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

TEST AND MEASUREMENT REPORT

For

Tigo Energy, Inc.

420 Blossom Hill Road,

Los Gatos, CA 95032, USA

FCC ID: XMYMD100AB148
IC: 11021A-MD100AB

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

Prepared By: Wei Sun

Report Number: R1302112-247A

Report Date: 2013-05-20

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

TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
1	R1302112-247A	Original	2013-05-20

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Tigo Energy, Inc*., and their product *FCC ID: XMYMD100AB148, IC: 11021A-MD100AB*, model: *MD-100AB* or the "EUT" as referred to in this report. The EUT is a Zigbee Transceiver module.

1.2 Mechanical Description of EUT

The EUT measures approximately 18 mm (L) x 30 mm (W) x 3.5 mm (H) and weighs 2.5 g.

The test data gathered are from typical production sample, serial number: 158242 for radiated test and 158061 for conducted test, provided by the Manufacture.

1.3 Objective

This report is prepared on behalf of *Tigo Energy, 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)

The EUT is fully identical to the OEM module certified on May 09, 2013 under FCC ID: XNNMD100AB148. The original report of R1302112-247 can accurately represent test results for the current device. All data and plots are copied from the original application.

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

1.6 Measurement Uncertainty

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

Based on CISPR16-4-2:2003, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.7 Test Facility

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

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2003, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: 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

The test utility used was Tera Term was provided by Tigo Energy, Inc., and was verified Wei Sun to comply with the standard requirements being tested against.

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

Manufacturer	Description	Model	Serial Number
DELL	Laptop	Latitude E5420	-

2.6 EUT Internal Configuration Details

For Radiated Test

Manufacturer	Description	Model	Serial Number
Tigo Energy	Main PCB Board	P83604	158242

For Conducted

Manufacturer	Description	Model	Serial Number
Tigo Energy	Main PCB Board	P83604	158061

2.7 Interface Ports and Cables

Cable Description	Length (m)	To	From
RF Cable	<1.0	PSA	EUT
Serial Cable	<1.0	LAPTOP	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & IC Rules	Description of Test	Results
FCC §15.247(i), §2.1091 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	N/A
FCC §15.247 (d) IC RSS-210 §A8.5	Spurious Emissions at Antenna Port	Compliant
FCC §15.205 IC RSS-210 §2.2	Restricted Bands	Compliant
FCC §15.209, §15.247 (d) IC RSS-210 §A8.5	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

N/A - EUT is battery powered.

4 FCC §15.247 (i), §2.1091 & IC RSS-102 – 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

Before equipment certification is granted, the procedure of IC RSS-102 must be followed concerning the exposure of humans to RF fields.

According to IC RSS-102 Issue 2 section 4.1, RF limits used for general public will be applied to the EUT.

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Time Averaging (min)
0.003 - 1	280	2.19	-	6
1 - 10	280 / f	2.19 / f	-	6
10 - 30	28	2.19 / f	-	6
30 – 300	28	0.073	2*	6
300 – 1 500	$1.585\ f^{0.5}$	$0.0042\ f^{0.5}$	f / 150	6
1 500 – 15 000	61.4	0.163	10	6
15 000 – 150 000	61.4	0.163	10	$616000 / f^{1.2}$
150 000- 300 000	$0.158\ f^{0.5}$	$4.21 \times 10^{-4}\ f^{0.5}$	$6.67 \times 10^{-5}\ f$	$616000 / f^{1.2}$

Note: *f* is frequency in MHz
* = Power density limit is applicable at frequencies greater than 100 MHz

4.2 MPE Prediction

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

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

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

4.3 MPE Results

Maximum peak output power at antenna input terminal (dBm):	-5.94
Maximum peak output power at antenna input terminal (mW):	0.255
Prediction distance (cm):	20
Prediction frequency (MHz):	2480
Maximum Antenna Gain, typical (dBi):	2
Maximum Antenna Gain (numeric):	1.58
Power density of prediction frequency at 20.0 cm (mW/cm^2):	1.84E-5
Power density of prediction frequency at 20.0 cm (W/m^2):	1.84E-4
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0
MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	10

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 1.84E-5 mW/cm^2 (1.84E-4 W/m^2). Limit is 1.0 mW/cm^2 (10 W/m^2).

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 Antenna List

The antenna is soldered on the PCB board with 2 dBi again which is less than 6 dBi gain; therefore, it complies with the antenna requirement. Please refer to the internal photos.

6 FCC §2.1051, §15.247(d) & IC RSS-210 §A8.5 – Spurious Emissions at Antenna Terminals

6.1 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.

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	2012-02-28	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:	22-24 °C
Relative Humidity:	42-45 %
ATM Pressure:	101-102kPa

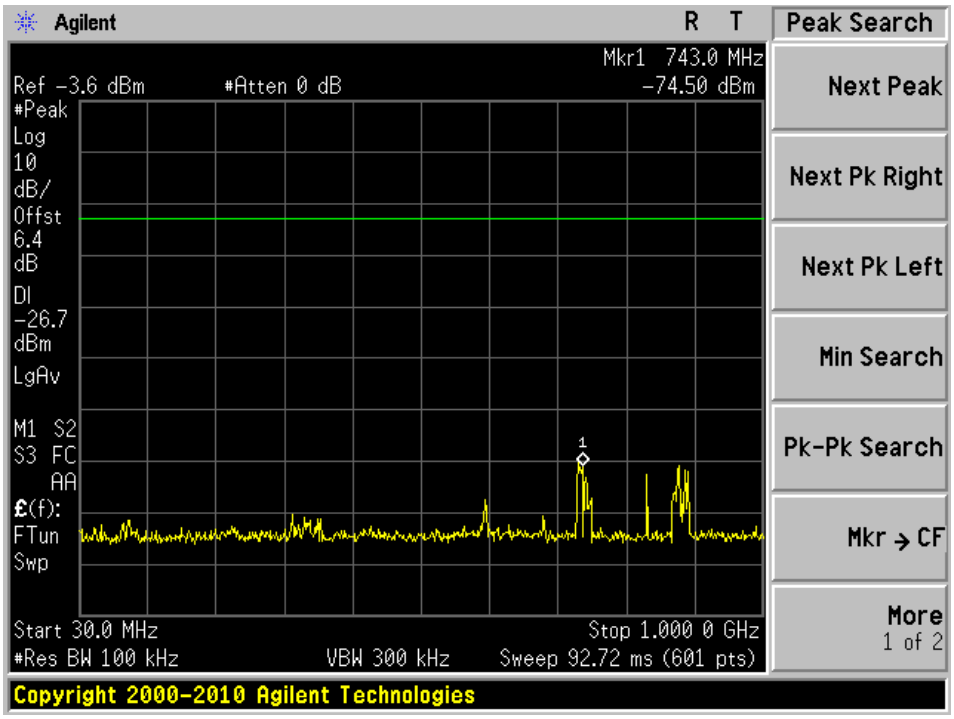
The testing was performed by Wei Sun from 2013-02-11 at RF site.

