



FCC PART 15 SUBPART C



TEST AND MEASUREMENT REPORT

For

iMPak Health, LLC

1350 Campus Parkway, Neptune, NJ 07753, USA

FCC ID: 2ABEF-KMB121

| | |
|---|---|
| Report Type: Original Report | Product Type: Bluetooth Low Energy Device |
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| Report Number: <u>R1310226-247</u> | |
| Report Date: <u>2013-12-12</u> | |
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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 A2LA*, NIST, or any agency of the Federal Government.

* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*" 06-13

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DOCUMENT REVISION HISTORY

| Revision Number | Report Number | Description of Revision | Date of Revision |
|------------------------|----------------------|--------------------------------|-------------------------|
| 0 | R1310226-247 | Original Report | 2013-12-12 |

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *iMPak Health LLC* and their product FCC ID: 2ABEF-KMB121 which will henceforth be referred to as the EUT (Equipment Under Test). The EUT is a Bluetooth Low Energy Device operates in 2.4 GHz.

1.2 Mechanical Description of EUT

The EUT measures approximately 7.7 cm (L) x 10.8 cm (W) x 1.3 cm (H) and weighs 0.2(kg).

The test data gathered are from typical production sample, serial number: 4657300, provided by the BAACL.

1.3 Objective

This report is prepared on behalf of *iMPak Health LLC* in accordance with Part 2, Subpart J, and Part 15, Subparts B and 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)

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 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 ± 2.0 dB for Conducted Emissions tests and ± 4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BAACL 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.: A-0027. 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 an American Association for laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

<http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b>

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.4-2009.

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

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

N/A.

2.3 Special Equipment

There were no special accessories were required, included, or intended for use with EUT during these tests.

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

N/A

2.6 EUT Internal Configuration Details

| Manufacturer | Description | Model | Serial Number |
|-------------------|-------------|-----------------------|---------------|
| iMPak Health LLC | PCB Board | Daypak BLE | - |
| Texas Instruments | - | CC2541F256 | - |
| NDK | - | NX2520SA-32.000000MHz | - |
| Abracon | - | ABS07-32.768KHZ-T | - |

2.7 Interface Ports and Cables

| Cable Description | Length (m) | To | From |
|-------------------|------------|-----|------|
| RF Cable | < 1.0 | PSA | EUT |

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 | Compliant |
| §15.203 | Antenna Requirement | Compliant |
| §15.207(a) | AC Line Conducted Emissions | Compliant |
| §15.247 (d) | Spurious Emissions at Antenna Port | Compliant |
| §15.205 | Restricted Bands | Compliant |
| §15.209, §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

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

| | |
|---|------------------|
| <u>Maximum peak output power at antenna input terminal (dBm):</u> | <u>-2.02</u> |
| <u>Maximum peak output power at antenna input terminal (mW):</u> | <u>0.628058</u> |
| <u>Prediction distance (cm):</u> | <u>20</u> |
| <u>Prediction frequency (MHz):</u> | <u>2402</u> |
| <u>Maximum Antenna Gain, typical (dBi):</u> | <u>-1.7</u> |
| <u>Maximum Antenna Gain (numeric):</u> | <u>0.676083</u> |
| <u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u> | <u>0.0000845</u> |
| <u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u> | <u>1.0</u> |

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0000845 Limit is 1.0 mW/cm².

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 List

| Frequency Range (MHz) | External/Internal/Integral | Antenna Type/Pattern | Antenna Gain (dBi) |
|-----------------------|----------------------------|----------------------|--------------------|
| 2400-2500 | Integral | PCB | -1.7 |

The antenna consists of non-standard (UFL) connectors with less than 6 dBi gain; therefore, it complies with the antenna requirement.

6 FCC §2.1051 & §15.247(d) – Spurious Emissions at Antenna Terminals

6.1 Applicable Standard

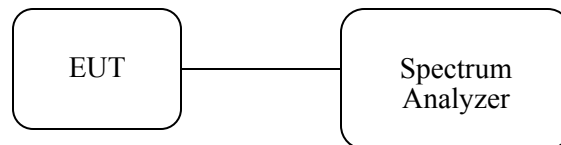
For FCC §15.247(d) in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band 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.

Requirements: CFR 47, §2.1051.

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

6.2 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.



6.3 Test Equipment List and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|--------------|-------------------|-----------|------------|------------------|----------------------|
| Agilent | Spectrum Analyzer | E4440A | US42221851 | 2013-03-05 | 1 year |

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

6.4 Test Environmental Conditions

| | |
|--------------------|--------|
| Temperature: | 23°C |
| Relative Humidity: | 42% |
| ATM Pressure: | 102kPa |

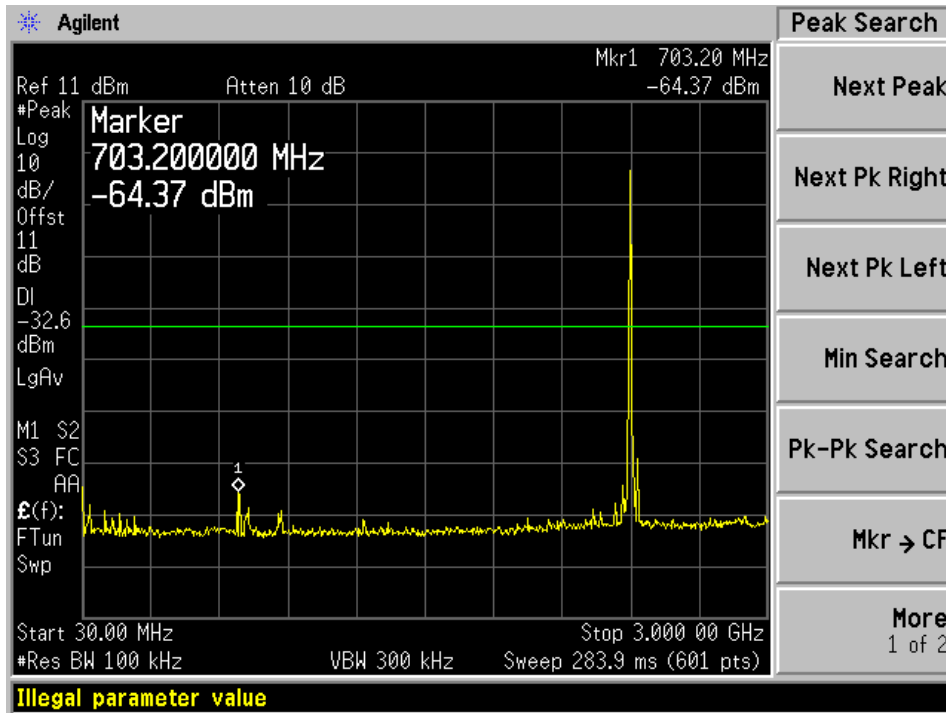
The testing was performed by Cipher Chu on 2013-10-28 at RF site.

6.5 Test Results

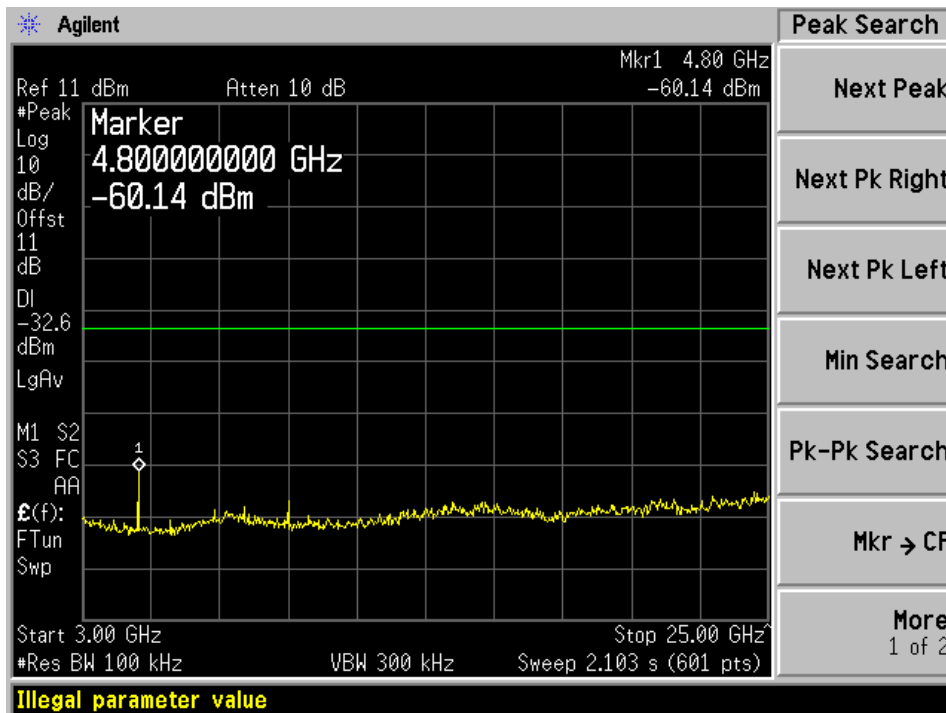
Please refer to following plots of spurious emissions.

