

TEST REPORT

Reference No..... : WTS16S0448158E
FCC ID : 2AIO2-F1
Applicant..... : Dellking Industrial Co., Ltd
Address..... : 2F, Building D, No 3, Ganli 2nd Road, Buji, Longgang District,
Shenzhen, China
Manufacturer : The same as above
Address..... : The same as above
Product Name..... : Helmet Bluetooth headset
Model No : F1
Standards..... : FCC CFR47 Part 15 Section 15.247:2015
Date of Receipt sample : Apr. 18, 2016
Date of Test : Apr. 19 – May 24, 2016
Date of Issue..... : May 27, 2015
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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Approved by:



Philo Zhong / Manager

2 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	PASS
Band edge	15.247(d) 15.205(a)	PASS
Conduct Emission	15.207	PASS
Bandwidth	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 Report Revision History

Report No.	Report Version	Description	Issue Date
WTS16S0448158E	NONE	Original	May 27, 2016

5 General Information

5.1 General Description of E.U.T.

Product Name:	Helmet Bluetooth headset
Model No.:	F1
Model Description:	N/A
Operation Frequency:	2402MHz ~ 2480MHz, 79 channels in total
Bluetooth Version:	Bluetooth v3.0
Type of Modulation:	GFSK, Pi/4DQPSK, 8DPSK
The lowest oscillator:	16 MHz
Antenna installation:	PCB printed antenna
Antenna Gain:	3dBi

5.2 Details of E.U.T.

Technical Data:	DC 3.7V , 430mA Power by battery
	DC 5V with USB port by PC

5.3 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	2402	1	2403	2	2404	3	2405
4	2406	5	2407	6	2408	7	2409
8	2410	9	2411	10	2412	11	2413
12	2414	13	2415	14	2416	15	2417
16	2418	17	2419	18	2420	19	2421
20	2422	21	2423	22	2424	23	2425
24	2426	25	2427	26	2428	27	2429
28	2430	29	2431	30	2432	31	2433
32	2434	33	2435	34	2436	35	2437
36	2438	37	2439	38	2440	39	2441
40	2442	41	2443	42	2444	43	2445
44	2446	45	2447	46	2448	47	2449
48	2450	49	2451	50	2452	51	2453
52	2454	53	2455	54	2456	55	2457
56	2458	57	2459	58	2460	59	2461
60	2462	61	2463	62	2464	63	2465
64	2466	65	2467	66	2468	67	2469
68	2470	69	2471	70	2472	71	2473
72	2474	73	2475	74	2476	75	2477
76	2478	77	2479	78	2480	-	-

5.4 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode	Low channel	Middle channel	High channel
Transmitting	2402MHz	2441MHz	2480MHz

5.5 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, October 15, 2015
- **FCC Test Site 1#– 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.
- **FCC Test Site 2#– Registration No.: 328995**
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 328995, December 3, 2014.

6 Equipment Used during Test

6.1 Equipments List

Conducted Emissions Test Site 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMI Test Receiver	R&S	ESCI	100947	Sep.15,2015	Sep.14,2016
2.	LISN	R&S	ENV216	101215	Sep.15,2015	Sep.14,2016
3.	Cable	Top	TYPE16(3.5M)	-	Sep.15,2015	Sep.14,2016
Conducted Emissions Test Site 2#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMI Test Receiver	R&S	ESCI	101155	Sep.15,2015	Sep.14,2016
2.	LISN	SCHWARZBECK	NSLK 8128	8128-289	Sep.15,2015	Sep.14,2016
3.	Limiter	York	MTS-IMP-136	261115-001-0024	Sep.15,2015	Sep.14,2016
4.	Cable	LARGE	RF300	-	Sep.15,2015	Sep.14,2016
3m Semi-anechoic Chamber for Radiation Emissions Test site 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	EMC Analyzer	Agilent	E7405A	MY45114943	Sep.15,2015	Sep.14,2016
2	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	Sep.15,2015	Sep.14,2016
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Apr.19,2016	Apr.18,2017
4	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.15,2015	Sep.14,2016
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr.19,2016	Apr.18,2017
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	Apr.19,2016	Apr.18,2017
7	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Mar.17,2016	Mar.16,2017
8	Coaxial Cable (above 1GHz)	Top	1GHz-25GHz	EW02014-7	Apr.10,2016	Apr.09,2017
3m Semi-anechoic Chamber for Radiation Emissions Test site 2#						
Item	Equipment	Manufacturer	Model No.	Serial No	Last Calibration Date	Calibration Due Date
1	Test Receiver	R&S	ESCI	101296	Sep.15,2015	Sep.14,2016
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	Sep.15,2015	Sep.14,2016
3	Amplifier	Compliance pirection systems inc	PAP-0203	22024	Sep.15,2015	Sep.14,2016
4	Cable	HUBER+SUHNER	CBL2	525178	Sep.15,2015	Sep.14,2016

RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMC Analyzer (9k~26.5GHz)	Agilent	E7405A	MY45114943	Sep.15,2015	Sep.14,2016
2.	Spectrum Analyzer (9k-6GHz)	R&S	FSL6	100959	Sep.15,2015	Sep.14,2016
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	Sep.15,2015	Sep.14,2016

6.2 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-6}$
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Radiated Spurious Emissions test	± 5.03 dB (Bilog antenna 30M~1000MHz)
	± 5.47 dB (Horn antenna 1000M~25000MHz)
Conducted Spurious Emissions test	± 3.64 dB (AC mains 150KHz~30MHz)

6.3 Test Equipment Calibration

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

7 Conducted Emission

Test Requirement:	FCC CFR 47 Part 15 Section 15.207
Test Method:	ANSI C63.10:2013
Test Result:	PASS
Frequency Range:	150kHz to 30MHz
Class/Severity:	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)

7.1 E.U.T. Operation

Operating Environment :

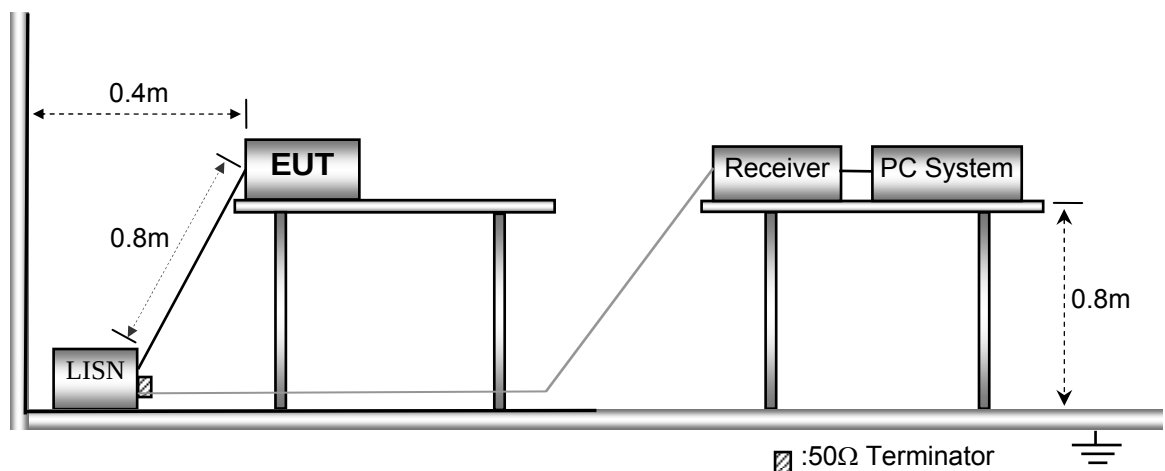
Temperature:	25.5 °C
Humidity:	51 % RH
Atmospheric Pressure:	101.2kPa

EUT Operation :

The test was performed in transmitting mode, the test data were shown in the report.

7.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013.

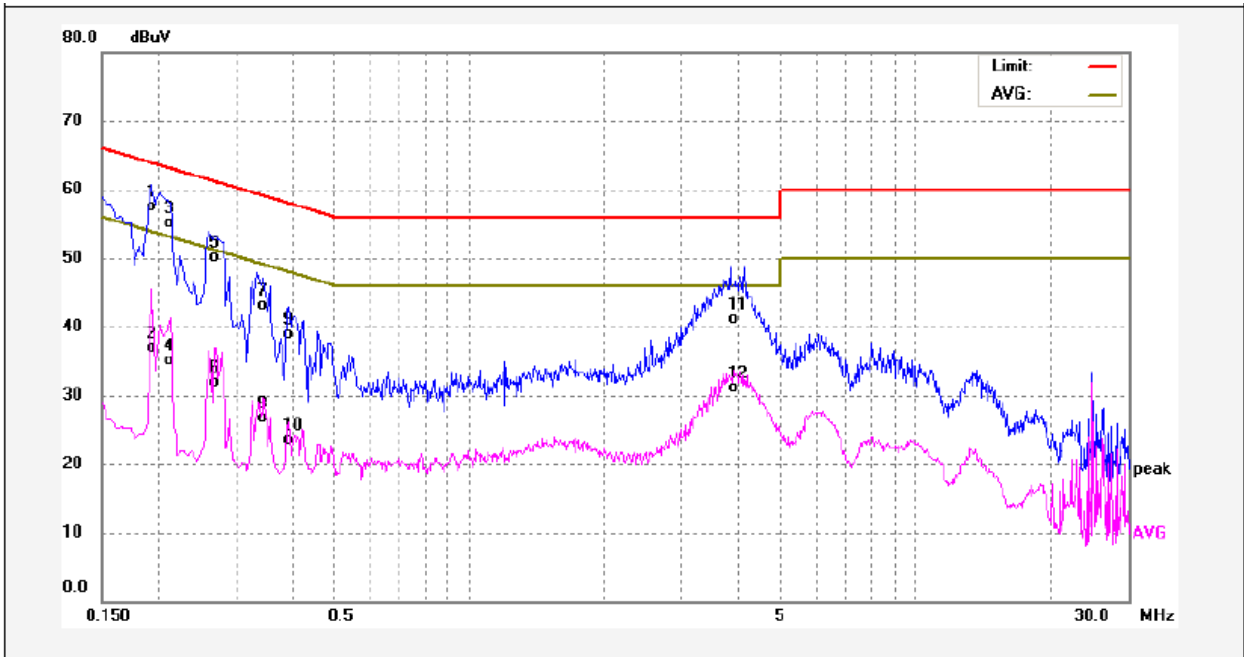


7.3 Measurement Description

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.

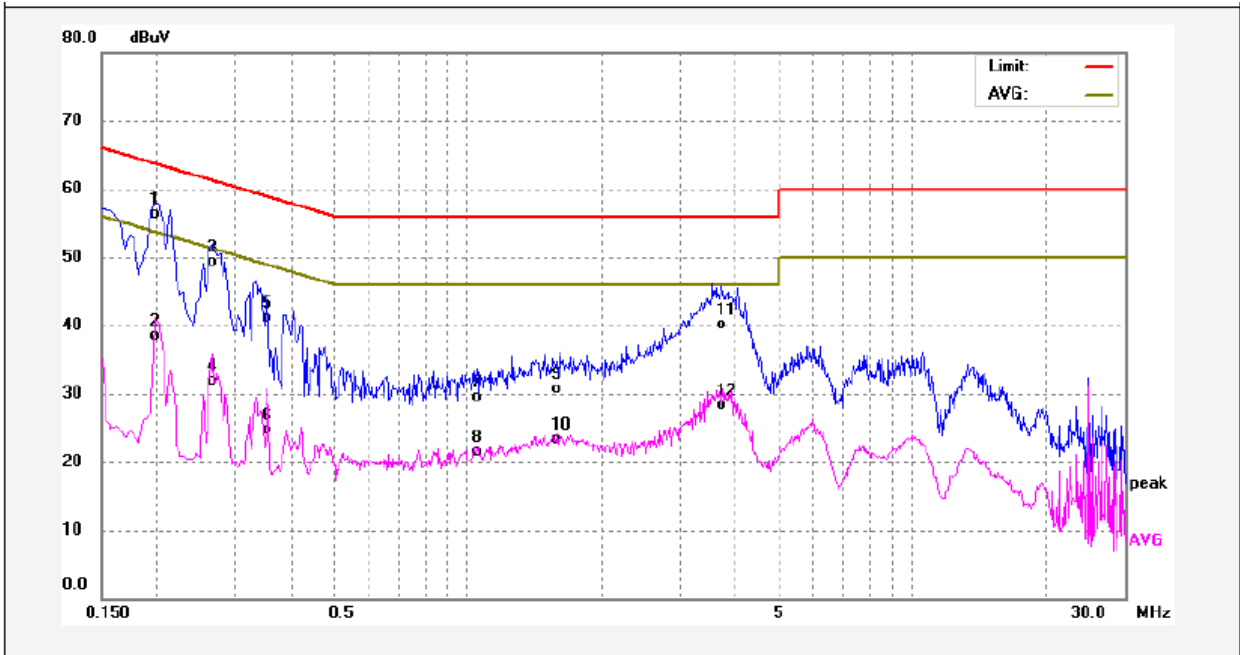
7.4 Conducted Emission Test Result

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1940	47.34	10.26	57.60	63.86	-6.26	QP	
2	0.1940	26.70	10.26	36.96	53.86	-16.90	AVG	
3	0.2140	44.92	10.26	55.18	63.04	-7.86	QP	
4	0.2140	24.84	10.26	35.10	53.04	-17.94	AVG	
5	0.2700	39.91	10.27	50.18	61.12	-10.94	QP	
6	0.2700	21.66	10.27	31.93	51.12	-19.19	AVG	
7	0.3460	32.85	10.29	43.14	59.06	-15.92	QP	
8	0.3460	16.39	10.29	26.68	49.06	-22.38	AVG	
9	0.3940	28.62	10.27	38.89	57.98	-19.09	QP	
10	0.3940	13.32	10.27	23.59	47.98	-24.39	AVG	
11	3.9060	30.68	10.51	41.19	56.00	-14.81	QP	
12	3.9060	20.59	10.51	31.10	46.00	-14.90	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1980	46.00	10.26	56.26	63.69	-7.43	QP	
2	0.1980	28.21	10.26	38.47	53.69	-15.22	AVG	
3	0.2660	38.96	10.27	49.23	61.24	-12.01	QP	
4	0.2660	21.63	10.27	31.90	51.24	-19.34	AVG	
5	0.3540	30.91	10.29	41.20	58.87	-17.67	QP	
6	0.3540	14.32	10.29	24.61	48.87	-24.26	AVG	
7	1.0580	19.16	10.40	29.56	56.00	-26.44	QP	
8	1.0580	11.14	10.40	21.54	46.00	-24.46	AVG	
9	1.5900	20.26	10.44	30.70	56.00	-25.30	QP	
10	1.5900	12.96	10.44	23.40	46.00	-22.60	AVG	
11	3.7500	29.61	10.51	40.12	56.00	-15.88	QP	
12	3.7500	17.77	10.51	28.28	46.00	-17.72	AVG	

8 Radiated Spurious Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method: ANSI C63.10:2013

Test Result: PASS

Measurement Distance: 3m

Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Distance	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	24000/F(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	$20\log^{(500)}$

8.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

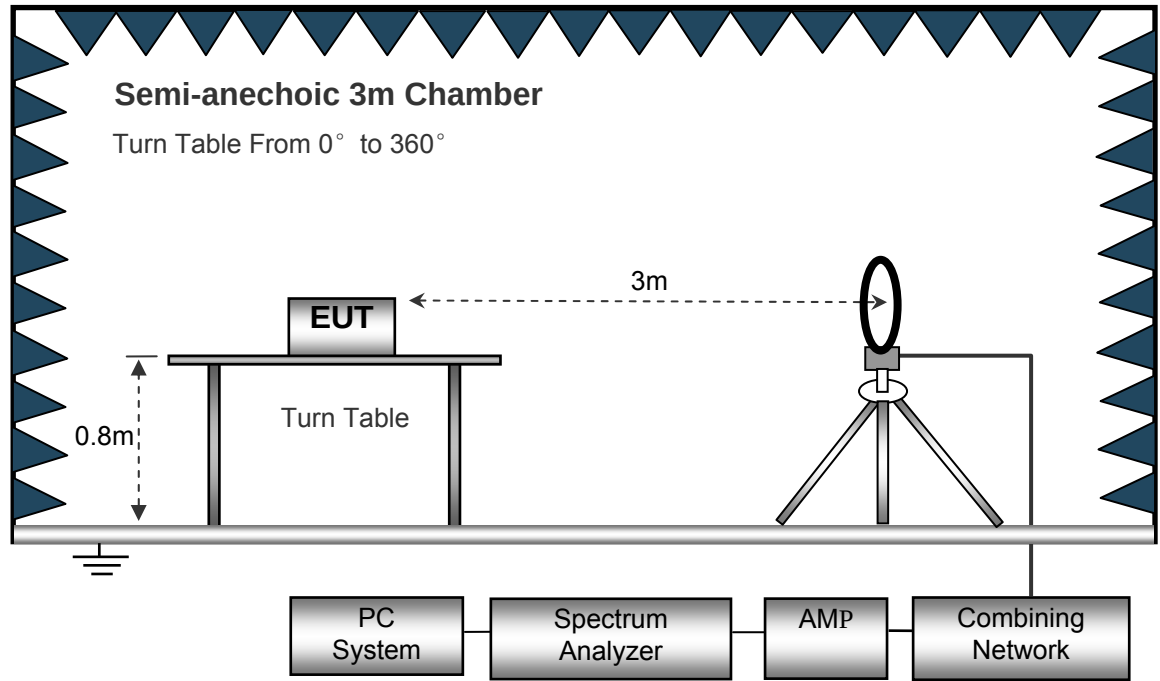
EUT Operation :

The test was performed in transmitting mode, the test data were shown in the report.

