Products: R&S CMU300, NetHawk RNC/Iub Simulator

Testing the Ericsson® Node B Typ RBS 3202®
with
R&S® CMU300® BTS Radio Communication Tester
and
NetHawk® RNC/I_{ub} Simulator®

Application Note

Testing the RF parameters of a WCDMA base station during the network rollout phase ensures subsequent trouble-free operation of networks as a basic prerequisite for general UMTS customer acceptance. This document describes a complete solution for testing the main transmission and reception parameters according to Specification 3GPP TS 25.141 FDD R99 on the basis of the R&S CMU300 Radio Communication Tester (RF measurements) and the NetHawk RNC/Iub Simulator (base station controller). The solution presented here is particularly recommended for installation measurements and regression tests on new UMTS system components.

ROHDE & SCHWARZ

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1 Overview

Specification 3GPP TS 25.141 FDD R99 [1] describes methods for testing the transmission parameters (chapter 6) and reception parameters (chapter 7) of WCDMA base stations. The expressed high flexibility of UMTS with regard to the provision of different services imposes a correspondingly high flexibility on the physical layer. Without special measures, however, this would inflate testing costs enormously. Therefore to ensure perfect comparability of measurement results and to reduce the cost of testing, the specification committees have developed the following test scenarios:

- All transmitter measurements of the downlink (DL) signal must be carried out using specially designated channel combinations known as test models. Specification 3GPP FDD R99 details four test models.

- BER measurements for testing the reception channel must be performed using what is known as a reference measurement channel (RMC). In this the pseudo random noise (PN) modulated uplink (UL) signal is started by the transmission time interval (TTI) trigger on the base station. The bit error ratio (BER) can be evaluated in the Node B, the RNC or an external BER analyzer. Specification 3GPP FDD R99 details five reference measurement channels (RMC).

2   Operating Principle

Node B
Ericsson RBS3202

RF Tester
R&S CMU300

NetHawk
RNC/Iub Simulator

Uu

Iub
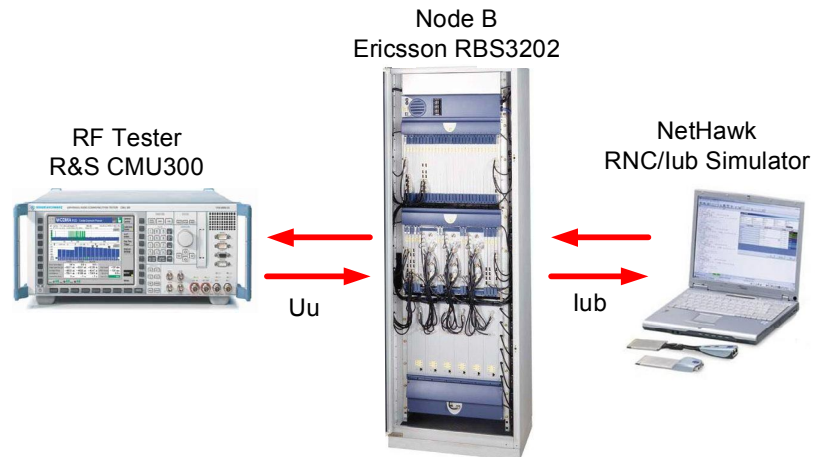
Before the R&S CMU300 can test the RF parameters according to [1], the Node B must be altered to a test mode with the above-mentioned test scenarios. In most cases these test modes are not supported by the radio network controller (RNC) of the operative network. In this particular case the NH RNC/Iub Simulator assumes this role. The BTS, being isolated from the network, is activated by the NH RNC/Iub Simulator via the Iub interface. The BTS is then tested as follows:

Transmission parameters:

- The NH RNC/Iub Simulator activates an appropriate test model on the downlink (DL)

- The R&S CMU300 measures the transmission parameters (RF power, modulation, spectrum, code domain measurements)

Reception parameters:

