

FCC TEST REPORT

Reference No...... : WTS14S1119871E
FCC ID : PB4-TDKA28
Applicant..... : Imation Corp.
Address..... : 1 Imation Way, Oakdale, MN 55128 USA
Manufacturer : Imation Corp.
Address..... : 1 Imation Way, Oakdale, MN 55128 USA
Product Name..... : Wireless Speaker
Model No : A28
Trademark..... : TDK Life on Record
Standards..... : FCC CFR47 Part 15 Subpart C: 2014
Date of Receipt sample : Nov.06, 2014
Date of Test : Nov.11-14, 2014
Date of Issue..... : Nov.25, 2014
Test Result..... : **Pass**

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

Prepared By:

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2 Test Summary

Test Items	Test Requirement	Result
Spurious Radiated Emissions	15.205(a) 15.209 15.247(d)	PASS
Band edge Emissions	15.247(d)	PASS
Duty Cycle	15.35	PASS
Conducted Emissions	15.207	PASS
20dB Bandwidth	15.215c 15.247(a)(1)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Frequency Separation	15.247(a)(1)	PASS
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS
Dwell time	15.247(a)(1)(iii)	PASS
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	1.1307(b)(1)	PASS

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4 General Information

4.1 General Description of E.U.T.

Product Name	: Wireless Speaker
Model No.	: A28
Brand Name	: TDK Life on Record
Remark	: The model No. A28 has two colors (black and grey), black model sample was tested .
Operation Frequency	: 2402MHz ~ 2480MHz, 79 channels in total, separated by 1MHz
Type of Modulation	: GFSK, Pi/4DQPSK, 8DPSK
Oscillator	: Crystal 12.88MHz for CPU, 26MHz for RF module
Antenna installation	: Copper foil Antenna
Antenna Gain	: 2.11dBi

4.2 Details of E.U.T.

Technical Data	(1)DC 5V, 1A
	(2)DC 3.6V, 2000mAh by battery

4.3 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	2402	2	2403	3	2404	4	2405
5	2406	6	2407	7	2408	8	2409
9	2410	10	2411	11	2412	12	2413
13	2414	14	2415	15	2416	16	2417
17	2418	18	2419	19	2420	20	2421
21	2422	22	2423	23	2424	24	2425
25	2426	26	2427	27	2428	28	2429
29	2430	30	2431	31	2432	32	2433
33	2434	34	2435	35	2436	36	2437
37	2438	38	2439	39	2440	40	2441
41	2442	42	2443	43	2444	44	2445
45	2446	46	2447	47	2448	48	2449
49	2450	50	2451	51	2452	52	2453
53	2454	54	2455	55	2456	56	2457
57	2458	58	2459	59	2460	60	2461
61	2462	62	2463	63	2464	64	2465
65	2466	66	2467	67	2468	68	2469
69	2470	70	2471	71	2472	72	2473
73	2474	74	2475	75	2476	76	2477
77	2478	78	2479	79	2480	-	-

4.4 Description of Support Units

No.	Equipment	Manufacturer	Model No.	Serial No.
1.	Notebook	LENOVO	X201i	75Y4408

4.5 Test Facility

The test facility has a test site registered with the following organizations:

- **IC – Registration No.: 7760A-1**

Waltek Services(Shenzhen) Co., Ltd. has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files.

Registration 7760A-1, July 12, 2012.

- **FCC – Registration No.: 880581**

Waltek Services(Shenzhen) Co., Ltd. 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. Registration 880581, April 29, 2014.

4.6 Test Location

All the tests were performed at:

Waltek Services(Shenzhen) Co., Ltd. at 1/F, Fukangtai Building, West Baima Rd.,Songgang Street, Baoan District, Shenzhen, China

5 Equipment Used during Test

5.1 Equipments List

Conducted Emissions						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMI Test Receiver	R&S	ESCI	100947	Sep.21,2014	Sep.20,2015
2.	LISN	R&S	ENV216	101215	Sep.21,2014	Sep.20,2015
3.	Cable	Top	TYPE16(3.5M)	-	Sep.21,2014	Sep.20,2015
3m Semi-anechoic Chamber for Radiation Emissions						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMC Analyzer	Agilent	E7405A	MY45114943	Sep.18,2014	Sep.17,2015
2.	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	Sep.18,2014	Sep.17,2015
3.	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Apr.19,2014	Apr.18,2015
4.	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.18,2014	Sep.17,2015
5.	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr.19,2014	Apr.18,2015
6.	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	Apr.19,2014	Apr.18,2015
7.	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Mar.17,2014	Mar.16,2015
8.	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	Apr.10,2014	Apr.09,2015
RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMC Analyzer	R&S	ESCI	101155	Sep.18,2014	Sep.17,2015
2.	Humidity Chamber	GF	GTH-225-40-1P	IAA061213	May 16,2014	May 15,2015
3.	DC Power Supply	EVERFINE	WY305	1004002	Apr.11,2014	Apr.10,2015

5.2 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-6}$
Bandwidth	$\pm 1.5 \times 10^{-6}$
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Temperature	± 1 °C
DC Source	$\pm 0.05\%$
Radiated Emissions test	± 5.03 dB (Bilog antenna 30M~1000MHz)
	± 4.74 dB (Horn antenna 1000M~25000MHz)
Conducted Emissions test	3.64dB (150kHz~30MHz)

5.3 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Don guan Zhuang RD. Guangzhou, P.R.China.

6 Conducted Emission

Test Requirement:	FCC CFR 47 Part 15 Section 15.207
Test Method:	ANSI C63.4:2003
Test Result:	PASS
Frequency Range:	150kHz to 30MHz
Class:	Class B
Limit:	66-56 dB μ V between 0.15MHz & 0.5MHz 56 dB μ V between 0.5MHz & 5MHz 60 dB μ V between 5MHz & 30MHz
Detector:	Peak for pre-scan (9kHz Resolution Bandwidth) Quasi-Peak & Average if maximised peak within 6dB of Average Limit

6.1 E.U.T. Operation

Operating Environment:

Temperature: 25.5 °C

Humidity: 51 % RH

Atmospheric Pressure: 1012 mbar

EUT Operation:

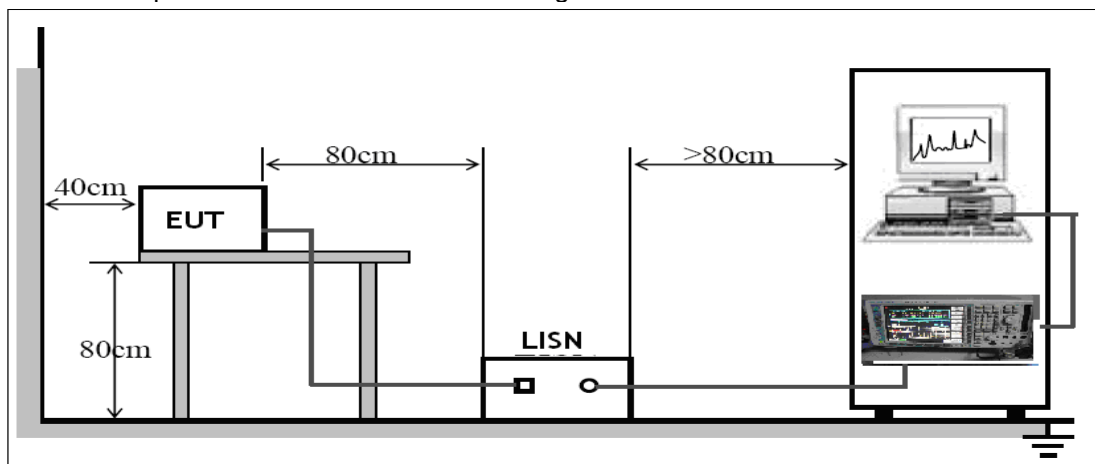
The pre-test was performed in Bluetooth linking, and the data were shown as follow.

The EUT was tested according to ANSI C63.4:2003. The frequency spectrum from 150kHz to 30MHz was investigated.

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

6.2 EUT Setup

The EUT was placed on the test table in shielding room.

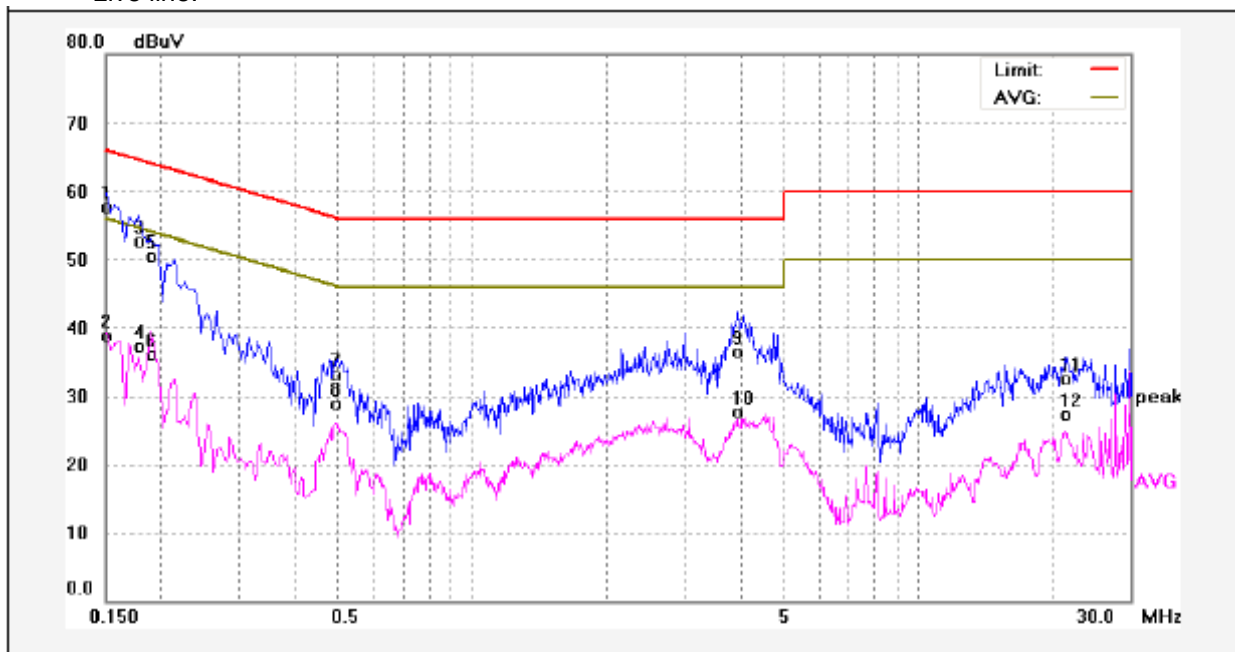


6.3 Conducted Emission Test Result

An initial pre-scan was performed on the live and neutral lines.

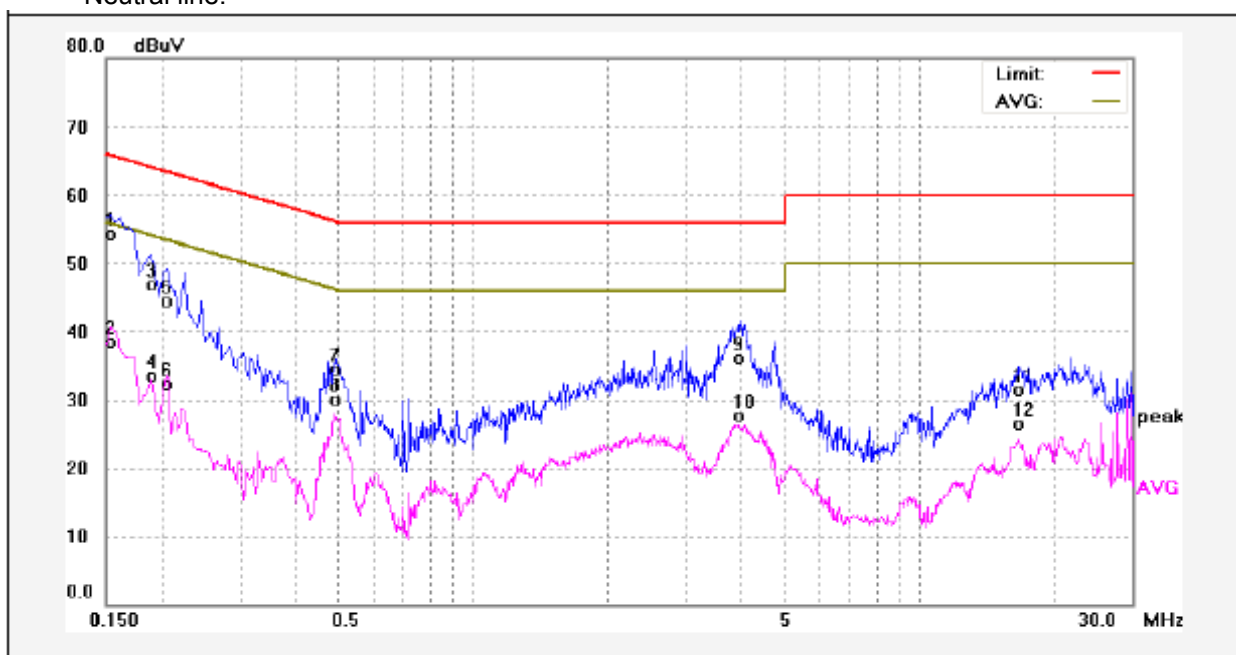
Test Mode: Bluetooth linking

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	47.92	9.80	57.72	65.99	-8.27	QP	
2	0.1500	29.04	9.80	38.84	55.99	-17.15	AVG	
3	0.1780	42.93	9.82	52.75	64.57	-11.82	QP	
4	0.1780	27.44	9.82	37.26	54.57	-17.31	AVG	
5	0.1900	40.67	9.83	50.50	64.03	-13.53	QP	
6	0.1900	26.19	9.83	36.02	54.03	-18.01	AVG	
7	0.4980	23.26	9.93	33.19	56.03	-22.84	QP	
8	0.4980	18.96	9.93	28.89	46.03	-17.14	AVG	
9	3.9620	26.48	10.07	36.55	56.00	-19.45	QP	
10	3.9620	17.72	10.07	27.79	46.00	-18.21	AVG	
11	21.4020	21.13	11.31	32.44	60.00	-27.56	QP	
12	21.4020	16.07	11.31	27.38	50.00	-22.62	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1539	44.50	9.80	54.30	65.78	-11.48	QP	
2	0.1539	28.73	9.80	38.53	55.78	-17.25	AVG	
3	0.1900	37.05	9.83	46.88	64.03	-17.15	QP	
4	0.1900	23.62	9.83	33.45	54.03	-20.58	AVG	
5	0.2060	34.64	9.84	44.48	63.36	-18.88	QP	
6	0.2060	22.43	9.84	32.27	53.36	-21.09	AVG	
7	0.4940	24.53	9.93	34.46	56.10	-21.64	QP	
8	0.4940	20.21	9.93	30.14	46.10	-15.96	AVG	
9	3.9940	26.07	10.07	36.14	56.00	-19.86	QP	
10	3.9940	17.62	10.07	27.69	46.00	-18.31	AVG	
11	16.6660	20.53	11.00	31.53	60.00	-28.47	QP	
12	16.6660	15.47	11.00	26.47	50.00	-23.53	AVG	

7 Spurious Radiated Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method: DA 00-705

Test Result: PASS

Measurement Distance: 3m

Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	$2400/F(\text{kHz})$	300	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	$24000/F(\text{kHz})$	30	$100 * 24000/F(\text{kHz})$	$20\log^{(24000/F(\text{kHz}))} + 40$
1.705 ~ 30	30	30	$100 * 30$	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

7.1 EUT Operation :

Operating Environment:

Temperature: 25.5 °C

Humidity: 51 % RH

Atmospheric Pressure: 1010 mbar

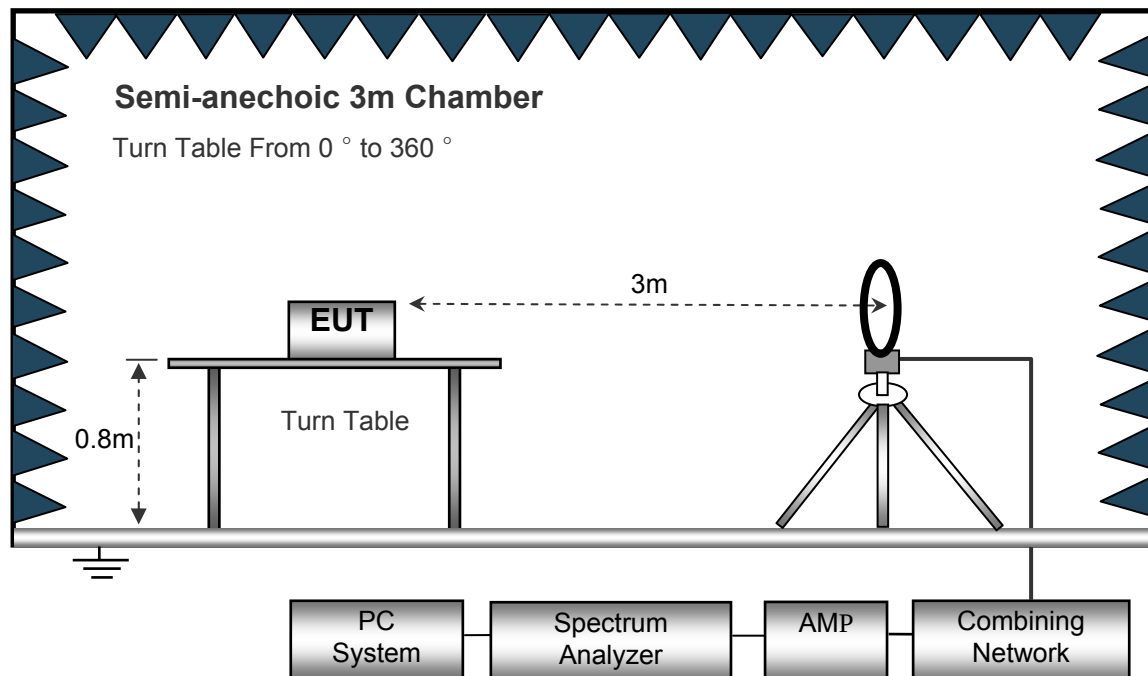
Operation Mode:

The EUT was tested in transmitting mode, and the data were shown as follow.

