Radio Test Report
FCC Part 27
(2496 MHz to 2690 MHz)
FCC Part 27

Intel® Centrino® Advanced-N + WiMAX 6250
Model 622ANXHMW

FCC ID(s):	PD9622ANXH, PD9622ANXHU and E2K625ANXH
COMPANY:	Intel Corporation 2111 NE 25th Avenue JF3-302 Hillsboro, OR 97124
TEST SITE(S):	Elliott Laboratories 684 W. Maude Avenue Sunnyvale, CA 94085
REPORT DATE:	September 17, 2009
FINAL TEST DATES:	September 9, September 10 and September 14, 2009

AUTHORIZED SIGNATORY:

Mark Briggs

Mark Briggs
Staff Engineer
Elliott Laboratories.

Testing Cert #2016.01

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	September 23, 2009	First release	

TABLE OF CONTENTS

SCOPE

Tests have been performed on the Intel Corporation Intel® Centrino® Advanced-N + WiMAX 6250 model 622ANXHMW, pursuant to the relevant requirements of the following standard(s) in order to obtain device certification against the regulatory requirements of the Federal Communications Commission and Industry Canada.

- Code of Federal Regulations (CFR) Title 47 Part 2
- CFR 47 Part 27

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in Elliott Laboratories test procedures:

ANSI C63.4:2003
ANSI TIA-603-C August 17, 2004

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the Intel Corporation Intel® Centrino® Advanced-N + WiMAX 6250 model 622ANXHMW and therefore apply only to the tested sample. The sample was selected and prepared by Steve Hackett of Intel Corporation.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, the device requires certification. Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested sample of Intel Corporation Intel® Centrino® Advanced-N + WiMAX 6250 model 622ANXHMW complied with the requirements of the standards and frequency bands declared in the scope of this test report.

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS

FCC Part 27 (2496 – 2690 MHz Mobile Digital Stations)

FCC	Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics				
§2.1033 (c) (5) §27.5 (i) (2)	Frequency range(s)	10MHz Channel: 2501-2685 MHz 5MHz Channel: 2498.5-2687.5 MHz	2495 – 2690 MHz	Pass
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 §27.50	RF power output at the antenna terminals	10MHz Channel: 0.229W 5MHz Channel: 0.269W	2 Watts 33 dBm	Pass
	EIRP	27.1 dBm	2 Watts 33 dBm	Pass
§2.1033 (c) (4) §2.1047 §27.53(m)(4) (6)	Emission types	BPSK, QPSK, 8PSK, 16QAM (OFDM)	-	-
	Emission mask Note 3	10MHz Channel: Complies 5MHz Channel: Complies	< 5.5MHz from channel edge -13dBm ≥ 5.5MHz from channel edge -25dBm	Pass
§2.1049 §27.53	99% Bandwidth Occupied Bandwidth	10MHz Channel: 9.2MHz 5 MHz Channel: 4.6 MHz	-	-
		10MHz Channel: 9.2MHz 5 MHz Channel: 4.6 MHz		
Transmitter spurious emissions (more than 5.5MHz from the band edge)				
§2.1051 §2.1053 §2.1057 §27.53(m)(4) (6)	At the antenna terminals	< -40 dBm	-25 dBm	
	Field strength	-35.2dBm erp at 7497.6 MHz	-25 dBm erp	
Receiver spurious emissions				
15.109	At the antenna terminals	Note 2	2nW / 100kHz (-57dBm)	N/A
15.109	Field strength		See limit table on page 16	N/A
Other details				
§2.1055 §27.54	Frequency stability	0.11 ppm	2.5 ppm Note 1	
§2.1093	RF Exposure	Refer to MPE calculation for 20cm separation from persons	-	Pass
§2.1033 (c) (8)	Final radio frequency amplifying circuit's dc voltages and currents for normal operation over the power range	3.3Vdc @ 600mA max	-	-
-	Antenna Gain	2.8dBi used to detemrine eirp	-	-

Notes

Note 1 – The requirement for frequency stability is that the signal remains within the allocated band. A limit of 2.5ppm is being used to ensure the signal remains within the allocated band as defined by the spurious limits at the channel edges.

Note 2 – As the frequency of operation is above 960 MHz there are no technical requirements for spurious emissions from the receiver.

Note 3 – The measurement at the channel edge is made in a reference bandwidth of at least 1% the emission bandwidth is used. For measurements more than 1MHz from the edge of the channel the measurement bandwidth is 1MHz. The adjacent channel power feature of the spectrum analyzer is used to integrate the power over the required measurement bandwidth(s).

EXTREME CONDITIONS

Frequency stability is determined over extremes of temperature and voltage. The extremes of voltage were 85 to 115 percent of the nominal value of 3.3Vdc.

The extremes of temperature were -30°C to +50°C as specified in FCC §2.1055(a)(1).

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2) and were calculated in accordance with NAMAS document NIS 81 and M3003.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF frequency	Hz	25 to 7,000 MHz	1.7×10^{-7}
RF power, conducted	dBm	25 to 7,000 MHz	± 0.52 dB
Conducted emission of transmitter	dBm	25 to 40,000 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 40,000 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 40,000 MHz	± 2.5 dB
Radiated emission (field strength)	dBµV/m	25 to 1,000 MHz 1 to 40 GHz	± 3.6 dB ± 6.0 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Intel Corporation Intel® Centrino® Advanced-N + WiMAX 6250 model 622ANXHMW is a PCI express form factor (half-mini) card that is designed to provide a 2x2 802.11abgn and 1x2 802.16e interfaces for host systems such as laptop PCs. The electrical rating of the EUT is 3.3Vdc (via mini PCI bus).

For module-level tests of the transceiver the card was installed into a test fixture that was controlled from a laptop PC. The test fixture exposed the card outside of a host system to meet the modular test requirements of FCC and Industry Canada.

The evaluation assumes the use of an antenna with a maximum gain of

The sample was received on August 3, 2009 and tested on September 9, September 10 and September 14, 2009. The EUT consisted of the following component(s):

Company	Model	Description	MAC Address	FCC ID
Intel Corporation	622ANXHMW	802.11abgn 2x2 and WiMax 1x2 PCIe HMC card	00150059F2BE	PD9622ANXH PD9622ANXHU E2K625ANXH

ENCLOSURE

The EUT has no enclosure. It is designed to be installed within the enclosure of a host computer.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at Elliott.

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
Intel	None	PCIe test fixture		N/A
Dell	-	Laptop PC	Prototype	None
Topward	-	DC Supply		N/A

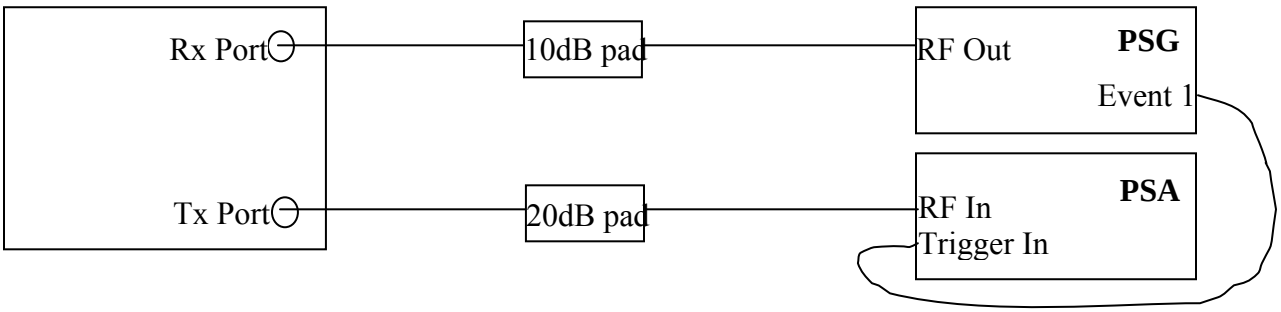
EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded / Unshielded	Length(m)
Test fixture PCI	Laptop PCI	Ribbon Cable	Unshielded	0.8
Test fixture 3.3Vdc	Bench supply	2-wire	Unshielded	0.8

EUT OPERATION

During transmitter tests the EUT was being controlled by the Intel VATU tool and an external signal generator (PSG shown below) to operate in a transmit mode on the top, bottom or center channel as required. The signal generator was programmed to transmit a test vector pattern that was sent to the second receive port on the EUT. This test vector triggered a response from the EUT, at a data arte and modulation determined by the specific test vector. The signal generator also provided a gate signal for the spectrum analyzer (PSA below) via the event output. This gating signal was used to ensure that the spectrum analyzer would sweep only when the EUT was transmitting.



Nominal channel bandwidths of 5MHz and 10MHz were evaluated. In each bandwidth mode the output power and spectral mask in QPSK (test vector file DQ64_xx_UQ4_xx_xxx_BW) and QAM16 (test vector file DQ4_xx_UQ16_xx_BW) modulations were measured.

Conducted and radiated spurious emissions were evaluated in each bandwidth mode using the modulation that produced the highest output power (QAM16 for the 5MHz channel and QPSK for the 10MHz channel). Radiated measurements were made with the transmit port of the EUT terminated into 50-ohms. Gating was not sued for the radiated and conducted spurious measurements, rather the spectrum analyzer was set for a peak detector and used in a maximum hold mode to ensure all emissions were captured.

TESTING

GENERAL INFORMATION

Antenna port measurements were taken at the Elliott Laboratories test site located at 684 West Maude Ave, Sunnyvale, CA 94085-3518. Radiated spurious emissions measurements were taken at the Elliott Laboratories Anechoic Chambers and/or Open Area Test Site(s) listed below. The sites conform to the requirements of ANSI C63.4: 2003 *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz* and CISPR 16-1-4:2007 - *Specification for radio disturbance and immunity measuring apparatus and methods Part 1-4: Radio disturbance and immunity measuring apparatus Ancillary equipment Radiated disturbances*. They are on file with the FCC and industry Canada.

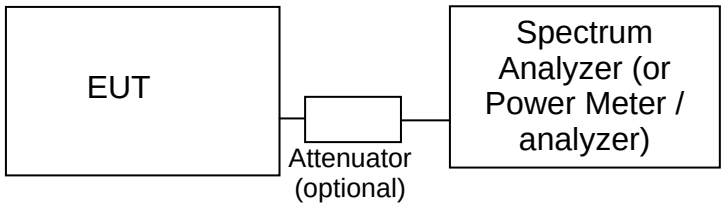
Site	Registration Numbers		Location
	FCC	Canada	
SVOATS #2	90593	IC 2845A-2	684 West Maude Ave, Sunnyvale CA 94085-3518

In the case of Open Area Test Sites, ambient levels are at least 6 dB below the specification limits with the exception of predictable local TV, radio, and mobile communications traffic.

Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements.

RF PORT MEASUREMENT PROCEDURES

Conducted measurements are performed with the EUT's rf input/output connected to the input of a spectrum analyzer, power meter or modulation analyzer. When required an attenuator, filter and/or dc block is placed between the EUT and the spectrum analyzer to avoid overloading the front end of the measurement device. Measurements are corrected for the insertion loss of the attenuators and cables inserted between the rf port of the EUT and the measurement equipment.



