FCC PART 15 SUBPART C

TEST AND MEASUREMENT REPORT

For

Streetline Inc.

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Foster City, CA 94404, USA

FCC ID: V2ISL-SPS

Report Type:	**Product Type:**
Original Report	Wireless Surfacemount Vehicle Sensor

Prepared By	Chen Ge Test Engineer
Report Number	R1303184-247
Report Date	2014-09-19
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1303184-247	Original Report	2014-09-19

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Streetline Inc*., and their product model: SL-SPS , FCC ID: V2ISL-SPS, or the "EUT" as referred to in this report. The EUT is a wireless surfacemount vehicle sensor operates in 2.4 GHz ISM band.

1.2 Mechanical Description of EUT

The EUT measures approximately 13.8 cm (L) x 13.0 cm (W) x 2.4 cm (H) and weighs 414.9 g.

The test data gathered are from typical production sample, model number: SL-SPS assigned by Client.

1.3 Objective

This report is prepared on behalf of *Streetline Inc*. in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commissions rules.

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

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz and ANSI C63.10-2009, American National Standard for Testing Unlicensed Wireless Devices.

1.6 Measurement Uncertainty

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

The following calculation follows the procedures as set forth in clause 7.2.3, ETSI TR 100 028-1 V1.4.1 (2001-12), the expression of Uncertainty in Radiated RF Testing is in accordance to ISO/IEC 17025 and TR 100 028-1 V1.4.1 (2001-12).

The expanded Measurement Uncertainty value having a confidence factor of 95%, is  nge of 5.48 dB.

This means that the value of conducted RF carrier power test will be within +/- 2.74 dB of the measuring radiated emissions power versus the expected value.

The expected value is defined as the power at the antenna of the Transmitter under Test.

1.7 Test Facility

Bay area compliance Laboratories Corp. (BACL) is:
1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminares and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to **ISO Guide 65: 1996** by **A2LA** to certify:
1- Unlicensed, Licensed radio frequency devices and Telephone Terminal Equipment for the FCC. Scope A1, A2, A3, A4, B1, B2, B3, B4 & C.
2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
3. Radio Communication Equipment for Singapore.
4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s),Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

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 C63.4-2009, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

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

2 System Test Configuration

2.1 Justification

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

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

2.2 EUT Exercise Software

N/A

2.3 Special Equipment

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

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

N/A

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
Streetline, Inc.	Main board	SL-SPS	-

2.7 Interface Ports and Cables

N/A

3 Summary of Test Results

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
§15.247(i), §2.1091	RF Exposure	Compliant
§15.203	Antenna Requirement	Compliant
§15.207(a)	AC Line Conducted Emissions	N/A[1]
§15.247 (d)	Spurious Emissions at Antenna Port	N/A[2]
§15.209, §15.247(d), §15.205	Radiated Spurious Emissions Including Restricted Bands	Compliant
§15.247(a)(2)	6 dB Emission Bandwidth	Compliant
§15.247(b)(3)	Maximum Peak Output Power	Compliant
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
§15.247(e)	Power Spectral Density	Compliant

Note: N/A[1]: The device is only for battery powered.
N/A[2]: The device has no antenna port; all tests are performed by radiated method.

4 FCC §15.247 (i) & §2.1091 - RF Exposure

4.1 Applicable Standard

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

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* (100)	30
1.34-30	824/f	2.19/f	* ($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

4.2 MPE Prediction

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

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

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

4.3 MPE Results

Maximum peak output power at antenna input terminal (dBm):	16.79
Maximum peak output power at antenna input terminal (mW):	47.75
Prediction distance (cm):	20
Prediction frequency (MHz):	2440
Maximum Antenna Gain, typical (dBi):	0
Maximum Antenna Gain (numeric):	1.0
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0095
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure.

5 FCC §15.203 - Antenna Requirements

5.1 Applicable Standard

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

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

5.2 Antenna List

Frequency	Antenna Type	Antenna Gain (dBi)
2.4 GHz	Integrated	0

6 FCC §15.205, §15.209 & §15.247(d) - Spurious Radiated Emissions

6.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	960 – 1240	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5. 35 – 5. 46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52480 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 –167.17	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).

6.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.4-2003. The specification used was the FCC 15 Subpart C limits.

6.3 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

6.4 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

6.5 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	2013-08-15	1 year
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2013-06-09	1 year
WiseWave	Horn Antenna	ARH-4223-02	10555-01	2012-08-09	3 Years
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2013-06-12	1 year
Agilent	Spectrum Analyzer	E4440A	US42221851	2014-02-28	1 year
EMCO	Horn Antenna	3115	9511-4627	2013-10-17	1 year
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2014-03-22	1 year

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

6.6 Test Environmental Conditions

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

The testing was performed by Chen Ge on 2014-05-08 at 5m chamber 3.

