FCC TEST REPORT

For

Zhuhai Lei Shan Technology Co., Ltd.

IFD-68 Bluetooth mechanical keyboard

Model No.: IFD-68, IFD-68A, IFD-68B, IFD-68C, IFD-68D, IFD-68E, IFD-68F, IFD-68G, IFD-68H, IFD-68I, IFD-68J, IFD-68K, IFD-68L, IFD-68M, IFD-68N, IFD-68DS, IFD-68RGB

Prepared For	:	Zhuhai Lei Shan Technology Co., Ltd.
Address	:	26603, Room105, No.6 of Baohua Road, Hengqin New District, Zhuhai, China

Prepared By	:	Shenzhen Anbotek Compliance Laboratory Limited
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Report Number	:	R0217060026W
Date of Test	:	Jun. 05~22, 2017
Date of Report	:	Jun. 23, 2017

Contents

1. General Information....5
1.1. Client Information....5
1.2. Description of Device (EUT)....5
1.3. Auxiliary Equipment Used During Test....5
1.4. Description of Test Modes....6
1.5. List of channels....6
1.6. Description Of Test Setup....7
1.7. Test Equipment List....8
1.8. Measurement Uncertainty....8
1.9. Description of Test Facility....9
2. Summary of Test Results....10
3. Conducted Emission Test....11
3.1. Test Standard and Limit....11
3.2. Test Setup....11
3.3. Test Procedure....11
3.4. Test Data....11
4. Radiation Spurious Emission and Band Edge....16
4.1. Test Standard and Limit....16
4.2. Test Setup....16
4.3. Test Procedure....17
4.4. Test Data....18
5. Maximum Peak Output Power Test....25
5.1. Test Standard and Limit....25
5.2. Test Setup....25
5.3. Test Procedure....25
5.4. Test Data....25
6. 6DB Occupy Bandwidth Test....28
6.1. Test Standard and Limit....28
6.2. Test Setup....28
6.3. Test Procedure....28
6.4. Test Data....28
7. Power Spectral Density Test....31
7.1. Test Standard and Limit....31
7.2. Test Setup....31
7.3. Test Procedure....31
7.4. Test Data....31
8. 100kHz Bandwidth of Frequency Band Edge Requirement....34
8.1. Test Standard and Limit....34
8.2. Test Setup....34

8.3. Test Procedure....34
8.4. Test Data....34
9. Antenna Requirement....36
9.1. Test Standard and Requirement....36
9.2. Antenna Connected Construction....36
APPENDIX I -- TEST SETUP PHOTOGRAPH....37
APPENDIX II -- EXTERNAL PHOTOGRAPH....39
APPENDIX III -- INTERNAL PHOTOGRAPH....43

TEST REPORT

Applicant	:	Zhuhai Lei Shan Technology Co., Ltd.
Manufacturer	:	Zhuhai Lei Shan Technology Co., Ltd.
Product Name	:	IFD-68 Bluetooth mechanical keyboard
Model No.	:	IFD-68, IFD-68A, IFD-68B, IFD-68C, IFD-68D, IFD-68E, IFD-68F, IFD-68G, IFD-68H, IFD-68I, IFD-68J, IFD-68K, IFD-68L, IFD-68M, IFD-68N, IFD-68DS, IFD-68RGB
Trade Mark	:	KEYWALKER 键行者
Rating(s)	:	Input DC 5V, 300mA (Battery DC 3.7V, 1200mAh)

Test Standard(s)	**:**	**FCC Part15 Subpart C 2016, Section 15.247**
Test Method(s)	**:**	**ANSI C63.10: 2013, KDB558074 D01 DTS Meas Guidance v04**

The device described above is tested by Shenzhen Anbotek Compliance Laboratory Limited to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and Shenzhen Anbotek Compliance Laboratory Limited is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the FCC Part 15 Subpart C requirements.

This report applies to above tested sample only and shall not be reproduced in part without written approval of Shenzhen Anbotek Compliance Laboratory Limited.

Date of Test : : Jun. 05~22, 2017

Prepared by : : Winkey Wang

(Tested Engineer / Winkey Wang)

Reviewer : : Amy Ding

(Project Manager / Amy Ding)

Approved & Authorized Signer : : Tom Chen

(Manager / Tom Chen)

1. General Information

1.1. Client Information

Applicant	:	Zhuhai Lei Shan Technology Co., Ltd.
Address	:	26603, Room105, No.6 of Baohua Road, Hengqin New District, Zhuhai, China
Manufacturer	:	Zhuhai Lei Shan Technology Co., Ltd.
Address	:	26603, Room105, No.6 of Baohua Road, Hengqin New District, Zhuhai, China

1.2. Description of Device (EUT)

Product Name	:	IFD-68 Bluetooth mechanical keyboard	
Model No.	:	IFD-68, IFD-68A, IFD-68B, IFD-68C, IFD-68D, IFD-68E, IFD-68F, IFD-68G, IFD-68H, IFD-68I, IFD-68J, IFD-68K, IFD-68L, IFD-68M, IFD-68N, IFD-68DS, IFD-68RGB (Note: All samples are the same except the model number, color of the key cap, shell, and LED backlight, so we prepare "IFD-68" for test only.)	
Trade Mark	:	KEYWALKER 键行者	
Test Power Supply	:	AC 120V, 60Hz for adapter/AC 240V, 60Hz for adapter/ DC 3.7V Battery inside	
Product Description	:	Operation Frequency:	2402MHz~2480MHz
		Transfer Rate:	1 Mbits/s
		Number of Channel:	40 Channels
		Modulation Type:	GFSK
		Antenna Type:	PCB Antenna
		Antenna Gain(Peak):	0 dbi
Remark: 1)For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.			

1.3. Auxiliary Equipment Used During Test

Adapter	:	Manufacturer: ZTE M/N: STC-A2050I1000USBA-C S/N: 201202102100876 Input: 100-240V~50/60Hz 0.3A Output: DC 5V, 1000mA

1.4. Description of Test Modes

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	CH00
Mode 2	CH19
Mode 3	CH39
Mode 4	Keeping TX mode

For Conducted Emission	
Final Test Mode	Description
Mode 4	Keeping TX mode

For Radiated Emission	
Final Test Mode	Description
Mode 1	CH00
Mode 2	CH19
Mode 3	CH39

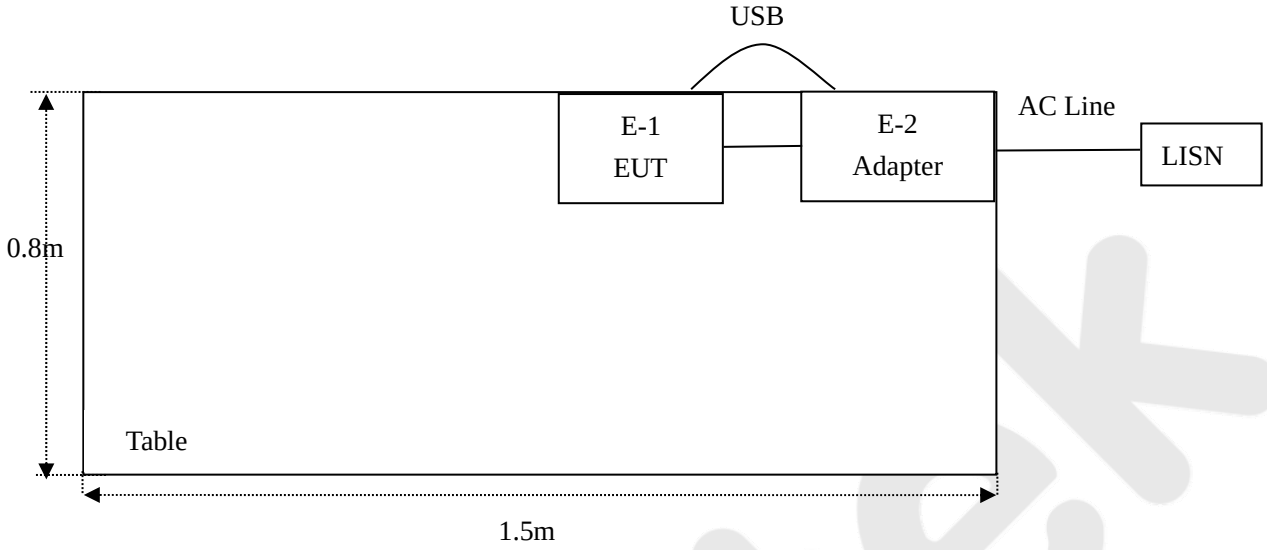
Note:
(1) The measurements are performed at the highest, middle, lowest available channels.
(2)The data rate was set in 1Mbps for radiated emission due to the highest RF output power.

1.5. List of channels

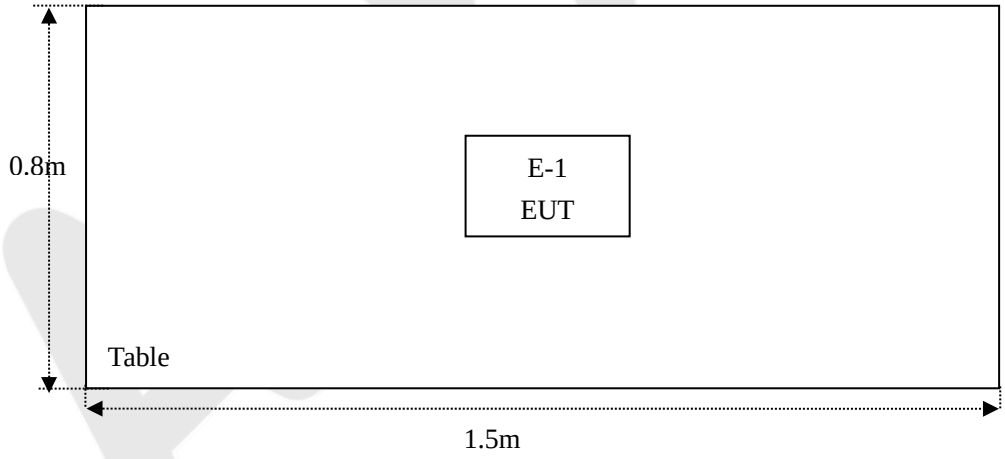
Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
00	2402	09	2420	18	2438	27	2456	36	2474
01	2404	10	2422	19	2440	28	2458	37	2476
02	2406	11	2424	20	2442	29	2460	38	2478
03	2408	12	2426	21	2444	30	2462	39	2480
04	2410	13	2428	22	2446	31	2464		
05	2412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

1.6. Description Of Test Setup

CE



RE



1.7. Test Equipment List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Two-Line V-network	Rohde & Schwarz	ENV216	100055	Jul. 19, 2016	1 Year
2.	EMI Test Receiver	Rohde & Schwarz	ESCI	100627	Jun. 17, 2017	1 Year
3.	RF Switching Unit	Compliance Direction	RSU-M2	38303	Jun. 17, 2017	1 Year
4.	Spectrum Analysis	Agilent	E4407B	US39390582	Jul. 12, 2016	1 Year
5	Preamplifier	Instruments corporation	EMC011830	980100	Jun. 17, 2017	1 Year
6.	EMI Test Receiver	Rohde & Schwarz	ESPI	101604	Jun. 17, 2017	1 Year
7.	Double Ridged Horn Antenna	Instruments corporation	GTH-0118	351600	May 06, 2017	1 Year
8.	Bilog Broadband Antenna	Schwarzbeck	VULB9163	VULB 9163-289	May 06, 2017	1 Year
9.	Loop Antenna	Schwarzbeck	FMZB 1519	012	May 11, 2017	1 Year
10.	Pre-amplifier	SONOMA	310N	186860	Jun. 17, 2017	1 Year
11	EMI Test Software EZ-EMC	SHURPLE	N/A	N/A	N/A	N/A
12.	Power Sensor	Agilent	KFSW150502	15I00041SN045	Jun. 17, 2017	1 Year
13.	MXA Spectrum Analysis	Agilent	N9020A	MY51170037	Jun. 17, 2017	1 Year
14.	MXG RF Vector Signal Generator	Agilent	N5182A	MY48180656	Jun. 17, 2017	1 Year
15	Signal Generator	Agilent	E4421B	MY41000743	Jun. 17, 2017	1 Year
16.	DC Power supply	IV	IV-8080	YQSB0096	Jun. 17, 2017	1 Year
17.	TEMP&HUMI PROGRAMMABLE CHAMBER	Bell Group	BE-THK-150 M8	SE-0137	Jun. 17, 2017	1 Year

1.8. Measurement Uncertainty

Radiation Uncertainty	:	Ur = 4.1 dB (Horizontal)
		Ur = 4.3 dB (Vertical)
Conduction Uncertainty	:	Uc = 3.4dB

1.9. Description of Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

FCC-Registration No.: 752021

Shenzhen Anbotek Compliance Laboratory Limited, EMC Laboratory has been registed and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 752021, July 06, 2016.

