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

TEST REPORT

For

Zebra Technologies Corporation

3 Overlook Point
Lincolnshire, IL 60069, USA

FCC ID: I28-ZBRZQ3BT
IC: 3798B-ZBRZQ3BT

Report Type: Class II Permissive Change	**Product Type:** Bluetooth Module

Prepared By	Zhao Zhao Test Engineer
Report Number	R1909274-247 DSS
Report Date	2019-11-27
Reviewed By	Frank Wang RF Lead

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ACCREDITED
CERTIFICATE #3297.02

* This test report may contain data and test methods that are not covered by BACL's scope of accreditation as of the test report date shown above. These items are marked within the test report text with an asterisk "*"

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1909274-247 DSS	Class II Permissive Change Report	2019-11-27

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test report was prepared on behalf of *Zebra Technologies Corporation*, and their product model: ZQ3BT, *FCC ID: I28-ZBRZQ3BT, IC: 3798B-ZBRZQ3BT,* or the "EUT" as referred to in this report. The EUT is a Bluetooth radio module operates in 2400 – 2483.5 MHz.
The model was installed in the host model: ZQ210

1.2 Objective

This report is prepared on behalf of *Zebra Technologies Corporation,* in accordance with FCC CFR47 §15.247 and ISED RSS-247 Issue 2, February 2017.

The objective is to determine compliance with FCC Part 15.247 and ISED RSS-247 Issue 2 rules to allow Limited Radio Module, Model Number: ZQ3BT, FCC ID: I28-ZBRZQ3BT, IC: 3798B-ZBRZQ3BT installed in host products, ZQ210. Class II Permissive Change for this radio module with host device: ZQ210 is filed.

Radio Type	ZQ3BT (Bluetooth Ver4.0+EDR)
Operating Frequency	2402MHz - 2480MHz
Modulation	FHSS (BDR/EDR); GFSK (LE)
Channel Spacing	1MHz (BDR, EDR); 2MHz (LE)
Chip Type Antenna Gain	1.69 dBi
RF Output power	0.0052W (BDR/EDR); 0.0029 (LE)

1.3 Related Submittal(s)/Grant(s)

R1909274-247 DTS

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) and FCC KDB 789033 D02 General U-NII Test Procedures New Rules v02r01: Guidelines For Compliance Testing of Usnlicensed National Information Infrastructure (U-NII).

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

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013 and FCC KDB 558074 D01 DTS Meas Guidance v05r02.

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

2.2 EUT Exercise Software

The software "Toolbox v1.83" was used to transmit signal for all the modules. The software was provided by *Zebra Technologies, Corp.* and verified by Zhao Zhao to comply with the standard requirements being tested against.

2.3 Equipment Modifications

A conducted port was modified by the manufacturer for the conducted tests.

2.4 Local Support Equipment

None

2.5 Support Equipment

Manufacturer	Description	Model	Serial Number
Dell	Laptop	Latitude E4610	3CKR4Q1

2.6 Interface Ports and Cabling

Cable Descriptions	Length (m)	From	To
USB to Type-C	1	Laptop	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

FCC and ISED Rules	Description of Test	Results
FCC §15.207 ISED RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §2.1091, §15.247(i) ISED RSS-102	RF Exposure	Compliant
FCC §2.1053, §15.205, §15.209, §15.247 (d) ISED RSS-247 §5.5 RSS-Gen §8.9 and §8.10	Radiated Spurious Emissions	Compliant

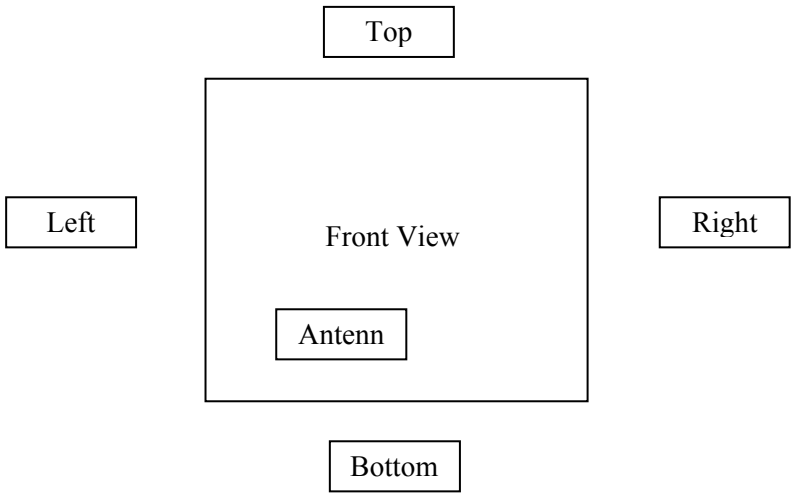
4 FCC §15.247(f) §2.1093 & ISED RSS-102 - RF Exposure

4.1 Applicable Standards

According to FCC §2.1093 (Portable Devices) RF exposure is calculated.