6.7 Summary of Test Results

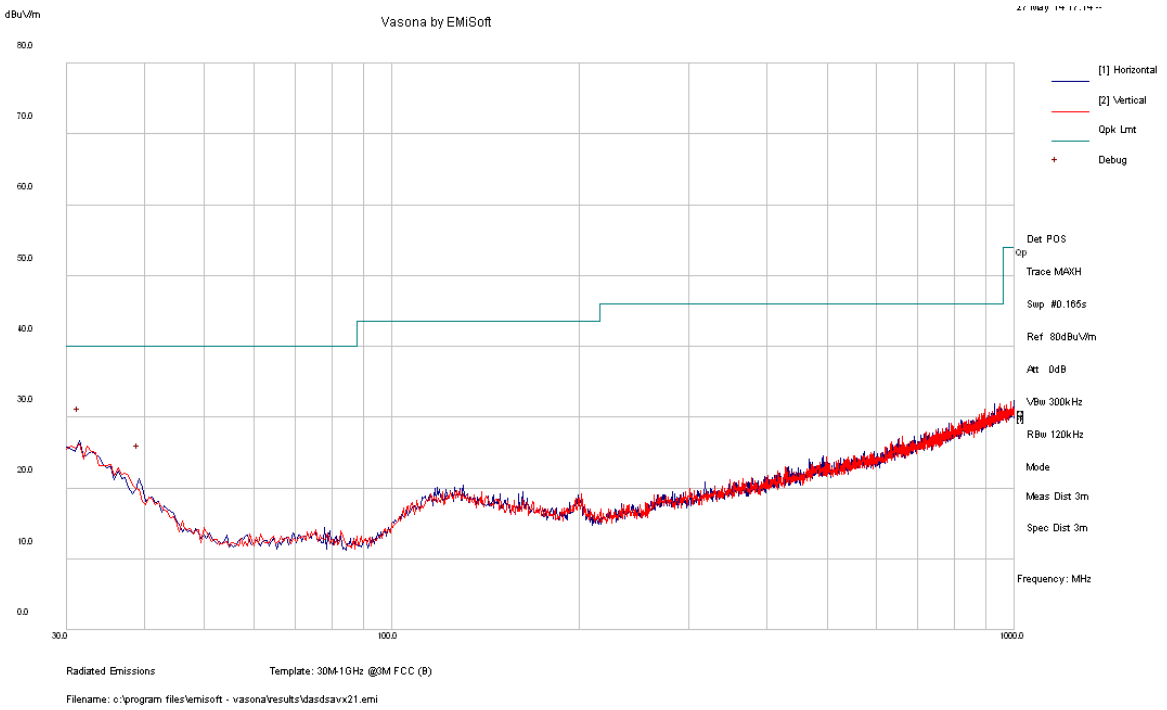
According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15C standard's radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel/Frequency Range**
-22.62	31.455	Horizontal	Low CH/30-1000 MHz
-15.21	7425	Vertical	High CH/1 – 25 GHzl

Please refer to the following table for specific test result details

6.8 Radiated Emissions Test Data and Plots

1) 30-1000 MHz, measured at 3 meters distance Low Channel, worst case.



Frequency (MHz)	Corrected Amplitude (dBuV)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBuV)	Margin (dB)	Detector (PK/QP/Ave)
31.455	17.38	241	H	125	40	-22.62	QP
39.215	11.14	121	H	30	40	-28.86	QP