Low Channel, 2402 MHz

30 MHz – 3 GHz

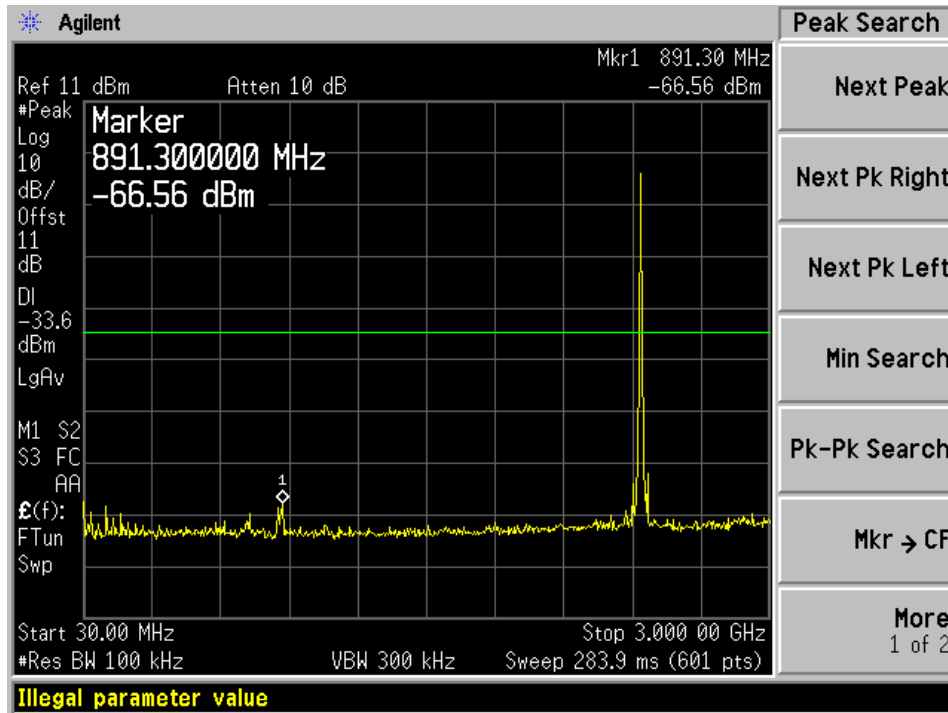


3 GHz – 25 GHz

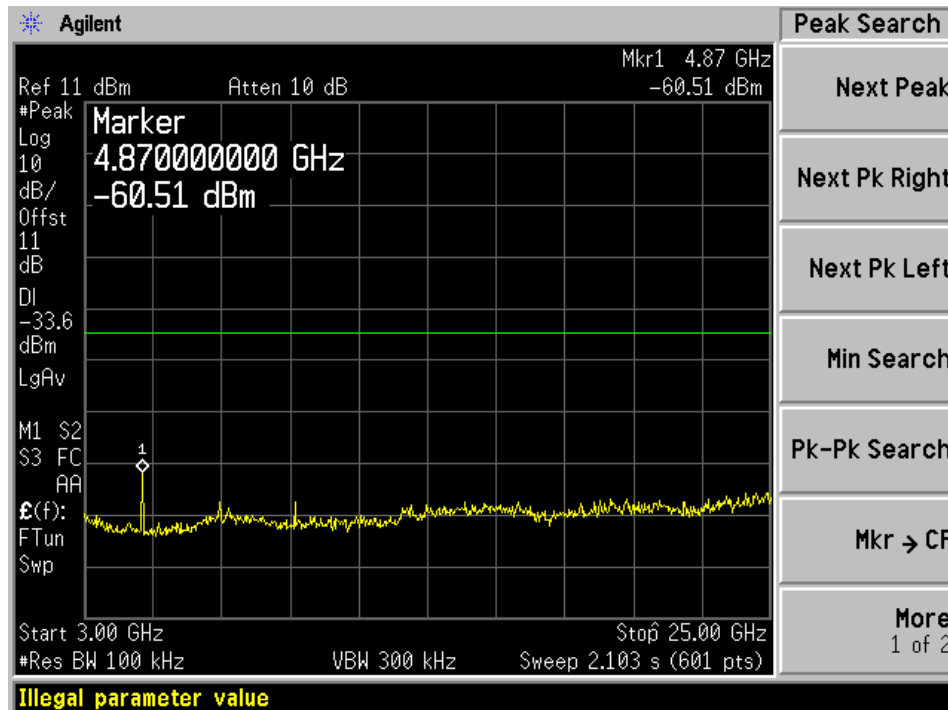


Middle Channel, 2440 MHz

30 MHz – 3 GHz

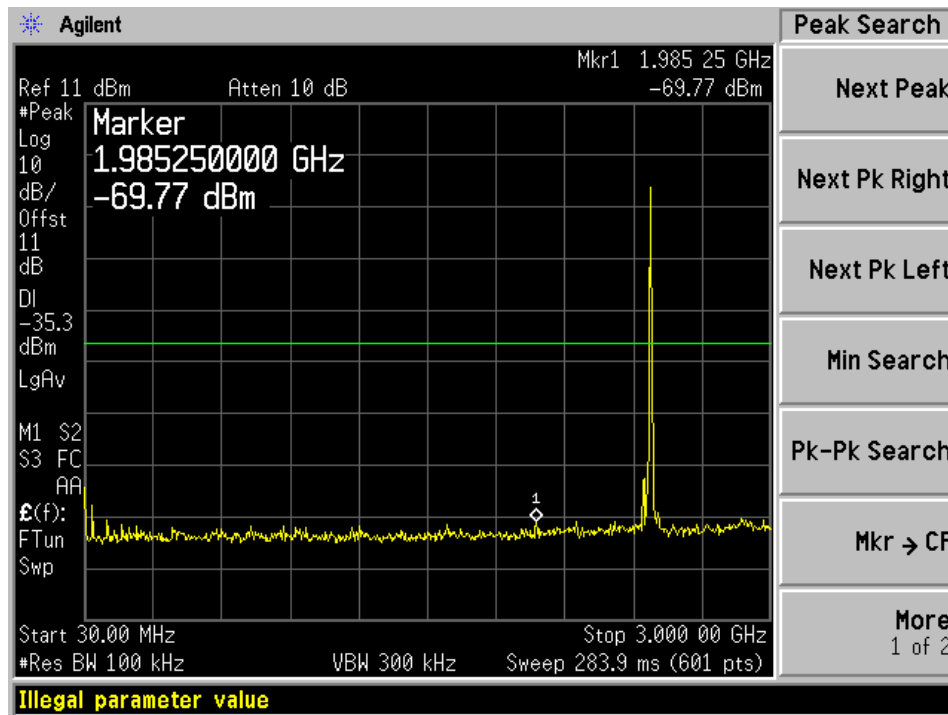


3 GHz – 25 GHz

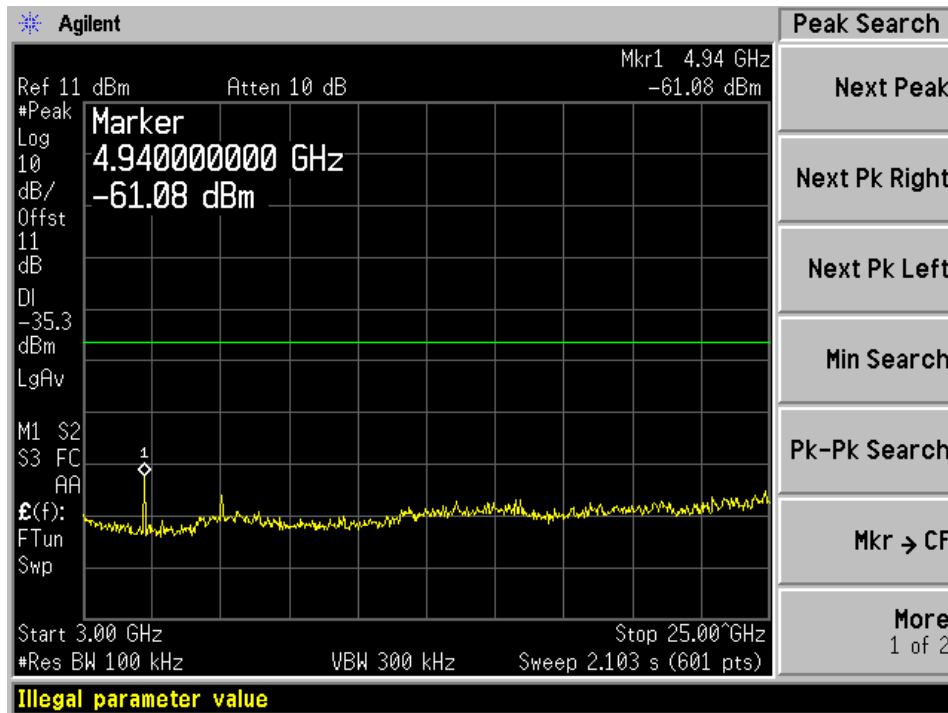


High Channel, 2480 MHz

30 MHz – 3 GHz



3 GHz – 25 GHz



7 FCC §15.205, §15.209 & §15.247(d) – Spurious Radiated Emissions

7.1 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** | 3 |
| 88 - 216 | 150** | 3 |
| 216 - 960 | 200** | 3 |
| Above 960 | 500 | 3 |

** 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 | 156.52480 – 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 | 3332 – 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 | 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)).

7.2 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.

7.3 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 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

7.4 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 indicated Amplitude (Ai) reading. The basic equation is as follows:

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

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (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:

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

7.5 Test Equipment List and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|--------------------|---------------------|-------------------|------------|------------------|----------------------|