IC-Registration No.: 8058A-1

Shenzhen Anbotek Compliance Laboratory Limited., EMC Laboratory has been registered and fully described in a report filed with the (IC) Industry Canada. The acceptance letter from the IC is maintained in our files. Registration 8058A, June 13, 2016.

Test Location

All Emissions tests were performed at

Shenzhen Anbotek Compliance Laboratory Limited. at 1/F., Building 1, SEC Industrial Park, No.0409 Qianhai Road, Nanshan District, Shenzhen, Guangdong, China

2. Summary of Test Results

Standard Section	Test Item	Result
15.203/15.247(c)	Antenna Requirement	PASS
15.207	Conducted Emission	PASS
15.205/15.209	Spurious Emission	PASS
15.247(b)(3)	Conducted Peak Output Power	PASS
15.247(a)(2)	6dB Occupied Bandwidth	PASS
15.247(e)	Power Spectral Density	PASS
15.247(d)	Band Edge	PASS
Remark: "N/A" is an abbreviation for Not Applicable.		

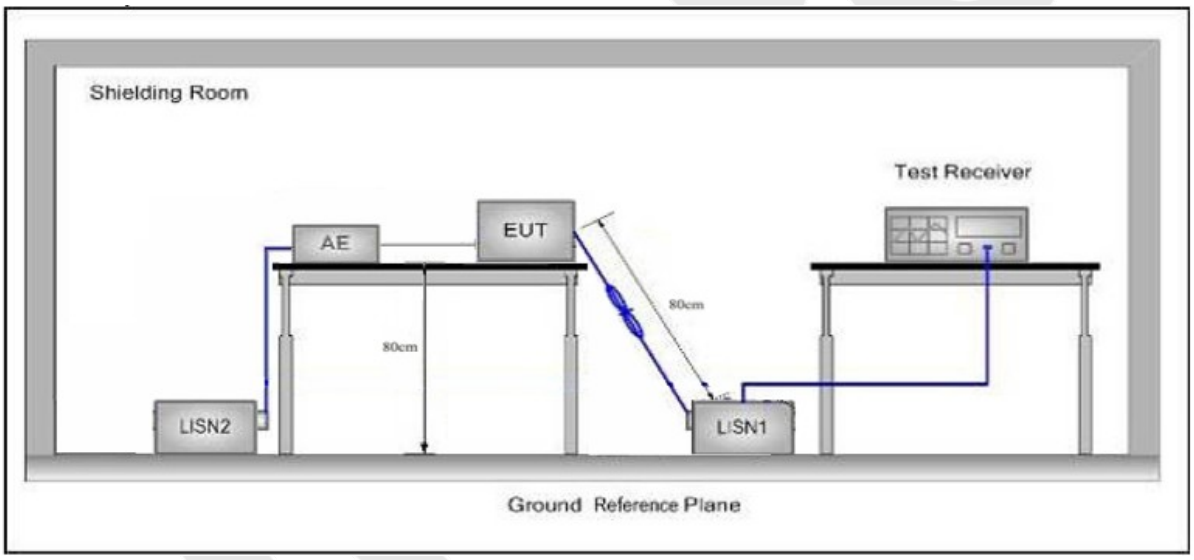
3. Conducted Emission Test

3.1. Test Standard and Limit

Test Standard	FCC Part15 Section 15.207		
Test Limit	Frequency	Maximum RF Line Voltage (dBuV)	
		Quasi-peak Level	Average Level
	150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
	500kHz~5MHz	56	46
	5MHz~30MHz	60	50

Remark: (1) *Decreasing linearly with logarithm of the frequency.
(2) The lower limit shall apply at the transition frequency.

3.2. Test Setup



3.3. Test Procedure

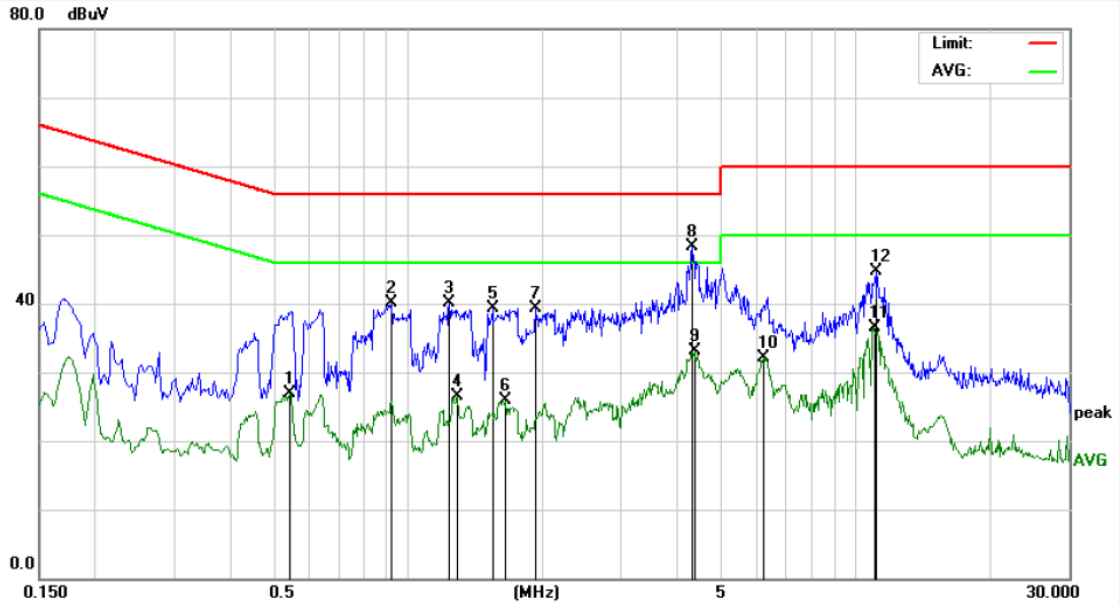
The EUT system is connected to the power mains through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm coupling impedance for the EUT system. Please refer the block diagram of the test setup and photographs. Both sides of AC line are checked to find out the maximum conducted emission. In order to find the maximum emission levels, the relative positions of equipment and all of the interface cables shall be changed according to FCC ANSI C63.10-2013 on Conducted Emission Measurement.
The bandwidth of test receiver (ESCI) set at 9kHz.
The frequency range from 150kHz to 30MHz is checked.

3.4. Test Data

Please to see the following pages

Conducted Emission Test Data

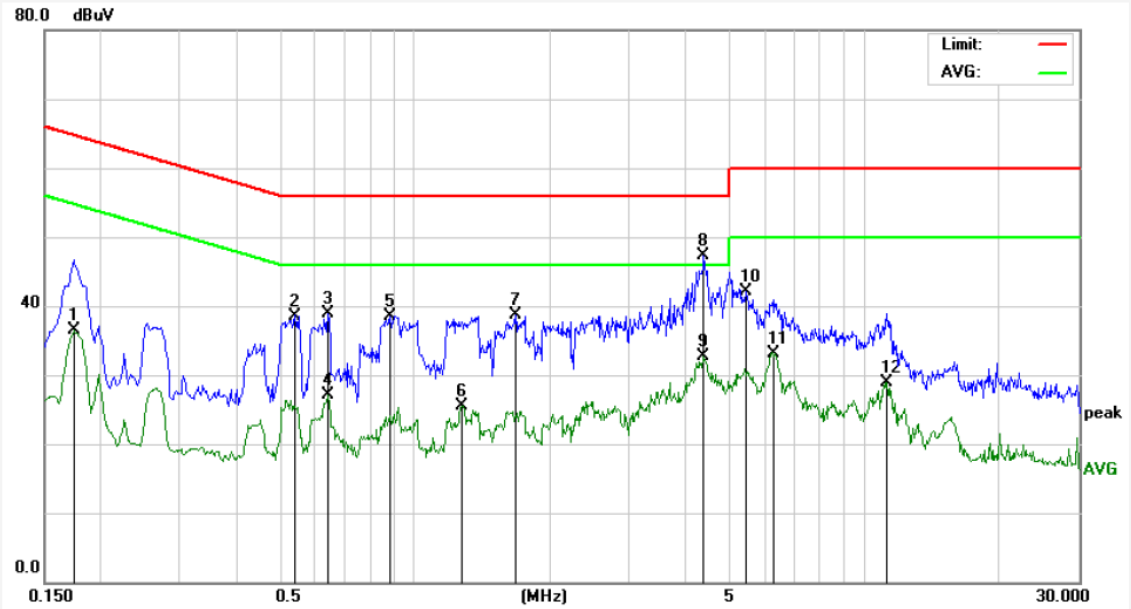
Test Site: 1# Shielded Room
Operating Condition: Keeping TX mode
Test Specification: AC 120V, 60Hz for adapter
Comment: Live Line
Tem.:25℃ Hum.:50%



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Over Limit (dB)	Detector	Remark
1	0.5460	6.82	19.99	26.81	46.00	-19.19	AVG	
2	0.9220	19.96	20.10	40.06	56.00	-15.94	QP	
3	1.2420	19.98	20.12	40.10	56.00	-15.90	QP	
4	1.2900	6.37	20.13	26.50	46.00	-19.50	AVG	
5	1.5460	19.26	20.13	39.39	56.00	-16.61	QP	
6	1.6460	5.75	20.13	25.88	46.00	-20.12	AVG	
7	1.9300	19.14	20.14	39.28	56.00	-16.72	QP	
8	4.3220	28.11	20.19	48.30	56.00	-7.70	QP	
9	4.3620	12.87	20.19	33.06	46.00	-12.94	AVG	
10	6.2460	11.95	20.24	32.19	50.00	-17.81	AVG	
11	10.9819	16.27	20.32	36.59	50.00	-13.41	AVG	
12	11.1140	24.34	20.32	44.66	60.00	-15.34	QP	

