Replacing R&S® CMU200 with R&S® CMW500 in 2G and 3G Speech Test Applications

Application Note

Products:

- R&S®CMU200
- R&S®CMW500
- R&S®UPV
- R&S®UPV-K9
- R&S®UPV-K61
- R&S®UPV-K63

The combination of R&S® CMU200 and R&S® UPV is in use for various tests of mobile phone speech functionality, such as acoustic tests according to 3GPP 26.132 or speech quality tests according to ITU-T P.862 (PESQ®) or ITU-T P.863 (POLQA®). This application note explains how to replace the R&S® CMU200 in these tasks with R&S® CMW500.

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1 Introduction

1.1 Overview

The R&S® CMU200 radio communication tester, herein below further called CMU200, together with the R&S® UPV audio analyzer, herein below further called UPV, forms a test platform for various measurement tasks in the speech functionality of mobile phones. Examples are acoustic testing according to 3GPP TS 26.132 and speech quality evaluation according to ITU-T P.862 (PESQ®) and ITU-T P.863 (POLQA®).

With all these applications the audio level has significant influence on the results. Therefore correct adjustment of levels at the analog speech interfaces between the radio communication tester and the audio analyzer is required.

With the advent of new wireless radio access technologies like LTE, R&S® CMW500 wideband radio communication tester, herein below further called CMW500, is gradually replacing the CMU200.

The method of adjusting the levels at the analog input and output of the speech codec is fundamentally different between CMU200 and CMW500. This application note explains the differences and gives instruction on the use of the CMW500 in well-known speech test applications.

1.2 Speech input and output level in the CMU200

The analog speech interface of the CMU200 has a fixed but uncalibrated input and output level. For this reason the CMU firmware provides special functionality for adjusting the levels of the test platform. The nominal full-scale peak output level is 1V. For the input there are two different settings, “Handset” or “Speech Codec”, respectively with 0.1 V full-scale peak input level, and “Handset low” or “Speech Codec low”, respectively, with 1.4 V full-scale peak input level.

1.2.1 Decoder Calibration

The “Decoder Cal” function outputs a full-scale sinewave with a frequency of 1 kHz from the CMU200 speech output. This functionality can be used to determine the analog full-scale output level by means of an appropriate measurement.

Note that the “Decoder Cal” function is only available in an active call, although the mobile is not involved in the signal path.

1.2.2 Encoder Calibration

The “Encoder Cal” function establishes a digital connection from the A/D converter to the D/A converter of the speech codec. In this operational mode, the input level to the speech input can be adjusted such that the analog output level equals the level measured during decoder calibration. This input level is then the full-scale input level of the analog speech codec input.

The internal analog gain settings equal those of the “Handset low” or “Speech Codec low” operation. Therefore this operational mode has to be used during all measurements.

Note that the “Encoder Cal” function is only available in an active call. The signal at the speech input is at the same time sent as downlink speech signal to the connected mobile.

1.3 Speech input and output level in the CMW500

Other than the CMU200, the CMW500 has no dedicated speech input and output. Instead AF input 1 and AF output 1 of the audio measurement unit are used for this purpose. For this reason, the full-scale peak input and output levels can be set in the user interface of the audio measurement unit.

The conformity of the analog speech input and output levels with the settings in the user interface are part of the calibration procedure of the CMW500 in factory and service. Therefore decoder and encoder calibration functionality is not required.

