TEST REPORT

Applicant Name :	Xunison Inc
Address :	11720 Amber Park Dr.Suite 160 Atlanta, GA 30009 United States
Report Number :	RA221215-61881E-RF-00A
FCC ID:	2BAT3D50H

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	Xunison Hub
Model No.:	D50 Home
Multiple Model(s) No.:	N/A
Trade Mark:	XUNISON
Date Received:	2022/12/15
Report Date:	2023/05/10

Test Result:	Pass*

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

Prepared and Checked By:

Nick Fang

Nick Fang
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	RA221215-61881E-RF-00A	Original Report	2023/05/10

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Frequency Range	Zigbee : 2405-2480MHz
Maximum Conducted Peak Output Power	Zigbee: 16.34dBm
Modulation Technique	Zigbee: O-QPSK
Antenna Specification*	5dBi (provided by the applicant)
Voltage Range	DC 12V from adapter
Sample serial number	1ZF5 for Conducted and Radiated Emissions Test 1ZF4 for RF Conducted Test (Assigned by ATC)
Sample/EUT Status	Good condition
Adapter 1 Information	Model: AS2406A-1202000DM Input: AC 100-240V, 50/60Hz, 0.8A MAX Output: DC 12.0V, 2.0A, 24.0W
Adapter 2 Information	Model: AS2406A-1202000US Input: AC 100-240V, 50/60Hz, 0.8A MAX Output: DC 12.0V, 2000mA
Adapter 3 Information	Model: RD1202000-C55-154MG Input: AC 100-240V, 50/60Hz, 1.0A MAX Output: DC 12.0V, 2.0A

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.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF Frequency		$0.082*10^{-7}$
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.72dB
Emissions, Radiated	9kHz - 30MHz	2.66dB
	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
	26.5GHz - 40GHz	4.72dB
Temperature		1℃
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

Test Site 1:
The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

Test Site 2:
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.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For Zigbee mode, 16 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
11	2405	19	2445
12	2410	20	2450
13	2415	21	2455
14	2420	22	2460
15	2425	23	2465
16	2430	24	2470
17	2435	25	2475
18	2440	26	2480

EUT was tested with Channel 11, 19 and 26.

Equipment Modifications

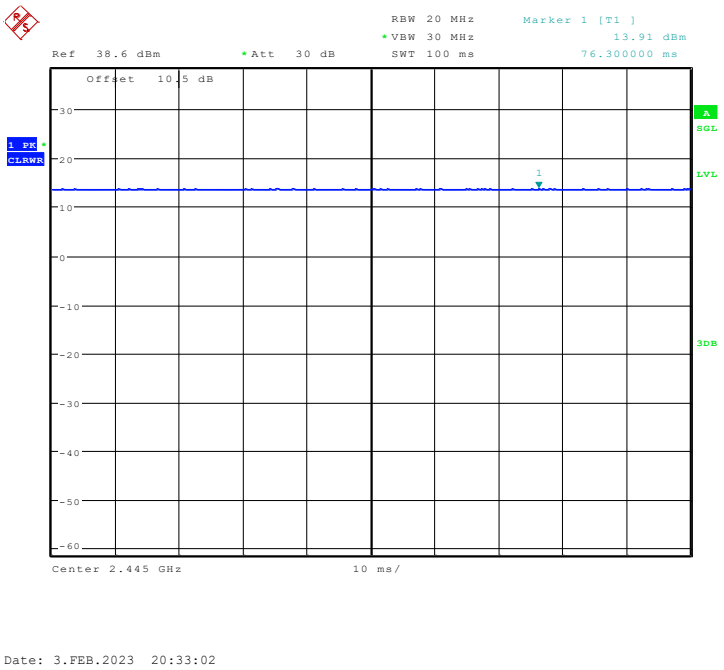
No modification was made to the EUT tested.

EUT Exercise Software

"SSCOM42"* software was used during test and power level is 14*. The software and power level was provided by applicant.

Duty cycle

Mode	T_{on} (ms)	T_{on+off} (ms)	Duty Cycle (%)
Zigbee	100	100	100



Support Equipment List and Details

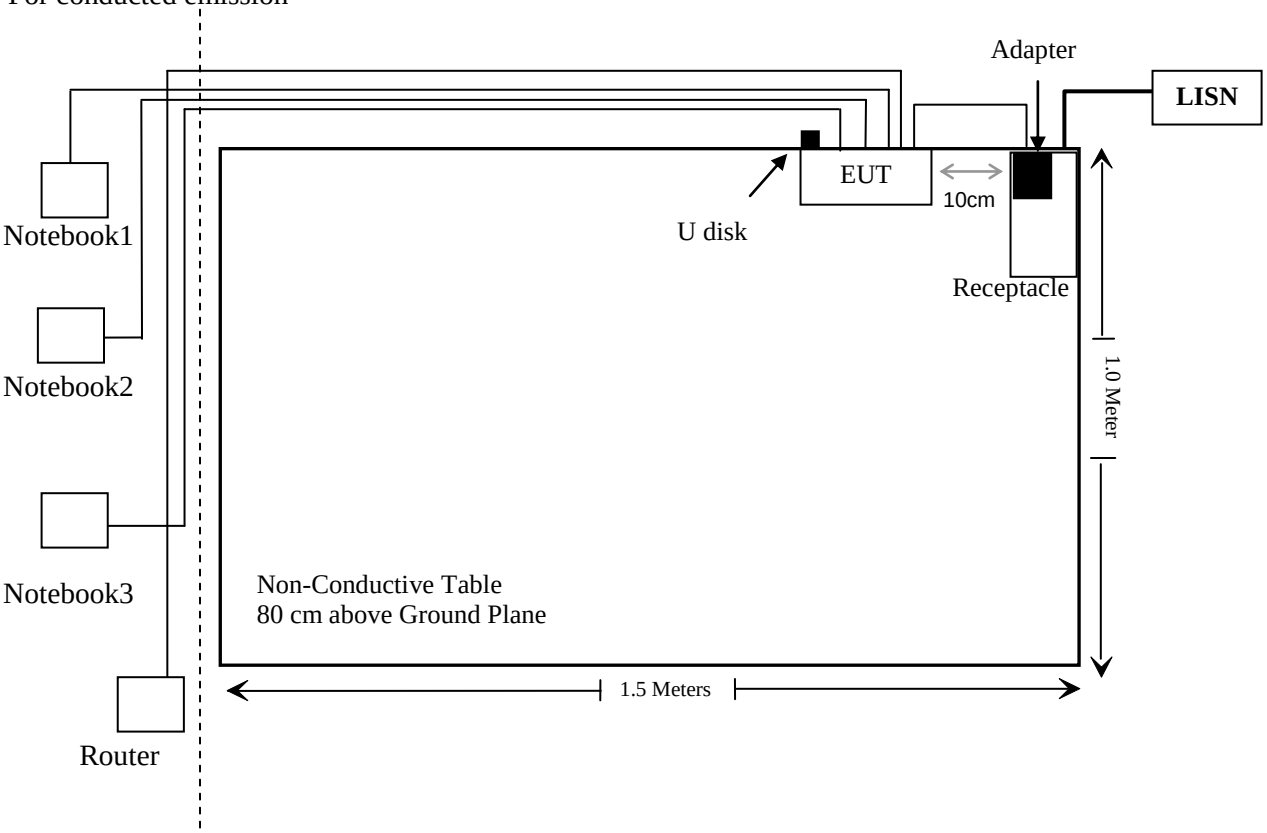
Manufacturer	Description	Model	Serial Number
DELL	Note Book1	Latitude E4710	PC201911252059
DELL	Note Book2	Latitude E4710	PC201911252060
DELL	Note Book3	Latitude E4710	PC201911252061
HUAWEI	Router	WS5100	A4933FEF1D01
Kingston	U-disk	DTKN	100008447371

External I/O Cable

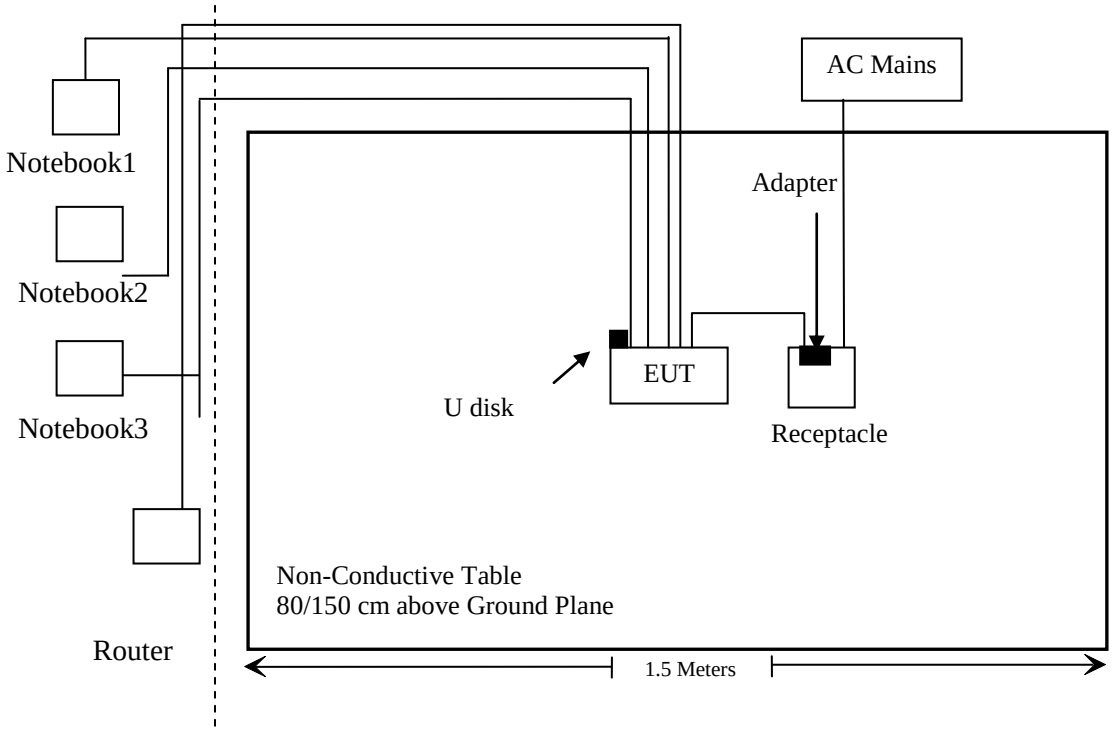
Cable Description	Length (m)	From Port	To
Un-shielded detachable RJ45 cable	8.0	EUT	NoteBook1
Un-shielded detachable RJ45 cable	8.0	EUT	NoteBook2
Un-shielded detachable RJ45 cable	8.0	EUT	NoteBook3
Un-shielded detachable RJ45 cable	8.0	EUT	Router
Unshielded Un-detachable DC cable	1.8	Adapter	EUT