- The NH RNC/Iub Simulator configures the BTS receiver to receive a RMC

- The BTS provides the TTI trigger signal

- The CMU300 transmits the requested PN modulated RMC; the start of transmission is determined by the TTI signal

- The BER is evaluated (transport level) in the NH RNC/Iub Simulator

3 Hardware and Software Requirements

Configuration of measurement components and cable:

Radio Communication Tester:

- R&S CMU300 basic unit* and options CMU-B12, CMU-B76, CMU-U75, CMU-K75, CMU-K76, CMU-K77

*) The R&S CMU300 should be equipped with the latest hardware version, which has been available for supply since August 2003. Older instruments can be retrofitted in Rohde & Schwarz Service Centers with the aid of option CMU-U74. It should also be noted that in the case of WCDMA retrofits it is necessary to order option CMU-**U**76 instead of option CMU-**B**76.
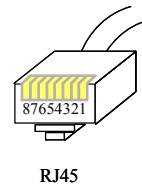
RNC/Iub Simulator:

- NetHawk RNC/Iub Simulator Software

- NetHawk N2 Adapter and Accurate Clock Source Unit (ACSU)

Notebook (2GHz Pentium 4, 512M RAM, Cardbus slot)

Cable: (not part of the equipment supplied)

- RF cable with "N" (male) / "9/16" (male)

- RF cable BNC (male) / SMA (male)

- Trigger cable SMA (male) / Sub-D 15 pin 6 (male)

- RJ45 cable; configuration:

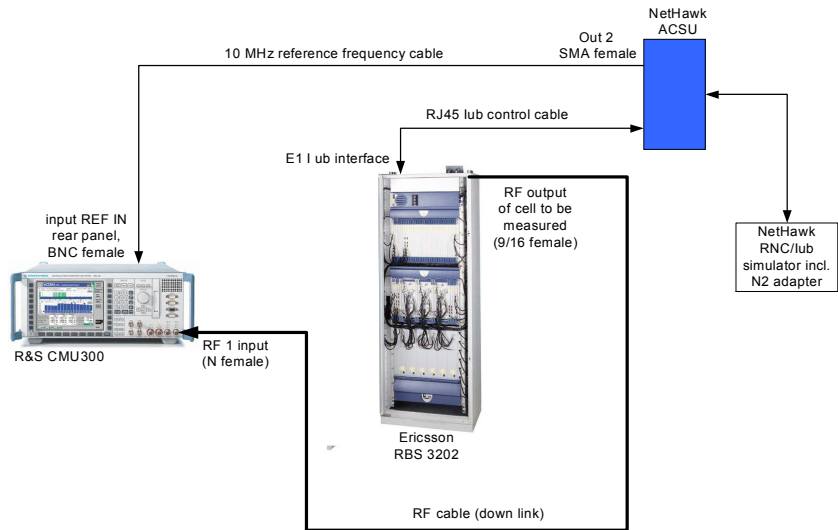| NetHawk RJ45		Ericsson RJ45
3 TX neg	↻	2
4 TX pos	↻	1
5 RX neg	↻	5
6 RX pos	↻	4