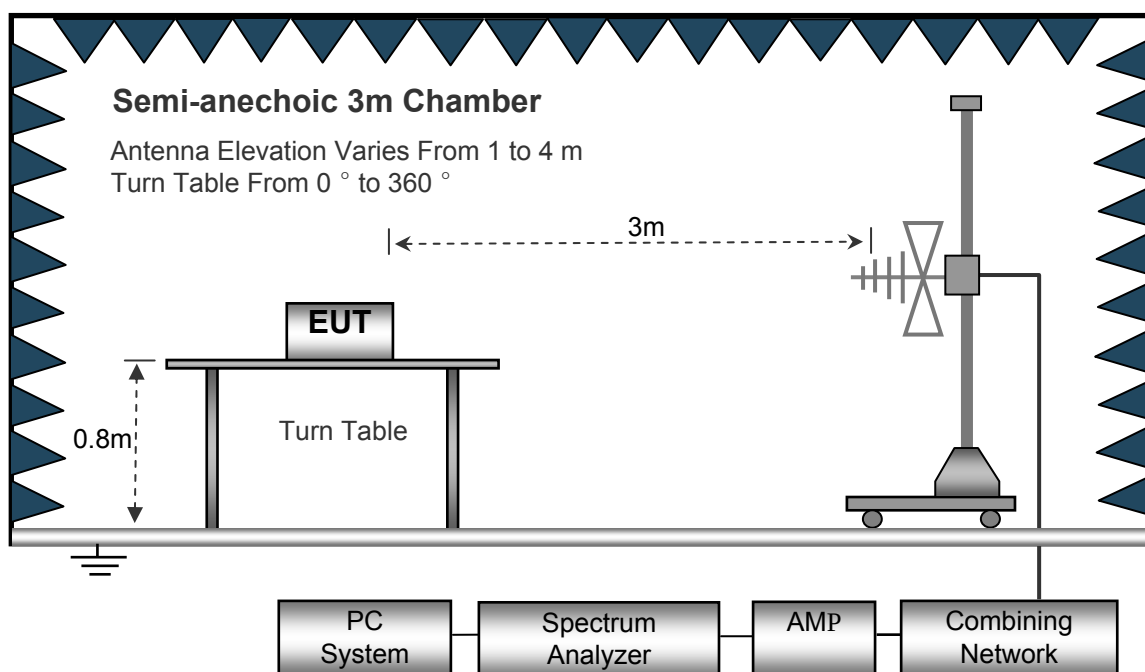
7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.4: 2003.

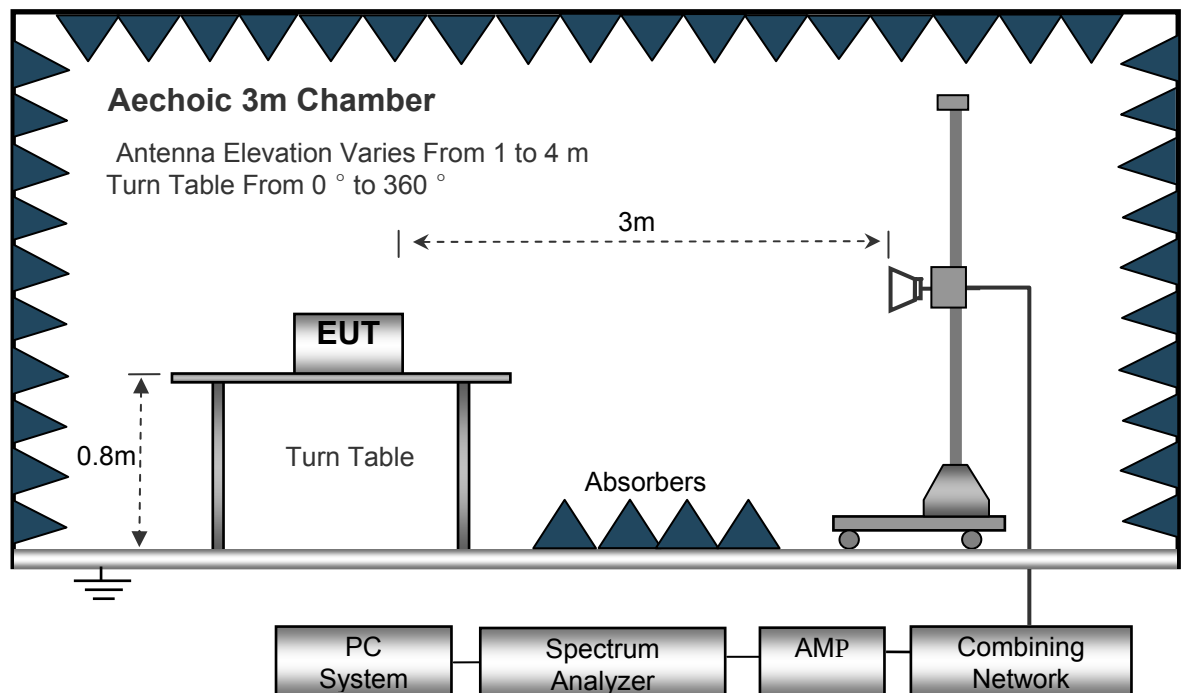
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



7.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed Auto
 IF Bandwidth..... 10kHz
 Video Bandwidth..... 10kHz
 Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed Auto
 Detector PK
 Resolution Bandwidth..... 100kHz
 Video Bandwidth..... 300kHz

Above 1GHz

Sweep Speed Auto
 Detector PK
 Resolution Bandwidth..... 1MHz
 Video Bandwidth..... 3MHz
 Detector Ave.
 Resolution Bandwidth..... 1MHz
 Video Bandwidth..... 10Hz

7.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m 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 moved from 1m to 4m to find out the maximum 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 radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

7.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$

7.6 Summary of Test Results

Test Frequency :12.88MHz-30MHz

The measurements were more than 20 dB below the limit and not reported.

Test Frequency : 30MHz ~ 18GHz

Test mode: transmitting

All the modulation modes were tested, the data of the worst mode (GFSK) were recorded in the following pages.

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Lower Channel 2402MHz									
452.64	16.50	PK	280	1.9	H	20.49	36.99	46.00	-9.01
452.64	15.20	PK	332	1.8	V	20.49	35.69	46.00	-10.31
4804.00	64.35	PK	335	1.6	V	-2.36	61.99	74.00	-12.01
4804.00	44.28	Ave	335	1.6	V	-2.36	41.92	54.00	-12.08
7206.00	63.47	PK	224	1.1	H	1.33	64.80	74.00	-9.20
7206.00	42.69	Ave	224	1.1	H	1.33	44.02	54.00	-9.98
2337.85	46.79	PK	152	1.2	V	-13.19	33.60	74.00	-40.40
2337.85	39.62	Ave	152	1.2	V	-13.19	26.43	54.00	-27.57
2385.81	44.53	PK	290	1.4	H	-13.14	31.39	74.00	-42.61
2385.81	36.17	Ave	290	1.4	H	-13.14	23.03	54.00	-30.97
2485.63	42.56	PK	47	1.0	V	-13.08	29.48	74.00	-44.52
2485.63	36.40	Ave	47	1.0	V	-13.08	23.32	54.00	-30.68

Frequency	Receiver Reading	Detector	Turntable Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Center Channel 2441MHz									
452.64	17.29	PK	353	1.6	H	20.49	37.78	46.00	-8.22
452.64	15.24	PK	116	1.5	V	20.49	35.73	46.00	-10.27
4882.00	65.17	PK	279	1.8	V	-2.30	62.87	74.00	-11.13
4882.00	43.36	Ave	279	1.8	V	-2.30	41.06	54.00	-12.94
7323.00	63.48	PK	185	1.5	H	2.21	65.69	74.00	-8.31
7323.00	40.29	Ave	185	1.5	H	2.21	42.50	54.00	-11.50
2338.43	45.10	PK	139	1.9	V	-13.19	31.91	74.00	-42.09
2338.43	39.54	Ave	139	1.9	V	-13.19	26.35	54.00	-27.65
2369.02	43.18	PK	243	1.3	H	-13.14	30.04	74.00	-43.96
2369.02	38.43	Ave	243	1.3	H	-13.14	25.29	54.00	-28.71
2493.54	42.11	PK	88	1.3	V	-13.08	29.03	74.00	-44.97
2493.54	37.03	Ave	88	1.3	V	-13.08	23.95	54.00	-30.05

Frequency	Receiver Reading	Detector	Turntable Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.247	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Upper Channel 2480MHz									
452.64	17.13	PK	115	1.0	H	20.49	37.62	46.00	-8.38
452.64	16.21	PK	326	1.3	V	20.49	36.70	46.00	-9.30
4960.00	66.18	PK	312	1.0	V	0.05	66.23	74.00	-7.77
4960.00	45.63	Ave	312	1.0	V	0.05	45.68	54.00	-8.32
7440.00	62.61	PK	116	1.7	H	2.84	65.45	74.00	-8.55
7440.00	41.23	Ave	116	1.7	H	2.84	44.07	54.00	-9.93
2338.06	46.08	PK	348	1.4	V	-13.19	32.89	74.00	-41.11
2338.06	38.73	Ave	348	1.4	V	-13.19	25.54	54.00	-28.46
2352.52	44.37	PK	179	1.7	H	-13.14	31.23	74.00	-42.77
2352.52	36.21	Ave	179	1.7	H	-13.14	23.07	54.00	-30.93
2492.73	44.85	PK	188	1.2	V	-13.08	31.77	74.00	-42.23
2492.73	37.23	Ave	188	1.2	V	-13.08	24.15	54.00	-29.85

Test Frequency : 18-25GHz

The measurements were more than 20 dB below the limit and not reported.

8 Band Edge Measurement

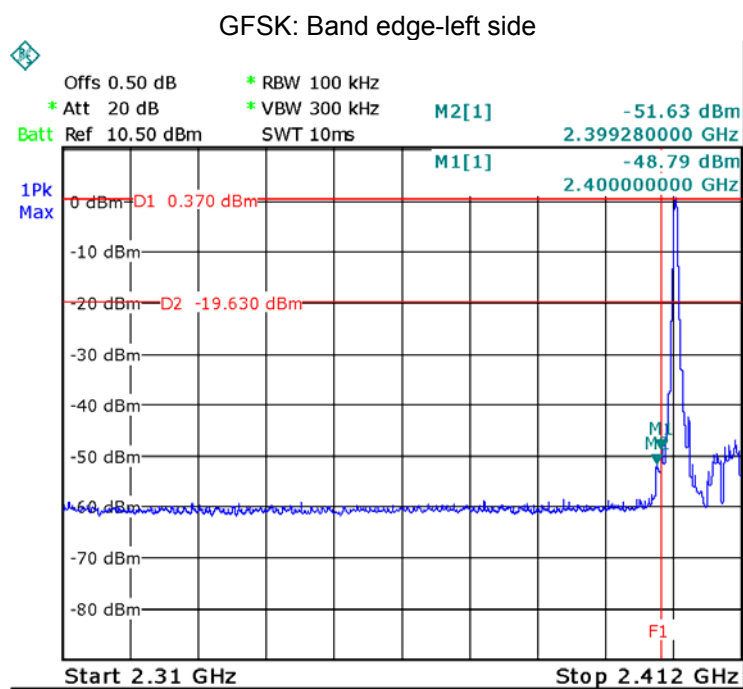
Test Requirement:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method:	DA 00-705
Limit:	40.0 dBuV/m between 30MHz & 88MHz; 43.5 dBuV/m between 88MHz & 216MHz; 46.0 dBuV/m between 216MHz & 960MHz; 54.0 dBuV/m above 960MHz. 74.0 dBuV/m for peak above 1GHz 54.0 dBuV/m for AVG above 1GHz

8.1 Test Procedure

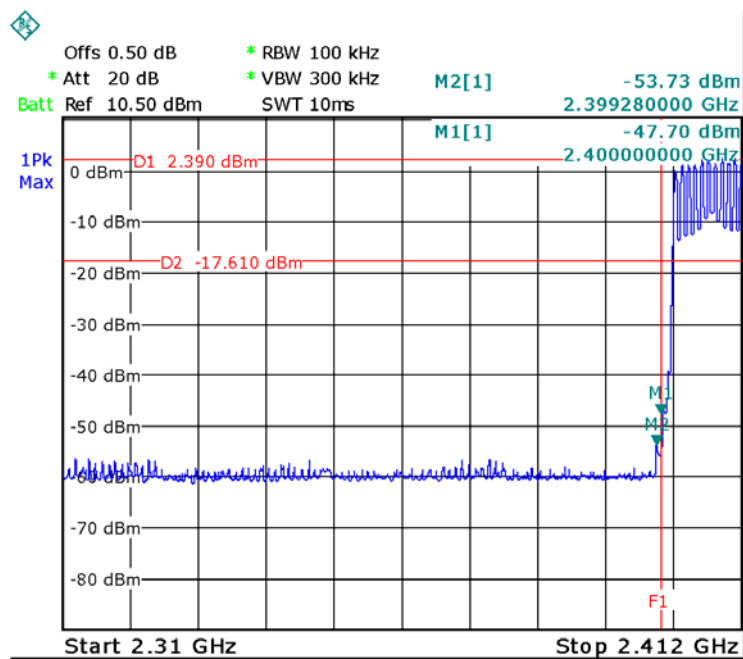
1. The EUT was placed on a turntable which is 0.8m above ground plane
2. Measurement Distance is 3m
3. Detector:
 - For Peak value:
RBW = 1 MHz for $f \geq 1$ GHz
VBW $\geq$ RBW; Sweep = auto
Detector function = peak
Trace = max hold
 - For AVG value:
RBW = 1 MHz for $f \geq 1$ GHz
VBW = 10Hz; Sweep = auto
Detector function = AVG
Trace = max hold
4. continuous transmitting

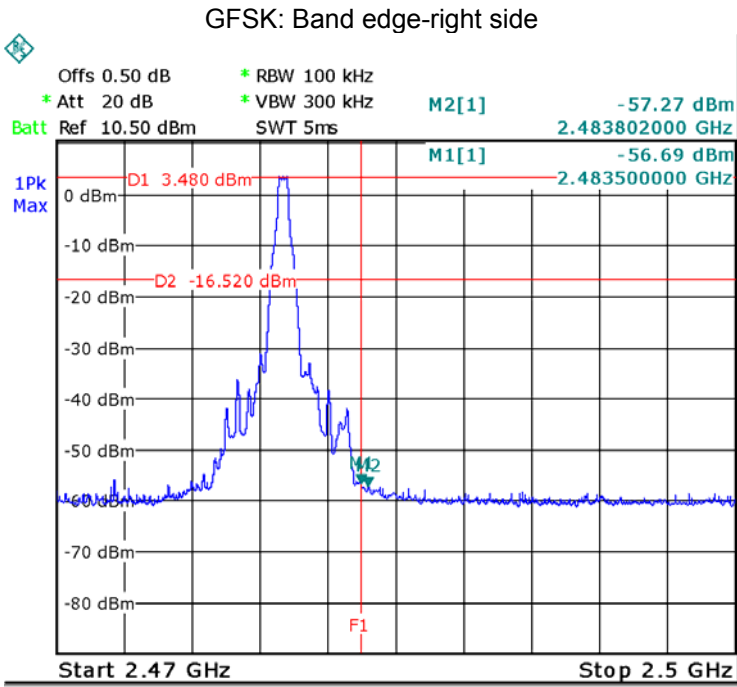
8.2 Test Result:

Test result plots shown as follows:

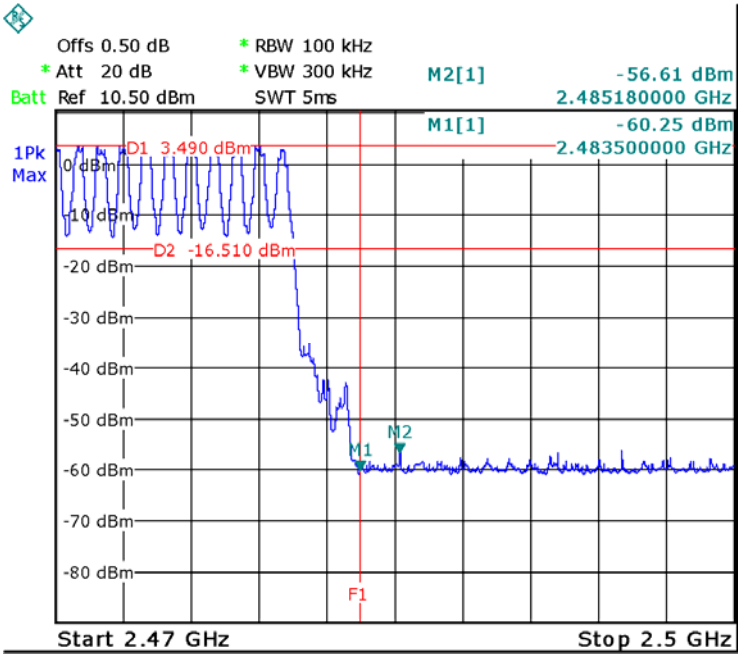


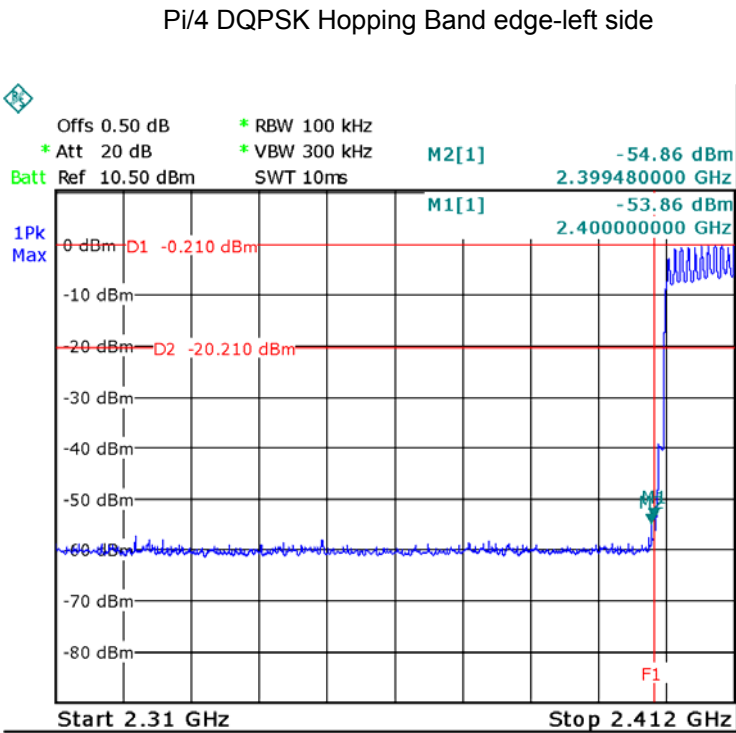
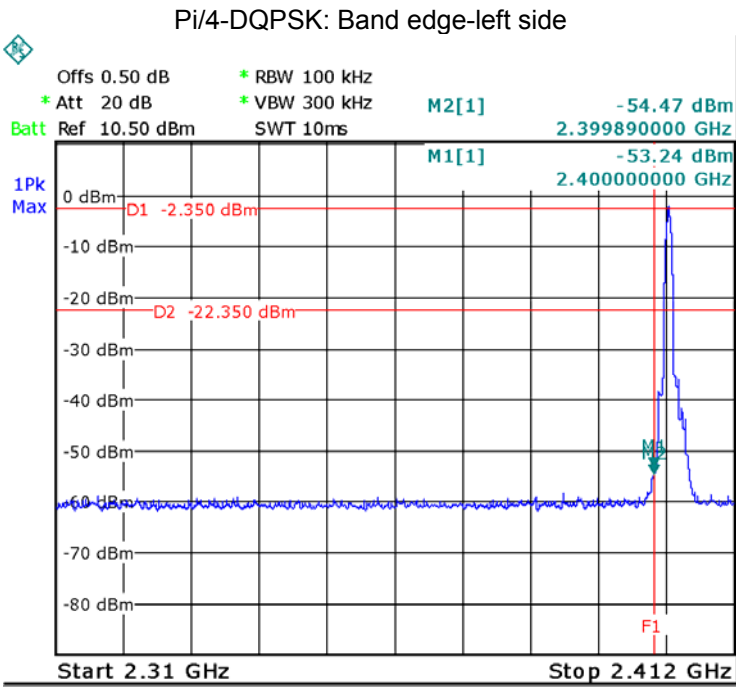
GFSK Hopping Band edge-left side

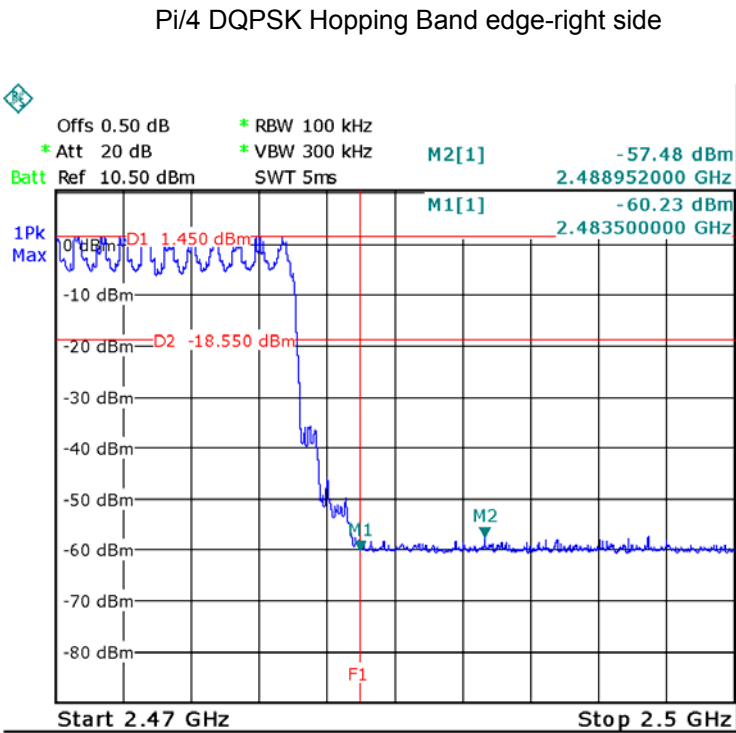
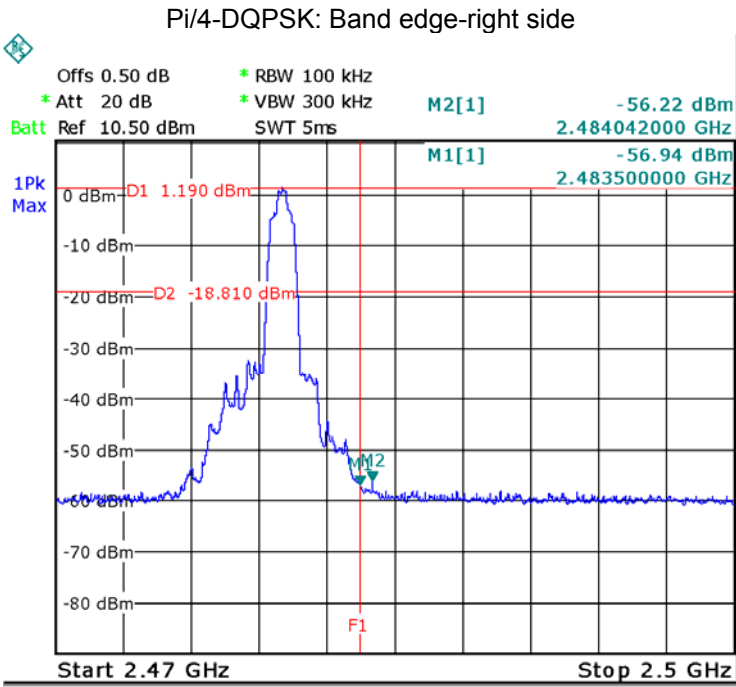




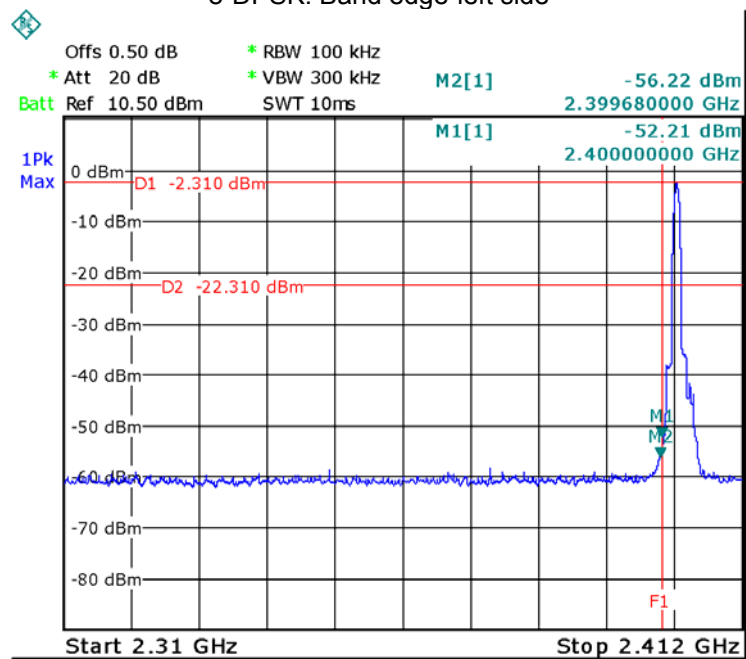
GFSK Hopping Band edge-right side



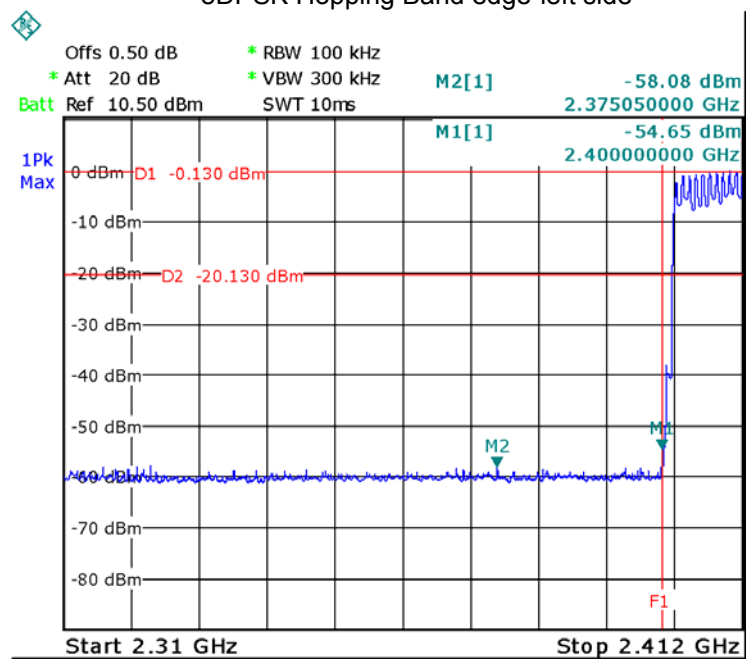


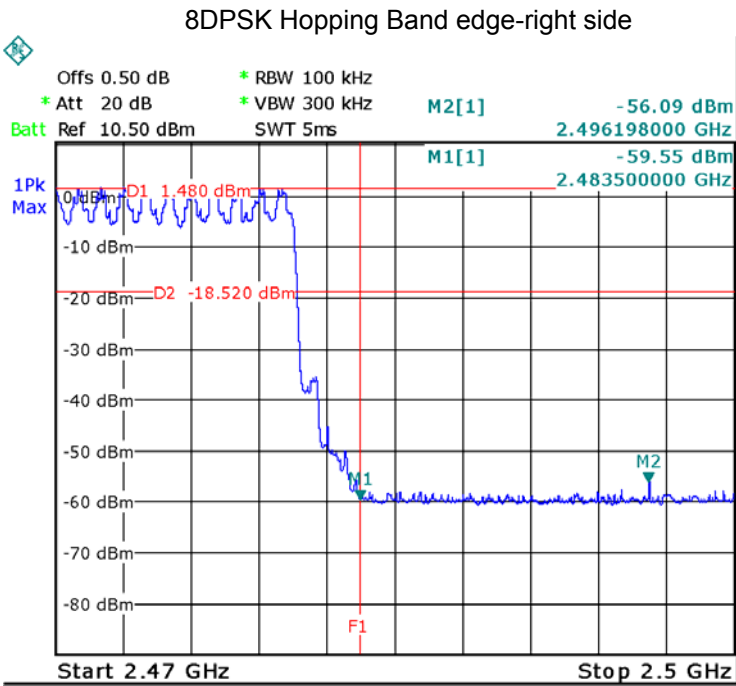
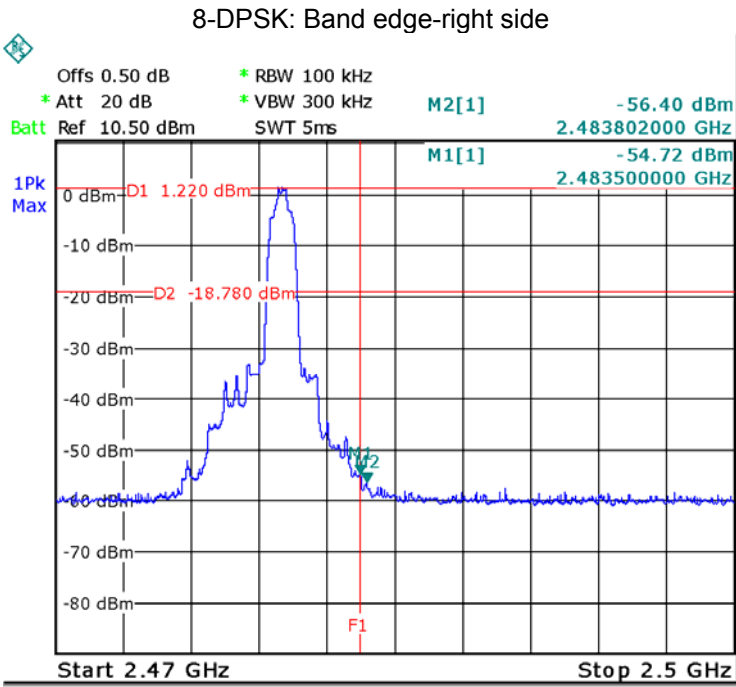


8-DPSK: Band edge-left side



8DPSK Hopping Band edge-left side





9 20 dB Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: DA 00-705

Test Mode: Test in fixing operating frequency at low, Middle, high channel.

