FCC TEST REPORT

FCC ID:2BFIL-L1

Product	:	illuminance spectrophotometer
Model Name	:	L1
Serial Model	:	S1
Brand	:	MICRO-LIGHT
Report No.	:	PTC24030102301E-FC02

Prepared for

MICRO-LIGHT OPTICS CO., LTD

17F-3,No.531,Zhongshan Rd.Wuxi City,P.R.C

Prepared by

Precise Testing & Certification Co., Ltd

Building 1, No. 6, Tongxin Road, Dongcheng Street, Dongguan, Guangdong, China

1 TEST RESULT CERTIFICATION

Applicant's name	:	MICRO-LIGHT OPTICS CO., LTD
Address	:	17F-3,No.531,Zhongshan Rd.Wuxi City,P.R.C
Manufacture's name	:	MICRO-LIGHT OPTICS CO., LTD
Address	:	17F-3,No.531,Zhongshan Rd.Wuxi City,P.R.C
Product name	:	illuminance spectrophotometer
Model name	:	L1, S1
Standards	:	FCC CFR47 Part 15 Section 15.247
Test procedure	:	ANSI C63.10:2013
Test Date	:	Mar. 11, 2024 to Apr. 08, 2024
Date of Issue	:	Apr. 08, 2024
Test Result	:	Pass

This device described above has been tested by PTC, 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.

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Test Engineer:

Jack Zhou / Engineer

Technical Manager:

Simon Pu/ Manager

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2 Test Summary

Test Items	Test Requirement	Result
Conduct Emission	15.207	PASS
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	PASS
Conducted Spurious Emission	15.247(d)	PASS
Band edge	15.247(d) 15.205(a)	PASS
6dB Bandwidth	15.247(a)(2)	PASS
Maximum Peak Output Power	15.247(b)(3)	PASS
Power Spectral Density	15.247(e)	PASS
Antenna Requirement	15.203	PASS

2.1 Test Site

Precise Testing & Certification Co., Ltd

Address: Building 1, No. 6, Tongxin Road, Dongcheng Street, Dongguan, Guangdong, China

FCC Registration Number: 790290

A2LA Certificate No.: 4408.01

IC Registration Number: 12191A

FCC Designation Number: CN1219

3 General Information

3.1 General Description of E.U.T.

Product Name	:	illuminance spectrophotometer
Model Number	:	L1
Additional model	:	S1
Model difference	:	The difference between L1 and S1 is that the measuring head position is different, the measuring head position of L1 is forward, and the measuring head position of S1 is upward.
Operating frequency	:	2402-2480MHz
Number of Channels	:	40 channels For DTS
Type of Modulation	:	GFSK, For DTS
Antenna installation	:	PCB Antenna
Antenna Gain	:	3.11 dBi
Power supply	:	Input: DC 3.7V
Hardware Version	:	MST72128Y050_WXCW_V1.2
Software Version	:	msm8953.wxcw-userdebug-053-20230919-10
Test Sample No.	:	PTC24030102301E-1/2, PTC24030102301E-2/2

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		

Note:

1. Test of channel was included the lowest 2402MHz, middle 2440MHz and highest frequency 2480MHz in highest data rate and to perform the test, then record on this report.

4 Equipment During Test

4.1 Equipments List

RF Conducted Test

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Date	Calibration period
MXG Signal Analyzer	Agilent	N9020A	SER MY5111038	10Hz-30GHz	Aug. 21, 2023	1 year
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	Aug. 21, 2023	1 year
Power Meter	Anritsu	ML2495A	0949003	300MHz-40GHz	Aug. 21, 2023	1 year
Power Sensor	Anritsu	MA2411B	0917017	300MHz-40GHz	Aug. 21, 2023	1 year
Test S/W	Tonscend	JS1120-3	/	/	/	/

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

Radiated Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Date	Calibration period
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Aug. 21, 2023	1 year
Loop Antenna	Schwarzbeck	FMZB 1519	012	9 KHz -30MHz	Aug. 21, 2023	1 year
Bilog Antenna	SCHWARZBECK	VULB9160	9160-3355	25MHz-2GHz	Aug. 21, 2023	1 year
Preamplifier (low frequency)	SCHWARZBECK	BBV 9475	9745-0013	1MHz-1GHz	Aug. 21, 2023	1 year
Cable	Schwarzbeck	PLF-100	549489	9KHz-3GHz	Aug. 21, 2023	1 year
Spectrum Analyzer	Agilent	E4407B	MY45109572	9KHz-40GHz	Aug. 21, 2023	1 year
Horn Antenna	SCHWARZBECK	9120D	9120D-1246	1GHz-18GHz	Aug. 21, 2023	1 year
Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	1GHz-26.5GHz	Aug. 21, 2023	1 year

Horn Antenna	SCHWARZBECK	BBHA 9170	9170-181	14GHz-40GHz	Aug. 21, 2023	1 year
Amplifier	SCHWARZBECK	BBV 9721	9721-205	18GHz-40GHz	Aug. 21, 2023	1 year
Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	Aug. 21, 2023	1 year
RF Cable	R&S	R204	R21X	1GHz-40GHz	Aug. 21, 2023	1 year
Test S/W	Tonscend	TS+	/	/	/	/

Conducted Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Date	Calibration period
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Aug. 21, 2023	1 year
Artificial Mains Network	Rohde&Schwarz	ENV216	102453	9KHz-300MHz	Aug. 21, 2023	1 year
Artificial Mains Network	Rohde&Schwarz	ENV216	101342	9KHz-300MHz	Aug. 21, 2023	1 year
Test S/W	Tonscend	JS32-CE	/	/	/	/

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)	±3.15dB
Radiated Emission(30MHz~1GHz)	±5.03dB
Radiated Emission(1GHz~25GHz)	±4.74dB
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%	

4.3 Description of Support Units

Equipment	Model No.	Series No.
N/A	N/A	N/A

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

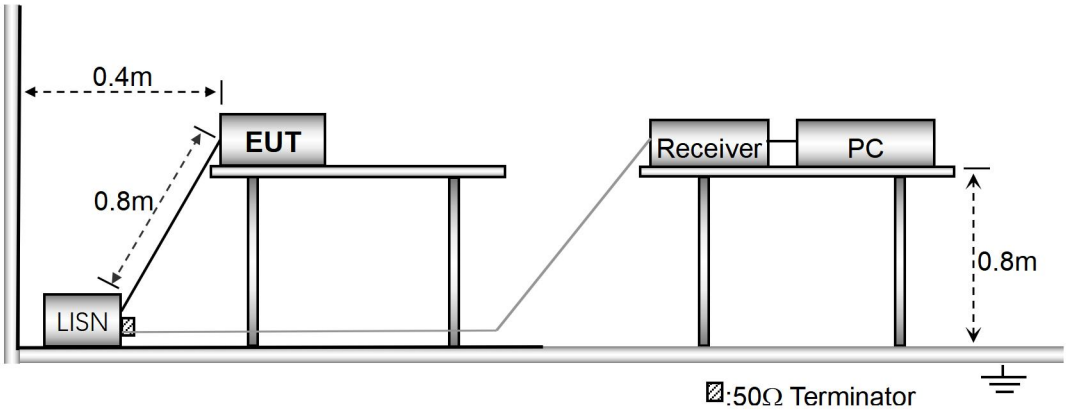
5.1 E.U.T. Operation

Operating Environment :

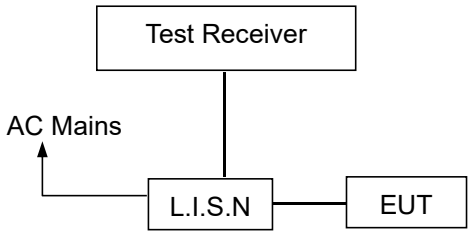
Temperature	:	25.5 °C
Humidity	:	51 % RH
Atmospheric Pressure	:	101.2kPa

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

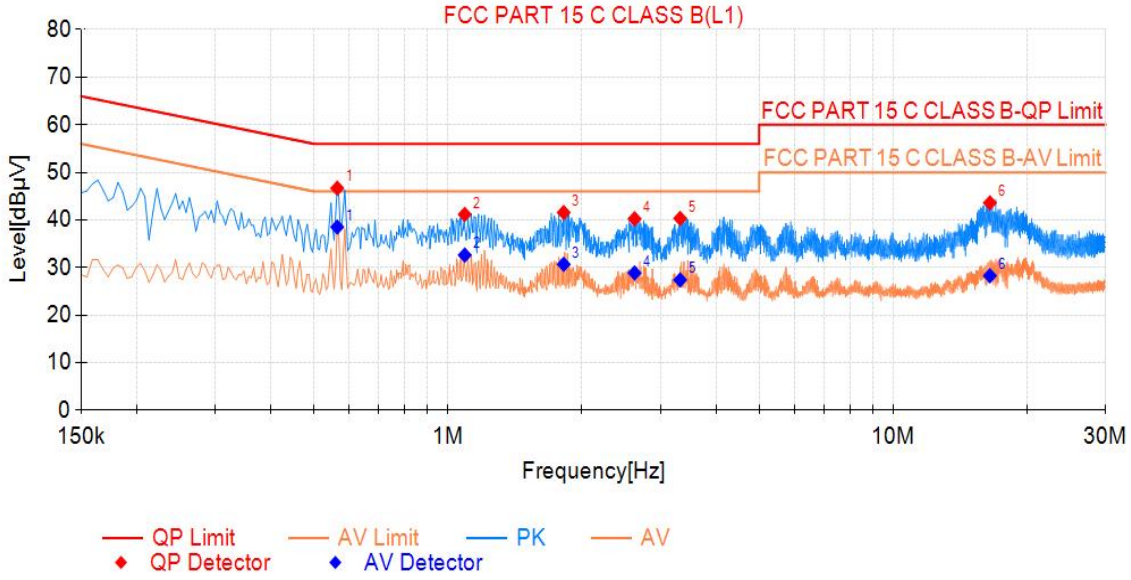
The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

5.7 Conducted Emission Test Result

Pass.

