FCC TEST REPORT

FCC ID: 2BAZQ-BBL2023

Product	:	Safety Lighting Systems
Model Name	:	BBL_BrightBird, EarlyBird
Brand	:	BASIN BOAT LIGHTING
Report No.	:	PTC23032806201E-FC01

Prepared for

Basin Boat Lighting, LLC

425 BLACKWATER RIVER DRIVE LAFAYETTE Louisiana, 70508, United States

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	:	Basin Boat Lighting, LLC
Address	:	425 BLACKWATER RIVER DRIVE LAFAYETTE Louisiana, 70508, United States
Manufacture's name	:	Basin Boat Lighting, LLC
Address	:	425 BLACKWATER RIVER DRIVE LAFAYETTE Louisiana, 70508, United States
Product name	:	Safety Lighting Systems
Model name	:	BBL_BrightBird, EarlyBird
Standards	:	FCC CFR47 Part 15 Section 15.247
Test procedure	:	ANSI C63.10:2013
Test Date	:	Apr. 07, 2023 to Apr. 22, 2023
Date of Issue	:	May. 22, 2023
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:

Simon Pu / Engineer

Technical Manager:

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2 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	PASS
Band edge	15.247(d) 15.205(a)	PASS
Conduct Emission	15.207	N/A
20dB Bandwidth	15.247(a)(1)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Frequency Separation	15.247(a)(1)	PASS
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS
Dwell time	15.247(a)(1)(iii)	PASS
Antenna Requirement	15.203	PASS

3 TEST FACILITY

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

4 General Information

4.1 General Description of E.U.T.

Product Name	:	Safety Lighting Systems
Model Name	:	BBL_BrightBird
Additional model	:	EarlyBird
Specification	:	BT 5.0 BR
Operation Frequency	:	2402-2480MHz
Number of Channel	:	79 channels for BR
Type of Modulation	:	GFSK For DSS
Antenna installation	:	PCB antenna
Antenna Gain	:	2.85 dBi
Rated Power Supply	:	Input: DC 12V
Test Power Supply	:	DC 12V
Hardware Version	:	N/A
Software Version	:	N/A
Test sample No.	:	PTC23032806201E-1/2,PTC23032806201E-2/2.
Model difference	:	The models in the series differ only by main LED size (60W and 120W) and components, The tested model contains all components.

4.2 Test Mode

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 harmonics of the highest fundamental frequency or to 40 GHz, whichever is lower).

The EUT has been tested under TX operating condition.

This EUT is a FHSS system, were conducted to determine the final configuration from all possible combinations. We use software control the EUT, Let EUT hopping on and transmit with highest power, all the modes GFSK have been tested. 79 Channels are provided by EUT. The 3 channels of lower, medium and higher were chosen for test.

Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	1	2403	2	2404	3	2405
4	2406	5	2407	6	2408	7	2409
8	2410	9	2411	10	2412	11	2413
12	2414	13	2415	14	2416	15	2417
16	2418	17	2419	18	2420	19	2421
20	2422	21	2423	22	2424	23	2425
24	2426	25	2427	26	2428	27	2429
28	2430	29	2431	30	2432	31	2433
32	2434	33	2435	34	2436	35	2437
36	2438	37	2439	38	2440	39	2441
40	2442	41	2443	42	2444	43	2445
44	2446	45	2447	46	2448	47	2449
48	2450	49	2451	50	2452	51	2453
52	2454	53	2455	54	2456	55	2457
56	2458	57	2459	58	2460	59	2461
60	2462	61	2463	62	2464	63	2465
64	2466	65	2467	66	2468	67	2469
68	2470	69	2471	70	2472	71	2473
72	2474	73	2475	74	2476	75	2477
76	2478	77	2479	78	2480	-	-

Channel	Frequency(MHz)
0	2402
39	2441
78	2480

5 Equipment During Test

5.1 Equipments List

RF Conducted Test

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due	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.

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due	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 Due	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	/	/	/	/

5.2 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

5.3 Description of Support Units

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

6 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
Detector:	:	Peak for pre-scan (9kHz Resolution Bandwidth)

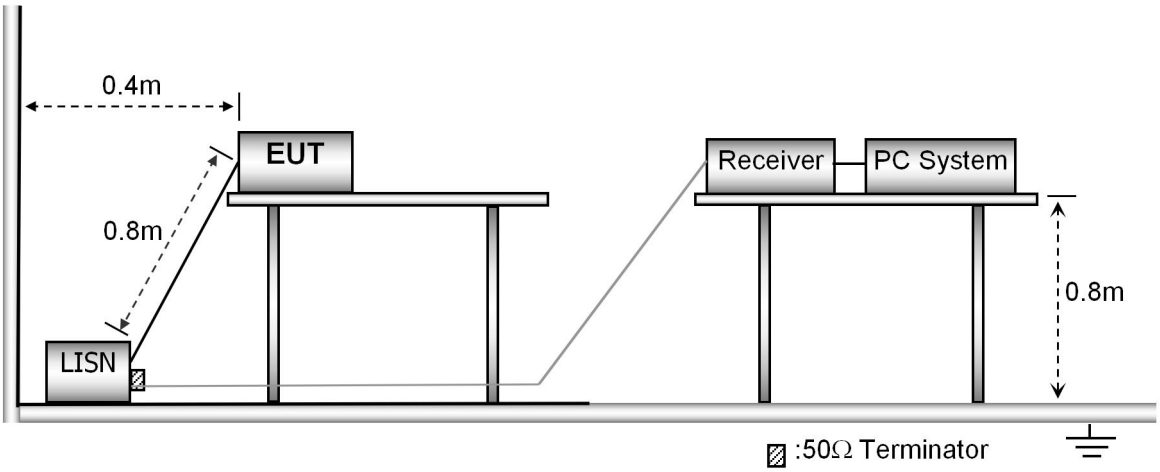
6.1 E.U.T. Operation

Operating Environment **:**

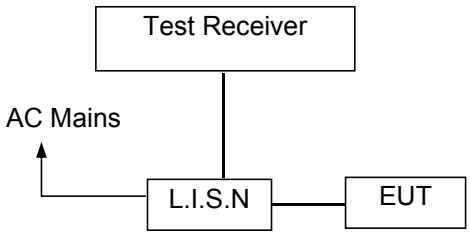
Temperature:	:	23.2°C
Humidity:	:	51 % RH
Atmospheric Pressure:	:	101.12 kPa
Test Voltage	:	AC 120V/60Hz

6.2 EUT Setup

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



6.3 Test SET-UP (Block Diagram of Configuration)



6.4 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.

6.5 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.

6.6 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.

6.7 Conducted Emission Test Result

N/A.

Note: Its only powered by DC 12V Battery.

