Lab Code: 200167-0

FCC PART 15, SUBPART C

TEST AND MEASUREMENT REPORT

For

Panamax, LLC

1690 Corporate Circle,

Petaluma, CA 94954, USA

FCC ID: LDVMD2-ZB

Report Type:	**Product Type:**
Original Report	Energy Management Module with Zigbee Transceiver

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Report Number:	R1109151-247
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1109151-247	Original Report	2011-12-06

1 General Description

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Panamax, LLC*, and their product, FCC ID: LDVMD2-ZB, model: MD-ZB which will be henceforth referred to as the EUT (Equipment under Test). The EUT is an Energy Management Module with Zigbee transceiver which operates in the 2.4 GHz band.

1.2 Mechanical Description of EUT

The EUT measures approximately 8.5cm L x 13.5cm W x 4cm H and weighs approximately 333g.

The test data gathered are from production sample, project number: R1109151-1, assigned by BACL.

1.3 Objective

This report is prepared on behalf of *Panamax, LLC, Inc.* in accordance with Part 2, Subpart J, and Part 15, Subparts A and C of the FCC.

The objective is to determine compliance with FCC rules for Output Power, Antenna Requirements, 6 dB Bandwidth, and power spectral density, 100 kHz Bandwidth of Band Edges Measurement, Spurious Emissions, Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with 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 ANSI C63.10-2009, American National Standard for Testing Unlicensed Wireless Devices.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are: spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the values range from $\pm$2.0 for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL.

Detailed instrumentation measurement uncertainties can be found in BACL report QAP-018.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.7 Test Facility

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test sites at BACL have been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission, Industry Canada, and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464, IC registration number: 3062A, and VCCI Registration Number: C-2463 and R-2698. The test site has been approved by the FCC, IC, and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at http://ts.nist.gov/Standards/scopes/2001670.htm

2 System Test Configuration

2.1 Justification

The system was configured for testing according to ANSI C63.4-2003 Standard.

2.2 EUT Exercise Software

The software used, Ember Range Test Application V2.0, provided by client and was verified by BACL (Quinn Jiang) to comply with the standard requirements being tested against.

2.3 Equipment Modifications

No modification of the EUT was necessary to meet testing requirements.

2.4 Special Accessories

N/A

2.5 Power Supply and Line Filters

N/A

2.6 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Ember	Insight Development Kit	-	-
IBM	Laptop	Lenovo X60	63664DU

2.7 Interface Ports and Cabling

Cable Description	Length (m)	From	To
Ethernet Cable	< 1	Laptop	Ember Insight Development Kit
Insight Port Cable	< 1	EUT	Ember Insight Development Kit
RF Cable	< 1	EUT	Spectrum Analyzer

2.8 EUT Internal Configuration Details

Manufacturers	Description	Model No.	Serial No.
Panamax, LLC	RF PCB Assembly	200-00051 REV A	-
Panamax, LLC	Power Supply PCB Assembly	200-00059 REV A	-

3 Summary of Test Results

Results reported relate only to the product tested.

FCC Rules	Description of Tests	Results
§15.247 (i), §2.1091	RF Exposure (MPE) Information	Compliant
§15.203	Antenna Requirement	Compliant
§15.207 (a)	AC Line Conducted Emissions	Compliant
§2.1051, §15.247 (d)	Spurious Emissions at Antenna Port	Compliant
§15.205	Restricted Bands	Compliant
§15.209 (a), §15.247 (d)	Radiated Spurious Emissions	Compliant
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliant
§15.247 (b)(3)	Maximum Peak Output Power	Compliant
§15.247 (d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
§15.247 (e)	Power Spectral Density	Compliant

4 FCC §15.247(i) & §2.1091 - RF Exposure Information

4.1 Applicable Standards

According to FCC §15.247(i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

4.3 MPE Results

Maximum peak output power at antenna input terminal (dBm):	3.19
Maximum peak output power at antenna input terminal (mW):	2.08
Prediction distance (cm):	20
Prediction frequency (MHz):	2405
Maximum Antenna Gain, typical (dBi):	0
Maximum Antenna Gain (numeric):	1.0
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0004
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0004 mW/cm^2, The Limit is 1.0 mW/cm^2.

5 FCC §15.203 - Antenna Requirement

5.1 Applicable Standard

According to FCC §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to FCC §15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.2 Antenna Connector Construction

EUT has one Transmitter/Receiver antenna which is an internal, PCB, Inverted-F antenna and features a permanent attachment to the EUT chassis as well as non-standard connector. The Transmitter antenna has a max gain of 0 dBi which fulfills the requirements of FCC rule 15.203.

Frequency Band	Antenna Gain (dBi)
2.4 GHz	0

6 FCC §15.207 – AC Line Conducted Emissions

6.1 Applicable Standard

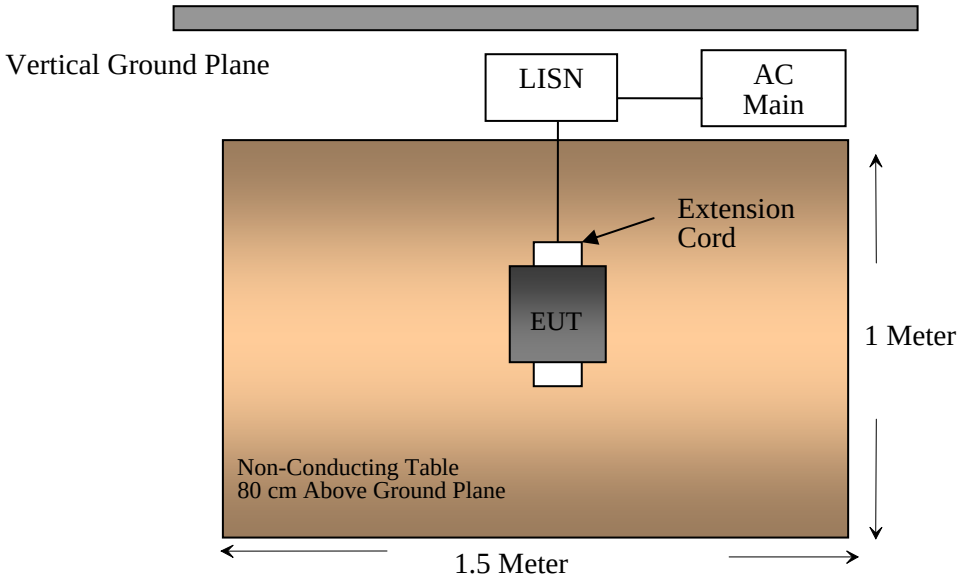
Section 15.207 Conducted limits:

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 (1)	56 to 46 (1)
0.5-5	56	46
5-30	60	50

(1) *Decreases with the logarithm of the frequency.*

6.2 Test Setup Block Diagram



6.3 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4-2003 measurement procedure. The specification used was FCC Part 15.207 limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.
The AC/DC power adapter of the unit was connected with LISN-1 which provided 120 V/60 Hz AC power.

6.4 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the peak detection mode, quasi-peak and average. Quasi-Peak readings are distinguished with a "QP". Average readings are distinguished with an "Ave".

6.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2011-03-21
Solar Electronics	LISN	9252-R-24-BNC	511213	2011-06-28
TTE	Filter, High Pass	H962-150k-50-21378	K7133	2011-06-10

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

6.6 Test Environmental Conditions

Temperature:	20-24 °C
Relative Humidity:	40-44 %
ATM Pressure:	101.2kPa

The testing was performed by Quinn Jiang on 2011-09-15 at 5m Chamber3.

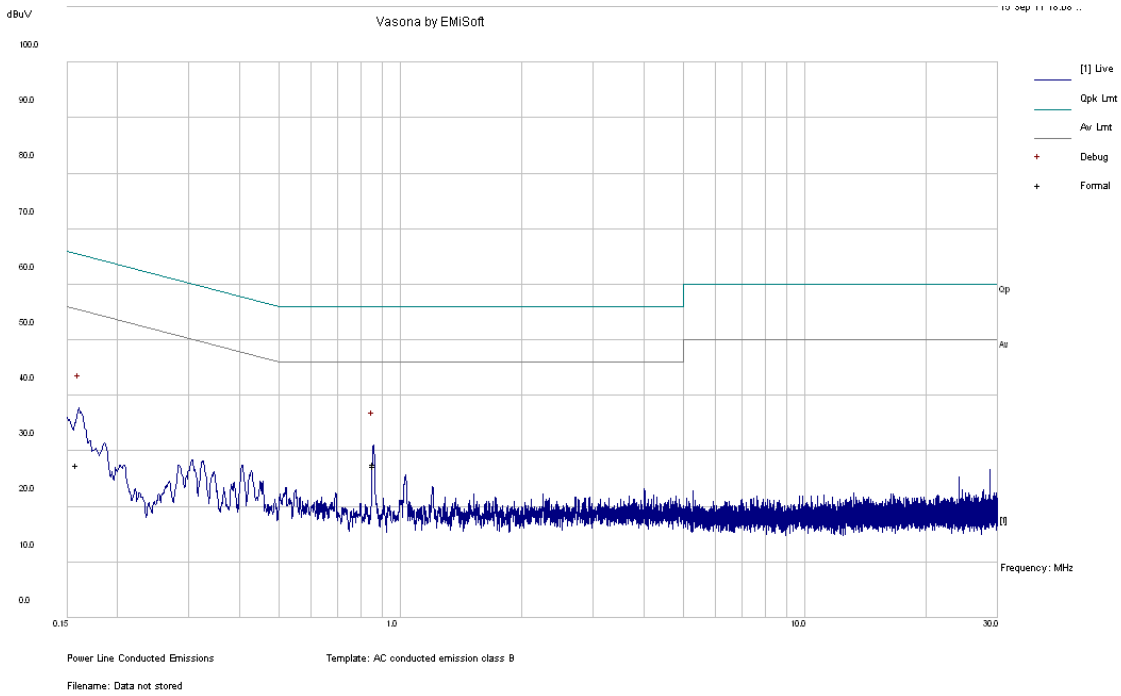
6.7 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC standard's conducted emissions limits, with the *worst* margin reading of:

Connection: AC/DC adapter connected to 120 V/60 Hz AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-17.45	0.858333	Neutral	0.15 to 30

6.8 Conducted Emissions Test Plots and Data

120 V, 60 Hz – Line



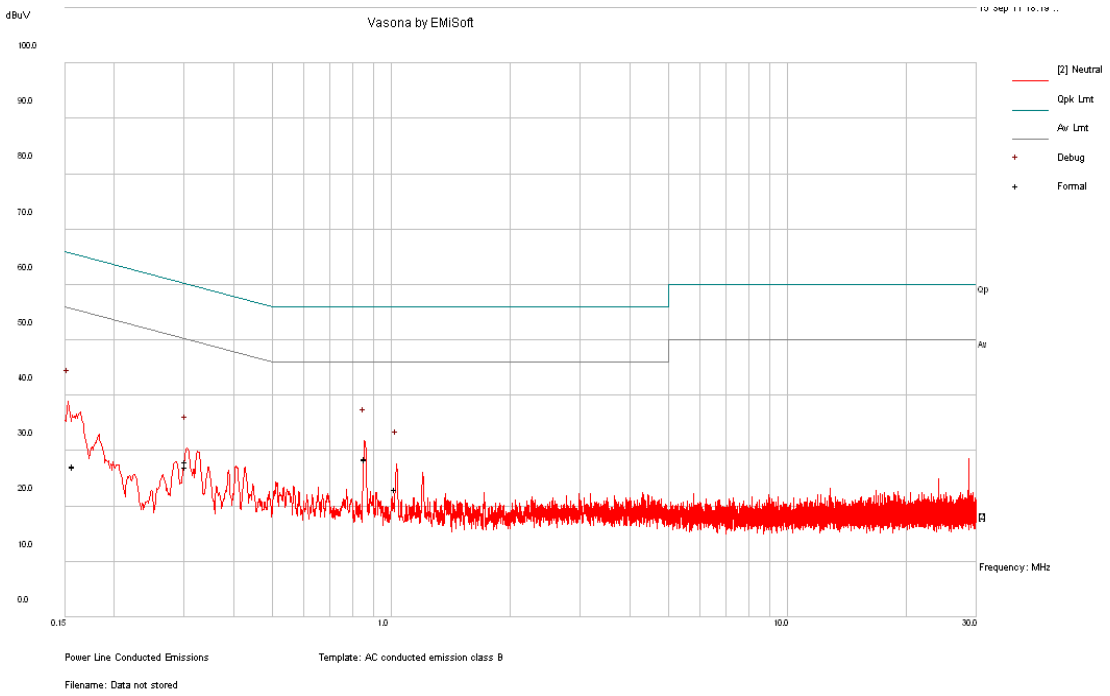
Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.859122	27.33	Line	56.00	-28.67
0.159129	27.50	Line	65.51	-38.01

Average Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.859122	27.62	Line	46.00	-18.38
0.159129	27.52	Line	55.51	-27.99

120 V, 60 Hz – Neutral



Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.858333	28.42	Neutral	56.00	-27.58
0.158235	27.16	Neutral	65.56	-38.40
1.028631	23.09	Neutral	56.00	-32.91
0.304377	28.02	Neutral	60.12	-32.11

Average Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.858333	28.55	Neutral	46.00	-17.45
0.158235	27.26	Neutral	55.56	-28.30
1.028631	23.15	Neutral	46.00	-22.85
0.304377	27.14	Neutral	50.12	-22.99

7 FCC §2.1051 & §15.247(d) - Spurious Emissions at Antenna Terminals

7.1 Applicable Standard

For FCC §15.247(d) in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

The spectrum was to be investigated to the tenth harmonics of the highest fundamental frequency as specified in §2.1057.

7.2 Measurement Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

7.4 Test Environmental Conditions

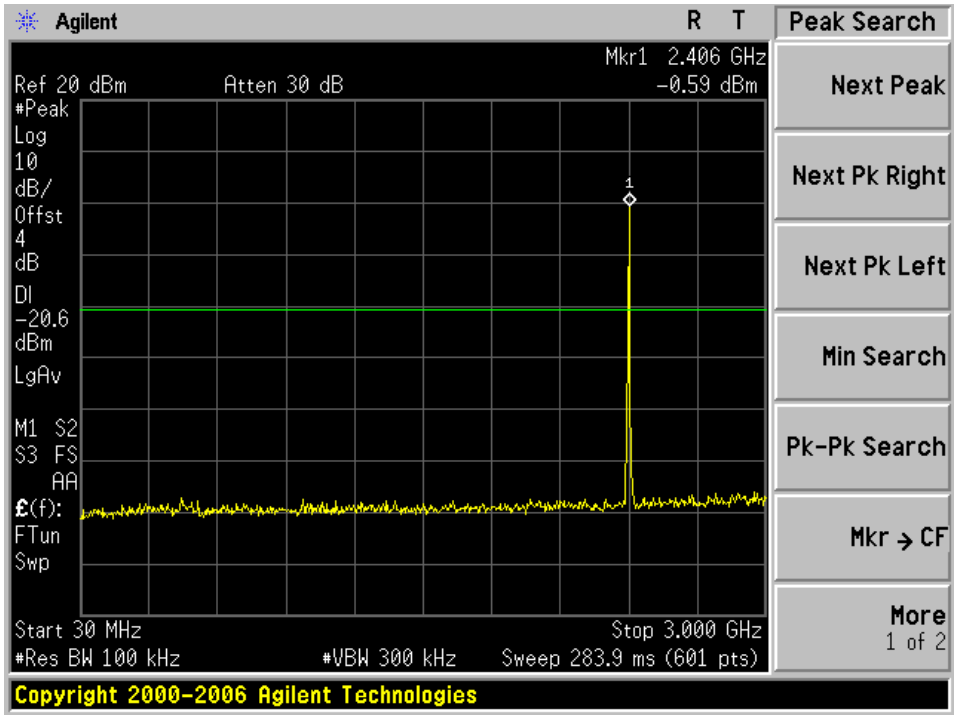
Temperature:	20-24 °C
Relative Humidity:	40-44 %
ATM Pressure:	101.2kPa

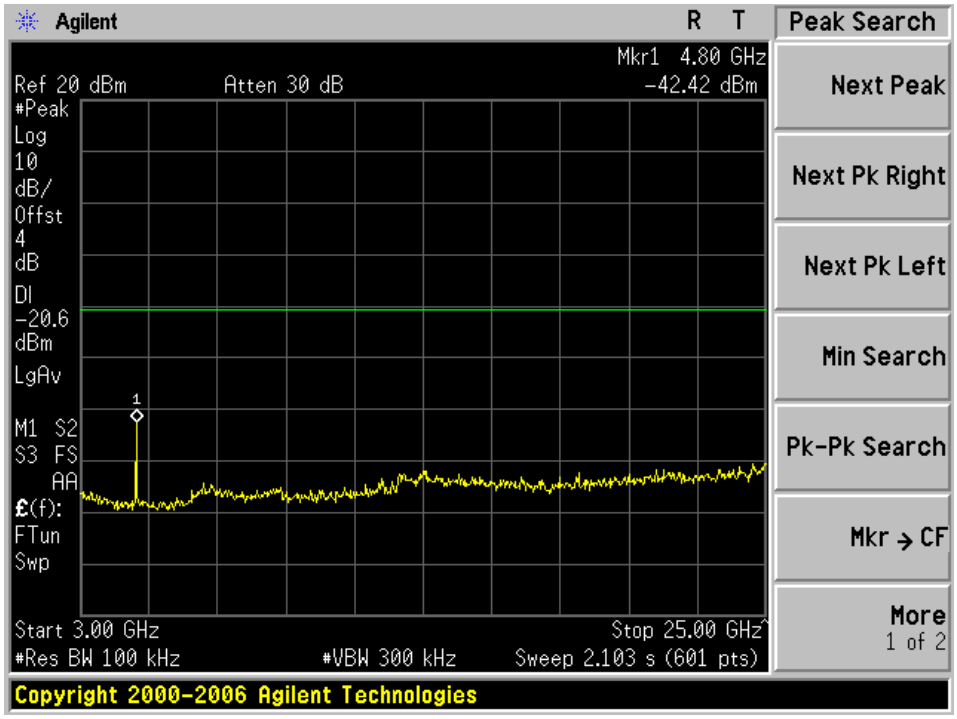
The testing was performed by Quinn Jiang on 2011-09-16 at RF Site.

