FCC PART 15, SUBPART C
IC RSS-210, ISSUE 8, DECEMBER 2010

TEST AND MEASUREMENT REPORT

For

KHN Solutions, Inc.

300 Broadway, Suite 26,

San Francisco, CA 94133, USA

FCC ID: S8B-BTBLE40
IC: 10935A-BTBLE40

Report Type:	**Product Type:**
Original Report	BT 4.0 GFSK Module

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1302123-247	Original Report	2013-04-16

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *KHN Solutions, Inc.*, and their product *FCC ID: S8B-BTBLE40, IC: 10935A-BTBLE40, model: BTBLE40* or the "EUT" as referred on this report is a Bluetooth 4.0 GFSK module for breath alcohol detector which operates on 2402-2480 MHz.

1.2 Mechanical Description of EUT

The "EUT" measures approximately *4.3 cm (L) x 2.0 cm (W) x 0.3 cm (H)*, and weighs approximately *2.5*g.

The test data gathered are from typical production sample, serial number: 1301000064 for the radiated testing and 1301000042 for the conducted provided by manufacturer.

1.3 Objective

This report is prepared on behalf of *KHN Solutions, Inc.* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commissions rules and IC RSS-210 Issue 8, Dec 2010.

The objective is to determine compliance with FCC Part 15.247 and IC RSS-210 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, and power spectral density, 100 kHz Bandwidth of Band Edges Measurement, Spurious Emissions, Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2009, 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 CISPR16-4-2:2007, 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.: 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.

2.2 EUT Exercise Software

The test utility used was CoolTerm, Version 1.4.1 (Build 162) was provided by KHN Solutions, Inc. and was verified by Jeffrey Wu to comply with the standard requirements being tested against.

Radio Mode	Frequency (MHz)		
	Low CH	Mid CH	High CH
Bluetooth 4.0	2402	2442	2480

2.3 Special Equipment

There were no special accessories 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

Manufacturer	Description	Model	Serial Number
Punch Through Design	Supporting Board	1Breath RevB_Breakout	-

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
BACtrack	Main PCB (Radiated)	BTBLE40	1301000042
BACtrack	Main PCB (Conducted)	BTBLE40	1301000042

2.7 Interface Ports and Cables

Cable Description	Length (m)	To	From
USB	< 1	EUT	Laptop

2.8 External I/O Cabling List and AC Cord

N/A

2.9 Power Supply List and Details

Manufacturer	Description	Model	Serial Number
Kuanten	AC/DC Adaptor	SSA051F050100USU	-
Powerizer	3.7 V 800mAh Battery	CU-JAS138	-

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & IC Rules	Description of Test	Results
FCC §15.247(i), §2.1093 IC RSS-102	RF Exposure	Compliant
FCC §15.203 IC RSS-Gen §7.1.2	Antenna Requirement	Compliant
FCC §15.207(a) IC RSS-Gen §7.2.4	AC Line Conducted Emissions	Compliant
FCC §15.247 (d) IC RSS-210 §A8.5	Spurious Emissions at Antenna Port	Compliant
FCC §15.209, §15.205, §15.247(d) IC RSS-210 §2.2, §A8.5	Restricted Bands, Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) IC RSS-210 §A8.2	6 dB Emission Bandwidth	Compliant
FCC §15.247(b)(3) IC RSS-210 §A8.4	Maximum Peak Output Power	Compliant
FCC §15.247(d) IC RSS-210 §A8.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) IC RSS-210 §A8.2(b)	Power Spectral Density	Compliant
IC RSS-210 §2.3 & RSS-Gen §6.1	Receiver Spurious Emission	Compliant

4 FCC §15.247 (i), §2.1093 & IC RSS-102 – RF Exposure

4.1 Applicable Standard

FCC §2.1093, §15.247(i) and IC RSS-102

4.2 SAR Exemption Guild lines

According to FCC KDB 447498 D01, Appendix A:

SAR Test Exclusion Thresholds for 100 MHz-6 GHz and ≤ 50 mm

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distance are illustrated in the following Table:

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

According to IC RSS-102 §2.5.1: Exemption from Routine Evaluation Limits-SAR evaluation

SAR evaluation is required if the separation distance between the user and the radiated element of the device is less than or equal to 20 cm, except when the device operates as follows.

- Above 2.2 GHz and up to 3GHz inclusively, and with output power (i.e. the higher of the conducted or radiated(e.i.r.p.) source-based, time-average output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled used;

4.3 Evaluation Result

The maximum conducted output power of this device is -0.33 dBm, the antenna gain is 2.3 dBi, the maximum e.i.r.p. is -0.33+ 2.3 = 1.97 dBm, i.e. 158. mW which is less than the SAR threshold of 10 mw (FCC KDB 447498 D01 Appendix A), and 20 mw (IC RSS-102 §2.5.1). SAR evaluation is not required.

5 FCC §15.203 & IC RSS-Gen §7.1.2 – 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.

According to IC RSS-Gen §7.1.2: Transmitter Antenna

A transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest-gain antenna of each combination of transmitter and antenna type for which certification is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type and having equal or lesser gain as an antenna that had been successfully tested for certification with the transmitter, will also be considered certified with the transmitter, and may be used and marketed with the transmitter. The manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limits specified in RSS-210 or RSS-310 for devices of RF output powers of 10 mW or less. For devices of output powers greater than 10 mW, except devices subject to RSS-210 Annex 8 (Frequency Hopping and Digital Modulation Systems Operating in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz Bands) or RSS-210 Annex 9 (Local Area Network Devices), the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

5.2 Result

The EUT’s antenna has the maximum gain of 2.3 dBi and permanently attached to the PCB; which complies with sections FCC Part 15.203 and IC RSS-Gen §7.1.2.

6 FCC §15.207 & IC RSS-Gen §7.2.4 – AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 and IC RSS-Gen §7.2.4 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 *	56 to 46 *
0.5-5	56	46
5-30	60	50

**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 and IC RSS-Gen §7.2.4 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 which provided 120 V / 60 Hz AC power.

