FCC TEST REPORT(Bluetooth)

for

TOYO ELECTRIC MFG. Co., LTD

Music Box

Model Number: TY-S-002

FCC ID: N9STY-S-002
IC: 11065A-TYS002

Prepared for : TOYO ELECTRIC MFG. Co., LTD
Address : 9TH,FL 30 SEC 3 RENAI RD DAAN DISTRICT, TAIPEI 106 TAIWAN

Prepared by : Keyway Testing Technology Co., Ltd.
Address : Baishun Industrial Zone, Zhangmutou Town, Dongguan, Guangdong, China

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Report No. : 15KWE032336F
Date of Test : Mar. 6~10, 2015
Date of Report : Mar. 11, 2015

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Keyway Testing Technology Co., Ltd.

Applicant: **Address:**	TOYO ELECTRIC MFG. Co., LTD 9TH,FL 30 SEC 3 RENAI RD DAAN DISTRICT, TAIPEI 106 TAIWAN		
Manufacturer: **Address:**	Shenzhen Great Power Enterprise Co., Ltd Bldg E Xin Xulong Industrial Area, Kukeng Village Guanlan Town, Baoan District, Shenzhen, Guangdong,China 518110		
E.U.T:	Music Box		
Model Number:	TY-S-002		
Trade Name:	Holiday Brilliant	**Serial No.:**	------
Date of Receipt:	Feb. 12, 2015	**Date of Test:**	Mar. 6~10, 2015
Test Specification:	FCC Part 15, Subpart C: Oct. 1, 2014 ANSI C63.10:2013 RSS-210 Issue 8 December 2010 RSS-Gen Issue 4 November 2014		
Test Result:	The equipment under test was found to be compliance with the requirements of the standards applied. **Issue Date: Mar. 11, 2015**		

Tested by:	Reviewed by:	Approved by:
Jack	Andy	Jade Yang
Jack Bu / Engineer	Andy Gao / Supervisor	Jade Yang/ Supervisor

Other Aspects:
None.

Abbreviations: OK/P=passed fail/F=failed n.a/N=not applicable E.U.T=equipment under tested

This test report is based on a single evaluation of one sample of above mentioned products. It is not permitted to be duplicated in extracts without written approval of Keyway Testing Technology Co., Ltd.

1. TEST SUMMARY

Test Items	Test Requirement	Result
Conducted Emissions	15.207/RSS-GEN	PASS
Radiated Emissions	15.205(a)/15.209 15.247(d)/ RSS-GEN	PASS
20dB Bandwidth	15.247(a)(1)/ RSS-210	PASS
Frequency Separation	15.247(a)(1)/ RSS-210	PASS
Maximum Peak Output Power	15.247(b)(1)/ RSS-210	PASS
Number of Hopping Frequency	15.247(a)(1)(iii)/ RSS-210	PASS
Dwell time	15.247(a)(1)(iii)/ RSS-210	PASS
Emissions from out of band	15.247(d)/ RSS-210	PASS
Antenna Requirement	15.203/RSS-GEN	PASS

2.GENERAL PRODUCT INFORMATION

2.1. Product Function

Refer to Technical Construction Form and User Manual.

2.2. Description of Device (EUT)

Product Name:	Music Box
Model No.:	TY-S-002
Operation Frequency:	2402~2480MHz
Channel numbers:	79 Channels
Channel separation:	1M
Modulation technology:	GFSK, Pi/4DQPSK, 8-DPSK
Antenna Type:	PCB Antenna
Antenna gain:	0dBi
BT version:	2.1+EDR
Power supply:	AC 120V/60Hz

2.3. Difference between Model Numbers

None.

2.4. Independent Operation Modes

The basic operation modes are:

Modulation technology	Channel	Frequency(MHz)
GFSK Pi/4DQPSK 8-DPSK	Low	2402
	Middle	2441
	High	2480

2.5. Test Supporting System

None.

3. TEST SITES

3.1. Test Facilities

Lab Qualifications : 944 Shielded Room built by ETS-Lindgren, USA
Date of completion: March 28, 2011

966 Chamber built by ETS-Lindgren, USA
Date of completion: March 28, 2011

Certificated by TUV Rheinland, Germany.
Registration No.: UA 50207153
Date of registration: July 13, 2011

Certificated by UL, USA
Registration No.: 100567-237
Date of registration: September 1, 2011

Certificated by Intertek
Registration No.: 2011-RTL-L1-31
Date of registration: October 11, 2011

Certificated by Industry Canada
Registration No.: 9868A
Date of registration: December 8, 2011

Certificated by FCC, USA
Registration No.: 370994
Date of registration: February 21, 2012

Certificated by CNAS China
Registration No.: CNAS L5783
Date of registration: August 8, 2012

Name of Firm : Keyway Testing Technology Co., Ltd.

Site Location : Baishun Industrial Zone, Zhangmutou Town,
Dongguan, Guangdong, China

3.2. List of Test and Measurement Instruments

3.2.1. For conducted emission at the mains terminals test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr. 27,14	Apr. 27,15
Artificial Mains Network	Rohde&Schwarz	ENV216	101315	Apr. 27,14	Apr. 27,15
Artificial Mains Network (AUX)	Rohde&Schwarz	ENV216	101314	Apr. 27,14	Apr. 27,15
RF Cable	FUJIKURA	3D-2W	944 Cable	Apr. 27,14	Apr. 27,15

3.2.2. For radiated emission test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr. 27,14	Apr. 27,15
System Simulator	Agilent	E5515C	GB43130245	Apr. 30,14	Apr. 30,15
Power Splitter	Weinschel	1506A	NW425	Apr. 30,14	Apr. 30,15
Bilog Antenna	ETS-LINDGREEN	3142D	135452	Apr. 27,14	Apr. 27,15
Spectrum Analyzer	Agilent	E4411B	MY4511304	Apr. 27,14	Apr. 27,15
3m Semi-anechoic Chamber	ETS-LINDGREEN	966	KW01	Apr. 27,14	Apr. 27,15
Signal Amplifier	SONOMA	310	187016	Apr. 27,14	Apr. 27,15
Signal Amplifier	Agilent	8449B	3008A00251	Apr. 27,14	Apr. 27,15
RF Cable	IMRO	IMRO-400	966 Cable 1#	N/A	N/A
MULTI-DEVICE Controller	ETS-LINDGREEN	2090	126913	N/A	N/A
Horn Antenna	DAZE	ZN30701	11003	Apr. 27,14	Apr. 27,15
Horn Antenna	SCHWARZBECK	BBHA9170	9170-068	Apr. 27,14	Apr. 27,15
Spectrum Analyzer	Agilent	8593E	3911A04271	Apr. 27,14	Apr. 27,15
Spectrum Analyzer	Agilent	E4408B	MY44211125	Apr. 30,14	Apr. 30,15
Signal Amplifier	DAZE	ZN3380C	11001	Apr. 27,14	Apr. 27,15
High Pass filter	Micro	HPM50111	324216	Apr. 30,14	Apr. 30,15
Filter	COM-MW	ZBSF-C836.5-25-X	KW032	Apr. 30,14	Apr. 30,15
Filter	COM-MW	ZBSF-C1747.5-75-X2	KW035	Apr. 30,14	Apr. 30,15
Filter	COM-MW	ZBSF-C1880-60-X2	KW037	Apr. 30,14	Apr. 30,15
DC Power Supply	LongWei	PS-305D	010964729	Apr. 27,14	Apr. 27,15
Constant temperature and humidity box	GF	GTH-800-40-1P	MAA9906-005	Apr. 27,14	Apr. 27,15
Universal radio communication tester	Rohde&Schwarz	CMU200	3215420	Apr. 27,14	Apr. 27,15
Splitter	Agilent	11636B	0025164	Apr. 27,14	Apr. 27,15

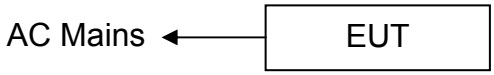
4. TEST SET-UP AND OPERATION MODES

4.1. Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the Operating Instructions.

4.2. Block Diagram of Test Set-up

System Diagram of Connections between EUT and Simulators



(EUT: Music Box)

4.3. Test Operation Mode and Test Software

None.

4.4. Special Accessories and Auxiliary Equipment

None.

4.5. Countermeasures to Achieve EMC Compliance

None.

4.6. Product Version

Product SW version	V0.2
Product HW version	V1.0
Radio SW version	AVRCPV1.0
Radio HW version	HFPV1.5
Test SW Version	BT1.0
RF power setting in TEST SW	BT:0dBm

Note: SW means software, HW means hardware.

4.7. Test Environment:

Ambient conditions in the test laboratory:

Items	Actual
Temperature (℃)	21~23
Humidity (%RH)	50~65

5. MAXIMUM PEAK OUTPUT POWER

5.1. Limits

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

5.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the power meter, during the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

Test data:

	Channel Frequency (MHz)	Peak output Power dBm	Limit dBm	Result
GFSK	2402	1.32	30.00	Pass
	2441	1.46	30.00	Pass
	2480	1.76	30.00	Pass
Pi/4DQPSK	2402	1.64	21.00	Pass
	2441	1.94	21.00	Pass
	2480	1.46	21.00	Pass
8-DPSK	2402	1.02	21.00	Pass
	2441	1.17	21.00	Pass
	2480	1.24	21.00	Pass

6. EMISSION TEST RESULTS

6.1. Conducted Emission at the Mains Terminals Test

6.1.1. Limit 15.207 & RSS-GEN limits

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

6.1.2. Test Setup

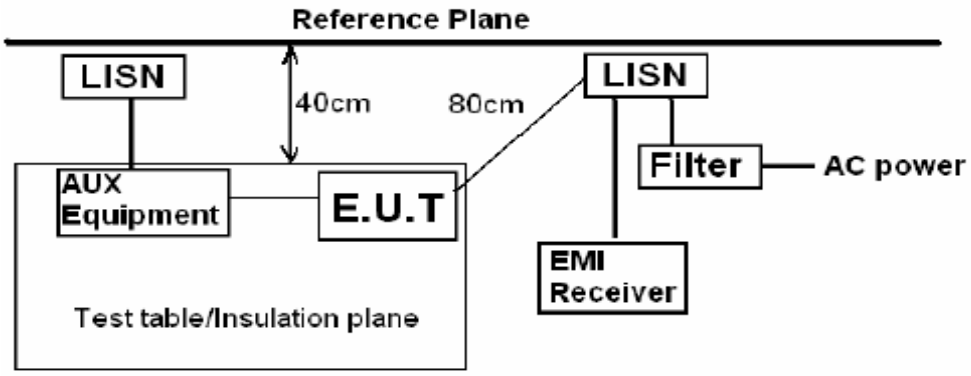
The EUT was put on a wooden table which was 0.8 m high above the ground and connected to the AC mains through the Artificial Mains Network (AMN). Where the mains cable supplied by the manufacture was longer than 0.8 m, the excess was folded back and forth parallel to the cable at the centre so as to form a bundle no longer than 0.4 m.

