Lab Code: 200167-0

FCC PART 15 SUBPART C

TEST AND MEASUREMENT REPORT

For

PulseIQ! LLC

3241 Highland Lane,

Fairfax, VA 22031, USA

FCC ID: Z99-TSTATONE

Report Type:	**Product Type:**
Original Report	Thermostat with Zigbee Transceiver

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1111102-247	Original Report	2011-12-16

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *PulseIQ! LLC*, and their product FCC ID: Z99-TSTATONE, model: *TstatOne* which will henceforth be referred to as the EUT (Equipment Under Test). The EUT is a thermostat with Zigbee Transceiver working at 2405-2480 MHz.

1.2 Mechanical Description of EUT

The "EUT" measures *10.0cm (L) x 12.0cm (W) x 2.0cm (H)*, and weighs approximately *112g*.

The test data gathered are from typical production sample with s/n: 5C for Conducted Test.
The test data gathered are from typical production sample with s/n: 4C for Radiated Test.

1.3 Objective

This report is prepared on behalf of *PulseIQ! LLC.* in accordance with Part 2, Subpart J, and Part 15, Subparts C of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15.247 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)

No Related Submittals.

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2009, 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.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the 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 CISPR16-4-2:2003, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB 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 Corp.

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 site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have 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 test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2003, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: R-3729, C-4176, G-469, and T-1206. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. 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 EUT was configured for testing according to ANSI C63.4-2009.

The EUT had been tested with the following channels:

Radio Mode	Frequency		
	Low CH (MHz)	Mid CH (MHz)	High CH (MHz)
Zigbee	2405	2440	2480

2.2 EUT Exercise Software

The test utility f/w using was provided by the client and the f/w is built into the system. The s/w will control the device in fixed channel with the rated MAX output power with modulation of pseudorandom data. The s/w and f/w with verify by Victor from BACL.

2.3 Special Equipment

N/A

2.4 Equipment Modifications

N/A

2.5 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
Skynet Electronic	AC/DC Adapter	SNP-K026-D	000308558
Everfine	DC Power Supply	WY305	809024

2.6 Power Supply List and Details

AC/DC Power Adaptor.

2.7 EUT Internal Configuration Details

Conducted Unit, s/n: 5C

Manufacturers	Description	Model No.	Serial No.
PulseIQ! LLC	Main PCB Board	TstatOne	5C

Radiated Unit, s/n: 4C

Manufacturers	Description	Model No.	Serial No.
PulseIQ! LLC	Main PCB Board	TstatOne	4C

2.8 External I/O Cabling List and AC Cord

Cable Description	Length (m)	From	To
RF cable	< 1m	EUT	PSA

3 Summary of Test Results

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
§15.247(i), §2.1091	RF Exposure Information	Compliant
§15.203	Antenna Requirement	Compliant
§15.207(a)	Conducted Emissions	Compliant
§15.209	Spurious Emissions at Antenna Port	Compliant
§15.205	Restricted Bands	Compliant
§15.209, §15.247	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 Standard

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.

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)
Limits for General Population/Uncontrolled Exposure				
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 = power 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):	19.07
Maximum peak output power at antenna input terminal (mW):	80.72
Prediction distance (cm):	20
Prediction frequency (MHz):	2440
Maximum Antenna Gain, typical (dBi):	3.3
Maximum Antenna Gain (numeric):	2.14
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.034
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with FCC MPE requirement for uncontrolled exposure at 20 cm distance. The maximum power density at the distance of 20 cm is 0.034 mW/cm2. FCC Limit is 1.0 mW/cm^2.

5 FCC §15.203 – Antenna Description

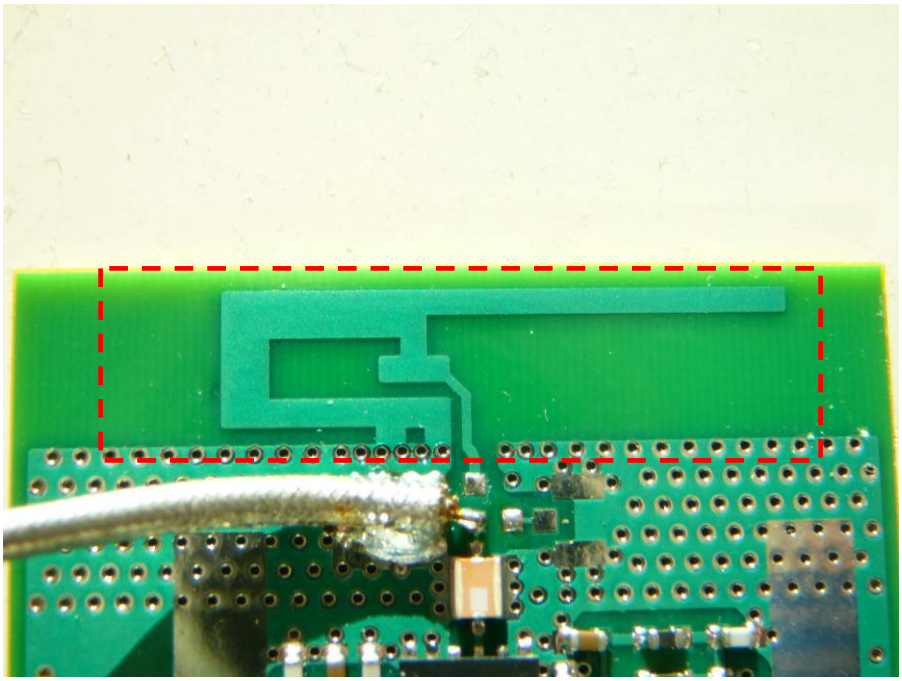
5.1 Applicable Standard

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

The radio has an internal PCB antenna with 3.3 dBi Max antenna gains which fulfilled with the FCC §15.203 antenna requirement.



Antenna Photo

6 FCC §15.207 – AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §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 Note 1	56 to 46 Note 1
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4-2009 measurement procedure. The specification used was FCC §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 EUT was connected with LISN-1 which provided 120 V/60 Hz AC power.

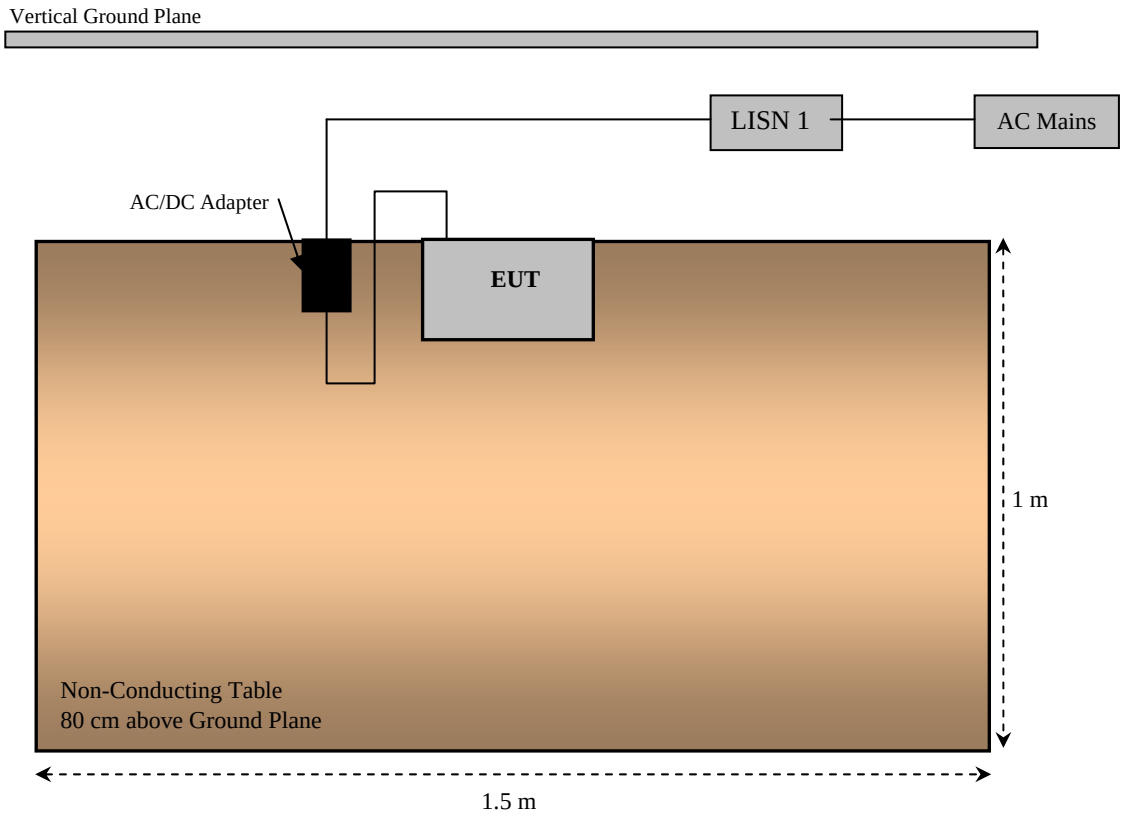
6.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-2.

