

TEST REPORT

Applicant Name: JEM ACCESSORIES INC.
Address: 32 Brunswick Avenue, Edison, New Jersey, United States,
08817
Report Number: RA230529-29951E-RF-00
FCC ID: 2AHAS-XCA21013-2R

Test Standard (s)

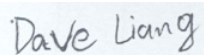
FCC PART 15.247

Sample Description

Product Type: Dongle
Model No.: XCA2-1013-BLK-dongle
Multiple Model(s) No.: SC-1013-BLK-dongle
Trade Mark: XTREME
Date Received: 2023/05/29
Report Date: 2023/07/27

Test Result:	Pass*
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* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:**Approved By:**

Dave Liang
EMC Engineer



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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TABLE OF CONTENTS

DOCUMENT REVISION HISTORY	4
GENERAL INFORMATION.....	5
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	5
OBJECTIVE	5
TEST METHODOLOGY	5
MEASUREMENT UNCERTAINTY	6
TEST FACILITY	6
SYSTEM TEST CONFIGURATION	7
DESCRIPTION OF TEST CONFIGURATION	7
EUT EXERCISE SOFTWARE	7
SPECIAL ACCESSORIES	7
EQUIPMENT MODIFICATIONS	7
SUPPORT EQUIPMENT LIST AND DETAILS	8
EXTERNAL I/O CABLE	8
BLOCK DIAGRAM OF TEST SETUP	8
SUMMARY OF TEST RESULTS	10
TEST EQUIPMENT LIST	11
FCC§15.247 (I)&§1.1307 (B) &§2.1093 – RF EXPOSURE	12
APPLICABLE STANDARD	12
FCC §15.203 – ANTENNA REQUIREMENT	13
APPLICABLE STANDARD	13
ANTENNA CONNECTOR CONSTRUCTION	13
FCC §15.207 (A) – AC LINE CONDUCTED EMISSIONS	14
APPLICABLE STANDARD	14
EUT SETUP	14
EMI TEST RECEIVER SETUP	14
TEST PROCEDURE	14
TRANSD FACTOR & OVER LIMIT CALCULATION	15
TEST DATA	15
FCC §15.205, §15.209&§15.247(D) – RADIATED EMISSIONS	18
APPLICABLE STANDARD	18
EUT SETUP	18
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP	19
TEST PROCEDURE	19
FACTOR & OVER LIMIT/MARGIN CALCULATION	19
TEST DATA	19
FCC §15.247(A) (1)-CHANNEL SEPARATION TEST	27
APPLICABLE STANDARD	27
TEST PROCEDURE	27
TEST DATA	27

FCC §15.247(A) (1)–20DBEMISSION BANDWIDTH&99% OCCUPIED BANDWIDTH	29
APPLICABLE STANDARD	29
TEST PROCEDURE	29
TEST DATA	30
FCC §15.247(A) (1) (III)-QUANTITY OF HOPPING CHANNEL TEST	34
APPLICABLE STANDARD	34
TEST PROCEDURE	34
TEST DATA	34
FCC §15.247(A) (1) (III) - TIME OF OCCUPANCY (DWELL TIME).....	36
APPLICABLE STANDARD	36
TEST PROCEDURE	36
TEST DATA	36
FCC §15.247(B) (1) - PEAK OUTPUT POWER MEASUREMENT	38
APPLICABLE STANDARD	38
TEST PROCEDURE	38
TEST DATA	38
FCC §15.247(D) - BAND EDGES TESTING.....	41
APPLICABLE STANDARD	41
TEST PROCEDURE	41
TEST DATA	41

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RA230529-29951E-RF-00	Original Report	2023/07/27

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Dongle
Tested Model	XCA2-1013-BLK-dongle
Multiple Model(s)	SC-1013-BLK-dongle (model difference see product declaration letter of similarity)
Frequency Range	2402-2480MHz
Maximum conducted peak output power	2.70dBm
Modulation Technique	GFSK
Antenna Specification*	-2.1dBi (provided by the applicant)
Voltage Range	DC5V from USB Port
Sample serial number	26BB-1 for RF Conducted Test 26BB-2 for Conducted Emissions and Radiated Emissions (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 rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, 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.

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		2.72dB
Audio Frequency Response		0.1dB
Low Pass Filter Response		1.2dB
Modulation Limiting		1%
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

The system was configured for testing in an engineering mode.

Channel list

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	2402	11	2422	21	2442	31	2462
2	2404	12	2424	22	2444	32	2464
3	2406	13	2426	23	2446	33	2466
4	2408	14	2428	24	2448	34	2468
5	2410	15	2430	25	2450	35	2470
6	2412	16	2432	26	2452	36	2472
7	2414	17	2434	27	2454	37	2474
8	2416	18	2436	28	2456	38	2476
9	2418	19	2438	29	2458	39	2478
10	2420	20	2440	30	2460	40	2480

Note: the device has totally 40 channels, only 16 channels selected randomly from the channel list were active to transmit at same time.

Channel 1, 20, 40 was tested.

EUT Exercise Software

“SE67T_Test_V161.exe*” software was used and the power level is 15*. The software and power level was provided by the manufacturer.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

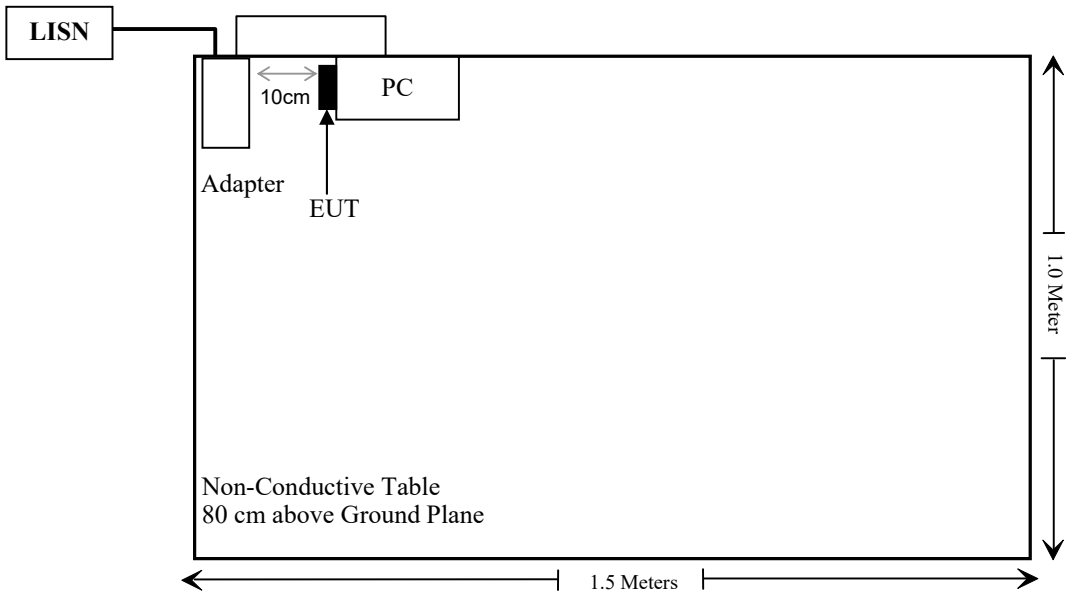
Manufacturer	Description	Model	Serial Number
Lenovo	AC Adapter	42T4417	11S42T4416Z1ZGWF1207A1
DELL	NoteBook	Latitude E4710	PC201911252059

External I/O Cable

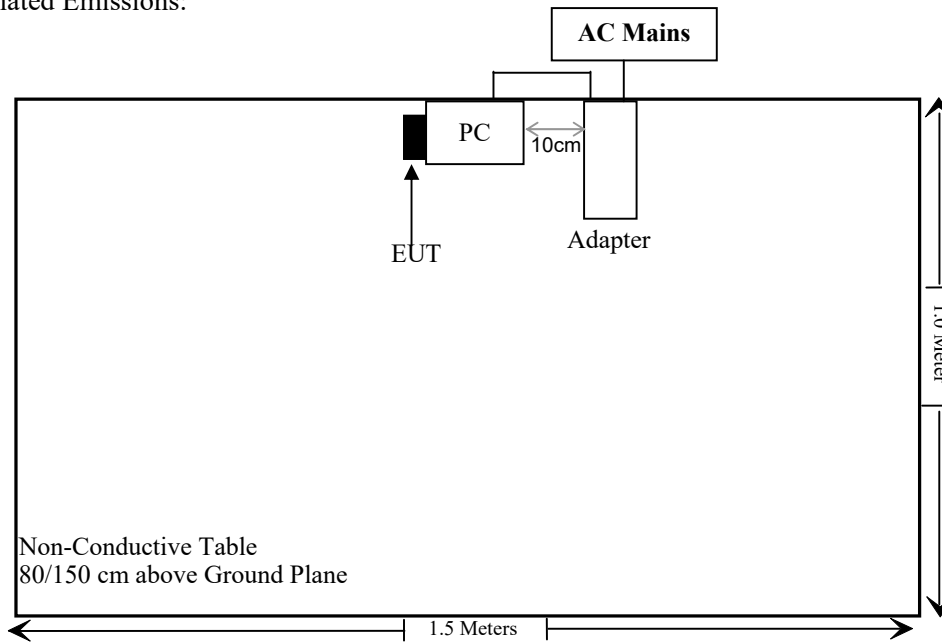
Cable Description	Length (m)	From/Port	To
Unshielded Un-detachable Cable	1.2	Adapter	LISN/AC Mains

Block Diagram of Test Setup

For conducted emission



For Radiated Emissions:



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

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC§15.247 (i), §1.1307 (b) (1) &§2.1093	RF EXPOSURE	Compliant
§15.203	Antenna Requirement	Compliant
§15.207(a)	AC Line Conducted Emissions	Compliant
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliant
§15.247(a)(1)	20dBEmission Bandwidth&99% Occupied Bandwidth	Compliant
§15.247(a)(1)	Channel Separation Test	Compliant
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliant
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliant
§15.247(b)(1)	Peak Output Power Measurement	Compliant
§15.247(d)	Band edges	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-18405536-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	101948	2022/11/25	2023/11/24
WEINSCHL	10dB Attenuator	5324	AU 3842	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.31	RF-01	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) &§2.1093 – RF EXPOSURE

Applicable Standard

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

According to KDB 447498 D01 General RF Exposure Guidance

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

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

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

Measurement Result

Frequency (MHz)	Maximum Tune-up power		Calculated Distance (mm)	Calculated Value	Threshold (1-g SAR)	SAR Test Exclusion
	(dBm)	(mW)				
2402-2480	3.0	2.0	5	0.6	3.0	Yes

Note: the maximum tune up power was declared by the applicant.

