

TEST REPORT

FCC ID:2BA3W-M1632

Product : LED Cap
Model Name : M1632, M536, M1248, PCB-M536, PCB-M1248,
PCB-M1632, MA1248, M16, M12, M5
Brand : N/A
Report No. : NCT24046404E

Prepared for

ShenZhen TBD Optoelectronic Technology Co., Ltd.

**6th Floor, Building A, Xinlong Industrial Park, No.50, zhuangcun Road, Xinqiao Street
Shajing, Baoan Dist., Shenzhen, China**

Prepared by

Shenzhen NCT Testing Technology Co., Ltd.

**A101&2F B2, Fuqiao 6th Area, Xintian Community, Fuhai Street, Baoan District,
Shenzhen, People's Republic of China**

TEL: 400-8868-419

1 TEST RESULT CERTIFICATION

Applicant's name : ShenZhen TBD Optoelectronic Technology Co., Ltd.
Address : 6th Floor, Building A, Xinlong Industrial Park, No.50, zhuangcun Road, Xinqiao Street Shajing, Baoan Dist., Shenzhen, China
Manufacture's name : ShenZhen TBD Optoelectronic Technology Co., Ltd.
Address : 6th Floor, Building A, Xinlong Industrial Park, No.50, zhuangcun Road, Xinqiao Street Shajing, Baoan Dist., Shenzhen, China
Product name : LED Cap
Model name : M1632, M536, M1248, PCB-M536, PCB-M1248, PCB-M1632, MA1248, M16, M12, M5
Standards : FCC CFR47 Part 15 Section 15.247
Test procedure : ANSI C63.10:2013
KDB 558074 D01 v05r02
Date of test : Nov. 13, 2024- Nov. 21, 2024
Date of Issue : Nov. 21, 2024

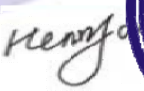
This device described above has been tested by NCT, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

This report shall not be reproduced except in full, without the written approval of NCT, this document may be altered or revised by NCT, personal only, and shall be noted in the revision of the document.

Test Engineer:


Keven Wu / Engineer

Technical Manager:


Henry Wang / Manager



Contents

Page

1	TEST RESULT CERTIFICATION	
2		
2	TEST SUMMARY	5
2.1	TEST SITE	6
3	GENERAL INFORMATION	7
3.1	GENERAL DESCRIPTION OF E.U.T.	7
3.2	CHANNEL LIST	8
3.3	TEST SETUP CONFIGURATION	9
3.4	TEST MODE	9
4	EQUIPMENT DURING TEST	10
4.1	EQUIPMENTS LIST	10
4.2	MEASUREMENT UNCERTAINTY	12
4.3	DESCRIPTION OF SUPPORT UNITS	12
5	CONDUCTED EMISSION	13
5.1	E.U.T. OPERATION	13
5.2	EUT SETUP	13
5.3	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)	14
5.4	MEASUREMENT PROCEDURE	14
5.5	CONDUCTED EMISSION LIMIT	14
5.6	MEASUREMENT DESCRIPTION	14
5.7	CONDUCTED EMISSION TEST RESULT	14
6	RADIATED SPURIOUS EMISSIONS	17
6.1	EUT OPERATION	17
6.2	TEST SETUP	18
6.3	SPECTRUM ANALYZER SETUP	19
6.4	TEST PROCEDURE	20
6.5	SUMMARY OF TEST RESULTS	22
7	CONDUCT BAND EDGE AND SPURIOUS EMISSIONS MEASUREMENT	29
7.1	TEST PROCEDURE	29

7.2	TEST SETUP	29
7.3	TEST RESULT	29
8	6DB BANDWIDTH MEASUREMENT	34
8.1	TEST PROCEDURE.....	34
8.2	TEST SETUP	34
8.3	TEST RESULT	34
9	MAXIMUM PEAK OUTPUT POWER	37
9.1	TEST PROCEDURE.....	37
9.2	TEST SETUP	37
9.3	TEST RESULT	37
10	POWER SPECTRAL DENSITY	40
10.1	TEST PROCEDURE.....	40
10.2	TEST SETUP	40
10.3	TEST RESULT	40
11	ANTENNA APPLICATION	43
11.1	ANTENNA REQUIREMENT	43
11.2	RESULT.....	43
12	ST SETUP PHOTOS AND EUT PHOTOS	
44		

2 Test Summary

Test Items	Test Requirement	Result
Conduct Emission	FCC part 15.207	PASS
Radiated Spurious Emissions	FCC part 15.205/15.209	PASS
Conducted Spurious Emission	FCC part 15. 247(d)	PASS
Band edge	FCC part 15.247(d)	PASS
6dB&99% Bandwidth	FCC part 15.247 (a)(2)	PASS
Maximum Peak Output Power	FCC part 15.247 (b)(3)	PASS
Power Spectral Density	FCC part 15.247 (e)	PASS
Antenna Requirement	FCC part 15.203/15.247 (c)	PASS

Remark:

1. "N/A" denotes test is not applicable in this Test Report.

2.1 Test Site

Site Description

EMC Lab. : Accredited by CNAS, 2022-09-27

The certificate is valid until 2028.01.07

The Laboratory has been assessed and proved to be in compliance with CNAS-CL01:2006 (identical to ISO/IEC 17025:2017)

The Certificate Registration Number is L8251

Designation Number: CN1347

Test Firm Registration Number: 894804

Accredited by A2LA, June 14, 2023

The Certificate Registration Number is 6837.01

Accredited by Industry Canada, November 09, 2018

The Conformity Assessment Body Identifier is CN0150

Company Number: 30806

Name of Firm : Shenzhen NCT Testing Technology Co., Ltd.

Site Location : A101&2F B2, Fuqiao 6th Area, Xintian Community, Fuhai Street, Baoan District, Shenzhen, People's Republic of China

3 General Information

3.1 General Description of E.U.T.

Product Name	:	LED Cap
Model Name	:	M1632
Sample ID	:	NCT24046404-001
Sample(s) Status:	:	Engineer sample
Series Model	:	M536, M1248, PCB-M536, PCB-M1248, PCB-M1632, MA1248, M16, M12, M5
Model Different.:	:	All the same except the model number
Operating frequency	:	2402 MHz to 2480 MHz
Number of Channels	:	40 Channels
Type of Modulation	:	GFSK
Antenna installation	:	PCB Antenna
Antenna Gain	:	3.0dBi
Power supply	:	DC 3.7V from Battery or DC 5V from adapter input AC 120V/60Hz
Hardware Version	:	/
Software Version	:	/
Remark: the Antenna gain is provided by customer from Antenna spec. and the laboratory will not be responsible for the accumulated calculation results which covers the information provided by the applicant.		

3.2 Channel List

The EUT has been tested under its typical operating condition. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting. Only the worst case data were reported.

The EUT has been associated with peripherals pursuant to ANSI C63.10-2013 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 KHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

The details of test channels and bandwidth were for RF conductive measurement.

Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	14	2430	28	2458
01	2404	15	2432	29	2460
02	2406	16	2434	30	2462
03	2408	17	2436	31	2464
04	2410	18	2438	32	2466
05	2412	19	2440	33	2468
06	2414	20	2442	34	2470
07	2416	21	2444	35	2472
08	2418	22	2446	36	2474
09	2420	23	2448	37	2476
10	2422	24	2450	38	2478
11	2424	25	2452	39	2480
12	2426	26	2454		
13	2428	27	2456		

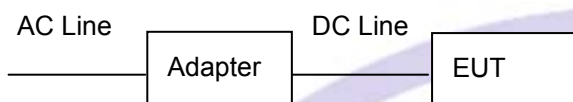
lowest	middle	highest
2402 MHz	2440 MHz	2480 MHz

Note:

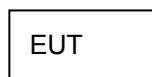
1. Test of channel was included the lowest, middle and highest frequency in highest data rate and to perform the test, then record on this report.

3.3 Test Setup Configuration

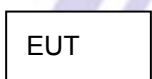
Conducted Emission



Radiated Emission(30MHz-1GHz)



Radiated Emission(above 1GHz)



Conducted Spurious



3.4 Test Mode

Transmitting mode	Keep the EUT in continuously transmitting mode.
Remark: During the test, the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data.	

