

Products: R&S® CMU200, R&S® SMU200A, R&S® UPV

PESQ Measurement for GSM with CMUgo

Application Note

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. GSM PESQ is an add-on tool for CMUgo for automatic measurement of the PESQ for GSM mobile phones according to recommendation ITU-T P.862.1 featuring selectable fading profiles, frequency hopping sequences and variable Additional White Gaussian Noise (AWGN).



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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. GSM PESQ is an add-on tool for CMUgo for automatic measurement of the PESQ for GSM mobile phones according to recommendation ITU-T P.862 featuring selectable fading profiles, frequency hopping sequences and variable Additional White Gaussian Noise (AWGN). It features selectable fading profiles TU3, TU50 TU120 for 6 and 12 paths and variable Additional White Gaussian Noise (AWGN) for realistic receiving scenarios and frequency hopping sequences A, B, C and D for counteracting negative effect on the signal quality caused by fading.

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[®] 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 bandwidth. 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 degradation 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, undegraded 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. 2).

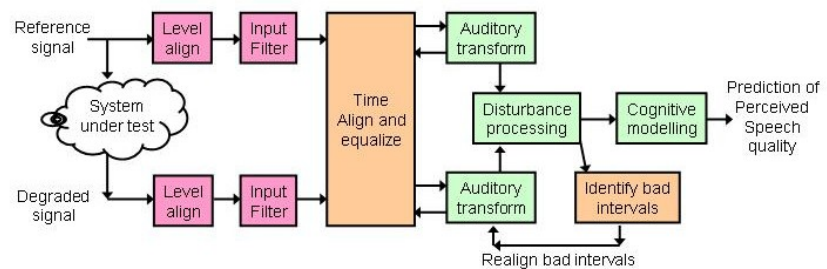


Fig. 1 Algorithm of PESQ Measurement in UPV

In Fig. 2 the R&S instruments involved in the PESQ measurement setup 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 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.

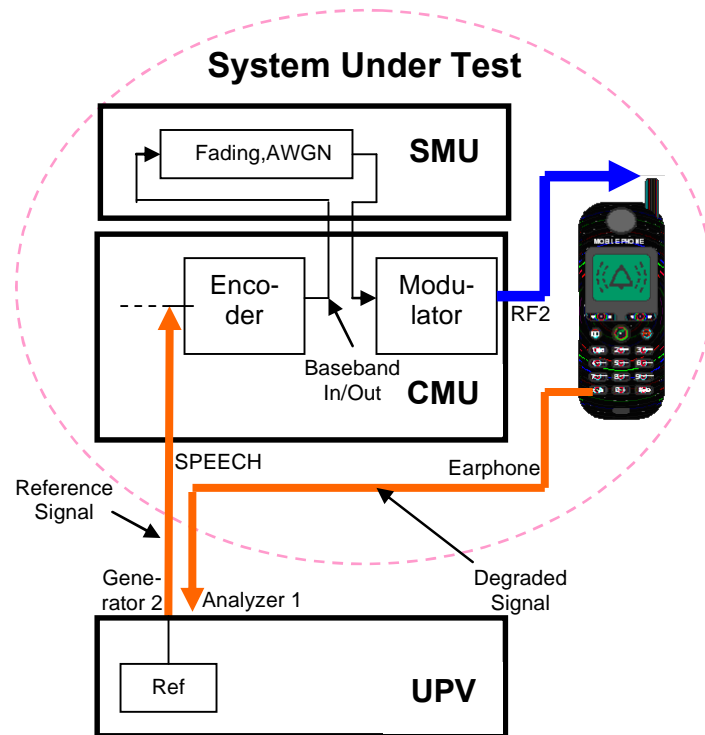


Fig. 2 PESQ Measurement Setup with R&S Instruments

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.

P.862 Algorithm's Mapping Function

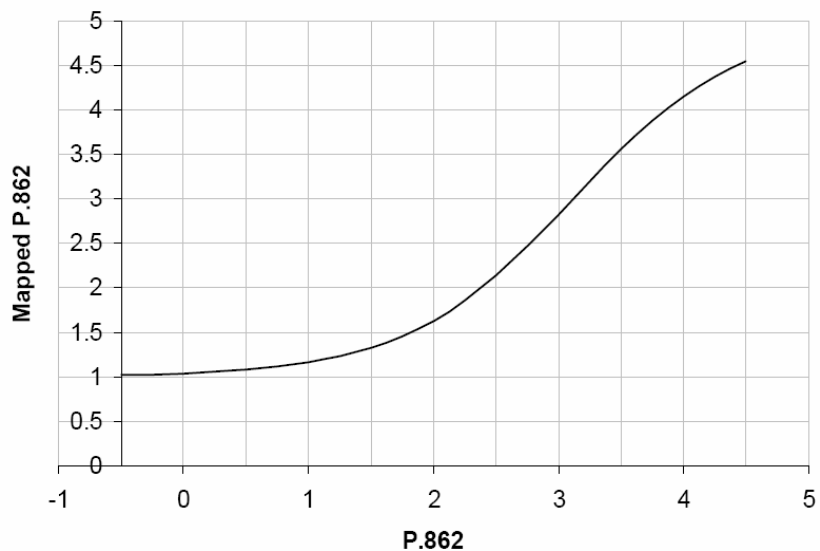


Fig. 3 P.862 Algorithm's Mapping Function

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 from 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 possible range is -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 LQO” (Listening Quality, Objective). The possible range is -0.5 (worst) to +4.5 (best). This standard is used with the included CMUgo measurement item **GSMPEAQ.DLL**. It is referred to as PESQ measurement in the following chapters.

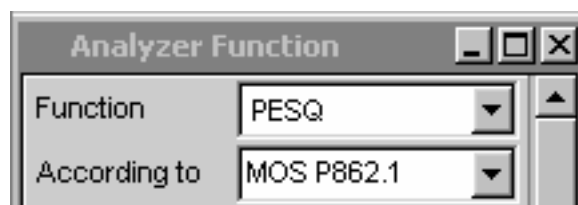


Fig. 4 UPV PESQ Version

GSM PESQ Measurement for CMUgo

- ITU P.862.2: This is the wideband extension (bandwidth > 6.3 kHz) of P.862. The measured value is the “MOS”. The possible range is –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.

