FCC TEST REPORT

FCC ID: 2AHGBBY-AU-BS-116

Product	:	Bluetooth speaker
Model Name	:	BY-AU-BS-116,GT-01
Brand	:	BYTECH
Report No.	:	PT800147160118E-FC01

Prepared for

ShenZhen Grand Electronics Co.,ltd

RM301,3rd floor,PengHua industrial Park,HePing Road,LongHua district,

ShenZhen,China.

Prepared by

DongGuan Precise Testing Service Co.,Ltd.

Building D, Baoding Technology Park, Guangming Road 2, Guangming Community

Dongcheng District, Dongguan, Guangdong, China

TEST RESULT CERTIFICATION

Applicant's name	:	ShenZhen Grand Electronics Co.,ltd
Address	:	RM301,3rd floor,PengHua industrial Park,HePing Road,LongHua district,ShenZhen,China.
Manufacture's name	:	ShenZhen Grand Electronics Co.,ltd
Address	:	RM301,3rd floor,PengHua industrial Park,HePing Road,LongHua district,ShenZhen,China.
Product name	:	Bluetooth speaker
Model name	:	BY-AU-BS-116,GT-01
Standards	:	FCC CFR47 Part 15 Section 15.247
Test procedure	:	ANSI C63.10:2013,DA 00-705
Test Date	:	Dec. 25, 2016~Feb. 25, 2016
Date of Issue	:	Feb. 26, 2016
Test Result	:	Pass

This device described above has been tested by PTS, 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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Testing Engineer

August Qiu

Technical Manager

Hack Ye

Authorized Signatory

Chris Du

Contents

Page

2 TEST SUMMARY 5

3 GENERAL INFORMATION 6

3.1 GENERAL DESCRIPTION OF E.U.T. 6

3.2 CHANNEL LIST 7

3.3 TEST MODE 8

3.4 TEST VOLTAGE 8

3.5 CONFIGURATION OF SYSTEM 8

4 EQUIPMENT DURING TEST 9

4.1 EQUIPMENTS LIST 9

4.2 DESCRIPTION OF SUPPORT UNITS 10

4.3 MEASUREMENT UNCERTAINTY 10

5 CONDUCTED EMISSION 11

5.1 E.U.T. OPERATION 11

5.2 EUT SETUP 11

5.3 MEASUREMENT DESCRIPTION 12

5.4 CONDUCTED EMISSION TEST RESULT 12

6 RADIATED SPURIOUS EMISSIONS 14

6.1 EUT OPERATION 14

6.2 TEST SETUP 15

6.3 SPECTRUM ANALYZER SETUP 16

6.4 TEST PROCEDURE 17

6.5 SUMMARY OF TEST RESULTS 18

7 BAND EDGE MEASUREMENT 21

7.1 TEST PROCEDURE 21

7.2 TEST RESULT 21

8 20 DB BANDWIDTH MEASUREMENT 28

8.1 TEST PROCEDURE 28

8.2 TEST RESULT 28

9 MAXIMUM PEAK OUTPUT POWER 34

9.1 TEST PROCEDURE 34

9.2 TEST RESULT 34

10 HOPPING CHANNEL SEPARATION 40

10.1 TEST PROCEDURE 40
10.2 TEST RESULT 40
11 NUMBER OF HOPPING FREQUENCY 46
11.1 TEST PROCEDURE 46
11.2 TEST RESULT 46
12 DWELL TIME 48
12.1 TEST PROCEDURE 48
12.2 TEST RESULT 48
13 ANTENNA REQUIREMENT 51
14 TEST SETUP 52
15 EUT PHOTOS 54

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
20dB 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
Antenna Requirement	15.203	PASS

Remark:

N/A: Not Applicable

3 General Information

3.1 General Description of E.U.T.

Product Name	:	Bluetooth speaker
Model Name	:	BY-AU-BS-116,GT-01
Model Description	:	Only the model names and colors are different.
Bluetooth Version:	:	V2.1+EDR
Frequency Range:	:	2402-2480MHz, 79 channels
Antenna installation:	:	PCB Printed Antenna
Antenna Gain:	:	1.4dBi
Type of Modulation	:	GFSK, Pi/4DQPSK, 8DPSK
The lowest oscillator:	:	24MHz
Power supply	:	DC 3.7V power by battery, DC 5V charging by USB port

3.2 Channel List

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

3.3 Test Mode

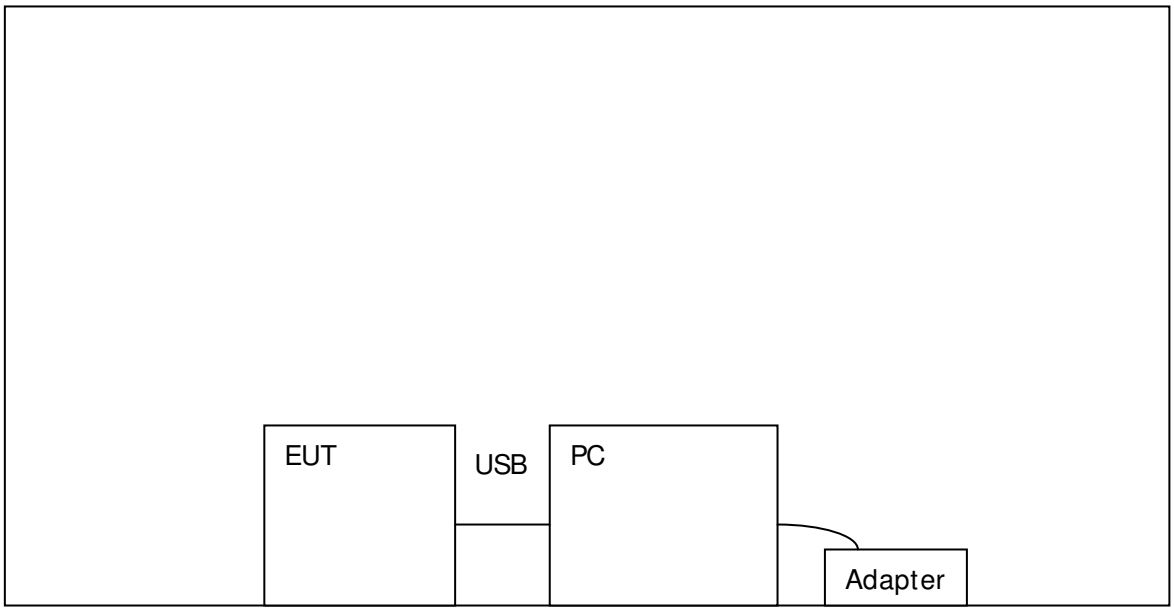
All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Modulation	Test mode	Low channel	Middle channel	High channel
GFSK	Transmitting	2402MHz	2441MHz	2480MHz
Pi/4DQPSK	Transmitting	2402MHz	2441MHz	2480MHz
8DPSK	Transmitting	2402MHz	2441MHz	2480MHz
Tests Carried Out Under FCC part 15.207				
Test Item		Test Mode		
Conduction Emission, 0.15MHz to 30MHz		BT Communication		

3.4 Test Voltage

Normal Test Voltage	Item
120V 60Hz	Conducted Emission & Radiated Emission
240V 60Hz	Conducted Emission & Radiated Emission
Remark: Only the worst case (120V 60Hz) was recorded in the report.	

3.5 Configuration of System



4 Equipment During Test

4.1 Equipments List

RF Conducted Test							
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	EMC Analyzer (9k~26.5GHz)	Agilent	E4407B	MY45109572	Aug.04, 2015	Aug.03, 2016	1 year
2	EXA Signal Analyzer	Keysight	N9010A	MY50520207 526B25MPB W7X	Aug.04, 2015	Aug.03, 2016	1 year
3	EMI Test Receiver	R&S	ESCI	101155	July 15, 2015	July 14, 2016	1 year
RadiatedEmissions							
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	EMI Test Receiver	Rohde&Schwarz	ESCI	101417	July 15, 2015	July 14, 2016	1 year
2	Analyzer (9k~26.5GHz)	Agilent	E4407B	MY45109572	Aug.04, 2015	Aug.03, 2016	1 year
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3355	July 15, 2015	July 14, 2016	1 year
4	Amplifier	EM	EM-30180	060538	July 15, 2015	July 14, 2016	1 year
5	Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-1246	July 15, 2015	July 14, 2016	1 year
6	Coaxial Cable(below 1GHz)	LARGE	CALB1	-	July 15, 2015	July 14, 2016	1 year
7	Coaxial Cable(above 1GHz)	LARGE	CALB2	-	July 15, 2015	July 14, 2016	1 year
Conducted Emissions							
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	EMI Test Receiver	R&S	ESCI	101155	July 15, 2015	July 14, 2016	1 year
2	LISN	SCHWARZBECK	NSLK 8128	8128-289	July 15, 2015	July 14, 2016	1 year
3	Cable	LARGE	RF300	-	July 15, 2015	July 14, 2016	1 year

4.2 Description of Support Units

Equipment	Manufacturer	Model No.	Series No.
Note Book	Dell	D610	OU7670
AC Adapter(with1.2mDC cable)	Dell	HA65NS1-00	OHN662
AC power line(0.8m)	Cold come	JYD-20	C-2201
USB Cable(1.0m,without shielding)	-	-	-

4.3 Measurement Uncertainty

Parameter	**Uncertainty**
RF output power, conducted	±1.0dB
Power Spectral Density, conducted	±2.2dB
Radio Frequency	$\pm 1 \times 10^{-6}$
Bandwidth	$\pm 1.5 \times 10^{-6}$
Time	±2%
Duty Cycle	±2%
Temperature	±1°C
Humidity	±5%
DC and low frequency voltages	±3%
Conducted Emissions (150kHz~30MHz)	±3.64dB
Radiated Emission(30MHz~1GHz)	±5.03dB
Radiated Emission(1GHz~25GHz)	±4.74dB

5 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 dBμV between 0.15MHz & 0.5MHz
	:	56 dBμV between 0.5MHz & 5MHz
	:	60 dBμV between 5MHz & 30MHz
Detector:	:	Peak for pre-scan(9kHz Resolution Bandwidth)

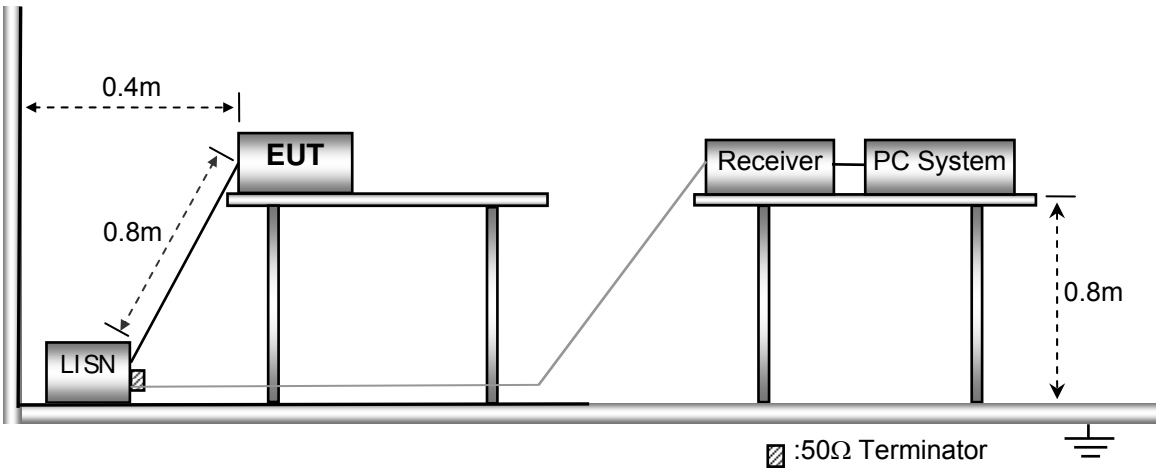
5.1 E.U.T. Operation

Operating Environment**:**

Temperature:	:	25.5 °C
Humidity:	:	51 % RH
Atmospheric Pressure:	:	101.2kPa
EUT Operation**:**	:	Refer to section 3.3

5.2 EUT Setup

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

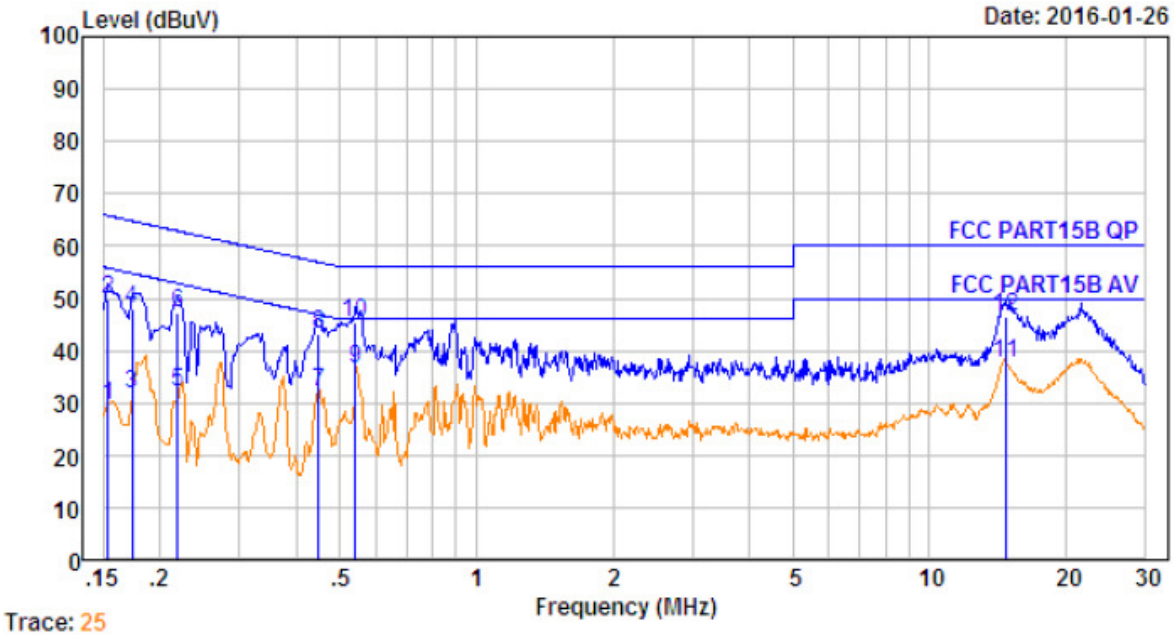


5.3 Measurement Description

The maximized 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.