4 Equipment During Test

4.1 Equipments List

Conducted emission Test Equipment

Name	Model No.	Serial No.	Manufacturer	Date of Cal.	Due Date
944 Shielded Room	944 Room	/	EMToni	2022/5/31	2025/5/30
EMI Test Receiver	ESPI	101604	Rohde & Schwarz	2024/6/21	2025/6/20
LISN	ENV 216	102796	Rohde & Schwarz	2024/6/21	2025/6/20
LISN	VN1-13S	004023	CRANAGE	2024/6/21	2025/6/20
Cable	RG223-1500MM	NA	RG	2024/6/21	2025/6/20

Radiated emission & Radio Frequency Test Equipment

Name	Model No.	Serial No.	Manufacturer	Date of Cal.	Due Date
966 Shielded Room	966 Room	/	EMToni	2022/5/31	2025/5/30
EMI Test Receiver	ESCI	101178	Rohde & Schwarz	2024/6/21	2025/6/20
Amplifier (30MHz-1GHz)	BBV 9743 B	00374	SCHNWARZBECK	2024/6/21	2025/6/20
Bilog Antenna (30MHz-1GHz)	VULB9162	00473	SCHNWARZBECK	2023/3/19	2025/3/18
Horn antenna (1GHz-18GHz)	BBHA 9120 D	02622	SCHNWARZBECK	2023/3/19	2025/3/18
Preamplifier (1GHz-18GHz)	BBV 9718D	0024	SCHNWARZBECK	2024/6/21	2025/6/20
Spectrum Analyzer (10Hz-40GHz)	FSV 40	100952	Rohde & Schwarz	2024/6/21	2025/6/20
Preamplifier (18GHz-40GHz)	BBV 9721	0056	SCHNWARZBECK	2024/6/21	2025/6/20
Double Ridge Guide Horn Antenna (18GHz-40GHz)	SAS-574	588	A.H.System	2023/3/19	2025/3/18
Loop Antenna (9KHz-30MHz)	FMZB 1513-60	00115	SCHNWARZBECK	2024/6/21	2025/6/20

Amplifier (9KHz-30MHz)	BBV 9745	00109	CHNWARZBECK	2024/6/21	2025/6/20
MXG Signal Analyzer	N9020A	MY50510202	Agilent	2024/6/21	2025/6/20
MXG Vector Signal Generator	N5182A	MY50140020	Agilent	2024/6/21	2025/6/20
MXG Analog Signal Generator	N5181A	MY47420919	Agilent	2024/6/21	2025/6/20
Power Sensor	TR1029-2	512364	Techoy	2024/6/21	2025/6/20
RF Swith	TR1029-1	512364	Techoy	2024/6/21	2025/6/20
Cable	DA800- 4000MM	NA	DA	2024/6/21	2025/6/20
Cable	DA800- 11000MM	NA	DA	2024/6/21	2025/6/20

Other

Item	Name	Manufacturer	Model	Software version
1	EMC Conduction Test System	AUDIX	e3	6.120718
2	EMC radiation test system	AUDIX	e3	6.120718
3	RF test system	TACHOY	RFTest	V1.0.0
4	RF communication test system	TACHOY	RFTest	V1.0.0

4.2 Measurement Uncertainty

Parameter	Uncertainty
RF output power, conducted	±1.0dB
Power Spectral Density, conducted	±2.2dB
Radio Frequency	± 1 x 10 ⁻⁶
Bandwidth	± 1.5 x 10 ⁻⁶
Time	±2%
Duty Cycle	±2%
Temperature	±1°C
Humidity	±5%
DC and low frequency voltages	±3%
Conducted Emissions (150kHz~30MHz)	±3.64dB
Radiated Emission(9KHz~30MHz)	±4.51dB
Radiated Emission(30MHz~1GHz)	±5.03dB
Radiated Emission(1GHz~25GHz)	±4.74dB
Radiated Emission(25GHz~40GHz)	±3.38dB
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%	

4.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
E-1	LED Cap	N/A	M1632	N/A	EUT
E-2	Adapter	anju	A18A-050100U-US2	AJ-230600002514	Auxiliary

Note: (1)The support equipment was authorized by Declaration of Confirmation.

(2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.

5 Conducted Emission

Test Requirement : FCC CFR 47 Part 15 Section 15.207
Test Method : ANSI C63.10:2013
Test Result : PASS
Frequency Range : 150kHz to 30MHz
Class/Severity : Class B

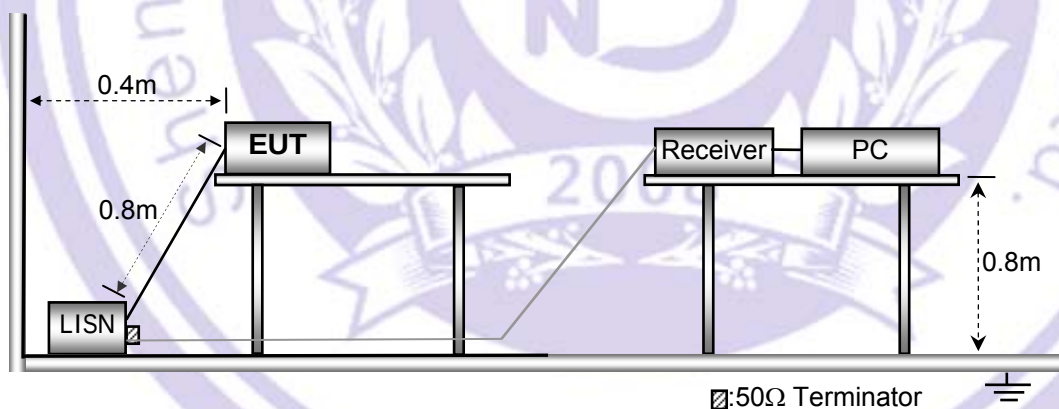
5.1 E.U.T. Operation

Operating Environment :

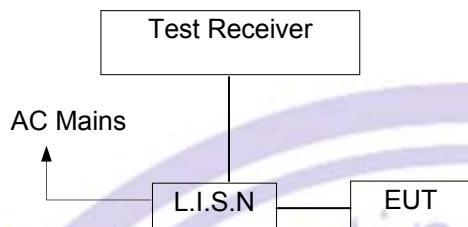
Temperature : 25.5 °C
Humidity : 51 % RH
Atmospheric Pressure : 101.2kPa

5.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013.



5.3 Test SET-UP (Block Diagram of Configuration)



5.4 Measurement Procedure

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

5.5 Conducted Emission Limit

Conducted Emission

Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note:

1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

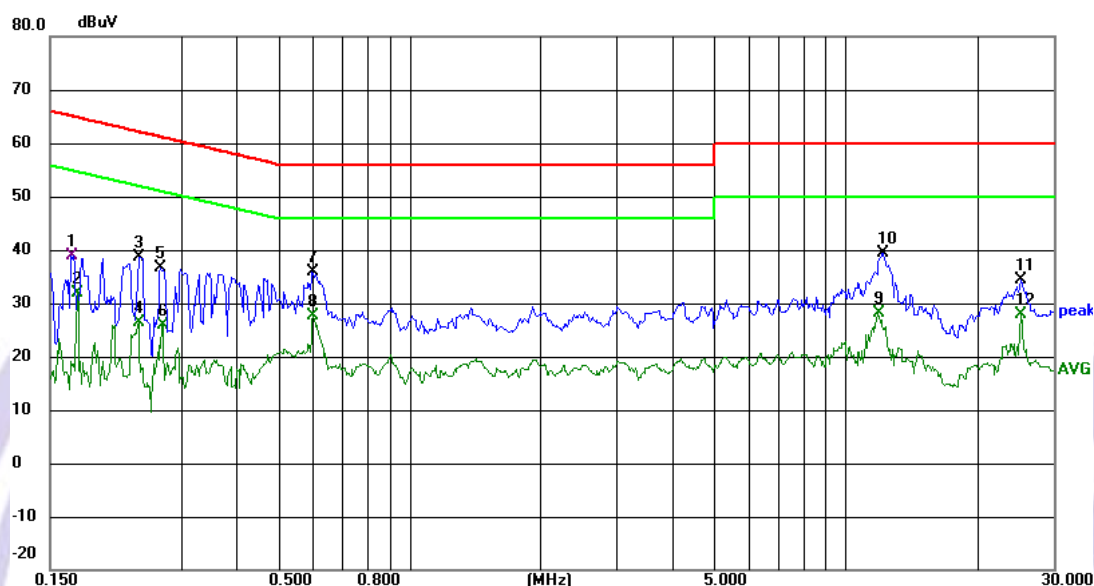
5.6 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

