note that **Fading** is switched On.



5. Measure the BLER at the base station.

Demo Program

Fig. 3-26 shows the parameters of the test. Select the wanted **Ref Measurement Ch.** and the **Required BLER**. When selecting a particular test all settings are default according to the specification. The setting of the **Eb/N0** depends on the RMC and the required BLER and diversity. The level depends also on the base station power class. For this test the fading is **On**, the settings are moving propagation.

Test Specific Parameters			
Wanted Signal			
Ref. Measurement Ch.	RMC 64 🗸	kbps	
Block Error Rate	0.01	·	
Transport Block Size	168	Bits	
AWGN			
Power Level	-84.00	dBm	
Required BLER	< 0.1 ▼	·]	
Required Pd	>= 0.99 -	·	
Eb/N0	5.90	dB	
Fading			
State	On		

Fig. 3-26: Parameter for DCH test 8.4

Fig. 3-27 shows the report.

WCDMA Base Station Performance Test Test Case: 8.4 Demodulation of DCH in Moving Propagation Conditions Generator Settings: Trigger Configuration: Armed Auto (Ext.) Diversity: Off Attenuation (Path A): 1.23 dB Base Station Configuration: Power Class: Wide Area Scrambling Mode: Long Scrambling Scrambling Code: 000000 HEX Value Unit Status Settings Item and Configuration Wanted Signal **RF Frequency** 1950.00 MHz Power Level -95.88 dBm ---Reference Measurement Channel ____ RMC 64 kbps AWGN Power Level within 3.84 MHz BW -84.00 dBm Required BLER < 0.1 -1----Eb/N0 5.90 dB ___ Fading State On -/-

Settings in compliance with TS 25.141!

Fig. 3-27: Report 8.4

3.2.4 Demodulation of DCH in birth/death propagation conditions (Clause 8.5)

In this test the BLER is determined in birth/death propagation conditions and additional AWGN at certain $E_{\rm b}/N_{0}$

The test shall verify the receiver's ability to receive the test signal to find new multi path components with a BLER not exceeding a specified limit [1].

Requirements for DCH in birth/death channel				
Measurement channel (kbit/s)	BLER	E _♭ /N₀ With Rx Diversity (dB)	E _b /N₀ Without Rx Diversity (dB)	
	0.1	n.a.	n.a.	
12.2	0.01	8.3	11.4	
04	0.1	4.7	8.0	
64	0.01	4.8	8.1	

Table 3-10: Requirements for 8.5

Test Setup

Fig. 3-28 shows the test setup.

For diversity the wanted signal generated by SMx baseband A is split up in two paths. AWGN is added.



The SMU needs an external trigger at input TRIGGER1, the SMW at USER3.

Fig. 3-28: Test setup for DCH test 8.5

Test Procedure

As an example the settings for diversity, wide area BS, RMC 64 and a BLER of 0.01 are shown.

- 1. For the basic steps see section 3.1.1.
- 2. Select **8.5 Demodulation of DCH in Birth/Death Propagation Conditions** and switch **Diversity ON.** (both in tab **General**)

General Base Station 🔘 Wanted Signal 🔘 AWGN	● Fading
Test Case 8.5 Demodulation of DCH in Birth/Death Pro	pagation Conditions
Edit Mode	According to Standard Marker Configuration Auto
Trigger Configuration	Auto (Ext. Trigger 1) · Diversity On ·

 Select the Reference Measurement Channel and set the RF Frequency. In addition the resulting Power Level is displayed. (example: RMC 64 kbps, 1.95 GHz)

General	Base Station	O Wanted Signal	O AWGN	• Fading			
State		Off		On Referen	nce Measurement Channel	RMC 64 kbps]
RF Frequ	ency	1.950 000) 000 00 GH	lz · Power I	_evel	-96.98 dBm	-

 Set the required BLER (example 0.01). In addition the AWGN level (depends on the Base station power class) and the Eb/No is displayed. Note that Fading is switched On.

3GPP FDD: Test Case Wizar	d (TS 25.141)				_	×
Wanted Signal AWGN Fading	-80 Egeneration -100 -140		Faded			
	1.94	1.945	1.95 Frequency / GHz	1.955	1.9	16
General Base Station	n 🔘 Wanted Signal 🔘	AWGN O Fading	J			
State	Off	On Requi	red BLER		< 0).01 ·
Power Level (within 3.8	34 MHz BW) -84.(00 dBm + Eb/N0	È.		4.8	0 dB
8.5 Demodulation of D	CH in Birth/Death Propaga	ation Conditions			O Ap	ply

5. Measure the BLER at the base station.

Demo Program

Fig. 3-29 shows the parameters of the test. Select the wanted **Ref Measurement Ch.** and the **Required BLER**. When selecting a particular test all settings are default according to the specification. The setting of the **Eb/N0** depends on the RMC and the required BLER and diversity. The level depends also on the base station power class. For this test the fading is **On**, the settings are birth/death propagation.

