



FCC PART 15.407

TEST REPORT

For

Roku Inc.

150 Winchester Circle
Los Gatos, CA 95032, USA

FCC ID: TC2-R1016

Report Type: Class II Permissive Change	Model: 4670X
Prepared By: Christian McCaig Test Technician	
Report Number: R1906285-407	
Report Date: 2019-08-21	
Reviewed By: Frank Wang Test Engineer	
Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue, Sunnyvale, CA 94089, USA Tel: (408) 732-9162 Fax: (408) 732-9164	



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

* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*" (Rev. 0)

TABLE OF CONTENTS

1	GENERAL DESCRIPTION.....	4
1.1	PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	4
1.2	OBJECTIVE.....	4
1.3	RELATED SUBMITTAL(S)/GRANT(S)	4
1.4	TEST METHODOLOGY	4
1.5	MEASUREMENT UNCERTAINTY	5
1.6	TEST FACILITY REGISTRATIONS	5
1.7	TEST FACILITY ACCREDITATIONS.....	5
2	SYSTEM TEST CONFIGURATION.....	8
2.1	JUSTIFICATION	8
2.2	EUT EXERCISE SOFTWARE.....	8
2.3	EQUIPMENT MODIFICATIONS	9
2.4	LOCAL SUPPORT EQUIPMENT	9
2.5	SUPPORT EQUIPMENT	9
2.6	INTERFACE PORTS AND CABLING	9
3	SUMMARY OF TEST RESULTS	10
4	FCC §15.209, §15.407(B) - SPURIOUS RADIATED EMISSIONS	11
4.1	APPLICABLE STANDARD	11
4.2	TEST SETUP	12
4.3	TEST PROCEDURE	12
4.4	CORRECTED AMPLITUDE AND MARGIN CALCULATION	13
4.5	TEST EQUIPMENT LIST AND DETAILS	13
4.6	TEST ENVIRONMENTAL CONDITIONS.....	14
4.7	SUMMARY OF TEST RESULTS.....	15
4.8	RADIATED EMISSIONS TEST RESULT DATA	16
5	FCC §15.207 - AC LINE CONDUCTED EMISSIONS	20
5.1	APPLICABLE STANDARDS	20
5.2	TEST SETUP	20
5.3	TEST PROCEDURE	20
5.4	CORRECTED AMPLITUDE AND MARGIN CALCULATION	21
5.5	TEST SETUP BLOCK DIAGRAM.....	21
5.6	TEST EQUIPMENT LIST AND DETAILS	22
5.7	TEST ENVIRONMENTAL CONDITIONS.....	22
5.8	SUMMARY OF TEST RESULTS.....	23
5.9	CONDUCTED EMISSIONS TEST PLOTS AND DATA	24
6	ANNEX A (NORMATIVE) - EUT TEST SETUP PHOTOGRAPHS.....	26
7	ANNEX B (NORMATIVE) – EUT EXTERNAL PHOTOGRAPHS	27
8	ANNEX C (NORMATIVE) – EUT INTERNAL PHOTOGRAPHS	28
9	ANNEX D (NORMATIVE) - A2LA ELECTRICAL TESTING CERTIFICATE	29

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1906285-407	CIIPC Report	2019-08-21

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Roku Inc.*, and their product model: 4670X, FCC ID: TC2-R1016, the “EUT” as referred to in this report.

1.2 Objective

This report is prepared on behalf of *Roku, Inc* in accordance with FCC CFR47 §15.407.

The objective is to determine compliance with FCC Part 15.407 and ISERC RSS-247 rules for Radiated Spurious Emissions testing and to verify the Output Power.

This project is a Permissive Change II submission for the purpose of adding built in extra memory and slightly modifying digital circuitry compared with model 4670X.

1.3 Related Submittal(s)/Grant(s)

FCC Part 15, Subpart C, Equipment DTS Report with FCC ID: TC2-R1016

1.4 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz, and FCC KDB 789033 D02 General UNII Test Procedure New Rules v02r01.

1.5 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system 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 according to ANSI C63.10-2013 and FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

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

The worst-case data rates are determined by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

The test firmware used was the TeraTerm serial terminal and setup commands provided by Roku Inc., the software is compliant with the standard requirements being tested against.

Please refer to the following power setting table.