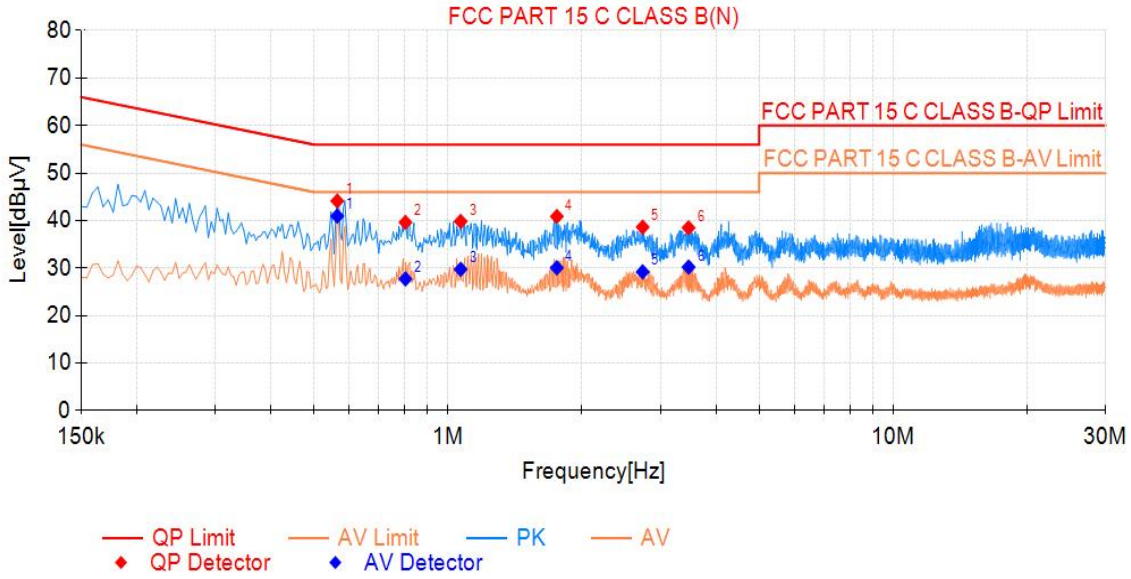
All the modulation modes were tested the data of the worst mode (AC 120V/60Hz, GFSK TX 2402MHz) are recorded in the following pages and the others modulation methods do not exceed the limits.

Line-AC 120V/60Hz



Final Data List								
NO.	Freq. [MHz]	QP Value	QP Limit	QP Margin	AV Value	AV Limit	AV Margin	Verdict
1	0.564	19.25	46.69	56.00	9.31	38.53	46.00	PASS
2	1.091	19.30	41.17	56.00	14.83	32.63	46.00	PASS
3	1.820	19.34	41.58	56.00	14.42	30.69	46.00	PASS
4	2.625	19.41	40.25	56.00	15.75	28.87	46.00	PASS
5	3.323	19.32	40.33	56.00	15.67	27.41	46.00	PASS
6	16.490	20.16	43.60	60.00	16.40	28.28	50.00	PASS

Neutral-AC 120V/60Hz



Final Data List								
NO.	Freq. [MHz]	QP Value	QP Limit	QP Margin	AV Value	AV Limit	AV Margin	Verdict
1	0.564	19.19	44.13	56.00	11.87	40.96	46.00	PASS
2	0.803	19.26	39.64	56.00	16.36	27.73	46.00	PASS
3	1.068	19.25	39.84	56.00	16.16	29.75	46.00	PASS
4	1.757	19.25	40.88	56.00	15.12	30.07	46.00	PASS
5	2.738	19.23	38.64	56.00	17.36	29.20	46.00	PASS
6	3.471	19.22	38.48	56.00	17.52	30.21	46.00	PASS

Note: QP Margin[dB]= QP Limit[dBµV]- QP Value[dBµV], AV Margin[dB]= AV Limit[dBµV]- AV Value[dBµV].

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(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
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