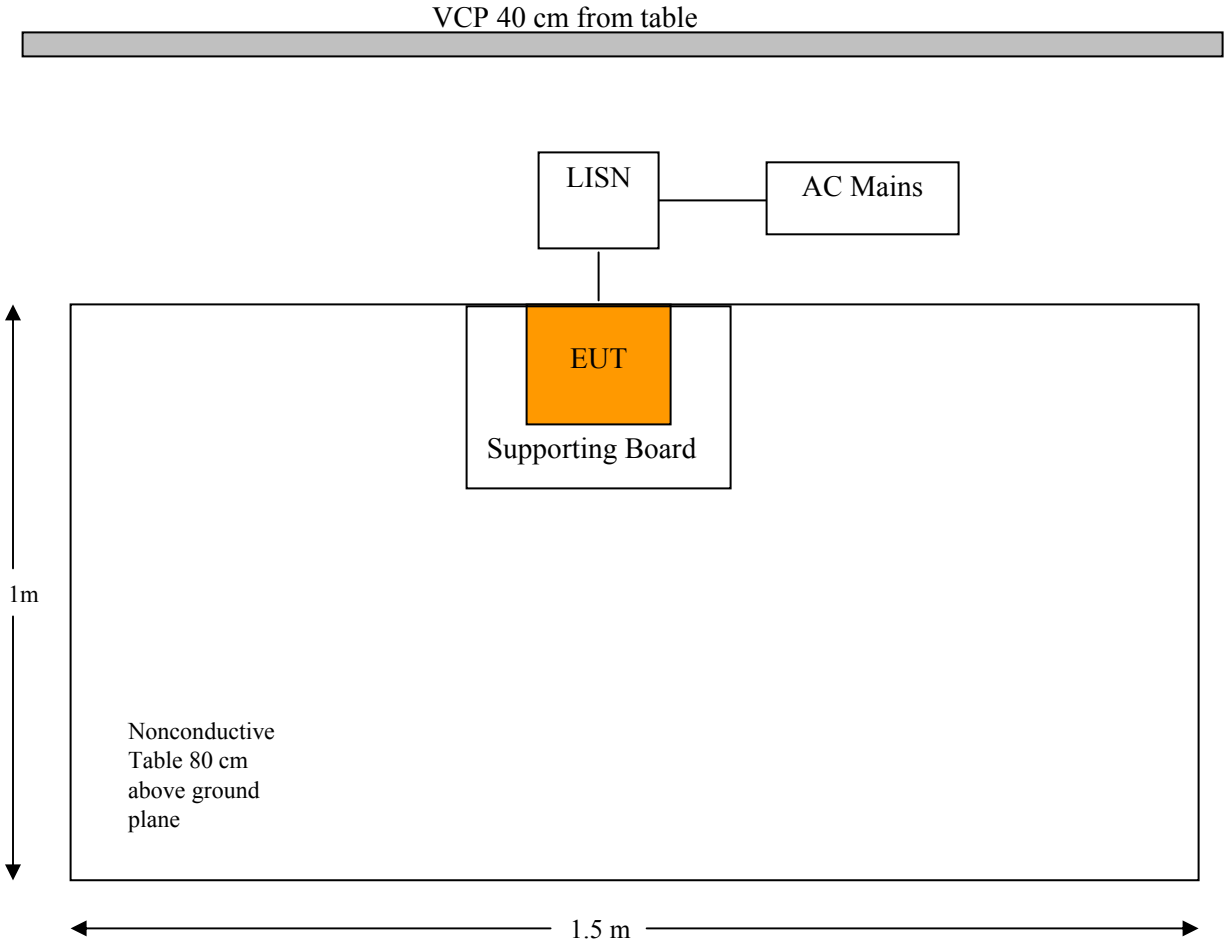
6.3 Test Procedure

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

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	Calibration Interval
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100338	2012-09-19	1 year
Solar Electronics	LISN	9252-R-24-BNC	511213	2012-06-25	1 year
TTE	Filter, High Pass	H9962-150K-50-21378	K7133	2012-05-30	1 year

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

6.7 Test Environmental Conditions

Temperature:	22.7 ºC
Relative Humidity:	37 %
ATM Pressure:	101.1 kPa

The testing was performed by Jeffrey Wu on 2013-03-25 in 5 m chamber 3.

6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC and IC standards conducted emissions limits, with the margin reading of:

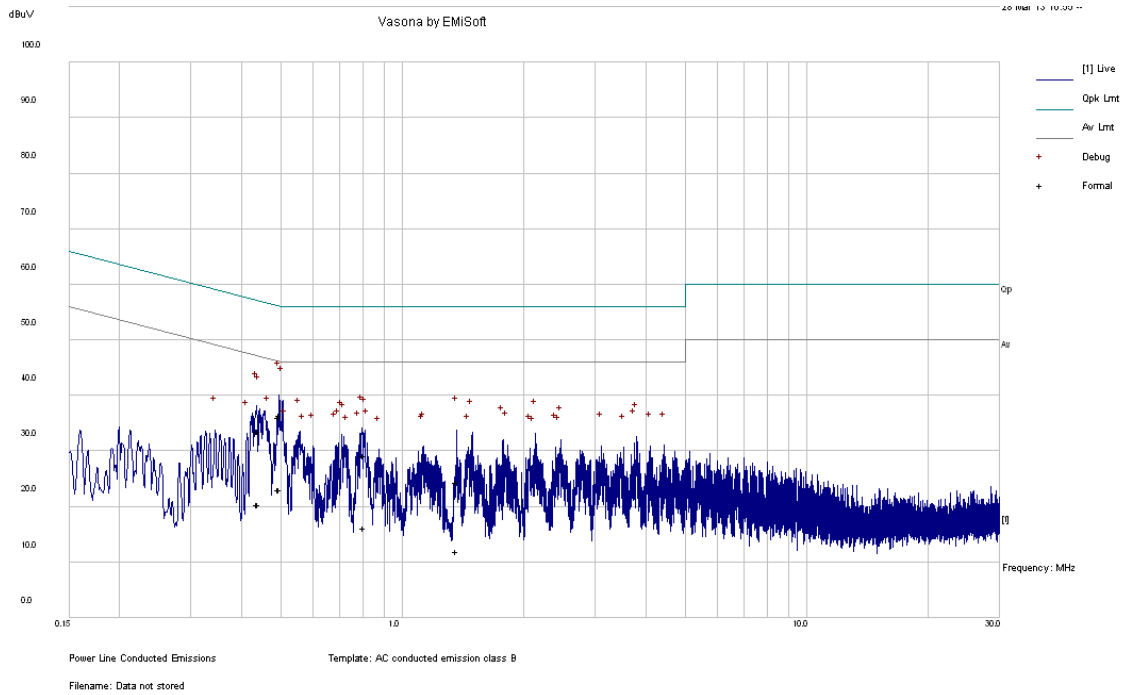
Transmitting Mode: Low Channel

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-15.27	0.497961	Neutral	0.15-30

6.9 Conducted Emissions Test Plots and Data

Transmitting Mode: Low Channel 2402 MHz

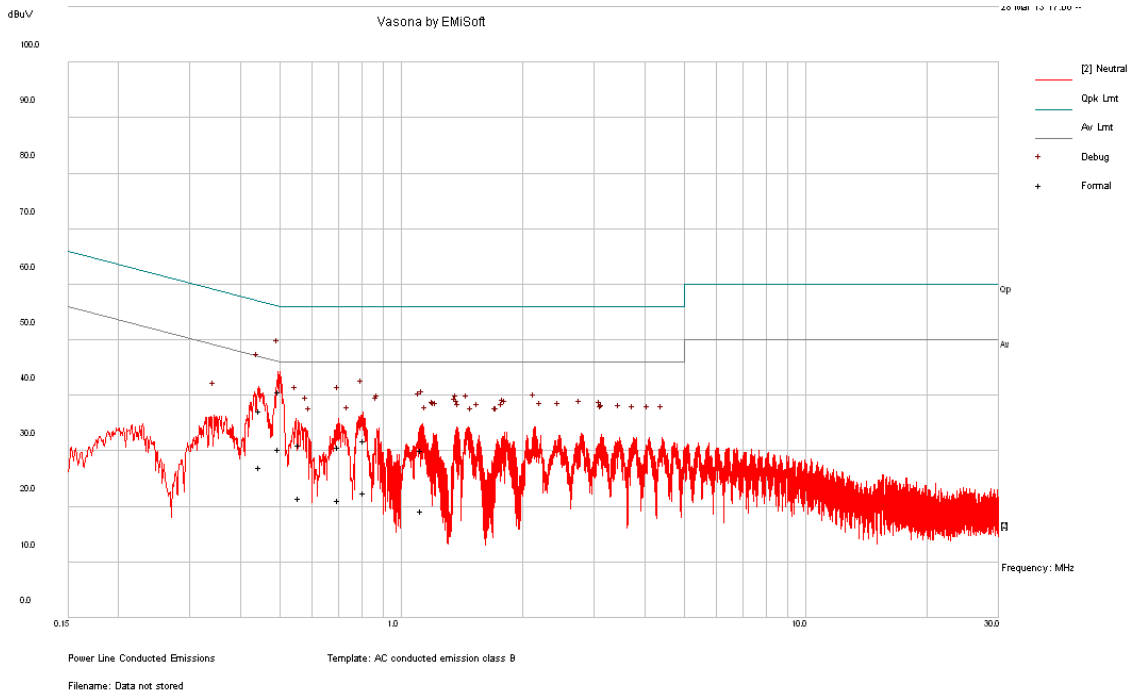
120 V, 60 Hz – Line, AC/DC Adaptor



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.49791	36.42	Line	56.03	-19.62	QP
0.496725	36.2	Line	56.05	-19.85	QP
0.439254	33.66	Line	57.08	-23.42	QP
0.441132	33.55	Line	57.04	-23.49	QP
0.8037	29.23	Line	56	-26.77	QP
1.366827	24.36	Line	56	-31.64	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.49791	23.14	Line	46.03	-22.89	Ave.
0.496725	23.14	Line	46.05	-22.91	Ave.
0.441132	20.47	Line	47.04	-26.57	Ave.
0.439254	20.46	Line	47.08	-26.62	Ave.
0.8037	16.25	Line	46	-29.75	Ave.
1.366827	12.03	Line	46	-33.97	Ave.

120 V, 60 Hz – Neutral, AC/DC Adaptor



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.497961	40.77	Neutral	56.03	-15.27	QP
0.446526	37.2	Neutral	56.94	-19.74	QP
0.809802	31.81	Neutral	56	-24.19	QP
0.558561	31.17	Neutral	56	-24.83	QP
0.699987	30.67	Neutral	56	-25.33	QP
1.124679	30.25	Neutral	56	-25.75	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.497961	30.31	Neutral	46.03	-15.73	Ave.
0.446526	27.06	Neutral	46.94	-19.88	Ave.
0.809802	22.56	Neutral	46	-23.44	Ave.
0.558561	21.58	Neutral	46	-24.42	Ave.
0.699987	21.11	Neutral	46	-24.89	Ave.
1.124679	19.21	Neutral	46	-26.79	Ave.