Test Specific Parameters			
Wanted Signal			
Ref. Measurement Ch.	RMC 64 🔹	kbps	
Block Error Rate	0.01 👻		
Transport Block Size	168 -	Bits	
AWGN			
Power Level	-84.00	dBm	
Required BLER	< 0.1 ▼]	
Required Pd	>= 0.99 💌		
Eb/N0	8.00	dB	
Fading			
State	On		

Fig. 3-29: Parameter for DCH test 8.5

Fig. 3-30 shows the report.

WCDMA Base Station Performance Test

Test Case: 8.5 Demodulation of DCH in Birth/Death Propagation Conditions

Generator Settings: Trigger Configuration: Armed Auto (Ext.) Diversity: Off Attenuation (Path A): 1.23 dB Base Station Configuration: Power Class: Wide Area Scrambling Mode: Long Scrambling Scrambling Code: 000000 HEX

Settings Item and Configuration		Value	Unit	Status
Wanted Signal				
RF Frequency		 1950.00	MHz	
Power Level		 -93.78	dBm	
Reference Measurement Channel		 RMC 64	kbps	
AWGN				
Power Level within 3.84 MHz BW		 -84.00	dBm	
Required BLER		 < 0.1	-/-	
Eb/N0		 8.00	dB	
Fading				
State		 On	-/-	
	-			

Settings in compliance with TS 25.141!

Fig. 3-30: Report 8.5

3.3 Verification of the internal BLER calculation (Clause 8.6)

Base Station System with internal BLER calculates block error rate from the CRC blocks of the received. This test is performed only if Base Station System has this kind of feature. All data rates which are used in clause 8 Performance requirement testing shall be used in verification testing. This test is performed by feeding measurement signal with known BLER to the input of the receiver. Locations of the erroneous blocks shall be randomly distributed within a frame. Erroneous blocks shall be inserted into the UL signal as shown in figure Fig. 3-31 [1].



Fig. 3-31: BLER insertion into the information data [1]

The aim of this test is to verify that the internal BER calculation accuracy shall meet requirements for conformance testing. BLER indicated by the base station system shall be within $\pm 10\%$ of the BLER generated by the RF signal source for the measurement signals specified in Table 3-11.

Measurement signal requirements				
Transport channel combination	Data rate	BER		
DPCH	12.2 kbps	0.01		
DPCH	64 kbps	0.01		
DPCH	144 kbps	0.01		
DPCH	384 kbps	0.01		

Table 3-11: Measurement signals requirements for internal BER calculation

Signal source parameters should be set according Table 3-12

Uplink leve	ls				
Parameters	ters Uplink Level (dBm/3.84 MHz)				
	BS Class	12.2	64	144	484
UL signal	Wide Area BS	- 111	- 107	- 104	- 100
level	Medium Range BS	- 101	- 97	- 94	- 90
	Local Area BS / Home BS	- 97	- 93	- 90	- 86
Data sequence		F	N9 or longer		

Table 3-12: Parameters for signal source

Test Setup



Fig. 3-32: Verification of the internal LBER calculation test setup (8.6). The SMx generates the W-CDMA uplink reference measurement channel.

As an example the settings for diversity, wide area BS, RMC 64 and a BLER of 0.01 are shown.

- 1. For the basic steps see section 3.1.1.
- 2. Select **8.6 Verification of internal BLER** and switch **Diversity ON.** (both in tab **General**)

General	Base Station	O Wanted Signal		
Test Case	8.6 Verification	on of Internal BLER		
Edit Mode)		According to Standard - Marker Configuration A	Auto -
Trigger Co	onfiguration		Auto (Ext. Trigger 1) · Diversity C	Dn -

 Select the Reference Measurement Channel, the RF Frequency and the Block Error Rate to 0.01. In addition the resulting Power Level is displayed. (example: RMC 64 kbps, 1.95 GHz)

3GPP FDD: Test Case	e Wizard (TS 25.141)					—	×
— Wanted Signal	I .90 understand						
		1.948	1.949	1.95 Frequency / GHz	1.951	1.952	
General Base	Station OWanted Si	ignal					
State	Off On		Reference Me	asurement Chanr	nel RMC 144 k	bps -	
RF Frequency	1.950 000 000	00 GHz	Power Level			-104.0 dBm	·] -
Block Error Rate	0.01						
8.6 Verification of	fInternal BLER					Ap	ply

4. Measure the BLER at the base station at least over 50000 blocks.

Demo Program

Fig. 3-33 shows the parameters of the test. Select the wanted **Ref Measurement Ch.** and the **Bock Error Rate**. When selecting a particular test all settings are default according to the specification. The level depends also on the base station power class.

Test Specific Parameters					
Wanted Signal		_			
Ref. Measurement Ch.	RMC 12.2 -	kbps			
Block Error Rate	0.01 🔹				
Transport Block Size	168 -	Bits			
AWGN					
Power Level	-84.00	dBm			
Required BLER	< 0.01 👻				
Required Pd	>= 0.99 -				
Eb/N0	8.70	dB			
Fading					
State	Off				

Fig. 3-33: Parameter for BLER verification test 8.6

Fig. 3-34 shows the report.