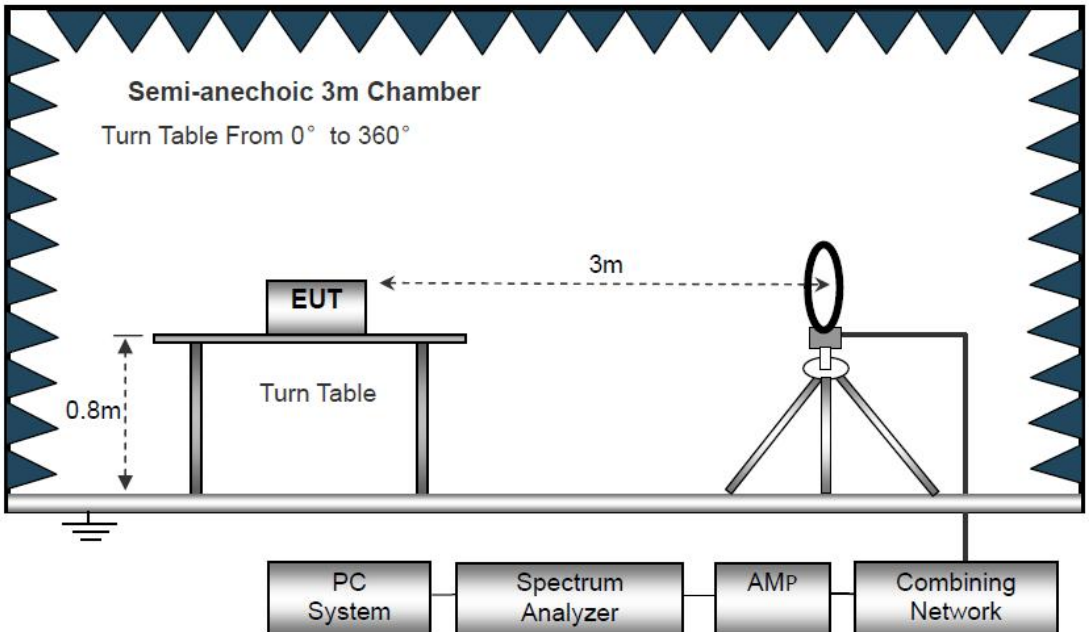
Humidity : 51.1 % RH

Atmospheric Pressure : 101.2kPa

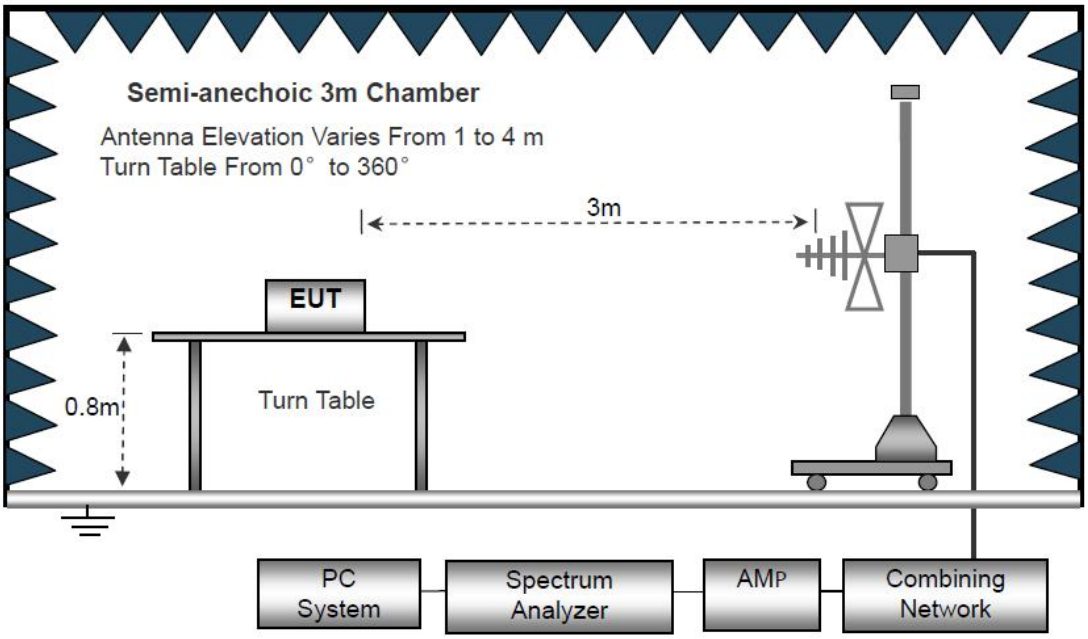
6.2 Test Setup

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

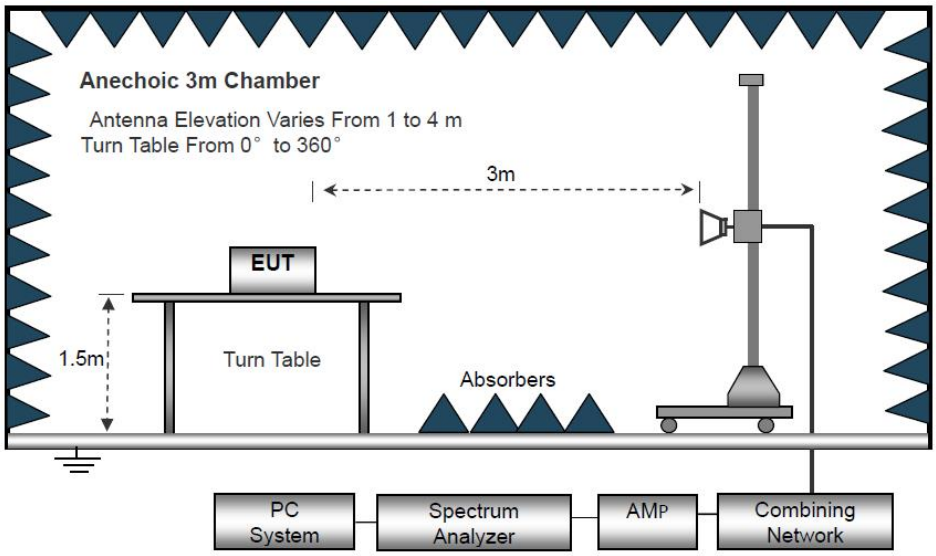
The test setup for emission measurement below 30MHz



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	RMS	1MHz	3MHz	--
	30MHz ~ 1GHz	RMS	1MHz	3MHz	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≥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.

Band	Duty Cycle(%)	T(μs)	1/T(KHz)	Average Correction Factor	VBW Setting
2402-2480	100	-	-	0	10Hz

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.

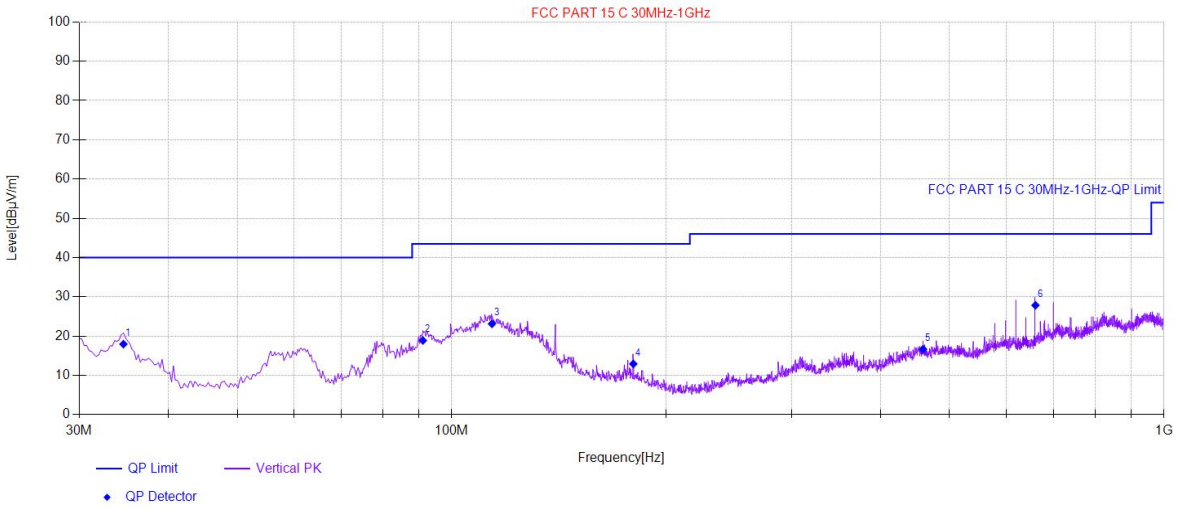
Distance extrapolation factor =40log(Specific distance/ test distance)(dB);
Limit line=Specific limits(dBuV) + distance extrapolation factor.

Test Frequency: 30MHz ~ 1GHz

Pass.

Please refer to the following test plots for the worst test mode (GFSK (CH00: 2402MHz)).

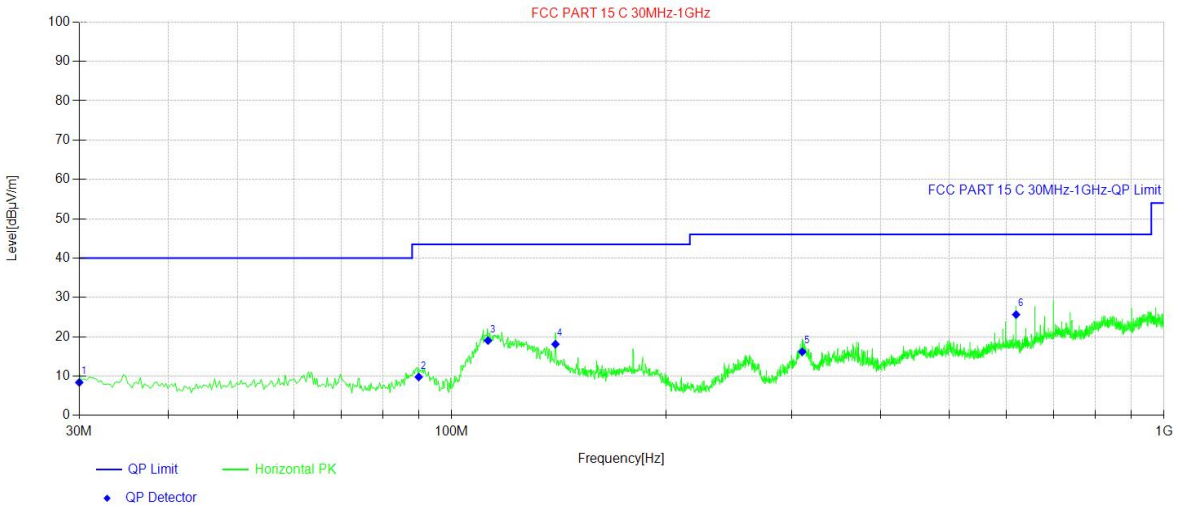
Antenna Polarization: Vertical GFSK(CH00: 2402MHz)



Final Data List[QP]								
NO.	Freq. [MHz]	QP Reading [dBμV/m]	Factor [dB]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Polarity	Verdict
1	34.61	36.09	-18.12	17.97	40.00	22.03	Vertical	PASS
2	91.11	39.69	-20.80	18.89	43.50	24.61	Vertical	PASS
3	113.91	41.88	-18.75	23.13	43.50	20.37	Vertical	PASS
4	179.87	30.42	-17.48	12.94	43.50	30.56	Vertical	PASS
5	458.98	28.05	-11.37	16.68	46.00	29.32	Vertical	PASS
6	660.02	34.5	-6.65	27.85	46.00	18.15	Vertical	PASS

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

Antenna Polarization: Horizontal GFSK(CH00: 2402MHz)



Final Data List[QP]								
NO.	Freq. [MHz]	QP Reading [dBμV/m]	Factor [dB]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Polarity	Verdict
1	30.00	26.76	-18.36	8.40	40.00	31.60	Horizontal	PASS
2	89.90	30.78	-20.99	9.79	43.50	33.71	Horizontal	PASS
3	112.45	37.89	-18.85	19.04	43.50	24.46	Horizontal	PASS
4	139.85	34.77	-16.66	18.11	43.50	25.39	Horizontal	PASS
5	310.57	31.4	-15.20	16.20	46.00	29.80	Horizontal	PASS
6	620.00	33.18	-7.53	25.65	46.00	20.35	Horizontal	PASS

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

Test Frequency 1GHz-25GHz:

Test Mode: CH00 GFSK					Test channel:Low Channel (2402MHz)			
Peak Value								
Frequency (MHz)	Read Level (dBuV/m)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Pol.
4804	45.47	30.16	6.58	34.09	48.12	74.00	-25.88	V
7206	42.22	37.11	7.73	34.50	52.56	74.00	-21.44	V
9608	38.63	39.31	9.23	34.79	52.38	74.00	-21.62	V
4804	46.49	34.04	6.58	34.09	53.02	74.00	-20.98	H
7206	36.37	37.11	7.73	34.50	46.71	74.00	-27.29	H
9608	39.95	39.31	9.23	34.79	53.70	74.00	-20.30	H
Average Value								
Frequency (MHz)	Read Level (dBuV/m)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Pol.
4804	34.61	34.04	6.58	34.09	41.14	54.00	-12.86	V
7206	28.07	37.11	7.73	34.50	38.41	54.00	-15.59	V
9608	23.90	39.31	9.23	34.79	37.65	54.00	-16.35	V
4804	32.64	34.04	6.58	34.09	39.17	54.00	-14.83	H
7206	27.45	37.11	7.73	34.50	37.79	54.00	-16.21	H
9608	26.11	39.31	9.23	34.79	39.86	54.00	-14.14	H

