HEADacoustics

A
ACQUA

Establish LTE & 2G/3G connections to HEAD acoustics equipment via R&S®CMW500

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1. Introduction

This Application Note suggests different measurement setups using the Rohde & Schwarz (R&S®) radio communication tester CMW500 in combination with specific HEAD acoustics equipment.

The presented measurement setups are intended to test mobile devices with current mobile communication standards. The setups are designed for testing communication via VoLTE, 3G or 2G.

Both setup guides (VoLTE, 2G/3G) have a similar structure. First the interconnection setup is illustrated. All necessary hardware and software equipment is listed. Then the document guides through the configuration of the HEAD acoustics hardware with the measurement software ACQUA. Eventually the last section instructs the correct configuration of the radio communication tester for the mentioned communication standards.

The Application Note is written assuming that the user has an advanced knowledge of handling HEAD acoustics equipment and the R&S®CMW500. HEAD acoustics will not respond to support requests concerning general handling and technical configuration of the R&S®CMW500.

2. VoLTE Setup with MFE VIII.1 and CMW500

The first section illustrates the VoLTE setup using the Rohde & Schwarz radio communication tester CMW500 in combination with HEAD acoustics hardware. The second section describes the main configurations in ACQUA followed by the MFE VIII.1 configuration in the third section. The fourth section explains the connection buildup between the device under test with the CMW500.
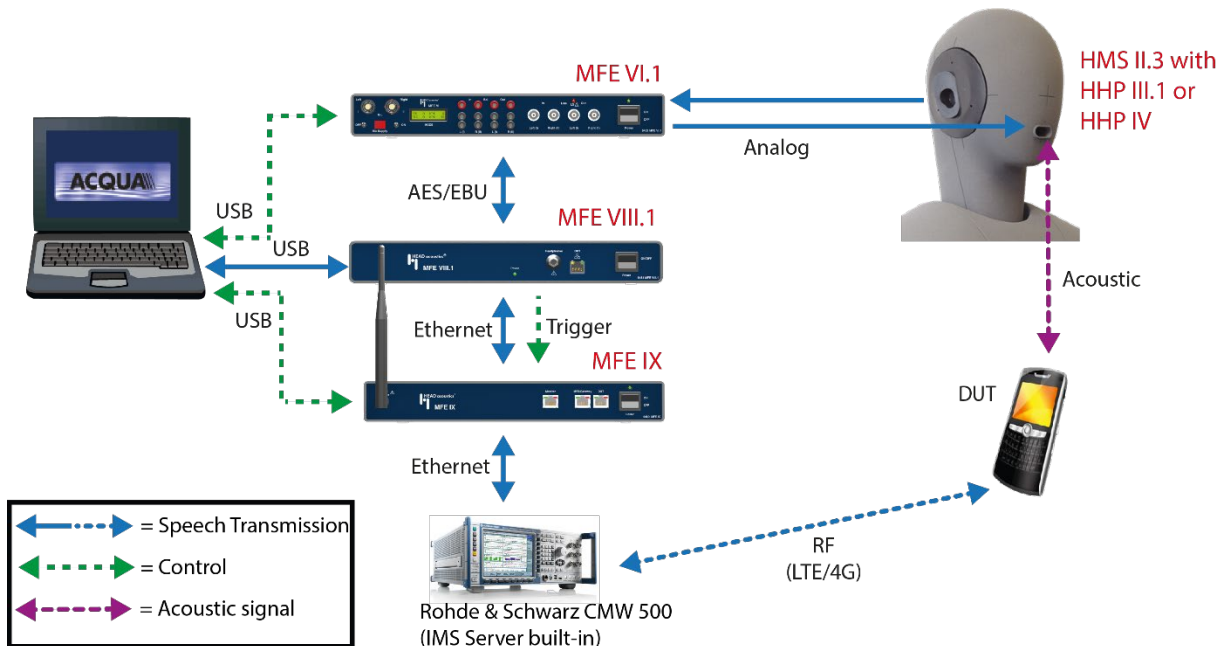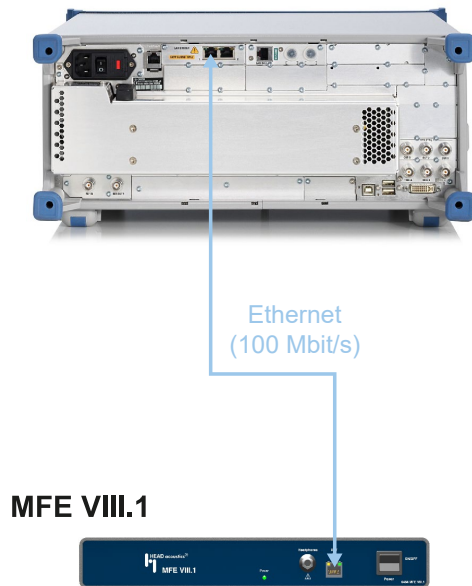
2.1 Measurement Setup

Figure 1: Overview of the measurement setup

The measurement setup (Figure 1) consists of the following components:

- ACQUA Analysis System (Code 6810) (Version 3.2.200 and higher)
- HMS II.3 (Code 1230) with HHP III.1 (Code 1403) or HHP IV (Code 1406)
- MFE VI.1 (Code 6462)
- MFE VIII.1 (Code 6484) with Option Cod-AMR (Code 6485) and IMP (Code 6496)
- Optional MFE IX (Code 6480) for network impairment measurements
- Optional HAE-BGN Background Noise Simulation (Code 6971)
- Optional 3PASS Background Noise Simulation (Code 6990)
- CMW500

The CMW500 is connected via Ethernet cable to the MFE VIII.1 (optional MFE IX interconnected). **Note:** Newer models of the CMW500 exclusively support Gigabit Ethernet and therefore are not compatible with the Fast Ethernet port of MFE VIII.1. In case a network connection cannot be established, please insert a Gigabit Ethernet switch capable of both transmission speeds inbetween the devices to mediate.
The MFE VIII.1 is connected via AES/EBU to the MFE VI.1 and via USB to ACQUA (see Figure 1: Overview of the measurement setup).

CMW500 (100/1000 Mbit/s)

CMW500 (1000 Mbit/s only)

Ethernet
(100 Mbit/s)

Ethernet
(1000 Mbit/s)

Gigabit Switch
(100/1000 Mbit/s)

Ethernet
(100 Mbit/s)
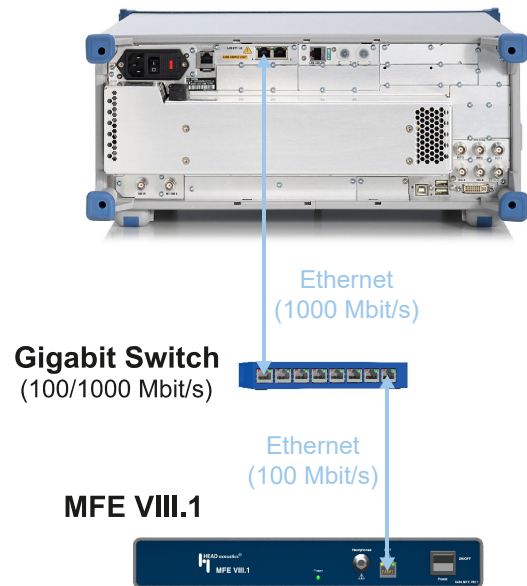
MFE VIII.1

MFE VIII.1

2.2 Configuration in ACQUA

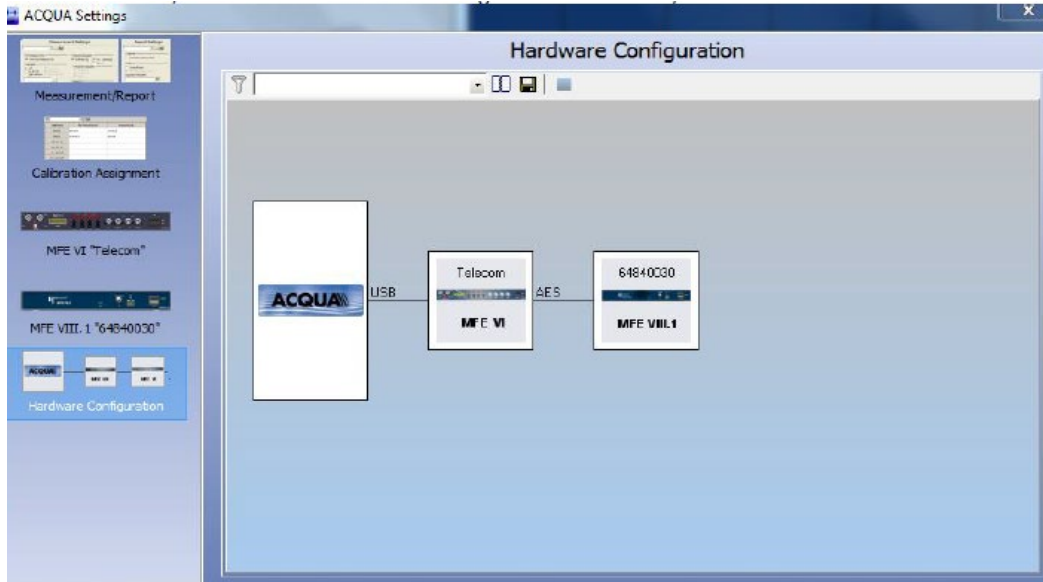### 2.2.1 Hardware Configuration

Figure 2: ACQUA Hardware Configuration with MFE VI.1 and MFE VIII.1
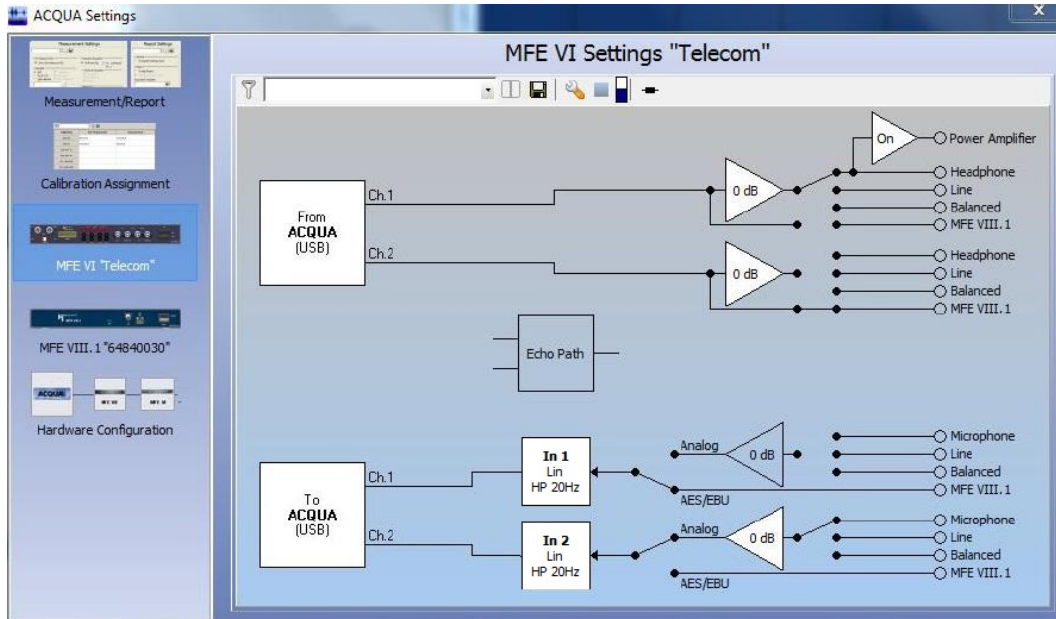
2.2.2 MFE VI.1 Settings

Figure 3: MFE VI.1 Settings in ACQUA

2.2.3 MFE VIII.1 Settings
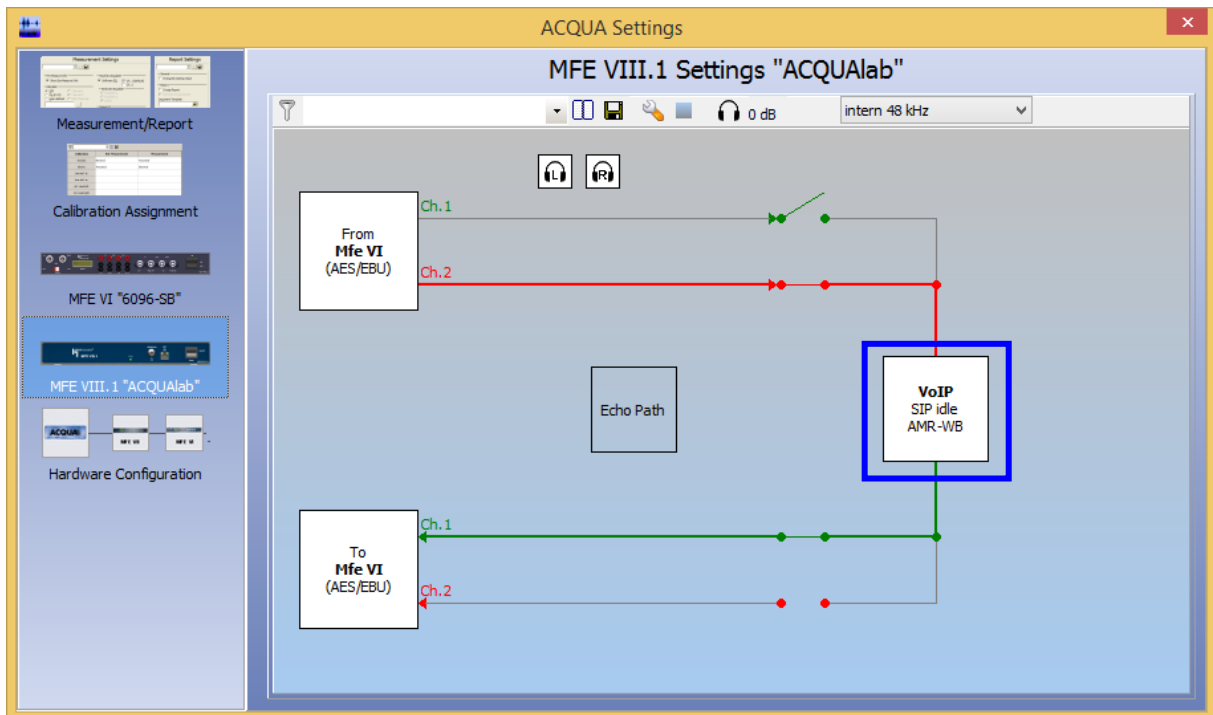
Figure 4: MFE VIII.1 Settings in ACQUA

Open the configuration menu of the MFE VIII.1 by double-clicking on the VoIP field (see Figure 4).