The EUT was kept 0.4 m from any other earthed conducting surface. Both sides of AC line were checked to find out the maximum conducted emission levels according to the test procedure during the conducted emission test.

The frequency range from 150 kHz to 30 MHz was investigated.

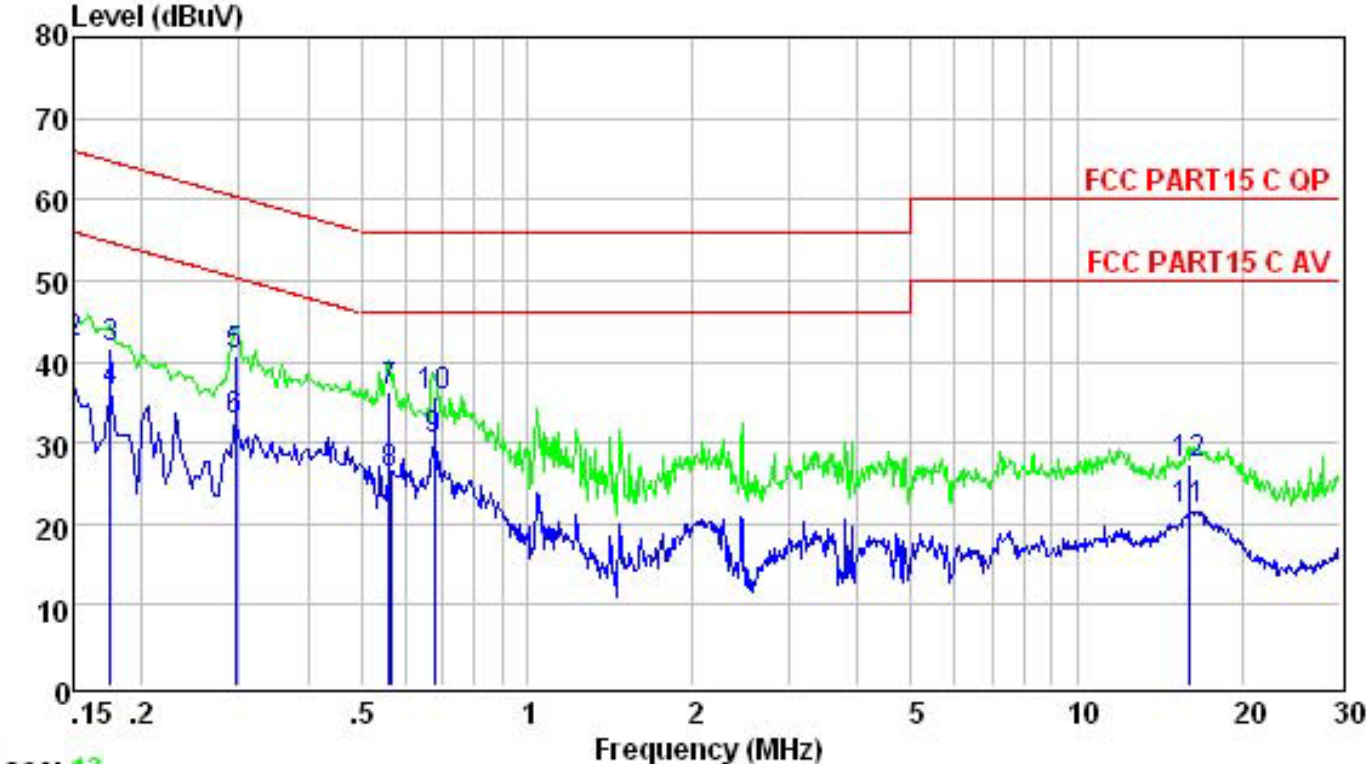
The bandwidth of the test receiver was set at 9 kHz.

Pretest for all mode, The worst mode was GFSK low channel and the data was reported on the following page.



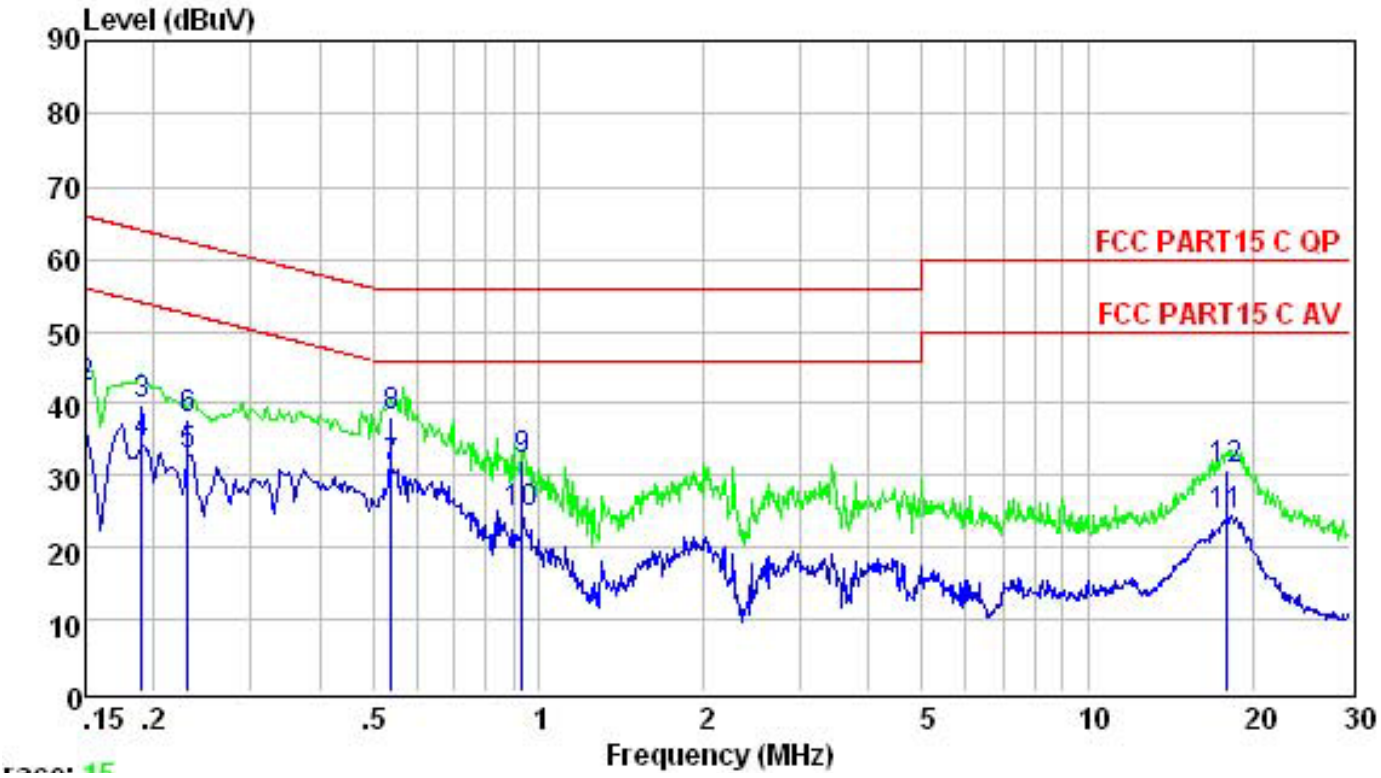
Remark:
E.U.T: Equipment Under Test
LISN: Line Impedence Stabilization Network
Test table height=0.8m

Line:



	Freq	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	
1	0.150	36.93	56.00	-19.07	Average
2	0.150	42.10	66.00	-23.90	QP
3	0.175	41.70	64.72	-23.02	QP
4	0.175	36.35	54.72	-18.37	Average
5	0.295	40.80	60.38	-19.58	QP
6	0.296	32.60	50.37	-17.77	Average
7	0.564	36.30	56.00	-19.70	QP
8	0.564	26.15	46.00	-19.85	Average
9	0.679	30.23	46.00	-15.77	Average
10	0.679	35.68	56.00	-20.32	QP
11	16.055	21.62	50.00	-28.38	Average
12	16.055	27.40	60.00	-32.60	QP

Neutral



	Freq	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	
1	0.150	36.28	56.00	-19.72	Average
2	0.150	42.30	66.00	-23.70	QP
3	0.190	39.80	64.02	-24.22	QP
4	0.190	34.34	54.02	-19.68	Average
5	0.230	32.87	52.44	-19.57	Average
6	0.230	37.70	62.44	-24.74	QP
7	0.541	31.17	46.00	-14.83	Average
8	0.541	38.26	56.00	-17.74	QP
9	0.933	32.20	56.00	-23.80	QP
10	0.933	24.65	46.00	-21.35	Average
11	17.849	24.43	50.00	-25.57	Average
12	17.849	30.80	60.00	-29.20	QP

6.2. Radiated Emission Test

6.2.1. Limit 15.209 limits

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		μV/m	dB(μV)/m
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	74.0 dB(μV)/m (Peak) 54.0 dB(μV)/m (Average)	

6.2.2. Restricted bands of operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

6.2.3. Test setup

The EUT was placed on a turn table which was 0.8 m above the ground（above 1GHz, the table was 1.5m）. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was set 3 m away from the receiving antenna which was mounted on an antenna tower. The measuring antenna moved up and down to find out the maximum emission level. It moved from 1 m to 4 m for both horizontal and vertical polarizations.

