

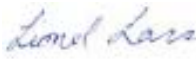

FCC PART 15 SUBPART C
IC RSS-210 ISSUE 8, DEC 2010
TEST AND MEASUREMENT REPORT

For

Sensys Networks, Inc

2560 Ninth Street, Suite 219 & 217,
Berkeley, CA 94710, USA

FCC ID: Y8XVSN240M
IC: 9498A-VSN240M

Report Type: Original Report	Product Type: Zigbee Transmitter Sensor with MicroRadar 6.3 GHz Function
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Report Number: <u>R1201242-247</u>	
Report Date: <u>2012-03-15</u>	
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1201242-247	Original Report	2012-03-15

1 General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Sensys Networks* and their product, *model: VSN240-M, FCC ID: Y8XVSN240M, IC: 9498A-VSN240M* or the “EUT” as referred to this report. The EUT is a battery powered 2.4 GHz Zigbee transmitter sensor with MicroRadar 6.3 GHz function for traffic use.

1.2 Mechanical Description of EUT

The EUT measures approximately 70 mm (**L**) x 70 mm (**W**) x 60 mm (**H**) and weighs approximately 240g.

The data gathered are from a typical production sample provided by the manufacturer with serial number: 18FDD for the radiated testing and 19266 for the conducted testing.

1.3 Objective

This report is prepared on behalf of *Sensys Networks* 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.

1.4 Related Submittal(s)/Grant(s)

6.3 GHz radar FCC Part 15C and IC RSS-210 submission with FCC ID: Y8XVSN240M, IC: 9498A-VSN240M.

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2003.

1.6 Measurement Uncertainty

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

Based on CISPR16-4-2:2003, The Treatment of Uncertainty in EMC Measurements, the values ranging from +2.0 dB for Conducted Emissions tests and +4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at 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.: R-3729, C-4176, G-469, and T-1206. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

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

2 System Test Configuration

2.1 Justification

The system was configured for testing in accordance with ANSI C63.4-2003.

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

2.2 EUT Exercise Software

The EUT exercise program, provided by the client, used during radiated testing was designed to exercise the system components.

Radio Mode	Frequency (MHz)		
	Low Channel	Middle Channel	High Channel
Zigbee	2405	2440	2480

2.3 Special Accessories

N/A.

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
Lenovo	Laptop	Thinkpad SL510	LR-NKDPN
Sensys Networks	Access Point	AP240-E	200852

2.6 Interface Ports and Cabling

Cable Description	Length (m)	From	To
RF Cable	< 1	EUT	Spectrum Analyzer

2.7 Internal Parts List and Details

Manufacturers	Descriptions	Models	Serial Numbers
Sensys Networks	PCB Board	MicroRadar	FXR45145 Rev. 1.9

3 Summary of Test Results

FCC & IC Rules	Description of Test	Result
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 ¹
FCC §15.247(d) IC RSS-210 §A8.5	Spurious Emissions at Antenna Port	Compliant
FCC §15.205, §15.209, §15.247 (d) IC RSS-210 §2.2, §2.5, §A8.5	Restricted Bands, Spurious Radiated Emissions	Compliant
FCC §15.247 (a)(1) IC RSS-210 §A8.1	99% & 6 dB Emission Bandwidth	Compliant
FCC §15.247 (b)(3) IC RSS-210 §A8.4	Maximum Peak Output Power	Compliant
FCC §15.247 (e), IC RSS-210 §A8.2 (b)	Power Spectral Density	Compliant
FCC §15.247(d) IC RSS-210 §A8.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
IC RSS-210 §2.5 IC RSS-Gen §6	Receiver Spurious Emission	Compliant

Note 1: EUT is battery powered.

4 FCC §15.203 & IC RSS-Gen §7.1.2 – Antenna Requirements

4.1 Applicable Standard

For intentional device, according to FCC Part §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used.

Per IC RSS-Gen §7.1.2, A transmitter can only be sold or operated with antennas with which it was certified. A transmitter maybe 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 IC 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 IC RSS-210 Annex 8 or RSS-210 Annex 9, the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to IC RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

4.2 Result

The EUT has maximum gain of 0.55 dBi antenna, which in accordance to sections FCC Part 15.203 and IC RSS-Gen §7.1.2, is considered sufficient to comply with the provisions of these sections. Please refer to the EUT photos.

5 FCC §15.205, §15.209, §15.247(d) & IC RSS-210 §2.2, §2.5, §A8.5 – Spurious Radiated Emissions

5.1 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 ^{Note 1}	3
88 - 216	150 ^{Note 1}	3
216 - 960	200 ^{Note 1}	3
Above 960	500	3

Note 1: 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)).

5.2 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 15C and IC RSS-210/RSS-Gen 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.

5.3 Test Procedure

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

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

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

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

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

Above 1000 MHz:

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

5.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to the indicated Amplitude (Ai) reading. The basic equation is as follows:

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

For example, the Corrected Amplitude (CA) of 40.3 dBuV/m = indicated Amplitude reading (Ai) 32.5 dBuV + Antenna Factor (AF) 23.5dB + Cable Loss (CL) 3.7 dB + Attenuator (Atten) 10 dB - Amplifier Gain (Ga) 29.4 dB

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

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

5.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
A.H Systems	Antenna, Horn	SAS-200/571	261	2012-01-18
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2011-06-09
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2011-08-10
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2011-03-21
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11
Mini-Circuits	Pre-amplifier	ZVA-183-S	667400960	2011-05-08

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

5.6 Test Environmental Conditions

Temperature:	20-22 °C
Relative Humidity:	30-34 %
ATM Pressure:	101.5kPa

The testing was performed by Lionel Lara on 2012-02-21 in 5 meter chamber #3.

