



FCC PART 15.247 TEST REPORT

For

Zeeva International Limited

Suite 1007B,10th Floor, Exchange Tower, 33 Wang Chiu Road, Kowloon Bay, HongKong, China

FCC ID: 2ADM5-ET-0052

Report Type:
Original Report

Report Number:

RESZ190722833-00B

Report Date:

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TABLE OF CONTENTS

GENERAL INFORMATION	3
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	
OBJECTIVE	3
RELATED SUBMITTAL(S)/GRANT(S)	
TEST METHODOLOGY	
SYSTEM TEST CONFIGURATION	
DESCRIPTION OF TEST CONFIGURATION	
EQUIPMENT MODIFICATIONS	
EUT Exercise Software	
External I/O Cable	
BLOCK DIAGRAM OF TEST SETUP	
SUMMARY OF TEST RESULTS	
TEST EQUIPMENT LIST	9
FCC§15.247 (i), §1.1307 (b) (1) & §2.1093 – RF EXPOSURE	
APPLICABLE STANDARD	10
FCC §15.203 - ANTENNA REQUIREMENT	11
APPLICABLE STANDARD	
ANTENNA CONNECTOR CONSTRUCTION	
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS	12
APPLICABLE STANDARD	
EUT SETUP	
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP	
TEST PROCEDURE	
TEST RESULTS SUMMARY	
TEST DATA	
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH	
APPLICABLE STANDARD	
TEST PROCEDURE	
Test Data	21
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER	24
APPLICABLE STANDARD	
Test Procedure	
Test Data	
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE	25
APPLICABLE STANDARD	
TEST PROCEDURE	
Test Data	25
FCC §15.247(e) - POWER SPECTRAL DENSITY	27
APPLICABLE STANDARD	
TEST PROCEDURE	
Test Data	27

Report No.: RSZ190722833-00B

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	BLUETOOTH ROBOT	
Tested Model	ET-0052	
UPC Number	192234033722	
SKU Number	3190063	
Frequency Range	Bluetooth LE: 2402~2480MHz	
Conducted Peak Power	Bluetooth LE:2.47dBm	
Modulation Technique	Bluetooth LE: GFSK	
Antenna Specification	Integrated Antenna: 0dBi	
Voltage Range	DC 1.5V*3 AA battery	
Date of Test	2019-08-06~2019-08-30	
Sample serial number	190722833(Assigned by BACL, Shenzhen)	
Received date	2019-07-22	
Sample/EUT Status	Good condition	

Report No.: RSZ190722833-00B

Objective

This report is prepared on behalf of *Zeeva International Limited* in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

FCC Part 15.247 DSS submissions with FCC ID: 2ADM5-ET-0052.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

FCC Part 15.247 Page 3 of 29

Measurement Uncertainty

Parameter		Uncertainty
Occupied Char	nnel Bandwidth	±5%
RF Output Power	with Power meter	±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions,	Below 1GHz	±4.75dB
Radiated	Above 1GHz	±4.88dB
Temperature		±1℃
Humidity		±6%
Supply	voltages	±0.4%

Report No.: RSZ190722833-00B

Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

FCC Part 15.247 Page 4 of 29

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For BLE mode, 40 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

Report No.: RSZ190722833-00B

EUT was tested with Channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

"FCCAssist" exercise software was used

The device was tested with the worst case was performed as below:

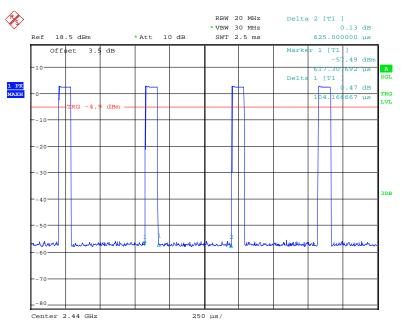
Mode	Data mata		Power level	
Mode	Data rate	Low channel	Middle channel	High channel
BLE	1Mbps	Default	Default	Default

FCC Part 15.247 Page 5 of 29

Duty cycle

BLE Mode

Report No.: RSZ190722833-00B



Date: 6.AUG.2019 21:08:32

Mode	Duty Cycle (%)	T(us)	1/T(kHz)	VBW Setting	10log(1/ Duty Cycle)
BLE	16.67	104	9.62	10kHz	7.78