4.2 SAR Consideration

EUT Antennas Location



Note 1: the diagram above is only to show antenna location, and it doesn't represent the shape of the host device or the antenna. Please refer to the EUT photos exhibit for detailed information.

The EUT was considered only have hand-hold configuration for SAR evaluation. The separation distance declared from the antenna to human hand is 5 mm.

FCC SAR calculation:

According to 447498 Section 4.3.1 (a), for 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by [(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR. Calculation details are shown in the tables below.

Bluetooth/BLE							
Mode	**Frequency (MHz)**	**Max. Power (dBm)**	**Antenna Gain (dBi)**	**Turn-up Tolerance**	**Separation distance from body (mm)**	**Exclusion Threshold**	**Comment**
BT-EDR	2402	7.40	1.69	±1	5	2.14	<7.5
BLE	2402	4.72	1.69	±1	5	1.16	<7.5

Result: The exclusion threshold is below 7.5, SAR test can be exempted.

4.3 According to ISED RSS-102:

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Table 1: SAR evaluation — Exemption limits for routine evaluation based on frequency and separation distance[4.5]

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Note: For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5.

ISEDC SAR Calculation:

Bluetooth/BLE							
Mode	**Frequency (MHz)**	**Max. Power (dBm)**	**Antenna Gain (dBi)**	**Turn-up Tolerance**	**EIRP Power (mW)**	**Separation distance from body (mm)**	**Exclusion Threshold**
BT-EDR	2402	7.40	1.69	±1	10.04	5	10.65 mW
BLE	2402	4.72	1.69	±1	8.70	5	10.65 mW

Result: The EIRP including with turn-up tolerance is lower than the exclusion threshold, the SAR test can be exempted.

Note: The threshold is linear calculated based on table 1.

5 FCC §15.207 & RSS-210 §8.8 - AC Line Conducted Emissions

5.1 Applicable Standards

As per FCC §15.207 and ISED RSS-Gen §8.8 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 μH/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 and ISED RSS-Gen §8.8 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 & 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:

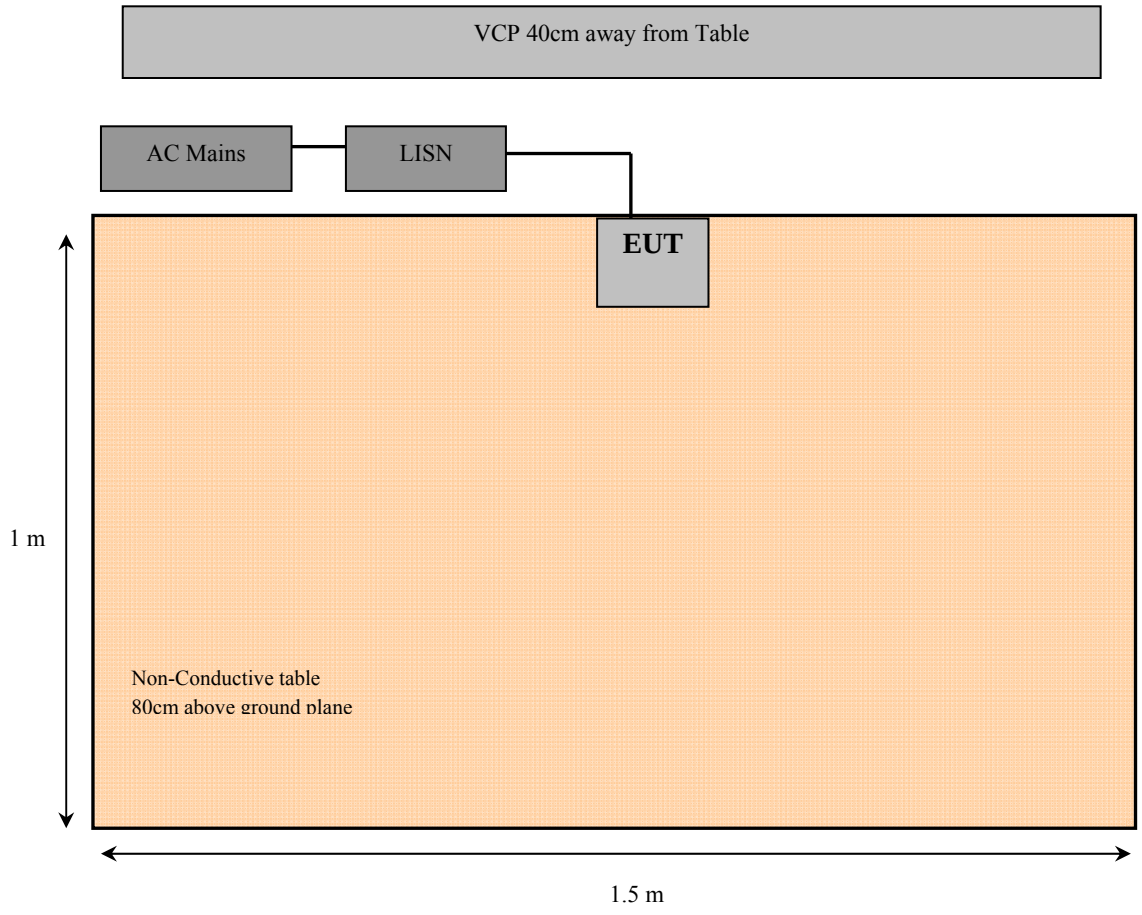
CA = Ai + CL + Atten

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:

Margin = Corrected Amplitude – 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 & Schwarz	Impulse Limiter	ESH3-Z2	101963	2019-07-31	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150202	2019-02-25	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	N/R	N/A
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2019-04-11	1 year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950.03	100338	2018-07-05	2 years

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:	23º C
Relative Humidity:	44 %
ATM Pressure:	101.6 kPa

The testing was performed by Zhao Zhao on 2019-10-16 at ground panel.

5.8 Summary of Test Results

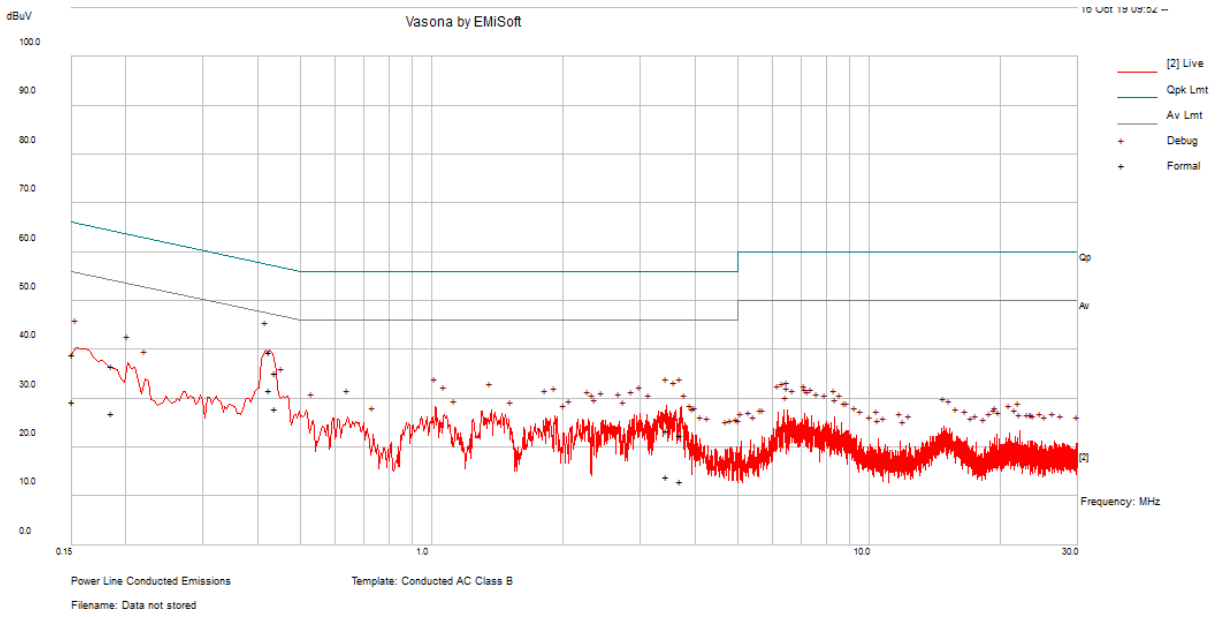
According to the recorded data in following table, the EUT complied with the FCC 15C and RSS-Gen standard's conducted emissions limits, with the margin reading of:

Connection: AC/DC Adapter Connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-14.94	0.422891	Neutral	0.15-30