3 PESQ Measurement According to ITU P.862.1

Hardware Configuration

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

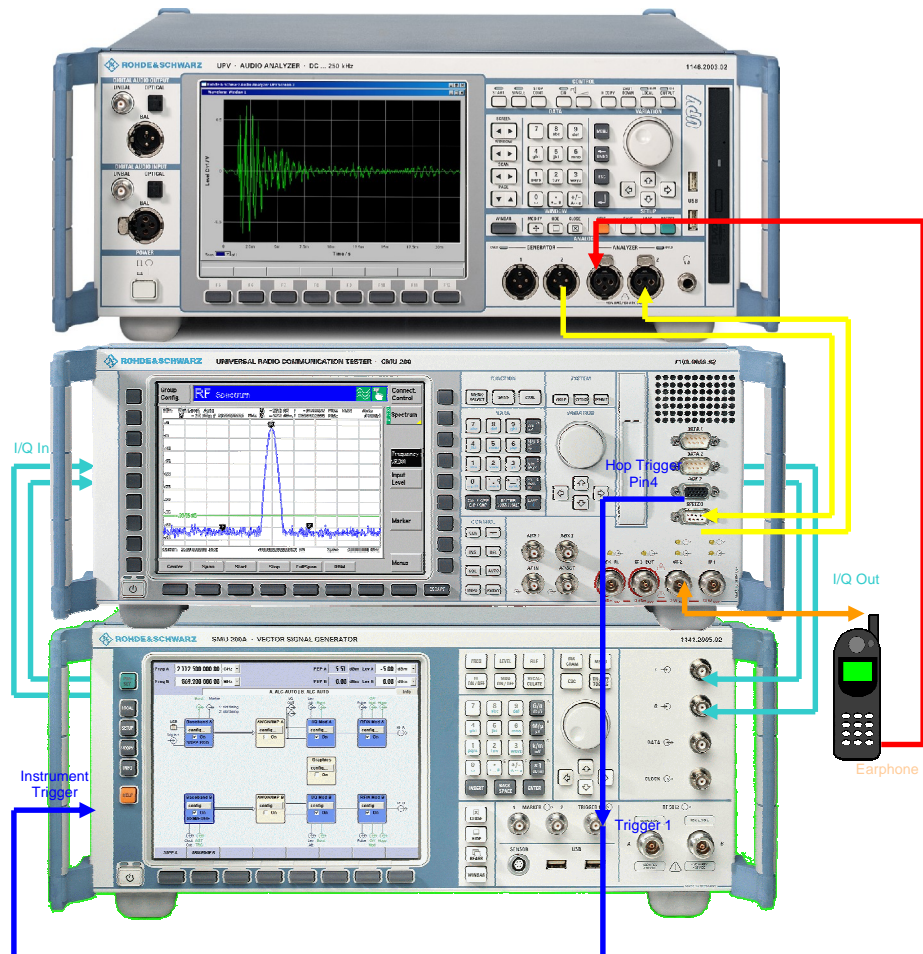


Fig. 5 Hardware Configuration

- CMU I/Q Output (I/Q Chan1 connector) → SMU I/Q Input
- SMU I/Q Output → CMU I/Q Input (I/Q Chan1 connector)
- CMU RF2 output ↔ mobile phone RF connector
- UPV GENERATOR2 → CMU SPEECH connector
- Mobile earphone → UPV ANALYZER1 input
- CMU SPEECH connector → UPV ANALYZER2 input
- CMU AUX3 Pin 4 Hop Trigger → SMU Trigger 1 (front) → SMU Instrument Trigger (rear).

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.

UPV Software Requirement

The UPV requires option UPV-K61 PESQ measurements. PESQ measurements require the CMU 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.

Flowchart of the PESQ Measurement

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

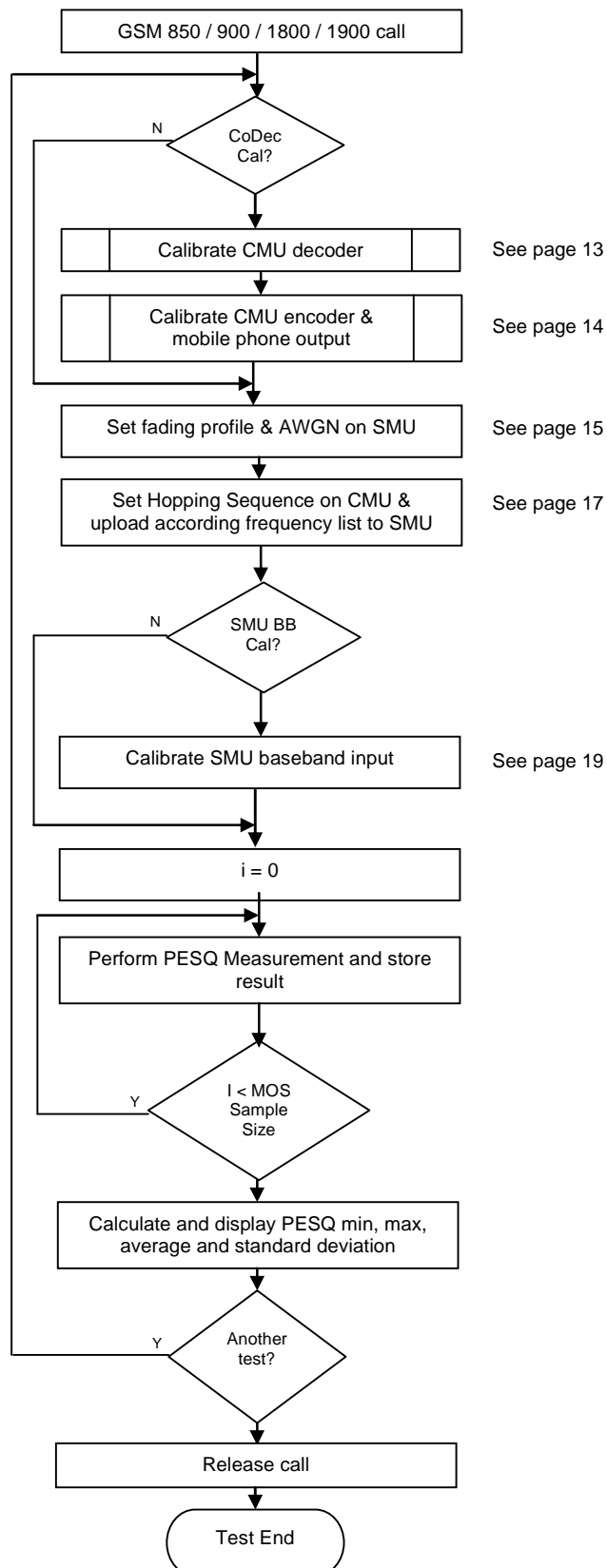


Fig. 6 GSM PESQ Measurement

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, UPV).

GSM Call Setup

First establish a GSM call in order to access certain parameters, such as the hopping sequence on the CMU.

