FCC RADIO TEST REPORT

FCC ID: 2ASH7-HUB

Product: Bluetooth earphone

Trade Name: Hub

Model Name: Hub

Serial Model: N/A

Report No.: UNIA19010415FR-01

Prepared for

Dynamic Technology Group Limited

Office A 17/F Loyong Court Comm BLDG NO 212-220 Lockhart RD Wan Chai, Hong Kong

Prepared by

Shenzhen United Testing Technology Co., Ltd.

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TEST RESULT CERTIFICATION

Applicant's name .....: Dynamic Technology Group Limited

Address.....: Office A 17/F Loyong Court Comm BLDG NO 212-220 Lockhart RD Wan Chai, Hong Kong

Manufacture's Name.....: Dynamic Technology Group Limited

Address.....: Office A 17/F Loyong Court Comm BLDG NO 212-220 Lockhart RD Wan Chai, Hong Kong

Product description

Product name.....: Bluetooth earphone

Trade Mark.....: Hub

Model and/or type reference .: Hub

Standards .....: FCC Rules and Regulations Part 15 Subpart C Section 15.247
ANSI C63.10: 2013
KDB558074 D01 V05: Guidance for Performing Compliance

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 .....: Jan. 03, 2019

Date (s) of performance of tests .....: Jan. 03, 2019 -- Feb. 13, 2019

Date of Issue.....: Feb. 13, 2019

Test Result .....: Pass

Prepared by: Kahn.Yang

Kahn.yang/Editor

Reviewer: Sherwin Qian

Sherwin Qian/Supervisor

Approved & Authorized Signer: Liuze

Liuze/Manager

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1 TEST SUMMARY

1.1 ENVIRONMENTAL CONDITIONS

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

Temperature	Normal Temperature:	25°C
Voltage	Normal Voltage	DC 3.70V
Other	Relative Humidity	55 %
	Air Pressure	101 kPa

1.2 TEST PROCEDURES AND RESULTS

FCC PART 15.247		
FCC Part 15.207	AC Power Conducted Emission	N/A
FCC Part 15.247(a)(1)	20dB Bandwidth	PASS
FCC Part 15.247(d)	Spurious RF Conducted Emission	PASS
FCC Part 15.247(b)(1)	Maximum Peak Output Power	PASS
FCC Part 15.247(a)(1)	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	Antenna Requirement	PASS

1.3 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.

1.4 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 GENERAL DESCRIPTION OF EUT

Equipment	Bluetooth earphone
Trade Mark	Hub
Model Name	Hub
Serial No.	N/A
Model Difference	N/A
FCC ID	2ASH7-HUB
Antenna Type	Internal antenna
Antenna Gain	0 dBi
Frequency Range	2402MHz - 2480MHz
Number of Channels	79
Modulation Type	GFSK, pi/4DQPSK, 8DPSK
Battery	3.7V 45mAh
Power Source	3.7V from battery
Adapter Model	N/A

2.2 CARRIER FREQUENCY OF CHANNELS

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

2.3 OPARATION OF EUT DURING TESTING

Operating Mode
The mode is used: Transmitting mode

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

2.4 DESCRIPTION OF TEST SETUP

Operation of EUT during Conducted testing:

N/A

Operation of EUT during Radiation and Above1GHz Radiation testing:

EUT

2.5 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	Spectrum Analyzer	Agilent	E4407B	MY41440676	2019.09.28
9	MXA Signal Analyzer	Agilent	N9020A	MY50510140	2019.09.28
10	MXA Signal Analyzer	Agilent	N9020A	MY51110104	2019.09.09
11	ANT Tower&Turn table Controller	Champro	EM 1000	60764	2019.09.28
12	Anechoic Chamber	Taihe Maorui	9m*6m*6m	966A0001	2019.09.09
13	Shielding Room	Taihe Maorui	6.4m*4m*3m	643A0001	2019.09.09
14	RF Power sensor	DARE	RPR3006W	15I00041SNO88	2019.03.14
15	RF Power sensor	DARE	RPR3006W	15I00041SNO89	2019.03.14
16	RF power divider	Anritsu	K241B	992289	2019.09.28

17	Wideband radio communication tester	Rohde&Schwarz	CMW500	154987	2019.09.28
18	Biconical antenna	Schwarzbeck	VHA 9103	91032360	2019.09.08
19	Biconical antenna	Schwarzbeck	VHA 9103	91032361	2019.09.08
20	Broadband Hybrid Antennas	Schwarzbeck	VULB9163	VULB9163#958	2019.09.08
21	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1680	2020.01.12
22	Active Receive Loop Antenna	Schwarzbeck	FMZB 1919B	00023	2019.11.02
23	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170651	2019.03.14
24	Microwave Broadband Preamplifier	Schwarzbeck	BBV 9721	100472	2019.10.24
25	Active Loop Antenna	Com-Power	AL-130R	10160009	2019.05.10
26	Power Meter	KEYSIGHT	N1911A	MY50520168	2019.05.10
27	EMI Test Software	FALA	EZ-EMC	FA-03A	2019.05.10

2.6 Special Accessories

Manufacturer	Description	Model	Serial Number	Certificate
HP	notebook	HP-CQ45	CNU1254XFC	FCC ID
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3 TEST CONDITIONS AND RESULTS

3.1 CONDUCTED EMISSIONS TEST

Limit

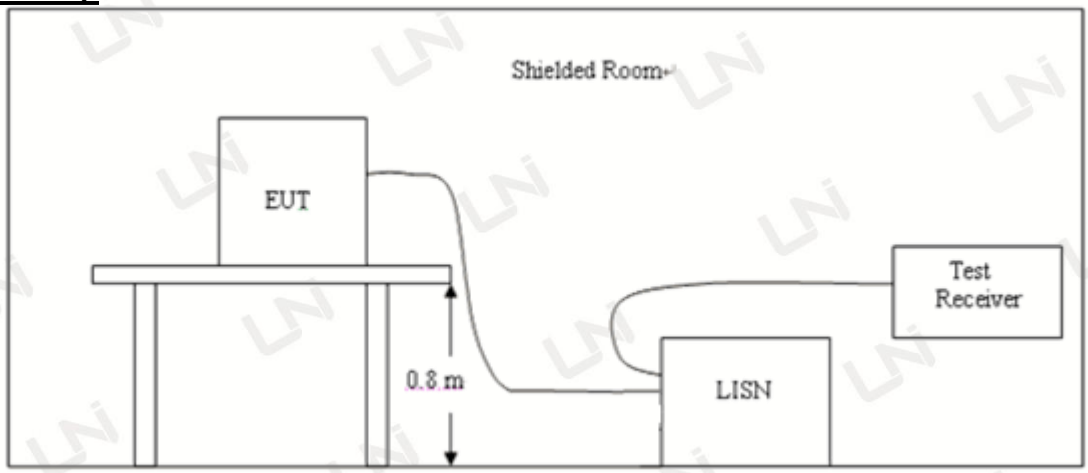
According to FCC CFR Title 47 Part 15 Subpart C Section 15.207, AC Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus as below:

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

Note: when charging,earphone can not transmit

Not application to this device, which is power by battery

3.2 RADIATED EMISSION TEST

Radiation Limit

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.

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)

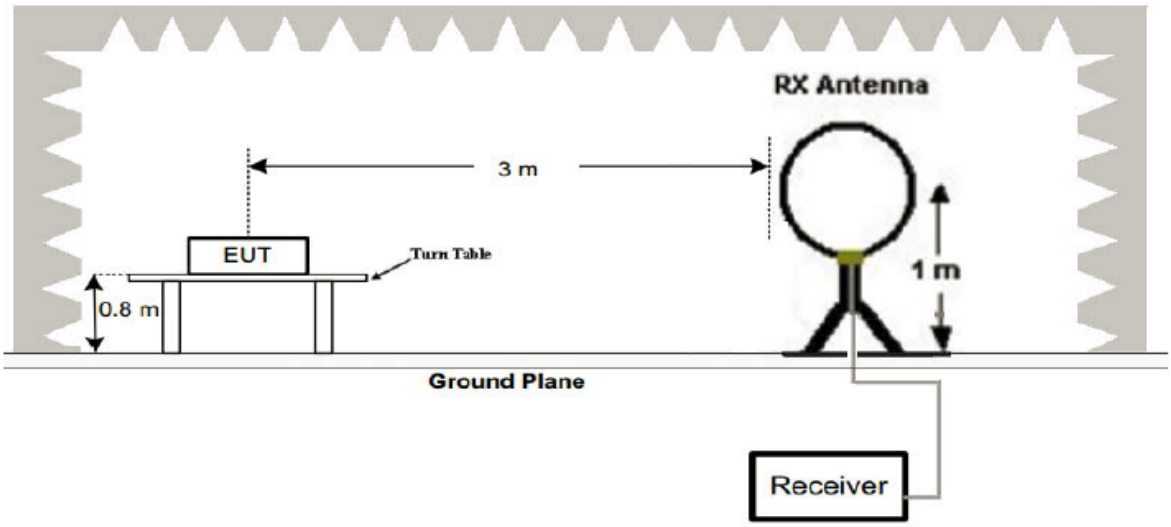
Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission

Radiated emission limits

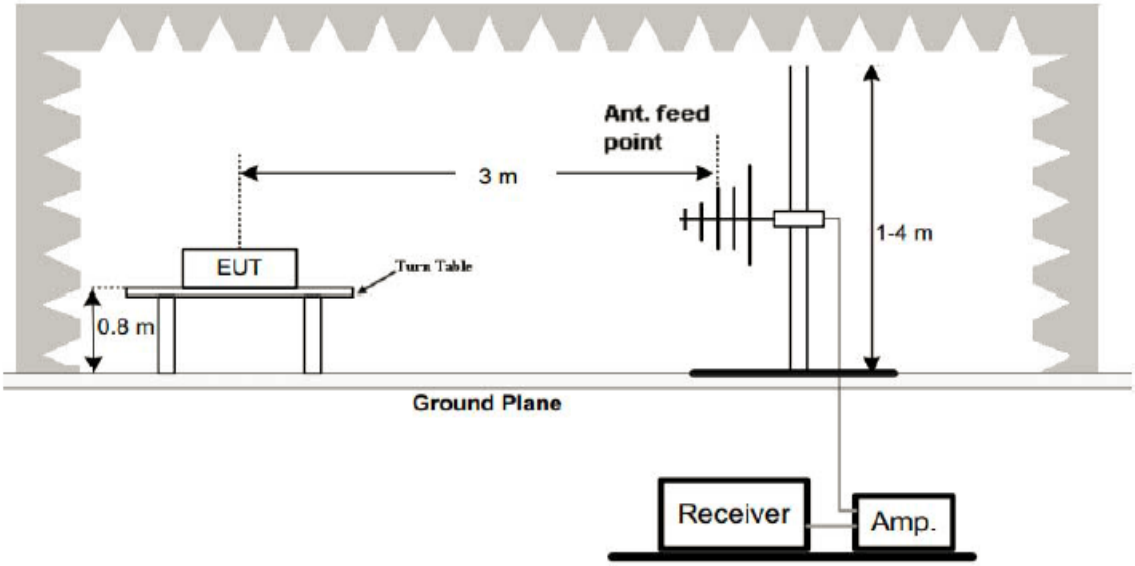
Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

Test Setup

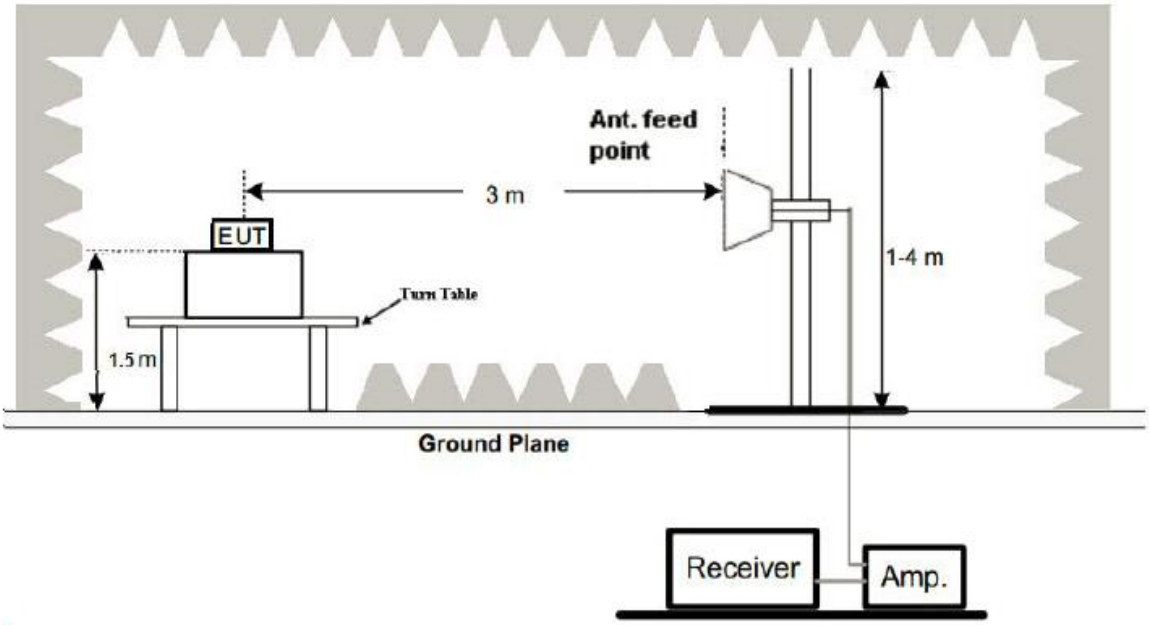
1. Radiated Emission Test-Up Frequency Below 30MHz



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 a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 9KHz to 25GHz.

6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Bilog Antenna	3
1GHz-18GHz	Horn Antenna	3
18GHz-25GHz	Horn Anternna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	PK,AV,QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	PK,AV,QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

Test Result

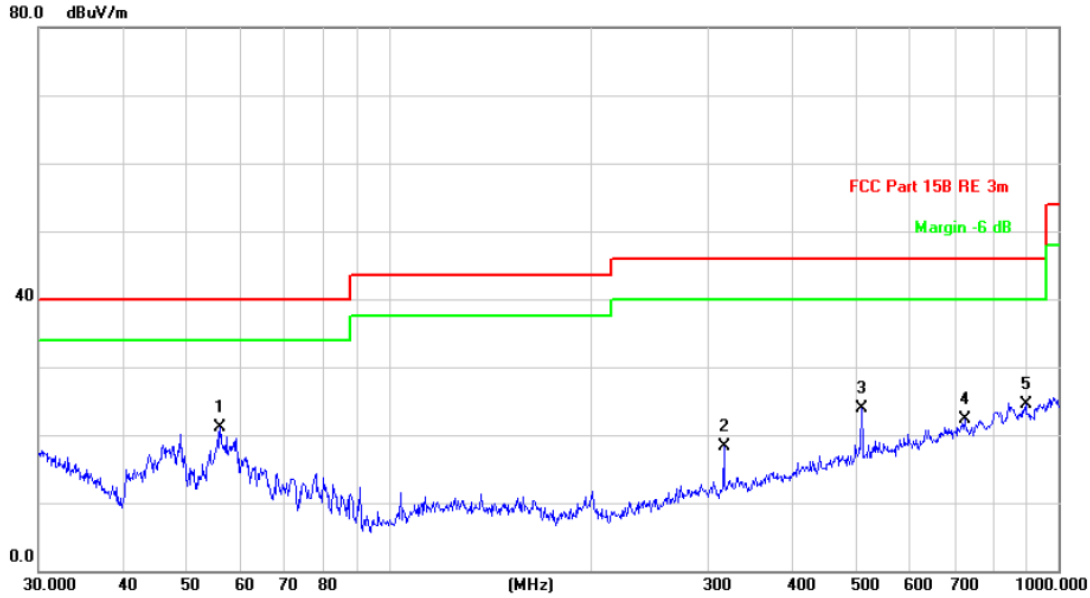
---PASS---

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:	Jan .15, 2019	Pressure:	1030hPa
Test Voltage:	DC 3.7V from battery	Polarization:	Horizontal / Vertical
Test mode	TX mode		

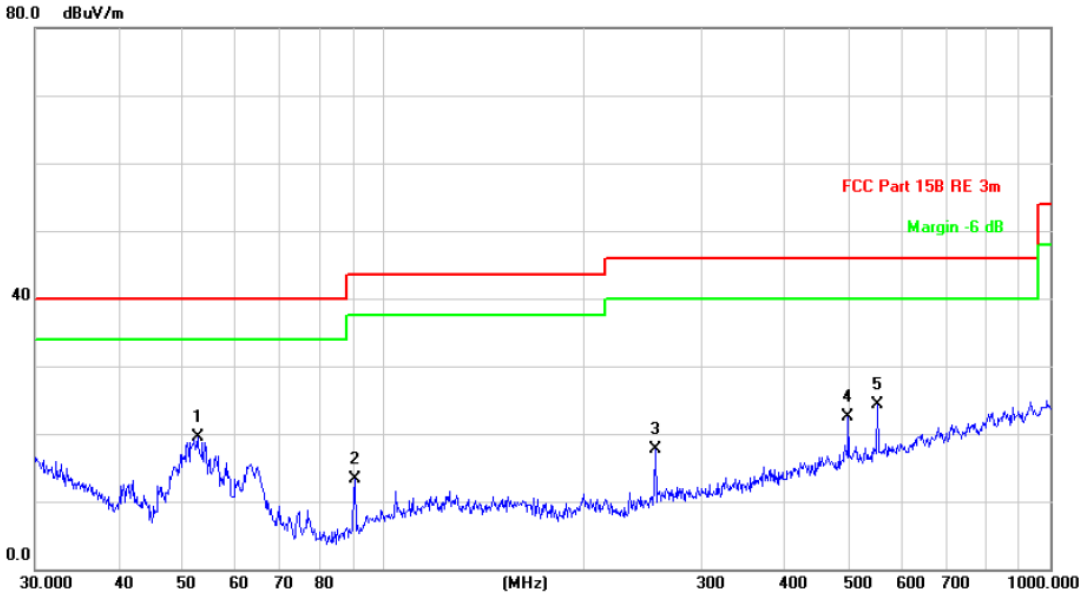
Polarization:	Horizontal



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	*	56.0007	39.94	-18.88	21.06	40.00	-18.94	peak			
2		316.5889	28.86	-10.65	18.21	46.00	-27.79	peak			
3		508.2581	29.98	-6.11	23.87	46.00	-22.13	peak			
4		724.2611	24.51	-2.27	22.24	46.00	-23.76	peak			
5		893.8567	24.35	0.13	24.48	46.00	-21.52	peak			

