



FCC PART 15, SUBPART C

TEST AND MEASUREMENT REPORT

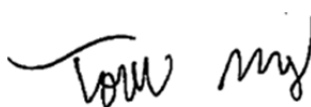

For

Ologic, Inc.

1394 Borregas Ave.,

Sunnyvale, CA 94089, USA

FCC ID: 2AH6T070613

Report Type: Original Report	Product Type: Educational Robotics Kit
Prepared By: Todd Moy Test Engineer 	
Report Number: R1604061-247	
Report Date: 2016-05-24	
Reviewed By: Bo Li RF Supervisor 	
Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue, Sunnyvale, CA 94089, USA Tel: (408) 732-9162 Fax: (408) 732-9164	

Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report **must not** be used by the customer to claim product certification, approval, or endorsement by A2LA*, NIST, or any agency of the Federal Government.

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

TABLE OF CONTENTS

1 General Description.....	5
1.1 Product Description for Equipment Under Test (EUT)	5
1.2 Mechanical Description of EUT	5
1.3 Objective.....	5
1.4 Related Submittal(s)/Grant(s)	5
1.5 Test Methodology	5
1.6 Measurement Uncertainty	5
1.7 Test Facility	6
2 System Test Configuration.....	7
2.1 Justification	7
2.2 EUT Exercise Software.....	7
2.3 Duty Cycle Correction Factor	7
2.4 Equipment Modifications.....	8
2.5 Local Support Equipment	8
2.6 EUT Internal Configuration Details.....	8
2.7 Support Equipment	9
2.8 Interface Ports and Cabling.....	9
3 Summary of Test Results	10
4 FCC §15.203 - Antenna Requirements	11
4.1 Applicable Standards	11
4.2 Antenna Description	11
5 FCC §2.1091 & §15.247(i) - RF Exposure Information.....	12
5.1 Applicable Standards	12
5.2 MPE Prediction.....	12
6 FCC §15.207 - AC Line Conducted Emissions.....	14
6.1 Applicable Standards	14
6.2 Test Setup	14
6.3 Test Procedure	14
6.4 Corrected Amplitude & Margin Calculation.....	15
6.5 Test Setup Block Diagram	15
6.6 Test Equipment List and Details.....	16
6.7 Test Environmental Conditions	16
6.8 Summary of Test Results	16
6.9 Conducted Emissions Test Plots and Data.....	17
7 FCC §15.209 & §15.247(d) - Spurious Radiated Emissions.....	21
7.1 Applicable Standards	21
7.2 Test Setup	22
7.3 Test Procedure	22
7.4 Corrected Amplitude & Margin Calculation.....	23
7.5 Test Equipment List and Details.....	23
7.6 Test Environmental Conditions	23
7.7 Summary of Test Results	24
7.8 Radiated Emissions Test Results	25
8 FCC §15.247(a) (2) -Emission Bandwidth	30
8.1 Applicable Standards	30
8.2 Measurement Procedure.....	30
8.3 Test Equipment List and Details.....	30
8.4 Test Environmental Conditions	30
8.5 Test Results.....	30
9 FCC §15.247(b) (3) - Output Power Measurement.....	33

9.1	Applicable Standards	33
9.2	Measurement Procedure.....	33
9.3	Test Equipment List and Details.....	33
9.4	Test Environmental Conditions	33
9.5	Test Results.....	33
10	FCC §15.247(d) – 100 kHz Bandwidth of Band Edges	36
10.1	Applicable Standards	36
10.2	Measurement Procedure.....	36
10.3	Test Equipment List and Details.....	36
10.4	Test Environmental Conditions	36
10.5	Test Results.....	36
11	FCC §15.247(e) – Power Spectral Density	38
11.1	Applicable Standards	38
11.2	Measurement Procedure.....	38
11.3	Test Equipment List and Details.....	38
11.4	Test Environmental Conditions	38
11.5	Test Results.....	38
12	FCC §15.247(d) – Spurious Emissions at Antenna Terminals.....	41
12.1	Applicable Standards	41
12.2	Test Procedure	41
12.3	Test Equipment List and Details.....	41
12.4	Test Environmental Conditions	41
12.5	Test Results.....	41
13	Exhibit A - FCC Equipment Labeling Requirements	45
13.1	FCC ID Label Requirements	45
13.2	FCC ID Label Contents and Location.....	45
14	Exhibit B - Test Setup Photos	46
14.1	AC Conducted Line Emission – Front View	46
14.2	AC Line Conducted Emission Side View.....	46
14.3	Radiated Spurious Emissions below 1 GHz – Front View	47
14.4	Radiated Spurious Emissions below 1 GHz– Rear View	47
14.5	Radiated Spurious Emissions above 1 GHz – Front View.....	48
14.6	Radiated Spurious Emissions above 1 GHz– Rear View.....	48
15	Exhibit C- EUT Photos.....	49
15.1	EUT Photo – Front View	49
15.2	EUT Photo – Back View.....	49
15.3	EUT Photo – Front Side Board View	50
15.4	EUT Photo – Bottom Side Board View	50
15.5	EUT Photo – Top Side Main Board Clouse-up View	51
15.6	EUT Photo – Bottom Side Main Board Clouse-up View	51
15.7	EUT Photo –Uncovered Wi-Fi Module	52
15.8	EUT Photo – Battery.....	52

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1604061-247	Original Report	2016-05-24

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report has been compiled on behalf of *Ologic, Inc.*, and their product, *FCC ID: 2AH6T070613*, model number: Jackson, Rev D, which henceforth is referred to as the EUT (Equipment Under Test.) The EUT is an Educational Robotics Kit that is to teach about robotics and software engineering with Bluetooth Low Energy and Wi-Fi capabilities. Wi-Fi module was pre-certified under FCC ID: YCJGTIMW302, which granted in October 11th, 2015.

1.2 Mechanical Description of EUT

The EUT measures approximately 95 mm (L) x 55 mm (W) x 17mm (H) and weighs 0.028 kg.

The data gathered are from a production sample provided by the manufacturer, serial number: R1604061-01, assigned by BACL.

1.3 Objective

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

The objective is to determine compliance with FCC Part 15.247 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, Power Spectral Density, 100 kHz Bandwidth of Band Edges Measurement, 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 C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB 558074 D01 DTS Meas Guidance v03r03: 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.

Based on CISPR16-4-2:2011, 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

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 Luminaires 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 17065: 2012** by **A2LA** to certify:

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 C63.10-2013, ANSI C63.4-2014, 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 C63.10-2013 and FCC KDB 558074 D01 DTS Meas Guidance v03r04.

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

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

The test utility used were Nordic Direct Test Mode to run the BLE module and Marvell 3.3.30 SDK for the Wi-Fi module; the software were verified by *Todd Moy* to comply with the standard requirements being tested against.

2.3 Duty Cycle Correction Factor

According to KDB 558074 D01 DTS Meas Guidance v03r04 section 6.0:

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be utilized to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data is being acquired (i.e., no transmitter off-time is to be considered).

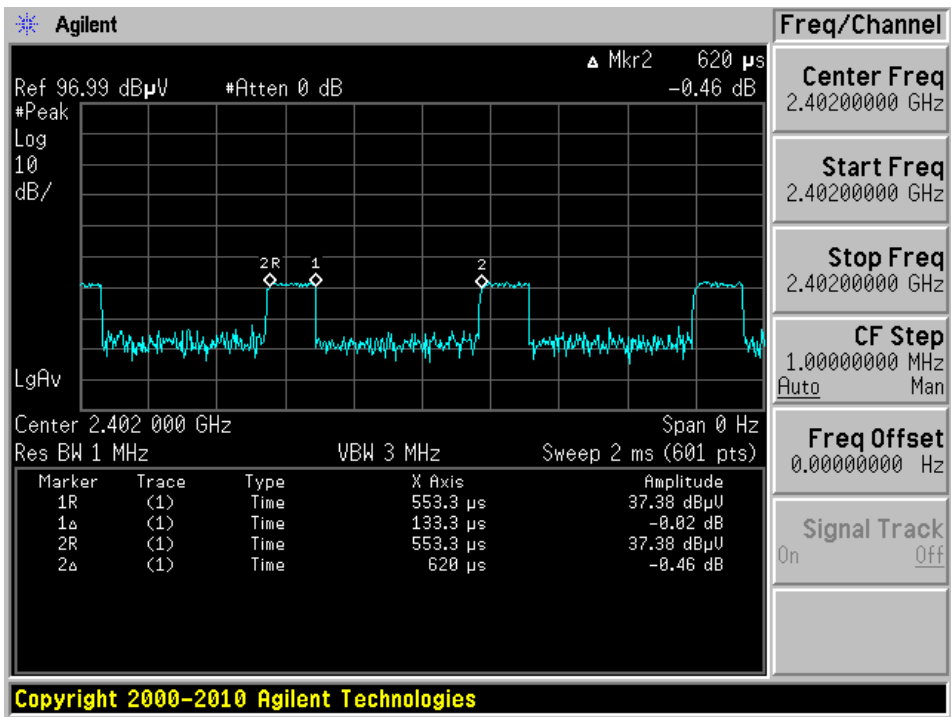
Radio Mode	On Time (μ s)	Period (μ s)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
BLE	133.3	553.3	24	6.18

Duty Cycle = On Time (ms)/ Period (ms)

Duty Cycle Correction Factor (dB) = $10 \cdot \log(1/\text{Duty Cycle})$

Please refer to the following plot.

BLE



2.4 Equipment Modifications

SMA cables were connected to the output trace of the Bluetooth and power leads were attached to the EUT.

