# PESQ® Measurement for WCDMA with R&S®CMUgo

## Application Note

**Products:**

- R&S®SMU200A
- R&S®AMU200A
- R&S®CMU200
- R&S®UPV

Recent mobile test methods could not evaluate the quality of data reduced speech signals with different coded and decoded signals. The Perceptual Evaluation of Speech Quality (PESQ) provides the solution for this measuring problem. WCDMA PESQ is an add-on tool for CMUgo for automatic measurement of the PESQ for WCDMA mobile phones according to recommendation ITU-T P.862.1 and P.862.2 featuring selectable fading profiles and variable Additional White Gaussian Noise (AWGN).



ROHDE&SCHWARZ

Application Note

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# 1 Overview

Recent mobile test methods could not evaluate the quality of data reduced speech signals with different coded and decoded signals. The Perceptual Evaluation of Speech Quality (PESQ) provides the solution for this measuring problem. WCDMA PESQ is an add-on tool for CMUgo for automatic measurement of the PESQ for WCDMA mobile phones according to recommendation ITU-T P.862 featuring selectable fading profiles and variable Additional White Gaussian Noise (AWGN). It features selectable fading profiles for up to 40 paths and variable Additional White Gaussian Noise (AWGN) for realistic receiving.

The following abbreviations are used in the following text for R&S® test equipment:

- The R&S® CMU200 Universal Radio Communication Tester is referred to as CMU.
- The R&S® SMU200A Vector Signal Generator is referred to as SMU.
- The R&S® AMU200A Baseband Signal Generator and Fading Simulator is referred to as AMU.
- The R&S® UPV Audio Analyzer is referred to as UPV.
- R&S® refers to Rohde & Schwarz GmbH und Co KG

# 2 Introduction to PESQ

The “Perceptual Evaluation of Speech Quality” (PESQ) measurement method, which was published by the International Telecommunications Union in 2001 as recommendation ITU-T P.862, enables measurements to be made on speech signals that are transmitted at low bit rates using high compression psychoacoustic coding methods. PESQ employs an algorithm that enables these signals to be evaluated by comparing them with reference signals. The R&S UPV supports this measuring method, with the software licensed by Opticom GmbH in Erlangen (Germany).
A common feature of all psychoacoustic coding methods is that they utilize the properties of human hearing to clip the transmitted signal so that the portions of the signal that would in any case not be perceived are removed from the signal. Speech can be compressed more easily as other types of signals, since it occupies considerably less band-width. When speech compression is used, it is necessary to be able to determine objectively, with the aid of psychoacoustic measuring methods, whether the speech transmission technique produces unacceptable degrading of the perceiving speech quality.
PESQ was developed using a large number of recordings containing sentences spoken by a variety of speakers in a variety of languages. The recordings were made using several different speech encoders with different levels of quality and with typical network transmission disturbances. In a series of listening tests, an adequate number of test listeners classified these examples on a speech quality scale ranging from 1 (bad) to 5 (excellent).

The goal in the development of PESQ was a method for determining an objective measurement that correlates very well with the listening test results, based on comparing the original, non-degraded speech signal (the reference signal) with the degraded signal (the measured signal). To perform a PESQ measurement, the reference signal must be connected to the input of the system under test and the measurement signal must be taken from the output of the system under test (see Fig. 1).

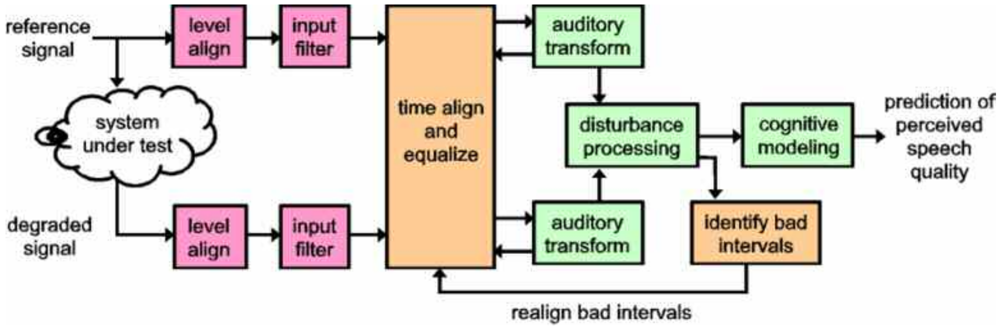


**Fig. 1 Algorithm of PESQ Measurement in UPV**

In Fig. 2 the R&S instruments involved in the PESQ measurement setup for a downlink and their function is shown. The UPV provides the reference audio speech signal, the CMU modulates the baseband signal to RF which has been interfered by the SMU / AMU with fading and AWGN. The mobile phone demodulates the RF signal and supplies the degraded audio signal (system under test). The UPV performs the PESQ measurement which determines the speech quality of the mobile phone receiver.

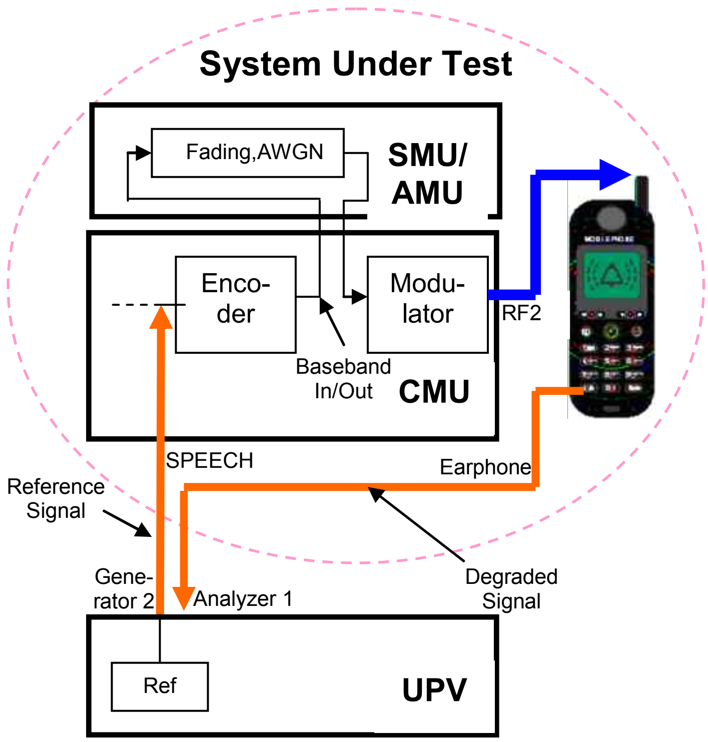


**Fig. 2 PESQ Measurement with R&S Instruments**

The setup for an uplink measurement is similar, but reversed. The reference signal is provided from the UPV into the mobile phone's microphone input. The mobile modulates the baseband signal to RF. The CMU demodulates the RF signal and supplies the audio signal to the UPV for the PESQ measurement.

## 2.1 PESQ Value and MOS Value

Over the course of time, the ITU has developed several different methods for calculating objective measurements from the average values of the listening test results. This calculation is performed by using a mapping function such as the example shown below.

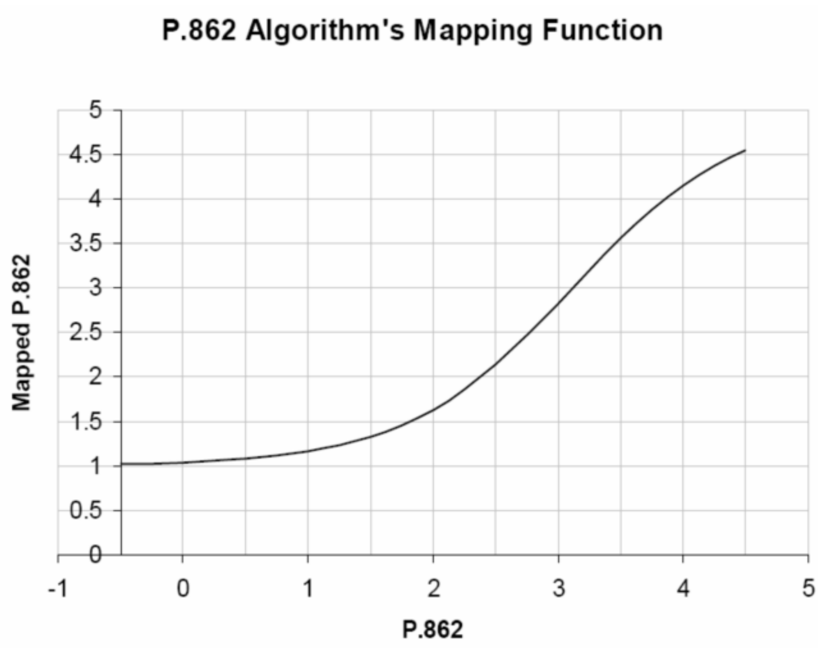


**Fig. 3 P.862 Algorithm's Mapping Function**

The average values from the listening tests are plotted on the Y axis, and the associated PESQ values in accordance with ITU P862.1 are shown on the X axis. This constraint will help ensure that MOS-LQO scores will be comparable for all implementations of ITU P.862.

The R&S UPV implements the three most important standards which differ only slightly from each other and have been approved by the ITU:

- ITU P.862: The measured value is the “PESQ Score” or the “PESQ MOS” (Mean Opinion Score). The range of values extends from -0.5 (worst) to +4.5 (best). In addition, measurements can be made with reference to the speech component or the silence component of the signal. The latter is particularly interesting because it shows how well the codec replaces background noise.
- ITU P.862.1: The measured value is the “MOS-LQON” (listening quality objective narrowband). The range of values extends from–0.5 (worst) to +4.5 (best). The following chapters describe the manual and automatic measurement with the included CMUgo test item WCDMAPesq.dll based on this measurement standard.