2) 1 – 25 GHz, measured at 3 meters distance

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2405 MHz, measured at 3 meters											
2405	77.9	65	100	V	28.956	3.12	-	109.976	-	-	Peak
2405	69.26	100	135	H	28.956	3.12	-	101.336	-	-	Peak
2405	57.62	62	100	V	28.956	3.12	-	89.696	-	-	Ave
2405	57.68	101	135	H	28.956	3.12	-	89.756	-	-	Ave
2390	48.422	0	100	V	28.192	3.12	34.29	45.444	74	-28.556	Peak
2390	48.181	0	100	H	28.192	3.12	34.29	45.203	74	-28.797	Peak
2390	34.047	0	100	V	28.192	3.12	34.29	31.069	54	-22.931	Ave
2390	34.066	0	100	H	28.192	3.12	34.29	31.088	54	-22.912	Ave
4810	45.326	0	100	V	33.097	4.56	34.29	48.693	74	-25.307	Peak
4810	45.238	0	100	H	33.097	4.56	34.29	48.605	74	-25.395	Peak
4810	30.709	0	100	V	33.097	4.56	34.29	34.076	54	-19.924	Ave
4810	30.707	0	100	H	33.097	4.56	34.29	34.074	54	-19.926	Ave
7215	45.313	0	100	V	35.928	5.49	34.39	52.341	89.976	-37.635	Peak
7215	45.392	0	100	H	35.928	5.49	34.39	52.42	81.336	-28.916	Peak
7215	30.877	0	100	V	35.928	5.49	34.39	37.905	69.696	-31.791	Ave
7215	30.89	0	100	H	35.928	5.49	34.39	37.918	69.756	-31.838	Ave
9620	46.122	0	100	V	37.954	6.54	34.9	55.716	89.976	-34.26	Peak
9620	46.701	0	100	H	37.954	6.54	34.9	56.295	81.336	-25.041	Peak
9620	31.463	0	100	V	37.954	6.54	34.9	41.057	69.696	-28.639	Ave
9620	31.493	0	100	H	37.954	6.54	34.9	41.087	69.756	-28.669	Ave
Middle Channel 2440 MHz, measured at 3 meters											
2440	79.97	215	100	V	28.956	3.12	-	112.046	-	-	Peak
2440	73.28	162	100	H	28.956	3.12	-	105.356	-	-	Peak
2440	58.47	215	100	V	28.956	3.12	-	90.546	-	-	Ave
2440	58.69	162	100	H	28.956	3.12	-	90.766	-	-	Ave
4880	45.368	0	100	V	33.327	4.54	34.29	48.945	74	-25.055	Peak
4880	46.065	0	100	H	33.327	4.54	34.29	49.642	74	-24.358	Peak
4880	30.558	0	100	V	33.327	4.54	34.29	34.135	54	-19.865	Ave
4880	30.561	0	100	H	33.327	4.54	34.29	34.138	54	-19.862	Ave
7320	45.481	0	100	V	36.369	5.57	34.39	53.03	74	-20.97	Peak
7320	45.347	0	100	H	36.369	5.57	34.39	52.896	74	-21.104	Peak
7320	30.58	0	100	V	36.369	5.57	34.39	38.129	54	-15.871	Ave
7320	30.615	0	100	H	36.369	5.57	34.39	38.164	54	-15.836	Ave
9760	47.16	0	100	V	38.287	6.62	34.9	56.967	92.046	-35.079	Peak
9760	46.318	0	100	H	38.287	6.62	34.9	56.125	85.356	-29.231	Peak
9760	31.368	0	100	V	38.287	6.62	34.9	41.175	70.546	-29.371	Ave
9760	31.42	0	100	H	38.287	6.62	34.9	41.227	70.766	-29.539	Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 2475 MHz, measured at 3 meters											
2475	77.96	165	100	V	29.155	3.25	-	110.365	-	-	Peak
2475	72.67	114	108	H	29.155	3.25	-	105.075	-	-	Peak
2475	57.65	165	100	V	29.155	3.25	-	90.055	-	-	Ave
2475	58.69	114	108	H	29.155	3.25	-	91.095	-	-	Ave
2483.5	45.368	0	100	V	29.155	3.25	34.29	43.483	74	-30.517	Peak
2483.5	46.232	0	100	H	29.155	3.25	34.29	44.347	74	-29.653	Peak
2483.5	31.787	0	100	V	29.155	3.25	34.29	29.902	54	-24.098	Ave
2483.5	31.803	0	100	H	29.155	3.25	34.29	29.918	54	-24.082	Ave
4950	45.762	0	100	V	33.327	4.52	34.29	49.319	74	-24.681	Peak
4950	45.301	0	100	H	33.327	4.52	34.29	48.858	74	-25.142	Peak
4950	30.885	0	100	V	33.327	4.52	34.29	34.442	54	-19.558	Ave
4950	30.927	0	100	H	33.327	4.52	34.29	34.484	54	-19.516	Ave
7425	44.795	0	100	V	36.565	5.62	34.39	52.59	74	-21.41	Peak
7425	45.24	0	100	H	36.565	5.62	34.39	53.035	74	-20.965	Peak
7425	30.995	0	100	V	36.565	5.62	34.39	38.79	54	-15.21	Ave
7425	30.968	0	100	H	36.565	5.62	34.39	38.763	54	-15.237	Ave
9900	44.513	0	100	V	38.287	6.55	34.9	54.45	88.225	-33.775	Peak
9900	45.818	0	100	H	38.287	6.55	34.9	55.755	90.605	-34.85	Peak
9900	31.228	0	100	V	38.287	6.55	34.9	41.165	85.235	-44.07	Ave
9900	31.236	0	100	H	38.287	6.55	34.9	41.173	87.905	-46.732	Ave

7 FCC §15.247(a)(2) - 6 dB Emission Bandwidth

7.1 Applicable Standard

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz

7.2 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.

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US42221851	2014-02-28	1 year
EMCO	Horn Antenna	3115	9511-4627	2013-10-17	1 year

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

7.4 Test Environmental Conditions

Temperature:	21 °C
Relative Humidity:	44 %
ATM Pressure:	101.6 kPa

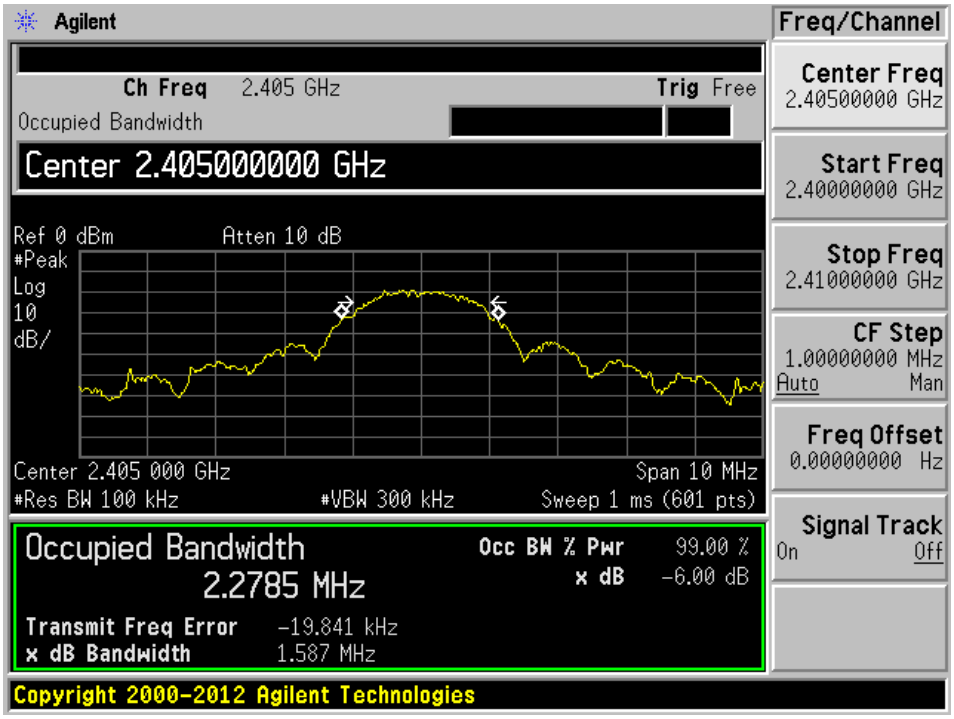
The testing was performed by Chen Ge on 2013-05-16 at RF site.

