RX Diversity

HSDPA

Fading

SMU200
Vector Signal Generator

IQ
baseband

RF
Att.

User Equipment

CMU200
Radio Communication Tester

RF

Rohde & Schwarz products: Universal Radio Communication Tester R&S®CMU200,
Vector Signal Generator R&S®SMU200A

Testing HSDPA UE RX Diversity

Application Note 1MA87

For Enhanced Performance Requirements Type 1 of standard TS 34.121, user equipment that provides RX diversity is tested under fading conditions.

This Application Note illustrates how easy it is to perform the Type 1/2/3 RX diversity tests using the Universal Radio Communication Tester R&S®CMU200 in combination with the Vector Signal Generator R&S®SMU200A.

For the great number of measurements a new generic test item was implemented for the free-of-charge CMUgo software. The new test item and a test sequence example with predefined parameters are presented in this application note to run the tests in accordance with the standard.

ROHDE & SCHWARZ

Contents

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

- The Universal Radio Communication Tester R&S®CMU200 is referred to as the CMU.

- The Vector Signal Generator R&S®SMU200A is referred to as the SMU.

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1 Overview

Both in 3GPP-UMTS and GERAN, receive diversity and advanced receiver technologies are used in mobile radios to increase the downlink performance in terms of capacity and coverage. These enhanced receivers need to be checked by new types of tests [3].

In 3GPP-UMTS, the tests for user equipment (UE) with RX antenna diversity emerged in the standard TS34.121 [1] from release 6 onwards. They have been titled *Enhanced Performance Requirements Type 1/2/3* and measure the performance of the high speed downlink packet access (HSDPA) channels.

This application note demonstrates how easily these tests can be performed using the Universal Radio Communication Tester R&S®CMU200 in combination with the Vector Signal Generator R&S®SMU200A.

The application note describes the tests for UE with RX antenna diversity and single link performance (no TX diversity). These tests can be found in the sections 9.2.1A, B, C, D, E, F, G and 9.4.1A of the standard TS34.121. All three tests run under fading conditions with additional white Gaussian noise (AWGN).

For the great number of measurements in each of the sections mentioned above, a new test item and a new generic test sequence with predefined parameter sets are implemented in the application software CMUgo, which is available free-of-charge from Rohde & Schwarz. Both make it easy to measure in accordance with the standard.

(The tests 9.2.1A, 9.2.1B, and 9.2.1C are very similar to the tests 9.2.1D and 9.2.1E. Although they do not need the RX diversity they have been added to the same test item to round off the list.)

To run the tests described in this application note, you need the following configuration bundle:

- CMU200, firmware 4.1.0 or later, options CMU-B21 var. 14 or var. 54, CMU-B68, CMU-B56, CMU-U65, CMU-PK-60, CMU-K64, and CMU-B17

- SMU200, firmware 1.40.17 or later, options SMU-B13 (two times), SMU-B14, SMU-B15, SMU-K43, SMU-K62 (two times), and SMU-K71 (two times)

- Software CMUgo, version 1.9.6 or later

  download it from here

The application note 1MA87 refers to version 7.0.0 of TS34.121.

For ordering numbers, see the section *Ordering Information* in chapter 9 on page 28.

Notes: To get an overview of the test and measurement requirements arising from the new technologies for both GERAN and 3GPP-UMTS, see R&S® Application Note [1MA88](1MA88) *T&M Requirements for Receive Diversity and Advanced Receivers* [3].

2 HSDPA UE RX Diversity Tests

The HSDPA UE RX Diversity tests 9.2.1D and 9.2.1E measure the information bit throughput (T-put) on the high speed downlink shared channel (HS-DSCH). It indicates the actual bitrate in kbps which must not fall below the minimum values specified in the standard. The T-put is evaluated by counting the number of acknowledge and not acknowledge (ACK and NACK) messages from the UE.

Test 9.4.1A checks how reliably the high speed shared control channel (HS-SCCH) will be detected by the UE. This downlink channel signals to the UE connected to the NodeB when a HSDPA receive slot is assigned to it. TS34.121 defines the event E_m for the case that the UE is signalled on the HS-SCCH, but neither an ACK nor a NACK message is observed in the uplink. The probability of event E_m - denoted as $P(E_m)$ - must not exceed the maximum values specified in the standard.

To measure the receiver performance for HSDPA the standard TS34.121 release 6 defines six fixed reference channels (FRCs) for the downlink with different data rates, for example. Considered as a set of parameters they are called H-Set 1 to H-Set 6.

User equipment supporting HSDPA is categorized by its maximum data rate. Table 2_1 shows which H-Sets are to be applied for each category. Table 2_1 is for single link, i.e. for UE without transmit diversity.

HSDPA category	Max. data rate	Fixed reference channel
Category 1	1.22 Mbps	H-Set 1
Category 2	1.22 Mbps	H-Set 1
Category 3	1.82 Mbps	H-Set 2
Category 4	1.82 Mbps	H-Set 2
Category 5	3.65 Mbps	H-Set 3
Category 6	3.65 Mbps	H-Set 3
Category 7	7.21 Mbps	H-Set 3, H-Set 6
Category 8	7.21 Mbps	H-Set 3, H-Set 6
Category 11	0.91 Mbps	H-Set 4
Category 12	1.82 Mbps	H-Set 5

Table 2_1: HSDPA Categories and applicable H-Sets for single link

The tests 9.2.1D, 9.2.1E, and 9.4.1A comprise a lot of measurements, each with a specific set of parameters: the fixed reference channel (H-Set), the modulation scheme, the fading profile, the ratio of the channel power to the total power E_c/I_{or}, and the ratio of signal to AWGN $\hat{I}_{or}/I_{oc}$.

As an example the table 2_2 shows the "measurement tree" of test 9.2.1D.

Fixed reference channel	Modulation scheme	Fading pofile	Level-ratio E_c/I_{or} (dB)	SN-ratio $\hat{I}_{or}/I_{oc}$ (dB)
H-Set 1 H-Set 2 H-Set 3	QPSK	Test 1 PA3 *	-11.9	10.6
			-8.9	10.6
			-5.9	0.6
			-2.9	0.6
		Test 2 PB3 *	-8.9	10.6
			-5.9	0.6
			-5.9	10.6
			-2.9	0.6
		Test 3 VA30 *	-8.9	10.6
			-5.9	0.6
			-5.9	10.6
			-2.9	0.6
		Test 4 VA120 *	-8.9	10.6
			-5.9	0.6
			-5.9	10.6
			-2.9	0.6
	16QAM	Test 1 PA3 *	-8.9	10.6
			-5.9	10.6
		Test 2 PB3 *	-5.9	10.6
			-2.9	10.6
		Test 3 VA30 *	-5.9	10.6
			-2.9	10.6
		Test 4 VA120 *	-5.9	10.6
			-2.9	10.6

Table 2_2: Structure of test 9.2.1D (measurement tree)

* Notes: The fading profiles PA3 and PB3 simulate pedestrians walking at 3 km/h. VA30 and VA120 refer to vehicular scenarios with speeds of 30 km/h or 120 km/h respectively.

Table 2_2 contains 24 measurements for test 9.2.1D. Therefore the CMUgo test item *HSDPA Enhanced, Type 1* - which is presented in this Application Note - provides 24 corresponding parameter sets. Fig. 2_1 shows the beginning of the selection list of the item.
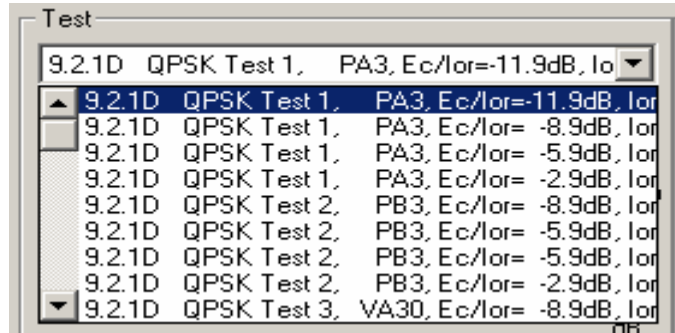

Fig. 2_3: Predefined parameters for test 9.2.1D (section)

Scooping from this pool frees you from entering a lot of values in a test program and makes it easy to compile your own test sequence. Take the presettings as a starting point, and modify single values if you need to.