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude D630

2.6 EUT Internal Configuration Details

Manufacturers	Descriptions	Models	Serial Numbers
Nordic	-	NRF-1822QFAA-R7	-
ST Micro	-	LSM6DS3	-
GlobalScale	WiFi Module	RD-88Mw302-QFN88	-

2.7 Support Equipment

Manufacturer	Description	Model
B&K Precision	DC Power Supply	1670A

2.8 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB Cable	< 1 m	Laptop	EUT
Power Leads	< 1 m	Power Supply	EUT
SMA Pigtailed	< 1 m	EUT	PSA

3 Summary of Test Results

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
§15.203	Antenna Requirement	Compliant
§15.207	AC Line Conducted Emissions	Compliant
§2.1091, §15.247(i)	RF Exposure	Compliant
§2.1051, §15.247(d)	Spurious Emissions at Antenna Port	Compliant
§15.209, §15.247(d)	Radiated Spurious Emissions	Compliant
§15.247(a)(2)	6 dB & 99% Emission Bandwidth	Compliant
§15.247(b)(3)	Output Power	Compliant
§15.247(d)	Band Edge	Compliant
§15.247(e)	Power Spectral Density	Compliant

4 FCC §15.203 - Antenna Requirements

4.1 Applicable Standards

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.

4.2 Antenna Description

The antennas used by the EUT are permanently attached antennas.

Antenna Port	Maximum Antenna Gain (dBi) @ 2.4 GHz
Bluetooth	0
Wi-Fi	0

5 FCC §2.1091 & §15.247(i) - RF Exposure Information

5.1 Applicable Standards

FCC §2.1091, (a) Requirements of this section are a consequence of Commission responsibilities under the National Environmental Policy Act to evaluate the environmental significance of its actions. See subpart I of part 1 of this chapter, in particular §1.1307(b).

Limits for Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f ²)	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	f/300	6
1500-100,000	/	/	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	842/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	30

5.2 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

BLE:

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>-7.56</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>0.1754</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>2442</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>0</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1</u>
<u>Power density of prediction frequency at 20 cm (mW/cm²):</u>	<u>3.49E-05</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>

Wi-Fi (FCC ID: YCJGTIMW302):

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>23.24</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>211</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>2437</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>0</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1</u>
<u>Power density of prediction frequency at 20 cm (mW/cm²):</u>	<u>0.042</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>

Conclusion

The total MPE is $0.042 \text{ mW/cm}^2 + 3.49\text{E-}05 \text{ mW/cm}^2$, which is less than 1.0 mW/cm^2 . The device complies with the MPE requirements by providing a safe separation distance of at least 20 cm between the antenna with maximum 0 dBi gain, including any radiating structure, and any persons when normally operated.

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 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 ^{Note1}	56 to 46 ^{Note2}
0.5-5	56	46
5-30	60	50

Note1: Decreases with the logarithm of the frequency.

Note2: A linear average detector is required

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.10-2013 measurement procedure. The specification used were 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-1 and the power cords of support equipment were connected to LISN-2.

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

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

6.4 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:

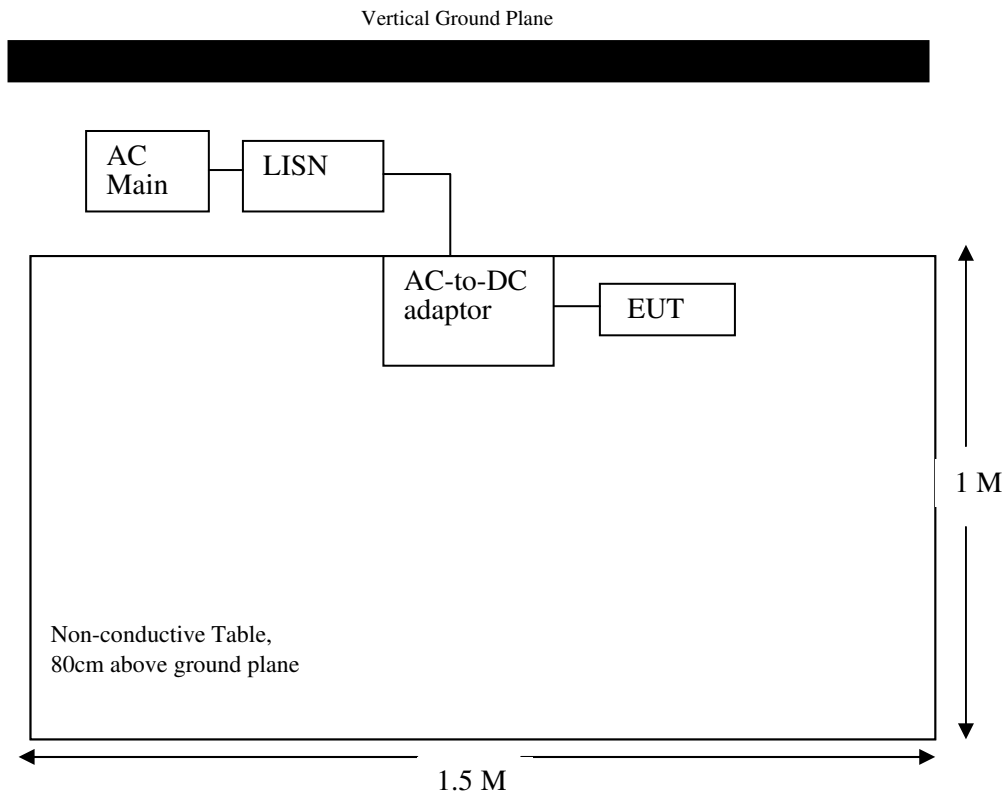
$$CA = Ai + CL + Atten$$

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:

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

6.5 Test Setup Block Diagram



6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100044	2015-07-23	1 year
Rohde & Schwarz	Impulse Limiter	ESH3-Z2	101963	2015-07-15	1 year
Keysight Technologies	RF Limiter	11867A	MY42242931	2015-12-15	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150204	2016-03-09	1 year
Wireless Solutions	Conducted Emission Cable	LMR 400	691	2015-07-02	1 year
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2016-04-11	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:	23° C
Relative Humidity:	56 %
ATM Pressure:	101.2 kPa

The testing was performed by Todd Moy on 2016-05-05 in 5m chamber3.

6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC 15C standard's conducted emissions limits, with the margin reading of:

BLE

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	Frequency (MHz)	Conductor Mode (Line/Neutral)	Range (MHz)
-17.15	0.600581	Line	0.15-30

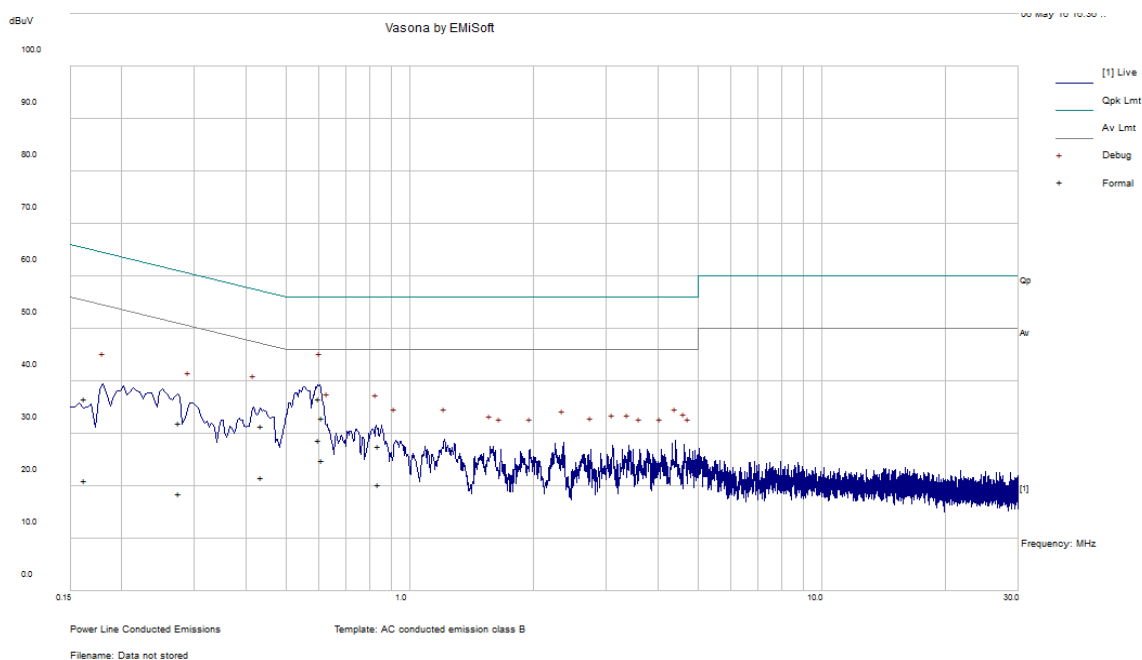
Collocation

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	Frequency (MHz)	Conductor Mode (Line/Neutral)	Range (MHz)
-11.5	0.588812	Line	0.15-30

