Measurements on 3GPP UE's according to TS34.121 with CMUgo

Tests with combined Instruments

Application Note

Products:

- R&S®CMU200
- R&S®SMU200A
- R&S®SMATE
- R&S®FSQ
- R&S®FSG
- R&S®FSP
- R&S®FSV

Most of the tests specified in standard TS 34.121 that 3GPP WCDMA user equipment (UE) has to fulfill can be performed solely by the CMU200 universal radio communication tester. Other tests, however, require additional instruments for generating one or more interfering signals, for fading setup or for high dynamic spectrum analysis.

This Application Note shows how easy it is to perform these tests with the remote-control software CMUgo, using the CMU200 in combination with a R&S signal generator and a R&S spectrum analyzer.

Application Note

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ROHDE&SCHWARZ

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

- The R&S®CMU200 universal radio communication tester is referred to as the CMU.
- The R&S®SMR microwave signal generator is referred to as the SMR.
- The R&S®SMJ100A vector signal generator is referred to as the SMJ.
- 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 R&S®FSP spectrum analyzer is referred to as the FSP.
- The R&S®FSQ signal analyzer is referred to as the FSQ.
- The R&S®FSG signal analyzer is referred to as the FSG.
- The R&S®FSV spectrum analyzer is referred to as the FSV.
- The SMR, SMJ, SMATE and SMU are referred to as the SMx.
- The FSP, FSQ, FSV and FSG are referred to as the FSx.

1 Introduction

Most of the tests specified in standard TS 34.121 that 3GPP WCDMA user equipment (UE) has to fulfill can be performed solely by the CMU universal radio communication tester. Other tests, however, require additional instruments for generating one or more interfering signals, for fading setup or for high dynamic spectrum analysis up to 12.75 GHz, i.e. features that a tester optimized for production cannot offer.
This Application Note shows how easy it is to perform these tests with the remote-control software CMUgo, using the CMU in combination with the SMU, SMJ, SMATE or SMR signal generator, and the FSQ, FSU, FSP or FSV spectrum analyzer.

Benefits

- Free-of-charge solution with CMUgo
- Automatic, remote-controlled sequence
- Flexible, editable test plans
- Easy operation

1.1 Covered Tests in Accordance with TS34.121

The following tables show which tests can be performed with the CMU together with additional instruments. All tests are implemented as modules in CMUgo and are described in this Application Note.

Transmitter characteristics (5)	
Chapter	**Name**
5.11	Spurious emissions
5.12	Transmit intermodulation

Receiver characteristics (6)	
Chapter	**Name**
6.4	Adjacent channel selectivity (ACS) (Release 99 and Release 4)
6.4A	Adjacent channel selectivity (ACS) (Release 5 and later)
6.5	Blocking characteristics
6.6	Spurious response
6.7	Intermodulation characteristics
6.8	Spurious emissions

Performance tests (7)	
Chapter	**Name**
7.3.1	Demodulation of DCH in multipath fading propagation conditions (single link performance)
7.4.1	Demodulation of DCH in moving propagation conditions (single link performance)
7.5.1	Demodulation of DCH in birth-death propagation conditions (single link performance)
7.5.1A	Demodulation of DCH in high speed train conditions (single link performance)

Performance requirements for HSPDA (9)	
Chapter	**Name**
9.2.1	Demodulation of HS-DSCH (fixed reference channel) / single link performance
9.3.2	Reporting of channel quality indicator / single link performance – fading propagation conditions
9.4.1	HS-SCCH detection performance / single link performance
9.4.1A	HS-SCCH detection performance / single link performance – enhanced performance requirements type 1

Performance requirement (E-DCH) (10)	
Chapter	**Name**
10.2.1.1	Detection of E-DCH HARQ ACK indicator channel (E-HICH) / single link performance (10 ms TTI)
10.2.1.2	Detection of E-DCH HARQ ACK indicator channel (E-HICH) / single link performance (2 ms TTI)
10.3.1.1	Detection of E-DCH relative grant channel (E-RGCH) / single link performance (2 ms TTI)
10.3.1.2	Detection of E-DCH relative grant channel (E-RGCH) / single link performance (10 ms TTI)
10.4.1	Demodulation of E-DCH absolute grant channel (E-AGCH) / single link performance

1.2 Preparing for Operation

1.2.1 Setting the GPIB Parameters in CMUgo

The GPIB parameters of the CMU can be set via CONFIGURATION|REMOTE PORT. CMUgo uses auxiliary channels to communicate with additional devices like SMx and FSx.
To configure an additional device, open the Configuration menu (Fig. 1) and select an Auxiliary GPIB Port. A window containing further parameters will open (Fig. 2).

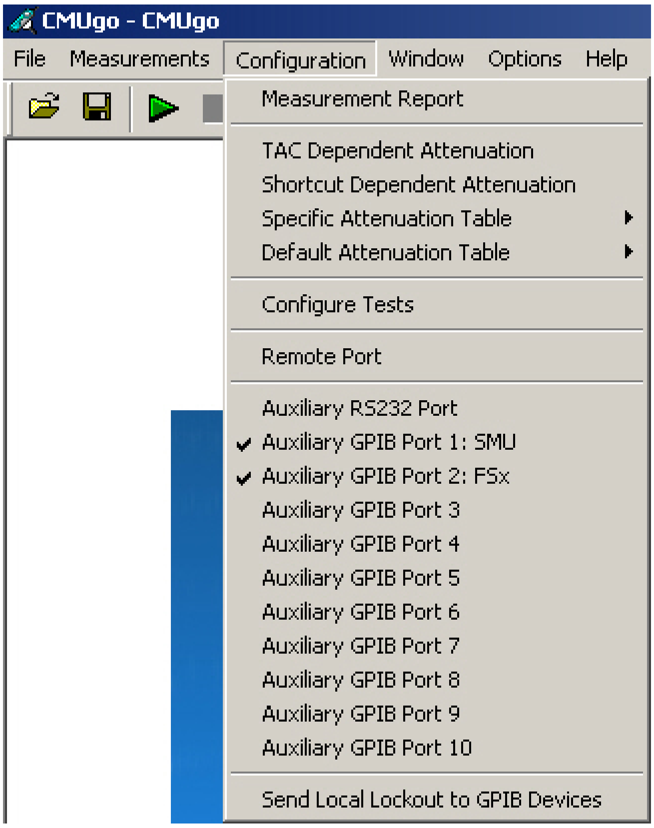


Fig. 1: Configuration menu

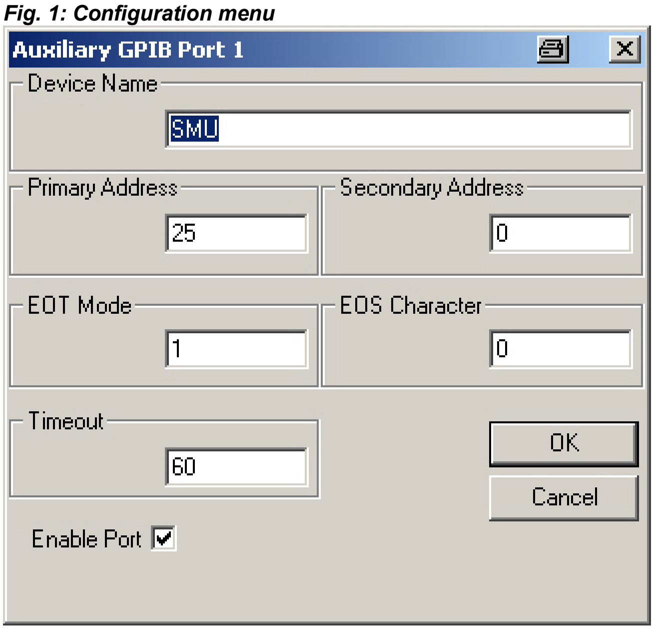


Fig. 2: Auxiliary GPIB Port x

The device name entered under Auxiliary GPIB Port x must be identical to the name entered in the CMUgo modules for the individual tests. The usual GPIB parameters can be set. Note that **Enable Port** must be activated.

1.2.2 Setting the Reference Frequency in CMUgo

Via the Basic Initializing module, the CMU can be synchronized with other equipment using a 10 MHz clock signal. For this purpose, activate External 10 MHz Reference (Fig. 4), and connect a BNC cable between the REF OUT output of a generator / analyzer and the REF IN socket of the CMU. For test setups with three instruments, a switch is available in the corresponding module of CMUgo.
In the dedicated figures of the test setups, the synchronization connections are not shown due to clarity reasons.

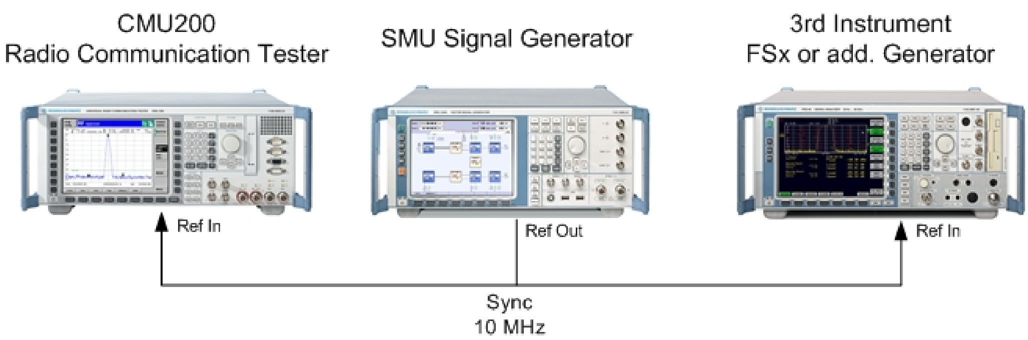


Fig. 3: Synchronization with 10 MHz

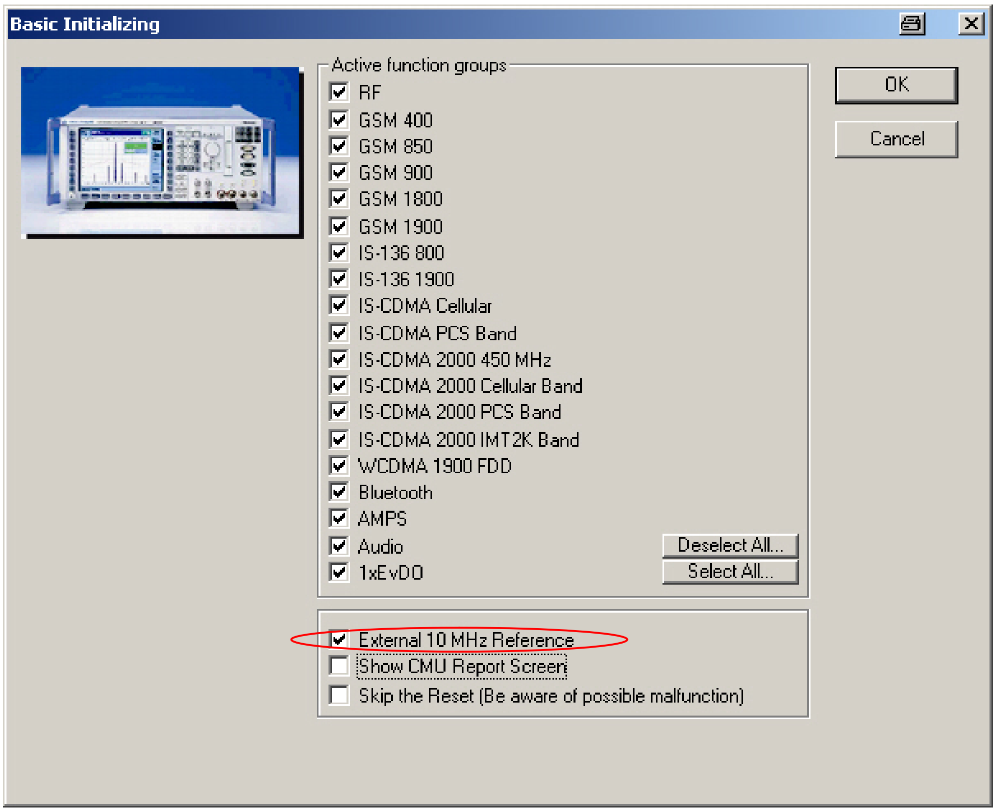


Fig. 4: Activating the external 10 MHz reference

1.2.3 Measuring the RF Attenuation Values

To obtain correct results, the attenuation between the CMU and the DUT must be measured and entered into the CMUgo modules. Likewise, the attenuation between the DUT and the signal generator(s) and / or the spectrum analyzer must be measured and entered into the appropriate module(s).
Rohde & Schwarz also offers the free-of-charge **FreRes** software which allows you to record the frequency response. It is available under the following link:

http://www.rohde-schwarz.com/appnote/1MA09

1.2.4 Damage Warning

Make sure that the power from the UE at the RF output of the SMU does not exceed 0.5 W (e.g. attenuator 20 dB). The DC input must be less than 10 V.

2 Tests according to TS34.121

2.1 Preliminary Remark: Call Setup

All modules presented here assume that a call has already been set up. Different modules are available for this purpose in CMUgo but will not be described in detail here. Reference in the individual chapters will only be made to parameters that require settings that differ from the default settings. The following call setup modules are required for the tests:

- WCDMA call setup (for tests in accordance with chapters 5, 6 and 7 of the standard)
- HSDPA call setup (for tests in accordance with chapter 9 of the standard)
- HSUPA call setup (for tests in accordance with chapter 10 of the standard)

2.2 Transmitter Characteristics (Chapter 5)

2.2.1 Spurious Emissions (5.11)

Spurious emissions are emissions caused by unwanted transmitter effects such as harmonics emissions, parasitic emissions, intermodulation products and frequency conversion products. If not suppressed sufficiently, they can considerably impair the reception of other radio services.
Spurious emissions are measured outside the frequency band from 12.5 MHz below to 12.5 MHz above the UE center frequency. (Frequencies closer to the carrier are checked by tests 5.9 Spectrum Emission Mask and 5.10 Adjacent Channel Leakage Ratio. Tests 5.9 and 5.10 are performed by the CMU without additional equipment.)
The purpose of test 5.11 is to verify that the UE spurious emissions do not exceed the values shown in Table 1 and Table 2.

General Spurious Emissions test requirements		
Frequency band	**Measurement bandwidth**	**Minimum requirement**
9 kHz ≤ f < 150 kHz	1 kHz	−36 dBm
150 kHz ≤ f < 30 MHz	10 kHz	−36 dBm
30 MHz ≤ f < 1000 MHz	100 kHz	−36 dBm
1 GHz ≤ f < 12.75 GHz	1 MHz	−30 dBm

Table 1: General Spurious Emissions test requirements

Additional Spurious Emissions test requirements			
Operating band	**Frequency bandwidth**	**Measurement bandwidth**	**Minimum requirement**
I	860 MHz ≤ f ≤ 895 MHz	3.84 MHz	−60 dBm
	921 MHz ≤ f < 925 MHz	100 kHz	−60 dBm (see note 1)
	925 MHz ≤ f ≤ 935 MHz	100 kHz 3.84 MHz	−67 dBm (see note 1) −60 dBm
	935 MHz < f ≤ 960 MHz	100 kHz	−79 dBm (see note 1)
	1475.9 MHz ≤ f ≤ 1500.9 MHz	3.84 MHz	−60 dBm
	1805 MHz ≤ f ≤ 1880 MHz	100 kHz	−71 dBm (see note 1)
	1844.9 MHz ≤ f ≤ 1879.9 MHz	3.84 MHz	−60 dBm
	1884.5 MHz < f < 1919.6 MHz	300 kHz	−41 dBm
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm
	2620 MHz ≤ f ≤ 2690 MHz	3.84 MHz	−60 dBm
II	869 MHz ≤ f ≤ 894 MHz	3.84 MHz	−60 dBm
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	−60 dBm
	2110 MHz ≤ f ≤ 2155 MHz	3.84 MHz	−60 dBm (see note 3)
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm (see note 4)
III	921 MHz ≤ f < 925 MHz	100 kHz	−60 dBm (see note 1)
	925 MHz ≤ f ≤ 935 MHz	100 kHz 3.84 MHz	−67 dBm (see note 1) −60 dBm
	935 MHz < f ≤ 960 MHz	100 kHz	−79 dBm (see note 1)
	1805 MHz ≤ f ≤ 1880 MHz	3.84 MHz	−60 dBm
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm
	2620 MHz ≤ f ≤ 2690 MHz	3.84 MHz	−60 dBm
IV	869 MHz ≤ f ≤ 894 MHz	3.84 MHz	−60 dBm
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	−60 dBm
	2110 MHz ≤ f ≤ 2155 MHz	3.84 MHz	−60 dBm (see note 3)
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm (see note 4)
V	869 MHz ≤ f ≤ 894 MHz	3.84 MHz	−60 dBm
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	−60 dBm
	2110 MHz ≤ f ≤ 2155 MHz	3.84 MHz	−60 dBm (see note 3)
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm (see note 4)
VI	860 MHz ≤ f < 875 MHz	1 MHz	−37 dBm
	875 MHz ≤ f ≤ 895 MHz	3.84 MHz	−60 dBm
	1475.9 MHz ≤ f ≤ 1500.9 MHz	3.84 MHz	−60 dBm
	1844.9 MHz ≤ f ≤ 1879.9 MHz	3.84 MHz	−60 dBm
	1884.5 MHz ≤ f ≤ 1919.6 MHz	300 kHz	−41 dBm
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm
VII	921 MHz ≤ f < 925 MHz	100 kHz	−60 dBm (see note 1)
	925 MHz ≤ f ≤ 935 MHz	100 kHz 3.84 MHz	−67 dBm (see note 1) −60 dBm
	935 MHz < f ≤ 960 MHz	100 kHz	−79 dBm (see note 1)
	1805 MHz ≤ f ≤ 1880 MHz	100 kHz	−71 dBm (see note 1)
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm
	2620 MHz ≤ f ≤ 2690 MHz	3.84 MHz	−60 dBm
	2590 MHz ≤ f ≤ 2620 MHz	3.84 MHz	−50 dBm
VIII	925 MHz ≤ f ≤ 935 MHz	100 kHz 3.84 MHz	−67 dBm (see note 1) −60 dBm
	935 MHz < f ≤ 960 MHz	100 kHz	−79 dBm (see note 1)

Additional Spurious Emissions test requirements			
		3.84 MHz	−60 dBm
	1805 MHz < f ≤ 1830 MHz	100 kHz 3.84 MHz	−71 dBm (see notes 1 and 2) −60 dBm (see note 2)
	1830 MHz < f ≤ 1880 MHz	100 kHz 3.84 MHz	−71 dBm (see note1) −60 dBm
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm
	2620 MHz ≤ f ≤ 2640 MHz	3.84 MHz	−60 dBm
	2640 MHz < f ≤ 2690 MHz	3.84 MHz	−60 dBm (see note 2)
IX	860 MHz ≤ f ≤ 895 MHz	3.84 MHz	−60dBm
	1475.9 MHz ≤ f ≤ 1500.9 MHz	3.84 MHz	−60 dBm
	1844.9 MHz ≤ f ≤ 1879.9 MHz	3.84 MHz	−60dBm
	1884.5 MHz ≤ f ≤1919.6 MHz	300 kHz	−41 dBm
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm
X	860 MHz ≤ f ≤ 895 MHz	3.84 MHz	−60 dBm
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	−60 dBm
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm
XI	860 MHz ≤ f ≤ 895 MHz	3.84 MHz	−60 dBm
	1475.9 MHz ≤ f ≤ 1500.9 MHz	3.84 MHz	−60 dBm
	1844.9 MHz ≤ f ≤ 1879.9 MHz	3.84 MHz	−60 dBm
	1884.5 MHz ≤ f ≤ 1919.6 MHz	300 kHz	−41 dBm
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm
XII	728 MHz ≤ f ≤ 746 MHz	3.84 MHz	−60 dBm
	746 MHz ≤ f ≤ 756 MHz	3.84 MHz	−60 dBm
	758 MHz ≤ f ≤ 768 MHz	3.84 MHz	−60 dBm
	869 MHz ≤ f ≤ 894 MHz	3.84 MHz	−60 dBm
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	−60 dBm
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm
XIII	728 MHz ≤ f ≤ 746 MHz	3.84 MHz	−60 dBm
	746 MHz ≤ f ≤ 756MHz	3.84 MHz	−60 dBm
	758 MHz ≤ f ≤ 768 MHz	3.84 MHz	−60 dBm
	763 MHz ≤ f ≤ 775 MHz	6.25 kHz	[TBD] dBm (see note 6)
	793 MHz ≤ f ≤ 805 MHz	6.25 kHz	[TBD] dBm (see note 6)
	869 MHz ≤ f ≤ 894 MHz	3.84 MHz	−60 dBm
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	−60 dBm
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm
XIV	728 MHz ≤ f ≤ 746 MHz	3.84 MHz	−60 dBm
	746 MHz ≤ f ≤ 756 MHz	3.84 MHz	−60 dBm
	758 MHz ≤ f ≤ 768 MHz	3.84 MHz	−60 dBm
	769 MHz ≤ f ≤ 775 MHz	6.25 kHz	[TBD] dBm (see note 6)
	799 MHz ≤ f ≤ 805 MHz	6.25 kHz	[TBD] dBm (see note 6)
	869 MHz ≤ f ≤ 894 MHz	3.84 MHz	−60 dBm
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	−60 dBm
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm

Table 2: Additional Spurious Emissions test requirements

Table 1 (General Spurious Emissions) contains a set of limits for the continuous frequency band from 9 kHz to 12.75 GHz. These limits can be checked by the **WCDMA UE General TX Spur. Emissions** module of CMUgo.
Within the frequency range of Table 1, there are additional, more stringent limits for frequency bands that are allocated by other mobile services, e.g. GSM; see Table 2 (Additional Spurious Emissions). These limits can be checked by the **WCDMA UE Add. TX Spur. Emissions Band x** module of CMUgo (x stands for the required band).

To achieve the necessary dynamic range for these measurements, a notch filter is used to suppress the UE carrier.

Recommended test setup:

Fig. 5 shows the test setup for spurious emissions measurements.
In the path between the CMU and the UE, the analyzer is coupled via a resistive combiner. This ensures a flat frequency response. Additional attenuators reduce the power and improve the impedance matching.
For measurements of the *General Spurious Emissions*, connect the signal analyzer directly to the resistive combiner.
For measurements of the *Additional Spurious Emissions* (in the receive bands of other standards), a notch filter is inserted between the analyzer and the resistive divider. Tune it carefully to suppress the UE uplink signal by about 40 dB to avoid a mixer level inside the analyzer that is too high.