5.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC 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)	Range
-5.52	165.8898	Vertical	30 MHz– 1 GHz

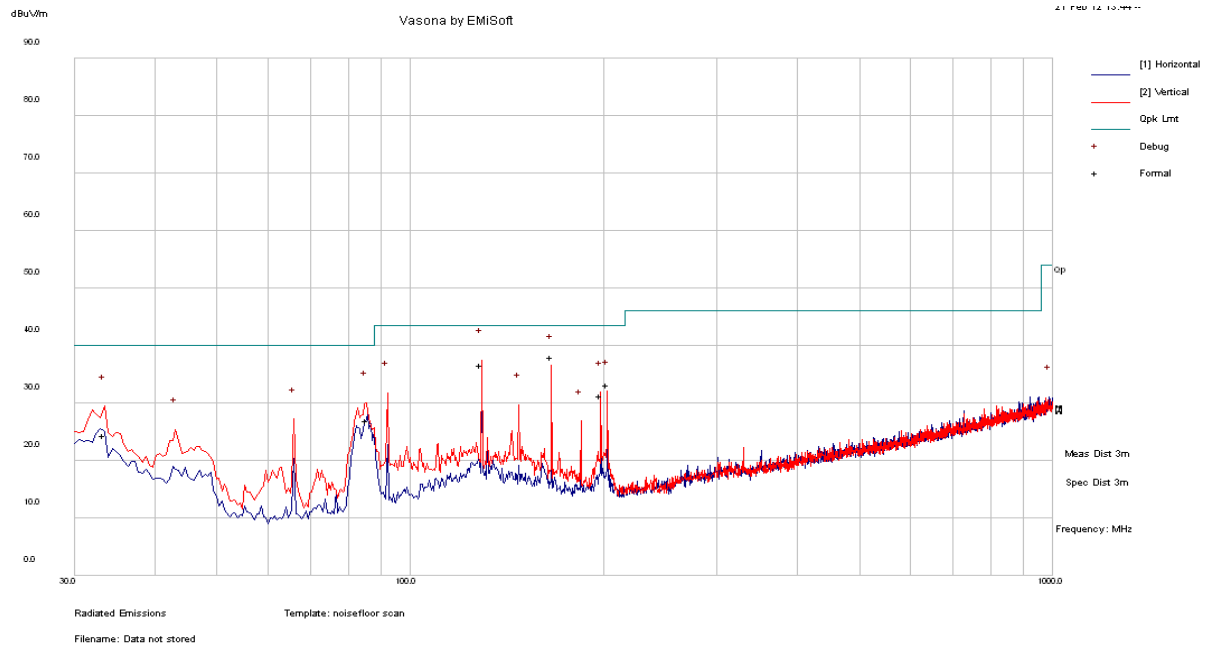
Above 1 GHz:

Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Channel, Range
-3.08	2483.81	Vertical	High, 1GHz – 25GHz

5.8 Radiated Emissions Test Data & Plots

1) 30 MHz – 1 GHz, Radiated Spurious Emissions Measured at 3 meters

Worst Channel



Quasi-Peak Measurement:

Frequency (MHz)	Corrected Amplitude (dB)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)
165.8898	37.98	99	V	310	43.5	-5.52
129.0273	36.65	158	V	128	43.5	-6.85
202.7565	33.2	113	V	18	43.5	-10.30
197.9883	31.38	252	V	258	43.5	-12.12
85.48325	26.96	270	V	0	40	-13.04
33.27875	24.37	225	V	202	40	-15.63

2) 1 – 25 GHz, Radiated Spurious Emissions 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)											
4810	39.59	31	100	V	32.603	3.96	27.77	48.383	74	-25.617	Peak
4810	41.35	276	186	H	32.629	3.96	27.77	50.169	74	-23.831	Peak
4810	22.51	31	100	V	32.603	3.96	27.77	31.303	54	-22.697	Ave
4810	22.67	276	186	H	32.629	3.96	27.77	31.489	54	-22.511	Ave
Middle Channel (2440 MHz)											
4880	39.76	250	160	V	32.603	3.96	27.71	48.613	74	-25.387	Peak
4880	40.87	104	171	H	32.629	3.96	27.71	49.749	74	-24.251	Peak
4880	19.87	250	160	V	32.603	3.96	27.71	28.723	54	-25.277	Ave
4880	19.59	104	171	H	32.629	3.96	27.71	28.469	54	-25.531	Ave
High Channel (2480 MHz)											
4960	36.73	32	160	V	32.732	4.02	27.71	45.772	74	-28.228	Peak
4960	38.38	239	140	H	32.800	4.02	27.71	47.490	74	-26.510	Peak
4960	21.59	32	160	V	32.732	4.02	27.71	30.632	54	-23.368	Ave
4960	22.08	239	140	H	32.800	4.02	27.71	31.190	54	-22.810	Ave

3) Spurious Emissions in Restricted Band

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)	
(Near Band Edge) Lowest Channel											
2390	51.65	36	104	V	28.12	3.12	27.9	54.99	74	-19.01	Peak
2390	50.28	304	194	H	28.159	3.12	27.9	53.659	74	-20.341	Peak
2390	23.9	36	104	V	28.12	3.12	27.9	27.24	54	-26.76	Ave
2390	23.89	304	194	H	28.159	3.12	27.9	27.269	54	-26.731	Ave
(Near Band Edge): Highest Channel											
2483.81	67.45	40	160	V	28.12	3.25	27.9	70.92	74	-3.08	Peak
2486.75	64.64	196	216	H	28.3	3.25	27.9	68.29	74	-5.71	Peak
2483.81	24.47	40	160	V	28.12	3.25	27.9	27.94	54	-26.06	Ave
2486.75	22.75	196	216	H	28.3	3.25	27.9	26.4	54	-27.6	Ave

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

6.1 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

6.2 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.

6.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	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.

6.4 Test Environmental Conditions

Temperature:	20-22 °C
Relative Humidity:	30-34 %
ATM Pressure:	101.5kPa

The testing was performed by Lionel Lara on 2012-02-22 at RF test site.