6.9 Conducted Emissions Test Plots and Data

BLE

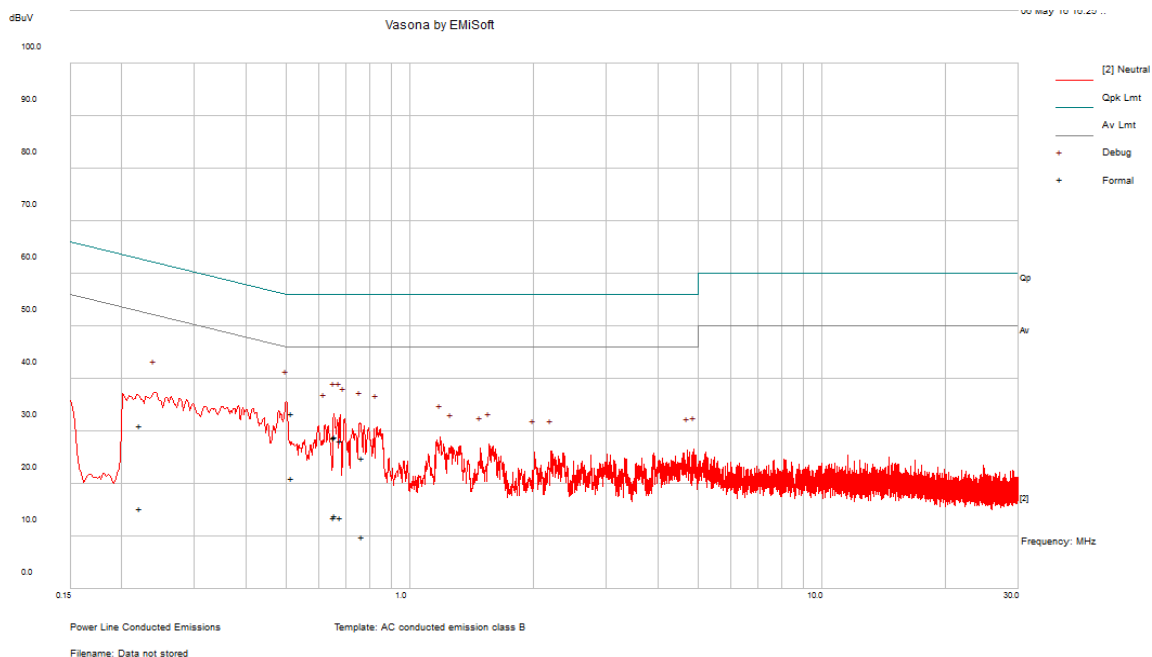
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.600581	36.72	Line	56	-19.28	QP
0.436164	31.56	Line	57.13	-25.57	QP
0.613508	32.94	Line	56	-23.06	QP
0.837935	27.72	Line	56	-28.28	QP
0.275867	32.04	Line	60.94	-28.9	QP
0.162626	36.67	Line	65.33	-28.66	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.600581	28.85	Line	46	-17.15	Ave.
0.436164	21.58	Line	47.13	-25.55	Ave.
0.613508	25	Line	46	-21	Ave.
0.837935	20.33	Line	46	-25.67	Ave.
0.275867	18.56	Line	50.94	-32.38	Ave.
0.162626	21.11	Line	55.33	-34.21	Ave.

120 V, 60 Hz – Neutral



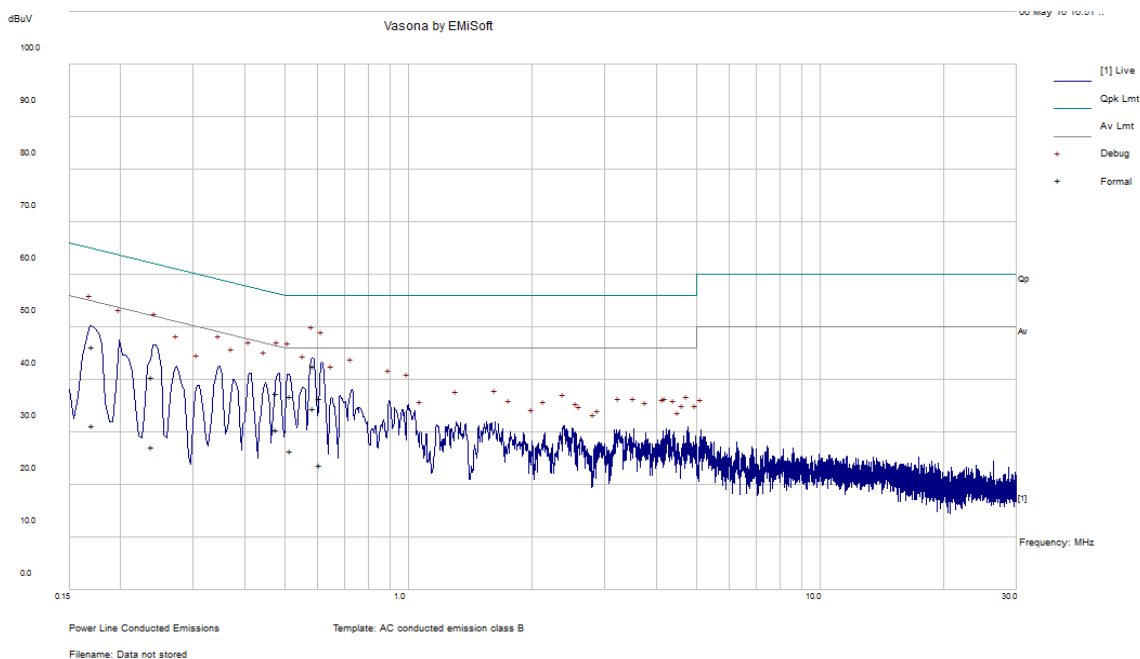
Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.517058	33.42	Neutral	56	-22.58	QP
0.653445	28.88	Neutral	56	-27.12	QP
0.658863	28.97	Neutral	56	-27.03	QP
0.681107	28.2	Neutral	56	-27.8	QP
0.768348	24.92	Neutral	56	-31.08	QP
0.22167	31.12	Neutral	62.76	-31.63	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.517058	21.17	Neutral	46	-24.83	Ave.
0.653445	13.66	Neutral	46	-32.34	Ave.
0.658863	13.89	Neutral	46	-32.11	Ave.
0.681107	13.54	Neutral	46	-32.46	Ave.
0.768348	10.04	Neutral	46	-35.96	Ave.
0.22167	15.25	Neutral	52.76	-37.5	Ave.

Collocation

Worst Case Mode: BLE Low Channel and 802.11g mode Middle Channel

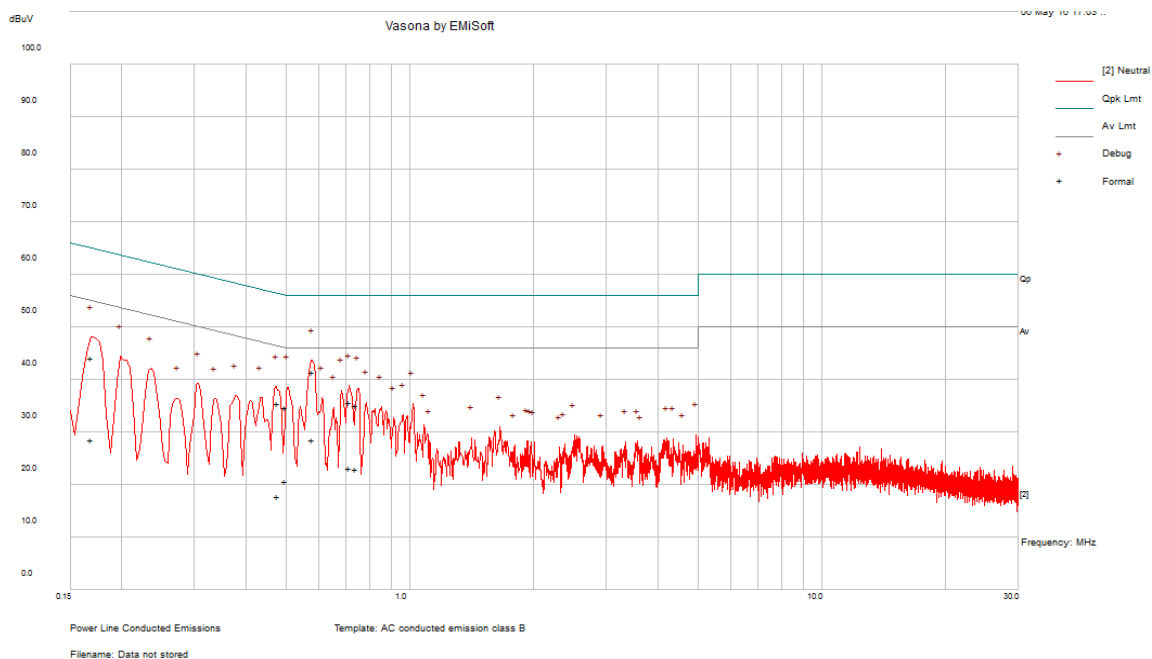
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.588812	42.61	Line	56	-13.39	QP
0.609922	36.5	Line	56	-19.5	QP
0.170944	46.31	Line	64.91	-18.6	QP
0.518598	36.9	Line	56	-19.1	QP
0.47944	37.44	Line	56.35	-18.91	QP
0.23877	40.55	Line	62.14	-21.59	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.588812	34.5	Line	46	-11.5	Ave.
0.609922	23.78	Line	46	-22.22	Ave.
0.170944	31.29	Line	54.91	-23.63	Ave.
0.518598	26.52	Line	46	-19.48	Ave.
0.47944	30.52	Line	46.35	-15.83	Ave.
0.23877	27.16	Line	52.14	-24.98	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.580815	41.49	Neutral	56	-14.51	QP
0.168874	44.25	Neutral	65.02	-20.76	QP
0.711747	35.73	Neutral	56	-20.27	QP
0.498265	34.73	Neutral	56.03	-21.3	QP
0.741676	35.22	Neutral	56	-20.78	QP
0.477431	35.58	Neutral	56.38	-20.8	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.580815	28.61	Neutral	46	-17.39	Ave.
0.168874	28.58	Neutral	55.02	-26.44	Ave.
0.711747	23.21	Neutral	46	-22.79	Ave.
0.498265	20.76	Neutral	46.03	-25.26	Ave.
0.741676	22.98	Neutral	46	-23.02	Ave.
0.477431	17.85	Neutral	46.38	-28.53	Ave.

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

7.1 Applicable Standards

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 §15.205(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 §15.209(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 §15.247 (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 C63.10-2013. The specification used was the FCC 15 Subpart C 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.

7.3 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords were 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 was set 3 meter away from the testing antenna, which was varied from 1-4 meter, and the EUT was placed on a turntable, which was 0.8 meter and 1.5 meter above the ground plane for below and above 1000 MHz measurements, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna's polarity should be changed between horizontal and vertical.

The spectrum analyzer or receiver was 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:

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

7.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100044	2015-07-23	1 year
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Keysight Technologies	RF Limiter	11867A	MY42242931	2015-12-17	1 year
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2015-07-11	2 years
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2015-03-09	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2016-03-23	1 year
Agilent	Pre-Amplifier	8449B	3008A01978	2015-09-02	1 year
Wisewave	Amplifier, Low Noise	ALN-22093530-01	12263-01	2016-05-16	1 year
Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2013-09-20	3 years

Note¹: cable and attenuator included in the test set-up will be checked each time before testing.