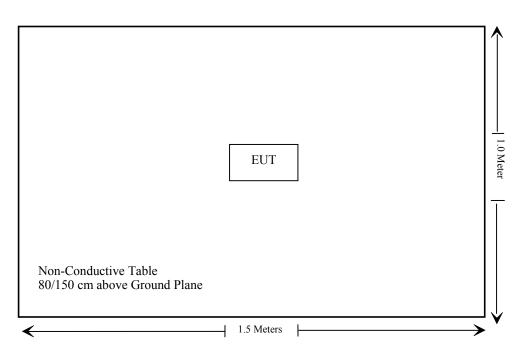
External I/O Cable

Cable Description	Length (m)	From Port	То
/	/	/	/

FCC Part 15.247 Page 6 of 29

Block Diagram of Test Setup

For Radiated emission:



Report No.: RSZ190722833-00B

FCC Part 15.247 Page 7 of 29

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (1)& §2.1093	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions Not Applica	
\$15.205, \$15.209, \$15.247(d)	Spurious Emissions Complian	
§15.247 (a)(2)	6 dB Emission Bandwidth Compliance	
§15.247(b)(3)	Maximum Conducted Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge Compliance	
§15.247(e)	Power Spectral Density	Compliance

Report No.: RSZ190722833-00B

Not Applicable: The EUT is power by battery.

FCC Part 15.247 Page 8 of 29

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date	
	Radia	ated Emission T	est	•		
A.H. System	Horn Antenna	SAS-200/571	135	2018-09-01	2021-08-31	
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2019-07-22	2020-07-21	
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017-12-22	2020-12-21	
COM-POWER	Pre-amplifier	PA-122	181919	2018-11-12	2019-11-12	
Sonoma Instrument	Amplifier	310N	186238	2018-11-12	2019-11-12	
Rohde & Schwarz	EMI Test Receiver	ESR3	102455	2019-07-09	2020-07-08	
UTiFLEX MICRO- C0AX	RF Cable	UFA147A- 2362-100100	MFR64639 231029-003	2018-11-12	2019-11-12	
Ducommun Technologies	RF Cable	104PEA	218124002	2018-11-12	2019-11-12	
Ducommun Technologies	RF Cable	RG-214	1	2019-05-21	2019-11-19	
Ducommun Technologies	RF Cable	RG-214	2	2018-11-12	2019-11-12	
Ducommun Technologies	Horn Antenna	ARH-4223- 02	1007726-04	2017-12-29	2020-12-28	
Heatsink Required	Amplifier	QLW- 18405536-J0	15964001002	2018-11-12	2019-11-12	
Sinoscite	Band Reject Filter	BSF2402- 2480MN- 0898-001	99632	2018-11-12	2019-11-12	
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR	
	RF Conducted Test					
Agilent	USB wideband power meter	U2021XA	MY54250003	2019-07-10	2020-07-09	
WEINSCHEL	3dB Attenuator	6231	666	Each	Time	
Rohde & Schwarz	Spectrum Analyzer	FSU26	200120	2019-03-02	2020-03-01	
Ducommun Technologies	RF Cable	RG-214	3	Each	Time	

Report No.: RSZ190722833-00B

FCC Part 15.247 Page 9 of 29

^{*} **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC§15.247 (i), §1.1307 (b) (1) & §2.1093 – RF EXPOSURE

Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

Report No.: RSZ190722833-00B

According to KDB 447498 D01 General RF Exposure Guidance

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances \leq 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] $\cdot [\sqrt{f(GHz)}] \le 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- 1. f(GHz) is the RF channel transmit frequency in GHz.
- 2. Power and distance are rounded to the nearest mW and mm before calculation.
- 3. The result is rounded to one decimal place for comparison.
- 4. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test Exclusion.

Measurement Result

For worst case:

Mode	Frequency (MHz)	Max Tune-up Conducted Power (dBm)	Max Tune-up Conducted Power (mW)	Calculated Distance (mm)	Calculated value	Threshold (1-g SAR)	SAR Test Exclusion
BLE	2480	2.6	1.82	5	0.6	3.0	Yes

Result: No SAR test is required

FCC Part 15.247 Page 10 of 29

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

Report No.: RSZ190722833-00B

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has an integrated antenna arrangement, which was permanently attached and the antenna gain is 0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

FCC Part 15.247 Page 11 of 29

FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Report No.: RSZ190722833-00B

Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

FCC Part 15.247 Page 12 of 29

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Report No.: RSZ190722833-00B

Frequency Range	ency Range RBW Video B/W		IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
	1MHz	3 MHz	/	PK
Above 1 GHz	1MHz	10 Hz Note 1	/	Average
	1MHz	>1/T Note 2	/	Average

Note 1: when duty cycle is no less than 98% Note 2: when duty cycle is less than 98%

Test Procedure

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

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

The "Margin" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the EUT complied with the <u>FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247</u>.

