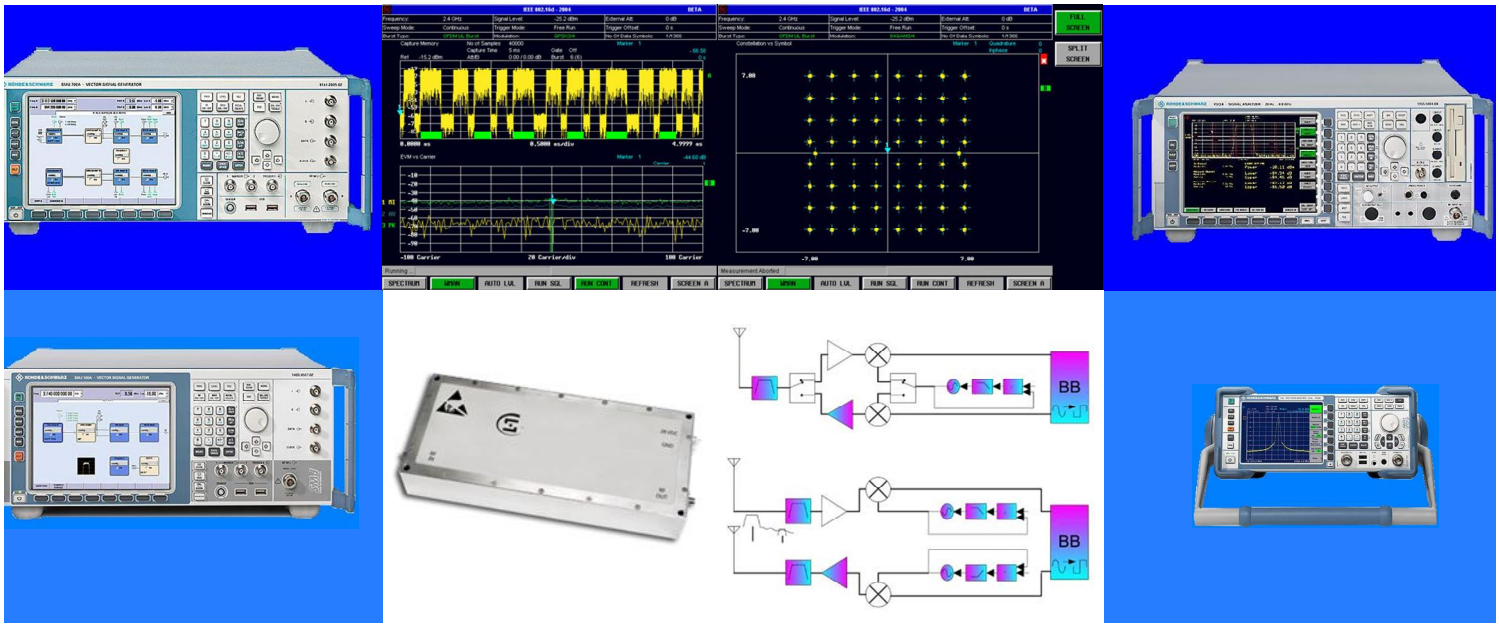


Products: SMU,SMJ,FSL,FSQ

Wimax power amplifier testing
Application program “DemoMeas_Wimax”

Application Note

DemoMeas_Wimax is a application program suitable for generating and analyzing Wimax IEEE 802.16 signals for amplifier testing. The program allows the user to change the generator settings, select specific pre-defined test parameters and analyze the test results. The application note describes the test parameters and the features and capabilities of the program.

ROHDE&SCHWARZ

Subject to change – CY Kuek / Mike Cheong 11.2006 – RAC0611-0025

Contents

1 Overview

Rohde & Schwarz has a wide range of signal generators and signal analyzers that are capable of generating and analyzing IEEE 802.16 signals. R&S signal generators such as R&S SMU200A or R&S SMJ100A with the firmware option R&S SMU-K49 or R&S SMJ-K49 are capable of producing test signals according to IEEE 802.16 standards for transmitter and receiver tests. In order to demodulate such signals, high end signal analyzers, such as R&S FSQ or R&S FSL are required with the firmware option R&S FSQ-K92/K93 or R&S FSL-K92. With these instruments manufacturers of Wimax amplifiers can easily make measurements and analyze the performance of their products. However, the user must measure several test parameters for a complete evaluation to analyze the performance of the amplifiers,. With different configurations required for each test parameter the user must set the necessary configurations manually in both the signal generator and analyzer. Setting these configurations may be time consuming and tedious.

The application note describes the features and capabilites of an external program that utilizes R&S signal generators and R&S signal analyzers to automate the measurements for amplifiers. The application note also provides information regarding the basics of the pre-defined test parameters. The program is optimized to perform measurements of all test parameters very quickly. The test parameters in the program are appropriate especially for transmitter test requirement.

The program allows the user to change the generator settings, select specific tests parameters and analyze the test results using an application program installed in a remote PC. A report of the test performance will be generated with graphical representation and details of the test including the measurement time taken for each test parameter.

The program is suitable for manufacturers of Wimax amplifiers. It is also suitable to showcase the strength of R&S signal generators and R&S signal analyzers for generating and analyzing IEEE 802.16 signals.

2 Basic of test parameters

Test parameters in the program are chosen according to the specification examples obtained from amplifer manufacturers and the test requirements specified in Wimax IEEE 802.16. These test parameters are evaluated by changing different input parameters such as frequency, power level etc. The application note will briefly describe the basic principles of the measurement of each test parameter. The test parameters in the program are as follows:

- Output burst power
- Symbol clock error
- EVM
- Spectrum Flatness
- Spectrum Mask
- Frequency error
- Crest factor
- ACPR
- Spectrum Difference

2.1 Output Burst Power

The measurement of output power versus input power for an amplifier is a typical measurement of linearity of the amplifier. The output power is typically linear for an input power ranging from sufficient level to a specific level that causes a certain degree of compression. The region where the output power is increasing linear with the input power is regarded as “linear amplification region”. This is the region where the amplifier is working at its best performance. The power measurement allows the user to determine the 1 dB compression point with reference to the linear region. Further increase of the input power will cause the amplifier to work in the saturation region.

For Wimax measurements the signal is not continuous and has a burst structure. Using the option R&S FSQ-K92/K93 or R&S FSL-K92 in R&S FSQ or R&S FSL analyzers the burst power can be measured directly as shown in Figure 2.1. The burst power measurements are obtained in terms of minimum RMS burst power, average RMS burst power and maximum RMS burst power. The program described in the application note utilizes the average RMS burst power.

IEEE 802.16 - 2004

Frequency:	2.4 GHz	Signal Level:	-11.5 dBm	External Att:	0 dB
Sweep Mode:	Continuous	Trigger Mode:	Free Run	Trigger Offset:	-10 µs
Burst Type:	OFDM DL Burst	Modulation:	64QAM3/4	No Of Data Symbols:	1/2425

Result Summary

No. of Bursts	9					
	Min	Mean	Limit	Max	Limit	Unit
EVM All Carriers	- 48.16	- 48.08	- 31.00	- 47.90	- 31.00	dB
EVM Data Carriers	- 48.10	- 48.02	- 31.00	- 47.84	- 31.00	dB
EVM Pilot Carriers	- 49.99	- 49.75		- 49.38		dB
IQ Offset	- 39.17	- 39.00		- 38.74		dB
Gain Imbalance	- 0.01	- 0.01		- 0.01		dB
Quadrature Error	0.072	0.076		0.080		°
Center Frequency Error	150.27	150.37	± 19200	150.48	± 19200	Hz
Symbol Clock Error	0.06	0.06	± 8	0.07	± 8	ppm
Burst Power	- 11.60	- 11.60		- 11.60		dBm
Crest Factor	10.15	10.15		10.18		dB
RSSI	...	...		...		dBm
RSSI Standard Deviation		...				dB
CINR	...	...		...		dB
CINR Standard Deviation		...				dB

Running ...

Figure 2.1 Measurement results in tabular format

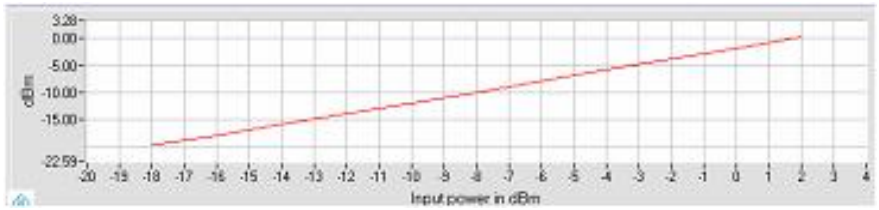


Figure 2.2 Measurement of average RMS output burst power vs input power at specific frequency.

2.2 Frequency Error

In any modulation format it is critical that the receiver accurately tracks the transmitter frequency. Frequency error can be described as the carrier frequency error relative to the analyzer's center frequency. A frequency error between the transmitter and the receiver will cause shifts to the spectrum of each subcarrier relative to the FFT receiver frequencies to the point that the spectral nulls are no longer aligned with the FFT frequencies which results in inter carrier interference (ICI).

