TEST REPORT

Applicant Name :	Leotec Electronics Co. LTD
Address :	No.174 Wenzhou Road, Dongcheng District, Dongguan, Guangdong, China
Report Number :	RA230717-41157E-RF-00B
FCC ID:	2BABOLT-BT2311

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	Barbie Collection Wireless Speaker
Model No.:	LT-BT2311
Multiple Model(s) No.:	N/A
Trade Mark:	LEOTEC, MINISO
Date Received:	2023/07/17
Report Date:	2023/07/27

Test Result:	Pass*

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Dave Liang

Dave Liang
EMC Engineer

Approved By:

Candy Li

Candy Li
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★ ".
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RA230717-41157E-RF-00B	Original Report	2023-07-27

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Frequency Range	BLE 1M: 2402-2480MHz
Maximum Conducted Peak Output Power	BLE 1M:-1.38dBm
Modulation Technique	BLE 1M: GFSK
Antenna Specification*	1.9dBi (provided by the applicant)
Voltage Range	DC 3.7V from battery or DC 5V from type-c port
Sample serial number	28CW-1for Conducted and Radiated Emissions Test 28CW-2 for RF Conducted Test (Assigned by ATC)
Sample/EUT Status	Good condition

Objective

This test report is 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, 15.207, 15.209 and 15.247 rules.

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 Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF Frequency		$0.082*10^{-7}$
RF output power, conducted		0.71dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions	9k-30MHz	2.74dB, k=2
Emissions, Radiated	9kHz - 30MHz	2.06dB
	30MHz - 1GHz	5.08dB
	1GHz - 18GHz	4.96dB
	18GHz - 26.5GHz	5.16dB
	26.5GHz - 40GHz	4.64dB
Temperature		1°C
Humidity		6%
Supply voltages		0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. 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 Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the Floor 1, KuMaKe Building, Dongzhou Community, Guangming Street, Guangming District, 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.: 708358, the FCC Designation No.: CN1189.

Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0016. The Registration Number is 30241.

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

EUT was tested with Channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

“BT_Tool”* software was used to test and power level as below:

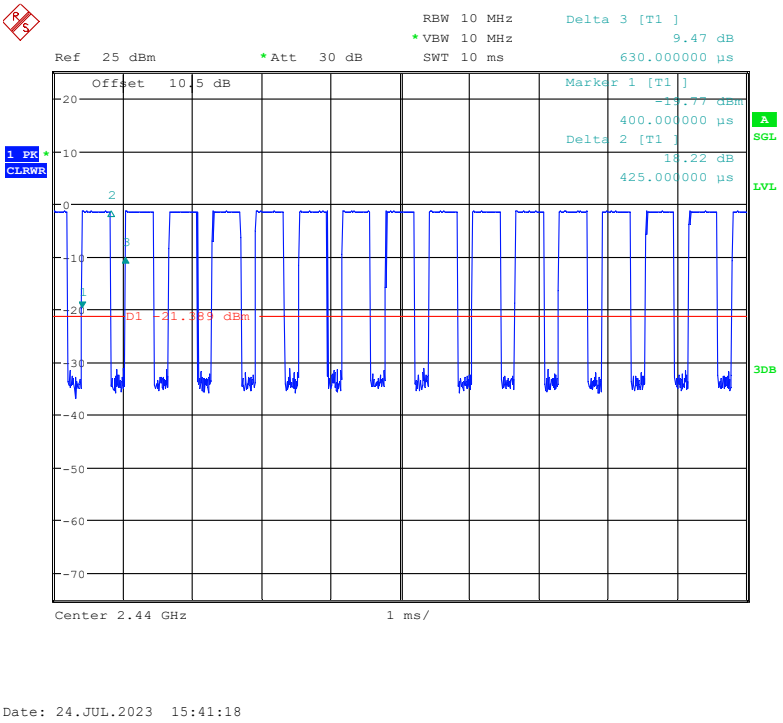
Mode	Data rate	Power Level		
		Low Channel	Middle Channel	High Channel
BLE	1Mbps	7	7	7

The software and power level was provided by the applicant.

Duty cycle

Mode	Ton (ms)	Ton+off (ms)	Duty Cycle (%)	1/T(kHz)	VBW Setting(kHz)
BLE 1M	0.425	0.630	67.46	2.35	3

BLE 1M Mode



Support Equipment List and Details

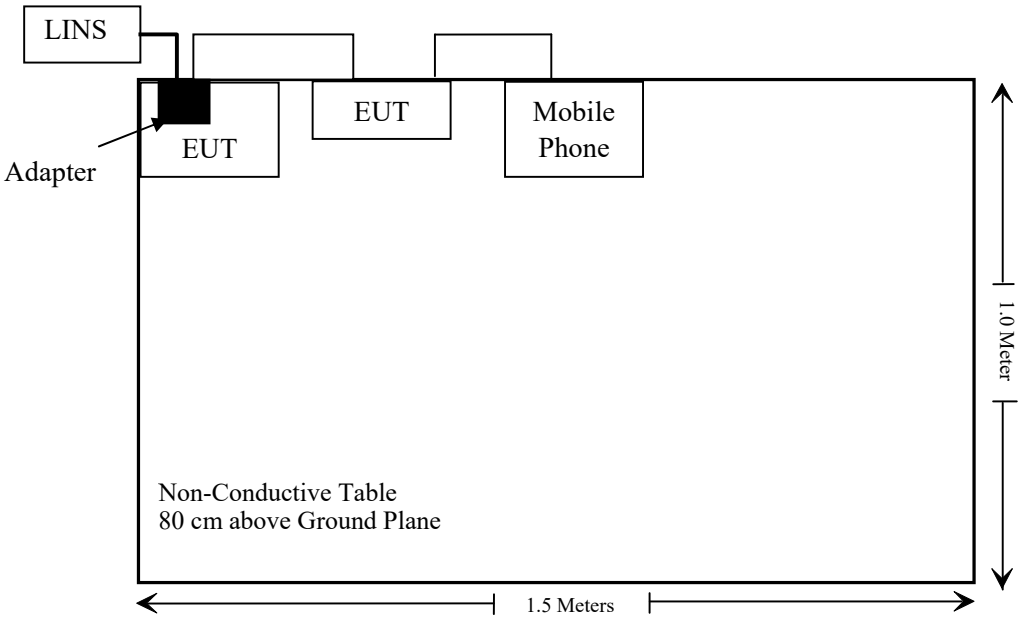
Manufacturer	Description	Model	Serial Number
Honor	Mobile phone	TFY-AN00	A00000E76E0FD2
Xiaomi	Mobile phone	M7	2356U2589
Switching	adapter	TPA-46B050100UU	/

External I/O Cable

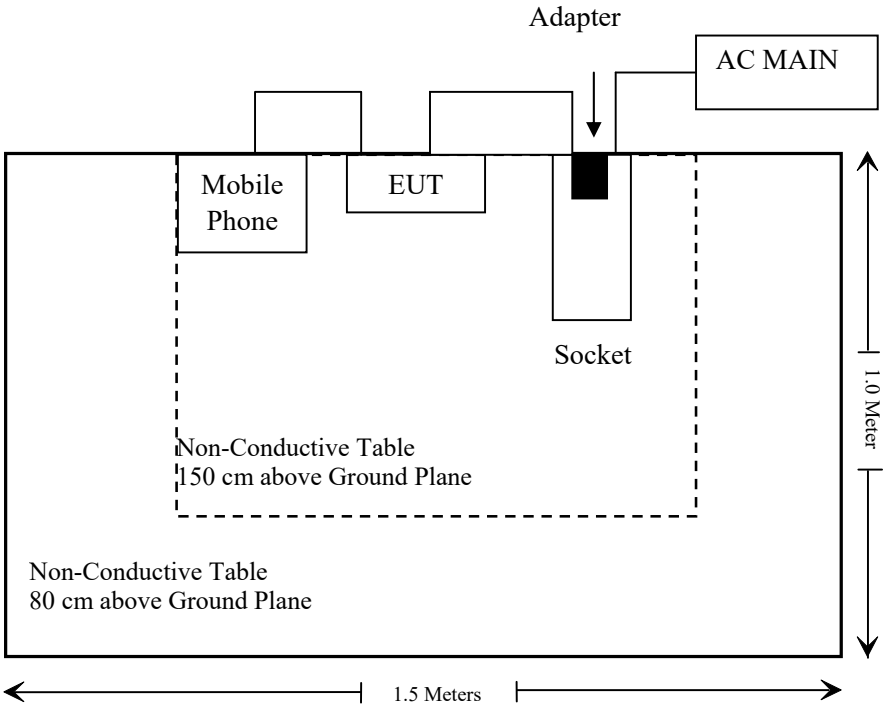
Cable Description	Length (m)	From Port	To
Un-shielding Detachable DC Cable	0.8	socket	Adapter
Un-shielding Detachable USB Cable	1.0	Mobile phone	EUT

