FCC Test Report (Bluetooth)

FCC ID	:	**2ABPGDK-MBOX-040**
Applicant	:	DKnight Inc 10990 Matinal Cir, San Diego, CA, USA 92127
Sample Description		
Product Name	:	**DKnight Magicbox II Bluetooth Speaker**
Model No.	:	DK-MAGICBOX-040
Trademark	:	DKnight
Receipt Date	:	2015-06-07
Test Date	:	2015-06-07 to 2015-06-13
Issue Date	:	2015-06-15
Test Standard(s)	:	**FCC CFR Title 47 Part 15 Subpart C Section 15.247**
Conclusions	:	**PASSED***

*In the configuration tested, the EUT complied with the standards specified above.

Test/Witness Engineer : Jason Deng

Approved & Authorized : Frank Zhang

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in the report.

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1. General Information

1.1. Client Information

Applicant	:	DKnight Inc
Address	:	10990 Matinal Cir, San Diego, CA, USA 92127
Manufacturer	:	Shenzhen Tranbel Technology CO., LTD
Address	:	Floor 4, Building C, Yinfeng Industrial Park, Aviation Road, Xixiang Street, Bao'an District, Shenzhen, China

1.2. General Description of EUT (Equipment Under Test)

Product Name	:	DKnight Magicbox II Bluetooth Speaker	
Models No.	:	DK-MAGICBOX-040	
Trademark	:	DKnight	
Product Description	:	Operation Frequency:	2402MHz~2480MHz
		Transfer Rate:	1/2/3 Mbits/s
		Number of Channel:	79 Channels
		Modulation Type:	GFSK, π/4-DQPSK, 8-DPSK
		Modulation Technology:	FHSS
		Antenna Type:	Integral PCB Antenna
		Antenna Gain:	0 dBi
Power Supply	:	DC 3.7V From battery or DC 5V From USB For Charge	

Note:

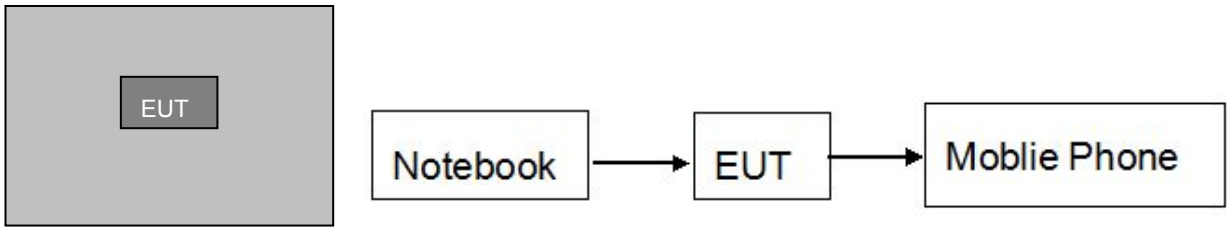
(1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

(2) Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	27	2429	54	2456
01	2403	28	2430	55	2457
02	2404	29	2431	56	2458
03	2405	30	2432	57	2459
04	2406	31	2433	58	2460
05	2407	32	2434	59	2461
06	2408	33	2435	60	2462

07	2409	34	2436	61	2463
08	2410	35	2437	62	2464
09	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454		
26	2428	53	2455		
Remark: Channel 0, 39 &78 selected for GFSK, π/4-DQPSK and 8DPSK.					

1.3. Block Diagram Showing The Configuration of System Tested



1.4. Description of Support Units

Name	Model	Serial Number	Manufacturer
Notebook	Thinkpad	/	lenovo
Moblie Phone	/	/	SAMSUNG

1.5. External I/O Cable

N/A

1.6. Description of Test Mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned follow was evaluated respectively.

Test Mode	Description
Transmitting mode	Keep the EUT in Transmitting mode with worst case data rate
Remark	GFSK(1Mbps) is the worst case mode

Remark: The sample was placed 0.8m above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

1.7. Test Instruments List

	Test Equipment	Manufacturer	Model No.	Cal. Date	Cal. Due date
1	Bilog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	May 23, 2015	May 22, 2016
2	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA9120D	May 28, 2015	May 27, 2016
3	Coaxial Cable	N/A	N/A	Mar. 30, 2015	Mar. 29, 2016
4	Coaxial Cable	N/A	N/A	Mar. 30, 2015	Mar. 29, 2016
5	Coaxial cable	N/A	N/A	Mar. 30, 2015	Mar. 29, 2016
6	Coaxial Cable	N/A	N/A	Mar. 30, 2015	Mar. 29, 2016
7	Coaxial Cable	N/A	N/A	Mar. 30, 2015	Mar. 29, 2016
8	Amplifier (10kHz-1.3GHz)	HP	8447D	Mar. 30, 2015	Mar. 29, 2016
9	Amplifier (1GHz-18GHz)	Compliance Direction Systems Inc.	PAP-1G18	Jun. 07, 2015	Jun. 06, 2016
10	Pre-amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	Mar. 30, 2015	Mar. 29, 2016
11	Horn Antenna	ETS-LINDGREN	3160	Mar. 30, 2015	Mar. 29, 2016

12	Positioning Controller	UC	UC3000	N/A	N/A
13	Spectrum analyzer 9kHz-30GHz	Rohde & Schwarz	FSP	May 27, 2015	May 26, 2016
14	EMI Test Receiver	Rohde & Schwarz	ESPI	Mar. 30, 2015	Mar. 29, 2016
15	Loop antenna	Laplace instrument	RF300	May 27, 2015	May 26, 2016
16	Universal radio communication tester	Rhode & Schwarz	CMU200	May 27, 2015	May 26, 2016
17	Signal Analyzer	Rohde & Schwarz	FSIQ3	May 27, 2015	May 26, 2016
18	L.I.S.N.#1	Rohde & Schwarz	NSLK8126	May 27, 2015	May 26, 2016
19	L.I.S.N.#2	Rohde & Schwarz	ENV216	May 27, 2015	May 26, 2016
20	Power Meter	Anritsu	ML2487A	May 27, 2015	May 26, 2016
21	Power sensor	Anritsu	MA2491A	May 27, 2015	May 26, 2016

1.8. Laboratory Location

Shenzhen TOBY technology Co.,Ltd
Address: 1 A/F., Bldg.6, Yusheng Industrial Zone The National Road No.107 Xixiang Section 467, Xixiang, Bao'an, Shenzhen, Guangdong, 518057, China

At the time of testing, the Laboratory is accredited. It is listed in the United States of American Federal Communications Commission (FCC), and the registration number is 811562 7.
Tel:0086-755-26509301 Fax: 0086-755-26509195

2. Test Summary

Standard Section	Test Item	Judgment
15.203/15.247(c)	Antenna Requirement	PASSED
15.207	Conducted Emission	PASSED
15.247(b)(1)	Conducted Peak Output Power	PASSED
15.247(a)(1)	20dB Occupied Bandwidth	PASSED
15.247(a)(1)	Carrier Frequencies Separation	PASSED
15.247(a)(1)	Hopping Channel Number	PASSED
15.247(a)(1)	Dwell Time	PASSED
15.247(b)(4)&TCB Exclusion List (7 July 2002)	Pseudorandom Frequency Hopping Sequence	PASSED
15.205/15.209	Spurious Emission	PASSED
15.247(d)	Band Edge	PASSED
Remark: “N/A” is an abbreviation for Not Applicable.		