7 FCC §15.247(d) & IC RSS-210 §A8.5 – Spurious Emissions at Antenna Terminals

7.1 Applicable Standard

For FCC §15.247(d) and IC RSS-210 §A8.5 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	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 Year

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

7.4 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	35 %
ATM Pressure:	101.4 kPa

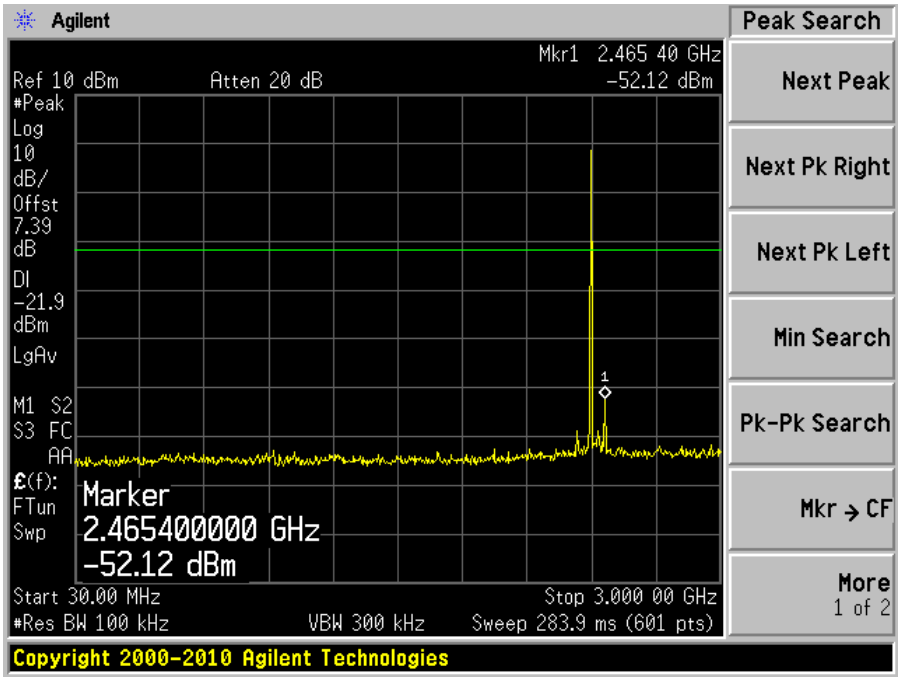
The testing was performed by Jeffrey Wu on 2013-03-21 at the RF Test Site.

7.5 Test Results

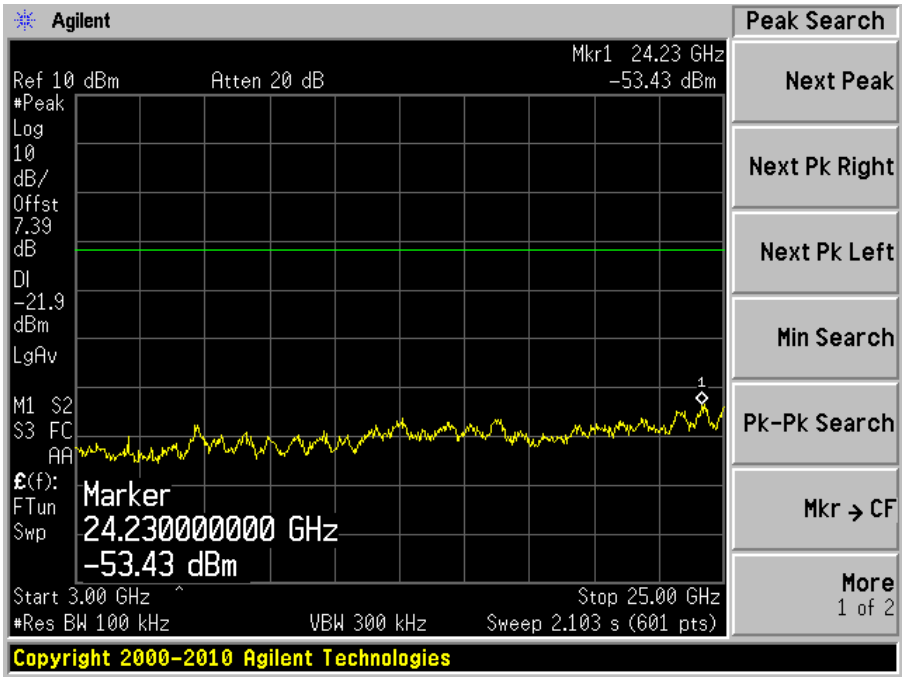
Please refer to following plots of spurious emissions.