Block Diagram of Test Setup

For conducted emission:



For Radiated Emissions:



Note: the edge of support table was flush with the center of turntable

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC§15.247 (i), §1.1307 (b) (3) &§2.1091	MPE-Based Exemption	Compliant
§15.203	Antenna Requirement	Compliant
§15.207 (a)	AC Line Conducted Emissions	Compliant
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliant
§15.247 (a)(2)	6 dB Emission Bandwidth & Occupied Bandwidth	Compliant
§15.247(b)(3)	Maximum Conducted Output Power	Compliant
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
§15.247(e)	Power Spectral Density	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde& Schwarz	EMI Test Receiver	ESCI	100784	2022/11/25	2023/11/24
Rohde & Schwarz	L.I.S.N.	ENV216	101314	2022/11/25	2023/11/24
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2022/12/07	2023/12/06
Unknown	RF Coaxial Cable	No.18	N0850	2022/11/25	2023/11/24
Conducted Emission Test Software: e3 191218 (V9)					
Radiated Emissions Test					
Rohde& Schwarz	Test Receiver	ESR	102725	2022/11/25	2023/11/24
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2022/11/25	2023/11/24
SONOMA INSTRUMENT	Amplifier	310 N	186131	2022/11/08	2023/11/07
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2022/11/08	2023/11/07
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2022/11/08	2023/11/07
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/06
Schwarzbeck	Horn Antenna	BBHA9120D	837	2023/02/22	2026/02/21
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2022/12/26	2025/12/25
Radiated Emission Test Software:e3 191218 (V9)					
Unknown	RF Coaxial Cable	No.10	N050	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.11	N1000	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.12	N040	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.13	N300	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.14	N800	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.15	N600	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.16	N650	2022/11/25	2023/11/24
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2022/11/25	2023/11/24

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde&Schwarz	Spectrum Analyzer	FSU26	200120	2023/4/18	2024/4/17
WEINSCHEL	10dB Attenuator	5324	AU 3842	2022/11/25	2023/11/24
Unknown	RF Cable	Unknown	1	Each time	Each time

*** Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. 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) (3) & §2.1091- MPE-Based Exemption

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz.

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

Ris the minimum separation distance in meters
f = frequency in MHz

Result

Mode	Frequency (MHz)	Tune up conducted power	Antenna Gain		ERP		Evaluation Distance (m)	ERP Limit (mW)
		(dBm)	(dBi)	(dBd)	(dBm)	(mW)		
BLE	2402-2480	0	1.9	-0.25	-0.25	0.944	0.2	768

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.
2. 0dBd=2.15dBi

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant.

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:

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 one internal antenna arrangement, which was permanently attached and the antenna gain is 1.9dBi, fulfill the requirement of this section. Please refer to the EUT photos.

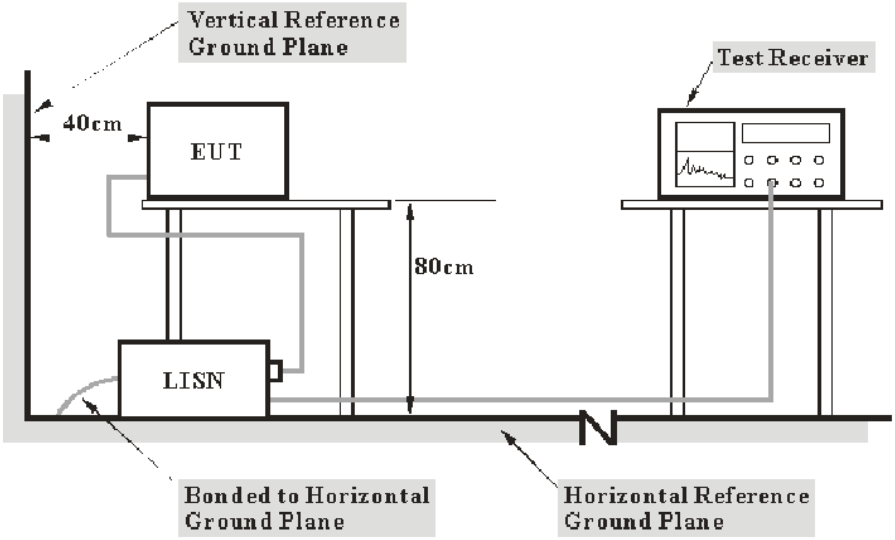
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

EUT Setup



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

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

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

All final data was recorded in the Quasi-peak and average detection mode.

Factor & Over Limit Calculation

The factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss. The basic equation is as follows:

Factor = LISN VDF + Cable Loss

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

Over Limit = level – Limit
Level= reading level+ Factor

Test Data

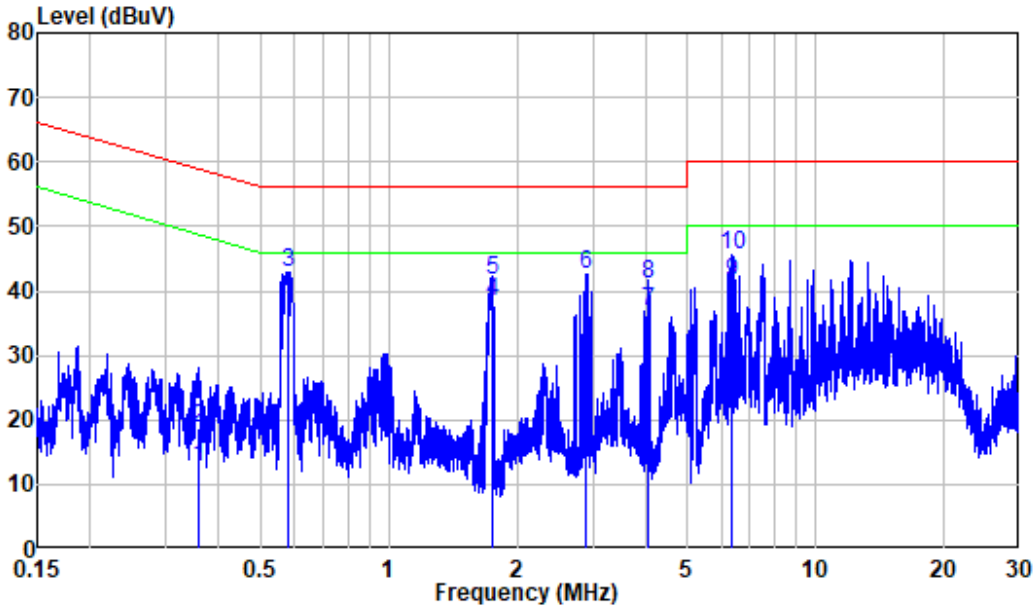
Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	100.19 kPa

The testing was performed by Jeef Huang on 2023-07-19.

