



FCC PART 15, SUBPART C
ISED C RSS-247, ISSUE 2, FEBRUARY 2017

TEST REPORT

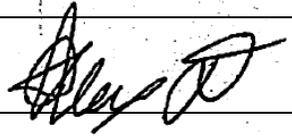
For

Axon Enterprise, Inc.

17800 N. 85th Street,

Scottsdale, Arizona, United States 85255

FCC ID: X4GS01165
IC: 8803A-S01165

Report Type: Original Report	Product Type: Junction Box
Prepared By Alexandrae Duran Test Technician	
Report Number R1902277-DSS	
Report Date 2019-04-01	
Reviewed By Frank Wang RF Lead	
Bay Area Compliance Laboratories Corp. 1274 Anvilwood Ave 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 "*" en-2

TABLE OF CONTENTS

1	General Description.....	5
1.1	Product Description for Equipment Under Test (EUT)	5
1.2	Objective.....	5
1.3	Related Submittal(s)/Grant(s).....	5
1.4	Test Methodology	5
1.5	Measurement Uncertainty	6
1.6	Test Facility Registrations	6
1.7	Test Facility Accreditations	6
2	System Test Configuration.....	9
2.1	Justification.....	9
2.2	EUT Exercise Software.....	9
2.3	Duty Cycle Correction Factor.....	9
2.4	Equipment Modifications.....	10
2.5	Local Support Equipment	10
2.6	Support Equipment	11
2.7	Power Supply/Adapter	11
2.8	Interface Ports and Cabling.....	11
3	Summary of Test Results	12
4	FCC §15.203 & ISEDC RSS-Gen §6.8 - Antenna Requirements	13
4.1	Applicable Standards	13
4.2	Antenna Description	14
5	FCC §2.1091, §15.247(i) & ISEDC RSS-102 - RF Exposure.....	15
5.1	Applicable Standards	15
5.2	MPE Prediction.....	16
5.3	MPE Results	16
5.4	RF exposure evaluation exemption for IC	16
7	FCC §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10 - Spurious Radiated Emissions.....	17
7.1	Applicable Standards	17
7.2	Test Setup	20
7.3	Test Procedure	20
7.4	Corrected Amplitude and Margin Calculation	20
7.5	Test Equipment List and Details.....	21
7.6	Test Environmental Conditions	21
7.7	Summary of Test Results	22
8	FCC §15.247(a) (1) & ISEDC RSS-247 §5.1, RSS-Gen §6.6 - Emission Bandwidth.....	27
8.1	Applicable Standards	27
8.2	Measurement Procedure.....	27
8.3	Test Equipment List and Details.....	27
8.4	Test Environmental Conditions	27
8.5	Test Results.....	28
9	FCC §15.247(b)(1) & ISEDC RSS-247 §5.4 - Output Power	30
9.1	Applicable Standards	30
9.2	Measurement Procedure.....	30
9.3	Test Equipment List and Details.....	30
9.4	Test Environmental Conditions	30
9.5	Test Results.....	31
10	FCC §15.247(d) & ISEDC RSS-247 §5.5 - 100 kHz Bandwidth of Band Edges.....	33
10.1	Applicable Standards	33
10.2	Measurement Procedure.....	33
10.3	Test Equipment List and Details.....	33
10.4	Test Environmental Conditions	34
10.5	Test Results.....	34

11 FCC §15.247(a)(1)(iii) & ISEDC RSS-247 §5.1(4) - Dwell Time	35
11.1 Applicable Standards	35
11.2 Measurement Procedure.....	35
11.3 Test Equipment List and Details.....	36
11.4 Test Environmental Conditions	36
11.5 Test Results.....	37
12 FCC §15.247(a)(1)(iii) & ISEDC RSS-247 §5.1(4) - Number of Hopping Channels.....	39
12.1 Applicable Standards	39
12.2 Test Procedure	39
12.3 Test Equipment List and Details.....	39
12.4 Test Environmental Conditions	39
12.5 Test Results.....	40
13 FCC §15.247(a)(1) & ISEDC RSS-247 §5.1(2) - Hopping Channel Separation	41
13.1 Applicable Standards	41
13.2 Test Procedure	41
13.3 Test Equipment List and Details.....	41
13.4 Test Environmental Conditions	41
13.5 Test Results.....	42
14 FCC §15.247(d) & ISEDC RSS-247 §5.5 - Spurious Emissions at Antenna Terminals	44
14.1 Applicable Standards	44
14.2 Test Procedure	44
14.3 Test Equipment List and Details.....	44
14.4 Test Environmental Conditions	45
14.5 Test Results.....	45
15 Exhibit A - FCC & ISED Equipment Labeling Requirements.....	46
15.1 FCC ID Label Requirements	46
15.2 IC Label Requirements	46
15.3 Recommended Label Contents and Location	47
16 Appendix A- EUT Test Setup Photographs	48
17 Appendix B- EUT External Photographs.....	49
18 Appendix C- EUT Internal Photographs.....	50
19 Appendix D (Normative) - A2LA Electrical Testing Certificate	51

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1902277-DSS	Original Report	2019-04-01

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

Manufacturer:	Axon Enterprise, Inc.
EUT Name:	Axon Fleet 2 Junction Box
EUT Model(s):	AX1017
FCC ID:	X4GS01165
IC:	8803A-S01165
Serial Number(s):	X58000502

This test and measurement report was prepared on behalf of *Axon Enterprise, Inc.*, and their product model: *AX1017*, FCC ID: X4GS01165 IC: 8803A-S01165, or the “EUT” as referred to in this report. The EUT is a junction box for *Axon Fleet 2* vehicle system.

The RF chipset utilized in this system is a 2.4GHz transceiver pair – the “PurePath Wireless” Chipset (CC8520 IC), and range extender (CC2592). One transceiver is located in the Wireless Mic and it is used to transmit digitized audio over the air to the receiving end. This receiver is called the Junction Box (the EUT), and it is where the other transceiver is located.

1.2 Objective

This report is prepared on behalf of *Axon Enterprise Inc.* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission’s rules and ISEDC RSS-247 Issue 2, February 2017.

The objective is to determine compliance with FCC Part 15.247 and ISEDC RSS-247 rules for Output Power, Antenna Requirements, RF Exposure, 20 dB Bandwidth, 100 kHz Bandwidth of Band Edges Measurement, Hopping Channel Separation, Number of Frequencies Used, Dwell Time, as well as Conducted and Radiated Spurious Emissions.

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 of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB 558074 D01 DTS Meas Guidance v04: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.

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 repeatability.

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 ° 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 Industry 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 (Industry Canada):
 - 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 (Info-Communications Development Authority (IDA)):
 - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA 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):
 - o BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
 - o NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
 - o EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
 - o Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
 - o 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:
 - o ENERGY STAR Recognized Test Laboratory – US EPA
 - o Telecommunications Certification Body (TCB) – US FCC;
 - o Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

The EUT was configured for testing in accordance to ANSI C63.10-2013

The worst-case data rates are determined by measuring the peak power across all data rates.