5.7 Conducted Emission Test Result

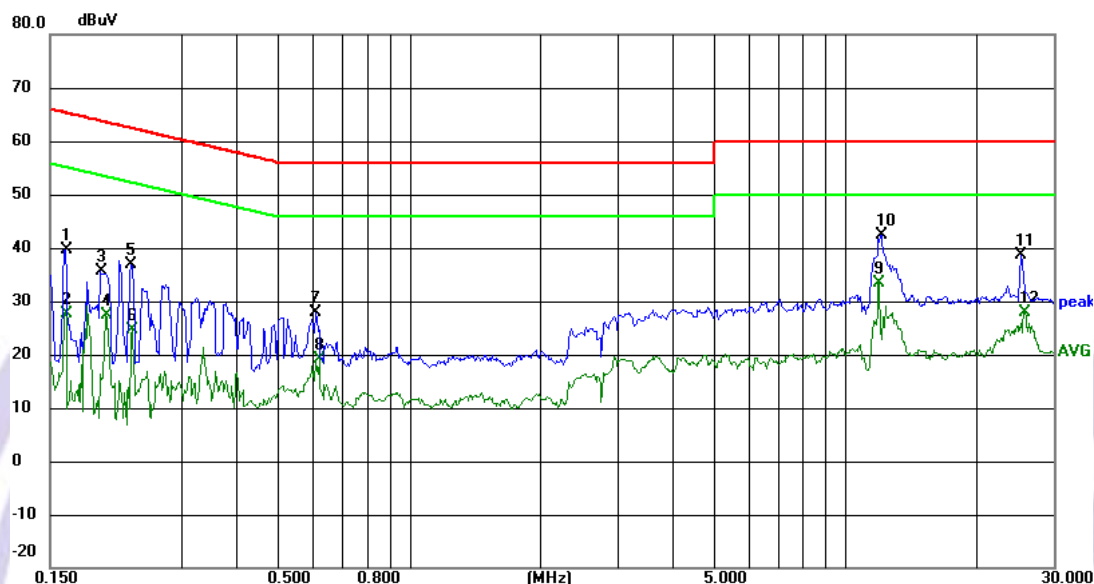
Conducted emission at both 120V & 240V is assessed, and emission at 120V represents the worst case. All the modulation modes were tested the data of the worst mode (GFSK, middle channel) are recorded in the following pages and the others modulation methods do not exceed the limits.

Channel:	middle channel	Phase :	L
----------	----------------	---------	---



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.1676	28.62	10.33	38.95	65.08	-26.13	QP	P
2	0.1733	21.55	10.33	31.88	54.80	-22.92	AVG	P
3	0.2396	28.34	10.33	38.67	62.11	-23.44	peak	P
4	0.2396	15.98	10.33	26.31	52.11	-25.80	AVG	P
5	0.2686	26.19	10.34	36.53	61.16	-24.63	peak	P
6	0.2708	15.58	10.34	25.92	51.09	-25.17	AVG	P
7	0.5979	25.39	10.43	35.82	56.00	-20.18	peak	P
8 *	0.6023	17.20	10.43	27.63	46.00	-18.37	AVG	P
9	11.8697	13.88	14.31	28.19	50.00	-21.81	AVG	P
10	12.1259	25.01	14.38	39.39	60.00	-20.61	peak	P
11	25.2300	-6.14	40.52	34.38	60.00	-25.62	peak	P
12	25.2300	-12.71	40.52	27.81	50.00	-22.19	AVG	P

Channel:	middle channel	Phase :	N
----------	----------------	---------	---



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.1624	29.39	10.33	39.72	65.34	-25.62	peak	P
2	0.1624	17.27	10.33	27.60	55.34	-27.74	AVG	P
3	0.1954	25.24	10.32	35.56	63.80	-28.24	peak	P
4	0.2007	17.13	10.32	27.45	53.58	-26.13	AVG	P
5	0.2291	26.58	10.33	36.91	62.48	-25.57	peak	P
6	0.2318	14.35	10.33	24.68	52.38	-27.70	AVG	P
7	0.6107	17.52	10.43	27.95	56.00	-28.05	peak	P
8	0.6219	8.78	10.44	19.22	46.00	-26.78	AVG	P
9 *	11.9327	18.98	14.33	33.31	50.00	-16.69	AVG	P
10	12.0635	27.92	14.36	42.28	60.00	-17.72	peak	P
11	25.2300	-1.88	40.52	38.64	60.00	-21.36	peak	P
12	25.7271	-13.03	40.92	27.89	50.00	-22.11	AVG	P

Notes:

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Measurement Level = Reading level + Correct Factor

6 Radiated Spurious Emissions

Test Requirement : FCC CFR47 Part 15 Section 15.209 & 15.247
Test Method : ANSI C63.10:2013
Test Result : PASS
Measurement Distance : 3m
Limit : See the follow table

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	$2400/F(\text{kHz})$	300	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	$24000/F(\text{kHz})$	30	$100 * 24000/F(\text{kHz})$	$20\log^{(24000/F(\text{kHz}))} + 40$
1.705 ~ 30	30	30	$100 * 30$	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

6.1 EUT Operation

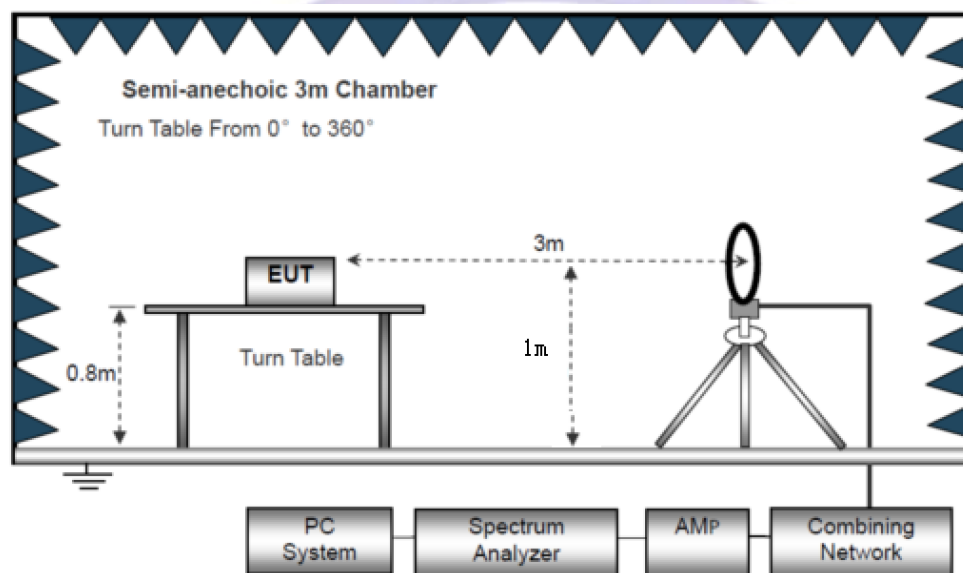
Operating Environment :

Temperature : 23.5 °C
Humidity : 51.1 % RH
Atmospheric Pressure : 101.2kPa

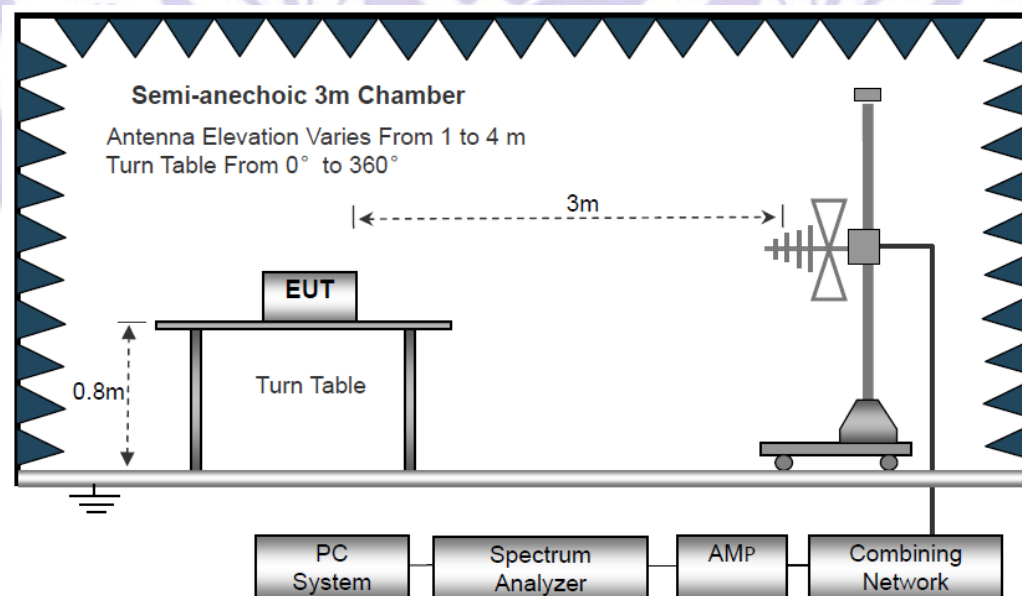
6.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

