

FCC TEST REPORT(Bluetooth)

for

OMATE LIMITED

Bluetooth wrist watch

Model Number: OMATE X

FCC ID: 2ABF5-OMX1

Prepared for : OMATE LIMITED

Address : Room 1101,11/F San Toi Building, No.139 Connaught
Road, Central District, HongKong

Prepared by : Keyway Testing Technology Co., Ltd.

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Report No. : 14KWE10199506F


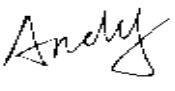

Date of Test : Oct. 17~23, 2014

Date of Report : Oct. 23, 2014

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Keyway Testing Technology Co., Ltd.

Applicant:	OMATE LIMITED		
Address:	Room 1101,11/F San Toi Building,No.139 Connaught Road, Central District, HongKong		
Manufacturer:	OMATE LIMITED		
Address:	Room 1101,11/F San Toi Building,No.139 Connaught Road, Central District, HongKong		
E.U.T:	Bluetooth wrist watch		
Model Number:	OMATE X		
Trade Name:	OMATE	Serial No.:	-----
Date of Receipt:	Oct. 17, 2014	Date of Test:	Oct. 17~23, 2014
Test Specification:	FCC Part 15, Subpart C: 2014 ANSI C63.4:2009		
Test Result:	The equipment under test was found to be compliance with the requirements of the standards applied.		
Issue Date: Oct. 23, 2014			
Tested by:	Reviewed by:	Approved by:	
 <hr style="width: 100%;"/>	 <hr style="width: 100%;"/>	 <hr style="width: 100%;"/>	
Cissy Song / Engineer	Andy Gao / Supervisor	Jade Yang / Supervisor	
Other Aspects:			
None.			
<i>Abbreviations: OK/P=passed fail/F=failed n.a/N=not applicable E.U.T=equipment under tested</i>			
<i>This test report is based on a single evaluation of one sample of above mentioned products. It is not permitted to be duplicated in extracts without written approval of Keyway Testing Technology Co., Ltd.</i>			

1.TEST SUMMARY

Test Items	Test Requirement	Result
Conducted Emissions	15.207	PASS
Radiated Emissions	15.205(a)/15.209 15.247(d)	PASS
20dB Bandwidth	15.247(a)(1)	PASS
Frequency Separation	15.247(a)(1)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS
Dwell time	15.247(a)(1)(iii)	PASS
Emissions from out of band	15.247(d)	PASS
Antenna Requirement	15.203	PASS

2. GENERAL PRODUCT INFORMATION

2.1. Product Function

Refer to Technical Construction Form and User Manual.

2.2. Description of Device (EUT)

Product Name:	Bluetooth wrist watch
Model No.:	OMATE X
Operation Frequency:	2402~2480 MHz
Modulation technology:	FHSS GFSK, Pi/4 QPSK, 8DPSK BLE:GFSK
Channel numbers:	FHSS:79 BLE:40
Channel separation:	FHSS:1MHz BLE: 2MHz
Antenna Type:	Integral Antenna
Antenna gain:	0dBi (declare by Applicant)
Power supply:	DC 3.7V DC 5V from adapter

2.3. Difference between Model Numbers

None.

2.4. Independent Operation Modes

The basic operation modes are:

2.4.1. EUT work continues TX mode and frequency as below:

Modulation	Channel	Frequency
FHSS, Pi/4DQPSK, 8-DQPSK	Low	2402MHz
	Middle	2441MHz
	High	2480MHz

Note: Bluetooth signal has 9 packages DH1, DH3, DH5, 2DH1, 2DH3, 2DH5, 3DH1, 3DH3, 3DH5, DH5 package is largest; we are testing DH5 in the report.

2.5. Test Supporting System

Adapter:	Provide: Keyway M/N:KW005 Input :AC 100~240V 50-60Hz; Output: DC 5V 1A
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3. TEST SITES

3.1. Test Facilities

Lab Qualifications : 944 Shielded Room built by ETS-Lindgren, USA
Date of completion: March 28, 2011

966 Chamber built by ETS-Lindgren, USA
Date of completion: March 28, 2011

Certificated by TUV Rheinland, Germany.
Registration No.: UA 50207153
Date of registration: July 13, 2011

Certificated by UL, USA
Registration No.: 100567-237
Date of registration: September 1, 2011

Certificated by Intertek
Registration No.: 2011-RTL-L1-31
Date of registration: October 11, 2011

Certificated by Industry Canada
Registration No.: 9868A
Date of registration: December 8, 2011

Certificated by FCC, USA
Registration No.: 370994
Date of registration: February 21, 2012

Certificated by CNAS China
Registration No.: CNAS L5783
Date of registration: August 8, 2012

Name of Firm : Keyway Testing Technology Co., Ltd.

Site Location : Building 1, Baishun Industrial Zone, Zhangmotou
Town, Dongguan, Guangdong, China

3.2. List of Test and Measurement Instruments

3.2.1. For conducted emission at the mains terminals test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr. 27,14	Apr. 27,15
Artificial Mains Network	Rohde&Schwarz	ENV216	101315	Apr. 27,14	Apr. 27,15
Artificial Mains Network (AUX)	Rohde&Schwarz	ENV216	101314	Apr. 27,14	Apr. 27,15
RF Cable	FUJIKURA	3D-2W	944 Cable	Apr. 27,14	Apr. 27,15

3.2.2. For radiated emission test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr. 27,14	Apr. 27,15
System Simulator	Agilent	E5515C	GB43130245	Apr. 30,14	Apr. 30,15
Power Splitter	Weinschel	1506A	NW425	Apr. 30,14	Apr. 30,15
Bilog Antenna	ETS-LINDGREEN	3142D	135452	Apr. 27,14	Apr. 27,15
Spectrum Analyzer	Agilent	E4411B	MY4511304	Apr. 27,14	Apr. 27,15
3m Semi-anechoic Chamber	ETS-LINDGREEN	966	KW01	Apr. 27,14	Apr. 27,15
Signal Amplifier	SONOMA	310	187016	Apr. 27,14	Apr. 27,15
Signal Amplifier	Agilent	8449B	3008A00251	Apr. 27,14	Apr. 27,15
RF Cable	IMRO	IMRO-400	966 Cable 1#	N/A	N/A
MULTI-DEVICE Controller	ETS-LINDGREEN	2090	126913	N/A	N/A
Horn Antenna	DAZE	ZN30701	11003	Apr. 27,14	Apr. 27,15
Horn Antenna	SCHWARZBECK	BBHA9170	9170-068	Apr. 27,14	Apr. 27,15
Spectrum Analyzer	Agilent	8593E	3911A04271	Apr. 27,14	Apr. 27,15
Spectrum Analyzer	Agilent	E4408B	MY44211125	Apr. 30,14	Apr. 30,15
Signal Amplifier	DAZE	ZN3380C	11001	Apr. 27,14	Apr. 27,15
High Pass filter	Micro	HPM50111	324216	Apr. 30,14	Apr. 30,15
Filter	COM-MW	ZBSF-C836.5-25-X	KW032	Apr. 30,14	Apr. 30,15
Filter	COM-MW	ZBSF-C1747.5-75-X2	KW035	Apr. 30,14	Apr. 30,15
Filter	COM-MW	ZBSF-C1880-60-X2	KW037	Apr. 30,14	Apr. 30,15
DC Power Supply	LongWei	PS-305D	010964729	Apr. 27,14	Apr. 27,15
Constant temperature and humidity box	GF	GTH-800-40-1P	MAA9906-005	Apr. 27,14	Apr. 27,15
Universal radio communication tester	Rohde&Schwarz	CMU200	3215420	Apr. 27,14	Apr. 27,15
Splitter	Agilent	11636B	0025164	Apr. 27,14	Apr. 27,15

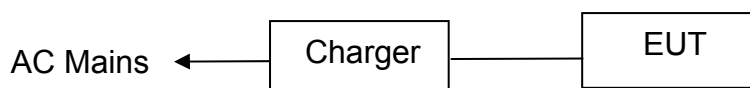
4. TEST SET-UP AND OPERATION MODES

4.1. Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the Operating Instructions.

4.2. Block Diagram of Test Set-up

System Diagram of Connections between EUT and Simulators



(EUT: Bluetooth wrist watch)

4.3. Test Operation Mode and Test Software

None.

4.4. Special Accessories and Auxiliary Equipment

None.

4.5. Countermeasures to Achieve EMC Compliance

None.