2 Settings on the R&S® CMW500

2.1 Audio Measurement

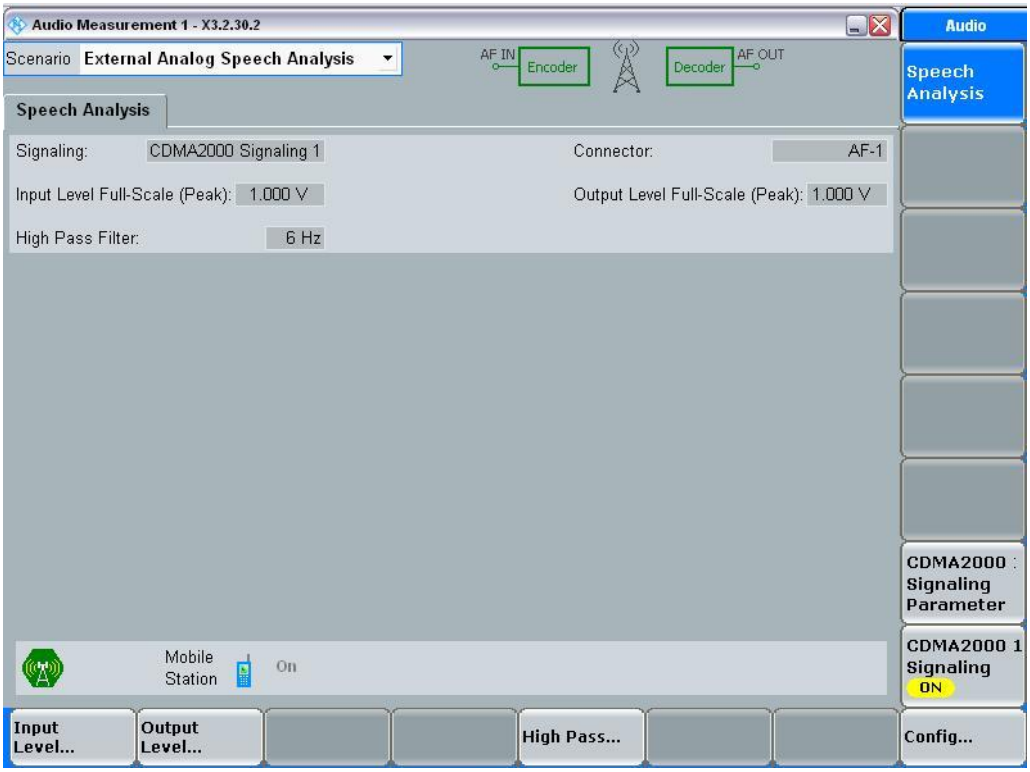

Figure 1 Settings in the Audio Measurement page

The scenario must be set to “External Analog Speech Analysis”. The full-scale input and output levels can be set with the softkeys on bottom of the screen.

2.2 GSM

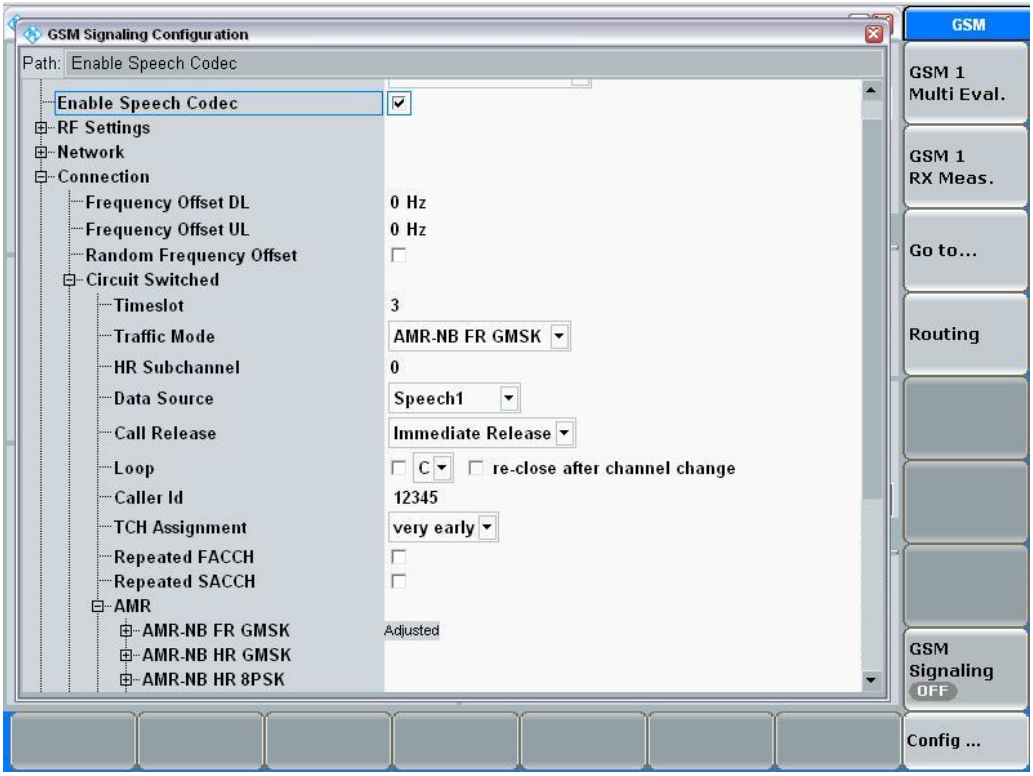

Figure 2 GSM signaling configuration for speech

The speech codec must be enabled in the Config page of the GSM signaling user interface. Set “Data Source” to “Speech” and select the appropriate codec and rate.

