FCC PART 15.407
ISEDC RSS-247, ISSUE 2, FEBRUARY 2017

TEST REPORT

For

Angie Hospitality, Inc.

6203 San Ignacio Avenue
San Jose, CA 95119

FCC ID: 2AQSG-73500010
IC:24166-73500010

Report Type:	**Product Type:**
Class II Permissive Change	802.11 a/b/g/n/ac Module

Prepared By:	Chin Ming Lui Test Engineer
Report Number:	R1807278-407
Report Date:	2018-11-29
Reviewed By:	Xiao Lin RF Lead
	Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue, Sunnyvale, CA 94089, USA Tel: (408) 732-9162 Fax: (408) 732-9164

TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1807278-407	CIIPC Report	2018-11-29

1 General Description

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Angie Hospitality, Inc.*, and their product model: *735-00010, FCC ID: 2AQSG-73500010, IC: 24166-73500010* or the "EUT" as referred to in this report. The product is an 802.11 a/b/g/n/ac Module.

1.2 Objective

This report is prepared on behalf of *Angie Hospitality, Inc.,* in accordance with FCC CFR47 §15.407 and ISEDC RSS-247 Issue 2, February 2017.

The objective is to determine compliance with FCC Part 15.407 and ISEDC RSS-247 rules for Antenna Requirements, and Radiated Spurious Emissions.

This project is a Permissive Change II submission for the purpose of certifying a customized DualBand Flag antenna by disabling 2.4GHz, 5.3GHz, and 5.6GHz bands, a/b/g/n/ac modes, and 40 and 80 MHz bandwidth channels. Also allowing this module co-locate with 4 other radios in one host. Those 4 radiaos are 2.4 GHz Wi-Fi module (*FCC ID: 2AQSG-73500011, IC: 24166-73500011*) with dipole loop antenna, 2.4GHz Wi-Fi module (*FCC ID: 2AQSG-73500011, IC: 24166-73500011*) with PiFa antenna, Bluetooth radio (*FCC ID: A8TBM64S2, IC: 12246A-BM64S2*) and ZigBee radio (*FCC ID: MCQ-XBS2C, IC: 1846A-XBS2C*)

1.3 Related Submittal(s)/Grant(s)

N/A

1.4 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, 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 789033 D02 General U-NII Test Procedures New Rules v02r01.

1.5 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 repeatabil

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Power Spectral Density, conducted	±1.48dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2 º C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.6 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Innovation, Science and Economic development Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.7 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3279.02),*** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide

range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.03)*** to certify

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Innovation, Science and Economic development Canada - ISEDC):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Infocomm Media Development Authority - IMDA):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IMDA MRA Recognition Scheme: 2011, Annex 2
  - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IMDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)
- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes & Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)

- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)
- for Commercial Ovens (ver. 2.1)
- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D- ***A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:***

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
  - Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

2 EUT Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013 and FCC KDB 789033 D02 General U-NII Test Procedures New Rules v02r01.

2.2 EUT Exercise Software

The test firmware used was Putty provided by *Angie Hospitality, Inc*. The software is compliant with the standard requirements being tested against.

2.3 Equipment Modifications

No modifications to the EUT were made.

2.4 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E6410

2.5 Support Equipment

Manufacturer	Description	Model
ASUS	Laptop	SonicMaster
Shenzhen ABP Technology Co., ltd.	Adapter	CGSW48-120-3730II

2.6 Interface Ports and Cabling

Cable Description	Length (m)	To	From
Ethernet Cable	2 m	Laptop	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

FCC and IC Rules	Description of Test	Result
FCC §15.203 ISEDC RSS-Gen Clause 6.8	Antenna Requirement	Compliant
FCC §2.1091, §15.407(f), ISED RSS-102	RF Exposure	Compliant
FCC §2.1053, §15.205, §15.209, 15.407(b) ISEDC RSS-247 Clause 6.2	Spurious Radiated Emissions	Compliant

4 FCC §15.203 and ISEDC RSS-Gen Clause 6.8 - 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

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

According to ISEDC RSS-Gen Clause 6.8: Transmitter Antenna

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

4.2 Antenna List

The antennas used by the EUT are permanent attached antennas.