WCDMA Base Station Performance Test						
Test Case: 8.6 Verification of Internal BLER Cal	culation					
Generator Settings: Trigger Configuration: Armed Auto (Ext.) Diversity: Off Attenuation (Path A): 1.23 dB Base Station Configuration: Power Class: Wide Area Scrambling Mode: Long Scrambling Scrambling Code: 000000 HEX						
Settings Item and Configuration			Value	Unit	Status	
Wanted Signal						
RF Frequency			1950.00	MHz		
Power Level			-107.00	dBm		
Reference Measurement Channel			RMC 64	kbps		
Block Error Rate			0.01	-/-		

Settings in compliance with TS 25.141!

Fig. 3-34: Report 8.6

3.4 RACH performance (Clause 8.8)

The Random Access Channel (RACH) is used by the UE for initial access to the radio interface. The UE transmits RACH with preambles until it receives a confirmation by the network (via AICH). Then the UE sends a RACH with a message part. Both receiving cases (preamble and message) are tested in the next sections.

The AWGN is for all RACH tests:

AWGN settings	
Base Station	AWGN
Wide Area	(dBill) - 8/
Medium Range	- 74
	- 74
Local Area / Home BS	- 70

Table 3-13: AWGN settings for RACH tests

The test is split in four different tests with different fading conditions. Please also note the applicability for the different BS power classes:

Test	Purpose	Channel	BS class
8.8.1	_	AWGN	All
8.8.2	Preamble	AWGN + Case 3	Not Home BS
8.8.3		AWGN	All
8.8.4	Message	AWGN + Case 4	Not Home BS

Table 3-14: Four tests for RACH 8.8

Please note, that for RACH tests the power level is offset by 5.79 dB. That means the shown level at the SMx is 5.79 dB lower than the wanted level in the wizard.

3GPP FDD A: l	User Equipment1				_	. ×
General	PRACH Structure Pres	amble Message P	art OCoding			
	Preamble Power Step 0.00	dB 5.79 dB			5.79 dB	
Start Offset #	Slots Preamble Pream	ble Preamble		Data 3.92 dB	Message Part	Control 1.23 dB
	Time Pre->Pre	Time Pre->M	NP cc. Slots •	→		
Structure Ler	ngth 36 Slots					,
ARB Sequen Start Uplink Fra	nce Length 120 Slots ame				End Of AR	B Sequenc
Repeat Stru	ucture After ARB Seque	ence Length	∕ On			

3.4.1 RACH preamble detection in static propagation conditions (Clause 8.8.1)

The test shall verify the receiver's ability to detect RACH preambles under static propagation conditions [1].

The performance requirement is determined by the two parameters probability of false detection of the preamble (Pfa) and the probability of detection of preamble (Pd). Only one signature is used and it is known by the receiver [1].

The preamble is repeated.

.

Preamble Preamble						
Requirements for RACH in AWGN channel						
Pfa ≤	Pd ≥	E _b /N₀ With Rx Diversity (dB)	E _b /N₀ Without Rx Diversity (dB)			
0.004	0.99	- 20.1	- 17.2			
0.001	0.999	- 19.7	-16.4			

Table 3-15: Requirements for 8.8.1

Test Setup

Fig. 3-35 shows the test setup.

For diversity the wanted signal generated by SMx baseband A is split up in two paths. AWGN is added.

The SMU needs an external trigger at input TRIGGER1, the SMW at USER3.



Fig. 3-35: Test setup for RACH test 8.8.1

Test Procedure

As an example the settings for diversity, wide area BS and a Pd of 0.999 are shown.

- 1. For the basic steps see section 3.1.1.
- 2. Select **8.8.1 RACH Preamble Detection in Static Propagation Conditions** and switch **Diversity ON.** (both in tab **General**)

General	Base Station	Wanted Signal	AWGN	○ Fading	# 5-		
Test Case	8.8.1 RACH	Preamble Detection	n in Static Pr	opagation C	onditions		
Edit Mode	L.			According	g to Standard	• Marker Configuration	Auto
Trigger Co	onfiguration			Auto (Ext	. Trigger 1)	• Diversity	On

3. Set the **RF Frequency**. In addition the resulting **Power Level** is displayed. (example: 1.95 GHz)

General	Base Station	Wanted Signal	O AWGN	○ Fading		
State		Off(On		
RF Frequ	ency	1.950 000	000 00 GH	z • Power Le	evel	-104.1 dBm

4. Set the **required Pd** (example **0.999**). In addition the **AWGN level** (depends on the Base station power class) and the **Ec/N0** is displayed



5. Measure the probabilities at the base station.

Demo Program

Fig. 3-36 shows the parameters of the test. Select the wanted **Required Pd**. When selecting a particular test all settings are default according to the specification. The setting of the **Ec/N0** depends on the required Pd and diversity. The level depends also on the base station power class. For this test the fading is **Off.**

Test Specific Parameters					
Wanted Signal					
Ref. Measurement Ch.	RMC 12.2 -	kbps			
Block Error Rate	0.01 -				
Transport Block Size	168 -	Bits			
AWGN					
Power Level	-84.00	dBm			
Required BLER	< 0.01 -	_			
Required Pd	>= 0.99 ▼				
Ec/N0	-17.20	dB			
Fading					
State	Off				

Fig. 3-36: Parameter for RACH test 8.8.1

Fig. 3-37 shows the report.