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”.

6.4 Test Setup Block Diagram



6.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Cable Loss (CL), the Attenuator Factor (Atten) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + CL + Atten

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Cable Loss (3.7 dB) + Attenuator (10 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within 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 - Limit

6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100044	2011-04-14
Solar Electronics	LISN	9252-R-24-BNC	511205	2011-06-25
TTE	Filter, High Pass	H9962-150K-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.

6.7 Test Environmental Conditions

Temperature:	17 °C
Relative Humidity:	49%
ATM Pressure:	102.3kPa

The testing was performed by Ning Ma on 2011-12-14 at 5meter chamber3.

6.8 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 margin reading of:

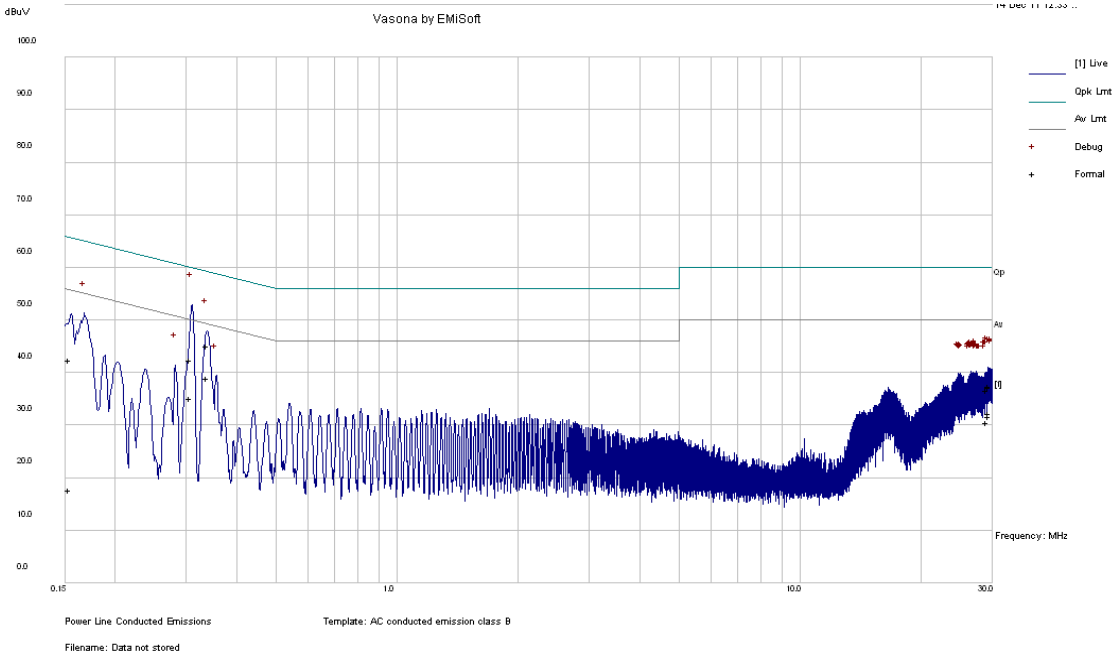
Transmitting Mode the Worst Channel: Middle channel

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-10.27	0.338793	Line	0.15 to 30

6.9 Conducted Emissions Test Plots and Data

Transmitting Mode the Worst Channel: Middle channel

120 V, 60 Hz – Line



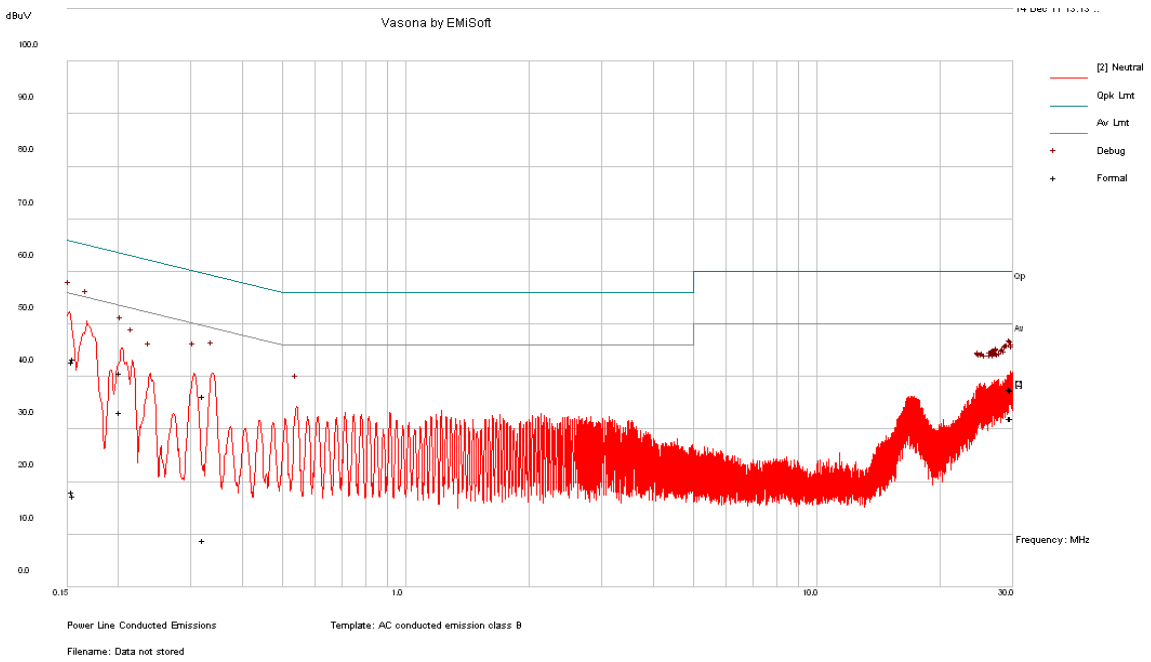
Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.338793	45.04	Line	59.23	-14.19
0.307509	42.5	Line	60.04	-17.54
29.53527	37.51	Line	60	-22.49
29.39636	37.29	Line	60	-22.71
29.15521	36.78	Line	60	-23.22
0.153813	42.35	Line	65.79	-23.44

Average Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.338793	38.96	Line	49.23	-10.27
0.307509	35.16	Line	50.04	-14.88
29.53527	32.32	Line	50	-17.68
29.39636	31.74	Line	50	-18.26
29.15521	30.48	Line	50	-19.52
0.153813	17.8	Line	55.79	-37.99

120 V, 60 Hz – Neutral



Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.155988	43.35	Neutral	65.67	-22.32
29.60019	37.58	Neutral	60	-22.42
29.87678	37.45	Neutral	60	-22.55
0.154497	42.9	Neutral	65.75	-22.85
0.201792	40.67	Neutral	63.54	-22.86
0.321744	36.38	Neutral	59.66	-23.29

Average Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
29.87678	32.15	Neutral	50	-17.85
29.60019	32.03	Neutral	50	-17.97
0.201792	33.32	Neutral	53.54	-20.22
0.154497	18.12	Neutral	55.75	-37.64
0.155988	17.32	Neutral	55.67	-38.35
0.321744	8.9	Neutral	49.66	-40.76

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.