**Fig. 4 UPV PESQ Version**

- ITU P.862.2: This is the wideband extension of P.862. The measured value is the “MOS-LQOW” (listening quality objective wideband). The range of values extends from–0.5 (worst) to +4.5 (best). Note that measurements obtained using this option cannot be compared with results obtained in accordance with P.862 or P.862.1.

In Addition to the overall results, the measurements can be made by calculating PESQ values for the active speech intervals or for the silence intervals of the signal. The latter is of particular interest because it shows how well the codec may substitute background noise.

Note that for wideband PESQ the PESQ score is not used, but only the mapped MOS-LQO. In Order to use common terms in both narrow- and wideband mode, it is strongly recommended to always use the PESQ-LQO, which is mapped either by Recommendation P.862.1 for narrowband or by P.862.2 for wideband speech.

The R&S® UPV audio analyzer uses the short forms "PESQ" for PESQ and "MOS" for MOS-LQO.

# 3 PESQ Measurement According to ITU P.862.1

## 3.1 Hardware Configuration

For manual and automatic PESQ (MOS LQO) measurement of the uplink or downlink signal featuring fading and AWGN the hardware (R&S®CMU, R&S®SMU or R&S®AMU, and R&S®UPV) must be configured as follows:

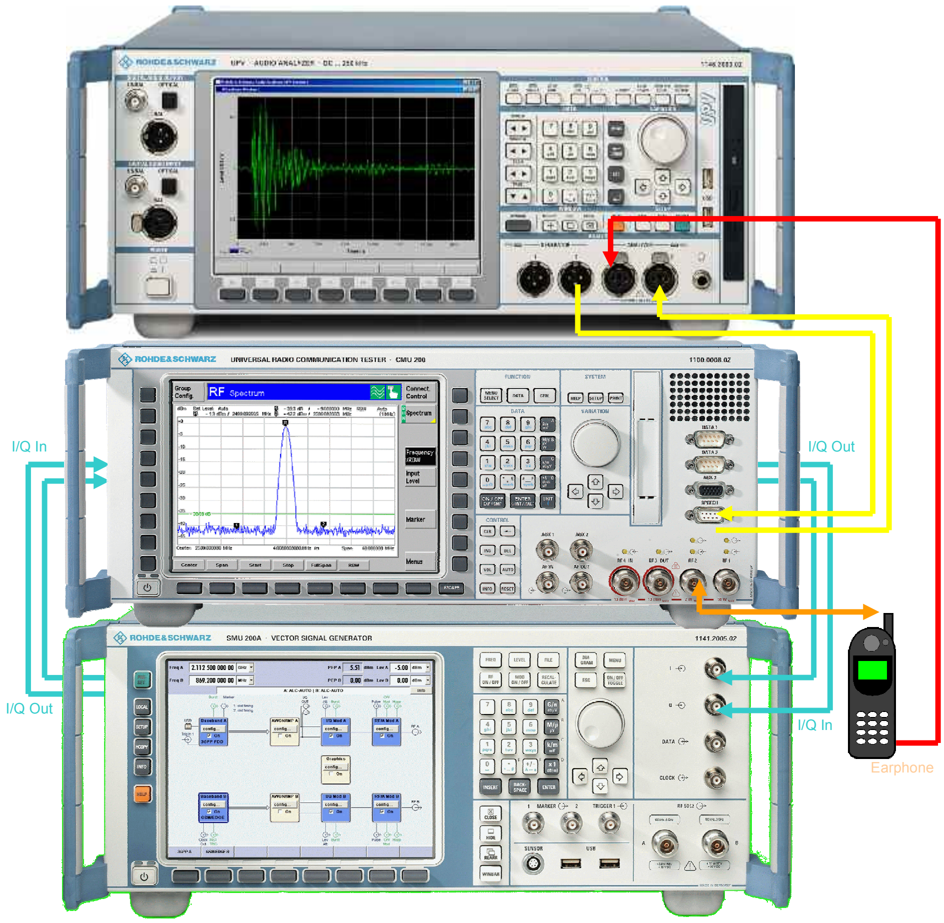


**Fig. 5 Hardware Configuration**

CMU I/Q Output (I/Q connector) → SMU / AMU I/Q Input
SMU / AMU I/Q Output → CMU I/Q Input (I/Q connector)
CMU RF2 output ←→ mobile phone RF connector
UPV GENERATOR2 → CMU SPEECH connector input
Mobile earphone output → UPV ANALYZER1 input

CMU SPEECH connector output → UPV ANALZER2 input

A mobile phone can be connected to the UPV either with an acoustic coupler or by cutting off the earphone of a regular headset and reconnecting it to an XLR male plug.

**Software Requirement**

The UPV requires option UPV-K61 PESQ measurements. PESQ measurements require the **CMU-B85** coder and decoder to be calibrated first by the UPV (See pages 13 and 14 for details). The macros **DECODER.EXE** and **ENCODER_PESQ.EXE** must be installed with the included file **CMUCAL_PESQ.MSI** which needs to be copied to the UPV via USB Stick or LAN and executed on the UPV. In order to run the macros the Universal Sequence Controller option **UPV-K1** needs to be installed on the UPV. In order to run CMUgo the Remote Control option **UPV-K4** needs to be installed on the UPV.

## 3.2 Flowchart of the PESQ Measurement

The following flowchart shows the necessary steps to perform a PESQ measurement for WCDMA.

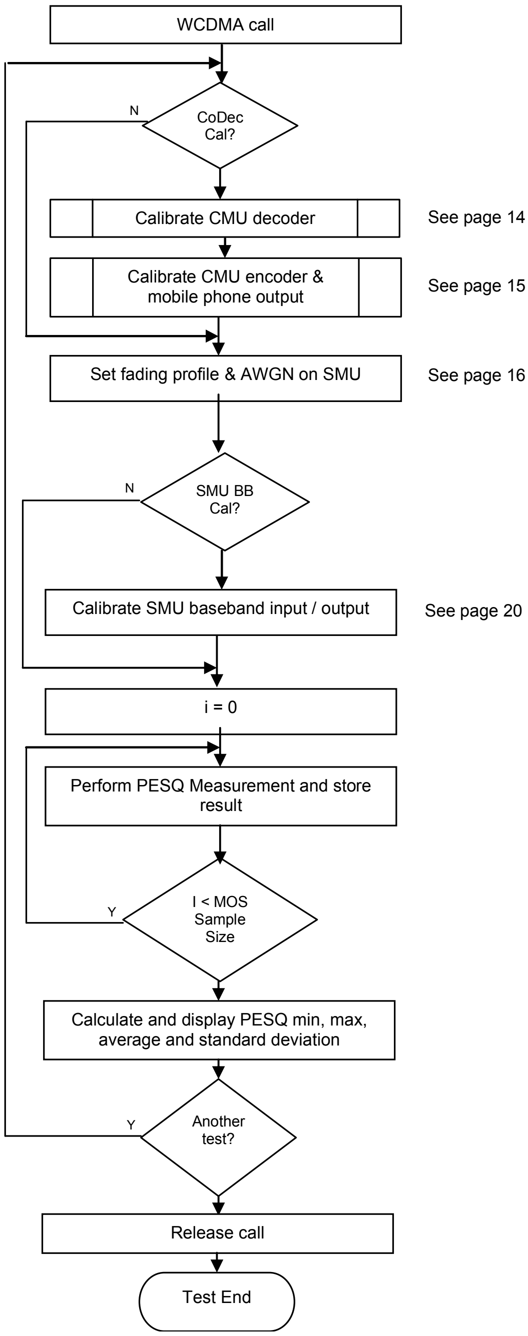


**Fig. 6 WCDMA PESQ Measurement**

## 3.3 Manual PESQ Measurement

The following section shows in detail the necessary steps to perform a PESQ measurement manually. In order to ensure repeatability of measurement results it is recommended to preset all instruments involved (CMU, SMU / AMU, UPV).

### 3.3.1 WCDMA Call Setup

First establish a WCDMA call.