Frequency Range (MHz)	Antenna Usage	Maximum Antenna Gain (dBi)	Antenna Type
5150 - 5850	5 GHz Wi-Fi	3.14	DualBand Flag

5 FCC §2.1091, §15.407(f) and ISED RSS-102 - RF Exposure

5.1 Applicable Standards

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

Limits for General Population/Uncontrolled Exposure

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

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

Before equipment certification is granted, the procedure of IC RSS-102 must be followed concerning the exposure of humans to RF field

According to ISED RSS-102 Issue 5:

2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz[6] and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

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

5.3 Antenna List

Frequency Range (MHz)	Antenna Usage	Maximum Antenna Gain (dBi)	Antenna Type
2400 - 2500	2.4 GHz Wi-fi	0.70	PiFa
2400 - 2500	2.4 GHz Wi-fi	2.80	Dipole Loop
5150 - 5850	5 GHz Wi-fi	3.14	DualBand Flag
2400 - 2500	Bluetooth	1.927	Printed PCB
2400 - 2500	Zigbee	19	Panel

5.4 MPE Results

2.4GHz Wi-Fi (PiFa Antenna, FCC ID: 2AQSG-73500011, IC: 24166-73500011):

Maximum peak output power at antenna input terminal (dBm):	16.04
Maximum peak output power at antenna input terminal (mW):	40.18
Prediction distance (cm):	20
Prediction frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	0.70
Maximum Antenna Gain (numeric):	1.175
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0094
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

2.4GHz Wi-Fi (Dipole Loop Antenna, FCC ID: 2AQSG-73500011, IC: 24166-73500011):

Maximum peak output power at antenna input terminal (dBm):	18.38
Maximum peak output power at antenna input terminal (mW):	68.87
Prediction distance (cm):	20
Prediction frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	2.80
Maximum Antenna Gain (numeric):	1.905
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0261
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

5 GHz band (FCC ID: 2AQSG-73500010, IC: 24166-73500010):

Maximum peak output power at antenna input terminal (dBm):	22.75
Maximum peak output power at antenna input terminal (mW):	188.36
Prediction distance (cm):	20
Prediction frequency (MHz):	5240
Maximum Antenna Gain, typical (dBi):	3.14
Maximum Antenna Gain (numeric):	2.061
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0772
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

Bluetooth (FCC ID: A8TBM64S2, IC: 12246A-BM64S2):

Maximum peak output power at antenna input terminal (dBm):	5.58
Maximum peak output power at antenna input terminal (mW):	3.614
Prediction distance (cm):	20
Prediction frequency (MHz):	2480
Maximum Antenna Gain, typical (dBi):	1.927
Maximum Antenna Gain (numeric):	1.558
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0011
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

Zigbee (FCC ID: MCQ-XBS2C, IC: 1846A-XBS2C):

Maximum peak output power at antenna input terminal (dBm):	7.97
Maximum peak output power at antenna input terminal (mW):	6.266
Prediction distance (cm):	20
Prediction frequency (MHz):	2405
Maximum Antenna Gain, typical (dBi):	19
Maximum Antenna Gain (numeric):	79.43
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0990
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

Multi Transmitter MPE Evaluation

2.4 GHz Wifi (Dipole Loop) + 2.4 GHz Wifi (PiFa) + 5GHz Wifi + Bluetooth + Zigbee =
$0.0094 + 0.0261 + 0.0772 + 0.0011 + 0.0990 = 0.2128$ $mW/cm^2 \leq 1.0$ mW/cm^2

Conclusion

The device is compliant with the requirement MPE limit for uncontrolled exposure. All transceiver modules must be installed with a separation distance of no less than **20** cm from all persons.