2.3 WCDMA

The speech codec must be enabled in the Config page of the WCDMA signaling user interface.

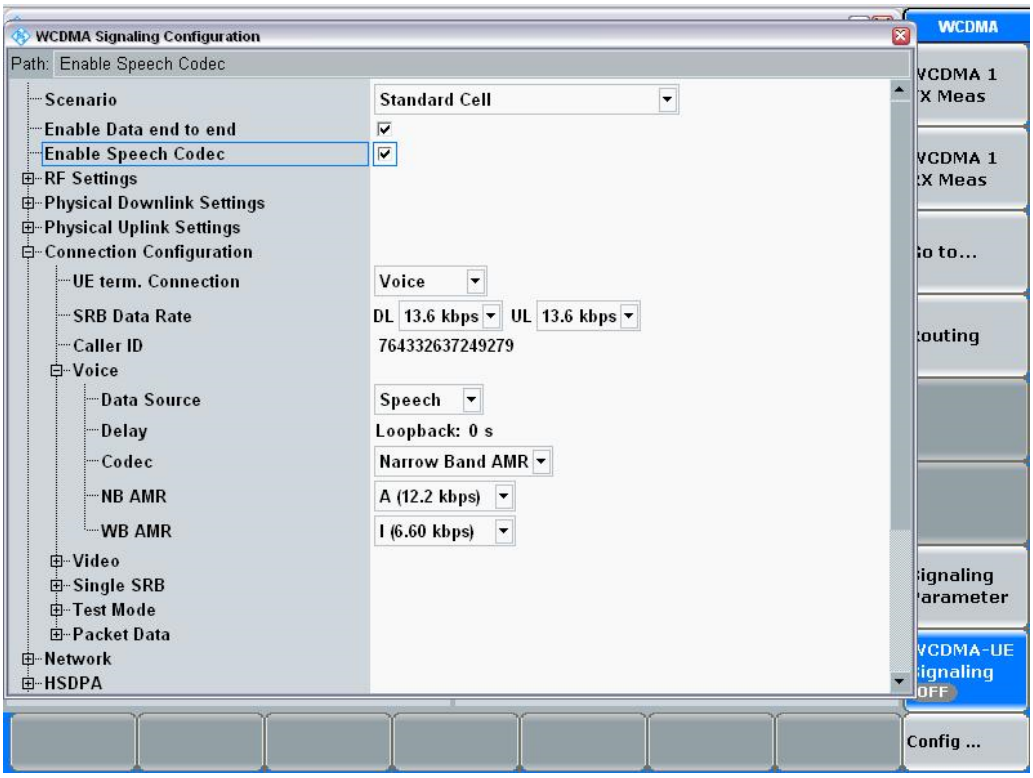

Figure 3 WCDMA signaling configuration for speech

Set “Data Source” to “Speech” and select the appropriate codec and rate.

2.4 CDMA2000®

The service option is selected on the CDMA2000® signalling page:

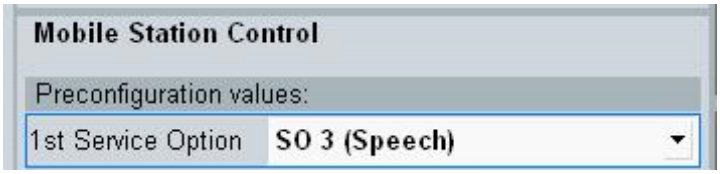

Figure 4 Setting the service option in the main page of CDMA2000 signalling

The speech codec must be enabled in the Config page of the CDMA2000 signalling user interface. The following settings apply for NB-EVRC according to service option 3:

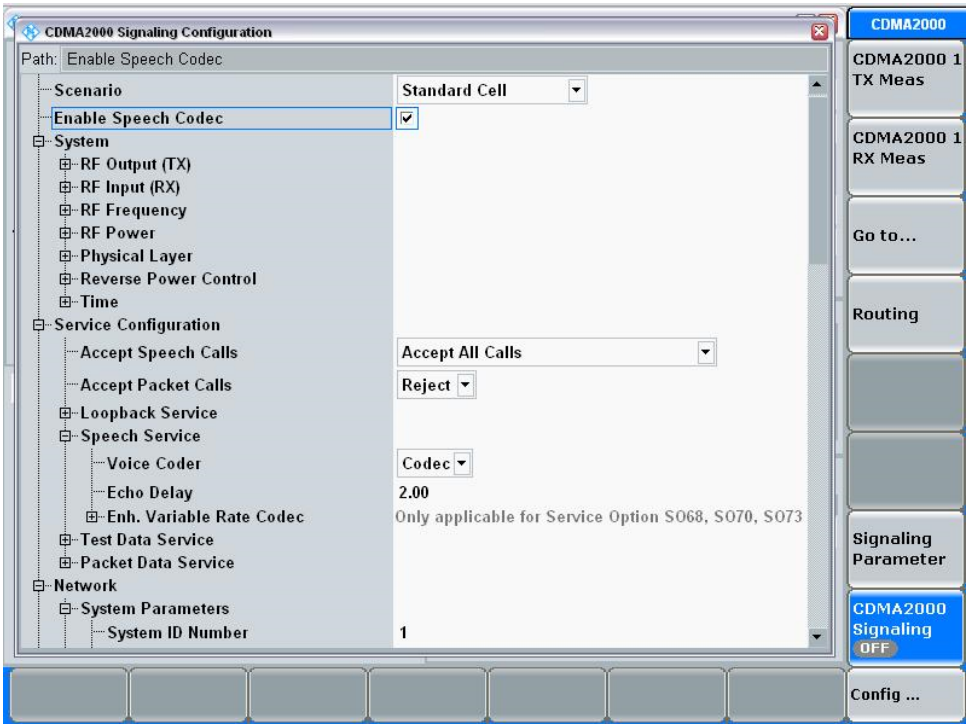

Figure 5 Setting the parameters for narrowband speech (SO3) on the CMW500

The CMW500 also allows wideband EVRC connections according to service option 73, codec operating point 0. Please see the settings below for this operational mode.

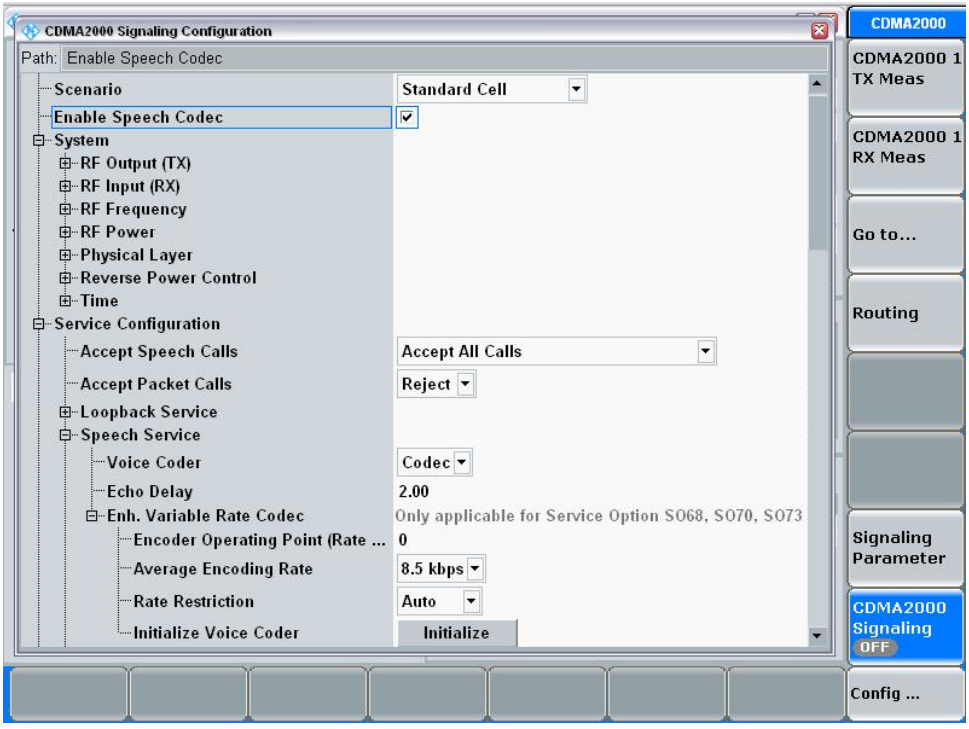

Figure 6 Setting the parameters for wideband speech (SO73 COP 0) on the CMW500

3 Settings in R&S® UPV Applications

3.1 Acoustic Tests with Option UPV-K9

The UPV-K9 programs store the decoder output level in terms of a so-called “decoder loss” $a_{dec.}$ a_{dec} is a virtual value which means the attenuation of the analog RMS output signal V_O relative to 0 dBU (775 mV RMS) for a digital level of 0 dBm0 (-3.14 dBFS) on the digital side. The full-scale peak output voltage $V_{O\text{-}FSpk}$ can be calculated as