1. Set the desired call parameters on the CMU, e.g. WCDMA RF channel and power.

2. Register and establish the call

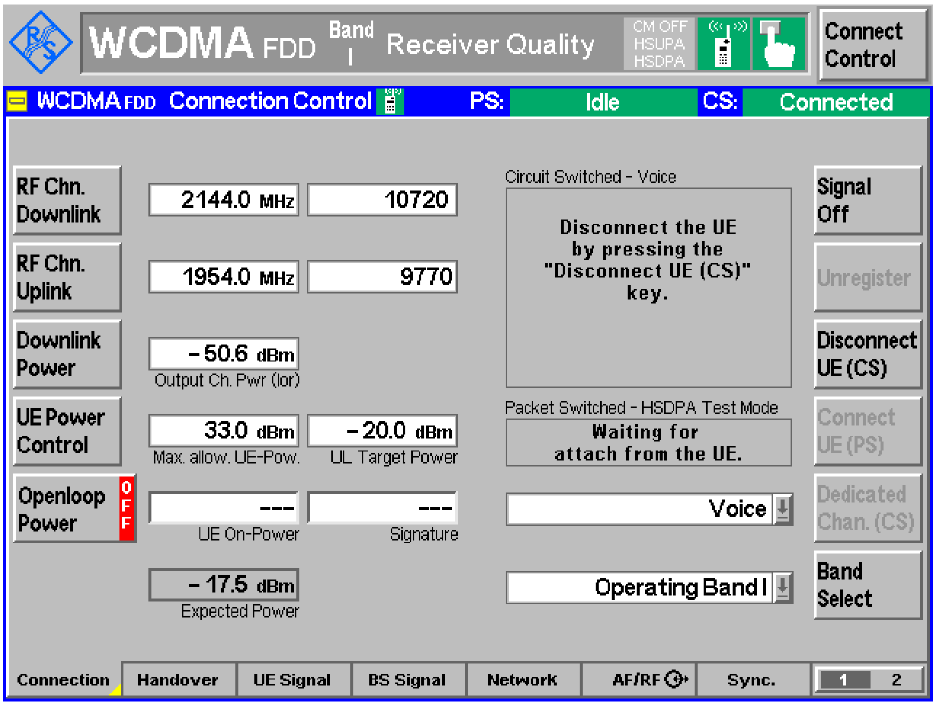


Fig. 7 WCDMA Call Setup

### 3.3.2 WCDMA PESQ Measurement

1. Turn CMU-B17 TX Path to **Bypass w. I/Q IF OUT**. and RX Path to **Bypass**. This ensures that the call will not be lost if the SMU / AMU is set to a non proper state, e.g. baseband input turned OFF, AWGN level too high etc. The CMU baseband output level must be attenuated by 3 dB to avoid peak distortion at the SMU / AMUU baseband input.

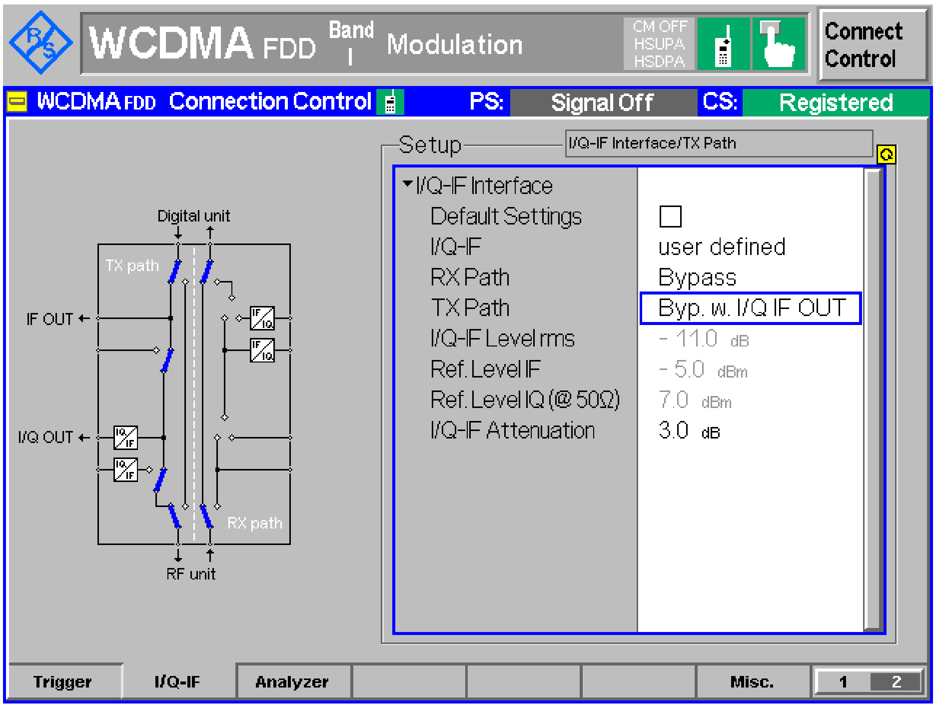


**Fig. 8 CMU-B17 RX/TX Bypass**

```
Remote-control command:
CONF:IQIF:TXP BYIQ      // feed IQ to SMU/AMU BB input
IQIF:ATT 3.0            // I/Q-IF attenuation
```

2. Select RF2 input, RF2 output on CMU. Enter the cable loss to the mobile e.g. 0.7 dB.

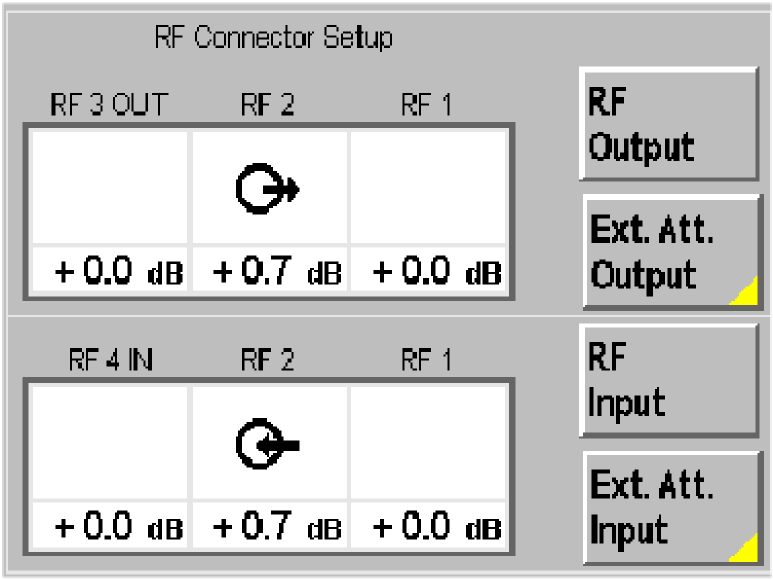


**Fig. 9 CMU RF Connector Setup**

```
Remote-control command:
INP RF2;OUTP RF2
```

3. For the first measurement perform a decoder calibration since it is instrument specific. The decoder output is measured for a digital full-scale signal applied to the speech decoder.

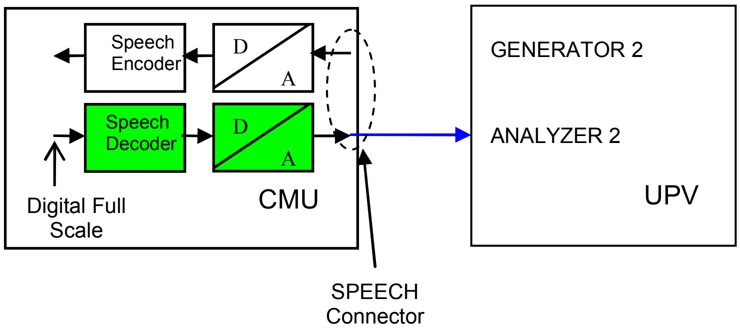


**Fig. 10 Signal Path for Decoder Calibration**

Set Voice Coder to DECODER CAL on the CMU.

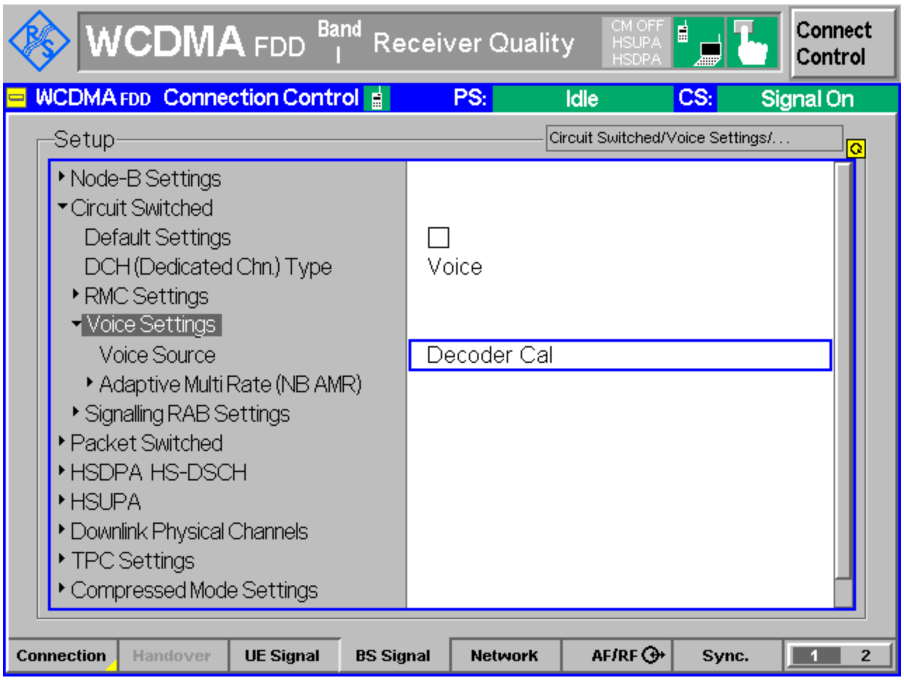


**Fig. 11 Decoder Calibration**

```
Remote-control command:
CONF:BSS:DCH:VOIC:SOUR DCAL
```

Start the decoder calibration on the UPV with the menu **SEQUENCE → EXECUTE MACRO → DECODERCAL.EXE**.

```
Remote-control commands:
SYST:PROG:EXEC 'C:\\Program Files\\
      Rohde&Schwarz\\CMUCal_PESQ\\DecoderCal.exe'
SYST:MEM:STR1?  // Continue when 'OK'
```

4. It is necessary to perform a encoder calibration the first time since it is instrument specific. It measures the encoder input voltage which is required for a digital full-scale signal at the speech encoder.

