Electromagnetic Compatibility Test Report

Test Report No: MOT 310510
Issued on: July 18, 2010

Product Name
WiMAX VSM VM2500
Model: F7400A

Tested According to
FCC 47 CFR, Part 27
Industry Canada RSS 199

Tests Performed for
Motorola Inc.
One Motorola Plaza, Holtsville, N.Y 11742, USA

QualiTech EMC Laboratory, ECI Telecom
30 Hasivim Street,
Petah-Tikva, 49517, Israel
Tel: +972-3-926 8443
Fax: +972-3-928 7490

ELECTRICAL TESTING
CERT #1633.01

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Test Personnel

Tests Performed By: ----------

Rami Nataf Sergey Kapustin

Report Prepared By: ----------

Bina Talkar

Report Reviewed By: ----------

Y. Zucker
QA and Lab. Manager
QualiTech EMC Laboratory

Test Report details:

Test commencement date: 13.05.2010

Test completion date: 31.05.2010

Customer's representative: Assi Gershon

Issued on: 18.07.2010

Revision details:

Version	Date	Details/Reasons
Rev. 1	31.05.2010	-
Rev. 2	07.07.2010	Industry Canada RSS 199 requirements added on pages 1, 4 & 7.
Rev. 3	11.07.2010	Added conducted output power & 26 dB Bandwidth measurements for all modulation types.
Rev.4	14.07.2010	The lowest frequencies were changed for Channel Edge Measurements test and the start frequency measurement was 2496MHz.
Rev.5	18.07.2010	The lowest frequencies were changed for all measurements

Assessment information:

This report contains an assessment of the EUT against Electromagnetic Compatibility based upon tests carried out on the samples submitted. The results contained in this report relate only to the items tested. Manufactured products will not necessarily give identical results due to production and measurement tolerances. QualiTech, EMC Lab does not assume responsibility for any conclusion and generalization drawn from the test results with regards to other specimens or samples of type of the equipment represented by test item.

The EUT was set up and exercised using the configuration, modes of operation and arrangements defined in this report only.

Modifications:

Modifications made to the EUT

None

Modifications made to the Test Standard

None

Summary of Compliance Status

Test Spec. /Clause	Remarks
e.i.r.p. Output Power, §27.50(h)(2) & §2.1046 & RSS 199 Sec.4.4	Comply
Emission Bandwidth, §27.53(m)(6) & §2.1049 & RSS 199 Sec.4.2	Comply
Conducted Spurious Emissions, §27.53(m)(6) & §2.1051 & RSS 199 Sec.4.5	Comply
Channel Edge Emissions, §27.53(m)(6) & §2.1051 & RSS 199 Sec.4.5	Comply
Radiated Spurious Emissions, §2.1053 & RSS 199 Sec.4.5	Comply
Frequency stability, §27.54 & §2.1055 & RSS 199 Sec.4.3	Comply

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1. General Description

General Information:

Product: VSM, Model F7400A

FCC ID: AZ492FT7041

IC: 109U-92FT7041

Power Supply: Vehicular 12VDC

Maximum Output Power: 1,122 mW

Modulation Type: QPSK and 16 QAM

Modulation Technique: OFDM

Data Rates: 1.25, 1.88, 2.5, 3.75, 5, 7.5 Mbps

Downlink		Uplink	
Modulation	Coding Rate	Modulation	Coding Rate
QPSK	½	QPSK	½
	¾		¾
16 QAM	½	16 QAM	½
	¾		¾

Duplex Method: TDD

Operating Range: 2495MHz ÷ 2690MHz

Channel Bandwidth: 5MHz and 10MHz

Antenna Type: Vehicular Colinear Two Dipole Array

Operation Temperature range: -30°C ÷ 60°C

The above EUT information was declared by the manufacturer.

2. Test Facility & Uncertainty of Measurement

2.1. Accreditation/ Registration reference:

- *A2LA Certificate Number: 1633.01*
- *Industry Canada File Number: IC4808*

2.2. Test Facility description

The tests were performed at the EMC Laboratory, QualiTech Division, ECI Telecom Group

Address: 30, Hasivim St., Petah Tikva, Israel.
Tel: 972-3-926-8443

3m Anechoic Chamber:

The 3m-screened chamber is used in two configurations: the semi-anechoic configuration for Radiated Emission measurements and the full-anechoic configuration for Radiated Immunity tests.

Semi Anechoic Configuration:

Measurement distance	3m
Chamber dimensions	9.5m x 6.5m x 5.2m
Antenna height	1 - 4m
Shielding Effectiveness	Magnetic field ≥80dB at 15 kHz ≥90dB at 100 kHz Electric field >120dB from 1MHz to 1GHz >110dB from 1GHz to 10GHz
Absorbing material	Ferrite tiles on the walls and ceiling Frankonia hybrid absorbing material in selected positions on the walls
Normalized Site Attenuation measured at 5 positions	±3.49dB, 30MHz to 1GHz
Transmission Loss measured at 5 positions, at 1.5m height	±3dB, 1GHz to 18GHz

Full-Anechoic Configuration:

Measurement distance	3m
Chamber dimensions	7m x 4m x 3m
Antenna height	1.55m at Horizontal & Vertical polarizations
Shielding Effectiveness	Magnetic field ≥80dB at 15 kHz ≥90dB at 100 kHz Electric field >120dB from 1MHz to 1GHz >110dB from 1GHz to 10GHz
Absorbing material	Ferrite tiles on the walls and ceiling Frankonia hybrid absorbing material in selected positions on the walls and floor
Field Uniformity to EN61000-4-3	±3dB 80MHz to 18GHz

2.3. Uncertainty of Measurement:

Test Name	Test Method & Range	Uncertainty	
		Combined std. Uc(y) [dB]	Expanded U [dB]
Radiated Emission	30MHz÷230MHz, Horiz. polar. 30MHz÷230MHz, Ver. polar. 230MHz÷1000MHz, Horiz. polar. 230MHz÷1000MHz, Vert. polar.	1.8 2.0 1.5 1.5	3.6 3.9 3.0 3.0
Conducted Emission	9 kHz÷150 kHz 150 kHz÷30MHz	1.4 1.1	2.8 2.2

3. Method of Measurements

3.1. Conducted RF Measurements:

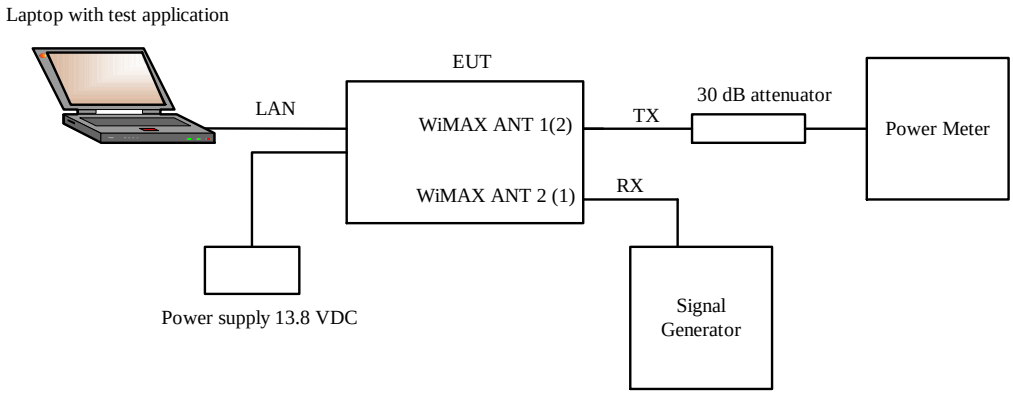
The RF output of the transmitter under test was directly connected to the input of the Spectrum analyzer through a specialized antenna connector provided by the manufacturer and an attenuator as specified. The external attenuator and cable loss were added to the reading. Worst-case results of the various modulation modes (where applicable) were reported.

For Maximum Conducted Output Power, the spectrum analyzer was set for free run, and 100 traces were averaged in power averaging mode. The transmitter was continuously transmitting at a duty cycle of about 99% and power was integrated across a bandwidth of the 26dB EBW of the signal, using the spectrum analyzer's band power measurement function with band limits set equal to the EBW band edges. Alternatively, Peak Output Power was measured using a Peak Power Meter.

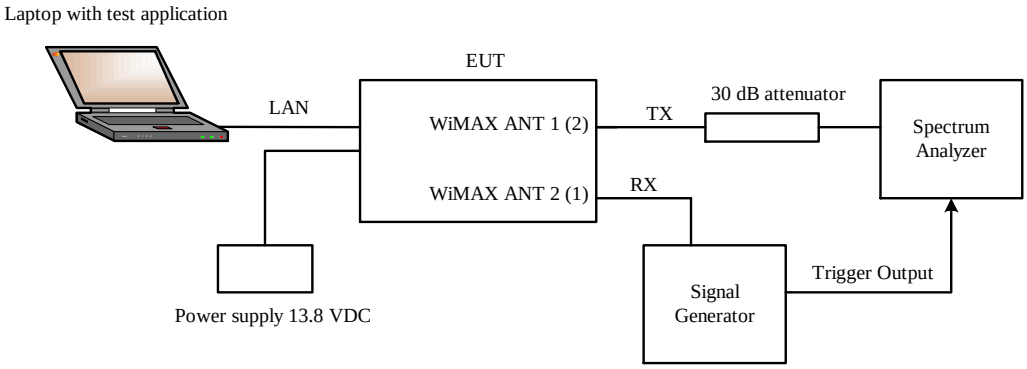
For spurious emissions measurement, the spectrum from 9 kHz to 40 GHz was investigated with the transmitter set to the lowest, middle and highest channel frequencies.

Test Setup

Conducted Output Power



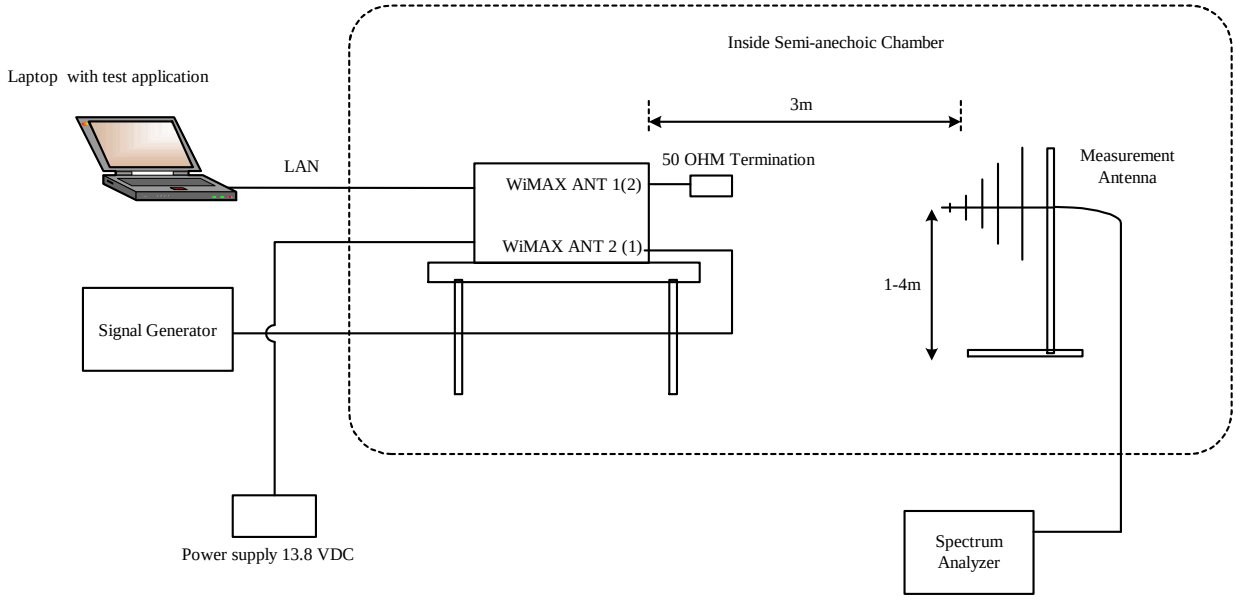
Conducted Spurious Emissions



3.2. Radiated Emission measurements:

Measurements were performed in a semi-anechoic chamber at a 3-meter measurement distance in order to evaluate the radiated electromagnetic interference characteristics of the EUT. The EUT was placed on a non-metallic table/support, 0.8m above the turntable, was configured, arranged and operated in a manner consistent with typical application and load conditions. The test program of exercising the equipment ensured that various parts of the EUT were exercised to permit detection of all EUT disturbances.
While the turntable was being rotated around 360 degrees, the height of the antenna was varied from 1 to 4m for the frequency range of 30MHz to 40GHz. Measurements were performed for vertical and horizontal polarization.
Using the Substitution Method in accordance to TIA/EIA 603, an antenna with a known gain substituted the EUT, and an RF signal source was connected to the antenna input. The signal source level was adjusted until the previously recorded maximum reading was obtained. The power source reading was corrected for the cable loss, and the antenna gain was added to obtain the EIRP peak power. EIRP measurements were made at the upper, center, and lower carrier frequencies.

Test Setup



3.3. Frequency Stability

The frequency stability shall be measured with variations of ambient temperature from -30°C to +50°C. Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of 10°C.
Frequency stability shall be measured with variations of primary supply voltage to the battery-operating end point, which shall be specified by the manufacturer.

3.4. Worst Case Results:

Worst case result is determined for applicable modulation types and data rates. Pre-scan has been conducted to determine the worst-case.

4. Measurements

4.1. Conducted Output Power

Reference document:	47 CFR §27.50 (h) (2) & §2.1046		
Test Requirements:	Mobile stations are limited to 2.0 watts EIRP.		
Test setup:	See sec 3.1	**Pass**	
Method of testing:	Conducted		
Operating conditions:	Under normal test conditions		
Power meter Settings:	AVG		
Environment conditions:	Ambient Temperature: 23.1°c	Relative Humidity: 55.4%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	---	

Test results: Output ANT 1:

Channel	Frequency [MHz]	Output Power* [dBm]	Output Power* [mW]	Antenna Gain** [dBi]	EIRP calculated [dBm]	Limit [dBm]	Margin [dB]
WiMAX 802.16e (5MHz), OFDMA, QPSK, Duty Cycle 32%							
Low	2498.5	29.91	916.220	1.71	31.33	33	-1.67
Middle	2600	29.70	933.25	2.55	32.25	33	-0.75
High	2687.5	29.19	829.85	1.71	30.90	33	-2.10
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%							
Low	2498.5	29.94	986.279	1.71	31.65	33	-1.35
Middle	2600.0	29.61	914.11	2.55	32.16	33	-0.84
High	2687.5	29.21	833.68	1.71	30.92	33	-2.08
WiMAX 802.16e (10MHz), OFDMA, QPSK, Duty Cycle 27%							
Low	2501	29.62	916.220	1.71	31.33	33	-1.67
Middle	2600	29.07	807.24	2.55	31.62	33	-1.38
High	2685	28.71	743.02	1.73	30.44	33	-2.56
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%							
Low	2501	29.71	935.406	1.71	31.42	33	-1.58
Middle	2600	29.22	835.60	2.55	31.77	33	-1.23
High	2685	28.83	763.84	1.73	30.56	33	-2.44

* Corrected for external attenuations.
** As provided by the manufacturer (including cable loss).

Test results: Output ANT 2:

Channel	Frequency [MHz]	Output Power* [dBm]	Output Power* [mW]	Antenna Gain** [dBi]	EIRP calculated [dBm]	Limit [dBm]	Margin [dB]
WiMAX 802.16e (5MHz), OFDMA, QPSK, Duty Cycle 32%							
Low	2498.5	29.97	993.116	1.71	31.68	33	-1.32
Middle	2600.0	29.98	995.41	2.55	32.53	33	-0.47
High	2687.5	29.97	993.12	1.71	31.68	33	-1.32
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%							
Low	2498.5	29.94	986.279	1.71	31.65	33	-1.35
Middle	2600.0	29.32	855.07	2.55	31.87	33	-1.13
High	2687.5	29.34	859.01	1.71	31.05	33	-1.95
WiMAX 802.16e (10MHz), OFDMA, QPSK, Duty Cycle 27%							
Low	2501	29.66	924.698	1.71	31.37	33	-1.63
Middle	2600	29.47	885.12	2.55	32.02	33	-0.98
High	2685	29.42	874.98	1.73	31.15	33	-1.85
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%							
Low	2501	29.84	963.829	1.71	31.55	33	-1.45
Middle	2600	28.99	792.50	2.55	31.54	33	-1.46
High	2685	29.04	801.68	1.73	30.77	33	-2.23

* Corrected for external attenuations.
** As provided by the manufacturer (including cable loss).

4.2. 26 dB Bandwidth

Reference document:	47 CFR §27.53 (m) (6) & §2.1049		
Test Requirements:	The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.		
Test setup:	See sec 3.1	**Pass**	
Method of testing:	Conducted		
Operating conditions:	Under normal test conditions		
S.A. Settings:	RBW: 100kHz, VBW: 300kHz for 5MHz channel bandwidth RBW: 300kHz, VBW: 1MHz for 10MHz channel bandwidth		
Environment conditions:	Ambient Temperature: 23.1°c	Relative Humidity: 55.4%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.2.1 - Plot 4.2.24	

Test results for output ANT 1:

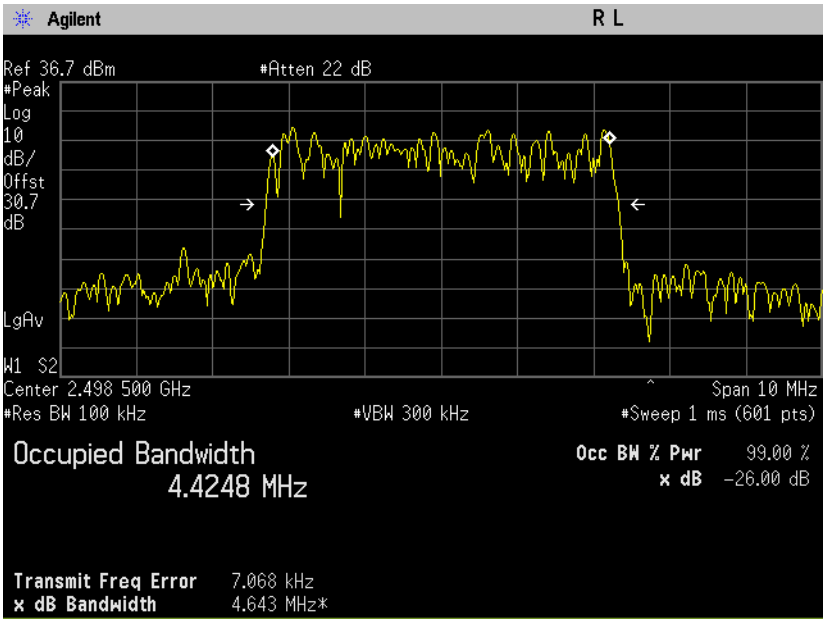
Channel	Frequency [MHz]	Occupied BW 99% Power [MHz]	26 dB Bandwidth [MHz]	Ref Plots
WiMAX 802.16e (5MHz), OFDMA, QPSK, Duty Cycle 32%				
Low	2498.5	4.4248	4.643	4.2.1
Middle	2600.0	4.4279	4.642	4.2.2
High	2687.5	4.4315	4.640	4.2.3
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%				
Low	2498.5	4.4785	4.672	4.2.4
Middle	2600.0	4.4704	4.674	4.2.5
High	2687.5	4.4749	4.675	4.2.6
WiMAX 802.16e (10MHz), OFDMA, QPSK, Duty Cycle 27%				
Low	2501	9.1729	9.728	4.2.7
Middle	2600	9.1796	9.723	4.2.8
High	2685	9.1787	9.726	4.2.9
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%				
Low	2501	8.9769	9.692	4.2.10
Middle	2600	8.9863	9.696	4.2.11
High	2685	8.9896	9.698	4.2.12

Test results for output ANT 2:

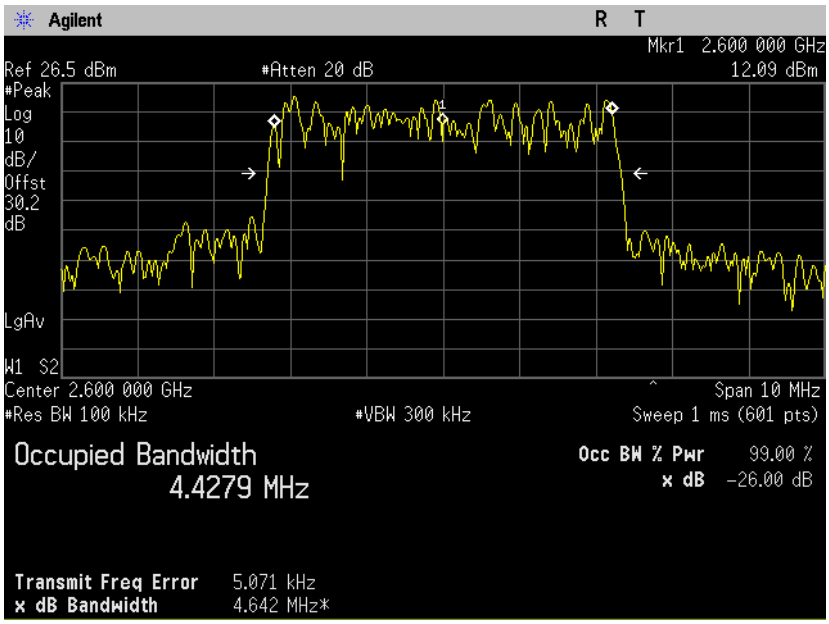
Channel	Frequency [MHz]	Occupied BW 99% Power [MHz]	26 dB Bandwidth [MHz]	Ref Plots
WiMAX 802.16e (5MHz), OFDMA, QPSK, Duty Cycle 32%				
Low	2498.5	4.4247	4.638	4.2.13
Middle	2600.0	4.4296	4.639	4.2.14
High	2687.5	4.4288	4.641	4.2.15
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%				
Low	2498.5	4.4692	4.673	4.2.16
Middle	2600.0	4.4744	4.675	4.2.17
High	2687.5	4.4741	4.677	4.2.18
WiMAX 802.16e (10MHz), OFDMA, QPSK, Duty Cycle 27%				
Low	2501	9.1685	9.726	4.2.19
Middle	2600	9.1787	9.722	4.2.20
High	2685	9.1772	9.725	4.2.21
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%				
Low	2501	8.9789	9.695	4.2.22
Middle	2600	8.9852	9.699	4.2.23
High	2685	8.9886	9.698	4.2.24