6.5 Test Results

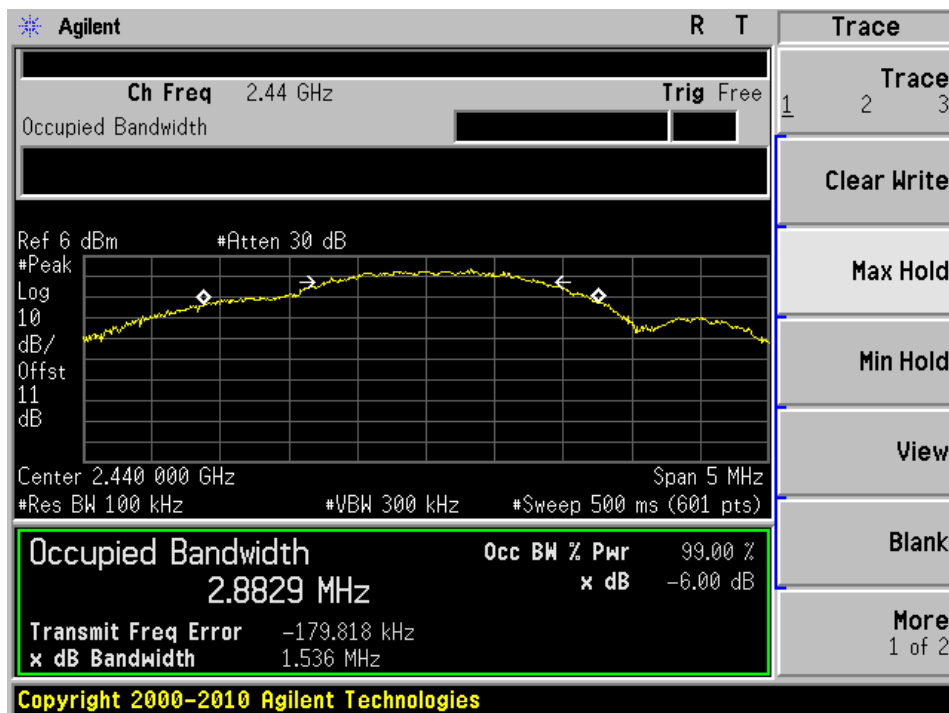
Channel	Frequency (MHz)	99% Emission Bandwidth (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)	Results
Low	2405	2.5838	1.542	> 500	Compliant
Mid	2440	2.8829	1.536	> 500	Compliant
High	2480	3.3489	1.623	> 500	Compliant

Please refer to the following plots.

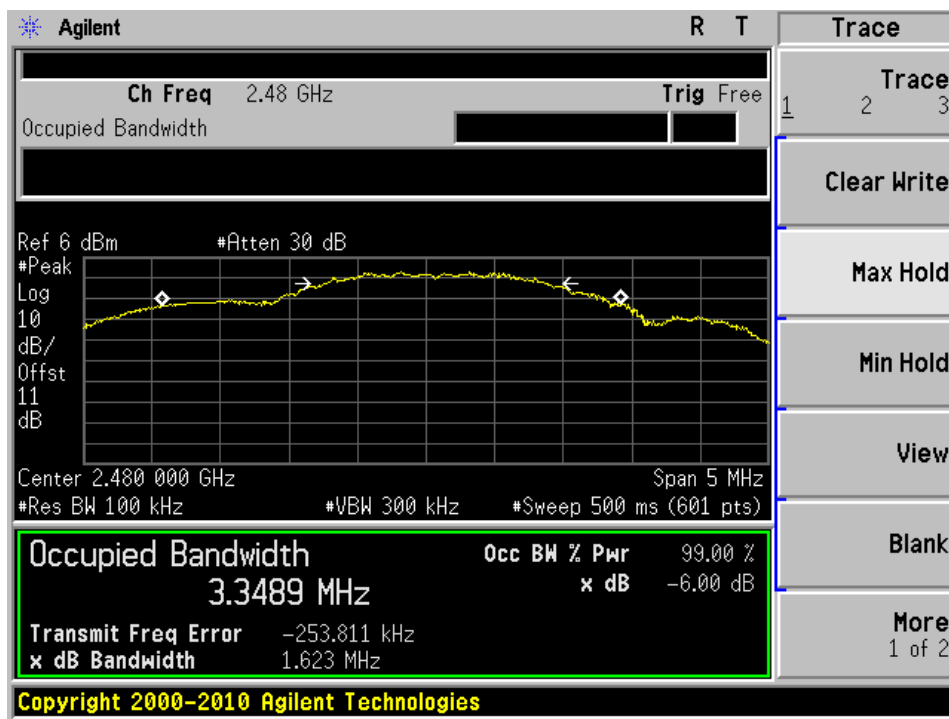
Low Channel



Middle Channel



High Channel



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

7.1 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.

7.2 Measurement Procedure

1. Place the EUT on the turntable 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 the spectrum analyzer.

7.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	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:	20-22 °C
Relative Humidity:	30-34 %
ATM Pressure:	101.5kPa

The testing was performed by Lionel Lara on 2012-02-22 at RF test site.

7.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC/IC Limit (dBm)	Result
Low	2405	2.92	30	Pass
Mid	2440	2.49	30	Pass
High	2480	2.35	30	Pass

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

8.1 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.

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 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 4 MHz span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Repeat above procedures until all frequencies measured were complete.

8.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	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.

8.4 Test Environmental Conditions

Temperature:	20-22 °C
Relative Humidity:	30-34 %
ATM Pressure:	101.5kPa

The testing was performed by Lionel Lara on 2012-02-22 at RF test site.