5.9 Conducted Emissions Test Plots and Data

Worst Case Classic Bluetooth 3-EDR Middle Channel 2441MHz

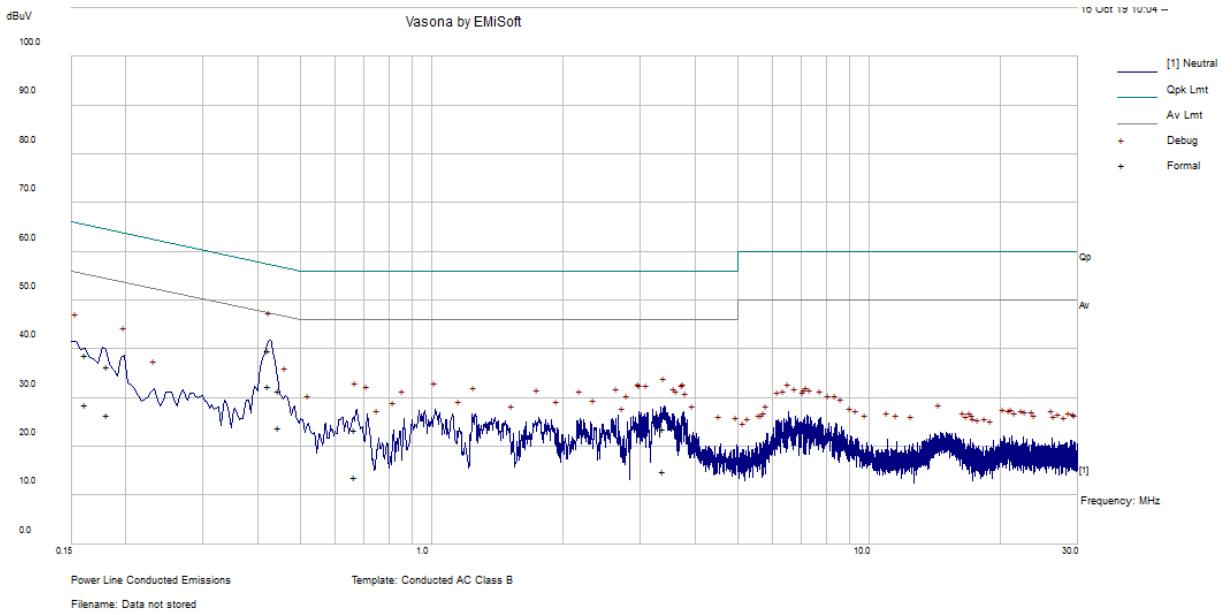
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.425832	39.54	Line	57.33	-17.8	QP
0.151122	39.03	Line	65.94	-26.91	QP
0.440431	35.21	Line	57.05	-21.85	QP
0.185465	36.53	Line	64.24	-27.71	QP
3.440841	23.38	Line	56	-32.62	QP
3.712215	22.56	Line	56	-33.44	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.425832	31.64	Line	47.33	-15.69	Ave.
0.151122	29.43	Line	55.94	-26.51	Ave.
0.440431	27.89	Line	47.05	-19.16	Ave.
0.185465	27.06	Line	54.24	-27.18	Ave.
3.440841	13.88	Line	46	-32.12	Ave.
3.712215	12.96	Line	46	-33.04	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.422891	39.62	Neutral	57.39	-17.77	QP
0.161904	38.84	Neutral	65.37	-26.53	QP
0.181536	36.5	Neutral	64.42	-27.92	QP
0.44631	31.36	Neutral	56.94	-25.58	QP
3.383343	23.54	Neutral	56	-32.46	QP
0.668288	23.37	Neutral	56	-32.63	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.422891	32.45	Neutral	47.39	-14.94	Ave.
0.161904	28.72	Neutral	55.37	-26.65	Ave.
0.181536	26.36	Neutral	54.42	-28.05	Ave.
0.44631	23.83	Neutral	46.94	-23.11	Ave.
3.383343	14.79	Neutral	46	-31.21	Ave.
0.668288	13.63	Neutral	46	-32.37	Ave.

6 FCC § 2.1053, § 15.205, §15.209 & §15.247(d) RSS-Gen §8.9 & §8.10 RSS-247 §5.5 Spurious Radiated Emissions

6.1 Applicable Standards

As per FCC §15.35(b): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

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

MHz	MHz	MHz	GHz
0.090 – 0.110 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 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

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 ISED RSS-Gen 8.9,

> Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 or Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz

Frequency (MHz)	Field Strength (µv/m at 3 metres)
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 ISED 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.

6.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15.209, FCC 15.247, 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.

6.3 Test Procedure

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

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

The EUT 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, the table was rotated for 360 degrees to find out the highest emission. The receiving antenna's polarity changed between horizontal and vertical.

