

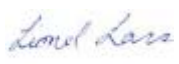
FCC PART 15.247
IC RSS-210, ISSUE 8, DECEMBER 2010
TEST AND MEASUREMENT REPORT

For

Renaissance Learning Inc.

PO Box 8036, Wisconsin Rapids, Wisconsin 54495-8036, USA

FCC ID: TJA-NEO2A
IC: 6077A-NEO2A

Report Type: Original Report	Product Type: Interactive Educational Writing Device/Laptop
Test Engineer: <u>Lionel Lara</u>	
Report Number: <u>R1109194-247</u>	
Report Date: <u>2011-11-16</u>	
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* This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk "*" (000-0)

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
1	R1109194-247	Original Report	2011-11-16

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Renaissance Learning Inc.*, and their product FCC ID: TJA-NEO2A, IC: 6077A-NEO2A, model: NEO2-KB which will henceforth be referred to as the EUT (Equipment Under Test). The EUT is an interactive educational writing device/laptop operating 802.15.4 technology and has a frequency range of 2405-2480 MHz.

1.2 Mechanical Description of EUT

The “EUT” measures 305 mm (**L**) x 229 mm (**W**) x 26 mm (**H**), weighing approximately 817 g..

The test data gathered are from typical production sample with serial number: 04MUL9 for Conducted Test.

The test data gathered are from typical production sample with serial number: XSKWEE for Radiated Test.

1.3 Objective

This report is prepared on behalf of *Renaissance Learning Inc* in accordance with Part 2, Subpart J, and Part 15, Subparts C of the Federal Communication Commissions rules and IC RSS-210 Issue 8, June 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)

No Related Submittals.

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in 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 NIS 81, The Treatment of Uncertainty in EMC Measurements, the values range from +2.0 for Conducted Emissions tests and +4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.7 Test Facility

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

The test sites at BACL have been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has 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 facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission, Industry Canada, and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464, IC registration number: 3062A, and VCCI Registration Number: R-2463 and C-2698. The test site has been approved by the FCC, IC, and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at <http://ts.nist.gov/Standards/scopes/2001670.htm>

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.4-2003.

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

2.2 EUT Exercise Software

The test utility software used: NEOFCCTest 2.1b and Prometheus applets, was provided by client.

2.3 Special Equipment

N/A

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
IBM	Laptop	Thinkpad	1875DLU
HP	DeskJet professional series printer	990cxi	MY12R111V3

2.6 Power Supply List and Details

Manufacturer	Description	Model No.	Serial No.
CUI	Power supply	41-7.5-500	66P976

2.7 EUT Internal Configuration Details

Manufacturers	Description	Model No.	Serial No.
Renaissance Learning Inc.	NEO2 PCB	23-00302 Rev. 4	-

2.8 External I/O Cabling List and AC Cord

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

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & IC Rules	Description of Test	Results
FCC §15.247(i), §2.1093 IC RSS-102	RF Exposure Information	Compliant
FCC §15.203 IC RSS-Gen §7.1.4	Antenna Requirement	Compliant
FCC §15.207(a) IC RSS-Gen §7.2.2	Conducted Emissions	Compliant
FCC §15.209 IC RSS-210 §2.6	Spurious Emissions at Antenna Port	Compliant
FCC §15.205 IC RSS-210 §2.2	Restricted Bands	Compliant
FCC §15.209, §15.247 IC RSS-210 §2.6	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) IC RSS-210 §A8.2	6 dB 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 §2.6 & RSS-Gen §4.10	Receiver Spurious Emission	Compliant

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

4.1 Applicable Standards

FCC §15.247(i) and §2.1093. According to KDB 447498 1) c), portable device with output power $>60/f_{\text{GHz}}$ mW shall include SAR data for equipment approval.

IC RSS-102 §2.5.1, above 2.2 GHz up to 3 GHz, if the output power (the higher of the conducted or radiated – EIRP, source-based time Average output) is less than or equal to 20 mW for general public use and 100 mW for controlled use, SAR evaluation can be exempted.

4.2 Results

Maximum peak output power of device: -0.49 dBm

Antenna Gain: 3.3 dBi

EIRP = $-0.49 + 3.3 = 2.81$ dBm = 1.91 mW

$60/f_{\text{GHz}} = 60/2.440 = 24.59$ mW

The EIRP of EUT was less than the SAR threshold; the SAR measurement is not required.

5 FCC §15.203 & IC RSS-Gen §7.1.4 – Antenna Description

5.1 Applicable Standard

According to FCC §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to FCC §15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to IC RSS-Gen §7.1.4: 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 milliwatts or less. For devices of output powers greater than 10 milliwatts, 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 Connector Construction

EUT has one transmitter antenna which is an integral antenna. The Transmitter antenna has a max gain of 3.3 dBi which fulfills the requirements of FCC rule 15.203.

Antenna: +3.3 dBi

6 FCC §15.207 & IC RSS-Gen §7.2.2 – AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 and IC RSS-Gen §7.2.2 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 μ H/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 C63.4-2003 measurement procedure. The specification used was FCC §15.207 and IC RSS-Gen §7.2.2 limits.

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

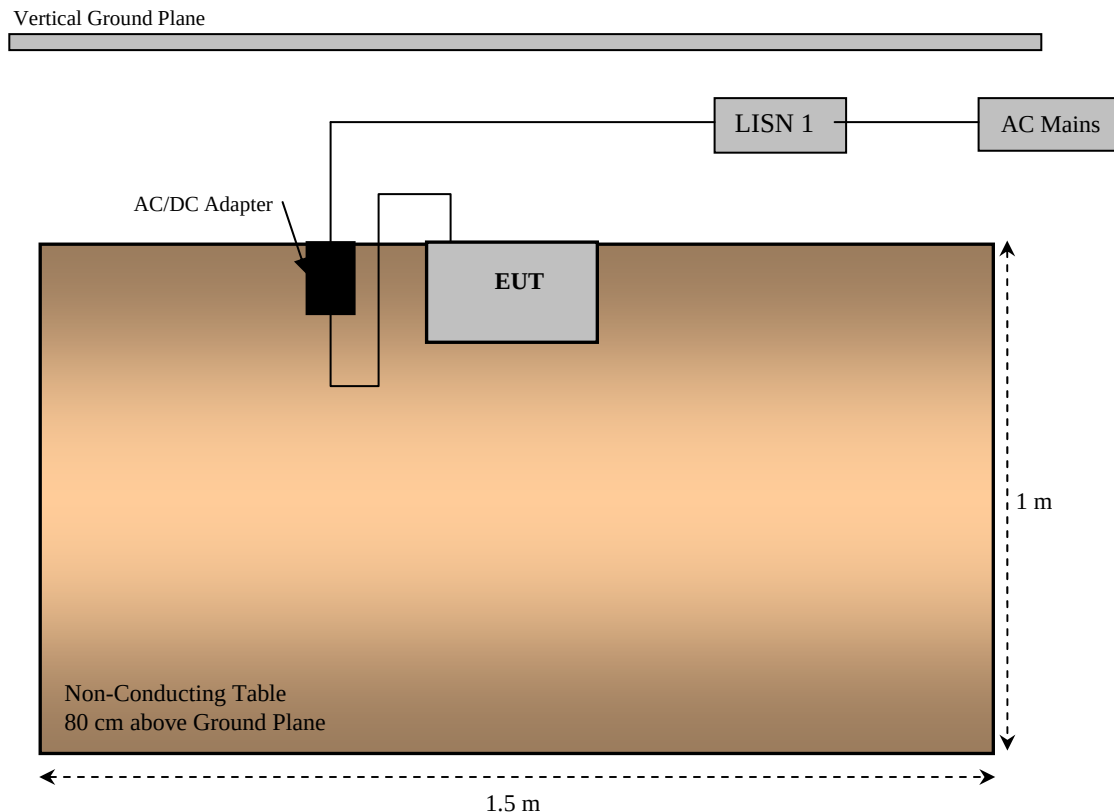
The AC/DC power adapter of the EUT was connected with LISN-1 which provided 120 V / 60 Hz AC power.