3. Antenna Requirement

3.1. Standard Requirement

3.1.1 Test standard

FCC Part15 Section 15.203 /247(c)

3.1.2 Requirement

1) 15.203 requirement:
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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

2) 15.247(c) (1)(i) requirement:
Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

3.2. Antenna Connected Construction

The bluetooth antenna is an integral antenna which permanently attached, and the best case gain of the antenna is 0 dBi. It complies with the standard requirement.

4. Conducted Emission Test

4.1. Test Standard and Limit

4.1.1 Test Standard

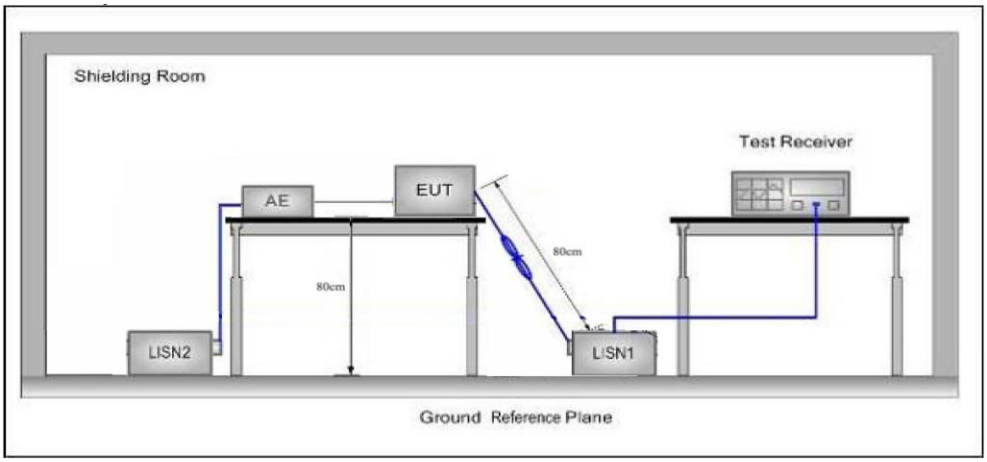
FCC Part15 Section 15.207

4.1.2 Test Limit

Conducted Emission Test Limit

Frequency	Maximum RF Line Voltage (dBμV)	
	Quasi-peak Level	Average Level
150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
500kHz~5MHz	56	46
5MHz~30MHz	60	50
Remark: (1) *Decreasing linearly with logarithm of the frequency. (2) The lower limit shall apply at the transition frequencies.		

4.2. Test Setup



4.3. Test Procedure

1) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.

2) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane.

The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal

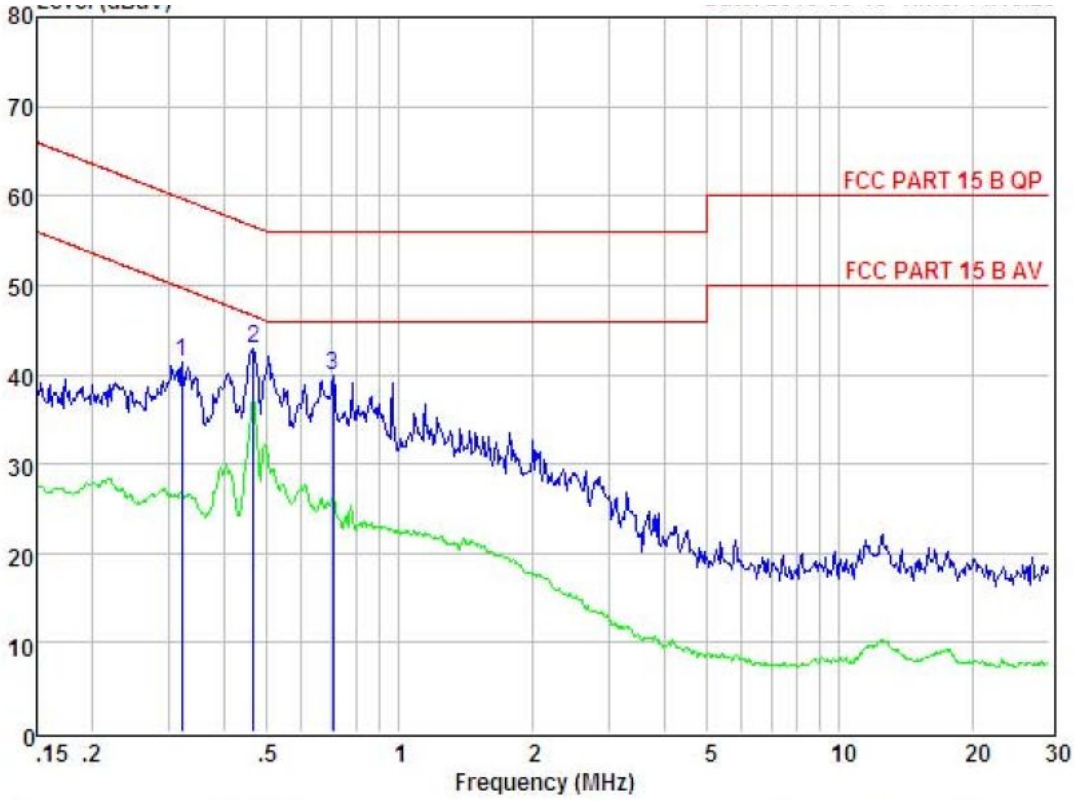
ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.

The Test Receiver setup: RBW=9kHz, VBW=30kHz, Sweep time= auto

4.4. Test Data

PASS.