Low Channel, 2402 MHz

Plot: 30 MHz – 3 GHz

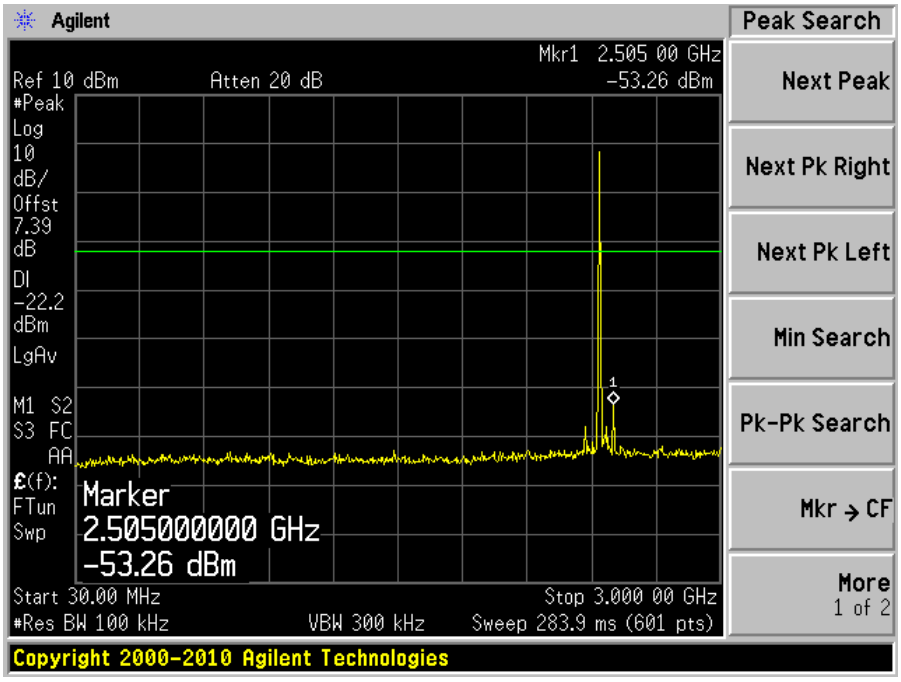


Plot: 3 GHz – 25 GHz

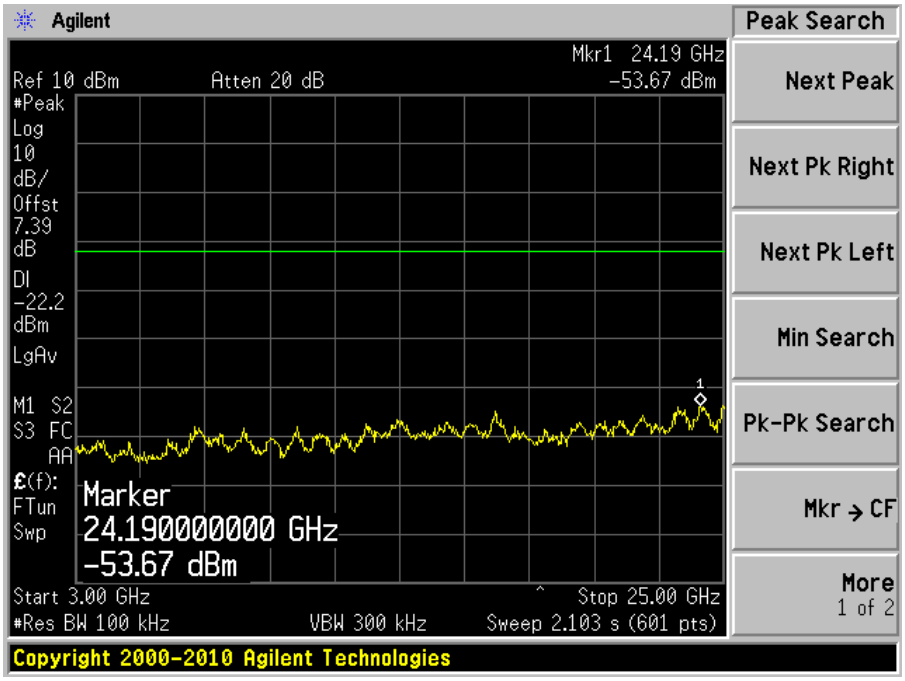


Middle Channel, 2442 MHz

Plot: 30 MHz – 3 GHz

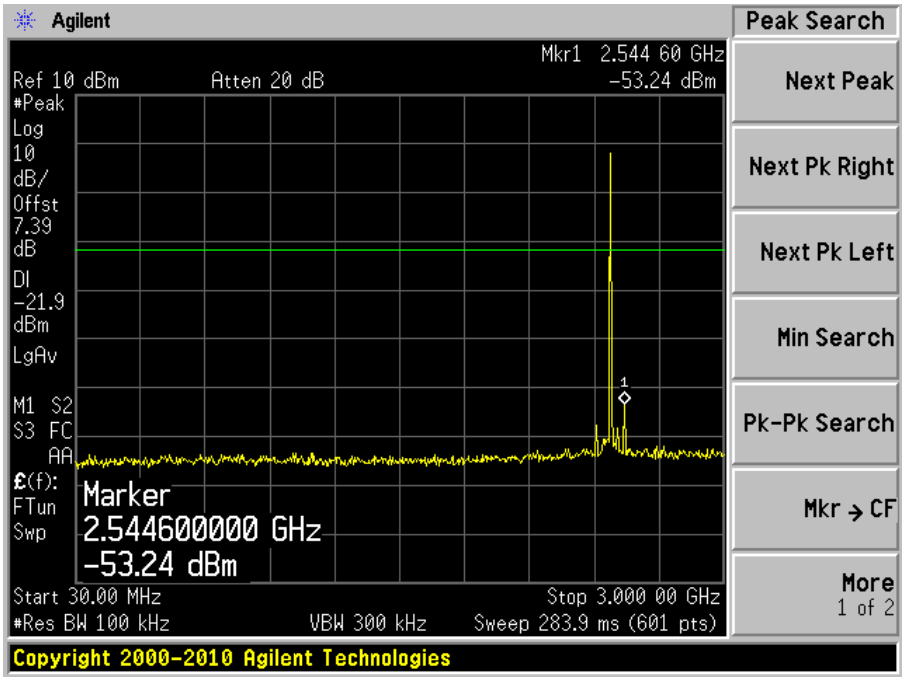


Plot: 3 GHz – 25 GHz

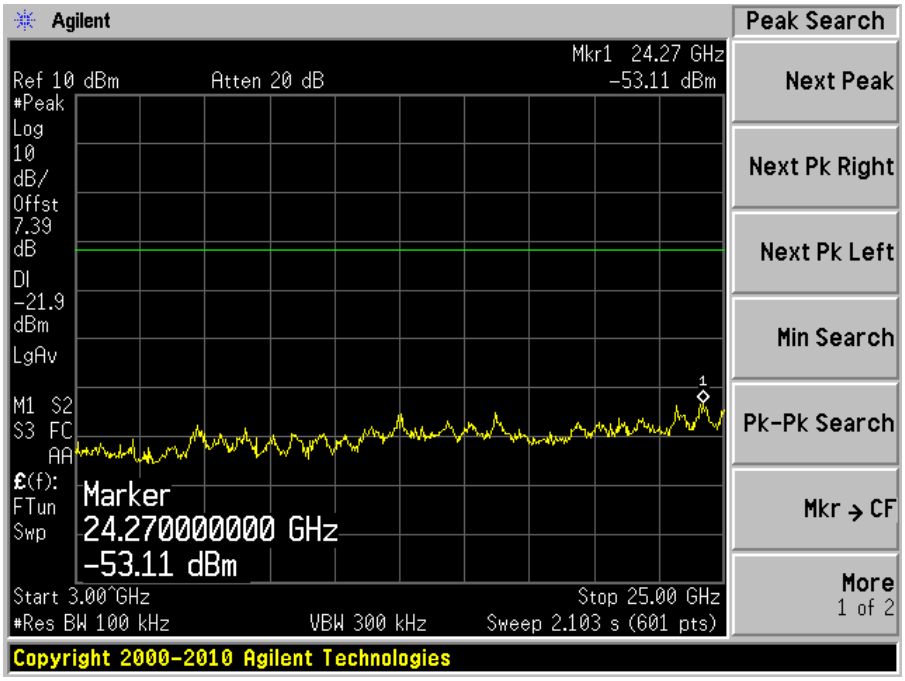


High Channel, 2480 MHz

Plot: 30 MHz – 3 GHz



Plot: 3 GHz – 25 GHz



8 FCC §15.205, §15.209, §15.247(d) & IC RSS-210 §2.2, §A8.5 – 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**	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	156.52475 – 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).

As per IC RSS-210 §A8.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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 and IC RSS-210 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 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

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

8.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (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:

Margin (dB) = Corrected Amplitude (dBuV/m) - Limit (dBuV/m)

8.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 Year
Sunol Sciences	Horn Antenna	DRH-118	A052704	2013-03-17	1 Year
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2012-05-09	1 Year
Rohde & Schwarz	Test Receiver	ESCI 1166.5950K03	100338	2012-09-19	1 Year
Sunol Sciences	Biconi-Log Antenna	JB3	A020106-2	2012-08-15	1 Year
Agilent	Pre-amplifier	8447D	2944A10187	2013-03-08	1 Year
Sunol Sciences	System Controller	SC104V	113005-1	N/A	N/A

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

8.6 Test Environmental Conditions

Temperature:	20-23 °C
Relative Humidity:	38-45 %
ATM Pressure:	101-102 kPa

The testing was performed by Jeffrey Wu from 2013-02-06 to 2013-03-25 at the 5m chamber 2.

8.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15C and IC RSS-210 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**
-23.17	30	Horizontal	High, 30 MHz to 1 GHz

1-25 GHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-2.024	7206	Horizontal	Low, 1GHz to 25 GHz

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

8.8 Radiated Emissions Test Data

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

Quasi-Peak Measurements

Low Channel, 2402 MHz

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
31.08175	14.73	194	H	179	40	-25.27
38.98525	9.32	400	V	147	40	-30.68

Middle Channel, 2442 MHz

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
30	16.8	190	H	90	40	-23.2
39.37075	9.06	344	V	267	40	-30.94
110.048	7.53	283	H	0	43.5	-35.97

High Channel, 2480 MHz

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
30	16.83	136	H	61	40	-23.17
37.32425	10.19	328	H	360	40	-29.81
43.1035	7.51	313	H	162	40	-32.49

