Calibration and Verification of

GCT Semiconductor, Inc.

Wave 2 chipsets

Application Note 1MA131

Rohde & Schwarz offers complete non signalling & signalling based Production Test Solutions for WiMAX Chipsets: From “single box” test solutions, using the R&S® CMW270 WiMAX Communication Tester, to traditional multi-instrument setups, using the R&S® SMJ100A Signal Generator together with the R&S® FSL Spectrum Analyser, Rohde&Schwarz provides a time and cost effective test solution. The implementation of chipset specific Auto Test Software enables automatic Rx/Tx measurements and the realisation of a fast calibration routine.

ROHDE & SCHWARZ

Contents

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

- The R&S®SMJ100A vector signal generator is referred to as the R&S SMJ.
- The R&S®CMW 270 WiMAX Communication Tester is referred to as the R&S CMW.
- The R&S®FSL3/6 spectrum analyzers are referred to as the R&S FSL.
- The R&S®CMWrun software is referred to as the CMWrun.

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1 Overview

In this document Rohde & Schwarz is introducing two cost and time efficient solutions for WiMAX chipset production lines: From a “single box” test solution, using the **CMW270**, to multi-instrument setup, using the **Signal Generator SMJ100A** together with the **Spectrum Analyser FSL**.

All instruments, which can be used, have integrated WiMAX personalities complying to the 802.16e-2005 standard. Through our cooperation with the chipset manufacturer, the Test Software (CMWrun) is customized to the chipset and enables our customers the realisation of fast calibration and verification routines with automatic Rx/Tx measurements.

Test Features

Calibration Measurement

Supports GCT’s Reference Calibration Tests

- RSSI parameters
- TX Output power
- Flexible settings of frequencies (separated in static and variable part)

Verification Measurement

Supports GCT’s Reference Verification Tests

- RSSI
- CINR
- Constellation Error (EVM)
- Tx Output Power
- Spectrum Mask
- Flexible setting of frequencies and test depth

Benefits

- Stability, repeatability and measurement speed is improved significantly
- The test Software is customized to the requirements of the specific chipset to speedup test processes.
- Flexible signal generation by utilizing integrated WiMAX personality for quick adoption to new measurement task.
- Cost efficient solutions - please check pricing with the local R&S subsidiary.

2 Test Setups

Two different test setups are available.

CMW 270

The **CMW270 Mobile WiMAX Communication Tester** combines signal analysis and signal generation in a single instrument. For time optimized RF calibration in non-signaling mode, the CMW270 provides fast transmitter measurements and a versatile arbitrary waveform generator for receiver testing.

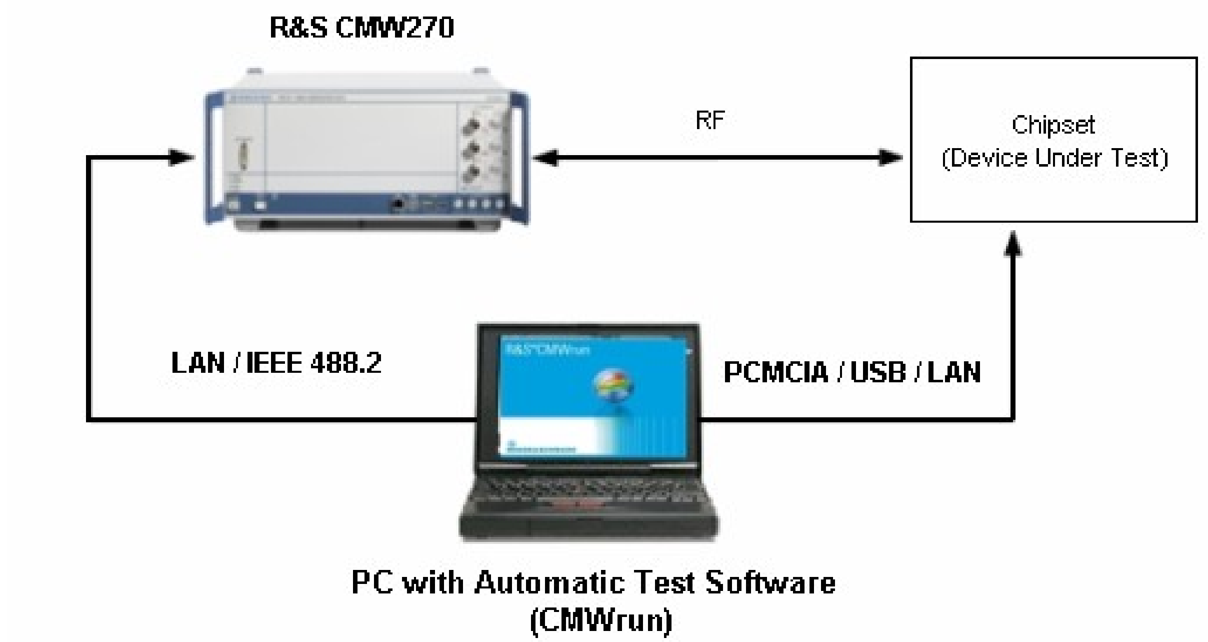


Fig. 1 - R&S Test Setup with CMW270 and CMWrun

Rohde&Schwarz's solution provides a manageable test setup: The Device under Test (DUT) can be connected via USB or LAN to a notebook or PC. The CMW270 can be easily integrated into production lines by remote control via LAN or USB and IEEE 488.2 (GPIB).

The software CMWrun is designed as a Sequencer for different Software Tests with R&S instruments. It is also used to control the R&S Test Solution for WiMAX Radio Conformance Testing.

FSL & SMJ100A

The alternative setup is based on **Spectrum Analyzer FSL and** the **Signal Generator SMJ100A** which can be remote-controlled via IEEE 488.2 (GPIB) or LAN. Figure 2 shows the principal test setup. For generating the signals the arbitrary waveform generator or the WiMAX option for the SMJ can be used. Also for the FSL the WiMAX option has to be available.

