TCT 通测检测 TESTING CENTRE TECHNOLOGY

TEST REPORT

FCC ID: TJ7M21

Product: Bluetooth Headset

Model No.: M21

Additional Model No.: M21A, M21B, M21C

Trade Mark: BTK, Lindero, KISS

Report No.: TCT160801E005

Issued Date: Aug. 18, 2016

Issued for:

SHENZHEN SHI KISB ELECTRONIC CO.,LTD.
3-5/F, A Building Shanghe Industrial Park Nanchang Road, Xixiang Town Bao'an District Shenzhen, Guangdong, 518103 P.R. China

Issued By:

Shenzhen Tongce Testing Lab.
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Hotline: 400-6611-140 Tel: 86-755-27673339 Fax: 86-755-27673332 http://www.tct-lab.com

1. Test Certification

Product:	Bluetooth Headset
Model No.:	M21
Additional Model:	M21A, M21B, M21C
Applicant:	SHENZHEN SHI KISB ELECTRONIC CO.,LTD.
Address:	3-5/F, A Building Shanghe Industrial Park Nanchang Road, Xixiang Town Bao'an District Shenzhen, Guangdong, 518103 P.R. China
Manufacturer:	SHENZHEN SHI KISB ELECTRONIC CO.,LTD.
Address:	3-5/F, A Building Shanghe Industrial Park Nanchang Road, Xixiang Town Bao'an District Shenzhen, Guangdong, 518103 P.R. China
Date of Test:	Aug. 01 – Aug. 17, 2016
Applicable Standards:	FCC CFR Title 47 Part 15 Subpart C Section 15.247

The above equipment has been tested by Shenzhen Tongce Testing Lab. and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Tested By: Beryl Zhao ***Date:*** ***Aug. 17, 2016***

Beryl Zhao

Reviewed By: Joe Zhou ***Date:*** ***Aug. 18, 2016***

Joe Zhou

Approved By: Tomsin ***Date:*** ***Aug. 18, 2016***

Tomsin

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2. Test Result Summary

Requirement	CFR 47 Section	Result
Antenna Requirement	§15.203/§15.247 (c)	PASS
AC Power Line Conducted Emission	§15.207	PASS
Conducted Peak Output Power	§15.247 (b)(1)	PASS
20dB Occupied Bandwidth	§15.247 (a)(1)	PASS
Carrier Frequencies Separation	§15.247 (a)(1)	PASS
Hopping Channel Number	§15.247 (a)(1)	PASS
Dwell Time	§15.247 (a)(1)	PASS
Radiated Emission	§15.205/§15.209	PASS
Band Edge	§15.247(d)	PASS

Note:

1. PASS: Test item meets the requirement.

2. Fail: Test item does not meet the requirement.

3. N/A: Test case does not apply to the test object.

4. The test result judgment is decided by the limit of test standard.

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3. EUT Description

Product Name:	Bluetooth Headset
Model :	M21
Additional Model:	M21A, M21B, M21C
Trade Mark:	**BTK, Lindero, KISS**
BT Version:	V4.0 (This report is forV3.0 + EDR)
Operation Frequency:	2402MHz~2480MHz
Transfer Rate:	1/2/3 Mbits/s
Number of Channel:	79
Modulation Type:	GFSK, π/4-DQPSK, 8DPSK
Modulation Technology:	FHSS
Antenna Type:	Internal Antenna
Antenna Gain:	0dBi
Power Supply:	DC3.7V via battery
Remark:	All models above are identical in interior structure, electrical circuits and components, and just model names and trade name are different for the marketing requirement.

Operation Frequency each of channel for GFSK, π/4-DQPSK, 8DPSK

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	20	2422MHz	40	2442MHz	60	2462MHz
1	2403MHz	21	2423MHz	41	2443MHz	61	2463MHz
…	…	…	…	…	…	…	…
10	2412MHz	30	2432MHz	50	2452MHz	70	2472MHz
11	2413MHz	31	2433MHz	51	2453MHz	71	2473MHz
…	…	…	…	…	…	…	…
18	2420MHz	38	2440MHz	58	2460MHz	78	2480MHz
19	2421MHz	39	2441MHz	59	2461MHz	-	
Remark: Channel 0, 39 &78 have been tested for GFSK, π/4-DQPSK, 8DPSK modulation mode.							

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4. Genera Information

4.1. Test environment and mode

Operating Environment:	
Temperature:	25.0 °C
Humidity:	56 % RH
Atmospheric Pressure:	1010 mbar
Test Mode:	
Engineering mode:	Keep the EUT in continuous transmitting by select channel and modulations
The sample was placed (0.8m below 1GHz, 1.5m above 1GHz) 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.	

4.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Equipment	Model No.	Serial No.	FCC ID	Trade Name
Notebook	G485	/	/	Lenovo
Power Adapter	XRN-AC01	/	/	XRN

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.

2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

3. For conducted measurements (Output Power, 20dB Occupied Bandwidth, Carrier Frequencies Separation, Hopping Channel Number, Dwell Time, Spurious Emissions), the antenna of EUT is connected to the test equipment via temporary antenna connector, the antenna connector is soldered on the antenna port of EUT, and the temporary antenna connector is listed in the Test Instruments.

5. Facilities and Accreditations

5.1. Facilities

The test facility is recognized, certified, or accredited by the following organizations:

- FCC - Registration No.: 572331

  Shenzhen Tongce Testing Lab

  The 3m Semi-anechoic chamber has been registered and fully described in a report with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

- IC - Registration No.: 10668A-1

  The 3m Semi-anechoic chamber of Shenzhen TCT Testing Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing

- CNAS - Registration No.: CNAS L6165

  Shenzhen TCT Testing Technology Co., Ltd. is accredited to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration laboratories for the competence of testing. The Registration No. is CNAS L6165.

5.2. Location

Shenzhen Tongce Testing Lab
Address: 1F, Leinuo Watch Building, Fuyong Town, Baoan Dist, Shenzhen, China
Tel: 86-755-36638142

5.3. Measurement Uncertainty

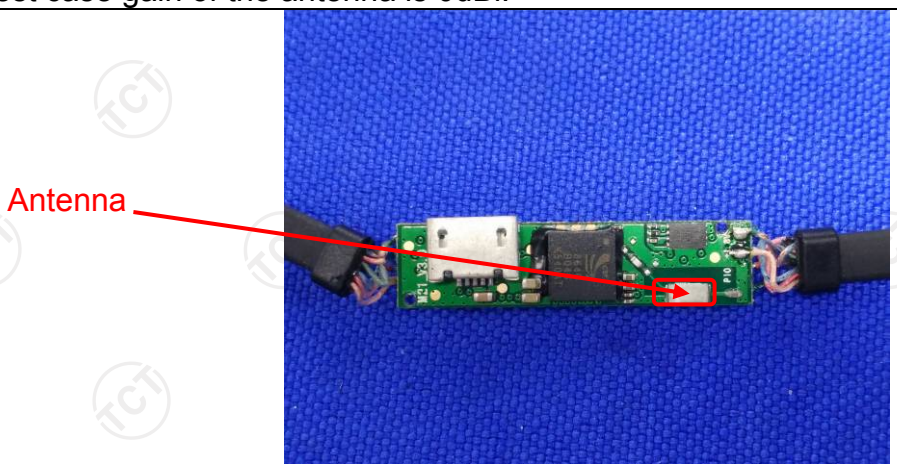
The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 %.

No.	Item	MU
1	Conducted Emission	±2.56dB
2	RF power, conducted	±0.12dB
3	Spurious emissions, conducted	±0.11dB
4	All emissions, radiated(<1G)	±3.92dB
5	All emissions, radiated(>1G)	±4.28dB
6	Temperature	±0.1°C
7	Humidity	±1.0%

6. Test Results and Measurement Data

6.1. Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)
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. 15.247(c) (1)(i) requirement: (i) 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 6dBi.	
E.U.T Antenna:	
The Bluetooth antenna is an internal antenna which permanently attached, and the best case gain of the antenna is 0dBi.	



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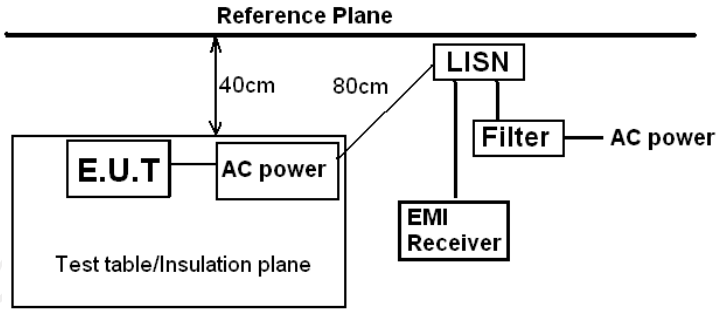
6.2. Conducted Emission

6.2.1. Test Specification

<table>
<tr><td>Test Requirement:</td><td>FCC Part15 C Section 15.207</td></tr>
<tr><td>Test Method:</td><td>ANSI C63.4:2014</td></tr>
<tr><td>Frequency Range:</td><td>150 kHz to 30 MHz</td></tr>
<tr><td>Receiver setup:</td><td>RBW=9 kHz, VBW=30 kHz, Sweep time=auto</td></tr>
<tr><td>Limits:</td><td>
<table>
<tr><td rowspan="2">Frequency range (MHz)</td><td colspan="2">Limit (dBuV)</td></tr>
<tr><td>Quasi-peak</td><td>Average</td></tr>
<tr><td>0.15-0.5</td><td>66 to 56*</td><td>56 to 46*</td></tr>
<tr><td>0.5-5</td><td>56</td><td>46</td></tr>
<tr><td>5-30</td><td>60</td><td>50</td></tr>
</table>
</td></tr>
<tr><td>Test Setup:</td><td> 

Remark:
E.U.T: Equipment Under Test
LISN: Line Impedence Stabilization Network
Test table height=0.8m</td></tr>
<tr><td>Test Mode:</td><td>Refer to item 4.1</td></tr>
<tr><td>Test Procedure:</td><td>1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment.
2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs).
3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2014 on conducted measurement.</td></tr>
<tr><td>Test Result:</td><td>PASS</td></tr>
</table>

6.2.1. Test Instruments

Conducted Emission Shielding Room Test Site (843)				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
EMI Test Receiver	R&S	ESCS30	100139	Sep. 11, 2016
LISN	Schwarzbeck	NSLK 8126	8126453	Sep. 16, 2016
Coax cable	TCT	CE-05	N/A	Sep. 11, 2016
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A