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/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2402 MHz, measured at 3 meters											
2402	59.17	214	112	V	29.0	2.94	0	91.09	Fund.	-	Peak
2402	61.3	52	108	H	29.0	2.94	0	93.22	Fund.	-	Peak
2402	58.18	214	112	V	29.0	2.94	0	90.12	Fund.	-	Ave
2402	60.19	52	108	H	29.0	2.94	0	92.13	Fund.	-	Ave
4804	39.22	384	100	V	32.71	4.06	27.78	48.211	74	-25.789	Peak
4804	37.57	311	112	H	32.71	4.06	27.78	46.561	74	-27.439	Peak
4804	29.74	284	100	V	32.71	4.06	27.78	38.731	54	-15.269	Ave
4804	28.56	311	112	H	32.71	4.06	27.78	37.551	54	-16.449	Ave
7206	53.61	100	114	V	36.25	4.93	27.59	67.196	71.09	-3.894	Peak
7206	57.61	79	100	H	36.25	4.93	27.59	71.196	73.22	-2.024	Peak
7206	37.84	100	114	V	36.25	4.93	27.59	51.426	70.12	-18.694	Ave
7206	40.38	79	100	H	36.25	4.93	27.59	53.966	72.13	-18.164	Ave
9608	32.29	242	100	V	37.38	5.82	27.05	48.435	71.09	-22.655	Peak
9608	32.23	0	100	H	37.38	5.82	27.05	48.375	73.22	-24.845	Peak
9608	18.12	242	100	V	37.38	5.82	27.05	34.265	70.12	-35.855	Ave
9608	17.19	0	100	H	37.38	5.82	27.05	33.335	72.13	-38.795	Ave
Middle Channel 2442 MHz, measured at 3 meters											
2442	57.07	217	104	V	29.0	2.94	0	88.99	Fund.	-	Peak
2442	62.42	52	103	H	29.0	2.94	0	94.34	Fund.	-	Peak
2442	56.19	217	104	V	29.0	2.94	0	88.11	Fund.	-	Ave
2442	61.82	52	103	H	29.0	2.94	0	93.74	Fund.	-	Ave
4884	39.23	289	118	V	32.86	4.10	27.67	48.518	74	-25.482	Peak
4884	38.43	97	115	H	32.86	4.10	27.67	47.718	74	-26.282	Peak
4884	34.88	289	118	V	32.86	4.10	27.67	44.168	54	-9.832	Ave
4884	34.53	97	115	H	32.86	4.10	27.67	43.818	54	-10.182	Ave
7320	39.77	80	141	V	36.52	4.88	27.50	53.673	74	-20.327	Peak
7320	42.33	71	102	H	36.52	4.88	27.51	56.223	74	-17.777	Peak
7320	31.76	80	141	V	36.52	4.88	27.51	45.653	54	-8.347	Ave
7320	35.04	71	102	H	36.52	4.88	27.51	48.933	54	-5.067	Ave
9760	31.03	0	100	V	37.39	5.77	27.03	47.164	68.99	-21.826	Peak
9760	31.28	0	100	H	37.39	5.77	27.03	47.414	74.34	-26.926	Peak
9760	16.58	0	100	V	37.39	5.77	27.03	32.714	68.11	-35.396	Ave
9760	16.62	0	100	H	37.39	5.77	27.03	32.754	73.74	-40.986	Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 2480 MHz, measured at 3 meters											
2480	58.03	196	108	V	29.1	3.01	0	90.162	Fund.	-	Peak
2480	63.25	54	108	H	29.1	3.01	0	95.382	Fund.	-	Peak
2480	57.07	196	108	V	29.1	3.01	0	89.202	Fund.	-	Ave
2480	62.6	54	108	H	29.1	3.01	0	94.732	Fund.	-	Ave
4960	38.51	289	101	V	33.07	4.21	27.70	48.092	74	-25.908	Peak
4960	38.42	91	100	H	33.07	4.21	27.70	48.002	74	-25.998	Peak
4960	34.09	289	101	V	33.07	4.21	27.70	43.672	54	-10.328	Ave
4960	33.27	91	100	H	33.07	4.21	27.70	42.852	54	-11.148	Ave
7440	39.37	210	108	V	36.43	4.89	27.53	53.163	74	-20.837	Peak
7440	40.87	130	100	H	36.43	4.89	27.53	54.663	74	-19.337	Peak
7440	31.26	210	108	V	36.43	4.89	27.53	45.053	54	-8.947	Ave
7440	33.61	130	100	H	36.43	4.89	27.53	47.403	54	-6.597	Ave
9920	31.47	0	100	V	37.56	5.92	27.01	47.937	70.16	-22.225	Peak
9920	31.18	0	100	H	37.56	5.92	27.01	47.647	75.38	-27.735	Peak
9920	16.61	0	100	V	37.56	5.92	27.01	33.077	69.20	-36.125	Ave
9920	16.67	0	100	H	37.56	5.92	27.01	33.137	74.73	-41.595	Ave

3) Restricted Band Edge

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2402 MHz, measured at 3 meters											
2390	24.95	214	112	V	28.98	2.94	0	56.87	74	-17.130	Peak
2390	24.92	52	108	H	28.98	2.94	0	56.84	74	-17.160	Peak
2390	12.34	214	112	V	28.98	2.94	0	44.26	54	-9.740	Ave
2390	12.473	52	108	H	28.98	2.94	0	44.39	54	-9.607	Ave
High Channel 2480 MHz, measured at 3 meters											
2483.5	25.12	196	108	V	29.12	3.01	0	57.25	74	-16.748	Peak
2483.5	26.23	54	108	H	29.12	3.01	0	58.36	74	-15.638	Peak
2483.5	12.64	196	108	V	29.12	3.01	0	44.77	54	-9.228	Ave
2483.5	13.08	54	108	H	29.12	3.01	0	45.21	54	-8.788	Ave

9 FCC§15.247(a)(2) & IC RSS-210 §A8.2 – 6 dB & 99% Emission Bandwidth

9.1 Applicable Standard

According to FCC §15.247(a)(2) and IC RSS-210 A8.2 (a), 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	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	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:	22 °C
Relative Humidity:	35 %
ATM Pressure:	101.4 kPa

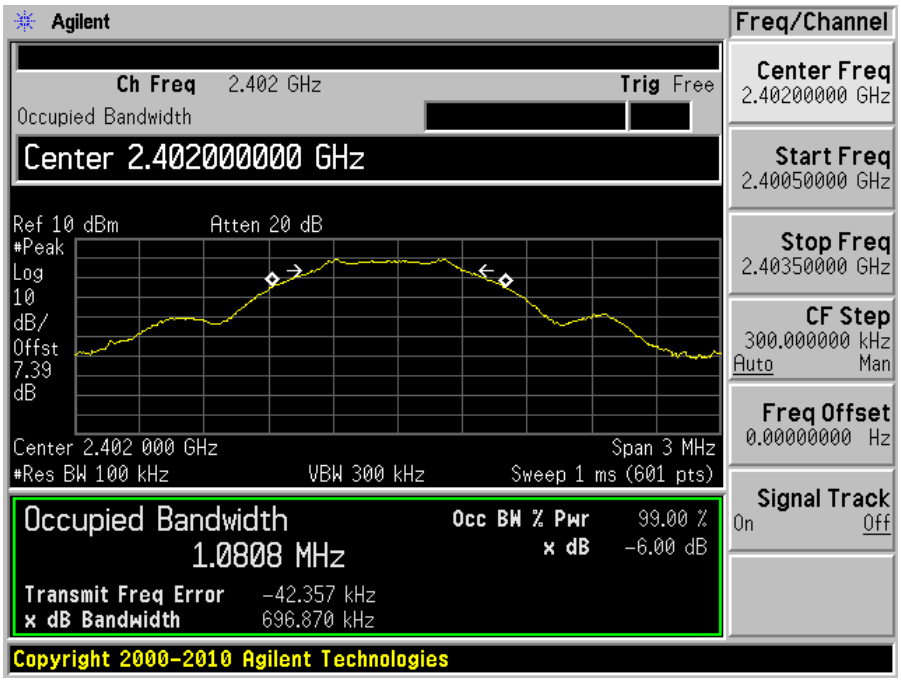
The testing was performed by Jeffrey Wu on 2013-03-21 at the RF Test Site.

9.5 Test Results

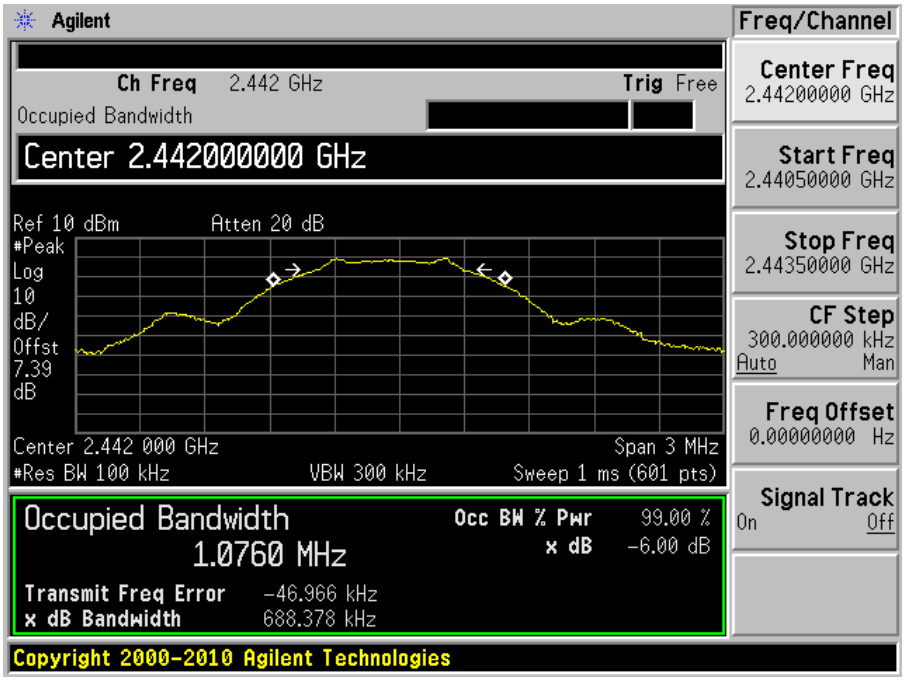
Channel	Frequency (MHz)	6 dB Emission Bandwidth (kHz)	99% Emission Bandwidth (kHz)	Limit (kHz)	Results
Low	2402	696.870	1080.8	6 dB BW > 500	Pass
Middle	2442	688.378	1076.0	6 dB BW > 500	Pass
High	2480	689.128	1079.4	6 dB BW > 500	Pass