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	E4440A	MY44303352	2011-05-10

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:	22.2 °C
Relative Humidity:	34 %
ATM Pressure:	102.7kPa

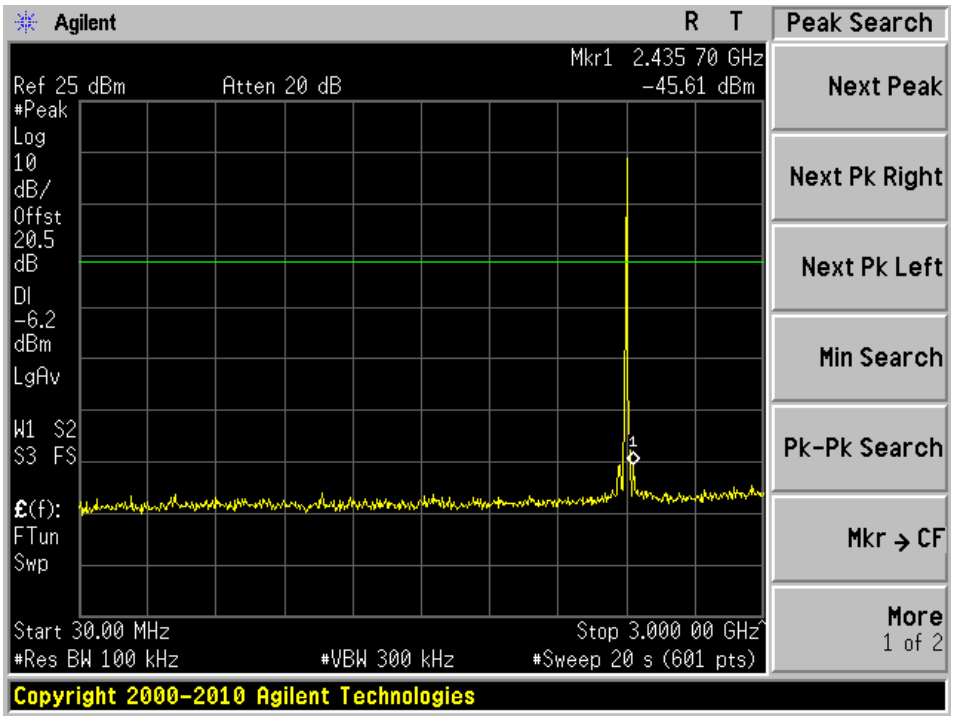
The testing was performed by Victor Zhang on 2011-11-17 at RF Site.

7.5 Measurement Result

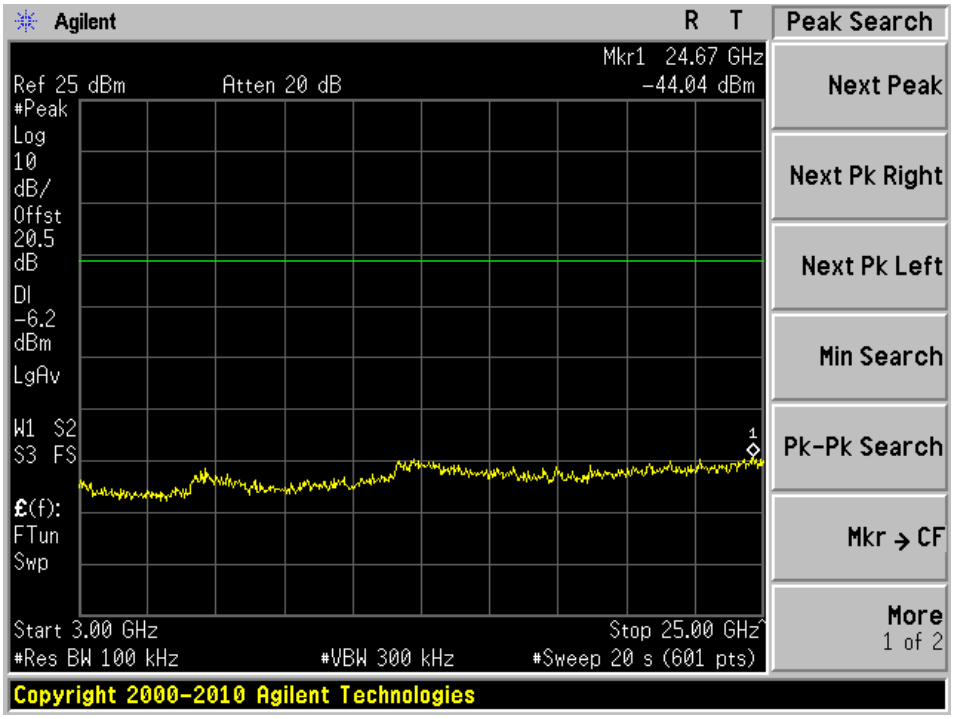
Please refer to following plots of spurious emissions.