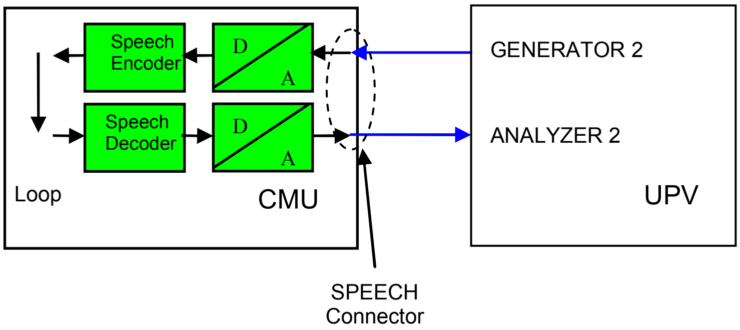


**Fig. 12 Signal Path for Encoder Calibration**

Set the Voice Coder to ENCODER CAL on the CMU.

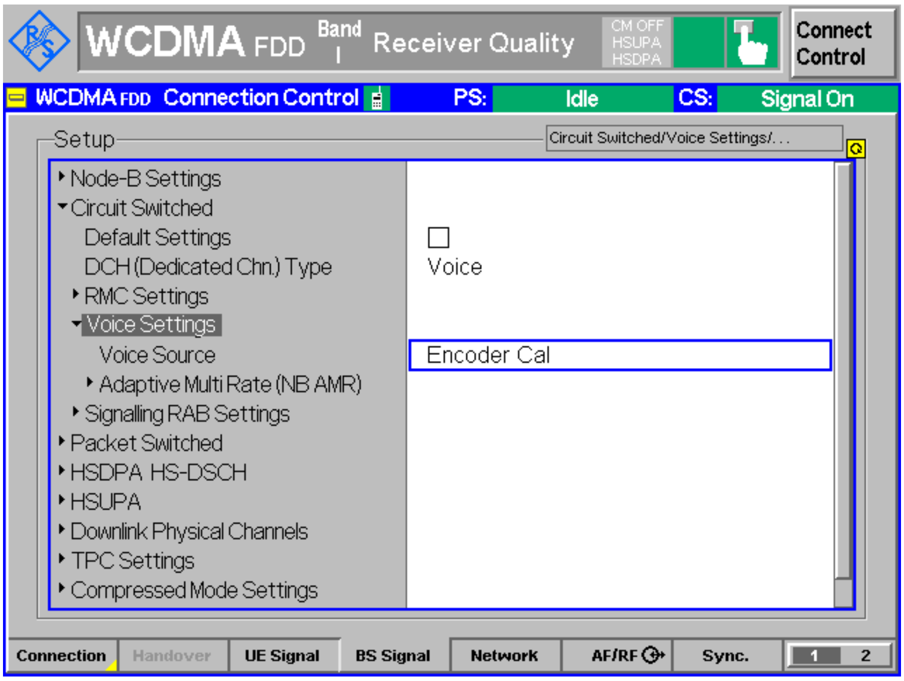


**Fig. 13 Encoder Calibration**

```
Remote-control command:
CONF:BSS:DCH:VOIC:SOUR ECAL
```

Start the encoder calibration on the UPV with the menu **SEQUENCE → EXECUTE MACRO → CMUCAL_PESQ.EXE**.

```
Remote-control commands:
SYST:PROG:EXEC 'C:\\Program Files\\
 Rohde&Schwarz\\CMUCal_PESQ\\EncoderCal_PESQ.exe'
SYST:MEM:STR1?  // Continue when 'OK'
```

5. Route SMU / AMU baseband input to path A or B (if available).

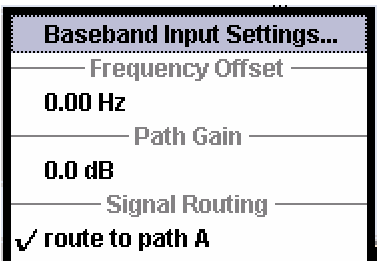


**Fig. 14 SMU / AMU Baseband Input A**

```
Remote-control command:
BBIN:ROUT A
```

6. Route SMU baseband output to path A (if available).

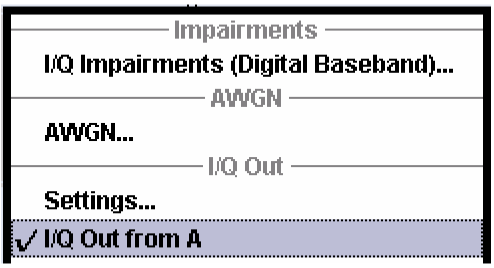


**Fig. 15 SMU / AMU Baseband Output A**

```
Remote-control command:
BB:IQO:SOUR A
```

9. Turn the SMU / AMU fading simulator ON and select a fading profile e.g. **3GPP CASE 1 (UE/BS)**.

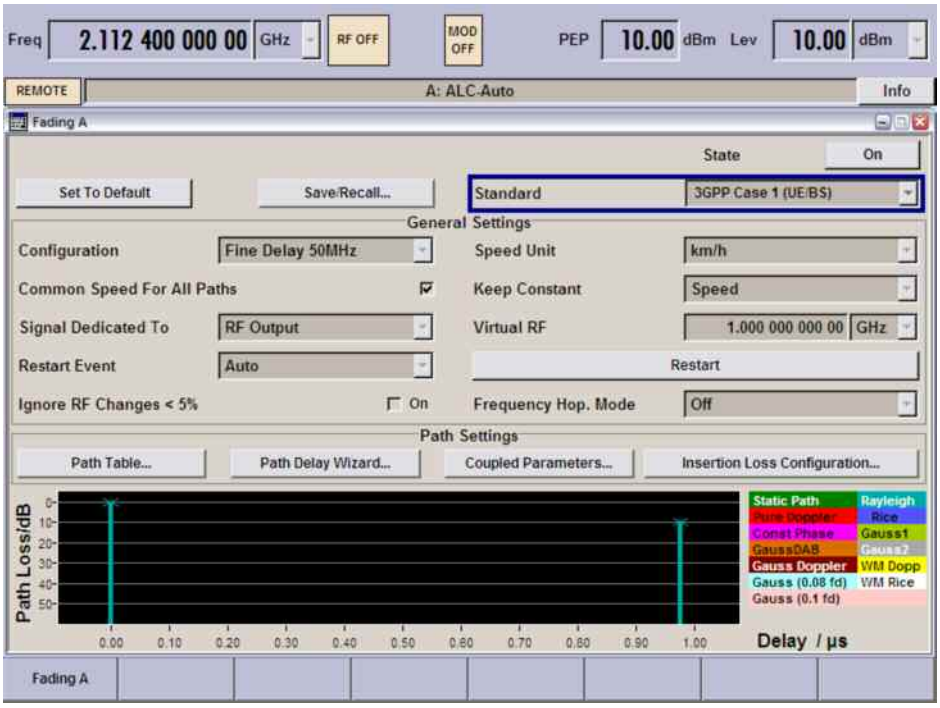


**Fig. 16 Fading Simulator Configuration**

```
Remote-control commands:
FSIM:ILOS:MODE NORM
FSIM ON
FSIM:STAN G3UEC1
```

10. Turn the SMU / AMU AWGN ON and set the parameters as defined in the Recommendation ITU-T P.862.

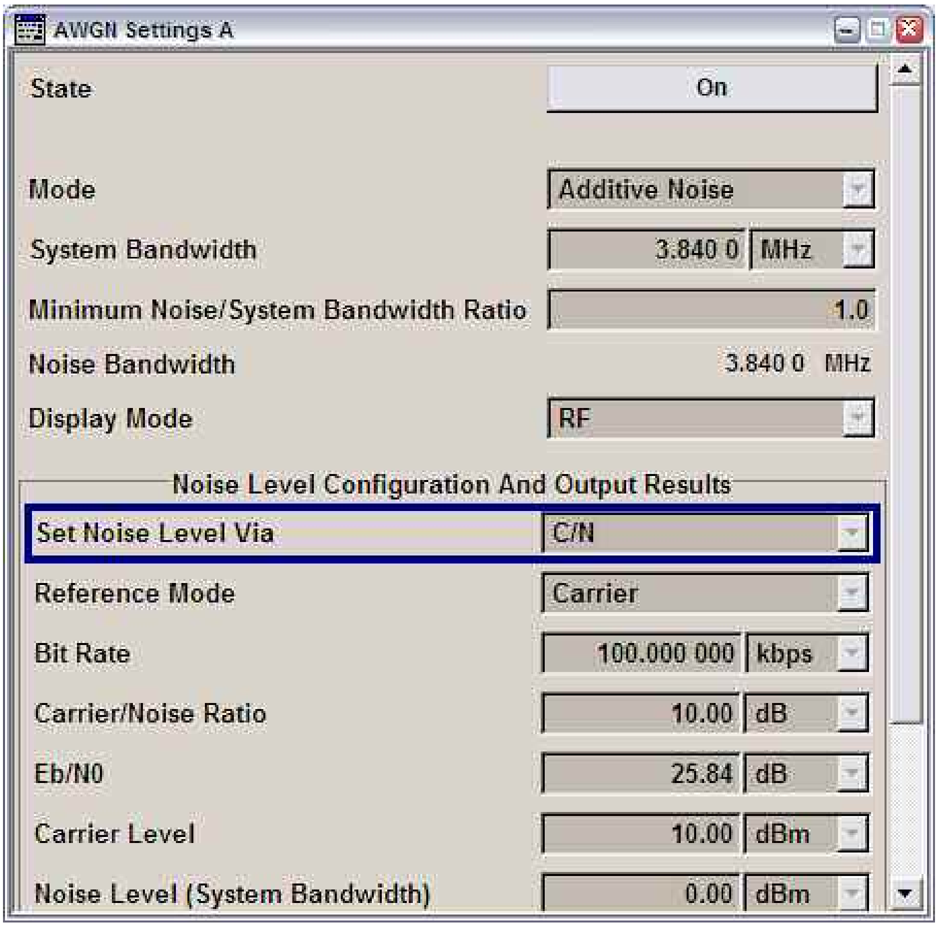


**Fig. 17 AWGN Settings**

```
Remote-control commands:
AWGN:STAT ON
AWGN:BWID 3.84 MHZ
AWGN:BWID:RAT 1
AWGN:POW:MODE CN
AWGN:POW:RMOD CARR
AWGN:POW:CARR -60.0
AWGN:CNR 10.0
```

11. Calculate the SMU / AMU insertion loss by subtracting the base-band output level from the baseband input level. The baseband insertion loss can be compensated with the CMU RF level. If using the AMU, an alternative method is to slightly increase the output level to remove the insertion loss.