6.5 Test Results

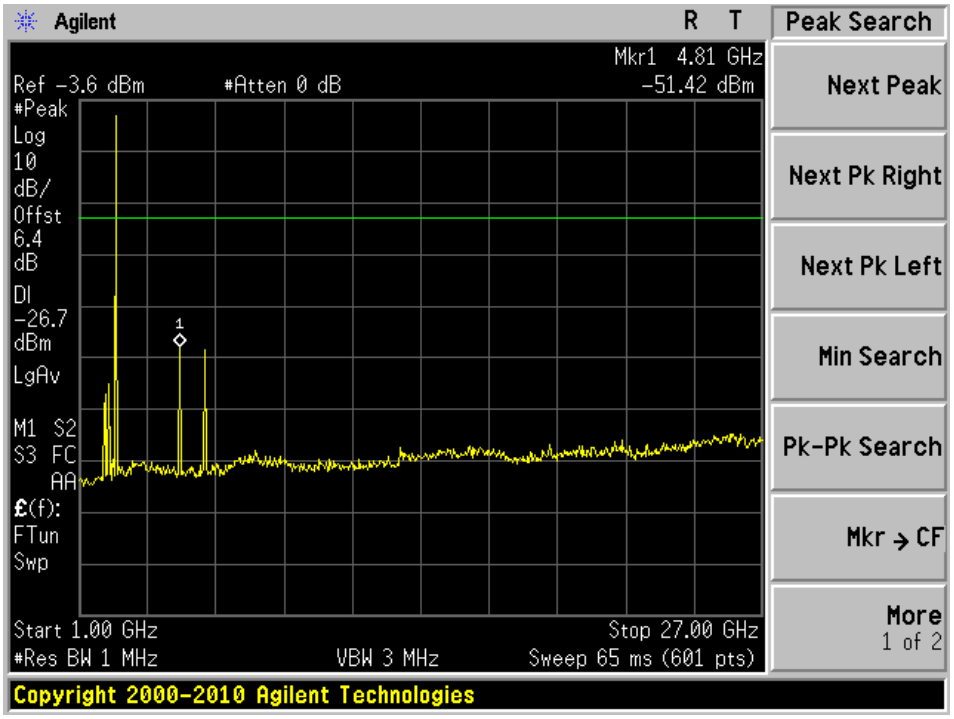
Please refer to following plots of spurious emissions.