5. EMISSION TEST RESULTS

5.1. Conducted Emission at the Mains Terminals Test

5.1.1. Limit 15.207 limits

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

5.1.2. Test Setup

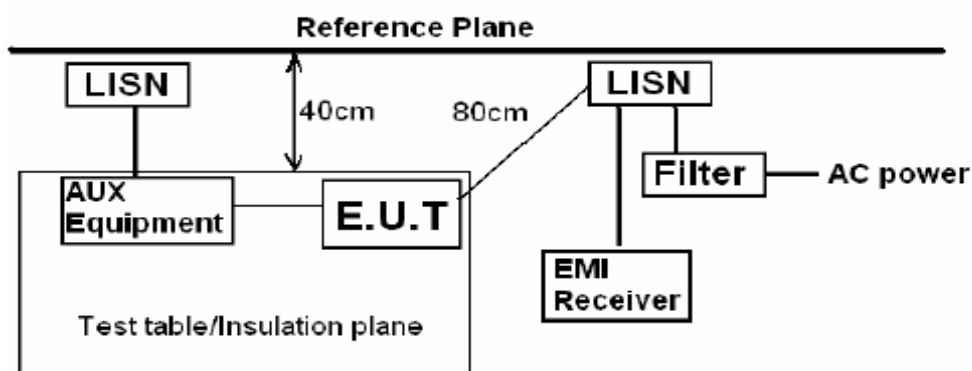
The EUT was put on a wooden table which was 0.8 m high above the ground and connected to the AC mains through the Artificial Mains Network (AMN). Where the mains cable supplied by the manufacture was longer than 0.8 m, the excess was folded back and forth parallel to the cable at the centre so as to form a bundle no longer than 0.4 m.

The EUT was kept 0.4 m from any other earthed conducting surface. Both sides of AC line were checked to find out the maximum conducted emission levels according to the test procedure during the conducted emission test.

The frequency range from 150 kHz to 30 MHz was investigated.

The bandwidth of the test receiver was set at 9 kHz.

Pretest for all mode, The test data of the worst case condition(s) was reported on the following page.

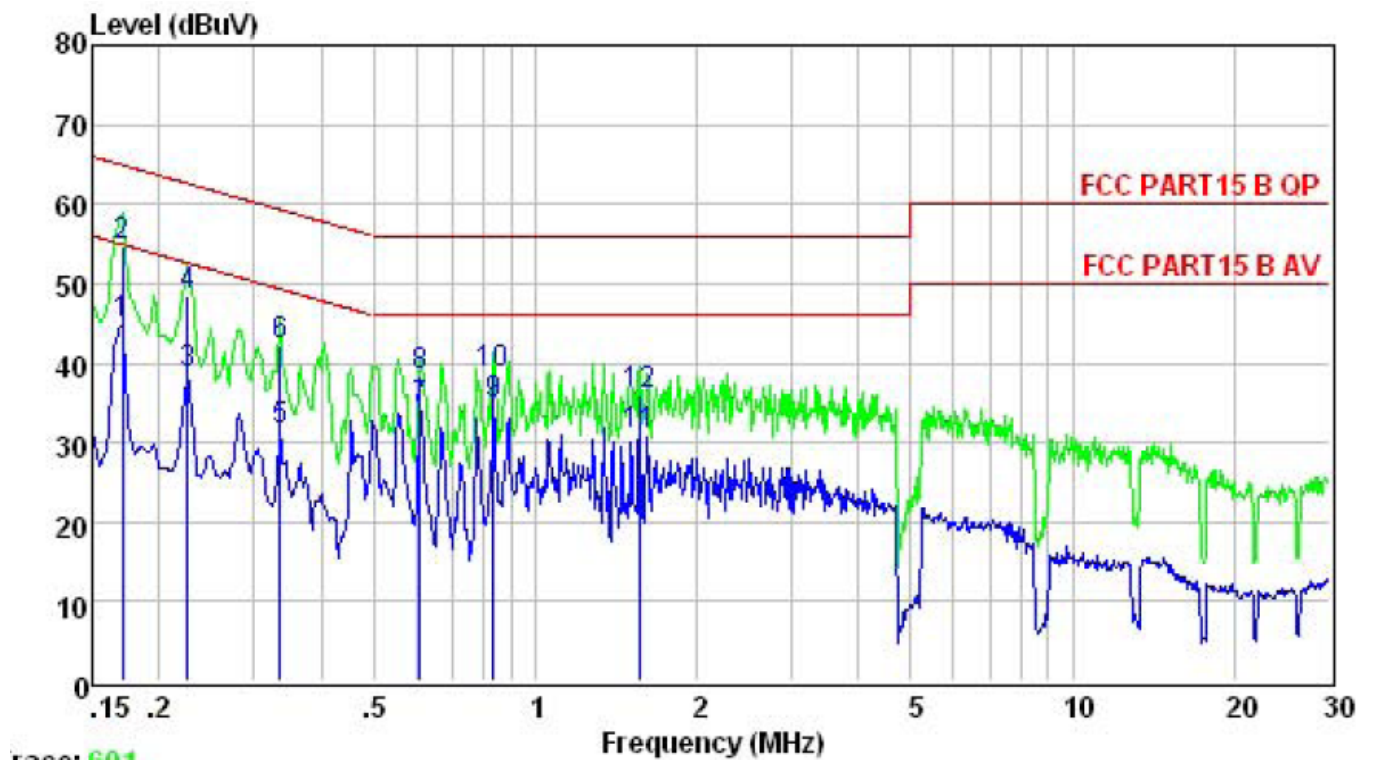


Remark:
E.U.T: Equipment Under Test
LISN: Line Impedance Stabilization Network
Test table height=0.8m

5.1.3. Test Mode

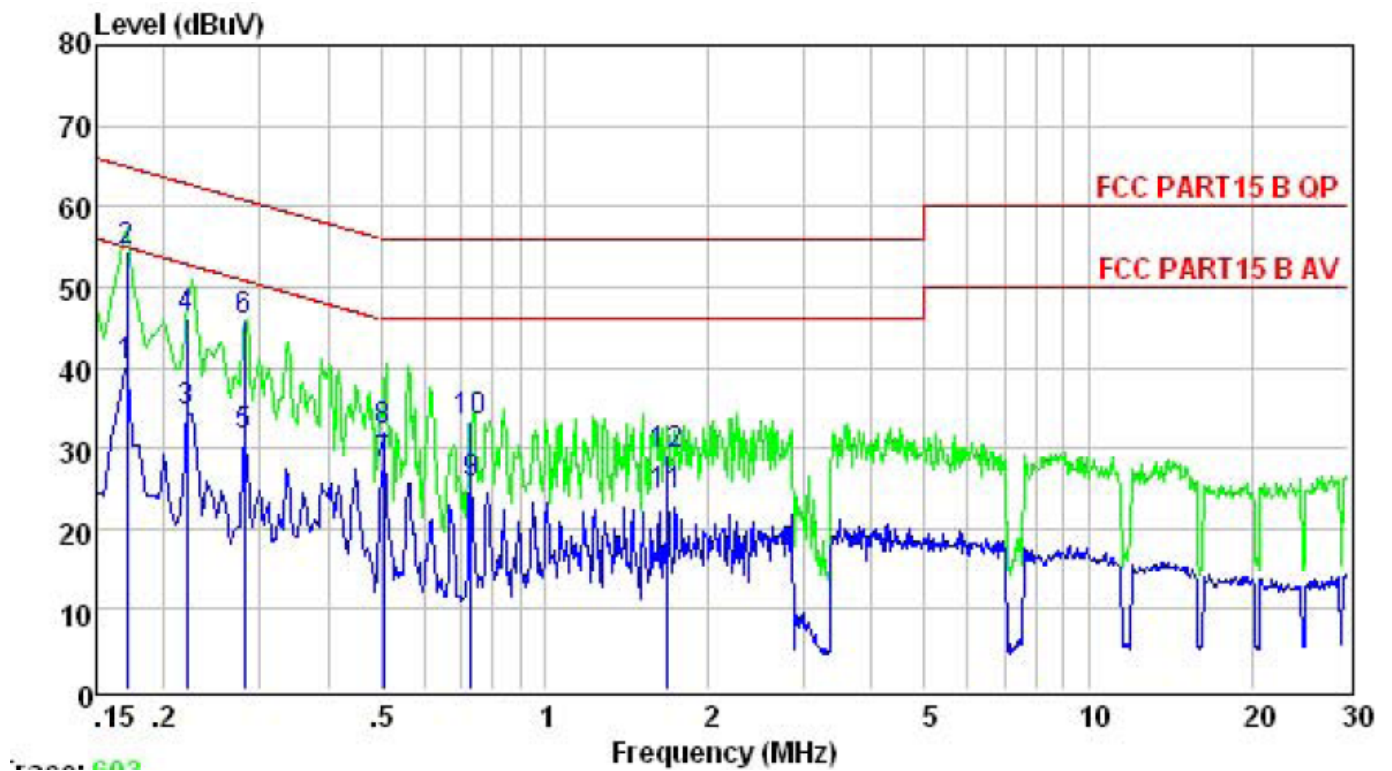
Set EUT in TX mode.