RJ45

• Versions tested: Status 09/2004

- Node B: Type Ericsson RBS3202, HW Version R2, SW Version R 2.1.4

- CMU300: SW Version V3.25

- RNC/Iub Simulator: SW Version 1.3 with 3GPP TS 25.141 test library (Ericsson R99 baseline option)
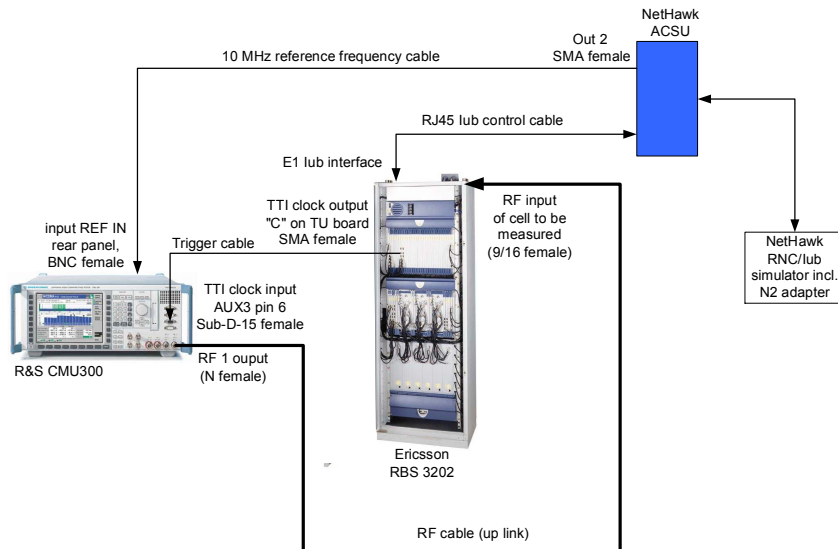
4 Test Setup

Please create the test setup according to the following block diagrams.

Transmitter measurements:

The input RF 1 to the R&S CMU300 is directly connected to the transmitter output. Continuous power of 47 dBm RMS (54 dBm PEP) is possible on this input. Externally applied attenuator pads can be considered in the R&S CMU300 when configuring the RF paths. We strongly recommend that you deactivate any DC excitation voltages that may be hooked up to RF lines.

NetHawk
ACSU

Out 2
SMA female

10 MHz reference frequency cable

RJ45 Iub control cable

E1 I ub interface

RF output
of cell to be
measured
(9/16 female)

NetHawk
RNC/Iub
simulator incl.
N2 adapter

input REF IN
rear panel,
BNC female

R&S CMU300

RF 1 input
(N female)

Ericsson
RBS 3202

RF cable (down link)

Receiver measurements:

NetHawk
ACSU

Out 2
SMA female

10 MHz reference frequency cable

RJ45 Iub control cable

E1 Iub interface

TTI clock output
"C" on TU board
SMA female

RF input
of cell to be
measured
(9/16 female)

NetHawk
RNC/Iub
simulator incl.
N2 adapter

input REF IN
rear panel,
BNC female

Trigger cable

TTI clock input
AUX3 pin 6
Sub-D-15 female

R&S CMU300

RF 1 ouput
(N female)

Ericsson
RBS 3202

RF cable (up link)