Test Mode: CH19 GFSK					Test channel:Middle Channel (2440MHz)			
Peak Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Pol.
4880	42.19	34.38	6.69	34.09	49.17	74.00	-24.83	V
7320	39.78	37.22	7.78	34.53	50.25	74.00	-23.75	V
9760	34.92	39.46	9.35	34.80	48.93	74.00	-25.07	V
4880	41.77	34.38	6.69	34.09	48.75	74.00	-25.25	H
7320	37.96	37.22	7.78	34.53	48.43	74.00	-25.57	H
9760	37.06	39.46	9.35	34.80	51.07	74.00	-22.93	H
Average Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Pol.
4880	33.04	34.38	6.69	34.09	40.02	54.00	-13.98	V
7320	27.38	37.22	7.78	34.53	37.85	54.00	-16.15	V
9760	24.15	39.46	9.35	34.80	38.16	54.00	-15.84	V
4880	33.84	34.38	6.69	34.09	40.82	54.00	-13.18	H
7320	29.32	37.22	7.78	34.53	39.79	54.00	-14.21	H
9760	25.09	39.46	9.35	34.80	39.10	54.00	-14.90	H

Test Mode: CH39 GFSK					Test channel:High Channel (2480MHz)			
Peak Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Pol.
4960	42.38	34.72	6.68	34.09	49.69	74.00	-24.31	V
7440	40.22	37.34	6.73	34.57	49.72	74.00	-24.28	V
9920	34.59	39.62	6.81	34.81	46.21	74.00	-27.79	V
4960	41.13	34.72	6.68	34.09	48.44	74.00	-25.56	H
7440	37.27	37.34	6.73	34.57	46.77	74.00	-27.23	H
9920	38.03	39.62	6.81	34.81	49.65	74.00	-24.35	H
Average Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Pol.
4960	32.05	34.72	6.68	34.09	39.36	54.00	-14.64	V
7440	28.08	37.34	6.73	34.57	37.58	54.00	-16.42	V
9920	25.02	39.62	6.81	34.81	36.64	54.00	-17.36	V
4960	31.87	34.72	6.68	34.09	39.18	54.00	-14.82	H
7440	27.14	37.34	6.73	34.57	36.64	54.00	-17.36	H
9920	23.66	39.62	6.81	34.81	35.28	54.00	-18.72	H

Note: 1. The testing has been conformed to 10*2480MHz=24800MHz.

2. All other emissions more than 30dB below the limit.

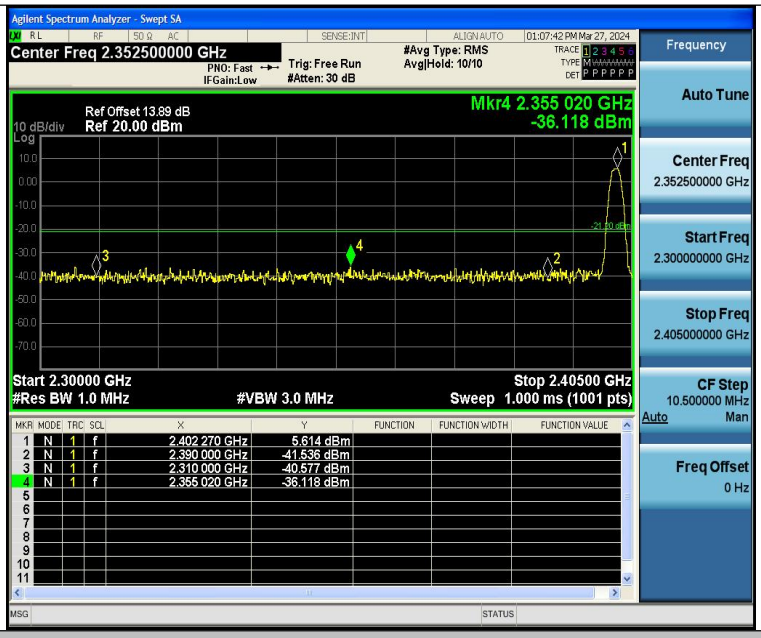
3. Factor = Antenna Factor + Cable Loss – Pre-amplifier.
Emission Level = Reading + Factor
Margin=Emission Level-Limit

Spurious Emission in Restricted Bands

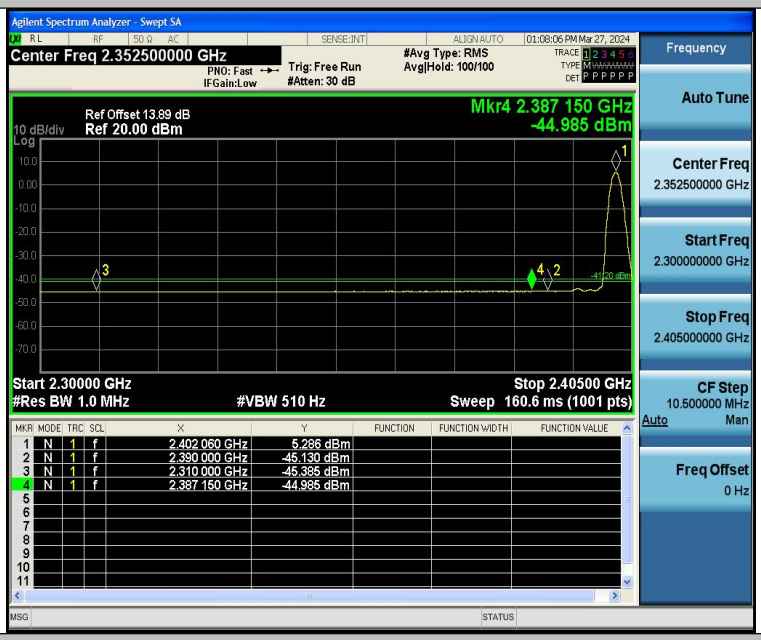
Test Mode	Antenna	Ch Name	Frequency[MHz]	Detector	Freq [MHz]	Result [dBm]	Limit [dBm]	Result [dBuV/m]	Limit [dBuV/m]	Verdict
BLE_1M	Ant1	Low	2402	Peak	2390.000	-41.54	≤-21.20	53.66	≤74	PASS
BLE_1M	Ant1	Low	2402	Peak	2310.000	-40.58	≤-21.20	54.62	≤74	PASS
BLE_1M	Ant1	Low	2402	Peak	2355.020	-36.12	≤-21.20	59.08	≤74	PASS
BLE_1M	Ant1	Low	2402	AV	2390.000	-45.13	≤-41.20	50.07	≤54	PASS
BLE_1M	Ant1	Low	2402	AV	2310.000	-45.39	≤-41.20	49.81	≤54	PASS
BLE_1M	Ant1	Low	2402	AV	2387.150	-44.98	≤-41.20	50.22	≤54	PASS
BLE_1M	Ant1	High	2480	Peak	2483.500	-37.49	≤-21.20	57.71	≤74	PASS
BLE_1M	Ant1	High	2480	Peak	2500.000	-39.96	≤-21.20	55.24	≤74	PASS
BLE_1M	Ant1	High	2480	Peak	2486.080	-35	≤-21.20	60.20	≤74	PASS
BLE_1M	Ant1	High	2480	AV	2483.500	-44.52	≤-41.20	50.68	≤54	PASS
BLE_1M	Ant1	High	2480	AV	2500.000	-45.08	≤-41.20	50.12	≤54	PASS
BLE_1M	Ant1	High	2480	AV	2486.640	-44.16	≤-41.20	51.04	≤54	PASS

Note:

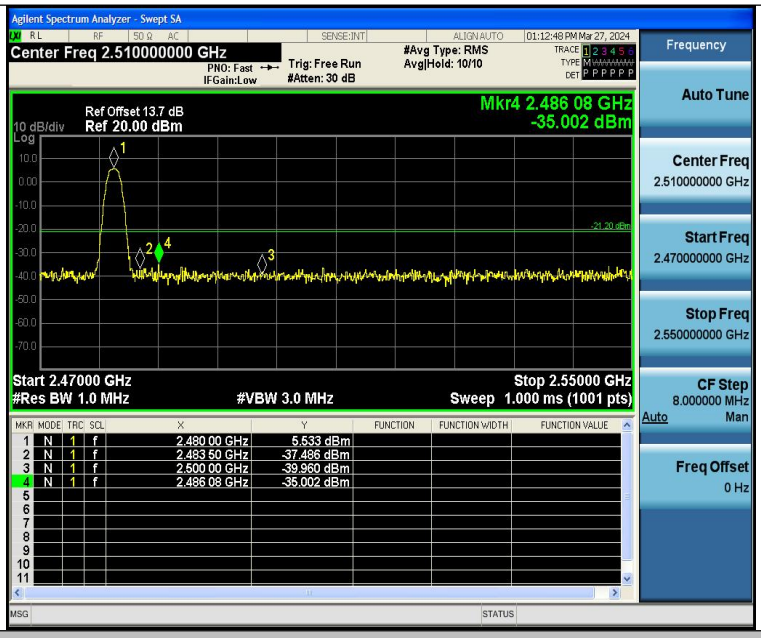
1. The Antenna Gain is compensated in the graph.
2. The limit in dBm for average detector is conversion from 54dBuV/m, according to 15.209(a). The limit in dBm for peak detector is 20dB above the limit of average detector in dBm.