Line



	Freq	Level	Limit	Over	Remark
	MHz	dBuV	dBuV	dB	
1	0.170	45.05	54.94	-9.89	Average
2	0.170	54.60	64.94	-10.34	QP
3	0.226	38.70	52.61	-13.91	Average
4	0.226	48.60	62.61	-14.01	QP
5	0.336	31.60	49.31	-17.71	Average
6	0.336	42.10	59.31	-17.21	QP
7	0.611	34.17	46.00	-11.83	Average
8	0.611	38.30	56.00	-17.70	QP
9	0.835	34.73	46.00	-11.27	Average
10	0.835	38.60	56.00	-17.40	QP
11	1.560	30.92	46.00	-15.08	Average
12	1.560	35.90	56.00	-20.10	QP

Neutral



	Freq	Level	Limit	Over	Remark
	MHz	dBuV	Line	Limit	
			dBuV	dB	
1	0.170	40.28	54.94	-14.66	Average
2	0.170	54.30	64.94	-10.64	QP
3	0.220	34.46	52.83	-18.37	Average
4	0.220	45.98	62.83	-16.85	QP
5	0.280	31.42	50.81	-19.39	Average
6	0.280	45.67	60.81	-15.14	QP
7	0.505	27.89	46.00	-18.11	Average
8	0.505	32.12	56.00	-23.88	QP
9	0.731	25.43	46.00	-20.57	Average
10	0.731	33.24	56.00	-22.76	QP
11	1.680	24.11	46.00	-21.89	Average
12	1.680	29.25	56.00	-26.75	QP

5.2. Radiated Emission Test

5.2.1. Limit 15.209 limits

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		$\mu\text{V/m}$	$\text{dB}(\mu\text{V})/\text{m}$
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	74.0 $\text{dB}(\mu\text{V})/\text{m}$ (Peak) 54.0 $\text{dB}(\mu\text{V})/\text{m}$ (Average)	

5.2.2. Restricted bands of operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

5.2.3. Test setup

The EUT was placed on a turn table which was 0.8 m above the ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was set 3 m away from the receiving antenna which was mounted on an antenna tower. The measuring antenna moved up and down to find out the maximum emission level. It moved from 1 m to 4 m for both horizontal and vertical polarizations.

The EUT was tested in the Chamber Site. It was pre-scanned with a Peak detector from the spectrum, and all the final readings from the test receiver were measured with the Quasi-Peak detector.

The bandwidth of the EMI test receiver is set at 120kHz for frequency range from 30MHz to 1000 MHz.

The bandwidth of the Spectrum's VBW is set at 3MHz and RBW is set at 1MHz for peak emissions measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emissions measure above 1GHz.

The frequency range from 30MHz to 10th harmonic (25GHz) are checked. and no any emissions were found from 18GHz to 25 GHz, So the radiated emissions from 18GHz to 25GHz were not record.

Notes: 1. Emission Level = Antenna Factor + Cable Loss + Meter Reading-Preamp Factor.

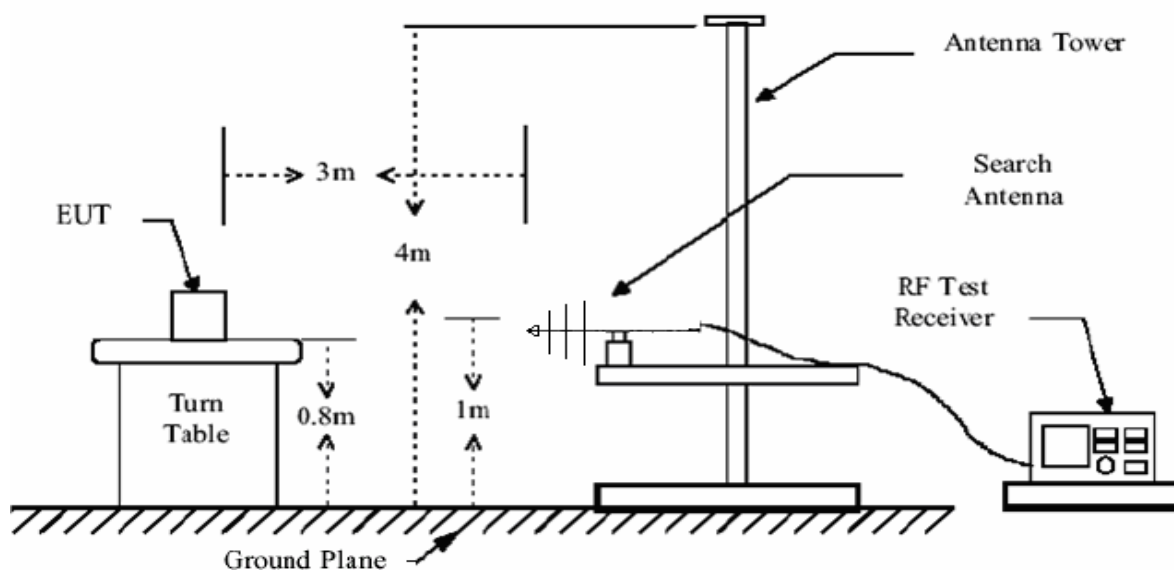
2. Measurement Uncertainty: ± 3.2 dB at a level of confidence of 95%.

3. For emissions above 1GHz, if peak level comply with average limit, then the average level is deemed to comply with average limit.

4. For emissions below 1GHz, pretest for all mode, The test data of the worst case condition(s) was reported on the following pages.

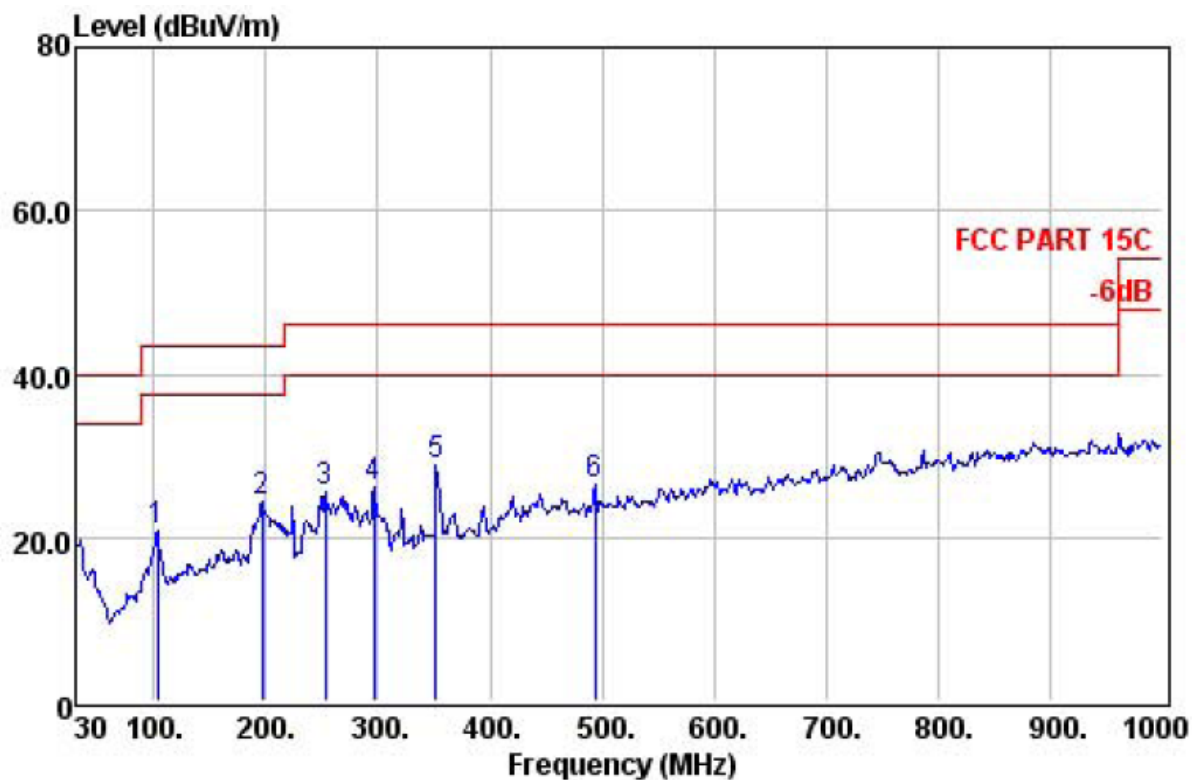
5: During the test, pre-scan the GFSK, Pi/4DQPSK, 8DPSK modulation, and found the GFSK modulation which it is worse case.

6:Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.