Note: If the BTS uses remote amplifiers (tower-mounted), these must be taken into consideration in the test setup, that is, the R&S CMU300 must be directly connected to the RF connectors on the amplifier.
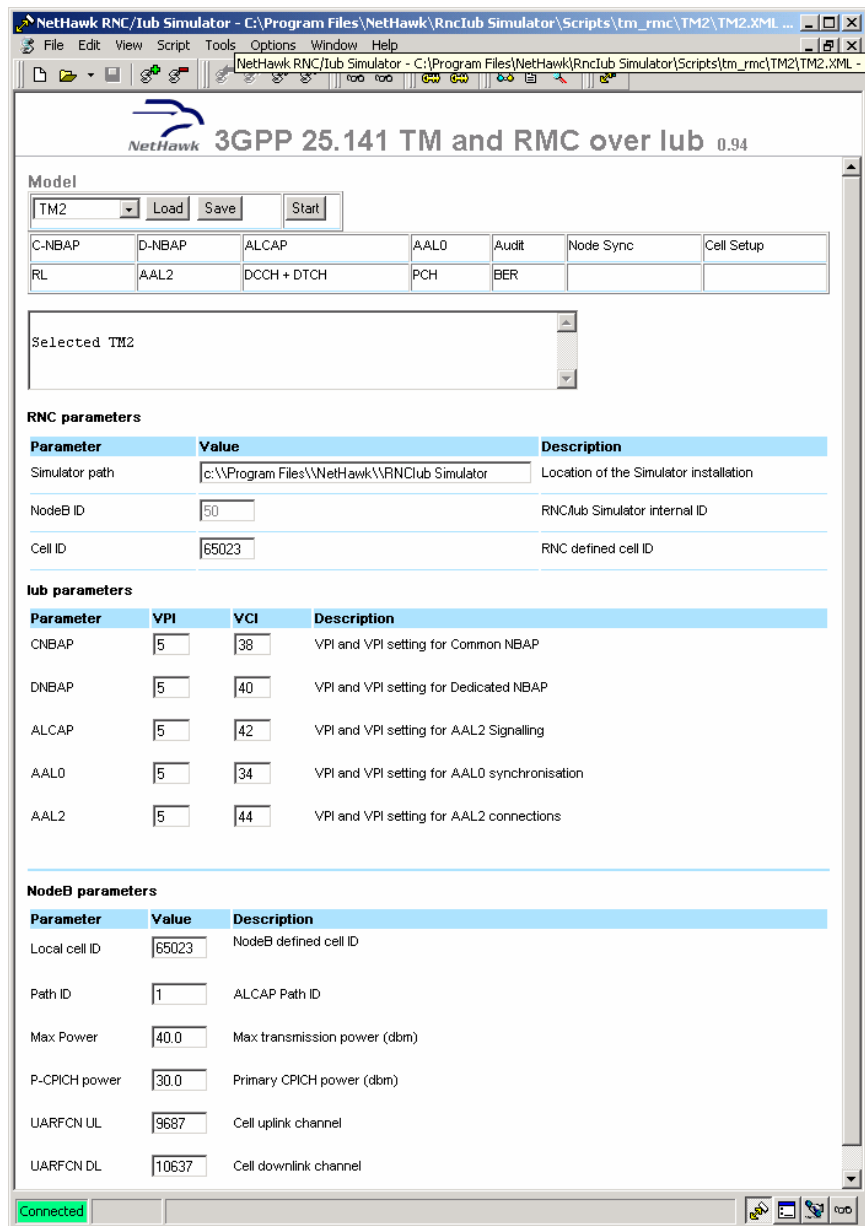
5   Test Sequence

The following description of the test sequence assumes basic knowledge of operating the BTS Radio Communication Tester and the RNC/Iub simulator. It is recommended as a first step that testing should be carried out in the sequence mentioned below and that no settings should be entered other than those mentioned.

Activating the BTS

NH RNC/Iub Simulator:

Before activating the BTS the listed below parameters must be configured. Be aware, that the parameters have to correspond to the site to be measured!

Activation of the RF power can be monitored with the aid of the spectrum analyzer on the R&S CMU300 (function group: Basic Functions / RF).

Transmitter measurements

R&S CMU300:

- Start the function group 3G UMTS Node B / WCDMA 1900 / FDD / Non-Signalling Mode on the R&S CMU300.

- Reset the activated WCDMA function group (hardkey RESET).

- Configure the instrument for measurement (softkey Connect. Control) as follows:
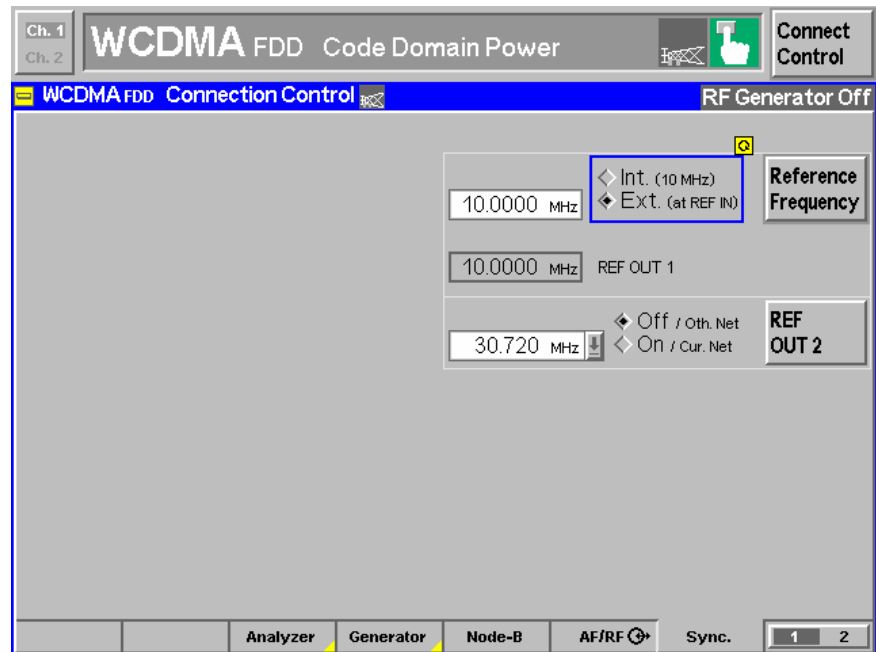