7 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	$20\log^{(500)}$

7.1 EUT Operation

Operating Environment :

Temperature : 24.5 °C

Humidity : 55.5% RH

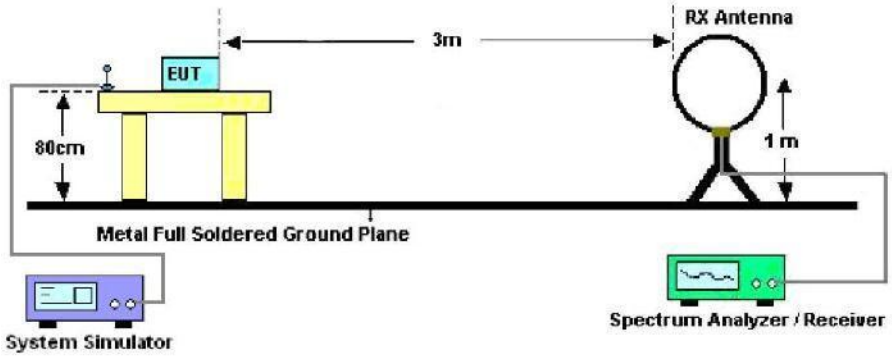
Atmospheric Pressure : 101.3kPa

Test Voltage : AC 120V60Hz

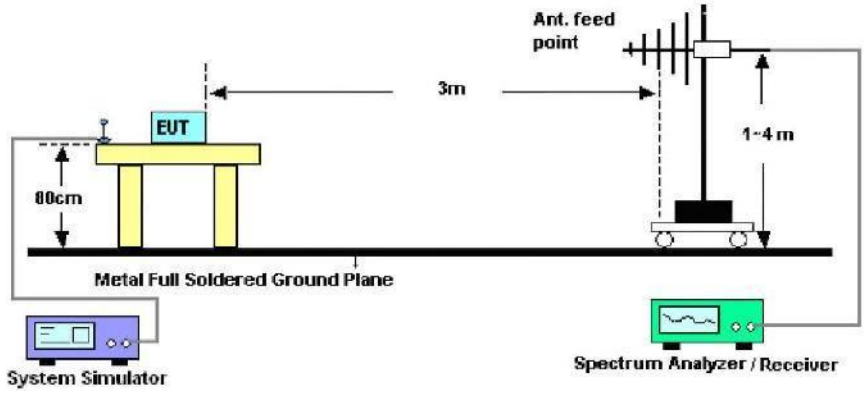
7.2 Test Setup

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

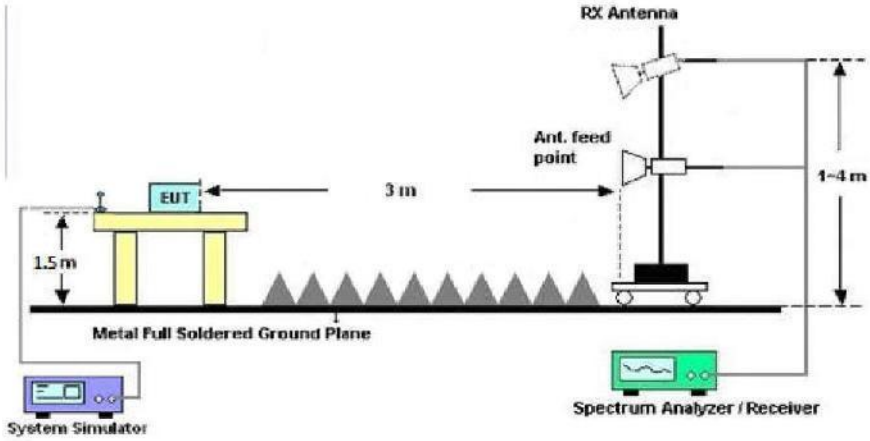
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



7.3 Spectrum Analyzer Setup

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / *10Hz* for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

7.4 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.

7. 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.

7.5 Summary of Test Results

Test Frequency: 9KHz-30MHz

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

Note:

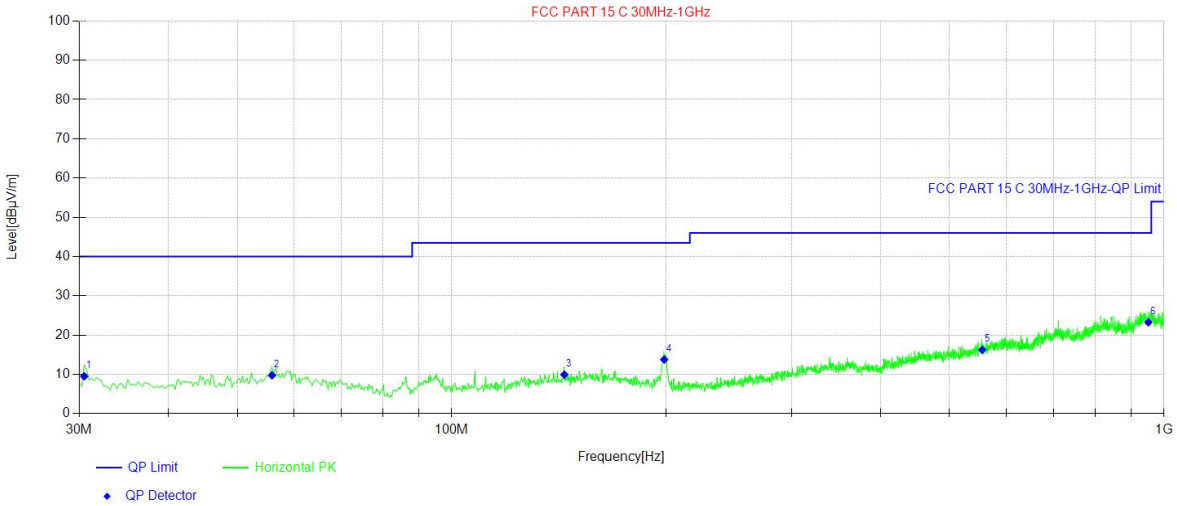
The amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

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

Test Frequency: 30MHz ~ 1GHz

Please refer to the following test plots,Low Channel (2402MHz) Worst case GFSK for record:

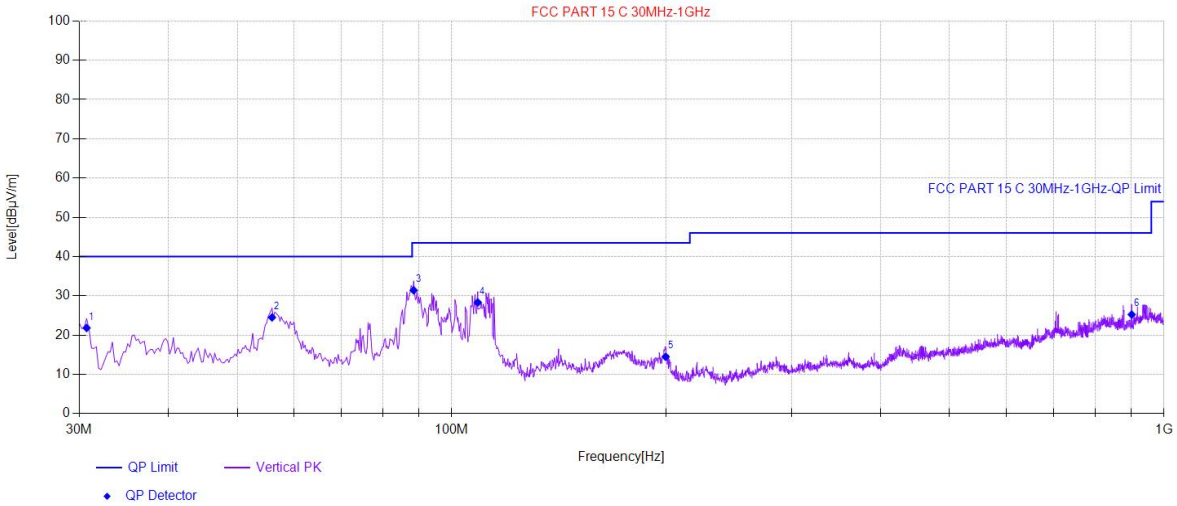
Test plot for Horizontal



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	30.49	27.84	-18.32	9.52	40.00	30.48	Horizontal	PASS
2	55.95	27.7	-17.93	9.77	40.00	30.23	Horizontal	PASS
3	143.98	26.4	-16.46	9.94	43.50	33.56	Horizontal	PASS
4	198.78	32.54	-18.75	13.79	43.50	29.71	Horizontal	PASS
5	555.74	25.56	-9.31	16.25	46.00	29.75	Horizontal	PASS
6	950.77	25.48	-2.20	23.28	46.00	22.72	Horizontal	PASS