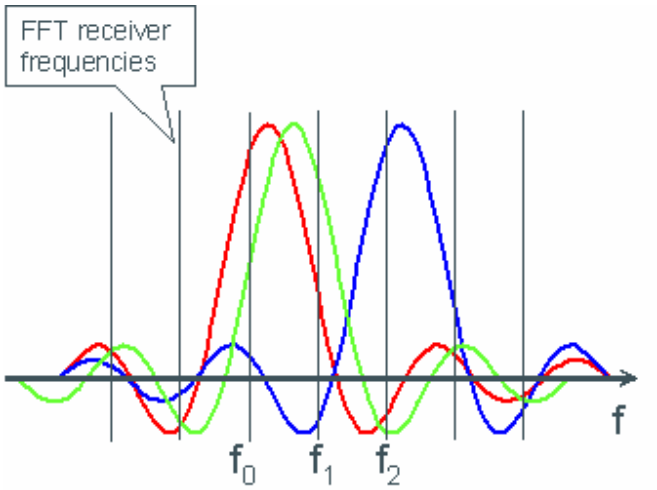


Figure 2.3 Intercarrier interferences due to frequency error

A result of the frequency error measurement with the analyzer is shown in Figure 2.1. The plot of frequency error versus guard period is designed based on IEEE 802.16 specification requirements. The measurement allows the frequency error to be determined when the guard period is changed. The application program executes the measurement in a very short time, utilizing the average frequency error. The measurement speed is one of the significant advantages of R&S signal generators and analyzers.

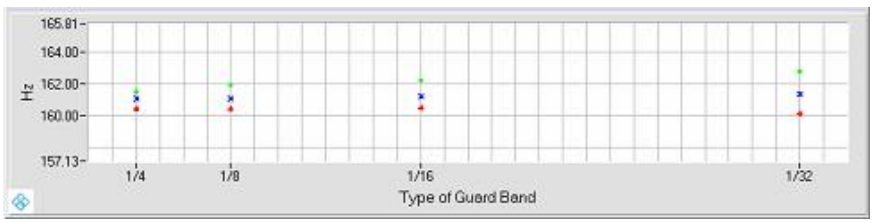


Figure 2.4 Measurement of average frequency error vs guard period at specific power level.

2.3 Symbol Clock Error

The table in Figure 2.1 also provides values for symbol clock error which is the difference between measured and reference symbol clock relative to the system sampling rate. A symbol clock that is lower than the reference symbol clock will make the orthogonal frequency-division multiple access (OFDM) signal longer than required and cause the subcarrier spacings to decrease. A symbol clock that is greater than the reference clock will make

the OFDM signal shorter and cause the subcarrier spacings to increase. These circumstances will generate intercarrier interference and are detrimental to the signal's EVM performance.

The application program plots the symbol clock error against guard band period which is based on the IEEE 802.16 specification requirements. The measurement allows the symbol clock error to be determined when the guard period is changed. The external program utilizes the average symbol clock error, executes the measurement in very short time and again, this showcases one of the significant advantages of R&S signal generators and analyzers.

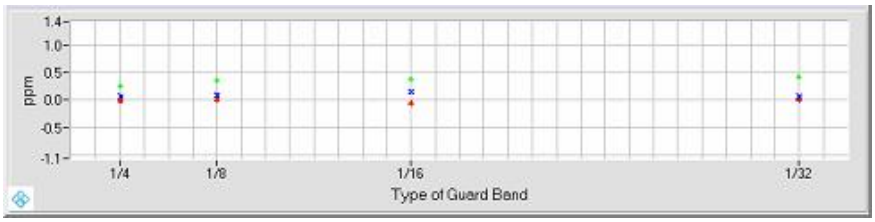


Figure 2.5 Measurement of average symbol clock error vs guard period at specific power level.

2.4 EVM (Error Vector Magnitude)

When evaluating the performance of Wimax amplifiers, error vector magnitude (EVM) is one of the most important test parameter in ensuring the amplifier abilities to produce more power and yet maintaining signal quality. EVM is a measurement of the quality of the modulated signal and the user can use the EVM results to ensure that the receiver signal to noise ratio (SNR) does not degrade more than a specified minimum value due to the transmitter SNR.

The EVM results obtained in the analyzers involve measurements of EVM for all carriers, data carriers and pilot carriers as shown in Figure 2.1. The measurements are evaluated in terms of maximum, average and minimum values. The program uses the average EVM measurement for all carriers.

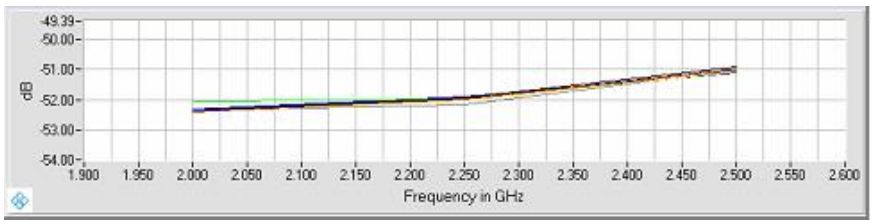


Figure 2.6 Measurement of average EVM vs frequency at different modulation schemes

Measurement of the EVM at different modulation schemes is based on the IEEE 802.16 specification requirements.

An amplifier may distort the input signal, and therefore worsen the EVM performance, due to compression effects or non-linearities. The measurement allows the user to check amplifier quality with reference to the EVM results when different modulation schemes are used.

2.5 ACPR (Adjacent Channel Power Ratio)

Adjacent channel power ratio (ACPR) is used to characterize the distortion of amplifiers causing interference with neighbouring channels. It is specified as the ratio of the amount of power measured in the adjacent channel to the amount of power in the main channel. R&S analyzer (FSQ) allows the user to measure this test parameter easily as shown in Figure 2.7.

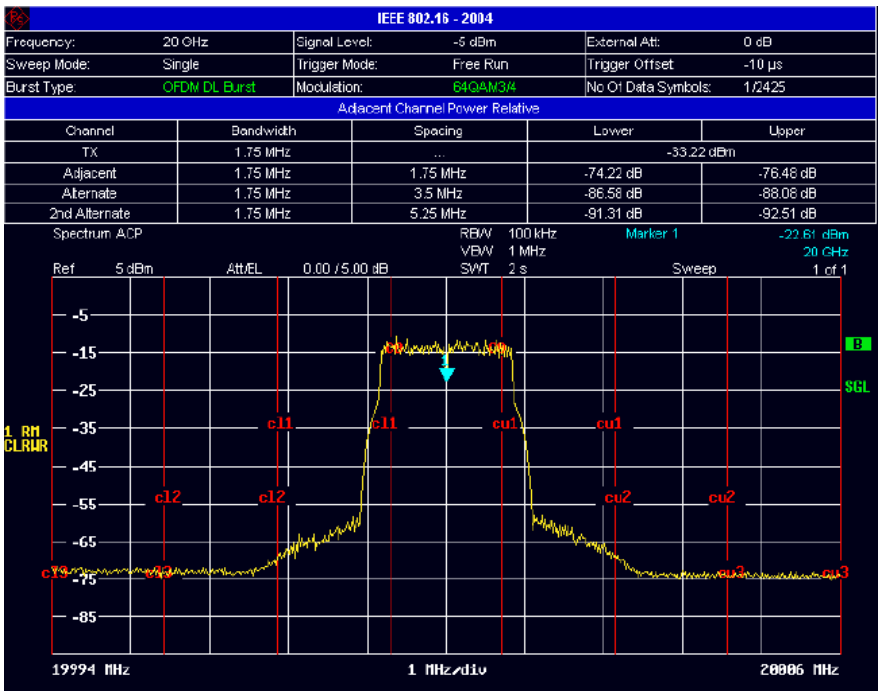


Figure 2.7 ACPR measurement display

The measurement results from the analyzer involve measurements of adjacent, alternate and 2nd alternate channels. The measurements are taken from the lower and upper frequency bands. The application program measures both the adjacent and alternate channels and it utilizes the worst case value by comparing the lower and upper frequency band of the ACPR values. A measurement result is shown in Figure 2.8.

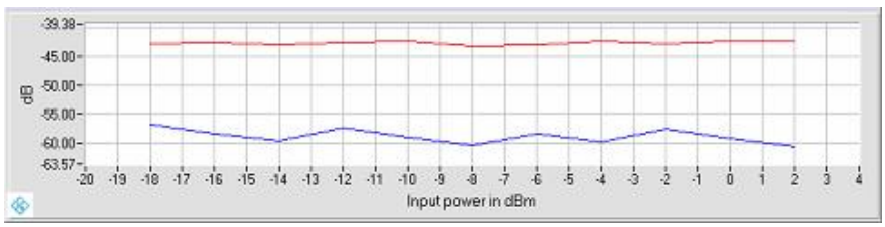


Figure 2.8 Measurement of worst case ACPR vs frequency for adjacent and alternate channels

The plot allows the user to analyze variation in ACPR performance when the input power is varied. The test parameter is designed based on examples taken from amplifier specification requirements.