- Reset the instrument to external reference frequency (tab Sync. / Reference Frequency: Ext. (at REF IN); 10 MHz).

- Configure the RF paths (tab AF / RF: RF 1 is RF input and RF output; external attenuation must be taken into account as appropriate).

- Set the DL scrambling code to be used on the RNC/Iub simulator (tab Node B / DL Channel Settings / Scrambling Code / Primary: 0; Secondary: 0 ;these are default values and normally must not be changed).

- Switch to the Measurement menus (softkey Connect. Control) and enter the following settings in the Power Measurement menu (WCDMA FDD POWER):

- softkey Analyzer Settings: Set the DL frequency or channel number to be used on the RNC simulator.

- softkey Exp. Pow. Trigger: Switch to manual control (mode: Manual) and set the expected power approx. 13 dB (PEP) higher than the maximum Node B output power set on the RNC. If the message "Overload at connector RF1" occurs, increase the value of the expected input power until the message ceases to occur.

- Carry out power measurement.

- Switch to modulation analysis (softkeys Menus / Modulation) and set the activated DL test model (softkeys Analyzer Settings / Test Model).

- Carry out modulation analysis. The RMS values of the error vector magnitude (EVM) measurement are relevant to Specification 3 GPP TS 25.141 FDD.

- Switch to spectral analysis (softkeys Menus / Spectrum). You can use the Application softkey to access the inband spectral measurements ACLR, OBW and SEM.
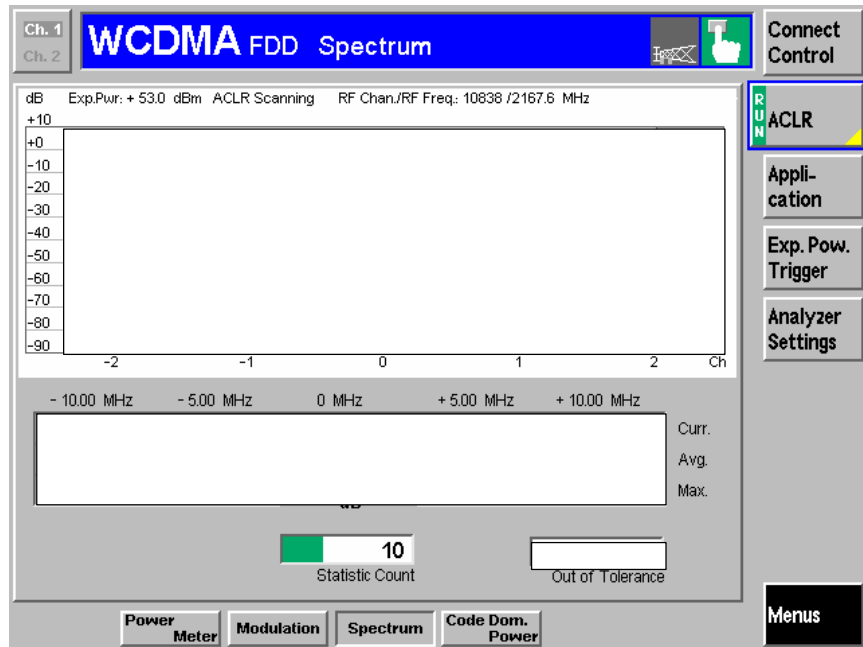