2.2 EUT Exercise Software

The test firmware used for fixed channel measurement was *WirelessMic_rfctest_2-18.bin*. And the test firmware used for hopping channel measurement was *WirelessMic_v2.2.4._radiopwr_0db.bin*. The test software used was *PuTTY* version: *Release 0.70*, and *adm_tool* version: *build 3.7.170929.1603-48-gf379999*. The firmware and software were supplied by *Axon Enterprise, Inc.* The software complies with the standard requirements being tested against

Modulation	Frequency (MHz)	Power Setting
2FSK	2406	0
	2442	0
	2474	0

2.3 Duty Cycle Correction Factor

According to ANSI C63.10-2013 section 7.5:

Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 s (100 ms). In cases where the pulse train exceeds 0.1 s, the measured field strength shall be determined during a 0.1 s interval. The following procedure is an example of how the average value may be determined. The average field strength may be found by measuring the peak pulse amplitude (in log equivalent units) and determining the duty cycle correction factor (in dB) associated with the pulse modulation as shown in following equation:

$$\delta(\text{dB}) = 20\log(\Delta)$$

where: δ is the duty cycle correction factor (dB)
 Δ is the duty cycle (dimensionless)

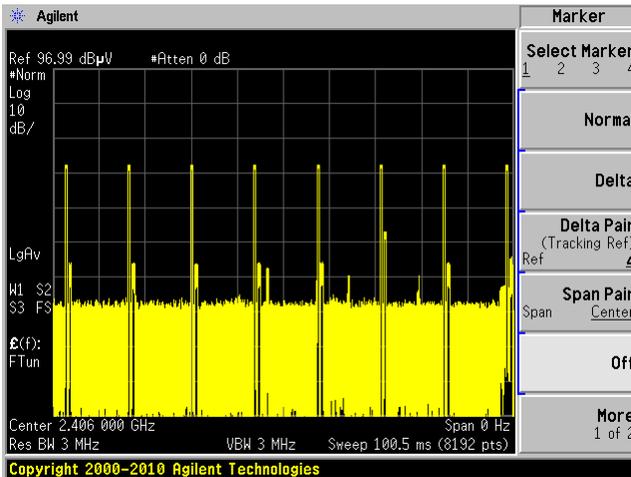
Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
2FSK	3.4816	100	3.48	-29.16

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

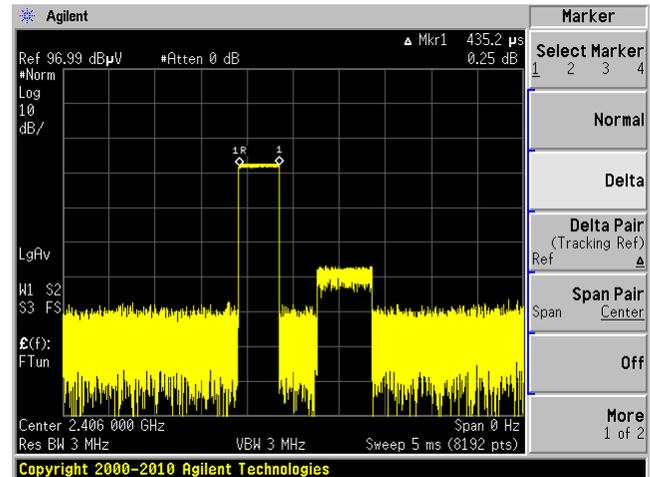
Note: The testing and calculation is performed on the normal frequency hopping mode.

Please refer to the following plots.

Pulses in 100 ms



Pulse Width



2.4 Equipment Modifications

Cables were soldered to the EUT's main board to configure the EUT for testing.

2.5 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Dell	Laptop	Latitude E6410	3CKRAQ1

2.6 Support Equipment

Manufacturer	Description	Model	Serial Number
SparkFun	USB to Serial UART I/O Expander	FT232RL	N/A

2.7 Power Supply/Adapter

Manufacturer	Description	Model
BK Precision	DC Power Supply	1740

2.8 Interface Ports and Cabling

Description	Length (m)	To	From
U.F.L to SMA	< 1 m	PSA	EUT
USB 2.0 Type A to Micro USB Cable	<1m	Laptop	EUT
DC Power Supply Cables	< 1 m	EUT	Power Supply

3 Summary of Test Results

Results reported relate only to the product tested.

FCC and ISEDC Rules	Description of Test	Results
FCC §15.203 ISEDC RSS-Gen §6.8	Antenna Requirement	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	N/A*
FCC §2.1091, §15.247(i) ISEDC RSS-102	RF Exposure	Compliant
FCC §2.1051, §15.247(d) ISEDC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant
FCC §2.1053, §15.205, §15.209, §15.247(d) ISEDC RSS-247 §5.5 ISEDC RSS-Gen §8.9, §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(1) ISEDC RSS-247 §5.1(1) ISEDC RSS-Gen §6.6	20 dB and 99% Emission Bandwidth	Compliant
FCC §15.247(b)(1) ISEDC RSS-247 §5.4	Maximum Peak Output Power	Compliant
FCC §15.247(d) ISEDC RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(a)(1)(iii) ISEDC RSS-247 §5.1(4)	Number of Hopping Channels	Compliant
FCC §15.247(a)(1) ISEDC RSS-247 §5.1(2)	Hopping Channel Separation	Compliant
FCC §15.247(a)(1)(iii) ISEDC RSS-247 §5.1 (4)	Dwell Time	Compliant

Note: EUT is DC powered, no AC Line conducted emission testing is needed.

4 FCC §15.203 & ISEDC RSS-Gen §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.

According to ISEDC RSS-Gen §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 license-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 Description

The antenna is connected by U.F.L port.

Antenna Name	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
PurePath	2406-2474	5.0

5 FCC §2.1091, §15.247(i) & ISEDC 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

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 MHzFootnote6 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 $22.48/f0.5$ 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 $1.31 \times 10^{-2} f0.6834$ 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 MPE Results

2.4 GHz PurePath Wireless

<u>Maximum output power at antenna input terminal (dBm):</u>	<u>15.98</u>
<u>Maximum output power at antenna input terminal (mW):</u>	<u>39.63</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>2406</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>5.0</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>3.16</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.024914</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.024914mW/cm². Limit is 1.0 mW/cm².

5.4 RF exposure evaluation exemption for IC

2.4 GHz PurePath Wireless

$$15.98 + 5.0 \text{ dBi} = 20.98 \text{ dBm} < 1.31 \times 10^{-2} * f^{0.6834} = 2.679 \text{ W} = 34.280 \text{ dBm}$$

Therefore the RF exposure is not required.

7 FCC §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10 - 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) and RSS-Gen 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	3500 – 4400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4	4500 – 5150	36.43 – 36.5
12.57675 – 12.57725	399.9 – 410	5350 – 5460	Above 38.6
13.36 – 13.41	608 – 614	7250 – 7750	
		8025 – 8500	

ISED RSS-Gen §8.10 Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	12.36 - 13.41	608 - 614	
2.1.35 - 2.1905	16.42-16.432	960 - 1427	
3.020 - 3.026	6.42-16.432	1435 - 1626.5	9.0 - 9.2
4.125 - 4.128	16.69475 - 16.69525	1660 - 1710	9.3 - 9.5
4.17725 - 4.17775	16.80425 - 12.80475	1718.8-1722.22	10.6 - 12.7
4.20725 - 4.20775	25.5 - 25.67	2200 - 2300	13.25 - 13.4
5.677 - 5.683	37 - 38.25	2310 - 2390	14.47 - 14.5
6.215 - 6.218	73 - 74.6	2655 - 2900	15.36 - 16.2
6.26775 - 6.26825	74-75.2	3260 - 3267	17.7 - 21.4
6.31175 - 6.31225	108 - 138	3332 - 3339	22.01 -23.12
8.291 - 8.294	156.52475 - 156.52525	3345.8 - 3358	23.6 - 24.0
8.362 - 8.366	156.7 - 156.9	3500 - 4400	31.2 - 36.5
8.37625 - 8.38675	240 - 285	4500 - 5150	Above 38.6
8.41425 - 8.41475	322 - 335.4	5350 - 5460	
12.29 - 12.293	399.9 - 410	7250 - 7750	
12.57675 - 12.57725		8025 -8500	

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)).

As per ISEDC RSS-Gen 8.9,

Except when the requirements applicable to a given device state otherwise, emission from license-exempt transmitters shall comply with the field strength limits shown in the table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

General Field Strength Limits for License-Exemption Transmitters at Frequencies above 30 Mhz

Frequency (MHz)	Field Strength ($\mu\text{v}/\text{m}$ at 3 meters)
30-88	100
88-216	150
216-960	200
Above 960*	500

* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for license-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a

linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

As per ISEDC RSS-247 §5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

7.2 Test Setup

The radiated emissions tests were performed in a 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15 Subpart C 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.