Modulation	Channel	Frequency (MHz)	Power Setting
802.11a mode	36	5180	49
	40	5200	62
	48	5240	62
	149	5745	49
	157	5785	56
	165	5825	54
802.11n20 mode	36	5180	53
	40	5200	56
	48	5240	56
	149	5745	56
	157	5785	56
	165	5825	56
802.11ac20 mode	36	5180	53
	40	5200	56
	48	5240	56
	149	5745	56
	157	5785	56
	165	5825	56

* Note: This is only an FCC channel.

*Data rates tested:

802.11a mode: 6Mbps

802.11n HT20: MCS0

802.11ac VHT20: MCS0

2.3 Equipment Modifications

N/A

2.4 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Dell	Laptop	Latitude E6410	3CKRAQ1

2.5 Support Equipment

Manufacturer	Description	Model
Atmel Corp.	Debug/Programmer Board (USB-JTAG Jig), FASTPCB	LJ001-3v4

2.6 Interface Ports and Cabling

Cable Description	Length (m)	To	From
Standard USB Adapter (A-Male to B-Male)	< 1m	Laptop	EUT
Ribbon Cable	< 1m	EUT	Debug/Programmer Board

3 Summary of Test Results

FCC Rules	Description of Test	Result
FCC §2.1053, §15.205, §15.209, 15.407(b)	Radiated Spurious Emissions	Compliant
FCC §15.207	AC Line Conducted Emissions	Compliant

4 FCC §15.209, §15.407(b) - Spurious Radiated Emissions

4.1 Applicable Standard

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

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	960 – 1240	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5.35 – 5.46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 – 167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3.3458 – 3.358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As per FCC §15.209: The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

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

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

As per FCC Part 15.407 (b)

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

(4) For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm/MHz.

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

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

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

4.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15.407 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.

4.3 Test Procedure

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

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

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 meter, and the EUT is placed on a turntable, which is 0.8 meter or 1.5 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

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

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 3MHz / Sweep = 100ms

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

4.4 Corrected Amplitude and Margin Calculation

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

$$CA = Ai + AF + CL + Atten - Ga$$

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

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

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

4.5 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	2018-10-26	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
Agilent	Pre-Amplifier	8447D	2944A10187	2019-04-10	1 Year
A.H. Systems	Horn Antenna	SAS-200/571	261	2019-06-07	2 Years
WiseWave	Horn Antenna	ARH-4223-02	10555-1	2018-02-04	2 Years
WiseWave	Horn Antenna	ARH-2823-02	10555-02	2017-12-15	2 Years
Agilent	Pre-Amplifier	8449B	3008A01978	2018-09-18	1 Year
A.H. Systems	Pre-Amplifier	PAM 1840V	18091112	2018-09-11	1 Year
Insulated Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2019-05-08	1 Year
-	SMA cable	-	C0002	Each time ¹	N/A
-	N-Type Cable	-	C00013	Each time ¹	N/A
-	N-Type Cable	-	C00014	Each time ¹	N/A
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 calibrations have been performed per the A2LA requirements, traceable to the NIST.

4.6 Test Environmental Conditions

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

The testing was performed by Christian McCaig on 2019-07-28 in 5m chamber 3.

