

ELECTROMAGNETIC COMPATIBILITY TEST REPORT

PREPARED FOR SIX GUYS LABS BY QAI LABORATORIES



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EMC Test Laboratory:

Address: Phone: Fax: **QAI Laboratories Inc.** 3980 North Fraser Way, Burnaby, BC, V5J 5K5 Canada (604) 527-8378 (604) 527-8368

Laboratory Accreditations (per ISO/IEC 17025:2005):



American Association for Laboratory Accreditation Certificate Number: 3657.02

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EMC Client: Address: Phone:

Applicable Test Standards:

Equipment Tested Model Number: FCC ID: IC Certification Number: Manufacturer: Six Guys Labs, s.r.o. Slovanska 16, 326 00, Pilsen, Czech Republic. 00420 604 204 479

FCC Title 47 CFR Part 15: Subpart B FCC Title 47 CFR Part 15: Subpart C - § 15.247 RSS-247 Issue 2, RSS-Gen Issue 5, ICES-003 Issue 6

Actijoy Smart Base Unit AJBOWLV2 2AQVI-AJBOWLV2 24198-AJBOWLV2 Six Guys Labs





REVISION HISTORY

Date	Report Number Rev # Details		Author	
January 31, 2019	E11003-1802_SixGuysLabs-ActijoyBowl_V2_rev1.1	1.1	Typographical corrections	AN
January 30, 2019	E11003-1802_SixGuysLabs-ActijoyBowl_V2_rev1.0	1.0	Final Release	AN
January 24 2019	E11003-1802_SixGuysLabs-ActijoyBowl_V2_rev0.0	0.0	D.0 Draft	
All previous versions previous electronic and	of this report have been superseded by the latest dated revision ad paper printed revisions accordingly.	as listed in	the above table. Please dispose of	all

REPORT AUTHORIZATION

The data documented in this report is for the test equipment provided by Six Guys Labs Tests were conducted on the sample equipment as requested by Six Guys Labs for the purpose of demonstrating compliance with FCC Title 47 CFR Part 15: Subpart B, FCC Title 47 CFR Part 15: Subpart C - § 15.247, RSS-247 Issue 2 & ICES-003 Issue 6 as agreed upon by Six Guys Labs as per Quote 18RM08239R3. Six Guys Labs is responsible for the tested product configuration, continued product compliance, and for the appropriate auditing of subsequent products as required. This report may comprise partial list of tests that are required for FCC & IC Declaration of Conformity and can only be produced by the manufacturer.

This is to certify that the following report is true and correct to the best of our knowledge.

Testing Done by Report Prepared by Alireza Nezam Alireza Nezam **EMC Test Engineer EMC** Test Engineer Rajuider S. Ottwood Reviewed by Approved by **Parminder Singh** Raj Atwal Director of EMC EMC Engineering Manager Department



QAI FACILITIES

Founded in 1994 by a group of experienced certification and testing experts, QAI is an independent third-party testing, inspection and certification organization which serves the building industry, government and individuals with cost effective solutions through our inhouse capabilities / services, and an established world-wide network of qualified affiliates. To help get your product to market, trust the provider that many leading global manufacturers do: QAI.

British Columbia	Ontario	Virginia
QAI Laboratories Inc.	QAI Laboratories Inc.	QAI Laboratories Ltd.
Main Laboratory/Headquarters	1081 Meyerside Drive, Unit #14	1047 Zachary Taylor Hwy,
3980 North Fraser Way,	Mississauga, ON L5T 1M4 Canada	Suite A Huntly, VA 22640 USA
Burnaby, BC V5J Canada		
California	Oklahoma	
QAI Laboratories Ltd.	QAI Laboratories Ltd.	
8385 White Oak Avenue Rancho	108th East Avenue,	
Cucamonga, CA 91730 USA	Tulsa, OK 74116 USA	

QAI EMC ACCREDITATION

QAI EMC is your one-stop regulatory compliance partner for electromagnetic compatibility (EMC) and electromagnetic interference (EMI). Products are tested to the latest and applicable EMC/EMI requirements for domestic and international markets. QAI EMC goes above and beyond being a testing facility—we are your regulatory compliance partner. QAI EMC has the capability to perform RF Emissions and Immunity for all types of electronics manufacturing including Industrial, Scientific, Medical, Information Technology, Telecom, Wireless, Automotive, Marine and Avionics.