Low Channel: 2405 MHz

Plot range: 30 MHz – 3 GHz

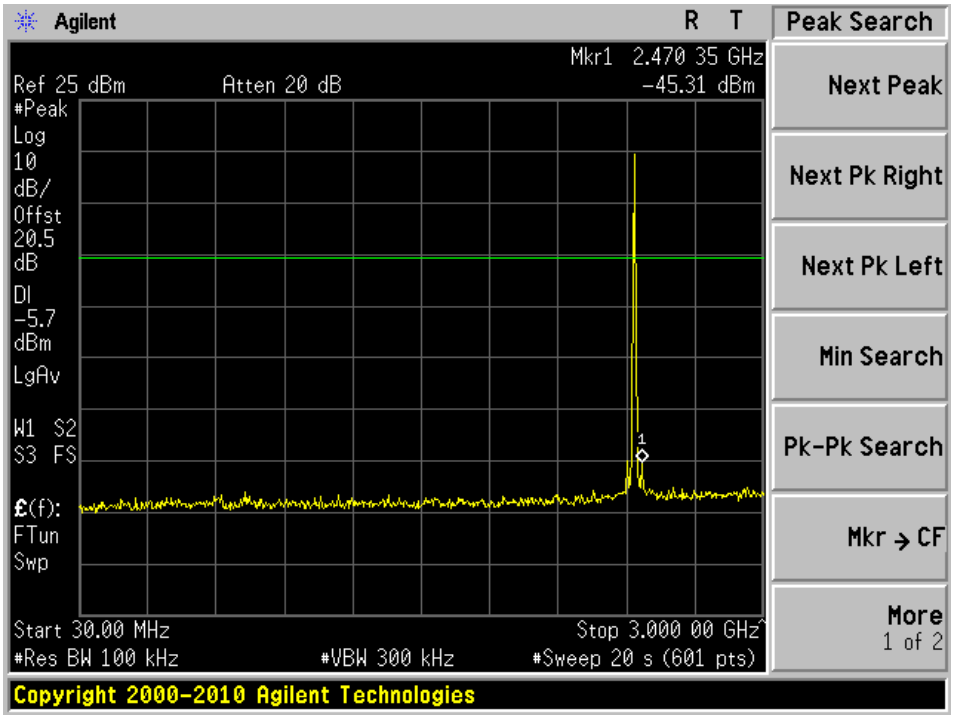


Plot range: 3 GHz – 25 GHz

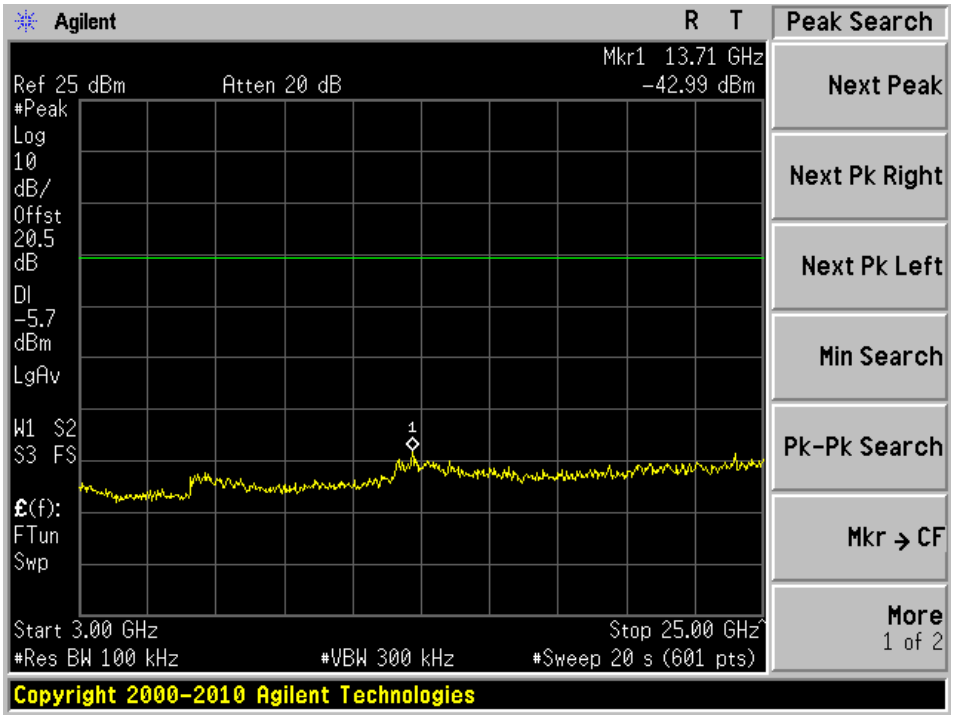


Middle Channel: 2440 MHz

Plot range: 30 MHz – 3 GHz

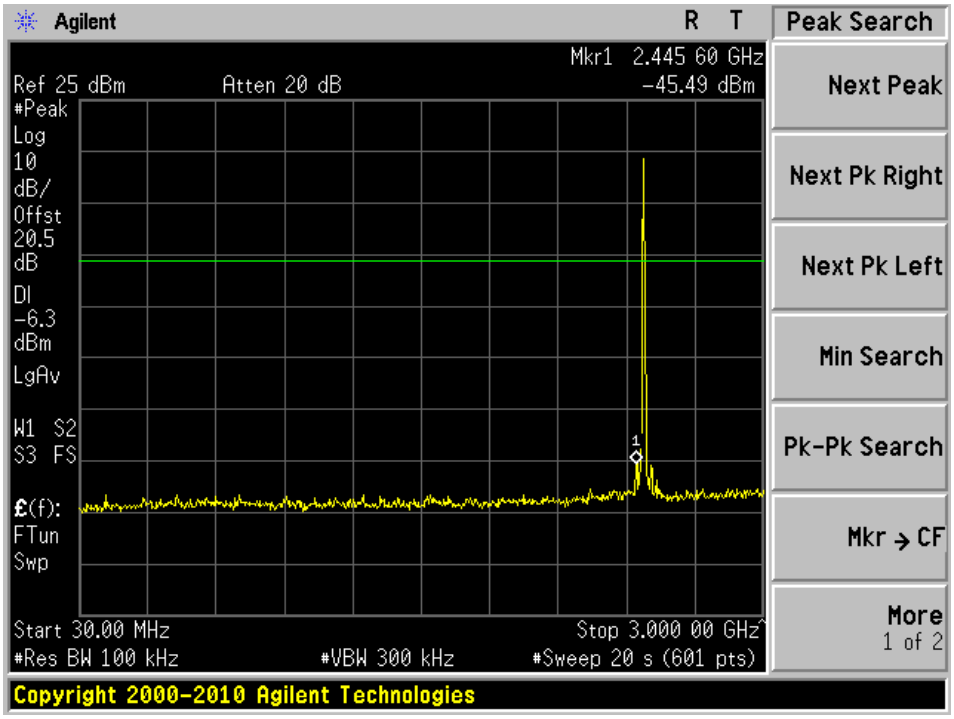


Plot range: 3 GHz – 25 GHz

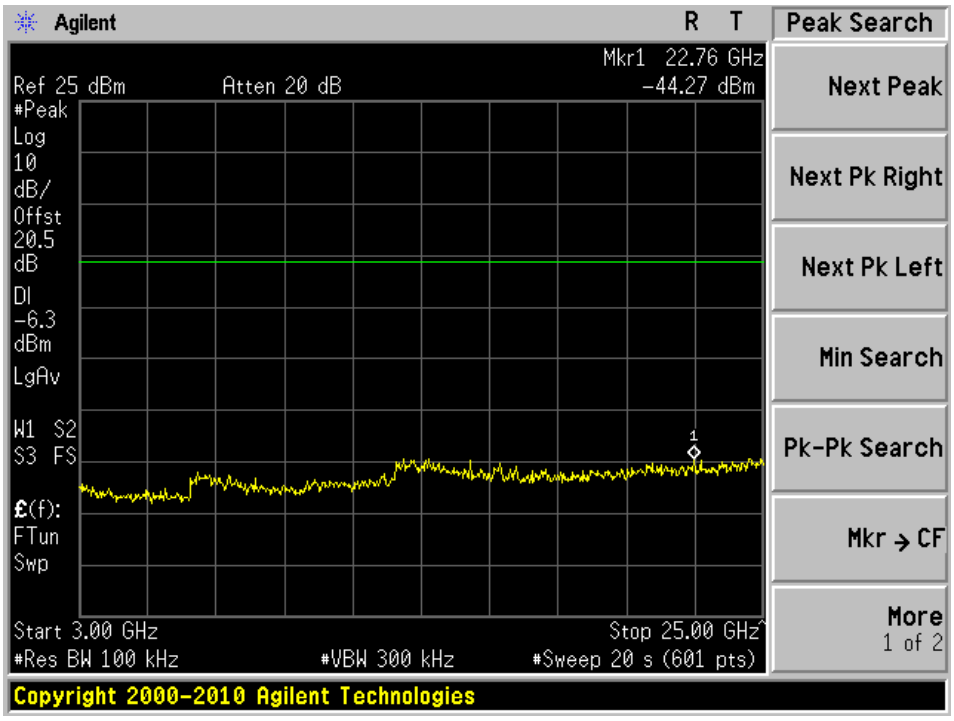


High Channel: 2480 MHz

Plot range: 30 MHz – 3 GHz



Plot range: 3GHz – 25GHz



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

8.1 Applicable Standard

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) and RSS-210: 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 Note 1	3
88 - 216	150 Note 1	3
216 - 960	200 Note 1	3
Above 960	500	3

Note 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:

MHz	MHz	MHz	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 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3 3458 – 3 358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	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 C63.4-2009. The specification used was the FCC 15 Subpart C limits.

8.3 EUT Setup

The radiated emissions tests were performed using the setup accordance with the ANSI C63.4-2009. The specification used was the FCC 15C limits.

The spacing between the peripherals was 3 centimeters.

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

8.4 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords was connected to the 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

8.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to the indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, the Corrected Amplitude (CA) of 40.3 dBuV/m = indicated Amplitude reading (Ai) 32.5 dBuV + Antenna Factor (AF) 23.5dB + Cable Loss (CL) 3.7 dB + Attenuator (Atten) 10 dB - Amplifier Gain (Ga) 29.4 dB

The "**Margin**" column of the following data tables indicates the degree of compliance within 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 - Limit

8.6 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
Agilent	Spectrum Analyzer	E4440A	MY44303352	2011-05-10
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB3	A0020106-3	2011-06-29
A.R.A Inc	Horn antenna	DRG-1181A	1132	2010-11-29
Hewlett Packard	Pre amplifier	8447D	2944A06639	2011-06-09
Mini-Circuits	Pre Amplifier	ZVA-183-S	570400946	2011-05-09

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

8.7 Test Environmental Conditions

Temperature:	22.2 °C
Relative Humidity:	34 %
ATM Pressure:	102.7kPa

The testing was performed by Victor Zhang on 2011-11-18 in 5 meter chamber #3.

