FCC PART 15 SUBPART C

TEST AND MEASUREMENT REPORT

For

BlackBox Biometrics, Inc.

125 Tech Park Drive,

Rochester, New York 14623, USA

Model: Linx IAS
FCC ID: 2AHN8LIAS10

Report Type:	**Product Type:**
Original Report	BLE v4.0 Concussion Detection Sensor

Prepared By:	Chen Ge Testing Engineer
Report Number:	R1411103-247
Report Date::	2016-03-29
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1411103-247	Original Report	2015-01-29
1	R1411103-247 Rev 1	Updated FCC ID, header, label and section 12, 4.2, 6.6	2016-03-29

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *BlackBox Biometrics, Inc*. And their product model: Linx IAS, FCC ID: 2AHN8LIAS10 or the "EUT" as referred to in this report. The EUT is a BLE v4.0 concussion detection sensor.

1.2 Mechanical Description of EUT

The EUT measures approximately 3.1 cm (L) x 1.2 cm (W) x 0.3 cm (H) and weighs 5 g.

The test data gathered are from typical production sample, model number: E0000213 assigned by Client.

1.3 Objective

This report is prepared on behalf of *BlackBox Biometrics, 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 C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz and FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.

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 within a range 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 C63.10-2009, 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 C63.10-2009.

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

2.2 EUT Exercise Software

The test utility used was *FCC B3 Test Application* was provided by BlackBox Boimetrics, and was verified *Chen Ge* to comply with the standard requirements being tested against.

2.3 Special Equipment

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

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

N/A

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
TTM	Main board	M39A-0	4214

3 Summary of Test Results

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
FCC §15.247(i), §2.1093	RF Exposure	Compliant
FCC §15.203	Antenna Requirement	Compliant
FCC §15.207(a)	AC Line Conducted Emissions	Compliant
FCC §15.205, §15.209, §15.247 (d)	Radiated Spurious Emissions Including Restricted Bands	Compliant
FCC §15.247(a)(2)	6 dB Emission Bandwidth	Compliant
FCC §15.247(b)(3)	Maximum Peak Output Power	Compliant
FCC §15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e)	Power Spectral Density	Compliant

4 FCC §15.247 (i) & §2.1093 - RF Exposure

4.1 Applicable Standard

According to FCC §15.247(i) and §2.1093(d)(2), The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.

4.2 SAR evaluation guidance

According to KDB 447498 D01 General RF Exposure Guidance v06, section 4.3.1 (a):

For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR, where

- *f(GHz) is the RF channel transmit frequency in GHz*
- *Power and distance are rounded to the nearest mW and mm before calculation31*
- *The result is rounded to one decimal place for comparison*
- *The values 3.0 and 7.5 are referred to as numeric thresholds in step b) below*

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

4.3 SAR Evaluation Results

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR

Maximum conducted output power = -7.08 dBm = 0.196 mW

[0.196/5]*√2.48=0.06 which is less than 3.0, so the SAR testing is not required.

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 -2.5 GHz	SMD	4.4

5.3 Result

The antenna is with less 6 dBi gain; therefore, it complies with the antenna requirement.

6 FCC §15.207- AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 Conducted limits:

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

**Decreases with the logarithm of the frequency.*

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4-2009 measurement procedure. The specification used was FCC §15.207 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.

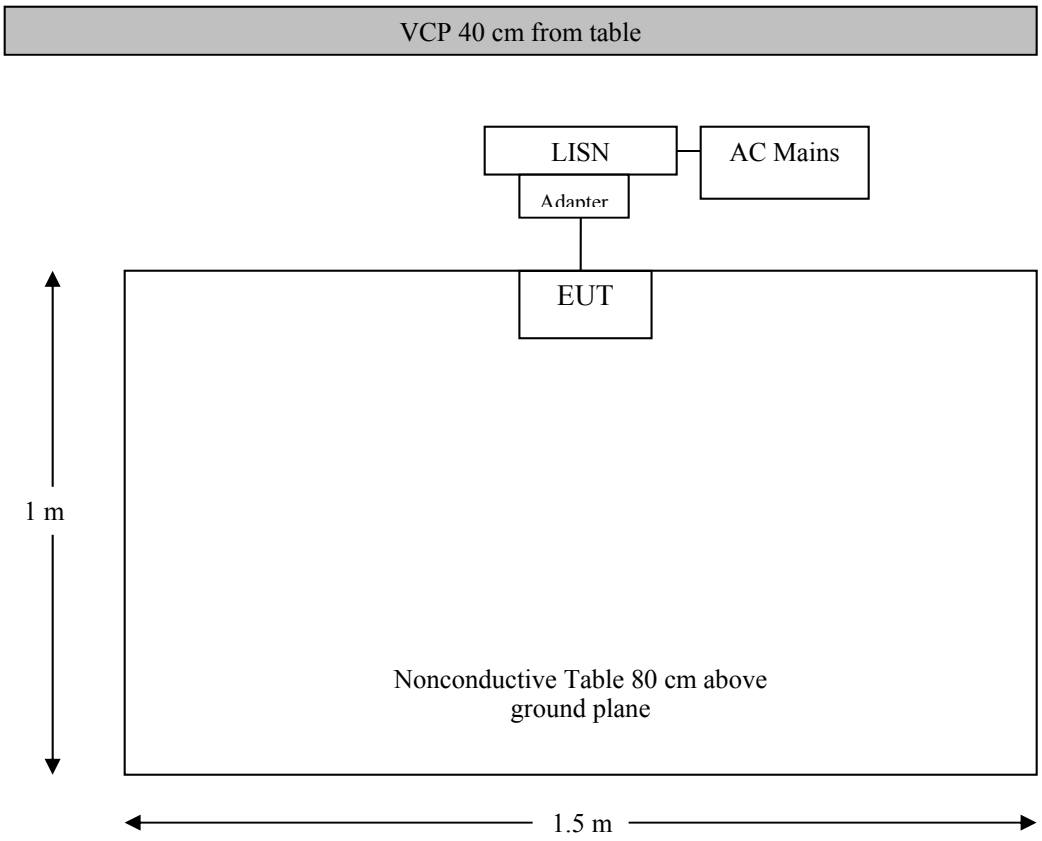
6.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-2.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the peak detection mode, quasi-peak and average. Quasi-Peak readings are distinguished with a “QP.” Average readings are distinguished with an “Ave”.