Remark:1. Absolute Level= Reading Level+ Factor, Margin= Absolute Level – Limit
Factor=Ant. Factor + Cable Loss – Pre-amplifier
2. GFSK, pi/4DQPSK, 8DPSK all have been tested,Worse case is reported

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	*	52.5753	38.30	-18.86	19.44	40.00	-20.56	peak			
2		90.5374	30.53	-17.21	13.32	43.50	-30.18	peak			
3		255.6231	30.27	-12.60	17.67	46.00	-28.33	peak			
4		497.6765	28.96	-6.48	22.48	46.00	-23.52	peak			
5		550.9480	30.11	-5.88	24.23	46.00	-21.77	peak			

Remark:1. Absolute Level= Reading Level+ Factor, Margin= Absolute Level – Limit
Factor=Ant. Factor + Cable Loss – Pre-amplifier
2.GFSK, pi/4DQPSK, 8DPSK all have been tested,Worse case is reported

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 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	57.16	-3.64	53.52	74	20.48	PK
4804	45.22	-3.64	41.58	54	12.42	AV
7206	54.59	-0.95	53.64	74	20.36	PK
7206	41.14	-0.95	40.19	54	13.81	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	57.31	-3.64	53.67	74	20.33	PK
4804	43.25	-3.64	39.61	54	14.39	AV
7206	55.32	-0.95	54.37	74	19.63	PK
7206	41.93	-0.95	40.98	54	13.02	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit						

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

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	58.13	-3.51	54.62	74	19.38	PK
4882.00	44.75	-3.51	41.24	54	12.76	AV
7323.00	55.01	-0.82	54.19	74	19.81	PK
7323.00	42.80	-0.82	41.98	54	12.02	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	57.37	-3.51	53.86	74	20.14	PK
4882.00	44.05	-3.51	40.54	54	13.46	AV
7323.00	55.28	-0.82	54.46	74	19.54	PK
7323.00	41.41	-0.82	40.59	54	13.41	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin= Absolute Level – Limit						

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

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	58.43	-3.43	55.00	74	19.00	PK
4960.00	45.95	-3.43	42.52	54	11.48	AV
7440.00	54.61	-0.75	53.86	74	20.14	PK
7440.00	41.61	-0.75	40.86	54	13.14	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	58.21	-3.43	54.78	74	19.22	PK
4960.00	45.56	-3.43	42.13	54	11.87	AV
7440.00	55.06	-0.75	54.31	74	19.69	PK
7440.00	41.57	-0.75	40.82	54	13.18	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) Factor = Antenna Factor + Cable Loss – Pre-amplifier.
(3) Margin= Limits –Emission Level
(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) 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.
(6) 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. RBW 1MHz VBW 3MHz peak detector is for PK value; RBW 1MHz VBW 10Hz peak detector is for AV value .

Test Result

---PASS---

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

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
2322.58	58.46	-5.8	52.66	74	21.34	PK
2322.58	37.55	-5.8	31.75	54	22.25	AV
2390	59.02	-5.84	53.18	74	20.82	PK
2390	40.47	-5.84	34.63	54	19.37	AV
2400	67.94	-5.84	62.10	74	11.90	PK
2400	45.91	-5.84	40.07	54	13.93	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
2322.58	61.89	-5.8	56.09	74	17.91	PK
2322.58	38.45	-5.8	32.65	54	21.35	AV
2390	58.96	-5.84	53.12	74	20.88	PK
2390	41.10	-5.84	35.26	54	18.74	AV
2400	66.40	-5.84	60.56	74	13.44	PK
2400	45.84	-5.84	40.00	54	14.00	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
2483.5	58.15	-5.65	52.50	74	21.50	PK
2483.5	38.39	-5.65	32.74	54	21.26	AV
2500	58.58	-5.72	52.86	74	21.14	PK
2500	39.59	-5.72	33.87	54	20.13	AV
2551.60	68.87	-5.75	63.12	74	10.88	PK
2551.60	44.30	-5.75	38.55	54	15.45	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
2483.5	59.05	-5.65	53.40	74	20.60	PK
2483.5	38.62	-5.65	32.97	54	21.03	AV
2500	57.51	-5.72	51.79	74	22.21	PK
2500	40.90	-5.72	35.18	54	18.82	AV
2551.60	68.19	-5.75	62.44	74	11.56	PK
2551.60	42.97	-5.75	37.22	54	16.78	AV
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

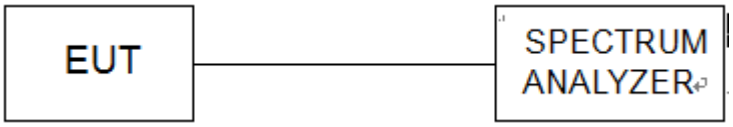
3.4 CONDUCTED OUTPUT POWER

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.



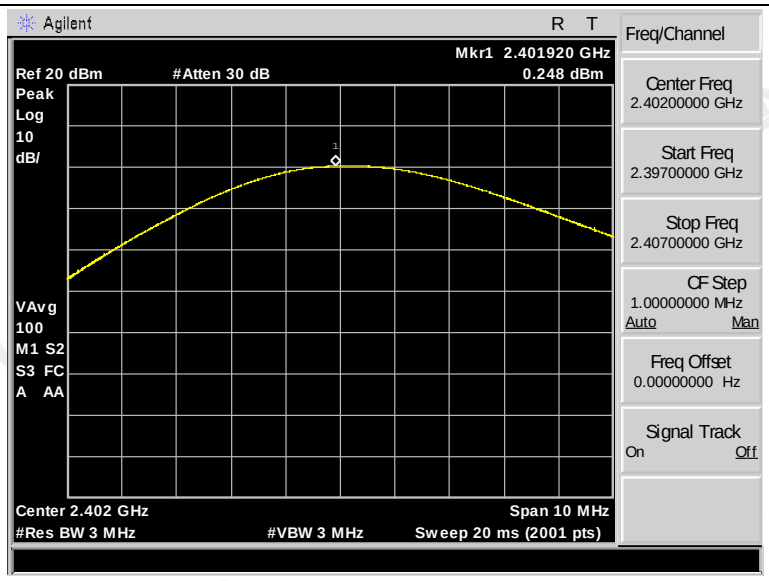
Test Result

Type	Channel	Output power (dBm)	Limit (dBm)	Result
GFSK	00	0.248	30	Pass
	39	1.081		
	78	0.981		
pi/4DQPSK	00	2.471	30	Pass
	39	3.177		
	78	3.245		
8DPSK	00	2.804	30	Pass
	39	3.572		
	78	2.802		

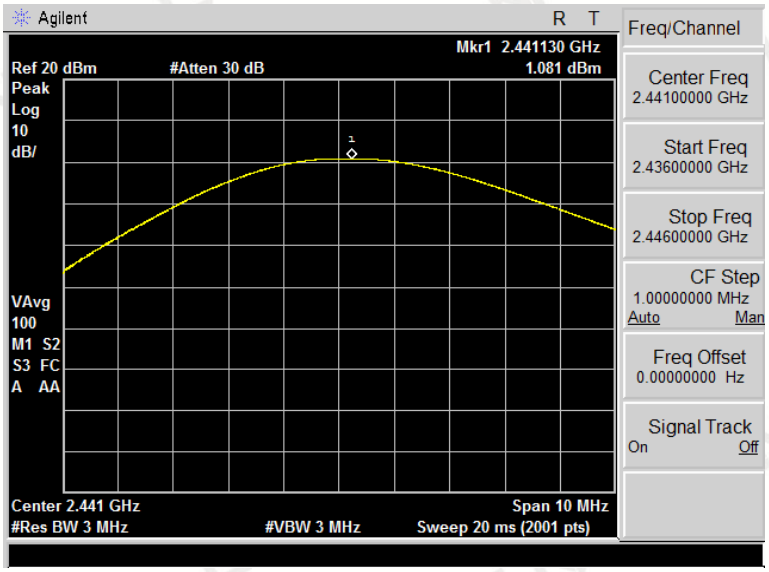
Note: 1.The test results including the cable lose.

GFSK Modulation

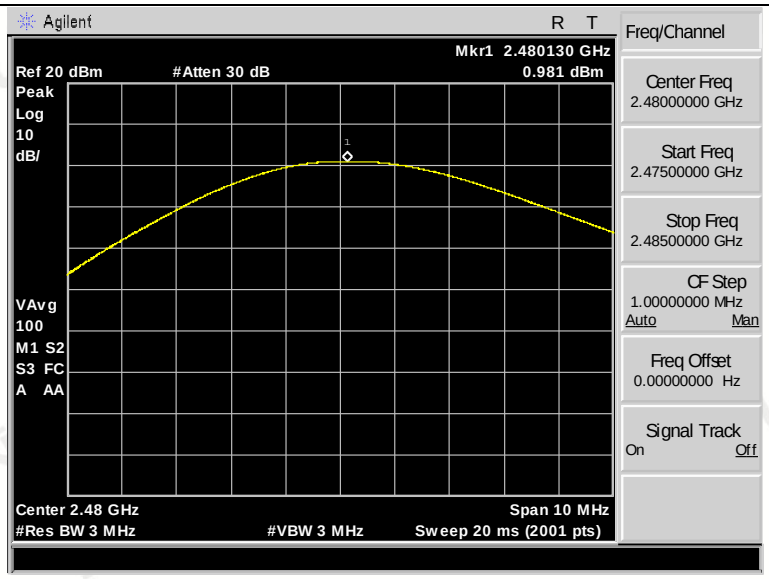
CH00



CH39

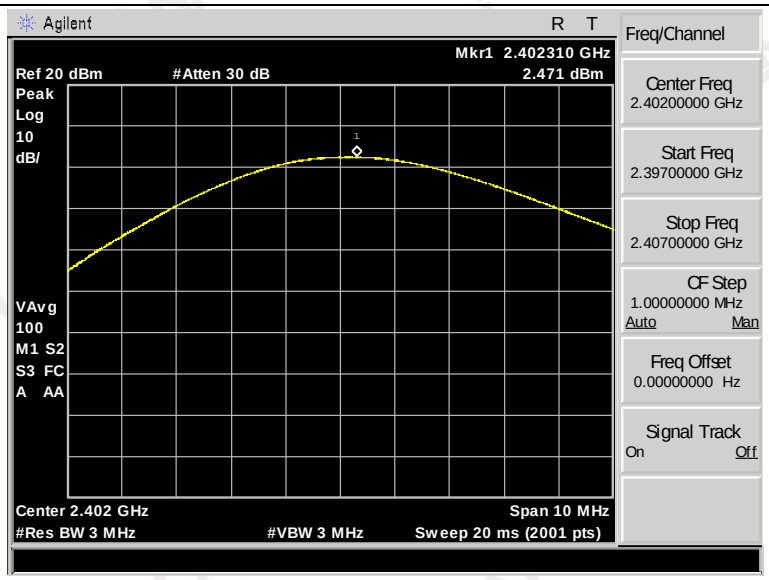


CH78

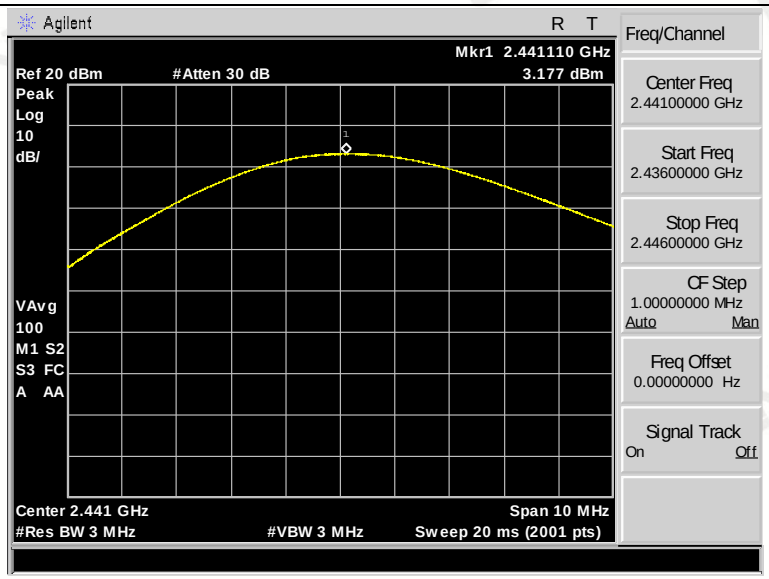


pi/4DQPSK *Modulation*

CH00



CH39



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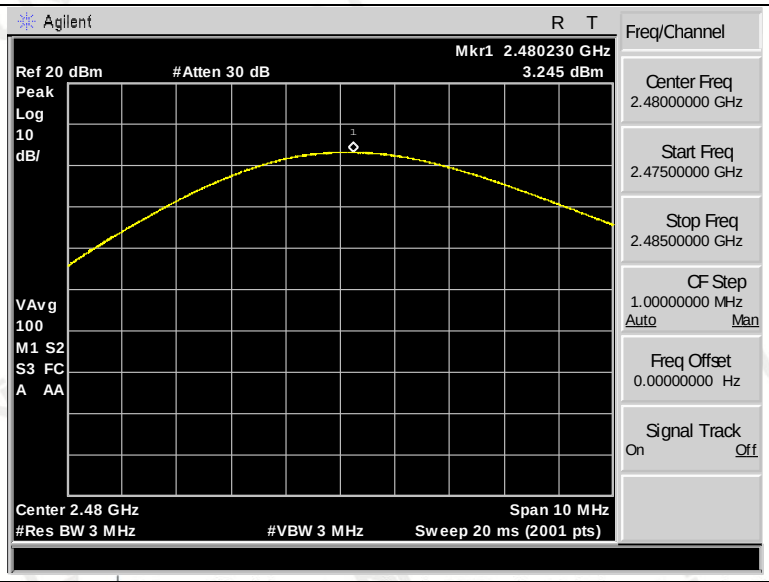
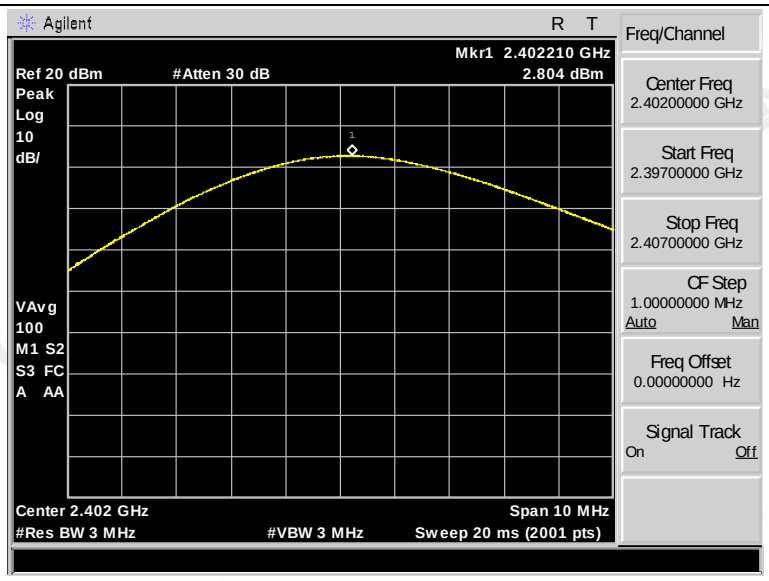
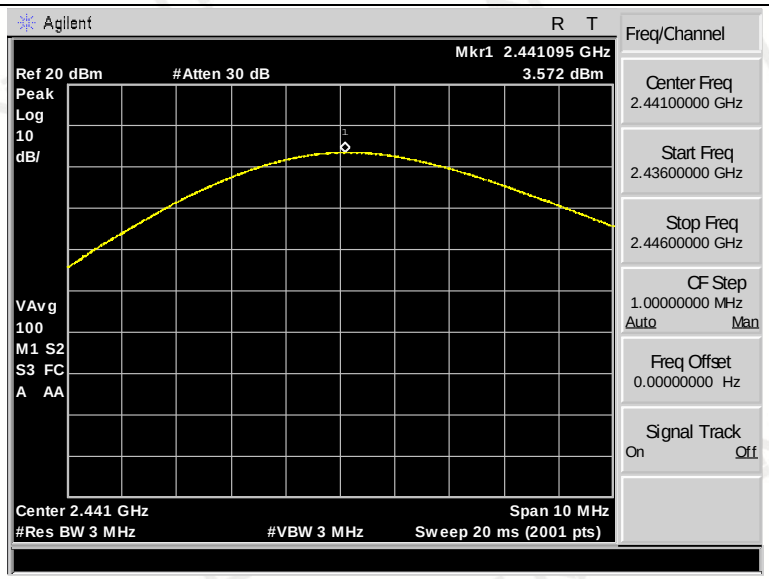


8DPSK *Modulation*

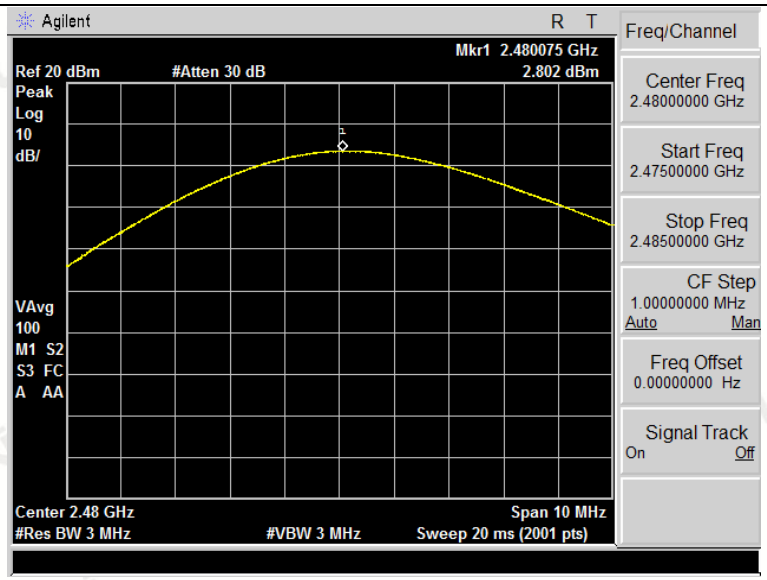
CH00



CH39



CH78



3.5 OCCUPIED BANDWIDTH MEASUREMENT

Limit

FCC Part15(15.247), Subpart C			
Section	Test Item	Frequency Range (MHz)	Result
15.247(a)(2)	20dB BW	2400-2483.5	PASS

Test Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation.
3. RBW=100KHz, VBW=300KHz, Span=3MHz.
4. The useful radiated emission from the EUT was detected by the spectrum analyzer with peak detector.