The test item *HSDPA Enhanced, Type 1* also allows you to simply change to another H-Set or fading profile. All parameters are predefined in accordance with the standard.

You will find a detailed description on how to configure the test item and how to run a test under CMUgo in chapter 5 *Test Procedure* on page 13.

3   Setting up the Test Hardware

The three tests 9.2.1D, 9.2.1E, 9.2.1F, 9.2.1G and 9.4.1A require two fading downlink channels. Both are derived from one source. The two fading profiles are not correlated with each other.

Fig. 3_1 shows the functional hardware setup as outlined in the standard, using two RF fading channel simulators (*Fader*).
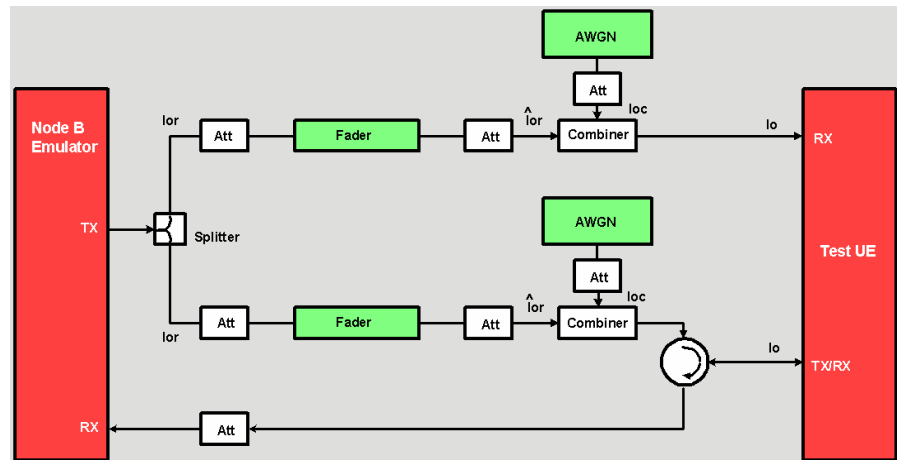

Fig. 3_1: Functional hardware setup in standard TS34.121. Tests without RX-diversity (9.2.1A, 9.2.1B, and 9.2.1C) don't use the upper path.

A power splitter generates two downlink paths from the one TX source of the Node B Emulator (the tester). Both paths are processed in the same way but independently of each other (not correlated).

In each path an RF *Fader* transforms the static level TX signal I_{or} into the fading signal $\hat{I}_{or}$. An AWGN generator adds white Gaussian noise I_{oc} to simulate other traffic channels. Io is the signal summary at each of the two antennas of the test UE.

Recommended test setup:

Instead of using RF faders the R&S instruments CMU and SMU benefit from fading in the baseband, because:

- **Baseband fading ensures optimum signal quality**

  Any RF-channel simulator has to convert the RF signal down to a low intermediate frequency before applying a fading profile. This is followed by an up-conversion. Each conversion causes signal distortion and additional noise, and may decrease the dynamic range. Baseband fading does not need conversions; there are no such impairments.

- **Automatic calibration is provided inside the SMU. No external measurements are necessary**

  The most critical parameters for the receiver measurements are the absolute signal power $\hat{I}_{or}$ and the ratio $\hat{I}_{or}$ / I_{oc}. (signal to Gaussian Noise). With an external channel simulator, you have to measure both signals and adjust the levels precisely. Using baseband techniques, the ratio $\hat{I}_{or}$ / I_{oc} is automatically set correctly inside the SMU, and the absolute power can be adjusted at the CMU and SMU without any

additional measurement required. Because the ratio of $\hat{I}_{or}$ / I_{oc} is adjusted in the baseband, no extra calibrations are needed if the RF channel changes.

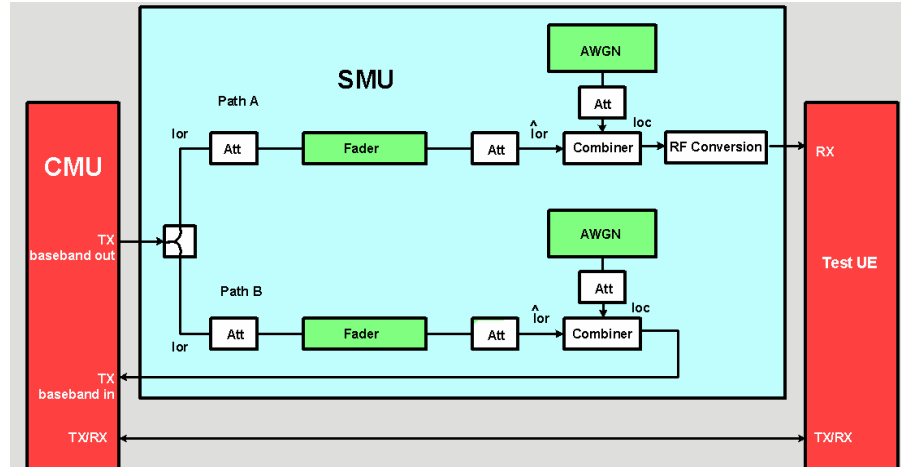Fig. 3_2 shows the functional setup for baseband fading.

Fig. 3_2: Functional hardware setup using baseband fading. Tests without RX-diversity (9.2.1A, 9.2.1B, and 9.2.1C) don't use the upper path.

The CMU provides the downlink stream at the TX (IQ) baseband outputs. This signal is fed into the baseband inputs of the SMU generator (option SMU-B17).

Inside the SMU, the signal branches into the paths A and B. In both paths the fading profiles are applied, and AWGN is added. The signal of path A will be up-converted into the RF band inside the SMU.

The signal of path B is returned from the SMU baseband outputs to the TX (IQ) baseband inputs of the CMU (option CMU-B17), where it is up-converted into the RF band.

From the RF connectors of the two instruments we get the two signals for the two antenna inputs of the device under test.

Connecting the instruments is easy (see Fig. 3_3). Use the dedicated IQ cable included with the option CMU-B17. It provides one DSUB connector to the CMU200 and four BNC connectors to the SMU.

Note that the RF cable between the CMU and the user equipment also carries the uplink signal of the user equipment.

Make sure that the power from the User Equipment at the RF-output of the SMU does not exceed 0.5W. The DC input must be less than 10 V.
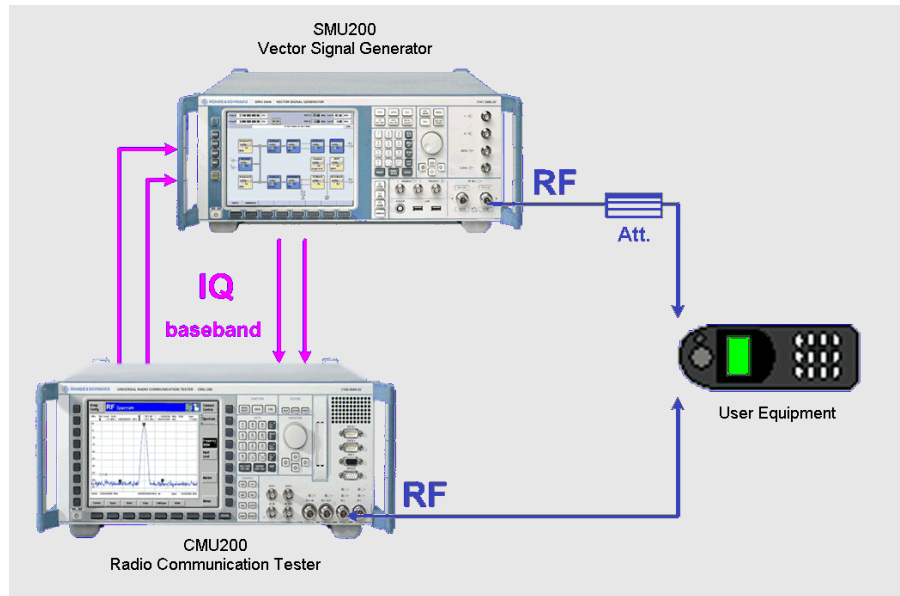
Fig. 3_3: Hardware setup for baseband fading. For tests without RX-diversity (9.2.1A, 9.2.1B, and 9.2.1C) the UE is only connected to the CMU RF output .