The EUT was tested in the Chamber Site. It was pre-scanned with a Peak detector from the spectrum, and all the final readings from the test receiver were measured with the Quasi-Peak detector.

The bandwidth of the EMI test receiver is set at 120kHz for frequency range from 30MHz to 1000 MHz.

The bandwidth of the Spectrum's VBW is set at 3MHz and RBW is set at 1MHz for peak emissions measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emissions measure above 1GHz.

The frequency range from 30MHz to 10th harmonic (25GHz) are checked. and no any emissions were found from 18GHz to 25 GHz, So the radiated emissions from 18GHz to 25GHz were not record.

Notes: 1. Emission Level = Antenna Factor + Cable Loss + Meter Reading-Preamp Factor.

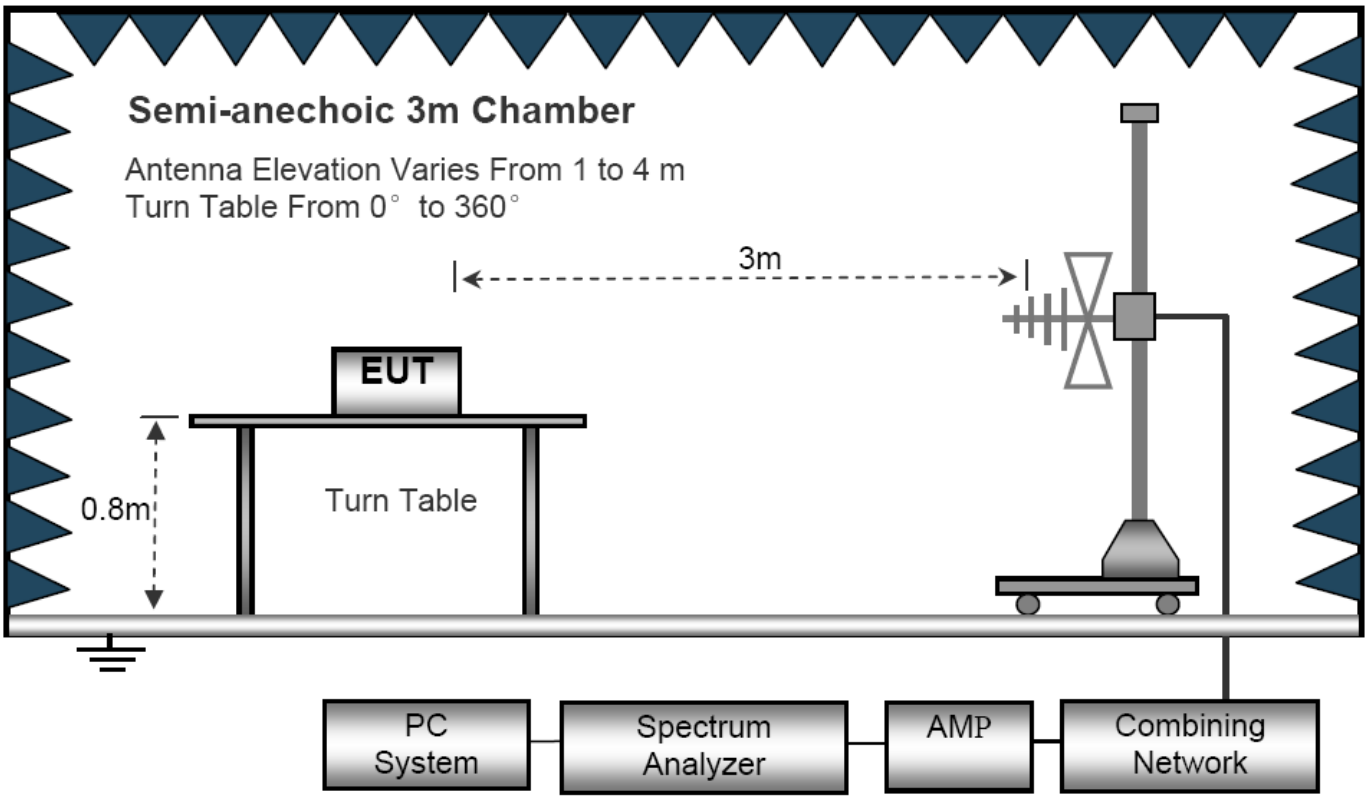
2. Measurement Uncertainty: ±3.2 dB at a level of confidence of 95%.

3. For emissions above 1GHz, if peak level comply with average limit, then the average level is deemed to comply with average limit.

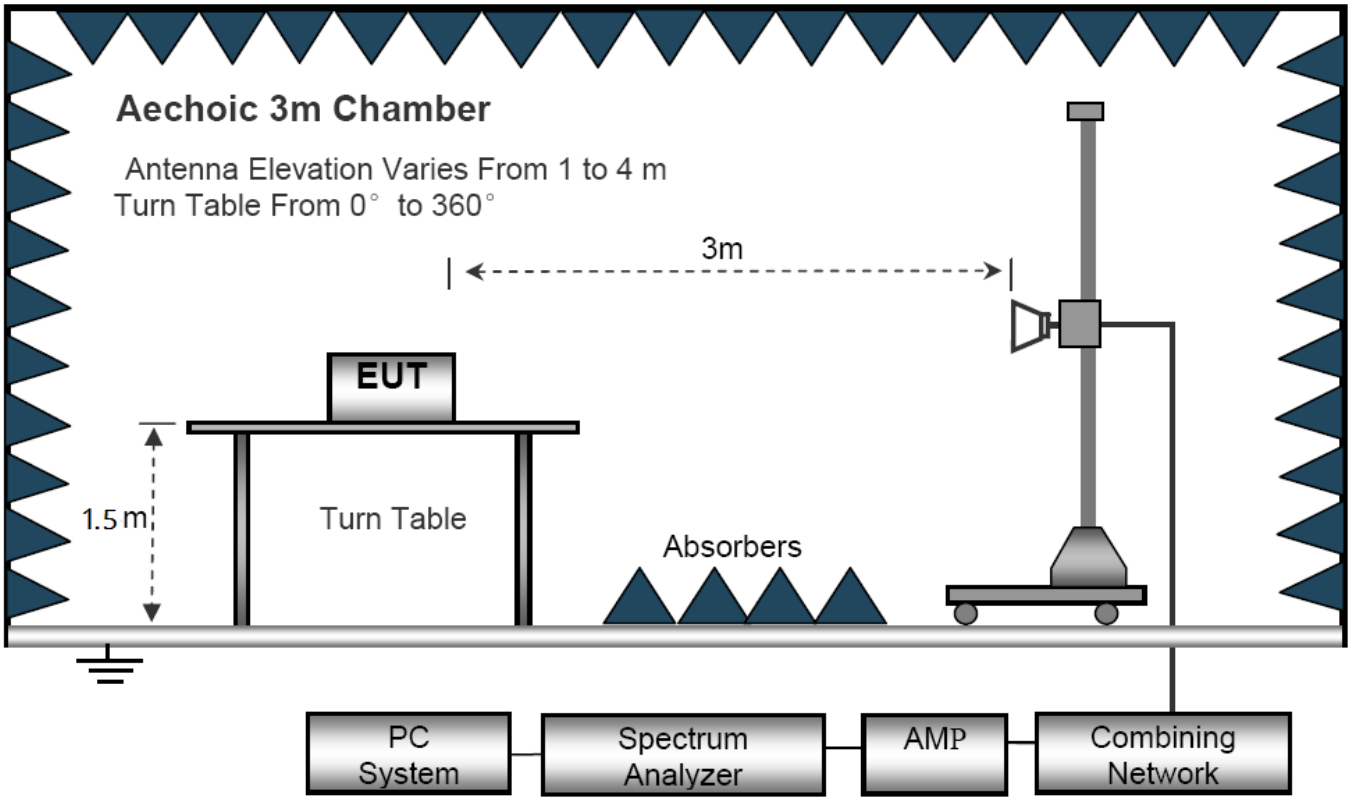
5: we pretest 3 packages DH1, DH3, DH5, package DH5 is largest; we are testing DH5 in the report.

7：we pretest all modulation, The worst mode was 8-DPSK, the worst data was show in the report.