1. Set the desired call parameters on CMU, e.g. GSM1900, BCCH and TCH channel and level.
2. Register and establish the call

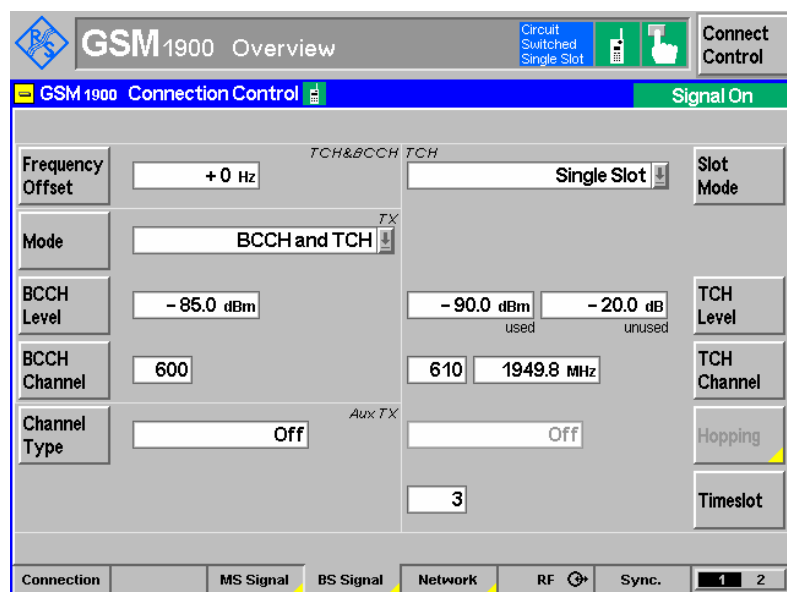


Fig. 7 GSM Call setup

GSM PESQ Measurement

1. Turn CMU-B17 Bypass ON unless you have performed a CMU pre-set. This ensures that the call will not be lost if the SMU or AMU is set to a non proper state, e.g. baseband turned OFF, AWGN level too high etc.

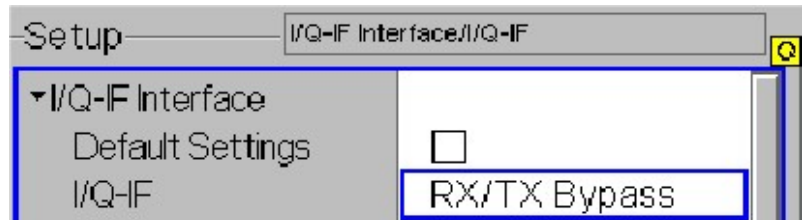


Fig. 8 CMU-B17 RX/TX Bypass

Remote-control command:
CONF:IQIF:RXTX BYP

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

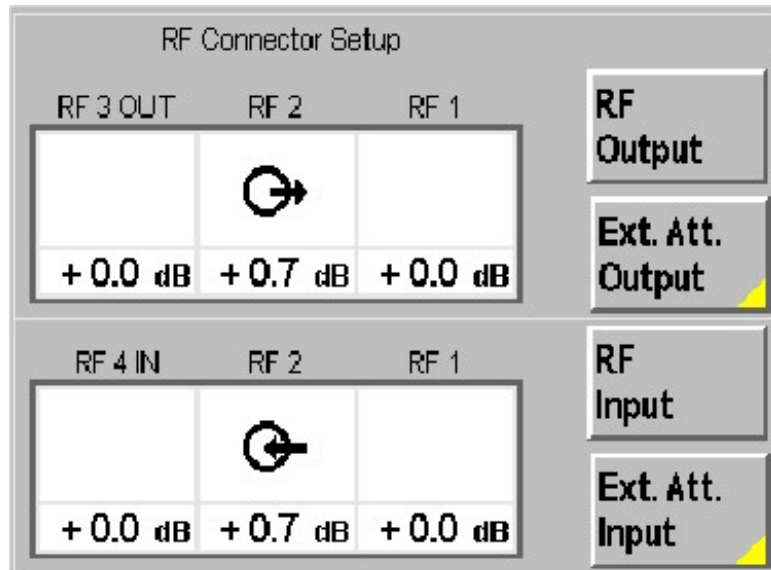


Fig. 9 CMU RF Connector Setup

Remote-control command:
INP RF2;OUTP RF2

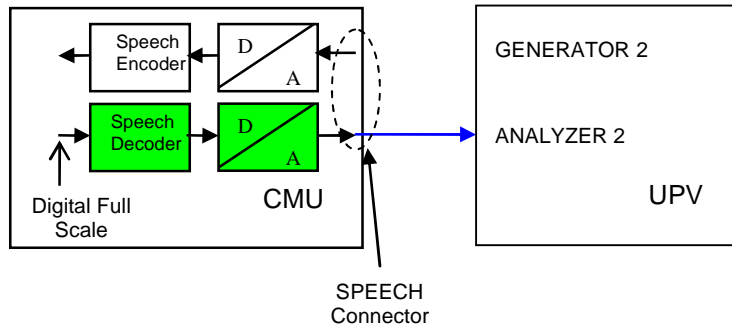
3. Set the Traffic Mode to one of the recommended values, Full Rate v2 or Half Rate v1.



Fig. 10 CMU Traffic Mode

Remote-control command:
PROC:NETW:SMOD:TRAF FRV2 or HRV1

4. 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.



Set BIT STREAM to DECODER CAL on the CMU.



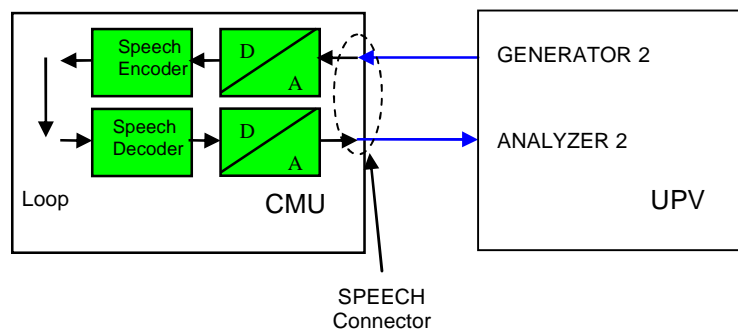
Fig. 11 Decoder Calibration

Remote-control command:
 PROC:NETW:SMOD:BITS 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'

- 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.



Set BIT STREAM to ENCODER CAL on the CMU.



Fig. 12 Encoder Calibration

Remote-control command:
 PROC:NETW:SMOD:BITS 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'

- Change to **measurement mode** by setting BIT STREAM to SPEECH-COD./HANDSET LOW on CMU. The CMU now repeatedly transmits a defined audio signal to the mobile.



Fig. 13 Handset Low

Remote-control command:
 PROC:NETW:SMOD:BITS HLOW

7. Route SMU baseband input to path A or B (if available).

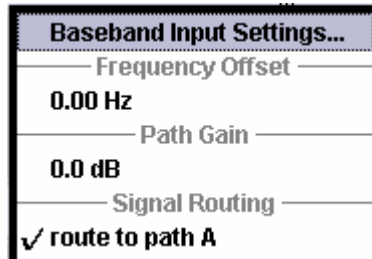


Fig. 14 SMU / AMU Baseband Input A

Remote-control command:
BBIN:ROUT A

8. Route SMU baseband output to path A or B (if available).

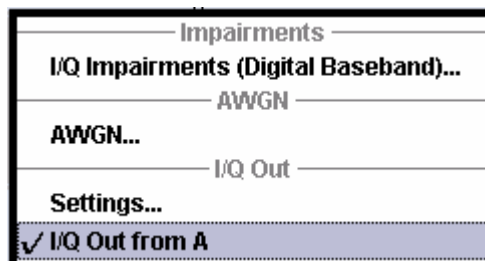


Fig. 15 SMU Baseband Output A

Remote-control command:
BB:IQO:SOUR A

9. Turn the SMU fading simulator ON and select a fading profile e.g. GSM TU50 (12Path). The signal must be dedicated to RF to use the frequencies defined in LIST MODE.