EUT operation mode: Transmitting (worst case is BLE 1M, low channel)

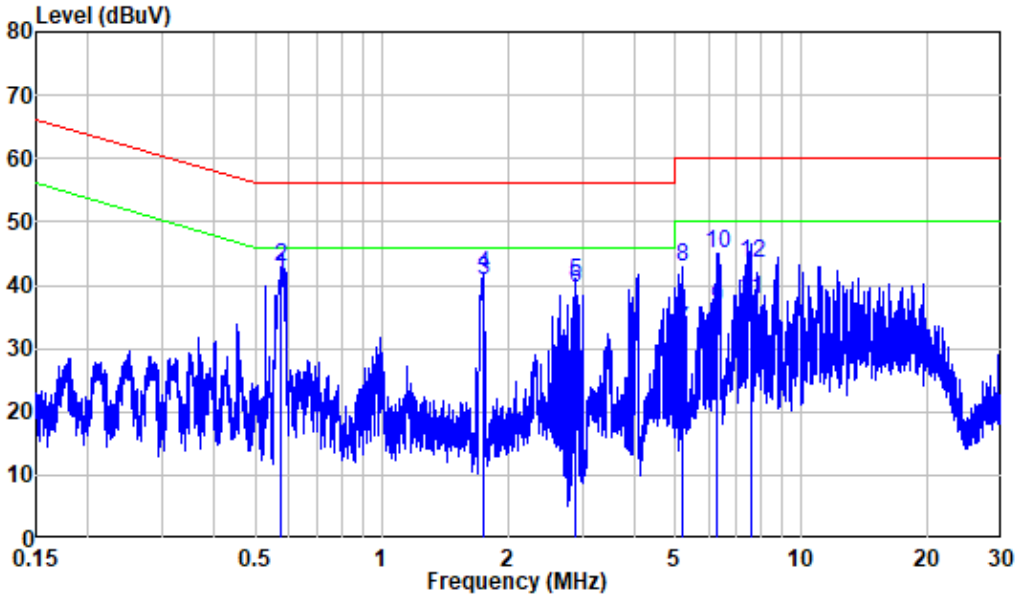
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Job No. : RA230717-41157E-RF
Mode : Charging+BLE Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.357	10.46	2.24	12.70	48.79	-36.09	Average
2	0.357	10.46	8.39	18.85	58.79	-39.94	QP
3	0.580	10.61	32.29	42.90	56.00	-13.10	
4	1.741	10.41	28.04	38.45	46.00	-7.55	Average
5	1.741	10.41	31.18	41.59	56.00	-14.41	QP
6	2.894	10.48	32.16	42.64	56.00	-13.36	
7	4.060	10.54	26.27	36.81	46.00	-9.19	Average
8	4.060	10.54	30.61	41.15	56.00	-14.85	QP
9	6.369	10.60	30.65	41.25	50.00	-8.75	Average
10	6.369	10.60	34.87	45.47	60.00	-14.53	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Job No. : RA230717-41157E-RF
Mode : Charging+BLE Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.577	10.47	30.78	41.25	46.00	-4.75	Average
2	0.577	10.47	32.50	42.97	56.00	-13.03	QP
3	1.741	10.47	30.31	40.78	46.00	-5.22	Average
4	1.741	10.47	31.25	41.72	56.00	-14.28	QP
5	2.890	10.53	29.91	40.44	46.00	-5.56	Average
6	2.890	10.53	29.01	39.54	56.00	-16.46	QP
7	5.221	10.51	22.26	32.77	50.00	-17.23	Average
8	5.221	10.51	32.36	42.87	60.00	-17.13	QP
9	6.264	10.51	25.66	36.17	50.00	-13.83	Average
10	6.264	10.51	34.56	45.07	60.00	-14.93	QP
11	7.566	10.56	27.12	37.68	50.00	-12.32	Average
12	7.566	10.56	33.02	43.58	60.00	-16.42	QP

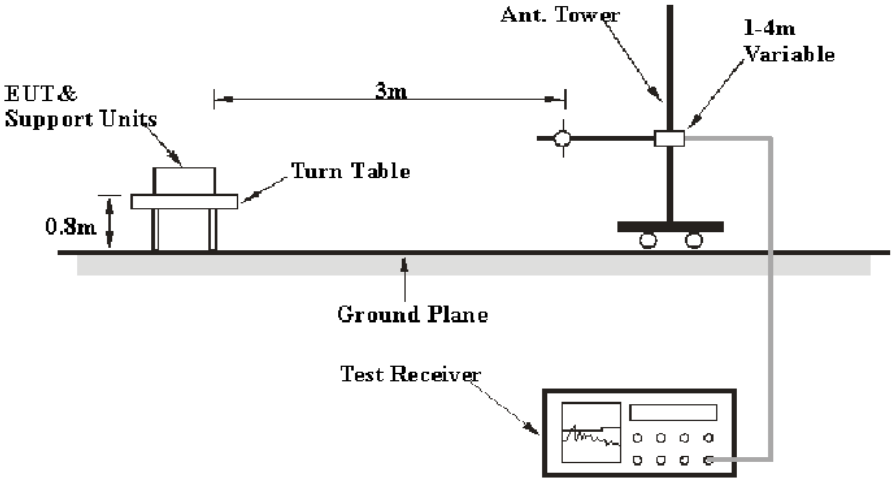
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

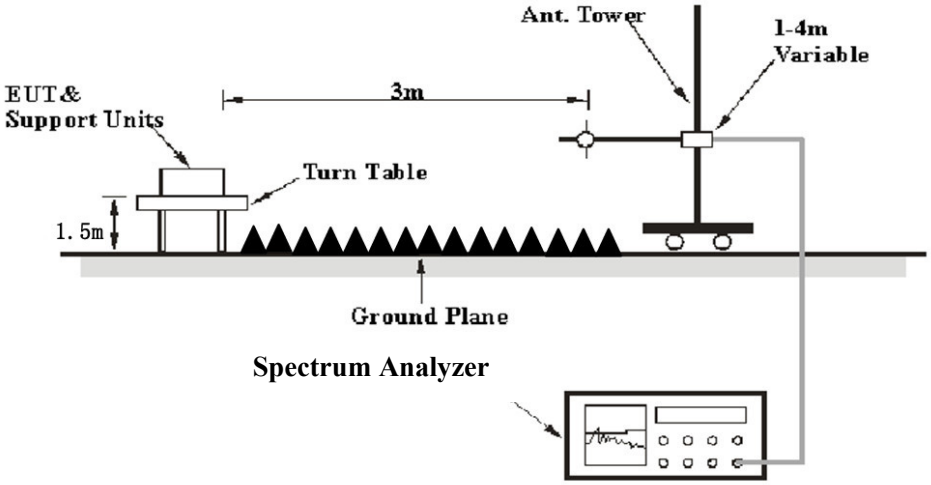
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



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.

EMI Test Receiver & Spectrum Analyzer Setup

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

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	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.

Factor & Over limit/Margin Calculation

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

Factor = Antenna Factor + Cable Loss - Amplifier Gain

The "**Over Limit/Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit/Margin of -7dB means the emission is 7dB below the limit. The equation for calculation is as follows:

Over Limit/Margin = Level – Limit
Level = Read Level + Factor

Test Data

Environmental Conditions

Temperature:	23~25.6 ℃
Relative Humidity:	51~53 %
ATM Pressure:	100.19 ~101 kPa

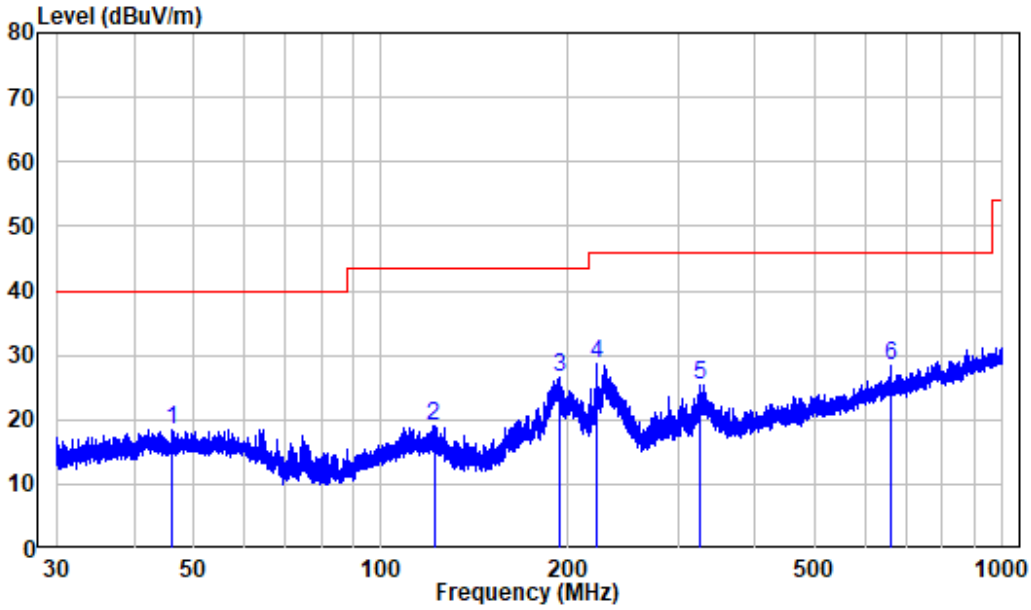
The testing was performed by Jason Liu on 2023-07-19 for below 1GHz and Leve Li on 2023-07-21 for above 1GHz.