Result: Compliant.

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 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 use of a standard antenna jack or electrical connector is prohibited.

Antenna Connector Construction

The EUT has one internal antenna arrangement which was permanently attached and the antenna gain is -2.1 dBi, 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(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 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.

Transd Factor & Over Limit Calculation

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

$$\text{Transd Factor} = \text{LISN VDF} + \text{Cable Loss}$$

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 margin calculation is as follows:

$$\begin{aligned}\text{Over Limit} &= \text{level} - \text{Limit} \\ \text{Level} &= \text{reading level} + \text{Transd Factor}\end{aligned}$$

Test Data

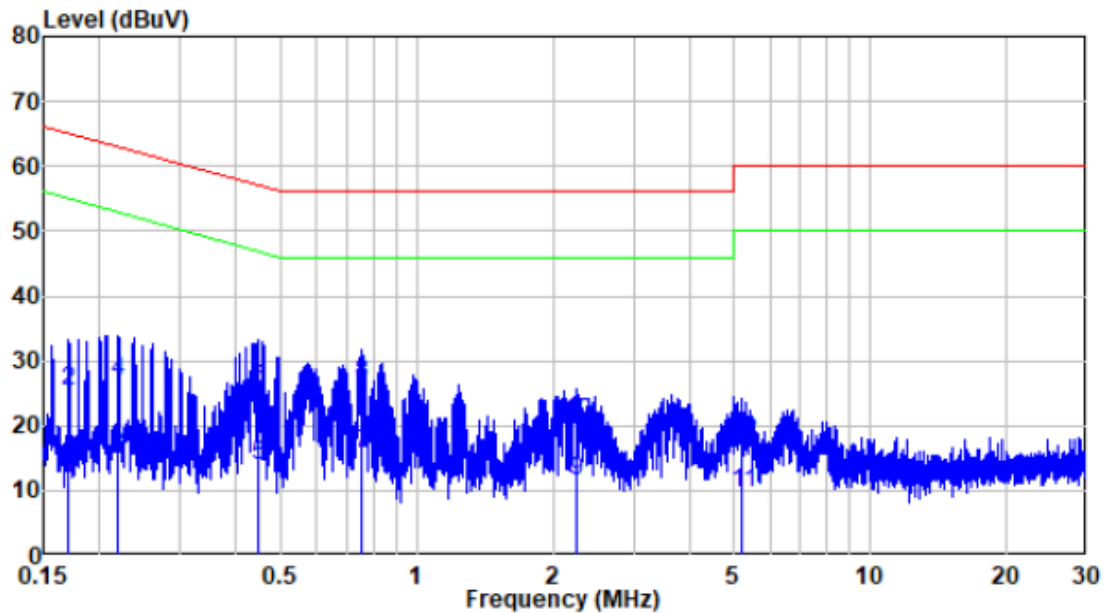
Environmental Conditions

Temperature:	23 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Jerry Wu on 2023-06-16.

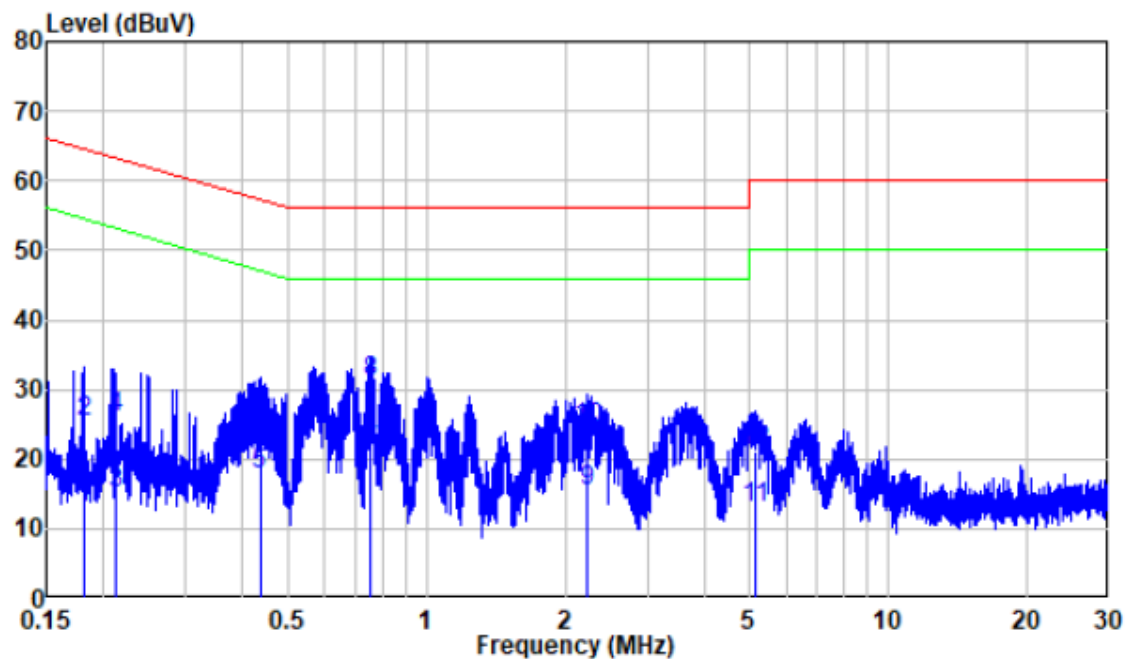
EUT operation mode: Transmitting (the worst case for Middle channel)

AC 120V/60 Hz, Line



	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.170	10.34	1.48	11.82	54.98	-43.16	Average
2	0.170	10.34	15.00	25.34	64.98	-39.64	QP
3	0.219	10.31	5.08	15.39	52.86	-37.47	Average
4	0.219	10.31	16.42	26.73	62.86	-36.13	QP
5	0.446	10.53	3.31	13.84	46.96	-33.12	Average
6	0.446	10.53	15.10	25.63	56.96	-31.33	QP
7	0.751	10.62	5.01	15.63	46.00	-30.37	Average
8	0.751	10.62	16.09	26.71	56.00	-29.29	QP
9	2.252	10.42	0.91	11.33	46.00	-34.67	Average
10	2.252	10.42	10.11	20.53	56.00	-35.47	QP
11	5.221	10.56	-0.90	9.66	50.00	-40.34	Average
12	5.221	10.56	6.83	17.39	60.00	-42.61	QP

AC 120V/60 Hz, Neutral



	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.181	10.28	2.63	12.91	54.45	-41.54	Average
2	0.181	10.28	15.16	25.44	64.45	-39.01	QP
3	0.211	10.30	4.64	14.94	53.15	-38.21	Average
4	0.211	10.30	15.71	26.01	63.15	-37.14	QP
5	0.435	10.43	7.31	17.74	47.15	-29.41	Average
6	0.435	10.43	16.26	26.69	57.15	-30.46	QP
7	0.754	10.44	10.70	21.14	46.00	-24.86	Average
8	0.754	10.44	20.71	31.15	56.00	-24.85	QP
9	2.234	10.50	4.96	15.46	46.00	-30.54	Average
10	2.234	10.50	13.89	24.39	56.00	-31.61	QP
11	5.122	10.51	2.50	13.01	50.00	-36.99	Average
12	5.122	10.51	10.59	21.10	60.00	-38.90	QP

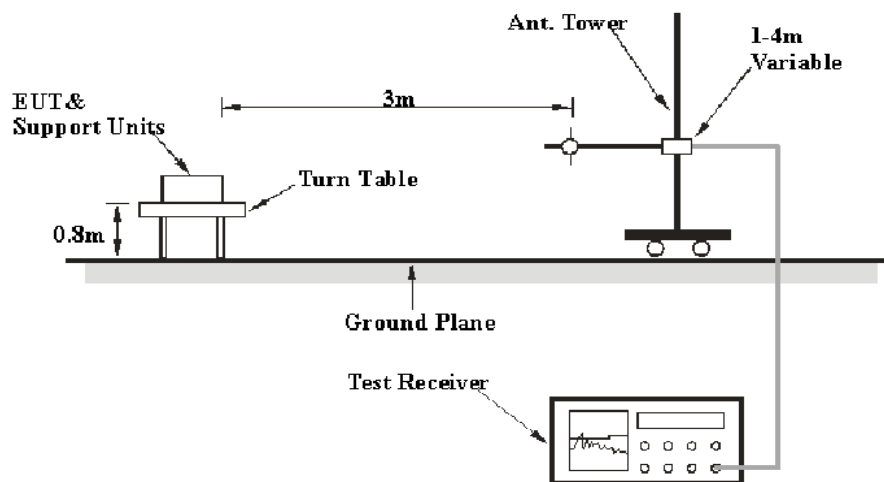
FCC §15.205, §15.209&§15.247(d) – RADIATED EMISSIONS