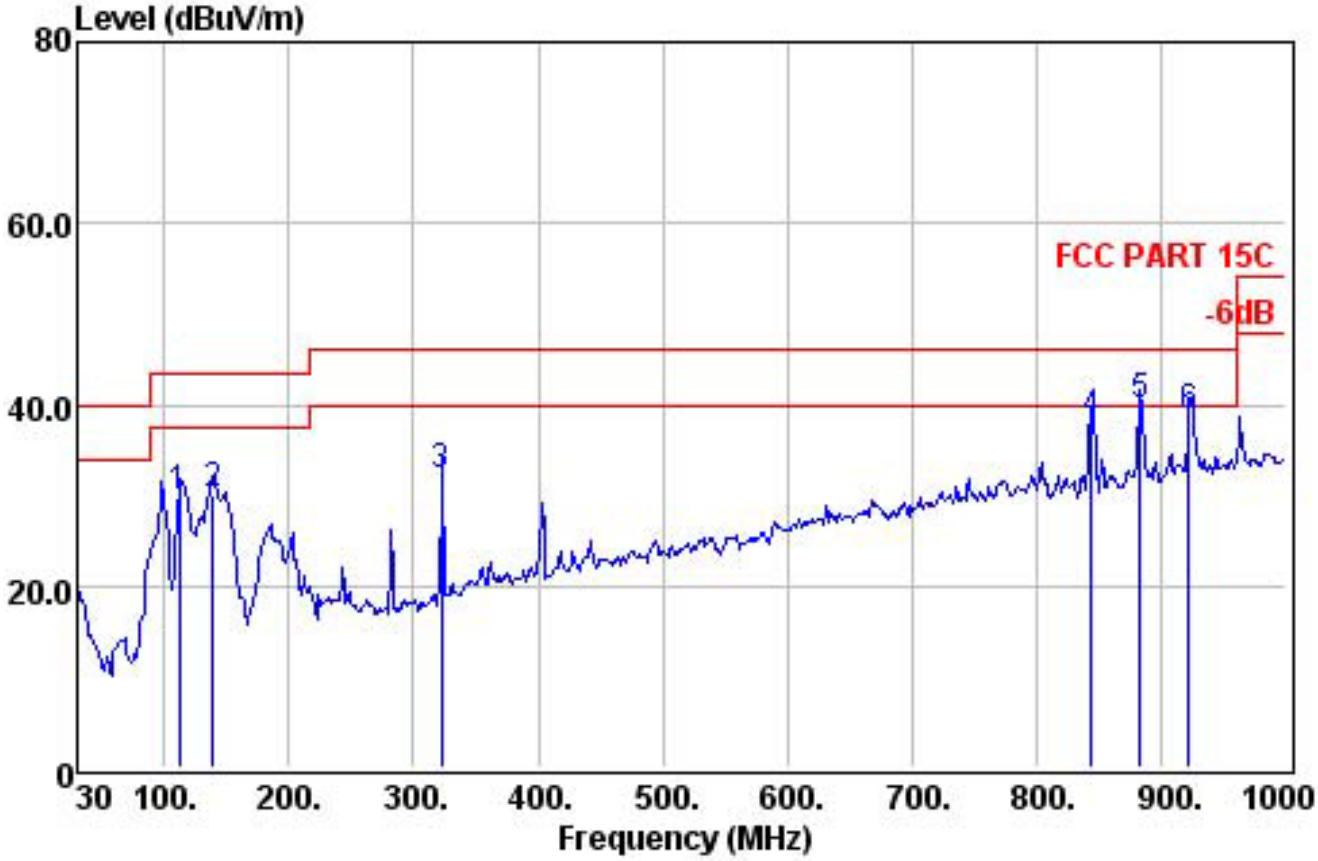
Below 1GHz



Above 1GHz

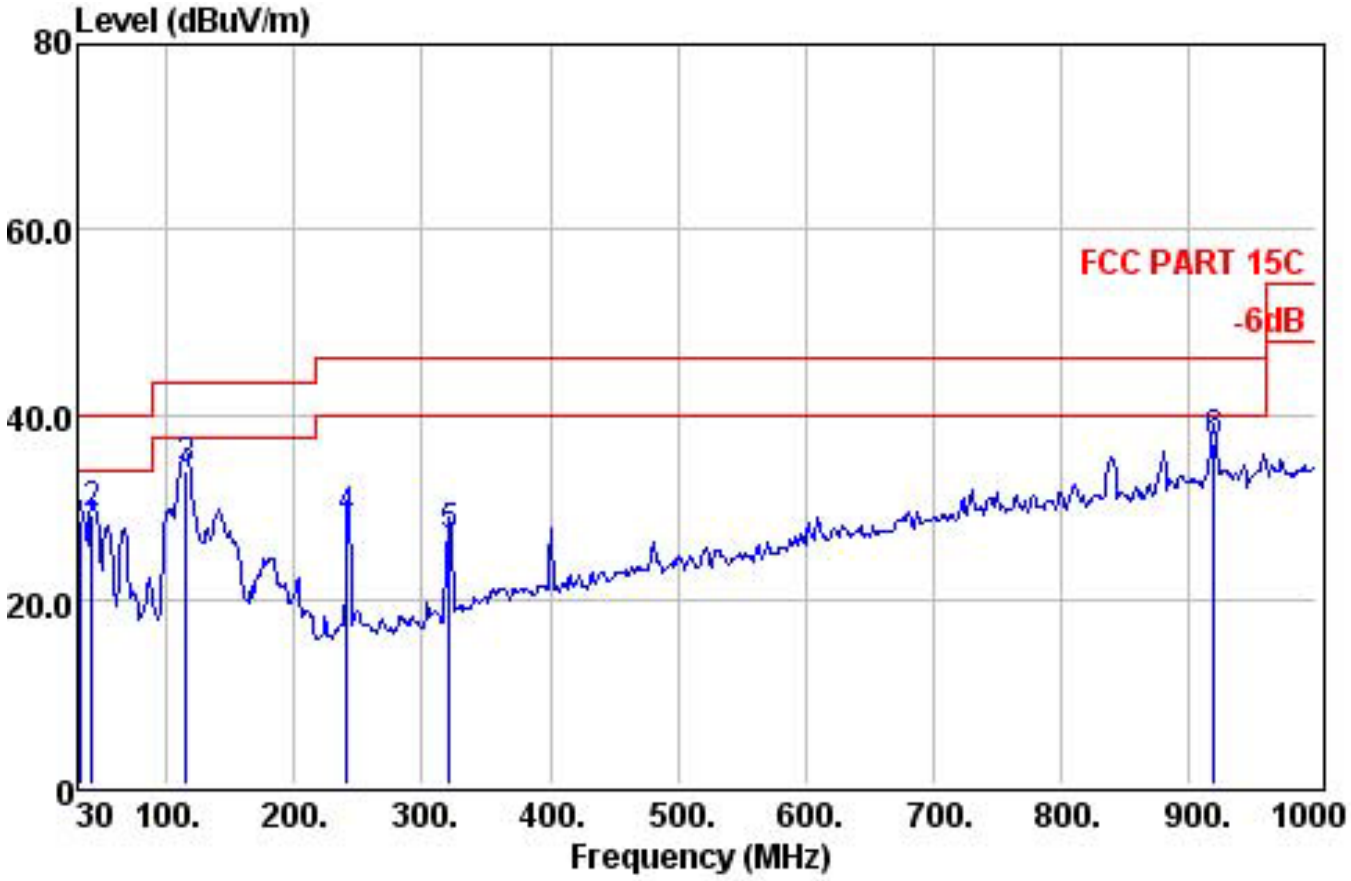


Below 1GHz
BT Mode Horizontal polarizations



	Freq	Preamp Factor	Read Level	Cable Loss	Antenna Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	112.45	31.29	50.93	1.03	9.10	29.77	43.50	-13.73	QP
2	138.64	31.21	51.63	1.22	8.39	30.03	43.50	-13.47	QP
3	322.94	30.83	46.51	2.02	14.44	32.14	46.00	-13.86	QP
4	844.80	30.39	40.63	4.59	23.10	37.93	46.00	-8.07	QP
5	883.60	30.16	41.45	4.76	23.67	39.72	46.00	-6.28	QP
6	922.40	29.87	39.17	4.87	24.63	38.80	46.00	-7.20	QP

BT Mode Vertical polarizations



	Freq	Preamp Factor	Read Level	Cable Loss	Antenna Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	31.94	31.40	41.69	0.56	17.66	28.51	40.00	-11.49	QP
2	41.64	31.38	47.64	0.56	12.23	29.05	40.00	-10.95	QP
3	115.36	31.27	55.35	1.03	8.87	33.98	43.50	-9.52	QP
4	241.46	30.95	45.21	1.61	12.66	28.53	46.00	-17.47	QP
5	321.00	30.84	41.18	2.02	14.39	26.75	46.00	-19.25	QP
6	920.46	29.89	37.34	4.87	24.57	36.89	46.00	-9.11	QP

Above 1GHz

2402MHz Horizontal polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Antenna Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4804.00	27.49	32.27	11.96	32.94	49.68	74.00	-24.32	Peak
2	6916.00	27.88	18.12	16.60	36.98	43.82	74.00	-30.18	Peak
3	8684.00	28.30	15.61	16.81	37.02	41.14	74.00	-32.86	Peak
4	11455.00	28.95	12.69	17.26	39.86	40.86	74.00	-33.14	Peak
5	13410.00	29.28	9.82	18.69	42.60	41.83	74.00	-32.17	Peak
6	15212.00	29.58	13.14	20.13	38.46	42.15	74.00	-31.85	Peak

2402MHz Vertical polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Antenna Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4804.00	27.49	32.46	11.96	32.94	49.87	74.00	-24.13	Peak
2	7120.00	27.92	14.99	16.60	37.25	40.92	74.00	-33.08	Peak
3	8820.00	28.34	15.45	16.84	37.18	41.13	74.00	-32.87	Peak
4	10418.00	28.84	13.93	17.05	39.07	41.21	74.00	-32.79	Peak
5	11829.00	28.98	12.71	17.33	39.57	40.63	74.00	-33.37	Peak
6	14532.00	29.48	10.99	19.70	40.46	41.67	74.00	-32.33	Peak

2441MHz Horizontal polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Antenna Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4882.00	27.53	31.34	12.14	33.11	49.06	74.00	-24.94	Peak
2	7171.00	27.93	15.52	16.61	37.27	41.47	74.00	-32.53	Peak
3	8667.00	28.30	16.12	16.81	37.00	41.63	74.00	-32.37	Peak
4	10299.00	28.83	17.60	17.03	38.88	44.68	74.00	-29.32	Peak
5	11761.00	28.98	14.84	17.32	39.64	42.82	74.00	-31.18	Peak
6	13444.00	29.29	12.28	18.73	42.76	44.48	74.00	-29.52	Peak

2441MHz Vertical polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Antenna Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4882.00	27.53	31.25	12.14	33.11	48.97	74.00	-25.03	Peak
2	6950.00	27.89	15.22	16.60	37.07	41.00	74.00	-33.00	Peak
3	9636.00	28.66	13.19	16.93	38.11	39.57	74.00	-34.43	Peak
4	10554.00	28.86	15.63	17.08	39.23	43.08	74.00	-30.92	Peak
5	12390.00	29.08	14.34	17.70	39.48	42.44	74.00	-31.56	Peak
6	15144.00	29.57	13.19	20.09	38.47	42.18	74.00	-31.82	Peak