EUT operation mode: Transmitting (Pre-scan in the X,Y and Z axes of orientation, the worst case X-axis of orientation was recorded)

30MHz-1GHz: *(worst case is BLE 1M, low channel)*

Note: When the test result of peak was less than the limit of QP more than 6dB, just peak value were recorded.

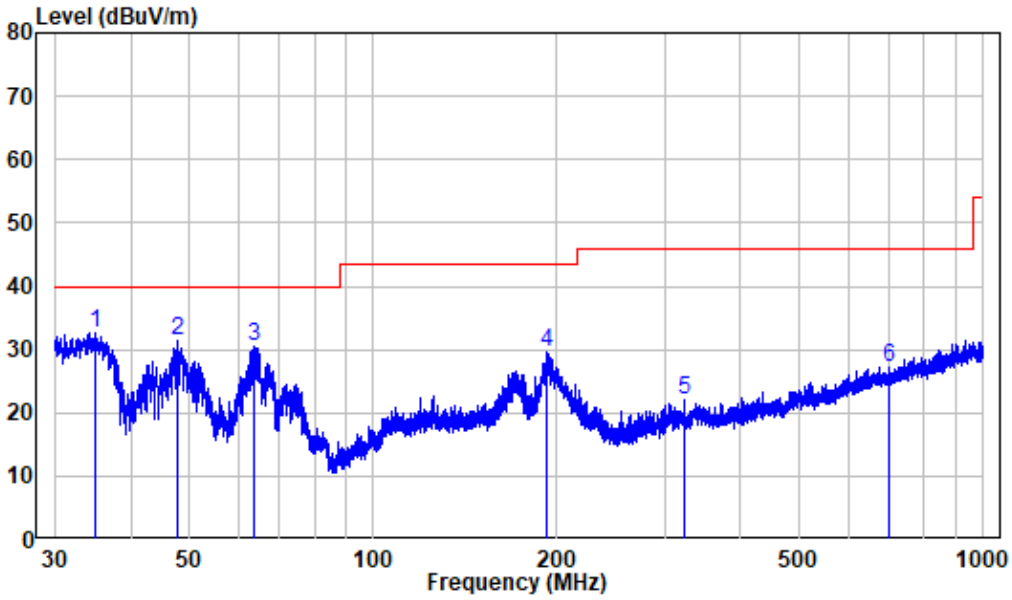
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA230717-41157E-RF
Test Mode: Charging+BLE Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	46.016	-9.99	28.55	18.56	40.00	-21.44	Peak
2	121.602	-13.85	32.98	19.13	43.50	-24.37	Peak
3	193.603	-11.30	37.81	26.51	43.50	-16.99	Peak
4	221.878	-11.35	39.93	28.58	46.00	-17.42	Peak
5	325.453	-8.24	33.63	25.39	46.00	-20.61	Peak
6	663.182	-1.65	30.01	28.36	46.00	-17.64	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA230717-41157E-RF
Test Mode: Charging+BLE Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	34.913	-11.57	44.28	32.71	40.00	-7.29	Peak
2	47.805	-10.00	41.38	31.38	40.00	-8.62	Peak
3	63.731	-12.06	42.59	30.53	40.00	-9.47	Peak
4	193.010	-11.28	40.83	29.55	43.50	-13.95	Peak
5	322.613	-8.36	30.33	21.97	46.00	-24.03	Peak
6	702.377	-1.55	28.83	27.28	46.00	-18.72	Peak

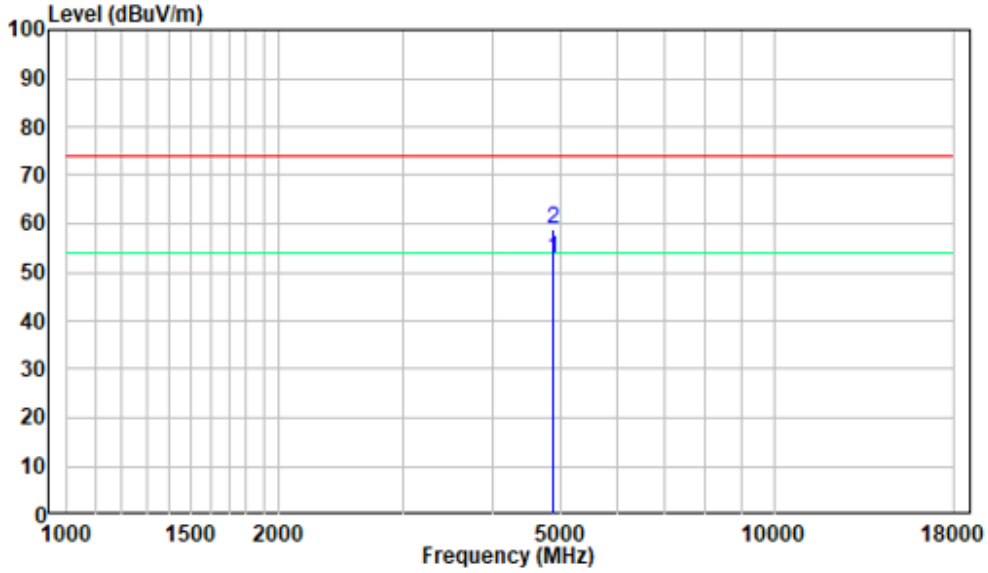
1-18 GHz:

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel 2402MHz									
2376.28	65.95	PK	349	1.4	H	-10.67	55.28	74	-18.72
2376.28	55.33	AV	349	1.4	H	-10.67	44.66	54	-9.34
2311.68	64.76	PK	75	1.2	V	-10.34	54.42	74	-19.58
2311.68	52.62	AV	75	1.2	V	-10.34	42.28	54	-11.72
2390	65.30	PK	1	1.1	H	-10.62	54.68	74	-19.32
2390	54.24	AV	1	1.1	H	-10.62	43.62	54	-10.38
2390	64.89	PK	185	2.5	V	-10.62	54.27	74	-19.73
2390	52.71	AV	185	2.5	V	-10.62	42.09	54	-11.91
4804	63.93	PK	189	1.8	H	-5.57	58.36	74	-15.64
4804	57.84	AV	189	1.8	H	-5.57	52.27	54	-1.73
4804	63.17	PK	170	2.1	V	-5.57	57.60	74	-16.40
4804	55.36	AV	170	2.1	V	-5.57	49.79	54	-4.21
Middle Channel 2440MHz									
4880	64.01	PK	154	2.2	H	-5.24	58.77	74	-15.23
4880	58.19	AV	154	2.2	H	-5.24	52.95	54	-1.05
4880	62.66	PK	167	1.5	V	-5.24	57.42	74	-16.58
4880	55.55	AV	167	1.5	V	-5.24	50.31	54	-3.69
High Channel 2480MHz									
2483.5	69.66	PK	264	2	H	-10.46	59.2	74	-14.80
2483.5	54.64	AV	264	2	H	-10.46	44.18	54	-9.82
2483.5	67.83	PK	207	2.1	V	-10.46	57.37	74	-16.63
2483.5	53.98	AV	207	2.1	V	-10.46	43.52	54	-10.48
2483.51	69.96	PK	188	2.1	H	-10.46	59.5	74	-14.50
2483.51	55.27	AV	188	2.1	H	-10.46	44.81	54	-9.19
2494.47	68.95	PK	201	2	V	-10.37	58.58	74	-15.42
2494.47	54.91	AV	201	2	V	-10.37	44.54	54	-9.46
4960	62.28	PK	287	2.4	H	-4.90	57.38	74	-16.62
4960	56.09	AV	287	2.4	H	-4.90	51.19	54	-2.81
4960	61.91	PK	198	1.2	V	-4.90	57.01	74	-16.99
4960	54.33	AV	198	1.2	V	-4.90	49.43	54	-4.57