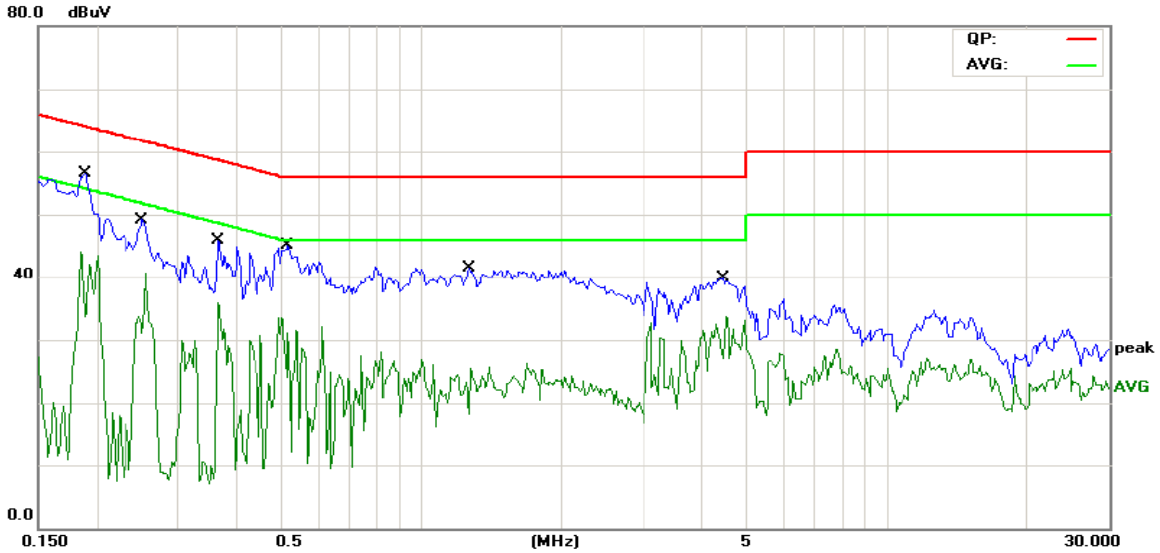
Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

6.2.2. Test data

Please refer to following diagram for individual

The test data (Link with Notebook)

Conducted Emission on Line Terminal of the power line (150 kHz to 30MHz)



Site Chamber #2 Phase: *L1* Temperature: 23 (C)

Limit: EN55022 Class B Conduction(QP) Power: Humidity: 54 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1891	39.92	11.49	51.41	64.07	-12.66	QP	
2		0.1891	26.77	11.49	38.26	54.07	-15.81	AVG	
3		0.2516	31.96	11.45	43.41	61.70	-18.29	QP	
4		0.2516	17.59	11.45	29.04	51.70	-22.66	AVG	
5		0.3648	28.34	11.39	39.73	58.62	-18.89	QP	
6		0.3648	14.78	11.39	26.17	48.62	-22.45	AVG	
7		0.5172	30.04	11.30	41.34	56.00	-14.66	QP	
8		0.5172	15.38	11.30	26.68	46.00	-19.32	AVG	
9		1.2633	24.53	11.32	35.85	56.00	-20.15	QP	
10		1.2633	8.58	11.32	19.90	46.00	-26.10	AVG	
11		4.4336	23.48	10.83	34.31	56.00	-21.69	QP	
12		4.4336	12.19	10.83	23.02	46.00	-22.98	AVG	

Note:

Freq. = Emission frequency in MHz

Reading level (dBμV) = Receiver reading

Corr. Factor (dB) = Antenna factor + Cable loss

Measurement (dBμV) = Reading level (dBμV) + Corr. Factor (dB)

Limit (dBμV) = Limit stated in standard

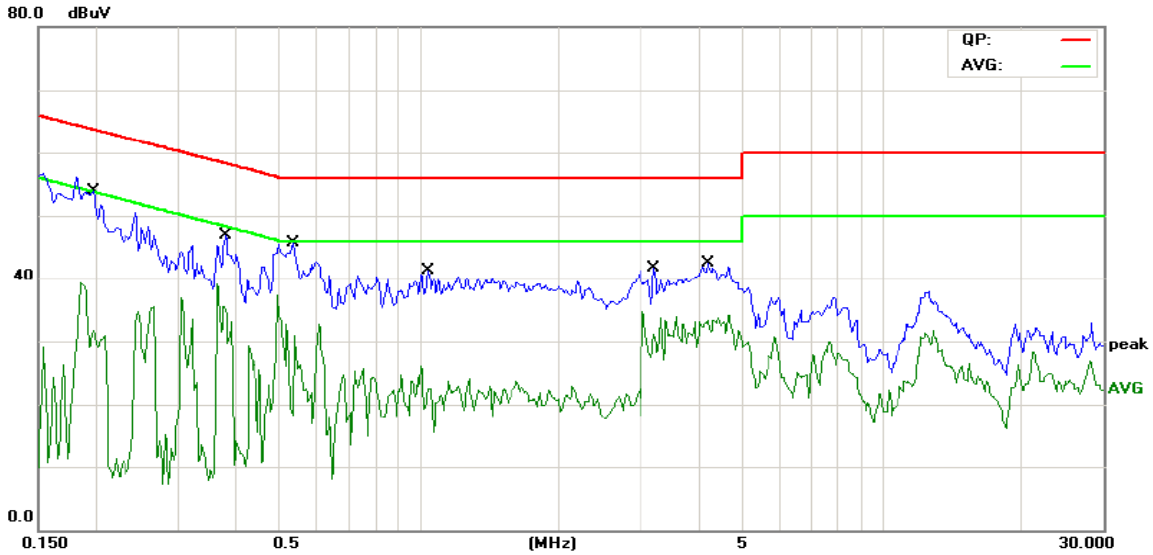
Margin (dB) = Measurement (dBμV) – Limits (dBμV)

Q.P. =Quasi-Peak

AVG =average

** is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz*

Conducted Emission on Neutral Terminal of the power line (150 kHz to 30MHz)



Site Chamber #2 Phase: N Temperature: 23 (C)

Limit: EN55022 Class B Conduction(QP) Power: Humidity: 54 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1969	38.92	11.48	50.40	63.74	-13.34	QP	
2		0.1969	25.58	11.48	37.06	53.74	-16.68	AVG	
3		0.3805	31.39	11.37	42.76	58.27	-15.51	QP	
4		0.3805	17.59	11.37	28.96	48.27	-19.31	AVG	
5		0.5328	30.55	11.29	41.84	56.00	-14.16	QP	
6		0.5328	14.34	11.29	25.63	46.00	-20.37	AVG	
7		1.0444	22.72	11.20	33.92	56.00	-22.08	QP	
8		1.0444	8.61	11.20	19.81	46.00	-26.19	AVG	
9		3.2109	23.98	11.26	35.24	56.00	-20.76	QP	
10		3.2109	9.72	11.26	20.98	46.00	-25.02	AVG	
11		4.1836	25.41	10.91	36.32	56.00	-19.68	QP	
12		4.1836	14.19	10.91	25.10	46.00	-20.90	AVG	

Note1:

Freq. = Emission frequency in MHz

Reading level (dBμV) = Receiver reading

Corr. Factor (dB) = Antenna factor + Cable loss

Measurement (dBμV) = Reading level (dBμV) + Corr. Factor (dB)

Limit (dBμV) = Limit stated in standard

Margin (dB) = Measurement (dBμV) – Limits (dBμV)

Q.P. =Quasi-Peak AVG =average

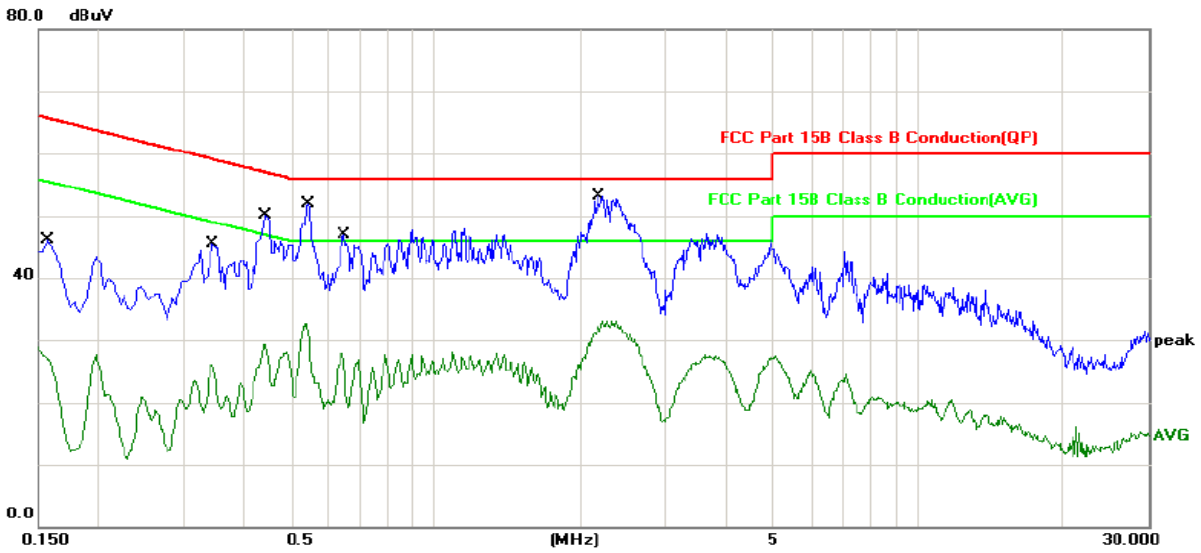
** is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.*

Note2:

Measurements were conducted in all three channels (high, middle, low) and three modulation (GFSK, Pi/4 DQPSK, 8DPSK), and the worst case Mode (Highest channel and GFSK) was submitted only.