WiMAX 802.16e (5MHz), OFDMA, QPSK, Duty Cycle 32%
Output ANT 1

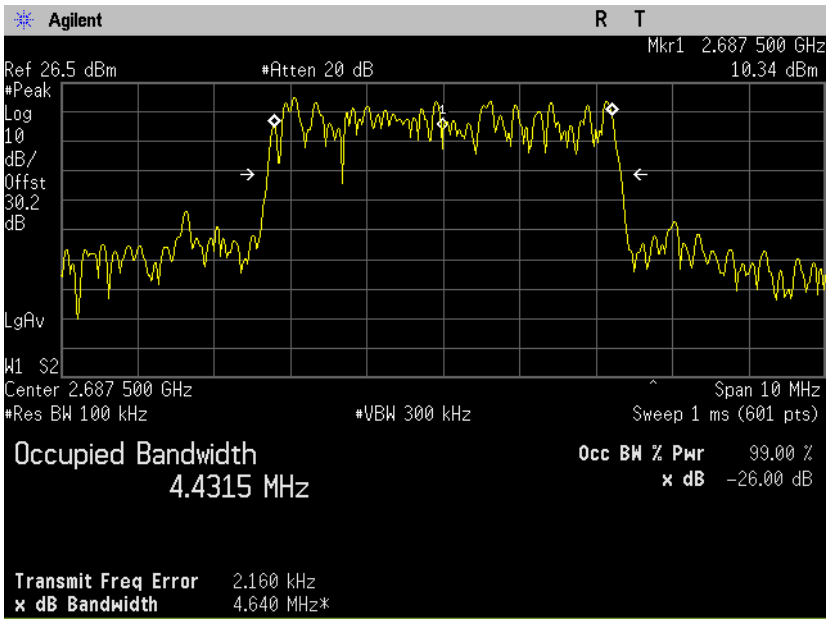
Low Frequency 2498.5 MHz
Plot 4.2.1



Middle Frequency 2600 MHz
Plot 4.2.2

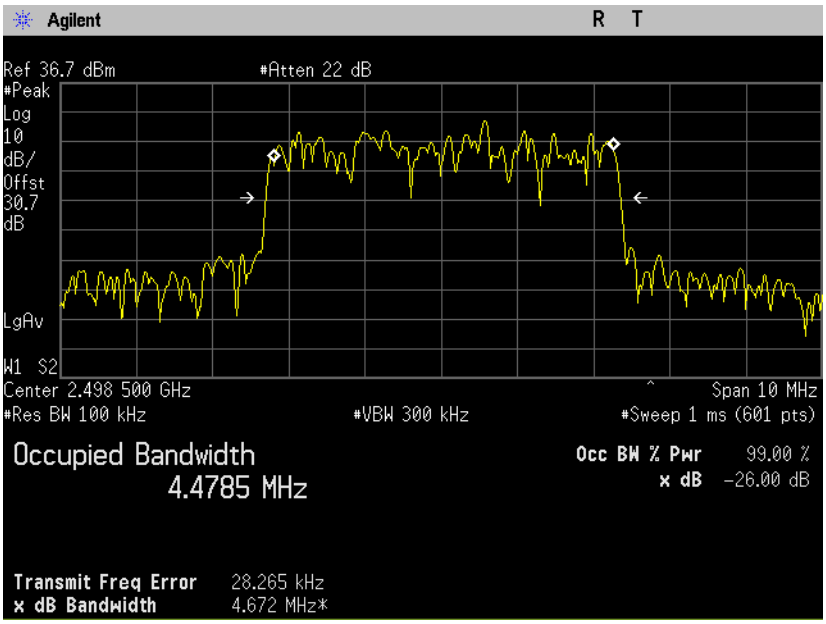


High Frequency 2687.5 MHz
Plot 4.2.3

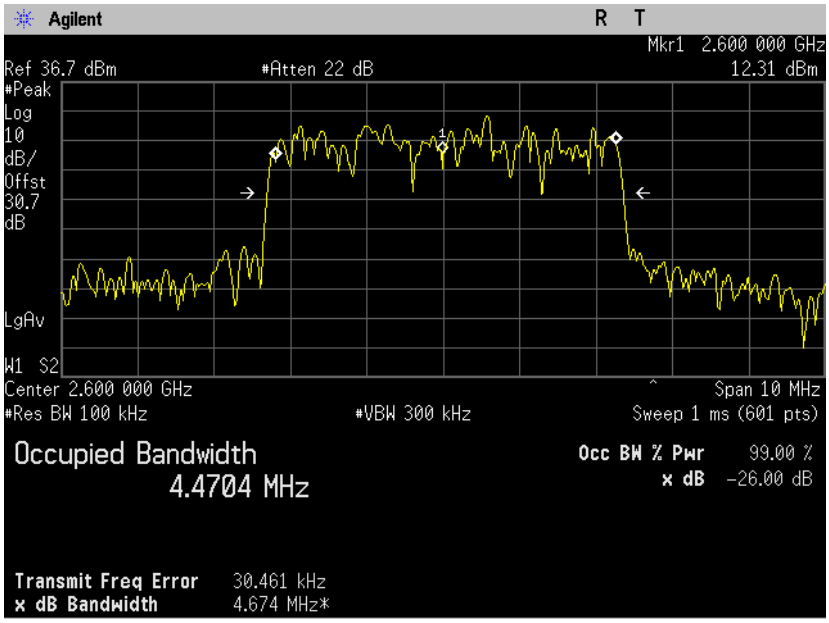


WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 1

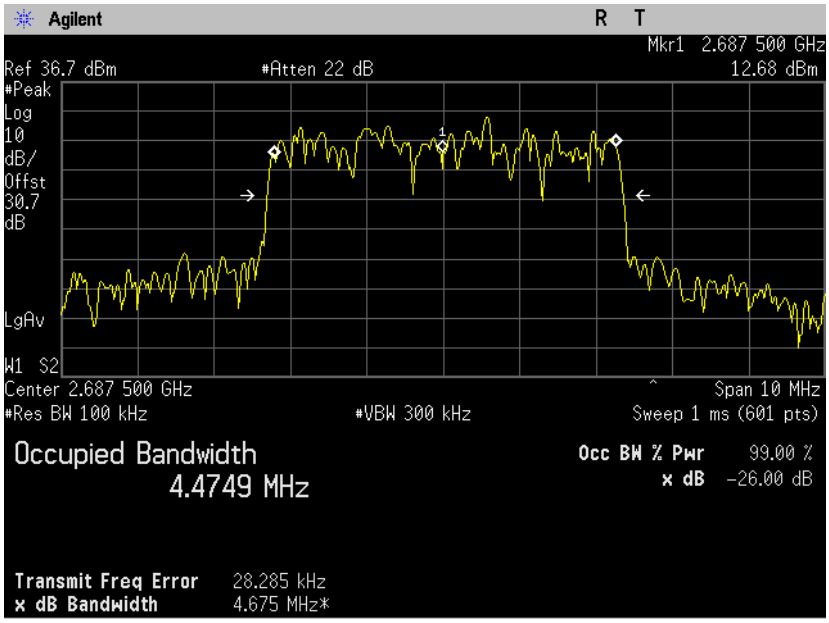
Low Frequency 2498.5 MHz
Plot 4.2.4



Middle Frequency 2600 MHz
Plot 4.2.5

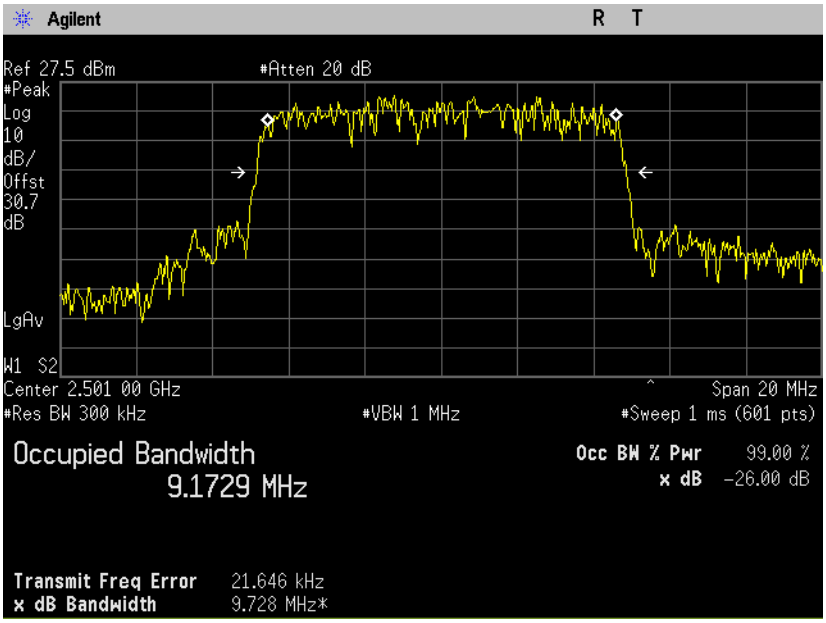


High Frequency 2687.5 MHz
Plot 4.2.6

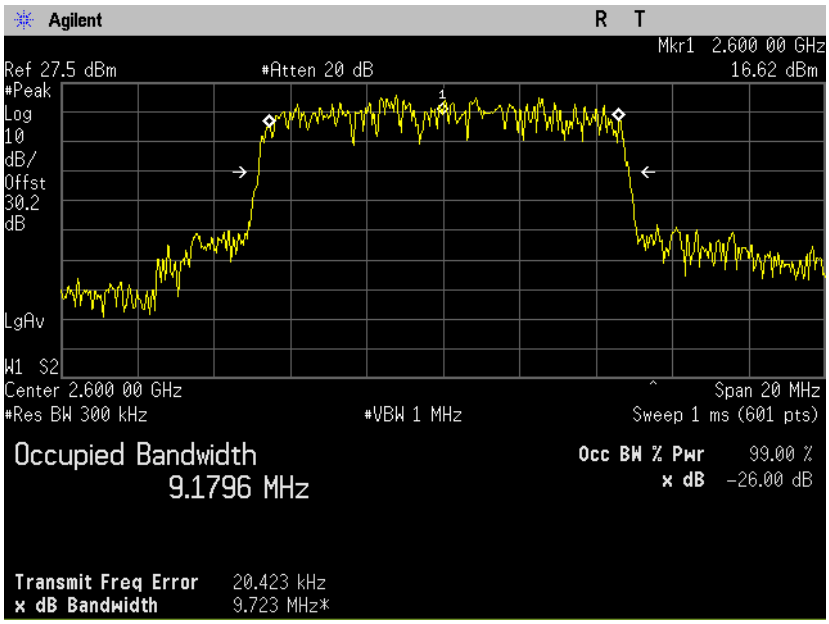


WiMAX 802.16e (10MHz), OFDMA, QPSK, Duty Cycle 27%
Output ANT 1

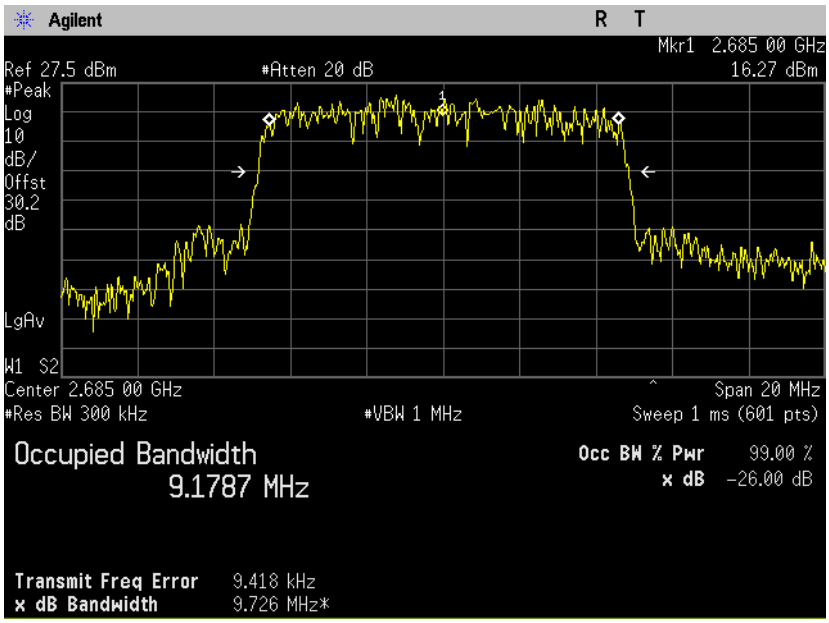
Low Frequency 2501 MHz
Plot 4.2.7



Middle Frequency 2600 MHz
Plot 4.2.8

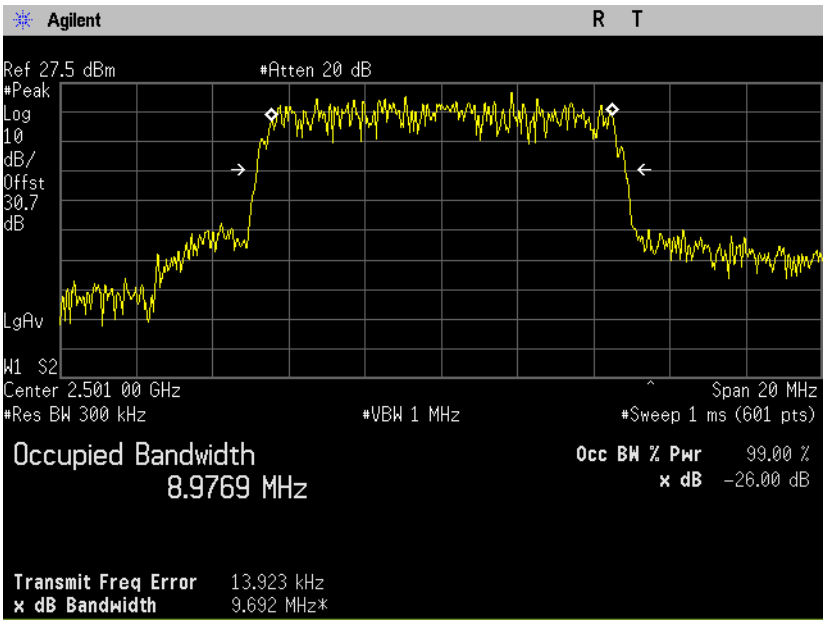


High Frequency 2685 MHz
Plot 4.2.9

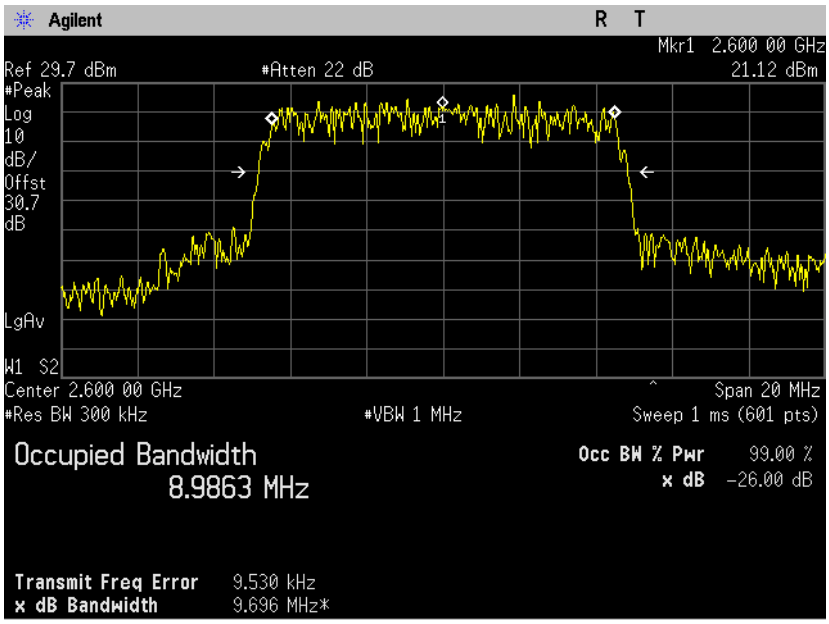


WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 1

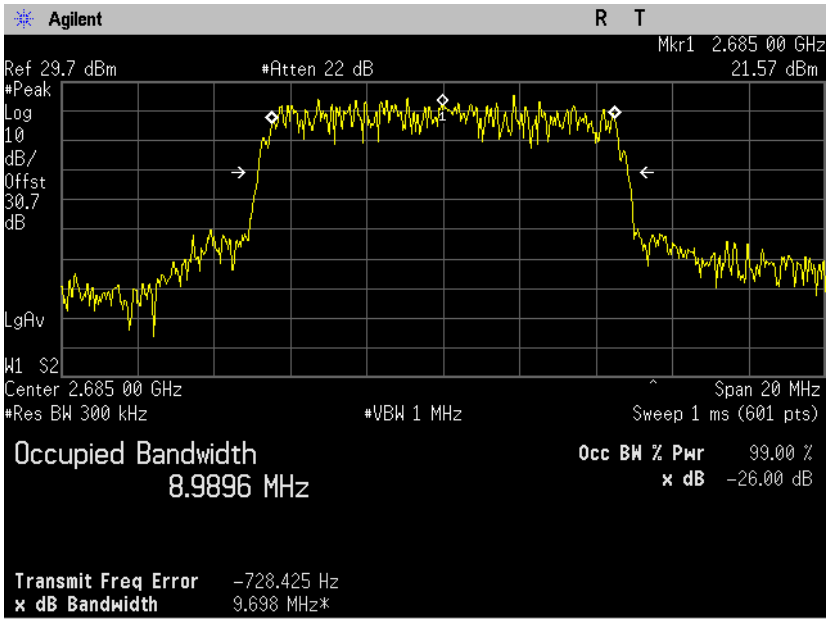
Low Frequency 2501 MHz
Plot 4.2.10



Middle Frequency 2600 MHz
Plot 4.2.11

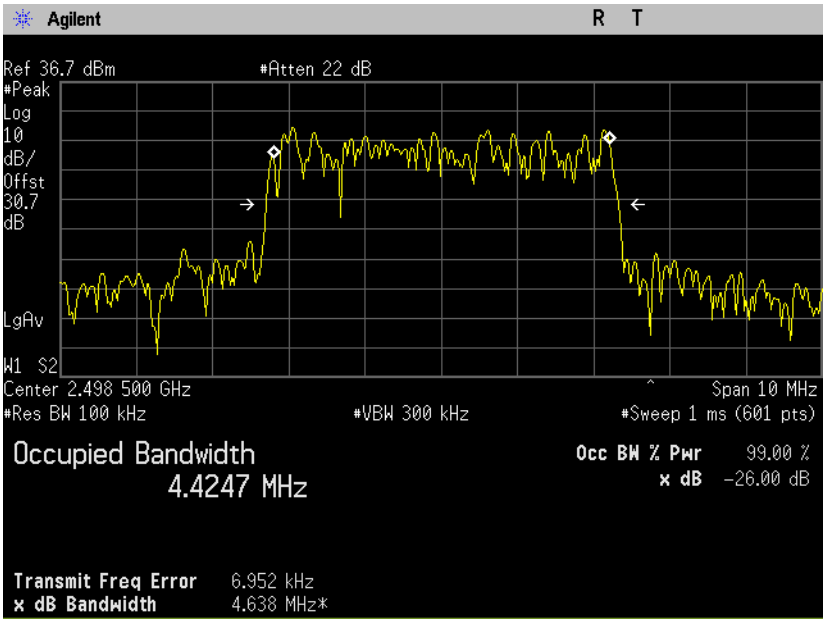


High Frequency 2685 MHz
Plot 4.2.12

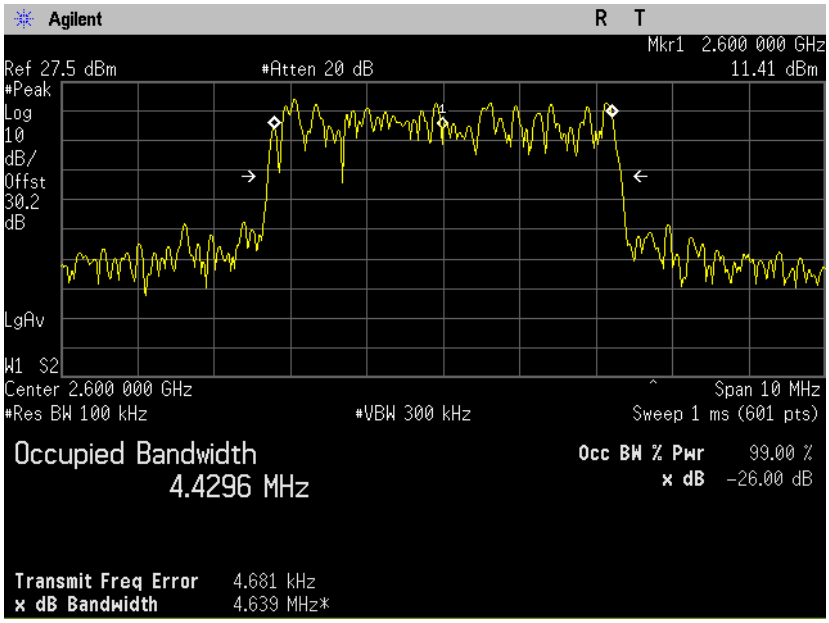


WiMAX 802.16e (5MHz), OFDMA, QPSK, Duty Cycle 32%
Output ANT 2

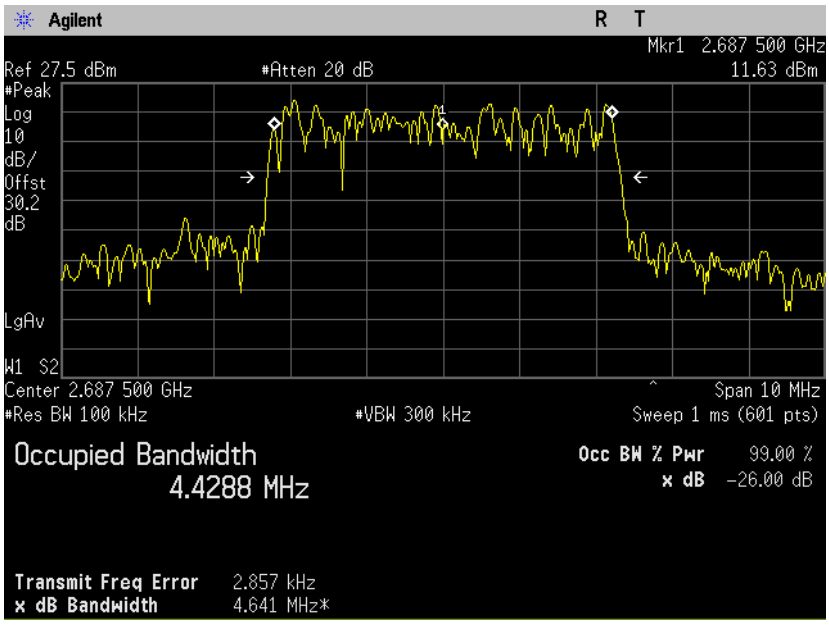
Low Frequency 2498.5 MHz
Plot 4.2.13



Middle Frequency 2600 MHz
Plot 4.2.14

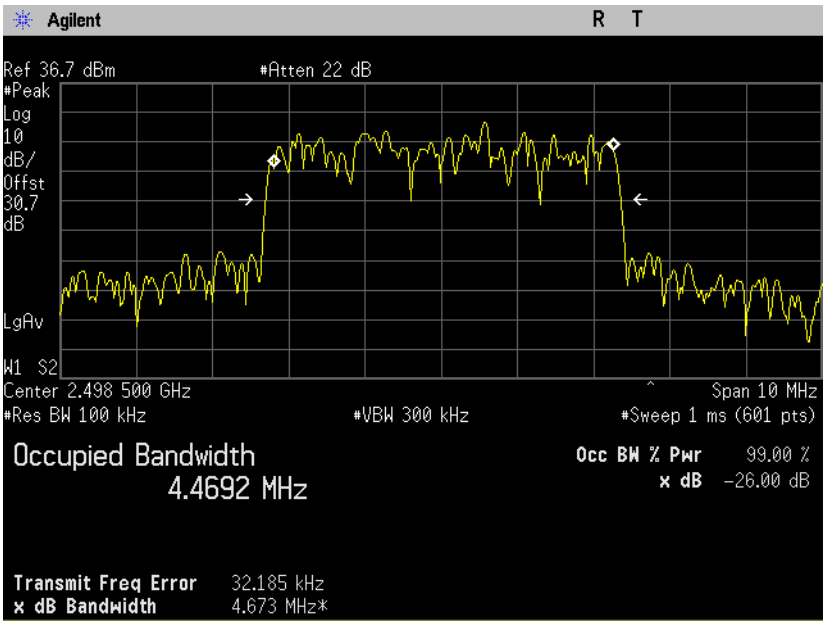


High Frequency 2687.5 MHz
Plot 4.2.15

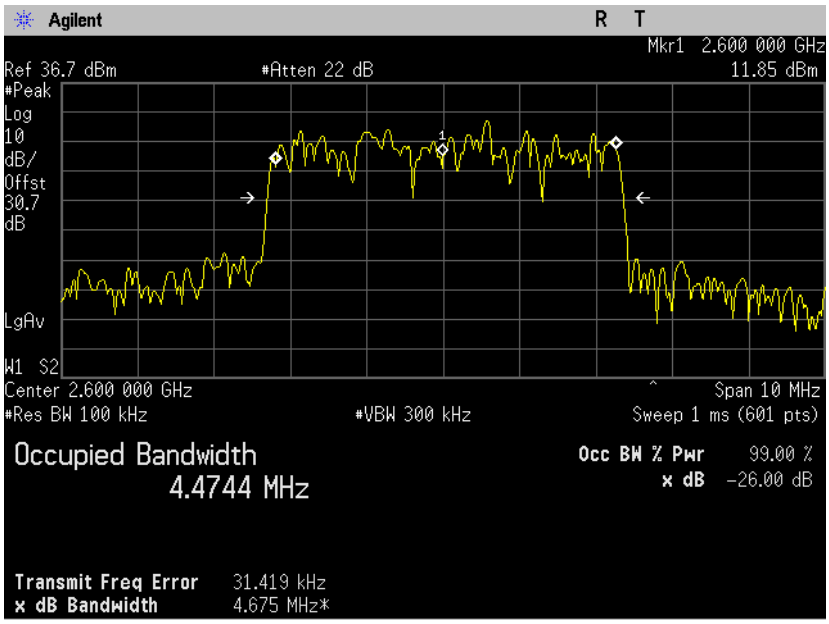


WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 2

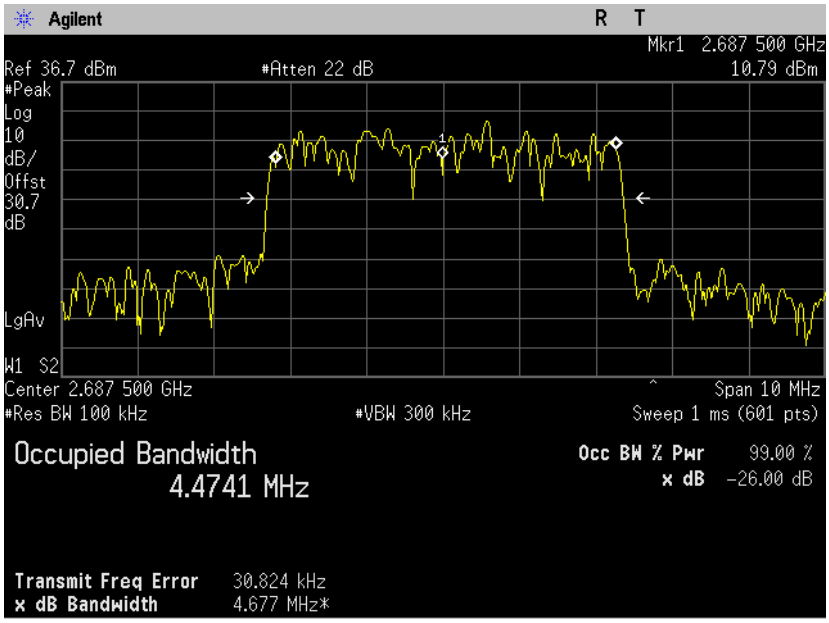
Low Frequency 2498.5 MHz
Plot 4.2.16



Middle Frequency 2600 MHz
Plot 4.2.17

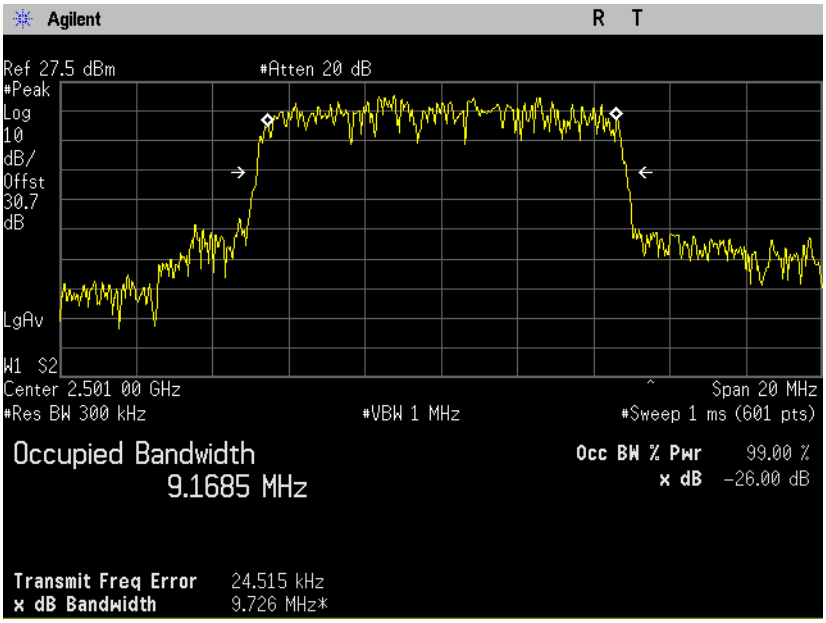


High Frequency 2687.5 MHz
Plot 4.2.18

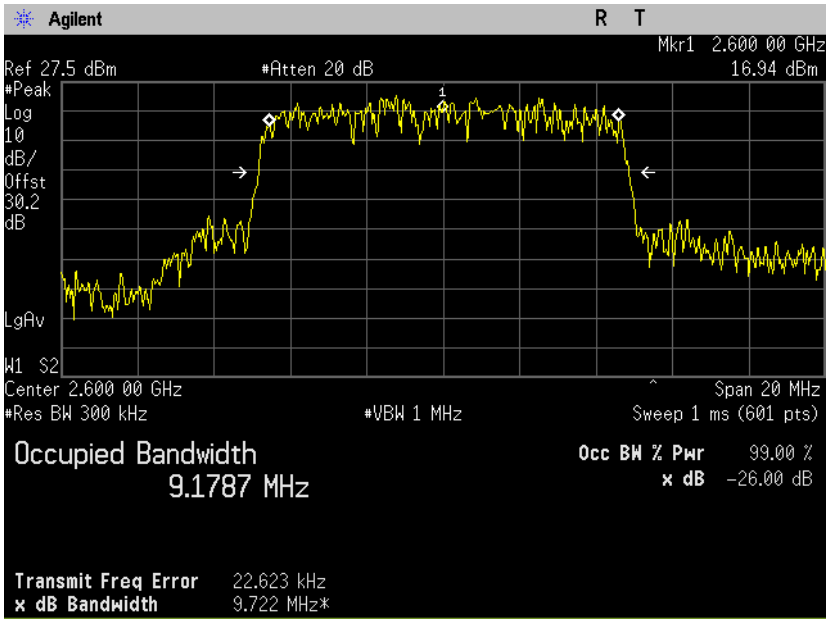


WiMAX 802.16e (10MHz), OFDMA, QPSK, Duty Cycle 27%
Output ANT 2

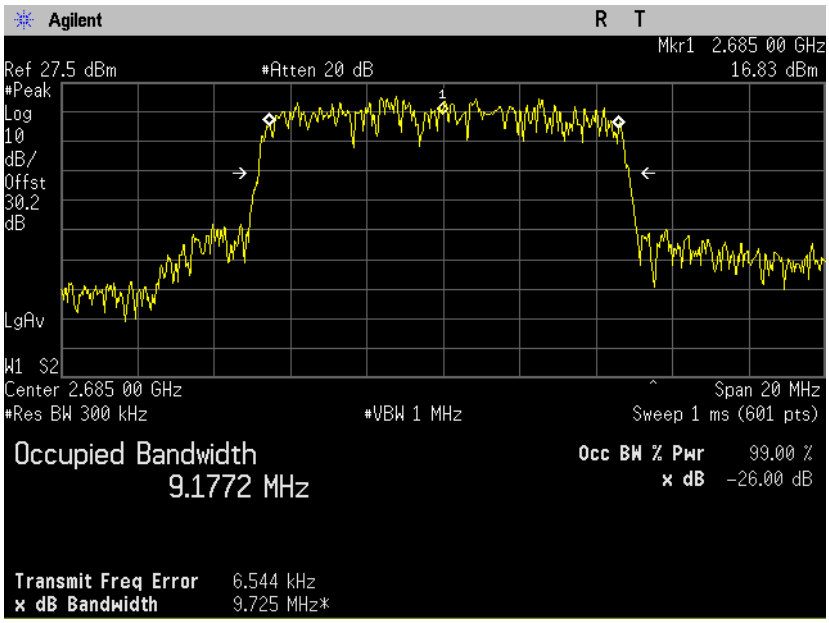
Low Frequency 2501 MHz
Plot 4.2.19



Middle Frequency 2600 MHz
Plot 4.2.20

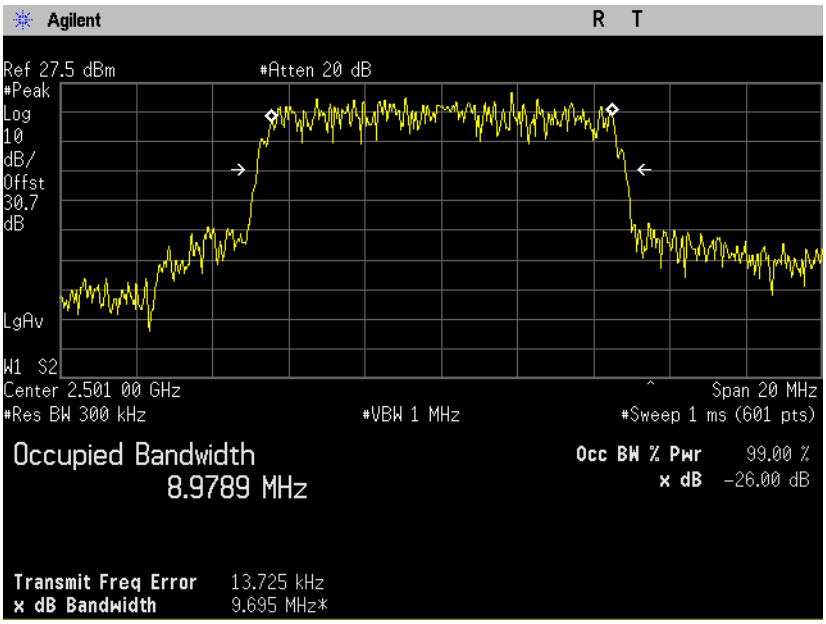


High Frequency 2685 MHz
Plot 4.2.21

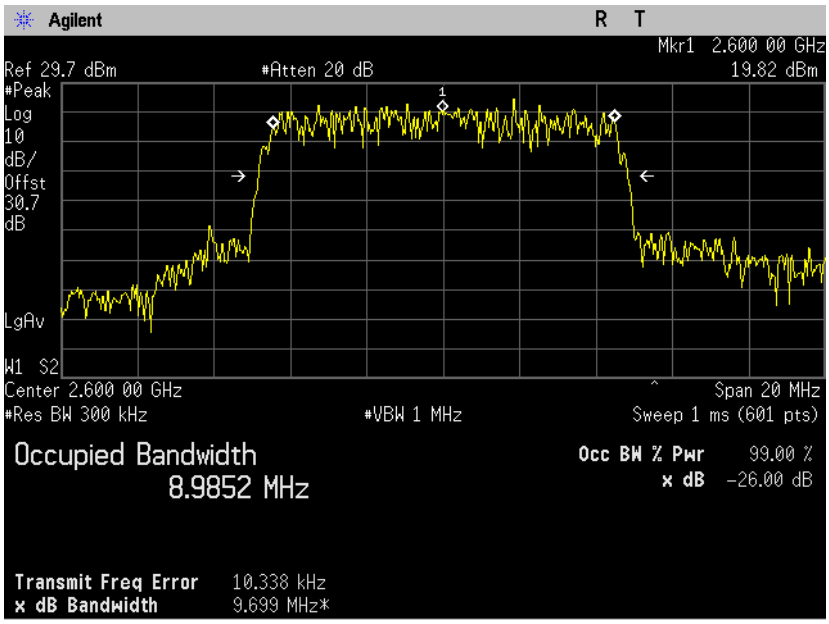


WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 2

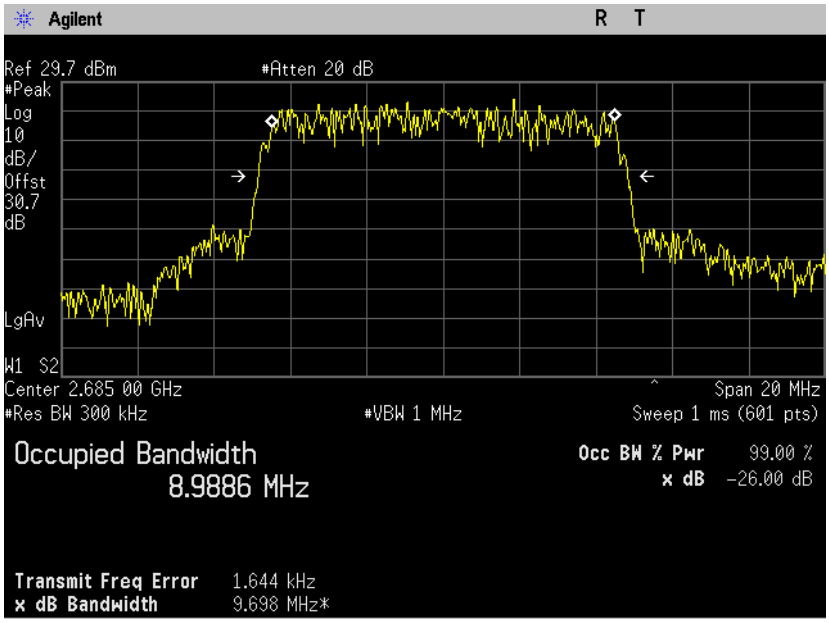
Low Frequency 2501 MHz
Plot 4.2.22



Middle Frequency 2600 MHz
Plot 4.2.23



High Frequency 2685 MHz
Plot 4.2.24

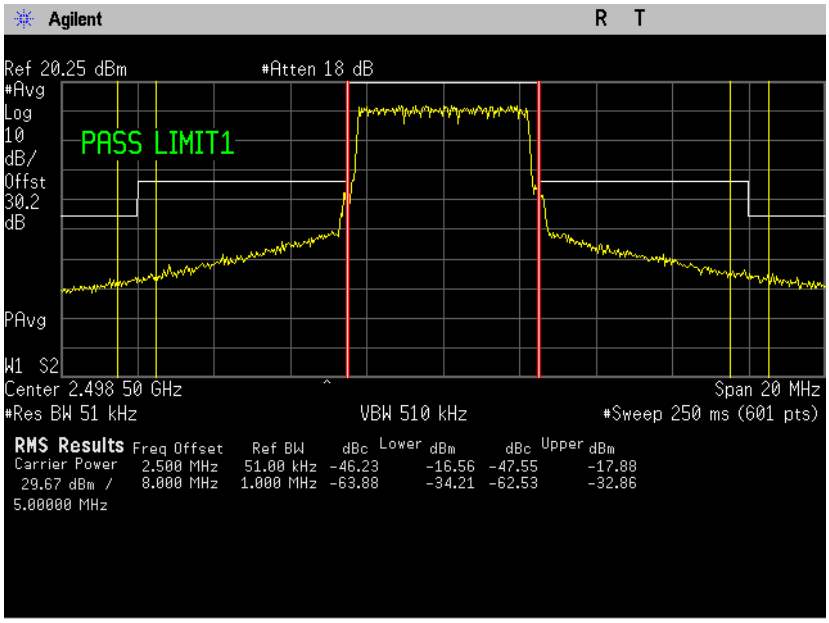


4.3. Channel Edge Measurement

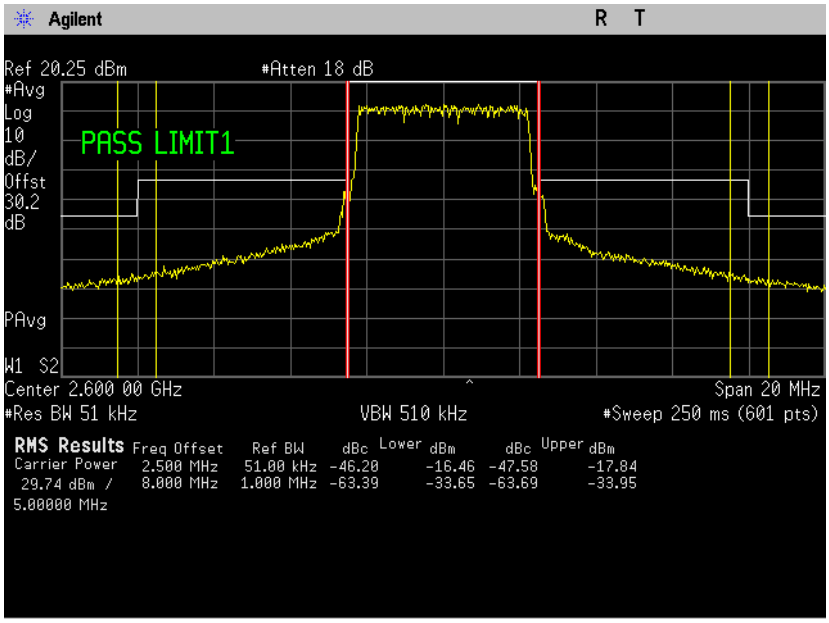
Reference document:	47 CFR §27.53 (m) (4) (6) & §2.1049		
Test Requirements:	For mobile digital stations, the attenuation factor shall not be less than 43 + 10 log (P) dB at the channel edge and 55 + 10 log (P) dB at 5.5 megahertz from the channel edges. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.		
Test setup:	See sec 3.1	**Pass**	
Method of testing:	Conducted		
Operating conditions:	Under normal test conditions		
S.A. Settings:	RBW: 51kHz, VBW: 510kHz for 5MHz channel bandwidth RBW: 100kHz, VBW: 1MHz for 10MHz channel bandwidth		
Environment conditions:	Ambient Temperature: 23.1°c	Relative Humidity: 55.4%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.3.1 - Plot 4.3.12	

Test results for output ANT 1 & ANT 2: All readings below the emissions mask.