Block Diagram of Test Setup

For conducted emission



For Radiated Emissions:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§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.17	N0350	2022/11/25	2023/11/24
Conducted Emission Test Software: e3 19821b (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-18405 536-J0	15964001002	2022/11/08	2023/11/07
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2022/11/30	2025/11/29
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2022/12/26	2025/12/25
Radiated Emission Test Software: e3 19821b (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
RF Conducted Test					
Rohde&Schwarz	Spectrum Analyzer	FSV-40	101495	2022/11/25	2023/11/24
WEINSCHEL	10dB Attenuator	5324	AU 3842	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.31	RF-01	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 1.1307 (b) (3) 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 exemptionfrom 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

For multiple RF sources: Multiple RF sources are exempt if:

in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation:

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c} \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

Result

Mode	Frequency (MHz)	Tune up conducted power	Antenna Gain		ERP		Evaluation Distance (m)	ERP Limit (W)
		(dBm)	(dBi)	(dBd)	(dBm)	(W)		
ZigBee	2405-2480	17.0	5	2.85	19.85	0.097	0.2	0.768
2.4G Wi-Fi	2412-2462	18.0	5	2.85	20.85	0.122	0.2	0.768
5G Wi-Fi	5150-5250	19.0	5	2.85	21.85	0.153	0.2	0.768
	5250-5350	21.0	5	2.85	23.85	0.243	0.2	0.768
	5470-5725	21.0	5	2.85	23.85	0.243	0.2	0.768
	5725-5850	20.0	5	2.85	22.85	0.193	0.2	0.768

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.
2. The ZigBee, 2.4G Wi-Fi and 5G Wi-Fi can Simultaneous transmitting
3. 0dBd=2.15dBi

Simultaneous transmitting consideration (worst case):

The ratio=ERP_{Zigbee}/limit+$ERP_{2.4G\ Wi\text{-}Fi}$/limit+$ERP_{5G\ Wi\text{-}Fi}$/limit
=0.097/0.768+0.122 /0.768+0.243/0.768=0.602＜1.0, so simultaneous exposure is compliant.

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 integral Antenna arrangement which was permanently attached and the antenna gain is 5.0dBi, fulfill the requirement of this section. Please refer to the product photos.

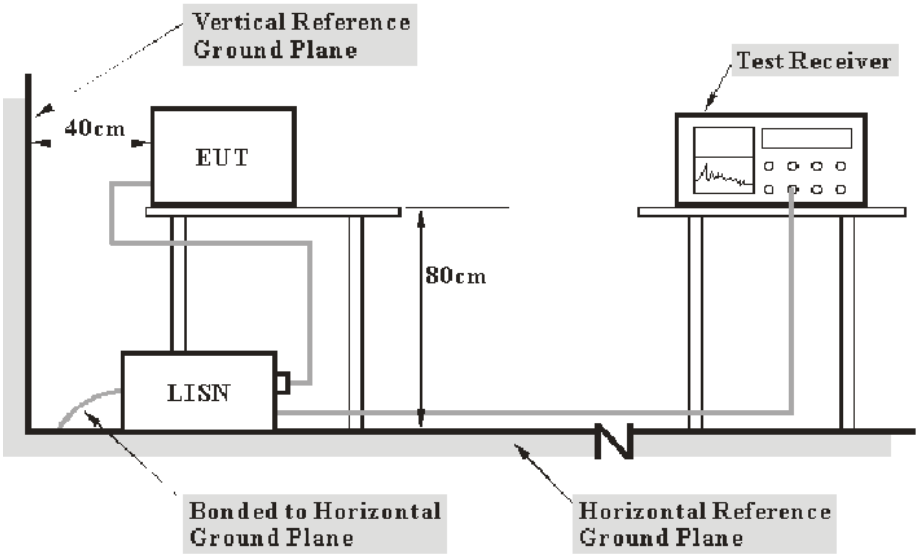
Result: Compliant.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

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 measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

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 device 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 & Margin Calculation

The factor is calculated by adding LISN VDF (Voltage Division Factor) and 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, an Over limit of -7 dB means the emission is 7 dB below the limit. The equation for calculation is as follows:

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

Test Data

Environmental Conditions

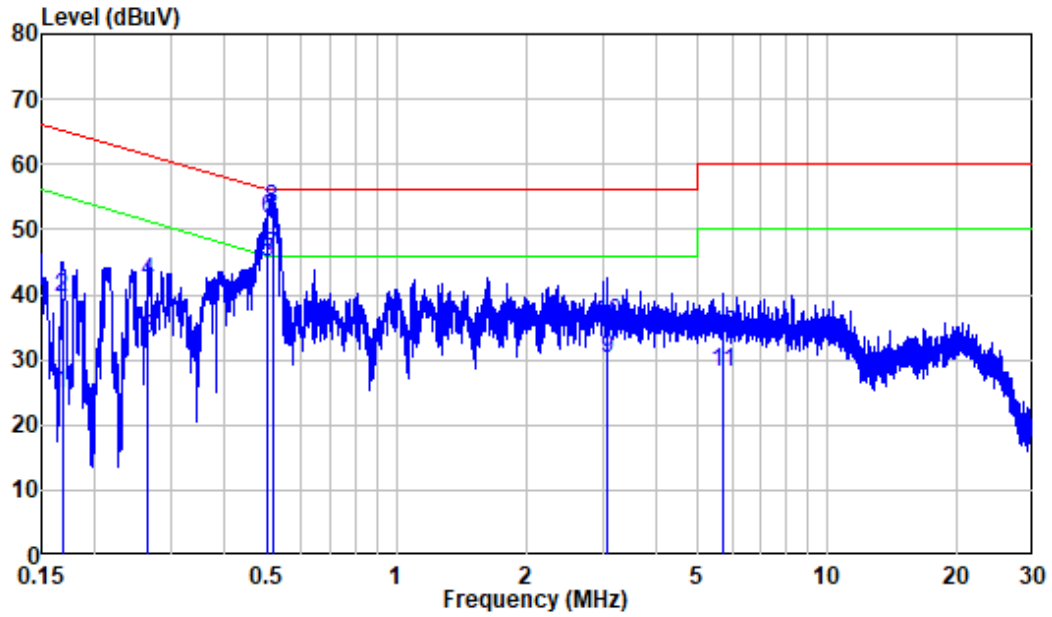
Temperature:	23 °C
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Lipa Wu on 2023-02-04 and 2023-03-14.

EUT operation mode: Transmitting (worst case is low channel)

For Adapter 1

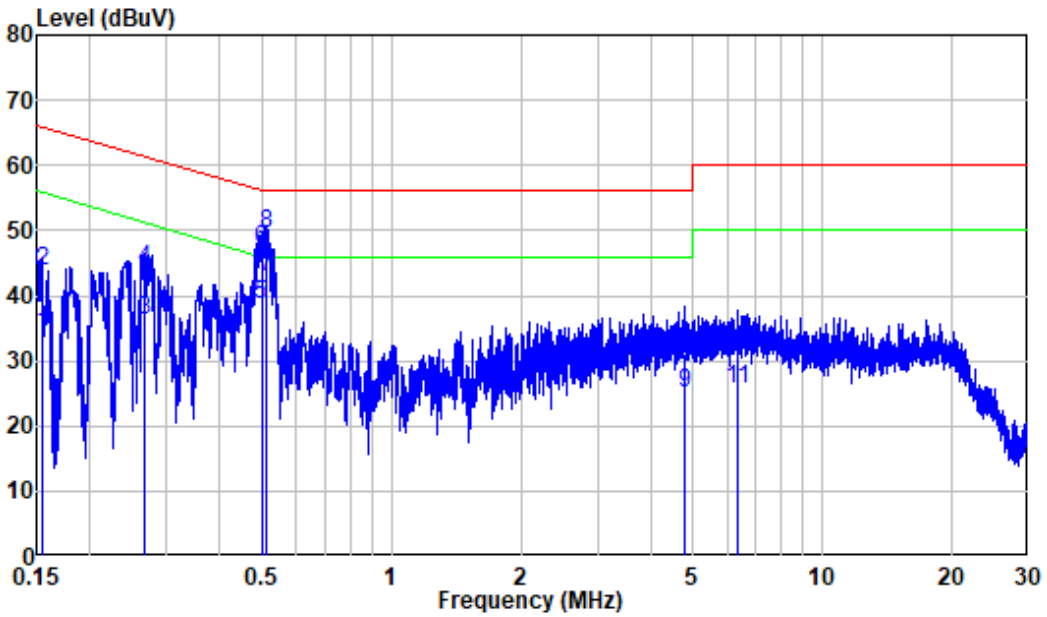
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Job No. : RA221215-61881E-RF
Mode : ZigBee&Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.168	9.90	14.93	24.83	55.08	-30.25	Average
2	0.168	9.90	29.68	39.58	65.08	-25.50	QP
3	0.265	9.87	23.41	33.28	51.28	-18.00	Average
4	0.265	9.87	32.16	42.03	61.28	-19.25	QP
5	0.500	9.80	35.18	44.98	46.00	-1.02	Average
6	0.500	9.80	41.74	51.54	56.00	-4.46	QP
7	0.515	9.82	36.07	45.89	46.00	-0.11	Average
8	0.515	9.82	43.41	53.23	56.00	-2.77	QP
9	3.090	9.93	20.17	30.10	46.00	-15.90	Average
10	3.090	9.93	25.60	35.53	56.00	-20.47	QP
11	5.721	9.96	18.06	28.02	50.00	-21.98	Average
12	5.721	9.96	23.77	33.73	60.00	-26.27	QP