WCDMA Base Station Performance Test

Test Case: 8.8.1 RACH Preamble Detection in Static Propagation Conditions

Generator Settings: Trigger Configuration: Armed Auto (Ext.) Diversity: Off Attenuation (Path A): 0.00 dB Base Station Configuration: Power Class: Wide Area Scrambling Mode: Long Scrambling Scrambling Code: 000000 HEX

Settings Item and Configuration			Value	Unit	Status	
Wanted Signal						
RF Frequency	-		1950.00	MHz		
Power Level			-101.20	dBm		
AWGN						
Power Level within 3.84 MHz BW			-84.00	dBm		
Required Pd			>= 0.99	-/-		
Ec/N0			-17.20	dB		
Fading						
State			Off	-/-		

Settings in compliance with TS 25.141!

Fig. 3-37: Report 8.8.1

3.4.2 RACH preamble detection in multipath fading case 3 (Clause 8.8.2)

The test shall verify the receiver's ability to detect RACH preambles under multipath fading case 3 propagation conditions [1].

The performance requirement is determined by the two parameters probability of false detection of the preamble (Pfa) and the probability of detection of preamble (Pd). Only one signature is used and it is known by the receiver [1].

The requirement shall not be applied to Home BS.

The preamble is repeated.

Preamble	Preamble						
Requiremen	ts for RACH i	n AWGN channel					
Pfa ≤	Pd ≥	E _♭ /N₀ With Rx Diversity (dB)	E♭/N₀ Without Rx Diversity (dB)				
0.004	0.99	- 14.9	- 8.8				
0.001	0.999	- 12.8	- 5.8				

Table 3-16: Requirements for 8.8.2

Test Setup

Fig. 3-38shows the test setup.

For diversity the wanted signal generated by SMx baseband A is split up in two paths. The channel is simulated and AWGN is added.

The SMU needs an external trigger at input TRIGGER1, the SMW at USER3.



Fig. 3-38: Test setup for DCH test 8.8.2

Test Procedure

As an example the settings for diversity, wide area BS and a Pd of 0.999 are shown.

1. For the basic steps see section 3.1.1.

2. Select 8.8.2 RACH Preamble Detection in Multipath Fading Case 3 Conditions and switch Diversity ON. (both in tab General)

General Base Station Wanted Signal AWGN	Fading
Test Case 8.8.2 RACH Preamble Detection in Multipath	Fading Case 3
Edit Mode	According to Standard Marker Configuration Auto
Trigger Configuration	Auto (Ext. Trigger 1) · Diversity On ·

3. Set the **RF Frequency**. In addition the resulting **Power Level** is displayed. (example: 1.95 GHz)

General	ase Station	Wanted Signal	O AWGN	O Fading
State		Off(On
RF Frequenc	cy	1.950 000	000 00 GH	z · Power Level -96.80 dBm ·

4. Set the **required Pd** (example **0.999**). In addition the **AWGN level** (depends on the Base station power class) and the **Ec/N0** is displayed. Note that **Fading** is switched On.

3GPP FDD: Test Case Wizard	d (TS 25.141)				_	×
Wanted Signal AWGN Fading	80 Hgp.100 100 120 120 140		Faded			
	1.94	1.945	1.95 Frequency / GHz	1.955	1.9	16
General Base Station	n 🔘 Wanted Signal 🚺	AWGN OFading				
State	Off		ed Pd		>=0).999 -
Power Level (within 3.8	4 MHz BW) -84.0	00 dBm Ec/N0			-12.8	0 dB -
		40	~~~			
8.8.2 RACH Preamble	Detection in Multipath Fac	ling Case 3			💎 Ap	ply

5. Measure the probabilities at the base station.

Demo Program

Fig. 3-39 shows the parameters of the test. Select the wanted **Required Pd**. When selecting a particular test all settings are default according to the specification. The

setting of the **Ec/N0** depends on the required Pd and diversity. The level depends also on the base station power class. For this test the fading is **ON**, the setting is multipath case 3.

Test Specific Parameters					
Wanted Signal					
Ref. Measurement Ch.	RMC 12.2	Y	kbps		
Block Error Rate	0.01	-			
Transport Block Size	168	-	Bits		
AWGN					
Power Level	-84.	00	dBm		
Required BLER	< 0.01	Y			
Required BLER	< 0.01 >= 0.999	•			
Required BLER Required Pd Ec/N0	< 0.01 >= 0.999 -5.4		dB		
Required BLER Required Pd Ec/N0 Fading	< 0.01 >= 0.999 -5.	▼	dB		

Fig. 3-39: Parameter for RACH test 8.8.2

Fig. 3-40 shows the report.