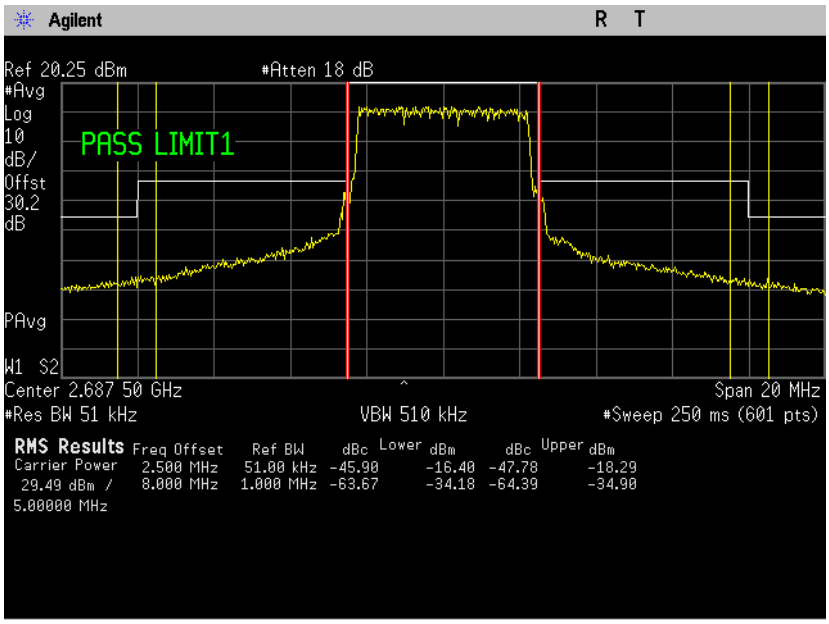
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 1
Low Frequency 2498.5 MHz
Plot 4.3.1



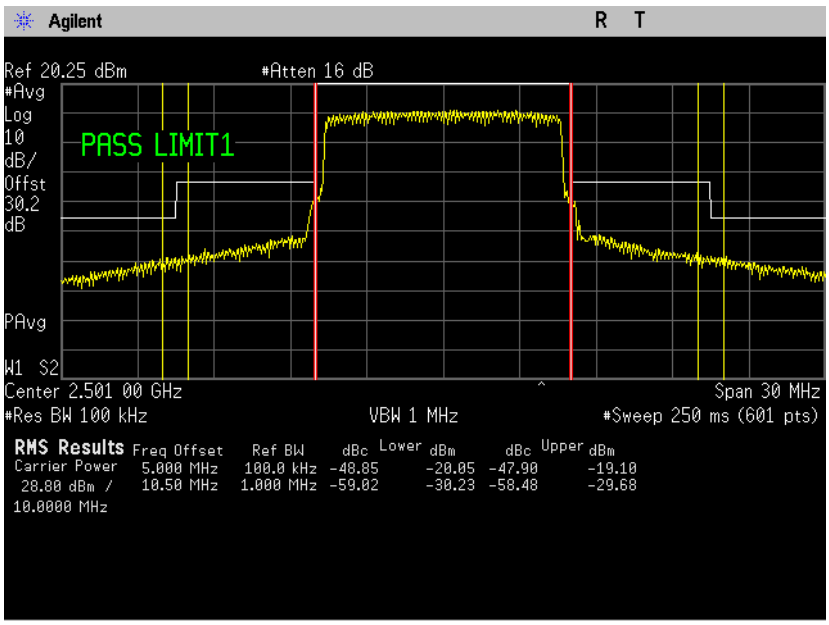
Middle Frequency 2600 MHz
Plot 4.3.2



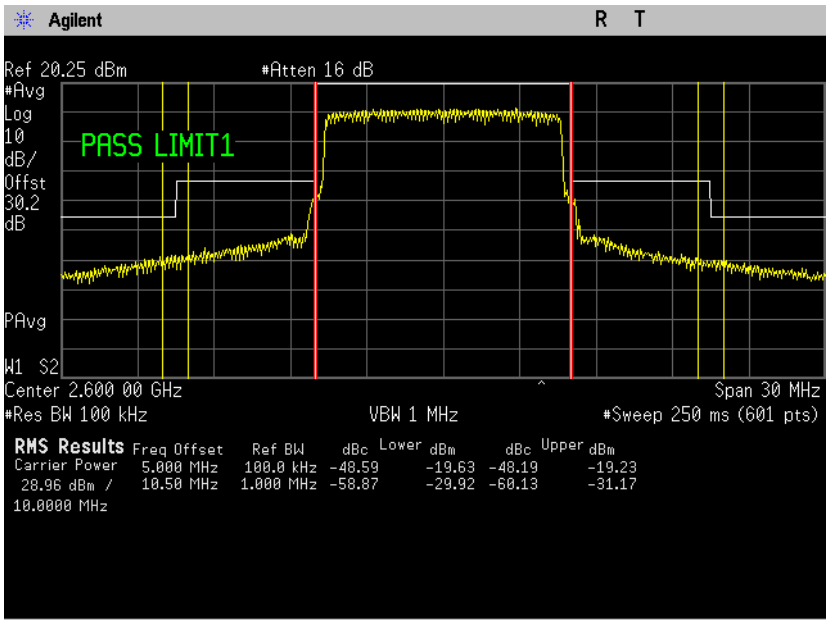
High Frequency 2687.5 MHz
Plot 4.3.3



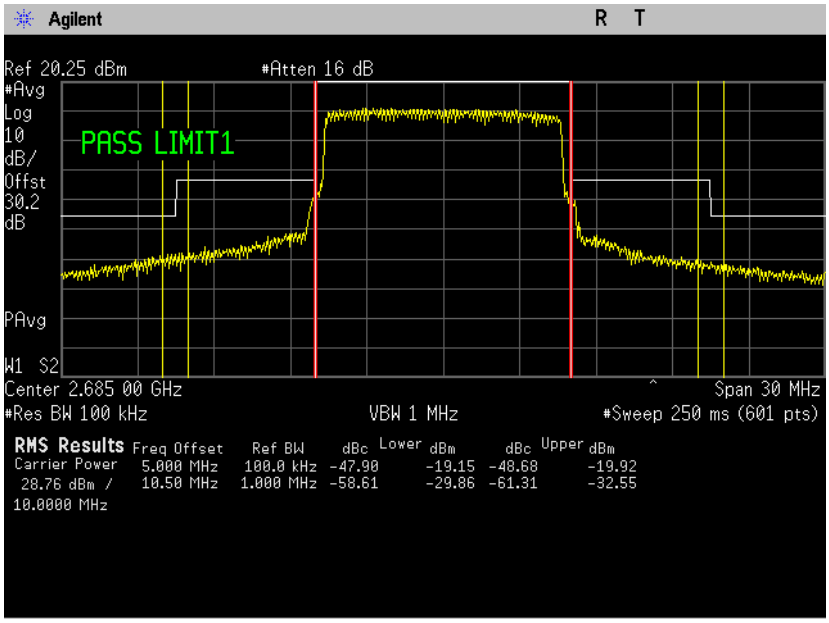
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 1
Low Frequency 2501 MHz
Plot 4.3.4



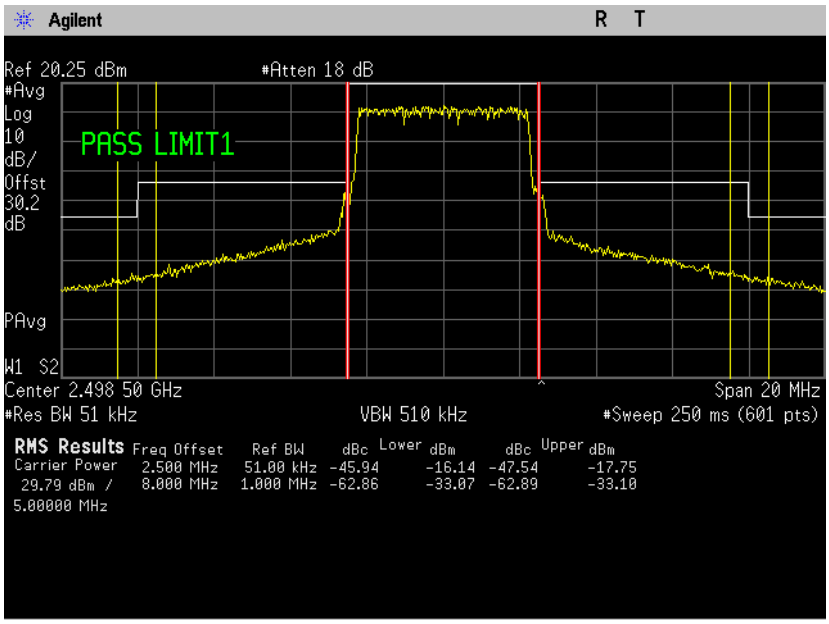
Middle Frequency 2600 MHz
Plot 4.3.5



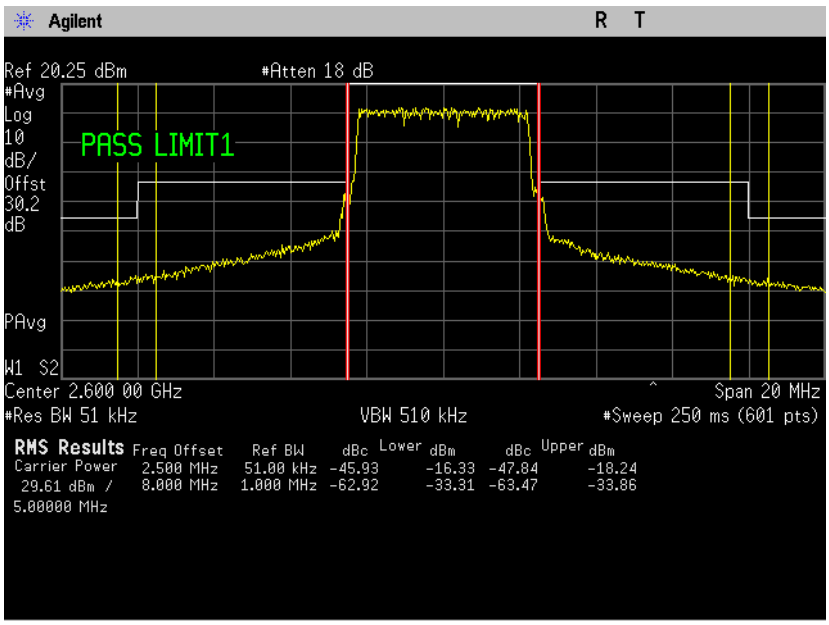
High Frequency 2685 MHz
Plot 4.3.6



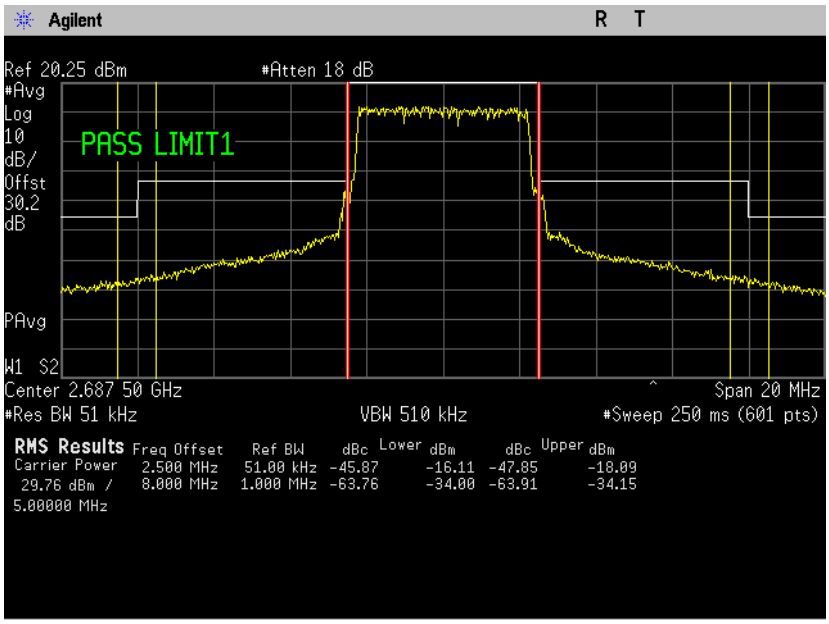
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 2
Low Frequency 2498.5 MHz
Plot 4.3.7



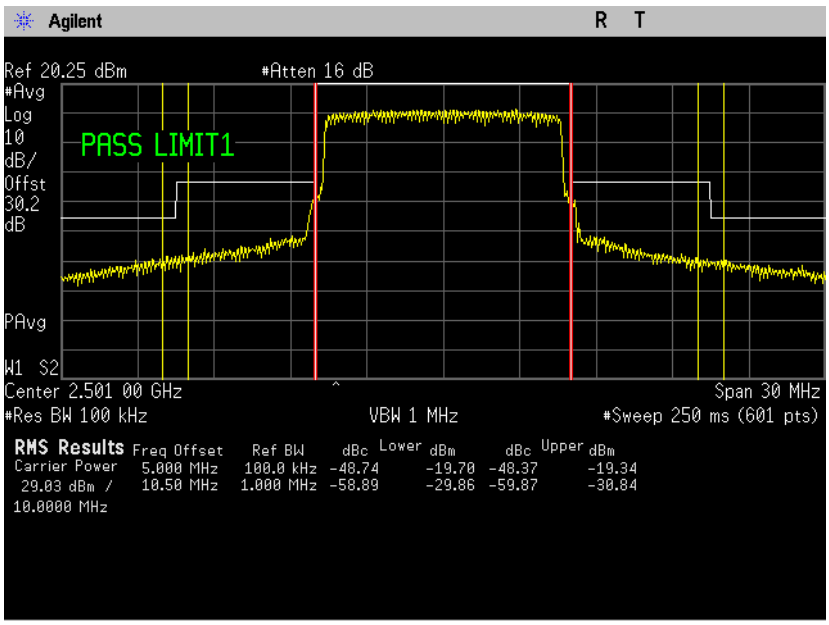
Middle Frequency 2600 MHz
Plot 4.3.8



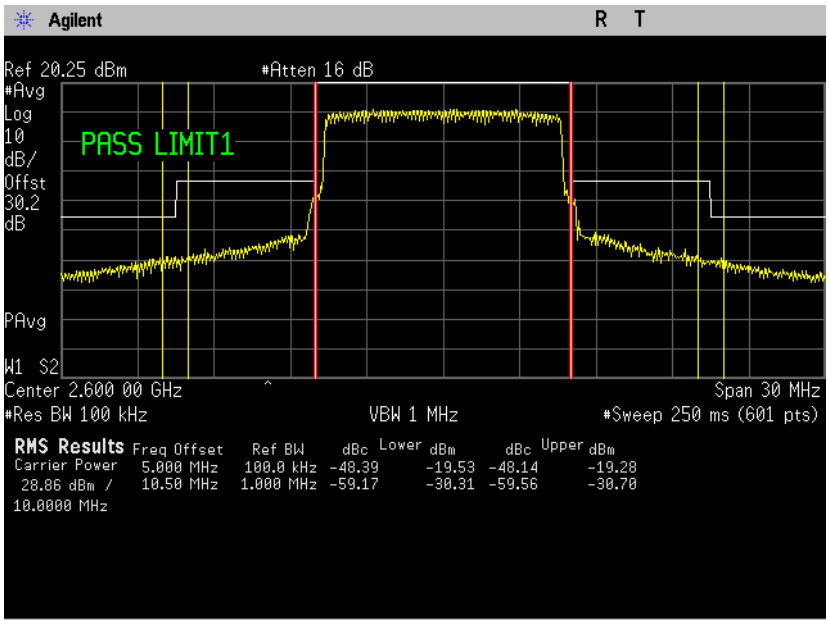
High Frequency 2687.5 MHz
Plot 4.3.9



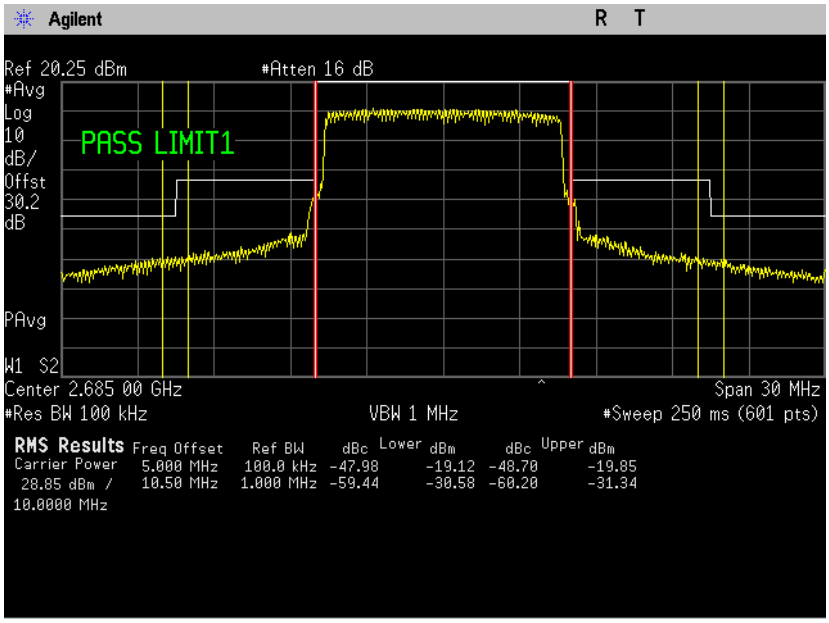
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 2
Low Frequency 2501 MHz
Plot 4.3.10



Middle Frequency 2600 MHz
Plot 4.3.11



High Frequency 2685 MHz
Plot 4.3.12



4.4. Conducted Spurious Emissions

Reference document:	47 CFR §27.53 (m) (4) (6) & §2.1049		
Test Requirements:	For mobile digital stations, the attenuation factor shall not be less than 43 + 10 log (P) dB at the channel edge and 55 + 10 log (P) dB at 5.5 megahertz from the channel edges.		
Test setup:	See sec 3.1	**Pass**	
Method of testing:	Conducted		
Operating conditions:	Under normal test conditions		
S.A. Settings:	Peak: RBW= 1MHz, VBW= 3MHz		
Environment conditions:	Ambient Temperature: 22°c	Relative Humidity: 48%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.4.1 to Plot 4.4.36	

Test results for output ANT 1:

Channel	Spurious Emission Frequency [MHz]	Measured [dBm]	Limit [dBm]	Reference Plots*	Result
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%					
Low	*	*	-25	4.4.1 - 4.4.3	Comply
Middle	*	*	-25	4.4.4 - 4.4.6	Comply
High	5375	-27.81	-25	4.4.7 - 4.4.9	Comply
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%					
Low	*	*	-25	4.4.10 – 4.4.12	Comply
Middle	*	*	-25	4.4.13 - 4.4.15	Comply
High	5370	-30.92	-25	4.4.16 - 4.4.18	Comply

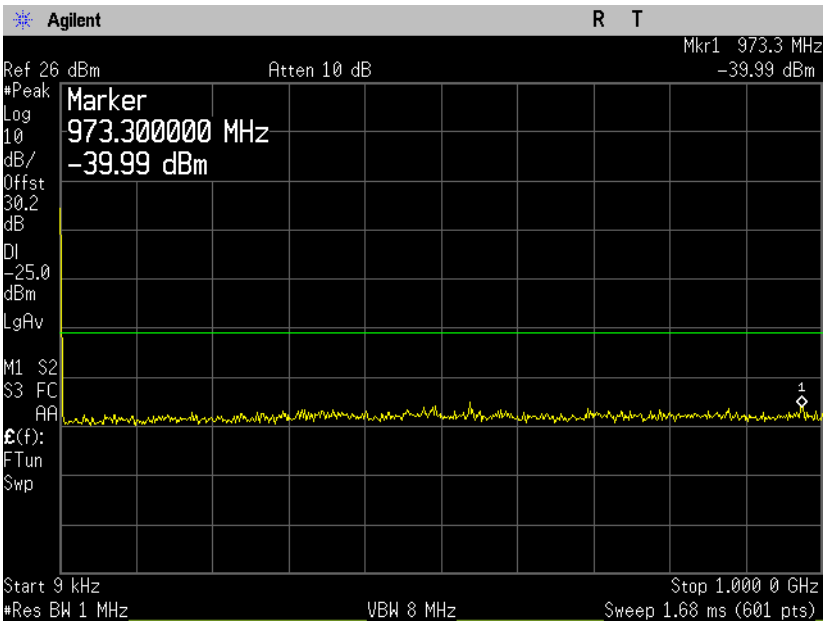
* All readings below the limit.

Test results for output ANT 2:

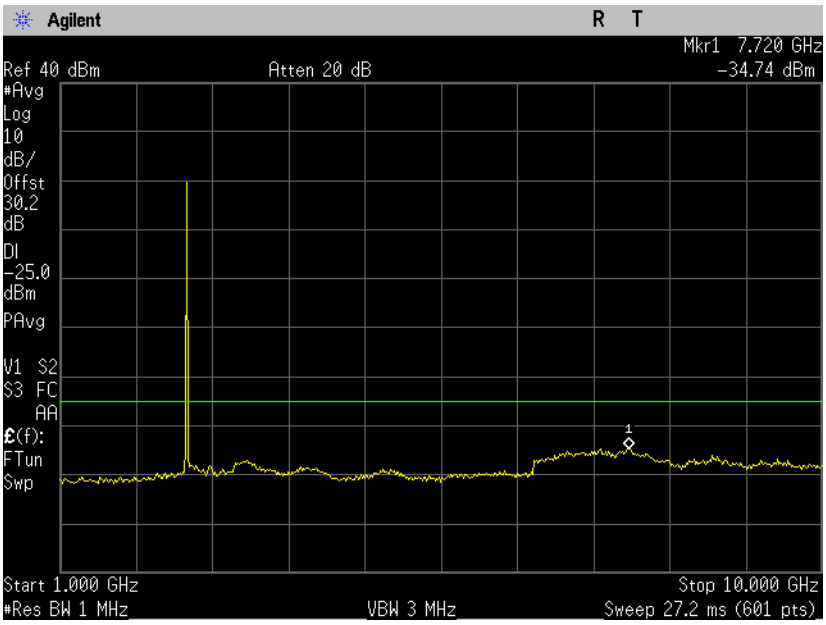
Channel	Spurious Emission Frequency [MHz]	Measured [dBm]	Limit [dBm]	Reference Plots*	Result
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%					
Low	*	*	-25	4.4.19 - 4.4.21	Comply
Middle	*	*	-25	4.4.22 - 4.4.24	Comply
High	*	*	-25	4.4.25 - 4.4.27	Comply
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%					
Low	*	*	-25	4.4.28 – 4.4.30	Comply
Middle	*	*	-25	4.4.31 - 4.4.33	Comply
High	*	*	-25	4.4.34 - 4.4.36	Comply

* All readings below the limit.

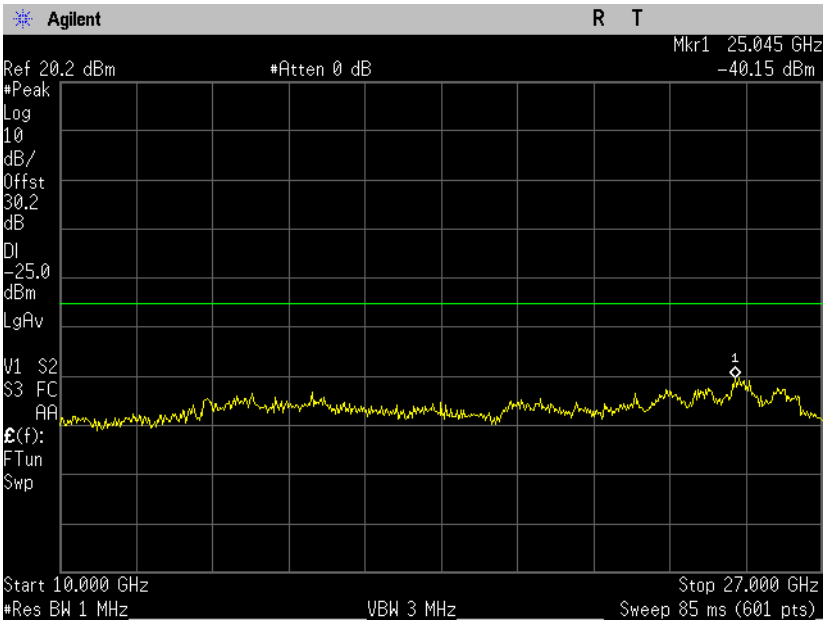
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 1
Low Frequency 2498.5 MHz
Plot 4.4.1



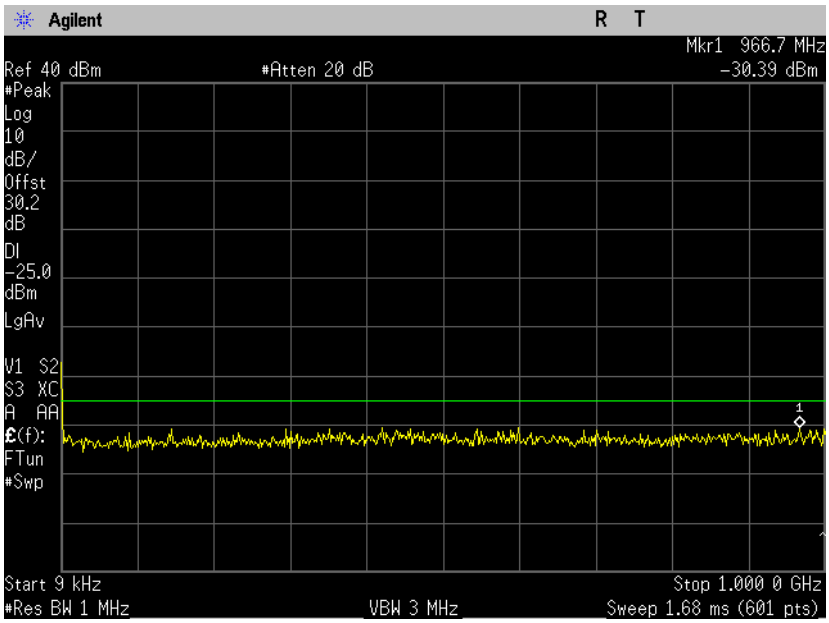
Plot 4.4.2



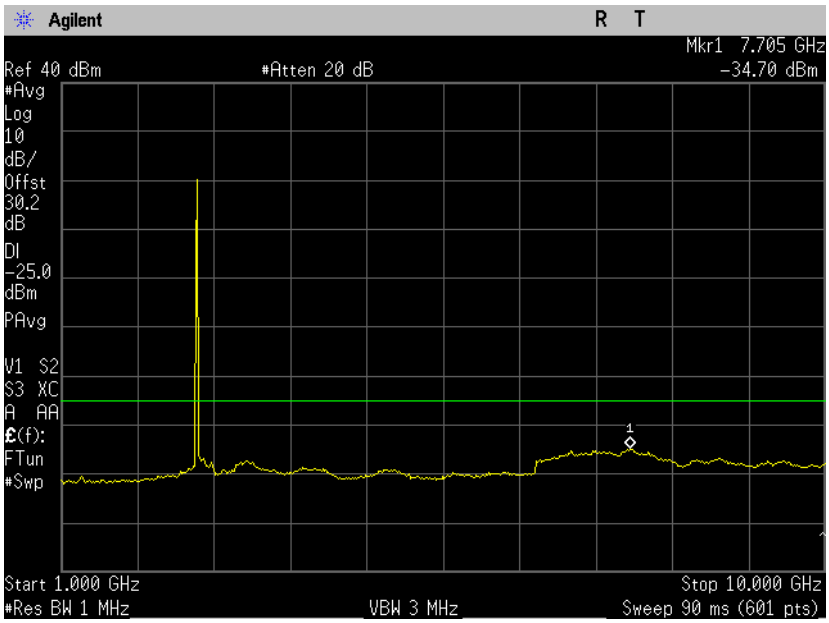
Plot 4.4.3



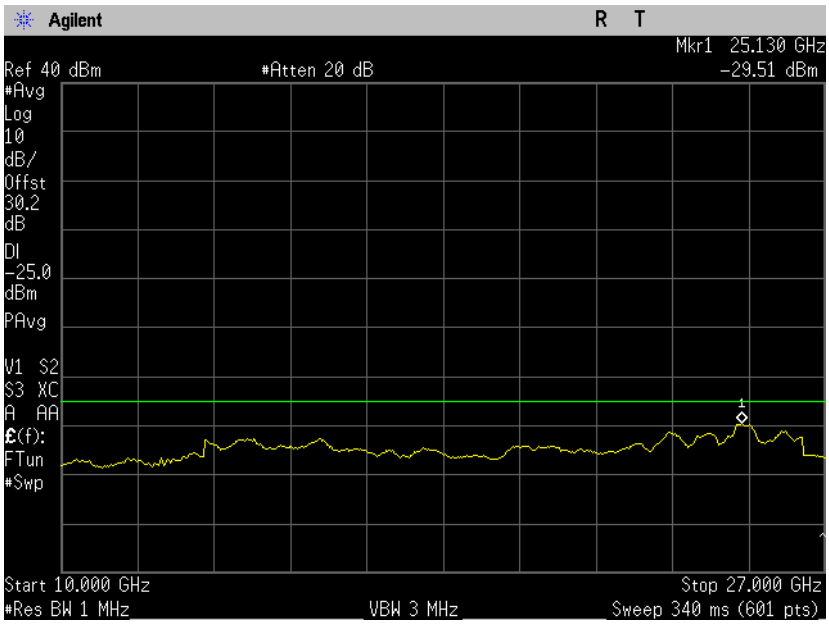
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 1
Middle Frequency 2600 MHz
Plot 4.4.4



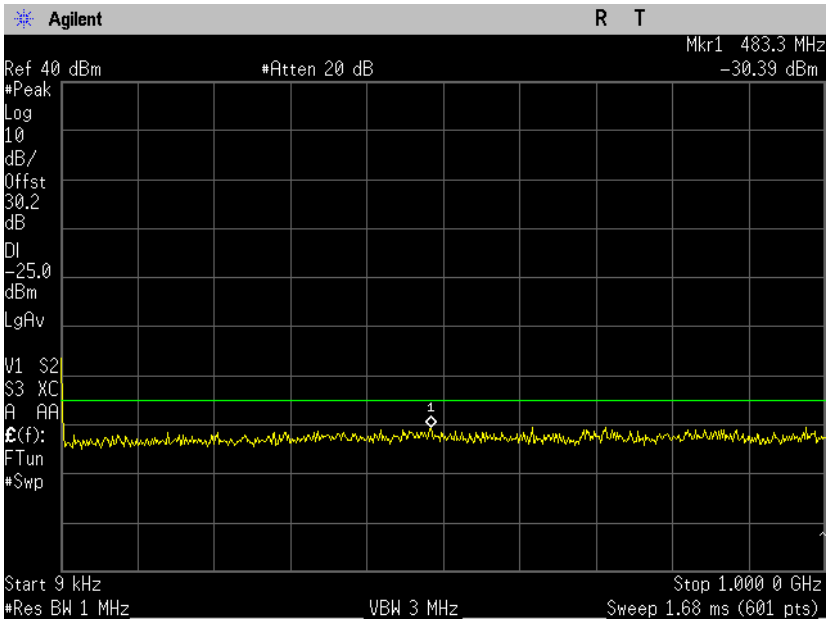
Plot 4.4.5



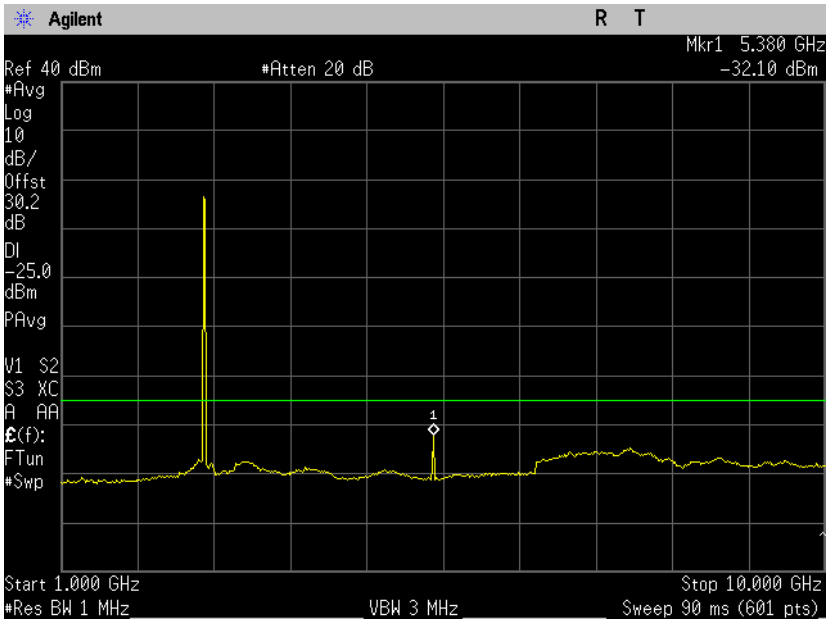
Plot 4.4.6



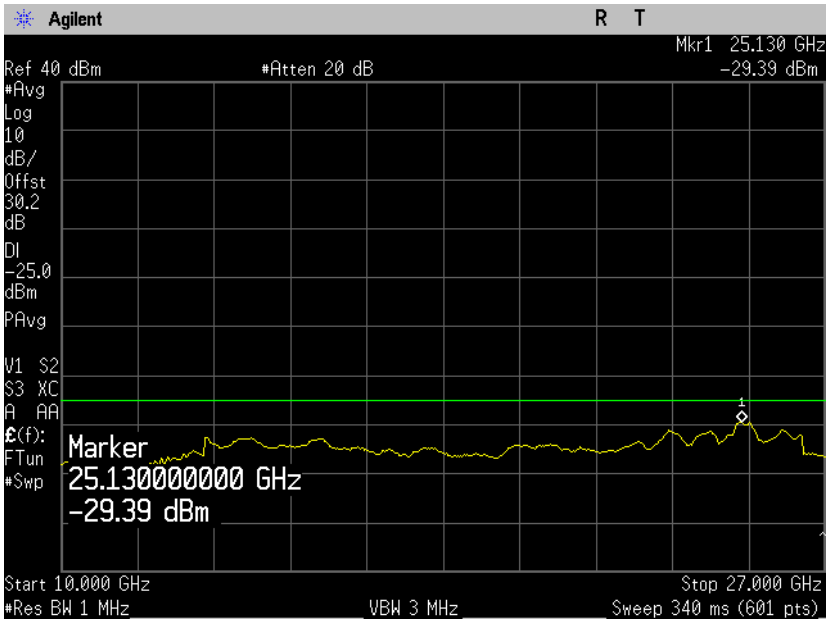
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 1
High Frequency 2687.5 MHz
Plot 4.4.7



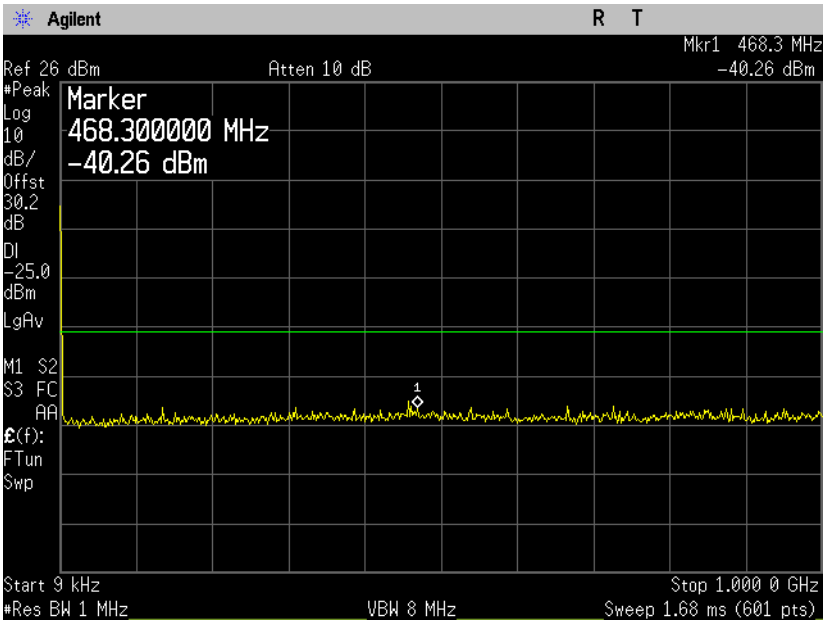
Plot 4.4.8



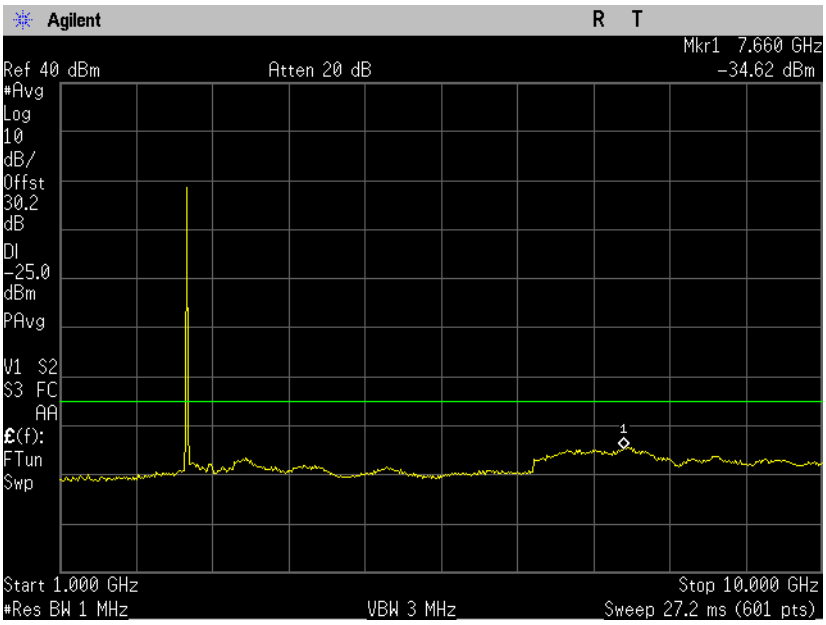
Plot 4.4.9



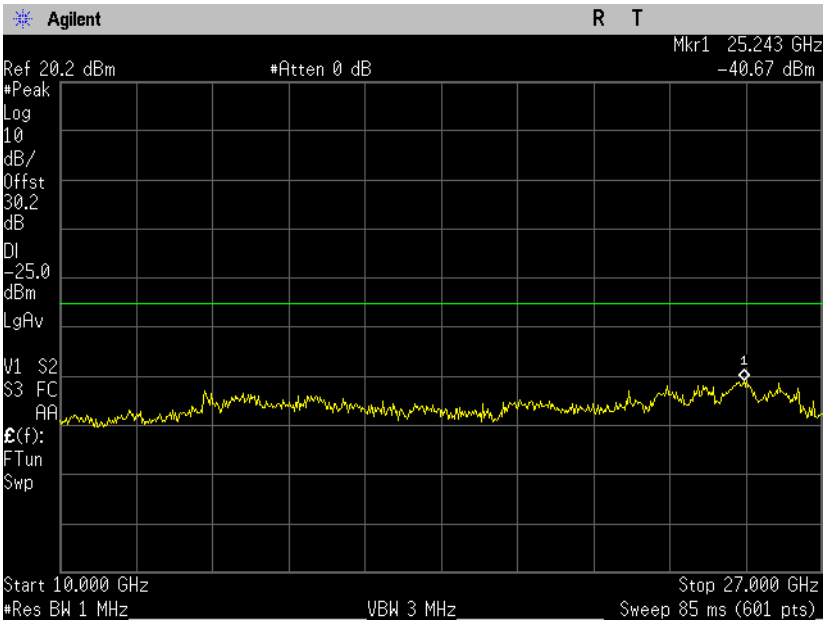
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 1
Low Frequency 2501 MHz
Plot 4.4.10