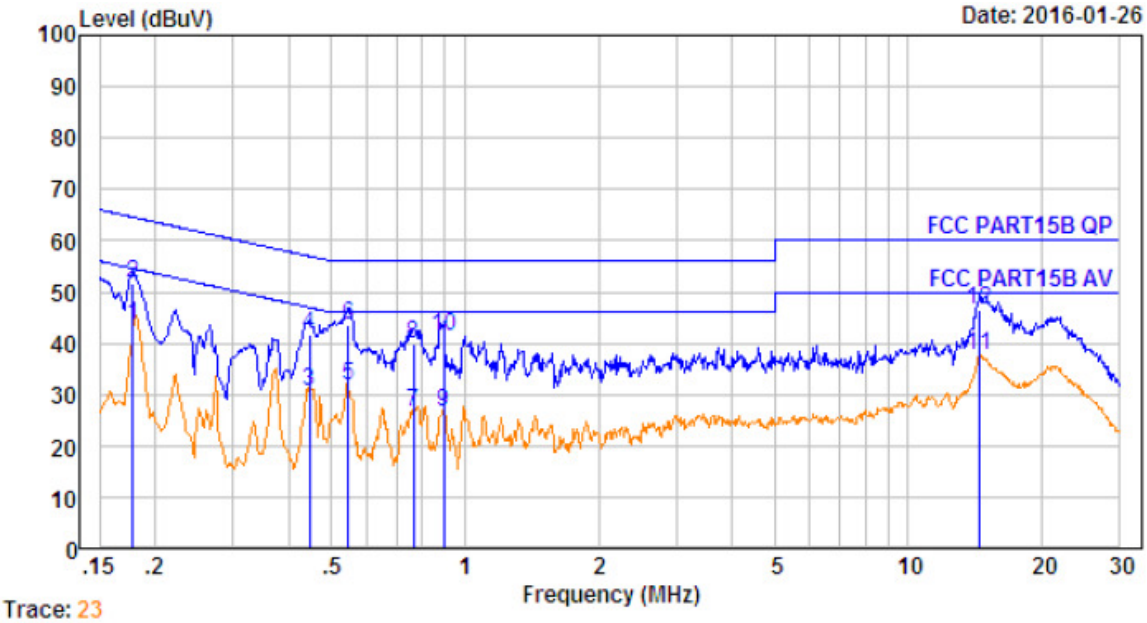
5.4 Conducted Emission Test Result

Live line:



No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBuV	Emission Level dBuV	Limit dBuV	Over Limit dB	Remark
1.	0.154	10.60	0.60	18.45	29.65	55.78	-26.13	Average
2.	0.154	10.60	0.60	38.45	49.65	65.78	-16.13	QP
3.	0.174	10.60	0.60	20.61	31.81	54.77	-22.96	Average
4.	0.174	10.60	0.60	36.61	47.81	64.77	-16.96	QP
5.	0.219	10.61	0.60	20.94	32.15	52.88	-20.73	Average
6.	0.219	10.61	0.60	35.94	47.15	62.88	-15.73	QP
7.	0.449	10.64	0.60	20.87	32.11	46.89	-14.78	Average
8.	0.449	10.64	0.60	31.87	43.11	56.89	-13.78	QP
9.	0.541	10.65	0.60	25.15	36.40	46.00	-9.60	Average
10.	0.541	10.65	0.60	34.15	45.40	56.00	-10.60	QP
11.	14.750	10.77	0.60	26.13	37.50	50.00	-12.50	Average
12.	14.750	10.77	0.60	35.13	46.50	60.00	-13.50	QP

Neutral line:



No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBuV	Emission Level dBuV	Limit dBuV	Over Limit dB	Remark
1.	0.178	10.61	0.60	32.30	43.51	54.59	-11.08	Average
2.	0.178	10.61	0.60	40.30	51.51	64.59	-13.08	QP
3.	0.447	10.64	0.60	19.52	30.76	46.93	-16.17	Average
4.	0.447	10.64	0.60	30.52	41.76	56.93	-15.17	QP
5.	0.546	10.65	0.60	20.31	31.56	46.00	-14.44	Average
6.	0.546	10.65	0.60	32.31	43.56	56.00	-12.44	QP
7.	0.767	10.66	0.60	15.46	26.72	46.00	-19.28	Average
8.	0.767	10.66	0.60	28.46	39.72	56.00	-16.28	QP
9.	0.894	10.67	0.60	15.12	26.39	46.00	-19.61	Average
10.	0.894	10.67	0.60	30.12	41.39	56.00	-14.61	QP
11.	14.517	10.77	0.60	26.11	37.48	50.00	-12.52	Average
12.	14.517	10.77	0.60	35.11	46.48	60.00	-13.52	QP

6 Radiated Spurious Emissions

Test Requirement: : FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method: : ANSI C63.10:2013,DA 00-705

Test Result: : PASS

Measurement Distance: : 3m

Limit: : See the follow table

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(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
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	$20\log^{(500)}$

6.1 EUT Operation

Operating Environment :

Temperature: : 23.5 °C

Humidity: : 51.1 % RH

Atmospheric Pressure: : 101.2kPa

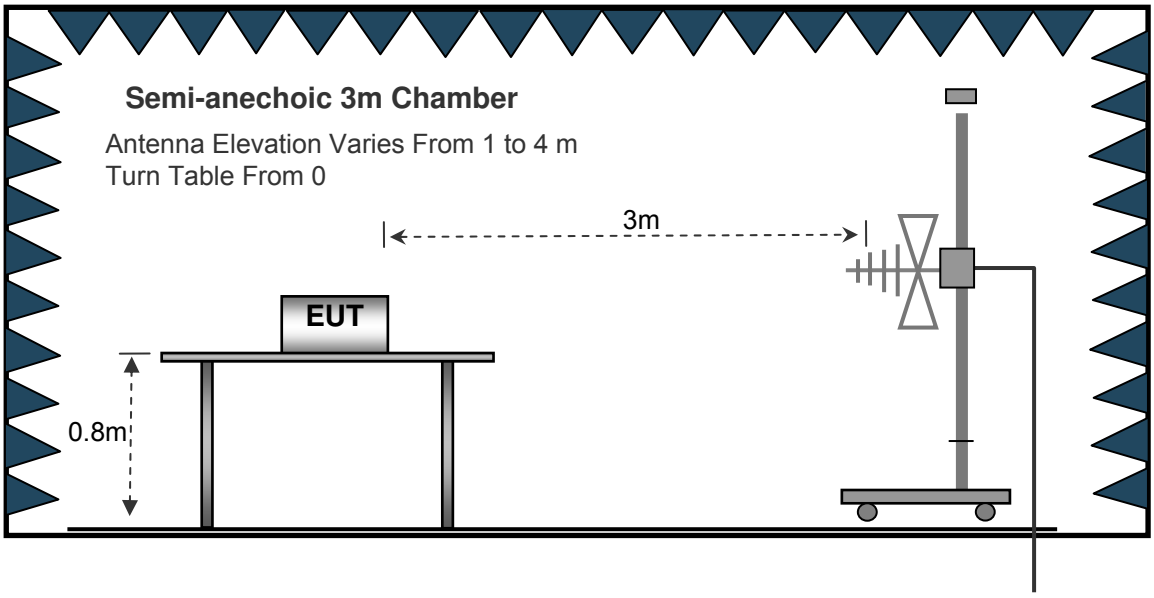
EUT Operation : : Refer to section 3.3

6.2 Test Setup

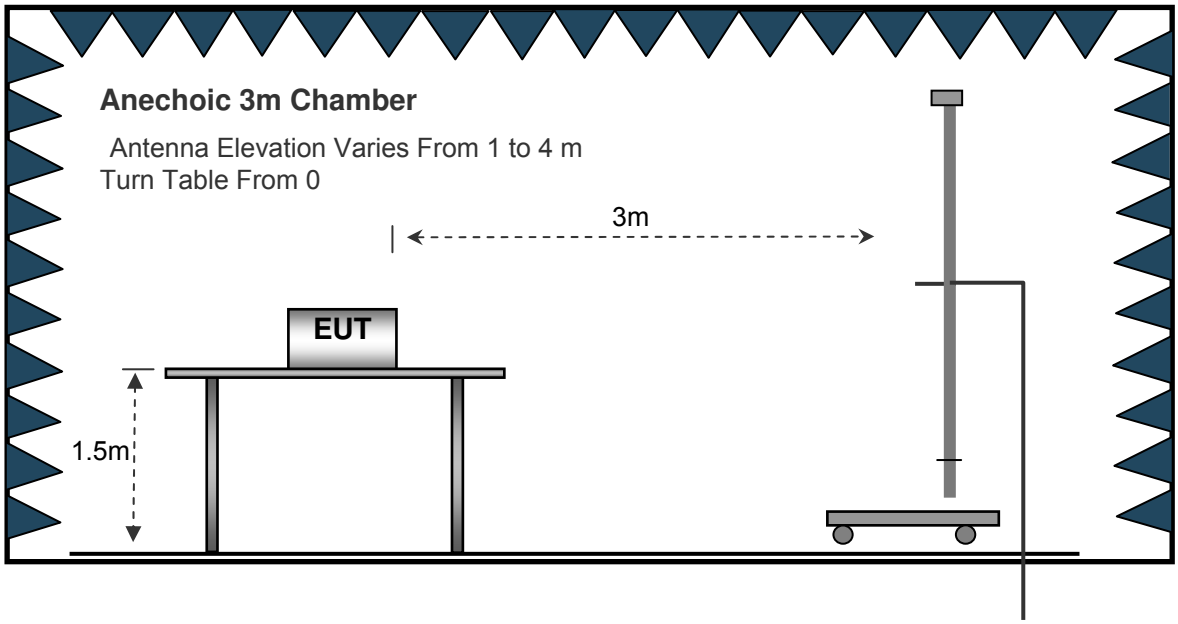
The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

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.



6.3 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

6.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane for below 1GHz and 1.5m for above 1GHz..

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.

6.5 Summary of Test Results

Test Frequency: Below 30MHz

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

Test Frequency: 30MHz ~ 18GHz

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

Frequency	Receiver Reading	Detector	Corrected Factor	Corrected Amplitude	Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Low Channel						
175.69	42.54	QP	-17.72	24.82	43.50	-18.68
175.69	38.67	QP	-17.72	20.95	43.50	-22.55
4804.00	49.87	PK	-1.06	48.81	74.00	-25.19
4804.00	43.69	Ave	-1.06	42.63	54.00	-11.37
7206.00	49.53	PK	1.33	50.86	74.00	-23.14
7206.00	44.79	Ave	1.33	46.12	54.00	-7.88
2350.00	45.02	PK	-13.19	31.83	74.00	-42.17
2350.00	39.30	Ave	-13.19	26.11	54.00	-27.89
2387.77	42.91	PK	-13.14	29.77	74.00	-44.23
2387.77	38.12	Ave	-13.14	24.98	54.00	-29.02
2484.13	42.47	PK	-13.08	29.39	74.00	-44.61
2484.13	40.29	Ave	-13.08	27.21	54.00	-26.79
Remark: Corrected Factor=ANT Factor + Cable Loss – Amp Gain						

Frequency	Receiver Reading	Detector	Corrected Factor	Corrected Amplitude	Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK Middle Channel						
175.69	43.28	QP	-17.72	25.56	43.50	-17.94
175.69	37.96	QP	-17.72	20.24	43.50	-23.26
4882.00	50.18	PK	-0.93	49.25	74.00	-24.75
4882.00	43.24	Ave	-0.93	42.31	54.00	-11.69
7323.00	48.55	PK	1.67	50.22	74.00	-23.78
7323.00	44.79	Ave	1.67	46.46	54.00	-7.54
2344.12	45.09	PK	-13.19	31.90	74.00	-42.10
2344.12	39.87	Ave	-13.19	26.68	54.00	-27.32
2358.03	42.02	PK	-13.14	28.88	74.00	-45.12
2358.03	38.68	Ave	-13.14	25.54	54.00	-28.46
2497.42	43.43	PK	-13.08	30.35	74.00	-43.65
2497.42	39.75	Ave	-13.08	26.67	54.00	-27.33
Remark: Corrected Factor=ANT Factor + Cable Loss – Amp Gain						

Frequency	Receiver Reading	Detector	Corrected Factor	Corrected Amplitude	Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
GFSK High Channel						
175.69	42.95	QP	-17.72	25.23	43.50	-18.27
175.69	38.77	QP	-17.72	21.05	43.50	-22.45
4960.00	49.23	PK	-0.87	48.36	74.00	-25.64
4960.00	43.07	Ave	-0.87	42.20	54.00	-11.80
7440.00	49.51	PK	1.84	51.35	74.00	-22.65
7440.00	43.83	Ave	1.84	45.67	54.00	-8.33
2323.89	44.48	PK	-13.19	31.29	74.00	-42.71
2323.89	39.82	Ave	-13.19	26.63	54.00	-27.37
2364.49	42.01	PK	-13.14	28.87	74.00	-45.13
2364.49	38.00	Ave	-13.14	24.86	54.00	-29.14
2484.23	42.98	PK	-13.08	29.90	74.00	-44.10
2484.23	40.40	Ave	-13.08	27.32	54.00	-26.68
Remark: Corrected Factor=ANT Factor + Cable Loss – Amp Gain						

Test Frequency: Above 18GHz

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

7 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,DA 00-705

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 & Hopping

7.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

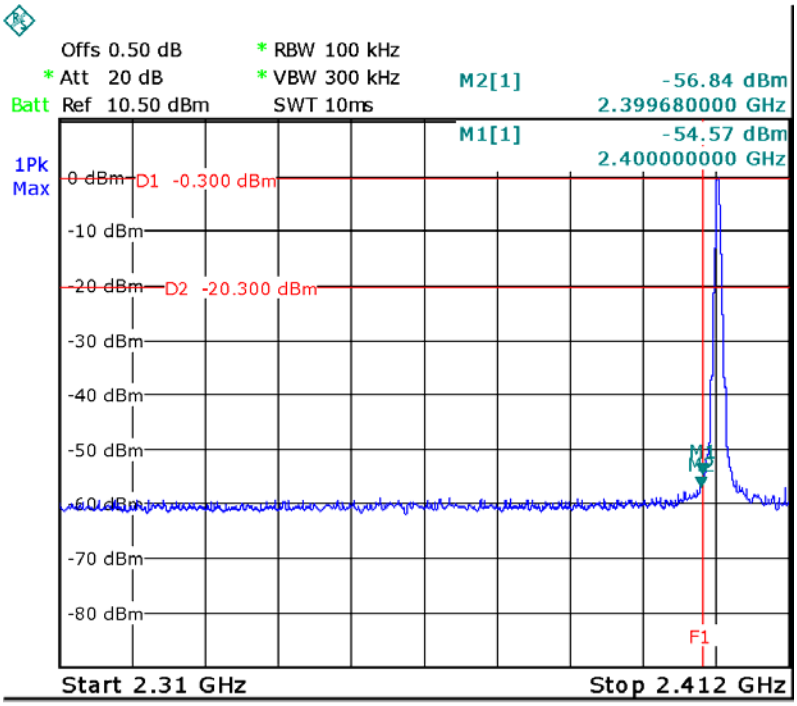
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto

Detector function = peak, Trace = max hold

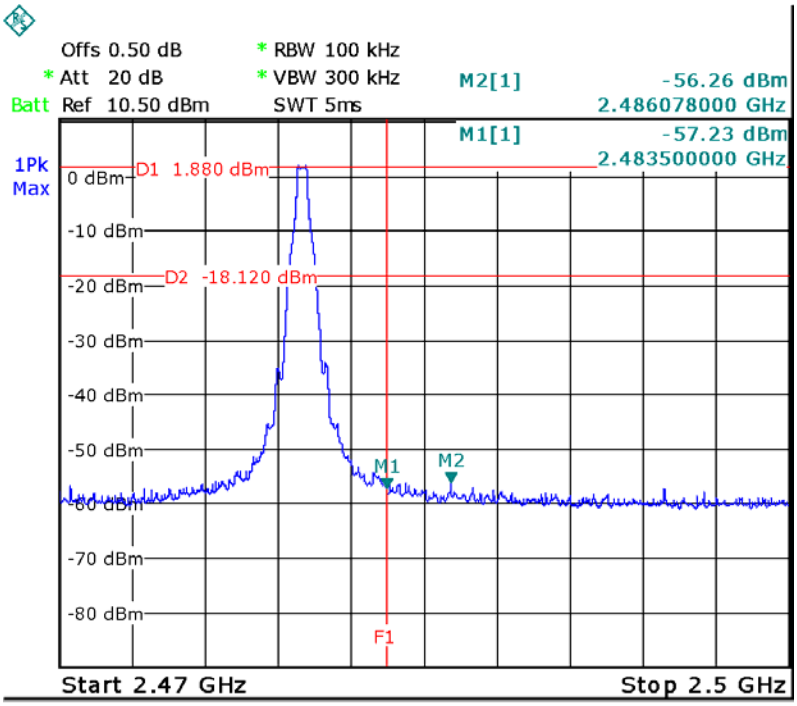
7.2 Test Result

Modulation	Mode	Band edge	Value	Limit	Result
GFSK	Transmitting	Left	-56.84	-20.30	Pass
		Right	-56.26	-18.12	Pass
	Hopping	Left	-58.39	-20.12	Pass
		Right	-58.25	-18.36	Pass
Pi/4 DQPSK	Transmitting	Left	-56.13	-21.38	Pass
		Right	-56.17	-19.17	Pass
	Hopping	Left	-57.47	-21.12	Pass
		Right	-57.36	-19.35	Pass
8DPSK	Transmitting	Left	-54.38	-21.42	Pass
		Right	-56.60	-19.11	Pass
	Hopping	Left	-58.67	-21.02	Pass
		Right	-58.11	-19.13	Pass
Remark:					
The limit is 20dB below the maximum peak level, please refer to the display line of the follow plot					