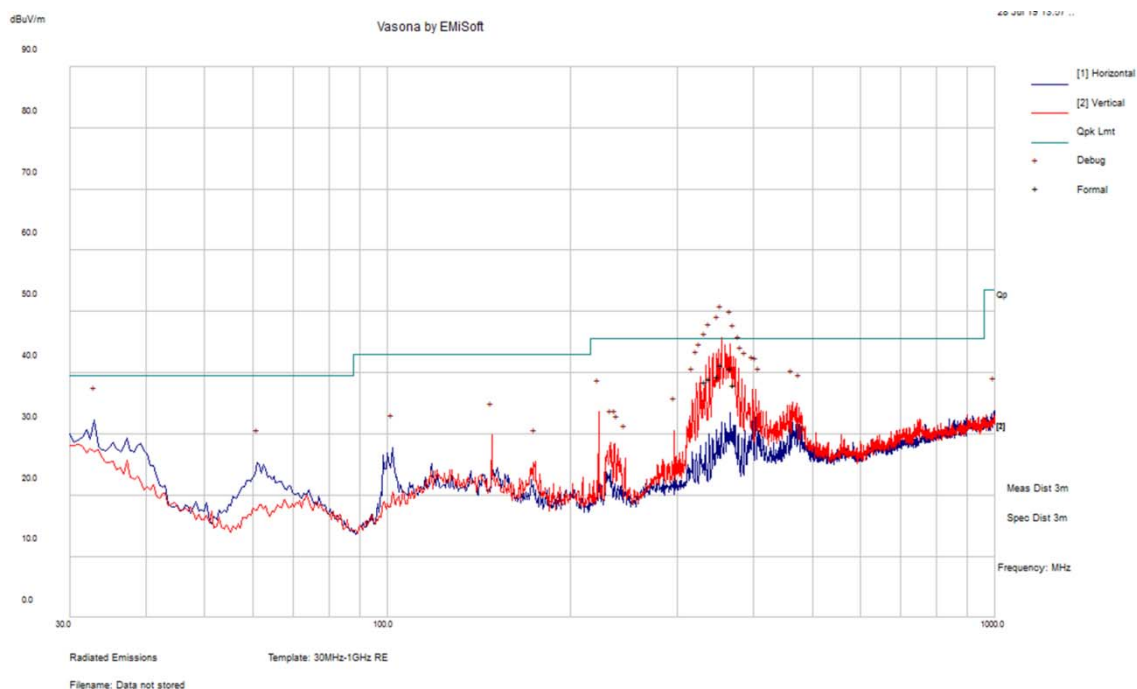
4.7 Summary of Test Results

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

Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Mode, Channel
-3.03	26407.56	Horizontal	a mode, middle channel

4.8 Radiated Emissions Test Result Data

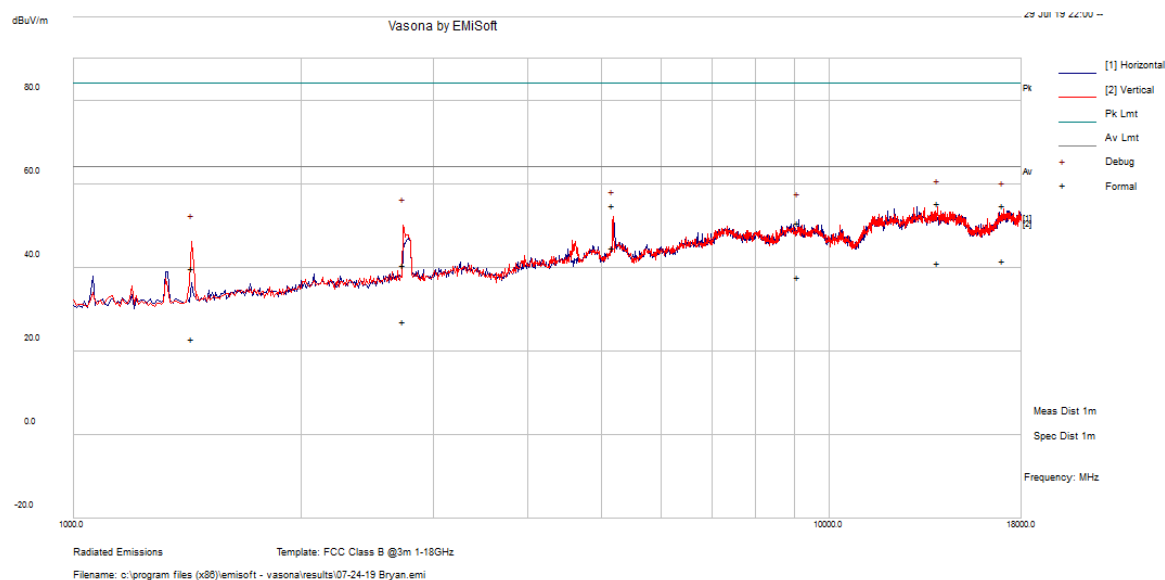
1) 30 MHz – 1 GHz Worst Case, Measured at 3 meters



Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)	Comments (PK/QP/Ave.)
354.5708	41.28	104	V	18	45.5	-4.22	QP
366.4523	40.78	108	V	26	45.5	-4.72	QP
350.1028	39.45	121	V	33	45.5	-6.05	QP
338.571	39.04	104	V	359	45.5	-6.46	QP
371.0815	38.07	112	V	31	45.5	-7.43	QP
333.8035	38.48	103	V	18	45.5	-7.02	QP