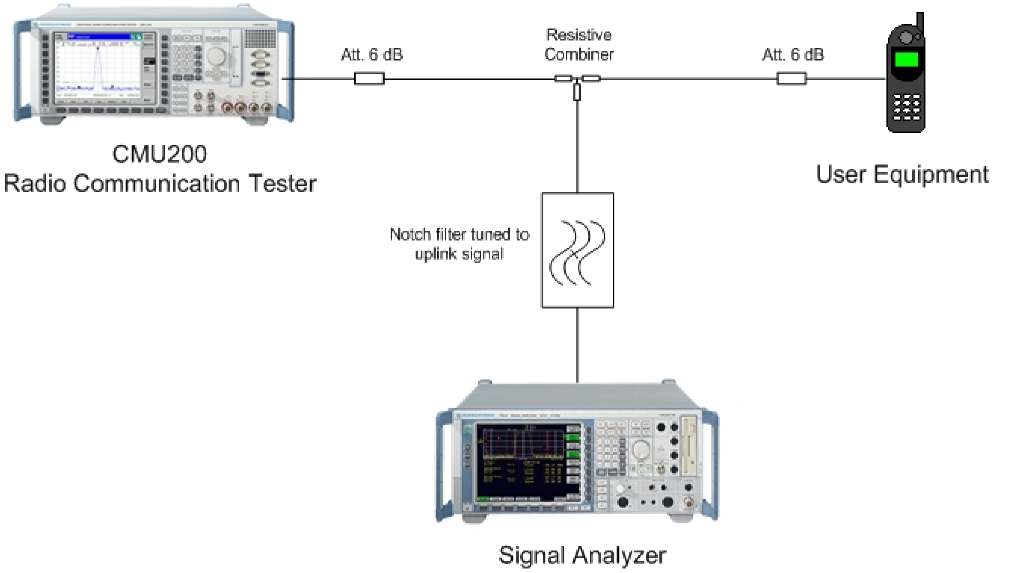


Fig. 5: Test setup for Spurious Emissions test

Instruments and accessories:

- CMU, FSQ or FSU,FSP or FSV
- Resistive combiner: DC to 12.75 GHz (e.g. Weinschel 1515-1)
- Notch filter: 1920 MHz to 1980 MHz, 40 dB min. (e.g. Wainwright WRCT 1920/2200-(5/40)-10SSK)
- Attenuators 6 dB, DC to 12.75 GHz (e.g. Suhner)

WCDMA UE General TX Spur. Emissions

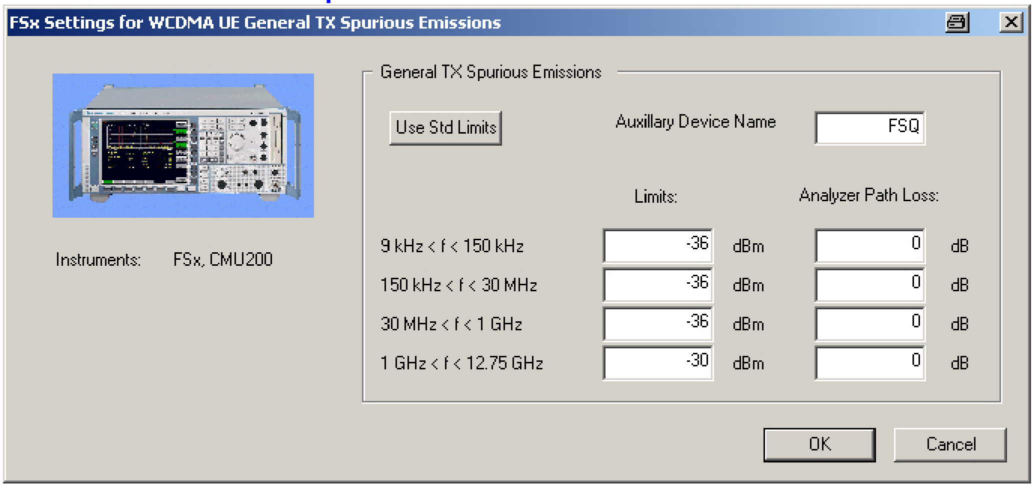


Fig. 6: Setup of the analyzer for General Spurious Emissions test

You can enter the path loss between the UE and the signal analyzer. To be on the safe side, always enter the maximum path loss, i.e. the path loss at the upper end of the frequency band. If limits are exceeded at a lower frequency, reduce the entry value to the actual path loss at that frequency point, and repeat the test.
If necessary, enter your individual limit values.
To reset the limits to the TS 34.121 standard, click the button *Use Std Limits*.

WCDMA UE Add. TX Spur. Emissions Band I to XIV

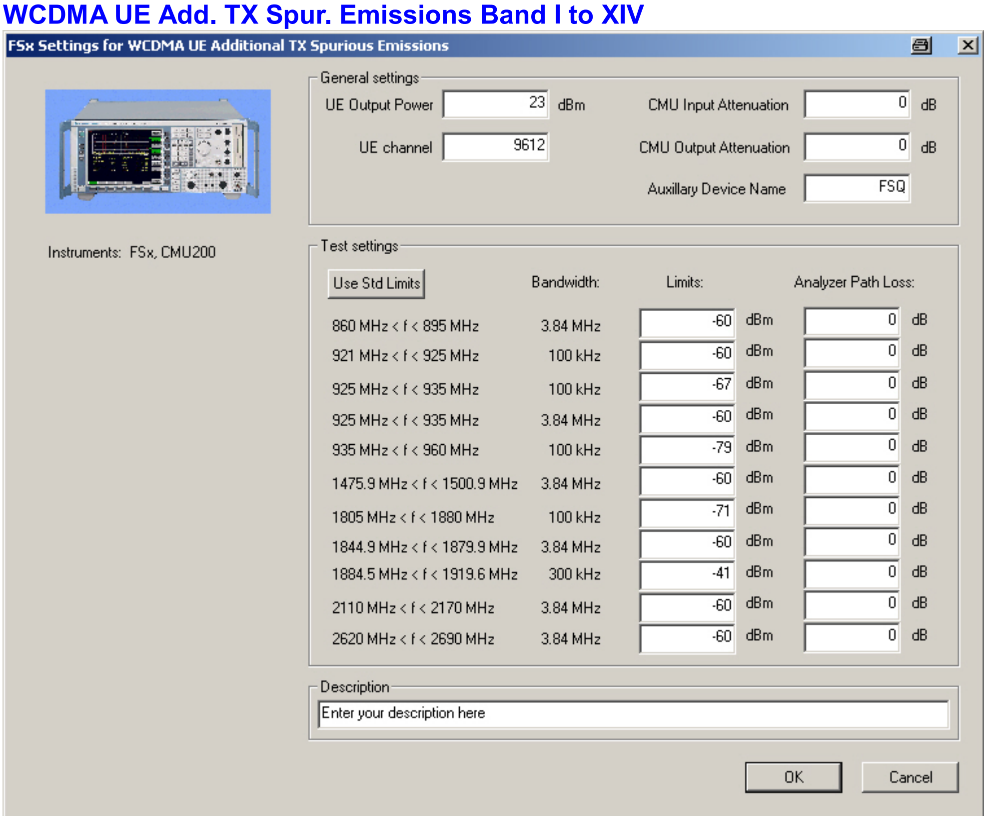


Fig. 7: Setup of the analyzer for Additional Spurious Emissions test

Here you also can change the limits and the path loss. The button *Use Std Limits* resets the limits to TS 34.121.

Test description and measurement report:

The frequency range for General Spurious Emissions − from 9 kHz up to 12.75 GHz − has been divided into several sections; see Fig. 7. The test leaves a gap of ±12.5 MHz around the uplink and downlink frequencies of 1950 MHz and 2140 MHz.
CMUgo scans all sections. For General Spurious Emissions, the limit of each section specified in Fig. 7 is visible as a limit line on the analyzer's screen. Once a section is scanned, the marker of the analyzer is set to highest peak. This value will be displayed later as a measurement value for the section.
For General Spurious Emissions, a display similar to Fig. 8 appears.

UE Gen. TX Spur. Emissions:	*9 kHz < f < 150 kHz*		-36.00 dBm	-91.93 dBm	✔
UE Gen. TX Spur. Emissions:	*150 kHz < f < 30 MHz*		-36.00 dBm	-60.44 dBm	✔
UE Gen. TX Spur. Emissions:	*30 MHz < f < 1 GHz*		-36.00 dBm	-81.17 dBm	✔
UE Gen. TX Spur. Emissions:	*1 GHz < f < 1937.5 MHz*		-30.00 dBm	-46.71 dBm	✔
UE Gen. TX Spur. Emissions:	*1962.5 MHz < f < 12.75 GHz*		-30.00 dBm	-59.24 dBm	✔

Fig. 8: Measurement report for General Spurious Emissions test

For the Additional Spurious Emissions, the frequency sections are scanned. If a limit is exceeded, the frequency and the measurement result is displayed. If no limit is exceeded, the maximum value will be shown (Fig. 9).
For the fourth frequency section, a limit line is visible on the analyzer's screen.

Add. TX Spur. Emissions Band I *Freq 1922.4 Mhz Power 23.0 dB*				
From 860.0 MHz to 895.0 MHz, BW: 3.84 MHz:				
Add. TX Spur. Emissions Band I *Max: 873.5 MHz*		-60.00 dBm	-75.09 dBm	✔
From 921.0 MHz to 925.0 MHz, BW: 0.10 MHz (see note1):				
Add. TX Spur. Emissions Band I *No violations, Max: 921.6 MHz*		-60.00 dBm	-92.23 dBm	✔
From 925.0 MHz to 935.0 MHz, BW: 0.10 MHz (see note1):				
Add. TX Spur. Emissions Band I *No violations, Max: 934.6 MHz*		-67.00 dBm	-90.81 dBm	✔
From 925.0 MHz to 935.0 MHz, BW: 3.84 MHz:				
Add. TX Spur. Emissions Band I *Max: 934.9 MHz*		-60.00 dBm	-79.04 dBm	✔
From 935.0 MHz to 960.0 MHz, BW: 0.10 MHz (see note1):				
Add. TX Spur. Emissions Band I *No violations, Max: 940.2 MHz*		-79.00 dBm	-92.11 dBm	✔
From 1475.9 MHz to 1500.9 MHz, BW: 3.84 MHz:				
Add. TX Spur. Emissions Band I *Max: 1477.7 MHz*		-60.00 dBm	-78.14 dBm	✔
From 1805.0 MHz to 1880.0 MHz, BW: 0.10 MHz (see note1):				
Violation 1 (tolerated) at Frequency 1805.0 MHz		-71.00 dBm	-64.45 dBm	–
Violation 2 (tolerated) at Frequency 1805.2 MHz		-71.00 dBm	-65.37 dBm	–
Violation 3 (tolerated) at Frequency 1805.4 MHz		-71.00 dBm	-66.11 dBm	–
Violation 4 (tolerated) at Frequency 1805.6 MHz		-71.00 dBm	-59.86 dBm	–
Violation 5 (tolerated) at Frequency 1805.8 MHz		-71.00 dBm	-62.14 dBm	–
Violation 6 (max exceeded) at Frequency 1806.0 MHz		-71.00 dBm	-68.57 dBm	–
Add. TX Spur. Emissions Band I *Overall fail, Max: 1805.6 MHz*			-59.86 dBm	–

Fig. 9: Measurement report for Additional Spurious Emissions test

2.2.2 Transmit Intermodulation (5.12)

The transmit intermodulation performance is a measure of the capability of the UE transmitter to avoid generating signals caused by the presence of the wanted signal and an interfering signal reaching the transmitter via the antenna.
UEs transmitting in close vicinity to each other can produce intermodulation products, which can fall into the UE, or Node B receive band as an unwanted interfering signal.
The UE transmit intermodulation attenuation is defined by the ratio of the output power of the wanted signal to the output power of the intermodulation product when an interfering CW signal is added at a level below the wanted signal. Both the wanted signal power and the IM product power are measured with a filter that has a root-raised cosine (RRC) filter response with roll-off factor = 0.22 and a bandwidth equal to the chip rate.
The purpose of test 5.12 is to verify that the UE transmit intermodulation does not exceed the limits in Table 3:

Transmit Intermodulation limits		
CW signal frequency offset from transmitting carrier	**5 MHz**	**10 MHz**
Interference CW signal level	−40 dBc	
Intermodulation product	−31 dBc	−41 dBc

Table 3: Transmit Intermodulation limits

The intermodulation products that fall into the UE transmit band appear at

$(2f_{transmitter} - f_{interferer})$ and $(2\,f_{interferer} - f_{transmitter})$.

This means that they can be found below the lower and above the higher of two frequencies at a distance equal to the difference of the frequencies.

Recommended test setup:
Fig. 10 shows the test setup for Transmit Intermodulation measurements.

The CW interferer is added to the CMU signal using a hybrid combiner. The interfering signal comes from an SMx (SMU, SMJ, SMATE) generator that is protected against the transmit power of the UE by a 10 dB attenuator. The hybrid isolates the generator and the CMU.
The analyzer is coupled via a resistive combiner.

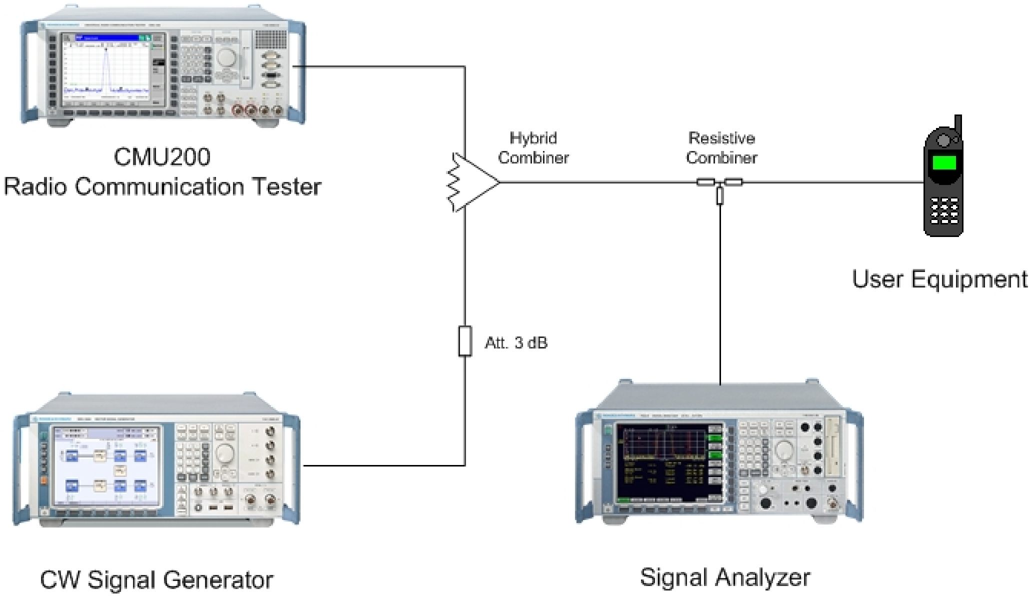


Fig. 10: Test setup for Transmit Intermodulation test

Instruments and accessories:

- CMU, FSx (FSQ or FSU or FSP or FSV) analyzer and SMx (SMU, SMJ, SMATE) generator
- Hybrid combiner: 1920 MHz to 2170 MHz (e.g. Minicircuits ZFSC-2-2500)
- Resistive combiner: up to 2.5 GHz (e.g. Weinschel 1515-1)
- Attenuator 3 dB, up to 2.5 GHz (e.g. Suhner)

WCDMA UE TX Intermod

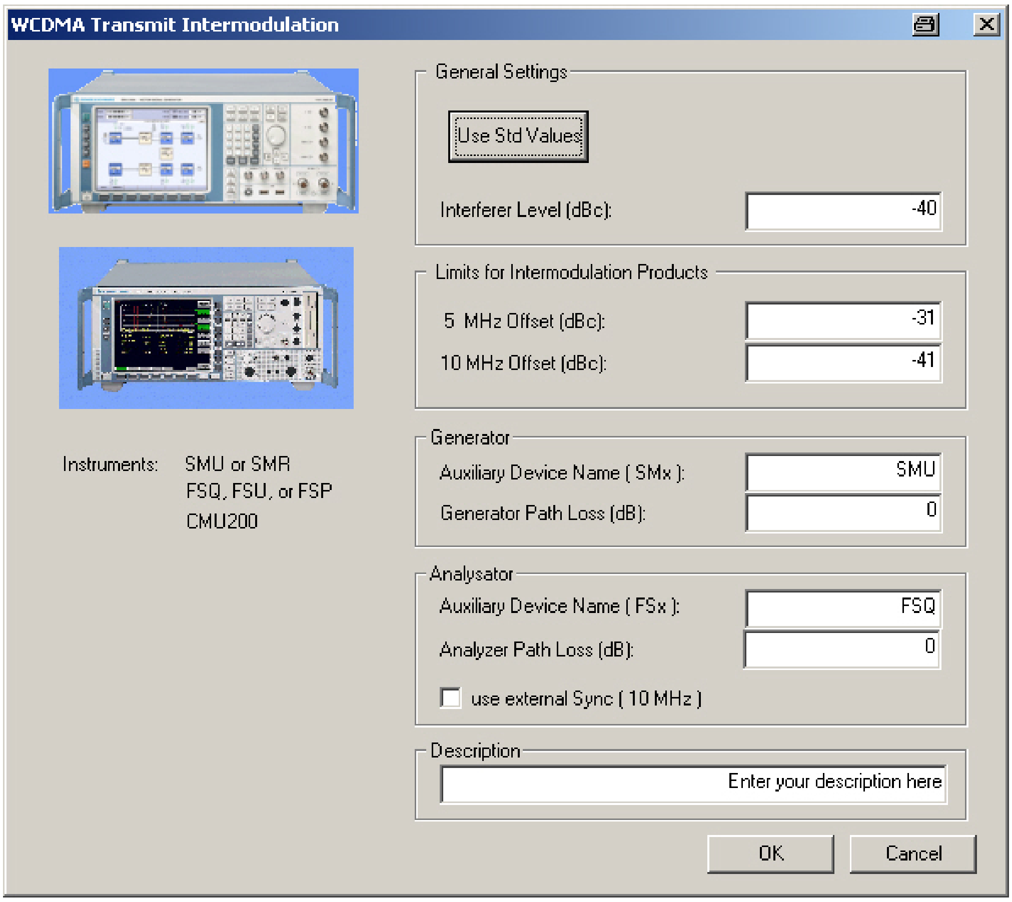


Fig. 11: WCDMA Transmit Intermodulation test module

Under **General Settings** you can enter the relative (to the UE transmit power) value for the *Interferer Level*. To reset the limits to the TS 34.121 standard, click the button *Use Std Limits*.
If necessary, enter your individual limit values.
Under **Generator / Analyzer** you can enter the *Auxiliary Device Name* and the *Path Losses*. You can *use external Sync* for the analyzer.

Test description and measurement report:

Test 5.12 uses the multicarrier-measurement function of the analyzer. The current number of carriers (channels) to be measured simultaneously is set to 9. The channel in the middle shows the uplink signal.
First, the interferer signal is set to a frequency of 5 MHz above the uplink signal (one channel offset), and the channel powers immediately below the uplink signal and above the interferer is measured.
Second, the frequency offset is set to 10 MHz, and the channel power is measured in a two-channel offset.

Fig. 12 shows an analyzer screenshot for the 10 MHz offset:

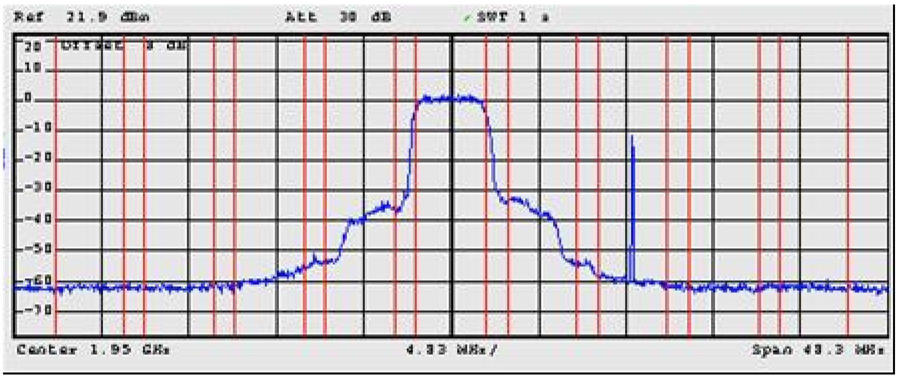


Fig. 12: Transmit Intermodulation test / 10 MHz interferer offset

In Fig. 12, no significant intermodulation products can be found. The adjacent channel power ratio of the tested UE is about 40 dB.

A display similar to Fig. 13 appears.

Frequenz Offset 5 MHz: UE Kanal 9612, Frequenz: 1922.40 MHz, Interferer 1927.40 MHz					
UE TX Intermodulation:	*3rd order IP at 1917.40 MHz*		**-31.00 dBc**	**-40.27 dBc**	✔
UE TX Intermodulation:	*3rd order IP at 1932.40 MHz*		**-31.00 dBc**	**-61.37 dBc**	✔
Frequenz Offset 10 MHz: UE Kanal 9612, Frequenz: 1922.40 MHz, Interferer 1932.40 MHz					
UE TX Intermodulation:	*3rd order IP at 1912.40 MHz*		**-41.00 dBc**	**-62.09 dBc**	✔
UE TX Intermodulation:	*3rd order IP at 1942.40 MHz*		**-41.00 dBc**	**-70.05 dBc**	✔

Fig. 13: Measurement report for Transmit Intermodulation test

2.3 Receiver Characteristics (Chapter 6)

Nearly all receiver tests are bit error measurements. For these tests, a loop inside the device under test is closed to re-transmit the received, demodulated and corrected bits. To make sure that the uplink does not contribute additional errors, the output power of the device under tests is fairly high.
The bit error rate (BER) is counted inside the CMU. In accordance with the TS 34.121 standard, statistical BER has to be done. CMUgo offers both possibilities, Confidence BER (statistical) and "normal" BER.
The reference sensitivity level depends on the operating band.

2.3.1 Adjacent Channel Selectivity (ACS) (6.4 and 6.4A)

Adjacent channel selectivity (ACS) is a measure of a receiver's ability to receive a WCDMA signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the center frequency of the assigned channel. ACS is the ratio of the receive filter attenuation on the assigned channel frequency to the receive filter attenuation on the adjacent channels.

The purpose of this test is to verify that the BER does not exceed 0.001. Different parameter sets are defined for UE in accordance with Release 99 and Release 4 (Table 4) and for UE in accordance with Release 5 and later (Table 5).

Test parameters for ACS for Release 99 and Release 4		
Parameter	**Level / status**	**Unit**
DPCH_Ec	−103	dBm / 3.84 MHz
$\hat{I}_{or}$	−92.7	dBm / 3.84 MHz
I_{oac} mean power (modulated)	−52	dBm
F_{uw} (offset)	−5 or +5	MHz
UE transmitted mean power	20 (for power class 3) 18 (for power class 4)	dBm

Table 4: Test parameters for ACS for Release 99 and Release 4.

Test parameters for ACS for Release 5 and later releases			
Parameter	**Unit**	**Case 1**	**Case 2**
DPCH_Ec	dBm/3.84 MHz	<REFSENS> + 14 dB	<REFSENS> + 41 dB
$\hat{I}_{or}$	dBm/3.84 MHz	<REF$\hat{I}_{or}$> + 14 dB	<REF$\hat{I}_{or}$> + 41 dB
I_{oac} mean power (modulated)	dBm	−52	−25
F_{uw} (offset)	MHz	+5 or −5	+5 or −5
UE transmitted mean power	dBm	20 (for power class 3 and 3bis) 18 (for power class 4)	20 (for Power class 3 and 3bis) 18 (for power class 4)

Table 5: Test parameters for ACS for Release 5 and later releases

Recommended test setup

Fig. 14 shows the test setup for adjacent channel selectivity measurements.
The WCDMA interferer is generated by an SMU signal generator. It is added to the CMU signal using a resistive combiner. The generator is protected against the transmit power of the UE by a 10 dB attenuator.

