TEST REPORT

1. Applicant

Name : Handheld Group AB

Address : Kinnegatan 17A S-531 33 Lidköping, Sweden

2. Products

Name : Mobile Computer

Model : NAUTIZ X4

Manufacturer : POINTMOBILE CO.,LTD

3. Test Standard : FCC CFR 47 Part 15C, section 15.247 / RSS-210 Issue 8

4. Test Method : ANSI C63.4-2009

5. Test Results : Positive

6. Date of Application : January 16, 2014

7. Date of Issue : June 20, 2014

Tested by

Jong-gon Ban
ICT Infrastructure
Technology Center
Senior Engineer

Approved by

T. S. Song

Tae-Seung Song
ICT Infrastructure
Technology Center
Manager

Korea Testing Laboratory

Test Report revision History

Revision	Date	Comments
00	2014-06-20	Initial Version

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1. Administrative Information

1.1. Applicant (Client)

Company Name	Handheld Group AB
Address	Kinnegatan 17A S-531 33 Lidköping, Sweden
Contact Person	
Name	Jerker Hellstrom
E-mail	j.hellstrom@handheldgroup.com
Phone	+46(0)510-54 7170

1.2. Manufacturer Data (only if different from Appicant)

Company Name	POINTMOBILE CO.,LTD
Address	Gasan-dong, B-9F Kabul Great Valley 32, Digital-ro9-gil, Geumcheon-gu, Seoul, Korea
Contact Person	
Name	Chloe Kim
E-mail	chloe.kim@pointmobile.co.kr
Phone	+82 70 7090 2642

1.3. Testing Laboratory Data

The following list shows all places and laboratories involved for test result generation.

Company Name	Korea Testing Laboratory
Address	723 Haean-ro, Sangnok-Gu, Ansan-Si, Gyeounggi-Do, 426-901 KOREA
Contact Person	
Name	Jong-gon Ban
E-mail	banjg@ktl.re.kr
Phone	+82-31-500-0133
Fax	+82-31-500-0149

2.EUT Information

2.1. General Description of the EUT

The following section lists all specifications of EUT (Equipment Under Test) involved in test. Additionally, KTL has received sufficient documentation from the client and/or manufacturer to perform the tests

General Information		
FCC ID & Model Number		FCC ID: **YY3-14244C**, Model Number: **NAUTIZ X4**
IC Number & Model Number		IC Number: **11695A-14244C**, Model Number: **14244-CDMA**
Antenna Type		Internal Antenna
SKU	NX4-1DCN-0-E	BT, WiFi, CDMA, GPS, Camera, 1D scanner, Numeric Key
Type of Radio transmission		FHSS (GFSK / π/4 DQPSK and 8DPSK)
Frequency Range		2,402 ~ 2,480 MHz
Channel Numbers		79
Antenna Gain		2.2 dBi
Battery options		Li-ion, 3.7 V (4000 mAh)
Date(s) tested		2014.01.16 ~ 2014.06.04

2.2. Maximum Output Power

Modulation	Conducted Output Power (dBm)
GFSK	3.72
π/4 DQPSK	3.60
8DPSK	3.67

Note: According to the measured results to maximum output power, the EUT was tested with GFSK and 8DPSK modulation.

3. SUMMARY OF TEST RESULTS

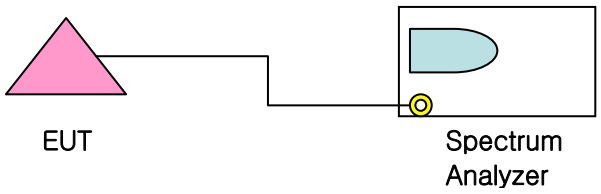
The following table represents the list of measurements required under the FCC CFR47 Part 15.247 & RSS 210.

FCC Rules	IC Rules	Test Items	Results	Remarks
15.247(a)(1)	RSS-210 A8.4(2)	20dB Bandwidth	Pass	-
-	RSS-210 A8.4(2)	99% Bandwidth	Pass	-
15.247(b)(1)	RSS-210 A8.1(a)	Maximum Peak Power	Pass	-
15.247(d)	RSS-210 A8.5	100 KHz Bandwidth of Frequency Band Edges	Pass	-
15.247(a)(1)	RSS-210 A8.1(b)	Hopping channel separation	Pass	-
15.247(b)(iii)	RSS-210 A8.4(2)	Number of hopping channels	Pass	-
15.247(a)(1)(iii)	RSS-210 A8.1(d)	Dwell time	Pass	-
15.205, 15.209, 15.247(d)	RSS-Gen 7.2.2	Radiated Spurious Emissions	Pass	-
15.207	RSS-Gen 7.2.4	AC Line Conducted Emission	Pass	-
-	Gen 4.10	Receiver Spurious Emissions	Pass	

4. Measurement & Results

4.1. 20 dB Bandwidth & 99% Bandwidth

4.1.1. Test Setup Layout



4.1.2. Test Condition & Limit

- Set RBW & VBW of Spectrum analyzer to 10 kHz
- The 20dB bandwidth is defined as the frequency range where the power is higher than the peak power minus 20dB. 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.

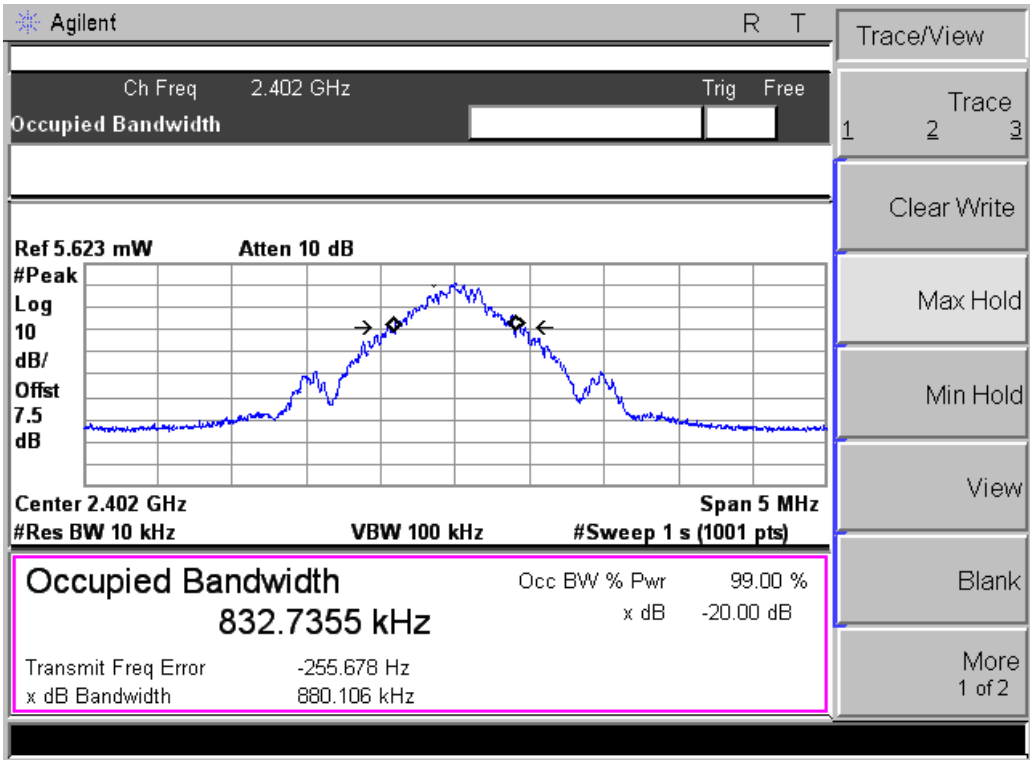
4.1.3. Test result

* Operation Mode: GFSK

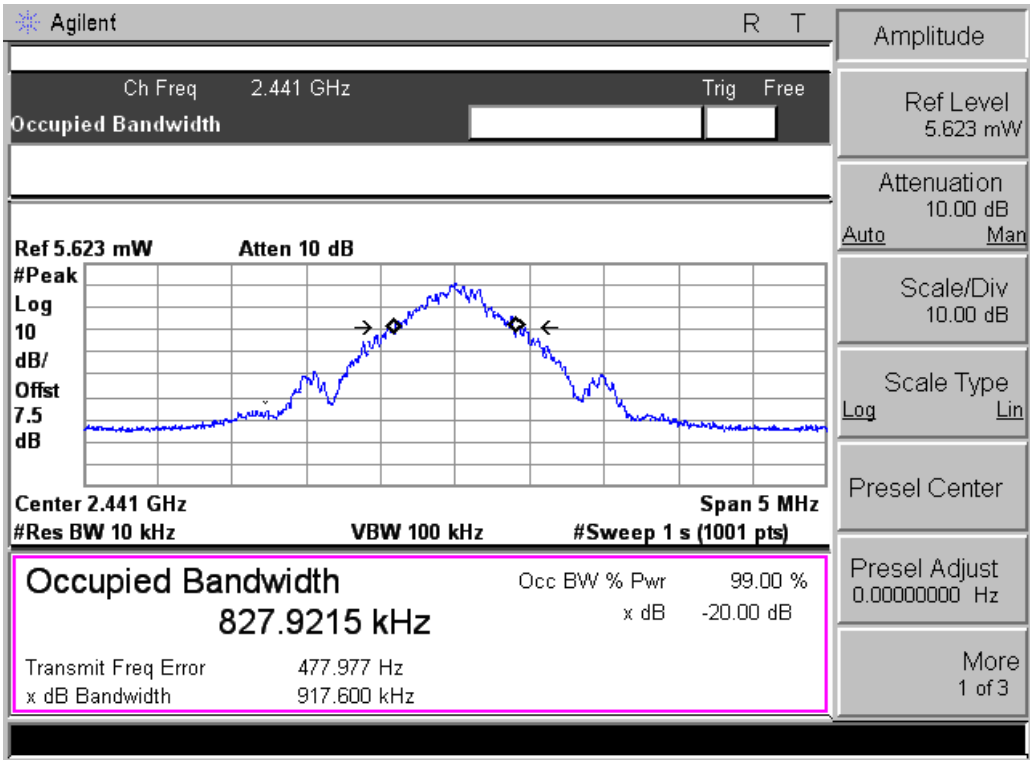
Channels	Frequency (MHz)	20dB Bandwidth Result (MHz)	99% Bandwidth Result (MHz)	Verdict
Low	2402	0.88	0.83	Pass
Middle	2441	0.92	0.83	Pass
High	2480	0.88	0.83	Pass

