

FCC PART 15.247  
TEST AND MEASUREMENT REPORT

For

**CentraLite Systems, Inc.**

6420 Wall Street,  
Mobile, AL 36695, USA

**FCC ID: T3L-JS003**

|  |  |
|--|--|
| <b>Report Type:</b><br>Original Report   | <b>Product Type:</b><br>Zigbee Transceiver |
| <p style="text-align: right;"><i>Lionel Lara</i></p> <p><b>Test Engineers:</b> <u>Lionel Lara</u></p>  |  |
| <p><b>Report Number:</b> <u>R1112064-247</u></p>   |  |
| <p><b>Report Date:</b> <u>2012-03-01</u></p>   |  |
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**Note:** This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report **must not** be used by the customer to claim product certification, approval, or endorsement by NVLAP\*, NIST, or any agency of the Federal Government.

\* This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk "\*" enr

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**DOCUMENT REVISION HISTORY**

| <b>Revision Number</b> | <b>Report Number</b> | <b>Description of Revision</b> | <b>Date of Revision</b> |
|------------------------|----------------------|--------------------------------|-------------------------|
| 0                      | R1112064-247         | Original Report                | 2012-03-01              |

# 1 General Description

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## 1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *CentraLite Systems* and their product, *model: 4256050-RZHA, FCC ID: T3L-JS003* or the “EUT” as referred to in this report. The EUT is Zigbee transceiver operating in the 2.4 GHz band.

## 1.2 Mechanical Description of EUT

The EUT measures approximately 55 mm (L) x 35 mm (W) x 75 mm (H) and weighs approximately 1.5 g.

*The data gathered are from a typical production sample provided by the manufacturer with serial 482GT1 provided by the manufacturer.*

## 1.3 Objective

This Type approval report is prepared on behalf of *CentraLite Systems, Inc.* in accordance with Part 2, Subpart J, Part 15, Subparts B and C of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart B and C and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

## 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 C63.4-2003, 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.

## 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.

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 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 C63.4-2003.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

### 2.2 EUT Exercise Software

N/A

### 2.3 Equipment Modifications

No modifications were made to the EUT.

### 2.4 Special Accessories

N/A

### 2.5 Local Support Equipment

N/A.

### 2.6 EUT Internal Configuration Details

| Manufacturer             | Description | Model             | Serial Number |
|--------------------------|-------------|-------------------|---------------|
| CentraLite Systems, Inc. | PCB Board   | Houndshark Rev. C | -             |

### 2.7 Interface Ports and Cabling

N/A.

### 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                         | AC Line Conducted Emissions                   | Compliant |
| §15.247(d)                      | Spurious Emissions at Antenna Port            | Compliant |
| §15.205, §15.209<br>§15.247 (d) | Restricted Bands, Radiated Spurious Emissions | Compliant |
| §15.247 (a)(2)                  | 6 dB & 99% Emission Bandwidth                 | Compliant |
| §15.247 (b)(3)                  | Maximum Peak Output Power                     | Compliant |
| §15.247 (e)                     | Power Spectral Density                        | Compliant |
| §15.247 (d)                     | 100 kHz Bandwidth of Frequency Band Edge      | 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.

#### Limits for General Population/Uncontrolled Exposure

| Frequency Range (MHz)                               | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm <sup>2</sup> ) | 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 <sup>2</sup> )              | 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

|   |              |
|---|--------------|
| <u>Maximum peak output power at antenna input terminal (dBm):</u>                       | <u>11.83</u> |
| <u>Maximum peak output power at antenna input terminal (mW):</u>                        | <u>15.24</u> |
| <u>Prediction distance (cm):</u>  | <u>20</u>    |
| <u>Prediction frequency (MHz):</u>  | <u>2440</u>  |
| <u>Maximum Antenna Gain, typical (dBi):</u>   | <u>2.73</u>  |
| <u>Maximum Antenna Gain (numeric):</u>  | <u>1.87</u>  |
| <u>Power density of prediction frequency at 20 cm (mW/cm<sup>2</sup>):</u>              | <u>0.006</u> |
| <u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u> | <u>1.0</u>   |

The device meets FCC MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.006 mW/cm<sup>2</sup>, the limit is 1.0 mW/cm<sup>2</sup>.

## 5 FCC §15.203 – Antenna Requirements

### 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 EUT has one Transmitter integral antenna, The Transmitter antenna has a max gain of 2.73 dBi which fulfills the requirements of FCC §15.203.

| Frequency Band<br>(MHz) | Antenna Gain<br>(dBi) |
|-------------------------|-----------------------|
| 2400-2483.5             | 2.73                  |

## 6 FCC §15.207 – AC Line Conducted Emissions

### 6.1 Applicable Standard

As per FCC §15.207, 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 <sup>1</sup>  | 56 to 46 <sup>1</sup> |
| 0.5-5                       | 56                     | 46                    |
| 5-30                        | 60                     | 50                    |

1) Note: Decreases with the logarithm of the frequency.

### 6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4-2003 measurement procedure. The specification used was FCC Part15.207 limits.

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

The EUT was connected with LISN-1 which provided 120 V/60 Hz AC power.

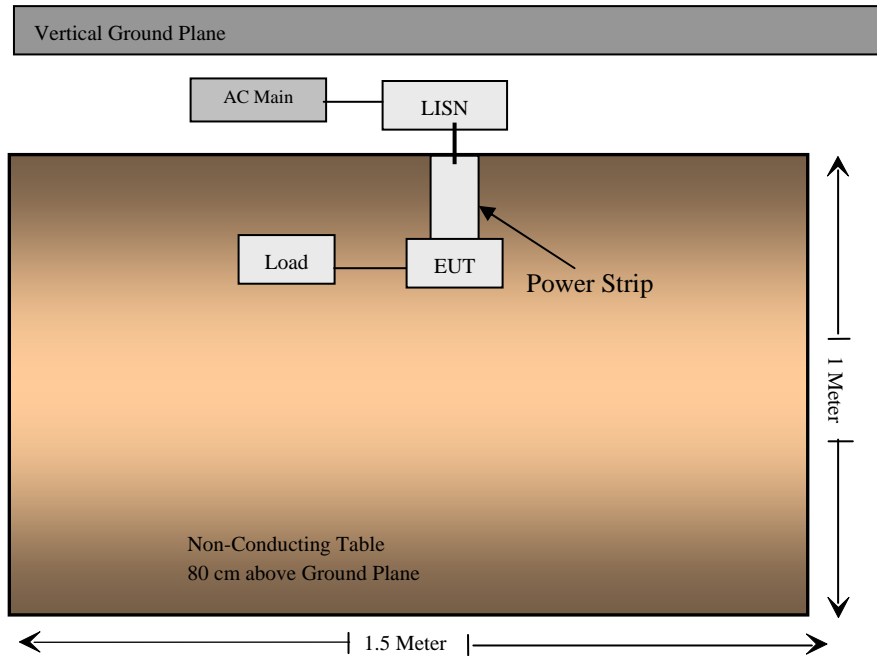
### 6.3 Test Procedure

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) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

$$CA = Ai + CL + Atten - Ga$$

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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

