FCC RADIO TEST REPORT

FCC ID: 2ARNF-M07325

Product： Wireless Bluetooth Controller for NES/ PC/ Mac

Trade Name： Hyperkin

Model Name： M07325

Serial Model： N/A

Report No.： UNIA2018101131FR-01

Prepared for

Hyperkin,inc

1939 W. Mission Blvd., Pomona, CA 91766

Prepared by

Shenzhen United Testing Technology Co., Ltd.

2F, Annex Bldg, Jiahuangyuan Tech Park, #365 Baotian 1 Rd, Tiegang Community, Xixiang Str, Bao'an District, Shenzhen, China

TEST RESULT CERTIFICATION

Applicant's name ..... :	Hyperkin,inc
Address ..... :	1939 W. Mission Blvd., Pomona, CA 91766
Manufacture's Name ..... :	QS POWER TECHNOLOGY CO., LTD
Address ..... :	2F No.101, Xiangyuandong Road, Shangtun Village, LiaoBu Town, Dongguan City, Guang Dong, China

Product description

Product name ..... :	Wireless Bluetooth Controller for NES/ PC/ Mac
Trade Mark ..... :	Hyperkin
Model and/or type reference .. :	M07325
Standards ..... :	FCC Rules and Regulations Part 15 Subpart C Section 15.247 ANSI C63.10: 2013

This device described above has been tested by Shenzhen United Testing Technology Co., Ltd., 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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Date of Test ..... :	Oct. 18, 2018
Date (s) of performance of tests ..... :	Oct. 18, 2018 -- Oct. 31, 2018
Date of Issue ..... :	Oct. 31, 2018
Test Result ..... :	Pass

Prepared by: Kahn yang/Editor

Reviewer: Sherwin Qian/Supervisor

Approved & Authorized Signer: Lilize/Manager

Table of Contents

1 TEST SUMMARY

1 TEST PROCEDURES AND RESULTS

FCC PART 15.247		
FCC Part 15.207	AC Power Conducted Emission	PASS
FCC Part 15.247(a)(1)(i)	20dB Bandwidth	PASS
FCC Part 15.247(d)	Spurious RF Conducted Emission	PASS
FCC Part 15.247(b)	Maximum Peak Output Power	PASS
FCC Part 15.247(b)	Pseudorandom Frequency Hopping Sequence	PASS
FCC Part 15.247(a)(1)(iii)	Number of hopping frequency& Time of Occupancy	PASS
FCC Part 15.247(a)(1)	Frequency Separation	PASS
FCC Part 15.205/15.209	Radiated Emissions	PASS
FCC Part 15.247(d)	Band Edge Compliance of RF Emission	PASS
FCC Part 15.247(g)(h)	Pseudorandom Frequency Hopping Sequence	PASS
FCC Part 15.203/15.247 (b)	Antenna Requirement	PASS

2 TEST FACILITY

Test Firm : Shenzhen United Testing Technology Co., Ltd.

Address : 2F, Annex Bldg, Jiahuangyuan Tech Park, #365 Baotian 1 Rd, Tiegang Community, Xixiang Str, Bao'an District, Shenzhen, China

The testing quality ability of our laboratory meet with "Quality Law of People's Republic of China" Clause 19.The testing quality system of our laboratory meets with ISO/IEC-17025 requirements, which is approved by CNAS. This approval result is accepted by MRA of APLAC.

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

CNAS-LAB Code: L6494

The EMC Laboratory has been assessed and in compliance with CNAS-CL01 accreditation criteria for testing Laboratories (identical to ISO/IEC 17025:2017 General Requirements) for the Competence of testing Laboratories.

Designation Number: CN1227

Test Firm Registration Number: 674885

The EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications commission. The acceptance letter from the FCC is maintained in our files.

3 MEASUREMENT UNCERTAINTY

Measurement Uncertainty

Conducted Emission Expanded Uncertainty	=	2.23dB, k=2
Radiated emission expanded uncertainty(9kHz-30MHz)	=	3.08dB, k=2
Radiated emission expanded uncertainty(30MHz-1000MHz)	=	4.42dB, k=2
Radiated emission expanded uncertainty(Above 1GHz)	=	4.06dB, k=2

2 GENERAL INFORMATION

2.1 ENVIRONMENTAL CONDITIONS

During the measurement the environmental conditions were within the listed ranges:

Temperature	Normal Temperature:	25℃
Voltage	Normal Voltage	3.7V
Other	Relative Humidity	55 %
	Air Pressure	101 kPa

2.2 GENERAL DESCRIPTION OF EUT

Equipment	Wireless Bluetooth Controller for NES/ PC/ Mac
Trade Mark	Hyperkin
Model Name	M07325
Serial No.	N/A
Model Difference	All models have the same functionality, software and electronics, only the color, front frame shape and model names may differ. Test sample model: M07325
FCC ID	2ARNF-M07325
Antenna Type	PCB Antenna
Antenna Gain	0.0 dbi
Frequency Range	2402MHz - 2480MHz
Number of Channels	79
Modulation Type	GFSK, π/4DQPSK, 8DPSK
Battery	3.7V 500mah 1.85Wh
Power Source	3.7V from battery
Adapter Model	N/A

2.3 CARRIER FREQUENCY OF CHANNELS

Channel	Frequency (MHz)
00	2402
01	2403
:	:
:	:
77	2479
78	2480

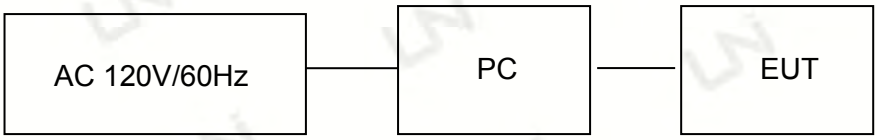
2.4 OPARATION OF EUT DURING TESTING

Operating Mode
The mode is used: Transmitting mode

Low Channel	2402MHz
Middle Channel	2441MHz
High Channel	2480MHz

2.5 DESCRIPTION OF TEST SETUP

Operation of EUT during Conducted testing:



Operation of EUT during Radiation and Above1GHz Radiation testing:

2.6 MEASUREMENT INSTRUMENTS LIST

Item	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
CONDUCTED EMISSIONS TEST					
1	AMN	Schwarzbeck	NNLK8121	8121370	2019.09.09
2	AMN	ETS	3810/2	00020199	2019.09.09
3	EMI TEST RECEIVER	Rohde&Schwarz	ESCI	101210	2019.09.09
4	AAN	TESEQ	T8-Cat6	38888	2019.09.09
RADIATED EMISSION TEST					
1	Horn Antenna	Sunol	DRH-118	A101415	2019.09.29
2	BicoNILog Antenna	Sunol	JB1 Antenna	A090215	2019.09.29
3	PREAMP	HP	8449B	3008A00160	2019.09.09
4	PREAMP	HP	8447D	2944A07999	2019.09.09
5	EMI TEST RECEIVER	Rohde&Schwarz	ESR3	101891	2019.09.09
6	VECTOR Signal Generator	Rohde&Schwarz	SMU200A	101521	2019.09.28
7	Signal Generator	Agilent	E4421B	MY4335105	2019.09.28
8	MXA Signal Analyzer	Agilent	N9020A	MY50510140	2019.9.28
9	MXA Signal Analyzer	Agilent	N9020A	MY51110104	2019.09.09
10	ANT Tower&Turn table Controller	Champro	EM 1000	60764	2019.09.28
11	Anechoic Chamber	Taihe Maorui	9m*6m*6m	966A0001	2019.09.09
12	Shielding Room	Taihe Maorui	6.4m*4m*3m	643A0001	2019.09.09
13	RF Power sensor	DARE	RPR3006W	15I00041SNO88	2019.03.14
14	RF Power sensor	DARE	RPR3006W	15I00041SNO89	2019.03.14
15	RF power divider	Anritsu	K241B	992289	2019.09.28
16	Wideband radio communication tester	Rohde&Schwarz	CMW500	154987	2019.09.28
17	Biconical antenna	Schwarzbeck	VHA 9103	91032360	2019.09.08
18	Biconical antenna	Schwarzbeck	VHA 9103	91032361	2019.09.08
19	Broadband Hybrid Antennas	Schwarzbeck	VULB9163	VULB9163#958	2019.09.08
20	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1680	2019.01.12
21	Active Receive Loop Antenna	Schwarzbeck	FMZB 1919B	00023	2019.11.02
22	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170651	2019.03.14
23	Microwave Broadband Preamplifier	Schwarzbeck	BBV 9721	100472	2019.10.24
24	Active Loop Antenna	Com-Power	AL-130R	10160009	2019.05.10
25	Power Meter	KEYSIGHT	N1911A	MY50520168	2019.05.10

3 TEST CONDITIONS AND RESULTS

3.1 CONDUCTED EMISSIONS TEST

Limit

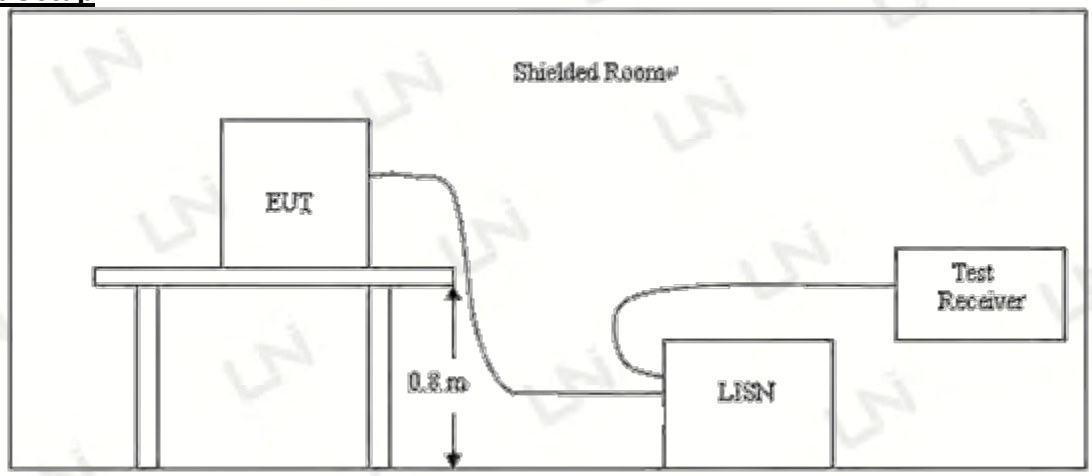
For unintentional device, according to § 15.107(a) Line Conducted Emission Limits is as following

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreasing linearly with the logarithm of the frequency

For intentional device, according to §15.207(a) Line Conducted Emission Limit is same as above table.

Test Setup



Test Procedure

1, The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. A wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10.
2, Support equipment, if needed, was placed as per ANSI C63.10.
3, All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
4, If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5, All support equipments received AC power from a second LISN, if any.
6, The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7, Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.

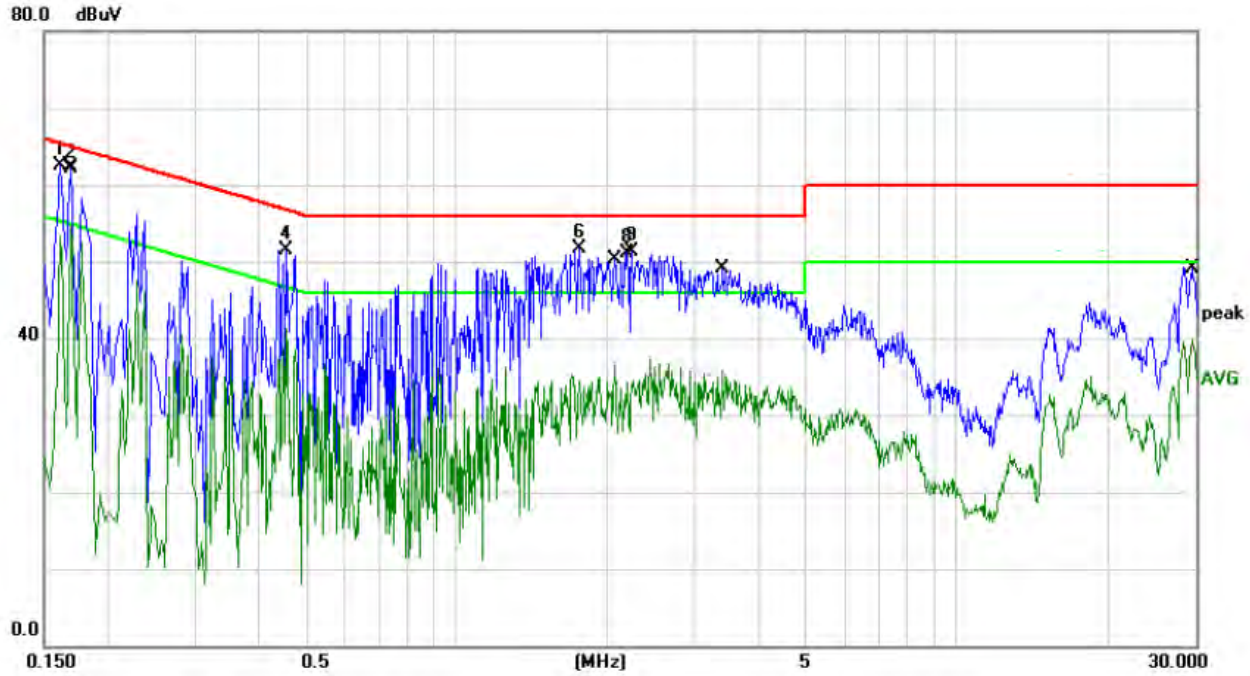
Test Result

---PASS---

Please refer to test data as follows:

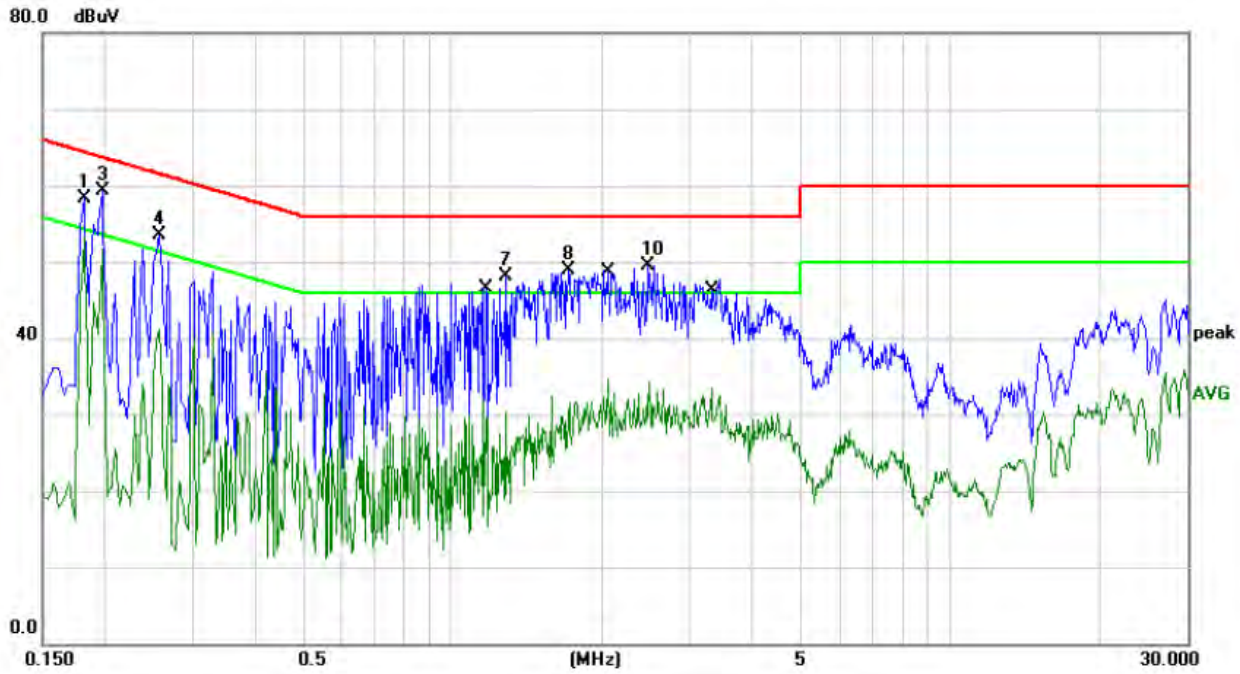
Temperature:	25℃	Relative Humidity:	48%
Test Date:	Oct. 28, 2018	Pressure:	1030hPa
Test Voltage:	AC 120V 60Hz	Polarization:	

Line	L



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1620	62.58	-0.13	62.45	65.36	-2.91	peak	
2		0.1700	62.33	-0.13	62.20	64.96	-2.76	peak	
3	*	0.1700	54.63	-0.13	54.50	54.96	-0.46	AVG	
4		0.4580	51.50	-0.02	51.48	56.73	-5.25	peak	
5		0.4580	41.23	-0.02	41.21	46.73	-5.52	AVG	
6		1.7580	52.00	-0.21	51.79	56.00	-4.21	peak	
7		2.0660	36.64	-0.23	36.41	46.00	-9.59	AVG	
8		2.1900	51.34	-0.24	51.10	56.00	-4.90	peak	
9		2.2460	51.57	-0.24	51.33	56.00	-4.67	peak	
10		3.4100	36.10	-0.19	35.91	46.00	-10.09	AVG	
11		29.5220	40.26	-0.40	39.86	50.00	-10.14	AVG	

Line	N



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1819	58.41	-0.13	58.28	64.39	-6.11	peak	
2	*	0.1819	53.42	-0.13	53.29	54.39	-1.10	AVG	
3		0.1980	59.37	-0.13	59.24	63.69	-4.45	peak	
4		0.2580	53.58	-0.11	53.47	61.49	-8.02	peak	
5		0.2580	41.29	-0.11	41.18	51.49	-10.31	AVG	
6		1.1539	32.18	-0.14	32.04	46.00	-13.96	AVG	
7		1.2780	48.22	-0.16	48.06	56.00	-7.94	peak	
8		1.7100	49.11	-0.21	48.90	56.00	-7.10	peak	
9		2.0579	34.94	-0.23	34.71	46.00	-11.29	AVG	
10		2.4660	49.68	-0.19	49.49	56.00	-6.51	peak	
11		3.3140	33.79	-0.19	33.60	46.00	-12.40	AVG	

3.2 RADIATED EMISSION TEST

Radiation Limit

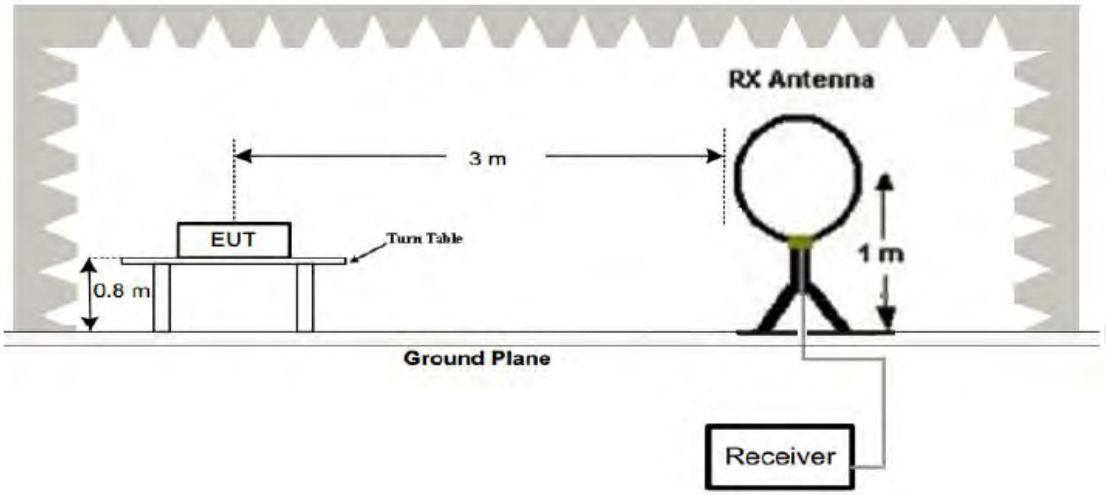
For unintentional device, according to § 15.109(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
30-88	3	40	100
88-216	3	43.5	150
216-960	3	46	200
Above 960	3	54	500

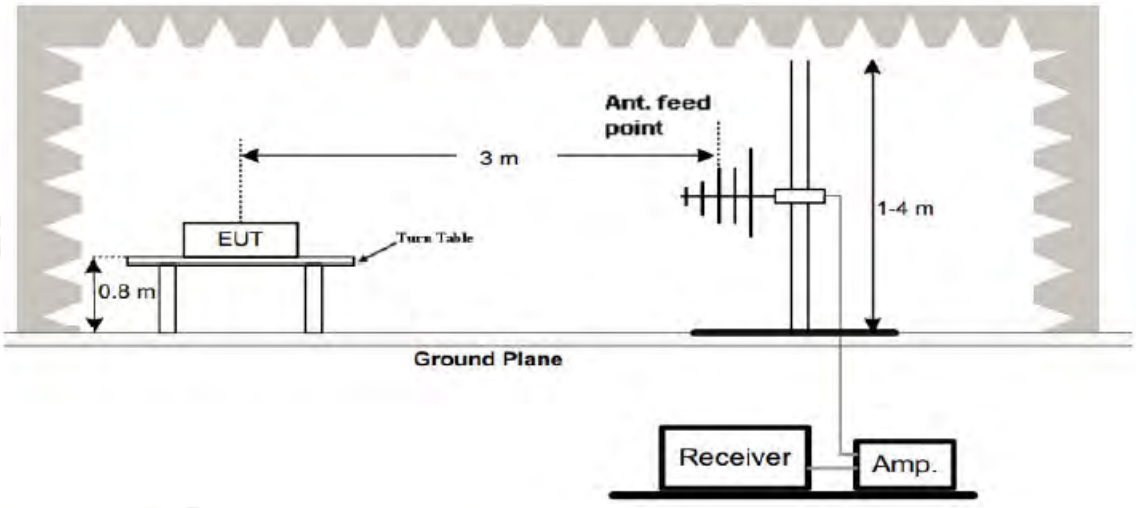
For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

Test Setup

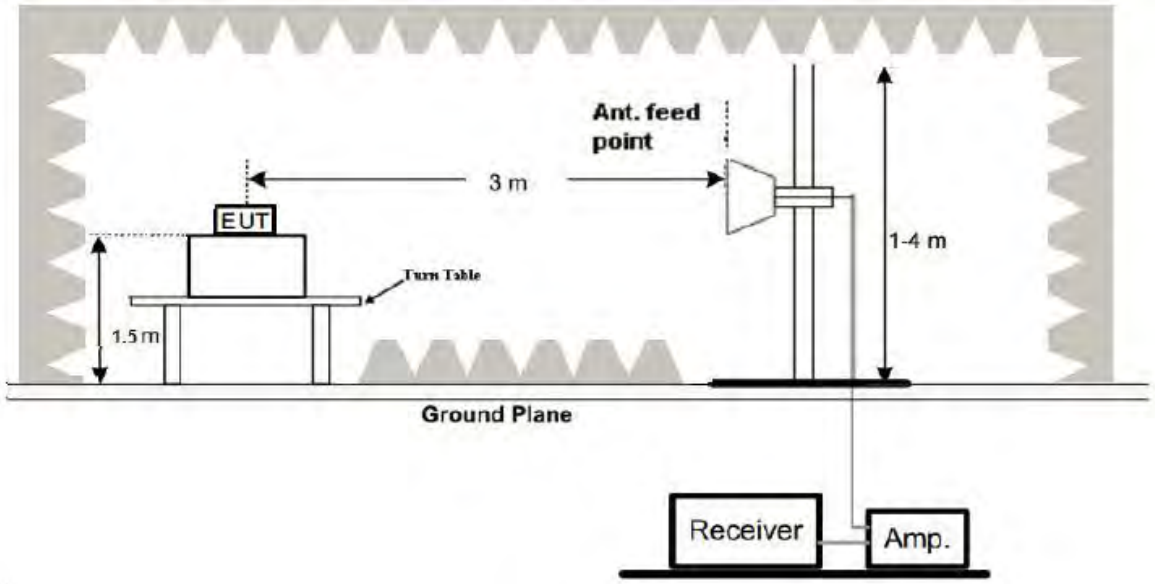
1. Radiated Emission Test-Up Frequency Below 30MHz



2. Radiated Emission Test-Up Frequency 30MHz~1GHz



3. Radiated Emission Test-Up Frequency Above 1GHz



Test Procedure

1. Below 1GHz measurement the EUT is placed on turntable which is 0.8m above ground plane. And above 1GHz measurement EUT was placed on low permittivity and low tangent turn table which is 1.5m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The test frequency range from 9kHz to 25GHz per FCC PART 15.33(a).

Note:
For battery operated equipment, the equipment tests shall be performed using a new battery.

Test Result

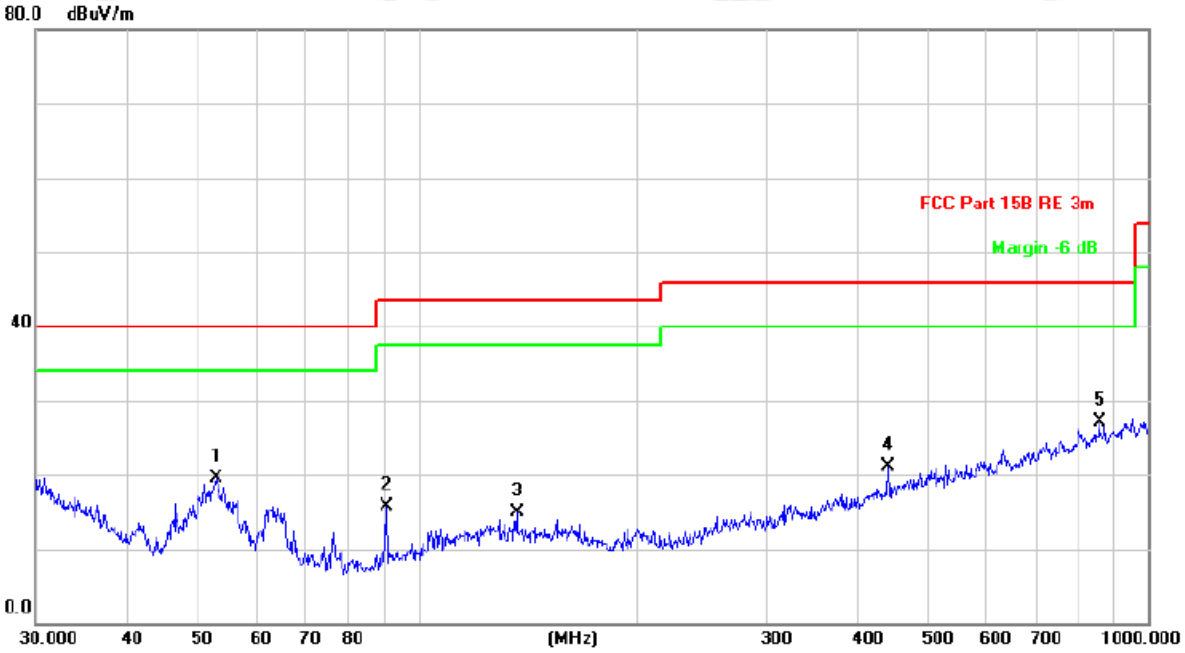
---PASS---

Remark:
1. All the test modes completed for test. The worst case of Radiated Emission is Middle channel, the test data of this mode was reported.
2. By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that “Z axis” position was the worst, and test data recorded in this report.
3. Radiated emission test from 9KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9KHz to 30MHz and not recorded in this report.