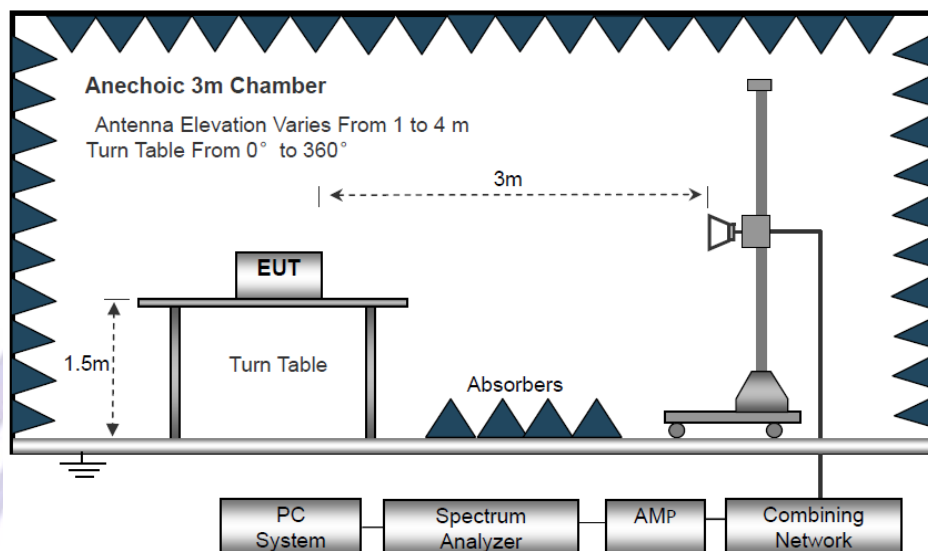
The test setup for emission measurement below 30MHz



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz



6.3 Spectrum Analyzer Setup

	Frequency	Detector	RBW	VBW	Remark
Receiver Setup	Below 30MHz	--	10kHz	10kHz	--
	30MHz ~ 1GHz	Quasi-peak	120kHz	300kHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
		RMS	1MHz	3MHz	Average Value

6.4 Test Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2013.
2. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degree) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.
7. Test Procedure of measurement (For Above 1GHz):
 - 1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).
 - 2) Change the antenna polarization and repeat 1) with vertical polarization.
 - 3) Make a hardcopy of the spectrum.
 - 4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
 - 5) Change the analyser mode to Clear/ Write and found the cone of emission.
 - 6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.
 - 7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.
 - 8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.
8. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

For Average Measurement:

VBW=10Hz, when duty cycle is no less than 98 percent.

VBW $\geq$ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.



6.5 Summary of Test Results

Test Frequency: 9KHz-30MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)
--	--	--	--	>20

Note:

The amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

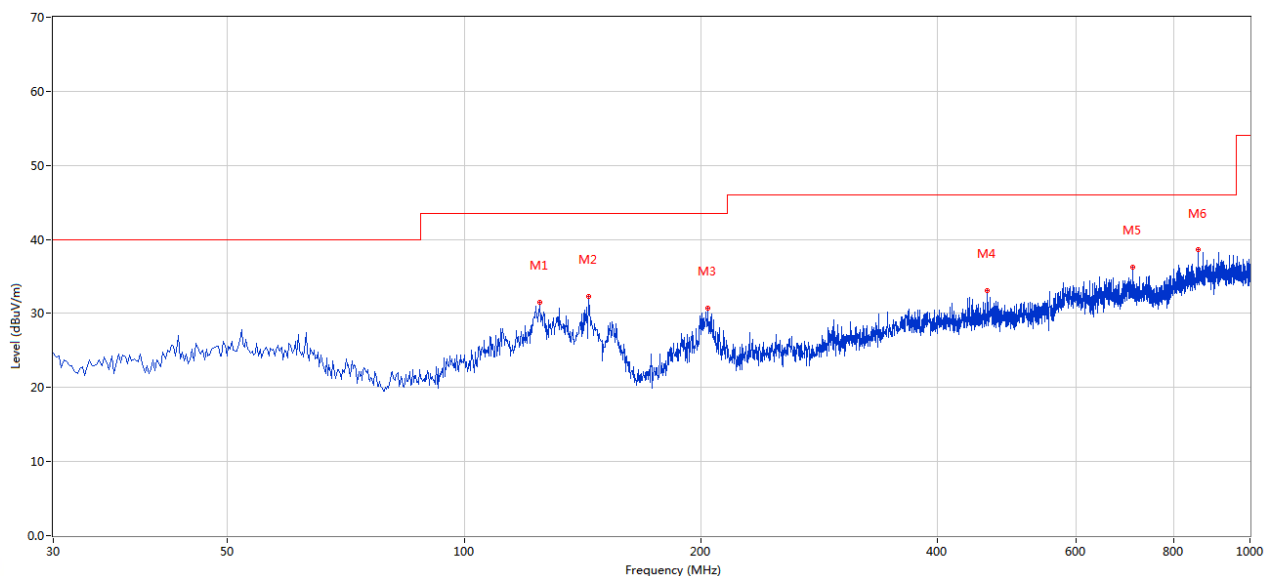
Distance extrapolation factor = $40\log(\text{Specific distance} / \text{test distance})$ (dB);
Limit line = Specific limits (dBuV) + distance extrapolation factor.

Test Frequency: 30MHz ~ 1GHz

Pass.

Please refer to the following test plots for the worst test mode (GFSK, Middle channel).

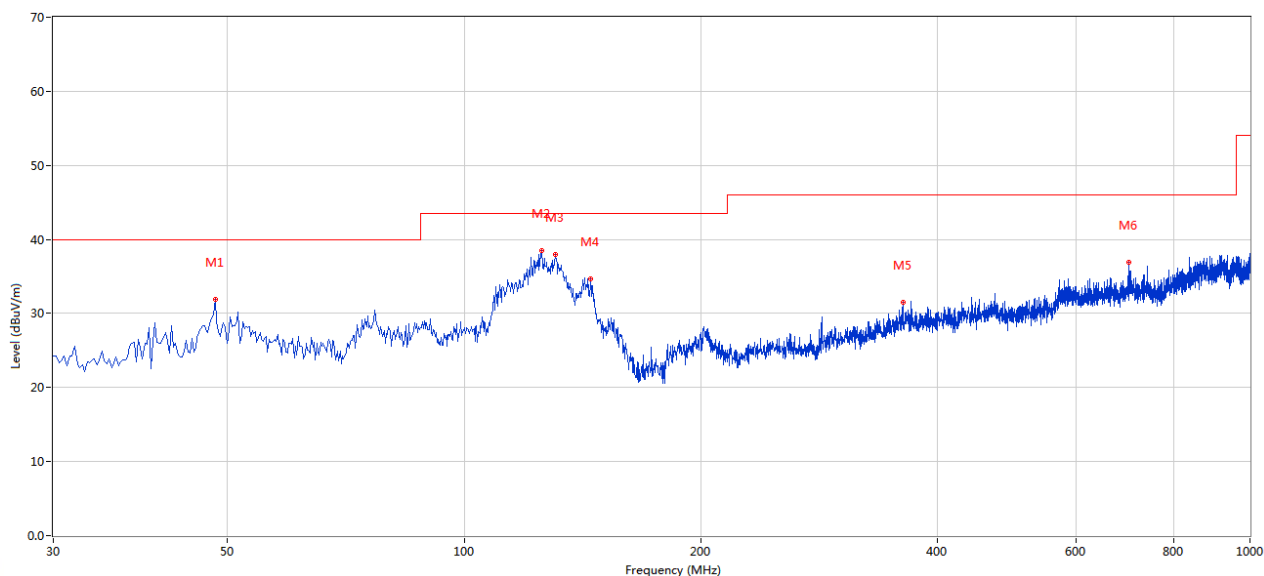
Test plot for Horizontal



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	ANT	Verdict
1	124.794	31.53	-7.80	43.5	11.97	Peak	Horizontal	Pass
2	144.189	32.36	-9.60	43.5	11.14	Peak	Horizontal	Pass
3	204.314	30.78	-7.19	43.5	12.72	Peak	Horizontal	Pass
4	462.754	33.09	-0.78	46.0	12.91	Peak	Horizontal	Pass
5	708.588	36.28	2.35	46.0	9.72	Peak	Horizontal	Pass
6	859.870	38.56	4.83	46.0	7.44	Peak	Horizontal	Pass

Remark: Emission Level = Reading + Cable Loss + ANT Factor - AMP Factor

Test plot for Vertical



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	ANT	Verdict
1	48.183	31.91	-5.34	40.0	8.09	Peak	Vertical	Pass
2	125.521	38.54	-7.93	43.5	4.96	Peak	Vertical	Pass
3	130.612	38.00	-8.59	43.5	5.50	Peak	Vertical	Pass
4	144.916	34.66	-9.69	43.5	8.84	Peak	Vertical	Pass
5	361.657	31.57	-1.86	46.0	14.43	Peak	Vertical	Pass
6	702.042	36.92	2.54	46.0	9.08	Peak	Vertical	Pass