RF Path Loss Compensation

- Measure the RF cable loss at your uplink and downlink frequency between the CMU and the user equipment (see Fig. 3_3). You need these values later as input parameters in the test program CMUgo.

- Measure the RF cable loss at your downlink frequency between the SMU and the mobile station. You need this value later as input parameter in the test program CMUgo.

CMUgo automatically compensates these losses.

Calibration

Using the CMUgo test items you do not need any extra measurements to calibrate the paths:

In the IQ path two attenuations are effective:

- WCDMA signals exhibit a certain peak to average level ratio (crest factor). To prevent signals from being clipped, the CMU automatically reduces the average level at its baseband outputs if WCDMA is selected. Moreover, the CMUgo test item for this application reduces the IQ level further.

- Multipath fading is done in the SMU by adding various single signals. This increases the crest factor of the summary signal enormously causing the SMU to reduce the levels further. This attenuation is called the "Insertion Loss" in Fig. 3_4.
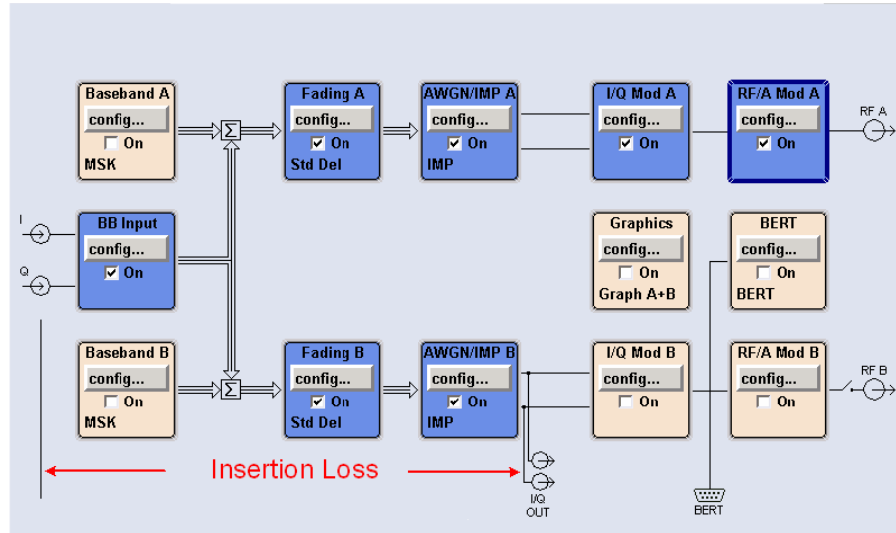

Fig. 3_4: Functional signal processing inside the SMU

In the functional diagram above the upper path (A) is the "SMU path"; the lower path (B) is the "CMU path". Only the blue blocks are active.

Calibration of SMU path (A):

The baseband levels are measured if the checkbox *SMU Baseband Calibration* in the CMUgo test item *HSDPA Enhanced, Type 1* is activated (see Fig. 5_4 on page 16) during the test run.

Knowing the IQ input level and the insertion loss, the SMU always adjusts the correct ratio of faded signal to AWGN and compensates for the reduced IQ input signal automatically.

Calibration of CMU path (B):

Using CMUgo test items the program reads the insertion loss from the SMU and compensates for it by simulating a higher RF output attenuation for the CMU: The fading insertion loss is added to the CMU RF cable loss, and the CMU raises its level accordingly.

Knowing the IQ input level and the insertion loss, the SMU always adjusts the correct ratio of faded signal to AWGN.

The baseband level reduction of the CMU IQ output is automatically compensated in the CMU IQ input stage.

4   Testing with CMUgo

CMUgo is a software tool for running remote-control tests using the CMU and additional instruments. You will find the requirements on your computer hardware, and instructions on how to install CMUgo in the Annex of this Application Note.

We presume that you are already familiar with the CMU and CMUgo. Otherwise first read the manual in the file CMUgo.pdf, which was extracted during installation. It describes the menus, the entries and the controls, and provides examples. We encourage you to learn as you go.

CMUgo remote-controls the instruments via the IEC/IEEE bus. Therefore the SMU and the CMU have to be connected with the controller board of your PC. To keep the figures with the test setup simple, these remote control cables have been omitted on the following pages.

The test items provided by CMUgo execute an extensive task, e.g. setting up a call, running a single test, or showing a summary result. Use the test items as building blocks to compile your own test sequences, and to run them under CMUgo.

For 3GP-WCDMA, there already are many test items, including *WCDMA Spurious Emmissions, Adjacent Channel Selectivity, Blocking, Intermodulation*, etc. The version 1.7.2 of CMUgo adds the generic test item **HSDPA Enhanced, Type 1** to the list. This test item executes the single measurements of the tests 9.2.1D, 9.2.1E, and 9.4.1A.

Further test items are provided: *Basic Initializing and HSDPA Call Setup* always build a test header, *HSDPA Call Release* and *Test End* a test tail.

The test sequence **HSDPA_Enhanced_Type1.SEQ** contains all necessary building blocks in the right order. To run a single measurement out of the extensive test suites of the standard simply adapt some parameters in the test items to your application and you are ready to go!

Fig. 4_1 shows the elements of sequence *HSDPA Enhanced, Type 1.*
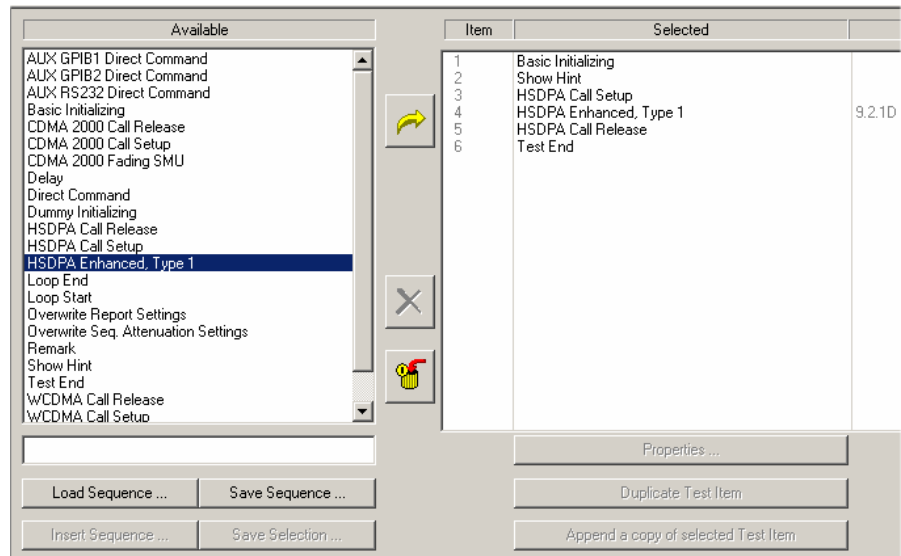

Fig. 4_1: Sequence *HSDPA_Enhanced_Type1.SEQ* for a single measurement

To run several measurements subsequently, line up more test items between call setup and call realease (see Fig. 4_2). These items probably

differ from each other in only one or two parameters. In particular the RF Channel and the Cable Losses might always be the same.