2.3   Configuration of MFE VIII.1

2.3.1   Mandatory Settings
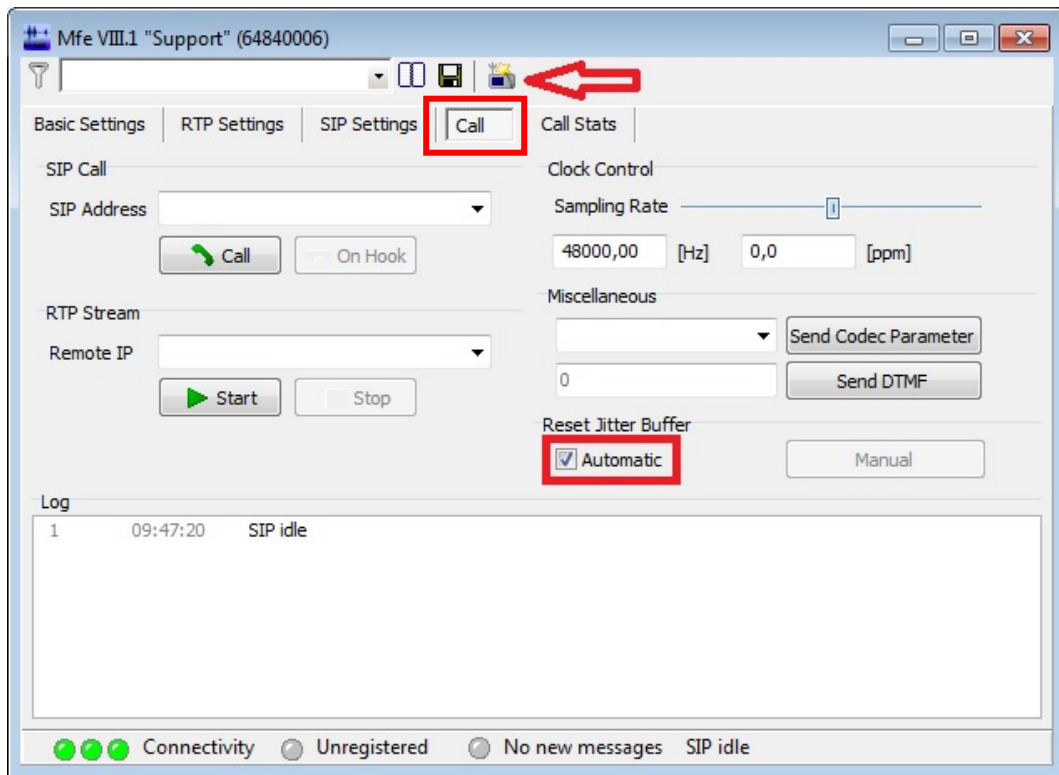
Figure 5: Mandatory settings for MFE VIII.1

1. Select the "Call" tabulator (see Figure 5).
2. Enable the automatic jitter buffer reset function (see Figure 5).
3. Start the radio tester wizard by by clicking on the symbol next to the red arrow in Figure 5. The radio tester wizard prepares the front end for the RTP stream to and from the radio tester.
4. Follow steps 1–4 of section 2.3.2 MFE VIII.1 Radio Tester Wizard and adjust the settings.

Do **not** start the RTP stream by hand. The RTP stream is automatically detected by the MFE VIII.1 after closing the wizard.

2.3.2   MFE VIII.1 Radio Tester Wizard

1. Select CMW500 as the radio tester.	Figure 6: Radio tester Selection
2. The MFE VIII.1 must have the IP address where the CMW500 expects to find the media server. Typically, this is 172.22.2.2, and the corresponding subnet mask is 255.255.0.0.	Figure 7: IP Settings
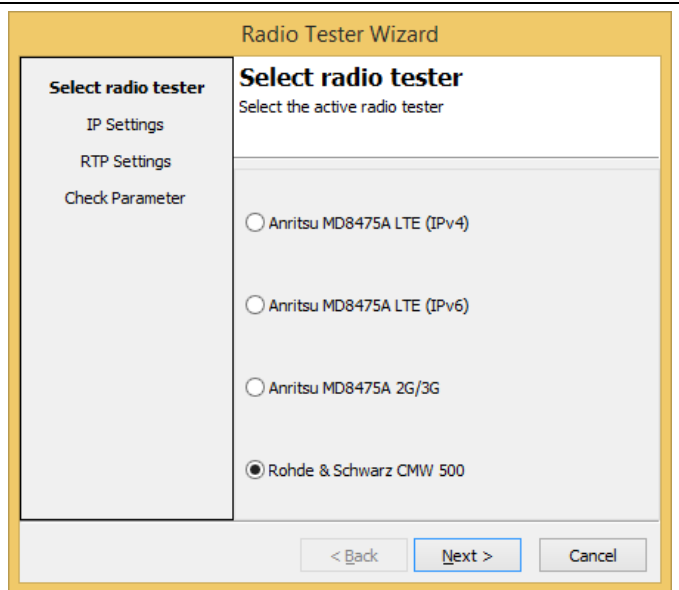
3. Select a suitable initial jitter buffer length. Default setting is 140 ms. 4. Select the preferred (audio) codec.	 Figure 8: RTP Settings
5. Double check the settings and close the wizard by selecting "Finish".	 Figure 9: Parameter Check
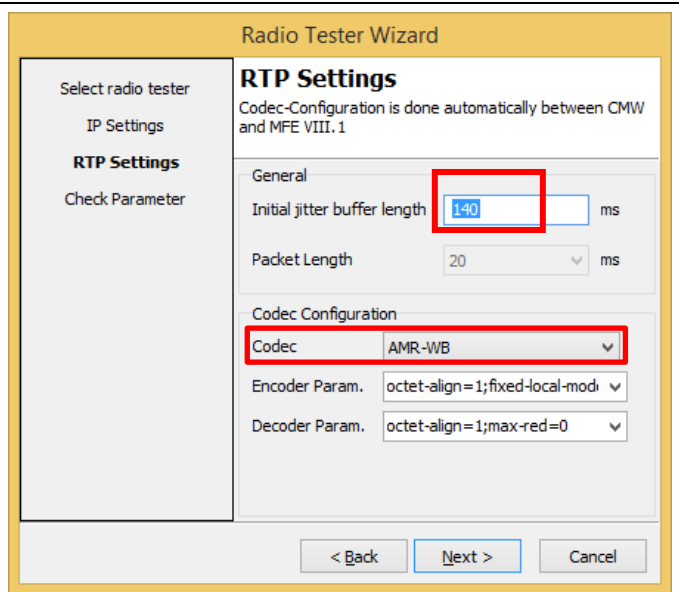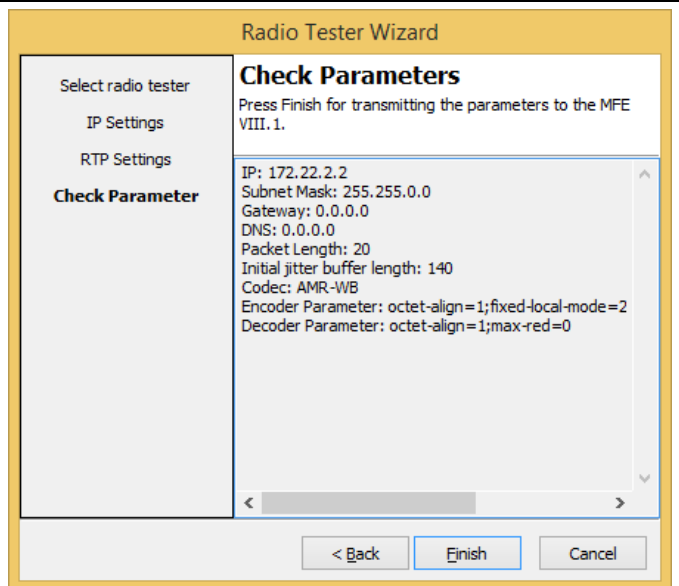
2.4 Configuration of CMW500

2.4.1 Presets of CMW500

Please ensure that all necessary Rohde & Schwarz measuring equipment for the VoLTE setup is available. For example, CMW500 Options or CMW500 Routing Options. If in doubt, please contact the Rohde & Schwarz sales department.

Figure 10: CMW500 front panel

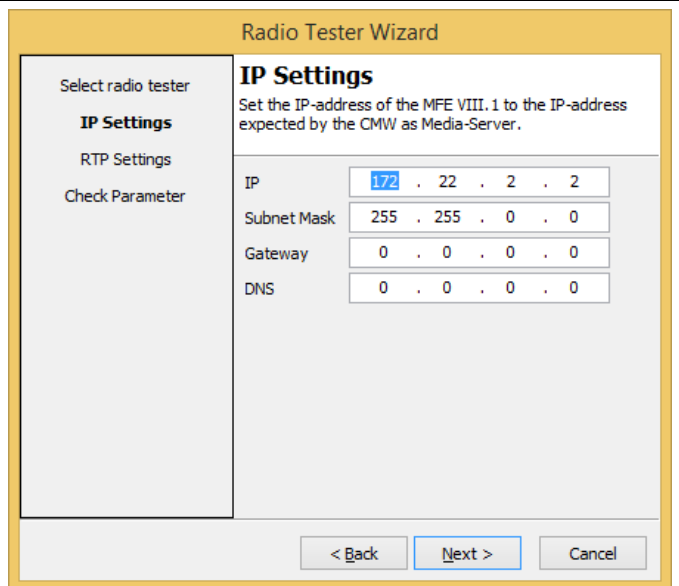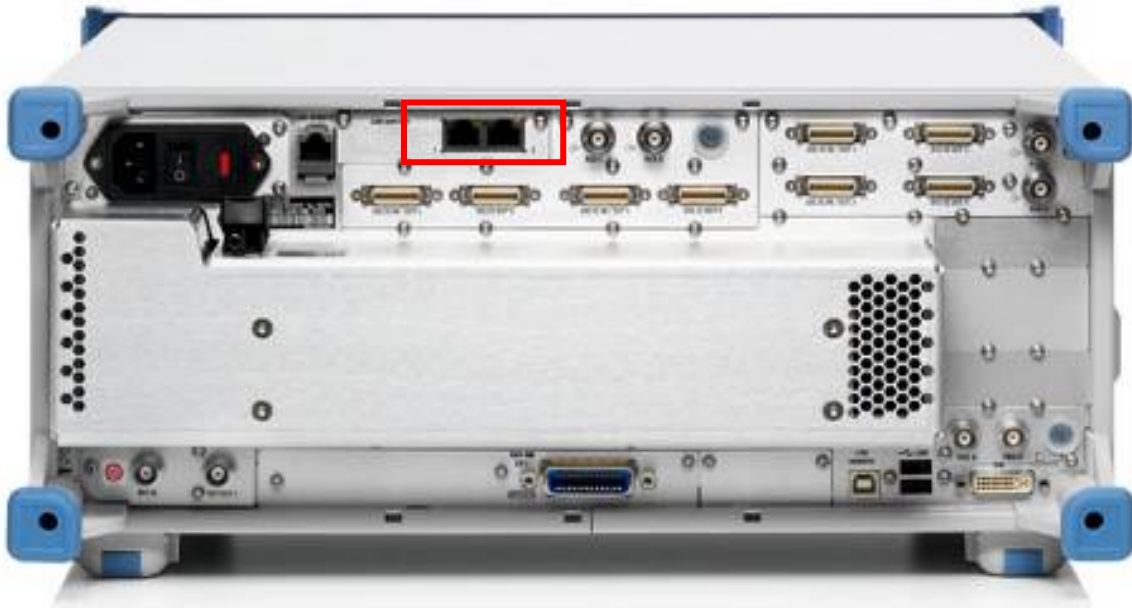Figure 11: CMW500 back view

1. Press the button ⬚MEASURE⬚ at the front panel of the CMW500 (**blue** box in Figure 10). Select **Data Appl. → Measurement 1** and **Selected RAN → LTE Signaling 1** (see Figure 12).