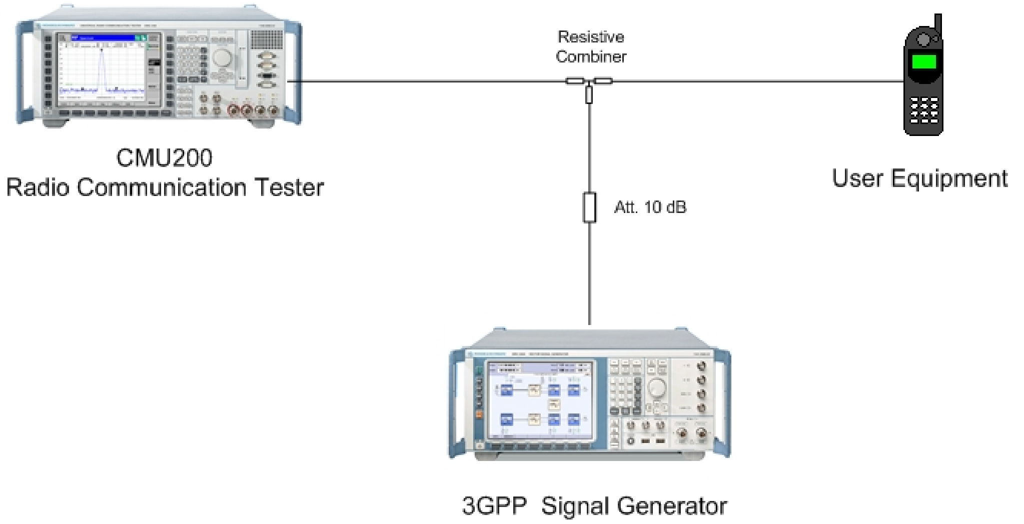


Fig. 14: Test setup for Adjacent Channel Selectivity test

Instruments and accessories:

- CMU, SMU
- Resistive combiner: up to 2.5 GHz (e.g. Weinschel 1515-1)
- Attenuator 10 dB, up to 2.5 GHz (e.g. Suhner)

WCDMA UE RX Adj. Chan. Sel.

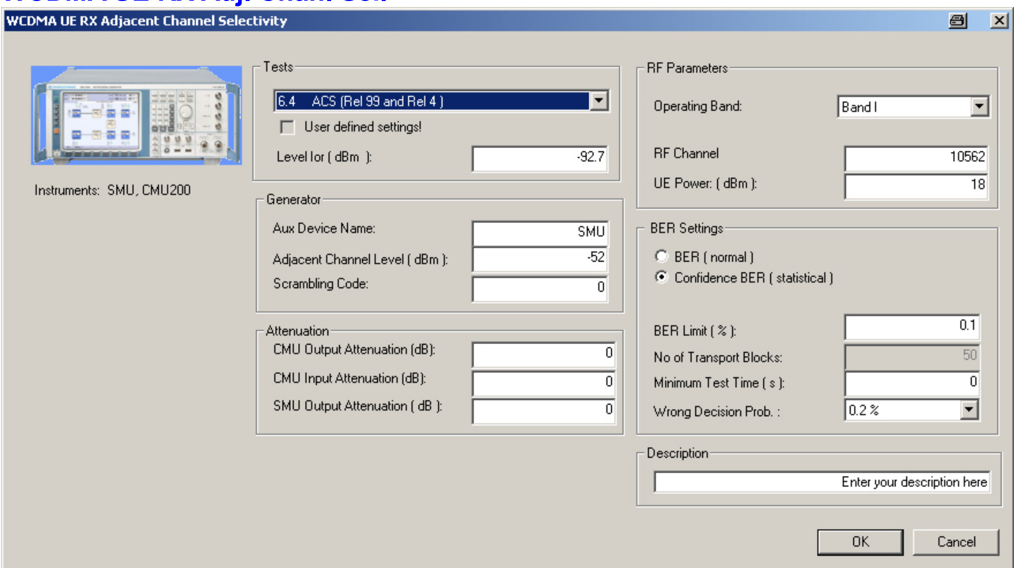


Fig. 15: Adjacent Channel Selectivity (ACS) module

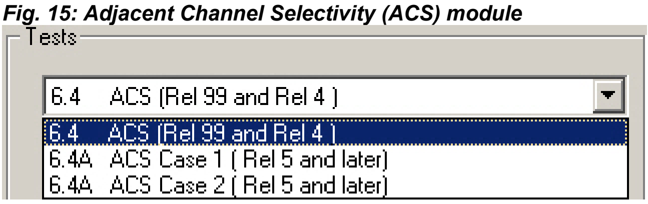


Fig. 16: ACS tests

Under **Tests** you can select between the three different tests (Fig. 16), which automatically sets the parameter to the standard defaults. *Level Ior* is the CMU level. If *User defined settings* is marked, you have changed one or more default settings. Under **Generator** you can enter the *Device Name*, the *Level* and the *Scrambling Code* of the adjacent WCDMA signal. Enter under **Attenuation** the different CMU and SMU attenuations. Under **RF Parameters** you can select the *Operating Band*, the *RF Channel* and the *uplink target power* of the UE. Under **BER Settings** you can choose between the (normal) *BER* with a certain number of transport blocks or a *Confidence BER* (statistical). Here you can enter additionally a *Minimum Test time* (should be zero) and the *Wrong Decision Probability*.

Test description and measurement report:

The generator calculates the WCDMA signal, and the first BER measurement is performed with the interfering signal at 5 MHz below the UE receive channel. This is followed by a BER measurement with the interfering signal at 5 MHz above the UE receive channel.

Fig. 17 and Fig. 18 show a typical entry in the measurement report. If confidence BER is selected, the decision (e.g. *Early Pass*) will be written in the measurement line.

Band I, RF Channel 10562, UL target Power: 18.0 dBm, CMU Attenuation (Out/In): 0.0 / 0.0 dB, SMU Attenuation: 0.0 dB

Level Ior : -92.70 dBm, Adj Channel Level: -52.00 dBm, Scrambling code: 0

Confidence BER, Min Test Time: 0.00 s, Wrong Decision Prob.: P0_2

Fig. 17: Report: ACS general

6.4 ACS (Rel 99 and Rel 4)

UE RX Adj. Chan. Selectivity: *Interferer - 5 MHz, EPAS*		**0.10 %**	**0.06 %**	✔
UE RX Adj. Chan. Selectivity: *Interferer + 5 MHz, EPAS*		**0.10 %**	**0.02 %**	✔

Fig. 18: Report: ACS measurement

2.3.2 Blocking Characteristics (6.5)

The blocking characteristic is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response or the adjacent channels, without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit.
There are three types of blocking tests: in-band, out-of-band and narrow-band (certain bands only).

2.3.2.1 In-Band Blocking

In-band blocking uses a WCDMA-modulated interferer with frequency offsets to the wanted signal falling into the UE receive band or into the first 15 MHz near to the receive band.
The purpose of this test is to verify that the UE's bit error rate (BER) does not exceed 0.001 for the parameters specified in Table 6:

Test parameters for in-band blocking characteristics			
Parameter	**Unit**	**Level**	
DPCH_Ec	dBm/3.84 MHz	<REFSENS>+3 dB	
$\hat{I}_{or}$	dBm/3.84 MHz	<REF$\hat{I}_{or}$> + 3 dB	
$I_{blocking}$ mean power (modulated)	dBm	−56	−44
F_{uw} offset		=±10 MHz	≤−15 MHz & ≥15 MHz
F_{uw} (Band I operation)	MHz	2102.4≤ f ≤2177.6	2095≤ f ≤2185
F_{uw} (Band II operation)	MHz	1922.4≤ f ≤1997.6	1915≤ f ≤2005
F_{uw} (Band III operation)	MHz	1797.4≤ f ≤1887.6	1790≤ f ≤1895
F_{uw} (Band IV operation)	MHz	2102.4≤ f ≤2162.6	2095≤ f ≤2170
F_{uw} (Band V operation)	MHz	861.4≤ f ≤901.6	854≤ f ≤909
F_{uw} (Band VI operation)	MHz	867.4≤ f ≤892.6	860≤ f ≤900
F_{uw} (Band VII operation)	MHz	2612.4≤ f ≤2697.6	2605 ≤ f ≤ 2705
F_{uw} (Band VIII operation)	MHz	917.4≤ f ≤967.6	910 ≤ f ≤ 975
F_{uw} (Band IX operation)	MHz	1837.4 ≤ f ≤ 1887.4	1829.9 ≤ f ≤ 1894.9
F_{uw} (Band X operation)	MHz	2102.4 ≤ f ≤ 2177.6	2095 ≤ f ≤ 2185
F_{uw} (Band XI operation)	MHz	1468.4 ≤ f ≤ 1508.4	1460.9 ≤ f ≤ 1515.9
F_{uw} (Band XII operation)	MHz	720.4 ≤ f ≤ 753.6	713 ≤ f ≤ 761
F_{uw} (Band XIII operation)	MHz	738.4 ≤ f ≤ 763.6	731 ≤ f ≤ 771
F_{uw} (Band XIV operation)	MHz	750.4 ≤ f ≤ 775.6	743 ≤ f ≤ 783
UE transmitted mean power	dBm	20 (for power class 3 and 3bis) 18 (for power class 4)	

Table 6: Test parameters for in-band blocking characteristics

Recommended test setup:

Fig. 19 shows the test setup for the in-band blocking measurements.
The WCDMA interfering signal is generated by an SMx signal generator. It is added to the CMU signal using a resistive combiner. The generator is protected against the transmit power of the UE by a 10 dB attenuator.

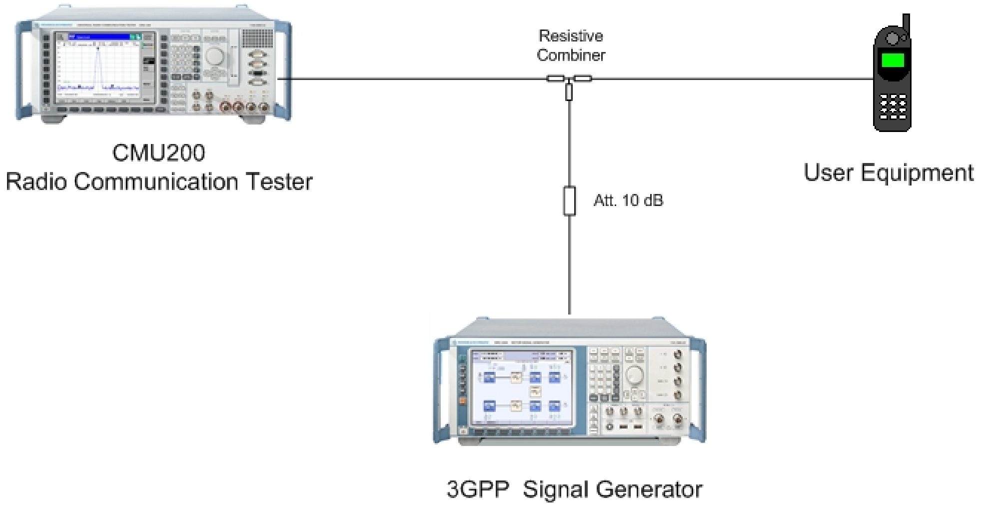


Fig. 19: Test setup for in-band blocking characteristics

Instruments and accessories:

- CMU, SMx (SMU, SMJ, SMATE)
- Resistive combiner: up to 2.5 GHz (e.g. Weinschel 1515-1)
- Attenuator 10 dB: up to 2.5 GHz (e.g. Suhner)

WCDMA UE In-Band Blocking

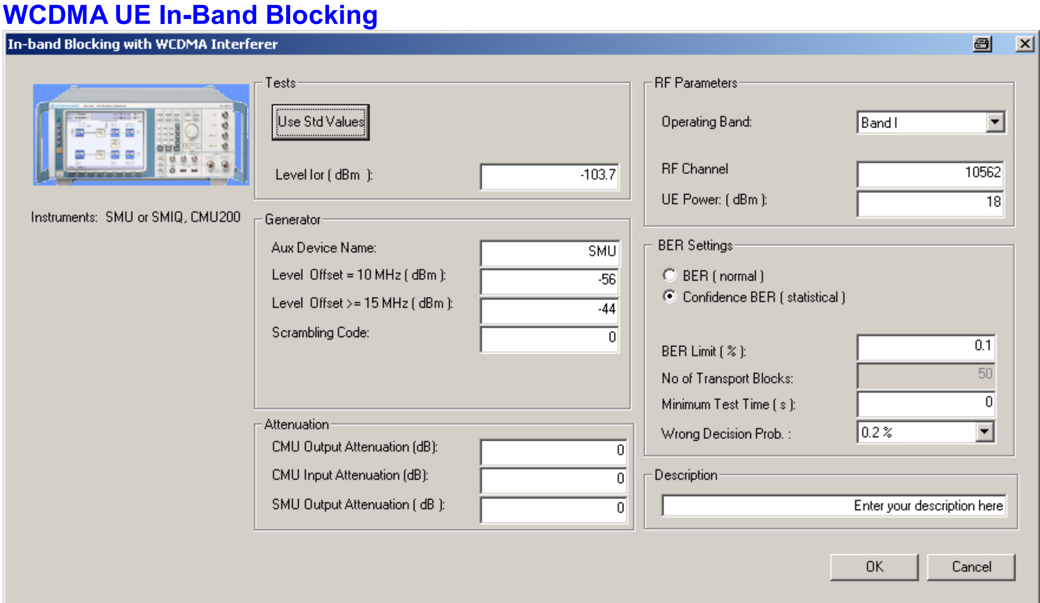


Fig. 20: WCDMA In-Band Blocking module

Under **Tests** you can enter the *Level* Ior of the CMU. The button *Use Std Values* sets the relevant parameters to the standard defaults. Under **Generator** you can enter the *Device Name*, the *Level* at different offsets and the *Scrambling Code* of the WCDMA signal. Enter under **Attenuation** the different CMU and SMU attenuations. Under **RF Parameters** you can select the *Operating Band*, the *RF Channel* and the uplink *target power* of the UE. Under **BER settings** you can choose between the (normal) *BER* with a certain number of transport blocks or a *Confidence BER* (statistical). Here you can enter additionally a *Minimum Test Time* (should be zero) and the *Wrong Decision Probability*.

Test description and measurement report:

The generator calculates the WCDMA signal, and the BER measurement is automatically performed with the interfering signal in 5 MHz steps (starting at 10 MHz offsets) below and above the UE receive channel.

Fig. 21 shows a typical entry in the measurement report. If confidence BER is selected, the decision (e.g. *Early Pass*) will be written in the measurement line.

Band I, RF Channel 10562, UL target Power: 18.0 dBm, CMU Attenuation (Out/In): 0.0 / 0.0 dB, SMU Attenuation: 0.0 dB

Level Ior : -103.70 dBm, Scrambling code: 0

Confidence BER, Min Test Time: 0.00 s, Wrong Decision Prob.: P0_2

In-band Blocking: *Interf. @ 10 MHz, @ -56.00 dBm, Early Pass*		0.10 %	0.00 %	✔
In-band Blocking: *Interf. @ 15 MHz, @ -44.00 dBm, Early Pass*		0.10 %	0.06 %	✔
In-band Blocking: *Interf. @ 20 MHz, @ -44.00 dBm, Early Pass*		0.10 %	0.02 %	✔
In-band Blocking: *Interf. @ 25 MHz, @ -44.00 dBm, Early Pass*		0.10 %	0.08 %	✔
In-band Blocking: *Interf. @ 30 MHz, @ -44.00 dBm, Early Pass*		0.10 %	0.06 %	✔
In-band Blocking: *Interf. @ 35 MHz, @ -44.00 dBm, Early Pass*		0.10 %	0.05 %	✔
In-band Blocking: *Interf. @ 40 MHz, @ -44.00 dBm, Early Pass*		0.10 %	0.04 %	✔
In-band Blocking: *Interf. @ 45 MHz, @ -44.00 dBm, Early Pass*		0.10 %	0.09 %	✔
In-band Blocking: *Interf. @ 50 MHz, @ -44.00 dBm, Early Pass*		0.10 %	0.08 %	✔
In-band Blocking: *Interf. @ 55 MHz, @ -44.00 dBm, Early Pass*		0.10 %	0.07 %	✔
In-band Blocking: *Interf. @ 60 MHz, @ -44.00 dBm, Early Pass*		0.10 %	0.02 %	✔
In-band Blocking: *Interf. @ 65 MHz, @ -44.00 dBm, Early Pass*		0.10 %	0.09 %	✔
In-band Blocking: *Interf. @ 70 MHz, @ -44.00 dBm, Early Pass*		0.10 %	0.07 %	✔
In-band Blocking: *Interf. @ -10 MHz, @ -56.00 dBm, Early Pass*		0.10 %	0.00 %	✔
In-band Blocking: *Interf. @ -15 MHz, @ -44.00 dBm, Early Pass*		0.10 %	0.00 %	✔

Fig. 21: Report: In-Band Blocking

2.3.2.2 Out-of-Band Blocking

Out-of-band blocking uses an unmodulated (CW) interferer falling 15 MHz below or above the UE receive band with frequencies in the range from 1 MHz to 12.75 GHz using a 1 MHz step size.

The purpose of this test is to verify that the UE's bit error rate (BER) does not exceed 0.001 for the parameters specified in Table 7.

Frequencies for which BER exceeds the test requirements are called spurious response frequencies. They have to be recorded for test 6.6 Spurious Response. For each wanted channel, up to 24 spurious response frequencies are allowed for the ranges 1,2 and 3. For range 4, up to eight spurious response frequencies are allowed.

Test parameters for out-of-band blocking characteristics					
Parameter	**Unit**	**Frequency range 1**	**Frequency range 2**	**Frequency range 3**	**Frequency range 4**
DPCH_Ec	dBm/3.84 MHz	<REFSENS>+3 dB	<REFSENS>+3 dB	<REFSENS>+3 dB	<REFSENS> +3 dB
$\hat{I}_{or}$	dBm/3.84 MHz	<REF$\hat{I}_{or}$> + 3 dB	<REF$\hat{I}_{or}$> + 3 dB	<REF$\hat{I}_{or}$> + 3 dB	<REF$\hat{I}_{or}$> + 3 dB
$I_{blocking}$ (CW)	dBm	−44	−30	−15	−15
F_{uw} (Band I operation)	MHz	2050 < f < 2095 2185 < f < 2230	2025 < f ≤ 2050 2230 ≤f <2255	1< f ≤2025 2255 ≤ f < 12750	-
F_{uw} (Band II operation)	MHz	1870 < f < 1915 2005 < f < 2050	1845 < f ≤ 1870 2050 ≤ f < 2075	1 < f ≤ 1845 2075 ≤ f < 12750	1850 ≤ f ≤ 1910
F_{uw} (Band III operation)	MHz	1745 < f < 1790 1895 < f < 1940	1720 < f ≤ 1745 1940 ≤ f < 1965	1 < f ≤ 1720 1965 ≤ f < 12750	-
F_{uw} (Band IV operation)	MHz	2050 < f < 2095 2170 < f < 2215	2025 < f ≤ 2050 2215 ≤ f < 2240	1 < f ≤ 2025 2240 ≤ f < 12750	-
F_{uw} (Band V operation)	MHz	809 < f < 854 909 < f < 954	784 < f ≤ 809 954 ≤ f < 979	1 < f ≤ 784 979≤f<12750	824 ≤ f ≤ 849
F_{uw} (Band VI operation)	MHz	815 < f < 860 900 < f < 945	790 < f ≤ 815 945 ≤ f < 970	1 < f ≤ 790 970 ≤ f < 12750	-
F_{uw} (Band VII operation)	MHz	2570 < f < 2605 2705 < f < 2750	na 2750 ≤ f < 2775	1 < f ≤ 2570 2775 ≤ f < 12750	-
F_{uw} (Band VIII operation)	MHz	865 < f < 910 975 < f < 1020	840 < f ≤ 865 1020 ≤ f < 1045	1 < f ≤ 840 1045 ≤ f < 12750	-
F_{uw} (Band IX operation)	MHz	1784.9 < f < 1829.9 1894.9 < f < 1939.9	1759.9 < f ≤ 1784.9 1939.9 ≤ f < 1964.9	1 < f ≤ 1759.9 1964.9 ≤ f < 12750	-
F_{uw} (Band X operation)	MHz	2050 < f < 2095 2185 < f < 2230	2025 < f ≤ 2050 2230 ≤ f < 2255	1 < f ≤ 2025 2255 ≤ f < 12750	-
F_{uw} (Band XI operation)	MHz	1415.9 < f < 1460.9 1515.9 < f < 1560.9	1390.9 < f ≤ 1415.9 1560.9 ≤ f < 1585.9	1 < f ≤ 1390.9 1585.9 ≤ f< 12750	-
F_{uw} (Band XI operation)	MHz	668 < f < 713 761 < f < 791	643 < f ≤ 668 791 < f < 816	1 < f ≤ 643 816 ≤ f < 12750	698 ≤ f ≤ 716
F_{uw} (Band XII operation)	MHz	686 < f < 731 771 < f < 816	661 < f ≤ 686 816 < f < 841	1 < f ≤ 661 841 ≤ f < 12750	776 ≤ f ≤ 788
F_{uw} (Band XIV operation)	MHz	698 < f < 743 783 < f < 828	673 < f ≤ 698 828 < f < 853	1 < f ≤ 673 853 ≤ f ≤ 12750	788 ≤ f ≤ 798
UE transmitted mean power	dBm	20 (for power class 3 and 3bis) 18 (for power class 4)			

Table 7: Test parameters for out-of-band blocking characteristics

Recommended test setup:

For out-of-band blocking characteristics, two test setups are shown in Fig. 22 and Fig. 23. The first setup is for frequencies below about 3 GHz. For the CW interferer, use any SMx (SMU, SMJ or SMATE).

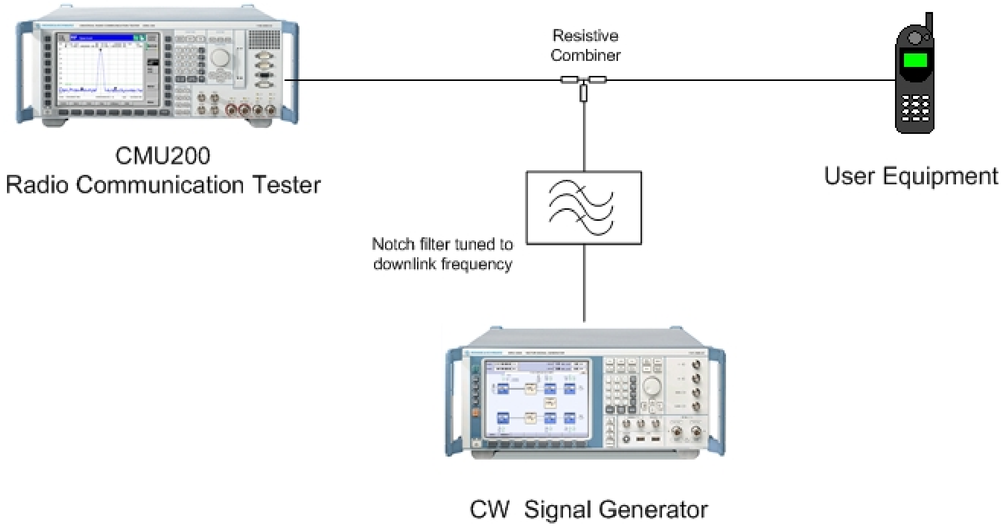


Fig. 22: Out-of-band blocking below 3 GHz.

Every signal generator outputs a wanted signal and unwanted broadband noise. The noise power is proportional to the power of the wanted signal.
In frequency ranges 3 and 4 (see Table 7), the interferer level is so high that the broadband noise in the 5 MHz bandwidth of the RX channel could exceed the levels of the downlink signal and the spreading gain added together. If no measures are taken, the connection would break as soon as the generator is switched on.
To reduce the broadband noise, a notch filter is inserted into the interferer path. Tune it carefully to the UE RX channel. Make sure to suppress the whole 5 MHz channel span.

Note: No relevant harmonic emission of the blocking generator should fall into the UE's receive channel. If the harmonic level exceeds the wanted signal by more than 10 dB, it has to be suppressed by an additional filter.