Therefore we recommend that you begin with a test sequence containing just one test item: *HSDPA Enhanced, Type 1*. Edit this one first. Then make as many copies of this test item for as many measurements as you need. Now edit the copies.
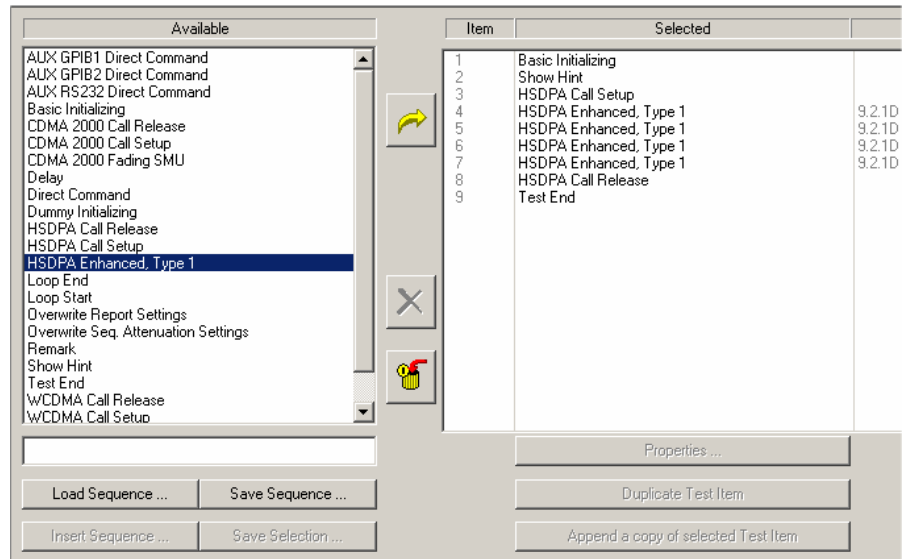

Fig. 4_2: Sequence *HSDPA_Enhanced_Type1_Example for four measurements*

The sequence *HSDPA_Enhanced_Type1_Example.SEQ* executes the first four measurements of test 9.2.1D.

Chapter 5 *Test Procedure* shows you in detail how to configure the test items and how to run a test under CMUgo.

5 Test Procedure

Install the CMUgo software on your PC and connect the CMU and the SMU to your IEEE controller board. Set the instrument names and addresses correctly in the CMUgo configuration (see sections *Installation of CMUgo* and *Configuring the GPIB Settings* on page 26ff. in the Annex).

With the help of a test sequence either provided by CMUgo or taken from your own test library, running a test always requires the following steps:

➢ Load a test sequence.

➢ Configure the test items.

➢ Add further test items if needed, and configure them.

➢ Save your test sequence for later use.

➢ Start the test.

➢ Check the results.

All measurements of the tests 9.2.1D, 9.2.1E and 9.4.1A work with the same test item *HSDPA_Enhanced_Type 1*. From the user's point of view they differ from each other only in their parameters.

The following description uses the sequence *HSDPA_Enhanced_Type 1_ Example.SEQ* which is included in CMUgo version 1.7.6. Take this example as a model for creating your own sequences. Simply modify single parameters, and duplicate or delete test items.

Test Setup

1) Connect instruments and mobile station as shown in Fig. 3_3.

2) Launch CMUgo. Then click *Configuration, Configure Tests*.

The *Configure Test* window opens.

3) Click *Load Sequence*,

4) Select *HSDPA_Enhanced_Type 1_ Example.SEQ*.

Now the *Configure Test* window looks like the screenshot in Fig. 5_1. The left-hand column contains all test items of CMUgo, and the right-hand column shows which of those items have been selected to build the current test sequence.

In general every CMUgo test sequence starts with a *Basic Initializing* of the CMU. It always ends with the item *Test End*, which provides a summary result. Each WCDMA HSDPA UE test needs a corresponding call connection, which is established by the test item *HSDPA Call Setup* and released by item *HSDPA Call Release*.

In addition, CMUgo contains a bitmap to show the hardware setup. The item *Show Hint* in the sequence below displays it as wallpaper until the measurement result is available. You can remove this item if you don't need it.

The essential part of the test are the items between the *HSDPA Call Setup* and the *HSDPA Call Release*. With the *HSDPA_Enhanced_Type 1_Example* sequence, the first four measurements of test 9.2.1D are

provided, in accordance with the standard TS34.121 (also see Table 2_2 on page 5).
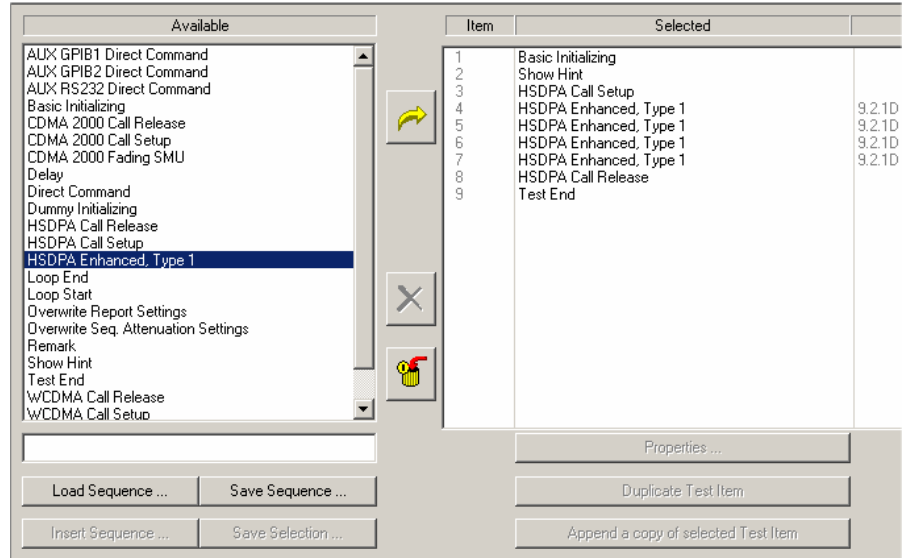

Fig. 5_1: Available and selected test items (test sequence)

Test items have to be configured before you run a test. Double-click a test item to open its configuration window.

Configure test item *Basic Initializing*:

1) Double-click the test item *Basic Initializing*. The configuration window opens (see Fig. 5_2). It enables the function groups inside the CMU.
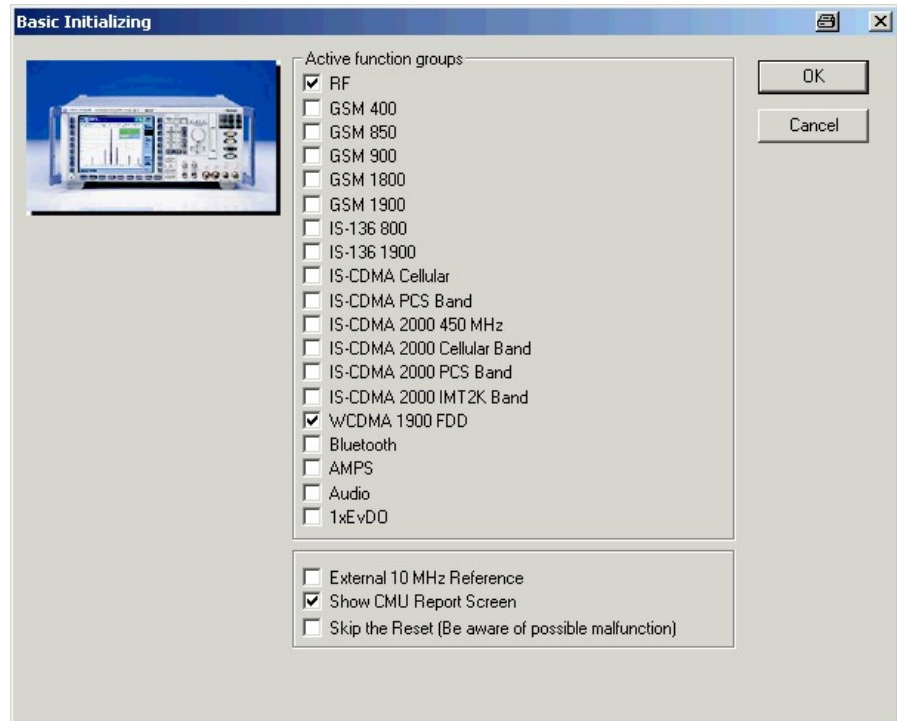

Fig. 5_2: Available function groups inside the CMU

2) Always enable the function group *RF*.