5.5 RF exposure evaluation exemption for IC

2.4GHz band (Dipole Loop): 16.04 + 0.70 dBi = 16.74dBm < $1.31\times10^{-2}f^{0.6834}$ = 2.703 W = 34.32 dBm

2.4GHz band (PiFa): 18.38 + 2.80 dBi = 21.18dBm < $1.31\times10^{-2}f^{0.6834}$ = 2.703 W = 34.32 dBm

5 GHz band: 22.75 + 3.14 dBi = 25.89dBm < $1.31\times10^{-2}f^{0.6834}$ = 4.561 W = 36.59 dBm

Bluetooth: 5.58 + 1.927 dBi = 7.507dBm < $1.31\times10^{-2}f^{0.6834}$ = 2.736 W = 34.37 dBm

Zigbee: 7.97 + 19 dBi = 26.97dBm < $1.31\times10^{-2}f^{0.6834}$ = 2.679 W = 34.28 dBm

Multi Transmitter RF exposure Evaluation

2.4GHz band (Dipole Loop) + 2.4GHz band (PiFa) + 5GHz Wifi + Bluetooth + Zigbee =
30.29 dBm < 34.28 dBm

Conclusion

Therefore the RF exposure is not required. All transceiver modules must be installed with a separation distance of no less than **20** cm from all persons.

6 FCC §15.209, §15.407(b) and ISEDC RSS-247 Clause 6.2 - Spurious Radiated Emissions

6.1 Applicable Standard

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	3332 – 3339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3345.8 – 3358	23.6 – 24.0
12.29 – 12.293	240 – 285	3600 – 4400	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: The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100 Note 1	3
88 - 216	150 Note 1	3
216 - 960	200 Note 1	3
Above 960	500	3

Note 1: Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per FCC Part 15.407 (b)

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(3) For transmitters operating in the 5.47 -5.725 GHz band: All emissions outside of the 5.47-5725 GHz band shall not exceed an ei.r.p. of -27 dBm/MHz.

(4) For transmitters operating in the 5.725-5.85 GHz band:

(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

(ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.

(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

(7) The provisions of §15.205 apply to intentional radiators operating under this section.

As per ISEDC RSS-247 Clause 6.2

For transmitters with operating frequencies in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. Any unwanted emissions that fall into the band 5250-5350 MHz shall be attenuated below the channel power by at least 26 dB, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth (i.e. 99% bandwidth), above 5250 MHz. The 26 dB bandwidth may fall into the 5250-5350 MHz band; however, if the occupied bandwidth also falls within the 5250-5350 MHz band, the transmission is considered as intentional and the devices shall comply with all requirements in the band 5250-5350 MHz including implementing dynamic frequency selection (DFS) and TPC, on the portion of the emission that resides in the 5250- 5350 MHz band.

For devices with both operating frequencies and channel bandwidths contained within the band 5250-5350 MHz, the device shall comply with the following:

1. All emissions outside the band 5250-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p.; or
2. All emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. and its power shall comply with the spectral power density for operation within the band 5150-5250 MHz. The device, except devices installed in vehicles, shall be labelled or include in the user manual the following text “for indoor use only.”

For transmitters operating in the band 5470-5725 MHz, emissions outside the band 5470-5725 MHz shall not exceed -27 dBm/MHz e.i.r.p. However, devices with bandwidth overlapping the band edge of 5725 MHz can meet the emission limit of -27 dBm/MHz e.i.r.p. at 5850 MHz instead of 5725 MHz.

For the band 5725-5850 MHz, devices operating in the band 5725-5850 MHz shall have e.i.r.p. of unwanted emissions comply with the following:
a) 27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 dBm/MHz at 5 MHz above or below the band edges;
b) 15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges;
c) 10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to -27 dBm/MHz at 75 MHz above or below the band edges; and
d) -27 dBm/MHz at frequencies more than 75 MHz above or below the band edges

6.2 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 15.407 and ISEDC RSS-247 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.