Test Configuration for Antenna Port Measurements

For devices with an integral antenna the output power and spurious emissions are measured as a field strength at a test distance of (typically) 3m and then converted to an eirp using a substitution measurement (refer to RADIATED EMISSIONS MEASUREMENTS). All other measurements are made as detailed below but with the test equipment connected to a measurement antenna directed at the EUT.

OUTPUT POWER

Output power is measured using a power meter and an average sensor head, a spectrum analyzer or a power meter and peak power sensor head as required by the relevant rule part(s). Where necessary measurements are gated to ensure power is only measured over periods that the device is transmitting.

Power measurements made directly on the rf power port are, when appropriate, converted to an EIRP by adding the gain of the highest gain antenna that can be used with the device under test, as specified by the manufacturer.

BANDWIDTH MEASUREMENTS

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS GEN. The measurement bandwidth is set to be at least 1% of the instrument's frequency span.

CONDUCTED SPURIOUS EMISSIONS

Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode measurements). Where the limits are expressed as an average power the spectrum analyzer is tunes to that frequency with a narrow span (wide enough to capture the emission and its sidebands) and the resolution and video bandwidths are adjusted as required by the reference measurement standards. For transmitter measurements the appropriate detector (average, peak, normal ,sample, quasi-peak) is used when making measurements for licensed devices. For receiver conducted spurious measurements the detector is set to peak.

TRANSMITTER MASK MEASUREMENTS

The transmitter mask measurements are made using resolution bandwidths as specified in the pertinent rule part(s). Where narrower bandwidths are used the measurement is corrected to account for the reduced bandwidth by either using the adjacent channel power function of the spectrum analyzer to sum the power across the required measurement bandwidth. The frequency span of the analyzer is set to ensure the fundamental signal and all significant sidebands are displayed.

The top of the mask may be set by the total output power of the signal, the power of the unmodulated signal or the peak value of the signal in the reference bandwidth being used for the mask measurement.

FREQUENCY STABILITY

The EUT is placed inside a temperature chamber with all support and test equipment located outside of the chamber. The temperature is varied across the specified frequency range in 10 degree increments with frequency measurements made at each temperature step. The EUT is allowed enough time to stabilize at each temperature variation.

The spectrum analyzer is configured to give a 5- or 6-digit display for the marker-frequency function. The spectrum analyzer's built-in frequency counter is used to measure the maximum deviation of the fundamental frequency at each temperature. Where possible the device is set to transmit an unmodulated signal. Where this is not

possible the frequency drift is determined by finding a stable point on the signal (e.g. the null at the centre of an OFDM signal) or by calculating a centre frequency based on the XdB points on the signal skirts, where X is typically 10dB.

RADIATED EMISSIONS MEASUREMENTS

Receiver radiated spurious emissions measurements are made in accordance with ANSI ANSI C63.4:2003 by measuring the field strength of the emissions from the device at a specific test distance and comparing them to a field strength limit. Where the field strength limit is specified at a longer distance than the measurement distance the measurement is extrapolated to the limit distance.

Transmitter radiated spurious emissions are initially measured as a field strength. The eirp or erp limit as specified in the relevant rule part(s) is converted to a field strength at the test distance and the emissions from the EUT are then compared to that limit. Emissions within 20dB of this limit are the subjected to a substitution measurement.

All radiated emissions measurements are performed in two phases. A preliminary scan of emissions is conducted in either an anechoic chamber or on an OATS during which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed across the complete frequency range of interest and at each operating frequency identified in the reference standard. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode).

During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit. For transmitter spurious emissions, where the limit is expressed as an effective radiated power, the eirp or erp is converted to a field strength limit.

Final measurements are made on an OATS or in a semi-anechoic chamber at the significant frequencies observed during the preliminary scan(s) using the same process of rotating the EUT and raising/lowering the measurement antenna to find the highest level of the emission. The field strength is recorded and, for receiver spurious emissions, compared to the field strength limit. For the final measurement the appropriate detectors (average, peak, normal, sample, quasi-peak) are used. For receiver measurements below 1GHz the detector is a Quasi-Peak detector, above 1GHz a peak detector is used and the peak value (RB=VB=1MHz) and average value (RB=1MHz, VB=10Hz) are recorded.

For transmitter spurious emissions, the radiated power of all emissions within 20dB of the calculated field strength limit are determined using a substitution measurement. The substitution measurement is made by replacing the EUT with an antenna of known gain (typically a dipole antenna or a double-ridged horn antenna), connected to a signal source. The output power of the signal generator is adjusted until the maximum field strength from the substitution antenna is similar to the field strength recorded from the EUT. The erp of the EUT is then calculated.

INSTRUMENTATION

An EMI receiver as specified in CISPR 16-1-1 is used for radiated emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 7000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary.

For measurements above the frequency range of the receivers and for all conducted measurements a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis.

Measurement bandwidths for the test instruments are set in accordance with the requirements of the standards referenced in this document.

Software control is used to correct the measurements for transducer factors (e.g. antenna) and the insertion loss of cables, attenuators and other series elements to obtain the final measurement value. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are exported in a graphic and/or tabular format, as appropriate.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the EUT antenna port or receiving antenna and the test receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A combination of biconical, log periodic or bi-log antennas are used to cover the range from 30 MHz to 1000 MHz. Broadband antennas or tuned dipole antennas are used over the entire 25 to 1000 MHz frequency range as the reference antenna for substitution measurements. Above 1000 MHz, a dual-ridge guide horn antenna or octave horn antenna are used as reference and measurement antennas.

The antenna calibration factors are included in site factors that are programmed into the test receivers and instrument control software when measuring the radiated field strength.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

Table mounted devices are placed on a non-conductive table at a height of 80 centimeters above the floor. Floor mounted equipment is placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. The EUT is positioned on a motorized turntable to allow it to be rotated during testing to determine the angel with the highest level of emissions.

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS - CONDUCTED SPURIOUS EMISSIONS

Measurements are compared directly to the conducted emissions specification limit (decibel form). The calculation is as follows:

$$R_r - S = M$$

where:

R_r = Measured value in dBm
S = Specification Limit in dBm
M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH

Measurements of radiated field strength are compared directly to the specification limit (decibel form). The receiver and/or control software corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor is sued when measurements are made at a test distance that is different to the specified limit distance by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB
D_m = Measurement Distance in meters
D_s = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40*LOG_{10} (D_m/D_s)$$

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_S = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

SAMPLE CALCULATIONS –RADIATED POWER

The erp/eirp limits for transmitter spurious measurements are converted to a field strength in free space using the following formula:

$$E = \frac{\sqrt{30\ P\ G}}{d}$$

where:

E = Field Strength in V/m
P = Power in Watts
G = Gain of isotropic antenna (numeric gain) = 1
D = measurement distance in meters

The field strength limit is then converted to decibel form (dBuV/m) and the margin of a given emission peak relative to the limit is calculated (refer to *SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH*).

When substitution measurements are required (all signals with less than 20dB of margin relative to the calculated field strength limit) the eirp of the spurious emission is calculated using:

$$P_{EUT} = P_S - (E_S - E_{EUT})$$

and

$$P_S = G + P_{in}$$

where:

P_S = effective isotropic radiated power of the substitution antenna (dBm)
P_{in} = power input to the substitution antenna (dBm)
G = gain of the substitution antenna (dBi)
E_S = field strength the substitution antenna (dBm) at eirp P_S
E_{EUT} = field strength measured from the EUT

Where necessary the effective isotropic radiated power is converted to effective radiated power by subtracting the gain of a dipole (2.2dBi) from the eirp value.

RECEIVER RADIATED SPURIOUS EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from receivers as detailed in FCC Part 15.109, RSS 210 Table 2, RSS GEN Table 1 and RSS 310 Table 3. Note that receivers operating outside of the frequency range 30 MHz – 960 MHz are exempt from the requirements of 15.109.

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

Appendix A Test Equipment Calibration Data

Radio Antenna Port (Power and Spurious Emissions), 09-Sep-09
Engineer: Mehran Birgani

Manufacturer	Description	Model #	Asset #	Cal Due
Agilent	PSG Vector Signal Generator (250kHz - 20GHz)	E8267C	1877	15-Feb-10
Agilent	PSA, Spectrum Analyzer	E4446A	2139	30-Dec-09

Radiated Emissions, 30 - 27,000 MHz, 10-Sep-09
Engineer: Mehran Birgani

Manufacturer	Description	Model #	Asset #	Cal Due
EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	23-Dec-09
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	18-Sep-10
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	12-Mar-10
EMCO	Biconical Antenna, 30-300 MHz	3110B	1497	15-Sep-10
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	10-Jun-10
Hewlett Packard	Preamplifier, 100 kHz - 1.3 GHz	8447D OPT 010	1826	26-May-10
A.H. Systems	Red System Horn, 18-40GHz	SAS-574, p/n: 2581	2161	17-Mar-10

Radiated Emissions, 30 - 27,000 MHz, 11-Sep-09
Engineer: Mehran Birgani

Manufacturer	Description	Model #	Asset #	Cal Due
Elliott Laboratories	Biconical Antenna, 30-300 MHz	EL30.300	54	03-Apr-11
EMCO	Antenna, Horn, 1-18 GHz	3115	487	15-Jul-10
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	18-Sep-10
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	12-Mar-10
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	14-Apr-10
EMCO	Antenna, Horn, 1-18 GHz	3117	1662	11-Apr-10

Frequency Stability, 14-Sep-09
Engineer: Mehran Birgani

Manufacturer	Description	Model #	Asset #	Cal Due
Agilent	PSA, Spectrum Analyzer,	E4446A	2139	30-Dec-09
Thermotron	Temp Chamber (w/ F4 Watlow Controller)	S1.2	2170	29-Jun-10

Appendix B Test Data

T76609 19 Pages

Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		Mark Briggs
Emissions Standard(s):	FCC Part 27	Class:	-
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Intel Corporation

Model

Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card

Date of Last Test: 9/17/2009

Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

FCC Part 27

Power, Occupied Bandwidth, Frequency Stability and Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform engineering evaluation testing of the EUT with respect to the specification listed above.

General Test Configuration

With the exception of the radiated spurious emissions tests, all measurements are made with the EUT's rf port connected to the measurement instrument via an attenuator or dc-block if necessary. All amplitude measurements are adjusted to account for the attenuation between EUT and measuring instrument. For frequency stability measurements the EUT was placed inside an environmental chamber.

Radiated measurements are made with the EUT located on a non-conductive table, 3m from the measurement antenna.