6.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2011-03-21
Solar Electronics	LISN	9252-R-24-BNC	511205	2011-06-10
TTE	Filter, High Pass	H962-150k-50-21378	K7133	2011-06-10

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

6.4 Test Setup Block Diagram



6.5 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”.

6.6 Test Environmental Conditions

Temperature:	23-25 °C
Relative Humidity:	35-50 %
ATM Pressure:	101-103kPa

The testing was performed by Lionel Lara from 2011-10-10 to 2011-10-13 at 5meter chamber3.

6.7 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 44.2 dBuV = Indicated Reading (30.5 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:

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

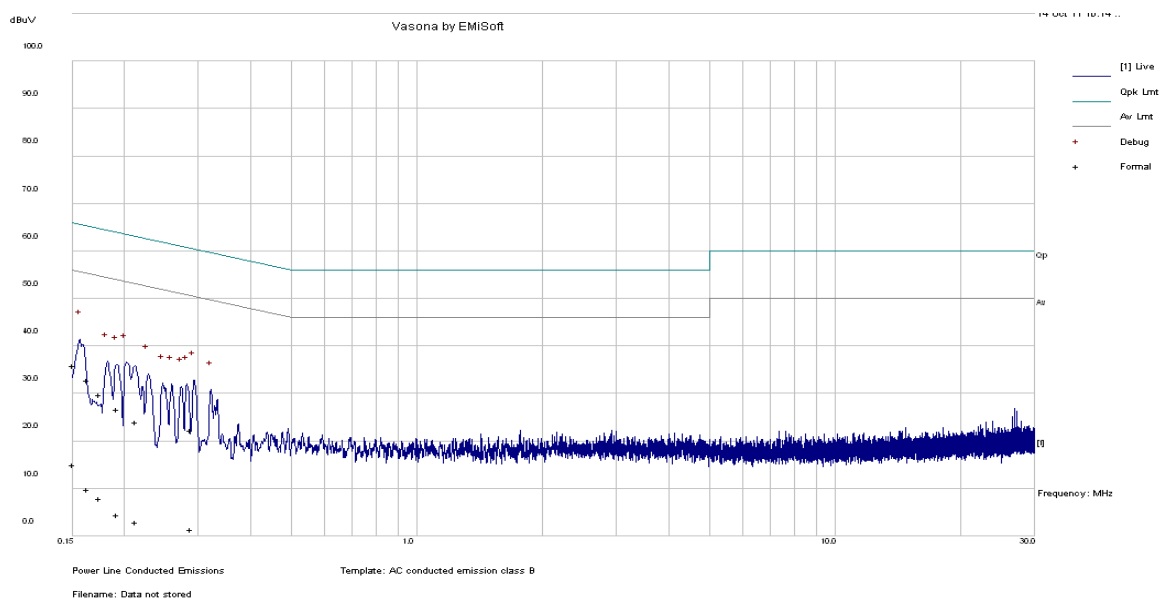
6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC §15.207 and IC RSS-Gen §7.2.2 standards’ conducted emissions limits, with the margin reading of:

Connection: AC/DC adapter connected to 120 V/60 Hz, AC (TX Mode)			
Margin (dB)	Frequency (MHz)	Conductor Mode (Line/Neutral)	Range (MHz)
-28.77	0.1533	Neutral	0.15 to 30

6.9 Conducted Emissions Test Plots and Data

120 V, 60 Hz – Line

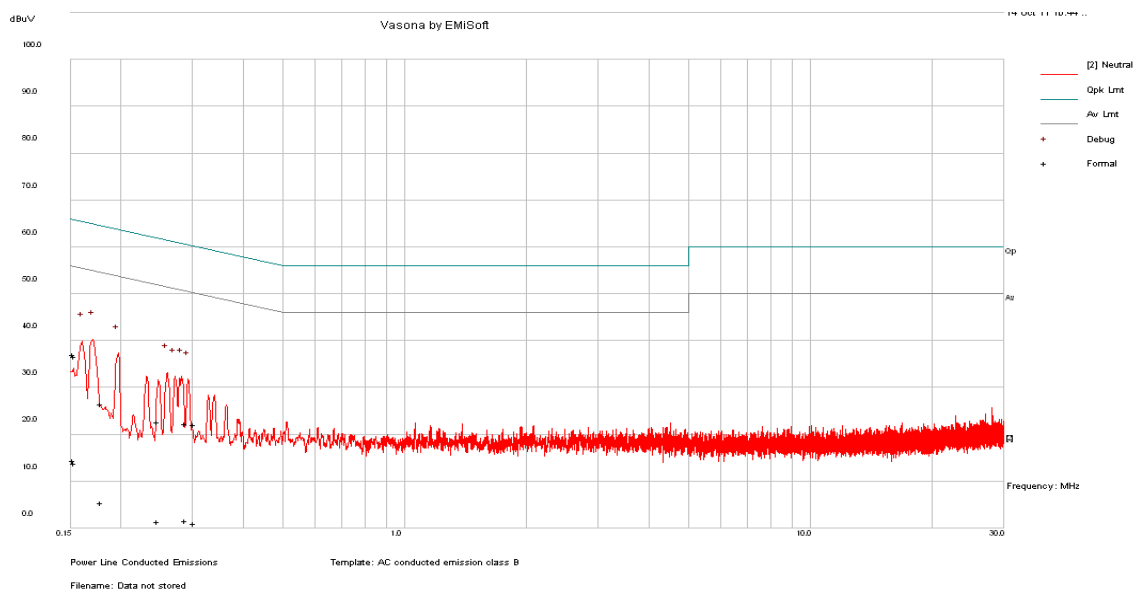


Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBμV)	Conductor (Line/Neutral)	Limit (dBμV)	Margin (dB)
0.151131	36.00	Line	65.94	-29.94
0.164082	32.90	Line	65.25	-32.36
0.175263	29.84	Line	64.71	-34.87
0.192315	26.74	Line	63.94	-37.19
0.289743	22.34	Line	60.53	-38.20
0.213579	23.98	Line	63.06	-39.09

Average Measurements

Frequency (MHz)	Corrected Amplitude (dBμV)	Conductor (Line/Neutral)	Limit (dBμV)	Margin (dB)
0.151131	15.05	Line	55.94	-40.89
0.164082	9.91	Line	55.25	-45.35
0.175263	7.94	Line	54.71	-46.77
0.289743	1.51	Line	50.53	-49.02
0.192315	4.47	Line	53.94	-49.47
0.213579	3.00	Line	53.06	-50.07

120 V, 60 Hz – Neutral**Quasi-Peak Measurements**

Frequency (MHz)	Corrected Amplitude (dBμV)	Conductor (Line/Neutral)	Limit (dBμV)	Margin (dB)
0.153300	37.05	Neutral	65.82	-28.77
0.154215	36.71	Neutral	65.77	-29.06
0.179568	26.50	Neutral	64.51	-38.00
0.302793	22.09	Neutral	60.17	-38.08
0.288426	22.34	Neutral	60.57	-38.22
0.247152	22.73	Neutral	61.85	-39.13

Average Measurements

Frequency (MHz)	Corrected Amplitude (dBμV)	Conductor (Line/Neutral)	Limit (dBμV)	Margin (dB)
0.153300	14.40	Neutral	55.82	-41.42
0.154215	13.95	Neutral	55.77	-41.82
0.288426	1.69	Neutral	50.57	-48.88
0.179568	5.55	Neutral	54.51	-48.96
0.302793	1.08	Neutral	50.17	-49.08
0.247152	1.39	Neutral	51.85	-50.46