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

7.6 Test Environmental Conditions

Temperature:	20-22° C
Relative Humidity:	42-50 %
ATM Pressure:	102.7 kPa

The testing was performed by Todd Moy from 2016-05-11 in 5m chamber 3.

7.7 Summary of Test Results

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

BLE

Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Channel
-3.88	2483.5	Horizontal	High CH

Collocation

Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Mode, Channel
-3.86	2390	Horizontal	BLE, Low CH and 802.11g Mid CH

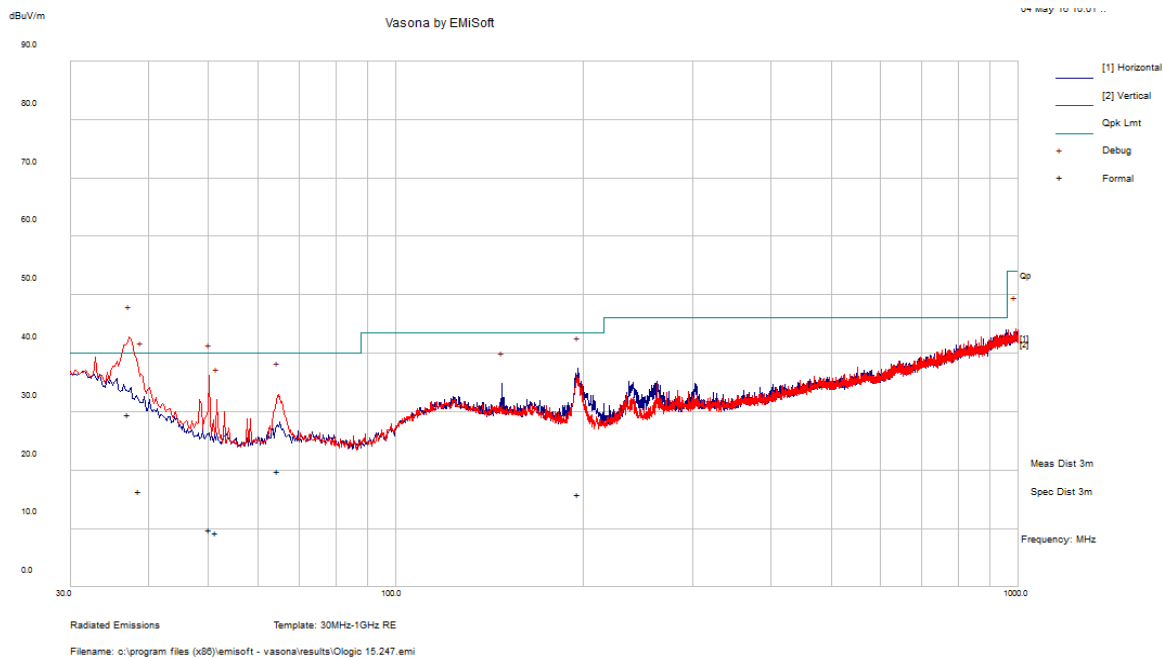
Note: Testing was performed to the EUT without enclosure, the enclosure is made of plastic with no metal parts.

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

7.8 Radiated Emissions Test Results

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

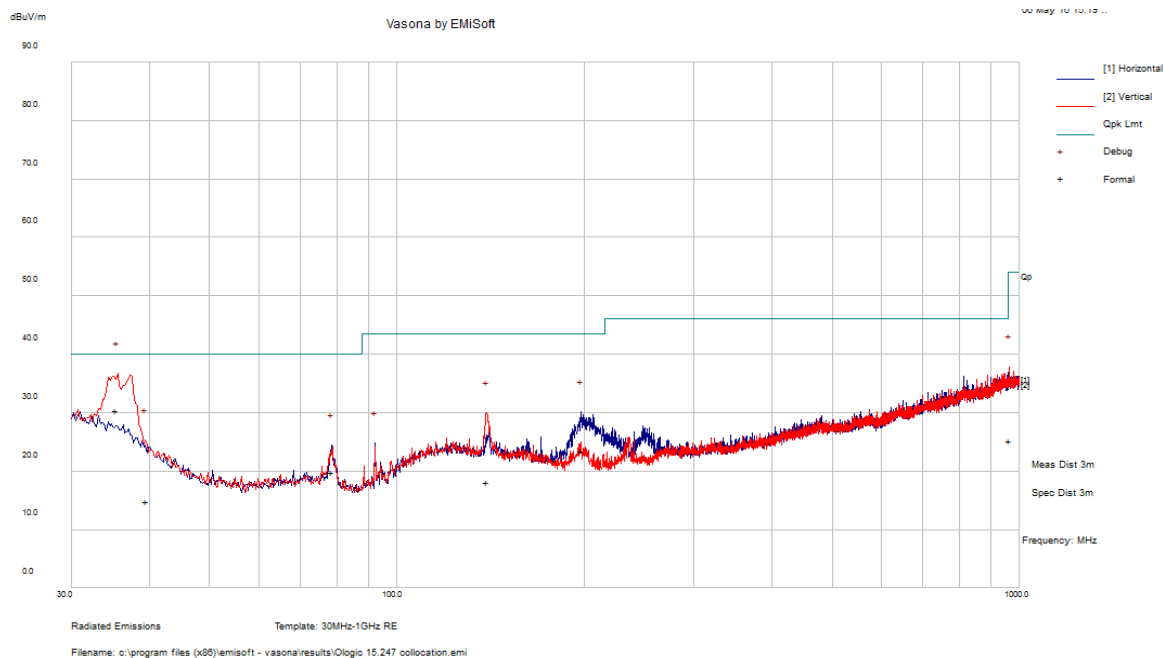
BLE



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
37.17275	29.49	114	V	101	40	-10.51	QP
38.73775	16.47	300	V	1	40	-23.53	QP
50.22325	9.83	260	V	1	40	-30.17	QP
196.3383	15.91	100	H	1	43.5	-27.59	QP
64.7285	19.86	158	V	291	40	-20.14	QP
51.41675	9.24	235	V	294	40	-30.76	QP

Collocation

Worst Case Mode: BLE Low Channel and 802.11g mode Middle Channel



Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)	Comment
35.374	30.35	124	V	176	40	-9.65	QP
197.8355	23.52	139	H	163	43.5	-19.98	QP
139.6045	18.16	260	V	0	43.5	-25.34	QP
39.5435	14.91	206	V	112	40	-25.09	QP
78.572	19.8	218	H	166	40	-20.2	QP
963.2873	25.15	184	V	145	54	-28.85	QP

2) 1–25 GHz Measured at 3 meters

BLE (Max Power)

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											
2402	56.13	13	291	V	29.04	5.22	0.00	90.39	-	-	Peak
2402	60.35	346	233	H	29.04	5.22	0.00	94.61	-	-	Peak
2402	42.15	92	292	V	29.04	5.22	0.00	76.41	-	-	Ave
2402	46.37	342	293	H	29.04	5.22	0.00	80.63	-	-	Ave
2390	27.07	13	219	V	29.04	5.22	0.00	61.33	74.00	-12.67	Peak
2390	28.57	346	233	H	29.04	5.22	0.00	62.83	74.00	-11.17	Peak
2390	13.07	92	292	V	29.04	5.22	0.00	47.33	54.00	-6.67	Ave
2390	13.10	342	293	H	29.04	5.22	0.00	47.36	54.00	-6.64	Ave
4804	57.22	225	260	V	32.47	7.76	38.01	59.45	74.00	-14.55	Peak
4804	58.51	253	258	H	32.47	7.76	38.01	60.74	74.00	-13.26	Peak
4804	43.24	0	100	V	32.47	7.76	38.01	45.47	54.00	-8.53	Ave
4804	44.53	252	129	H	32.47	7.76	38.01	46.76	54.00	-7.24	Ave
7206	47.81	0	100	V	36.69	9.71	37.53	56.68	70.39	-13.70	Peak
7206	48.94	0	100	H	36.69	9.71	37.53	57.81	74.61	-16.79	Peak
7206	33.83	0	100	V	36.69	9.71	37.53	42.71	56.41	-13.70	Ave
7206	34.96	0	100	H	36.69	9.71	37.53	43.84	60.63	-16.79	Ave
9608	48.17	0	100	V	37.77	11.37	38.00	59.32	70.39	-11.07	Peak
9608	48.85	0	100	H	37.77	11.37	38.00	60.00	74.61	-14.61	Peak
9608	34.19	0	100	V	37.77	11.37	38.00	45.34	56.41	-11.07	Ave
9608	34.87	0	100	H	37.77	11.37	38.00	46.02	60.63	-14.61	Ave
Middle Channel 2442 MHz											
2442	54.77	301	281	V	29.04	5.22	0.00	89.03	-	-	Peak
2442	59.76	269	291	H	29.04	5.22	0.00	94.02	-	-	Peak
2442	40.79	296	282	V	29.04	5.22	0.00	75.05	-	-	Ave
2442	45.78	145	169	H	29.04	5.22	0.00	80.04	-	-	Ave
4884	57.27	128	253	V	32.64	7.93	37.92	59.92	74.00	-14.08	Peak
4884	59.36	254	182	H	32.64	7.93	37.92	62.01	74.00	-11.99	Peak
4884	43.29	129	251	V	32.64	7.93	37.92	45.95	54.00	-8.05	Ave
4884	45.38	356	276	H	32.64	7.93	37.92	48.04	54.00	-5.96	Ave
7326	48.26	0	100	V	37.15	9.86	37.53	57.74	74.00	-16.26	Peak
7326	48.24	0	100	H	37.15	9.86	37.53	57.72	74.00	-16.28	Peak
7326	34.28	0	100	V	37.15	9.86	37.53	43.76	54.00	-10.24	Ave
7326	34.26	0	100	H	37.15	9.86	37.53	43.74	54.00	-10.26	Ave
9768	49.30	0	100	V	37.92	11.48	38.27	60.43	69.03	-8.60	Peak
9768	49.34	0	100	H	37.92	11.48	38.27	60.47	74.02	-13.55	Peak
9768	35.32	0	100	V	37.92	11.48	38.27	46.45	55.05	-8.60	Ave
9768	35.36	0	100	H	37.92	11.48	38.27	46.49	60.04	-13.55	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											
2480	51.87	77	246	V	29.41	5.47	0.00	86.76	-	-	Peak
2480	56.45	301	241	H	29.41	5.47	0.00	91.34	-	-	Peak
2480	37.89	214	100	V	29.41	5.47	0.00	72.78	-	-	Ave
2480	42.47	140	106	H	29.41	5.47	0.00	77.36	-	-	Ave
2483.5	28.45	0	100	V	29.41	5.47	0.00	63.34	74.00	-10.66	Peak
2483.5	29.21	301	242	H	29.41	5.47	0.00	64.10	74.00	-9.90	Peak
2483.5	14.47	0	100	V	29.41	5.47	0.00	49.36	54.00	-4.64	Ave
2483.5	15.23	0	100	H	29.41	5.47	0.00	50.12	54.00	-3.88	Ave
4960	57.09	153	230	V	32.99	7.93	37.85	60.16	74.00	-13.84	Peak
4960	60.84	240	230	H	32.99	7.93	37.85	63.91	74.00	-10.09	Peak
4960	43.11	151	294	V	32.99	7.93	37.85	46.18	54.00	-7.82	Ave
4960	46.86	292	106	H	32.99	7.93	37.85	49.93	54.00	-4.07	Ave
7440	49.05	0	100	V	37.14	9.86	37.62	58.42	74.00	-15.58	Peak
7440	49.16	0	100	H	37.14	9.86	37.62	58.53	74.00	-15.47	Peak
7440	35.07	0	100	V	37.14	9.86	37.62	44.44	54.00	-9.56	Ave
7440	35.18	0	100	H	37.14	9.86	37.62	44.55	54.00	-9.45	Ave
9920	49.10	0	100	V	37.99	11.59	38.38	60.29	66.76	-6.46	Peak
9920	48.65	0	100	H	37.99	11.59	38.38	59.84	71.34	-11.49	Peak
9920	35.12	0	100	V	37.99	11.59	38.38	46.31	52.78	-6.46	Ave
9920	34.67	0	100	H	37.99	11.59	38.38	45.86	57.36	-11.49	Ave