WCDMA Base Station Performance Test

Test Case: 8.8.2 RACH Preamble Detection in Multipath Fading Case 3

Generator Settings: Trigger Configuration: Armed Auto (Ext.) Diversity: Off Attenuation (Path A): 0.00 dB Base Station Configuration: Power Class: Wide Area Scrambling Mode: Long Scrambling Scrambling Code: 000000 HEX

Settings Item and Configuration			Value	Unit	Status
Wanted Signal					
RF Frequency			1950.00	MHz	
Power Level			-89.80	dBm	
AWGN					
Power Level within 3.84 MHz BW	-	-	-84.00	dBm	
Required Pd			>= 0.999	-/-	
Ec/N0			-5.80	dB	
Fading					
State			On	-/-	

Settings in compliance with TS 25.141!

Fig. 3-40: Report 8.8.2

3.4.3 Demodulation of RACH message in static propagation conditions (Clause 8.8.3)

The test shall verify the receiver's ability to receive the message part of the RAC under static propagation conditions [1].

In this test the BLER of the RACH message is determined in multipath fading conditions and additional AWGN at certain $E_b/N_{0.}$

The receiver tries to detect the preamble and the message. The block error rate is calculated for the messages that have been decoded. Messages following undetected preambles shall not be taken into account in the BLER measurement [1].

Г

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The RACH pattern is repeated.

Preamble	Message		Preamble	Messag
Requiremer	nts for RACH in	AWGN chan	nel, TTI = 20 I	ms
	TB size ²	168 bits	TB size	360 bits
BLER	E _b /N₀ With Rx Diversity	E _b /N₀ Without Rx Diversity	E _b /N₀ With Rx Diversity	E _b /N₀ Without Rx Diversity
	(dB)	(dB)	(dB)	(dB)
0.1	4.5	7.6	4.3	7.3
0.01	5.4	8.5	5.2	8.2

Table 3-17: Requirements for 8.8.3

The resulting RF level is calculated:

$$Level = AWGN + 10 \times log_{10} \frac{TB}{TTI \times 3.84 \times 10^6} + \frac{E_b}{N_0}$$

Test Setup

Fig. 3-41 shows the test setup.

For diversity the wanted signal generated by SMx baseband A is split up in two paths. AWGN is added.

The SMU needs an external trigger at input TRIGGER1, the SMW at USER3.



Fig. 3-41: Test setup for RACH test 8.8.3

Test Procedure

As an example the settings for diversity, wide area BS, TB of 183 bits and a BLER of 0.01 are shown.

- 1. For the basic steps see section 3.1.1.
- 2. Select **8.8.3 Demodulation of RACH Message in Static Propagation Conditions** and switch **Diversity ON.** (both in tab **General**)

General	Base Station	◯ Wanted Signal	O AWGN	◯ Fading				
Test Case	8.8.3 Democ	dulation of RACH M	essage in S	tatic Propag	ation Condition	s		-
Edit Mode	•			Accordir	ng to Standard	Marker Configuration	Auto	
Trigger Co	onfiguration			Auto (Ex	t. Trigger 1)	Diversity	On	·

3. Select the **Transport Block Size**, the **RF Frequency**. In addition the resulting **Power Level** is displayed. (example: 168 bits, 1.95 GHz)

General	Base Station	Wanted Signal	O AWGN	◯ Fading		
State		Off		On Transpo	ort Block Size	168 bits -
RF Frequ	ency	1.950 000	000 00 GH	lz ∙ Power I	_evel -106.	1 dBm

4. Set the required **BLER** (example **0.01**). In addition the **AWGN level** (depends on the Base station power class) and the **Eb/No** is displayed.

3GPP FDD: Te	est Case Wizard	(TS 25.141)					_	×
Wanted AWGN Fading	l Signal	-70 -80 -90 -100 -131 -110 -140 -1.94	1.94	5	1.95 Fremency / GHz	1.955	1.	96
General	Base Station	◯ Wanted Signal	O AWGN	Fading				
State		Off		n Require	ed BLER			<0.01 •
Power Lev	el (within 3.84	MHz BW)	-84.00 dBm	• Eb/N0			5.4	IO dB ·
8.8.3 Demo	odulation of R	ACH Message in S	tatic Propagat	ion Condit	ions		Ap	oply

5. Measure the BLER at the base station.

Demo Program

Fig. 3-42 shows the parameters of the test. Select the wanted **Transport Block Size** and the **Required BLER**. When selecting a particular test all settings are default according to the specification. The setting of the **Eb/N0** depends on the Transport Block size, required BLER and diversity. The level depends also on the base station power class. For this test the fading is **Off.**

Test Specific Parameters					
Wanted Signal					
Ref. Measurement Ch.	RMC 12.2 - kbps				
Block Error Rate	0.01 -				
Transport Block Size	Bits				
414/01					
AWGN					
Power Level	-84.00 dBm				
Required BLER	< 0.1 ▼				
Required Pd	>= 0.999 👻				
Eb/N0	7.60 dB				
Fading					
State	Off				

Fig. 3-42: Parameter for RACH test 8.8.3

Fig. 3-43 shows the report.