Please refer to the following plots for detailed test results

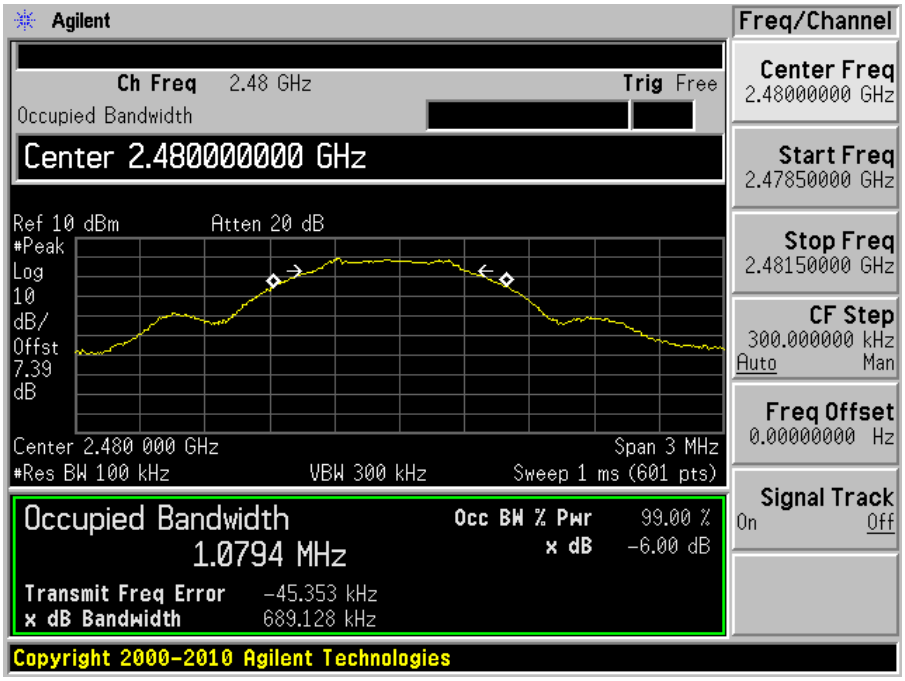
Low channel: 2402 MHz



Middle channel: 2442 MHz



High channel: 2480 MHz



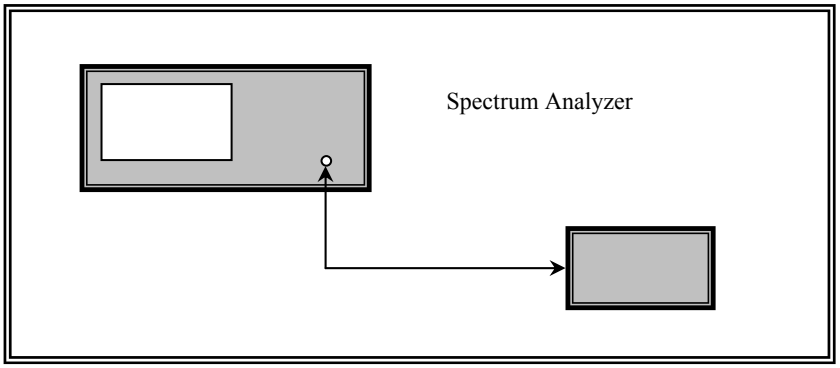
10 FCC §15.247(b) & IC RSS-210 §A8.4 – Peak Output Power Measurement

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	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	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

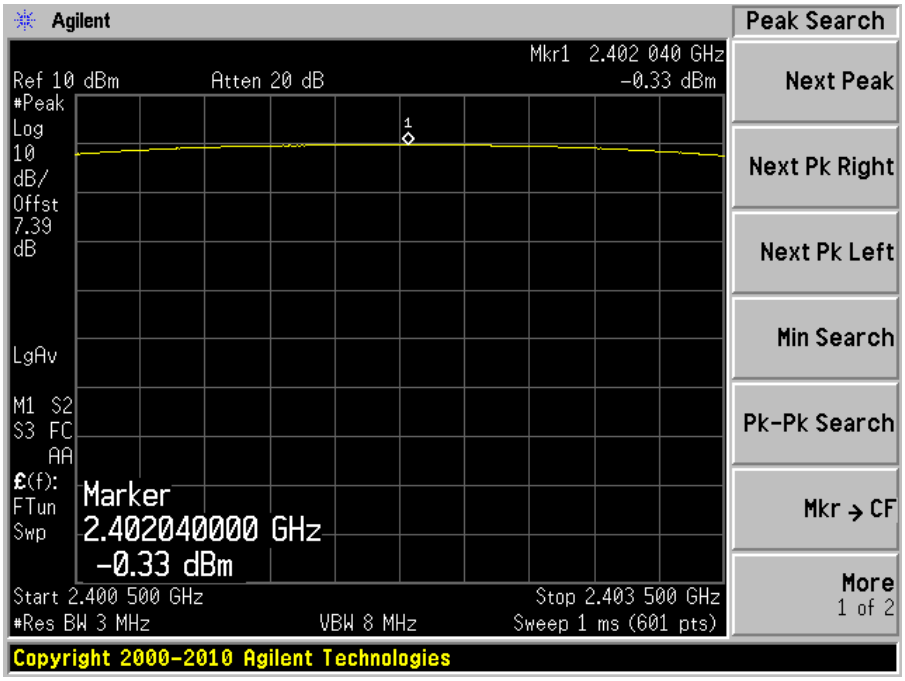
Temperature:	22 °C
Relative Humidity:	35 %
ATM Pressure:	101.4 kPa

The testing was performed by Jeffrey Wu on 2013-03-21 at the RF Test Site.

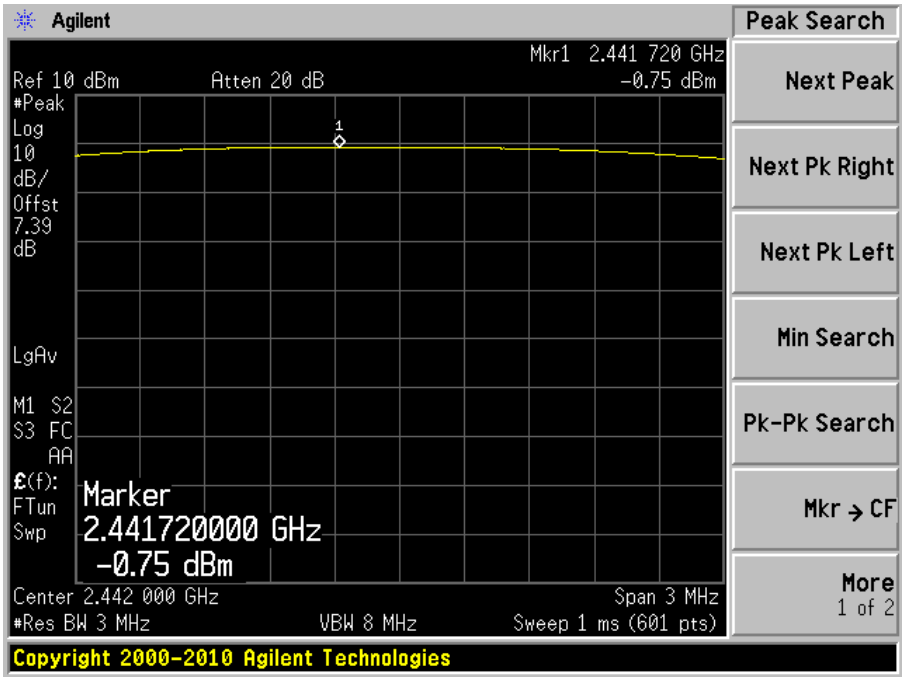
10.5 Test Results

Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)	FCC/IC Limit (dBm)	Margin (dB)
Low	2402	-0.33	30	-30.33
Middle	2442	-0.75	30	-30.75
High	2480	-0.88	30	-30.88