9.1 Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 100kHz

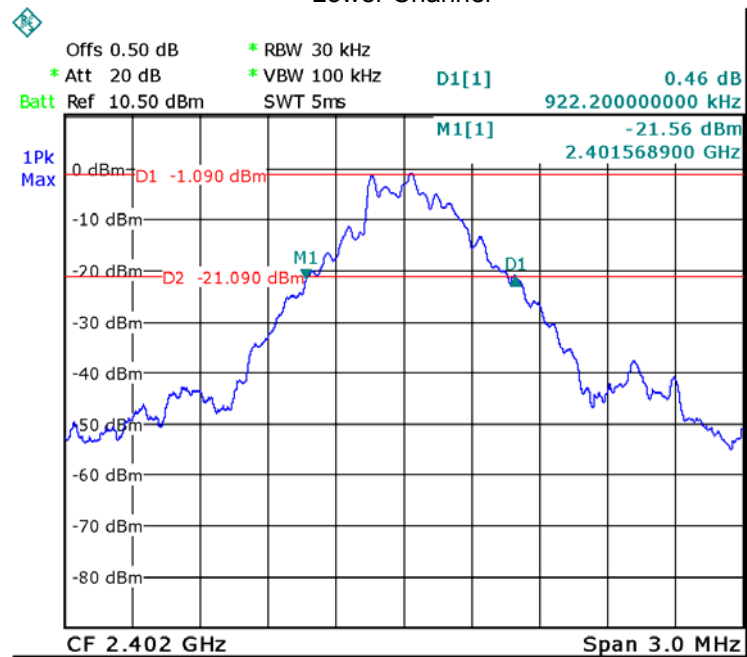
9.2 Test Result:

Modulation	Test Channel	Bandwidth(MHz)
GFSK	Lower	0.922
	Middle	0.922
	Upper	0.922
Pi/4DQPSK	Lower	1.222
	Middle	1.222
	Upper	1.222
8DPSK	Lower	1.216
	Middle	1.216
	Upper	1.216

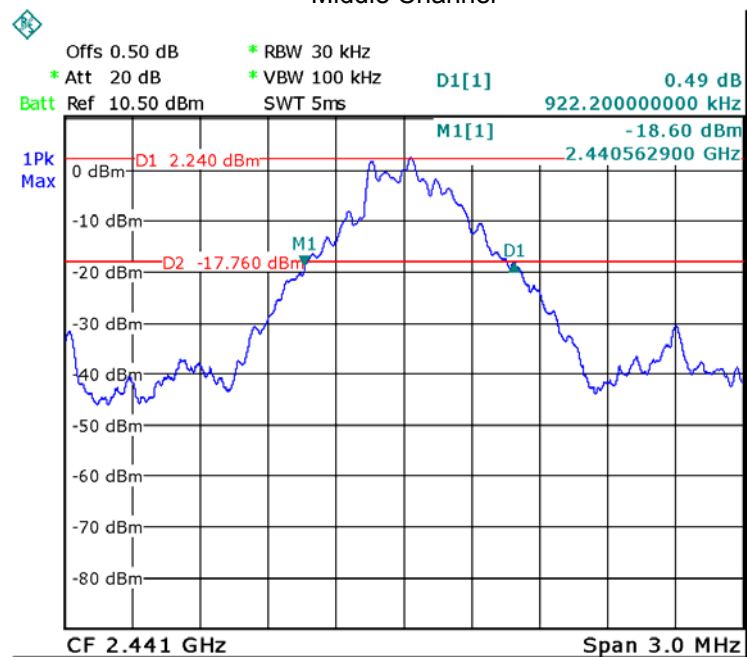
Test result plot as follows:

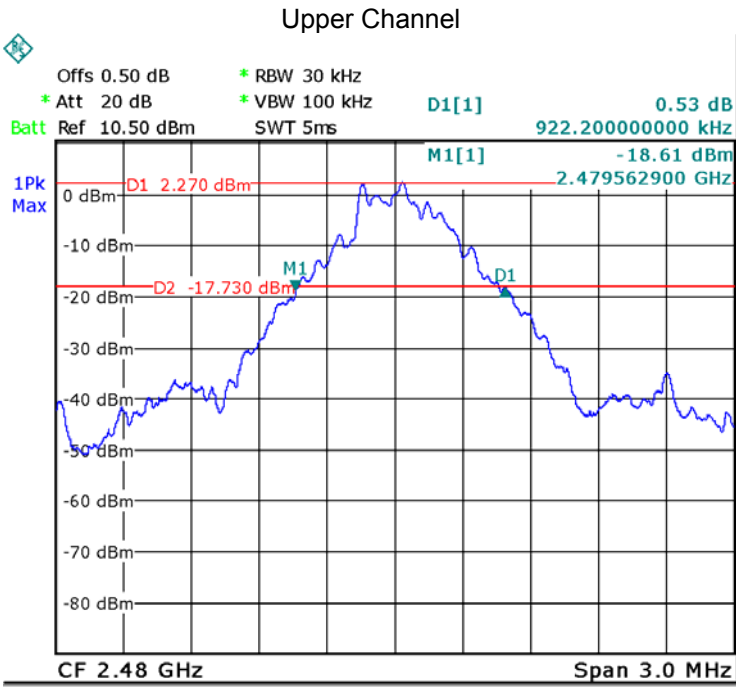
Modulation:GFSK

Lower Channel

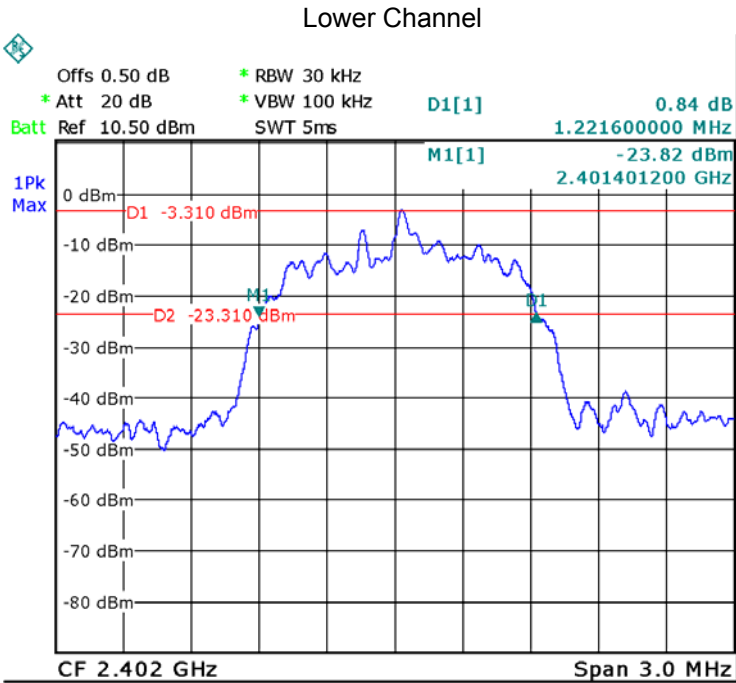


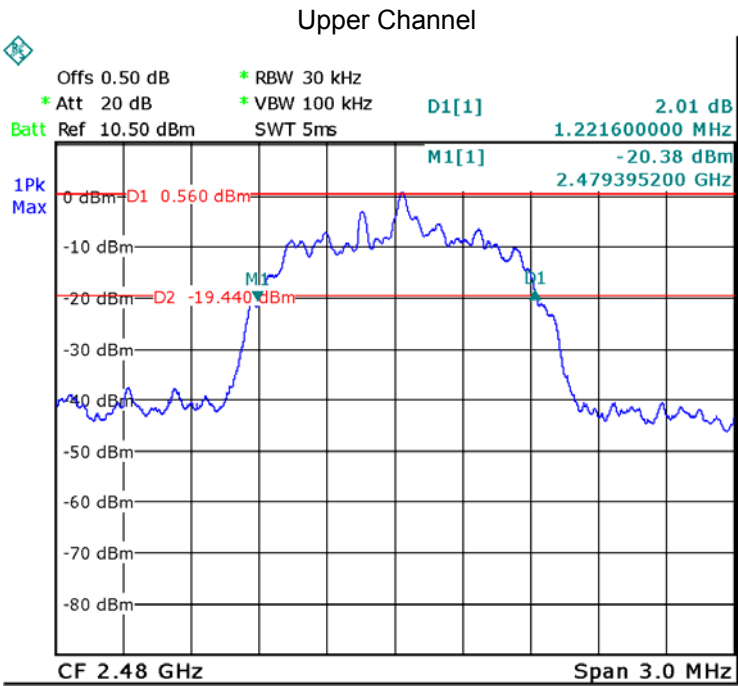
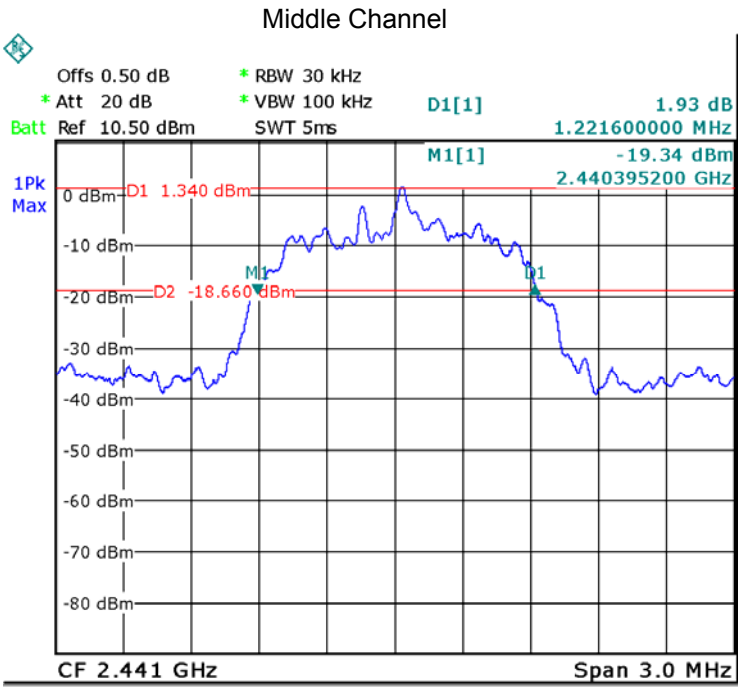
Middle Channel





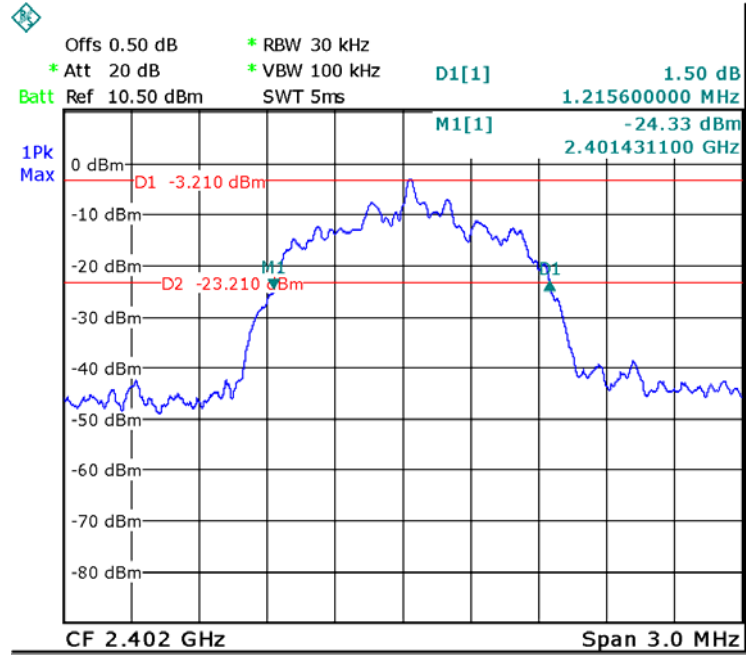
Modulation: Pi/4DQPSK



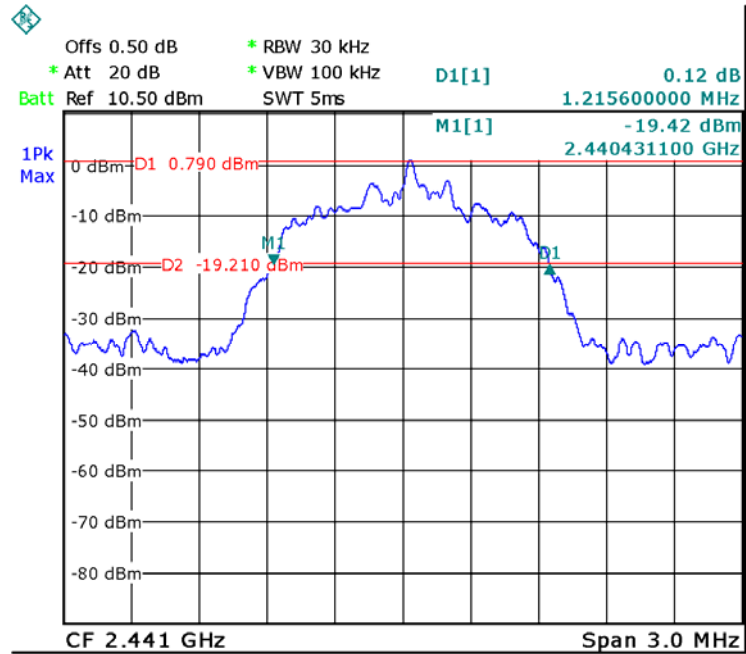


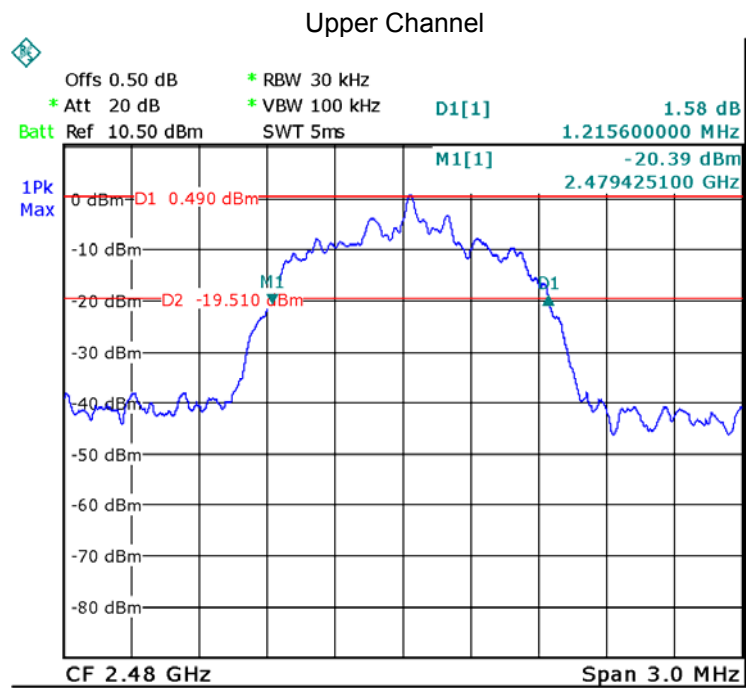
Modulation: 8DPSK

Lower Channel



Middle Channel





10 Maximum Peak Output Power

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	DA 00-705
Test Limit:	Regulation 15.247 (b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts. Refer to the result "Number of Hopping Frequency" of this document. The 1watts (30 dBm) limit applies.
Test mode:	Test in fixing frequency transmitting mode.

