FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.247

Report Reference No. .....:	**CTA26082600101**
FCC ID. ..... :	**2BX4Z-AF-JZSB-FBA**
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Date of issue .....:	Sep. 02, 2026
Testing Laboratory Name.....:	**Shenzhen CTA Testing Technology Co., Ltd.**
Address .....:	Room 106, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, China
Applicant's name.....:	**shenzhenshiyalianfengkejiyouxiangongsi**
Address .....:	xixiangjiedaogushushequhaibinxincun biwanludong1haobiwandasha 207 shenzhenshibaoanqu guangdongsheng, 518000 China
Test specification..... :	
Standard.....:	**FCC Part 15.247**

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Equipment description ..... :	**Trackball Mouse**
Trade Mark.....:	ALEENFOON
Manufacturer .....:	shenzhenshiyalianfengkejiyouxiangongsi
Model/Type reference .....:	AF-JZSB-FBA
Listed Models .....:	AF-WTSB, AF-FRSB, AF-JZSB-US
Modulation .....:	GFSK
Frequency .....:	From 2402MHz to 2480MHz
Ratings .....:	Input: 5V ⎓ 0.15A Battery: 3.7V 80mAh
Result .....:	**PASS**

TEST REPORT

Equipment under Test	:	Trackball Mouse
Model /Type	:	AF-JZSB-FBA
Listed Models	:	AF-WTSB, AF-FRSB, AF-JZSB-US
Model difference	:	The PCB board, circuit, structure and internal of these models are the same, only model number and colour are different for these models. So the tests were performed on model AF-JZSB-FBA and the test results for the main test model can cover the listed models.
Applicant	:	**shenzhenshiyalianfengkejiyouxiangongsi**
Address	:	xixiangjiedaogushushequhaibinxincun biwanludong1haobiwandasha 207 shenzhenshibaoanqu guangdongsheng, 518000 China
Manufacturer	:	**shenzhenshiyalianfengkejiyouxiangongsi**
Address	:	xixiangjiedaogushushequhaibinxincun biwanludong1haobiwandasha 207 shenzhenshibaoanqu guangdongsheng, 518000 China

Test Result:	**PASS**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
ANSI C63.10-2020 +COR. 1-2023+ C63.10A-2024+ ERRATA TO C63.10A-2024: American National Standard for Testing Unlicensed Wireless Devices

KDB558074 D01 V05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

2 SUMMARY

2.1 General Remarks

Date of receipt of test sample	:	Aug. 26, 2026
Testing commenced on	:	Aug. 26, 2026
Testing concluded on	:	Sep. 02, 2026

2.2 Product Description*

Product Description:	Trackball Mouse
Model/Type reference:	AF-JZSB-FBA
Power supply:	Input: 5V ⎓ 0.15A Battery: 3.7V 80mAh
Hardware version:	V1.0
Software version:	V1.0
Testing sample ID:	CTA260826001-1# (Engineer sample) CTA260826001-2# (Normal sample)
Bluetooth BLE	
Supported type:	Bluetooth low Energy
Modulation:	GFSK
Operation frequency:	2402MHz to 2480MHz
Channel number:	40
Channel separation:	2 MHz
Antenna type:	Ceramic antenna
Antenna gain:	2.93 dBi

2.3 Equipment Under Test

Power supply system utilised

Refer to section 2.2

2.4 Short description of the Equipment under Test (EUT)

This is a Trackball Mouse.
For more details, refer to the user's manual of the EUT.

Test Software Version	Tools software(dongle_hid_emi_tool_1.0.3)		
Frequency	2402 MHz	2440MHz	2480 MHz
GFSK	Default	Default	Default

2.5 EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

○ - supplied by the manufacturer
● - supplied by the lab

●	Adapter information (Auxiliary test supplied by test Lab)	Model: HW-100225C00 Input: AC100-240V 50/60Hz 0.75A Output: DC5V 2A, DC9V 2A, DC10V 2.25A

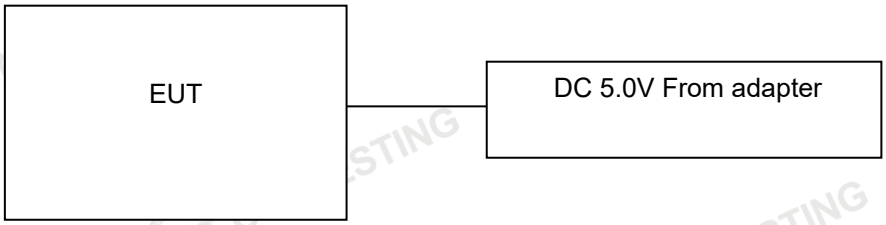
2.6 EUT operation mode

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing. There are 40 channels provided to the EUT and Channel 00/19/39 were selected to test.

Operation Frequency:

Channel	Frequency (MHz)
00	**2402**
01	2404
02	2406
⋮	⋮
19	**2440**
⋮	⋮
37	2476
38	2478
39	**2480**

2.7 Block Diagram of Test Setup



2.8 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.9 Modifications

No modifications were implemented to meet testing criteria.

3 TEST ENVIRONMENT

3.1 Address of the test laboratory

Shenzhen CTA Testing Technology Co., Ltd.
Room 106, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, China

3.2 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:
FCC-Registration No.: 517856 Designation Number: CN1318
Shenzhen CTA Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

A2LA-Lab Cert. No.: 6534.01
Shenzhen CTA Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010.

3.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:
Radiated Emission:

Temperature:	23 ° C
Humidity:	44 %
Atmospheric pressure:	950-1050mbar

AC Main Conducted testing：

Temperature:	24 ° C
Humidity:	47 %
Atmospheric pressure:	950-1050mbar

Conducted testing：

Temperature:	24 ° C
Humidity:	46 %
Atmospheric pressure:	950-1050mbar

3.4 Summary of measurement results

Test Specification clause	Test case	Test result
§15.247(e)	Power spectral density	complies
§15.247(a)(2)	Spectrum bandwidth – 6 dB bandwidth	complies
§15.247(b)(3)	Maximum output Peak power	complies
§15.247(d)	Band edge compliance conducted	complies
§15.205	Band edge compliance radiated	complies
§15.247(d)	TX spurious emissions conducted	complies
§15.247(d)	TX spurious emissions radiated	complies
§15.209(a)	TX spurious Emissions radiated Below 1GHz	complies
§15.207	AC Power Conducted Emission	complies

Remark:
1. The measurement uncertainty is not included in the test result.
2. We tested all test mode and recorded worst case in report
3. RF Conducted test Offset= cable loss,For conducted spurious emission test, cable loss is the maximum value in the range of test.