7.3 Test Procedure

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 1.5 meter above the ground plane for above 1000 MHz measurements, the table shall be rotated for 360 degrees to ascertain the highest emission. The receiving antenna will be oriented by the polarizations of horizontal and vertical positions.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

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

Above 1000 MHz:

- (1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = 100 ms
- (2) Average: Peak+DCCF

7.4 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:

$$\text{CA} = \text{Ai} + \text{AF} + \text{CL} + \text{Atten} - \text{Ga}$$

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 and Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100044	2017-09-19	2 years
Agilent	Analyzer, Spectrum	E4446A	US44300386	2018-06-01	1 year
Rohde & Schwarz	Analyzer, Spectrum	FSQ26	200749	2017-06-08	2 years
Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
Sunol Sciences	Antenna, Biconi-Log	JB1	A013105-3	2018-02-26	2 years
Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2017-12-15	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2018-04-02	1 year
IW	AOBOR Hi frequency Co AX Cable	DC 1531	KPS-1501A3960KPS	2018-01-11	1 year
-	SMA 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	Pre-Amplifier	8449B	3008A01978	2018-08-10	1 year
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2017-03-27	2 years
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

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

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 9 June 2016) “A2LA Policy on Metrological Traceability”.

7.6 Test Environmental Conditions

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

The testing was performed by Harry Zhao, Zhao Zhao, and Alexandrae Duran between 2019-03-05 and 2019-03-14 in 5m chamber 3.

7.7 Summary of Test Results

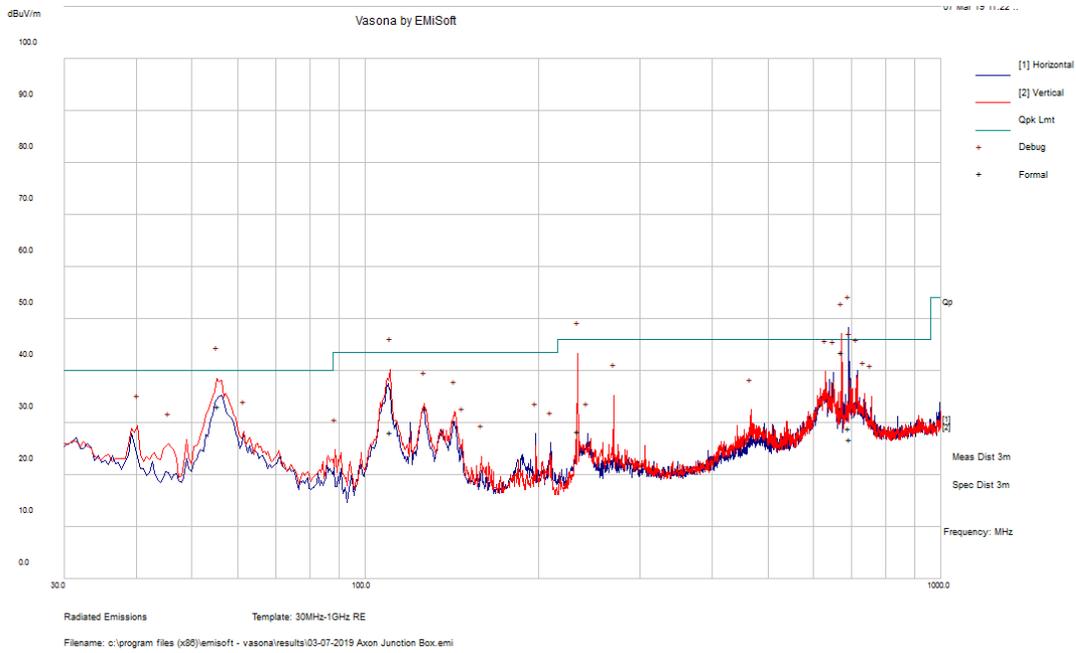
According to the data hereinafter, the EUT complied with FCC Title 47, Part 15C and ISEDC RSS-247 standard's radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Fundamental Channel (MHz)
-2.44	672.009	Vertical	2406

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

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

Low Channel 2406 MHz



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
691.3038	29.01	194	H	341	46	-16.99	QP
672.009	43.56	171	V	99	46	-2.44	QP
55.3785	33.15	227	V	67	40	-6.85	QP
233.822	28.39	228	V	38	46	-17.61	QP
110.586	28.27	208	V	327	43.5	-15.23	QP
694.0883	26.85	282	H	12	46	-19.15	QP

2) 1–18 GHz Measured at 3 meters

Peak Measurement

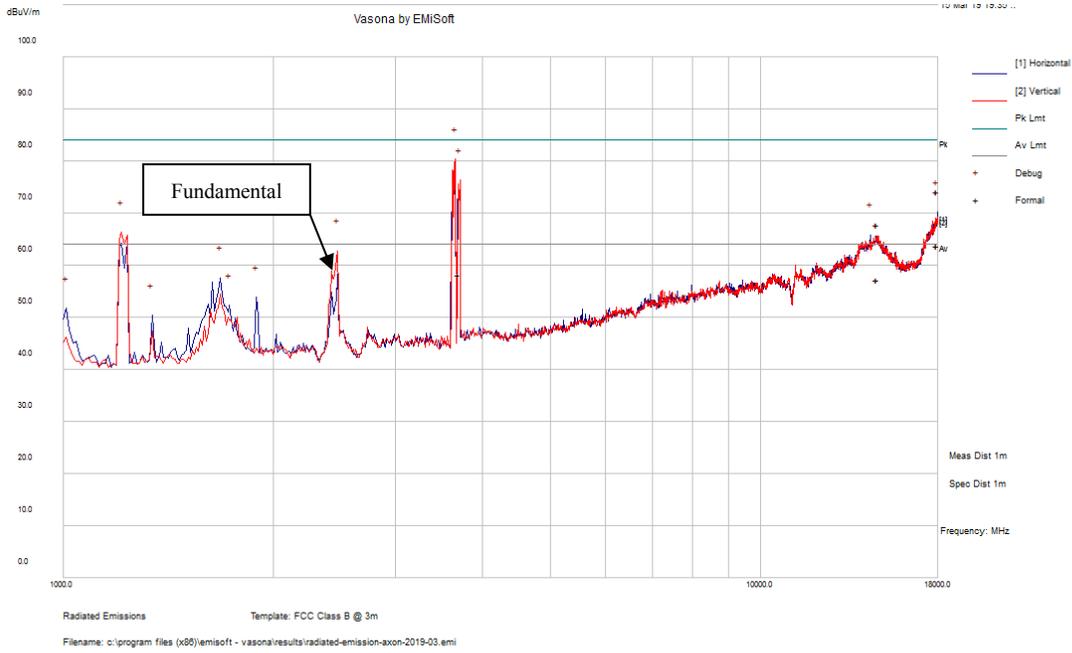
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2406 MHz (power setting: 0)											
2406	72.04	302	233	H	28.94	5.76	0.00	106.74	-	-	PK
2406	77.46	135	195	V	28.93	5.76	0.00	112.15	-	-	PK
2390	26.39	302	233	H	28.94	5.76	0.00	61.09	74	-12.91	PK
2390	27.26	135	195	V	28.93	5.76	0.00	61.95	74	-12.05	PK
3709.998	65.64	100	223	V	32.10	5.97	35.66	68.05	74	-5.95	PK
4812	45.12	0	100	V	32.56	8.52	35.66	50.54	74	-23.46	PK
7218	45.40	0	100	V	36.73	10.92	35.67	57.37	74	-16.63	PK
Middle Channel 2442 MHz (power setting: 0)											
2442	69.53	240	163	H	29.15	5.76	0.00	104.44	-	-	PK
2442	73.63	328	169	V	29.19	5.76	0.00	108.57	-	-	PK
3709.998	65.64	100	223	V	32.10	5.97	35.66	68.05	74	-5.95	PK
4884	45.04	0	100	V	32.81	8.52	35.66	50.71	74	-23.29	PK
7326	44.30	0	100	V	37.06	10.92	35.67	56.60	74	-17.40	PK
High Channel 2474 MHz (power setting: 0)											
2474	69.46	310	172	H	29.25	5.76	0.00	104.47	-	-	PK
2474	72.12	142	189	V	29.18	5.76	0.00	107.06	-	-	PK
2483.5	31.00	310	172	H	29.25	5.76	0.00	66.01	74	-7.99	PK
2483.5	68.20	142	189	V	29.18	5.76	36.05	67.09	74	-6.91	PK
3709.998	65.64	100	223	V	32.10	5.97	35.66	68.05	74	-5.95	PK
4948	44.94	0	100	V	32.79	8.52	35.66	50.59	74	-23.41	PK
7422	44.77	0	100	V	37.02	11.05	35.67	57.17	74	-16.83	PK