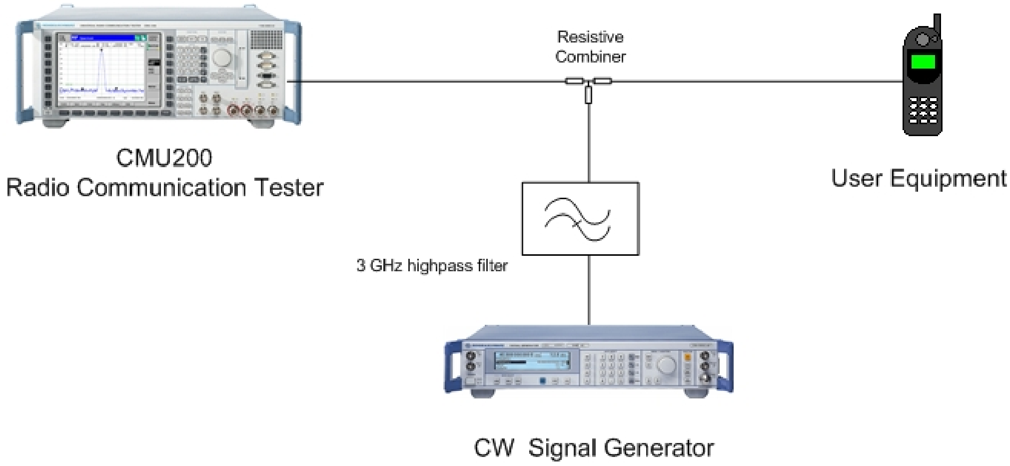


Fig. 23: Out-of-band blocking above 3 GHz.

An SMR microwave generator now provides the CW interferer signal. Because a notch filter designed for 2 GHz has no flat frequency response for frequencies up to 12.5 GHz, it is replaced by a highpass filter here.

Instruments and accessories:

- CMU, SMx (SMU, SMJ or SMATE) for frequencies to 3 GHz, SMR for frequencies up to 12.75 GHz
- Resistive combiner: up to 12.75 GHz (e.g. Weinschel 1515-1)
- Tunable Notch filter (e.g. Wainwright WRCT 1900/2200-5/40-10SSK)
- 3 GHz highpass filter (e.g. Filtek HP12/3000-5AA)

WCDMA Out-of-Band Blocking

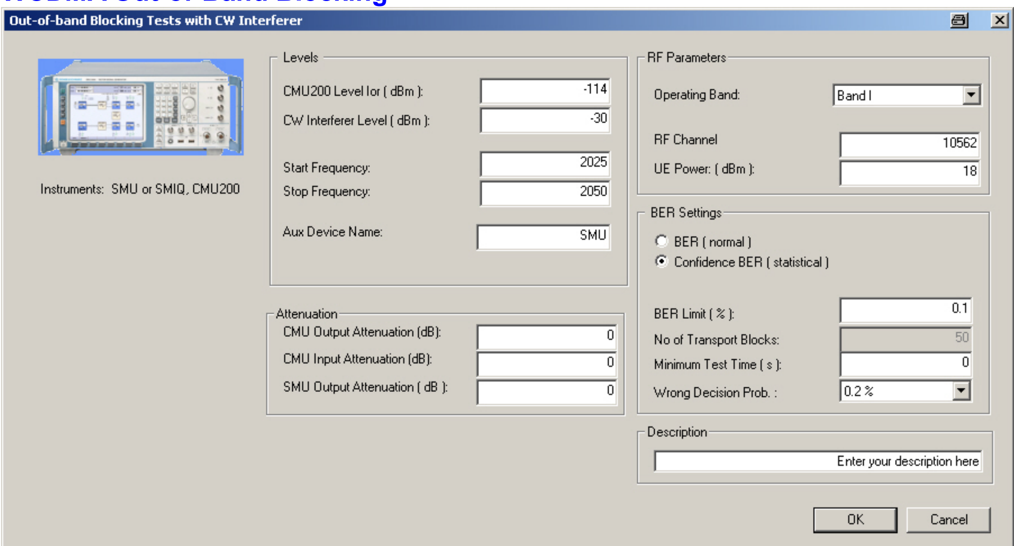


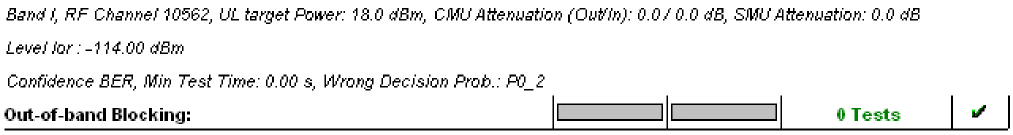
Fig. 24: WCDMA Out-of-Band Blocking module

Under **Levels** you can enter the *Level Ior* of the CMU, the *CW Interferer Level*, *Device Name* and the *Start Frequency* and the *Stop Frequency*. Enter in **Attenuation** the different CMU and SMU attenuations. Under **RF Parameters** you can select the *Operating Band*, the *RF Channel* and the uplink *target power* of the UE. Under **BER Settings** you can choose between the (normal) *BER* with a certain number of transport blocks or a *Confidence BER* (statistical). Here you can enter additionally a *Minimum Test Time* (should be zero) and the *Wrong Decision Probability*.

Please note that there is no full automatic testing. You have to enter the different settings specified in Table 7 yourself.

Test description and measurement report:

The signal generator is set to the start frequency, and the first BER measurement is performed. Then the measurement is repeated with an interferer frequency incremented by 1 MHz, and so on, until the stop frequency is reached.
Fig. 25 shows a typical entry in the measurement report. If confidence BER is selected, the decision (e.g. *Early Pass*) will be written in the measurement line. If the limits were exceeded for one or more frequencies, only these measurement results are displayed (in red). Finally the number of failed tests is displayed.
The program stops the test at the 25th limit violation.


Band I, RF Channel 10562, UL target Power: 18.0 dBm, CMU Attenuation (Out/In): 0.0 / 0.0 dB, SMU Attenuation: 0.0 dB

Level Ior : -114.00 dBm

Confidence BER, Min Test Time: 0.00 s, Wrong Decision Prob.: P0_2

Out-of-band Blocking: 0 Tests ✔

Fig. 25: Report: out-of-band blocking

2.3.2.3 Narrow-Band Blocking

Narrow-band blocking uses a continuous GMSK-modulated interferer in a certain offset to the assigned channel.
The purpose of this test is to verify that the UE's bit error rate (BER) does not exceed 0.001 for the parameters specified in Table 8.
This test only applies to bands II, III, IV, V, VIII, X, XII, XIII or XIV.

Test parameters for narrow-band blocking			
Parameter	**Unit**	**Band II, IV, V, X**	**Band III, VIII, XII, XIII, XIV**
DPCH_Ec	dBm/3.84 MHz	<REFSENS> + 10 dB	<REFSENS> + 10 dB
$\hat{I}_{or}$	dBm/3.84 MHz	<REF$\hat{I}_{or}$> + 10 dB	<REF$\hat{I}_{or}$> + 10 dB
$I_{blocking}$ (GMSK)	dBm	−57	−56
F_{uw} (offset)	MHz	2.7	2.8
UE transmitted mean power	dBm	20 (for power class 3 and 3bis) 18 (for power class 4)	

Table 8: Test parameters for narrow-band blocking

Recommended test setup:
Fig. 26 shows the test setup for the in-band blocking measurements.
The GMSK interfering signal is generated by an SMx signal generator. It is added to the CMU signal using a resistive combiner. The generator is protected against the transmit power of the UE by a 10 dB attenuator.

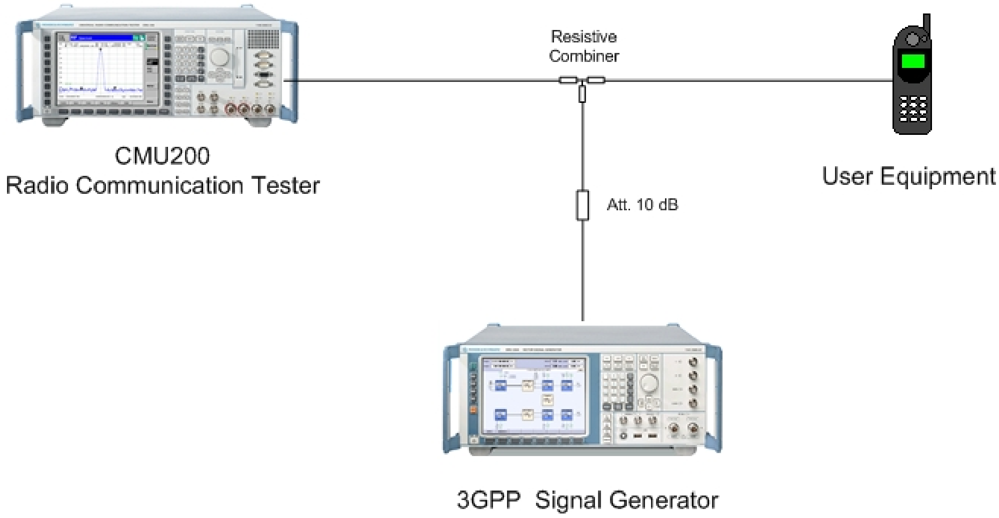


Fig. 26: Test setup for narrow-band blocking characteristics

Instruments and accessories:

- CMU, SMx (SMU, SMJ, SMATE)
- Resistive combiner: up to 2.5 GHz (e.g. Weinschel 1515-1)
- Attenuator 10 dB: up to 2.5 GHz (e.g. Suhner)

WCDMA Narrow-Band Blocking

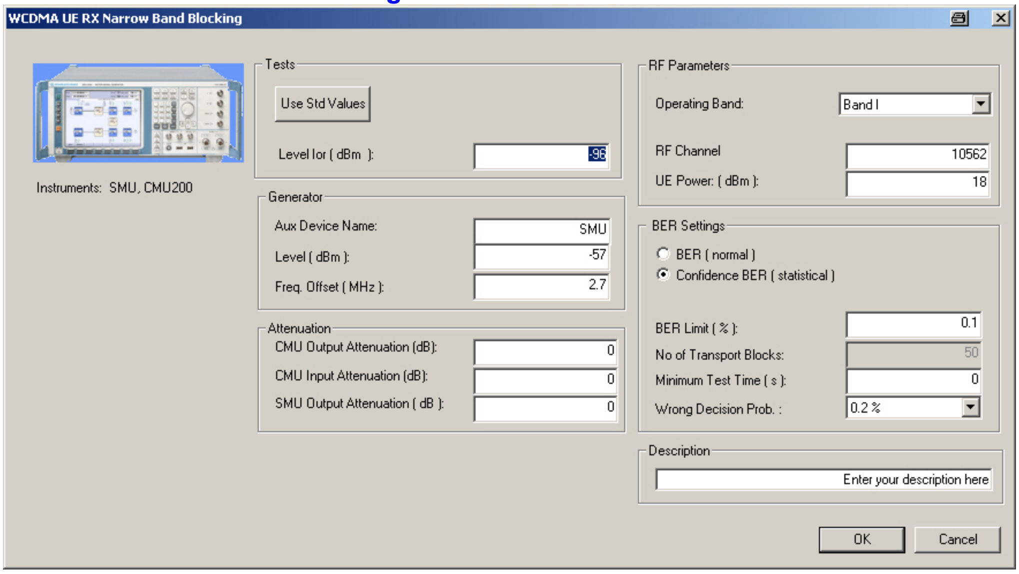


Fig. 27: Narrow Band Blocking module

Under **Tests** you can enter the *Level Ior* of the CMU. Under **Generator** you can enter the *Device Name*, the *Level* at different offsets and the *Scrambling Code* of the GMSK signal. Enter under **Attenuation** the different CMU and SMU attenuations. Under **RF Parameters** you can select the *Operating Band*, the *RF Channel* and the uplink *target power* of the UE. Under **BER Settings** you can choose between the (normal) *BER* with a certain number of transport blocks or a *Confidence BER* (statistical). Here you can enter additionally a *Minimum Test Time* (should be zero) and the *Wrong Decision Probability.*

Test description and measurement report:

The generator calculates the GMSK signal, and the BER measurement is automatically performed with the interfering signal at the selected offset above the UE receive channel.

Fig. 28 shows a typical entry in the measurement report. If confidence BER is selected, the decision (e.g. *Early Pass*) will be written in the measurement line.

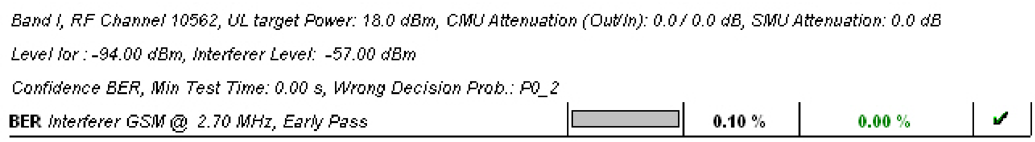


Fig. 28: Report: narrow-band blocking

2.3.3 Spurious Response (6.6)

Spurious response is a measure of the receiver's ability to receive a wanted signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency at which a response is obtained, i.e. for which the blocking limit is not met.
For test 6.5 of the out-of-band blocking characteristics, up to 24 exceptions were allowed to exceed the limits. The frequencies at which the limits for blocking were exceeded − the spurious response frequencies − can now be checked again using an interferer level of −44 dBm.
The purpose of this test is to verify that the UE's bit error rate (BER) does not exceed 0.001 for the parameters in Table 9 at the spurious response frequencies:

Test parameters for spurious response		
Parameter	**Level**	**Unit**
DPCH_Ec	<REFSENS> +3 dB	dBm / 3.84 MHz
$\hat{I}_{or}$	<REF$\hat{I}_{or}$> +3 dB	dBm / 3.84 MHz
$I_{blocking}$(CW)	−44	dBm
F_{uw}	Spurious response frequencies	MHz
UE transmitted mean power	20 (for power class 3 and 3bis) 18 (for power class 4)	dBm

Table 9: Test parameters for spurious response

Test setup, instruments and accessories, test procedure:
The test setup, the instruments and accessories, and all test steps are the same as for test 6.5 Out-of-band Blocking Characteristic (see section 2.3.2.2).

For single frequency measurements, you can enter the same value for the start and stop frequencies at WCDMA Out-of-band Blocking items.

2.3.4 Intermodulation Characteristics (6.7)

Third- and higher-order mixing of the two interfering RF signals can produce an interfering signal in the band of the desired channel. Intermodulation response rejection is a measure of the capability of the receiver to receive a wanted signal on its assigned channel frequency in the presence of two or more interfering signals that have a specific frequency relationship to the wanted signal.

Two tests with different modulated signals (WCDMA or GMSK) as an interferer are defined. The test with a GMSK interferer is called narrow-band intermodulation and applies to bands II, III, IV, V, VIII, X, XII, XIII and XIV only.

The purpose of this test is to verify that the UE's bit error rate (BER) does not exceed 0.001 for the parameters specified in Table 10 and Table 11.

Test parameters for intermodulation			
Parameter	**Level**		**Unit**
DPCH_Ec	<REFSENS> +3 dB		dBm / 3.84 MHz
$\hat{I}_{or}$	<REF$\hat{I}_{or}$> +3 dB		dBm / 3.84 MHz
I_{ouw1} (CW)	−46		dBm
I_{ouw2} mean power (modulated)	−46		dBm
F_{uw1} (offset)	10	−10	MHz
F_{uw2} (offset)	20	−20	MHz
UE transmitted mean power	20 (for power class 3 and 3bis) 18 (for power class 4)		dBm

Table 10: Test parameters for intermodulation

Test parameters for narrow-band intermodulation					
Parameter	**Unit**	**Band II, IV, V, X**		**Band III, VIII, XII, XIII, XIV**	
DPCH_Ec	DdBm/3.84 MHz	<REFSENS>+ 10 dB		<REFSENS>+ 10 dB	
$\hat{I}_{or}$	DdBm/3.84 MHz	<REF$\hat{I}_{or}$> + 10 dB		[<REF$\hat{I}_{or}$> +10 dB	
I_{ouw1} (CW)	dBm	−44		−43	
I_{ouw2} (GMSK)	dBm	−44		−43	
F_{uw1} (offset)	MHz	3.5	−3.5	3.6	−3.6
F_{uw2} (offset)	MHz	5.9	−5.9	6.0	−6.0
UE transmitted mean power	dBm	20 (for power class 3 and 3bis) 18 (for power class 4)			

Table 11: Test parameters for narrow-band intermodulation

Recommended test setups:

If you have a two-channel SMU, set up the hardware as shown in Fig. 29.

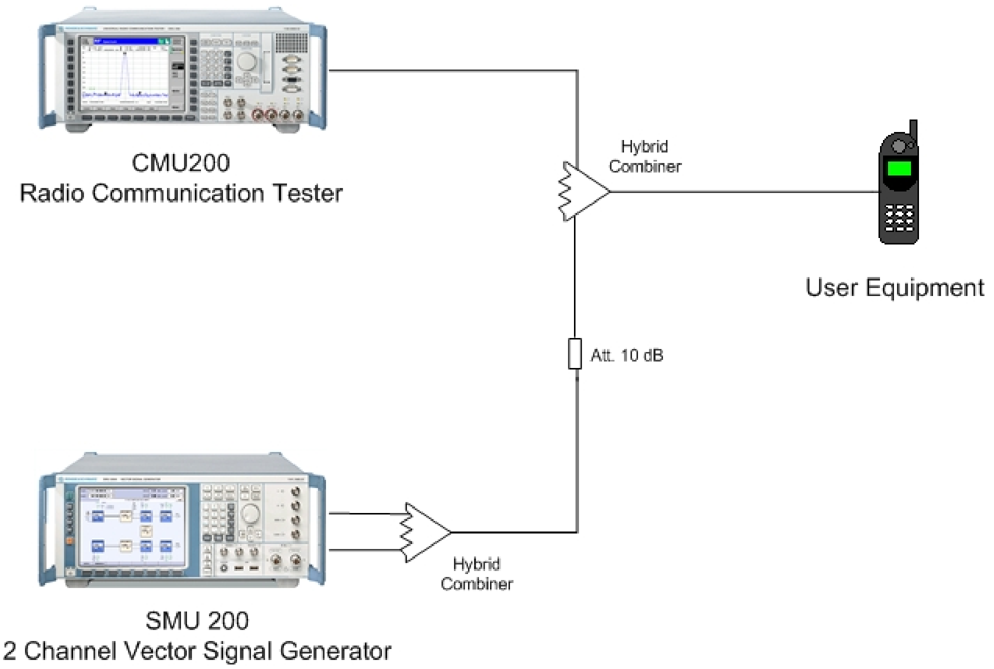


Fig. 29: Test setup for RX Intermodulation test using a two-channel SMU

Channel A of SMU generates the first (WCDMA or GMSK) interfering signal, and channel B the second one (CW). A hybrid combiner adds the two signals. The generator outputs are protected against the transmit power of the UE by a 10 dB attenuator. Another hybrid feeds the interferer signals into the RF path between the UE and the CMU toward the UE.

If you have two separate generators, use the hardware setup shown in Fig. 30.

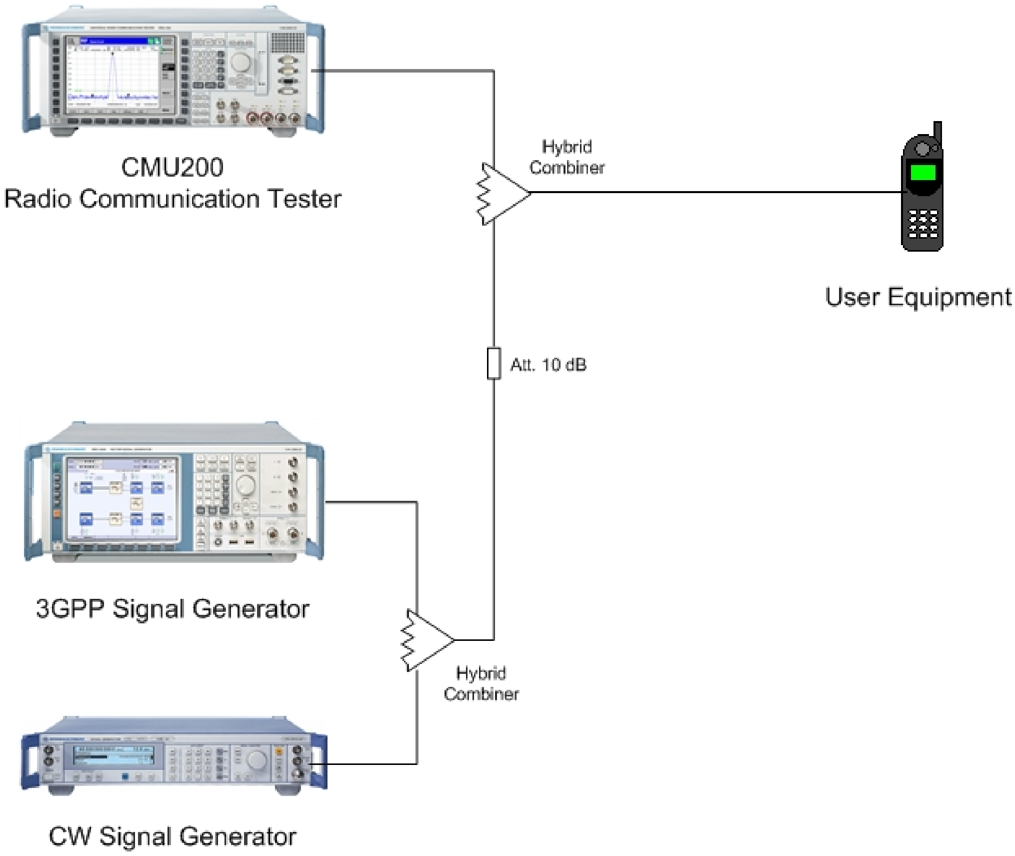


Fig. 30: Test setup for RX intermodulation test using two separate generators

The WCDMA or GMSK signal (generated by an SMx) and the CW signal (generated by a second SMx) are combined using a hybrid coupler. The generators are protected against the transmit power of the UE by a 10 dB attenuator.
A second hybrid feeds the interferer signals into the RF path between the UE and the CMU toward the UE.

Instruments and accessories:

- CMU, SMx (SMU, SMJ, SMATE,) and SMR
- Hybrid combiner: 1920 MHz to 2170 MHz (e.g. Minicircuits ZFSC-2-2500)
- Resistive combiner: up to 2.5 GHz (e.g. Weinschel 1515-1)
- Attenuator 10 dB: up to 2.5 GHz (e.g. Suhner)

WCDMA RX Intermod.