EMC Laboratory Location	FCC Designation (3m SAC)	IC Registration (3m SAC)	A2LA Certificate
Burnaby, BC, Canada	CA9543	21146-1	3657.02



Headquarters & EMC Laboratory in Burnaby, BC



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Section I: EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this report is to demonstrate and document the compliance of AJ Bowl V2 as per Sections 1.2 & 1.3.

1.2 Scope

The information documented in this report is based on the test methods and levels as per Quote 18RM08239R3:

FCC Title 47 Part 15 - Radio Frequency Devices, Subpart C – Intentional Radiators.

• 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.

CFR Title 47 FCC Part 15 - Radio Frequency Devices, Subpart B – Unintentional Radiators.

RSS-247 Issue 2 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 5 – General Requirements and Information for the Certification of Radio Apparatus

ICES-003 Issue 6 – Information Technology Equipment (Including Digital Apparatus) – Limits and Methods of Measurement

The tests documented in this report were performed in accordance with ANSI C63.4-2014, ANSI C63.10-2013, and FCC KDB 558074 D01 DTS Meas Guidance v05.

Reference Standards:

The following standards are included as a normative reference.

- ANSI C63.4(2014) 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
- KDB 558074 D01 v05 Guidance for compliance measurements on Digital Transmission System, Frequency Hopping Spread Spectrum system, and Hybrid system devices operating under 15.247 of the FCC rules
- KDB 789033 D02 v02r01 Guidance for compliance testing of Unlicensed National Information Infrastructure (U-NII) devices Part 15, Subpart E
- KDB 412172 D01 v01r01 Guidelines for determining the Effective Radiated Power (ERP) and Equivalent Isotropically Radiated Power (EIRP) of an RF transmitting system
- KDB Publication 996369 D01 Module Equip Auth Guide v02Transmitter Module Equipment Authorization Guide
- KDB Publication 447498 D01 General RF Exposure Guidance v06



1.3 Summary of Results

The following tests were performed pursuant to the FCC/IC Unintentional Radiated Emissions, Intentional Radiated Emissions, and Radio Testing Standards:

No.	Test Description	Standard Clause	Result
3.1	Antenna Requirement	FCC 47 CFR Part 15.203 IC RSS-Gen Issue 5 Section 7.1.2	Complies
3.2	6 dB Bandwidth	FCC Subpart C §15.247 (a) (2) RSS-247 Issue 2 §5.2	Complies
3.3	99% Bandwidth	RSS-247-Issue 2, RSS-Gen Issue 5	Complies
3.4	RF Peak Power Output	FCC Title 47 CFR Part 15: Subpart C - §15.247 (b)(3) RSS-247 Issue 2	Complies
3.5	Power Spectral Density	FCC Title 47 CFR Part 15: Subpart C §15.247 (e) RSS-247 Issue 2: 5.2 (2)	Complies
3.6	Radiated Spurious Emissions	FCC Subpart C §15.205, §15.209 & §15.247 RSS-247-Issue 2, RSS-Gen Issue 5	Complies
3.7	Out-of-Band Emissions (Band Edge)	FCC Title 47 CFR Part 15: Subpart C - §15.247 (d) RSS-247-Issue 2 §5.5	Complies
3.8	Unintentional Radiated Emissions	FCC Title 47 CFR Part 15: Subpart B - §15.109 ICES-003 Issue 6	Complies
3.9	RF Exposure	FCC Title 47 CFR 1.1310 RSS-102 Section 2.5.2	Complies
3.10	Co-Location Testing	FCC Subpart C §15.205, §15.209 & §15.247, 1.1310 RSS-247-Issue 2, RSS-Gen Issue 5, RSS-102 Section 2.5.2	Complies



Section II: GENERAL INFORMATION

2.1 Product Description

The information provided in this section is for the Equipment Under Test (EUT) and the corresponding Auxiliary Equipment needed to perform the tests as a complete system.