### 6.6 Test Equipment List and Details

| Manufacturer      | Description       | Model No.         | Serial No. | Calibration Date |
|-------------------|-------------------|-------------------|------------|------------------|
| Solar Electronics | LISN              | 9252-R-24-BNC     | 511205     | 2011-06-25       |
| Rohde & Schwarz   | EMI Test Receiver | ESCI 1166.5950K03 | 100337     | 2011-03-21       |

**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**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 20-21 °C  |
| <b>Relative Humidity:</b> | 38-40 %   |
| <b>ATM Pressure:</b>      | 101.2 kPa |

*The testing was performed by Lionel Lara on 02-13-2012 in 5 meter chamber 3.*

**6.8 Summary of Test Results**

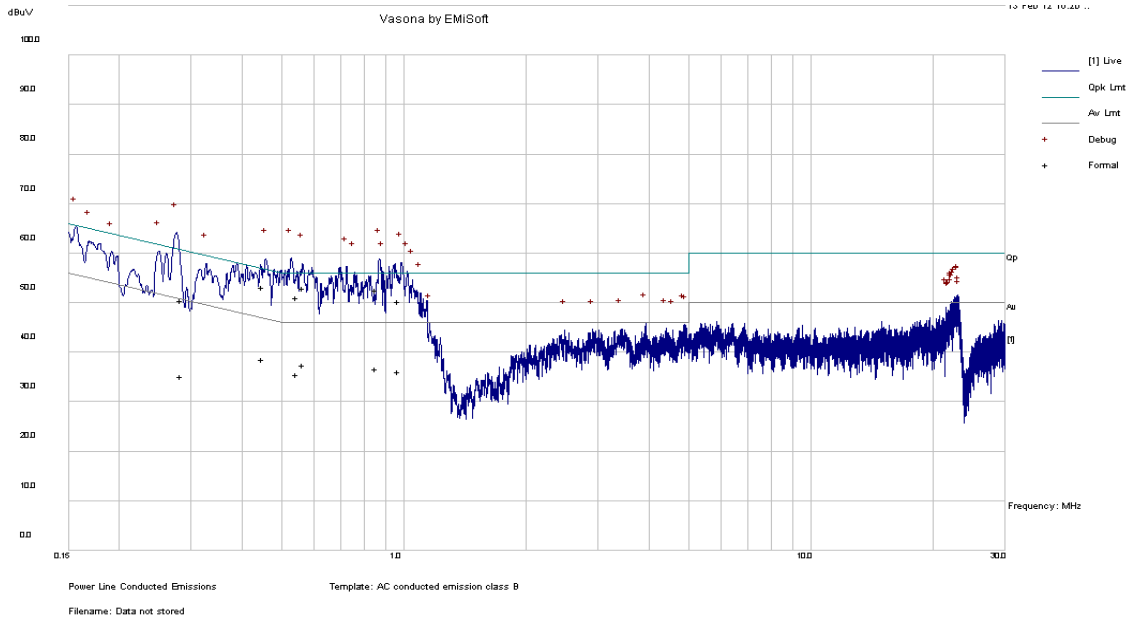
According to the recorded data in following table, the EUT complied with the FCC standard's conducted emissions limits, with the margin reading of:

Transmitting Mode (Worst channel)

| <b>Connection: Connected to 120 V/60 Hz, AC</b> |                        |                                 |                    |
|---|------------------------|---------------------------------|--------------------|
| <b>Margin (dB)</b>                              | <b>Frequency (MHz)</b> | <b>Conductor (Line/Neutral)</b> | <b>Range (MHz)</b> |
| -1.30   | 0.498677               | Neutral                         | 0.15 to 30         |

### 6.9 Conducted Emissions Test Plots and Data

#### 120 V, 60 Hz – Line



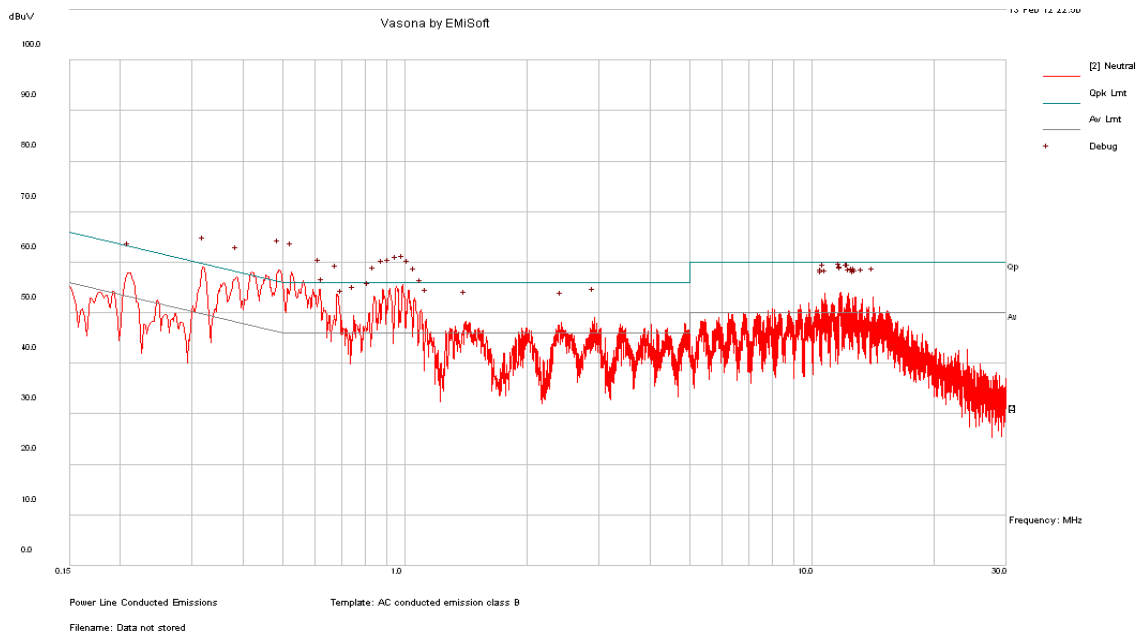
#### Quasi-Peak Measurements

| Frequency (MHz) | Corrected Amplitude (dBµV) | Conductor (Line/Neutral) | Limit (dBµV) | Margin (dB) |
|-----------------|----------------------------|--------------------------|--------------|-------------|
| 0.565551        | 53.06                      | Line                     | 56           | -2.94       |
| 0.85604         | 52.63                      | Line                     | 56           | -3.37       |
| 0.449396        | 53.23                      | Line                     | 56.89        | -3.66       |
| 0.545829        | 51.03                      | Line                     | 56           | -4.97       |
| 0.974112        | 50.26                      | Line                     | 56           | -5.74       |
| 0.283299        | 50.43                      | Line                     | 60.72        | -10.29      |

#### Average Measurements

| Frequency (MHz) | Corrected Amplitude (dBµV) | Conductor (Line/Neutral) | Limit (dBµV) | Margin (dB) |
|-----------------|----------------------------|--------------------------|--------------|-------------|
| 0.449396        | 38.69                      | Line                     | 46.89        | -8.20       |
| 0.565551        | 37.4                       | Line                     | 46           | -8.60       |
| 0.85604         | 36.75                      | Line                     | 46           | -9.25       |
| 0.974112        | 36.21                      | Line                     | 46           | -9.79       |
| 0.545829        | 35.55                      | Line                     | 46           | -10.45      |
| 0.283299        | 35.16                      | Line                     | 50.72        | -15.56      |