WCDMA Base Station Performance Test

Test Case: 8.8.3 Demodulation of RACH Message in Static Propagation Conditions

Generator Settings: Trigger Configuration: Armed Auto (Ext.) Diversity: Off Attenuation (Path A): 0.00 dB Base Station Configuration: Power Class: Wide Area Scrambling Mode: Long Scrambling Scrambling Code: 000000 HEX

Settings and Configuration		Value	Unit	Status
Wanted Signal				
RF Frequency	 	1950.00	MHz	
Power Level	 	-103.00	dBm	
Transport Block Size	 	168	Bits	
AWGN				
Power Level within 3.84 MHz BW	 	-84.00	dBm	
Required BLER	 	< 0.1	-/-	
Eb/N0	 	7.60	dB	
Fading				
State	 	Off	-/-	

Settings in compliance with TS 25.141!

Fig. 3-43: Report 8.8.3

3.4.4 Demodulation of RACH message in multipath fading case 3 (Clause 8.8.4)

The test shall verify the receiver's ability to receive the test signal under multipath fading case 3 propagation conditions with a BLER not exceeding a specified limit [1].

In this test the BLER of the RACH message is determined in multipath fading conditions and additional AWGN at certain $E_b/N_{0.}$

The receiver tries to detect the preamble and the message. The block error rate is calculated for the messages that have been decoded. Messages following undetected preambles shall not be taken into account in the BLER measurement [1].

Only one signature is used and it is known by the receiver [1].

The requirement shall not be applied to Home BS.

The preamble is repeated.

Preamble	Message	Preamble	Message	•••

Requiremen	ts for RACH i	n fading case	3 channel, TT	l = 20 ms
	TB size	168 bits	TB size	360 bits
BLER	E _b /N₀ With Rx Diversity (dB)	E _b /N₀ Without Rx Diversity (dB)	E _b /N₀ With Rx Diversity (dB)	E _b /N₀ Without Rx Diversity (dB)
0.1	8.0	11.7	7.9	11.6
0.01	9.1	13.0	8.9	12.7

Table 3-18: Requirements for 8.8.4

The resulting RF level is calculated:

$$Level = AWGN + 10 \times log_{10} \frac{TB}{TTI \times 3.84 \times 10^6} + \frac{E_b}{N_0}$$

Test Setup

Fig. 3-44 shows the test setup.

For diversity the wanted signal generated by SMx baseband A is split up in two paths. The channel is simulated and AWGN is added.

The SMU needs an external trigger at input TRIGGER1, the SMW at USER3.



Fig. 3-44: Test setup for DCH test 8.8.4

Test Procedure

As an example the settings for diversity, wide area BS, a TB of 183 bits and a BLER of 0.01 are shown.

1. For the basic steps see section 3.1.1.

2. Select **8.8.4 Demodulation of RACH Message in Multipath Fading Case 3** and switch **Diversity ON.** (both in tab **General**)

General	Base Station	Wanted Signal	AWGN	O Fading				
Test Case	8.8.4 Demo	dulation of RACH M	essage in M	ultipath Fad	ing Case 3			-
Edit Mode				Accordin	ng to Standa	rd - Marker Configuration	Auto	•
Trigger Co	onfiguration			Auto (Ex	t. Trigger 1)	- Diversity	On	-

3. Select the **Transport Block Size**, the **RF Frequency**. In addition the resulting **Power Level** is displayed. (example: 168 bits, 1.95 GHz)

General	Base Station	Wanted Signal	O AWGN	• Fading		
State		Off		On Transp	ort Block Size	168 bits
RF Frequ	ency	1.950 000	000 00 GH	lz - Power	Level	-102.6 dBm

4. Set the required **BLER** (example **0.01**). In addition the **AWGN level** (depends on the Base station power class) and the **Eb/No** is displayed. Note that **Fading** is switched On.

3GPP FDD: Test Case Wizard	(TS 25.141)				_ ×
Wanted Signal AWGN Fading	-80 		Faded		
General Base Station	1.94	1.945	1.95 Frequency / GHz	1.955	1.96
State	Off		red BLER		<0.01 -
Power Level (within 3.84	4 MHz BW) -8	4.00 dBm Eb/NC)		9.10 dB
8.8.4 Demodulation of R	ACH Message in Mult	ipath Fading Case 3			Apply

5. Measure the BLER at the base station.

Demo Program

Fig. 3-45 shows the parameters of the test. Select the wanted **Transport Block Size** and the **Required BLER**. When selecting a particular test all settings are default according to the specification. The setting of the **Eb/N0** depends on the Transport Block size, required BLER and diversity. The level depends also on the base station power class. For this test the fading is **ON**, the setting is multipath case 3.

Test Specific Parameters	\$	
Wanted Signal		
Ref. Measurement Ch.	RMC 12.2 -	kbps
Block Error Rate	0.01 -	
Transport Block Size	168 🔻	Bits
AWGN		
Power Level	-84.00	dBm
Required BLER	< 0.01 ▼	
Required Pd	>= 0.999 -	
Eb/N0	13.00	dB
Fading		
State	On	

Fig. 3-45: Parameter for RACH test 8.8.4

Fig. 3-46 shows the report.