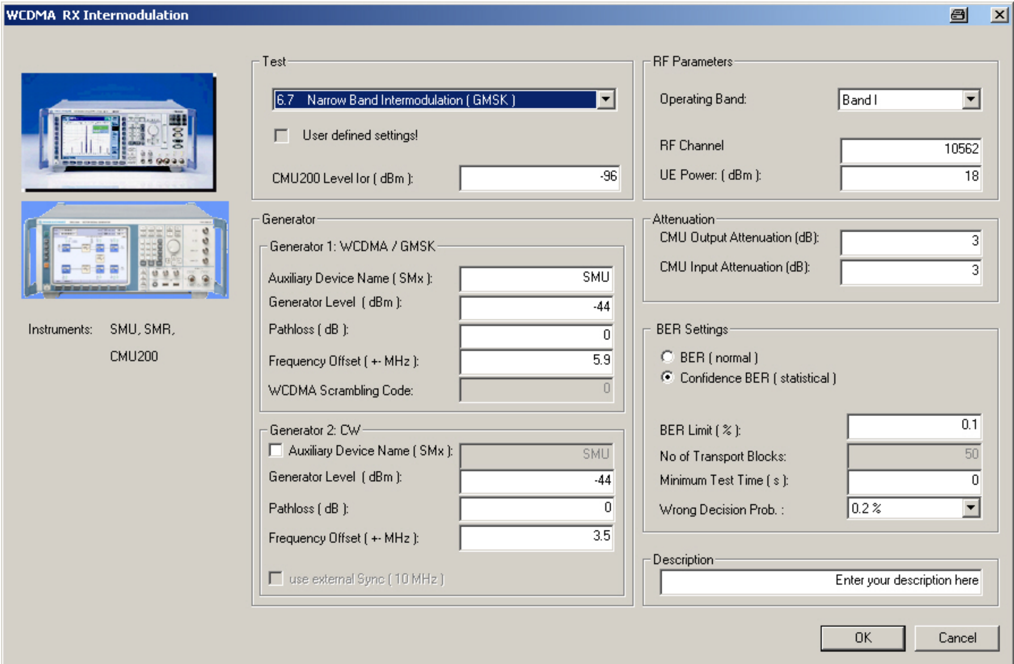


Fig. 31: WCDMA RX Intermodulation module

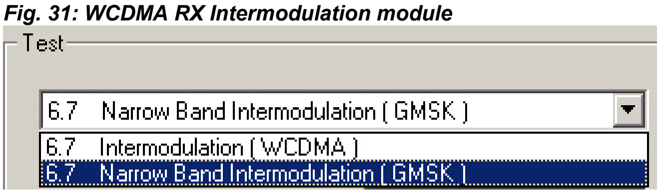


Fig. 32: Tests in WCDMA RX Intermodulation

Under **Tests** you can select between the two different tests, which automatically sets the parameter to the standard defaults. *CMU200 Level Ior* is the CMU level. If *User defined settings* is marked, you have changed one or more default settings. Under **Generator 1** and **Generator 2**, the *Auxiliary Device Name* must be entered. The name must be identical to that entered for Auxiliary GPIB Port x in the Configuration menu. Moreover, the *Path loss* between the generator and the DUT, the *Generator Level* as well as the *Frequency Offset* can be entered for each generator. A second generator can be included in the test setup if the first generator does not offer dual-channel capability. For the second generator, also activate the *use external Sync* checkbox. Under **RF Parameters** you can select the *Operating Band*, the *RF Channel* and the *uplink target* power of the UE. Enter under **Attenuation** the different CMU attenuations. Under **BER settings** you can choose between the (normal) *BER* with a certain number of transport blocks or a *Confidence BER* (statistical). Here you can enter additionally a *Minimum Test Time* (should be zero) and the *Wrong Decision Probability*.

Test description and measurement report:

The first generator establishes, depending on the selected test, a WCDMA or GMSK signal at certain offset 1 to the UE receive channel, and the second generator establishes an unmodulated (CW) interferer at certain offset 2 to the UE receive channel.

Two BER measurements are performed, one with offsets below and one with offsets above the receive channel.
Fig. 33 shows a typical entry in the measurement report. If confidence BER is selected, the decision (e.g. *Early Pass*) will be written in the measurement line.

Band I, RF Channel 10562, UL target Power: 18.0 dBm, CMU Attenuation (Out/In): 3.0 / 3.0 dB

Level Ior : -103.00 dBm, Interferer Level: -46.00 dBm, Gen 1 Attenuation: 0.0 dB, Gen 2 Attenuation: 0.0 dB

Confidence BER, Min Test Time: 0.00 s, Wrong Decision Prob.: P0_2

BER *Interferer WCDMA: -20.00 MHz, CW: -10.00 MHz, Early Pass*	[bar]	0.10 %	0.00 %	✔
BER *Interferer WCDMA: 20.00 MHz, CW: 10.00 MHz, Early Pass*	[bar]	0.10 %	0.06 %	✔

Fig. 33: Report: RX intermodulation

2.3.5 Spurious Emissions (6.8)

The spurious emission power is the power of emissions generated or amplified in a UE's receiver that appears at the UE antenna connector. Excess spurious emissions increase interference to other systems.
The purpose of test 6.8 is to verify that the UE spurious emissions do not exceed the values shown in Table 12 and Table 13:

General RX Spurious Emissions test requirements			
Frequency band	**Measurement bandwidth**	**Max. level**	**Note**
30 MHz ≤ f < 1 GHz	100 kHz	−57 dBm	
1 GHz ≤ f ≤ 12.75 GHz	1 MHz	−47 dBm	

Table 12: General RX Spurious Emissions test requirements

Additional RX Spurious Emissions test requirements				
Operating band	**Frequency band**	**Measurement bandwidth**	**Maximum level**	**Note**
I	1475.9 MHz ≤ f ≤ 1500.9 MHz	3.84 MHz	−60 dBm	
	1844.9 MHz ≤ f ≤ 1879.9 MHz	3.84 MHz	−60 dBm	
	1 920 MHz ≤ f ≤ 1 980 MHz	3.84 MHz	−60 dBm	UE transmit band
	2 110 MHz ≤ f ≤ 2 170 MHz	3.84 MHz	−60 dBm	UE receive band
II	1850 MHz ≤ f ≤ 1910 MHz	3.84 MHz	−60 dBm	UE transmit band
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	−60 dBm	UE receive band
III	1710 MHz ≤ f ≤ 1785 MHz	3.84 MHz	−60 dBm	UE transmit band
	1805 MHz ≤ f ≤ 1880 MHz	3.84 MHz	−60 dBm	UE receive band
IV	869 MHz ≤ f < 894 MHz	3.84 MHz	−60 dBm	
	1710 MHz ≤ f < 1755 MHz	3.84 MHz	−60 dBm	UE transmit band
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	−60 dBm	
	2110 MHz≤ f ≤ 2155 MHz	3.84 MHz	−60 dBm	UE receive band (see note 1)
	2110 MHz ≤ f ≤ 2170 MHz	3.8.4 MHz	−60 dBm	UE receive band (see note 2)
V	824 MHz ≤ f ≤ 849 MHz	3.84 MHz	−60 dBm	UE transmit band
	869 MHz ≤ f < 894 MHz	3.84 MHz	−60 dBm	UE receive band
VI	815 MHz ≤ f ≤ 850 MHz	3.84 MHz	−60 dBm	
	860 MHz ≤ f ≤ 895 MHz	3.84 MHz	−60 dBm	
	1475.9 MHz ≤ f ≤ 1500.9 MHz	3.84 MHz	−60 dBm	
	1844.9 MHz ≤ f ≤ 1879.9 MHz	3.84 MHz	−60 dBm	
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm	
VII	921 MHz ≤ f < 925 MHz	100 kHz	−60 dBm (see note)	
	925 MHz ≤ f ≤ 935 MHz	100 kHz −3.84 MHz	−67 dBm (see note) −60 dBm	
	935 MHz < f ≤ 960 MHz	100 kHz	−79 dBm (see note)	
	1805 MHz ≤ f ≤ 1880 MHz	100 kHz	−71 dBm (see note)	
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm	
	2500 MHz ≤ f ≤ 2570 MHz	3.84 MHz	−60 dBm	UE transmit band
	2620 MHz ≤ f ≤ 2690 MHz	3.84 MHz	−60 dBm	UE receive band
VIII	880 MHz ≤ f ≤ 915 MHz	3.84 MHz	−60 dBm	
	921 MHz ≤ f < 925 MHz	100 kHz	−60 dBm (see note)	
	925 MHz ≤ f ≤ 935 MHz	100 kHz 3.84 MHz	−67 dBm (see note) −60 dBm	
	935 MHz < f ≤ 960 MHz	100 kHz	−79 dBm (see note)	
	1805 MHz < f ≤ 1880 MHz	3.84 MHz	−60 dBm	
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm	
	2620 MHz ≤ f ≤ 2690 MHz	3.84 MHz	−60 dBm	
IX	860 MHz ≤ f ≤ 895 MHz	3.84 MHz	−60 dBm	
	1475.9 MHz ≤ f ≤ 1500.9 MHz	3.84 MHz	−60 dBm	
	1749.9 MHz ≤ f ≤ 1784.9 MHz	3.84 MHz	−60 dBm	UE transmit band
	1844.9 MHz ≤ f ≤ 1879.9 MHz	3.84 MHz	−60 dBm	UE receive band
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm	
X	869 MHz ≤ f < 894 MHz	3.84 MHz	−60 dBm	
	1710 MHz ≤ f < 1770 MHz	3.84 MHz	−60 dBm	UE transmit band
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	−60 dBm	

	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm	UE transmit band
XI	860 MHz ≤ f ≤ 895 MHz	3.84 MHz	−60 dBm	
	1427.9 MHz ≤ f ≤ 1452.9 MHz	3.84 MHz	−60 dBm	UE transmit band
	1475.9 MHz ≤ f ≤ 1500.9 MHz	3.84 MHz	−60 dBm	UE receive band
	1844.9 MHz ≤ f ≤ 1879.9 MHz	3.84 MHz	−60 dBm	
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm	
XII	698 MHz ≤ f ≤ 716 MHz	3.84 MHz	−60 dBm	UE transmit band
	728 MHz ≤ f ≤ 746 MHz	3.84 MHz	−60 dBm	UE receive band
	746 MHz ≤ f ≤ 756 MHz	3.84 MHz	−60 dBm	
	758 MHz ≤ f ≤ 768 MHz	3.84 MHz	−60 dBm	
	869 MHz ≤ f ≤ 894 MHz	3.84 MHz	−60 dBm	
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	−60 dBm	
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm	
XIII	728 MHz ≤ f ≤ 746 MHz	3.84 MHz	−60 dBm	
	746 MHz ≤ f ≤ 756 MHz	3.84 MHz	−60 dBm	UE receive band
	758 MHz ≤ f ≤ 768 MHz	3.84 MHz	−60 dBm	
	776 MHz ≤ f ≤ 788 MHz	3.84 MHz	−60 dBm	UE transmit band
	869 MHz ≤ f ≤ 894 MHz	3.84 MHz	−60 dBm	
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	−60 dBm	
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm	
XIV	728 MHz ≤ f ≤ 746 MHz	3.84 MHz	−60 dBm	
	746 MHz ≤ f ≤ 756 MHz	3.84 MHz	−60 dBm	
	758 MHz ≤ f ≤ 768 MHz	3.84 MHz	−60 dBm	UE receive band
	788 MHz ≤ f ≤ 798 MHz	3.84 MHz	−60 dBm	UE transmit band
	869 MHz ≤ f ≤ 894 MHz	3.84 MHz	−60 dBm	
	1930 MHz ≤ f ≤ 1990 MHz	3.84 MHz	−60 dBm	
	2110 MHz ≤ f ≤ 2170 MHz	3.84 MHz	−60 dBm	

Note: The measurements are made on frequencies which are integer multiples of 200 kHz. As exceptions, up to five measurements with a level up to the applicable requirements defined in Table 7.10 are permitted for each UARFCN used in the measurement.
Note 1: For UEs that conform to Release 6 and support Band IV shall support the defined frequency bandwidth.
Note 2: For UEs that conform to Release 7 and later releases and support Band IV shall support the defined frequency bandwidth.

Table 13: Additional RX Spurious Emissions test requirements

Table 12 contains a set of limits for the continuous frequency band from 30 MHz to 12.75 GHz (band I operation only). Additional, more stringent limits are defined for the inherent transmit and receive band in Table 13.

The setup procedure changes the UE to the CELL FACH state. In this state, no transmission of the UE will interfere the measurement. In the WCDMA Call Setup module, you have to set the connection type to CELL FACH.

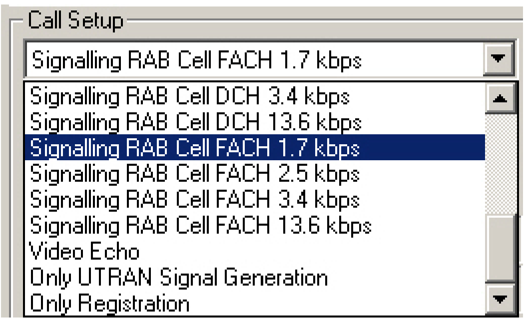


Fig. 34: CELL FACH in Call Setup

Recommended test setup:

Fig. 35 shows the test setup for spurious emissions measurements.
In the path between the CMU and the UE, the analyzer is coupled via a resistive combiner. This ensures a flat frequency response. An additional attenuator reduces the power to protect the analyzer input.

Instruments and accessories:

- CMU and FSQ, FSU, FSP or FSV
- Resistive combiner: DC to 12.75 GHz (e.g. Weinschel 1515-1)
- Attenuators 10 dB: DC to 12.75 GHz (e.g. Suhner)

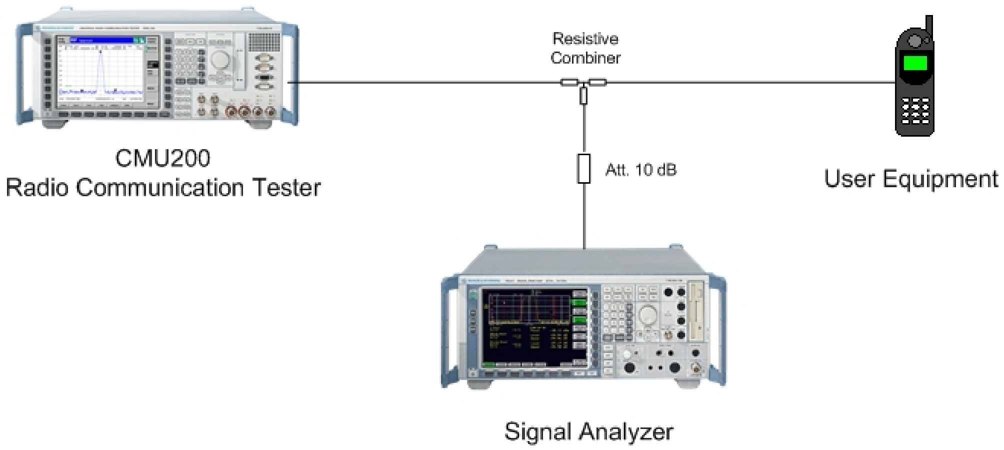


Fig. 35: Test setup for RX Spurious Emission test

WCDMA UE General RX Spur. Emissions

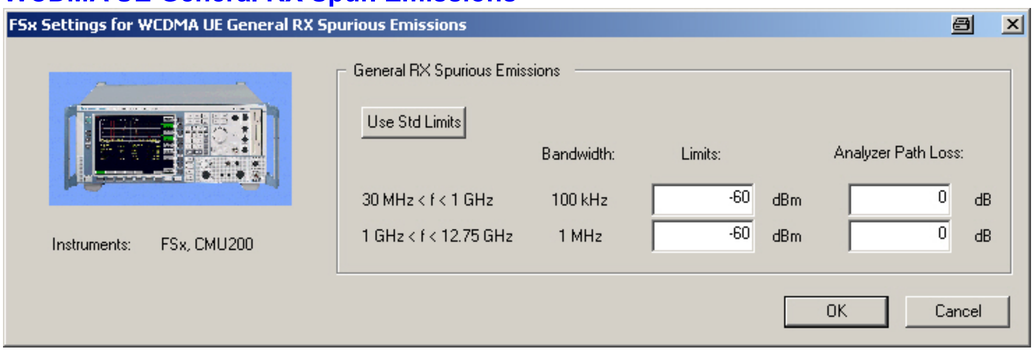


Fig. 36: Module RX General Spurious Emission tests

You can enter the *path loss* between the UE and the signal analyzer. To be on the safe side, always enter the maximum path loss, i.e. the path loss at the upper end of the frequency band. If limits are exceeded at a lower frequency, reduce the entry value to the actual path loss at that frequency point, and repeat the test.
If necessary, enter your individual limit values.
To reset the limits to the TS 34.121 standard, click the button *Use Std Limits*.

WCDMA UE Add- RX Spur. Emissions

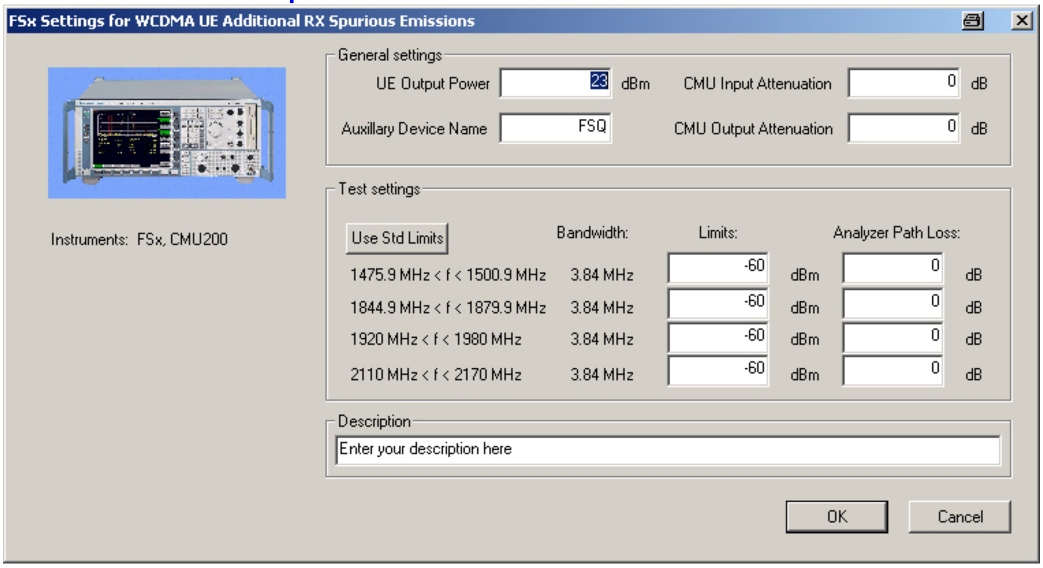


Fig. 37: WCDMA Additional Spurious Emissions

Test description and measurement report:

The frequency range for the RX spurious emissions test − from 30 MHz to 12.75 GHz − has been divided into two sections; see Fig. 38. In addition, measurements are performed in the inherent receive and transmit bands.
CMUgo now scans all sections. The upper limit of each section is visible as a limit line on the analyzer's screen. Once a section is scanned, the marker of the analyzer is set to peak. This value will be displayed later as a measurement value for the section.

Fig. 38 and Fig. 39 show the measurement result:

UE Gen. RX Spur. Emissions: *30.0 MHz to 1000.0 MHz*		**-60.00 dBm**	**-91.96 dBm**	✔
UE Gen. RX Spur. Emissions: *1000.0 MHz to 12750.0 MHz*		**-60.00 dBm**	**-75.09 dBm**	✔

Fig. 38: Measurement report for RX General Spurious Emission test

Add. RX Spur. Emissions Band I *Power 23.0 dB*				
From 1475.9 MHz to 1500.9 MHz, BW: 3.84 MHz:				
Add. RX Spur. Emissions Band I *Max: 1480.7 MHz*		**-60.00 dBm**	**-68.73 dBm**	✔
From 1844.9 MHz to 1879.9 MHz, BW: 3.84 MHz:				
Add. RX Spur. Emissions Band I *Max: 1861.7 MHz*		**-60.00 dBm**	**-68.30 dBm**	✔
From 1920.0 MHz to 1980.0 MHz, BW: 3.84 MHz:				
Add. RX Spur. Emissions Band I *Max: 1969.4 MHz*		**-60.00 dBm**	**-62.08 dBm**	✔
From 2110.0 MHz to 2170.0 MHz, BW: 3.84 MHz:				
Add. RX Spur. Emissions Band I *Max: 2161.5 MHz*		**-60.00 dBm**	**-76.52 dBm**	✔

Fig. 39: Report: RX Additional Spurious Emissions

2.4 Performance Requirements (Chapter 7)

In this section, the receiver characteristic of the DCH is determined by the block error rate (BLER) under certain fading and AWGN conditions. For these tests, a loop inside the device under test is closed to re-transmit the received blocks. To make sure that the uplink does not contribute additional errors, the output power of the device under test should be greater than −10 dBm. The BLER is counted inside the CMU.
The CMU can measure two different BLERs:

- the DL BLER, which is used in this section by CMUgo, counts wrong received blocks by evaluating the CRC.
- the DBLER counts wrong received bits inside a block to evaluate wrong blocks

The CMU also supports the S-CPICH, which is needed as a phase reference for a couple of tests.

Test setup

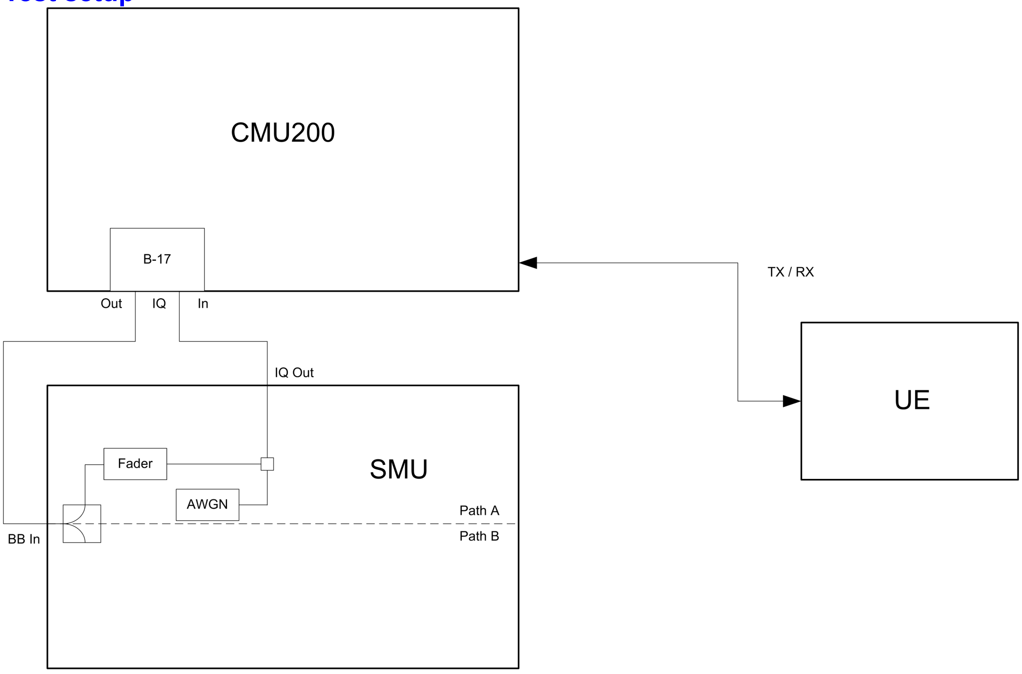


Fig. 40: Block diagram of test setup for WCDMA fading

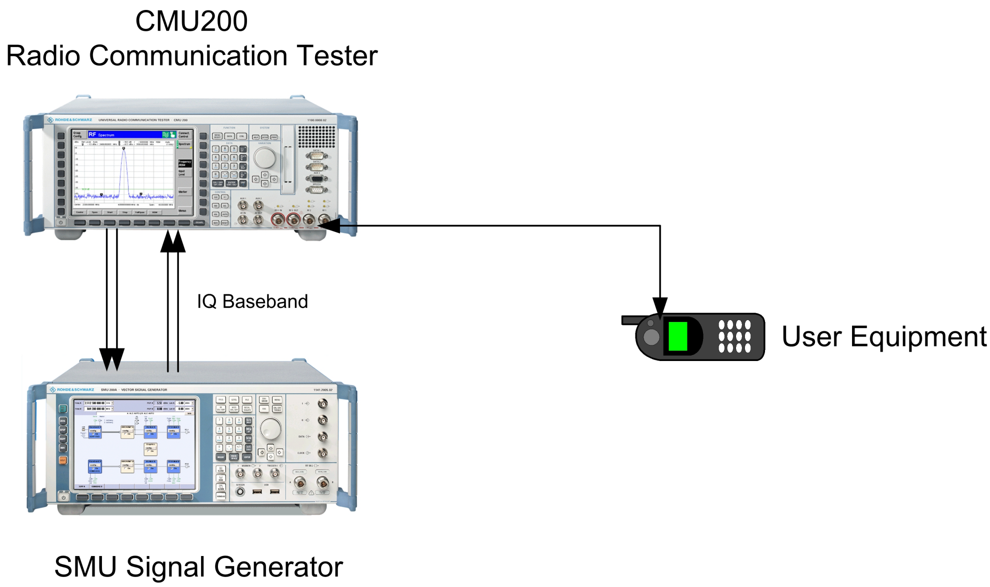


Fig. 41: Test setup instruments for WCDMA fading

All tests in this section are performed using the CMUgo WCDMA Fading SMU module.