EUT:	DKnight Magicbox II Bluetooth Speaker	M/N: DK-MAGICBOX-040
Operating Condition:	Bluetooth TX mode	
Test Site:	Conduction Room	
Operator:	Jason	
Test Specification:	DC 5V from USB port with AC120V/60HZ	
Polarization:	Line	
Note	Tem:23℃ Hum:50%	

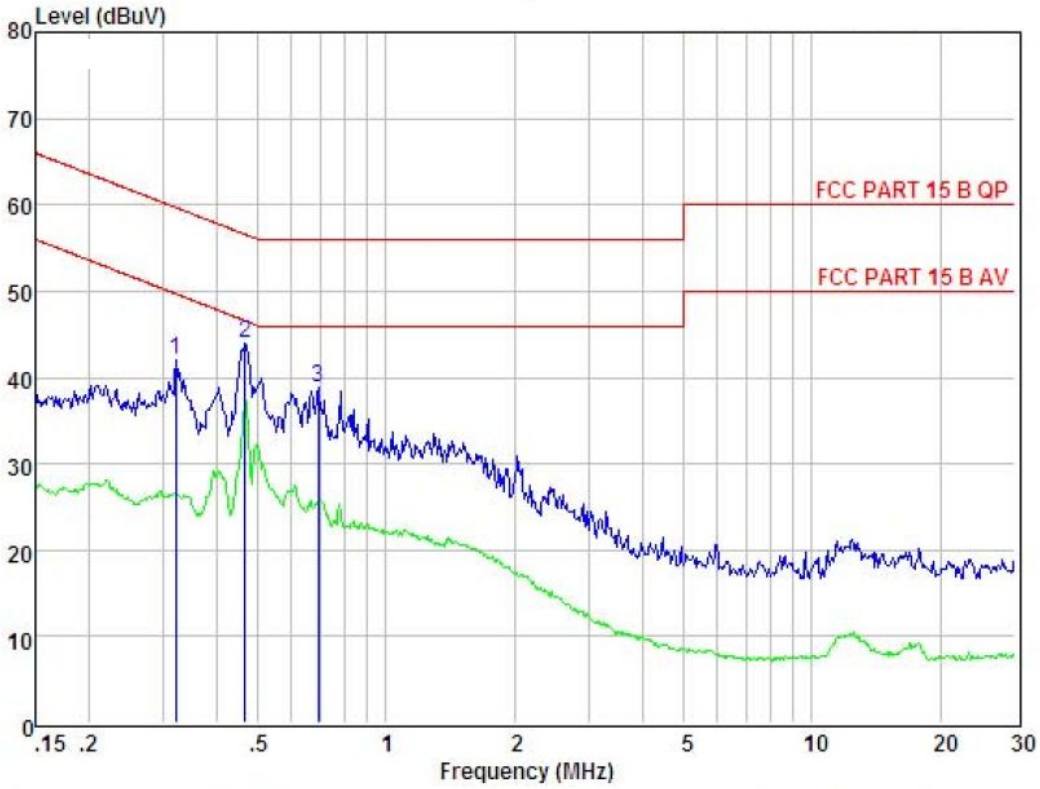


Condition : FCC PART 15 B QP POL: LINE Temp:25.7 ℃ Hum:51 %

Item	Freq MHz	Read dBuV	LISN Factor dB	Preamp Factor dB	Cable Lose dB	Level dBuV	Limit dBuV	Margin dBuV	Remark
1	0.320	31.45	0.03	-9.72	0.10	41.30	59.71	-18.41	Peak
2	0.466	33.11	0.03	-9.72	0.10	42.96	56.58	-13.62	Peak
3	0.708	30.03	0.04	-9.72	0.10	39.89	56.00	-16.11	Peak

Remarks: Level = Read + LISN Factor - Preamp Factor + Cable loss

EUT:	DKnight Magicbox II Bluetooth Speaker	M/N: DK-MAGICBOX-040
Operating Condition:	Bluetooth TX mode	
Test Site:	Conduction Room	
Operator:	Jason	
Test Specification:	DC 5V from USB port with AC120V/60HZ	
Polarization:	Neutral	
Note	Tem:23℃ Hum:50%	



Condition : FCC PART 15 B QP POL: NEUTRAL Temp:25.7 ℃ Hum:51 %

Item	Freq MHz	Read dBuV	LISN Factor dB	Preamp Factor dB	Cable Lose dB	Level dBuV	Limit dBuV	Margin dBuV	Remark
1	0.320	32.13	0.03	-9.72	0.10	41.98	59.71	-17.73	Peak
2	0.466	34.15	0.03	-9.72	0.10	44.00	56.58	-12.58	Peak
3	0.694	28.87	0.04	-9.72	0.10	38.73	56.00	-17.27	Peak

Remarks: Level = Read + LISN Factor - Preamp Factor + Cable loss

5. Conducted Peak Output Power Test

5.1. Test Standard and Limit

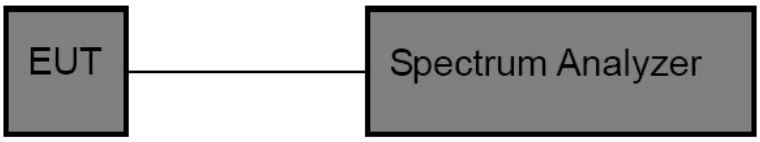
5.1.1 Test Standard

FCC Part15 C Section 15.247 (b)(3)

5.1.2 Test Limit

FCC Part 15 Subpart C(15.247)		
Test Item	Limit	Frequency Range (MHz)
Peak Output Power	Hopping Channels>75 Power<1W(30dBm) Other <125 mW(21dBm)	2400~2483.5

5.2. Test Setup



5.3. Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

(2) Spectrum Setting:

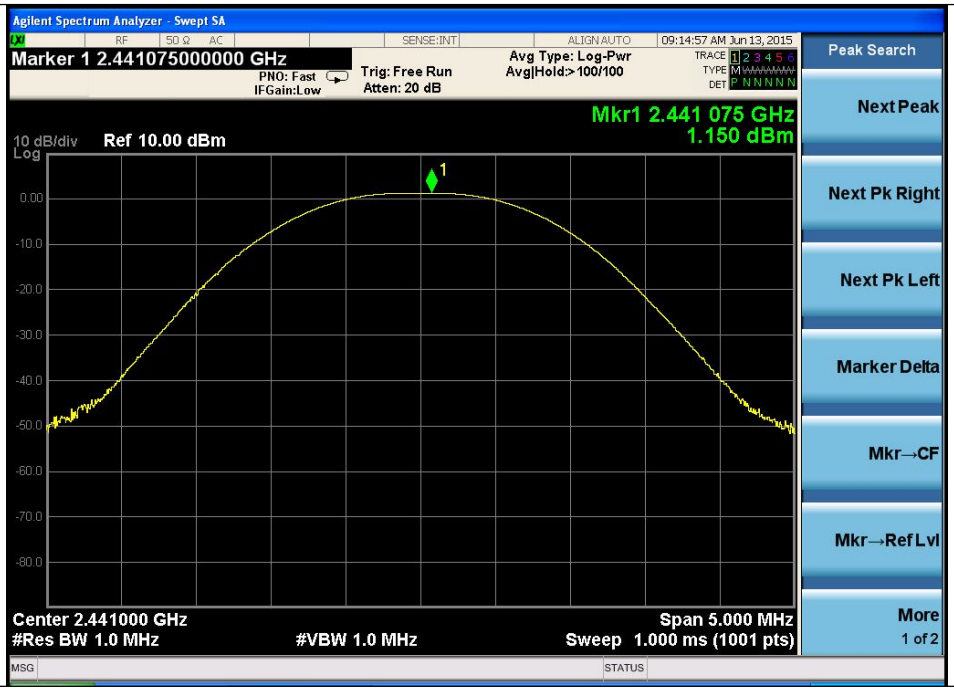
RBW=1MHz, VBW=3MHz, Detector=Peak (If 20dB BW ≤1 MHz)

RBW=3MHz, VBW=10MHz, Detector=Peak (If 20dB BW > 1 MHz)

(3) The EUT was set to continuously transmitting in the max power during the test.