The spectrum analyzer or receiver was set as:

Below 1000 MHz:

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

Above 1000 MHz:

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

6.4 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100044	2018-10-26	2 year
Rhode & Schwarz	Signal Analyzer	FSV40	1321.3008K39-101203-UW	2019-08-06	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB1	A013105-3	2018-02-26	2 year
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2019-04-02	2 years
Wisewave	Antenna, Horn	ARH-4223-02	10555-01	2018-01-18	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2019-04-11	1 year
HP	Pre-Amplifier	8449B	3147A004008	2019-05-20	1year
A.H. Systems	Pre-Amplifer	PAM 1840V	170	2019-09-24	1 year
Insulted 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

Note[1]: cables included in the test set-up will be checked each time before testing.
***Statement of Traceability: BACL** attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.*

6.5 Test Location, Date, Personnel and Environmental Conditions

Temperature:	22-24° C
Relative Humidity:	44-46 %
Barometric Pressure:	101.7-102.9 kPa

The testing was performed by Zhao Zhao from 2019-10-16 and 2019-10-18 in 5m3 chamber.

6.6 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Part 15.209, 15.247 and RSS-247 standards' radiated emissions limits, and had the worst margin of:

30-1000 MHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Detector Mode**
-8.11	43.52075	Horizontal	Quasi Peak

1-26.5 GHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Detector Mode**
-5.33	2483.5	Vertical	Average

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

6.7 Radiated Emissions Test Results Data

1-18 GHz at 3 Meter

BDR

Freq. (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 2402 MHz											
2390	28.54	18	176	H	28.33	5.08	0.00	61.96	74.00	-12.04	PK
2390	14.06	18	176	H	28.33	5.08	0.00	47.48	54.00	-6.52	AV
2390	28.39	277	171	V	28.33	5.08	0.00	61.81	74.00	-12.19	PK
2390	14.22	277	171	V	28.33	5.08	0.00	47.64	54.00	-6.36	AV
4804	45.56	18	176	H	32.86	7.43	38.17	47.68	74.00	-26.32	PK
4804	35.64	18	176	H	32.86	7.43	38.17	37.76	54.00	-16.24	AV
4804	45.85	277	171	V	32.86	7.43	38.17	47.97	74.00	-26.03	PK
4804	36.24	277	171	V	32.86	7.43	38.17	38.36	54.00	-15.64	AV
Mid Channel 2441 MHz											
4882	52.40	6	176	H	33.19	7.43	38.09	54.92	74.00	-19.08	PK
4882	37.65	6	176	H	33.19	7.43	38.09	40.17	54.00	-13.83	AV
4882	51.63	286	171	V	33.19	7.43	38.09	54.15	74.00	-19.85	PK
4882	37.53	286	171	V	33.19	7.43	38.09	40.05	54.00	-13.95	AV
High Channel 2480 MHz											
2483.5	29.25	6	176	H	28.26	5.08	0.00	62.59	74.00	-11.41	PK
2483.5	15.01	6	176	H	28.26	5.08	0.00	48.35	54.00	-5.65	AV
2483.5	28.96	286	171	V	28.26	5.08	0.00	62.30	74.00	-11.70	PK
2483.5	15.33	286	171	V	28.26	5.08	0.00	48.67	54.00	**-5.33**	AV
4960	46.58	6	176	H	33.15	7.60	38.15	49.18	74.00	-24.82	PK
4960	36.69	6	176	H	33.15	7.60	38.15	39.29	54.00	-14.71	AV
4960	46.17	286	171	V	33.15	7.60	38.15	48.77	74.00	-25.23	PK
4960	36.18	286	171	V	33.15	7.60	38.15	38.78	54.00	-15.22	AV