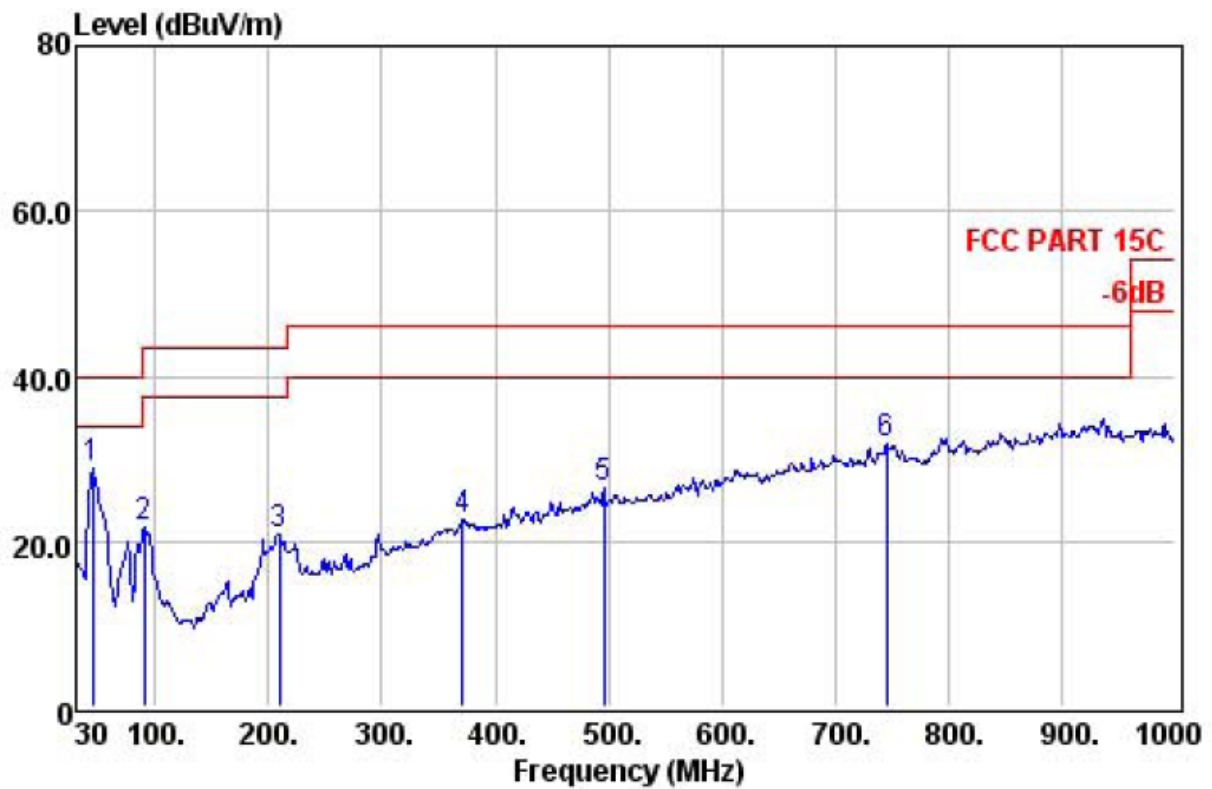
Below 1GHz

BT Mode Horizontal polarizations



	Preamp Freq	Factor	Read Level	CableAntenna Loss	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	102.75	31.35	41.75	1.03	9.52	20.95	43.50	-22.55	QP
2	196.84	31.11	43.22	1.46	10.72	24.29	43.50	-19.21	QP
3	253.10	30.97	41.87	1.70	12.91	25.51	46.00	-20.49	QP
4	296.75	30.93	41.62	1.87	13.70	26.26	46.00	-19.74	QP
5	352.04	30.66	41.66	2.10	15.67	28.77	46.00	-17.23	QP
6	493.66	30.59	35.72	2.77	18.60	26.50	46.00	-19.50	QP

BT Mode Vertical polarizations



	Preamp Freq	Factor	Read Level	CableAntenna Loss	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	44.55	31.40	48.64	0.56	11.03	28.83	40.00	-11.17	QP
2	90.14	31.35	43.13	0.94	9.11	21.83	43.50	-21.67	QP
3	209.45	31.08	38.99	1.53	11.45	20.89	43.50	-22.61	QP
4	371.44	30.62	34.92	2.27	16.17	22.74	46.00	-23.26	QP
5	495.60	30.59	35.54	2.77	18.63	26.35	46.00	-19.65	QP
6	745.86	30.67	35.61	4.04	22.77	31.75	46.00	-14.25	QP

Above 1GHz

GFSK 2402MHz Horizontal polarizations

	Freq	Preamp Factor	Read Level	CableAntenna Loss	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4804.00	27.49	32.11	11.96	32.94	49.52	74.00	-24.48	Peak
2	6967.00	27.89	18.41	16.60	37.11	44.23	74.00	-29.77	Peak
3	8599.00	28.28	15.56	16.79	36.92	40.99	74.00	-33.01	Peak
4	10588.00	28.86	14.96	17.08	39.25	42.43	74.00	-31.57	Peak
5	12679.00	29.14	13.40	17.94	39.94	42.14	74.00	-31.86	Peak
6	15535.00	29.63	9.89	20.34	38.53	39.13	74.00	-34.87	Peak

GFSK 2402MHz Vertical polarizations

	Freq	Preamp Factor	Read Level	CableAntenna Loss	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4804.00	27.49	31.96	11.96	32.94	49.37	74.00	-24.63	Peak
2	7307.00	27.96	14.74	16.61	37.32	40.71	74.00	-33.29	Peak
3	8973.00	28.39	16.72	16.87	37.36	42.56	74.00	-31.44	Peak
4	11081.00	28.91	13.36	17.18	39.57	41.20	74.00	-32.80	Peak
5	13291.00	29.26	11.00	18.54	42.05	42.33	74.00	-31.67	Peak
6	15688.00	29.65	13.11	20.43	39.12	43.01	74.00	-30.99	Peak

GFSK 2441MHz Horizontal polarizations

	Freq	Preamp Factor	Read Level	CableAntenna Loss	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4882.00	27.53	31.57	12.14	33.11	49.29	74.00	-24.71	Peak
2	7035.00	27.91	16.33	16.60	37.21	42.23	74.00	-31.77	Peak
3	8667.00	28.30	16.12	16.81	37.00	41.63	74.00	-32.37	Peak
4	10078.00	28.81	16.78	16.98	38.53	43.48	74.00	-30.52	Peak
5	11880.00	28.99	16.13	17.34	39.52	44.00	74.00	-30.00	Peak
6	13393.00	29.28	13.37	18.67	42.52	45.28	74.00	-28.72	Peak

GFSK 2441MHz Vertical polarizations

	Freq	Preamp Factor	Read Level	CableAntenna Loss	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4882.00	27.53	31.65	12.14	33.11	49.37	74.00	-24.63	Peak
2	6967.00	27.89	14.53	16.60	37.11	40.35	74.00	-33.65	Peak
3	9517.00	28.61	18.65	16.92	38.01	44.97	74.00	-29.03	Peak
4	12067.00	29.01	16.00	17.43	39.41	43.83	74.00	-30.17	Peak
5	14430.00	29.46	14.25	19.63	41.00	45.42	74.00	-28.58	Peak
6	15348.00	29.60	18.04	20.23	38.43	47.10	74.00	-26.90	Peak

GFSK 2480MHz Horizontal polarizations

	Freq	Preamp Factor	Read Level	CableAntenna Loss	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4960.00	27.58	31.07	12.36	33.32	49.17	74.00	-24.83	Peak
2	6780.00	27.86	14.14	16.60	36.62	39.50	74.00	-34.50	Peak
3	8735.00	28.32	14.67	16.82	37.08	40.25	74.00	-33.75	Peak
4	11761.00	28.98	12.86	17.32	39.64	40.84	74.00	-33.16	Peak
5	13971.00	29.39	8.53	19.33	43.47	41.94	74.00	-32.06	Peak
6	16113.00	29.75	12.85	20.71	41.02	44.83	74.00	-29.17	Peak

GFSK 2480MHz Vertical polarizations

	Freq	Preamp Factor	Read Level	CableAntenna Loss	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	4960.00	27.58	31.53	12.36	33.32	49.63	74.00	-24.37	Peak
2	7477.00	27.99	17.52	16.63	37.39	43.55	74.00	-30.45	Peak
3	9007.00	28.40	14.83	16.88	37.40	40.71	74.00	-33.29	Peak
4	10622.00	28.86	14.82	17.09	39.27	42.32	74.00	-31.68	Peak
5	13359.00	29.27	10.44	18.63	42.37	42.17	74.00	-31.83	Peak
6	14974.00	29.55	13.77	19.99	38.64	42.85	74.00	-31.15	Peak

6. 20DB OCCUPY BANDWIDTH

6.1. Limits

According to FCC Section 15.247(a)(1), the 20dB bandtidth is known as the 99% emission bandwidth, or 20dB bandwidth($10 \cdot \log 1\% = 20\text{dB}$)taking the RF output power