10.1 Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3 MHz. VBW =3 MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

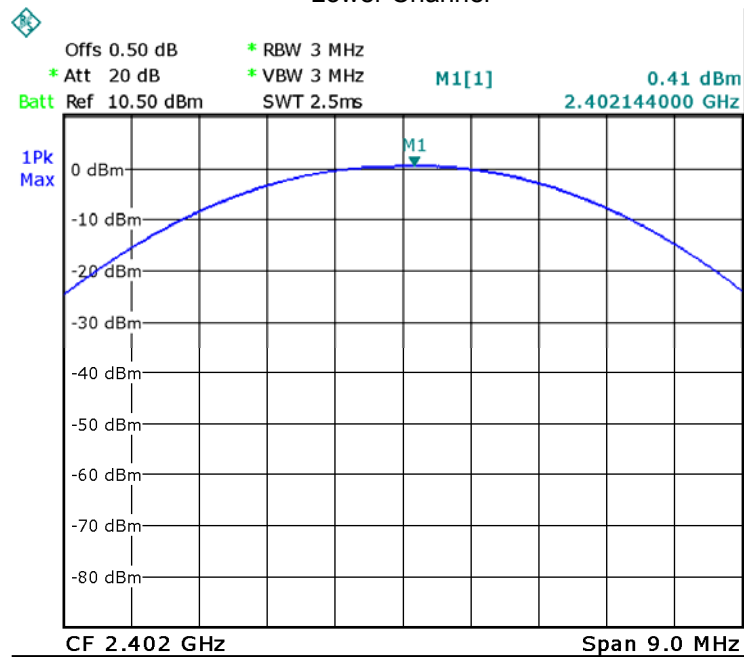
10.2 Test Result:

Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Lower	0.41	30
	Middle	3.29	30
	Upper	3.64	30
Pi/4DQPSK	Lower	-1.2	30
	Middle	2.56	30
	Upper	2.3	30
8DPSK	Lower	-0.61	30
	Middle	2.8	30
	Upper	2.66	30

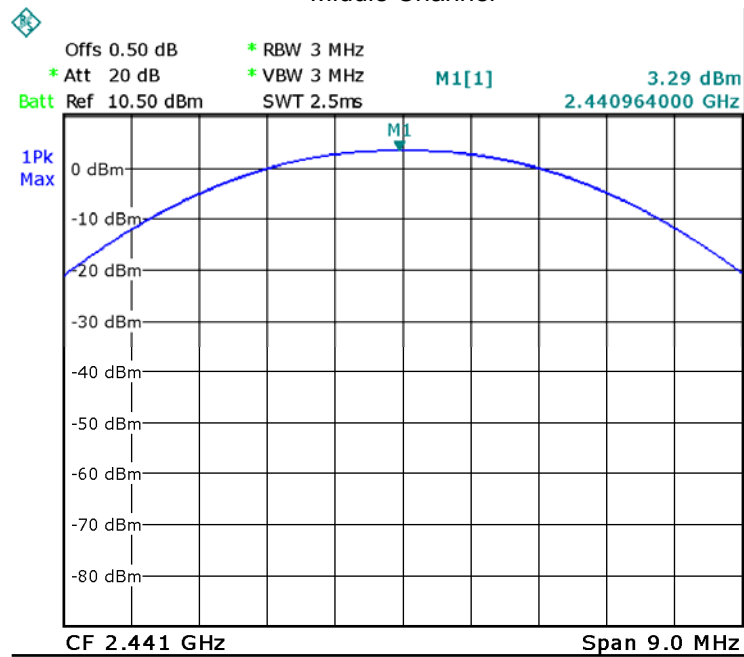
Test result plot as follows:

Modulation:GFSK

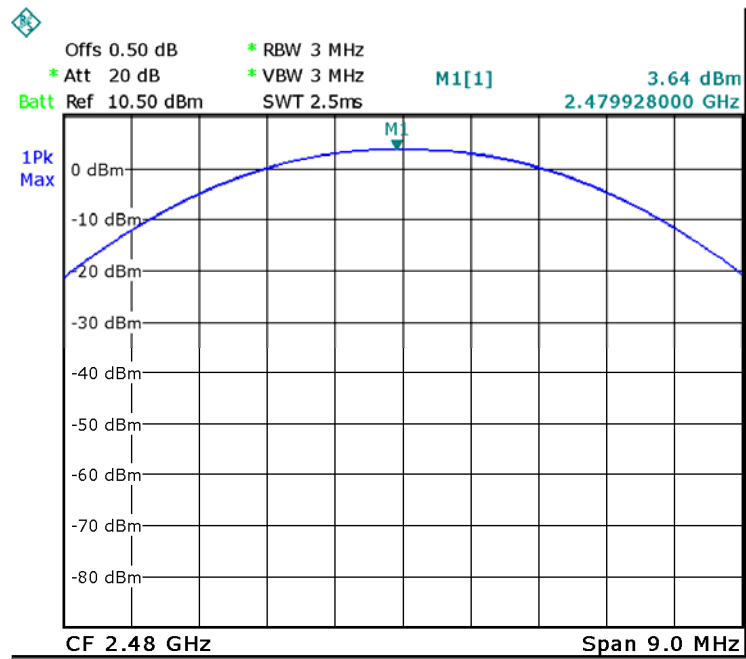
Lower Channel



Middle Channel

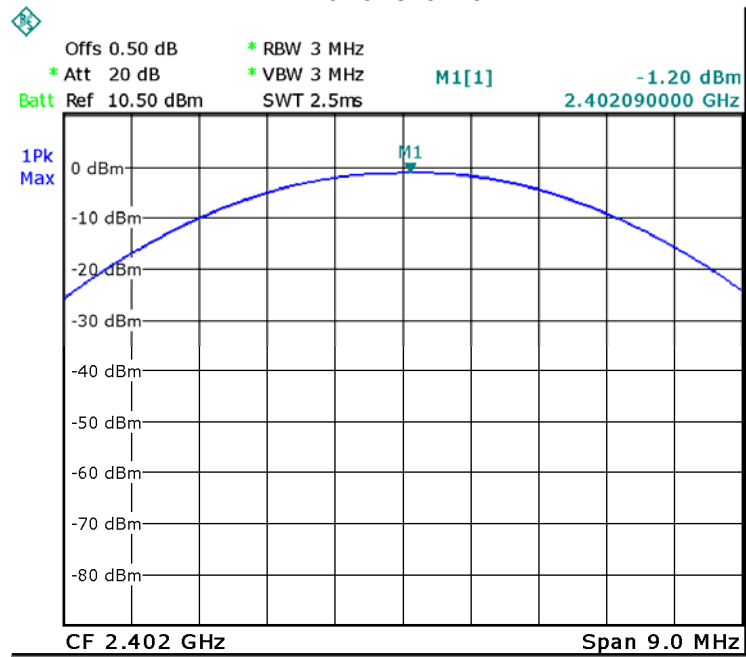


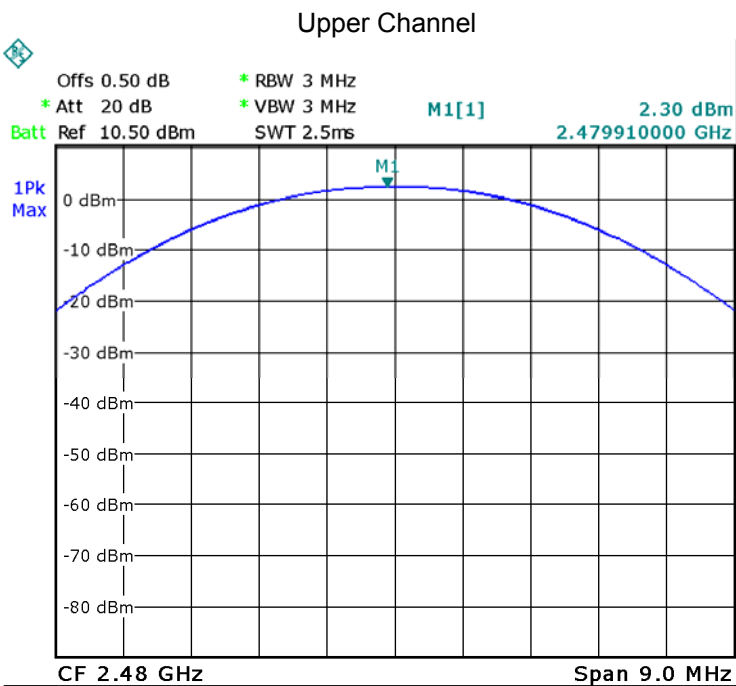
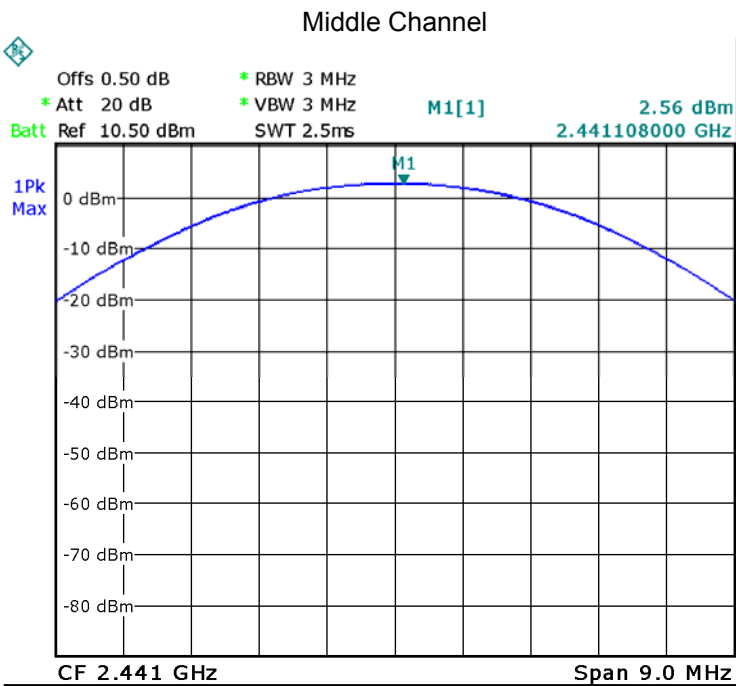
Upper Channel



Modulation: Pi/4DQPSK

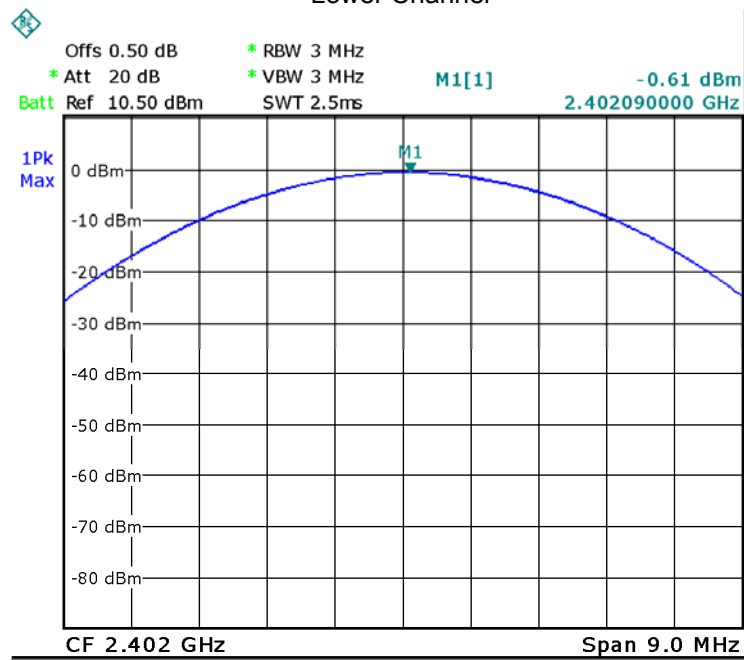
Lower Channel



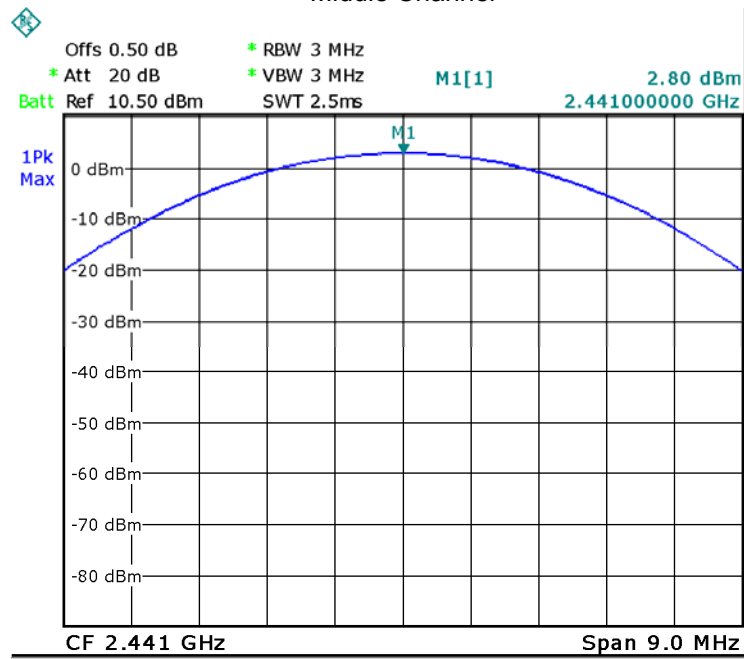


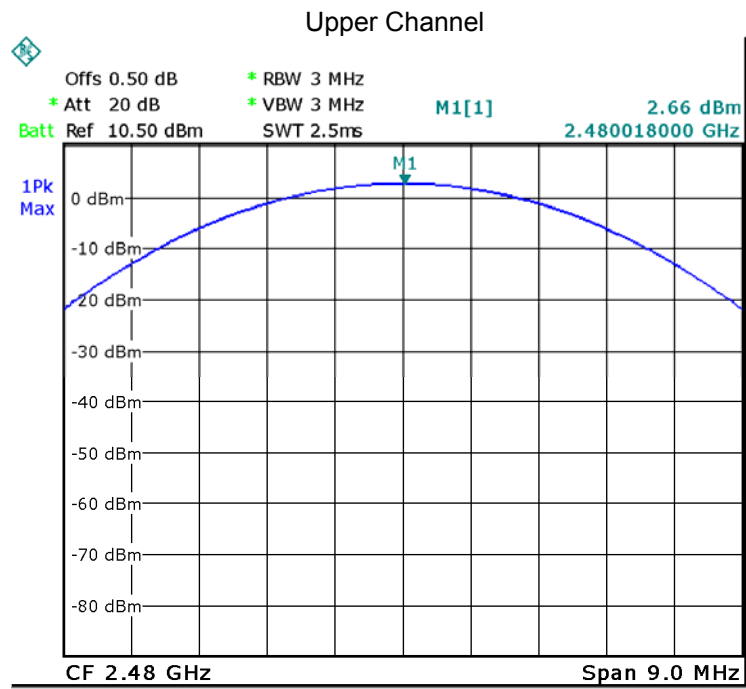
Modulation: 8DPSK

Lower Channel



Middle Channel





11 Hopping Channel Separation

Test Requirement: FCC CFR47 Part 15 Section 15.247

Test Method: DA 00-705

Test Limit: Regulation 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping 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 1W.

Test Mode: Test in hopping transmitting operating mode.

11.1 Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100KHz. VBW = 100KHz , Span = 6MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section
Submit this plot.

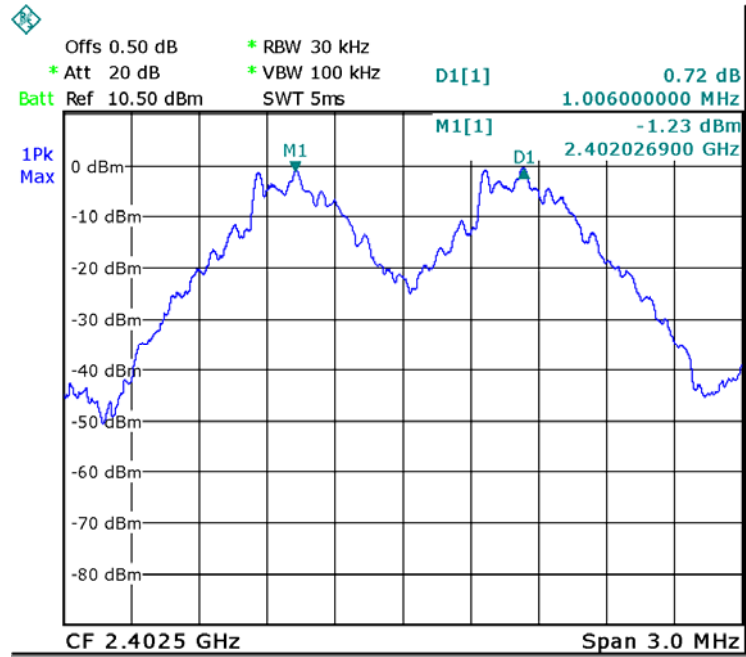
11.2 Test Result:

Modulation	Test Channel	Separation (MHz)
GFSK	Lower	1.006
	Middle	1.006
	Upper	1.006
Pi/4DQPSK	Lower	1.006
	Middle	1.006
	Upper	1.006
8DPSK	Lower	1.006
	Middle	1.006
	Upper	1.006

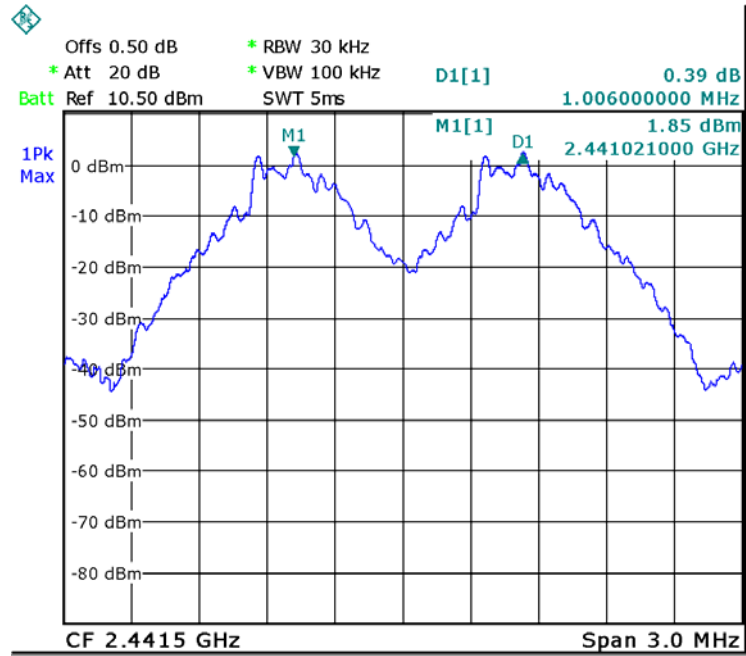
Test result plot as follows:

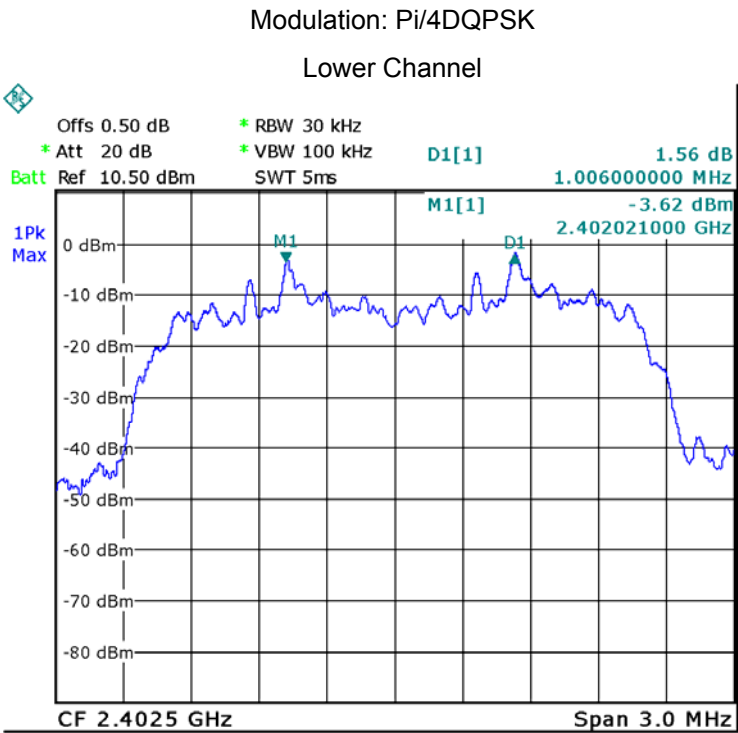
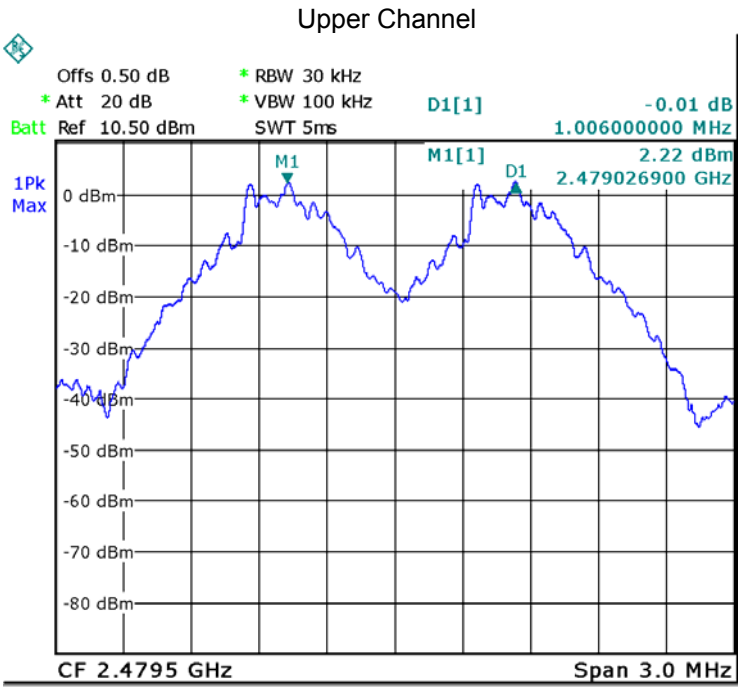
Modulation: GFSK

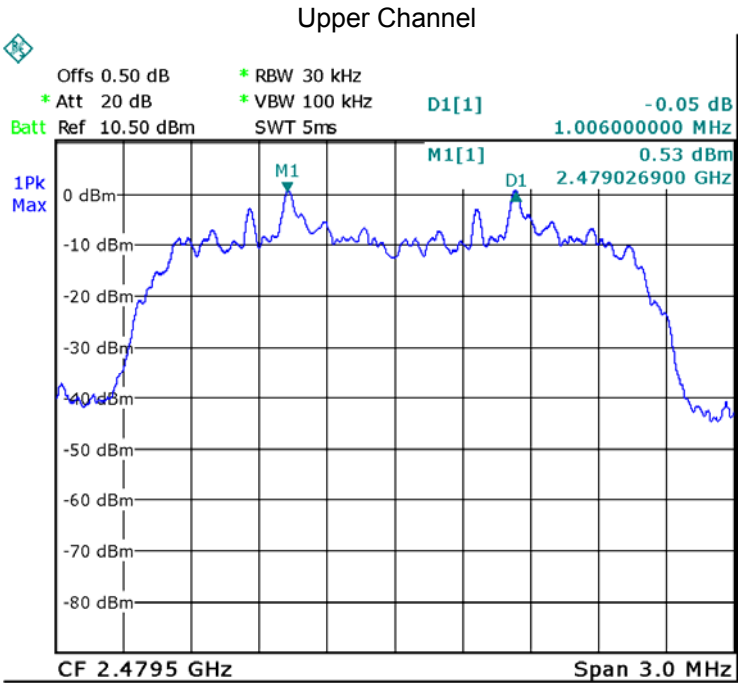
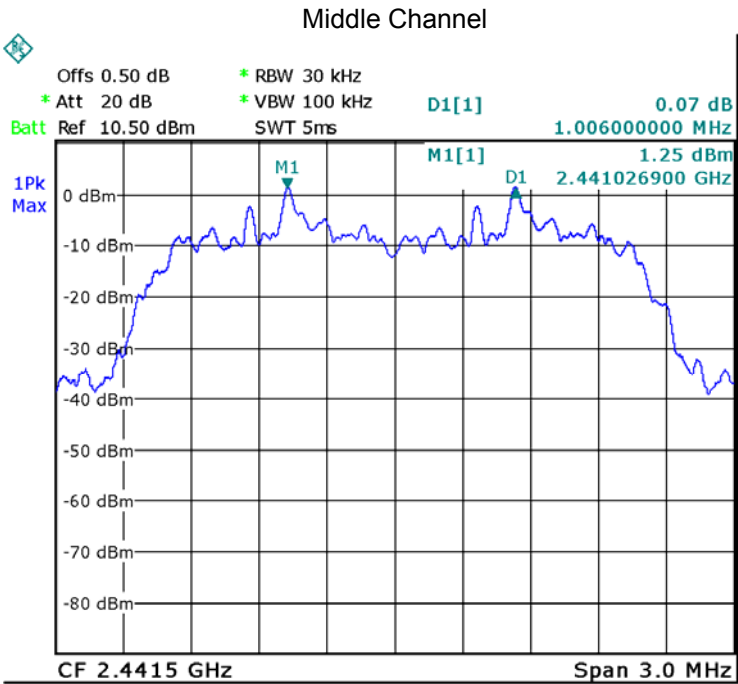
Lower Channel



Middle Channel

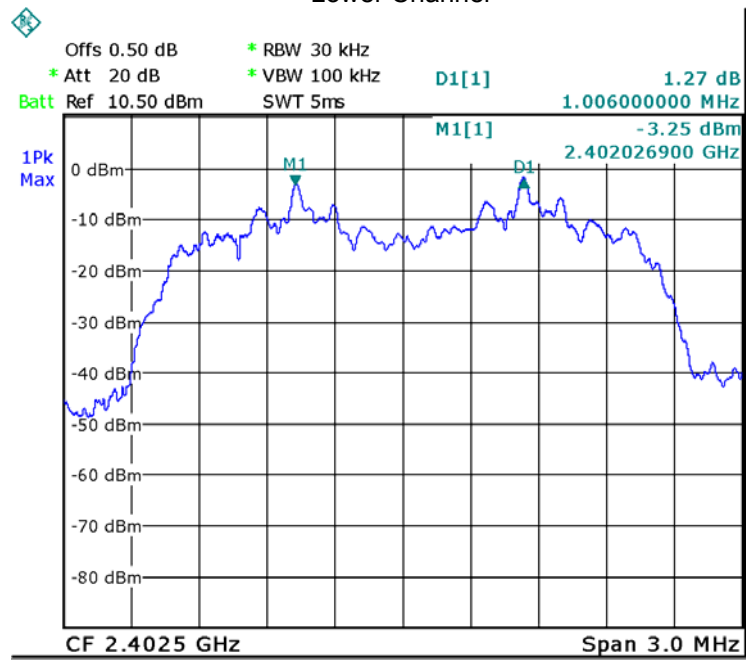




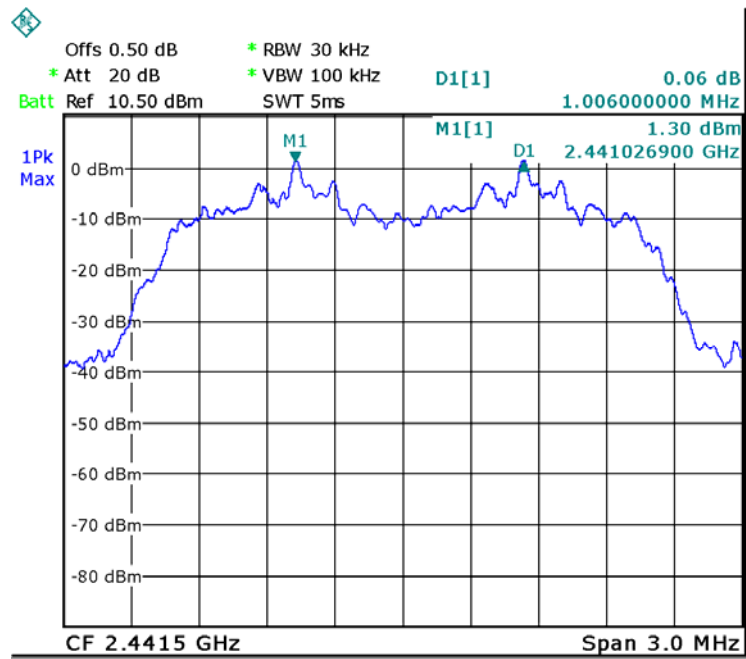


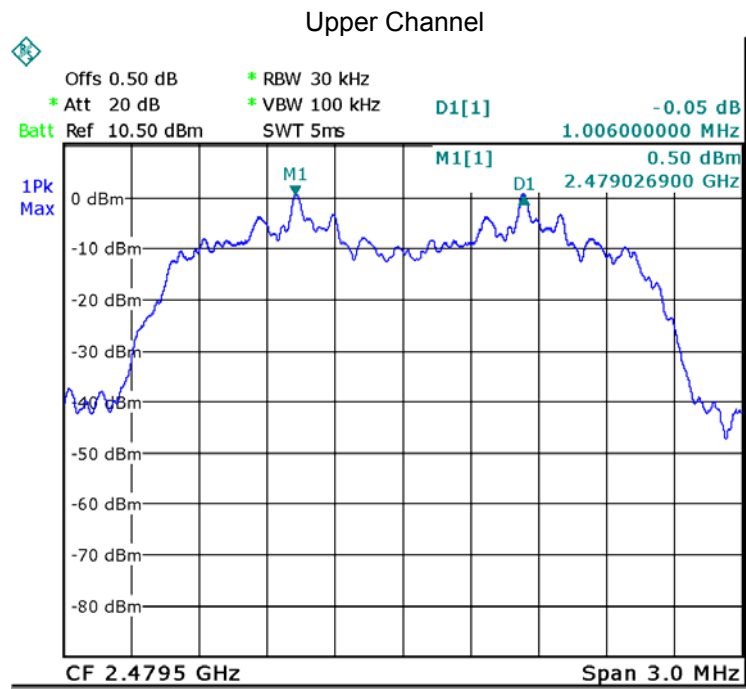
Modulation: 8DPSK

Lower Channel



Middle Channel





12 Number of Hopping Frequency

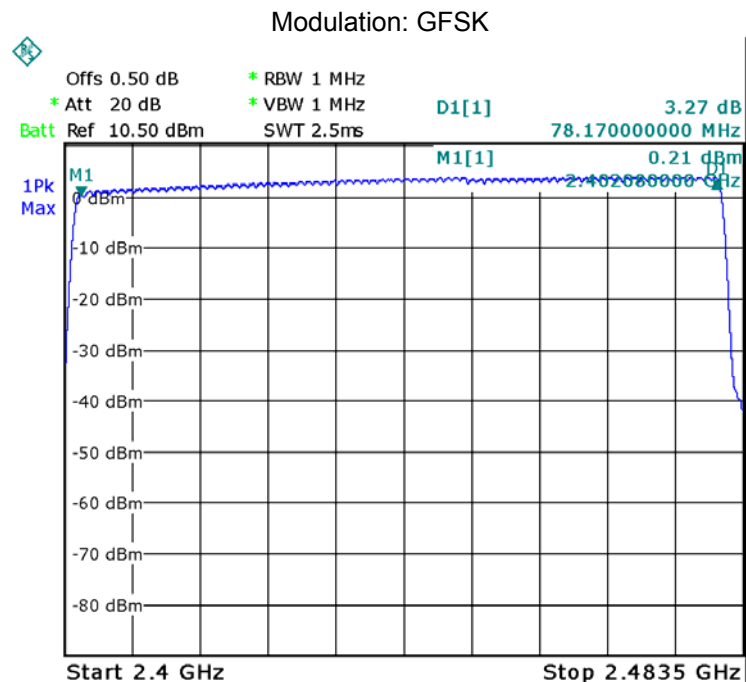
Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	DA 00-705
Test Limit:	Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Mode:	Test in hopping transmitting operating mode.

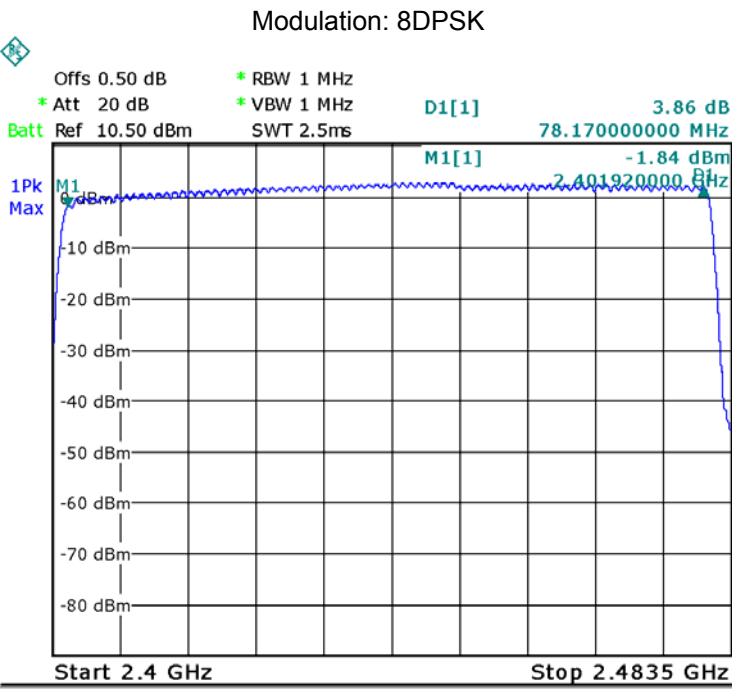
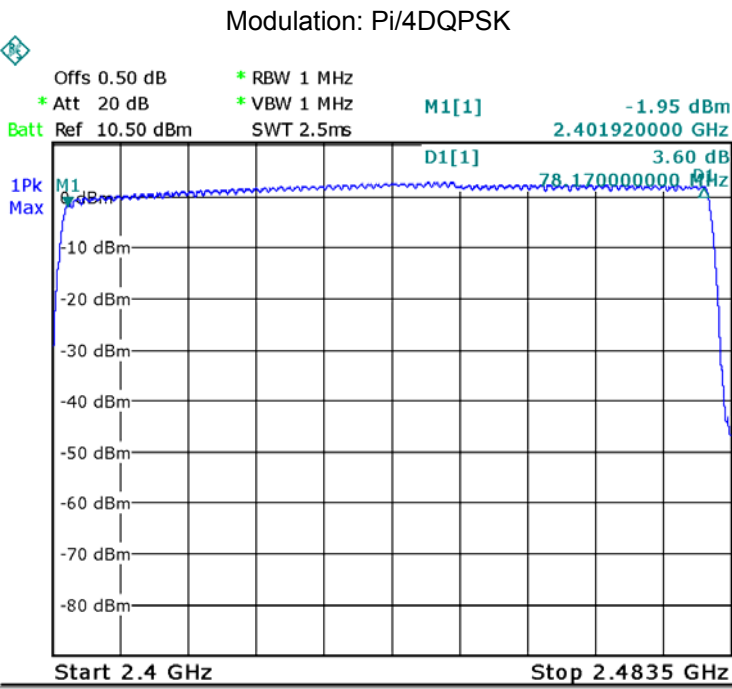
12.1 Test Procedure:

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 1MHz. VBW = 1MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Centre Frequency = 2.441GHz, Span = 86MHz. Sweep=auto;

12.2 Test Result:

Total Channels are 79 Channels.