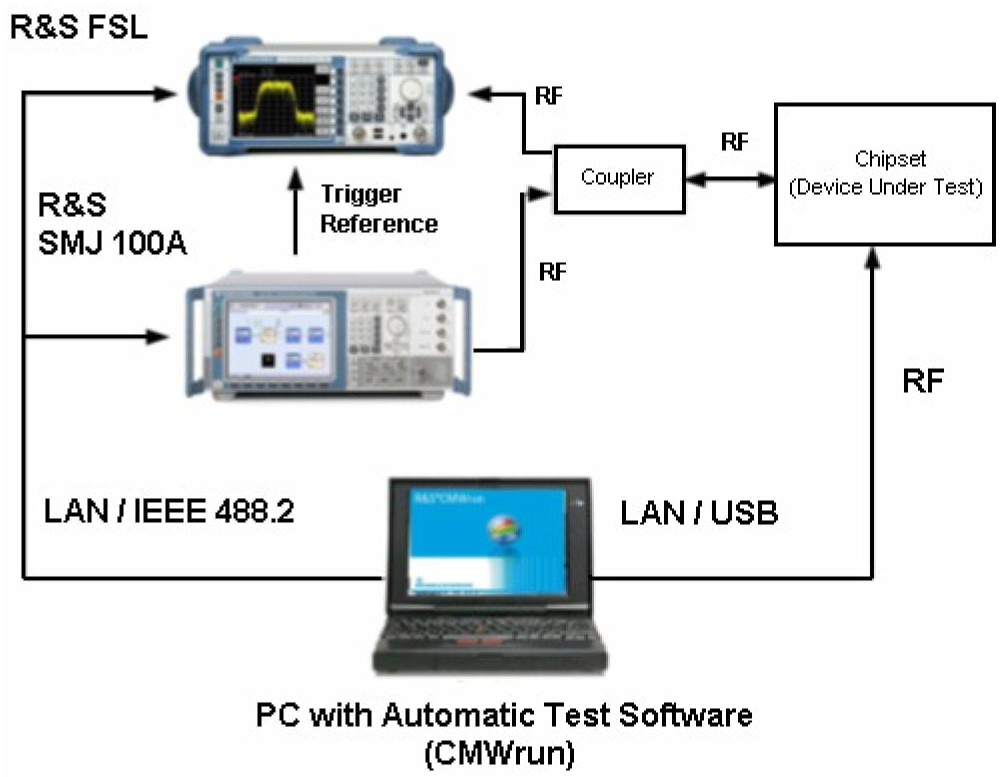


Fig. 2 - R&S Test Setup with the SMJ100A and FSL

3 Hardware and Software Requirements

Test & Measurement Instruments

- CMW270 WiMAX Communication Tester

or

- Signal Generator SMJ100A together with the Spectrum Analyzer FSL

PC Hardware Requirements for Test Setups with CMWrun

	Minimum	Recommended
CPU	Intel® Pentium M Prozessor 1,4 GHz	Intel® Core™2 Duo Processor 2 GHz
RAM	512 MByte	1024 MByte
Hard disc	100 MByte free hard disc space	
Monitor	XGA colour monitor, resolution 1024x768 or better	
Remote Control	GBIP, LAN or USB	
DUT Control	Depending on the device	

PC Software Requirements for CMWrun

OS	Windows XP32 Bit incl. Service Pack 2
OS add-ons	Administration rights Microsoft NET Framework 2.0 or higher
VISA	R&S VISA or different VISA solution

4 Example: Testing GCT GDM 7205 with the CMW270

In cooperation with GCT Rohde&Schwarz offers a customized chipset test solution for the GCT GDM 7205 WiMAX chipset.

In the following you find in detail the system settings for our test solution, the calibration and verification measurement and the approach for TX- and RX- measurements. This Application Note is focused on the CMW270. If support in testing the GCT GDM 7205 with the SMJ100A and the FSL is needed please contact your local Rohde & Schwarz Application or Sales Engineer.

Fig. 3 - R&S Test Setup (CMW270)

CMW270 - The all-in-one solution for IEEE 802.16e WiMAX mobile station testing

- WiMAX mobile station testing in accordance with the IEEE 802.16e standard and the system profiles of the WiMAX Forum
- Non-signalling mode for time optimized RF alignment
- Signal analyzer for transmitter measurements and versatile arbitrary waveform generator for receiver testing
- Base station emulation for RF verification with WiMAX real-time signalling
- RF generator and RF power meter for additional general-purpose measurement

5 Installation Instructions

For the use of the Automated Test Software CMWrun together with the CMW270 for WiMAX chipset testing please follow the installation sequence on your local computer as per particulars given below:

1. Microsoft .NET Framework 2.0
2. R&S CMWrun
3. CMWrun will automatically install R&S VISA, if no VISA installed
4. GCT WiBro Protocol Driver

For further installation information and support please contact your local Rohde & Schwarz Application Engineer.

6 System Settings

This chapter describes the configuration of the GCT GDM 7205 chip with CMW270 and CMWrun.

GCT WiBro Connection Manager for Manual control for GCT device.