7 FCC §2.1051, §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
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11

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

7.4 Test Environmental Conditions

Temperature:	23-25 °C
Relative Humidity:	35-50 %
ATM Pressure:	101-103kPa

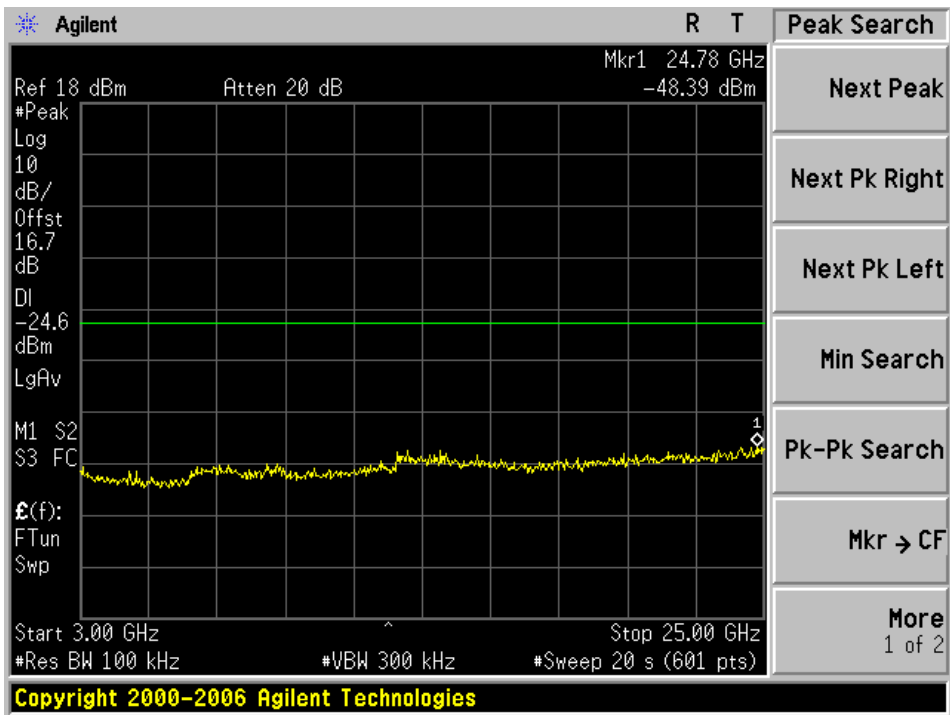
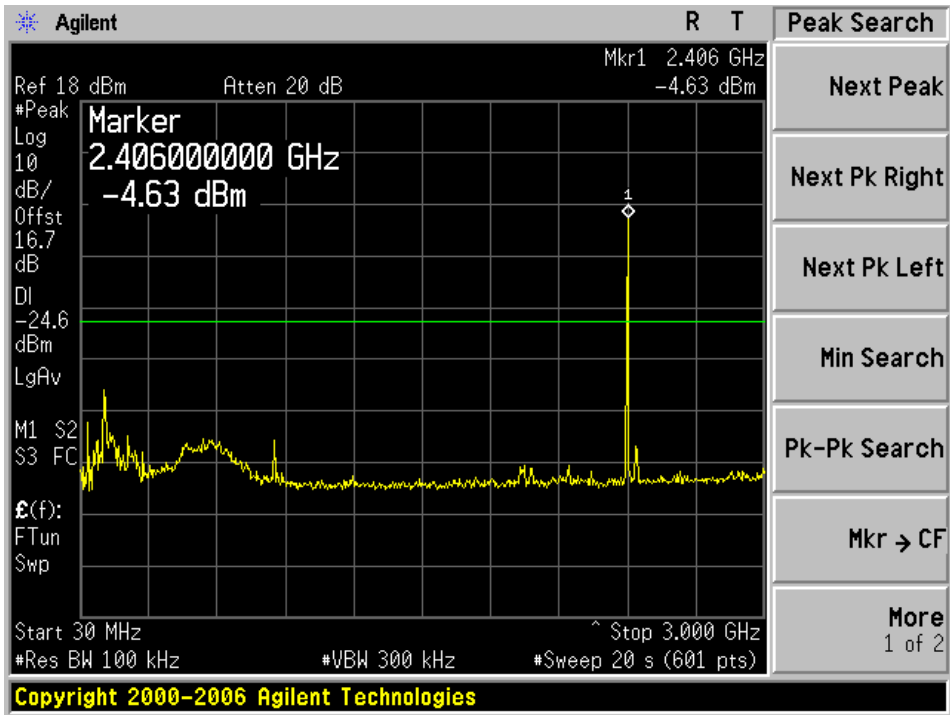
The testing was performed by Lionel Lara on 2011-10-10 to 2011-10-13 at RF Site.

7.5 Measurement Result

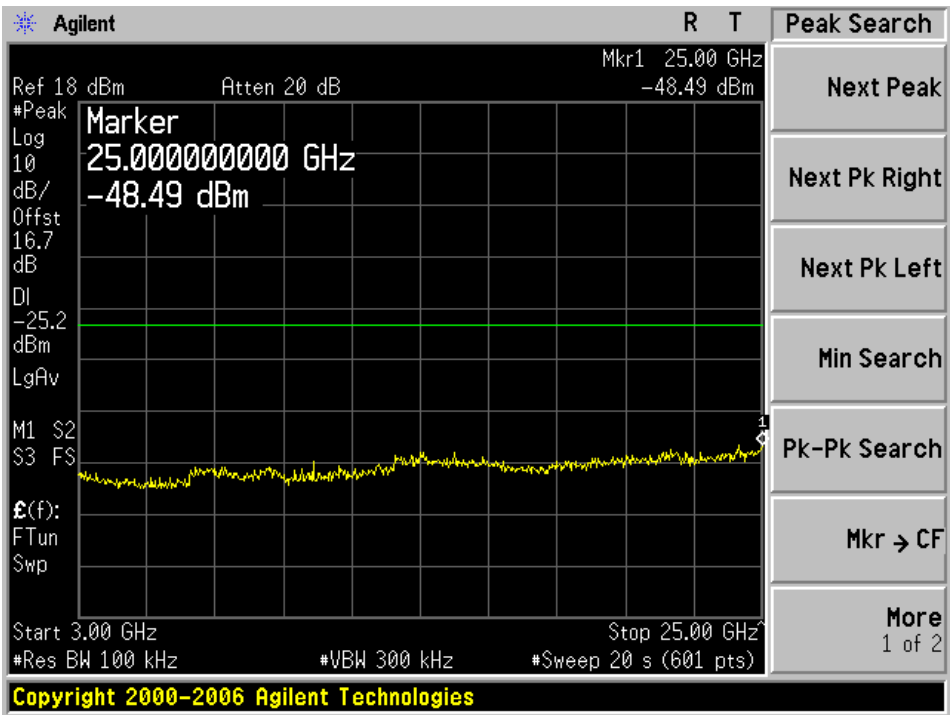
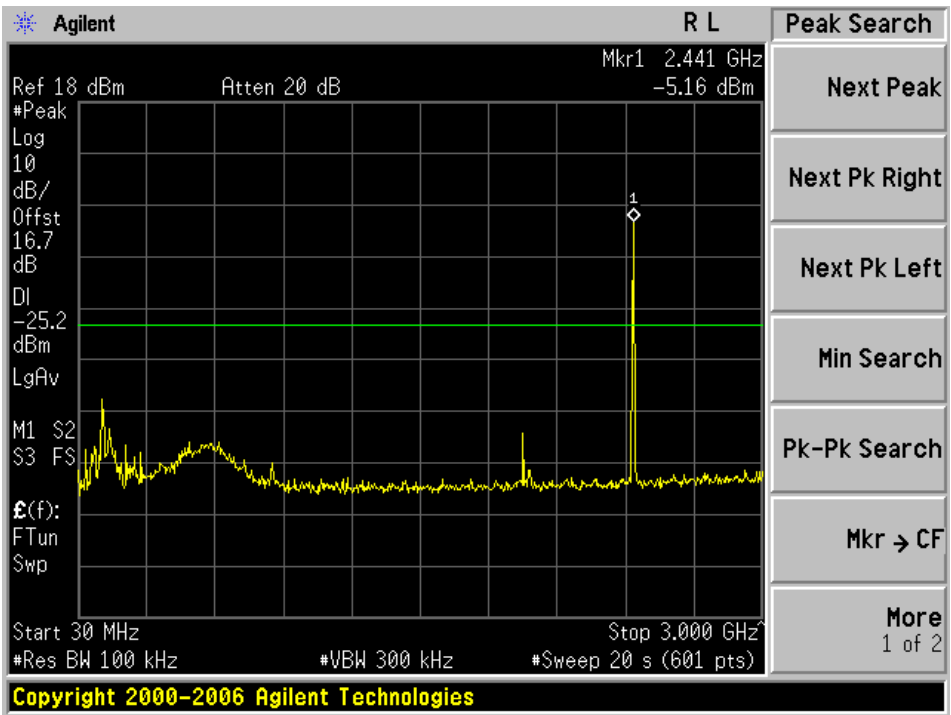
Please refer to following plots of spurious emissions.