6.4 Test Setup Block Diagram



6.5 Corrected Amplitude & Margin Calculation

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

CA = Ai + CL + Atten

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Cable Loss (3.7 dB) + Attenuator (10 dB)

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

Margin = Corrected Amplitude - Limit

6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2014-03-28	1 year
Solar Electronics	LISN	9252-50-R-24-N	511205	2014-06-25	1 year
Solar Electronics	LISN	9252-50-R-24-N	511213	2014-06-25	1 year
TTE	Filter, High Pass	H9962-150K-50-21378	K7133	2014-05-30	1 year

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

6.7 Test Environmental Conditions

Temperature:	24 °C
Relative Humidity:	41 %
ATM Pressure:	101.21 kPa

The testing was performed by Chen Ge on 2014-12-13 at 5m chamber 3.

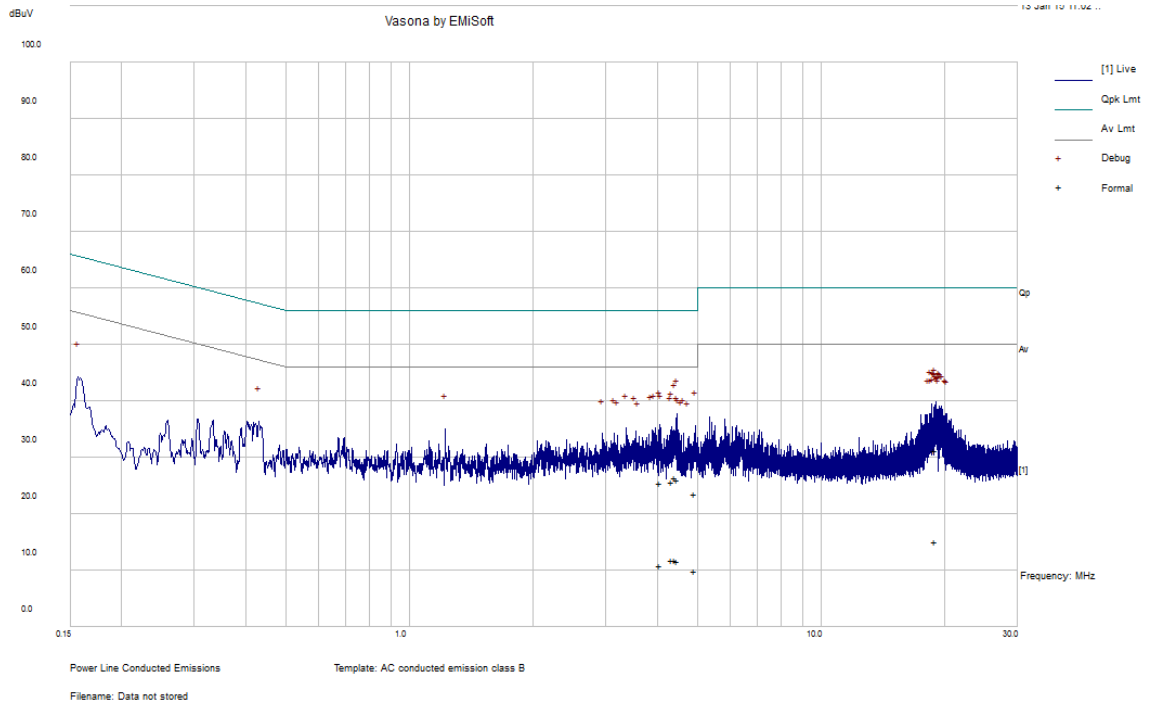
6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC standard's conducted emissions limits, with the margin reading of:

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-27.17	19.39077	Neutral	0.15-30

6.9 Conducted Emissions Test Plots and Data

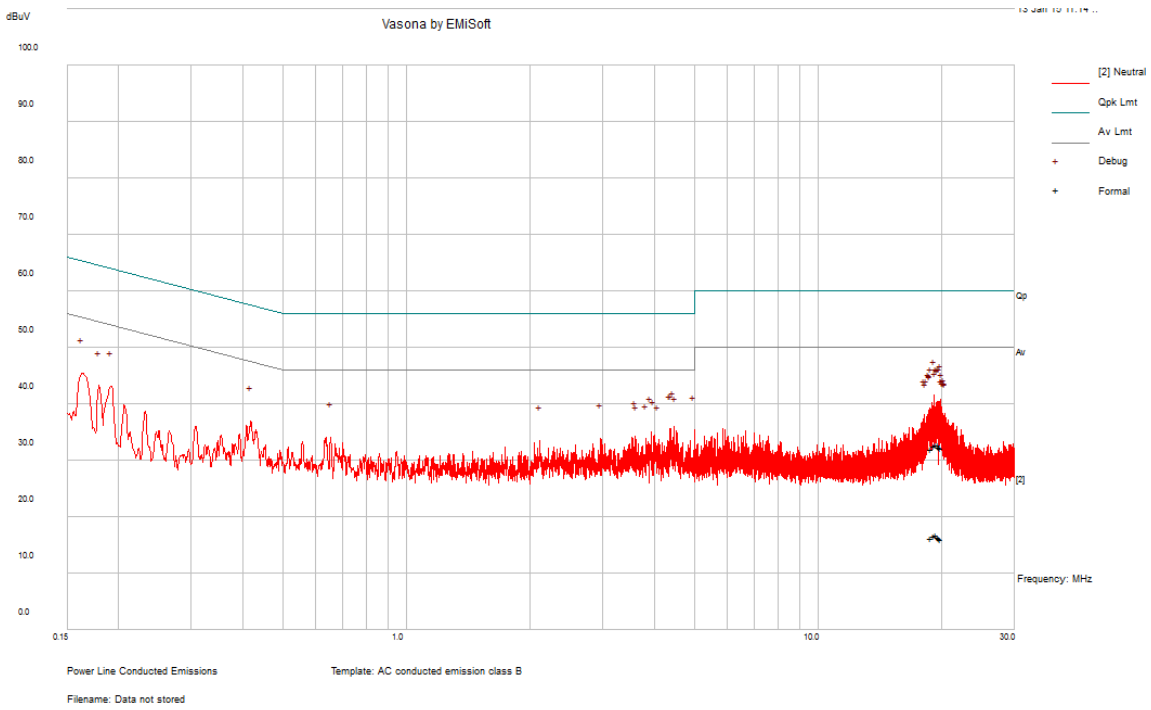
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
4.468919	26.13	Line	56	-29.87	QP
4.418099	26.47	Line	56	-29.53	QP
18.96919	31.25	Line	60	-28.75	QP
4.055639	25.47	Line	56	-30.53	QP
4.937765	23.55	Line	56	-32.45	QP
4.330853	25.68	Line	56	-30.32	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
4.468919	11.59	Line	46	-34.41	Ave.
4.418099	11.8	Line	46	-34.2	Ave.
18.96919	15.18	Line	50	-34.82	Ave.
4.055639	10.95	Line	46	-35.05	Ave.
4.937765	10.03	Line	46	-35.97	Ave.
4.330853	11.9	Line	46	-34.1	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
19.11652	32.63	Neutral	60	-27.37	QP
19.8226	32.22	Neutral	60	-27.78	QP
19.71838	32.43	Neutral	60	-27.57	QP
19.59568	32.78	Neutral	60	-27.22	QP
19.39077	32.83	Neutral	60	-27.17	QP
18.8442	32.04	Neutral	60	-27.96	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
19.11652	16.59	Neutral	50	-33.41	Ave.
19.8226	16.12	Neutral	50	-33.88	Ave.
19.71838	16.35	Neutral	50	-33.65	Ave.
19.59568	16.56	Neutral	50	-33.44	Ave.
19.39077	16.79	Neutral	50	-33.21	Ave.
18.8442	16.23	Neutral	50	-33.77	Ave.