8.8 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Part 15.209 standard's radiated emissions limits, and had the worst margin of:

30-1000 MHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-10.75	105.627	Vertical	Middle Channel, 30-1000 MHz

1 – 25 GHz:

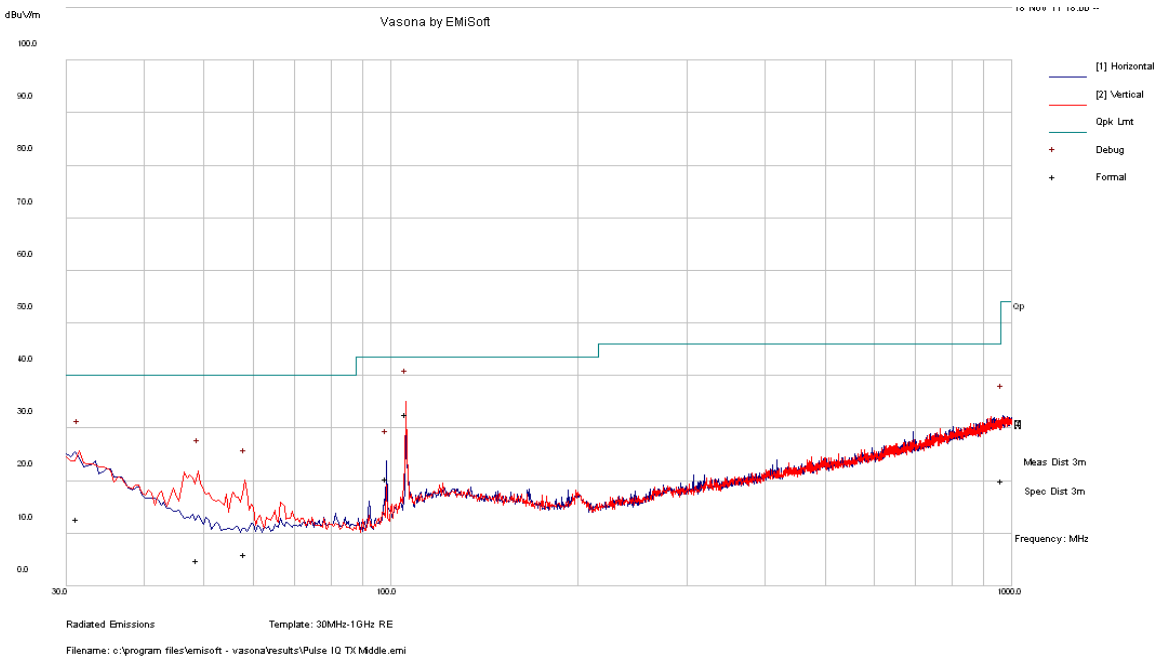
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-0.8	7320	Vertical	Middle Channel, 1 GHz – 25 GHz

Please refer to the following table and plots for specific test result details

8.9 Radiated Emissions Test Data and Plots

1) 30 MHz – 1 GHz, Measured at 3 meters

(Worst Channel: Middle Channel 2440 MHz)



Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
105.627	32.75	126	V	146	43.5	-10.75
98.4655	20.35	218	H	126	43.5	-23.15
31.2105	12.8	234	V	37	40	-27.20
58.2955	6.11	166	V	160	40	-33.89
965.6028	20.04	225	H	23	54	-33.96
48.84125	4.93	255	V	360	40	-35.07

2) 1 – 25 GHz, Measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC 15C		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2405 MHz, measured at 3 meters											
2405	87.24	115	100	V	28.16	3.12	0	118.52	Fund	-	Peak
2405	83.48	224	119	H	28.16	3.12	0	114.76	Fund	-	Peak
2405	84.95	115	100	V	28.16	3.12	0	116.23	Fund	-	Ave
2405	81.69	224	119	H	28.16	3.12	0	112.97	Fund	-	Ave
4810	41.92	0	145	V	32.63	4.56	27.71	51.4	74	-22.6	Peak
4810	40.83	112	110	H	32.63	4.56	27.71	50.31	74	-23.69	Peak
4810	37.01	0	145	V	32.63	4.56	27.71	46.49	54	-7.51	Ave
4810	35.35	112	110	H	32.63	4.56	27.71	44.83	54	-9.17	Ave
7215	45.91	297	100	V	35.47	5.49	27.48	59.39	74	-14.61	Peak
7215	44.98	231	127	H	35.47	5.49	27.48	58.46	74	-15.54	Peak
7215	37.27	297	100	V	35.47	5.49	27.48	50.75	54	-3.25	Ave
7215	36.55	231	127	H	35.47	5.49	27.48	50.03	54	-3.97	Ave
Middle Channel 2440 MHz, measured at 3 meters											
2440	85.85	112	100	V	28.16	3.25	0	117.26	Fund	-	Peak
2440	84.03	226	115	H	28.16	3.25	0	115.44	Fund	-	Peak
2440	84.07	112	100	V	28.16	3.25	0	115.48	Fund	-	Ave
2440	82.1	226	115	H	28.16	3.25	0	113.51	Fund	-	Ave
4880	42.09	0	140	V	32.73	4.52	27.71	51.63	74	-22.37	Peak
4880	41.97	115	110	H	32.73	4.52	27.71	51.51	74	-22.49	Peak
4880	37.69	0	140	V	32.73	4.52	27.71	47.23	54	-6.77	Ave
4880	36.01	115	110	H	32.73	4.52	27.71	45.55	54	-8.45	Ave
7320	47.75	321	139	V	35.94	5.57	27.99	61.27	74	-12.73	Peak
7320	46.68	224	115	H	35.94	5.57	27.99	60.2	74	-13.8	Peak
7320	39.68	321	139	V	35.94	5.57	27.99	53.2	54	-0.8	Ave
7320	38.29	224	115	H	35.94	5.57	27.99	51.81	54	-2.19	Ave
High Channel 2480 MHz, measured at 3 meters											
2480	85.08	135	100	V	28.27	3.25	0	116.6	Fund	-	Peak
2480	83.06	204	115	H	28.27	3.25	0	114.58	Fund	-	Peak
2480	82.49	135	100	V	28.27	3.25	0	114.01	Fund	-	Ave
2480	81.14	204	115	H	28.27	3.25	0	112.66	Fund	-	Ave
4960	41.53	0	140	V	32.97	4.57	27.51	51.56	74	-22.44	Peak
4960	39.06	109	112	H	32.97	4.57	27.51	49.09	74	-24.91	Peak
4960	36.03	0	140	V	32.97	4.57	27.51	46.06	54	-7.94	Ave
4960	33.53	109	112	H	32.97	4.57	27.51	43.56	54	-10.44	Ave
7440	46.25	326	123	V	36.14	5.66	27.86	60.19	74	-13.81	Peak
7440	45.27	279	113	H	36.14	5.66	27.86	59.21	74	-14.79	Peak
7440	38.63	326	123	V	36.14	5.66	27.86	52.57	54	-1.43	Ave
7440	37.27	279	113	H	36.14	5.66	27.86	51.21	54	-2.79	Ave

3) Restricted Band Emissions

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC 15C		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2405 MHz, measured at 3 meters 2310-2390 MHz											
2373.73	29.87	115	100	V	28.16	3.12	0	61.15	74	-12.85	Peak
2373.73	28.36	224	119	H	28.16	3.12	0	59.64	74	-14.36	Peak
2373.73	21.55	115	100	V	28.16	3.12	0	52.83	54	-1.17	Ave
2373.73	21.18	224	119	H	28.16	3.12	0	52.46	54	-1.54	Ave
High Channel 2480 MHz, measured at 2483.5-2500 MHz											
2483.5	36.34	135	100	V	28.27	3.25	0	67.86	74	-6.14	Peak
2483.5	37.04	204	115	H	28.27	3.25	0	68.56	74	-5.44	Peak
2483.5	21.28	135	100	V	28.27	3.25	0	52.8	54	-1.2	Ave
2483.5	22.04	204	115	H	28.27	3.25	0	53.56	54	-0.44	Ave

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	E4440A	MY44303352	2011-05-10

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:	22.2 °C
Relative Humidity:	34 %
ATM Pressure:	102.7kPa