12. Turn SMU / AMU baseband input ON.

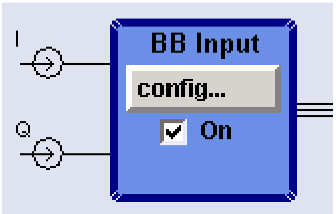


**Fig. 18 SMU / AMU Baseband Input ON**

```
Remote-control command:
SOUR:BBIN:STAT ON
```

13. Perform SMU / AMU Auto Level Set (baseband input calibration) at the beginning of the test sequence. The WCDMA output signal level is specified at 0.5Vp = 0.0 dBfs = +7.0 dBm for 50 Ohm resistance. Tolerances are instrument- and cable-specific.

```
Remote-control command:
BBIN:ALEV:EXEC
```

- SMU / AMU baseband input level → 6.76 dBm

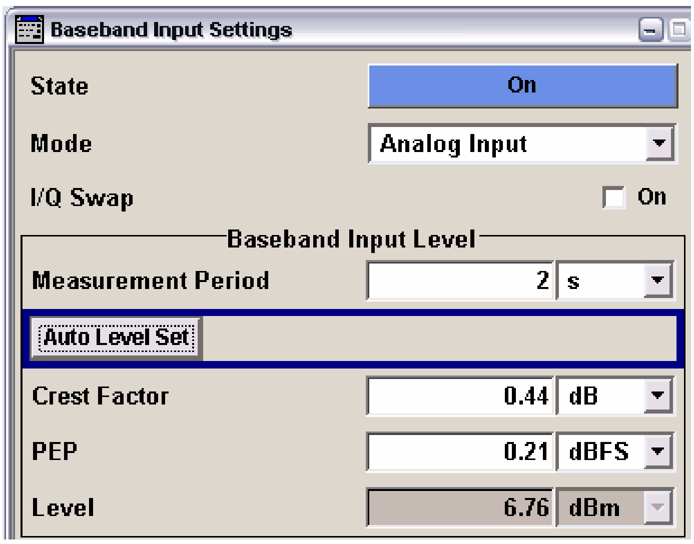


**Fig. 19 SMU / AMU Baseband Input Level**

```
Remote-control command:
BBIN:POW:RMS?
```

- SMU / AMU baseband output level can be found in the I/Q impairments menu → -13.77 dBfs = -6.77 dBm referred to 0.5Vp and 50 Ohms.

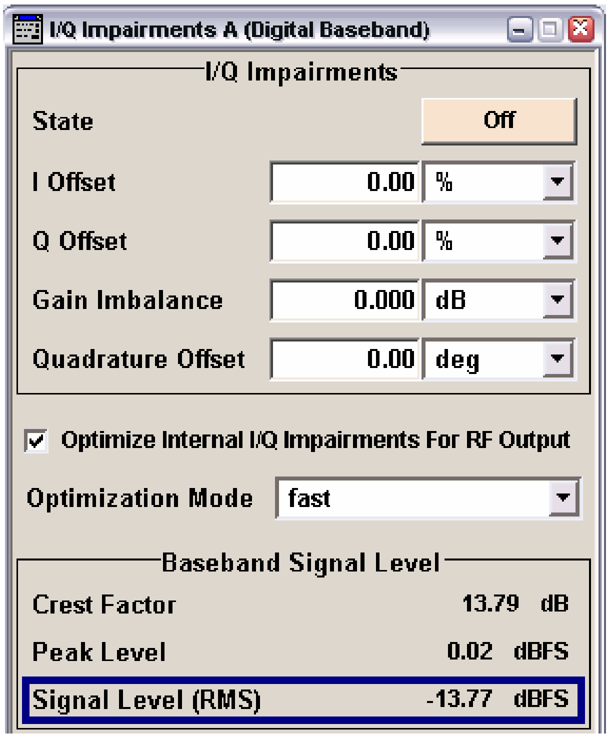


**Fig. 20 SMU / AMU Baseband Output Level**

```
Remote-control command:
BB:POW:RMS?
```

14. Compensate SMU / AMU insertion and cable loss with the CMU RF External Attenuation Output control.
→ SOUR:CORR:LOSS:OUTP2 14.23 (= Cable Loss - Baseband Output Level + Baseband Input Level = 0.7 dB + 6.77 dBm + 6.76 dBm).

15. Enter cable loss for mobile uplink (TX) with CMU RF External Attenuation Input control (e.g. 0.7 dB, see Fig. 9).

```
Remote-control command:
SOUR:CORR:LOSS:INP2 0.7
```

16. Turn CMU-B17 Fading ON to loop the baseband signal from the CMU to the SMU / AMU input.

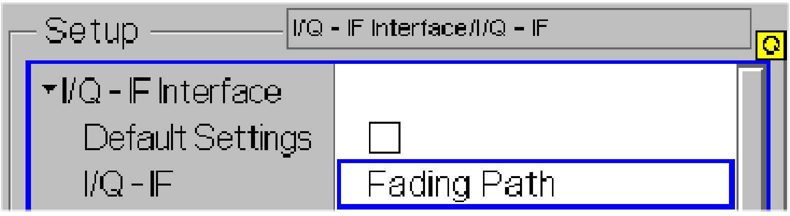


**Fig. 21 CMU Fading Path ON**

```
Remote-control command:
CONF:IQIF:RXTX FPAT
```

17. Perform a PESQ measurement on the UPV (the parameters were already set by the decoder / encoder calibration, p.16).

```
Remote-control commands:
INIT:CONT OFF;*WAI            // Trigger measurement
SENSe:DATA?                   // Read PESQ value
```

The MOS sample count defines how many measurements must be taken so you should keep track of all the results. The actual PESQ value according to Recommendation ITU-T P.862 is the resulting average. It is also convenient to determine the minimum, maximum and standard deviation of a test.

## 3.4 Automatic PESQ Measurement with CMUgo

The R&S software tool CMUgo allows you to generate custom test sequences for the CMU plus one or more additional R&S instruments such as generators, analyzers, power meters, step attenuators. It offers automatic instrument configuration, test and documentation. The test results can be saved in several typical file formats, allowing post-processing with e.g. Excel, MatLAB etc.
CMUgo Installation and Configuration

CMUgo v1.9.8 (or later), the WCDMAPesq measurement DLL and the demo sequence WCDMA PESQ Demo can be downloaded from http://www.rohde-schwarz.com/appnote/1MA137.html. Please install CMUgo first and then unzip the updated DLLs to the CMUgo directory. Before performing the sequence **WCDMA PESQ DEMO.SEQ** define the CMU, SMU / AMU and UPV GPIB addresses in CMUgo first.

1. The CMU address is defined by selecting the menu **CONFIGURATION → REMOTE PORT**. Select the **PRIMARY ADDRESS** (default 20), check the **ACTIVATE** box and press **OK**.

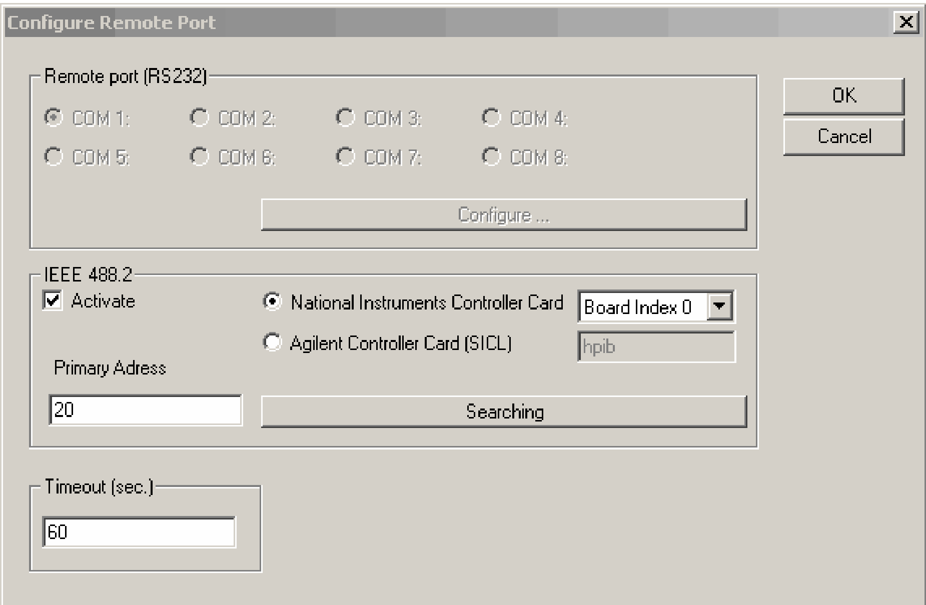


**Fig. 22 CMUgo Configure Remote Port**

2. The SMU / AMU is defined in the menu **CONFIGURATION → AUXILIARY GPIB PORT 1**. Set the **DEVICE NAME** (SMU / AMU), **PRIMARY ADDRESS**, check **ENABLE** Port and press OK.