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

7.1 Applicable Standard

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

As per FCC §15.209(a) and RSS-210: Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

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

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

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

MHz	MHz	MHz	GHz
0.090 – 0.110 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

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).

7.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.4-2009. The specification used was the FCC 15 Subpart C limits.

7.3 Test Procedure

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

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

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

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

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

Above 1000 MHz:

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

7.4 Corrected Amplitude & Margin Calculation

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

CA = Ai + AF + CL + Atten – Ga

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

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

Margin = Corrected Amplitude - Limit

7.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2014-08-15	1 year
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2014-06-09	1 year
WiseWave	Horn Antenna	ARH-4223-02	10555-01	2012-08-09	3 Years
Agilent	Pre-amplifier	8449B	3008A01978	2014-02-04	1 year
Agilent	Spectrum Analyzer	E4440A	US42221851	2014-02-28	1 year
EMCO	Horn Antenna	3115	9511-4627	2014-10-17	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.*

7.6 Test Environmental Conditions

Temperature:	20-24° C
Relative Humidity:	41-45 %
ATM Pressure:	101-102 kPa

The testing was performed by Chen Ge on 2014-12-03 to 2014-12-05 at 5m chamber 3.

7.7 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:

30-1000 MHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel**
-11.86	105.73	Vertical	Low Channel

1- 25 GHz:

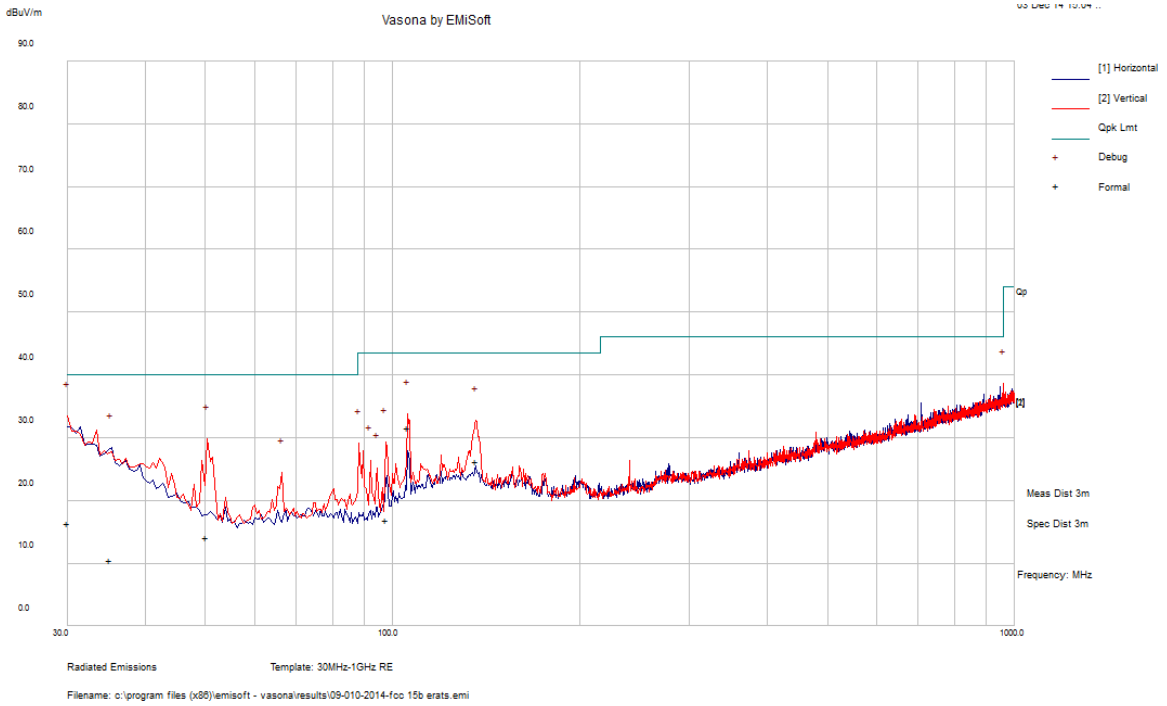
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel**
-9.426	2483.5	Horizontal	High Channel

Please refer to the following table for specific test result details

7.8 Radiated Emissions Test Data and Plots

1) 30-1000 MHz

Measured at 3 meters distance Low Channel, worst case.



Frequency (MHz)	Corrected Amplitude (dBuV)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBuV)	Margin (dB)
30.011	16.48	252	V	276	40	-23.52
105.73	31.64	108	V	32	43.5	-11.86
50.16625	14.2	100	V	256	40	-25.8
136.182	26.19	100	V	103	43.5	-17.31
35.13925	10.54	225	H	212	40	-29.46
97.62975	17	120	V	287	43.5	-26.5