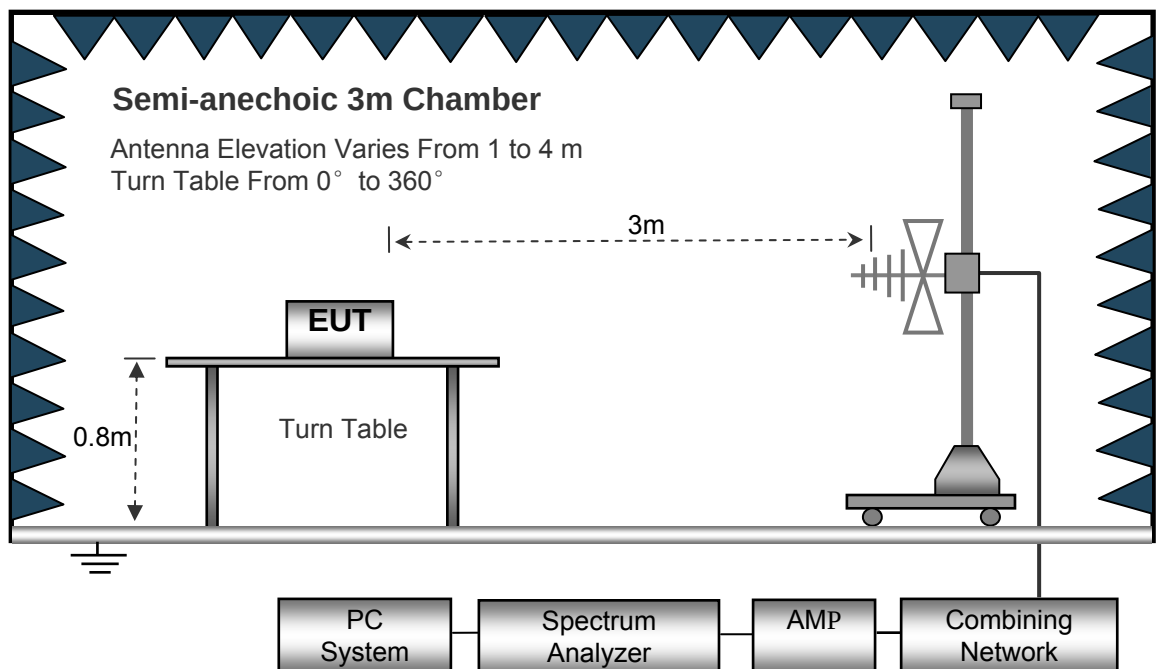
8.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10:2013.

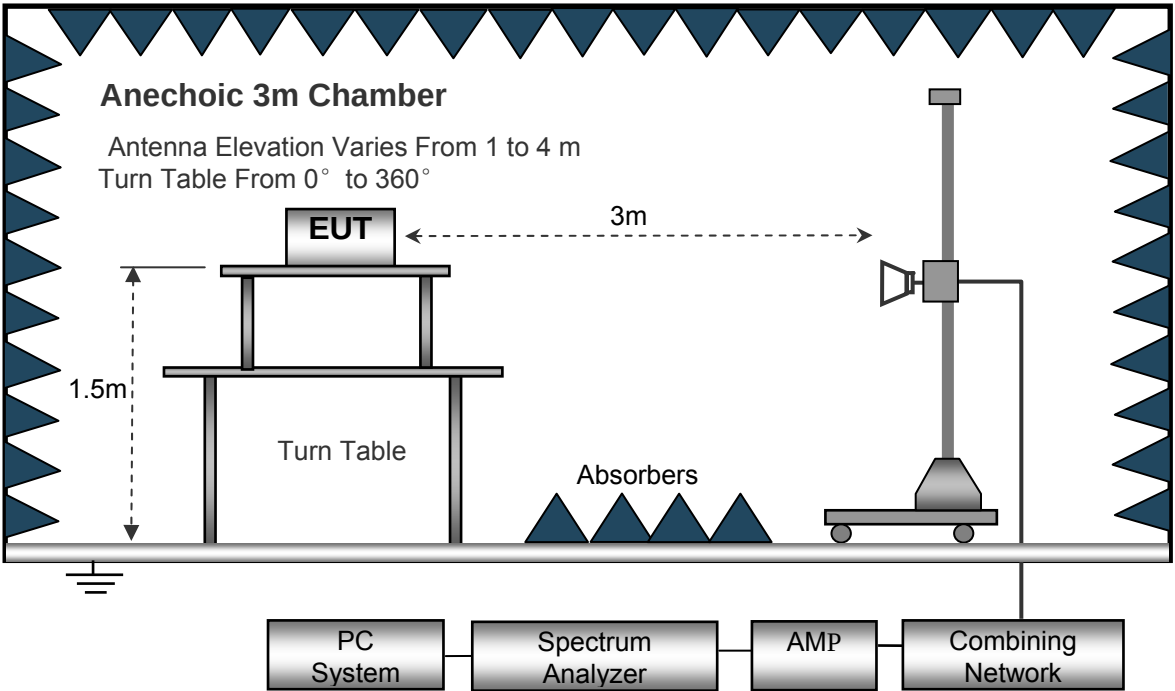
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



8.3 Spectrum Analyzer Setup

- Below 30MHz
- Sweep Speed Auto
 - IF Bandwidth.....10kHz
 - Video Bandwidth.....10kHz
 - Resolution Bandwidth.....10kHz
- 30MHz ~ 1GHz
- Sweep Speed Auto
 - DetectorPK
 - Resolution Bandwidth.....100kHz
 - Video Bandwidth.....300kHz
- Above 1GHz
- Sweep Speed Auto
 - DetectorPK
 - Resolution Bandwidth.....1MHz
 - Video Bandwidth.....3MHz
 - DetectorAve.
 - Resolution Bandwidth.....1MHz
 - Video Bandwidth.....10Hz

8.4 Test Procedure

1. The EUT is placed on a turntable, which is 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. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
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.

8.5 Summary of Test Results

Test Frequency: 16MHz ~ 30MHz

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

Test Frequency: 30MHz ~ 18GHz

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Low Channel									
272.83	48.79	QP	274	1.0	H	-13.35	35.44	46.00	-10.56
272.83	49.21	QP	178	1.4	V	-13.35	35.86	46.00	-10.14
4804.00	57.33	PK	324	1.3	V	-1.06	56.27	74.00	-17.73
4804.00	49.25	Ave	324	1.3	V	-1.06	48.19	54.00	-5.81
7206.00	60.62	PK	116	1.2	H	1.33	61.95	74.00	-12.05
7206.00	45.65	Ave	116	1.2	H	1.33	46.98	54.00	-7.02
2342.37	66.63	PK	162	1.2	V	-13.19	53.44	74.00	-20.56
2342.37	48.50	Ave	162	1.2	V	-13.19	35.31	54.00	-18.69
2383.77	63.86	PK	221	1.8	H	-13.14	50.72	74.00	-23.28
2383.77	52.50	Ave	221	1.8	H	-13.14	39.36	54.00	-14.64
2497.50	54.51	PK	314	1.2	V	-13.08	41.43	74.00	-32.57
2497.50	49.24	Ave	314	1.2	V	-13.08	36.16	54.00	-17.84

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Middle Channel									
272.83	49.32	QP	252	1.1	H	-13.35	35.97	46.00	-10.03
272.83	47.74	QP	107	1.7	V	-13.35	34.39	46.00	-11.61
4882.00	56.68	PK	306	1.7	V	-0.62	56.06	74.00	-17.94
4882.00	48.35	Ave	306	1.7	V	-0.62	47.73	54.00	-6.27
7323.00	61.28	PK	206	2.0	H	2.21	63.49	74.00	-10.51
7323.00	44.41	Ave	206	2.0	H	2.21	46.62	54.00	-7.38
2342.81	57.35	PK	10	1.0	V	-13.19	44.16	74.00	-29.84
2342.81	47.84	Ave	10	1.0	V	-13.19	34.65	54.00	-19.35
2382.63	56.09	PK	118	1.2	H	-13.14	42.95	74.00	-31.05
2382.63	48.90	Ave	118	1.2	H	-13.14	35.76	54.00	-18.24
2486.97	52.57	PK	67	1.8	V	-13.08	39.49	74.00	-34.51
2486.97	56.65	Ave	67	1.8	V	-13.08	43.57	54.00	-10.43

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK High Channel									
272.83	48.16	QP	313	1.7	H	-13.35	34.81	46.00	-11.19
272.83	49.08	QP	295	2.0	V	-13.35	35.73	46.00	-10.27
4960.00	57.27	PK	124	1.9	V	-0.24	57.03	74.00	-16.97
4960.00	49.28	Ave	124	1.9	V	-0.24	49.04	54.00	-4.96
7440.00	59.84	PK	185	1.4	H	2.84	62.68	74.00	-11.32
7440.00	43.56	Ave	185	1.4	H	2.84	46.40	54.00	-7.60
2325.84	55.49	PK	239	1.2	V	-13.19	42.30	74.00	-31.70
2325.84	54.89	Ave	239	1.2	V	-13.19	41.70	54.00	-12.30
2380.59	57.38	PK	232	1.5	H	-13.14	44.24	74.00	-29.76
2380.59	48.28	Ave	232	1.5	H	-13.14	35.14	54.00	-18.86
2492.28	57.41	PK	101	1.5	V	-13.08	44.33	74.00	-29.67
2492.28	54.74	Ave	101	1.5	V	-13.08	41.66	54.00	-12.34

Remark: only the worst data(GFSK modulation mode) were reported.

Test Frequency :Above 18GHz

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

9 Band Edge Measurement

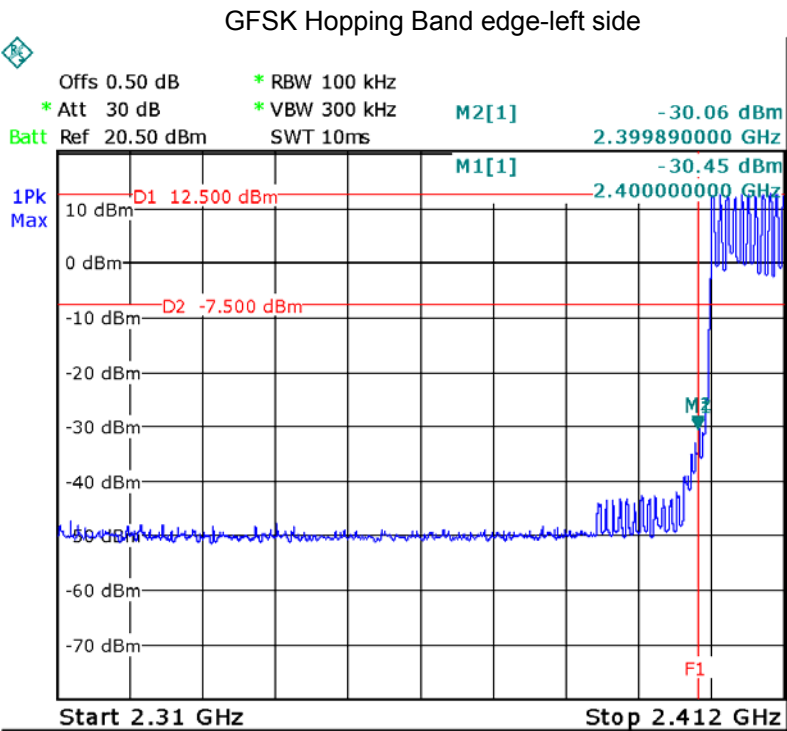
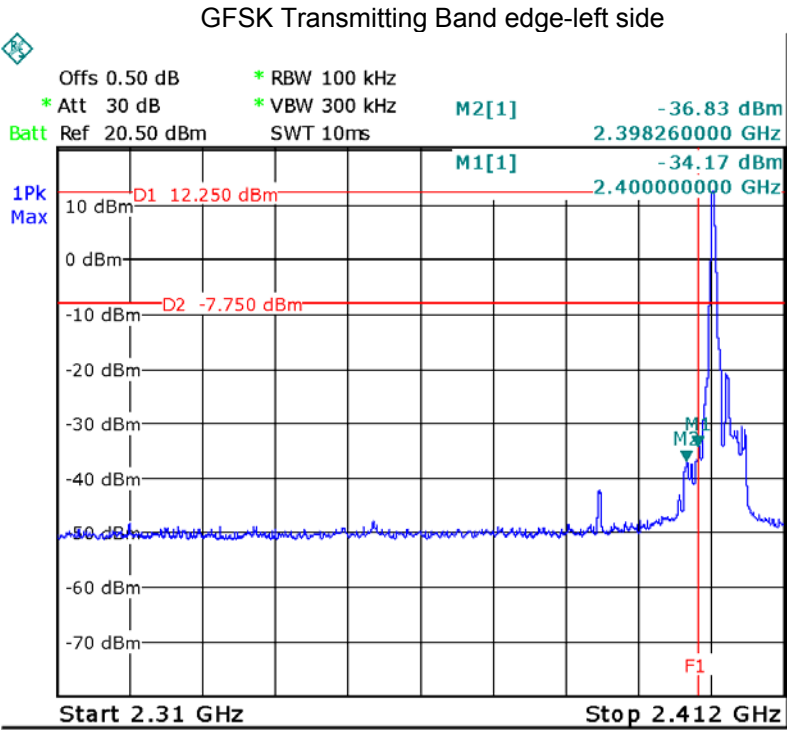
Test Requirement:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method:	ANSI C63.10:2013
Test Limit:	Regulation 15.247 (d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF 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 Mode:	Transmitting and Hopping

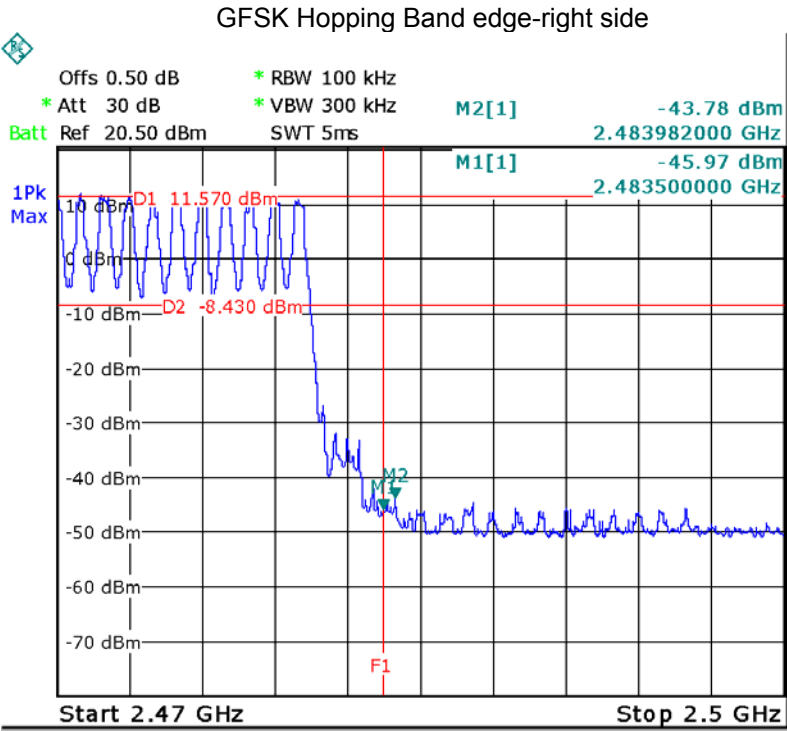
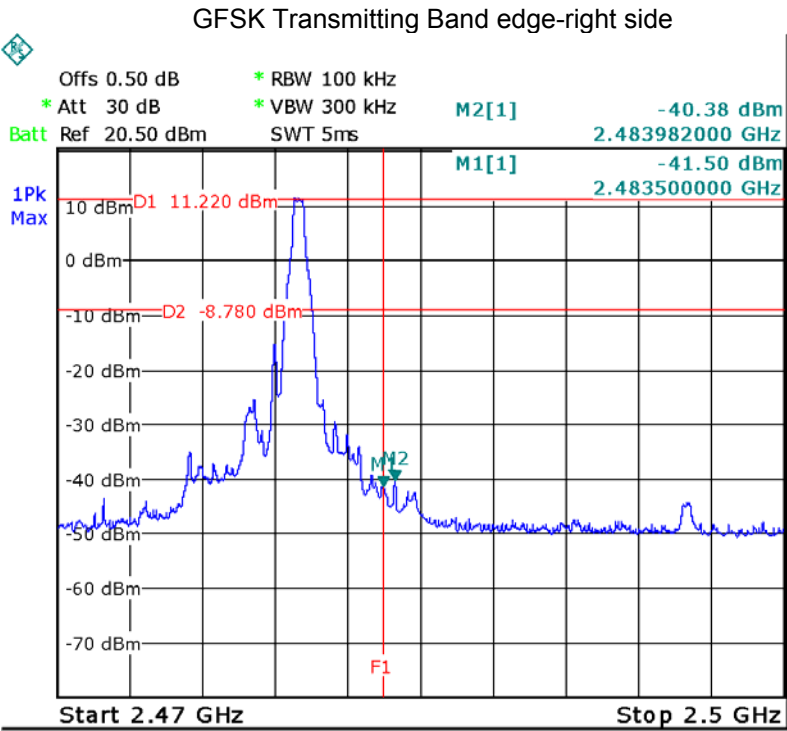
9.1 Test Procedure

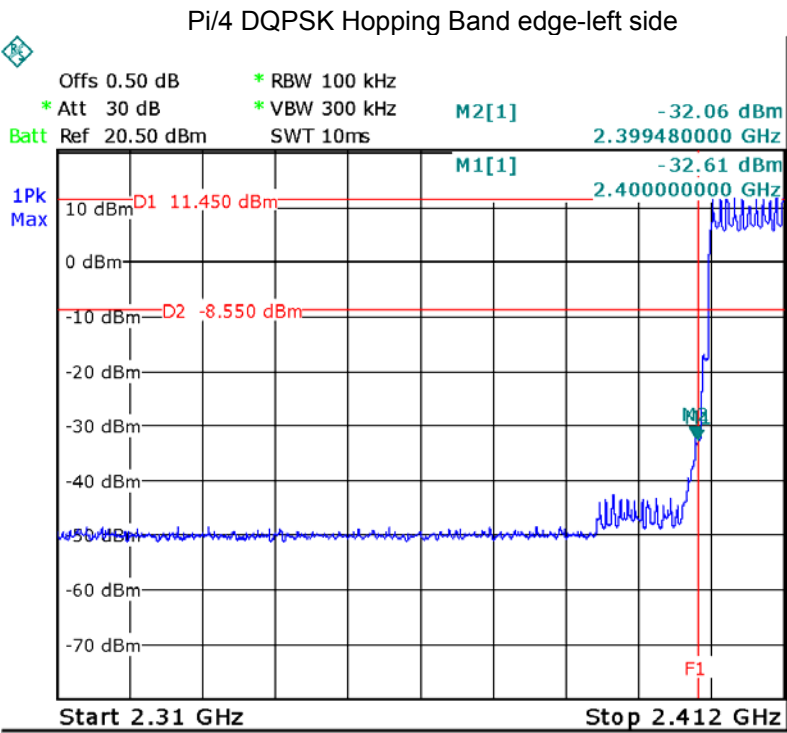
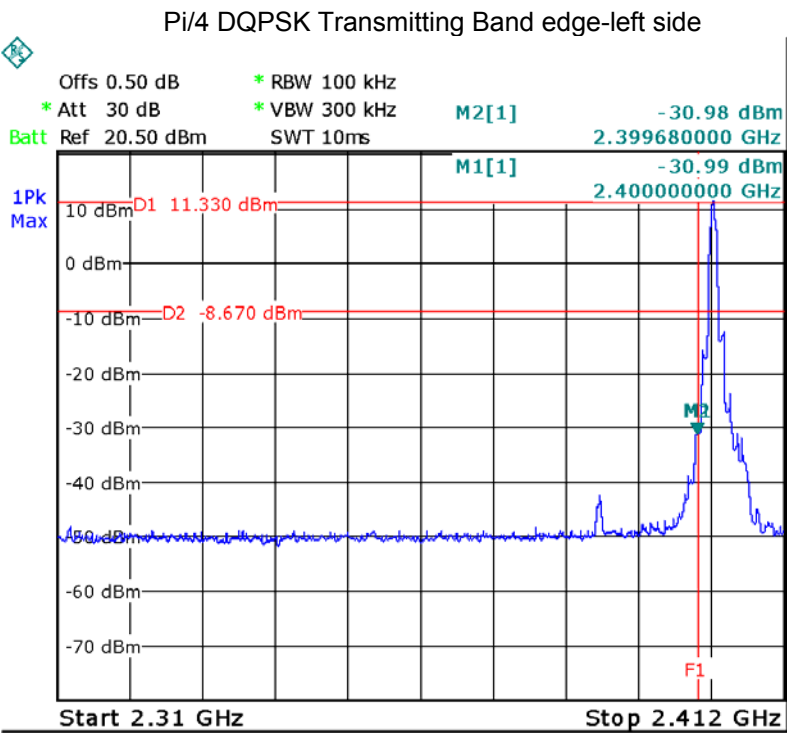
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold

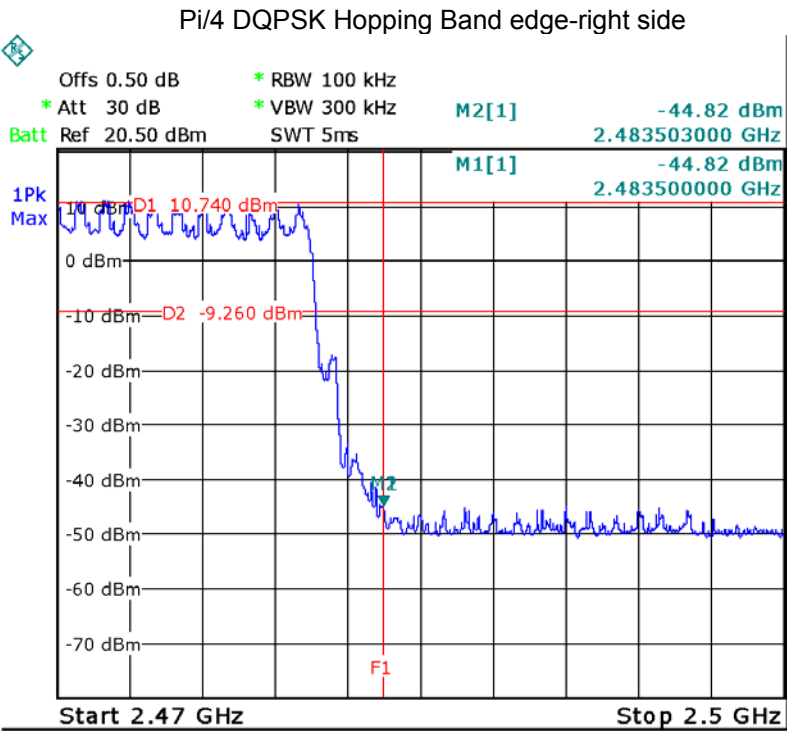
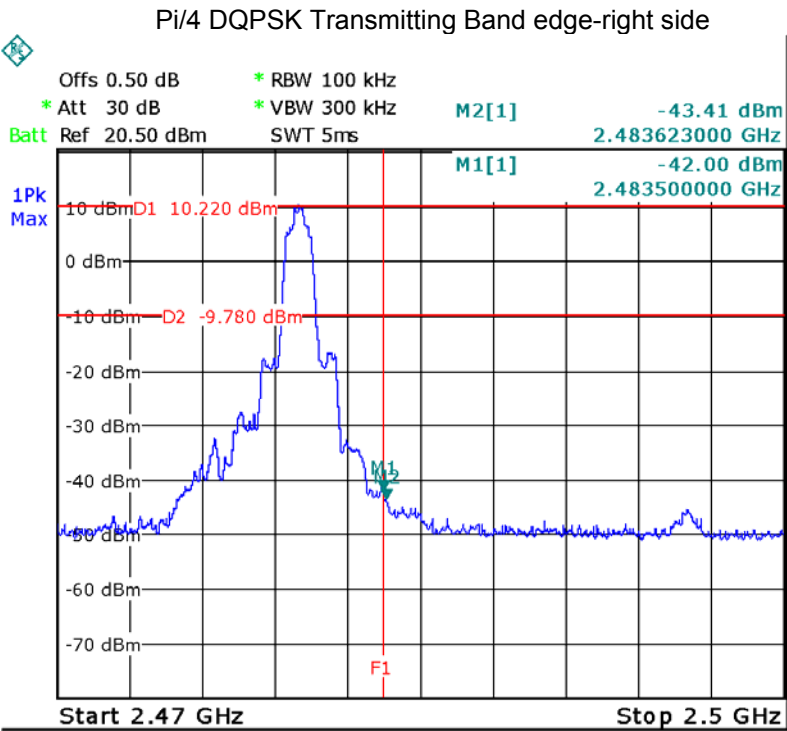
9.2 Test Result

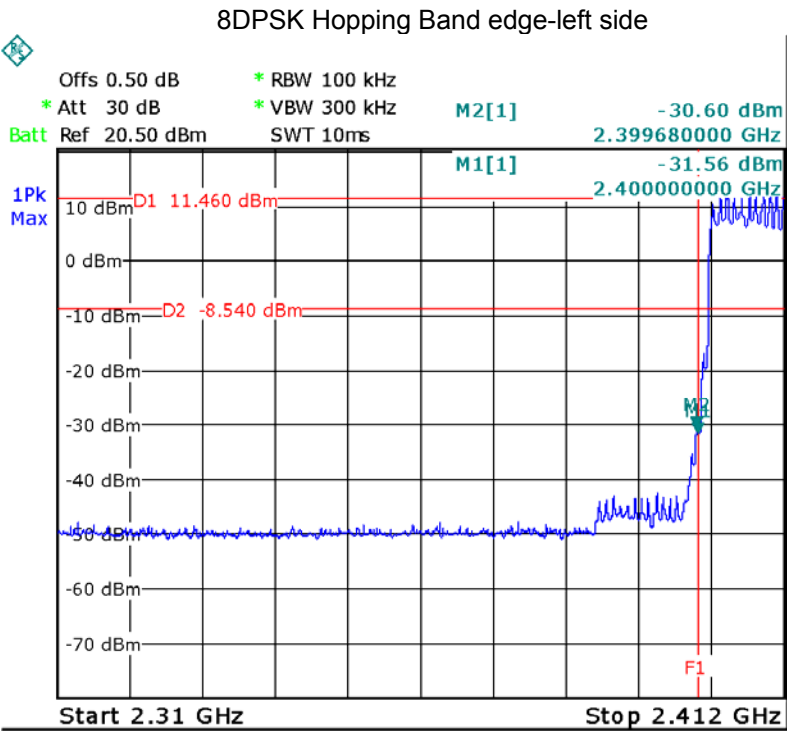
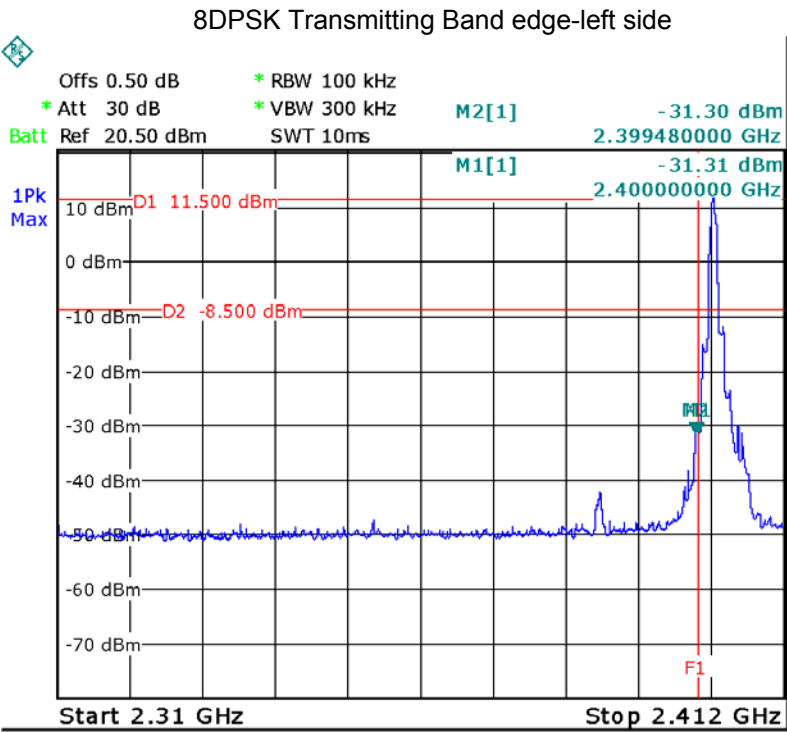
Test plots

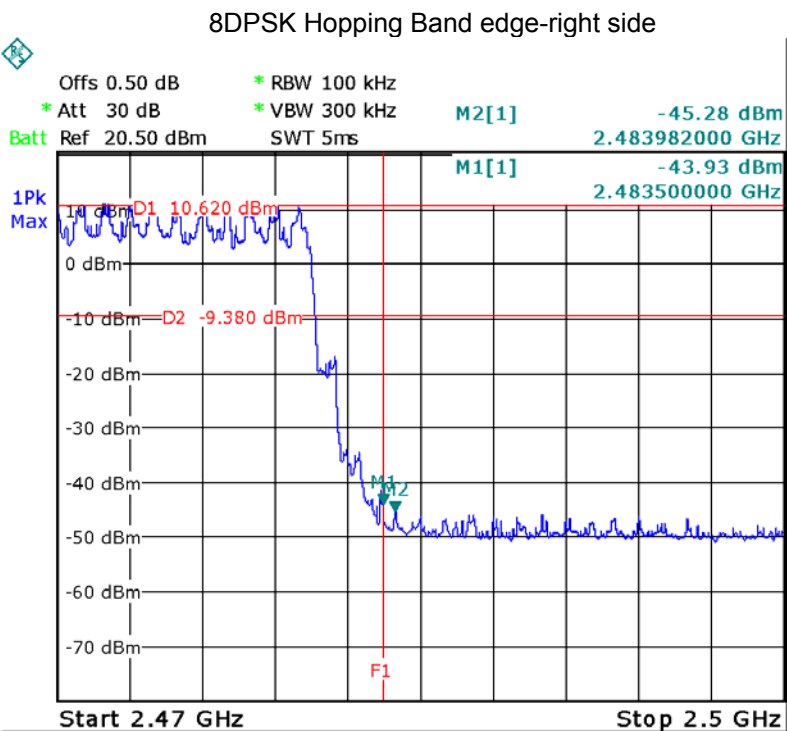
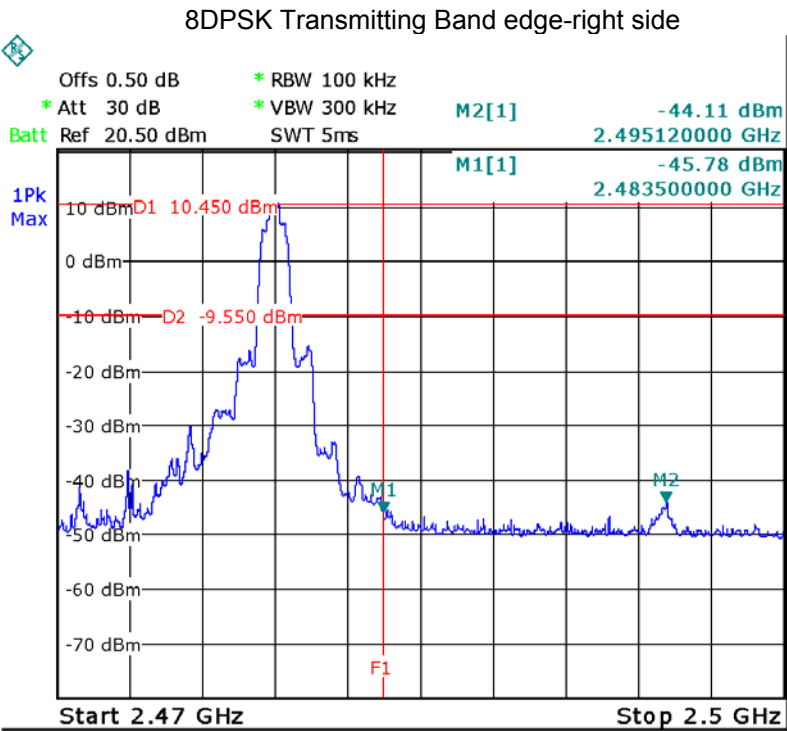












10 Bandwidth Measurement

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	ANSI C63.10:2013
Test Mode:	Test in fixing operating frequency at low, Middle, high channel.

10.1 Test Procedure

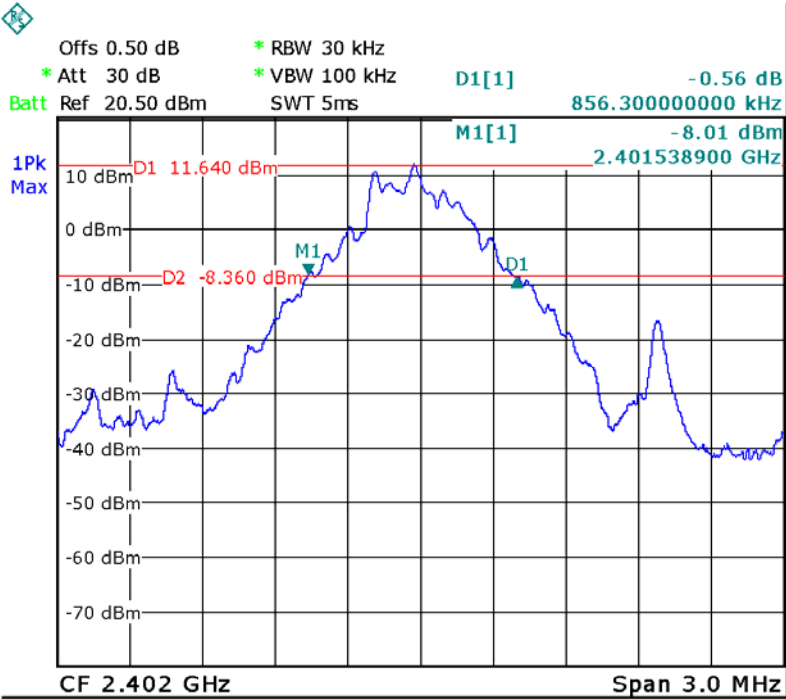
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

10.2 Test Result

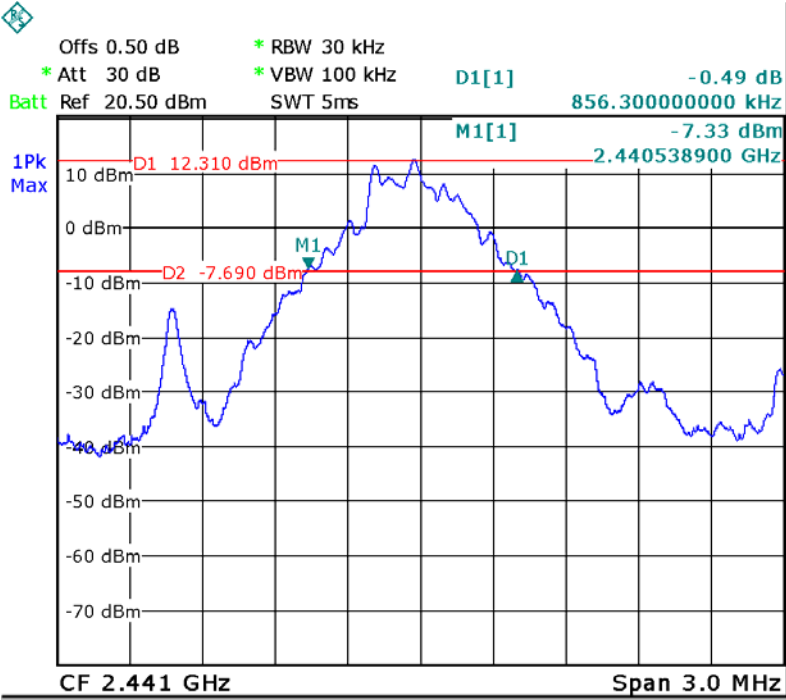
Modulation	Test Channel	20 dB Bandwidth
GFSK	Low	0.856MHz
GFSK	Middle	0.856MHz
GFSK	High	0.856MHz
Pi/4 DQPSK	Low	1.305MHz
Pi/4 DQPSK	Middle	1.270MHz
Pi/4 DQPSK	High	1.264MHz
8DPSK	Low	1.222MHz
8DPSK	Middle	1.222MHz
8DPSK	High	1.222MHz