FCC Part 15.247 Page 13 of 29

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Curry Xiang on 2019-08-22 and 2019-08-30.

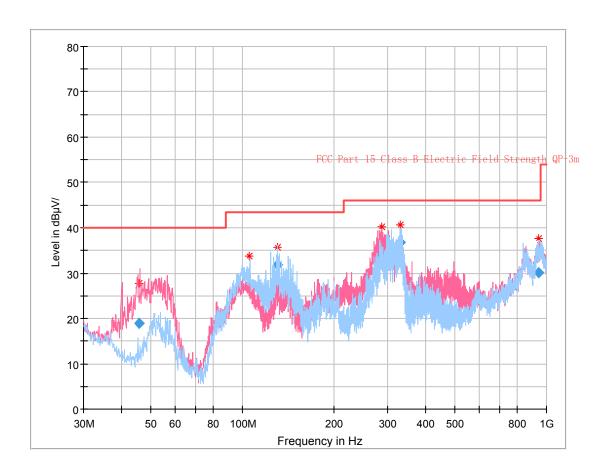
Report No.: RSZ190722833-00B

EUT operation mode: Transmitting

FCC Part 15.247 Page 14 of 29

BLE Mode:

30 MHz~1 GHz:



Report No.: RSZ190722833-00B

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
45.739250	18.93	123.0	V	0.0	-17.6	40.00	21.07
105.530250	27.61	265.0	Н	255.0	-16.2	43.50	15.89
130.013125	31.76	292.0	Н	231.0	-13.6	43.50	11.74
287.175875	33.71	192.0	V	256.0	-11.5	46.00	12.29
331.080750	36.80	109.0	Н	112.0	-10.8	46.00	9.20
939.769875	30.06	396.0	Н	234.0	8.8	46.00	15.94

FCC Part 15.247 Page 15 of 29

1 **GHz-25 GHz(BLE)**:

Frequency	Re	eceiver	Turntable	Rx An	tenna	Corrected	Corrected	Limit	Margin
(MHz)	Reading (dBµV)	PK/QP/Ave.	Degree	Height (m)	Polar (H/V)	Factor (dB/m)	Amplitude (dBμV/m)	(dBµV/m)	(dB)
			Low Ch	annel (2	402 MI	Hz)			
2373.62	28.25	PK	58	1.3	V	31.87	60.12	74	13.88
2373.62	14.11	Ave.	58	1.3	V	31.87	45.98	54	8.02
2496.52	28.12	PK	20	1.5	V	32.13	60.25	74	13.75
2496.52	14.06	Ave.	20	1.5	V	32.13	46.19	54	7.81
4804.00	45.20	PK	87	2.1	V	6.28	51.48	74	22.52
4804.00	35.40	Ave.	87	2.1	V	6.28	41.68	54	12.32
			Middle C	hannel ((2440 M	IHz)			
4880.00	45.30	PK	258	1.6	V	6.76	52.06	74	21.94
4880.00	34.92	Ave.	258	1.6	V	6.76	41.68	54	12.32
	High Channel (2480 MHz)								
2383.31	28.98	PK	326	1.5	V	31.87	60.85	74	13.15
2383.31	15.24	Ave.	326	1.5	V	31.87	47.11	54	6.89
2484.53	28.45	PK	196	1.5	V	32.13	60.58	74	13.42
2484.53	14.86	Ave.	196	1.5	V	32.13	46.99	54	7.01
4960.00	45.18	PK	333	1.7	V	6.80	51.98	74	22.02
4960.00	34.33	Ave.	333	1.7	V	6.80	41.13	54	12.87

Report No.: RSZ190722833-00B

Note:

 $Corrected\ Factor = Antenna\ factor\ (RX) + Cable\ Loss - Amplifier\ Factor$

Corrected Amplitude = Corrected Factor + Reading

Margin = Limit - Corrected. Amplitude

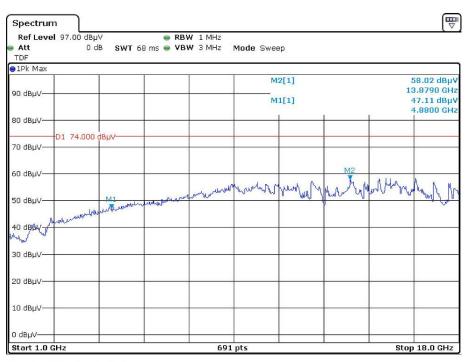
The other spurious emission which is 20dB to the limit was not recorded.