EUT	Actijoy Smart Base Unit
Model No./Serial No.	AJBOWLV2 / 10000
Functional Description	Measure food and water intake, Informs the user when a dog eats or drinks less or more Transferring analyzed data to user through radio Powered by AA batteries (no AC/DC adapter)
Operating Frequency	2400MHz to 2483.5MHz
FCC ID (BLE)	2AQVI-AJBOWLV2
IC Cert. No. (BLE)	24198-AJBOWLV2
FCC ID (WiFi) – Modular Cert.	2AHMR-ESP12F
IC Cert. No. (WiFi) – Modular Cert.	23236-ESP12F
Manufacturer	Six Guys Labs, s.r.o.

Equipment Under Test (EUT) Information



Equipment Under Test (EUT) – AJ Bowl V2

Auxiliarv	Equi	oment	Info	mation
riuminui y	Lyun	pincine	THILD	mation

Equipment	Manufacturer	Product Description	Model No.
Auxiliary 1	None		



2.2 Environmental Conditions

The equipment under test was operated and tested under the following environmental conditions:

Parameter	Conditions
Location	Indoors
Temperature	20°C
Relative Humidity	86%
Atmospheric Pressure	100 kPa

2.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Emissions, 30MHz-1GHz	± 2.40 dB
Radiated Emissions, 1GHz-40GHz	± 2.48 dB
Radio Frequency	±1.5 x 10-5 MHz
Total RF Power Conducted	±1.36 dB
Spurious Emissions Conducted	±1.36 dB
RF Power Density Conducted	±1.36 dB
Temperature	±1°C
Humidity	±5 %
DC and low frequency voltages	±3 %

2.4 Worst Test Case

Worst-case orientation was determined during the preliminary testing. The final radiated emissions were performed in the worst-case orientation.



2.5 Sample Calculations of Emissions Data

Radiated and conducted emissions were performed using EMC32 software developed by Rohdes & Schwarz. Transducer factors like Antenna factors, Cable Losses and Amplifier gains were stored in the test templates which are used to perform the emissions measurements. After test is finished, data is generated from the EMC32 consisting of product details, emission plots and final data tables as shown below.

Frequency (MHz)	QPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Ant. Ht. (cm)	Pol	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.663900	33.0	1000.000	120.000	100.0	Н	70.0	13.2	7.5	40.5

Quasi Peak reading shown in the table above is already corrected by the software using correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

Or

Corr.(dB) = Antenna factor + Cable Loss - Amp gain (if pre-amplifier was used)

The final Quasi peak reading shown in the data is calculated by the software using following equation:

Corrected Quasi Peak(dBµV/m) = Raw Quasi Peak Reading + Antenna factor + Cable loss

To obtain the final Quasi-Peak or Average reading during power line conducted emissions, transducer factors are included in the final measurement as shown below.

Frequency	QPeak	Meas. Time	Bandwidth		Corr.	Margin	Limit
(MHz)	(dBµV)	(ms)	(kHz) PE		(dB)	(dB)	(dBµV)
0.150	44.3	1000.000	9.000	GND	0.6	21.7	66.0

Frequency	QPeak	Meas. Time	Bandwidth	PE	Corr.	Margin	Limit
(MHz)	(dBµV)	(ms)	(kHz)		(dB)	(dB)	(dBµV)
0.150	27.2	1000.000	9.000	GND	0.6	28.8	56.0

Quasi Peak or Average reading shown in above table is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

The final Quasi peak or Average reading shown in the data is calculated by the software using following equation:

Corr. Quasi Peak/Average Reading (dBµV) = Raw Quasi Peak/Average Reading + Antenna factor + Cable loss

The allowable margin from the limits, as per the standards, were calculated for both radiated and conducted emissions:

Margin(dB) = Limit – Quasi-Peak or Average reading



2.6 Test Equipment List

The tables below contain all the equipment used by QAI Laboratories in conducting all tests on the Equipment Under Test (EUT) as per Section 1.3.