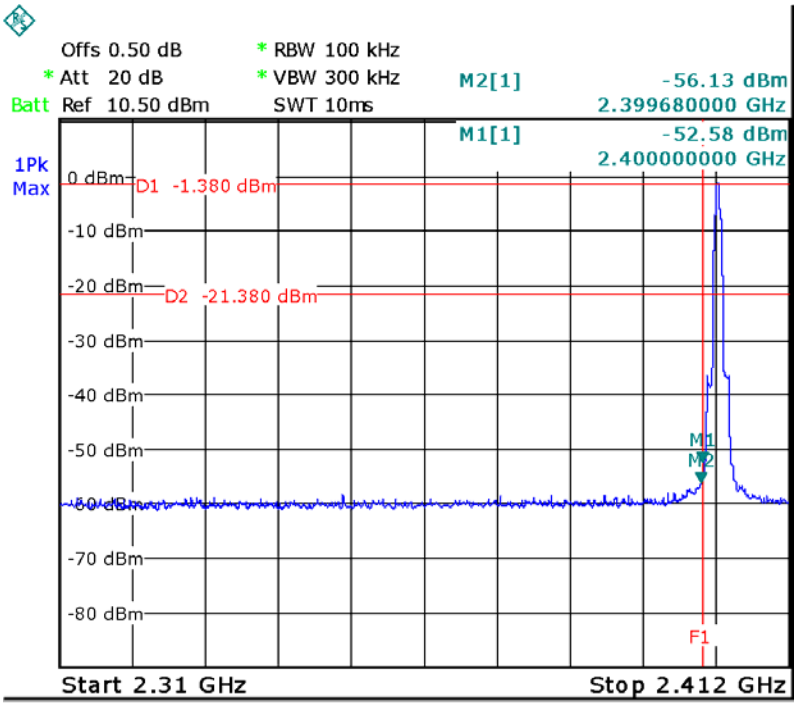
TX in GFSK Band edge-left side



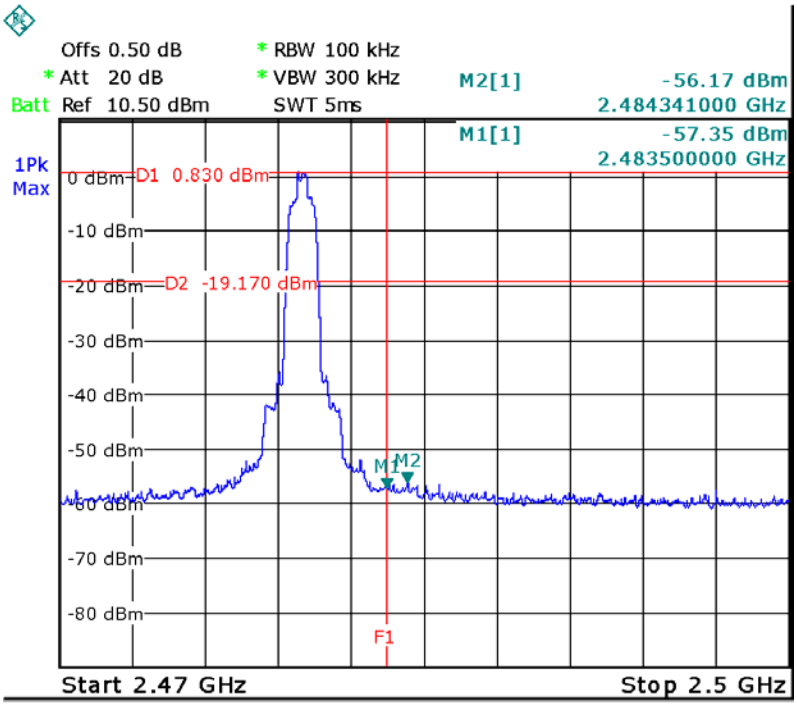
TX in GFSK Band edge-right side



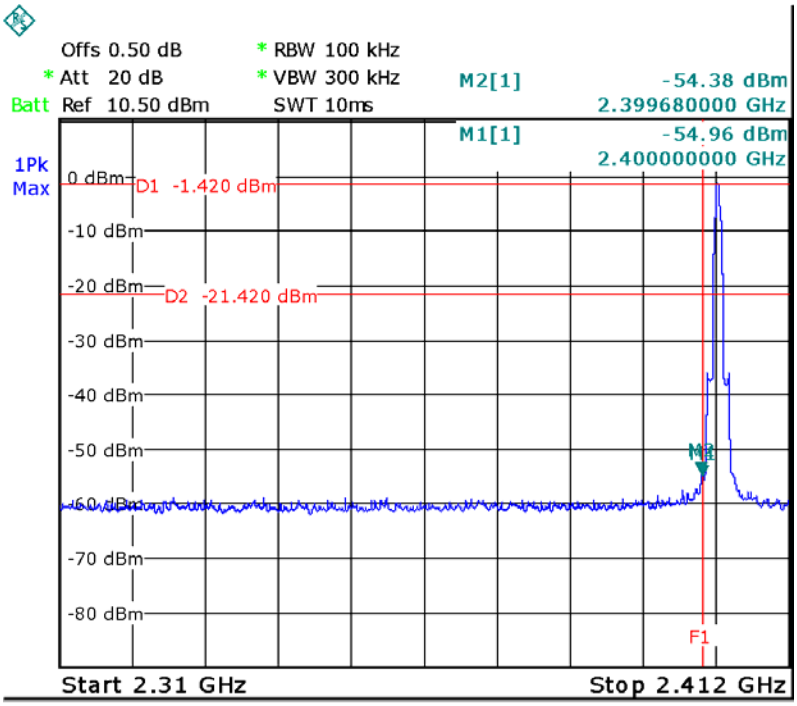
TX in Pi/4 DQPSK Band edge-left side



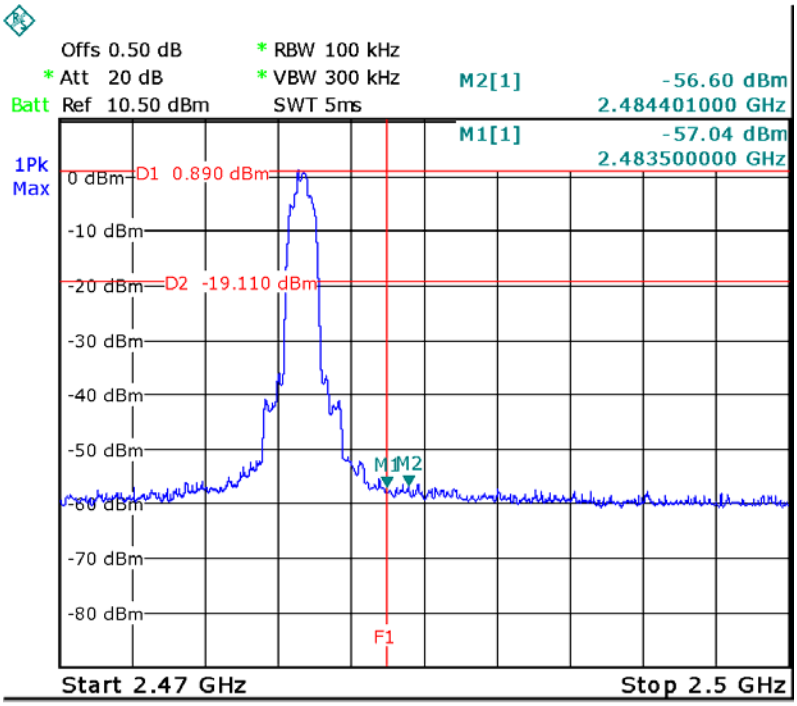
TX in Pi/4 DQPSK Band edge-right side



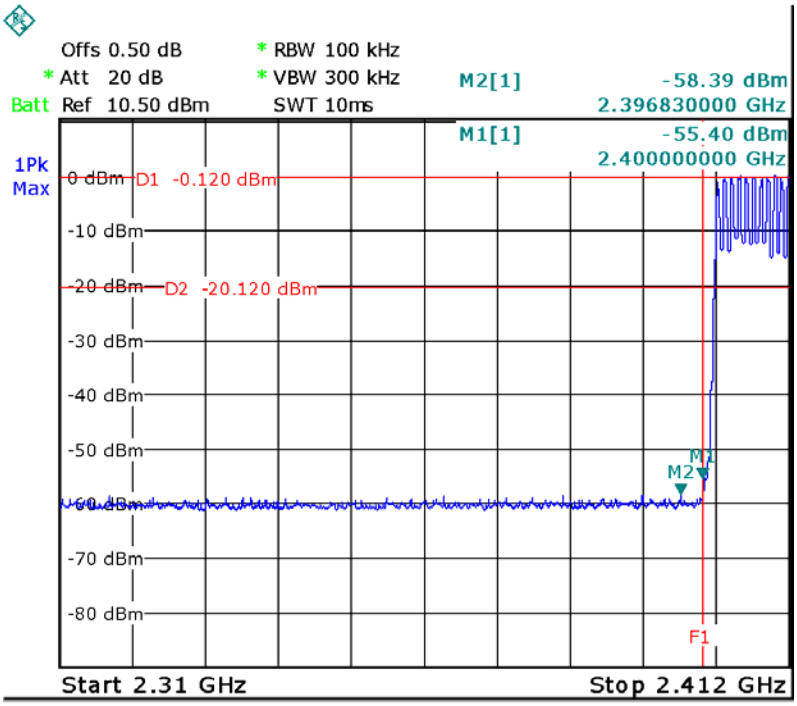
TX in 8DPSK Band edge-left side



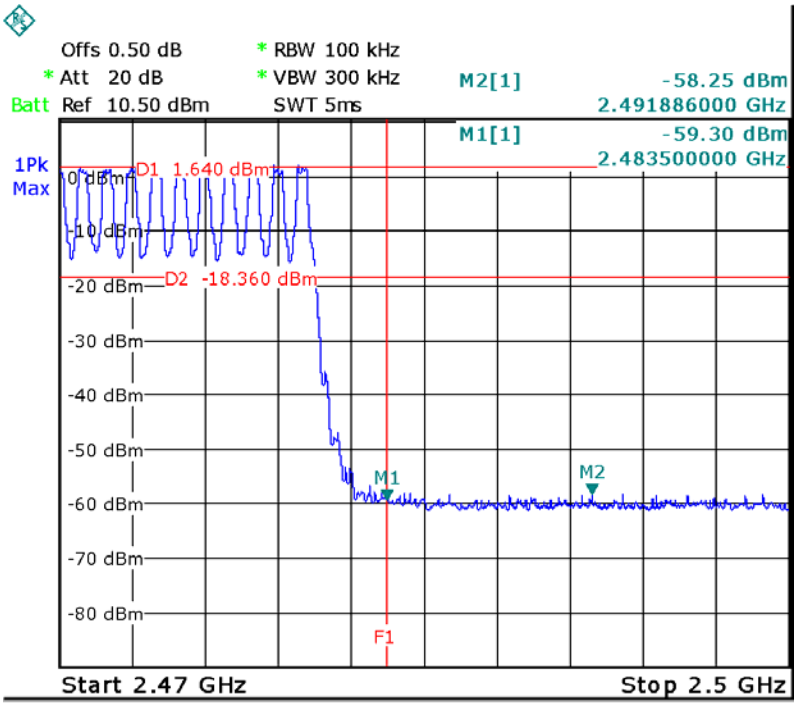
TX in 8DPSK Band edge-right side



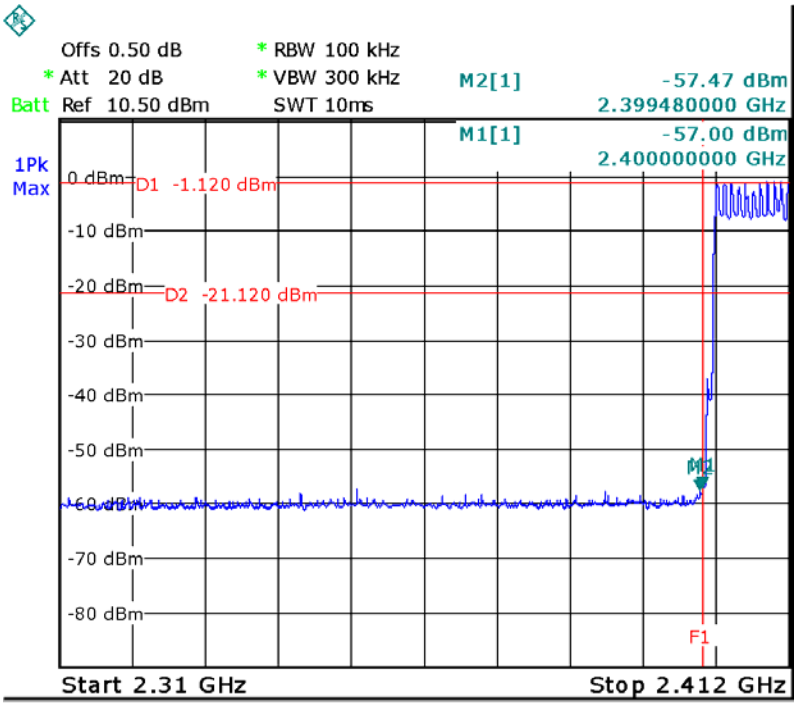
Hopping in GFSK Band edge-left side



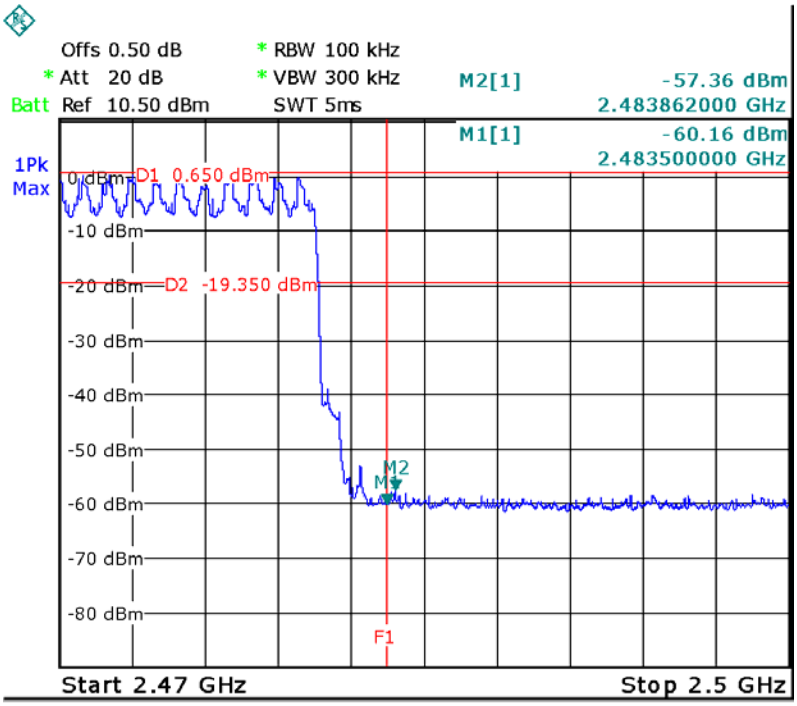
Hopping in GFSK Band edge-right side



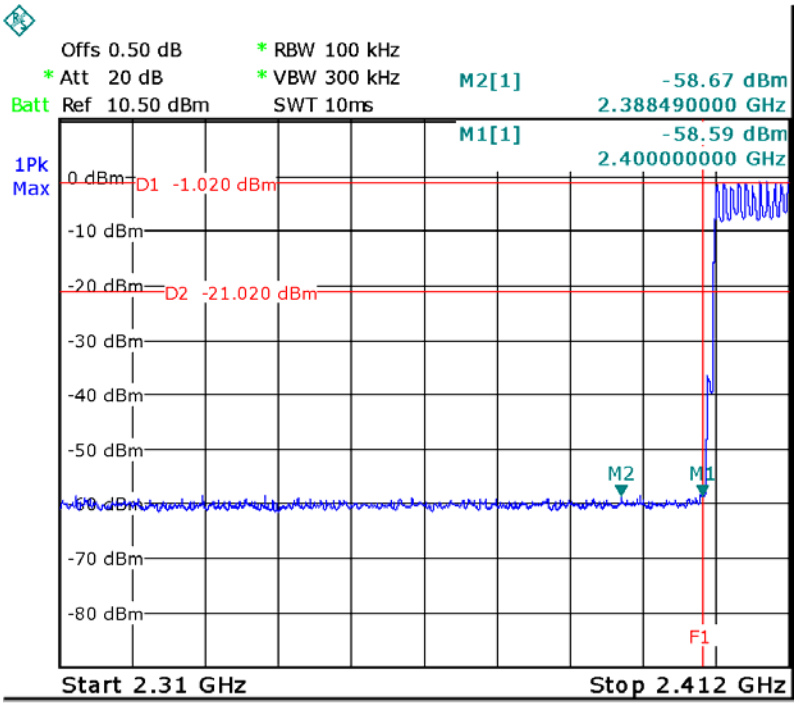
Hopping in Pi/4 DQPSK Band edge-left side



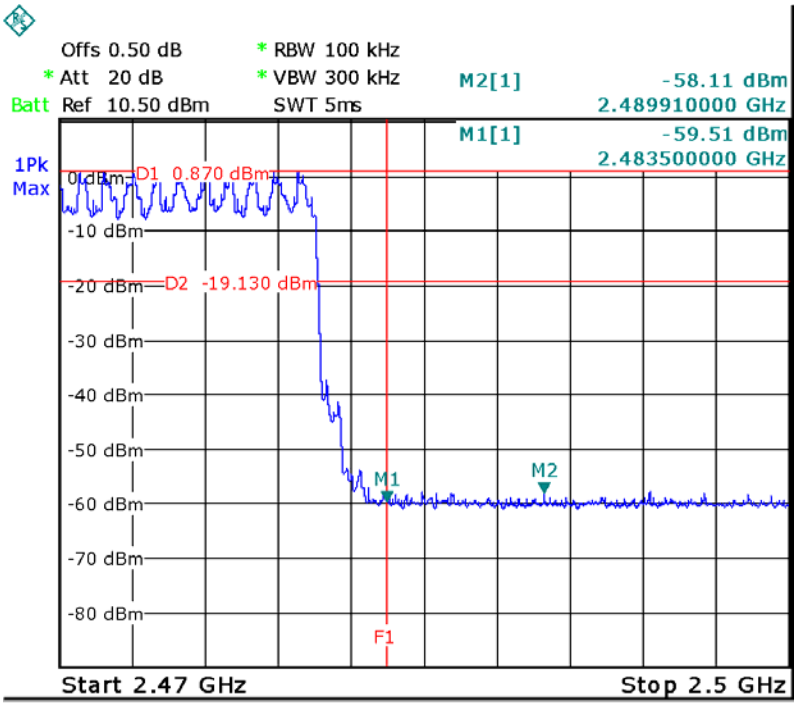
Hopping in Pi/4 DQPSK Band edge-right side



Hopping in 8DPSK Band edge-left side



Hopping in 8DPSK Band edge-right side



8 20 dB Bandwidth Measurement

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013,DA 00-705

Test Mode : Refer to section 3.3

8.1 Test Procedure

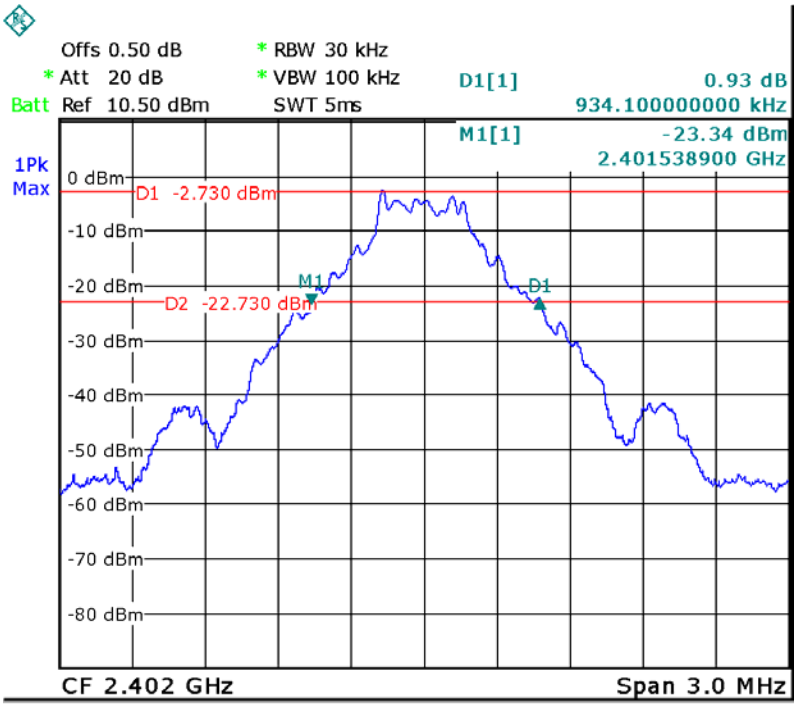
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

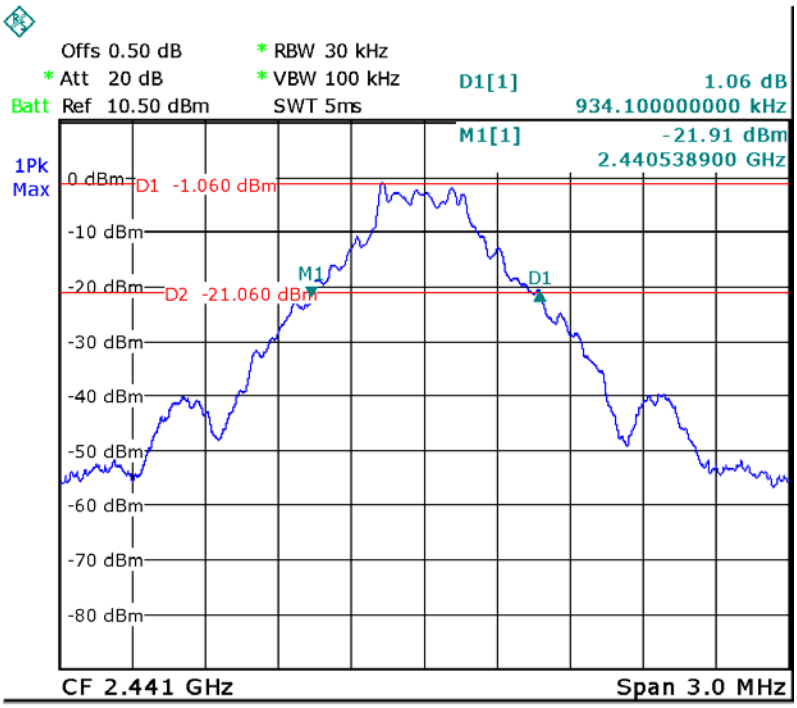
8.2 Test Result

Modulation	Test Channel	Bandwidth(MHz)
GFSK	Low	0.934
GFSK	Middle	0.934
GFSK	High	0.934
Pi/4 DQPSK	Low	1.252
Pi/4 DQPSK	Middle	1.252
Pi/4 DQPSK	High	1.252
8DPSK	Low	1.258
8DPSK	Middle	1.258
8DPSK	High	1.258