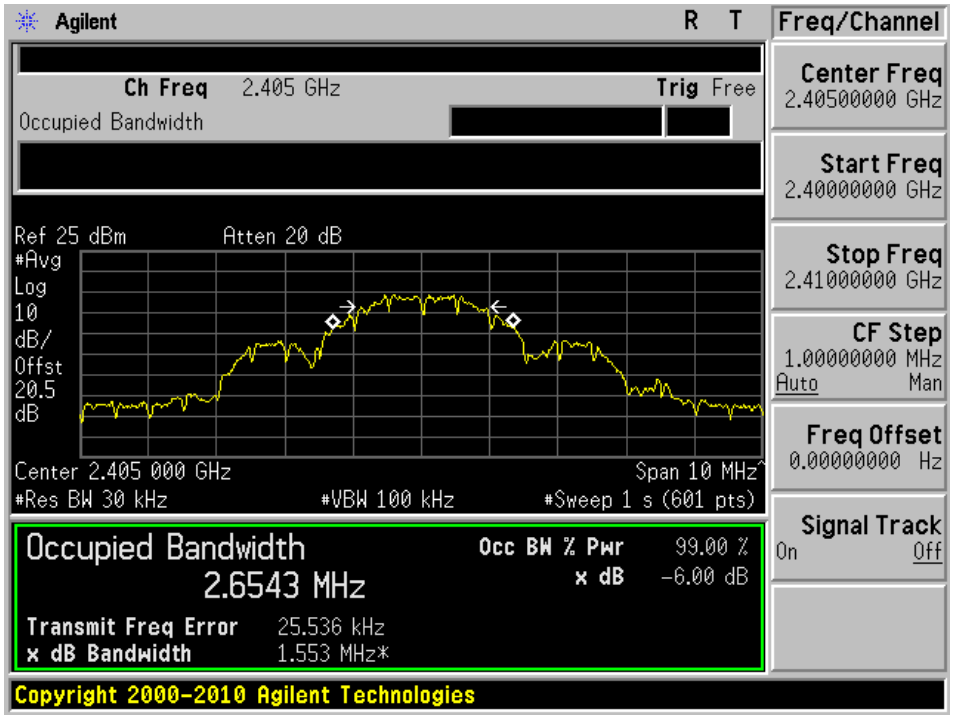
The testing was performed by Victor Zhang on 2011-11-17 at RF Site.

9.5 Summary of Test Results

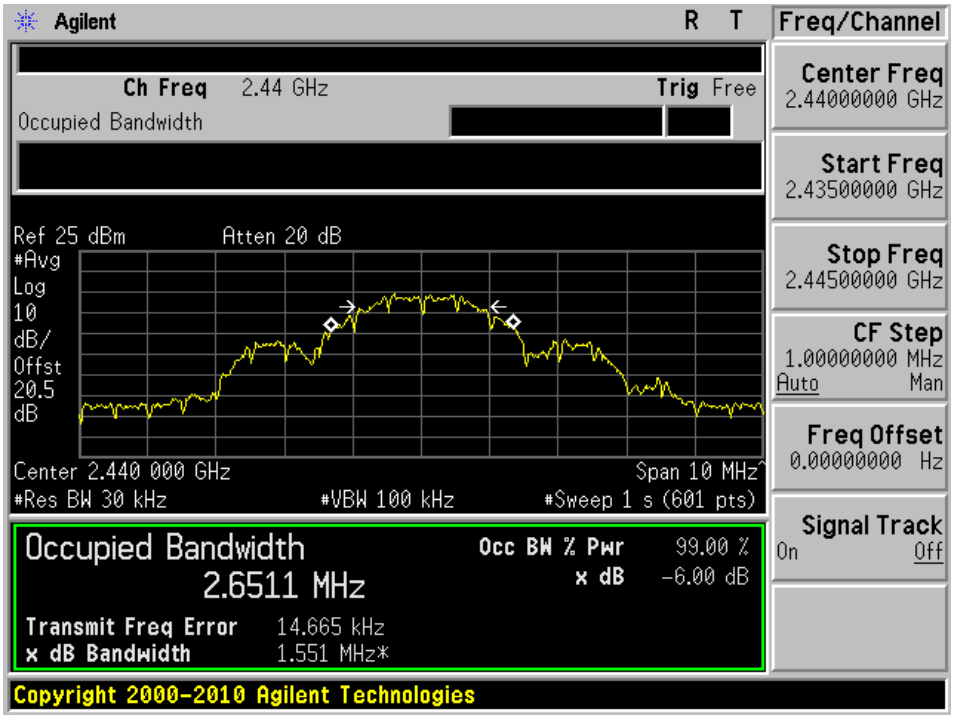
Channel	Frequency (MHz)	99% Emission Bandwidth (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)	Results
Low	2405	2.6543	1.553	> 0.5	Compliant
Middle	2440	2.6511	1.551	> 0.5	Compliant
High	2480	2.6835	1.453	> 0.5	Compliant

Please refer to the following plots for detailed test results

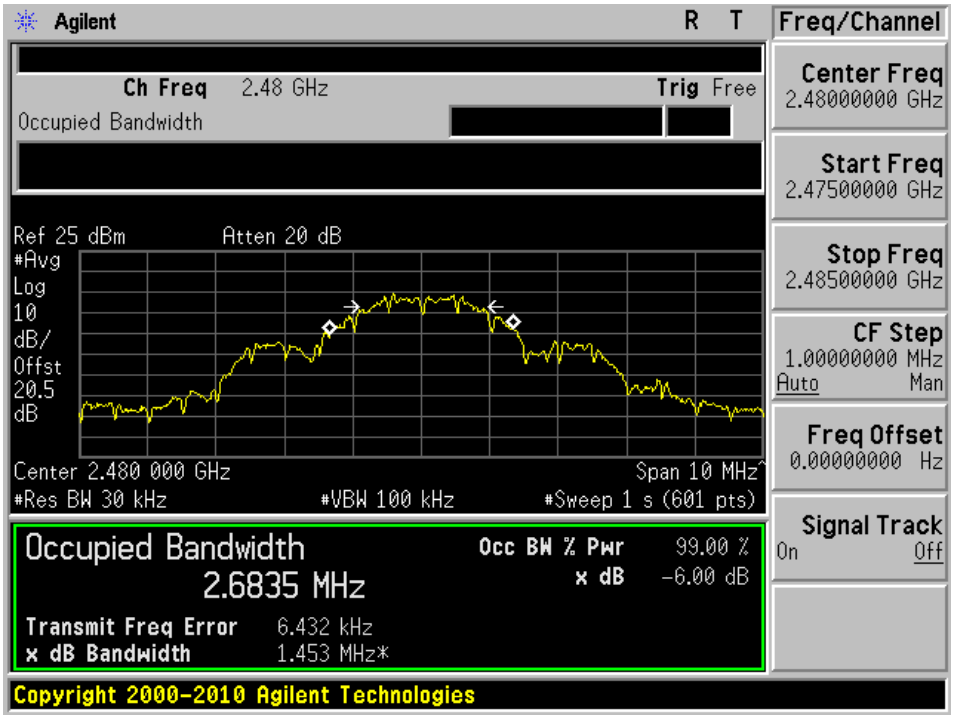
Low Channel



Middle Channel



High Channel



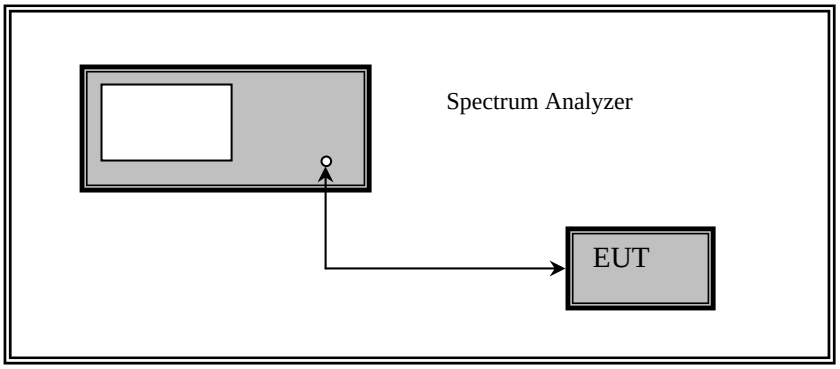
10 FCC §15.247(b) - Peak Output Power Measurement

10.1 Applicable Standard

According to FCC §15.247(b) and IC RSS-210 §A8.4 (4) 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	E4440A	MY44303352	2011-05-10

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:	22.2 °C
Relative Humidity:	34 %
ATM Pressure:	102.7kPa

The testing was performed by Victor Zhang on 2011-11-17 at RF Site.