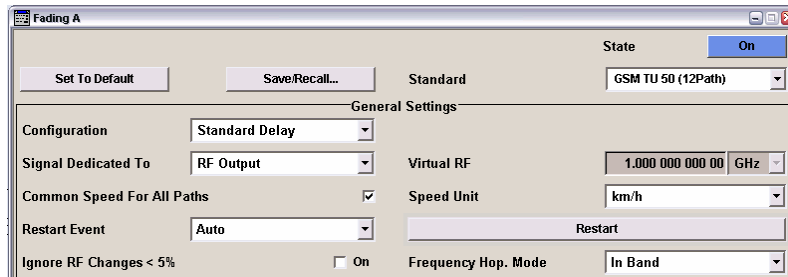


Fig. 16 Fading Simulator Configuration

Remote-control commands:
 FSIM:ILOS:MODE NORM
 FSIM ON
 FSIM:STAN <PropCond> // e.g. TU50
 FSIM:SDES RF
 FSIM:HOPP:MODE IBAN

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

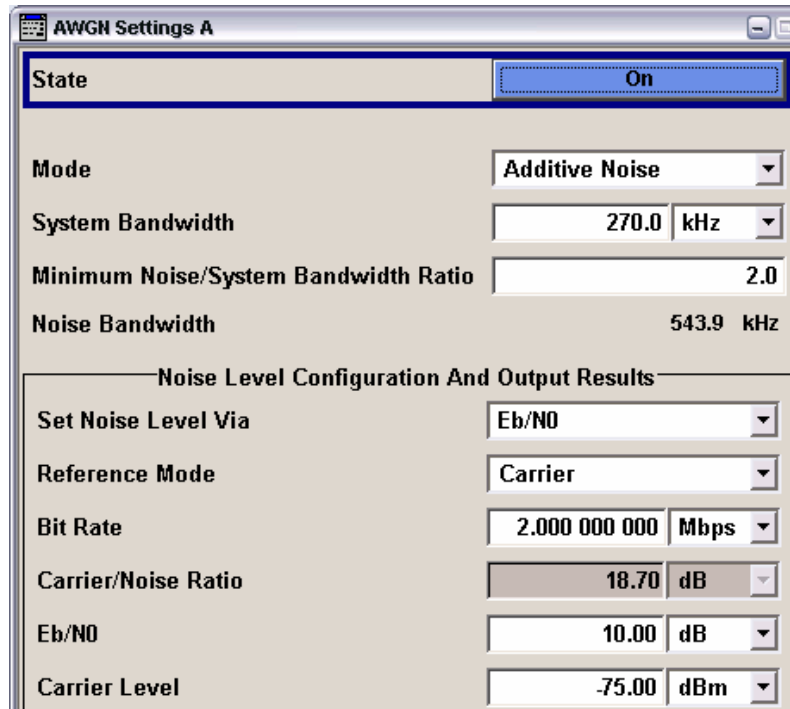


Fig. 17 AWGN Settings

Remote-control commands:

```
AWGN:STAT OFF
AWGN:BWID 270KHz
AWGN:BWID:RAT 2
AWGN:POW:MODE EN
AWGN:POW:RMOD CARR
AWGN:BRAT 2.0e6
AWGN:POW:CARR -75
AWGN:ENR <EbNo>
AWGN:STAT ON
```

- Turn the SMU RF A output ON to use the List Mode capability. The actual RF output is not required.



Fig. 18 SMU RF ON

Remote-control command:

```
OUTP ON
```

12. If Hopping Sequence A, B, C or D has been selected on the CMU, turn ON the SMU List Mode and set it to EXTERN STEP MODE.

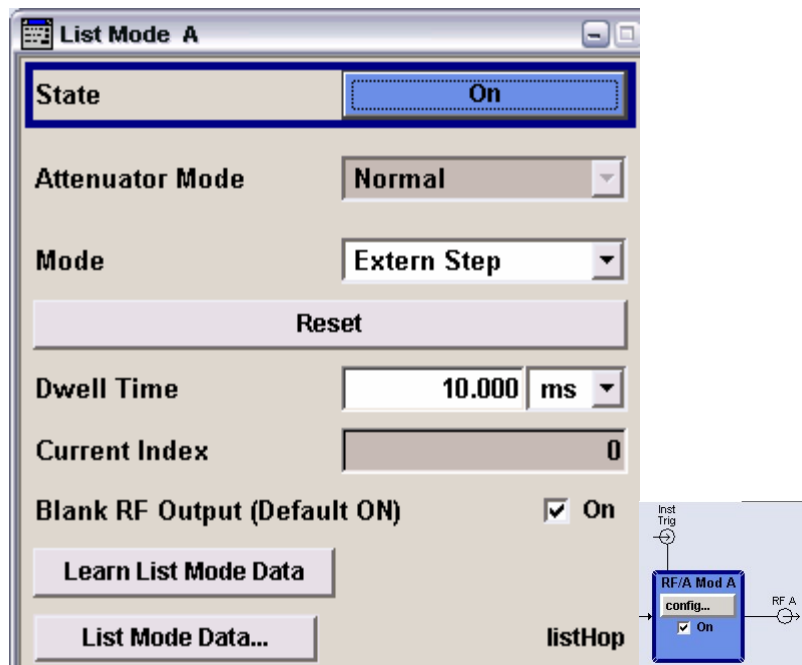


Fig. 19 SMU List Mode

Remote-control commands:

```
BB:GSM:TRIG ARET           // Armed Retrigger
BB:GSM:TRIG:SOUR EXT       // Trigger 1
```

13. Download the Hopping Sequence (e.g. A) to the SMU by converting the channel numbers (CMU-K20...-K24 manual, p 6.232) into frequencies and entering them into the SMU list. Keep in mind that the last frequency is first due to the external trigger and to ensure equal, synchronous frequencies on CMU and SMU.

	Frequency / Hz	Power / dBm
1	1 987 000 000.00	-75.00
2	1 934 400 000.00	-75.00
3	1 939 600 000.00	-75.00
4	1 941 400 000.00	-75.00
5	1 946 200 000.00	-75.00
6	1 948 600 000.00	-75.00
7	1 951 200 000.00	-75.00
8	1 954 000 000.00	-75.00
9	1 956 200 000.00	-75.00
10	1 963 400 000.00	-75.00
11	1 967 200 000.00	-75.00
12	1 972 200 000.00	-75.00
13	1 976 400 000.00	-75.00
14	1 979 600 000.00	-75.00

Fig. 20 SMU List for Hopping Sequence A

Remote-control commands:

```
LIST:SEL ' Hopping'
SOUR:LIST:FREQ frq[n],frq[1],...,frq[n-1]
SOUR:LIST:POW -75.0,-75.0,.....,-75.0
LIST:TRIG:SOUR EXT // SMU Instr. Trigger
LIST:MODE STEP // Step mode
FREQ:MODE LIST // List Mode ON
```

14. When CMU Hopping Sequence is OFF, turn the SMU Hopping Mode OFF and the frequency mode to CW.

Remote-control commands:

```
FSIM:HOPP:MODE OFF
FREQ:MODE CW
FREQ <Freq>
```

15. Calculate the SMU insertion loss by subtracting the baseband output level from the baseband input level. The SMU baseband insertion loss varies with the fading profile and must be compensated with the CMU RF level.