Low Channel, 2405 MHz

30 MHz – 1 GHz

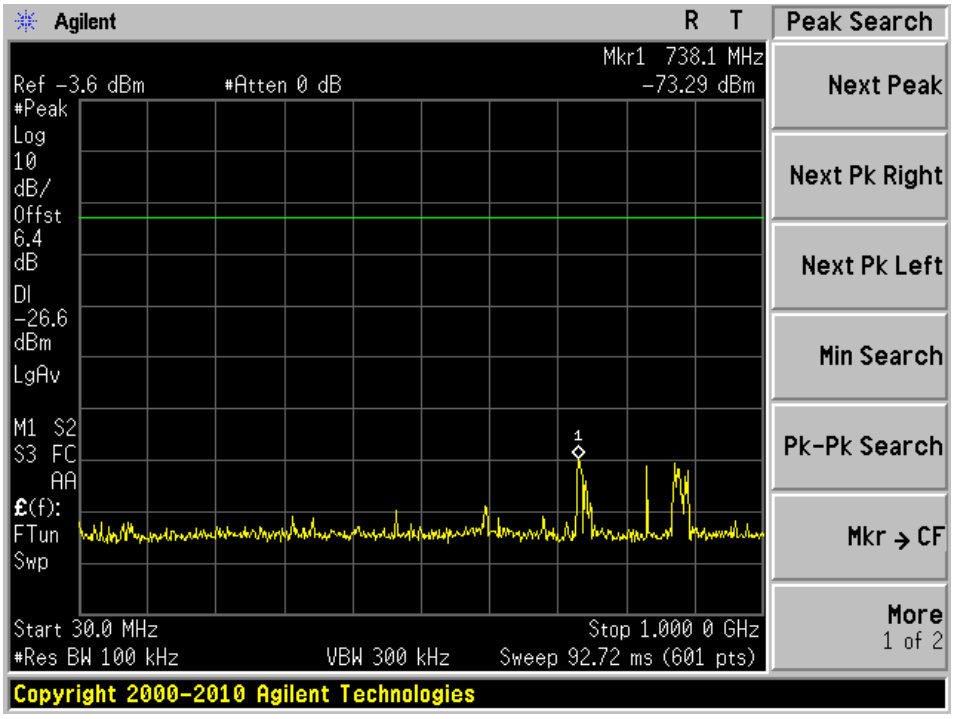


1 GHz – 25 GHz

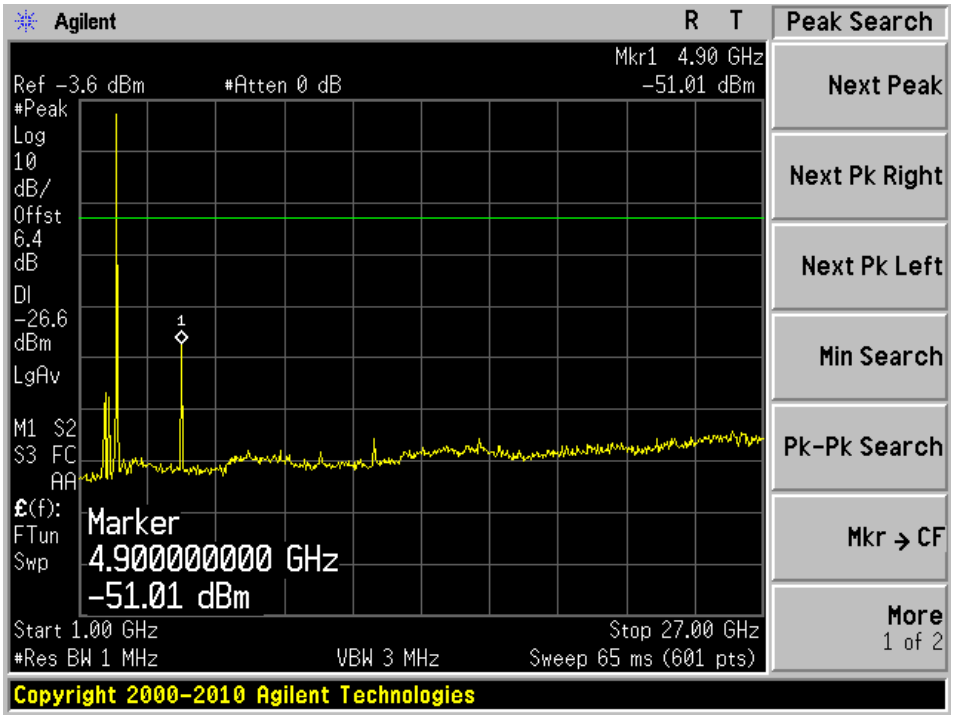


Middle Channel, 2440 MHz

30 MHz – 1 GHz

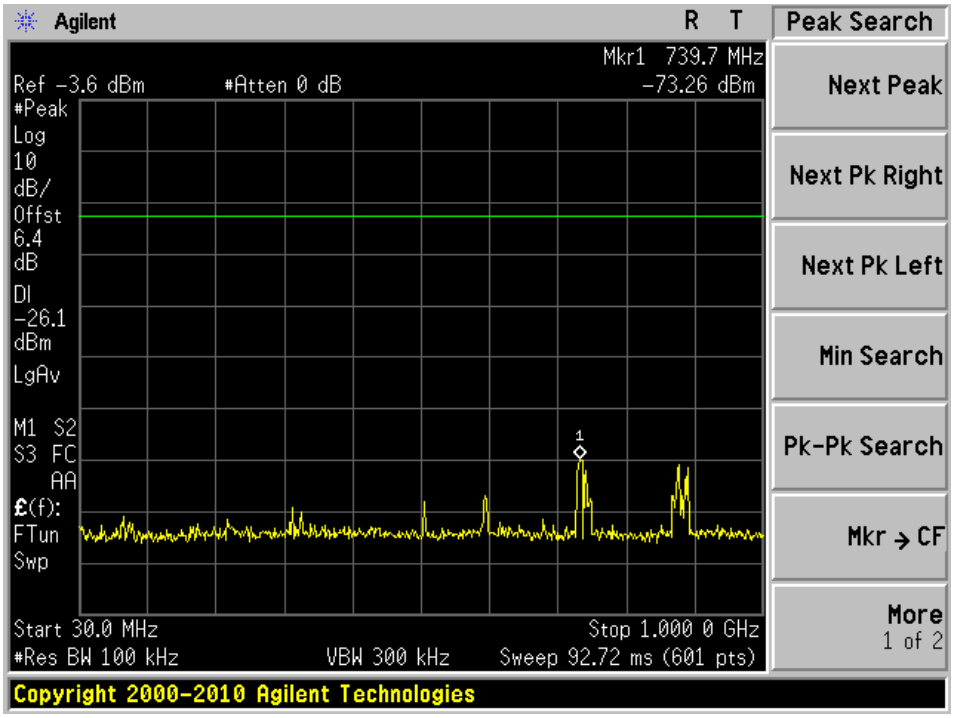


1 GHz – 25 GHz

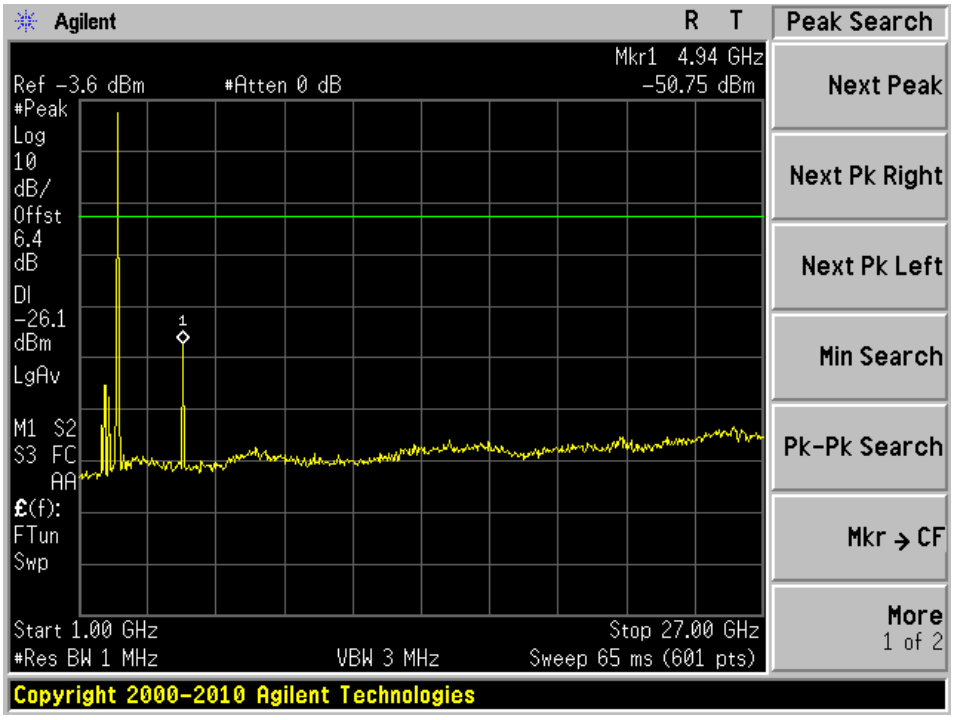


High Channel, 2480 MHz

30 MHz – 1 GHz



1 GHz – 25 GHz



7 FCC §15.205, §15.209 & §15.247(d) & IC RSS-210 §A8.5 – 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) 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 Out-of-band Emissions, 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.

7.2 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 3 centimeters.

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

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:

Margin = Corrected Amplitude - 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	2012-02-28	1 year
Sunol Science Corp	Horn Antenna	DHR-118	A052704	2012-02-24	1 year
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2012-03-22	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:	21-23°C
Relative Humidity:	42-45%
ATM Pressure:	101-102kPa

The testing was performed by Wei Sun on 2013-02-11 at 5 meter 3.

7.7 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**
-32.24	38.54175	Vertical	Low Channel

1- 25 GHz:

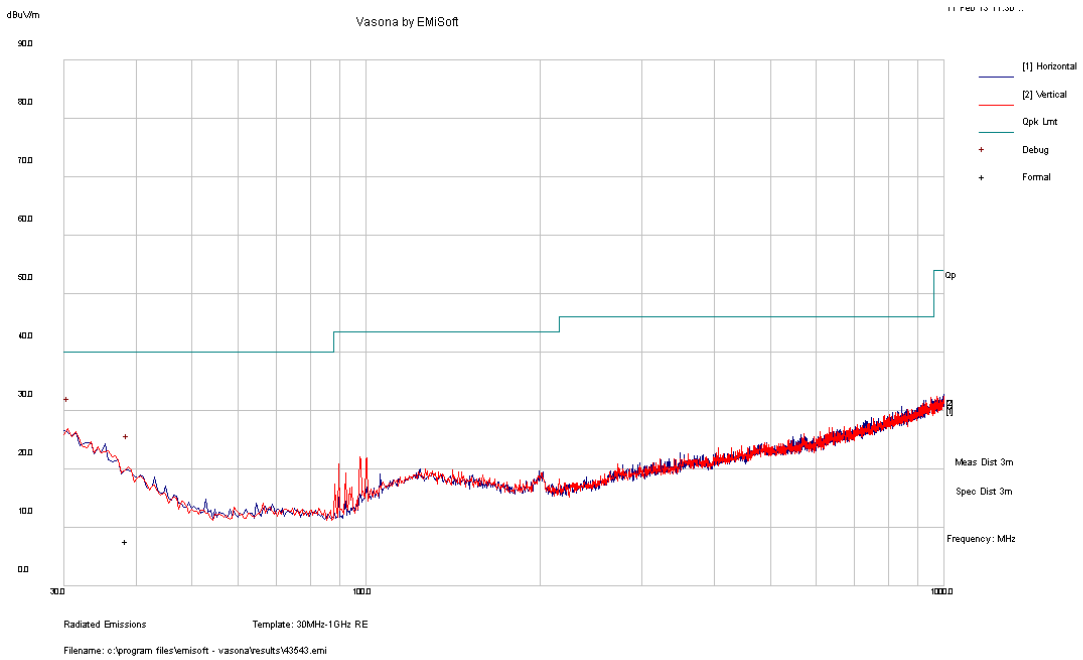
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel**
-3	2483.5	Vertical	High Channel