AC 120V/60 Hz, Neutral

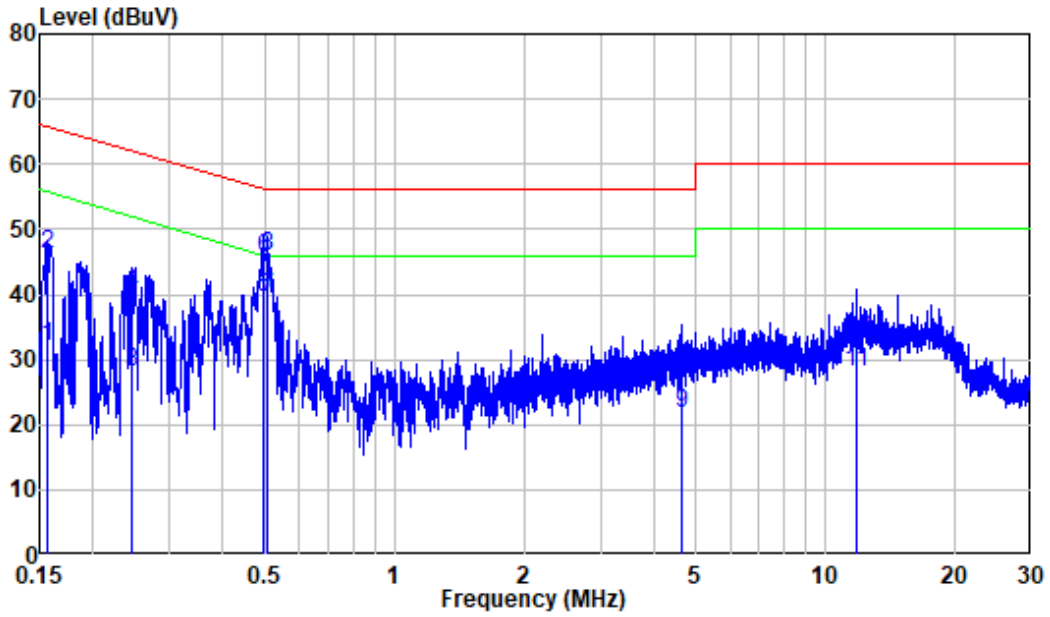


Site : Shielding Room
Condition: Neutral
Job No. : RA221215-61881E-RF
Mode : ZigBee&Transmitting
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.154	9.80	24.23	34.03	55.76	-21.73	Average
2	0.154	9.80	33.85	43.65	65.76	-22.11	QP
3	0.268	9.83	26.29	36.12	51.18	-15.06	Average
4	0.268	9.83	34.31	44.14	61.18	-17.04	QP
5	0.499	9.90	28.88	38.78	46.02	-7.24	Average
6	0.499	9.90	37.24	47.14	56.02	-8.88	QP
7	0.511	9.90	33.07	42.97	46.00	-3.03	Average
8	0.511	9.90	39.62	49.52	56.00	-6.48	QP
9	4.784	9.91	15.02	24.93	46.00	-21.07	Average
10	4.784	9.91	21.27	31.18	56.00	-24.82	QP
11	6.323	10.02	15.79	25.81	50.00	-24.19	Average
12	6.323	10.02	21.32	31.34	60.00	-28.66	QP

For Adapter 2

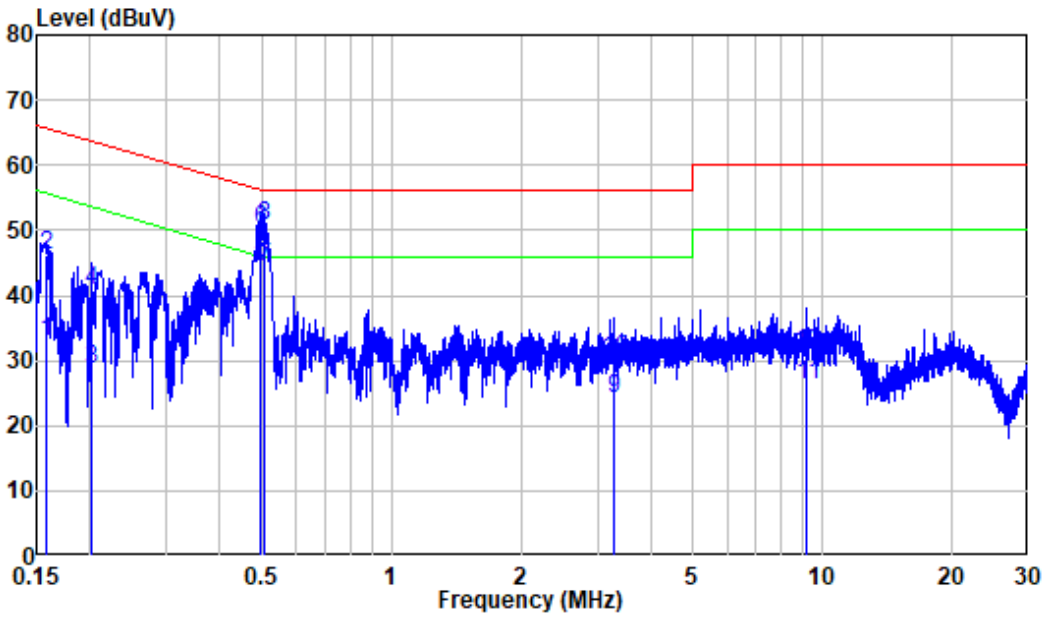
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Job No. : RA221215-61881E-RF
Mode : zigbee (AS2406A-1202000US)
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.157	10.10	21.76	31.86	55.62	-23.76	Average
2	0.157	10.10	36.09	46.19	65.62	-19.43	QP
3	0.246	10.10	17.90	28.00	51.89	-23.89	Average
4	0.246	10.10	30.12	40.22	61.89	-21.67	QP
5	0.494	10.10	29.46	39.56	46.09	-6.53	Average
6	0.494	10.10	35.57	45.67	56.09	-10.42	QP
7	0.507	10.10	29.52	39.62	46.00	-6.38	Average
8	0.507	10.10	35.74	45.84	56.00	-10.16	QP
9	4.644	10.74	11.13	21.87	46.00	-24.13	Average
10	4.644	10.74	17.07	27.81	56.00	-28.19	QP
11	11.784	13.09	14.94	28.03	50.00	-21.97	Average
12	11.784	13.09	20.10	33.19	60.00	-26.81	QP

AC 120V/60 Hz, Neutral

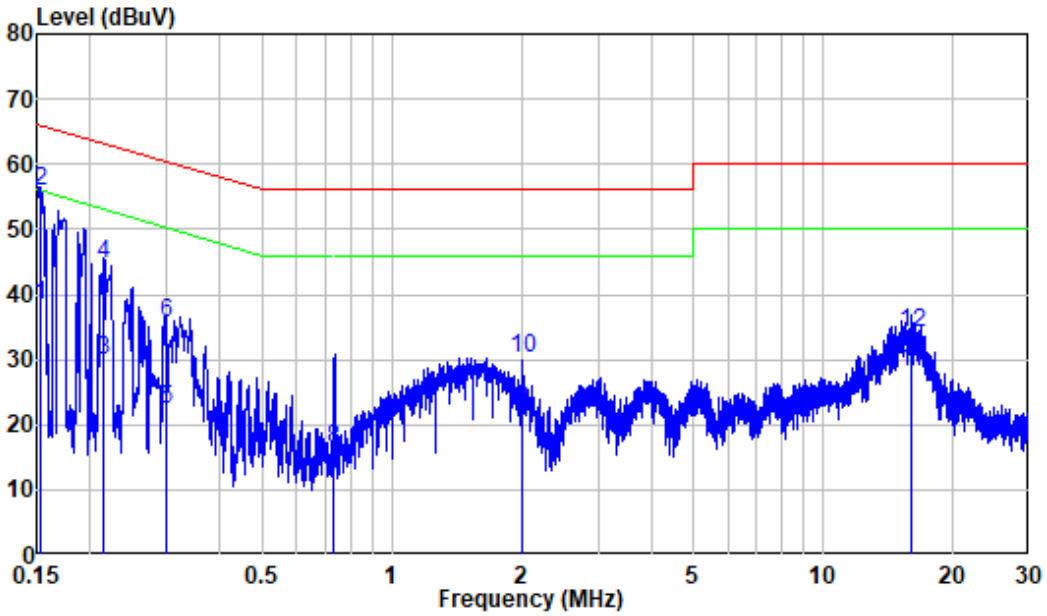


Site : Shielding Room
Condition: Neutral
Job No. : RA221215-61881E-RF
Mode : zigbee (AS2406A-1202000US)
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.159	10.30	22.54	32.84	55.54	-22.70	Average
2	0.159	10.30	35.76	46.06	65.54	-19.48	QP
3	0.201	10.30	18.43	28.73	53.56	-24.83	Average
4	0.201	10.30	30.57	40.87	63.56	-22.69	QP
5	0.497	10.40	34.64	45.04	46.05	-1.01	Average
6	0.497	10.40	39.57	49.97	56.05	-6.08	QP
7	0.506	10.38	34.09	44.47	46.00	-1.53	Average
8	0.506	10.38	40.23	50.61	56.00	-5.39	QP
9	3.278	10.24	13.98	24.22	46.00	-21.78	Average
10	3.278	10.24	20.04	30.28	56.00	-25.72	QP
11	9.192	11.95	14.30	26.25	50.00	-23.75	Average
12	9.192	11.95	19.18	31.13	60.00	-28.87	QP

For Adapter 3

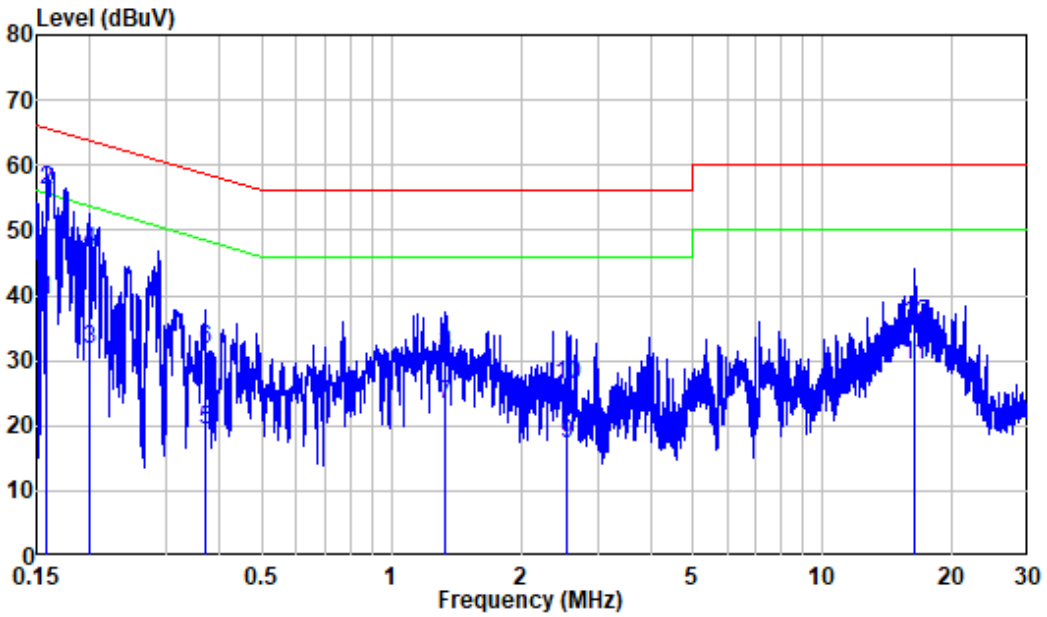
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Job No. : RA221215-61881E-RF
Mode : zigbee (RD1202000-C55-154MG)
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.153	10.10	28.39	38.49	55.85	-17.36	Average
2	0.153	10.10	45.88	55.98	65.85	-9.87	QP
3	0.215	10.10	19.91	30.01	53.00	-22.99	Average
4	0.215	10.10	34.61	44.71	63.00	-18.29	QP
5	0.301	10.10	12.21	22.31	50.22	-27.91	Average
6	0.301	10.10	25.48	35.58	60.22	-24.64	QP
7	0.734	10.21	0.51	10.72	46.00	-35.28	Average
8	0.734	10.21	6.01	16.22	56.00	-39.78	QP
9	2.007	10.32	11.96	22.28	46.00	-23.72	Average
10	2.007	10.32	19.98	30.30	56.00	-25.70	QP
11	15.938	14.47	13.56	28.03	50.00	-21.97	Average
12	15.938	14.47	19.67	34.14	60.00	-25.86	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Job No. : RA221215-61881E-RF
Mode : zigbee (RD1202000-C55-154MG)
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.159	10.30	28.81	39.11	55.53	-16.42	Average
2	0.159	10.30	45.94	56.24	65.53	-9.29	QP
3	0.200	10.30	21.27	31.57	53.62	-22.05	Average
4	0.200	10.30	36.48	46.78	63.62	-16.84	QP
5	0.369	10.37	9.01	19.38	48.52	-29.14	Average
6	0.369	10.37	21.36	31.73	58.52	-26.79	QP
7	1.326	9.95	13.33	23.28	46.00	-22.72	Average
8	1.326	9.95	21.26	31.21	56.00	-24.79	QP
9	2.562	10.14	7.19	17.33	46.00	-28.67	Average
10	2.562	10.14	16.01	26.15	56.00	-29.85	QP
11	16.258	14.54	14.62	29.16	50.00	-20.84	Average
12	16.258	14.54	21.13	35.67	60.00	-24.33	QP