Manufacturer	Model	Description	Serial No.	Last Calibration Date	Calibration Due Date
ETS Lindgren	S201	5-meter Semi-Anechoic Chamber	1030	N/A	N/A
Sunol Sciences	SM46C	Turntable	051204-2	N/A	N/A
Sunol Sciences	TWR95	Mast	TREML00 01	N/A	N/A
Sunol Sciences	JB3	Biconilog Antenna 30MHz – 3GHz	A120106	2017-Sep-24	2020-Sep-24
Sunol Sciences	DRH-118	Horn Antenna 1GHz-18GHz	A050905	2016-Mar-10	2019-Mar-10
Rohde & Schwarz	ESU40	EMI Receiver	100011	2017-Nov-20	2020-Nov-20
ЕМСО	3825/2	LISN (150kHz-30MHz)	9002-1601	2017-Aug-25	2020-Aug-25
ЕМСО	6502	Loop Antenna	6502	11/13/2017	2020-Nov-13
EMCO	3160-09	Horn Antenna 18-26.5GHz	9701-1071	13-Sep-17	2020-Sep-13

Emissions Test Equipment

The following components and equipment are calibrated as a complete signal path.

Manufacturer	Model	Description	Serial No.	Last Calibration Date	Calibration Due Date
AH Systems	PAM118	Amplifier 10KHz-18GHz	189		
Insulated Wire Inc.	SPS-1753-1140-SPS	Yellow cable, 3m	102395	December 21, 2019	December 21, 2010
Insulated Wire Inc.	SPS-1753-2400-SPS	Yellow cable, 6m	091096	December 31, 2010	December 31, 2019
WEINSCHEL ENGINEERING	44	6db attenuator	665		
A.H.Systems	PAM-1840VH	Preamplifier 18-40GHz	152		
A.H.Systems	2649-03	Green short input cable	395	December 31, 2018	December 31, 2019
A.H.Systems	2649-225	Green short output cable	396		

Measurement Software List

Manufacturer	Model	Version	Description
Rohde & Schwarz	EMC 32	6.20.0	Emissions Test Software



Section III: TEST RESULTS

3.1 Antenna Requirements

Date Performed:

Dec 19, 2018

Test Standard:

FCC 47 CFR Part 15.203 and IC RSS-Gen Issue 5 Section 7.1.2

Applicable Regulation:

The purpose of this requirement is to make certain that no other antenna, except for that provided by the responsible party, shall be used with the Equipment-Under-Test (EUT) as defined in FCC CFR 47 Part 15.203 & RSS-Gen Issue 5:

"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 the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited." ... "the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded."

Modifications:

No modification was required to comply for this test.

Result:

An integrated antenna is used on this product and it is not field replaceable.



3.2 6 dB Bandwidth

Date Performed:	December 20, 2018
Test Standard:	FCC Subpart C 15.247 (a) (2), RSS-247 Issue 2 5.2
Test Method:	ANSI C63.10:2013
Test Requirement:	Systems using digital modulation techniques may operate in the 902–928MHz, 2400–2483.5 MHz, and 5725–5850MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.
Result:	The EUT performed as expected.



Measurement Data and Plot:





3.3 99% Bandwidth

Date Performed: December 21, 2018

Test Standard: RSS-247 Issue 2, RSS-Gen Issue 5

Minimum Requirement: The Occupied Channel Bandwidth is the bandwidth that contains 99 % of the power of the signal. The bandwidth shall fall completely within the frequency range specified by the standard.