Average Measurement

Frequency (MHz)	Peak Value (dB μ V/m)	Duty Cycle Factor (dB)	Test Antenna Polarity (H/V)	Average Value (dB μ V/m)	FCC/ISED		Comments
					Limit (dB μ V/m)	Margin (dB)	
Low Channel 2406 MHz (power setting: 0)							
2406	106.74	-29.16	H	77.58	-	-	AVE
2406	112.15	-29.16	V	82.99	-	-	AVE
2390	61.09	-29.16	H	31.93	54	-22.07	AVE
2390	61.95	-29.16	V	32.79	54	-21.21	AVE
3709.998	68.05	-29.16	V	38.89	54	-15.11	AVE
4812	50.54	-29.16	V	21.38	54	-32.62	AVE
7218	57.37	-29.16	V	28.21	54	-25.79	AVE
Middle Channel 2442 MHz (power setting: 0)							
2442	104.44	-29.16	H	75.28	-	-	AVE
2442	108.57	-29.16	V	79.41	-	-	AVE
3709.998	68.05	-29.16	V	38.89	54	-15.11	AVE
4884	50.71	-29.16	V	21.55	54	-32.45	AVE
7326	56.6	-29.16	V	27.44	54	-26.56	AVE
High Channel 2474 MHz (power setting: 0)							
2474	104.47	-29.16	H	75.31	-	-	AVE
2474	107.06	-29.16	V	77.9	-	-	AVE
2483.5	66.01	-29.16	H	36.85	54	-17.15	AVE
2483.5	67.09	-29.16	V	37.93	54	-16.07	AVE
3709.998	68.05	-29.16	V	38.89	54	-15.11	AVE
4948	50.59	-29.16	V	21.43	54	-32.57	AVE
7422	57.17	-29.16	V	28.01	54	-25.99	AVE

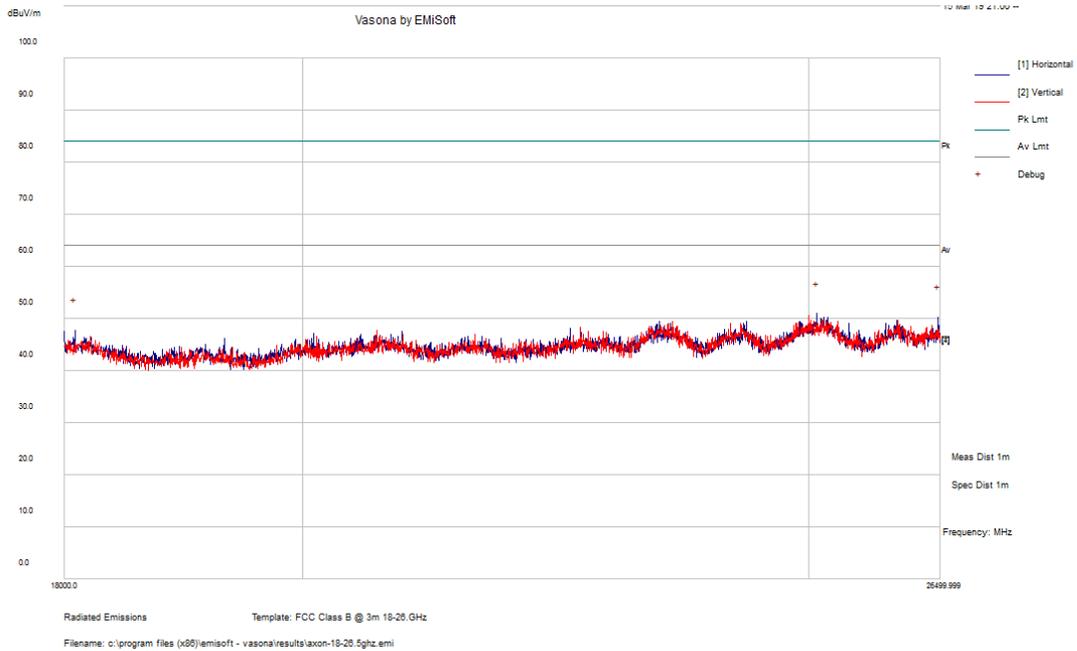
1 GHz – 18 GHz Worst Case, Measured at 1 Meter

Low Channel 2406 MHz



18 GHz – 26.5 GHz Worst Case, Measured at 1 Meter

Low Channel 2406 MHz



8 FCC §15.247(a) (1) & ISEDC RSS-247 §5.1, RSS-Gen §6.6 - Emission Bandwidth

8.1 Applicable Standards

According to FCC §15.247(a) (1) and ISEDC RSS-247 §5.1: the maximum 20 dB bandwidth of the hopping channel shall be presented.

8.2 Measurement Procedure

Span = approximately 2 to 5 times the 99% occupied bandwidth, centered on a hopping channel

RBW = 1% to 5 % of the 99% occupied bandwidth

VBW = 3RBW

Sweep = auto

Detector function = peak

Trace = max hold

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2018-06-01	1 year
-	RF cable	-	-	Each time ¹	N/A
-	20dB attenuator	-	-	Each time ¹	N/A

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

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 9 June 2016) “A2LA Policy on Metrological Traceability”.

8.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

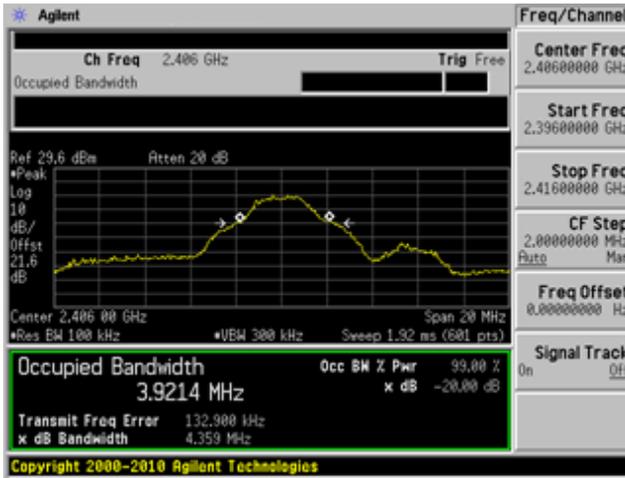
The testing was performed by Alexandrae Duran from 2019-03-04 in RF site.