7.5 Test Results

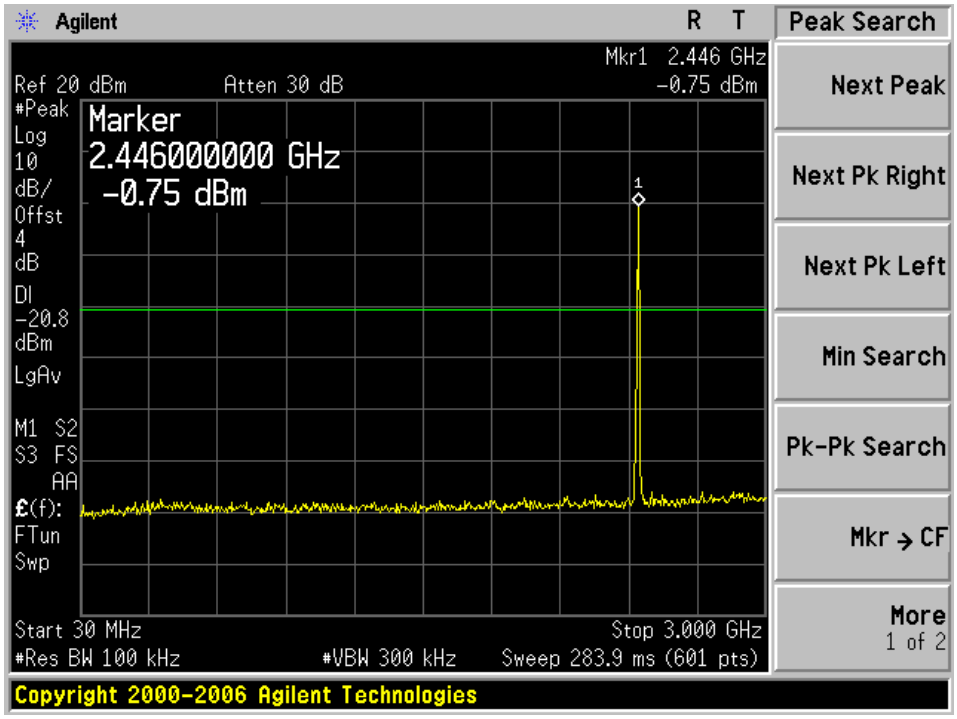
Please refer to following plots of spurious emissions.

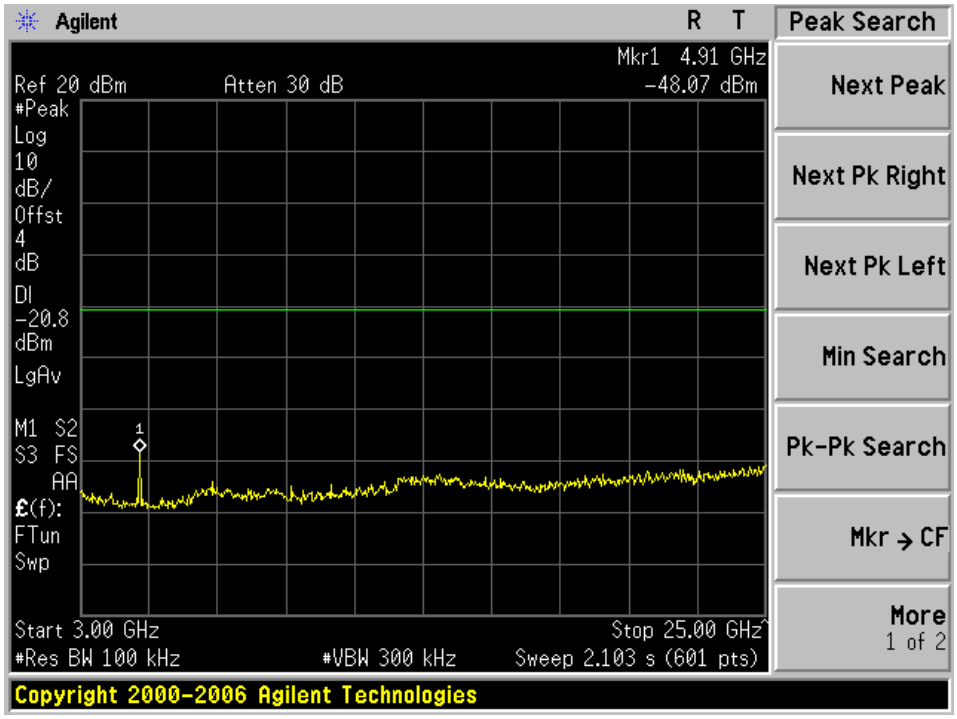
Low Channel, 2405 MHz



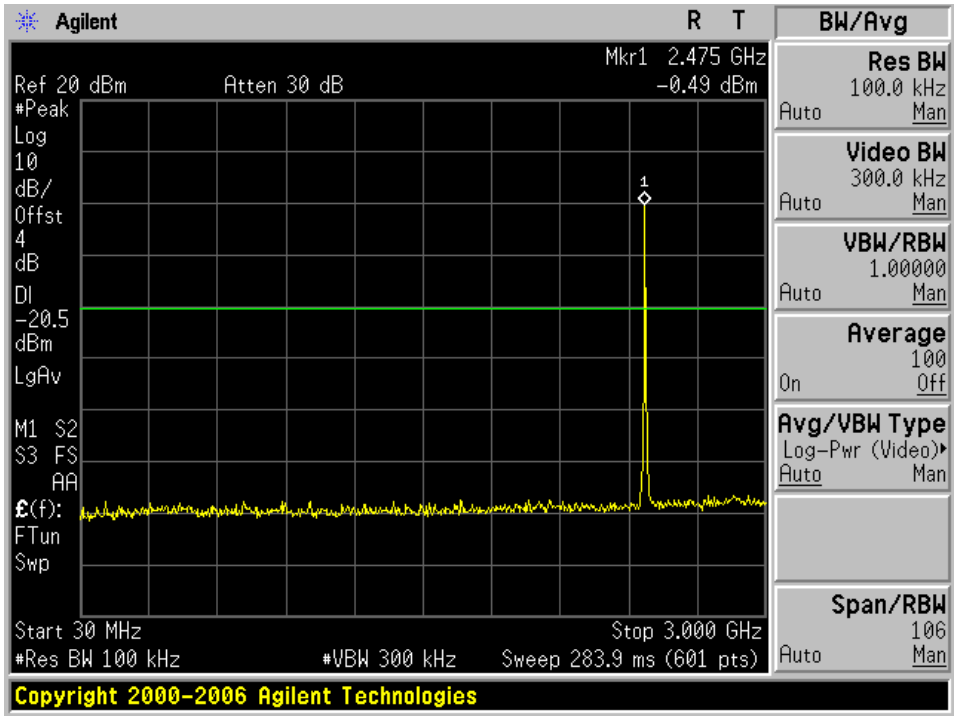


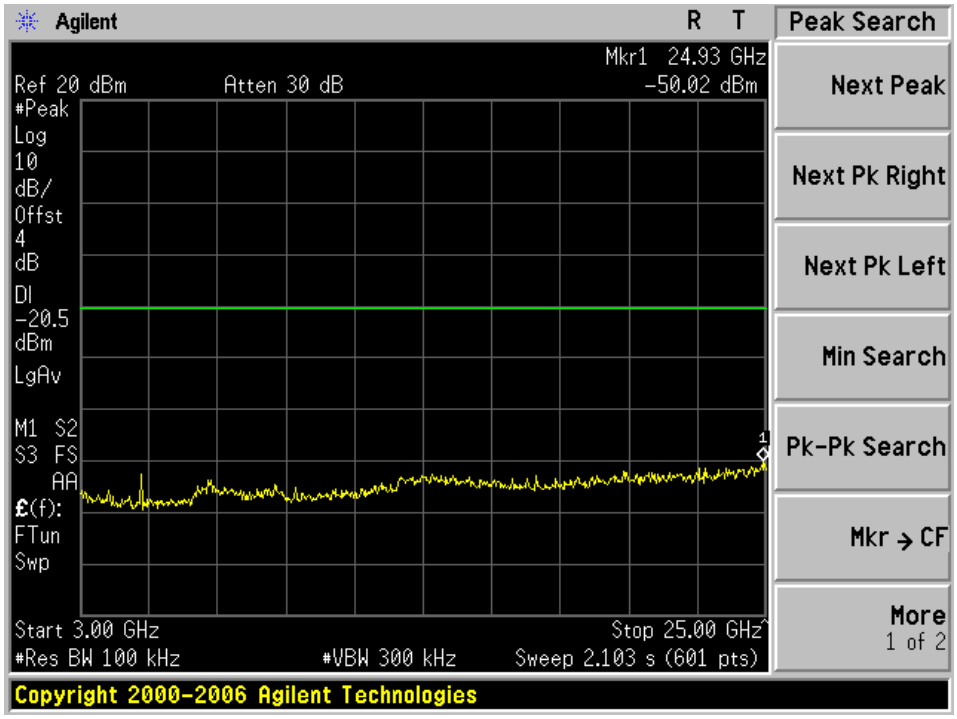
Middle Channel, 2445 MHz





High Channel, 2475 MHz





8 FCC §15.205, §15.209 & §15.247(d) - Spurious Radiated Emissions

8.1 Applicable Standards

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100 (1)	3
88 - 216	150 (1)	3
216 - 960	200 (1)	3
Above 960	500	3