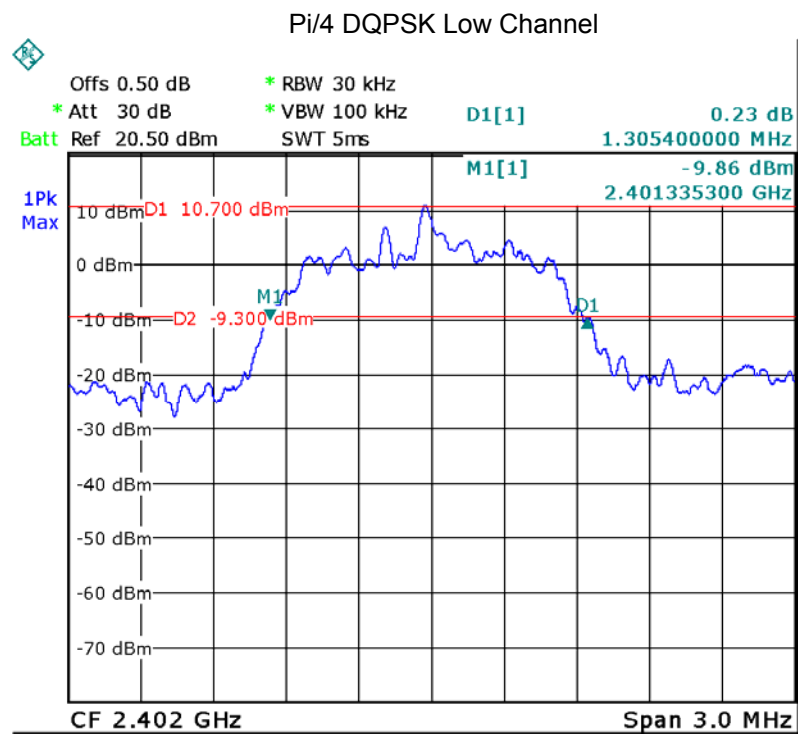
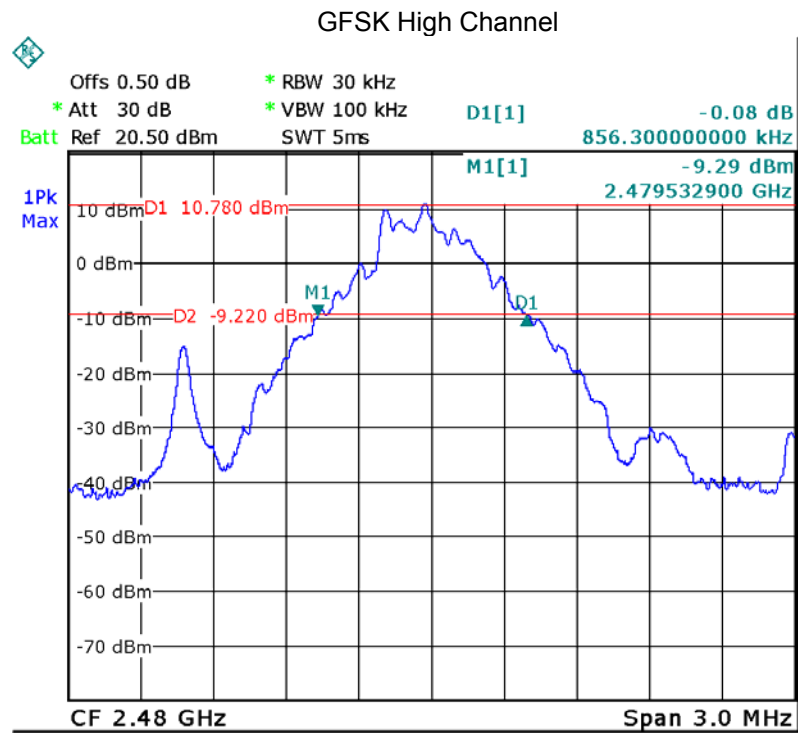
Test plots

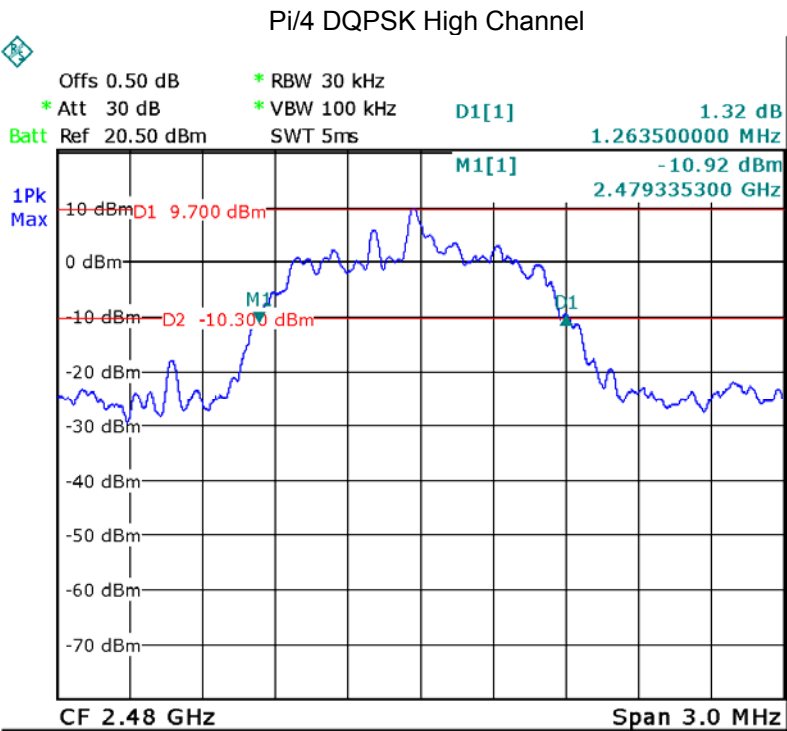
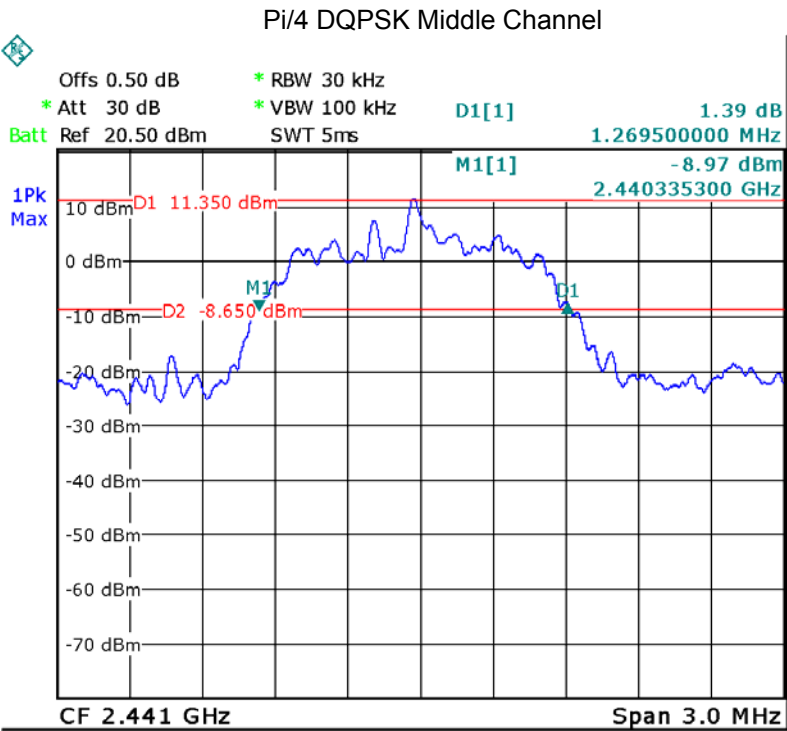
GFSK Low Channel

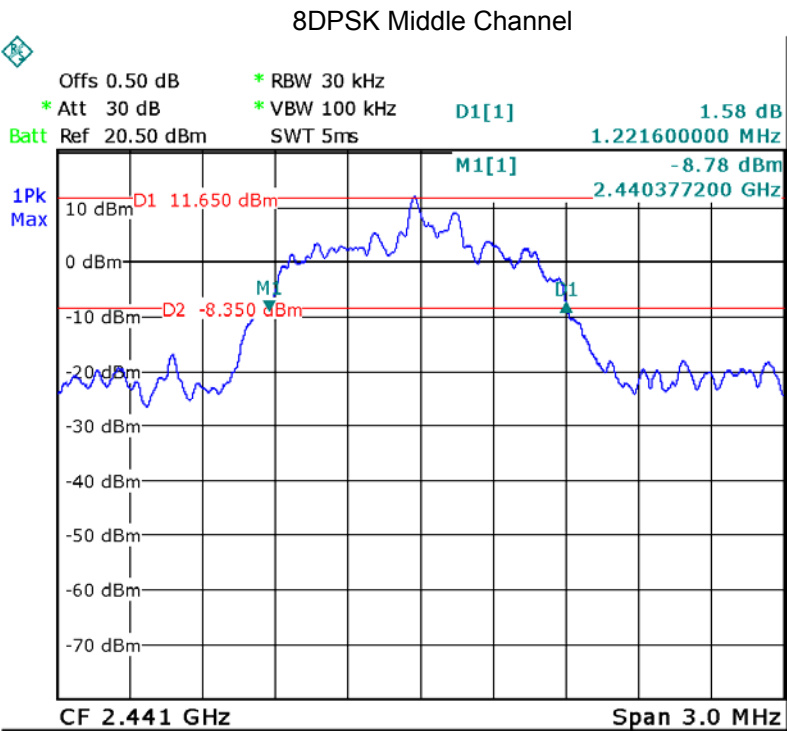
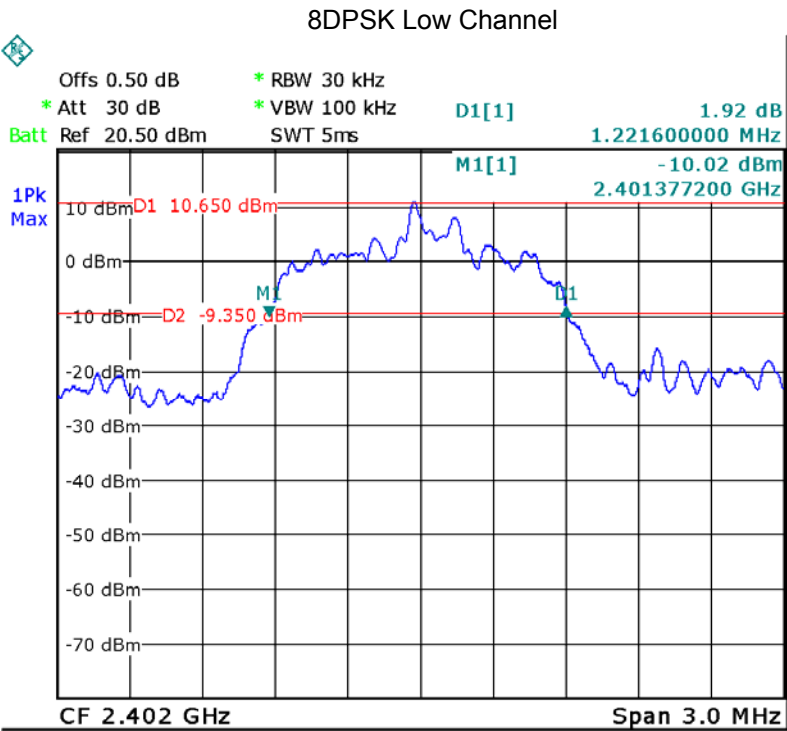


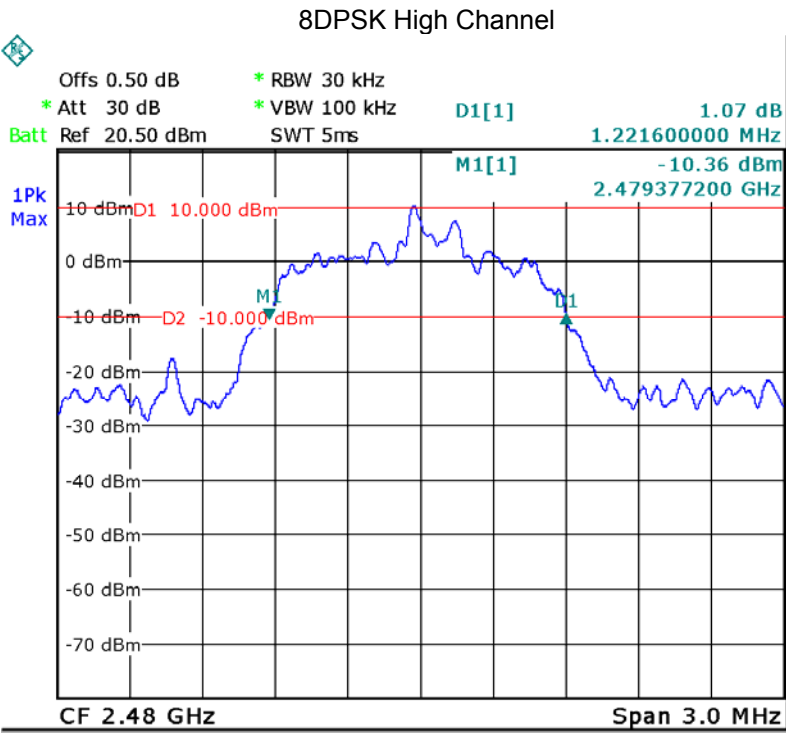
GFSK Middle Channel











11 Maximum Peak Output Power

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	ANSI C63.10:2013
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 0.125watts (20.97 dBm) limit applies.
Test mode:	Test in fixing frequency transmitting mode.

11.1 Test Procedure

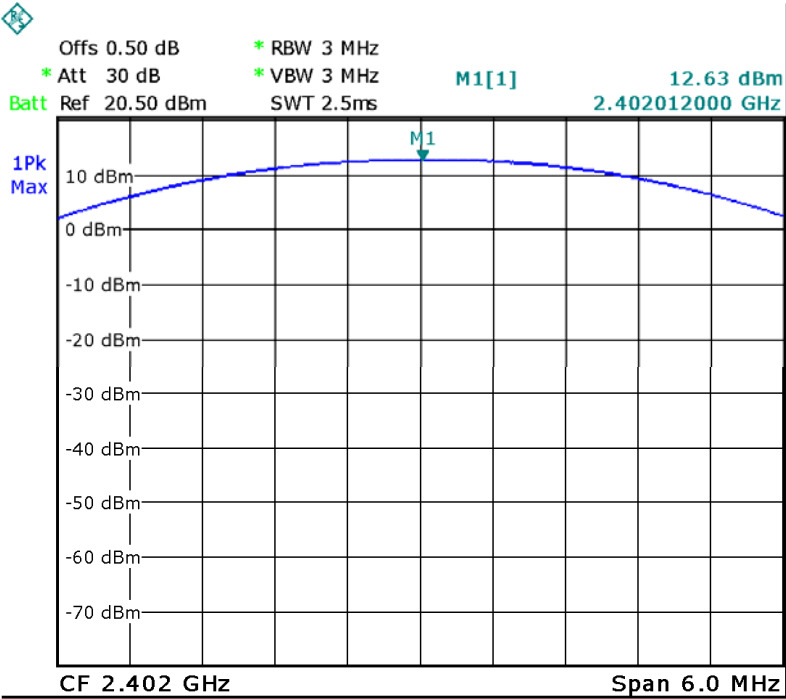
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3 MHz. VBW =3 MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

11.2 Test Result

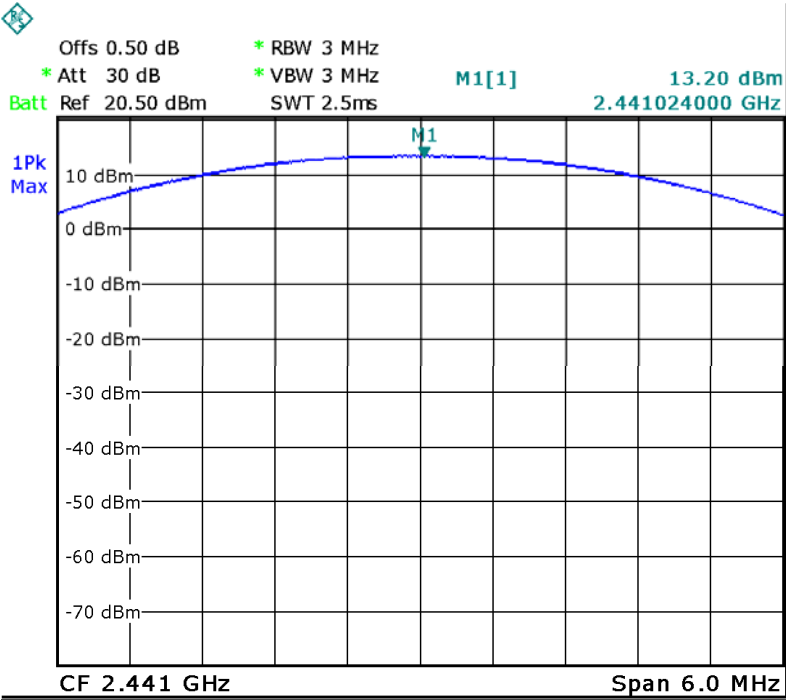
Test Mode	Data Rate	Peak Power(dBm)			Limit (dBm)
		CH00	CH39	CH78	
GFSK	1Mbps	12.63	13.20	11.60	20.97
4*π4DQPSK	2Mbps	13.84	14.26	12.32	20.97
8DPSK	3Mbps	13.79	14.67	12.83	20.97