7.5 Test Results

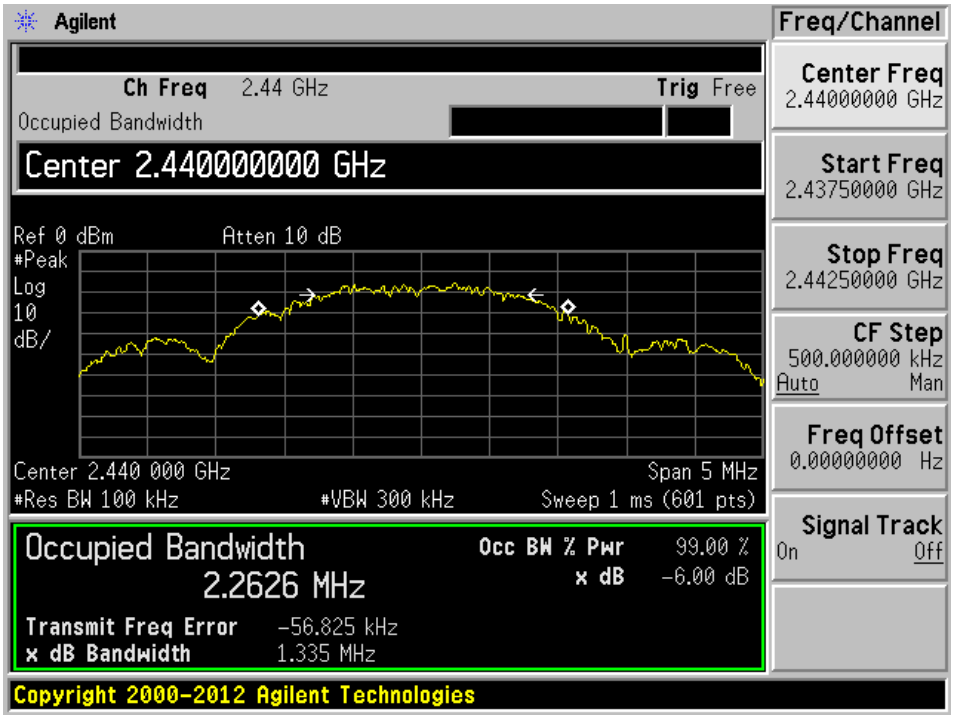
Channel	Frequency (MHz)	6 dB OBW (MHz)	99% OBW (MHz)	6 dB OBW Limit (MHz)	Results
Low	2405	1.587	2.2785	> 0.5	Compliant
Middle	2440	1.335	2.2626	> 0.5	Compliant
High	2475	1.511	2.2731	> 0.5	Compliant

Please refer to the following plots for detailed test results

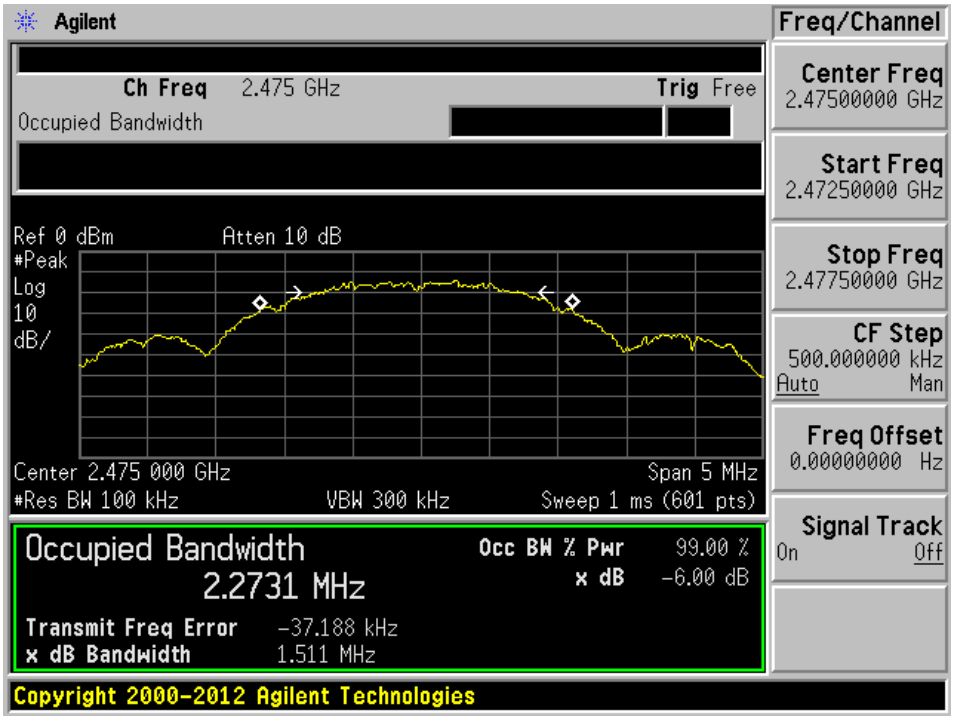
Low channel: 2405 MHz



Middle channel: 2440 MHz



High channel: 2475 MHz



8 FCC §15.247(b) - Peak Output Power Measurement

8.1 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.