2) 1–40 GHz Worst Case, Measured at 1 meter

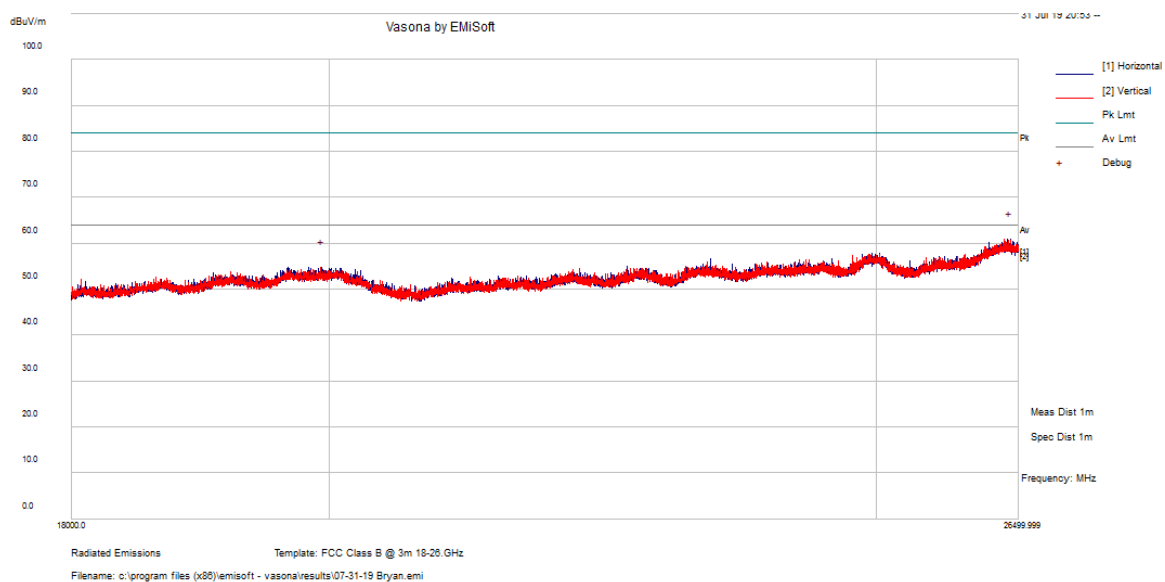
1-18GHz Worst Case, Measured at 1 meter



Frequency (MHz)	Corrected Amplitude (dBμV/m)	Polarity (H/V)	Height (cm)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)	Detector (Peak /Ave.)
13935.96	55.36	V	276	112	64	-8.64	Peak*
17021.4	54.84	V	115	284	64	-9.16	Peak*
5183.06	54.87	V	111	324	64	-9.13	Peak*

Note*: Due to the testing value by using peak detector is within the average limit, no average detector testing is needed.

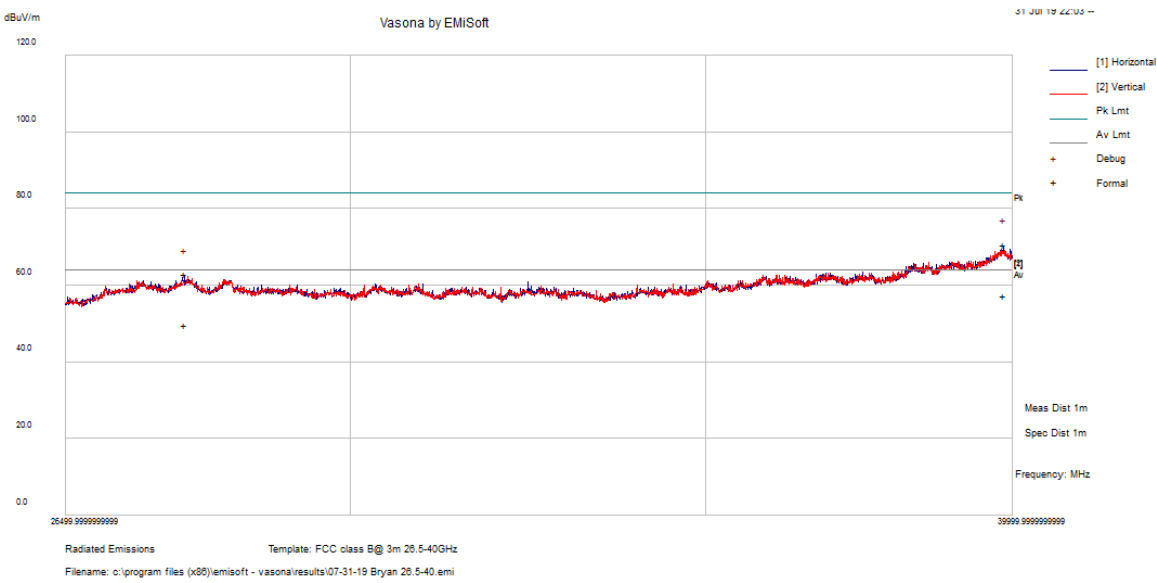
3) 18-26.5 GHz Worst Case, Measured at 1 meter