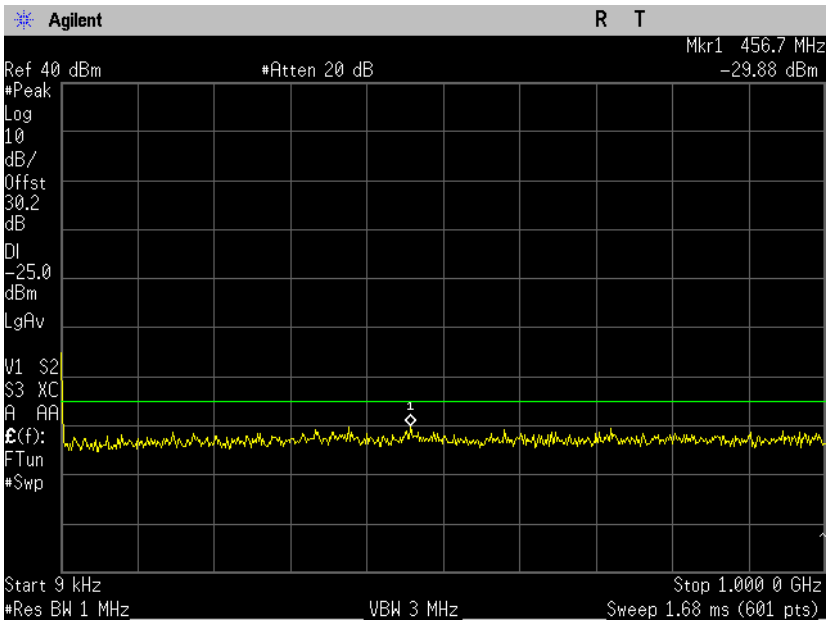
Plot 4.4.11



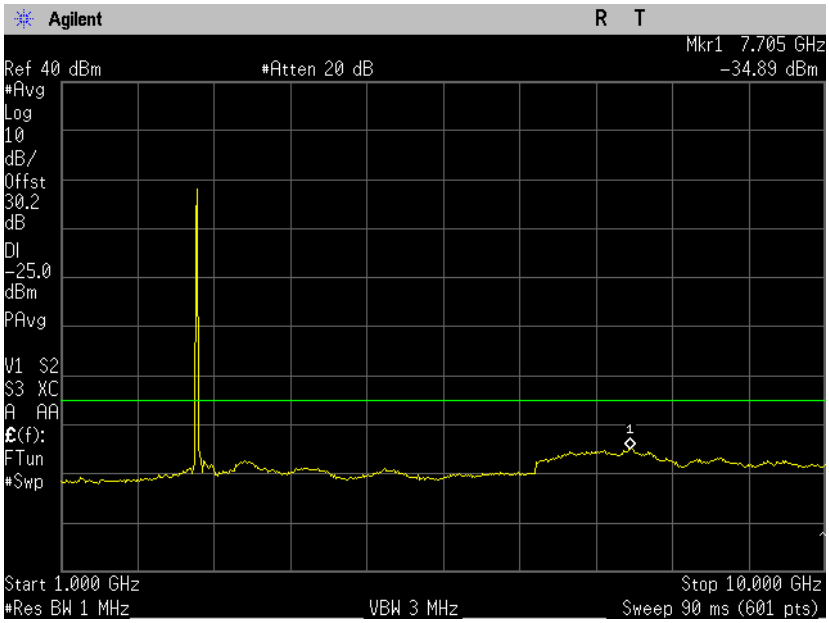
Plot 4.4.12



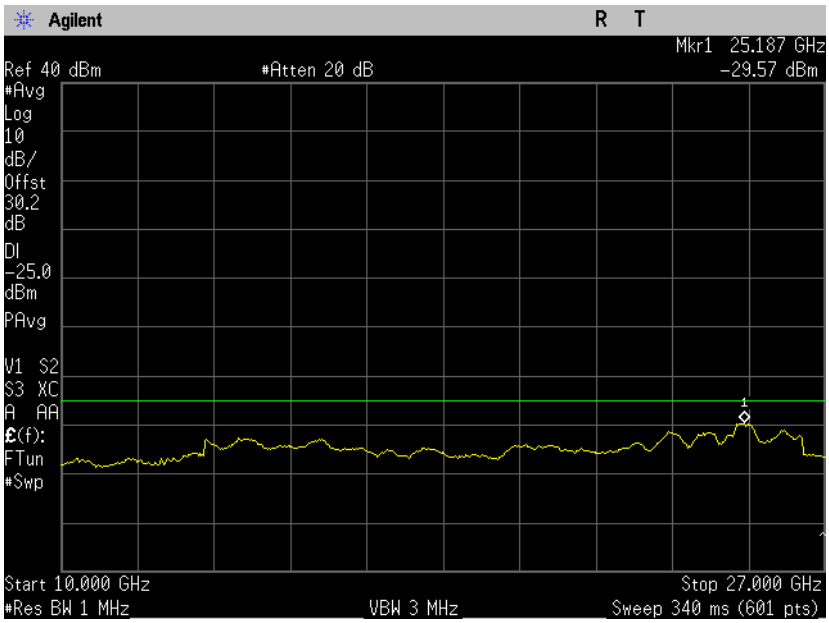
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 1
Middle Frequency 2600 MHz
Plot 4.4.13



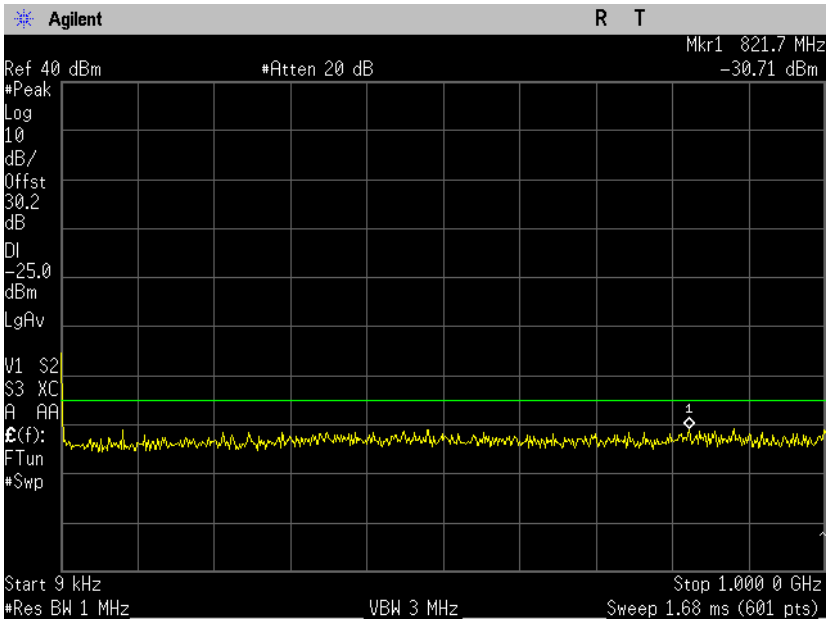
Plot 4.4.14



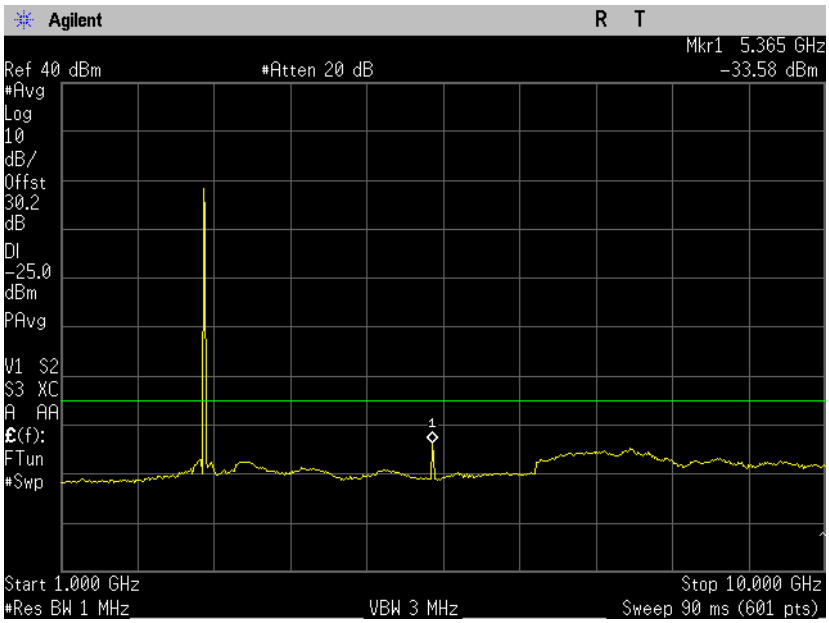
Plot 4.4.15



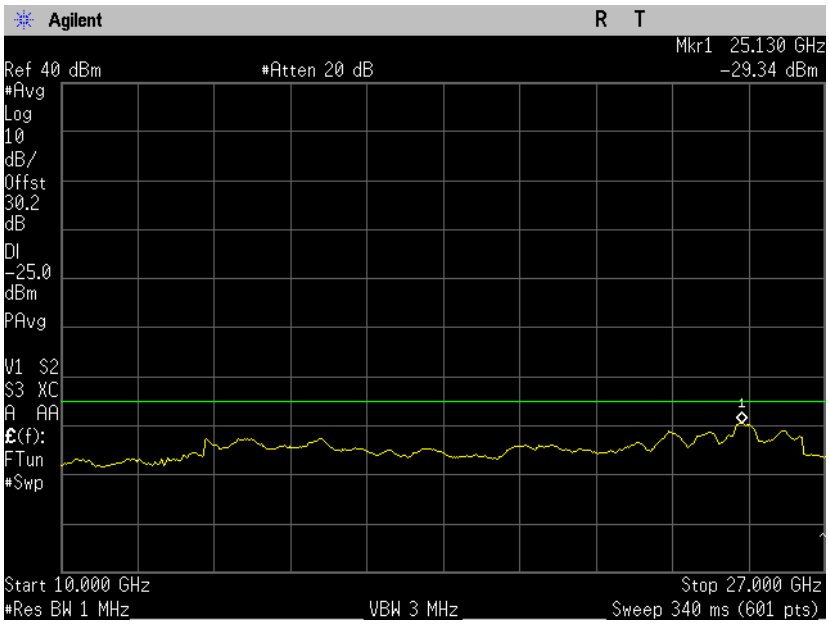
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 1
High Frequency 2685 MHz
Plot 4.4.16



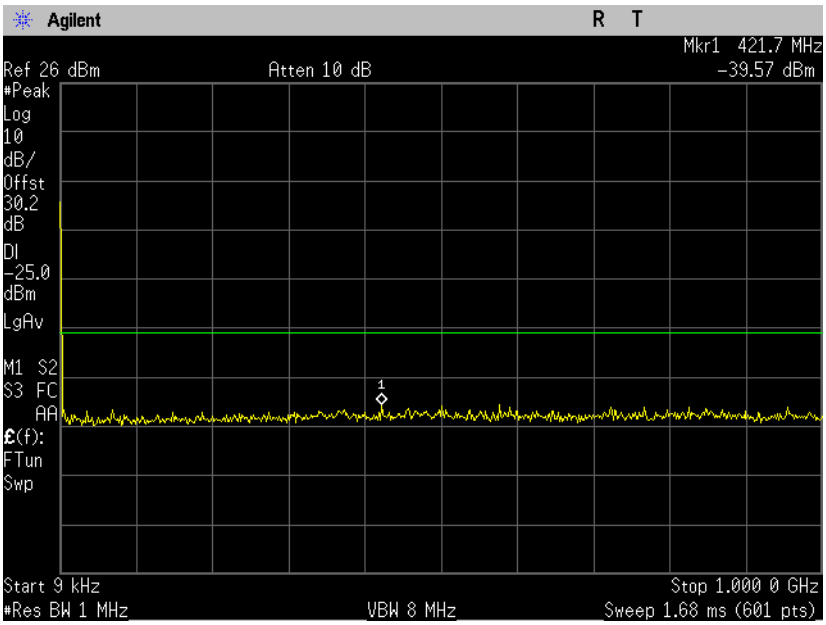
Plot 4.4.17



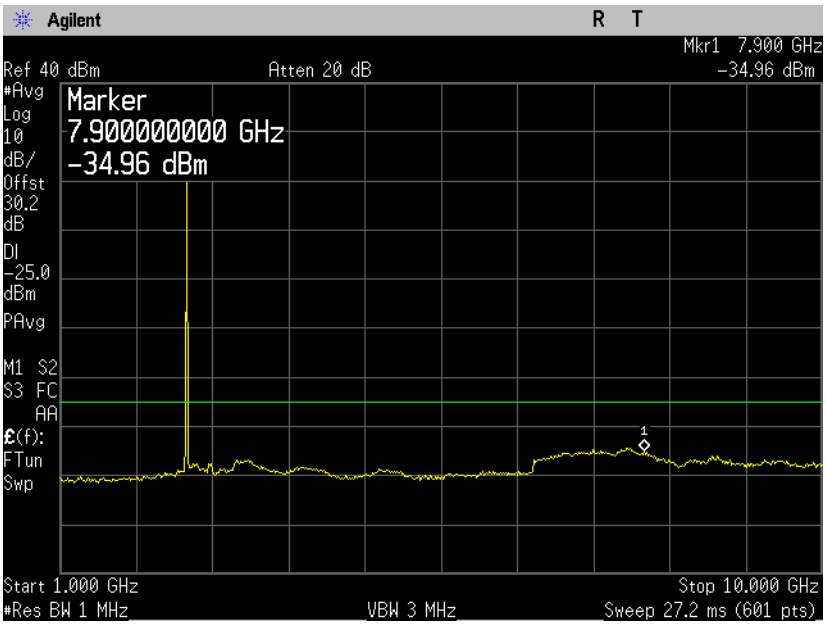
Plot 4.4.18



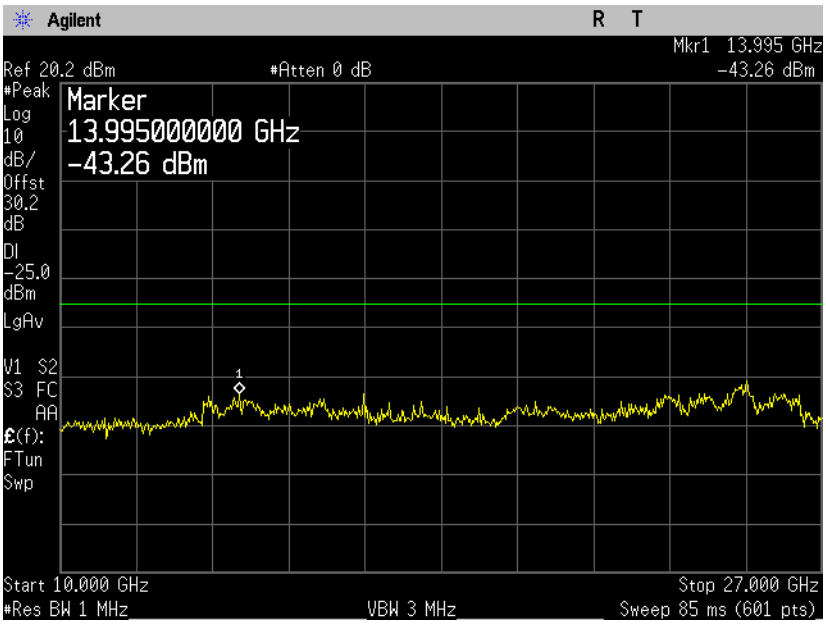
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 2
Low Frequency 2498.5 MHz
Plot 4.4.19



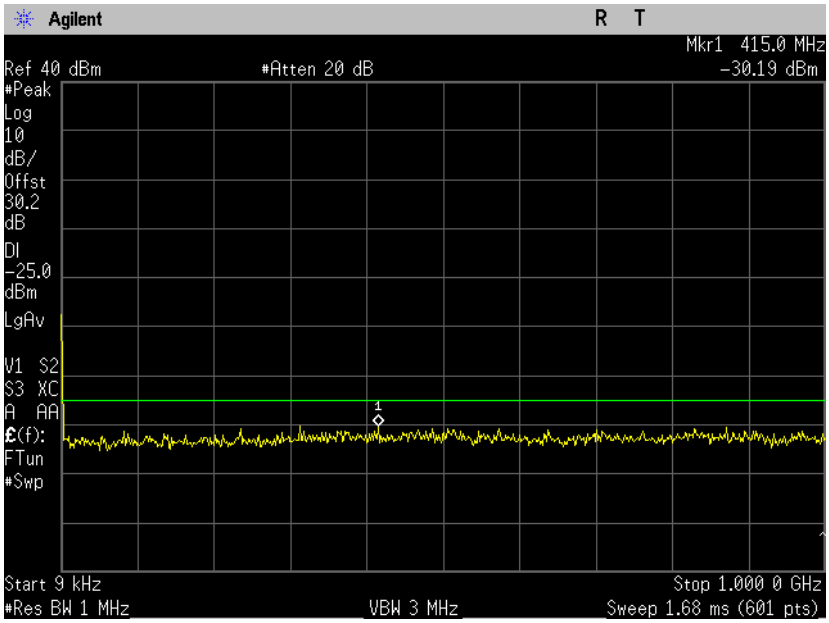
Plot 4.4.20



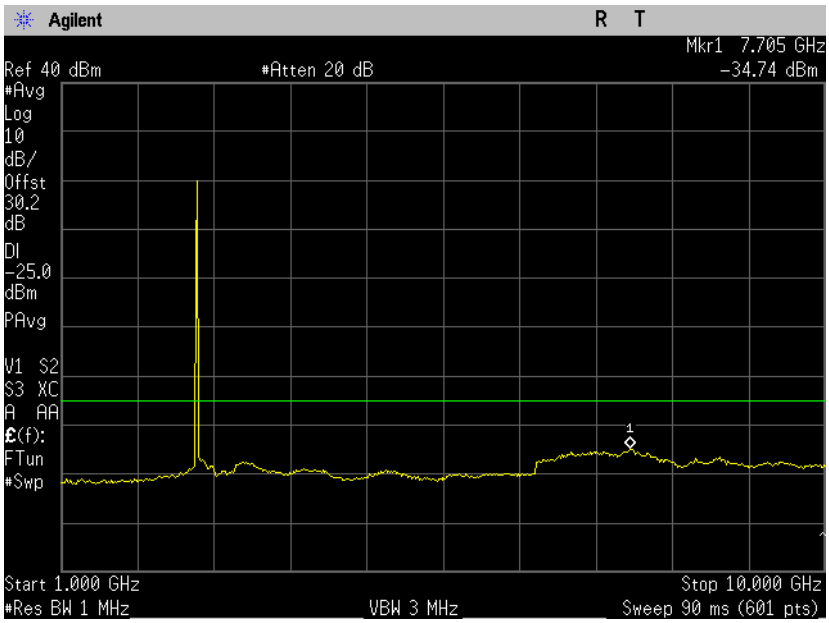
Plot 4.4.21



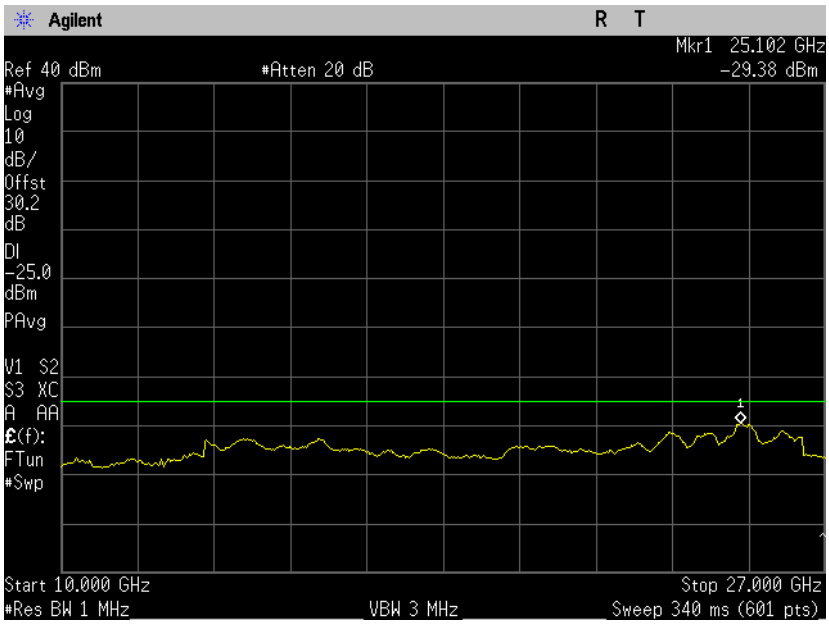
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 2
Middle Frequency 2600 MHz
Plot 4.4.22



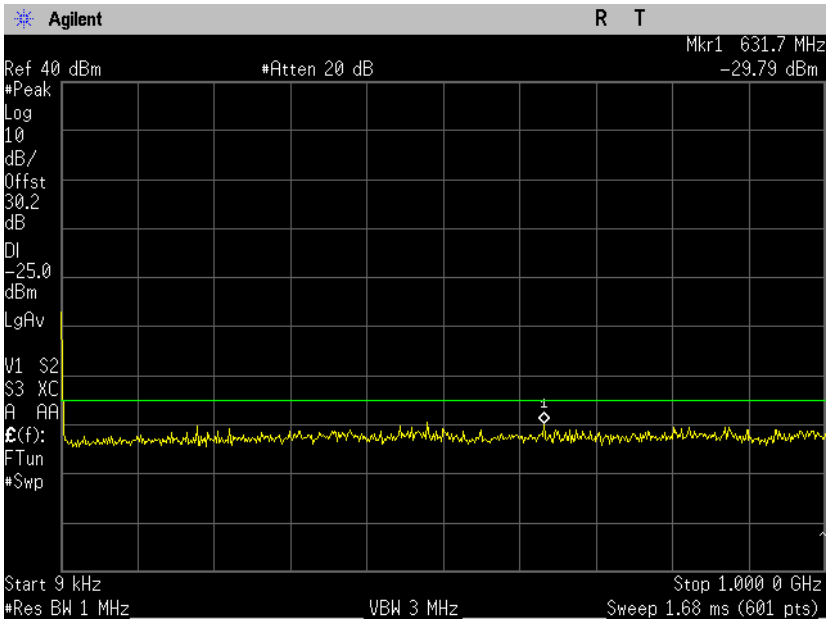
Plot 4.4.23



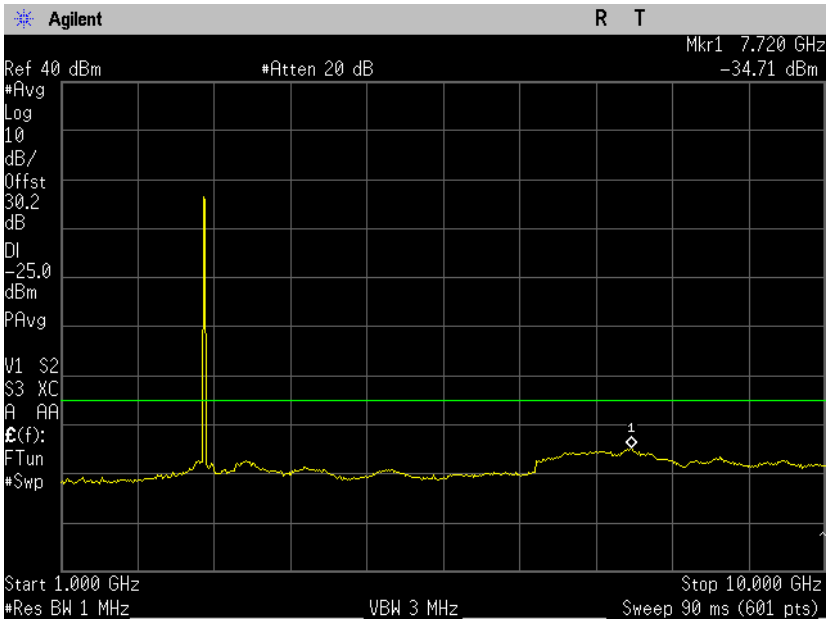
Plot 4.4.24



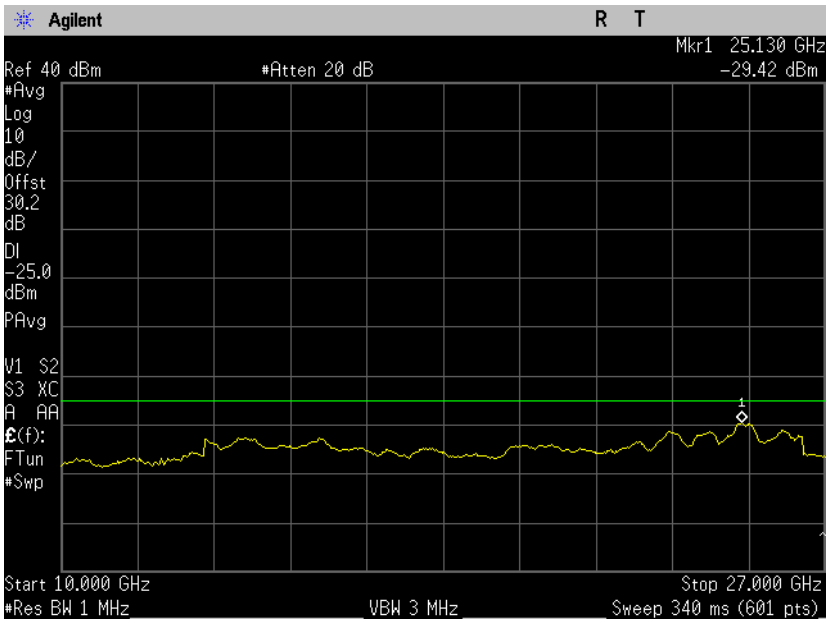
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 2
High Frequency 2687.5 MHz
Plot 4.4.25



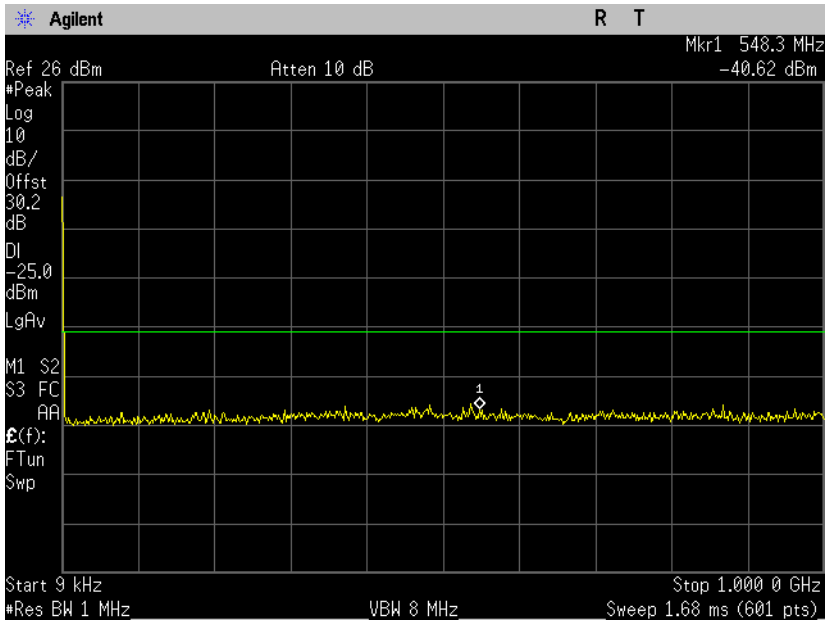
Plot 4.4.26



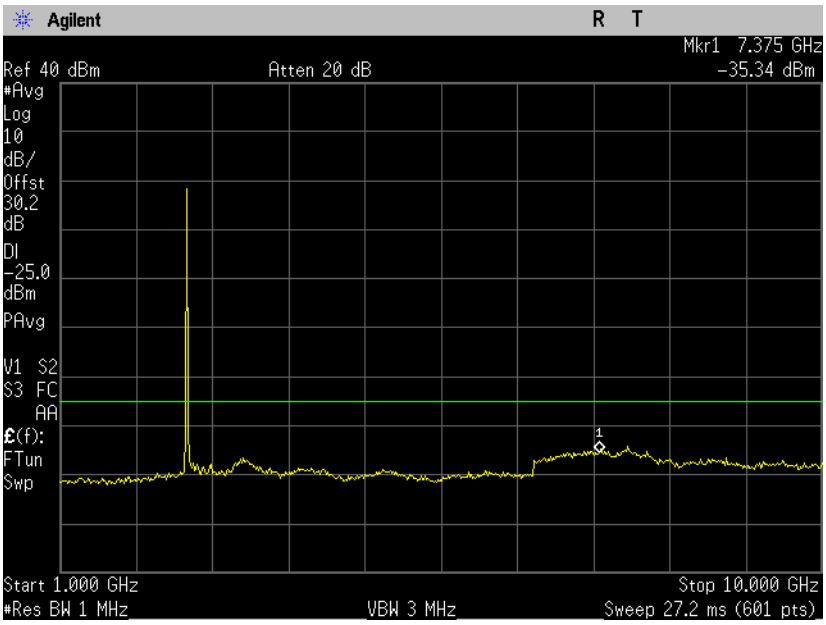
Plot 4.4.27



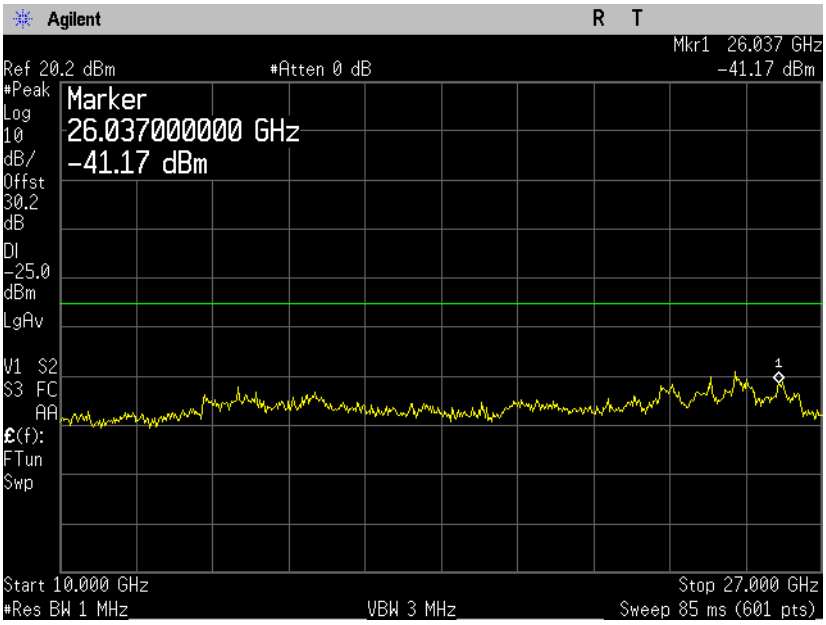
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 2
Low Frequency 2501 MHz
Plot 4.4.28