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 2402 MHz, measured at 3 meters											
2402	60.52	230	100	V	28.331	2.91	0	91.761	-	-	Peak
2402	60.46	244	137	H	28.331	2.91	0	91.701	-	-	Peak
2402	59.83	230	100	V	28.331	2.91	0	91.071	-	-	Ave
2402	59.79	244	137	H	28.331	2.91	0	91.031	-	-	Ave
2390	26.24	0	100	V	28.331	2.91	0	57.481	74	-16.519	Peak
2390	26.85	0	100	H	28.331	2.91	0	58.091	74	-15.909	Peak
2390	13.07	0	100	V	28.331	2.91	0	44.311	54	-9.689	Ave
2390	13.28	0	100	H	28.331	2.91	0	44.521	54	-9.479	Ave
4804	43.69	0	100	V	32.897	4.42	34.29	46.717	74	-27.283	Peak
4804	43.14	0	100	H	32.897	4.42	34.29	46.167	74	-27.833	Peak
4804	30.74	0	100	V	32.897	4.42	34.29	33.767	54	-20.233	Ave
4804	30.45	0	100	H	32.897	4.42	34.29	33.477	54	-20.523	Ave
7206	43.85	0	100	V	35.703	5.41	34.39	50.573	71.761	-21.188	Peak
7206	43.25	0	100	H	35.703	5.41	34.39	49.973	71.701	-21.728	Peak
7206	30.24	0	100	V	35.703	5.41	34.39	36.963	71.071	-34.108	Ave
7206	30.36	0	100	H	35.703	5.41	34.39	37.083	71.031	-33.948	Ave
9608	43.87	0	100	V	37.85	6.24	34.9	53.06	71.761	-18.701	Peak
9608	43.25	0	100	H	37.85	6.24	34.9	52.44	71.701	-19.261	Peak
9608	30.47	0	100	V	37.85	6.24	34.9	39.66	71.071	-31.411	Ave
9608	30.25	0	100	H	37.85	6.24	34.9	39.44	71.031	-31.591	Ave
Middle Channel 2440 MHz, measured at 3 meters											
2440	58.81	232	100	V	28.331	2.91	0	90.051	-	-	Peak
2440	60.65	247	131	H	28.331	2.91	0	91.891	-	-	Peak
2440	58.12	232	100	V	28.331	2.91	0	89.361	-	-	Ave
2440	59.97	247	131	H	28.331	2.91	0	91.211	-	-	Ave
4880	43.58	0	100	V	32.897	4.42	34.29	46.607	74	-27.393	Peak
4880	43.22	0	100	H	32.897	4.42	34.29	46.247	74	-27.753	Peak
4880	30.47	0	100	V	32.897	4.42	34.29	33.497	54	-20.503	Ave
4880	30.38	0	100	H	32.897	4.42	34.29	33.407	54	-20.593	Ave
7320	43.88	0	100	V	36.213	5.41	34.39	51.113	74	-22.887	Peak
7320	43.24	0	100	H	36.213	5.41	34.39	50.473	74	-23.527	Peak
7320	30.25	0	100	V	36.213	5.41	34.39	37.483	54	-16.517	Ave
7320	30.47	0	100	H	36.213	5.41	34.39	37.703	54	-16.297	Ave
9760	43.69	0	100	V	37.909	6.24	34.9	52.939	70.051	-17.112	Peak
9760	43.12	0	100	H	37.909	6.24	34.9	52.369	71.891	-19.522	Peak
9760	30.47	0	100	V	37.909	6.24	34.9	39.719	69.361	-29.642	Ave
9760	30.69	0	100	H	37.909	6.24	34.9	39.939	71.211	-31.272	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 2480 MHz, measured at 3 meters											
2480	59.85	206	100	V	28.394	2.91	0	91.154	-	-	Peak
2480	61.07	243	123	H	28.394	2.91	0	92.374	-	-	Peak
2480	59.07	206	100	V	28.394	2.91	0	90.374	-	-	Ave
2480	60.34	243	123	H	28.394	2.91	0	91.644	-	-	Ave
2483.5	26.13	0	100	V	28.394	2.91	0	57.434	74	-16.566	Peak
2483.5	26.47	0	100	H	28.394	2.91	0	57.774	74	-16.226	Peak
2483.5	13.16	0	100	V	28.394	2.91	0	44.464	54	-9.536	Ave
2483.5	13.27	0	100	H	28.394	2.91	0	44.574	54	-9.426	Ave
4960	43.38	0	100	V	33.2	4.29	34.29	46.58	74	-27.42	Peak
4960	43.29	0	100	H	33.2	4.29	34.29	46.49	74	-27.51	Peak
4960	30.43	0	100	V	33.2	4.29	34.29	33.63	54	-20.37	Ave
4960	30.87	0	100	H	33.2	4.29	34.29	34.07	54	-19.93	Ave
7440	43.05	0	100	V	36.354	5.51	34.39	50.524	74	-23.476	Peak
7440	43.17	0	100	H	36.354	5.51	34.39	50.644	74	-23.356	Peak
7440	30.13	0	100	V	36.354	5.51	34.39	37.604	54	-16.396	Ave
7440	30.14	0	100	H	36.354	5.51	34.39	37.614	54	-16.386	Ave
9920	42.99	0	100	V	38.264	6.34	34.9	52.694	71.154	-18.46	Peak
9920	43.47	0	100	H	38.264	6.34	34.9	53.174	72.374	-19.2	Peak
9920	30.36	0	100	V	38.264	6.34	34.9	40.064	70.374	-30.31	Ave
9920	30.25	0	100	H	38.264	6.34	34.9	39.954	71.644	-31.69	Ave

8 FCC§15.247(a)(2) - 6 dB & 99% Emission Bandwidth

8.1 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

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 8: DTS bandwidth

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
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
EMCO	Horn Antenna	3115	9511-4627	2014-10-17	1 year

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

8.4 Test Environmental Conditions

Temperature:	20-24 °C
Relative Humidity:	41-45 %
ATM Pressure:	101-102 kPa

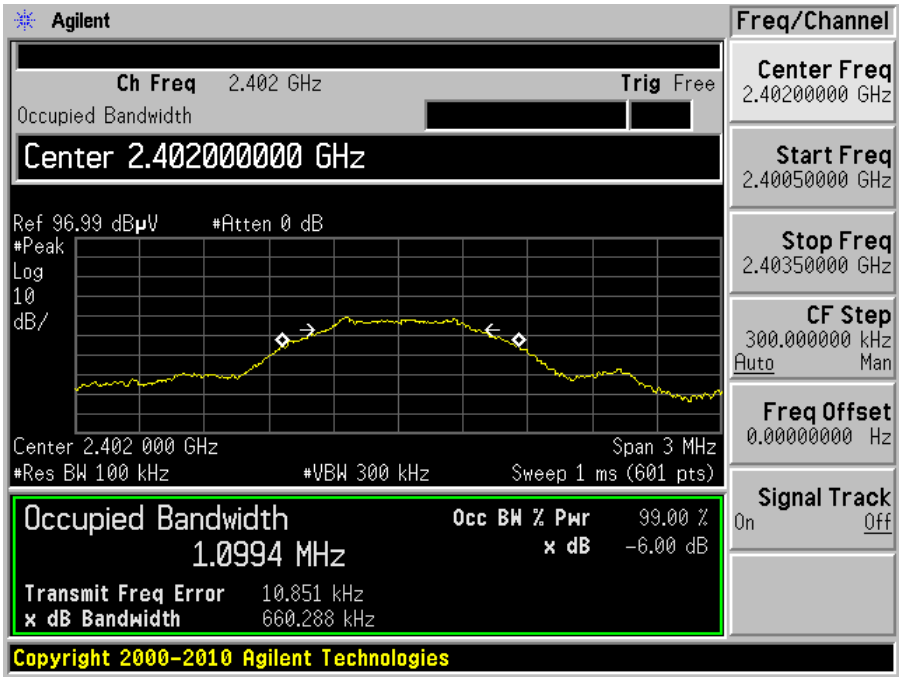
The testing was performed by Chen Ge on 2014-12-03 to 2014-12-05 at 5m chamber 3.