8.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Fundamental emission output power, and ANSI C63.10-2009.

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US42221851	2014-02-28	1 year
EMCO	Horn Antenna	3115	9511-4627	2013-10-17	1 Year
Sunol Sciences	System Controller	SC104V	113005-1	N/A	N/A

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

8.4 Test Environmental Conditions

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

The testing was performed by Chen Ge on 2014-05-16 at 5m chamber 3.

8.5 Test Results

Frequency (MHz)	Radiated Reading (dBµV) @ 3m	Antenna Polarity (H/V)	Antenna Factor (dB/m)	Cable Loss (dB)	Cord. Radiated (dBµV/m) @ 3m	Antenna Gain (dBi)	Cord. EIRP (dBm)	Conducted Output Power (dBm)	FCC Limit (dBm)	Margin (dB)
2405	77.9	V	28.956	3.12	109.976	0	14.72	14.72	30	-15.28
2405	69.26	H	28.956	3.12	101.336	0	6.08	6.08	30	-23.92
2440	79.97	V	28.956	3.25	112.046	0	16.79	16.79	30	-13.21
2440	73.28	H	28.956	3.25	105.356	0	10.10	10.10	30	-19.9
2475	77.96	V	29.155	3.25	110.036	0	14.78	14.78	30	-15.22
2475	72.67	H	29.155	3.25	104.746	0	9.49	9.49	30	-20.51

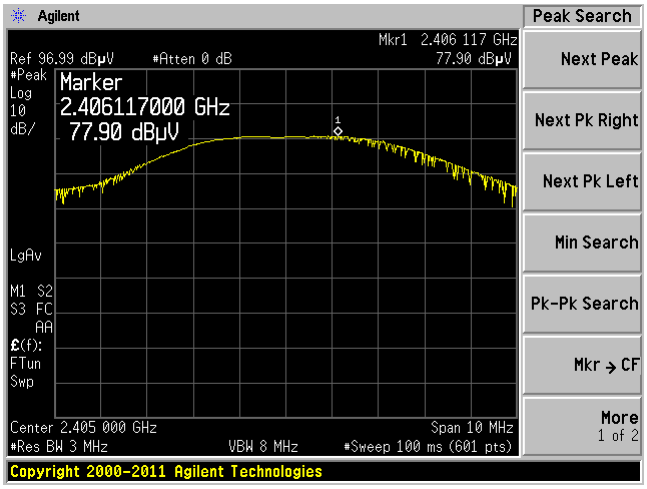
The field strength converts to conducted power should be as following:

E (dBµV/m)= EIRP [dBm] + 95.26 for the distance at 3 meters.

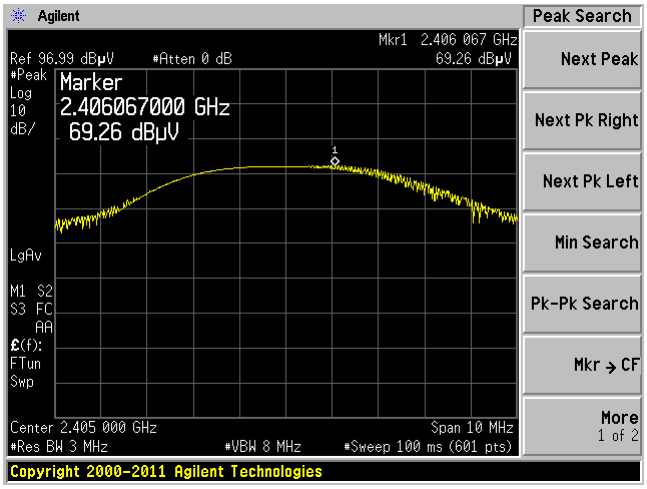
Please refer to the following plots:

Low channel: 2405 MHz

Vertical Polarity

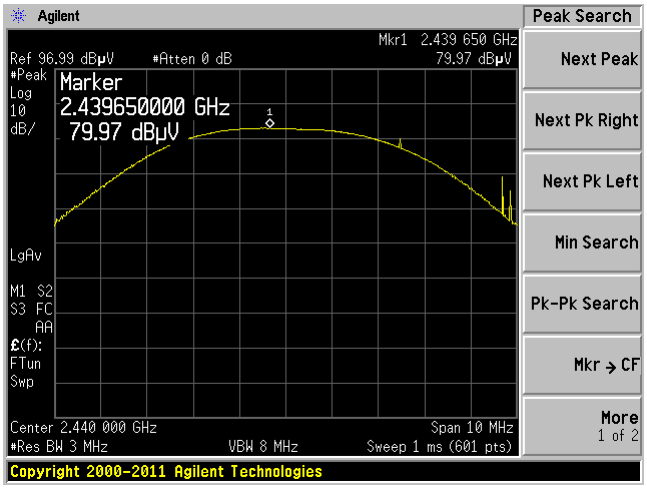


Horizontal Polarity

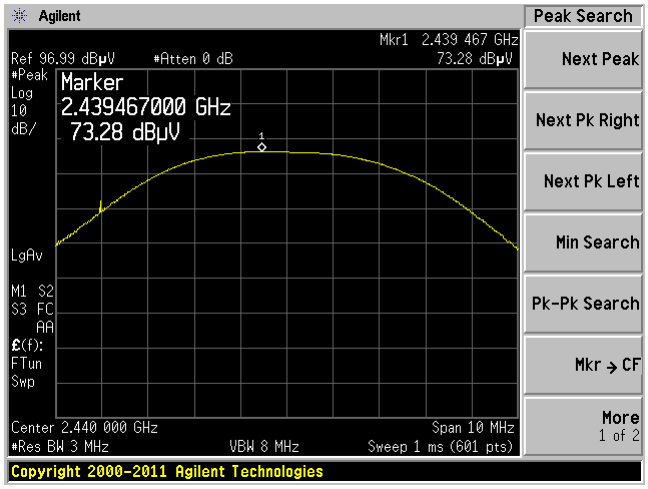


Middle channel: 2440 MHz

Vertical Polarity

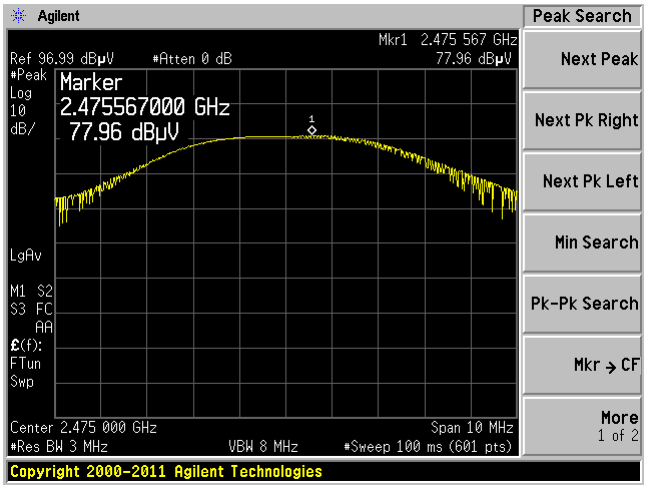


Horizontal Polarity

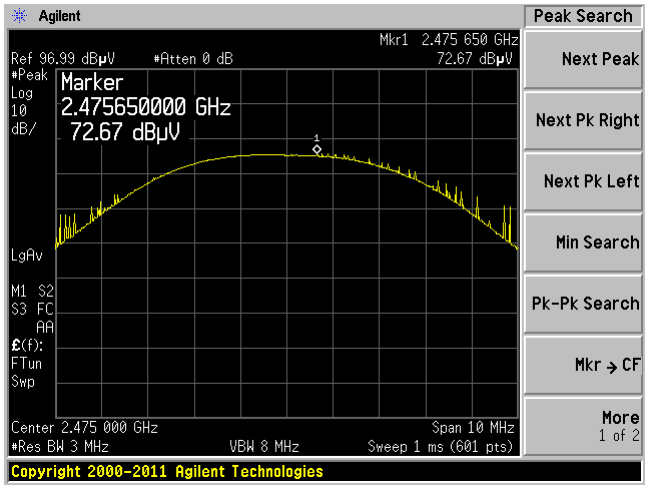


High channel: 2475 MHz

Vertical Polarity



Horizontal Polarity



9 FCC §15.247(d) - 100 kHz Bandwidth of Band Edges

9.1 Applicable Standard

According to §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)).

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 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.

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US42221851	2014-02-28	1 year
EMCO	Horn Antenna	3115	9511-4627	2013-10-17	1 Year

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

9.4 Test Environmental Conditions

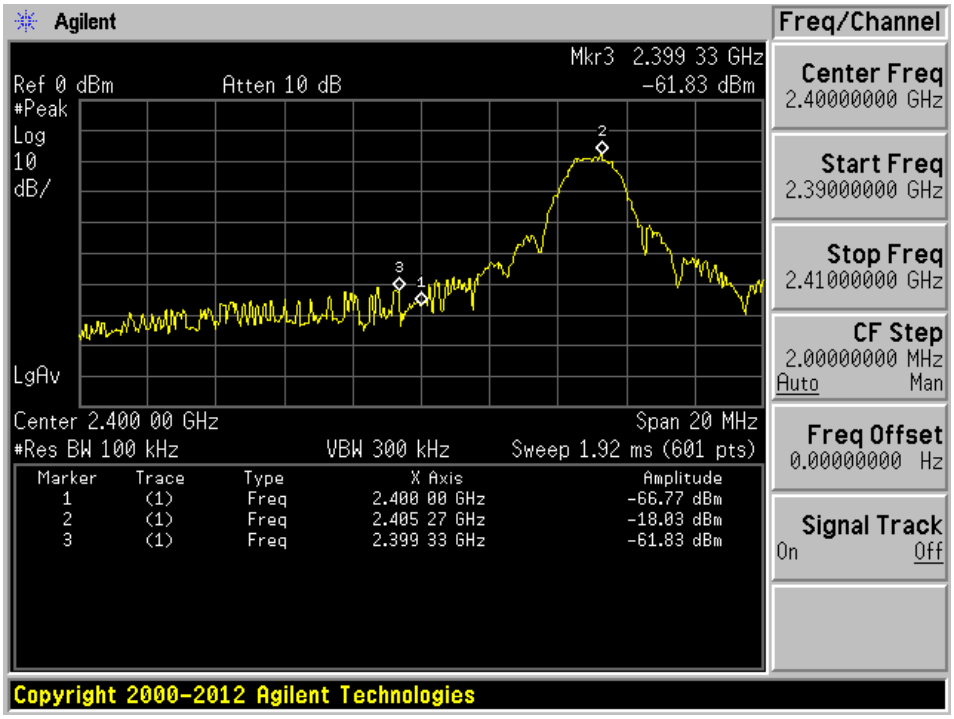
Temperature:	23°C
Relative Humidity:	42%
ATM Pressure:	102kPa