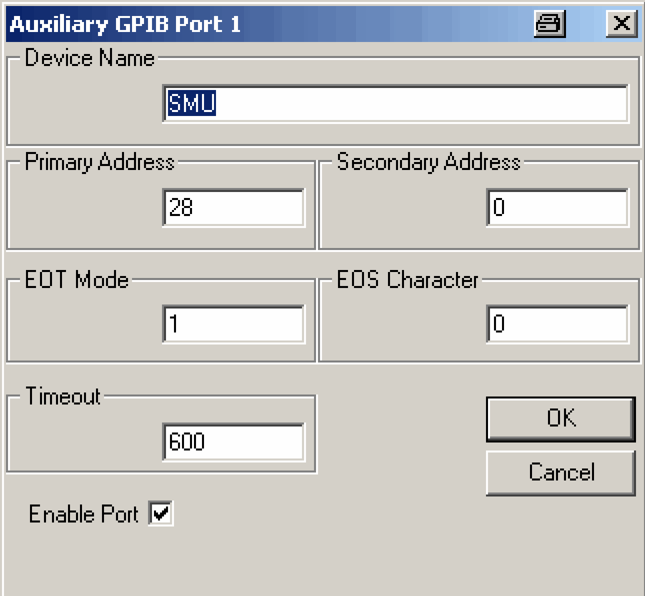


**Fig. 23 Auxiliary GPIB Port 1**

3. The UPV is defined in the menu Configuration → **AUXILIARY GPIB PORT 2**. Set the **DEVICE NAME** (UPV), **PRIMARY ADDRESS**, check **ENABLE PORT** and press **OK**.

For better compatibility with future CMUgo versions we recommend you to check the menu item **OPTIONS → SAVE CONFIGURATION AND REPORT AS XML FILE**.

### 3.4.1 Configuring and Starting the PESQ Measurement Sequence

Load the included measurement sequence with **CONFIGURATION** → **CONFIGURE TESTS** → **LOAD SEQUENCE…** → **WCDMA PESQ DEMO.SEQ**.

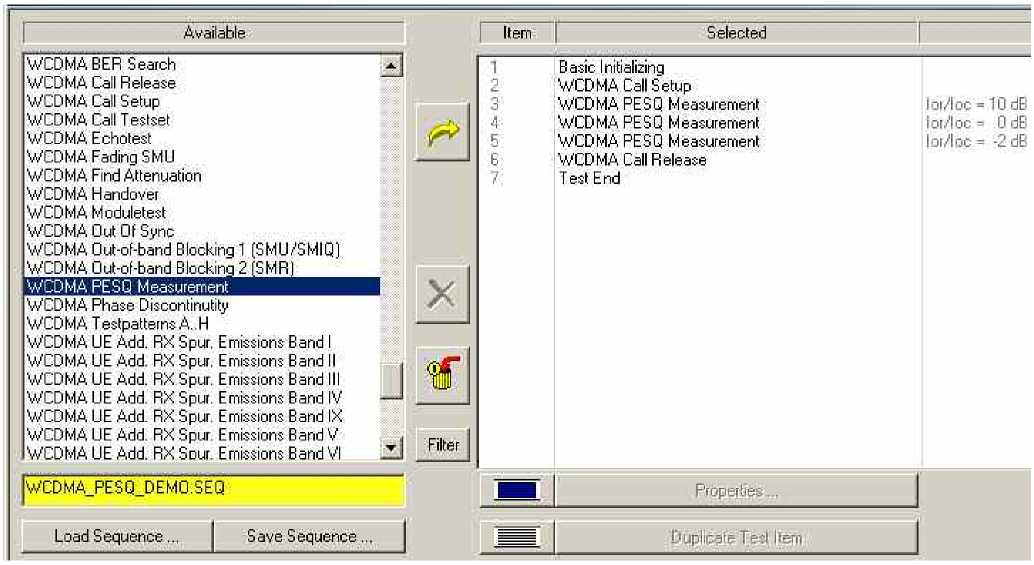


**Fig. 24 CMUgo Sequence**

The sequence consists of following functions

**BASIC INITIALIZING** – This function is necessary to define the required CMU function groups, e.g. WCDMA 1900 FDD (signaling), etc. The CMU groups are controlled via the secondary GPIB address (SAD). Basic Initializing automatically detects or defines according secondary addresses required automatically.

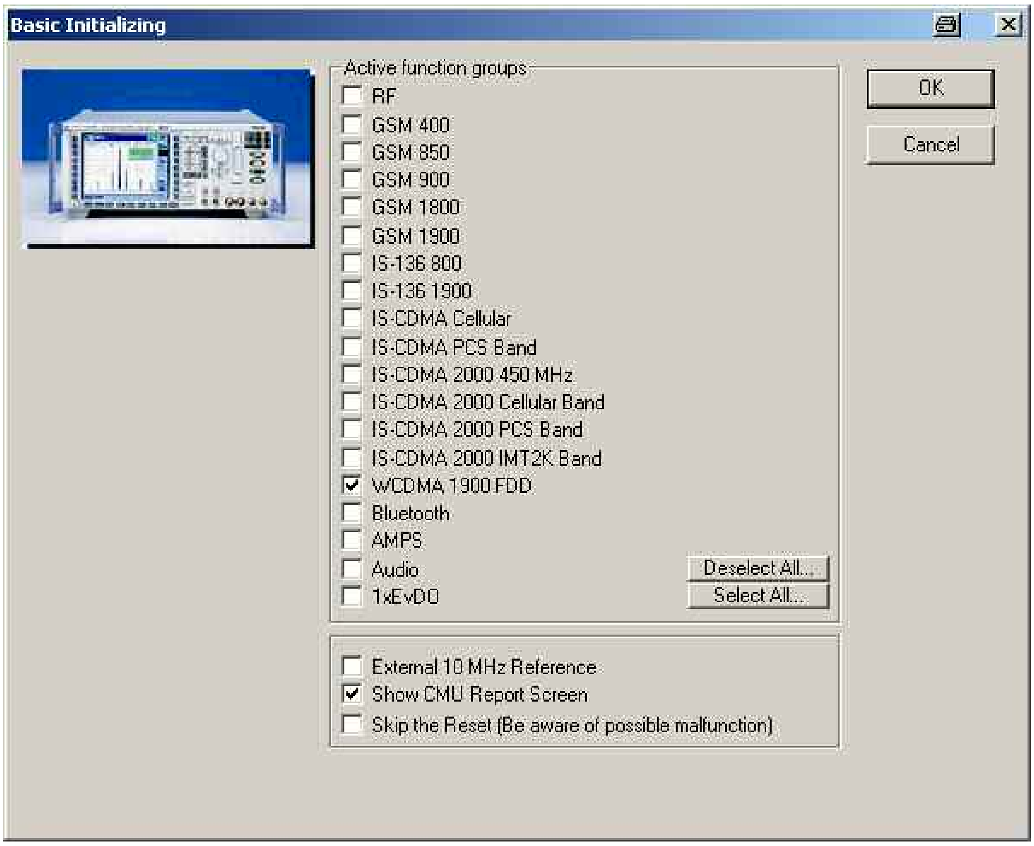


**Fig. 25 Basic Initializing**

**WCDMA CALL SETUP** – This function registers the phone and establishes a call. The example is for a US Cellular (BC0) network, the RF level is set to -50.6 dBm.

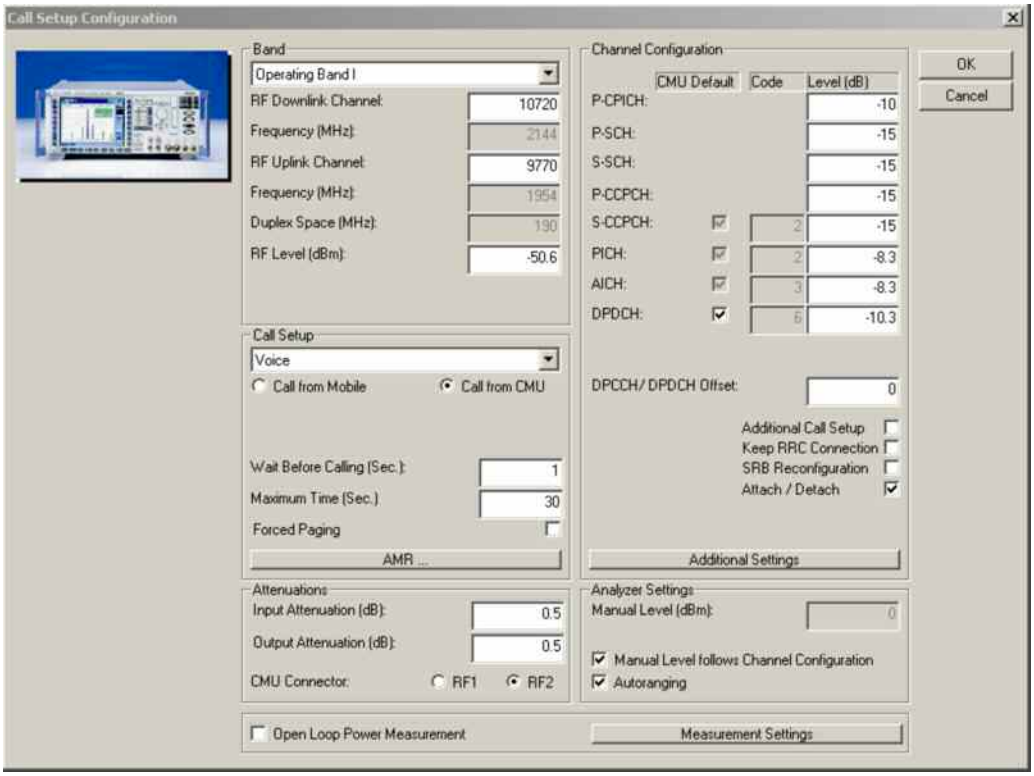


**Fig. 26 WCDMA Call Setup**

Wait one second before calling to make sure the mobile doesn't miss the call. The **CHANNEL Configuration** complies to TS 34.121 WCDMA performance testing. Set the loss of the cable between UE and CMU as Input- and Output Attenuation.