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Test Frequency 1GHz-25GHz:

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre- amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
Low Channel:2402MHz									
V	4804.00	52.46	34.12	5.03	32.39	55.76	74.00	-18.24	Pk
V	4804.00	40.59	34.12	5.03	32.39	43.89	54.00	-10.11	AV
V	7206.00	46.27	32.54	6.29	35.86	55.88	74.00	-18.12	Pk
V	7206.00	33.31	32.54	6.29	35.86	42.92	54.00	-11.08	AV
V	9608.00	45.34	32.98	7.55	38.4	58.31	74.00	-15.69	Pk
V	9608.00	30.81	32.98	7.55	38.4	43.78	54.00	-10.22	AV
V	12010.00	41.78	32.09	8.93	39	57.62	74.00	-16.38	Pk
V	12010.00	26.64	32.09	8.93	39	42.48	54.00	-11.52	AV
H	4804.00	53.39	34.12	5.03	32.39	56.69	74.00	-17.31	Pk
H	4804.00	40.28	34.12	5.03	32.39	43.58	54.00	-10.42	AV
H	7206.00	47.49	32.54	6.29	35.86	57.1	74.00	-16.9	Pk
H	7206.00	33.78	32.54	6.29	35.86	43.39	54.00	-10.61	AV
H	9608.00	46.11	32.98	7.55	38.4	59.08	74.00	-14.92	Pk
H	9608.00	29.88	32.98	7.55	38.4	42.85	54.00	-11.15	AV
H	12010.00	41.17	32.09	8.93	39	57.01	74.00	-16.99	Pk
H	12010.00	26.93	32.09	8.93	39	42.77	54.00	-11.23	AV

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre- amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
Middle Channel:2440MHz									
V	4880.00	52.24	34.07	5.09	32.59	55.85	74.00	-18.15	Pk
V	4880.00	40.02	34.07	5.09	32.59	43.63	54.00	-10.37	AV
V	7320.00	47.26	32.63	6.34	35.96	56.93	74.00	-17.07	Pk
V	7320.00	33.66	32.63	6.34	35.96	43.33	54.00	-10.67	AV
V	9760.00	42.89	32.92	7.59	38.4	55.96	74.00	-18.04	Pk
V	9760.00	30.15	32.92	7.59	38.4	43.22	54.00	-10.78	AV
V	12200.00	38.17	31.96	8.88	39.04	54.13	74.00	-19.87	Pk
V	12200.00	27.53	31.96	8.88	39.04	43.49	54.00	-10.51	AV
H	4880.00	54.22	34.07	5.09	32.59	57.83	74.00	-16.17	Pk
H	4880.00	40.13	34.07	5.09	32.59	43.74	54.00	-10.26	AV
H	7320.00	47.37	32.63	6.34	35.96	57.04	74.00	-16.96	Pk
H	7320.00	33.54	32.63	6.34	35.96	43.21	54.00	-10.79	AV
H	9760.00	43.96	32.92	7.59	38.4	57.03	74.00	-16.97	Pk
H	9760.00	30.64	32.92	7.59	38.4	43.71	54.00	-10.29	AV
H	12200.00	41.15	31.96	8.88	39.04	57.11	74.00	-16.89	Pk
H	12200.00	26.86	31.96	8.88	39.04	42.82	54.00	-11.18	AV

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre- amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
High Channel:2480MHz									
V	4960.00	51.71	34.02	5.15	32.8	55.64	74.00	-18.36	Pk
V	4960.00	38.39	34.02	5.15	32.8	42.32	54.00	-11.68	AV
V	7440.00	46.69	32.71	6.4	36.05	56.43	74.00	-17.57	Pk
V	7440.00	33.24	32.71	6.4	36.05	42.98	54.00	-11.02	AV
V	9920.00	43.17	32.86	7.62	38.4	56.33	74.00	-17.67	Pk
V	9920.00	30.41	32.86	7.62	38.4	43.57	54.00	-10.43	AV
V	12400.00	39.85	31.82	8.84	39.08	55.95	74.00	-18.05	Pk
V	12400.00	26.89	31.82	8.84	39.08	42.99	54.00	-11.01	AV
H	4960.00	53.43	34.02	5.15	32.8	57.36	74.00	-16.64	Pk
H	4960.00	39.66	34.02	5.15	32.8	43.59	54.00	-10.41	AV
H	7440.00	46.04	32.71	6.4	36.05	55.78	74.00	-18.22	Pk
H	7440.00	33.48	32.71	6.4	36.05	43.22	54.00	-10.78	AV
H	9920.00	42.39	32.86	7.62	38.4	55.55	74.00	-18.45	Pk
H	9920.00	29.08	32.86	7.62	38.4	42.24	54.00	-11.76	AV
H	12400.00	40.14	31.82	8.84	39.08	56.24	74.00	-17.76	Pk
H	12400.00	26.15	31.82	8.84	39.08	42.25	54.00	-11.75	AV

Note: 1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier,

Margin= Emission Level - Limit

2. If peak below the average limit, the average emission was no test.

3. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

4. All the modes have tested and recorded the worst mode(GFSK) in the report

Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

	Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB/m)	Emission level (dBuV/m)	Limit (dBuV/m)	Detector Type	Result
GFSK	Low Channel: 2402MHz									
	H	2310.00	54.26	35.17	3.48	27.49	50.06	74.00	PK	PASS
	H	2310.00	46.48	35.17	3.48	27.49	42.28	54.00	AV	PASS
	H	2390.00	57.06	35.17	3.48	27.49	52.86	74.00	PK	PASS
	H	2390.00	51.05	35.17	3.48	27.49	46.85	54.00	AV	PASS
	H	2400.00	58.42	35.16	3.49	27.52	54.27	74.00	PK	PASS
	H	2400.00	49.81	35.16	3.49	27.52	45.66	54.00	AV	PASS
	V	2310.00	52.58	35.17	3.48	27.49	48.38	74.00	PK	PASS
	V	2310.00	45.13	35.17	3.48	27.49	40.93	54.00	AV	PASS
	V	2390.00	59.17	35.17	3.48	27.49	54.97	74.00	PK	PASS
	V	2390.00	51.41	35.17	3.48	27.49	47.21	54.00	AV	PASS
	V	2400.00	59.58	35.16	3.49	27.52	55.43	74.00	PK	PASS
	V	2400.00	50.94	35.16	3.49	27.52	46.79	54.00	AV	PASS
	High Channel: 2480MHz									
	H	2483.50	58.21	35.11	3.56	27.75	54.41	74.00	PK	PASS
	H	2483.50	47.66	35.11	3.56	27.75	43.86	54.00	AV	PASS
	H	2500.00	56.75	35.1	3.57	27.8	53.02	74.00	PK	PASS
	H	2500.00	47.02	35.1	3.57	27.8	43.29	54.00	AV	PASS
	V	2483.50	60.27	35.11	3.56	27.75	56.47	74.00	PK	PASS
	V	2483.50	51.19	35.11	3.56	27.75	47.39	54.00	AV	PASS
	V	2500.00	57.89	35.1	3.57	27.8	54.16	74.00	PK	PASS
	V	2500.00	51.75	35.1	3.57	27.8	48.02	54.00	AV	PASS
Remark:										
1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier, Margin= Emission Level - Limit										

7 Conduct Band Edge And Spurious Emissions Measurement

Test Requirement : FCC Part15 C Section 15.247 (d)
Test Method : ANSI C63.10:2013
Test Limit : in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, 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).