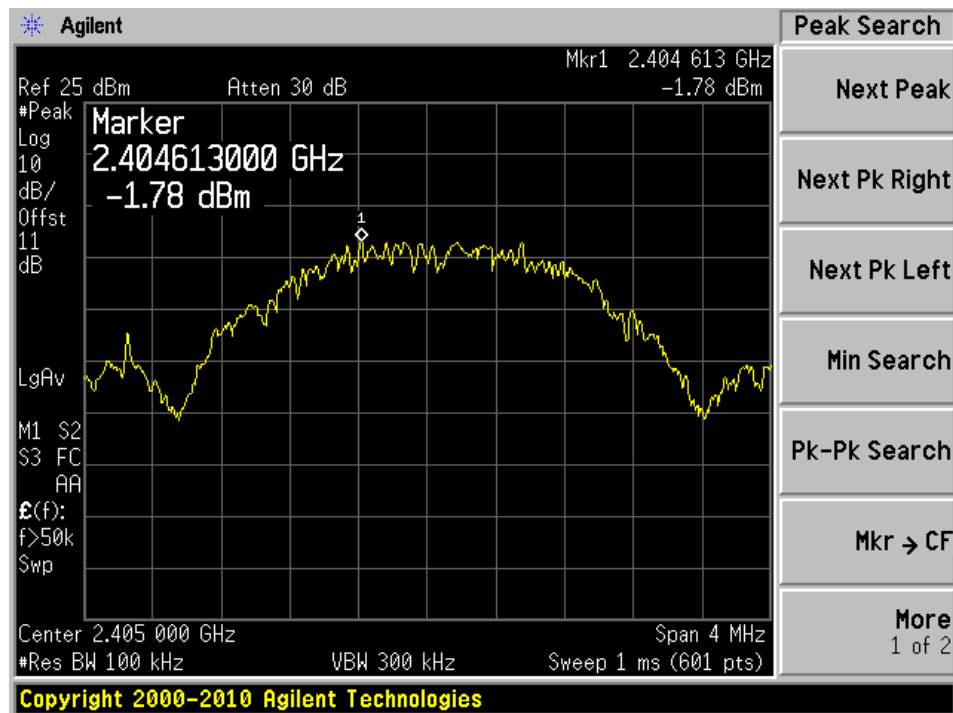
8.5 Test Results

Channel	Frequency (MHz)	PSD (dBm)	Corrected PSD (dBm)	Limit (dBm)	Results
Low	2405	-1.78	-16.98	8	Pass
Mid	2440	-1.32	-16.52	8	Pass
High	2480	-2.89	-18.09	8	Pass

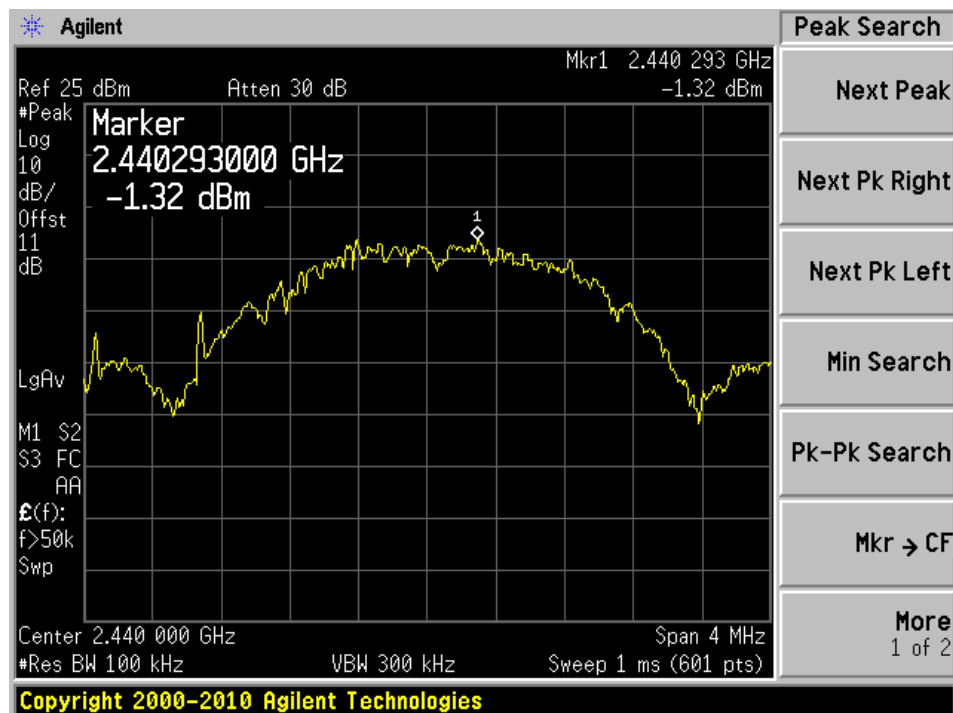
$BWCF \text{ (Bandwidth Correction Factor)} = 10 * \log(3 \text{ kHz} / 100 \text{ kHz}) = -15.2 \text{ dB}$

Please refer to the following plots.

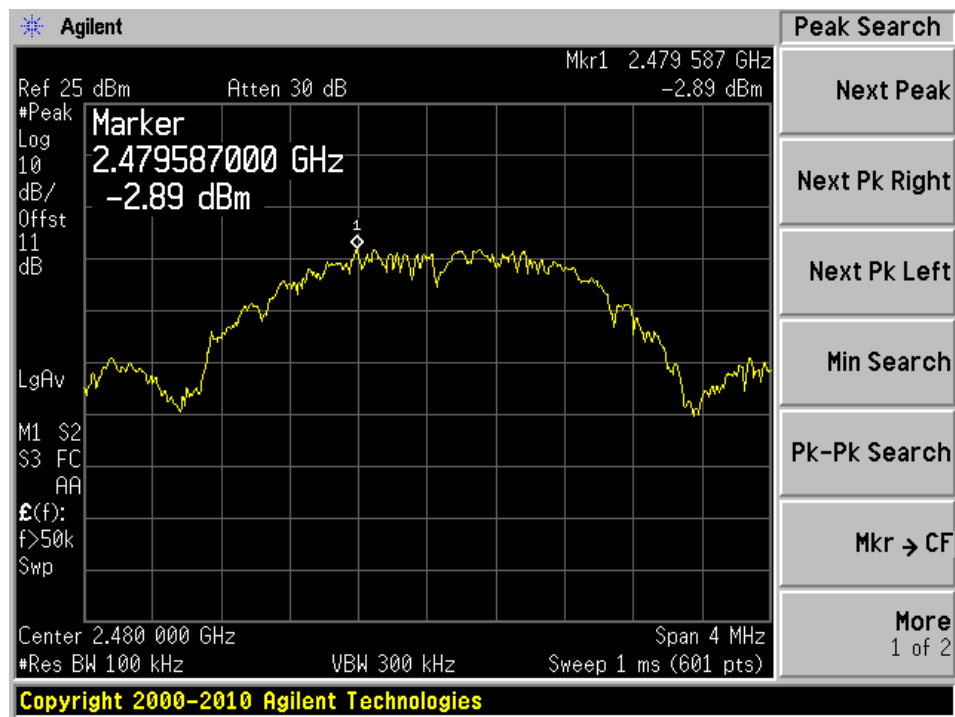
Low Channel



Middle Channel



High Channel



9 FCC §15.247(d) & IC RSS-210§A8.5 - 100 kHz Bandwidth of Band Edges

9.1 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.