Ambient Conditions:

Temperature: 22-26 °C

Rel. Humidity: 33-39 %

Summary of Results

Sample #1: WFM: 00150059F2BE; VATU Tool Version 5.0.01

Run #	BW	Data Rate	Test Performed	Limit	Pass / Fail	Result / Margin
1	10M	DQ64	Output Power	2W eirp for mobile	Pass	23.6 dBm (0.229W)
1	5M	DQ4	Output Power	2W for user stations	Pass	24.3 dBm (0.269W)
2	10M	-	Spectral Mask	5.05MHz from Fc= -13.0 6.5MHz from Fc= -13.0 11.0MHz from Fc= -25.0	Pass	-23.4 dBm -17.9 dBm -25.0 dBm
2	5M	-	Spectral Mask	2.525MHz from Fc= -13.0 4.0MHz from Fc= -13.0 8.5MHz from Fc= -25.0	Pass	-19.2 dBm -13.0 dBm -30.7 dBm
3	10M	-	99% Occupied Bandwidth	-	-	9.2 MHz
3	5M	-	99% Occupied Bandwidth	-	-	4.6 MHz
4	10M		Spurious Emissions (conducted)	FCC Part 27.53	Pass	> 15dB below the limit
4	5M		Spurious Emissions (conducted)	FCC Part 27.53	Pass	> 15dB below the limit
5	10M		Spurious emissions (radiated)	FCC Part 27.53	Pass	-35.2 dBm (erp) @ 7497.63MHz (-10.2dB margin)
5	5M		Spurious emissions (radiated)	FCC Part 27.53	Pass	
6	-	-	Frequency Stability	2.5ppm	Pass	0.11ppm

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

Run #1: Output Power and Mask

Date: 9/9/2009 Engineer: Mehran Birgani Location: Radio Lab Losses (Cable& Atten): 21.0 dBm

Signal bandwidth: 10 MHz Target power = 23 dBm

Attenuation Setting[2]	Frequency (MHz)	Output Power		Mask (Amplitude and limit at each step) dBm					
				Ref BW = 100 kHz		Ref BW = 1 MHz		Ref BW = 1 MHz	
		(dBm) [1]	mW	5.05MHz from Fc		6.5MHz from Fc		11MHz from Fc	
DQ4_12_UQ16_34_10M									
21.75	2501.0	23.4	218.8	-23.6	-13.0	-18.4	-13.0	-25.8	-25.0
21.25	2593.0	23.5	221.3	-23.4	-13.0	-17.9	-13.0	-25.5	-25.0
20.00	2685.0	23.4	218.8	-23.6	-13.0	-17.9	-13.0	-25.0	-25.0
DQ64_UQ4_12_21s_10M									
20.75	2501.0	23.6	229.1	-23.6	-13.0	-17.4	-13.0	-25.3	-25.0
19.75	2593.0	23.6	229.1	-23.4	-13.0	-17.0	-13.0	-25.0	-25.0
18.50	2685.0	23.5	223.9	-23.9	-13.0	-17.5	-13.0	-25.0	-25.0

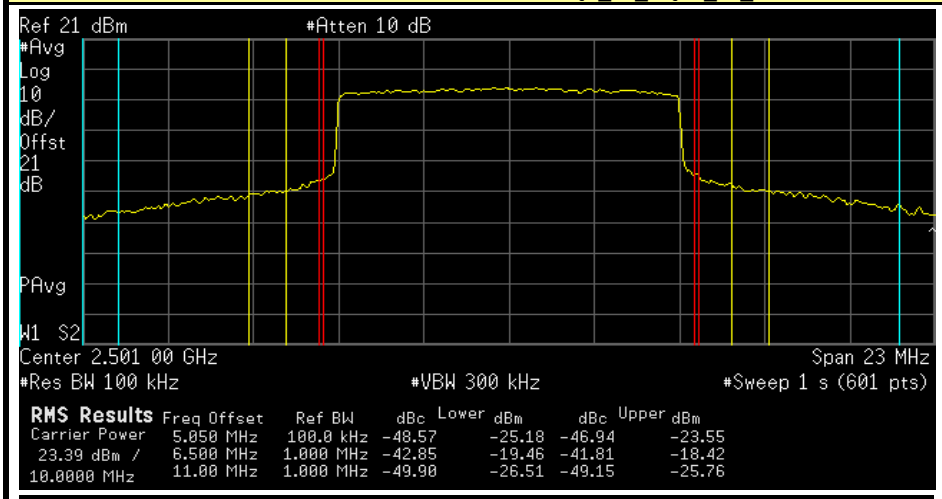
Signal bandwidth: 5 MHz Target power = 23 dBm

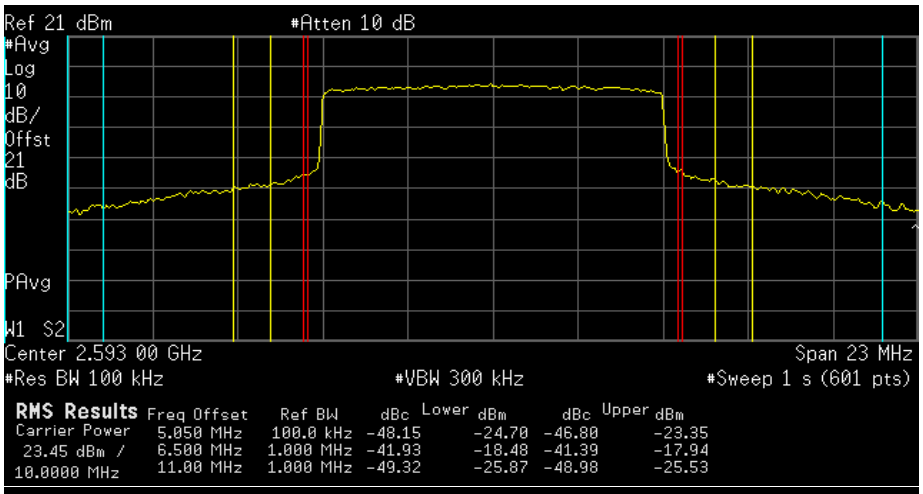
Attenuation Setting[2]	Frequency (MHz)	Output Power		Mask (Amplitude and limit at each step) dBm					
				Ref BW = 50 kHz		Ref BW = 1 MHz		Ref BW = 1 MHz	
		(dBm) [1]	mW	2.525MHz from Fc		4MHz from Fc		8.5MHz from Fc	
DQ4_12_UQ16_34_5M									
19.75	2498.5	24.3	269.2	-20.1	-13.0	-13.0	-13.0	-31.7	-25.0
19.25	2593.0	24.2	263.0	-20.2	-13.0	-13.1	-13.0	-31.9	-25.0
17.75	2687.5	24.3	269.2	-20.4	-13.0	-13.0	-13.0	-30.7	-25.0
DQ64_56_UQ4_12_5M									
19.75	2498.5	24.3	269.2	-19.3	-13.0	-13.0	-13.0	-31.8	-25.0
19.25	2593.0	24.2	263.0	-19.2	-13.0	-13.0	-13.0	-31.9	-25.0
17.75	2687.5	24.2	263.0	-19.4	-13.0	-13.0	-13.0	-30.8	-25.0

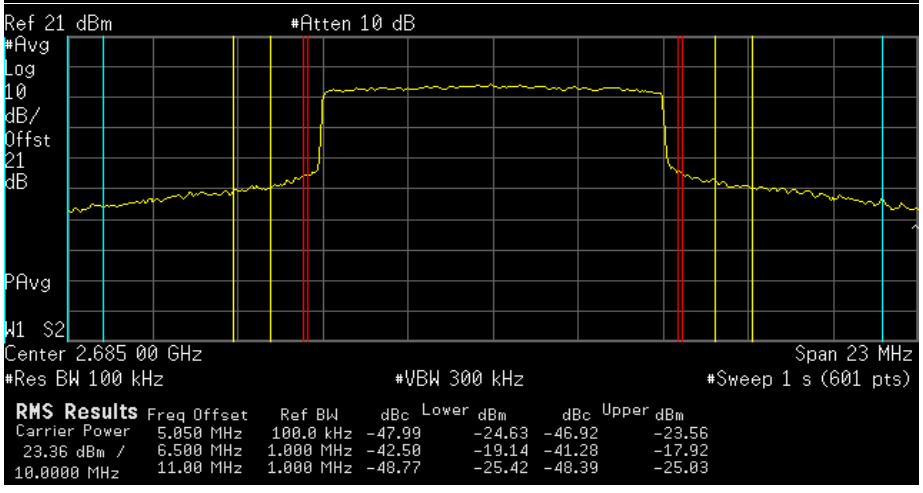
Note 1:	Output power measured using a spectrum analyzer (see plots below) with RB > 1% of the emission bandwidth and VB at least 3xRB (for 5Mhz channels RB=51kHz, VB = 300kHz and for 10MHz channels RB=100kHz, VB=300kHz). A RMS Average detector was used. The analyzer was gated to ensure it only swept when the EUT was transmitting to ensure the measurement and mask measurements are not including period where the EUT is not transmitting at full power.
Note 2:	Power setting - the software power setting used during testing, included for reference only.
Note 3:	Mask measurements are made at the transition points in the mask (channel edge, channel edge + 1 MHz and channel edge + 5.5 MHz). The analyzer is configured to make the measurements at a frequency offset by 1/2 of the reference bandwidth from the transition point and integrate the power across the reference bandwidth around that frequency (so that the total power across the reference bandwidth immediately adjacent to the transition point is measured)
Note 4:	The limit is taken from FCC Part 27.53 (l)(4) for mobile digital stations. The attenuation factor shall be not less than 43 + 10 log (P) dB at the channel edge and 55 + 10 log (P) dB at 5.5 MHz from the channel edges. The measurement bandiwdth required is 1MHz, except for the 1 MHz bands immediately outside and adjacent to the frequency block where the measurement bandwidth shall be at least one percent of the emission bandwidth. The rule part also allows for a narrower resolution bandwidth provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified).

Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

DQ4_12_UQ16_34_10M

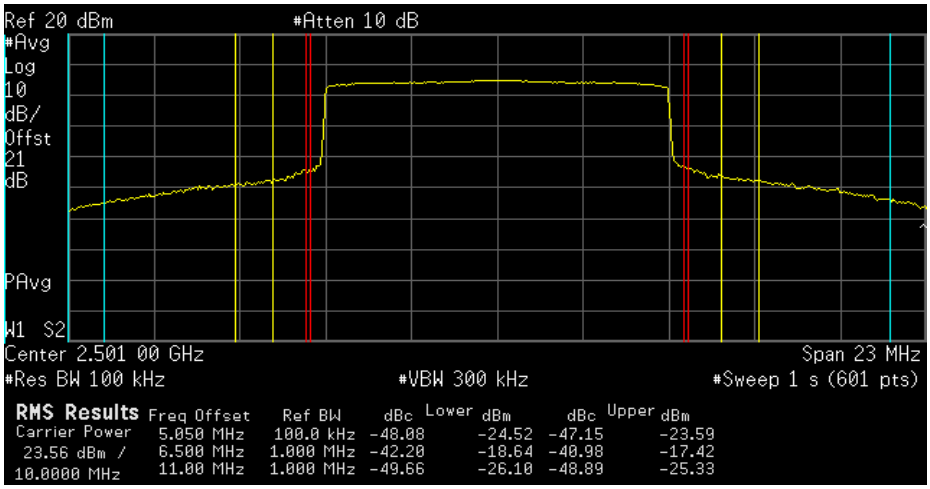


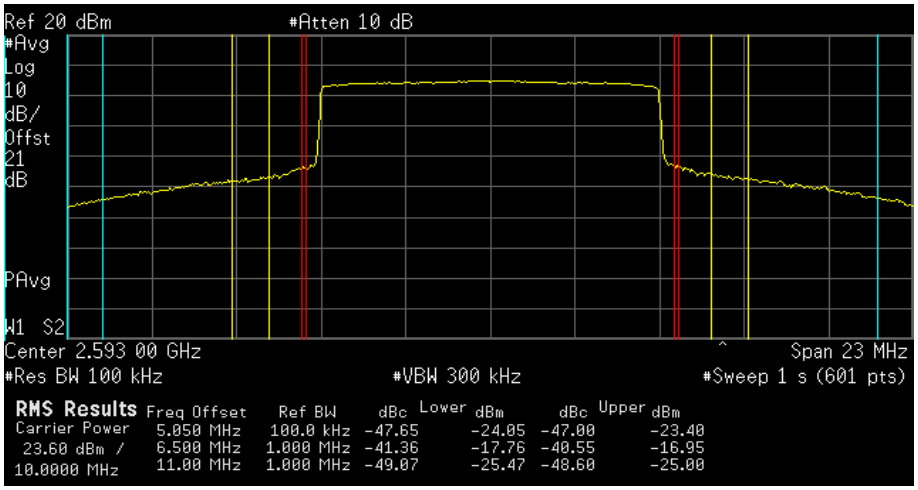


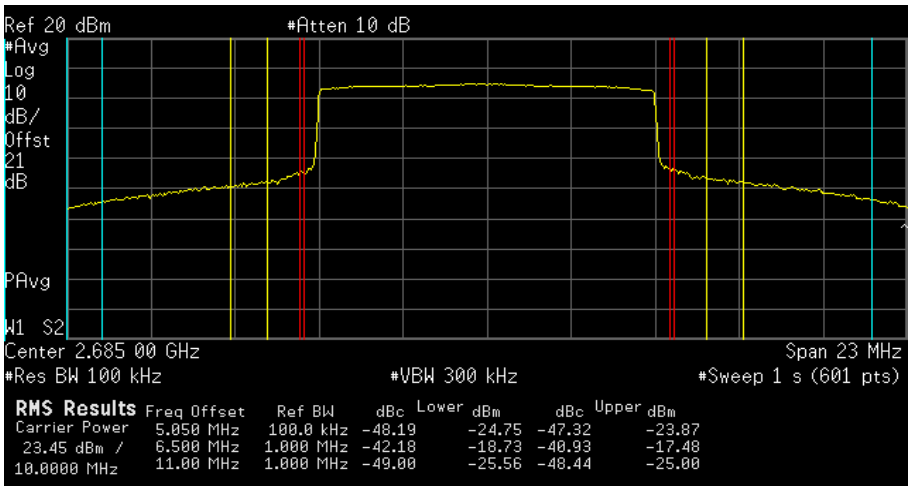


Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

DQ64_UQ4_12_21s_10M







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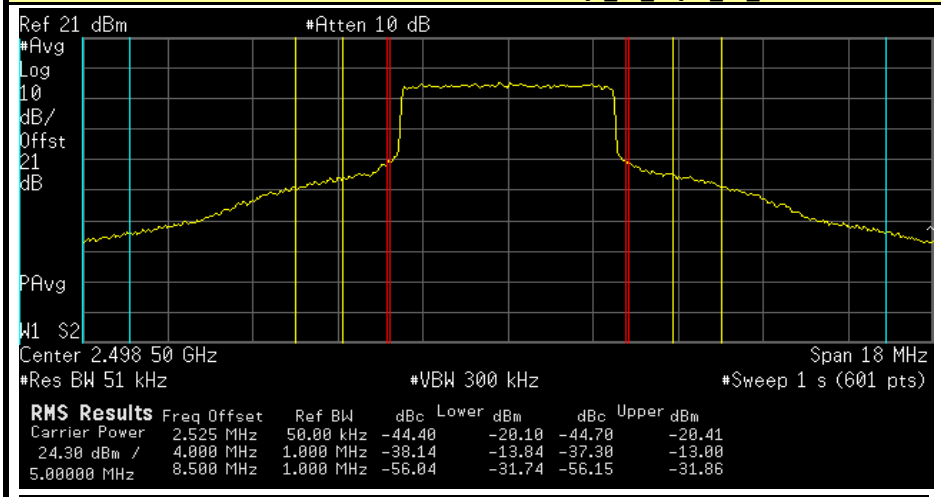
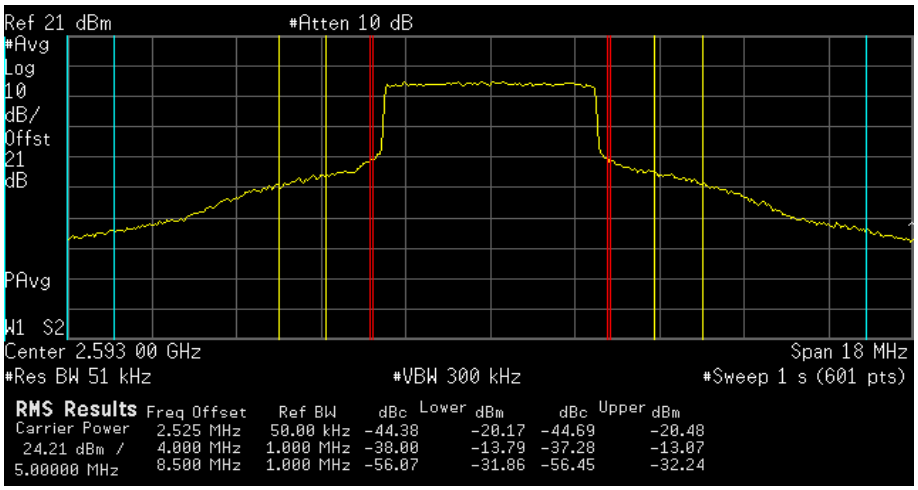
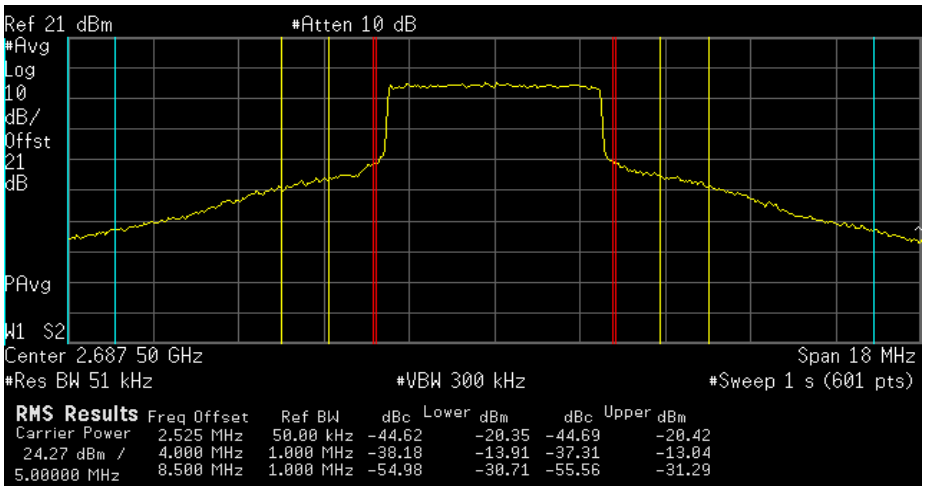
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