2480MHz Horizontal polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Antenna Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4960.00	27.58	31.21	12.36	33.32	49.31	74.00	-24.69	Peak
2	6950.00	27.89	15.72	16.60	37.07	41.50	74.00	-32.50	Peak
3	8616.00	28.28	13.43	16.79	36.94	38.88	74.00	-35.12	Peak
4	9976.00	28.79	13.42	16.96	38.39	39.98	74.00	-34.02	Peak
5	12203.00	29.04	13.15	17.55	39.44	41.10	74.00	-32.90	Peak
6	14209.00	29.43	12.30	19.49	42.30	44.66	74.00	-29.34	Peak

2480MHz Vertical polarizations

	Freq	Preamp Factor	Read Level	Cable Loss	Antenna Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4960.00	27.58	31.53	12.36	33.32	49.63	74.00	-24.37	Peak
2	6508.00	27.80	18.67	16.60	35.90	43.37	74.00	-30.63	Peak
3	8004.00	28.10	17.06	16.66	36.40	42.02	74.00	-31.98	Peak
4	9466.00	28.59	14.08	16.92	37.96	40.37	74.00	-33.63	Peak
5	11251.00	28.93	15.10	17.22	39.70	43.09	74.00	-30.91	Peak
6	13410.00	29.28	9.68	18.69	42.60	41.69	74.00	-32.31	Peak

7. 20DB AND 99% OCCUPY BANDWIDTH

7.1. Limits

According to FCC Section 15.247(a)(1) and RSS-210, the 20dB bandwidth is known as the 99% emission bandwidth, or 20dB bandwidth(10*log1%=20dB)taking the RF output power

7.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

2. Set the spectrum analyzer:

Span: approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel

RBW ≥1% of the 20dB bandwidth

VBW ≥ RBW

Sweep=auto

Detector function=peak

Trace=max hold

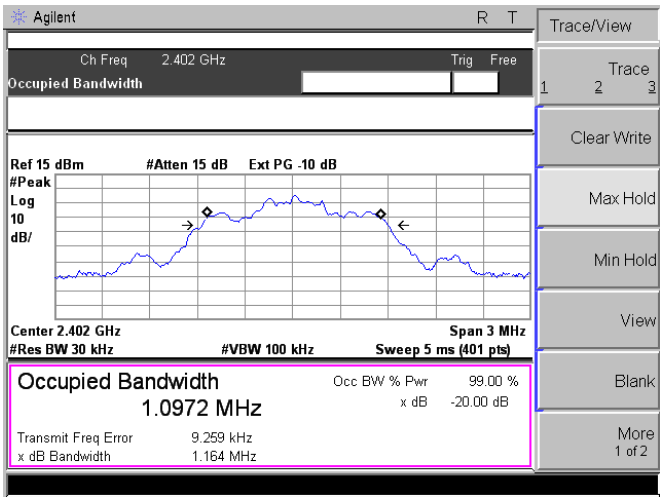
Test data:

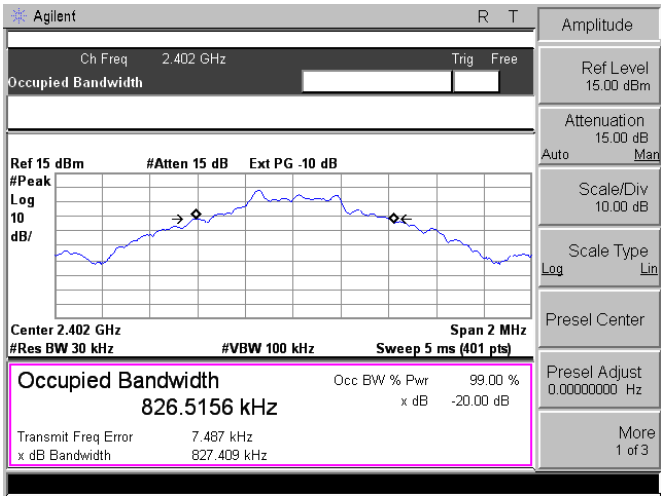
	Channel Frequency (MHz)	20dB Bandwidth (MHz)	99%dB Bandwidth (MHz)	Result
GFSK	2402	0.827	0.827	Pass
	2441	0.823	0.829	Pass
	2480	0.829	0.828	Pass
PI/4 DPSK	2402	1.089	1.016	Pass
	2441	1.103	1.017	Pass
	2480	1.103	1.016	Pass
8-DPSK	2402	1.164	1.097	Pass
	2441	1.165	1.099	Pass
	2480	1.163	1.098	Pass

Test plot as follows:

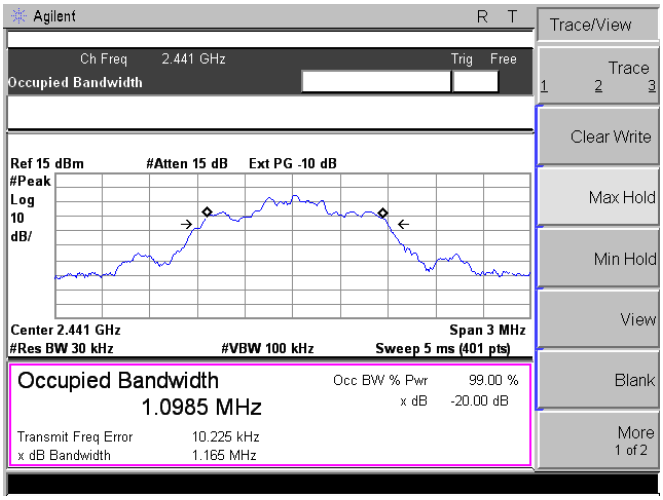
8-DPSK **GFSK**

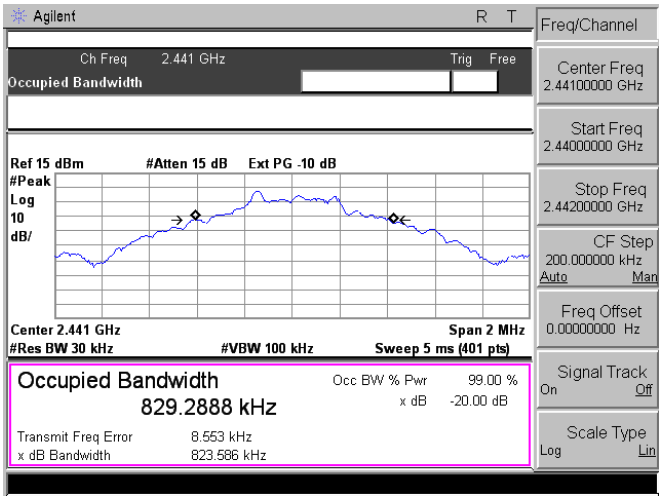
2402MHz



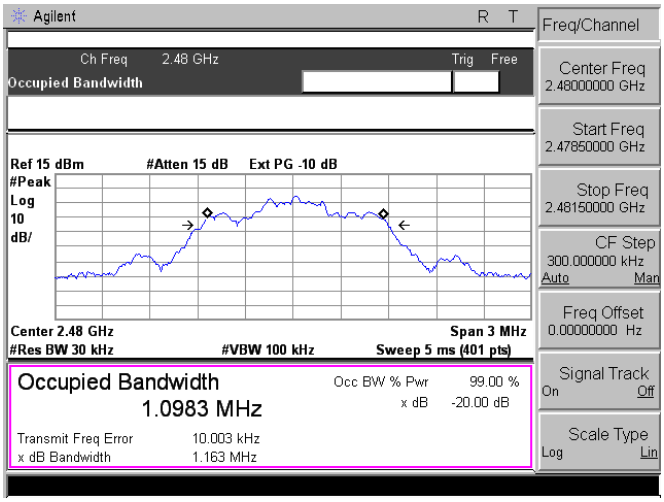


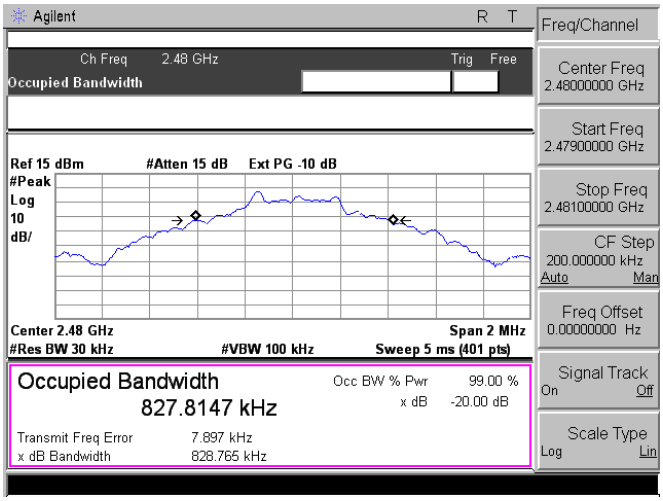
2441 MHz





2480 MHz





8. FREQUENCY SEPARATION

8.1. Limits

According to FCC Section 15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

8.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

2. Set the spectrum analyzer:

Span: wide enough to capture the peaks of two adjacent channels

RBW ≥1% of the span

VBW ≥ RBW

Sweep=auto

Detector function=peak

Trace=max hold

Test data:

	Separation (MHz)	**Limit (MHz)**	**Result**
8-DPSK	1.005	0.78	PASS
GFSK	1.000	0.83	PASS