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 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 100kHz 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.

9.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	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

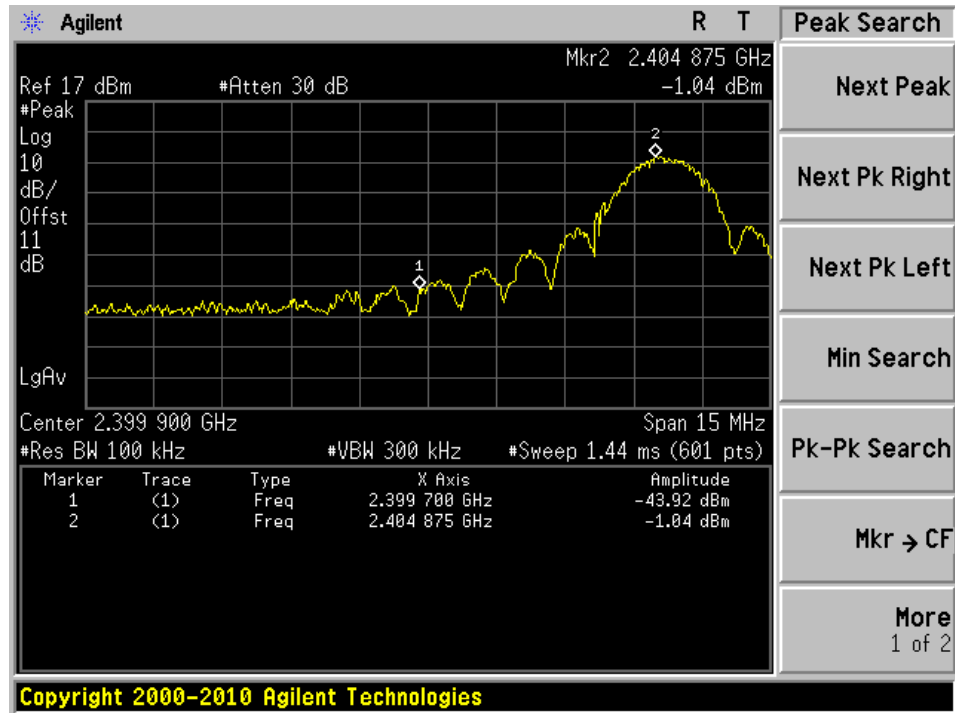
Temperature:	20-22 °C
Relative Humidity:	30-34 %
ATM Pressure:	101.5kPa

The testing was performed by Lionel Lara on 2012-02-22 at RF test site.

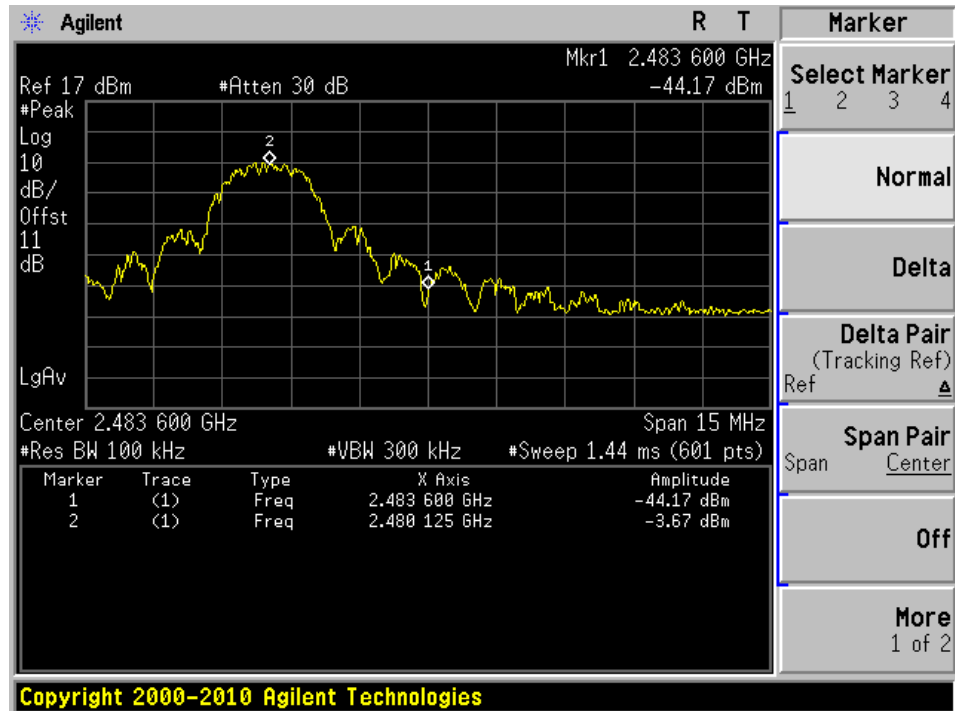
9.5 Test Results

Please refer to the following plots.

Band Edge: Lowest Channel



Band Edge: Highest Channel



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

10.1 Applicable Standard

As per 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.

10.2 Measurement Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on a bench 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 the SA on Max-Hold Mode, and then keep the EUT in transmitting mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View mode and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

10.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	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