DQ4_12_UQ16_34_5M

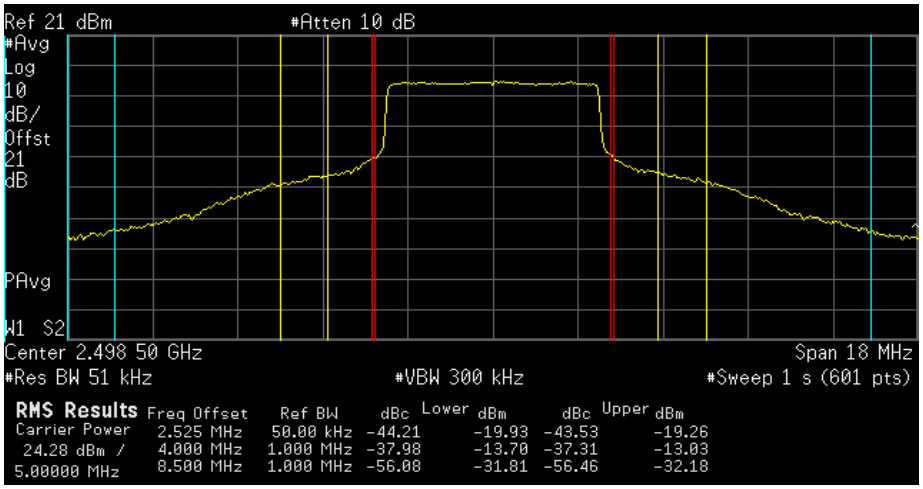


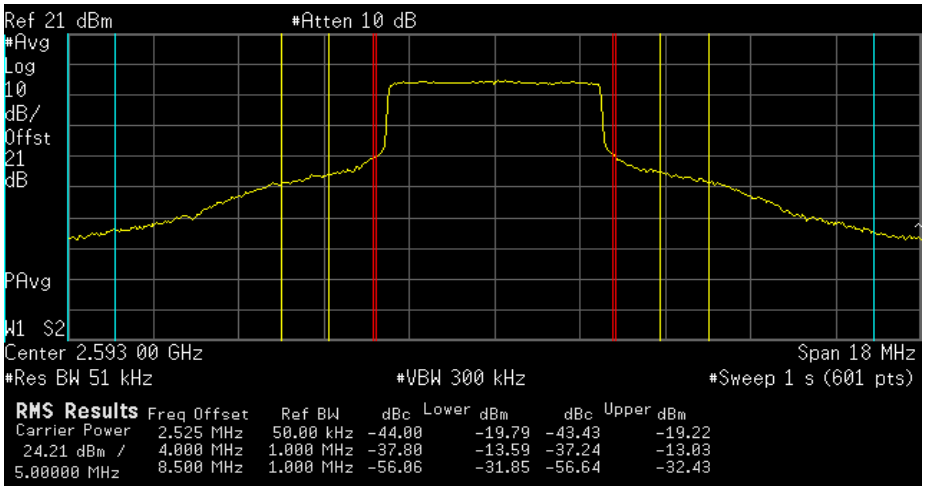


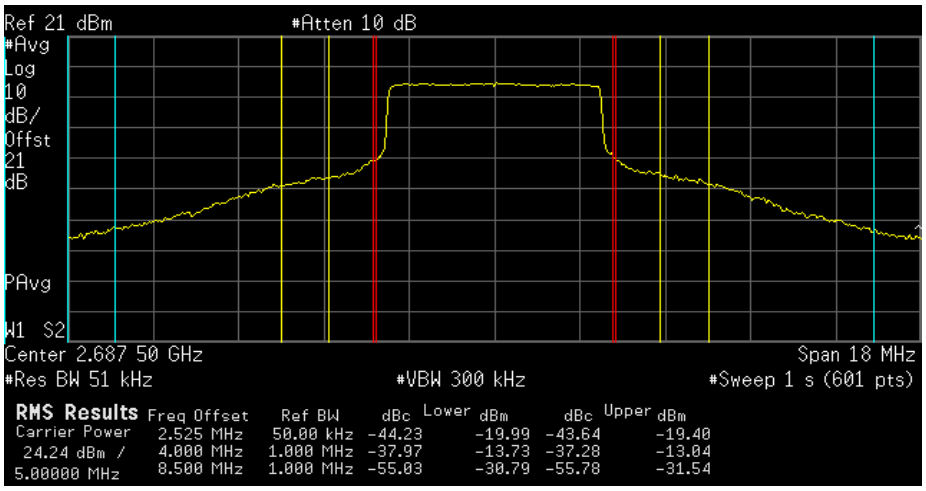


Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

DQ64_56_UQ4_12_5M







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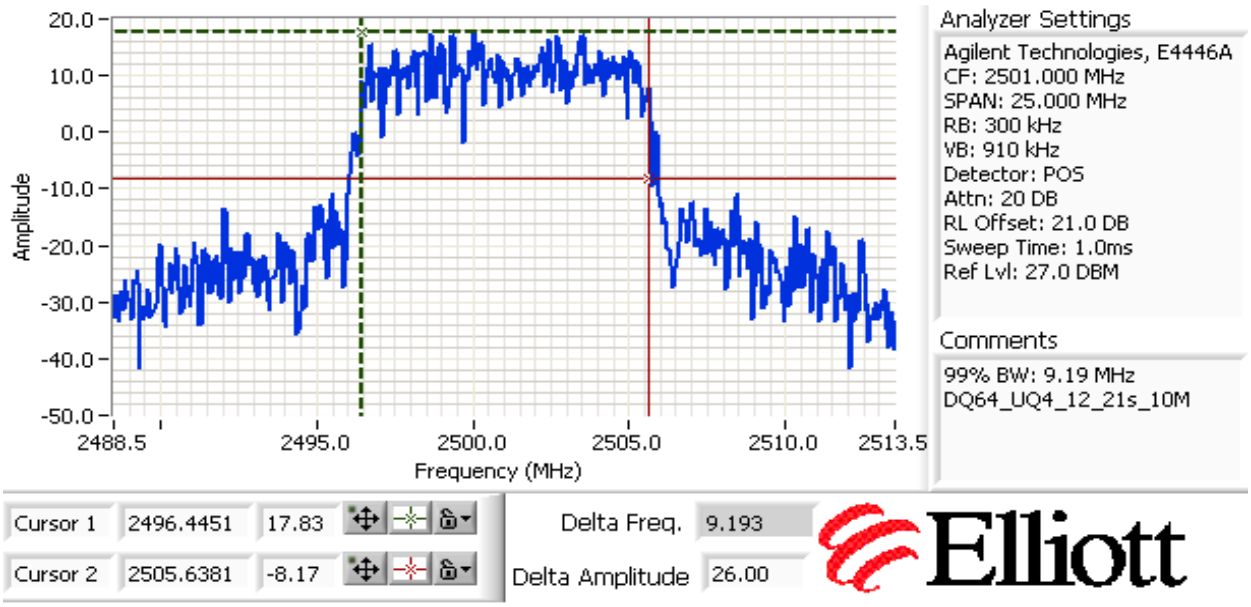
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

Run #2: Signal Bandwidth

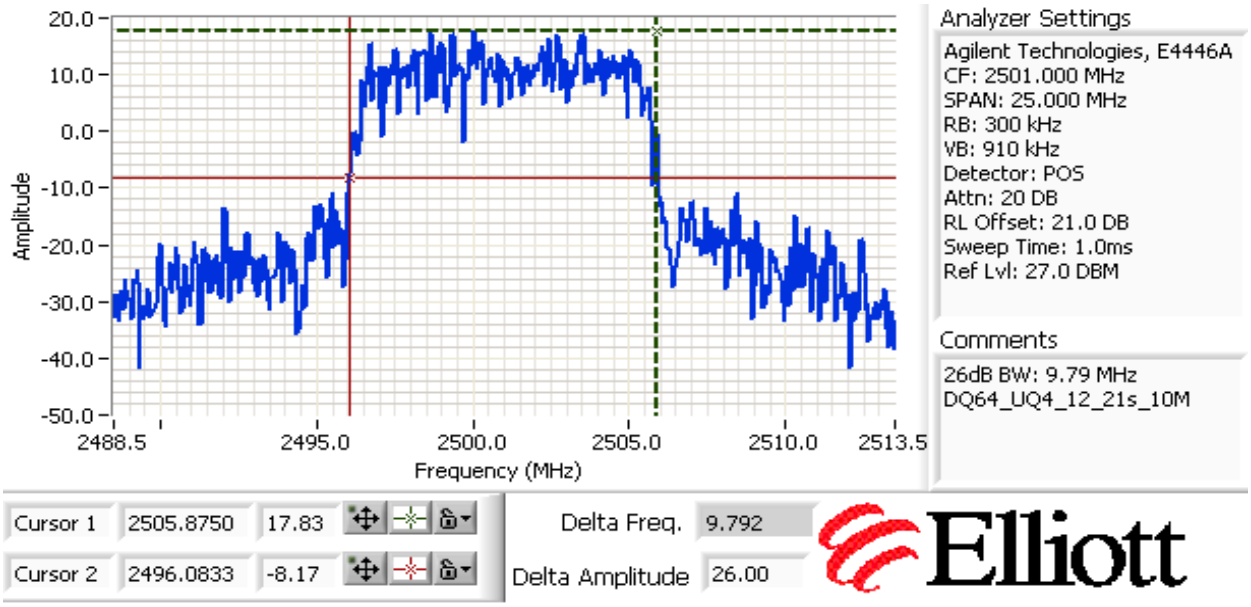
Date: 9/9/2009 Engineer: Mehran Birgani Location: Radio Lab Losses (Cable& Atten): 21.0 dBm

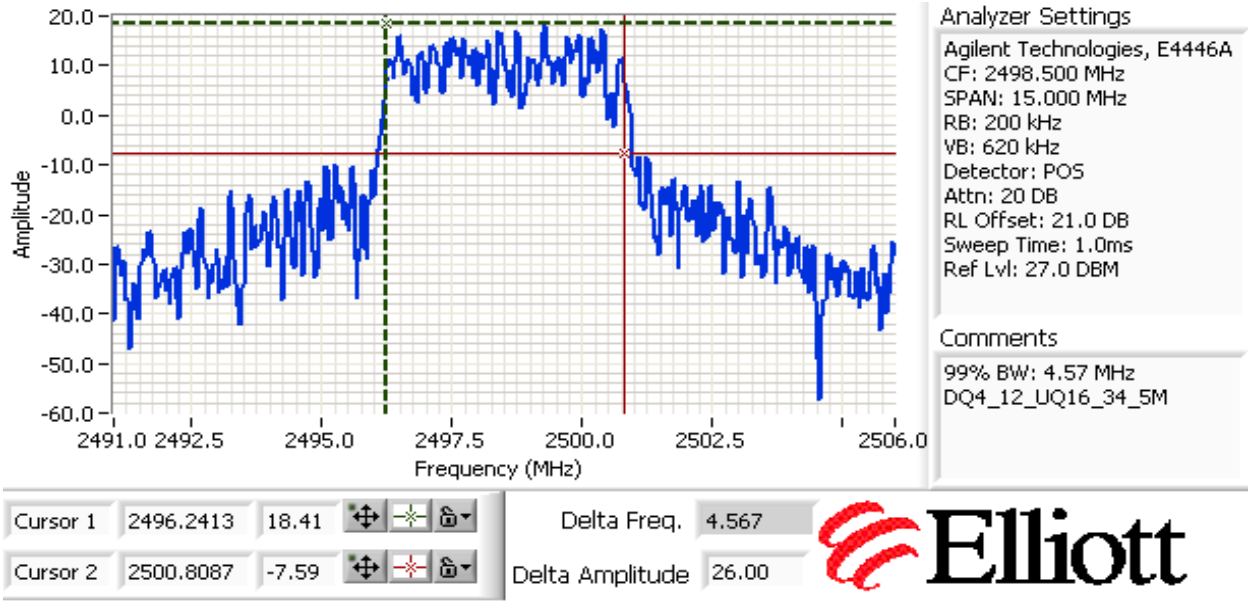
Waveform	Attenuation Setting	Frequency (MHz)	Resolution Bandwidth	Bandwidth (MHz) 26dB	Bandwidth (MHz) 99%
DQ64_UQ4_12_21s_10M	20.75	2501.0	300kHz	9.8	9.2
DQ4_12_UQ16_34_10M	20.00	2685.0	300kHz	9.5	9.1
DQ4_12_UQ16_34_5M	19.75	2498.5	200kHz	4.9	4.6
DQ64_56_UQ4_12_5M	17.75	2687.5	200kHz	5.3	4.6

Note 1: 99% bandwidth measured in accordance with RSS GEN, with RB > 1% of the span and VB > 3xRB

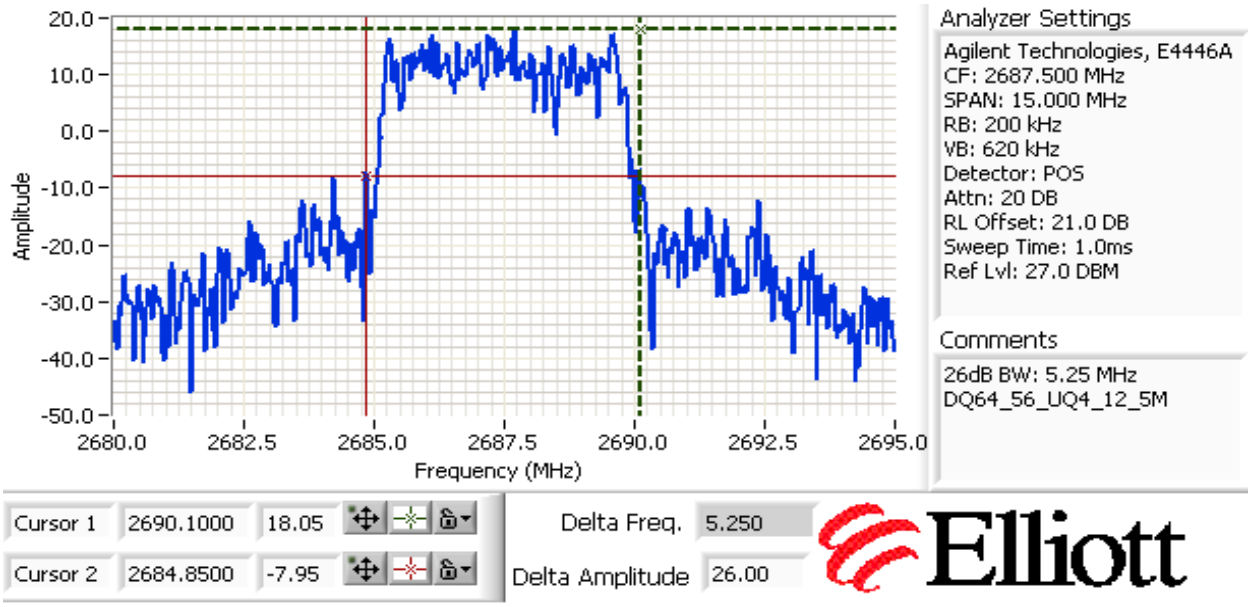


Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A





Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A



Run #3: Out of Band Spurious Emissions, Conducted

Date: 9/9/2009 Engineer: Mehran Birgani Location: Radio Lab Losses (Cable& Atten): 21.0 dBm