3) Make sure that *WCDMA 1900 FDD* is enabled.

Note: If you activate *Show CMU Report Screen*, the CMU monitors all GPIB commands from and to your remote controller. Otherwise the CMU screen will be blank during a test.

4) Click *OK*.

The test item *Basic Initializing* has been completely configured. You are back in the *Configure Test* window (see Fig. 5_1).

Configure test item HSDPA *Call Setup*:

1) Double-click *HSDPA Call Setup* in the list of the selected test items.

The window *Call Setup Configuration* opens (see Fig. 5_3).

2) Enter a channel number for the call setup at *Physical RF Channel*.

3) Enter the path losses you measured between the UE and the CMU as *Input* and *Output Attenuation*.

All other parameters are preset to the standard values. If you do not modify the default settings a call will be setup in accordance with TS34.108, clause 7.3.6.3 (second table), [2].

Fig. 5_3: HSDPA call setup with default settings

4) Click *OK* to return to the *Configure Test* window.

The test item *Call Setup* has been completely configured. You are back in the *Configure Test* window.

Configure test item *HSDPA Enhanced, Type 1*:

➢ Double-click the first test item HSDPA Enhanced, Type 1 in the list of the selected test items.

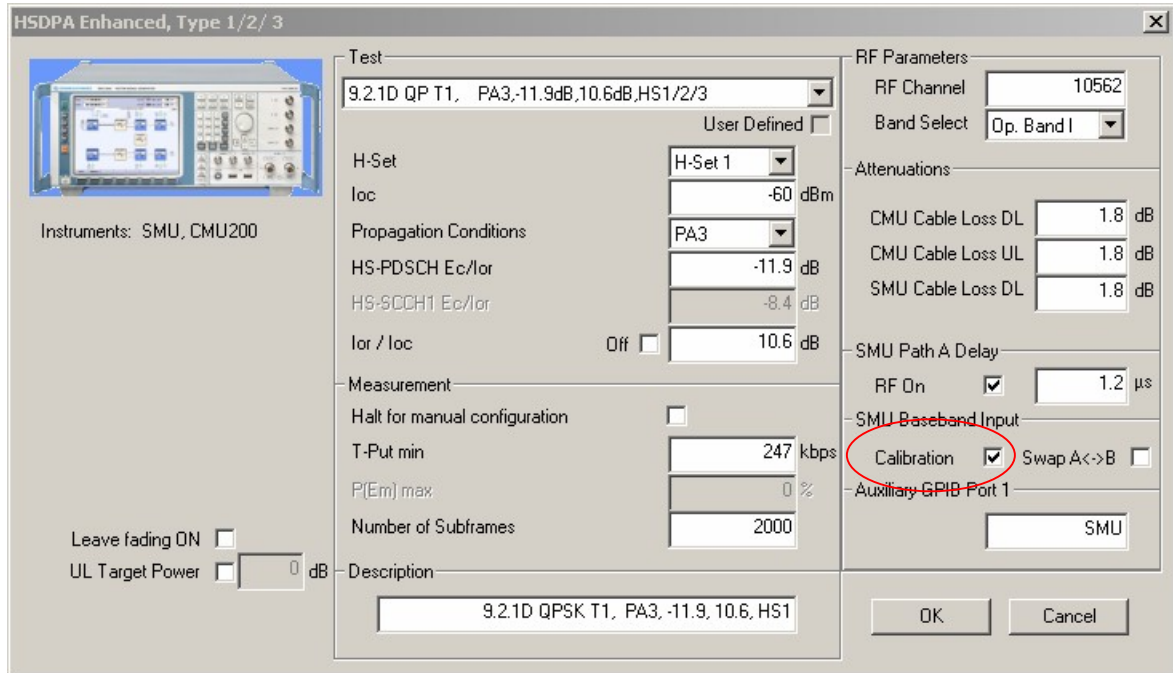The *HSDPA Enhanced, Type 1* window appears (see Fig. 5_4).

Fig. 5_4: Generic test item HSDPA Enhanced, Type 1. For *SMU Baseband Input Calibration* see step 8) on page 17.

The *HSDPA Enhanced, Type 1/2/3* window is prepared for the measurements of the three tests 9.2.1A, 9.2.1B, 9.2.1C, 9.2.1D, 9.2.1E, 9.2.1F, 9.2.1G, and 9.4.1A of standard TS34.121. Edit fields for the measurement configuration are in the middle, and edit fields for your specific test setup are on the right-hand side.

Open the pull-down menu of the field *Test.* You will see 23 selection items for test 9.2.1A, 30 for test 9.2.1B, 22 for test 9.2.1C, 24 for test 9.2.1D, 22 for test 9.2.1E, 16 for test 9.2.1F, 20 for test 9.2.1G and two for test 9.4.1A.
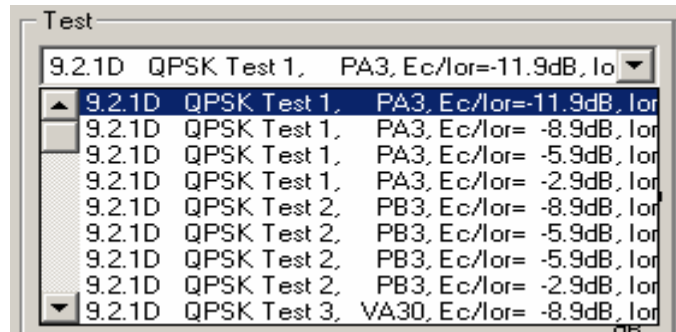
Fig. 5_5 shows you a part of this list.

Fig. 5_5: Predefined measurements in the test list

Each line shows the corresponding section number in the standard, the modulation scheme, the fading profile, and the level and noise ratios (see also Table 2_2 on page 5). All values are in accordance with TS 34.121.

1)   Select one measurement.

Once a measurement has been selected the following entry fields in the window are preset: $I_{oc,}$ *Propagation Condition*, E_c / I_{or}, $\hat{I}_{or} / I_{oc}$, and the limits for the *Measurement* results: the minimum throughput T-Put min for tests 9.2.1, or the maximum misdetection $P(E_m)$ max for test 9.4.1.

For tests 9.2.1 E_c/I_{or} refers to the HS-DSCH, for test 9.4.1 to the HS-SCCH.

If you modify one or more of these parameters, "*User Defined*" will be indicated in the checkbox below the *Test* box.

2)   Modify these parameters if necessary.

3)   Enter a channel number at *RF Channel* and select the *Band*.

4)   Select one H-Set.

5)   Enter the path *Attenuations* you measured between the UE and the CMU or the SMU respectively as *Cable Loss DL* and *UL*.

6)   Edit the *Number of Frames* for the measurement.

7)   For *Auxiliary Device* Name enter *SMU*.

8)   Enable the *SMU **Baseband Input Calibration*** checkbox, if the test item follows immediately after *HSDPA Call Setup*. Then the SMU will measure the incoming baseband signal and adjust the AWGN correctly. This calibration remains valid for all following test items.

   Also enable the *SMU Baseband Input Calibration* checkbox, if the current test items uses a different modulation type than the predecessor.

9)   The AWGN (Îor/Ioc) can be deactivated by checking the **Î<small>OR</small>/I<small>OC</small> OFF** checkbox.

10) **SMU P<small>ATH</small> A D<small>ELAY</small>** is the delay between CMU and SMU RF output due to filtering. The delay (default 1.2µs) is compensated with the fader path of the SMU RF path.

11) When activating the **RF O<small>N</small>** checkbox the RF generator of the CMU baseband fading is additionally turned ON (default OFF).