Below 1GHz Test Results:

Temperature:	25℃	Relative Humidity:	48%
Test Date:	Oct.28, 2018	Pressure:	1030hPa
Test Voltage:	DC 3.7V from battery	Polarization:	

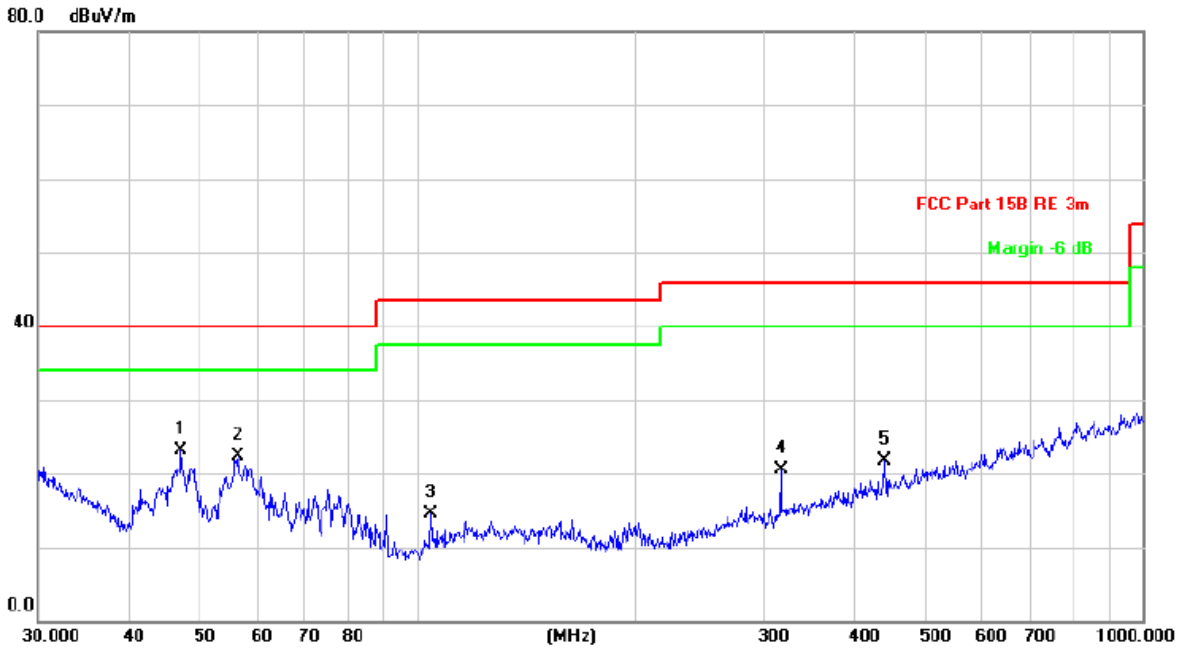
Polarization:	Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		52.9453	38.39	-18.91	19.48	40.00	-20.52	peak			
2		90.5374	33.00	-17.21	15.79	43.50	-27.71	peak			
3		136.4598	27.62	-12.68	14.94	43.50	-28.56	peak			
4		440.1963	29.09	-7.89	21.20	46.00	-24.80	peak			
5	*	857.0247	27.91	-0.86	27.05	46.00	-18.95	peak			

Remark: Absolute Level= Reading Level+ Factor, Margin= Absolute Level – Limit
Factor=Ant. Factor + Cable Loss – Pre-amplifier

Polarization:	Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	47.1599	39.47	-16.40	23.07	40.00	-16.93	peak			
2		56.5929	41.09	-18.88	22.21	40.00	-17.79	peak			
3		104.1701	29.21	-14.67	14.54	43.50	-28.96	peak			
4		316.5890	31.15	-10.65	20.50	46.00	-25.50	peak			
5		440.1963	29.38	-7.59	21.79	46.00	-24.21	peak			

Remark: Absolute Level= Reading Level+ Factor, Margin= Absolute Level – Limit
Factor=Ant. Factor + Cable Loss – Pre-amplifier

Remark:

(1) Measuring frequencies from 9 kHz to the 1 GHz, Radiated emission test from 9kHz to 30MHz was verified, and no any emission was found except system noise floor.

(2) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.

(3) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.

Above 1 GHz Test Results:

Note：GFSK, Pi/4 DQPSK,8DPSK all have been tested, only worse case GFSK is reported.

GFSK: CH Low (2402MHz)

Horizontal:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4804.00	58.12	-3.64	54.48	74	19.52	PK
4804.00	46.10	-3.64	42.46	54	11.54	AV
5735.80	55.52	-2.34	53.18	74	20.82	PK
5735.80	44.50	-2.34	42.16	54	11.84	AV
7206.00	54.46	-0.95	53.51	74	20.49	PK
7206.00	42.65	-0.95	41.70	54	12.30	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit						

Vertical:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4804.00	57.77	-3.64	54.13	74	19.87	PK
4804.00	44.21	-3.64	40.57	54	13.43	AV
5735.80	55.81	-2.34	53.47	74	20.53	PK
5735.80	44.98	-2.34	42.64	54	11.36	AV
7206.00	54.59	-0.95	53.64	74	20.36	PK
7206.00	42.81	-0.95	41.86	54	12.14	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit						

GFSK: CH Middle (2441MHz)

Horizontal:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4882.00	58.39	-3.51	54.88	74	19.12	PK
4882.00	45.53	-3.51	42.02	54	11.98	AV
5330.70	55.88	-2.41	53.47	74	20.53	PK
5330.70	45.24	-2.41	42.83	54	11.17	AV
7323.00	55.03	-0.82	54.21	74	19.79	PK
7323.00	42.43	-0.82	41.61	54	12.39	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit						

Vertical:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4882.00	58.57	-3.51	55.06	74	18.94	PK
4882.00	45.44	-3.51	41.93	54	12.07	AV
5330.70	56.17	-2.41	53.76	74	20.24	PK
5330.70	44.96	-2.41	42.55	54	11.45	AV
7323.00	55.20	-0.82	54.38	74	19.62	PK
7323.00	41.12	-0.82	40.30	54	13.70	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit						

GFSK: CH High (2480MHz)

Horizontal:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4960.00	57.54	-3.43	54.11	74	19.89	PK
4960.00	44.40	-3.43	40.97	54	13.03	AV
5740.50	56.33	-2.33	54.00	74	20.00	PK
5740.50	45.05	-2.33	42.72	54	11.28	AV
7440.00	54.47	-0.75	53.72	74	20.28	PK
7440.00	41.40	-0.75	40.65	54	13.35	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit						

Vertical:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4960.00	57.27	-3.43	53.84	74	20.16	PK
4960.00	43.60	-3.43	40.17	54	13.83	AV
5740.50	55.63	-2.33	53.30	74	20.70	PK
5740.50	43.96	-2.33	41.63	54	12.37	AV
7440.00	55.16	-0.75	54.41	74	19.59	PK
7440.00	43.10	-0.75	42.35	54	11.65	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit						

Remark：
(1) Measuring frequencies from 1 GHz to the 25 GHz。
(2) “F” denotes fundamental frequency; “H” denotes spurious frequency. “E” denotes band edge frequency.
(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(4) Data of measurement within this frequency range shown “--- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for peak measurement with peak detector at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average measurement with peak
detection at frequency above 1GHz.
(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.
(7) All modes of operation were investigated and the worst-case emissions are reported.

3.3 BAND EDGE

Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test Procedure

The band edge compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW to 100KHz and VBM to 300KHz to measure the peak field strength and set RBW to 1MHz and VBW to 10Hz to measure the average radiated field strength. The conducted RF band edge was measured by using a spectrum analyzer. Set span wide enough to capture the highest in-band emission and the emission at the band edge. Set RBW to 100 kHz and VBW to 300 kHz, to measure the conducted peak band edge.

Test Result

---PASS---

Radiated Band Edge Test:

Operation Mode: TX CH Low (2402MHz)

Horizontal (Worst case):

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2330.00	58.11	-5.78	52.33	74	21.67	PK
2330.00	/	-5.78	/	54	/	AV
2390.00	56.60	-5.84	50.76	74	23.24	PK
2390.00	/	-5.84	/	54	/	AV
2400.00	67.23	-5.84	61.39	74	12.61	PK
2400.00	/	-5.84	/	54	/	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2336.00	58.48	-5.78	52.70	74	21.30	PK
2336.00	/	-5.78	/	54	/	AV
2390.00	57.90	-5.84	52.06	74	21.94	PK
2390.00	/	-5.84	/	54	/	AV
2400.00	66.77	-5.84	60.93	74	13.07	PK
2400.00	/	-5.84	/	54	/	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Operation Mode: TX CH High (2480MHz)

Horizontal (Worst case):

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	67.53	-5.65	61.88	74	12.12	PK
2483.50	/	-5.65	/	54	/	AV
2485.30	58.53	-5.65	52.88	74	21.12	PK
2485.30	/	-5.65	/	54	/	AV
2500.00	58.17	-5.72	61.81	74	21.55	PK
2500.00	/	-5.72	/	54	/	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	67.03	-5.65	61.47	74	12.53	PK
2483.50	/	-5.65	/	54	/	AV
2489.00	58.01	-5.65	52.36	74	21.64	PK
2489.00	/	-5.65	/	54	/	AV
2500.00	58.41	-5.72	52.69	74	21.31	PK
2500.00	/	-5.72	/	54	/	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

3.4 CONDUCTED OUTPUT POWER

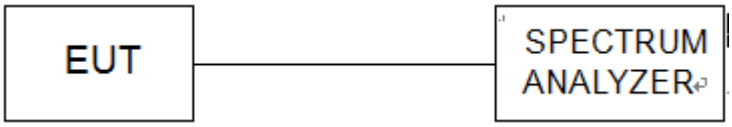
Limit

The Maximum Peak Output Power Measurement is 30dBm.

Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.

Test Configuration



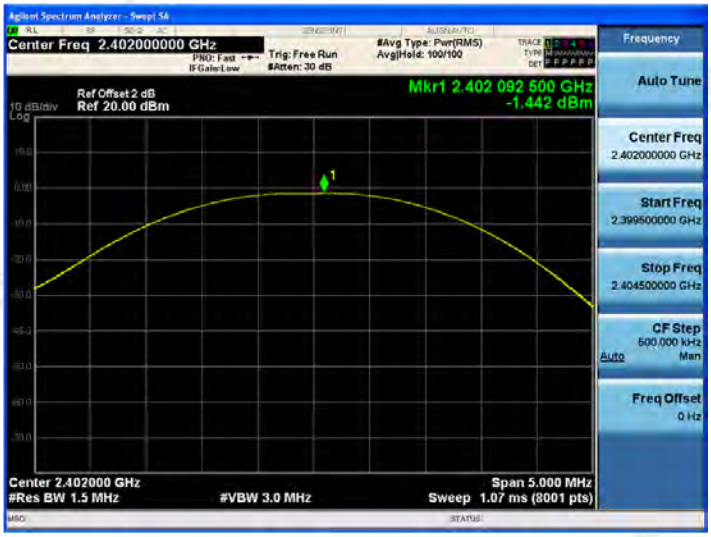
Test Result

Type	Channel	Output power (dBm)	Limit (dBm)	Result
GFSK	00	-1.442	30	Pass
	39	-2.488		
	78	-1.736		
π/4DQPSK	00	-0.369	30	Pass
	39	-1.388		
	78	-0.617		
8DPSK	00	-0.354	30	Pass
	39	-1.307		
	78	-0.559		

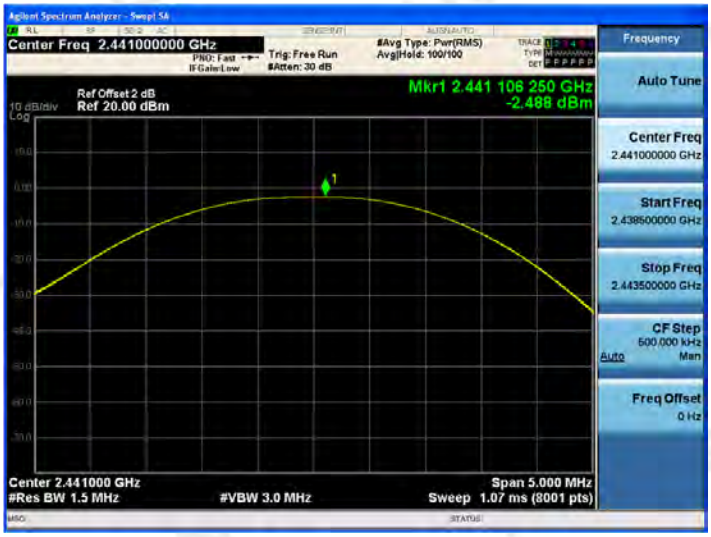
Note: 1.The test results including the cable lose.