- Switch to code domain analysis (softkeys Menus / Code Dom. Power) and set the activated DL test model (softkeys Analyzer Settings / Test Model). Here are some of the main settings that are possible:
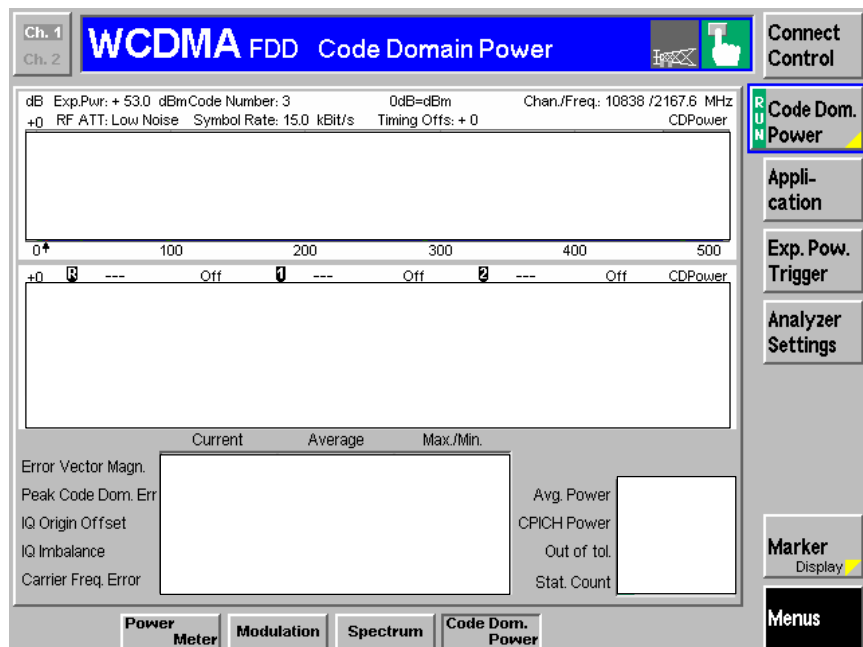
- To select the code channels to be measured use softkeys Code Dom. Power / Code Channel.

- To select the CDP measurement unit use softkeys Code Dom. Power / Unit.

- To measure the code domain power (CDP) of a code channel, activate the marker functions (softkeys Marker / Ref. / Rel. 1 / Rel. 2).

- To start the peak code domain error (PCDE) measurement use softkeys Application / Peak Code Dom. Error.

Receiver test

NH RNC/Iub Simulator:

- Start the BER Test menu

R&S CMU300:

- Switch to the Generator menu (softkey Connect. Control / tab Generator) and enter the following settings (press the Generator softkey at the foot of the screen twice).

- Set the starting output level to –70 dBm (Generator Level / Total Transmit Power: -70 dBm)

- Set the UL frequency or channel number to be used on the RNC simulator (Generator Settings / Channel or Frequency). Note: In normal conditions the UMTS UL frequency is 190 MHz below the DL frequency.

- Set the UL scrambling code to be used by the RNC simulator (Channel Settings / Dedicated Channel / Scrambling Code). Default value for the RNC simulator: 100 hex

- Set the required offset of 1024 chips between DL and UL (Channel Settings / Dedicated Channel / CPICH – UL DPCH Offset: 1024 Chips).

- Check whether the 3GPP reference measurement channel is set at 12.2 kbps incl. PN9.