2.6 Spectrum flatness

Spectral flatness is a measurement of power variations in subcarriers of a Wimax signal. It is a measure of deviation of average power in each subcarrier from the averaged power over the entire subcarriers. R&S analyzer (FSQ) provides a function to measure and display the results for spectrum flatness as shown in Figure 2.9

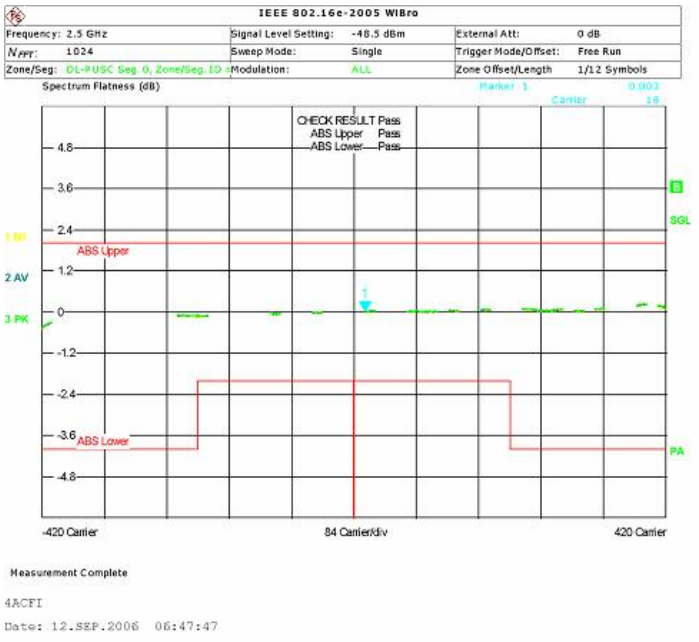


Figure 2.9 Spectrum flatness measurement display

The application program allows the user to measure the spectrum flatness at a specific power level.

2.7 Spectrum difference

The spectrum difference shows the adjacent subcarrier power difference in the preamble part of the burst. Again, R&S analyzer has a function that allows the user to measure the test parameter easily, and the result is shown in Figure 2.10.

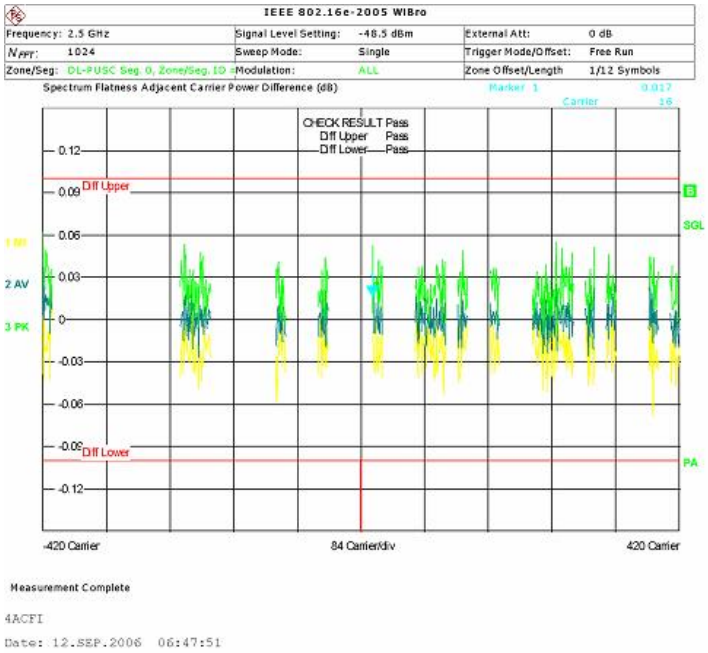


Figure 2.10 Spectrum difference measurement display

The application program allows the user to measure the spectrum difference at a specific power level.

2.8 Spectrum mask

The spectrum mask is a measure of the spectral profile of the transmitter to ensure that no excessive power is transmitted outside the main channel as shown in Figure 2.11.

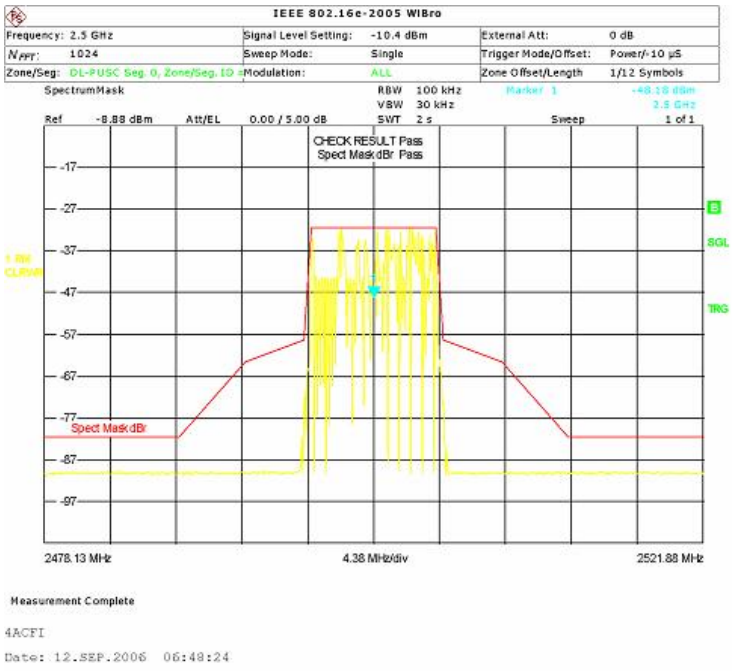


Figure 2.11 Spectrum mask measurement display

A limit line representing the spectrum mask for the selected frequency band is displayed but these frequency bands are controlled by the local regulations. R&S signal analyzers (R&S FSQ or R&S FSL) have a function that allows the user to measure the spectrum mask easily.

The application program allows the user to measure the spectrum mask at a specific power level.

3 Software Features

DemoMeas_Wimax is an external demo program for generating and analyzing the IEEE 802.16 signals for amplifier testing. The program is installed in a remote PC, and it allows the user to select specific test parameters and run them via GPIB or LAN connections. A wide range of R&S signal generators (R&S SMU200 and R&S SMJ100) and R&S signal analyzers (R&S FSQ and R&S FSL) can be used.

The test setup is shown in Figure 3.1

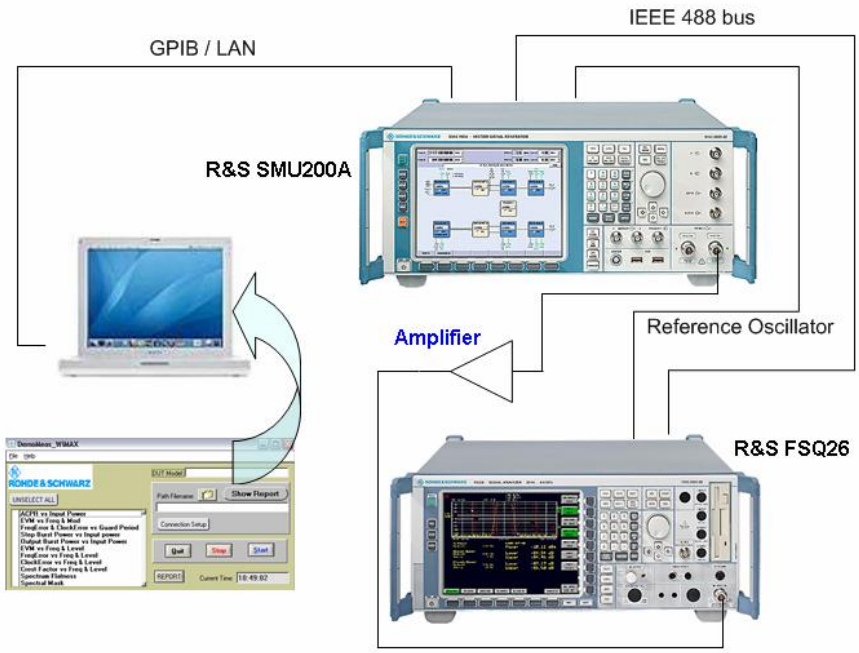


Figure 3.1 Test setup for measurement of Wimax signals using the application program

A R&S signal generator, such as R&S SMU200A, offers easy generation of the 802.16 fixed OFDM, WIMAX 802.16e OFDMA and WIBRO signals with the SMU-K49 option while a R&S signal analyzer, such as R&S FSQ26, offers the analysis of 802.16 fixed OFDM with the FSQ-K92 option and the analysis of Wimax 802.16e OFDMA and WIBRO signals with the FSQ-K93 option.

The program allows the user to choose a data file which has pre-defined settings for both the generator and analyzer according to different Wimax IEEE802.16 standards. The program has specific test parameters for the standards as shown in Table 3.1.

Test Parameters	OFDM	OFDMA	WIBRO
Step Burst Power vs Input Power	○		
Output Burst Power vs Input Power	○		
Frequency Error vs Guard Period	○		
Clock Error vs Guard Period	○		
ACPR vs Input Power	○		
EVM vs Frequency & Modulation	○	○*	○*
Frequency Error vs Frequency		○	○
Clock Error vs Frequency		○	○
Crest Factor vs Frequency		○	○
Spectrum Flatness at specific frequency		○	○
Spectrum Difference at specific frequency		○	○
Spectrum Mask at specific frequency		○	○

* The test is conducted at different frequencies with the modulation type fixed.

Table 3.1 Test parameters for different standards

Table 3.1 shows that tests for OFDM standard are slightly different compared with tests conducted for the OFDMA and WIBRO standards. The test parameters for all three standards are chosen according to examples taken from a wide range of available Wimax amplifier manufacturer specification requirements and the Wimax IEEE 802.16 transmitter test requirements. An example of a Wimax amplifier specification is shown in Annex 3.

The program has a list of setting files (*.lis) for the three standards (OFDM, OFDMA and WIBRO). The setting files can be easily viewed and edited using a text file editor (eg. Notepad). The user can choose to execute measurement in either the downlink or the uplink transmission direction. An example of executing in two zones for the OFDMA standard is also available. **Existing files in the list are for demonstration only.**

The user can choose the specific test parameters and execute the tests using the program. The program will make the necessary changes in the settings for both the generator and analyzer. A report will be generated with all measurement results recorded. The report will give graphical views of the measurements, details such as test time for each test parameter and total test time for the complete measurement.