2-EDR

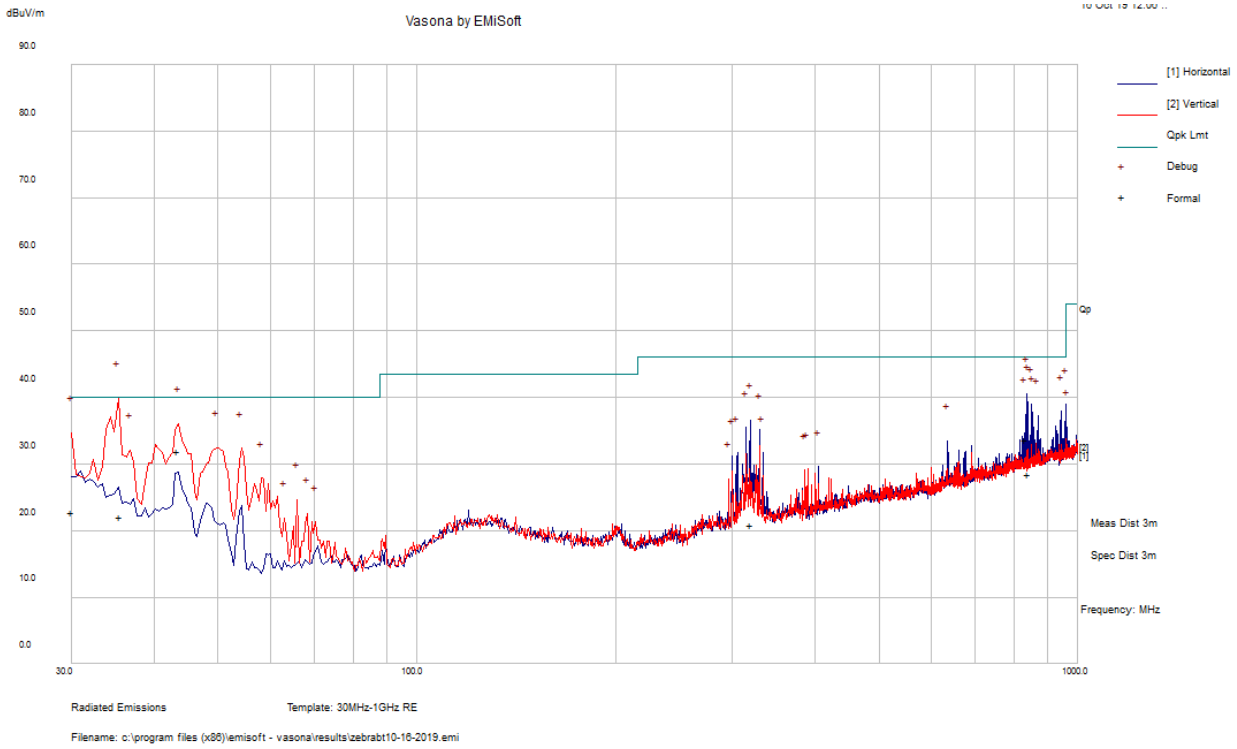
Freq. (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2402 MHz											
2390	28.66	18	176	H	28.33	5.08	0.00	62.08	74.00	-11.92	PK
2390	14.08	18	176	H	28.33	5.08	0.00	47.50	54.00	-6.50	AV
2390	28.47	277	171	V	28.33	5.08	0.00	61.89	74.00	-12.11	PK
2390	14.39	277	171	V	28.33	5.08	0.00	47.81	54.00	-6.19	AV
4804	45.56	18	176	H	32.86	7.43	38.17	47.68	74.00	-26.32	PK
4804	35.64	18	176	H	32.86	7.43	38.17	37.76	54.00	-16.24	AV
4804	45.85	277	171	V	32.86	7.43	38.17	47.97	74.00	-26.03	PK
4804	36.24	277	171	V	32.86	7.43	38.17	38.36	54.00	-15.64	AV
Mid Channel 2441 MHz											
4882	52.64	6	176	H	33.19	7.43	38.09	55.16	74.00	-18.84	PK
4882	39.37	6	176	H	33.19	7.43	38.09	41.89	54.00	-12.11	AV
4882	54.17	286	171	V	33.19	7.43	38.09	56.69	74.00	-17.31	PK
4882	40.08	286	171	V	33.19	7.43	38.09	42.60	54.00	-11.40	AV
High Channel 2480 MHz											
2483.5	29.05	6	176	H	28.26	5.08	0.00	62.39	74.00	-11.61	PK
2483.5	14.96	6	176	H	28.26	5.08	0.00	48.30	54.00	-5.70	AV
2483.5	28.88	286	171	V	28.26	5.08	0.00	62.22	74.00	-11.78	PK
2483.5	15.21	286	171	V	28.26	5.08	0.00	48.55	54.00	-5.45	AV
4960	46.58	6	176	H	33.15	7.60	38.15	49.18	74.00	-24.82	PK
4960	36.69	6	176	H	33.15	7.60	38.15	39.29	54.00	-14.71	AV
4960	46.17	286	171	V	33.15	7.60	38.15	48.77	74.00	-25.23	PK
4960	36.18	286	171	V	33.15	7.60	38.15	38.78	54.00	-15.22	AV