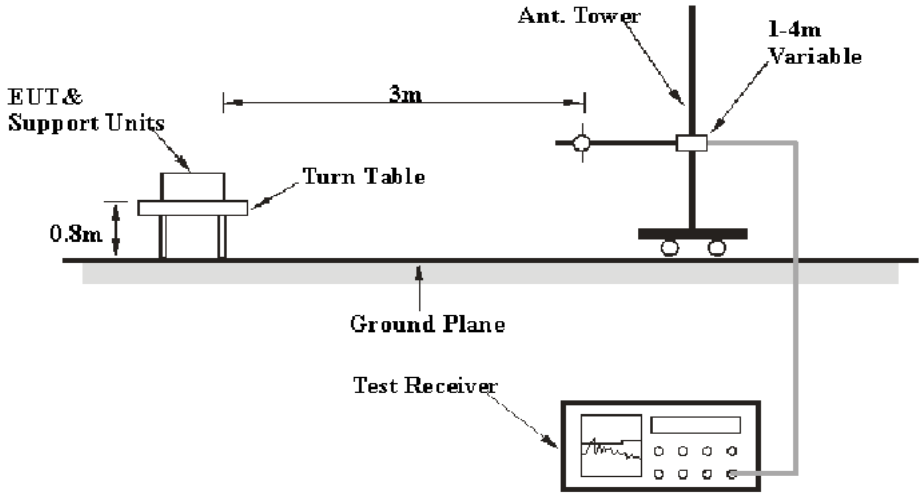
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

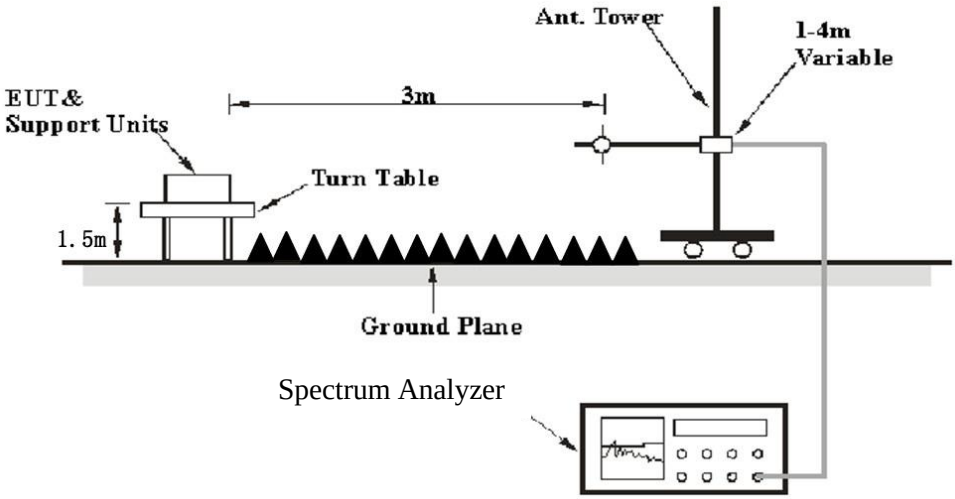
FCC §15.247 (d); §15.209; §15.205;

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 & 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 / Corrected Amplitude – Limit
Level / Corrected Amplitude = Read Level + Factor

Test Data

Environmental Conditions

Temperature:	24~24.5 ℃
Relative Humidity:	50~56 %
ATM Pressure:	101.0 kPa

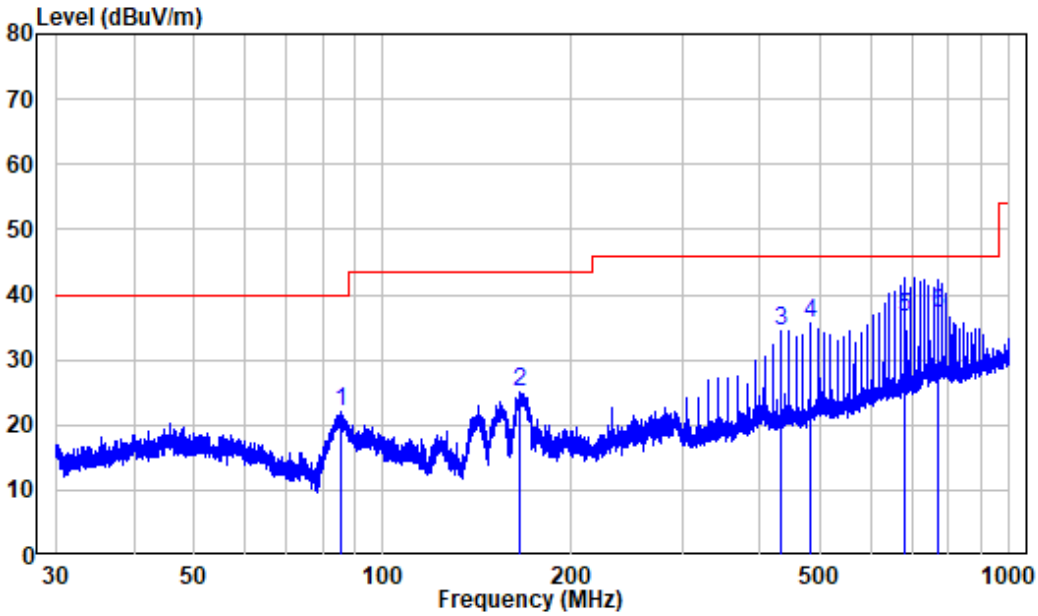
The testing was performed by Jimi Zheng on 2023-02-02 and 2023-03-14 for below 1GHz and on 2023-02-14 for above 1GHz.

EUT operation mode: Transmitting

For Adapter 1

30 MHz~1 GHz: Worst case is low channel

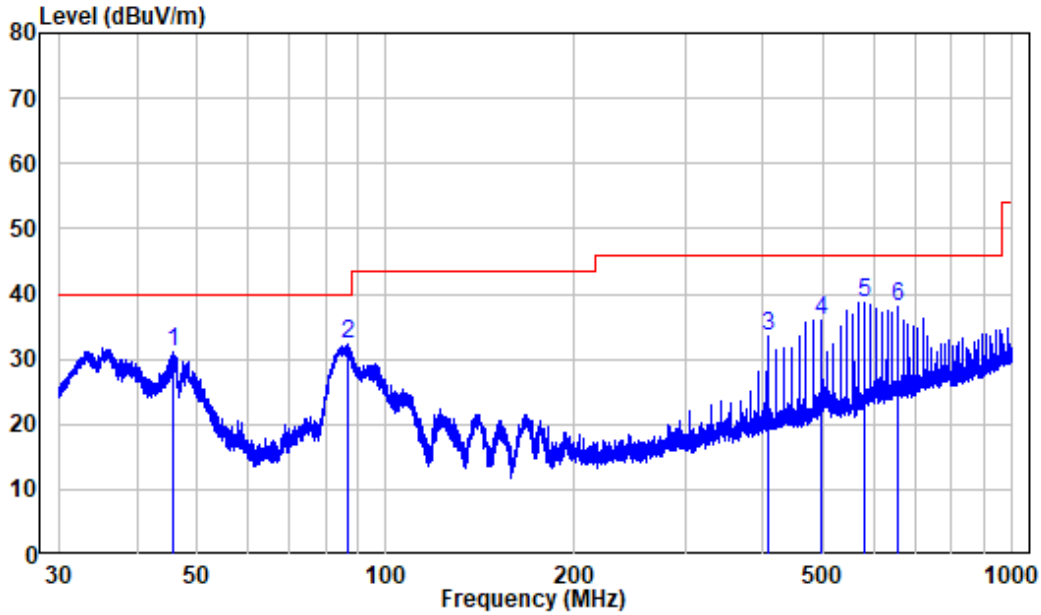
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA221215-61881E-RF
Test Mode: ZigBEE Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	85.898	-15.25	37.17	21.92	40.00	-18.08	Peak
2	165.414	-14.08	39.22	25.14	43.50	-18.36	Peak
3	431.221	-5.76	40.29	34.53	46.00	-11.47	Peak
4	481.371	-4.96	40.48	35.52	46.00	-10.48	Peak
5	681.452	-1.51	38.11	36.60	46.00	-9.40	QP
6	768.748	-0.25	37.51	37.26	46.00	-8.74	QP