$$V_{O-FSpk}/V = \sqrt{2} * 10^{(3.14/20)} * 10^{(-a_{dec})/20)} * 0.775$$

$$V_{O-FSpk}/V = \sqrt{2} * 10^{((0.9215-a_{dec})/20)}$$

The encoder input level is stored as full-scale RMS input voltage $V_{I\text{-}FSrms}$. Therefore the full-scale peak input voltage $V_{I\text{-}FSpk}$ can be calculated as

$$V_{I-FSpk} = \sqrt{2} * V_{I-FSrms}$$

3.1.1 Versions up to 2.x

3.1.1.1 Equivalence Method

This method allows direct replacement of the CMU200 by CMW500 without any change in the K9 program.

- Read the a_{dec} and $V_{I\text{-}FSrms}$ values from the UPV-K9 program using menu item “Calibration --> Show selected devices”.
- Calculate the full-scale peak values according to the formulae above.
- Enter the full-scale peak input and output value in the user interface of the CMW500 audio measurement unit.

Example:

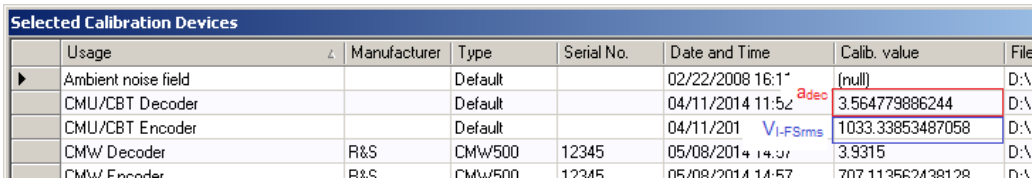

Figure 7 CMU calibration values in the K9 program

With the example values above, the full-scale peak values are

$V_{O\text{-}FSpk}$ = 1.0432 V

$V_{I\text{-}FSpk}$ = 1.4609 V

3.1.1.2 CMU-independent Method

- Set recommended full-scale peak input and output values in the user interface of the CMW500 audio measurement unit.
- In the UPV-K9 program, set the codec type in “Options --> System simulator” to “Electric”.
- Divide the full-scale peak input value entered in the user interface of the CMW500 audio measurement unit by √2 and enter the result as calibration value in “Calibration --> Electric connections --> replacing encoder”.
- Divide the full-scale peak output value entered in the user interface of the CMW500 audio measurement by √2 and enter the result as calibration value in “Calibration --> Electric connections --> replacing decoder”.

3.1.2 Versions from 3.x

- Set recommended full-scale peak input and output values in the user interface of the CMW500 audio measurement.
- In the UPV-K9 program, set the codec type in “Options --> System simulator” to “CMW”.
- In the UPV-K9 program, enter the full-scale peak output value from the CMW500 user interface (in mV) as decoder calibration value and the full-scale peak input value from the CMW500 user interface (in mV) as encoder calibration value in menu item “Calibration --> Codec --> CMW”.

3.2 Application Programs 1GA50 and 1GA62

The decoder and encoder calibration values in the application programs 1GA50 and 1GA62 are full-scale peak values, same as in the user interface of the CMW500 audio measurement unit.

3.2.1 1GA50 and 1GA62 up to version 1.2

3.2.1.1 Equivalence Method

- Read the encoder calibration value from the 1GA50 / 1GA62 application program and enter the value as full-scale peak input value in the user interface of the CMW500 audio measurement unit.
- Read the decoder calibration value from the 1GA50 / 1GA62 application program and enter the value as full-scale peak output value in the user interface of the CMW500 audio measurement unit.

3.2.1.2 CMU-independent Method

- Set recommended full-scale peak input and output values in the user interface of the CMW500 audio measurement unit.