The test data (Link with Adapter)

Conducted Emission on Line Terminal of the power line (150 kHz to 30MHz)



Site Chamber #2 Phase: L1 Temperature:

Limit: FCC Part 15B Class B Conduction(QP) Power: AC 120V/60Hz Humidity: %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1580	27.55	11.49	39.04	65.56	-26.52	QP	
2		0.1580	12.96	11.49	24.45	55.56	-31.11	AVG	
3		0.3460	26.84	11.40	38.24	59.06	-20.82	QP	
4		0.3460	13.85	11.40	25.25	49.06	-23.81	AVG	
5		0.4460	31.54	11.34	42.88	56.95	-14.07	QP	
6		0.4460	16.80	11.34	28.14	46.95	-18.81	AVG	
7		0.5460	32.39	11.29	43.68	56.00	-12.32	QP	
8		0.5460	18.42	11.29	29.71	46.00	-16.29	AVG	
9		0.6460	28.32	11.25	39.57	56.00	-16.43	QP	
10		0.6460	13.31	11.25	24.56	46.00	-21.44	AVG	
11	*	2.1740	32.39	11.64	44.03	56.00	-11.97	QP	
12		2.1740	19.57	11.64	31.21	46.00	-14.79	AVG	

Note:

Freq. = Emission frequency in MHz

Reading level (dBμV) = Receiver reading

Corr. Factor (dB) = Antenna factor + Cable loss

Measurement (dBμV) = Reading level (dBμV) + Corr. Factor (dB)

Limit (dBμV) = Limit stated in standard

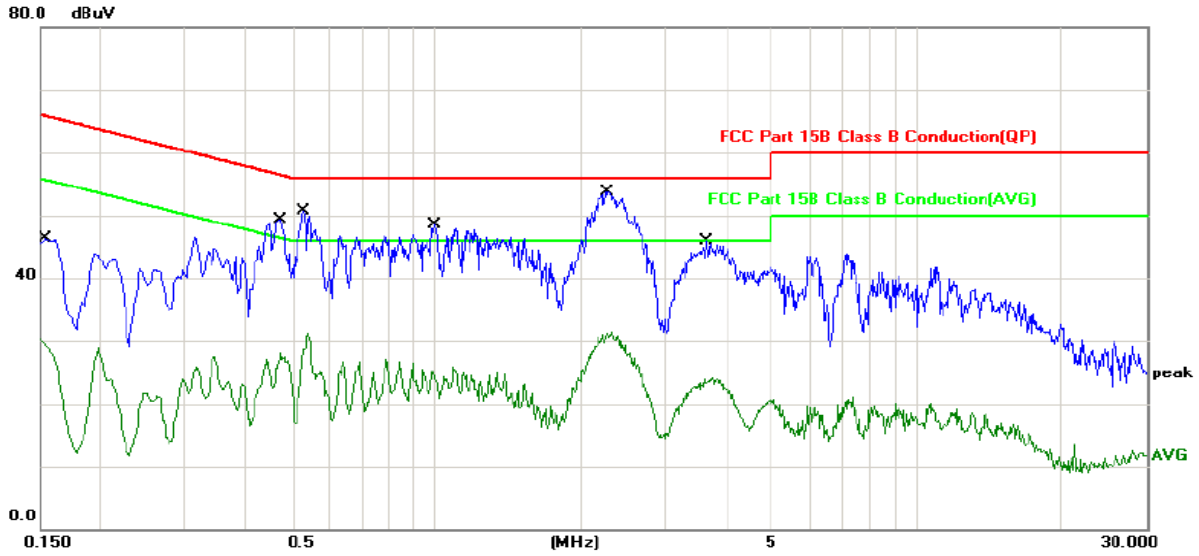
Margin (dB) = Measurement (dBμV) – Limits (dBμV)

Q.P. =Quasi-Peak

AVG =average

** is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz*

Conducted Emission on Neutral Terminal of the power line (150 kHz to 30MHz)



Site Chamber #2 Phase: N Temperature:

Limit: FCC Part 15B Class B Conduction(QP) Power: AC 120V/60Hz Humidity: %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1539	28.70	11.49	40.19	65.78	-25.59	QP	
2		0.1539	16.83	11.49	28.32	55.78	-27.46	AVG	
3		0.4740	32.81	11.32	44.13	56.44	-12.31	QP	
4		0.4740	16.10	11.32	27.42	46.44	-19.02	AVG	
5		0.5299	33.20	11.29	44.49	56.00	-11.51	QP	
6		0.5299	16.98	11.29	28.27	46.00	-17.73	AVG	
7		0.9900	30.41	11.21	41.62	56.00	-14.38	QP	
8		0.9900	13.30	11.21	24.51	46.00	-21.49	AVG	
9	*	2.2659	35.28	11.60	46.88	56.00	-9.12	QP	
10		2.2659	19.13	11.60	30.73	46.00	-15.27	AVG	
11		3.6500	27.10	11.11	38.21	56.00	-17.79	QP	
12		3.6500	12.33	11.11	23.44	46.00	-22.56	AVG	

Note1:

Freq. = Emission frequency in MHz

Reading level (dBμV) = Receiver reading

Corr. Factor (dB) = Antenna factor + Cable loss

Measurement (dBμV) = Reading level (dBμV) + Corr. Factor (dB)

Limit (dBμV) = Limit stated in standard

Margin (dB) = Measurement (dBμV) – Limits (dBμV)

Q.P. =Quasi-Peak AVG =average

** is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.*

Note2:

Measurements were conducted in all three channels (high, middle, low) and three modulation (GFSK, Pi/4 DQPSK, 8DPSK), and the worst case Mode (Highest channel and GFSK) was submitted only.

6.3. Conducted Output Power

6.3.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (b)(3)
Test Method:	ANSI C63.10:2013 and DA00-705
Limit:	Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (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.
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	Use the following spectrum analyzer settings: Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel RBW > the 20 dB bandwidth of the emission being measured VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission.
Test Result:	PASS

6.3.2. Test Instruments

Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	R&S	FSU	200054	Sep. 11, 2016
RF Cable	TCT	RE-06	N/A	Sep. 12, 2016
Antenna Connector	TCT	RFC-01	N/A	Sep. 12, 2016

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

6.3.3. Test Data

GFSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	3.08	21.00	PASS
Middle	4.82	21.00	PASS
Highest	5.01	21.00	PASS

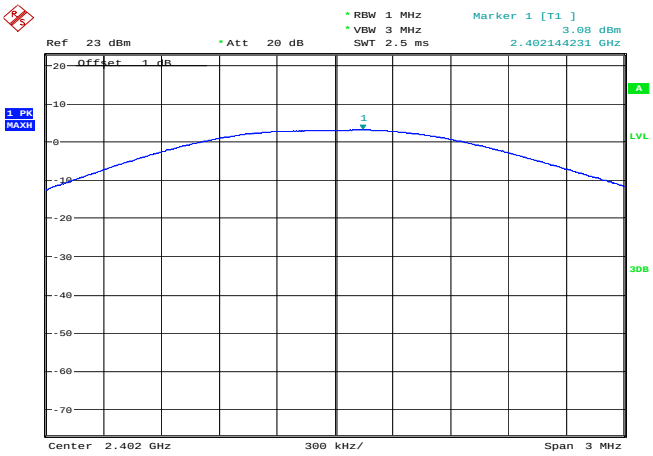
Pi/4DQPSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	0.77	21.00	PASS
Middle	3.22	21.00	PASS
Highest	3.57	21.00	PASS

8DPSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	1.20	21.00	PASS
Middle	3.82	21.00	PASS
Highest	3.85	21.00	PASS

Test plots as follows:

GFSK Modulation

Lowest channel



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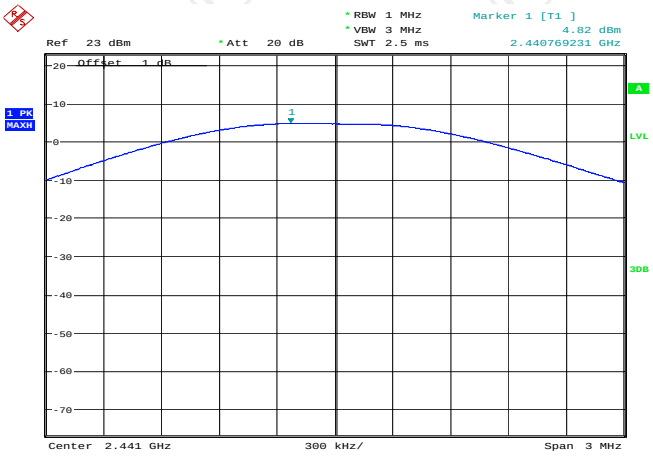
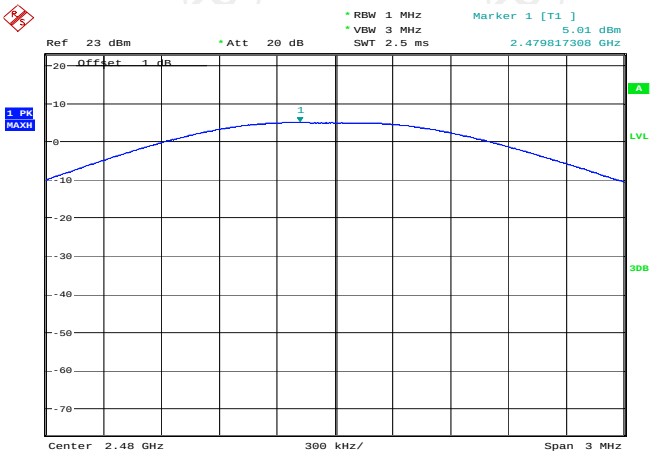
Middle channel



Date: 10.AUG.2016 10:29:44

Highest channel



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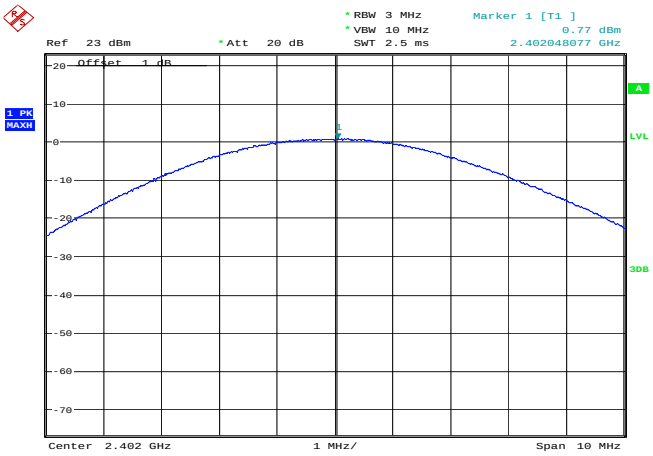
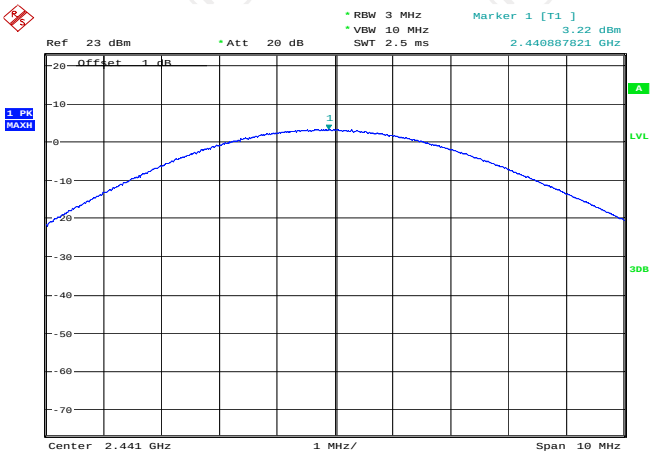
Pi/4DQPSK Modulation