Vertical



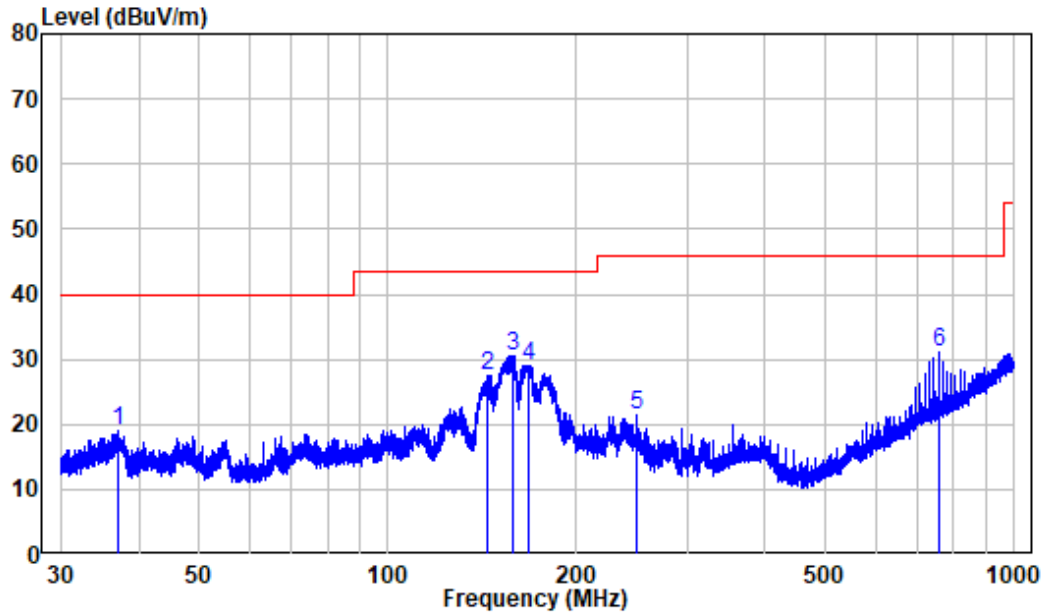
Site : chamber
Condition: 3m VERTICAL
Job No. : RA221215-61881E-RF
Test Mode: ZigBEE Transmitting

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	45.635	-9.97	40.98	31.01	40.00	-8.99	Peak
2	87.112	-14.86	47.08	32.22	40.00	-7.78	Peak
3	406.266	-6.63	40.05	33.42	46.00	-12.58	Peak
4	493.765	-4.52	40.57	36.05	46.00	-9.95	Peak
5	581.467	-3.25	42.01	38.76	46.00	-7.24	Peak
6	656.242	-1.59	39.64	38.05	46.00	-7.95	Peak

For Adapter 2

30 MHz~1 GHz: Worst case is low channel

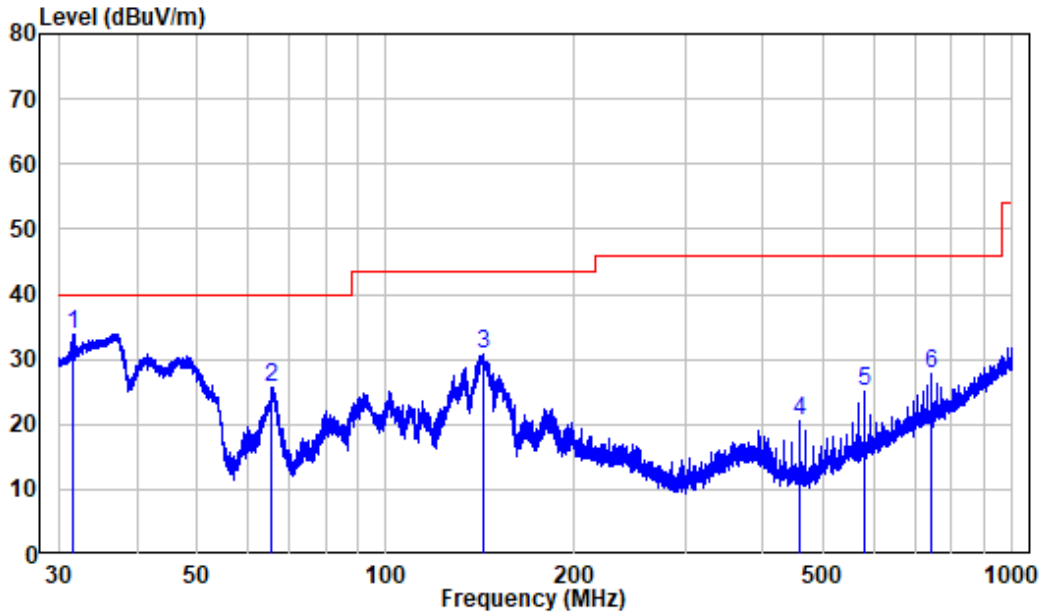
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA221215-61881E-RF
Test Mode: Zigbee
Adapter : AS2406A-1202000US

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	36.976	-14.46	33.43	18.97	40.00	-21.03	Peak
2	143.830	-10.52	38.11	27.59	43.50	-15.91	Peak
3	158.598	-10.30	40.81	30.51	43.50	-12.99	Peak
4	167.164	-10.29	39.33	29.04	43.50	-14.46	Peak
5	249.425	-12.50	33.98	21.48	46.00	-24.52	Peak
6	756.381	-5.42	36.37	30.95	46.00	-15.05	Peak

Vertical



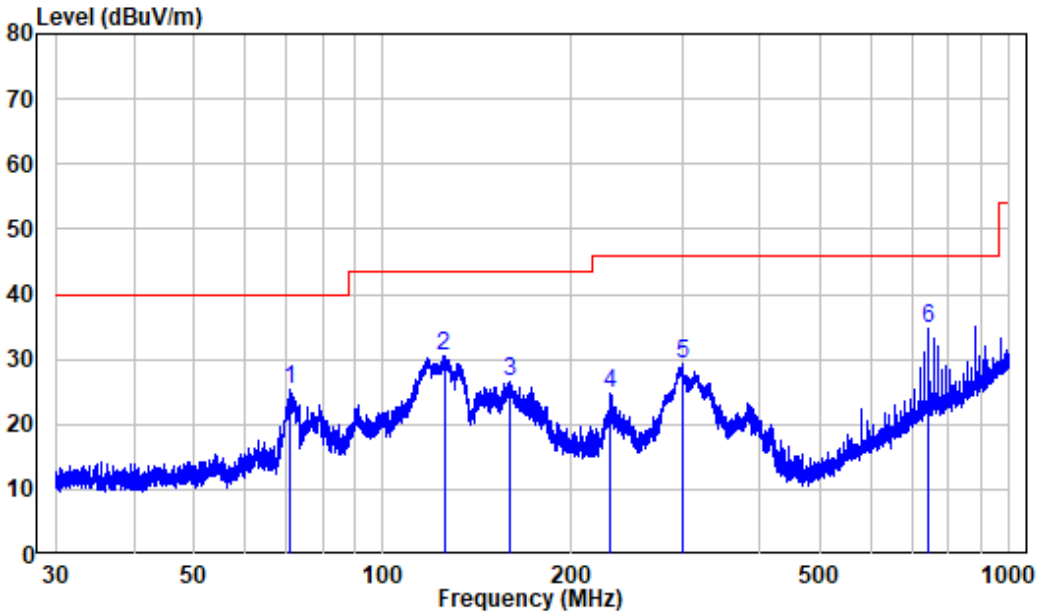
Site : chamber
Condition: 3m VERTICAL
Job No. : RA221215-61881E-RF
Test Mode: Zigbee
Adapter : AS2406A-1202000US

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	31.592	-14.38	48.34	33.96	40.00	-6.04	Peak
2	65.688	-13.77	39.46	25.69	40.00	-14.31	Peak
3	143.138	-10.52	41.31	30.79	43.50	-12.71	Peak
4	456.306	-14.84	35.24	20.40	46.00	-25.60	Peak
5	581.212	-10.79	35.76	24.97	46.00	-21.03	Peak
6	743.887	-5.91	33.54	27.63	46.00	-18.37	Peak

For Adapter 3

30 MHz~1 GHz: Worst case is low channel

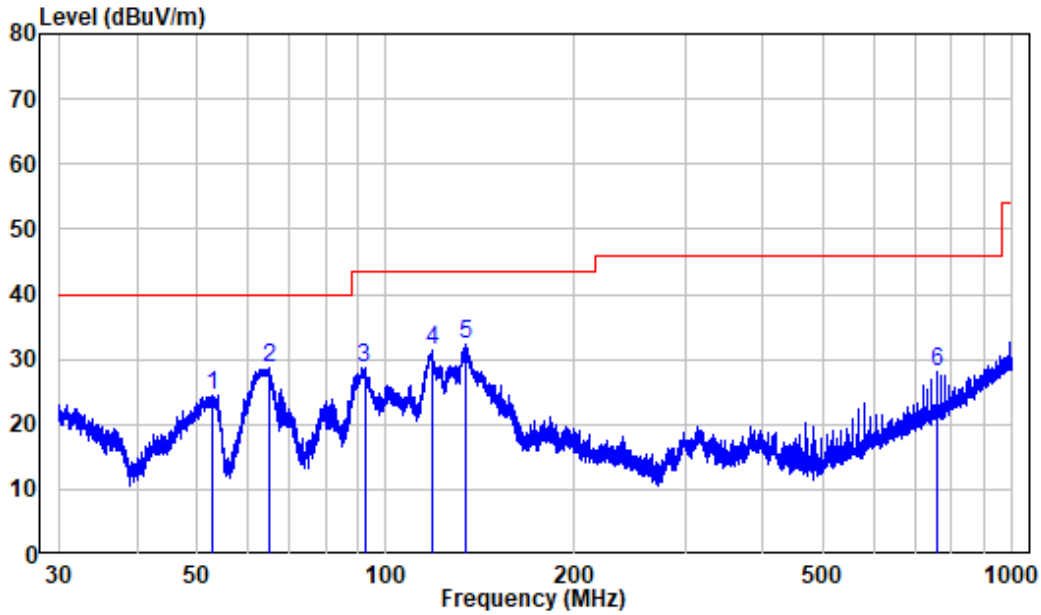
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA221215-61881E-RF
Test Mode: Zigbee
Adapter : RD1202000-C55-154MG

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	71.143	-13.73	38.98	25.25	40.00	-14.75	Peak
2	125.171	-10.81	41.40	30.59	43.50	-12.91	Peak
3	159.295	-10.29	36.93	26.64	43.50	-16.86	Peak
4	231.211	-11.64	36.29	24.65	46.00	-21.35	Peak
5	299.973	-15.63	44.87	29.24	46.00	-16.76	Peak
6	743.887	-5.91	40.51	34.60	46.00	-11.40	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA221215-61881E-RF
Test Mode: Zigbee
Adapter : RD1202000-C55-154MG

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	52.969	-14.17	38.54	24.37	40.00	-15.63	Peak
2	64.972	-13.76	42.31	28.55	40.00	-11.45	Peak
3	92.422	-12.30	41.11	28.81	43.50	-14.69	Peak
4	118.446	-11.11	42.39	31.28	43.50	-12.22	Peak
5	134.500	-10.57	42.79	32.22	43.50	-11.28	Peak
6	756.381	-5.42	33.36	27.94	46.00	-18.06	Peak

Above 1 GHz: (worst case adapter 1)