6.3 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 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 or 1.5 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 = 3MHz / Sweep = 100ms
(2) Average: RBW = 1MHz / VBW = 10Hz or 1/T/ Sweep = Auto

6.4 Corrected Amplitude and 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 for Class A. The equation for margin calculation is as follows:

Margin = Corrected Amplitude – Limit

6.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde and Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100338	2018-07-05	2 years
Agilent	Analyzer, Spectrum	E4446A	US44300386	2018-06-01	1 year
Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
Sunol Sciences	Antenna, Biconi-Log	JB1	A013105-3	2018-02-26	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2018-04-02	1 year
IW	AOBOR Hi frequency Co AX Cable	KPS-1501N-3960-KPS	-	2018-01-11	1 year
-	SMA-Type Cable	-	C00011	Each time[1]	N/A
-	N-Type Cable	-	C00012	Each time[1]	N/A
-	N-Type Cable	-	C00014	Each time[1]	N/A
HP	Amplifier, Pre	8449B	3147A00400	2018-02-02	1 year
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2017-03-27	2 years
Wisewave	Antenna, Horn	ARH-2823-02	10555-01	2018-01-18	2 years
Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2017-12-15	2 years
A.H. Systems	Pre-Amplifer	PAM 1840V	170	2018-09-10	1 year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 09 June 2016) "A2LA Policy on Metrological Traceability".*

Note[1]: cables and attenuators included in the test set-up will be checked each time before testing.

6.6 Test Environmental Conditions

Temperature:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Chin Ming Lui on 2018-10-01 in 5m chamber 3.

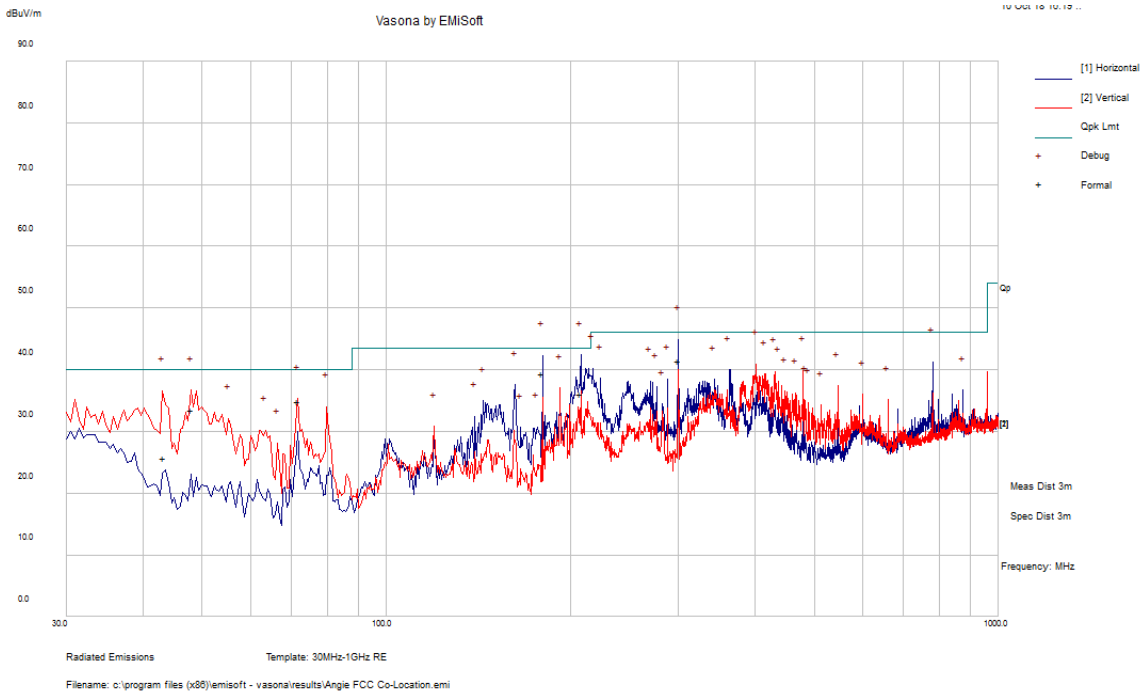
6.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Part 15.407 and RSS-247 standards' radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-0.50	10400	Vertical	ac20, middle channel