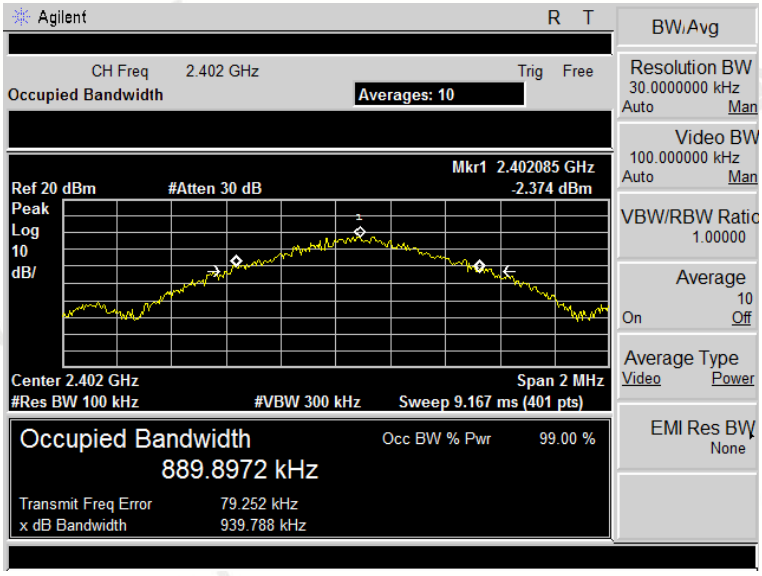
Test Result

---PASS---

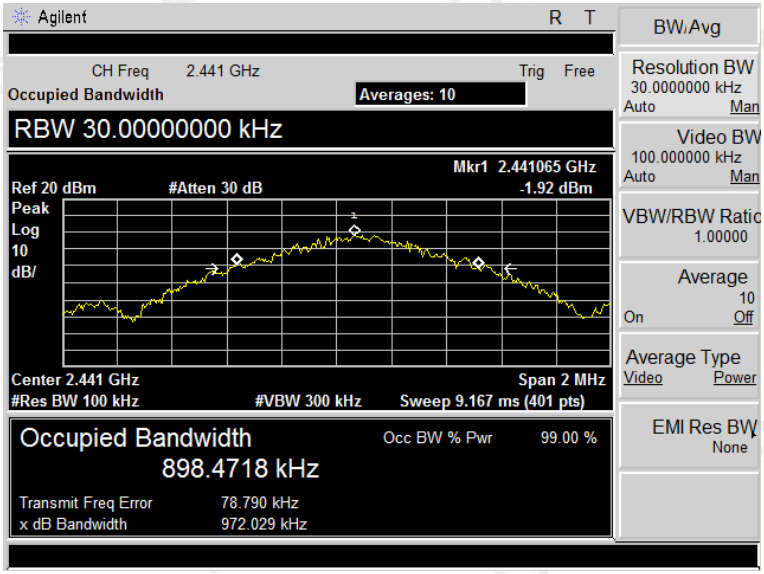
Modulation	Channel	-20dB bandwidth (MHz)	Result
GFSK	00	0.940	Pass
	39	0.972	
	78	0.951	
pi/4DQPSK	00	1.283	Pass
	39	1.327	
	78	1.321	
8DPSK	00	1.331	Pass
	39	1.301	
	78	1.314	

GFSK Modulation

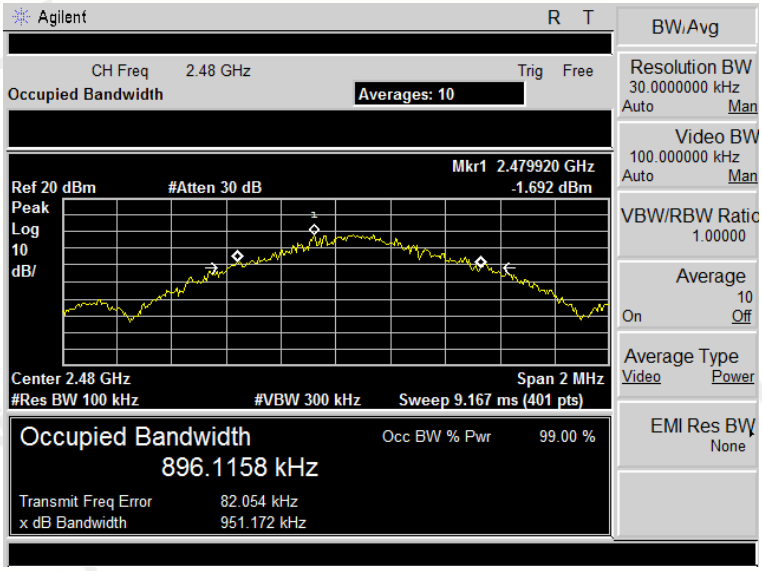
CH00



CH39

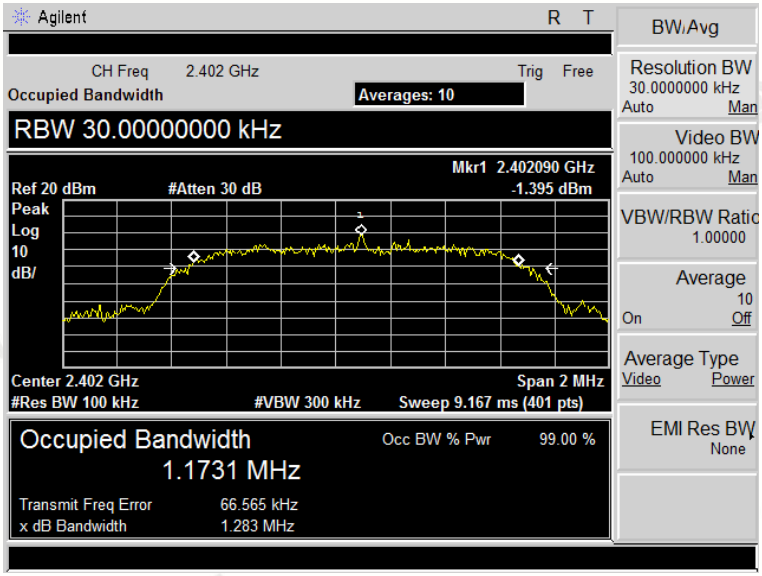


CH78

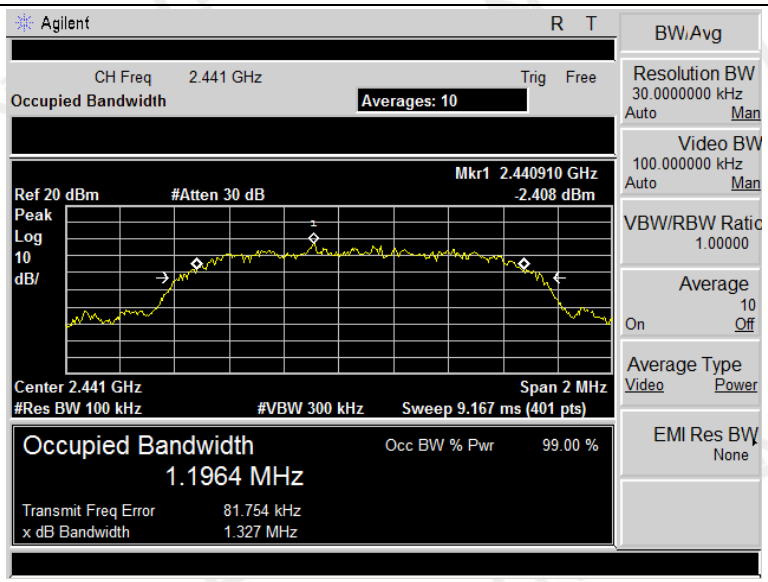


pi/4DQPSK Modulation

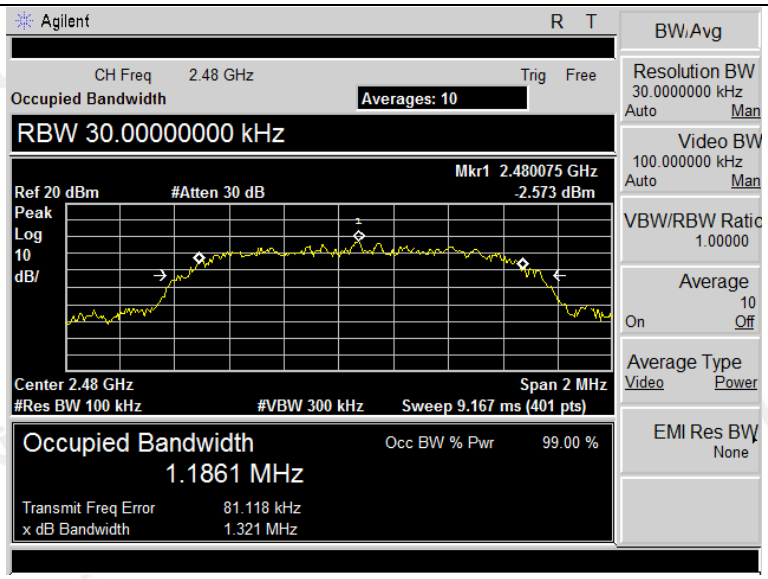
CH00



CH39

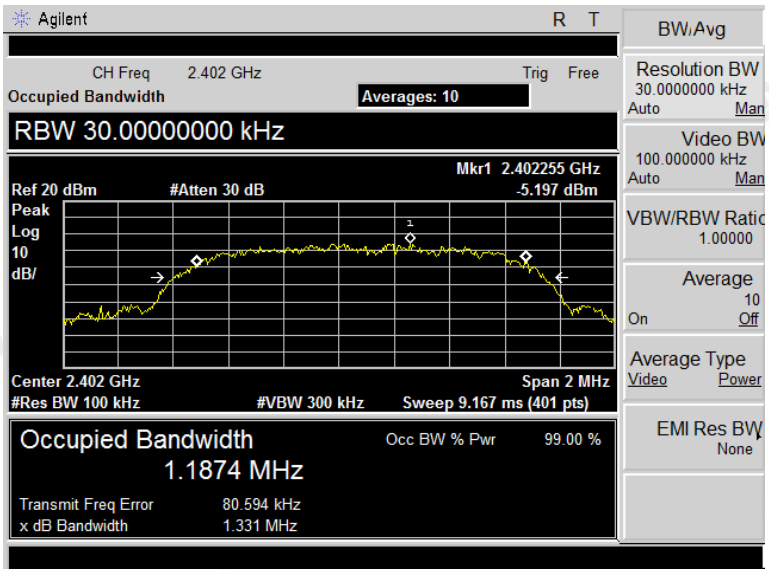


CH78

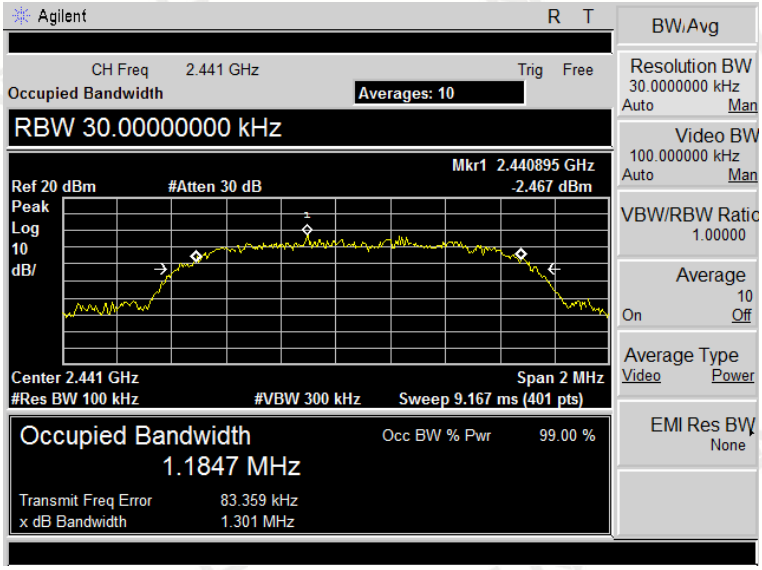


8DPSK Modulation

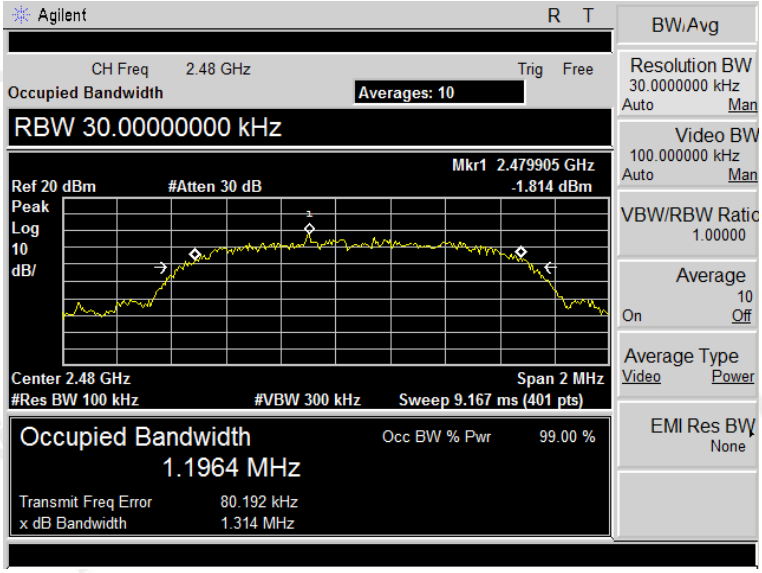
CH00



CH39



CH78



3.6 Frequency Separation

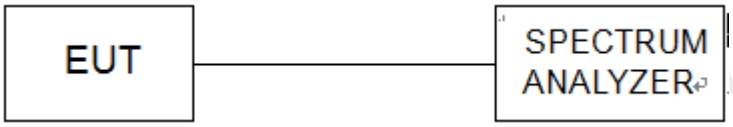
LIMIT

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

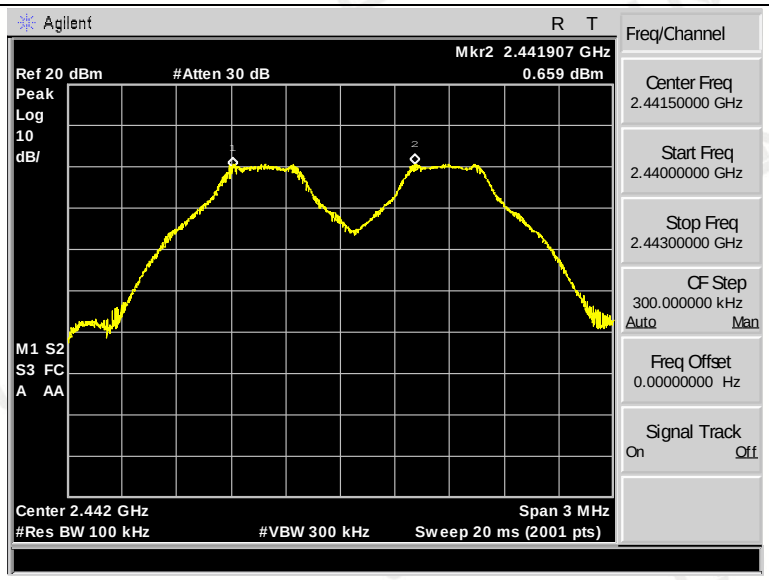


TEST RESULTS

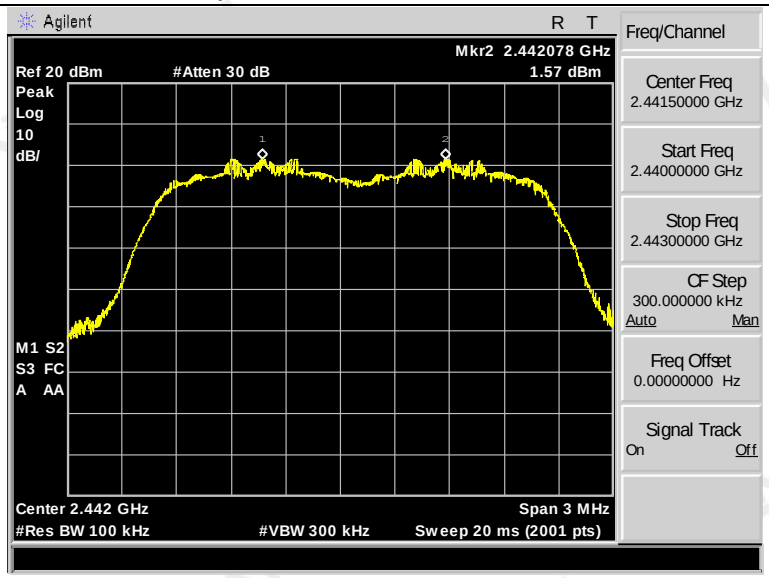
Modulation	Channel	Channel Separation (MHz)	Limit(MHz)	Result
GFSK	CH39	0.996	25KHz or 2/3*20dB bandwidth	Pass
	CH40			
pi/4DQPSK	CH39	1.004	25KHz or 2/3*20dB bandwidth	Pass
	CH40			
8DPSK	CH39	1.069	25KHz or 2/3*20dB bandwidth	Pass
	CH40			