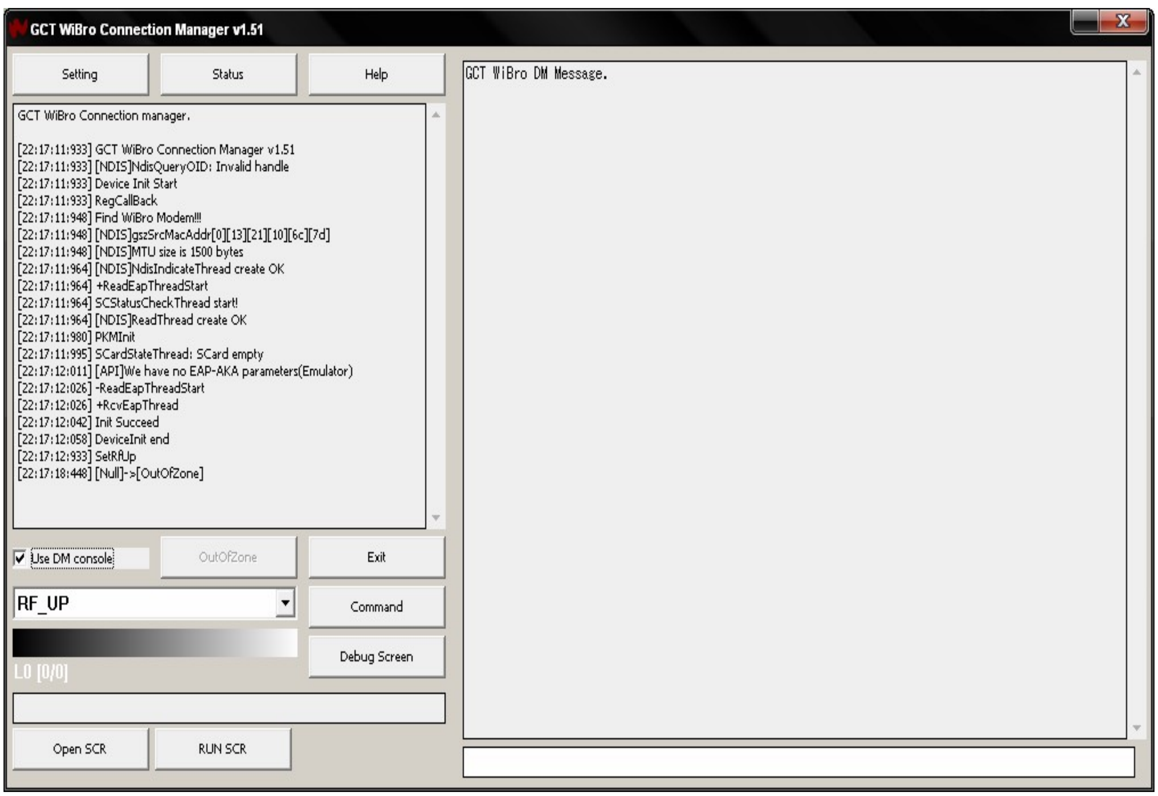


Fig. 4 - GCT WiBro Connection Manager (WCM Tool) with DM console

Instrument Settings

After connecting the measurement devices via LAN or GPIB according to the test setup and starting CMWrun, the connection to the measurement equipment has to be configured in the SCPI-Connection menu of CMWrun. This connection will remain established in subsequent test cases and tests.

CMWrun basic settings

CMWrun is based on a modular structure. Hence it is easy to configure the settings for a specific device under test.

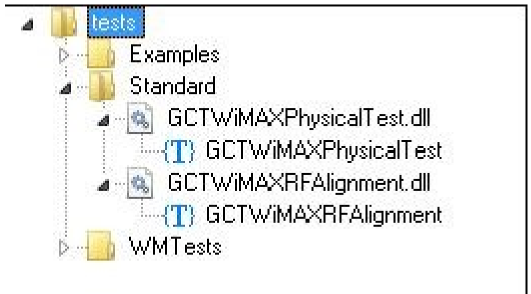


Fig. 5 - Delivered and used libraries

The GCTWiMAXRFAlignment.dll is the main component of the customized automated test. In this library Rohde & Schwarz implemented the specific parameters and settings for the GCT chipset calibration and verification measurement according to [1].

The control of the chipset is done via the Wibro DM Tool (based on Telnet) which is provided in CMWrun via the module TelnetLib.dll. Additionally needed is SettingsFileEditor.dll for modifying the calibration file.

Wibro DM Tool (GCT Chipset configuration Tool)

This picture shows order of progressing boot-up device. If you want to see this message, you should type ‘q’ on the input line.

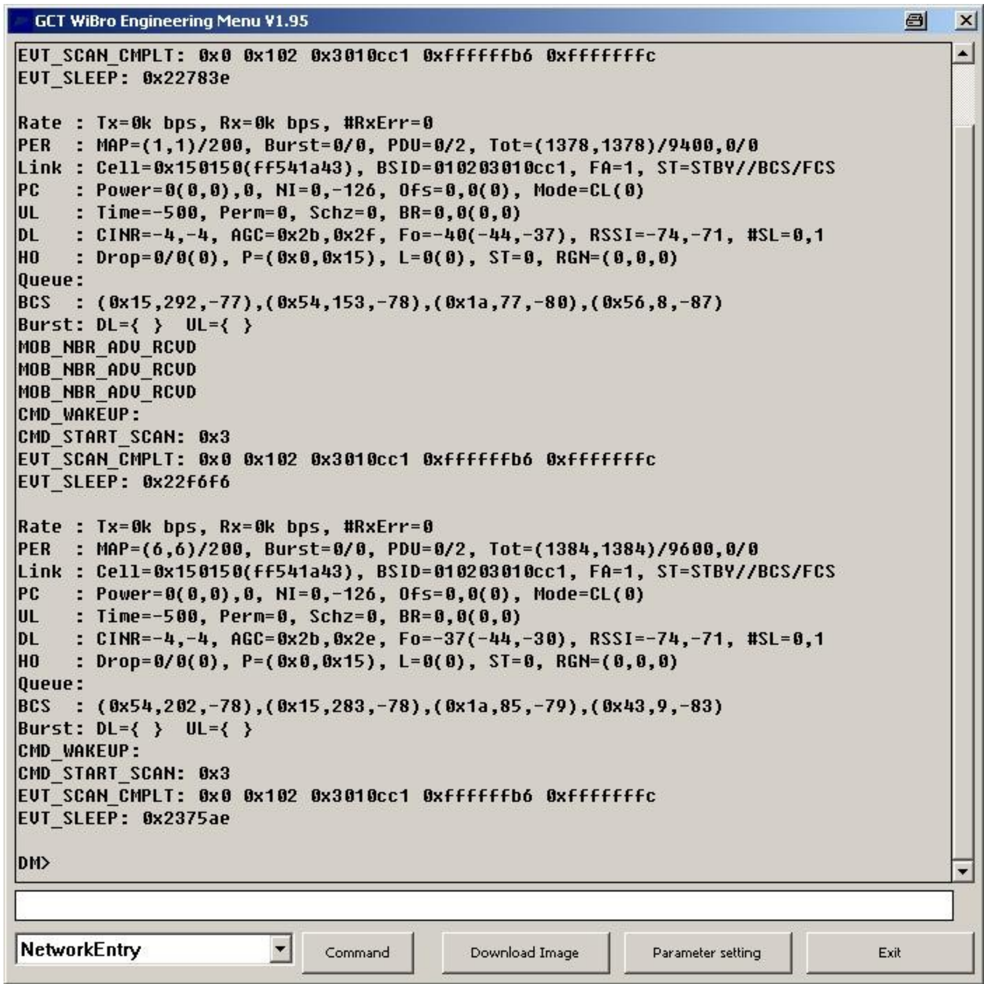


Fig. 6 - DM console in the GCT WiBro Connection Manager (WCM Tool)