Applicable Standard

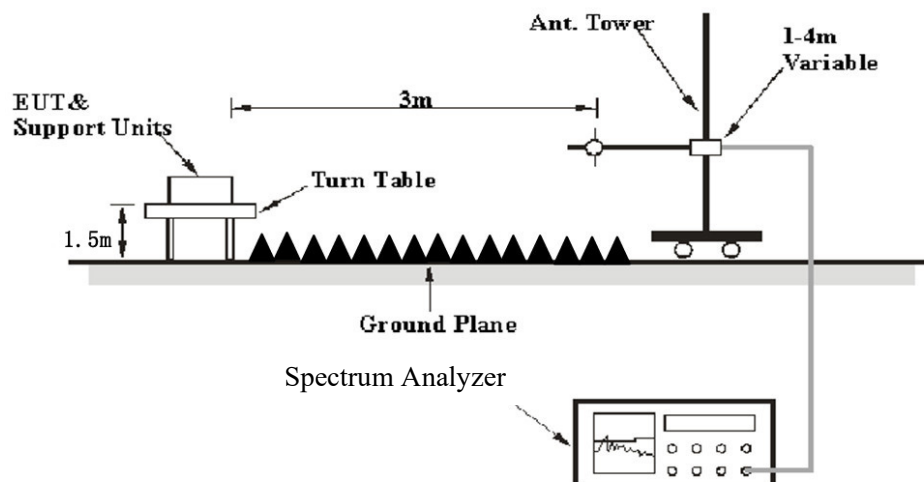
FCC §15.205; §15.209; §15.247(d)

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3meters, 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

The EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

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

For average measurement:

Use the duty cycle factor correction factor method per 15.35(c).

Duty cycle=On time/100milliseconds, On time= $N_1 \cdot L_1 + N_2 \cdot L_2 + \dots + N_{n-1} \cdot L_{n-1} + N_n \cdot L_n$,

Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulse, etc.

Average Emission Level=Peak Emission Level+20*log(Duty cycle)

Test Procedure

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

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and 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:

$$\text{Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Over Limit or 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 margin calculation is as follows:

$$\begin{aligned} \text{Margin/Over Limit} &= \text{Corrected Amplitude/Level-Limit} \\ \text{Corrected Amplitude/Level} &= \text{Reading} + \text{Factor} \end{aligned}$$

Test Data

Environmental Conditions

Temperature:	22~25.3 °C
Relative Humidity:	50~51 %
ATM Pressure:	101.0 kPa

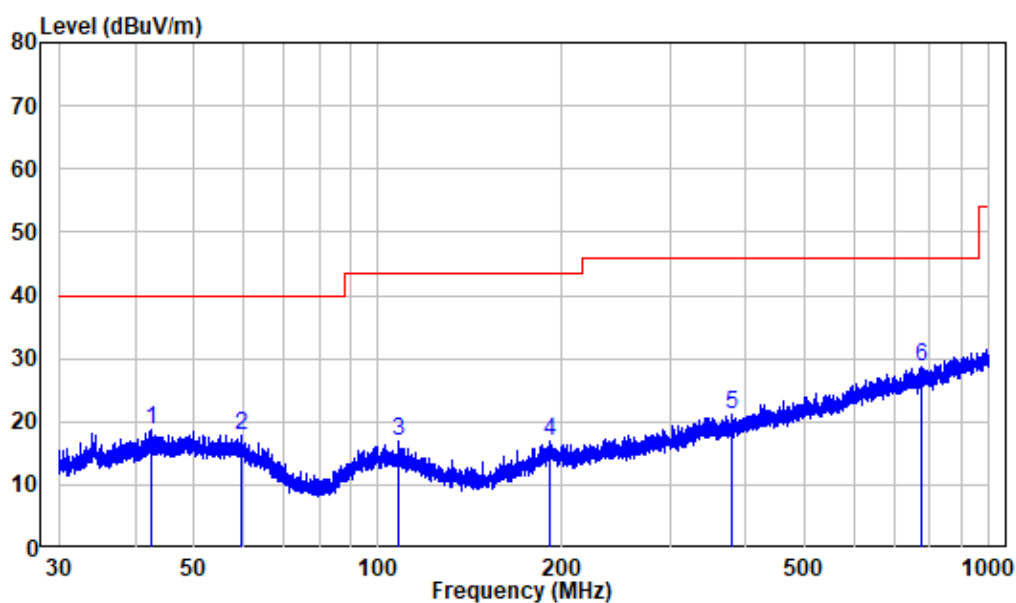
The testing was performed by Jason Liu on 2023-06-16 for below 1GHz and Jimi Zheng on 2023-07-27 for above 1GHz.

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

30MHz-1GHz: (worst case is Middle channel)

Note: When the test result of Peak was less than the limit of QP, just the peak value was recorded.

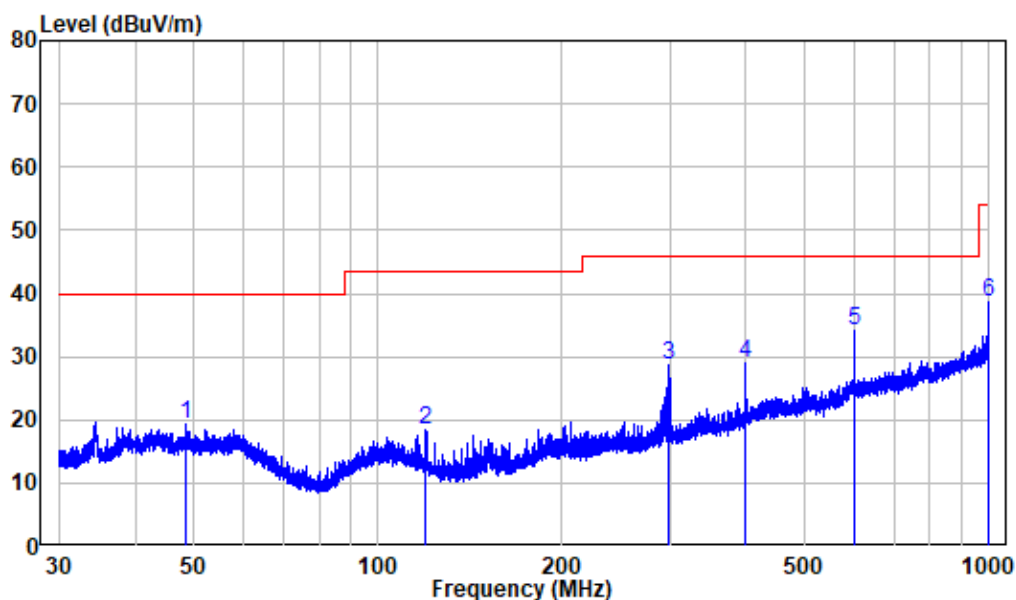
Horizontal:



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA230529-29951E-RF
Test Mode: Transmitting

	Freq Factor		Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	42.637	-9.98	28.64	18.66	40.00	-21.34	Peak
2	59.623	-10.48	28.41	17.93	40.00	-22.07	Peak
3	108.219	-11.99	28.81	16.82	43.50	-26.68	Peak
4	190.405	-11.51	28.45	16.94	43.50	-26.56	Peak
5	380.247	-7.14	28.36	21.22	46.00	-24.78	Peak
6	774.158	0.01	28.58	28.59	46.00	-17.41	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA230529-29951E-RF
Test Mode: Transmitting

	Freq	Factor	Read Level	Level	Limit	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	48.311	-9.98	29.21	19.23	40.00	-20.77	Peak
2	119.593	-13.46	32.01	18.55	43.50	-24.95	Peak
3	299.841	-9.23	37.91	28.68	46.00	-17.32	Peak
4	400.081	-6.73	35.66	28.93	46.00	-17.07	Peak
5	600.110	-2.43	36.68	34.25	46.00	-11.75	Peak
6	997.374	2.97	35.55	38.52	54.00	-15.48	Peak

Above 1GHz:

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel(2402MHz)									
2342.47	70.71	PK	353	1.5	H	-10.68	60.03	74	-13.97
2356.95	70.39	PK	218	1.3	V	-10.73	59.66	74	-14.34
2390	70.02	PK	80	1.9	H	-10.62	59.40	74	-14.60
2390	68.79	PK	329	2.3	V	-10.62	58.17	74	-15.83
4804	60.90	PK	228	1.5	H	-5.57	55.33	74	-18.67
4804	59.63	PK	54	1.5	V	-5.57	54.06	74	-19.94
Middle Channel(2440MHz)									
4880	60.65	PK	160	1.5	H	-5.22	55.43	74	-18.57
4880	59.89	PK	11	1.5	V	-5.22	54.67	74	-19.33
High Channel(2480MHz)									
2483.5	72.08	PK	239	1.3	H	-10.46	61.62	74	-12.38
2483.5	71.04	PK	333	1.5	V	-10.46	60.58	74	-13.42
2495.88	73.25	PK	190	1.1	H	-10.36	62.89	74	-11.11
2496.12	72.56	PK	42	1.6	V	-10.35	62.21	74	-11.79
4960	60.10	PK	58	2.3	H	-4.90	55.20	74	-18.80
4960	59.79	PK	325	2.3	V	-4.90	54.89	74	-19.11