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

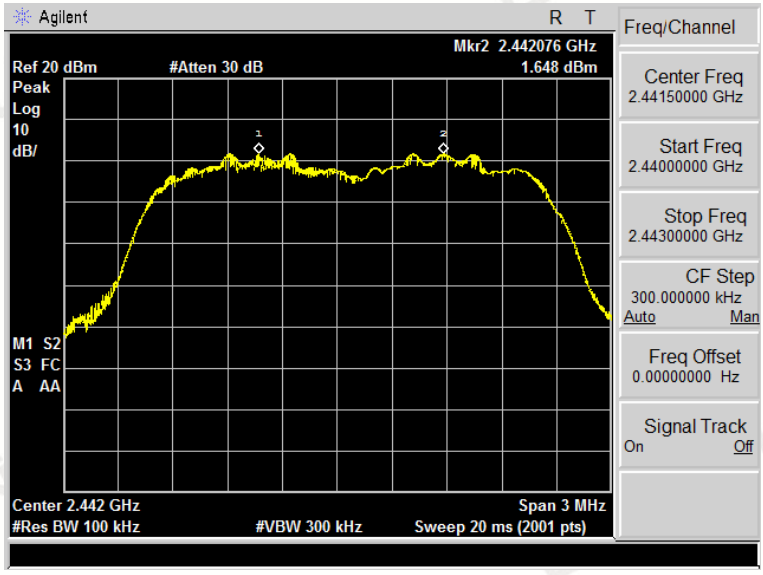
GFSK Modulation



pi/4DQPSK Modulation



8DPSK Modulation



3.7 Number of hopping frequency

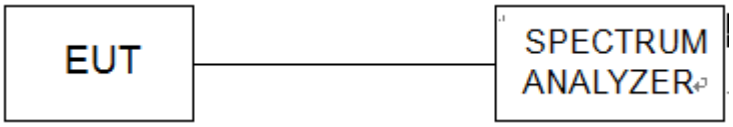
Limit

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.

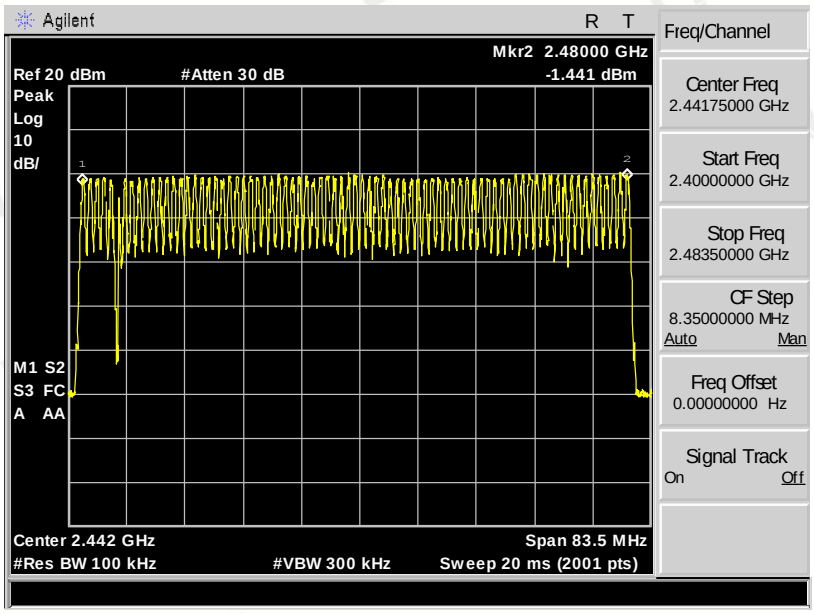
Test Configuration



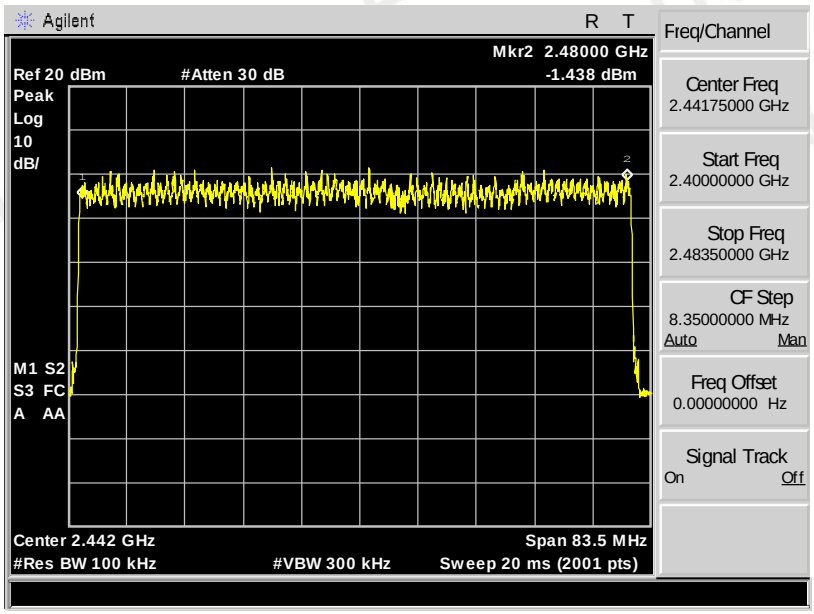
Test Results

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

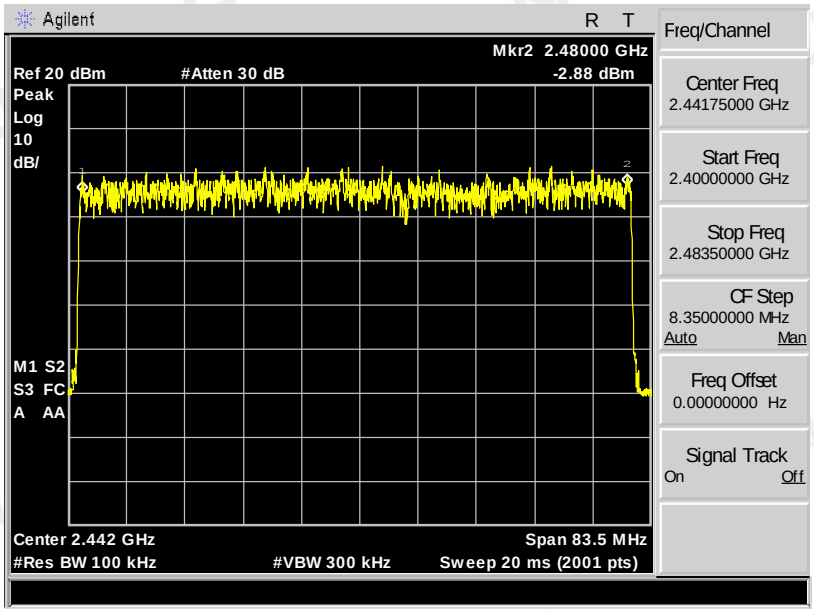
GFSK



pi/4DQPSK



8DPSK Modulation



3.8 Time of Occupancy (Dwell Time)

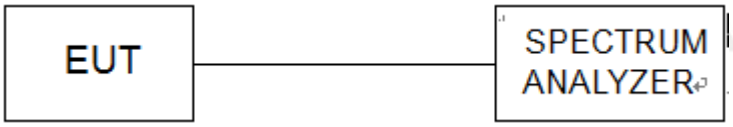
Limit

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 (s)	Limit (s)	Result
GFSK	DH1	0.400	0.1280	0.40	Pass
	DH3	1.610	0.2576		
	DH5	2.925	0.3120		
pi/4DQPSK	2-DH1	0.41	0.1312	0.40	Pass
	2-DH3	1.66	0.2656		
	2-DH5	2.866	0.3057		
8DPSK	3-DH1	0.410	0.1312	0.40	Pass
	3-DH3	1.651	0.2642		
	3-DH5	2.906	0.310		

Note:

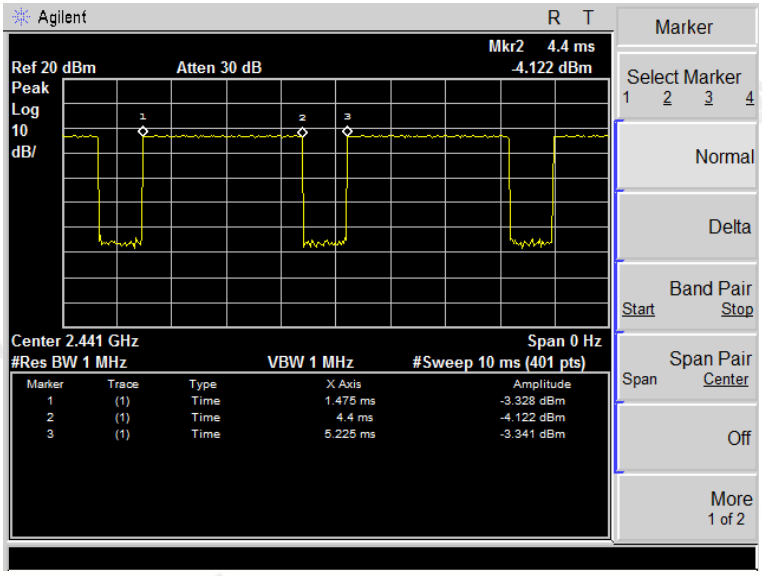
1. We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
2. Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2-DH1, 3-DH1

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

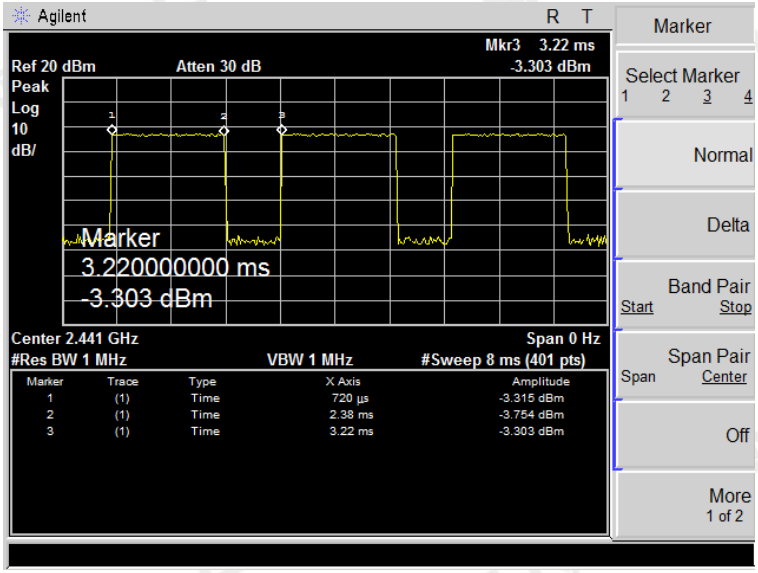
   Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for DH5, 2-DH5, 3-DH5