7.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold

7.2 TEST SETUP

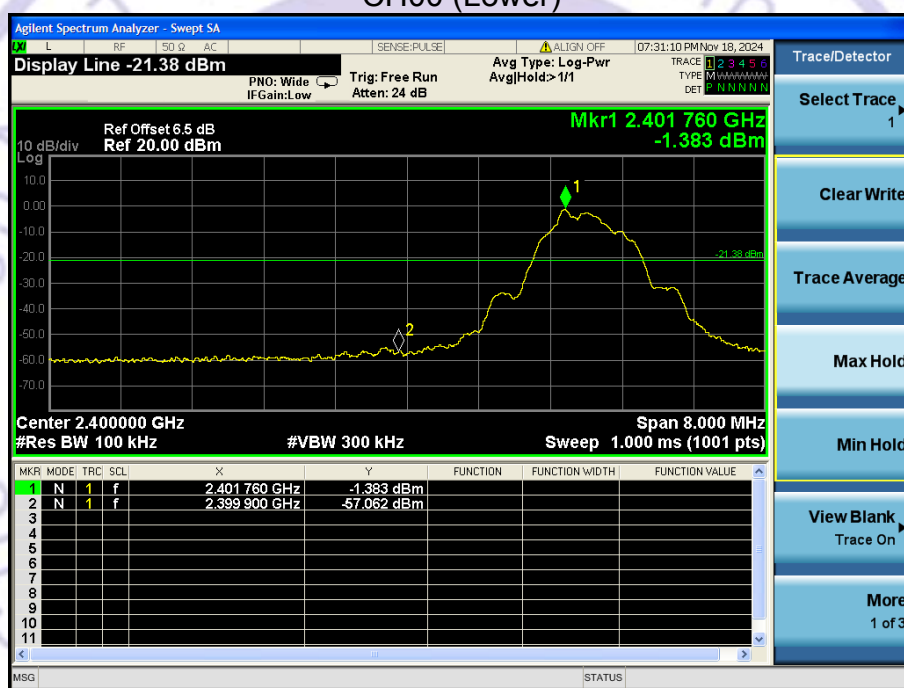


7.3 Test Result

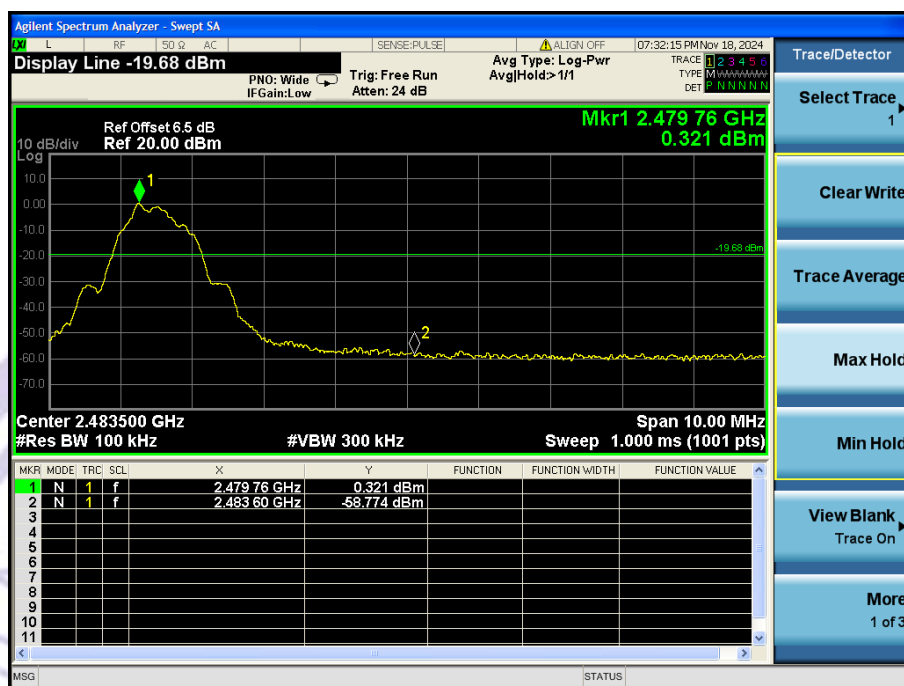
Please see the attachment for the BLE data

BLE

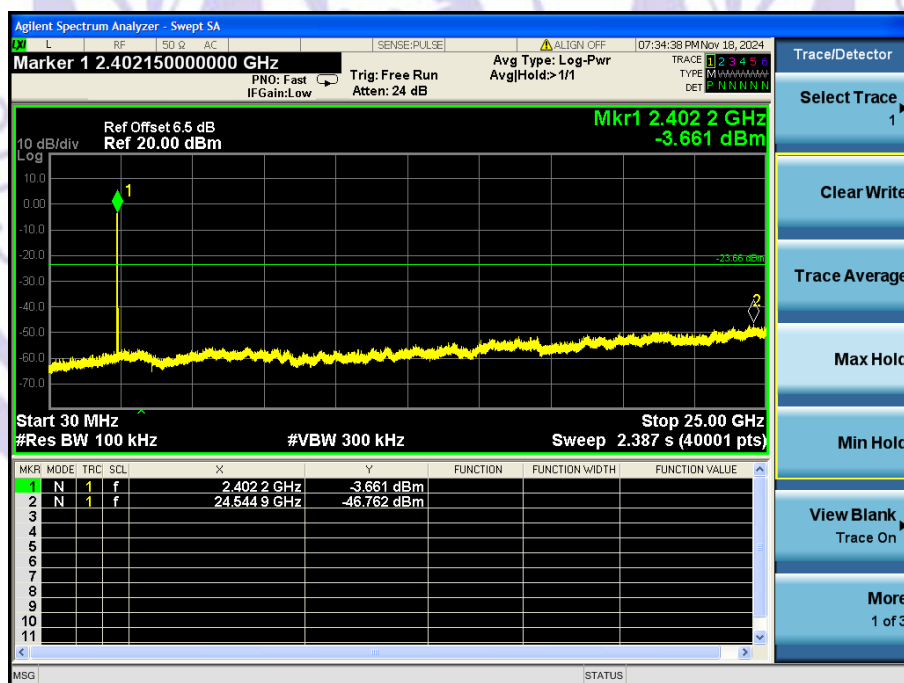
CH00 (Lower)



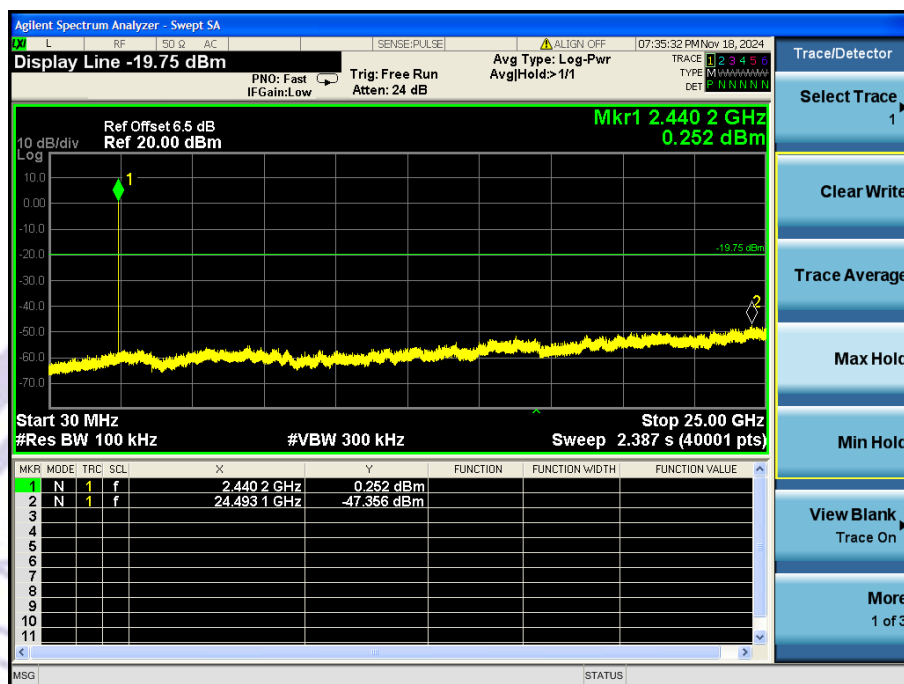
CH 39 (Upper)



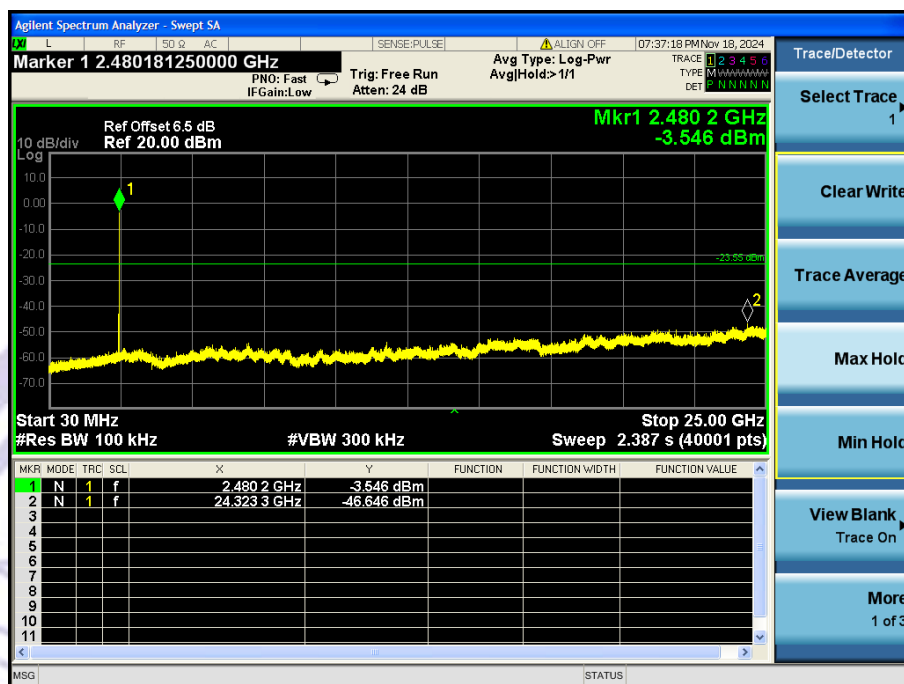
CH00



CH19



CH39



8 6dB Bandwidth Measurement

Test Requirement : FCC CFR47 Part 15 Section 15.247, RSS-247

Test Method : ANSI C63.10:2013

Test Limit 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.