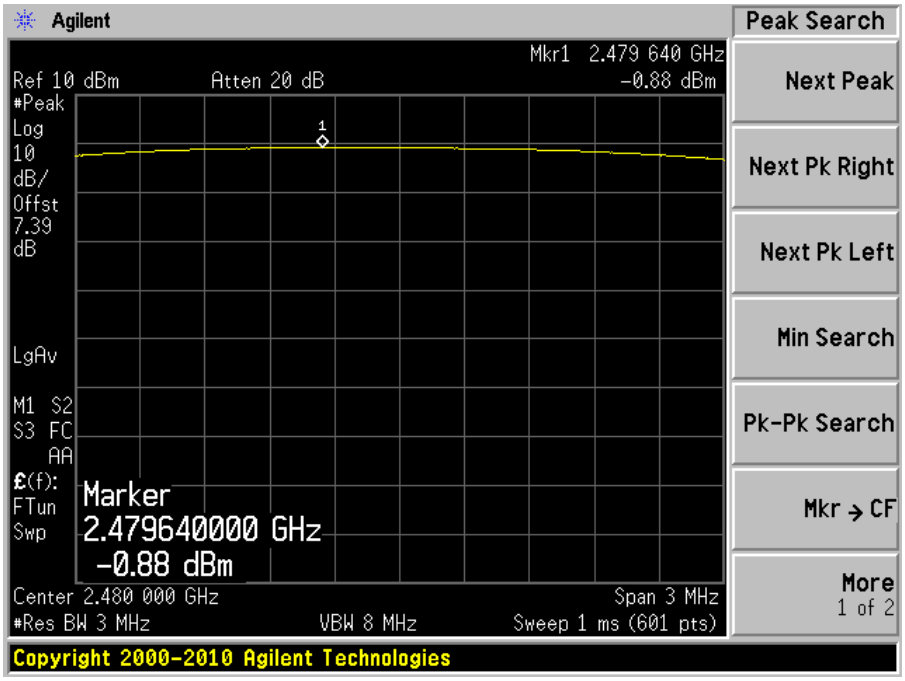
Low channel: 2402 MHz



Middle channel: 2442 MHz



High channel: 2480 MHz



11 FCC §15.247(d) & IC RSS-210 §A8.5 – 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).

According to IC Rss-210 §A8.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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 section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

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	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	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

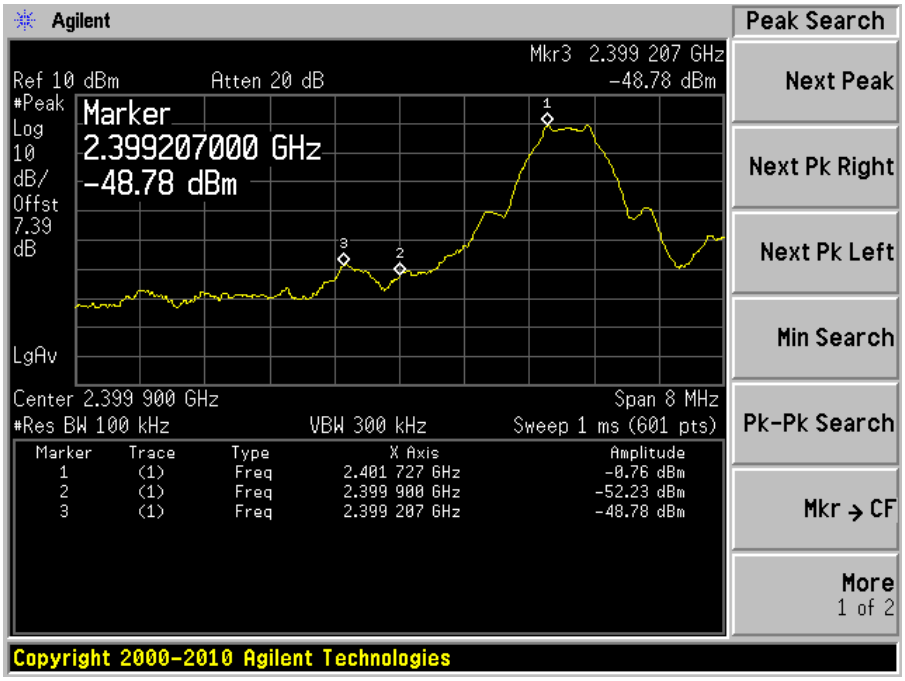
Temperature:	22 °C
Relative Humidity:	35 %
ATM Pressure:	101.4 kPa

The testing was performed by Jeffrey Wu on 2013-03-21 at the RF Test Site.

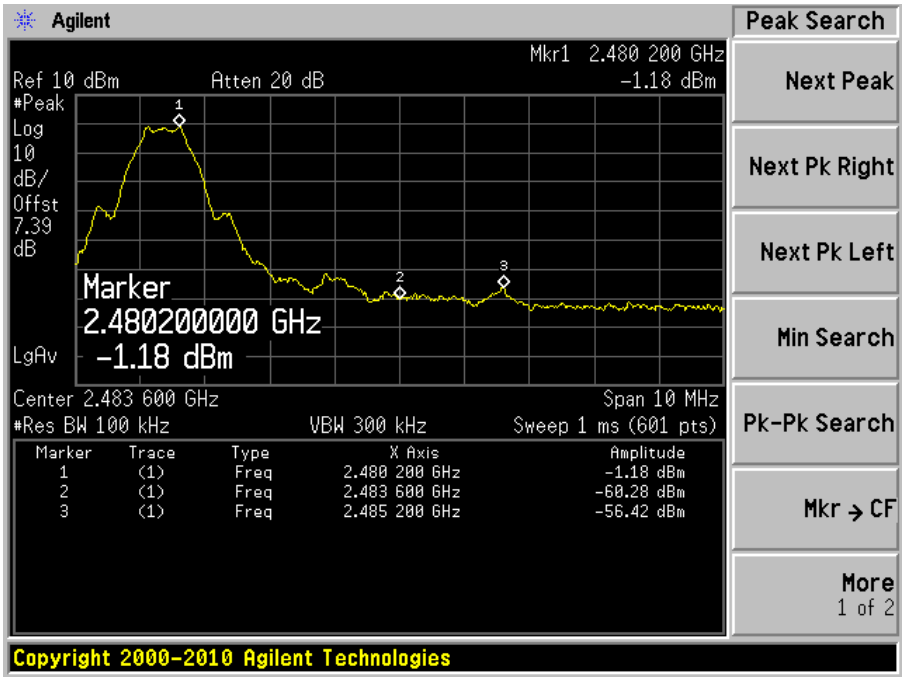
11.5 Test Results

Please refer to following pages for plots of band edge.

Low Band Edge



High Band Edge



12 FCC §15.247(e) & IC RSS-210 §A8.2 (b) – Power Spectral Density

12.1 Applicable Standard

According to FCC §15.247(e) and RSS-210 §A8.2 (b) , 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. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW ≥ 3 kHz.
3. Set the VBW ≥ 3 times of RBW
4. Set the span to 1.5 times the DTS channel bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. The resulting peak PSD level must be ≤ 8 dBm.

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 Year

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

12.4 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	35 %
ATM Pressure:	101.4 kPa

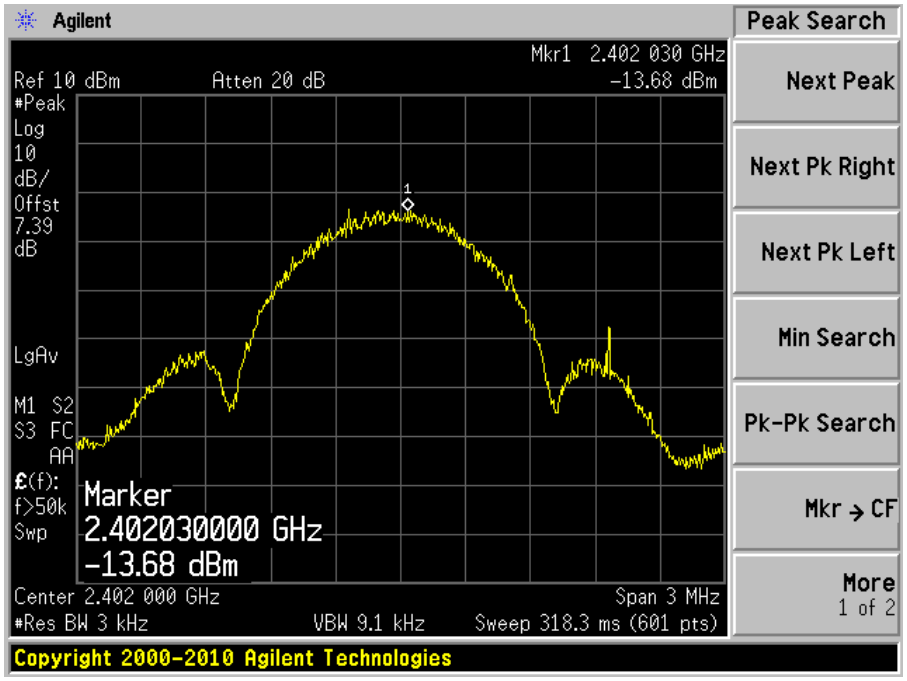
The testing was performed by Jeffrey Wu on 2013-03-21 at the RF Test Site.