Measurement Method: As called in ANSI C63.10-2013.

Result: The EUT complies with the applicable standard.



Measurement Data and Plot:

Mode	Carrier Frequency	Raw Peak @ 3m	OBW	Status [*]
	MHz	dBµV/m	MHz	
LCH	2402	75.81	2281	Complies
MCH	2440	80.7	2010	Complies
HCH	2480	76.38	2093	Complies





3.4 **RF Peak Power Output**

Date Performed:	December 21, 2018
Test Standard:	FCC Title 47 CFR Part 15: Subpart C - §15.247 (b)(3), RSS-247 Issue 2
Test Method:	FCC KDB 558074 D01 DTS Meas Guidance v05
Test Requirement:	For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt.
Result:	The EUT complies with the applicable standard.

Measurement Data:

Device Configuration	Carrier Frequency	Ant. Pol.	Cable loss	Ant. Factor	Correction Factor	Peak @ 3m	Corrected Peak @ 3m	EIRP	Ant. Gain	Peak Conducted Output Power	Limit	Margin	Status
	MHz	V or H	dB	dB/m	dB	dBµV/m	dBµV/m	dBm	dBi	dBm	dBm	dB	
Wi-Fi continually transmitting /Bluetooth different channels	2402	v	8.4	28.5	36.9	55.90	92.80	-2.43	4.0	-6.43	30	36.43	Complies
		Н	8.4	28.5	36.9	64.26	101.16	5.93	4.0	1.93	30	28.07	Complies
	2440	v	8.4	28.5	36.9	59.68	96.58	1.35	4.0	-2.65	30	32.65	Complies
		Н	8.4	28.5	36.9	61.6	98.5	3.27	4.0	-0.73	30	30.73	Complies
	2480	v	8.5	28.4	36.9	56.32	93.22	-2.01	4.0	-6.01	30	36.01	Complies
	2480	Н	8.5	28.4	36.9	57.86	94.76	-0.47	4.0	-4.47	30	34.47	Complies

Note: Corr. Peak@3m = Raw Peak@3m + Ant. Factor + System Loss

EIPR +Ant Gain = Peak Conducted power

Peak Conducted Output Power = EIPR - Ant. Gain

Power Density = $\frac{EIRP}{4\pi r^2}$ mW/cm²



3.5 Power Spectral Density (PSD)

Date Performed: December 19, 2018

Test Standard: FCC Title 47 CFR Part 15: Subpart C §15.247 (e), RSS-247 Issue 2: 5.2 (2)

Test Method: FCC KDB 558074

Test Requirement:

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission. The power spectral density was determined using the same method as is used to determine the conducted output power).

Modifications:

No modification was required to comply for this test.

Result:

The EUT complies with the applicable standard.



Measurement Data and Plot:

Channel	Frequency	Raw PSD	Correction Factor	Corrected PSD @ 3m	PSD EIRP	Limit	Margin	Status
	(MHz)	(dBuv)	(dB/m)	(dBuV/m)	(dBm)	(dBm)	(dB)	
Low	2402	41.21	36.9	78.11	-17.12	8	25.12	Complies
Mid	2440	35.17	36.9	72.07	-23.16	8	31.16	Complies
High	2480	36.63	36.9	73.53	-21.70	8	29.7	Complies





3.6 Radiated Spurious Emissions

Date Performed:	December 18, 2018
Test Standard:	RSS-247-Issue 2, RSS-Gen Issue 5
D	FCC Subpart C §15.205, 15.209 & 15.247

Required Limits:

1) Radiated emission limits; general requirements.