Conducted Emission Test Data

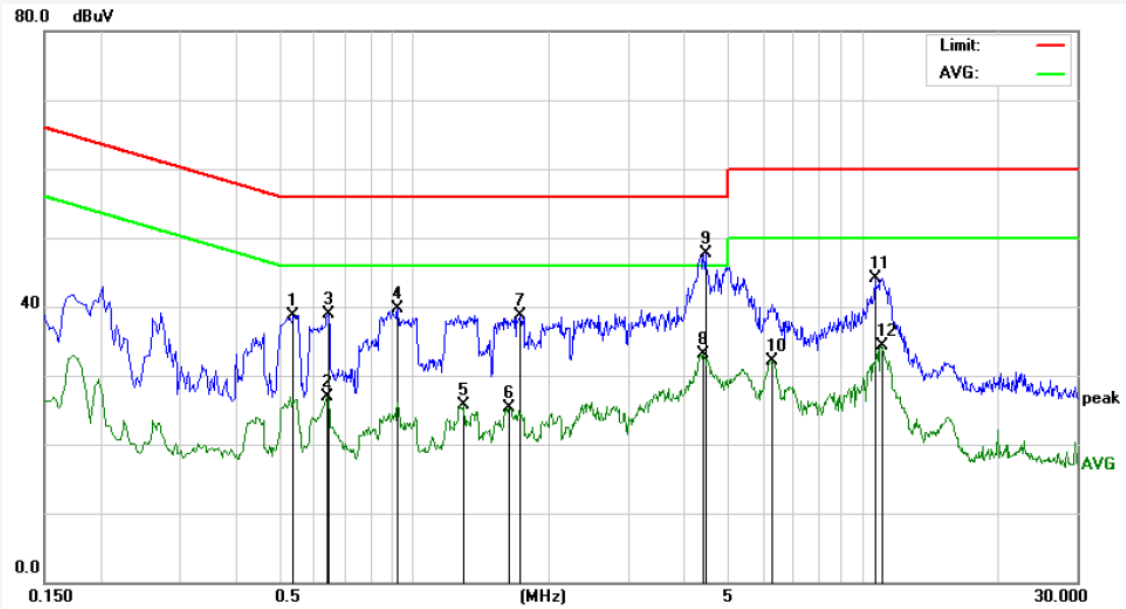
Test Site: 1# Shielded Room
Operating Condition: Keeping TX mode
Test Specification: AC 120V, 60Hz for adapter
Comment: Neutral Line
Tem.:25℃ Hum.:50%



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Over Limit (dB)	Detector	Remark
1	0.1740	16.53	19.90	36.43	54.76	-18.33	AVG	
2	0.5420	18.61	19.99	38.60	56.00	-17.40	QP	
3	0.6419	18.81	20.02	38.83	56.00	-17.17	QP	
4	0.6419	7.17	20.02	27.19	46.00	-18.81	AVG	
5	0.8820	18.41	20.09	38.50	56.00	-17.50	QP	
6	1.2700	5.44	20.13	25.57	46.00	-20.43	AVG	
7	1.6780	18.64	20.13	38.77	56.00	-17.23	QP	
8	4.4060	27.10	20.19	47.29	56.00	-8.71	QP	
9	4.4060	12.52	20.19	32.71	46.00	-13.29	AVG	
10	5.4660	21.81	20.22	42.03	60.00	-17.97	QP	
11	6.2460	12.96	20.24	33.20	50.00	-16.80	AVG	
12	11.2500	8.62	20.32	28.94	50.00	-21.06	AVG	

Conducted Emission Test Data

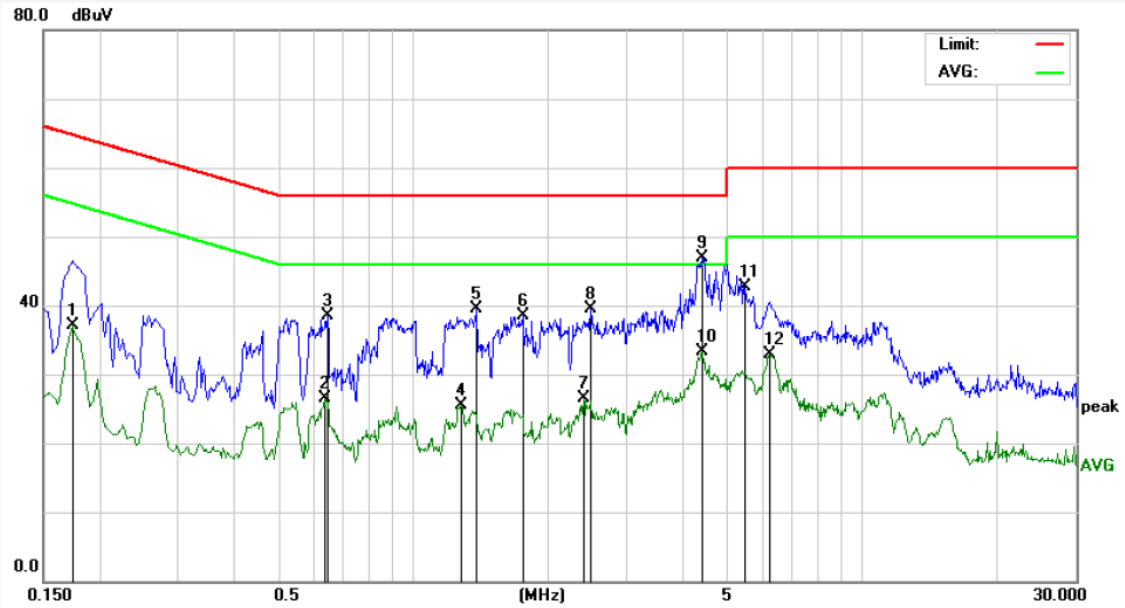
Test Site:	1# Shielded Room
Operating Condition:	Keeping TX mode
Test Specification:	AC 240V, 60Hz for adapter
Comment:	Live Line
	Tem.:25℃ Hum.:50%



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Over Limit (dB)	Detector	Remark
1	0.5380	18.81	19.99	38.80	56.00	-17.20	QP	
2	0.6419	6.85	20.02	26.87	46.00	-19.13	AVG	
3	0.6460	18.81	20.02	38.83	56.00	-17.17	QP	
4	0.9220	19.58	20.10	39.68	56.00	-16.32	QP	
5	1.2900	5.56	20.13	25.69	46.00	-20.31	AVG	
6	1.6300	5.16	20.13	25.29	46.00	-20.71	AVG	
7	1.7340	18.62	20.13	38.75	56.00	-17.25	QP	
8	4.4300	12.83	20.19	33.02	46.00	-12.98	AVG	
9	4.4660	27.60	20.19	47.79	56.00	-8.21	QP	
10	6.2860	11.86	20.24	32.10	50.00	-17.90	AVG	
11	10.6459	23.82	20.33	44.15	60.00	-15.85	QP	
12	10.9780	13.91	20.32	34.23	50.00	-15.77	AVG	

Conducted Emission Test Data

Test Site:	1# Shielded Room
Operating Condition:	Keeping TX mode
Test Specification:	AC 240V, 60Hz for adapter
Comment:	Neutral Line
	Tem.:25℃ Hum.:50%



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Over Limit (dB)	Detector	Remark
1	0.1740	17.17	19.90	37.07	54.76	-17.69	AVG	
2	0.6340	6.41	20.02	26.43	46.00	-19.57	AVG	
3	0.6460	18.42	20.02	38.44	56.00	-17.56	QP	
4	1.2780	5.38	20.13	25.51	46.00	-20.49	AVG	
5	1.3820	19.41	20.13	39.54	56.00	-16.46	QP	
6	1.7540	18.31	20.14	38.45	56.00	-17.55	QP	
7	2.4020	6.36	20.15	26.51	46.00	-19.49	AVG	
8	2.4900	19.39	20.15	39.54	56.00	-16.46	QP	
9	4.4260	26.77	20.19	46.96	56.00	-9.04	QP	
10	4.4260	13.04	20.19	33.23	46.00	-12.77	AVG	
11	5.4780	22.53	20.22	42.75	60.00	-17.25	QP	
12	6.2300	12.60	20.24	32.84	50.00	-17.16	AVG	

4. Radiation Spurious Emission and Band Edge

4.1. Test Standard and Limit

Test Standard	FCC Part15 C Section 15.209 and 15.205				
Test Limit	Frequency (MHz)	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
	0.009MHz~0.490MHz	2400/F(kHz)	-	-	300
	0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
	1.705MHz-30MHz	30	-	-	30
	30MHz~88MHz	100	40.0	Quasi-peak	3
	88MHz~216MHz	150	43.5	Quasi-peak	3
	216MHz~960MHz	200	46.0	Quasi-peak	3
	960MHz~1000MHz	500	54.0	Quasi-peak	3
	Above 1000MHz	500	54.0	Average	3
		-	74.0	Peak	3

Remark:

(1)The lower limit shall apply at the transition frequency.