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

Test plot for Vertical



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	30.73	40.13	-18.30	21.83	40.00	18.17	Vertical	PASS
2	55.95	42.44	-17.93	24.51	40.00	15.49	Vertical	PASS
3	88.44	52.17	-20.76	31.41	43.50	12.09	Vertical	PASS
4	108.81	47.09	-18.77	28.32	43.50	15.18	Vertical	PASS
5	199.75	33.3	-18.82	14.48	43.50	29.02	Vertical	PASS
6	900.82	28.25	-3.00	25.25	46.00	20.75	Vertical	PASS

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

Test Frequency 1GHz-25GHz

Bluetooth (GFSK)mode have been tested, and the worst result GFSK mode was report as below:

Test Mode: CH00 GFSK					Test channel: Lowest			
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	44.45	34.04	6.58	34.09	50.98	74	-23.02	V
7206	41.32	37.11	7.73	34.5	51.66	74	-22.34	V
9608	38.37	39.31	9.23	34.79	52.12	74	-21.88	V
4804	45.55	34.04	6.58	34.09	52.08	74	-21.92	H
7206	37.41	37.11	7.73	34.5	47.75	74	-26.25	H
9608	39.86	39.31	9.23	34.79	53.61	74	-20.39	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	34.23	34.04	6.58	34.09	40.76	54	-13.24	V
7206	27.66	37.11	7.73	34.5	38.00	54	-16.00	V
9608	24.64	39.31	9.23	34.79	38.39	54	-15.61	V
4804	33.65	34.04	6.58	34.09	40.18	54	-13.82	H
7206	29.17	37.11	7.73	34.5	39.51	54	-14.49	H
9608	23.91	39.31	9.23	34.79	37.66	54	-16.34	H

Test Mode: CH39 GFSK					Test channel: Middle			
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.
4882	42.12	34.38	6.69	34.09	49.10	74	-24.90	V
7323	37.61	37.22	7.78	34.53	48.08	74	-25.92	V
9764	34.38	39.46	9.35	34.8	48.39	74	-25.61	V
4882	43.52	34.38	6.69	34.09	50.50	74	-23.50	H
7323	37.73	37.22	7.78	34.53	48.20	74	-25.80	H
9764	35.32	39.46	9.35	34.8	49.33	74	-24.67	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.
4882	34.00	34.38	6.69	34.09	40.98	54	-13.02	V
7323	26.80	37.22	7.78	34.53	37.27	54	-16.73	V
9764	25.64	39.46	9.35	34.8	39.65	54	-14.35	V
4882	31.71	34.38	6.69	34.09	38.69	54	-15.31	H
7323	28.76	37.22	7.78	34.53	39.23	54	-14.77	H
9764	24.03	39.46	9.35	34.8	38.04	54	-15.96	H

Test Mode: CH78 GFSK					Test channel: Highest			
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	42.55	34.72	6.79	34.09	49.97	74	-24.03	V
7440	41.00	37.34	7.82	34.57	51.59	74	-22.41	V
9920	34.32	39.62	9.46	34.81	48.59	74	-25.41	V
4960	41.28	34.72	6.79	34.09	48.70	74	-25.30	H
7440	38.39	37.34	7.82	34.57	48.98	74	-25.02	H
9920	37.03	39.62	9.46	34.81	51.30	74	-22.70	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	34.04	34.72	6.79	34.09	41.46	54	-12.54	V
7440	28.26	37.34	7.82	34.5	38.92	54	-15.08	V
9920	24.71	39.62	9.46	34.79	39.00	54	-15.00	V
4960	31.63	34.72	6.79	34.09	39.05	54	-14.95	H
7440	28.73	37.34	7.82	34.5	39.39	54	-14.61	H
9920	25.62	39.62	9.46	34.79	39.91	54	-14.09	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

   Over Limit =Emission Level-Limit

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

Bluetooth (GFSK)mode have been tested, and the worst result GFSK model was report as below

Test Mode: Low Channel 2402MHz									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Polarity H/V	Test Value
2390	48.78	29.15	3.41	34.01	47.33	74	-26.67	H	Peak
2400	59.28	29.16	3.43	34.01	57.86	74	-16.14	H	Peak
2390	48.32	29.15	3.41	34.01	46.87	74	-27.13	V	Peak
2400	55.41	29.16	3.43	34.01	53.99	74	-20.01	V	Peak
2390	40.92	29.15	3.41	34.01	39.47	54	-14.53	H	AV
2400	43.50	29.16	3.43	34.01	42.08	54	-11.92	H	AV
2390	39.86	29.15	3.41	34.01	38.41	54	-15.59	V	AV
2400	44.06	29.16	3.43	34.01	42.64	54	-11.36	V	AV

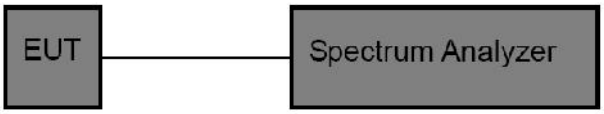
Test Mode: High Channel 2480MHz									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Polarity H/V	Test Value
2483.5	59.78	29.28	3.53	34.03	58.56	74	-15.44	H	Peak
2500	48.26	29.30	3.56	34.03	47.09	74	-26.91	H	Peak
2483.5	60.76	29.28	3.53	34.03	59.54	74	-14.46	V	Peak
2500	49.83	29.30	3.56	34.03	48.66	74	-25.34	V	Peak
2483.5	41.80	29.28	3.53	34.03	40.58	54	-13.42	H	AV
2500	40.27	29.30	3.56	34.03	39.10	54	-14.90	H	AV
2483.5	43.36	29.28	3.53	34.03	42.14	54	-11.86	V	AV
2500	39.07	29.30	3.56	34.03	37.90	54	-16.10	V	AV

8 Maximum Peak Output Power Test

8.1 Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (b)(3)
Test Limit	125mW

8.2 Test Setup



8.3 Test Procedure

1. The testing follows the Measurement Procedure of FCC KDB No. 558074 D01 15.247 Meas Guidance v05 section 8.3.1.
2. 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.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.

8.4 Test Data

Test Item	:	Max. peak output power	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 12V	Temperature	:	24.5℃
Test Result	:	PASS	Humidity	:	55%RH

Test Mode	Antenna	Frequency[MHz]	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	Verdict
DH5	Ant1	2402	-7.81	≤20.97	PASS
DH5	Ant1	2441	-8.11	≤20.97	PASS
DH5	Ant1	2480	-8.43	≤20.97	PASS

DH5-Ant1-2402

DH5-Ant1-2441

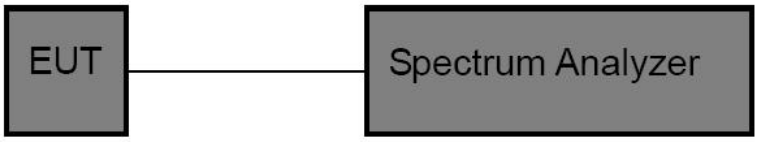
DH5-Ant1-2480

9 20DB Occupy Bandwidth Test

9.1 Test Standard

Test Standard	FCC Part15 C Section 15.247 (a)(1)

9.2 Test Setup



9.3 Test Procedure

Using the following spectrum analyzer settings:

1. Span= approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel.
2. Set the RBW = 30 kHz.
3. Set the VBW = 100 kHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