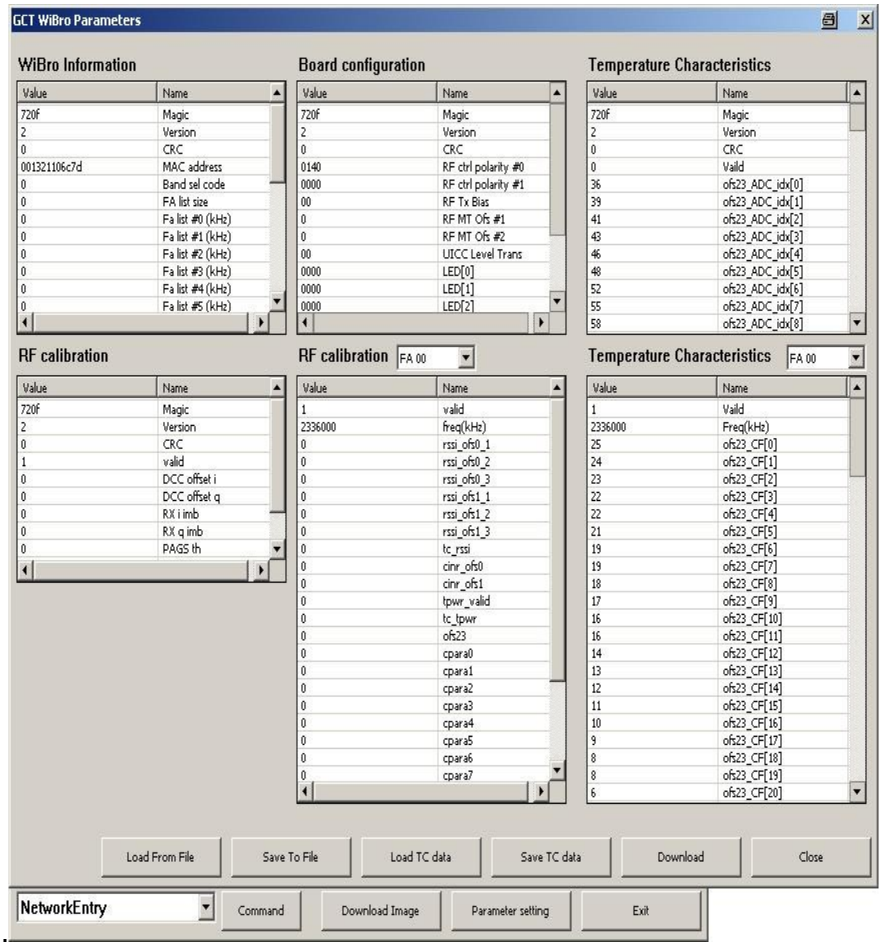
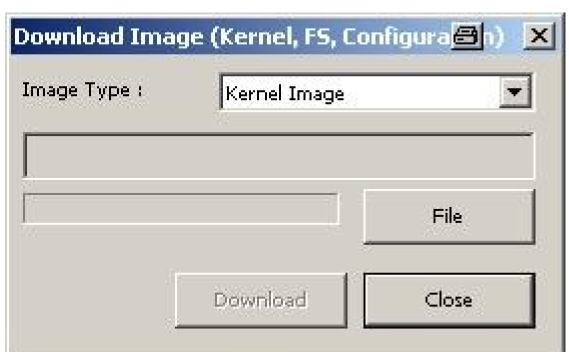


Fig. 7 - GCT WiBro Connection Manager (WCM Tool) Parameter Information

You can see, check and modify DUT's hardware options by clicking the parameter setting option. For example, you can change the temperature characteristics.



This picture shows when you click Download Image. You can use this option when you want to update DUT's firmware.

Below you find several command words so that you can run and see some of DUT's information on the Wibro DM. The Wibro DM is based on the Telnet mode.

- q: you can see boot-up progress and some of progressing information.
- Cfg band: this shows Frequency's information.

  For example…

  DM> cfg band

  Usage: cfg band [Bandwidth_MHz]

  Band=8.75M, FFT=1024, TTG=218, RTG=186, #UL=15, #DL=27, UL-SCH=35, Fs=10.0, Frame=12500, Sym=288
- Sf: you can see all of frequencies and FA supported by DUTs. Also, you can add frequencies missing on that screen.

  Usage: sf [chan_idx freq_kHz]
- Test: you can test rx/tx giving some CID information.

  DM> test iut-rx 0x1234

  IUT-Rx mode: CID=0x1234, Drop=0

  DM> test iut-tx 0 0 100

  IUT-Tx mode: pattern=0, length=0, CID=0x64

7 Calibration and Verification

Calibration routines are required to calibrate and balance the internal components of the DUT.

Following WiMAX settings (as recommended by GCT) will be used in calibration and verification:

- Bandwitdh: 10 MHz
- Framelength: 5 ms
- FFT size: 1024
- Guard period: 1/8
- Uplink:
  - Number of symbols: 15 (w/o control region)
  - Slot count: 175
  - QPSK ½ (½ = Coding)

Calibration

According to [1] the calibration is separated in static and a variable part. In the static part RX and TX deviations are measured over many frequencies, in the variable part the gain changes over a less amount of frequencies.

IQ Calibration

In the first step an IQ calibration is necessary. This is done automatically by the DUT. Additionally a calibration file is generated in the device and also copied via USB to the controlling PC.

Calibration of the Tx characteristics

Tx Power calibration ensures that the DUT transmits the defined power levels after the calibration. The CMW270 is configured to measure the power of the signal. The expected levels of the measurements are configured in CMWrun. In the static part the power is measured via demodulation of the WiMAX signal, in the variable part a CW signal (‘tone’) transmitted by the DUT is measured. The TX output power of the DUT is compared to the target power followed by an adjustment if necessary. The correction values are stored in a calibration file on the controlling PC.

Calibration of the Rx characteristics

The CMW270 generates a specified continuous Wimax waveform at a defined frequency. The DUT measures the power and reports it to the control software. Both are compared. In case of any differences the software store the respective correction value into the calibration file.

Testplan

The routines described above are chipset specific. Therefore it is necessary to create a specific Testplan for each device under test. The Testplan contains the main functionality. You can easily set up our test plan by selecting the desired test module provided by Rohde & Schwarz. For an example of calibration and verification measurements in a Testplan please refer to the next figure.

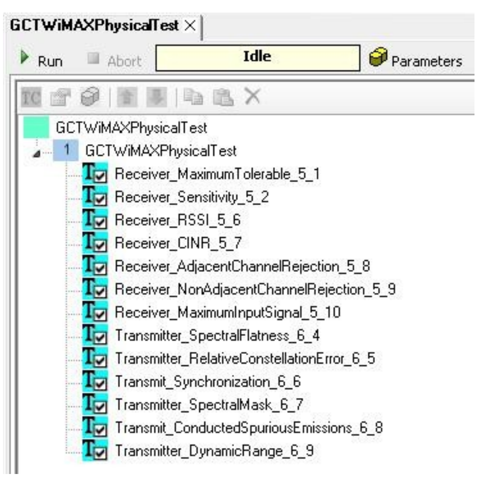


Fig. 8 - Creation of a new Testplan

Properties can be used to parameterize the Testplan. It is possible to edit the properties in the CMWrun by double-clicking the appropriate test.

Properties

To edit the properties double-click on the “GCTWiMAXPysicalTest” in the testplan.