Please refer to the following table for specific test result details

7.8 Radiated Emissions Test Data and Plots

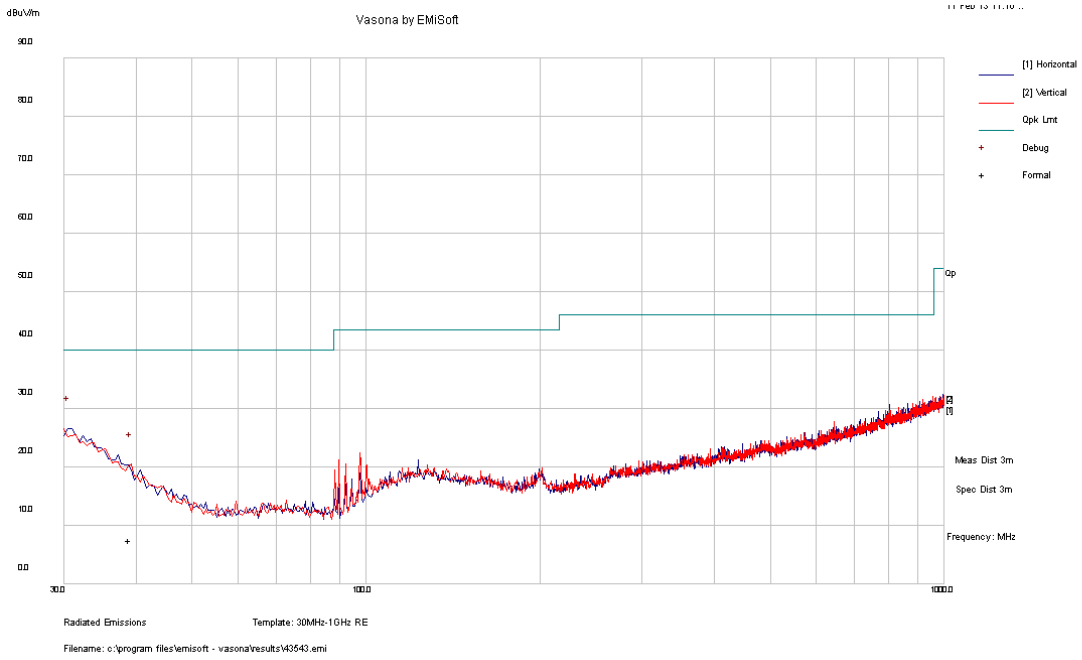
1) 30 – 1000 MHz, measured at 3 meters

Low Channel: 2405 MHz



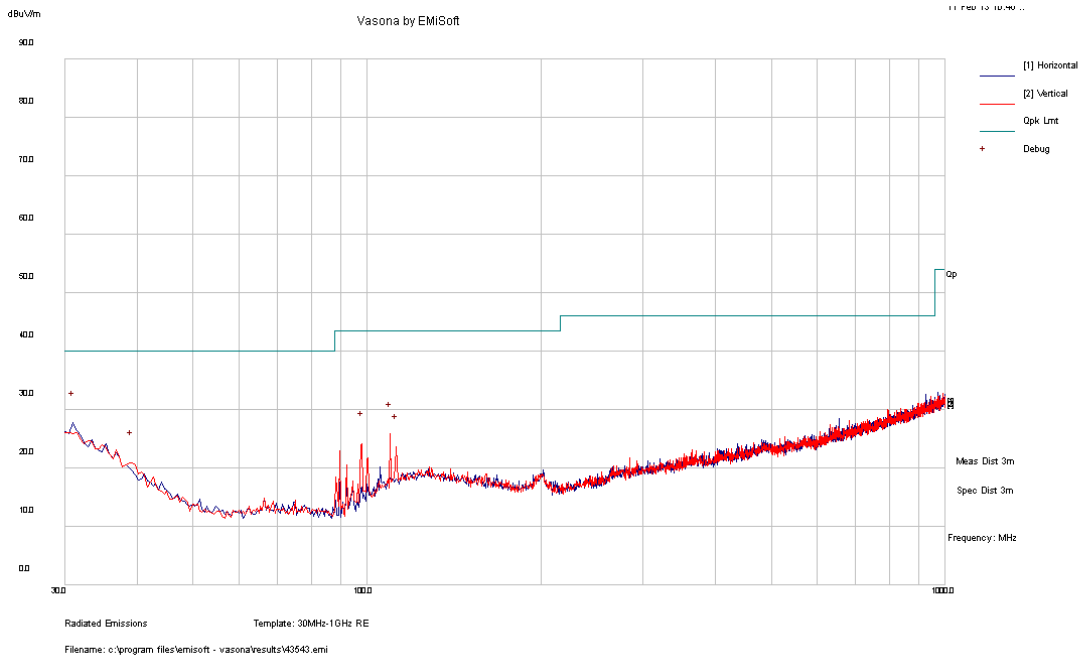
Frequency (MHz)	Corrected Amplitude (dBuV)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBuV)	Margin (dB)	Detector (PK/QP/Ave)
38.54175	7.76	117	V	46	40	-32.24	QP

Middle Channel: 2440 MHz



Frequency (MHz)	Corrected Amplitude (dBuV)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBuV)	Margin (dB)	Detector (PK/QP/Ave)
38.99625	7.45	114	V	46	40	-32.55	QP

High Channel: 2480 MHz



Frequency (MHz)	Corrected Amplitude (dBuV)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBuV)	Margin (dB)	Detector (PK/QP/Ave)
109.52525	6.41	127	V	304	43.5	-37.09	QP