12) If **SWAP A<->B** is checked, the path A and B of the SMU are swapped. This option is useful for testing 9.4.1A - C (no RX-diversity) without the SMU's 2nd baseband path.

13) Add a comment in the **DESCRIPTION** field if you like.

14) If **HALT FOR MANUAL CONFIGURATION** is checked, the HSDPA Enhanced Type 1 test stops and displays a message box to continue the measurement.
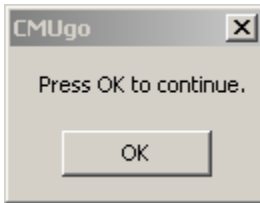

Fig. 5_6 Message Box to continue measurement

15) **LEAVE FADING ON** – keeps the the CMU-B17 IQ/IF interface set to **FADING** and does not reset it **BYPASS**.

16) **UL TARGET POWER** – When checkbox is clicked a command for setting the UE UL power is sent to the CMU.

17) Click **OK**.

The test item *HSDPA Enhanced, Type 1* has been completely configured. You are back in the *Configure Test* window.

18) Configure another item if necessary.

Notes: If you are building your own test sequence, subsequent items probably differ from each other in only one or two parameters. In particular the four parameters of the measurement setup - such as the RF Channel and the Cable Losses - might always be the same.

Therefore we recommend that you begin with a test sequence containing just one test item *HSDPA Enhanced, Type 1*. Edit this one at first. Then make as many copies of this item for as many measurements you need. Now edit the copies.

Do not forget to enable the *Calibration* checkbox in the first *HSDPA Enhanced, Type 1* test item!

If you want to store your sequence use the *Save Sequence* button in the *Configure Test* window (see Fig. 5_1).

19) Finally click *OK* (in the *Configure Test* window*).

This completes the measurement setup. The test sequence has been completely configured. Now run your sequence.

To start the sequence run:

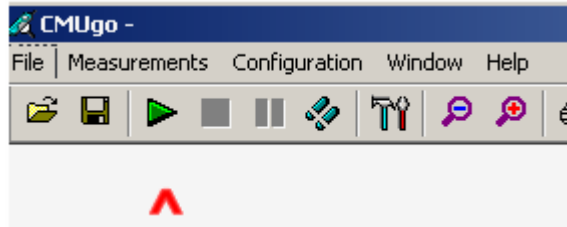Click the start icon in the menu bar of CMUgo:

Fig. 5_7: Start icon in the menu bar of CMUgo

Running the Tests, Measurement Reports

Clicking the start icon will display one of the following windows:

- the hardware setup as wallpaper, if the item *Show Hint* is present

- otherwise a temporary *Measurement Report* window.

To optimize the speed, these windows are not updated until the last measurement of the last test item has been finished.

The temporary *Measurement Report* window already shows the names of the tests and the test conditions. However, as long as the tests are running, all test items are indicated as *not performed*.

When the basic initialization is completed, a pop-up menu instructs you to *Switch on the Mobile*. Ignore this message if it is already powered up. After the individual response time of the mobile station, the CMU automatically registers the mobile station and sets up a connection including HSDPA traffic. The pop-up menu disappears when the connection is established.

The sequence of IEEE commands and the data flow between CMU and the PC running CMUgo appears on the CMU screen (if *Show CMU Report* Screen was enabled in test item *Basic Initialising*).

If not changed by the user the first test item *HSDPA_Enhanced_Type 1* in the sequence *HSDPA_Enhanced_Type 1_*Example*.SEQ* sets up a HSDPA connection using the following:

- H-Set1

- QPSK modulation

- Fading profile PA3 (pedestrian, 3 km/h)

- Level ratio E_c/I_{or} = -11.9 dB

- Signal to noise ratio $\hat{I}_{or}/I_{oc}$ = 10.6 dB

To measure the data throughput the number of ACKs is counted on the uplink HS-DPCCH in the CMU. If the number of frames specified in the current test item has elapsed, the result is stored inside CMUgo, and the sequence continues with the next test item. This uses the same H-Set and modulation, but a different level ratio E_c/I_{or} (see Table 2_2 on page 5).

The main CMUgo display is not updated until the sequence has finished but the bottom line of the CMUgo window shows which test item is currently active. Note that CMUgo considers the *HSDPA Call Setup* also as an equal test item. The displayed "steps" are internal program counts within a test item.

If the H-Set (1 to 6) or modulation scheme (QPSK, 16QAM) changes from one test item to the other the call is released automatically and a call established with the new parameters. In this case the test takes approx. 10 seconds longer as usual. It is convenient to group test items with matching H-Sets and modulation schemes in order to minimize test duration.

Once the sequence has been completed, a measurement report similar to Fig. 5_8 appears.
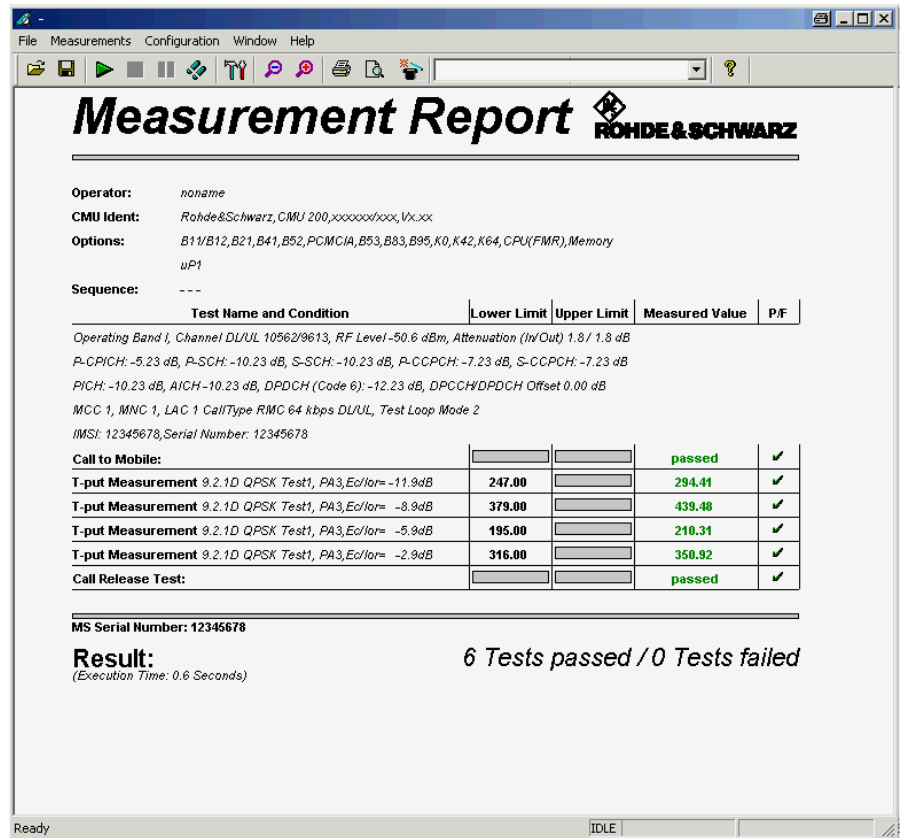

Fig. 5_8: Result for the first four measurements of test 9.2.1D

In the upper half of the window the CMU configuration is displayed, followed by the general test conditions, such as RF channels, levels etc. The lower half of the window reports the results.

The sequence *HSDPA_Enhanced_Type 1_* Example.*SEQ* starts with the *HSDPA Call Setup* and ends with the *HSDPA Call Release*. Both are test items without limits.

Between the call setup and the call release the first four measurements of test 9.2.1D are performed. They measure the information bit throughput (T-put) on the high speed downlink shared channel (HS-DSCH) at different ratios of channel power to total power (E_c/I_{or}), and of signal to AWGN ($\hat{I}_{or}/I_{oc}$).

Fig. 5_8 presents the actual bitrates in kbps as *Measured Values*.