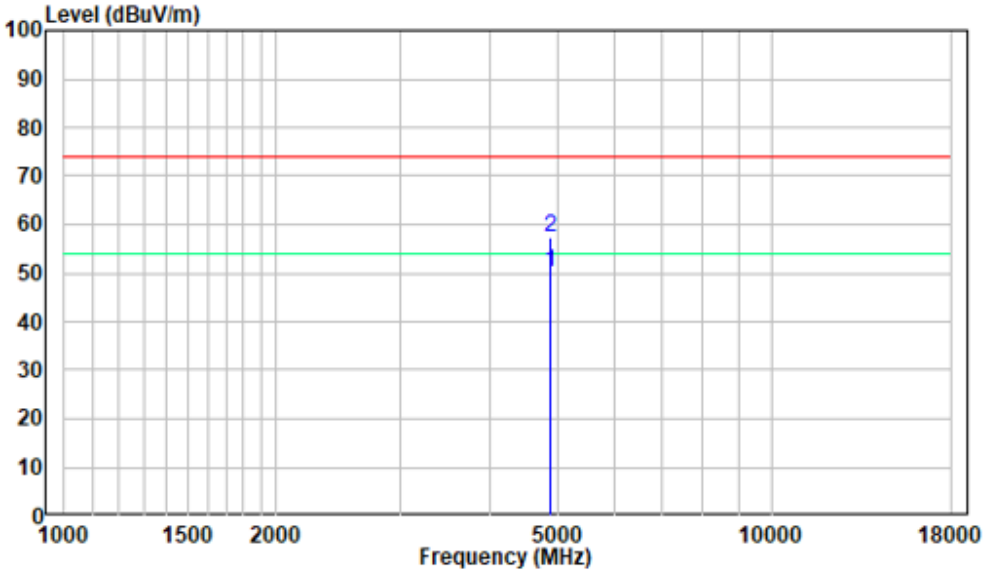
Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Absolute Level = Corrected Factor + Reading
Margin = Absolute Level - Limit
The other spurious emission which is in the noise floor level was not recorded.

1-18 GHz:

Pre-scan for
BLE 1M, Middle Channel
Horizontal

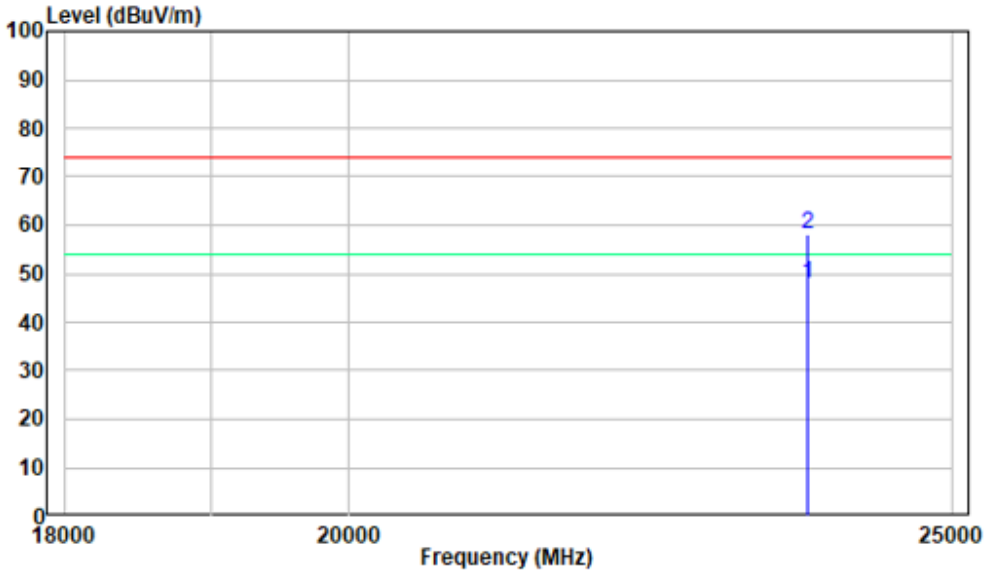


Vertical

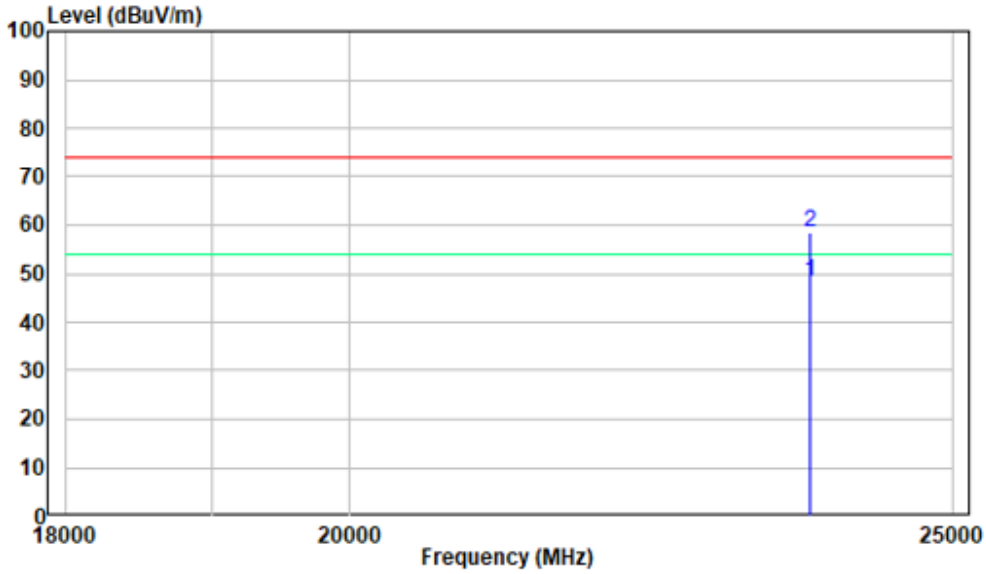


18 -25GHz:

Pre-scan for
BLE 1M, Middle Channel
Horizontal



Vertical



FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

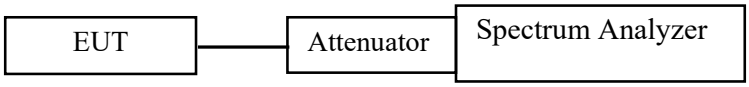
Applicable Standard

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.

Test Procedure

According to ANSI C63.10-2013 section 11.8

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:	26~27 ℃
Relative Humidity:	45~50 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-07-24.

Test Result: Pass.

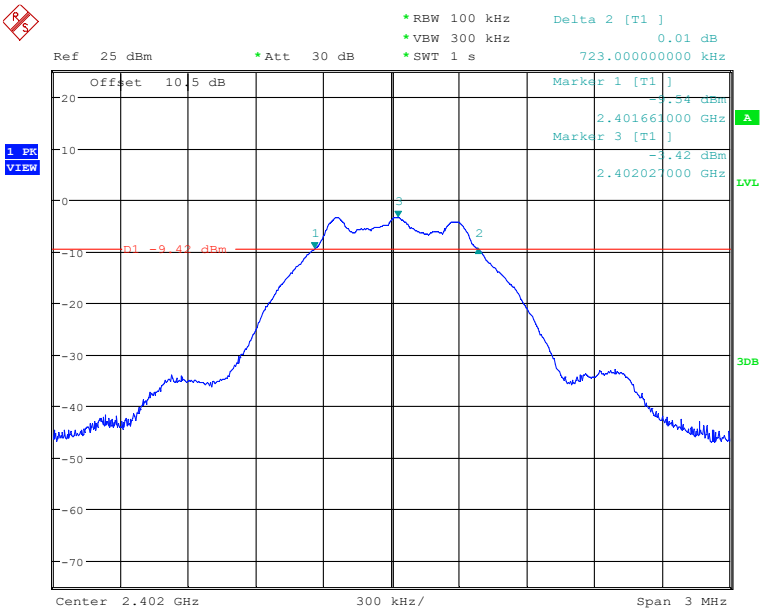
Please refer to the following table and plots.