(2) 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

4.2. Test Setup

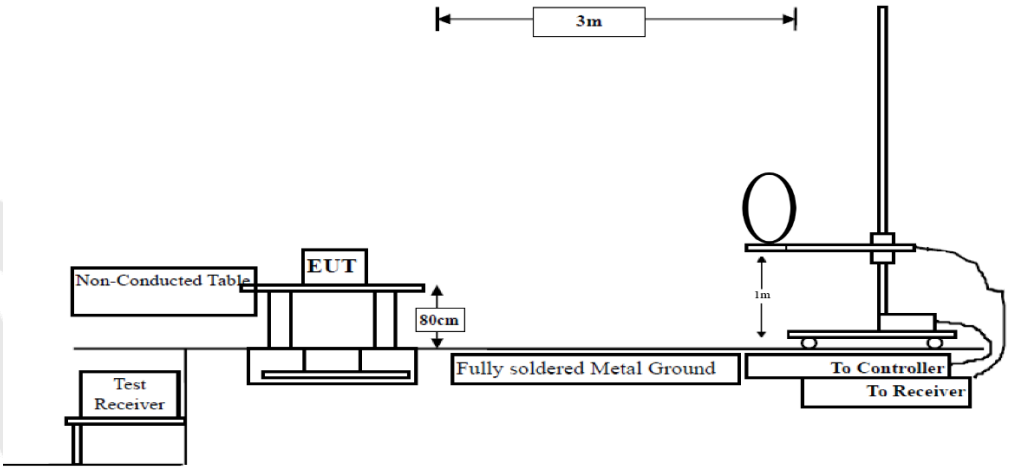


Figure 1. Below 30MHz

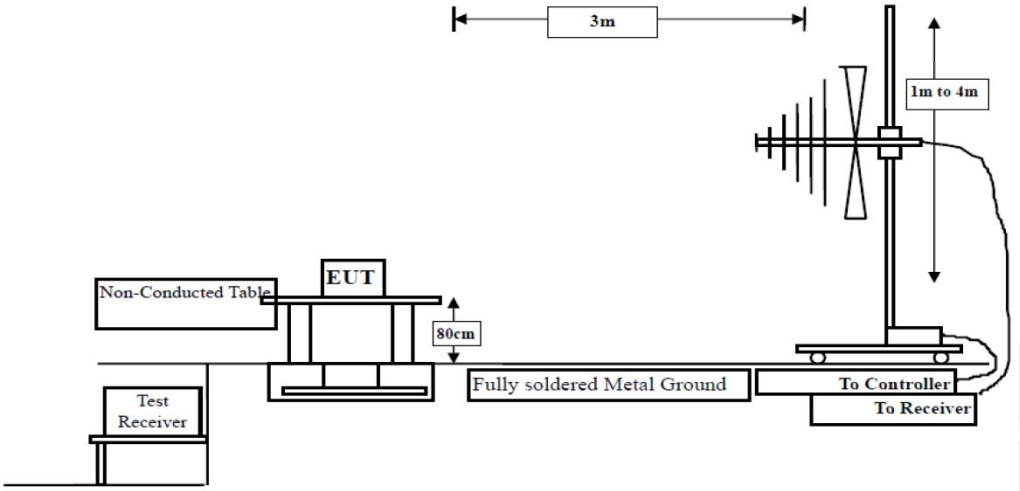


Figure 2. 30MHz to 1GHz

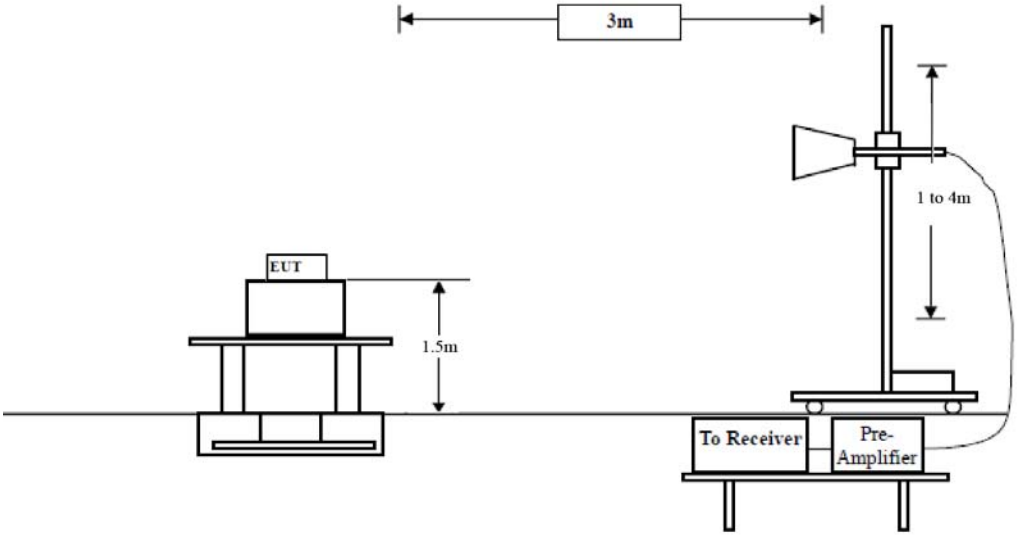


Figure 3. Above 1 GHz

4.3. Test Procedure

For below 1GHz: The EUT is placed on a turntable, which is 0.8m above the ground plane.
For above 1GHz: The EUT is placed on a turntable, which is 1.5m above the ground plane.
The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT is set 3 meters away from the receiving antenna which is mounted on a antenna tower. The antenna can be moved up and down from 1 to 4 meters to find out the maximum emission level. Rotated the EUT through three orthogonal axes to determine the maximum emissions, both horizontal and vertical polarization of the antenna are set on test. The EUT is tested in 9*6*6 Chamber. The device is evaluated in xyz orientation.

For 9kHz to 150kHz, Set the spectrum analyzer as:
RBW = 200Hz, VBW =1kHz, Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For 150kHz to 30MHz, Set the spectrum analyzer as:
RBW = 9KHz, VBW =30kHz, Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For 30MHz to 1000MHz, Set the spectrum analyzer as:
RBW = 100kHz, VBW =300kHz,Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For above 1GHz,Set the spectrum analyzer as:
RBW =1MHz, VBW =10Hz, Detector= Average, Trace mode= Max hold, Sweep- auto couple.

4.4. Test Data

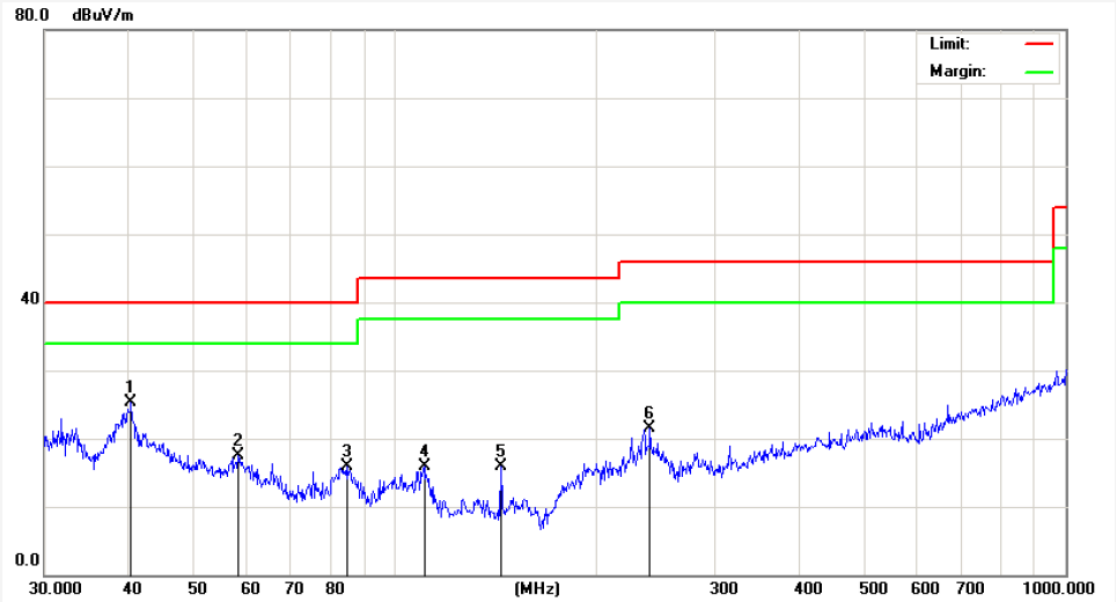
PASS

During the test, Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the X-axis is the worst case.

The test results of 9kHz-30MHz and above 18000MHz are attenuated more than 20dB below the permissible limits, so the results don't record in the report.

Test Results (30~1000MHz)

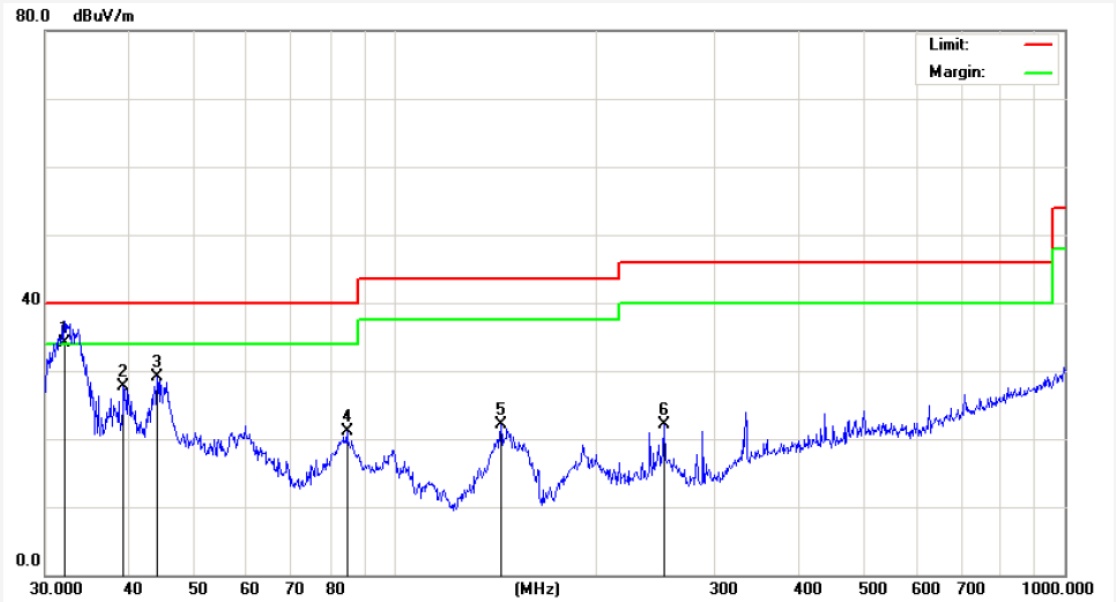
Job No.:	0217060026W	Temp.(℃)/Hum.(%RH):	24.3℃/55%RH
Standard:	FCC PART 15C	Power Source:	AC 120V, 60Hz for adapter
Test Mode:	TX Mode	Polarization:	Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	40.4172	35.91	-10.53	25.38	40.00	-14.62	peak			
2	58.4074	32.76	-15.26	17.50	40.00	-22.50	peak			
3	84.7019	36.37	-20.45	15.92	40.00	-24.08	peak			
4	110.5687	36.57	-20.66	15.91	43.50	-27.59	peak			
5	143.8295	39.26	-23.43	15.83	43.50	-27.67	peak			
6	239.9874	39.56	-18.09	21.47	46.00	-24.53	peak			

Test Results (30~1000MHz)

Job No.:	0217060026W	Temp.(℃)/Hum.(%RH):	24.3℃/55%RH
Standard:	FCC PART 15C	Power Source:	AC 120V, 60Hz for adapter
Test Mode:	TX Mode	Polarization:	Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	32.0667	49.96	-15.84	34.12	40.00	-5.88	QP	100	0	
2	39.2991	38.67	-10.92	27.75	40.00	-12.25	peak			
3	44.1202	41.18	-11.98	29.20	40.00	-10.80	peak			
4	84.7019	39.60	-18.45	21.15	40.00	-18.85	peak			
5	143.8295	40.59	-18.43	22.16	43.50	-21.34	peak			
6	252.0627	36.14	-14.03	22.11	46.00	-23.89	peak			

Test Results (Above 1000MHz)

Test Mode: TX Mode					Test channel: Lowest			
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.
4804.00	38.98	34.04	6.58	34.09	45.51	74.00	-28.49	V
7206.00	32.94	37.11	7.73	34.50	43.28	74.00	-30.72	V
9608.00	32.46	39.31	9.23	34.79	46.21	74.00	-27.79	V
12010.00	*					74.00		V
14412.00	*					74.00		V
4804.00	43.61	34.04	6.58	34.09	50.14	74.00	-23.86	H
7206.00	34.85	37.11	7.73	34.50	45.19	74.00	-28.81	H
9608.00	32.04	39.31	9.23	34.79	45.79	74.00	-28.21	H
12010.00	*					74.00		H
14412.00	*					74.00		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.
4804.00	27.48	34.04	6.58	34.09	34.01	54.00	-19.99	V
7206.00	21.44	37.11	7.73	34.50	31.78	54.00	-22.22	V
9608.00	20.41	39.31	9.23	34.79	34.16	54.00	-19.84	V
12010.00	*					54.00		V
14412.00	*					54.00		V
4804.00	31.89	34.04	6.58	34.09	38.42	54.00	-15.58	H
7206.00	23.72	37.11	7.73	34.50	34.06	54.00	-19.94	H
9608.00	20.28	39.31	9.23	34.79	34.03	54.00	-19.97	H
12010.00	*					54.00		H
14412.00	*					54.00		H

Test Results (Above 1000MHz)

Test Mode: TX Mode					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.
4880.00	37.46	34.38	6.69	34.09	44.44	74.00	-29.56	V
7320.00	31.94	37.22	7.78	34.53	42.41	74.00	-31.59	V
9760.00	31.56	39.46	9.35	34.80	45.57	74.00	-28.43	V
12200.00	*					74.00		V
14640.00	*					74.00		V
4880.00	41.78	34.38	6.69	34.09	48.76	74.00	-25.24	H
7320.00	33.71	37.22	7.78	34.53	44.18	74.00	-29.82	H
9760.00	31.00	39.46	9.35	34.80	45.01	74.00	-28.99	H
12200.00	*					74.00		H
14640.00	*					74.00		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.
4880.00	26.26	34.38	6.69	34.09	33.24	54.00	-20.76	V
7320.00	20.61	37.22	7.78	34.53	31.08	54.00	-22.92	V
9760.00	19.68	39.46	9.35	34.80	33.69	54.00	-20.31	V
12200.00	*					54.00		V
14640.00	*					54.00		V
4880.00	30.51	34.38	6.69	34.09	37.49	54.00	-16.51	H
7320.00	22.80	37.22	7.78	34.53	33.27	54.00	-20.73	H
9760.00	19.42	39.46	9.35	34.80	33.43	54.00	-20.57	H
12200.00	*					54.00		H
14640.00	*					54.00		H

Test Results (Above 1000MHz)

Test Mode: TX Mode					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.
4960.00	37.35	34.72	6.79	34.09	44.77	74.00	-29.23	V
7440.00	31.86	37.34	7.82	34.57	42.45	74.00	-31.55	V
9920.00	31.50	39.62	9.46	34.81	45.77	74.00	-28.23	V
12400.00	*					74.00		V
14880.00	*					74.00		V
4960.00	41.65	34.72	6.79	34.09	49.07	74.00	-24.93	H
7440.00	33.62	37.34	7.82	34.57	44.21	74.00	-29.79	H
9920.00	30.92	39.62	9.46	34.81	45.19	74.00	-28.81	H
12400.00	*					74.00		H
14880.00	*					74.00		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.
4960.00	26.25	34.72	6.79	34.09	33.67	54.00	-20.33	V
7440.00	20.60	37.34	7.82	34.57	31.19	54.00	-22.81	V
9920.00	19.67	39.62	9.46	34.81	33.94	54.00	-20.06	V
12400.00	*					54.00		V
14880.00	*					54.00		V
4960.00	30.49	34.72	6.79	34.09	37.91	54.00	-16.09	H
7440.00	22.79	37.34	7.82	34.57	33.38	54.00	-20.62	H
9920.00	19.41	39.62	9.46	34.81	33.68	54.00	-20.32	H
12400.00	*					54.00		H
14880.00	*					54.00		H

Remark:

1. Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor

2. “*”, means this data is the too weak instrument of signal is unable to test.