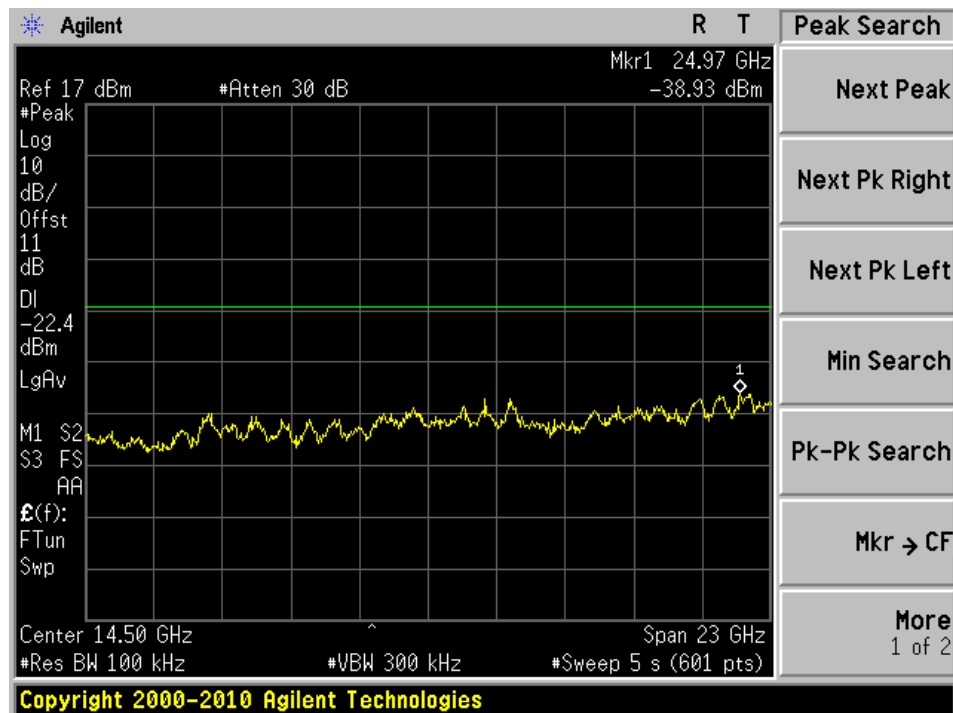
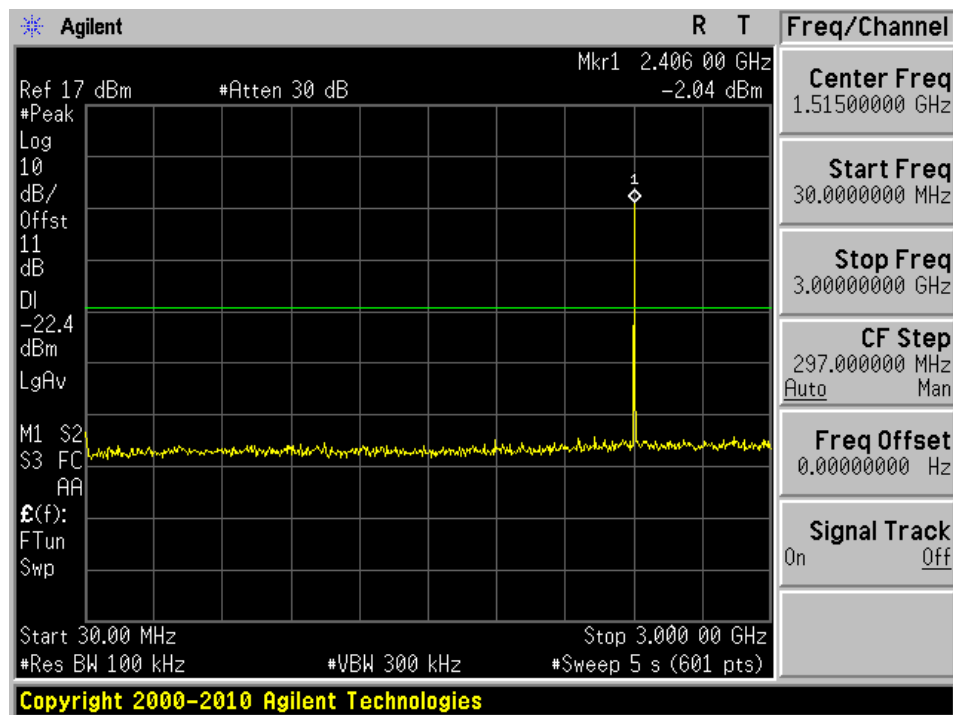
Temperature:	20-22 °C
Relative Humidity:	30-34 %
ATM Pressure:	101.5kPa

The testing was performed by Lionel Lara on 2012-02-22 at RF test site.

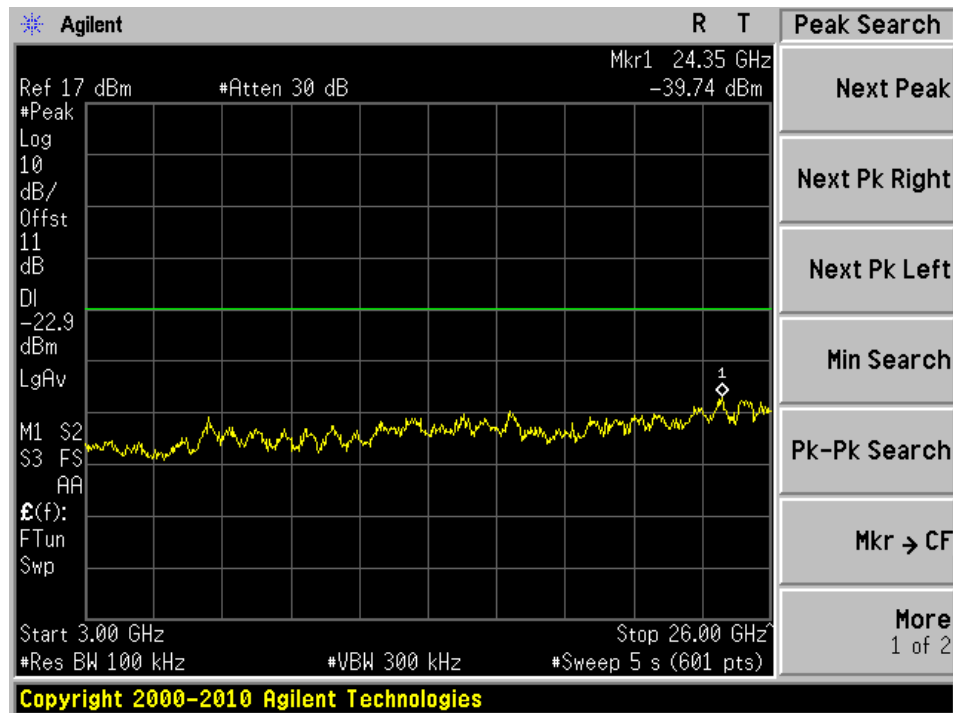
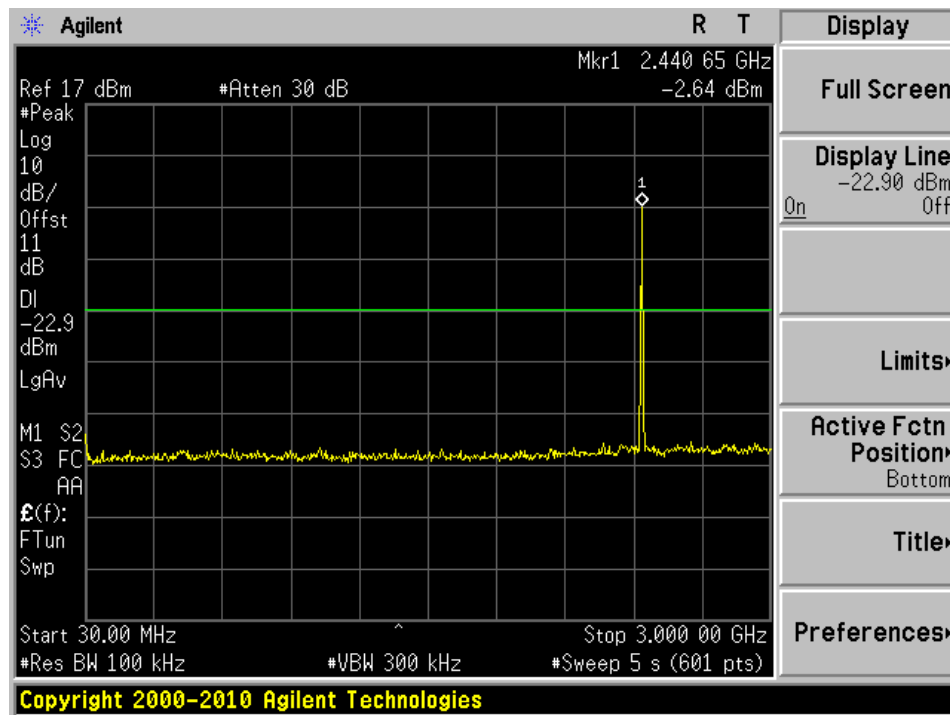
10.5 Test Results