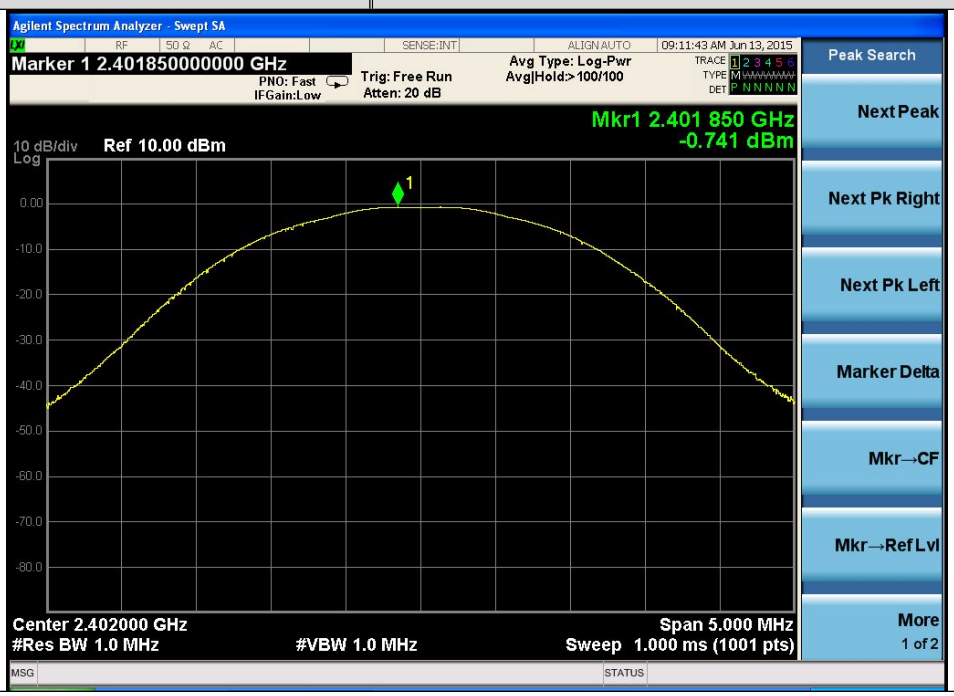
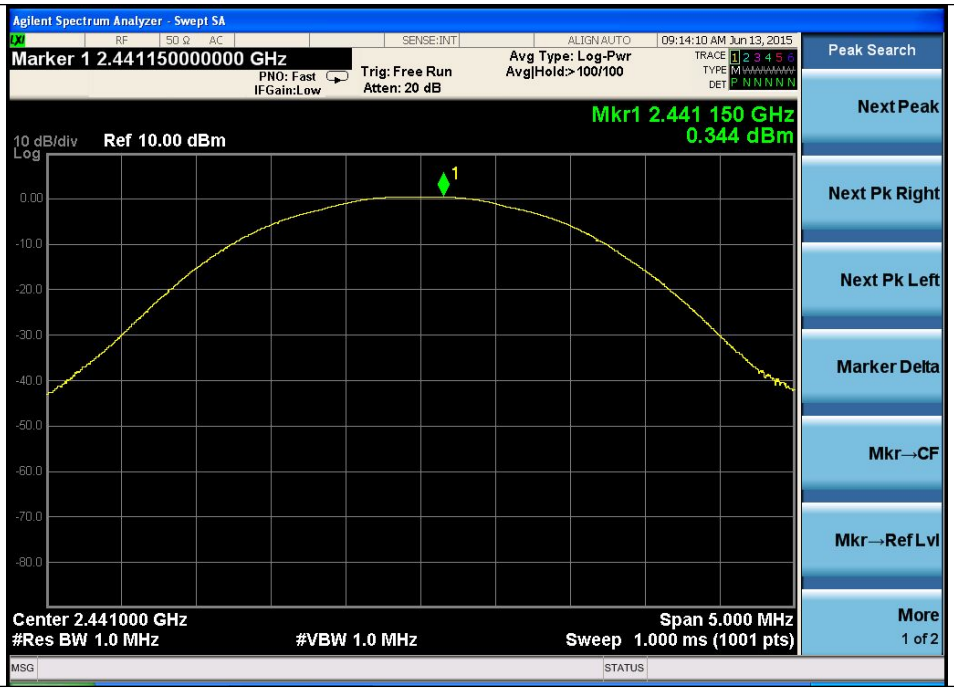
5.4. Test Data

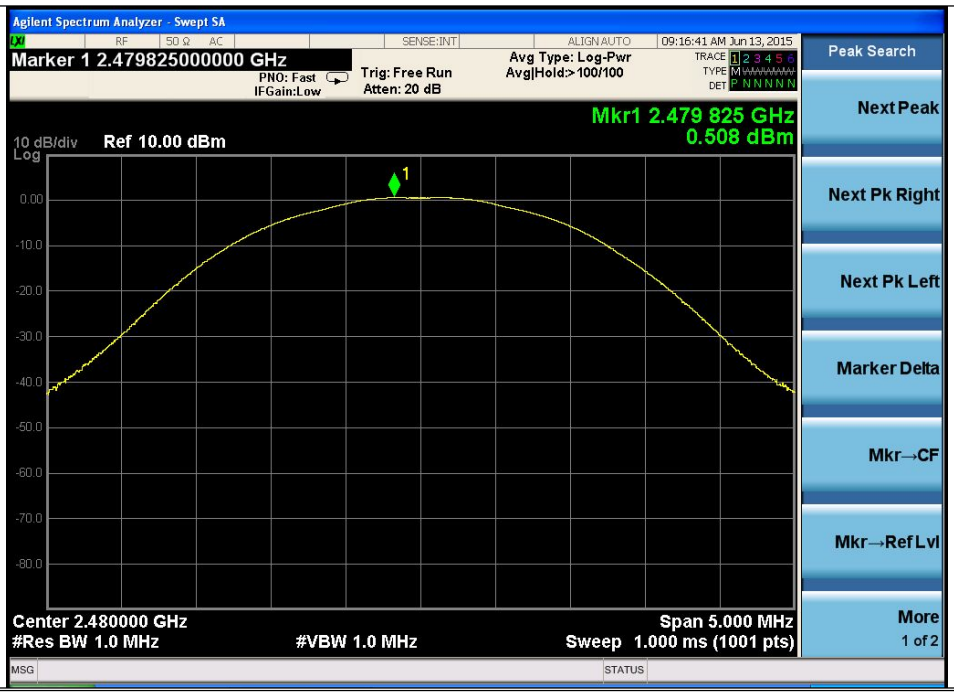
GFSK mode				
Channel Number	**Channel Frequency (MHz)**	**Test Result (dBm)**	**Limit (30dBm)**	**Judgment**
CH 00	2402	0.471	21	PASSED
CH 39	2441	1.150	21	PASSED
CH 78	2480	1.322	21	PASSED
π/4-DQPSK mode				
Channel Number	**Channel Frequency (MHz)**	**Test Result (dBm)**	**Limit (30dBm)**	**Judgment**
CH 00	2402	-0.741	21	PASSED
CH 39	2441	0.344	21	PASSED
CH 78	2480	0.508	21	PASSED
8DPSK mode				
Channel Number	**Channel Frequency (MHz)**	**Test Result (dBm)**	**Limit (30dBm)**	**Judgment**
CH 00	2402	-0.721	21	PASSED
CH 39	2441	0.344	21	PASSED
CH 78	2480	0.507	21	PASSED