* Operation Mode : 8DPSK

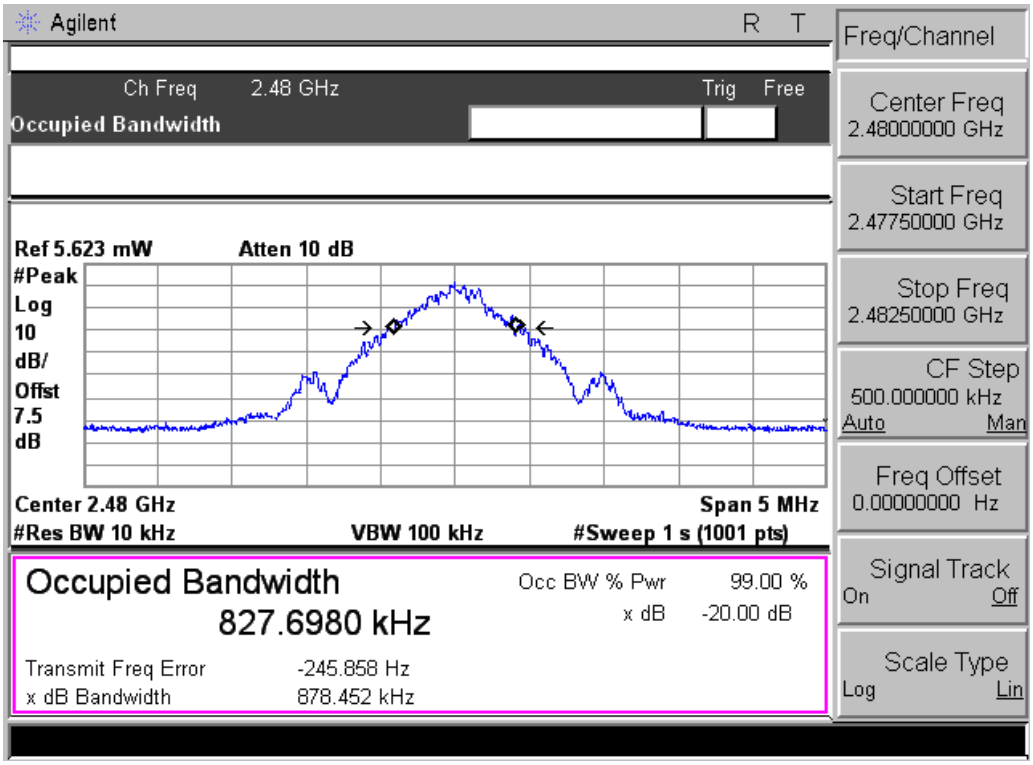
Channels	Frequency (MHz)	20dB Bandwidth Result (MHz)	99% Bandwidth Result (MHz)	Verdict
Low	2402	1.26	1.20	Pass
Middle	2441	1.26	1.20	Pass
High	2480	1.27	1.20	Pass