GFSK Modulation

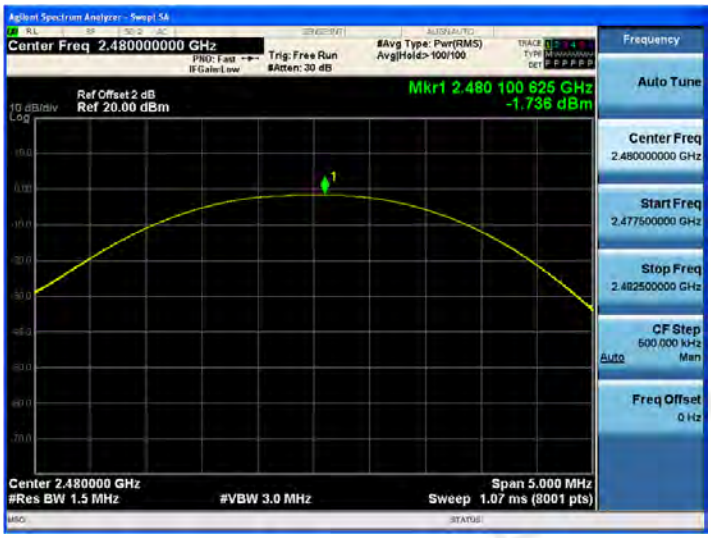
CH00

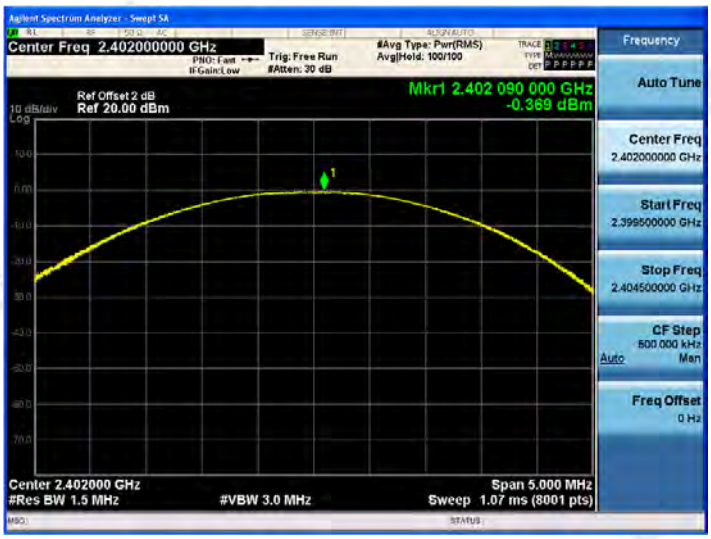
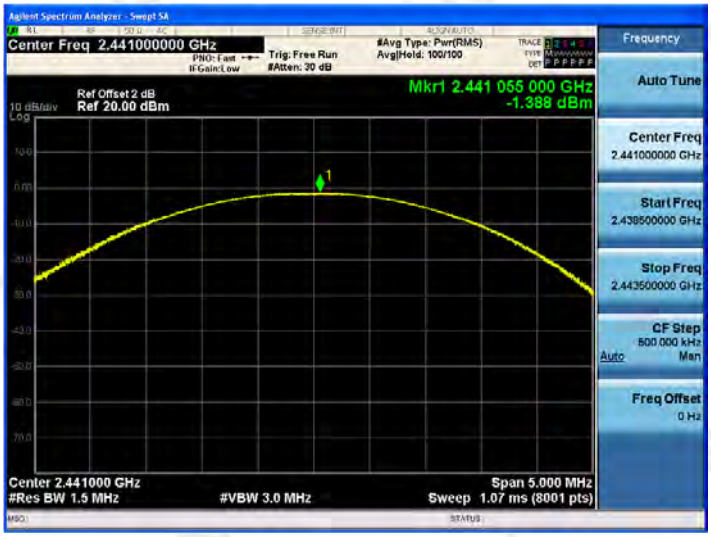
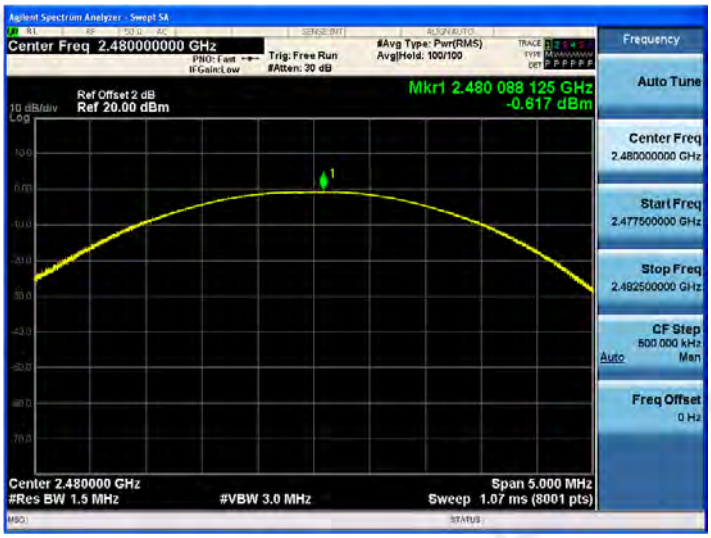


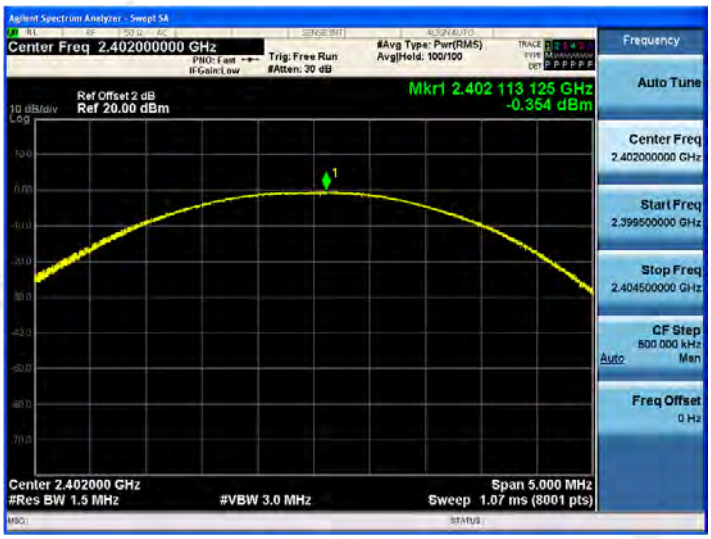
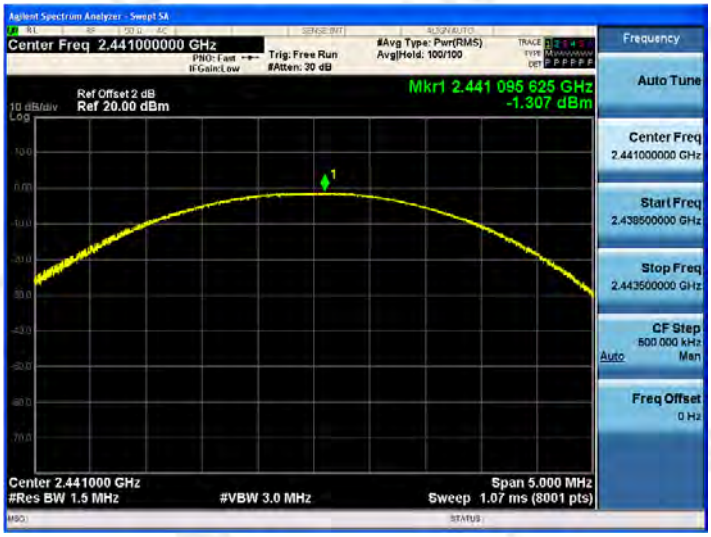
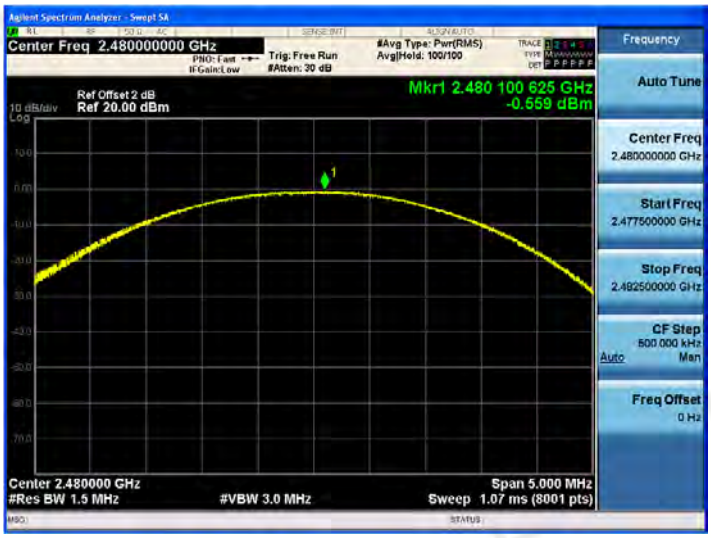
CH39



CH78



π/4DQPSK Modulation
CH00

CH39

CH78


8DPSK Modulation
CH00

CH39

CH78


3.5 OCCUPIED BANDWIDTH MEASUREMENT

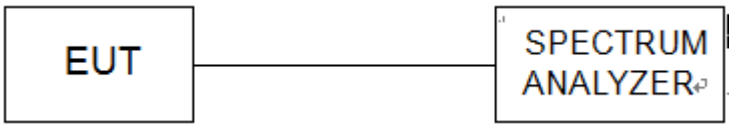
Limit

For frequency hopping systems operating in the 2400MHz - 2483.5MHz no limit for 20dB bandwidth.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 KHz RBW and 100 KHz VBW.
The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

Test Configuration



Test Result

---PASS---

Modulation	Channel	20dB bandwidth (MHz)	99% OBW (MHz)	Result
GFSK	CH00	0.9194	0.84943	Pass
	CH39	0.9121	0.84175	
	CH78	0.8972	0.84406	
π/4DQPSK	CH00	1.220	1.1649	
	CH39	1.264	1.1719	
	CH78	1.212	1.1668	
8DPSK	CH00	1.208	1.1559	
	CH39	1.214	1.1581	
	CH78	1.207	1.1561	

GFSK Modulation
CH00

CH39

CH78


π/4DQPSK Modulation
CH00

CH39

CH78


8DPSK Modulation
CH00

CH39

CH78


3.6 Frequency Separation

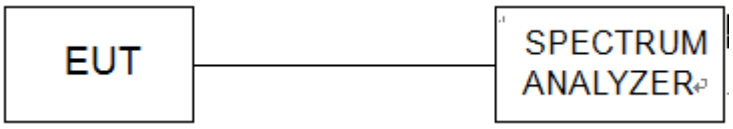
LIMIT

According to 15.247(a)(1),frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with100 KHz RBW and 300 KHz VBW.

Test Configuration



TEST RESULTS

Modulation	Channel	Channel Separation (MHz)	Limit(MHz)	Result
GFSK	CH38	1.006	25KHz or 2/3*20dB bandwidth	Pass
	CH39			
π/4DQPSK	CH38	0.839	25KHz or 2/3*20dB bandwidth	Pass
	CH39			
8DPSK	CH38	0.999	25KHz or 2/3*20dB bandwidth	Pass
	CH39			

Note:

We have tested all mode at high, middle and low channel, and recorded worst case at middle

GFSK Modulation

π/4DQPSK Modulation

8DPSK Modulation

3.7 Number of hopping frequency

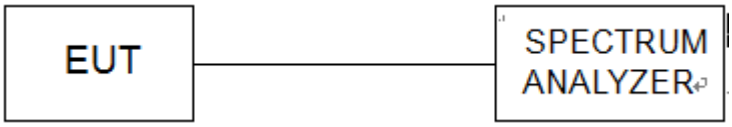
Limit

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

Test Procedure

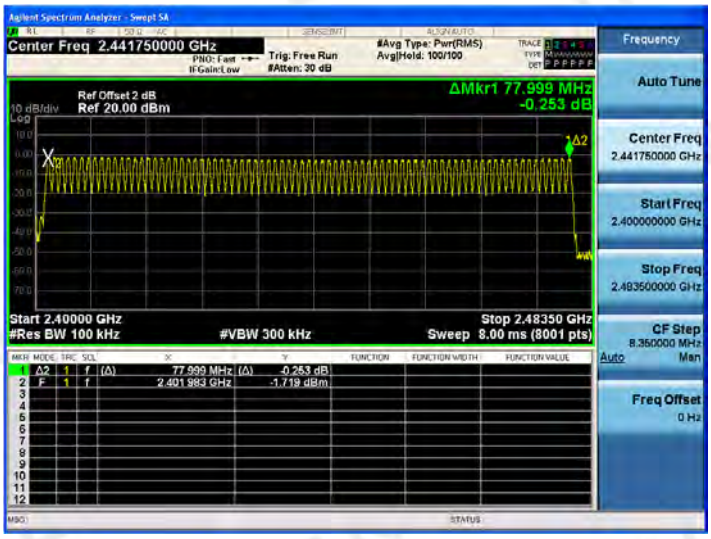
The transmitter output was connected to the spectrum analyzer through an attenuator. Set spectrum analyzer start 2400MHz to 2483.5MHz with 100 KHz RBW and 300 KHz VBW.

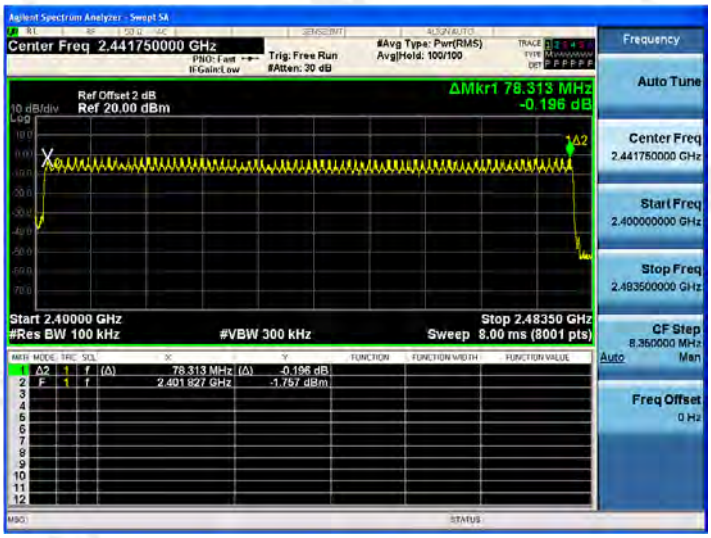
Test Configuration



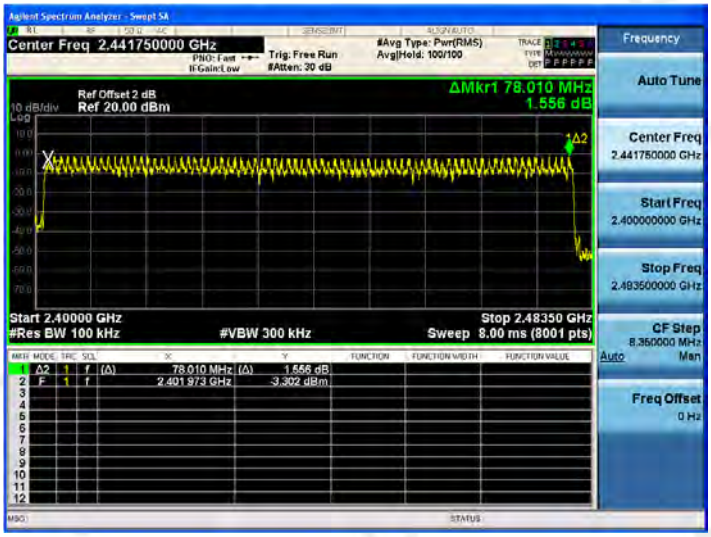
Test Results

Modulation	Number of Hopping Channel	Limit	Result
GFSK	79	≥15	Pass
π/4DQPSK	79		
8DPSK	79		

GFSK

π/4DQPSK


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441750000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: Pwr(RMS)
Avg|Hold: 100/100
Frequency
Auto Tune
ΔMkr1 78.313 MHz
-0.196 dB
Ref Offset 2 dB
10 dB/div
Ref 20.00 dBm
Log
Center Freq
2.441750000 GHz
Start Freq
2.400000000 GHz
Stop Freq
2.483500000 GHz
Start 2.40000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.48350 GHz
Sweep 8.00 ms (8001 pts)
CF Step
8.350000 MHz
Auto
Man
Freq Offset
0 Hz
Δ2 1 f (Δ) 78.313 MHz -0.196 dB
F 1 f 2.401 827 GHz -1.757 dBm

8DPSK


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441750000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: Pwr(RMS)
Avg|Hold: 100/100
Frequency
Auto Tune
ΔMkr1 78.010 MHz
1.556 dB
Ref Offset 2 dB
10 dB/div
Ref 20.00 dBm
Log
Center Freq
2.441750000 GHz
Start Freq
2.400000000 GHz
Stop Freq
2.483500000 GHz
Start 2.40000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.48350 GHz
Sweep 8.00 ms (8001 pts)
CF Step
8.350000 MHz
Auto
Man
Freq Offset
0 Hz
Δ2 1 f (Δ) 78.010 MHz 1.556 dB
F 1 f 2.401 973 GHz -3.302 dBm

3.8 Time of Occupancy (Dwell Time)

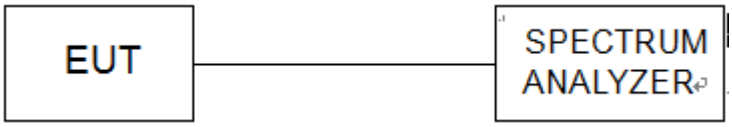
Limit

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.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with 1MHz RBW and 1MHz VBW, Span 0Hz.