Then set the correct **AMR CONFIGURATION** (**SELECTION H** in our example).

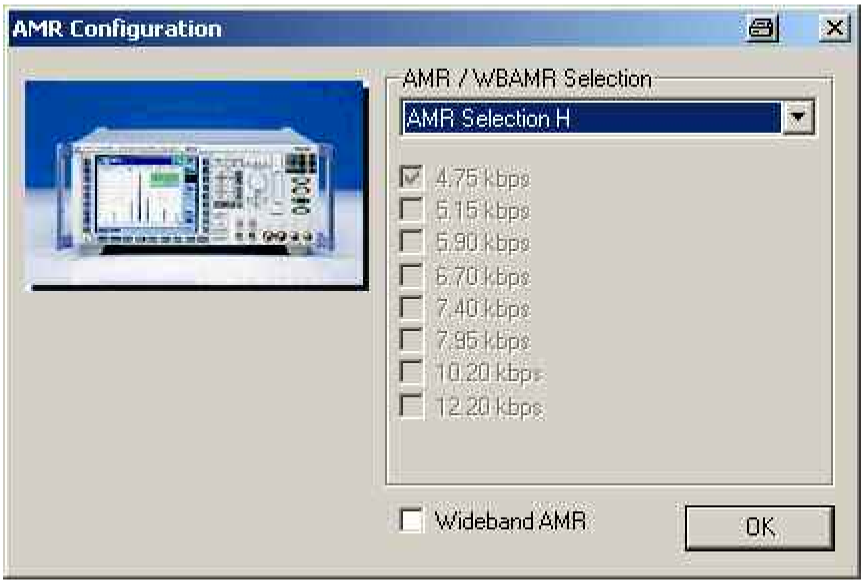


**Fig. 27 AMR Configuration**

**WCDMA PESQ MEASUREMENT** – Sets the SMU / AMU fading profile, AWGN level (Eb/No), compensates the insertion loss and performs a PESQ measurement.

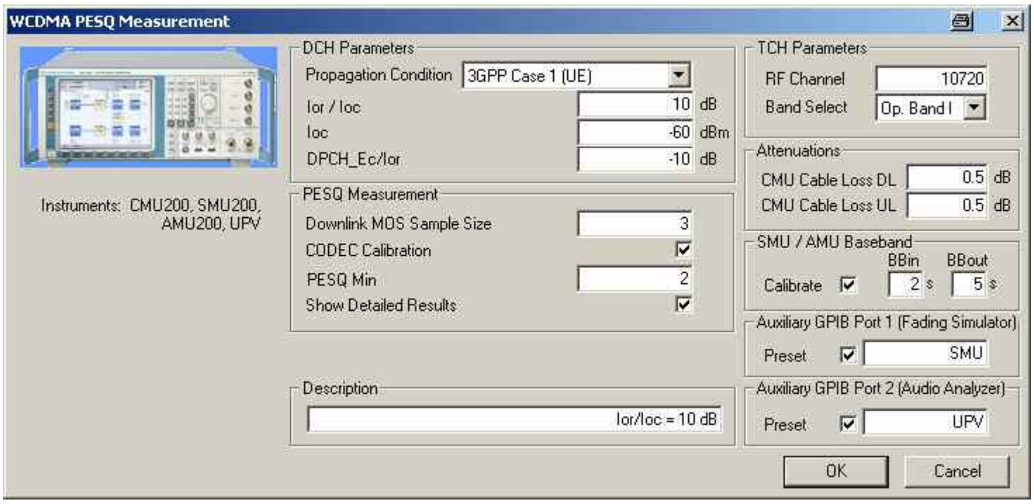


**Fig. 28 WCDMA PESQ Measurement**

Following parameters can be varied:

**PROPAGATION CONDITION** – Selects the WCDMA fading profile (default 3GPP Case 1 (UE)). The selection **NONE** turns fading OFF.

**IOR/ IOC** – Signal (Ior) to Noise (Ioc) SNR ratio.

**DOWNLINK MOS SAMPLE SIZE** – Number of samples taken for PESQ measurement. Typical values according to the Recommendation ITU-T P.862 are 40, 75, 150, 200. Each sample takes approximately 15 seconds.

**CODEC CALIBRATION** – UPV calibrates the CMU Decoder/Encoder path when checked. This needs to be performed in the prescribed CMU calibration cycle. The complete calibration process takes approximately 30 seconds.
**PESQ MIN** – Lower Pass/Fail limit of the average PESQ value.

**SHOW DETAILED RESULTS** – Additionally shows all measured PESQ values as defined in MOS Sample Size besides the Mean, Min, Max and standard deviation.

**CMU CABLE LOSS DL** – The downlink cable loss of the RF cable from the CMU to the mobile.

**CMU CABLE LOSS UL** – The uplink cable loss of the RF cable from the mobile to the CMU. The DL and UL values are usually the same except when a directional coupler is used for example.

**CALIBRATION** – Calibrates the SMU / AMU baseband input. This automatically adapts the wanted signal to the AWGN level and only required when the network is changed (see WCDMA Call Setup).

**AUXILIARY GPIB PORT 1 (FADING SIMULATOR)** – This is the symbolic name of the fading simulator, e.g. SMU / AMU. It must match the CMUgo menu **CONFIGURATION → AUXILIARY GPIB PORT 1**.

**AUXILIARY GPIB PORT 2 (AUDIO ANALYZER)** – This is the symbolic name of the audio analyzer, e.g. UPV. It must match the CMUgo menu **CONFIGURATION → AUXILIARY GPIB PORT 2**.

**WCDMA CALL RELEASE** – Releases the call and unregisters the phone and is necessary for setting the CMU and phone into a defined initial condition.

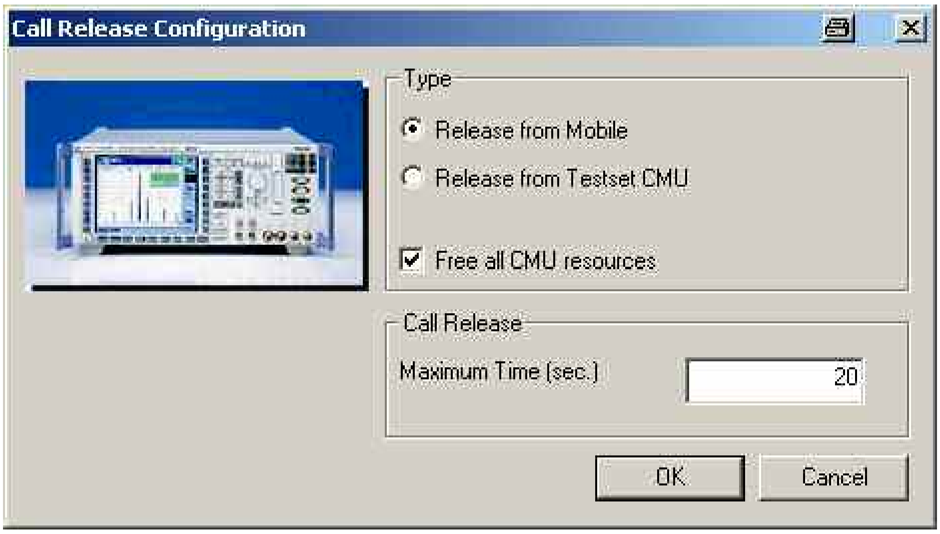


**Fig. 29 WCDMA Call Release**

**TEST END** – Must be located at the end of every test sequence (*.seq) to free CPU memory and resources.


**Fig. 30 Test End**

### 3.4.2 Storage and Further Processing of Measurement Data

When the example sequence has been performed correctly, the following message will be displayed when the **SHOW REPORT SCREEN** box in the **BASIC INITIALIZING** function has been checked.