WCDMA Base Station Performance Test					
Test Case: 8.8.4 Demodulation of RACH Messa	ge in Multipa	ath Fading (Case 3		
Generator Settings: Trigger Configuration: Armed Auto (Ext.) Diversity: Off Attenuation (Path A): 0.00 dB Base Station Configuration: Power Class: Wide Area Scrambling Mode: Long Scrambling Scrambling Code: 000000 HEX					
Settings and Configuration			Value	Unit	Status
Wanted Signal					
RF Frequency		-	1950.00	MHz	
Power Level			-97.60	dBm	
Transport Block Size			168	Bits	
AWGN					
Power Level within 3.84 MHz BW		-	-84.00	dBm	
Required BLER			< 0.01	-/-	
Eb/N0			13.00	dB	
Fading					
State			On	-/-	

Settings in compliance with TS 25.141!

Fig. 3-46: Report 8.8.4

4 Appendix

4.1 R&S TSrun Program

The TSrun software application makes it possible to combine tests (modules) provided by Rohde & Schwarz into test plans to allow rapid and easy remote control of test instruments. This program is available free of charge from our website.

Requirements

Operating system:

- Microsoft Windows XP / Vista / Windows 7 / Windows 8
- NET framework V4.0 or higher

General PC requirements:

- Pentium 1 GHz or faster
- 1 Gbyte RAM
- 100 Mbyte space harddisk
- XGA monitor (1024x768)

Remote control interface:

- National Instruments VISA
- GPIB card

Or

LAN connection. AfterTSrun is launched, the following splash screen appears:

AR R&S TSrun	
File View Resources Options Testplan Favorites Help	
Tile Browsers 🔁 New 🗁 Open 🥔 Save All 💷 Abort All	
Test Plans Tests Reports No Testplan Loaded	
🔁 Add 🔚 Remove 🖼 Favorite	
installed installed installed installed installed	
Application Notes	
Session: schulz License Server: None	

Fig. 4-1: Overview TSrun

Tests and test plans

Tests are separate, closed modules for TSrun. A test plan can consist of one or more tests.

WCDMA_	BS_Tx_Test	×						
🕨 Run	🗏 Abort 🕨	Step	Idle	Parameters	Resources	🕶 📝 Edit	😫 Save As	Ŧ
TC 😭		h ß X	🗒 🖙 🗠 🔁					
Steps			De	scription				
wo	DMA BS Tx T	est						
<u>.</u>	WCDMA_BS_	Tx_Test						
Testplan	Details Yield	Measurement F	Report SCPI Repo	t Progress Log				
	Fiç	g. 4-2: Overview	v of a test plan in	TSrun. The test plar	n in the example	e contains o	only one test	
	(W	CDMA BS Tx T	est). After the tes	st is completed, the l	par along the bo	ottom can b	e used to disp	olay

the measurement and SCPI reports.

The WCDMA BS tests can be found under Tests/ApplicationNotes.

Click **RUN** to start the current test plan.

SCPI connections

Under **Resources**|**SCPI Connections**, you can add all required instruments for remote control.

🏇 R&S	TSrun			-	Care Care	augura ine na ag
File	View	Resources	Options	Testplan	Favorites	Help
🔍 File B	rowsers	Bar Co	de Reader		pen 🗐 🤅	Save All 🖉 Abort All
Test Plar	ns Tes	CMWI	Instrument .		oaded	
🔁 Add	🖹 Re	Measu	rement Rep	ort		
	Installed	CMW-	ZASB Instru	ment		
i 🗄 🖷 🚺 I	My Test	SCPI C	onnections			
·	Applicati	SCPI R	eport			
		Serial F	Port			
		Test Se	etup			

Fig. 4-3: Setting the SCPI connections.

Use **Configure...** to open a wizard for entering the VISA parameters (Fig. 4-4). Use the **Test Connection** button to test the connection to the instrument. When the **Demo Mode** button is enabled, no instruments need to be connected because TSrun runs in demo mode and output a fictitious test report.

					_
D	Alias	Resource Name		Timeout	^
SMx2		TCPIP0::10.85.0.170::INS	STR	10000	
SMx		TCPIP0::10.85.0.117::INS	STR	10000	
					-
Reporting		Break test after	10	successive time	outs
Demo Mode					
A.L.				T IC	
Add	Delete	Lonfigure		Test Connec	ction

Fig. 4-4: SCPI connections.

Resource Name Composer		
Alias	Remote Interface Assistant VISA: National Instruments; V5.4.0f0	
SMx		
Resource Name	Interface Type: VXI11 (Network) -	
TCPIP0::10.85.0.117::INSTR	Board No. 0	
Timeout (ms)	TCPIP IP Address (©) Host Name (©)	
10000	IP Address 10 85 0 117	
OK Cancel		

Fig. 4-5: Wizard for entering VISA parameters. Both the IP address and a host name can be entered directly.

Reports: Measurement and SCPI

After the test is completed, TSrun automatically generates both a **Measurement Report** and a **SCPI Report**.