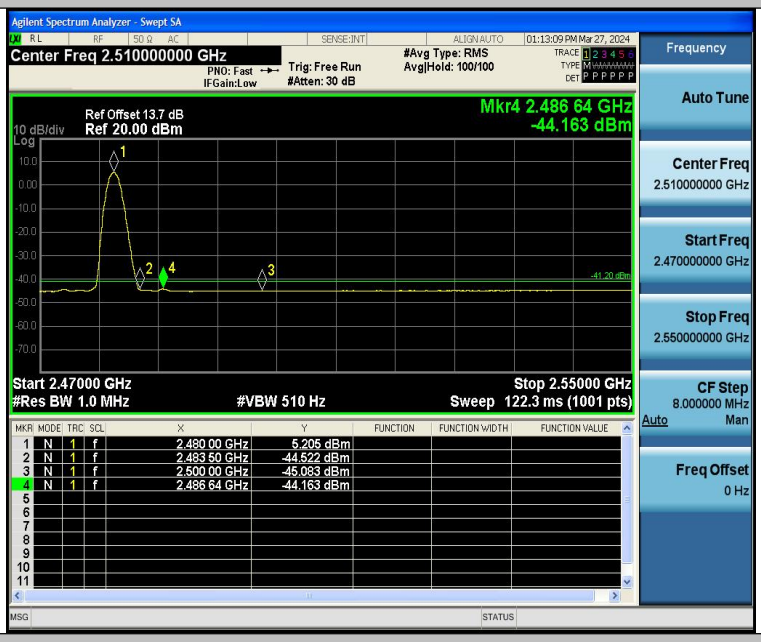
BLE_1M-Ant1-2402-PASS



BLE_1M-Ant1-2402-PASS



BLE_1M-Ant1-2480-PASS



BLE_1M-Ant1-2480-PASS

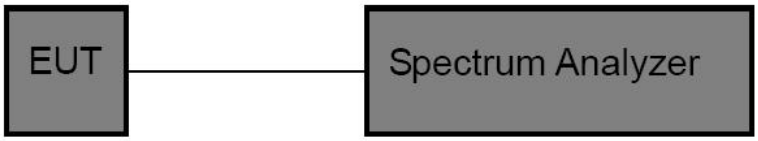
7 Conduct Band Edge And Spurious Emissions Measurement

Test Requirement	:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method	:	ANSI C63.10:2013
Test Limit	:	Regulation 15.247 (d),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)).

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

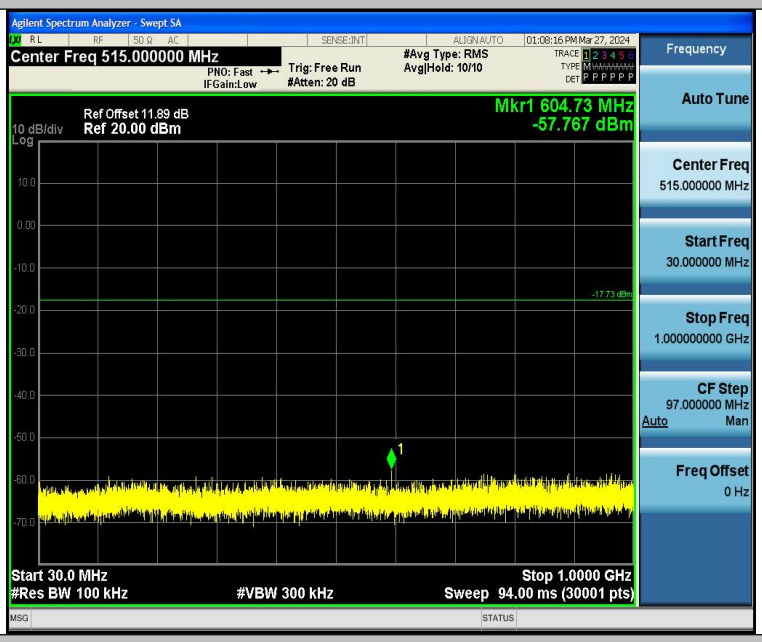


7.3 Test Result

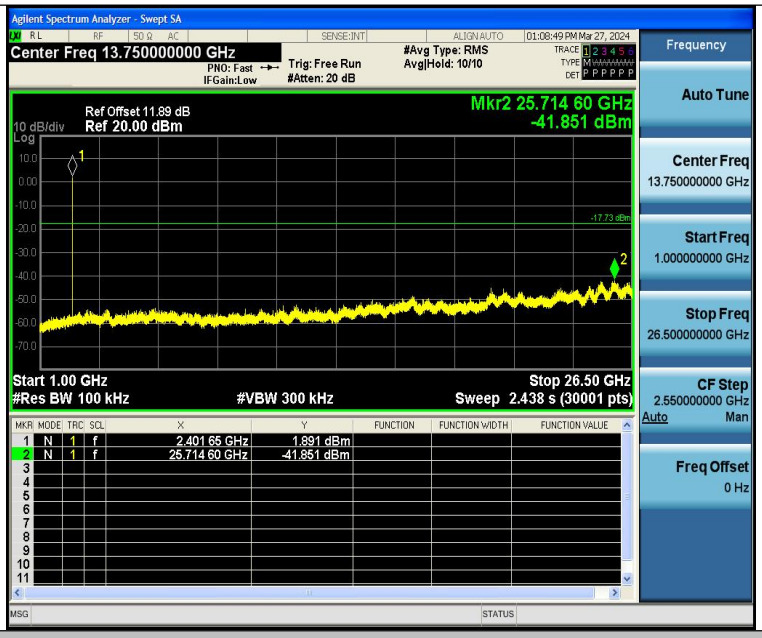
Test Mode	Antenna	Frequency[MHz]	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	0~Reference	2.27	2.27	---	PASS
BLE_1M	Ant1	2402	30~1000	2.27	-57.77	≤-17.73	PASS
BLE_1M	Ant1	2402	1000~26500	2.27	-41.85	≤-17.73	PASS
BLE_1M	Ant1	2440	0~Reference	1.52	1.52	---	PASS
BLE_1M	Ant1	2440	30~1000	1.52	-58.33	≤-18.48	PASS
BLE_1M	Ant1	2440	1000~26500	1.52	-41.97	≤-18.48	PASS
BLE_1M	Ant1	2480	0~Reference	2.51	2.51	---	PASS
BLE_1M	Ant1	2480	30~1000	2.51	-57.93	≤-17.49	PASS
BLE_1M	Ant1	2480	1000~26500	2.51	-42.35	≤-17.49	PASS