3.5 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01" Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the Shenzhen CTA Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.
Hereafter the best measurement capability for Shenzhen CTA Testing Technology Co., Ltd. :

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	9KHz~30MHz	3.02 dB	(1)
Radiated Emission	30~1000MHz	4.06 dB	(1)
Radiated Emission	1~18GHz	5.14 dB	(1)
Radiated Emission	18-40GHz	5.38 dB	(1)
Conducted Disturbance	0.15~30MHz	2.14 dB	(1)
Output Peak power	30MHz~18GHz	0.55 dB	(1)
Power spectral density	/	0.57 dB	(1)
Spectrum bandwidth	/	1.1%	(1)
Radiated spurious emission (30MHz-1GHz)	30~1000MHz	4.10 dB	(1)
Radiated spurious emission (1GHz-18GHz)	1~18GHz	4.32 dB	(1)
Radiated spurious emission (18GHz-40GHz)	18-40GHz	5.54 dB	(1)
Time	/	±2%	(1)

（1）This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3.6 Equipments Used during the Test

Item.	Test Equipment	Manufacturer	Model No.	Equipment No.	Calibration Date	Calibration Due Date
AC Conducted Test Equipment						
☒1	LISN	R&S	ENV216	CTA-308	2026/07/23	2027/07/22
☒2	LISN	R&S	ENV216	CTA-314	2026/07/23	2027/07/22
☒3	EMI Test Receiver	R&S	ESPI	CTA-307	2026/07/23	2027/07/22
☒4	CE Cable	SKET	RF Cable (9kHz-30MHz)	CTA-367	2026/07/23	2027/07/22
☒5	Temperature and humidity meter	Chigo	ZG-7020	CTA-327	2026/07/25	2027/07/24
☒6	EMI Test Software	Tonscend	TS®JS32-CE	5.0.0.1	N/A	N/A
RF Radiation Test Equipment						
☒1	EMI Test Receiver	R&S	ESCI	CTA-306	2026/07/23	2027/07/22
☒2	Spectrum analyzer	R&S	FSV40-N	CTA-344	2026/05/16	2027/05/15
☒3	Ultra-Broadband Antenna	Schwarzbeck	VULB9163	CTA-310	2023/10/17	2026/10/16
☒4	Horn Antenna	Schwarzbeck	BBHA 9120D	CTA-309	2023/10/13	2026/10/12
☒5	Loop Antenna	Zhinan	ZN30900C	CTA-311	2023/10/17	2026/10/16
☒6	Horn Antenna	Schwarzbeck	BBHA 9170	CTA-346	2025/05/18	2028/05/17
☒7	Amplifier	Schwarzbeck	BBV9745	CTA-312	2026/07/23	2027/07/22
☒8	Amplifier	Tonscend	TAP-011840	CTA-313	2026/07/23	2027/07/22
☒9	Amplifier	SKET	LNPA 1840G-50	CTA-345	2026/05/16	2027/05/15
☒10	6dB attenuator	Shanghaihuaxiang	GZL-TS5-6-6	CTA-347	2026/05/16	2027/05/15
☒11	RF cable	SKET	RF Cable (9kHz-1GHz)	CTA-360	2025/09/25	2026/09/24
☒12	RF cable	SKET	RF Cable (1GHz-18GHz)	CTA-361	2025/09/25	2026/09/24
☒13	Coaxialcable (1GHz-40GHz)	SKET	RE-04-D	CTA-348	2026/05/16	2027/05/15
☒14	Coaxialcable (1GHz-40GHz)	SKET	RE-04-M	CTA-349	2026/05/16	2027/05/15
☒15	Coaxialcable (1GHz-40GHz)	SKET	RE-04-L	CTA-350	2026/05/16	2027/05/15
☒16	Temperature and humidity meter	Chigo	ZG-7020	CTA-328	2026/07/25	2027/07/24
☒17	2.4GFilter	HX Microwave	HXLBQ-DZA61	CTA-365	2026/07/23	2027/07/22
☐18	5GFilter	CONCEPT	CNF05150M05850Q16A	CTA-366	2026/07/23	2027/07/22
☐19	902-928Filter	HX Microwave	HXLBQ-DZA05	CTA-371	2026/07/23	2027/07/22
☐20	400-415MHzFilter	HX Microwave	HXLBQ-DZA257LC	CTA-369	2026/07/23	2027/07/22
☐21	500-650MHzFilter	Tonscend	TSSF6-500-650	CTA-370	2026/07/23	2027/07/22
☐22	High-Pass Filter	XingBo	XBLBQ-GTA18	CTA-402	2026/07/23	2027/07/22
☐23	High-Pass Filter	XingBo	XBLBQ-GTA27	CTA-403	2026/07/23	2027/07/22
☐24	High-Pass Filter	XingBo	XBLBQ-GTA10	CTA-364	2026/07/23	2027/07/22
☒25	EMI Test Software	Tonscend	TS®JS32-RE	5.0.0.2	N/A	N/A
RF Conducted Test Equipment						
☒1	Spectrum Analyzer	Agilent	N9020A	CTA-342	2026/07/23	2027/07/22

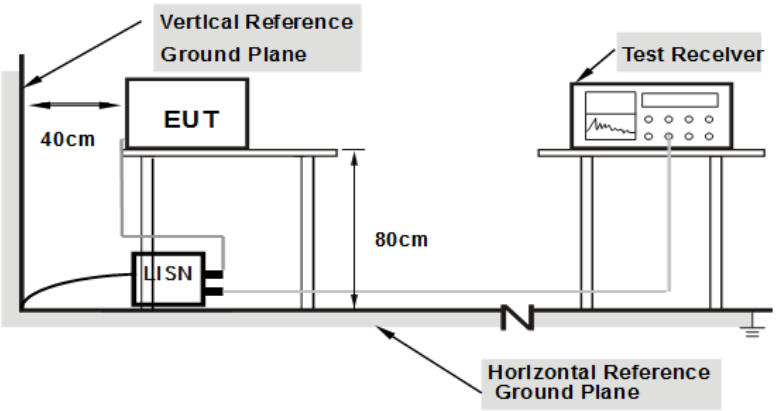
☐2	Spectrum analyzer	R&S	FSV40-N	CTA-344	2026/05/16	2027/05/15
☒3	RF Coaxial Cable	SKET	RF Cable (9kHz-40GHz)	CTA-368	2026/07/23	2027/07/22
☒4	Temperature and humidity meter	ZG-7020	Chigo	CTA-329	2026/07/25	2027/07/24
☐5	Programmable Constant Temperature And Humidity Test Chamber	DONGGUAN JINGYU	HT-H-408	CTA-053	2026/07/23	2027/07/22
☐6	Vector Signal generator	Agilent	N5182A	CTA-305	2026/07/23	2027/07/22
☐7	Analog Signal Generator	R&S	E4421B	CTA-304	2026/07/23	2027/07/22
☐8	WIDEBAND RADIO COMMUNICATION TESTER	R&S	CMW500	CTA-302	2026/07/23	2027/07/22
☒9	Automatic control unit	Tonscend	JS0806-2	CTA-351	2026/07/23	2027/07/22
☒10	RF Test Software	Tonscend	TS®JS1120-3	3.1.65	N/A	N/A
☒11	RF Test Software	Tonscend	TS®JS1120	3.1.46	N/A	N/A
☒12	RF Connection Cable	N/A	N/A	1#	Each time	N/A