Frequency (MHz)	Corrected Amplitude (dBuV/m)	Polarity (H/V)	Height (cm)	Turntable Azimuth (degrees)	Limit (dBuV/m)	Margin (dB)	Detector (Peak /Ave.)
26407.56	60.97	H	200	0	64	-3.03	Peak*
19940.13	54.82	H	100	0	64	-9.18	Peak*

Note*: Due to the testing value by using peak detector is within the average limit, no average detector testing is needed.

4) 26.5-40 GHz Worst Case, Measured at 1 meter



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Polarity (H/V)	Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (Peak /Ave.)
39843.94	70.63	H	154	9	84	-13.37	Peak
27909.53	63.01	H	108	271	84	-20.99	Peak
39843.94	57.3	H	154	9	64	-6.7	Ave
27909.53	49.56	H	108	271	64	-14.44	Ave

5 FCC §15.207 - AC Line Conducted Emissions

5.1 Applicable Standards

As per FCC §15.207 Conducted limits:

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

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

Note1: Decreases with the logarithm of the frequency.

Note2: A linear average detector is required

5.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.10-2013 measurement procedure. The specification used were FCC §15.207 limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The AC/DC power adapter of the EUT was connected with LISN-1 which provided 120 V / 60 Hz AC power.

5.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1 and the power cords of support equipment were connected to LISN-2.