9.4 Test Data

Test Item	:	20dB BW	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 12V	Temperature	:	24.5℃
Test Result	:	PASS	Humidity	:	55%RH

TestMode	Antenna	Frequency[MHz]	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	1.014	2401.454	2402.468	---	---
DH5	Ant1	2441	0.993	2440.478	2441.471	---	---
DH5	Ant1	2480	0.996	2479.475	2480.471	---	---

DH5-Ant1-2402

DH5-Ant1-2441

DH5-Ant1-2480

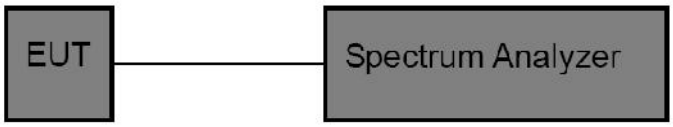
Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 40 dB
#Avg Type: RMS
Avg|Hold: 100/100
10:39:43 AM Apr 20, 2023
Ref Offset 11.7 dB
10 dB/div
Ref 30.00 dBm
ΔMkr3 996 kHz
0.142 dB
Center 2.480000 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 3.000 MHz
Sweep 3.200 ms (1001 pts)
1 N 1 f 2.479 475 GHz -32.995 dBm
2 N 1 f 2.479 967 GHz -12.656 dBm
3 Δ1 1 f (Δ) 996 kHz (Δ) 0.142 dB
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.478500000 GHz
Stop Freq
2.481500000 GHz
CF Step
300.000 kHz
Auto Man
Freq Offset
0 Hz

10 Carrier Frequency Separation Test

10.1 Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (a)(1)
Test Limit	>25KHz or >two-thirds of the 20 dB bandwidth

10.2 Test Setup



10.3 Test Procedure

The EUT must have its hopping function enabled. Using the following spectrum analyzer settings:

1. Span= Wide enough to capture the peaks of two adjacent channels
2. Set the RBW = 30 kHz.
3. Set the VBW = 100 kHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

10.4 Test Data

Test Item	:	Frequency Separation	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 12V	Temperature	:	24.5℃
Test Result	:	PASS	Humidity	:	55%RH

TestMode	Antenna	Frequency[MHz]	Result[MHz]	Limit[MHz]	Verdict
DH5	Ant1	Hop	0.756	≥0.676	PASS

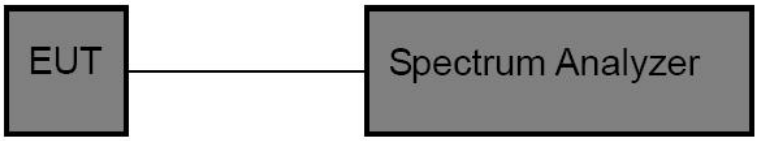
DH5-Ant1-Hop

11 Number of Hopping Channel Test

11.1 Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (a)(1)
Test Limit	>15 channels

11.2 Test Setup



11.3 Test Procedure

The EUT must have its hopping function enabled. Using the following spectrum analyzer setting:

1. Span= the frequency band of operation
2. Set the RBW = 100kHz.
3. Set the VBW = 300kHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

11.4 Test Data

Test Item	:	Number of Hopping Frequency	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 12V	Temperature	:	24.5℃
Test Result	:	PASS	Humidity	:	55%RH

TestMode	Antenna	Frequency[MHz]	Result[Num]	Limit[Num]	Verdict
DH5	Ant1	Hop	79	≥15	PASS

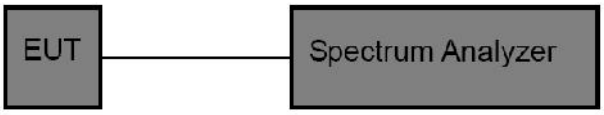
DH5-Ant1-Hop

12 Dwell Time Test

12.1 Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (a)(1)
Test Limit	0.4 sec

12.2 Test Setup



12.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span= zero span, centered on a hopping channel
2. Set the RBW = 1 MHz.
3. Set the VBW = 3 MHz.
4. Sweep time = as necessary to capture the entire dwell time per hopping channel.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

12.4 Test Data

Test Item	:	Time of Occupancy	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 12V	Temperature	:	24.5℃
Test Result	:	PASS	Humidity	:	55%RH

TestMode	Antenna	Frequency[MHz]	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH5	Ant1	Hop	2.885	106.67	0.308	≤0.4	PASS
DH1	Ant1	Hop	0.381	320	0.122	≤0.4	PASS
DH3	Ant1	Hop	1.637	160	0.262	≤0.4	PASS

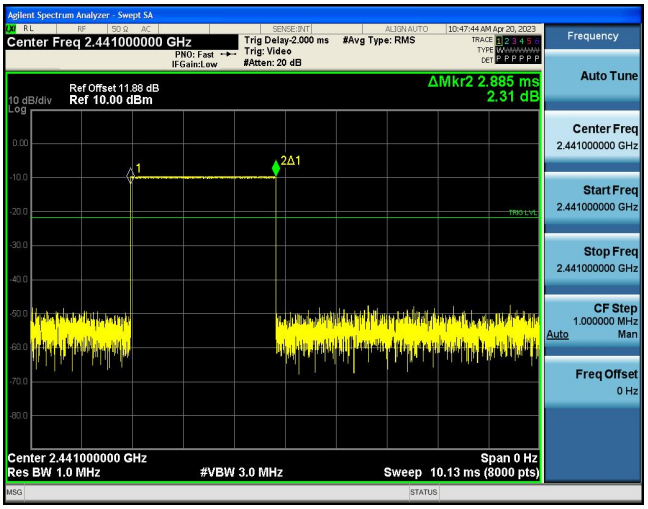
Note:

1.DH1/2DH1 Dwell Time: Reading * (1600/2)*31.6/(channel number).

2.DH3/2DH3 Dwell Time: Reading * (1600/4)*31.6/(channel number).

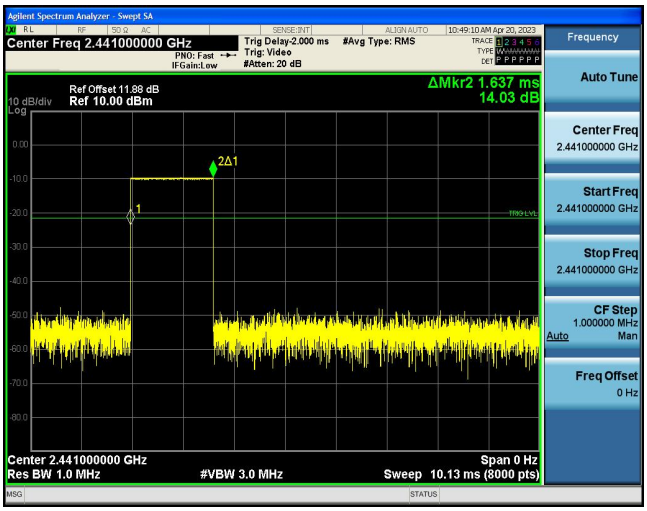
3.DH5/2DH5 Dwell Time: Reading * (1600/6)*31.6/(channel number).