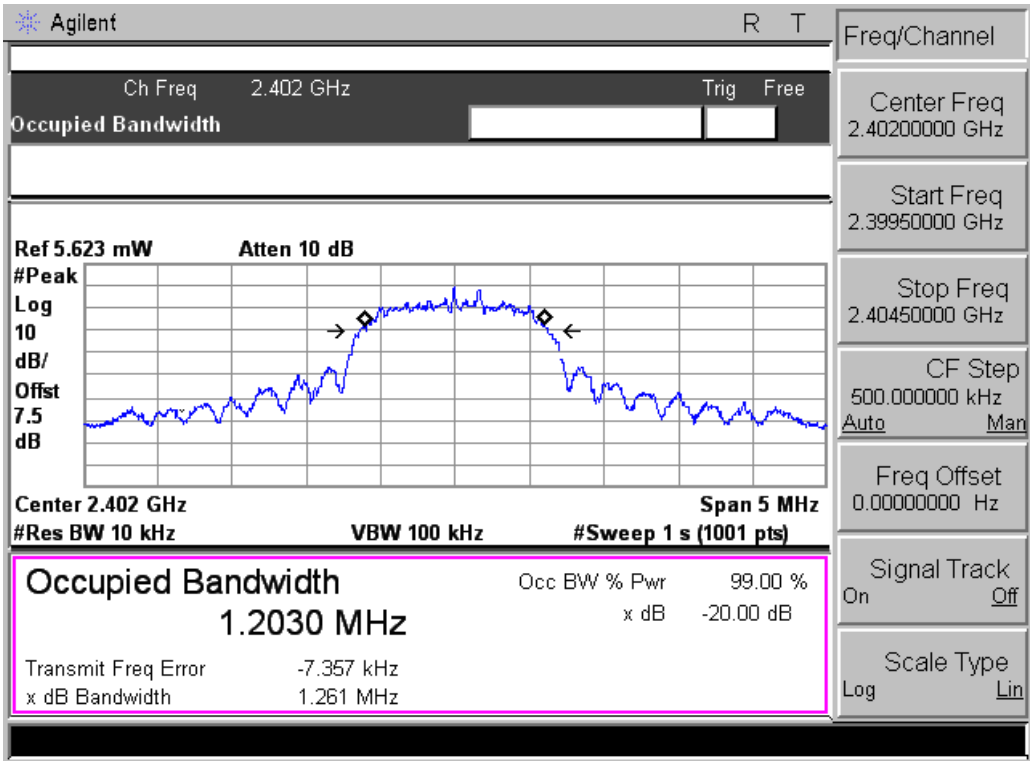
– Low Channel (GFSK) –



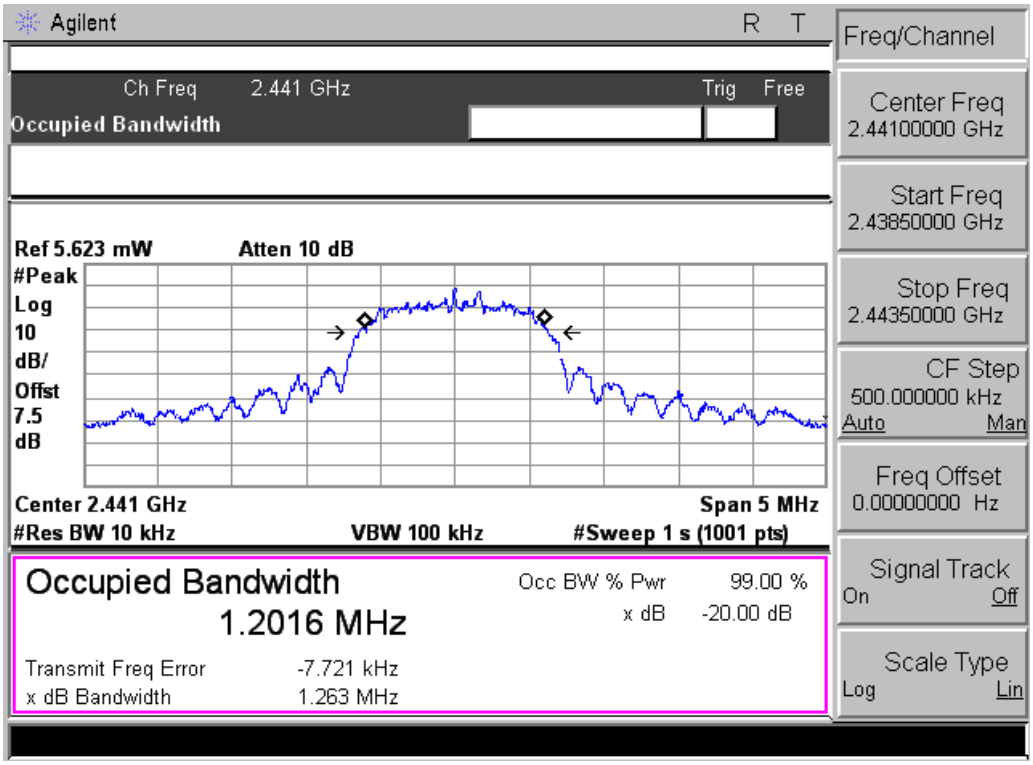
– Mid Channel (GFSK) –



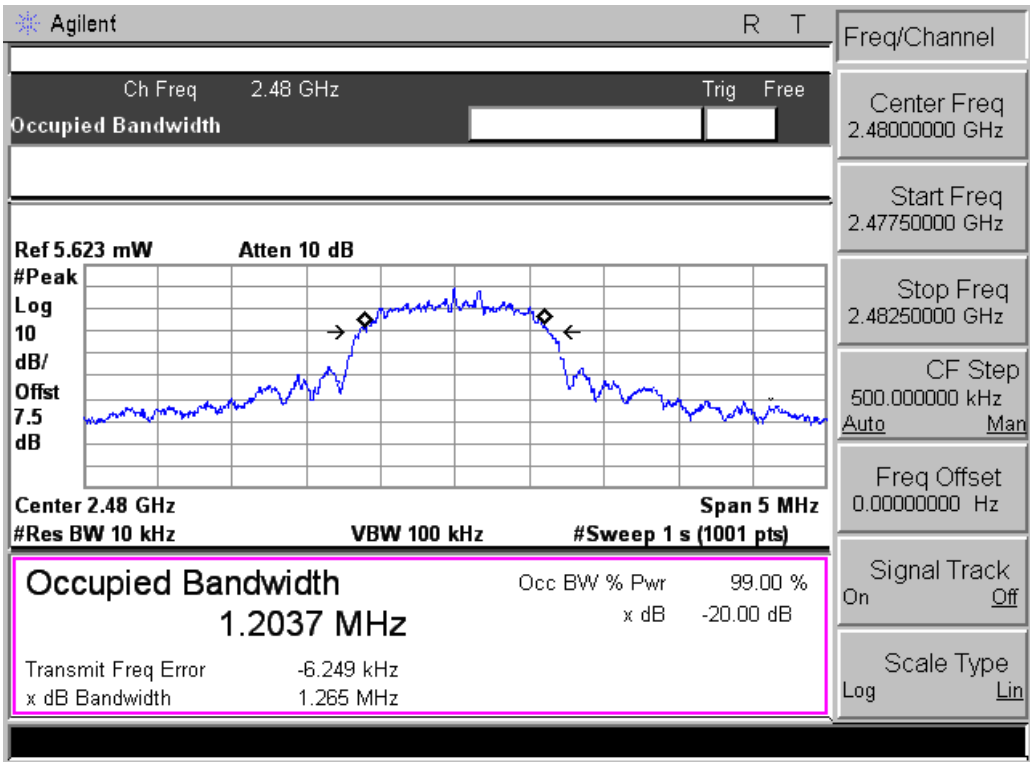
– High Channel (GFSK) –



– Low Channel (8DPSK) –



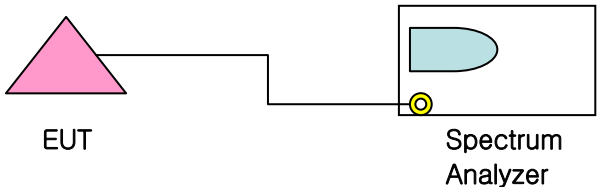
– Mid Channel (8DPSK) –



– High Channel (8DPSK) –

4.2. Maximum Peak Power

4.2.1. Test Setup Layout



4.2.2. Test Condition & Limit

- Set RBW & VBW of Spectrum analyzer to 1 MHz
- The Maximum Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

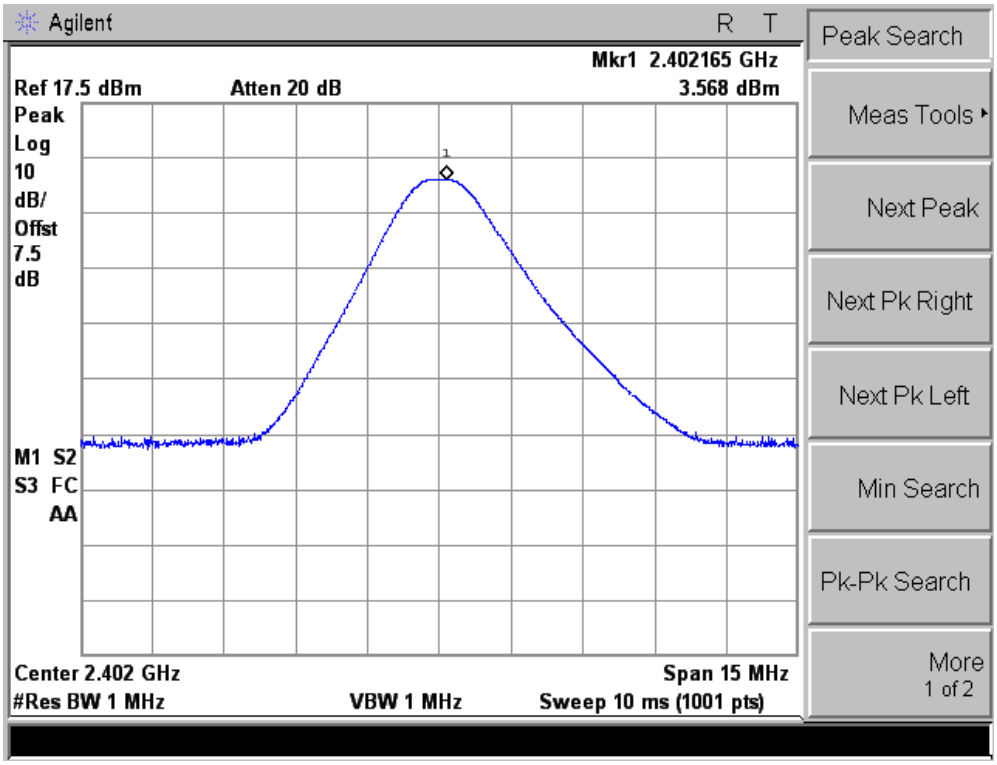
4.2.3. Test result

* Operation Mode: GFSK

Channels	Frequency (MHz)	Result (dBm)	Limit (dBm)	Verdict
0	2402	3.57	30	Pass
39	2441	3.45	30	Pass
78	2480	3.72	30	Pass

* Operation Mode: 8DPSK

Channels	Frequency (MHz)	Result (dBm)	Limit (dBm)	Verdict
0	2402	3.58	30	Pass
39	2441	3.54	30	Pass
78	2480	3.67	30	Pass



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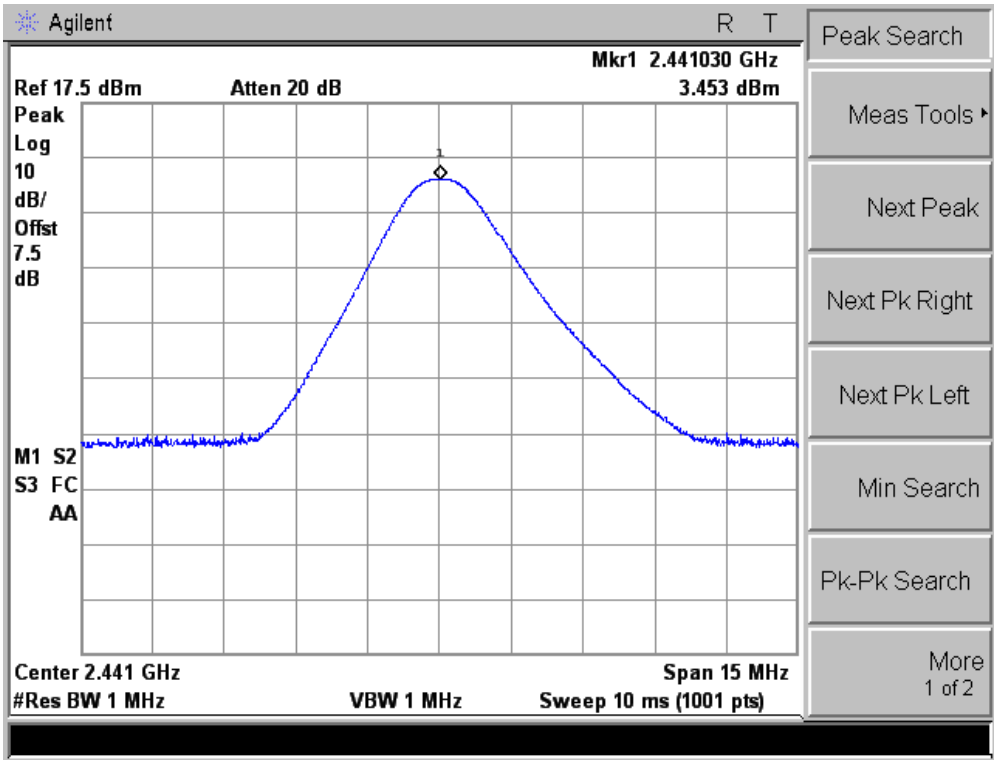