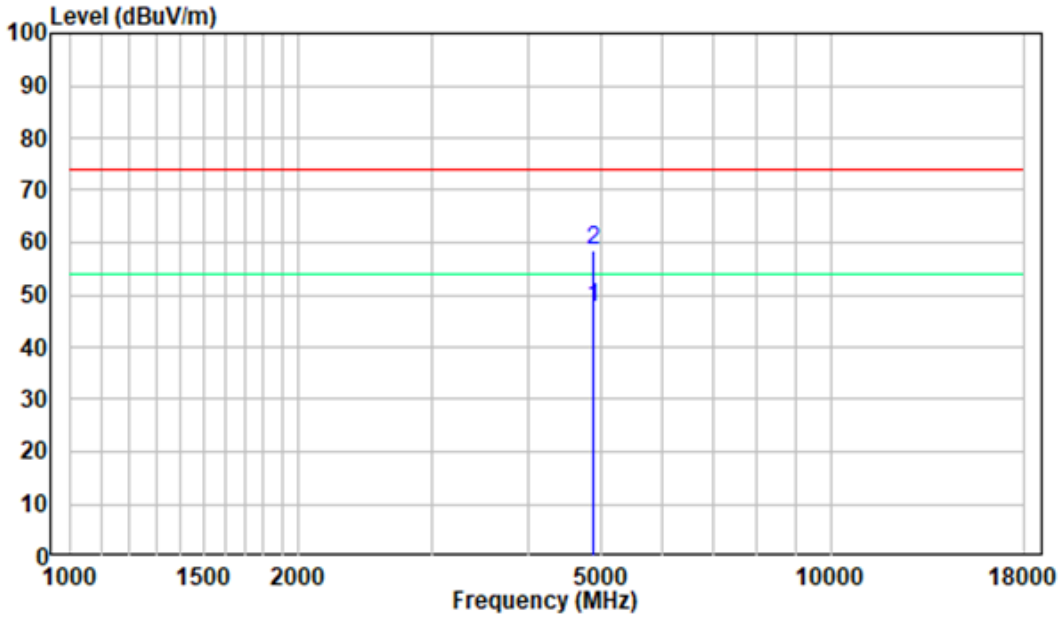
Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
	Reading (dBuV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel(2405MHz)									
2310	61.59	PK	59	1.8	H	-7.24	54.35	74	-19.65
2310	47.23	AV	59	1.8	H	-7.24	39.99	54	-14.01
2310	61.47	PK	278	1.9	V	-7.24	54.23	74	-19.77
2310	47.03	AV	278	1.9	V	-7.24	39.79	54	-14.21
2390	62.82	PK	117	1.7	H	-7.22	55.60	74	-18.40
2390	49.87	AV	117	1.7	H	-7.22	42.65	54	-11.35
2390	62.75	PK	136	2.3	V	-7.22	55.53	74	-18.47
2390	49.43	AV	136	2.3	V	-7.22	42.21	54	-11.79
4810	59.58	PK	39	1.8	H	-3.52	56.06	74	-17.94
4810	47.49	AV	39	1.8	H	-3.52	43.97	54	-10.03
4810	59.22	PK	202	2.4	V	-3.52	55.70	74	-18.30
4810	46.81	AV	202	2.4	V	-3.52	43.29	54	-10.71
Middle Channel(2445MHz)									
4890	61.74	PK	355	1.4	H	-3.33	58.41	74	-15.59
4890	50.74	AV	355	1.4	H	-3.33	47.41	54	-6.59
4890	60.00	PK	306	1.5	V	-3.33	56.67	74	-17.33
4890	48.88	AV	306	1.5	V	-3.33	45.55	54	-8.45
High Channel(2480 MHz)									
2483.5	74.20	PK	163	1.6	H	-7.20	67	74	-7.00
2483.5	60.03	AV	163	1.6	H	-7.20	52.83	54	-1.17
2483.5	72.66	PK	132	2	V	-7.20	65.46	74	-8.54
2483.5	59.33	AV	132	2	V	-7.20	52.13	54	-1.87
2500	63.51	PK	52	2.4	H	-7.18	56.33	74	-17.67
2500	49.17	AV	52	2.4	H	-7.18	41.99	54	-12.01
2500	63.35	PK	310	2.1	V	-7.18	56.17	74	-17.83
2500	49.18	AV	310	2.1	V	-7.18	42	54	-12.00
4960	60.40	PK	123	2.1	H	-3.01	57.39	74	-16.61
4960	47.73	AV	123	2.1	H	-3.01	44.72	54	-9.28
4960	59.14	PK	47	1.1	V	-3.01	56.13	74	-17.87
4960	46.54	AV	47	1.1	V	-3.01	43.53	54	-10.47

Note:
Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Factor + Reading
Margin = Corrected Amplitude – Limit
The other spurious emission which is 20dB to the limit or in noise floor level was not recorded.

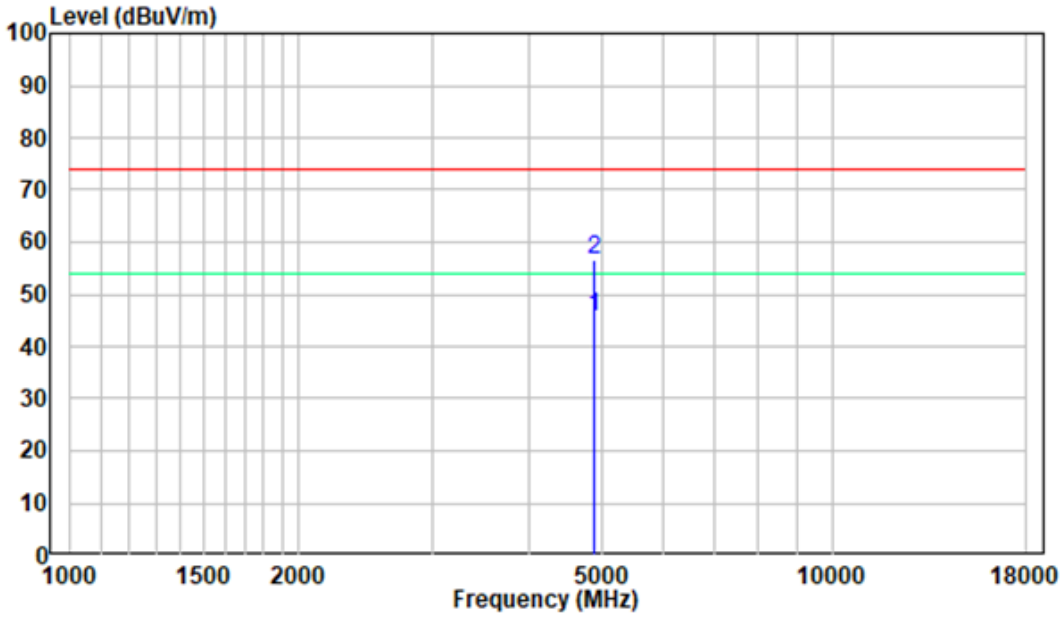
1-18GHz:

Pre-scan plots:

Middle Channel
Horizontal



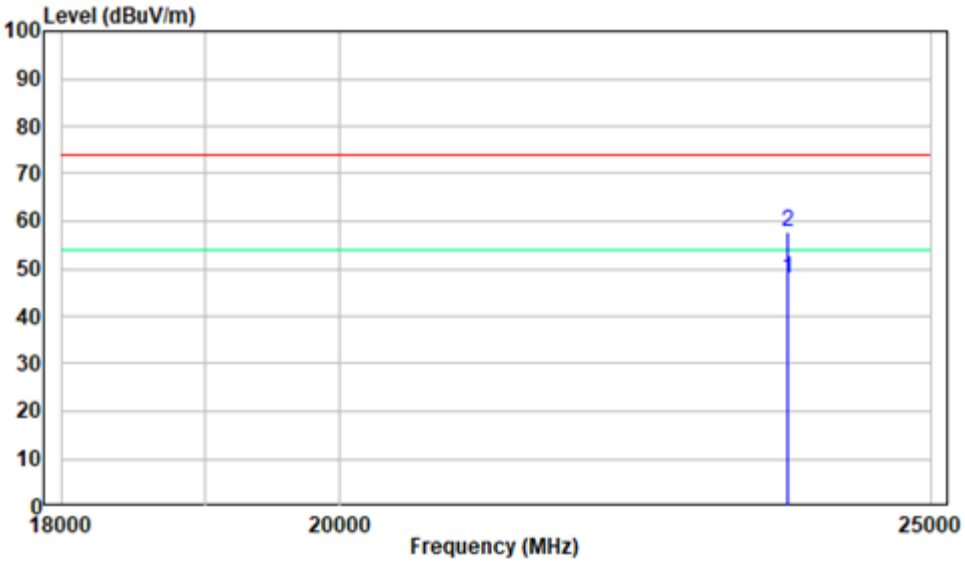
Vertical



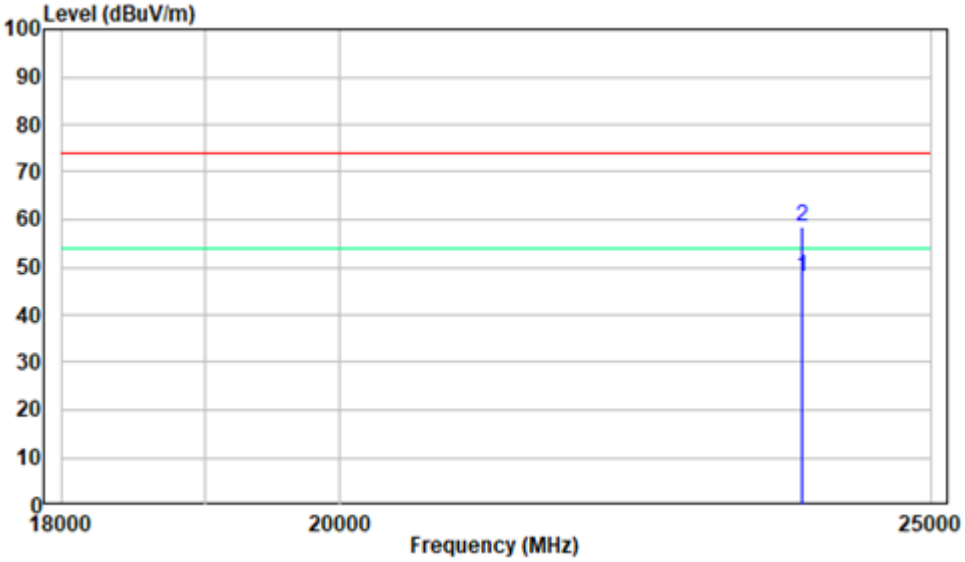
18-25GHz:

Pre-scan plots:

Middle Channel
Horizontal



Vertical



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

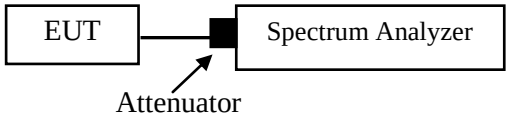
Applicable Standard

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 section 11.8.1 and section 6.9.3

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. Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
5. Repeat above procedures until all frequencies measured were complete.



Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

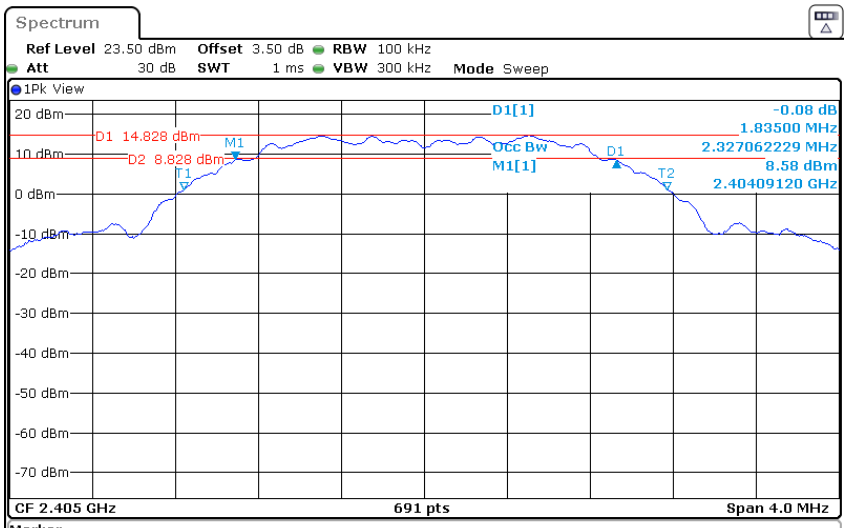
The testing was performed by Nick Fang on 2023-02-01.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the following table and plots.

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)	Limit (kHz)
ZigBee				
Low	2405	1.835	2.327	≥500
Middle	2445	1.841	2.327	≥500
High	2480	1.841	2.327	≥500

Low Channel

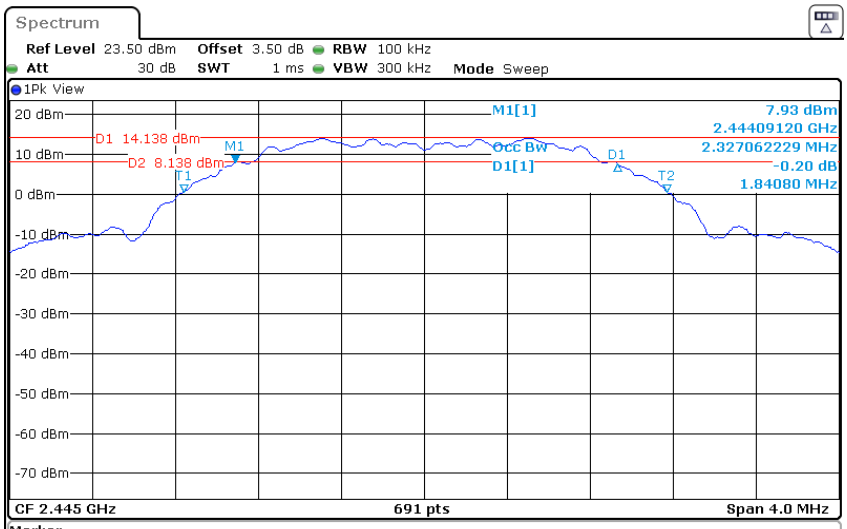


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4040912 GHz	8.58 dBm		
T1		1	2.40384226 GHz	1.08 dBm	Occ Bw	2.327062229 MHz
T2		1	2.40616932 GHz	1.09 dBm		
D1	M1	1	1.835 MHz	-0.08 dB		

Date: 1.FEB.2023 20:25:15

Middle Channel

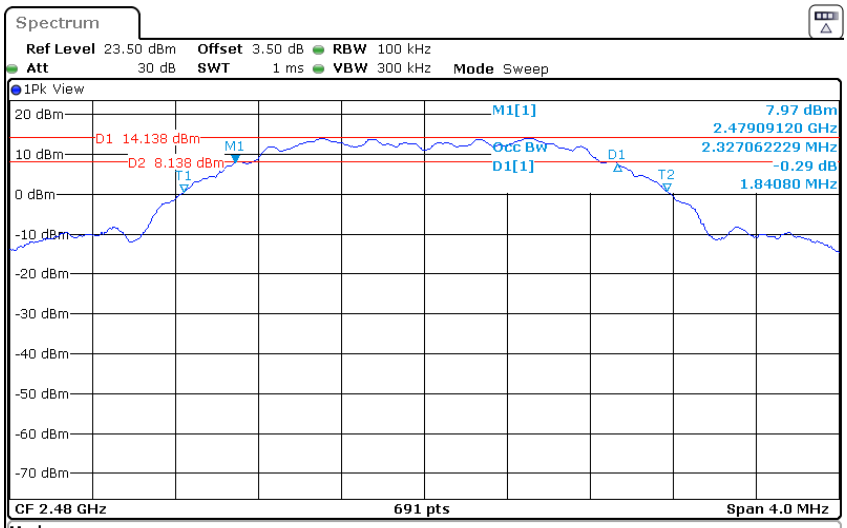


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4440912 GHz	7.93 dBm		
T1		1	2.44384226 GHz	0.51 dBm	Occ Bw	2.327062229 MHz
T2		1	2.44616932 GHz	0.49 dBm		
D1	M1	1	1.8408 MHz	-0.20 dB		

Date: 1.FEB.2023 20:22:47

High Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4790912 GHz	7.97 dBm		
T1		1	2.47884226 GHz	0.49 dBm	Occ Bw	2.327062229 MHz
T2		1	2.48116932 GHz	0.70 dBm		
D1	M1	1	1.8408 MHz	-0.29 dB		

Date: 1.FEB.2023 20:27:57

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

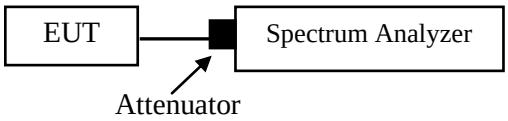
Applicable Standard

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 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:	25 ℃
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

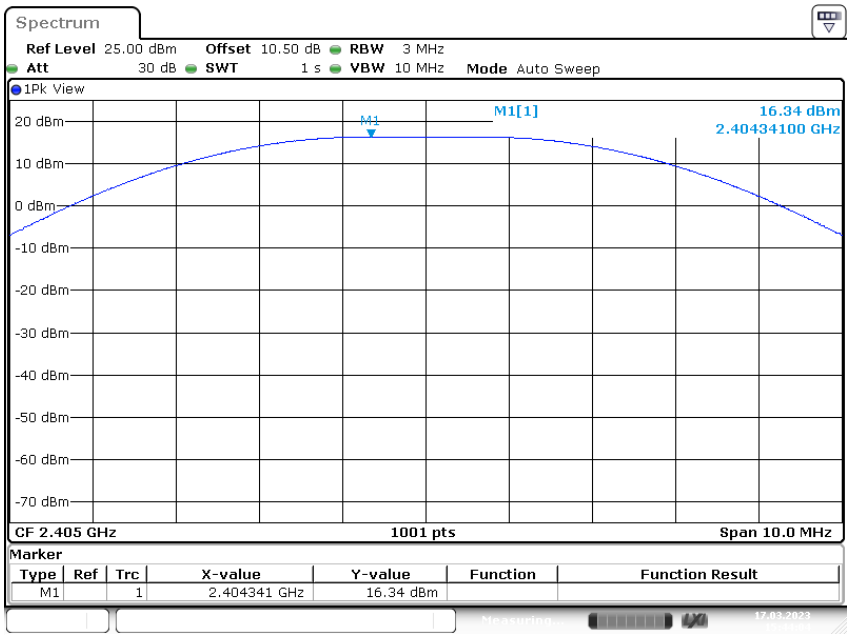
The testing was performed by Nick Fang on 2023-03-17.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the following table and plots.

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)
ZigBee			
Low	2405	16.34	30
Middle	2445	16.11	30
High	2480	15.87	30

Low Channel



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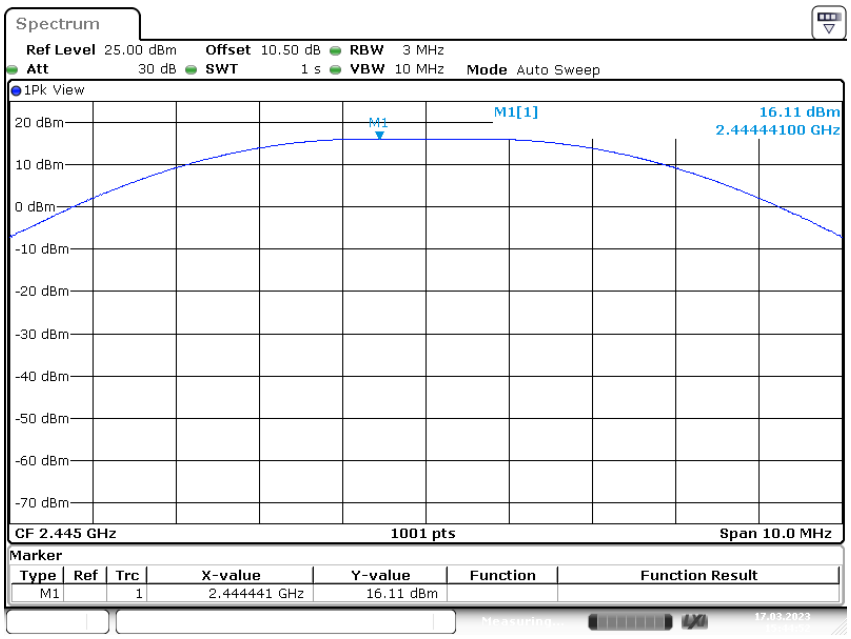
Middle Channel



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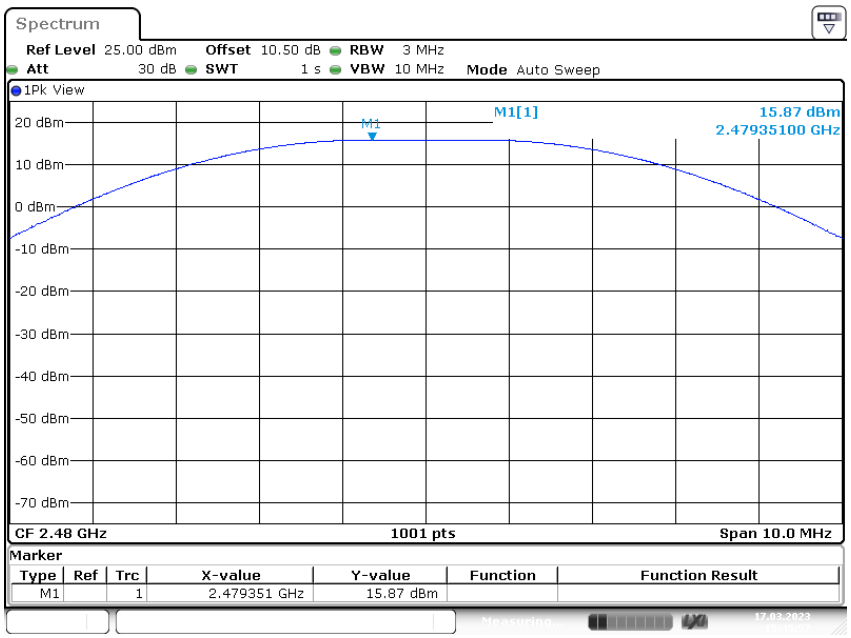
High Channel