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)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2405 MHz											
2405	61.68	187	100	V	28.98	3.12	0	93.78	-	-	Fund/Peak
2405	59.64	187	100	V	28.98	3.12	0	91.74	-	-	Fund/Ave
2405	58.32	100	100	H	28.98	3.12	0	90.42	-	-	Fund/Peak
2405	56.14	100	100	H	28.98	3.12	0	88.24	-	-	Fund/Ave
4910	30	0	100	V	33.07	4.52	27.75	39.84	74	-34.16	Harm/Peak
4910	18	0	100	V	33.07	4.52	27.75	27.84	54	-26.16	Harm/Ave
4910	30	0	100	H	33.07	4.52	27.75	39.84	74	-34.16	Harm/Peak
4910	18	0	100	H	33.07	4.52	27.75	27.84	54	-26.16	Harm/Ave
7215	30	0	100	V	36.24	5.49	27.59	44.14	75.78	-31.64	Harm/Peak
7215	18	0	100	V	36.24	5.49	27.59	32.14	71.74	-39.6	Harm/Ave
7215	30	0	100	H	36.24	5.49	27.59	44.14	70.42	-26.28	Harm/Peak
7215	18	0	100	H	36.24	5.49	27.59	32.14	68.24	-36.1	Harm/Ave
9620	30	0	100	V	37.36	6.54	27.02	46.88	75.78	-28.9	Harm/Peak
9620	18	0	100	V	37.36	6.54	27.02	34.88	71.74	-36.86	Harm/Ave
9620	30	0	100	H	37.36	6.54	27.02	46.88	70.42	-23.54	Harm/Peak
9620	18	0	100	H	37.36	6.54	27.02	34.88	68.24	-33.36	Harm/Ave
2390	23	0	100	V	28.98	3.12	0	55.1	74	-18.9	Spur/Peak
2390	12	0	100	V	28.98	3.12	0	44.1	54	-9.9	Spur/Ave
2390	23	0	100	H	28.98	3.12	0	55.1	74	-18.9	Spur/Peak
2390	12	0	100	H	28.98	3.12	0	44.1	54	-9.9	Spur/Ave
Middle Channel 2440 MHz											
2440	61.09	167	120	V	28.98	3.25	0	93.32	-	-	Fund/Peak
2440	58.97	167	120	V	28.98	3.25	0	91.2	-	-	Fund/Ave
2440	57.57	282	100	H	28.98	3.25	0	89.8	-	-	Fund/Peak
2440	55.12	282	100	H	28.98	3.25	0	87.35	-	-	Fund/Ave
4880	39.06	139	120	V	32.86	4.54	27.67	48.79	74	-25.21	Harm/Peak
4880	27.62	139	120	V	32.86	4.54	27.67	37.35	54	-16.65	Harm/Ave
4880	38.32	129	114	H	32.86	4.54	27.67	48.05	74	-25.95	Harm/Peak
4880	26.8	129	114	H	32.86	4.54	27.67	36.53	54	-17.47	Harm/Ave
7320	30	0	100	V	36.52	5.57	27.51	44.58	74	-29.42	Harm/Peak
7320	18	0	100	V	36.52	5.57	27.51	32.58	54	-21.42	Harm/Ave
7320	30	0	100	H	36.52	5.57	27.51	44.58	74	-29.42	Harm/Peak
7320	18	0	100	H	36.52	5.57	27.51	32.58	54	-21.42	Harm/Ave
9760	30	0	100	V	37.38	6.62	26.98	47.02	73.32	-26.3	Harm/Peak
9760	18	0	100	V	37.38	6.62	26.98	35.02	71.2	-36.18	Harm/Ave
9760	30	0	100	H	37.38	6.62	26.98	47.02	69.8	-22.78	Harm/Peak
9760	18	0	100	H	37.38	6.62	26.98	35.02	67.35	-32.33	Harm/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											
2480	60.06	163	118	V	29.12	3.25	0	92.43	-	-	Fund/Peak
2480	57.75	163	118	V	29.12	3.25	0	90.12	-	-	Fund/Ave
2480	58.94	88	100	H	29.12	3.25	0	91.31	-	-	Fund/Peak
2480	56.5	88	100	H	29.12	3.25	0	88.87	-	-	Fund/Ave
4960	39.02	332	157	V	33.07	4.52	27.7	48.91	74	-25.09	Harm/Peak
4960	27.86	332	157	V	33.07	4.52	27.7	37.75	54	-16.25	Harm/Ave
4960	37.37	230	141	H	33.07	4.52	27.7	47.26	74	-26.74	Harm/Peak
4960	25.2	230	141	H	33.07	4.52	27.7	35.09	54	-18.91	Harm/Ave
7440	30	0	100	V	36.43	5.66	27.53	44.56	74	-29.44	Harm/Peak
7440	18	0	100	V	36.43	5.66	27.53	32.56	54	-21.44	Harm/Ave
7440	30	0	100	H	36.43	5.66	27.53	44.56	74	-29.44	Harm/Peak
7440	18	0	100	H	36.43	5.66	27.53	32.56	54	-21.44	Harm/Ave
9920	30	0	100	V	37.53	6.67	27.01	47.19	72.43	-25.24	Harm/Peak
9920	18	0	100	V	37.53	6.67	27.01	35.19	70.12	-34.93	Harm/Ave
9920	30	0	100	H	37.53	6.67	27.01	47.19	71.31	-24.12	Harm/Peak
9920	18	0	100	H	37.53	6.67	27.01	35.19	68.87	-33.68	Harm/Ave
2483.5	30.64	161	118	V	29.12	3.25	0	63.01	74	-10.99	Spur/Peak
2483.5	18.63	161	118	V	29.12	3.25	0	51	54	-3	Spur/Ave
2483.5	29.59	301	100	H	29.12	3.25	0	61.96	74	-12.04	Spur/Peak
2483.5	17.05	301	100	H	29.12	3.25	0	49.42	54	-4.58	Spur/Ave

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

8.1 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

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	2012-02-28	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:	22-24 °C
Relative Humidity:	42-45 %
ATM Pressure:	101-102kPa

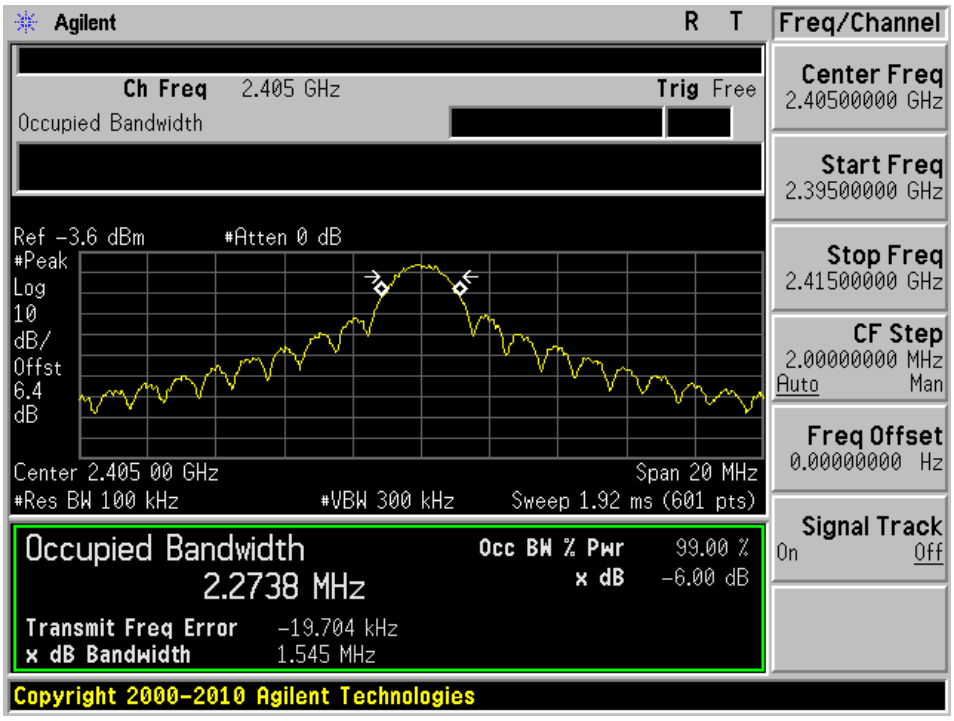
The testing was performed by Wei Sun on 2013-02-11 at RF site.