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

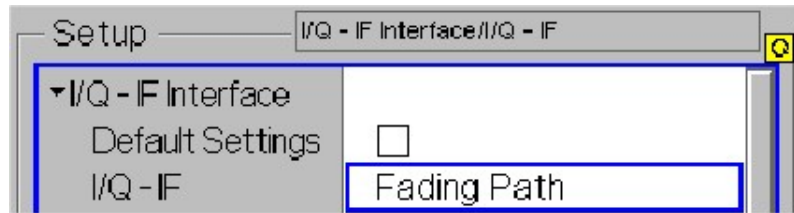


Fig. 21 CMU Fading Path ON

Remote-control command:
CONF:IQIF:RXTX FPAT

- Turn SMU baseband input ON.

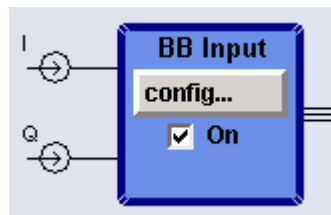


Fig. 22 SMU Baseband Input ON

Remote-control command:
SOUR:BBIN:STAT ON

- Perform SMU Auto Level Set (baseband input calibration) at the beginning of the test sequence. The GSM output signal level is specified at $0.5V_p = 0.0 \text{ dBfs} = +7.0 \text{ dBm}$ for 50 Ohm resistance. Tolerances are instrument- and cable-specific.

Remote-control command:
BBIN:ALEV:EXEC

- SMU baseband input level $\rightarrow 6.76 \text{ dBm}$

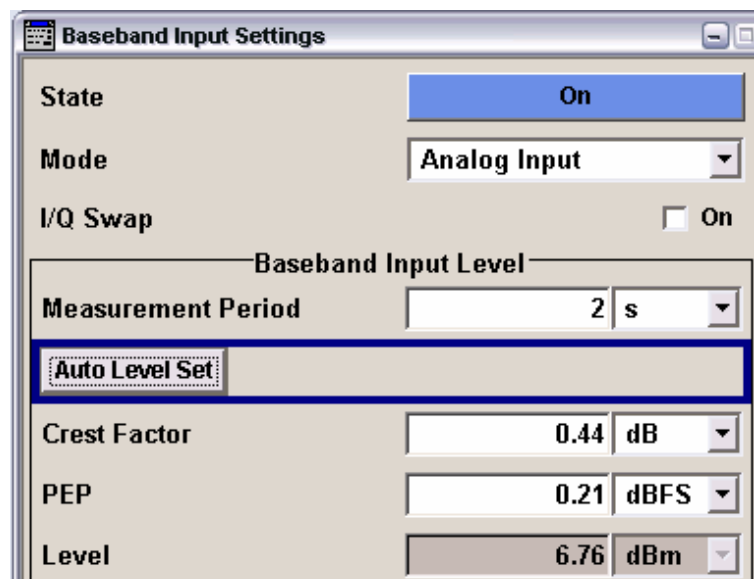


Fig. 23 SMU Baseband Input Level

Remote-control command:
BBIN:POW:RMS?

- SMU 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.

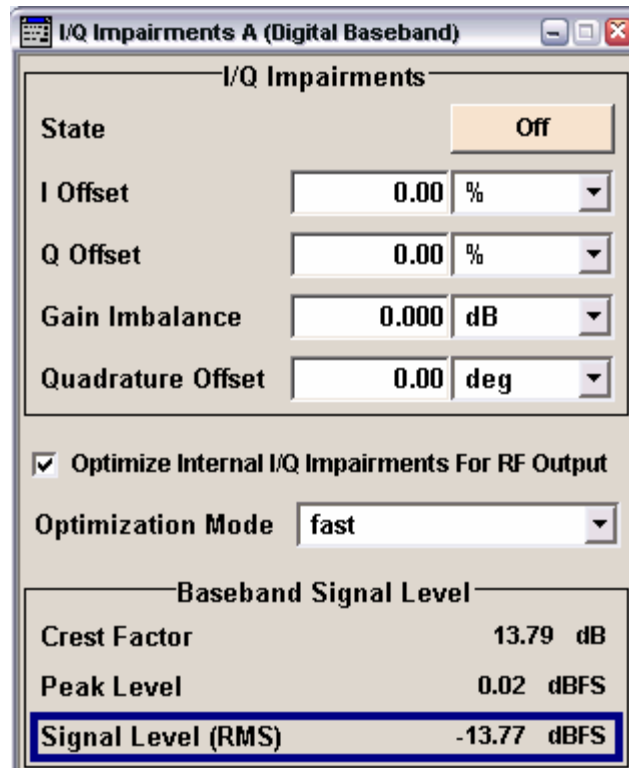


Fig. 24 SMU Baseband Output Level

Remote-control command:
BB:POW:RMS?

- Compensate SMU 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).

- Enter cable loss for mobile uplink (TX) with CMU RF External Attenuation Input control (e.g. 0.7 dB, see fig. 5).

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

- Set Hopping Sequence (OFF, A, B, C or D) on CMU. This control is only available when a call is established.

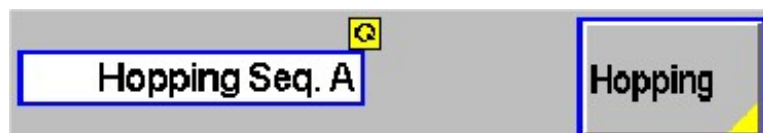


Fig. 25 CMU Hopping Sequence A

Remote-control command:
PROC:SIGN:FHOP:SEQ <OFF, A, B, C or D>

22. 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.

Automatic PESQ Measurement with CMUgo

The R&S software tool CMUgo allows 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 v1.9.6 (or later), the GSMPesq measurement DLL and the demo sequence GSM PESQ Demo can be downloaded from <http://www.rohde-schwarz.com/appnote/1MA87.html>. Please install CMUgo first. If **GSMPESQ.DLL** from the link above is newer than the DLL included in CMUgo just copy it to the CMUgo working directory. Before performing the sequence **GSM PESQ DEMO.SEQ** define the CMU, SMU 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.