Note: The automatic control unit integrated Power sensor

4 TEST CONDITIONS AND RESULTS

4.1 AC Power Conducted Emission

TEST CONFIGURATION



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes support units.

TEST PROCEDURE

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2020.
2 Support equipment, if needed, was placed as per ANSI C63.10-2020
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2020
4 The EUT received power from adapter, the adapter received AC120V/60Hz and AC 240V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 All support equipments received AC power from a second LISN, if any.
6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT.The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8 During the above scans, the emissions were maximized by cable manipulation.

AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following：

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

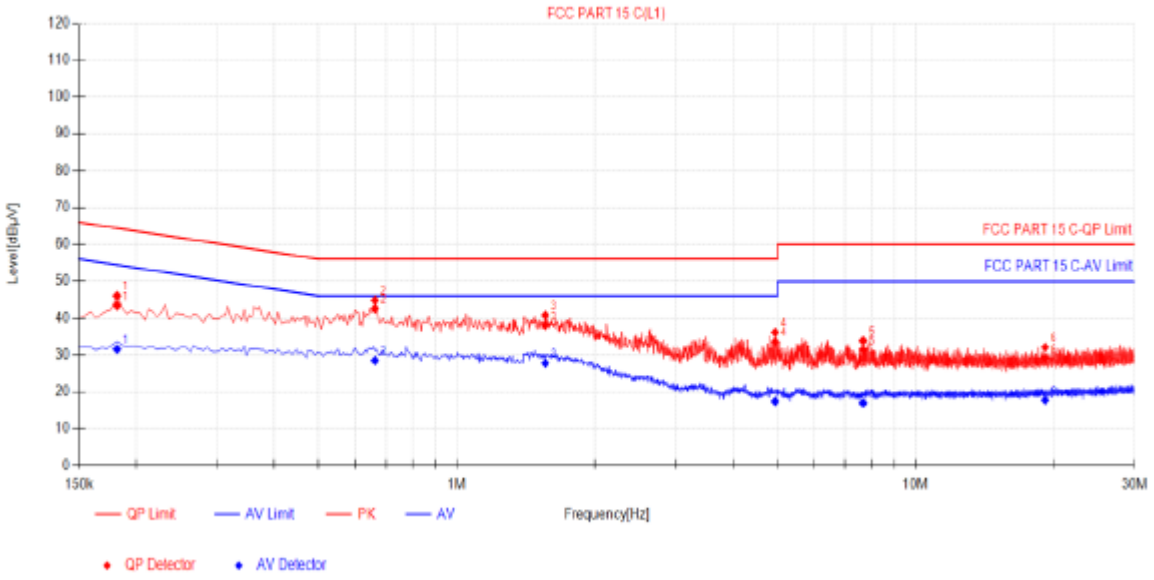
TEST RESULTS

Remark:

1. BLE 1Mpbs was tested at Low, Middle, and High channel; only the worst result of BLE 1Mpbs low channel was reported as below:

2. Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below:

Polarization:	L

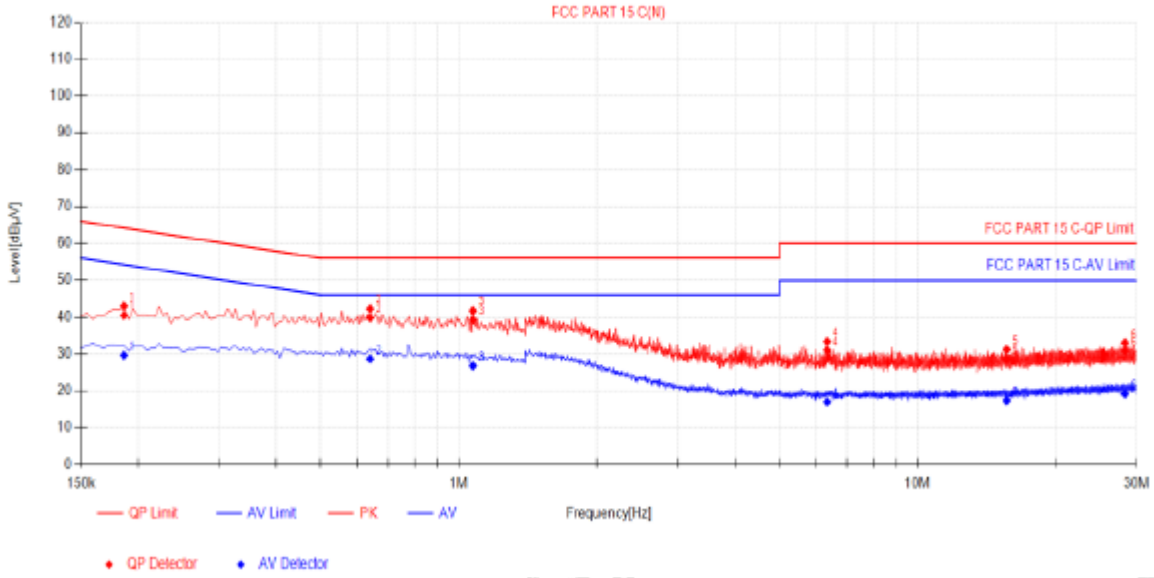


Final Data List

NO.	Freq. [MHz]	Factor [dB]	QP Reading[dBμV]	QP Value [dBμV]	QP Limit [dBμV]	QP Margin [dB]	AV Reading [dBμV]	AV Value [dBμV]	AV Limit [dBμV]	AV Margin [dB]	Verdict
1	0.1815	9.95	33.44	43.39	64.42	21.03	21.60	31.55	54.42	22.87	PASS
2	0.663	10.32	32.22	42.54	56.00	13.46	18.18	28.50	46.00	17.50	PASS
3	1.5585	10.46	27.66	38.12	56.00	17.88	17.30	27.76	46.00	18.24	PASS
4	4.9425	10.86	22.70	33.56	56.00	22.44	6.55	17.41	46.00	28.59	PASS
5	7.683	11.21	20.17	31.38	60.00	28.62	5.74	16.95	50.00	33.05	PASS
6	19.158	12.79	16.40	29.19	60.00	30.81	4.95	17.74	50.00	32.26	PASS