| Sunol Science Corp | System Controller | SC99V | 122303-1 | N/R | N/R |
| Sunol Science Corp | Combination Antenna | JB3 | A020106-2 | 2012-08-15 | 1 year |
| Hewlett Packard | Pre-amplifier | 8447D | 2944A06639 | 2012-06-09 | 1 year |
| Mini-Circuits | Pre-amplifier | ZVA-183-S | 570400946 | 2012-05-09 | 1 year |
| Agilent | Spectrum Analyzer | E4440A | US42221851 | 2013-03-05 | 1 year |
| EMCO | Horn Antenna | 3315 | 9511-4627 | 2012-10-17 | 1 year |
| Rohde & Schwarz | EMI Test Receiver | ESCI 1166.5950K03 | 100338 | 2013-01-08 | 1 year |

Statement of Traceability: BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.

7.6 Test Environmental Conditions

| | |
|---------------------------|----------|
| Temperature: | 22-23 °C |
| Relative Humidity: | 43 % |
| ATM Pressure: | 102 kPa |

The testing was performed by Cipher Chu on 2013-11-8 at 5M chamber 3.

7.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15C standard's radiated emissions limits, and had the worst margin of:

30-1000 MHz:

| Mode: Transmitting | | | |
|---------------------------|------------------------|---|----------------|
| Margin (dB) | Frequency (MHz) | Polarization (Horizontal/Vertical) | Channel |
| -19.85 | 30 | Horizontal | Middle Channel |

1-25 GHz:

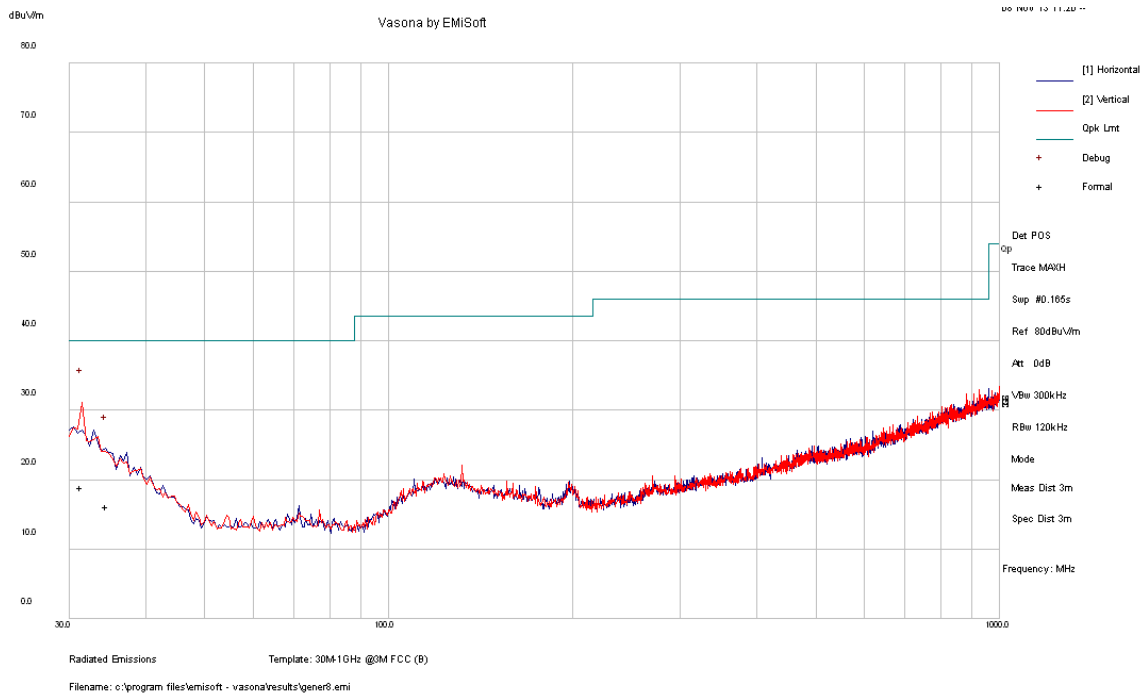
| Mode: Transmitting | | | |
|---------------------------|------------------------|---|----------------|
| Margin (dB) | Frequency (MHz) | Polarization (Horizontal/Vertical) | Channel |
| -1.263 | 4960 | Vertical | High Channel |