Test Configuration



Test Results

Modulation	Packet	Pulse time (ms)	Dwell time (ms)	Limit (s)	Result
GFSK	DH1	0.409	0.131	0.40	Pass
	DH3	1.664	0.266		
	DH5	2.912	0.311		
π/4DQPSK	2-DH1	0.419	0.134	0.40	Pass
	2-DH3	1.671	0.267		
	2-DH5	2.917	0.311		
8DPSK	3-DH1	0.418	0.134	0.40	Pass
	3-DH3	1.672	0.268		
	3-DH5	2.917	0.311		

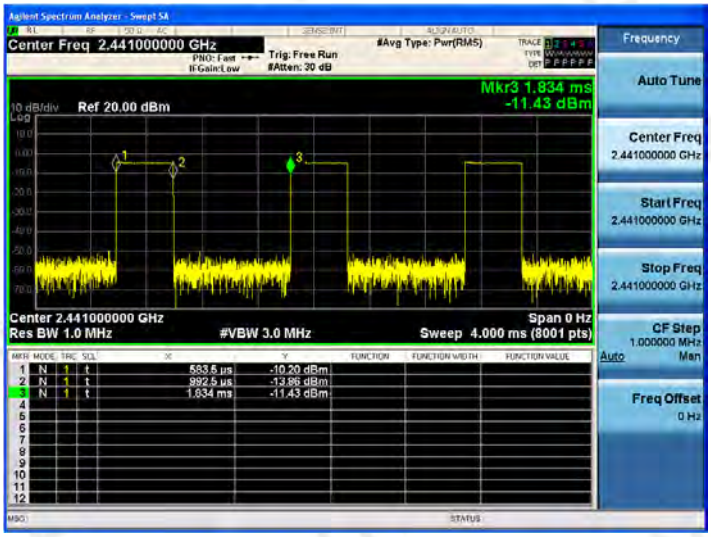
Note:

1. We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
2. Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2-DH1, 3-DH1

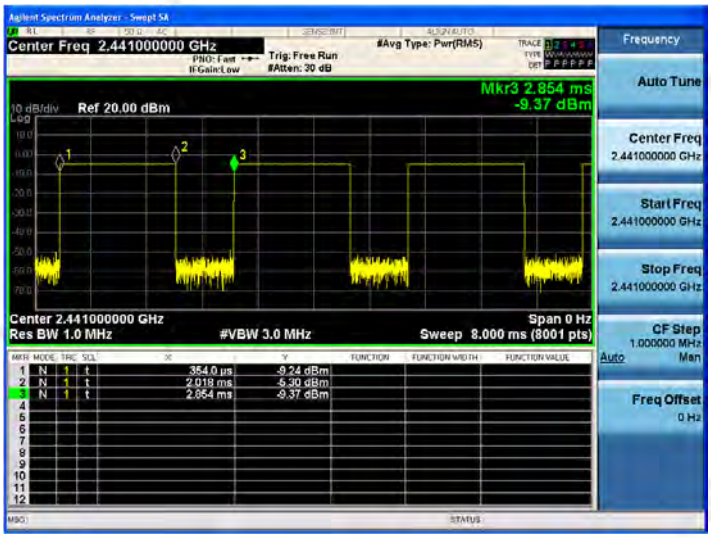
   Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for DH3, 2-DH3, 3-DH3

   Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for DH5, 2-DH5, 3-DH5

DH1


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: Pwr(RMS)
Mkr3 1.834 ms
-11.43 dBm
10 dB/div
Ref 20.00 dBm
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 4.000 ms (8001 pts)
1 N 1 t 583.6 µs -10.20 dBm
2 N 1 t 992.5 µs -13.86 dBm
3 N 1 t 1.834 ms -11.43 dBm
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

DH3


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: Pwr(RMS)
Mkr3 2.854 ms
-9.37 dBm
10 dB/div
Ref 20.00 dBm
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 8.000 ms (8001 pts)
1 N 1 t 354.0 µs -9.24 dBm
2 N 1 t 2.018 ms -5.30 dBm
3 N 1 t 2.854 ms -9.37 dBm
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

DH5

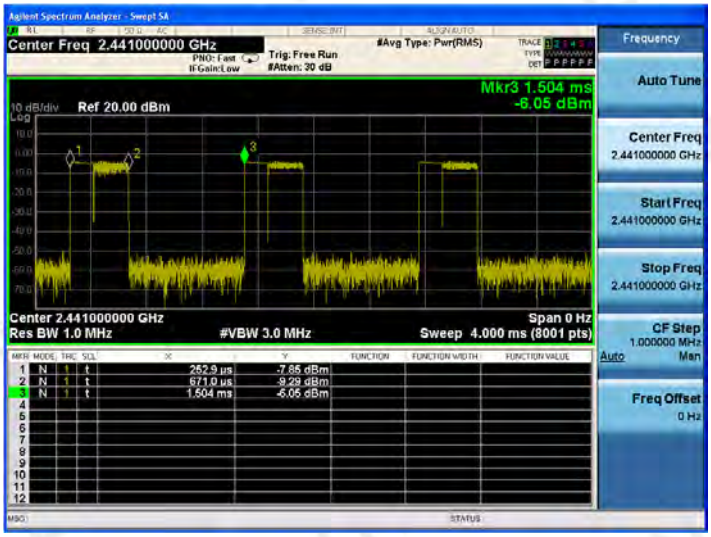

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.441000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: Pwr(RMS)
Mkr3 6.300 ms
-4.67 dBm
10 dB/div
Ref 20.00 dBm
Center 2.441000000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 10.13 ms (8001 pts)
1 N 1 t 2.550 ms -5.47 dBm
2 N 1 t 5.462 ms -6.86 dBm
3 N 1 t 6.300 ms -4.67 dBm
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

2-DH1

2-DH3

2-DH5

3-DH1



3-DH3

3-DH5

3.9 OUT-OF BAND EMISSIONS

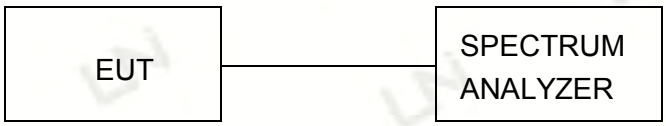
Limit

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, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

Test Procedure

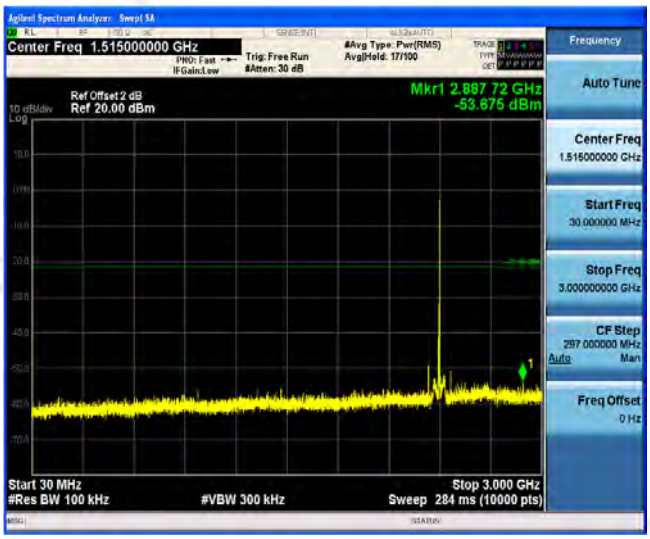
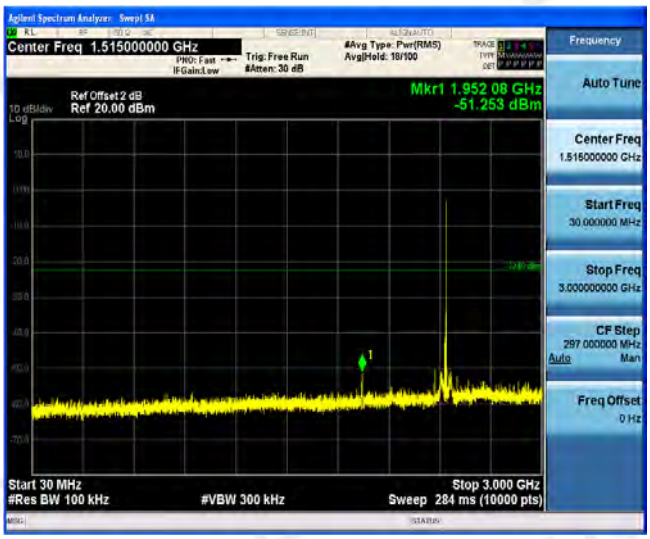
Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector , and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

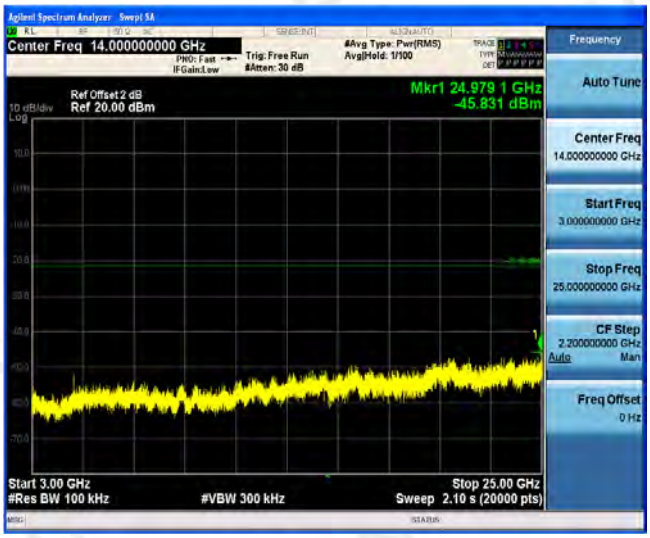
Test Configuration



Test Results

Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data.