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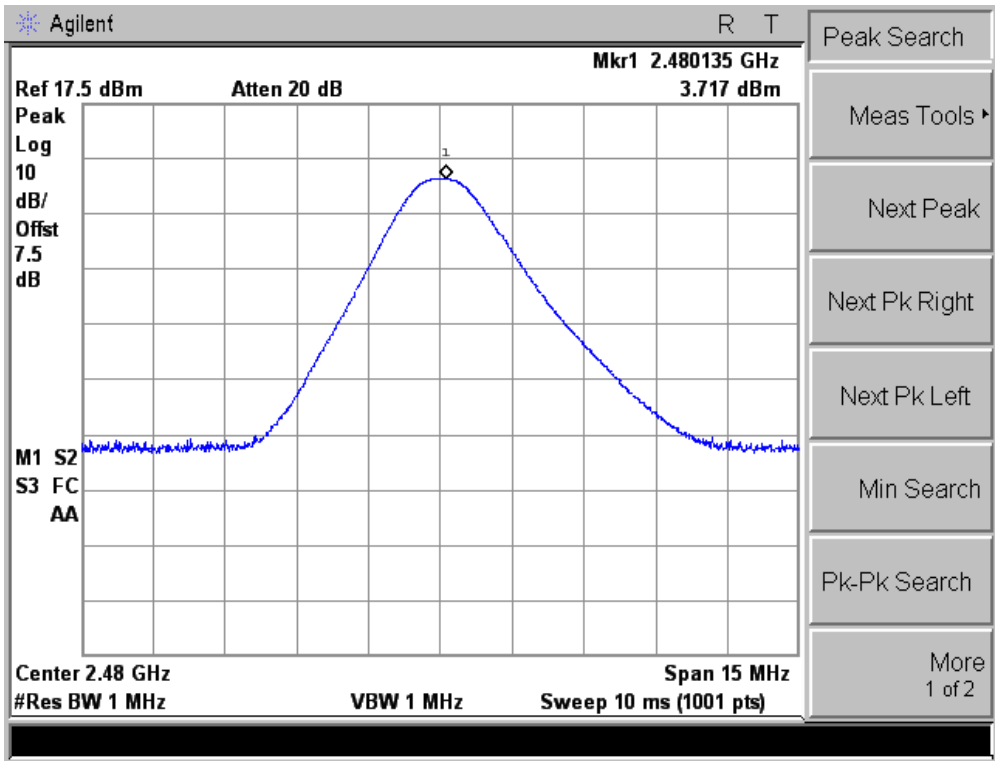
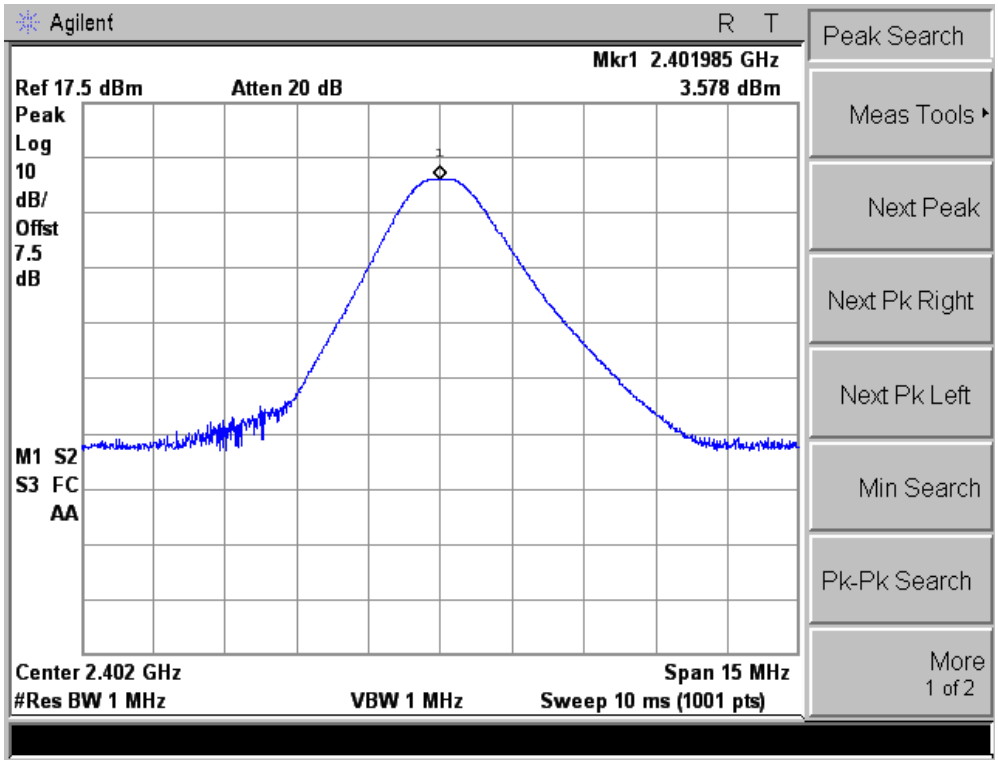
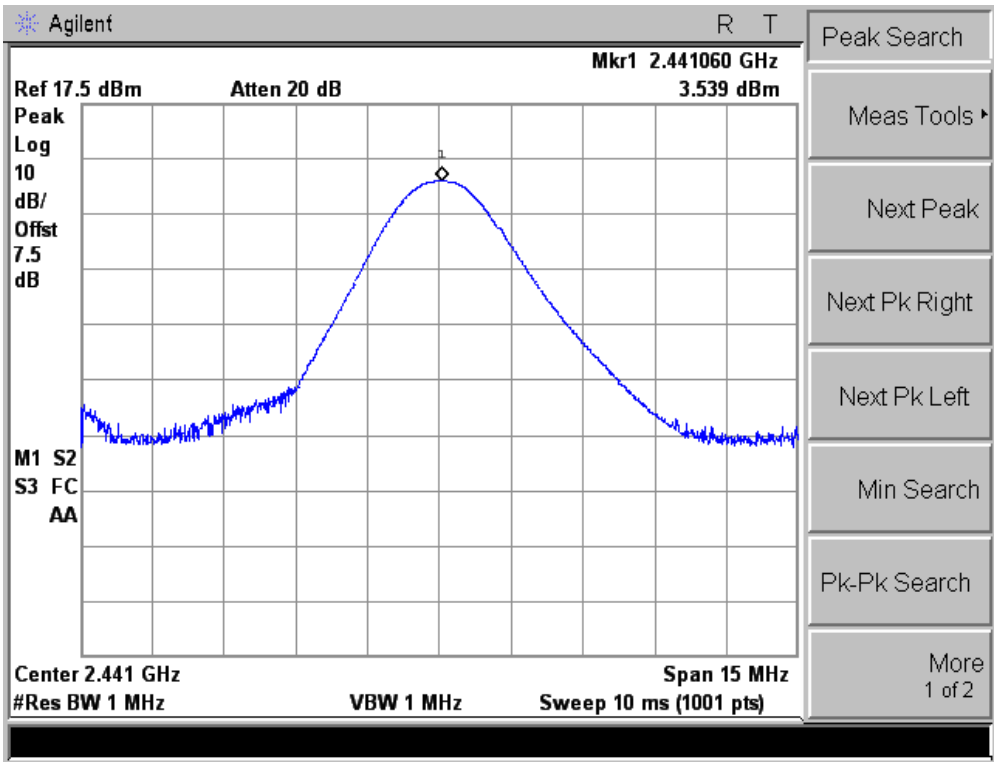


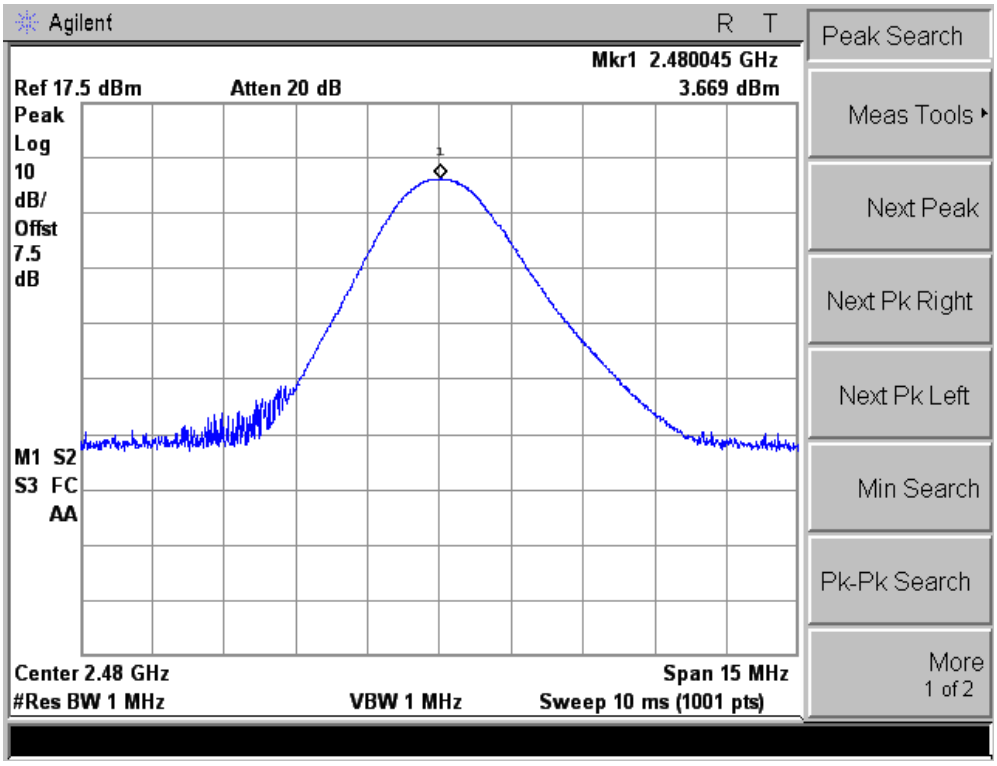
– High Channel (GFSK) –



– Low Channel (8DPSK) –



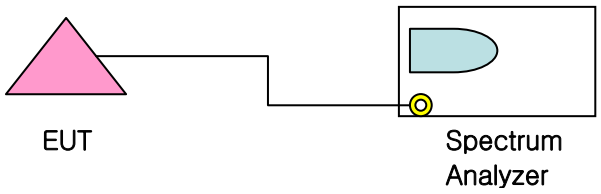
– Mid Channel (8DPSK) –



– High Channel (8DPSK) –

4.3. 100 KHz Bandwidth of Frequency Band Edges

4.3.1. Test Setup Layout



4.3.2. Test Condition & Limit

- Set RBW & VBW of Spectrum analyzer to 100 kHz
- 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.
- The maximum frequency range measuring with the spectrum from 30 MHz to 25 GHz is investigated with the transmitter