- Set the TFCI Bits to 1100000000. (Channel Settings / 3GPP Reference Channel / TFCI Bits: 1100000000)
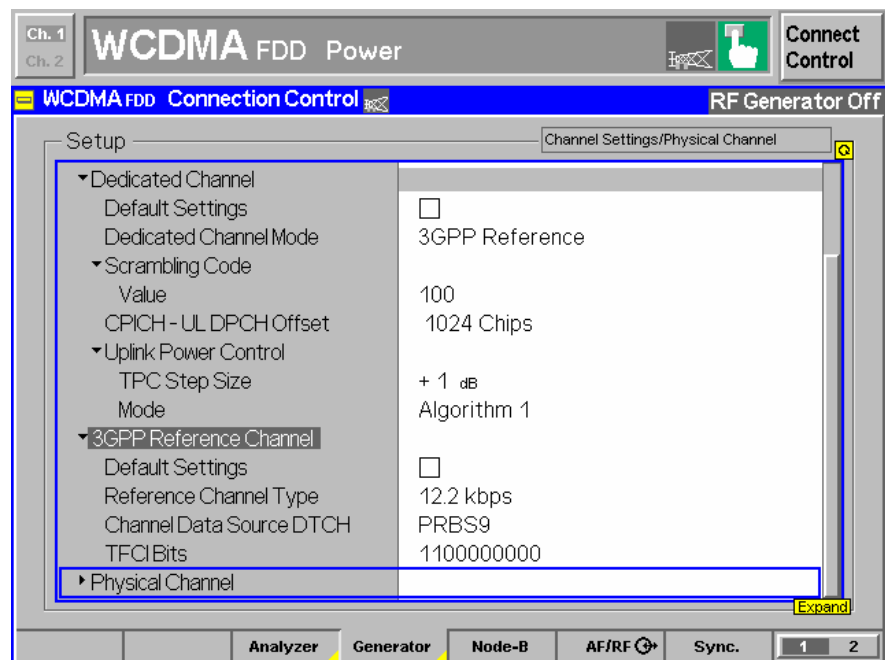
- Close the Generator Configuration menu and start the generator (press the Generator softkey on the right of the screen and the ON / OFF hardkey). The message "Waiting for Synchronisation" should appear and then disappear when the TTI trigger occurs. The TTI trigger is made available on the BTS relatively infrequently (approx. 1 to 2 times per minute).

- Check whether the BER test is currently operating correctly. For this to be the case, all error rates on the BER analyzer must be 0% and incoming bits must be present.

- Carry out receiver measurements by reducing the output level in accordance with the values mentioned in [1] (softkey Total TX Power).

Storing the measurement results

You can use the R&S CMU300 to save measurement results onto a PCMCIA Type 3 card by means of screen shots as follows:

- Hardkey Print

- Destination: External WMF

6 Possible Measurements to Standard 3GPP TS 25.141 FDD R99 [1]

Transmitter measurements (Chapter 6)

Chapter	Title	Test Model and CMU measurement menu
6.2.1	Base station maximum output power	1, Power Meter
6.2.2	CPICH power accuracy	2, Code Domain Power
6.3	Frequency error	4, Modulation
6.4.4	Total power dynamic range	1, Power Meter
6.5.1	Occupied bandwidth	1, Spectrum
6.5.2.1	Spectrum emission mask	1, Spectrum
6.5.2.2	Adjacent channel leakage power ratio (ACLR)	1, Spectrum
6.7.1	Error vector magnitude	4, Modulation
6.7.2	Peak code domain error	3, Code Domain Power

You can use R&S CMU300 and NH RNC/Iub Simulator in combination to carry out the transmitter measurements mentioned with the aid of test models 1/16, 2, 3/16 and 4.

Receiver measurements (Chapter 7)

Chapter	Title	Remarks
7.2	Reference sensitivity level	RMC 12.2 kbps, PN9 Sequence
7.3	Dynamic range	Additional AWGN signal covered by SW option R&S CMU-K77
7.8	Verification of the internal BER calculation	BER simulation function covered by SW option R&S CMU-K77

Further tests are possible with additional RF generators (interferers) and the corresponding coupling networks.