The program is suitable for amplifiers testing. It is also suitable to demonstrate the flexibility and speed of R&S signal generators and signal analyzers.

4 Hardware and Software Requirements

PC Hardware Requirements

	Minimum
CPU	Pentium 133 MHz
RAM	128 MByte or more
Hard disc	10 MByte free space
Monitor	VGA monitor (640x480)
IEEE Bus	IEC/IEEE-bus interface

Table 4.1 PC hardware requirements

PC Software Requirements

	Minimum
OS	Windows 95/98/NT 4.0 / 2000 / ME/XP
IEEE Bus Driver	Version 1.70 (or above)
VISA	NIVISA V2.5
Others	RSIB.DLL driver for LAN and internal connections

Table 4.2 PC software requirements

5 Connecting the Computer and the Instrument

The setup of the instrument connection is done via IEC/IEEE-bus primary address and IP address. Make sure that the GPIB and IP addresses are unambiguously specified; an address cannot be assigned twice.

In order to use the LAN for remote control connection, please go to the website http://www.rohde-schwarz.com/, download and install the RSIB-PassportV1.4.zip. The RSIB passport requires **NI-VISA V2.5** or higher to be installed. Note that NI-VISA has to be licensed separately.

6 Installing the Software

Extract the ZIP file, DemoMeas.zip

Start SETUP.EXE to install the program.

During installation program files are copied to a directory of your choice.

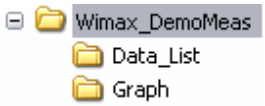
Note for Windows 95/98:

The installation process requires the Microsoft installer. If you have not installed software with the MS installer before, you need to run InstMSIA. EXE under Windows 95/98 and InstMSIW.EXE under Windows 98, before you can run SETUP.EXE

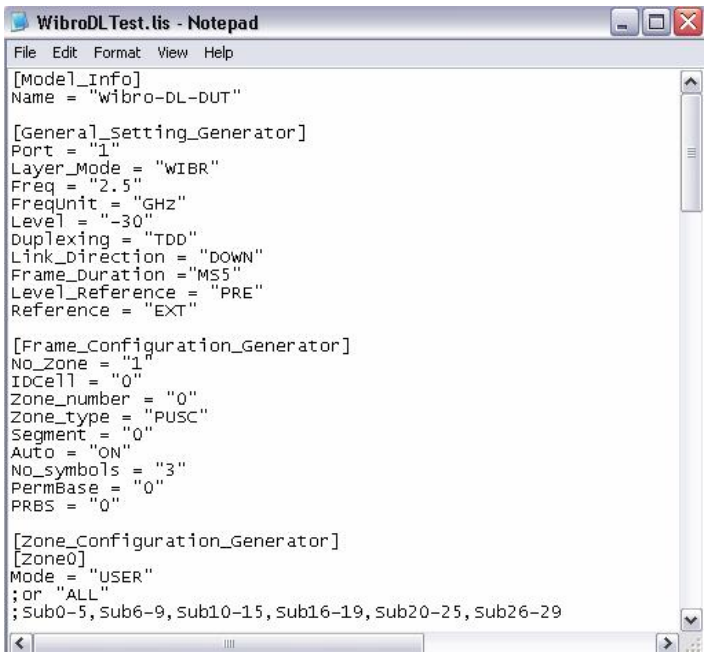
7 Starting the Software

7.1 Modifying the setting files

If the program is intended for amplifier measurement, the user must first define the necessary configurations for the signal generator and signal analyzer. The user can edit the configurations by modifying a setting file from a list of pre-defined setting files (*.lis). The files are located under the path where the program is installed, the default directory is \Program Files\Wimax_DemoMeas. In this directory there are two folders, Data_List and Graph.



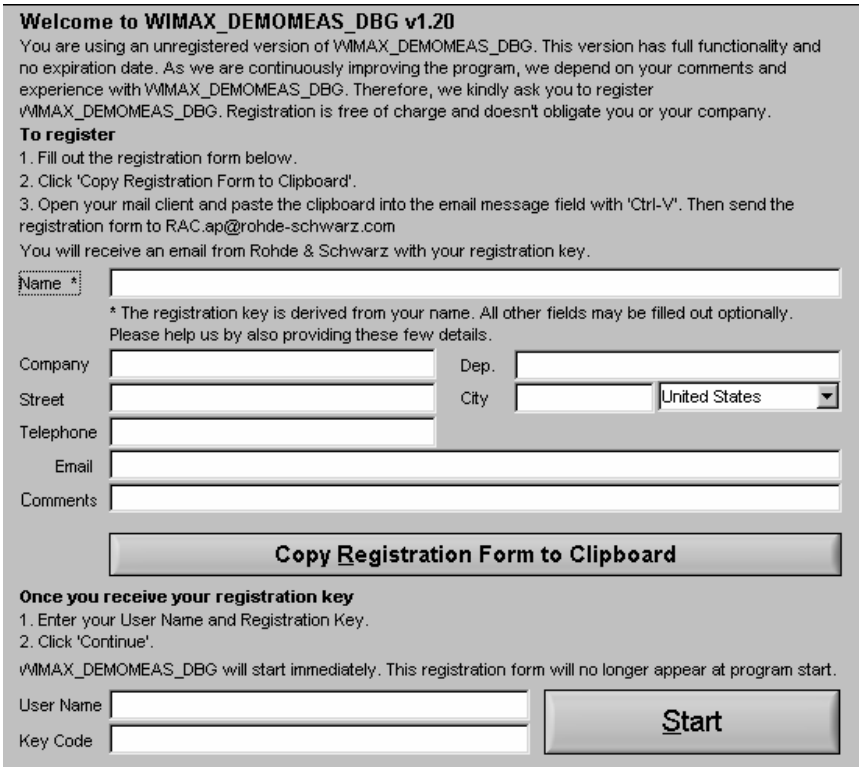
The Graph folder contains graphics saved from the instruments when the program is executed. The Data_List folder contains a list of pre-defined setting files for the three standards OFDM, OFDMA and WIBRO. The user can select the file according to the required standard and link direction. Annex 2 lists the descriptions of each setting file. The file can be edited by using a text editor such as Notepad or Wordpad.



The power level in the setting file needs to be changed so that the output level of the amplifier under test will not overload the signal analyzer. If the user intends to use the program for demonstration only, the user can use the pre-defined file and must select the correct source path of the generator. The default setting for source reference oscillator for the generator is EXTernal while the source reference oscillator for the analyzer is INTernal. Therefore, the user must connect the reference oscillator source as shown in Figure 3.1.

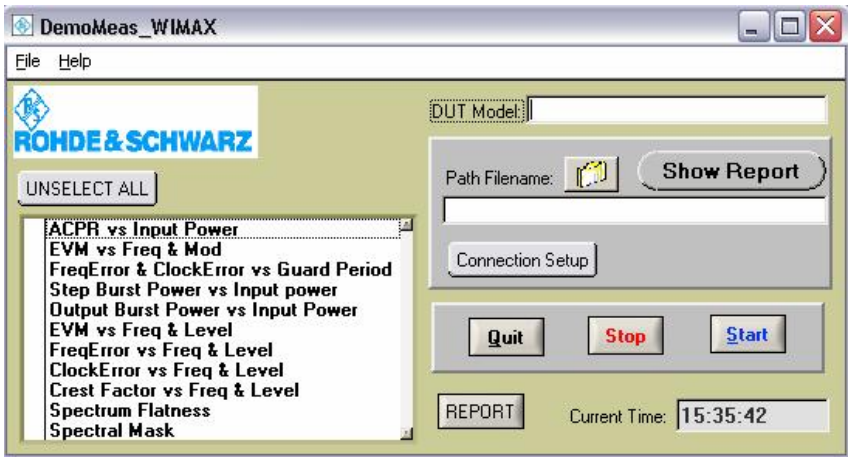
Please refer to Annex 1 for the definition of each parameter in the setting file.

7.2 Start WIMAX_DEMOMEAS.EXE



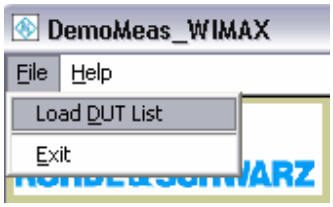
A registration form will appear and the user will need to complete the form and send it to RAC.ap@rohde-schwarz.com in order to receive a registration key. By entering the given keycode into the registration form and click on the 'Start' button, the main window for the program "DemoMeas_WIMAX" will appear.

Once registered, the registration form will not appear again in subsequent running of the program. However, the user can optionally operate the program without registration by selecting the 'Start' button. The registration form appears for 5 seconds before the main window for the measurement program appears.

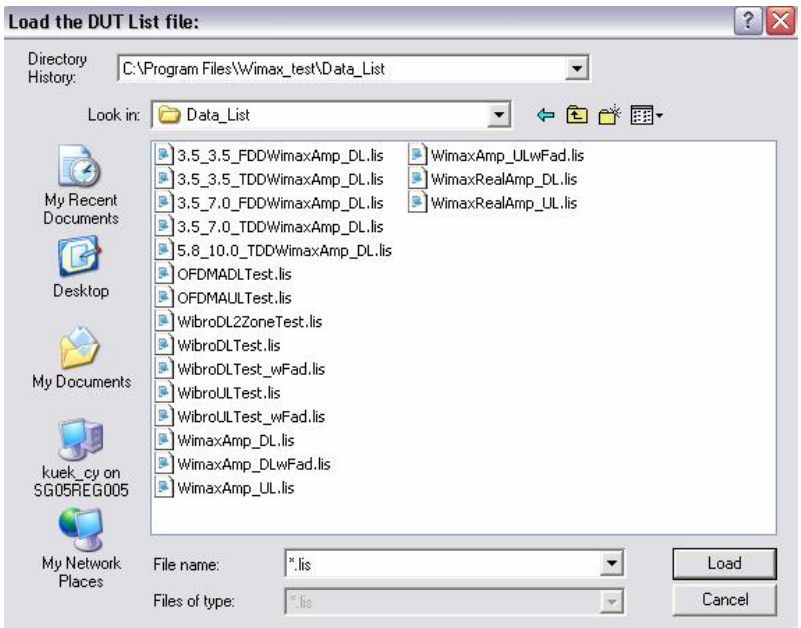


7.3 Loading of setting files

The user must select the appropriate setting file before making any measurement. This can be achieved by selecting the “Load DUT list” in the File menu.