DH5-Ant1-Hop-2.885-106.67



DH1-Ant1-Hop-0.381-320

DH3-Ant1-Hop-1.637-160

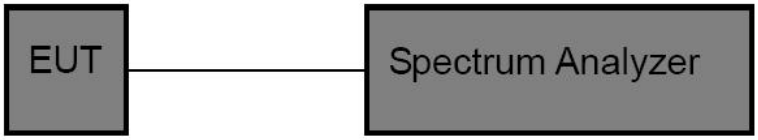

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441000000 GHz
Trig Delay-2.000 ms
Trig: Video
#Atten: 20 dB
#Avg Type: RMS
10:49:10 AM Apr 20, 2023
Ref Offset 11.88 dB
10 dB/div
Ref 10.00 dBm
ΔMkr2 1.637 ms
14.03 dB
2Δ1
1
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 10.13 ms (8000 pts)
Frequency
Auto Tune
Center Freq
2.441000000 GHz
Start Freq
2.441000000 GHz
Stop Freq
2.441000000 GHz
CF Step
1.000000 MHz
Auto
Man
Freq Offset
0 Hz

13 100kHz Bandwidth of Frequency Band Edge Requirement

13.1 Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (d)
Test Limit	in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in 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).

13.2 Test Setup



13.3 Test Procedure

The EUT must have its hopping/Non-hopping function enabled. Using the following spectrum analyzer setting:

1. Set the RBW = 100kHz.

2. Set the VBW = 300kHz.

3. Sweep time = auto couple.

4. Detector function = peak.

5. Trace mode = max hold.

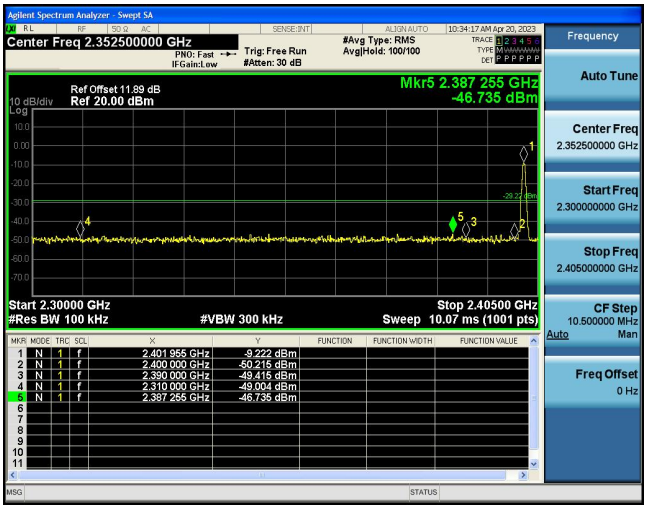
6. Allow trace to fully stabilize.

13.4 Test Data

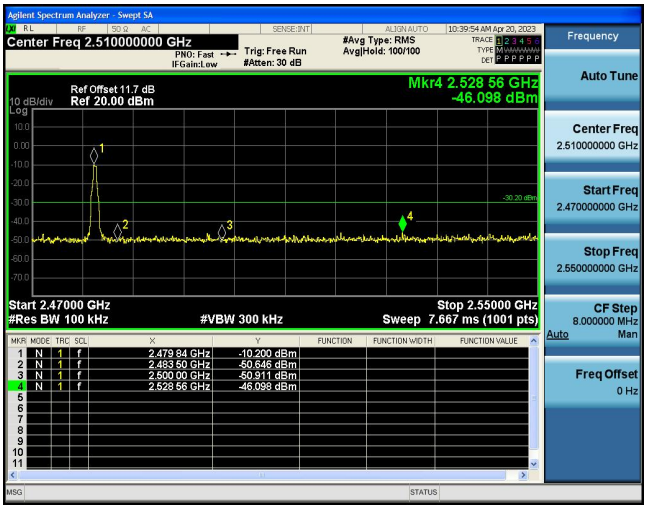
Test Item	:	Band edge	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 12V	Temperature	:	24.5℃
Test Result	:	PASS	Humidity	:	55%RH

TestMode	Antenna	ChName	Frequency[MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	Low	2402	-9.22	-46.74	≤-29.22	PASS
DH5	Ant1	High	2480	-10.20	-46.1	≤-30.2	PASS
DH5	Ant1	Low	Hop_2402	-10.14	-46.84	≤-30.14	PASS
DH5	Ant1	High	Hop_2480	-10.19	-45.48	≤-30.19	PASS

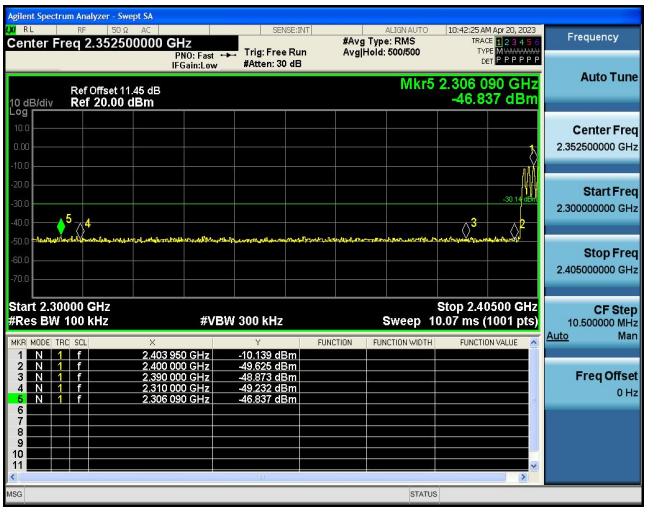
DH5-Ant1-Low-2402--9.22



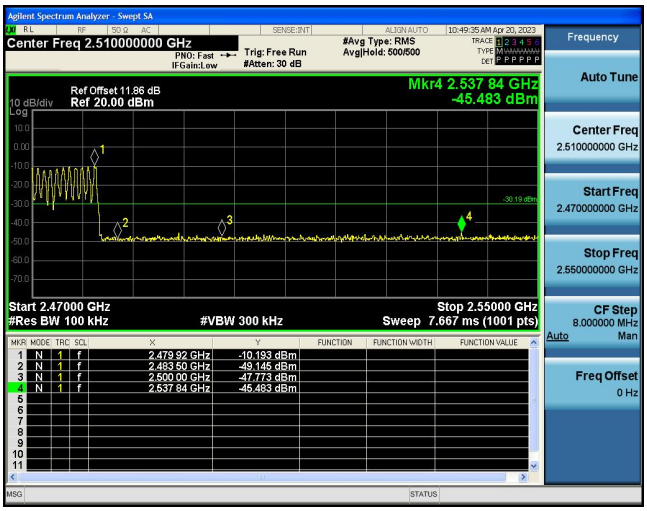
DH5-Ant1-High-2480--10.20



DH5-Ant1-Low-Hop_2402--10.14



DH5-Ant1-High-Hop_2480--10.19



Conducted Emission Method

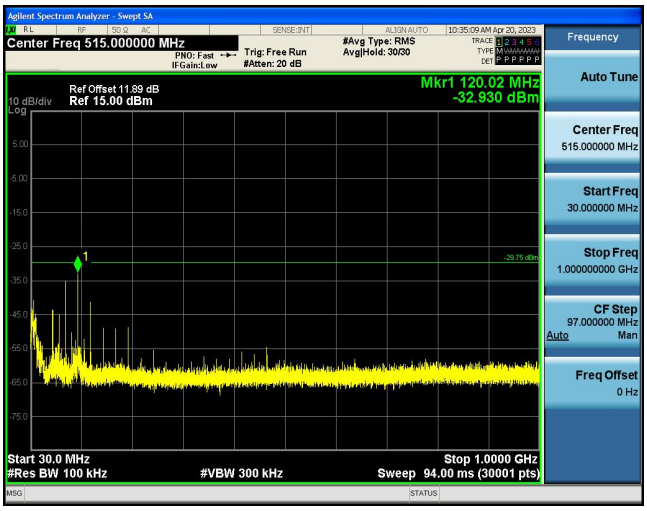
Test Result

TestMode	Antenna	Frequency[MHz]	FreqRange [MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	0~Reference	-9.75	-9.75	---	PASS
DH5	Ant1	2402	30~1000	-9.75	-32.93	≤-29.75	PASS
DH5	Ant1	2402	1000~26500	-9.75	-40.35	≤-29.75	PASS
DH5	Ant1	2441	0~Reference	-10.48	-10.48	---	PASS
DH5	Ant1	2441	30~1000	-10.48	-33.11	≤-30.48	PASS
DH5	Ant1	2441	1000~26500	-10.48	-41.62	≤-30.48	PASS
DH5	Ant1	2480	0~Reference	-10.83	-10.83	---	PASS
DH5	Ant1	2480	30~1000	-10.83	-33.16	≤-30.83	PASS
DH5	Ant1	2480	1000~26500	-10.83	-38.29	≤-30.83	PASS