The tables have been created to the best of our knowledge and belief and are intended to provide optimum clarity for possible users. However, the measurement solution providers accept no responsibility for the correct interpretation of the measurement standard.

7 References

[1]   3GPP TS 25.141 Technical Specification, 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Base Station (BS) conformance testing (FDD) (Release 1999)

[2]   Operating Manual 1100.4903.12 of Universal Radio Communication Tester R&S CMU200/300

8 Abbreviations

3GPP	3rd Generation Partnership Project
ACLR	Adjacent Channel Leakuage Ratio
ACSU	NetHawk Accurate Clock Source Unit
BER	Bit Error Ratio
BLER	Block Error Ratio
BTS	Base Transceiver Station
CDP	Code Domain Power
DL	Downlink
EVM	Error Vector Magnitude
FDD	Frequency Division Duplex
HW	Hardware
Iub	Node B line interface
Node B	WCDMA base station
OBW	Occupied Bandwidth
PCDEP	Peak Code Domain Error Power
PEP	Peak Envelope Power
R99	Release 1999
RF	Radio Frequency
RMC	Reference Measurement Channel
RMS	Root Mean Square
RNC	Radio Network Controller
RX	Receiver
SEM	Spectrum Emission Mask
SW	Software
TTI	Transmission Time Intervall
TX	Transmitter
UL	Uplink
Uu	RF interface in UMTS

9   Additional Information

The solution presented here corresponds to the status as of September 2004. We reserve the right to introduce modifications in the light of further technical advances. Although not explicitly tested, this solution should also work with other Node B types of the Ericsson RBS3000 Series. Please send your queries to the following address:

RF measurements: **TM-Applications@rsd.rohde-schwarz.com**

RNC/Iub simulator: **support@nethawk.fi**

10 Ordering Information

Rohde & Schwarz Radio Communication Tester

Type	Designation	Stock-No
CMU300	Universal Radio Communication Tester for BTS test	1100.0008.03
CMU-B12	HW-option: reference oscillator OXCO, aging 3.5x10E-8 / year	1100.5100.02
CMU-B76	HW-option: Layer1-board for WCDMA	1150.0601.02
CMU-U75	Upgrade-kit: measurement DSP module for WCDMA	1150.0501.02
CMU-K75	SW-option: WCDMA TX test (3GPP / FDD / DL)	1150.3200.02
CMU-K76	SW-option: WCDMA-generator (3GPP / FDD / UL)	1150.3300.02
CMU-K77	SW-option: AWGN generator and BER / BLER simulation	1150.4107.02
Optional: CMU-U74	Upgrade-kit: high dynamic WCDMA spectrum measurements (to be used only for upgrade of instruments delivered before 08 / 2003)	1159.0704.02
Optional: CMU-U76	Upgrade-kit: Layer1-board for WCDMA (to be used instead of CMU-B76 for upgrade of existing units)	1150.0701.02
Optional: CMU-Z1	Accessory: 256 MB memory card PCMCIA type 3	1100.7490.04

NetHawk RNC/Iub Simulator

RNC/Iub Simulator 1.3 Software		Tr-eft1-X-XXXX
Ericsson Iub Rel99		e
3GPP 25.141 test library (Ericsson R99 baseline)		f
3G BER Tester		t
One card		1

The R&S CMU300 can be ordered via your local Rohde & Schwarz partner. Please visit **http://www.rohde-schwarz.com** to find out the Rohde & Schwarz sales office for your area.The NetHawk sales representative can becontacted via **sales@nethawk.fi** and more information about NetHawk RNC/Iub Simulator can be found from **www.nethawk.fi**.

Amendment History

Version	Filename	Editor	Comments
1.0	1CM56_E	R&S Gr	Status 09/2005; RBS3202, HW Version R2, SW Version R 2.1.4

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