And for the pre-scan is performed with the 2400-2483.5MHz band filter.

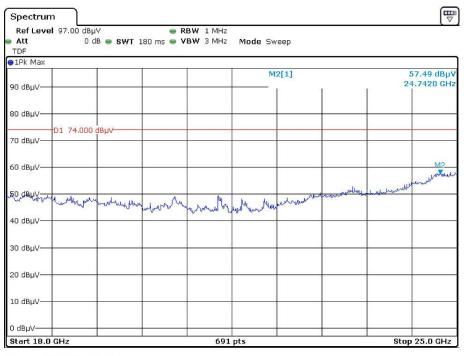
FCC Part 15.247 Page 16 of 29

Pre-scan with High Channel Horizontal

Report No.: RSZ190722833-00B



Date: 30.AUG.2019 21:34:01

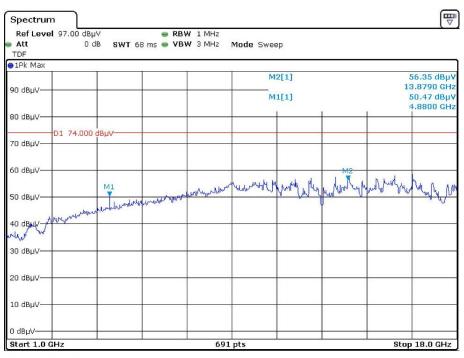


Date: 30.AUG.2019 22:22:30

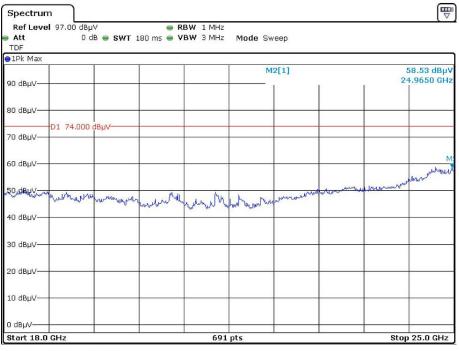
FCC Part 15.247 Page 17 of 29

Vertical

Report No.: RSZ190722833-00B



Date: 30.AUG.2019 21:41:18

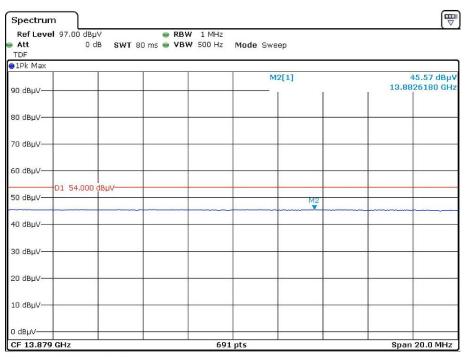


Date: 30.AUG.2019 22:28:50

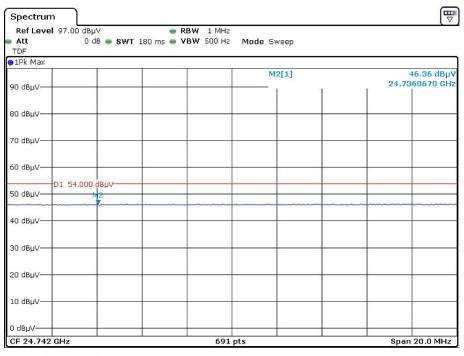
FCC Part 15.247 Page 18 of 29

Pre-scan for Average Horizontal

Report No.: RSZ190722833-00B



Date: 30.AUG.2019 21:37:42

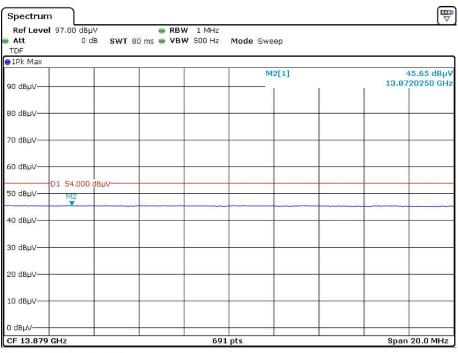


Date: 30.AUG.2019 22:25:10

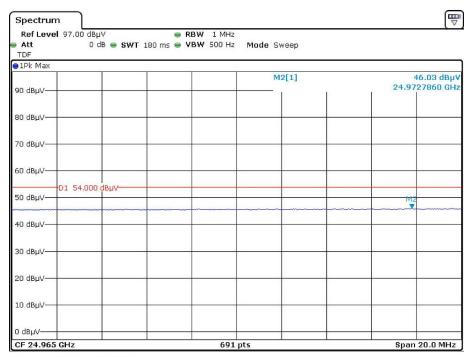
FCC Part 15.247 Page 19 of 29

Vertical

Report No.: RSZ190722833-00B



Date: 30.AUG.2019 21:46:56



Date: 30.AUG.2019 22:32:16

FCC Part 15.247 Page 20 of 29

FCC $\S15.247(a)$ (2) – 6 dB EMISSION BANDWIDTH

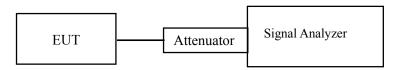
Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Report No.: RSZ190722833-00B

Test Procedure

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- 3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