2. Press the button ⬚SIGNAL GEN⬚ (**red** box in Figure 10) and select **LTE Signaling 1** (see Figure 13).

To switch between Data Measurement and LTE Signaling press ⬚TASKS⬚ (**green** box in Figure 10).
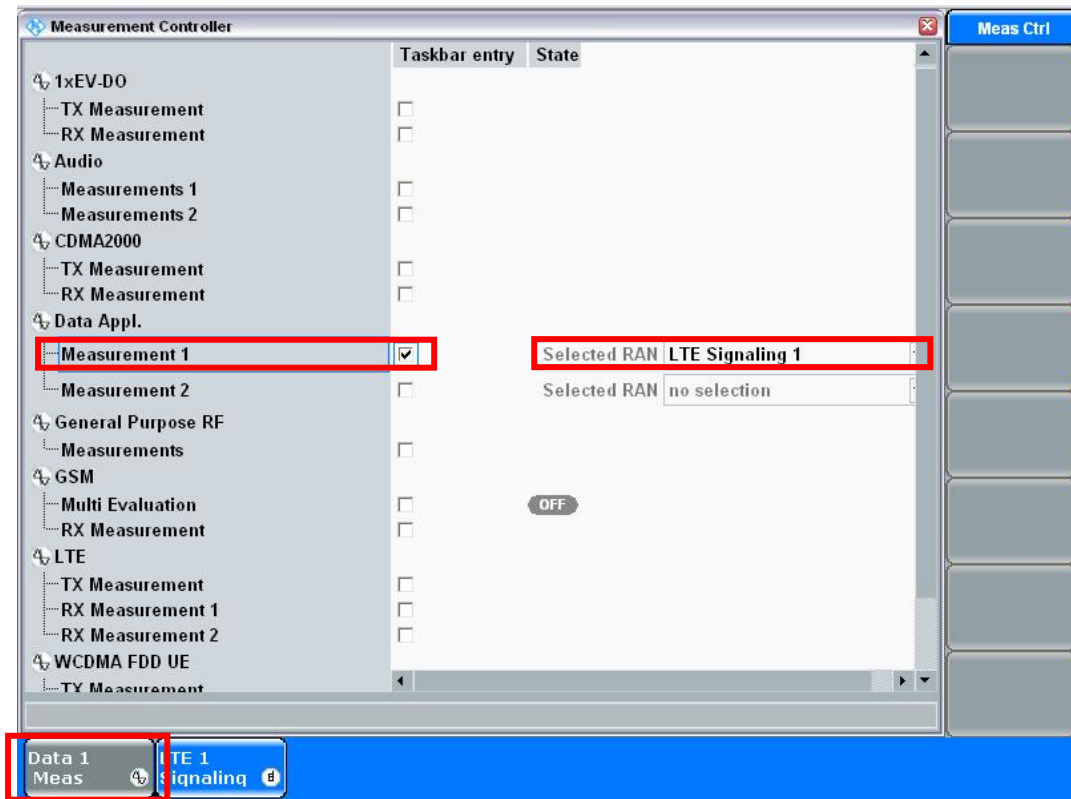
Figure 12: Selecting Measurement Task

3. Select **LTE Signaling** (Figure 13) and continue with section 2.4.2.
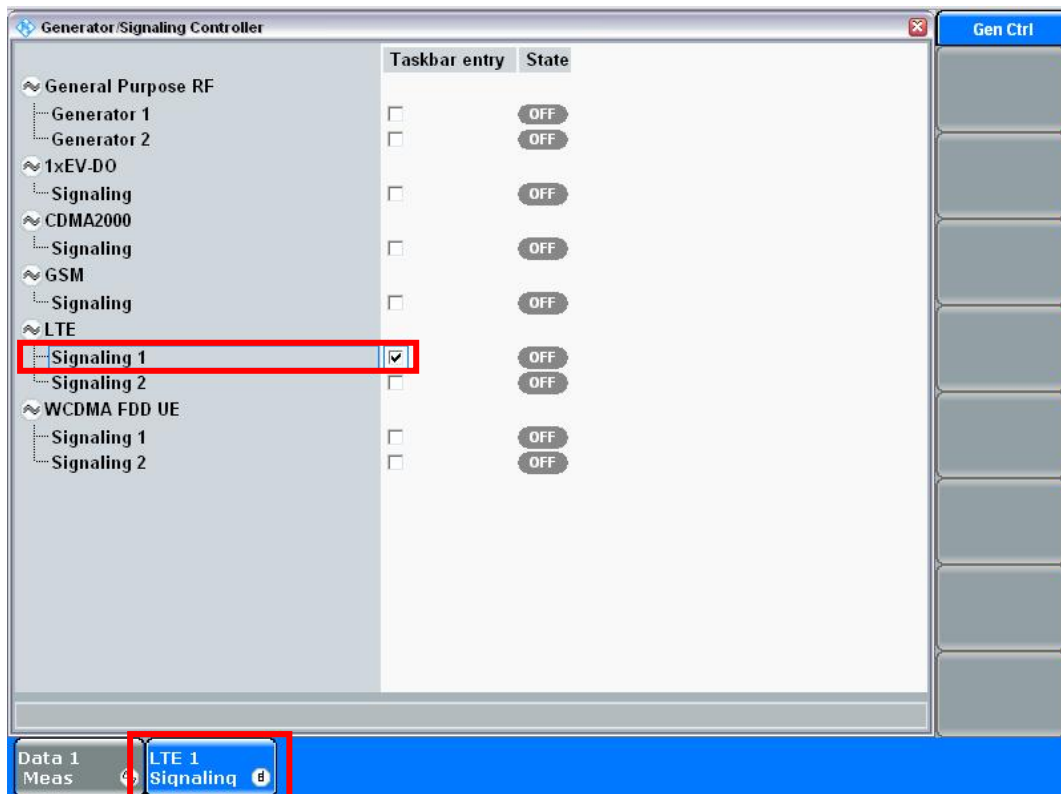
Figure 13: Selecting Signaling Task

2.4.2 LTE Signaling

This section provides hints to obtain a good LTE connection between the device under test and the CMW500.

1. Set the **RS EPRE Power** to **–62,8 dBm / 15 kHz** and the **PUSCH Open Loop Nom. Power** to **0 dBm** (see Figure 14).

2. Select Config… to continue with the advanced settings (see Figure 14).
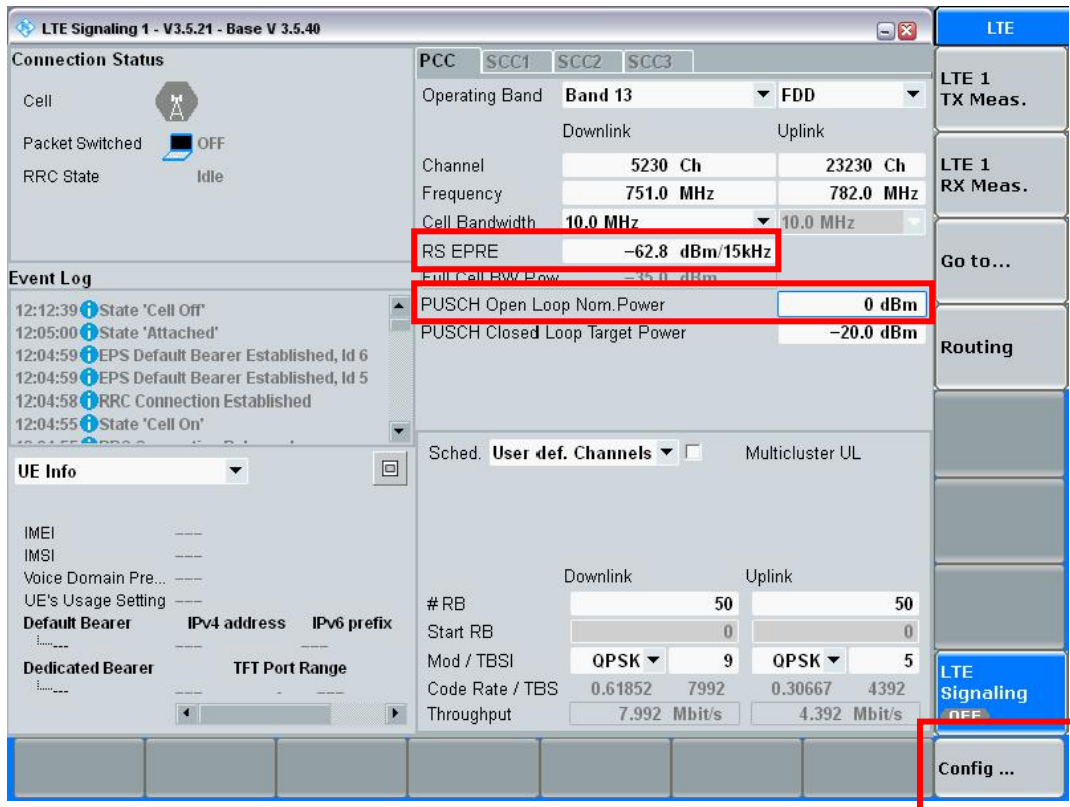
Figure 14: Main LTE Settings

3. Set the external attenuation of **RF Output (TX)** and **RF Input (RX)** according to the attenuation of the antenna and antenna cable (**External Attenuation** in Figure 15).

4. The **RF Frequency → Operating Band** (Figure 15) depends on the device under test. Set accordingly.
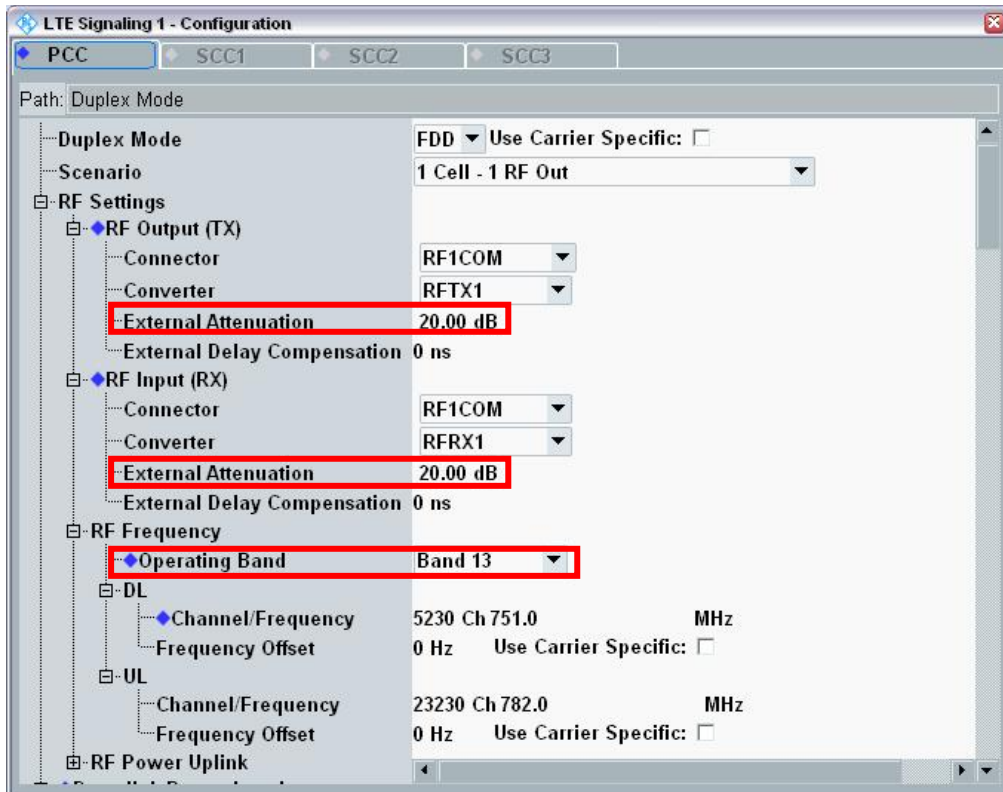
Figure 15: Configuration Menu LTE Signaling

5. The proper values for **Network → Network Identity → MCC/MNC** (Figure 16) depend on the SIM card that is used. The Rohde & Schwarz test SIM card uses **MCC *001*** and **MNC *01***.

6. The **Network → Security Settings** (Figure 16: MCC/MNC Settings) must match with the used SIM card. Refer to the technical data of the used sim card if in doubt. Set the security settings accordingly.

Figure 16: MCC/MNC Settings

7. Enable the **Send DNS PCO** and **EPS Network Feature Support** in the menu **NAS Signaling** (see Figure 17).

8. Set the **IMS Voice over PS Sess. Ind.** to *Supported* in the menu **NAS Signaling** (Figure 17).

9. In the menu **Connection**: Set the **Connection Type** to *Data Application* (Figure 17).
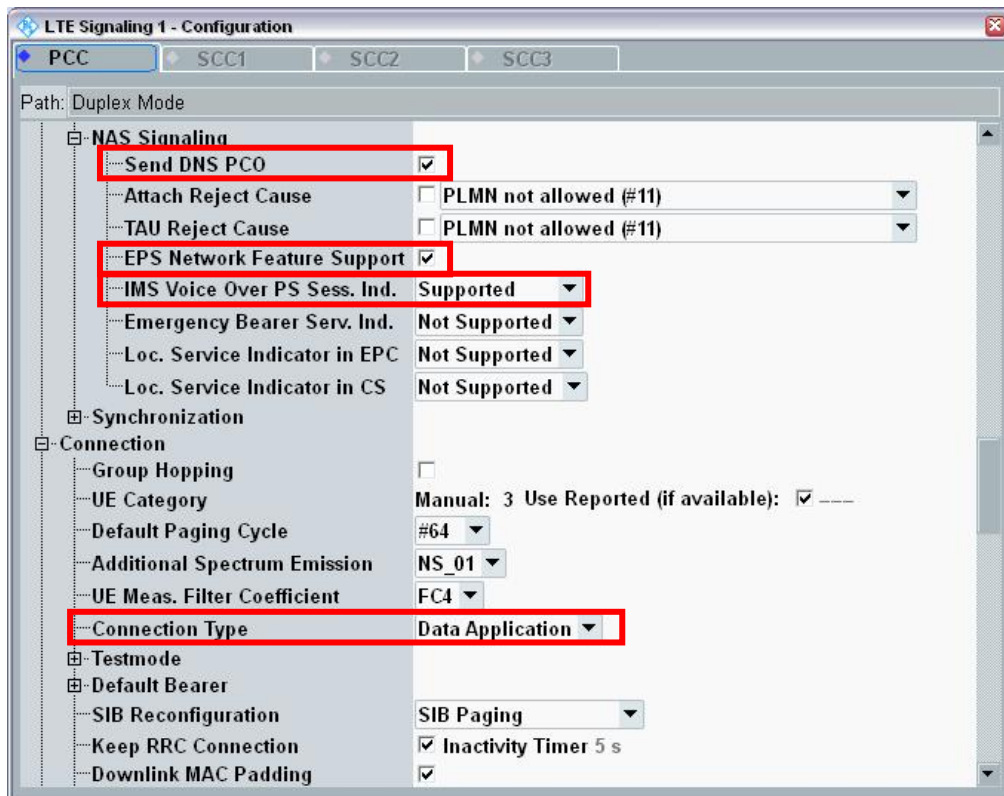
Figure 17: NAS Signaling and Connection