Note:1).QP Value (dBμV)= QP Reading (dBμV)+ Factor (dB)
2). Factor (dB)=insertion loss of LISN (dB) + Cable loss (dB)
3). QPMargin(dB) = QP Limit (dBμV) - QP Value (dBμV)
4). AVMargin(dB) = AV Limit (dBμV) - AV Value (dBμV)

Polarization:	N



Final Data List

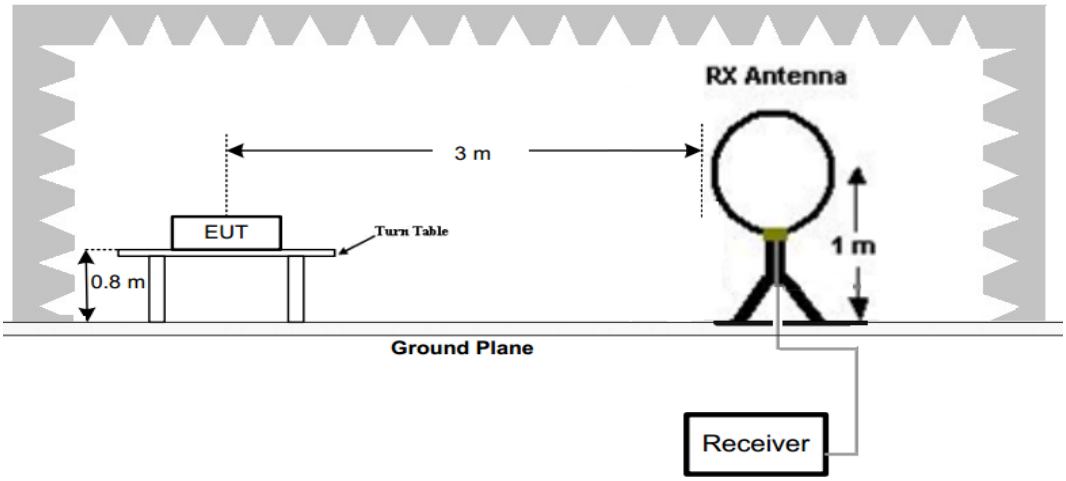
NO.	Freq. [MHz]	Factor [dB]	QP Reading[dBμV]	QP Value [dBμV]	QP Limit [dBμV]	QP Margin [dB]	AV Reading [dBμV]	AV Value [dBμV]	AV Limit [dBμV]	AV Margin [dB]	Verdict
1	0.186	9.94	30.51	40.45	64.21	23.76	19.72	29.66	54.21	24.55	PASS
2	0.6405	10.26	29.49	39.75	56.00	16.25	18.43	28.69	46.00	17.31	PASS
3	1.0725	10.38	28.84	39.22	56.00	16.78	16.41	26.79	46.00	19.21	PASS
4	6.3465	11.09	19.88	30.97	60.00	29.03	5.91	17.00	50.00	33.00	PASS
5	15.6255	12.43	16.22	28.65	60.00	31.35	4.96	17.39	50.00	32.61	PASS
6	28.3155	13.68	17.19	30.87	60.00	29.13	5.49	19.17	50.00	30.83	PASS

Note:1).QP Value (dBμV)= QP Reading (dBμV)+ Factor (dB)
2). Factor (dB)=insertion loss of LISN (dB) + Cable loss (dB)
3). QPMargin(dB) = QP Limit (dBμV) - QP Value (dBμV)
4). AVMargin(dB) = AV Limit (dBμV) - AV Value (dBμV)