Modulation mode		GFSK mode
2402MHz		
2441MHz		

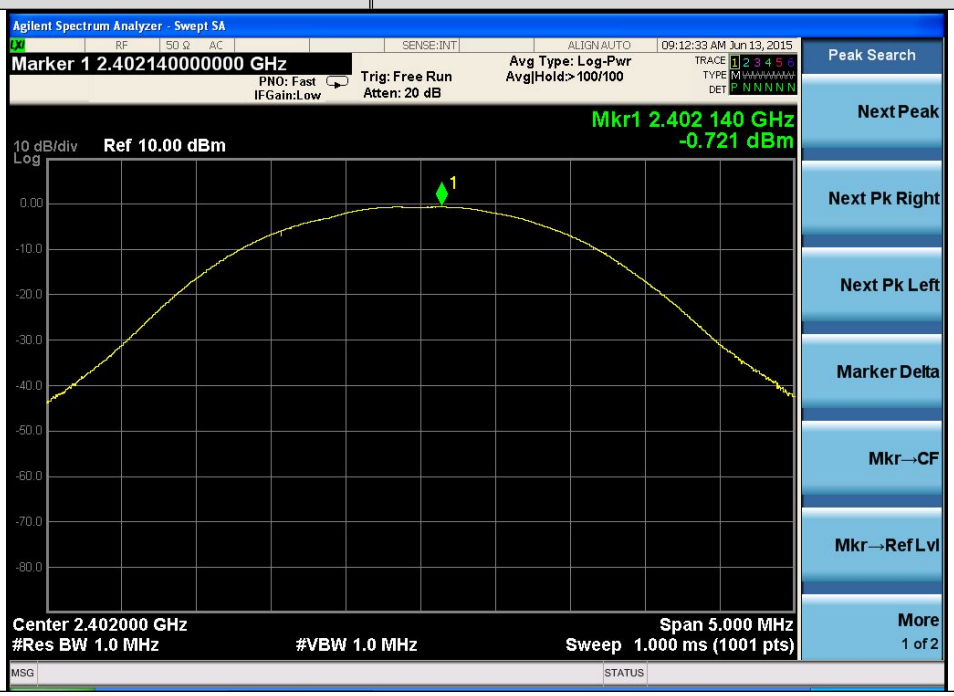
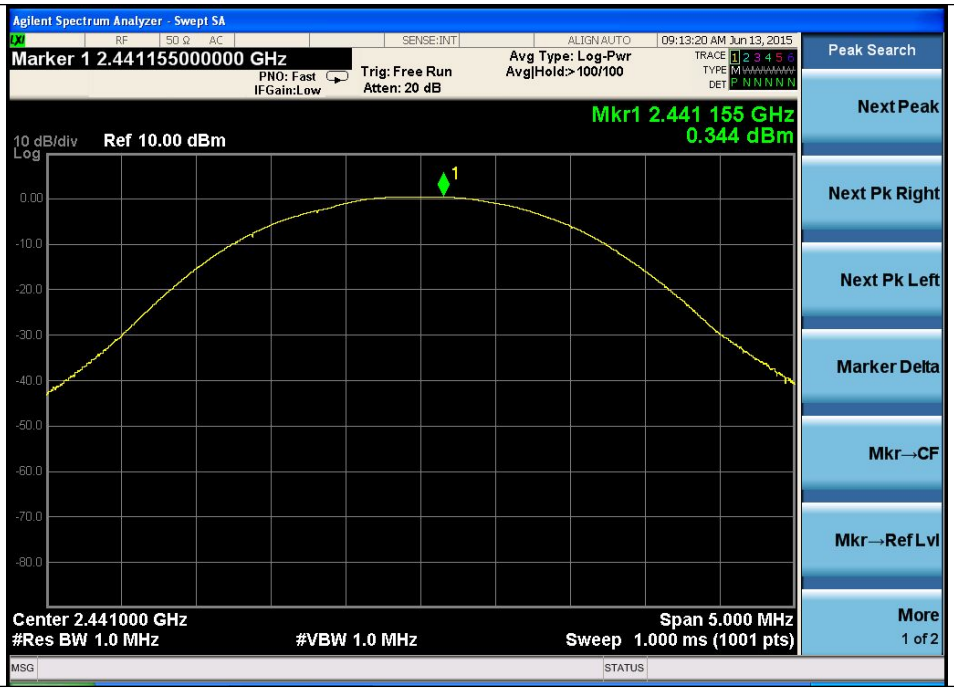
2480MHz		

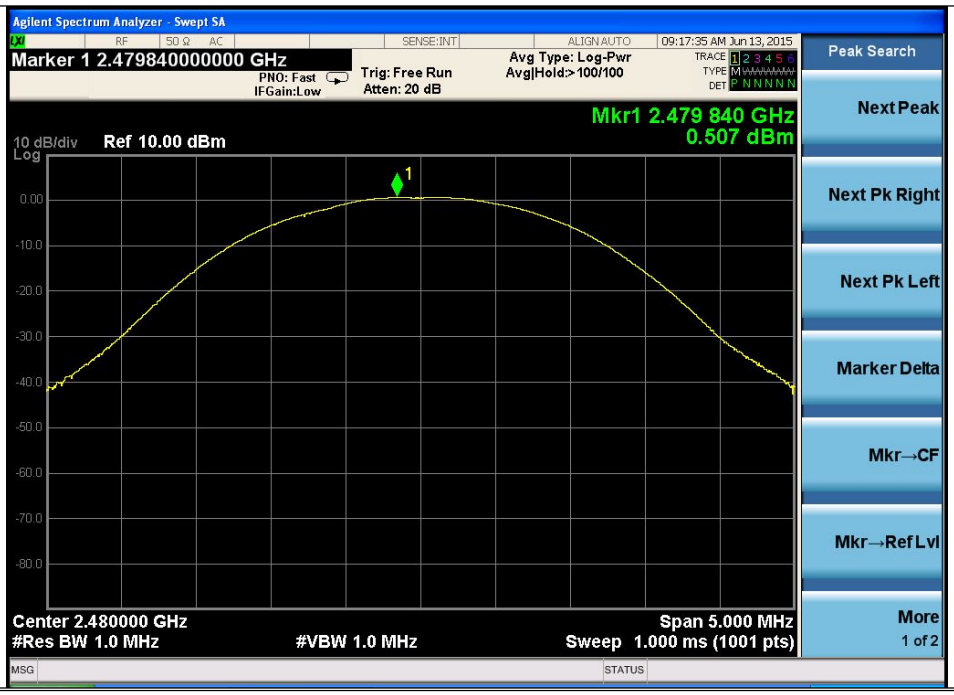
Agilent Spectrum Analyzer - Swept SA
Marker 1 2.480165000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
09:15:45 AM Jun 13, 2015
Mkr1 2.480 165 GHz
1.322 dBm
10 dB/div
Log
Ref 10.00 dBm
Center 2.480000 GHz
#Res BW 1.0 MHz
#VBW 1.0 MHz
Span 5.000 MHz
Sweep 1.000 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