Please refer to the following table for specific test result details

7.8 Radiated Emissions Test Data and Plots

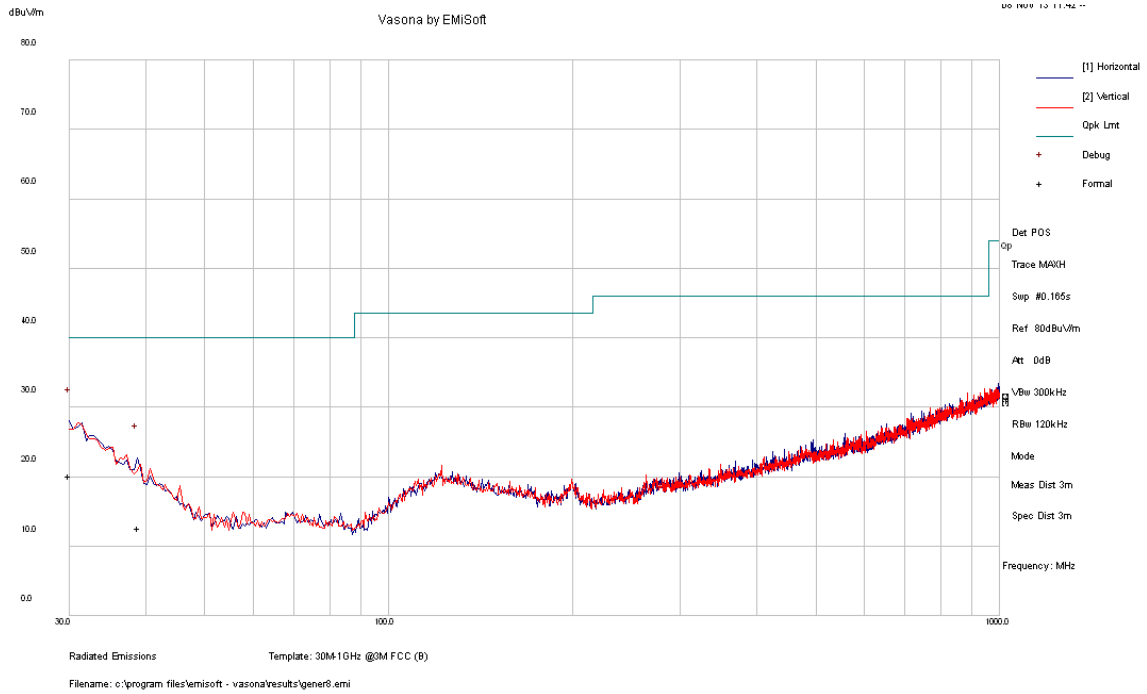
1) 30-1000 MHz, measured at 3m distance

Low Channel: 2402 MHz



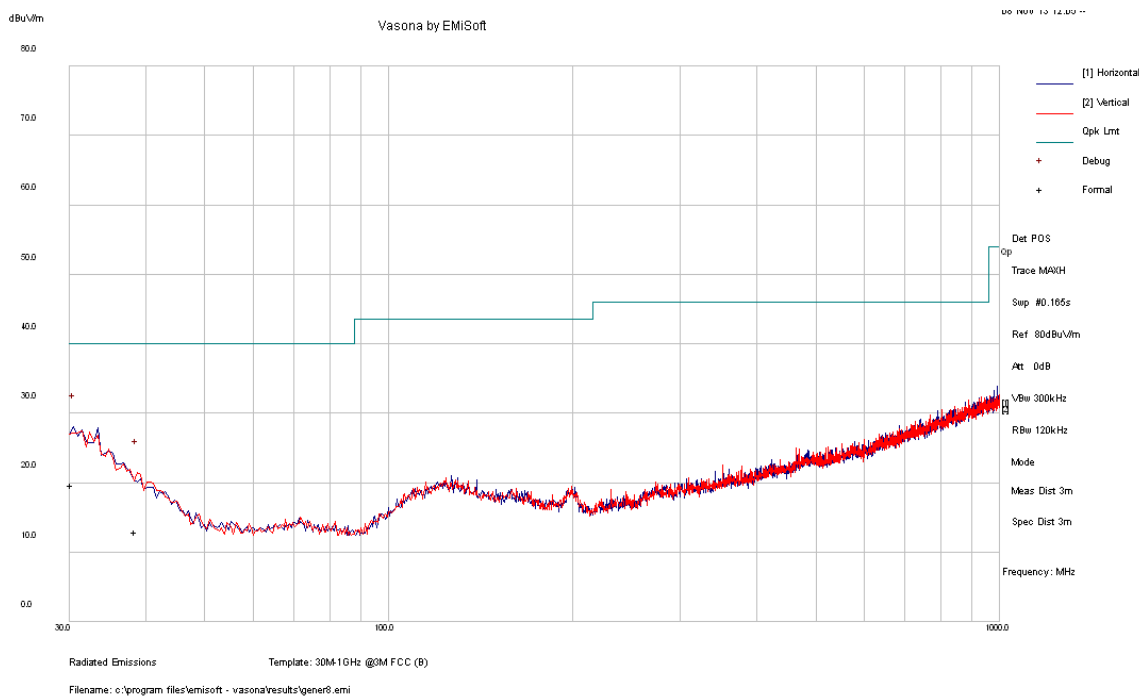
| Frequency (MHz) | Corrected Amplitude (dBuV/m) | Antenna Height (cm) | Antenna Polarity (H/V) | Turntable Azimuth (degrees) | Limit (dBuV/m) | Margin (dB) | Detector (PK/QP/Ave) |
|-----------------|------------------------------|---------------------|------------------------|-----------------------------|----------------|-------------|----------------------|
| 31.425 | 8.66 | 156 | V | 116 | 40 | -20.99 | QP |
| 34.538 | 8.18 | 263 | H | 294 | 40 | -23.83 | QP |

Middle Channel: 2440 MHz



| Frequency (MHz) | Corrected Amplitude (dBuV/m) | Antenna Height (cm) | Antenna Polarity (H/V) | Turntable Azimuth (degrees) | Limit (dBuV/m) | Margin (dB) | Detector (PK/QP/Ave) |
|-----------------|------------------------------|---------------------|------------------------|-----------------------------|----------------|-------------|----------------------|
| 30 | 8.61 | 374 | H | 325 | 40 | 30 | QP |
| 38.9255 | 8.1 | 111 | H | 330 | 40 | 38.9255 | QP |

High Channel: 2480 MHz



| Frequency (MHz) | Corrected Amplitude (dBuV/m) | Antenna Height (cm) | Antenna Polarity (H/V) | Turntable Azimuth (degrees) | Limit (dBuV/m) | Margin (dB) | Detector (PK/QP/Ave) |
|-----------------|------------------------------|---------------------|------------------------|-----------------------------|----------------|-------------|----------------------|
| 30.29575 | 8.5 | 306 | H | 193 | 40 | -20.23 | QP |
| 38.53975 | 8.05 | 314 | V | 114 | 40 | -27.08 | QP |

2) Above 1 GHz, measured at 3m distance

| Frequency (MHz) | S.A. Reading (dBµV) | Turntable Azimuth (degrees) | Test Antenna | | | Cable Loss (dB) | Pre-Amp. (dB) | Cord. Reading (dBµV/m) | FCC | | Comments |
|--------------------------|---------------------|-----------------------------|--------------|----------------|---------------|-----------------|---------------|------------------------|----------------|-------------|----------|
| | | | Height (cm) | Polarity (H/V) | Factor (dB/m) | | | | Limit (dBµV/m) | Margin (dB) | |
| Low Channel, 2402 MHz | | | | | | | | | | | |
| 2402 | 52.38 | 171 | 100 | V | 28.956 | 3.12 | 0 | 84.456 | - | - | Peak |
| 2402 | 59.94 | 230 | 100 | H | 28.956 | 3.12 | 0 | 92.016 | - | - | Peak |
| 2402 | 51.02 | 171 | 100 | V | 28.956 | 3.12 | 0 | 83.096 | - | - | Ave |
| 2402 | 58.86 | 230 | 100 | H | 28.956 | 3.12 | 0 | 90.936 | - | - | Ave |
| 2354 | 27.18 | 0 | 100 | V | 28.192 | 3.12 | 0 | 58.492 | 74 | -15.508 | Peak |
| 2354 | 27.02 | 0 | 100 | H | 28.192 | 3.12 | 0 | 58.332 | 74 | -15.668 | Peak |
| 2354 | 12.34 | 0 | 100 | V | 28.192 | 3.12 | 0 | 43.652 | 54 | -10.348 | Ave |
| 2354 | 12.31 | 0 | 100 | H | 28.192 | 3.12 | 0 | 43.622 | 54 | -10.378 | Ave |
| 4804 | 45.78 | 321 | 100 | V | 33.097 | 4.56 | 27.7 | 55.737 | 74 | -18.263 | Peak |
| 4804 | 45.1 | 288 | 100 | H | 33.097 | 4.56 | 27.7 | 55.057 | 74 | -18.943 | Peak |
| 4804 | 41.59 | 321 | 100 | V | 33.097 | 4.56 | 27.7 | 51.547 | 54 | -2.453 | Ave |
| 4804 | 40.36 | 288 | 100 | H | 33.097 | 4.56 | 27.7 | 50.317 | 54 | -3.683 | Ave |
| 7206 | 37.56 | 312 | 100 | V | 35.928 | 5.49 | 27.58 | 51.398 | 64.456 | -13.058 | Peak |
| 7206 | 36.06 | 274 | 100 | H | 35.928 | 5.49 | 27.58 | 49.898 | 72.016 | -22.118 | Peak |
| 7206 | 29.48 | 312 | 100 | V | 35.928 | 5.49 | 27.58 | 43.318 | 63.096 | -19.778 | Ave |
| 7206 | 23.97 | 274 | 100 | H | 35.928 | 5.49 | 27.58 | 37.808 | 70.936 | -33.128 | Ave |
| 9608 | 33.44 | 0 | 100 | V | 37.954 | 6.54 | 27.06 | 50.874 | 64.456 | -13.582 | Peak |
| 9608 | 32.75 | 0 | 100 | H | 37.954 | 6.54 | 27.06 | 50.184 | 72.016 | -21.832 | Peak |
| 9608 | 19.24 | 0 | 100 | V | 37.954 | 6.54 | 27.06 | 36.674 | 63.096 | -26.422 | Ave |
| 9608 | 19.26 | 0 | 100 | H | 37.954 | 6.54 | 27.06 | 36.694 | 70.936 | -34.242 | Ave |
| Middle Channel, 2440 MHz | | | | | | | | | | | |
| 2440 | 52.34 | 140 | 100 | V | 28.956 | 3.12 | 0 | 84.416 | - | - | Peak |
| 2440 | 58.96 | 235 | 100 | H | 28.956 | 3.12 | 0 | 91.036 | - | - | Peak |
| 2440 | 46.59 | 140 | 100 | V | 28.956 | 3.12 | 0 | 78.666 | - | - | Ave |
| 2440 | 58.05 | 235 | 100 | H | 28.956 | 3.12 | 0 | 90.126 | - | - | Ave |
| 4880 | 43.41 | 319 | 100 | V | 33.327 | 4.54 | 27.76 | 53.517 | 74 | -20.483 | Peak |
| 4880 | 42.5 | 250 | 100 | H | 33.327 | 4.54 | 27.76 | 52.607 | 74 | -21.393 | Peak |
| 4880 | 38.69 | 319 | 100 | V | 33.327 | 4.54 | 27.76 | 48.797 | 54 | -5.203 | Ave |
| 4880 | 36.93 | 250 | 100 | H | 33.327 | 4.54 | 27.76 | 47.037 | 54 | -6.963 | Ave |
| 7320 | 36.24 | 321 | 100 | V | 36.369 | 5.57 | 27.51 | 50.669 | 74 | -23.331 | Peak |
| 7320 | 34.55 | 274 | 100 | H | 36.369 | 5.57 | 27.51 | 48.979 | 74 | -25.021 | Peak |
| 7320 | 29.84 | 321 | 100 | V | 36.369 | 5.57 | 27.51 | 44.269 | 54 | -9.731 | Ave |
| 7320 | 25.57 | 274 | 100 | H | 36.369 | 5.57 | 27.51 | 39.999 | 54 | -14.001 | Ave |
| 9760 | 33.35 | 0 | 100 | V | 38.287 | 6.62 | 26.98 | 51.277 | 64.416 | -13.139 | Peak |
| 9760 | 32.22 | 0 | 100 | H | 38.287 | 6.62 | 26.98 | 50.147 | 71.036 | -20.889 | Peak |
| 9760 | 18.4 | 0 | 100 | V | 38.287 | 6.62 | 26.98 | 36.327 | 58.666 | -22.339 | Ave |
| 9760 | 18.45 | 0 | 100 | H | 38.287 | 6.62 | 26.98 | 36.377 | 70.126 | -33.749 | Ave |