8.5 Test Results

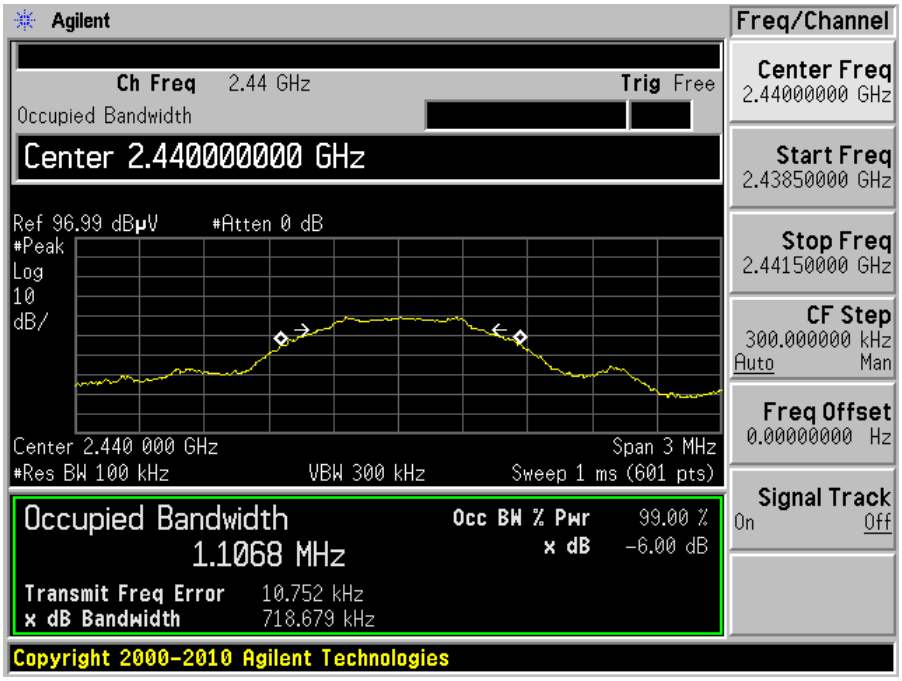
Channel	Frequency (MHz)	6 dB Emission Bandwidth (kHz)	99% Emission Bandwidth (MHz)	6 dB OBW Limit (MHz)	Results
Low	2402	660.288	1.0994	> 0.5	Compliant
Middle	2440	718.679	1.1068	> 0.5	Compliant
High	2480	719.086	1.0974	> 0.5	Compliant

Please refer to the following plots for detailed test results

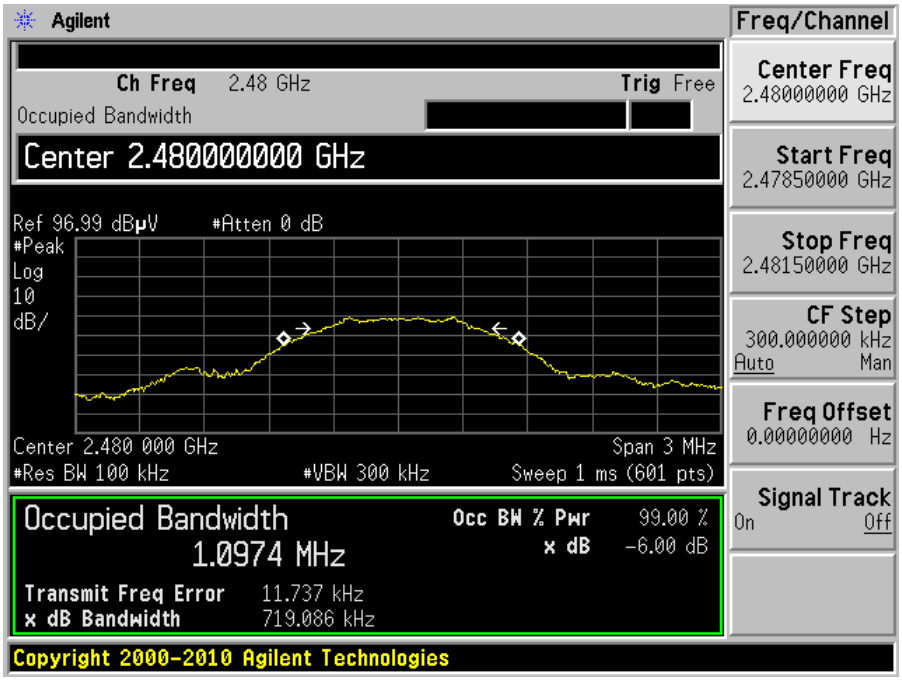
Low channel: 2402 MHz



Middle channel: 2440 MHz



High channel: 2480 MHz



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

9.1 Applicable Standard

According to FCC §15.247(b) and IC RSS-210 §A8.4 (4) for systems using digital modulation in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands: 1 Watt.

9.2 Measurement Procedure

The measurements are based 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.

9.3 Corrected Amplitude

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)

9.4 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	2014-10-17	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.

9.5 Test Environmental Conditions

Temperature:	20-24° C
Relative Humidity:	41-45 %
ATM Pressure:	101-102 kPa

The testing was performed by Chen Ge on 2014-12-03 to 2014-12-05 at 5m chamber 3.