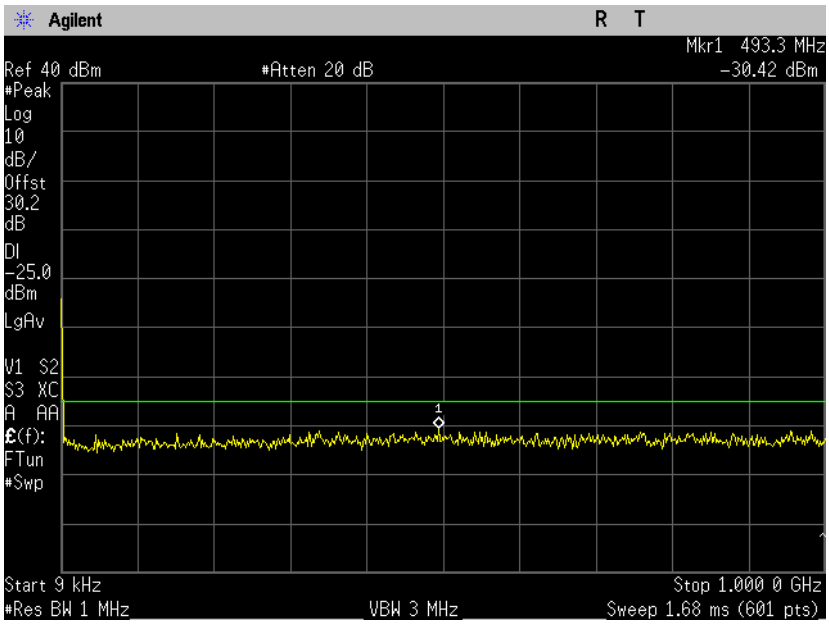
Plot 4.4.29



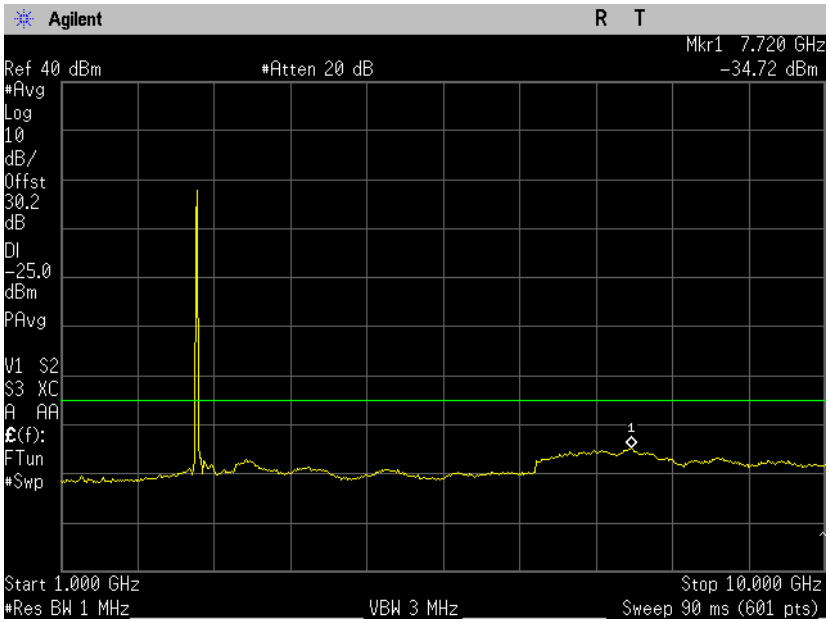
Plot 4.4.30



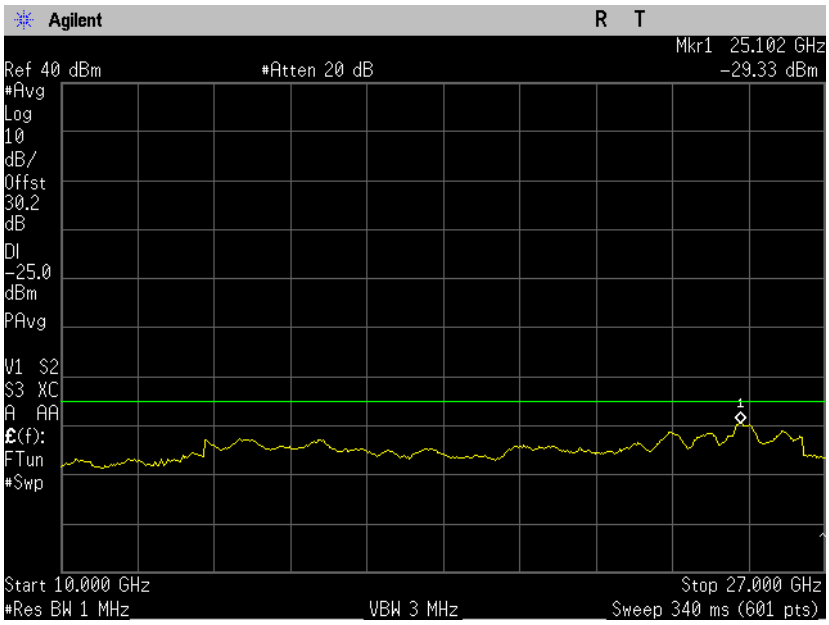
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 2
Middle Frequency 2600 MHz
Plot 4.4.31



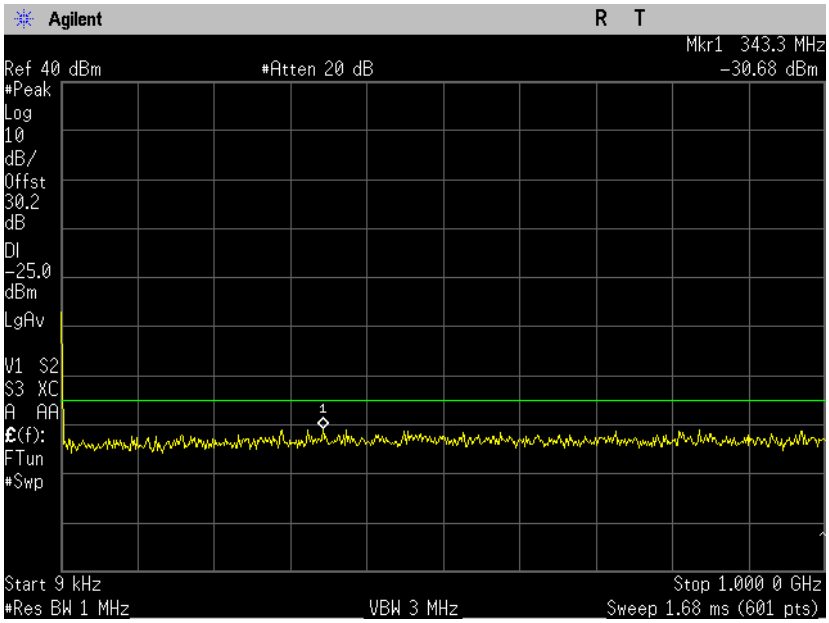
Plot 4.4.32



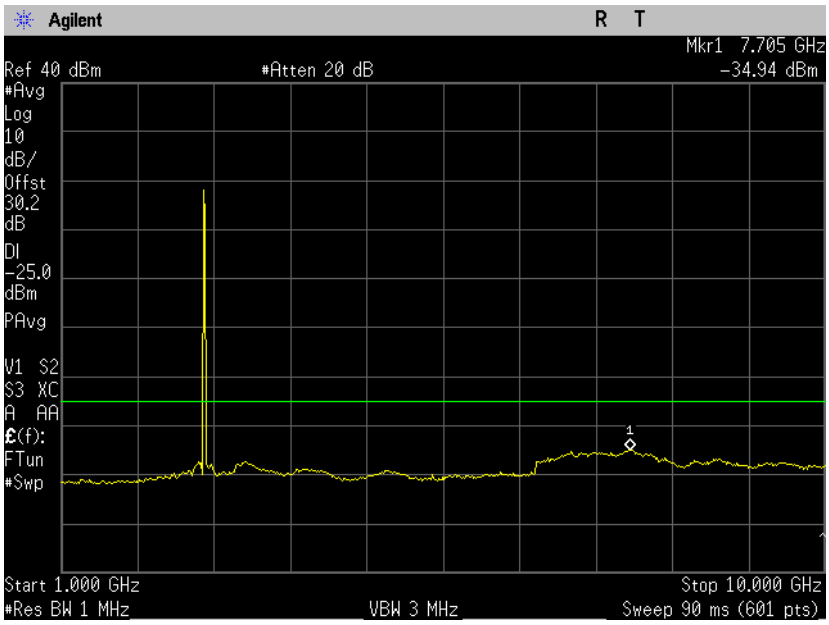
Plot 4.4.33



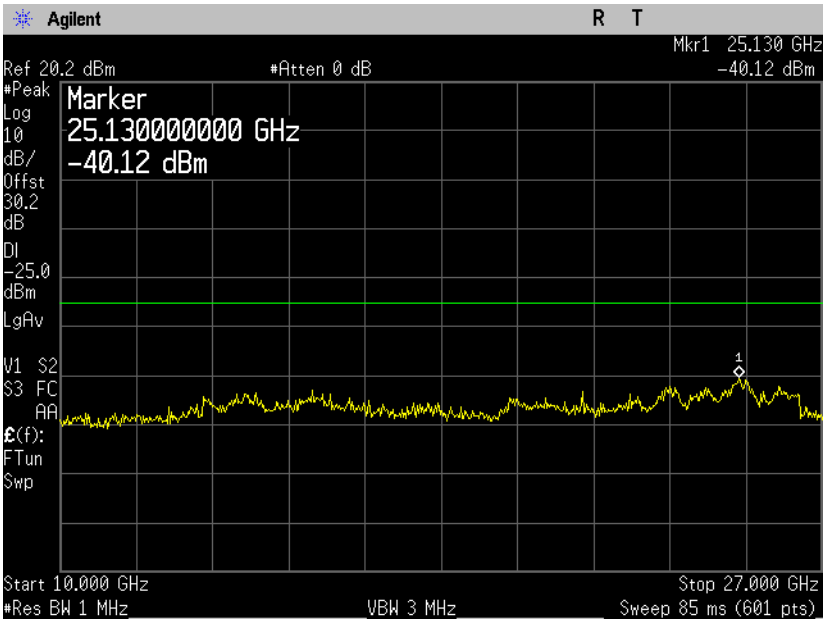
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 2
High Frequency 2685 MHz
Plot 4.4.34



Plot 4.4.35



Plot 4.4.36



4.5. Radiated Spurious Emissions

Reference document:	47 CFR §27.53 (m) (4) (6)		
Test Requirements:	For mobile digital stations, the attenuation factor shall not be less than 43 + 10 log (P) dB at the channel edge and 55 + 10 log (P) dB at 5.5 megahertz from the channel edges.		
Test setup:	See sec 3.2	**Pass**	
Method of testing:	Radiated		
Operating conditions:	Under normal test conditions		
S.A. Settings:	Peak: RBW= 1MHz, VBW= 3MHz		
Environment conditions:	Ambient Temperature: 22°c	Relative Humidity: 48%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.5.1 to Plot 4.5.64	

Test results: Output ANT 1:

All measurements were done in horizontal and vertical polarizations; the results show the worst case.

Frequency [MHz]	Max Reading [dBµV/m]	Polarization [H/V]	*Signal Generator Level [dBm]	Antenna Gain [dBd]	Emission power calculated [dBm]	Limit [dBm]	Result
WiMAX 802.16e (5MHz), Low Frequency 2498.5 MHz, OFDMA, 16 QAM, Duty Cycle 32%							
All emission at least 10 below the limit.							**Pass**
WiMAX 802.16e (5MHz), Middle Frequency 2600 MHz, OFDMA, 16 QAM, Duty Cycle 32%							
5200	67.91	V	-38.85	7.21	-31.64	-25	**Pass**
WiMAX 802.16e (5MHz), High Frequency 2687.5 MHz, OFDMA, 16 QAM, Duty Cycle 32%							
5375	56.11	V	-50.71	7.18	-43.53	-25	**Pass**
WiMAX 802.16e (10MHz), Low Frequency 2501 MHz, OFDMA, 16 QAM, Duty Cycle 27%							
All emission at least 10 below the limit.							**Pass**
WiMAX 802.16e (10MHz), Middle Frequency 2600 MHz, OFDMA, 16 QAM, Duty Cycle 27%							
5200	62.98	V	-43.78	7.21	-36.57	-25	**Pass**
WiMAX 802.16e (10MHz), High Frequency 2685 MHz, OFDMA, 16 QAM, Duty Cycle 27%							
5370	52.45	V	-55.26	7.18	-48.08	-25	**Pass**

* Corrected for cable loss

Ref. Plots: Plot 4.5.1 – Plot 4.5.30

Note: Measurements were taken using a notch filter (where appropriate) at the spectrum analyzer input, adjusted to the operating frequency.

Test results below 1GHz:

All measurements were done in horizontal and vertical polarizations; the results show the worst case for all frequencies.

Frequency [MHz]	Max Reading [dBµV/m]	Polarization [H/V]	*Signal Generator Level [dBm]	Antenna Gain [dBd]	Emission power calculated [dBm]	Limit [dBm]	Result
34.8	39.52	V	-50.82	-16.93	-67.75	-25	**Pass**
104.2	36.18	V	-67.38	-3.36	-70.74	-25	**Pass**

* Corrected for cable loss

Ref. Plots: Plot 4.5.31 – Plot 4.5.32

Test results: Output ANT 2

All measurements were done in horizontal and vertical polarizations; the results show the worst case.

Frequency [MHz]	Max Reading [dBµV/m]	Polarization [H/V]	*Signal Generator Level [dBm]	Antenna Gain [dBd]	Emission power calculated [dBm]	Limit [dBm]	Result
WiMAX 802.16e (5MHz), Low Frequency 2498.5 MHz, OFDMA, 16 QAM, Duty Cycle 32%							
All emission at least 10 below the limit.							**Pass**
WiMAX 802.16e (5MHz), Middle Frequency 2600 MHz, OFDMA, 16 QAM, Duty Cycle 32%							
5200	68.59	V	-38.17	7.21	-30.96	-25	**Pass**
WiMAX 802.16e (5MHz), High Frequency 2687.5 MHz, OFDMA, 16 QAM, Duty Cycle 32%							
5375	58.72	V	-48.10	7.18	-40.92	-25	**Pass**
WiMAX 802.16e (10MHz), Low Frequency 2501 MHz, OFDMA, 16 QAM, Duty Cycle 27%							
All emission at least 10 below the limit.							**Pass**
WiMAX 802.16e (10MHz), Middle Frequency 2600 MHz, OFDMA, 16 QAM, Duty Cycle 27%							
5200	65.03	V	-41.73	7.21	-34.52	-25	**Pass**
WiMAX 802.16e (10MHz), High Frequency 2685 MHz, OFDMA, 16 QAM, Duty Cycle 27%							
5370	52.19	V	-55.52	7.18	-48.34	-25	**Pass**

* Corrected for cable loss

Ref. Plots: Plot 4.5.33 – Plot 4.5.62

Note: All measurements were taken using a notch filter (where appropriate) at the spectrum analyzer input, adjusted to the operating frequency.

Test results below 1GHz:

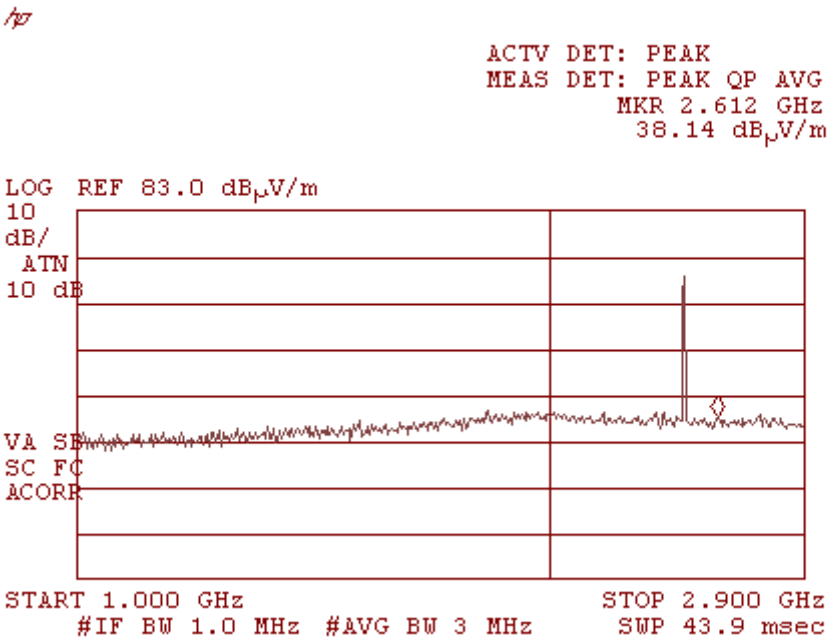
All measurements were done in horizontal and vertical polarizations; the results show the worst case for all frequencies.

Frequency [MHz]	Max Reading [dBµV/m]	Polarization [H/V]	*Signal Generator Level [dBm]	Antenna Gain [dBd]	Emission power calculated [dBm]	Limit [dBm]	Result
34.8	39.26	V	-51.08	-16.93	-68.01	-25	**Pass**
104.2	37.89	V	-65.67	-3.36	-69.03	-25	**Pass**

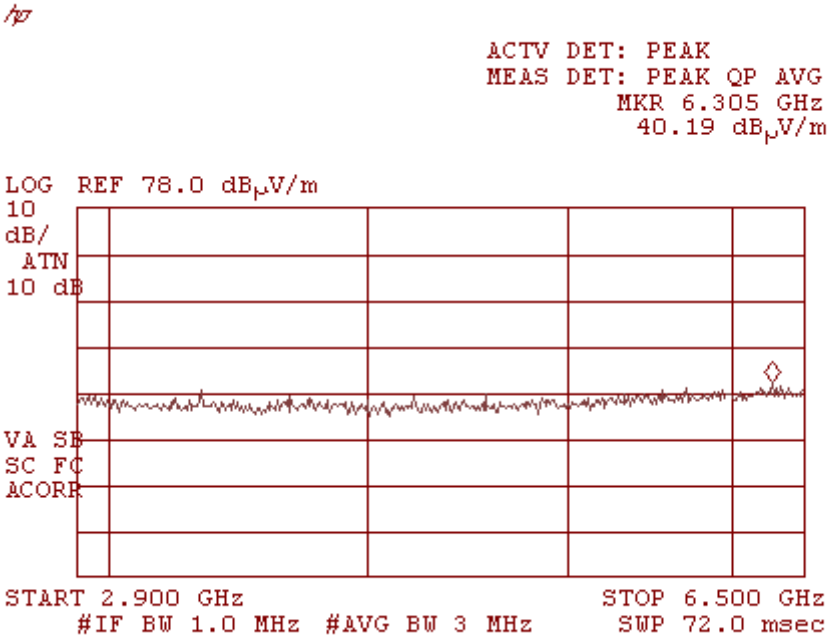
* Corrected for cable loss

Ref. Plots: Plot 4.5.63 – Plot 4.5.64

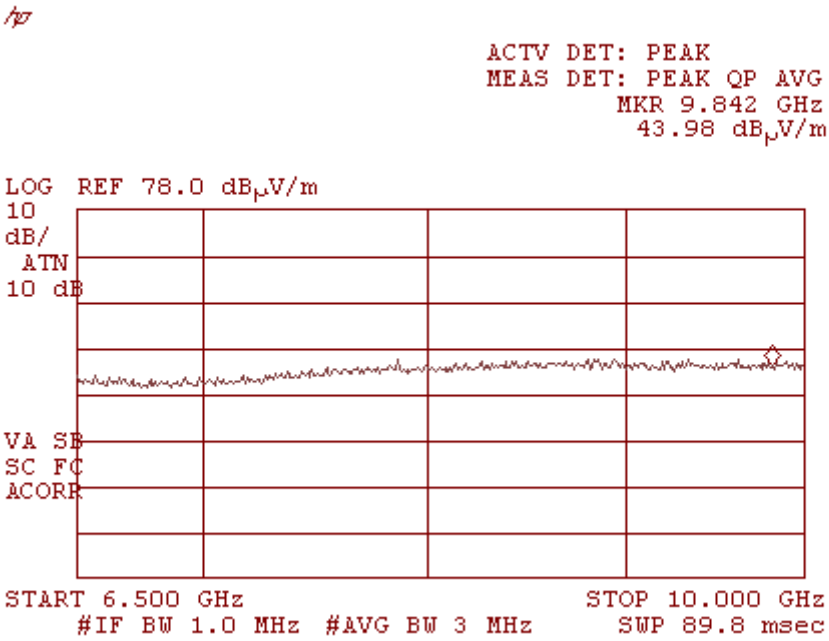
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 1
Low Frequency 2498.5 MHz
Horizontal & Vertical Polarization
Plot 4.5.1



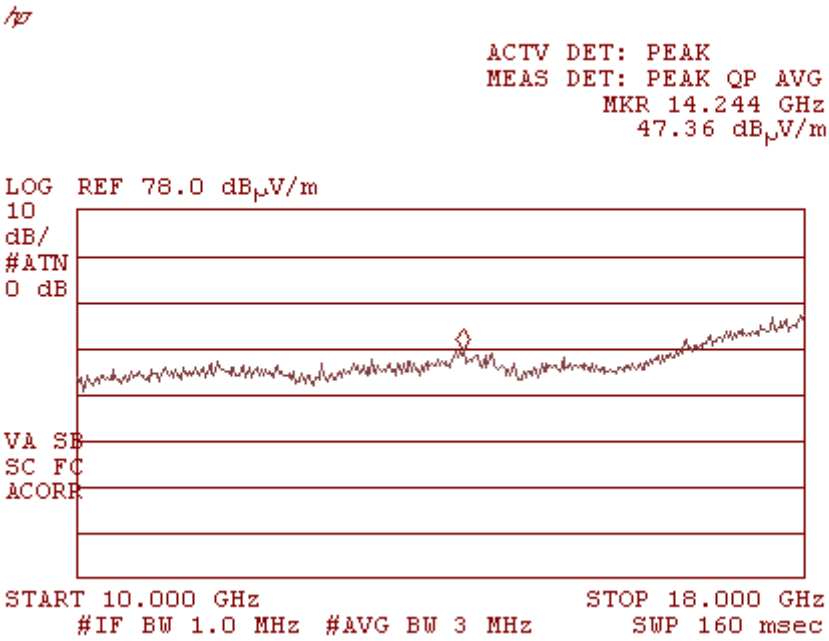
Horizontal & Vertical Polarization
Plot 4.5.2



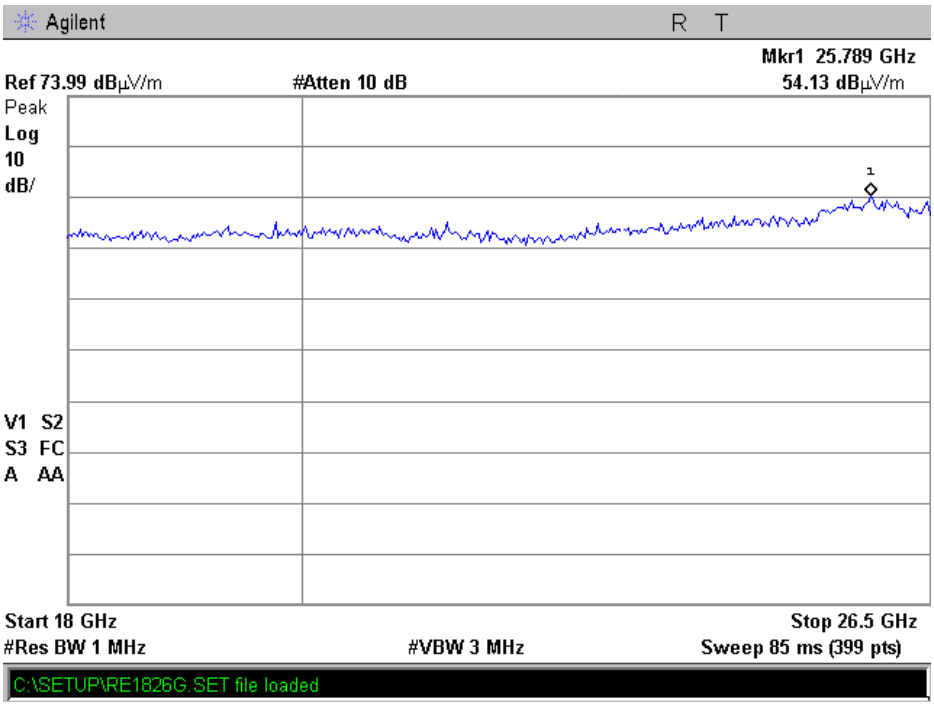
Horizontal & Vertical Polarization
Plot 4.5.3



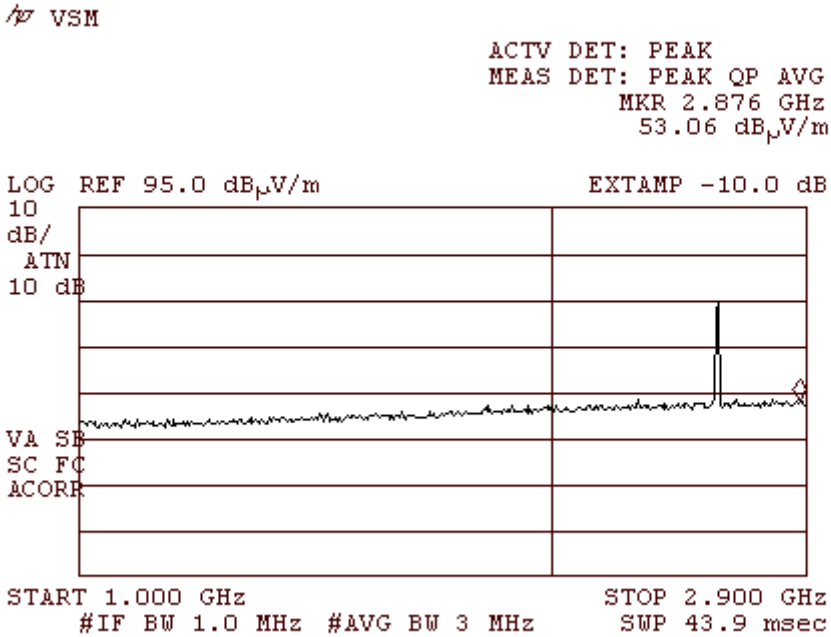
Horizontal & Vertical Polarization
Plot 4.5.4



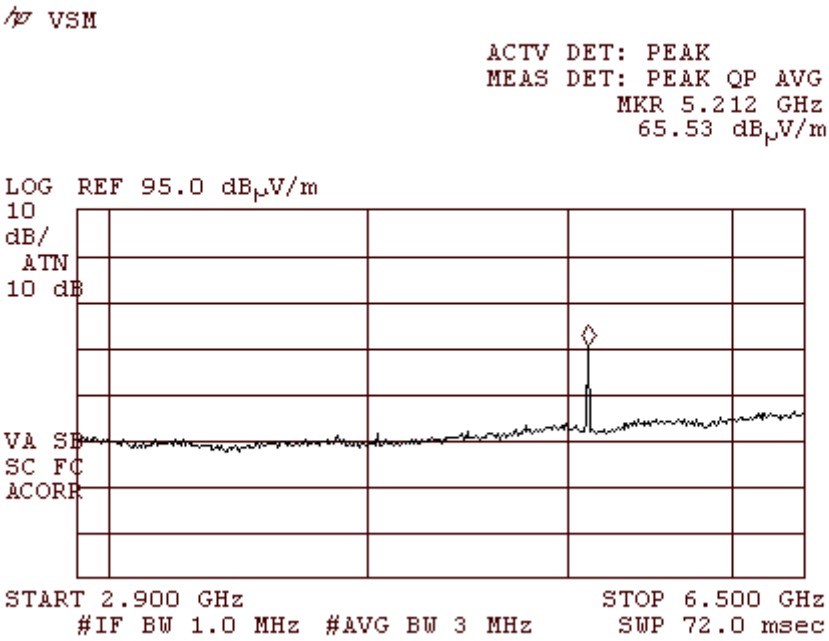
Horizontal & Vertical Polarization
Plot 4.5.5



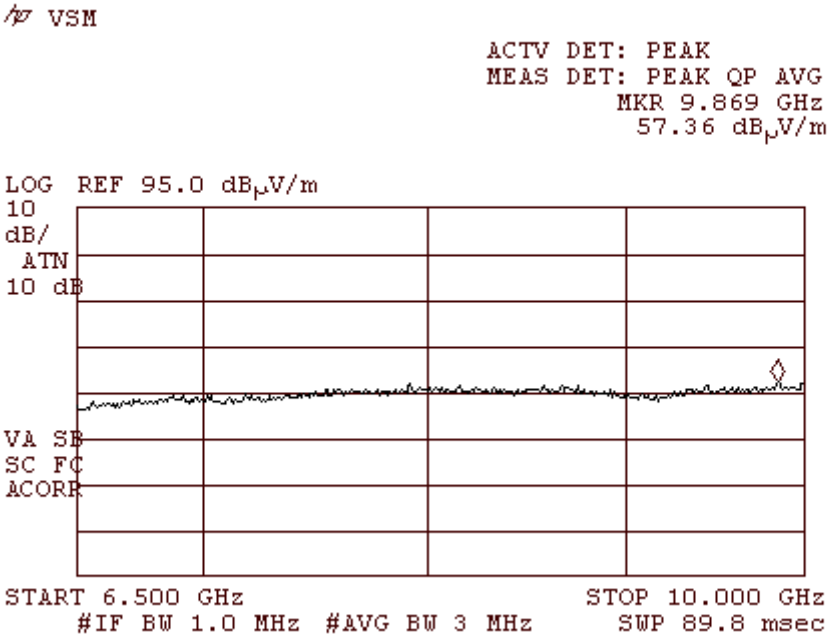
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 1
Middle Frequency 2600 MHz
Horizontal & Vertical Polarization
Plot 4.5.6



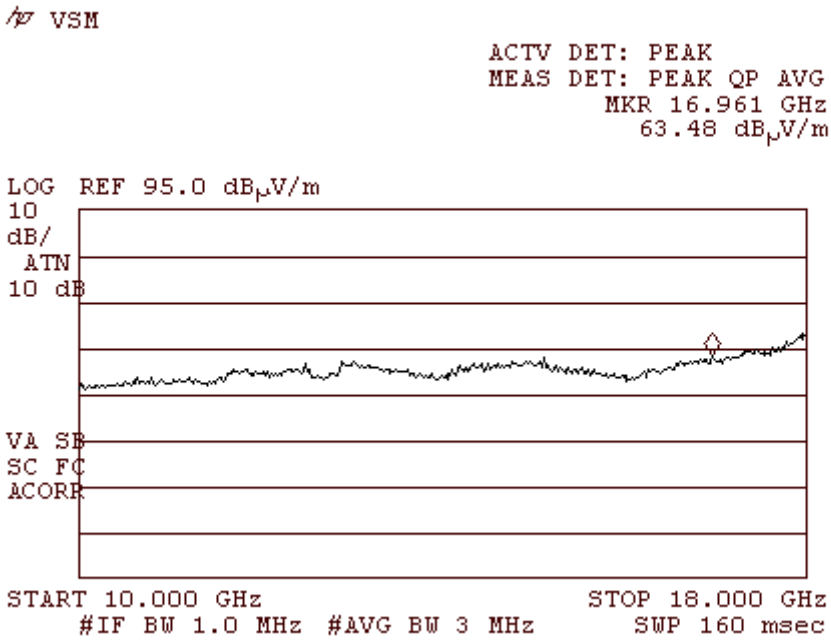
Horizontal & Vertical Polarization
Plot 4.5.7



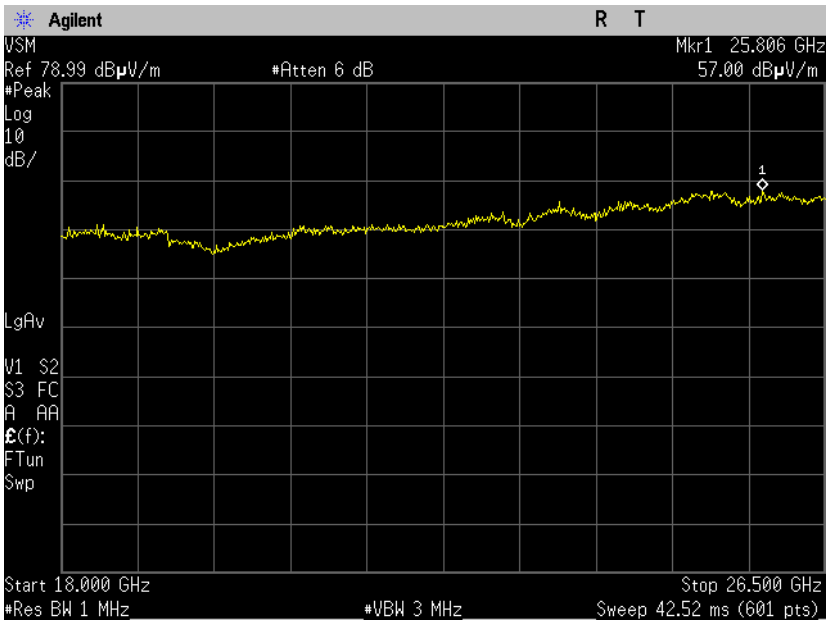
Horizontal & Vertical Polarization
Plot 4.5.8



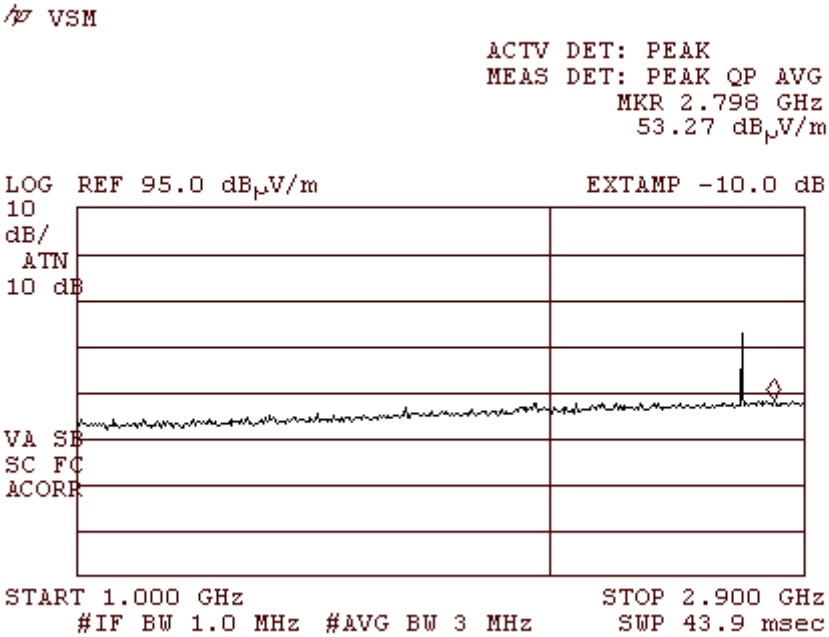
Horizontal & Vertical Polarization
Plot 4.5.9