Radiated Band Edge:

Test Mode: GFSK					Test channel: Lowest			
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.
2390.00	45.91	29.15	3.41	34.01	44.46	74.00	-29.54	H
2400.00	63.14	29.16	3.43	34.01	61.72	74.00	-12.28	H
2390.00	46.75	29.15	3.41	34.01	45.30	74.00	-28.70	V
2400.00	65.50	29.16	3.43	34.01	64.08	74.00	-9.92	V
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.
2390.00	35.78	29.15	3.41	34.01	34.33	54.00	-19.67	H
2400.00	47.20	29.16	3.43	34.01	45.78	54.00	-8.22	H
2390.00	35.94	29.15	3.41	34.01	34.49	54.00	-19.51	V
2400.00	44.13	29.16	3.43	34.01	42.71	54.00	-11.29	V

Test Mode: 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.
2483.50	48.38	29.28	3.53	34.03	47.16	74.00	-26.84	H
2500.00	46.97	29.30	3.56	34.03	45.80	74.00	-28.20	H
2483.50	49.73	29.28	3.53	34.03	48.51	74.00	-25.49	V
2500.00	48.26	29.30	3.56	34.03	47.09	74.00	-26.91	V
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.
2483.50	38.64	29.28	3.53	34.03	37.42	54.00	-16.58	H
2500.00	36.21	29.30	3.56	34.03	35.04	54.00	-18.96	H
2483.50	40.11	29.28	3.53	34.03	38.89	54.00	-15.11	V
2500.00	36.38	29.30	3.56	34.03	35.21	54.00	-18.79	V

Remark:

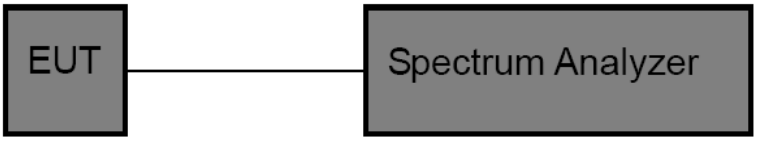
1. Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor

5. Maximum Peak Output Power Test

5.1. Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (b)(3)
Test Limit	30dBm

5.2. Test Setup



5.3. Test Procedure

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

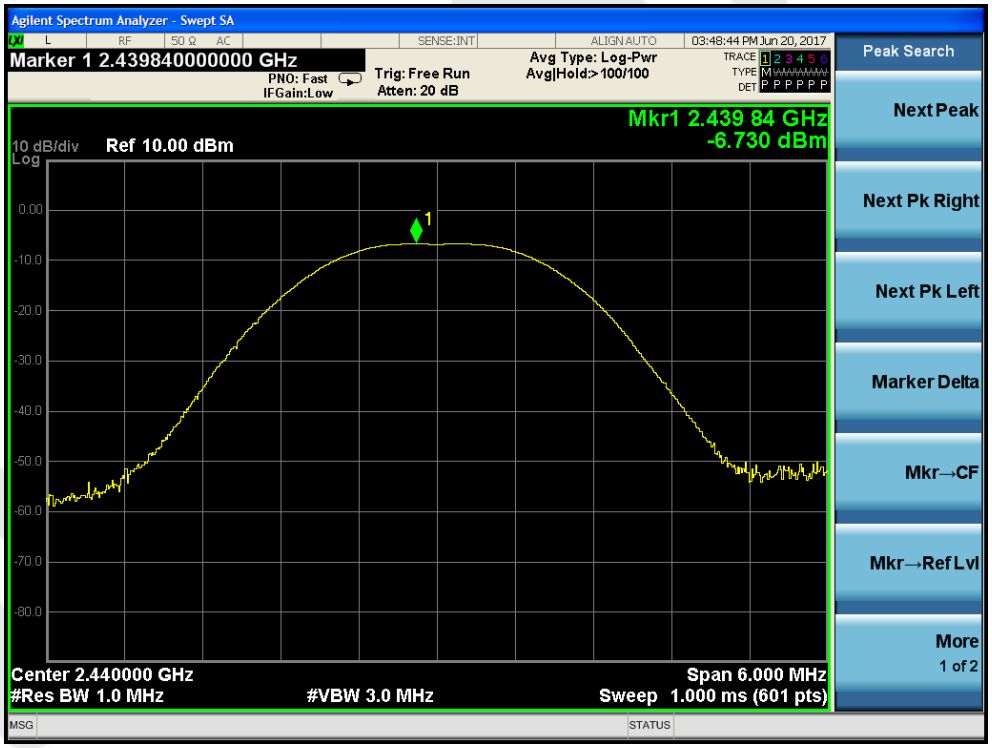
1. Set the RBW ≥DTS bandwidth.
2. Set the VBW≥3*RBW.
3. Set the span≥ 3*RBW.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use peak marker function to determine the peak amplitude level.

5.4. Test Data

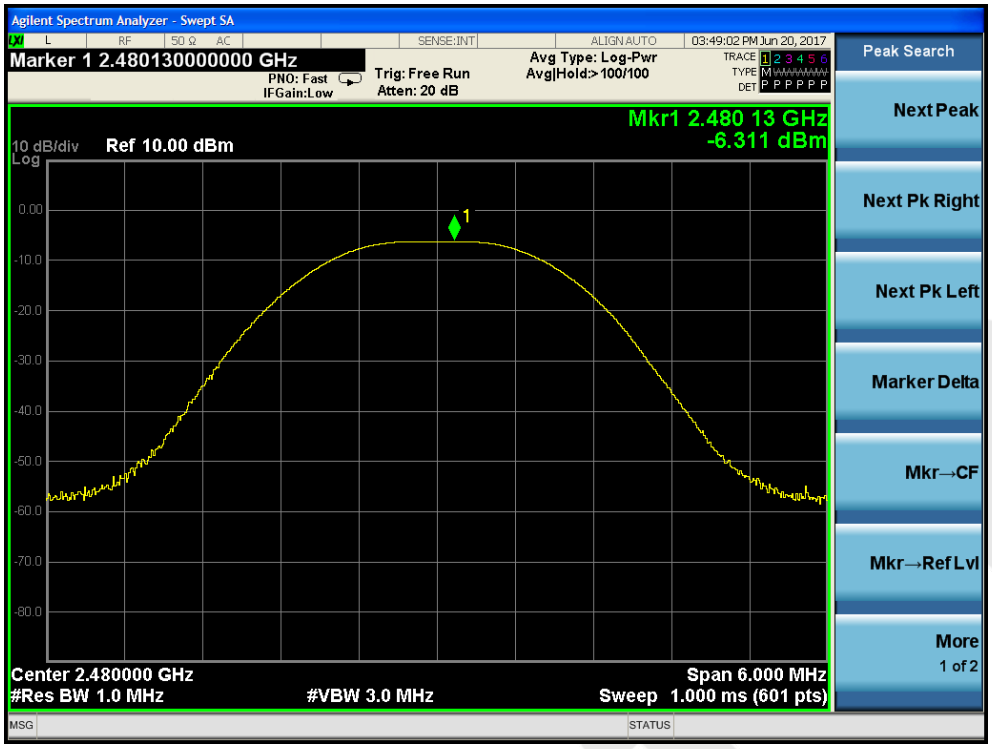
Test Item	:	Max. peak output power	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 3.7V Battery inside	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Channel Frequency (MHz)	Peak Power output (dBm)	Limit (dBm)	Results
2402	-6.830	30	PASS
2440	-6.730	30	PASS
2480	**-6.311**	30	PASS

CH: Low



CH: Middle


Agilent Spectrum Analyzer - Swept SA
Marker 1 2.480130000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
03:49:02 PM Jun 20, 2017
Mkr1 2.480 13 GHz
-6.311 dBm
10 dB/div
Log
Ref 10.00 dBm
Center 2.480000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Span 6.000 MHz
Sweep 1.000 ms (601 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

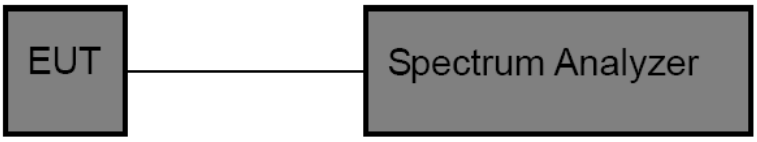
CH: High

6. 6DB Occupy Bandwidth Test

6.1. Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (a)(2)
Test Limit	>500kHz

6.2. Test Setup



6.3. Test Procedure

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as:

RBW = 100kHz, VBW⩾3*RBW =300kHz,

Detector= Peak

Trace mode= Max hold.

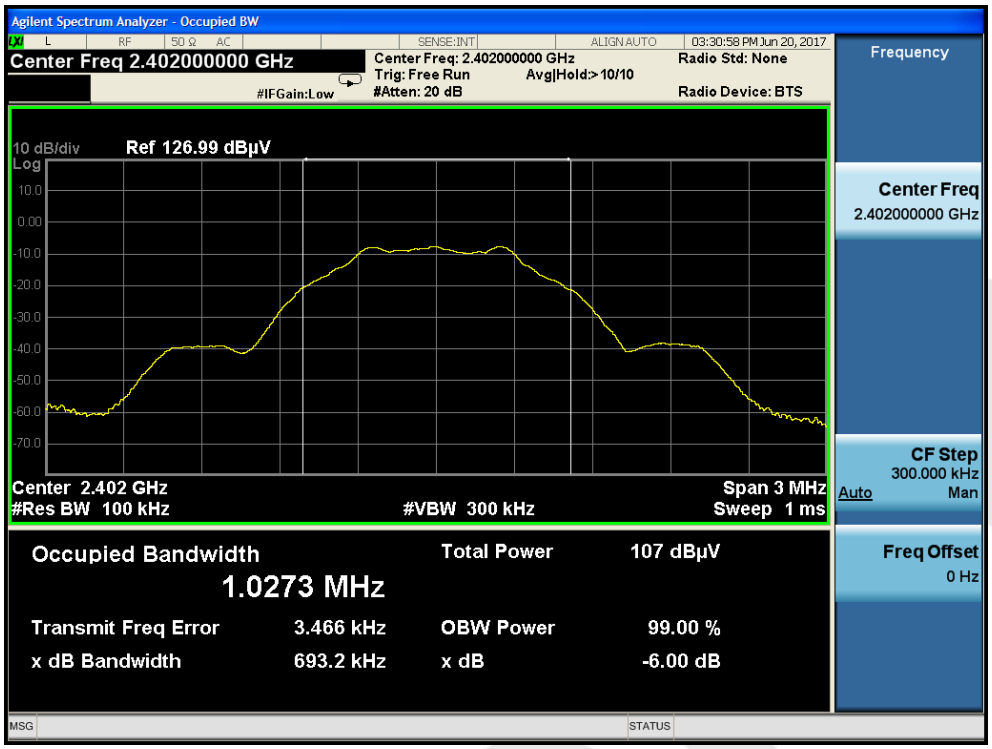
Sweep- auto couple.