Please refer to the following plots.

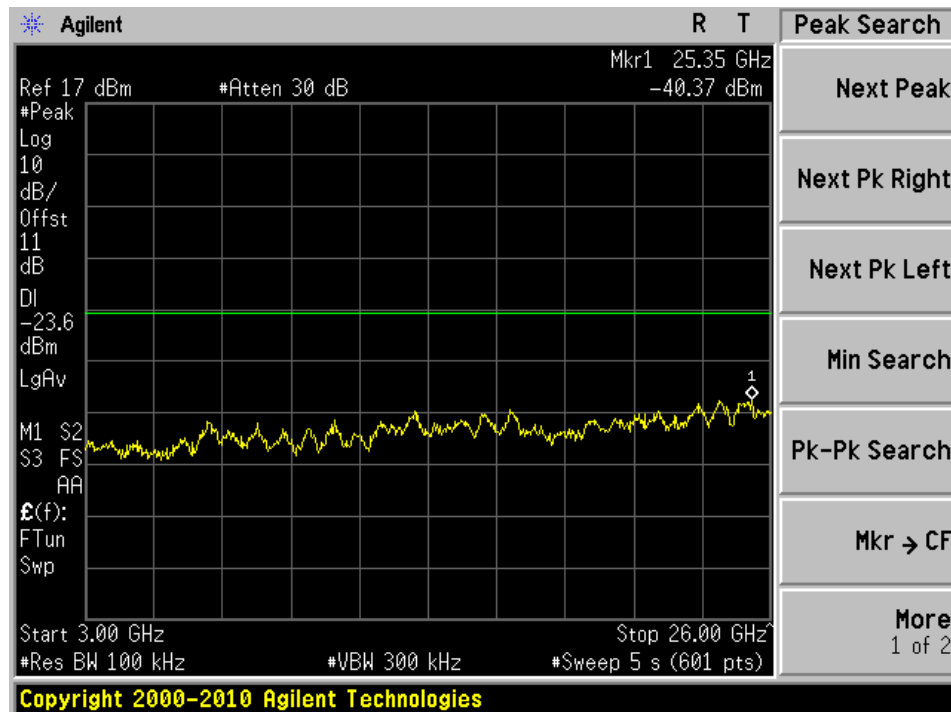
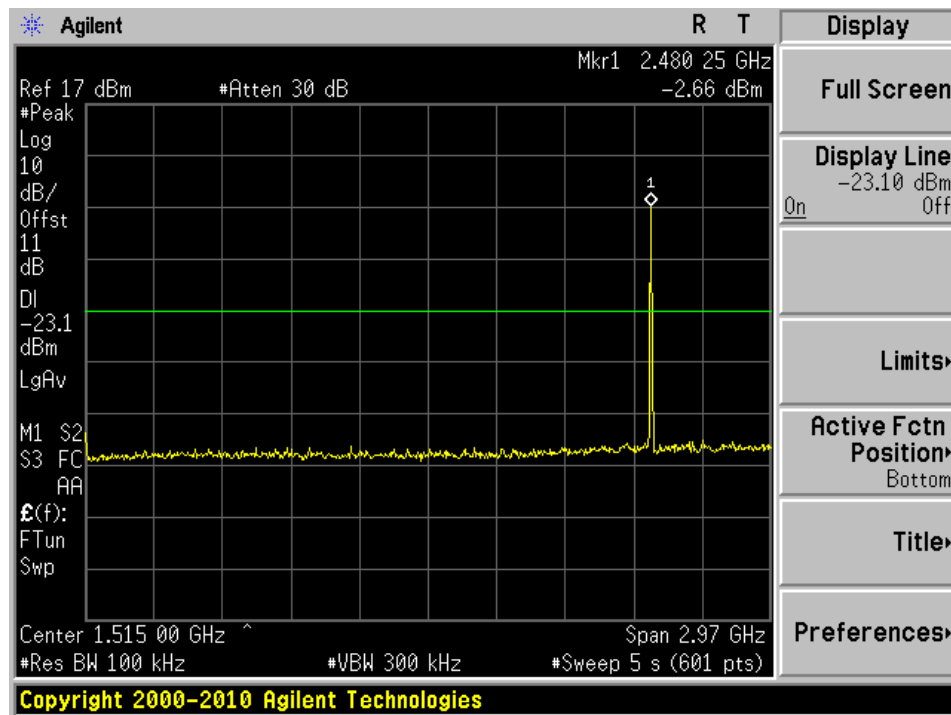
Low Channel



Middle Channel



High Channel



11 IC RSS-210 §2.5 & IC RSS-Gen §6 - Receiver Radiated Spurious Emissions

11.1 Applicable Standards

IC RSS-210 §2.5, IC RSS-Gen §6

11.2 EUT Setup

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

11.3 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.