Transmit-Modulated

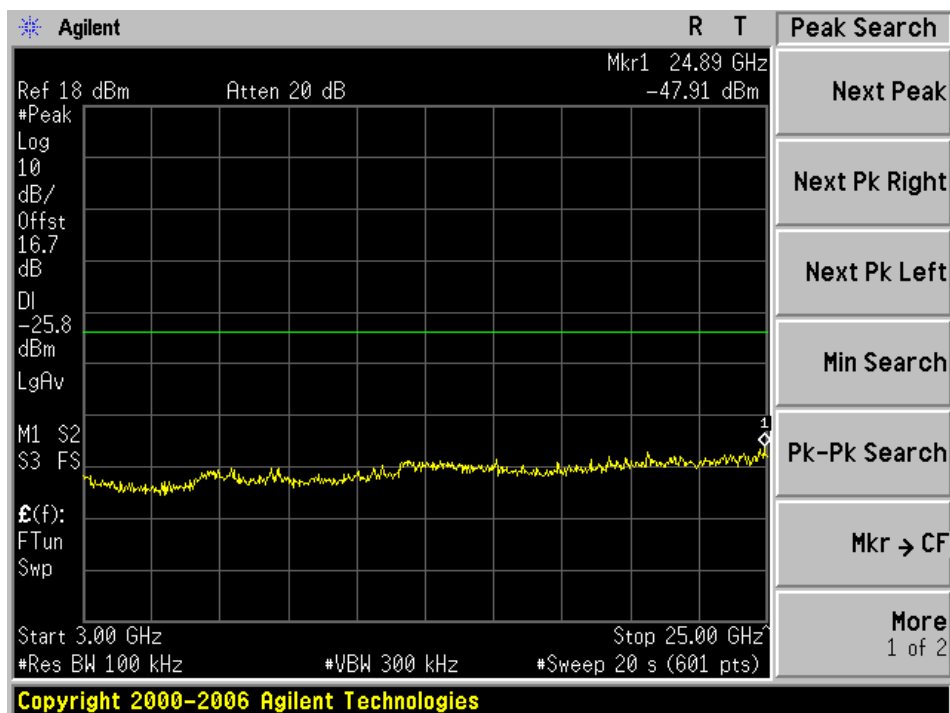
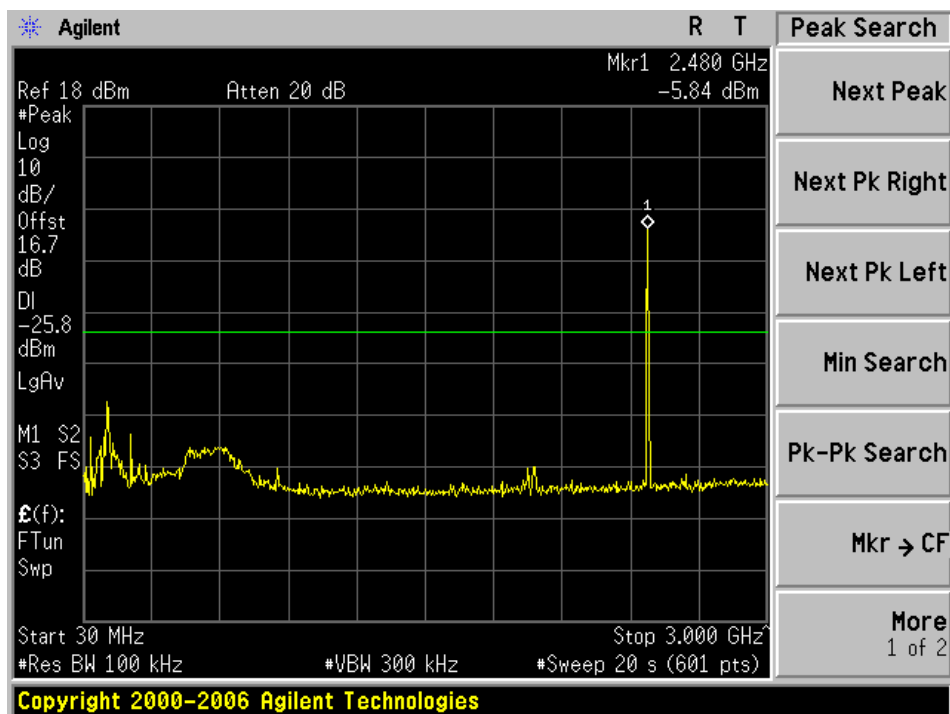
Low Channel 2405 MHz



Middle Channel 2440 MHz



High Channel 2480 MHz



8 FCC §15.205, §15.209 & §15.247(c) & IC RSS-210 §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)).

8.2 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 and IC RSS-210 limits.

8.3 EUT Setup

The radiated emissions tests were performed using the setup accordance with the ANSI C63.4-2003. The specification used was the FCC 15C limits.

The spacing between the peripherals was 3 centimeters.

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

8.4 Test Procedure

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

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 meter, and the EUT is placed on a turntable, which is 0.8 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto

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

8.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to 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:

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

8.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2011-03-21
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2011-06-29
EMCO	Horn antenna	3115	9511-4627	2011-10-03
Hewlett Packard	Pre amplifier	8447D	2944A10187	2011-03-08
Mini-Circuits	Pre Amplifier	ZVA-183-S	570400946	2011-05-09

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

8.7 Test Environmental Conditions

Temperature:	23-25 °C
Relative Humidity:	35-50 %
ATM Pressure:	101-103kPa

The testing was performed by Lionel Lara on 2011-10-10 to 2011-10-13 at RF Site.