6.8 Radiated Emissions Test Result Data

1) 30 MHz – 1 GHz



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comments (PK/QP/Ave.)
300.0003	41.53	131	H	85	46	-4.47	QP
207.8225	36.06	150	H	295	43.5	-7.44	QP
179.9968	39.37	133	H	269	43.5	-4.13	QP
47.97625	33.57	100	V	134	40	-6.43	QP
43.29975	25.7	153	V	307	40	-14.3	QP
71.62975	34.82	128	V	192	40	-5.18	QP

Note: Co-Location testing with five radios enabled, with each transmitting at worst case channel:

- 2.4 GHz TopLink Dipole Loop
- 2.4 GHz TopLink PiFa
- 5 GHz UNEX
- Bluetooth
- Zigbee

2) 1–40 GHz

5150 - 5250 MHz

802.11ac20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5180 MHz ac20 mode power setting: 55, 52											
5180	66.47	52	238	H	33.59	8.53	0.00	108.59	-	-	PK
5180	59.06	52	238	H	33.59	8.53	0.00	101.18	-	-	AV
5180	66.31	249	287	V	33.58	8.53	0.00	108.42	-	-	PK
5180	58.10	249	287	V	33.58	8.53	0.00	100.21	-	-	AV
5150	47.34	89	252	H	33.53	9.82	35.55	55.14	74.00	-18.87	PK
5150	35.74	89	252	H	33.53	9.82	35.55	43.54	54.00	-10.47	AV
5150	47.70	165	115	V	33.42	9.82	35.55	55.39	74.00	-18.61	PK
5150	36.48	165	115	V	33.42	9.82	35.55	44.17	54.00	-9.83	AV
10360	46.04	252	254	H	38.15	14.62	34.93	63.88	74.00	-10.12	PK
10360	34.81	252	254	H	38.15	14.62	34.93	52.65	54.00	-1.35	AV
10360	45.67	140	115	V	38.09	14.62	34.93	63.45	74.00	-10.55	PK
10360	34.85	140	115	V	38.09	14.62	34.93	52.63	54.00	-1.37	AV
Middle Channel 5200 MHz ac20 mode power setting: 60, 57											
5200	69.30	52	237	H	33.59	8.53	0.00	111.42	-	-	PK
5200	61.89	52	237	H	33.59	8.53	0.00	104.01	-	-	AV
5200	72.15	164	113	V	33.58	8.53	0.00	114.26	-	-	PK
5200	63.64	164	113	V	33.58	8.53	0.00	105.75	-	-	AV
10400	46.13	251	254	H	38.20	14.62	34.93	64.02	74.00	-9.98	PK
10400	35.43	251	254	H	38.20	14.62	34.93	53.32	54.00	-0.68	AV
10400	47.53	138	116	V	38.12	14.62	34.93	65.34	74.00	-8.66	PK
10400	35.69	138	116	V	38.12	14.62	34.93	53.50	54.00	-0.50	AV
High Channel 5240 MHz ac20 mode power setting: 63, 59											
5240	70.37	48	222	H	33.62	8.53	0.00	112.52	-	-	PK
5240	62.61	48	222	H	33.62	8.53	0.00	104.76	-	-	AV
5240	70.28	254	300	V	33.56	8.53	0.00	112.37	-	-	PK
5240	62.32	254	300	V	33.56	8.53	0.00	104.41	-	-	AV
10480	45.60	246	100	H	38.26	14.71	34.85	63.71	74.00	-10.29	PK
10480	34.87	246	100	H	38.26	14.71	34.85	52.98	54.00	-1.02	AV
10480	46.28	335	279	V	38.19	14.71	34.85	64.33	74.00	-9.67	PK
10480	34.95	335	279	V	38.19	14.71	34.85	53.00	54.00	-1.00	AV