- Open an existing encoder calibration *.ccl file in a text editor and enter the full-scale peak input value from the CMW500 audio measurement user interface in V.
- Save the modified file (file type “All files”) and load the file as encoder calibration in the downlink tab of the 1GA50 / 1GA62 program.
- Open an existing decoder calibration *.ccl file in a text editor and enter the full-scale peak output value from the CMW500 audio measurement user interface in V.
- Save the modified file (file type “All files”) and load the file as encoder calibration in the downlink tab of the 1GA50 / 1GA62 program.

3.2.2 1GA62 from version 1.3

The full-scale peak values for decoder and encoder can be directly entered in the user interface. Enter the full-scale peak value of the CMW500 speech input as encoder calibration value and the full-scale peak value of the CMW500 speech output as decoder calibration value.

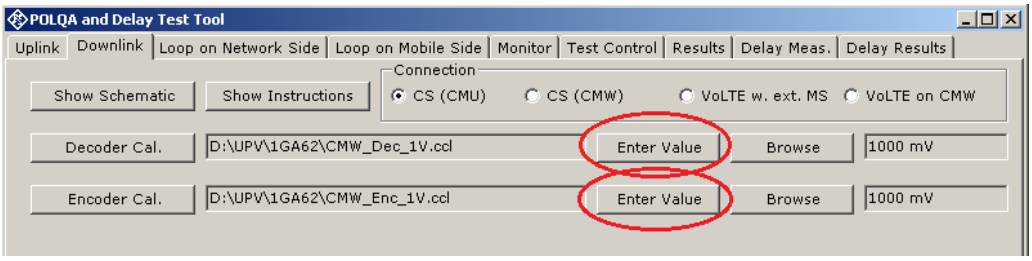

Figure 8 Buttons for direct entry of decoder and encoder calibration values

Click the respective “Enter Value” button for entering the full-scale peak decoder output and encoder input values from the CMW.

The “Connection” radio buttons have only influence on the displayed schematics and instructions, not on the other functionality of the macro.

4 Literature

1. R&S® UPV-K9 / -K91 User Manual
http://www.rohde-schwarz.com/en/search/common-library_63448.html?facet=facet.CommonLibraryType&facet.CommonLibraryType=Manuals&term=UPV-K91

2. R&S® UPV-K9 / -K92 User Manual
http://www.rohde-schwarz.com/en/search/common-library_63448.html?facet=facet.CommonLibraryType&facet.CommonLibraryType=Manuals&term=UPV-K92

3. R&S® CMW500 User Manual
http://www.rohde-schwarz.com/en/search/common-library_63448.html?facet=facet.CommonLibraryType&facet.CommonLibraryType=Manuals&term=CMW500

4. Application note 1GA50 “Calibration Tool for PESQ® Speech Quality Tests”
http://www.rohde-schwarz.com/en/search/applications_63466.html?term=1GA50&facet=facet.ApplicationType&facet.ApplicationType=Application%2520Note

5. Application note 1GA62 “Test Automation Tool for POLQA® and PESQ® Speech Quality Tests”
http://www.rohde-schwarz.com/en/search/applications_63466.html?term=1GA62&facet=facet.ApplicationType&facet.ApplicationType=Application%2520Note

5 Ordering Information

Ordering Information		
Type of instrument		
Description	**Instrument type**	**Ordering number**
Audio Analyzer	R&S®UPV or R&S®UPV66	1146.2003.02 1146.2003.66
Base software for mobile phone tests	R&S®UPV-K9	1402.0008.02
UMTS/GSM Mobile phone tests	R&S®UPV-K91	1402.0108.02
CDMA2000® Mobile phone tests	R&S®UPV-K92	1402.0608.02
Background noise control softw.	R&S®UPV-K98	1424.2003.02
Measurements using background noise	R&S®UPV-K101	1424.2203.02
Universal Sequence Controller	R&S®UPV-K1	1401.7009.02
SW for PESQ Measurements	R&S®UPV-K61	1401.7309.02
Listening quality analysis POLQA, to ITU-T rec. P.863	R&S®UPV-K63	1402.1156.02
Universal Radio Communication Tester	R&S®CMU200	1100.0008.02
Wideband Radio Communication Tester	R&S®CMW500	1201.0002K50

For help on the configuration of R&S® CMW500 please contact local R&S sales.

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 more than 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Certified Quality System
ISO 9001

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