8.5 Test Results

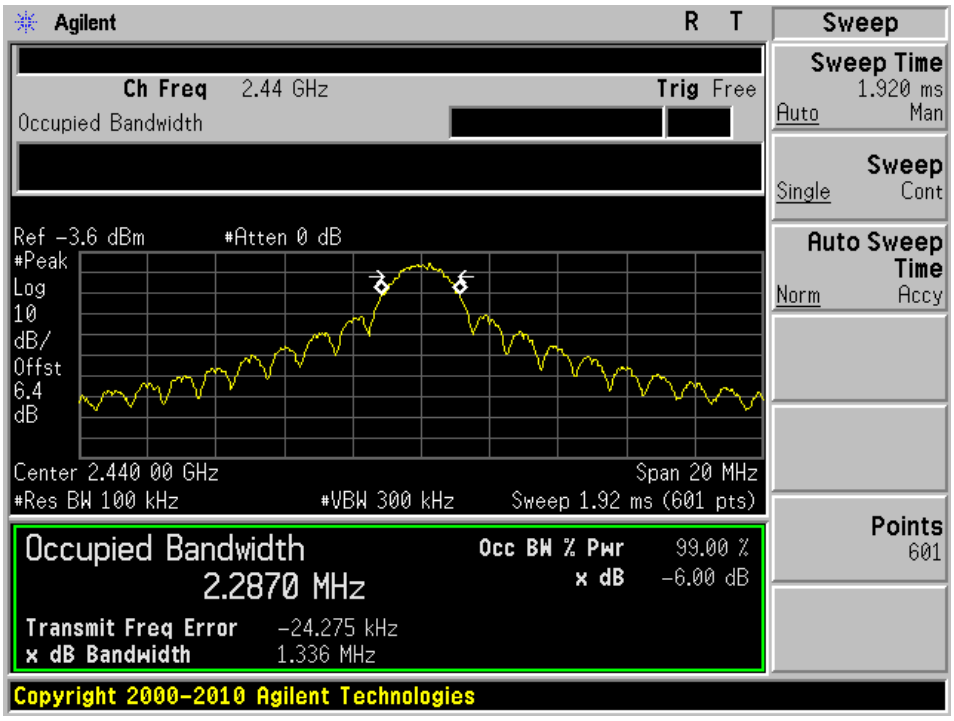
Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)	Limit (MHz)	Results
Low	2405	1.545	2.2738	> 0.5	Compliant
Middle	2440	1.336	2.2870	> 0.5	Compliant
High	2480	1.599	2.3245	> 0.5	Compliant

Please refer to the following plots for detailed test results

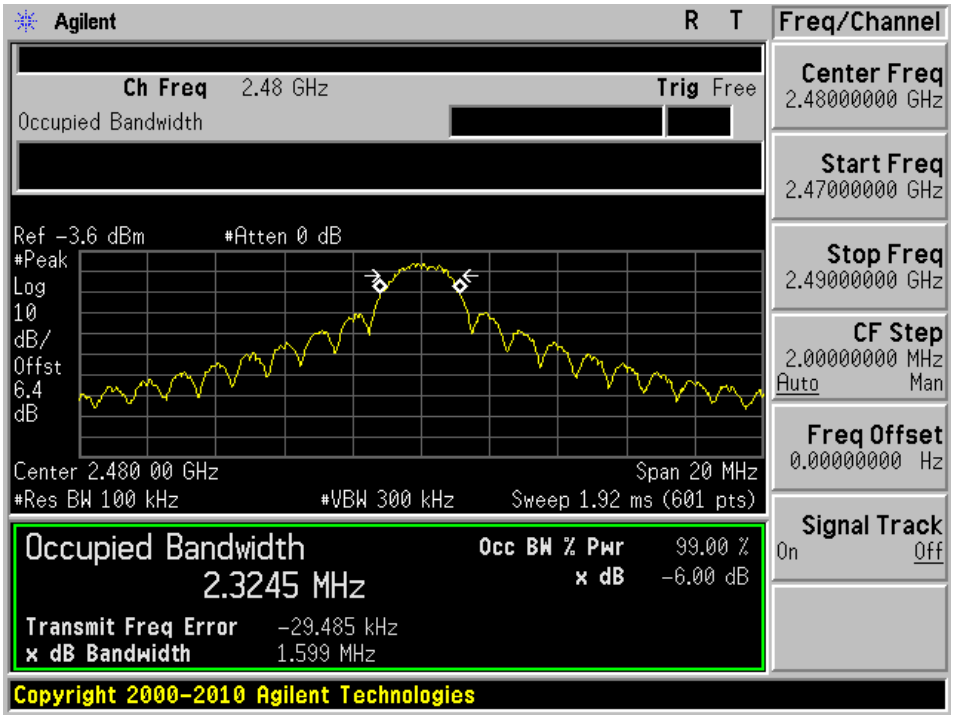
Low channel: 2405 MHz



Middle channel: 2440 MHz



High channel: 2480 MHz



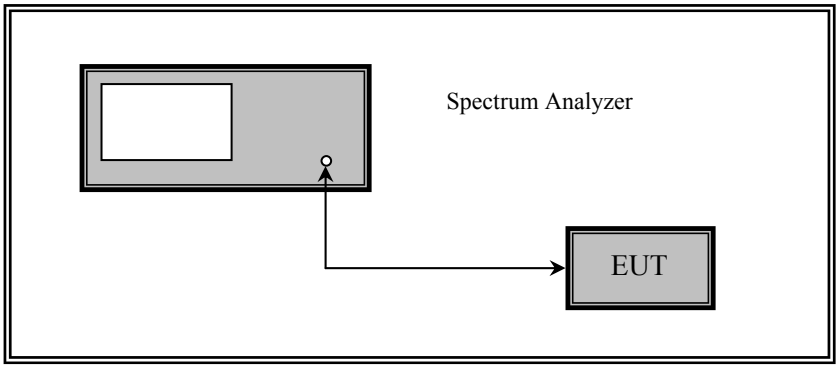
9 FCC §15.247(b) & IC RSS-210 §A8.4 – Peak Output Power Measurement

9.1 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.