Field Strength of Average							
Frequency (MHz)	Peak Measurement @3m (dBμV/m)	Polar (H/V)	Duty Cycle Correction Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.247		
					Limit (dBμV/m)	Margin (dB)	Comment
Low Channel(2402MHz)							
2342.47	60.03	H	-58.42	1.61	54	-52.39	Bandedge
2356.95	59.66	V	-58.42	1.24	54	-52.76	Bandedge
2390	59.40	H	-58.42	0.98	54	-53.02	Bandedge
2390	58.17	V	-58.42	-0.25	54	-54.25	Bandedge
4804	55.33	H	-58.42	-3.09	54	-57.09	Harmonic
4804	54.06	V	-58.42	-4.36	54	-58.36	Harmonic
Middle Channel(2440MHz)							
4880	55.43	H	-58.42	-2.99	54	-56.99	Harmonic
4880	54.67	V	-58.42	-3.75	54	-57.75	Harmonic
High Channel(2480MHz)							
2483.5	61.62	H	-58.42	3.20	54	-50.80	Bandedge
2483.5	60.58	V	-58.42	2.16	54	-51.84	Bandedge
2495.88	62.89	H	-58.42	4.47	54	-49.53	Bandedge
2496.12	62.21	V	-58.42	3.79	54	-50.21	Bandedge
4960	55.20	H	-58.42	-3.22	54	-57.22	Harmonic
4960	54.89	V	-58.42	-3.53	54	-57.53	Harmonic

Note:

Absolute Level = Corrected Factor + Reading

Margin = Corrected. Amplitude - Limit

Average level= Peak level+ Duty Cycle Corrected Factor

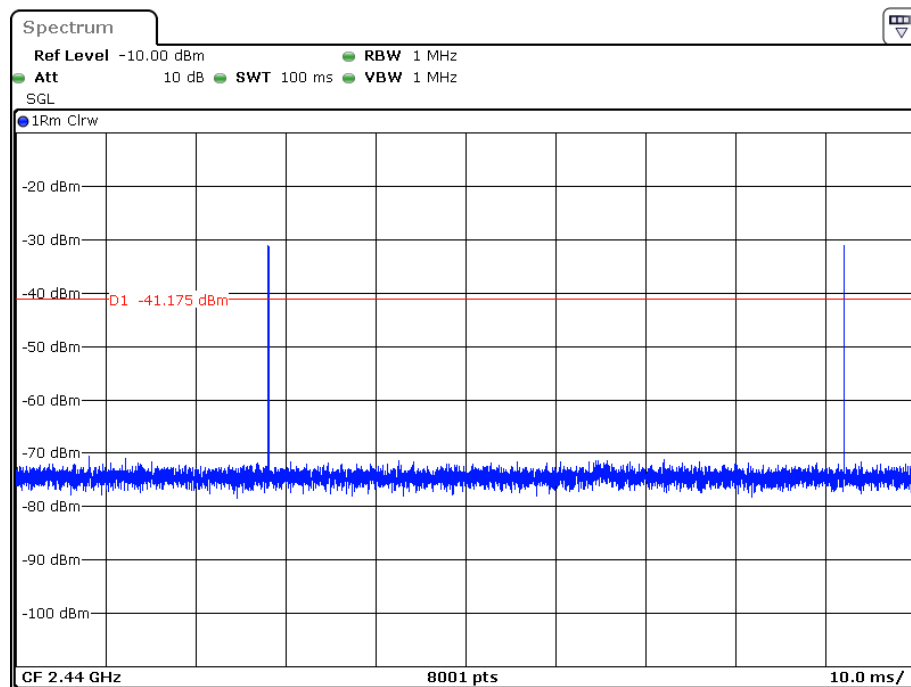
Other emissions which were more than 20dB below limit or on noise floor level was not recorded.

Worst case duty cycle:

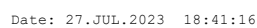
Duty cycle = Ton/100ms = 0.062*2/100=0.0012

Duty Cycle Corrected Factor = 20lg (Duty cycle) = 20lg0.0012 = -58.42

Duty cycle



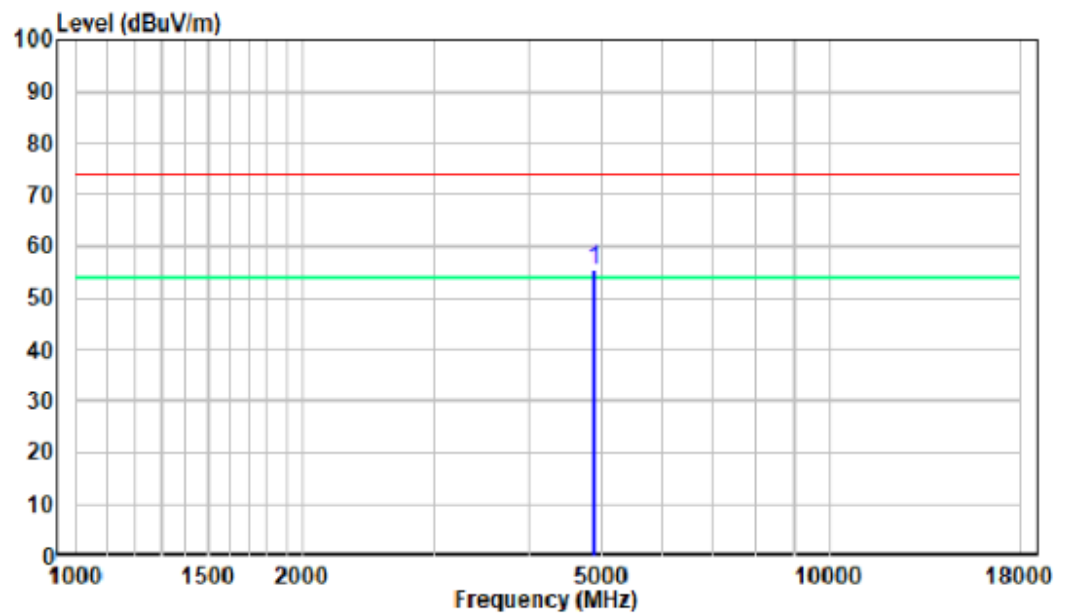
Date: 27.JUL.2023 18:39:30



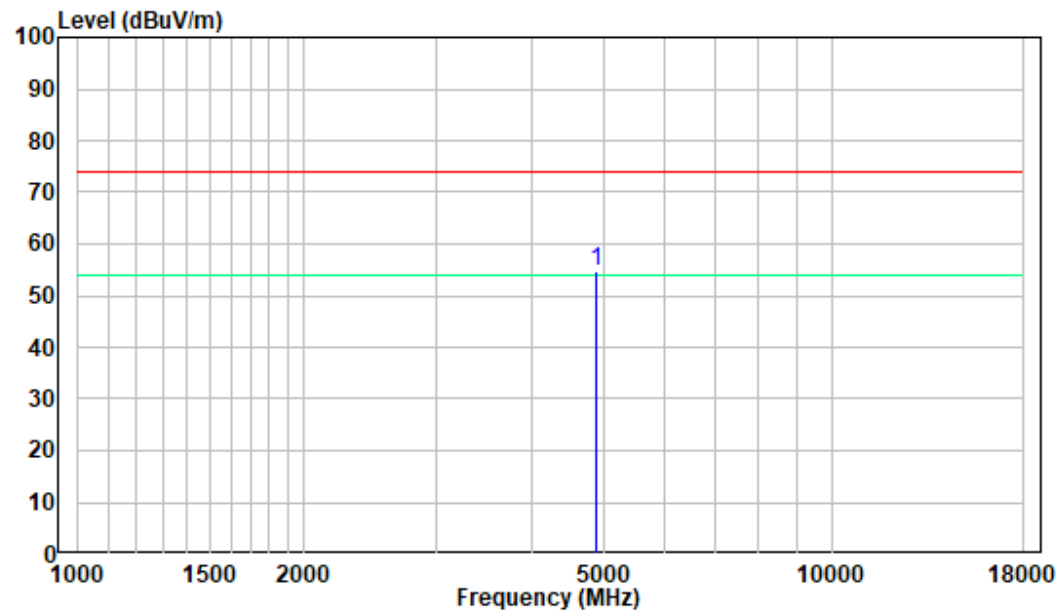
1-18GHz

Pre-scan for Middle Channel

Horizontal:



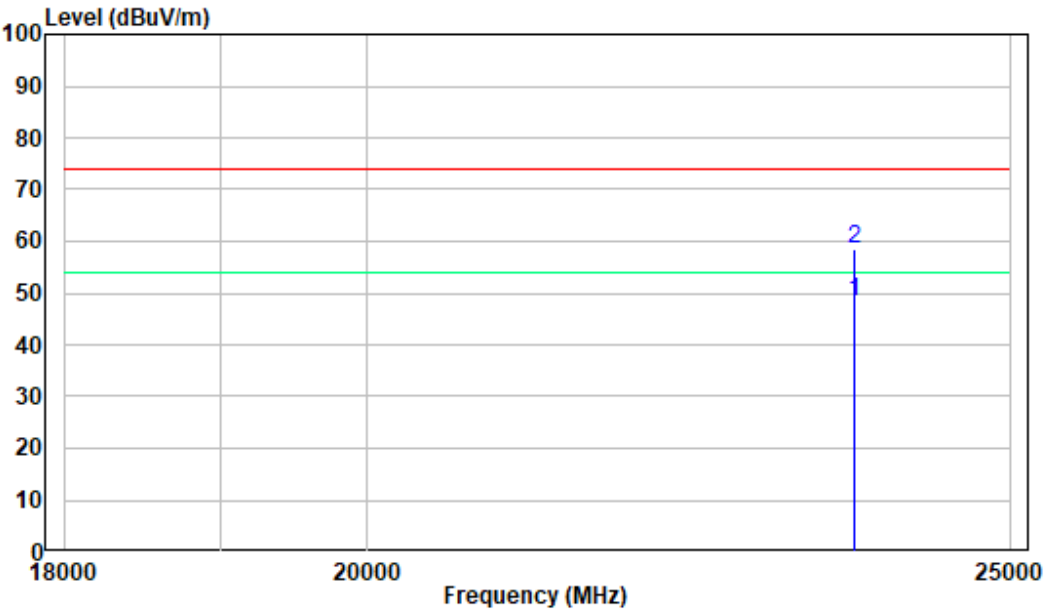
Vertical:



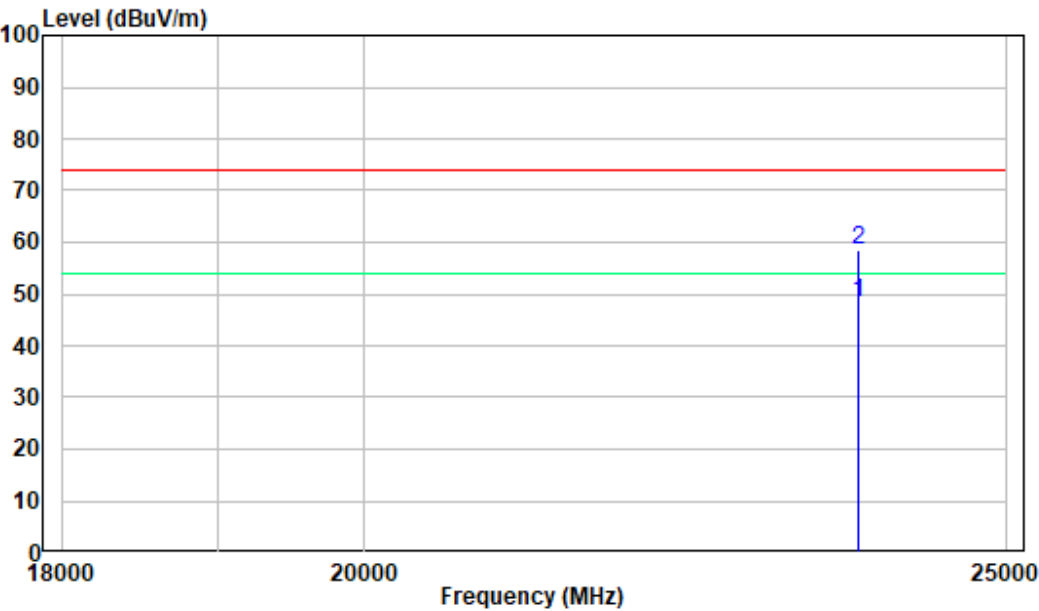
18-25GHz

Pre-scan for Middle Channel

Horizontal:



Vertical:



FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

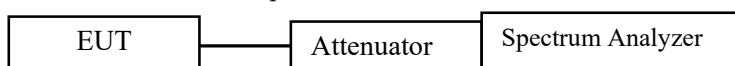
Applicable Standard

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.2

1. Set the EUT in transmitting mode, maxhold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.



Test Data

Environmental Conditions

Temperature:	26.8 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Mike Xiao on 2023-06-14.

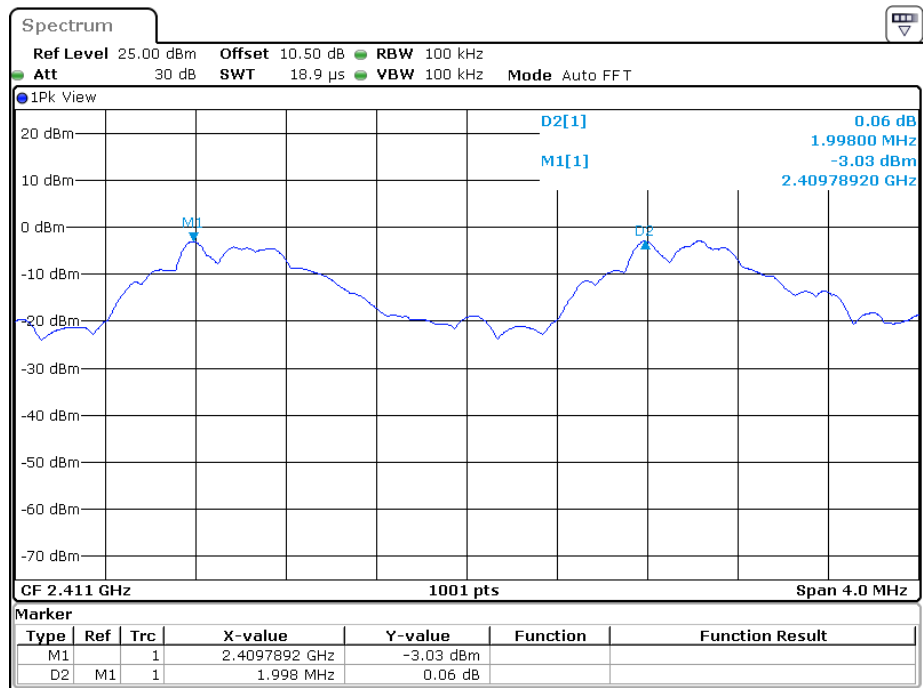
EUT operation mode: Transmitting

Test Result: Compliant.

Test Mode	Channel Separation (MHz)	20 dBc BW (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Channel Separation Limit	Result
GFSK					
Hopping	1.998	1.272	0.848	> two-thirds of the 20 dB bandwidth	Pass

Please refer to the below plots:

GFSK_Hop



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FCC §15.247(a) (1)–20dBEMISSION BANDWIDTH&99% OCCUPIED BANDWIDTH

Applicable Standard

Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Procedure

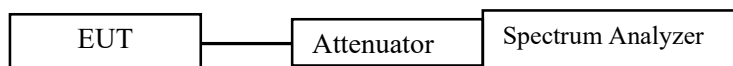
Test Method: ANSI C63.10-2013 Clause 7.8.7 & Clause 6.9.2

The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / 20 dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / 20 dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).



Test Data

Environmental Conditions

Temperature:	26.8 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Mike Xiao on 2023-06-14.

EUT operation mode: Transmitting

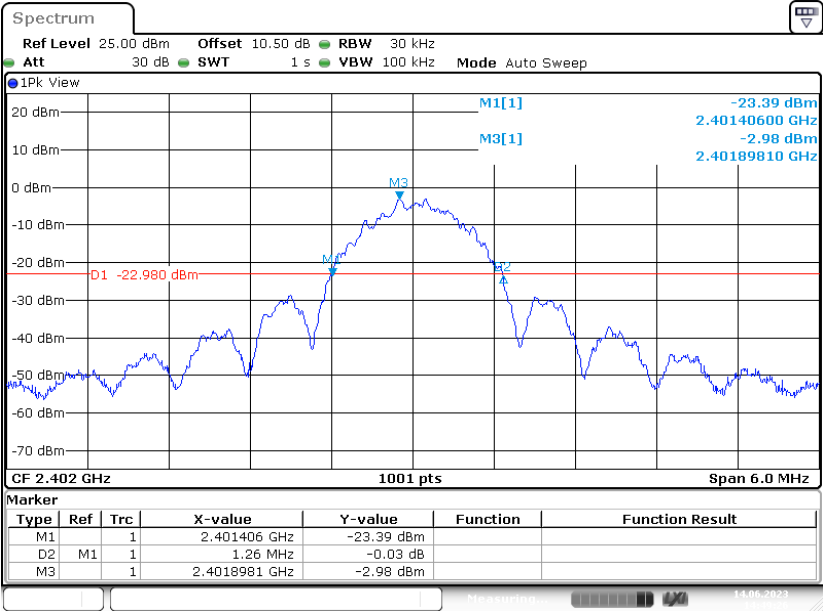
Test Result: Compliant.

Mode	Channel	Frequency (MHz)	99% Emission Bandwidth (MHz)	20 dB Emission Bandwidth (MHz)
GFSK	Low	2402	1.139	1.260
	Middle	2440	1.157	1.260
	High	2480	1.167	1.272

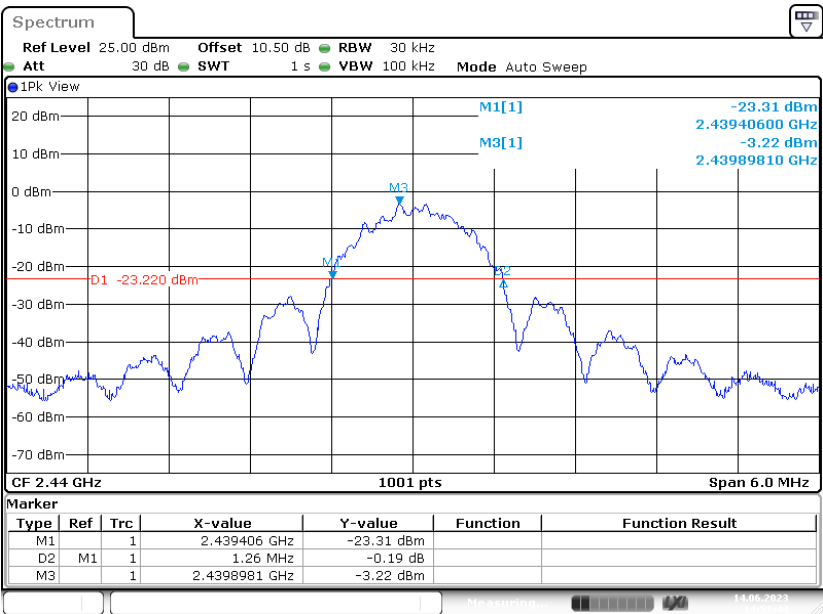
Please refer to the below plots:

20 dB Emission Bandwidth:

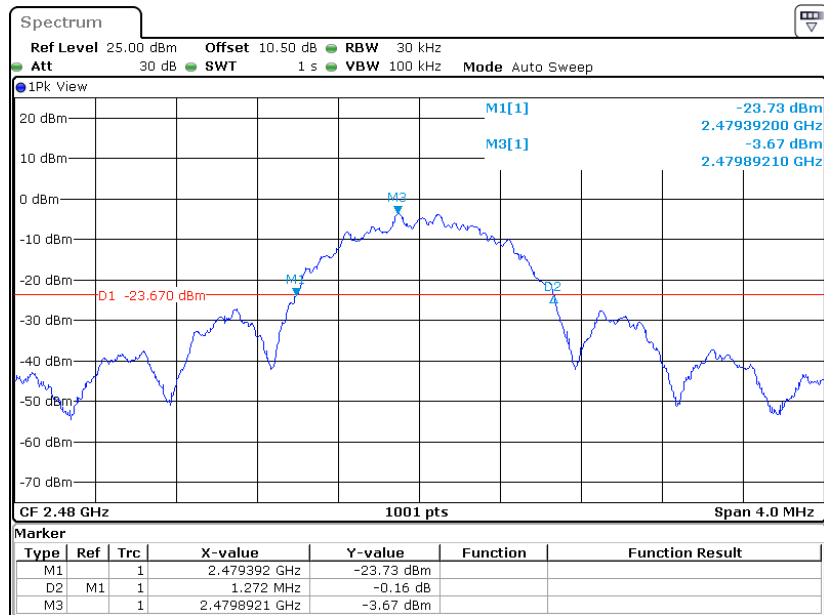
2402MHz



2440MHz



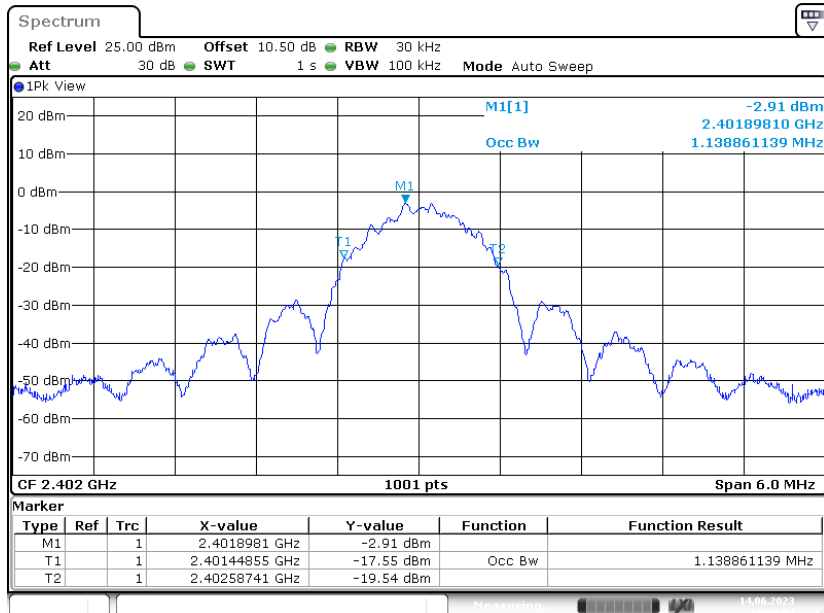
2480MHz



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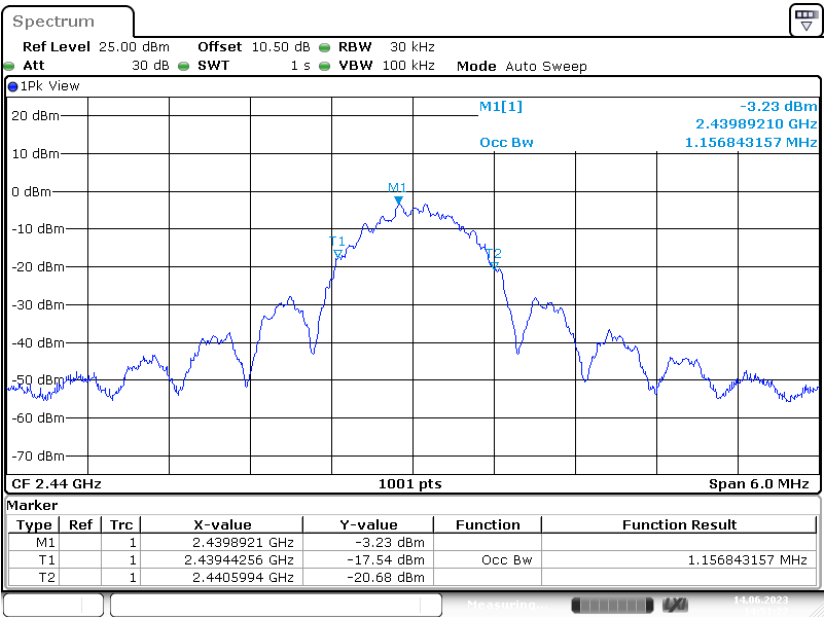
99% Emission Bandwidth:

2402MHz

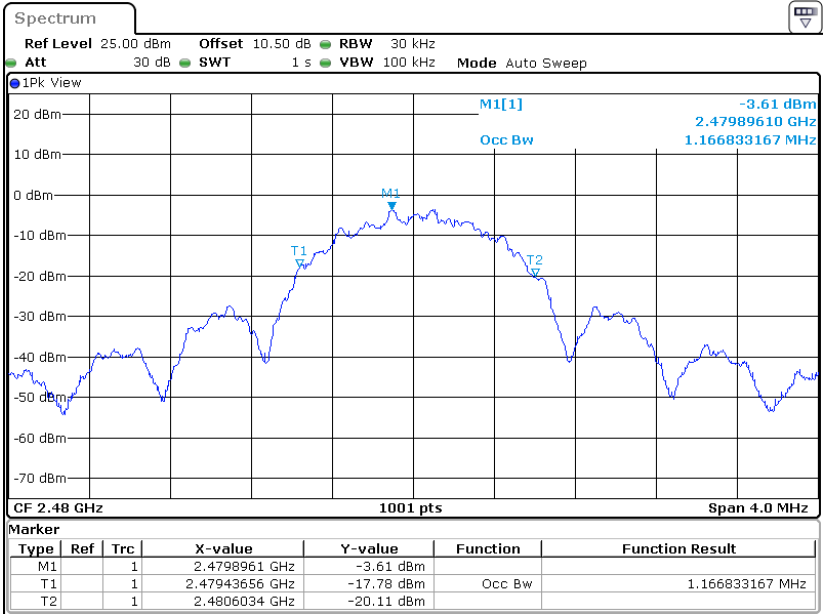


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2440MHz



2480MHz



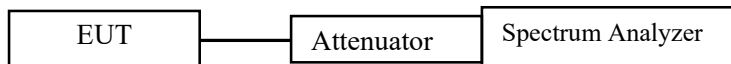
FCC §15.247(a) (1) (iii)-QUANTITY OF HOPPING CHANNEL TEST**Applicable Standard**

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.3

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Set the EUT in hopping mode from first channel to last.
3. By using the max-hold function record the quantity of the channel.

**Test Data****Environmental Conditions**

Temperature:	26.8 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

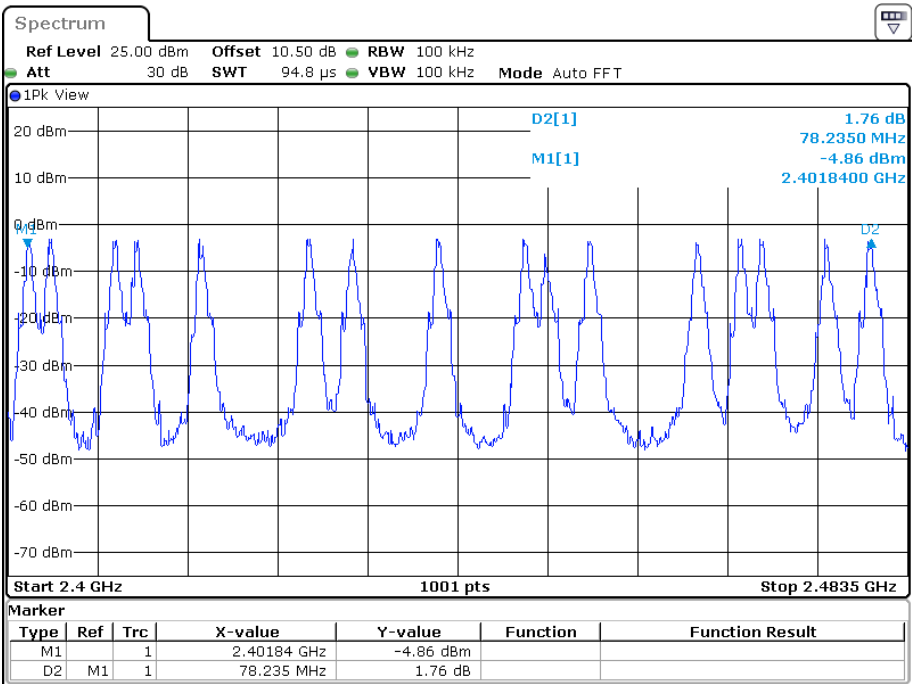
The testing was performed by Mike Xiao on 2023-06-14.

EUT operation mode: Transmitting

Test Result: Compliant.

Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
GFSK	2400-2483.5	16	≥15

GFSK_Hop



Date: 14.JUN.2023 10:00:06

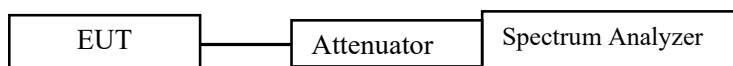
FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)**Applicable Standard**

Frequency hopping systems in the 2400-2483.5 MHz shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.4

1. The EUT was worked in channel hopping.
2. Set the RBW to: 1MHz.
3. Set the VBW $\geq 3 \times$ RBW.
4. Set the span to 0Hz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Recorded the time of single pulses

**Test Data****Environmental Conditions**

Temperature:	26.8 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Mike Xiao on 2023-06-14.