(1) Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

f (MHz)	f (MHz)	f (MHz)	f (GHz)
0.090 – 0.110	16.42 – 16.423	960 – 1240	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5. 35 – 5. 46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 –167.17	3.332 – 3339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	33458 – 3358	23.6 – 24.0
12.29 – 12.293	240 – 285	3600 – 4400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As Per FCC §15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

8.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.4-2003. The specification used was the FCC 15 Subpart C limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

8.3 Test Procedure

For the radiated emissions test, the EUT host AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 meter, and the EUT is placed on a turntable, which is 0.8 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

RBW=100 kHz, VBW=300 kHz, Sweep=Auto

Above 1000 MHz:

(1) Peak: RBW=1MHz, VBW=1MHz, Sweep=Auto
(2) Average: RBW=1MHz, VBW=10Hz, Sweep=Auto

8.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corrected Amplitude = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit.
The equation for margin calculation is as follows:

Margin = Corrected Amplitude - FCC Limit

8.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2011-03-21
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB1	A020106-1	2011-05-17
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2011-06-09
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2011-05-09
A.R.A Inc	Horn antenna	DRG-1181A	1132	2010-11-29

Statement of Traceability: BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

8.6 Test Environmental Conditions

Temperature:	20-24 °C
Relative Humidity:	40-44 %
ATM Pressure:	101.2kPa

The testing was performed by Quinn Jiang on 2011-09-15 at 5m Chamber3.

8.7 Summary of Test Results

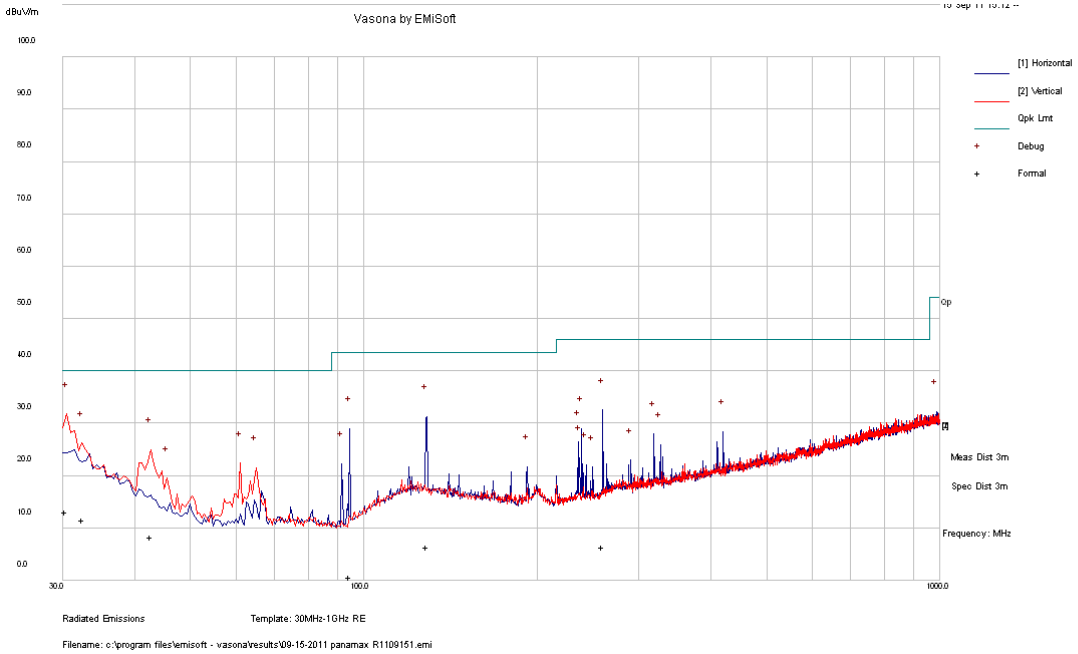
According to the data hereinafter, the EUT complied with the limits presented in FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
30-1000 MHz			
-26.9	30.40325	Vertical	Middle, 30 MHz – 1 GHz
Above 1 GHz			
-1.99	7213	Vertical	Low, 1 GHz – 25 GHz

8.8 Radiated Emissions Test Plot & Data

1) 30 – 1000 MHz Measured at 3 meters

Worst Case, Middle Channel, 2445 MHz, measured at 3 meters



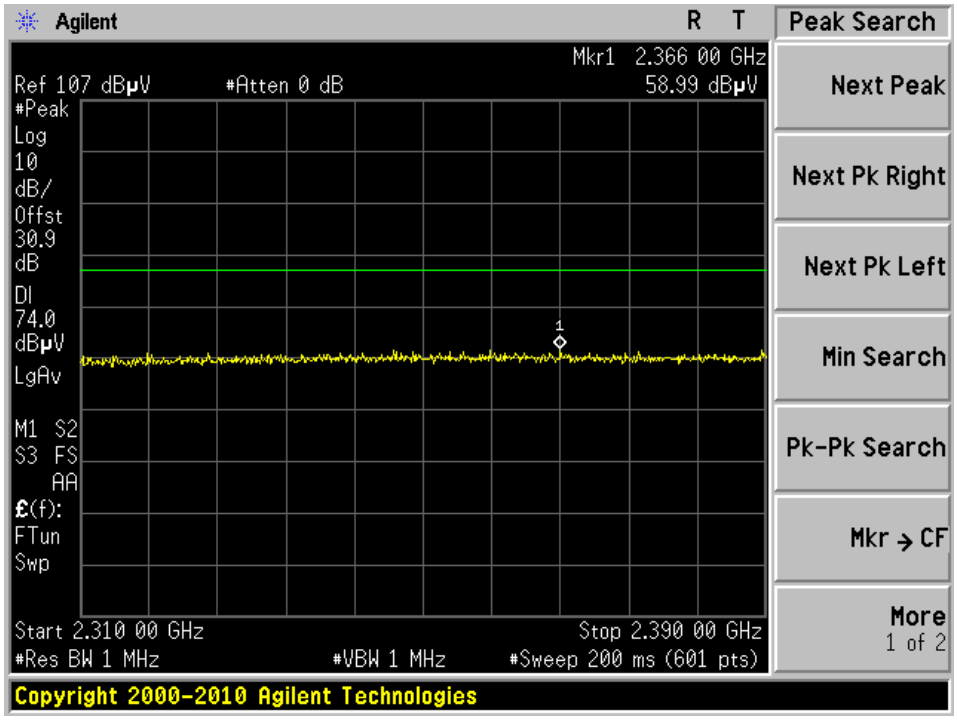
Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
30.40325	13.10	400	V	187	40.0	-26.90
128.6773	6.46	113	H	267	43.5	-37.04
260.0100	6.35	172	H	125	46.0	-39.65
32.60975	11.67	303	V	40	40.0	-28.33
94.74500	0.70	203	H	82	43.5	-42.80
42.8255	8.27	99	V	26	40.0	-31.73

2) Above 1 GHz Measured at 3 meters:

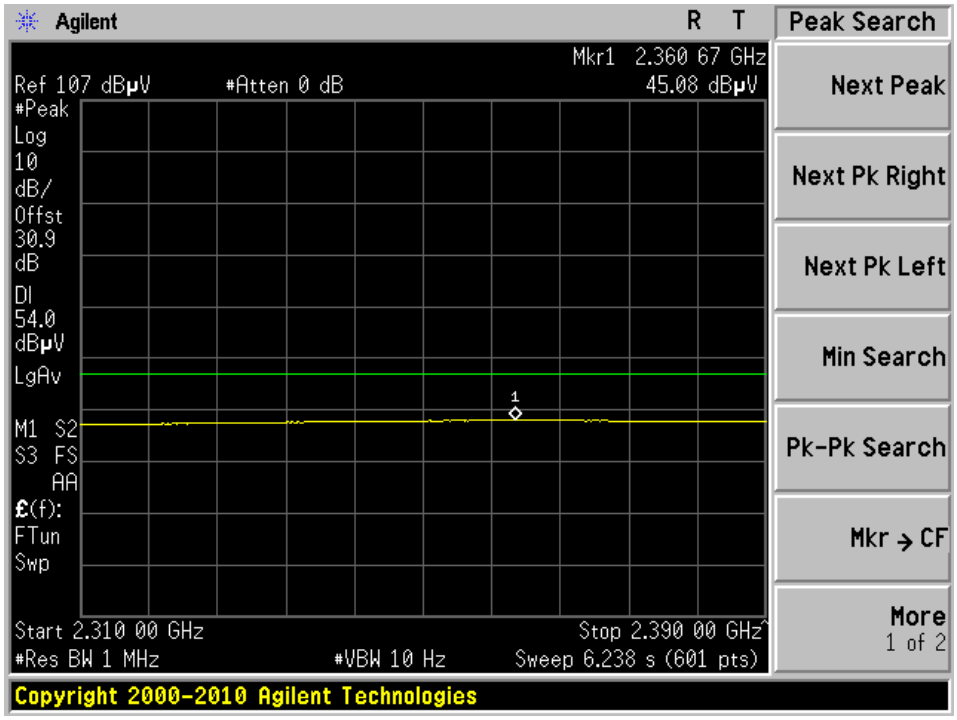
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2405 MHz, measured at 3 meters											
4808	43.92	24	144	V	32.9	4.56	27.5	53.880	74	-20.120	peak
4808	46.41	278	144	H	32.9	4.56	27.5	56.370	74	-17.630	peak
4808	32.68	24	144	V	32.9	4.56	27.5	42.640	54	-11.360	Ave
4808	35	278	144	H	32.9	4.56	27.5	44.960	54	-9.040	Ave
7213	47.35	21	138	V	37.7	5.57	26.9	63.720	74	-10.280	peak
7213	46.75	251	138	H	37.7	5.57	26.9	63.120	74	-10.880	peak
7213	35.64	21	138	V	37.7	5.57	26.9	52.010	54	-1.990	Ave
7213	35.02	251	138	H	37.7	5.57	26.9	51.390	54	-2.610	Ave
Middle Channel 2445 MHz, measured at 3 meters											
4888	41.72	193	166	V	32.9	4.56	27.5	51.680	74	-22.320	peak
4888	42.82	292	157	H	32.9	4.56	27.5	52.780	74	-21.220	peak
4888	29.46	193	166	V	32.9	4.56	27.5	39.420	54	-14.580	Ave
4888	30.38	292	157	H	32.9	4.56	27.5	40.340	54	-13.660	Ave
7336	44.83	21	135	V	37.7	5.57	26.9	61.20	74	-12.80	peak
7336	45.1	250	138	H	37.7	5.57	26.9	61.47	74	-12.53	peak
7336	33.39	21	135	V	37.7	5.57	26.9	49.76	54	-4.24	Ave
7336	32.71	250	138	H	37.7	5.57	26.9	49.08	54	-4.92	Ave
High Channel 2475 MHz, measured at 3 meters											
4951	39.92	203	147	V	32.9	4.56	27.5	49.88	74	-24.12	Peak
4951	41.32	296	133	H	32.9	4.56	27.5	51.28	74	-22.72	Peak
4951	27.63	203	147	V	32.9	4.56	27.5	37.59	54	-16.41	Ave
4951	28.9	296	133	H	32.9	4.56	27.5	38.86	54	-15.14	Ave
7423	45.28	21	132	V	37.7	5.57	26.9	61.65	74	-12.35	Peak
7423	44.05	243	133	H	37.7	5.57	26.9	60.42	74	-13.58	Peak
7423	33.17	21	132	V	37.7	5.57	26.9	49.54	54	-4.46	Ave
7423	31.39	243	133	H	37.7	5.57	26.9	47.76	54	-6.24	Ave

3) Restricted Band Edge:

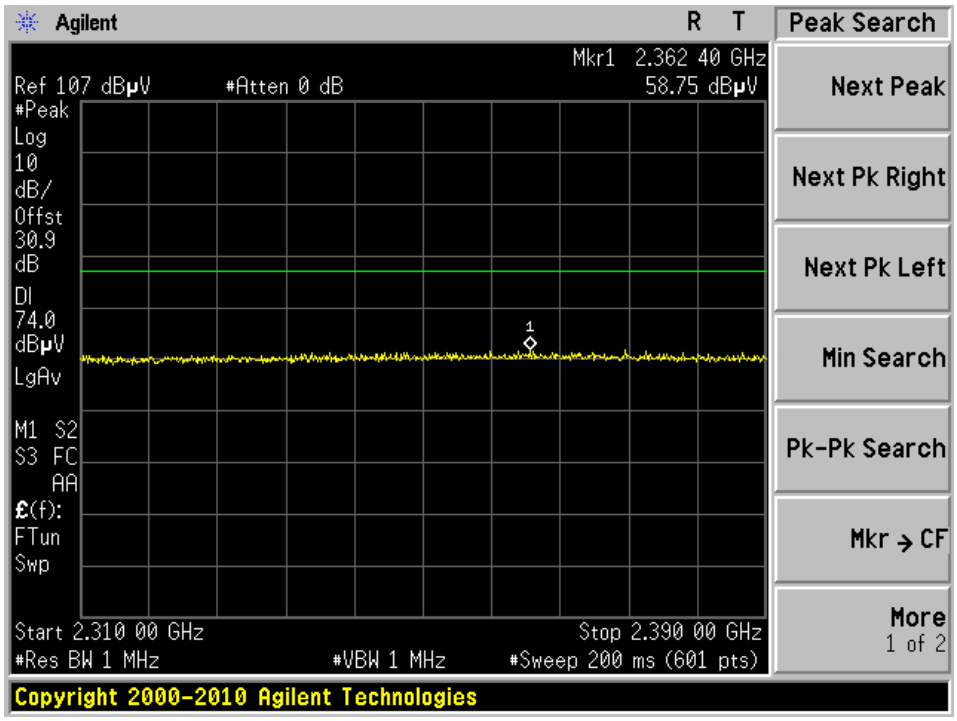
Lowest Channel at Horizontal, Peak



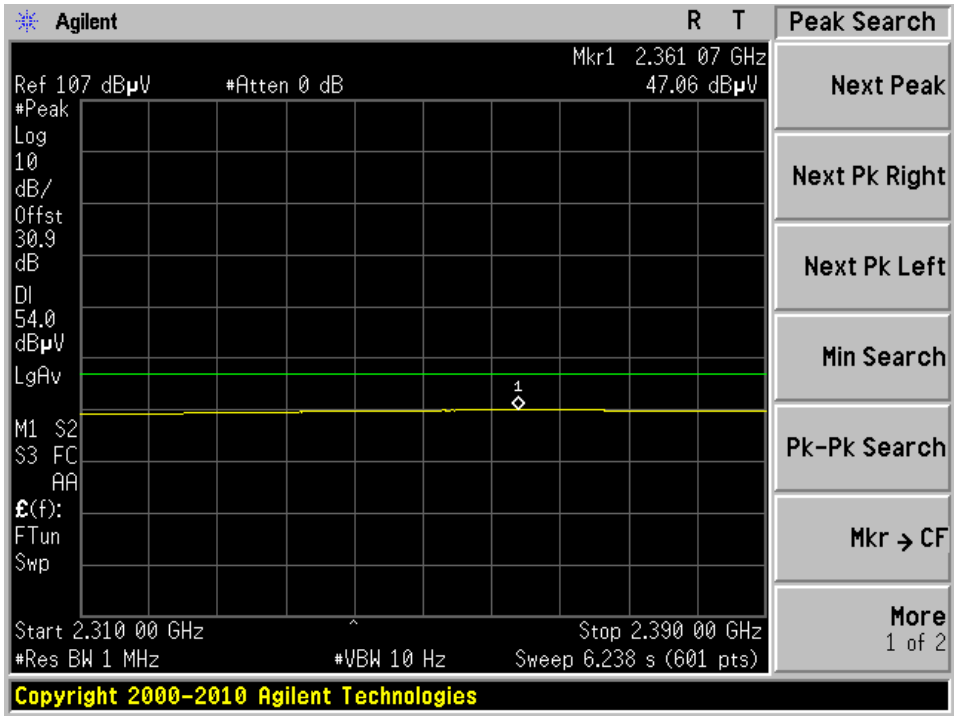
Lowest Channel at Horizontal, Average



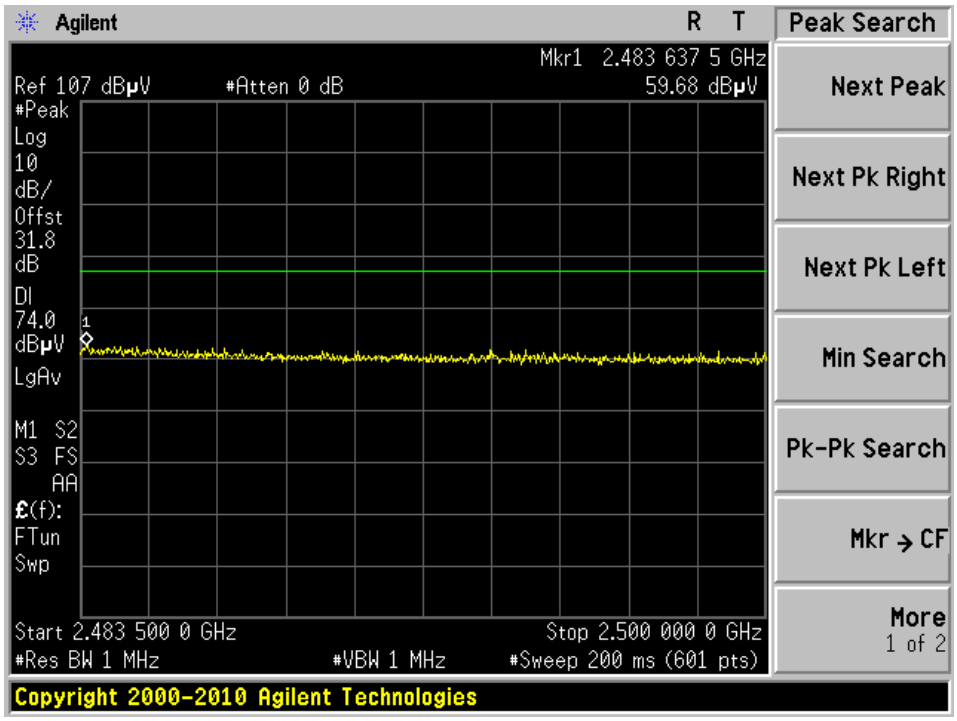
Lowest Channel at Vertical, Peak



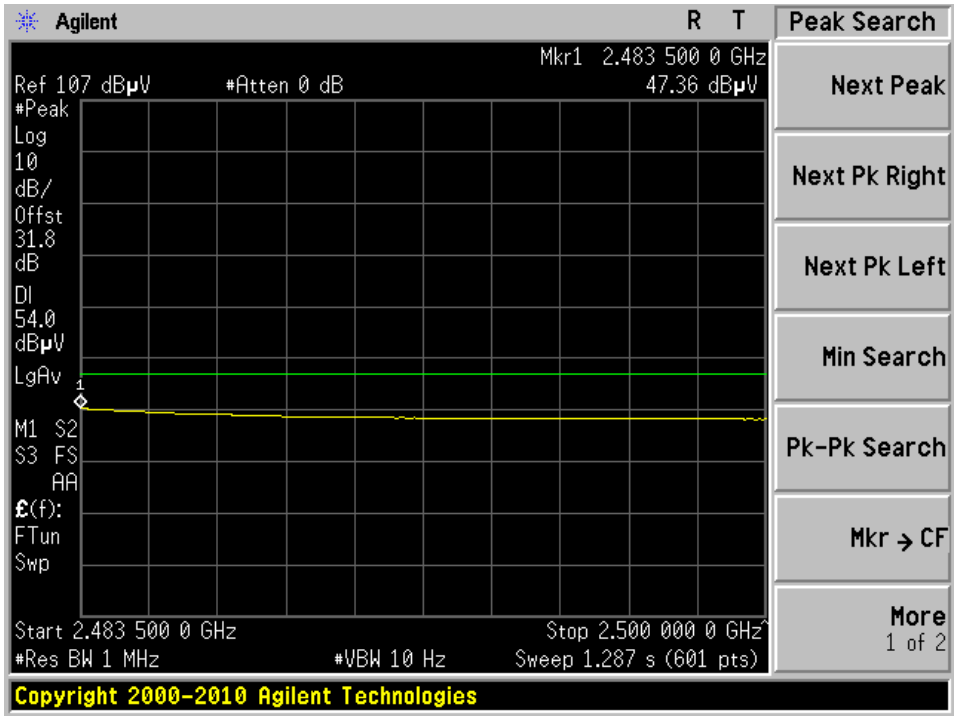
Lowest Channel at Vertical, Average



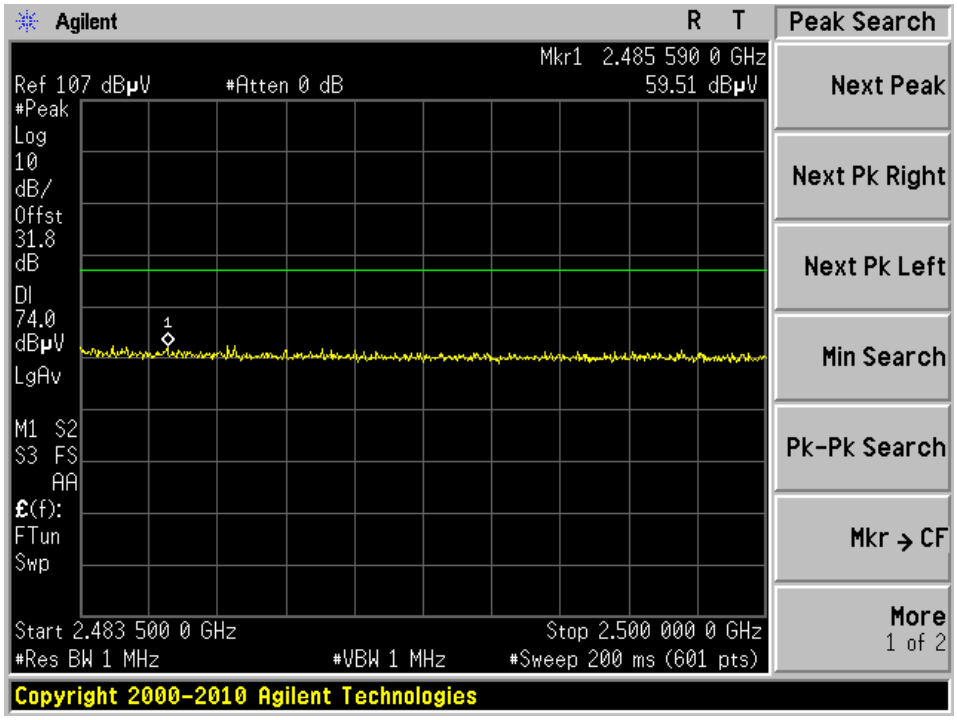
Highest Channel at Horizontal, Peak



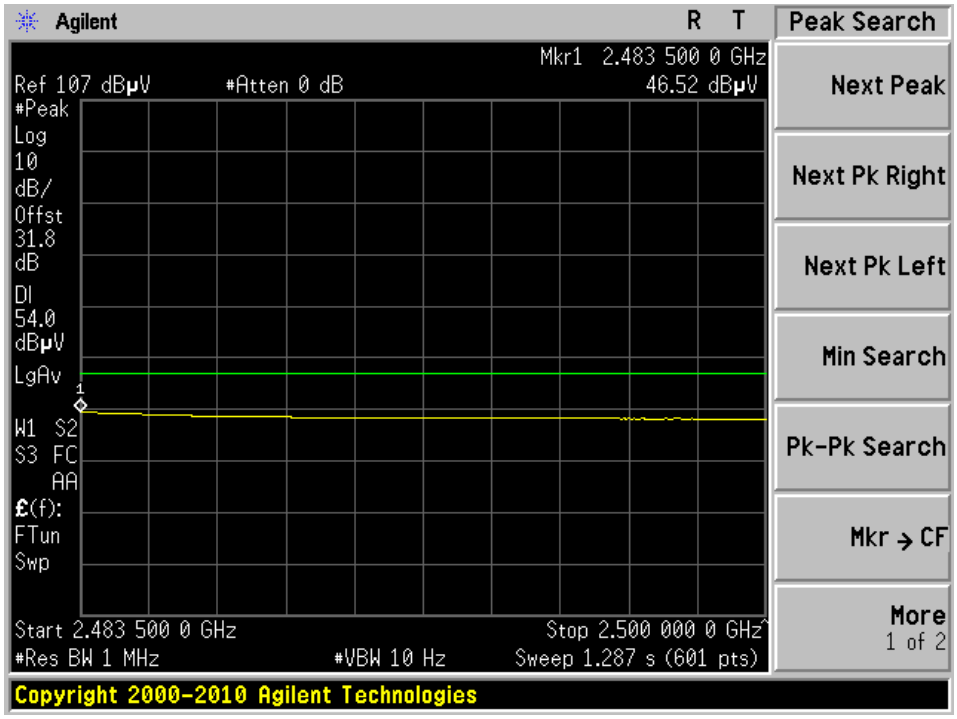
Highest Channel at Horizontal, Average



Highest Channel at Vertical, Peak



Highest Channel at Vertical, Average



9 FCC §15.247(a) (2) – 6 dB & 99% Emission Bandwidth

9.1 Applicable Standard

According to FCC §15.247(a)(2), systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz

9.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emissions bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

9.4 Test Environmental Conditions

Temperature:	20-24 °C
Relative Humidity:	40-44 %
ATM Pressure:	101.2kPa

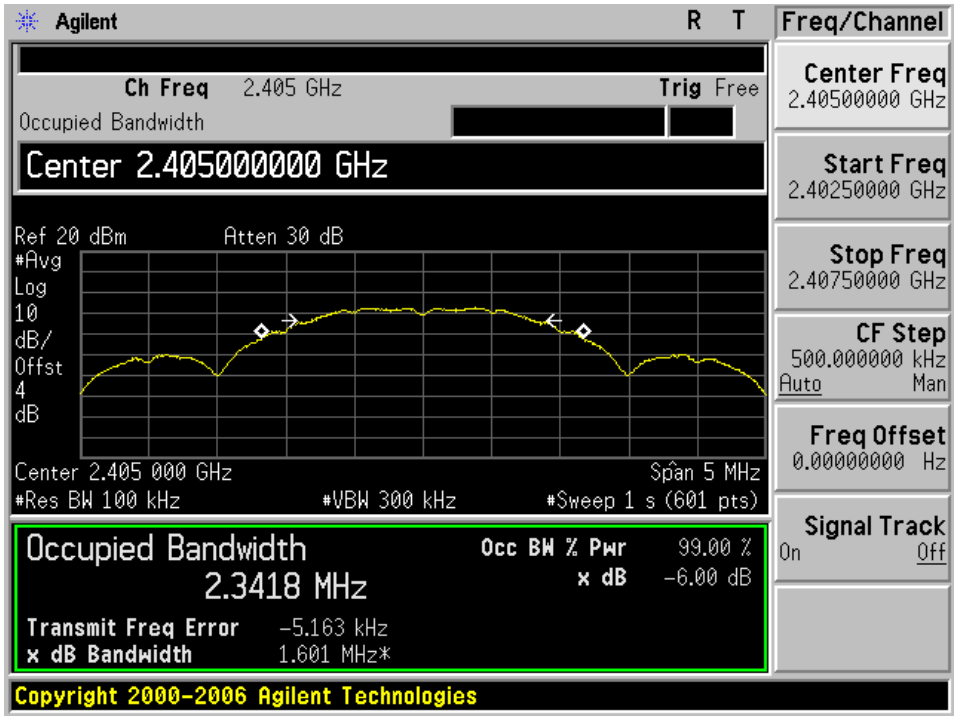
The testing was performed by Quinn Jiang on 2011-09-16 at RF Site.