Lowest channel



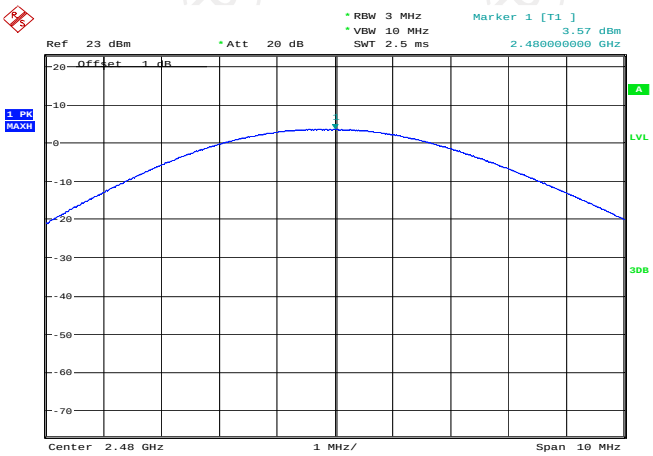
Date: 10.AUG.2016 10:32:14

Middle channel



Date: 10.AUG.2016 10:33:13

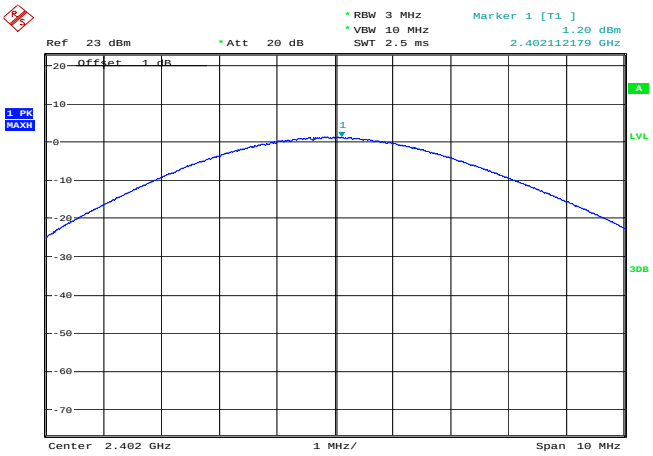
Highest channel



Date: 10.AUG.2016 10:34:46

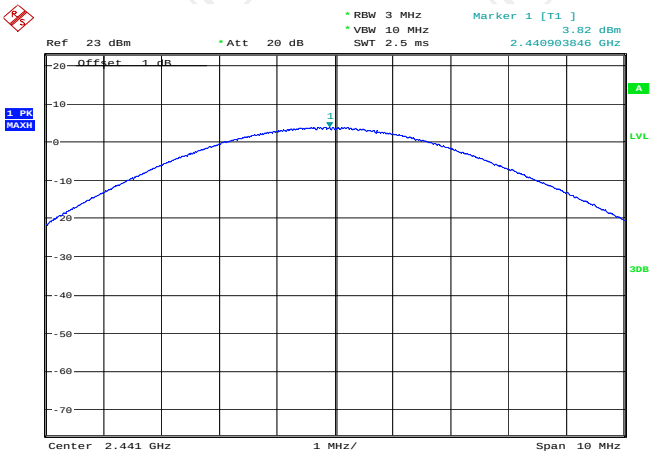
8DPSK Modulation

Lowest channel



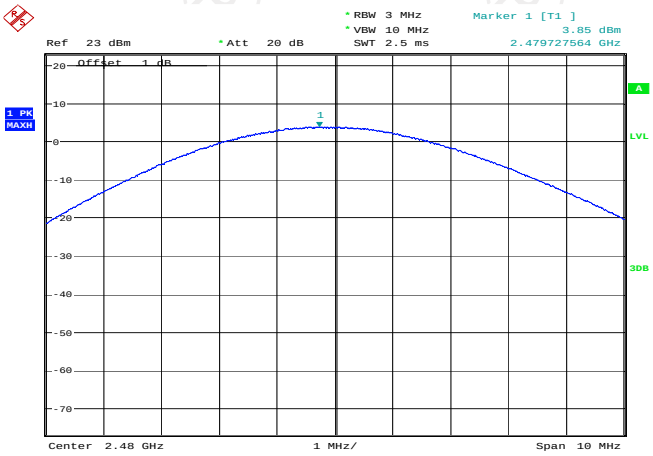
Date: 10.AUG.2016 10:35:59

Middle channel



Date: 10.AUG.2016 10:36:59

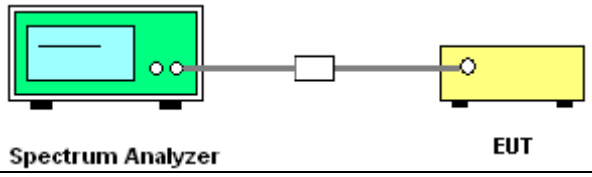
Highest channel



Date: 10.AUG.2016 10:37:57

6.4. 20dB Occupy Bandwidth

6.4.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 and DA00-705
Limit:	N/A
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines. 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Use the following spectrum analyzer settings for 20dB Bandwidth measurement. Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel; RBW≥1% of the 20 dB bandwidth; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold. 5. Measure and record the results in the test report.
Test Result:	PASS

6.4.2. Test Instruments

RF Test Room				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	R&S	FSU	200054	Sep. 11, 2016
RF cable	TCT	RE-06	N/A	Sep. 12, 2016
Antenna Connector	TCT	RFC-01	N/A	Sep. 12, 2016

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

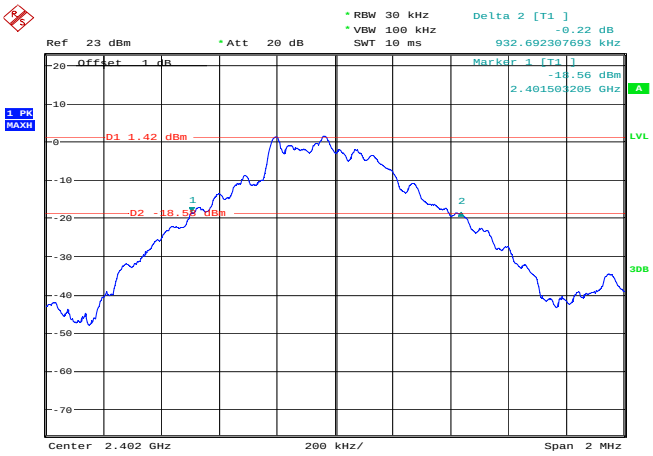
6.4.3. Test data

Test channel	20dB Occupy Bandwidth (kHz)			
	GFSK	π/4-DQPSK	8DPSK	Conclusion
Lowest	932.69	1211.54	1208.33	PASS
Middle	923.08	1214.74	1211.54	PASS
Highest	919.87	1214.74	1217.95	PASS

Test plots as follows:

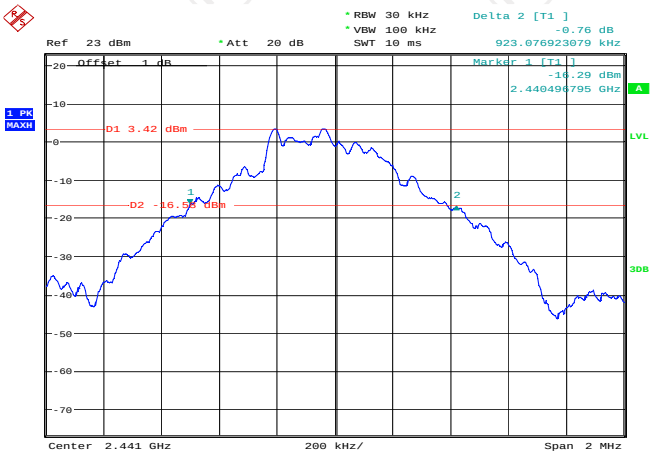
GFSK Modulation

Lowest channel



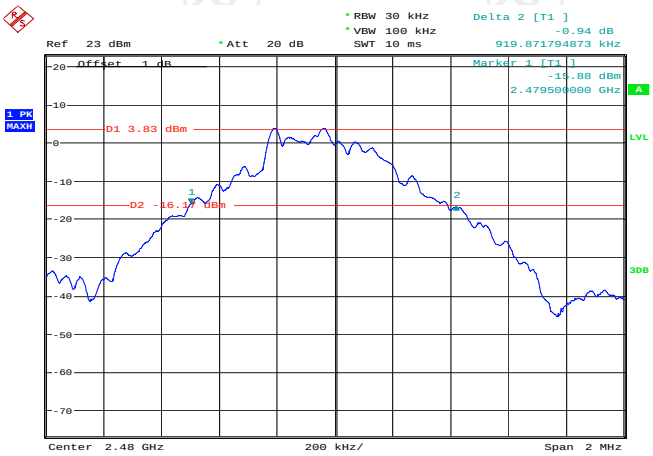
Date: 10.AUG.2016 10:08:22

Middle channel



Date: 10.AUG.2016 10:06:07

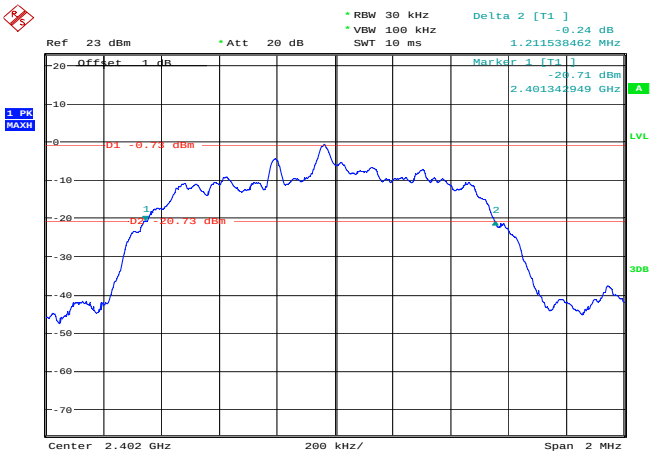
Highest channel



Date: 10.AUG.2016 10:11:38

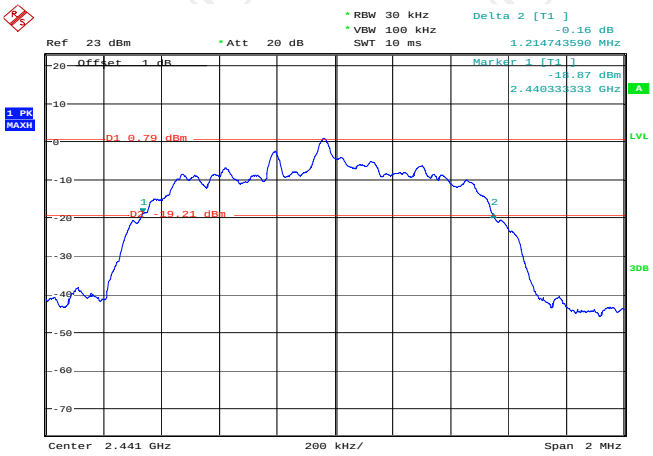
Pi/4DQPSK Modulation

Lowest channel



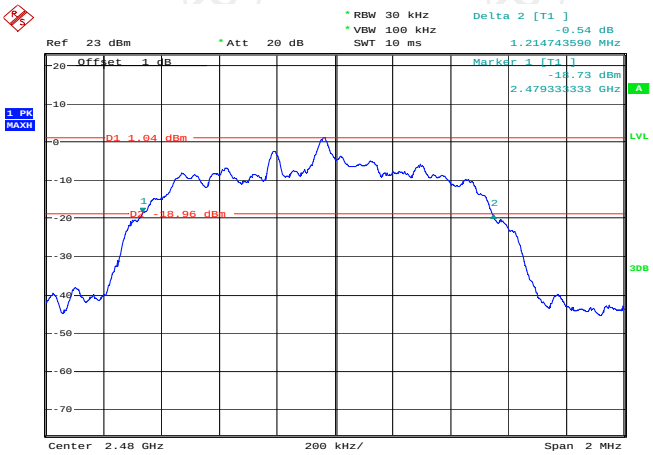
Date: 10.AUG.2016 10:14:00

Middle channel



Date: 10.AUG.2016 10:16:25

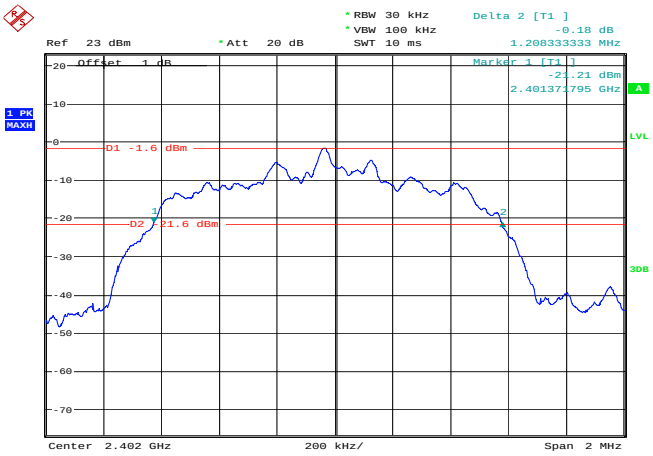
Highest channel



Date: 10.AUG.2016 10:18:10

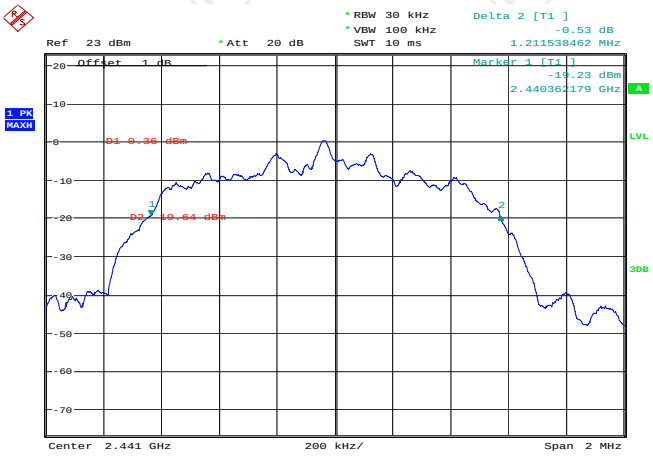
8DPSK Modulation

Lowest channel



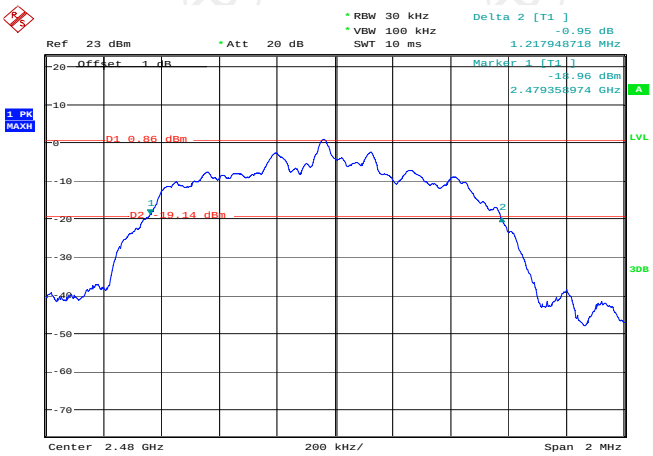
Date: 10.AUG.2016 10:22:29

Middle channel



Date: 10.AUG.2016 10:24:12

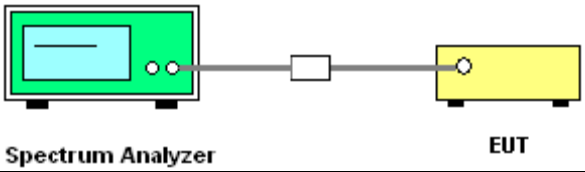
Highest channel



Date: 10.AUG.2016 10:25:41

6.5. Carrier Frequencies Separation

6.5.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 and DA00-705
Limit:	Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.
Test Setup:	
Test Mode:	Hopping mode
Test Procedure:	1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines. 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Enable the EUT hopping function. 5. Use the following spectrum analyzer settings: Span = wide enough to capture the peaks of two adjacent channels; RBW≥1% of the span; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold. 6. Measure and record the results in the test report.
Test Result:	PASS

6.5.2. Test Instruments

RF Test Room				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	R&S	FSU	200054	Sep. 11, 2016
RF cable	TCT	RE-06	N/A	Sep. 12, 2016
Antenna Connector	TCT	RFC-01	N/A	Sep. 12, 2016

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

6.5.3. Test data

GFSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Lowest	1006.41	*621.79*	PASS
Middle	1009.62	*621.79*	PASS
Highest	996.79	*621.79*	PASS

Pi/4 DQPSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Lowest	987.18	*809.83*	PASS
Middle	1003.21	*809.83*	PASS
Highest	1000	*809.83*	PASS

8DPSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Lowest	1003.21	*811.97*	PASS
Middle	1000	*811.97*	PASS
Highest	1009.62	*811.97*	PASS

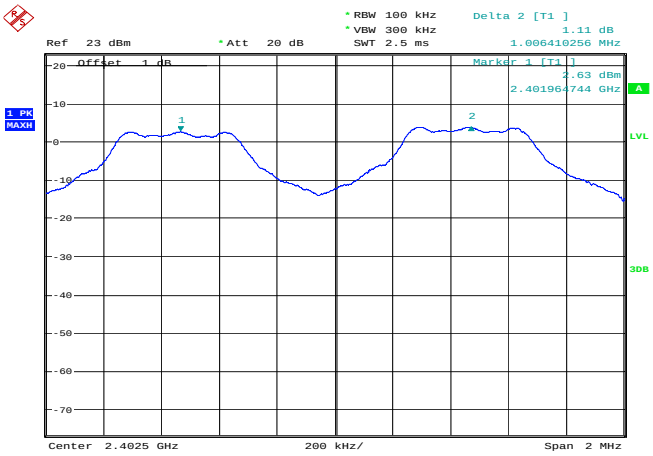
Note: According to section 6.4

Mode	*20dB bandwidth (kHz) (worse case)*	*Limit (kHz) (Carrier Frequencies Separation)*
GFSK	*932.69*	*621.79*
π/4-DQPSK	*1214.74*	*809.83*
8DPSK	*1217.95*	*811.97*

Test plots as follows:

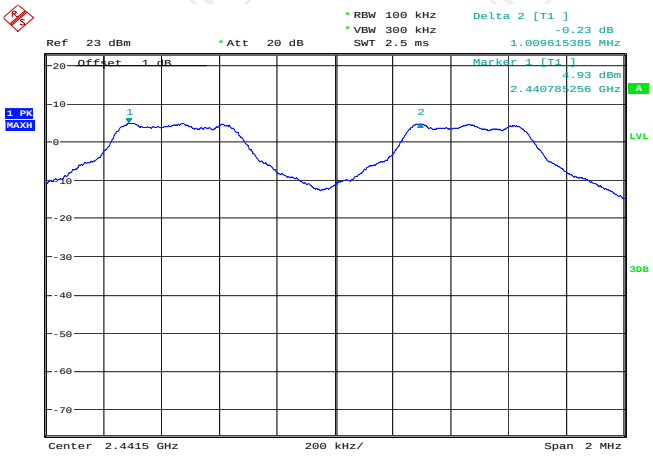
GFSK Modulation

Lowest channel



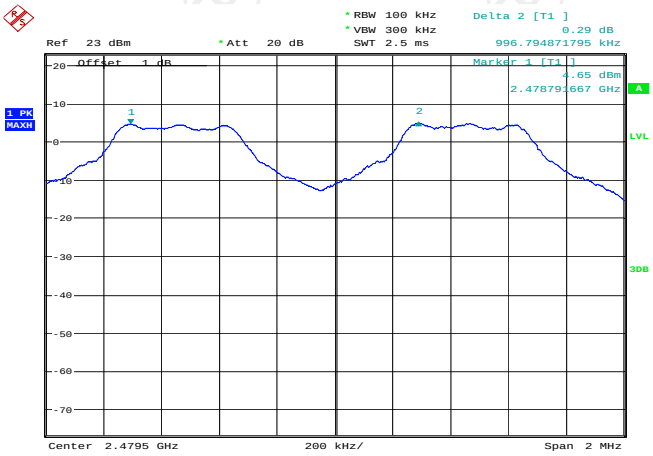
Date: 10.AUG.2016 11:05:51

Middle channel



Date: 10.AUG.2016 11:10:21

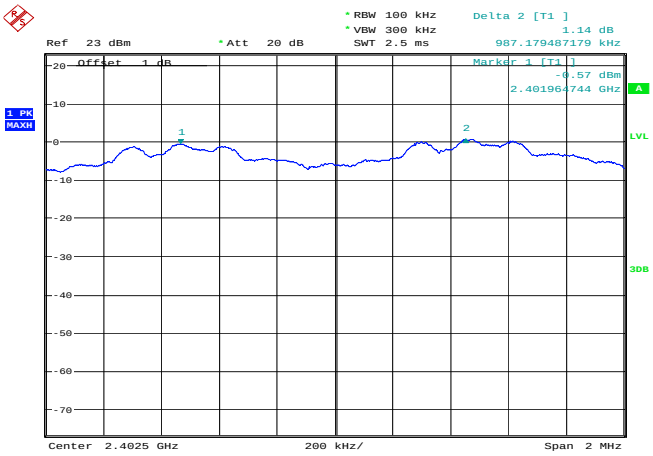
Highest channel



Date: 10.AUG.2016 11:11:28

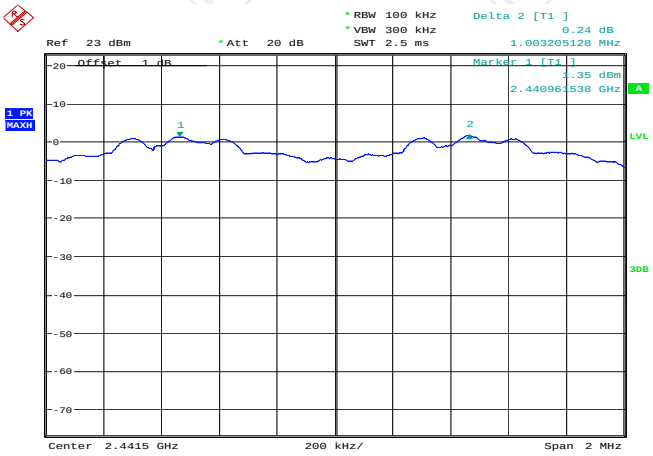
Pi/4DQPSK Modulation

Lowest channel



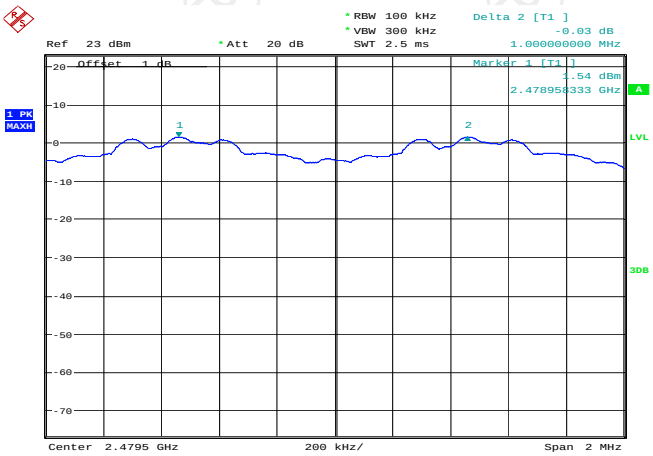
Date: 10.AUG.2016 11:13:14

Middle channel



Date: 10.AUG.2016 11:15:16

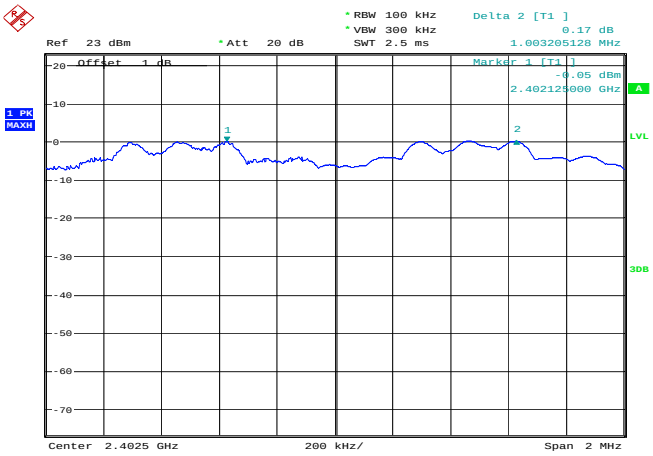
Highest channel



Date: 10.AUG.2016 11:16:26

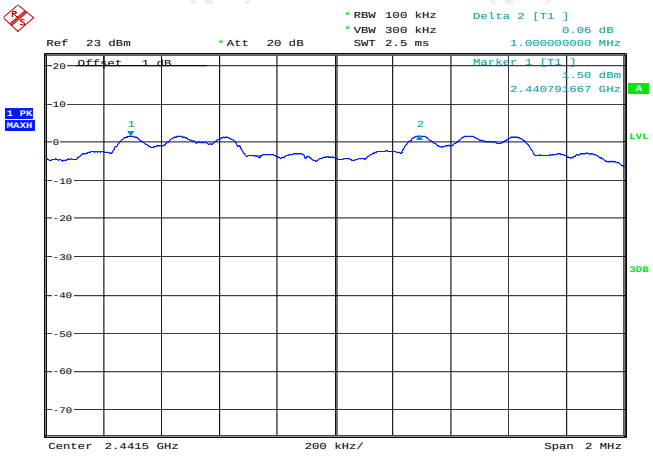
8DPSK Modulation

Lowest channel



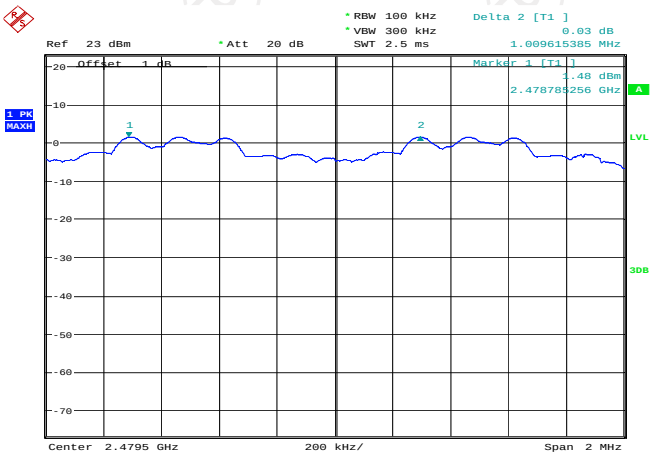
Date: 10.AUG.2016 11:19:31

Middle channel



Date: 10.AUG.2016 11:20:40

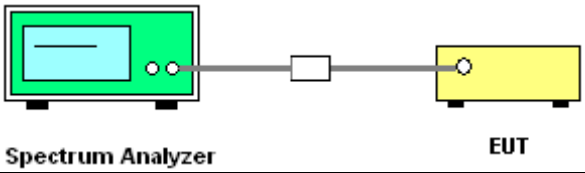
Highest channel



Date: 10.AUG.2016 11:21:59

6.6. Hopping Channel Number

6.6.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 and DA00-705
Limit:	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
Test Setup:	
Test Mode:	Hopping mode
Test Procedure:	1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines. 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Enable the EUT hopping function. 5. Use the following spectrum analyzer settings: Span = the frequency band of operation; RBW ≥1% of the span; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold. 6. The number of hopping frequency used is defined as the number of total channel. 7. Record the measurement data derived from spectrum analyzer.
Test Result:	PASS

6.6.2. Test Instruments

RF Test Room				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	R&S	FSU	200054	Sep. 11, 2016
RF cable	TCT	RE-06	N/A	Sep. 12, 2016
Antenna Connector	TCT	RFC-01	N/A	Sep. 12, 2016

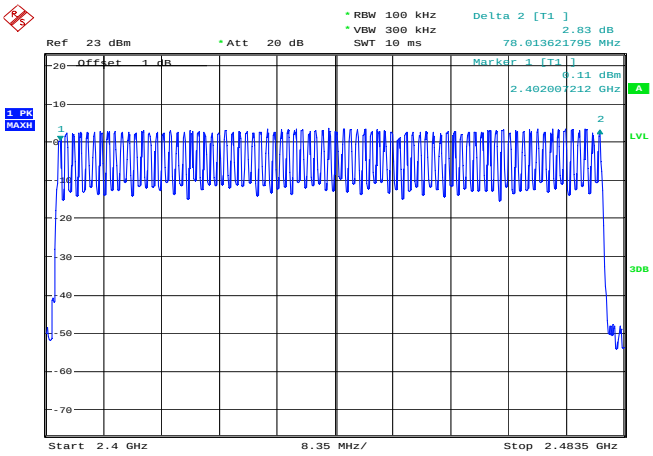
Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

6.6.3. Test data

Mode	Hopping channel numbers	Limit	Result
GFSK, P/4-DQPSK, 8DPSK	79	15	PASS

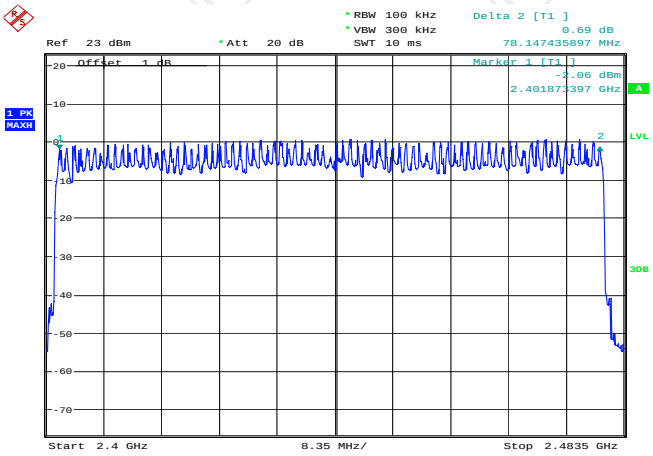
Test plots as follows:

GFSK



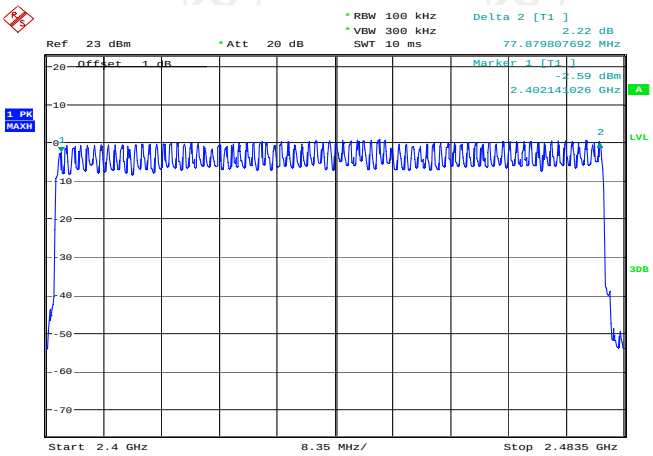
Date: 10.AUG.2016 10:41:57

Pi/4DQPSK



Date: 10.AUG.2016 10:44:01

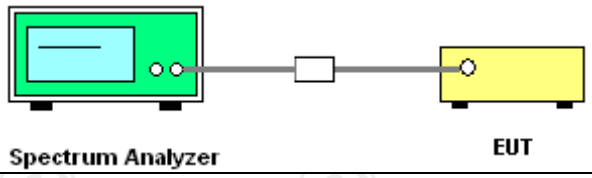
8DPSK



Date: 10.AUG.2016 10:48:57

6.7. Dwell Time

6.7.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013 and DA00-705
Limit:	The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.
Test Setup:	
Test Mode:	Hopping mode
Test Procedure:	1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines. 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Enable the EUT hopping function. 5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW = 1 MHz; VBW≥RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold. 6. Measure and record the results in the test report.
Test Result:	PASS

6.7.2. Test Instruments

RF Test Room				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	R&S	FSU	200054	Sep. 11, 2016
RF cable	TCT	RE-06	N/A	Sep. 12, 2016
Antenna Connector	TCT	RFC-01	N/A	Sep. 12, 2016

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

6.7.3. Test Data

Mode	Packet	Hops Over Occupancy Time (hops)	Package Transfer Time (ms)	Dwell time (second)	Limit (second)	Result
GFSK	DH5	106.67	2.96	0.32	0.4	PASS
Pi/4 DQPSK	2-DH5	106.67	2.97	0.32	0.4	PASS
8DPSK	3-DH5	106.67	2.99	0.32	0.4	PASS

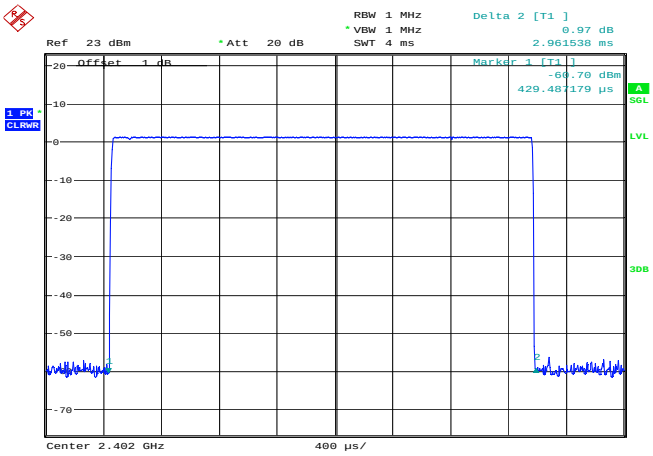
Note: *1. In normal mode, hopping rate is 1600 hops/s with 6 slots in 79 hopping channels.*

With channel hopping rate (1600 / 6 / 79) in Occupancy Time Limit (0.4 x 79) (s), Hops Over Occupancy Time comes to (1600 / 6 / 79) x (0.4 x 79) = 106.67 hops

2. Dwell Time(s) = Hops Over Occupancy Time (hops) x Package Transfer Time

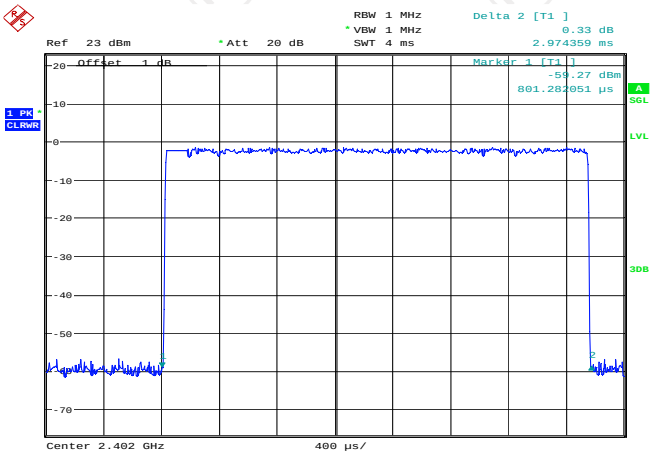
Test plots as follows:

GFSK



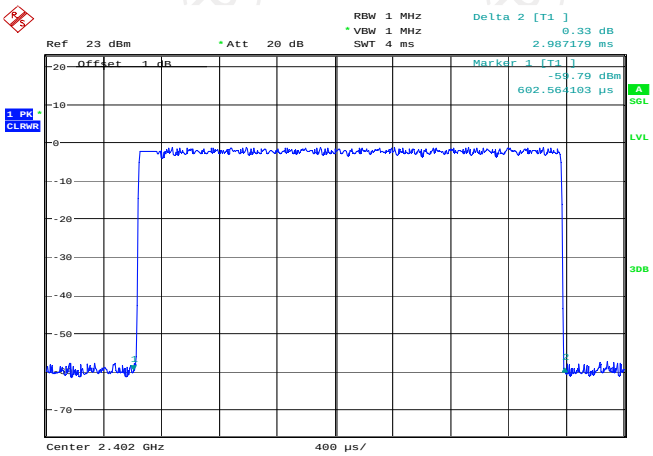
Date: 10.AUG.2016 10:56:17

Pi/4DQPSK



Date: 10.AUG.2016 10:58:39

8DPSK



Date: 10.AUG.2016 11:00:01

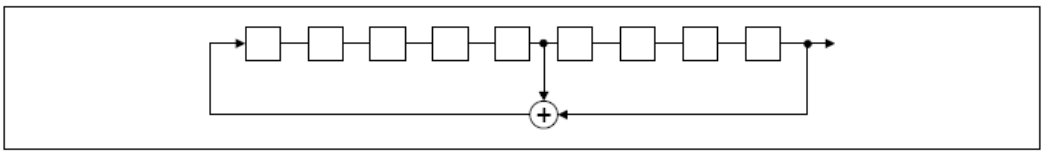
6.8. Pseudorandom Frequency Hopping Sequence

Test Requirement:	FCC Part15 C Section 15.247 (a)(1) requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.
Alternatively. Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

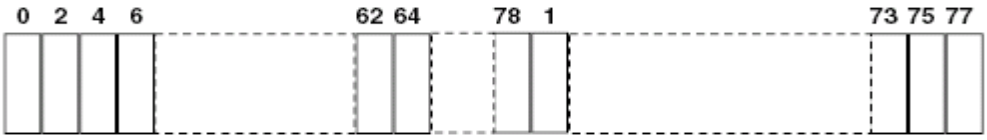
EUT Pseudorandom Frequency Hopping Sequence

The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones; i.e. the shift register is initialized with nine ones.
• Number of shift register stages: 9
• Length of pseudo-random sequence: 2^9 -1 = 511 bits
• Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

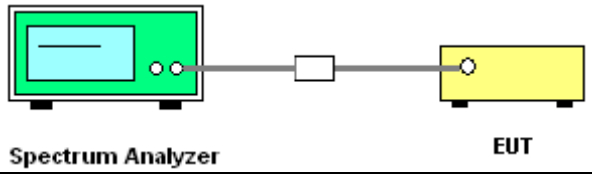
An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.
The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

6.9. Conducted Band Edge Measurement

6.9.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2013 and DA00-705
Limit:	In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows the guidelines in Band-edge Compliance of RF Conducted Emissions of FCC Public Notice DA 00-705 Measurement Guidelines. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Set RBW = 100 kHz (≥1% span=10MHz), VBW = 300 kHz (≥RBW). Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used. 4. Enable hopping function of the EUT and then repeat step 2 and 3. 5. Measure and record the results in the test report.
Test Result:	PASS