GFSK

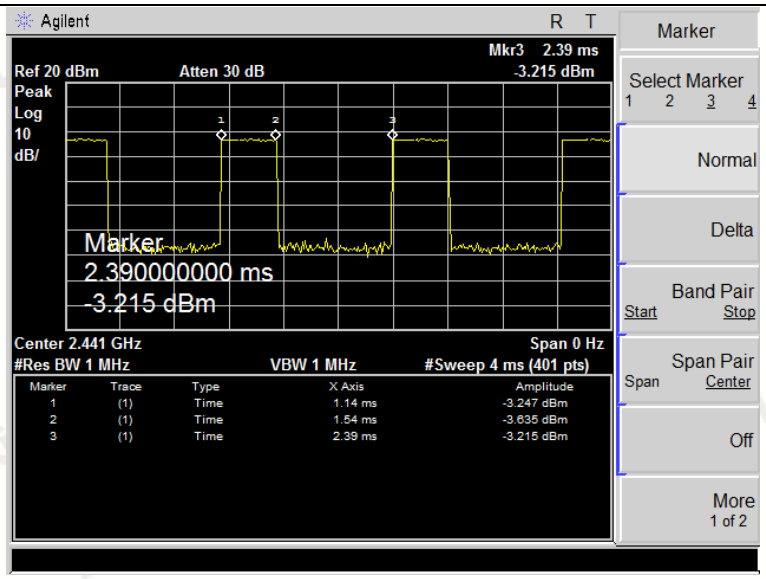
DH5



DH3

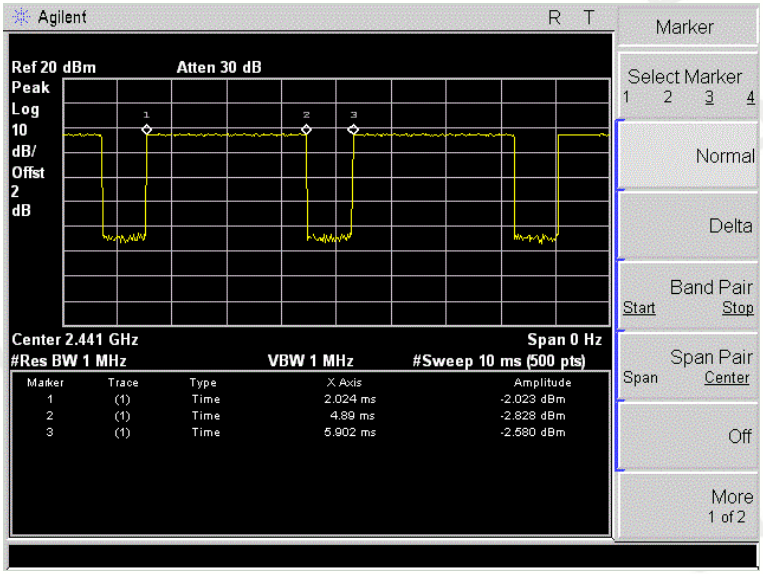


DH1

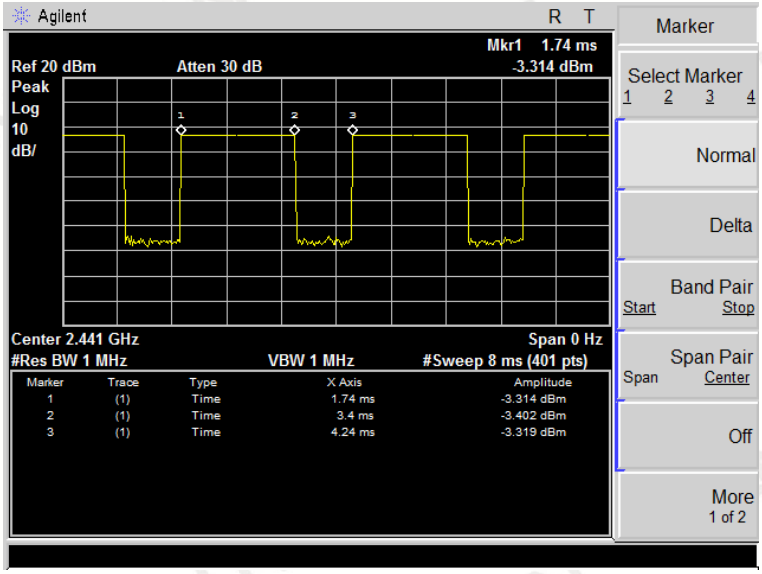


pi/4DQPSK

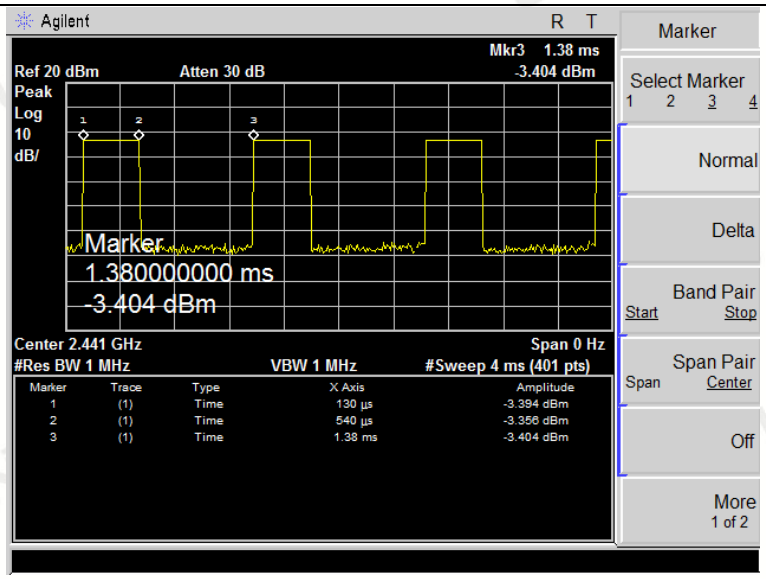
2-DH5



2-DH3

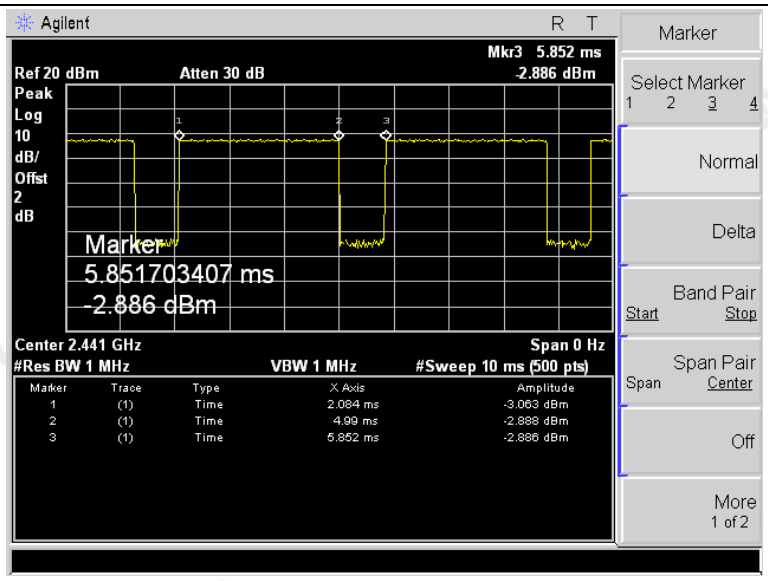


2-DH1

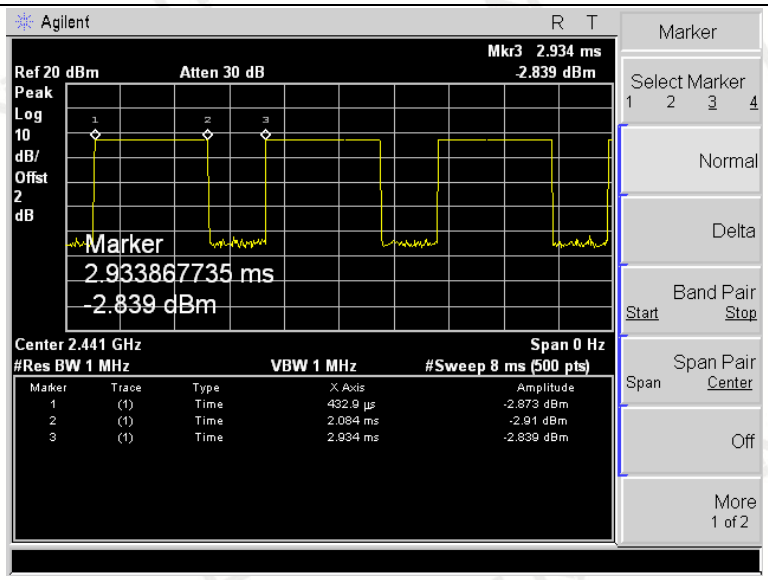


8DPSK

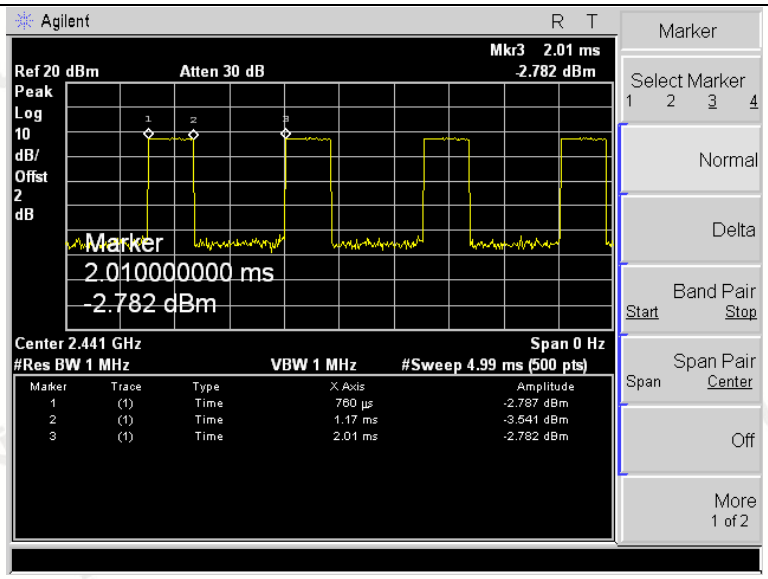
3-DH5



3-DH3



3-DH1



3.9 OUT-OF BAND EMISSIONS

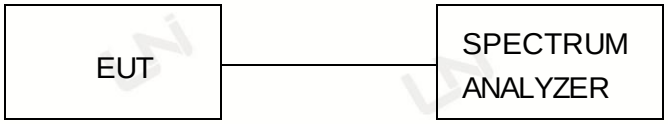
Limit

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

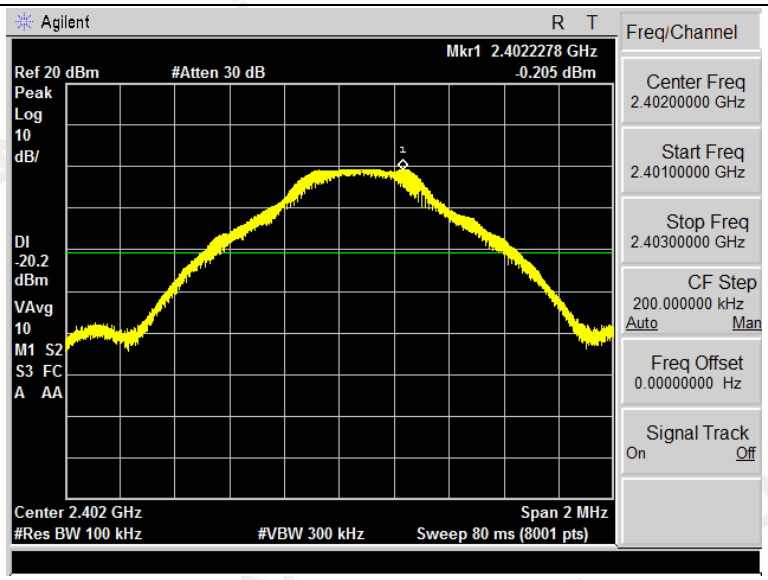
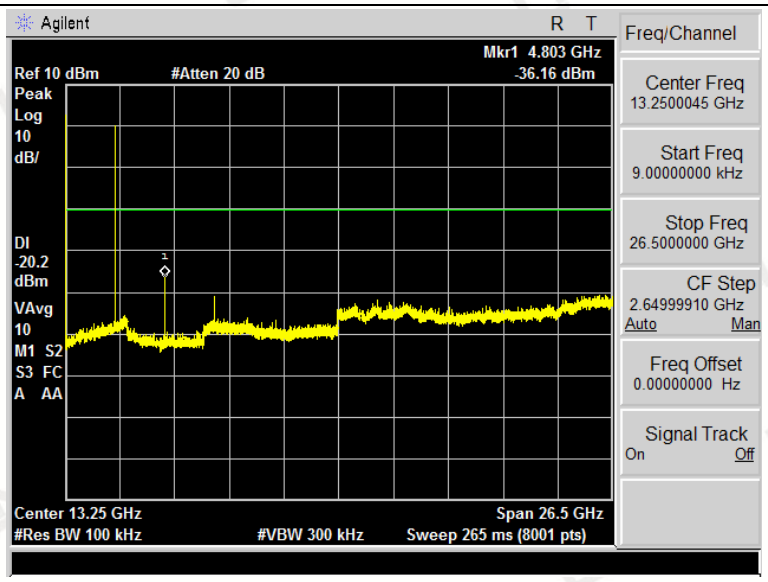
Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector , and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

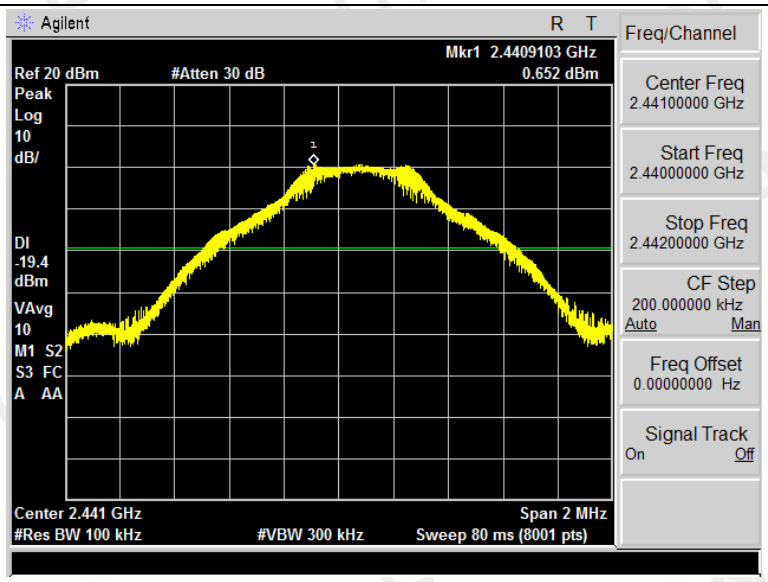
Test Configuration



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--2402MHz	
	Reference Level
	
	30MHz-25GHz

GFSK--2441MHz	
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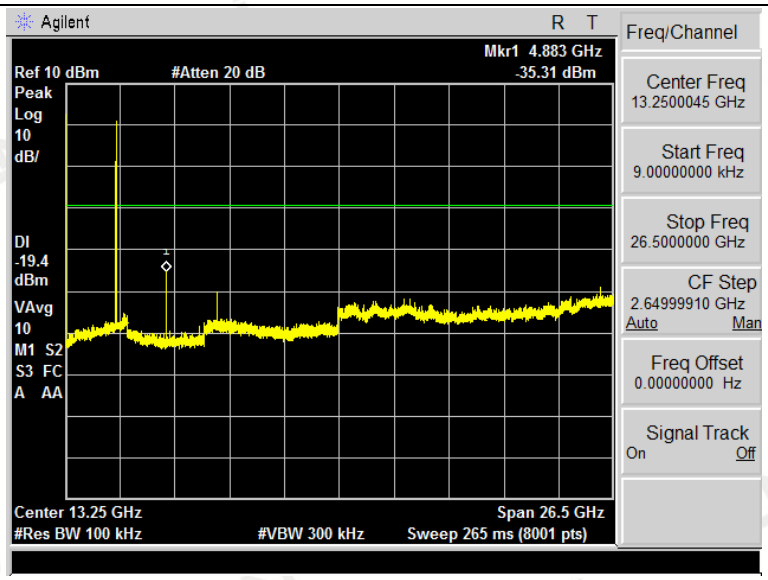
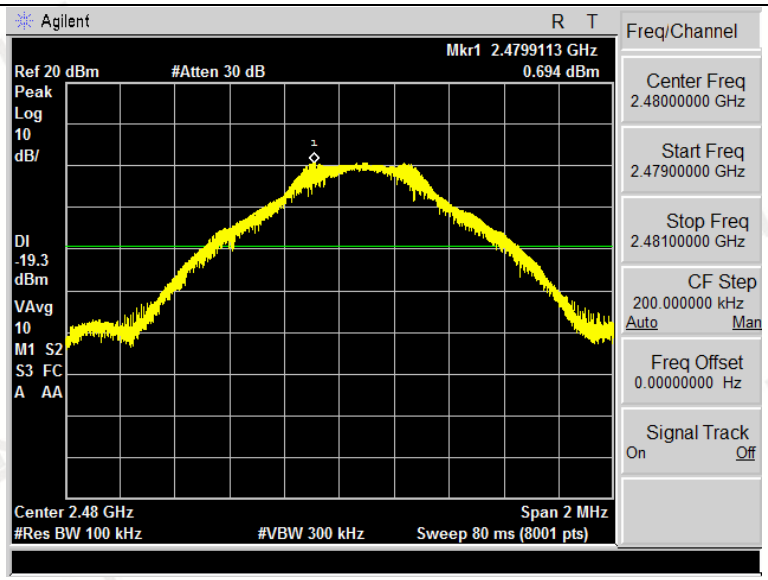


30MHz-25GHz

GFSK --2480MHz



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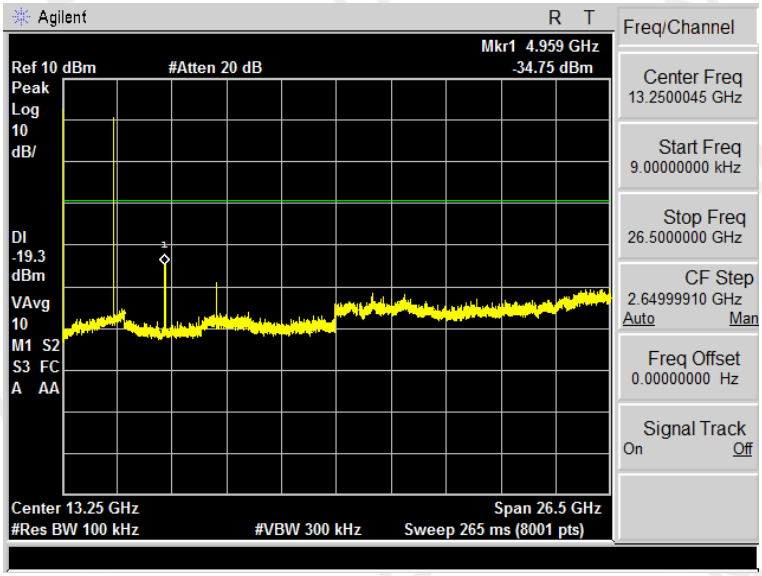
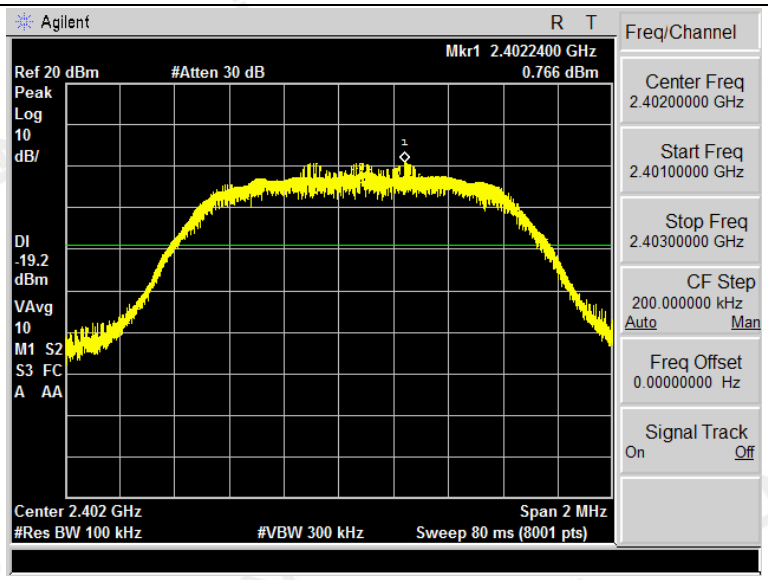