10. If all settings are configured correctly, switch on the LTE Signaling by pressing the button ⌈ON/OFF⌉ at the front panel (**yellow** box in Figure 10).
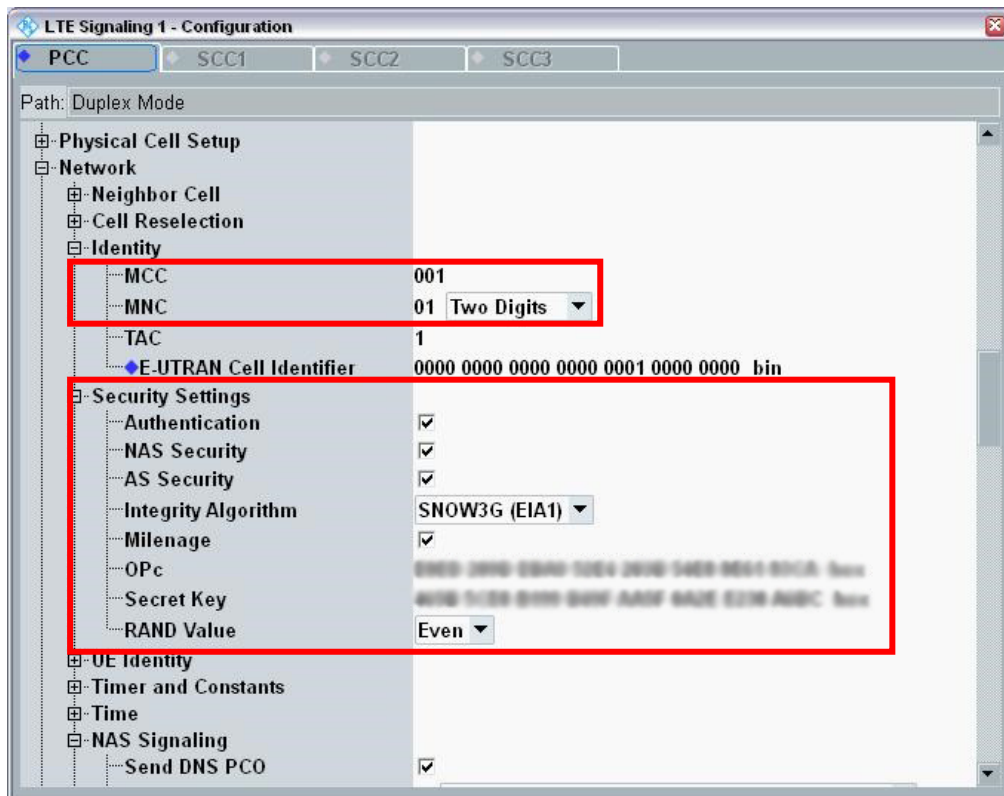
11. The device under test registers at the LTE cell automatically (see Figure 18).

12. View the measured RSRP value by switching the **UE Info** to *UE Measurement Report* (Figure 19).

To ensure a good radio communication quality, the value shall be similar to the adjusted RS EPRE Power (–62,8 dBm / 15 kHz, cf. Figure 14).

13. Change the external attenuation of the **RF Output** and **RF Input** (Figure 15) to adjust the appropriate target value.
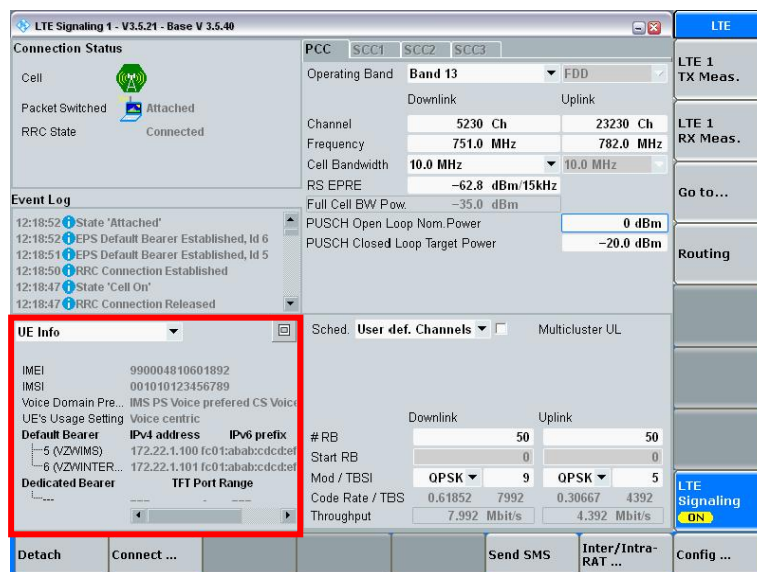
Figure 18: LTE Registration
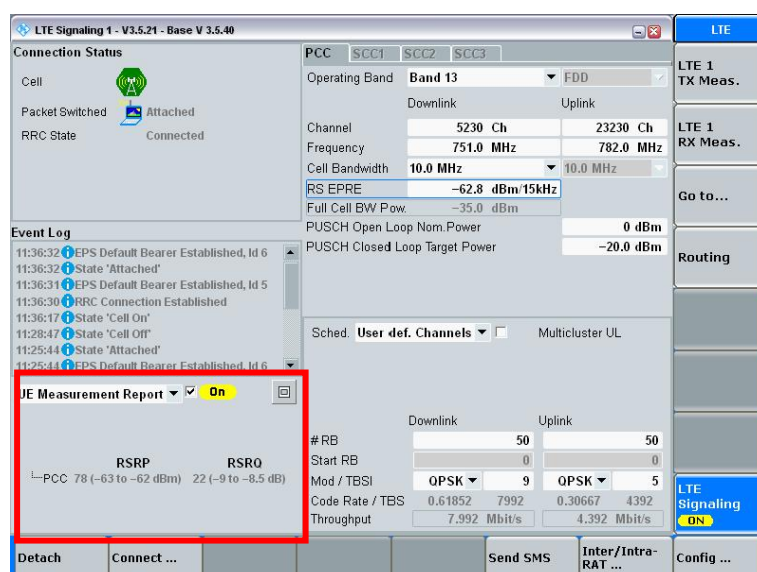
Figure 19: UE Measurement Report

2.4.3   IMS Server

This section instructs how to register the device under test at the IMS Server.

1. Press the button MEASURE at the front panel of the CMW500 (**blue** box in Figure 10) and select **Data Appl. Measurement 1** (see Figure 12).
2. Select the Task **Data 1 Meas** (lower part of Figure 12).
3. Select Configure Services (Figure 20).
4. Select the tab **IMS**.
5. Select Config… (Figure 22, right side, lower part).

Figure 20: Configure Services

Figure 21: IMS Config

6. Set the IMS server to *intern IMS* ([Figure 21](#)).
7. Whether to select *IPv4* or *IPv6* as **Address Type**, depends on the device under test.
8. Confirm IMS server and address type by selecting OK.
9. Select the section **Subscribers Configuration** (yellow box in [Figure 22](#)).
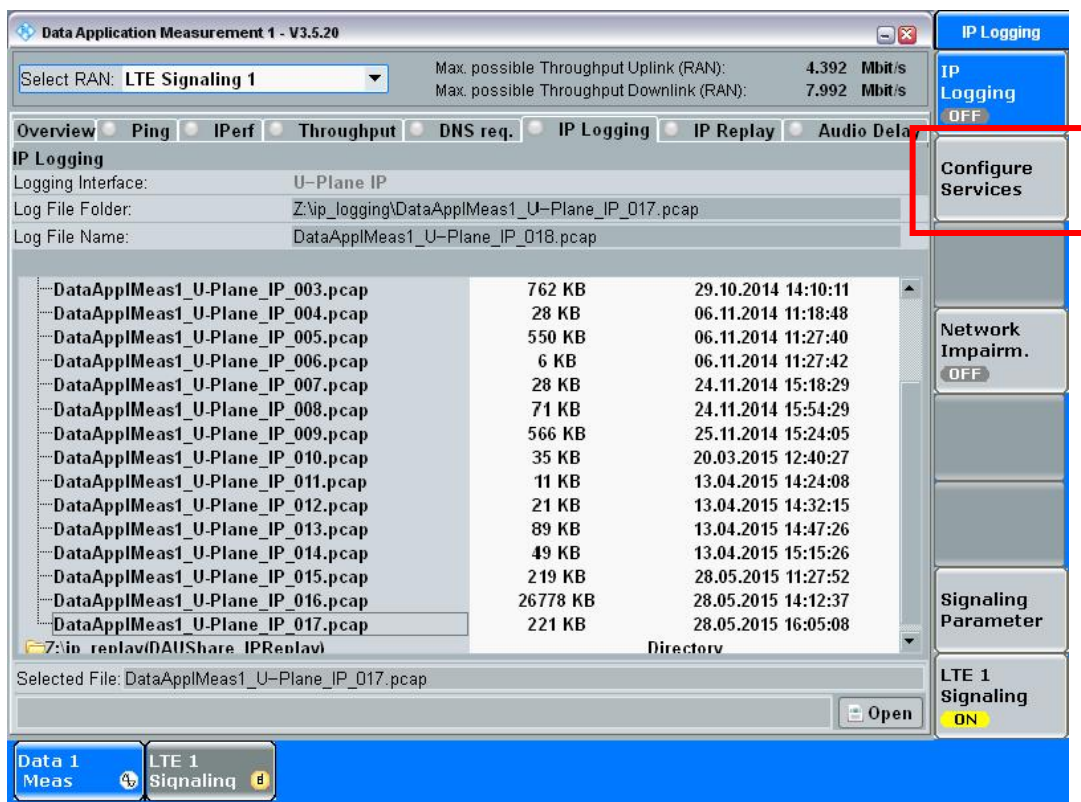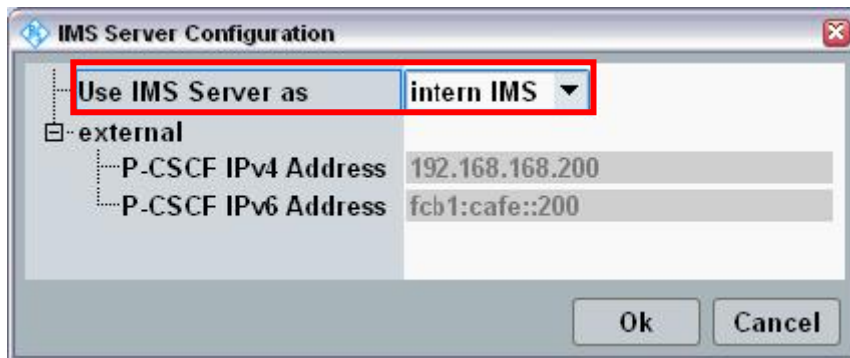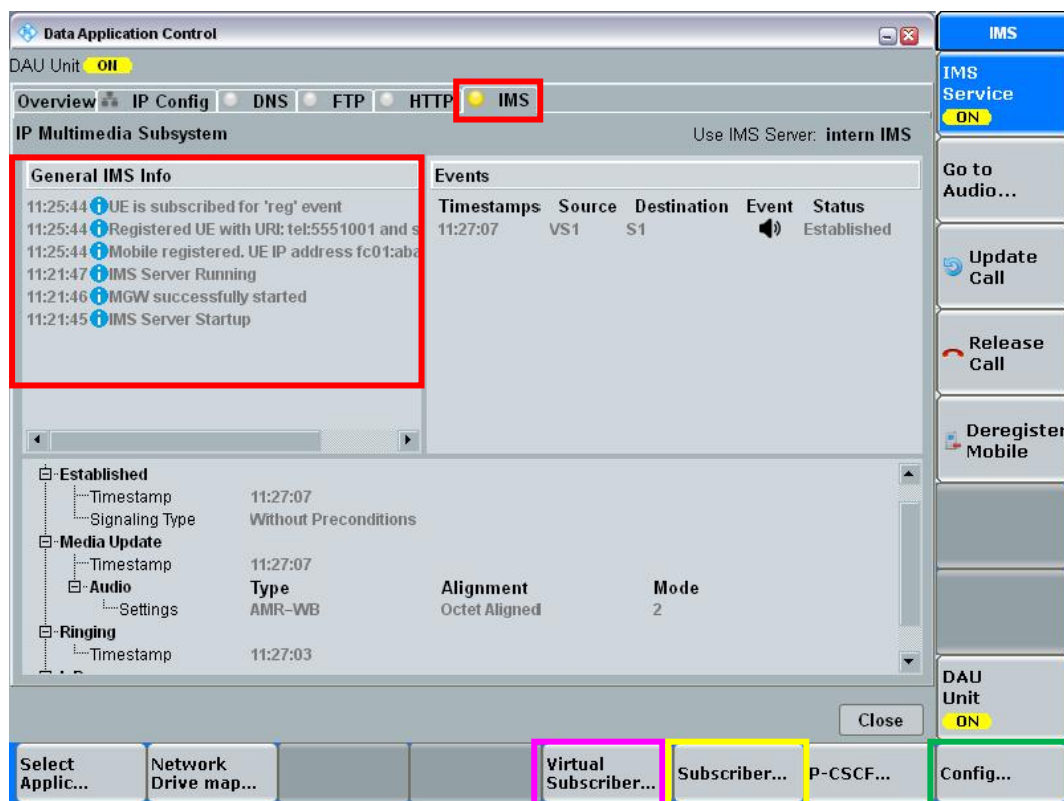

Figure 22: IMS Service

10. If the device under test requires **Authentication**, confirm authentication.

11. If user authentication is needed, adjust the **Authentication Data** to the SIM card in use and the device under test (Figure 23).