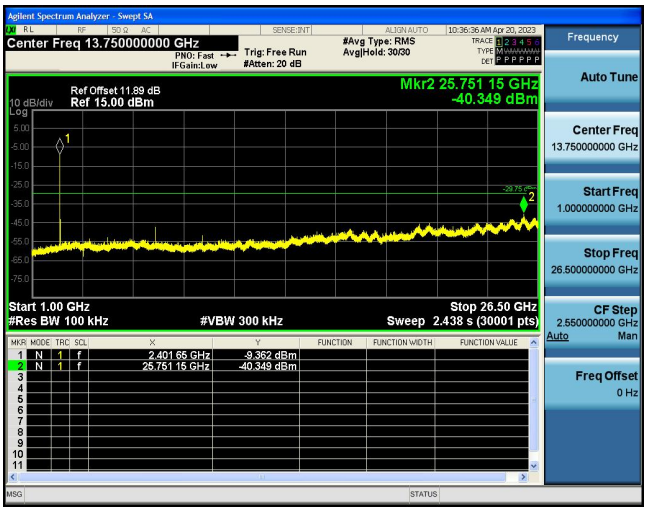
Test Graphs

DH5-Ant1-2402-0~Reference--9.75

DH5-Ant1-2402-30~1000--9.75

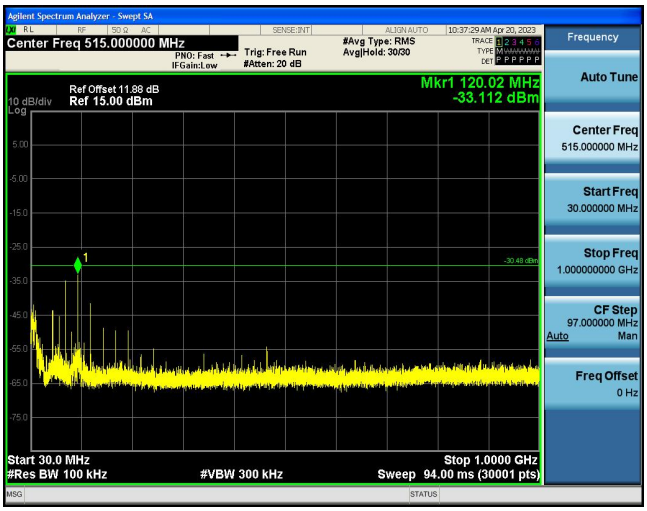


DH5-Ant1-2402-1000~26500--9.75

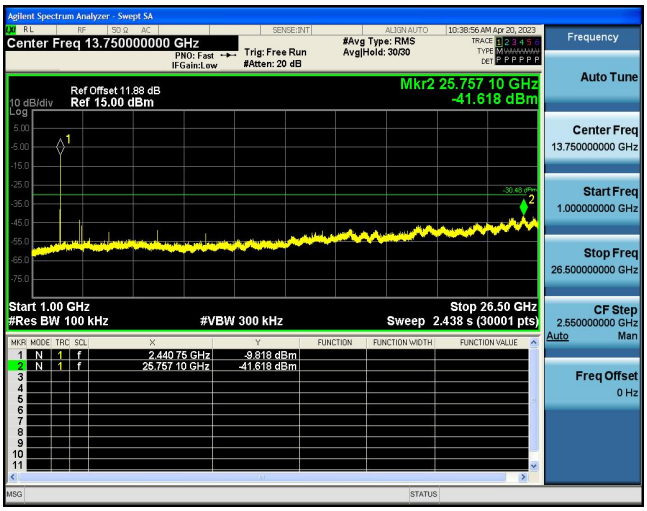


DH5-Ant1-2441-0~Reference--10.48

DH5-Ant1-2441-30~1000--10.48

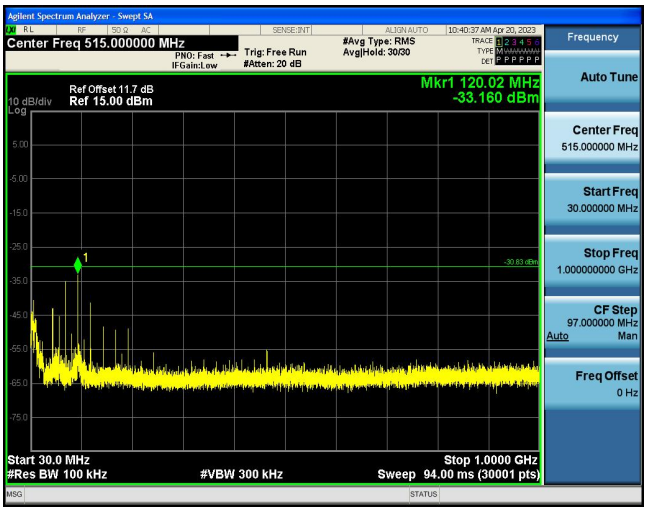


DH5-Ant1-2441-1000~26500--10.48

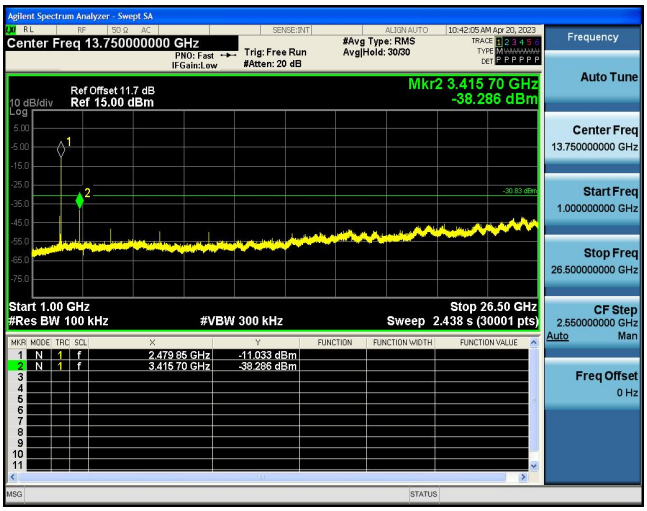


DH5-Ant1-2480-0~Reference--10.83

DH5-Ant1-2480-30~1000--10.83



DH5-Ant1-2480-1000~26500--10.83


Agilent Spectrum Analyzer - Swept SA
Center Freq 13.750000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 30/30
10:42:05 AM Apr 20, 2023
Ref Offset 11.7 dB
10 dB/div
Ref 15.00 dBm
Log
Mkr2 3.415 70 GHz
-38.286 dBm
-30.83 dBm
Start 1.00 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.50 GHz
Sweep 2.438 s (30001 pts)
1 N 1 f 2.479 85 GHz -11.033 dBm
2 N 1 f 3.415 70 GHz -38.286 dBm
Frequency
Auto Tune
Center Freq
13.750000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
26.500000000 GHz
CF Step
2.550000000 GHz
Auto
Man
Freq Offset
0 Hz