Mode/Waveform	Frequency (MHz)	Limit	Result
Highest power 10MHz BW	2501.0	-25 dBm	Pass
Highest power 10MHz BW	2593.0	-25 dBm	Pass
Highest power 10MHz BW	2685.0	-25 dBm	Pass
Highest power 5MHz BW	2498.5	-25 dBm	Pass
Highest power 5MHz BW	2593.0	-25 dBm	Pass
Highest power 5MHz BW	2687.5	-25 dBm	Pass

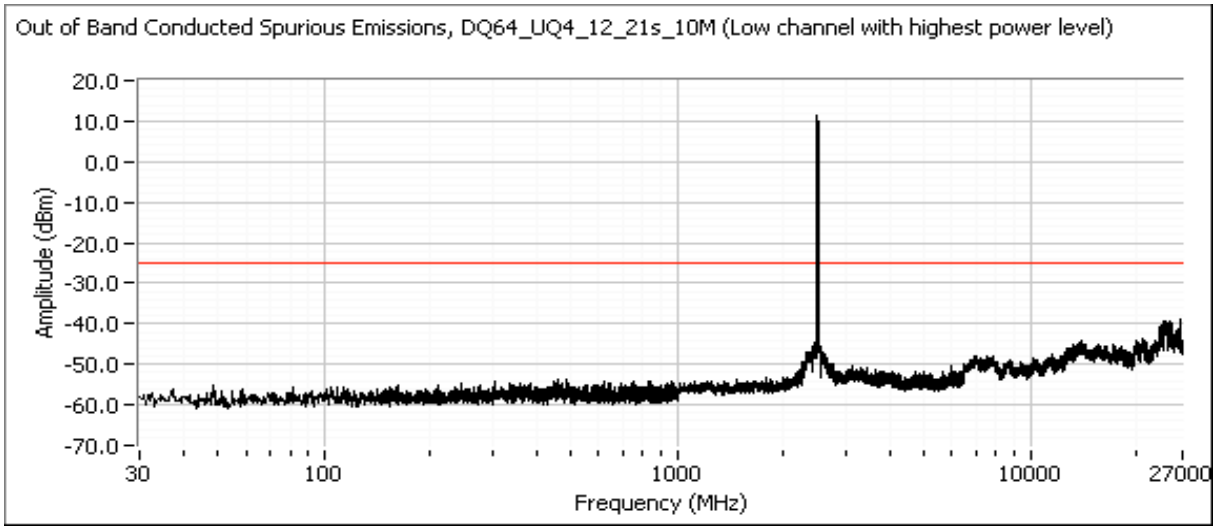
The limit is taken from FCC Part 27.53 (l)(4) -55 + 10 log (P)

Measurements are made with RB=VB=1MHz, peak detector and max hold. Signals above the limit using these settings are re-measured with RB=VB=1MHz, sample detector and rms averaging enabled, analyzer gated to only sweep when the device is transmitting.

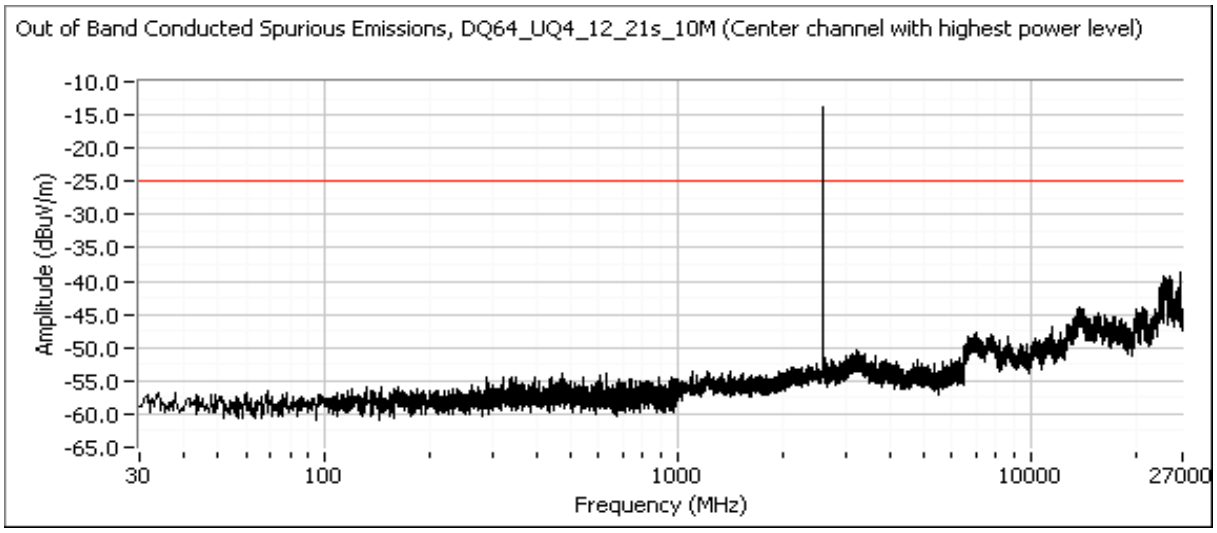
Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

10 MHz Mode

Plots for low channel (Power: 23.6 dBm)

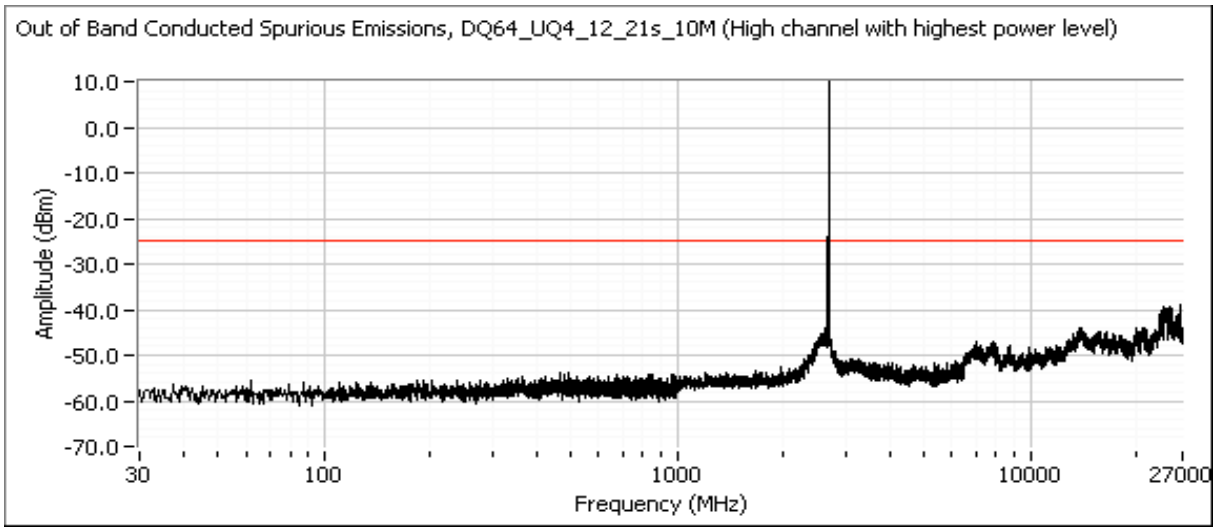


Plots for center channel (Power: 23.6 dBm)



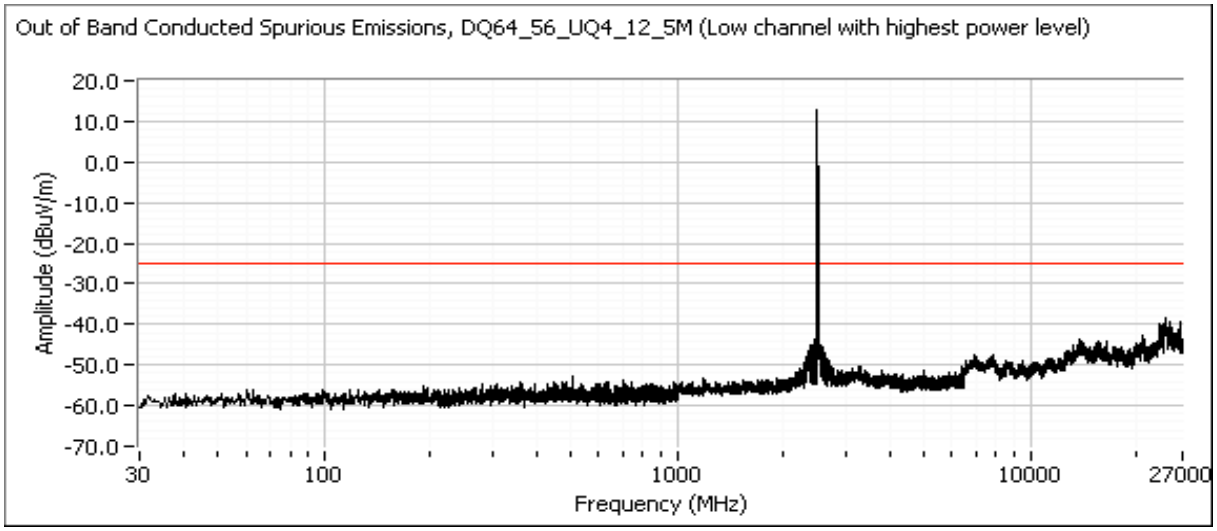
Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

Plots for high channel (Power: 23.5 dBm)



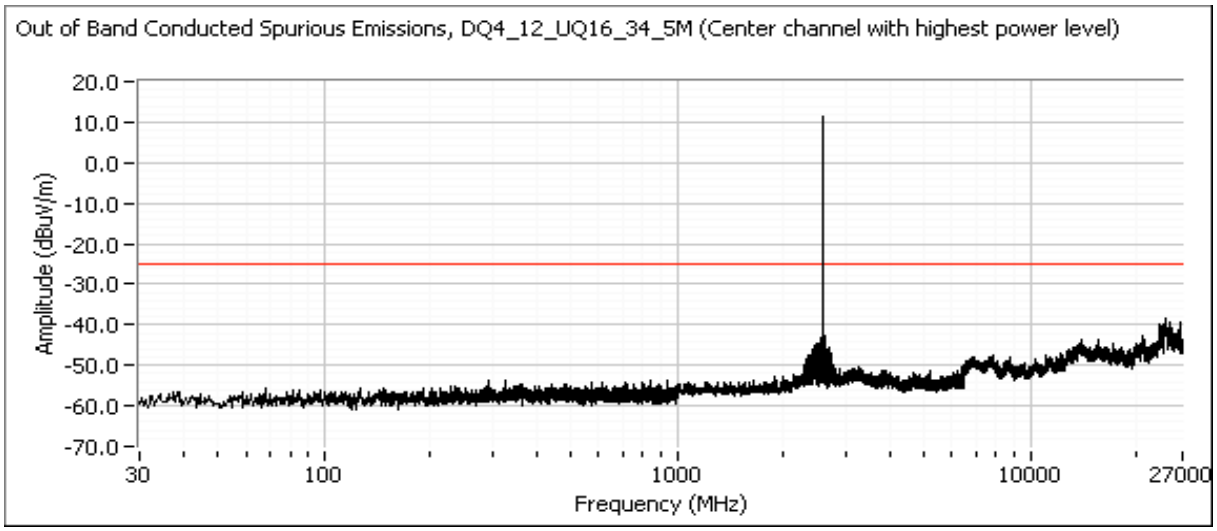
5 MHz Mode

Plots for low channel (Power: 24.3 dBm)