EUT operation mode: Transmitting

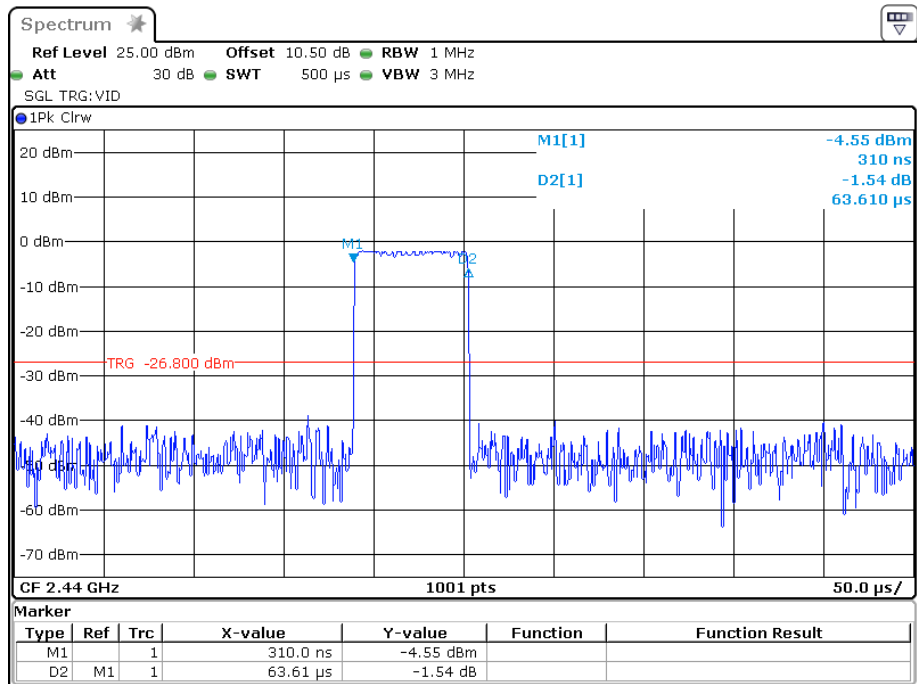
Test Result: Compliant.

Test Mode	Channel	Pulse Time [ms]	Total Hops [Num]	Result[s]	Limit[s]	Verdict
GFSK	Hop	0.064	100	0.0064	≤ 0.4	PASS

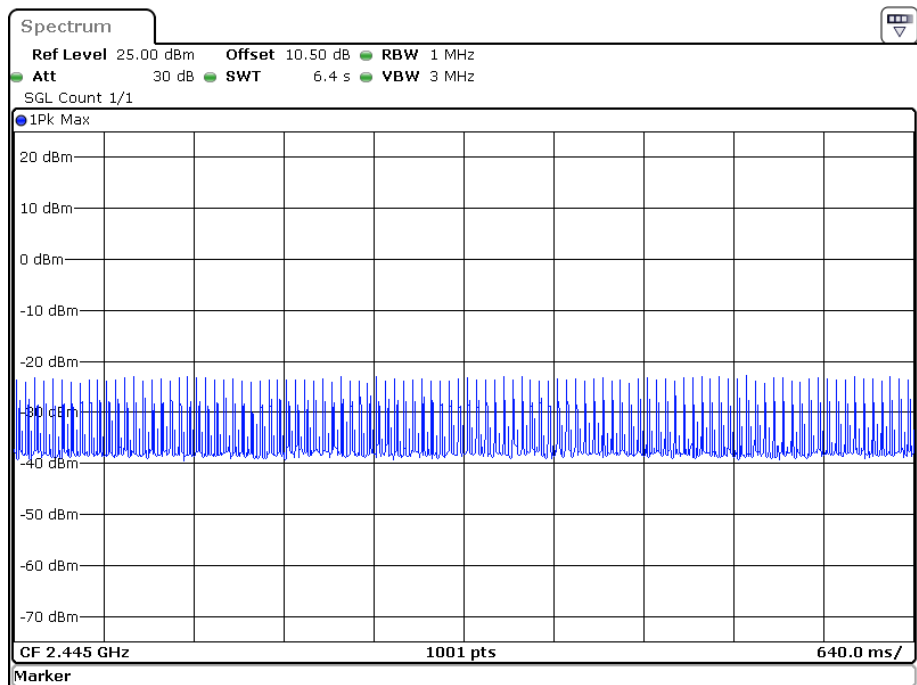
Note 1: A period time=0.4*16=6.4(s), Result= Pulse Time *Total hops

Note 2: Total hops=Hopping Number in 6.4s

Hop



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Date: 14.JUN.2023 09:48:45

FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

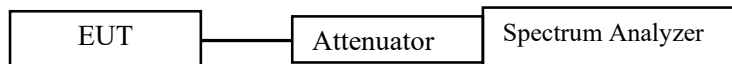
Applicable Standard

According to §15.247(b) (1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.5

1. Place the EUT on a bench and set 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:	26.8 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

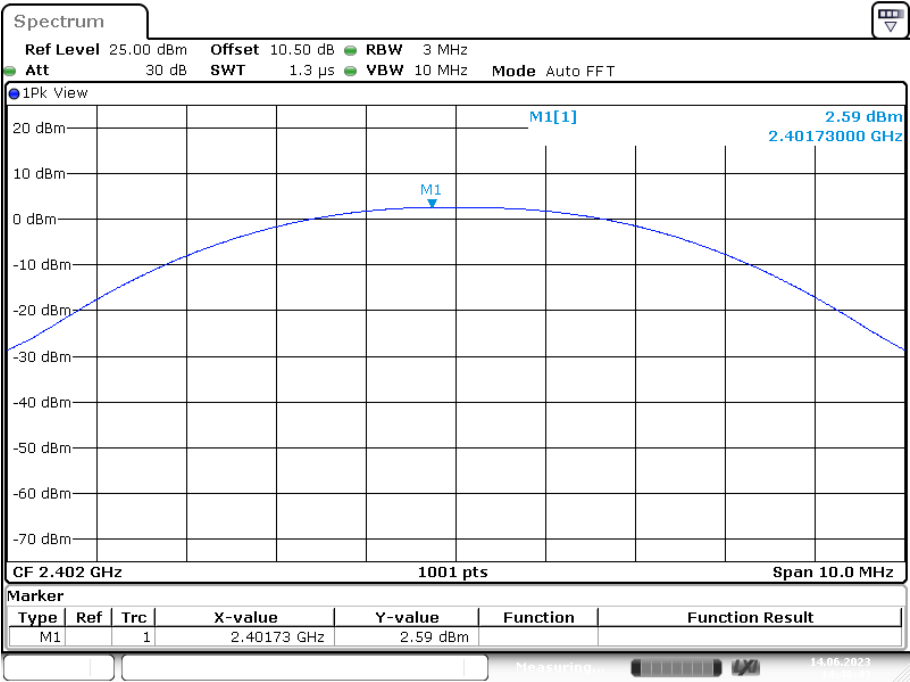
The testing was performed by Mike Xiao on 2023-06-14.

EUT operation mode: Transmitting

Test Result: Compliant.

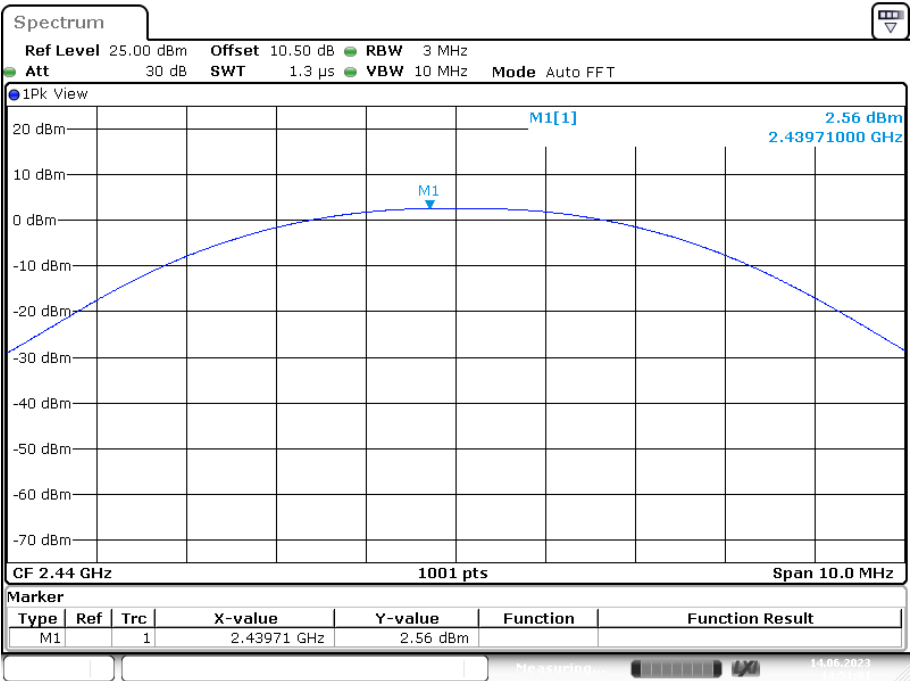
Mode	Channel	Frequency (MHz)	Peak Output Power	Limit (dBm)
			(dBm)	
GFSK	Low	2402	2.59	21
	Middle	2440	2.56	21
	High	2480	2.70	21