14 Antenna Requirement

14.1 Test Standard and Requirement

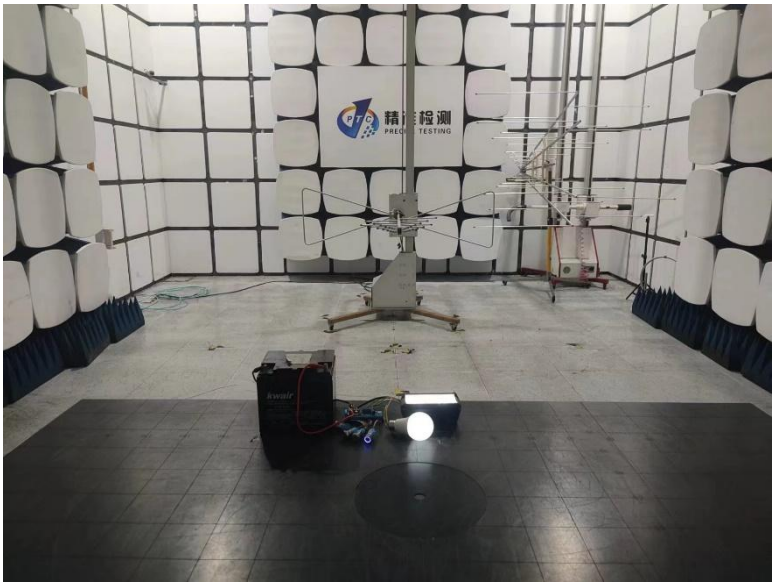
Test Standard	FCC Part15 Section 15.203 /247(c)
Requirement	1) 15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses 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. 2) 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 6 dBi.

14.2 Antenna Connected Construction

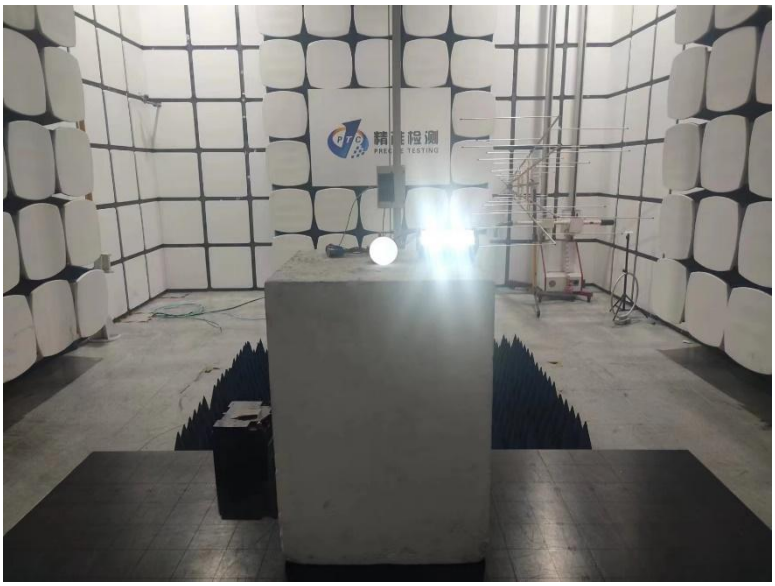
The antenna is PCB Antenna which permanently attached, and the best case gain of the antenna is 2.85dBi. It complies with the standard requirement.