Note: Duty Cycle Correction Factor has been added to the measurements.

Collocation

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)	
2390	28.16	222	288	V	29.04	5.22	0.00	62.42	74.00	-11.58	Peak
2390	29.23	127	300	H	29.04	5.22	0.00	63.49	74.00	-10.51	Peak
2390	14.81	222	288	V	29.04	5.22	0.00	49.07	54.00	-4.93	Ave
2390	15.88	127	300	H	29.04	5.22	0.00	50.14	54.00	-3.86	Ave
4804	57.38	206	235	V	32.47	7.76	38.01	59.61	74.00	-14.39	Peak
4804	57.92	34	252	H	32.47	7.76	38.01	60.15	74.00	-13.85	Peak
4804	44.03	206	235	V	32.47	7.76	38.01	46.25	54.00	-7.75	Ave
4804	44.57	34	252	H	32.47	7.76	38.01	46.79	54.00	-7.21	Ave
7206	48.20	0	100	V	36.69	9.71	37.53	57.07	70.85	-13.78	Peak
7206	48.16	0	100	H	36.69	9.71	37.53	57.03	73.30	-16.27	Peak
7206	34.84	0	100	V	36.69	9.71	37.53	43.72	57.50	-13.78	Ave
7206	34.80	0	100	H	36.69	9.71	37.53	43.68	59.95	-16.27	Ave
9608	47.95	0	100	V	37.77	11.37	38.00	59.09	70.85	-11.76	Peak
9608	48.23	0	100	H	37.77	11.37	38.00	59.37	73.30	-13.93	Peak
9608	34.60	0	100	V	37.77	11.37	38.00	45.74	57.50	-11.76	Ave
9608	34.88	0	100	H	37.77	11.37	38.00	46.02	59.95	-13.93	Ave
4874	52.07	218	264	V	32.638	7.93	37.92	54.72	74.00	-19.28	Peak
4874	52.53	30	300	H	32.638	7.93	37.92	55.18	74.00	-18.82	Peak
4874	38.04	220	100	V	32.638	7.93	37.92	40.69	54.00	-13.31	Ave
4874	36.96	33	274	H	32.638	7.93	37.92	39.61	54.00	-14.39	Ave
7311	47.33	0	100	V	37.148	9.86	37.53	56.80	74.00	-17.20	Peak
7311	47.27	0	100	H	37.148	9.86	37.53	56.74	74.00	-17.26	Peak
7311	33.30	205	300	V	37.148	9.86	37.53	42.77	54.00	-11.23	Ave
7311	33.42	195	107	H	37.148	9.86	37.53	42.89	54.00	-11.11	Ave
9748	47.32	0	100	V	37.923	11.48	38.27	58.45	84.83	-26.38	Peak
9748	47.56	0	100	H	37.923	11.48	38.27	58.69	86.72	-28.03	Peak
9748	33.96	0	100	V	37.923	11.48	38.27	45.09	76.41	-31.32	Ave
9748	33.94	0	100	H	37.923	11.48	38.27	45.07	77.01	-31.94	Ave

8 FCC §15.247(a) (2) -Emission Bandwidth

8.1 Applicable Standards

According to FCC §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 based on FCC KDB 558074 D01 DTS Meas Guidance v03r04: 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	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year

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

8.4 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

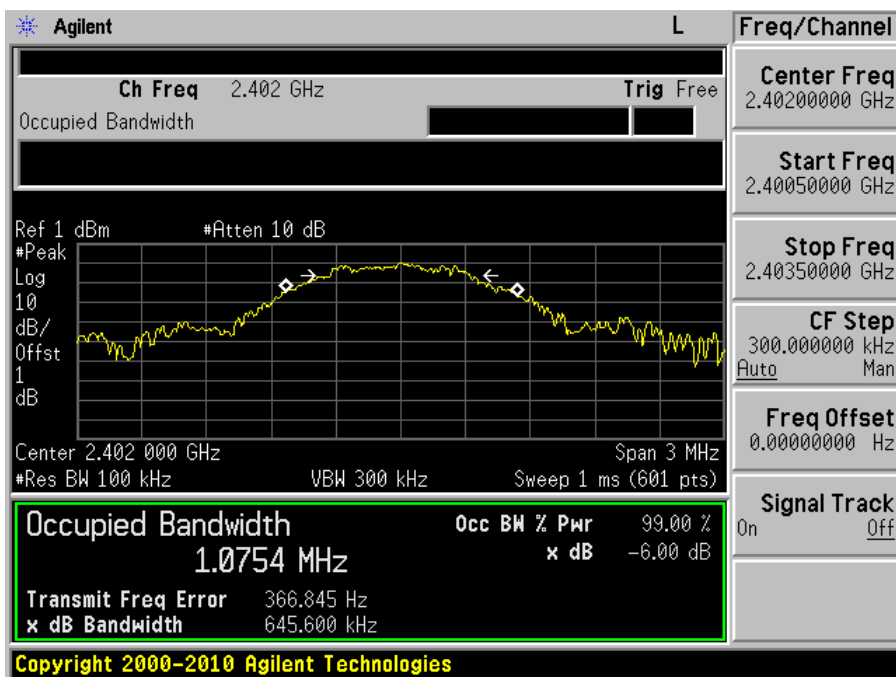
The testing was performed by Todd Moy on 2016-04-08 in RF site.

8.5 Test Results

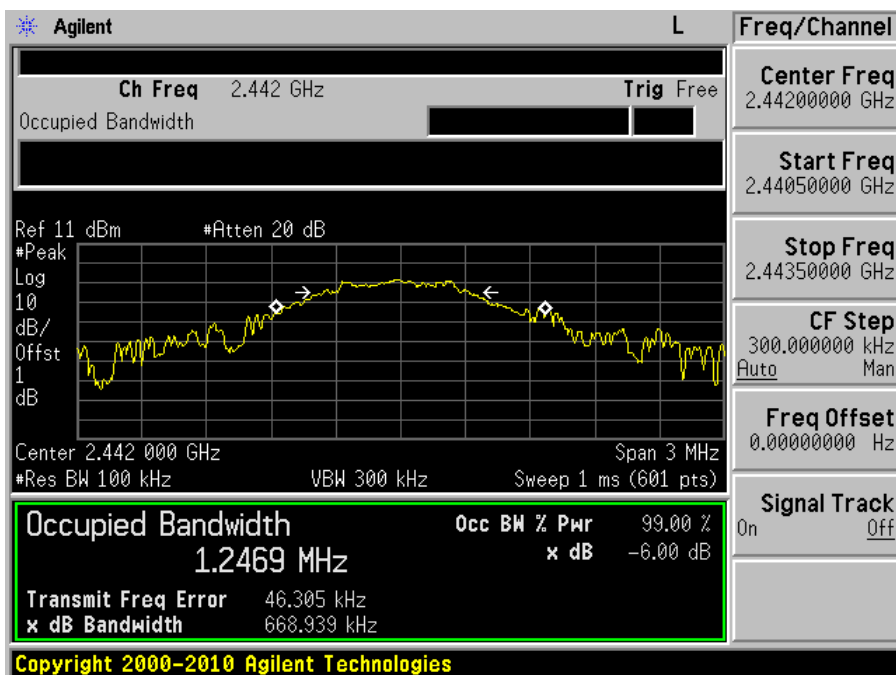
Channel	Frequency (MHz)	99% OBW (kHz)	6 dB OBW (kHz)	6 dB OBW limit (kHz)
BLE				
Low	2402	1075.4	645.600	500
Middle	2442	1246.9	668.939	500
High	2480	1114.1	650.349	500

Please refer to the following plots for detailed test results.