4. Mark the peak frequency and –6dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.

6.4. Test Data

Test Item	:	6dB Bandwidth	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 3.7V Battery inside	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Channel	Frequency(MHz)	Bandwidth (kHz)	Limit (kHz)	Results
Low	2402	693.2	>500	PASS
Middle	2440	695.2		PASS
High	2480	692.6		PASS



CH: Low

CH: Middle

Agilent Spectrum Analyzer - Occupied BW
Center Freq 2.480000000 GHz
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 20 dB
Radio Std: None
Radio Device: BTS
#IFGain:Low
10 dB/div
Ref 126.99 dBµV
Log
Center 2.48 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 3 MHz
Sweep 1 ms
Occupied Bandwidth
1.0308 MHz
Total Power 107 dBµV
Transmit Freq Error 3.513 kHz
OBW Power 99.00 %
x dB Bandwidth 692.6 kHz
x dB -6.00 dB
Frequency
Center Freq
2.480000000 GHz
CF Step
300.000 kHz
Auto Man
Freq Offset
0 Hz
MSG
STATUS

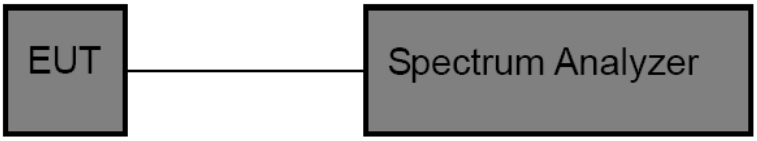
CH: High

7. Power Spectral Density Test

7.1. Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (e)
Test Limit	8dBm

7.2. Test Setup



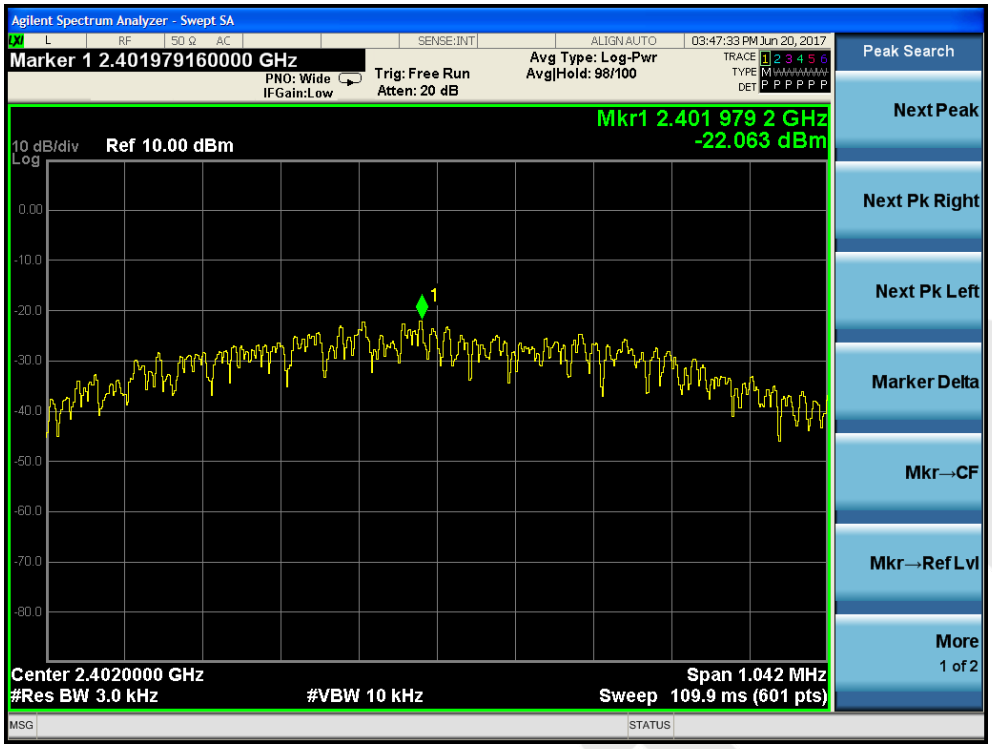
7.3. Test Procedure

1. Place the EUT on the table and set it in transmitting mode. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set the spectrum analyzer as RBW = 3kHz, VBW = 10kHz, Span = 1.5xDTS BW
3. Record the max. reading.
4. Repeat the above procedure until the measurements for all frequencies are completed.

7.4. Test Data

Test Item	:	Power Spectral Density	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 3.7V Battery inside	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Channel	Frequency (MHz)	PPSD (dBm/3KHz)	Limit (dBm/3KHz)	Results
Low	2402	-22.063	8.00	PASS
Middle	2440	-22.010	8.00	PASS
High	2480	-21.514	8.00	PASS



CH: Low

CH: Middle

Agilent Spectrum Analyzer - Swept SA
Marker 1 2.479979160000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
03:46:46 PM Jun 20, 2017
Mkr1 2.479 979 2 GHz
-21.514 dBm
10 dB/div
Log
Ref 10.00 dBm
Center 2.4800000 GHz
#Res BW 3.0 kHz
#VBW 10 kHz
Span 1.042 MHz
Sweep 109.9 ms (601 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

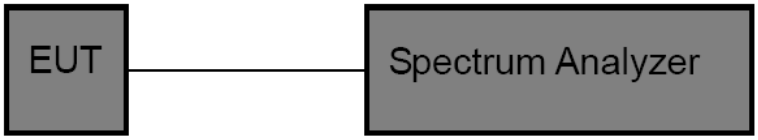
CH: High

8. 100kHz Bandwidth of Frequency Band Edge Requirement

8.1. 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 in15.209(a).

8.2. Test Setup



8.3. Test Procedure

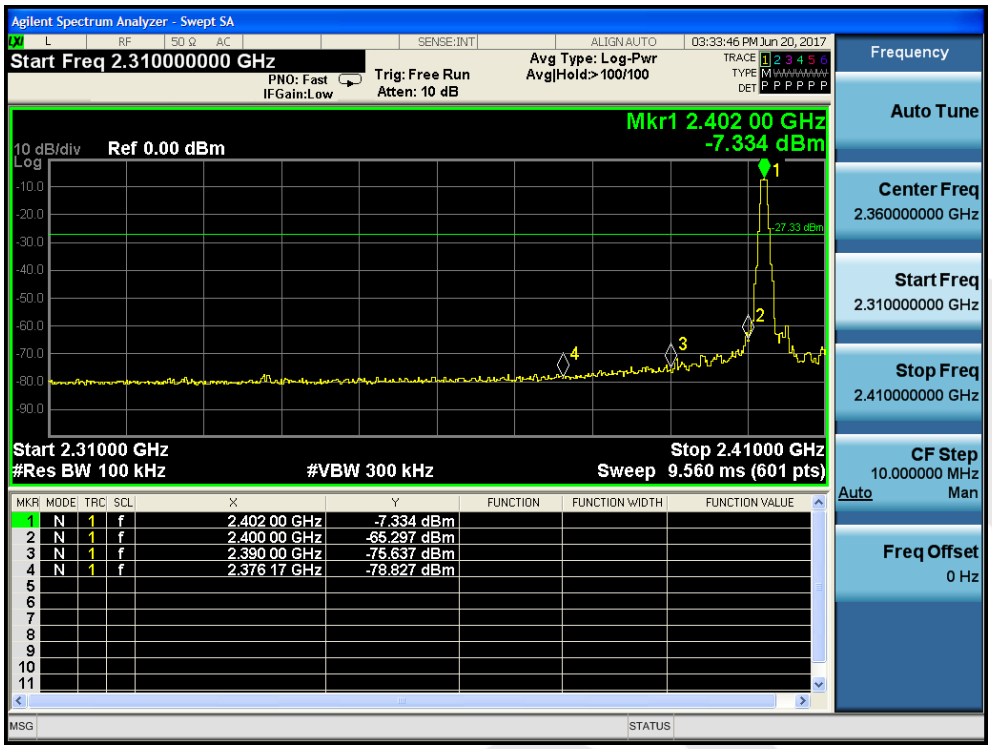
Using the following spectrum analyzer setting:

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.

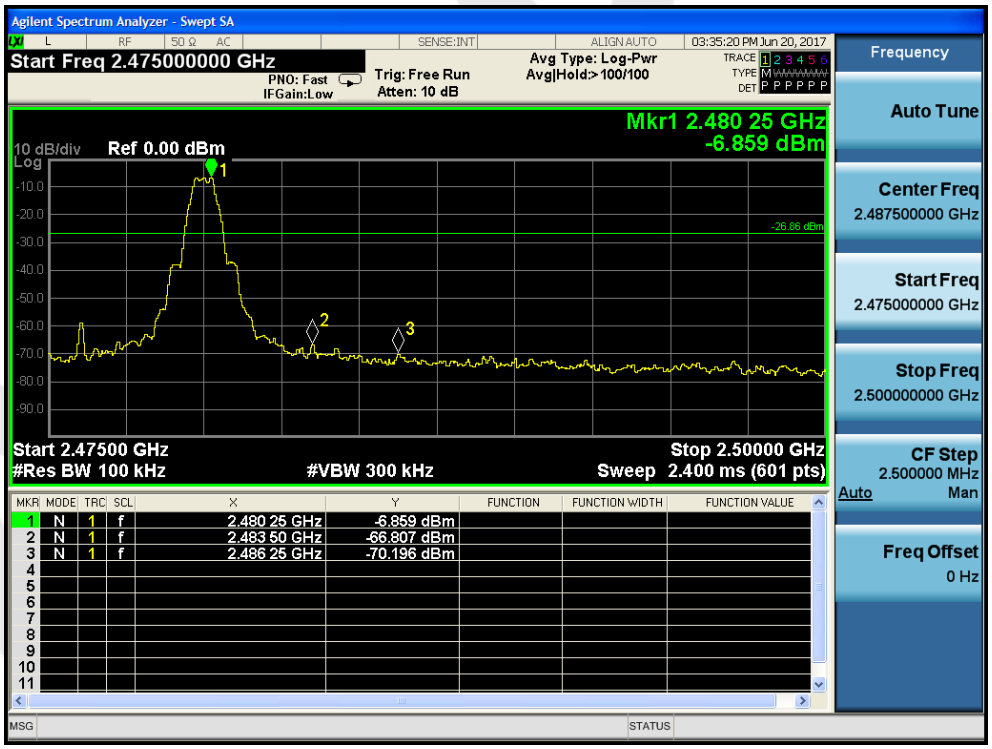
8.4. Test Data

Test Item	:	Band edge	Test Mode	:	CH Low ~ CH High
Test Voltage	:	DC 3.7V Battery inside	Temperature	:	24℃
Test Result	:	PASS	Humidity	:	55%RH

Frequency Band (MHz)	Delta Peak toBand Emission (dBc)	Limit (dBc)	Results
2400	57.963	>20	PASS
2483.5	59.948	>20	PASS



CH: Low



CH: High

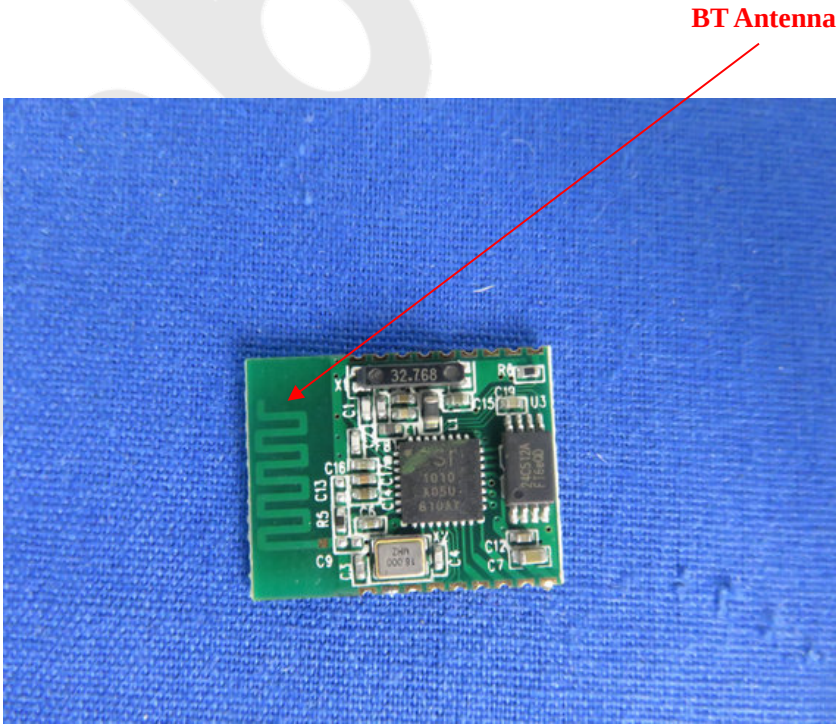
9. Antenna Requirement

9.1. 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.