10.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power		Limit (dBm)	Margin (dB)
		(dBm)	(mw)		
Low	2405	19.05	80.35	30	-10.95
Middle	2440	19.07	80.72	30	-10.93
High	2480	18.65	73.28	30	-11.35

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 §15.209(a) see §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	E4440A	MY44303352	2011-05-10

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

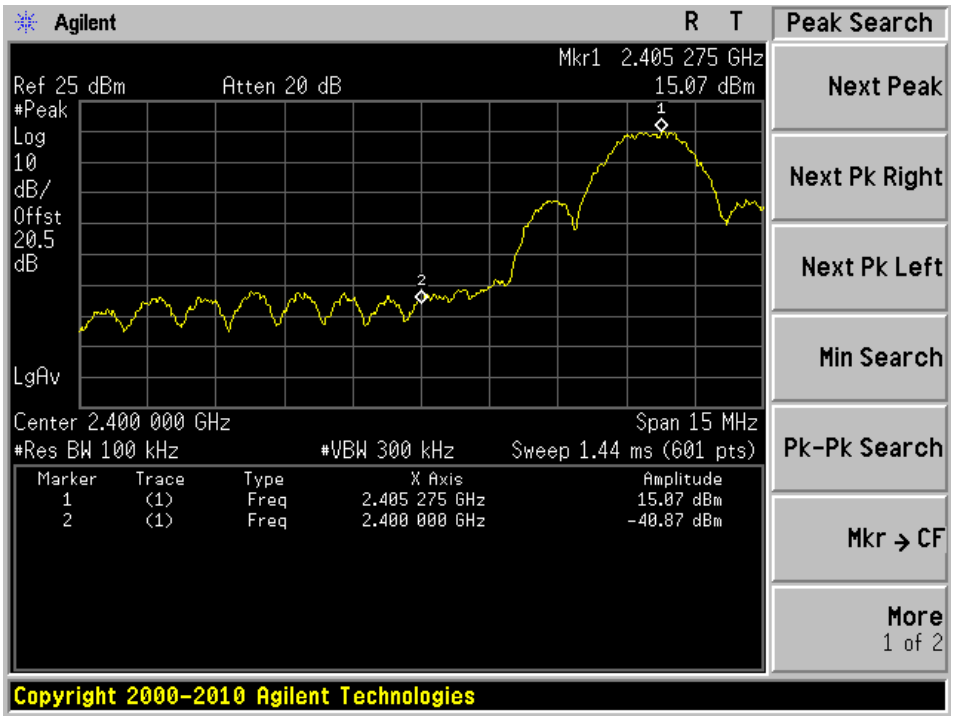
Temperature:	22.2 °C
Relative Humidity:	34 %
ATM Pressure:	102.7kPa

The testing was performed by Victor Zhang on 2011-11-17 at RF Site.

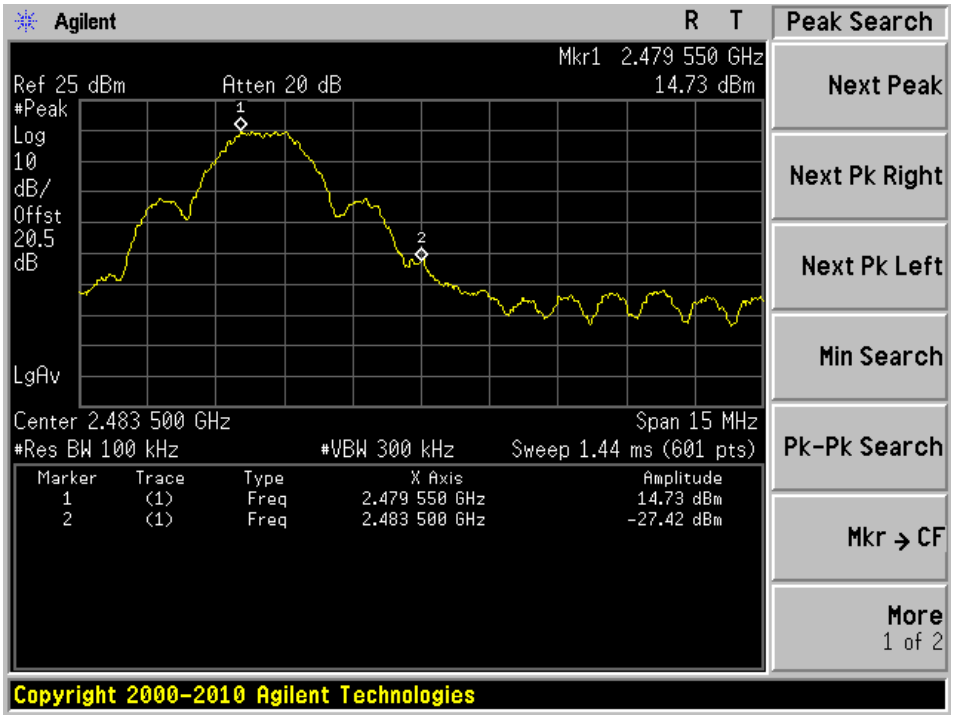
11.5 Measurement Results

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 1.5MHz 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	E4440A	MY44303352	2011-05-10

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:	22.2 °C
Relative Humidity:	34 %
ATM Pressure:	102.7kPa

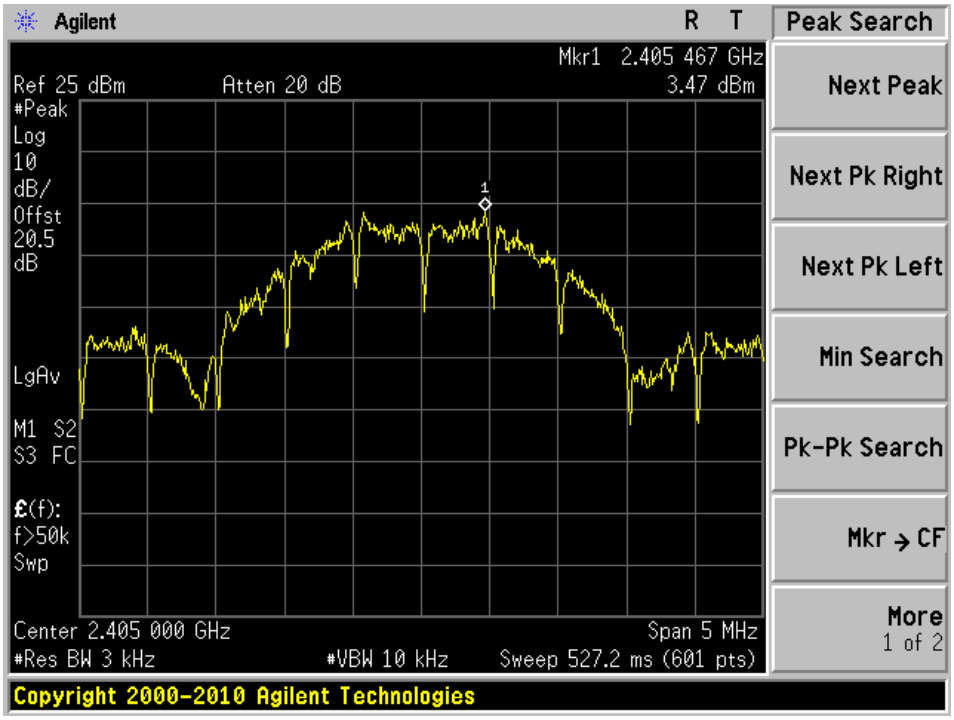
The testing was performed by Victor Zhang on 2011-11-17 at RF Site.