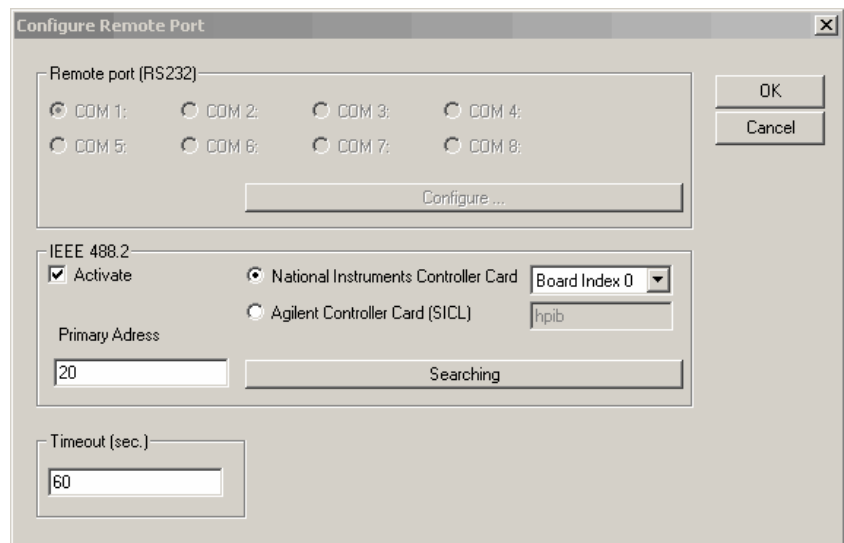
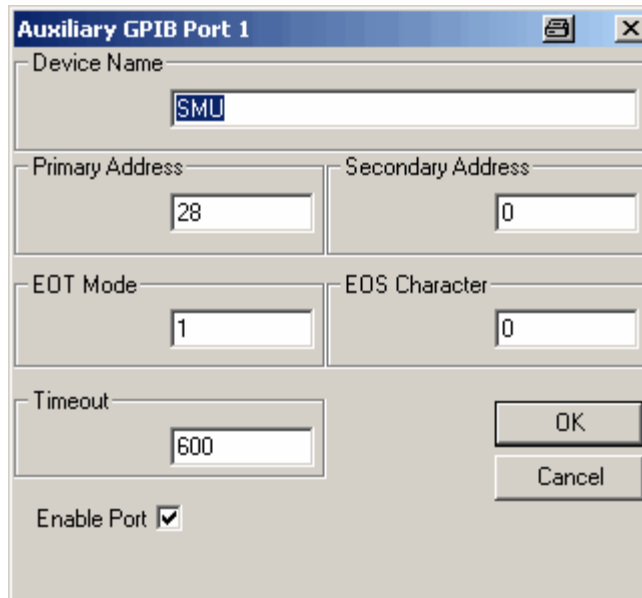


Fig. 26 CMUgo Configure Remote Port

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



The screenshot shows a configuration window titled "Auxiliary GPIB Port 1". It contains the following fields and controls:

- Device Name:** Text box containing "SMU".
- Primary Address:** Text box containing "28".
- Secondary Address:** Text box containing "0".
- EOT Mode:** Text box containing "1".
- EOS Character:** Text box containing "0".
- Timeout:** Text box containing "600".
- Enable Port:** A checked checkbox.
- Buttons:** "OK" and "Cancel" buttons on the right side.

Fig. 27 Auxiliary GPIB Port 1

- 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**.

Configuring and Starting the PESQ Measurement Sequence

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

Item	Selected	Description
1	Basic Initializing	
2	GSM Call Setup	
3	GSM PESQ Measurement	FR 12.2 - Eb/No 10
4	GSM PESQ Measurement	FR 12.2 - Eb/No 2
5	GSM PESQ Measurement	FR 12.2 - Eb/No 0
6	GSM PESQ Measurement	FR 12.2 - Eb/No -2
7	GSM Call Release	
8	Test End	

Fig. 28 CMUgo Sequence

The sequence consists of following functions

BASIC INITIALIZING – This function is necessary to define the required CMU function groups, e.g. GSM1900 (signalling), Audio, etc. The CMU groups are controlled via the secondary GPIB address (SAD). Basic Initializing automatically detects or defines according secondary addresses required automatically.

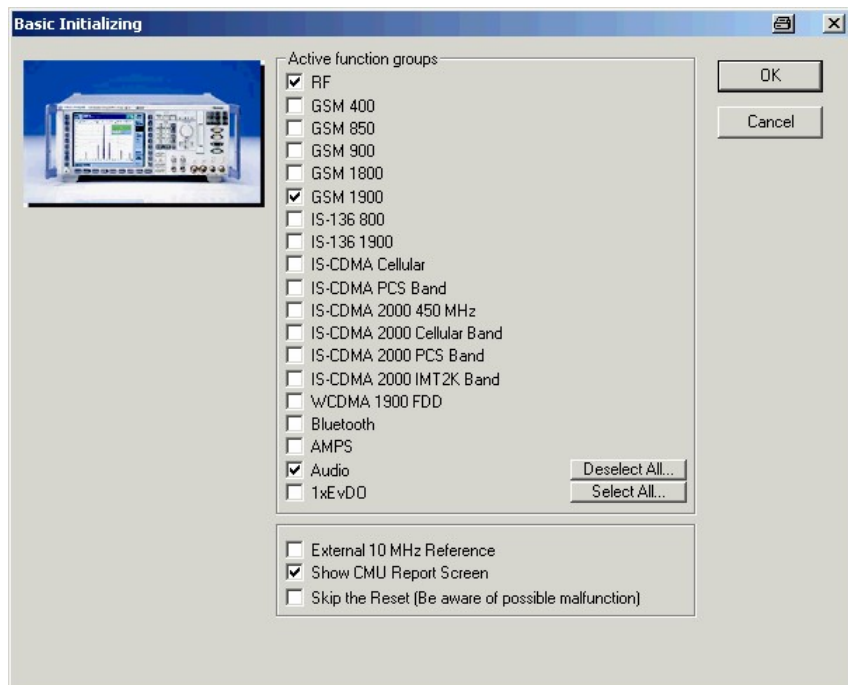


Fig. 29 Basic Initializing

GSM PESQ Measurement for CMUgo

GSM CALL SETUP – This function registers the phone and establishes a call. The example is for a GSM1900 network, the TCH RF level is set to -95 dBm.

Call Setup Configuration

Network: GSM1900

BCCH

use AuxTX (B95)

RF Channel: 600

RF Level: -85

TCH after call setup

RF Channel: 610

RF Level: -95

Network Setup

Support: GSM

Slot Mode: Single Slot

Single Slot Configuration

PCL: 15

Timeslot: 3

The dialed number should be:

Call:

to mobile

Send SMS

Attenuations

Input: 0.6

Output: 0.6

CMU Connector: RF1 RF2

Autoranging

Buttons: OK, Cancel, MultiSlot Configuration, Configure...

Fig. 30 GSM Call Setup Configuration

GSM PESQ Measurement for CMUgo

State of the art phones with a Windows Mobile OS may require to **WAIT BEFORE CALLING (Sec.)** of approx. 30 seconds after registration.