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	2012-02-28	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:	22-24 °C
Relative Humidity:	42-45 %
ATM Pressure:	101-102kPa

The testing was performed by Wei Sun on 2013-02-11 at RF site.

9.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC/IC Limit (dBm)	Margin (dB)
Low	2405	-6.53	30	36.53
Middle	2440	-6.59	30	36.59
High	2480	-5.94	30	35.94

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

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.

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	2012-02-28	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

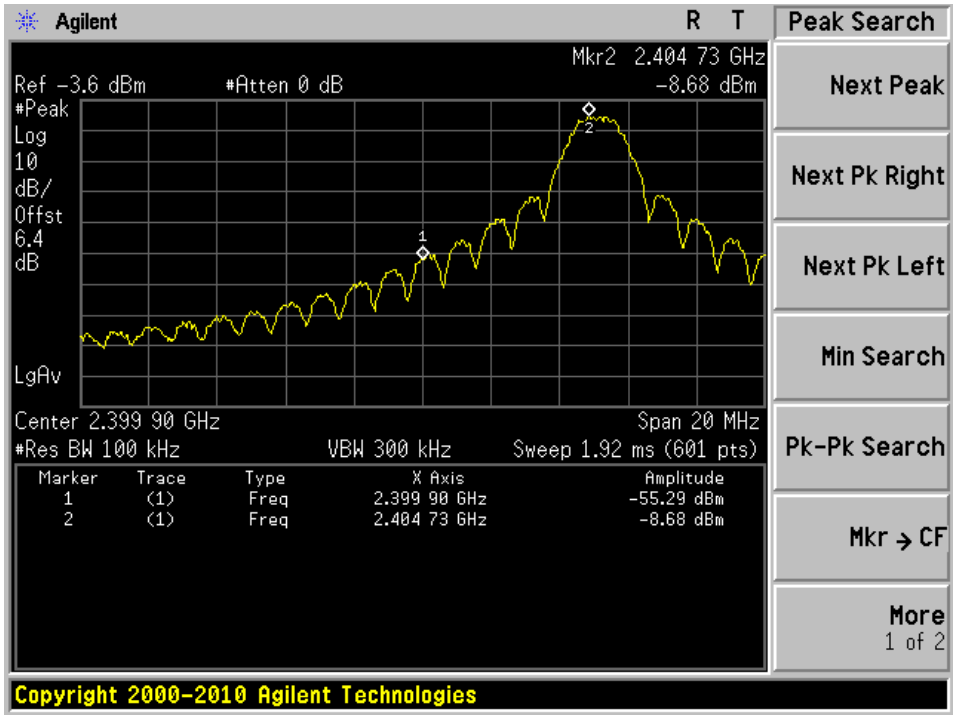
Temperature:	22-24 °C
Relative Humidity:	42-45 %
ATM Pressure:	101-102kPa

The testing was performed by Wei Sun on 2013-02-11 at RF site.

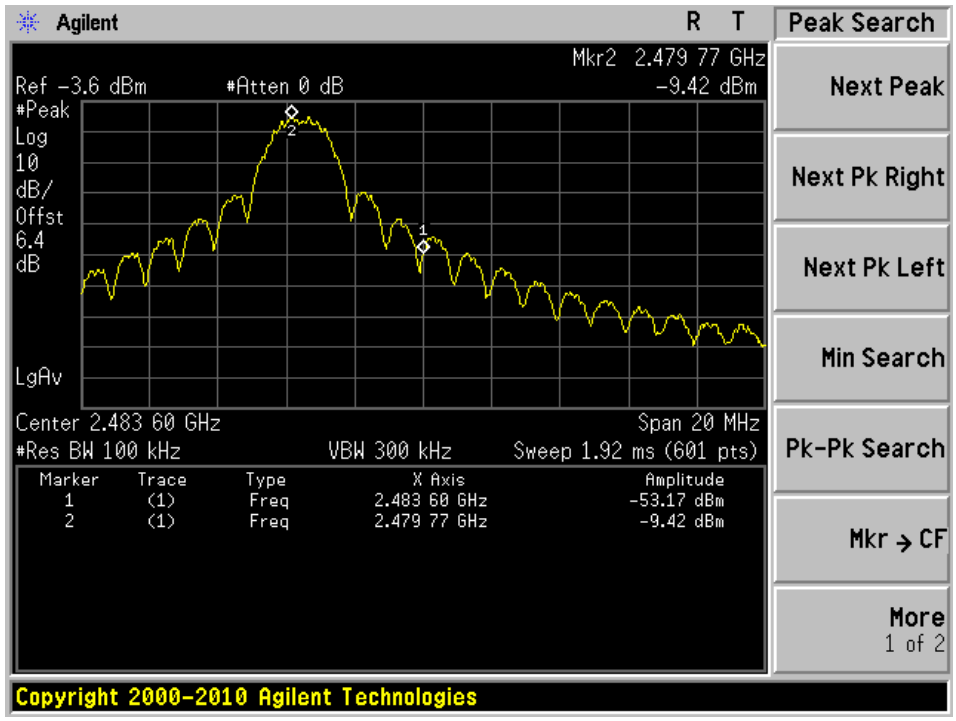
10.5 Test Results

Please refer to following pages for plots of band edge.

Low Band Edge



High Band Edge



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

11.1 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.

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 ≥ 3 x 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 power level in any 100 kHz band segment within the fundamental EBW.
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	2012-02-28	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:	22-24 °C
Relative Humidity:	42-45 %
ATM Pressure:	101-102kPa

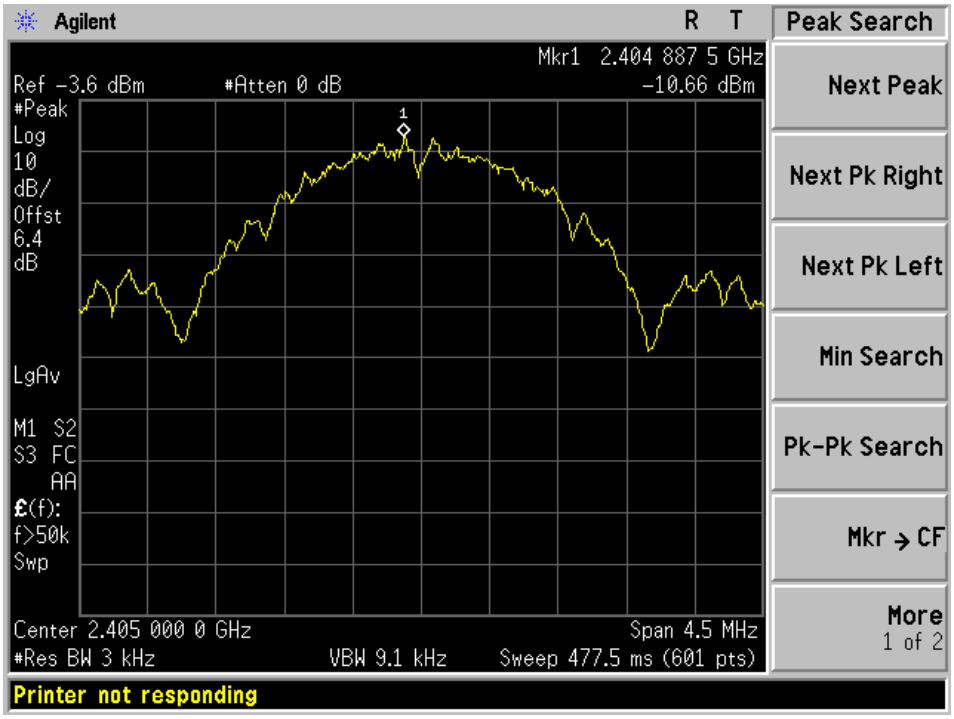
The testing was performed by Wei Sun on 2013-02-11 at RF site.