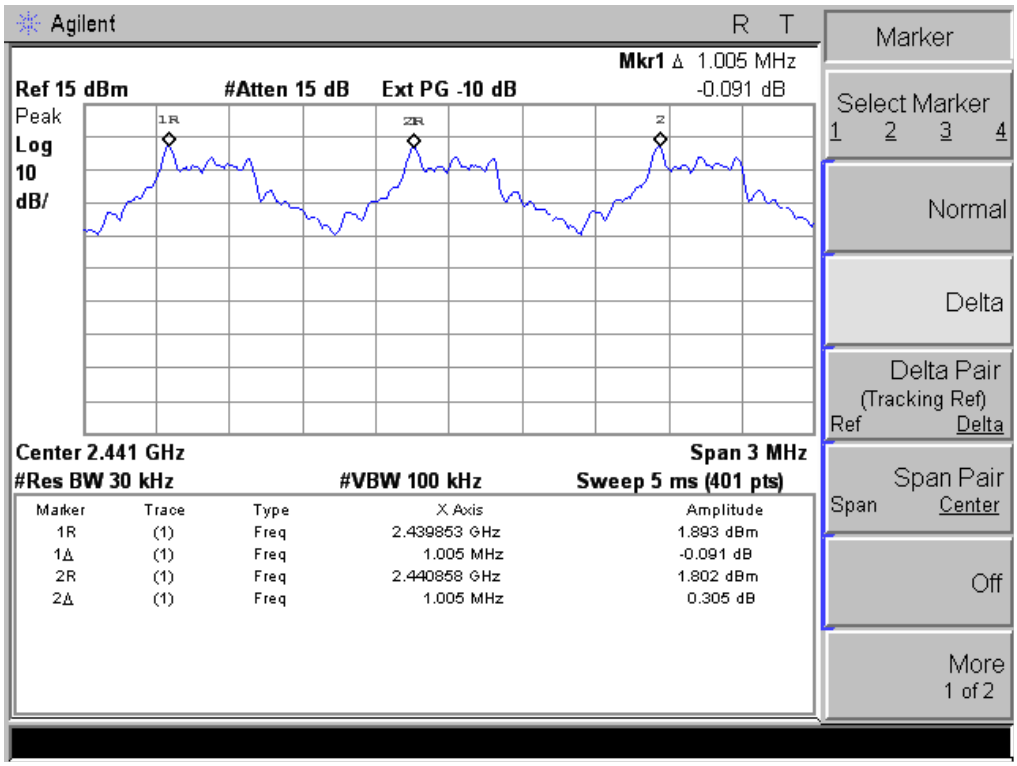
Note: we pretest low, middle, high channel. The middle channel's data record in the report.

Note: Limit according to section 6

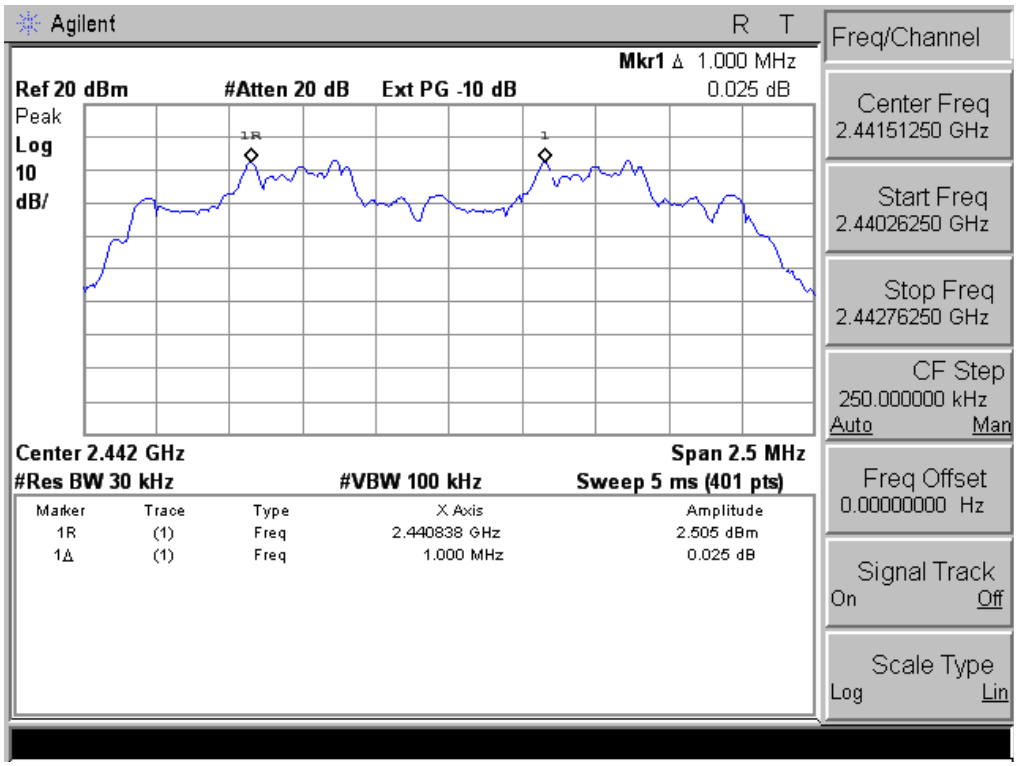
Mode	20dB bandwidth (kHz) (worse case)	Limit (kHz) (Carrier Frequencies Separation)
8-DPSK	1.17	0.78
GFSK	0.83	0.83

Test plot as follows:

8-DPSK


Agilent
R T
Mkr1 Δ 1.005 MHz
-0.091 dB
Ref 15 dBm
#Atten 15 dB
Ext PG -10 dB
Peak
Log
10
dB/
1R
2R
2
Center 2.441 GHz
Span 3 MHz
#Res BW 30 kHz
#VBW 100 kHz
Sweep 5 ms (401 pts)
Marker Trace Type X Axis Amplitude
1R (1) Freq 2.439853 GHz 1.893 dBm
1Δ (1) Freq 1.005 MHz -0.091 dB
2R (1) Freq 2.440858 GHz 1.802 dBm
2Δ (1) Freq 1.005 MHz 0.305 dB
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2

GFSK


Agilent
R T
Mkr1 Δ 1.000 MHz
0.025 dB
Ref 20 dBm
#Atten 20 dB
Ext PG -10 dB
Peak
Log
10
dB/
1R
1
Center 2.442 GHz
Span 2.5 MHz
#Res BW 30 kHz
#VBW 100 kHz
Sweep 5 ms (401 pts)
Marker Trace Type X Axis Amplitude
1R (1) Freq 2.440838 GHz 2.505 dBm
1Δ (1) Freq 1.000 MHz 0.025 dB
Freq/Channel
Center Freq
2.44151250 GHz
Start Freq
2.44026250 GHz
Stop Freq
2.44276250 GHz
CF Step
250.000000 kHz
Auto Man
Freq Offset
0.00000000 Hz
Signal Track
On Off
Scale Type
Log Lin

9. NUMBER OF HOPPING FREQUENCY

9.1. Limits

According to FCC Section 15.247(a)(1)(iii), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