3-EDR

Freq. (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 2402 MHz											
2390	28.83	18	176	H	28.33	5.08	0.00	62.25	74.00	-11.75	PK
2390	14.33	18	176	H	28.33	5.08	0.00	47.75	54.00	-6.25	AV
2390	29.02	277	171	V	28.33	5.08	0.00	62.44	74.00	-11.56	PK
2390	14.87	277	171	V	28.33	5.08	0.00	48.29	54.00	-5.71	AV
4804	45.58	0	100	H	33.14	11.34	38.17	51.88	74.00	-22.12	PK
4804	30.64	0	100	H	33.14	11.34	38.17	36.94	54.00	-17.06	AV
4804	45.24	0	100	V	33.14	11.34	38.17	51.54	74.00	-22.46	PK
4804	30.33	0	100	V	33.14	11.34	38.17	36.63	54.00	-17.37	AV
Mid Channel 2441 MHz											
4882	52.40	6	176	H	33.19	7.43	38.09	54.92	74.00	-19.08	PK
4882	37.65	6	176	H	33.19	7.43	38.09	40.17	54.00	-13.83	AV
4882	51.63	286	171	V	33.19	7.43	38.09	54.15	74.00	-19.85	PK
4882	37.53	286	171	V	33.19	7.43	38.09	40.05	54.00	-13.95	AV
High Channel 2480 MHz											
2483.5	28.29	6	176	H	28.26	5.08	0.00	61.63	74.00	-12.37	PK
2483.5	14.37	6	176	H	28.26	5.08	0.00	47.71	54.00	-6.29	AV
2483.5	28.62	286	171	V	28.26	5.08	0.00	61.96	74.00	-12.04	PK
2483.5	14.18	286	171	V	28.26	5.08	0.00	47.52	54.00	-6.48	AV
4960	52.39	6	176	H	32.86	7.43	38.17	54.51	74.00	-19.49	PK
4960	36.88	6	176	H	32.86	7.43	38.17	39.00	54.00	-15.00	AV
4960	52.63	286	171	V	32.86	7.43	38.17	54.75	74.00	-19.25	PK
4960	36.53	286	171	V	32.86	7.43	38.17	38.65	54.00	-15.35	AV

1) 30 MHz - 1 GHz radiated emission measured at 3 meters

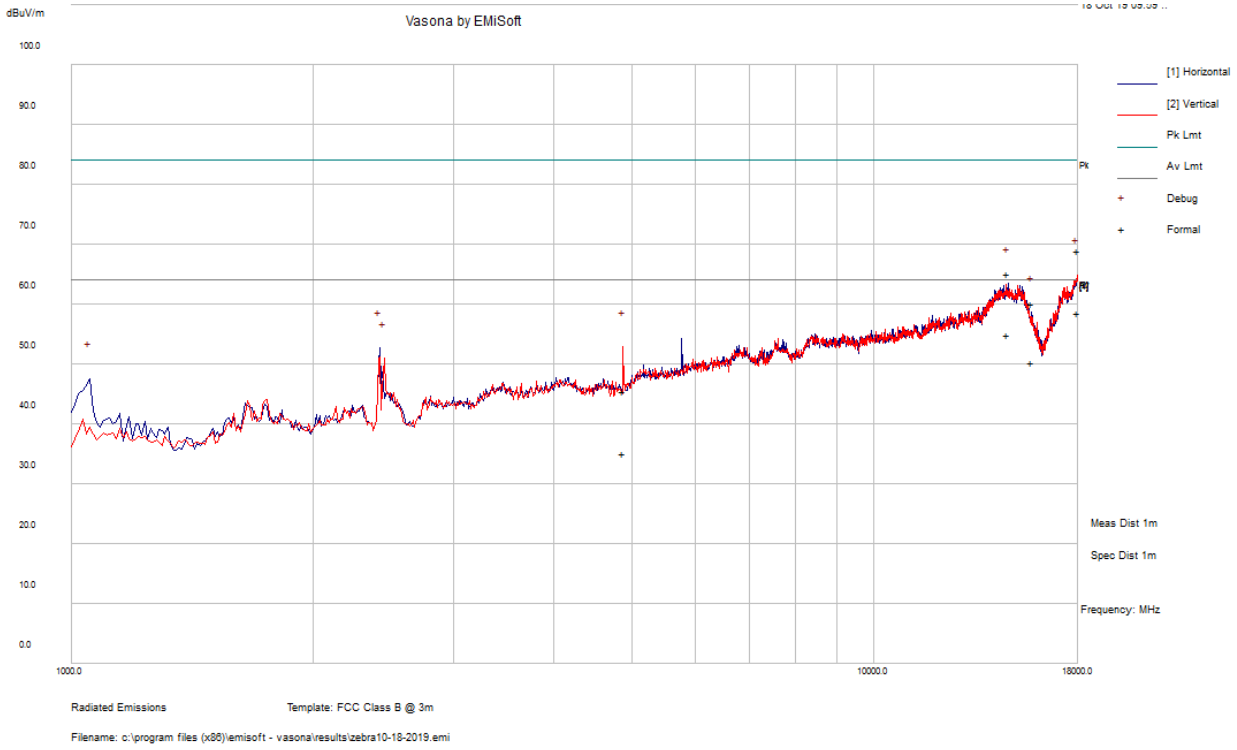
Worst Case (including BLE) Classic Bluetooth 3-EDR Middle Channel 2441MHz