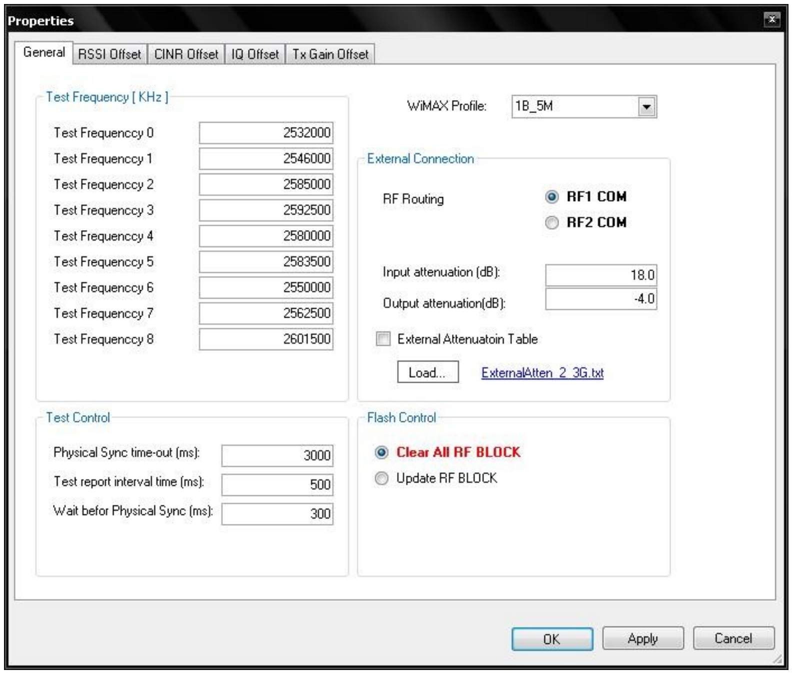


Fig. 9 - Properties of the Calibration Measurement

<u>Test Frequencies</u>

Here you can enter up to nine test frequencies in the range 2300000 KHz…2700000 kHz. The reference frequency can see on the GCT Connection Mager (WCM). The calibration is divided in a static and a variable part where you can select the wanted frequency indices. The default setting is recommended by GCT.

<u>WiMAX Profile</u>

Here you can enter which WiMAX profile shall be used.

<u>Test Control</u>

Test setup for Physical Sync. Time-out, Test report interval time on the DUT side, Wait time before the try to physical sync.

<u>1. Physical sync time: this option means that DUT’s sync time to connect</u>

<u>2. Test report interval time: this option can set each test interval time</u>

<u>3. Wait for Physical Sync: this means when DUT is connected successfully</u>

External Attenuation

Depending on the test setup and the physical connection between the DUT and the CMW270, the external attenuation has to be configured. In the test setup the CMW is used as signal generator and signal analyzer. The measured attenuations for both signal directions have to be configured.

Calibration settings

Calibration setup for each item, RSSI, CINR, IQ offset, Tx Gain Offset.

Verification with test mode (non signaling)

The verification consists of two parts: RX Verification and TX Verification.

Common for both parts is the setup of the frequencies and the external attenuation.

Test Frequencies

Here you can enter up to eight test frequencies in the range 2300000 kHz…2700000 kHz.

External Attenuation

Depending on the test setup and the established connection between the DUT and the CMW270, the attenuation has to be configured. In the test setup the CMW is used as signal generator and signal analyser. The measured attenuation for both functionalities has to be configured.

WiMAX Profile

Here you can enter which WiMAX profile shall be used.

Test Control

Test setup for Physical Sync. Time-out, Test report interval time on the DUT side, Wait time before the try to physical sync.

Test settings

Test setup for each item, Rx test, Sensitivity test, Flatness & constellation, Spectrum and dynamic test.

RX Verification

The following tests verify the receiver calibration. To perform these tests, the signal generator of the CMW270 is controlled by CMWrun to transmit a specific test signal with dedicated frequency/level settings. The level error and CINR will be measured by the device and reported back to the CMWrun.

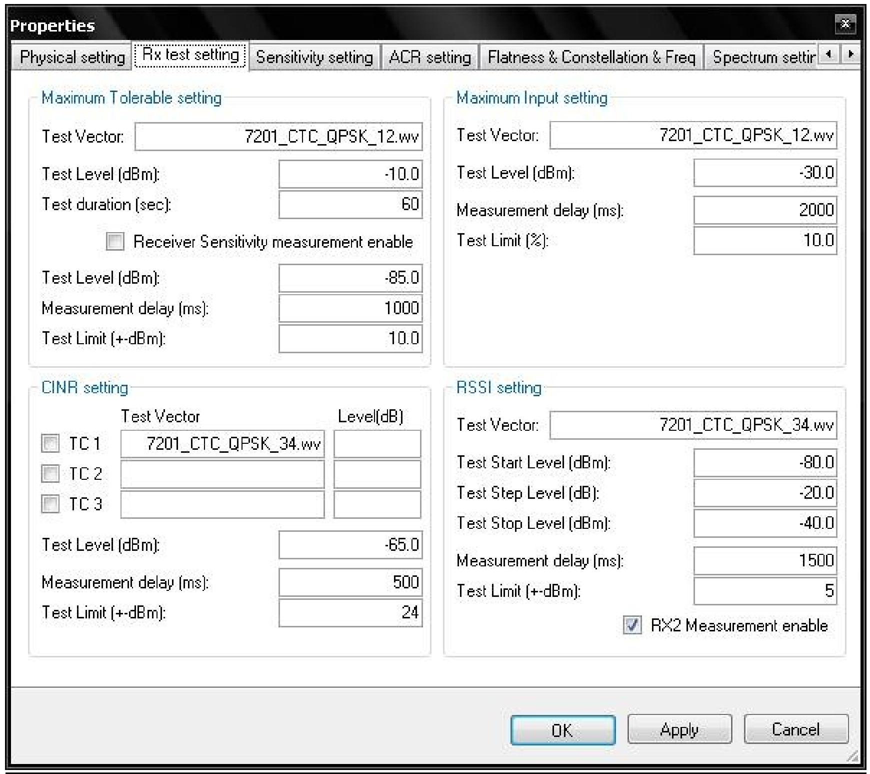


Fig. 10 - Properties of verification RX

Rx Level

You can enter four RX levels and also select which level shall be measured on which frequency. The measurement will also be done on the second RX connector of the DUT (RX1).

Rx Sensitivity

You can select the frequencies for the sensitivity measurement. The measurement can be either done on the fixed downlink level of test level dBm or with ‘Limit Search’ in a range from test level to when the measurement PER was out of limit in level step size. For sensitivity test GCT provide 8 different testvector files (ARB files). QPSK1/2, QPSK3/4, 16QAM1/2, 16QAM3/4, 64QAM1/2, 64QAM2/3, 64QAM3/4, 64QAM5/6

CINR Level

You can enter the test settings for CINR, 3 test cases are supported.