- 4. Repeat above procedures until all frequencies measured were complete.



Test Data

Environmental Conditions

Temperature:	25 ℃	
Relative Humidity:	52 %	
ATM Pressure:	101.0 kPa	

The testing was performed by James Fu on 2019-08-06.

Test Result: Pass.

Please refer to the following table and plots.

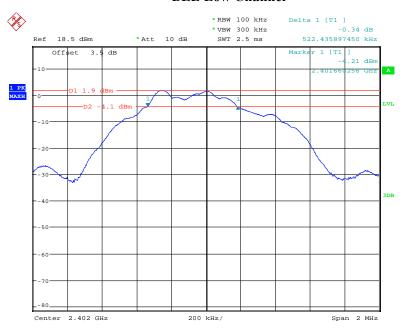
FCC Part 15.247 Page 21 of 29

EUT operation mode: Transmitting

Channel	Frequency (MHz)	6 dB Emission Bandwidth(MHz)	Limit (kHz)		
BLE mode					
Low	2402	0.522	≥500		
Middle	2440	0.526	≥500		
High	2480	0.513	≥500		

Report No.: RSZ190722833-00B

BLE Low Channel

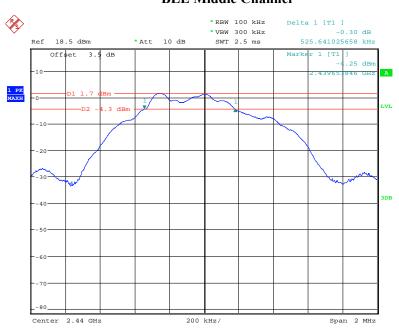


Date: 6.AUG.2019 21:06:00

FCC Part 15.247 Page 22 of 29

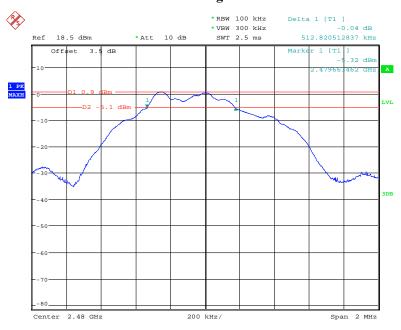
BLE Middle Channel

Report No.: RSZ190722833-00B



Date: 6.AUG.2019 21:02:24

BLE High Channel



Date: 6.AUG.2019 20:59:31

FCC Part 15.247 Page 23 of 29

FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

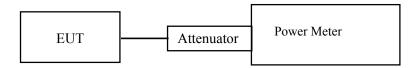
Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Report No.: RSZ190722833-00B

Test Procedure

- 1. Place the EUT on a bench and set it in transmitting mode.
- 2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
- 3. Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by James Fu on 2019-08-06.