Test plots

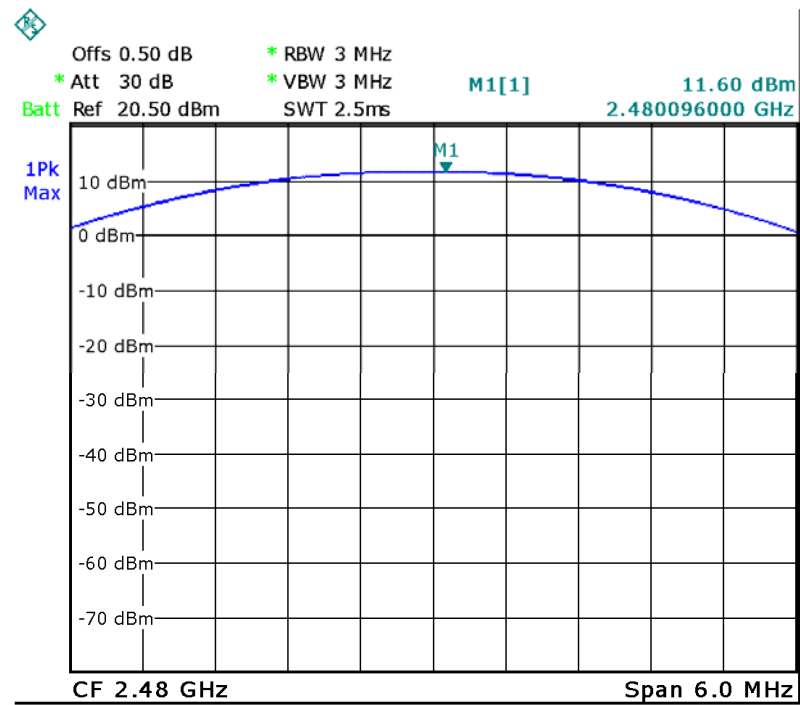
GFSK Low Channel



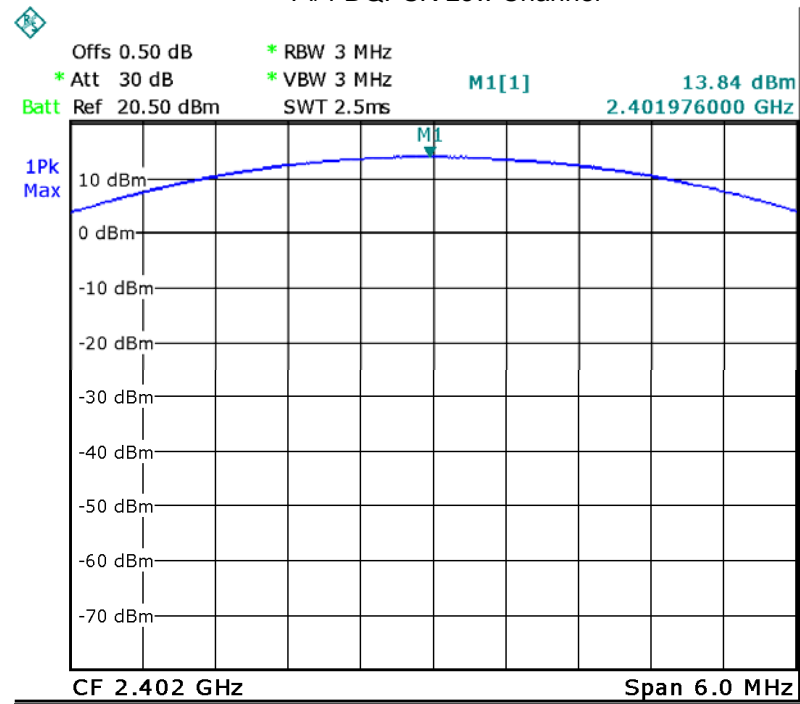
GFSK Channel

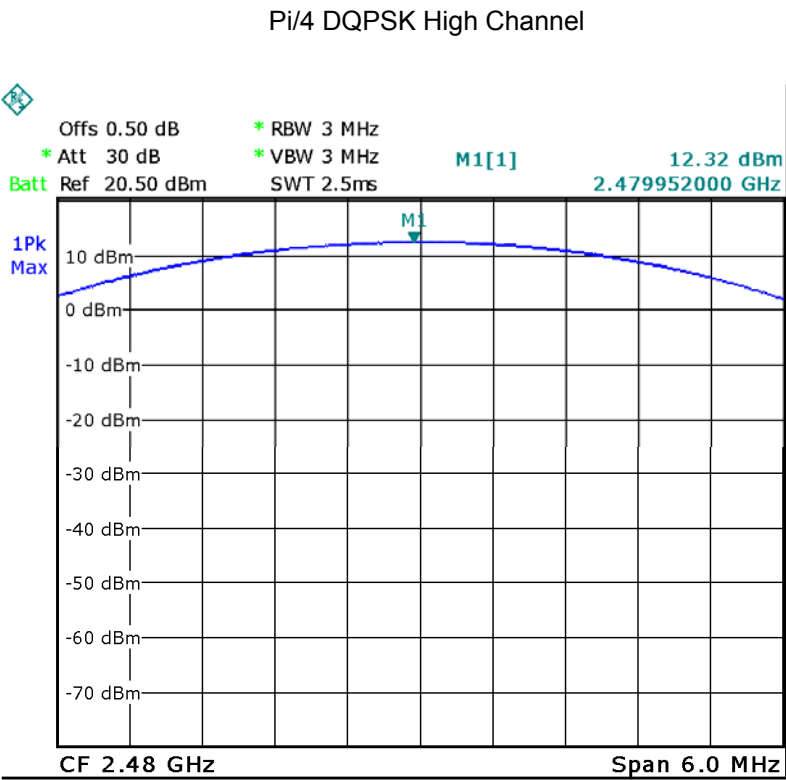
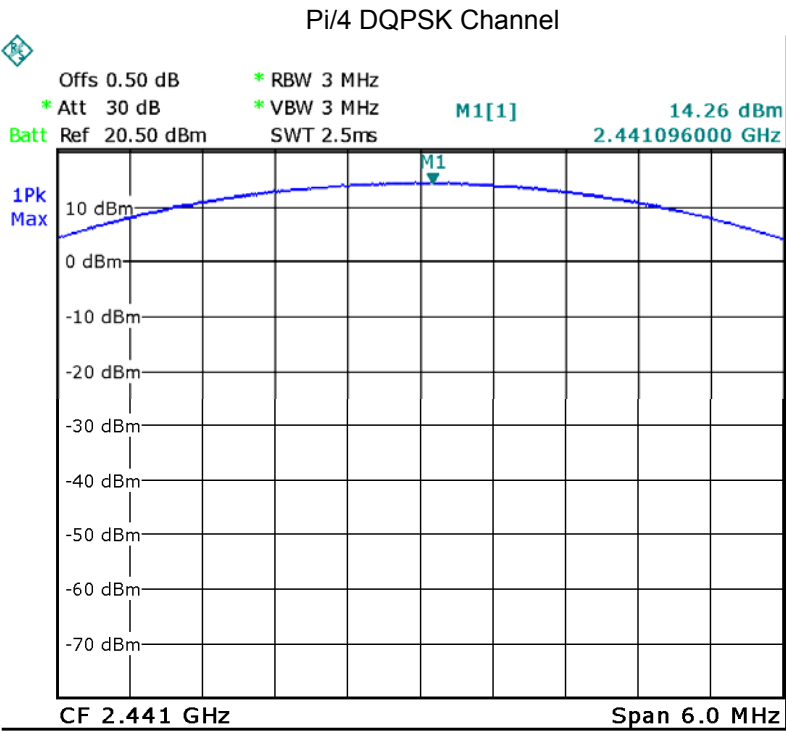


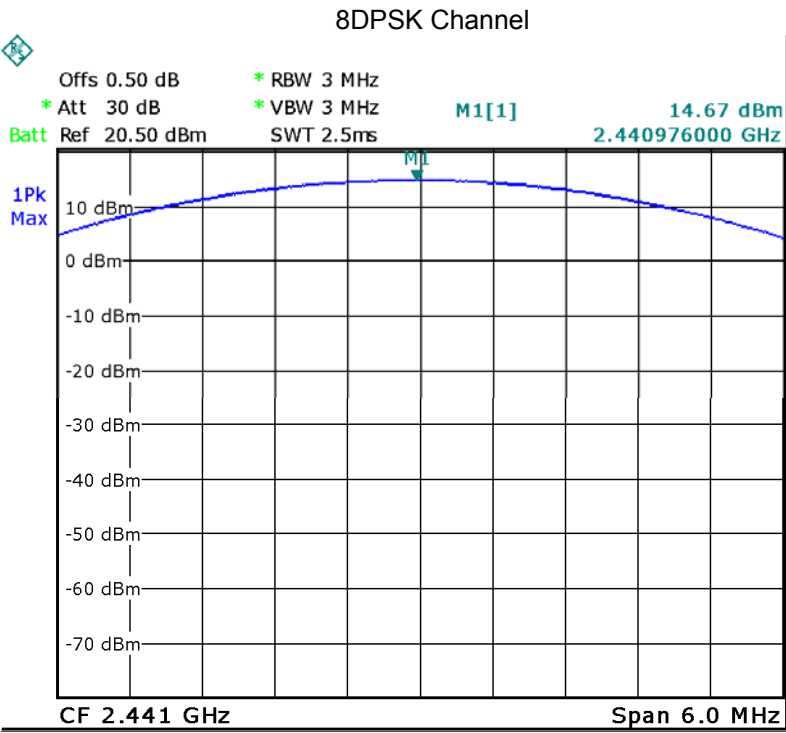
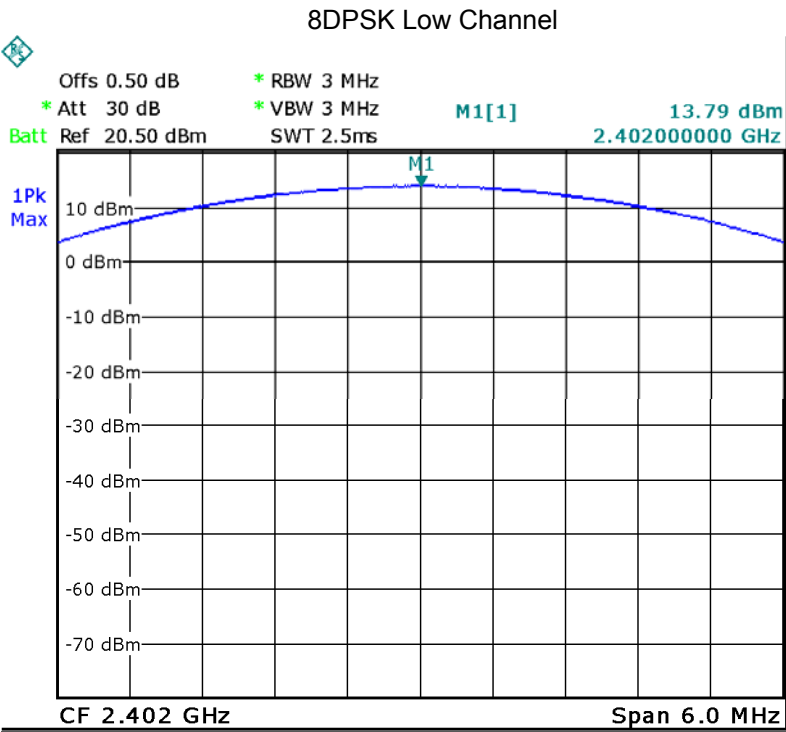
GFSK High Channel



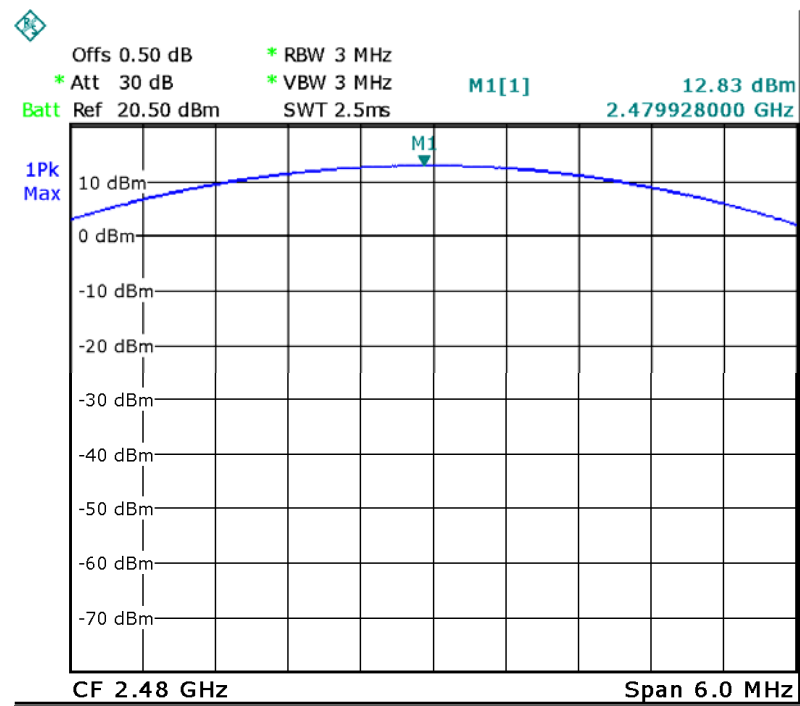
Pi/4 DQPSK Low Channel







8DPSK High Channel



12 Hopping Channel Separation

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	ANSI C63.10:2013
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 2400-2483.5MHz 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.

12.1 Test Procedure

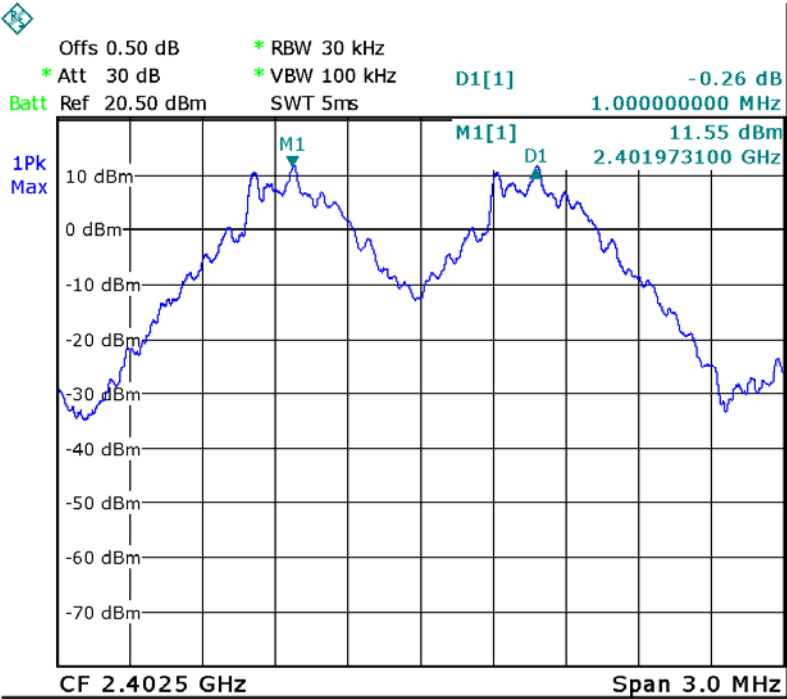
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30KHz. VBW = 100KHz , Span = 3MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to 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.

12.2 Test Result

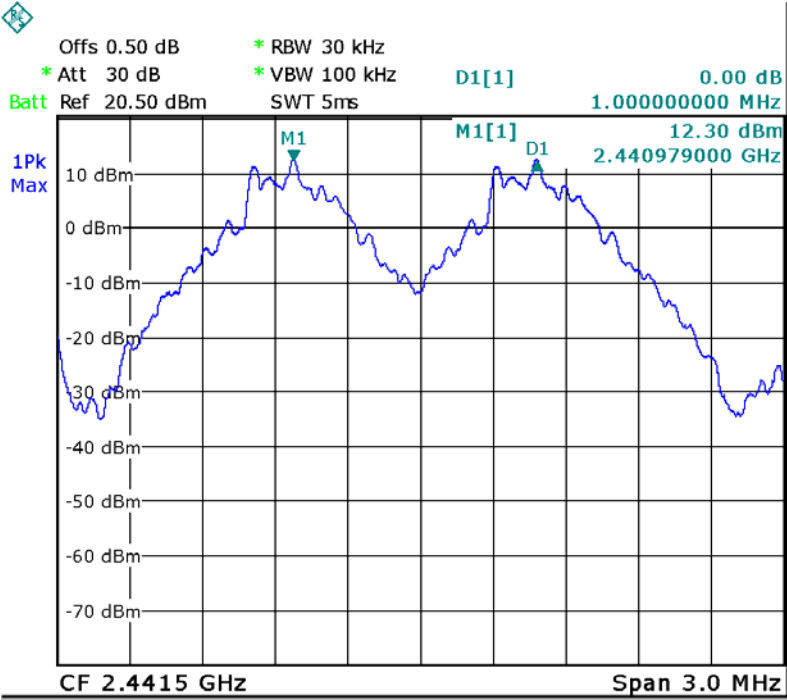
Modulation	Test Channel	Separation (MHz)	Result
GFSK	Low	1 MHz	PASS
GFSK	Middle	1 MHz	PASS
GFSK	High	1 MHz	PASS
Pi/4 DQPSK	Low	1 MHz	PASS
Pi/4 DQPSK	Middle	1 MHz	PASS
Pi/4 DQPSK	High	1 MHz	PASS
8DPSK	Low	1 MHz	PASS
8DPSK	Middle	1 MHz	PASS
8DPSK	High	1 MHz	PASS

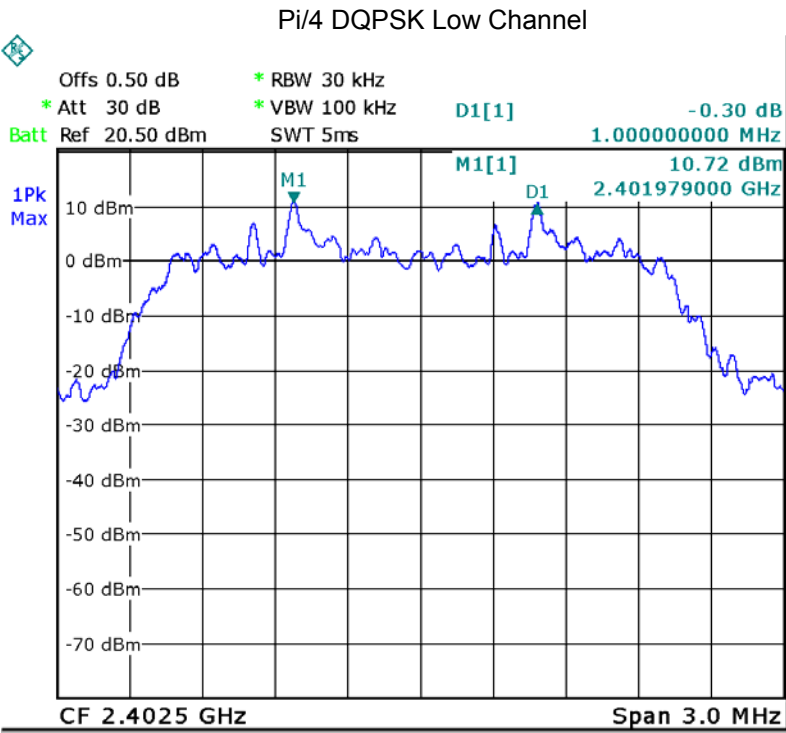
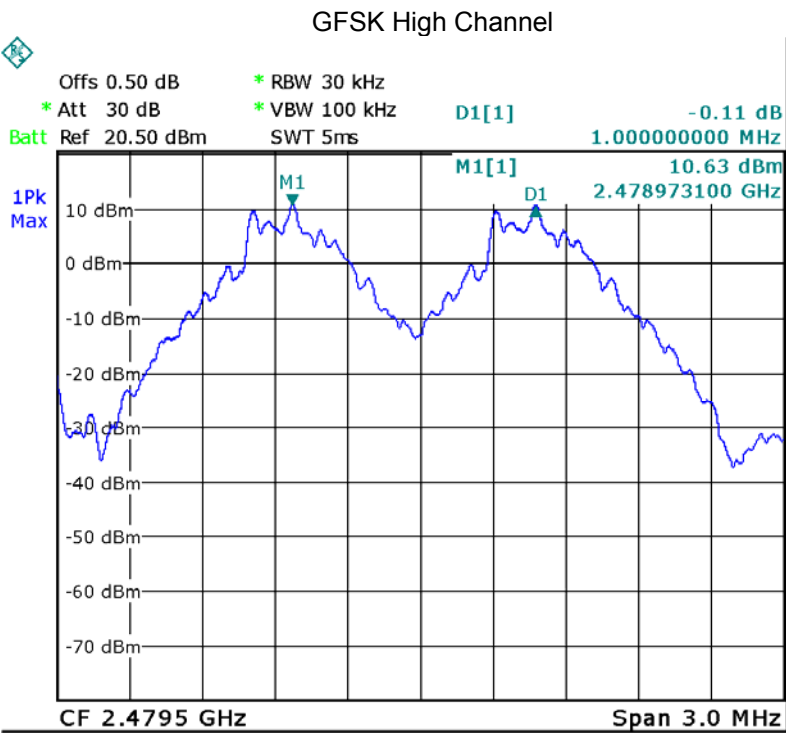
Test plots