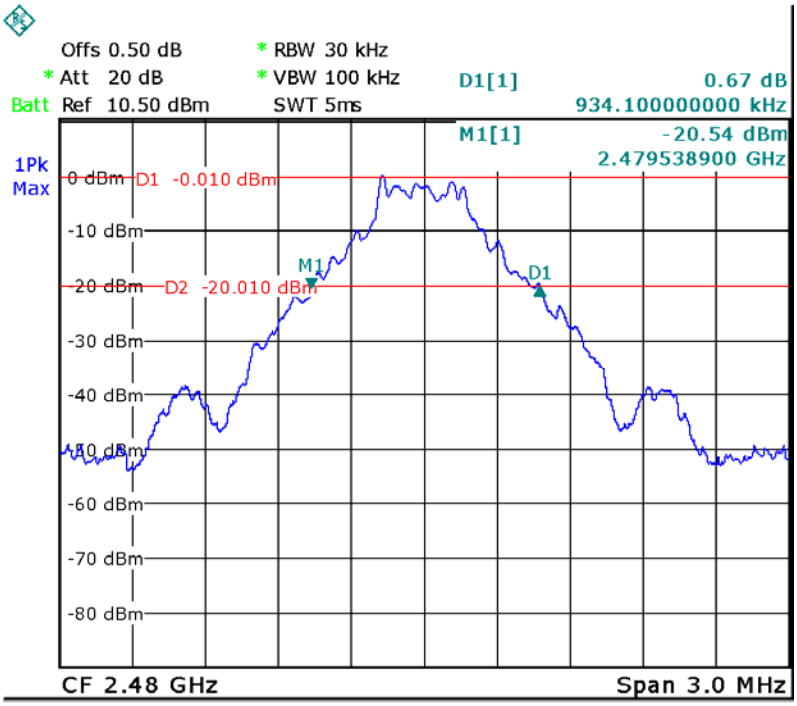
GFSK Low Channel



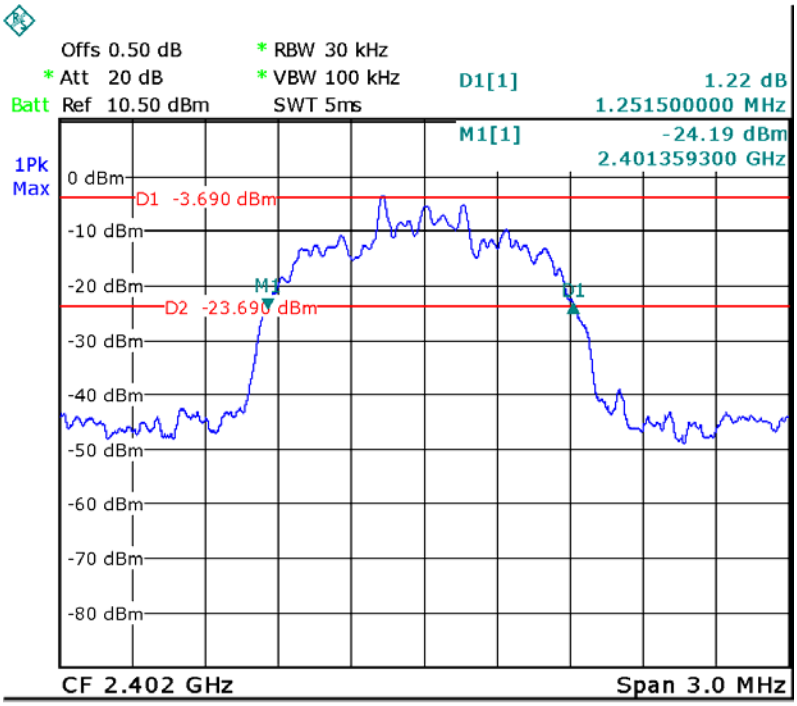
GFSK Middle Channel



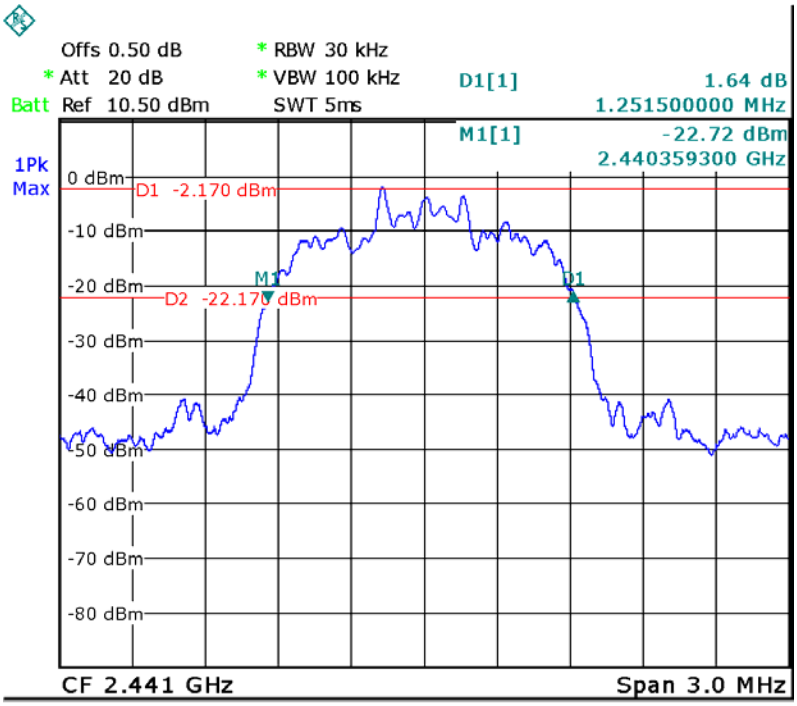
GFSK High Channel



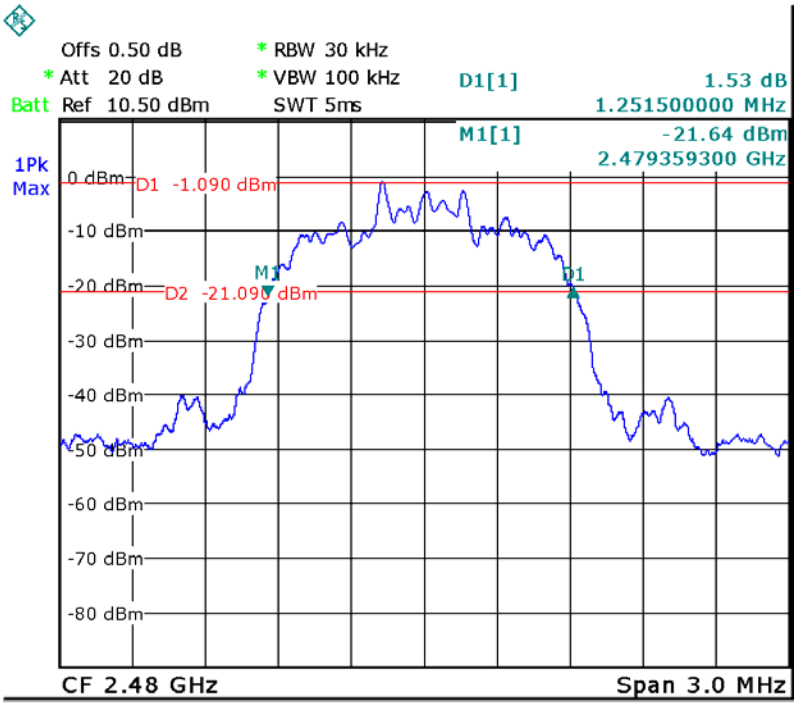
Pi/4DQPSK Low Channel



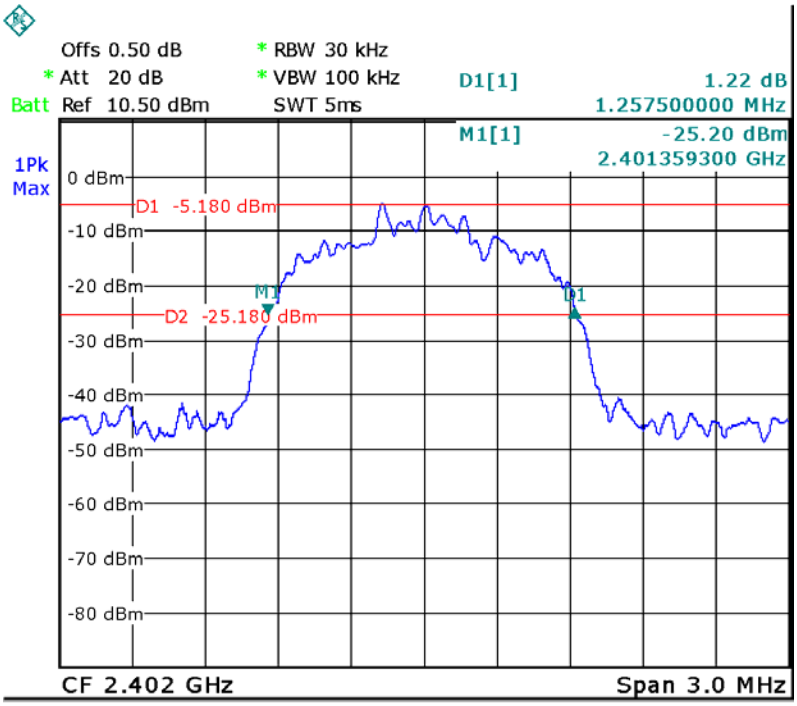
Pi/4DQPSK Middle Channel



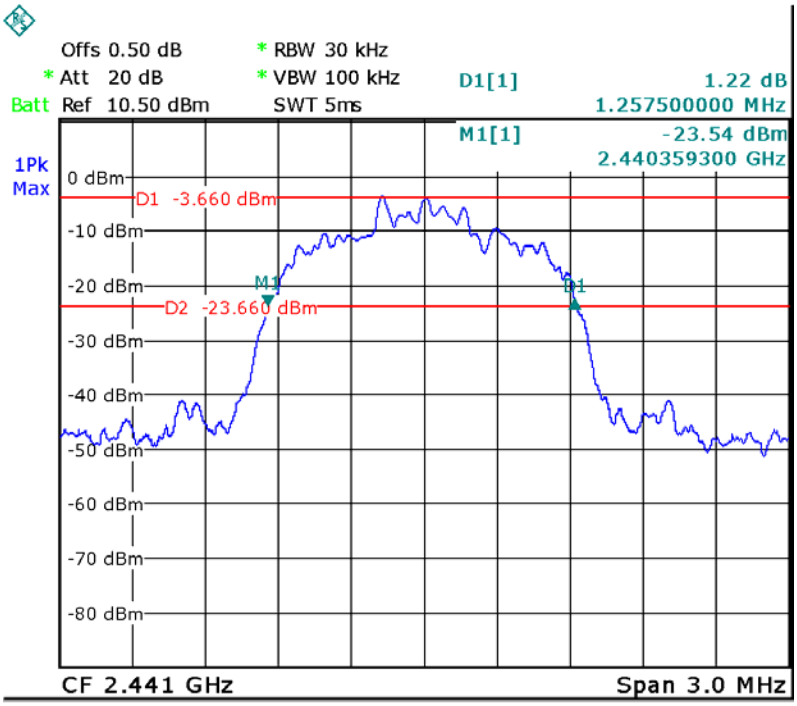
Pi/4DQPSK High Channel



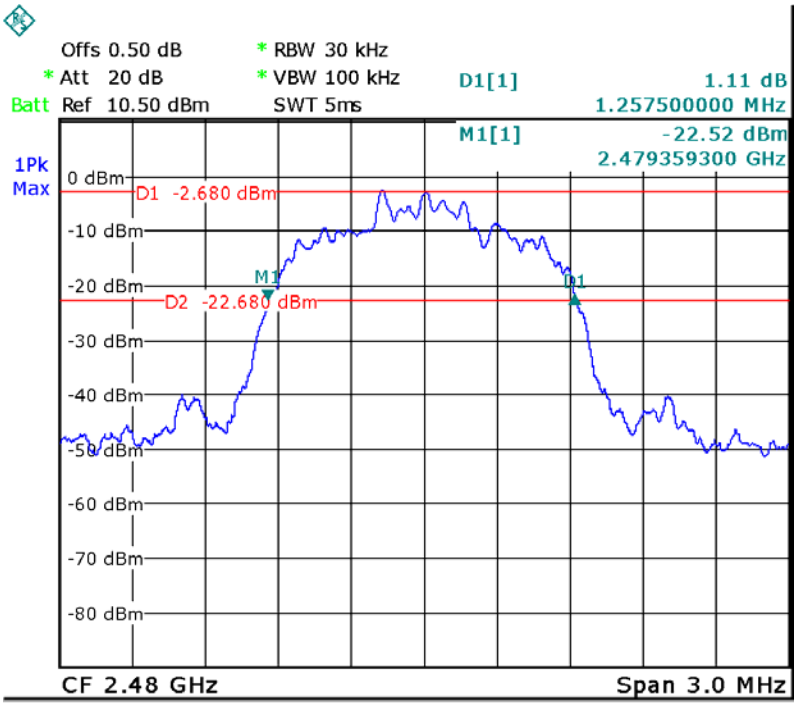
8DPSK Low Channel



8DPSK Middle Channel



8DPSK High Channel



9 Maximum Peak Output Power

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013,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 0.125watts (20.97 dBm) limit applies.

Test Mode : Refer to section 3.3

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.

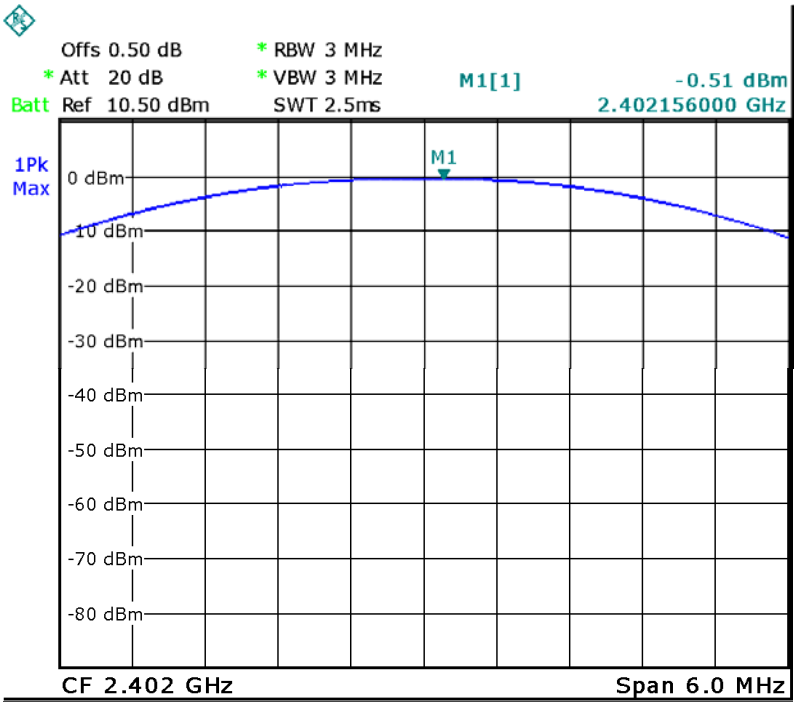
2. Set the spectrum analyser: RBW = 3 MHz. VBW =3 MHz. Sweep = auto; Detector Function = Peak.

3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

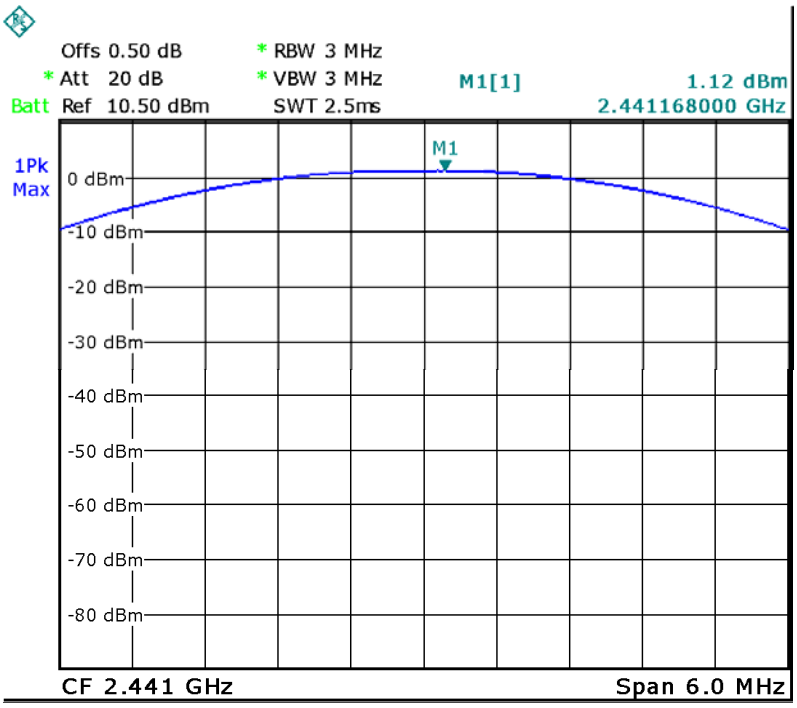
9.2 Test Result

Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Low	-0.51	30
GFSK	Middle	1.12	30
GFSK	High	2.16	30
Pi/4 DQPSK	Low	-0.94	21
Pi/4 DQPSK	Middle	0.60	21
Pi/4 DQPSK	High	1.67	21
8DPSK	Low	-0.57	21
8DPSK	Middle	1.05	21
8DPSK	High	2.13	21