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency, f	Field strength						
(MHZ)	(dBµV/m)						
0.009 - 0.490	$(20*\log(2400/f (kHz))) + 40 dB$						
0.490 - 1.705	$(20*\log(24000/f (kHz))) + 20 dB$						
1.705 - 30.0	49.5						
30-88	40.0						
88-216	43.5						
216 - 960	46.0						
above 960	54.0						
Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges. Note 2: The emissions limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9- 90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.							

2) Restricted bands of operation.

Unwanted emissions that fall into the restricted bands specified on the table below shall comply with the limits specified on the table limits above as per \$15.209 and Clause 8.9 of RSS-Gen.

FCC Restricted Bands:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			



IC Restricted Bands:

MHz	MHz	
0.090 - 0.110	149.9 - 150.05	9
0.495 - 0.505	156.52475 - 156.52525	9
2.1735 - 2.1905	156.7 - 156.9	1
3.020 - 3.026	162.0125 - 167.17	13
4.125 - 4.128	167.72 - 173.2	14
4.17725 - 4.17775	240 - 285	15
4.20725 - 4.20775	322 - 335.4	1'
5.677 - 5.683	399.9 - 410	22.
6.215 - 6.218	608 - 614	2:
6.26775 - 6.26825	960 - 1427	3
6.31175 - 6.31225	1435 - 1626.5	36
8.291 - 8.294	1645.5 - 1646.5	A
8.362 - 8.366	1660 - 1710	
8.37625 - 8.38675	1718.8 - 1722.2	* Certain f
8.41425 - 8.41475	2200 - 2300	and in ban
12.29 - 12.293	2310 - 2390	38.6 GHz
12.51975 - 12.52025	2483.5 - 2500	designated
12.57675 - 12.57725	2655 - 2900	These freq
13.36 - 13.41	3260 - 3267	and the rec
16.42 - 16.423	3332 - 3339	that apply
16.69475 - 16.69525	3345.8 - 3358	the 200 an
16.80425 - 16.80475	3500 - 4400	of RSSs.
25.5 - 25.67	4500 - 5150	
37.5 - 38.25	5350 - 5460	
73 - 74.6	7250 - 7750	
74.8 - 75.2	8025 - 8500	
108 - 138		

 GHz

 9.0 - 9.2

 9.3 - 9.5

 10.6 - 12.7

 13.25 - 13.4

 14.47 - 14.5

 15.35 - 16.2

 17.7 - 21.4

 22.01 - 23.12

 23.6 - 24.0

 31.2 - 31.8

 36.43 - 36.5

 Above 38.6

* Certain frequency bands listed in table 7 and in bands above 38.6 GHz are designated for licenceexempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

3) §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)).

Method of Measurement:

The EUT was tested in our 3 m SAC and was positioned on the center of the turntable. The transmitter was set for continuous transmission. The operating frequency of the device was measured for all radiated emissions 10 kHz to the 10th harmonic of the highest fundamental frequency. The EUT was pre-scanned in 3 different orthogonal orientations and was found to radiate highest when placed flat on the table top as indicated in the test photos.

Result: The EUT complies with the applicable standard.



Measurement Data and Plot:



Radiated Spurious Emissions at 3m, 10k -30M Hz – For Reference Only



Radiated Spurious Emissions at 3m, 30M – 1G Hz – For Reference Only

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Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.479992	23.24	40.00	16.76	1000.0	120.000	251.0	Н	50.0	26.4
622.152300	27.28	47.00	19.72	1000.0	120.000	173.0	V	168.0	29.7
775.617050	29.62	47.00	17.38	1000.0	120.000	401.0	Н	159.0	32.0
971.670000	31.99	47.00	15.01	1000.0	120.000	152.0	н	309.0	34.3