9.6 Test Results

Frequency (MHz)	Radiated Reading (dBµV@ 3m)	Test Antenna		Cable Loss (dB)	Cord. Peak Radiated (dBµV/m @ 3m)	Antenna Gain (dBi)	Cord. Peak EIRP (dBm)	Corrected Output Power (dBm)	FCC Limit (dBm)	Margin (dB)
		Polarity (H/V)	Factor (dB/m)							
2402	60.85	V	28.331	2.91	92.091	4.4	-3.109	-7.509	30	-37.509
2402	60.76	H	28.331	2.91	92.001	4.4	-3.199	-7.599	30	-37.599
2440	58.97	V	28.331	2.91	90.211	4.4	-4.989	-9.389	30	-39.389
2440	60.78	H	28.331	2.91	92.021	4.4	-3.179	-7.579	30	-37.579
2480	60.17	V	28.394	2.91	91.474	4.4	-3.726	-8.126	30	-38.126
2480	61.21	H	28.394	2.91	92.514	4.4	-2.686	-7.086	30	-37.086

a) Measure the conducted output power (in dBm) using the detector specified (see 12.2.2, 12.2.3, and 12.2.4 for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).

b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)

c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ⩽ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).

d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW)

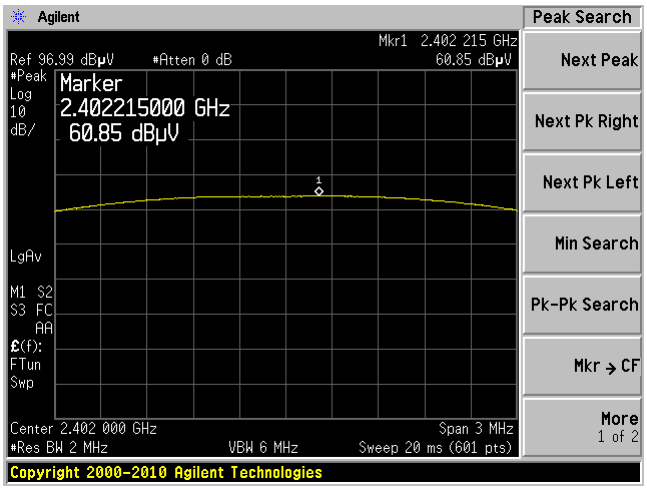
e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:
$E = EIRP - 20\log D + 104.8$
where:
E = electric field strength in dBµV/m,
EIRP = equivalent isotropic radiated power in dBm
D = specified measurement distance in meters.

f) Compare the resultant electric field strength level to the applicable limit.

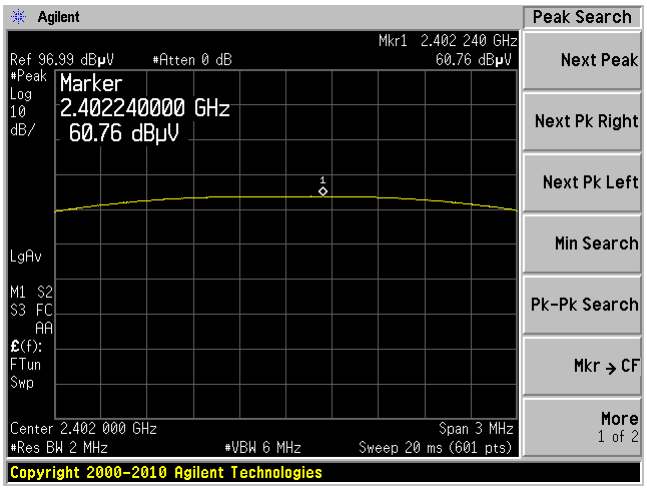
g) Perform radiated spurious emission test