Modulation mode		π/4-DQPSK
2402MHz		
2441MHz		

2480MHz		

Agilent Spectrum Analyzer - Swept SA
Marker 1 2.479825000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
09:16:41 AM Jun 13, 2015
Mkr1 2.479 825 GHz
0.508 dBm
10 dB/div
Log
Ref 10.00 dBm
Center 2.480000 GHz
#Res BW 1.0 MHz
#VBW 1.0 MHz
Span 5.000 MHz
Sweep 1.000 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

Modulation mode		8DPSK
2402MHz		
2441MHz		

2480MHz		

Agilent Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:INT
ALIGN AUTO
09:17:35 AM Jun 13, 2015
Marker 1 2.479840000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Mkr1 2.479 840 GHz
0.507 dBm
10 dB/div
Log
Ref 10.00 dBm
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
Center 2.480000 GHz
#Res BW 1.0 MHz
#VBW 1.0 MHz
Span 5.000 MHz
Sweep 1.000 ms (1001 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

6. 20dB Occupy Bandwidth Test

6.1. Test Standard and Limit

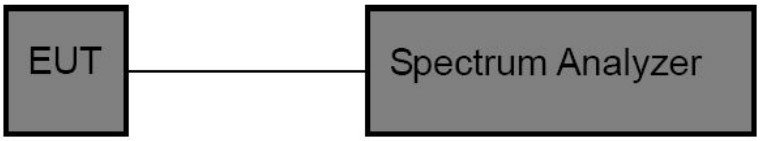
6.1.1 Test Standard

FCC Part15 C Section 15.247 (a)(1)

6.1.2 Test Limit

FCC Part 15 Subpart C(15.247)		
Test Item	Limit	Frequency Range (MHz)
Bandwidth	20dB bandwidth	2400~2483.5

6.2. Test Setup



6.3. Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

(2) Spectrum Setting:
Bandwidth: RBW=10 kHz, VBW=30 kHz, detector= Peak

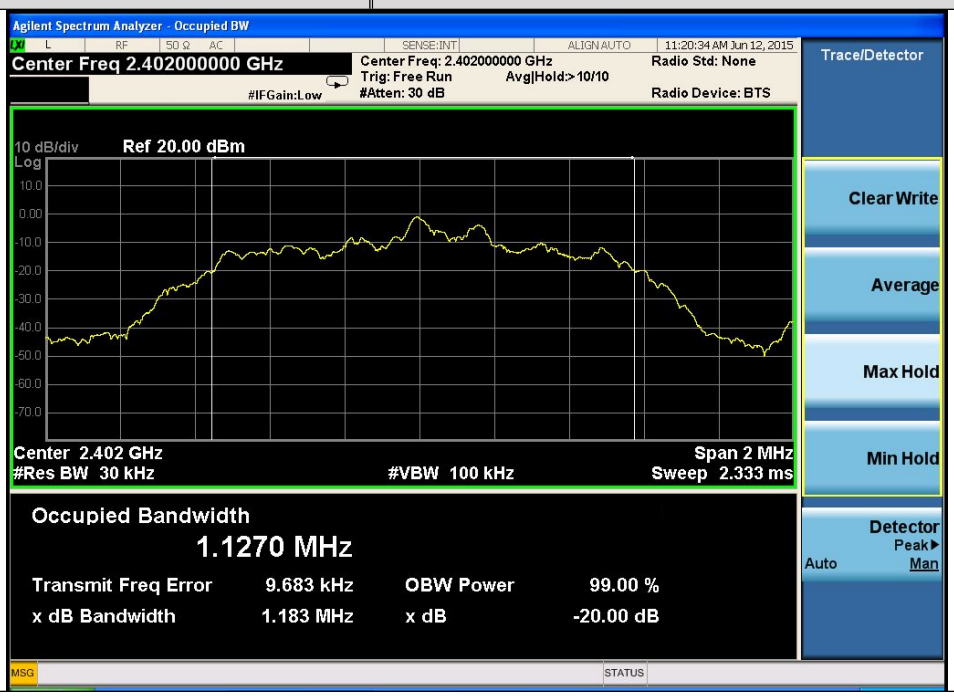
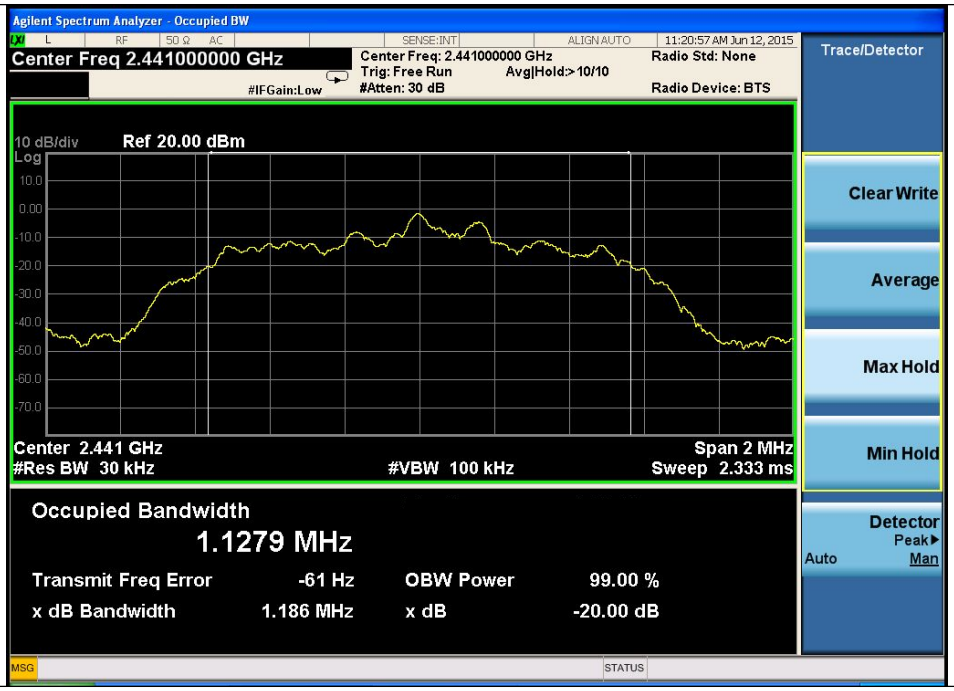
6.4. Test Data