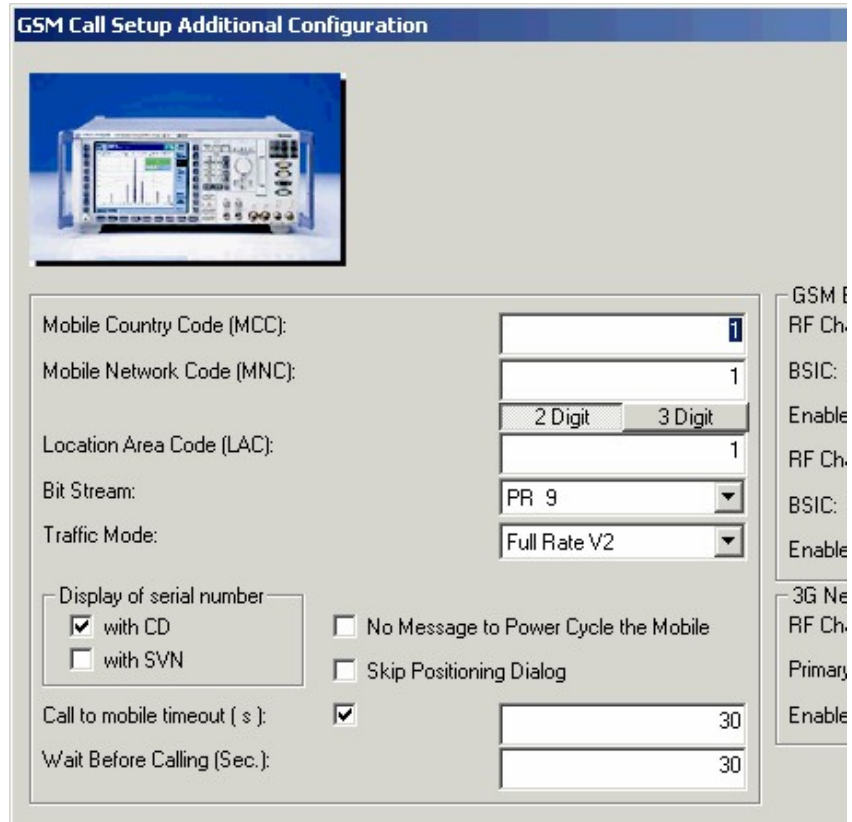


Fig. 31 GSM Call Setup Additional Configuration

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

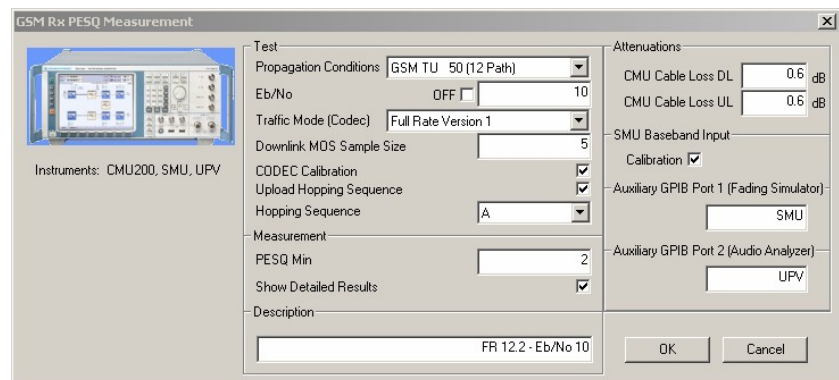


Fig. 32 GSM Rx PESQ Measurement

Following parameters can be varied:

PROPAGATION CONDITION – Selects the GSM fading profile (default GSM TU 50 (12 path)). The selection **NONE** turns fading OFF.

Eb/No – Signal to Noise ratio referenced to the bit rate.

OFF – Turns AWGN OFF

TRAFFIC MODE (CODEC) – Select from Full Rate Version 1, Full Rate Version 2 (12.2 kbps) and Half Rate V2 (5.9 kbps), Full Rate Data 4800 Baud, Full Rate Data 9600 Baud, Full Rate Data 14400 Baud, Half Rate Data 2400 Baud, Half Rate Data 4800 Baud, GPRS CS-1...GPRS CS-4, EGPRS MCS-1...EGPRS MCS-9, AMR half rate (option CMU-K45), AMR full rate (option CMU-K45), AMR half rate 8PSK (option CMU-K45), AMR wideband full rate GMSK (option CMU-K45), AMR wideband full rate 8PSK (option CMU-K45), AMR wideband half rate 8PSK (option CMU-K45). Default Full Rate V1.

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 lasts approximately 30 seconds.

UPLOAD HOPPING SEQUENCE – Converts the Hopping Channel Sequence to frequencies and uploads them to the SMU which operates in list mode. Only required the first time hopping is used or when the sequence is changed.

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 baseband input. This automatically adapts the wanted signal to the AWGN level and only required when the network is changed (see GSM Call Setup).

AUXILIARY GPIB PORT 1 (FADING SIMULATOR) – This is the symbolic name of the fading simulator, e.g. SMU. 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**.

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

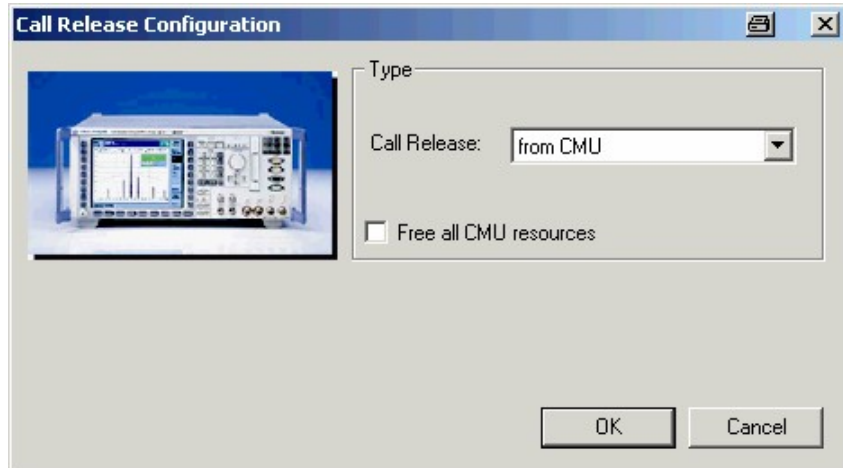


Fig. 33 Call Release

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

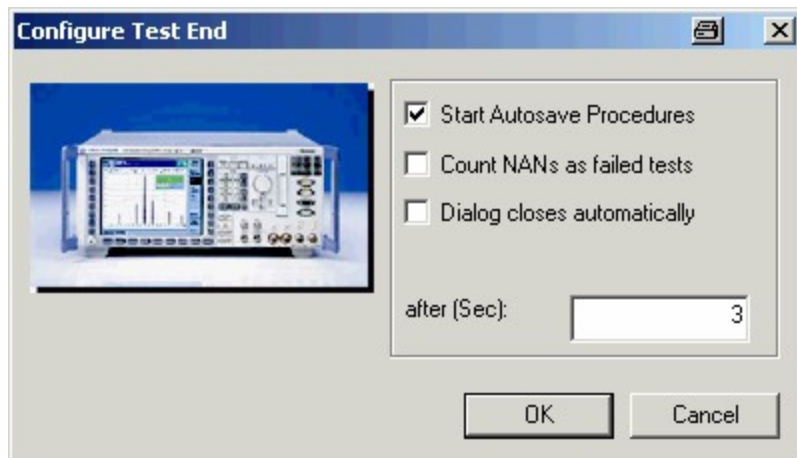


Fig. 34 Test End

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.