**120 V, 60 Hz – Neutral**



**Quasi-Peak Measurements**

| Frequency (MHz) | Corrected Amplitude (dBμV) | Conductor (Line/Neutral) | Limit (dBμV) | Margin (dB) |
|-----------------|----------------------------|--------------------------|--------------|-------------|
| 0.498677        | 54.73                      | Neutral                  | 56.02        | -1.30       |
| 0.517201        | 52.85                      | Neutral                  | 56           | -3.15       |
| 0.390285        | 54.26                      | Neutral                  | 58.06        | -3.80       |
| 0.986116        | 52.17                      | Neutral                  | 56           | -3.83       |
| 0.308799        | 55.77                      | Neutral                  | 60           | -4.24       |
| 0.954571        | 50.14                      | Neutral                  | 56           | -5.86       |

**Average Measurements**

| Frequency (MHz) | Corrected Amplitude (dBμV) | Conductor (Line/Neutral) | Limit (dBμV) | Margin (dB) |
|-----------------|----------------------------|--------------------------|--------------|-------------|
| 0.308799        | 43.13                      | Neutral                  | 50           | -6.88       |
| 0.498677        | 38.74                      | Neutral                  | 46.02        | -7.28       |
| 0.390285        | 40.45                      | Neutral                  | 48.06        | -7.61       |
| 0.986116        | 38.35                      | Neutral                  | 46           | -7.65       |
| 0.954571        | 36.98                      | Neutral                  | 46           | -9.02       |
| 0.517201        | 36.92                      | Neutral                  | 46           | -9.08       |

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

### 7.1 Applicable Standard

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.

### 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

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 20-21 °C  |
| <b>Relative Humidity:</b> | 38-40 %   |
| <b>ATM Pressure:</b>      | 101.2 kPa |

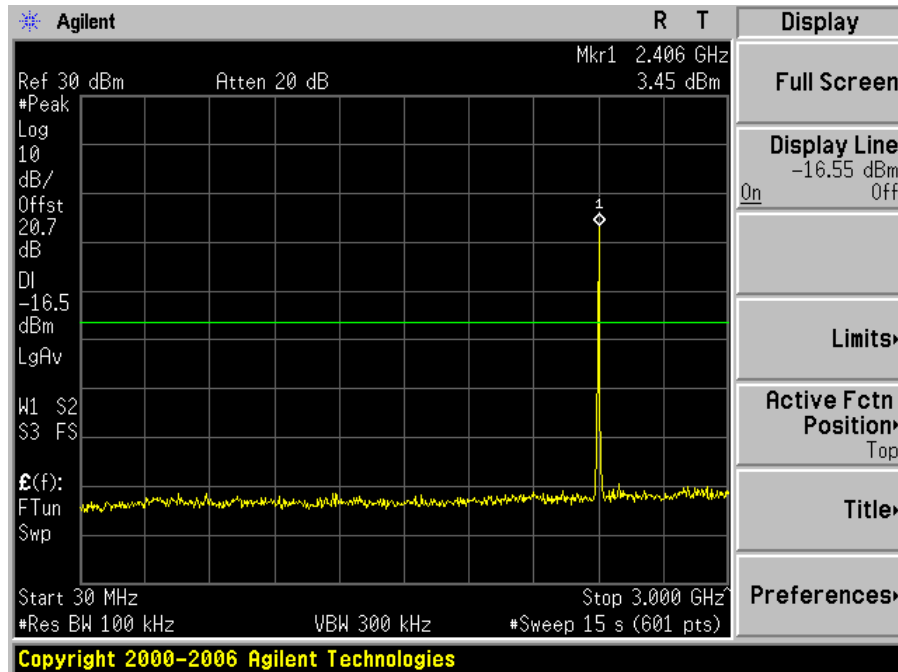
*The testing was performed by LionelLara on 01-18-2012 to 01-20-2012 in RF site.*

### 7.5 Test Results

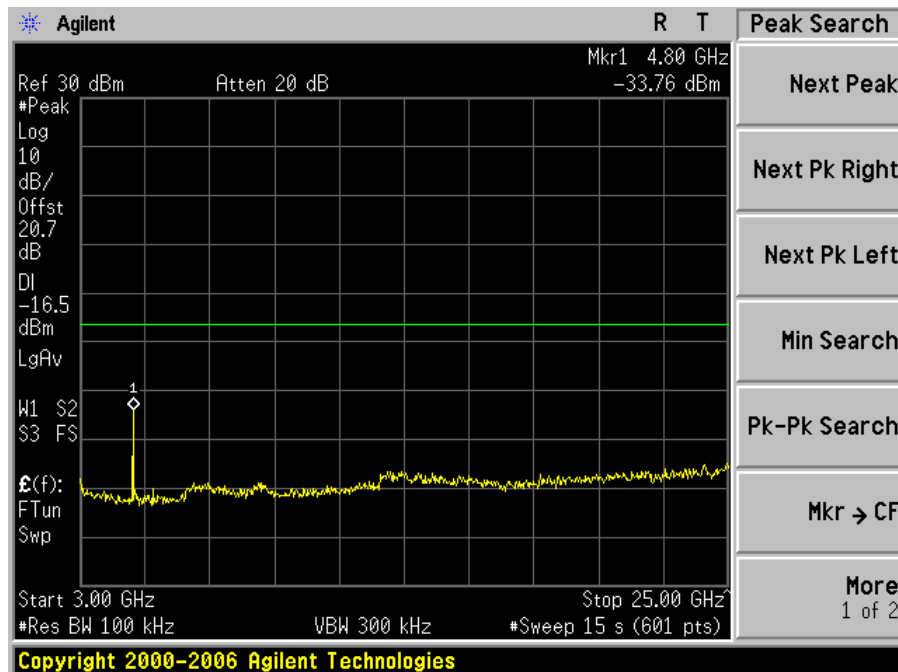
Please refer to following plots.