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

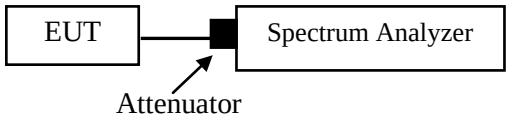
Applicable Standard

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 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

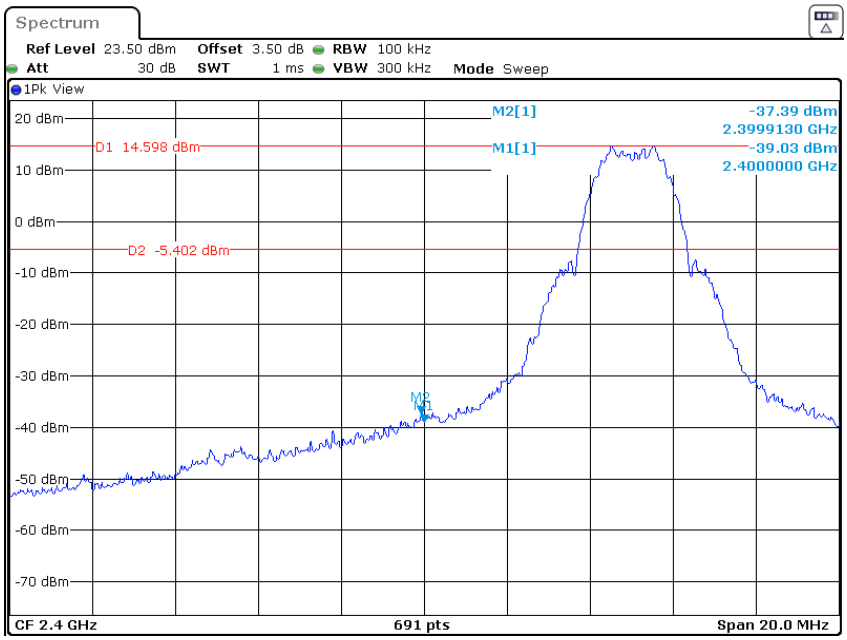
Temperature:	25 ℃
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

The testing was performed by Nick Fang on 2023-02-01.

EUT operation mode: Transmitting

Test Result: Compliant.

Left Side



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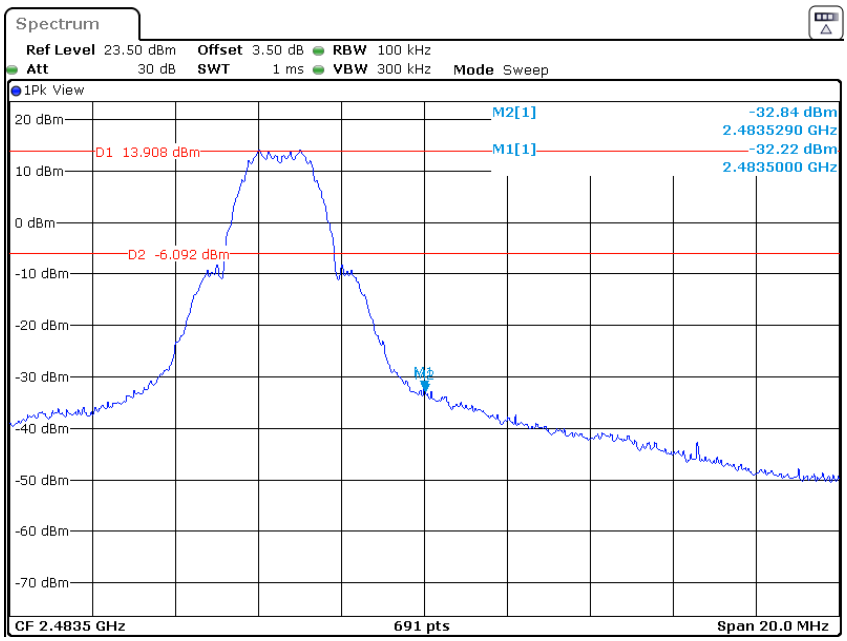
Right Side



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FCC §15.247(e) - POWER SPECTRAL DENSITY

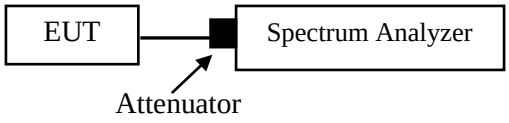
Applicable Standard

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 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:	25 ℃
Relative Humidity:	53 %
ATM Pressure:	101.0 kPa

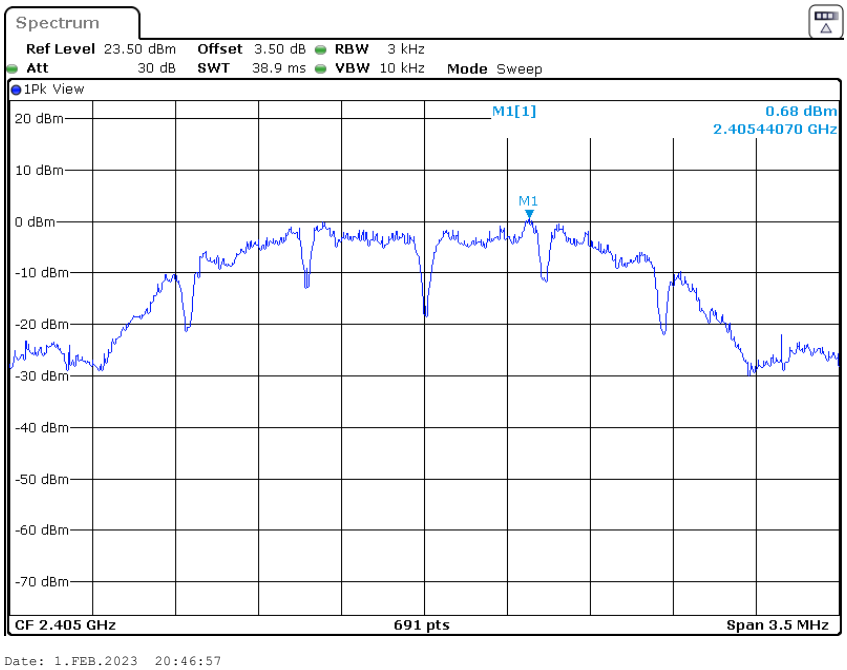
The testing was performed by Nick Fang on 2023-02-01.

EUT operation mode: Transmitting

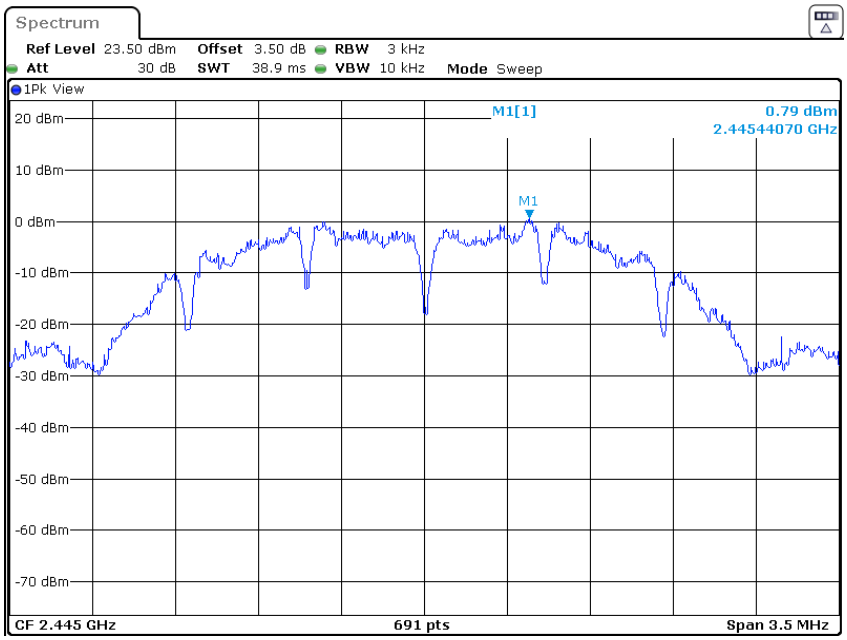
Test Result: Compliant. Please refer to the following table and plots.

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
ZigBee			
Low	2405	0.68	≤8
Middle	2445	0.79	≤8
High	2480	1.52	≤8

Power Spectral Density, Low Channel



Power Spectral Density, Middle Channel



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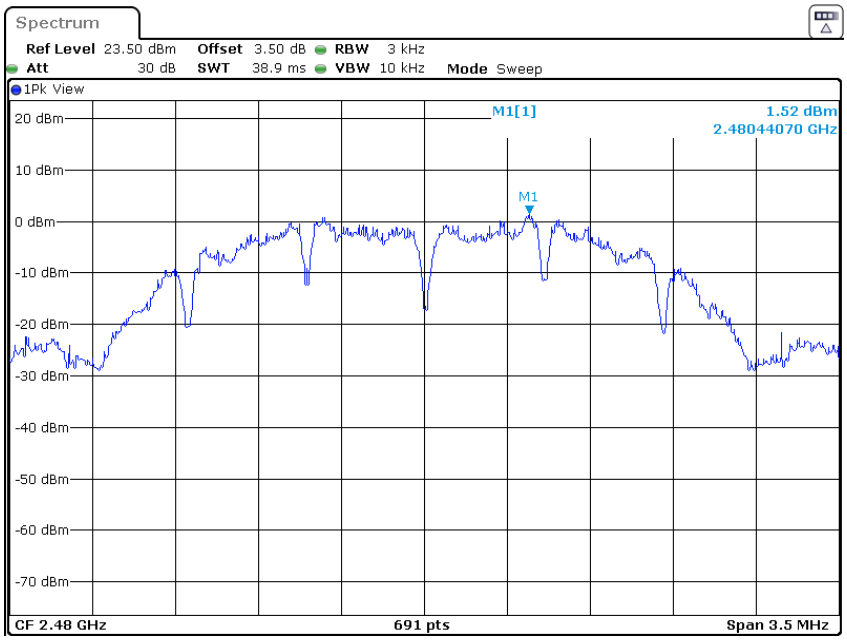
Power Spectral Density, High Channel



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