Low channel: 2402 MHz

Vertical Polarity

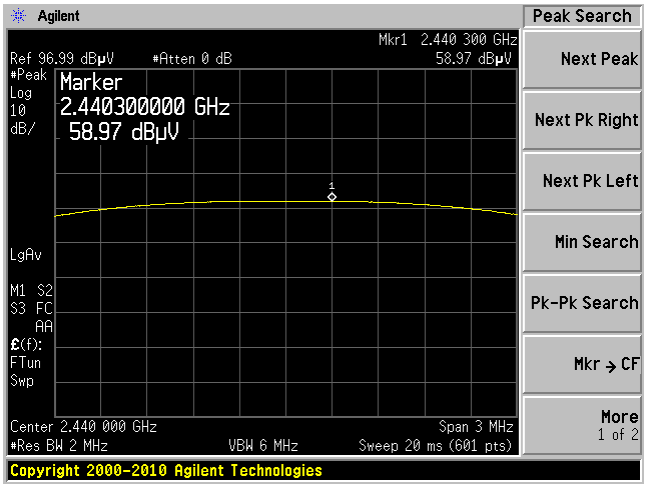


Horizontal Polarity

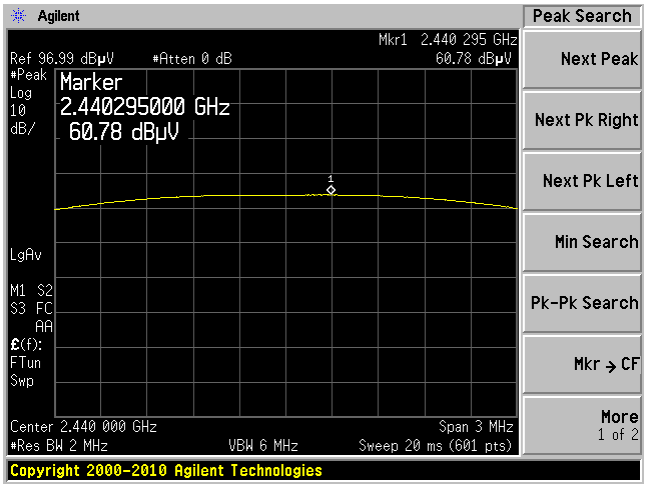


Middle channel: 2440 MHz

Vertical Polarity

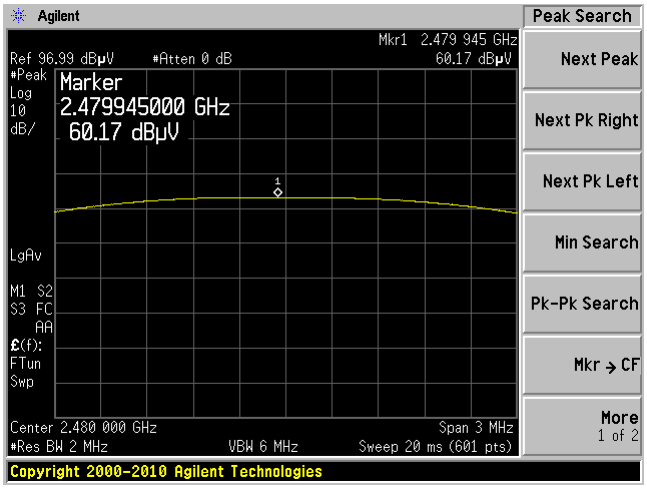


Horizontal Polarity

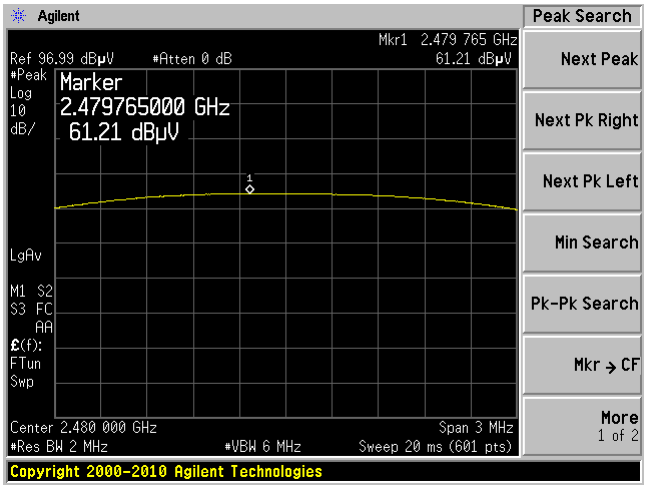


High channel: 2480 MHz

Vertical Polarity



Horizontal Polarity



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

10.1 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)).

10.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 13: Band-edge measurements

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
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
EMCO	Horn Antenna	3115	9511-4627	2014-10-17	1 year

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

10.4 Test Environmental Conditions

Temperature:	20-24° C
Relative Humidity:	41-45 %
ATM Pressure:	101-102 kPa

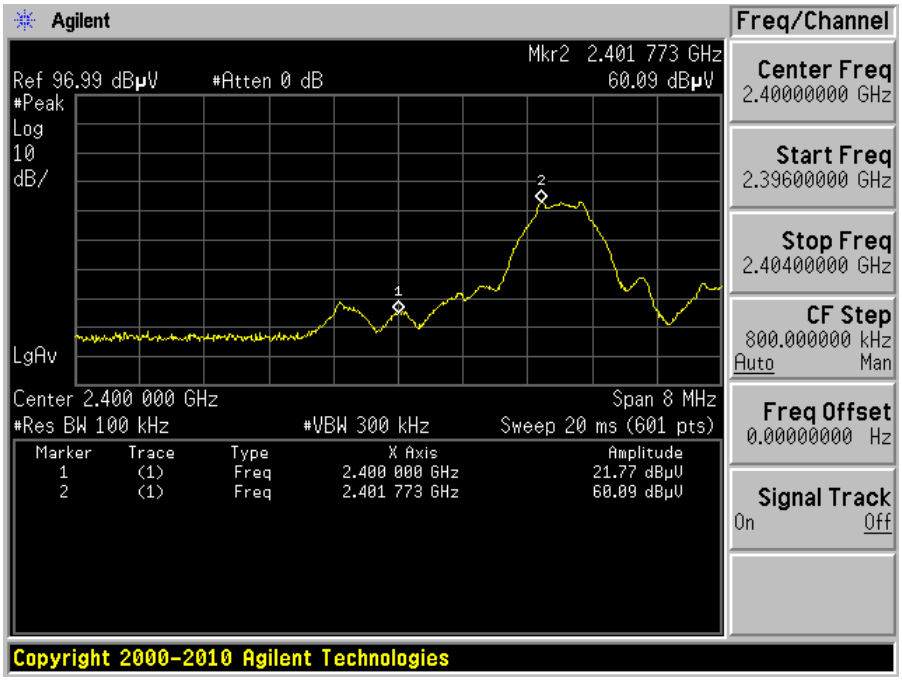
The testing was performed by Chen Ge on 2014-12-03 to 2014-12-05 at 5m chamber 3.

10.5 Test Results

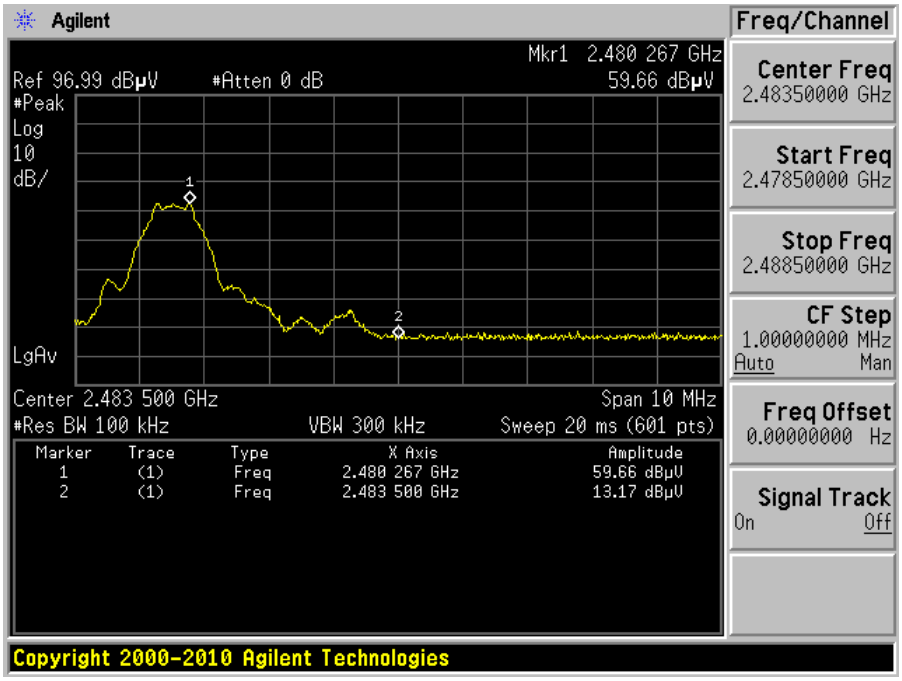
Please refer to following pages for plots of band edge.

Channel	Delta (dBc)	Limit
Low, 2402 MHz	38.32	> 20 dBc
High, 2480 MHz	46.49	> 20 dBc

Low Band Edge



High Band Edge



11 FCC §15.247(e) - Power Spectral Density

11.1 Applicable Standard

According to FCC §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

11.2 Measurement Procedure

The measurements are based 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.

11.3 Corrected Amplitude

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)

11.4 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2013-08-22	2 Years
EMCO	Horn Antenna	3115	9511-4627	2014-10-17	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.

11.5 Test Environmental Conditions

Temperature:	20-24° C
Relative Humidity:	41-45 %
ATM Pressure:	101-102 kPa

The testing was performed by Chen Ge on 2014-12-03 to 2014-12-05 at 5m chamber 3.