8.8 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:

1) 30-1000 MHz:

Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Channel, Range
-4.77	66.3605	Vertical	30-1000 MHz

2) 1 – 25 GHz:

Mode: Transmitting			
Margin (dB)	Margin (dB)	Margin (dB)	Margin (dB)
¹ -1	-	-	-

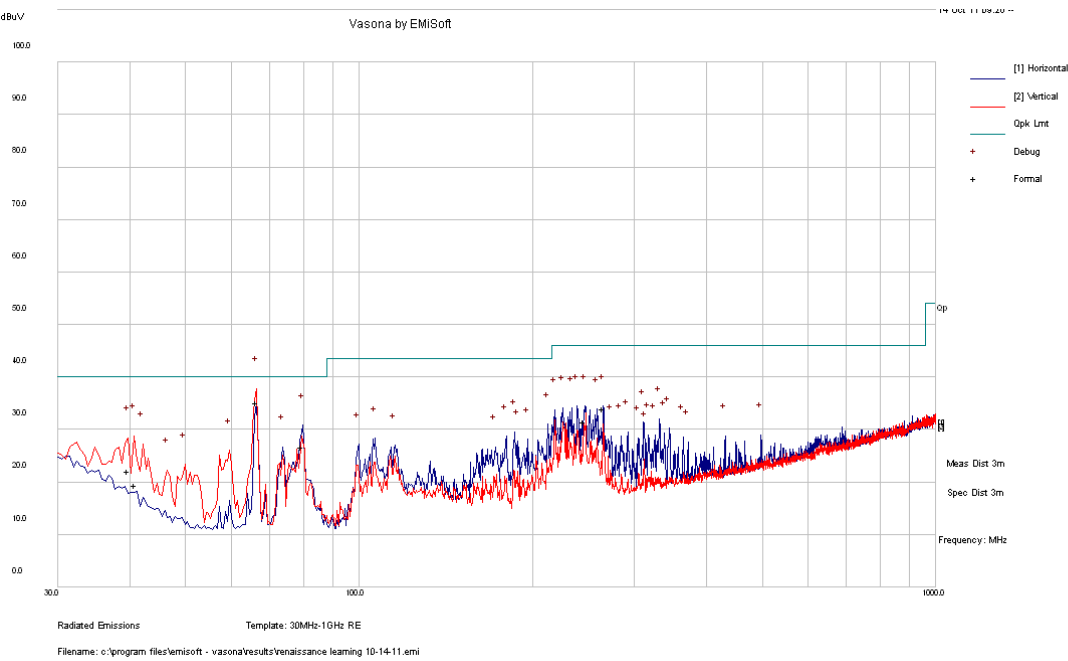
¹**Note:** All spurious emissions were at or below noise floor level.

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

8.9 Radiated Emissions Test Data and Plots

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

Worst channel (LC: 2405 MHz)



Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)
66.36050	35.23	213	V	360	40	-4.77
265.34350	34.01	102	H	209	46	-11.99
79.71900	26.8	282	H	254	40	-13.20
246.13730	31.49	153	H	217	46	-14.51
39.76150	22.18	102	V	98	40	-17.82
40.85675	19.4	163	V	176	40	-20.60

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 2405 MHz, measured at 3 meters											
-1	-	-	-	V	-	-	-	-	74		peak
-1	-	-	-	H	-	-	-	-	74		peak
-1	-	-	-	V	-	-	-	-	54		Ave
-1	-	-	-	H	-	-	-	-	54		Ave
Middle Channel 2440 MHz, measured at 3 meters											
-1	-	-	-	V	-	-	-	-	74	-	peak
-1	-	-	-	H	-	-	-	-	74	-	peak
-1	-	-	-	V	-	-	-	-	54	-	Ave
-1	-	-	-	H	-	-	-	-	54	-	Ave
High Channel 2480 MHz, measured at 3 meters											
-1	-	-	-	V	-	-	-	-	74	-	Peak
-1	-	-	-	H	-	-	-	-	74	-	Peak
-1	-	-	-	V	-	-	-	-	54	-	Ave
-1	-	-	-	H	-	-	-	-	54	-	Ave

¹Note: All spurious emissions were at or below noise floor level.

3) Restricted Band Emissions

Frequency (MHz)	S.A. Reading (dBμV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBμV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel 2405 MHz, measured at 3 meters											
2323.6	26.33	98	167	V	27.8	3.12	27.8	57.25	74	-16.75	Peak
2386.53	26.09	160	100	H	27.8	3.12	27.8	57.01	74	-16.99	Peak
2387.33	12.62	98	167	V	27.8	3.12	27.8	43.54	54	-10.46	Ave
2375.07	12.64	160	100	H	27.8	3.12	27.8	43.56	54	-10.44	Ave
High Channel 2480 MHz, measured at 3 meters											
2483.53	29.09	173	100	V	28.5	3.21	28.5	60.8	74	-13.20	Peak
2483.5	27.61	159	100	H	28.5	3.21	28.5	59.32	74	-14.68	Peak
2483.5	18.45	173	100	V	28.5	3.21	28.5	50.16	54	-3.84	Ave
2483.5	16.42	159	100	H	28.5	3.21	28.5	48.13	54	-5.87	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
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11

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

9.4 Test Environmental Conditions

Temperature:	23-25 °C
Relative Humidity:	35-50 %
ATM Pressure:	101-103kPa

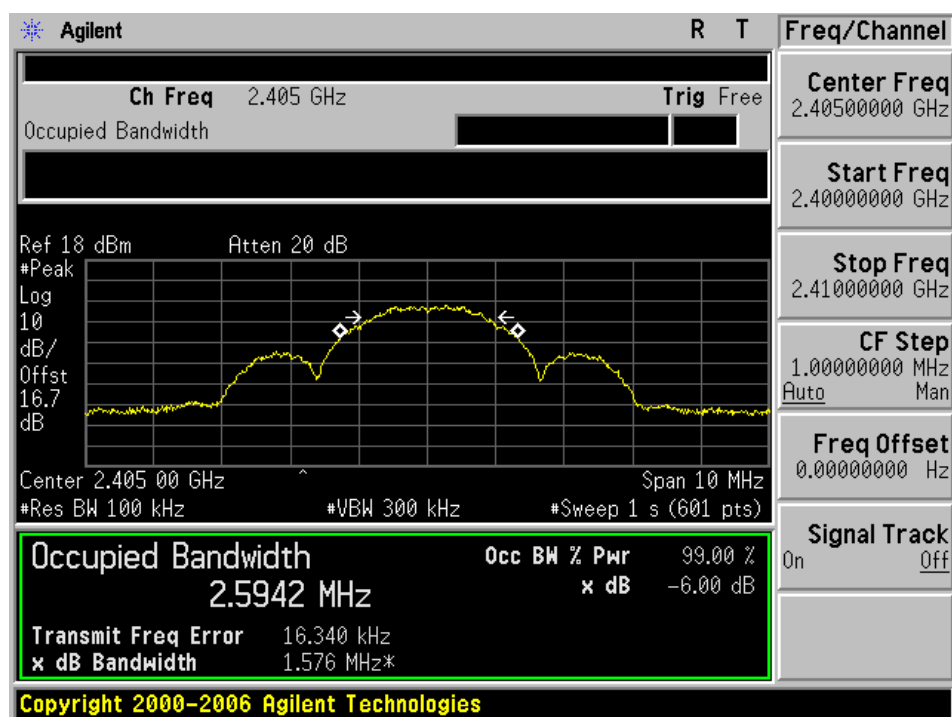
The testing was performed by Lionel Lara on 2011-10-10 to 2011-10-13 at RF Site.