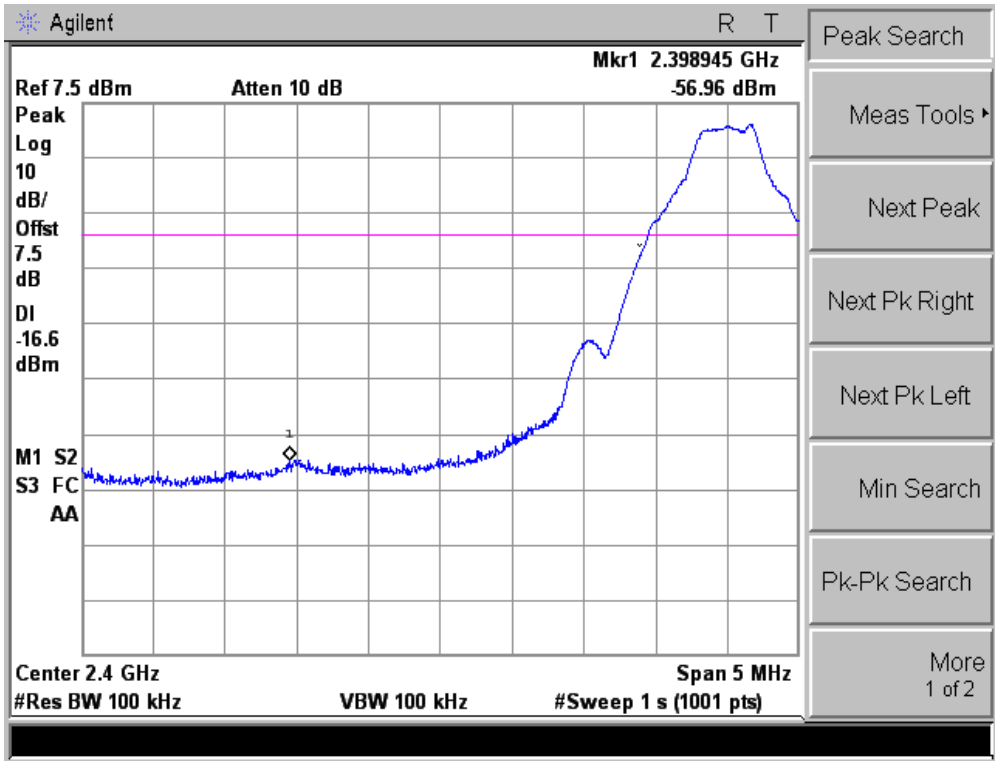
4.3.3. Test result

Operation Mode: Hopping Off

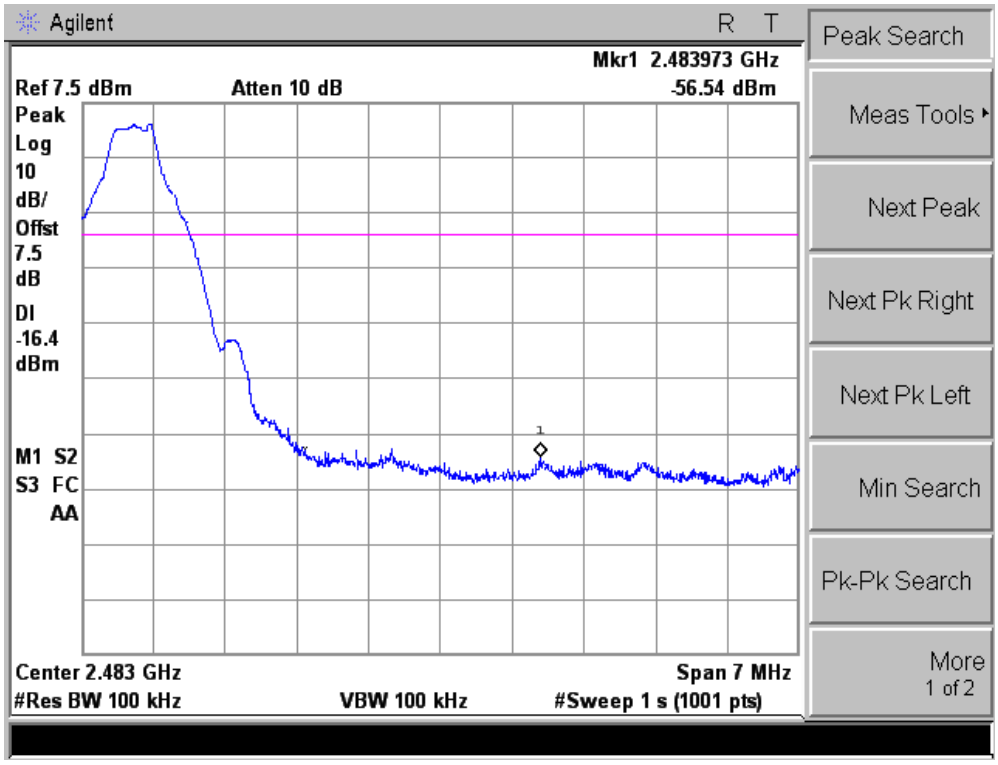
Modulation	Operation Mode		Result (dBc)	Limit (dBc)	Verdict
GFSK	Low	2402	40 >	20	Pass
	High	2480	40 >	20	Pass
8DPSK	Low	2402	40 >	20	Pass
	High	2480	40 >	20	Pass

Operation Mode: Hopping On

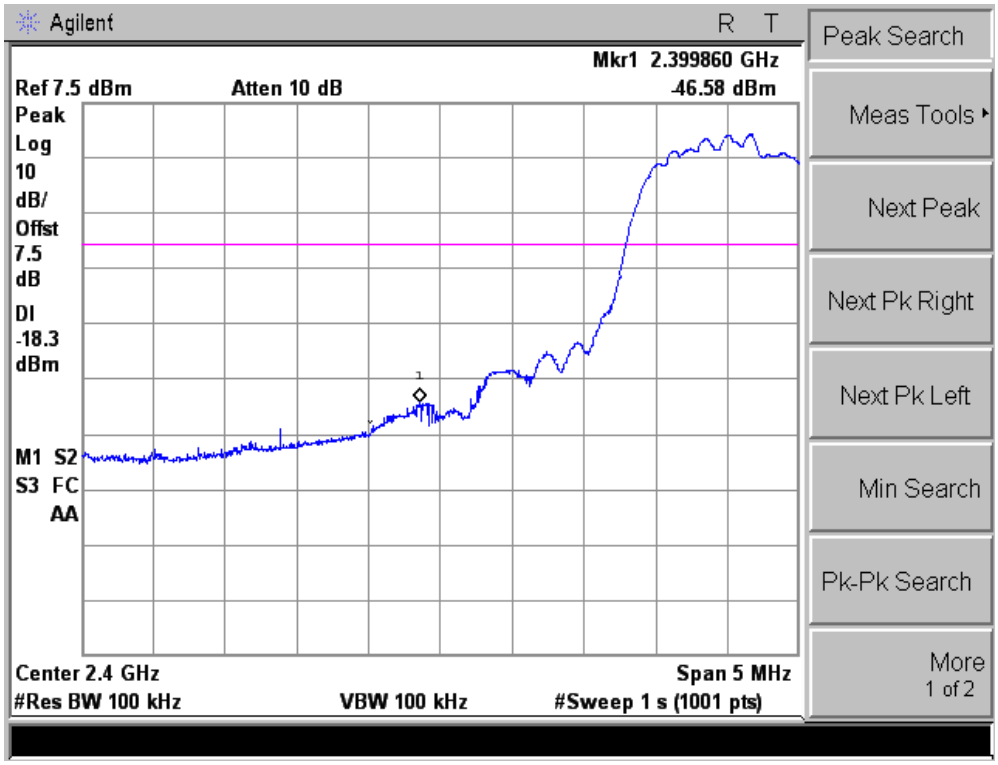
Modulation	Operation Mode	Result (dBc)	Limit (dBc)	Verdict
GFSK	Hopping enable	40 >	20	Pass
	Hopping enable	40 >	20	Pass
8DPSK	Hopping enable	40 >	20	Pass
	Hopping enable	40 >	20	Pass