8.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

8.2 TEST SETUP



8.3 Test Result

Test Mode	Test Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Limit (kHz)
Mode 1	CH00	2402	534.4	≥ 500
	CH19	2440	525.9	≥ 500
	CH39	2480	549.9	≥ 500

CH00 2402MHz



CH19 2440MHz



CH39 2480MHz



9 Maximum Peak Output Power

Test Requirement : FCC CFR47 Part 15 Section 15.247, RSS-247 § 5.4

Test Method : ANSI C63.10:2013

Test Limit : Regulation 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.

9.1 Test Procedure

1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Measure the conducted output power and record the results in the test report.

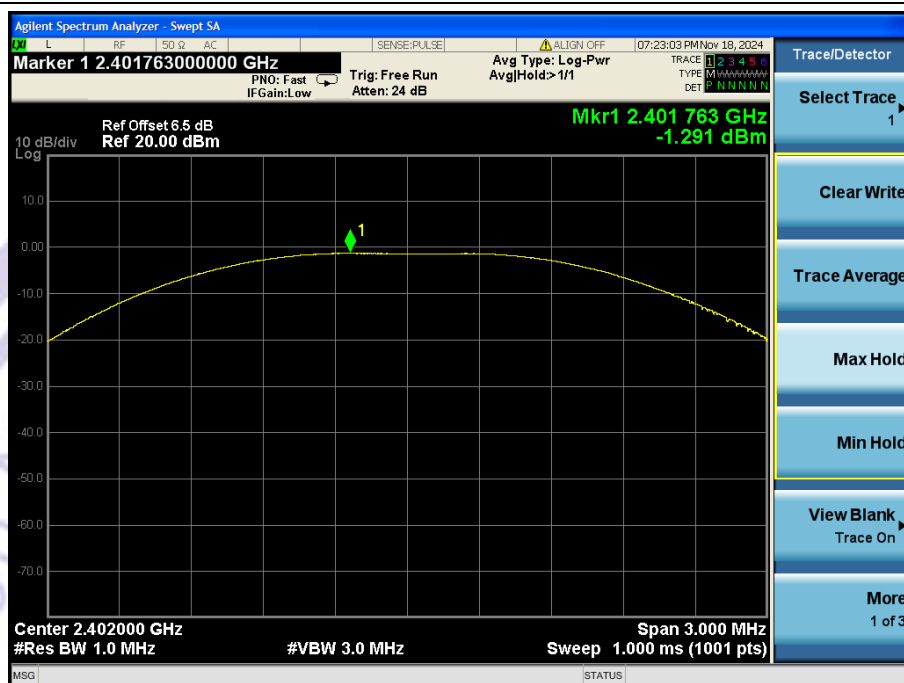
9.2 TEST SETUP



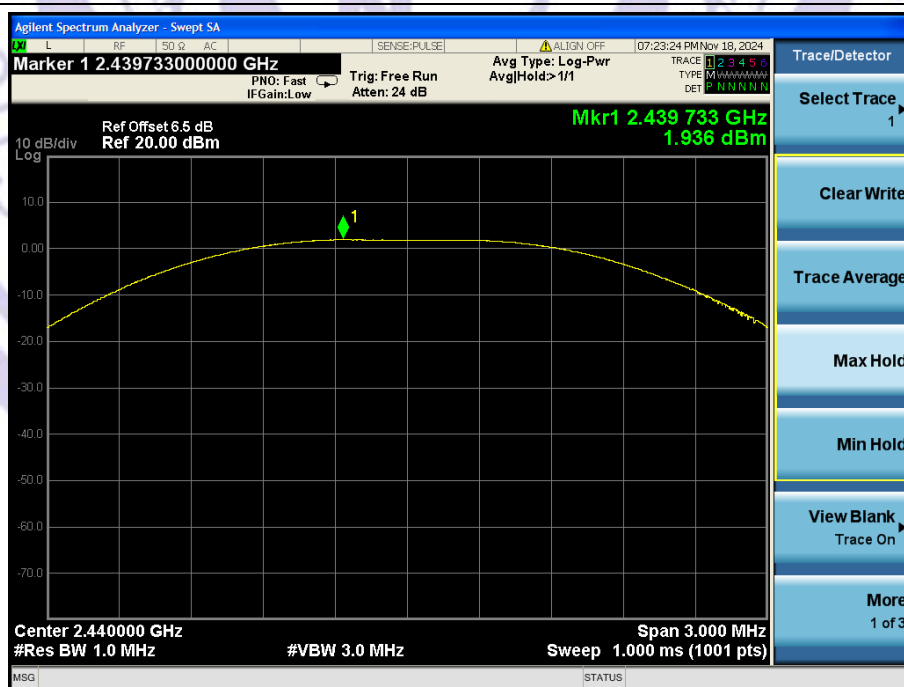
9.3 Test Result

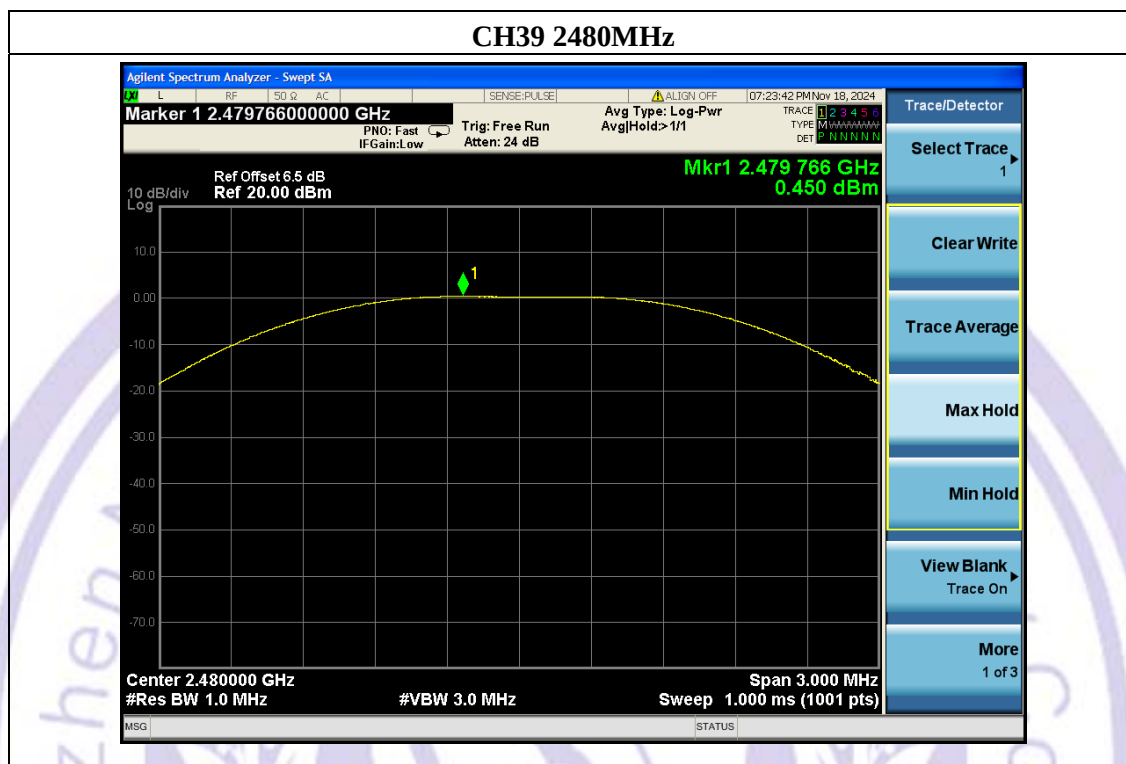
Test Channel	Frequency (MHz)	Output Power (dBm)	Limit(dBm)	Result
CH00	2402 MHz	-1.291	30	PASS
CH19	2440MHz	1.936	30	PASS
CH39	2480 MHz	0.450	30	PASS