12. Confirm the entered data and return to IMS tab with OK.

13. Start the IMS server by pressing the button ⌷ON/OFF⌷ at the front panel (**yellow** box in Figure 10).

14. Activate and deactivate the airplane/offline mode of the mobile phone to register it to the CMW500.

15. Confirm IMS server startup and phone registration in the "General IMS Info" box (Figure 22).

Figure 23: Subscribers Configuration

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Application Note

**Establish LTE & 2G/3G
connections to HEAD acoustics
equipment via R&S®CMW500**
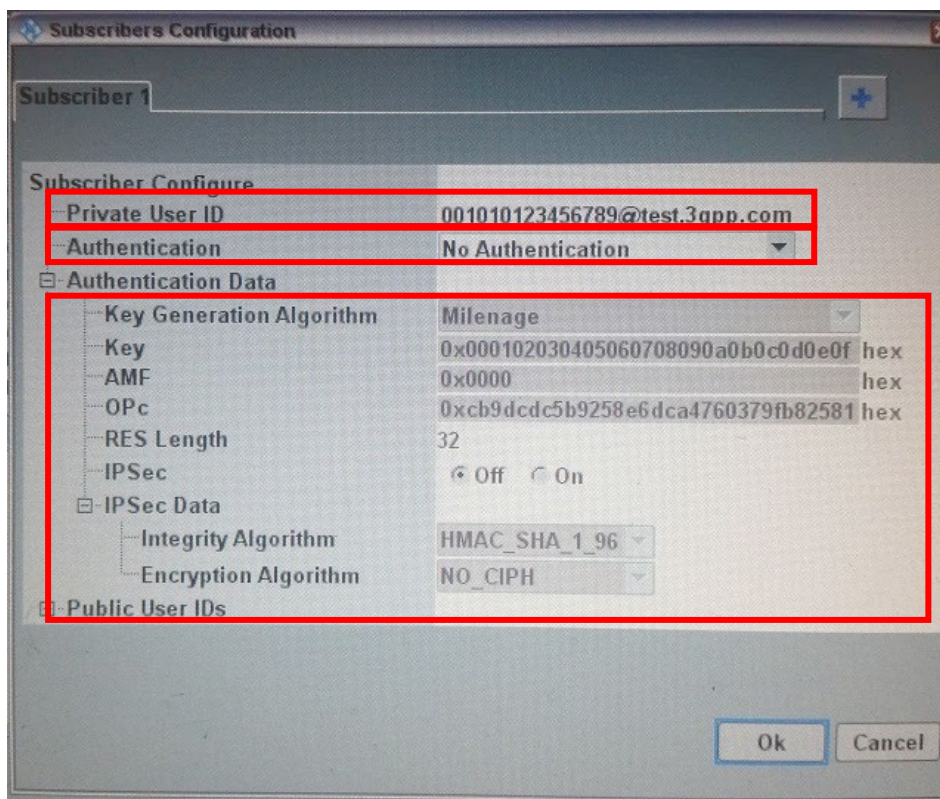
16. Select the section **Virtual Subscribers Configuration** (**pink** box in Figure 22).

17. Set **Signaling type** according to the device under test.

18. Set the **Audio Routing** to *Forward* (Figure 24). This ensures that the RTP stream is forwarded to the MFE VIII.1 via LAN SWITCH at the back of the CMW500 (Figure 11).

19. **Media Endpoint** is the IP Address of the MFE VIII.1 (see Figure 7 in Wizard, and Figure 24).

20. If all settings are correct, the device under test registers at the IMS server (Figure 22).

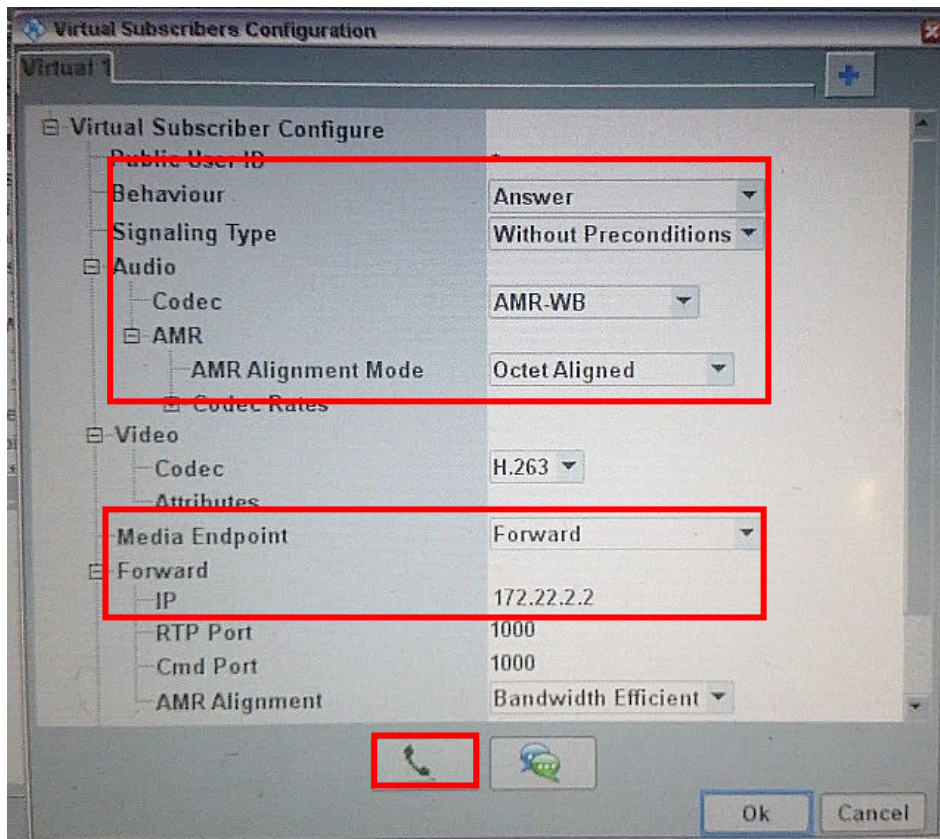21. Open the call menu (Figure 25) in the section **Virtual Subscribers Configuration** via the phone symbol button.

Figure 24: Virtual Subscribers Configuration

22. Set the **Call Type** to *Audio*.
23. The **AMR Type** and the **AMR Codec** have to be selected to match the DUT and the measurement (e.g. *AMR Wideband* with bit rate *12.65 kbps*).
24. Ensure that only the desired bit rate is selected during the connection.
25. Start the call by pressing Call (Figure 25).

The RTP stream starts automatically, and the status line in the configuration menu of the MFE VIII.1 changes from *SIP idle* to *RTP connected* (see Figure 4: MFE VIII.1 Settings in ACQUA).
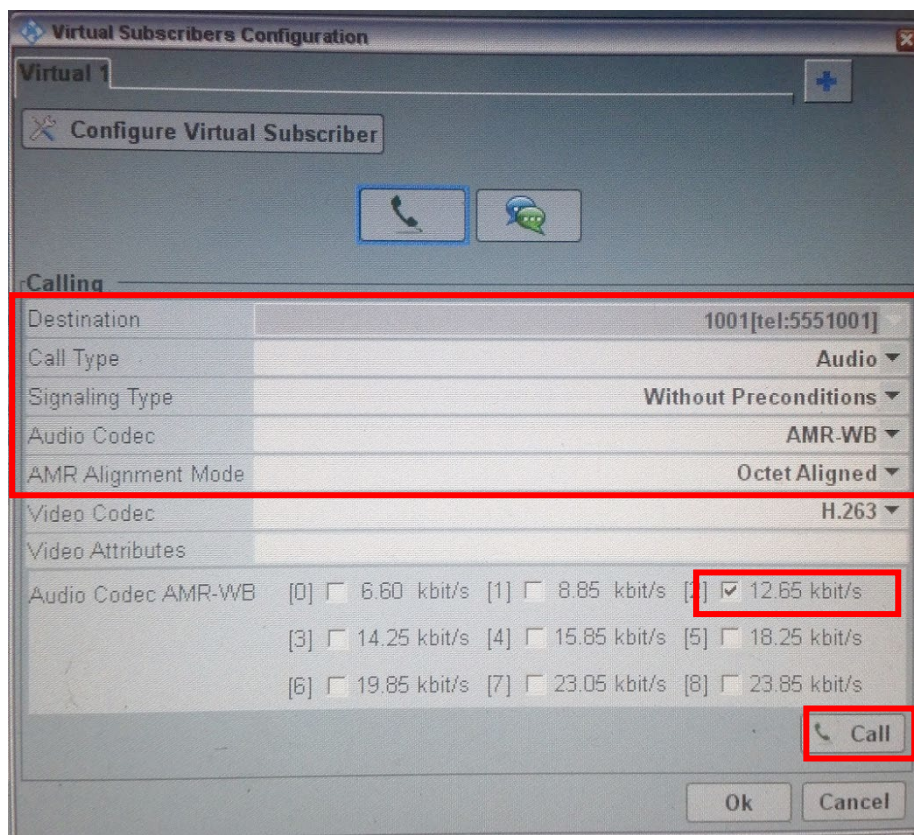

Figure 25: Call Voice over IMS

3.   2G/3G connection with CMW500 Audio Board

The first section illustrates the 2G/3G setup using the Rohde & Schwarz radio communication tester CMW500 in combination with HEAD acoustics hardware. The second section describes the main configurations in ACQUA. The third section instructs about the configuration of the CMW500 for 2G and 3G network measurements.
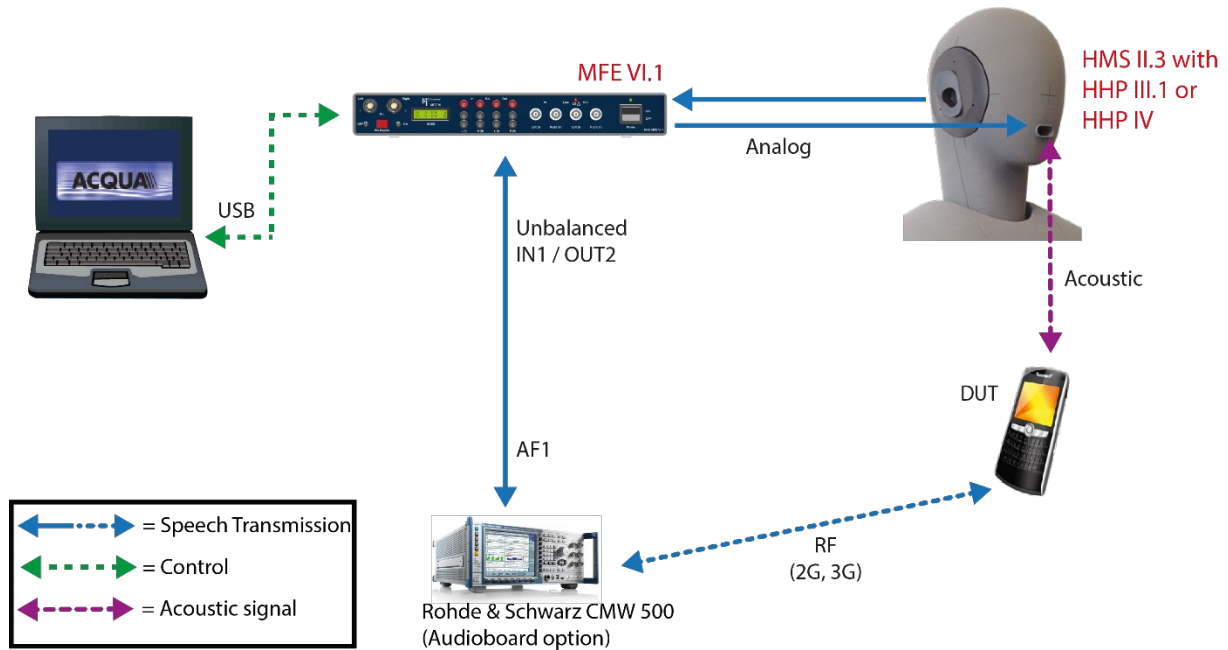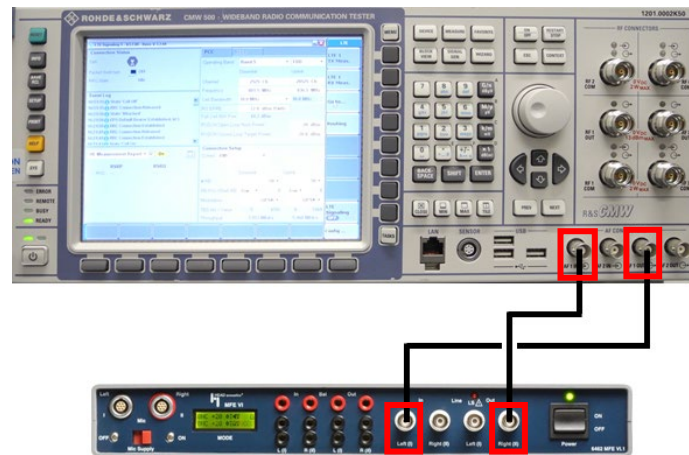
3.1   Measurement Setup

Figure 26: Overview of the measurement setup

The MFE VI.1 (**Line Out Right (II)** and **Line In Left (I)**) is connected via BNC cables to the CMW500 (**AF1 In** and **AF1 Out**):

The measurement setup ([Figure 26: Overview of the measurement setup](#)) consists of the following components:

– [ACQUA Analysis System (Code 6810) (Version 3.2.200 and higher)](#)
– [HMS II.3 (Code 1230) with HHP III.1 (Code 1403) or HHP IV (Code 1406)](#)
– [MFE VI.1 (Code 6462)](#)
– [Optional HAE-BGN Background Noise Simulation (Code 6971)](#)
– [Optional 3PASS Background Noise Simulation (Code 6990)](#)
– [CMW500 (Audioboard option)](#)