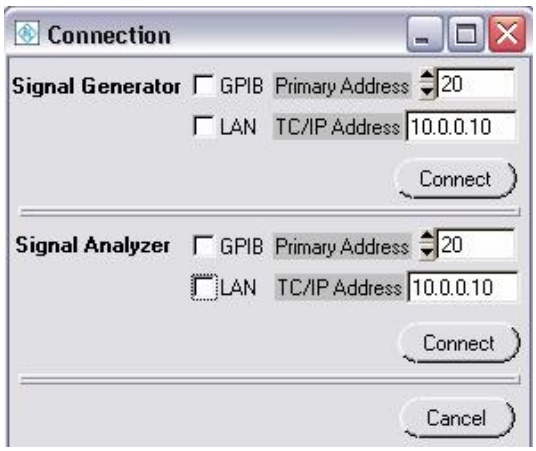


A dialog will appear and allows the user to select the specific setting file.



7.4 Connection and instrument control setup

There are two communication methods available. The user can install the program in an external PC and must configure the program to match the instrument setup using either the GPIB or LAN connections.

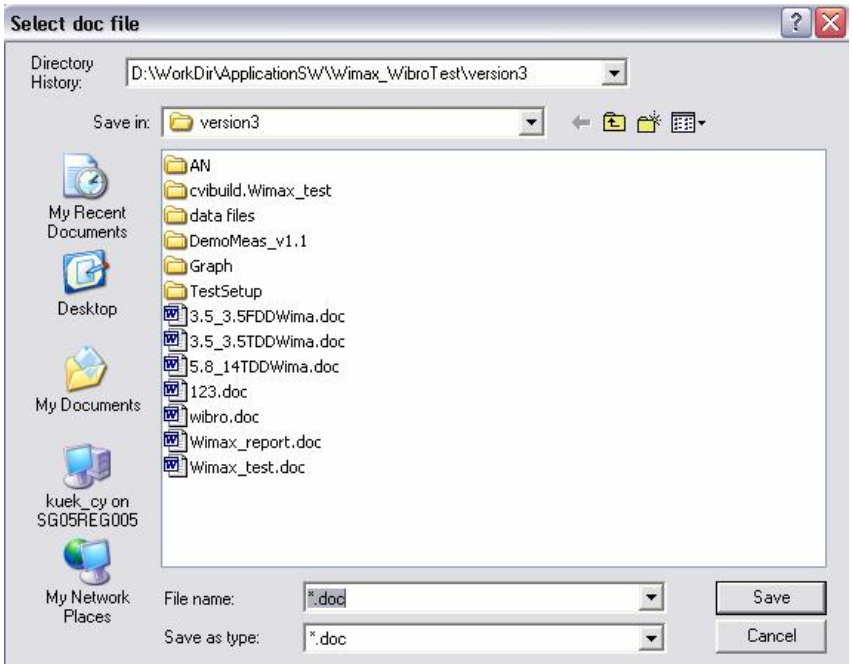


Choose GPIB by ticking the checkbox when communicating to the instrument using GPIB. The address of the instrument must match the address specified in the software.

Choose LAN by ticking the checkbox when communicating to the instrument through the LAN network by defining the TCPIP address.

7.5 Report setup

The path for the report filename can be selected accordingly by clicking on the disk symbol or double click on the path name.



A dialog will appear and allows the user to select the appropriate file name and path. The file will be saved in Microsoft Word format.

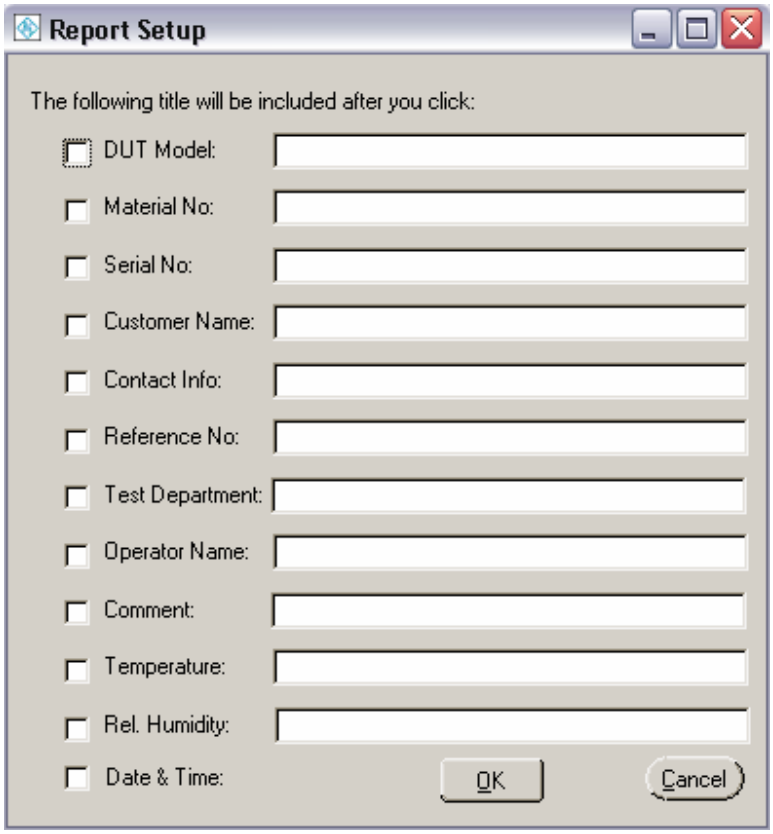
A new file can be appended to the existing file as follows

By selecting “No”, the measurement results will be appended to the previous report generated. If “Yes” is selected, the program will overwrite the previous report with the new measurement results.

It is necessary to select the report filename before any test can be executed.

7.6 DUT and user information setup

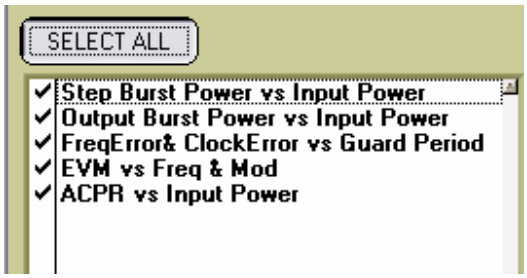
Information relating to the project can be input into the test report by selecting REPORT button and a menu will appear as follows:



The user can input the information by ticking the specific checkbox and key in the necessary information.

7.7 Test parameters selection

The user can select the test parameters either by clicking at the respective test parameters or click SELECT ALL button if all the tests parameters are needed.



7.8 Start measurements

Before clicking the START button, the user must ensure the following actions are taken:

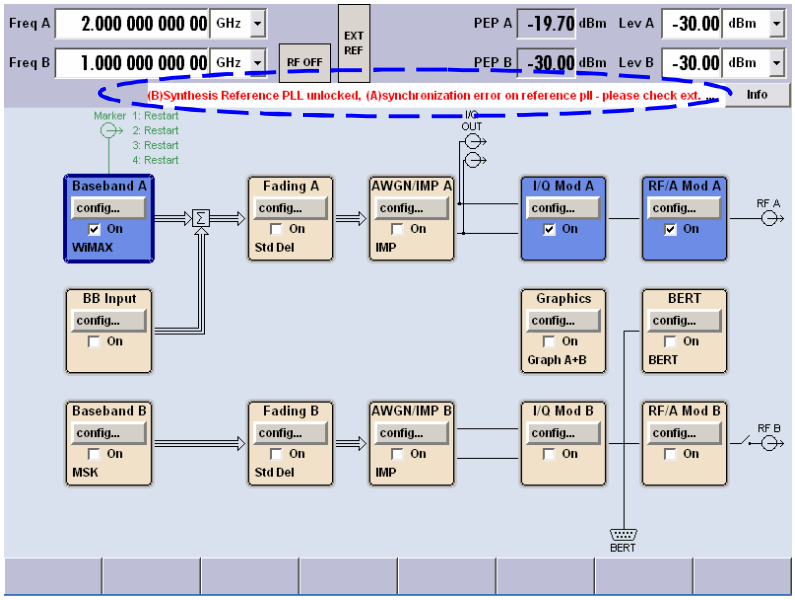
i) The user must ensure the communication between the instruments and the external PC is established.

ii) The user must select a setting file (*.lis). If no file is selected, an error dialog will appear.

iii) The user must select the required test parameters. If no test parameters are selected, an error dialog will appear.

When all the conditions are met and the communication between the instrument and external PC is successful, the program will start the measurement and the report will appear. The user will be able to see the results in the report while the measurement is still in progress. Once the measurement is completed, the program will close the report. The user can view the report by selecting the SHOW REPORT button. The report will then appear again.