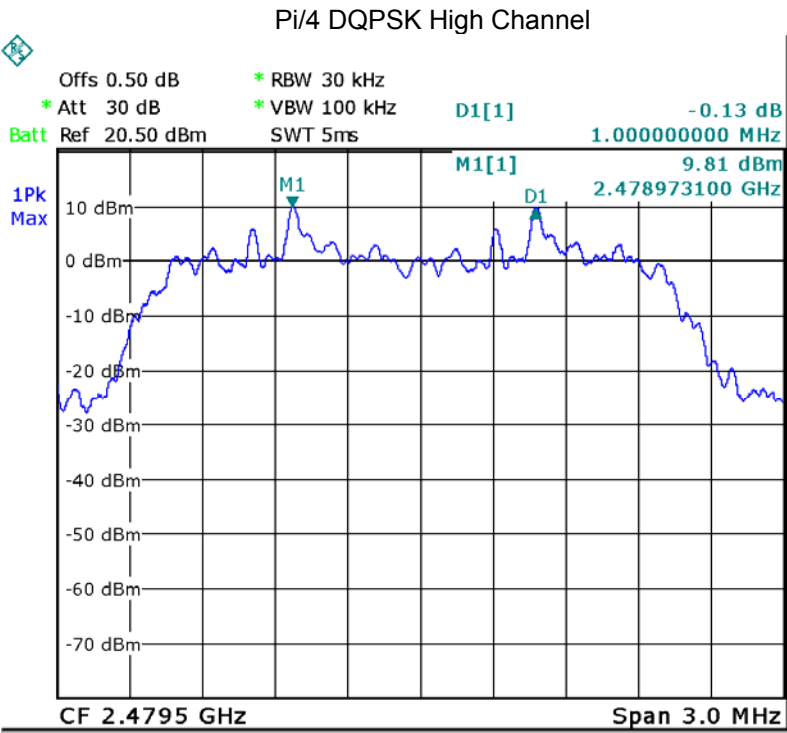
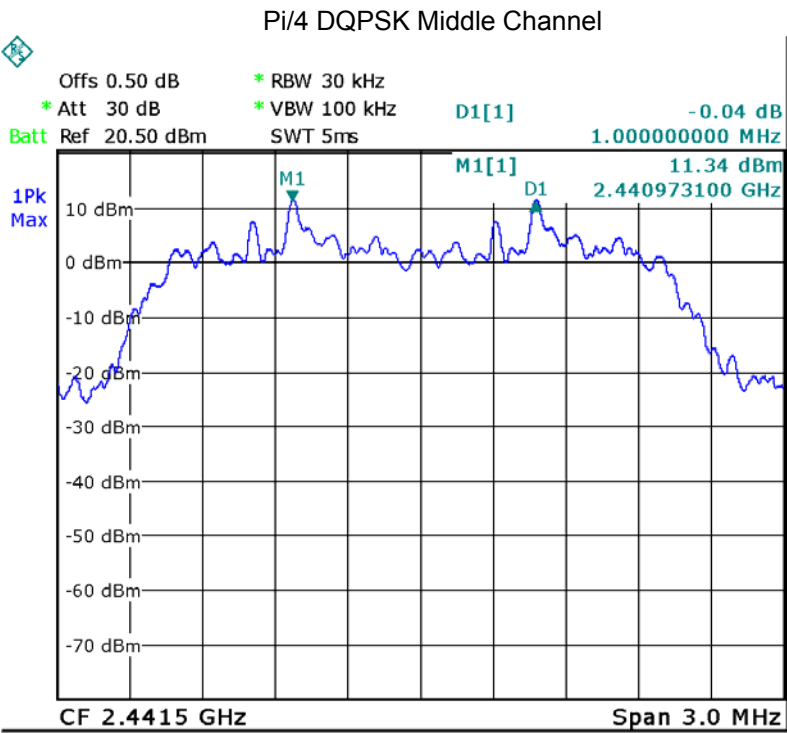
GFSK Low Channel

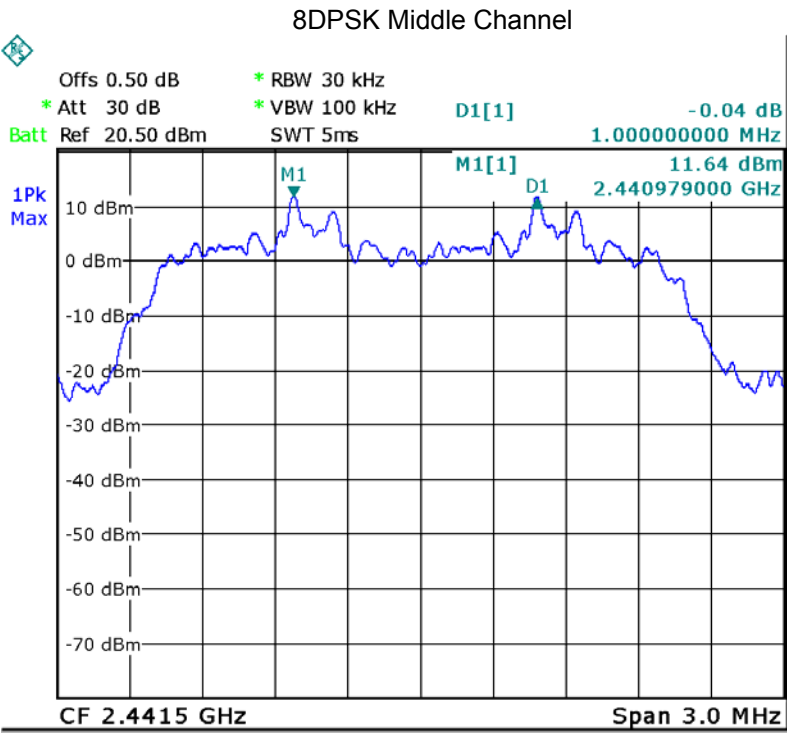
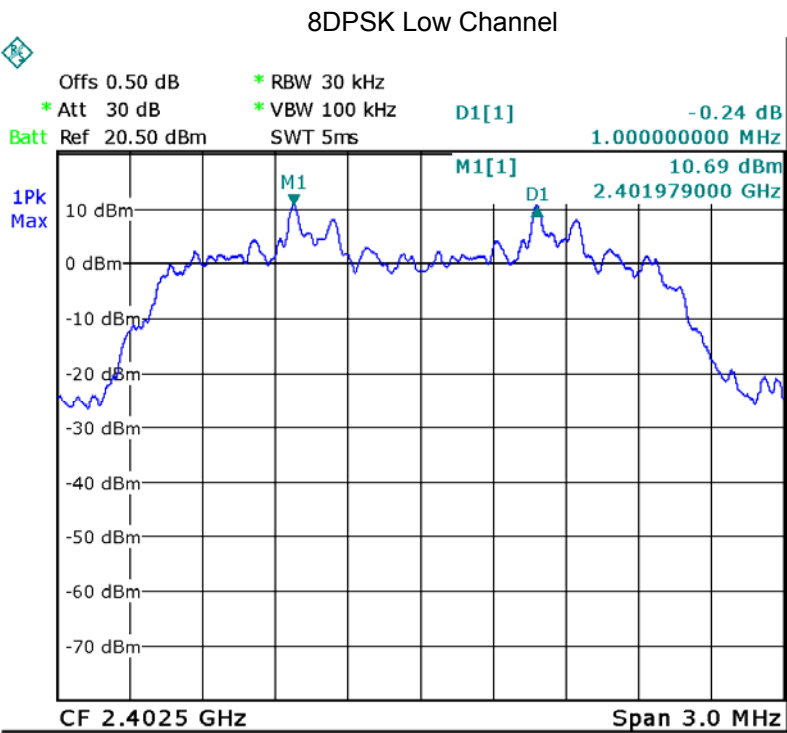


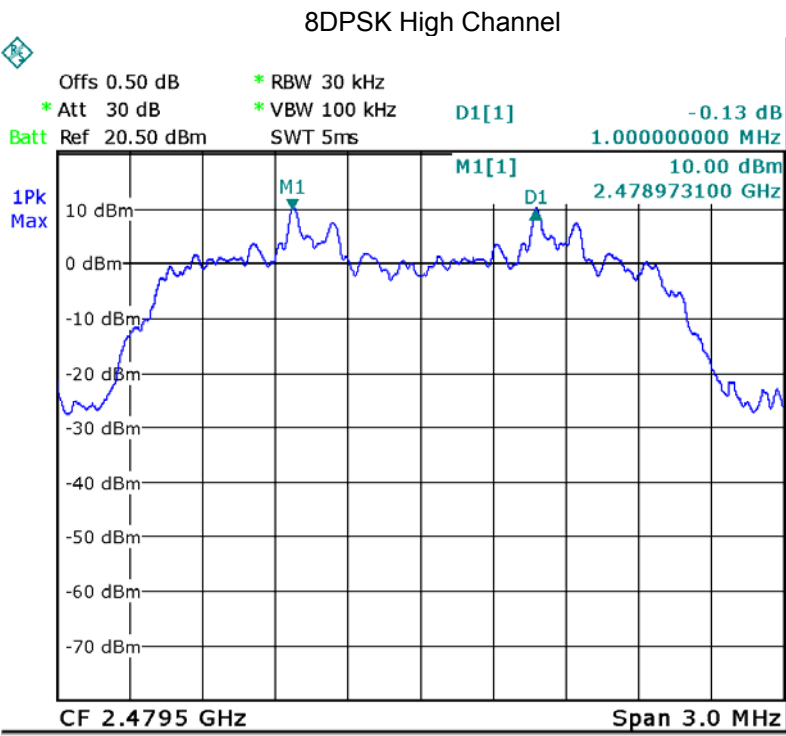
GFSK Middle Channel











13 Number of Hopping Frequency

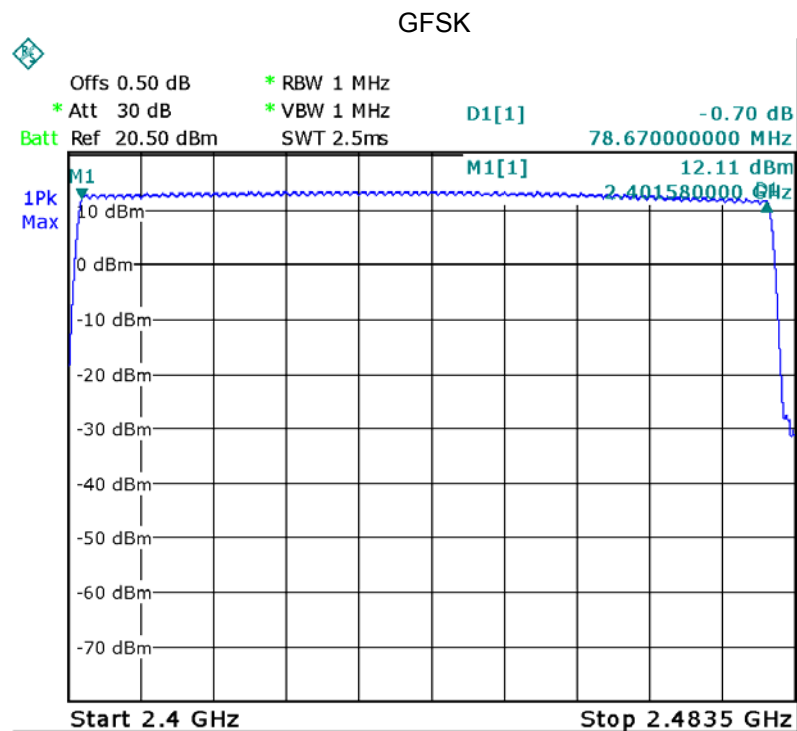
Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	ANSI C63.10:2013
Test Limit:	Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Mode:	Test in hopping transmitting operating mode.

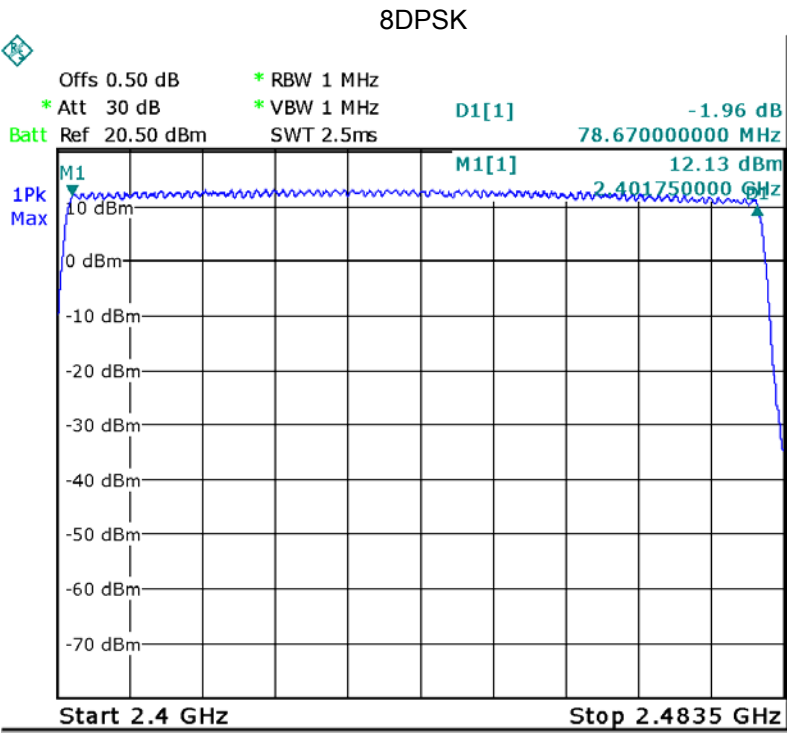
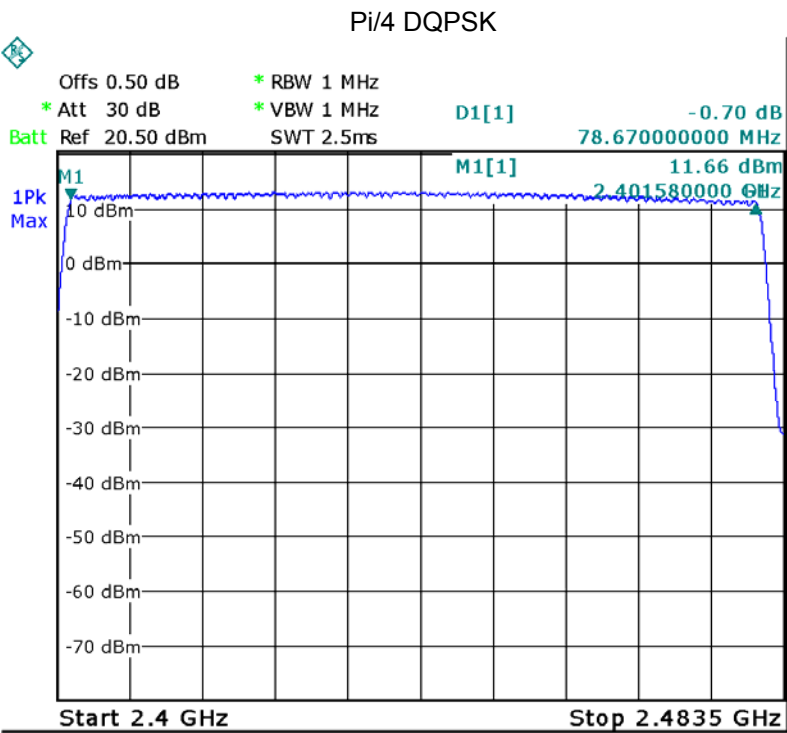
13.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set 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: Start Frequency = 2.4GHz, Stop Frequency = 2.483GHz. Sweep=auto;

13.2 Test Result

Test Plots: 79 Channels in total





14 Dwell Time

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	ANSI C63.10:2013
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.

14.1 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 = 3MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.
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).

14.2 Test Result

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

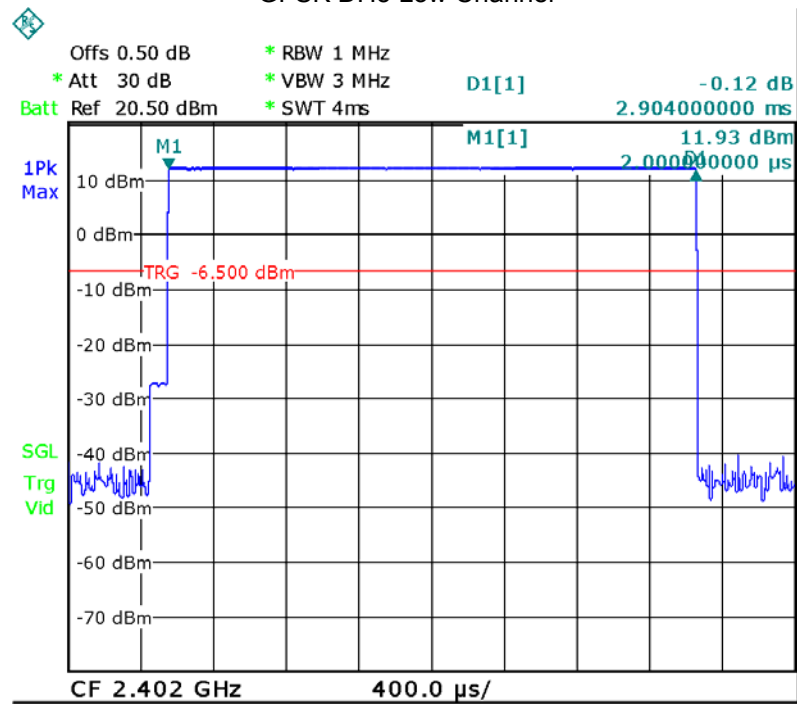
DH3 Packet permit maximum $1600 / 79 / 4$ hops per second in each channel (3 time slots RX, 1 time slot TX).