30MHz-25GHz

pi/4DQPSK--2402MHz	
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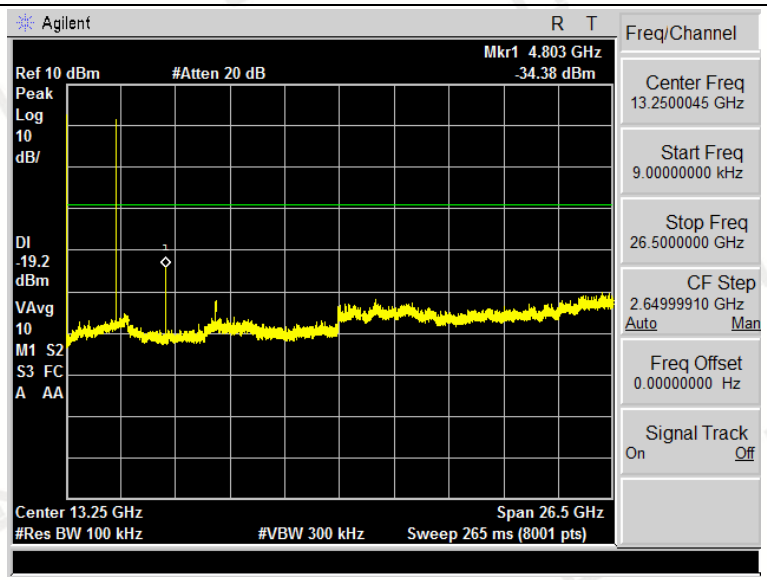
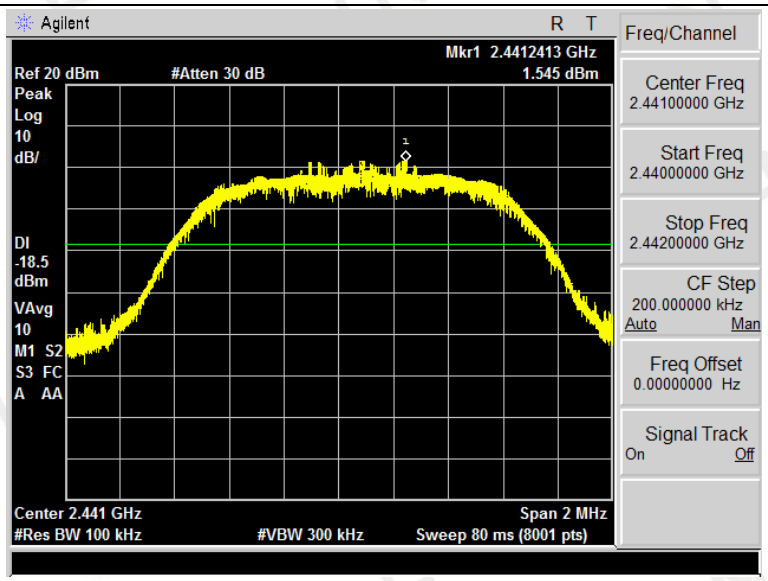
	
	30MHz-25GHz

pi/4DQPSK --2441MHz	
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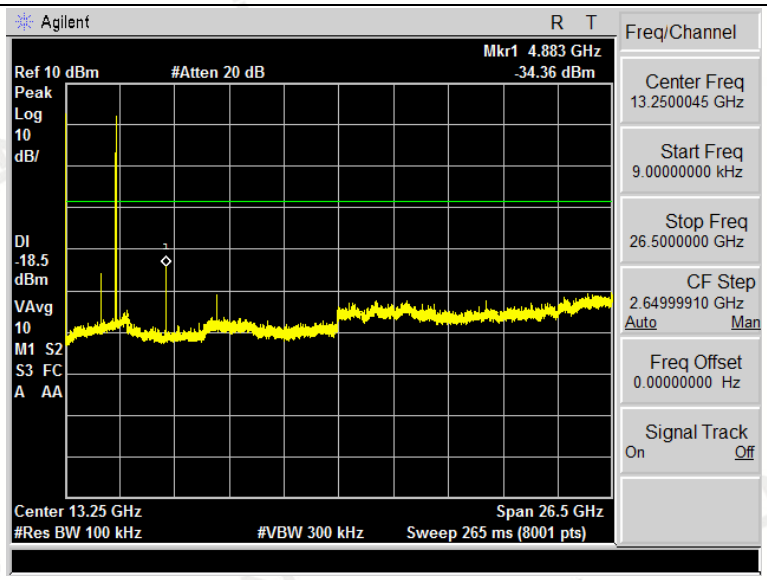
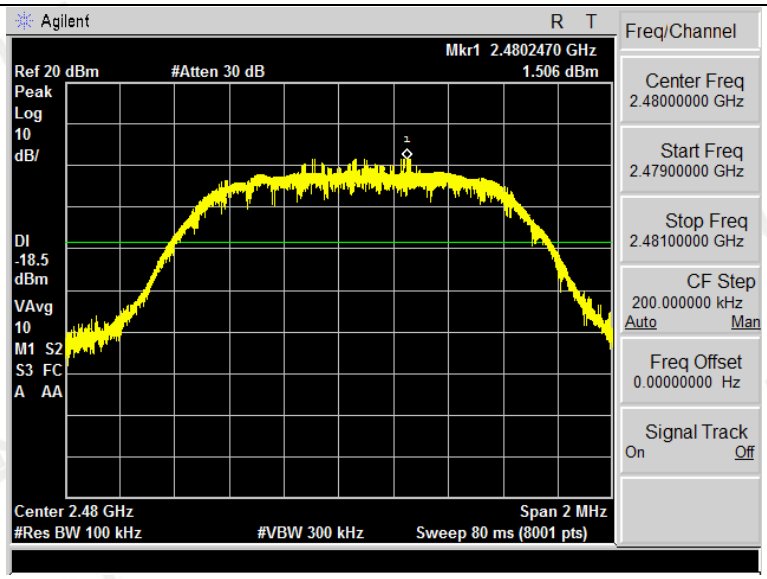


30MHz-25GHz

pi/4DQPSK --2480MHz



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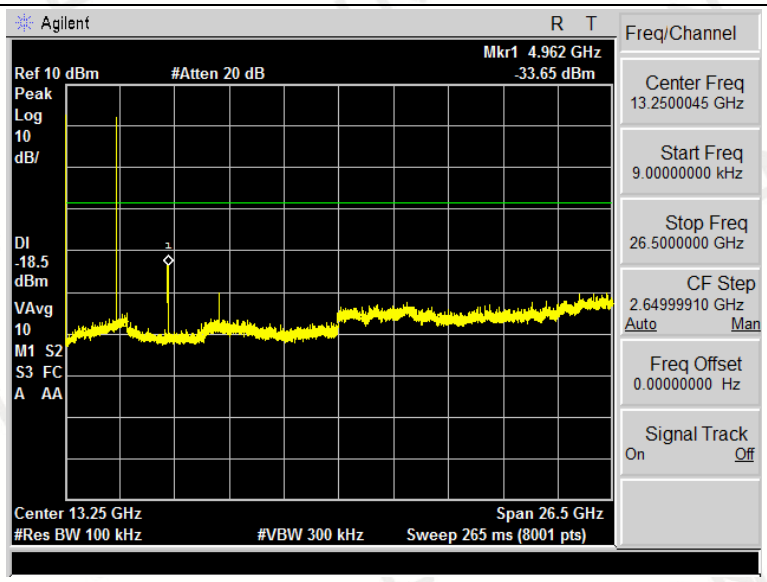
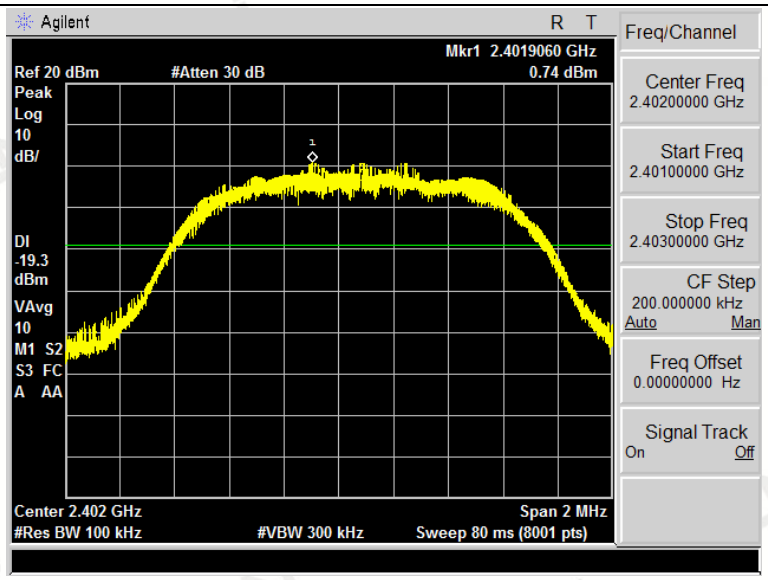


30MHz-25GHz

8DPSK --2402MHz	
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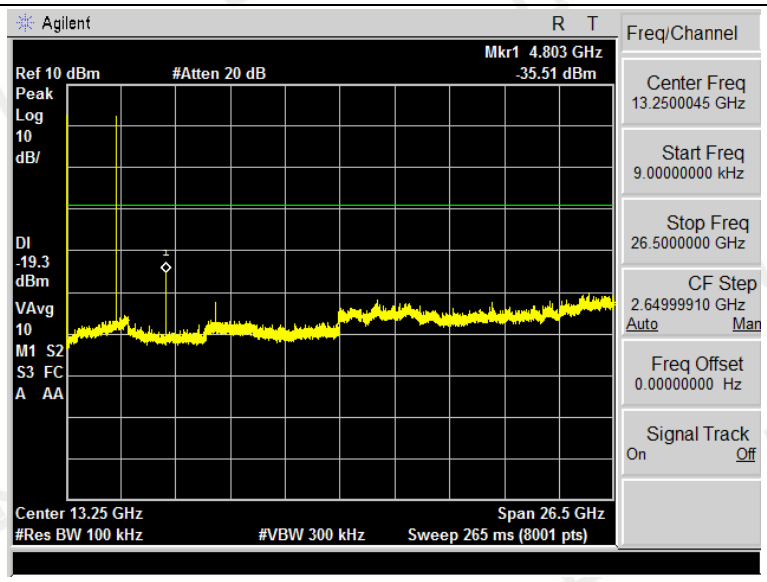
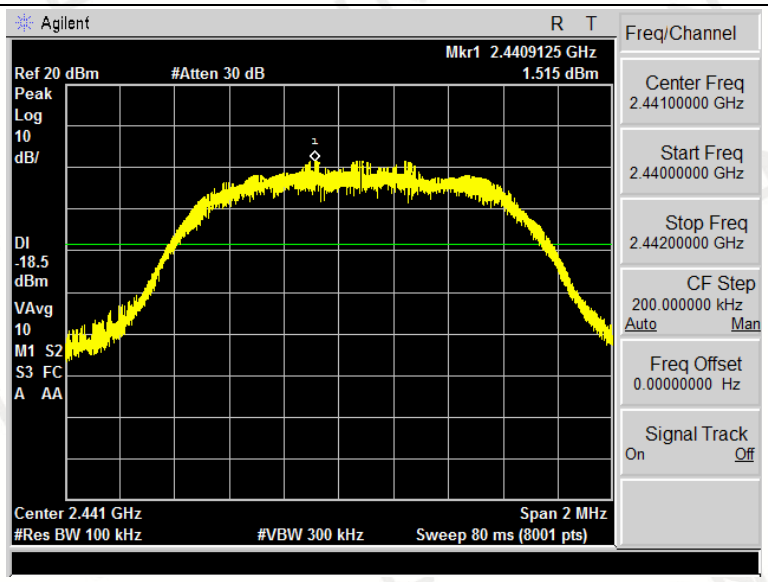
	
	30MHz-25GHz

8DPSK --2441MHz	
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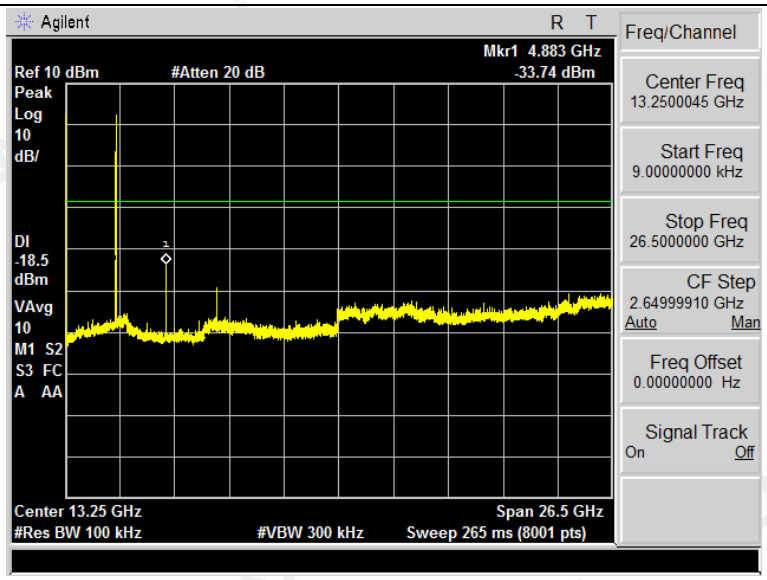
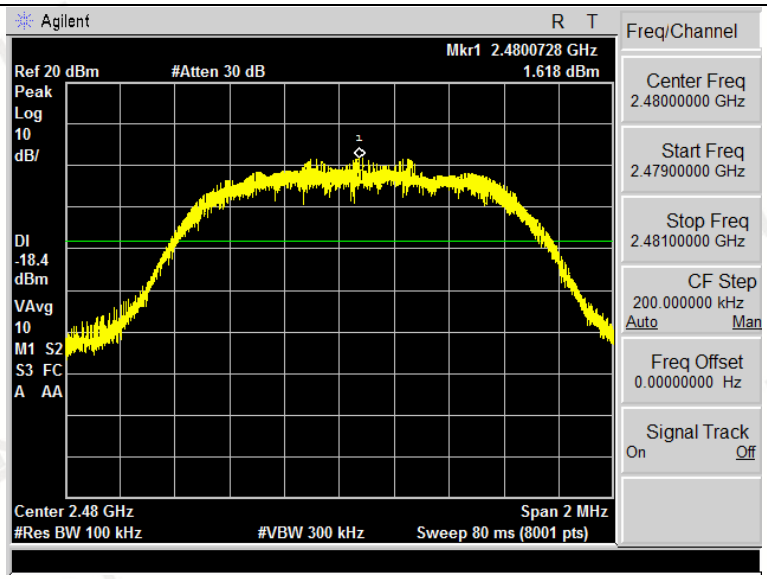


30MHz-25GHz

8DPSK --2480MHz



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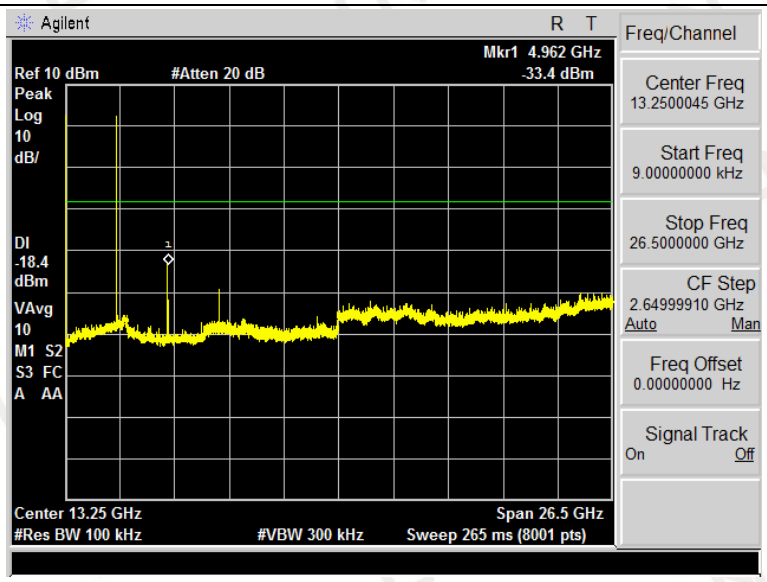
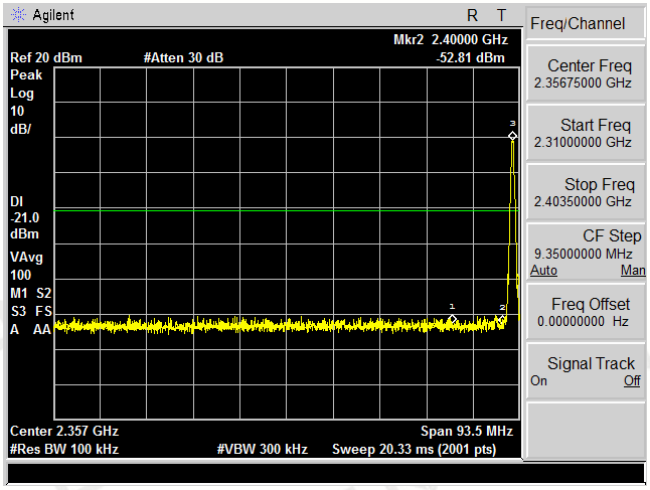
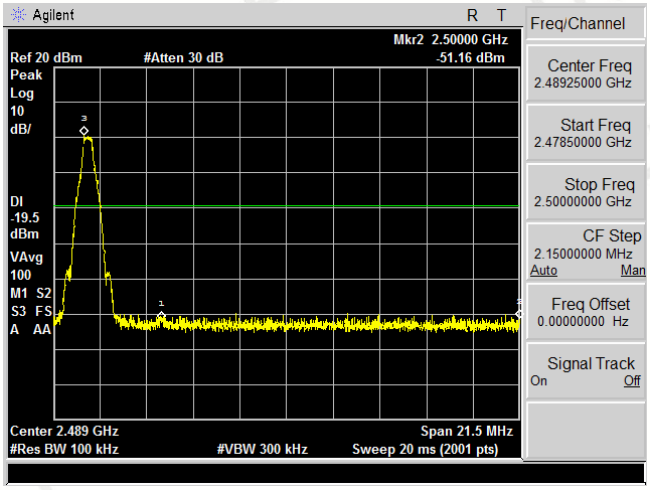