The results in Fig. 5_8 are inside the limits of the standard, so they are displayed in green. Otherwise they will be displayed in red. In addition, the right-hand column (P/F for Pass/Fail) indicates whether a test has passed or failed.

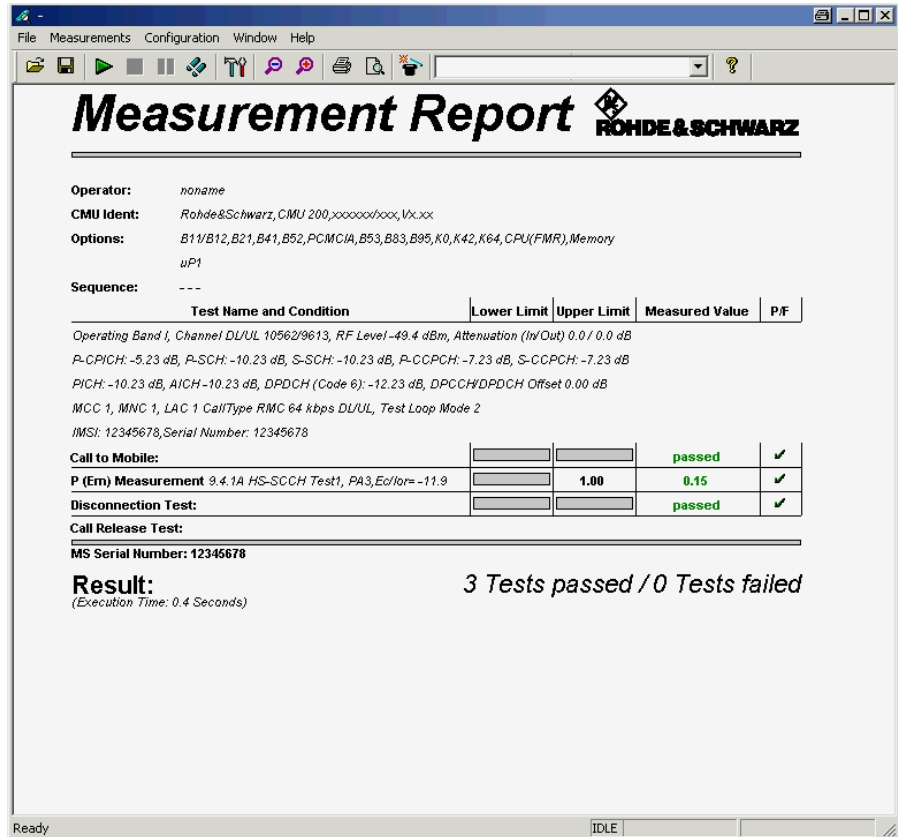Fig. 5_9 shows the result of one measurement of test 9.4.1A.

Fig. 5_9: Result of one measurements of test 9.4.1A

This test checks how reliably the high speed shared control channel (HS-SCCH) will be detected by the UE. Displayed is the probability of event E_m which is declared when the UE is signalled to receive, but neither an ACK nor a NACK message is indicated in the uplink. In Fig. 5_9 the probability of E_m is inside the limits of the standard; so the measured value is displayed in green.

Each test item in a test sequence provides a single result in the measurement report. The total number of passed and failed tests are counted inside CMUgo and presented as a summary by the last item *Test End* (see Fig. 5_10).

Some test items return *not a number* (*NAN*) e.g. if during the test run the radio connection has broken. These cases are indicated seperately below the number of passed and failed tests.
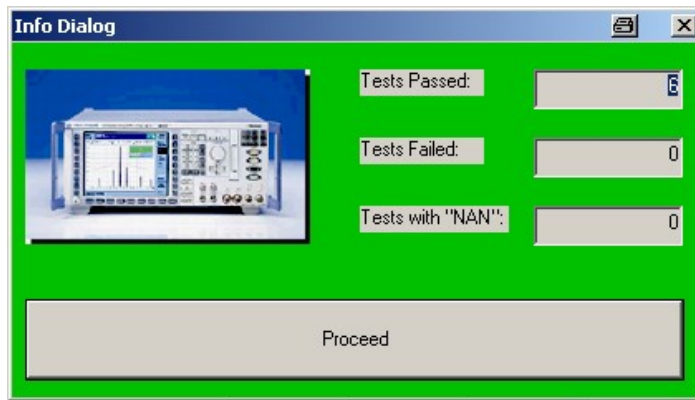
Fig. 5_10: Test summary provided by item *Test End.*

The summary window is displayed in green, if all tests have passed. If one ore more tests have failed it will be displayed in red.

To finish the session click *Proceed.* The test summary will be closed. Now you can start the test again, or modify the test item configuration or the test sequence.

To stop a running measurement:

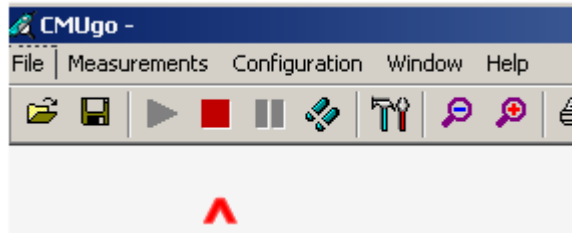➢ Click the stop icon (Fig. 5_10) in the menu bar of CMUgo:

Fig. 5_11: Stop icon in the menu bar of CMUgo

If you stop a measurement while *Show Hint* fills the screen, the measurement report remains invisible in the background. To make it visible click one of the *Zoom* buttons (see Fig. 5_11). This refreshes the CMUgo screen.
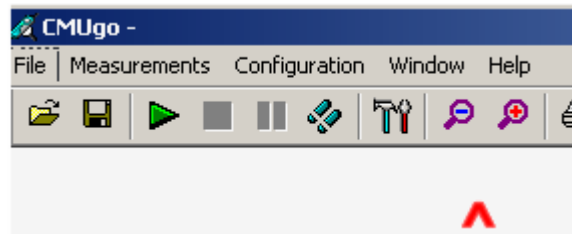

Fig. 5_12: Zoom icons

6 Summary

For the Enhanced Performance Requirements Type 1 of standard TS 34.121 a test setup is given in this Application Note, using the CMU universal radiocommunication tester and the SMU vector signal generator. Together they provide two downlink channels for UE RX diversity under multipath fading conditions. Fading and additional AWGN are applied inside the SMU generator in baseband for best dynamic range and minimum distortion. Using the baseband processing additional RF calibrations are obsolete.

For remote control the Rohde & Schwarz software CMUgo has been enhanced by adding a new generic test item for the tests 9.2.1D, 9.2.1E, and 9.4.1A. It provides predefined parameters to configure the instruments for the numerous measurements of the three tests in accordance with the standard. A test sequence including initialization, call set up, measurement, and call release helps to quickly build up your own test suites.

On the basis of an example sequence this Application Note contains a step-by-step description of the entire test procedure, including a measurement report for both tests 9.2.1 and test 9.4.1.

For comments and suggestions regarding this document, please contact

TM-Applications@rsd.rohde-schwarz.com.

7   Annex

System Requirements for CMUgo

To ensure proper operation of CMUgo, your computer should fulfill the following minimum requirements:

Platform: Windows 98 / ME / 2000 / XP

Processor: Pentium 300

RAM: 64 Mbytes

Display: SVGA 800x600 pixels

(For more convenient use of CMUgo, particularly the presentation of measurement reports, the video graphics card must have a higher resolution.)

Hard-disk storage: 50 Mbytes

Peripherals: Mouse

National Instruments GPIB bus card

To make full use of CMUgo's capabilities, the CMU firmware version must be 4.1.0 or later.

Installation of CMUgo

Application Note 1MA87 consists of two parts:

- This document (1MA87_xE.pdf)

Download it from http://www.rohde-schwarz.com/appnote/1MA87

- A link to the CMUgo software.

Download it from here

To get the installation files:

Unzip CMUgo.zip. One of the extracted files is setup.exe.

➢ Run setup.exe.

➢ Follow the instructions of the installer dialog.