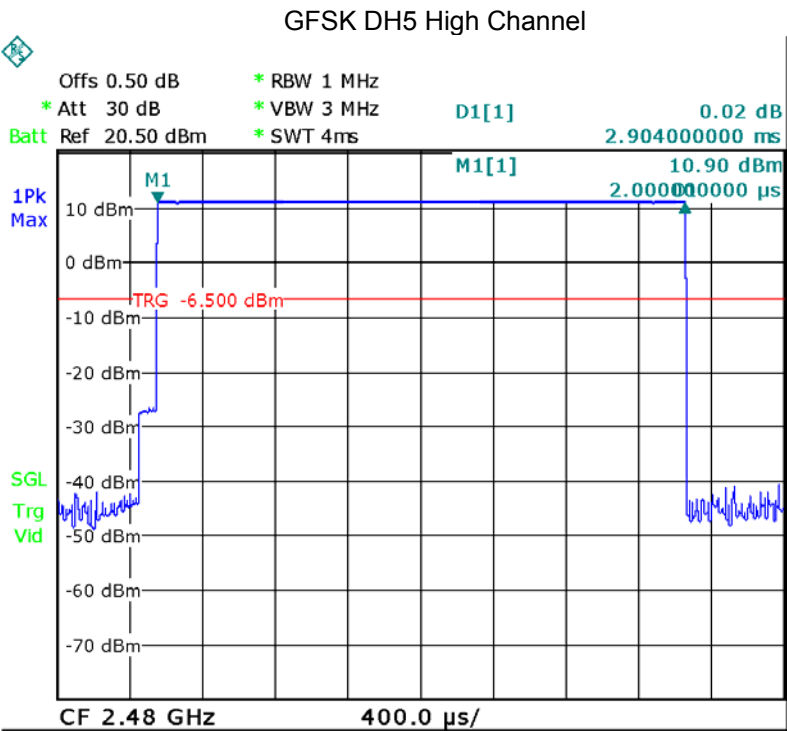
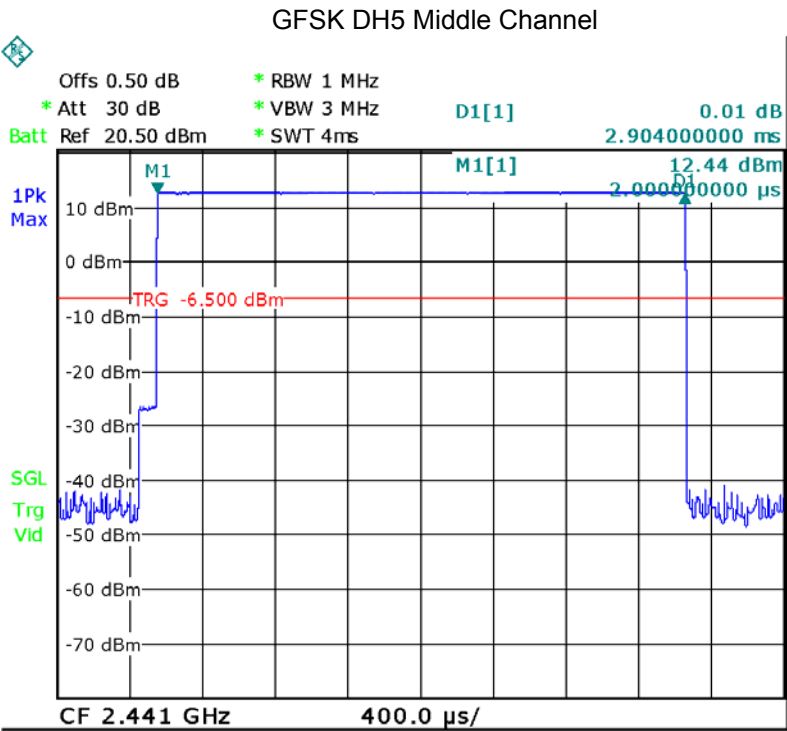
DH1 Packet permit maximum $1600 / 79 / 2$ hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

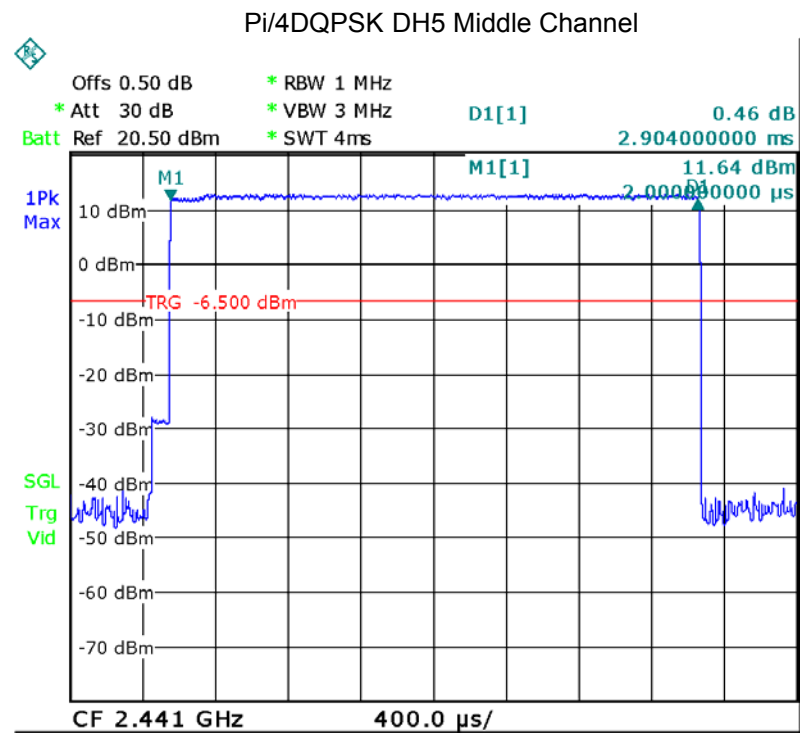
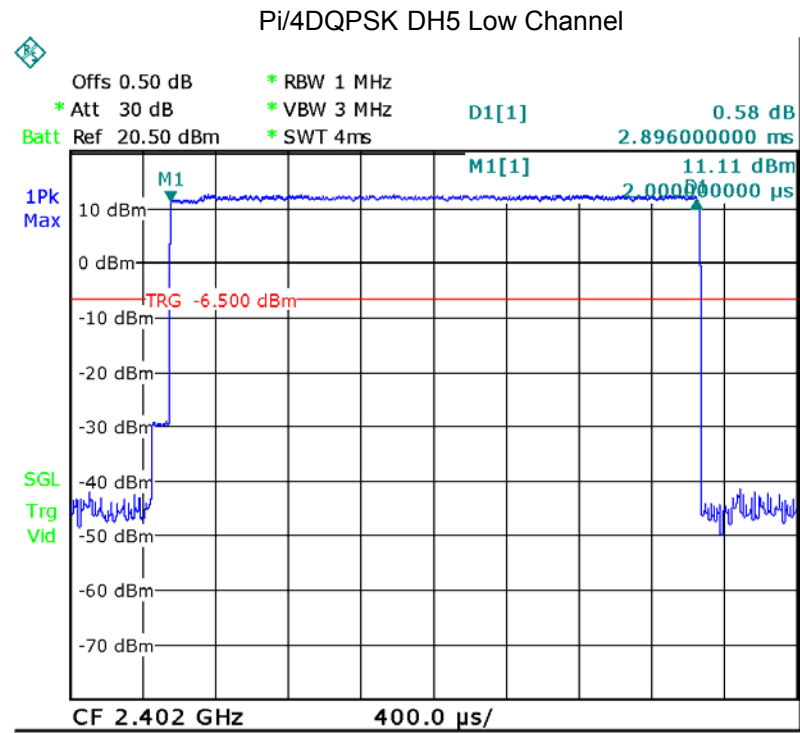
Data Packet	Dwell Time(s)
DH5	$1600/79/6*0.4*79*(MkrDelta)/1000$
DH3	$1600/79/4*0.4*79*(MkrDelta)/1000$
DH1	$1600/79/2*0.4*79*(MkrDelta)/1000$
Remark: Mkr Delta is once pulse time. Only the worst data(DH5) were show as follow.	

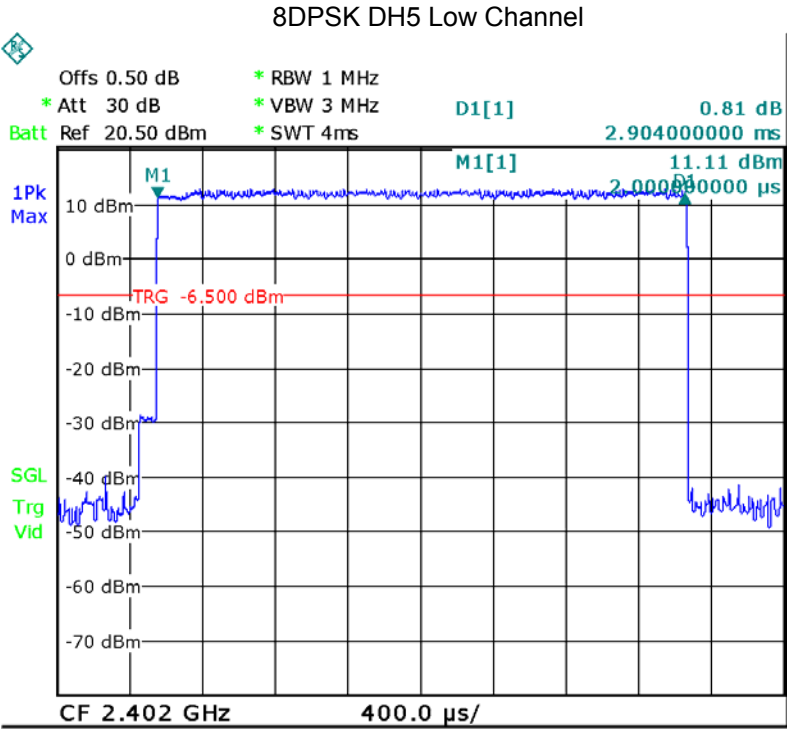
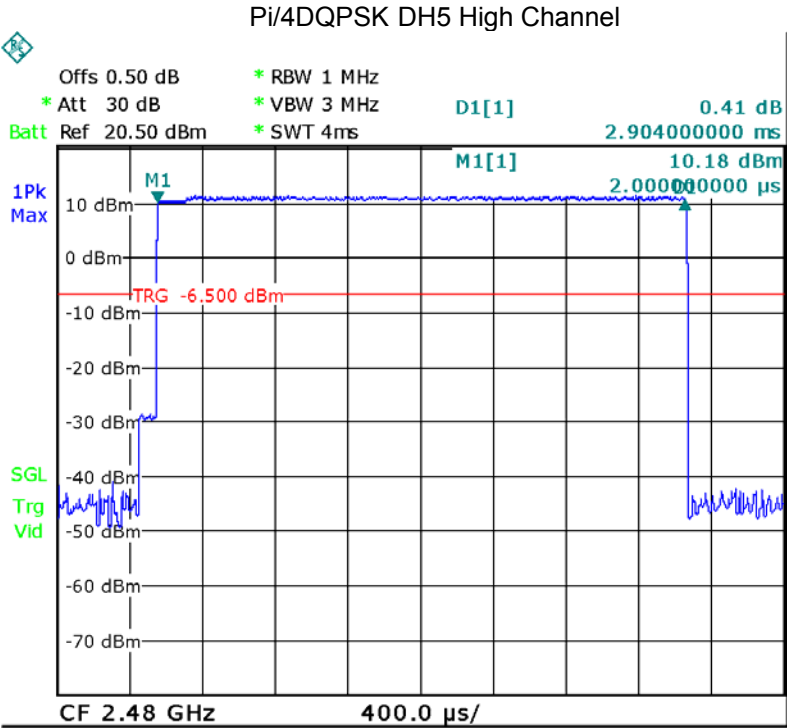
Modulation	Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
GFSK	DH5	Low	2.904	0.310	0.4
		middle	2.904	0.310	0.4
		High	2.904	0.310	0.4
Pi/4DQPSK	DH5	Low	2.896	0.309	0.4
		middle	2.904	0.310	0.4
		High	2.904	0.310	0.4
8DPSK	DH5	Low	2.904	0.310	0.4
		middle	2.904	0.310	0.4
		High	2.904	0.310	0.4

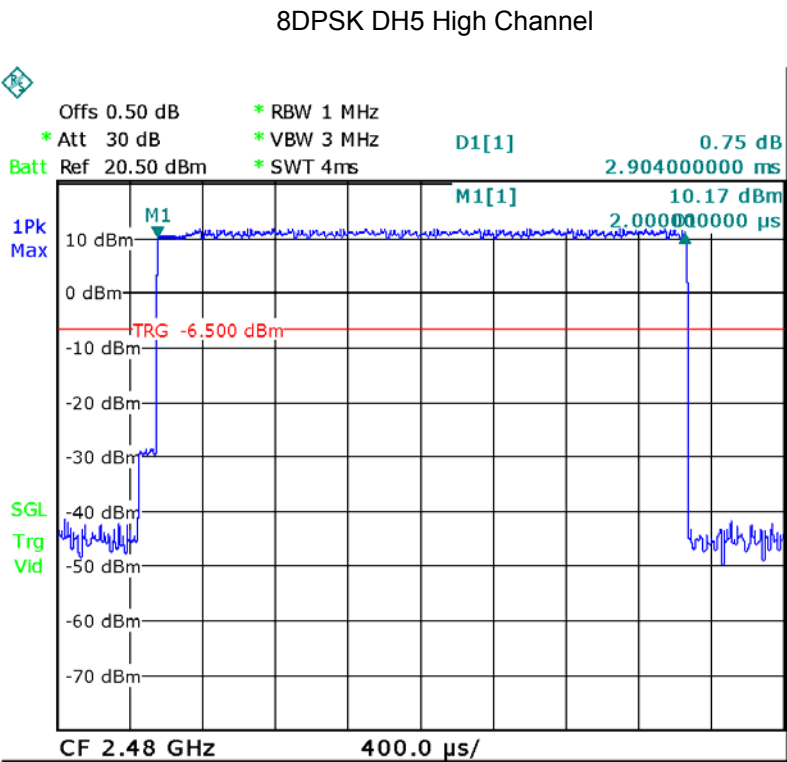
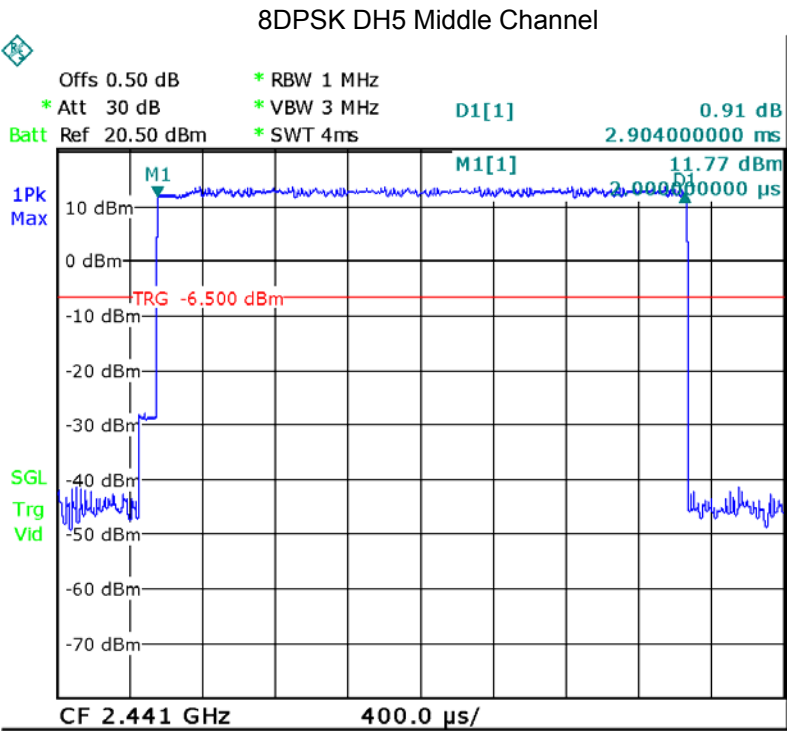
Test Plots
GFSK DH5 Low Channel











15 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 PCB printed antenna, fulfil the requirement of this section.