EUT operation mode: Transmitting

BLE mode

Channel	Frequency (MHz)	Max Peak Output Power (dBm)	Limit (dBm)	Result
Low	2402	2.47	30	Pass
Middle	2440	2.29	30	Pass
High	2480	1.42	30	Pass

FCC Part 15.247 Page 24 of 29

FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

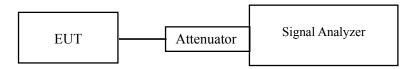
Report No.: RSZ190722833-00B

Applicable Standard

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)).

Test Procedure

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- 3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- 4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- 5. Repeat above procedures until all measured frequencies were complete.



Test Data

Environmental Conditions

Temperature:	25 ℃	
Relative Humidity:	52 %	
ATM Pressure:	101.0 kPa	

The testing was performed by James Fu on 2019-08-06.

EUT operation mode: Transmitting

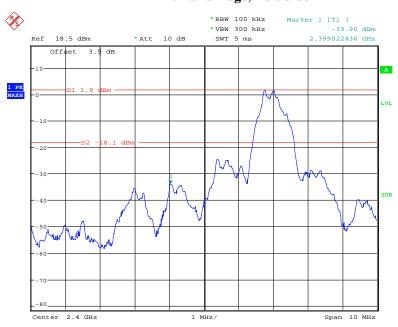
Test Result: Compliance

Please refer to the following plots.

FCC Part 15.247 Page 25 of 29

BLE: Band Edge, Left Side

Report No.: RSZ190722833-00B



Date: 6.AUG.2019 21:06:44

BLE: Band Edge, Right Side



Date: 6.AUG.2019 21:07:30

FCC Part 15.247 Page 26 of 29

FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Report No.: RSZ190722833-00B

Test Procedure

- 1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
- 2. Set the RBW to: $3kHz \le RBW \le 100 \text{ kHz}$.
- 3. Set the VBW $> 3 \times RBW$.
- 4. Set the span to 1.5 times the DTS bandwidth.
- 5. Detector = peak.
- 6. Sweep time = auto couple.
- 7. Trace mode = max hold.
- 8. Allow trace to fully stabilize.
- 9. Use the peak marker function to determine the maximum amplitude level within the RBW.
- 10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test Data

Environmental Conditions

Temperature:	25 ℃	
Relative Humidity:	52 %	
ATM Pressure:	101.0 kPa	

The testing was performed by James Fu on 2019-08-06.

EUT operation mode: Transmitting

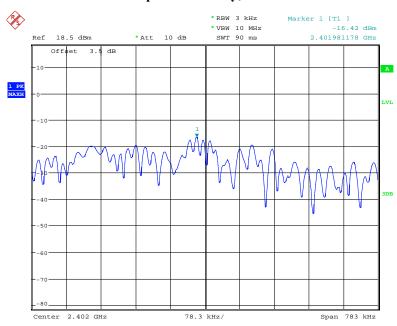
Test Result: Pass

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)		
BLE mode					
Low	2402	-16.42	≤8		
Middle	2440	-16.53	≤8		
High	2480	-17.57	≤8		

FCC Part 15.247 Page 27 of 29

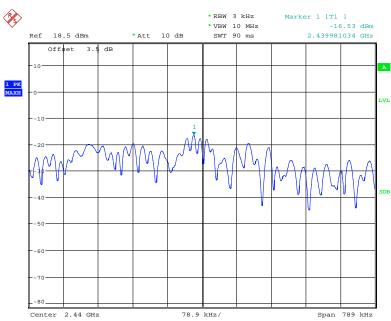
Power Spectral Density, BLE Low Channel

Report No.: RSZ190722833-00B



Date: 6.AUG.2019 21:10:44

Power Spectral Density, BLE Middle Channel

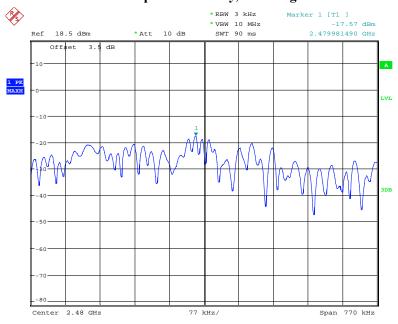


Date: 6.AUG.2019 21:10:05

FCC Part 15.247 Page 28 of 29

Power Spectral Density, BLE High Channel

Report No.: RSZ190722833-00B



Date: 6.AUG.2019 21:11:29

***** END OF REPORT *****

FCC Part 15.247 Page 29 of 29