Test Graphs

BLE_1M-Ant1-2402-0~Reference-PASS

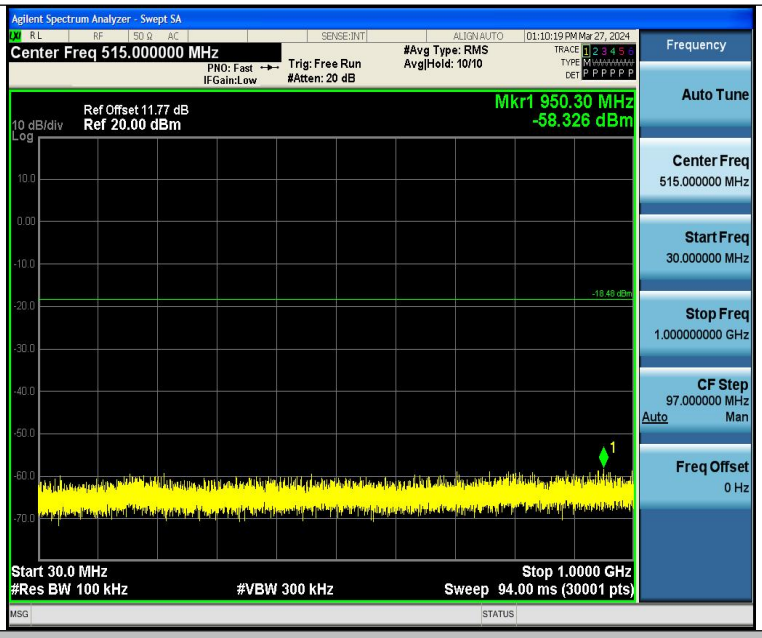


BLE_1M-Ant1-2402-30~1000-PASS

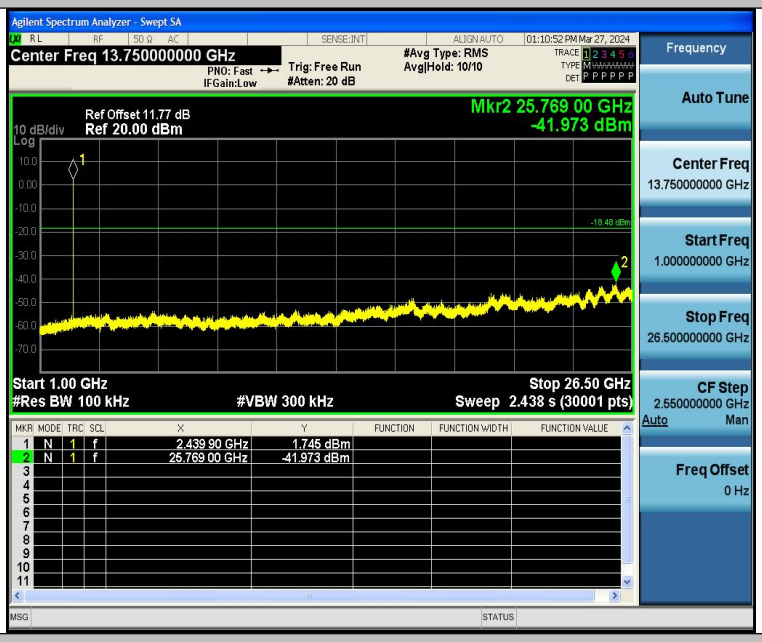


BLE_1M-Ant1-2402-1000~26500-PASS

BLE_1M-Ant1-2440-0~Reference-PASS

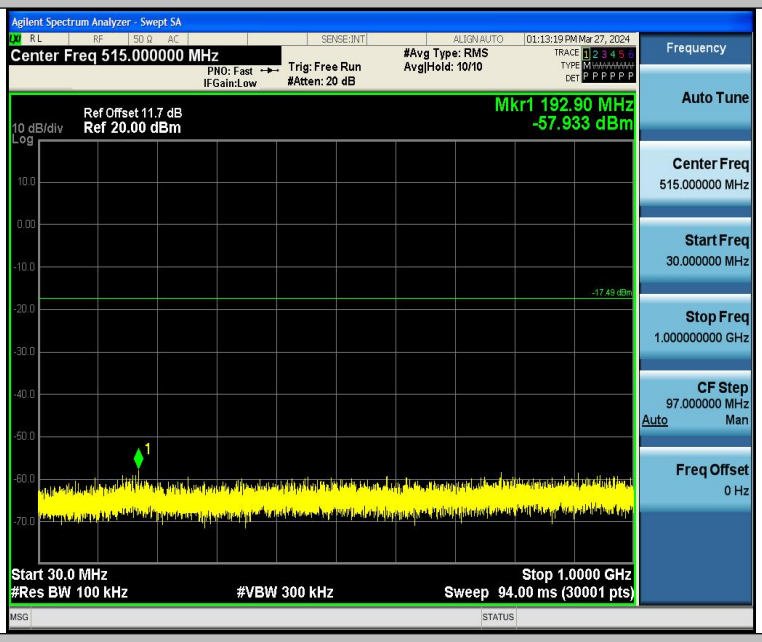


BLE_1M-Ant1-2440-30~1000-PASS

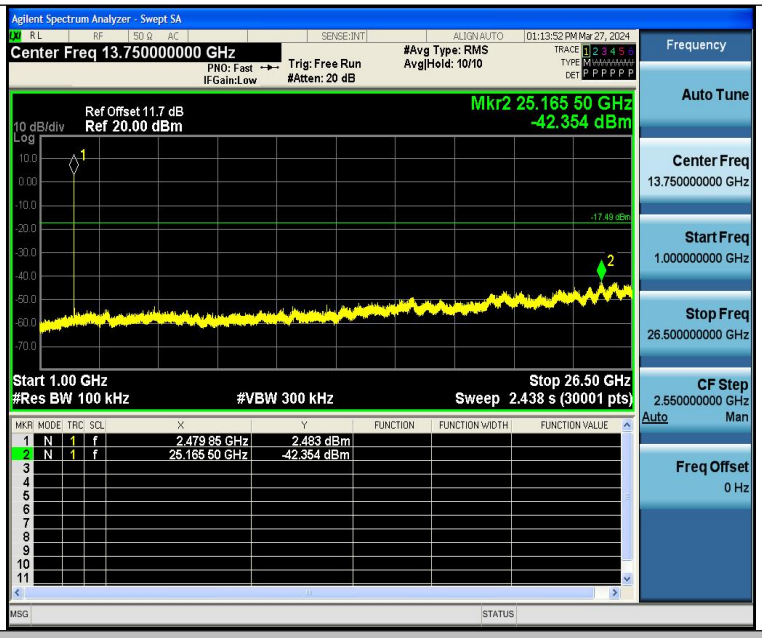


BLE_1M-Ant1-2440-1000~26500-PASS

BLE_1M-Ant1-2480-0~Reference-PASS



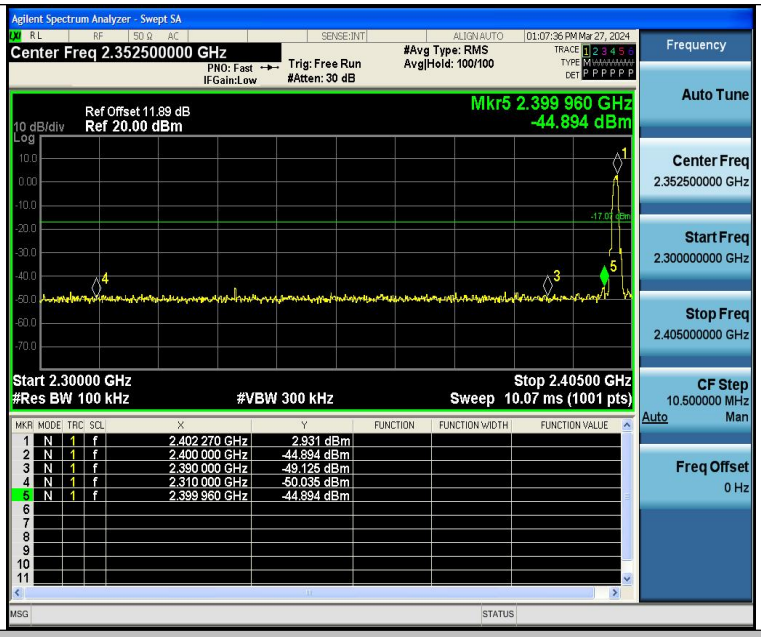
BLE_1M-Ant1-2480-30~1000-PASS



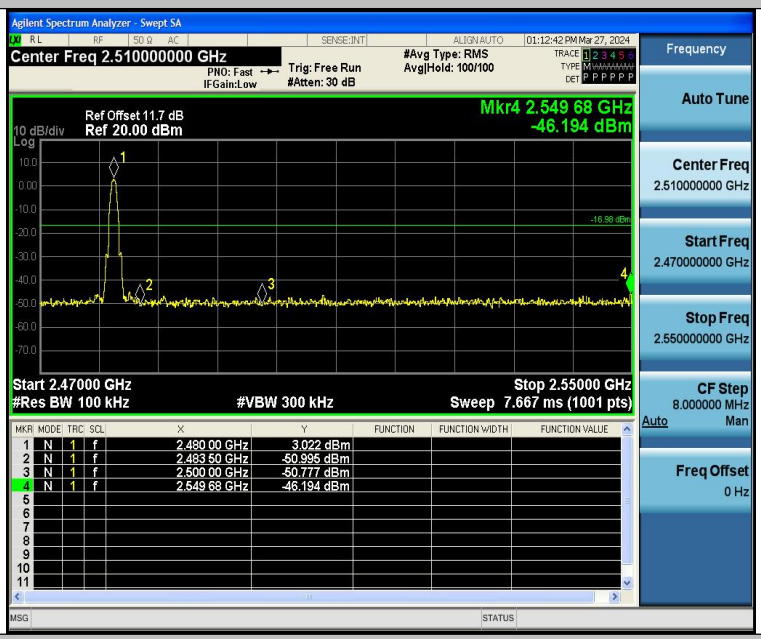
BLE_1M-Ant1-2480-1000~26500-PASS

Band edge:

Test Mode	Antenna	ChName	Frequency[MHz]	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	Low	2402	2.93	-44.89	≤-17.07	PASS
BLE_1M	Ant1	High	2480	3.02	-46.19	≤-16.98	PASS



BLE_1M-Ant1-2402-PASS



BLE_1M-Ant1-2480-PASS

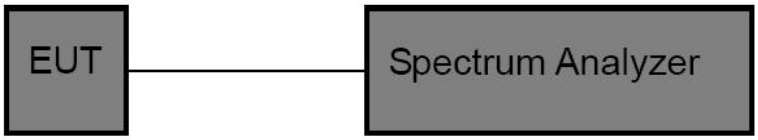
8 6dB Bandwidth Measurement

Test Requirement	:	FCC CFR47 Part 15 Section 15.247
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.