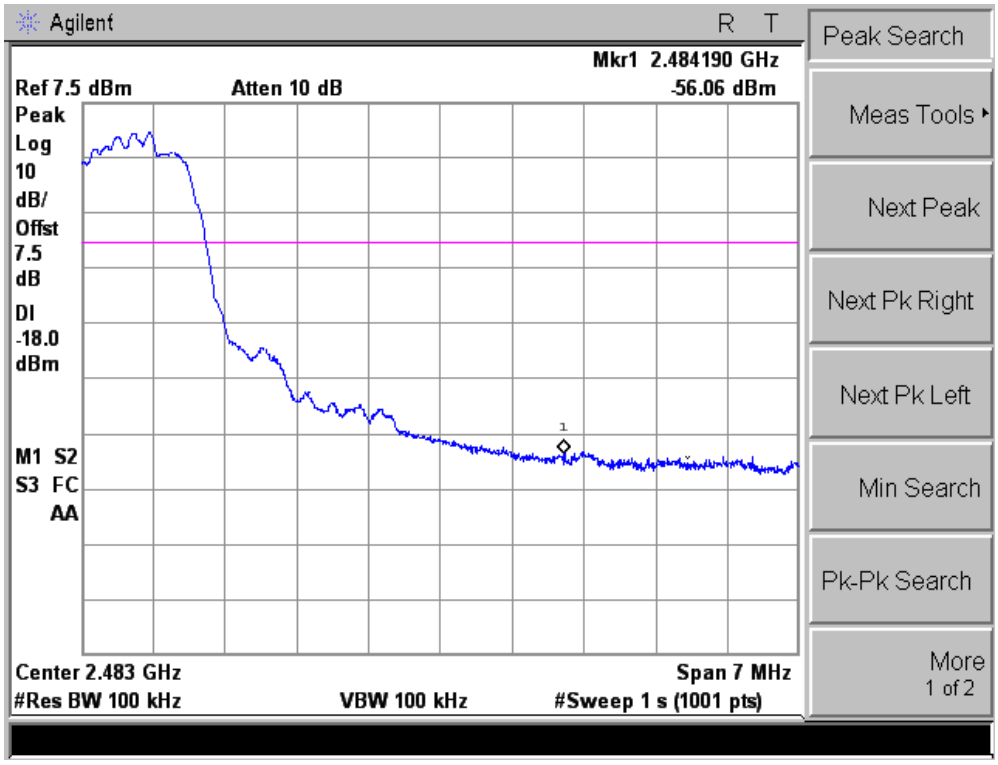
– Band edge lower side (GFSK) Hopping Off–



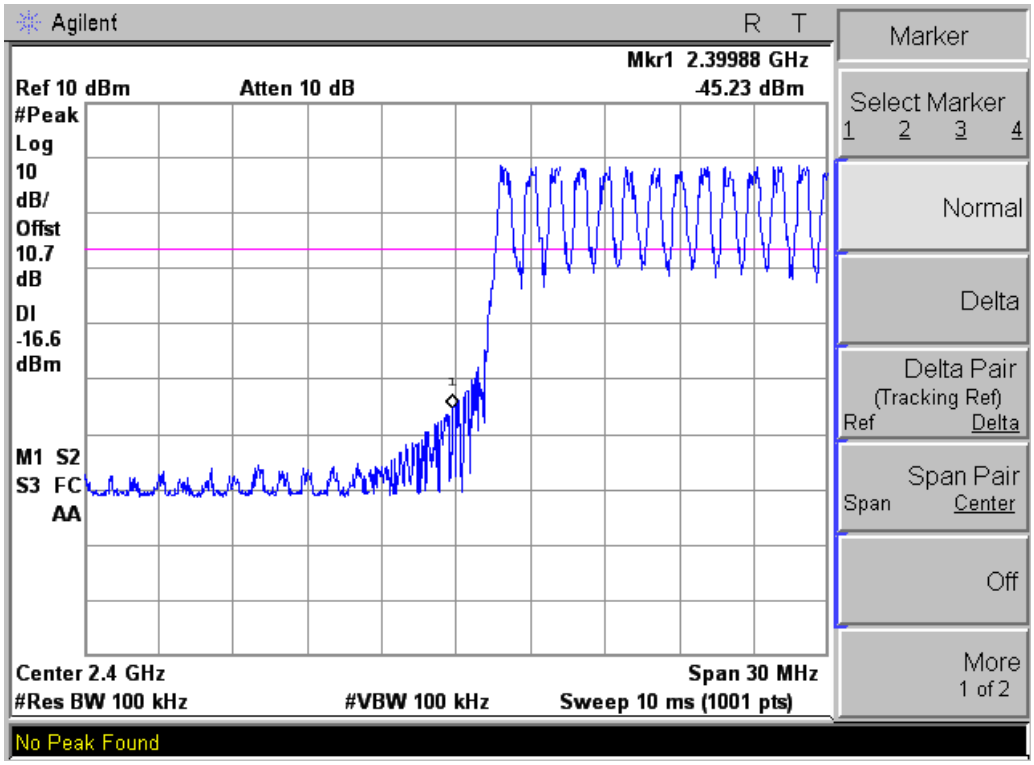
– Band edge higher side (GFSK) Hopping Off –



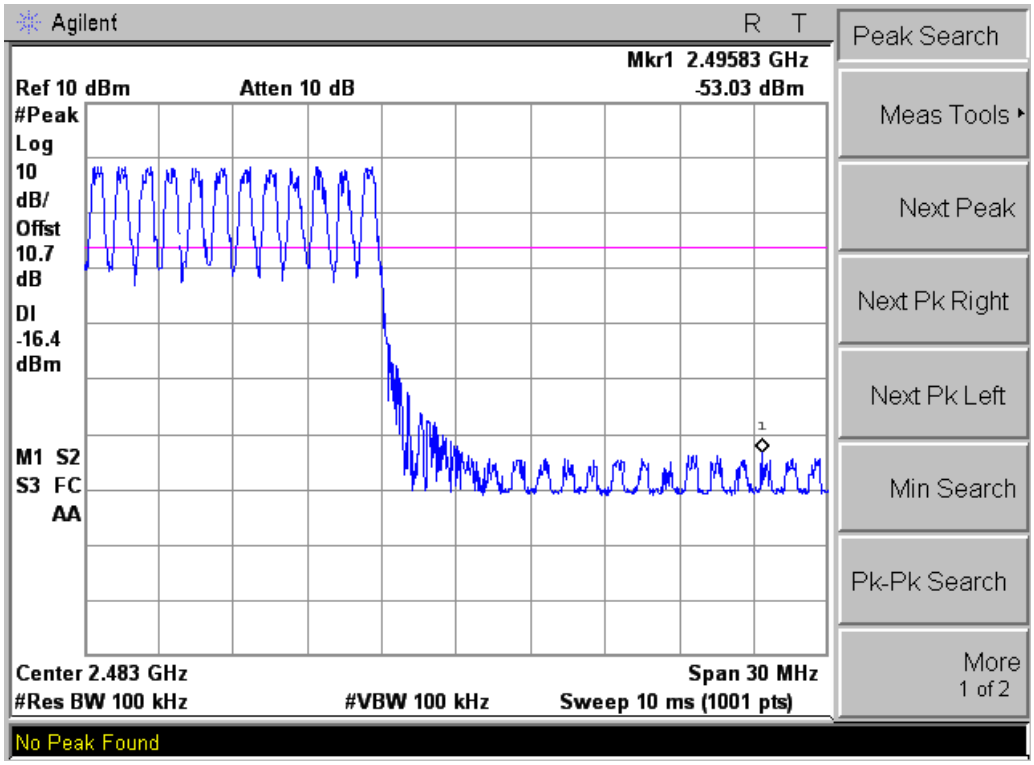
– Band edge lower side (8DPSK) Hopping Off–



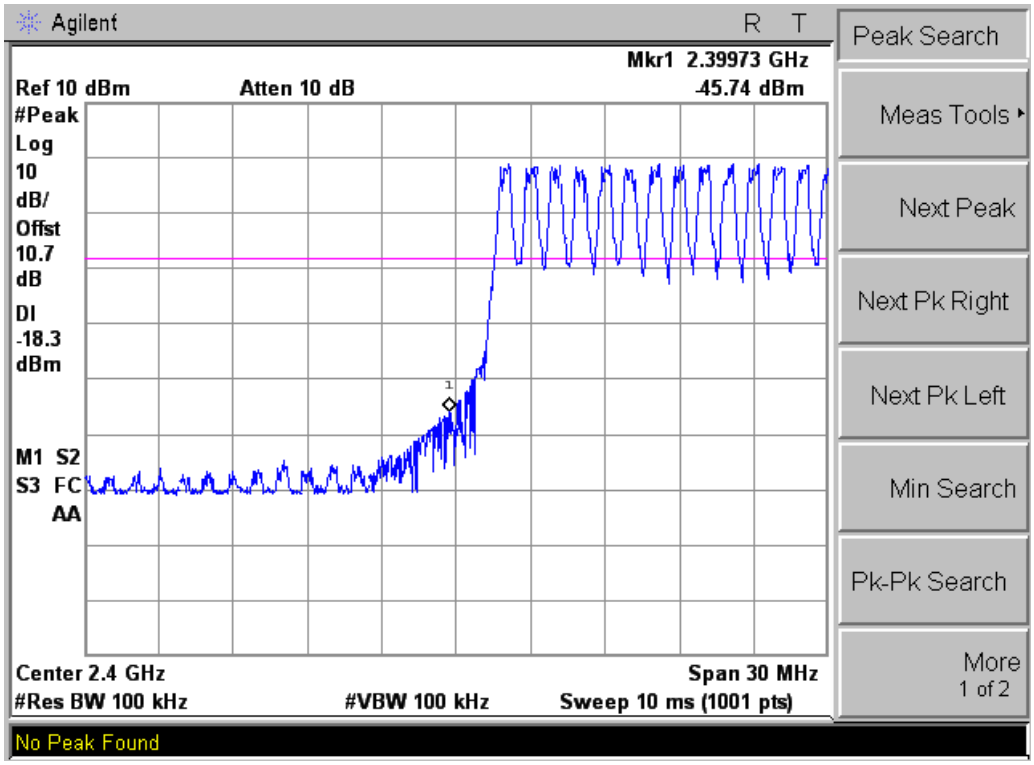
– Band edge higher side (8DPSK) Hopping Off –