9.2. Antenna Connected Construction

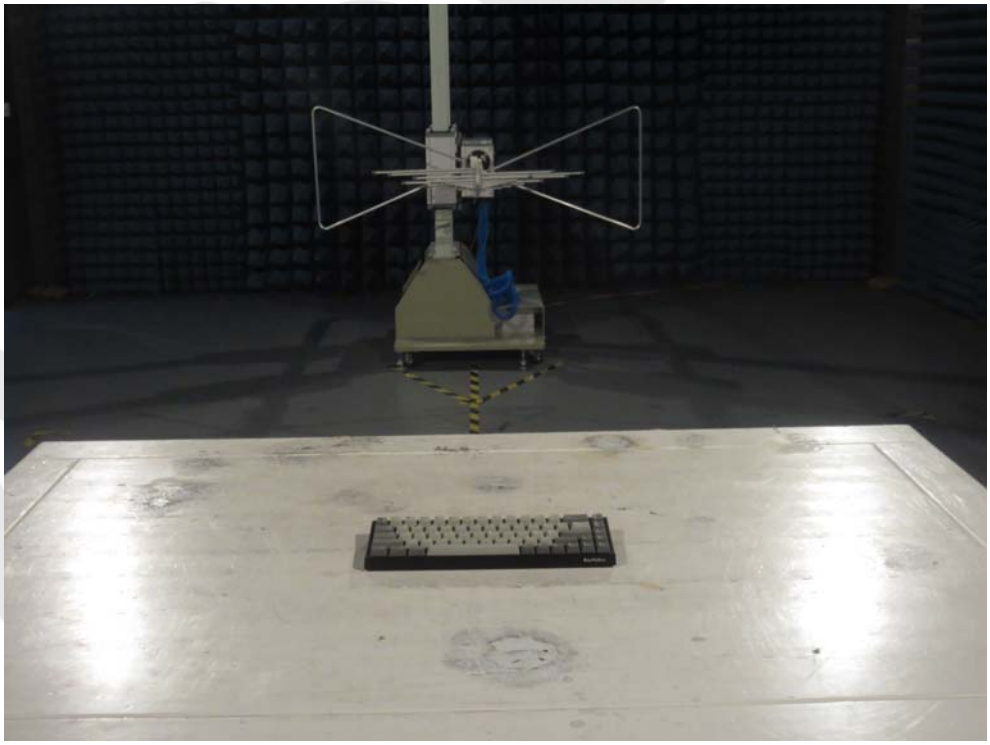
The bluetooth antenna is a PCB antenna which permanently attached, and the best case gain of the antenna is 0dBi. It complies with the standard requirement.