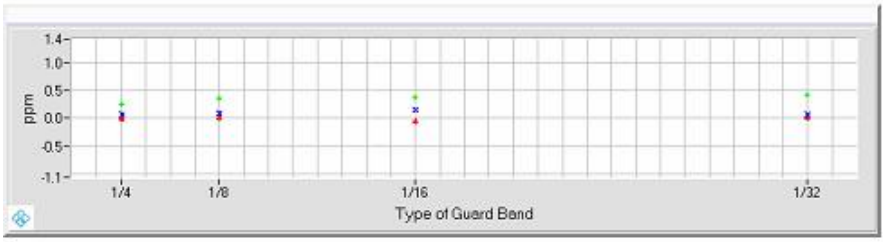
The signal generator will generate an error when the source reference oscillator is not properly connected. If the user did not change the setting files, the default setting for the generator is EXTernal reference while the default setting for the analyzer is INTernal reference. The error "Synthesis Reference PLL unlocked (Synchronization error on reference pll)" will appear in the INFO bar on the generator display when no reference is connected between the instruments or if both instruments are set to the instrument default settings.



7.9 Measurement report

The user may load and view the measurement report by selecting the SHOW REPORT button. A dialog will appear which will prompts for the measurement report filename and directory path. The program will then open the measurement report using Microsoft Word. A screen shot of the report generated is shown here.

Frequency Error vs Guard Band at input power -8.0dBm
Test time for both FrequencyError and ClockError = 8.738sec



Red Trace = Min Frequency error
Blue Trace = Average Frequency error
Green Trace = Max Frequency error

Min FreqError (Hz)	Ave FreqError (Hz)	Max FreqError (Hz)	GuardBand Type
160.44	161.09	161.49	1/4
160.44	161.09	161.92	1/8
160.52	161.22	162.24	1/16
160.13	161.33	162.81	1/32

8 Annex 1

There are a few regulations that the user must follow when editing the setting files. These regulations will ensure errors can be avoided.

1) Do not modify the words in the parentheses.(eg. [Model_Info])
2) Modification is only allowed within the double quotes (eg. “OFDM”, “WIBR”). Any modification outside the double quotes will result in errors.

Definitions of test parameters for all three standards (OFDM, OFDMA and WIBRO) in the setting file are described as follows:

8.1 OFDM standards parameter descriptions

Command in setting file	Definitions
[Model Info]	
Name = "WimaxAmp_DL_DUT"	The entry for the DUT Model name. It will appear in the report as well.
---	---
[General_Setting_Generator]	This section describes the common settings for the generator
Port = "1"	Configures the source path from the generator
Layer_Mode = "OFDM"	Sets the Physical layer mode (eg. WIBR, AOFD)
Freq = "2.5"	Sets the test frequency
FreqUnit = "GHz"	Sets the test frequency units (eg. MHz, kHz)
Level = "-30"	Sets the power level required
Duplexing = "TDD"	Sets the duplexing mode (eg. FDD, TDD)
Link_Direction = "DOWN"	Defines the transmission direction (eg. UP, DOWN)
Frame_Duration ="MS5"	Sets the frame duration (eg. MS2, MS2D5, MS4, MS5, MS8, MS10, MS12D5, MS20, CONT, USER)
Level_Reference = "BURS"	Sets the level reference (eg. BURS, PRE)
Reference = "EXT"	Sets the reference source for the generator (eg. EXT, INT)
---	---
[Frame_Configuration_Generator]	
Frequency_Band = "ETSI"	Sets the frequency band for the carrier frequencies (eg. ETSI, MMDS, WCS, UNII, USER)
Channel_BW = "3.5"	Sets the channel bandwidth (eg. 1.25 to 28MHz)
BW_unit = "MHz"	Sets the channel bandwidth units

BSID = "5"	Sets the 4 LSB of the base station ID
TGTB = "TGTB1D8"	Sets the ratio of guard period to symbol period (eg. TGTB1D4, TGTB1D8, TGTB1D16, TGTB1D32)
No_Subchannel = "SC16"	Sets the number of used subchannels (e. SC1, SC2, SC4, SC8, SC16)
Frame_Preamble = "LONG"	Activates/De-activates the generation of frame preamble (OFF, LONG, SHORT)
No_Bursts = "3"	Sets the number of active burst in one frame

[Burst_settings_generator]

;modulation,Chan_coding, data_length	1st burst settings according to the sequence (eg. For modulation, BPSK1D2,QPSK1D2,QPSK3D4, QAM1D2X16,QAM3D4X16, QAM2D3X64, QAM3D4X64)
Burst1 = "QPSK3D4,ON,500"	
;modulation,Chan_coding,	Subsequent bursts settings according
data_length,preamble	to the sequence (eg. for coding: ON, OFF)
Burst2 = "QAM3D4X16,ON,1000,LONG"	
Burst3 = "QAM2D3X64,ON,1000,SHORT"	

[General_Setting_Analyzer]	This section describes the common settings for the analyzer
Frequency = "2.5"	Sets the test frequency
FreqUnit = "GHz"	Sets the test frequency units (eg. kHz, MHz, GHz)
Standard = "0"	Sets the Physical layer mode (eg. 0=OFDM, 1=OFDMA, 2=WIBRO)
FrequencyBand = "ETSI"	Sets the frequency band for the carrier frequencies(eg.ETSI,ETSI1,ETSI2, MMDS,MMDS1,MMDS2,WCS,WCS1, WCS2,CEPT,CEPT1,CEPT2,UNII, UNII1,UNII2)
GRatio = "8"	Sets the ratio of guard period to symbol period (eg. 32,16,8,4)
Channel_BW = "3.5"	Sets the channel bandwidth (eg. 1.75MHz to 28MHz)
BW_Unit = "MHz"	Sets the channel bandwidth units
Sweeptime_AUTO = "ON"	Activates/De-activates the automatic sweep time calculation for ACP&MASK measurement (eg. OFF, ON)
Sweeptime_ACP = "2"	Sets the sweep time for ACP&MASK measurement

Sweeptime_ACP_unit = "s"	Sets the sweep time units
Sweeptime = "20"	Sets the capture time period
SweeptimeUnit = "ms"	Sets the capture time period units
SweepCount = "1"	Defines the number of sweeps for ACP&MASK measurement
Reference = "INT"	Sets the reference source for the analyzer (eg. INT, EXT)
---	---
[Demod_Setting_Analyzer]	
Link_mode = "DL"	Analyzes the downlink or uplink burst (eg. UP, DL)
Ch_Est = "ON"	Selects whether to use channel estimation (eg. ON, OFF)
Mod_Detect_Mode = "ALL"	Selects how signals to be demodulated (eg. ALL, QPSK,QAM16,QAM64)
Overall_Burst_count = "OFF"	Selects whether to use the burst count parameter (eg. ON, OFF)
TrackLevel = "ON"	Activates/De-activates level compensation (eg. ON, OFF)
TrackTime ="ON"	Activates/De-activates time compensation (eg. ON, OFF)
TrackPhase = "ON"	Activates/De-activates phase compensation (eg. ON, OFF)
---	---
[ACP_settings_analyzer]	Sets the number of adjacent channel
No_of_channels = "2"	pair to measure
---	---
[ACPR_VS_POW_settings_analyzer]	Sets Relative or Absolute
MODE = "REL"	measurement for ACPR (eg. ABS, REL)
---	---
[StepPower_test]	Settings for Step Burst Power vs Input Power
TITLE = "Step Burst Power vs Input Power"	
No_of_powersetting = "5"	Sets the number of power level to be measured
GenPower = "-8,-6,-4,0,2"	Sets the power levels
---	---
[OutputPower_test]	Settings for Output Burst Power vs Input Power
TITLE = "Output Burst Power vs Input Power"	
No_of_powersetting = "7"	Sets the number of power level to be measured
GenPower = "-18,-16,-14,-12,-10,-8,-6 "	Sets the power levels

[Freq&Clk_test]	Settings for Output Burst Power vs Input Power
TITLE = "FreqError& ClockError vs Guard Period"	
Power_dBm = "-8"	Sets the power level for the test
No_guard_band = "4"	Sets the number of guard band
Type_guard_band = "4,8,16,32"	Sets the type of guard band
---	---
[EVM_test]	Settings for EVM vs Frequency and Modulation
TITLE = "EVM vs Freq & Mod"	
No_Bursts = "1"	Sets the number of burst for test
No_of_freq = "3"	Sets the number of frequencies to measure
Frequencies = "2.5,2.25,2"	Sets the frequencies
Frequencies_unit = "GHz,GHz,GHz"	Sets the frequencies units
GenPower = "5"	Sets the power level
No_modulation = "2"	Sets the number of modulation to be tested
;Modulation type, data length	Settings for each modulation with appropriate data lenght
Modulation1 = "BPSK1D2,500"	
Modulation2 = "QPSK1D2,1000"	
---	---
[ACPR_test]	Settings for ACPR vs Input Power
TITLE = "ACPR vs Input Power"	
No_of_power_setting = "7"	Sets the number of power levels
GenPower = "-18,-16,-14,-12,-10,-8,-6"	Sets the power levels
---	---
[Fading_setting]	Settings for fading profile
State = "OFF"	Activates/De-activates the fading profile
Standard = "G6TU3"	Sets pre-defined fading settings
Configuration = "DEL"	Sets fading configurations
;DEL,DEL30,DEL50,BIRT,MDEL	
Signal_dedicated_to = "RF"	Sets the RF frequency for computing
;RF, BB	the Doppler shift
Restart_Event = "AUTO"	Sets the event which leads to restart of fading (eg. AUTO, MAN, INT, EXT1,EXT2)
Ignore_RF_Changes_<5% = "OFF"	Selects whether frequency changes <5% are to be ignored (eg. ON, OFF)
Frequency_Hop_Mode = "OFF"	Activates/De-activates frequency hop mode (eg. OFF, IBAN,OOB)