The measurement report shows the actual results and the selected settings.

The SCPI report returns a LOG file of all transmitted SCPI commands. These can then be copied and easily used in separate applications.

Protocol

Test Case 1: Measurement

	0:00:00.375.296:	Initializing testcase!			
	0:00:00.406.224:	Opening new remote channel: FSx			
	0:00:00.415.433:	Connection to FSx(TCPIP0::10.85.0.53::INSTR) established!			
	0:00:00.416.433:	Session handle: 1			
	0:00:00.417.797:	Resource Name: TCPIP0::10.85.0.53::INSTR			
	0:00:00.418.760:	VISA Manufacturer: National Instruments			
	0:00:00.420.853:	[>TCPIP0::10.85.0.53::INSTR] *IDN?			
	0:00:00.506.689:	[<tcpip0::10.85.0.53::instr] 101157,2.10<="" rohde&schwarz,fsw-13,1312.8000k13="" td=""></tcpip0::10.85.0.53::instr]>			
	0:00:00.508.290:	[>TCPIP0::10.85.0.53::INSTR] *RST;*CLS;*OPC?			
	0:00:00.645.087:	[<tcpip0::10.85.0.53::instr] 1<="" td=""></tcpip0::10.85.0.53::instr]>			
	0:00:00.647.203:	[>TCPIP0::10.85.0.53::INSTR] ROSC:SOUR INT			
	0:00:00.648.763:	[>TCPIP0::10.85.0.53::INSTR] DISP:TRAC:Y:RLEV:OFFS 0.00			
	0:00:00.650.252:	[>TCPIP0::10.85.0.53::INSTR] DISP:TRAC:Y:RLEV 0.00dBm			
	0:00:00.653.030:	[>TCPIP0::10.85.0.53::INSTR] INST:SEL BWCD			
	0:00:00.656.442:	[>TCPIP0::10.85.0.53::INSTR] SENS:FREQ:CENT 2000MHz			
	0:00:00.657.892:	[>TCPIP0::10.85.0.53::INSTR] SENS:CDP:LCOD #H0			
	0:00:01.133.068:	[>TCPIP0::10.85.0.53::INSTR] SENS:CDP:PREF TOT			
	0:00:01.140.435:	[>TCPIP0::10.85.0.53::INSTR] INIT:CONT OFF			
	0:00:01.144.236:	[>TCPIP0::10.85.0.53::INSTR] INIT:IMM;*OPC			
	0:00:02.149.043:	[>TCPIP0::10.85.0.53::INSTR] *ESR?			
	0:00:02.151.031:	[<tcpip0::10.85.0.53::instr] 1<="" td=""></tcpip0::10.85.0.53::instr]>			
	0:00:02.151.746:	[>TCPIP0::10.85.0.53::INSTR] CALC:MARK:FUNC:WCDP:RES? PTOT			
	0:00:02.161.245:	[<tcpip0::10.85.0.53::instr] -30.7061824799<="" p=""></tcpip0::10.85.0.53::instr]>			
	0:00:02.162.119:	[>TCPIP0::10.85.0.53::INSTR] CALC:MARK:FUNC:WCDP:RES? FERRor			
	0:00:02.164.324:	[<tcpip0::10.85.0.53::instr] 577.945495605<="" p=""></tcpip0::10.85.0.53::instr]>			
	0:00:02.165.064:	[>TCPIP0::10.85.0.53::INSTR] CALC:MARK:FUNC:WCDP:RES? EVMPeak			
	0:00:02.167.922:	<pre>[<tcpip0::10.85.0.53::instr] 82.5495986938<="" pre=""></tcpip0::10.85.0.53::instr]></pre>			
e	estplan Details Yield Measurement Report SCPI Report Progress Log				

Fig. 4-6: SCPI report.

4.2 References

1] Technical Specification Group Radio Access Network; **Base station conformance testing (FDD)**, **Release 10; 3GPP TS 25.141**, V 10.11.0, September 2014

[2] Rohde & Schwarz: W-CDMA Base Station Receiver Tests according to TS 25.141 Rel. 10, Application Note 1MA114, October 2014

[2] Rohde & Schwarz: W-CDMA Base Station Transmitter Tests according to TS 25.141 Rel. 10, Application Note 1MA67, October 2014

4.3 Additional Information

Please send your comments and suggestions regarding this white paper to

TM-Applications@rohde-schwarz.com

4.4 Ordering Information

Ordering Information for Signal Generators Vector Signal Generator				
Vector Signal Generator	SMW200A	1412.0000.02		
Baseband Generator	SMW-B10	1413.1200.02		
Baseband Generator	SMW-B11	1159.8411.02		
Baseband Main Module	SMW-B13	1141.8003.04		
Fading Simulator	SMW-B14	1413.1500.02		
1 _{st} RF path	SMW-B10x			
2nd RF path	SMW-B20x			
AWGN	SMW-K62	1413.3484.02		
Digital Standard 3GPP FDD	SMW-K42	1413.3784.02		

About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

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Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system



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