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

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

5.4 Corrected Amplitude and Margin Calculation

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

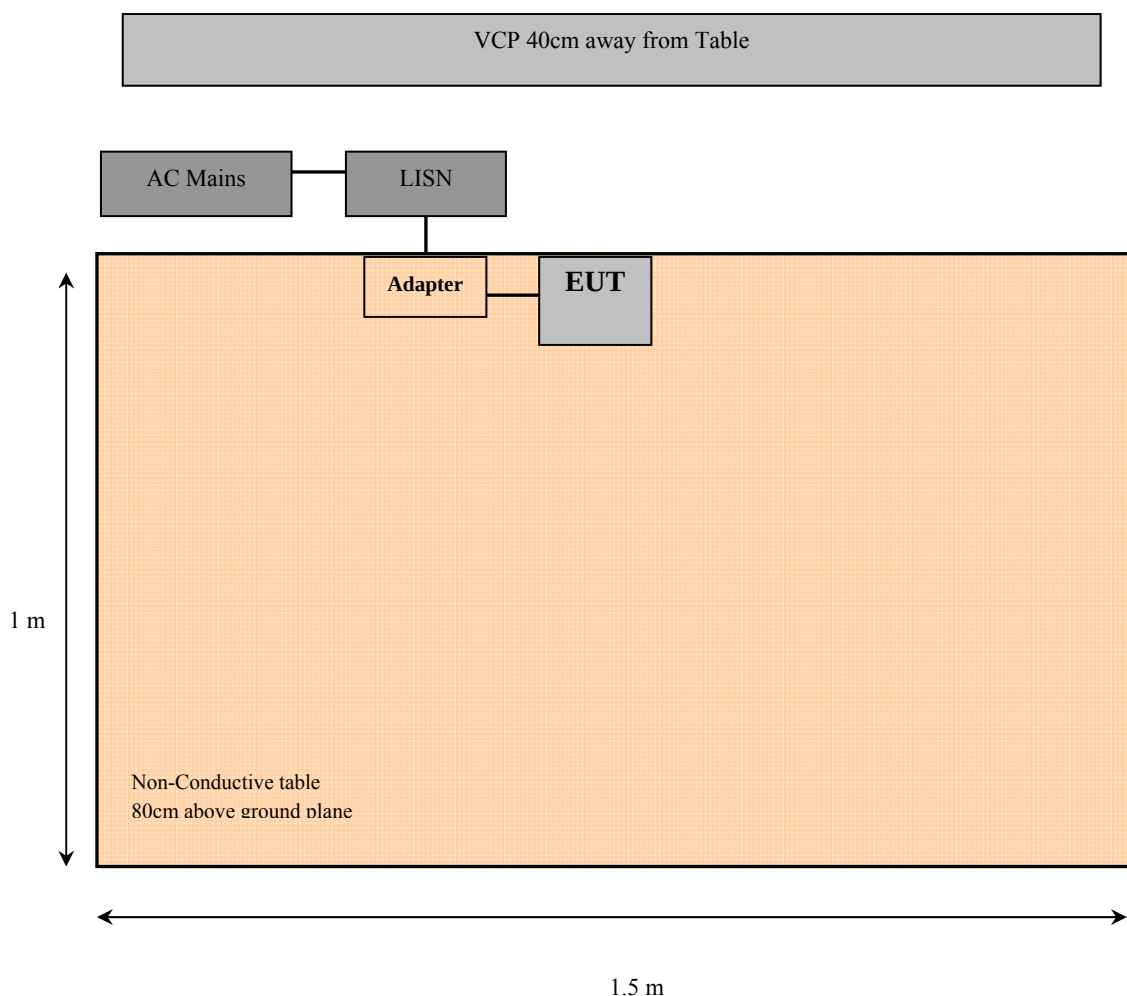
$$CA = Ai + CL + Atten$$

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

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

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

5.5 Test Setup Block Diagram



5.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde and Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100044	2017-09-18	2 years
Rohde and Schwarz	Impulse Limiter	ESH3-Z2	101964	2018-07-28	1 year
Keysight Technologies	RF Limiter	11867A	MY42242931	2018-09-04	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150202	2019-02-25	1 year
Fairview Microwave	Micro-Coaxial Cable	FMC0101223-360	102515	2019-07-18	1 year
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160130	2019-04-11	1 year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

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

5.7 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	101.31 kPa

The testing was performed by Corey Phan on 2019-07-26 in 5 chamber 3.

5.8 Summary of Test Results

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

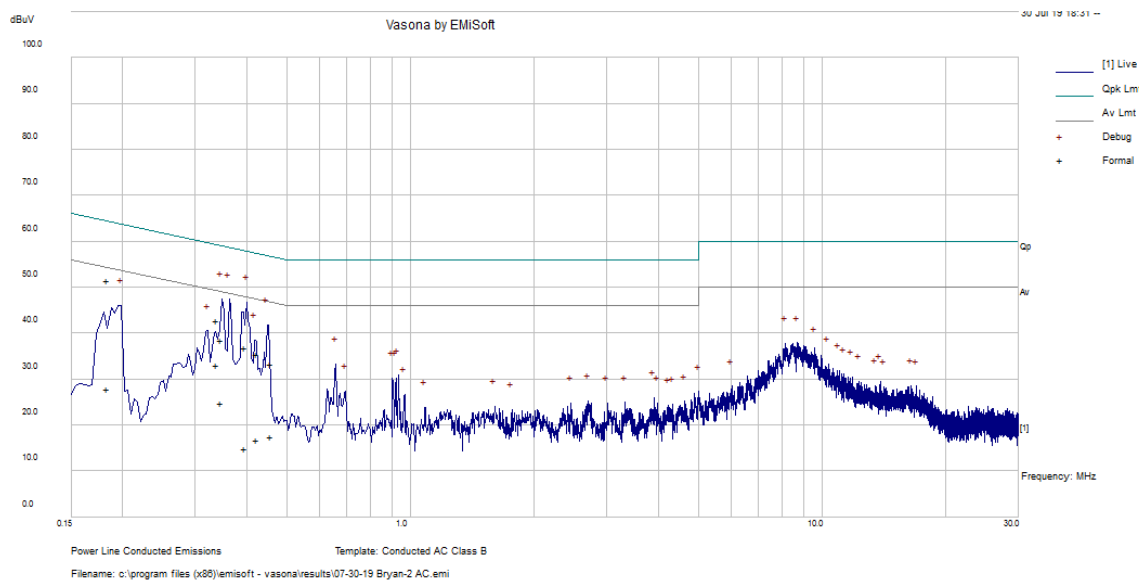
2.4 GHz Wi-Fi

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	Frequency (MHz)	Conductor Mode (Live/Neutral)	Range (MHz)
-12.83	0.177181	Neutral	0.15-30