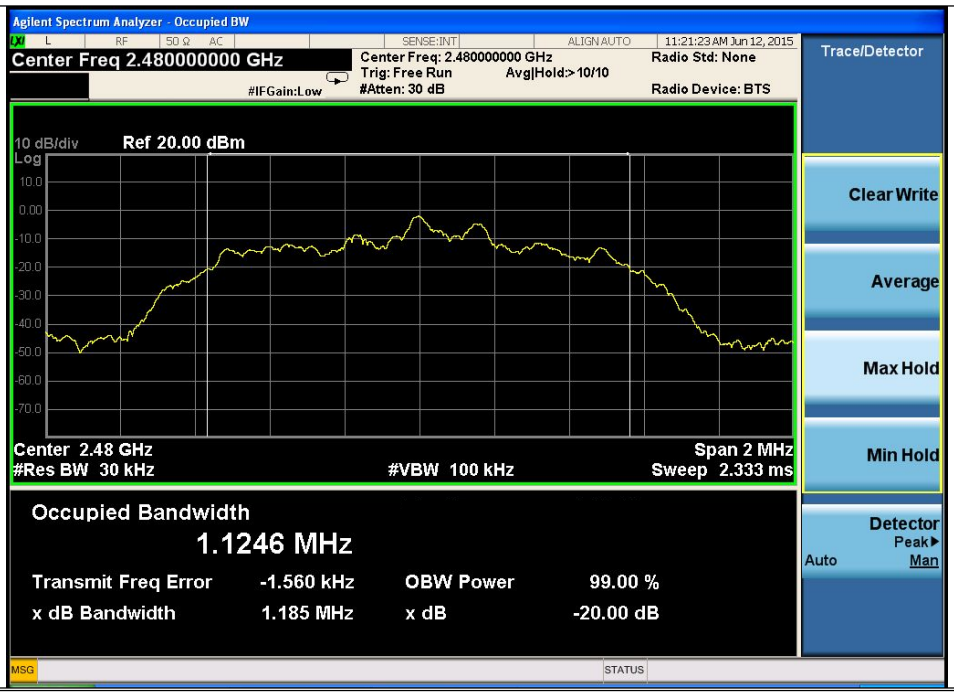
Channel Number	Channel Frequency	20dB Bandwidth (kHz)		
		GFSK	π/4-DQPSK	8DPSK
CH 00	2402(MHz)	832.1	1183	1212
CH 39	2441(MHz)	837.2	1186	1209
CH 78	2480(MHz)	840.6	1185	1208
Remark: Test plot as follows				

Modulation mode		GFSK mode
2402MHz		
2441MHz		

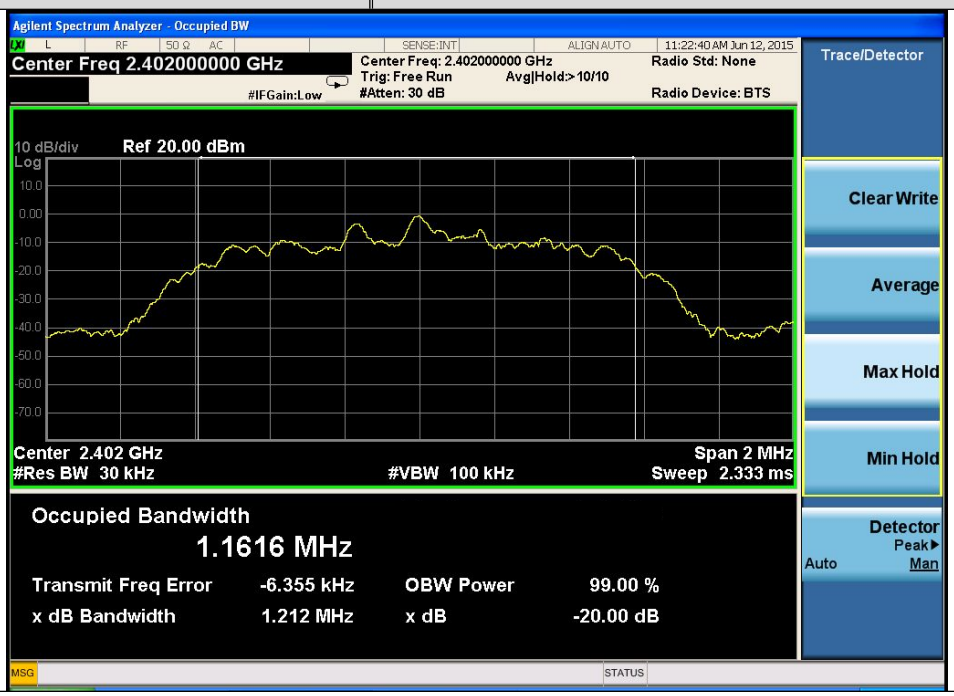
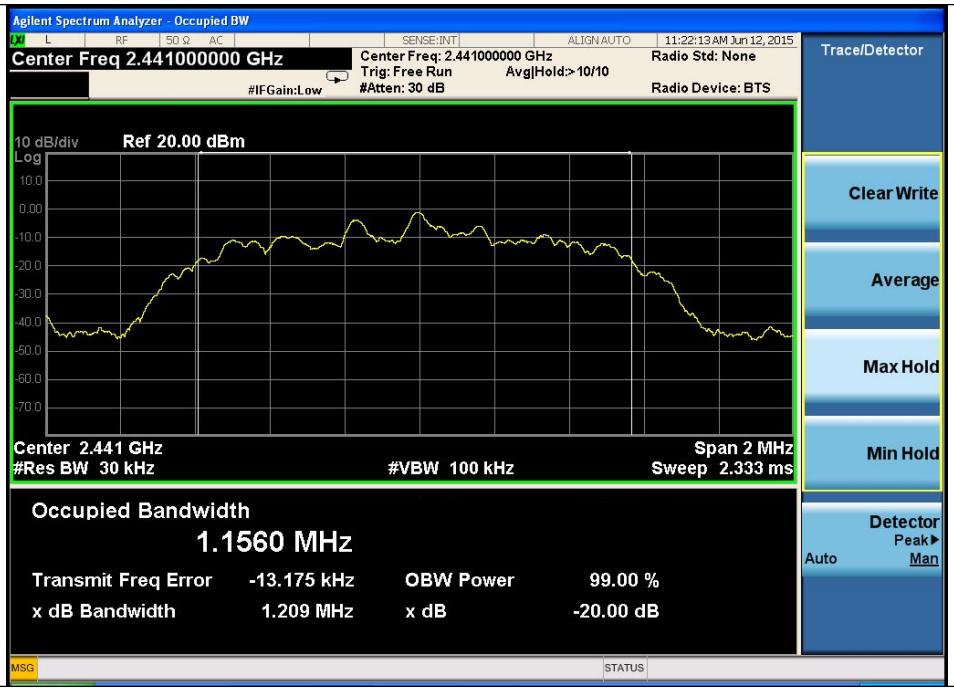
2480MHz		