9.5 Summary of Test Results

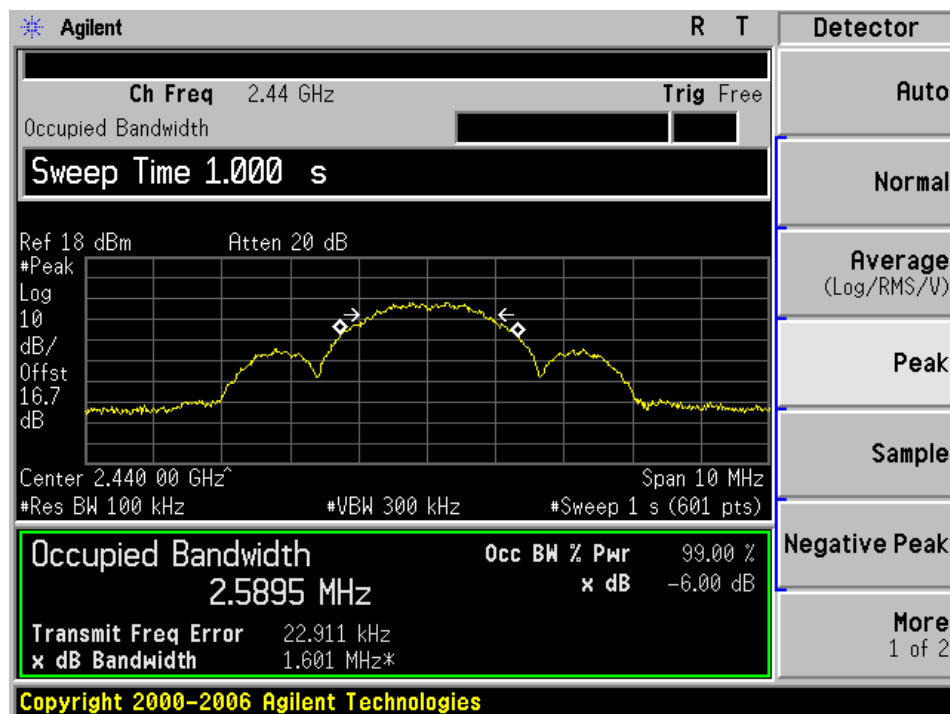
Channel	Frequency (MHz)	99% Emission Bandwidth (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)	Results
Low	2405	2.5942	1.576	> 500	Compliant
Middle	2440	2.5895	1.601	> 500	Compliant
High	2480	2.5932	1.596	> 500	Compliant

Please refer to the following plots for detailed test results.

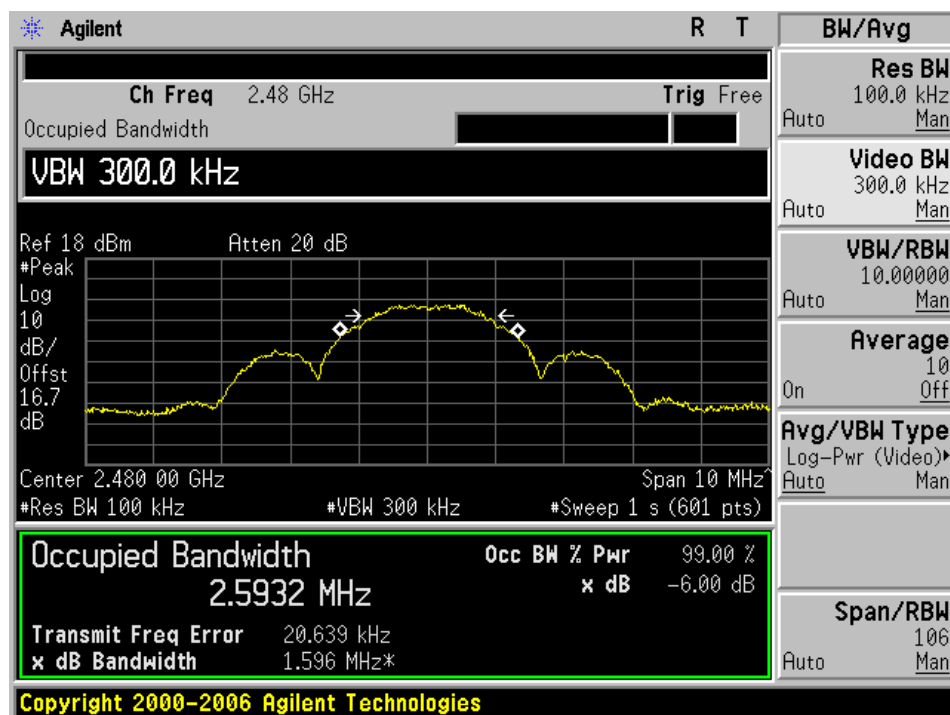
Low Channel



Middle Channel



High Channel



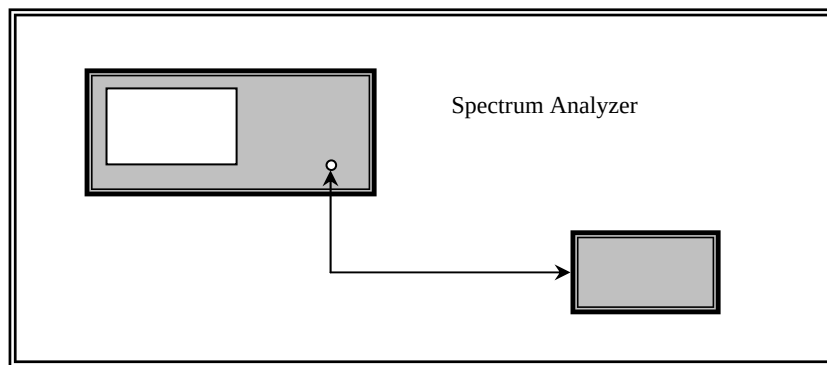
10 FCC §15.247(b) & IC RSS-210 §A8.4 - Peak Output Power Measurement

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
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11

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

10.4 Test Environmental Conditions

Temperature:	23-25 °C
Relative Humidity:	35-50 %
ATM Pressure:	101-103kPa

The testing was performed by Lionel Lara on 2011-10-10 to 2011-10-13 at RF Site.

10.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2405	-0.49	30	-30.49
Middle	2440	-0.60	30	-30.60
High	2480	-0.76	30	-30.76

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
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11