WCDMA Fading SMU

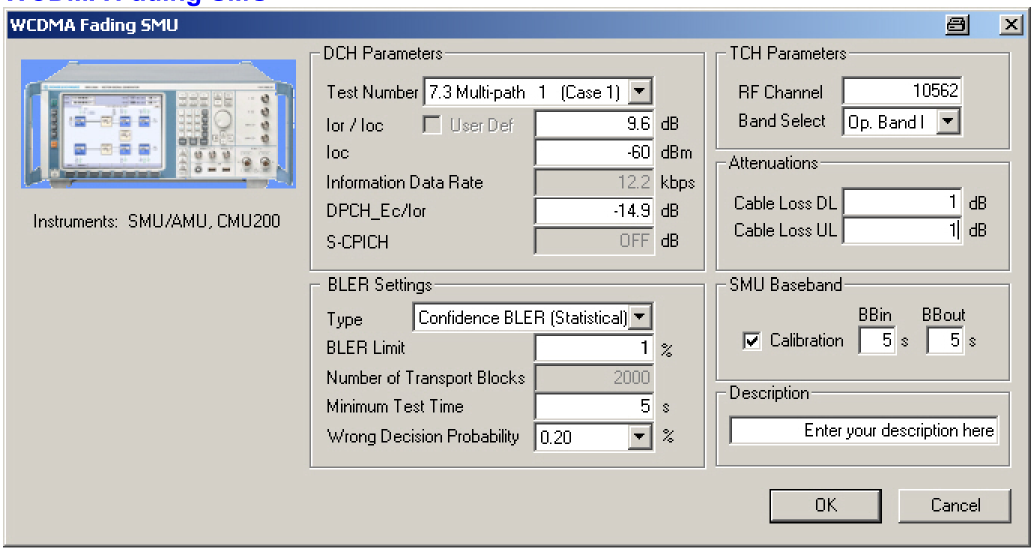


Fig. 42: WCDMA Fading SMU

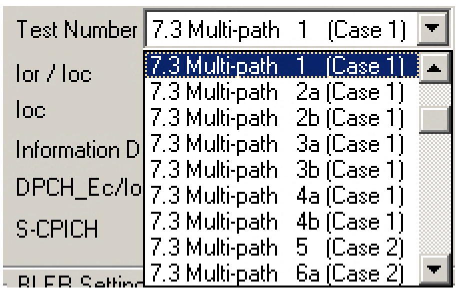


Fig. 43: WCDMA Fading tests

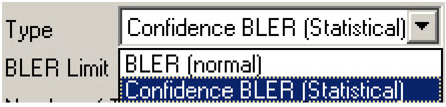


Fig. 44: WCDMA Fading BER

Under **DCH Parameters** you can select with Test Number (see Fig. 43) of the test in accordance with the TS 34.121 standard. (see Table 14 to Table 19).This sets the parameters I_{OR}/I_{OC} , I_{OC} , DPCH_E_C/I_{OR} , the BLER LIMIT and the fading path parameters to default values. You can change the absolute level of the AWGN interferer I_{oc} (at 3.84 MHz system bandwidth) and the signal-to-noise ratio Îor/Ioc between the WCDMA Output Channel Power Îor and the AWGN signal level Ioc. The ratio between DPCH_Ec/Ior of the DPCH and the signal level Îor can also be changed to suit your own needs. This is indicated by the checked box *User Def.*
Under **BLER settings** you can choose (see Fig. 44) between the (normal) *BLER* with a certain number of *Transport Blocks* or a *Confidence BLER* (statistical). Here you can enter additionally a *Minimum Test time* and the *Wrong Decision Probability*. Also the *BLER Limit* can be set.
You also can set up the *RF Channel and* the CMU *Attenuations*.
If *Calibration* is checked, a baseband calibration with the SMU is performed automatically using the set test times (BBin and BBout).

Fig. 45 shows a typical entry in the measurement report.

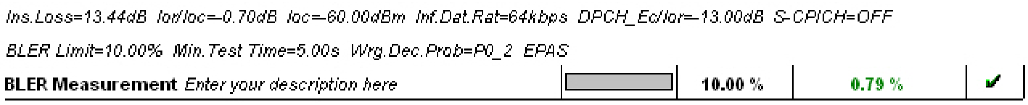


Fig. 45: Report: WCDMA Fading

2.4.1 Demodulation in Static Propagation conditions (7.2)

This section covers four tests in static propagation (no fading). Table 14 shows the parameters and requirements.

DCH parameters and requirements in static propagation conditions						
Test number	$\frac{DPCH\_E_c}{I_{or}}$ **dB**	**BLER (limit)**	**Information data rate**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	−16.5	10^{-2}	12.2	−0.7	−60	P-CPICH
2	−13.0	10^{-1}	64			
	−12.7	10^{-2}				
3	−9.8	10^{-1}	144			
	−9.7	10^{-2}				
4	−5.5	10^{-1}	384			
	−5.4	10^{-2}				

Table 14: DCH parameters and requirements in static propagation conditions

The tests can be selected under test number **7.2 Static xx**. The two different requirements for one test are noted as a and b (e.g. 7.2. Static 3b means test number 3 with DPCH_EC/Ior = −9.7 dB and BLER LIMIT = 10^{-2})

2.4.2 Demodulation of DCH in Multipath Fading Propagation Conditions (7.3)

For multipath fading propagation, several standard test case are defined in the specification (see Table 15). In this section, cases 1, 2, 3 and 6 are used.

The tests can be selected under test number **7.3 Multipath xx (Case y)**, where xx stands for the test number and y for the fading case.

Propagation conditions for multipath fading environments											
Case 1		**Case 2**		**Case 3**		**Case 4**		**Case 5 (Note 1)**		**Case 6**	
Speed for Band I, II, III, IV, IX and X: 3 km/h		Speed for Band I, II, III, IV, IX and X: 3 km/h		Speed for Band I, II, III, IV, IX and X: 120 km/h		Speed for Band I, II, III, IV, IX and X: 3 km/h		Speed for Band I, II, III, IV, IX and X: 50 km/h		Speed for Band I, II, III, IV, IX and X: 250 km/h	
Speed for Band V, VI and VIII: 7 km/h		Speed for Band V, VI and VIII: 7 km/h		Speed for Band V, VI and VIII: 282 km/h (Note 2)		Speed for Band V, VI and VIII: 7 km/h		Speed for Band V, VI and VIII: 118 km/h		Speed for Band V, VI and VIII: 583 km/h (Note 2)	
Speed for Band VII: 2.3 km/h		Speed for Band VII: 2.3 km/h		Speed for Band VII: 92 km/h		Speed for Band VII: 2.3 km/h		Speed for Band VII: 38 km/h		Speed for Band VII: 192 km/h	
Speed for Band XI: 4.1 km/h		Speed for Band XI: 4.1 km/h		Speed for Band XI: 166 km/h		Speed for Band XI: 4.1 km/h		Speed for Band XI: 69 km/h		Speed for Band XI: 345 km/h (Note 2)	
Relative delay [ns]	**Relative mean power [dB]**	**Relative delay [ns]**	**Relative mean power [dB]**	**Relative delay [ns]**	**Relative mean power [dB]**	**Relative delay [ns]**	**Relative mean power [dB]**	**Relative delay [ns]**	**Relative mean power [dB]**	**Relative delay [ns]**	**Relative mean power [dB]**
0	0	0	0	0	0	0	0	0	0	0	0
976	−10	976	0	260	−3	976	0	976	−10	260	−3
		20000	0	521	−6					521	−6
				781	−9					781	−9

Table 15: Propagation conditions for multipath fading environments

DCH parameters and requirements in multipath fading conditions								
Test number	CMUgo	$\frac{DPCH\_E_c}{I_{or}}$ dB	BLER (limit)	Information data rate	$\hat{I}_{or}/I_{oc}$ dB	I_{oc} dBm / 3.84 MHz	Fading case	Phase reference
1	1	−14.9	10^{-2}	12.2	9	−60	1	P-CPICH
2	2 a	−13.8	10^{-1}	64				
	2 b	−9.9	10^{-2}					

3	3 a	−10.5	10^{-1}	144				
	3 b	−6.7	10^{-2}					
4	4 a	−6.2	10^{-1}	384				
	4 b	−2.1	10^{-2}					
5	5	−7.6	10^{-2}	12.2	−2.4	−60	2	P-CPICH
6	6 a	−6.3	10^{-1}	64	-2.4			
	6 b	−2.6	10^{-2}					
7	7 a	−8.0	10^{-1}	144	3.6			
	7 b	−5.0	10^{-2}					
8	8 a	−5.4	10^{-1}	384	6.6			
	8 b	−3.1	10^{-2}					
9	9	−14.9	10^{-2}	12.2	-2.4	−60	3	P-CPICH
10	10 a	−11.7	10^{-2}	64	−2.4			
	10 b	−8.0	10^{-1}					
	10 c	−7.3	10^{-2}					
11	11 a	−6.7	10^{-3}	144	3.6			
	11 b	−8.9	10^{-1}					
	11 c	−8.4	10^{-2}					
12	12 a	−7.9	10^{-3}	384	6.6			
	12 b	−5.8	10^{-1}					
	12 c	−5.0	10^{-2}					
13	13	−14.9	10^{-2}	12.2	9.6	−60	1	S-CPICH
14	14 a	−13.8	10^{-1}	64				
	14 b	−9.9	10^{-2}					
15	15 a	−10.5	10^{-1}	144				
	15 b	−6.7	10^{-2}					
16	16 a	−6.2	10^{-1}	384				
	16 b	−2.1	10^{-2}					
17	17	-8.7	10^{-2}	12.2	-2.4	−60	6	P-CPICH
18	18 a	−5.0	10^{-1}	64	−2.4			
	18 b	−4.3	10^{-2}					
	18 c	−3.7	10^{-3}					
19	19 a	−5.9	10^{-1}	144	3.6			
	19 b	−5.4	10^{-2}					
	19 c	−4.9	10^{-3}					
20	20 a	−2.8	10^{-1}	384	6.6			
	20 b	−2.0	10^{-2}					
	20 c	−1.3	10^{-3}					

Table 16: DCH parameters and requirements in multipath fading conditions

2.4.3 Demodulation of DCH in Moving Propagation Conditions (7.4)

This section covers two tests in moving propagation conditions. Table 17 shows the parameters and requirements.

DCH parameters and requirements in moving propagation conditions						
Test number	$\frac{DPCH\_E_c}{I_{or}}$ dB	BLER limit)	Information data rate	$\hat{I}_{or}/I_{oc}$ dB	I_{oc} dBm / 3.84 MHz	Phase reference
1	−14,4 dB	10^{-2}	12,2	−0,4	−60	P-CPICH
2	−10,8 dB	10^{-2}	64			

Table 17: DCH parameters and requirements in moving propagation conditions

The tests can be selected under Test number **7.4 Moving 1** or **2**.

2.4.4 Demodulation of DCH in Birth-Death Propagation Conditions (7.5)

This section covers two tests in moving propagation. Table 18 shows the parameters and requirements.

DCH parameters and requirements in birth-death propagation conditions						
Test number	$\frac{DPCH\_E_c}{I_{or}}$ dB	BLER (limit)	Information data rate	$\hat{I}_{or}/I_{oc}$ dB	I_{oc} dBm / 3.84 MHz	Phase reference
1	−12.5 dB	10^{-2}	12.2	−0.4	−60	P-CPICH
2	−8.6 dB	10^{-2}	64			

Table 18: DCH parameters and requirements in birth-death propagation conditions

The tests can be selected under test number **7.5 Birth-Death 1** or **2.**

2.4.5 Demodulation of DCH in High-Speed Train Conditions (7.5A)

DCH parameters and requirements in high speed train propagation conditions						
Test number	$\frac{DPCH\_E_c}{I_{or}}$ dB	BLER (limit)	Information data rate	$\hat{I}_{or}/I_{oc}$ dB	I_{oc} dBm / 3.84 MHz	Phase reference
1	−21.7 dB	10^{-2}	12.2	5.6	−60	P-CPICH

Table 19: DCH parameters and requirements in high speed train condition

The test can be selected under test number **7.5A High Speed Train.**

2.5 Performance Requirements for HSDPA (Chapter 9)

In this section, the performance requirements of UEs with HSDPA (introduced in Release 6) under certain fading and AWGN conditions are described.
Also RX Diversity tests are introduced.

Test setup

The tests require up to two fading downlink channels. Both are derived from one source. The two fading profiles are not correlated with each other. The standard outlines RF fading using two RF fading channel simulators (Fader). 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 UE under test.

The combination of a CMU and an SMU uses I/Q fading (see section 3.2). Fig. 46 shows the functional setup with baseband fading.

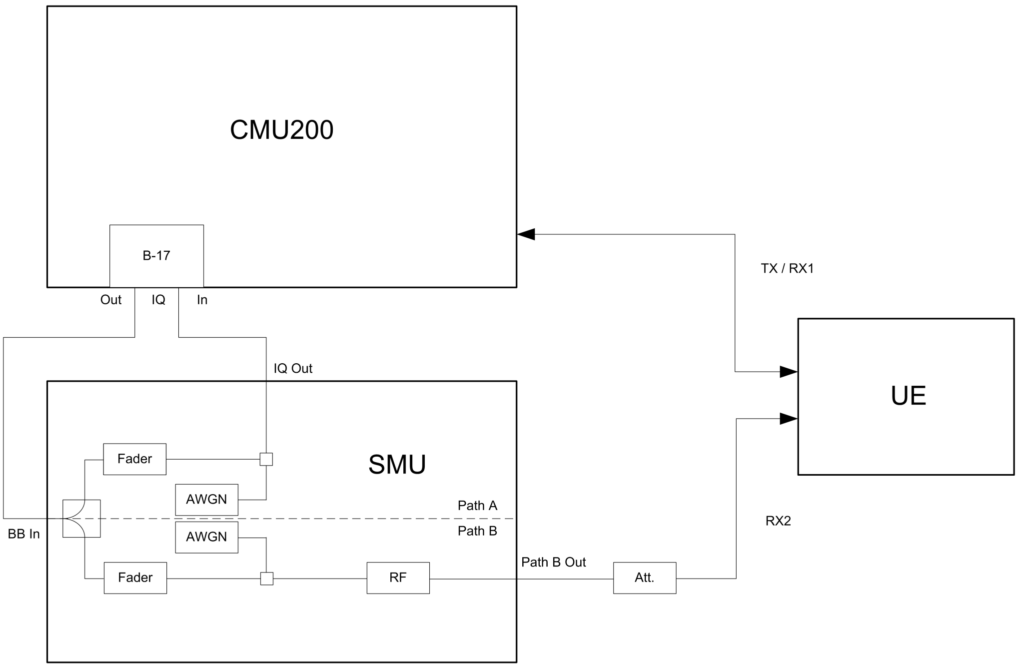


Fig. 46: Block diagram of test setup for HSDPA tests

The CMU provides the downlink stream at the TX (I/Q) 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. The fading profiles are applied in both paths, and AWGN is added. The signal of path B is up-converted into the RF band inside the SMU.
The signal of path A is returned from the SMU baseband outputs to the TX (I/Q) 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. 47). Use the dedicated I/Q cable included with the CMU-B17 option. It provides one DSUB connector to the CMU and four BNC connectors to the SMU.

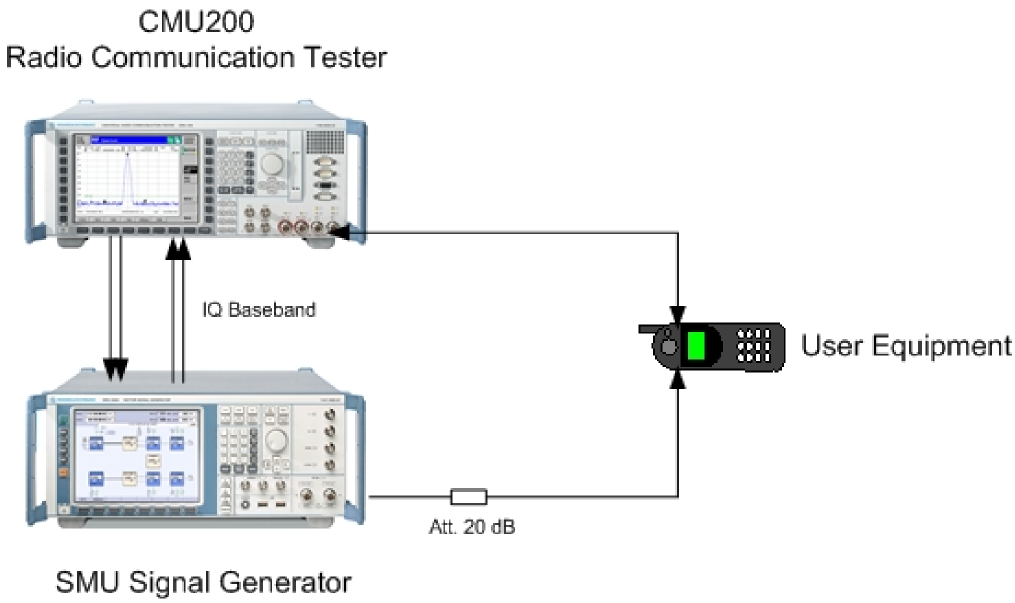


Fig. 47: Instrument test setup for HSDPA tests

HSDPA Enhanced, Type 1

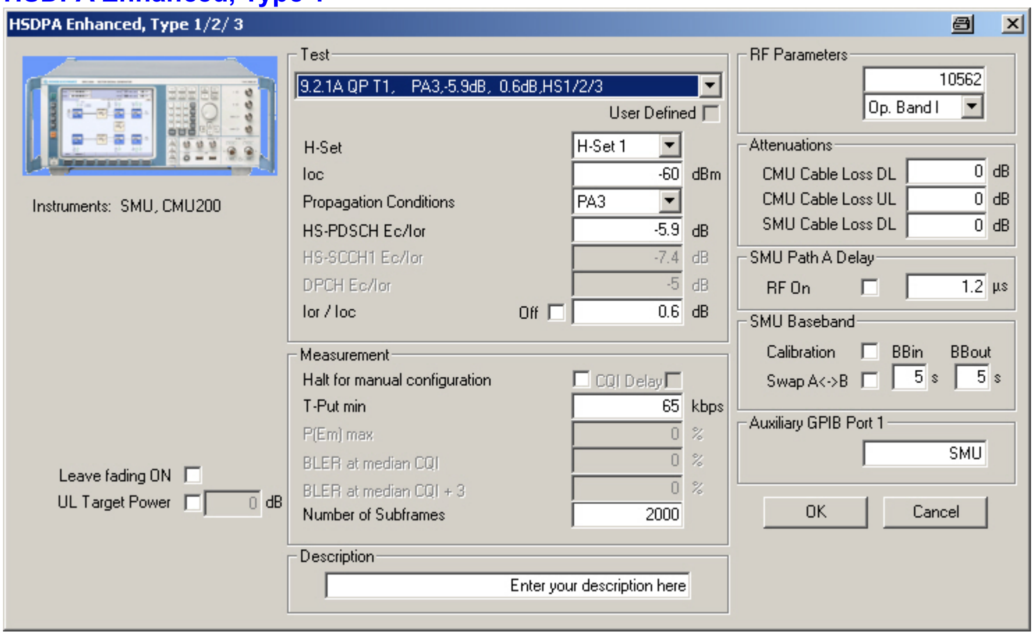


Fig. 48: HSDPA Enhanced module

The HSDPA Enhanced, Type 1 module is prepared for the measurements of the tests 9.2.1A to 9.2.1G, 9.3.2 and 9.4.1(A) of the TS34.121 standard.
Under *Test* you can select in a pull-down field different tests items for tests 9.2.1, 9.3.2 and 9.4.1. The different tests are described in the corresponding sections.

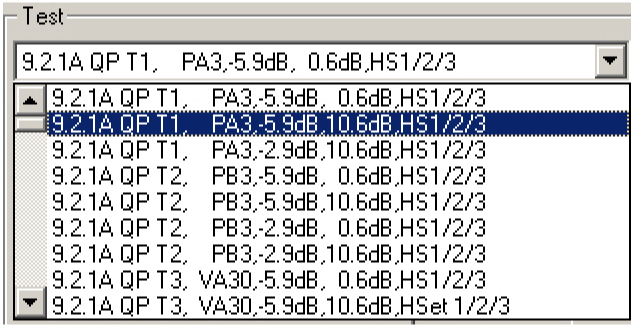


Fig. 49: HSDPA tests

Each line shows the corresponding section number in the standard, the modulation scheme (QP ≡ QPSK, 16 ≡ 16QAM), the test number in the standard, the fading profile, and the level and noise ratios. All values are in accordance with TS 34.121.
Once a measurement has been selected, the following entry fields in the window are preset: H-Set, 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, the *maximum misdetection P(Em) max* for test 9.4.1 or the BLER limits for 9.3.2.
For tests 9.2.1 E_c/I_{or}, refer to the HS-DSCH; for test 9.4.1, to the HS-SCCH.
If you modify one or more of these parameters, this will be indicated in the *User Defined* checkbox below the *Test* box.
Under **RF Parameters** you can enter the channel number and the operating band.
Under **Attenuations** you can enter the attenuations for the CMU and the SMU.
SMU Path A Delay (default 1.3 µs) is the delay between the CMU and SMU RF output due to filtering (see section 3.3).
Enable the **SMU Baseband** *Calibration* checkbox to calibrate the insertion loss of the SMU automatically with the set times for BBin and BBout.
Under **Auxiliary GPIB Port 1**, enter "SMU".

2.5.1 Demodulation of HS-DSCH (Fixed Reference Channel) (9.2)

To test the receiver performance, the information bit throughput (R) on the high-speed downlink shared channel (HS-DSCH) is determined. It indicates the actual bit rate in kbps, which must not fall below the minimum values. The throughput is evaluated by counting the number of acknowledge and not acknowledge (ACK and NACK) messages from the UE.

Fig. 50 shows an example of the report in CMUgo.

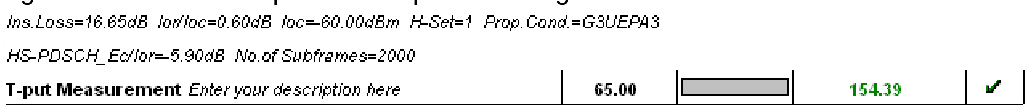


Fig. 50: Report: Throughput measurement (9.2)

The following (single link performance) tests can be performed with CMUgo:

2.5.1.1 QPSK/16QAM, Fixed Reference Channel (FRC) H-Set 1/2/3 (9.2.1A)

Table 20 shows test parameters for QPSK

9.2.1A: QPSK, FRC H-Set 1/2/3 test requirements						
Test number	**Propagation conditions**	**HS-PDSCH** E_c / I_{or} **dB**	**T-put** R **kbps**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	PA3	−5.9	**65**	0.6	−60	P-CPICH
			309	10.6		
		−2.9	**423**	10.6		
2	PB3	−5.9	**23**	0.6		
			181	10.6		
		−2.9	**138**	0.6		
			287	10.6		
3	VA30	−5.9	**22**	0.6		
			190	10.6		
		−2.9	**142**	0.6		
			295	10.6		
4	VA120	−5.9	**13**	0.6		
			181	10.6		
		−2.9	**140**	0.6		
			275	10.6		

Table 20: 9.2.1A: QPSK, FRC H-Set 1/2/3 test requirements

Table 21 shows the test parameters for 16QAM

9.2.1A: 16QAM, FRC H-Set 1/2/3 test requirements						
Test number	**Propagation conditions**	**HS-PDSCH** E_c / I_{or} **dB**	**T-put** R **kbps**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	PA3	−5.9	**198**	10.6	−60	P-CPICH
		−2.9	**368**			
2	PB3	−5.9	**34**			
		−2.9	**219**			
3	VA30	−5.9	**47**			
		−2.9	**214**			
4	VA120	−5.9	**28**			
		−2.9	**167**			

Table 21: 9.2.1A: 16QAM, FRC H-Set 1/2/3 test requirements

2.5.1.2 QPSK, Fixed Reference Channel (FRC) H-Set 4/5 (9.2.1B)

Table 22 shows the test parameters for QPSK H-Set 4.