30MHz-25GHz

GFSK



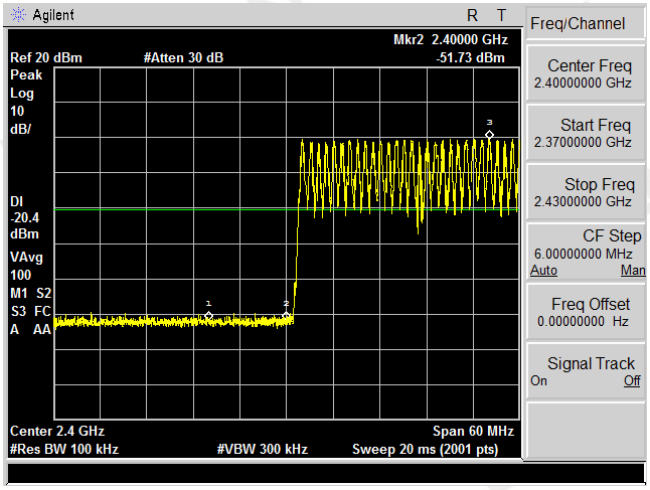


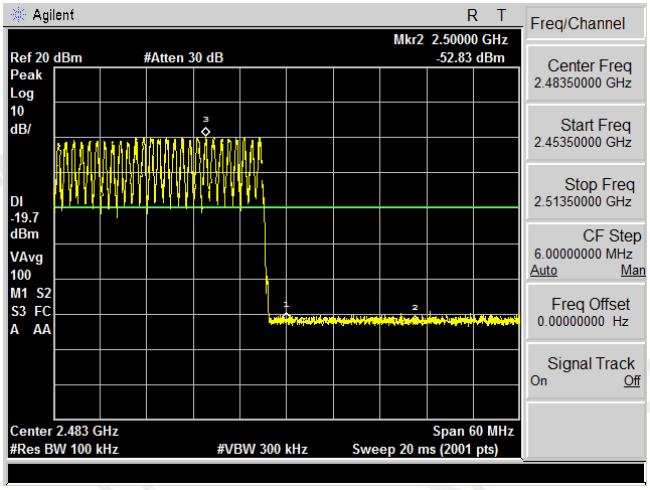
Frequency(MHz)	Bandedge(dBm)	limit(dBm)	Results
2390	-52.50	-21	Pass
2400	-52.81	-21	Pass

Left Band edge hoping off

Frequency(MHz)	Bandedge(dBm)	limit(dBm)	Results
2483.5	-51.68	-19.5	Pass
2500	-51.16	-19.5	Pass

Right Band edge hoping off





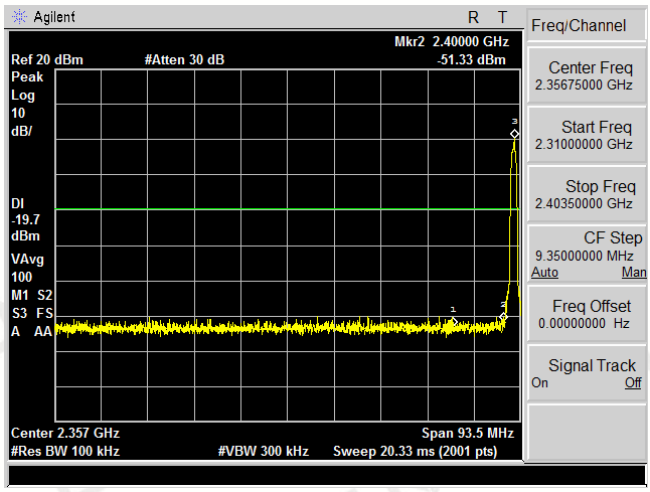
Frequency(MHz)	Bandedge(dBm)	limit(dBm)	Results
2390	-51.17	-20.4	Pass
2400	-51.73	-20.4	Pass

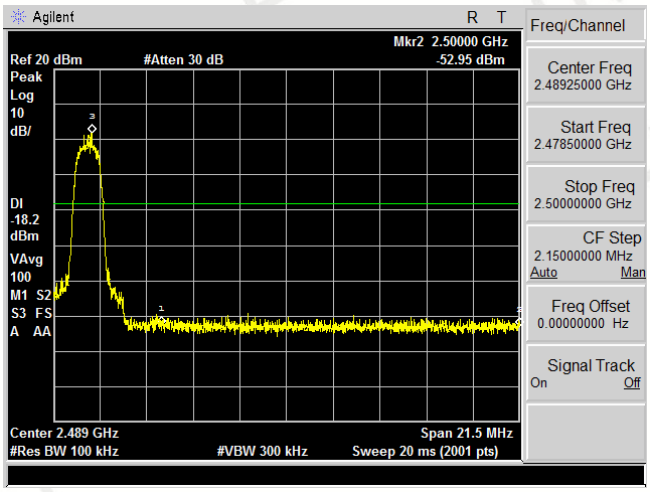
Left Band edge hoping on

Frequency(MHz)	Bandedge(dBm)	limit(dBm)	Results
2483.5	-51.86	-19.7	Pass
2500	-52.83	-19.7	Pass

Right Band edge hoping on

pi/4DQPSK



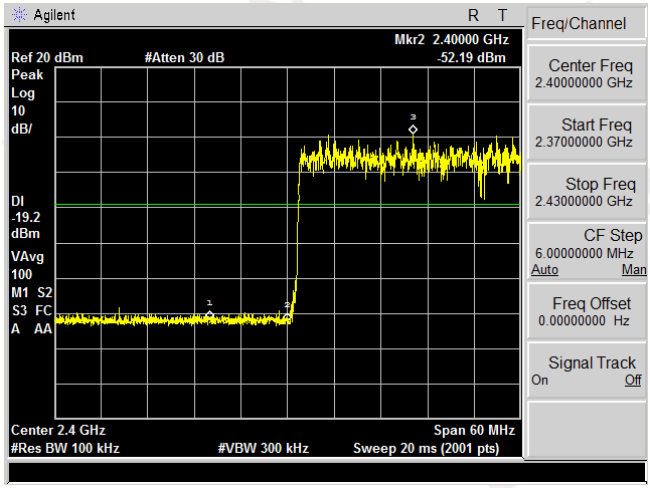


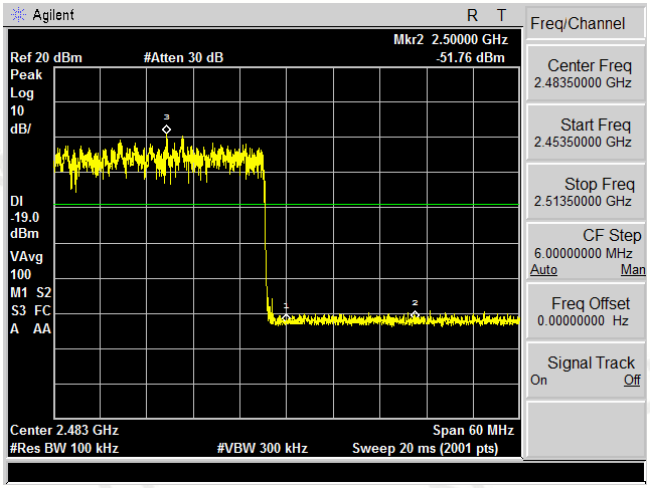
Frequency(MHz)	Bandedge(dBm)	limit(dBm)	Results
2390	-52.75	-19.7	Pass
2400	-51.33	-19.7	Pass

Left Band edge hoping off

Frequency(MHz)	Bandedge(dBm)	limit(dBm)	Results
2483.5	-52.45	-18.2	Pass
2500	-52.95	-18.2	Pass

Right Band edge hoping off





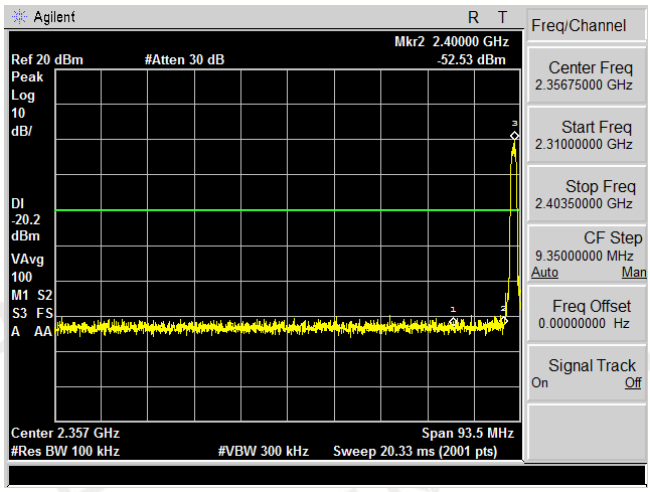
Frequency(MHz)	Bandedge(dBm)	limit(dBm)	Results
2390	-51.78	-19.2	Pass
2400	-52.19	-19.2	Pass

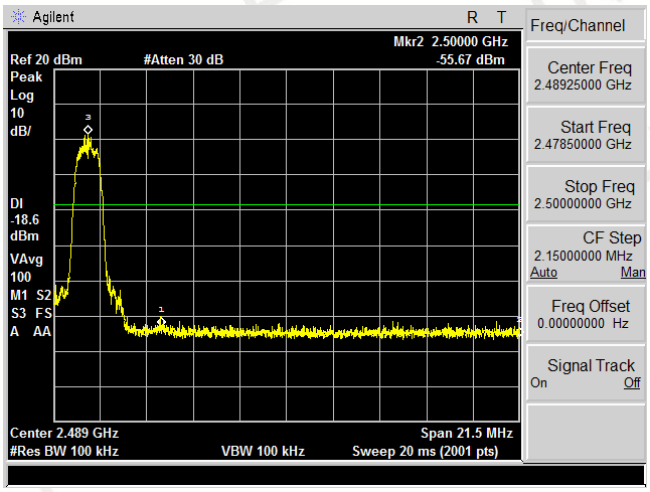
Left Band edge hoping on

Frequency(MHz)	Bandedge(dBm)	limit(dBm)	Results
2483.5	-52.57	-19.0	Pass
2500	-51.76	-19.0	Pass

Right Band edge hoping on

8DPSK



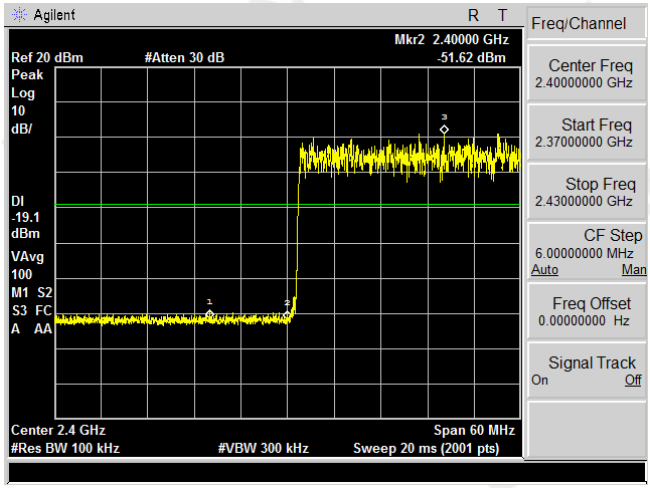


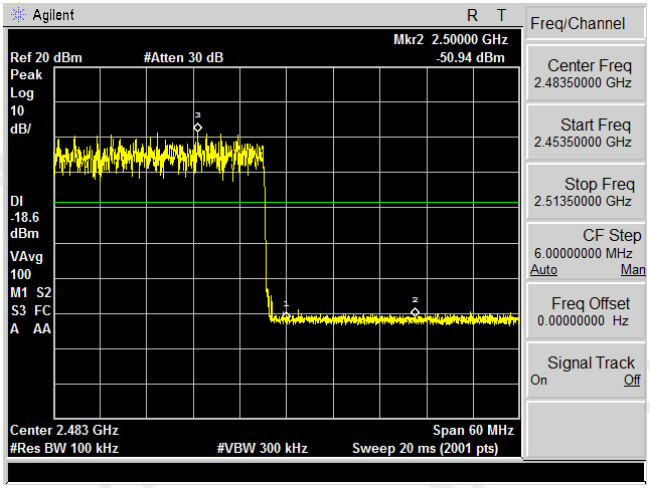
Frequency(MHz)	Bandedge(dBm)	limit(dBm)	Results
2390	-52.84	-20.2	Pass
2400	-52.53	-20.2	Pass

Left Band edge hoping off

Frequency(MHz)	Bandedge(dBm)	limit(dBm)	Results
2483.5	-52.96	-18.6	Pass
2500	-55.67	-18.6	Pass

Right Band edge hoping off





Frequency(MHz)	Bandedge(dBm)	limit(dBm)	Results
2390	-51.31	-19.1	Pass
2400	-51.62	-19.1	Pass

Left Band edge hoping on

Frequency(MHz)	Bandedge(dBm)	limit(dBm)	Results
2483.5	-51.93	-18.6	Pass
2500	-50.94	-18.6	Pass

Right Band edge hoping on

3.10 Pseudorandom Frequency Hopping Sequence

TEST APPLICABLE

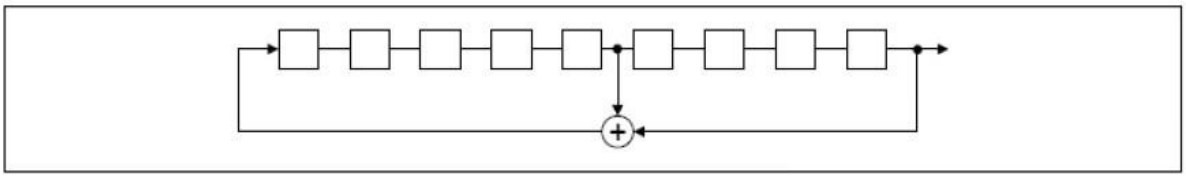
For 47 CFR Part 15C section 15.247 (g) (h) requirement:

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

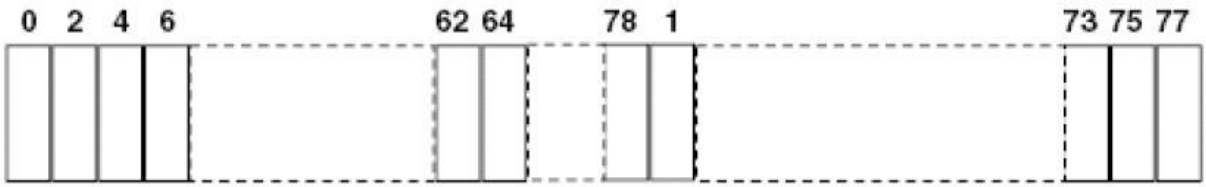
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: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

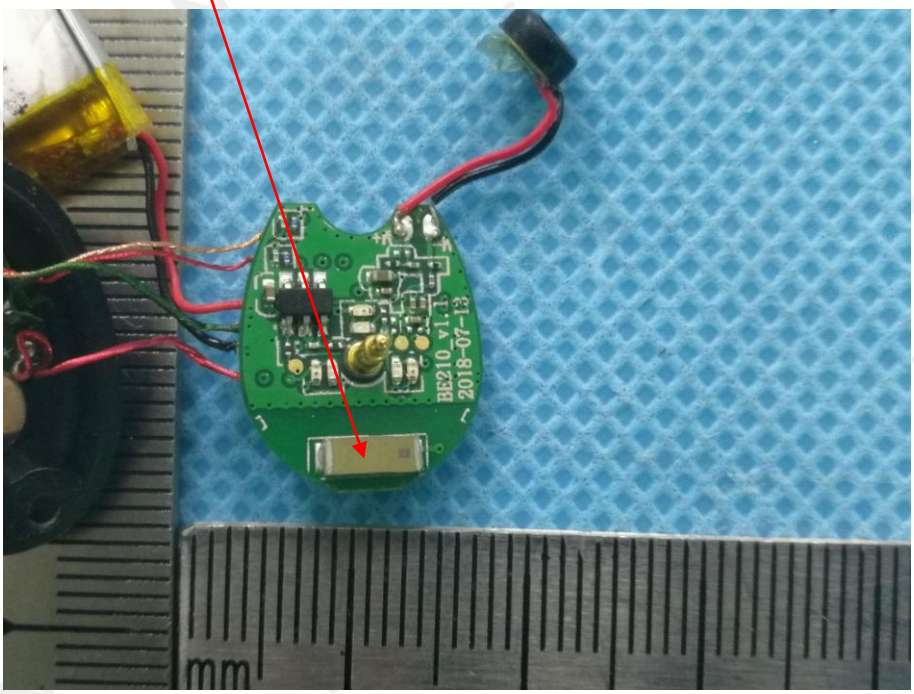
Compliance for section 15.247(g)
According to Bluetooth Core Specification, the Bluetooth system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the 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

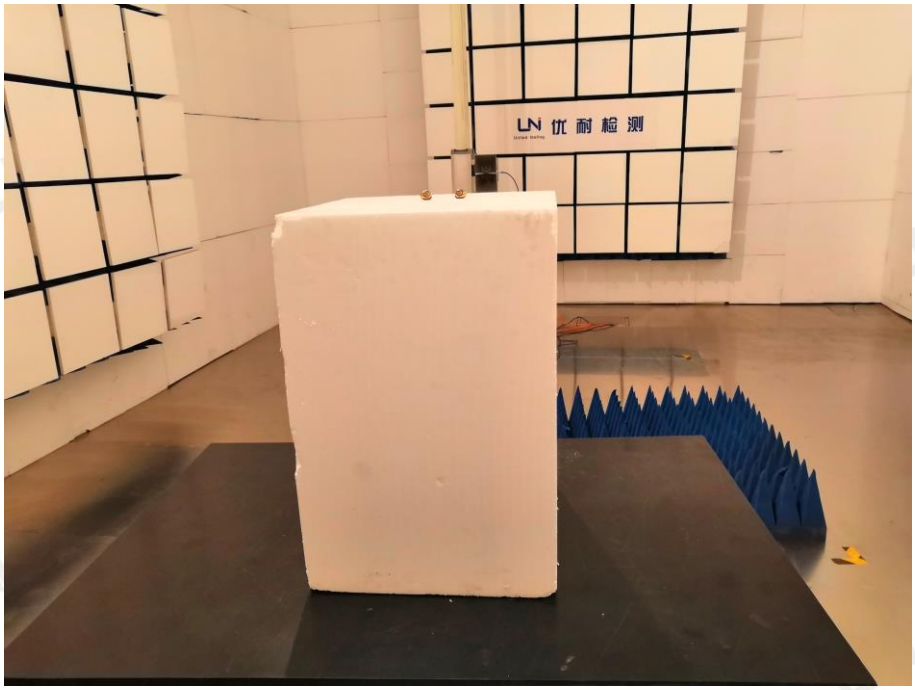
Standard Applicable:
For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Antenna Connected Construction
The antenna used in this product is an Integral Antenna, the directional gains of antenna used for transmitting is 0dBi.