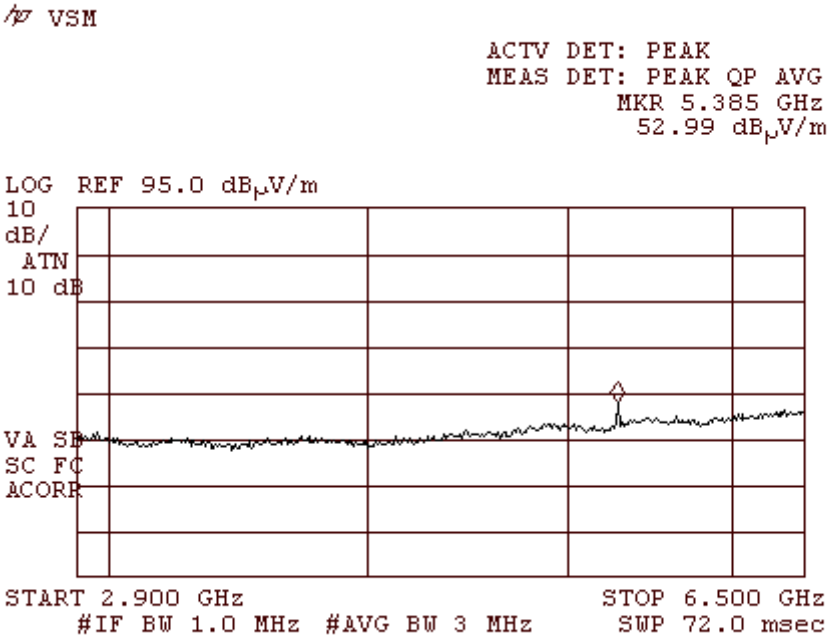
Horizontal & Vertical Polarization
Plot 4.5.10



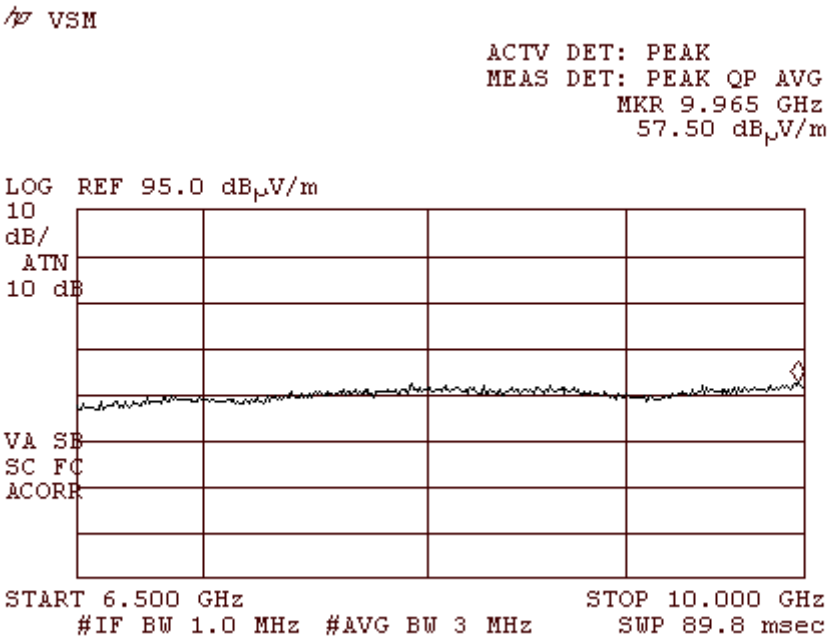
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 1
High Frequency 2687.5 MHz
Horizontal & Vertical Polarization
Plot 4.5.11



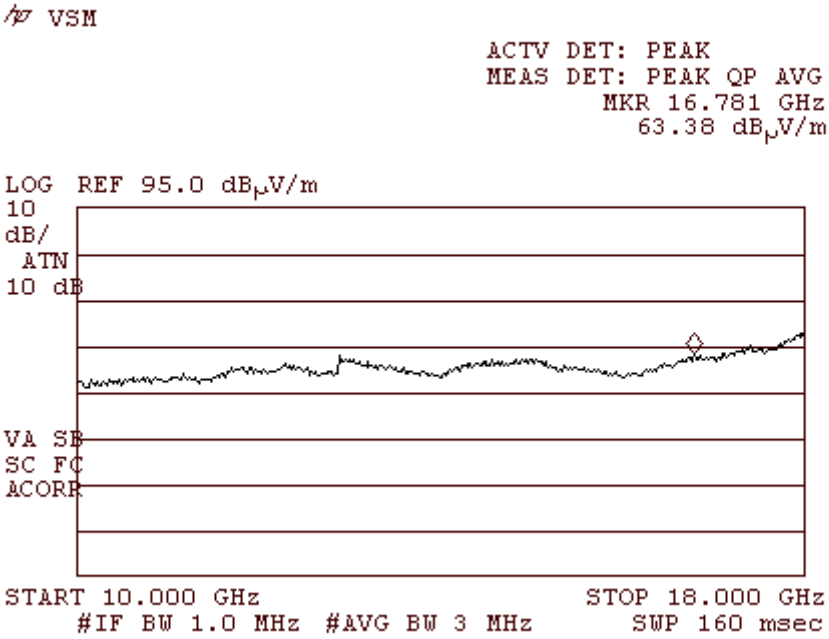
Horizontal & Vertical Polarization
Plot 4.5.12



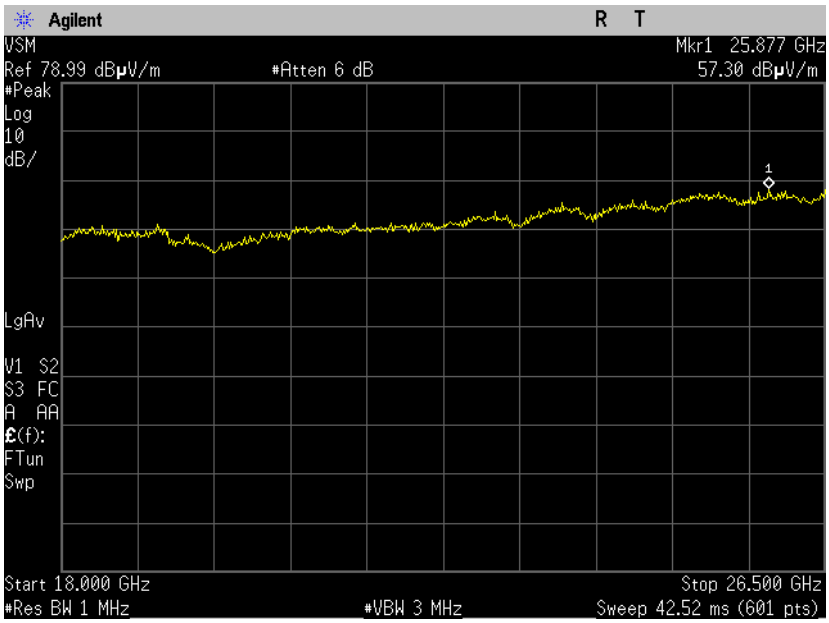
Horizontal & Vertical Polarization
Plot 4.5.13



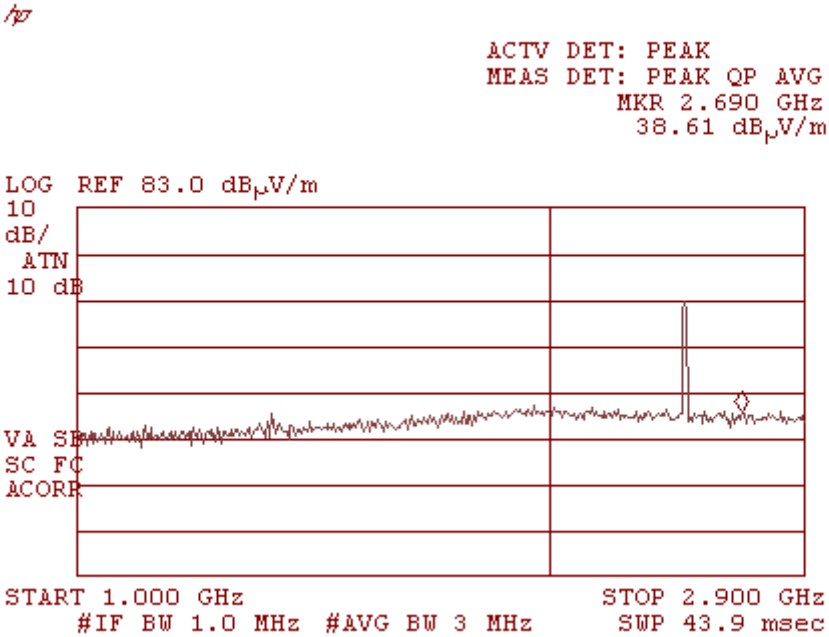
Horizontal & Vertical Polarization
Plot 4.5.14



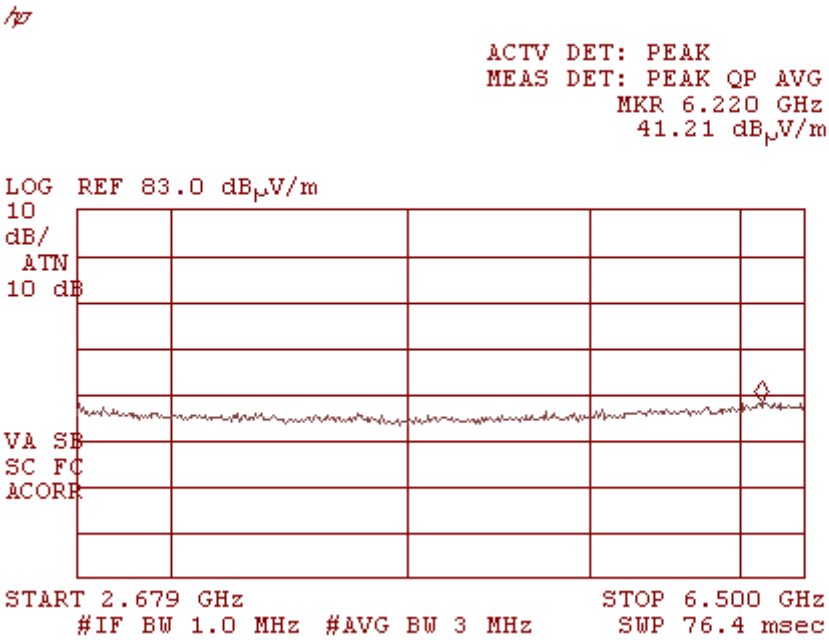
Horizontal & Vertical Polarization
Plot 4.5.15



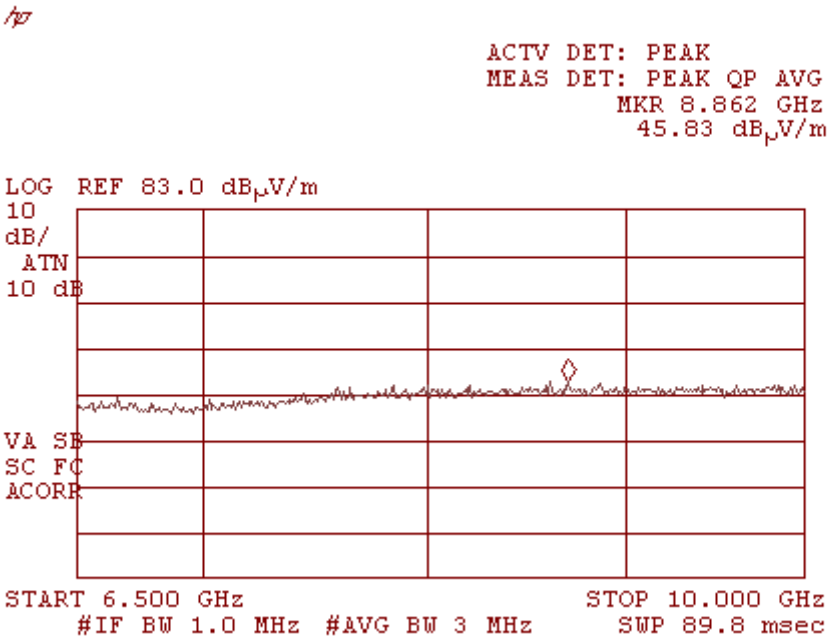
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 1
Low Frequency 2501 MHz
Horizontal & Vertical Polarization
Plot 4.5.16



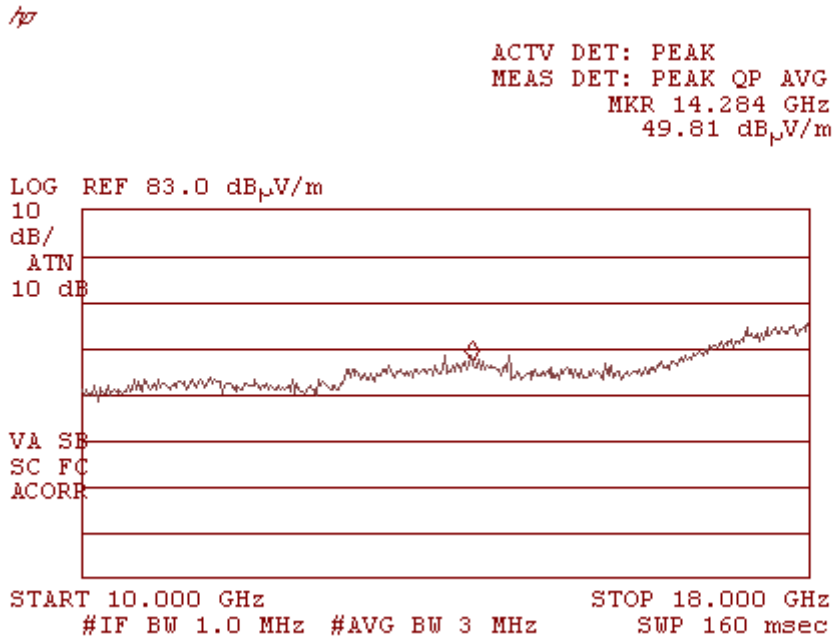
Horizontal & Vertical Polarization
Plot 4.5.17



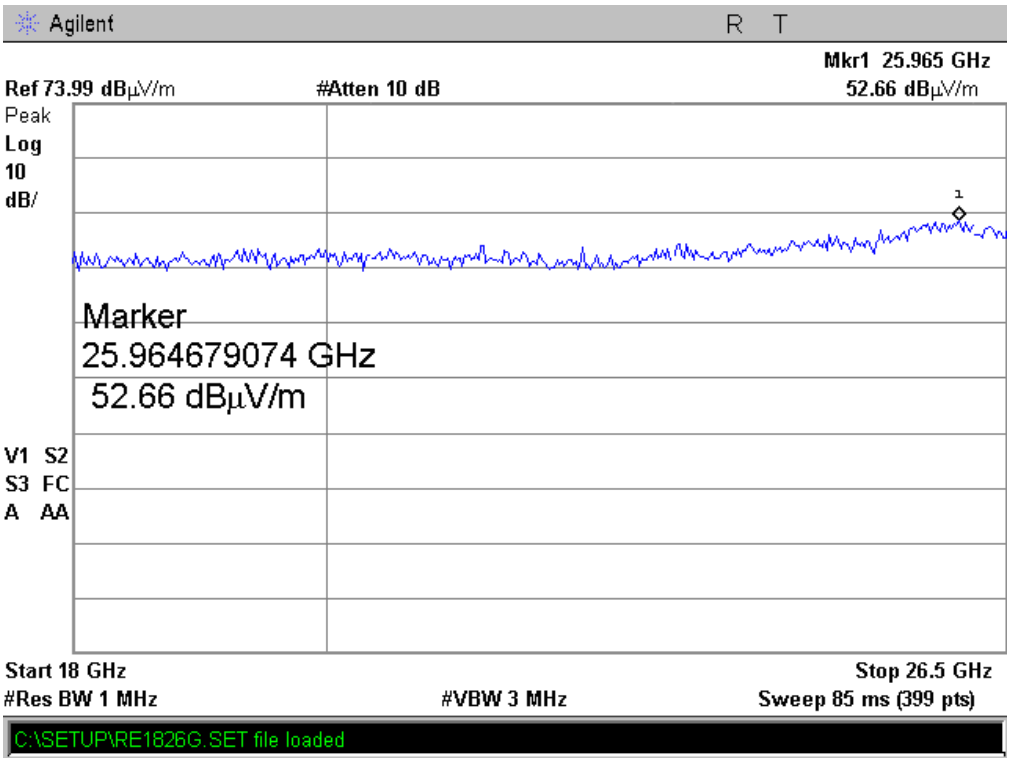
Horizontal & Vertical Polarization
Plot 4.5.18



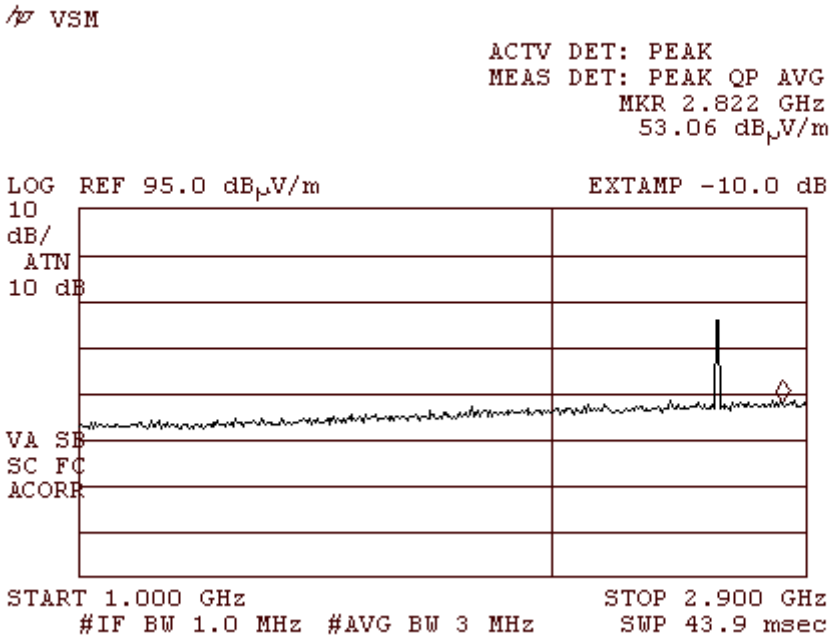
Horizontal & Vertical Polarization
Plot 4.5.19



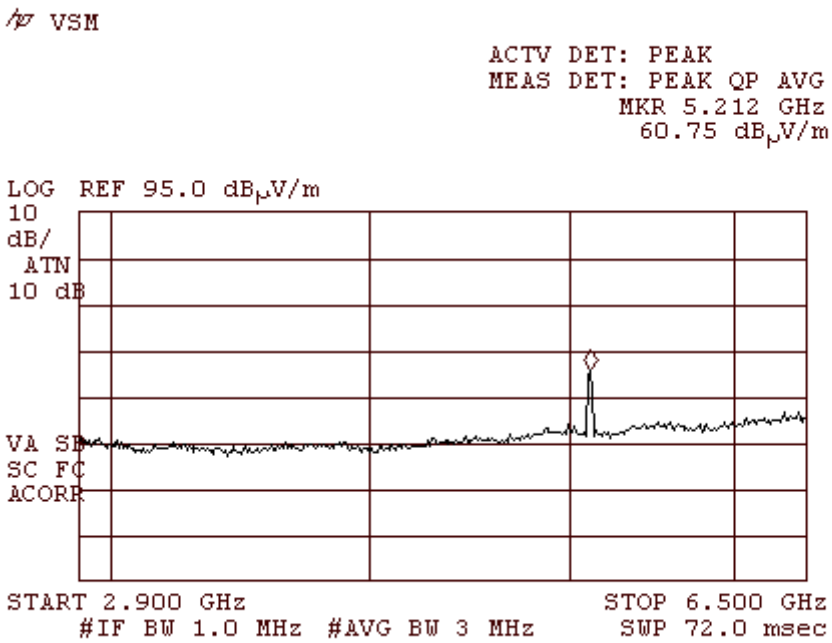
Horizontal & Vertical Polarization
Plot 4.5.20



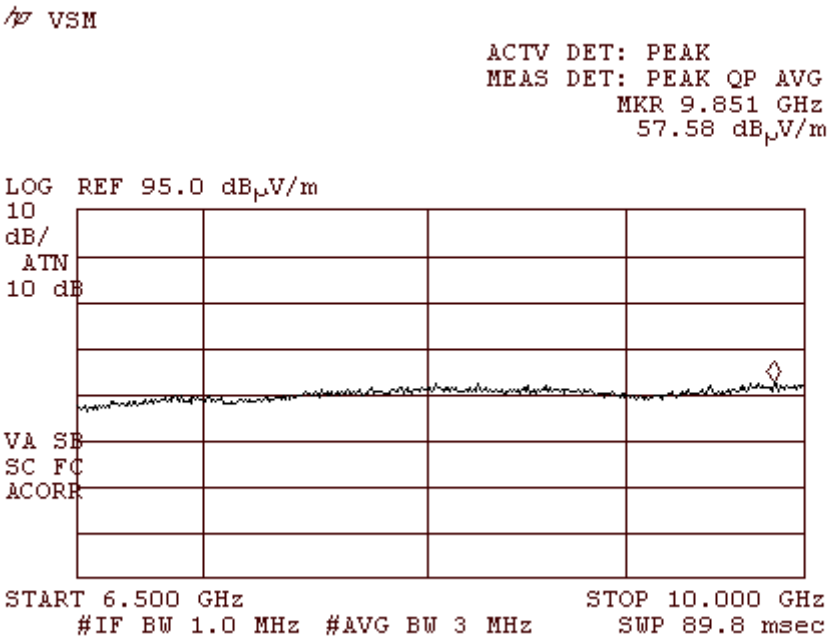
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 1
Middle Frequency 2600 MHz
Horizontal & Vertical Polarization
Plot 4.5.21



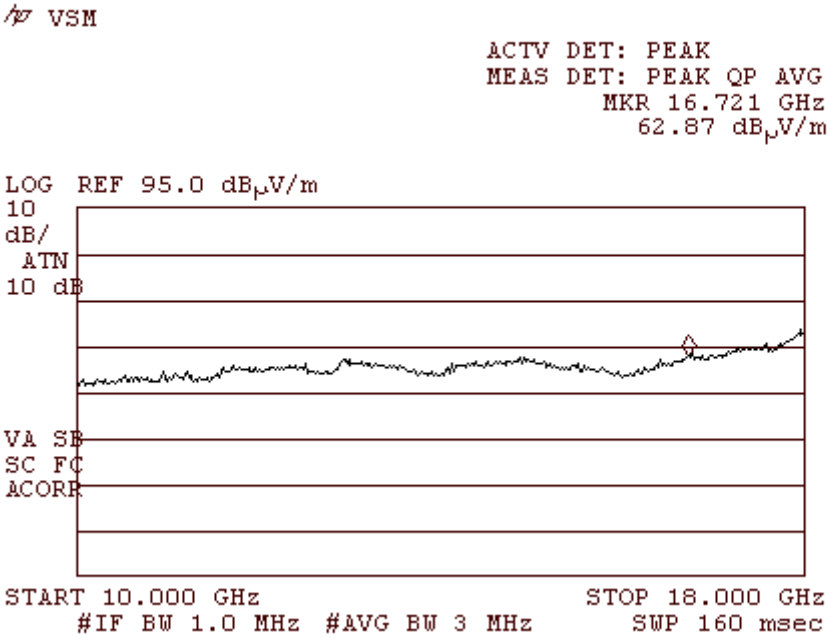
Horizontal & Vertical Polarization
Plot 4.5.22



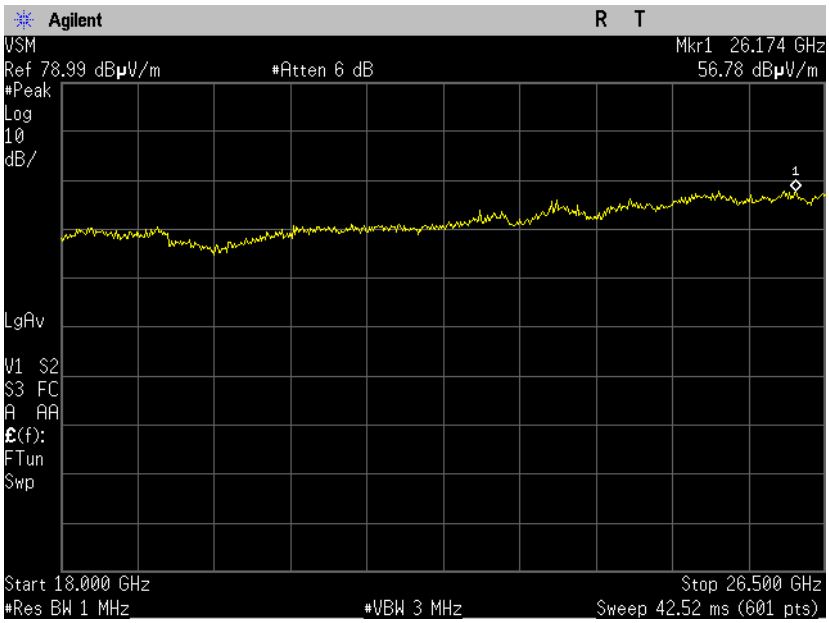
Horizontal & Vertical Polarization
Plot 4.5.23



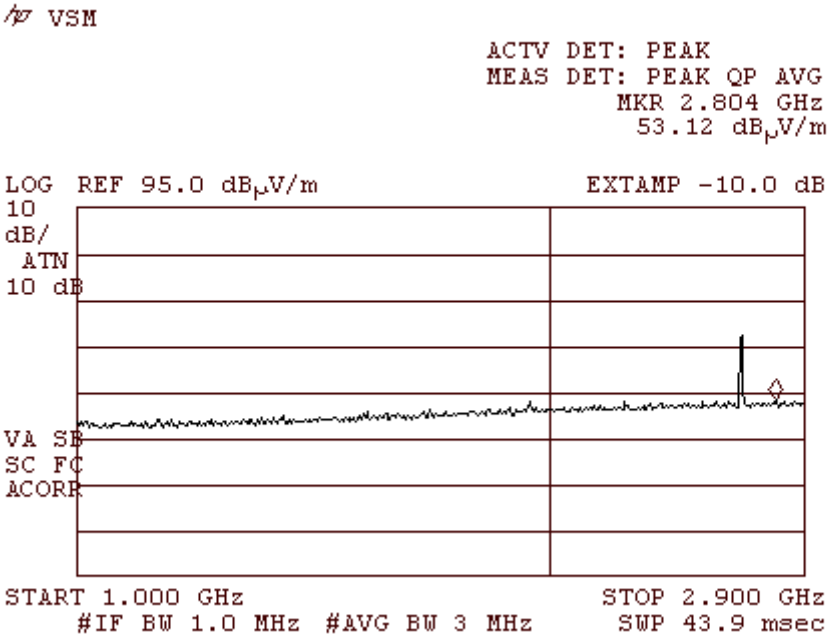
Horizontal & Vertical Polarization
Plot 4.5.24



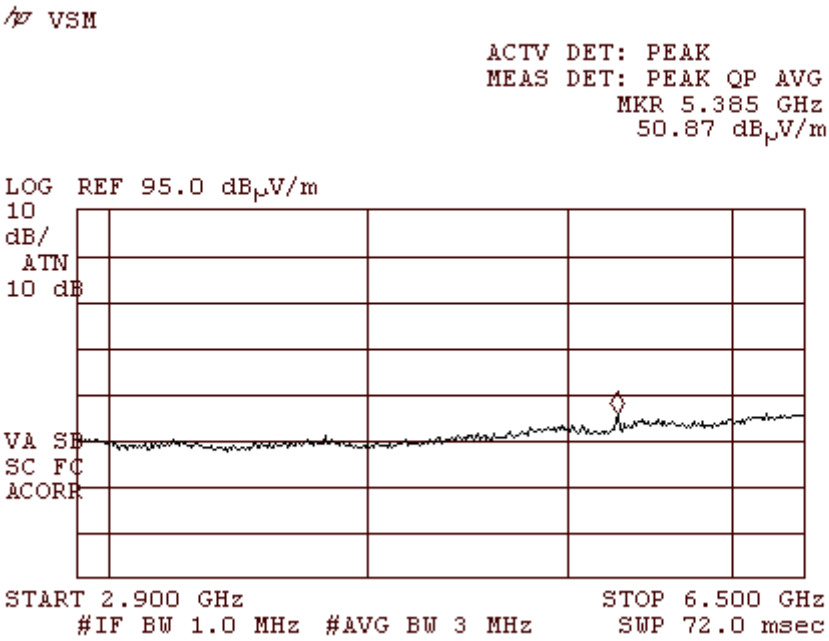
Horizontal & Vertical Polarization
Plot 4.5.25



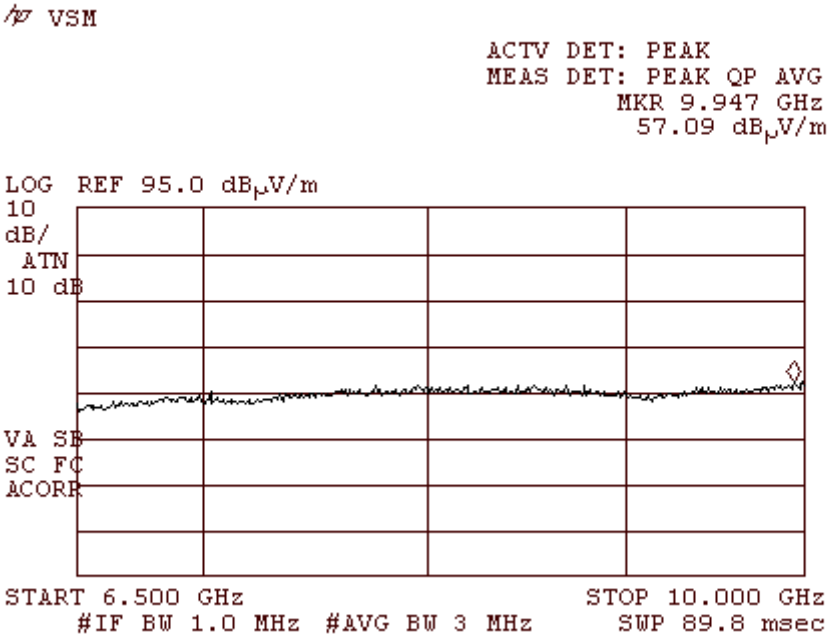
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 1
High Frequency 2685 MHz
Horizontal & Vertical Polarization
Plot 4.5.26



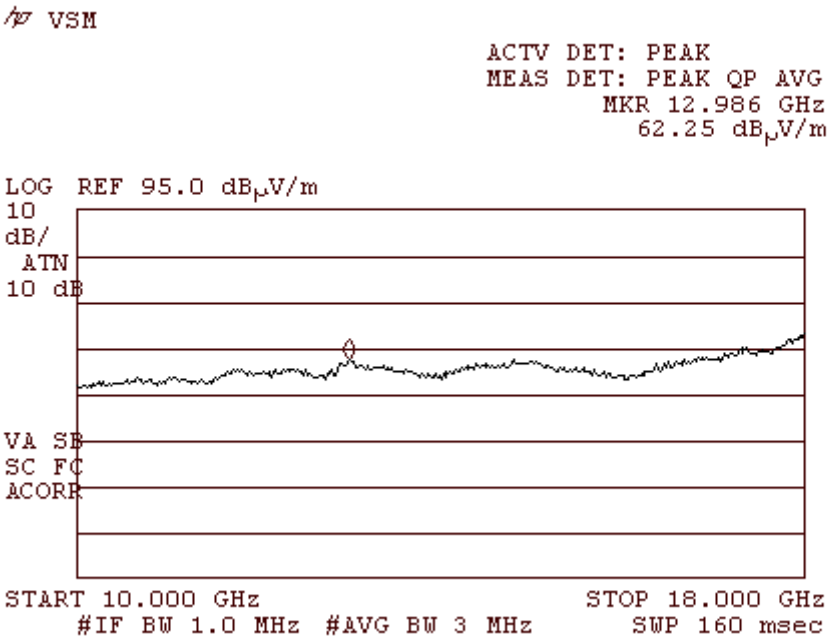
Horizontal & Vertical Polarization
Plot 4.5.27



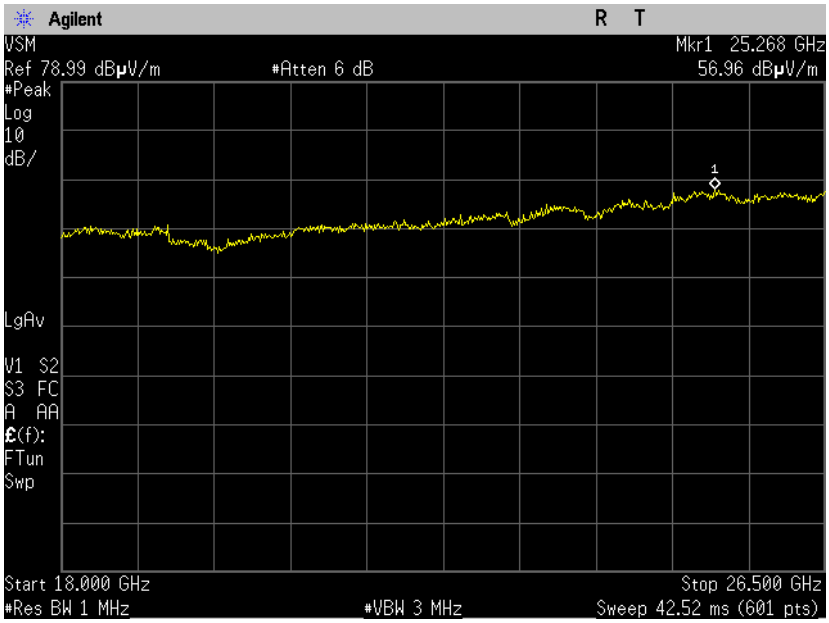
Horizontal & Vertical Polarization
Plot 4.5.28