13 Dwell Time

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	DA 00-705
Test Limit:	Regulation 15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
Test Mode:	Test in hopping transmitting operating mode.

13.1 Test Procedure:

- 1.Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
- 2.Set spectrum analyzer span = 0. centred on a hopping channel;
- 3.Set RBW = 1MHz and VBW = 1MHz. Sweep = as necessary to capture the entire dwell time per hopping channel.
- 4.Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

13.2 Test Result:

Dwell time = Pulse wide x (Hopping rate / Number of channels) x Period

The test period: $T = 0.4(s) * 79 = 31.6 (s)$

DH5 Packet permit maximum 1600 / 79 / 6 hops per second in each channel (5 time slots RX, 1 time slot TX).

DH3 Packet permit maximum 1600 / 79 / 4 hops per second in each channel (3 time slots RX, 1 time slot TX).

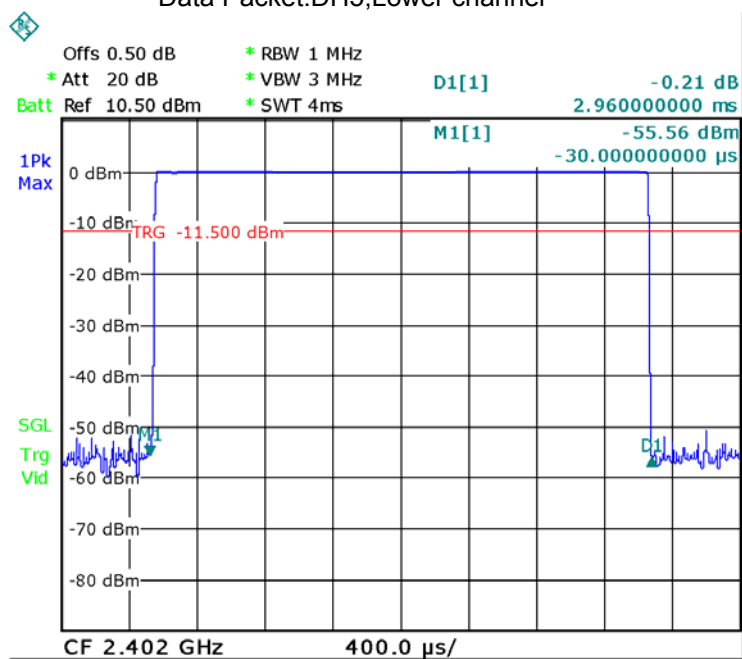
DH1 Packet permit maximum 1600 / 79 / 2 hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

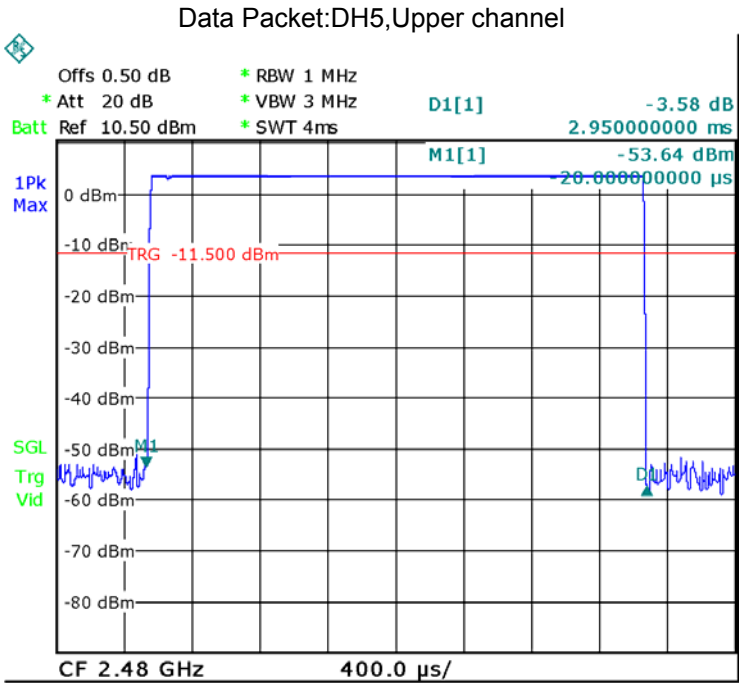
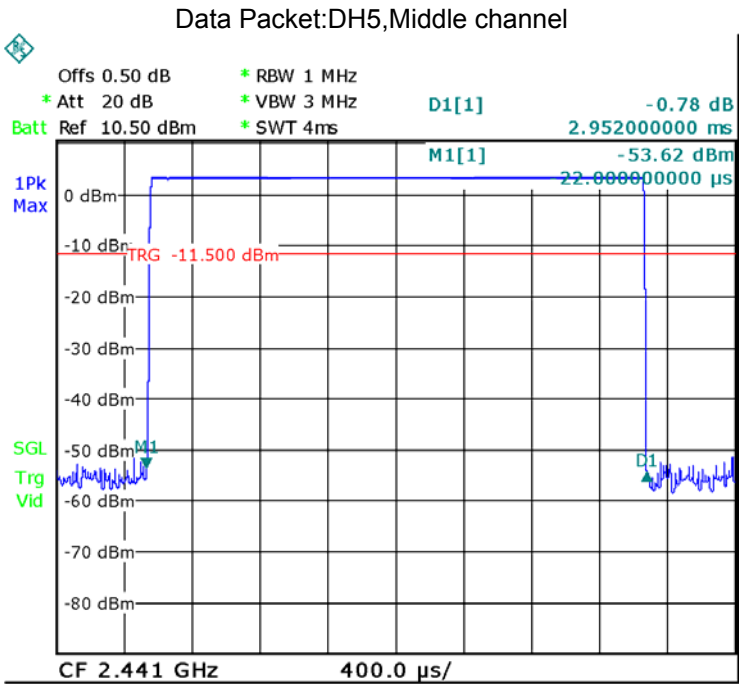
Data Packet	Dwell Time(s)
DH5	$1600/79/6*31.6*(MkrDelta)/1000$
DH3	$1600/79/4*31.6*(MkrDelta)/1000$
DH1	$1600/79/2*31.6*(MkrDelta)/1000$
Remark	Mkr Delta is once pulse time. Only the worst data(DH5) were show as follow.

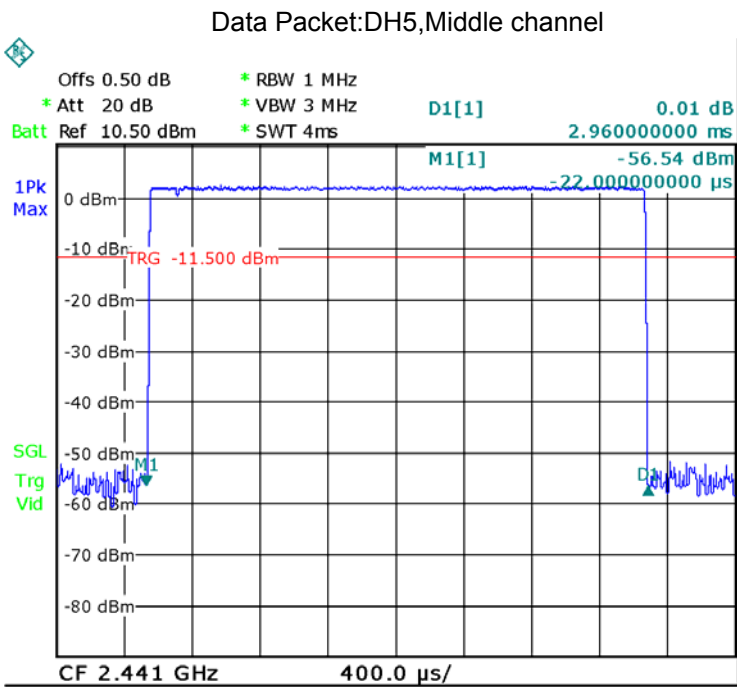
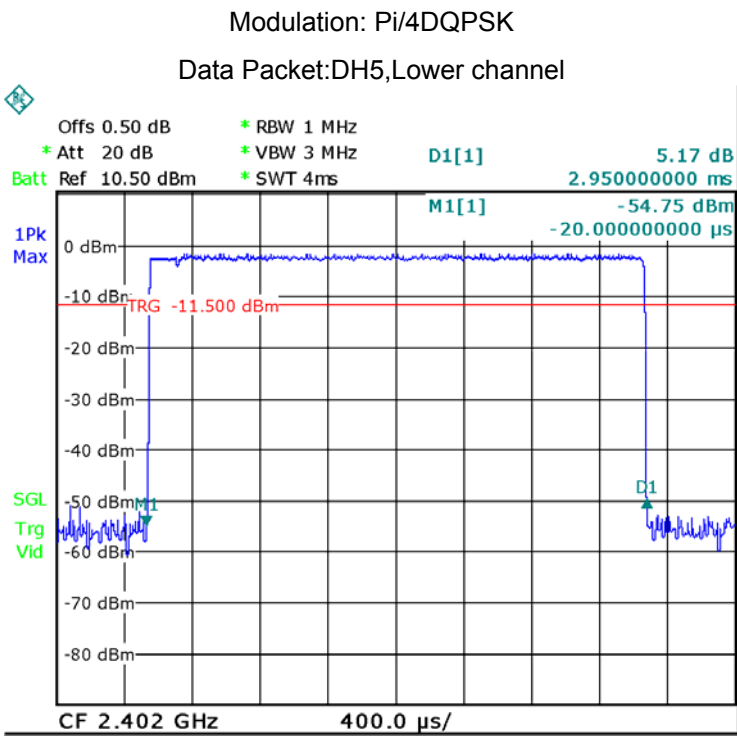
Modulation	Frequency	Data Packet	Mkr Delta(ms)	Dwell Time(s)	Limits(s)
GFSK	Lower channel	DH5	2.960	0.316	0.400
	Middle channel		2.952	0.315	0.400
	Upper channel		2.950	0.315	0.400
Pi/4DQPSK	Lower channel	DH5	2.950	0.315	0.400
	Middle channel		2.960	0.316	0.400
	Upper channel		2.960	0.316	0.400
8DPSK	Lower channel	DH5	2.960	0.316	0.400
	Middle channel		2.964	0.316	0.400
	Upper channel		2.972	0.317	0.400

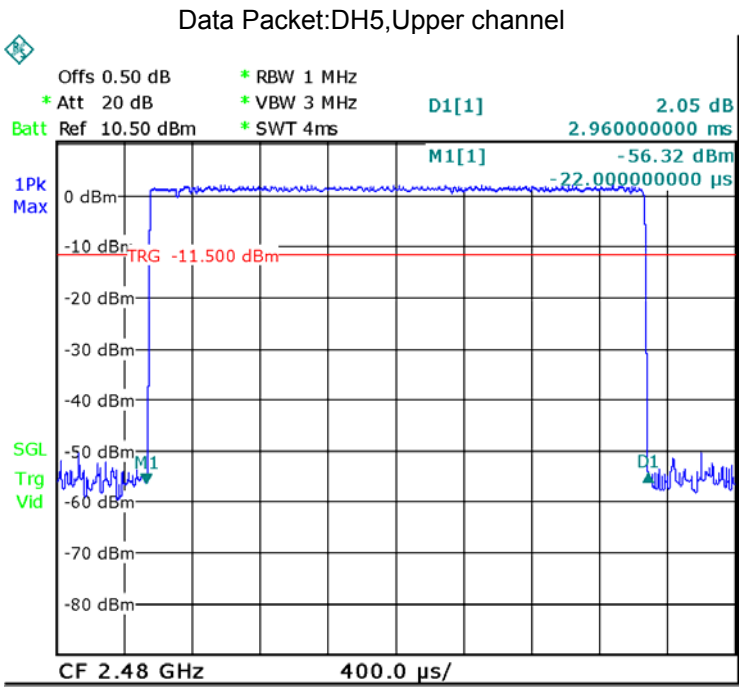
Modulation: GFSK

Data Packet:DH5,Lower channel

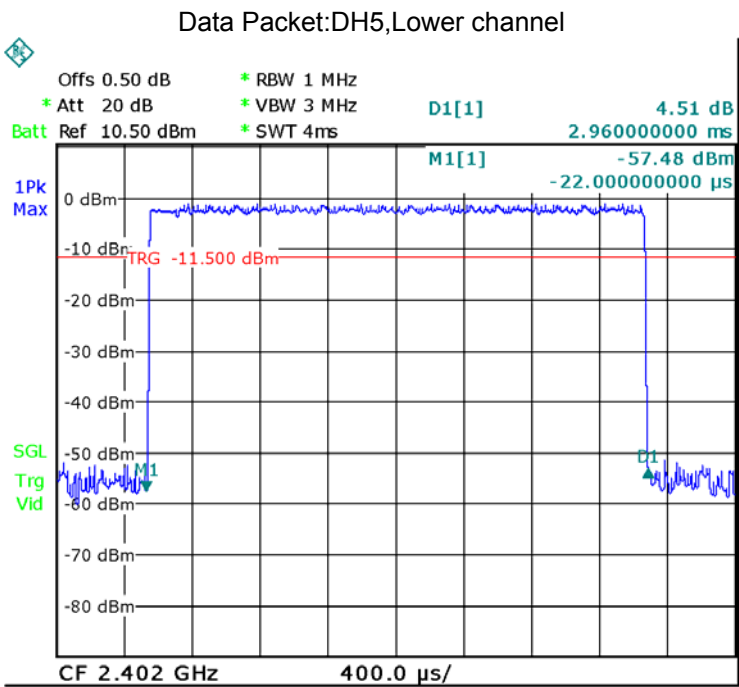


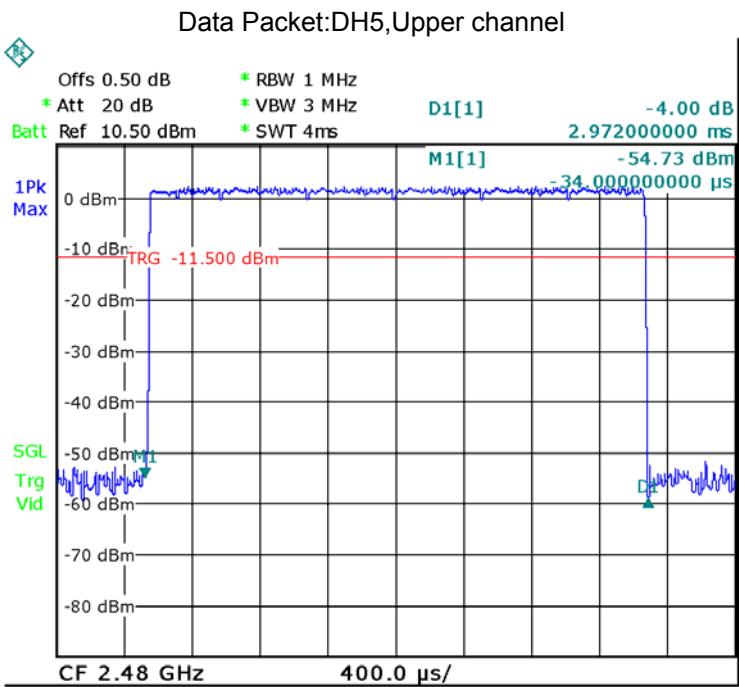
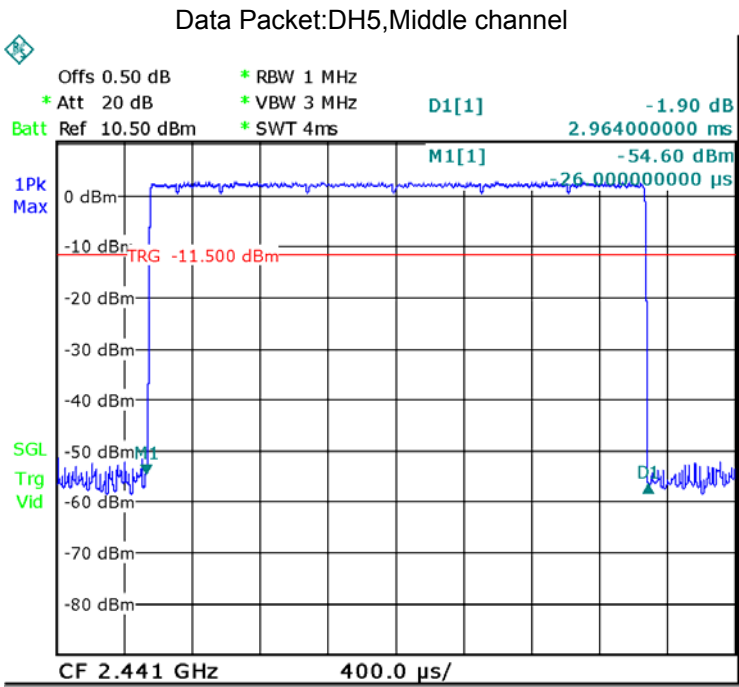






Modulation: 8DPSK





14 Antenna Requirement

According to the FCC Part 15 Paragraph 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. This product has a Copper foil antenna, fulfill the requirement of this section.