Low Channel, 2405 MHz

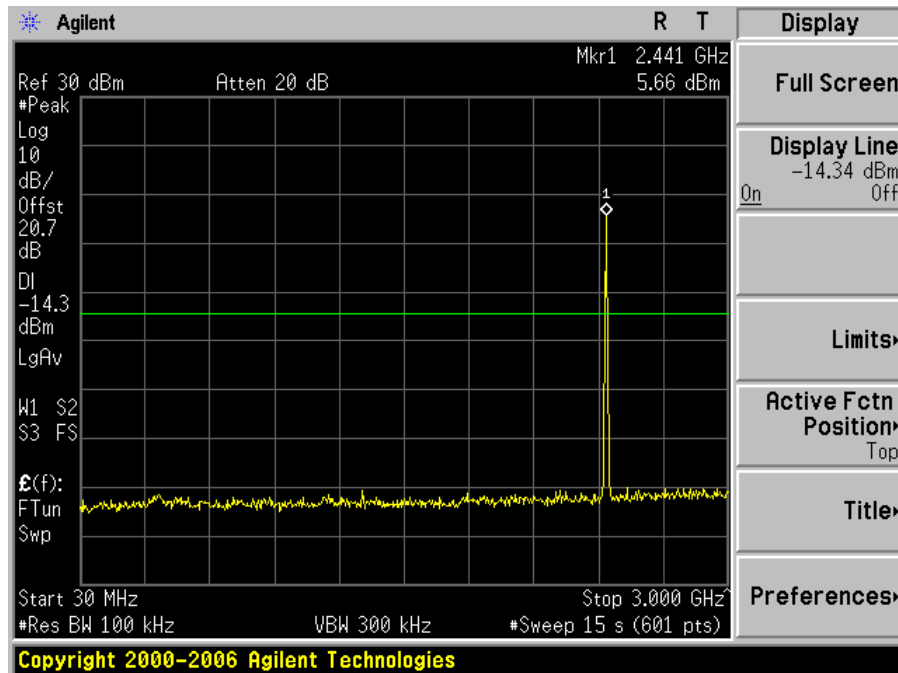


30 MHz to 3 GHz

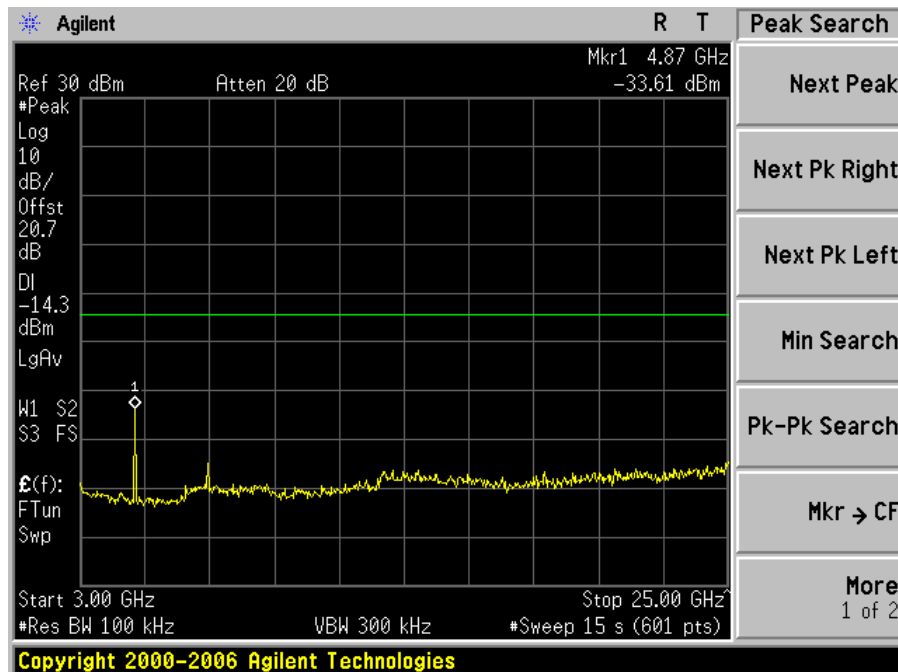


3 GHz to 25 GHz

Middle Channel, 2440 MHz

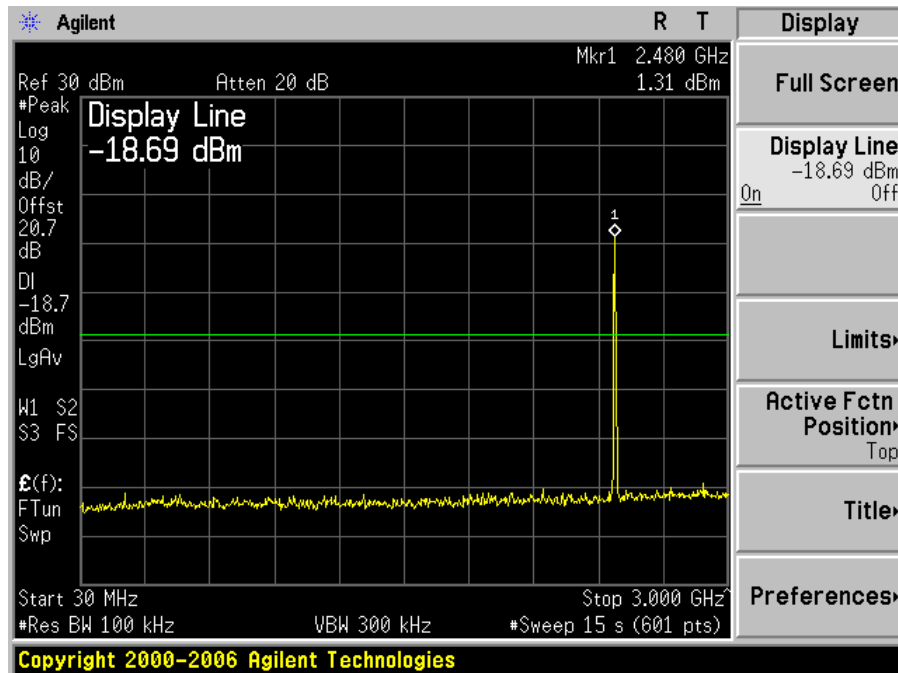


30 MHz to 3 GHz

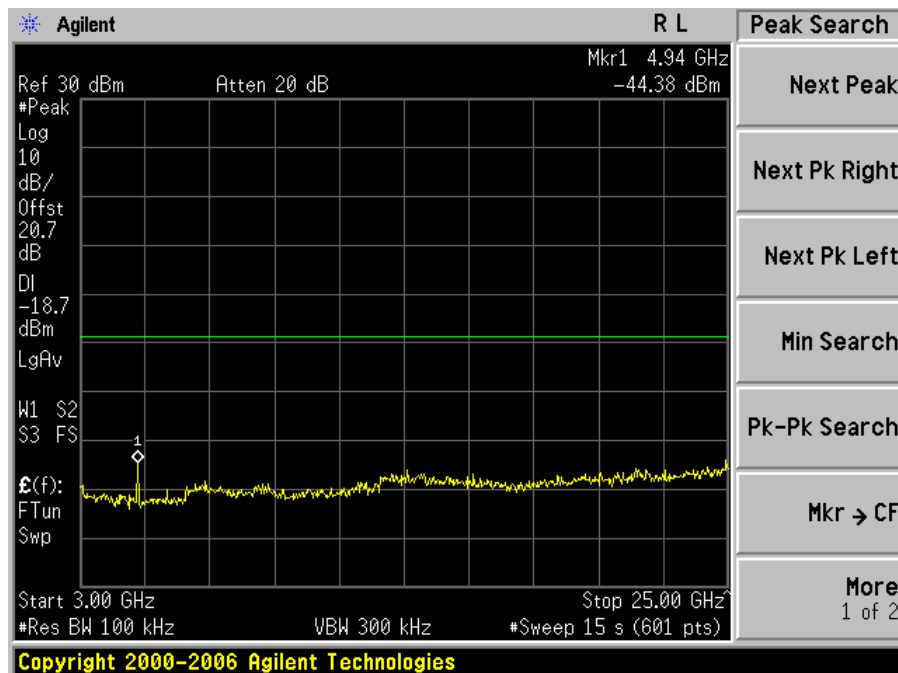


3 GHz to 25 GHz

### High Channel, 2480 MHz



30 MHz to 3 GHz



3 GHz to 25 GHz

## 8 FCC §15.205, §15.209 & §15.247(d) – 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): 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 <sup>1</sup>                   | 3                             |
| 88 - 216        | 150 <sup>1</sup>                   | 3                             |
| 216 - 960       | 200 <sup>1</sup>                   | 3                             |
| Above 960       | 500                                | 3                             |