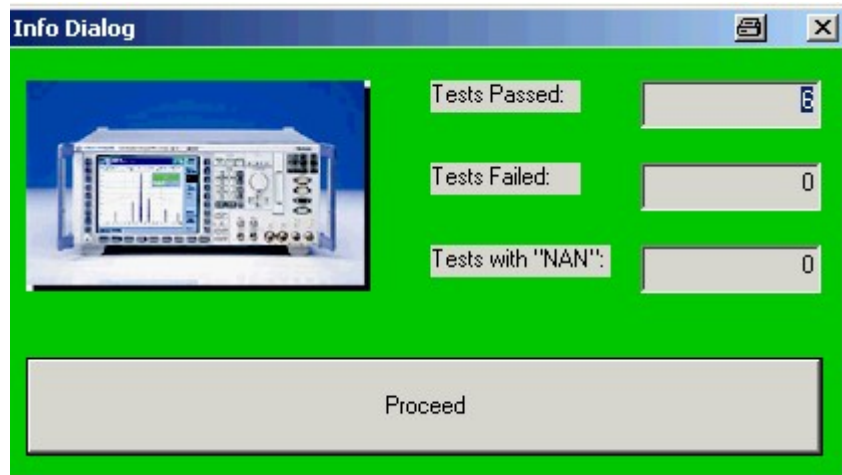


Fig. 35 Info Dialog

GSM PESQ Measurement for CMUgo

After pressing Ok the measurement report is visible.

Measurement Report

Operator: noname Freitag, 16. November 2007 15:12:05
CMU Ident: Rohde&Schwarz, CMU 200,xxxxxx/xxx, Vx.xx
Options: B11/B12, B21, B41, B52, PC/MCIA, B53, B83, B95, K0, K42, K64, CPU(FMR), Memory uP1
Sequence: ---

Test Name and Condition	Lower Limit	Upper Limit	Measured Value	P/F
<i>Network: GSM 1900, BCCH Channel/Level: 600-85.0 dBm, TCH Channel: 610, TCH Level (dBm): -95.0, Support GSM, PCL: 15 (Main) Timeslot: 3, Attenuation (In/Out): 0.6/0.6 dB, Slot Mode: Single Slot, Bitstream: PR9, AuxTX: Off</i>				
<i>Traffic Mode: Full Rate V2</i>				
<i>IMS: 0. 0.1000000095, Serial: 12345678-123456-8, Revision: PH2P, Number: , Traffic: FRV1, Power Class: 4</i>				

Call to Mobile:	[]	[]	passed	✓
PESQ Measurement FR 12.2 - Eb/No 10	4.00	[]	4.00	✓
	[]	[]	4.28	
	[]	[]	4.10	
	[]	[]	4.41	
	[]	[]	4.29	
	[]	[]	4.24	
<i>PESQ Min/Max/StdDev</i>	3.50	4.50	0.33	
PESQ Measurement FR 12.2 - Eb/No 2	4.00	[]	4.28	✓
	[]	[]	4.73	
	[]	[]	4.69	
	[]	[]	4.65	
	[]	[]	4.37	
	[]	[]	4.71	
<i>PESQ Min/Max/StdDev</i>	3.78	4.78	0.33	
PESQ Measurement FR 12.2 - Eb/No 0	4.00	[]	4.57	✓
	[]	[]	4.83	
	[]	[]	4.72	
	[]	[]	4.58	
	[]	[]	4.61	
	[]	[]	4.75	
<i>PESQ Min/Max/StdDev</i>	4.07	5.07	0.33	
PESQ Measurement FR 12.2 - Eb/No -2	4.00	[]	4.12	✓
	[]	[]	4.20	
	[]	[]	4.61	
	[]	[]	4.34	
	[]	[]	4.18	
	[]	[]	4.12	
<i>PESQ Min/Max/StdDev</i>	3.62	4.62	0.33	
Call Release Test:	[]	[]	passed	✓

MS Serial Number: 12345678-123456-8

Result:
 (Execution Time: 35.9 Seconds)

6 Tests passed / 0 Tests failed

Fig. 36 CMUgo Measurement Report

GSM PESQ Measurement for CMUgo

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....**

	A	B	C	D	E	F	G
1	Measurement Report						
2	Date & Time:	Freitag, 16. November 2007 15:12:05					
3	Operator:	noname					
4	CMU Ident:	Rohde&Schwarz,CMU 200,xxxxxx/xxx,\Vx.xx					
5	Options:	B11/B12,B21,B41,B52,PCMCIA,B53,B83,B95,K0,K42,K64,CPU(FMR),Memory					
6		uP1					
7	Sequence:	- - -					
8							
9	Test Name ar	Lower Limit	Upper Limit	Measured Va	Unit	P/F	
10							
11	<i>Network: GSM 1900, BCCH Channel#Level: 600-85.0 dBm, TCH Channel: 610, TCH Level (dBm): -95.0, Support G</i>						
12							
13	<i>(Main) Timeslot: 3, Attenuation (In/Out): 0.6/0.6 dB, Slot Mode: Single Slot, Bitstream: PR9, AuxTX: Off</i>						
14							
15	<i>Traffic Mode: Full Rate V2</i>						
16							
17	<i>IMS: 0.0.1000000095,Serial: 12345678-123456-8, Revision: PH2P, Number. , Traffic: FRV1, Power Class: 4</i>						
18							
19	Call to Mobile:					Passed	
20	PESQ Meas	4		4,00100101		Passed	
21				4,28279366			
22				4,09765313			
23				4,40537126			
24				4,29350666			
25				4,24093753			
26	PESQ Min/	3,50100101	4,50100101	0,33			

Fig. 37 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 Additional Information

Please contact TM-APPLICATIONS@RSD.ROHDE-SCHWARZ.COM for comments and further suggestions.

5 Ordering Information

Audio Analyzer

UPV	(0 Hz - 250 kHz)	1146.2003.02
Or		
UPV66	(0 Hz – 250 kHz)	1146.2003.66
UPV-K1	Universal Sequencer Controller	1401.7009.02
UPV-K61	PESQ Measurement Option	1401.7309.02

Vector Signal Generator

SMU200A	Vector Signal Generator	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	Additive White Gaussian Noise (AWGN)	1159.8511.02

Radio Communication Tester

CMU200	Univ. Radio Comm. Tester	1100.0008.02
CMU-B17	IQ/IF analogue Interface	
CMU-B21	Univ. Signalling Unit	1100.5200.54
CMU-K20	GSM400 SW-option and / or	1115.5900.02
CMU-K21	GSM900 SW-option and / or	1115.6007.02
CMU-K22	GSM1800 SW-option and / or	1115.6107.02
CMU-K23	GSM1900 SW-option and / or	1115.6207.02
CMU-K24	GSM850 SW-option	1115.6307.02



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