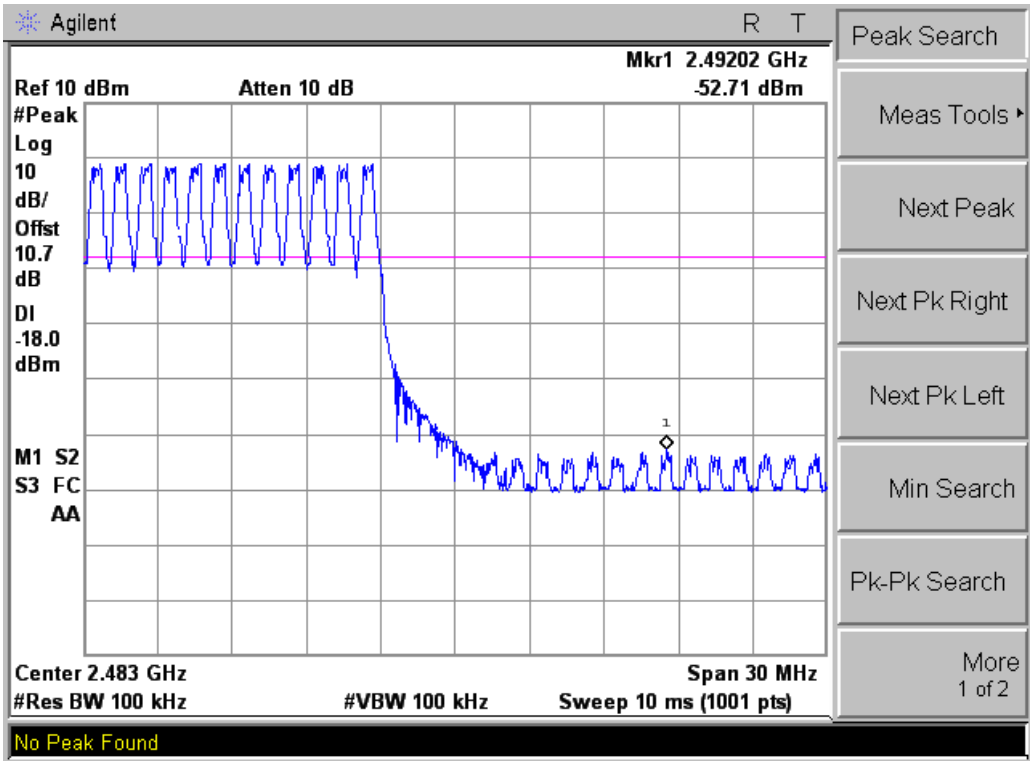
– Band edge lower side (GFSK) Hopping On–



– Band edge higher side (GFSK) Hopping On–



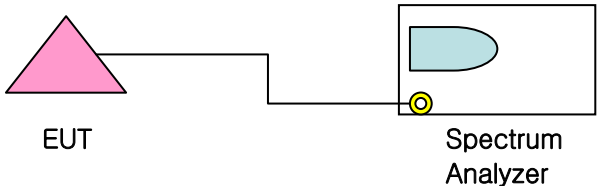
– Band edge lower side (8DPSK) Hopping On–



– Band edge higher side (8DPSK) Hopping On –

4.4. Hopping Channel Separation

4.4.1. Test Setup Layout



4.4.2. Test Condition & Limit

- Set the center frequency of spectrum analyzer = middle of hopping frequency
- Set the spectrum analyzer as RBW, VBW = 100 kHz, Span = 5 MHz
- Frequency hopping system shall have hopping channel carrier frequencies separated by minimum of 25 kHz or the two-third of 20dB bandwidth of the hopping channel, whichever is greater.

4.4.3. Test result

* Operation Mode: GFSK

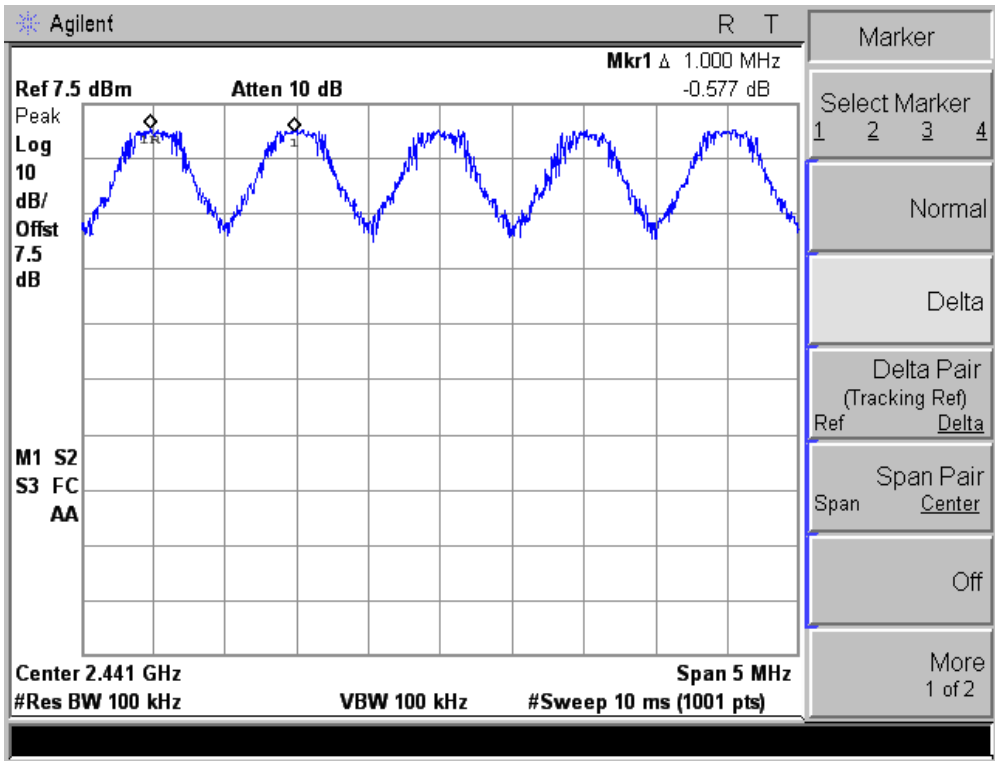
Channels	Frequency (MHz)	Result (MHz)	Limit (MHz)	Verdict
Hopping	2441	1.0	0.612	Pass

※Remark: 20dB bandwidth is 0.918 MHz

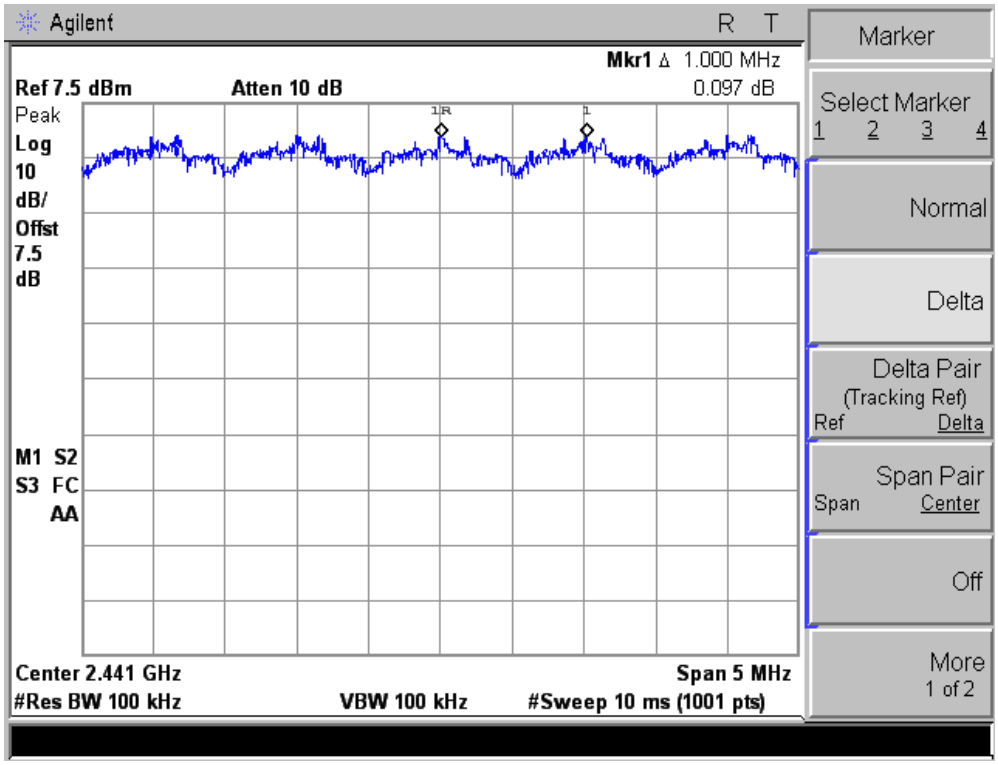
* Operation Mode: 8DPSK

Channels	Frequency (MHz)	Result (MHz)	Limit (MHz)	Verdict
Hopping	2441	1.0	0.842	Pass