1) Note: 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 using the setup accordance with the ANSI C63.4-2003. The specification used was the FCC 15C 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, 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:

$$RBW = 100 \text{ kHz/VBW} = 300 \text{ kHz/Sweep} = \text{Auto}$$

Above 1000 MHz:

- (1) Peak:  $RBW = 1\text{MHz/VBW} = 1\text{MHz/Sweep} = \text{Auto}$
- (2) Average:  $RBW = 1\text{MHz/VBW} = 10\text{Hz/Sweep} = \text{Auto}$

**8.4 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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

**8.5 Test Equipment List and Details**

| Manufacturer        | Description         | Model No.   | Serial No. | Calibration Date |
|---------------------|---------------------|-------------|------------|------------------|
| HP                  | Pre-amplifier       | 8447D       | 2944A06639 | 2011-06-09       |
| Sunol Science Corp. | Combination Antenna | JB3 Antenna | A020106-2  | 2011-08-10       |
| Agilent             | Spectrum Analyzer   | E4440A      | MY44303352 | 2011-05-10       |
| EMCO                | Antenna, Horn       | 3115        | 9511-4627  | 2011-10-03       |

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

**8.6 Test Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 20-21 °C  |
| <b>Relative Humidity:</b> | 38-40 %   |
| <b>ATM Pressure:</b>      | 101.2 kPa |

*The testing was performed by Lionel Lara on 01-12-2012 in 5 meter chamber 3.*

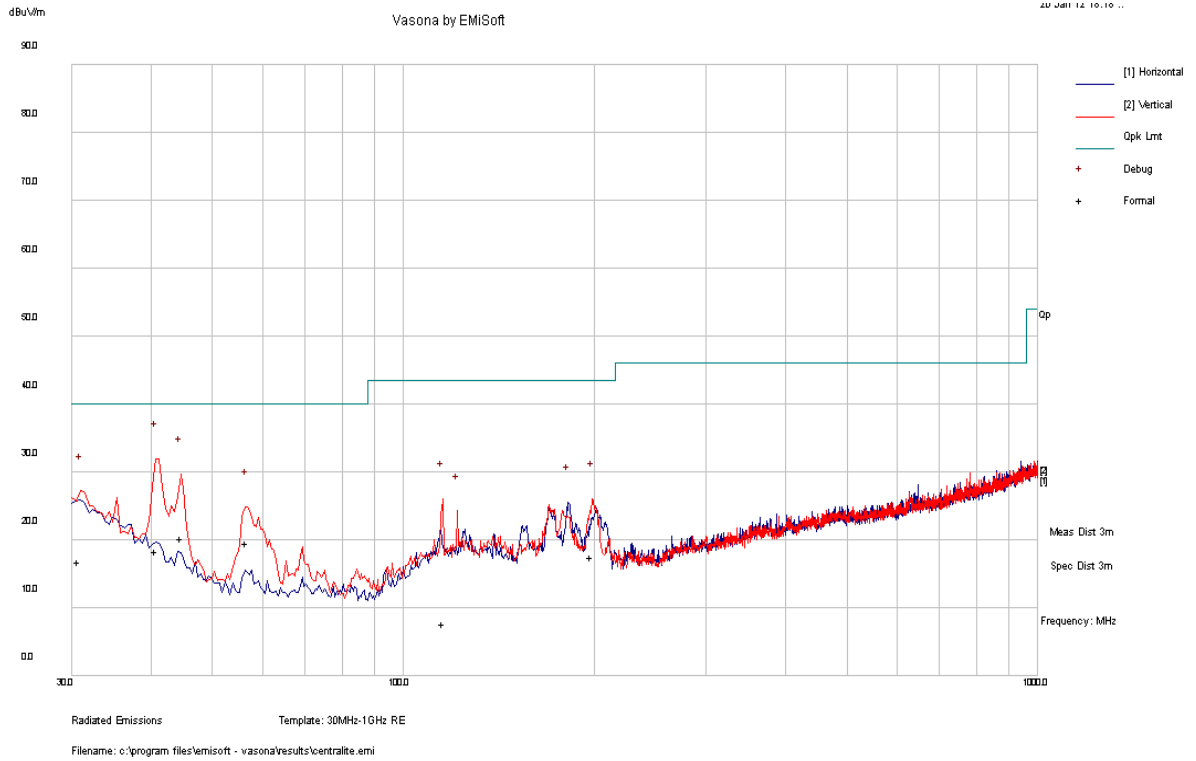
**8.7 Summary of Test Results**

According to the data hereinafter, the EUT complied with the FCC Part 15, Subpart C, section 15.205, 15.209 and 15.247 standard’s radiated emissions limits, and had the worst margin of:

| Margin (dB) | Frequency (MHz) | Polarization (Horizontal/Vertical) | Channel, Range                |
|-------------|-----------------|------------------------------------|-------------------------------|
| -19.68      | 44.69475        | Vertical                           | Middle Channel, 30 MHz – 1GHz |
| -1.87       | 4880            | Horizontal                         | Middle Channel, Above 1 GHz   |

### 8.8 Radiated Spurious Emissions Test Results

#### 1) Radiated Emission at 3 meters, 30 MHz – 1 GHz (Worst Channel: Middle Channel)



| Frequency (MHz) | Corrected Amplitude (dBµV/m) | Test Antenna |                | Turntable Azimuth (degrees) | Limit (dBµV/m) | Margin (dB) |
|-----------------|------------------------------|--------------|----------------|-----------------------------|----------------|-------------|
|                 |                              | Height (cm)  | Polarity (H/V) |                             |                |             |
| 44.69475        | 20.32                        | 103          | V              | 107                         | 40             | -19.68      |
| 56.52275        | 19.63                        | 138          | V              | 47                          | 40             | -20.37      |
| 40.795          | 18.41                        | 189          | V              | 159                         | 40             | -21.59      |
| 30.77125        | 16.73                        | 113          | V              | 49                          | 40             | -23.27      |
| 198.1873        | 17.53                        | 159          | V              | 174                         | 43.5           | -25.97      |
| 115.448         | 7.59                         | 280          | V              | 66                          | 43.5           | -35.91      |