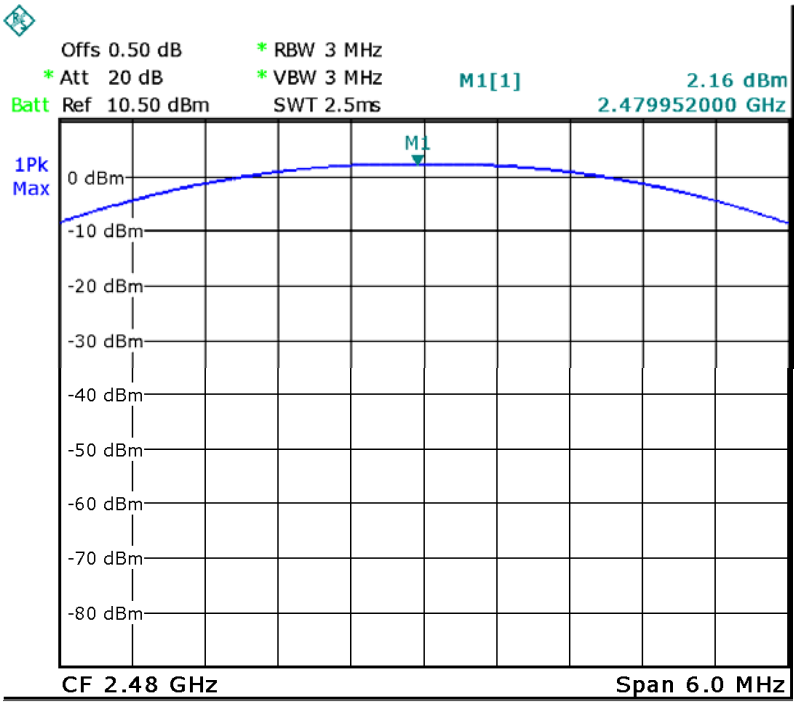
GFSK Low Channel



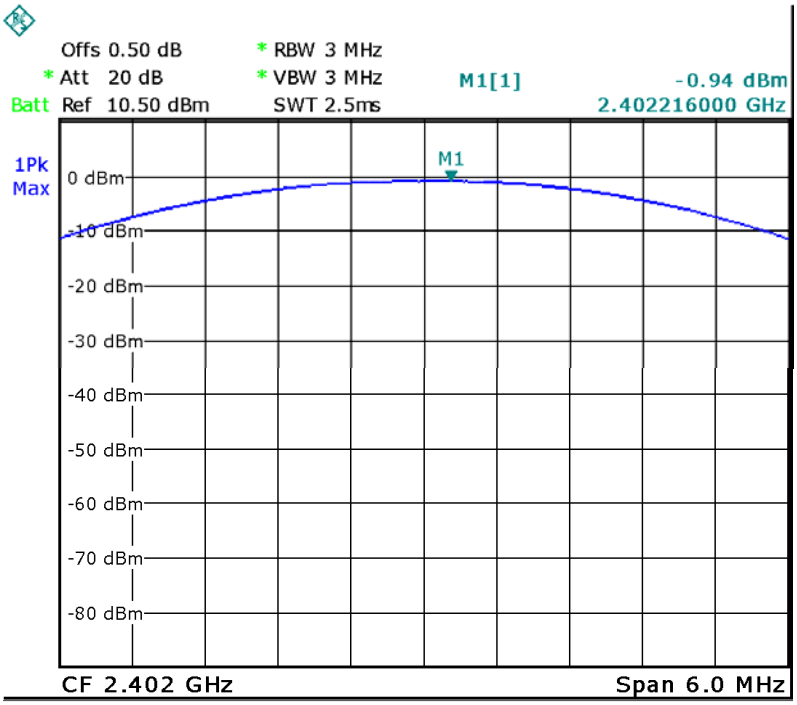
GFSK Middle Channel



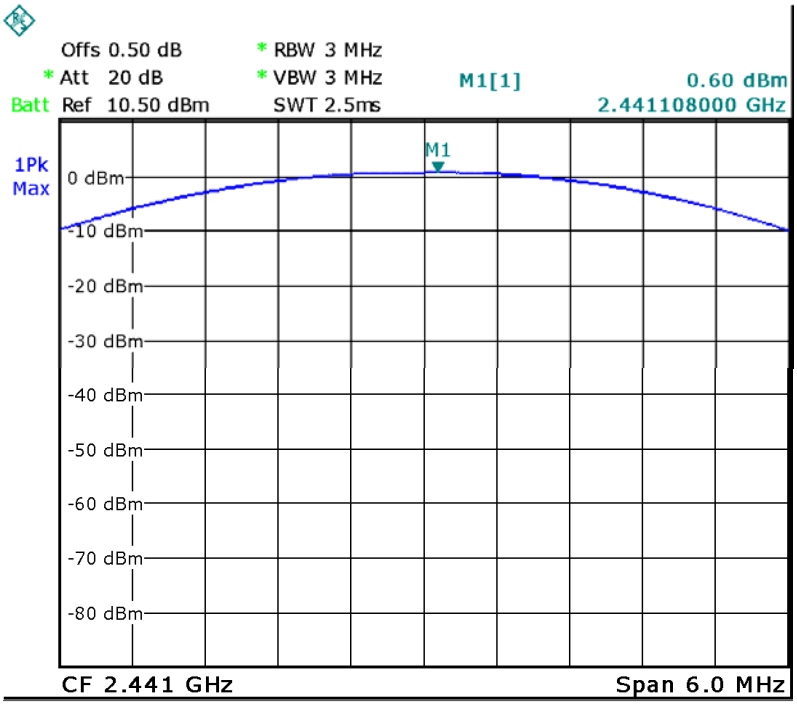
GFSK High Channel



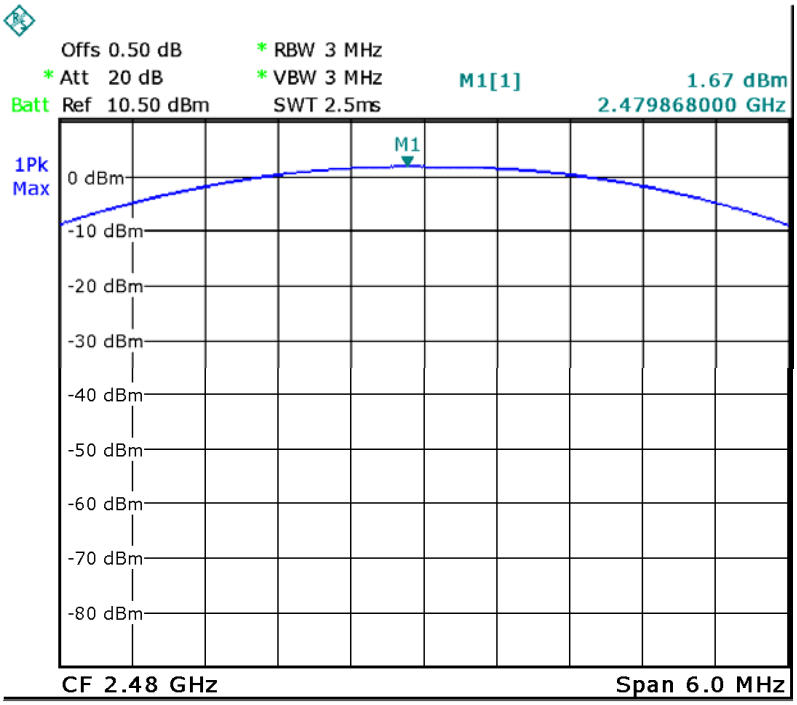
Pi/4DQPSK Low Channel



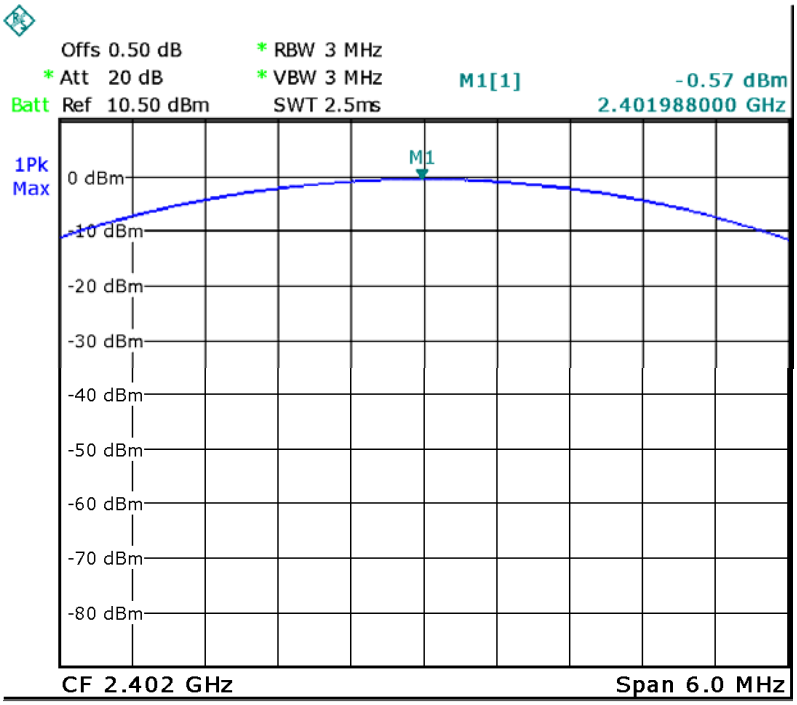
Pi/4DQPSK Middle Channel



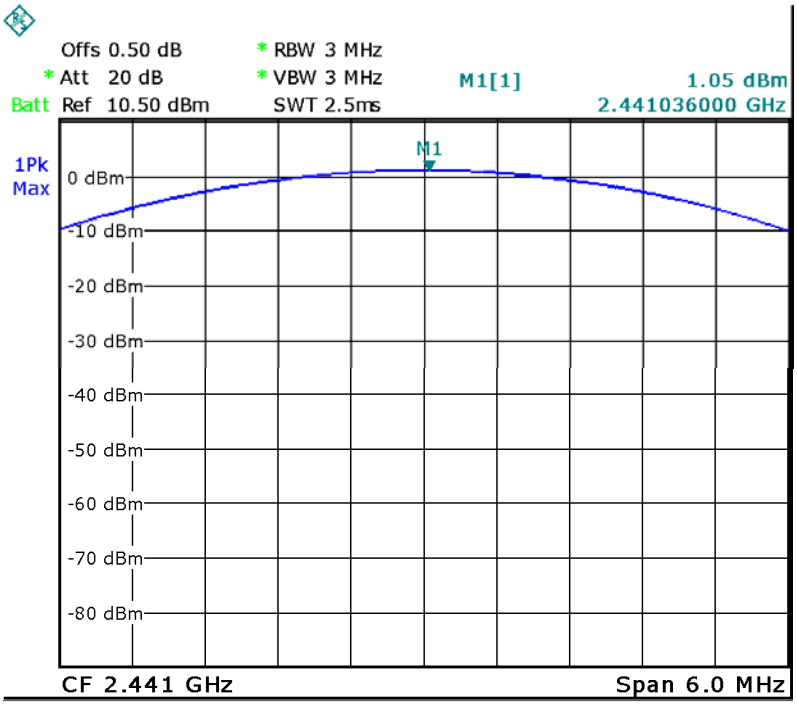
Pi/4DQPSK High Channel



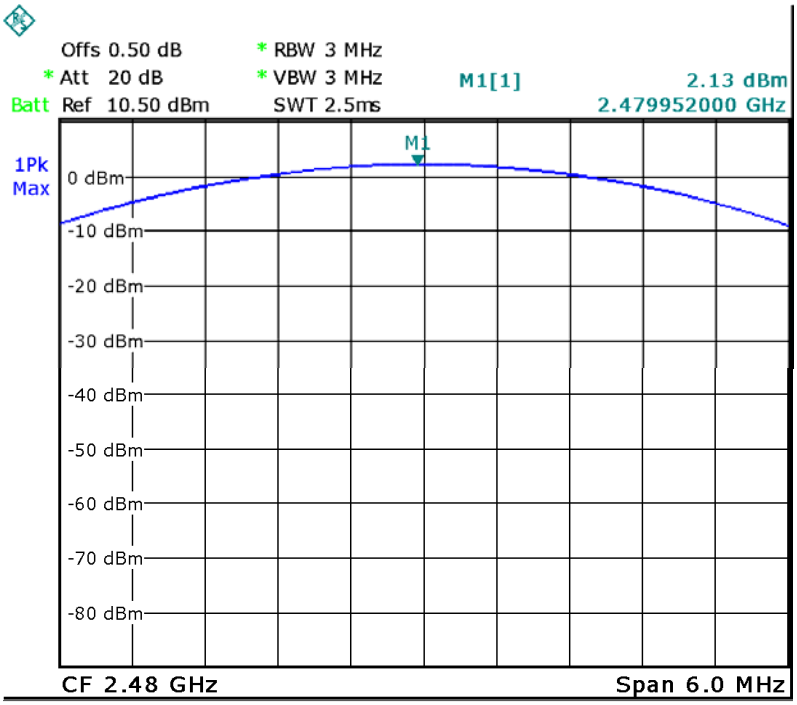
8DPSK Low Channel



8DPSK Middle Channel



8DPSK High Channel



10 Hopping Channel Separation

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

10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna portto the spectrum.

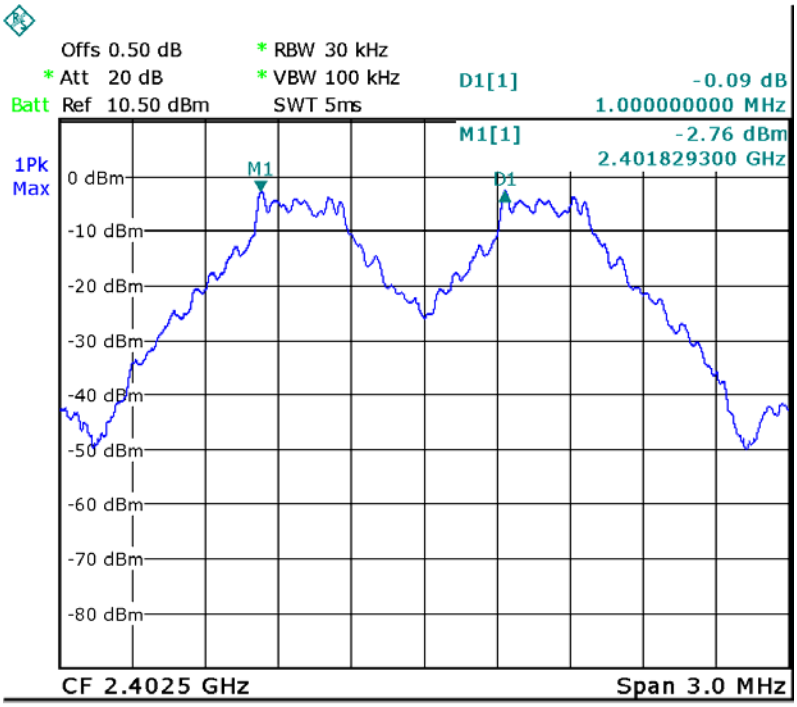
2. Set the spectrum analyzer: RBW = 30KHz. VBW = 100KHz , Span = 3MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

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.

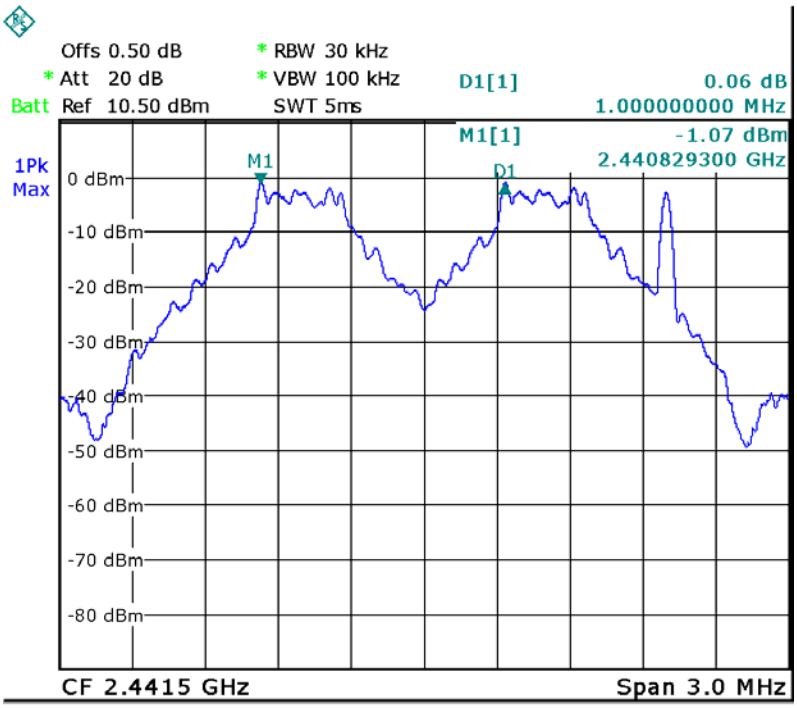
10.2 Test Result

Modulation	Test Channel	Separation (MHz)	Result
GFSK	Low	1.000	PASS
GFSK	Middle	1.000	PASS
GFSK	High	1.000	PASS
Pi/4 DQPSK	Low	1.000	PASS
Pi/4 DQPSK	Middle	1.000	PASS
Pi/4 DQPSK	High	1.000	PASS
8DPSK	Low	1.000	PASS
8DPSK	Middle	1.000	PASS
8DPSK	High	1.000	PASS