Final_Result





Radiated Spurious Emissions at 3m, 1G – 18G Hz – For Reference Only

Final_Result	
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Frequency	MaxPeak	Average	Limit	Margin	Height	Pol	Azimuth
(MHz)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dB)	(cm)		(deg)
12305.000000	54.68		74.00	19.32	150.0	Н	0.0
12333.900000		45.36	54.00	8.64	150.0	Н	0.0
17909.900000		51.64	54.00	2.36	200.0	Н	186.0
17935.400000	61.31		74.00	12.69	200.0	Н	249.0
6054.100000		34.18	54.00	19.82	150.0	V	0.0
8539.500000		37.25	54.00	16.75	250.0	V	48.0



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Radiated Spurious Emissions at 1m, 18G–25G Hz – For Reference Only

Modulation	Freq.	Peak Raw	Avg. Raw	Correction Factor	Peak Corr	Avg. Corr.	Peak Limit	Avg. Limit	Margin Peak	Margin Ave
	MHz	dBuV	dBuV	dB	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB	dB
Low channel	4804	56.8	35.5	5.7	62.5	41.2	74	54	11.5	12.8
2.402 GHz Carrier	7206	34.59	34.39	10.61	45.2	45	74	54	28.8	9
Mid channel	4480	46.8	34.6	5.7	52.5	40.3	74	54	21.5	13.7
2.440 GHz Carrier	7320	42.49	34.79	10.61	53.1	45.4	74	54	20.9	8.6
High channel	4960	56.37	34.87	5.73	62.1	40.6	74	54	11.9	13.4
2.480 GHz Carrier	7440	34.99	34.09	10.61	45.6	44.7	74	54	28.4	9.3

Data, Spurious Emissions of Harmonics

Note: Measurements were performed from 9 kHz to 25G Hz, only the signal within 10dB of the limit line was measured and reported.



3.7 Out of Band Emissions (Band Edge)

Date Performed: December 21, 2018

Test Standard: FCC Title 47 CFR Part 15: Subpart C - §15.247 (d), RSS-247-Issue 2 §5.5

Test Method: ANSI C63.10:2013

Test Requirement: In any 100kHz 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 100kHz 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 A8.4 (4), the attenuation required shall be 30 dB instead of 20dB.

Result:

The EUT complies with the applicable standard.

Measurement Data and Plot:





3.8 Unintentional Radiated Emissions

Date Performed:

August 17, 2018

Test Standard:

- FCC Title 47 CFR Part 15: Subpart B §15.109
- o ICES-003 Issue 6

Test Method:

o ANSI C63.4-2014

Required Limit:

The field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency, f (MHz)	Field strength (dBµV/m)				
30 - 88	40.0				
88-216	43.5				
216 - 960	46.0				
above 960	54.0				
Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges. Note 2: The emissions limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz Radiated emission limits in these three bands are based on measurements employing an average detector.					

Method of Measurement:

The EUT was positioned in the center of the turntable in the SAC. The EUT was then measured for all the radiated emissions in the frequency range of 30MHz - 1GHz. Measurements were made using the spectrum analyzer and receiver using the appropriate antennas, amplifiers, attenuators, and filters.

Emissions in both horizontal and vertical polarizations were measured while rotating the Equipment Under Test (EUT) on the turntable to maximize signal strength. In the case of high ambient noises, the measurements are performed at a closer distance and the limit is adjusted per the equation below. The result is added or subtracted to the required emission level to ensure compliance at the new distance.

20
$$\log\left(\frac{D1}{D2}\right)$$
; Where D1 = Current Distance
D2 = Required Distance

Result:

The EUT complies with the applicable standard.



Measurement Data and Plot:



Unintentional Radiated Emissions scanned at 3m SAC, Class B limit, 30MHz – 1GHz For Reference Only

Note: There are no signals of significance found in the frequency range from 30 MHz – 1 GHz when the transmitter is off.