CH00 2402MHz



CH19 2440MHz





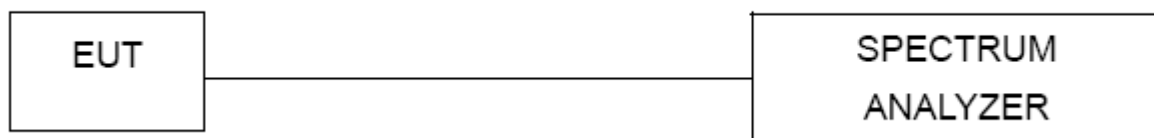
10 Power Spectral density

Test Requirement	: FCC CFR47 Part 15 Section 15.247,RSS-247 §5.2 (b)
Test Method	: ANSI C63.10:2013
Test Limit	: Regulation 15.247(f) The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3kHz. VBW = 10kHz , Span = 1.5 times the DTS channel bandwidth(6 dB bandwidth). Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

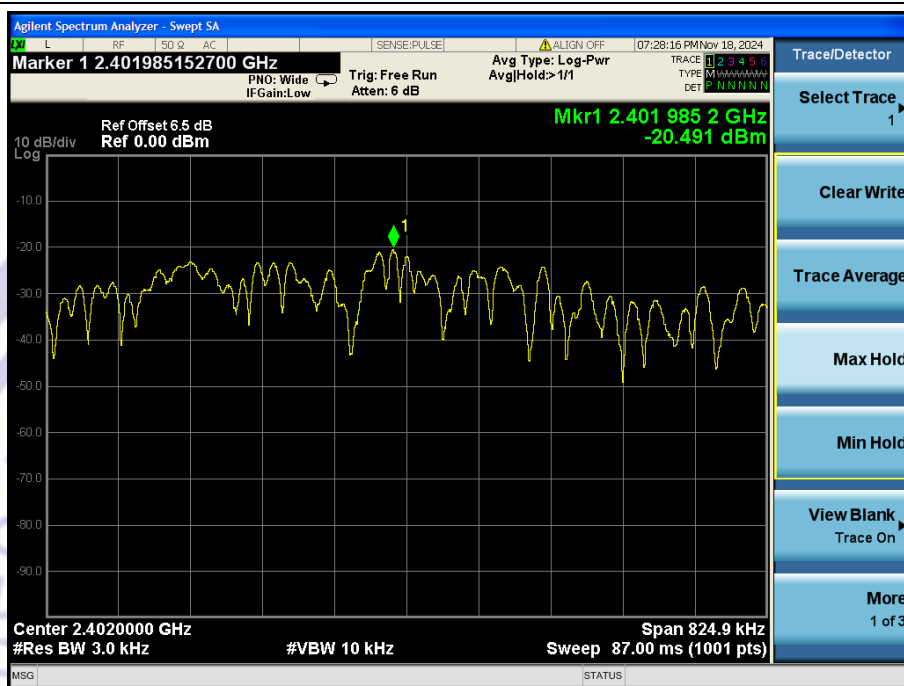
10.2 TEST SETUP



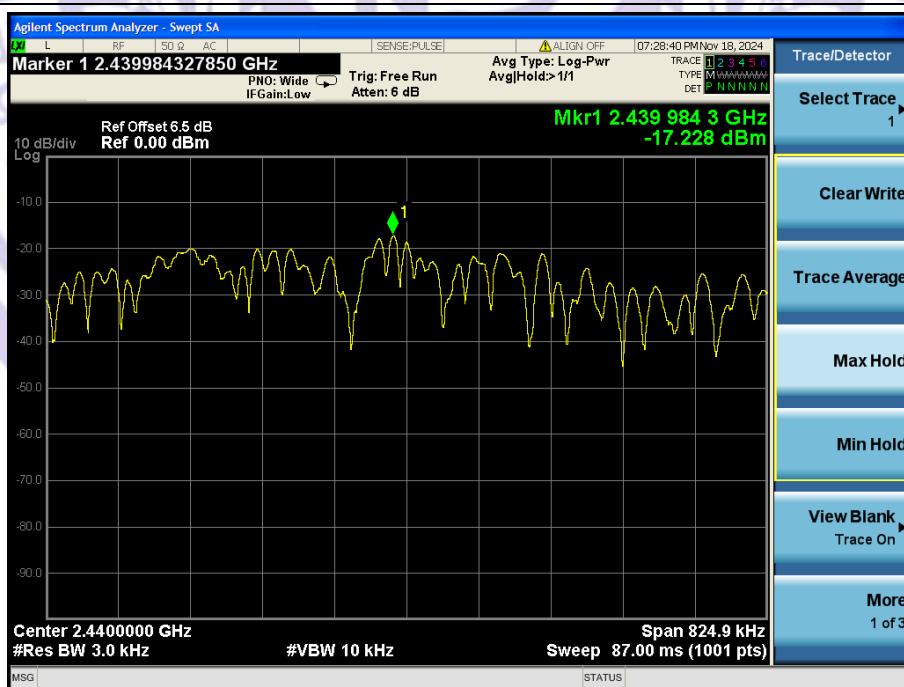
10.3 Test Result

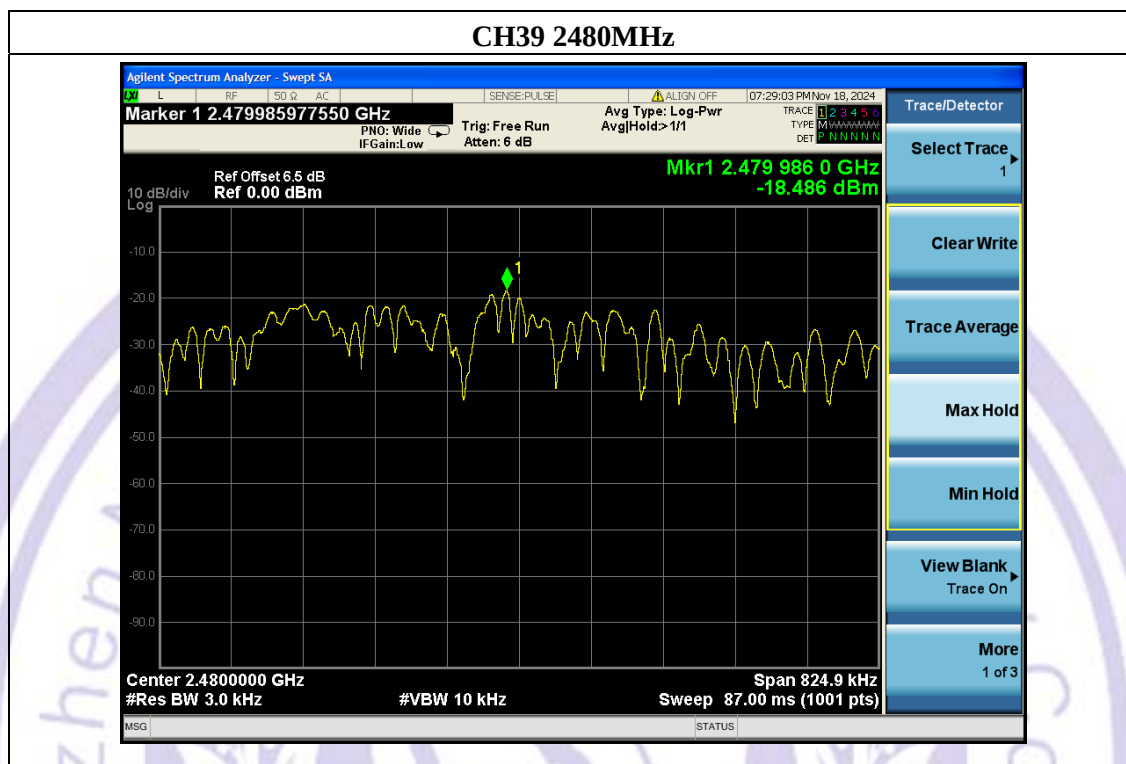
Test Channel	Frequency(MHz)	Power Density(dBm)	LIMIT(dBm)
CH00	2402 MHz	-20.491	8.00
CH19	2440 MHz	-17.228	8.00
CH39	2480 MHz	-18.486	8.00

CH00 2402MHz



CH19 2440MHz





11 Antenna Application

11.1 Antenna Requirement

15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(c) (1)(i) requirement:

Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

11.2 Result

The antenna is PCB Antenna which permanently attached, and the best case gain of the antenna is 3.0dBi. It complies with the standard requirement.

12 Test Setup Photos and EUT Photos

Please see the attachment for details.

*****THE END REPORT*****