2) Radiated Emission at 3 meters, 1 – 25 GHz

| Frequency (MHz)                              | S.A. Reading (dBµV) | Turntable Azimuth (degrees) | Test Antenna |                |               | Cable Loss (dB) | Pre-Amp. (dB) | Cord. Reading (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   |                     |                             |              |                |               |                 |               |                        |                |             |          |
| 4810   | 53.64               | 147                         | 129          | H              | 32.63         | 4.06            | 27.71         | 62.62                  | 74             | -11.38      | Peak     |
| 4810   | 52.71               | 289                         | 100          | V              | 32.6          | 4.06            | 27.71         | 61.66                  | 74             | -12.34      | Peak     |
| 4810   | 42.41               | 147                         | 129          | H              | 32.63         | 4.06            | 27.71         | 51.39                  | 54             | -2.61       | Avg      |
| 4810   | 41.57               | 289                         | 100          | V              | 32.6          | 4.06            | 27.71         | 50.52                  | 54             | -3.48       | Avg      |
| Middle channel 2440 MHz measured at 3 meters |                     |                             |              |                |               |                 |               |                        |                |             |          |
| 4880   | 53.09               | 93                          | 140          | H              | 32.8          | 4.1             | 27.71         | 62.28                  | 74             | -11.72      | Peak     |
| 4880   | 52.98               | 321                         | 100          | V              | 32.73         | 4.1             | 27.71         | 62.1                   | 74             | -11.9       | Peak     |
| 4880   | 42.94               | 93                          | 140          | H              | 32.8          | 4.1             | 27.71         | 52.13                  | 54             | -1.87       | Avg      |
| 4880   | 41.84               | 321                         | 100          | V              | 32.73         | 4.1             | 27.71         | 50.96                  | 54             | -3.04       | Avg      |
| High channel 2480 MHz measured at 3 meters   |                     |                             |              |                |               |                 |               |                        |                |             |          |
| 4960   | 46.38               | 92                          | 140          | H              | 33.06         | 4.21            | 27.51         | 56.14                  | 74             | -17.86      | Peak     |
| 4960   | 46.01               | 320                         | 100          | V              | 32.97         | 4.21            | 27.51         | 55.68                  | 74             | -18.32      | Peak     |
| 4960   | 35.57               | 92                          | 140          | H              | 33.06         | 4.21            | 27.51         | 45.33                  | 54             | -8.67       | Avg      |
| 4960   | 35.29               | 320                         | 100          | V              | 32.97         | 4.21            | 27.51         | 44.96                  | 54             | -9.04       | Avg      |

3) Restricted Band Emissions

| Frequency (MHz)                            | S.A. Reading (dBµV) | Turntable Azimuth (degrees) | Test Antenna |                |               | Cable Loss (dB) | Pre-Amp. (dB) | Cord. Reading (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 |                     |                             |              |                |               |                 |               |                        |                |             |          |
| 2356.7                                     | 28.21               | 155                         | 100          | H              | 28.42         | 3.01            | 0             | 59.64                  | 74             | -14.36      | Peak     |
| 2380.9                                     | 28.24               | 34                          | 100          | V              | 28.12         | 3.01            | 0             | 59.37                  | 74             | -14.63      | Peak     |
| 2356.7                                     | 13.51               | 155                         | 100          | H              | 28.42         | 3.01            | 0             | 44.94                  | 54             | -9.06       | Avg      |
| 2380.9                                     | 13.53               | 34                          | 100          | V              | 28.12         | 3.01            | 0             | 44.66                  | 54             | -9.34       | Avg      |
| High channel 2480 MHz measured at 3 meters |                     |                             |              |                |               |                 |               |                        |                |             |          |
| 2483.5                                     | 30.43               | 353                         | 221          | H              | 28.42         | 3.01            | 0             | 61.86                  | 74             | -12.14      | Peak     |
| 2483.5                                     | 31.47               | 37                          | 100          | V              | 28.12         | 3.01            | 0             | 62.6                   | 74             | -11.4       | Peak     |
| 2483.5                                     | 17.78               | 353                         | 221          | H              | 28.42         | 3.01            | 0             | 49.21                  | 54             | -4.79       | Avg      |
| 2483.5                                     | 19.44               | 37                          | 100          | V              | 28.12         | 3.01            | 0             | 50.57                  | 54             | -3.43       | Avg      |



## 9 FCC §15.247(a) – 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 20 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

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 20-21 °C  |
| <b>Relative Humidity:</b> | 38-40 %   |
| <b>ATM Pressure:</b>      | 101.2 kPa |

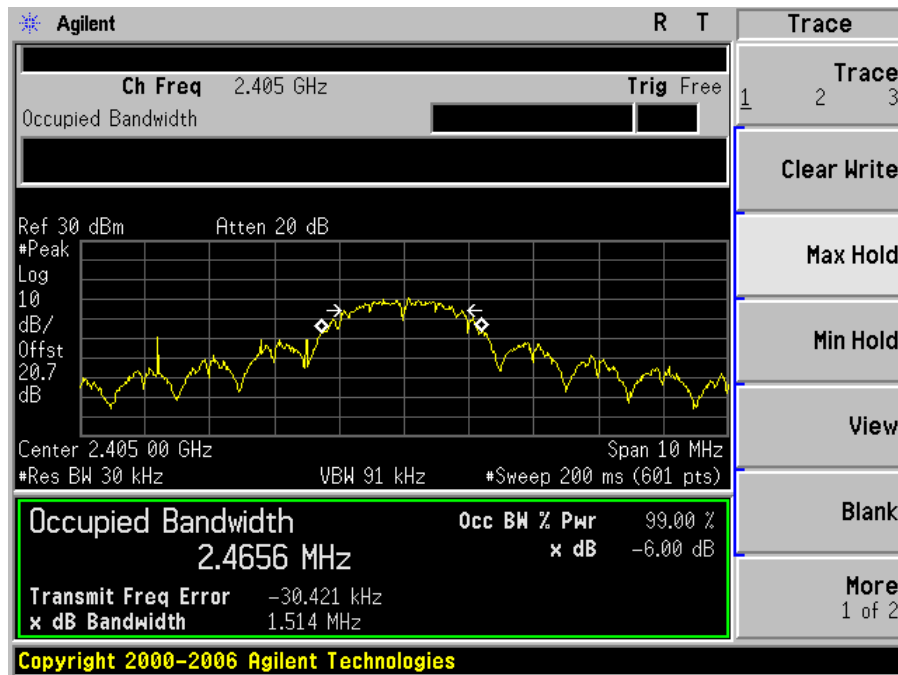
*The testing was performed by LionelLara on 01-18-2012 to 01-20-2012 in RF site.*

9.5 Test Results

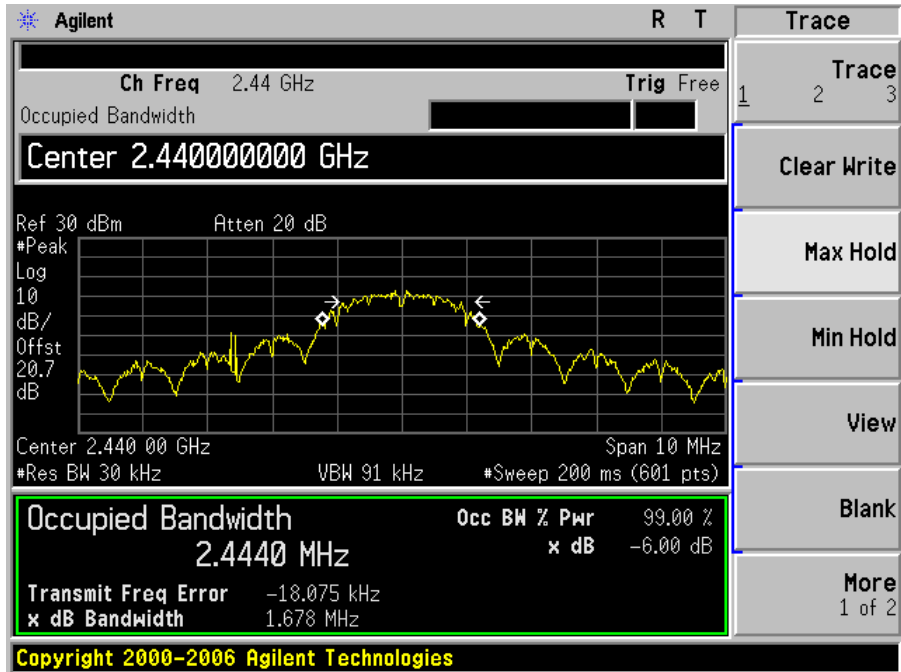
| Channel | Frequency (MHz) | 6 dB Emission Bandwidth (kHz) | 99% Emission Bandwidth (kHz) | Limit (kHz) | Results   |
|---------|-----------------|-------------------------------|------------------------------|-------------|-----------|
| Low     | 2405            | 1514                          | 2466                         | > 500       | Compliant |
| Middle  | 2440            | 1678                          | 2444                         | > 500       | Compliant |
| High    | 2480            | 1675                          | 2462                         | >500        | Compliant |