3.2 Configuration in ACQUA

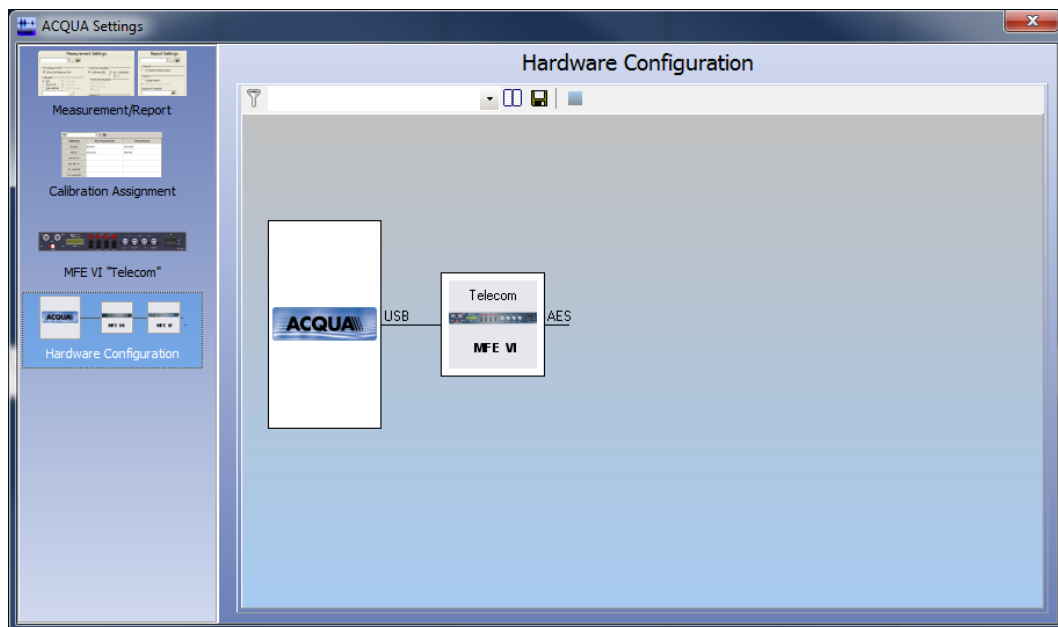### 3.2.1 Hardware Configuration

Figure 27: ACQUA Hardware Configuration with MFE VI.1

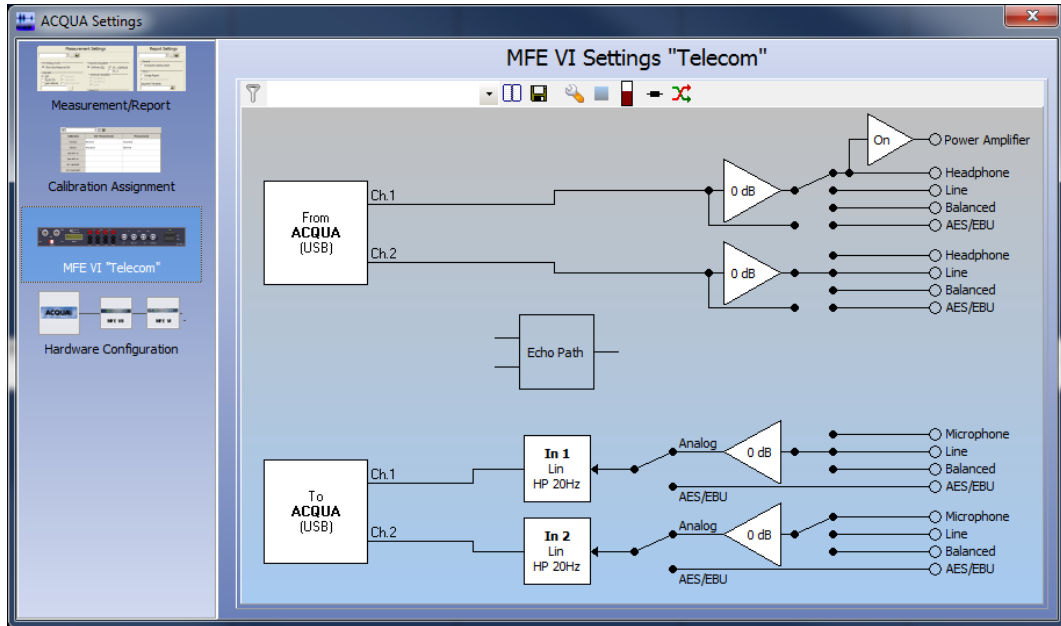### 3.2.2 MFE VI.1 Settings

Figure 28: MFE VI.1 Settings in ACQUA

3.3   Configuration of CMW500

3.3.1   Presets of CMW500

Please ensure that all necessary Rohde & Schwarz measuring equipment for the 2G/3G connection setup is available. For example, CMW500 Options or CMW500 Routing Options. If in doubt, please contact the Rohde & Schwarz sales department.

1. Press the button ⎡MEASURE⎤ at the front panel of the CMW500 (**blue** box in Figure 10) and select **Audio Measurement 1** (see Figure 29: Selecting Measurement Task).
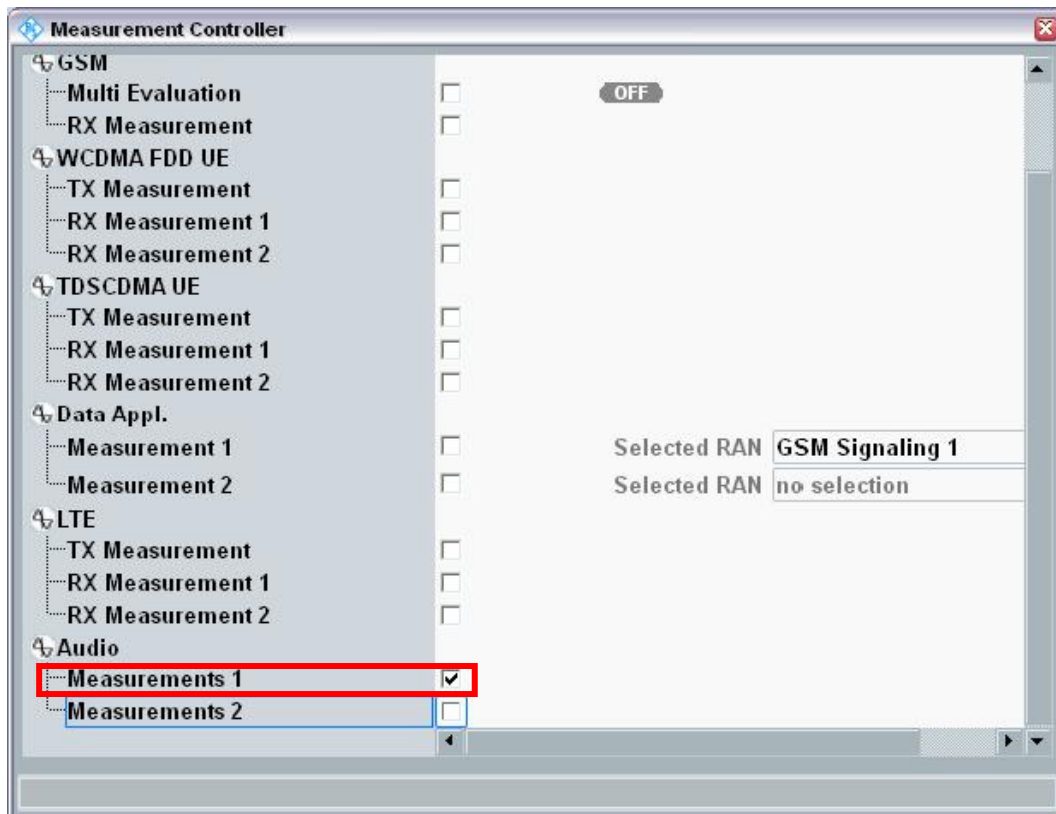

Figure 29: Selecting Measurement Task

2. Press the button SIGNAL GEN (**red** box in Figure 10) and select **GSM Signaling** or **WCDMA Signaling** (see Figure 30: Selecting Signaling Task).

To switch between Audio Measurement and GSM/WCDMA Signaling press TASKS (**green** box in Figure 10).
Select **GSM Signaling** and continue with section 3.3.2 or select **WCDMA Signaling** and continue with section 3.3.3.
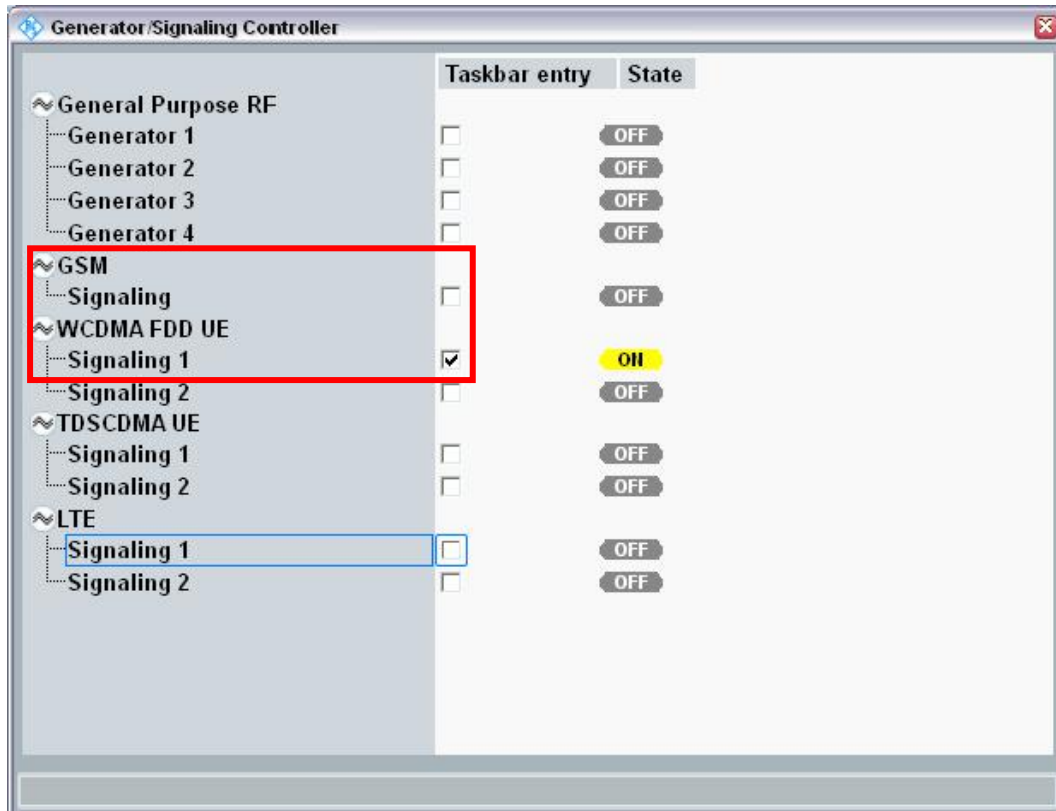

Figure 30: Selecting Signaling Task

3.3.2   GSM (2G) Signaling

This section provides hints to obtain a GSM (2G) connection between the device under test (DUT) and the CMW500.

1. In the main settings screen, set the **DL Reference Level** to **–60,0 dBm** and the **PMax (Power Class Level)** to 10 (or higher) (see Figure 31: Main GSM Settings).