For each test case, enter the the name of the testvector file (ARB file) and test.

Tx Verification

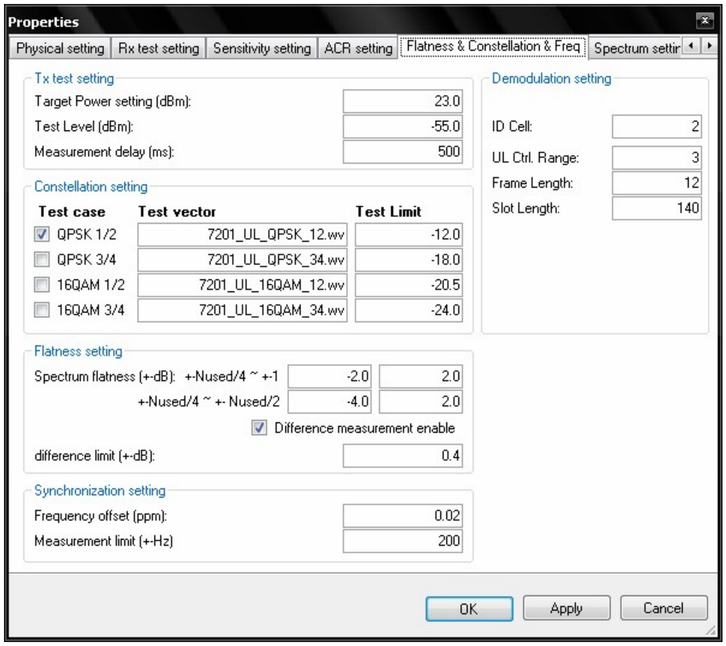


Fig. 11 - Properties of Verification Tx

The purpose of this test is to verify the accuracy of the Tx calibration on one absolute and a relative power measurement over the Tx range. For both parts you can select the frequencies separately.

The relative measurement is taken in 1 dB steps from -20 dB gain up to +23 dB gain. After the measurement a post processing is done where the relative errors of particular steps (-5 dB, 0 dB, 5 dB,) are calculated and displayed. These limits are:

- Delta = 1 dB: 0.5 dB
- Delta = 2 dB: 1.0 dB
- Delta = 3 dB: 1.5 dB
- else: 2.0 dB

You can also enter the Tx limits for the absolute power measurement and the EVM.

Demodulation setting

You can enter the test parameter for WiMAX demodulation. For example ID Cell, UL Ctrl. Range, Frame Length, Slot Length.

Verification signaling

Test depth will be significantly improved by verification under signaling conditions, thus also verifying higher layer inter-working in a real world scenario in order to guarantee a positive end-user experience by assuring immediate and successfull connection to the WiMAX network.

Realtime signalling allows testing the full functionality of a mobile station like in mobile WiMAX network operation, i.e.:

- Receiver sensitivity (PER)
- WiMAX signalling test
  - Initial ranging
  - Network registration
  - Periodic ranging
  - Data transfer (MAC)
- Channel Reporting
  - CINR (carrier to interference and noise ratio)
  - RSSI (receive signal strength indicator)

For customers using the R&S CMW270, a dedicated signalling HW/SW option as well as a module for CMWrun is available, making cost and resource intensive maintenance and adaptation of “Golden Sample Base Stations” within the production lines obsolete.

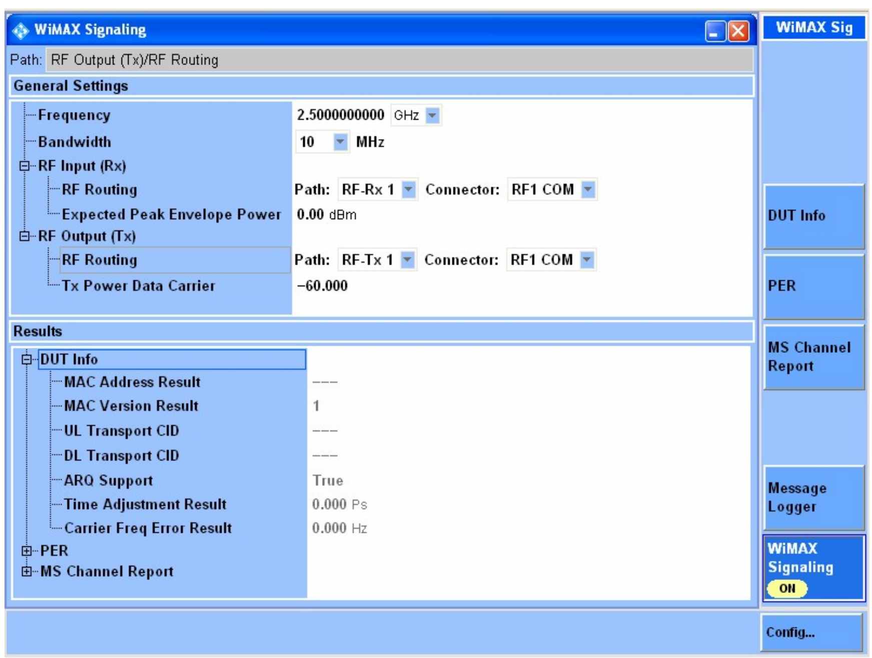


Fig. 12 – Operator interface of the R&S CMW-KS700 option for WiMAX signaling tests

Verification with signaling automatically works with all chipsets, as the communication is specified by the IEEE802.16e standard. As there's no special adaptation to the individual chipset necessary, this application note mainly discusses the non-signaling verification. Please ask your local Rohde & Schwarz representative for a signalling demonstration.

8 Measurement Report

CMWrun provides a measurement report for each Testplan. For the verification it shows the measured parameters in a table layout with limit checking.