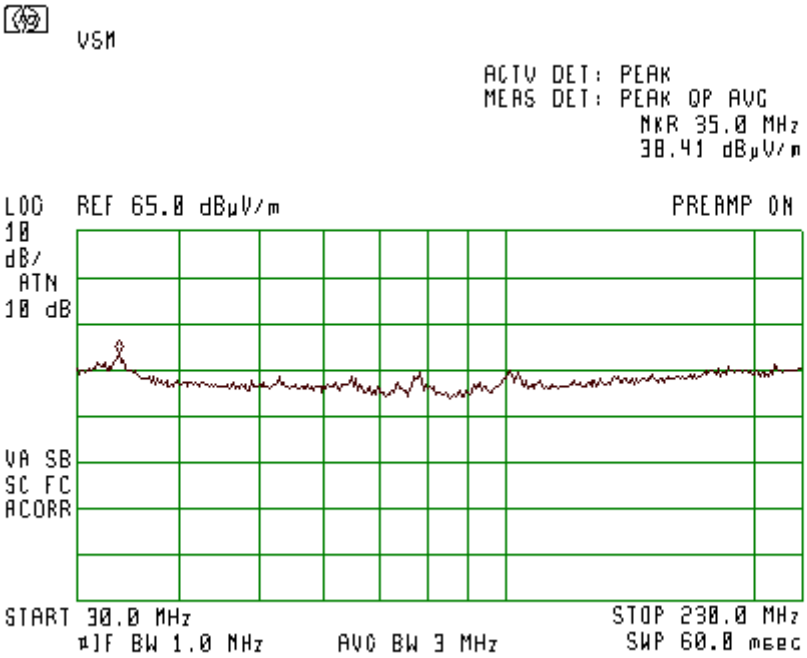
Horizontal & Vertical Polarization
Plot 4.5.29



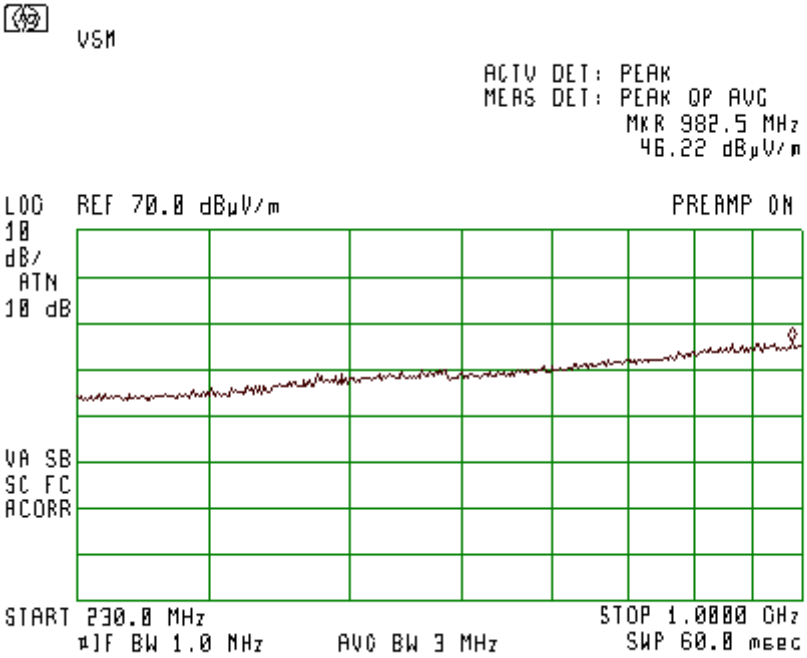
Horizontal & Vertical Polarization
Plot 4.5.30



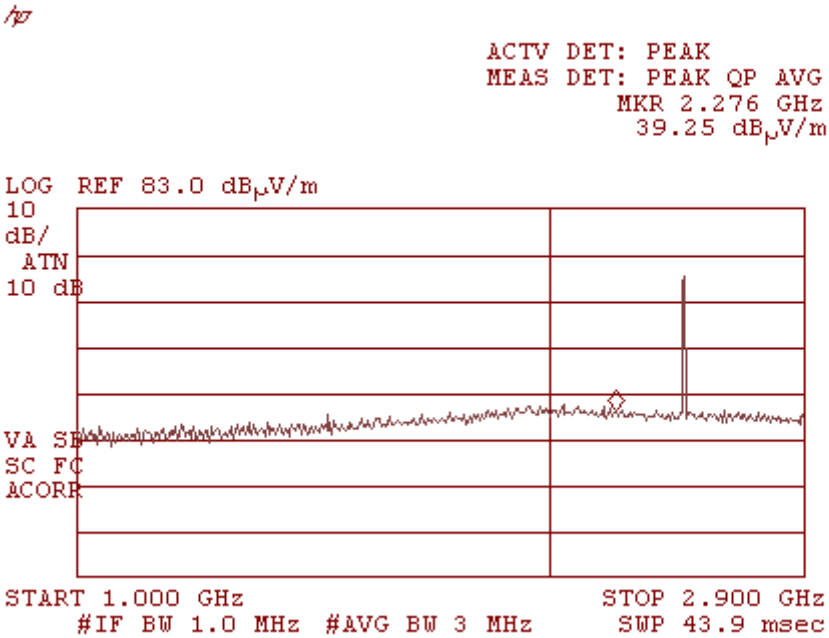
Below 1 GHz
Worst case for all frequencies
Output ANT 1
Horizontal & Vertical Polarization
Plot 4.5.31



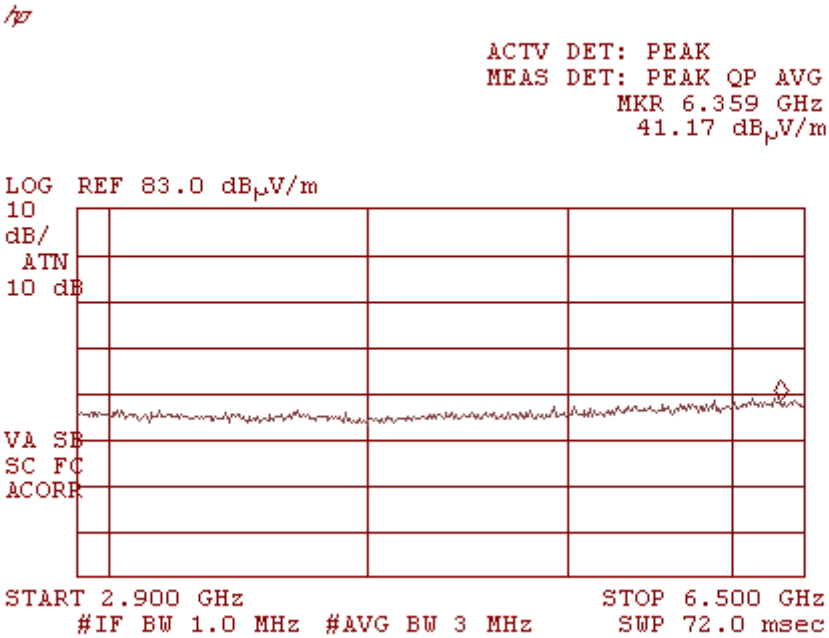
Horizontal & Vertical Polarization
Plot 4.5.32



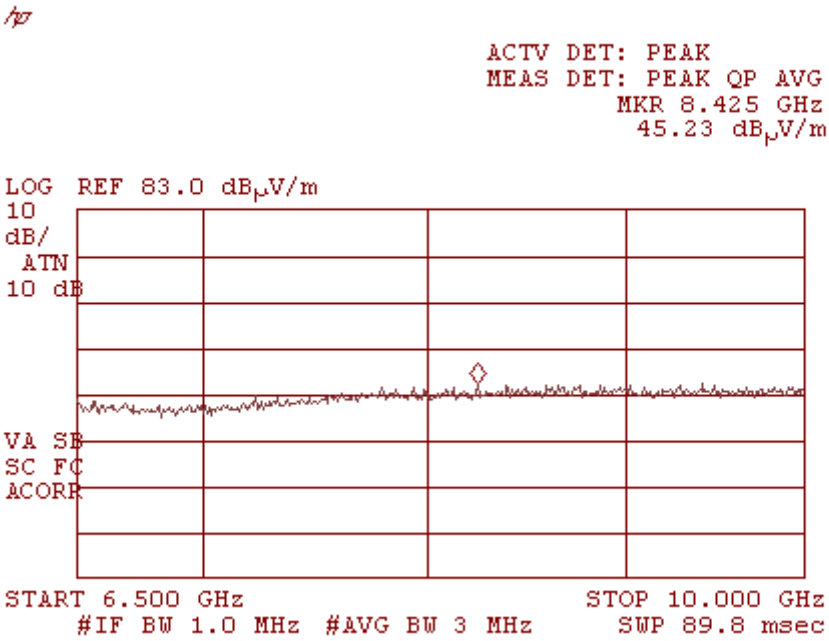
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 2
Low Frequency 2498.5 MHz
Horizontal & Vertical Polarization
Plot 4.5.33



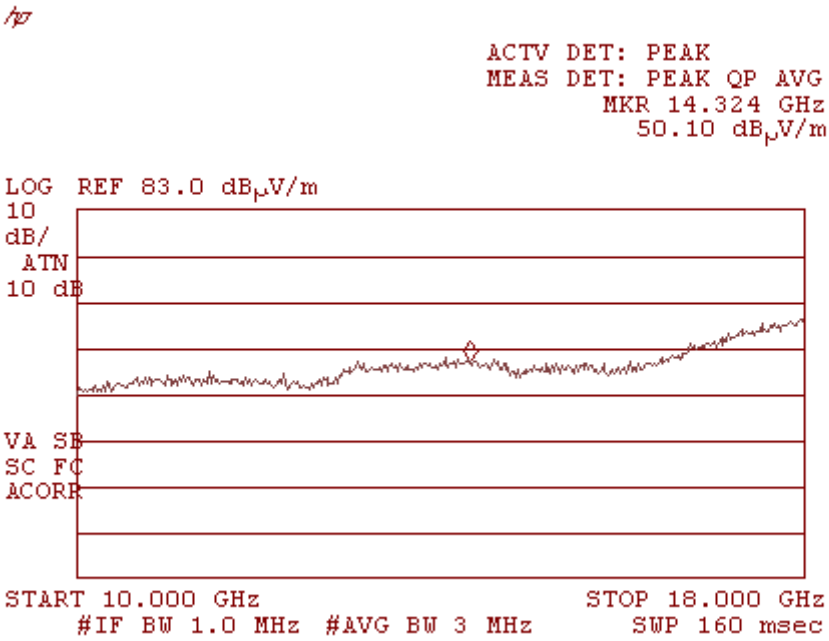
Horizontal & Vertical Polarization
Plot 4.5.34



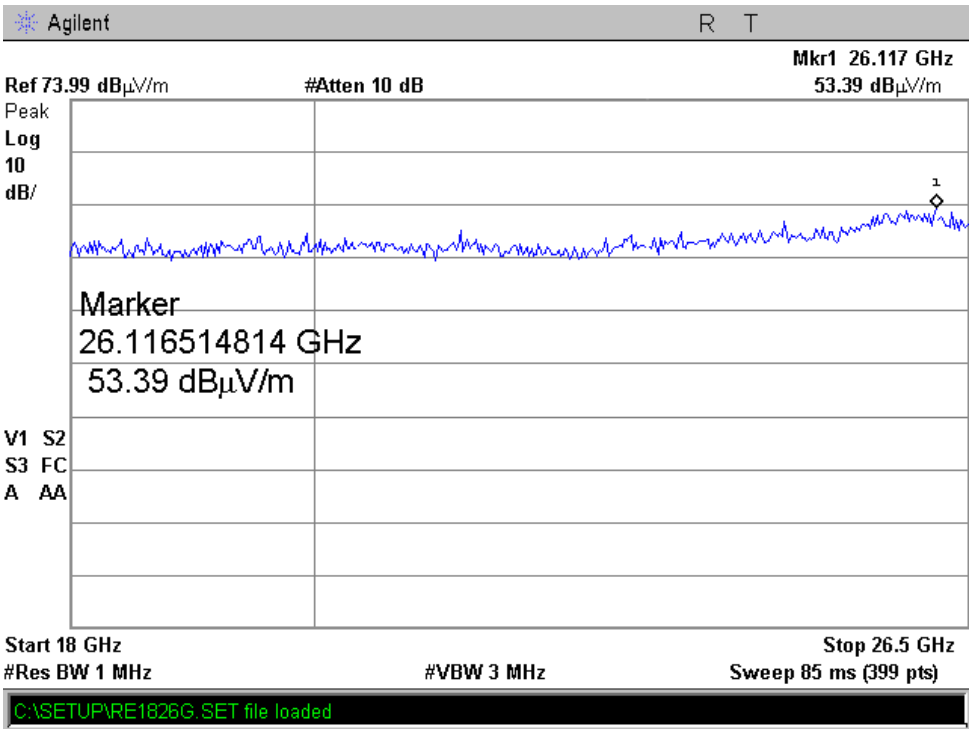
Horizontal & Vertical Polarization
Plot 4.5.35



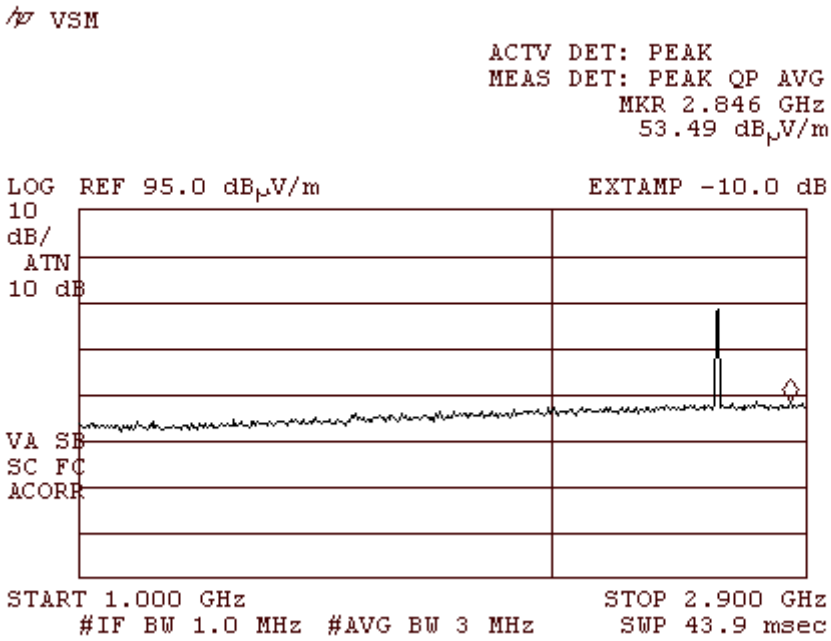
Horizontal & Vertical Polarization
Plot 4.5.36



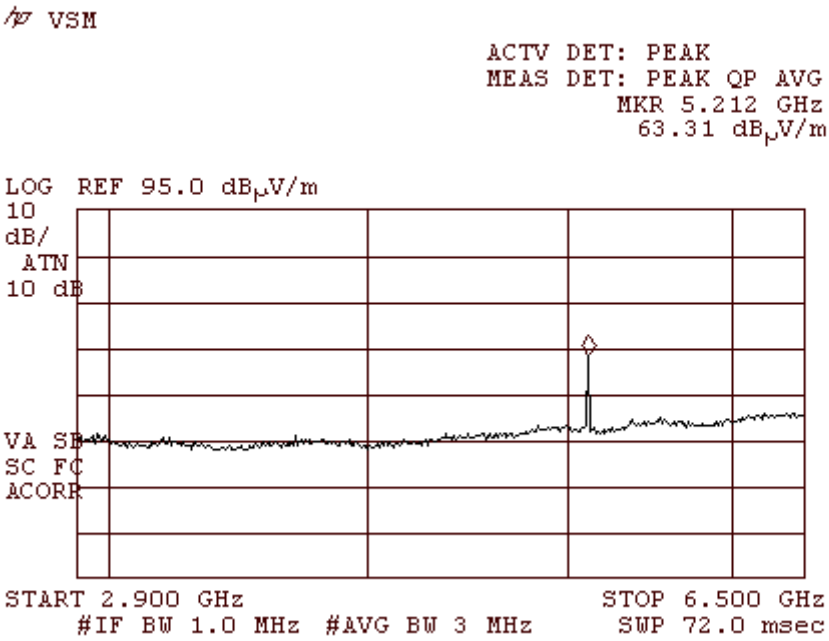
Horizontal & Vertical Polarization
Plot 4.5.37



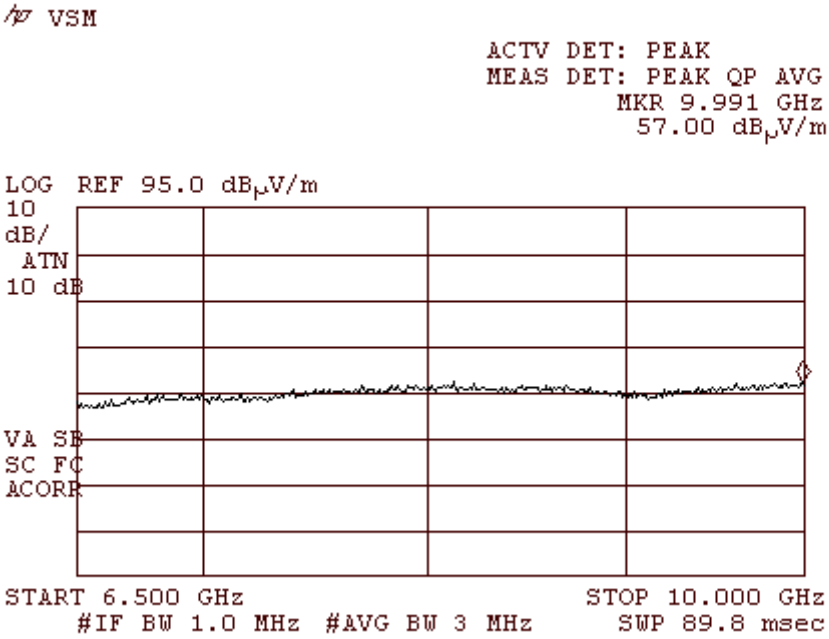
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 2
Middle Frequency 2600 MHz
Horizontal & Vertical Polarization
Plot 4.5.38



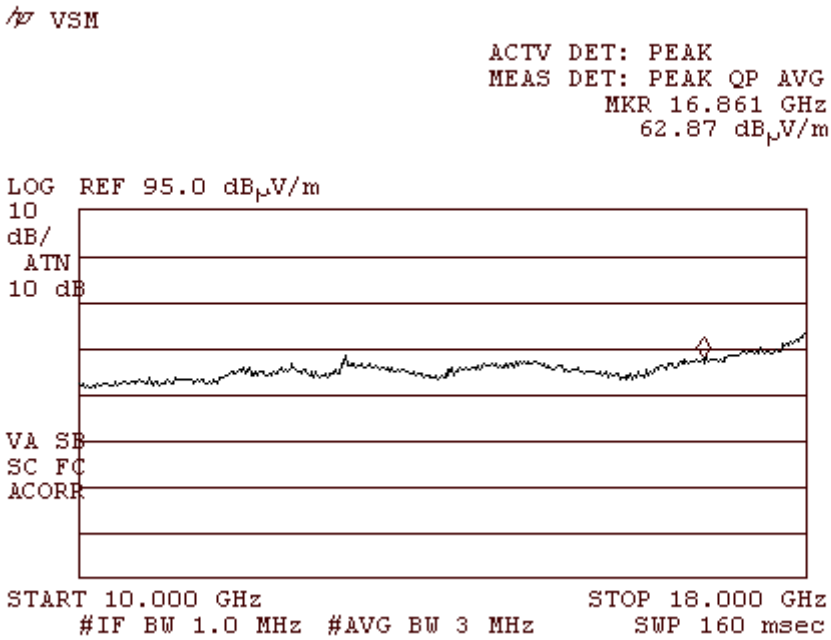
Horizontal & Vertical Polarization
Plot 4.5.39



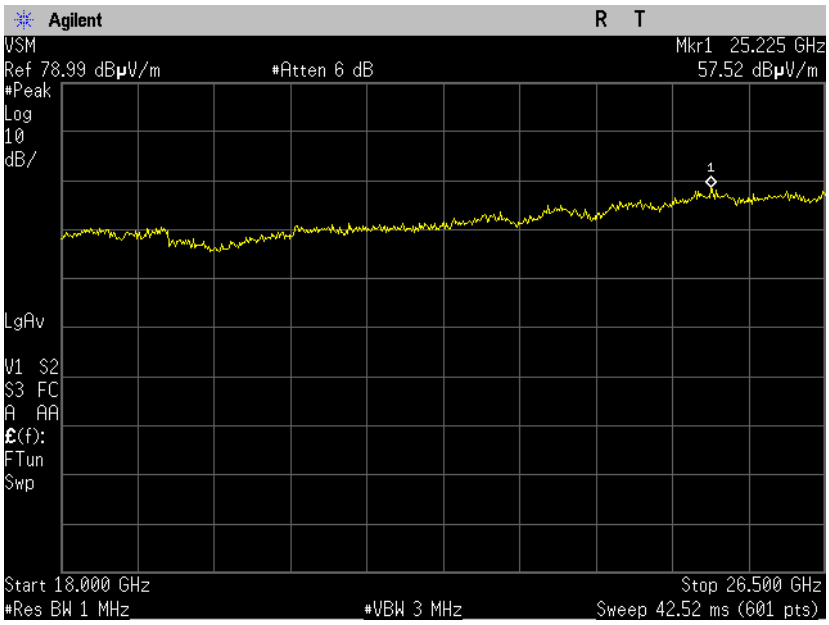
Horizontal & Vertical Polarization
Plot 4.40



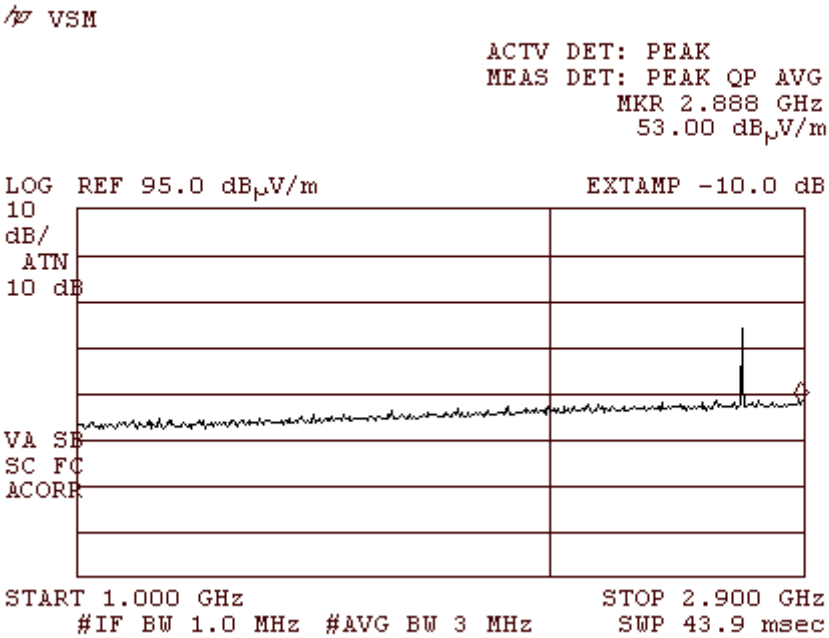
Horizontal & Vertical Polarization
Plot 4.5.41



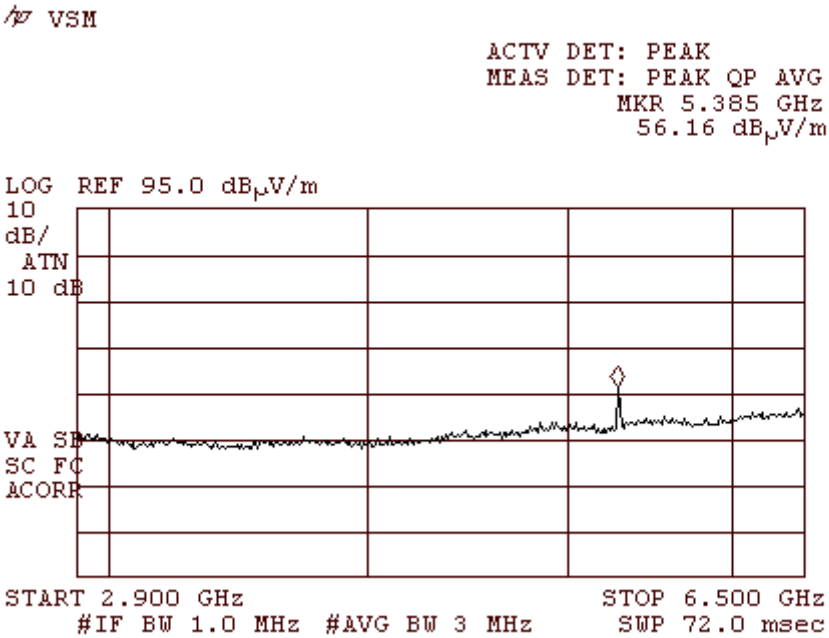
Horizontal & Vertical Polarization
Plot 4.5.42



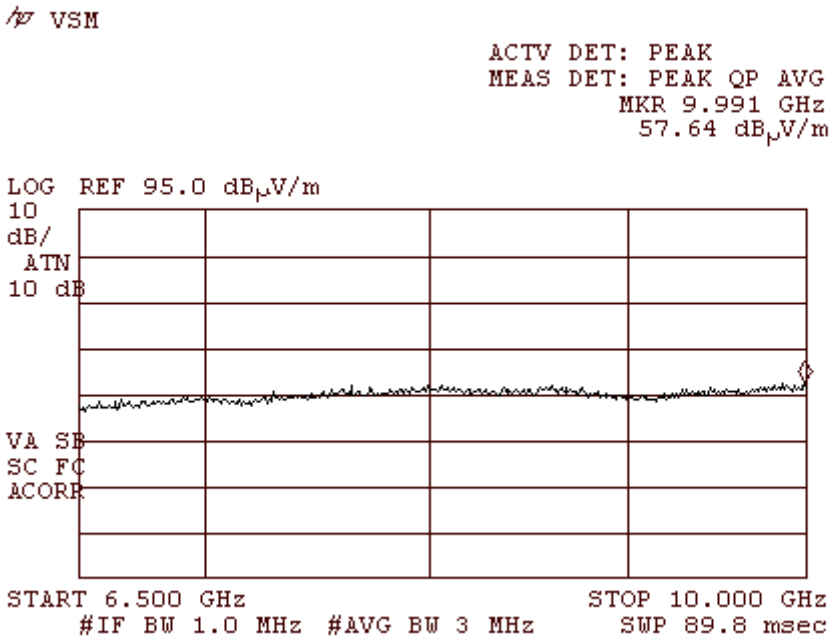
WiMAX 802.16e (5MHz), OFDMA, 16 QAM, Duty Cycle 32%
Output ANT 2
High Frequency 2687.5 MHz
Horizontal & Vertical Polarization
Plot 4.5.43



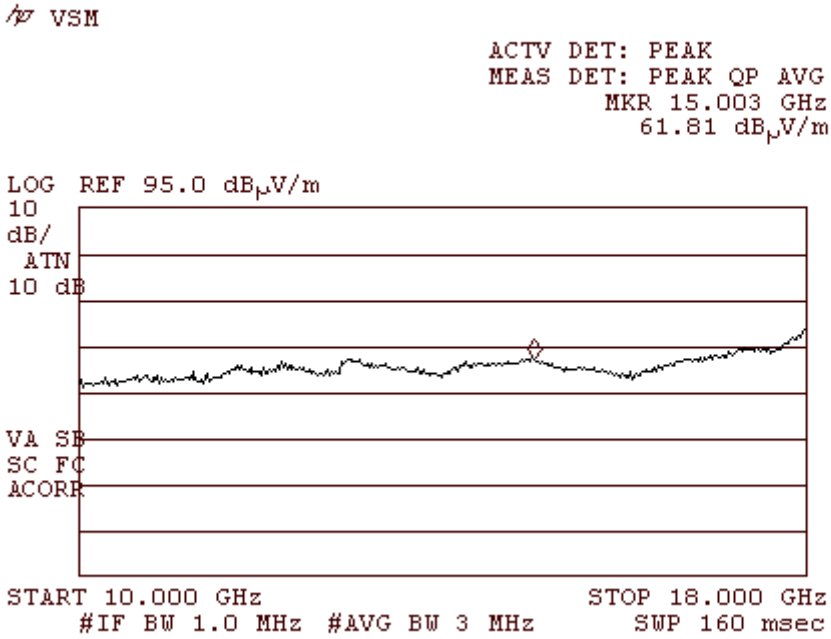
Horizontal & Vertical Polarization
Plot 4.5.44



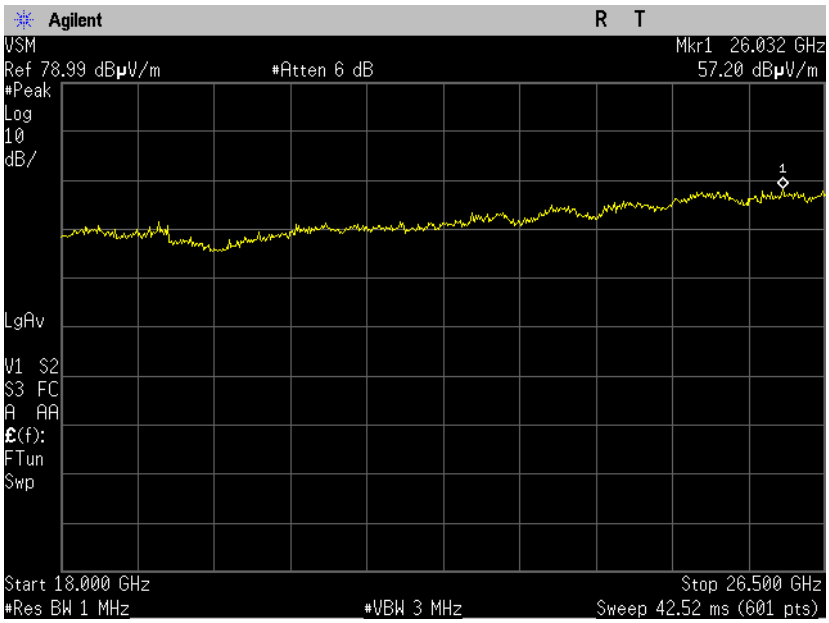
Horizontal & Vertical Polarization
Plot 4.5.45



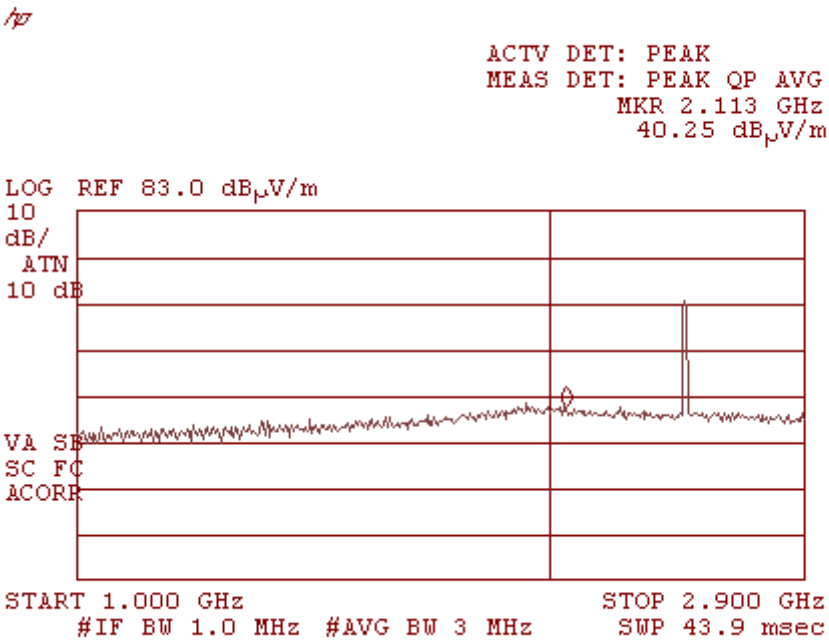
Horizontal & Vertical Polarization
Plot 4.5.46



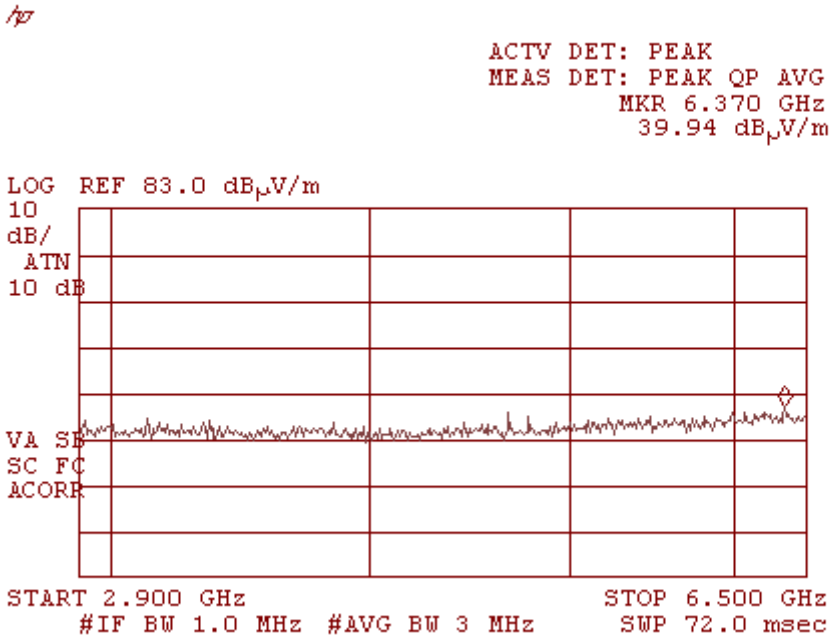
Horizontal & Vertical Polarization
Plot 4.5.47



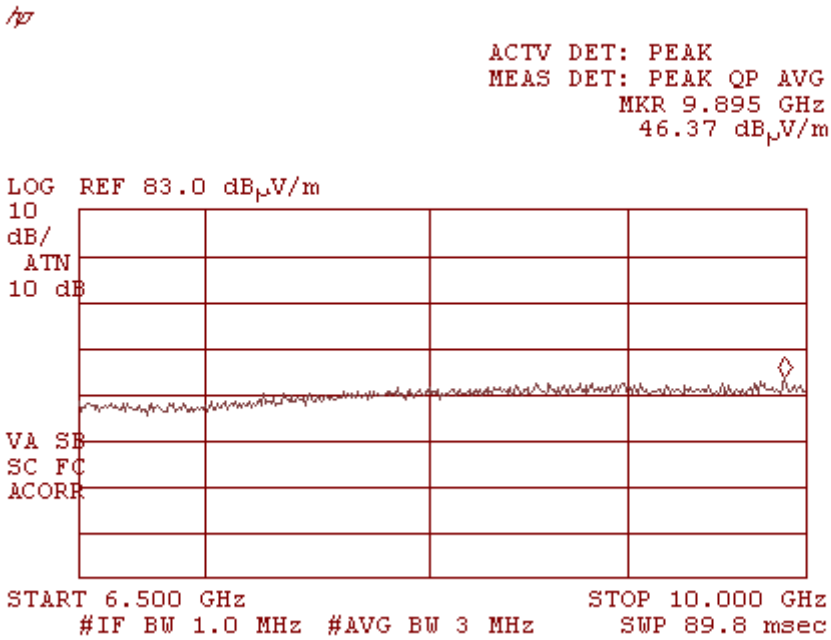
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 2
Low Frequency 2501 MHz
Horizontal & Vertical Polarization
Plot 4.5.48