2. Select Config… for the advanced settings (Figure 31).
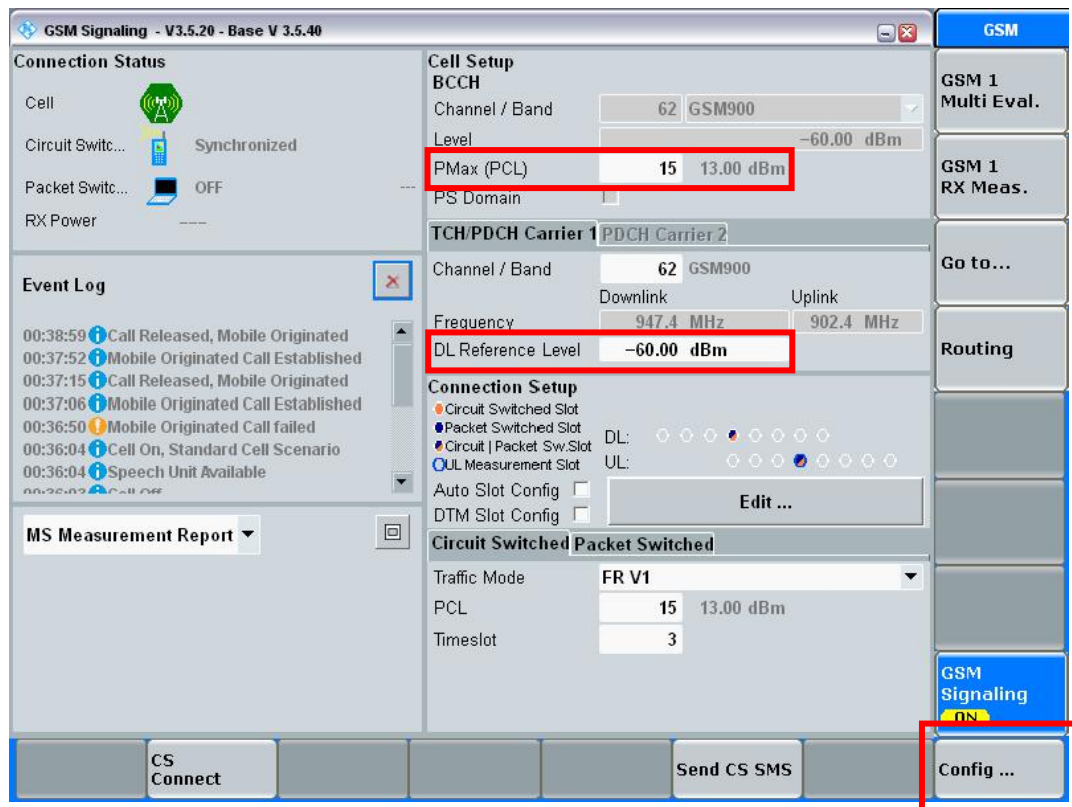

Figure 31: Main GSM Settings

3. Set the **RF Output (TX)** and **RF Input (RX)** settings according to the attenuation of the antenna and antenna cable (**External Attenuation** in Figure 32).
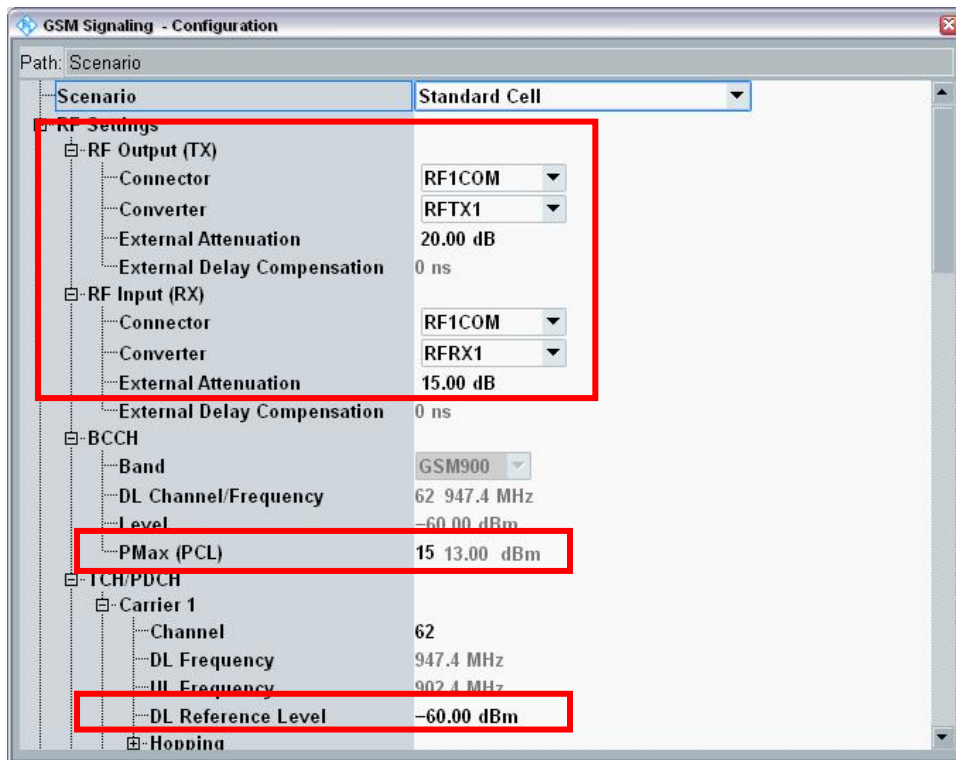
Figure 32: GSM Configuration

4. Set the preferred codec (**Traffic mode**) in the section **Circuit switched**.

5. Set **Data Source** to **Speech** ([Figure 33: GSM Circuit Switched](#)).
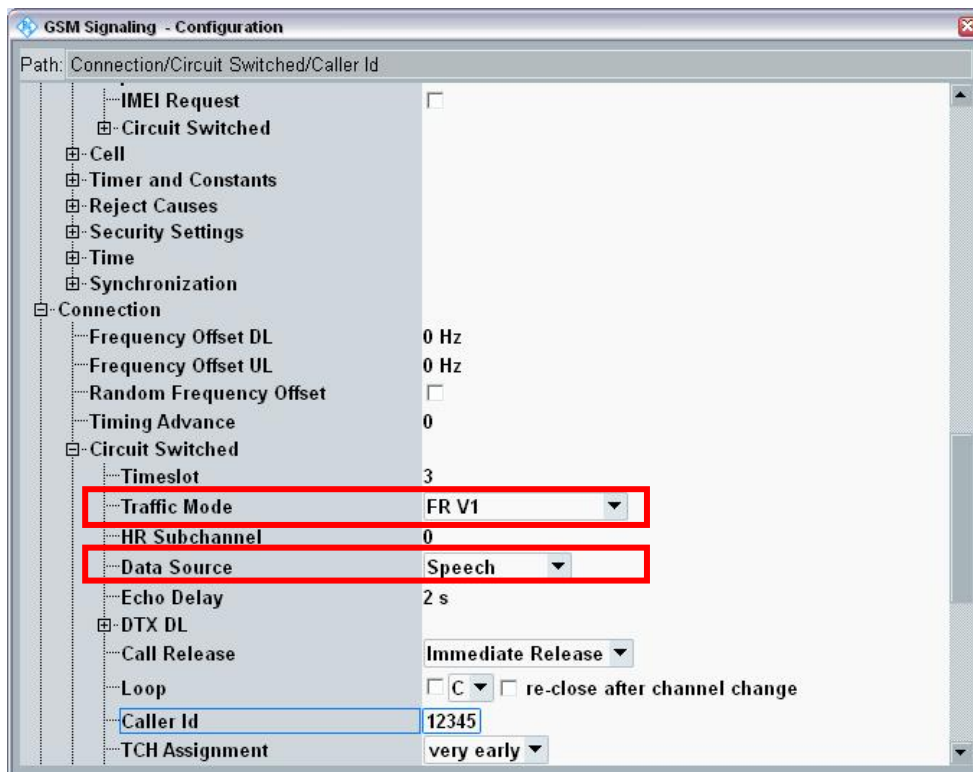

Figure 33: GSM Circuit Switched

6. The proper values for **Network Identity → MCC/MNC** (Figure 34: GSM Network Identity) depend on the SIM card that is used. The Rohde & Schwarz test SIM card uses **MCC 001** and **MNC 01**.
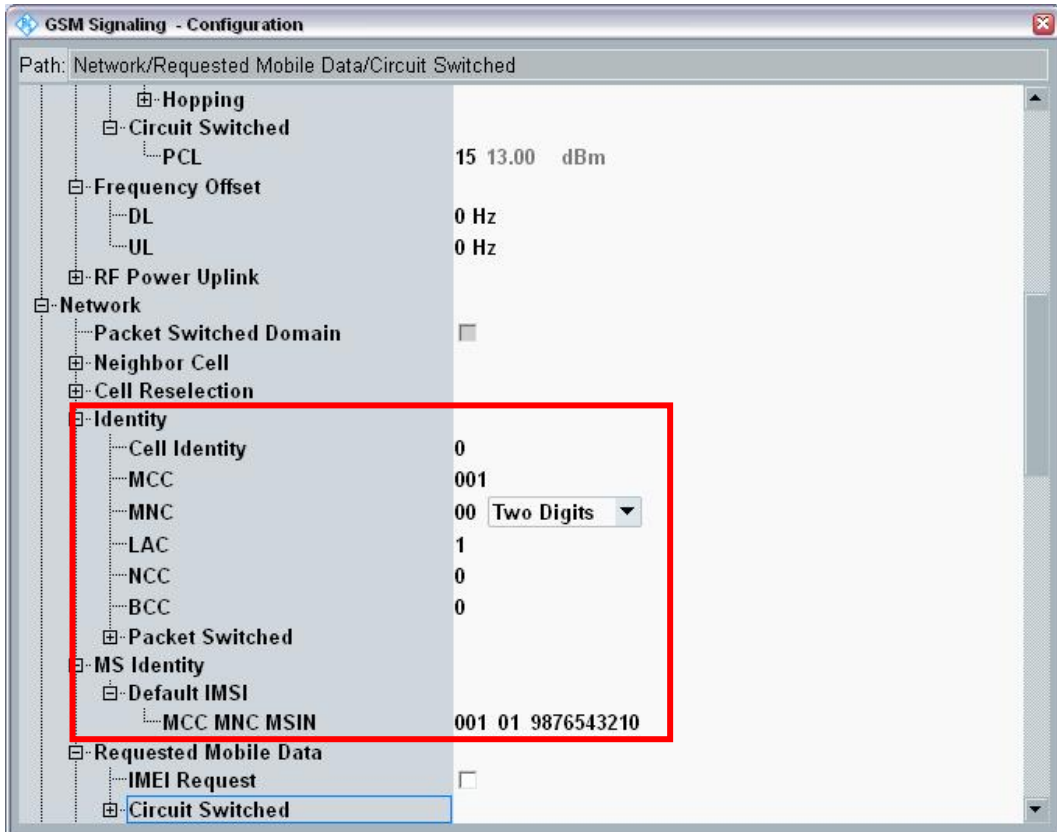
7. Please continue with Section 3.3.4.

Figure 34: GSM Network Identity

Application Note

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3.3.3 WCDMA (3G) Signaling

This section provides hints to obtain a WCDMA (3G) connection between the device under test and the CMW500.

1. In the main settings screen, set the **RS EPRE Power** between *–60 dBm to -70 dBm* (see Figure 35: Main WCDMA Settings).
2. Select Config… for the advanced settings (Figure 35: Main WCDMA Settings).
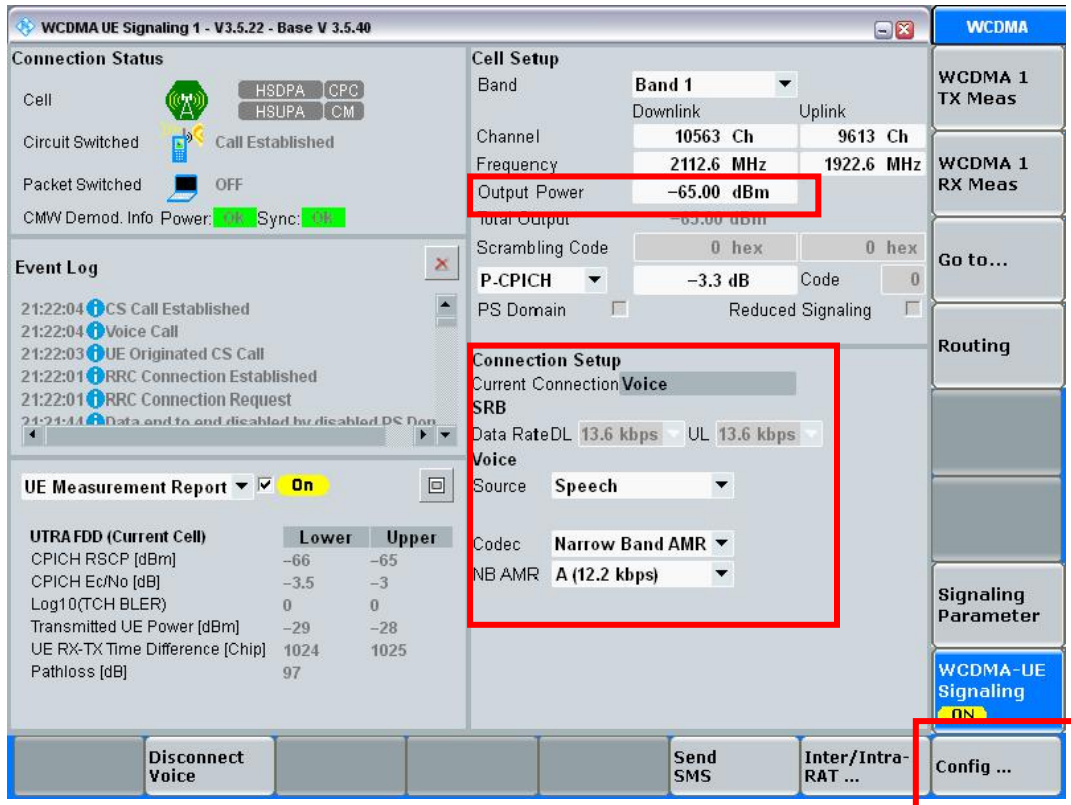

Figure 35: Main WCDMA Settings

3. Set the **RF Output (TX)** and **RF Input (RX)** settings according to the attenuation of the antenna and antenna cable (**External Attenuation** in Figure 36: WCDMA Configuration).
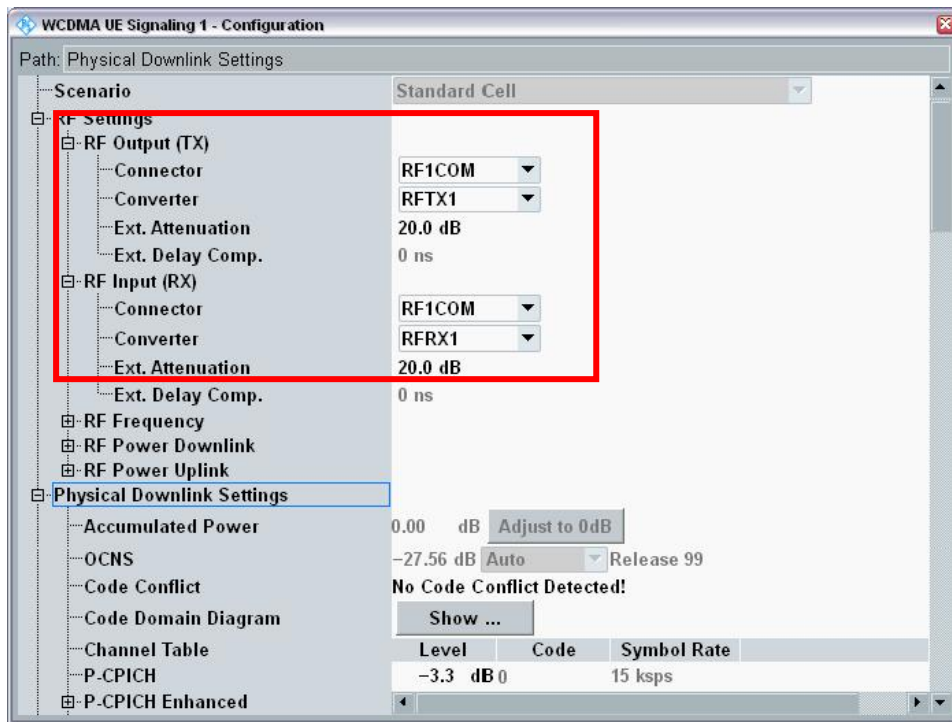
Figure 36: WCDMA Configuration