| Frequency (MHz) | S.A. Reading (dB μ V) | Turntable Azimuth (degrees) | Test Antenna | | | Cable Loss (dB) | Pre-Amp. (dB) | Cord. Reading (dB μ V/m) | FCC | | Comments |
|------------------------|---------------------------|-----------------------------|--------------|----------------|---------------|-----------------|---------------|------------------------------|----------------------|-------------|----------|
| | | | Height (cm) | Polarity (H/V) | Factor (dB/m) | | | | Limit (dB μ V/m) | Margin (dB) | |
| High Channel, 2480 MHz | | | | | | | | | | | |
| 2480 | 51.19 | 227 | 100 | V | 29.155 | 3.25 | 0 | 83.595 | - | - | Peak |
| 2480 | 59.75 | 307 | 100 | H | 29.155 | 3.25 | 0 | 92.155 | - | - | Peak |
| 2480 | 49.99 | 227 | 100 | V | 29.155 | 3.25 | 0 | 82.395 | - | - | Ave |
| 2480 | 58.64 | 307 | 100 | H | 29.155 | 3.25 | 0 | 91.045 | - | - | Ave |
| 2483.5 | 27.82 | 0 | 100 | V | 29.155 | 3.25 | 0 | 60.225 | 74 | -13.775 | Peak |
| 2483.5 | 28.74 | 0 | 100 | H | 29.155 | 3.25 | 0 | 61.145 | 74 | -12.855 | Peak |
| 2483.5 | 13.33 | 0 | 100 | V | 29.155 | 3.25 | 0 | 45.735 | 54 | -8.265 | Ave |
| 2483.5 | 12.87 | 0 | 100 | H | 29.155 | 3.25 | 0 | 45.275 | 54 | -8.725 | Ave |
| 4960 | 46.52 | 95 | 100 | V | 33.327 | 4.52 | 27.75 | 56.617 | 74 | -17.383 | Peak |
| 4960 | 40.67 | 71 | 100 | H | 33.327 | 4.52 | 27.75 | 50.767 | 74 | -23.233 | Peak |
| 4960 | 42.64 | 95 | 100 | V | 33.327 | 4.52 | 27.75 | 52.737 | 54 | -1.263 | Ave |
| 4960 | 35.2 | 71 | 100 | H | 33.327 | 4.52 | 27.75 | 45.297 | 54 | -8.703 | Ave |
| 7440 | 37.17 | 120 | 100 | V | 36.565 | 5.62 | 27.51 | 51.845 | 74 | -22.155 | Peak |
| 7440 | 35.3 | 54 | 100 | H | 36.565 | 5.62 | 27.51 | 49.975 | 74 | -24.025 | Peak |
| 7440 | 31.67 | 120 | 100 | V | 36.565 | 5.62 | 27.51 | 46.345 | 54 | -7.655 | Ave |
| 7440 | 27.03 | 54 | 100 | H | 36.565 | 5.62 | 27.51 | 41.705 | 54 | -12.295 | Ave |
| 9920 | 31.85 | 0 | 100 | V | 38.287 | 6.55 | 26.98 | 49.707 | 63.595 | -13.888 | Peak |
| 9920 | 30.89 | 0 | 100 | H | 38.287 | 6.55 | 26.98 | 48.747 | 72.155 | -23.408 | Peak |
| 9920 | 17.11 | 0 | 100 | V | 38.287 | 6.55 | 26.98 | 34.967 | 62.395 | -27.428 | Ave |
| 9920 | 17.08 | 0 | 100 | H | 38.287 | 6.55 | 26.98 | 34.937 | 71.045 | -36.108 | Ave |

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

8.1 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

8.2 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.

8.3 Test Equipment List and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|--------------|-------------------|-----------|------------|------------------|----------------------|
| Agilent | Spectrum Analyzer | E4440A | US42221851 | 2013-03-05 | 1 year |

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

8.4 Test Environmental Conditions

| | |
|--------------------|---------|
| Temperature: | 23 °C |
| Relative Humidity: | 42 % |
| ATM Pressure: | 102 kPa |

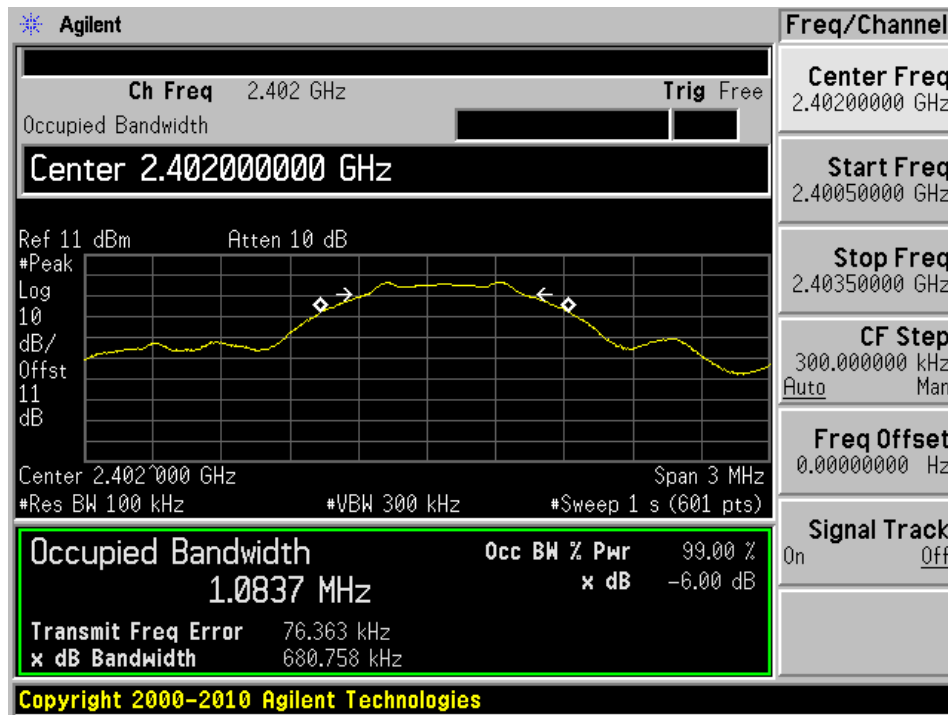
The testing was performed by Cipher Chu on 2013-10-28 at RF site.