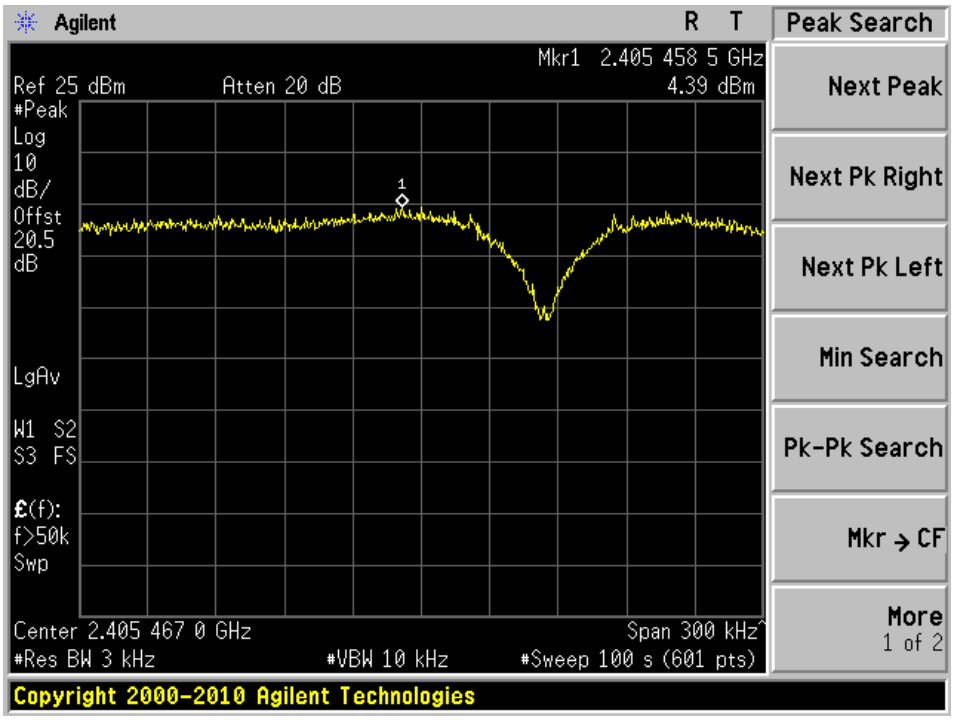
12.5 Test Results

Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm/3kHz)	Results
Low	2405	4.39	8	Compliant
Mid	2440	3.26	8	Compliant
High	2480	3.39	8	Compliant

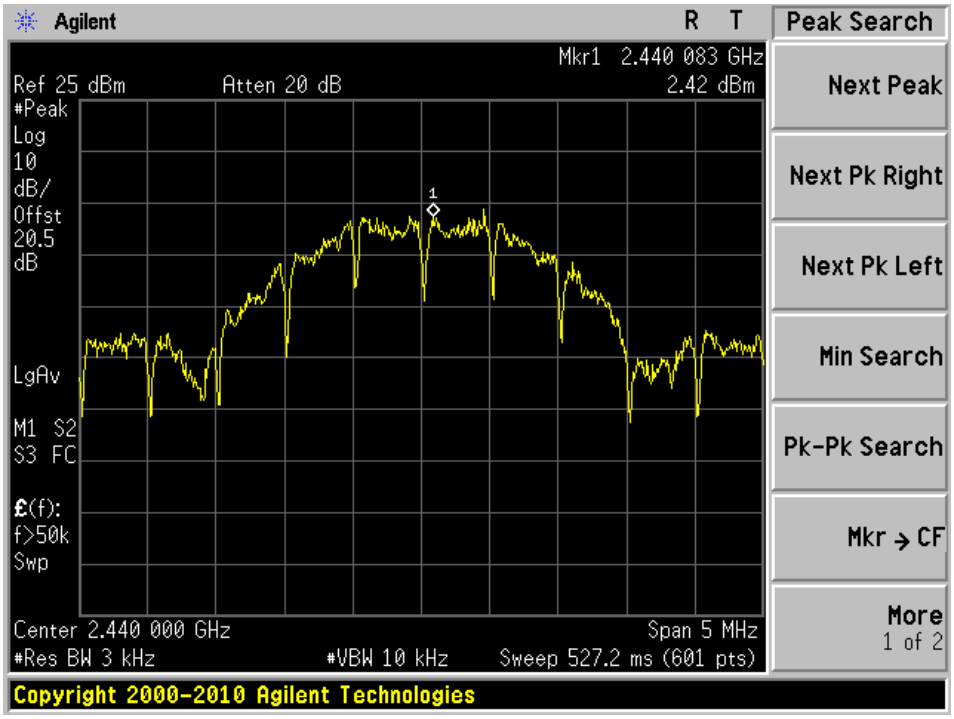
Please refer to the following plots for detailed test results:

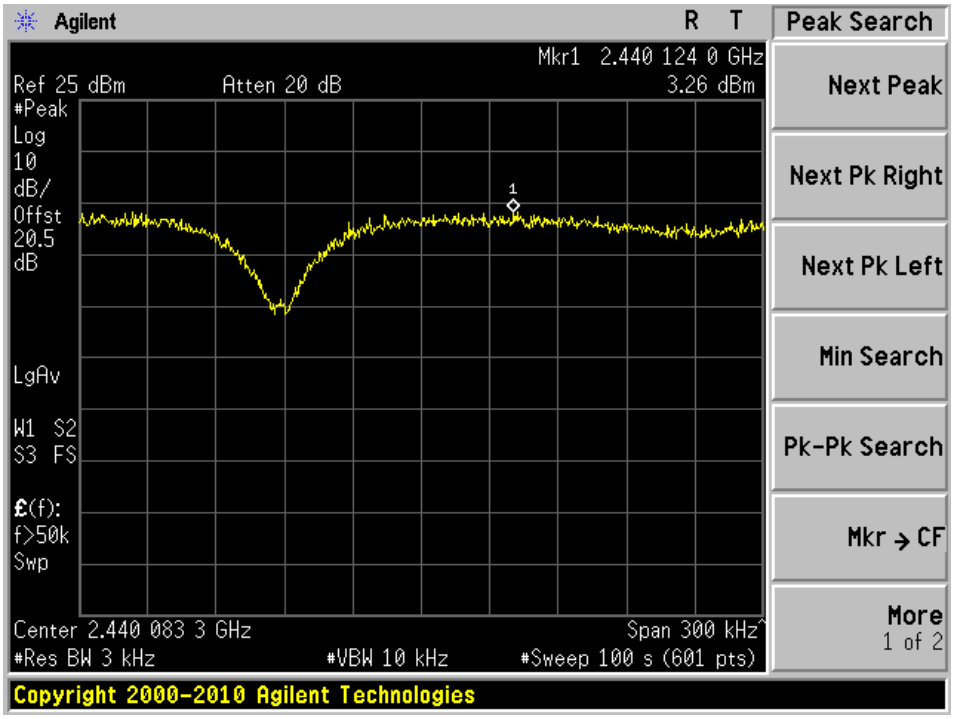
Low Channel


Agilent
R T
Peak Search
Mkr1 2.405 467 GHz
3.47 dBm
Ref 25 dBm
Atten 20 dB
#Peak
Log
10
dB/
Offst
20.5
dB
LgAv
M1 S2
S3 FC
£(f):
f>50k
Swp
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
Center 2.405 000 GHz
#Res BW 3 kHz
#VBW 10 kHz
Span 5 MHz
Sweep 527.2 ms (601 pts)
Copyright 2000-2010 Agilent Technologies


Agilent
R T
Peak Search
Mkr1 2.405 458 5 GHz
4.39 dBm
Ref 25 dBm
Atten 20 dB
#Peak
Log
10
dB/
Offst
20.5
dB
LgAv
W1 S2
S3 FS
£(f):
f>50k
Swp
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
Center 2.405 467 0 GHz
#Res BW 3 kHz
#VBW 10 kHz
Span 300 kHz
#Sweep 100 s (601 pts)
Copyright 2000-2010 Agilent Technologies

Middle Channel





High Channel