Please refer to the following plots:

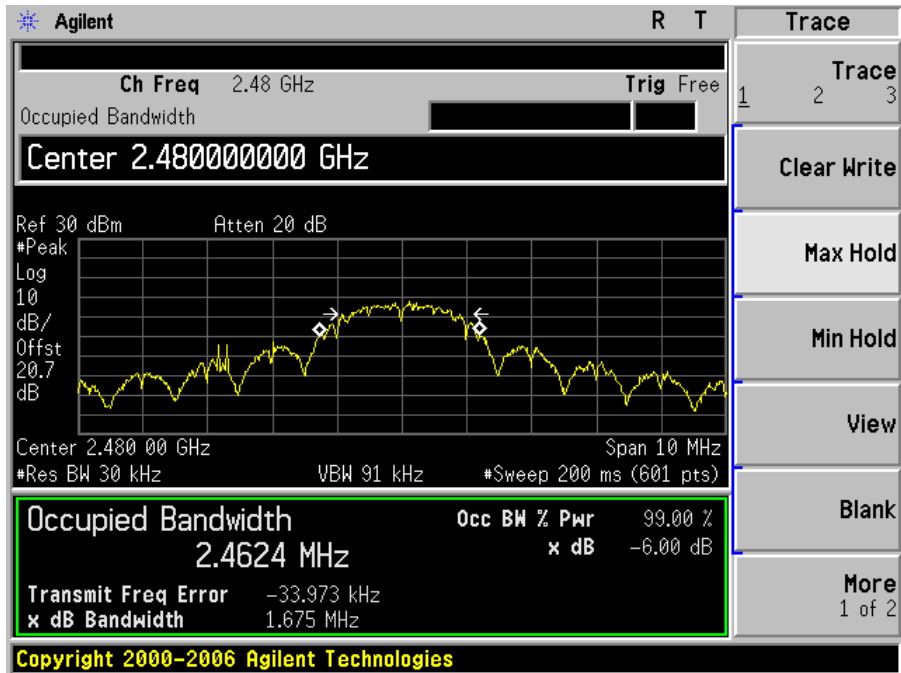
Low Channel, 2405 MHz



Middle Channel, 2440 MHz



High Channel, 2480 MHz



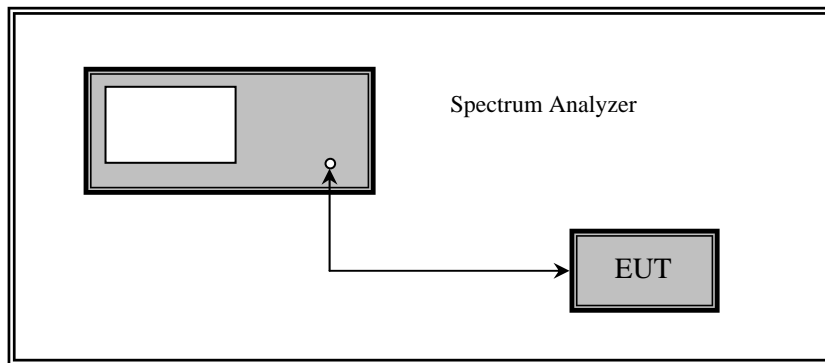
## 10 FCC §15.247(b) - Peak Output Power Measurement

### 10.1 Applicable Standard

According to 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 | 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

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 20-21 °C  |
| <b>Relative Humidity:</b> | 38-40 %   |
| <b>ATM Pressure:</b>      | 101.2 kPa |

*The testing was performed by LionelLara on 01-18-2012 to 01-20-2012 in RF site.*

**10.5 Test Results**

| <b>Channel</b> | <b>Frequency (MHz)</b> | <b>Conducted Peak Output Power (dBm)</b> | <b>Limit (dBm)</b> | <b>Result</b> |
|----------------|------------------------|--|--------------------|---------------|
| Low            | 2405                   | 9.61                                     | 30                 | Pass          |
| Mid            | 2440                   | 11.83                                    | 30                 | Pass          |
| High           | 2480                   | 8.47                                     | 30                 | Pass          |

## 11 FCC §15.247(e) - Power Spectral Density

### 11.1 Applicable Standard

According to §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.

### 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 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.

### 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

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 20-21 °C  |
| <b>Relative Humidity:</b> | 38-40 %   |
| <b>ATM Pressure:</b>      | 101.2 kPa |

The testing was performed by LionelLara on 01-18-2012 to 01-20-2012 in RF site.

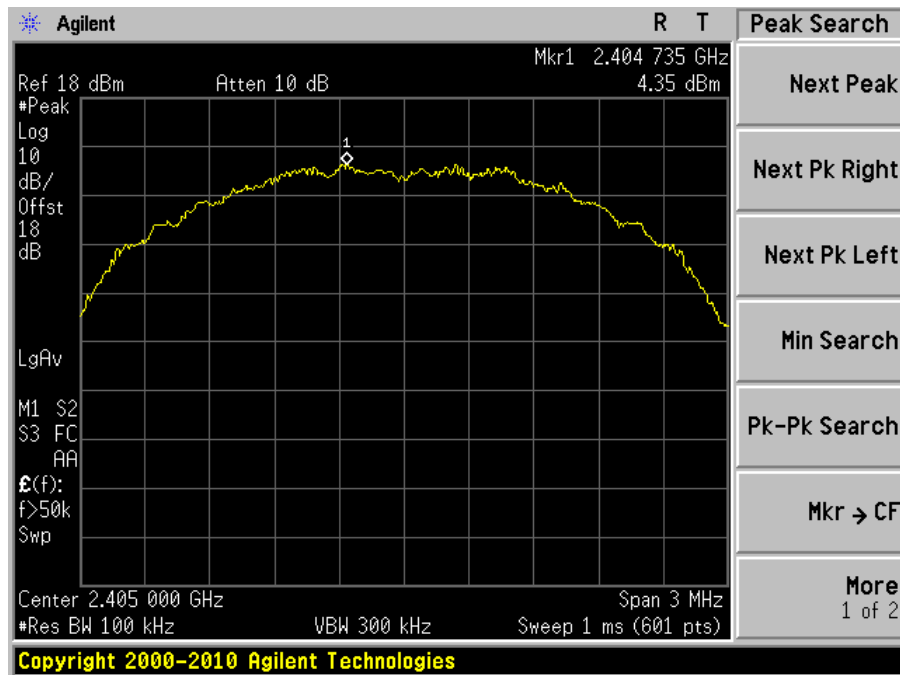
### 11.5 Test Results

| Channel | Frequency (MHz) | Power Spectral Density (dBm) | Corrected PSD (dBm) | Limit (dBm) | Result |
|---------|-----------------|------------------------------|---------------------|-------------|--------|
| Low     | 2405            | 4.35                         | -10.85              | 8           | Pass   |
| Mid     | 2440            | 5.79                         | -9.41               | 8           | Pass   |
| High    | 2480            | 4.01                         | -11.19              | 8           | Pass   |