8.5 Test Results

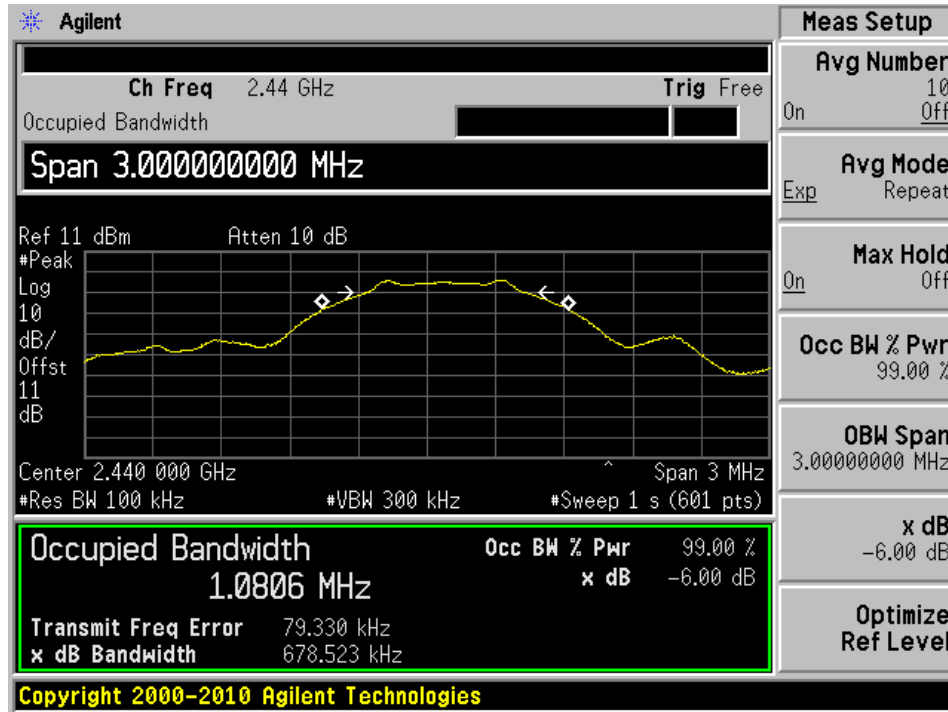
| Channel | Frequency (MHz) | 6 dB Emission Bandwidth (MHz) | 99% Emission Bandwidth (kHz) | Limit (MHz) | Results |
|---------|-----------------|-------------------------------|------------------------------|-------------|-----------|
| Low | 2402 | 1.0837 | 680.758 | > 0.5 | Compliant |
| Middle | 2440 | 1.0806 | 678.523 | > 0.5 | Compliant |
| High | 2480 | 1.0805 | 680.048 | > 0.5 | Compliant |

Please refer to the following plots for detailed test results

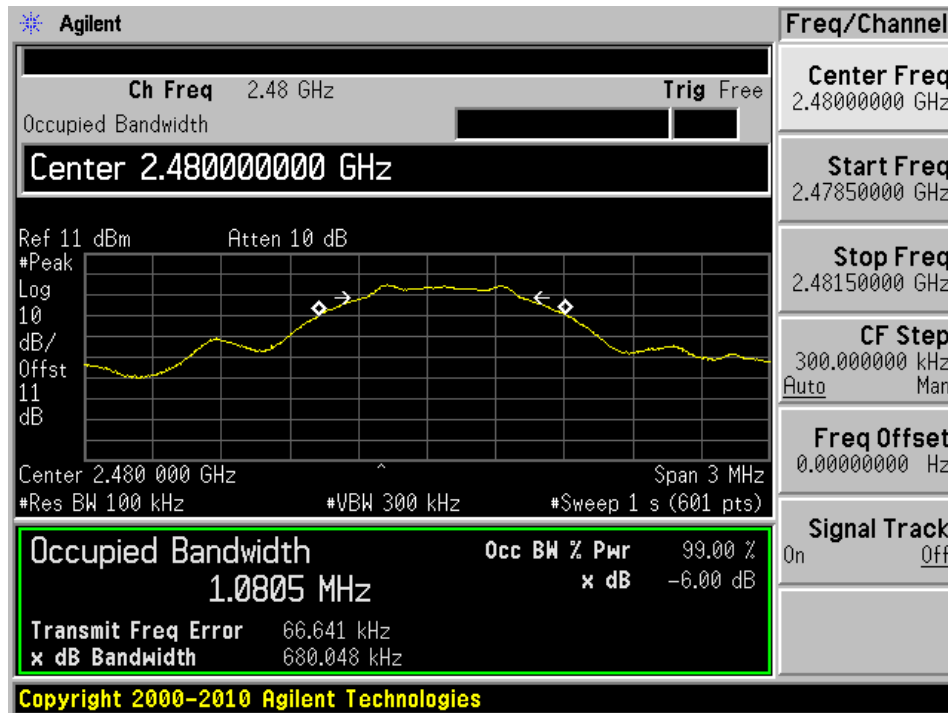
Low Channel: 2402 MHz



Middle Channel: 2440 MHz



High Channel: 2480 MHz



9 FCC §15.247(b) – Peak Output Power Measurement

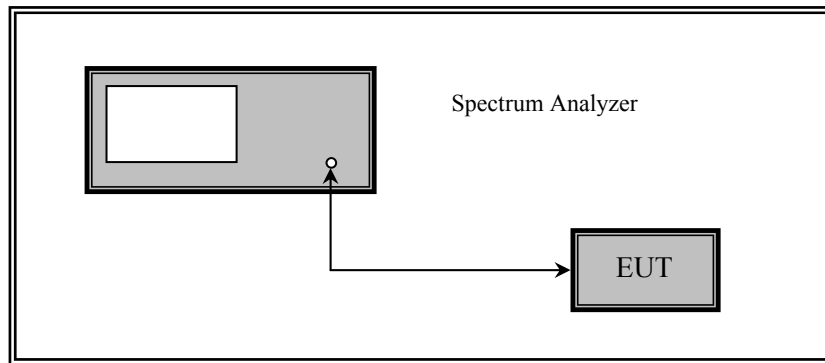
9.1 Applicable Standard

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.

9.2 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.



9.3 Test Equipment List and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|--------------|-------------------|-----------|------------|------------------|----------------------|
| Agilent | Spectrum Analyzer | E4440A | US42221851 | 2013-03-05 | 1 year |

Statement of Traceability: *BACL Corp.* attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

9.4 Test Environmental Conditions

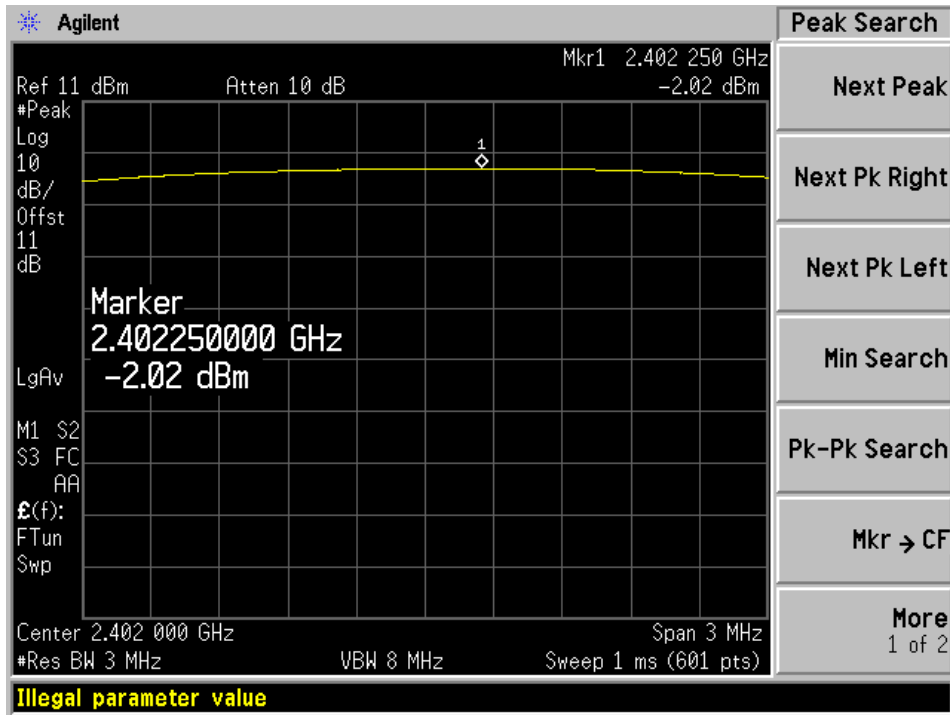
| | |
|--------------------|---------|
| Temperature: | 23 °C |
| Relative Humidity: | 42 % |
| ATM Pressure: | 102 kPa |

The testing was performed by CIPHER Chu on 2013-10-28 at RF site.