Configuring the GPIB Settings

CMUgo is used here as a tool to remote-control the CMU and other instruments via the GPIB bus. The devices must be set to different IEEE addresses, and be connected to your controller.

➢ Run CMUgo.

➢ Click *Configuration*

The port for remote control of the CMU can be configured at *Remote Port.* In addition, CMUgo can control up to ten additional *Auxiliary GPIB Ports*:
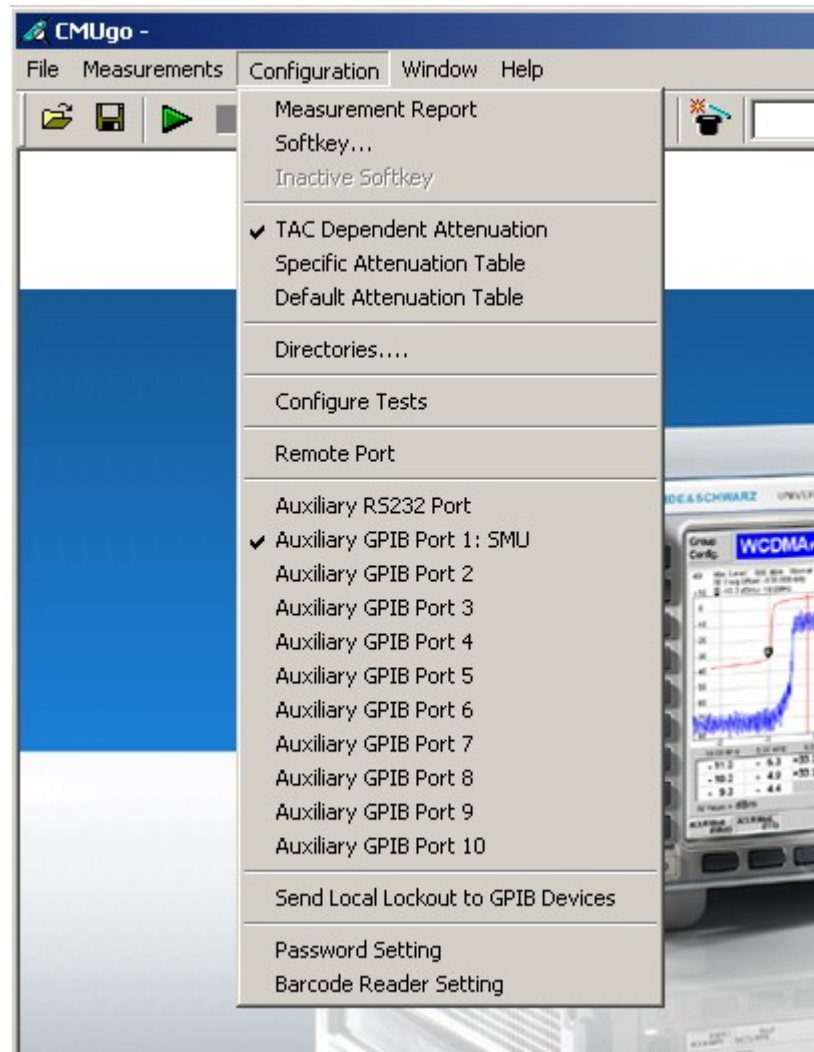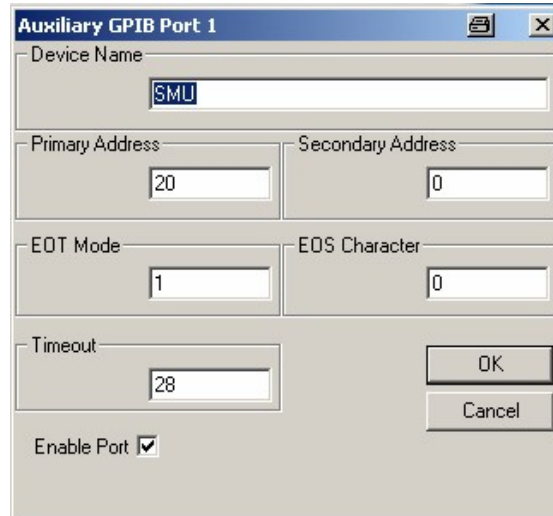

Fig. A_1: GPIB configuration for up to ten additional instruments

For this application, you need to announce the SMU generator.

➢ Double-click e.g. *Auxiliary GPIB Port 1* to make the instrument known to CMUgo.

The configuration window for this port opens (Fig. A_2).

Fig. A_2: Configuration of *Auxiliary GPIB Port*

➢ Enter **SMU** as *Device Name*.

➢ Enter the GPIB address.

➢ Enable port (do not omit this step!).

8 References

[1]   3GPP TS34.121; Terminal conformance specification; Radio transmission and reception (FDD) (Release 7.0.0)

[2]   3GPP TS34.108; Universal Mobile Telecommunications System; Common test environments for user equipment; Conformance testing (version 6.1.1 Release 6)

[3]   C. Gessner; T&M Requirements for Receiver Diversity and Advanced Receivers; Rohde & Schwarz Application Note 1MA88; 2006 http://www.rohde-schwarz.com/appnote/1MA88

[4]   O. Gerlach; UTRA-FDD Receiver Tests Under Fading Conditions with R&S$^®$CMU and R&S$^®$ABFS; R&S Application Note 1MA64; 2006 http://www.rohde-schwarz.com/appnote/1MA64

[5]   O. Gerlach; 3GPP Receiver Tests Under Fading Conditions with R&S$^®$CMU and R&S$^®$SMIQ; R&S Application Note 1MA76; 2006 http://www.rohde-schwarz.com/appnote/1MA76

9 Ordering Information

Universal Radio Communication Testers

R&S® CMU200	Universal Communication Tester	1100.0008.02
R&S® CMU-B68	Layer-1 Board (3GPP/FDD, DL+UL)	1149.9809.02
R&S® CMU-B56	WCDMA and Data E2E for CMU-B21/var.14	1150.1850.14
R&S® CMU-PK60	WCDMA-Sig.: 3GPP/FDD/UE, TX Test Generator, Band 1,2,3,4,5,6	1159.3355.02
R&S® CMU-K64	HSDPA	1157.3970.02
R&S® CMU-B17	IQ/Interface, analogue	1100.6906.02
R&S® CMU-B21	Universal signalling unit (3GPP capable)	1100.5200.14
R&S® CMU-U65	MESS-DSP-MOD. WDDC400	1100.7402.02

Vector Signal Generators

R&S® SMU200A	Vector Signal Generator	1141.2005.02
R&S® SMU-B102	RF Path A: 100 kHz to 2.2 GHz	1141.8503.02
R&S® SMU-B103	RF Path A: 100 kHz to 3 GHz	1141.8603.02
R&S® SMU-B104	RF Path A: 100 kHz to 4 GHz	1141.8703.02
R&S® SMU-B106	RF Path A: 100 kHz to 6 GHz	1141.8803.02
R&S® SMU-B13	Baseband Main Module (Path A)	1141.8003.02
R&S® SMU-B13	Baseband Main Module (Path B)	1141.8003.02
R&S® SMU-B14	Fading Simulator	1160.1800.02
R&S® SMU-B15	Fading Simulator Extension	1160.2288.02
R&S® SMU-B17	Analog baseband input	1142.2880.02
R&S® SMU-B30	Overvoltage protection high power	1159.7444.01
R&S® SMU-K42	Digital standard 3GPP FDD	1160.7909.02
R&S® SMU-K43	3GPP FDD enhanced MS/BS tests incl. HSDPA	1160.9660.02
R&S® SMU-K62	Additional white gaussian noise (Path A)	1159.8511.02
R&S® SMU-K62	Additional white gaussian noise (Path B)	1159.8511.02
R&S® SMU-K71	Dynamic Fading and Enhanced Resolution (Path A)	1160.9201.02
R&S® SMU-K71	Dynamic Fading and Enhanced Resolution (Path B)	1160.9201.02

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