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)	Verdict
BLE 1M				
Low	2402	0.723	≥500	PASS
Middle	2440	0.717	≥500	PASS
High	2480	0.723	≥500	PASS

Channel	Frequency (MHz)	99% Emission Bandwidth (MHz)	Limit	Verdict
BLE 1M				
Low	2402	1.026	---	---
Middle	2440	1.023	---	---
High	2480	1.026	---	---

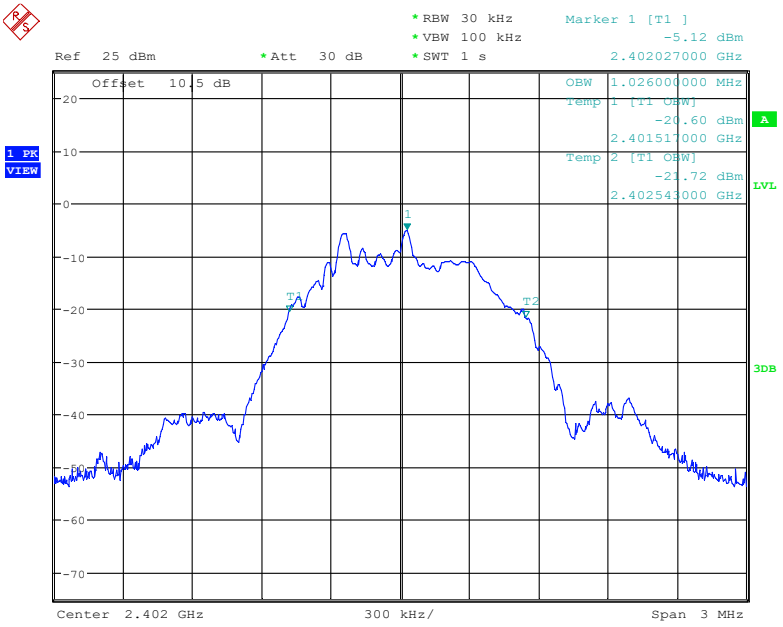
BLE 1M

6dB Emission Bandwidth, Low Channel



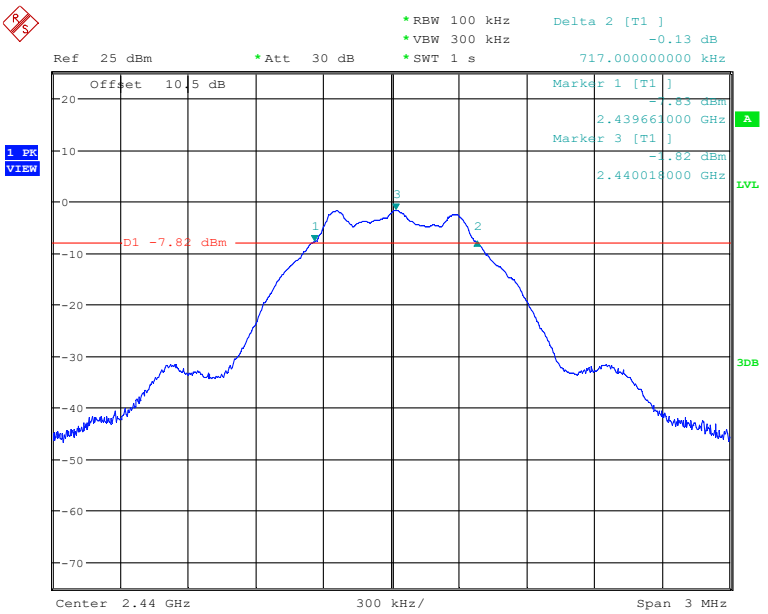
Date: 24.JUL.2023 15:39:45

Occupied Bandwidth, Low Channel



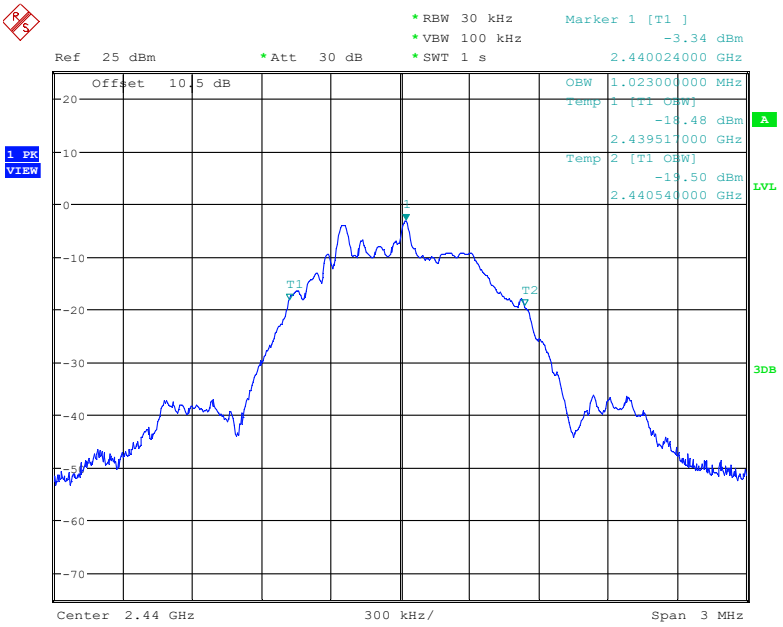
Date: 24.JUL.2023 15:39:21

6dB Emission Bandwidth, Middle Channel



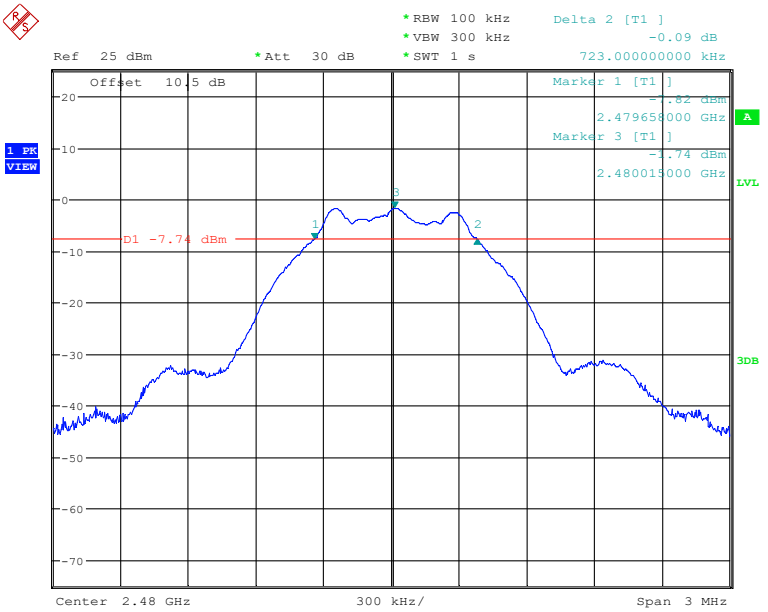
Date: 24.JUL.2023 15:42:30

Occupied Bandwidth, Middle Channel



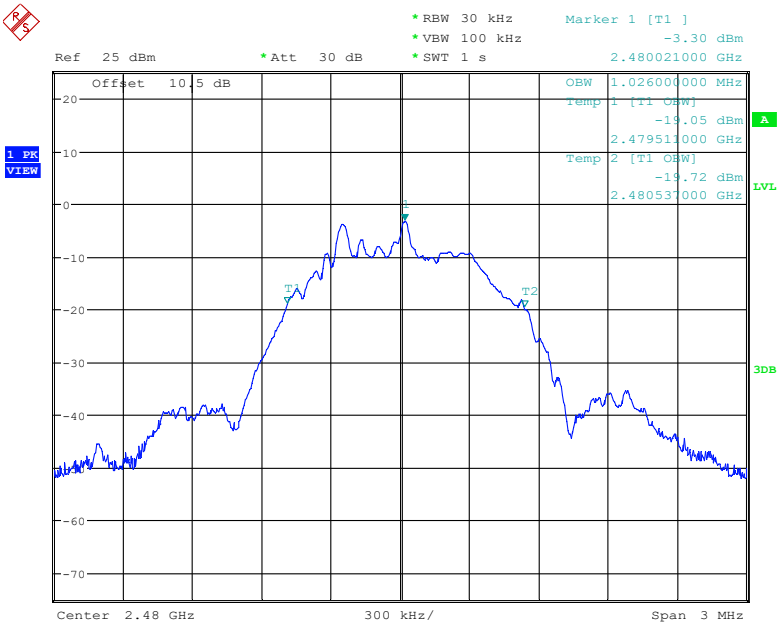
Date: 24.JUL.2023 15:42:06

6dB Emission Bandwidth, High Channel



Date: 24.JUL.2023 15:47:27

Occupied Bandwidth, High Channel



Date: 24.JUL.2023 15:47:04

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

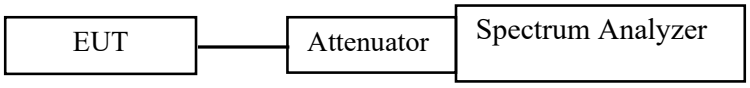
Applicable Standard

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.