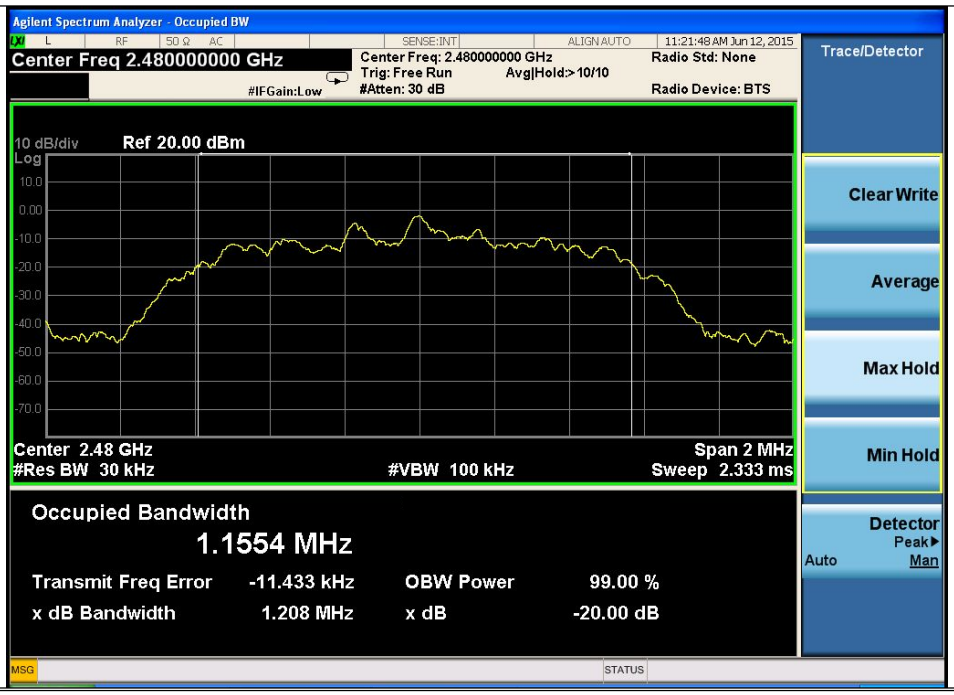
Agilent Spectrum Analyzer - Occupied BW
Marker 1 --- Hz
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
11:18:32 AM Jun 12, 2015
Trace/Detector
10 dB/div
Ref 20.00 dBm
Log
Clear Write
Average
Max Hold
Min Hold
Center 2.48 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 2 MHz
Sweep 2.333 ms
Occupied Bandwidth
829.15 kHz
Transmit Freq Error -12.178 kHz
OBW Power 99.00 %
x dB Bandwidth 840.6 kHz
x dB -20.00 dB
Detector
Peak
Auto
Man
MSG
STATUS

Modulation mode	π/4-DQPSK
2402MHz	
2441MHz	

2480MHz		

Agilent Spectrum Analyzer - Occupied BW
Center Freq 2.480000000 GHz
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
11:21:23 AM Jun 12, 2015
Trace/Detector
10 dB/div
Ref 20.00 dBm
Log
Clear Write
Average
Max Hold
Min Hold
Center 2.48 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 2 MHz
Sweep 2.333 ms
Occupied Bandwidth
1.1246 MHz
Transmit Freq Error -1.560 kHz
OBW Power 99.00 %
x dB Bandwidth 1.185 MHz
x dB -20.00 dB
Detector
Peak
Auto
Man
MSG
STATUS

Modulation mode		8DPSK
2402MHz		
2441MHz		

2480MHz		 Agilent Spectrum Analyzer - Occupied BW Center Freq 2.480000000 GHz Center Freq: 2.480000000 GHz Trig: Free Run Avg|Hold:>10/10 #Atten: 30 dB #IFGain:Low Radio Std: None Radio Device: BTS 11:21:48 AM Jun 12, 2015 Trace/Detector 10 dB/div Ref 20.00 dBm Log Clear Write Average Max Hold Min Hold Center 2.48 GHz #Res BW 30 kHz #VBW 100 kHz Span 2 MHz Sweep 2.333 ms Occupied Bandwidth 1.1554 MHz Transmit Freq Error -11.433 kHz OBW Power 99.00 % x dB Bandwidth 1.208 MHz x dB -20.00 dB Detector Peak Auto Man MSG STATUS

7. Carrier Frequency Separation Test

7.1. Test Standard and Limit

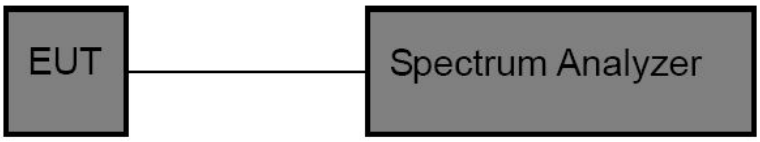
7.1.1 Test Standard

FCC Part15 C Section 15.247 (a)(1)

7.1.2 Test Limit

FCC Part 15 Subpart C(15.247)		
Test Item	Limit	Frequency Range (MHz)
Channel Separation	>25KHz or >two-thirds of the 20 dB bandwidth (Which is greater)	2400~2483.5

7.2. Test Setup



7.3. Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

(2) Spectrum Setting:
RBW=100 kHz, VBW=300 kHz, detector= Peak, Sweep Time =auto.

(3) The EUT was set to the Hopping Mode for Channel Separation Test and continuously transmitting for the Test.

7.4. Test Data

GFSK mode				
Channel Number	**Channel Frequency (MHz)**	**Test Result (KHz)**	**Limit (KHz)**	**Judgment**
CH 39	2441	998.4	558.133	PASSED
π/4-DQPSK mode				
Channel Number	**Channel Frequency (MHz)**	**Test Result (KHz)**	**Limit (KHz)**	**Judgment**
CH 39	2441	1000.2	790.667	PASSED
8DPSK mode				
Channel Number	**Channel Frequency (MHz)**	**Test Result (KHz)**	**Limit (KHz)**	**Judgment**
CH 39	2441	996.0	806.000	PASSED
Remark: Test plot as follows				

According to section 6.4

Test Mode	20dB bandwidth (KHz)	Limit (KHz) (Carrier Frequency Separation)
GFSK	837.2	558.133
π/4-DQPSK	1186	790.667
8DPSK	1209	806.000