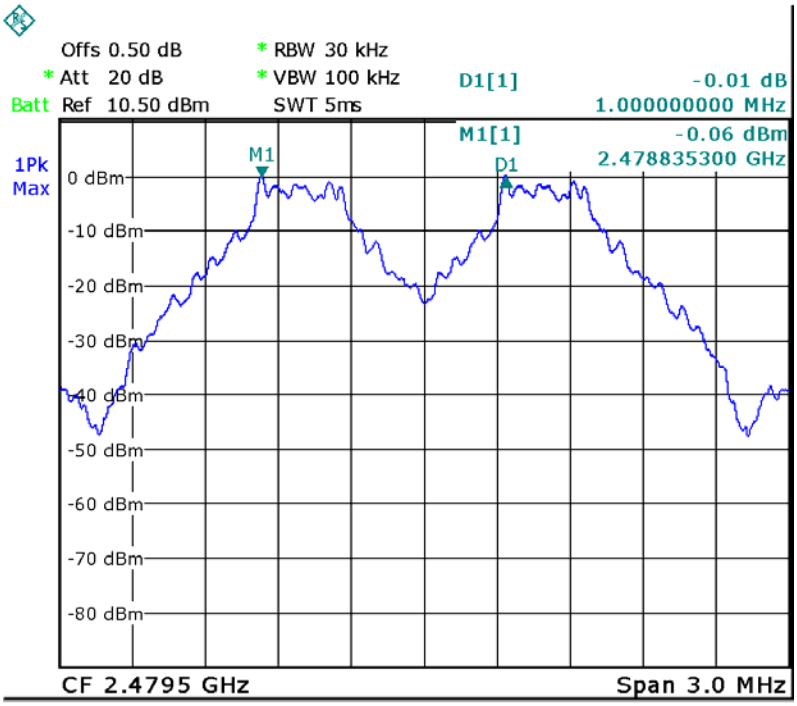
GFSK Low Channel



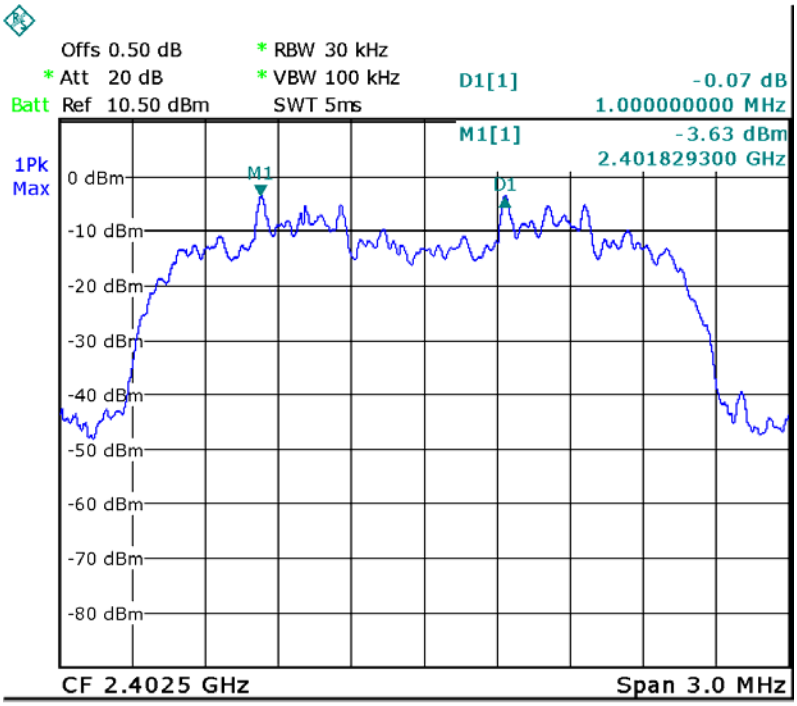
GFSK Middle Channel



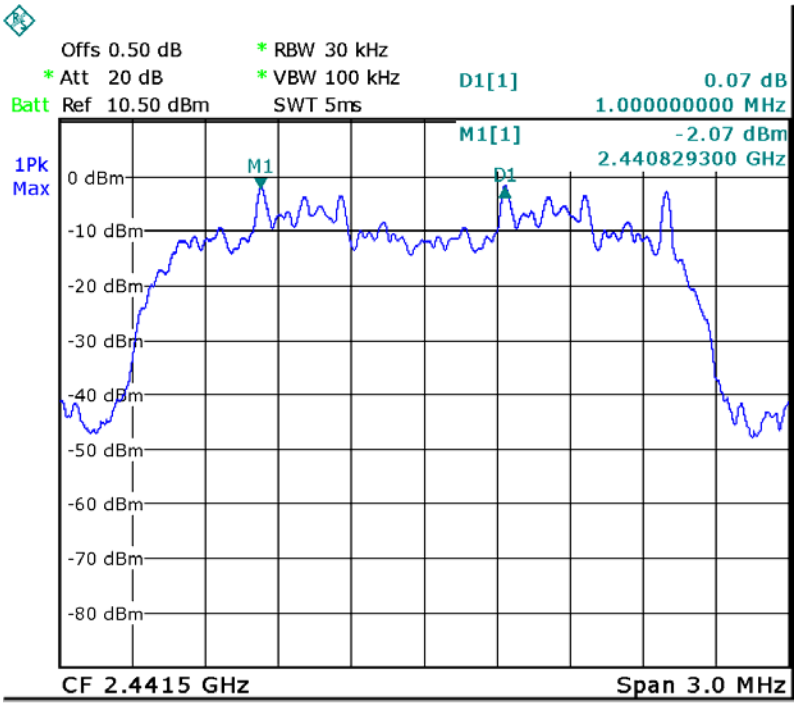
GFSK High Channel



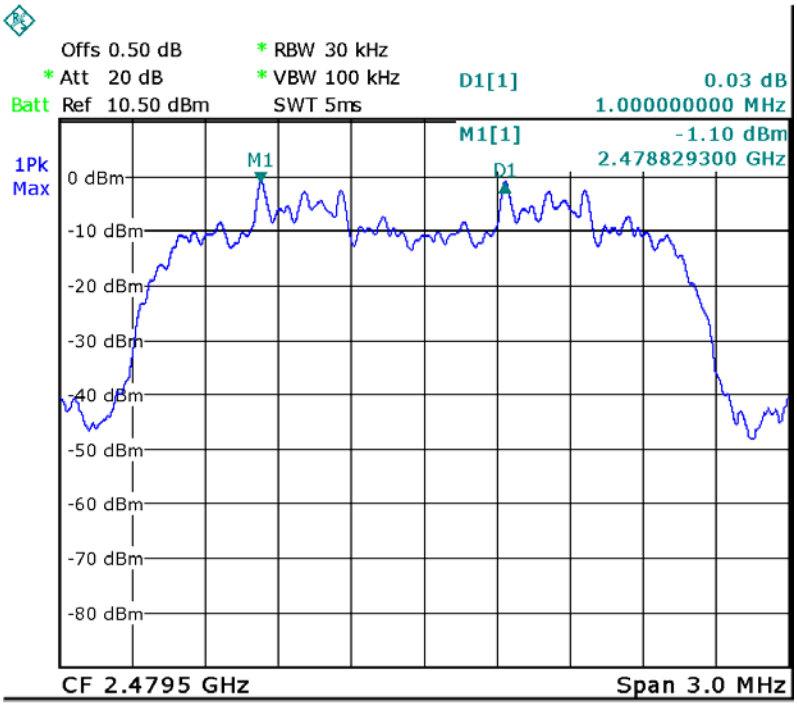
Pi/4DQPSK Low Channel



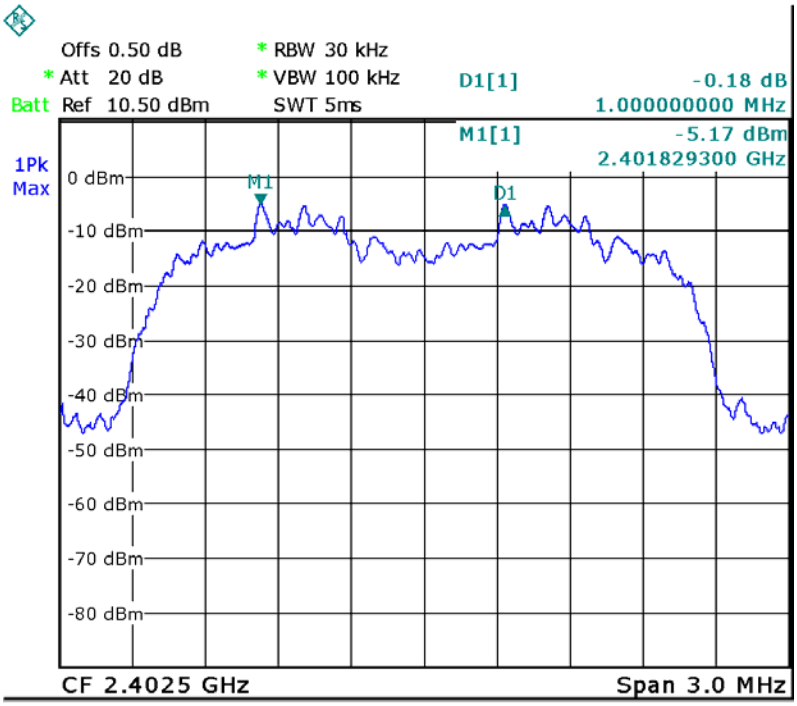
Pi/4DQPSK Middle Channel



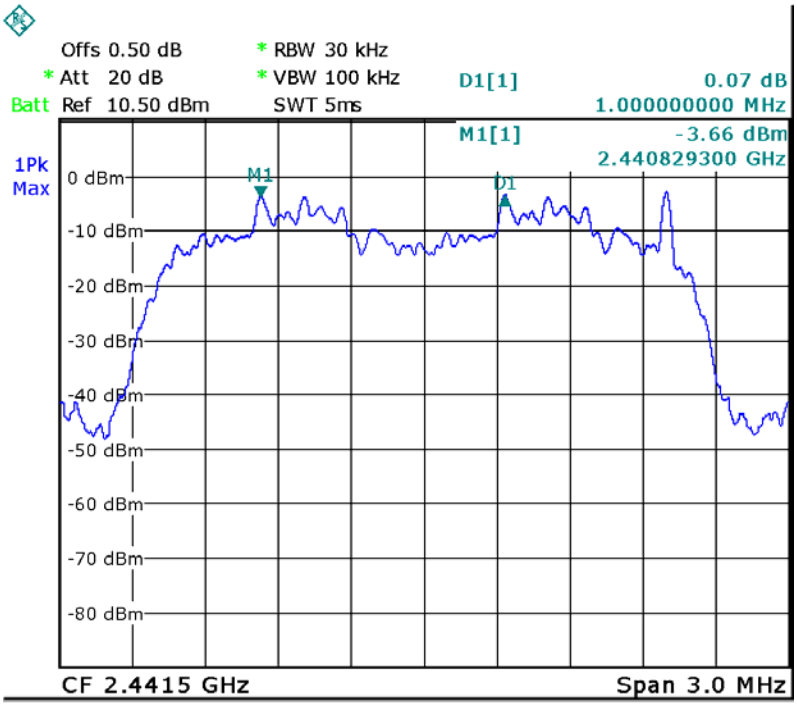
Pi/4DQPSK High Channel



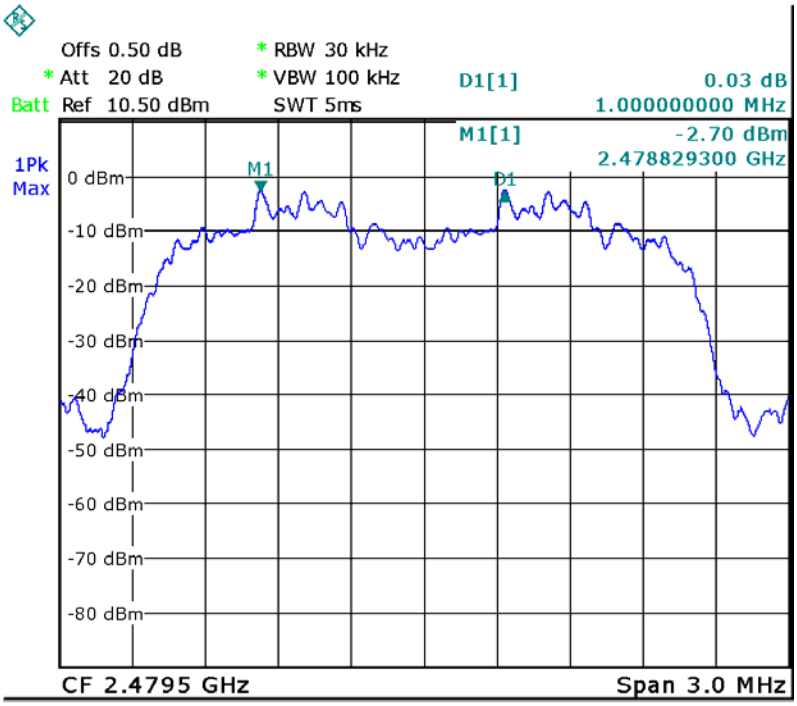
8DPSK Low Channel



8DPSK Middle Channel



8DPSK High Channel



11 Number of Hopping Frequency

Test Requirement	:	FCC CFR47 Part 15 Section 15.247
Test Method	:	ANSI C63.10:2013,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	:	Hopping(GFSK)

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.

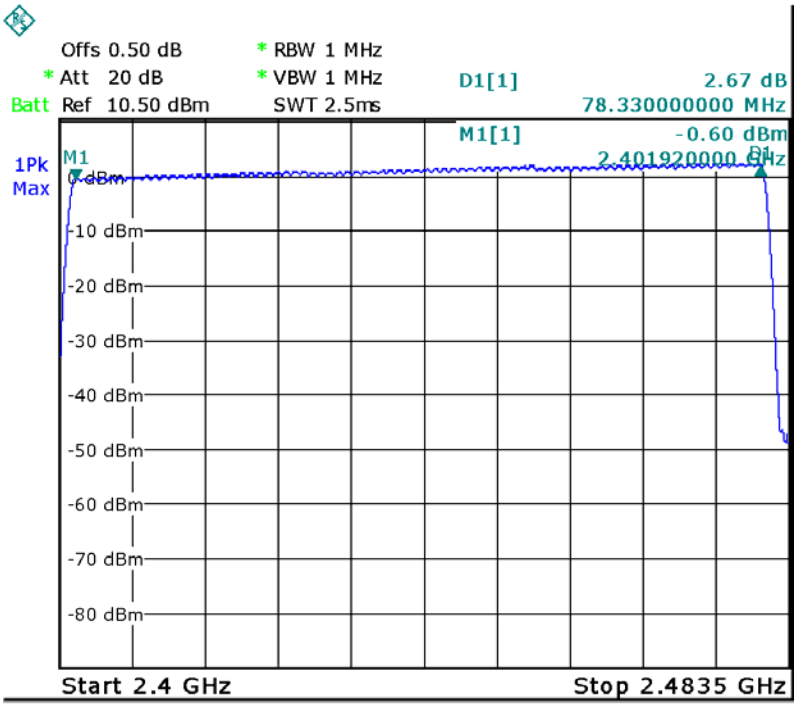
2. Set the spectrum analyzer: RBW = 1MHz. VBW = 1MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

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;

11.2 Test Result

Channel Number	Limit
79	


Offs 0.50 dB
* Att 20 dB
Batt Ref 10.50 dBm
* RBW 1 MHz
* VBW 1 MHz
SWT 2.5ms
D1[1]
2.67 dB
78.330000000 MHz
M1[1]
-0.60 dBm
2.401920000 GHz
1Pk
Max
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
Start 2.4 GHz
Stop 2.4835 GHz

12 Dwell Time

Test Requirement	:	FCC CFR47 Part 15 Section 15.247
Test Method	:	ANSI C63.10:2013,DA 00-705
Test Limit	:	Regulation 15.247(a)(1)(iii) Frequency hopping systems inthe 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.
Test Mode	:	Hopping
Remark	:	The worst case(8DPSK,DH5) was recorded

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 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).

12.2 Test Result

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

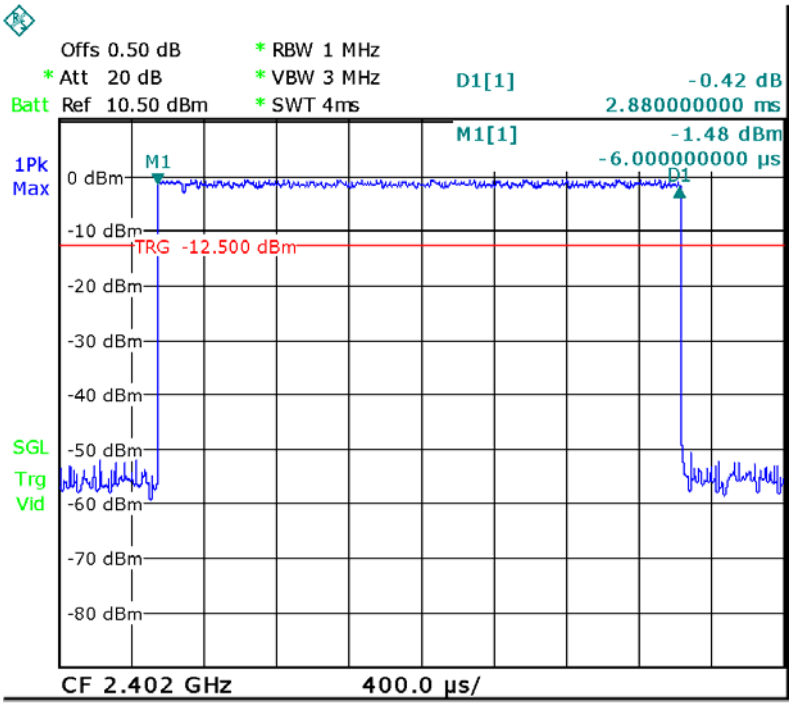
DH3 Packet permit maximum 1600 / 79 / 4 hops per second in each channel (3 time slots RX, 1 time slot TX).