12.5 Test Results

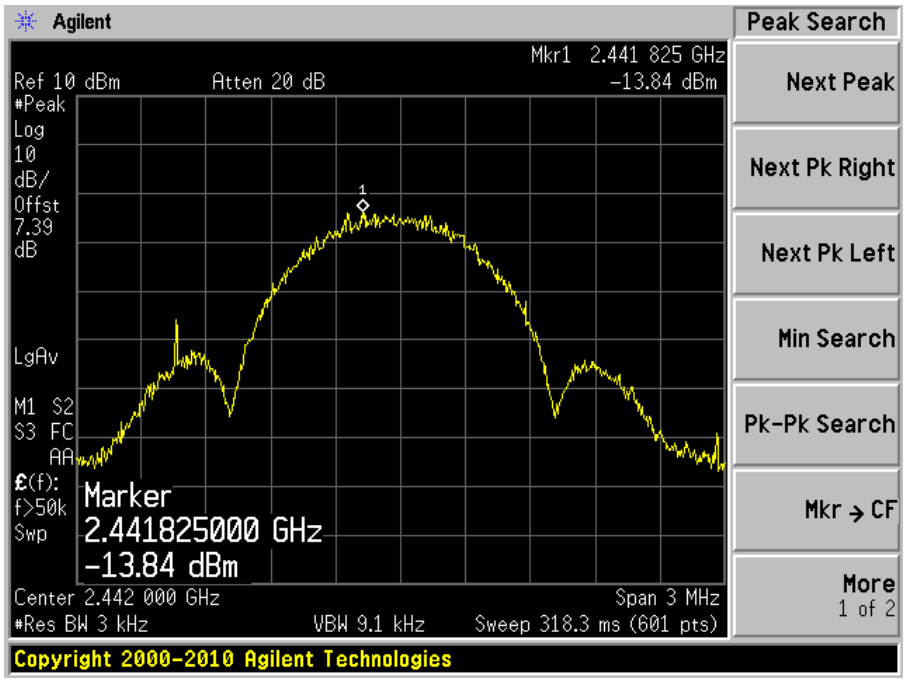
Channel	Frequency (MHz)	Power Spectral Density (dBm)	FCC/IC Limit (dBm)	Results
Low	2402	-13.68	8	Pass
Mid	2442	-13.84	8	Pass
High	2480	-12.77	8	Pass

Please refer to the following plots for detailed test results:

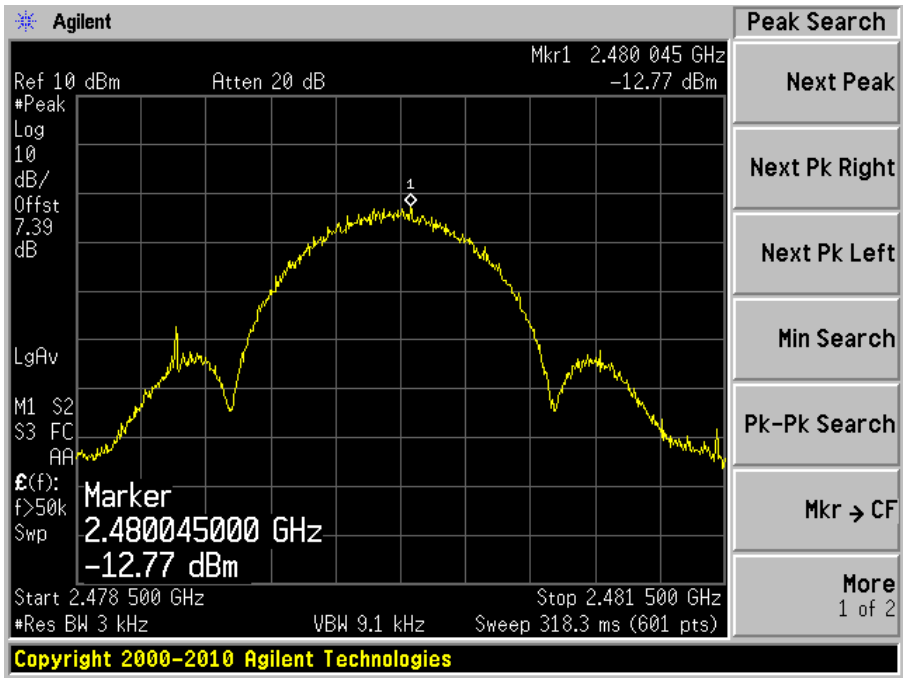
Low channel: 2402 MHz



Middle channel: 2442 MHz



High channel: 2480 MHz



13 IC RSS-210 §2.3 & RSS-Gen §6.1 – Receiver Spurious Radiated Emissions

13.1 Applicable Standards

According to IC RSS-Gen §6.1, spurious emissions from receivers shall not exceed the radiated limits shown in the table below.

Table 2: General Field Strength Limits for Transmitters and Receivers at Frequencies above 30 MHz

Frequency (MHz)	Field Strength Microvolts/m at 3 meters
	Receivers
30-88	100
88-216	150
216-960	200
Above 960	500

13.2 EUT Setup

The radiated emissions tests were performed in the 3 meter chamber, using the setup in accordance with ANSI C63.4-2009.

13.3 Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations.

All data were recorded in the peak detection mode. Quasi-peak readings was performed only when an emissions was found to be marginal (within -4 dB of specification limits), and are distinguished with a "**QP**" in the data table.

13.4 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:

Margin (dB) = Corrected Amplitude (dBuV/m) - Limit (dBuV/m)

13.5 Test Equipment Lists and Details

Manufacturer	Description	Model Number	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 Year
Sunol Sciences	Horn Antenna	DRH-118	A052704	2013-03-07	1 Year
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2012-05-09	1 Year
Rohde & Schwarz	Test Receiver	ESCI 1166.5950K03	100338	2012-09-19	1 Year
Sunol Sciences	Biconi-Log Antenna	JB3	A020106-2	2012-08-15	1 Year
Agilent	Pre-amplifier	8447D	2944A10187	2013-03-08	1 Year
Sunol Sciences	System Controller	SC104V	113005-1	N/A	N/A

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

13.6 Test Environmental Conditions

Temperature:	21-23 °C
Relative Humidity:	37-41 %
ATM Pressure:	101-102 kPa

The testing was performed by Jeffrey Wu from 2013-03-25 to 2013-03-28 at the 5m chamber 3.

13.7 Summary of Test Results

According to the test data, the EUT complied with the RSS-210, with the closest margins from the limit listed below:

Mode: Receiving			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Range (MHz)**
-8.554	4800	Horizontal	30 to 25000

13.8 Test Results

1) 30-1000 MHz, Measured at 3 meters

Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
31.25425	14.58	331	H	6	40	-25.42
47.1555	28.42	141	V	337	40	-11.58

2) Above 1 GHz, Measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
2464	46.48	315	100	V	29.1	1.92	27.76	49.693	74	-24.307	Peak
2464	46.81	271	100	H	29.1	1.92	27.76	50.023	74	-23.977	Peak
2464	20.36	315	100	V	29.1	1.92	27.76	23.573	54	-30.427	Ave
2464	21.72	271	100	H	29.1	1.92	27.76	24.933	54	-29.067	Ave
4800	40.43	56	113	V	32.7	2.72	27.78	48.096	74	-25.904	Peak
4800	41.52	41	100	H	32.7	2.72	27.78	49.186	74	-24.814	Peak
4800	36.39	56	113	V	32.7	2.72	27.78	44.056	54	-9.944	Ave
4800	37.78	41	100	H	32.7	2.72	27.78	45.446	54	-8.554	Ave
8960	32.62	0	100	V	38.7	3.45	27.28	47.489	74	-26.511	Peak
8960	31.75	0	100	H	38.7	3.45	27.28	46.619	74	-27.381	Peak
8960	17.62	0	100	V	38.7	3.45	27.28	32.489	54	-21.511	Ave
8960	17.55	0	100	H	38.7	3.45	27.28	32.419	54	-21.581	Ave