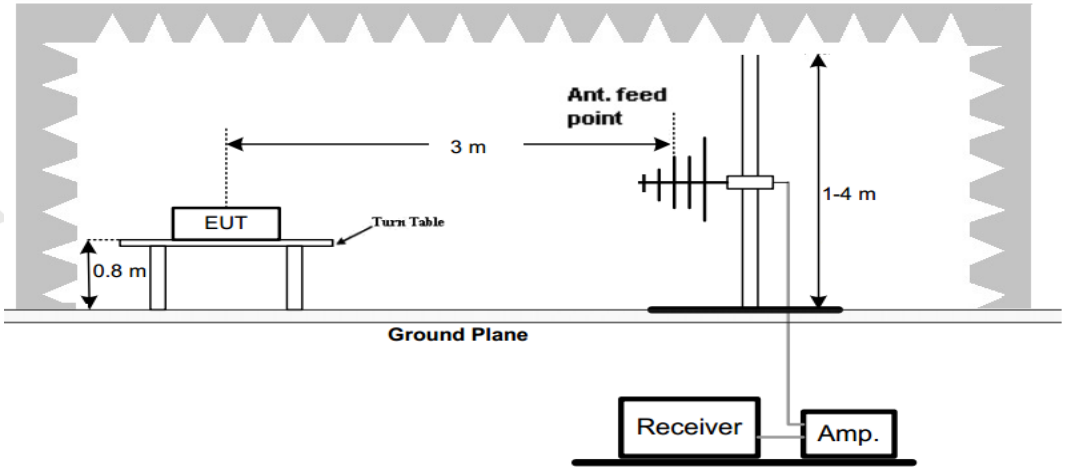
4.2 Radiated Emissions and Band Edge

TEST CONFIGURATION

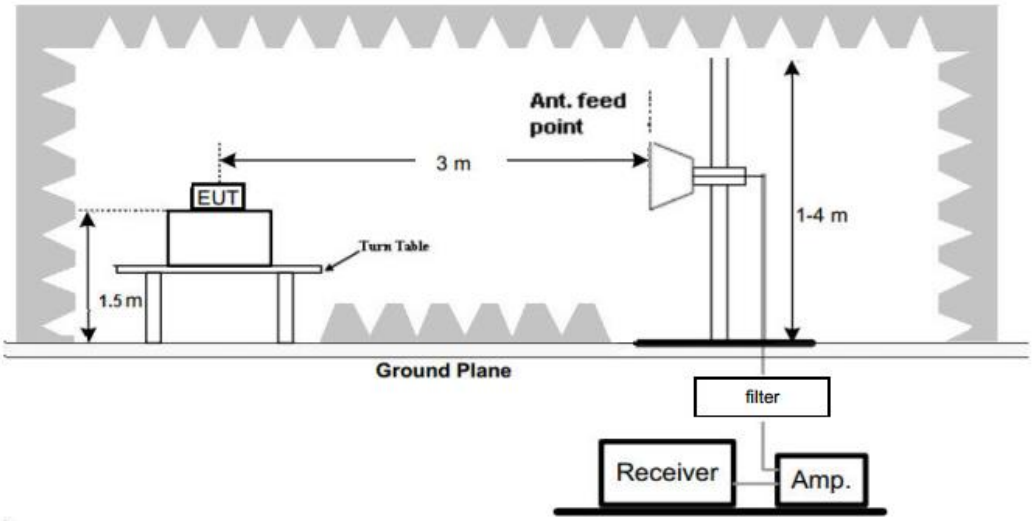
Frequency range 9 KHz – 30MHz

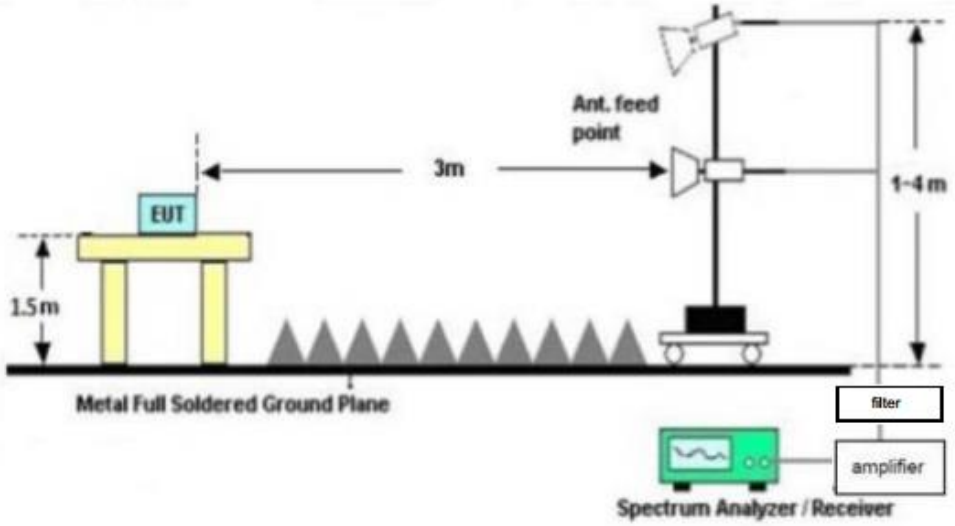


Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz





TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. The EUT minimum operation frequency was 32.768KHz and maximum operation frequency was 2480MHz.so radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-25GHz	Horn Anternna	3

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

Transd=AF +CL-AG

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

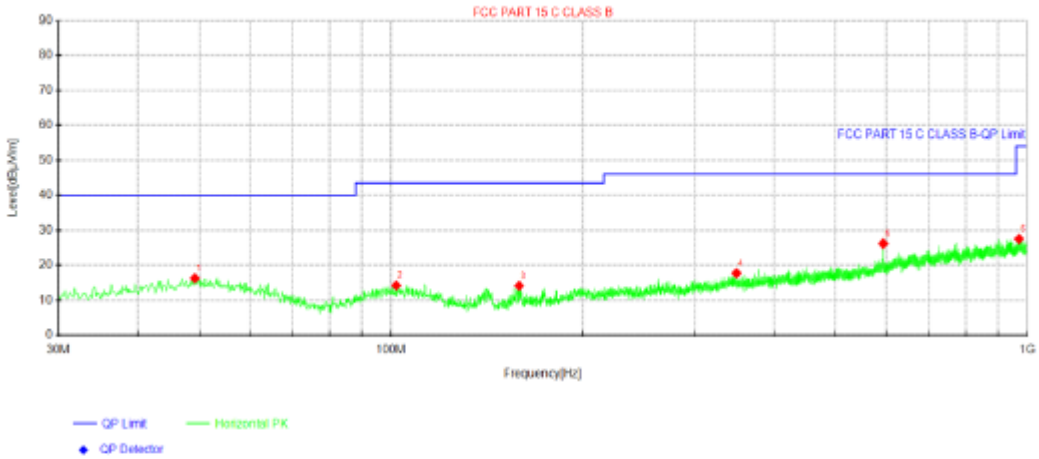
TEST RESULTS

Remark:

1. This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X position.
2. BLE 1Mpbs were tested at Low, Middle, and High channel for all models and recorded worst mode at the low channel.
3. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

For 30MHz-1GHz

Horizontal



Suspected Data List

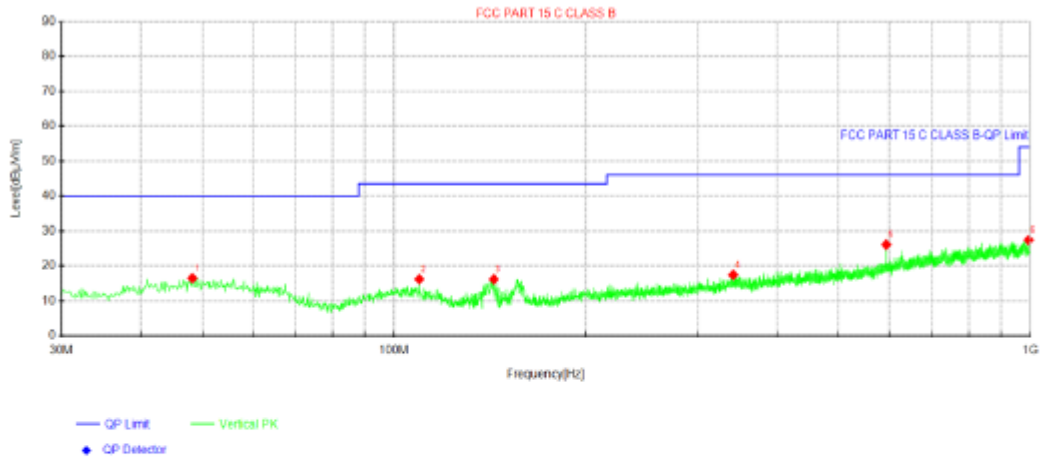
NO.	Freq. [MHz]	Reading [dBμV]	Level [dBμV/m]	Factor [dB/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	49.1575	26.76	16.27	-10.49	40.00	23.73	100	136	Horizontal
2	101.901	26.86	14.21	-12.65	43.50	29.29	100	322	Horizontal
3	159.01	30.15	14.11	-16.04	43.50	29.39	100	55	Horizontal
4	349.008	28.31	17.69	-10.62	46.00	28.31	100	350	Horizontal
5	594.055	32.82	26.17	-6.65	46.00	19.83	100	20	Horizontal
6	970.778	28.80	27.52	-1.28	54.00	26.48	100	136	Horizontal