Test Procedure

According to ANSI C63.10-2013 section 11.9.1.1

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:	26~27 ℃
Relative Humidity:	45~50 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Huang on 2023-07-24.

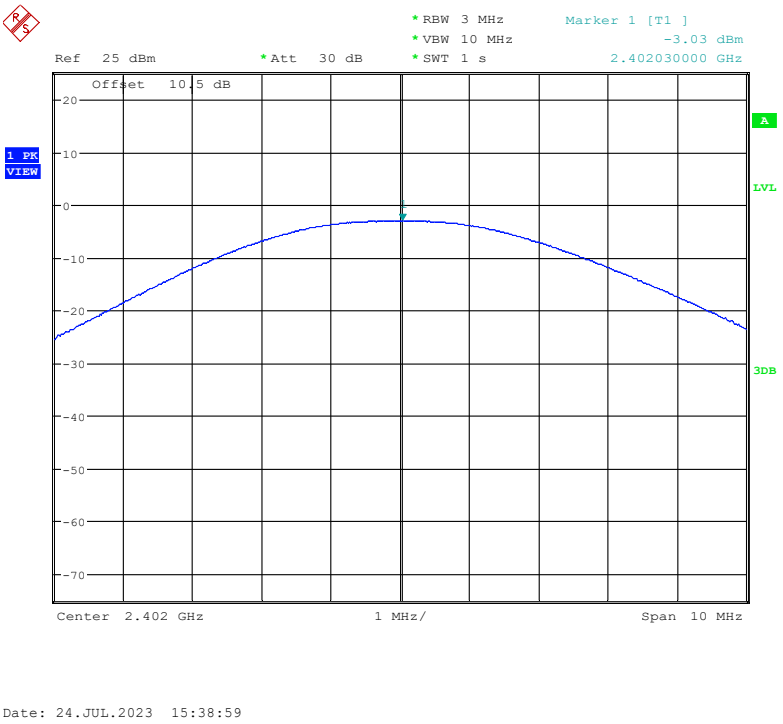
EUT operation mode: Transmitting

Test Result: Compliant.

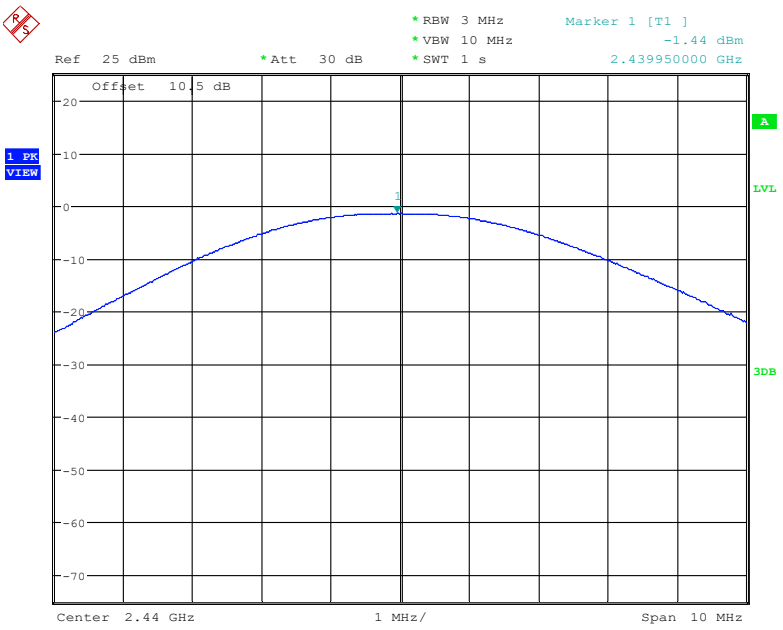
Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)
BLE 1M			
Low	2402	-3.03	30
Middle	2440	-1.44	30
High	2480	-1.38	30

BLE 1M

Low Channel

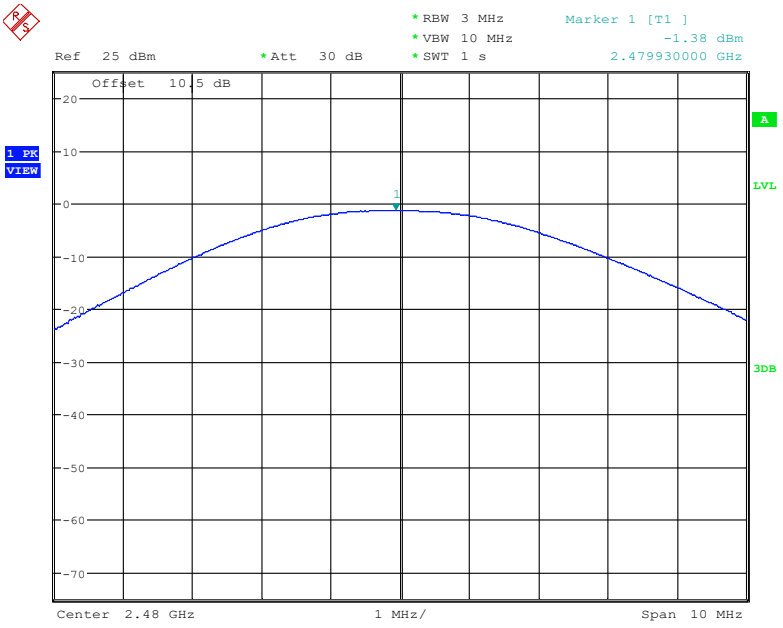


Middle Channel



Date: 24.JUL.2023 15:41:42

High Channel



Date: 24.JUL.2023 15:46:41

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

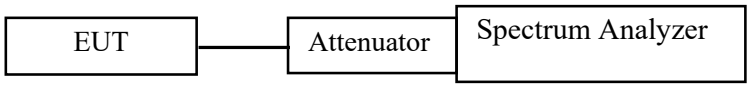
Applicable Standard

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

According to ANSI C63.10-2013 section 11.11

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:	26~27 ℃
Relative Humidity:	45~50 %
ATM Pressure:	101.0 kPa

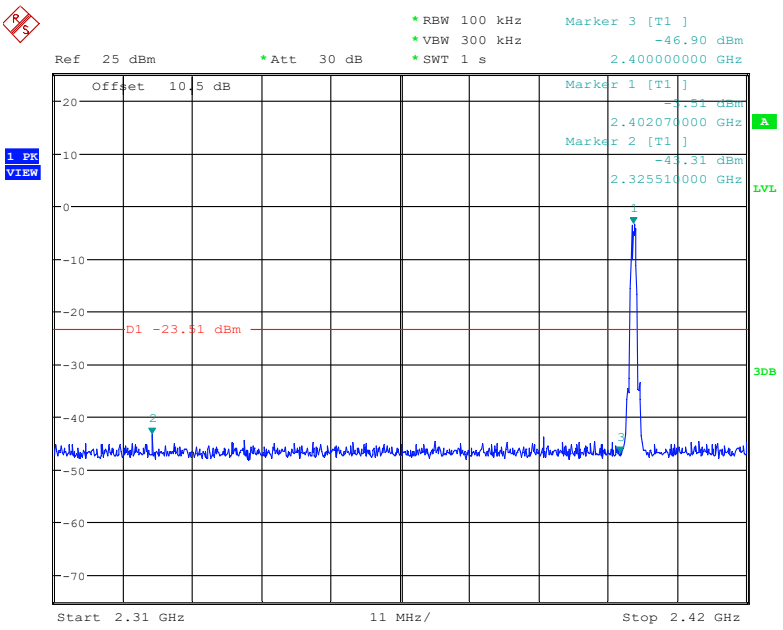
The testing was performed by Jacob Huang on 2023-07-24.