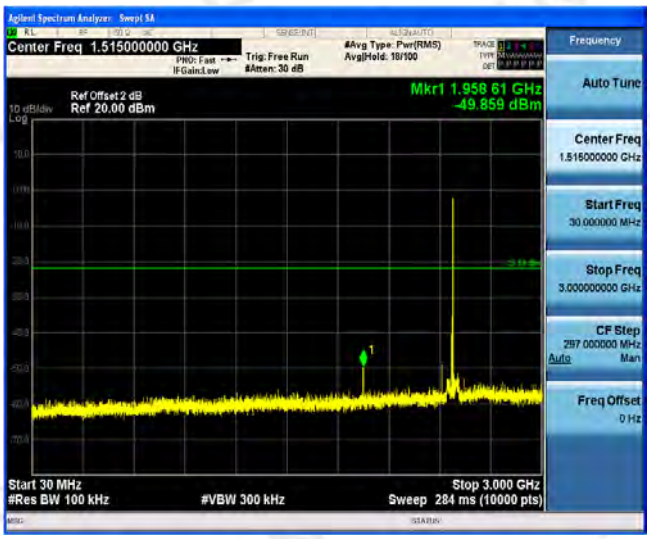
GFSK CH00	*GFSK CH39*
	
30MHz-3GHz	30MHz-3GHz



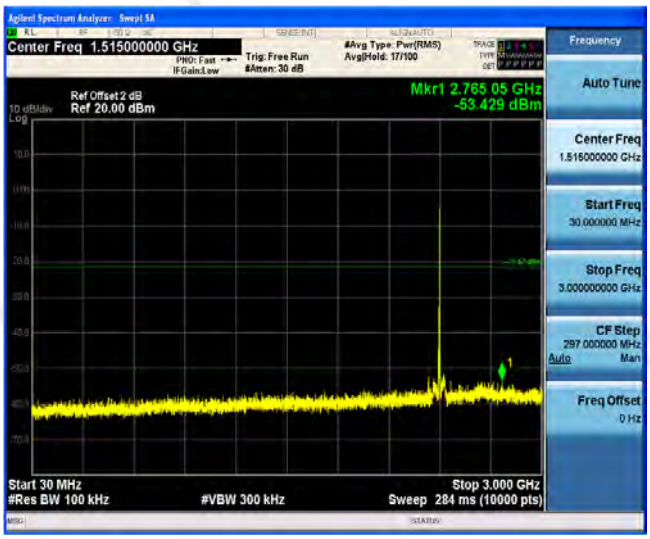
3GHz-25GHz

3GHz-25GHz

GFSK CH78	***π/4DQPSK CH00***

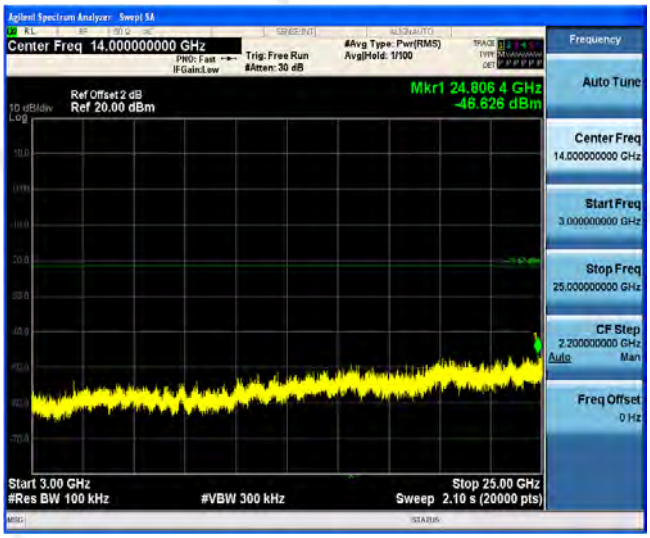


30MHz-3GHz



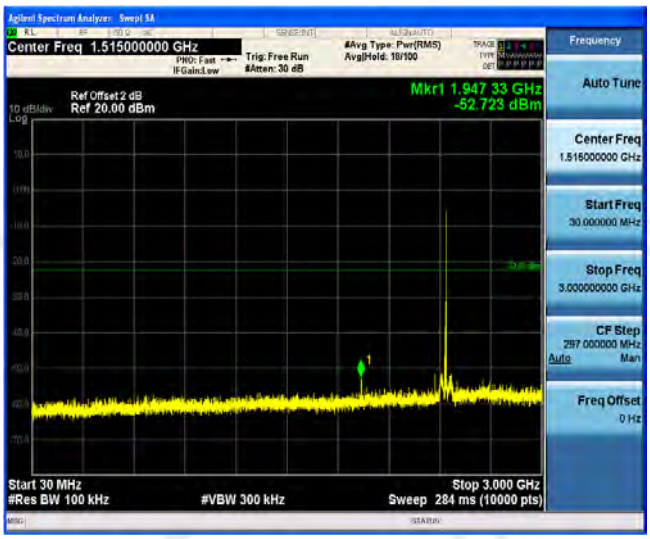
30MHz-3GHz

3GHz-25GHz

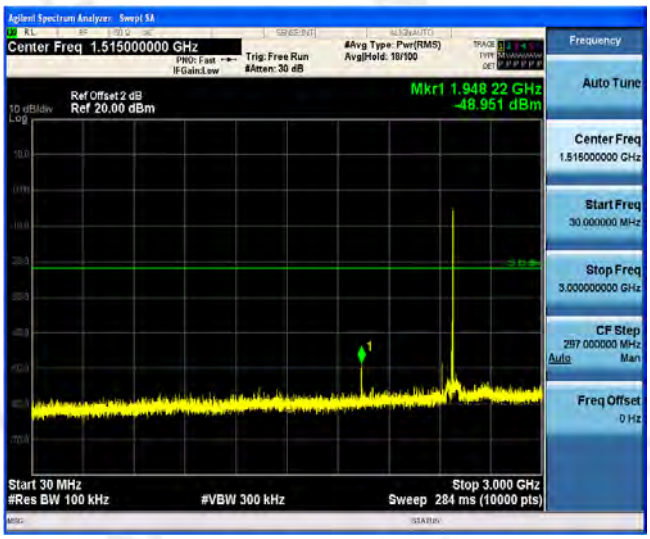


3GHz-25GHz

π/4DQPSK CH39	*π/4DQPSK CH78*



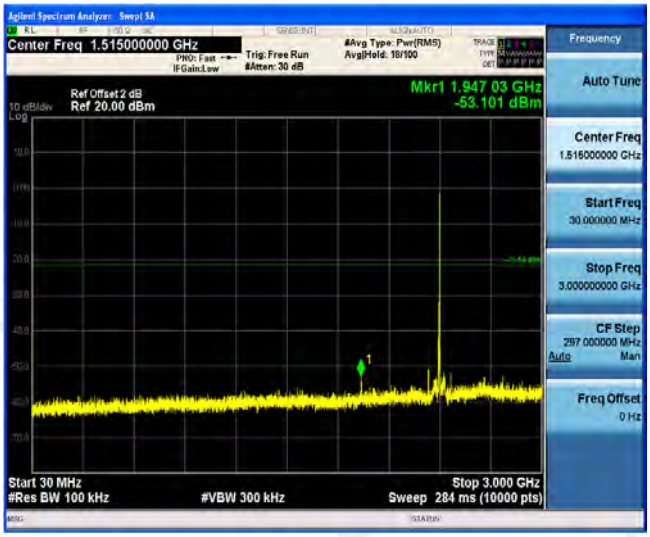
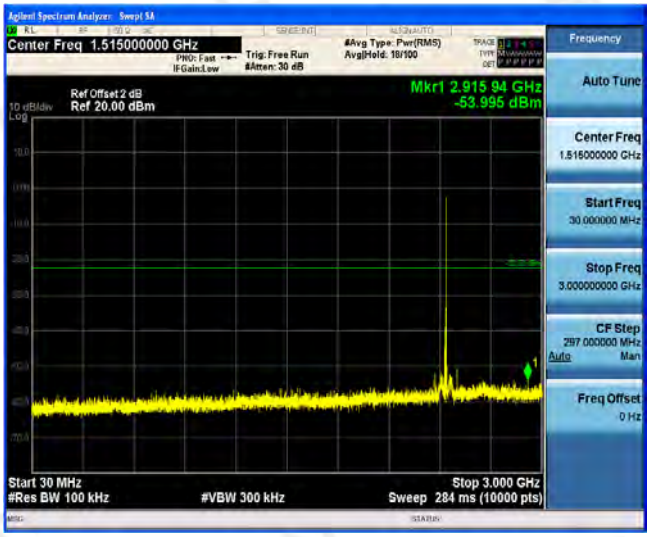
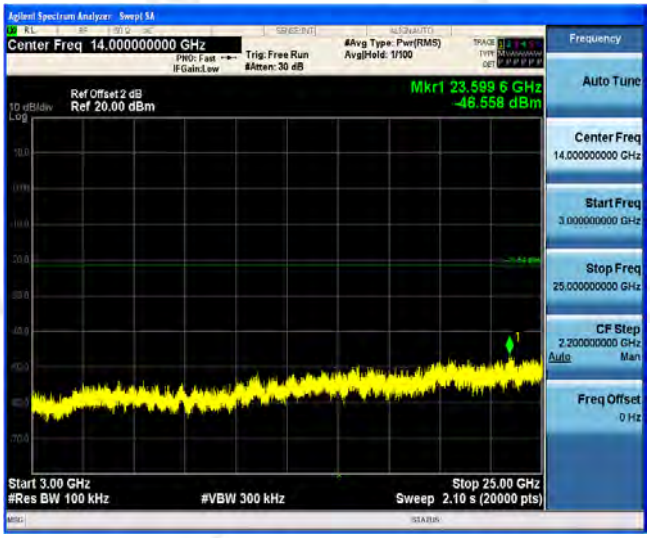
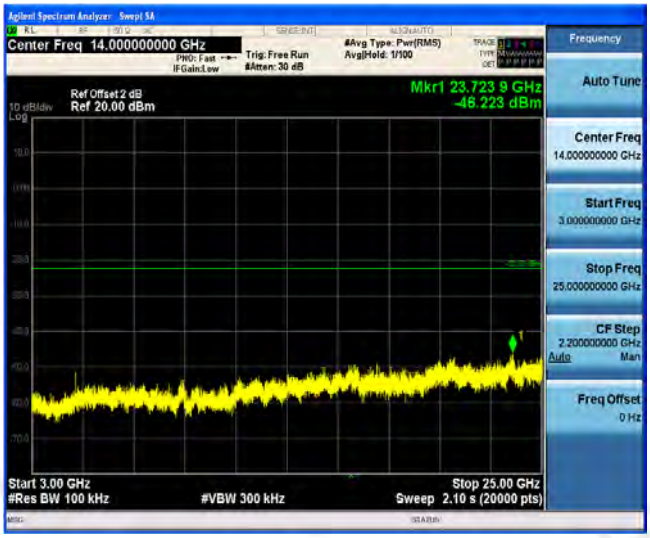
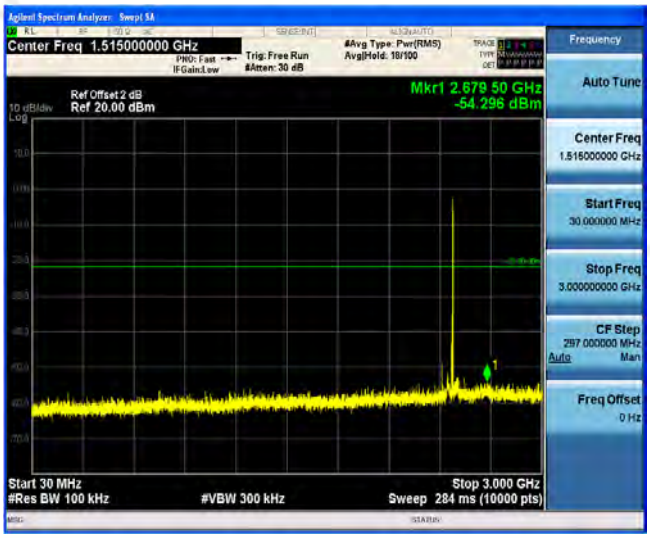
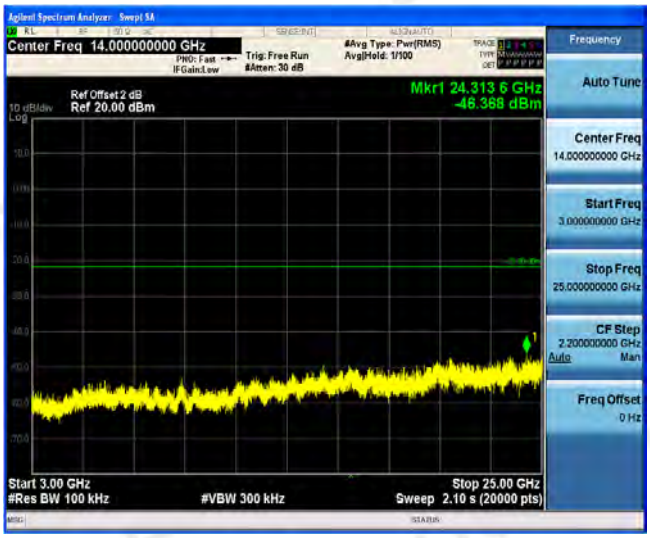
30MHz-3GHz