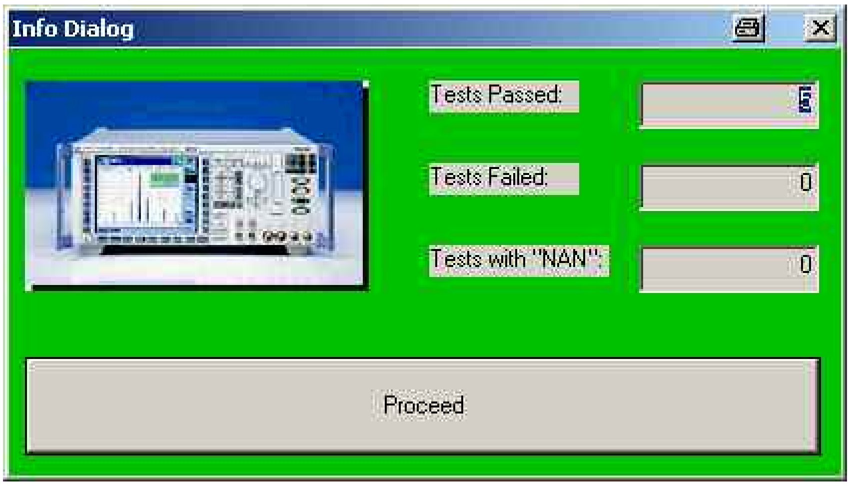


**Fig. 31 Info Dialog**

After pressing Proceed the measurement report is visible.

# Measurement Report

ROHDE&SCHWARZ

**Operator:** *noname* *Freitag, 13. Februar 2009 16:38:42*

**CMU Ident:** *Rohde&Schwarz,CMU 200-1100.0008.02,102652,V5.03*

**Options:** *0,B17,B21Var14,B52Var14,B53Var14,B54Var14,B56Var14,B66,COPROC_FULL,B83,B85,B89,B95,PCMCIA WDDC400,U99,K14,K20,K21,K22,K23,K42,K43,K45,K47,K53,K54,K56,K60,K61,K62,K63,K64,K65,K66,K67 K68,K69,K83,K84,K85,K86,K88,K96,K839,K849,K859,K869,FMR6,Intel Celeron,256 MB rxtx1*

**Sequence:** *- - -*

| Test Name and Condition | Lower Limit | Upper Limit | Measured Value | P/F |
|---|---|---|---|---|
| *Operating Band I, Channel DL/UL 10720/9770, RF Level -50.6 dBm, Attenuation (In/Out) 0.5 / 0.5 dB* | | | | |
| *P-CPICH: -10.00 dB, P-SCH: -15.00 dB, S-SCH: -15.00 dB, P-CCPCH: -15.00 dB, S-CCPCH: -15.00 dB* | | | | |
| *PICH: -8.30 dB, AICH -8.30 dB, DPDCH (Code 6): -10.30 dB, DPCCH/DPDCH Offset 0.00 dB* | | | | |
| *MCC 1, MNC 1, LAC 1 CallType Signalling RAB Cell DCH 1.7 kbps, AMR Profile H* | | | | |
| *IMSI: 001010123456063,Serial Number: 35154700-058160-8* | | | | |
| **Call to Mobile:** | | | passed | ✔ |
| *Ins.Loss=15.38dB Ior/Ioc=10.00dB Ioc=-60.00dBm Prop.Cond=G3UEC1 DPCH Ec/Ior=-10.00dB* | | | | |
| *PESQ Min/Max/StdDev* | 3.27 | 3.46 | 0.08 | |
| | | | 3.27 | |
| | | | 3.38 | |
| | | | 3.46 | |
| **PESQ Measurement** *Ior/Ioc = 10 dB* | 2.00 | | 3.37 | ✔ |
| *Ins.Loss=19.12dB Ior/Ioc=0.00dB Ioc=-60.00dBm Prop.Cond=G3UEC1 DPCH Ec/Ior=-10.00dB* | | | | |
| *PESQ Min/Max/StdDev* | 2.77 | 3.13 | 0.16 | |
| | | | 3.13 | |
| | | | 2.84 | |
| | | | 2.77 | |
| **PESQ Measurement** *Ior/Ioc = 0 dB* | 2.00 | | 2.91 | ✔ |
| *Ins.Loss=20.12dB Ior/Ioc=-2.00dB Ioc=-60.00dBm Prop.Cond=G3UEC1 DPCH Ec/Ior=-10.00dB* | | | | |
| *PESQ Min/Max/StdDev* | 2.13 | 2.46 | 0.14 | |
| | | | 2.13 | |
| | | | 2.31 | |
| | | | 2.46 | |
| **PESQ Measurement** *Ior/Ioc = -2 dB* | 2.00 | | 2.30 | ✔ |
| **Call Release Test:** | | | passed | ✔ |

**MS Serial Number: 35154700-058160-8**

**Result:** *5 Tests passed / 0 Tests failed*

*(Execution Time: 291.2 Seconds)*

**Fig. 32 CMUgo Measurement Report**

The report can be stored in the in the proprietary CMUgo format (*.mdf) with **FILE** → **SAVE** or exported, for example to Excel format with **FILE** → **EXPORT DATA** → **TO EXCEL**….

| **Measurement Report** | | | | | |
|---|---|---|---|---|---|
| Date & Time: | Freitag, 13. Februar 2009 16:38:42 | | | | |
| Operator: | noname | | | | |
| CMU Ident: | Rohde&Schwarz,CMU 200-1100.0008.02,102652,V5.03 | | | | |
| Options: | 0,B17,B21Var14,B52Var14,B53Var14,B54Var14,B56Var1 | | | | |
| | WDDC400,U99,K14,K20,K21,K22,K23,K42,K43,K45,K47 | | | | |
| | K68,K69,K83,K84,K85,K86,K88,K96,K839,K849,K859,K | | | | |
| | rxtx1 | | | | |
| Sequence: | - - - | | | | |
| | | | | | |
| Test Name and Condition | Lower Limit | Upper Limit | Measured Value | Unit | P/F |
| | | | | | |
| *Operating Band I, Channel DL/UL 10720/9770, RF Level -50.6 dBm, Attenuation (In/Out) 0.5 / 0.5 dB* | | | | | |
| | | | | | |
| *P-CPICH: -10.00 dB, P-SCH: -15.00 dB, S-SCH: -15.00 dB, P-CCPCH: -15.00 dB, S-CCPCH: -15.00 dB* | | | | | |
| | | | | | |
| *PICH: -8.30 dB, AICH -8.30 dB, DPDCH (Code 6): -10.30 dB, DPCCH/DPDCH Offset 0.00 dB* | | | | | |
| | | | | | |
| *MCC 1, MNC 1, LAC 1 CallType Signalling RAB Cell DCH 1.7 kbps, AMR Profile H* | | | | | |
| | | | | | |
| *IMSI: 001010123456063,Serial Number: 35154700-058160-8* | | | | | |
| | | | | | |
| Call to Mobile: | | | | | Passed |
| *Ins.Loss=15.38dB Ior/Ioc=10.00dB Ioc=-60.00dBm Prop.Cond=G3UEC1 DPCH Ec/Ior=-10.00dB* | | | | | |
| | | | | | |
| PESQ Min/Max/StdDev | 3,26753402 | 3,4590192 | 0,078580238 | | |
| | | | 3,267534018 | | |
| | | | 3,380215168 | | |
| | | | 3,459019184 | | |
| PESQ Measurement Ior/Ioc = 10 dB | 2 | | 3,36892279 | | Passed |

**Fig. 33 Excel Sheet**

The *.xls file is perfectly suited for further processing of the data with another Excel sheet or any Windows Application capable of copy and paste import. Simply mark the column containing the single PESQ measurements and drag and drop it to your desired application.

# 4 Literature

[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: **PESQ Measurement for GSM with CMUgo**, 1MA119, September 2008

[4] Rohde & Schwarz; Application Note: **PESQ Measurement for CDMA2000® with CMUgo**, 1MA136, October 2008

[5] Rohde & Schwarz; Application Note: **Psychoacoustic Audio Quality Measurements Using R&S®UPV Audio Analyzer**, 1GA49, April 2009

# 5 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/**

# 6 Ordering Information

| Ordering Information | | |
|---|---|---|
| **Radio Communication Tester** | | |
| **CMU200** | | **1100.0008.02** |
| CMU-B17 | IQ/IF analogue interface | 1100.6906.02 |
| CMU-B21 | Universal 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-Signaling | |
| **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 ext. (optional) | 1160.2288.02 |
| SMU-B17 | Analog baseband input | 1142.2880.02 |
| SMU-K62 | AWGN | 1159.8511.02 |
| **Baseband Signal Generator** | | |
| **AMU200A** | | **1402.4090.02** |
| AMU-B13 | Baseband Main Module | 1141.8003.04 |
| AMU-B14 | Fading Simulator | 1160.5600.02 |
| AMU-B15 | Fading Simulator ext. (optional) | 1160.5700.02 |
| AMU-B17 | Analog Baseband Input | 1142.5900.02 |
| AMU-K62 | AWGN | 1159.7202.02 |
| **Audio Analyzer** | | |
| **UPV** | **(0 Hz - 250 kHz)** | **1146.2003.02** |
| Or | | |
| **UPV66** | **(0 Hz - 250 kHz)** | **1146.2003.66** |
| UPV-K1 | Universal Sequence Controller | 1401.7009.02 |
| UPV-K4 | Remote Control | 1401.9001.02 |
| UPV-K61 | Software f. PESQ Measurements | 1401.7309.02 |

For additional information see the Rohde & Schwarz website www.rohde-schwarz.com or contact your local representative.
Note: Not all options are described in detail. The use of the R&S®SMATE Vector Generator is also possible.

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

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Certified Quality System
ISO 9001
DQS REG. NO 1954 QM

Certified Environmental System
ISO 14001
DQS REG. NO 1954 UM





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