EUT operation mode: Transmitting

Test Result: Compliant.

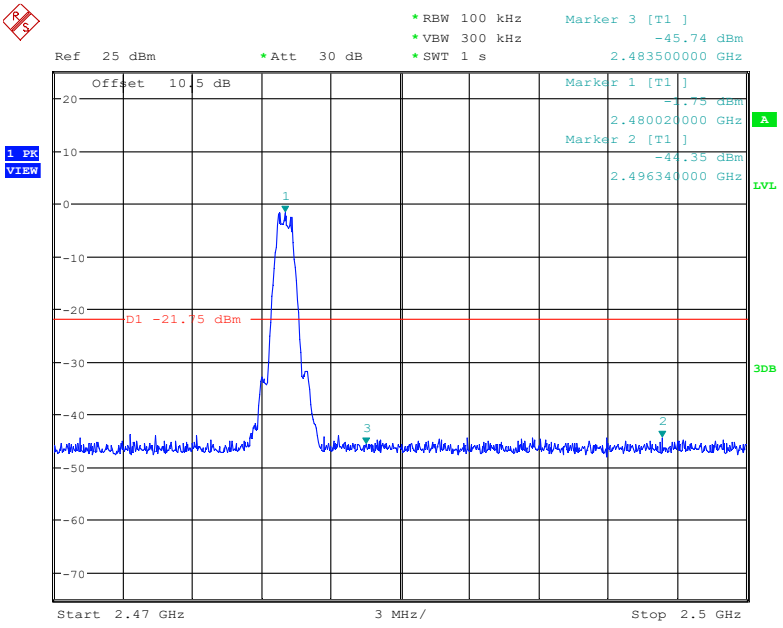
Please refer to the following plots.

BLE 1M: Band Edge, Left Side



Date: 24.JUL.2023 15:40:31

BLE 1M: Band Edge, Right Side



Date: 24.JUL.2023 15:48:14

FCC §15.247(e) - POWER SPECTRAL DENSITY

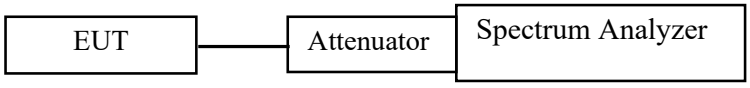
Applicable Standard

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.

Test Procedure

According to ANSI C63.10-2013 section 11.10.2

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≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×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:	26~27 ℃
Relative Humidity:	45~50 %
ATM Pressure:	101.0 kPa

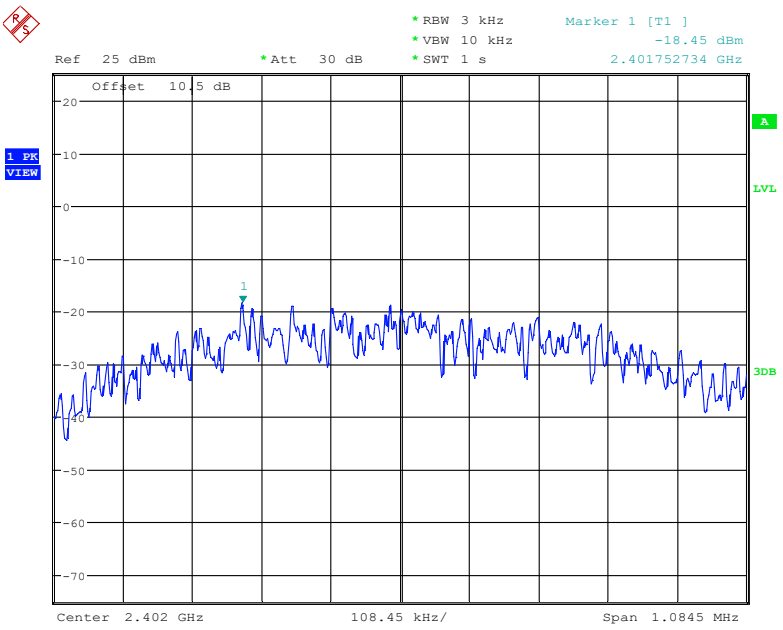
The testing was performed by Jacob Huang on 2023-07-24.

EUT operation mode: Transmitting

Test Result: Compliant.

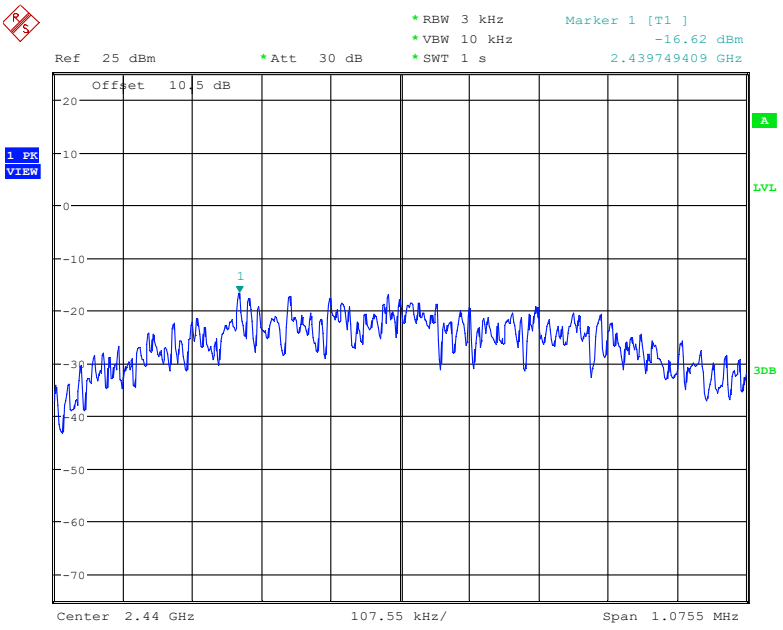
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
BLE 1M			
Low	2402	-18.45	≤8
Middle	2440	-16.62	≤8
High	2480	-16.58	≤8

Power Spectral Density, BLE 1M Low Channel



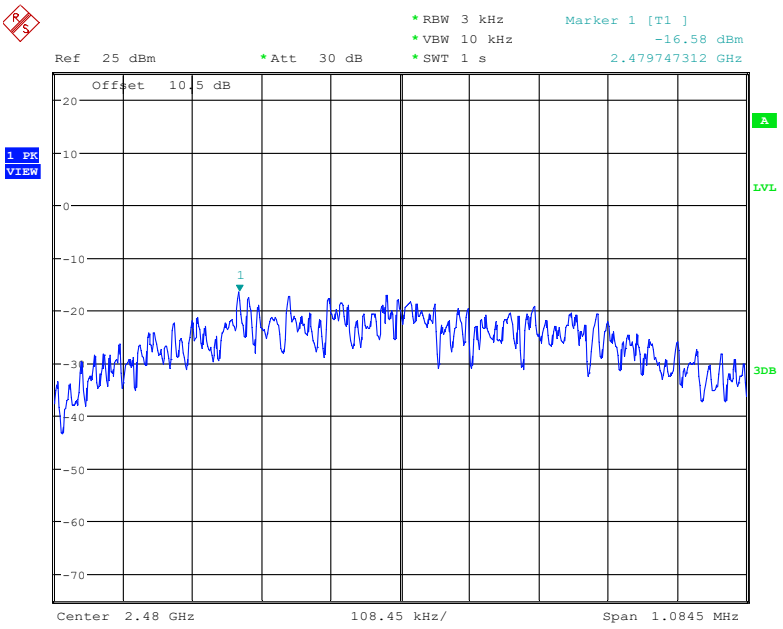
Date: 24.JUL.2023 15:40:08

Power Spectral Density, BLE 1M Middle Channel



Date: 24.JUL.2023 15:42:53

Power Spectral Density, BLE 1M High Channel



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