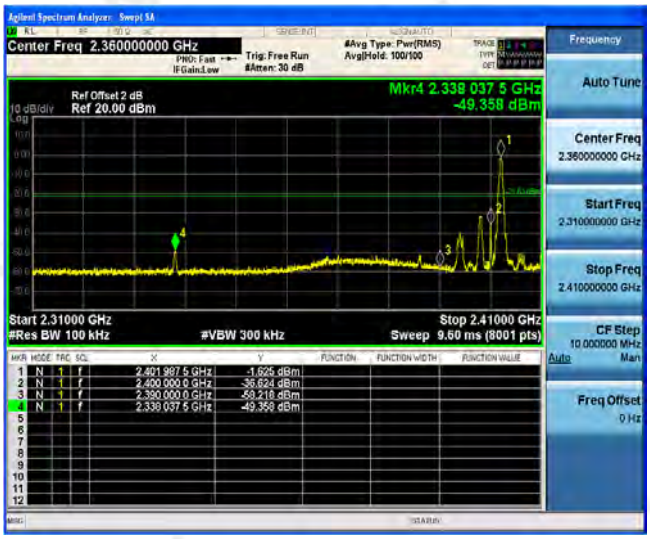
30MHz-3GHz

3GHz-25GHz

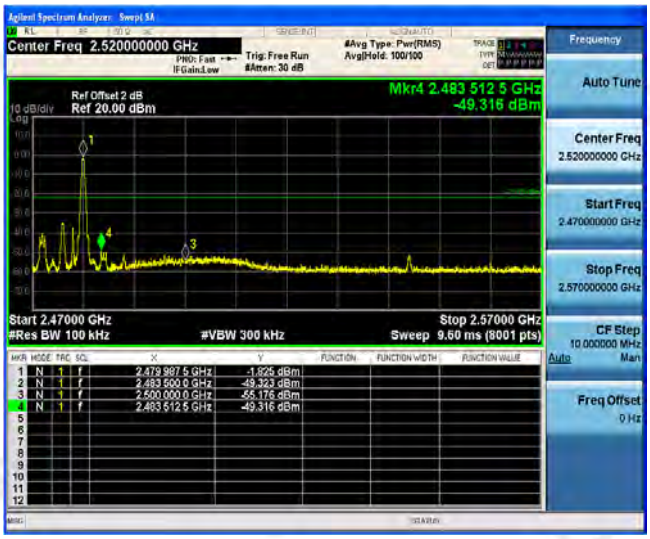
3GHz-25GHz

8DPSK CH00	8DPSK CH39
	
30MHz-3GHz	30MHz-3GHz
	
3GHz-25GHz	3GHz-25GHz
8DPSK CH78	
	
30MHz-3GHz	3GHz-25GHz

GFSK

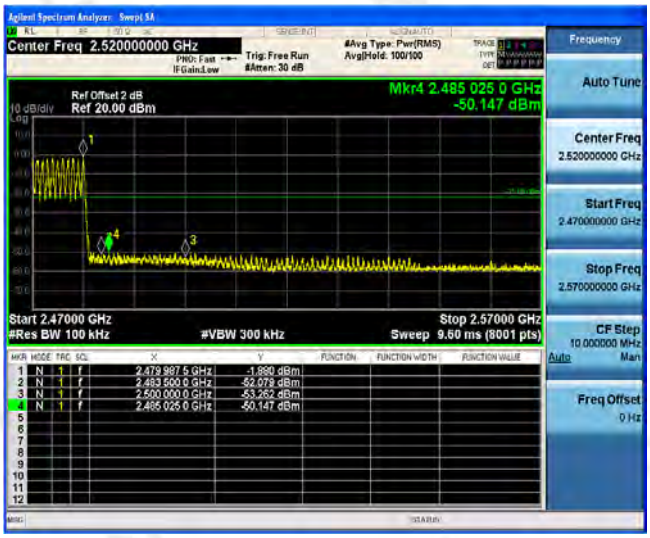


Left Band edge hoping off

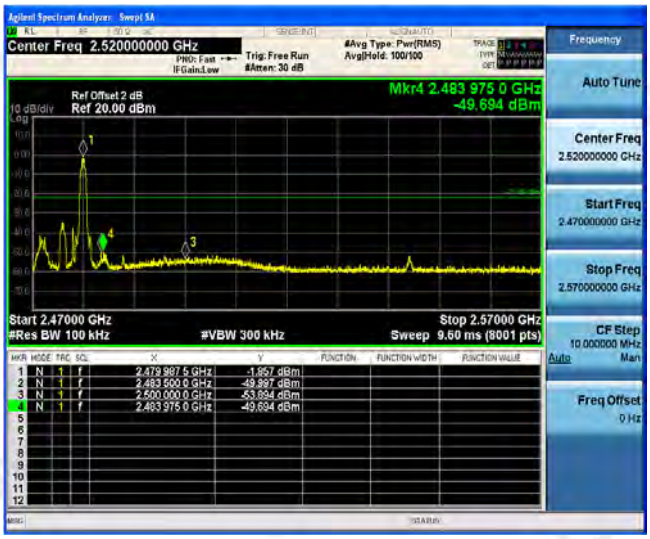
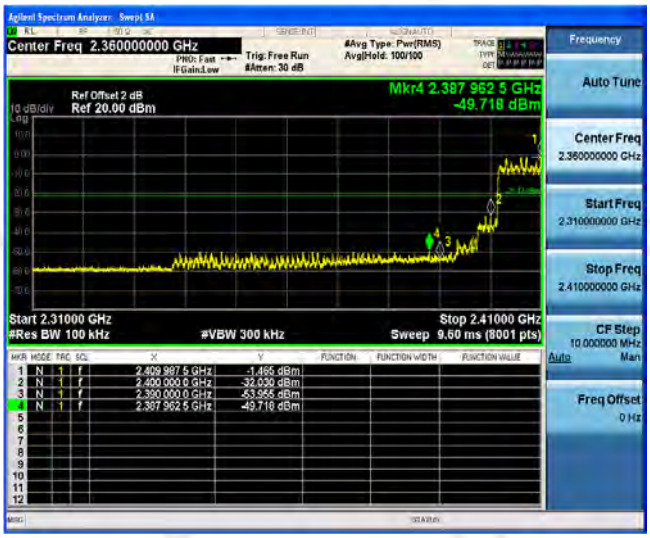
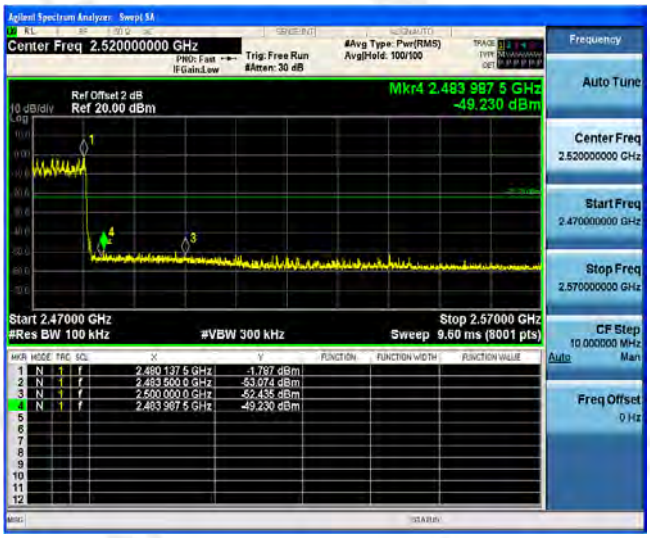


Right Band edge hoping off

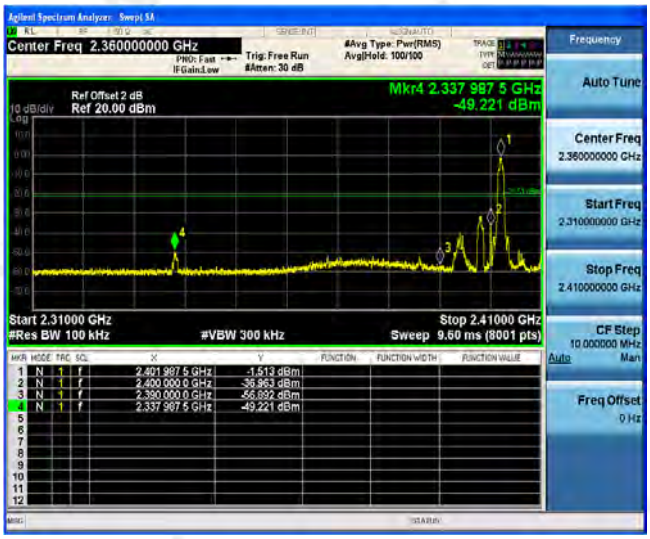
Left Band edge hoping on



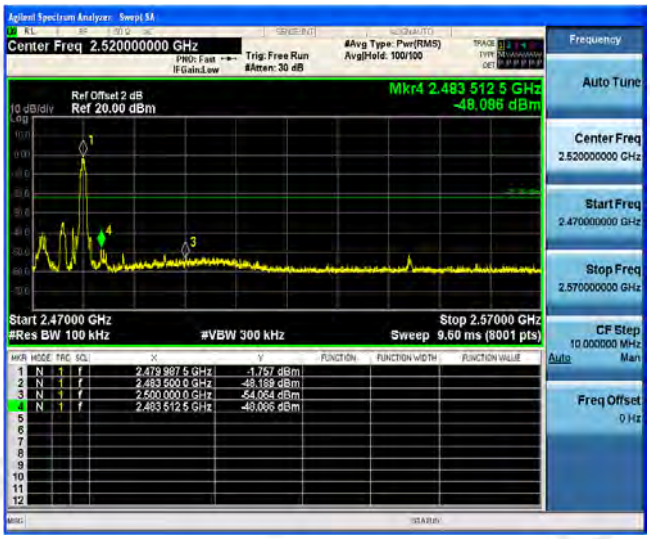
Right Band edge hoping on

π/4DQPSK	
	
Left Band edge hoping off	Right Band edge hoping off
	
Left Band edge hoping on	Right Band edge hoping on

8DPSK

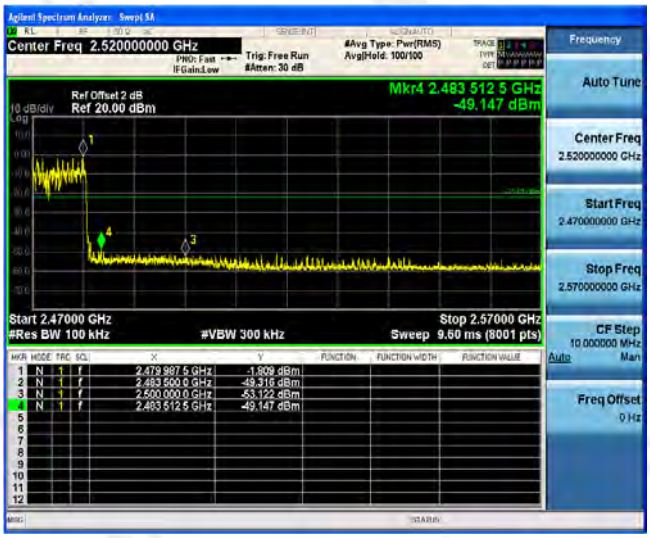


Left Band edge hoping off



Right Band edge hoping off

Left Band edge hoping on



Right Band edge hoping on

3.10 Pseudorandom Frequency Hopping Sequence

TEST APPLICABLE

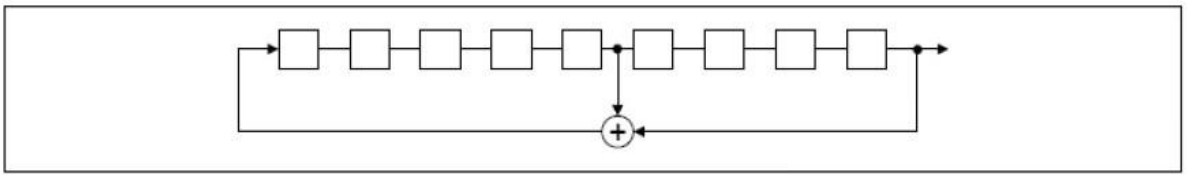
For 47 CFR Part 15C section 15.247 (g) (h) requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence Requirement

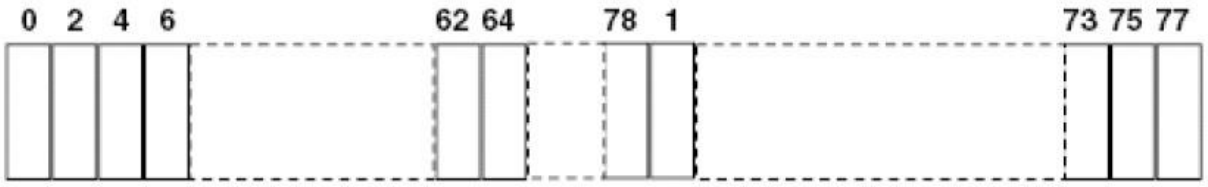
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of pseudorandom frequency hopping sequence as follows:



Each frequency used equally on the average by each transmitter.

According to Bluetooth Core Specification, Bluetooth receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any Bluetooth transmitters and shift frequencies in synchronization with the transmitted signals.

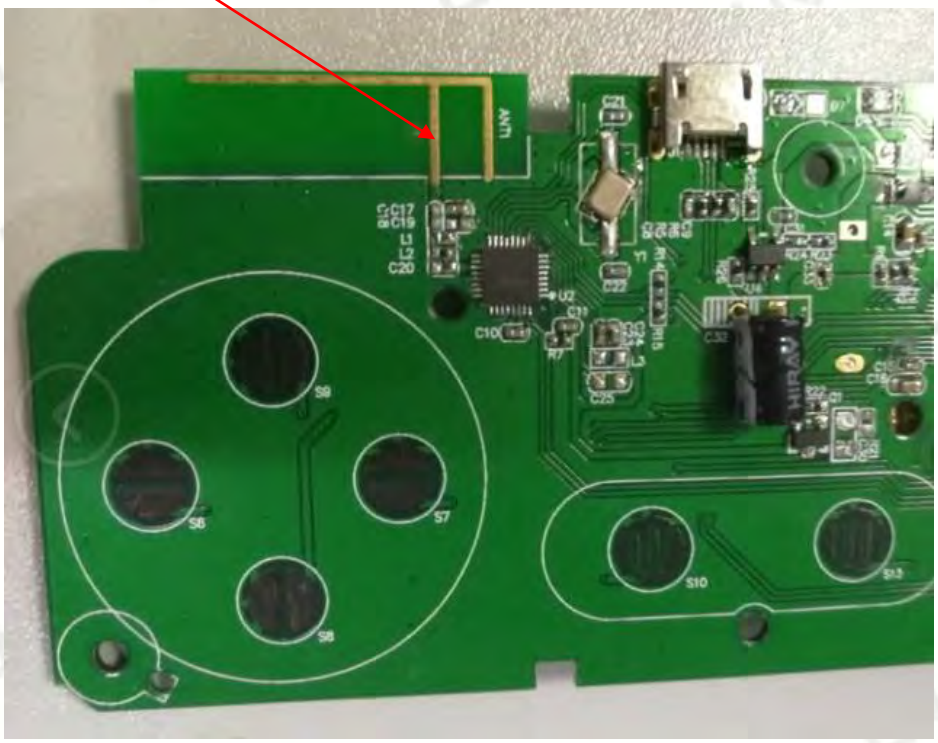
Compliance for section 15.247(g)
According to Bluetooth Core Specification, the Bluetooth system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.
Compliance for section 15.247(h)
According to Bluetooth Core specification, the Bluetooth system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels. According to the Bluetooth Core specification, the Bluetooth system is designed not have the ability to coordinated with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

3.11 ANTENNA REQUIREMENT

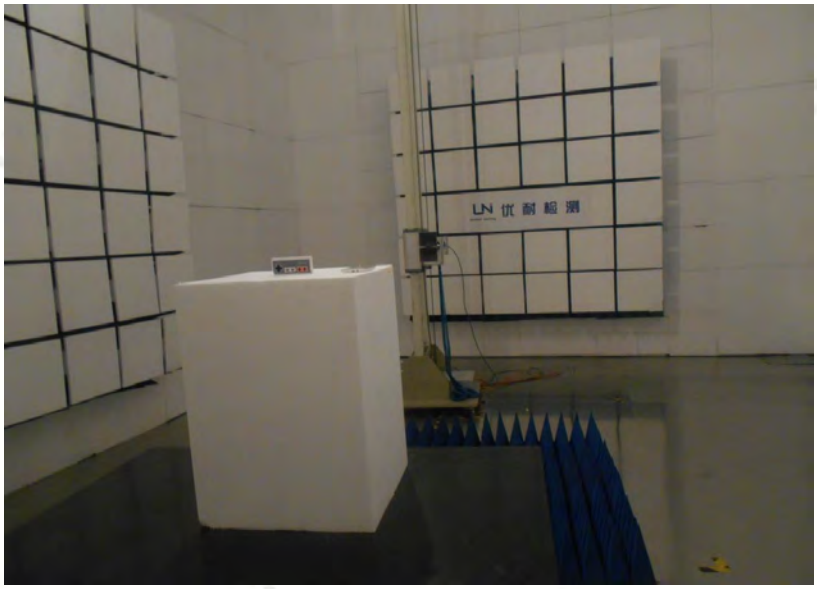
Standard Applicable:
For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Antenna Connected Construction
The antenna used in this product is an Integral Antenna, the directional gains of antenna used for transmitting is 0.0dbi.