8.5 Test Results

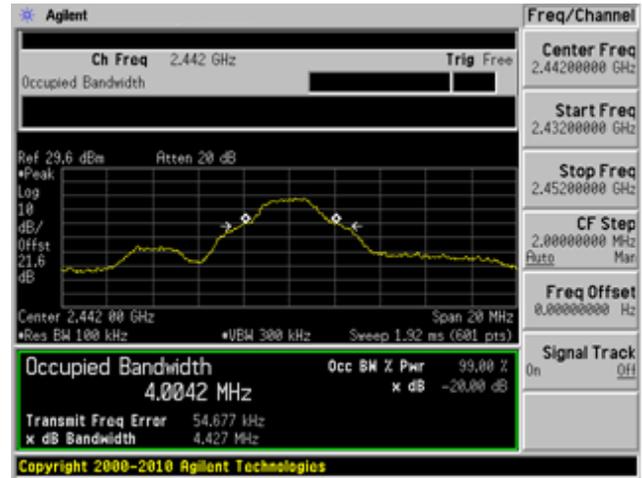
Channel	Frequency (MHz)	99% OBW (MHz)	20 dB OBW (MHz)
Low	2406	3.9214	4.359
Middle	2442	4.002	4.427
High	2474	3.8686	4.381

Please refer to the following plots for detailed test results.

Low Channel 2406 MHz



Middle Channel 2442 MHz



High Channel 2474 MHz



9 FCC §15.247(b)(1) & ISEDC RSS-247 §5.4 - Output Power

9.1 Applicable Standards

According to FCC §15.247(b) (1): For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

According to RSS-247 §5.4: For frequency hopping systems operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels.

9.2 Measurement Procedure

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2018-06-01	1 year
-	RF cable	-	-	Each time ¹	N/A
-	20dB attenuator	-	-	Each time ¹	N/A

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

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 9 June 2016) “A2LA Policy on Metrological Traceability”.

9.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

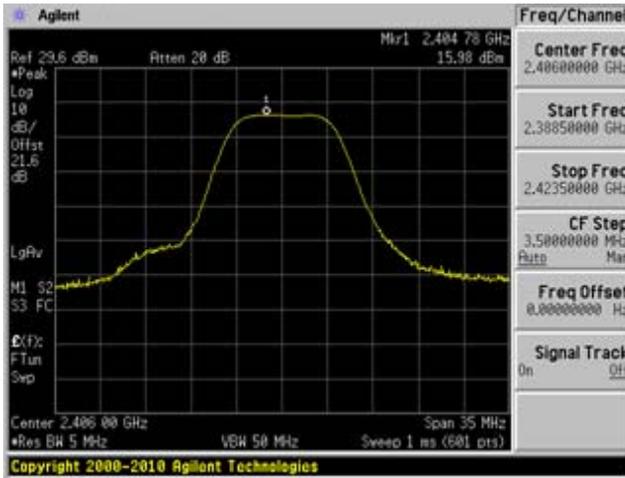
The testing was performed by Alexandrae Duran from 2019-03-04 in RF site.

9.5 Test Results

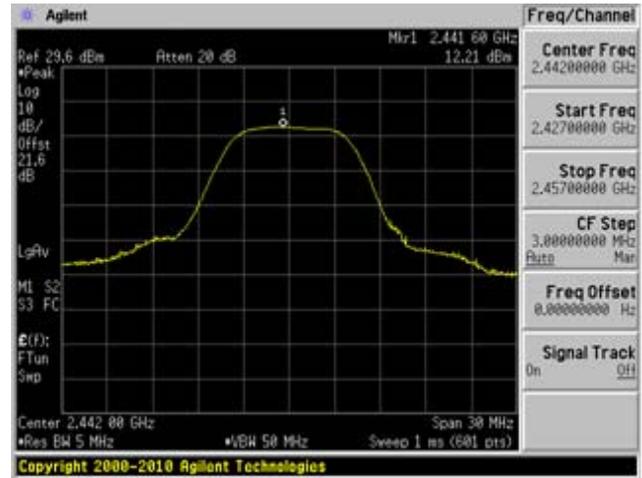
Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)
Low	2406	15.98	20.97
Middle	2442	12.21	20.97
High	2474	13.04	20.97

Please refer to the following plots for detailed test results.

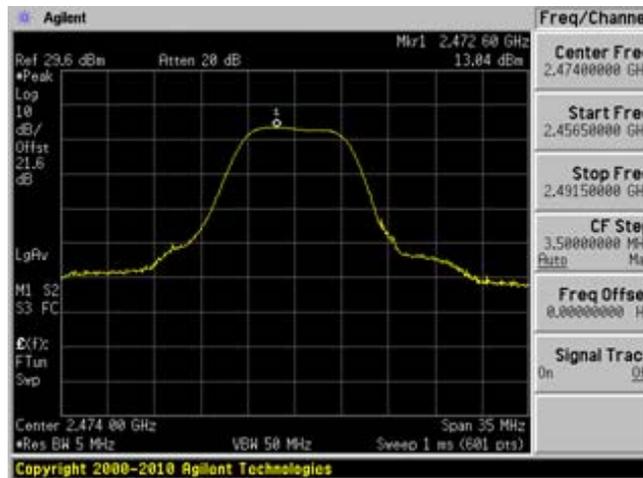
Low Channel 2406 MHz



Middle Channel 2442 MHz



High Channel 2474



10 FCC §15.247(d) & ISEDC RSS-247 §5.5 - 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).

According to ISEDC RSS-247 §5.5. In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

10.2 Measurement Procedure

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation

RBW = 100 kHz

VBW = 300 kHz

Sweep = coupled

Detector function = peak

Trace = max hold

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2018-06-01	1 year
-	RF cable	-	-	Each time ¹	N/A
-	20dB attenuator	-	-	Each time ¹	N/A

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

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 9 June 2016) "A2LA Policy on Metrological Traceability".

10.4 Test Environmental Conditions

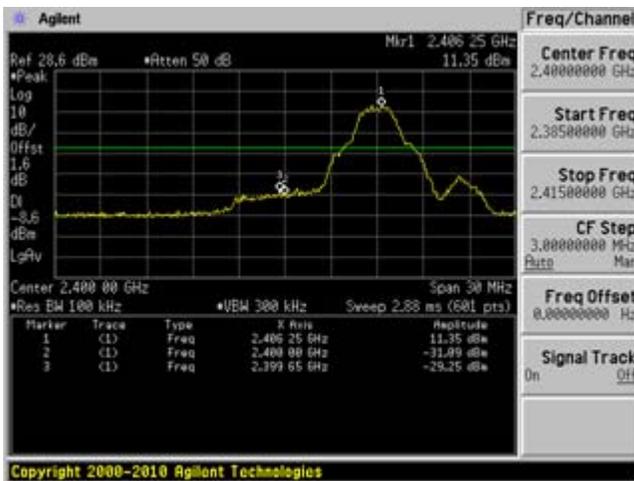
Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Alexandrae Duran from 2019-03-05 and 2019-03-25 in RF site.