Note:1).Level (dBμV/m)= Reading (dBμV)+ Factor (dB/m)

2). Factor(dB/m)=Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)

3). Margin(dB) = Limit (dBμV/m) - Level (dBμV/m)

Vertical



Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV]	Level [dBμV/m]	Factor [dB/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	48.1875	27.04	16.47	-10.57	40.00	23.53	100	1	Vertical
2	109.54	29.35	16.20	-13.15	43.50	27.30	100	0	Vertical
3	143.49	33.16	16.17	-16.99	43.50	27.33	100	245	Vertical
4	341.37	28.30	17.39	-10.91	46.00	28.61	100	314	Vertical
5	594.055	32.73	26.08	-6.65	46.00	19.92	100	268	Vertical
6	994.18	28.52	27.39	-1.13	54.00	26.61	100	186	Vertical

Note:1).Level (dBμV/m)= Reading (dBμV)+ Factor (dB/m)

2). Factor(dB/m)=Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)

3). Margin(dB) = Limit (dBμV/m) - Level (dBμV/m)

For 1GHz to 26GHz

GFSK (above 1GHz)

Frequency(MHz):			2402		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4804.00	48.75	PK	74	25.25	63.53	33.52	5.70	54.00	-14.78
4804.00	39.42	AV	54	14.58	54.20	33.52	5.70	54.00	-14.78
7206.00	43.17	PK	74	30.83	53.60	36.34	6.95	53.72	-10.43
7206.00	33.29	AV	54	20.71	43.72	36.34	6.95	53.72	-10.43

Frequency(MHz):			2402		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4804.00	45.91	PK	74	28.09	60.69	33.52	5.70	54.00	-14.78
4804.00	37.51	AV	54	16.49	52.29	33.52	5.70	54.00	-14.78
7206.00	40.18	PK	74	33.82	50.61	36.34	6.95	53.72	-10.43
7206.00	30.53	AV	54	23.47	40.96	36.34	6.95	53.72	-10.43

Frequency(MHz):			2440		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4880.00	49.36	PK	74	24.64	63.92	33.76	5.76	54.08	-14.56
4880.00	39.06	AV	54	14.94	53.62	33.76	5.76	54.08	-14.56
7320.00	43.20	PK	74	30.80	53.22	36.66	6.99	53.67	-10.02
7320.00	33.33	AV	54	20.67	43.35	36.66	6.99	53.67	-10.02

Frequency(MHz):			2440		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4880.00	47.31	PK	74	26.69	61.87	33.76	5.76	54.08	-14.56
4880.00	38.03	AV	54	15.97	52.59	33.76	5.76	54.08	-14.56
7320.00	40.48	PK	74	33.52	50.50	36.66	6.99	53.67	-10.02
7320.00	31.31	AV	54	22.69	41.33	36.66	6.99	53.67	-10.02

Frequency(MHz):			2480		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4960.00	49.22	PK	74	24.78	63.48	34.08	5.82	54.16	-14.26
4960.00	39.03	AV	54	14.97	53.29	34.08	5.82	54.16	-14.26
7440.00	42.33	PK	74	31.67	52.59	36.32	7.04	53.62	-10.26
7440.00	32.86	AV	54	21.14	43.12	36.32	7.04	53.62	-10.26

Frequency(MHz):			2480		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4960.00	47.35	PK	74	26.65	61.61	34.08	5.82	54.16	-14.26
4960.00	36.97	AV	54	17.03	51.23	34.08	5.82	54.16	-14.26
7440.00	40.32	PK	74	33.68	50.58	36.32	7.04	53.62	-10.26
7440.00	31.02	AV	54	22.98	41.28	36.32	7.04	53.62	-10.26

REMARKS:
1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

4.3 Maximum Peak Output Power

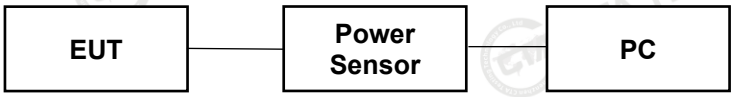
Limit

The Maximum Peak Output Power Measurement is 30dBm.

Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.
Method PM is Measurement using an RF Peak power sensor. The procedure for this method is as follows:
1. The testing follows the ANSI C63.10 Section 11.9.1.2
2. The maximum peak conducted output power may be measured using a broadband peak RF power sensor.
3. The power sensor shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

Test Configuration



Test Results

Please refer to FCC Appendix RF Test Data for BLE

Note: 1.The test results including the cable loss.

4.4 Power Spectral Density

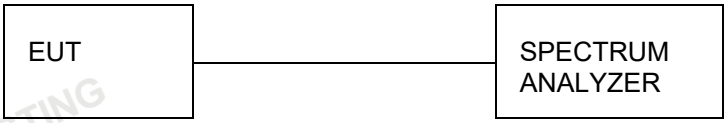
Limit

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.

Test Procedure

The testing follows the ANSI C63.10 2020 section 11.10.2:
a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span >1.5 times the DTS bandwidth.
c) Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ [3 × RBW].
e) Detector = peak.
f) Sweep time = No faster than coupled (auto) time.
g) Trace mode = max-hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

Test Configuration



Test Results

Please refer to FCC Appendix RF Test Data for BLE

4.5 6dB Bandwidth

Limit

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

Test Procedure

a) Set RBW = shall be in the range of 1% to 5% of the OBW but not less than 100 kHz.
b) Set the VBW ≥ [3 × RBW].
c) Detector = peak.
d) Trace mode = max-hold.
e) Sweep = No faster than coupled (auto) time.
f) Allow the trace to stabilize.

Test Configuration

Test Results

Please refer to FCC Appendix RF Test Data for BLE

4.6 Out-of-band Emissions

Limit

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 con-ducted or a radiated measurement, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies 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.

Test Procedure

The testing follows the ANSI C63.10 Section 11.11.2 and 11.11.3 and 6.10.4:
●Reference level measurement
Establish a reference level by using the following procedure:
a) Set instrument center frequency to DTS channel center frequency.
b) Set the span to≥1.5 times the DTS bandwidth.
c) Set the RBW = 100 kHz.
d) Set the VBW≥[3*RBW].
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum PSD level.
Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

●Emission level measurement
Establish an emission level by using the following procedure:
a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100 kHz.
c) Set the VBW≥[3*RBW].
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the peak marker function to determine the maximum amplitude level.
Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements specified in 11.11. Report the three highest emissions relative to the limit.