Final_Result									
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.479992	23.24	40.00	16.76	1000.0	120.000	251.0	н	50.0	26.4
622.152300	27.28	47.00	19.72	1000.0	120.000	173.0	V	168.0	29.7
775.617050	29.62	47.00	17.38	1000.0	120.000	401.0	н	159.0	32.0
971.670000	31.99	47.00	15.01	1000.0	120.000	152.0	н	309.0	34.3





Unintentional Radiated Emissions scanned at 3m SAC, Class B limits, 1 – 18 GHz For Reference Only

				-			
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)
12305.000000	54.68		74.00	19.32	150.0	Н	0.0
12333.900000		45.36	54.00	8.64	150.0	Н	0.0
17909.900000		51.64	54.00	2.36	200.0	Н	186.0
17935.400000	61.31		74.00	12.69	200.0	Н	249.0
6054.100000		34.18	54.00	19.82	150.0	V	0.0
8539.500000		37.25	54.00	16.75	250.0	V	48.0

Final_Result







For Reference Only

Note: There are no signals of significance in the frequency range from 18 GHz – 25 GHz when the transmitter is off.



3.9 RF Exposure Evaluation

Date Performed: January 03, 2019

Test Standard: FCC 47 CFR §1.1310: RSS-102 Section 2.5.2:

CC CFR 47 §1.1310:

"Radiofrequency radiation exposure limits for General Population/Uncontrolled Exposure at Frequency range 1500 - 100000 MHz: 1.0 mW/cm^2"

RSS-102 Section 2.5.2:

"*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:

-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 x 10-2 $f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz

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."

RF Exposure Evaluation:

The calculation below is used to consider situations in which simultaneous exposure to fields of different frequencies occur. The calculation is performed by the sum of each relative exposure for each equipment according to the following criteria:

Power Density = $\frac{EIRP}{4\pi r^2}$ mW/cm²

Max EIRP measured: 5.93 dBm (LCH)

Max power density at 20cm: 0.1056 mW/cm²

Power density limit at 20 cm (1500 - 100000 MHz): < 1.0 mW/cm²

Result:

The EUT complies with the applicable standard.



3.10 Co-Location Testing

Date Performed:	January 03, 2019
Test Standard:	FCC Subpart C §15.205, 15.209 & 15.247
	FCC 47 CFR §1.1310: RSS-102 Section 2.5.2: RSS-247-Issue 2, RSS-Gen Issue 5
Evaluation Guidance:	Transmitter Module Equipment Authorization Guide 996369 v02
Result:	The EUT complies with the applicable standard.
Measurement Data:	

FCC CFR 47 §1.1310:

There were no intermodulation frequencies detected during the simultaneous transmission of the two radio modules. All RF device worst-case combinations were evaluated. Peaks showing in the plots are harmonics of the fundamental frequencies, which are below the limits.



Spurious Emissions of Radio Collocation, 30M-1G Hz, BLE & 2.4G LE-LAN on









Spurious Emissions of Radio Collocation, 18G-26G Hz, BLE & 2.4G LE-LAN on



Appendix A: TEST PHOTOS



Radiated Emissions 3m SAC 1 - Photo1



Radiated Emissions 3m SAC 1 - Photo2





Radiated Emissions performed at the 3m SAC, 150kHz – 30MHz



Radiated Emissions performed at the 3m SAC, 30MHz – 1GHz





Radiated Emissions performed at the 3m, 1 -18 GHz



Radiated Emissions performed at the 1m, above 18 -25 GHz



Appendix B: ABBREVIATIONS

Abbreviation	Definition					
AC	Alternating Current					
AM	Amplitude Modulation					
CISPR	Comité International Spécial des Perturbations Radioélectriques					
DC	Direct Current					
EMC	ElectroMagnetic Compatibility					
EMI	ElectroMagnetic Interference					
EUT	Equipment Under Test					
FCC	Federal Communications Commission					
IC	Industry Canada					
ICES	Interference Causing Equipment Standard					
IEC	International Electrotechnical Commission					
LISN	Line Impedance Stabilizing Network					
OATS	Open Area Test Site					
RF	Radio Frequency					
RMS	Root-Mean-Square					
SAC	Semi-Anechoic Chamber					

END OF REPORT