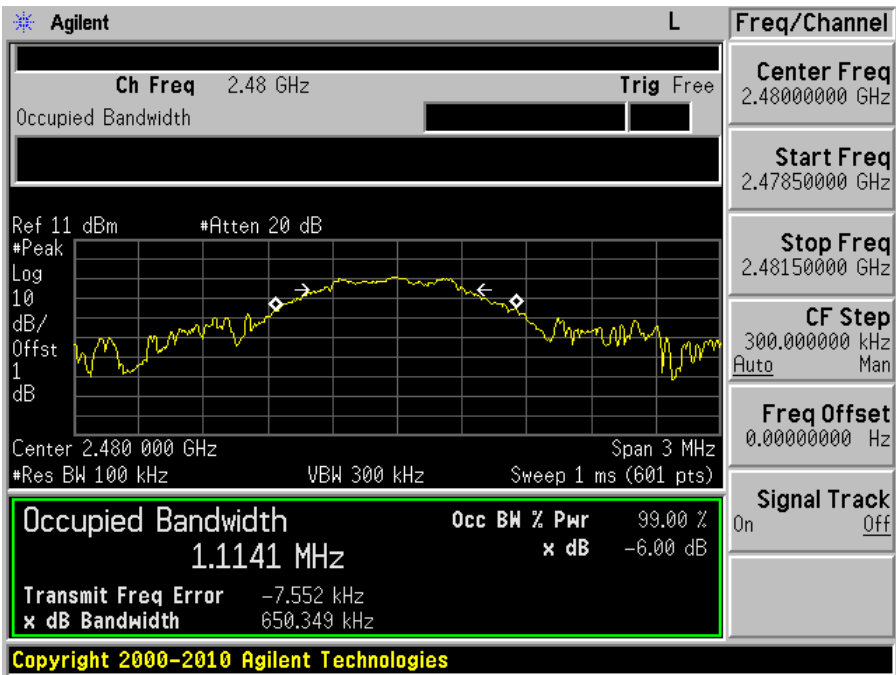
Low Channel 2402 MHz



Middle Channel 2442 MHz



High Channel 2480 MHz



9 FCC §15.247(b) (3) - Output Power Measurement

9.1 Applicable Standards

According to FCC §15.247(b) (3) 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 v03r04: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Fundamental emission output power

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year

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

9.4 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

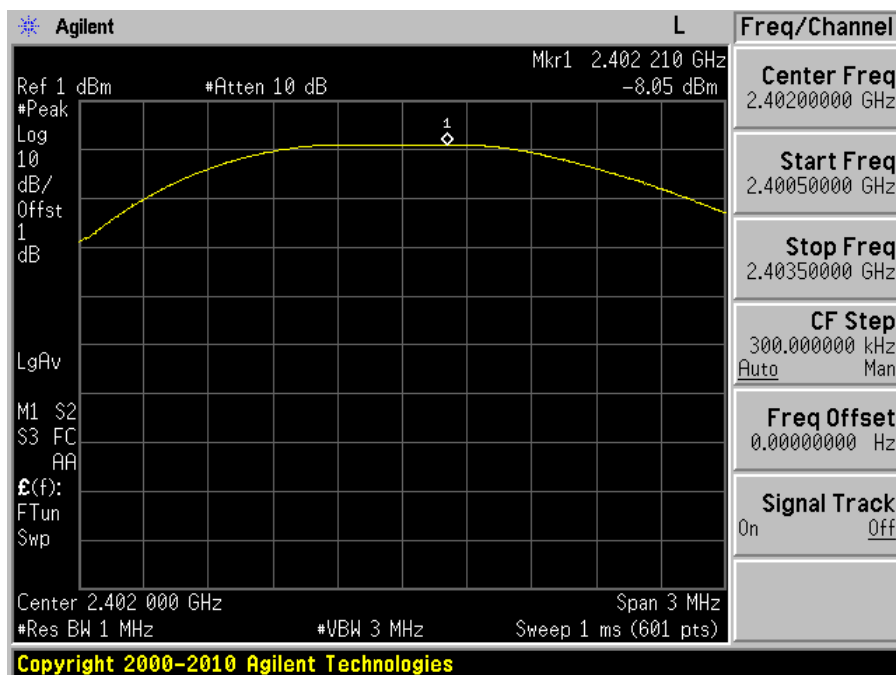
The testing was performed by Todd Moy on 2016-04-08 in RF site.

9.5 Test Results

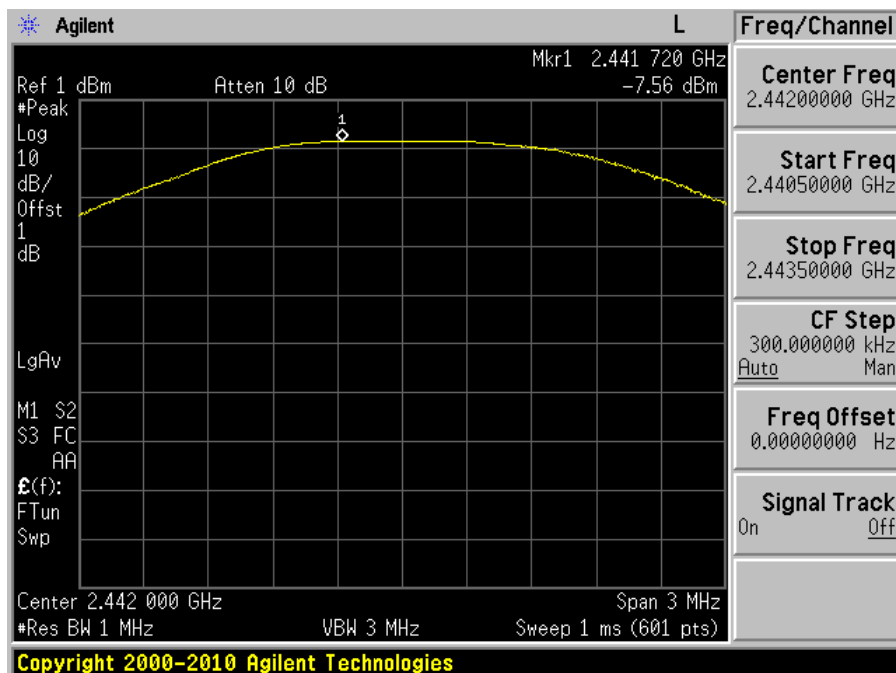
Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)
BLE			
Low	2402	-8.05	30
Middle	2442	-7.56	30
High	2480	-8.16	30

Please refer to the following plots for detailed test results.

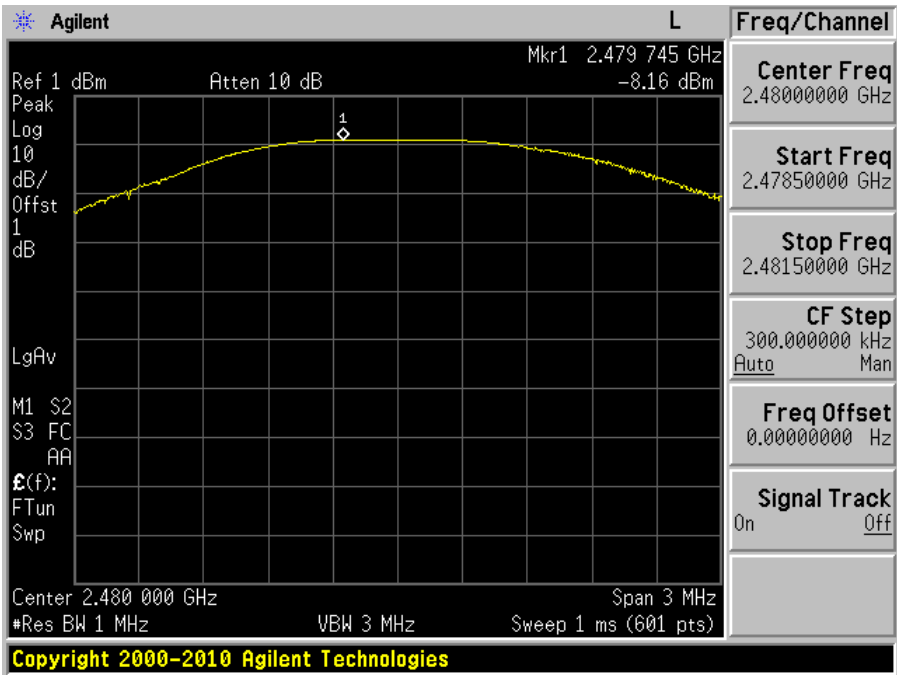
Low Channel 2402 MHz



Middle Channel 2440 MHz



High Channel 2480 MHz



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

10.1 Applicable Standards

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).

10.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v03r04: 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	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year

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

10.4 Test Environmental Conditions

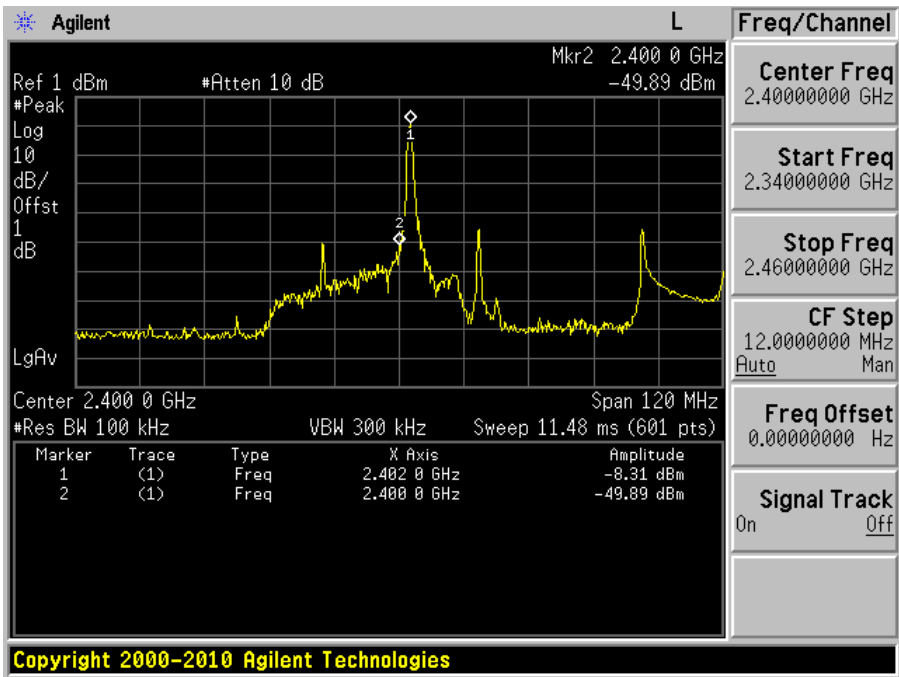
Temperature:	22° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Todd Moy on 2016-04-08 in RF site.