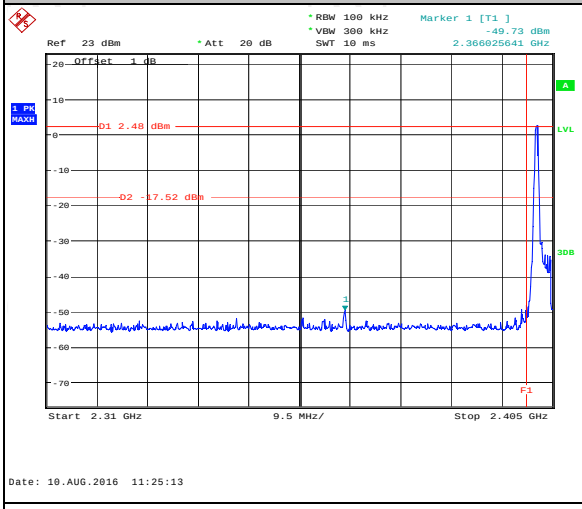
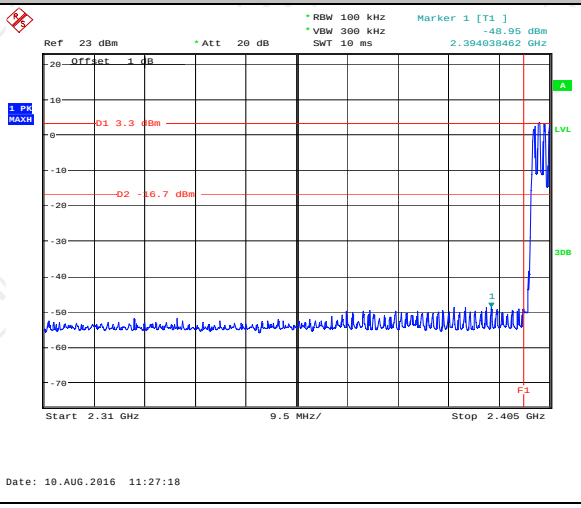
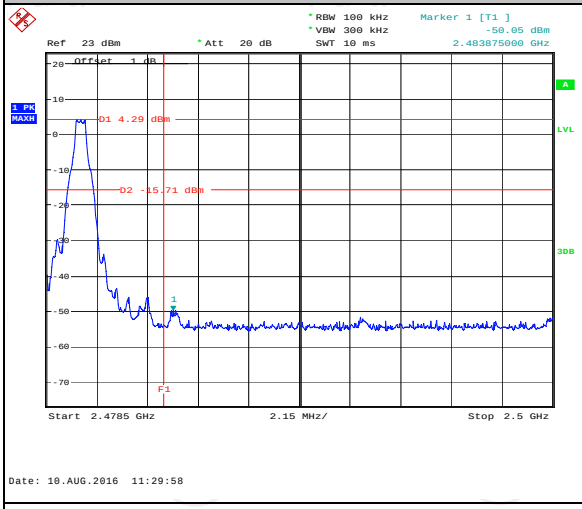
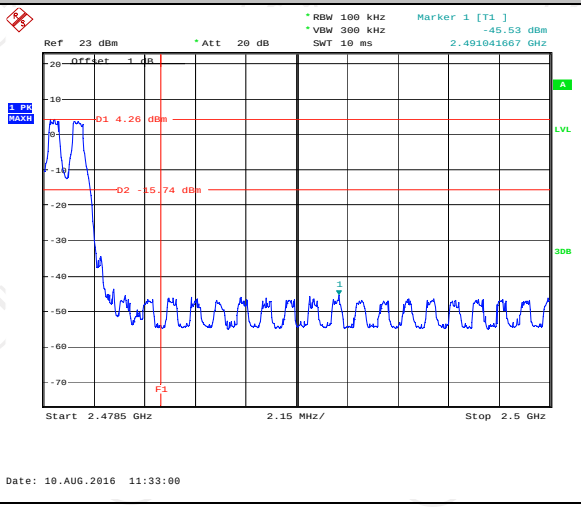
6.9.2. Test Instruments

RF Test Room				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	R&S	FSU	200054	Sep. 11, 2016
RF cable	TCT	RE-06	N/A	Sep. 12, 2016
Antenna Connector	TCT	RFC-01	N/A	Sep. 12, 2016

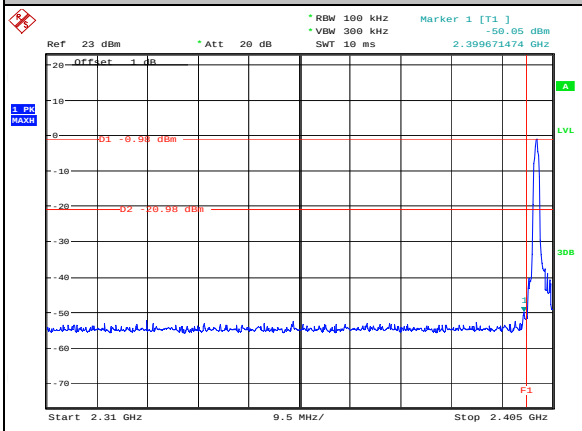
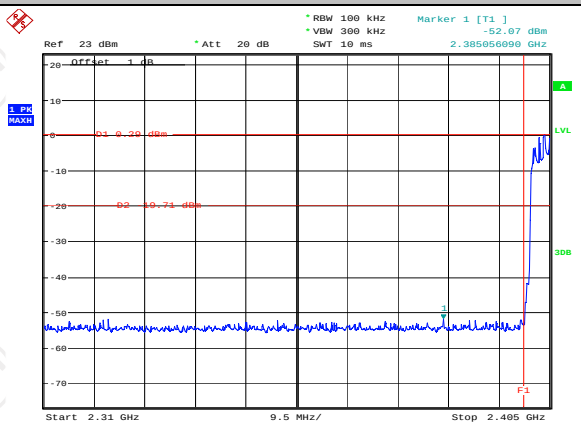
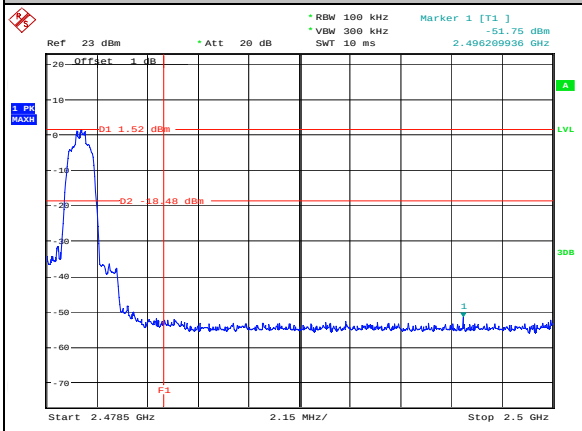
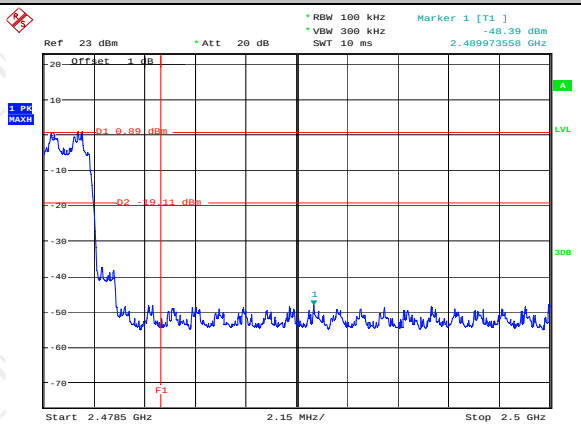
Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

6.9.3. Test Data

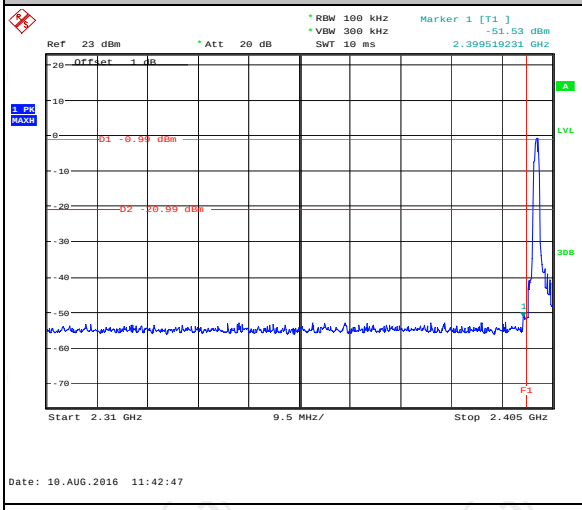
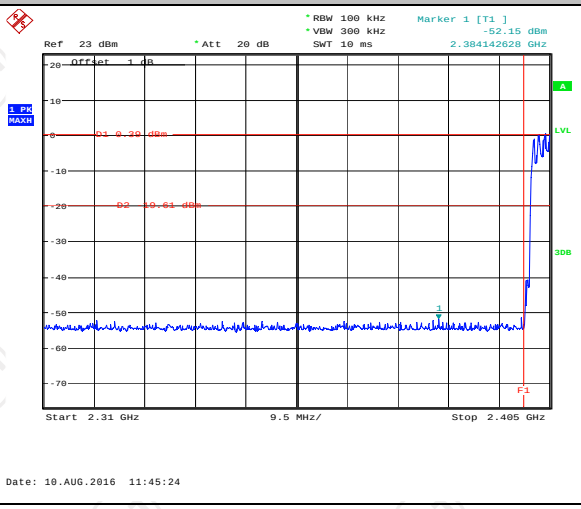
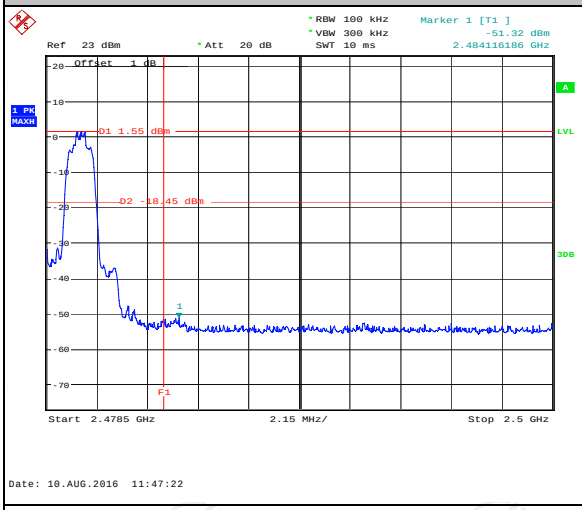
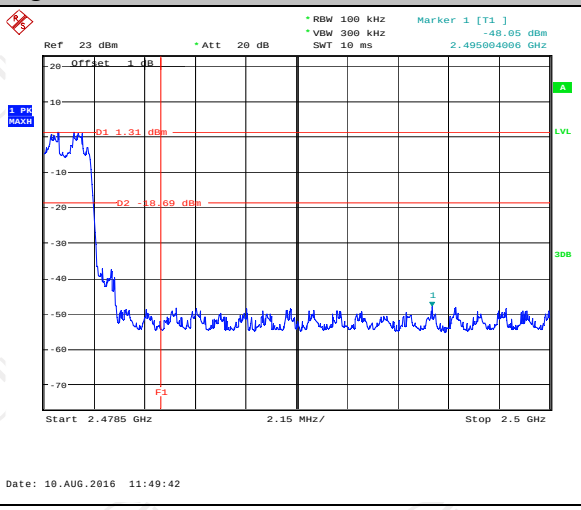
GFSK Modulation

Test channel:	Lowest channel
	
No-hopping mode	Hopping mode
Test channel:	Highest channel
	
No-hopping mode	Hopping mode

Pi/4DQPSK Modulation

Test channel:	Lowest channel
	
No-hopping mode	Hopping mode
Test channel:	**Highest channel**
	
No-hopping mode	Hopping mode

8DPSK Modulation

Test channel:	Lowest channel
	
No-hopping mode	Hopping mode
Test channel:	Highest channel
	
No-hopping mode	Hopping mode