16 RF Exposure

Remark: refer to SAR test report: WTS16S0448252E

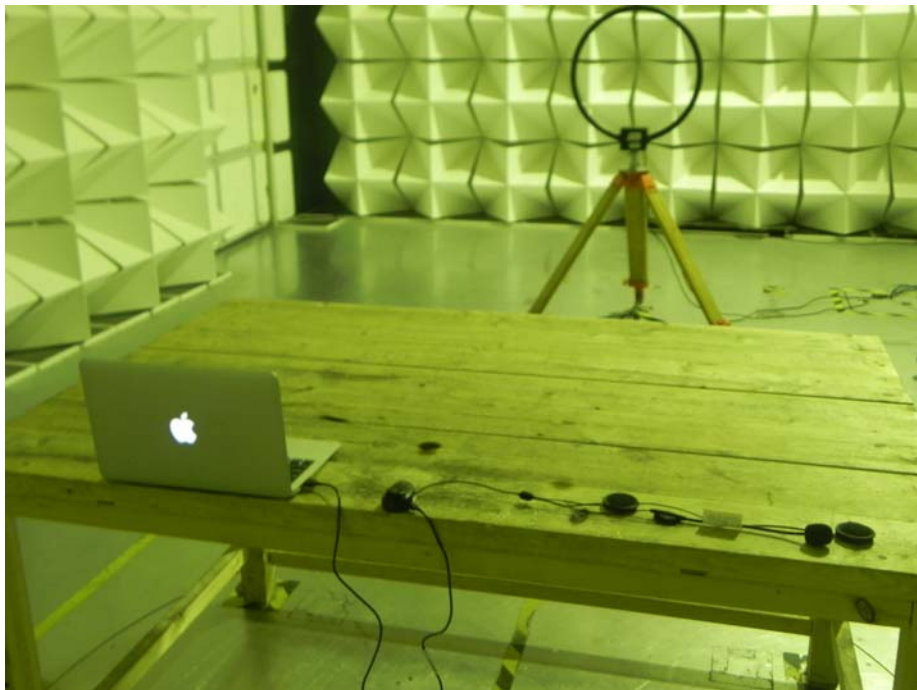
17 Photographs – Model F1 Test Setup

17.1 Photograph – Conducted Emission Test Setup at Test Site 1#

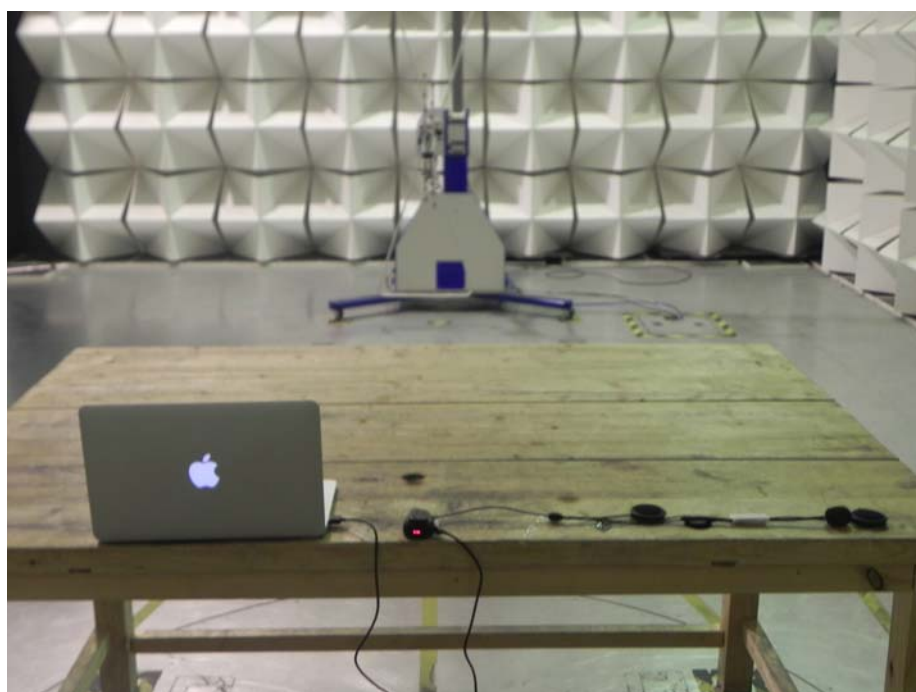


17.2 Photograph – Radiation Spurious Emission Test Setup

Below 30MHz at Test Site 2#



30MHz-1GHz at Test Site 2#



Above 1GHz at Test Site 1#



18 Photographs - Constructional Details

18.1 Model F1 -External Photos



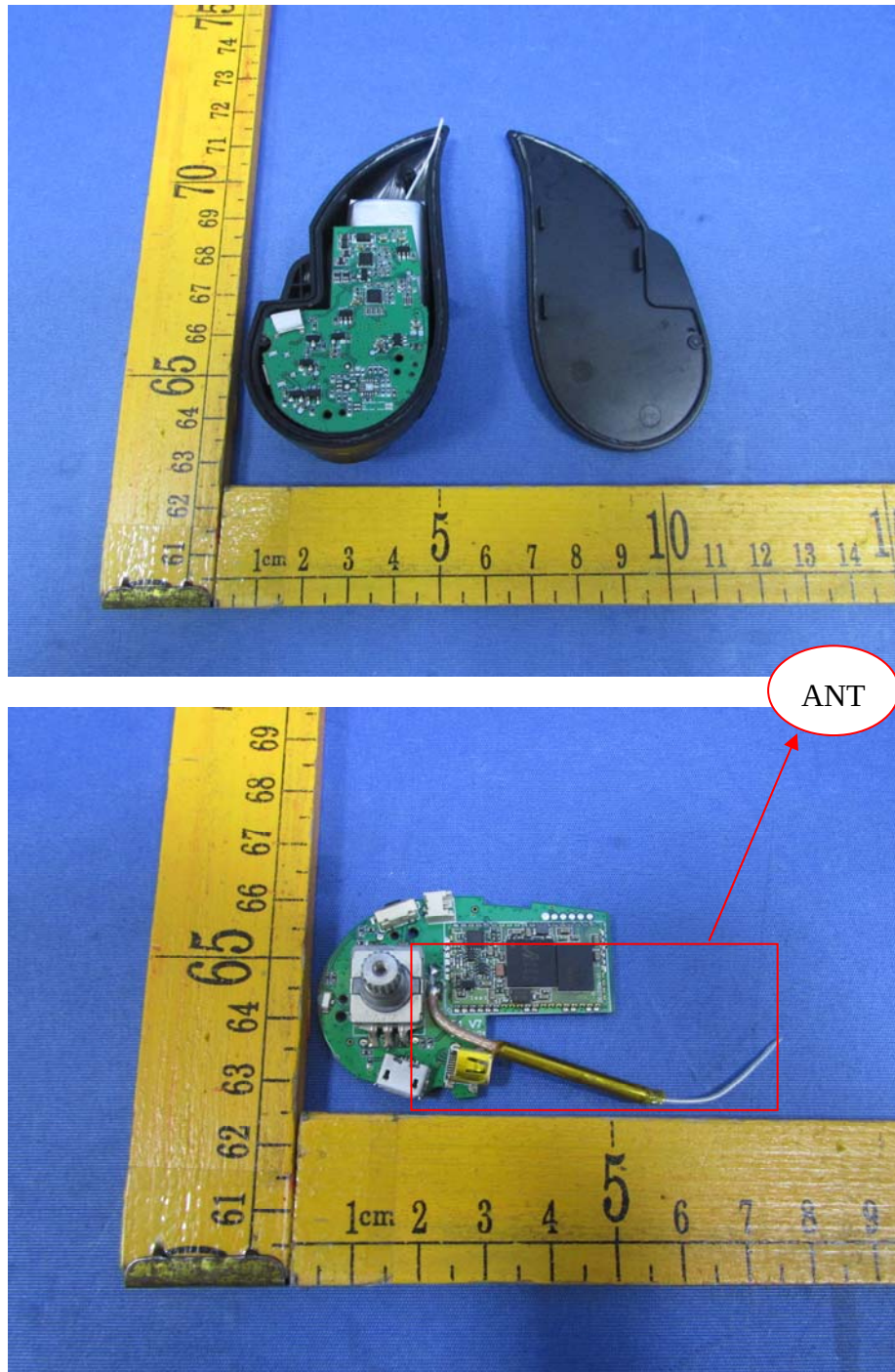


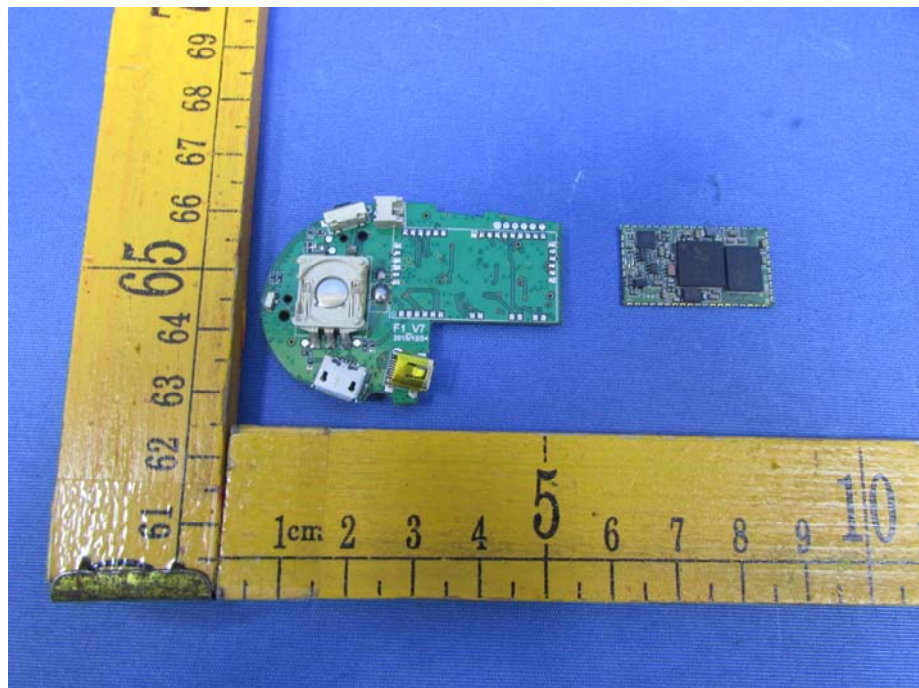
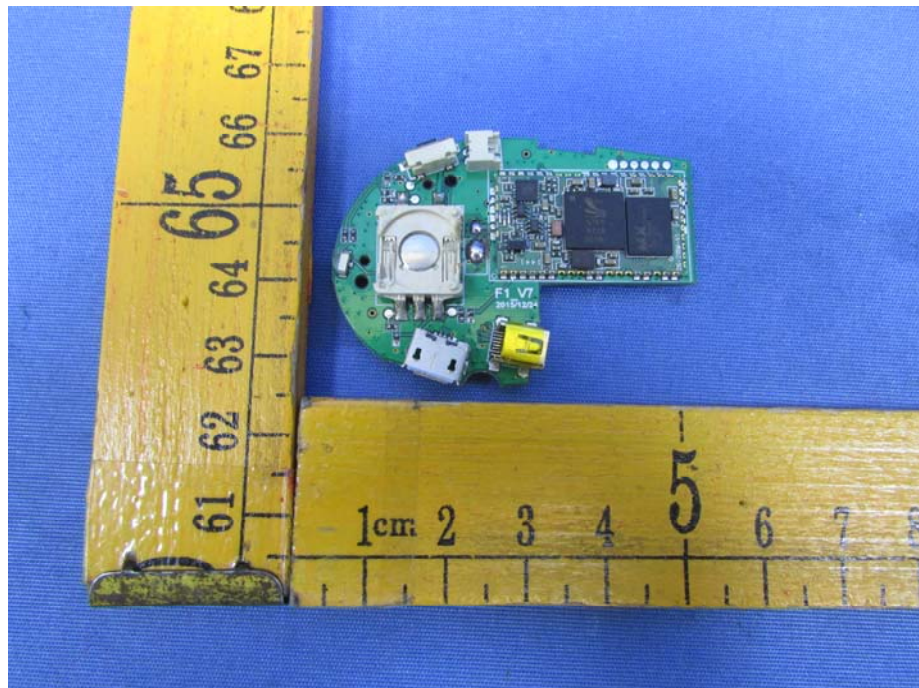


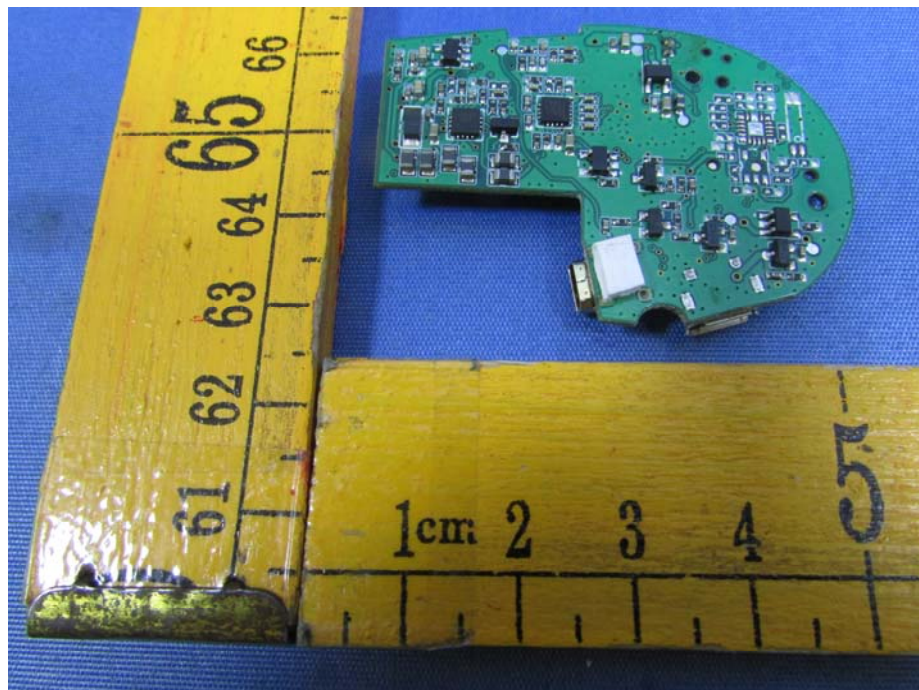
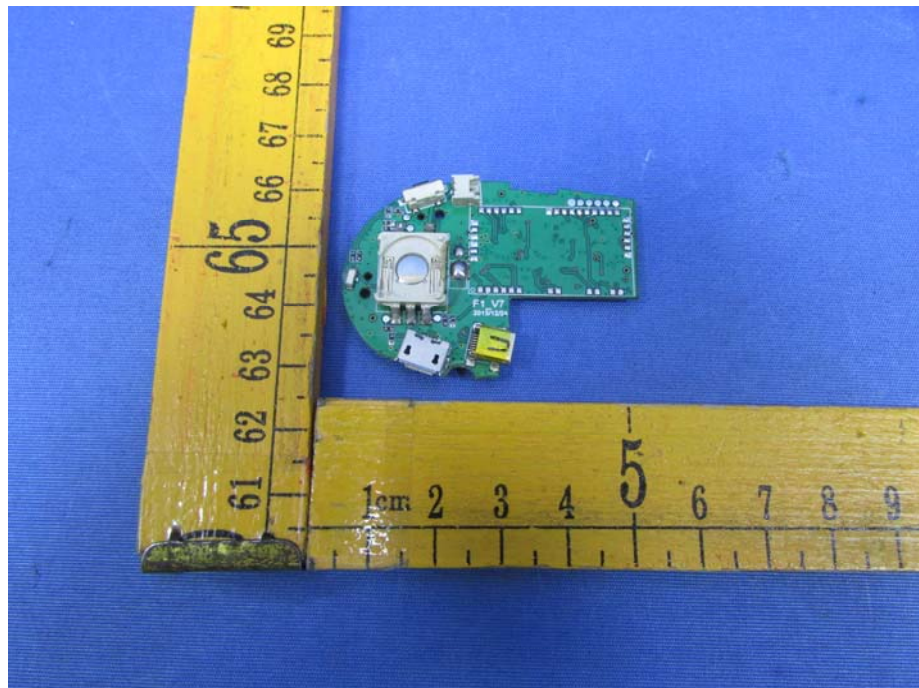


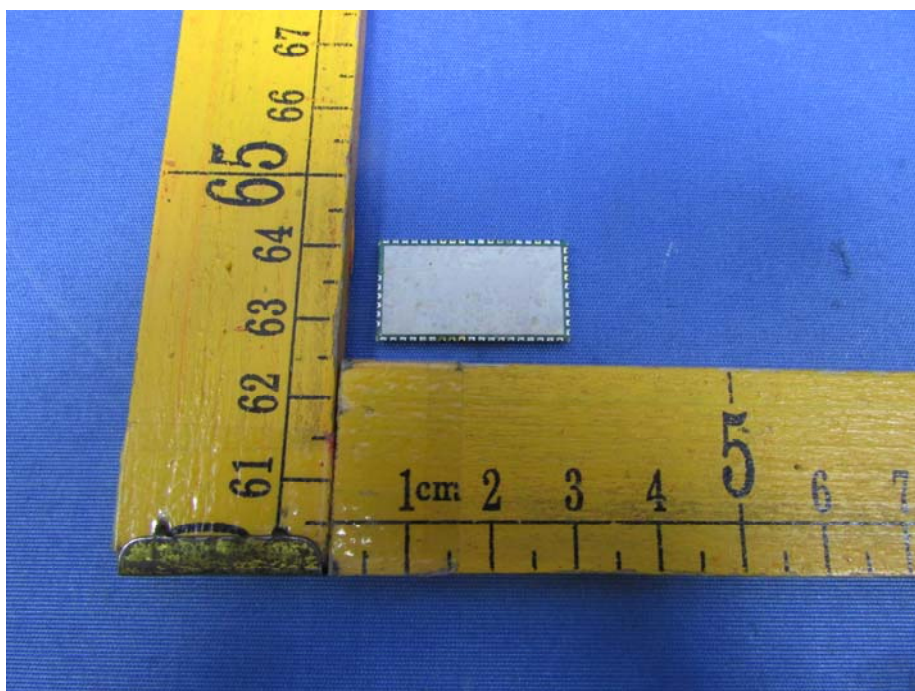
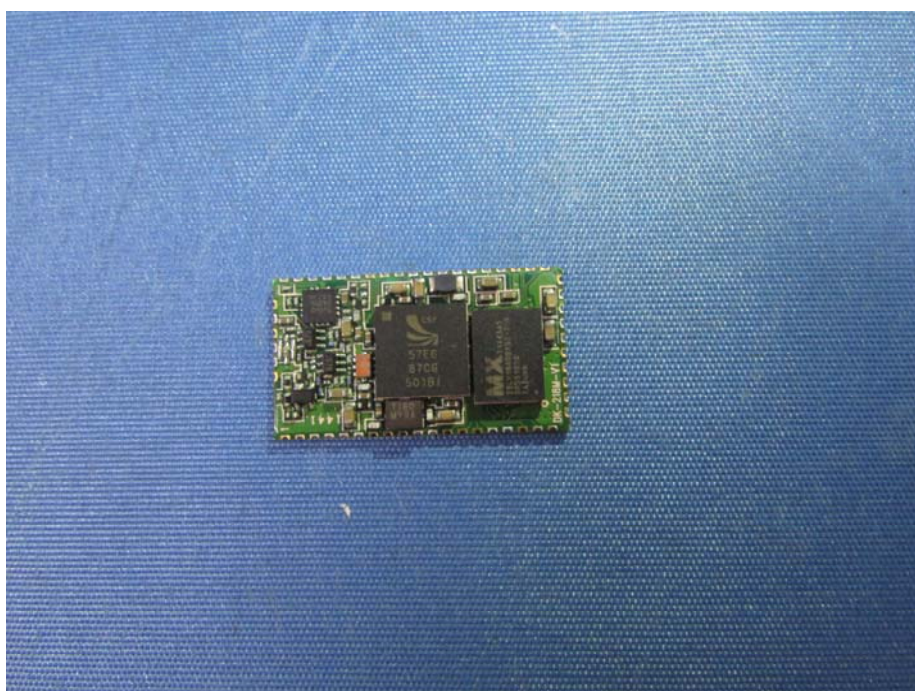


18.2 Model F1-Internal Photos











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