The testing was performed by Chen Ge on 2013-05-16 at RF site.

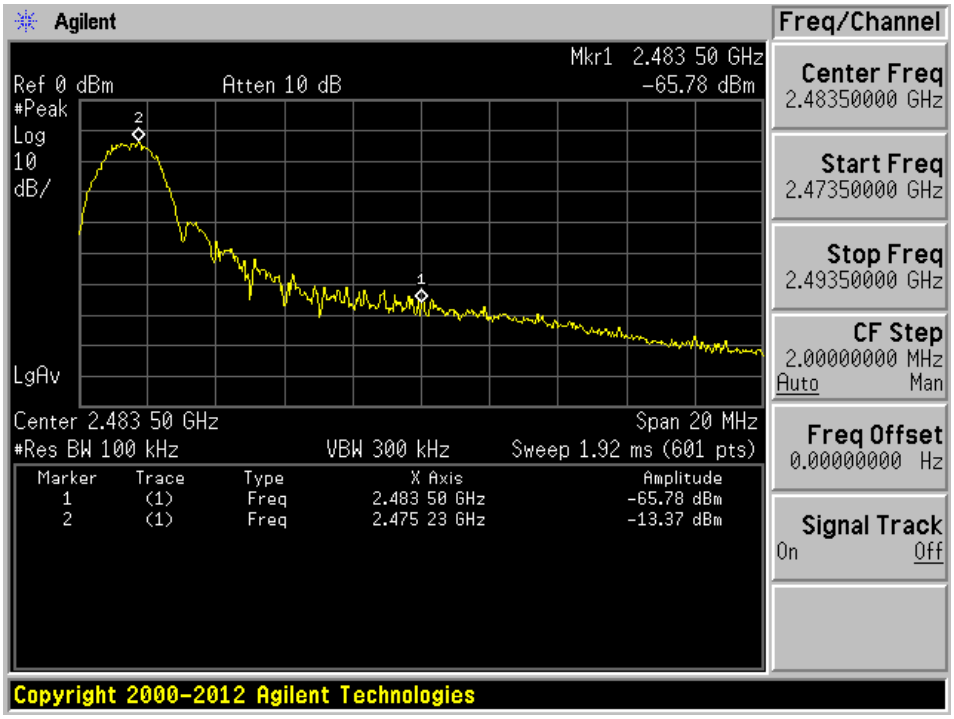
9.5 Test Results

Please refer to following plots of band edge.

Low Band Edge



High Band Edge



10 FCC §15.247(e) - Power Spectral Density

10.1 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.

10.2 Measurement Procedure

The measurements are base on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 10: Maximum power spectral density level in the fundamental emission, and ANSI C63.10 -2009.

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US42221851	2014-02-28	1 year
EMCO	Horn Antenna	3115	9511-4627	2013-10-17	1 Year
Sunol Sciences	System Controller	SC104V	113005-1	N/A	N/A

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

10.4 Test Environmental Conditions

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

The testing was performed by Chen Ge on 2014-05-16 at RF site.

10.5 Test Results

Frequency (MHz)	Radiated Reading (dBµV) @ 3m	Antenna Polarity (H/V)	Antenna Factor (dB/m)	Cable Loss (dB)	Cord. E-Field (dBµV/m) @ 3m	Antenna Gain (dBi)	Cord. PSD EIRP (dBm)	PSD (dBm)	FCC Limit (dBm)	Margin (dB)
2405	65.27	V	28.956	3.12	94.356	0	-0.90	-0.90	8	-8.9
2405	55.51	H	28.956	3.12	90.216	0	-5.04	-5.04	8	-13.04
2440	67.83	V	28.956	3.25	95.096	0	-0.16	-0.16	8	-8.16
2440	60.21	H	28.956	3.25	90.256	0	-5.00	-5.00	8	-13
2475	63.70	V	29.155	3.25	94.765	0	-0.49	-0.49	8	-8.49
2475	59.21	H	29.155	3.25	92.195	0	-3.06	-3.06	8	-11.06

The corrected Peak PSD was calculated from the formula:

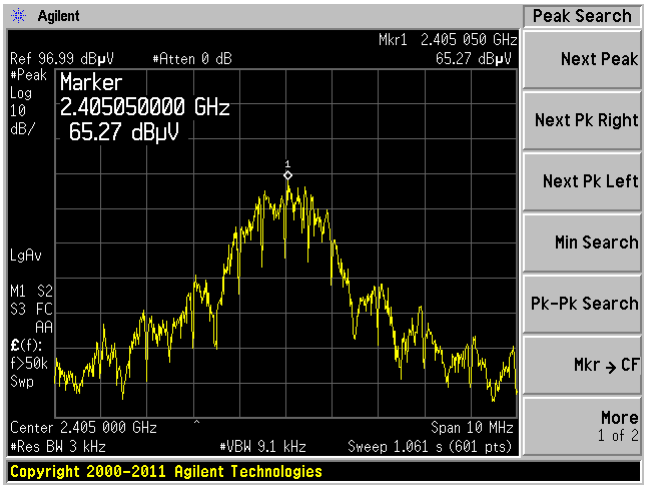
E = EIRP – 20log D + 104.8

Where: E = electric field strength in dBµV/m,
EIRP = equivalent isotropic radiated power in dBm
D = specified measurement distance in meters.