Test Configuration

Test Results

Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data.

Please refer to FCC Appendix RF Test Data for BLE

4.7 Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited

FCC CFR Title 47 Part 15 Subpart C Section 15.247(b) (4):

if 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 6dBi.

Antenna Connected Construction

The Ceramic antenna maximum gain of antenna was 2.93 dBi.

Remark:The antenna gain is provided by the customer , if the data provided by the customer is not accurate, Shenzhen CTA Testing Technology Co., Ltd. does not assume any responsibility.

4.8 On Time and Duty Cycle

Standard Applicable

None; for reporting purpose only.

TEST CONFIGURATION

Test Procedures

1). Set the Centre frequency of the spectrum analyzer to the transmitting frequency;
2). Set the span=0MHz, RBW=8MHz, VBW=8MHz, Sweep time=Auto;
3). Detector = peak;
4). Trace mode = Single hold.

Please refer to FCC Appendix RF Test Data for BLE

4.9 Emissions at Restricted Band

Standard Applicable

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 CONFIGURATION

Test Procedures

According to ANSI C63.10 Field Strength Approach (linear terms):

$$E = EIRP - 20 \log d + 104.8$$

Where:
E is the electric field strength in dBuV/m
EIRP is the equivalent isotropically radiated power in dBm
d is the specified measurement distance in m
f) Compare the resultant electric field strength level with the applicable regulatory limit.
g) Perform the radiated spurious emission test.

Where all terms are as previously defined.

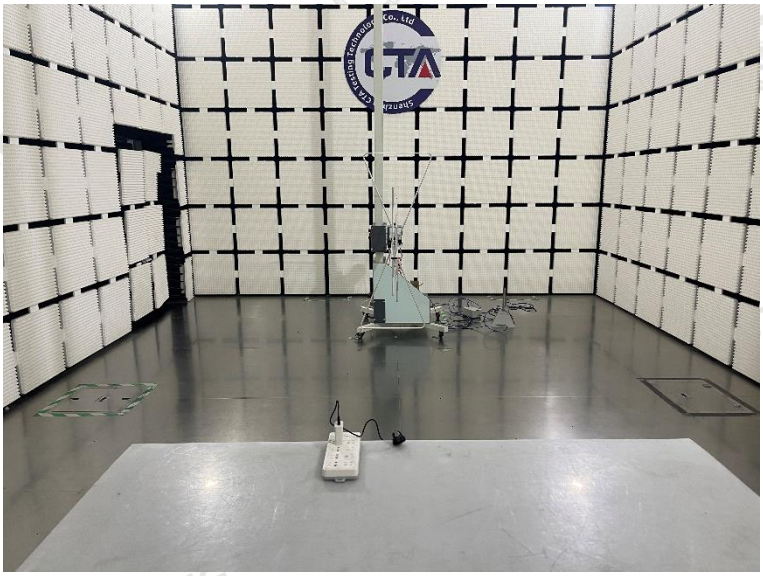
1). Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2). Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to an EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3). Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, for Radiated emissions restricted band RBW=1MHz, VBW=3MHz for peak detector and RBW=1MHz, VBW=3MHz for RMS detector, Max Hold=Average, Trace=100times for AV test.
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.
6). Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
7). Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)
8). Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for

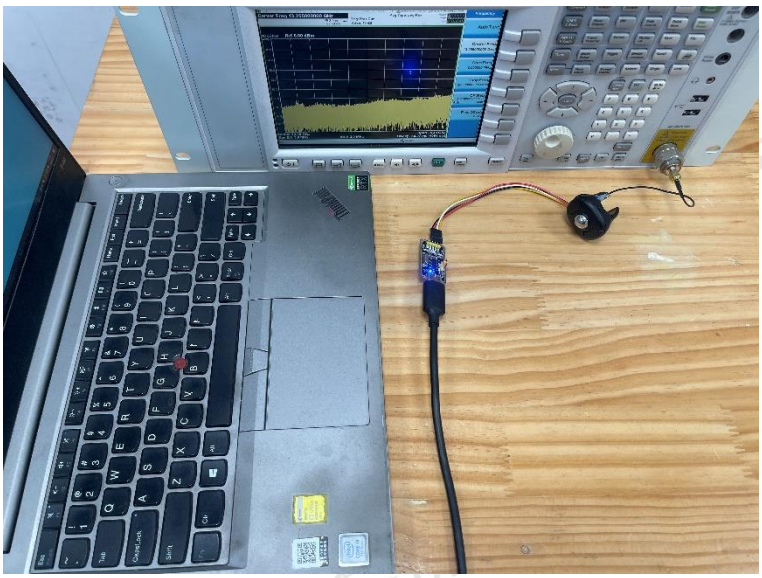
frequencies > 1000 MHz).
9). For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
10). Compare the resultant electric field strength level to the applicable regulatory limit.
11). Perform radiated spurious emission test duress until all measured frequencies were complete.

Test Results

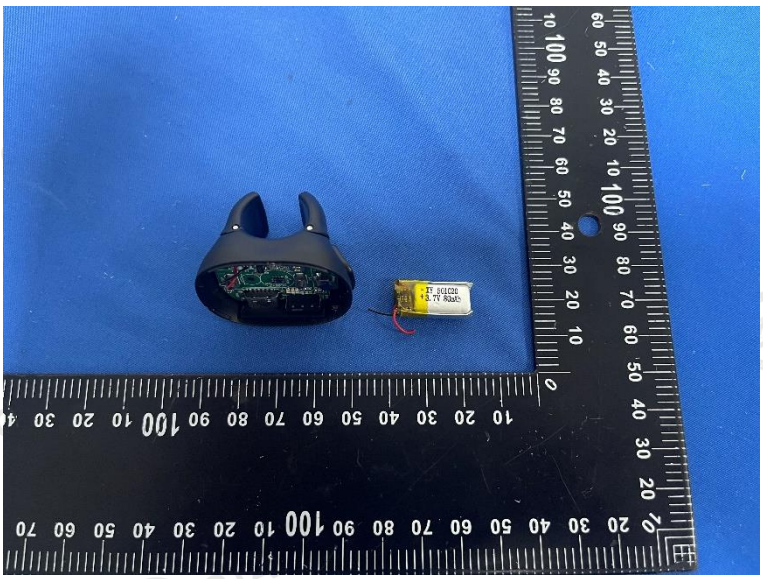
Please refer to FCC Appendix RF Test Data for BLE.
Remark:
1). Test results including cable loss;
2). Measured at difference Packet Type for each mode and recorded worst case for each mode.
3). "---"means that the fundamental frequency not for 15.209 limits requirement.
4). Measured at Hopping and Non-Hopping mode, recorded worst at Non-Hopping mode.
5). The other emission levels were very low against the limit.
6). The average measurement was not performed when the peak measured data under the limit of average detection.
7). Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=3MHz/Sweep time=Auto/Detector=RMS, Max Hold=Average,Trace=100times.
8). Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.