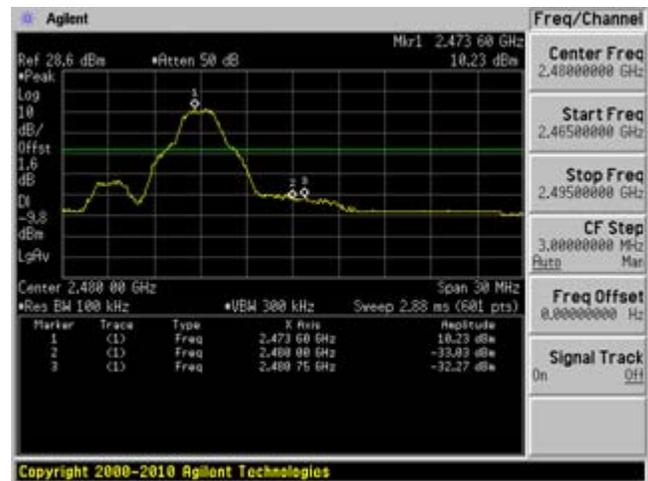
10.5 Test Results

Fixed Channels

Low Channel 2406 MHz

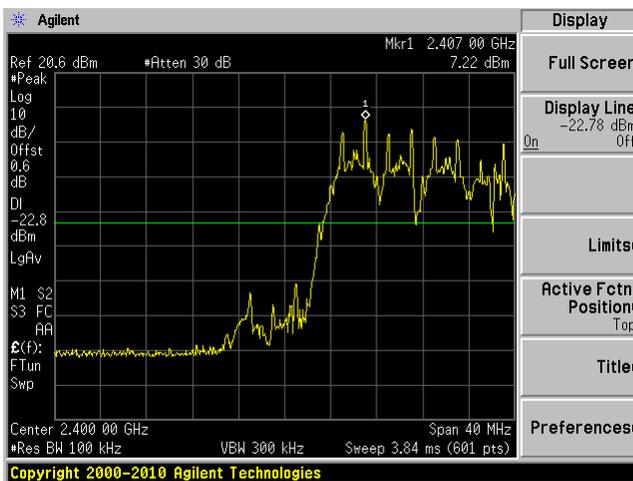


High Channel 2474 MHz

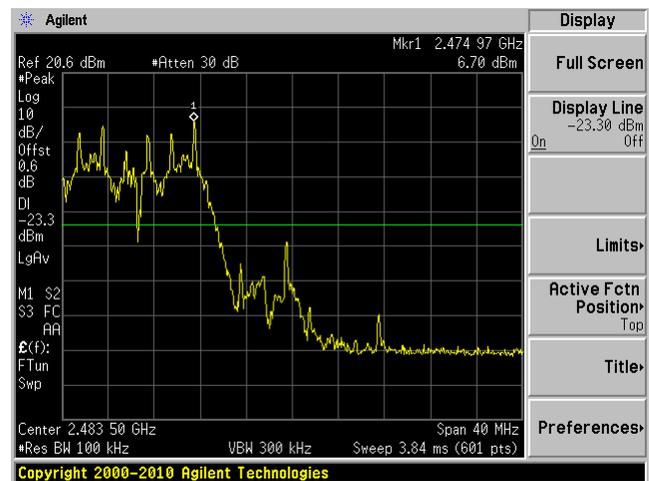


Hopping Channel

Low Edge



High Edge



11 FCC §15.247(a)(1)(iii) & ISEDC RSS-247 §5.1(4) - Dwell Time

11.1 Applicable Standards

According to FCC §15.247(a)(1)(iii) and RSS-247 §5.1(4), Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

11.2 Measurement Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = zero span, centered on a hopping channel

RBW \leq channel spacing and where possible RBW should be set $\gg 1/T$, where T is the expected dwell time per channel

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector function = peak

Trace = max hold

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

$$\begin{aligned} &(\text{Number of hops in the period specified in the requirements}) = \\ &(\text{Number of hops on spectrum analyzer}) \times (\text{period specified in the requirements} / \text{analyzer sweep time}) \end{aligned}$$

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2018-06-01	1 year
-	RF cable	-	-	Each time ¹	N/A
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2017-03-27	2 years

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

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 9 June 2016) “A2LA Policy on Metrological Traceability”.

11.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Alexandrae Duran on 2019-03-05 in the RF site.

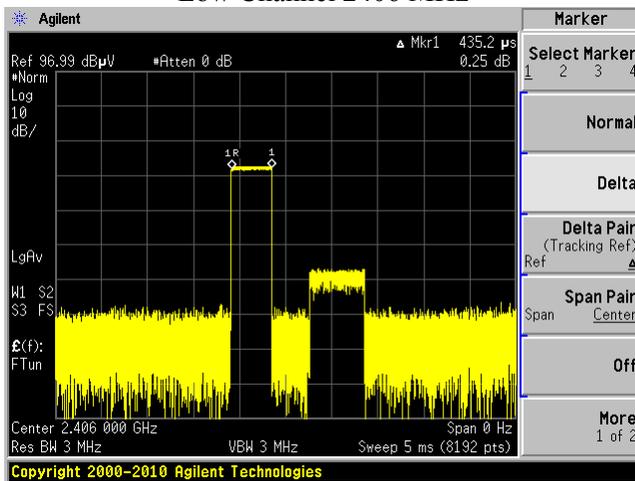
11.5 Test Results

Channel	Total on time in 100 ms (ms)	Number of 100 ms Period for the Specified Period in the Requirements	Average Time of Occupancy (s)	Limit (sec)	Results
Low	3.482	72	0.251	0.4	compliant
Middle	3.486	72	0.251	0.4	compliant
High	3.486	72	0.251	0.4	compliant

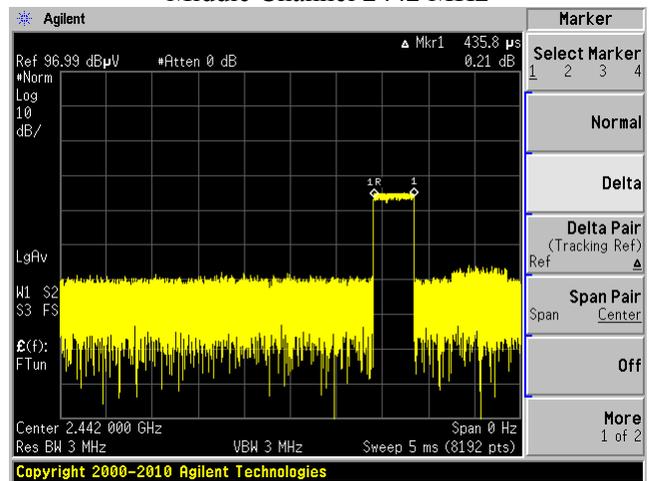
Please refer to the following plots for detailed test results.