11.6 Test Results

Frequency (MHz)	Radiated Reading (dBµV/m @ 3mP	Antenna Polarity (H/V)	Antenna Factor (dB/m)	Cable Loss (dB)	Cord. Peak Radiated (dBµV/m @ 3m)	Antenna Gain (dBi)	Cord. Peak PSD EIRP (dBm)	Corrected Peak PSD Power (dBm))	FCC Limit (dBm)	Margin (dB)
2402	46.91	V	28.331	2.91	78.151	4.4	-17.049	-21.449	8	-29.449
2402	47.86	H	28.331	2.91	79.101	4.4	-16.099	-20.499	8	-28.499
2440	45.70	V	28.331	2.91	76.941	4.4	-18.259	-22.659	8	-30.659
2440	48.47	H	28.331	2.91	79.711	4.4	-15.489	-19.889	8	-27.889
2480	47.71	V	28.394	2.91	79.014	4.4	-16.186	-20.586	8	-28.586
2480	47.47	H	28.394	2.91	78.774	4.4	-16.426	-20.826	8	-28.826

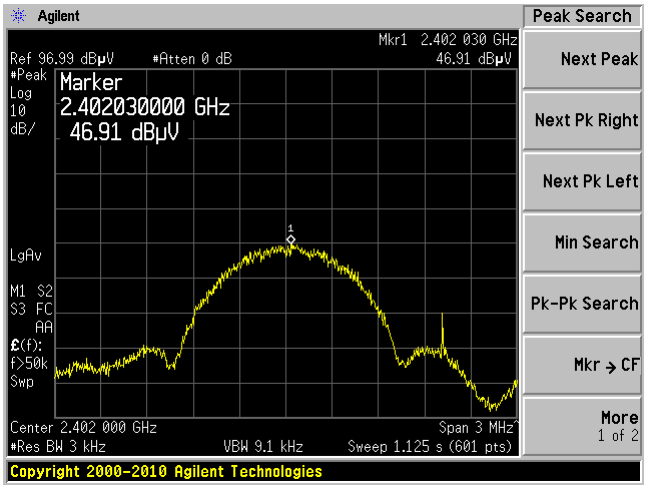
The corrected Peak PSD was calculated from the formula:

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.

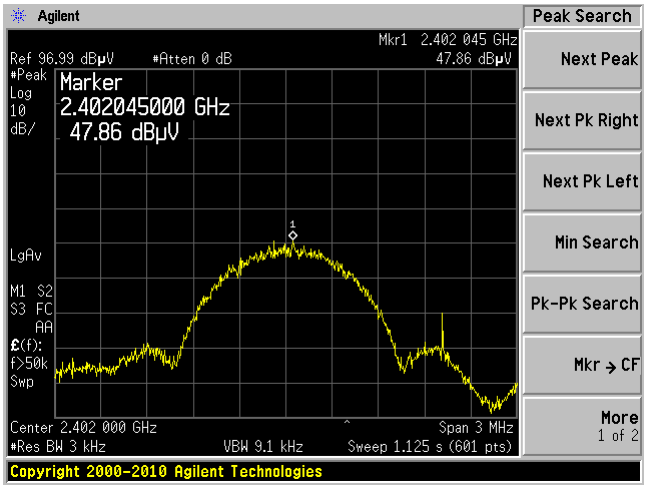
Please refer to the following plots for detailed test results:

Low channel: 2402 MHz

Vertical Polarity

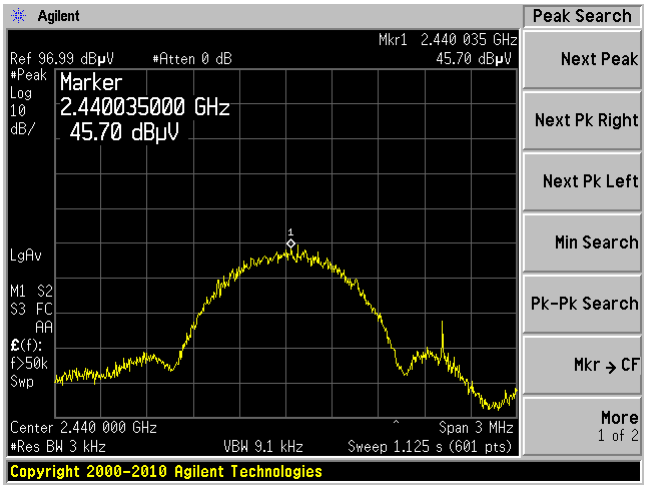


Horizontal Polarity

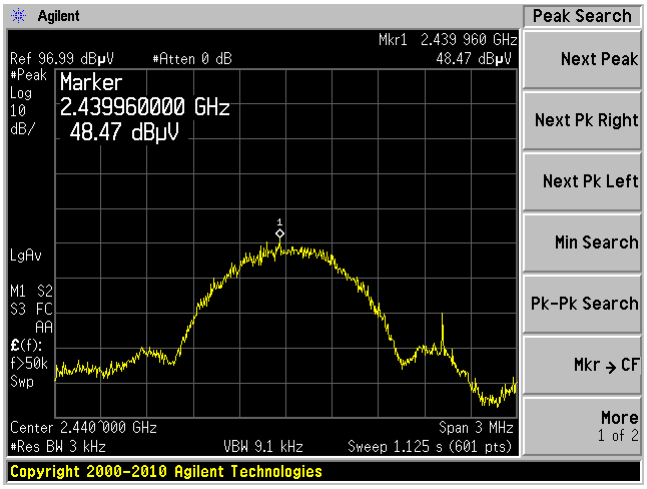


Middle channel: 2440 MHz

Vertical Polarity

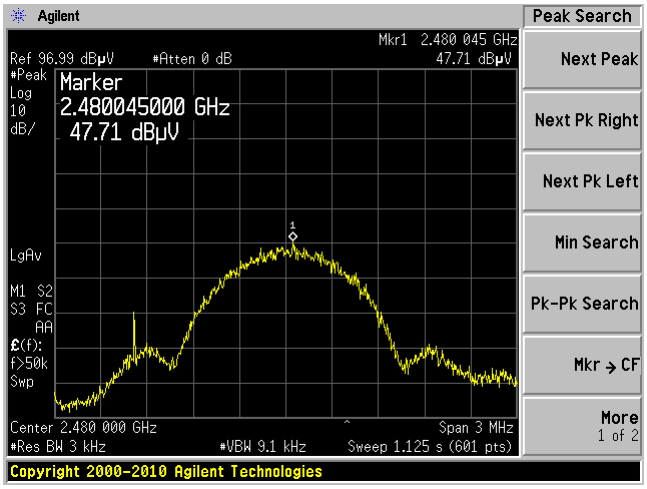


Horizontal Polarity



High channel: 2480 MHz

Vertical Polarity



Horizontal Polarity