8.2 OFDMA/ WIBRO standards parameter descriptions

Command in setting file	Definitions
[Model Info]	
Name = " OFDMA-DL-DUT"	The entry for the DUT Model name. It will appear in the report as well.
---	---
[General_Setting_Generator]	This section describes the common settings for the generator
Port = "1"	Configures the source path from the generator
Layer_Mode = " AOFD"	Sets the Physical layer mode. For Wibro, set to “WIBR”
Freq = "2.5"	Sets the test frequency
FreqUnit = "GHz"	Sets the test frequency units
Level = "-30"	Sets the power level required
Duplexing = "TDD"	Sets the duplexing mode
Link_Direction = "DOWN"	Defines the transmission direction
Frame_Duration ="MS5"	Sets the frame duration
Level_Reference = "PRE"	Sets the level reference. Only for downlink
Reference = "EXT"	Sets the reference source for the generator
---	---
[Frame_Configuration_Generator]	
Frequency_Band = "ETSI"	Sets the frequency band for the carrier frequencies. OFDMA only
TGTB = "TGTB1D8"	Sets the ratio of guard period to symbol period. OFDMA only
Channel_BW = "3.5"	Sets the channel bandwidth. OFDMA only (1.25 to 28MHz)
BW_unit = "MHz"	Sets the channel bandwidth units. OFDMA only
FFT_size = "1024"	Sets the FFT size. OFDMA only (eg. 128, 512,1024, 2048)
No_Zone = "1"	Sets the number of active zones in one frame
IDCell = "0"	Sets the IDCell
Zone_number = "0"	Sets the zone number of the zone
Zone_type = "PUSC"	Sets the type of subcarrier permutation (eg. PUSC, FUSC)
Segment = "0"	Sets the segnment of the zone index
Auto = "ON"	Activates/De-activates automatic zone length (eg. ON, OFF)

No_symbols = "3"	Sets the zone length in number of symbols
PermBase = "0"	Sets the PermBase of the zone
PRBS = "0"	Sets the PRBS ID of the zone

[Zone_Configuration_Generator]

[Zone0]	Sets the zone to be configured.
Mode = "USER"	Activates generation of subchannels. Subchannels setting only for downlink (eg. USER, ALL)

;Sub0-5,Sub6-9,Sub10-15,Sub16-19,Sub20-25,Sub26-29

Status = " ON, ON, ON, ON, ON, ON"	Sets the subchannel status using the sequence
No_Bursts = "3"	Sets the number of active bursts in segment/zone
;Burst_settings	Sets the modulation type (eg. BPSK1D2,QPSK1D2,QPSK3D4, QAM1D2X16,QAM3D4X16, QAM2D3X64, QAM3D4X64)

Modulation = "QPSK1D2,QPSK1D2, QAM3D4X16"

Coding_Channel = "CC,CC,CC"	Sets the channel coding mode (eg. OFF,CC,CTC)

;burst1,burst2,burst3

No_Subchannel = "2,6,5"	Specify the number of subchannels for selected burst. Used in downlink only
No_Symbol = "2,2,4"	Specify the number of symbols for selected burst. Used in downlink only
No_Slot = "77,50,20"	Specify the number of slots for selected burst. Used in uplink only
Auto = "USER,USER,USER"	(eg. USER,AUTO)
Offset_Subchannel = "0,2,0"	Specify the subchannel offset for selected burst
Offset_Symbol = "0,0,2"	Specify the symbol offset for selected burst
[Zone1]	Repeat the settings for the following zone if more than 1 zone exists.

Mode = "USER"

;or "ALL"

;Sub0-5,Sub6-9,Sub10-15,Sub16-19,Sub20-25,Sub26-29

Status = " ON, ON, ON, ON, ON, ON"

No_Bursts = "2"

;Burst_settings

Modulation = "QPSK1D2,QPSK1D2"

Coding_Channel = "CC,CC"

No_Subchannel = "2,6"

No_Symbol = "2,2"

Auto = "USER,USER"

Offset_Subchannel = "0,2"

Offset_Symbol = "0,0".

[General_Setting_Analyzer]	This section describes the common settings for the generator
Frequency = "2.5"	Sets the test frequency
FreqUnit = "GHz"	Sets the test frequency units
Standard = "1"	Sets the Physical layer mode
FrequencyBand = "ETSI"	Sets the frequency band for the carrier frequencies
ChannelBW = "1.75"	Sets channel bandwidth
BW_unit = "MHz"	Sets channel bandwidth units
FFTsize = "1024"	Sets the FFT size
GRatio = "8"	Sets the ratio of guard period to symbol period
Sweeptime_ACP = "ON"	Activates/De-activates the automatic sweep time calculation for ACP&MASK measurement
Sweeptime = "20"	Sets the capture time period
SweeptimeUnit = "ms"	Sets the capture time period units
SweepCount = "1"	Defines the number of sweeps for ACP&MASK measurement
Tracktime = "ON"	Activates/De-activates time compensation (eg. ON,OFF)
Trackphase = "ON"	Activates/De-activates phase compensation (eg. ON,OFF)
AdjacentChPair = "2"	Sets the number of adjacent channel pair to measure
Reference = "INT"	Sets the reference source for the generator (eg. EXT,INT)

[Frame_Global_Analyzer]	
IDCell = "0"	Specify the downlink IDCell number. Used in downlink only
Segment = "1"	Specify the segment used. Used in downlink only
Subchannel_bitmap = "63"	Specify the allowable logical subchannel. Used in downlink only. (eg. 63 =11111,3=00011)
Frame = "0"	Sets the frame number. Used in uplink only

[Frame_Config_Analyzer]	
[Zone setting]	
no_zone = "1"	Specify the number of active zone in the frame
;Analyze,Type,Segment,length,offset,permbase,prbs	
Zone1 = "ON,DLPUSC,0,12,1,0,0"	Sets the zone configuration following the sequence (eg. DLPUSC, DLFUSC,ULPUSC)
---	---
[Burst_Settings]	
[Zone_ana1]	1st zone settings
no_Burst = "3"	Sets the number of active burst in the zone/segment
;mod,subchannel,symbols,slot duration, subchannel offset, symbol offset, burst power, burst type	
Burst1 = "QPSK_1_2,2,2,0,0,0,0,DATA"	Sets the settings for each bursts according to the sequence (eg. QPSK_1_2,QPSK_3_4,QAM16_1_2, QAM16_3_4,QAM64_1_2,QAM64_2_3,QAM64_3_4)
Burst2 = "QPSK_1_2,6,2,0,2,0,0,DATA"	(eg. FCH,DLMAP,ULMAP,DATA)
Burst3 = "QAM16_3_4,5,4,0,0,2,0,DATA"	
---	---
[Analyze]	
Zone_to_analyze = "1"	Sets the zone for analysis
---	---
[Common_setting]	
No_of_freq = "3"	Sets the number of frequency to be measured
Freq = "2.5,2.25,2"	Sets the frequencies
Freq_units = "GHz,GHz,GHz"	Sets the frequencies units
---	---
[EVM vs Freq]	EVM test vs frequency
No_power = "2"	Sets the number of power level. Maximum limit = 10
Power = "-30,-8"	Sets the power levels
---	---
[FreqErr/ClkErr vs Freq]	Frequency Error vs Frequency and Clock Error vs Frequency tests
No_power = "2"	Sets the number of power level. Maximum limit = 10
Power = "-30,-8"	Sets the power levels
---	---

[Crestfactor vs Freq]	Crest Factor vs frequency test
No_power = "2"	Sets the number of power level. Maximum limit = 10
Power = "-30,-8"	Sets the power levels
---	---
[Spectrum Flatness]	Spectrum Flatness at specific power level
Power = "-30"	Sets power level
---	---
[Spectrum Difference]	Spectrum Difference at specific power level
Power = "-30"	Sets power level
---	---
[Spectrum Mask]	Spectrum Mask at specific power level
Power = "-8"	Sets power level
---	---
[Fading_setting]	Settings for fading profile
State = "OFF"	Activates/De-activates the fading profile (eg. ON, OFF)
Standard = "G6TU3"	Sets pre-defined fading settings
Configuration = "DEL"	Sets fading configurations (eg. DEL,DEL30,DEL50,BIRT,MDEL)
Signal_dedicated_to = "RF"	Sets the RF frequency for computing the Doppler shift (eg. RF,BB)
Restart_Event = "AUTO"	Sets the event which leads to restart of fading (eg. AUTO,MAN,INT,EXT1,EXT2)
Ignore_RF_Changes_<5% = "OFF"	Sets whether frequency changes <5% are to be ignored (eg. ON,OFF)
Frequency_Hop_Mode = "OFF"	Activates/De-activates frequency hop mode (eg. OFF,IBAN,OOB)