9.5 Test Results

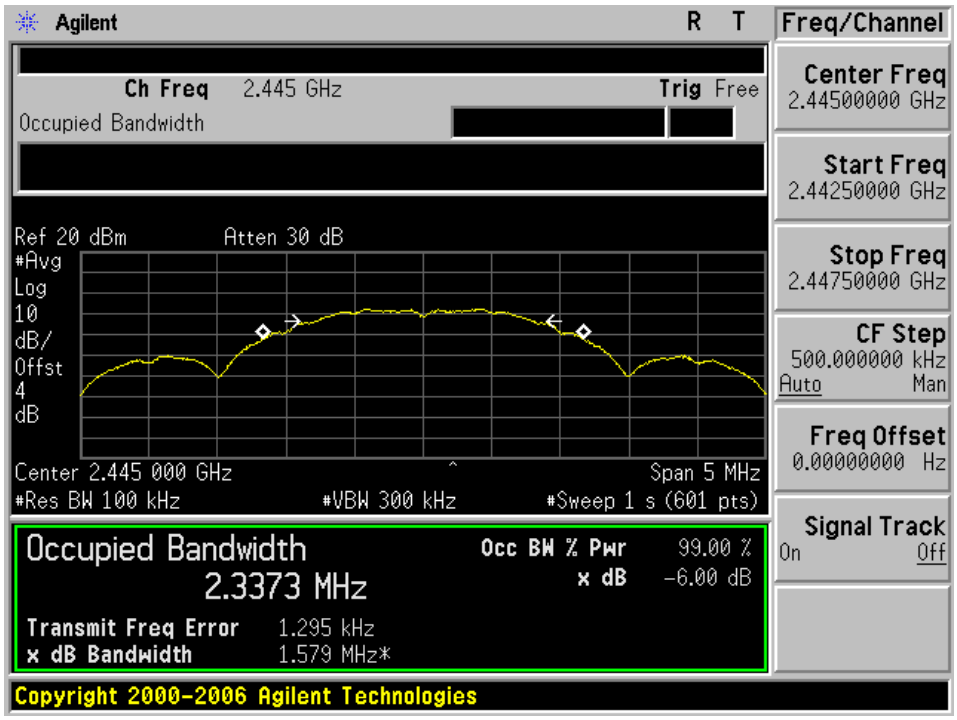
Channel	Frequency (MHz)	99% Emission Bandwidth (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)	Results
Low	2405	2.3418	1.601	> 0.5	Compliance
Middle	2445	2.3373	1.579	> 0.5	Compliance
High	2475	2.3306	1.579	> 0.5	Compliance

Please refer to the following plots for detailed test results

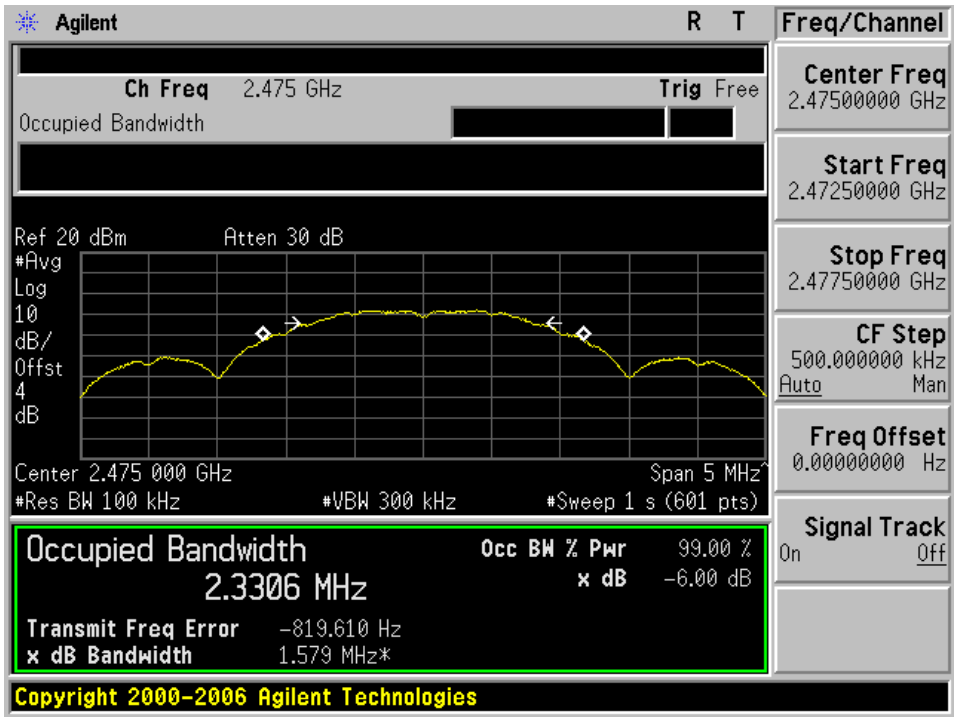
Low Channel, 2405 MHz



Middle Channel, 2445 MHz



High Channel, 2475 MHz



10 FCC §15.247(b) - Peak Output Power Measurement

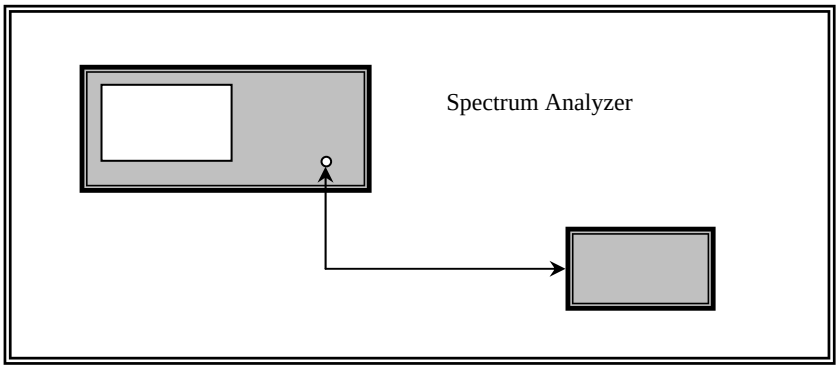
10.1 Applicable Standard

FCC §15.247(b) the maximum peak output power of the intentional radiator shall not exceed the following:

FCC §15.247(b) (3) for systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

10.2 Measurement Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to a spectrum analyzer.
3. Add a correction factor to the display.



10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

10.4 Test Environmental Conditions

Temperature:	20-24 °C
Relative Humidity:	40-44 %
ATM Pressure:	101.2kPa

The testing was performed by Quinn Jiang on 2011-09-16 at RF Site.

10.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power		FCC Limit (dBm)	Margin (dB)
		(dBm)	(mW)		
Low	2405	3.19	2.08	30	-26.81
Mid	2445	2.80	1.91	30	-27.20
High	2475	2.50	1.78	30	-27.50

11 FCC §15.247(d) - 100 kHz Bandwidth of Band Edges

11.1 Applicable Standard

According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in FCC §15.209(a) see FCC §15.205(c)).