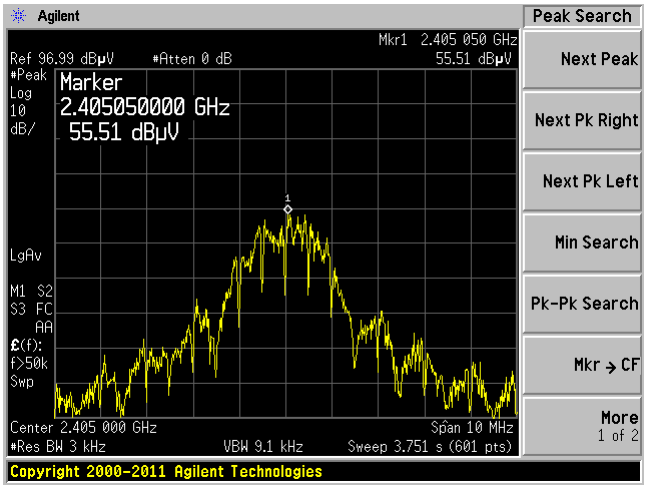
Please refer to the following plots for detailed test results:

Low channel: 2405 MHz

Vertical Polarity

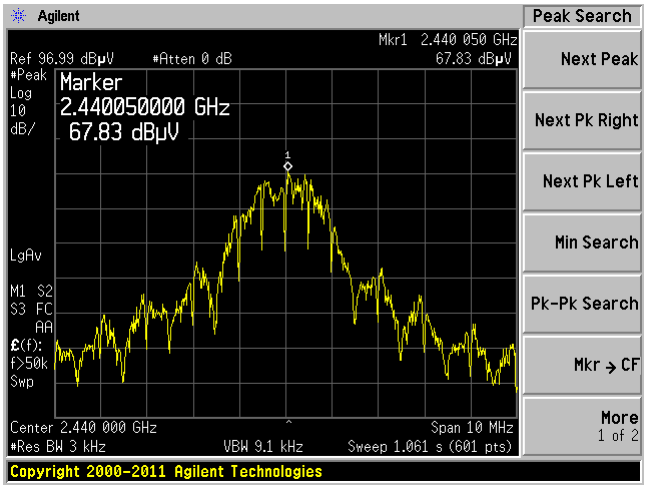


Horizontal Polarity

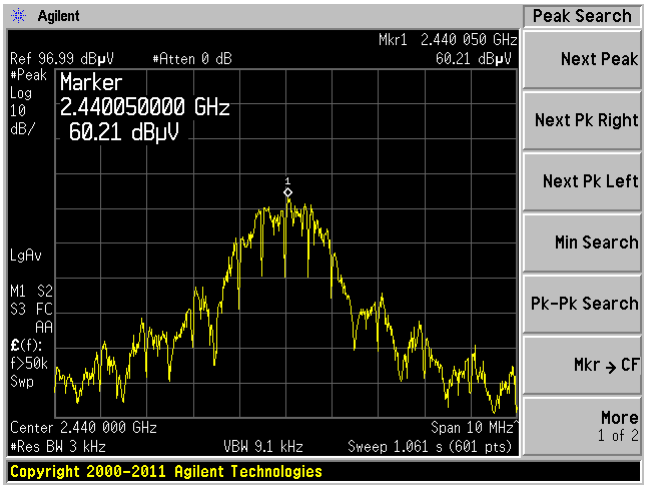


Middle channel: 2440 MHz

Vertical Polarity

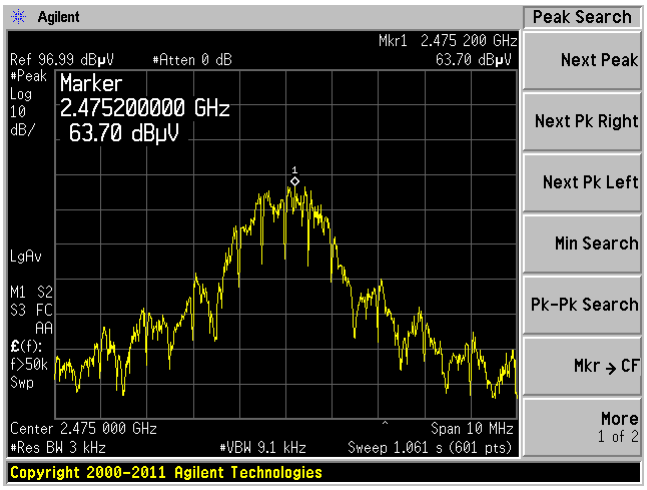


Horizontal Polarity



High channel: 2475 MHz

Vertical Polarity



Horizontal Polarity