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

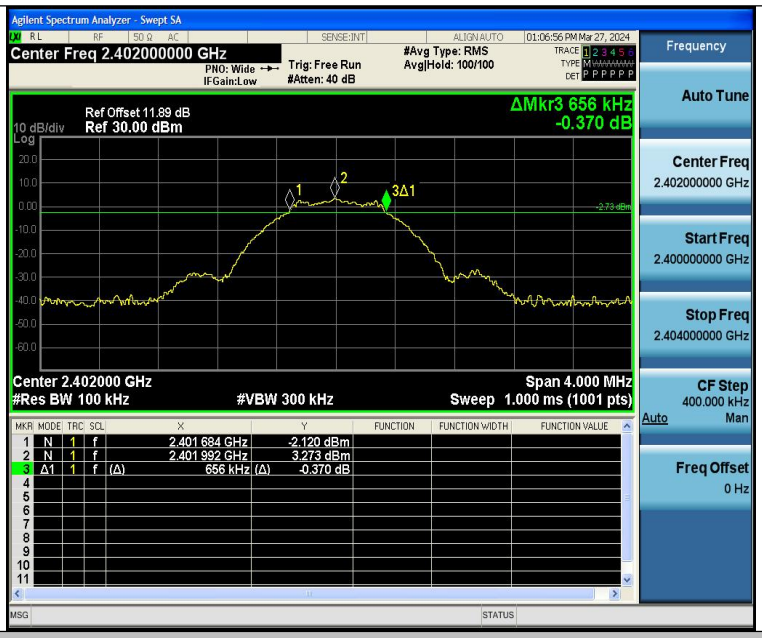
Test Setup



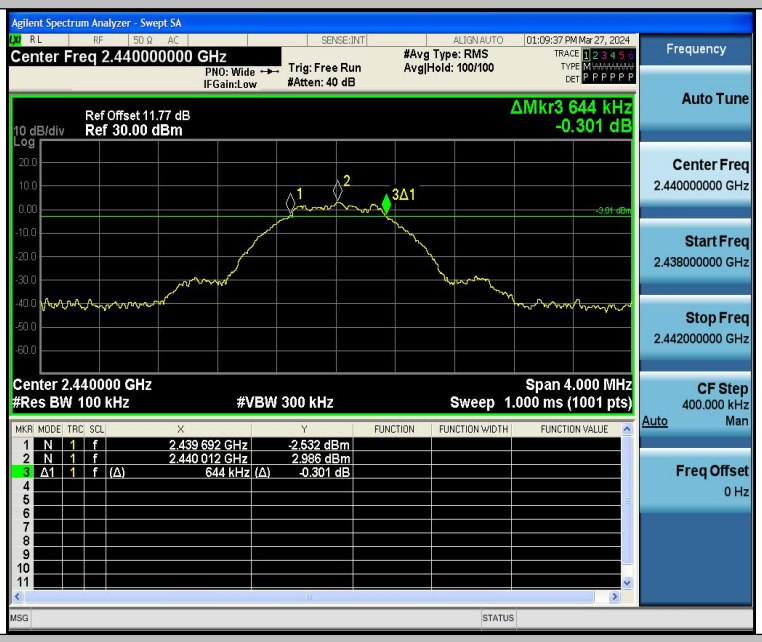
Test Result

Test Mode	Antenna	Frequency[MHz]	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.656	2401.684	2402.340	0.5	PASS
BLE_1M	Ant1	2440	0.644	2439.692	2440.336	0.5	PASS
BLE_1M	Ant1	2480	0.716	2479.644	2480.360	0.5	PASS

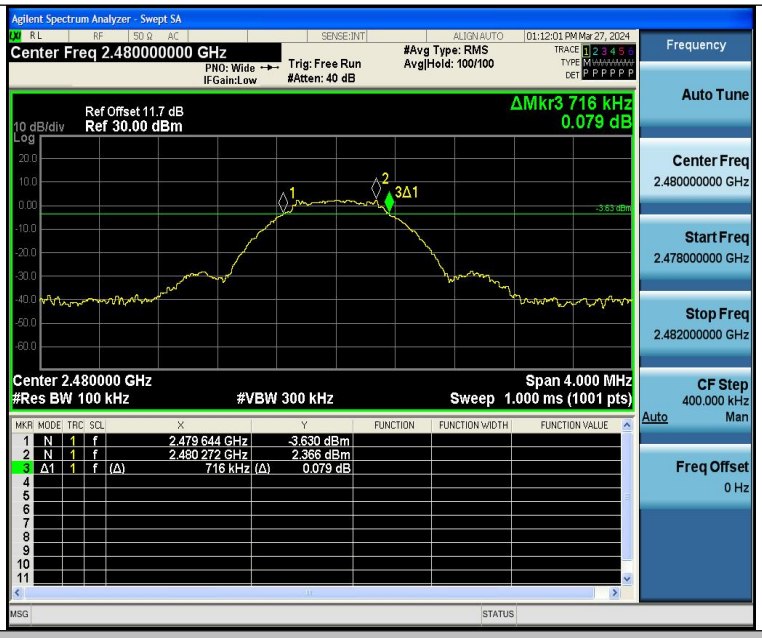
Test Graphs



BLE_1M-Ant1-2402-PASS



BLE_1M-Ant1-2440-PASS



BLE_1M-Ant1-2480-PASS

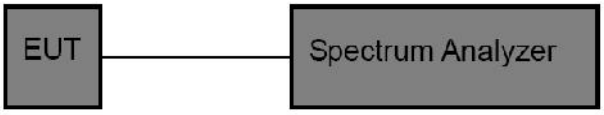
9 Maximum Peak Output Power

Test Requirement	:	FCC CFR47 Part 15 Section 15.247
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.

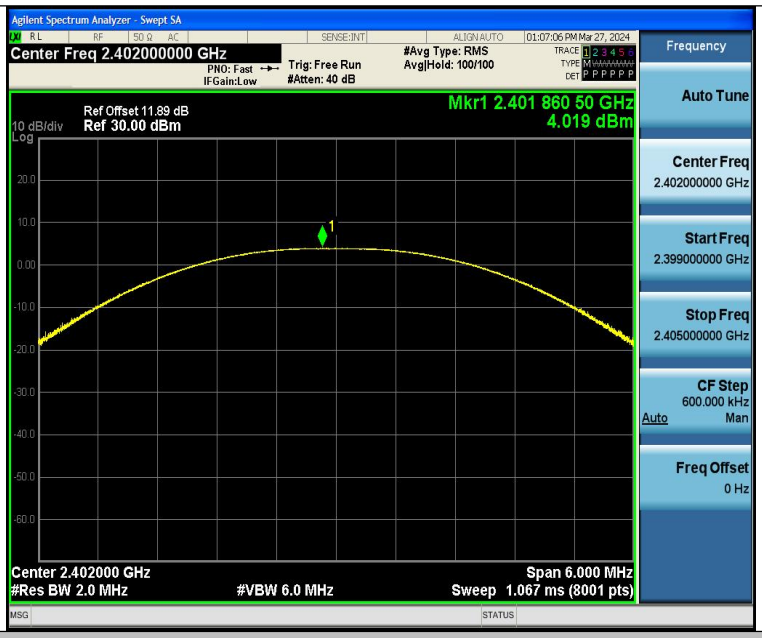
9.2Test Setup



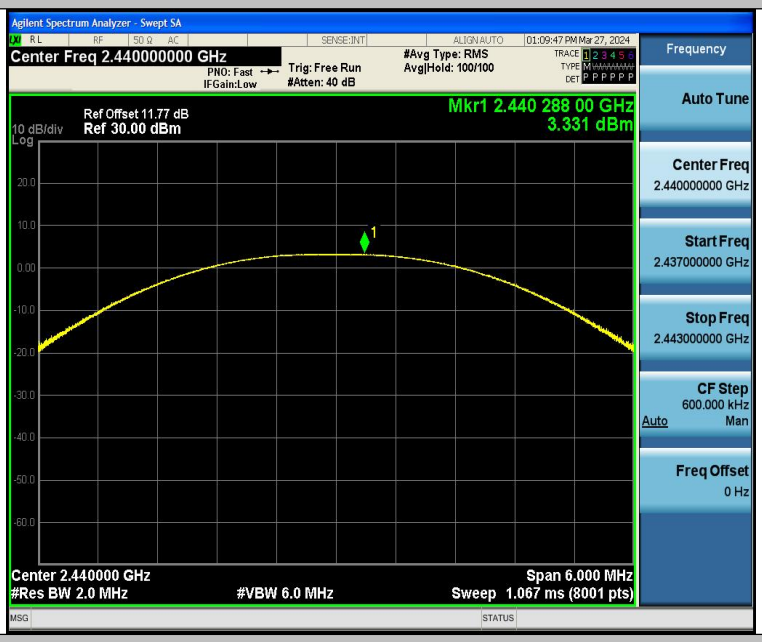
9.3 Test Result

Test Mode	Antenna	Frequency[MHz]	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	Verdict
BLE_1M	Ant1	2402	4.02	≤30	PASS
BLE_1M	Ant1	2440	3.33	≤30	PASS
BLE_1M	Ant1	2480	3.81	≤30	PASS

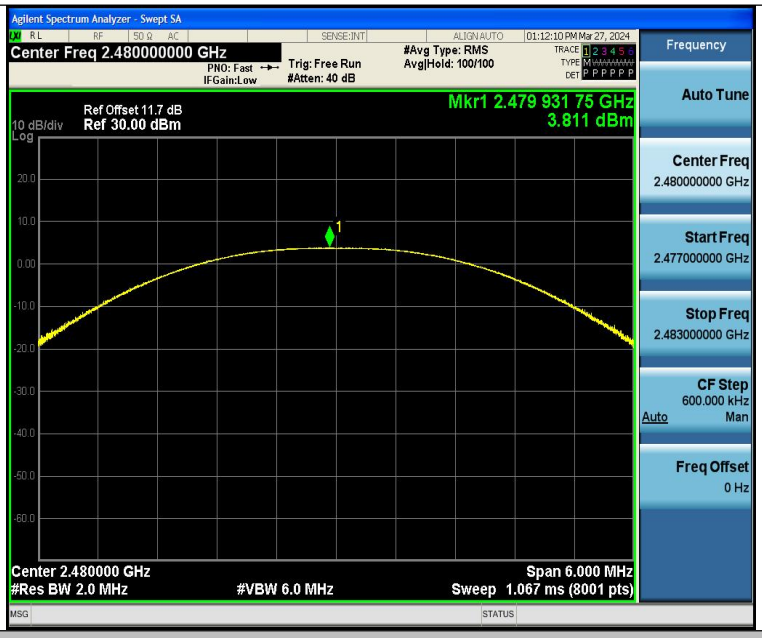
Test Graphs



BLE_1M-Ant1-2402-PASS



BLE_1M-Ant1-2440-PASS



BLE_1M-Ant1-2480-PASS

10 Power Spectral density

Test Requirement	:	FCC CFR47 Part 15 Section 15.247
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.