4. Set the preferred codec (AMR NB or AMR WB) and bitrate in the section **Connection Configuration → Voice**.

5. Set **Data Source** to **Speech**.

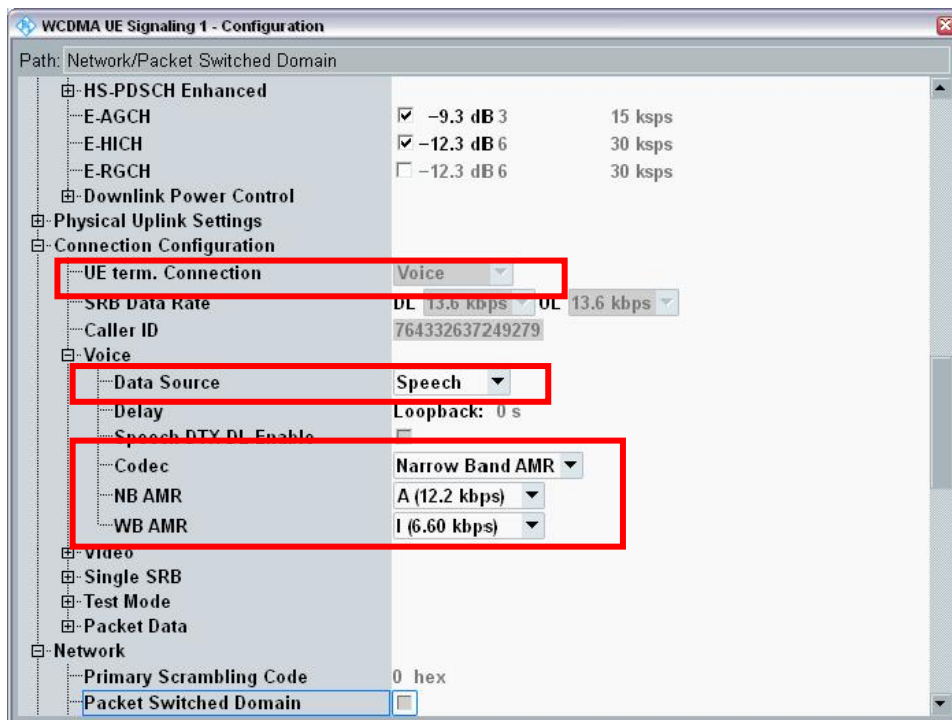6. Set the **UE term. Connection** to **Voice** (Figure 37: WCDMA Connection Configuration).

Figure 37: WCDMA Connection Configuration

7. The proper values for **Network Identity → MCC/MNC** depend on the SIM card that is used. The Rohde & Schwarz test SIM card uses **MCC *001*** and **MNC *01***.

8. Set the security settings according to the device under test (Figure 38: WCDMA Network Identity and Security Settings).

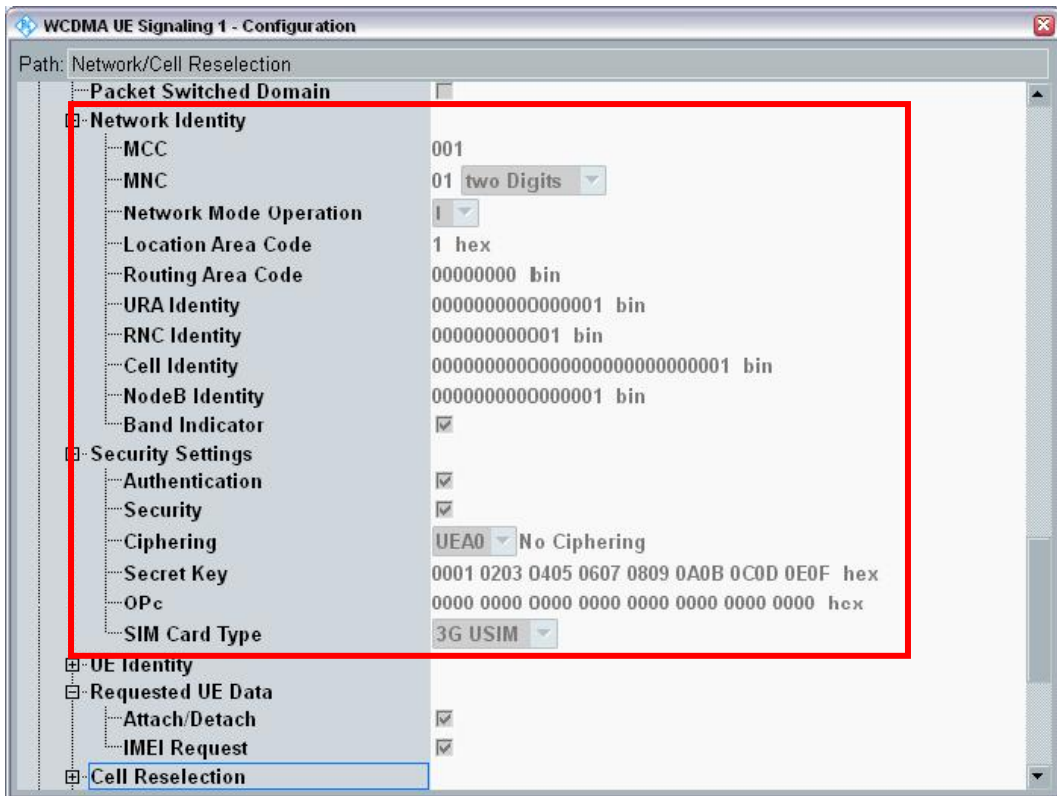9. Please continue with Section 3.3.4.

Figure 38: WCDMA Network Identity and Security Settings

3.3.4   Calibration of Analog Connection

The following steps are necessary to calibrate the Measurement Setup CMW500 and ACQUA.

1. Select the Task **Audio Measurement 1** (see Figure 29: Selecting Measurement Task) and select this task by pressing TASKS (**green** box in Figure 10).
2. Select the Scenario "**External Analog Speech Analysis**" (Figure 39: Audio Measurement 1).
3. Ensure that the **Routing** is **Controlled** by the desired Cell (GSM or WCDMA Signaling – see Figure 39).
4. Set the **Input Level Full-Scale (Peak)** and **Output Level Full-Scale (Peak)** to **1.572V** (See Figure 39).

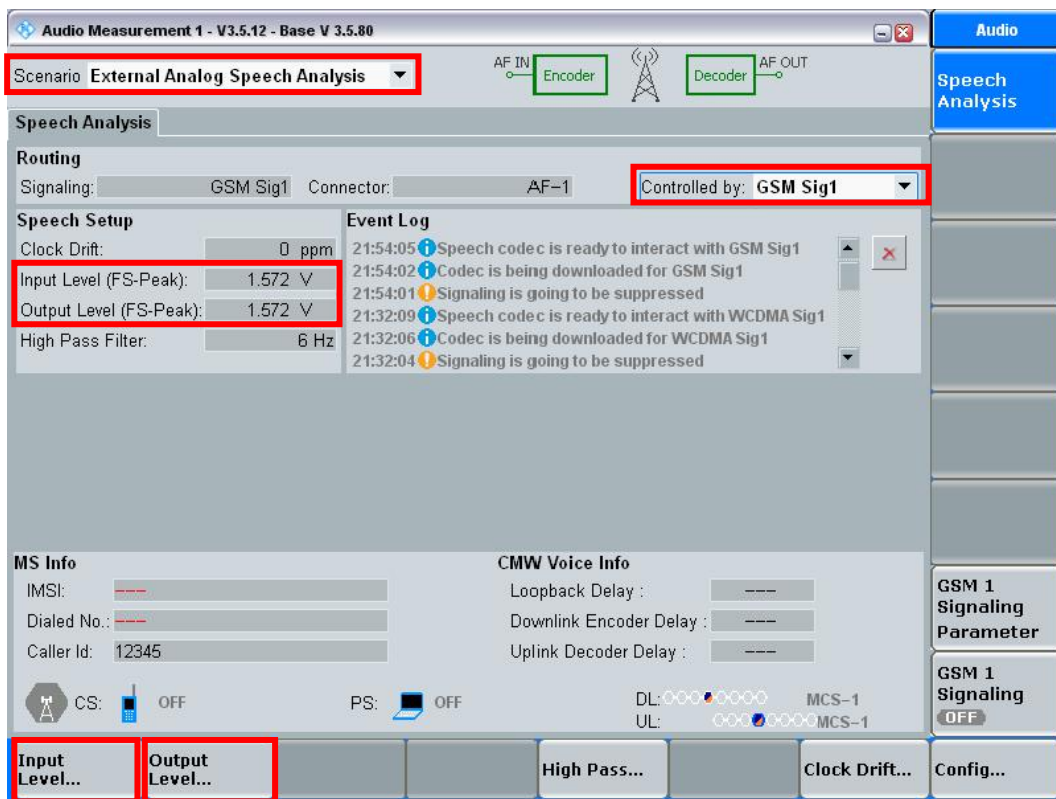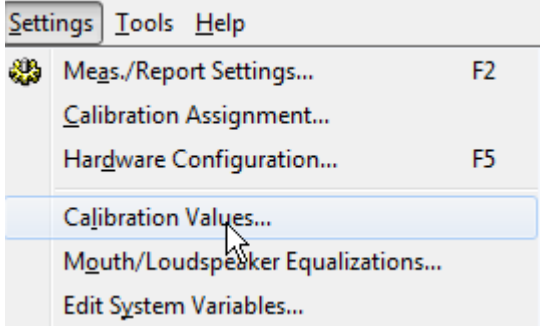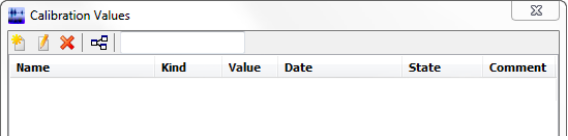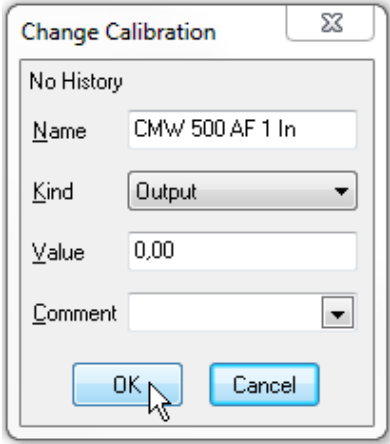With these settings the analog connection between CMW500 and MFE VI.1 is calibrated.
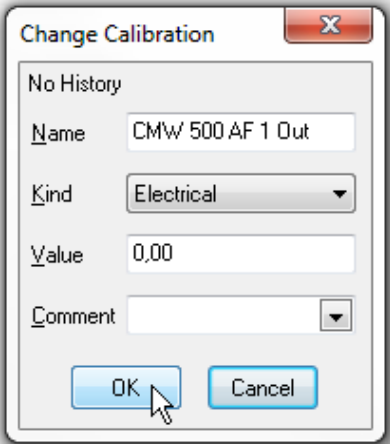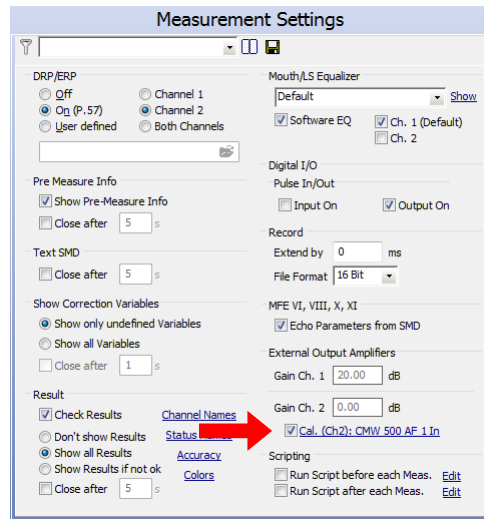

Figure 39: Audio Measurement 1

With the CMW500 settings described as above, both the **calibration value** for CMW500 and the corresponding **External Output Amplifier** setting for **Channel 2** will be **0 dB**.
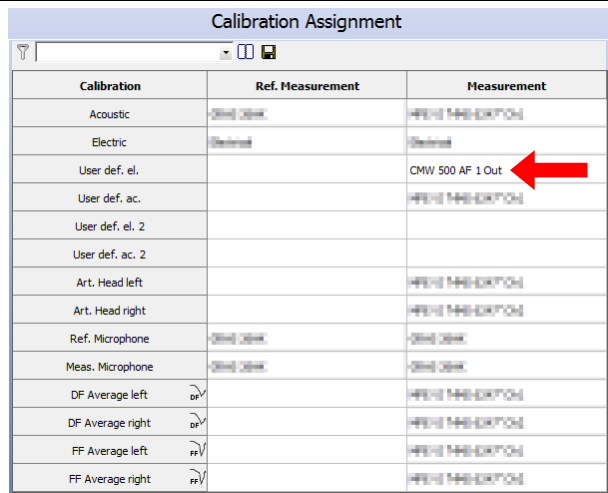
In ACQUA:

Create two calibration values and use them accordingly. Hence the report will have customized names for the calibrations:

1. Main menu, select **Settings** > **Calibration Values…**	Settings · Tools · Help Meas./Report Settings… F2 Calibration Assignment… Hardware Configuration… F5 Calibration Values… Mouth/Loudspeaker Equalizations… Edit System Variables…
2. Select **New** (click the icon or press the *Insert* key on the keyboard).	Calibration Values Name Kind Value Date State Comment
3. Use the following properties for the first calibration value: • Name: CMW500 AF 1 In • Kind: Output • Value: 0.00	Change Calibration No History Name: CMW 500 AF 1 In Kind: Output Value: 0,00 Comment: OK Cancel
4. Create another calibration value by repeating steps 1–3 with following parameters: • Name: CMW500 AF 1 Out • Kind: Electrical • Value: 0.00	Change Calibration No History Name: CMW 500 AF 1 Out Kind: Electrical Value: 0,00 Comment: OK Cancel

5. In Measurement Settings, use the "CMW500 AF 1 In" value for External Output Amplifier Gain Ch. 2.	
6. In Calibration Assignment, use the "CMW500 AF 1 Out" value for User Defined Electric calibration for measurement.	