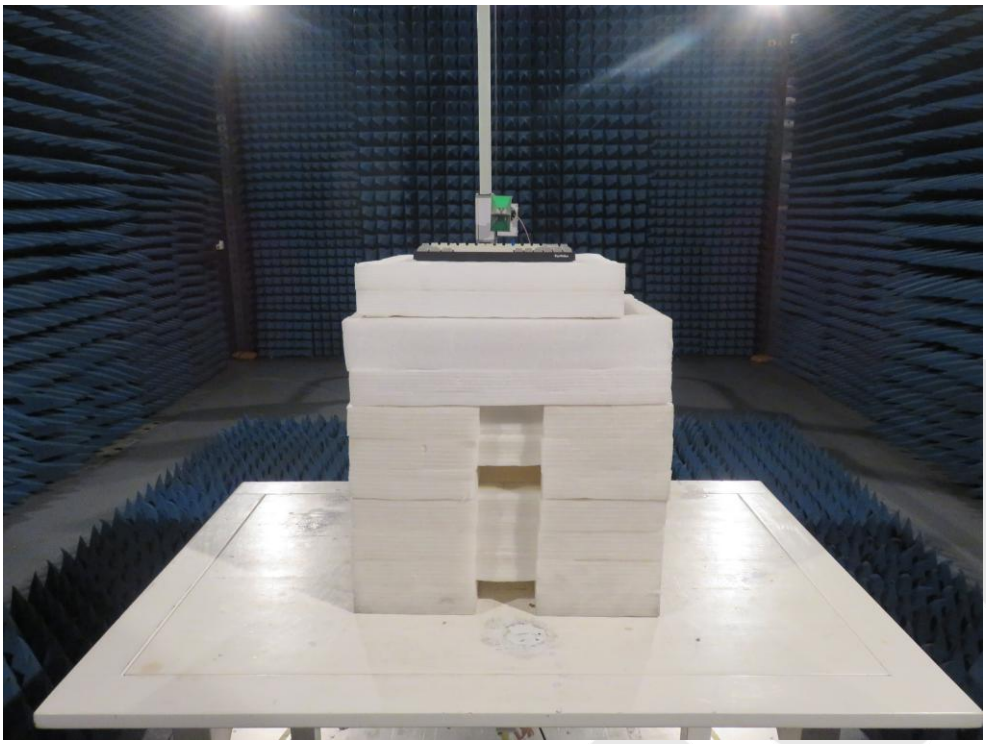


APPENDIX I -- TEST SETUP PHOTOGRAPH

Photo of Conducted Emission Measurement

Photo of Radiation Emission Test

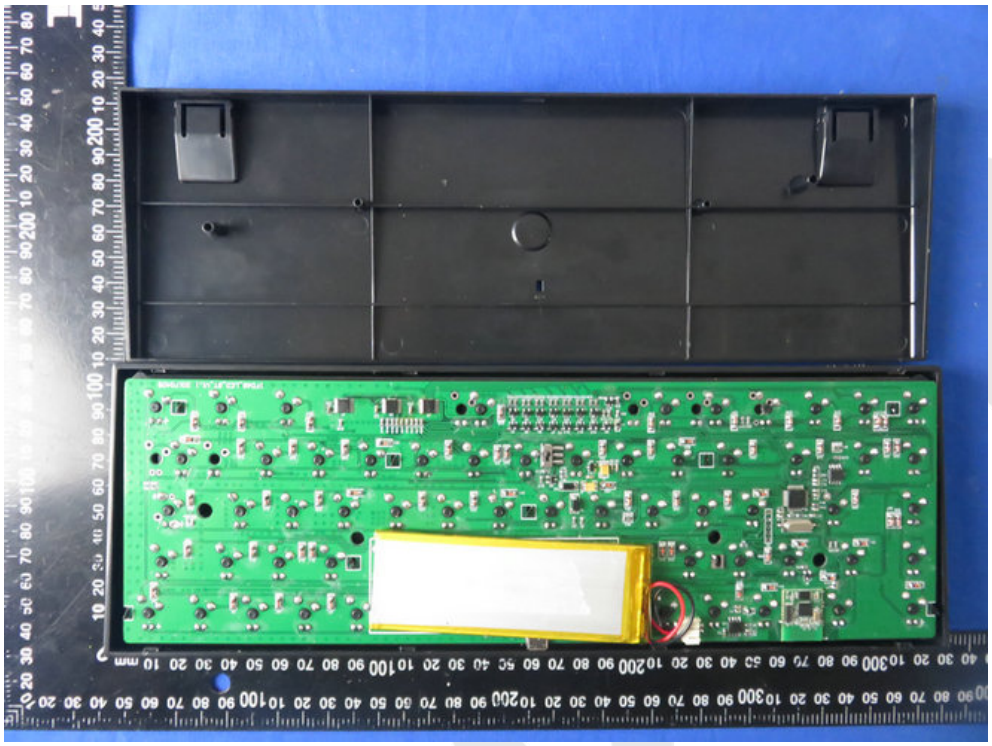


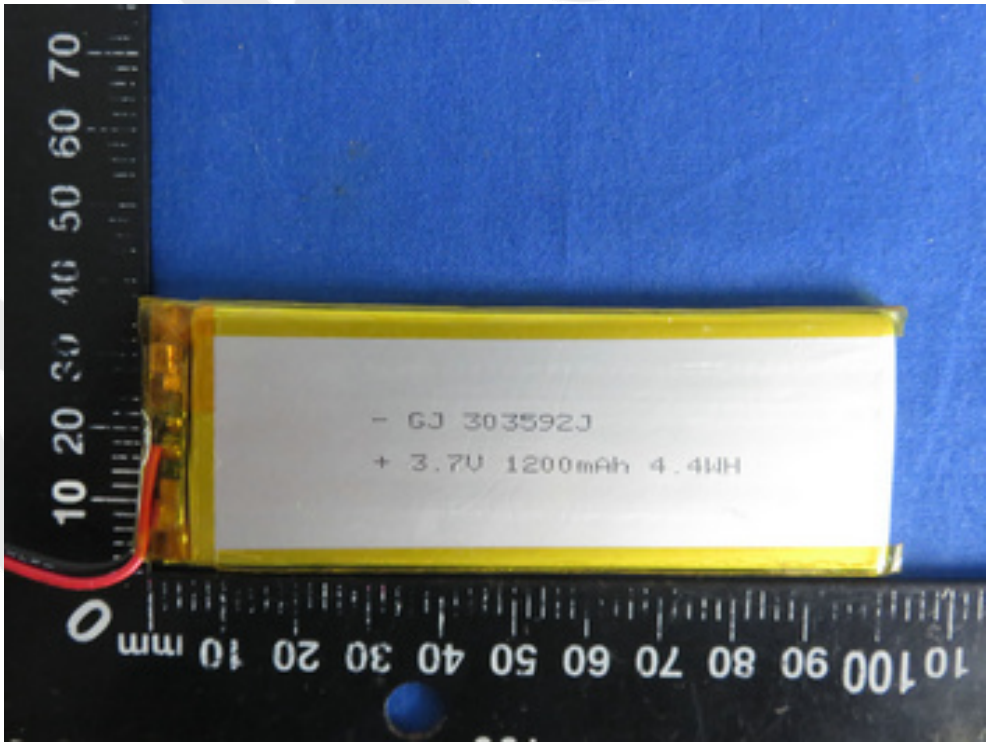


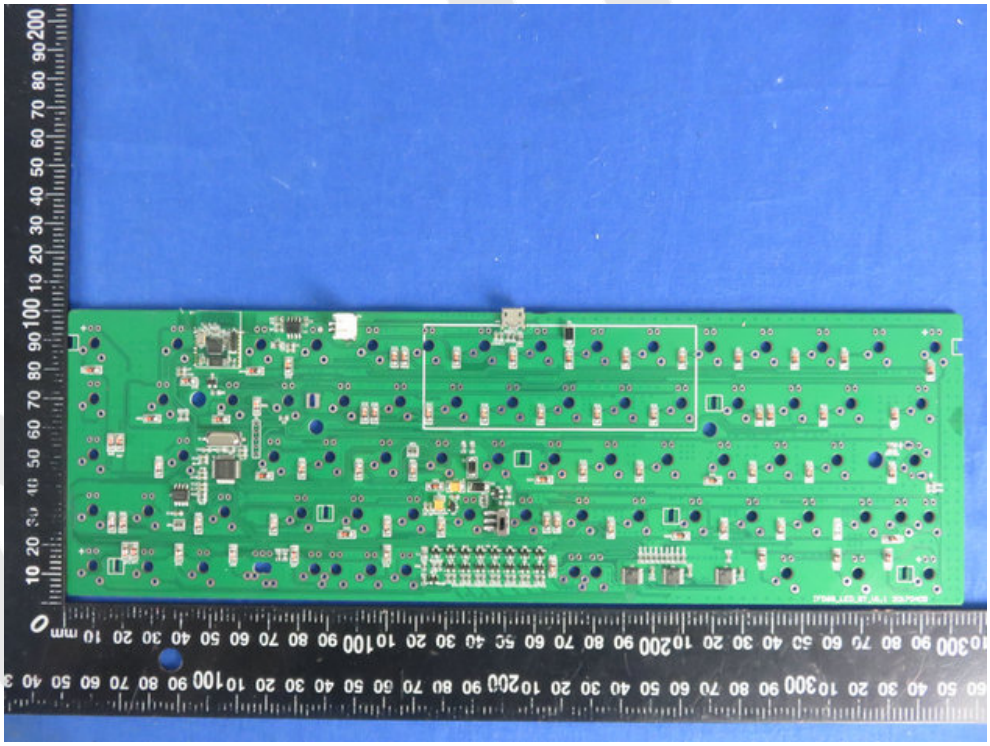
APPENDIX II -- EXTERNAL PHOTOGRAPH

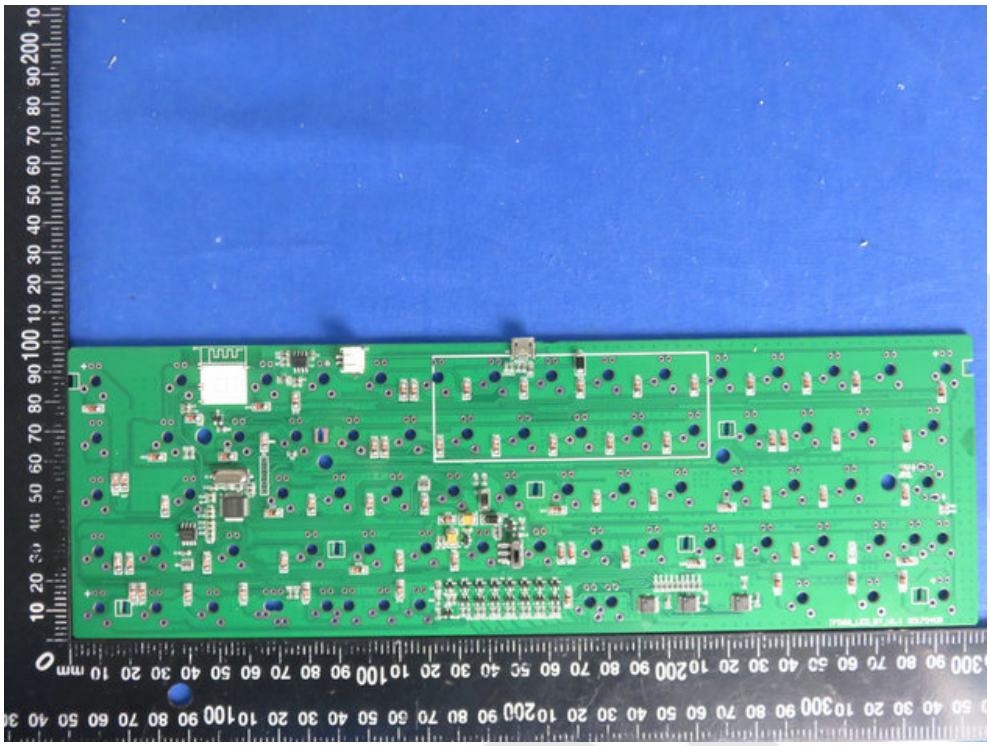
KeyWalker

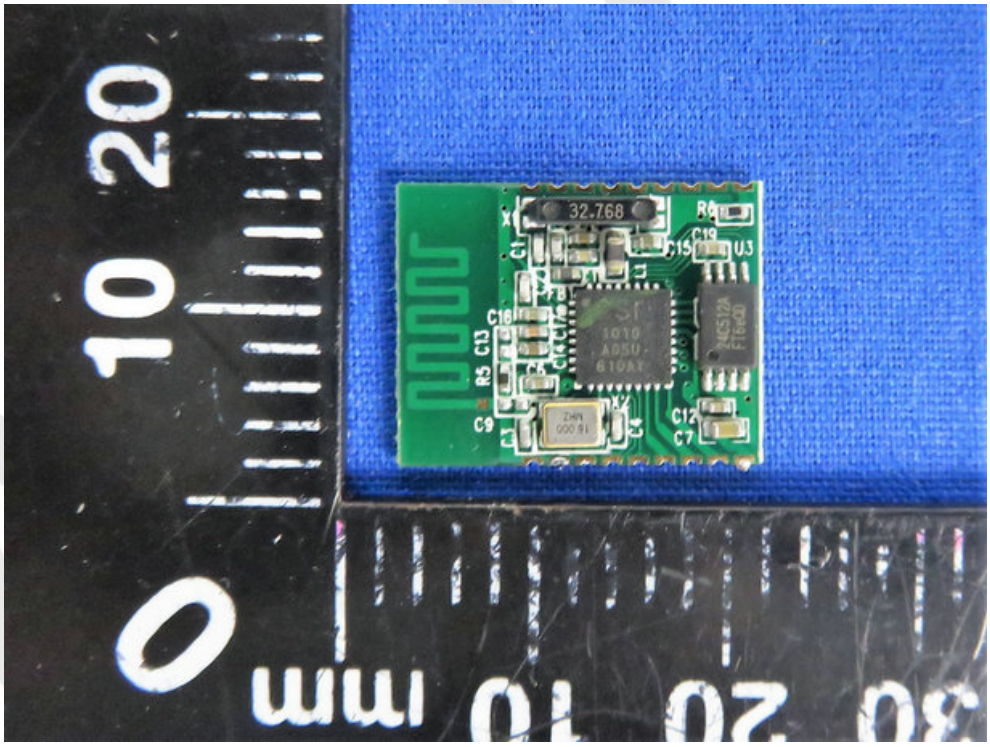
APPENDIX III -- INTERNAL PHOTOGRAPH







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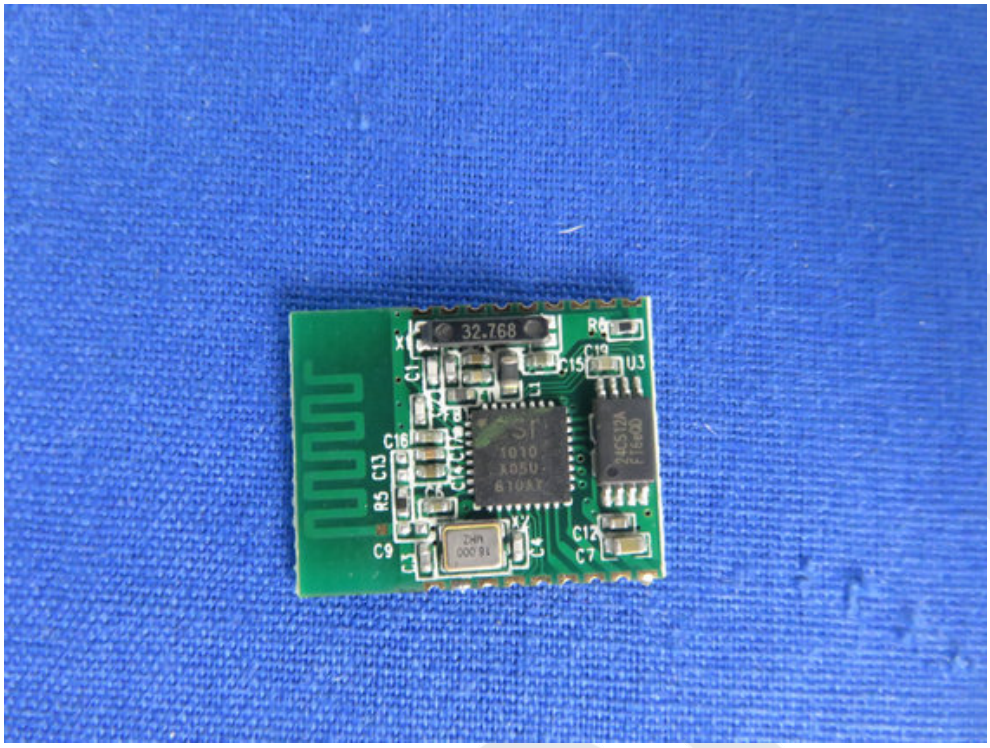
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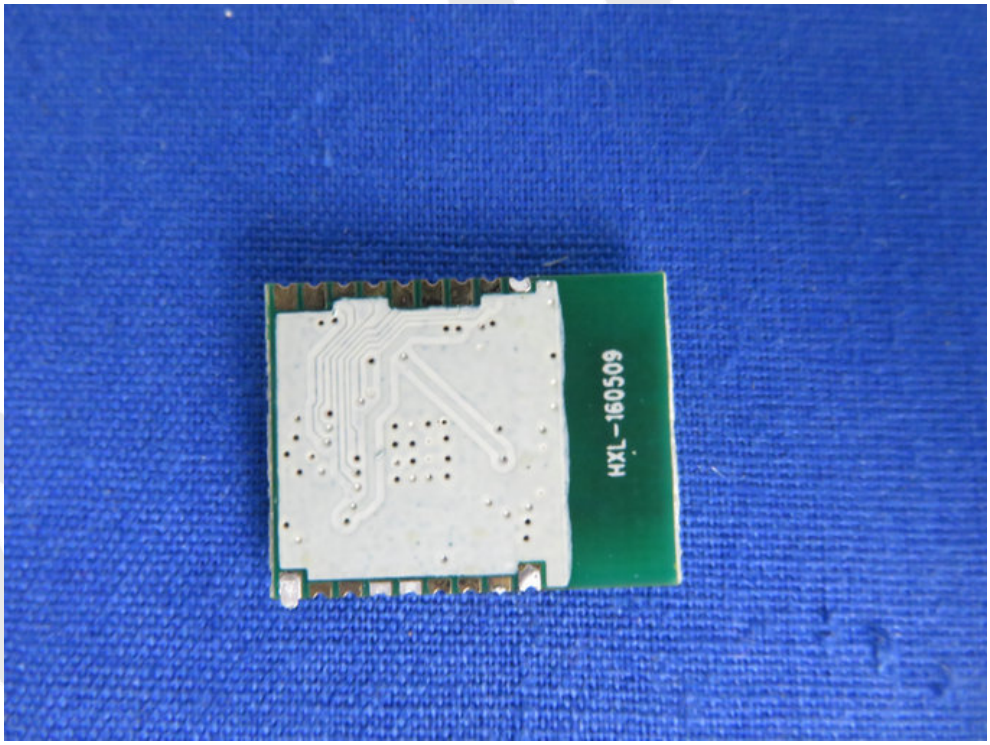
HXL-160509