11.5 Test Results

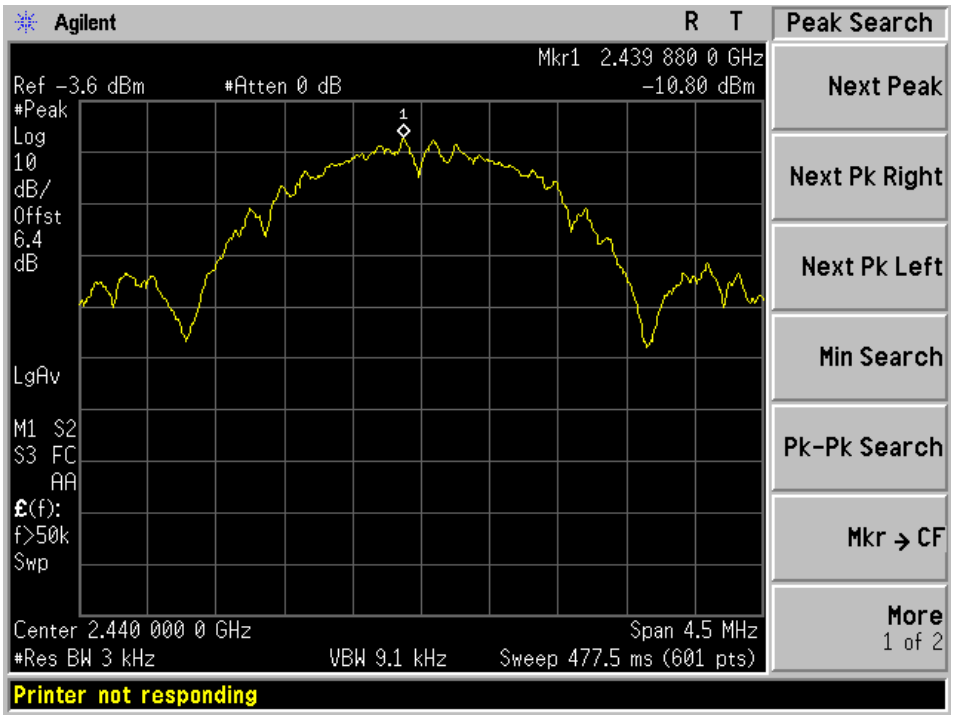
Channel	Frequency (MHz)	PSD (dBm/3 kHz)	FCC/IC Limit (dBm/3 kHz)	Margin (dB)
Low	2405	-10.66	8	18.66
Middle	2440	-10.80	8	18.80
High	2480	-11.20	8	19.20

Please refer to the following plots for detailed test results:

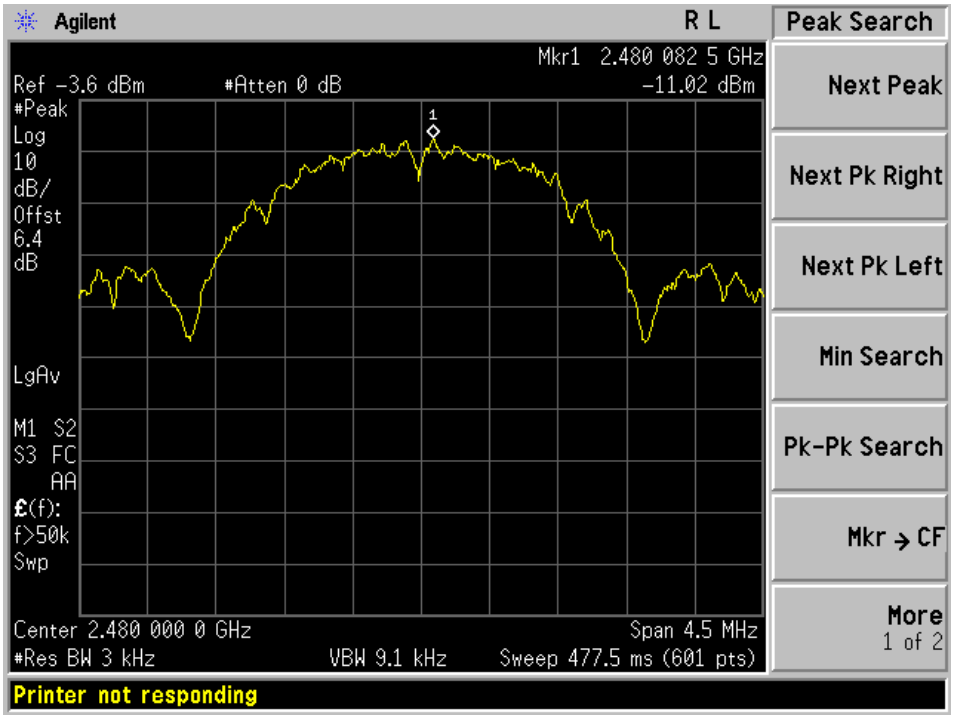
Low channel: 2405 MHz



Middle channel: 2440 MHz



High channel: 2480 MHz



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

12.1 Applicable Standard

According to RSS-Gen §6.1, Tables 2 show the general field strength limits of receiver spurious emissions

Table 2: Radiated Limits of Receiver Spurious Emissions

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

12.2 EUT Setup

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

12.3 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.

12.4 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 = Corrected Amplitude - Limit

12.5 Test Equipment Lists 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	2012-02-28	1 year
Sunol Science Corp	Horn Antenna	DHR-118	A052704	2012-02-24	1 year
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2012-03-22	1 year

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

12.6 Test Environmental Conditions

Temperature:	22°C
Relative Humidity:	45%
ATM Pressure:	102.1kPa

The testing was performed by Wei Sun on 2013-02-12 at 5 meter 3.

12.7 Summary of Test Results

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

12.8 Test Results and Plots

30 MHz – 25 GHz:

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
-	-	-	-	-	-	-*

Note*: All emissions were below the noise floor or 20 dB below the limit