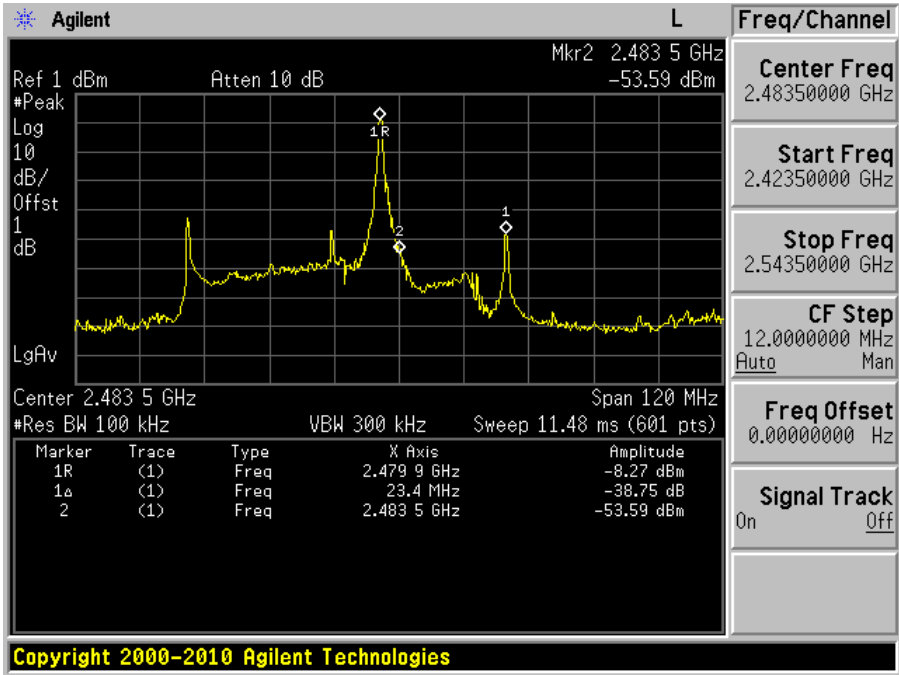
10.5 Test Results

Please refer to the following plots for detailed test results.

Low Channel 2402 MHz



High Channel 2480 MHz



11 FCC §15.247(e) – Power Spectral Density

11.1 Applicable Standards

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 v03r04: 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.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year

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

11.4 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

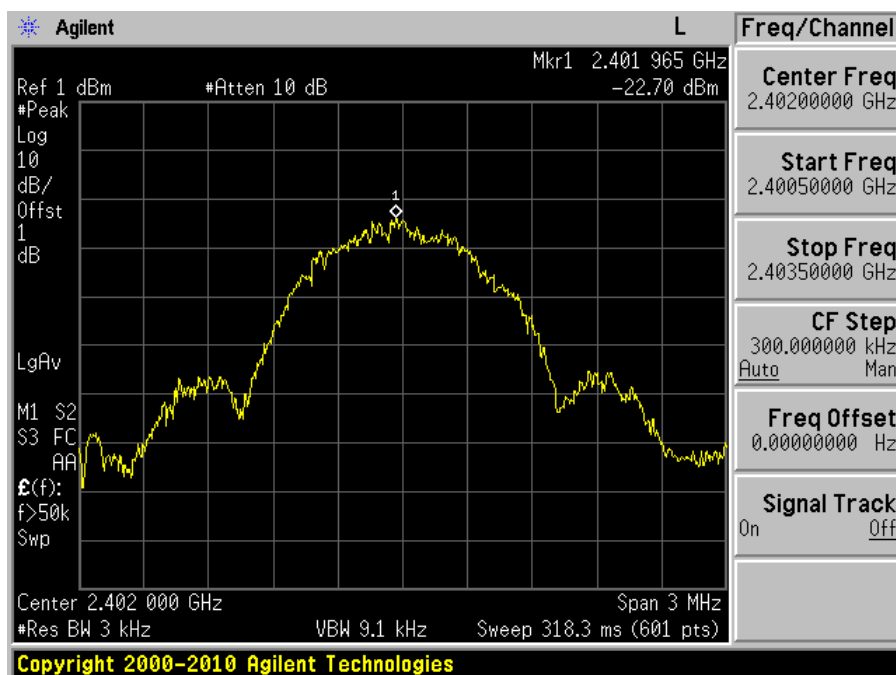
The testing was performed by Todd Moy on 2016-04-08 in RF site.

11.5 Test Results

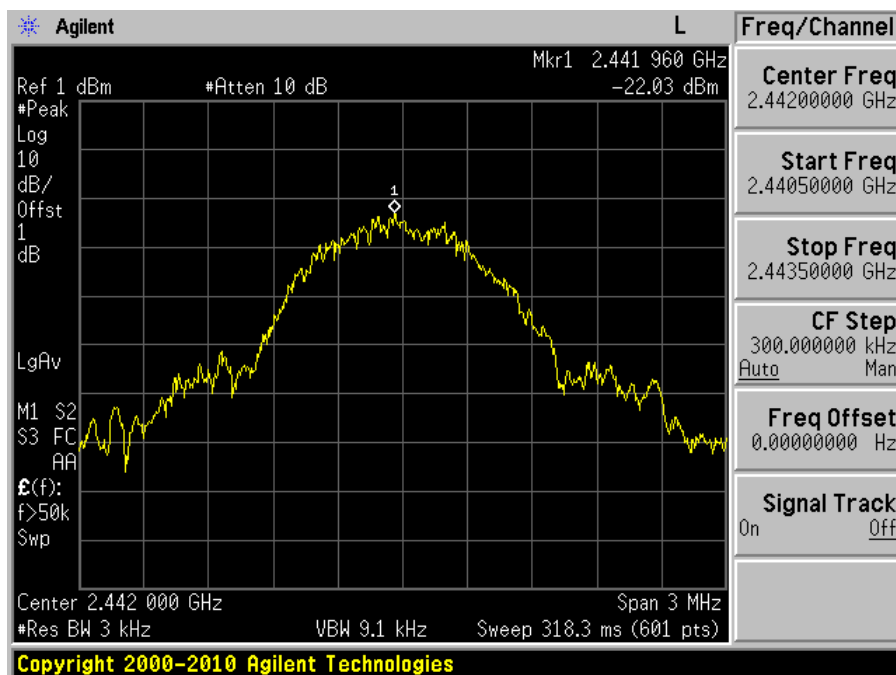
Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)
Low	2402	-22.70	8
Middle	2442	-22.03	8
High	2480	-22.31	8

Please refer to the following plots for detailed test results

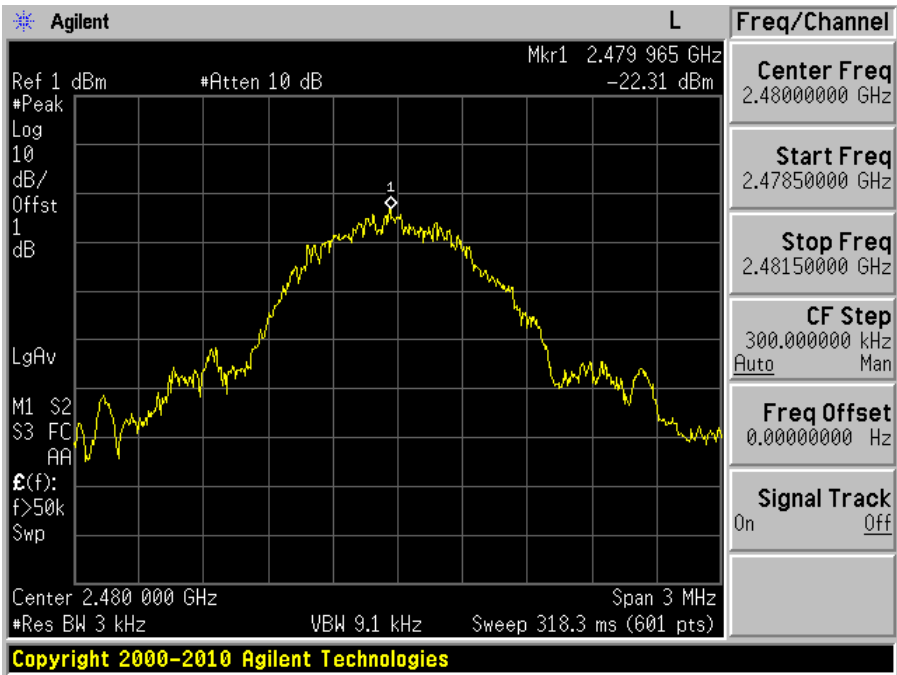
Low Channel 2402 MHz



Middle Channel 2442 MHz



High Channel 2480 MHz



12 FCC §15.247(d) – Spurious Emissions at Antenna Terminals

12.1 Applicable Standards

For 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)).