9.2.1B: QPSK, FRC H-Set 4 test requirements						
Test number	**Propagation conditions**	**HS-PDSCH** E_c/I_{or} **dB**	**T-put** R **kbps**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	PA3	−5.9	**72**	0.6	−60	P-CPICH
			340	10.6		
		−2.9	**439**	10.6		
2	PB3	−5.9	**24**	0.6		
			186	10.6		
		−2.9	**142**	0.6		
			299	10.6		
3	VA30	−5.9	**19**	0.6		
			183	10.6		
		−2.9	**148**	0.6		
			306	10.6		
4	VA120	−5.9	**11**	0.6		
			170	10.6		
		−2.9	**144**	0.6		
			284	10.6		

Table 22: 9.2.1B:QPSK, FRC H-Set 4 test requirements

Table 23 shows the test parameters for QPSK

9.2.1B:QPSK, FRC H-Set 5 test requirements						
Test number	**Propagation conditions**	**HS-PDSCH** E_c/I_{or} **dB**	**T-put** R **kbps**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	PA3	−5.9	**98**	0.6	−60	P-CPICH
			464	10.6		
		−2.9	**635**	10.6		
2	PB3	−5.9	**35**	0.6		
			272	10.6		
		−2.9	**207**	0.6		
			431	10.6		
3	VA30	−5.9	**33**	0.6		
			285	10.6		
		−2.9	**213**	0.6		
			443	10.6		
4	VA120	−5.9	**20**	0.6		
			272	10.6		
		−2.9	**210**	0.6		
			413	10.6		

Table 23: 9.2.1B: QPSK, FRC H-Set 5 test requirements

2.5.1.3 QPSK/16QAM, Fixed Reference Channel (FRC) H-Set 6/3 (9.2.1C)

Table 24 shows the test parameters for QPSK, H-Set 6/3

9.2.1C: QPSK, FRC H-Set 3/6 test requirements							
Test number	H-SET	Propagation conditions	HS-PDSCH E_c/I_{or} dB	T-put R kbps	$\hat{I}_{or}/I_{oc}$ dB	I_{oc} dBm / 3.84 MHz	Phase reference
1	6	PA3	−5.9	**1407**	10.6	−60	P-CPICH
			−2.9	**2090**	10.6		
2	3	PB3	−5.9	**23**	0.6		
				181	10.6		
			−2.9	**138**	0.6		
				287	10.6		
3		VA30	−5.9	**22**	0.6		
				190	10.6		
			−2.9	**142**	0.6		
				295	10.6		
4		VA120	−5.9	**13**	0.6		
				181	10.6		
			−2.9	**140**	0.6		
				275	10.6		

Table 24: 9.2.1C: QPSK, FRC H-Set 3/6 test requirements

Table 25 shows the test parameters for 16QAM, H-Set 6/3

9.2.1C: 16QAM, FRC H-Set 3/6 test requirements							
Test number	H-SET	Propagation conditions	HS-PDSCH E_c/I_{or} dB	T-put R kbps	$\hat{I}_{or}/I_{oc}$ dB	I_{oc} dBm / 3.84 MHz	Phase reference
1	6	PA3	−5.9	**887**	10.6	−60	P-CPICH
			−2.9	**1664**			
2	3	PB3	−5.9	**34**			
			−2.9	**219**			
3		VA30	−5.9	**57**			
			−2.9	**214**			
4		VA120	−5.9	**28**			
			−2.9	**167**			

Table 25: 9.2.1C: 16QAM, FRC H-Set 3/6 test requirements

2.5.1.4 Type 1 – QPSK/16QAM, Fixed Reference Channel (FRC) H-Set 1/2/3 (9.2.1D)

Table 26 shows the test parameters for QPSK

9.2.1D: Enhanced Type 1 QPSK, FRC H-Set 1/2/3 test requirements						
Test number	**Propagation conditions**	**HS-PDSCH** E_c/I_{or} **dB**	**T-put** R **kbps**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	PA3	−11.9	**247**	10.6	−60	P-CPICH
		−8.9	**379**	10.6		
		−5.9	**195**	0.6		
		−2.9	**329**	0.6		
2	PB3	−8.9	**195**	10.6		
		−5.9	**156**	0.6		
			316	10.6		
		−2.9	**263**	0.6		
3	VA30	−8.9	**212**	10.6		
		−5.9	**329**	10.6		
			171	0.6		
		−2.9	**273**	0.6		
4	VA120	−8.9	**191**	10.6		
		−5.9	**293**	10.6		
			168	0.6		
		−2.9	**263**	10.6		

Table 26: 9.2.1D: Enhanced Type 1 QPSK, FRC H-Set1/2/3 test requirements

Table 27 shows the test parameters for 16QAM

9.2.1D: Enhanced Type 1 16QAM, FRC H-Set 1/2/3 test requirements						
Test number	**Propagation conditions**	**HS-PDSCH** E_c/I_{or} **dB**	**T-put** R **kbps**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	PA3	−8.9	**312**	10.6	−60	P-CPICH
		−5.9	**487**			
2	PB3	−5.9	**275**			
		−2.9	**408**			
3	VA30	−5.9	**296**			
		−2.9	**430**			
4	VA120	−5.9	**271**			
		−2.9	**392**			

Table 27: 9.2.1D: Enhanced Type 1 16QAM, FRC H-Set 1/2/3 test requirements

2.5.1.5 Type 1− QPSK/16QAM, Fixed Reference Channel (FRC) H-Set 6/3 (9.2.1E)

Table 28 shows the test parameters for QPSK, H-Set 6/3

9.2.1E: : Enhanced Type 1 QPSK, FRC H-Set 3/6 test requirements							
Test number	**H-SET**	**Propagation conditions**	**HS-PDSCH** E_c/I_{or} **dB**	**T-put** R **kbps**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	6	PA3	−11.9	**672**	10.6	−60	P-CPICH
			−8.9	**1305**	10.6		
2	3	PB3	−8.9	**195**	10.6		
			−5.9	**316**	10.6		
				171	0.6		
			−2.9	**263**	0.6		
3		VA30	−8.9	**212**	10.6		
			−5.9	**329**	10.6		
				171	0.6		
			−2.9	**273**	0.6		
4		VA120	−8.9	**191**	10.6		
			−5.9	**293**	10.6		
				168	0.6		
			−2.9	**263**	10.6		

Table 28: 9.2.1E: : Enhanced Type 1 QPSK, FRC H-Set 3/6 test requirements

Table 29 shows the test parameters for 16QAM, H-Set 3/6

9.2.1E: Enhanced Type 1 16QAM, FRC H-Set 3/6 test requirements							
Test number	**H-SET**	**Propagation conditions**	**HS-PDSCH** E_c/I_{or} **dB**	**T-put** R **kbps**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	6	PA3	−8.9	**912**	10.6	−60	P−CPICH
			−5.9	**1730**			
2	3	PB3	−5.9	**275**			
			−2.9	**408**			
3		VA30	−5.9	**196**			
			−2.9	**430**			
4		VA120	−5.9	**271**			
			−2.9	**392**			

Table 29: 9.2.1E: Enhanced Type 1 16QAM, FRC H-Set 3/6 test requirements

2.5.1.6 Type 2 – QPSK/16QAM, Fixed Reference Channel (FRC) H-Set 6/3 (9.2.1F)

Table 30 shows the test parameters for QPSK, H-Set 6

9.2.1F: Enhanced Type 2 QPSK, FRC H-Set 6 test requirements						
Test number	Propagation conditions	HS-PDSCH E_c/I_{or} dB	T-put R kbps	$\hat{I}_{or}/I_{oc}$ dB	I_{oc} dBm / 3.84 MHz	Phase reference
1	PA3	−5.9	**1494**	10.6	−60	P-CPICH
		−2.9	**2153**			
2	PB3	−5.9	**1038**			
		−2.9	**1744**			
3	VA30	−5.9	**1142**			
		−2.9	**1782**			
4	VA120	−5.9	**909**			
		−2.9	**1467**			

Table 30: 9.2.1F: Enhanced Type 2 QPSK, FRC H-Set 6 test requirements

Table 31 shows the test parameters for 16QAM, H-Set 6

9.2.1F: Enhanced Type 2 16QAM, FRC H-Set 6 test requirements						
Test number	Propagation conditions	HS-PDSCH E_c/I_{or} dB	T-put R kbps	$\hat{I}_{or}/I_{oc}$ dB	I_{oc} dBm / 3.84 MHz	Phase reference
1	PA3	−5.9	**991**	10.6	−60	P-CPICH
		−2.9	**1808**			
2	PB3	−5.9	**465**			
		−2.9	**1370**			
3	VA30	−5.9	**587**			
		−2.9	**1488**			
4	VA120	−5.9	**386**			
		−2.9	**1291**			

Table 31: 9.2.1F: Enhanced Type 2 16QAM, FRC H-Set 6 test requirements

Table 32 shows the test parameters for QPSK, H-Set 3

9.2.1F: Enhanced Type 2 QPSK, FRC H-Set 3 test requirements						
Test number	**Propagation conditions**	**HS-PDSCH** E_c/I_{or} **dB**	**T-put** R **kbps**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	PA3	−5.9	**65**	0.6	−60	P-CPICH
		−2.9	**N/A**			
2	PB3	−5.9	**23**			
		−2.9	**138**			
3	VA30	−5.9	**22**			
		−2.9	**142**			
4	VA120	−5.9	**13**			
		−2.9	**140**			

Table 32: 9.2.1F: Enhanced Type 2 QPSK, FRC H-Set 3 test requirements

2.5.1.7 Type 3 – QPSK/16QAM, Fixed Reference Channel (FRC) H-Set 6/3 (9.2.1G)

Table 33 shows the test parameters for QPSK, H-Set 6

9.2.1G: Enhanced Type 3 QPSK, FRC H-Set 6 test requirements						
Test number	**Propagation conditions**	**HS-PDSCH** E_c/I_{or} **dB**	**T-put** R **kbps**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	PA3	−8.9	**1554**	10.6	−60	P-CPICH
		−5.9	**2495**			
2	PB3	−8.9	**1190**			
		−5.9	**2098**			
3	VA30	−8.9	**1229**			
		−5.9	**2013**			
4	VA120	−8.9	**1060**			
		−5.9	**1674**			
5	PB3	−8.9	**1248**	5.6		
		−5.9	**2044**			

Table 33: 9.2.1G: Enhanced Type 3 QPSK, FRC H-Set 6 test requirements

Table 34 shows the test parameters for 16QAM, H-Set 6

9.2.1G: Enhanced Type 3 16QAM, FRC H-Set 6 test requirements						
Test number	**Propagation conditions**	**HS-PDSCH** E_c/I_{or} **dB**	**T-put** R **kbps**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	PA3	−5.9	**1979**	10.6	−60	P-CPICH
		−2.9	**3032**			
2	PB3	−5.9	**1619**			
		−2.9	**2464**			
3	VA30	−5.9	**1710**			
		−2.9	**2490**			
4	VA120	−5.9	**1437**			
		−2.9	**2148**			
5	PB3	−5.9	**779**	5.6		
		−2.9	**1688**			

Table 34: 9.2.1G : Enhanced Type 3 16QAM, FRC H-Set 6 test requirements

2.5.2 Reporting of Channel Quality Indicator (9.3)

In this test case, the reporting accuracy of the CQI is measured. Under fading and AWGN conditions the UE can not always detect the HS-SCCH. This results in a DTX in the uplink.
The test with AWGN can be handled by the CMU alone and is part of a different CMUgo module.

9.3 Propagation conditions for CQI tests	
Case 8	
Speed for Band I, II, III, IV, IX and X: 30km/h Speed for Band V, VI and VIII: 71km/h Speed for Band VII: 23km/h Speed for Band XI: 41km/h Speed for Band XII, XIII and XIV: 80 km/h	
Relative delay [ns]	Relative mean power [dB]
0	0
976	−10

Table 35: Propagation conditions for CQI tests

9.3.2 Single Link Performance − Fading Propagation Conditions

First of all, the CMU determines the median CQI. Then the BLER is measured under different fading conditions. Two results are reported: one with blocks corresponding to the reported CQI median and one with blocks corresponding to the reported the CQI median + 3.

9.3.2 − Test requirements for CQI reporting in fading conditions

Test number	HS-PDSCH E_c / I_{or} dB	Max BLER	HS-SCCH_1 E_c / I_{or} dB	DPCH E_c / I_{or} dB	$\hat{I}_{or}/I_{oc}$ dB	I_{oc} dBm / 3.84 MHz	Phase reference
1	−8.0	**60 % (CQI med)** **15 % (CQI+3)**	−8.5	−6	0	−60	P-CPICH
2	−15.5				5		

Table 36: Test requirements for CQI reporting in fading conditions

Fig. 51shows a report in CMUgo.

Ins.Loss=12.28dB Ior/Ioc=0.00dB Ioc=-60.00dBm H-Set=2 Prop.Cond.=G3UEC8CQ

HS-PSCCH1_Ec/Ior=-8.00dB DPCH_Ec/Ior=-6.00 No.of Subframes=2000 CQI frames=0 CQI+3 frames=0

BLER at Median CQI Measurement *Enter your description here*		**60.00 %**	**0.00 %**	✔
BLER at Median CQI+3		**15.00 %**	**0.00 %**	✔

Fig. 51: CQI reporting test (9.3. 2)

2.5.3 HS-SCCH Detection Performance (9.4)

This section 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. The event E_m is defined when the UE is signaled 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.

2.5.3.1 Single Link Performance (9.4.1)

9.4.1 – Test requirements for HS-SCCH detection							
Test number	**Propagation conditions**	**HS-SCCH-1** E_c/I_{or} **dB**	$P(E_m)$	**P-CPICH** E_c/I_{or} **dB**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	PA3	−8.9	**0.05**	−9.9	0.6	−60	P-CPICH
2	PA3	−9.8	**0.01**		5.6		
3	VA30	−9.9	**0.01**		0.6		

Table 37: 9.4.1 – Test requirements for HS-SCCH detection

2.5.3.2 Single Link Performance – Enhanced Requirements Type 1 (9.4.1A)

9.4.1A – Test requirements for Enhanced Type 1 for HS-SCCH detection							
Test number	**Propagation conditions**	**HS-SCCH-1** E_c/I_{or} **dB**	$P(E_m)$	**P-CPICH** E_c/I_{or} **dB**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
1	PA3	−11.9	**0.01**	−9.9	0.6	−60	P-CPICH
2	VA30	−15.5	**0.01**				

Table 38: 9.4.1A – Test requirements for Enhanced Type 1 for HS-SCCH detection

Fig. 52 shows an example of the report in CMUgo.

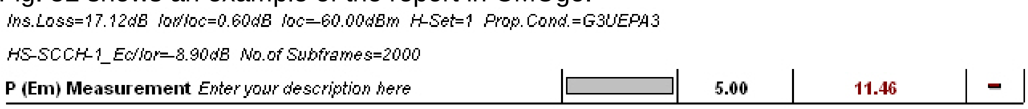


Fig. 52: HS-SCCH reporting test (9.4.1)

2.6 Performance Requirements (E-DCH) (Chapter 10)

The tests in this section apply to UEs with HSUPA. The receive characteristics of the UEs of the individual downlink channels (E-HICH, E-AGCH and ERGCH) are tested under fading conditions and AWGN.

The following parameters cannot be changed during a call and therefore must already be set up in the **HSPA Call Setup** module:

- DL RLC SDU size (bits)
- UL RLC SDU size (bits)
- RLC PDU size
- Number of retransmissions
- Happy bit delay (ms)
- Transmit time interval (TTI) (ms)

HSPA Call Setup

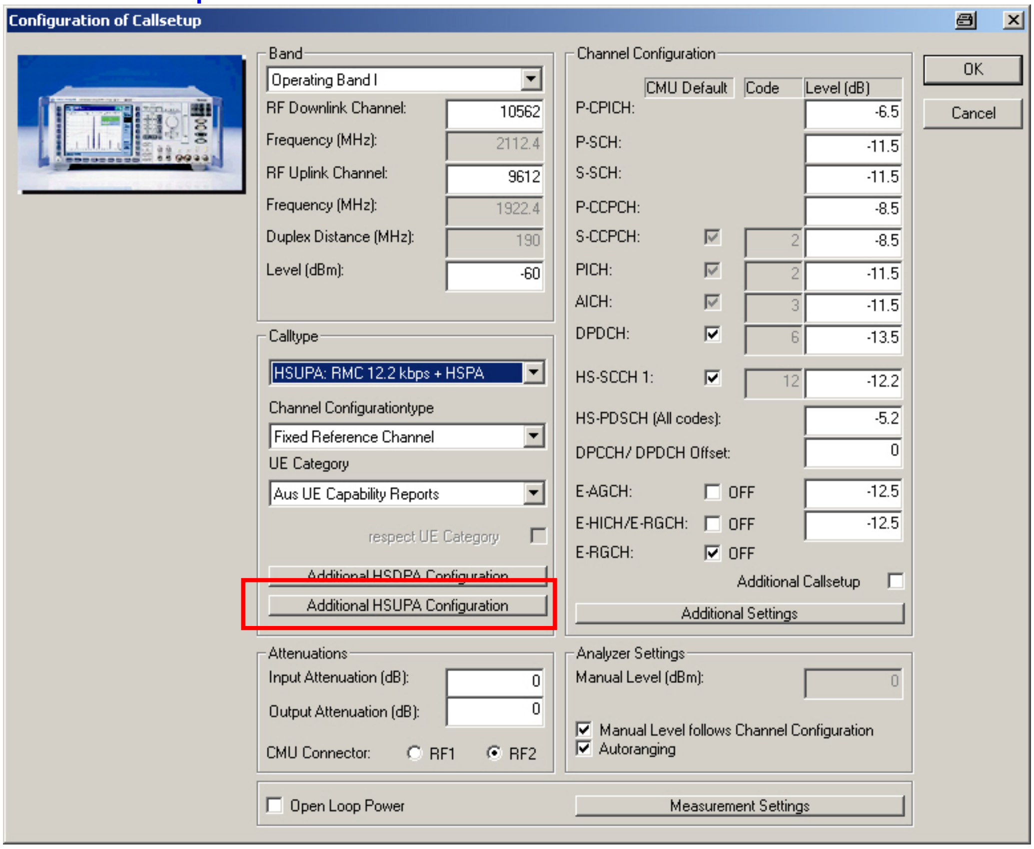


Fig. 53: HSPA Call Setup module

Clicking the *Additional HSUPA Configuration* button takes you to the window shown in Fig. 54.

HSUPA Additional Setup

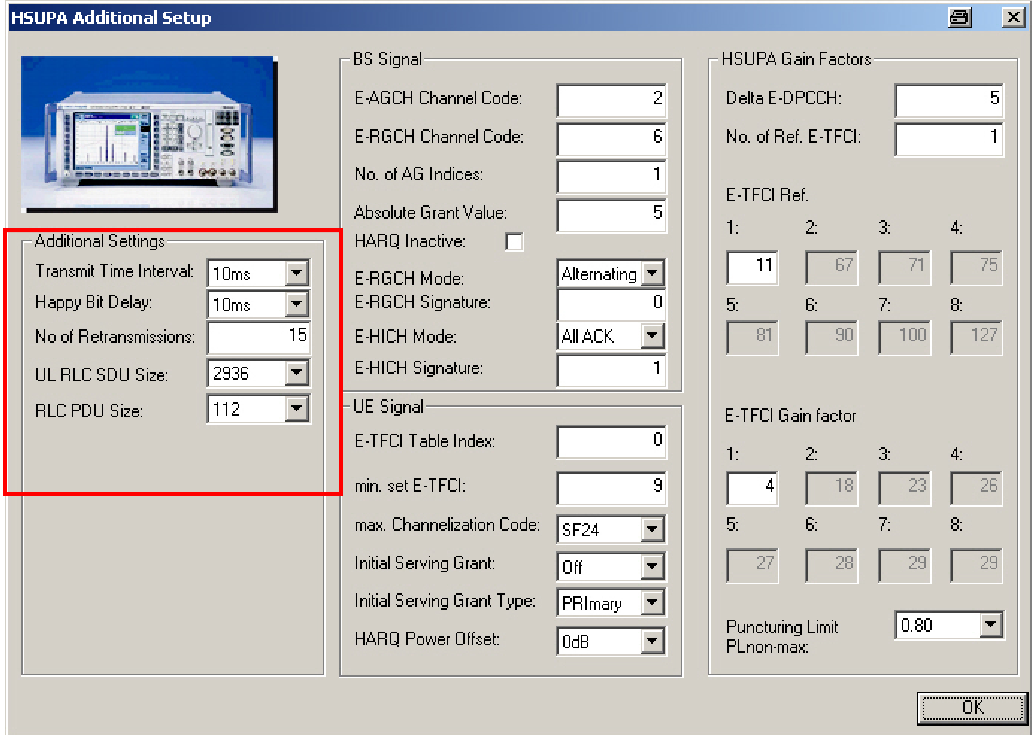


Fig. 54: HSUPA Additional Setup

Test setup

The test setup corresponds to the test setup described in section 2.5. Refer to section 2.5 for details.

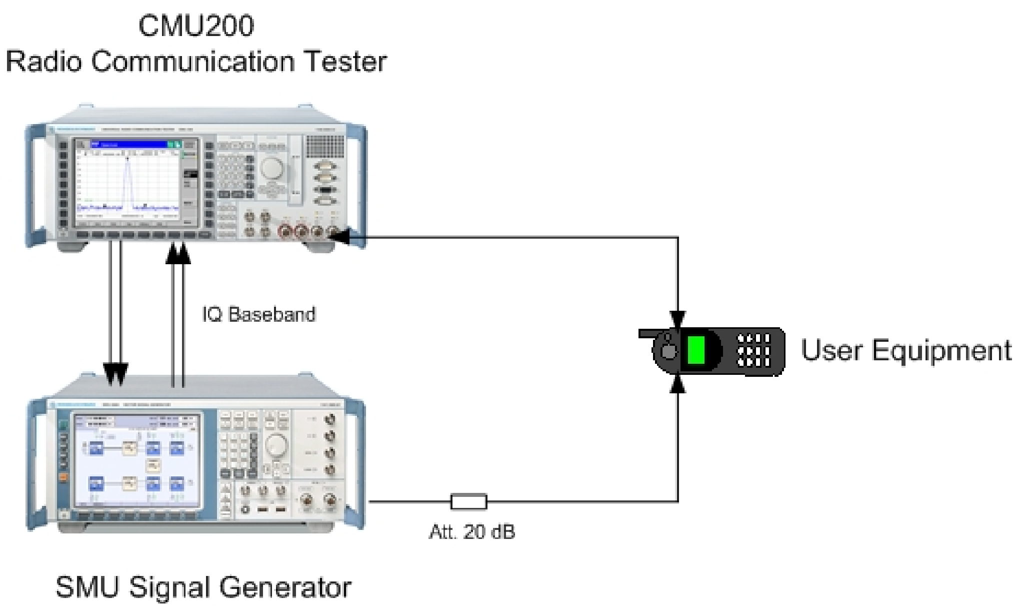


Fig. 55: HSUPA test setup

All tests in this section are performed with the CMUgo HSUPA Fading module.