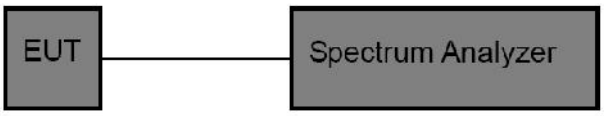
10.1 Test Procedure

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.

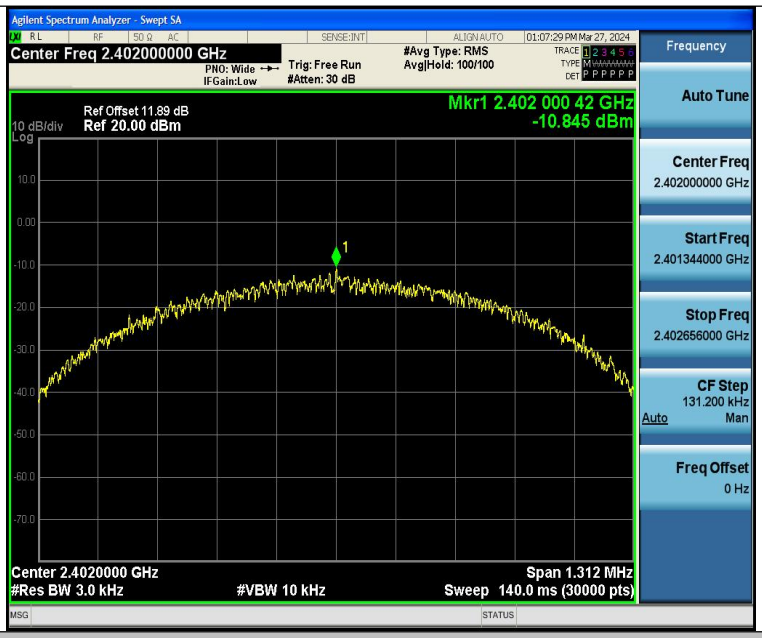
10.2 Test Setup



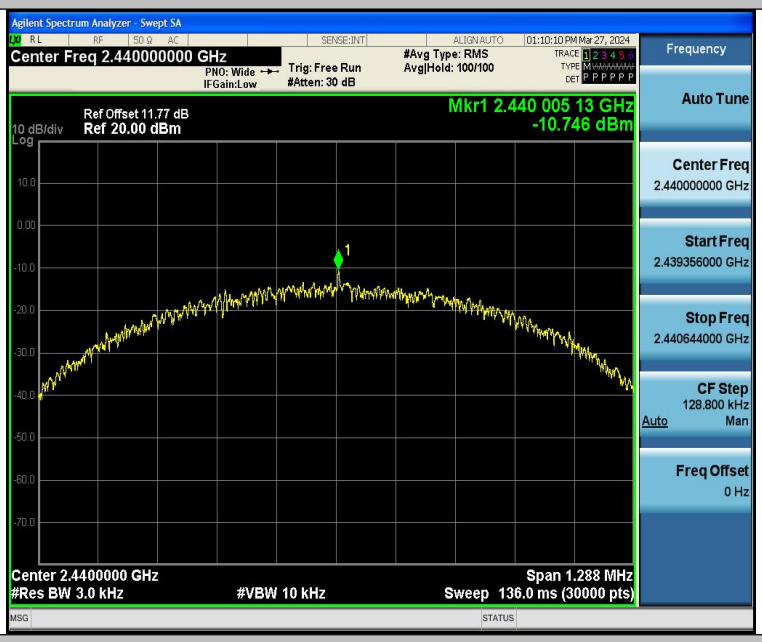
10.3 Test Result

Test Mode	Antenna	Frequency[MHz]	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-10.85	≤8.00	PASS
BLE_1M	Ant1	2440	-10.75	≤8.00	PASS
BLE_1M	Ant1	2480	-12.51	≤8.00	PASS

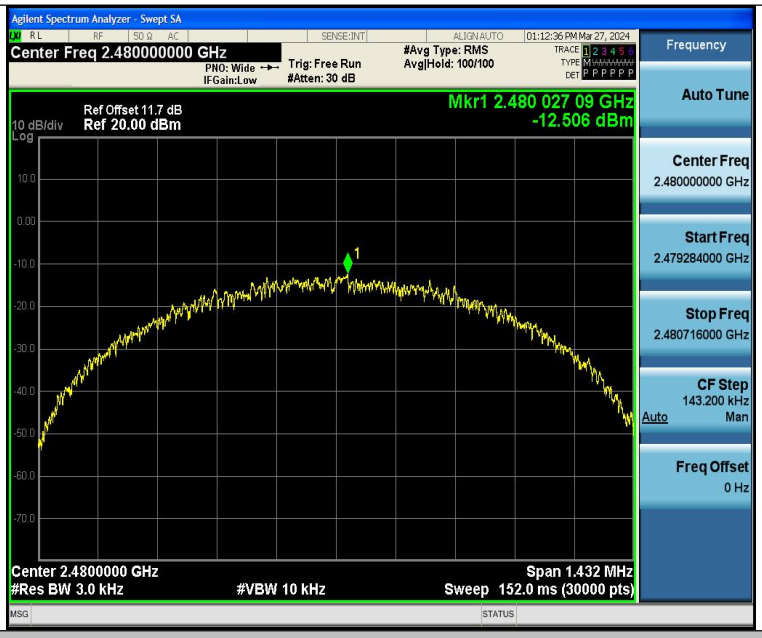
Test Graphs



BLE_1M-Ant1-2402-PASS



BLE_1M-Ant1-2440-PASS



BLE_1M-Ant1-2480-PASS

11 Antenna Application

11.1 Antenna Requirement

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

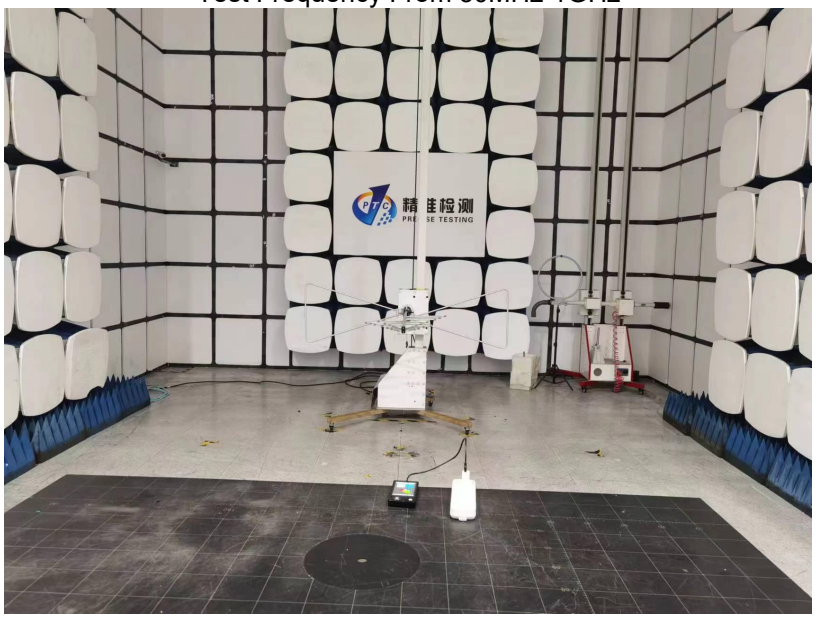
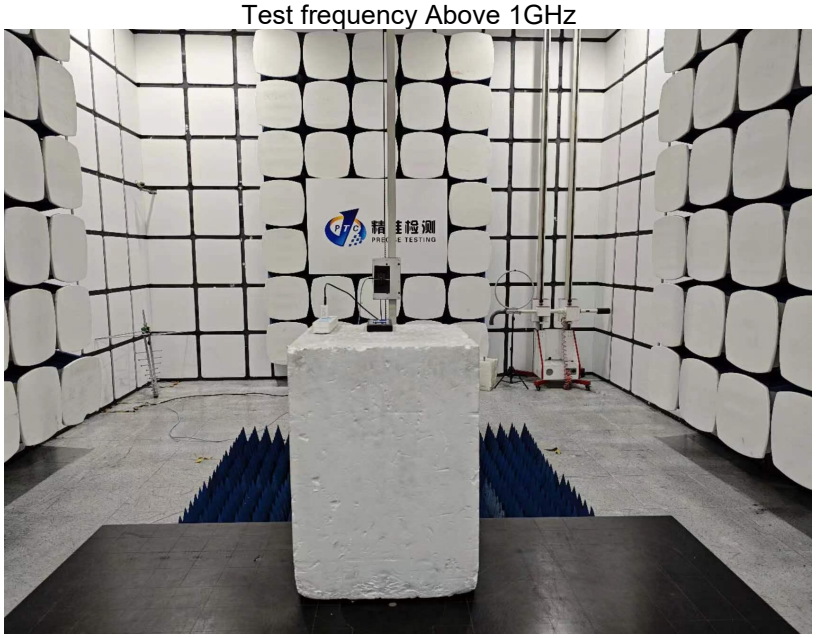
11.2 Result

The antenna is PCB Antenna which permanently attached, and the best case gain of the antenna is 3.11dBi. It complies with the standard requirement.

12 Test Setup

Conducted Emissions

Radiated Spurious Emissions
Test Frequency From 30MHz-1GHz



Test frequency Above 1GHz