12.2 Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year

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

12.4 Test Environmental Conditions

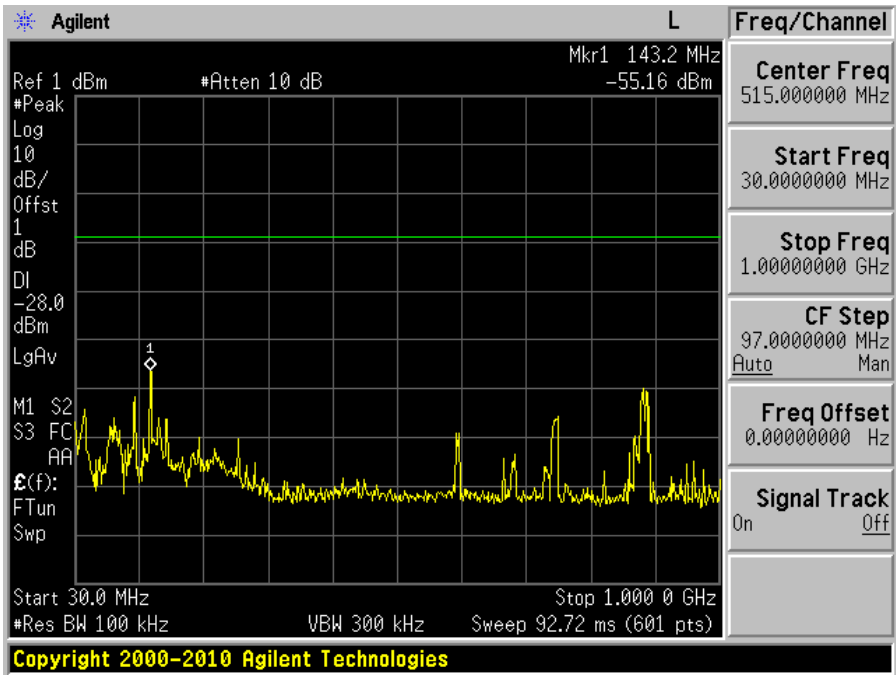
Temperature:	22° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Todd Moy on 2016-04-08 in RF site.

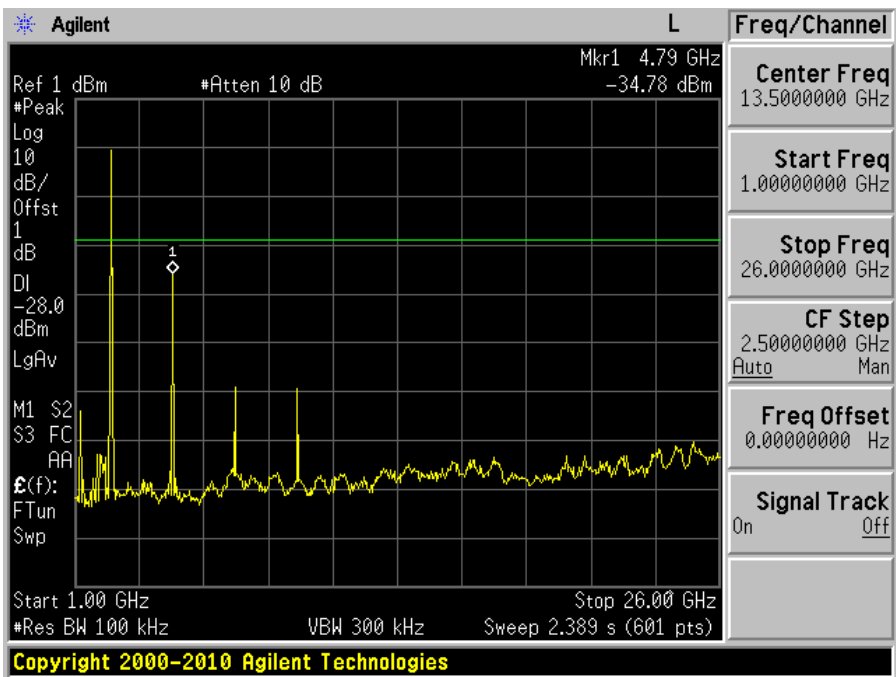
12.5 Test Results

Please refer to following plots.

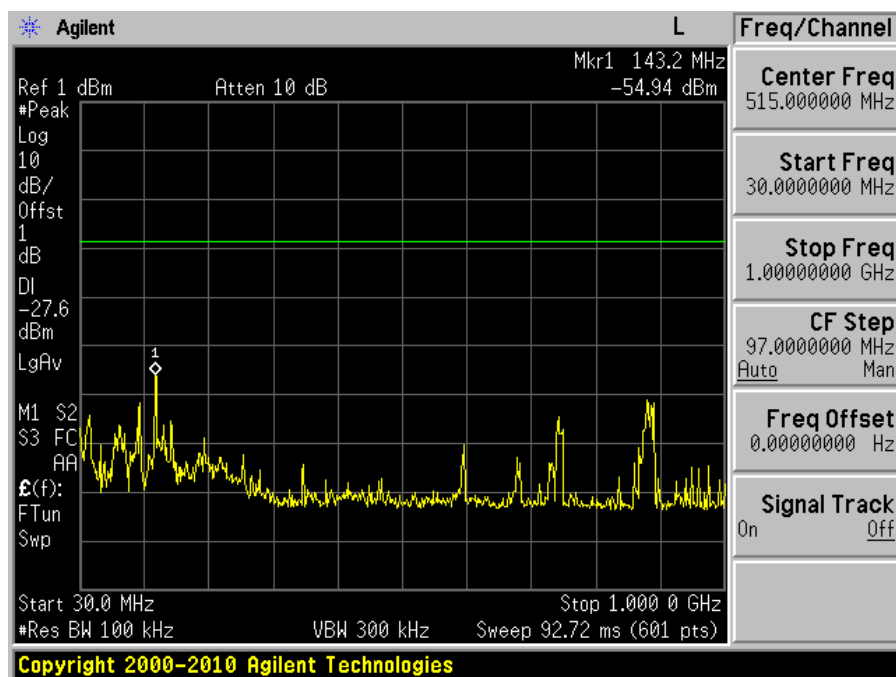
Low Channel 30 MHz – 3 GHz



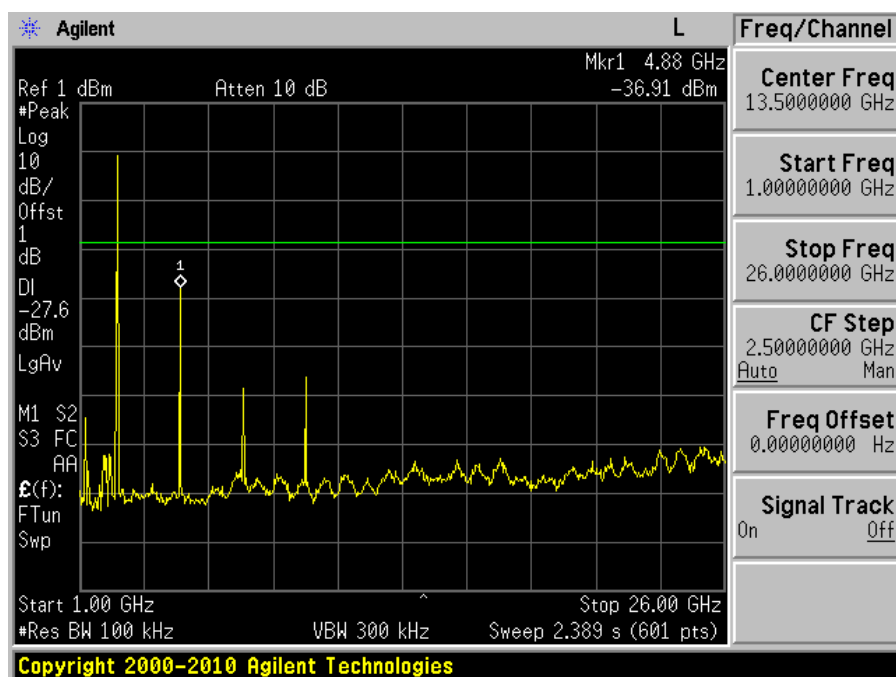
Low Channel 3 GHz – 26 GHz



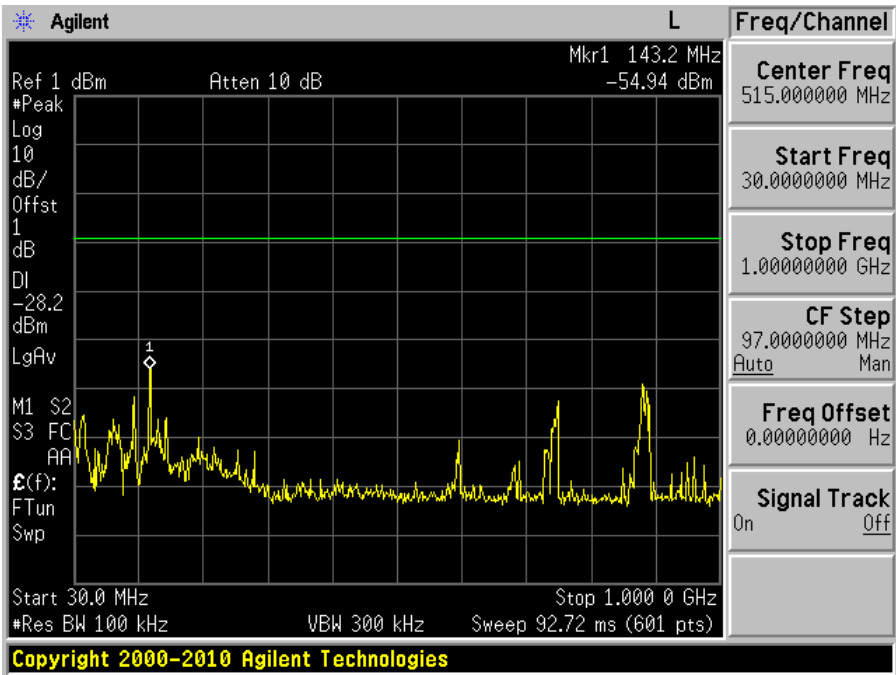
Middle Channel 30 MHz – 3 GHz



Middle Channel 3 GHz – 26 GHz



High Channel 30 MHz – 3 GHz



High Channel 3 GHz – 26 GHz