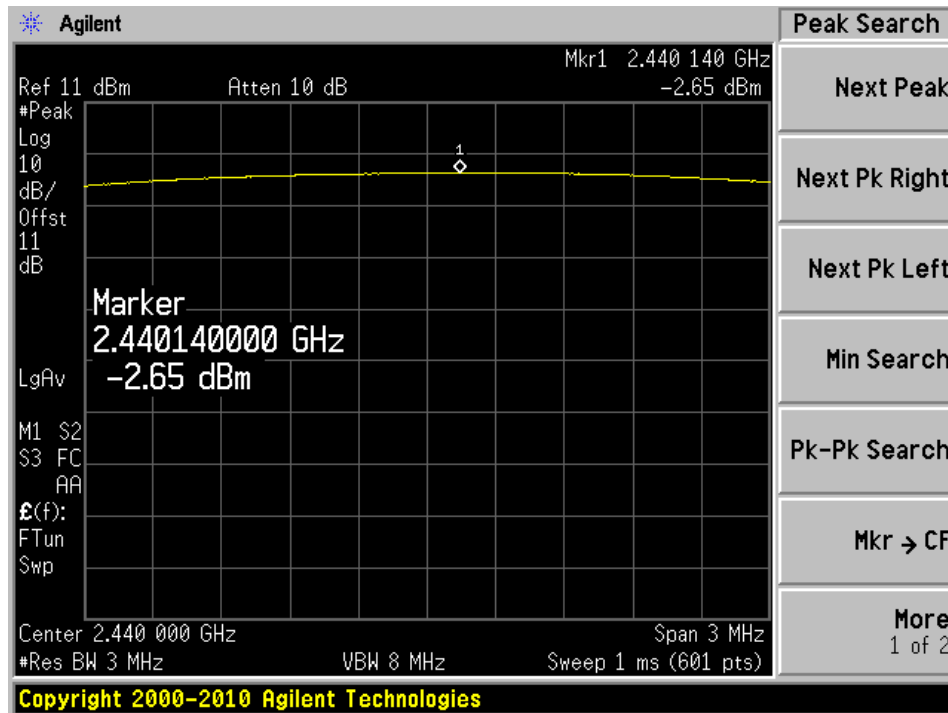
9.5 Test Results

| Channel | Frequency (MHz) | Conducted Output Power (dBm) | FCC Limit (dBm) | Margin (dB) |
|---------|-----------------|------------------------------|-----------------|-------------|
| Low | 2402 | -2.02 | 30 | -32.02 |
| Middle | 2440 | -2.65 | 30 | -32.65 |
| High | 2480 | -3.97 | 30 | -33.97 |

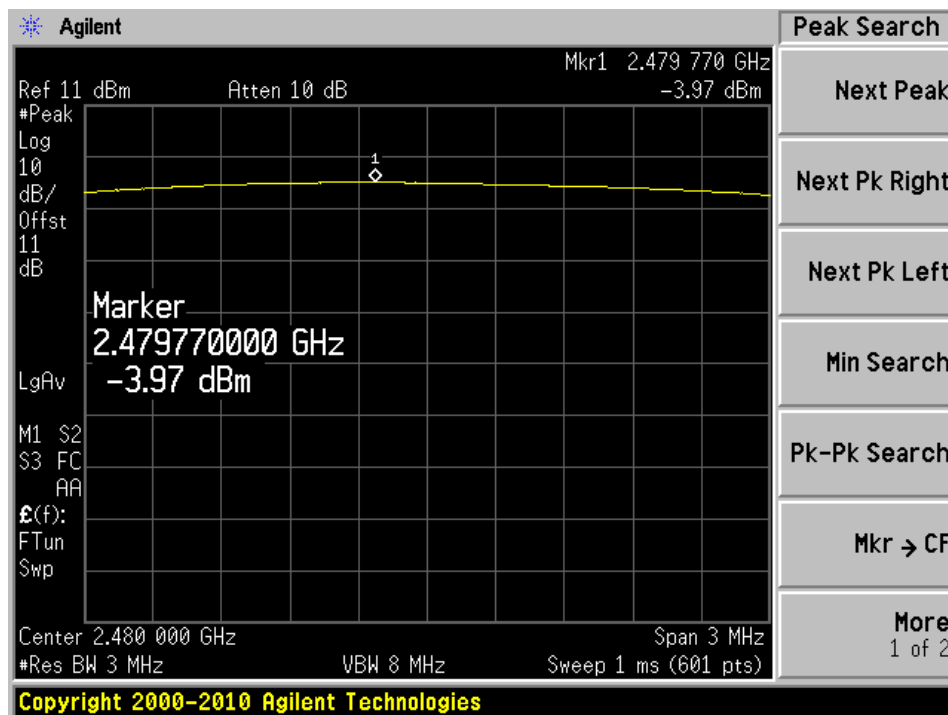
Low Channel: 2402 MHz



Middle Channel: 2440 MHz



High Channel: 2480 MHz



10 FCC §15.247(d) – 100 kHz Bandwidth of Band Edges

10.1 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).

10.2 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.

10.3 Test Equipment List and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|--------------|-------------------|-----------|------------|------------------|----------------------|
| Agilent | Spectrum Analyzer | E4440A | US42221851 | 2013-03-05 | 1 year |

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

10.4 Test Environmental Conditions

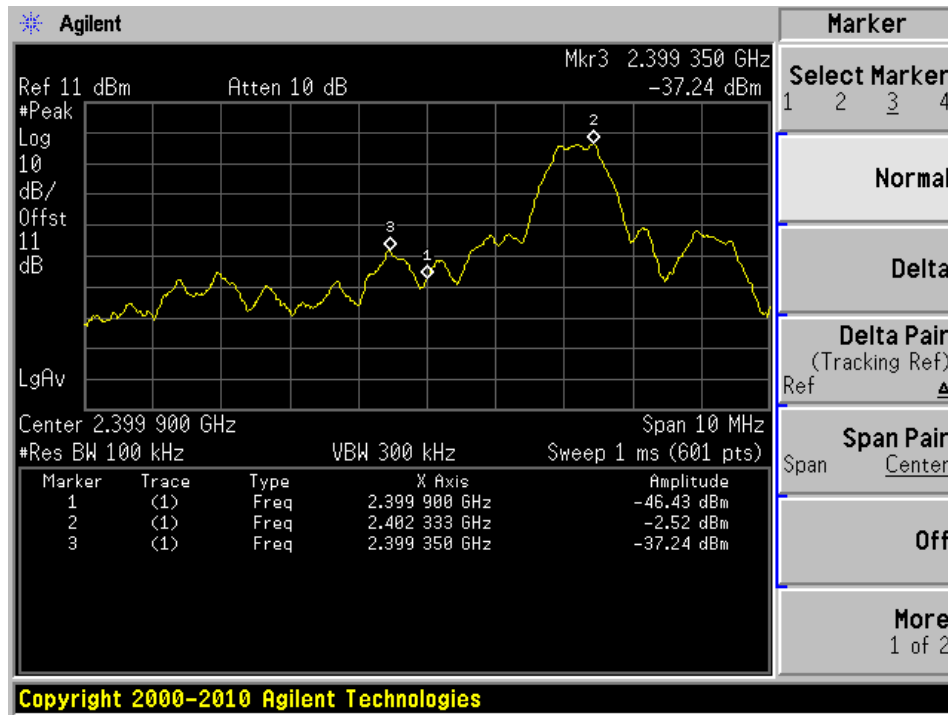
| | |
|--------------------|---------|
| Temperature: | 23 °C |
| Relative Humidity: | 42 % |
| ATM Pressure: | 102 kPa |

The testing was performed by Cipher Chu on 2013-10-28 at RF site.