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

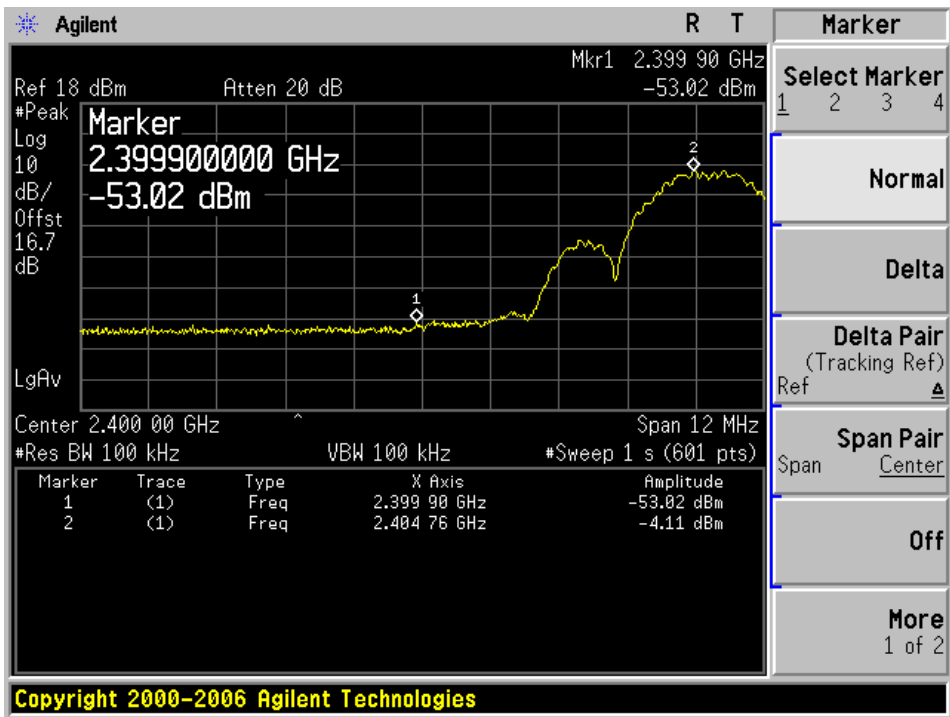
11.4 Test Environmental Conditions

Temperature:	23-25 °C
Relative Humidity:	35-50 %
ATM Pressure:	101-103kPa

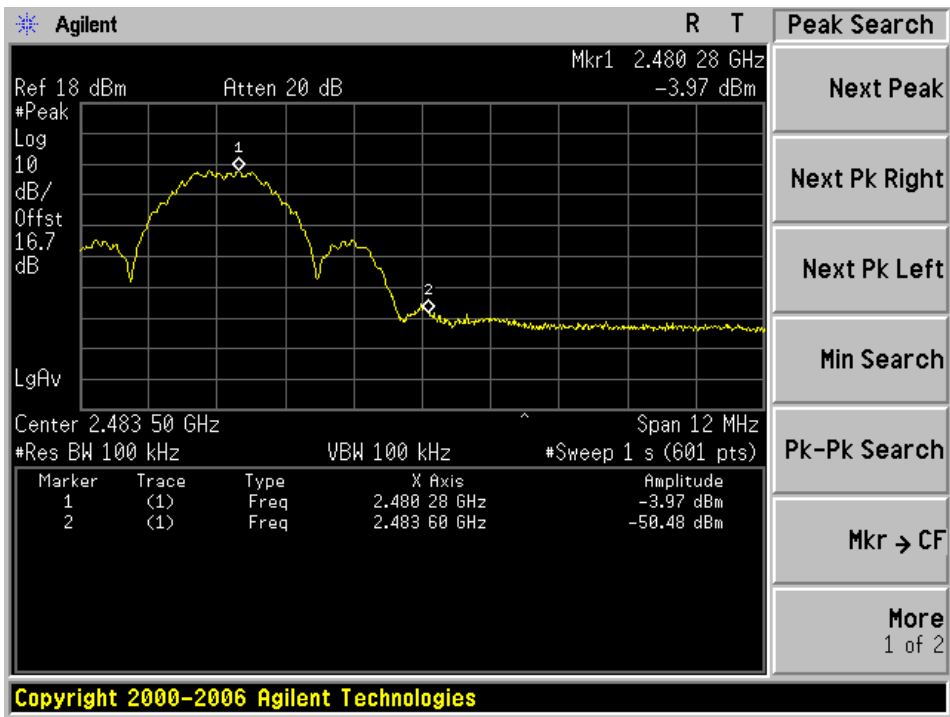
The testing was performed by Lionel Lara on 2011-10-10 to 2011-10-13 at RF Site.

11.5 Measurement Results

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. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to 1.5MHz span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Repeat above procedures until all frequencies measured were complete.

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11

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

12.4 Test Environmental Conditions

Temperature:	23-25 °C
Relative Humidity:	35-50 %
ATM Pressure:	101-103kPa

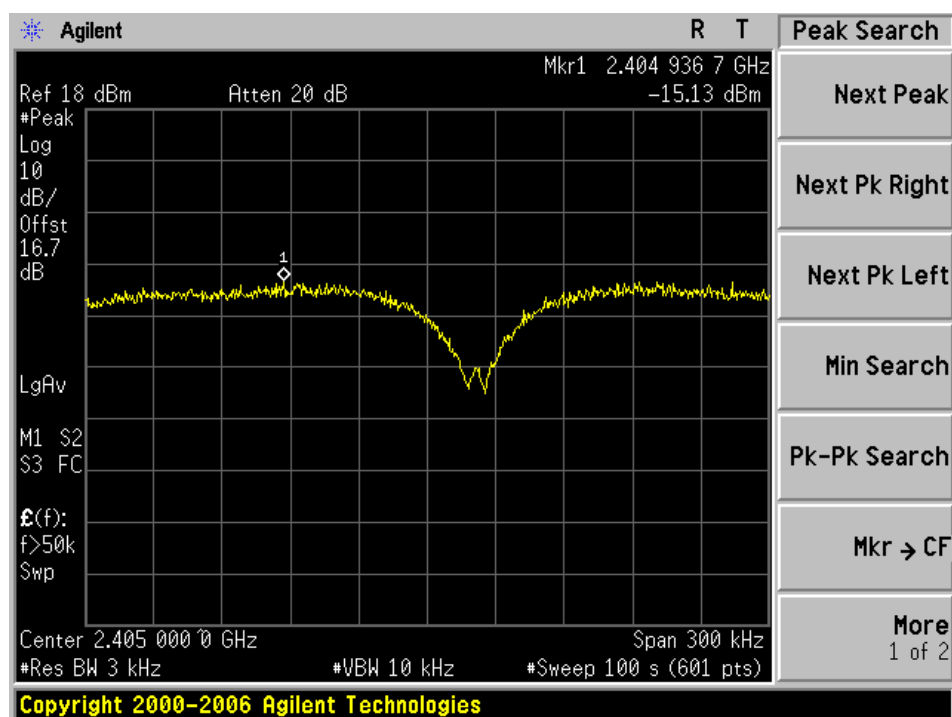
The testing was performed by Lionel Lara on 2011-10-10 to 2011-10-13 at RF Site.

12.5 Test Results

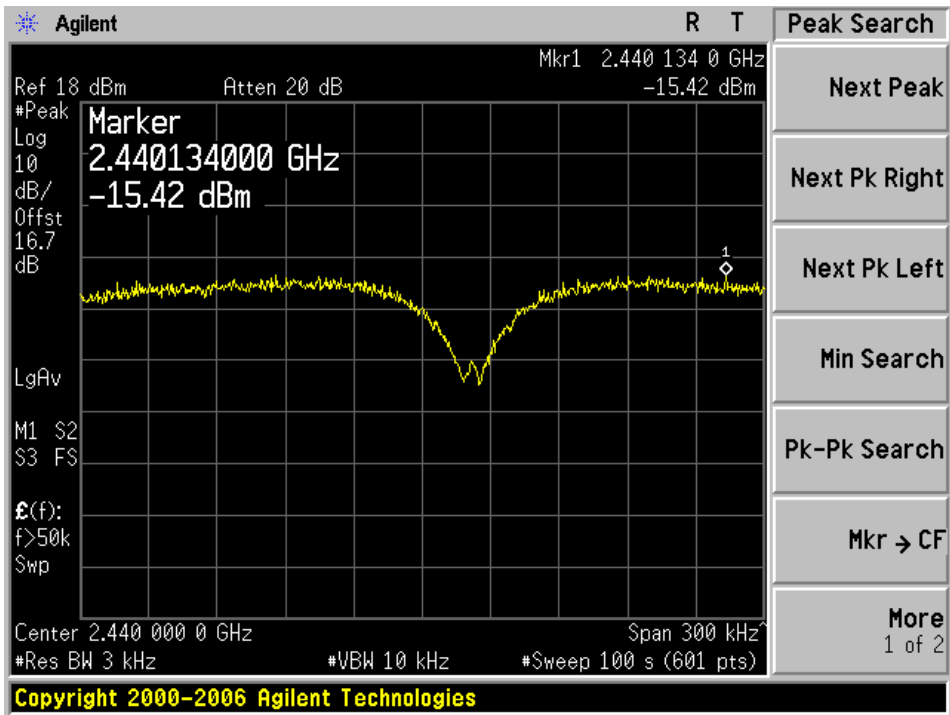
Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm/3kHz)	Results
Low	2405	-15.13	8	Compliant
Mid	2440	-15.42	8	Compliant
High	2480	-15.54	8	Compliant

Please refer to the following plots for detailed test results:

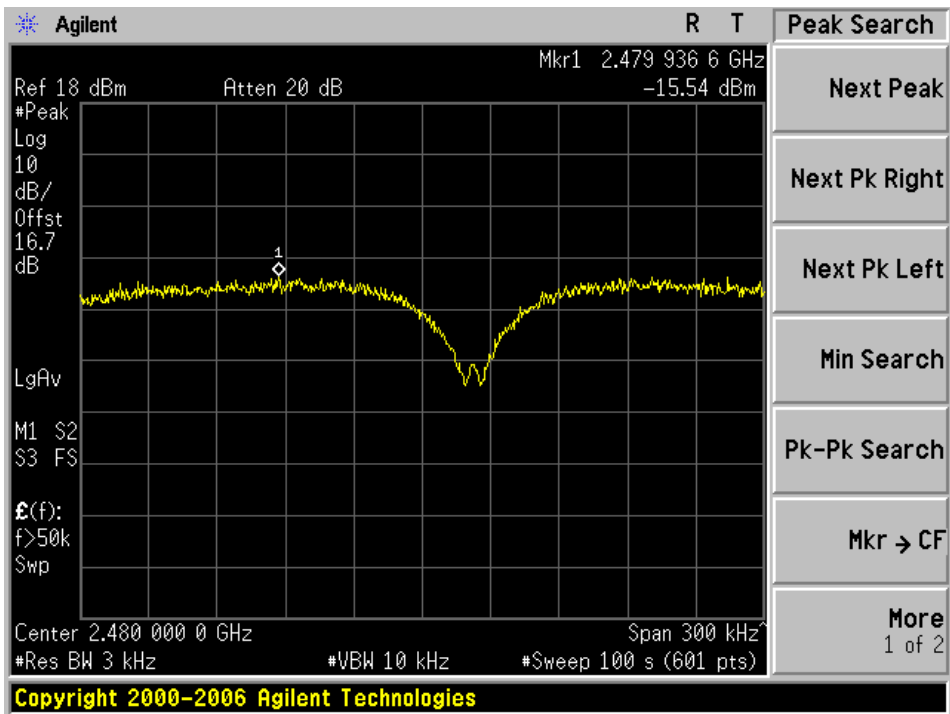
Low Channel



Middle Channel



High Channel



13 IC RSS-210 §2.6 & RSS-Gen §4.10 - Receiver Spurious Radiated Emissions

13.1 Applicable Standard

According to IC RSS-Gen §4.10, the receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate.

Unless otherwise specified in the applicable RSS, the radiated emission measurement is the standard measurement method (with the device's antenna in place) to measure receiver spurious emissions.

Radiated emission measurements are to be performed using a calibrated open-area test site.

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tuneable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

For emissions below 1 GHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector with the same measurement bandwidth as that for CISPR quasi-peak measurements. Above 1 GHz, measurements shall be performed using an average detector and a resolution bandwidth of 300 kHz to 1 MHz.

According to RSS-210 §2.6, Tables 2 and 3 show the general field strength limits of unwanted emissions, where applicable, for transmitters and receivers operating in accordance with the provisions specified in this RSS. Transmitters whose wanted emissions are also within the limits shown in Tables 2 and 3 may operate in any of the frequency bands of Tables 2 and 3, other than the restricted bands of Table 1 and the TV bands, and shall be certified under RSS-210.

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

Frequency (MHz)	Field Strength Microvolts/m at 3 meters (watts, e.i.r.p.)	
	Transmitters	Receivers
30-88	100 (3 nW)	100 (3 nW)
88-216	150 (6.8 nW)	150 (6.8 nW)
216-960	200 (12 nW)	200 (12 nW)
Above 960	500 (75 nW)	500 (75 nW)

Note: Transmitting devices are not permitted in Table 1 bands or in TV bands (54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz, and 614-806 MHz). Prohibition of operation in TV bands does not apply to momentary devices, or to medical telemetry devices in the band 174-216 MHz, and to perimeter protection systems in the bands 54-72 and 76-88 MHz. The perimeter protection devices are to meet Table 3 field strengths limits.

Table 3: General Field Strength Limits for Transmitters at Frequencies below 30 MHz (Transmit)

Frequency (fundamental or spurious)	Field Strength (microvolts/m)	Magnetic H-Field (microamperes/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1.705-30 MHz	30	N/A	30

Note: The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing an average detector.

13.2 EUT Setup

The radiated emissions tests were performed in the 3 meter chamber, using the setup in accordance with ANSI C63.4-2003.

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 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:

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

13.5 Test Equipment Lists and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2011-03-21
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2011-06-29
EMCO	Horn antenna	3115	9511-4627	2011-10-03
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2011-03-08
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2011-05-09

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

13.6 Test Environmental Conditions

Temperature:	23-25 °C
Relative Humidity:	35-50 %
ATM Pressure:	101-103kPa

The testing was performed by Lionel Lara on 2011-10-10 to 2011-10-13 at RF Site.

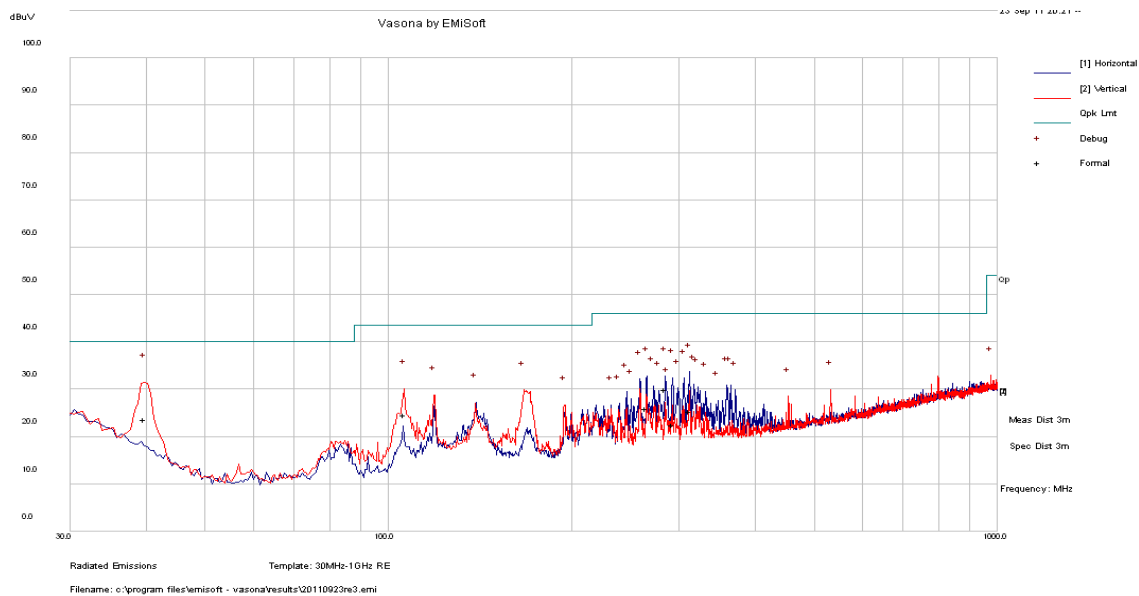
13.7 Summary of Test Results

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

Mode: Receiving			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Range (MHz)
-15.95	284.9098	Horizontal	30 to 25000

13.8 Radiated Emissions Test data and Plots

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)
284.9098	30.05	107	H	291	46.0	-15.95
39.8525	23.74	180	V	153	40.0	-16.26
106.3508	24.60	129	V	360	43.5	-18.90
265.6568	25.91	99	H	29	46.0	-20.09
312.3983	25.42	107	H	34	46.0	-20.58
292.8618	22.54	126	H	287	46.0	-23.46

2) Above 1 GHz Measured at 3 meters

Peak Measurements

Frequency (MHz)	Corrected Amplitude (dB μ V/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dB μ V/m)	Margin (dB)
.1	-	-	H	-	74	-
.1	-	-	V	-	74	-

Average Measurements

Frequency (MHz)	Corrected Amplitude (dB μ V/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dB μ V/m)	Margin (dB)
.1	-	-	H	-	54	-
.1	-	-	V	-	54	-

¹**Note:** All spurious emissions were at or below noise floor level.