9.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

2. Set the spectrum analyzer:

Span: the frequency band of operation

RBW ≥1% of the span

VBW ≥ RBW

Sweep=auto

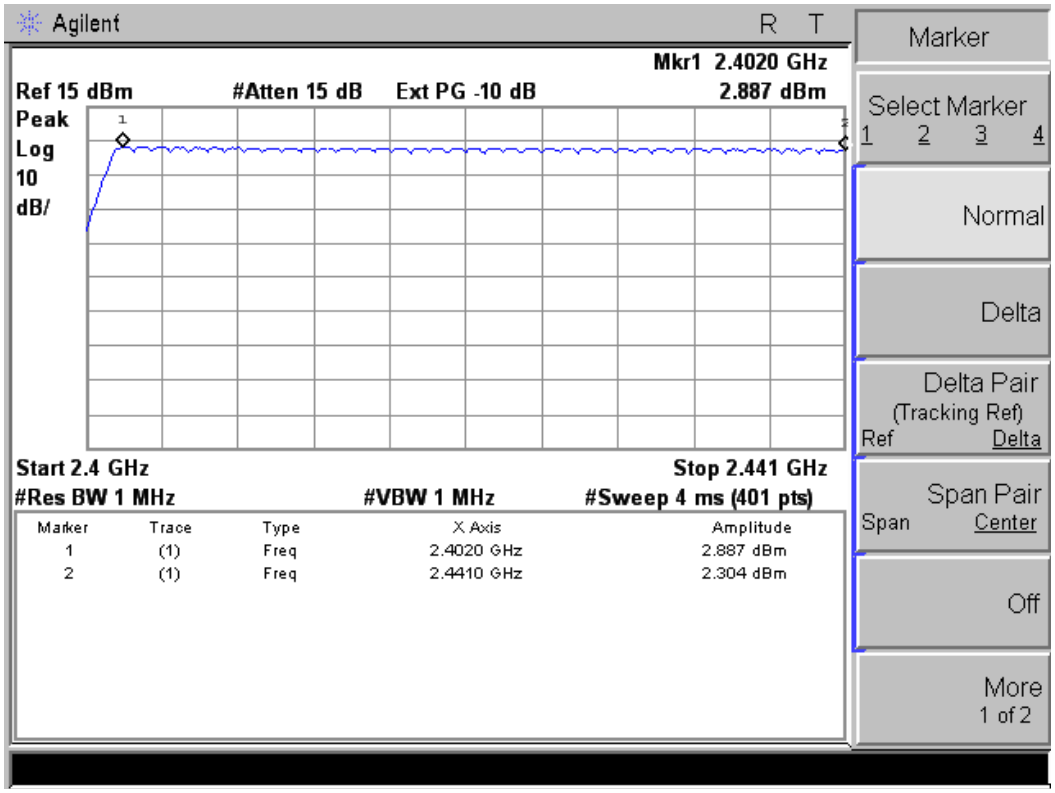
Detector function=peak

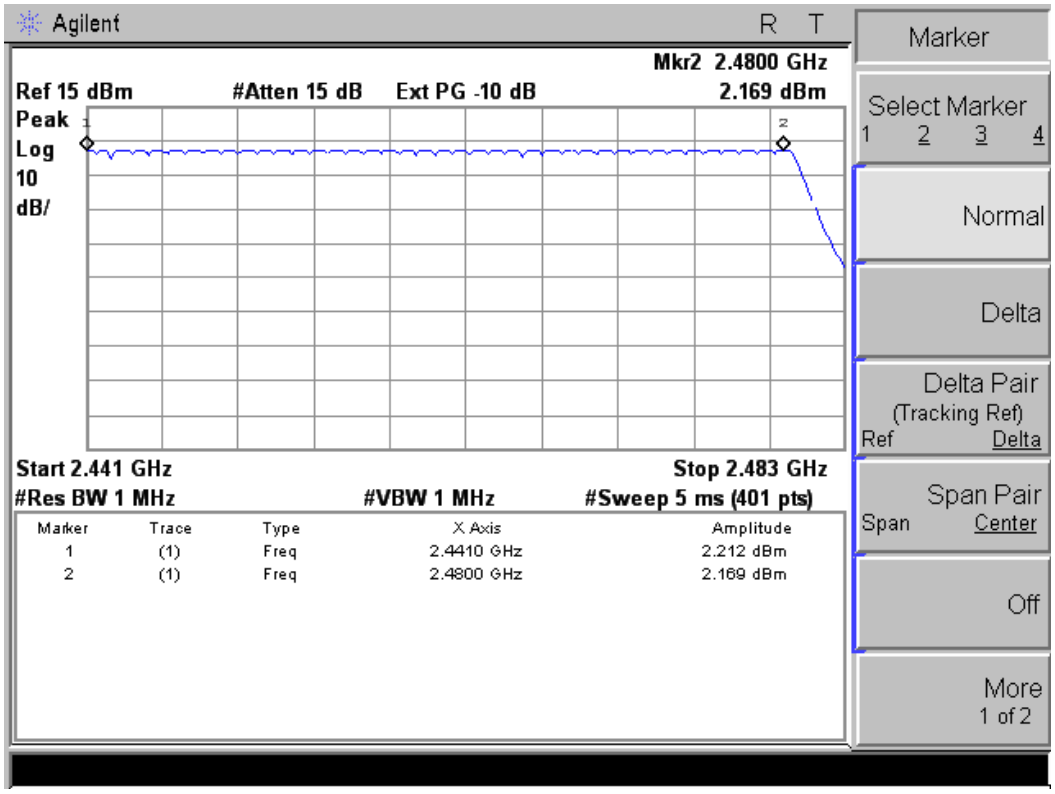
Trace=max hold

Test data:

Measured channel numbers	Limit	Result
79	>15	PASS

Test plot as follows:


Agilent
R T
Mkr1 2.4020 GHz
Ref 15 dBm
#Atten 15 dB
Ext PG -10 dB
2.887 dBm
Peak
Log
10
dB/
Start 2.4 GHz
Stop 2.441 GHz
#Res BW 1 MHz
#VBW 1 MHz
#Sweep 4 ms (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.4020 GHz 2.887 dBm
2 (1) Freq 2.4410 GHz 2.304 dBm
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2


Agilent
R T
Mkr2 2.4800 GHz
Ref 15 dBm
#Atten 15 dB
Ext PG -10 dB
2.169 dBm
Peak
Log
10
dB/
Start 2.441 GHz
Stop 2.483 GHz
#Res BW 1 MHz
#VBW 1 MHz
#Sweep 5 ms (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.4410 GHz 2.212 dBm
2 (1) Freq 2.4800 GHz 2.169 dBm
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2

10. DWELL TIME

10.1. Limits

According to FCC Section 15.247(a)(1)(iii), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

10.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

2. Set the spectrum analyzer:

Span= 0Hz

RBW =1000 kHz

VBW = 3000 kHz

Sweep=auto

Detector function=peak

Test data:

Frequency	Packet	Dwell time(ms)	Limit(ms)	Result
2402MHz 2441MHz 2480MHz	DH1	268.8	400	Pass
	DH3	356.3	400	Pass
	DH5	369.2	400	Pass
	3-DH1	258.1	400	Pass
	3-DH3	358.4	400	Pass
	3-DH5	375.0	400	Pass

A period time = 0.4 (s) * 79 = 31.6(s)

DH1 time slot = 0.42(ms) * (1600/(1*79)) * 31.6 = 268.8 (ms)

DH3 time slot = 1.67 (ms) * (1600/(3*79)) * 31.6 = 356.3 (ms)

DH5 time slot = 2.93 (ms) * (1600/(5*79)) * 31.6 = 369.2 (ms)

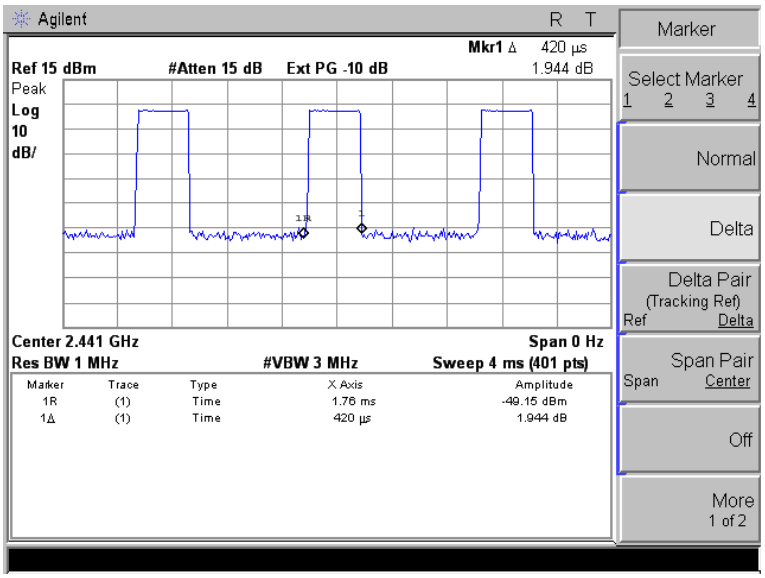
3-DH1 time slot = 0.42 (ms) * (1600/(1*79)) * 31.6 = 258.1 (ms)

3-DH3 time slot = 1.68 (ms) * (1600/(3*79)) * 31.6 = 358.4 (ms)

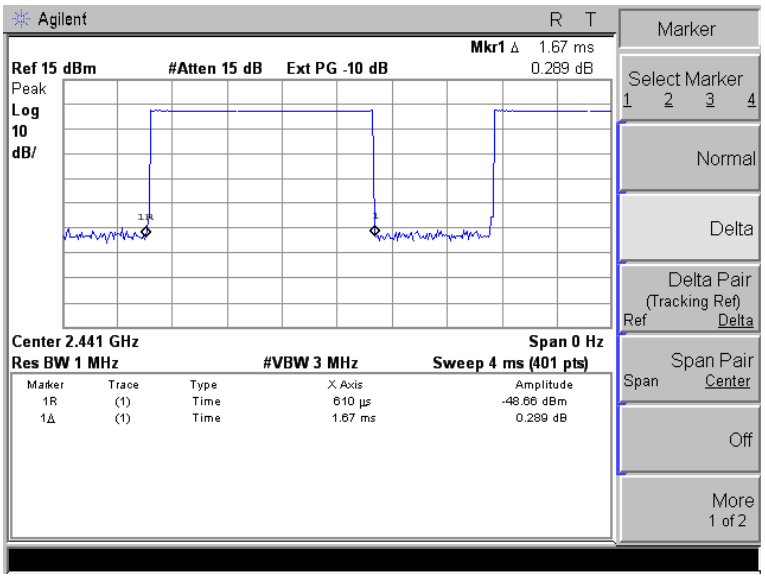
3-DH5 time slot = 2.93 (ms) * (1600/(5*79)) * 31.6 = 375.0 (ms)

Test plot as follows:

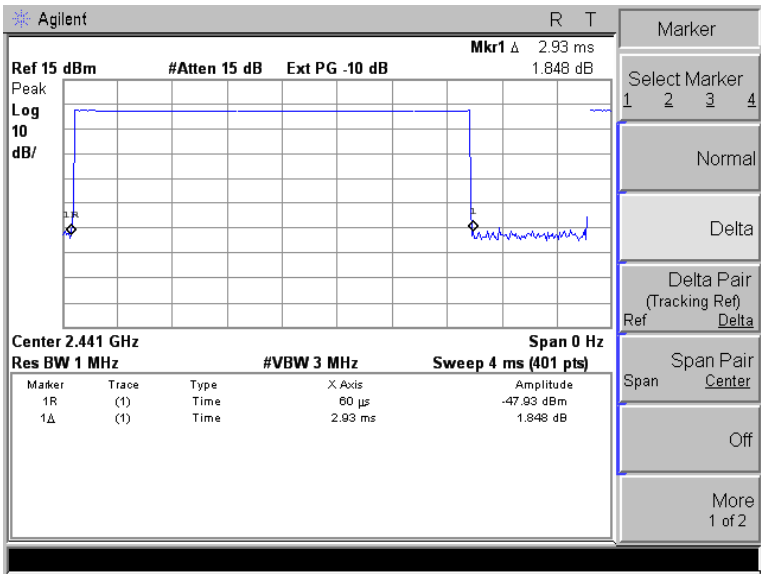
DH1



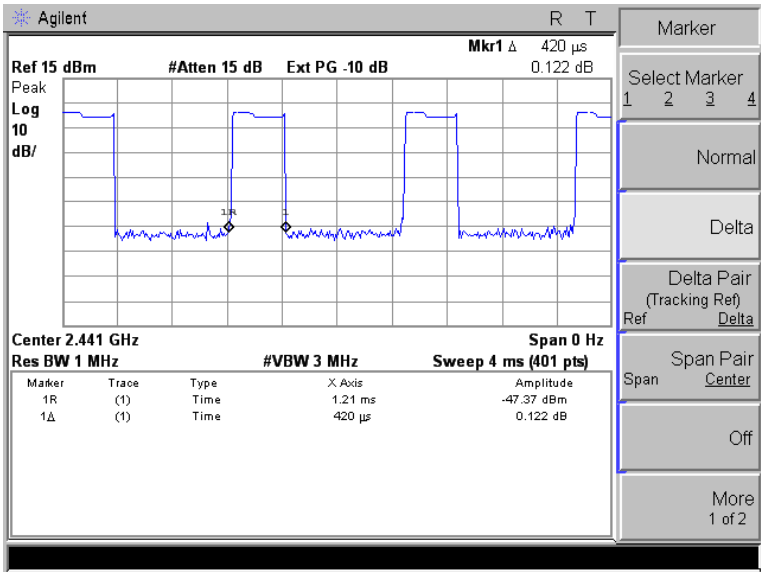
DH3



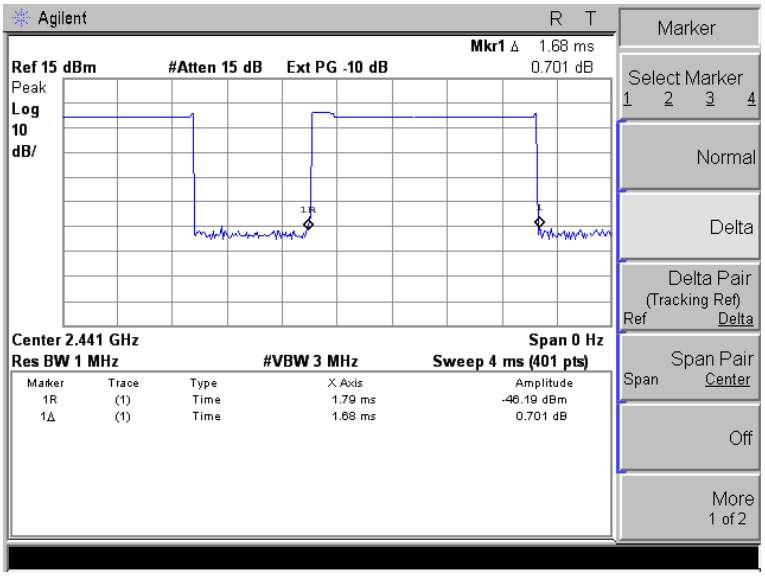
DH5



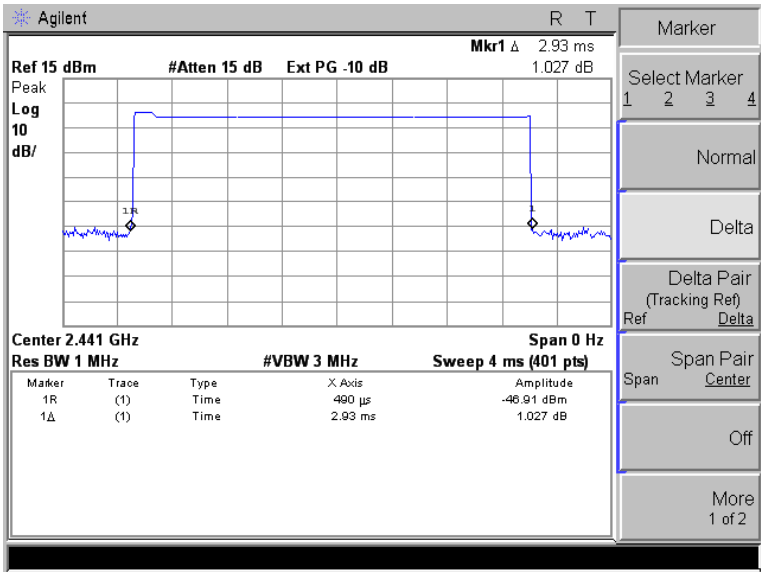
3-DH1



3-DH3



3-DH5



11. BAND EDGE COMPLIANCE TEST

11.1. Limits

According to FCC Section 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 con-ducted or a radiated measurement

11.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set to span from the lowest frequency generated in the device up to and including the tenth harmonic of the highest fundamental frequency

The bandwidth of the Spectrum's VBW is set at 3MHz and RBW is set at 1MHz for peak emissions measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emissions measure, for all test, used peak detector.

Note: If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.

For radiated test as follows:

	Frequency (MHz)	Antenna polarization (H/V)	Emission (dBuV/m)	Band edge Limit (dBuV/m)		Result
			PK	PK	AV	Pass
Hopping	<2400	H	50.13	74.00	54.00	Pass
	<2400	V	50.72	74.00	54.00	Pass
	>2483.5	H	50.27	74.00	54.00	Pass
	>2483.5	V	49.85	74.00	54.00	Pass
Unhopping	<2400	H	50.24	74.00	54.00	Pass
	<2400	V	50.31	74.00	54.00	Pass
	>2483.5	H	50.19	74.00	54.00	Pass
	>2483.5	V	50.28	74.00	54.00	Pass

If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.

12. ANTENNA REQUIREMENTS

12.1. Limits

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.

12.2. Result

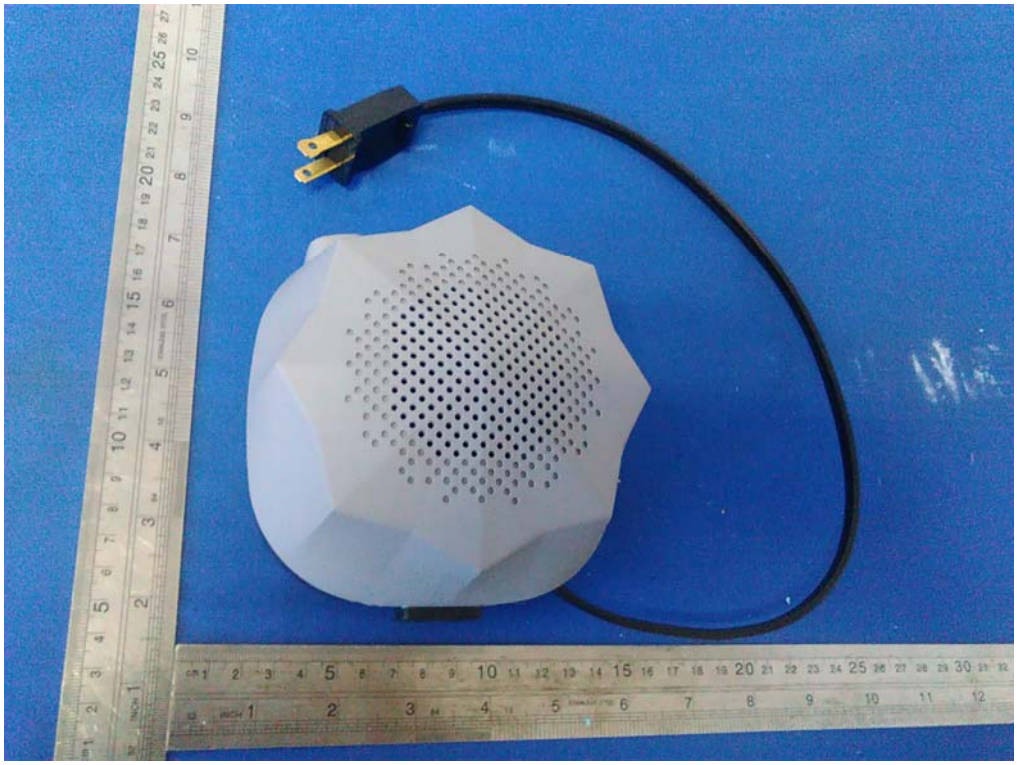
The antennas used for this product are integral Antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 0dBi.

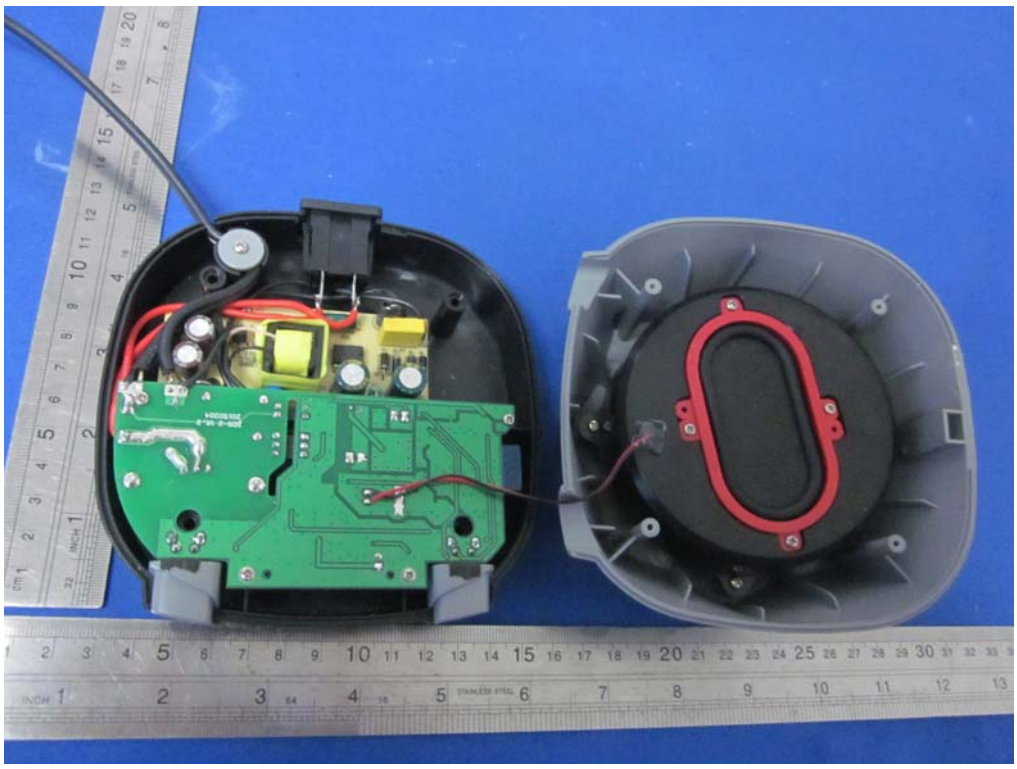
13. PHOTOGRAPHS OF TEST SET-UP

Conducted Emission Test

Radiated Emission Test

14. PHOTOGRAPHS OF THE EUT





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