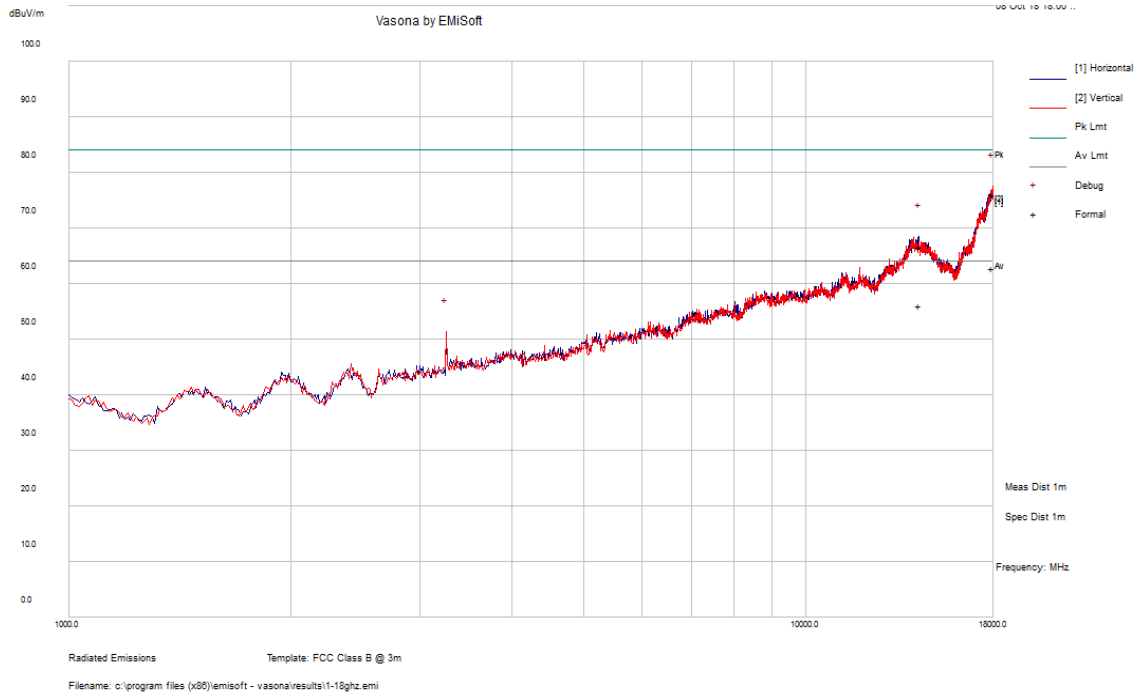
5725 - 5850 MHz

802.11ac20 mode

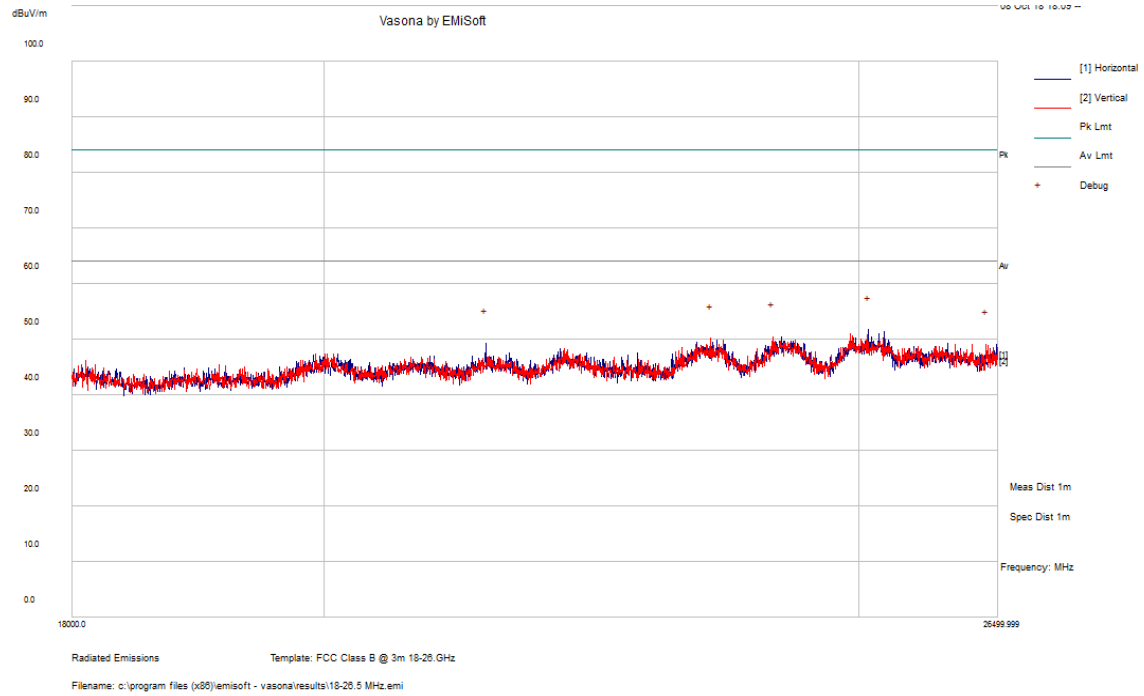
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5745 MHz ac20 mode (Power Setting: 49, 50)											
5745	65.67	27	253	H	34.07	9.00	0.00	108.74	-	-	PK
5745	56.68	27	253	H	34.07	9.00	0.00	99.75	-	-	AV
5745	64.84	352	290	V	33.97	9.00	0.00	107.81	-	-	PK
5745	56.18	352	290	V	33.97	9.00	0.00	99.15	-	-	AV
5725	54.29	129	266	H	34.07	10.31	35.47	63.20	68.26	-5.07	PK
5725	54.50	350	288	V	33.97	10.31	35.47	63.31	68.26	-4.95	PK
11490	43.57	238	100	H	38.45	12.88	34.36	60.54	74.00	-13.46	PK
11490	32.47	238	100	H	38.45	12.88	34.36	49.44	54.00	-4.56	AV
11490	44.25	138	100	V	38.38	12.88	34.36	61.15	74.00	-12.85	PK
11490	32.88	138	100	V	38.38	12.88	34.36	49.78	54.00	-4.22	AV
Middle Channel 5785 MHz ac20 mode (Power Setting: 50, 51)											
5785	65.53	27	255	H	34.17	9.10	0.00	108.80	-	-	PK
5785	57.06	27	255	H	34.17	9.10	0.00	100.33	-	-	AV