Pulse Width

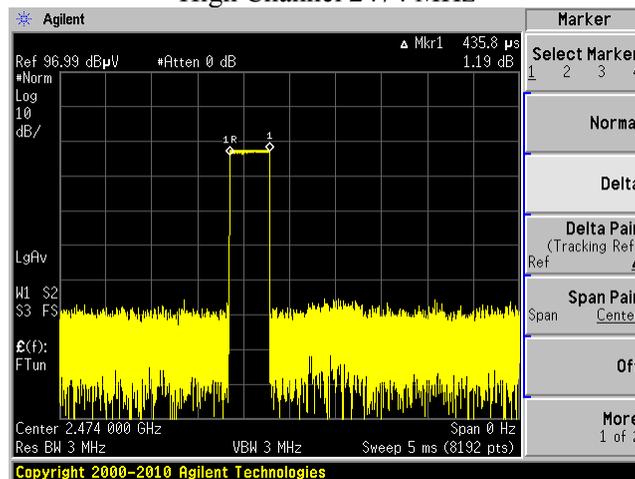
Low Channel 2406 MHz



Middle Channel 2442 MHz

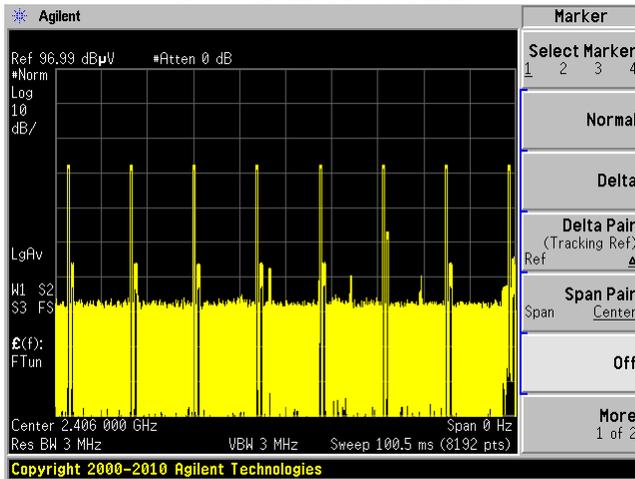


High Channel 2474 MHz

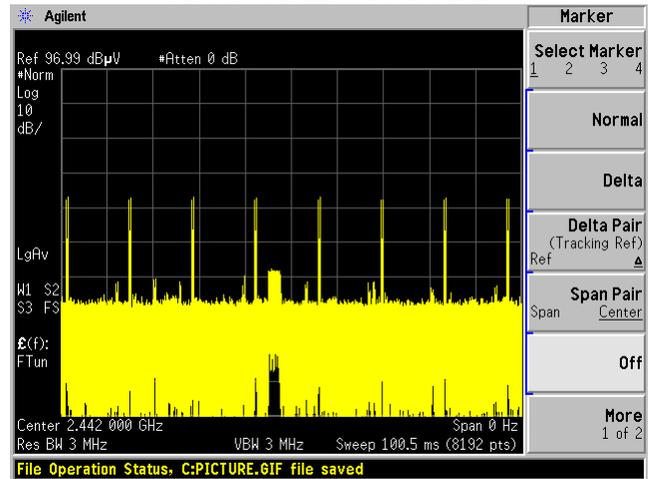


Number of Pulses within 100 ms

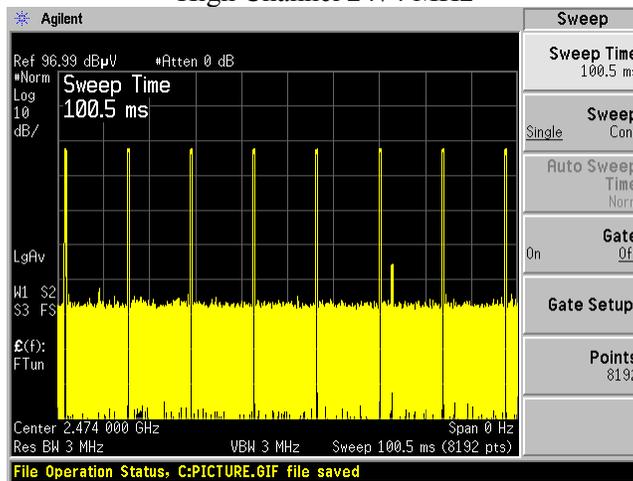
Low Channel 2406 MHz



Middle Channel 2442 MHz



High Channel 2474 MHz



12 FCC §15.247(a)(1)(iii) & ISEDC RSS-247 §5.1(4) - Number of Hopping Channels

12.1 Applicable Standards

According to FCC §15.247(a) (1) (iii) and RSS-247 §5.1(4): Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

12.2 Test Procedure

Span = the frequency band of operation

RBW < 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2018-06-01	1 year
-	RF cable	-	-	Each time ¹	N/A
-	20dB attenuator	-	-	Each time ¹	N/A

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

Statement of Traceability: BAEL 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 9 June 2016) “A2LA Policy on Metrological Traceability”.

12.4 Test Environmental Conditions

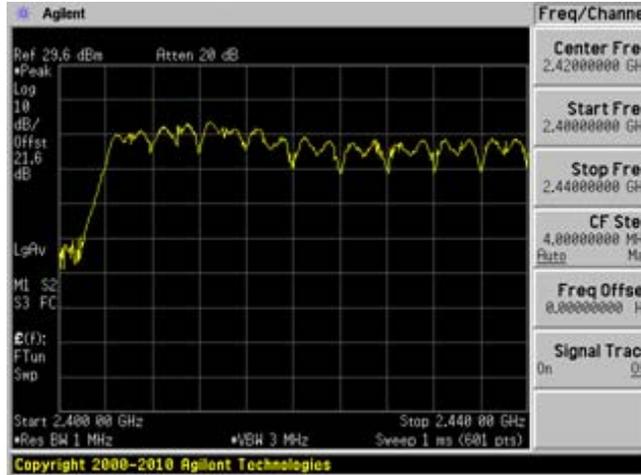
Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Alexandrae Duran from 2019-03-05 in RF site.

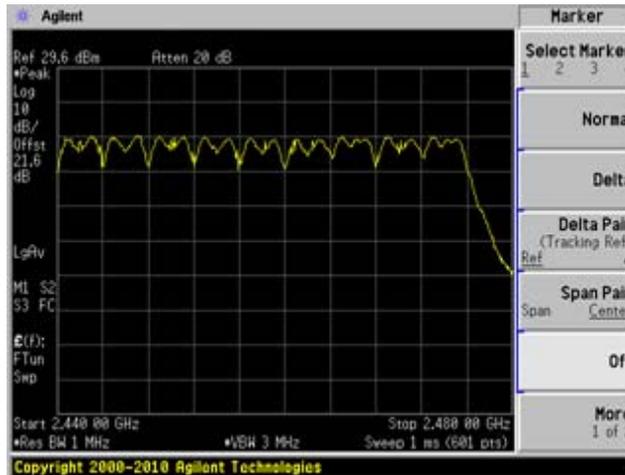
12.5 Test Results

Total of 18 channels; please refer to the plots hereinafter.

9 Channels between 2406 to 2440 MHz



9 Channels Between 2440 to 2474 MHz



13 FCC §15.247(a)(1) & ISEDC RSS-247 §5.1(2) - Hopping Channel Separation

13.1 Applicable Standards

According to FCC §15.247(a) (1) and RSS-247 §5.1(2): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

13.2 Test Procedure

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) \approx 30% of the channel spacing, adjust as necessary to best identify the center of each individual channel

Video (or Average) Bandwidth (VBW) \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

13.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2018-06-01	1 year
-	RF cable	-	-	Each time ¹	N/A
-	20dB attenuator	-	-	Each time ¹	N/A

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

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 9 June 2016) "A2LA Policy on Metrological Traceability".

13.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

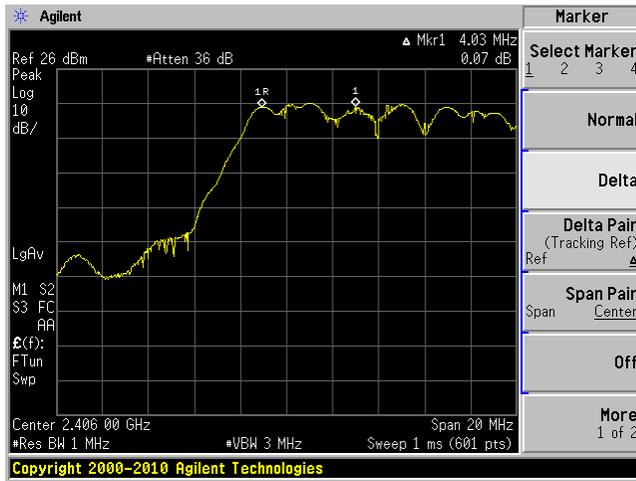
The testing was performed by Alexandrae Duran from 2019-03-29 in RF site.

13.5 Test Results

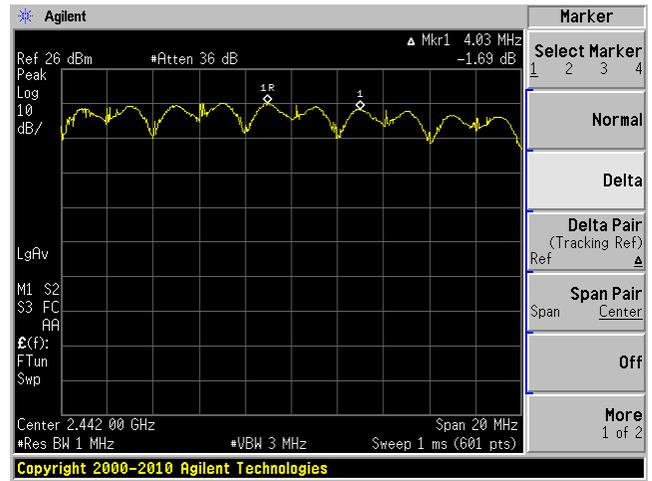
Channel	Frequency (MHz)	Channel Separation (MHz)	Limit > 2/3 20 dB OBW (MHz)
Low	2406	4.03	2.906
Middle	2442	4.03	2.951
High	2474	4.03	2.921

Please refer to following plots.