GFSK_2402



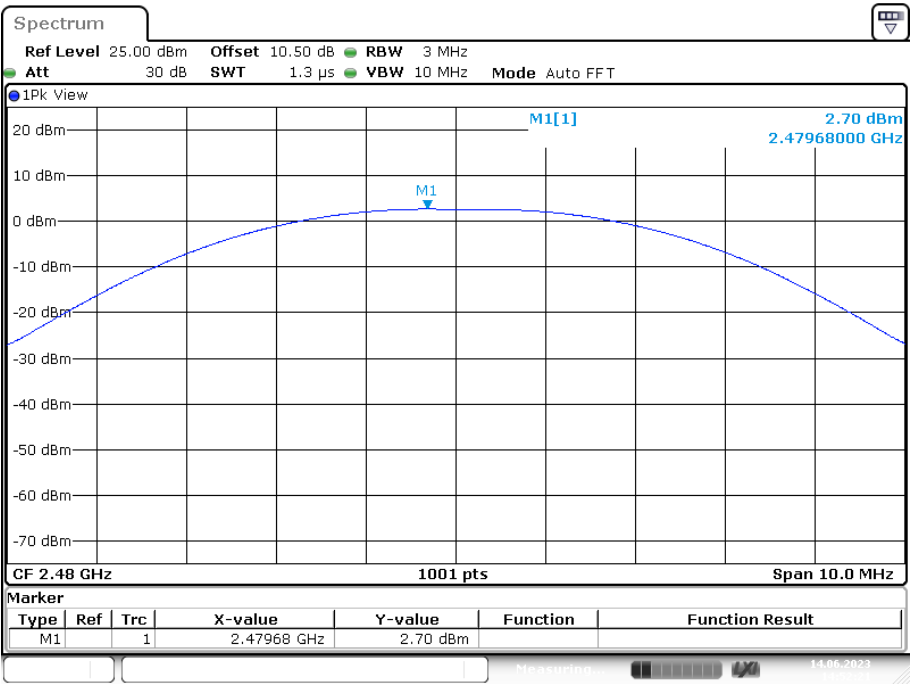
Date: 14.JUN.2023 14:48:43

GFSK_2440



Date: 14.JUN.2023 14:51:01

GFSK_2480



Date: 14.JUN.2023 14:52:21

FCC §15.247(d) - BAND EDGES TESTING

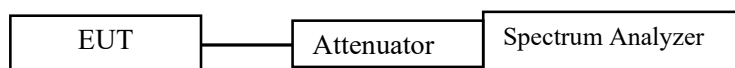
Applicable Standard

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

Test Method: ANSI C63.10-2013 Clause 7.8.6 & Clause 6.10

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 a 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 RBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz 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

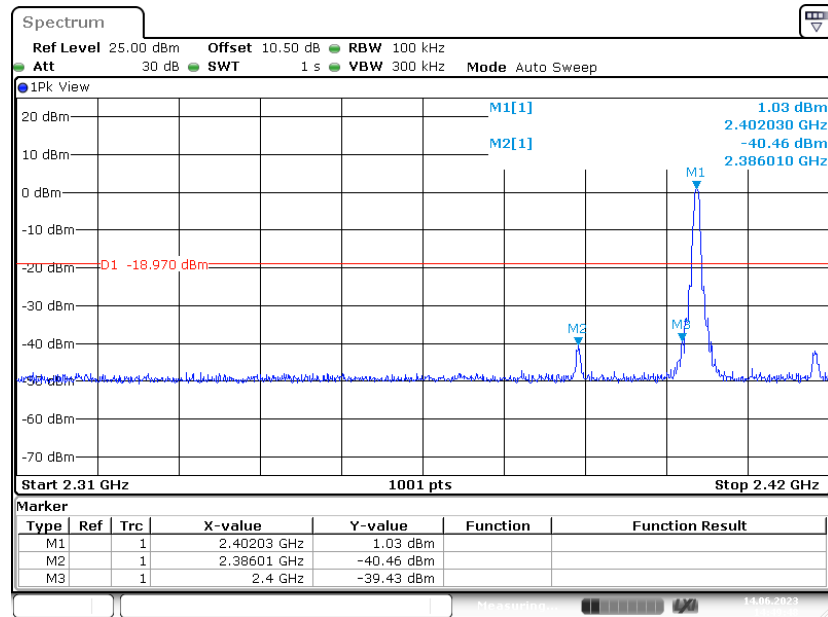
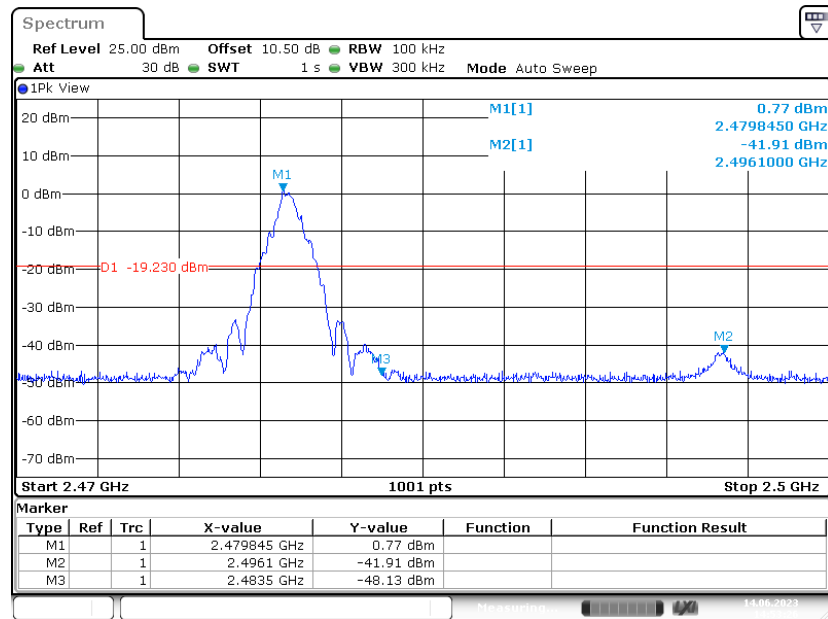
Environmental Conditions

Temperature:	26.8 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

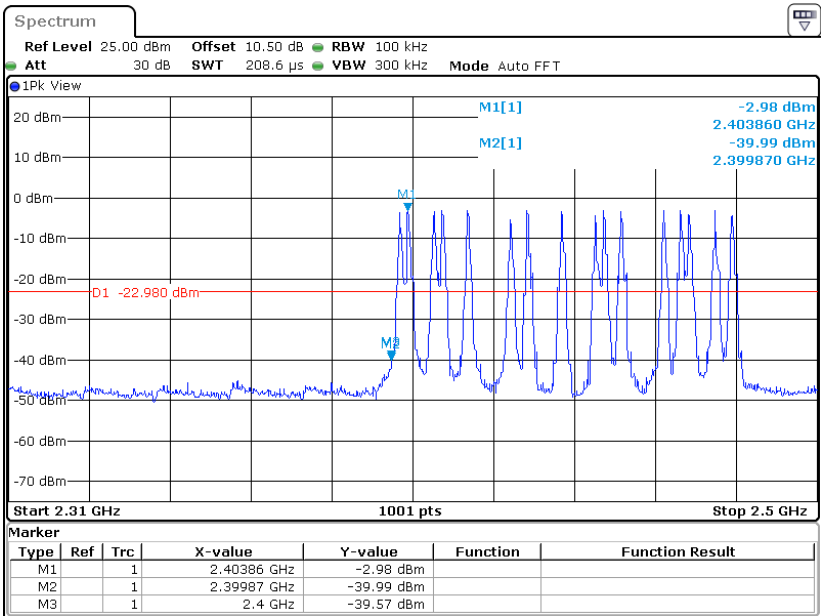
The testing was performed by Mike Xiao on 2023-06-14.

EUT operation mode: Transmitting

Test Result: Compliant.

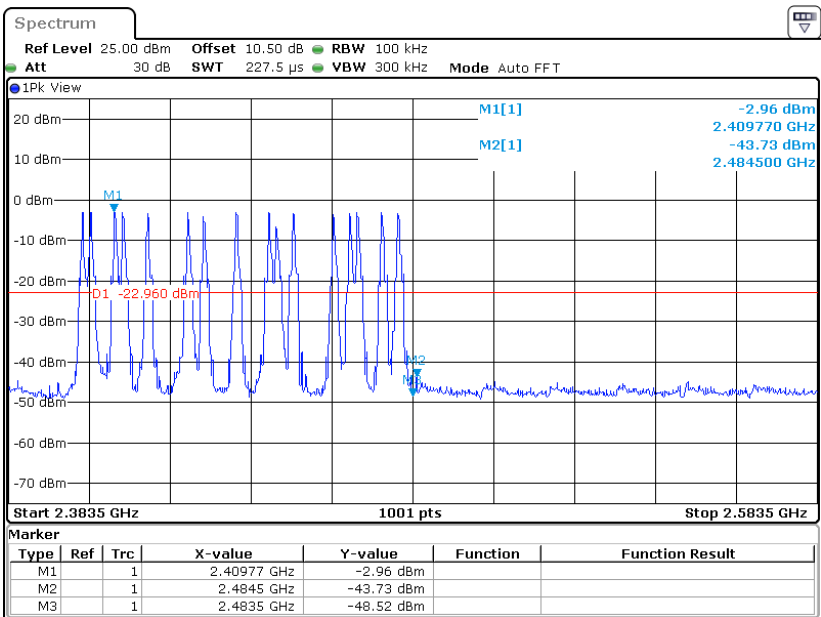
Conducted Band Edge Result:**Low_2402MHz****High_2480MHz**

Low_Hop



Date: 14.JUN.2023 09:54:37

High_Hop



Date: 14.JUN.2023 09:56:48

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