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:

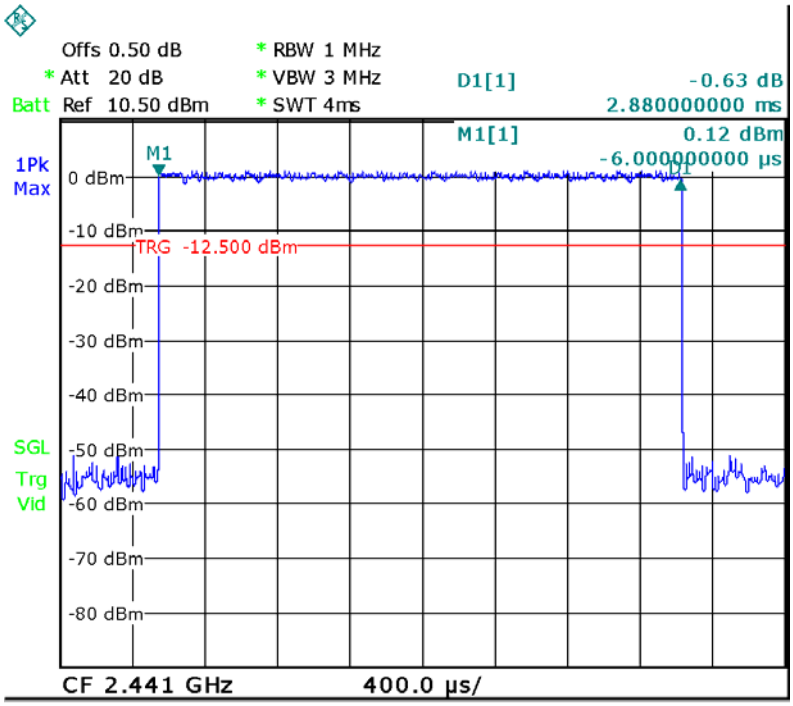
Data Packet	Dwell Time(s)
DH5/2DH5/3DH5	1600/79/6*0.4*79*(MkrDelta)/1000
DH3/2DH3/3DH3	1600/79/4*0.4*79*(MkrDelta)/1000
DH1/2DH1/3DH1	1600/79/2*0.4*79*(MkrDelta)/1000
Remark: Mkr Deltas once pulse time. Only the worst data(DH5) were show as follow.	

Modulation	Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
8DPSK	3DH5	Low	2.880	0.307	0.4
		middle	2.880	0.307	0.4
		High	2.880	0.307	0.4

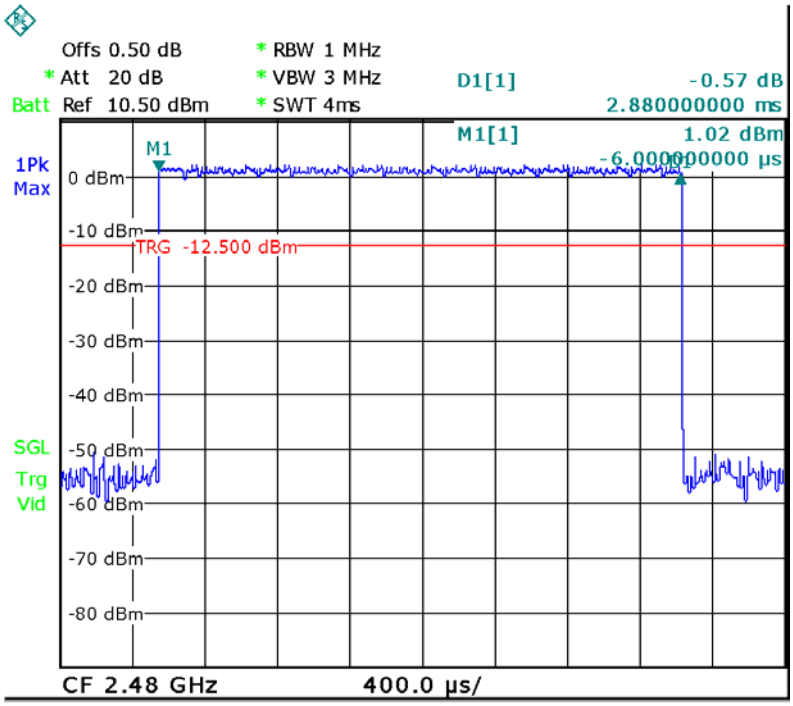
8DPSK Low Channel



8DPSK Middle Channel



8DPSK High Channel



13 Antenna Requirement

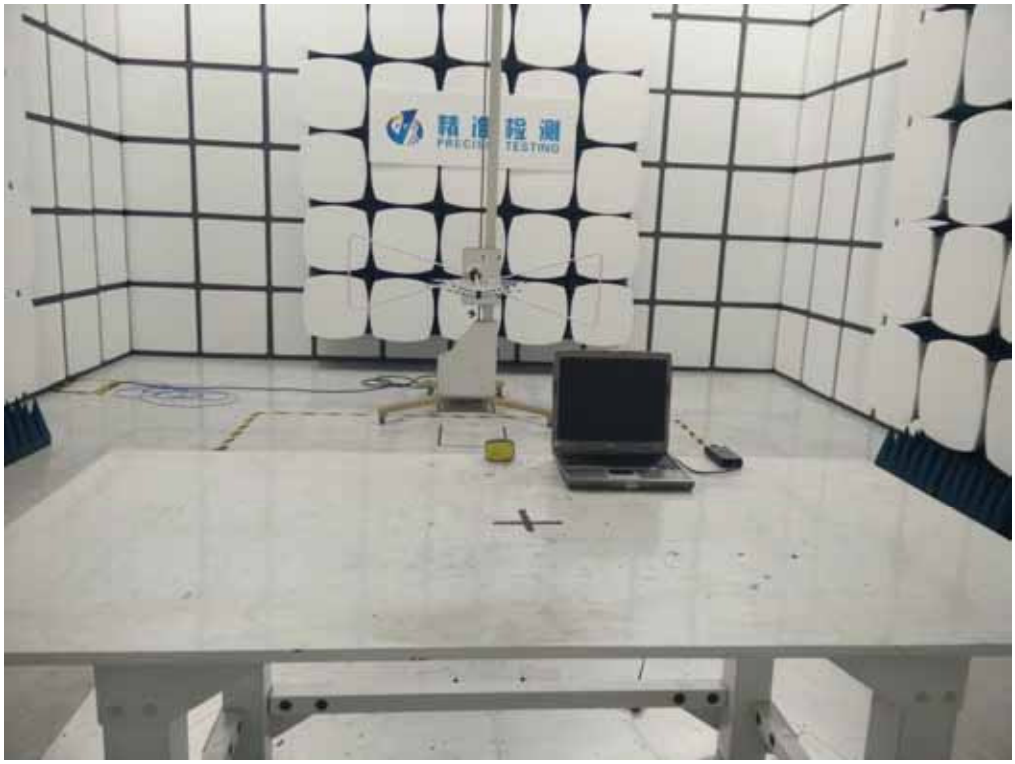
According to the FCC part15.203, a transmitter can only be sold or operated with antennas with which it was approved. This product has an PCB printed antenna which meet the requirement of this section.

14 Test Setup

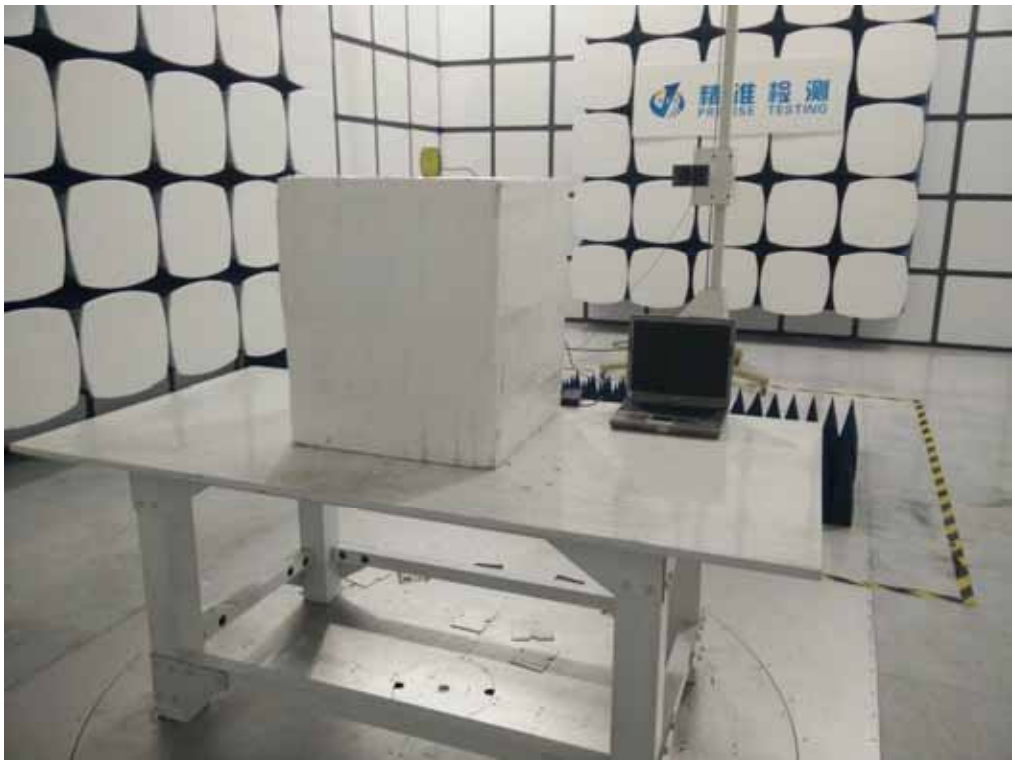
Conducted Emissions

Radiated Spurious Emissions

From 30MHz-1000MHz



Above 1GHz

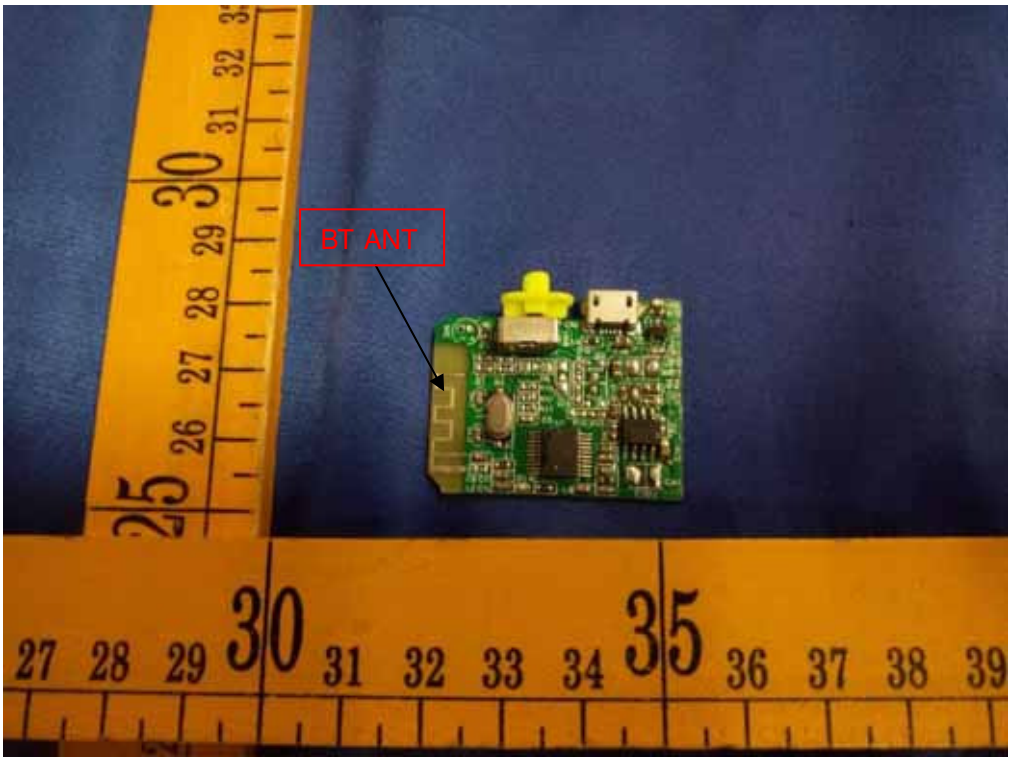


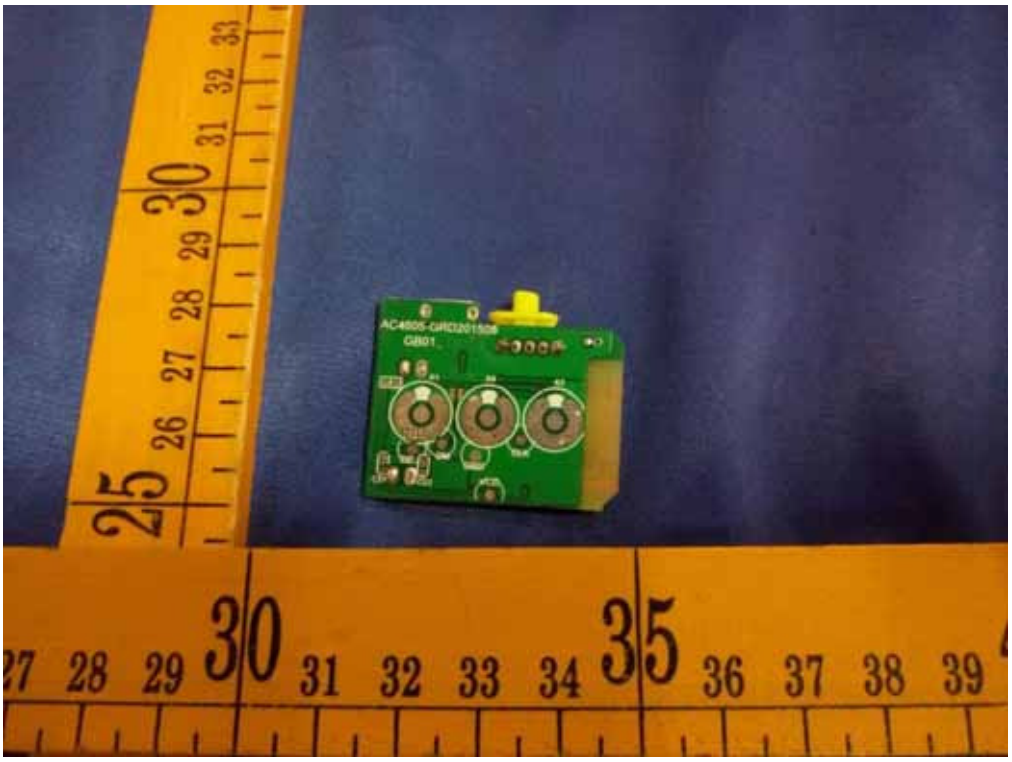
15 EUT Photos

External Photos

31 32 33 34 35 36 37 38 39 40 41 42 43 44 45

Internal Photos





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