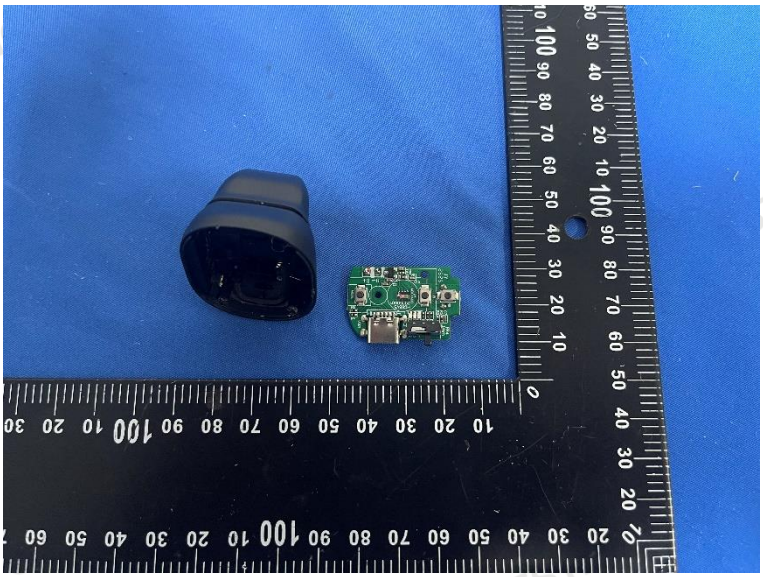
5 Test Setup Photos of the EUT

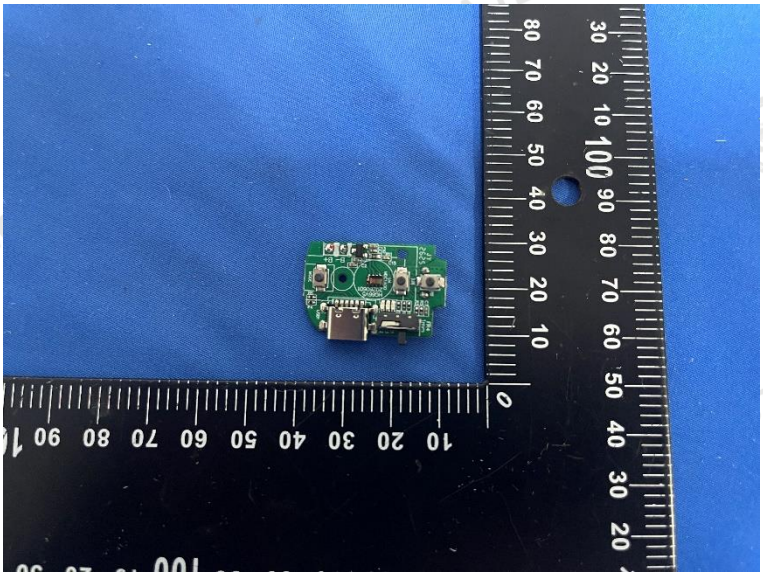


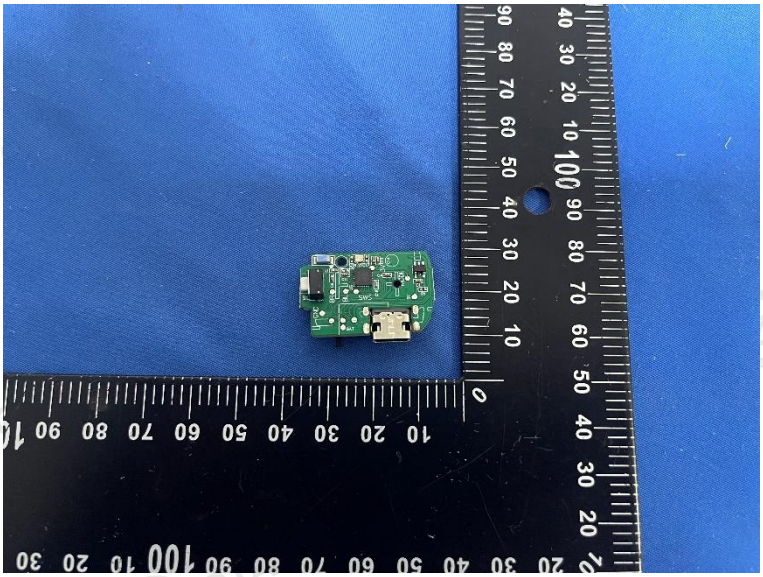


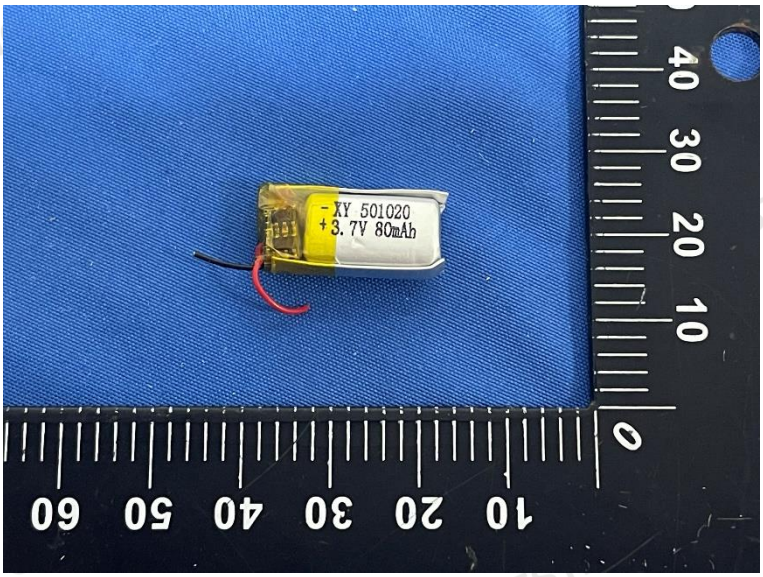
6 Photos of the EUT











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