5785	63.62	354	300	V	34.04	9.10	0.00	106.76	-	-	PK
5785	55.26	354	300	V	34.04	9.10	0.00	98.40	-	-	AV
11570	44.48	266	255	H	38.46	11.34	34.38	59.90	74.00	-14.10	PK
11570	33.78	266	255	H	38.46	11.34	34.38	49.20	54.00	-4.80	AV
11570	44.08	74	204	V	38.38	11.34	34.38	59.41	74.00	-14.59	PK
11570	33.07	74	204	V	38.38	11.34	34.38	48.40	54.00	-5.60	AV
High Channel 5825 MHz ac20 mode (Power Setting: 46, 50)											
5825	63.70	26	227	H	34.24	9.10	0.00	107.04	-	-	PK
5825	55.70	26	227	H	34.24	9.10	0.00	99.04	-	-	AV
5825	62.02	346	288	V	34.14	9.10	0.00	105.26	-	-	PK
5825	53.95	346	288	V	34.14	9.10	0.00	97.19	-	-	AV
5850	45.91	0	100	H	34.24	10.00	35.45	54.69	68.26	-13.57	PK
5850	46.21	0	100	V	34.14	10.00	35.45	54.89	68.26	-13.37	PK
11650	44.26	299	247	H	38.60	11.19	34.39	59.66	74.00	-14.34	PK
11650	32.99	299	247	H	38.60	11.19	34.39	48.39	54.00	-5.61	AV
11650	44.68	227	100	V	38.55	11.19	34.39	60.03	74.00	-13.97	PK
11650	33.69	227	100	V	38.55	11.19	34.39	49.04	54.00	-4.96	AV