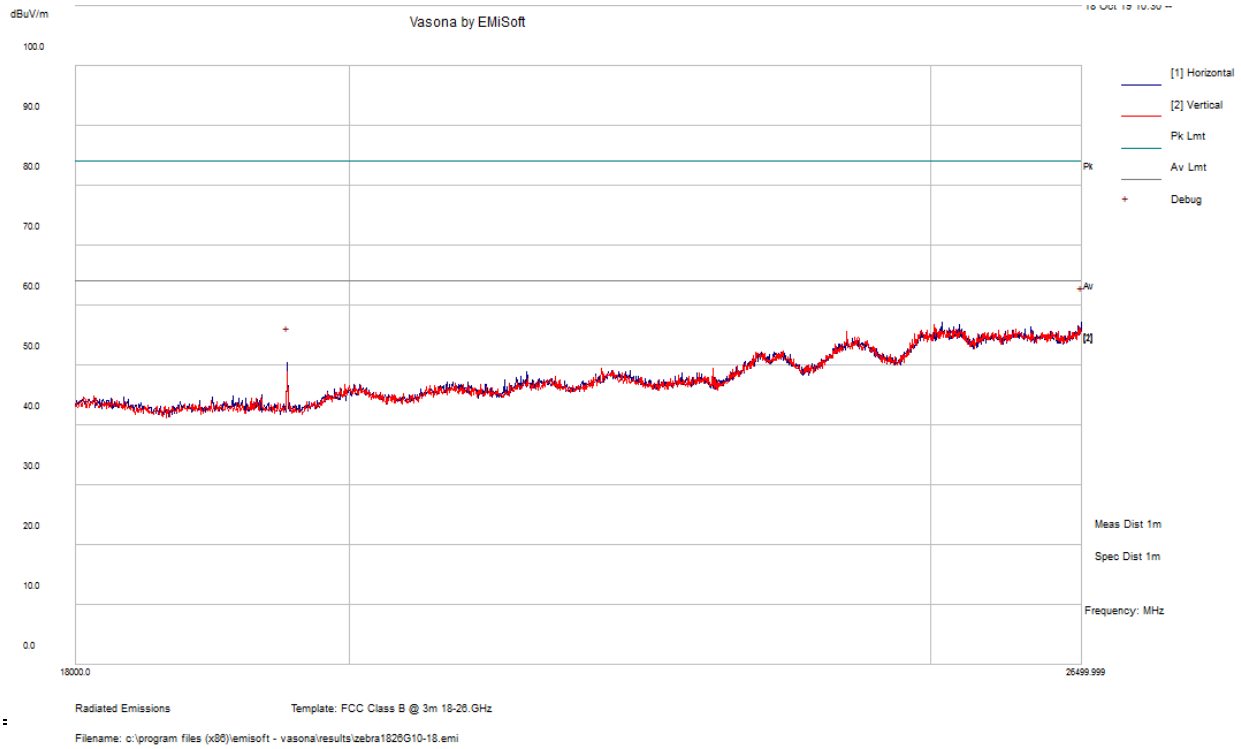
Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
35.54875	22.09	280	V	304	40	-17.91	QP
43.52075	31.89	138	V	225	40	**-8.11**	QP
30	22.72	199	V	162	40	-17.28	QP
836.377	33.61	107	H	167	46	-12.39	QP
840.20225	28.42	129	H	117	46	-17.58	QP
319.6815	20.9	125	H	272	46	-25.1	QP

2) 1–18 GHz radiated emission measured at 1 meter

Worst Case (including BLE) Classic Bluetooth 3-EDR Middle Channel 2441MHz



3) 18-26.5GHz radiated emission measured at 1 meter



7 Annex A - EUT Test Setup Photographs

Please refer to the attachment

8 Annex B – EUT and Host Photographs

Please refer to the attachment

9 Annex C (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 June 5, 2019

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

Please follow the web link below for a full ISO 17025 scope

https://www.a2la.org/scopepdf/3297-02.pdf

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