Test description	Min/LL	Max/UL	ResultValue	Unit	Status
Receiver CINR test, Test Frequency: 2304500KHz					
Receiver CINR - measured *Test Level = -65.0dBm*	24	---	28	dBm	Passed
Test description	**Min/LL**	**Max/UL**	**ResultValue**	**Unit**	**Status**
Receiver CINR test, Test Frequency: 2313500KHz					
Receiver CINR - measured *Test Level = -65.0dBm*	24	---	28	dBm	Passed
Test description	**Min/LL**	**Max/UL**	**ResultValue**	**Unit**	**Status**
Receiver CINR test, Test Frequency: 2322500KHz					
Receiver CINR - measured *Test Level = -65.0dBm*	24	---	28	dBm	Passed

Test description	Min/LL	Max/UL	ResultValue	Unit	Status
Receiver RSSI test, Test Frequency: 2304500KHz					
Receiver RSSI - Rx1 measured *Test Level = -80dBm*	-85	-75	-79	dBm	Passed
Receiver RSSI - Rx2 measured *Test Level = -80dBm*	-85	-75	-79	dBm	Passed
Receiver RSSI - Rx1 measured *Test Level = -60dBm*	-65	-55	-59	dBm	Passed
Receiver RSSI - Rx2 measured *Test Level = -60dBm*	-65	-55	-61	dBm	Passed
Receiver RSSI - Rx1 measured *Test Level = -40dBm*	-45	-35	-38	dBm	Passed
Receiver RSSI - Rx2 measured *Test Level = -40dBm*	-45	-35	-40	dBm	Passed
Test description	**Min/LL**	**Max/UL**	**ResultValue**	**Unit**	**Status**
Receiver RSSI test, Test Frequency: 2313500KHz					
Receiver RSSI - Rx1 measured *Test Level = -80dBm*	-85	-75	-79	dBm	Passed
Receiver RSSI - Rx2 measured *Test Level = -80dBm*	-85	-75	-79	dBm	Passed
Receiver RSSI - Rx1 measured *Test Level = -60dBm*	-65	-55	-59	dBm	Passed
Receiver RSSI - Rx2 measured *Test Level = -60dBm*	-65	-55	-61	dBm	Passed
Receiver RSSI - Rx1 measured *Test Level = -40dBm*	-45	-35	-38	dBm	Passed
Receiver RSSI - Rx2 measured *Test Level = -40dBm*	-45	-35	-40	dBm	Passed
Test description	**Min/LL**	**Max/UL**	**ResultValue**	**Unit**	**Status**
Receiver RSSI test, Test Frequency: 2322500KHz					
Receiver RSSI - Rx1 measured *Test Level = -80dBm*	-85	-75	-79	dBm	Passed
Receiver RSSI - Rx2 measured *Test Level = -80dBm*	-85	-75	-78	dBm	Passed
Receiver RSSI - Rx1 measured *Test Level = -60dBm*	-65	-55	-59	dBm	Passed
Receiver RSSI - Rx2 measured *Test Level = -60dBm*	-65	-55	-60	dBm	Passed
Receiver RSSI - Rx1 measured *Test Level = -40dBm*	-45	-35	-39	dBm	Passed
Receiver RSSI - Rx2 measured *Test Level = -40dBm*	-45	-35	-40	dBm	Passed

Fig. 13 - Report Rx verification

Test description	Min/LL	Max/UL	ResultValue	Unit	Status
Receiver Sensitivity test, Test Frequency: 2304500KHz, MCS = QPSK 1/2					
Receiver Sensitivity *Test Level = -84.56dBm*	---	10.0	0	%	Passed
Test description	**Min/LL**	**Max/UL**	**ResultValue**	**Unit**	**Status**
Receiver Sensitivity test, Test Frequency: 2313500KHz, MCS = QPSK 1/2					
Receiver Sensitivity *Test Level = -84.56dBm*	---	10.0	2	%	Passed
Test description	**Min/LL**	**Max/UL**	**ResultValue**	**Unit**	**Status**
Receiver Sensitivity test, Test Frequency: 2322500KHz, MCS = QPSK 1/2					
Receiver Sensitivity *Test Level = -84.56dBm*	---	10.0	2	%	Passed

Test description	Min/LL	Max/UL	ResultValue	Unit	Status
Receiver Maximum Input test, Test Frequency: 2304500KHz					
Maximum Input - measured PER *Test Level = -30.0dBm*	---	10.0	0	%	Passed
Test description	Min/LL	Max/UL	ResultValue	Unit	Status
Receiver Maximum Input test, Test Frequency: 2313500KHz					
Maximum Input - measured PER *Test Level = -30.0dBm*	---	10.0	0	%	Passed
Test description	Min/LL	Max/UL	ResultValue	Unit	Status
Receiver Maximum Input test, Test Frequency: 2322500KHz					
Maximum Input - measured PER *Test Level = -30.0dBm*	---	10.0	0	%	Passed

Fig. 14 – Report Rx verification: Sensitivity

Test description	Min/LL	Max/UL	ResultValue	Unit	Status
Transmitter Dynamic Range, Test Frequency: 2304500KHz					
Maxium out power *Target power: 23dBm*	21	24	21.12	dBm	Passed
Dynamic range start *Target power: -20dBm*	---	---	-20.8	dBm	Passed
Relative - Target power: -19dBm, Measured power: -19.9dBm *delta power: -0.93dB*	-0.5	0.5	0.062	dB	Passed
Relative - Target power: -18dBm, Measured power: -19.0dBm *delta power: -0.89dB*	-0.5	0.5	0.109	dB	Passed
Relative - Target power: -17dBm, Measured power: -18.0dBm *delta power: -1.04dB*	-0.5	0.5	-0.04	dB	Passed
Relative - Target power: -16dBm, Measured power: -17.1dBm *delta power: -0.90dB*	-0.5	0.5	0.095	dB	Passed
Relative - Target power: -15dBm, Measured power: -16.2dBm *delta power: -0.89dB*	-0.5	0.5	0.103	dB	Passed
Relative - Target power: -14dBm, Measured power: -15.4dBm *delta power: -0.73dB*	-0.5	0.5	0.268	dB	Passed
Relative - Target power: -13dBm, Measured power: -14.3dBm *delta power: -1.16dB*	-0.5	0.5	-0.16	dB	Passed
Relative - Target power: -12dBm, Measured power: -13.3dBm *delta power: -0.90dB*	-0.5	0.5	0.095	dB	Passed
Relative - Target power: -11dBm, Measured power: -12.5dBm *delta power: -0.87dB*	-0.5	0.5	0.127	dB	Passed
Relative - Target power: -10dBm, Measured power: -11.4dBm *delta power: -1.09dB*	-0.5	0.5	-0.09	dB	Passed
Relative - Target power: -9dBm, Measured power: -10.5dBm *delta power: -0.90dB*	-0.5	0.5	0.095	dB	Passed
Relative - Target power: -8dBm, Measured power: -9.66dBm *delta power: -0.86dB*	-0.5	0.5	0.133	dB	Passed
Relative - Target power: -7dBm, Measured power: -8.34dBm *delta power: -1.31dB*	-0.5	0.5	-0.31	dB	Passed
Relative - Target power: -6dBm, Measured power: -7.46dBm *delta power: -0.87dB*	-0.5	0.5	0.127	dB	Passed