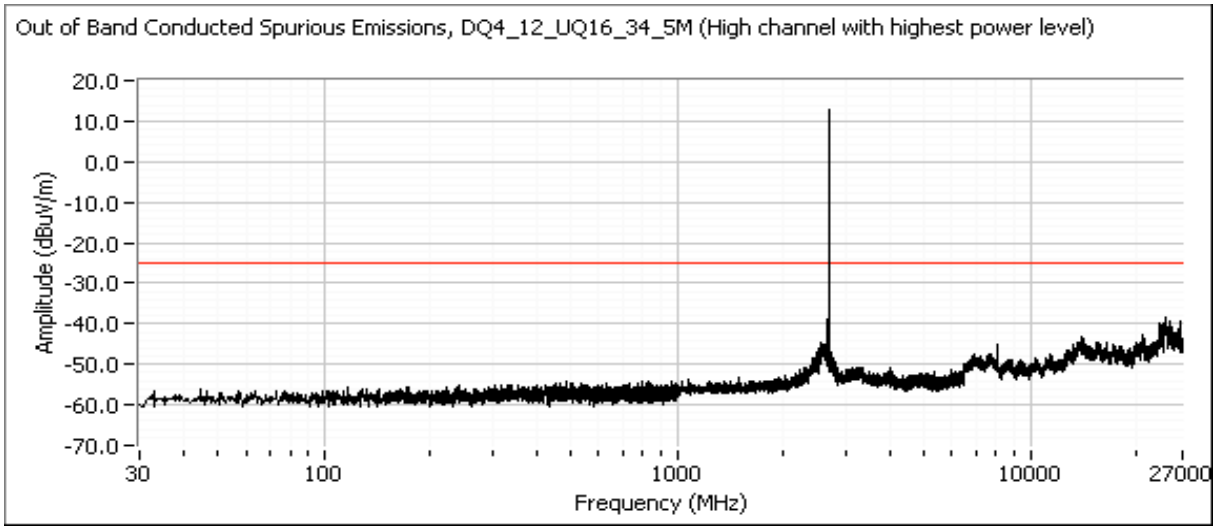


Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

Plots for center channel (Power: 24.2 dBm)



Plots for high channel (Power: 24.3 dBm)



Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

Run #4: Out of Band Spurious Emissions, Radiated

The limit is taken from FCC Part 27.53 (l)(4) -55 + 10 log (P), which is -25dBm (70.3dBuV/m)

Conducted limit (dBm): -25

Approximate field strength limit @ 3m: 70.3

Run #4a - Preliminary measurements - chamber scans

Date: 9/9/2009 Engineer: Mehran Birgani Location: Chamber #2

Frequency	Level	Pol	FCC 27.53 (l) (4)		Detector	Azimuth	Height	Mode	Channel
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters		
35.400	33.1	V	70.3	-37.2	Peak	121	1.7	10M	Low
35.400	33.1	V	70.3	-37.2	Peak	61	1.7	5M	Low
35.400	33.0	V	70.3	-37.3	Peak	2	1.7	10M	High
35.400	33.0	V	70.3	-37.3	Peak	119	1.7	5M	High
35.400	32.9	V	70.3	-37.4	Peak	148	1.7	10M	Center
35.400	32.7	V	70.3	-37.6	Peak	209	1.7	5M	Center
1326.040	34.8	V	70.3	-35.5	Peak	119	1.7	10M	High
1328.520	29.1	V	70.3	-41.2	Peak	42	1.7	10M	Low
4997.540	49.2	V	70.3	-21.1	Peak	20	1.7	5M	Low
5002.050	47.6	V	70.3	-22.7	Peak	15	1.7	10M	Low
5186.180	55.9	V	70.3	-14.4	Peak	16	1.7	5M	Center
5185.460	53.0	V	70.3	-17.3	Peak	25	1.7	10M	Center
5370.130	54.0	V	70.3	-16.3	Peak	20	1.7	10M	High
5374.640	54.0	V	70.3	-16.3	Peak	11	1.7	5M	High
7495.230	49.4	V	70.3	-20.9	Peak	127	1.7	5M	Low
7503.980	47.7	V	70.3	-22.6	Peak	22	1.7	10M	Low
7778.570	54.6	V	70.3	-15.7	Peak	11	1.7	5M	Center
7776.650	52.1	V	70.3	-18.2	Peak	21	1.7	10M	Center
8061.360	56.3	V	70.3	-14.0	Peak	16	1.7	5M	High
8053.480	51.4	V	70.3	-18.9	Peak	16	1.7	10M	High
12493.170	46.1	V	70.3	-24.2	Peak	289	1.7	5M	Low
12500.000	43.5	V	70.3	-26.8	Peak	172	1.7	10M	Low
12980.000	46.9	V	70.3	-23.4	Peak	296	1.7	5M	Center

Note 1:	The field strength limit in the tables above was calculated from the erp/eirp limit detailed in the standard using the free space propagation equation: E=√(30PG)/d. This limit is conservative - it does not consider the presence of the ground plane.
Note 2:	Measurements are made with the transmit antenna port terminated.
Note 3:	Measurements are made with RB=VB=1MHz, peak detector and max hold. Signals above the limit using these settings are re-measured with RB=VB=1MHz, sample detector and rms averaging enabled, analyzer gated to only sweep when the device is transmitting.
Note 4:	18-27GHz was scaned manually and no signal was found.

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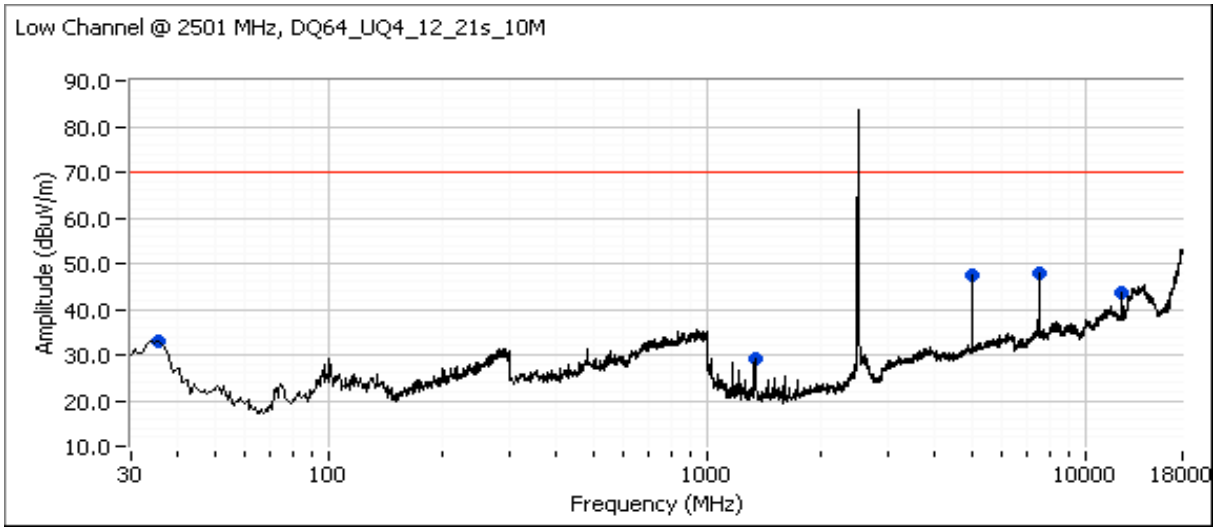
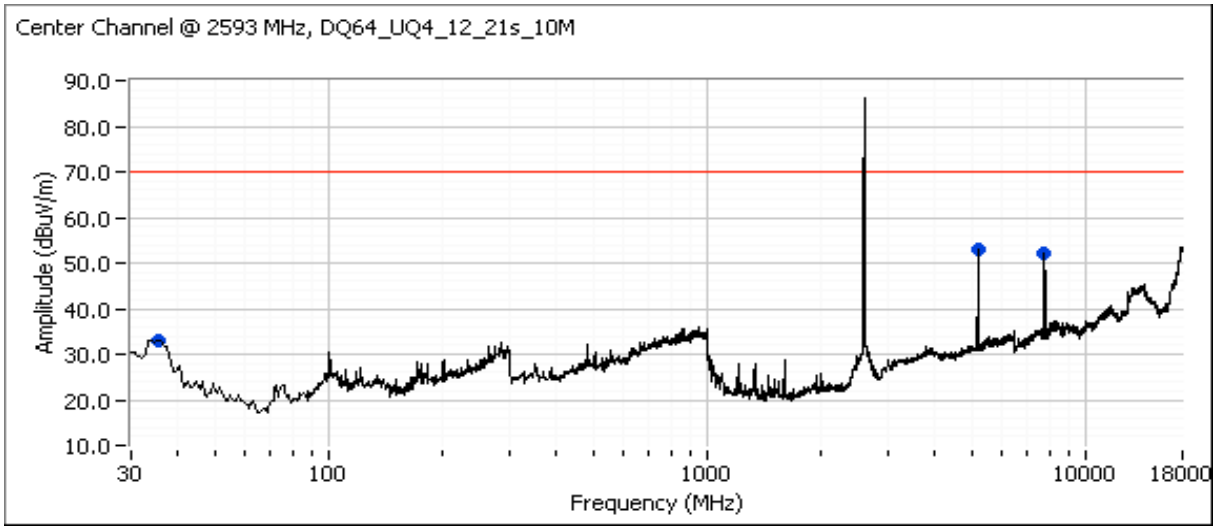
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