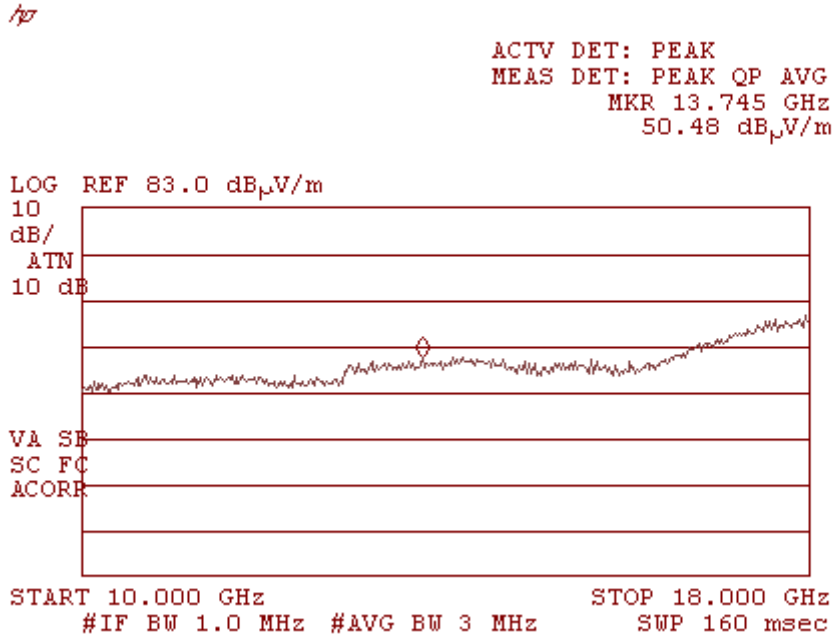
Horizontal & Vertical Polarization
Plot 4.5.49



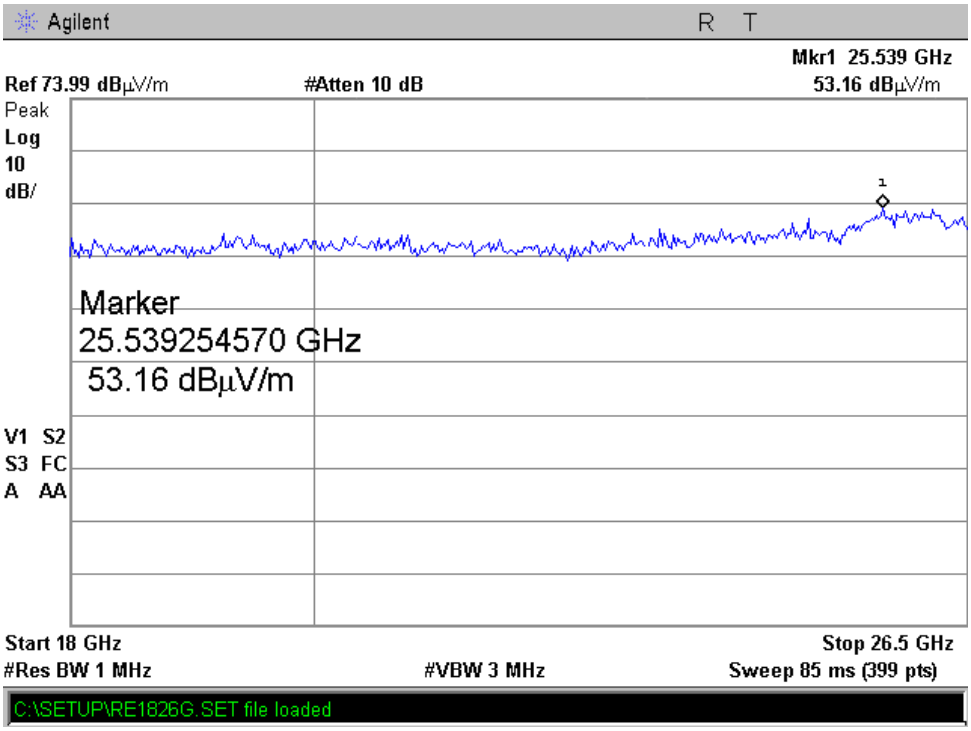
Horizontal & Vertical Polarization
Plot 4.5.50



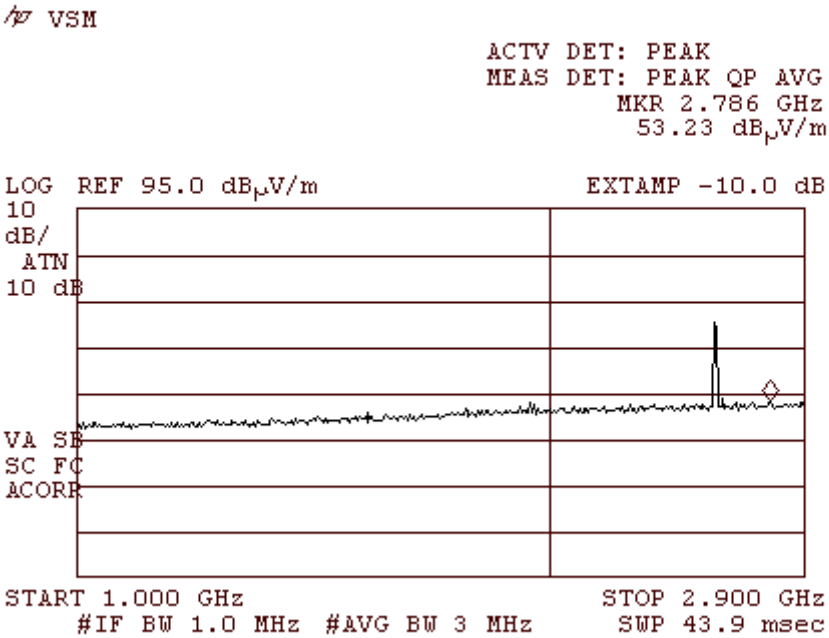
Horizontal & Vertical Polarization
Plot 4.5.51



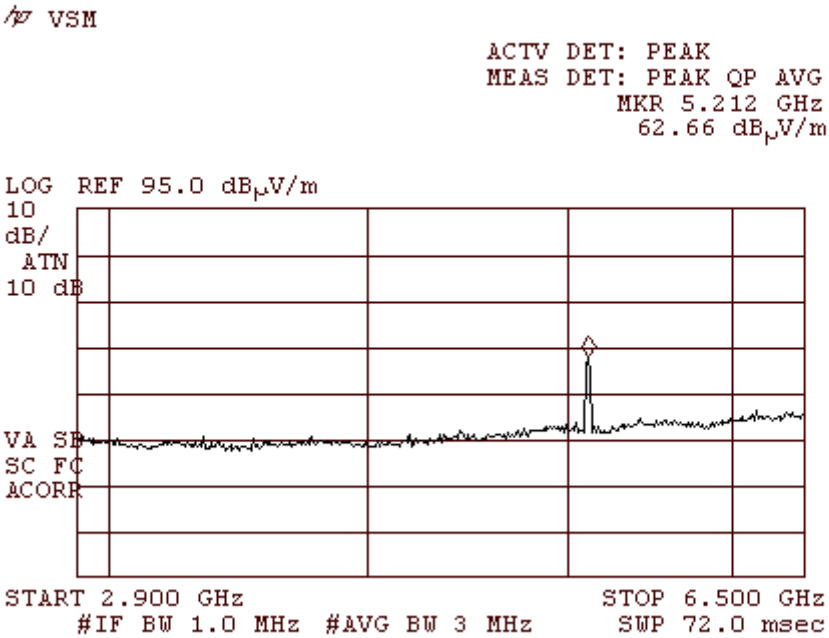
Horizontal & Vertical Polarization
Plot 4.5.52



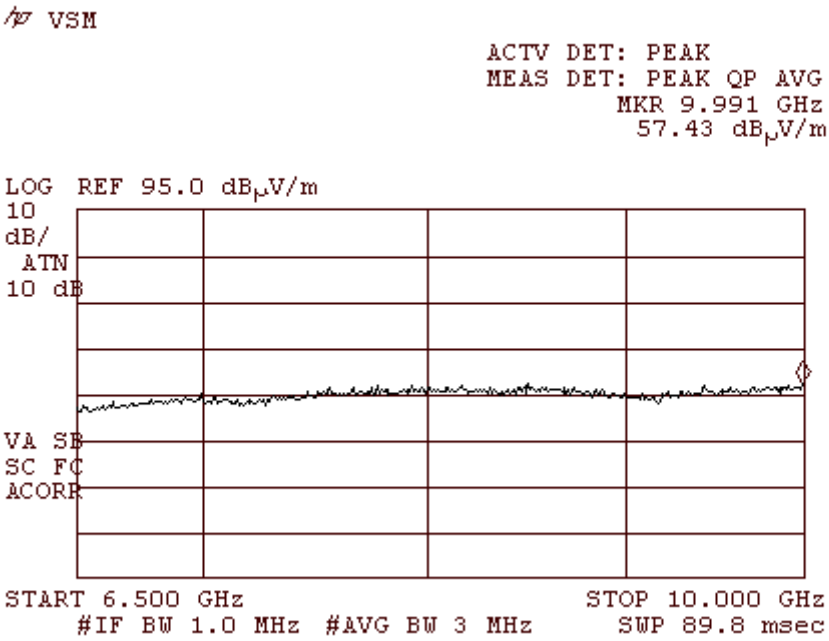
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 2
Middle Frequency 2600 MHz
Horizontal & Vertical Polarization
Plot 4.5.53



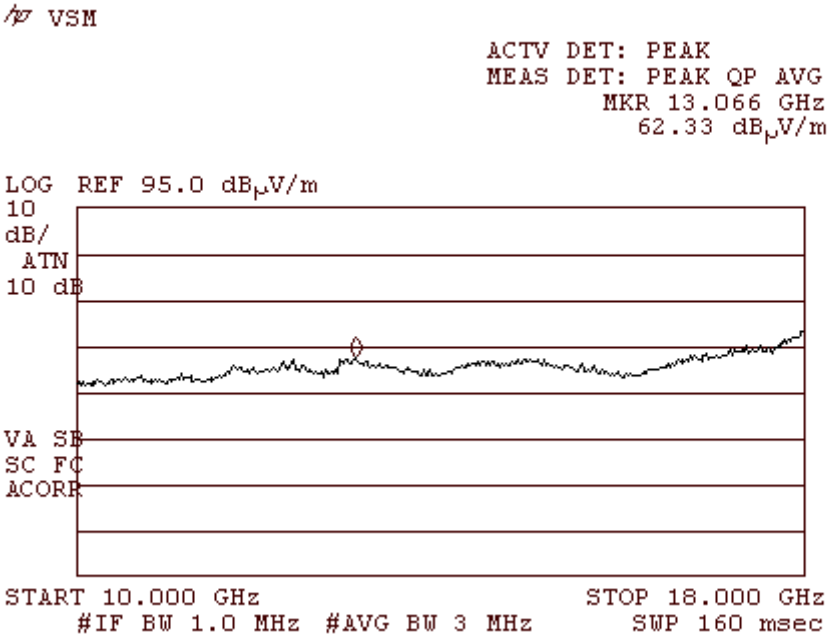
Horizontal & Vertical Polarization
Plot 4.5.54



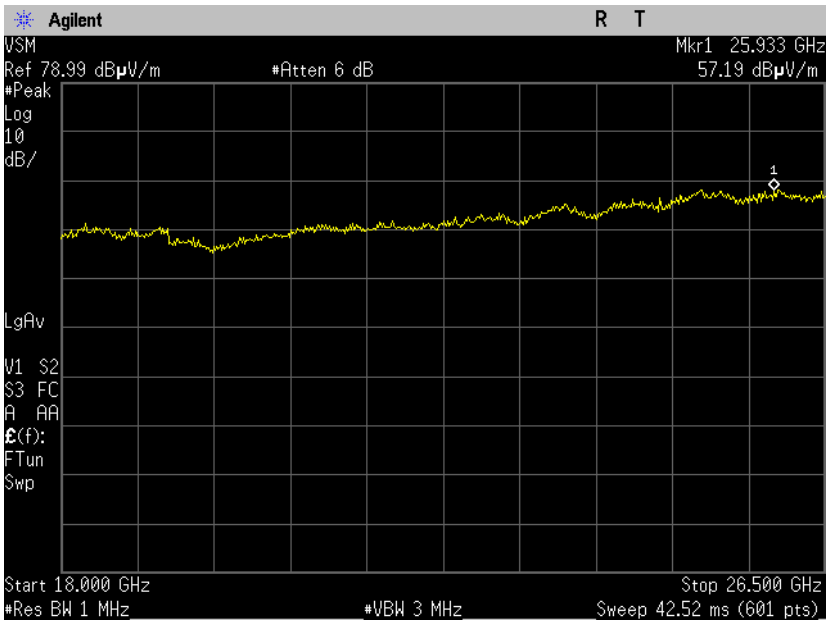
Horizontal & Vertical Polarization
Plot 4.5.55



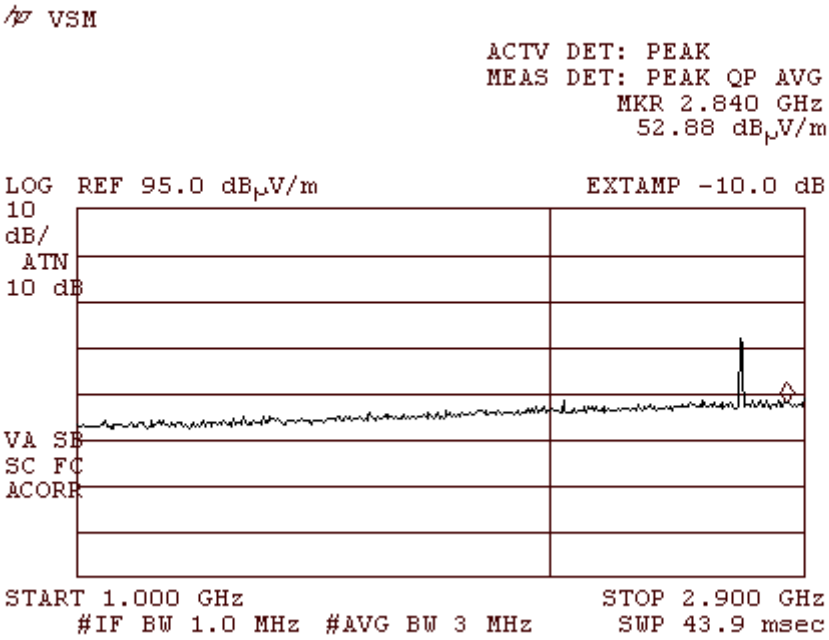
Horizontal & Vertical Polarization
Plot 4.5.56



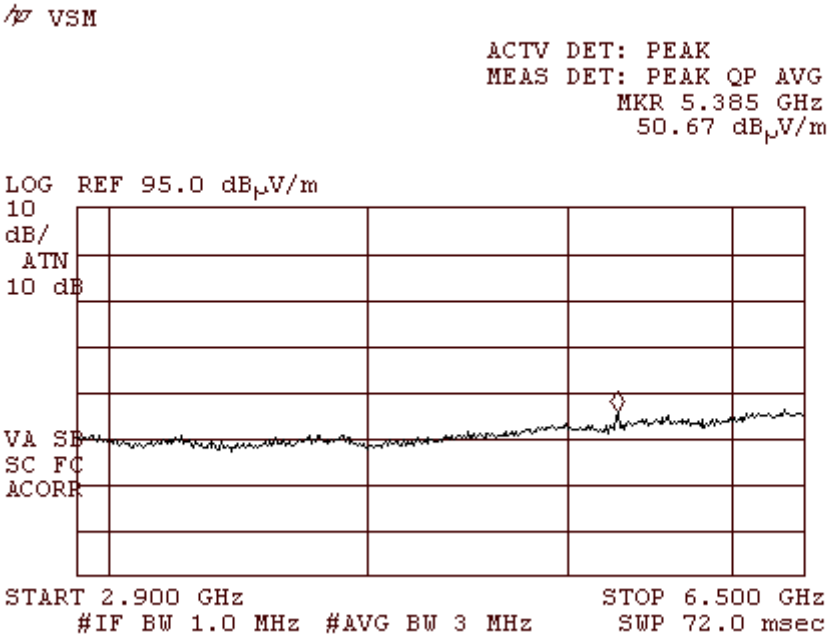
Horizontal & Vertical Polarization
Plot 4.5.57



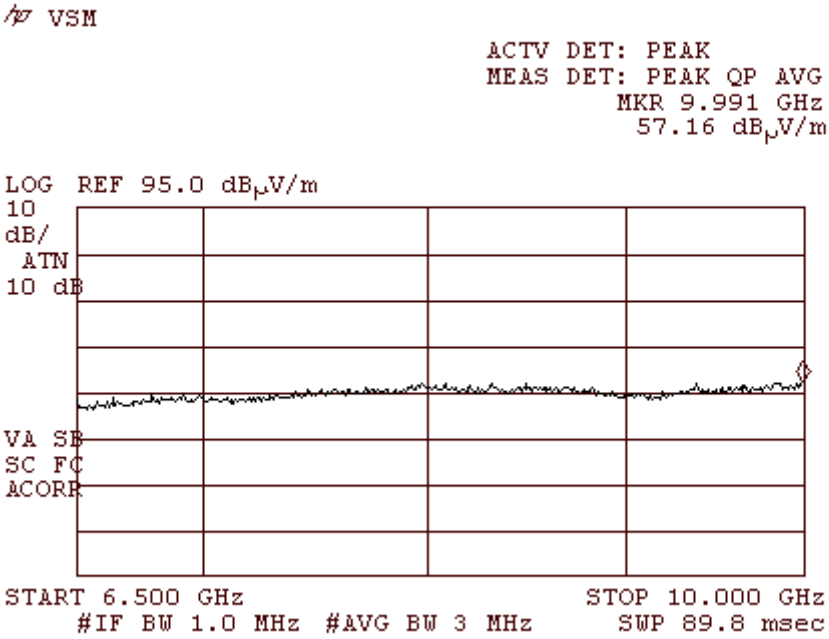
WiMAX 802.16e (10MHz), OFDMA, 16 QAM, Duty Cycle 27%
Output ANT 2
High Frequency 2685 MHz
Horizontal & Vertical Polarization
Plot 4.5.58



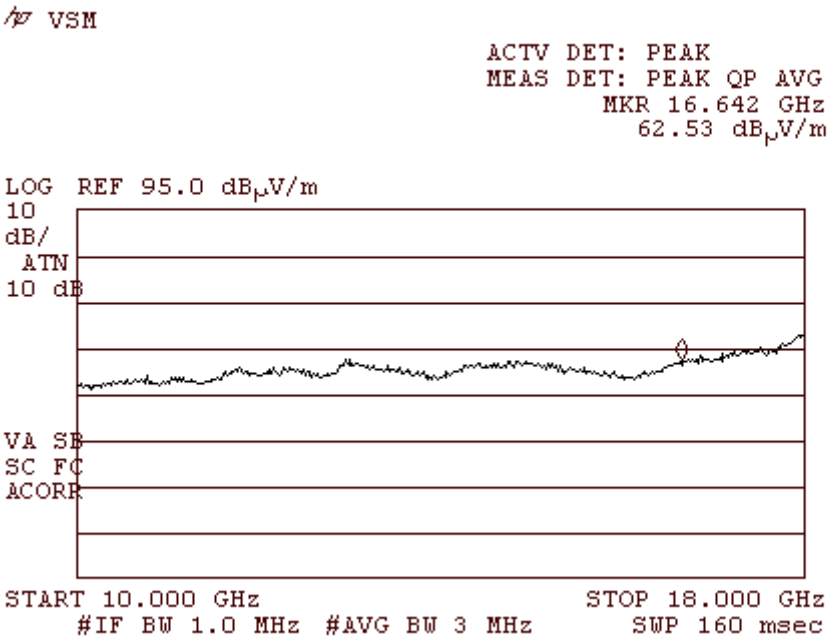
Horizontal & Vertical Polarization
Plot 4.5.59



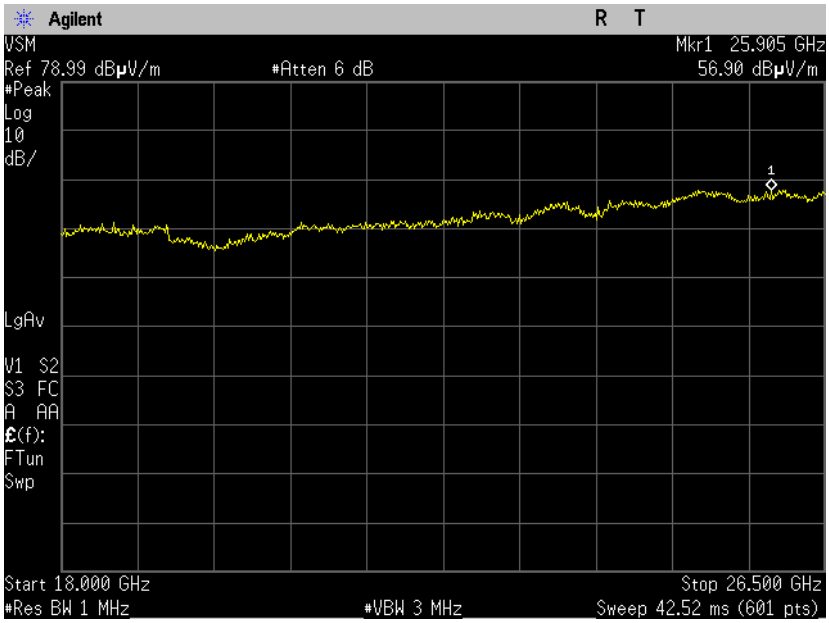
Horizontal & Vertical Polarization
Plot 4.5.60



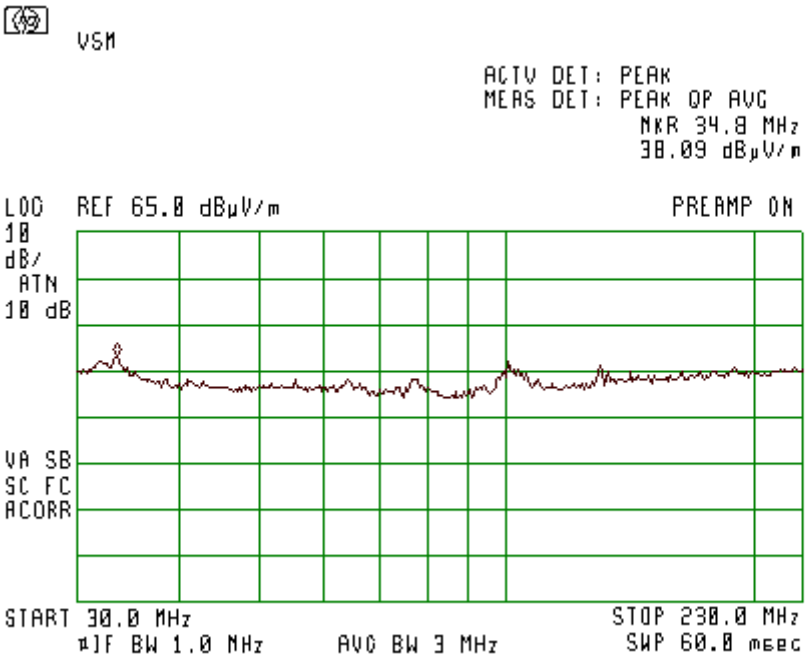
Horizontal & Vertical Polarization
Plot 4.5.61



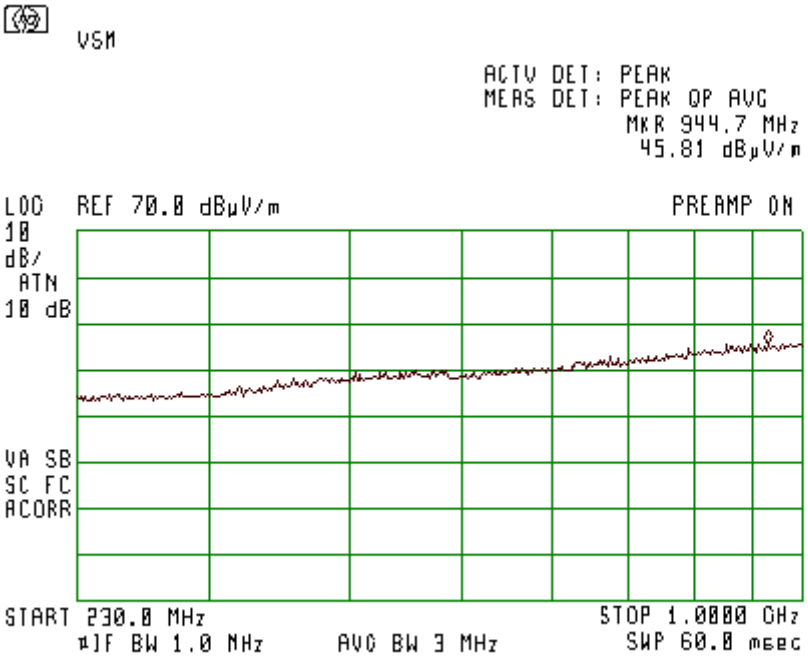
Horizontal & Vertical Polarization
Plot 4.5.62



Below 1 GHz
Worst case for all frequencies
Output ANT 2
Horizontal & Vertical Polarization
Plot 4.5.63



Horizontal & Vertical Polarization
Plot 4.5.64



4.6. Frequency stability

Reference document:	47 CFR §27.54 §2.1055		
Test Requirements:	The frequency stability shall be sufficient to ensure that the fundamental Emissions stay within the authorized bands of operation.		
Test setup:	See Sec. 3.3	**Pass**	
Method of testing:	Conducted		
Operating conditions:	Under normal & extreme test conditions		
Environment conditions:	Ambient Temperature: 22°c	Relative Humidity: 48.3%	Atmospheric Pressure: 1011.4 hPa
Test Result:	Maximum frequency deviation ~1 kHz, while the distance of the -26dB point of the lowest/highest carrier from the band edge >137 kHz**.**		

Test results:
Frequency Stability vs. Input Voltage:

Frequency Stability vs. Input Voltage								
Voltage [V]	Carrier frequency at 22°C (13.8 VDC): 2497.499283 MHz							
	Start up		2 minutes		5 minutes		10 minutes	
	Frequency Error [Hz]	Frequency Error [ppm]	Frequency Error [Hz]	Frequency Error [ppm]	Frequency Error [Hz]	Frequency Error [ppm]	Frequency Error [Hz]	Frequency Error [ppm]
11.7	9	0.003603605	9	0.003603605	9	0.003603605	0	0
13.8	0	0	0	0	17	0.006806809	17	0.006806809
15.9	-16	-0.006406408	-16	-0.006406408	-25	-0.010010013	-33	-0.013213217

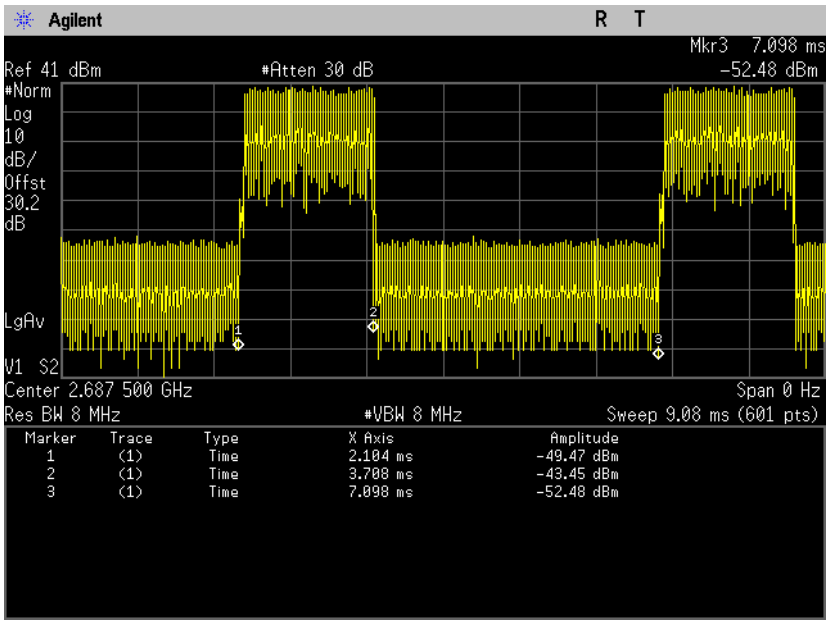
Frequency Stability vs. Temperature:

Frequency Stability vs. Temperature								
Temp. [°C]	Carrier frequency at 22°C (13.8 VDC): 2497.499420 MHz							
	Start up		2 minutes		5 minutes		10 minutes	
	Frequency Error [Hz]	Frequency Error [ppm]	Frequency Error [Hz]	Frequency Error [ppm]	Frequency Error [Hz]	Frequency Error [ppm]	Frequency Error [Hz]	Frequency Error [ppm]
-30	-1045	-0.418418516	-1041	-0.416816914	-1036	-0.414814911	-1011	-0.404804899
-20	-870	-0.348348429	-853	-0.341541621	-786	-0.314714788	-695	-0.278278343
-10	-345	-0.13813817	-336	-0.134534566	-295	-0.118118146	-245	-0.098098121
0	-161	-0.064464479	-145	-0.058058072	-111	-0.044444455	-70	-0.028028035
10	88	0.035235243	97	0.038838848	113	0.045245256	147	0.058858873
20	163	0.06526528	172	0.068868885	163	0.06526528	138	0.055255268
30	55	0.022022027	47	0.018818823	30	0.012012015	-12	-0.004804806
40	-137	-0.054854868	-145	-0.058058072	-170	-0.068068084	-245	-0.098098121
50	-437	-0.174975016	-478	-0.191391436	-553	-0.221421473	-653	-0.261461522

5. Appendix

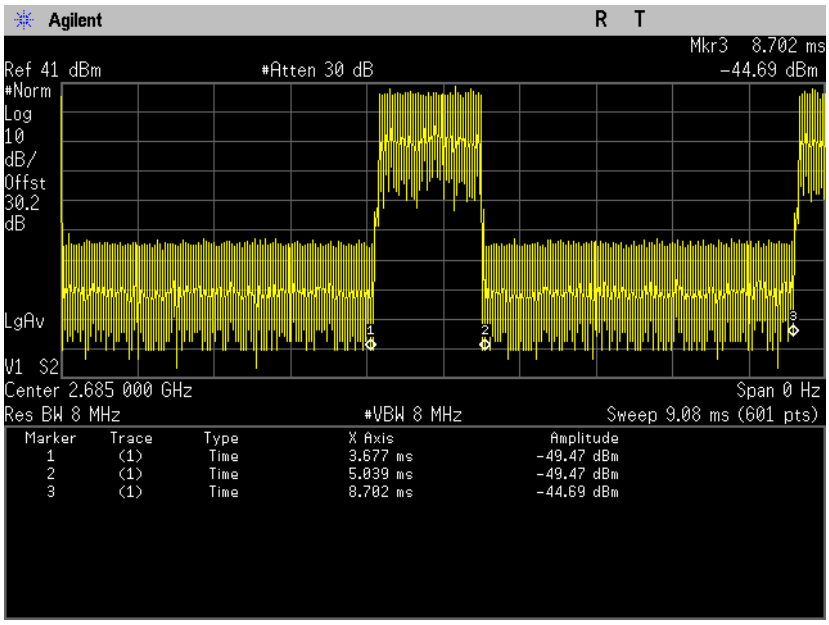
Appendix A: UL/DL Ratio for test

For reference (5MHz):



The ratio is approximately 32.1%

For reference (10MHz):



The ratio is approximately 27.1%

Appendix B: List of Measuring Equipment used:

Equipment	Manufacturer/ Model	Serial Number	Due date
CISPR16 EMI Receiver	HP8546A	3710A00392	30-06-10
Spectrum Analyzer 9kHz ÷ 22 GHz	HP 8593EM	3536A00131	30-06-10
Spectrum Analyzer 3 Hz ÷ 44 GHz	Agilent E4446A	MY46180602	30-06-10
Spectrum Analyzer 100 Hz ÷ 26.5 GHz	Agilent E7405A	US41160436	30-06-10
LNA Amplifier 1 GHz ÷ 18 GHz	MiTeq ,AMP – 5D-010180-30-10P-GW	618653	30-06-10
Power meter	Agilent N1911A	MY45100784	23-02-11
Dual Ridged Guide Ant.1-18 GHz	EMCO 3115	9602-4677	30-06-10
Antenna 18 GHz ÷ 26.5 GHz	Alpha Industry 861A/599	505	30-06-10
Turn table	HD100	100/693	-
Antenna Mast	HD 100	100/693	-
Biconical 20 –200 MHz	Schwarzbeck VHBB9124	9124/0255	16-05-11
Log-Periodic 200 – 1000 MHz	Schwarzbeck VUSLP9111	VUSLP9111184	16-05-11
LNA Amplifier 18 GHz ÷ 26.5 GHz	MiTeq, AMF-5F-18002650-30-10P	945372	30-06-10
LISN	Fischer 50/250-25-2	-	30-06-10
Transient Limiter	HP11947A	-	30-06-10
Notch Filter	Micro-Tronics BRM50702-05	0001	30-06-10

Appendix C: Accreditation Certificate

ilac-MRA

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited Laboratory

A2LA has accredited

QUALITECH (ECI TELECOM)

Petach-Tikva, Israel

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 27th day of May 2009.

President & CEO
For the Accreditation Council
Certificate Number 1633.01
Valid to September 30, 2010

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION CORPORATE SEAL 1978 DISTRICT OF COLUMBIA A2LA

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

End of the Test Report