6.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

2. Set the spectrum analyzer:

Span: approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel

RBW $\geq 1\%$ of the 20dB bandwidth

VBW \geq RBW

Sweep=auto

Detector function=peak

Trace=max hold

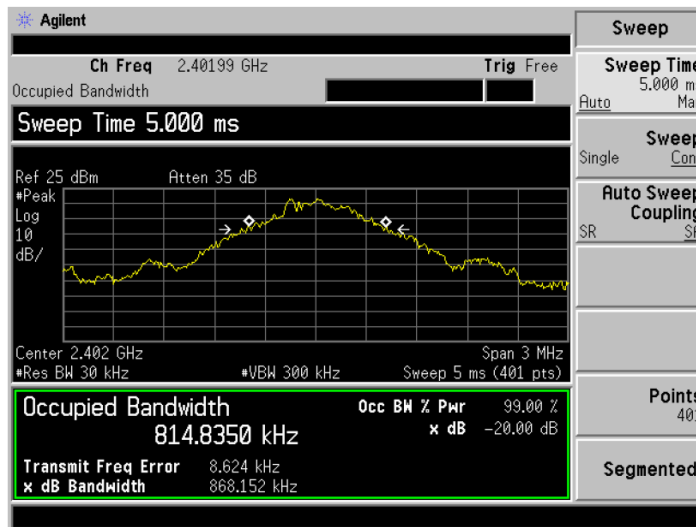
Test data:

	Channel Frequency (MHz)	20dB Bandwidth (MHz)
GFSK	2402	0.868
	2441	0.845
	2480	0.845
Pi/4DQPSK	2402	1.105
	2441	1.136
	2480	1.084
8-DPSK	2402	1.171
	2441	1.155
	2480	1.167

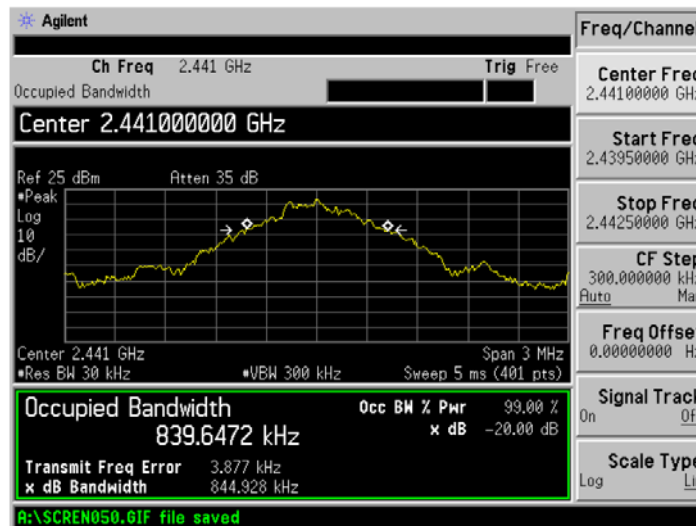
Test plot as follows:

GFSK

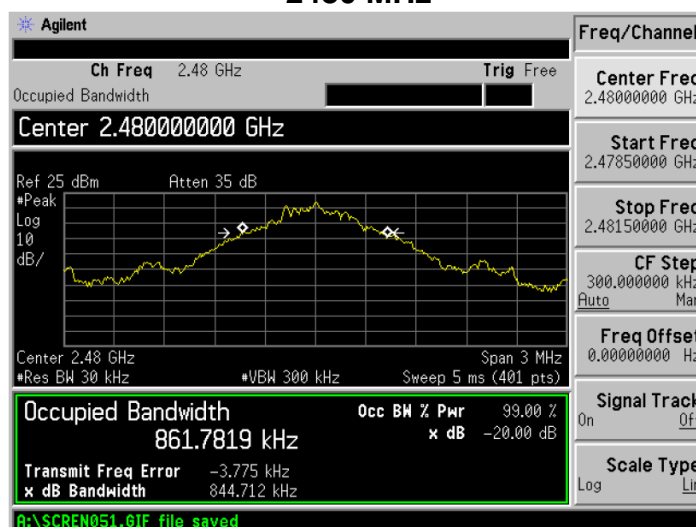
2402MHz



2441 MHz

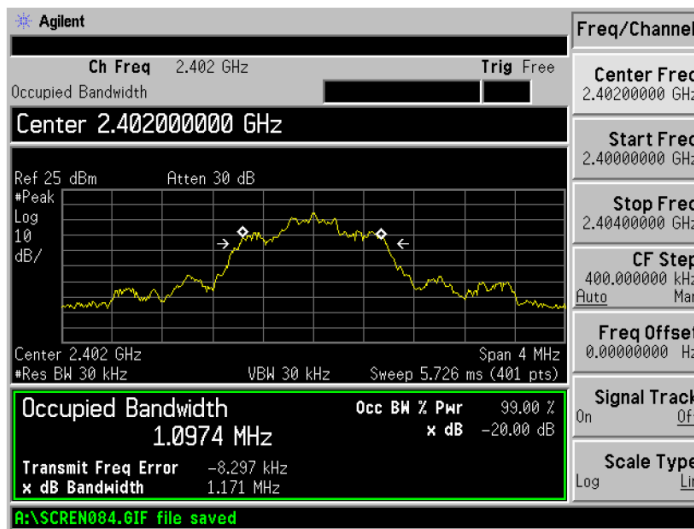


2480 MHz

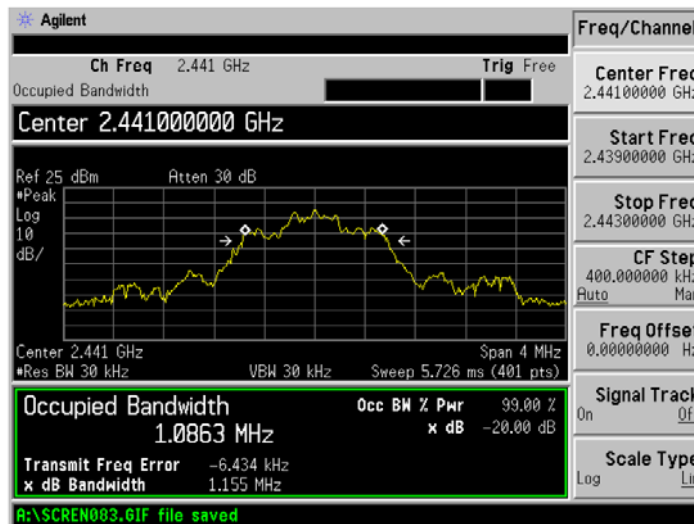


8-DPSK

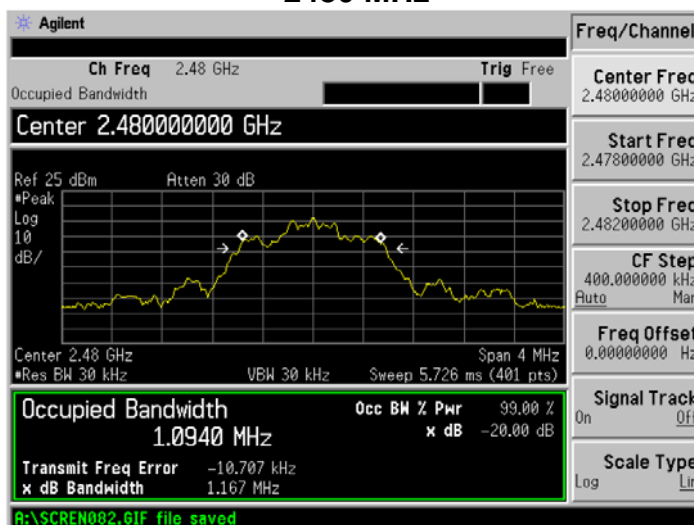
2402 MHz



2441 MHz



2480 MHz



7. FREQUENCY SEPARATION

7.1. Limits

According to FCC Section 15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

7.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

2. Set the spectrum analyzer:

Span: wide enough to capture the peaks of two adjacent channels

RBW $\geq 1\%$ of the span

VBW \geq RBW

Sweep=auto

Detector function=peak

Trace=max hold

Test data:

	Separation (MHz)	Limit (MHz)	Result
GFSK	1.002	868	PASS
Pi/4DQPSK	1.006	757	PASS
8-DPSK	1.002	781	PASS

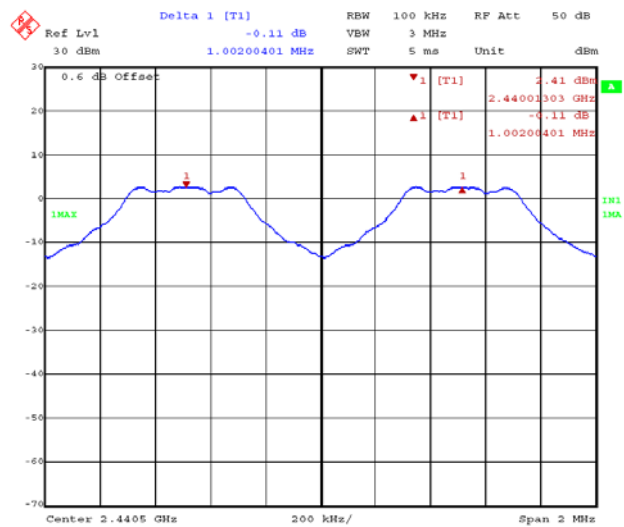
Note: we pretest low, middle, high channel. The middle channel's data record in the report.