Fig. 15 - Report Tx absolute and Tx relative

Test description	Min/LL	Max/UL	ResultValue	Unit	Status
Transmitter Relative Constellation Error, Test Frequency: 2304500KHz					
Relative Constellation Error - data and pilots *Target power: 23.0dBm*	-100	-12	-31.384	dB	Passed
Maximum Output Power *Target power: 23.0dBm*	21	24	21.227	dBm	Passed
Test description	Min/LL	Max/UL	ResultValue	Unit	Status
Transmitter Relative Constellation Error, Test Frequency: 2313500KHz					
Relative Constellation Error - data and pilots *Target power: 23.0dBm*	-100	-12	-31.624	dB	Passed
Maximum Output Power *Target power: 23.0dBm*	21	24	21.272	dBm	Passed
Test description	Min/LL	Max/UL	ResultValue	Unit	Status
Transmitter Relative Constellation Error, Test Frequency: 2322500KHz					
Relative Constellation Error - data and pilots *Target power: 23.0dBm*	-100	-12	-31.683	dB	Passed
Maximum Output Power *Target power: 23.0dBm*	21	24	21.314	dBm	Passed

Fig. 16 - Report Tx Constellation Error and Flatness

Test description	Min/LL	Max/UL	ResultValue	Unit	Status
Transmitter Spectral Flatness, Test Frequency: 2304500KHz					
Spectrum Flateness *Outer upper*	-4.0	2.0	0.73	dB	Passed
Spectrum Flateness *Outer lower*	-4.0	2.0	-0.56	dB	Passed
Spectrum Flateness *Inner upper:*	-2.0	2.0	0.23	dB	Passed
Spectrum Flateness *Inner lower*	-2.0	2.0	0.23	dB	Passed
Test description	**Min/LL**	**Max/UL**	**ResultValue**	**Unit**	**Status**
Transmitter Spectral Flatness, Test Frequency: 2313500KHz					
Spectrum Flateness *Outer upper*	-4.0	2.0	0.76	dB	Passed
Spectrum Flateness *Outer lower*	-4.0	2.0	-0.57	dB	Passed
Spectrum Flateness *Inner upper:*	-2.0	2.0	0.21	dB	Passed
Spectrum Flateness *Inner lower*	-2.0	2.0	0.21	dB	Passed
Test description	**Min/LL**	**Max/UL**	**ResultValue**	**Unit**	**Status**
Transmitter Spectral Flatness, Test Frequency: 2322500KHz					
Physical sync. error *Test Level: -55.0dBm*	---	---	---	---	Failed

Fig. 17 - Report Tx Spectral Flatness

9 Appendix

Literature

[1] GCT Semiconductors

[2] The IEEE 802.16 Working Group on Broadband Wireless Access Standards

http://www.ieee802.org/16

[3] Rohde & Schwarz: Application Note: 1MA96: WiMAX - General information about the standard 802.16

http://www.rohde-schwarz.com/appnote/1MA96

This application note is one of three papers dealing with the WiMAX standard, covering the theoretical aspects of WiMAX. It gives a detailed overview of the basic concepts of WiMAX (FFT, OFDM, frame structures, etc) and explains the physical standard parts of IEEE 802.16 standards 802.16-2004, corr1 and 802.16e.

[4] Rohde & Schwarz: Application Note: 1MA97: WiMAX - Generating and analyzing 802.16-2004 and 802.16e-2005 signals

http://www.rohde-schwarz.com/appnote/1MA97

This Application Note gives an introduction to measurements of WiMAX signals according to standards 80216-2004 and 802.16e-2005. It describes all kinds of signal generation from simple signals to multiple-zone signals, also under multipath environment (fading), and covers all signal measurements from power and spectrum analysis, crest factor and CCDF measurement down to bit pattern analysis and modulation measurements.

[5] Rohde & Schwarz: Application Note: 1EF57: WiMAX: 802.16-2004, 802.16e, WiBRO Introduction to WiMAX Measurements

http://www.rohde-schwarz.com/appnote/1EF57

The new WiMAX radio technology - worldwide interoperability for microwave access - is based on wireless transmission methods defined by the IEEE 802.16 standard. WiMAX has been developed to replace broadband cable networks such as DSL and to enable mobile broadband wireless access. Rohde & Schwarz offers a complete test solution for WiMAX applications by combining its Signal Generator R&S SMU200A and Signal Analyzer R&S FSQ plus the appropriate options.

RuS_WiMAX_OFDM is a 10 minutes video on WiMAX OFDM measurements.

Additional Information

This application note is updated from time to time. Please visit the website **1MA131** in order to download the latest versions.

Please send any comments or suggestions about this application note to **TM-Applications@rohde-schwarz.com**.

Ordering Information

WiMAX Communication Tester

	Base unit with following accessories: power cord, operating manual, documentation on CD ROM	1201.0002K75
R&S® CMW270		
R&S® CMW-B110A	Arbitrary waveform generator, H110A	1202.5508.02
R&S® CMW-B690A	Basic OCXO module, H690A	1202.5908.02
R&S® CMW-B690B	Highly stable OCXO module, H690B	1202.6004.02
R&S® CMW-B612A	IEEE bus interface module, H612A	1202.5608.02

CMWrun software

R&S® CMW-KT057 (1)	CMWrun WiMAX • Ready to use solution for R&S CMW270 mobile WiMAX signaling • Framework for non-signaling chipset calibration and verification applications. • Please contact your local Rohde & Schwarz representative for information on the individual chipset implementations (not part of delivery).	1203.4205.02

(1) Software licencing based on key code for instrument R&S® CMW270 or based on flexible external USB smart card reader. For licensing using a external hardware dongle please order the smart card reader R&S® CMWPC.

R&S® CMWPC	CMWPC smartcard for CMWPC	1201.0002K50

Vector Signal Generator

R&S® SMU200A		1141.2005.02
R&S® SMU-B10	Baseband with ARB (64 Msamples)	1141.7007.02
R&S® SMU-B13	Baseband Main Module	1141.8003.02
R&S® SMU-K49	Software: 802.16	1161.0366.02
R&S® SMJ100A		1403.4507.02
R&S® SMJ-B10	Baseband with ARB (64 Msamples)	1403.8902.02

Signal analyzer, spectrum analyzer, and options

R&S® FSQ3	20 Hz to 3.6 GHz	1155.5001.03
R&S® FSQ8	20 Hz to 8 GHz	1155.5001.08
R&S® FSQ26	20 Hz to 26.5 GHz	1155.5001.26
R&S® FSL3	9 kHz to 3 GHz	1300.2502.03
R&S® FSL6	9 kHz to 6 GHz	1300.2502.06
R&S®FS-K93	Software 802.16	1302.0736.02

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