15 RF Exposure

Test Requirement: FCC Part 1.1307

Test Mode: The EUT work in test mode(Tx).

15.1 Requirements:

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2 m normally can be maintained between the user and the device.

15.2 The procedures / limit

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	6
30-300	61.4	0.163	1.0	6
300-1500			F/300	6
1500-100,000			5	6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30

Note: f = frequency in MHz ; *Plane-wave equivalent power density

15.3 MPE Calculation Method

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d} \quad \text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = Peak RF output power (W)

G = EUT Antenna numeric gain (numeric) , $\text{Gain}_{\text{numeric}} = 10^{(\text{dBi}/10)}$

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

From the peak EUT RF output power, the minimum mobile separation distance, $d=0.2\text{m}$, as well as the gain of the used antenna, the RF power density can be obtained

Modulation	Antenna Gain (dBi)	Antenna Gain (numeric)	Max. Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)
GFSK	2.11	1.626	3.64	2.312	0.000748	1
Pi/4DQPSK	2.11	1.626	2.56	1.803	0.000583	1
8DPSK	2.11	1.626	2.8	1.905	0.000616	1

16 Photographs – Test Setup

16.1 Conducted Emissions



16.2 Radiated Emissions

Below 30MHz



From 30-1000MHz



Above 1GHz



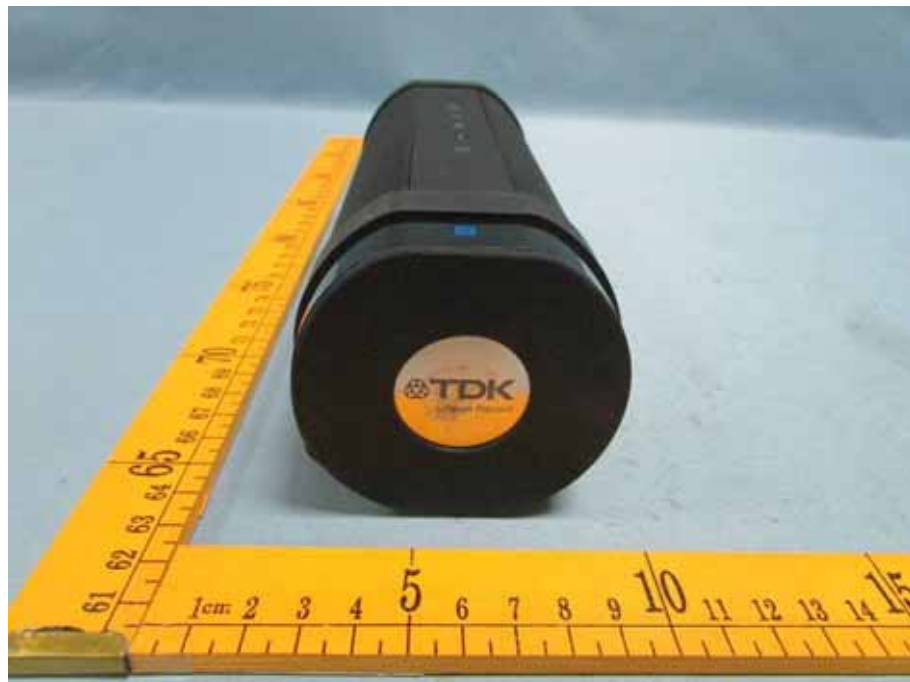
17 Photographs - Constructional Details

17.1 EUT –Black Sample Appearance View









17.2 EUT –Grey Sample Appearance View









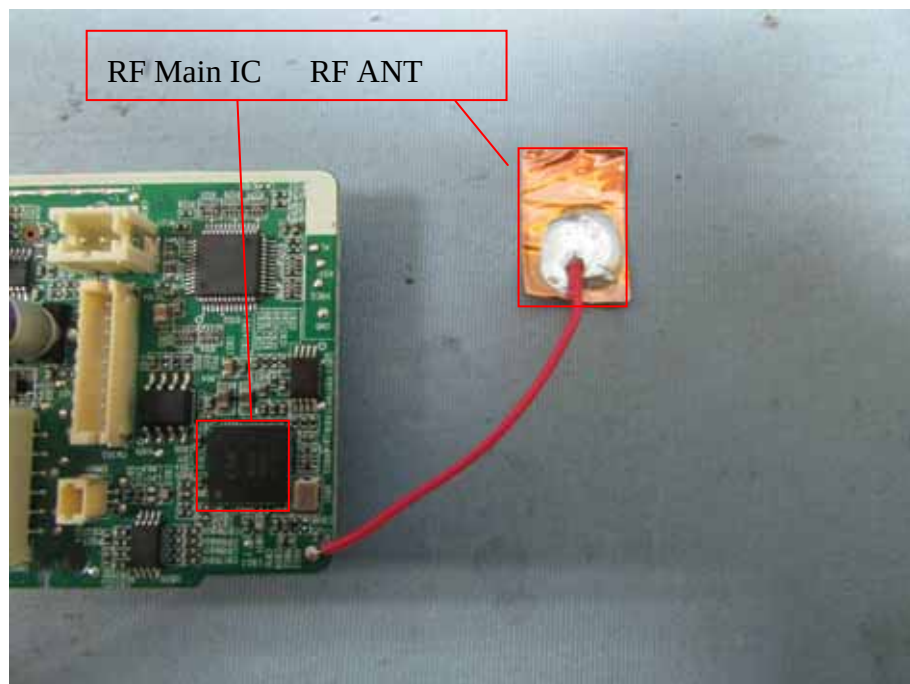
17.3 EUT –Open View

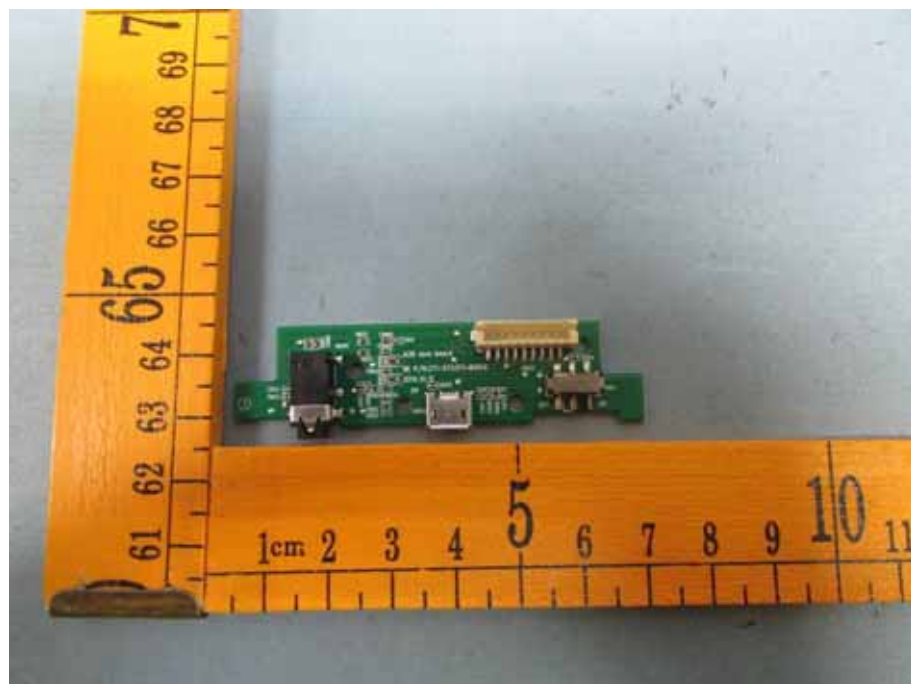
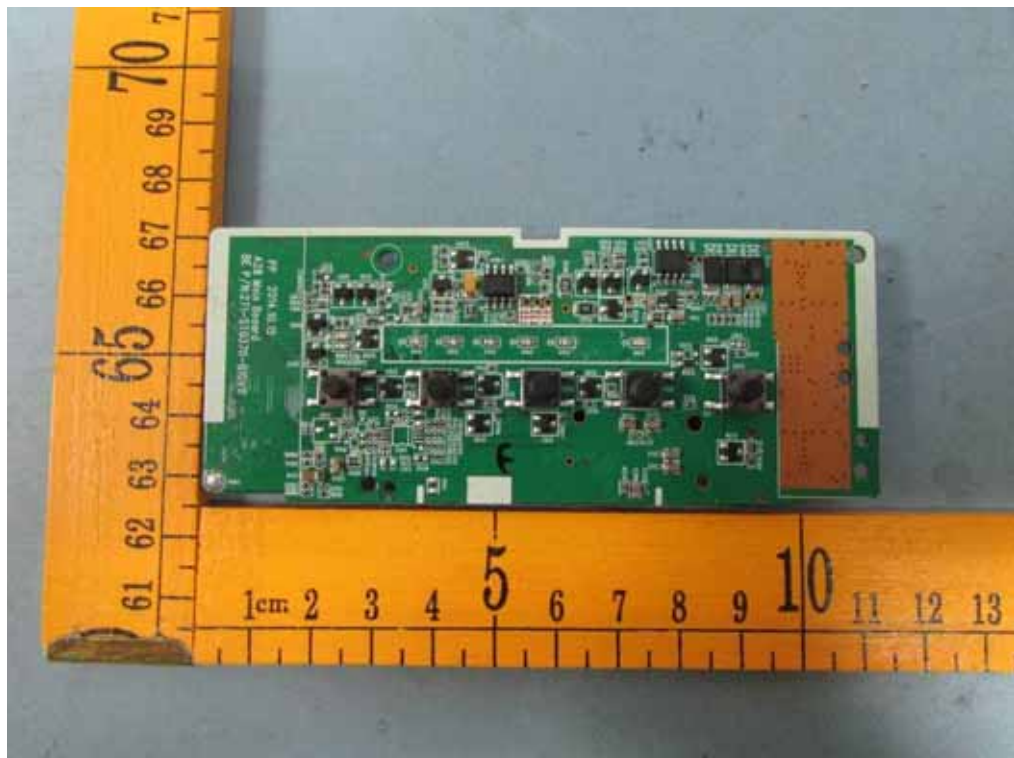
Black

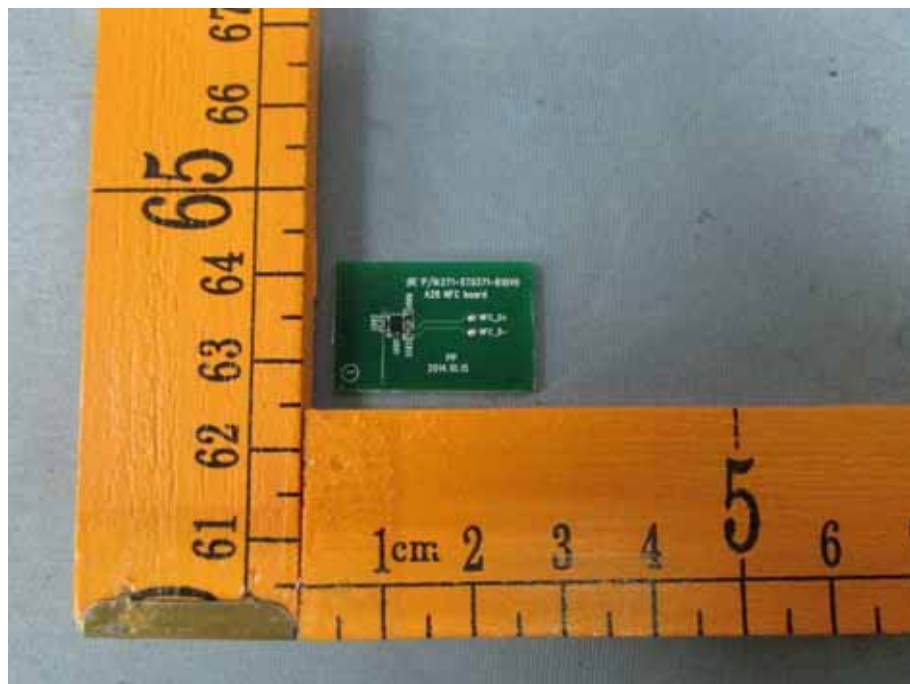
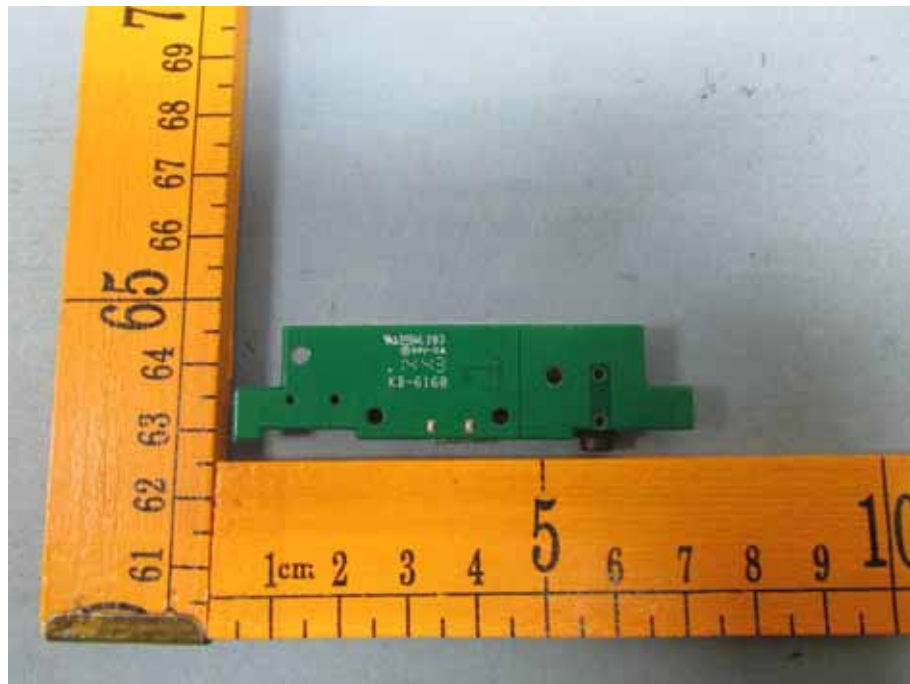


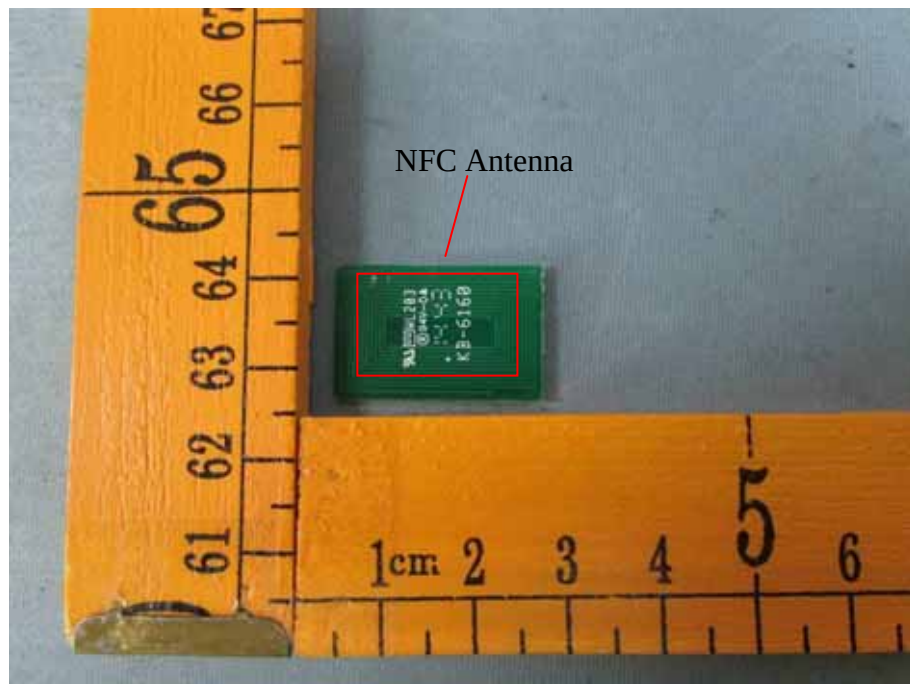
Grey











=====End of Report=====