Note: Limit according to section 6

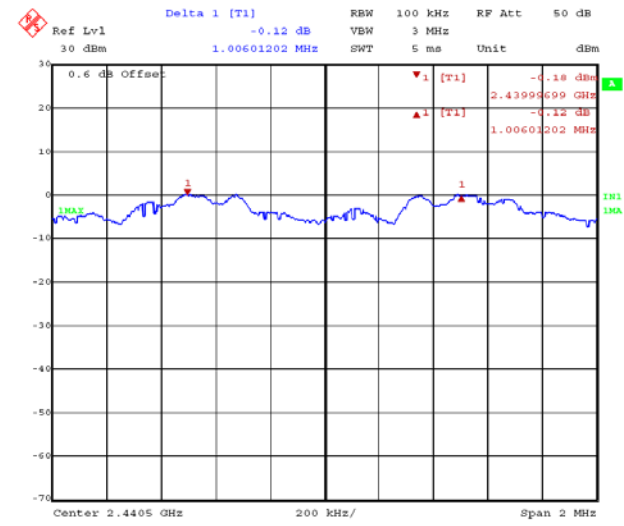
Mode	20dB bandwidth (kHz) (worse case)	Limit (kHz) (Carrier Frequencies Separation)
GFSK	868	868
Pi/4QPSK	1136	757
8DPSK	1171	781

Test plot as follows:

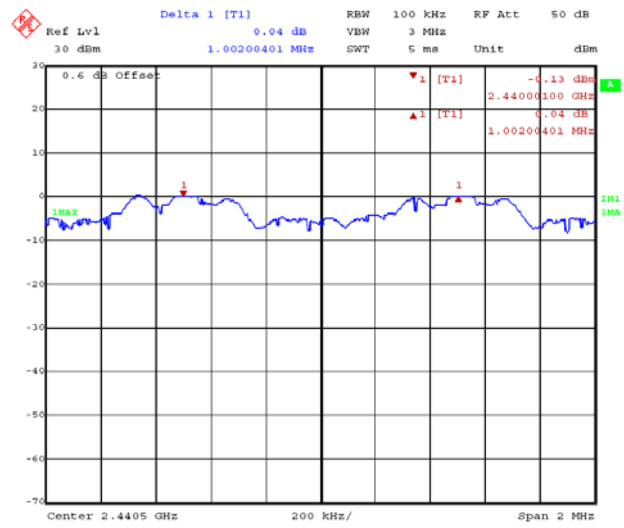
GFSK



Pi/4DQPSK



8-DPSK



8. MAXIMUM PEAK OUTPUT POWER

8.1. Limits

According to FCC Section 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.

8.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the power meter, during the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

Test data:

	Channel Frequency (MHz)	Peak output Power		Limit W	Result
		dBm	W		
GFSK	2402	1.18	0.00132	1.000	Pass
	2441	1.07	0.00128	1.000	Pass
	2480	1.14	0.00130	1.000	Pass
Pi/4DQPSK	2402	1.02	0.00126	0.125	Pass
	2441	0.92	0.00124	0.125	Pass
	2480	0.98	0.00125	0.125	Pass
8-DPSK	2402	1.07	0.00128	0.125	Pass
	2441	0.93	0.00124	0.125	Pass
	2480	0.98	0.00125	0.125	Pass

9. NUMBER OF HOPPING FREQUENCY

9.1. Limits

According to FCC Section 15.247(a)(1)(iii), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

9.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

2. Set the spectrum analyzer:

Span: the frequency band of operation

RBW $\geq 1\%$ of the span

VBW \geq RBW

Sweep=auto

Detector function=peak

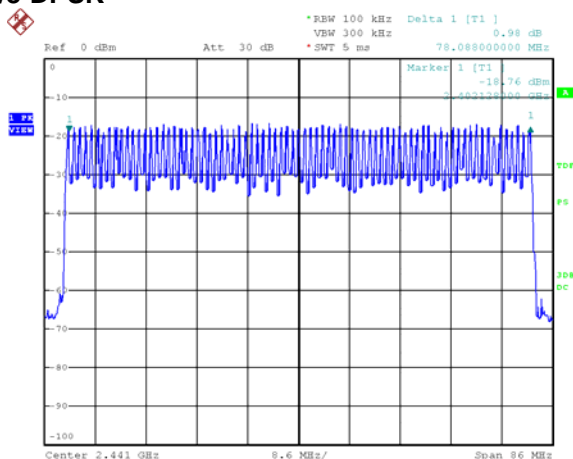
Trace=max hold

Test data:

	Measured channel numbers	Limit	Result
GFSK	79	>15	PASS
Pi/4DQPSK			PASS
8-DPSK			PASS

Test plot as follows:

GFSK/ Pi/4DQPSK/8-DPSK



10.DWELL TIME

10.1. Limits

According to FCC Section 15.247(a)(1)(iii), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

10.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

2. Set the spectrum analyzer:

Span= 0Hz

RBW =100 kHz

VBW = 300 kHz

Sweep=auto

Detector function=peak

Test data:

Frequency	Packet	Dwell time(ms)	Limit(ms)	Result
2402MHz 2441MHz 2480MHz	DH1/2-DH1/3-DH1	117.12	400	Pass
	DH3/2-DH3/3-DH3	259.20	400	Pass
	DH5/2-DH5/3-DH5	307.20	400	Pass

The test period: $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$

Test channel: 2402MHz/2441MHz/2480MHz as blow

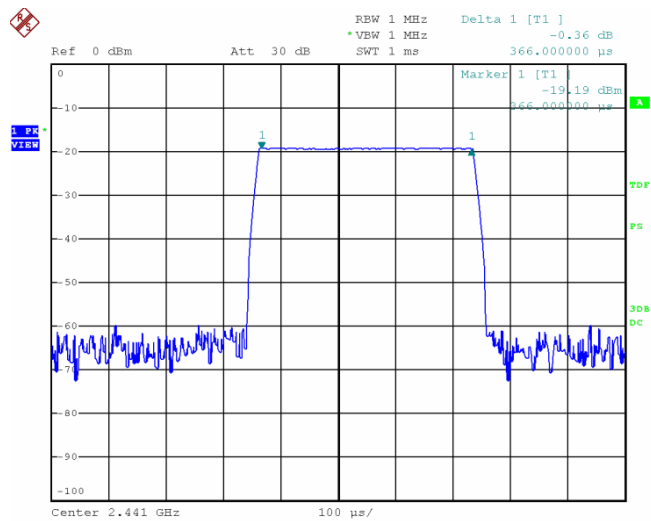
DH1/2-DH1/3-DH1 time slot= $0.366(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 117.12 \text{ ms}$

DH3/2-DH3/3-DH3 time slot= $1.62(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 259.20 \text{ ms}$

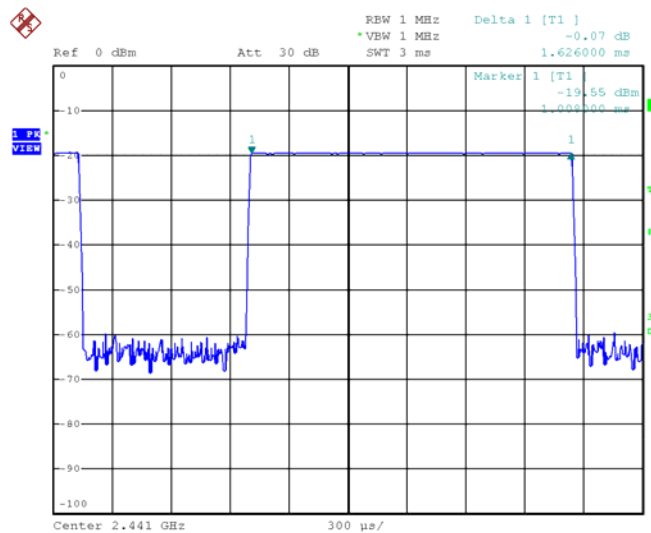
DH5/2-DH5/3-DH5 time slot= $2.88(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 307.20 \text{ ms}$

Test plot as follows:

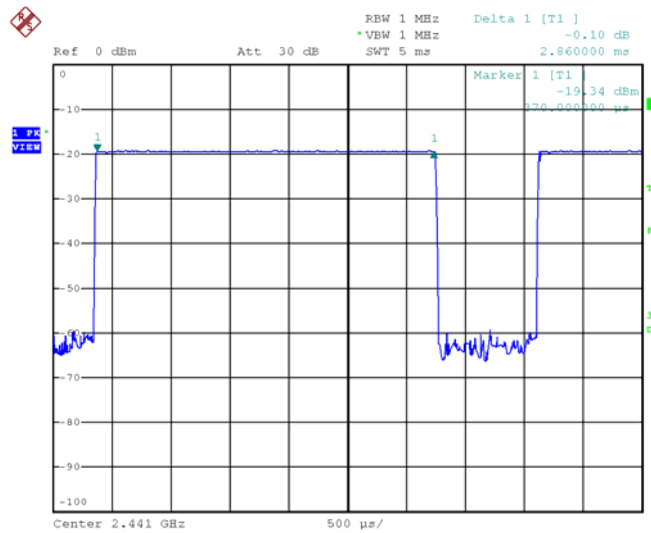
GFSK/ Pi/4DQPSK
DH1/2-DH1



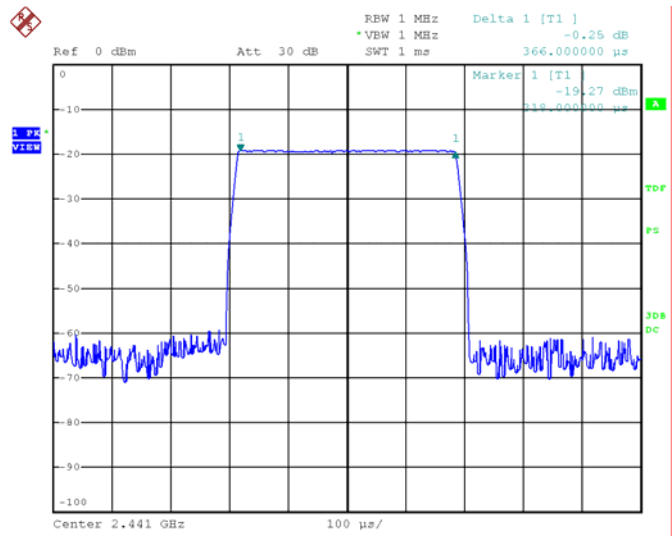
DH3/2-DH3



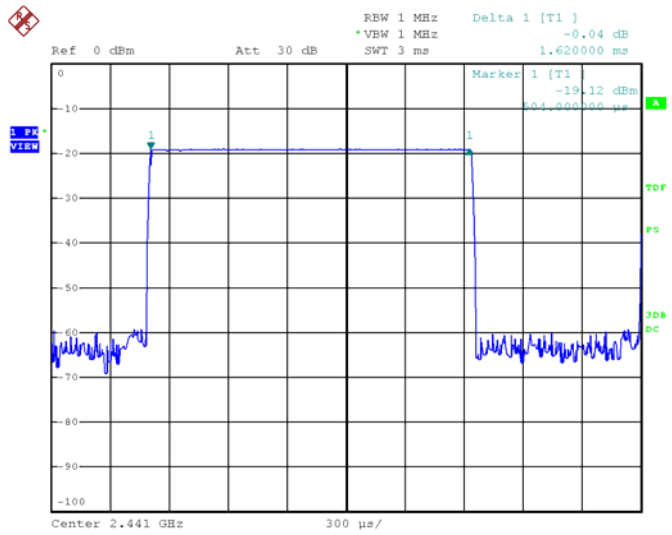
DH5/2-DH5



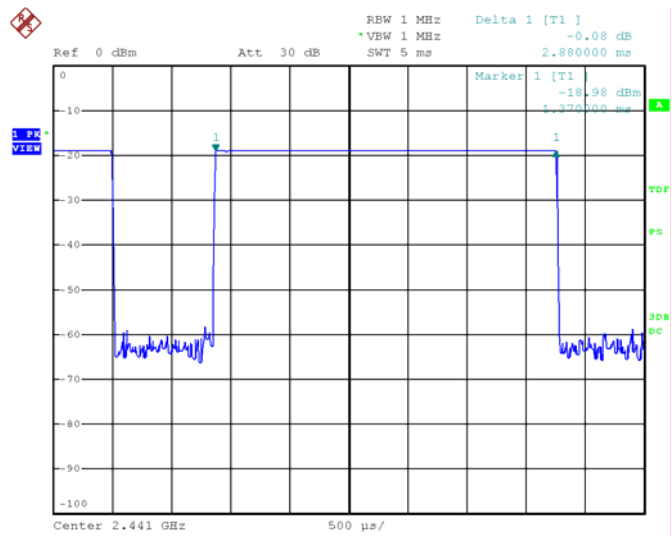
8-DPSK
3-DH1



3-DH3



3-DH5



11. BAND EDGE COMPLIANCE TEST

11.1. Limits

According to FCC Section 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

11.2. Test setup

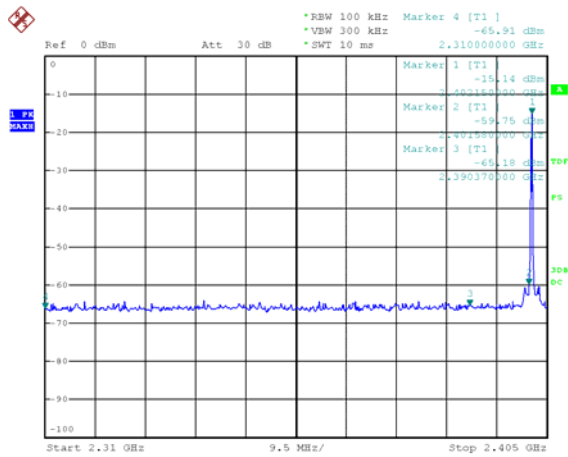
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set to span from the lowest frequency generated in the device up to and including the tenth harmonic of the highest fundamental frequency

The bandwidth of the Spectrum's VBW is set at 3MHz and RBW is set at 1MHz for peak emissions measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emissions measure.

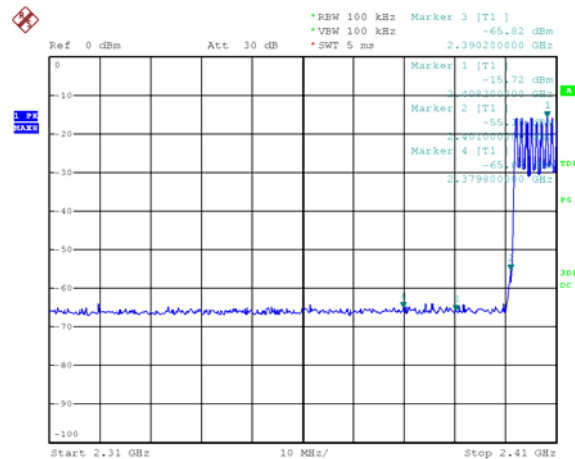
Note: If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.

Test plot as follows:

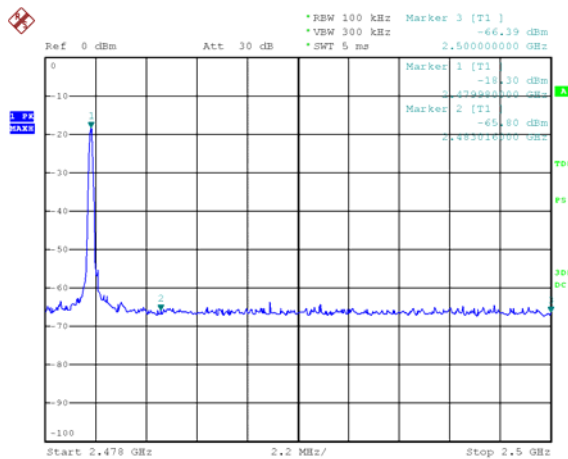
GFSK



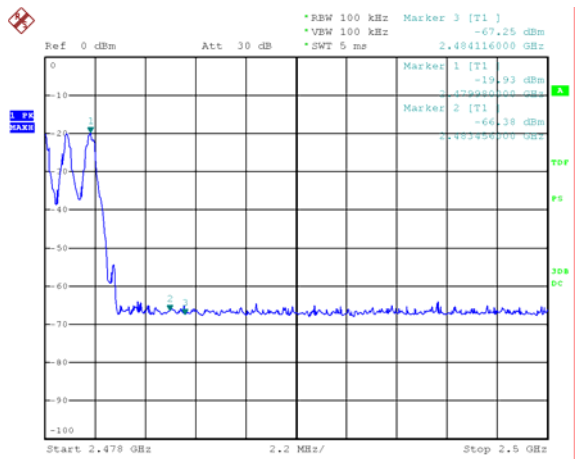
No-hopping mode



Hopping mode

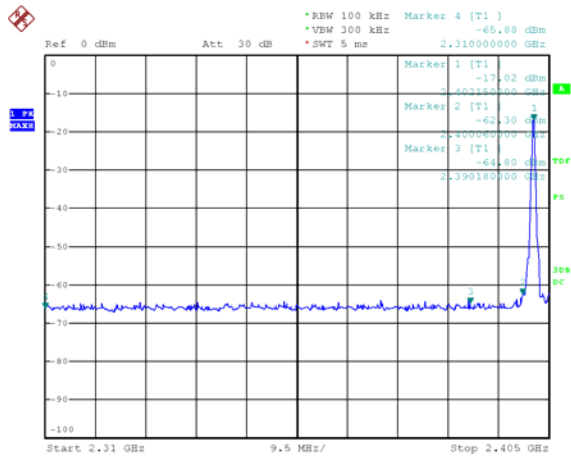


No-hopping mode

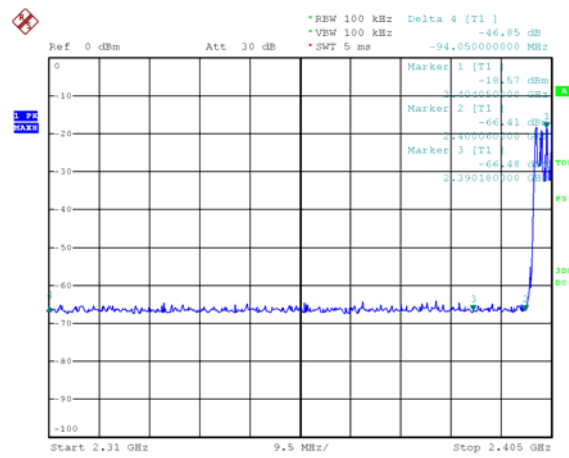


Hopping mode

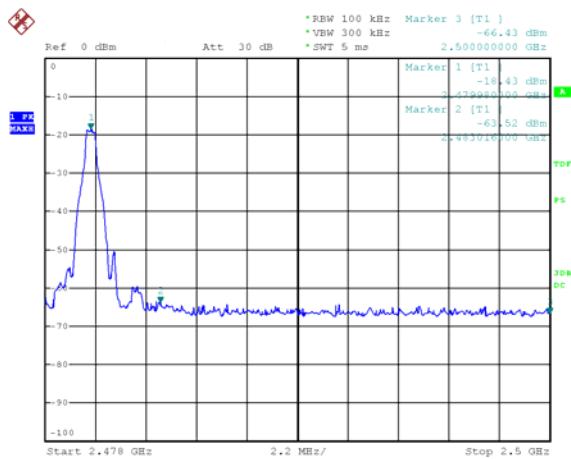
Pi/4DQPSK



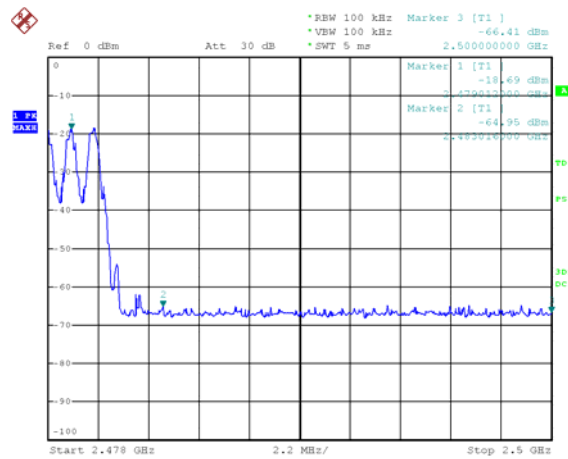
No-hopping mode



Hopping mode

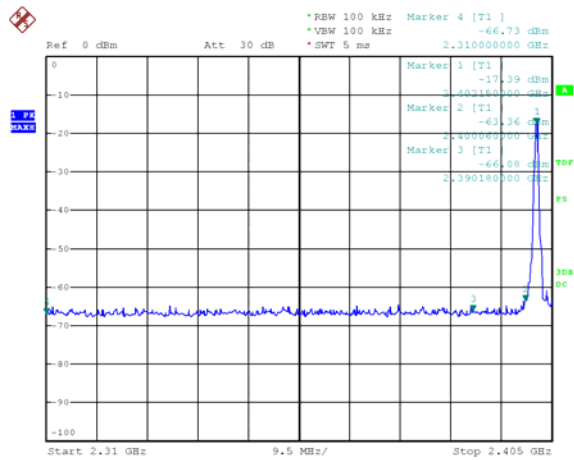


No-hopping mode

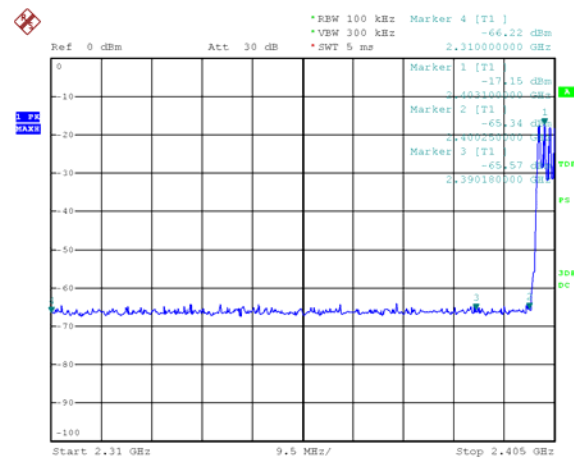


Hopping mode

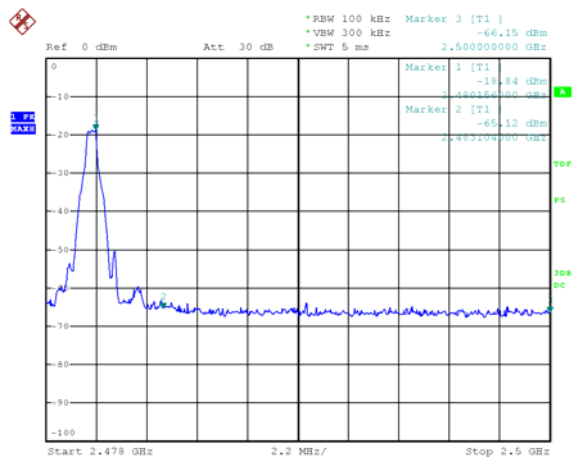
8-DPSK



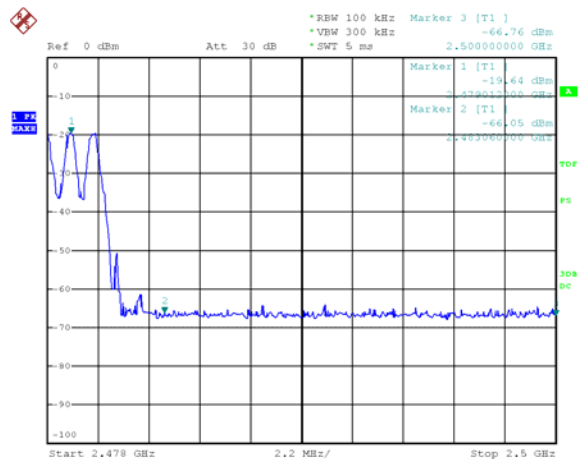
No-hopping mode



Hopping mode



No-hopping mode



Hopping mode

For radiated test as follows:

	Frequency (MHz)	Antenna polarization (H/V)	Emission (dBuV/m)	Band edge Limit (dBuV/m)		Result
			PK	PK	AV	
GFSK	<2400	H	46.02	74.00	54.00	Pass
	<2400	V	45.31	74.00	54.00	Pass
	>2483.5	H	45.29	74.00	54.00	Pass
	>2483.5	V	45.06	74.00	54.00	Pass
Pi/4DQPSK	<2400	H	44.87	74.00	54.00	Pass
	<2400	V	44.19	74.00	54.00	Pass
	>2483.5	H	43.61	74.00	54.00	Pass
	>2483.5	V	43.91	74.00	54.00	Pass
8-DPSK	<2400	H	44.27	74.00	54.00	Pass
	<2400	V	44.69	74.00	54.00	Pass
	>2483.5	H	46.08	74.00	54.00	Pass
	>2483.5	V	45.63	74.00	54.00	Pass

If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.

12. ANTENNA REQUIREMENTS

12.1.Limits

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

12.2. Result

The antennas used for this product are integral Antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 0dBi.

13. PHOTOGRAPHS OF TEST SET-UP

Conducted



Radiated



14. PHOTOGRAPHS OF THE EUT

Please see annex.

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