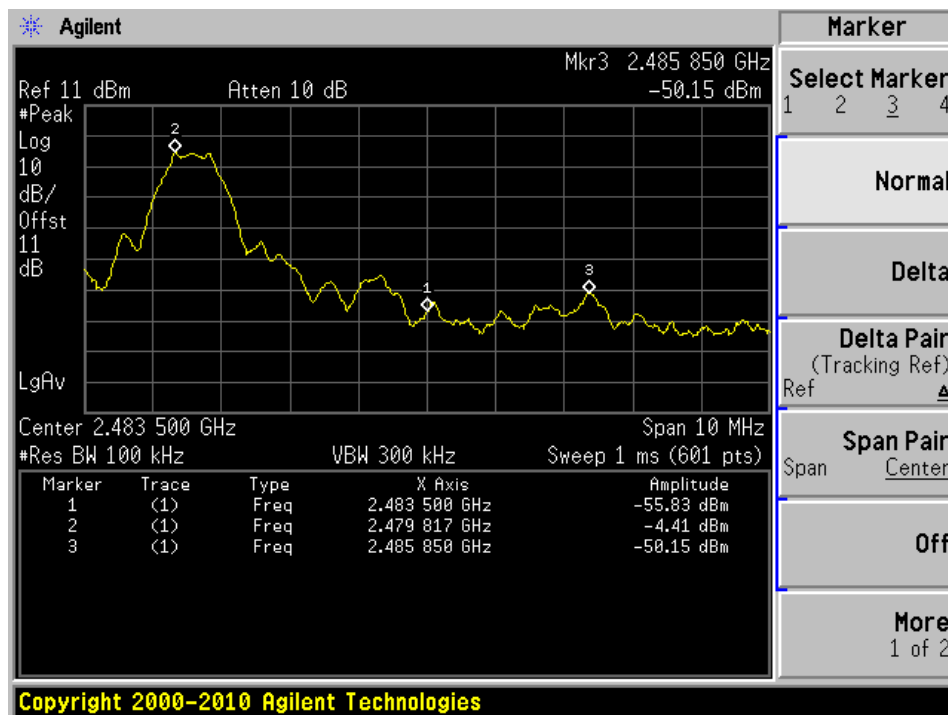
10.5 Test Results

Please refer to following pages for plots of band edge.

Low Band Edge



High Band Edge



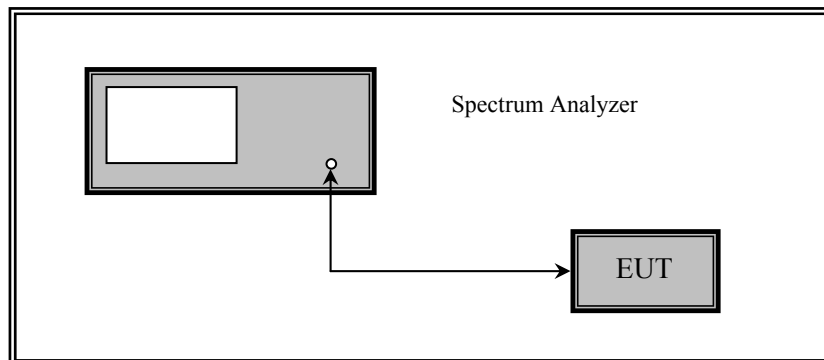
11 FCC §15.247(e) – Power Spectral Density

11.1 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.

11.2 Measurement Procedure

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW ≥ 3 kHz.
4. Set the VBW $\geq 3 \times$ RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



11.3 Test Equipment List and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|--------------|-------------------|-----------|------------|------------------|----------------------|
| Agilent | Spectrum Analyzer | E4440A | US42221851 | 2013-03-05 | 1 year |

Statement of Traceability: *BACL Corp.* attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

11.4 Test Environmental Conditions

| | |
|--------------------|--------|
| Temperature: | 23°C |
| Relative Humidity: | 42% |
| ATM Pressure: | 102kPa |

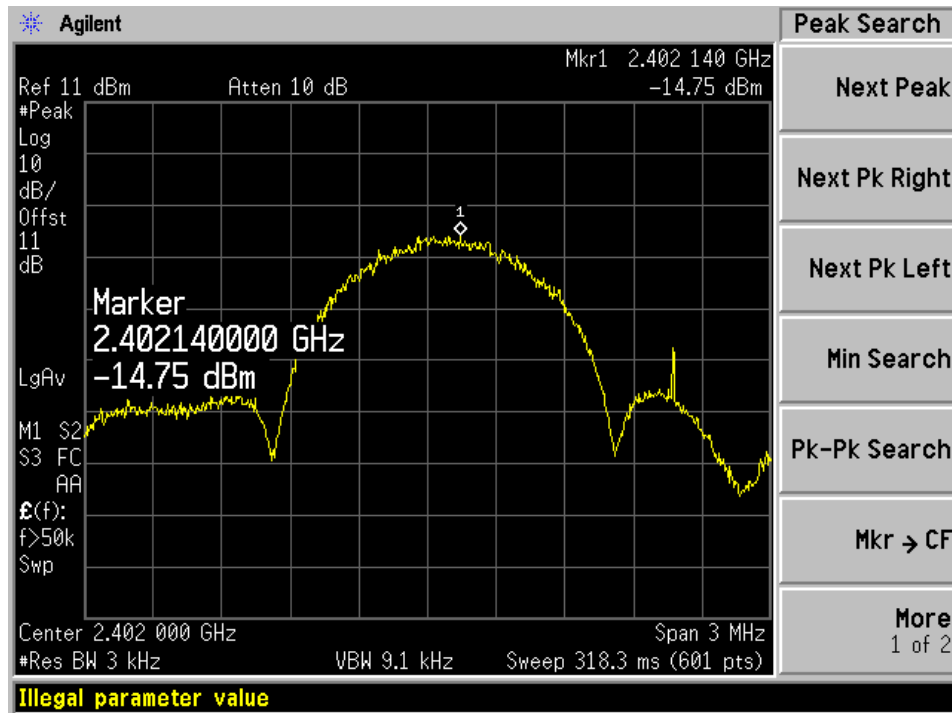
The testing was performed by Cipher Chu on 2013-10-28 at RF site.

11.5 Test Results

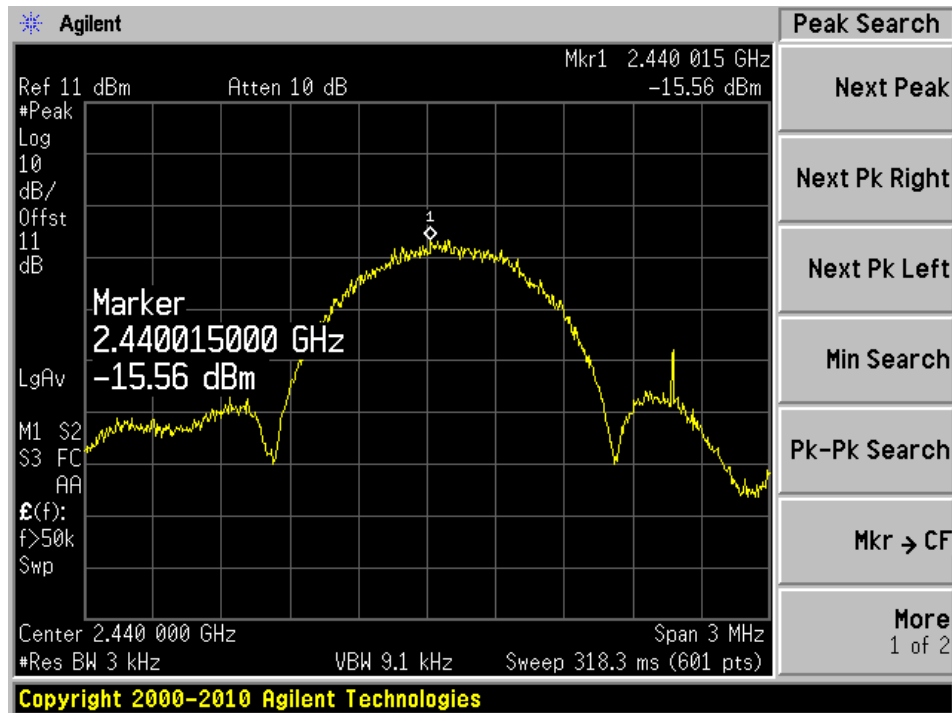
| Channel | Frequency (MHz) | PSD (dBm) | FCC Limit (dBm) | Margin (dB) |
|---------|-----------------|-----------|-----------------|-------------|
| Low | 2402 | -14.75 | 8 | -22.75 |
| Middle | 2440 | -15.56 | 8 | -23.56 |
| High | 2480 | -16.78 | 8 | -24.78 |

Please refer to the following plots for detailed test results:

Low Channel: 2402 MHz



Middle Channel: 2440 MHz



High Channel: 2480 MHz