ANTENNA

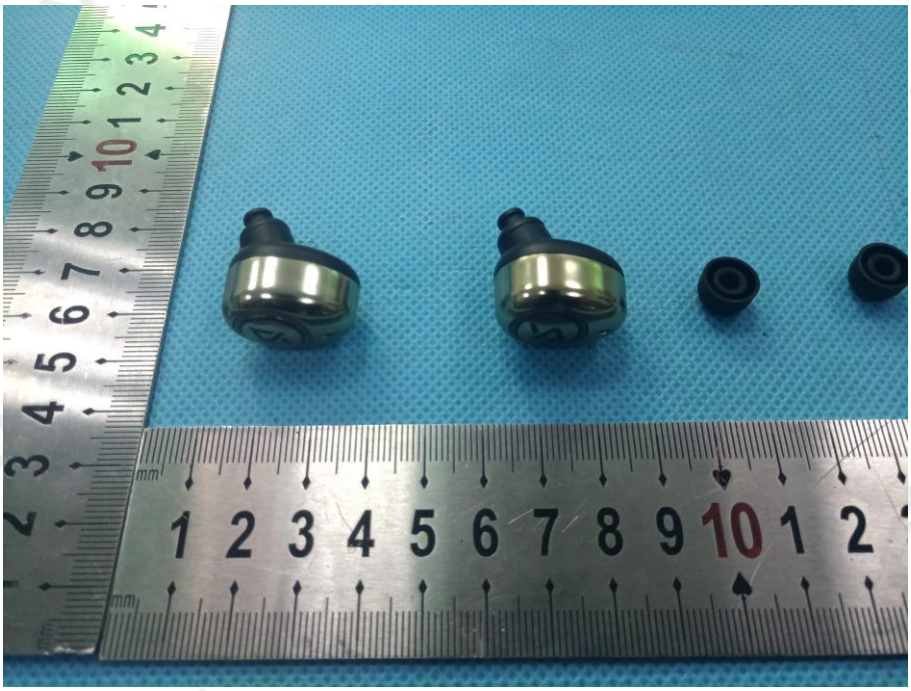


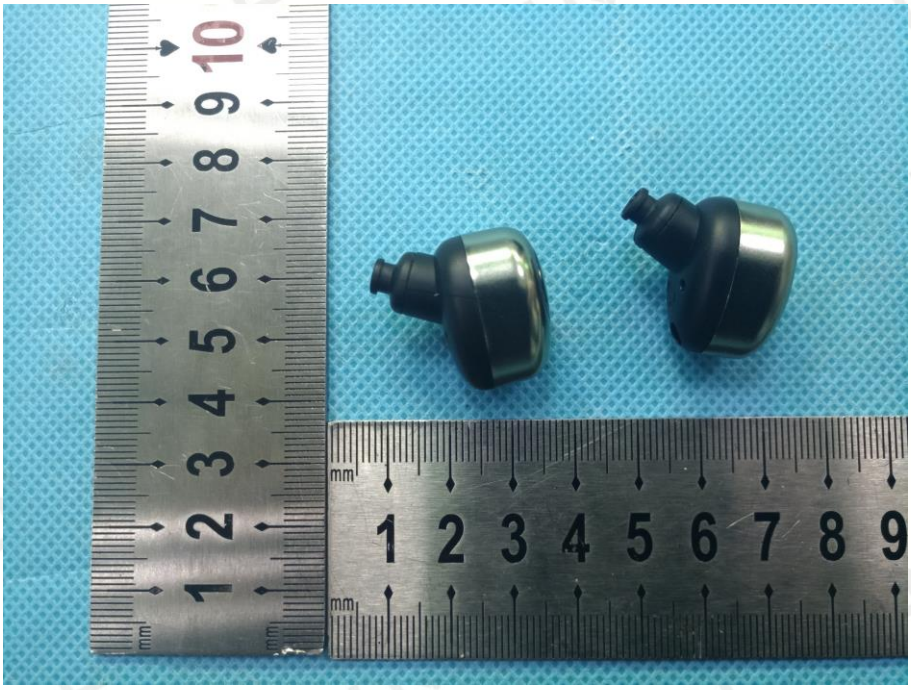
4 PHOTOGRAPH OF TEST

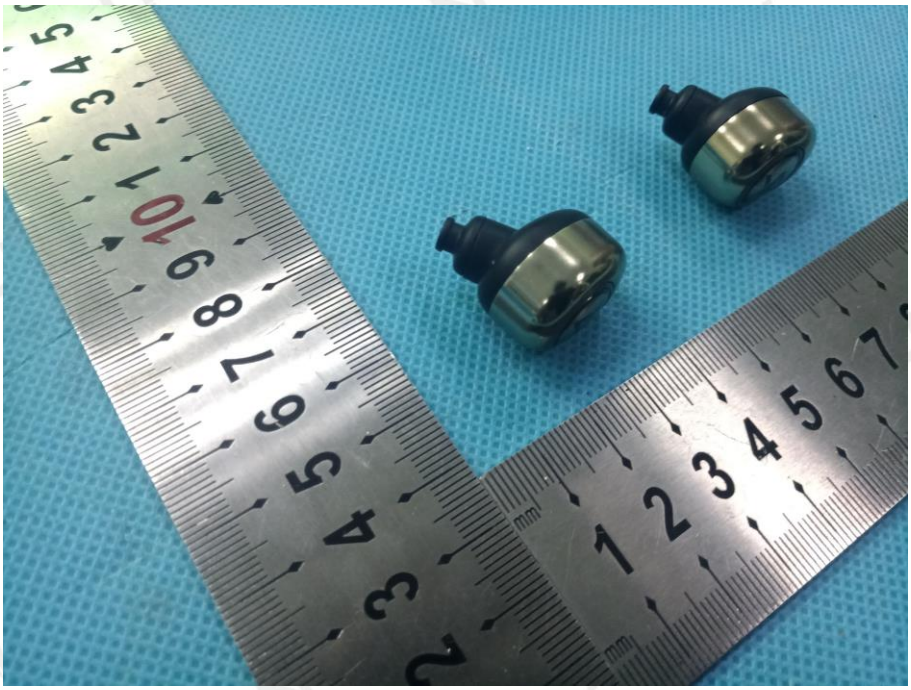


5 PHOTOGRAPH OF EUT

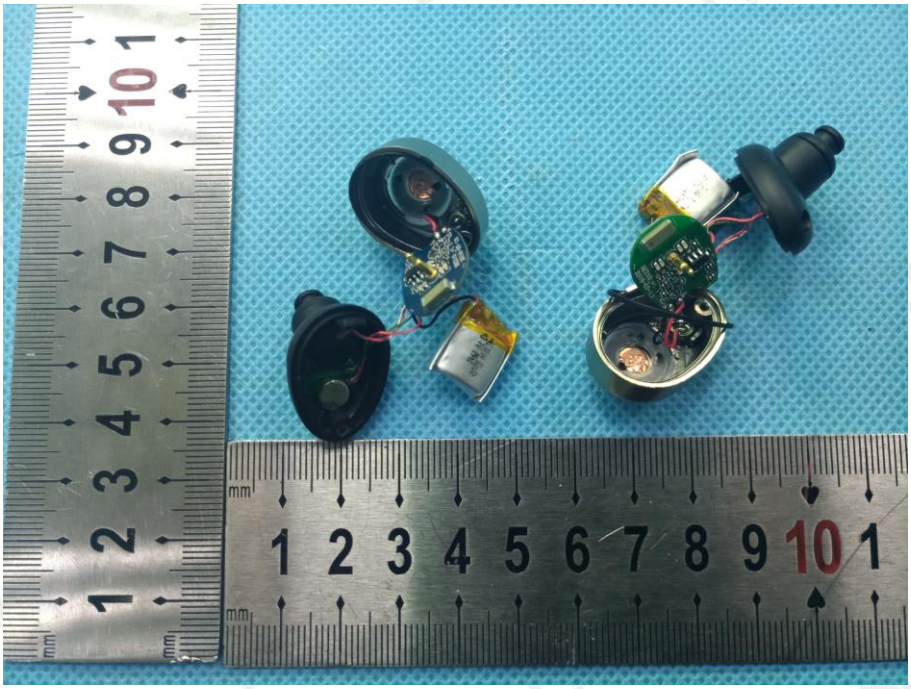
External Photos

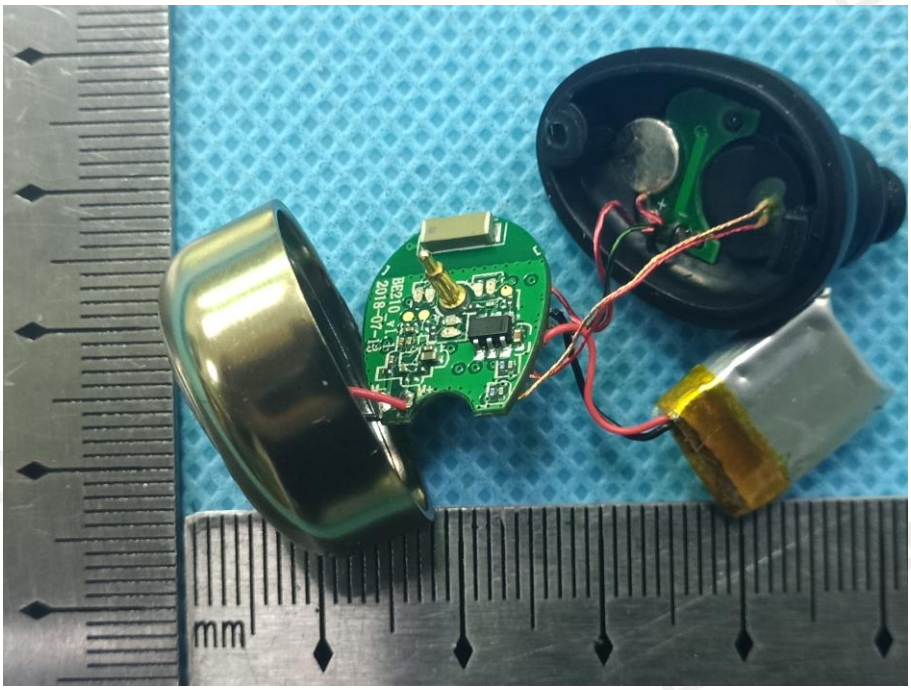


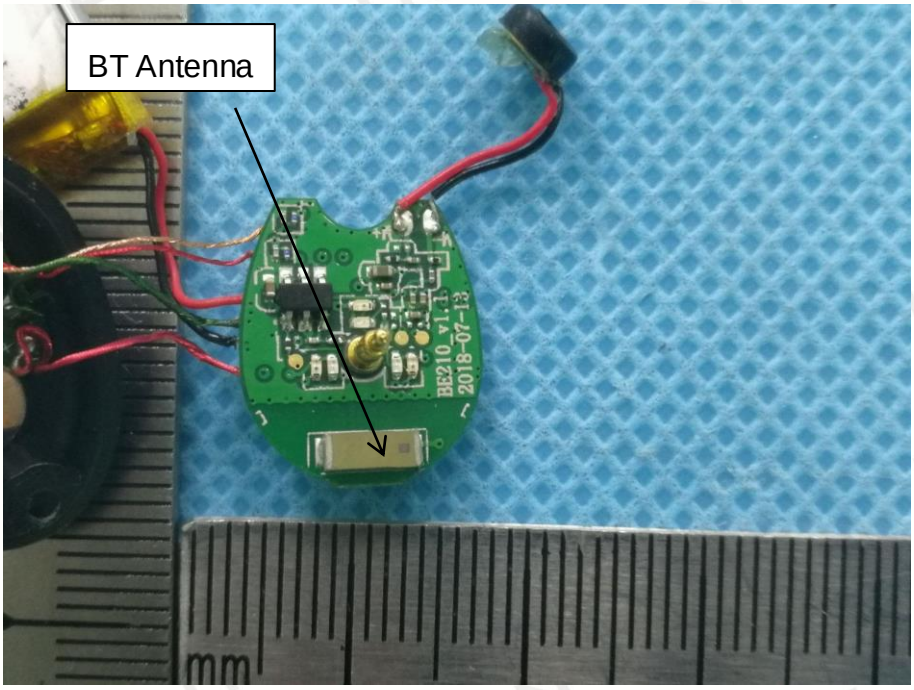


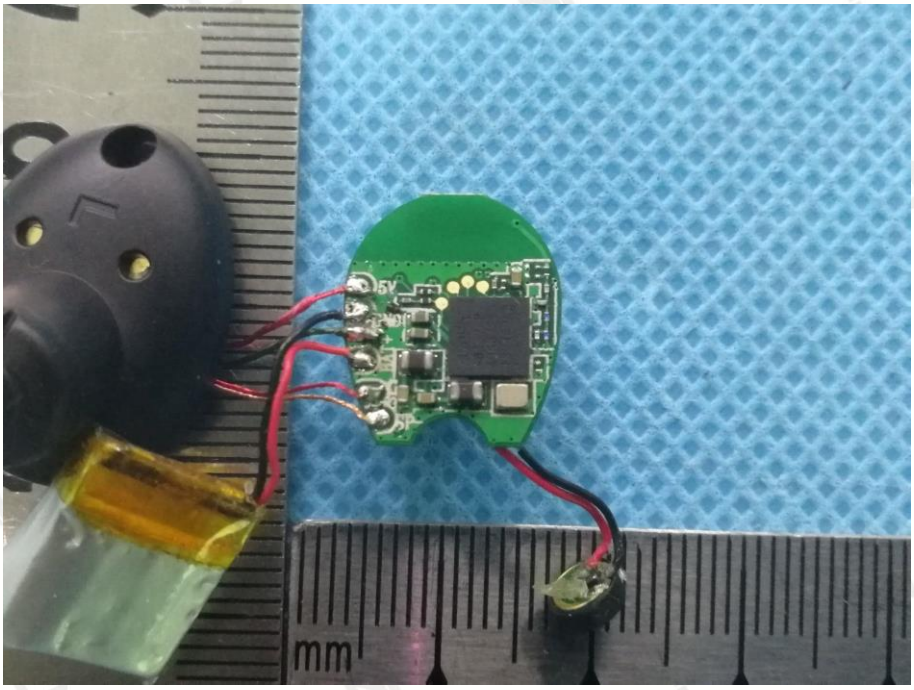


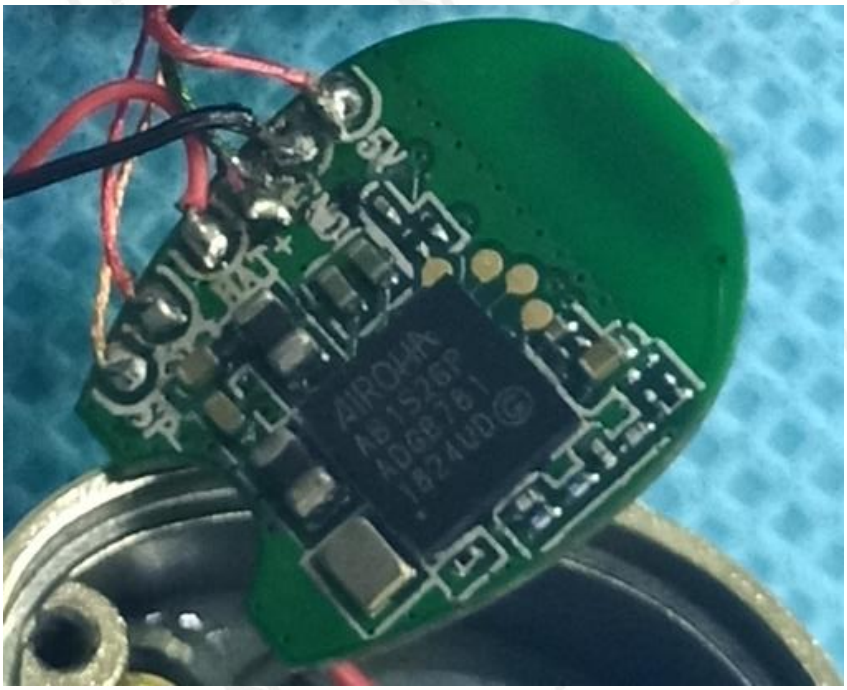
Internal Photos






BT Antenna
BE210_v1.1
2018-07-13
mm


5V
mm



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