15 APPENDIX I -- TEST SETUP PHOTOGRAPH

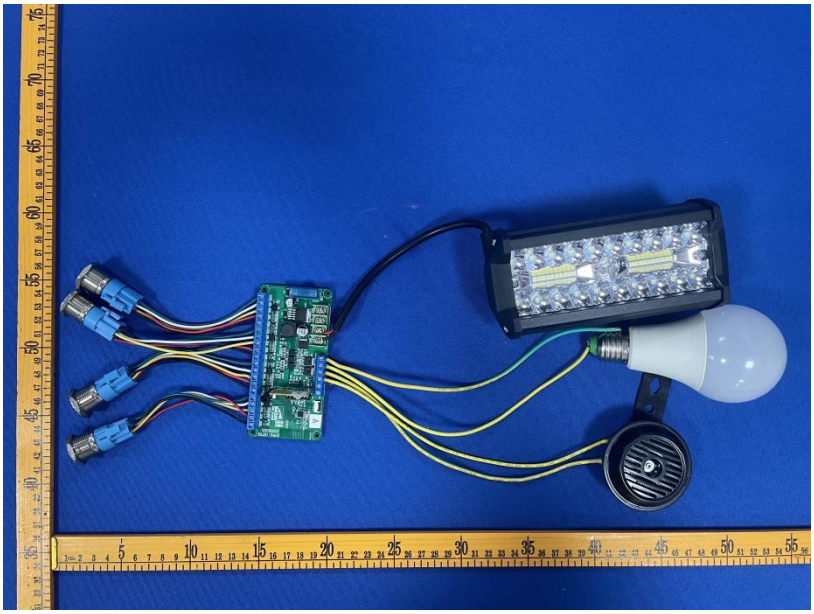
Radiated Emissions
From 30M-1GHz

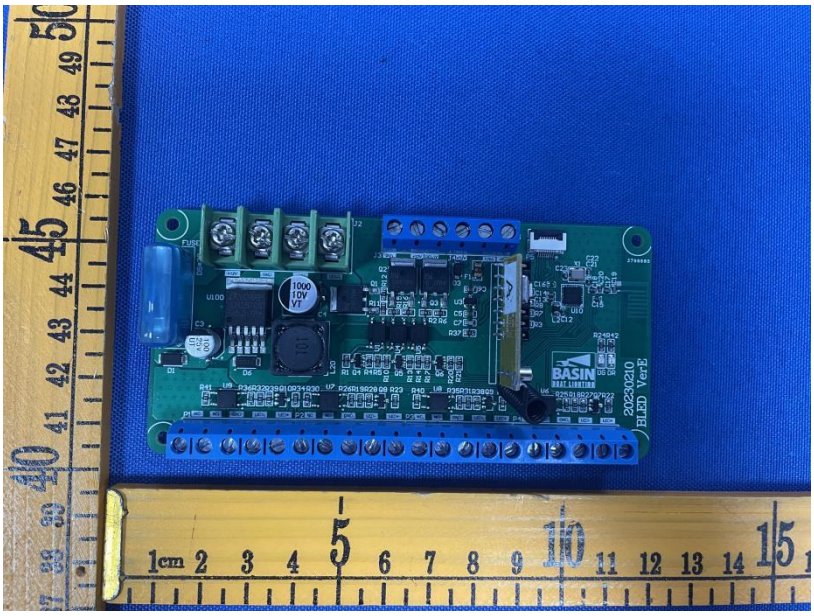


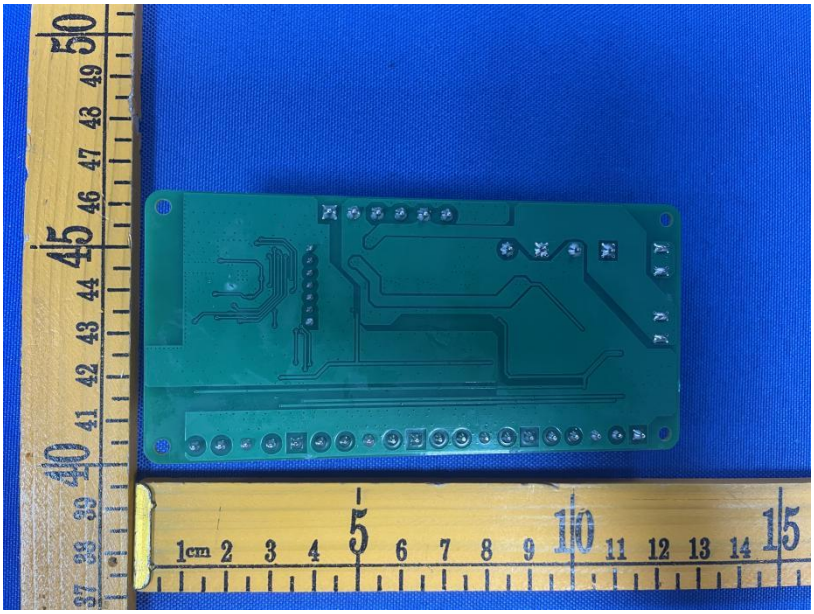
Above 1GHz

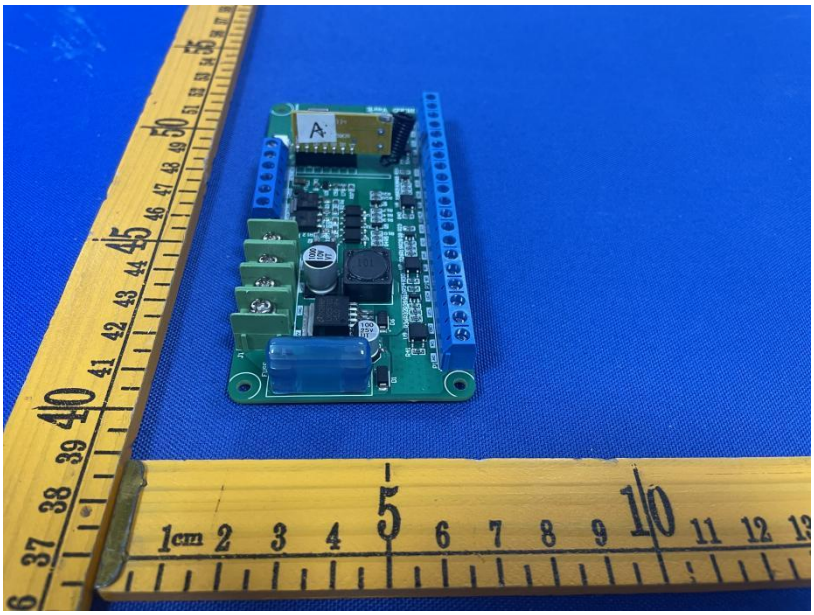


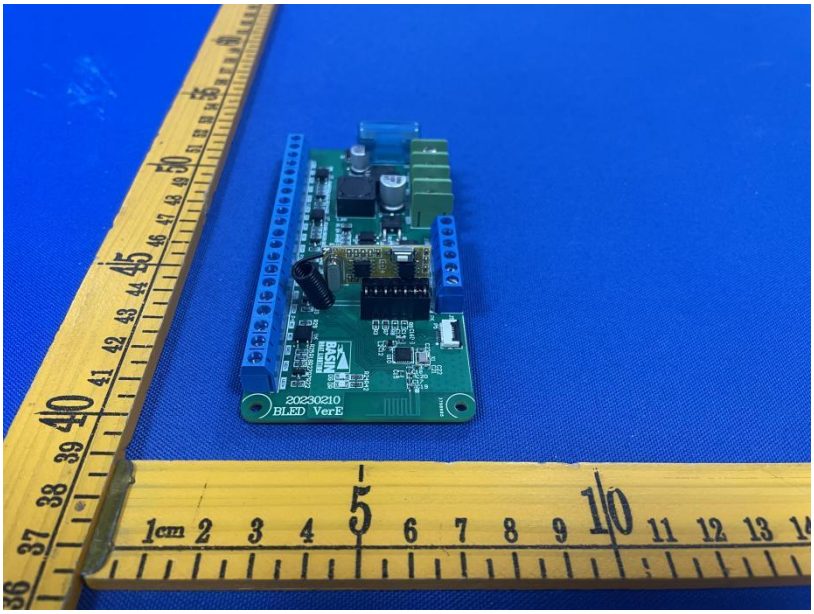
16 APPENDIX II -- EUT PHOTOGRAPH







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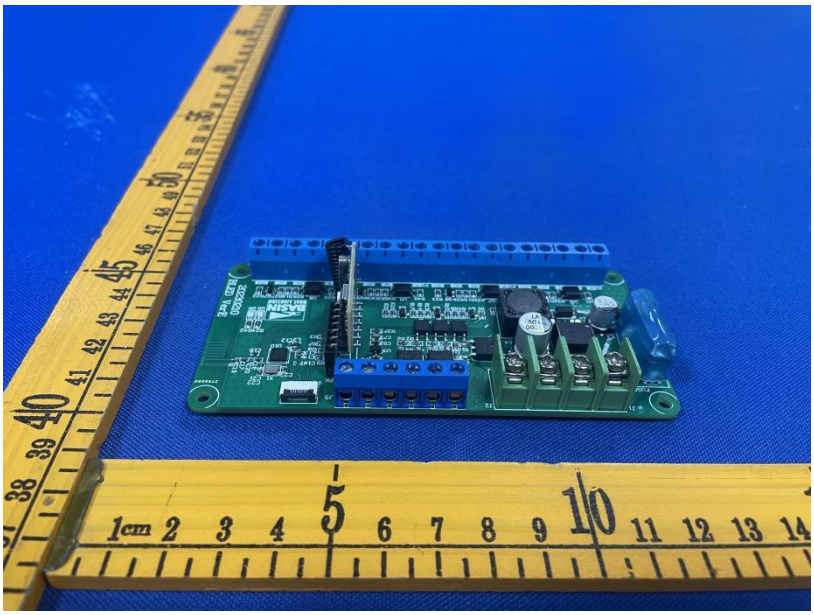

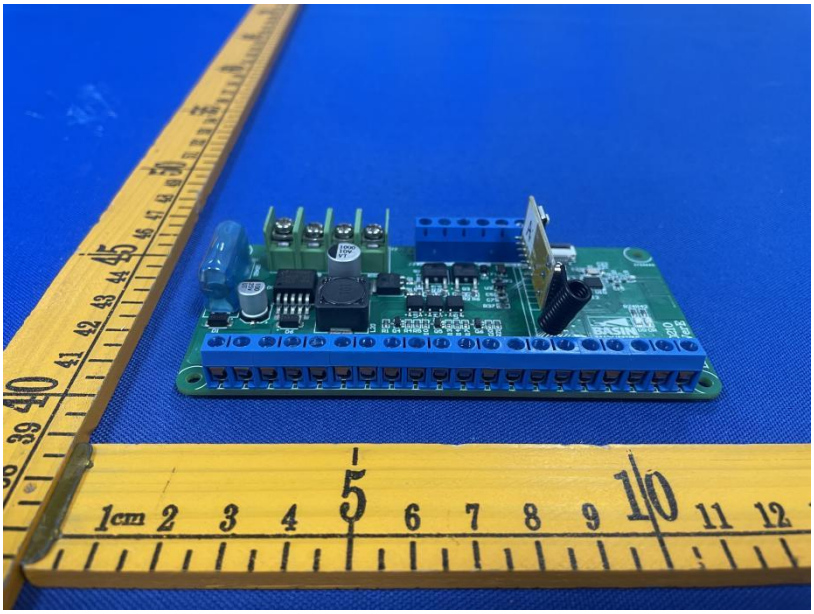

********THE END REPORT********