11.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

11.4 Test Environmental Conditions

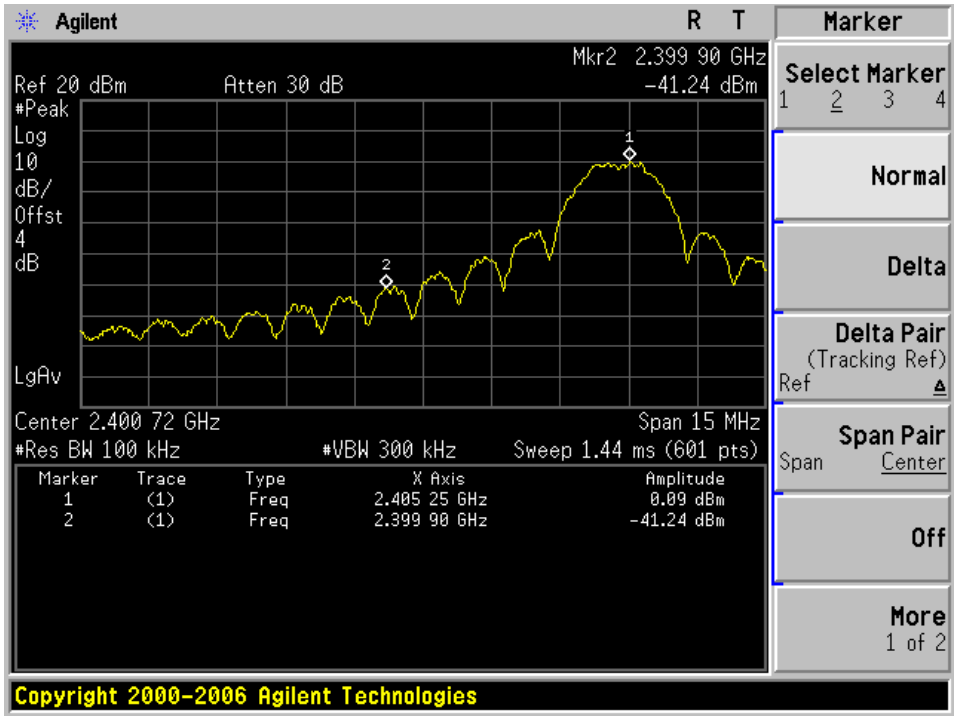
Temperature:	20-24 °C
Relative Humidity:	40-44 %
ATM Pressure:	101.2kPa

The testing was performed by Quinn Jiang on 2011-09-16 at RF Site.

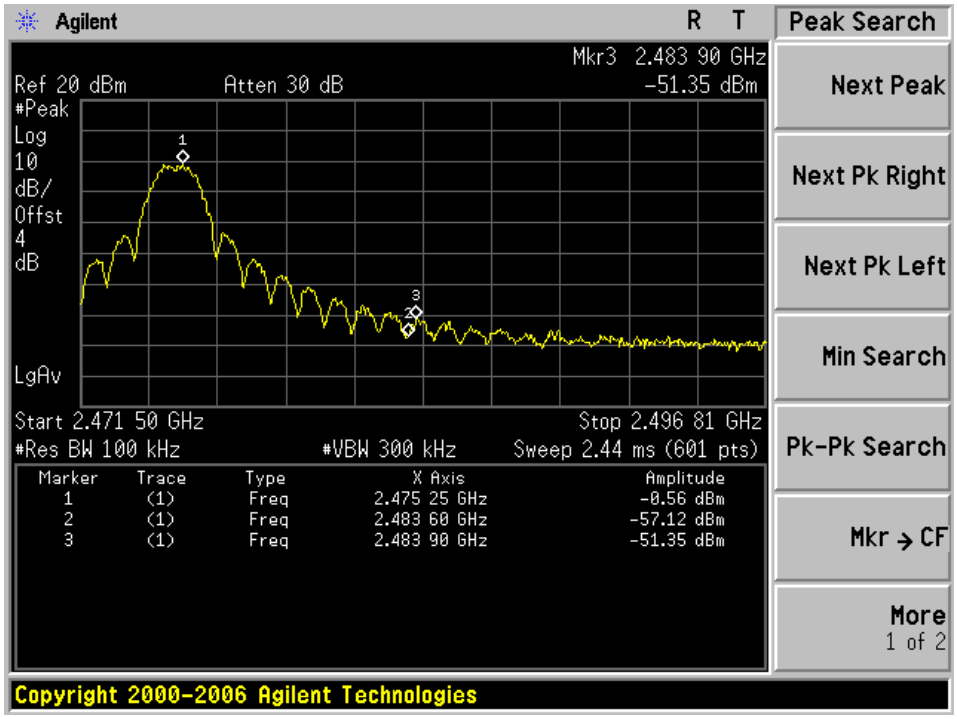
11.5 Test Results

Please refer to following pages for plots of band edge.

Low Band Edge



High Band Edge



12 FCC §15.247(e) - Power Spectral Density

12.1 Applicable Standard

According to FCC §15.247 (e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

12.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to 1.5 MHz span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Repeat above procedures until all frequencies measured were complete.

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

12.4 Test Environmental Conditions

Temperature:	20-24 °C
Relative Humidity:	40-44 %
ATM Pressure:	101.2kPa

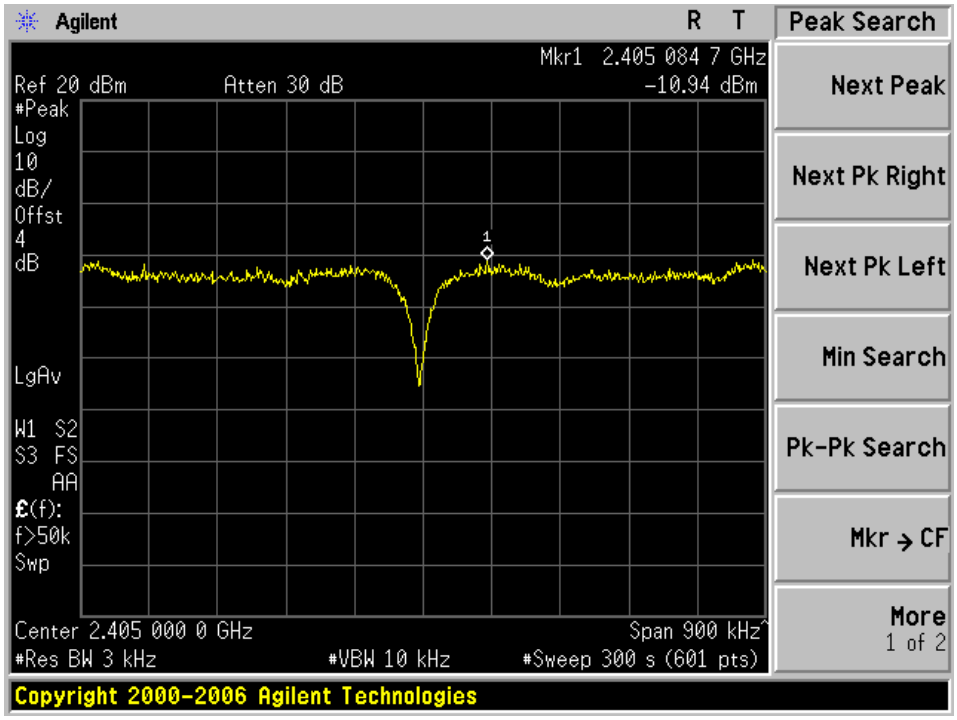
The testing was performed by Quinn Jiang on 2011-09-16 at RF Site.

12.5 Test Results

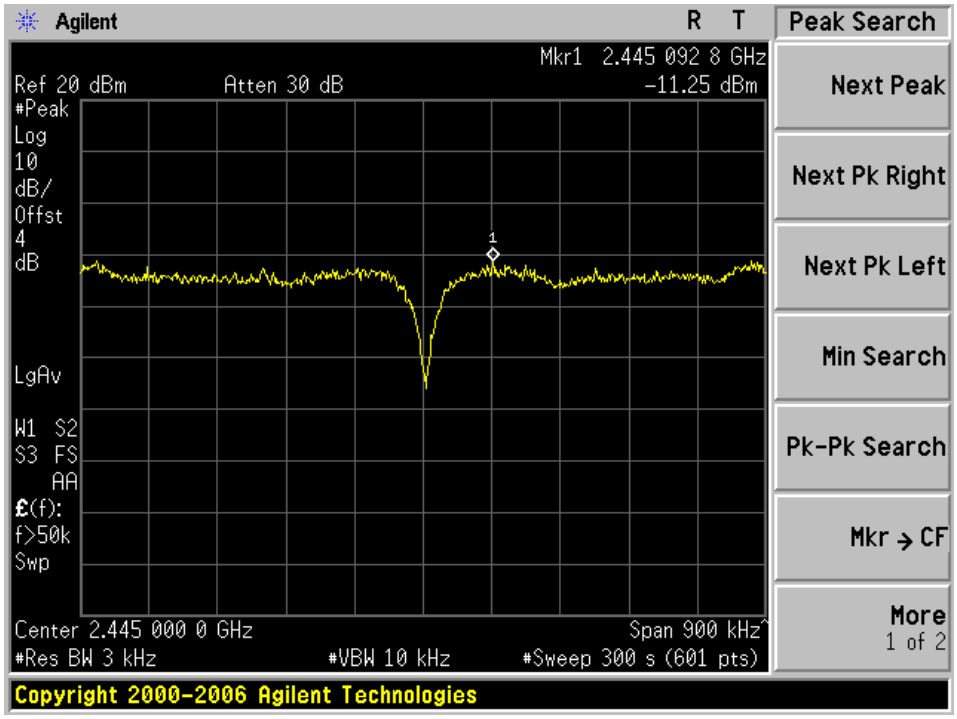
Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Results
Low	2405	-10.94	8	Compliance
Mid	2445	-11.25	8	Compliance
High	2475	-11.52	8	Compliance

Please refer to the following plots for detailed test results:

Low Channel, 2405 MHz



Middle Channel, 2445 MHz



High Channel, 2475 MHz