9 Annex 2

9.1 Setting files descriptions

Files	Descriptions
3.5_3.5_FDDWimaxAmp_DL.lis	Test frequency = 3.5GHz, Sampling bandwidth = 3.5GHz Duplex = FDD, Link = Downlink Standard = OFDM
3.5_3.5_TDDWimaxAmp_DL.lis	Test frequency = 3.5GHz, Sampling bandwidth = 3.5GHz Duplex = TDD, Link = Downlink Standard = OFDM
3.5_7.0_FDDWimaxAmp_DL.lis	Test frequency = 3.5GHz, Sampling bandwidth = 7.0GHz Duplex = FDD, Link = Downlink Standard = OFDM
3.5_7.0_TDDWimaxAmp_DL.lis	Test frequency = 3.5GHz, Sampling bandwidth = 7.0GHz Duplex = TDD, Link = Downlink Standard = OFDM
3.5_3.5_FDDWimaxAmp_DL.lis	Test frequency = 3.5GHz, Sampling bandwidth = 3.5GHz Duplex = FDD, Link = Downlink Standard = OFDM
5.8_10.0_TDDWimaxAmp_DL.lis	Test frequency = 5.8GHz, Sampling bandwidth = 10.0GHz Duplex = TDD, Link = Downlink Standard = OFDM
The following files are using Duplex TDD only	
OFDMADLTest.lis	Test frequency = 2.5GHz, Sampling bandwidth = 1.75GHz Link = Downlink Standard = OFDMA
OFDMAULTest.lis	Test frequency = 2.5GHz, Sampling bandwidth = 1.75GHz Link = Uplink Standard = OFDMA
WibroDL2ZoneTest.lis	Test frequency = 2.5GHz, Number of Zone = 2 Link = Downlink Standard = WIBRO
WibroDLTest.lis	Test frequency = 2.5GHz, Number of Zone = 1 Link = Downlink Standard = WIBRO

WibroDLTest_wFad.lis	Test frequency = 2.5GHz, Number of Zone = 1 Link = Downlink Fading profile = ON Standard = WIBRO
WibroULTest.lis	Test frequency = 2.5GHz, Number of Zone = 1 Link = Uplink Standard = WIBRO
WibroULTest_wFad.lis	Test frequency = 2.5GHz, Number of Zone = 1 Link = Uplink Fading profile = ON Standard = WIBRO
WimaxAmp_DL.lis	Test frequency = 2.5GHz, Link = Downlink Standard = OFDM
WimaxAmp_DLwFad.lis	Test frequency = 2.5GHz, Link = Downlink Fading profile = ON Standard = OFDM
WimaxAmp_UL.lis	Test frequency = 2.5GHz, Link = Uplink Standard = OFDM
WimaxAmp_ULwFad.lis	Test frequency = 2.5GHz, Link = Uplink Fading profile = ON Standard = OFDM

10 Annex 3

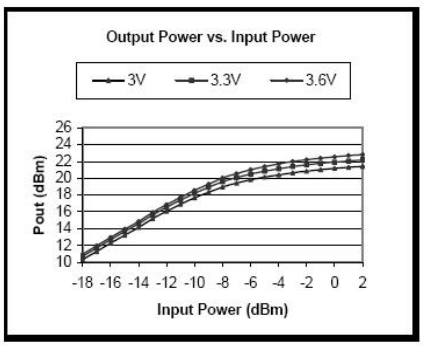
10.1 Examples of amplifier specifications

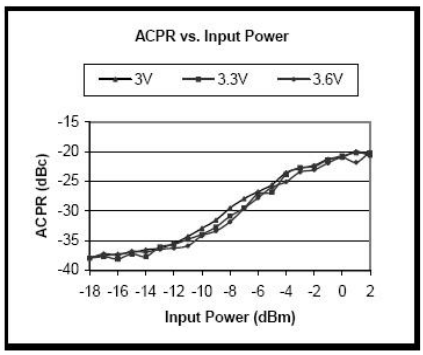
AC Electrical Characteristics

Conditions: V_{CC0} = V_{CC1} = V_{CC2} = V_{EN} = 3.3V, V_{CTL} = 1.6V, P_{IN} = -8dBm, T_A = 25°C, f = 2.45GHz, using SiGe SE2520L-EV1 Evaluation Board.

Symbol	Parameter	Note	Min.	Typ.	Max.	Unit
f_{L-U}	Frequency Range	1	2400		2500	MHz
P_{OUT}	Output power, P_{IN} = -8dBm, V_{CTL} = 1.6V	1	18	20	22	dBm
	Output power, P_{IN} = -8dBm, V_{CTL} = 0.1V	1		-10	5	dBm
	Saturated Output Power, P_{IN} = +2dBm, V_{CTL} = 1.6V	1	21	23		dBm
dP_{OUT} /dV_{CTL}	Control Voltage Sensitivity			40		dBm/V
G	Gain, small signal			29		dB
G_{VAR}	Gain Variation over band (2400-2485 MHz)			1.0	2.0	dB
2f,3f,4f,5f	Harmonics	2			-30	dBm/100kHz
IS_{21} I_{OFF}	Isolation in "OFF" State, P_{IN} <= +2dBm, V_{EN} = 0V		25	35		dB
$IS_{12}I$	Reverse Isolation		32	42		dB
t_R	Rise and Fall Time 10% to 90%			1.2		µs
STAB	Stability (P_{IN} <= +2dBm, Load VSWR = 6:1)		All non-harmonically related outputs less than -50 dBc/100kHz			

Notes: (1) Parameter measured with RF modulation based on IEEE 802.11b standard, meeting ACPR of –30dBc 1st lobe and –50dBc 2nd lobe
(2) Harmonic levels and ACPR are greatly affected by topology of external matching networks.





11 Additional Information

Please contact your nearest Rohde-Schwarz office or rac.ap@rohde-schwarz.com for additional information or further suggestions.

12 Literature

1) "WIMAX – Generate and Analyze 802.16-2004 and 802.16e Signals", *Rohde & Schwarz Application Note 1MA97*
2) "WIMAX – General Information about the standard 802.16", *Rohde & Schwarz Application Note 1MA96*
3) "WIMAX – 802.16-2004, 802.16e, WIBRO – Introduction to Wimax Measurements", *Rohde & Schwarz Application Note 1EF57*
4) "Vector Signal Generator R&S SMU200A – Manual", *Rohde & Schwarz 1007.9845.32*
5) "Signal Analyzer R&S FSQ3/8/26/31/40 – Operating Manual", *Rohde & Schwarz 1155.5047.12*
6) "WIMAX IEEE 802.16-2004, IEEE802.16e-2005 TX Tests – Application Firmware R&S FSQ-K92/K93", *Rohde & Schwarz 1200.7410.02*
7) "Part16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems", *IEEE P802.16e/D12*
8) "SE2520L 2.4GHz Power Amplifier IC", *SiGe Semiconductor Dataste*

13 Ordering information

RF Signal Analyzer and Options		
R&S FSQ3	20 Hz ... 3.6 GHz	1155.5001.03
R&S FSQ8	20 Hz ... 8.0 GHz	1155.5001.08
R&S FSQ26	20 Hz ... 26.5 GHz	1155.5001.26
R&S FSQ40	20 Hz ... 40 GHz	1155.5001.40
R&S FSL3	9kHz to 3GHz	1300.2502.03
R&S FSL3	9kHz to 3GHz with tracking generator	1300.2502.13
R&S FSL6	9kHz to 6GHz	1300.2502.06
R&S FSL6	9kHz to 6GHz with tracking generator	1300.2502.16
R&S FSL-K92	Wimax IEEE 802.16-2004	1302.0236.02
R&S FSQ-K92	Wimax (802.16-2004)	1300.7410.02
R&S FSQ-K92U	Upgrade K92 to K93	1300.8500.02
R&S FSQ-K93	Wimax (802.16e)	1300.8600.02
R&S FSQ-B71	I/Q Baseband Inputs	1157.0113.03
R&S FSQ-B72	I/Q Bandwidth Extension	1157.0336.02
RF Signal Generator and Options		
R&S SMU200A	Vector Signal Generator	1141.2005.02
RF Path A		
R&S SMU-B102	100kHz to 2.2GHz	1141.8503.02
R&S SMU-B103	100kHz to 3GHz	1141.8603.02
R&S SMU-B104	100kHz to 4GHz	1141.8703.02
R&S SMU-B106	100kHz to 6GHz	1141.8803.02
RF Path B		
R&S SMU-B202	100kHz to 2.2GHz	1141.9400.02
R&S SMU-B203	100kHz to 3GHz	1141.9500.02
R&S SMU-B13	Baseband Main Module	1141.8003.02
R&S SMU-B14	Fading Simulator	1160.1800.02
R&S SMU-B15	Fading Simulator Extension	1160.2288.02
R&S SMU-B10	Baseband Generator with ARB (64M samples)	1141.7007.02
R&S SMU-B11	Baseband Generator with ARB (16M samples)	1159.8411.02
R&S SMU-K49	Digital Standard IEEE 802.16	1161.0366.02
R&S SMJ100A	Vector Signal Generator	1403.4507.02
RF Path		
R&S SMJ-B103	100kHz to 3GHz	1403.8502.02
R&S SMJ-B106	100kHz to 6GHz	1403.8702.02
R&S SMJ-B10	Baseband Generator with ARB (64M samples)	1403.8902.02
R&S SMJ-B11	Baseband Generator with ARB (16M samples)	1403.8909.02
R&S SMJ-B13	Baseband Main Module	1403.9109.02
R&S SMJ-K49	Digital Standard IEEE 802.16	1404.1101.02

ROHDE & SCHWARZ · Systems & Communications Asia Pte Ltd · 1 Kaki Bukit View #04-12 TECHVIEW S'pore 415941 ·
Telephone +65 6513 0475 · Fax +65 6846 1090 · Email: rac.ap@rohde-schwarz.com