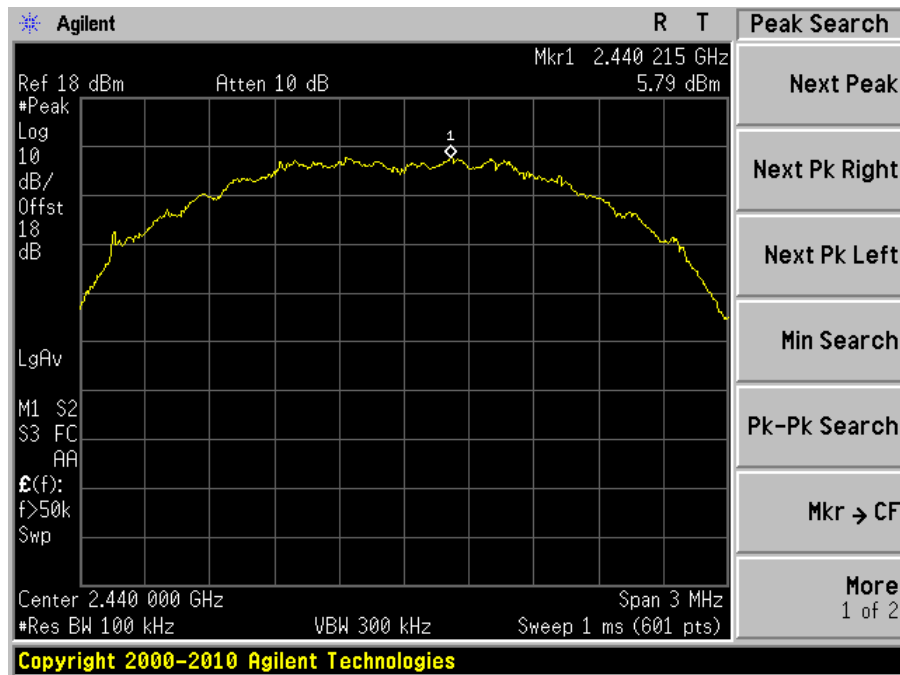
$BWCF$  (Bandwidth Correction Factor) =  $10 * \log(3 \text{ kHz} / 100 \text{ kHz}) = -15.2 \text{ dB}$

Please refer to the following plots:

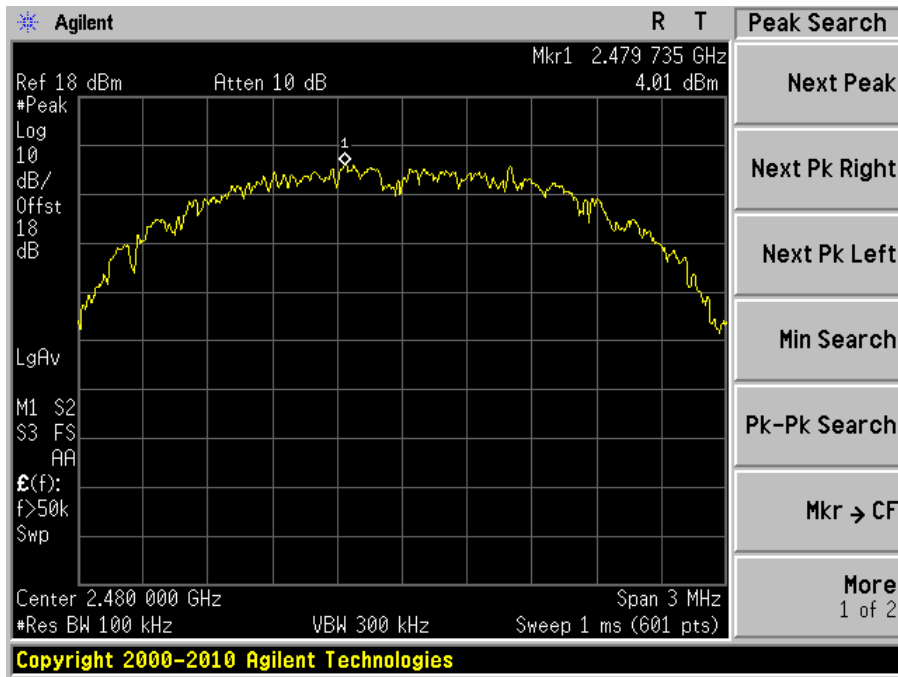
Low Channel, 2405 MHz



Middle Channel, 2440 MHz



### High Channel, 2480 MHz





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

### 12.1 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).

### 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 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.

### 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

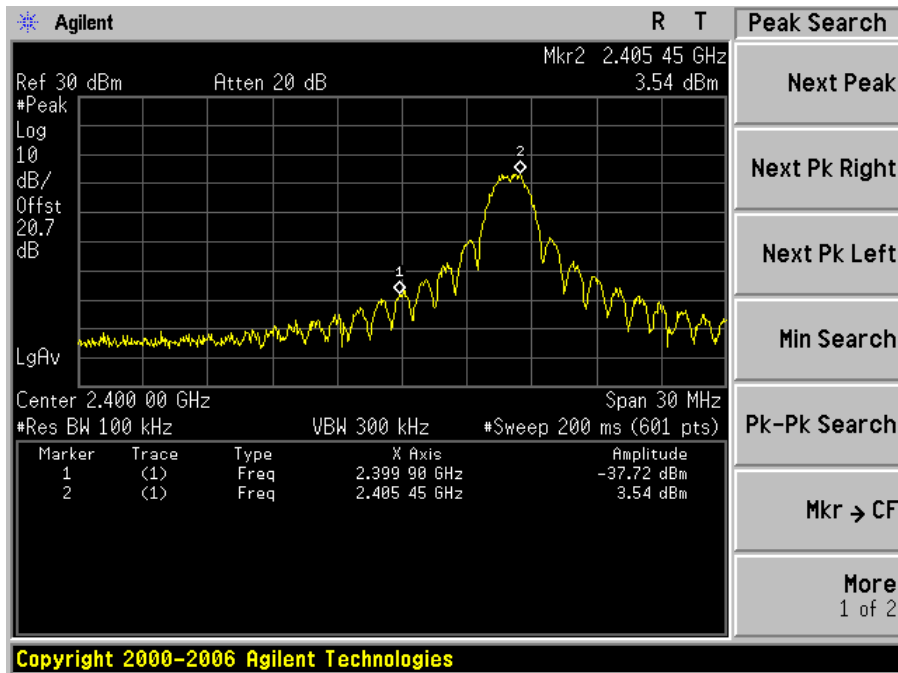
|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 20-21 °C  |
| <b>Relative Humidity:</b> | 38-40 %   |
| <b>ATM Pressure:</b>      | 101.2 kPa |

*The testing was performed by LionelLara on 01-18-2012 to 01-20-2012 in RF site.*

### 12.5 Test Results

Please refer to following pages for plots.

Low Band Edge



High Band Edge