5.9 Conducted Emissions Test Plots and Data

5 GHz Wi-Fi

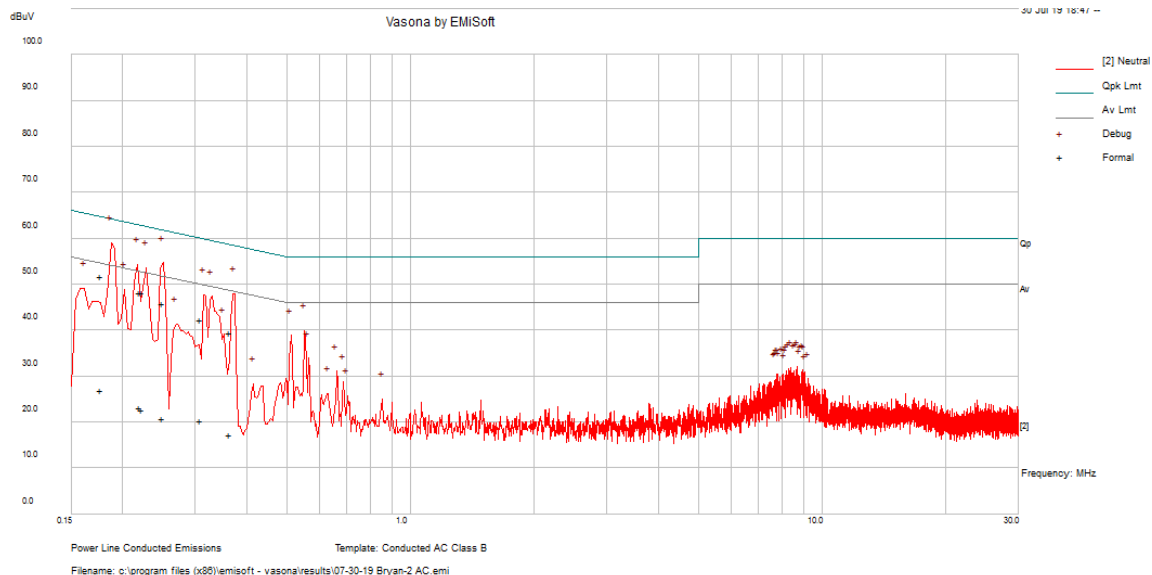
120 V, 60 Hz – Live



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Live/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.18312	51.49	Live	64.34	-12.86	QP
0.339238	42.82	Live	59.22	-16.4	QP
0.345938	38.61	Live	59.06	-20.44	QP
0.395241	36.97	Live	57.95	-20.99	QP
0.423294	35.45	Live	57.38	-21.94	QP
0.458384	33.37	Live	56.72	-23.35	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Live/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.345938	24.81	Live	49.06	-24.25	Ave.
0.339238	33.15	Live	49.22	-16.07	Ave.
0.18312	28	Live	54.34	-26.34	Ave.
0.458384	17.58	Live	46.72	-29.14	Ave.
0.423294	16.75	Live	47.38	-30.63	Ave.
0.395241	14.84	Live	47.95	-33.12	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Live/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.177181	51.79	Neutral	64.87	-12.83	QP
0.249995	45.74	Neutral	62.3	-16.02	QP
0.220173	48.17	Neutral	61.99	-14.65	QP
0.222872	48.13	Neutral	60.12	-14.58	QP
0.363198	39.46	Neutral	57.35	-19.2	QP
0.30938	42.22	Neutral	61.12	-17.77	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Live/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.177181	26.93	Neutral	54.62	-27.69	Ave.
0.249995	20.88	Neutral	51.76	-30.88	Ave.
0.220173	23.07	Neutral	52.81	-29.75	Ave.
0.222872	22.68	Neutral	52.71	-30.03	Ave.
0.363198	17.34	Neutral	48.66	-31.31	Ave.
0.30938	20.29	Neutral	49.99	-29.69	Ave.

6 Annex A (Normative) - EUT Test Setup Photographs

Please refer to the attachment.

7 Annex B (Normative) – EUT External Photographs

Please refer to the attachment.

8 Annex C (Normative) – EUT Internal Photographs

Please refer to the attachment.

9 Annex 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.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2020
Revised June 5, 2019

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

--- END OF REPORT ---