11.4 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) 23.5 dB + Cable Loss (CL) 3.7 dB + Attenuator (Atten) 10 dB - Amplifier Gain (Ga) 29.4 dB

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

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

11.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
A.H Systems	Antenna, Horn	SAS-200/571	261	2012-01-18
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2011-06-09
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2011-08-10
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2011-03-21
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Agilent	Spectrum Analyzer	E4446A	US44300386	2011-08-11
Mini-Circuits	Pre-amplifier	ZVA-183-S	667400960	2011-05-08

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

11.6 Test Environmental Conditions

Temperature:	20-22 °C
Relative Humidity:	30-34 %
ATM Pressure:	101.5kPa

The testing was performed by Lionel Lara on 2012-02-21 in 5 meter chamber #3.

11.7 Summary of Test Results

According to the test data,, the EUT complied with the FCC Part 15.109 and IC RSS-Gen, with the closest margins from the limit listed below:

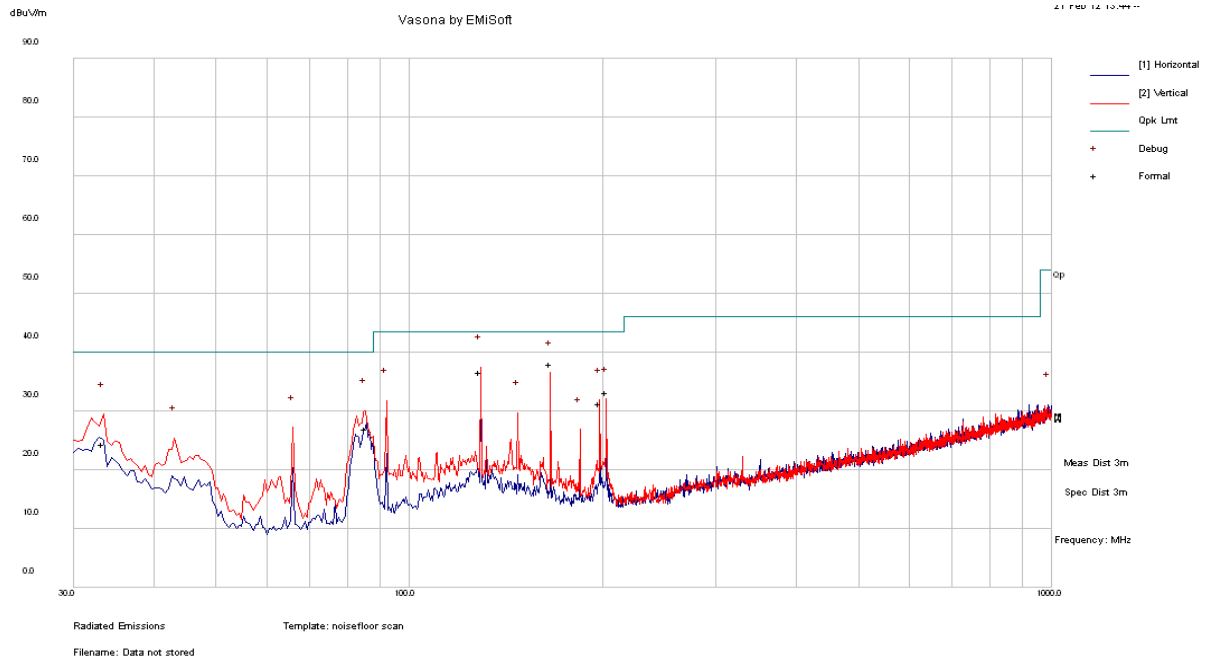
Mode: Receiving			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Range (MHz)
-5.24	165.8640	Vertical	30 MHz to 1000 MHz
_1	-	-	-

Note 1: Spurious emissions at noise floor level.

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

11.8 Test Results

1) 30 MHz -1 GHz, measured at 3 meters



Frequency (MHz)	Corrected Amplitude (dB)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dB μ V/m)	Margin (dB)
165.8640	37.98	101	V	327	43.5	-5.24
129.0436	36.65	157	V	132	43.5	-7.38
202.7177	33.2	116	V	11	43.5	-9.62
197.9661	31.38	247	V	266	43.5	-12.65
85.5144	26.96	265	V	0	40	-13.79
33.3284	24.37	226	V	210	40	-14.97

2) 1 – 25 GHz, measured at 3 meters

Frequency (MHz)	S.A. Reading (dB μ V)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dB μ V/m)	IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dB μ V/m)	Margin (dB)	
_1	-	-	-	-	-	-	-	-	-	-	-

Note 1: Spurious emissions at noise floor level.

12 FCC §15.247(i), § 2.1091 & IC RSS-102 - RF Exposure Information

12.1 Applicable Standards

According to FCC §15.247(i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm 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 x 10 ⁻⁴ f ^{0.5}	6.67 x 10 ⁻⁵ f	616000 / f ^{1.2}

Note: f is frequency in MHz

* Power density limit is applicable at frequencies greater than 100 MHz

12.2 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

12.3 MPE Results

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>2.92</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>1.56</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>2405</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>0.55</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.14</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.0004</u>
<u>Power density of prediction frequency at 20.0 cm (W/m²):</u>	<u>0.04</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (W/m²):</u>	<u>10</u>

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0004 mW/cm² (0.004 W/m²), Limit is 1 mW/cm² (10 W/m²).