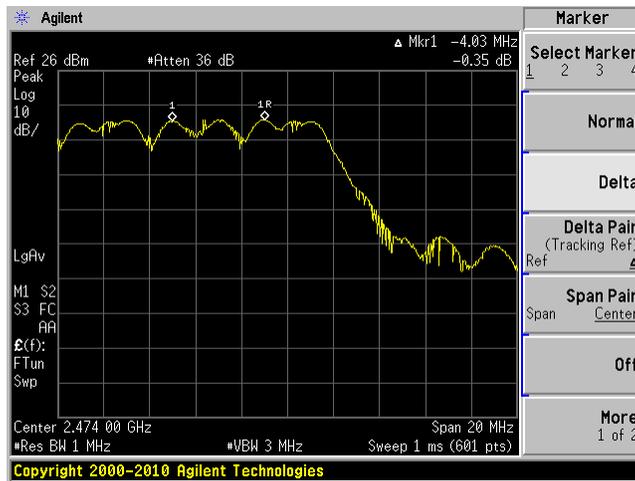
Low Channel 2406 MHz



Middle Channel 2442 MHz



High Channel 2474 MHz



14 FCC §15.247(d) & ISEDC RSS-247 §5.5 - Spurious Emissions at Antenna Terminals

14.1 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)).

As per ISEDC RSS-247 §5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

14.2 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.

14.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2018-06-01	1 year
-	RF cable	-	-	Each time ¹	N/A

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

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 9 June 2016) "A2LA Policy on Metrological Traceability".

14.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

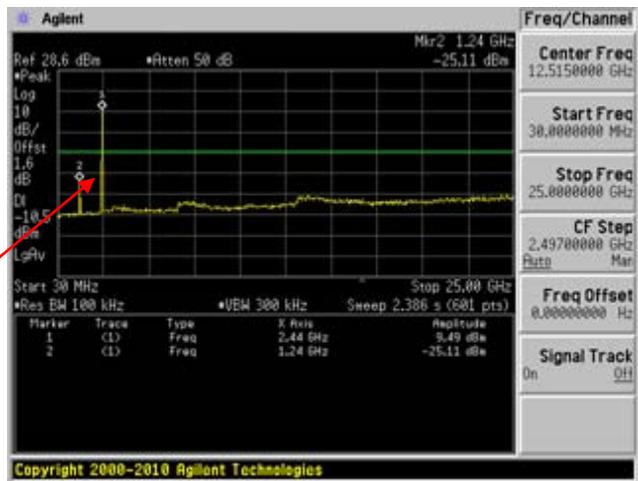
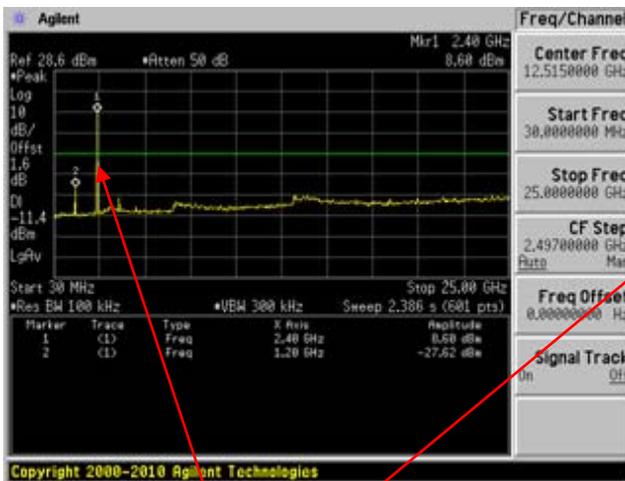
The testing was performed by Alexandrae Duran from 2019-03-05 in RF site.

14.5 Test Results

Please refer to following plots.

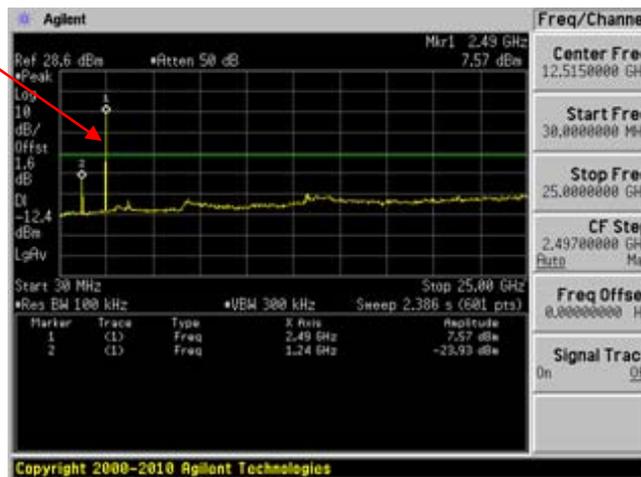
Low Channel 30 MHz – 25 GHz

Middle Channel 30 GHz – 25 GHz



High Channel 30 MHz to 25 GHz

Fundamental Signal



15 Exhibit A - FCC & ISED Equipment Labeling Requirements

15.1 FCC ID Label Requirements

As per FCC §2.925,

(a) Each equipment covered in an application for equipment authorization shall bear a nameplate or label listing the following:

(1) FCC Identifier consisting of the two elements in the exact order specified in §2.926. The FCC Identifier shall be preceded by the term FCC ID in capital letters on a single line, and shall be of a type size large enough to be legible without the aid of magnification.

Example: FCC ID: XXX123

Where: XXX—Grantee Code, 123—Equipment Product Code

As per FCC §15.19,

(a) In addition to the requirements in part 2 of this chapter, a device subject to certification, or verification shall be labeled as follows:

(3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified above is required to be affixed only to the main control unit. If the EUT is integrated within another device then a label affixed to the host shall also state, "Contains FCC ID: XXXXXX"

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

15.2 IC Label Requirements

As per IC RSP-100 Section 3.1, the certification number shall appear as follows:

IC: XXXXXX-YYYYYYYY

Where:

- The letters "IC:" indicate that this is an Innovation, Science and Economic Development Canada's certification number, but they are not part of the certification number. XXXXXXYYYYYYYYYYYY is the ISED certification number.
- XXXXXX is the CN assigned by Innovation, Science and Economic Development Canada. Newly assigned CNs will be made up of five numeric characters (e.g. "20001") whereas existing CNs may consist of up to five numeric characters followed by an alphabetic character (e.g. "21A" or "15589J").
- YYYYYYYYYYYY is the Unique Product Number (UPN) assigned by the applicant, made up of a maximum of 11 alphanumeric characters.

- The CN and UPN are limited to capital alphabetic characters (A-Z) and numerals (0-9) only. The use of punctuation marks or other symbols, including “wildcard” characters, is not permitted.
- The HVIN may contain punctuation marks or symbols but they shall not represent any indeterminate (“wildcard”) characters.

As per RSS-Gen §2.1 Equipment Labeling:

The application for equipment certification shall be submitted in accordance with Industry Canada’s Radio Standards Procedure RSP-100, Radio Equipment Certification Procedure which sets out the requirements for certification and labelling of radio apparatus. RSP-100 shall be used in conjunction with RSS-Gen and other Radio Standards Specifications (RSSs) specifically applicable to the type of radio apparatus for which certification is sought.

15.3 Recommended Label Contents and Location



16 Appendix A- EUT Test Setup Photographs

Please refer to the attachment.

17 Appendix B- EUT External Photographs

Please refer to the attachment.

18 Appendix C- EUT Internal Photographs

Please refer to the attachment.

19 Appendix D (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.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2020
Revised February 21, 2019

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

--- END OF REPORT ---