ANTENNA

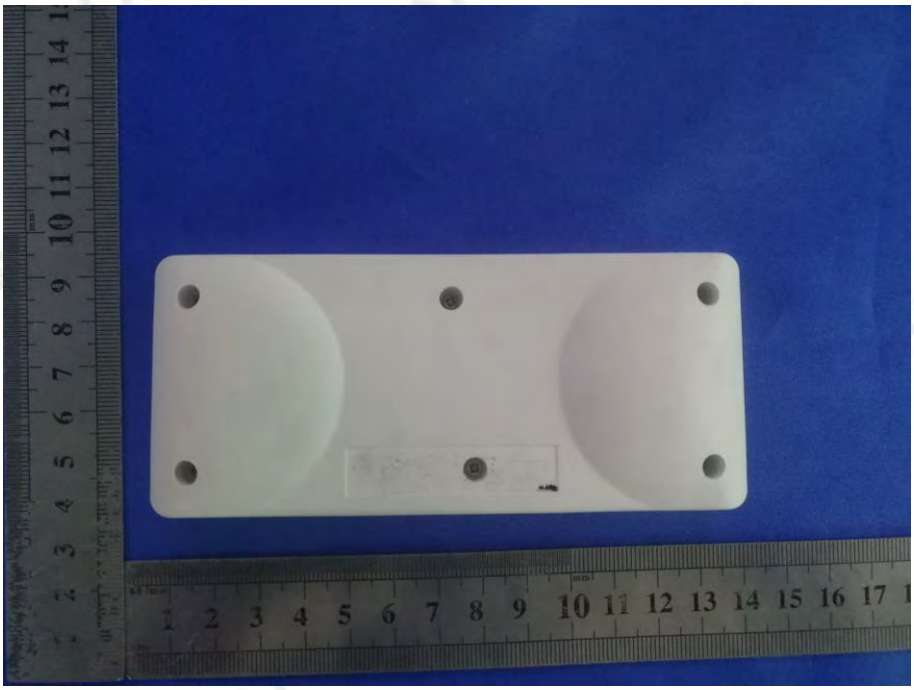


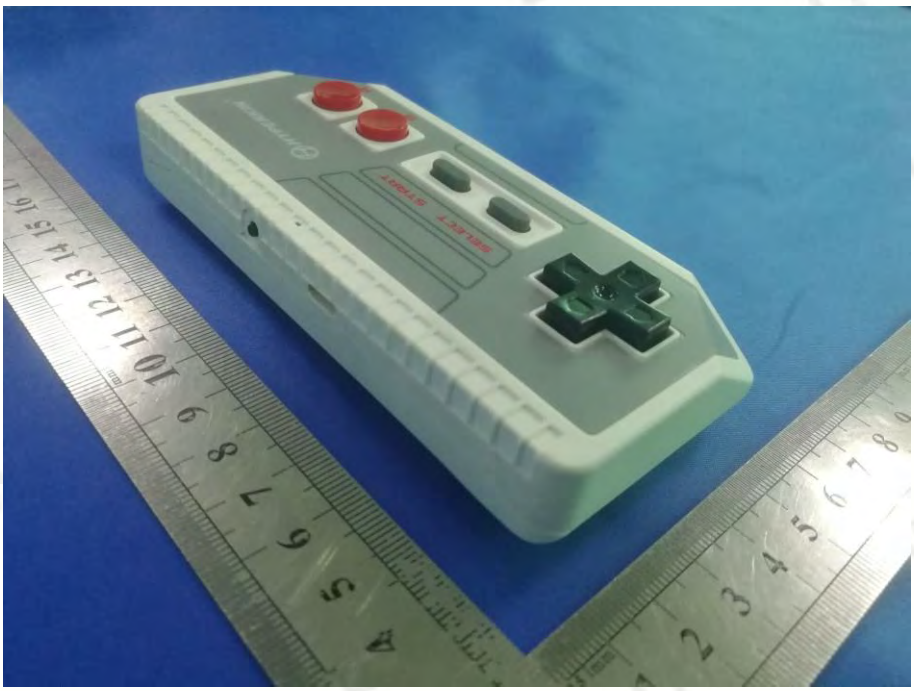
4 PHOTOGRAPH OF TEST

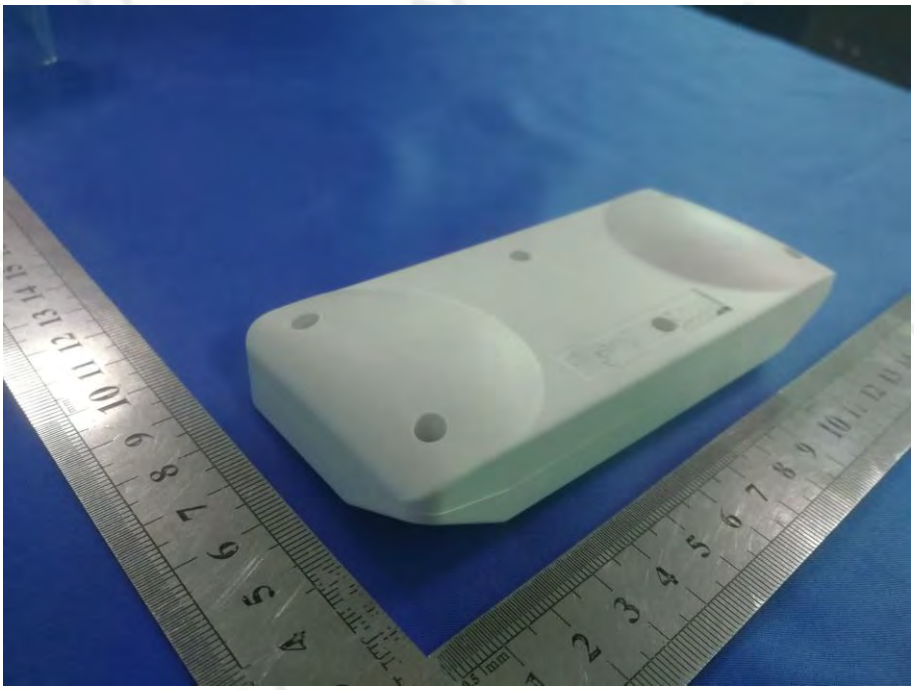


5 PHOTOGRAPH OF EUT

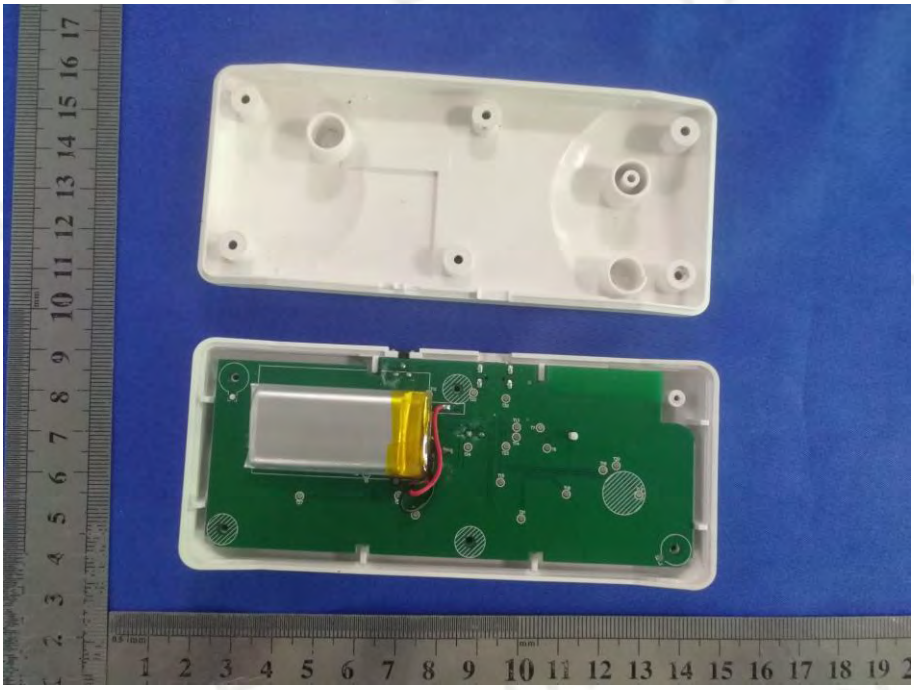
External photos

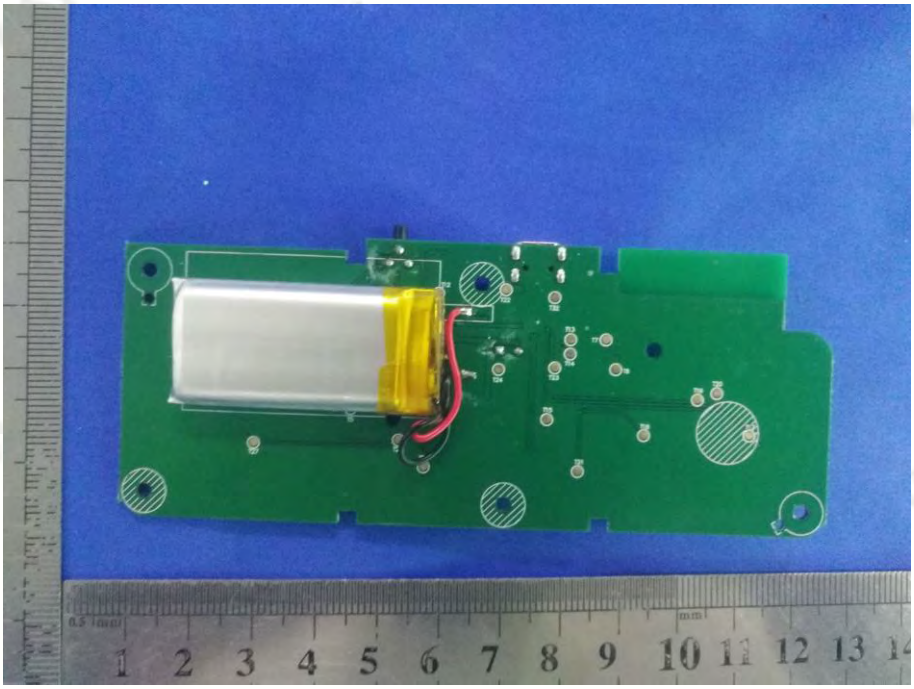


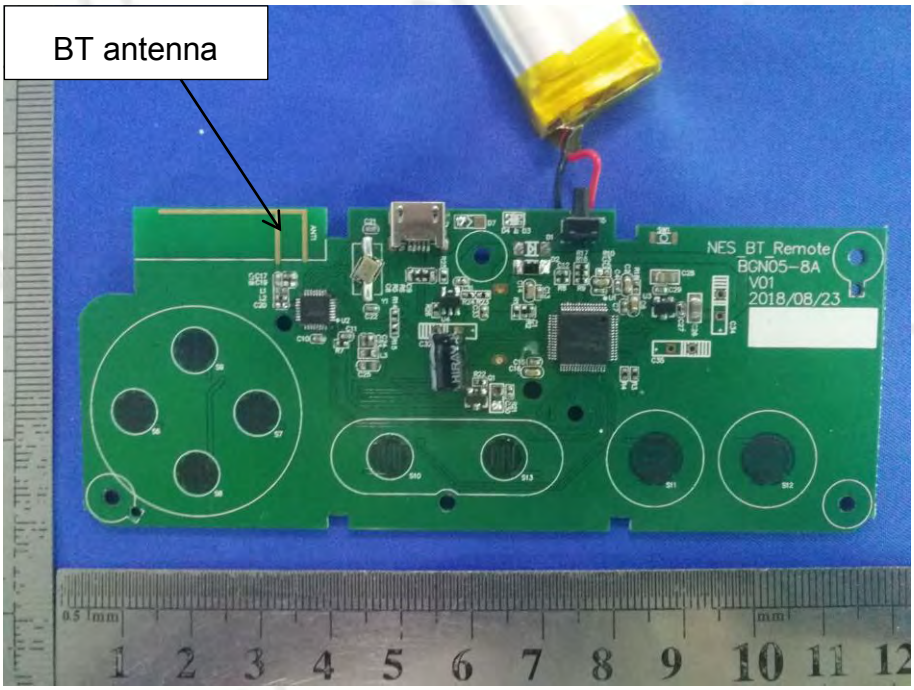


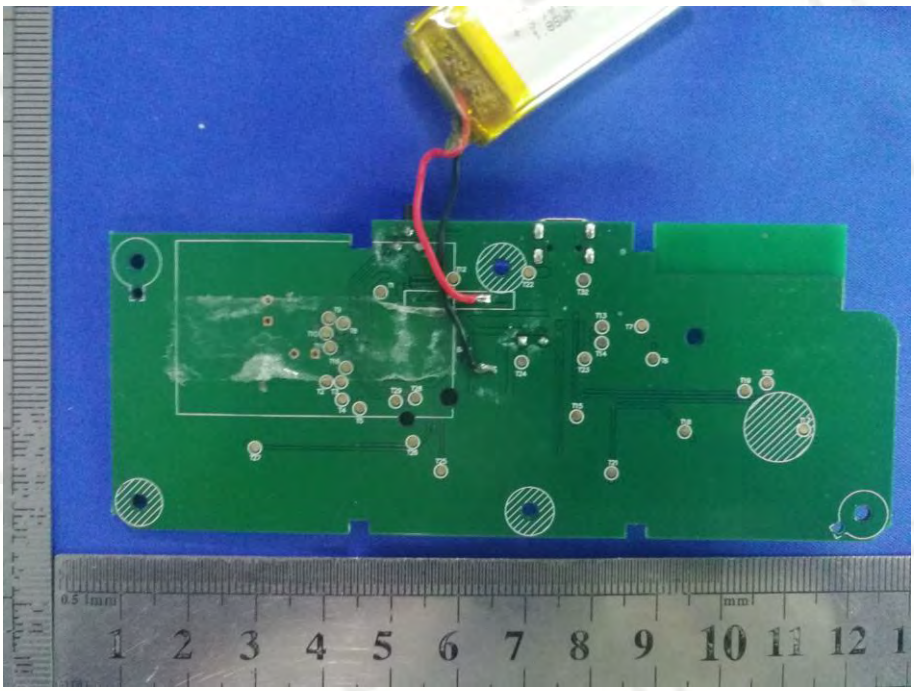


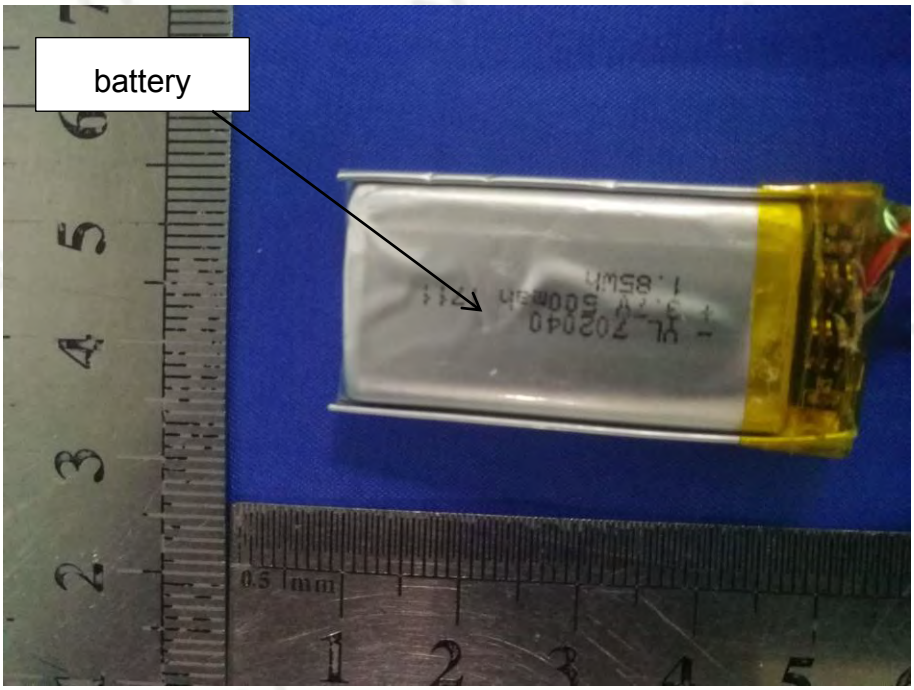
Internal Photos






BT antenna
NES_BT_Remote
BGN05-8A
V01
2018/08/23





********** End of Report **********