HSUPA Fading

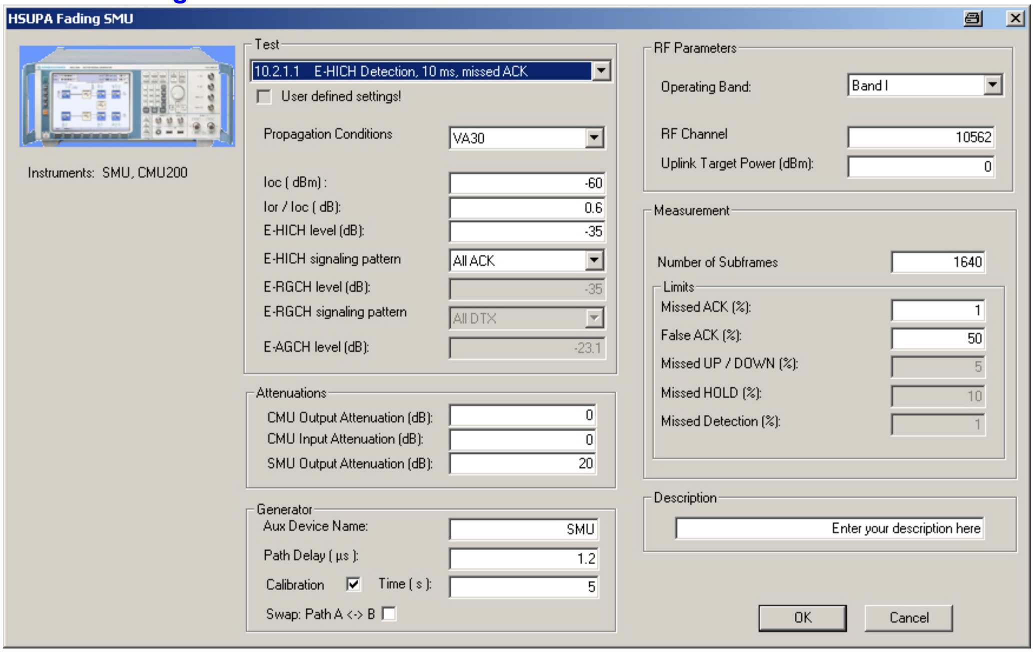


Fig. 56: HSUPA Fading module

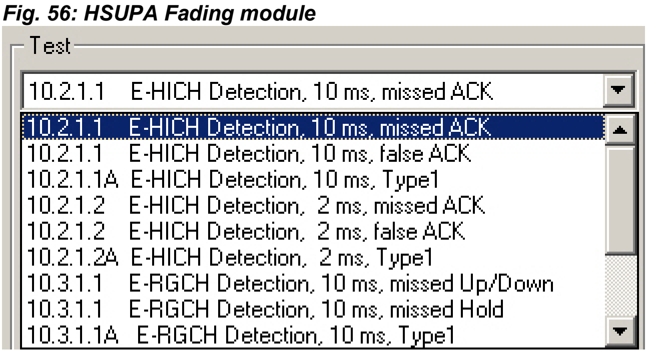


Fig. 57: HSUPA Fading tests

First of all, you can select an individual test under **Test**. This sets the important parameters to the values stated in the specification and dims the nonrelevant parameters. The *fading profile* can be selected, and the individual levels and patterns can be set. If one or more parameters deviate from the specification, this will be indicated in the *User defined settings!* checkbox.
Under **Attenuations** you can enter the attenuations for the CMU as well as for the second path of the SMU.
Under **Generator** specify the *Aux Device Name* and the *Path Delay* (see section 3.3). If you mark the *Calibration* checkbox, the I/Q path (path A of the SMU) is recalibrated with the set measurement time and the appropriate attenuation is set on the CMU. With *Swap: Path A <> B* you can swap the paths in the SMU.
Under **RF Parameters** you can set the *Operating Band* and the *RF Channel* as well as the desired *Uplink Target Power* of the UE.
Under **Measurement** you can enter the *Number of Subframes* and the *Limits* of the individual tests.

2.6.1 Detection of E-HICH − Single Link (10.2.1)

The receiver characteristics of the E-DCH HARQ indicator channel (E-HICH) are tested here using the following two tests:

- The base station transmits via the E-HICH at 100 % ACK -> The ACK signals not understood by the UE (*missed ACK*) are counted
- The base station transmits via the E-HICH at 100 % DTX -> The signals erroneously understood by the UE as ACK (*false ACK*) are counted

Both tests are performed for TTI = 10 ms as well as TTI = 2 ms. The *missed ACK* test is also specified for RX diversity.

The following parameters must already be set in the call setup:

Call setup parameters for E-HICH		
Parameter	**TTI 10 ms**	**TTI 2 ms**
DL RLC SDU size (bits)	2936	
UL RLC SDU size (bits)	2936	5872
RLC PDU size:	112	
Max number retransmission	15	
Happy bit Delay (ms)	10	2

Table 39: Call setup parameters for E-HICH

Table 40 summarizes all E-HICH tests.

10.2.1 − Test requirements for E-HICH detection								
Test TTI	**Test number**	**Propagation conditions**	**E-HICH E_c/I_{or} dB**	**E-HICH pattern**	**Probability**	**$\hat{I}_{or}/I_{oc}$ dB**	**I_{oc} dBm / 3.84 MHz**	**Phase reference**
10 ms	1	VA30	−35.0	100 % ACK	**Missed ACK: 0.01**	0.6	−60	P-CPICH
	2		N/A	100 % DTX	**False ACK: 0.5**			
10 ms Type 1	1		−38.2	100 % ACK	**Missed ACK: 0.01**			
2 ms	1		−28.2	100 % ACK	**Missed ACK: 0.01**			
	2		N/A	100 % DTX	**False ACK: 0.5**			
2 ms Type 1	1		−31.6	100 % ACK	**Missed ACK: 0.01**			

Table 40: 10.2.1 − Test requirements for E-HICH detection

Fig. 58 shows the entry for the general settings in the test report; Fig. 59 shows the entry for the E-HICH measurement. The set test is indicated in the first line. The second line shows the actual measurement with the number of valid patterns.

Band I, RF Channel 10562, UL target Power: 0.0 dBm, CMU Attenuation (Out/In): 0.0 / 0.0 dB, SMU Attenuation: 0.0 dB
Ioc: -60.0 dBm, Ior/Ioc: 0.6 dB, SMU 2nd path delay: 1.20 µs, Fading profile: G3UEVA30, Speed: 30.00 km/h
E-HICH level: -35.0 dBm, E-HICH signalling pattern: AACK

Fig. 58: Settings report, section 10

10.2.1.1. E-HICH, 10 ms, falseACK

False E-HICH ratio: *1640* | 50.00 % | 9.67 % | ✔

Fig. 59: Report: 10.2.1

2.6.2 Detection of E-RGCH – Single Link (10.3.1)

The receiver characteristics of the E-DCH relative grant channel (E-RGCH) are tested here using the following two tests:

- The base station transmits via the E-RGCH at 50 % UP and at 50 % DOWN -> UP/DOWN signals not understood by the UE (*missed UP/DOWN*) are counted
- The base station transmits via the E-RGCH at 100 % HOLD -> The HOLD signals incorrectly understood by the UE (*missed HOLD*) are counted

Both tests are performed for TTI = 10 ms as well as TTI = 2 ms. The *missed UP/DOWN* test is also specified for RX diversity.

The following parameters must already be set in the call setup:

<table>
<tr><th colspan="3">Call setup parameters for E-RGCH</th></tr>
<tr><th>Parameter</th><th>TTI 10 ms</th><th>TTI 2 ms</th></tr>
<tr><td>DL RLC SDU size (bits)</td><td colspan="2">2936</td></tr>
<tr><td>UL RLC SDU size (bits)</td><td>2936</td><td>5872</td></tr>
<tr><td>RLC PDU size:</td><td colspan="2">112</td></tr>
<tr><td>Max number retransmission</td><td colspan="2">0</td></tr>
<tr><td>Happy bit Delay (ms)</td><td>10</td><td>2</td></tr>
</table>

Table 41: Call setup parameters for E-RGCH

Table 42 summarizes the tests for E-RGCH.

Test requirements for E-RGCH detection								
Test TTI	**Test number**	**Propagation conditions**	**E-RGCH** E_c/I_{or} **dB**	**E-RGCH pattern**	**Probability**	$\hat{I}_{or}/I_{oc}$ **dB**	I_{oc} **dBm / 3.84 MHz**	**Phase reference**
10 ms	1	VA30	−30.9	50% UP 50% DOWN	**Missed Up / Down: 0.05 / 0.05**	0.6	−60	P-CPICH
	2		N/A	100 % HOLD	**Missed HOLD: 0.1**			
10 ms Type 1	1		−34.9	50% UP 50% DOWN	**Missed Up / Down: 0.05 / 0.05**			
2 ms	1		−24.3	50% UP 50% DOWN	**Missed Up / Down: 0.05 / 0.05**			
	2		N/A	100 % HOLD	**Missed HOLD: 0.1**			
2 ms Type 1	1		−28.4	100 % HOLD	**Missed HOLD: 0.1**			

Table 42: Test requirements for E-RGCH detection

Fig. 60 shows the entry for the E-RGCH measurement in the test report. The set test is indicated in the first line. The second and third lines show the measurement and the number of valid patterns.

10.3.1.1. E-RGCH, 10 ms, missed UP/ DOWN

Missed E-RGCH ratio: *valid UP: 820*	5.00 %	0.97 %	✔
Missed E-RGCH ratio: *valid DOWN: 820*	5.00 %	4.04 %	✔

Fig. 60: Report: 10.3.1

2.6.3 Detection of E-AGCH − Single Link (10.4.1)

The receiver characteristics of the E-DCH absolute grant channel (E-AGCH) are tested here. The base station alternately signals three absolute grants (AG4, AG8 and AG10). Receive signals incorrectly understood by the UE (*missed detection*) are counted. This test is designed for TTI = 10 ms and is also specified for RX diversity.

The following parameters must already be set in the call setup:

Call setup parameters for E-AGCH	
Parameter	**TTI 10 ms**
DL RLC SDU size (bits)	2936
UL RLC SDU size (bits)	8808
RLC PDU size:	336
Max number retransmission	0
Happy bit Delay (ms)	10

Table 43: Call setup parameters for E-AGCH

Table 44 summarizes the tests for E-AGCH.

10.4.1 – Test requirements for E-AGCH detection							
Test TTI	**Test number**	**Propagation conditions**	**E-AGCH E_c/I_{or} dB**	**Probability**	**$\hat{I}_{or}/I_{oc}$ dB**	**I_{oc} dBm / 3.84 MHz**	**Phase reference**
10 ms	1	VA30	−23.1	**Missed: 0.01**	0.6	−60	P-CPICH
10 ms Type 1	1		−26.7	**Missed: 0.01**			

Table 44: 10.4.1 – Test requirements for E-AGCH detection

Fig. 61 shows the entry for the E-AGCH measurement in the test report. The set test is indicated in the first line. The second line shows the actual measurement and the number of valid patterns.

10.4.1. E-AGCH, 10 ms

Missed E-AGCH Detection Ratio: *1640* | **1.00 %** | **0.19 %** | ✔

Fig. 61: Report: 10.4.1

3 Appendix

3.1 CMUgo

To install CMUgo, unpack the Setup_CMUgo_Vxxx.zip file (e.g. Setup_CMUgo_V198.zip) and start Setup.exe.

For a detailed description of CMUgo installation and operation, please refer to [2].

3.2 Fading

3.2.1 I/Q Fading

Instead of using RF faders, the CMU and SMU from Rohde & Schwarz benefit from fading in the baseband, for the following reasons:

- 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 path loss compensation is provided inside the SMU. No external measurements are necessary

  The most critical parameters for the receiver measurements are the absolute signal power Îor and the Îor/Ioc (signal to Gaussian noise) ratio. With an external channel simulator, you have to measure both signals and adjust the levels precisely. Using baseband techniques, the Îor/Ioc ratio is automatically set correctly inside the SMU, and the absolute power can be adjusted on the CMU and SMU without any additional measurement required. Because the Îor/Ioc ratio is adjusted in the baseband, no extra compensations are needed if the RF channel changes.

3.2.2 Insertion Loss (Automatic path loss compensation of SMU)

Using the CMUgo test items you do not need any extra measurements to compensate the path losses:

In the I/Q 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 further reduces the I/Q level.
- 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 further reduce the levels. This attenuation is referred to as insertion loss.

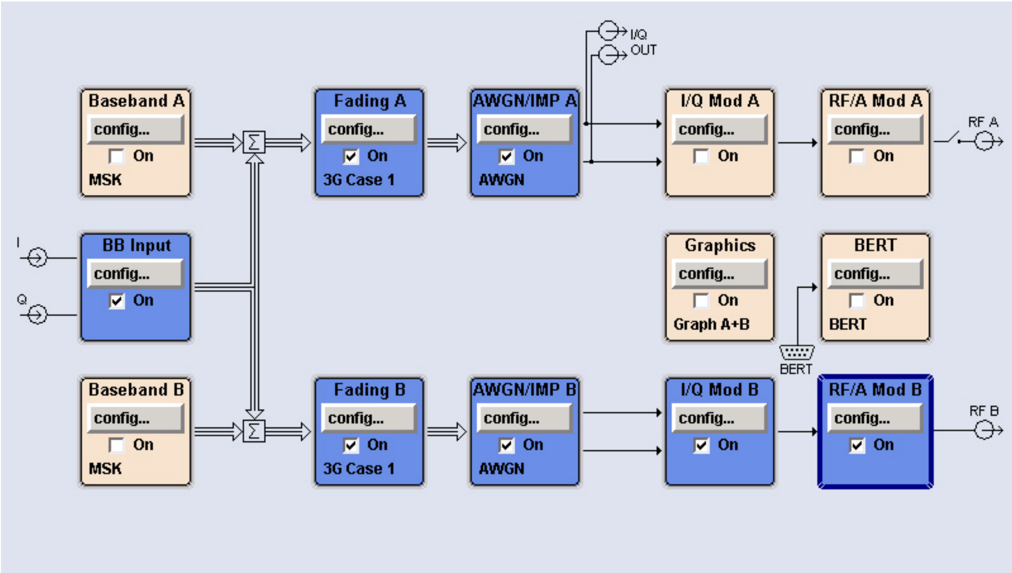


Fig. 62: Functional signal processing inside the SMU

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

CMU path (A):

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 I/Q 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 I/Q output is automatically compensated in the CMU I/Q input stage.

SMU path (B):

The baseband levels are measured if the *SMU Baseband Calibration* checkbox in the CMUgo test items is activated (see) during the test run.
Knowing the I/Q 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.

3.3 Measurement: Delay Diversity

In the RX diversity tests, different paths (SMU and CMU hardware) with different characteristics are used. This results in different delays in the paths. To perform correct measurements, these delays must be made equal. For this purpose, the delays in the SMU path can be set in CMUgo. As the delay depends on the hardware the measurement only has to be done once per instrument.
The delay differences can be measured using an FSQ. The FSQ is externally triggered on the frame trigger of the CMU (connector AUX3, pin 2). The FSQ can now determine the delay of the signal for this frame trigger. The delays are measured once with the SMU and once with the CMU. The difference between the two measured values yields the sought delay value.

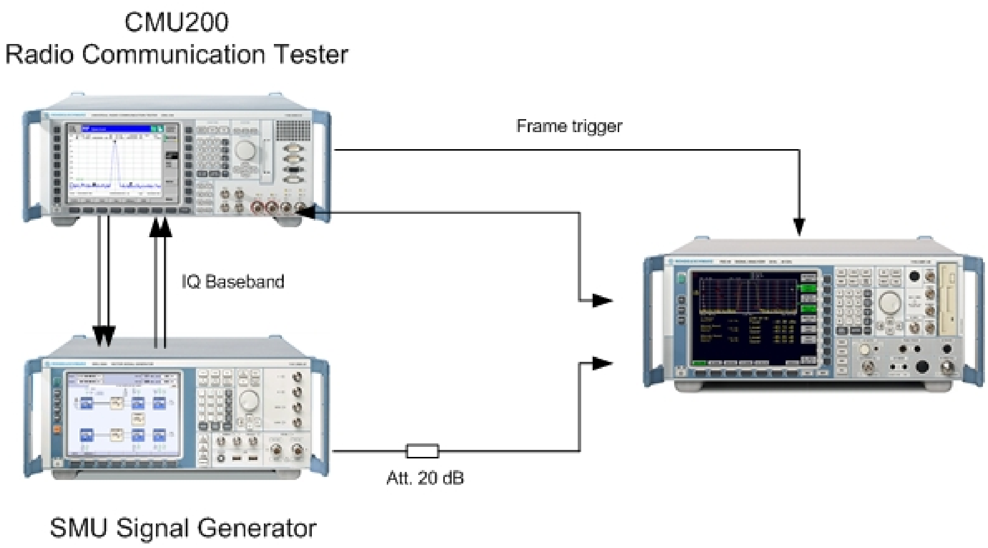


Fig. 63: Setup path delay

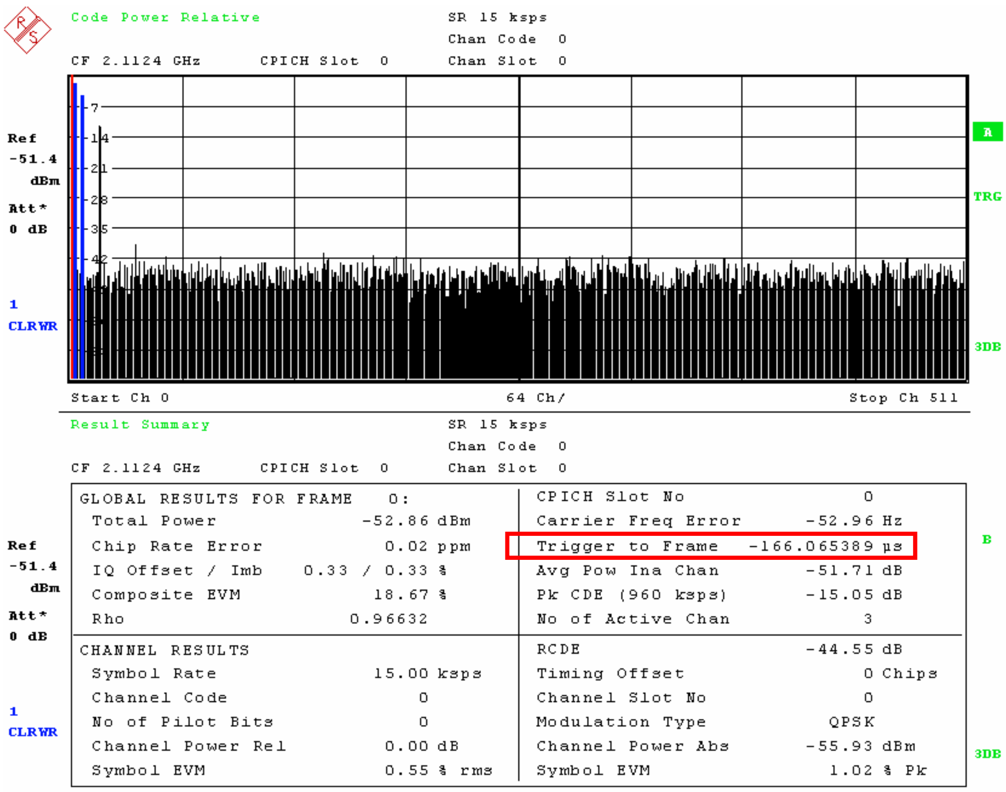


Fig. 64: FSQ: Trigger to frame

3.4 List of Figures

3.5 List of Tables

3.6 Abbreviations

3GPP	3rd Generation Partnership Project
ACK	Acknowledgement
ACLR	Adjacent Channel Leakage Ratio
ARQ	Automatic Repeat Request
BCCH	Broadcast Control Channel
BCH	Broadcast Channel
CCPCH	Common Control Physical Channel
CQI	Channel Quality Indicator
CRC	Cyclic Redundancy Check
DCCH	Dedicated Control Channel
DL	Downlink
DL-SCH	Downlink Shared Channel
DRX	Discontinuous Reception
DTCH	Dedicated Traffic Channel
DTX	Discontinuous Transmission
FDD	Frequency Division Duplex
FFT	Fast Fourier Transform
HARQ	Hybrid Automatic Repeat Request
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
MAC	Medium Access Control
NACK	Negative Acknowledgement
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
PDCCH	Physical Downlink Control Channel
PCCH	Paging Control Channel
PCH	Paging Channel
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
PDSCH	Physical Downlink Shared Channel
PDU	Protocol Data Unit
PS	Packet Switched
PUCCH	Physical Uplink Control Channel
PUSCH	Physical Uplink Shared Channel
RACH	Random Access Channel
RAN	Radio Access Network
RAT	Radio Access Technology
RB	Radio Bearer
RF	Radio Frequency
TDD	Time Division Duplex
TTI	Transmission Time Interval
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunications System
WCDMA	Wideband Code Division Multiple Access

3.7 References

[1] Technical Specification Group Radio Access Network; User Equipment (UE) conformance specification; **3GPP TS 34.121-1 V 8.3.0**, June 2008

[2] Rohde & Schwarz; Manual **Windows Application CMUgo**, April 2006

[3] Rohde & Schwarz; Application Note: **Fading Path Compensation for Mobile Station Tests with R&S©CMU200 and R&S©SMU200A**, 1MA135, October 2008

3.8 Additional Information

Please send your comments and suggestions regarding this application note to

TM-Applications@rohde-schwarz.com

Visit the CMUgo website at

http://www2.rohde-schwarz.com/en/products/test_and_measurement/product_categories/mobile_radio/CMU200-|-Software-|-24-|-2674.html

or as a registered user in GLORIS the CMU Customer Web at

https://extranet.rohde-schwarz.com/

4 Ordering Information

For additional information see the Rohde & Schwarz website www.rohde-schwarz.com or contact your local representative.

Ordering Information		
Radio Communication Tester		
CMU200		**1100.0008.02**
CMU-B17	IQ/IF analogue interface	1100.6906.02
CMU-B21	Univ Signaling unit	1100.5200.54
CMU-B56	HW option: 3GPP Signalling Module	1150.1850.54
CMU-B68	HW-option: layer 1-board	1149.9809.02
CMU-Kxx Bands 1…12 available	SW option: WCDMA-Sig.	
CMU-K64	SW option: HSDPA 3.6 Mb/s	1157.3970.02
CMU-K60	SW option: HSDPA 14 Mb/s	1200.8200.02
CMU-K56	SW option: HSUPA 5.7 Mb/s	1200.7803.02
Vector Signal Generator		
SMU200A		**1141.2005.02**
SMU-B13	Baseband Main Module	1141.8003.04
SMU-B14	Fading Simulator	1160.1800.02
SMU-B15	Fading Simulator extension	1160.2288.02
SMU-B17	Analog baseband input	1142.2880.02
SMU-K62	AWGN	1159.8511.02
Signal Generators		
SMR	**Up to 20, 27, 30, 40, 50 or 60 GHz**	**1104.0002.xx**
Signal Analyzers, Spectrum Analyzers		
FSQ	**Up to 3, 8, 26, 31 or 40 GHz**	**1155.5001.xx**
FSG	**Up to 8 or 13 GHz**	**1309.0002.xx**
FSP	**Up to 3, 7, 13, 30 or 40 GHz**	**1093.4495.xx**
FSV	**Up to 3 or 7 GHz**	**1307.9002.0x**

Note: Not all options are described in detail. The use of the SMATE Vector Generator is also possible.
Please contact your local Rohde & Schwarz sales office for further assistance.

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