3) Co-Location Above 1 GHz

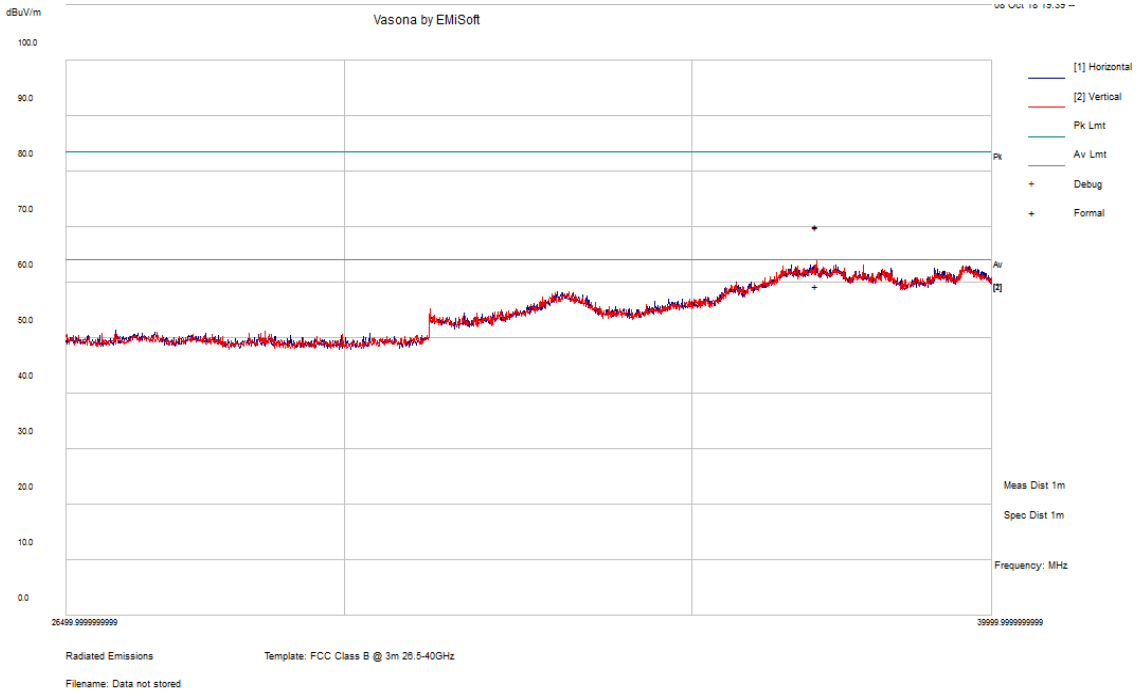
1 – 18 GHz



18 – 26.5 GHz



26.5 – 40 GHz


dBuV/m
Vasona by EMiSoft
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
26499.9999999999
39999.9999999999
[1] Horizontal
[2] Vertical
Pk Lmt
Av Lmt
Debug
Formal
Meas Dist 1m
Spec Dist 1m
Frequency: MHz
Radiated Emissions
Template: FCC Class B @ 3m 26.5-40GHz
Filename: Data not stored

7 Appendix A – EUT Test Setup Photographs

Please refer to the attachment

8 Appendix B (Normative) - A2LA Electrical Testing Certificate

Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets A2LA R222 - *Specific Requirements EPA ENERGY STAR Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system *(refer to joint ISO-ILAC-IAF Communiqué dated April 2017)*.

Presented this 2nd day of October 2018.

President and CEO
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2020

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

--- END OF REPORT ---