10MHz Mode

Plots for low channel, power setting = 23.4 dBm

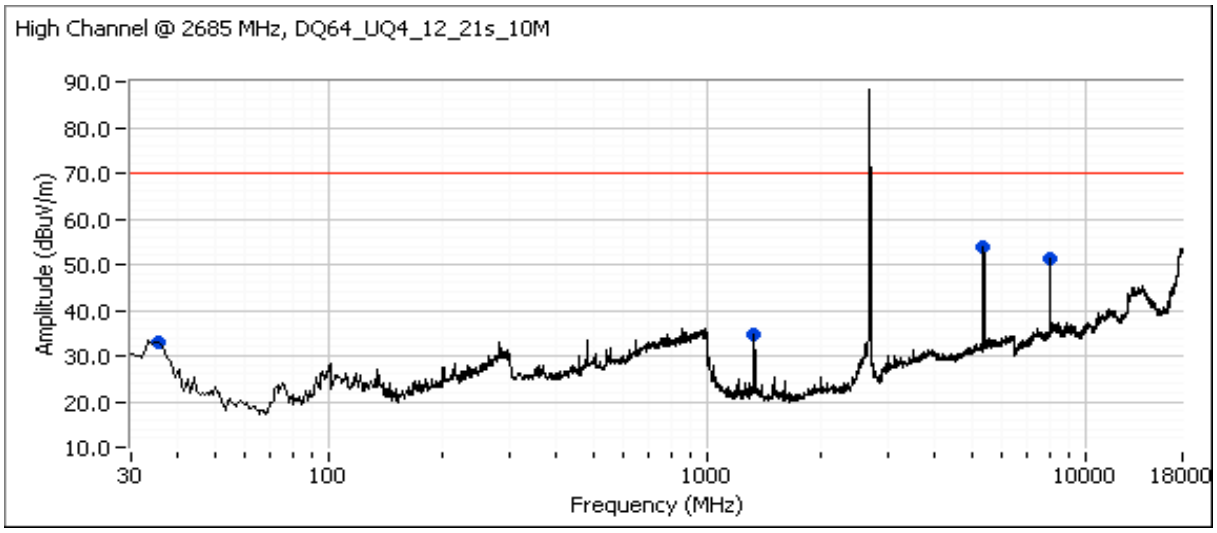


Plots for center channel, power setting = 23.5 dBm



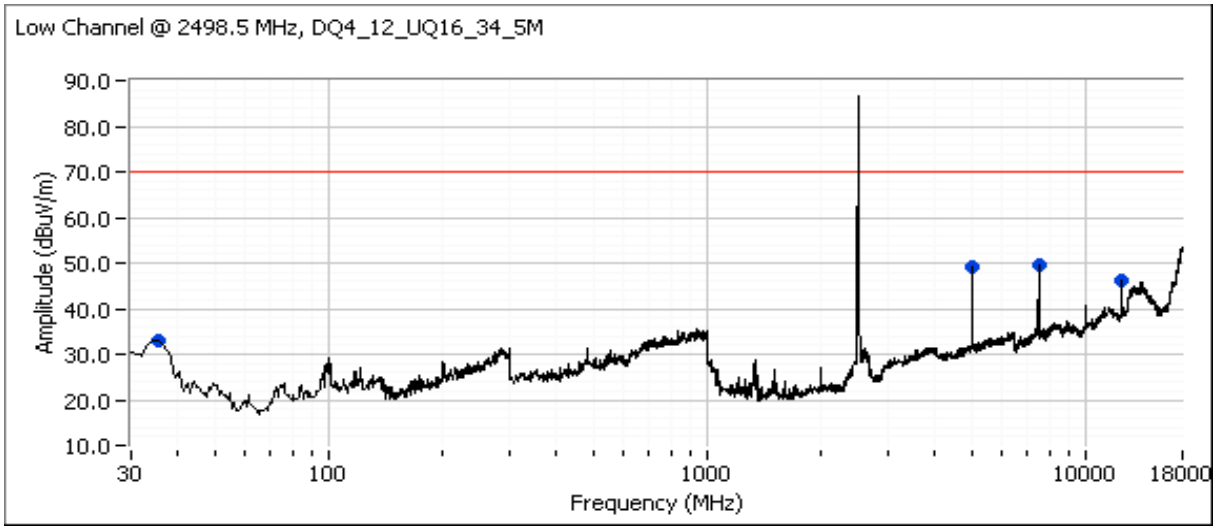
Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

Plots for high channel, power setting = 23.4 dBm



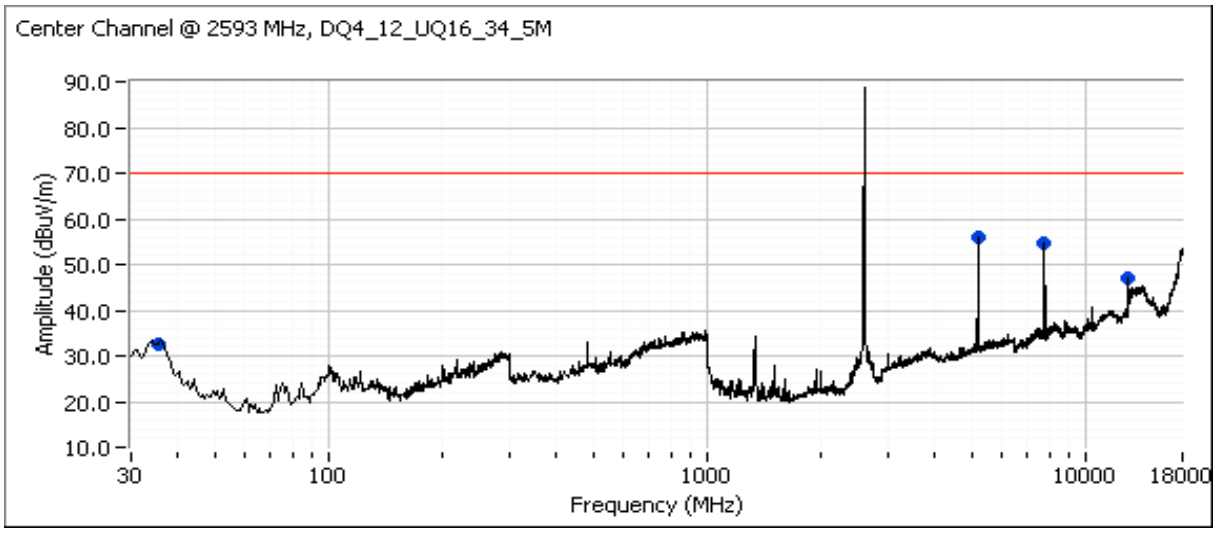
5MHz Mode

Plots for low channel, power setting = 24.3 dBm

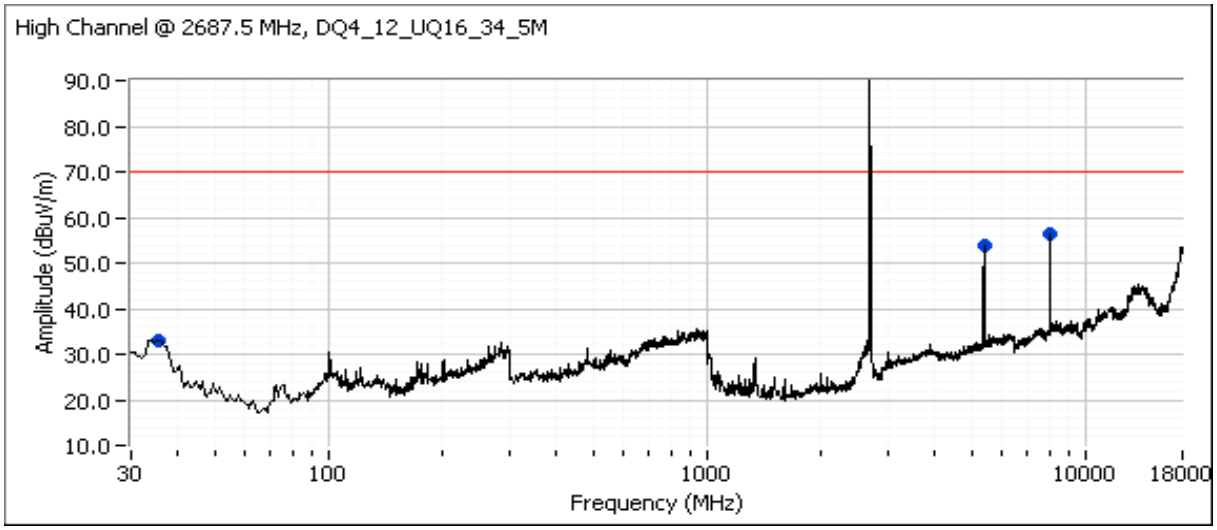


Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

Plots for center channel, power setting = 24.2 dBm



Plots for high channel, power setting = 24.3 dBm



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Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

Run #4b: - OATS EUT Field Strength Measurements and Substitution Measurements

Date: 9/10/2009 Engineer: Mehran Birgani Location: SVOATS #2

EUT Field Strength

Frequency	Level	Pol	FCC 27.53 (l) (4)		Detector	Azimuth	Height	Mode	Channel
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters		
35.400	24.7	V	70.3	-45.6	PK	5	1.0	10M	Low
1327.470	44.2	V	70.3	-26.1	PK	227	1.0	10M	High
5371.180	42.8	V	70.3	-27.5	PK	360	1.0	10M	High
7497.630	62.7	V	70.3	-7.6	PK	48	1.6	5M	Low
4995.120	43.2	V	70.3	-27.1	PK	57	1.0	5M	Low
12489.120	59.0	V	70.3	-11.3	PK	70	1.0	5M	Low
5185.250	45.4	V	70.3	-24.9	PK	270	1.0	5M	Center
7777.260	59.4	V	70.3	-10.9	PK	360	1.1	5M	Center
12976.020	52.2	V	70.3	-18.1	PK	55	1.0	5M	Center
8060.560	62.4	V	70.3	-7.9	PK	55	1.3	5M	High

Note 1:	The field strength limit in the tables above was calculated from the erp/eirp limit detailed in the standard using the free space propagation equation: E=√(30PG)/d. This limit is conservative - it does not consider the presence of the ground plane. The erp or eirp for all signals with less than 20dB of margin relative to this field strength limit is determined using substitution measurements.
Note 2:	Measurements are made with the antenna port terminated.

Substitution measurements
Vertical

Frequency	Substitution measurements			Site	EUT measurements			eirp Limit	erp Limit	Margin
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	dBm	dBm	dB
7497.630	-10.0	11.5	97.2	95.7	62.7	-33.0	-35.2		-25.0	-10.2
7777.260	-10.0	12.0	99.0	97.0	59.4	-37.6	-39.8		-25.0	-14.8
8061.360	-10.0	12.3	99.8	97.5	62.4	-35.1	-37.3		-25.0	-12.3
12489.120	-10.0	12.3	101.2	98.9	59.0	-39.9	-42.1		-25.0	-17.1
12976.020	-10.0	13.0	96.9	93.9	52.2	-41.7	-43.9		-25.0	-18.9

Note 1:	Pin is the input power (dBm) to the substitution antenna
Note 2:	Gain is the gain (dBi) for the substitution antenna.
Note 3:	FS is the field strength (dBuV/m) measured from the substitution antenna.
Note 4:	Site Factor - this is the site factor to convert from a field strength in dBuV/m to an eirp in dBm.
Note 5:	EUT field strength as measured during initial run.

Client:	Intel Corporation	Job Number:	J75722
Model:	Kilmer Peak 2x2 WiMax/WiFi Combo HMC Card	T-Log Number:	T76609
		Account Manager:	Christine Krebbil
Contact:	Robert Paxman, Steve Hackett		
Standard:	FCC Part 27	Class:	N/A

Run #5: Frequency Stability

Date: 9/14/2009 Engineer: Mehran Birgani Location: Radio Lab Losses (Cable& Atten): 21.4 dBm

Nominal Frequency: 2593.0000 MHz

Frequency Stability Over Temperature

The EUT was soaked at each temperature for a minimum of 30 minutes prior to making the measurements to esnure the EUT and chamber had stabilized at that temperature.

Temperature	Frequency Measured	Drift	
(Celsius)	(MHz)	(Hz)	(ppm)
-30	2592.999910	90	0.03
-20	2592.999910	90	0.03
-10	2592.999825	175	0.07
0	2592.999825	175	0.07
10	2592.999870	130	0.05
20	2592.999835	165	0.06
30	2592.999765	235	0.09
40	2592.999825	175	0.07
50	2592.999780	220	0.08

Frequency Stability Over Input Voltage

Nominal Voltage is 3.3Vdc.

Voltage		Frequency Measured	Drift	
%	Actual	(MHz)	(Hz)	(ppm)
85%	2.81	2592.999810	190	0.07
115%	3.80	2592.999725	275	0.11

Worst case: 275 Hz
0.11 ppm