※Remark: 20dB bandwidth is 1.263 MHz



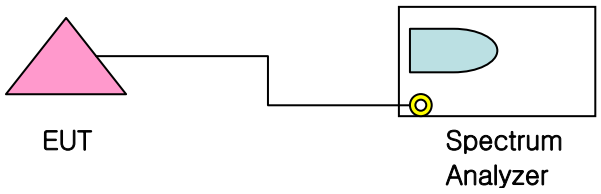
– Channel Separation (GFSK) –



–Channel Separation (8DPSK)

4.5. Number of Hopping Channels

4.5.1. Test Setup Layout



4.5.2. Test Condition & Limit

- Set the spectrum analyzer as start frequency = 2,400 MHz, stop frequency = 2,441.5 MHz and start frequency = 2,441.5 MHz, stop frequency = 2,483.5 MHz
- Set the spectrum analyzer as RBW, VBW = 300 kHz
- Frequency hopping system operating in the 2,400 ~ 2,483.5 MHz bands shall use at least 15 hopping frequencies.

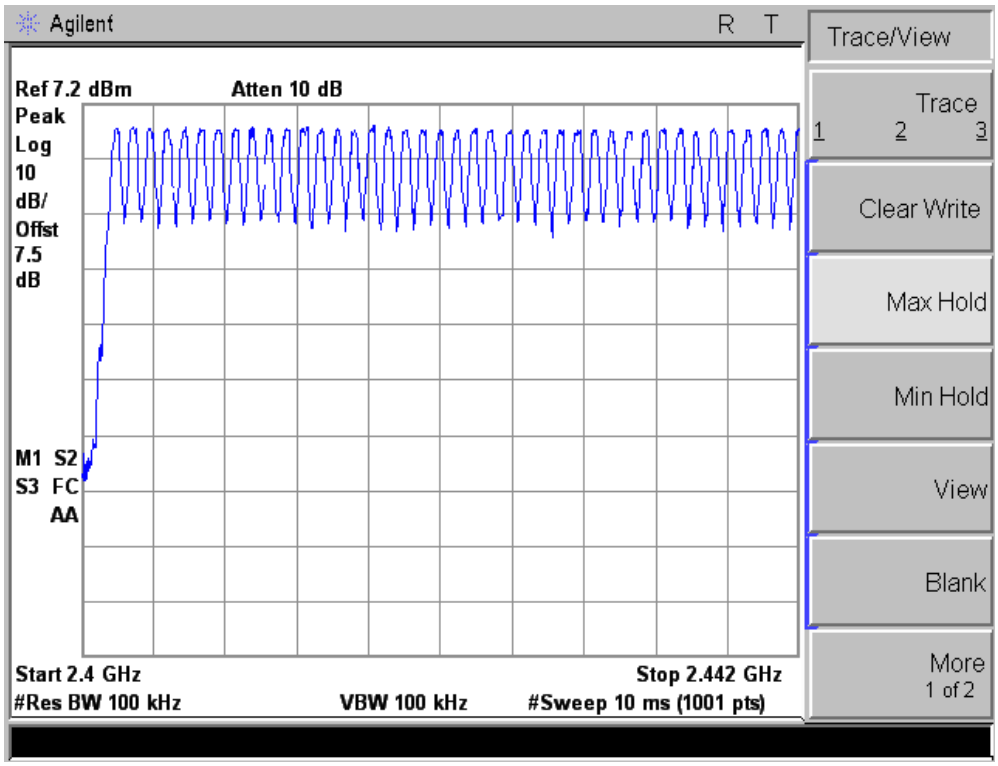
4.5.3. Test result

* Operation Mode : GFSK

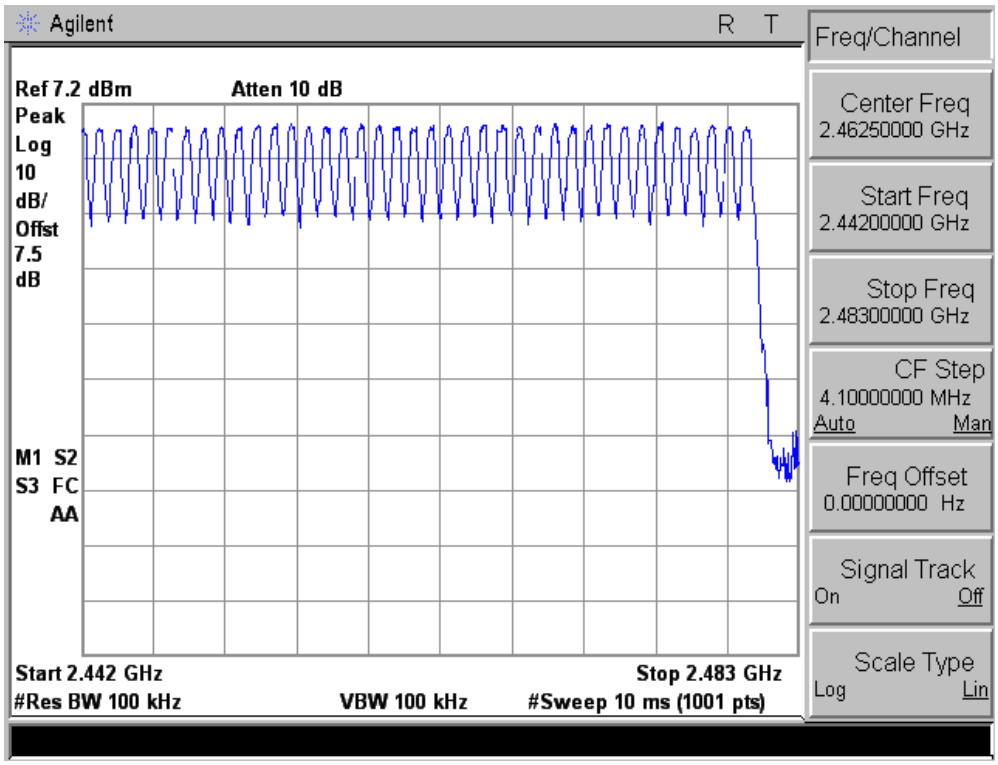
Channels	Result (Number fo Hopping channels)	Limit (channel)	Verdict
Hopping	79	>=15	Pass

* Operation Mode : 8DPSK

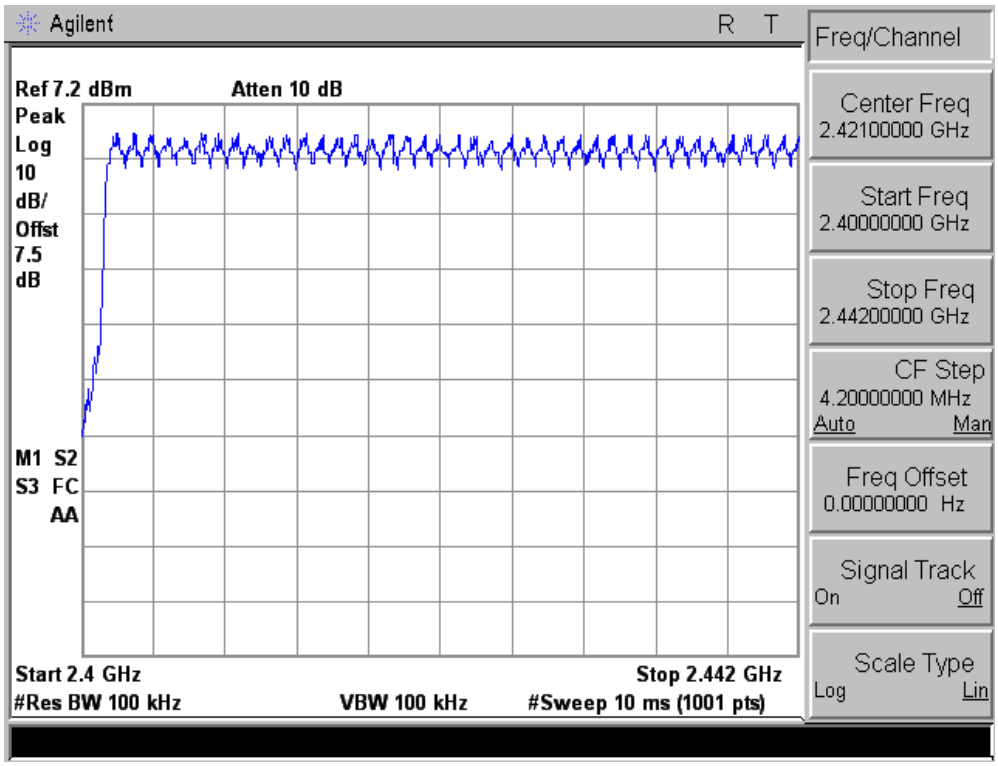
Channels	Result (Number fo Hopping channels)	Limit (channel)	Verdict
Hopping	79	>=15	Pass



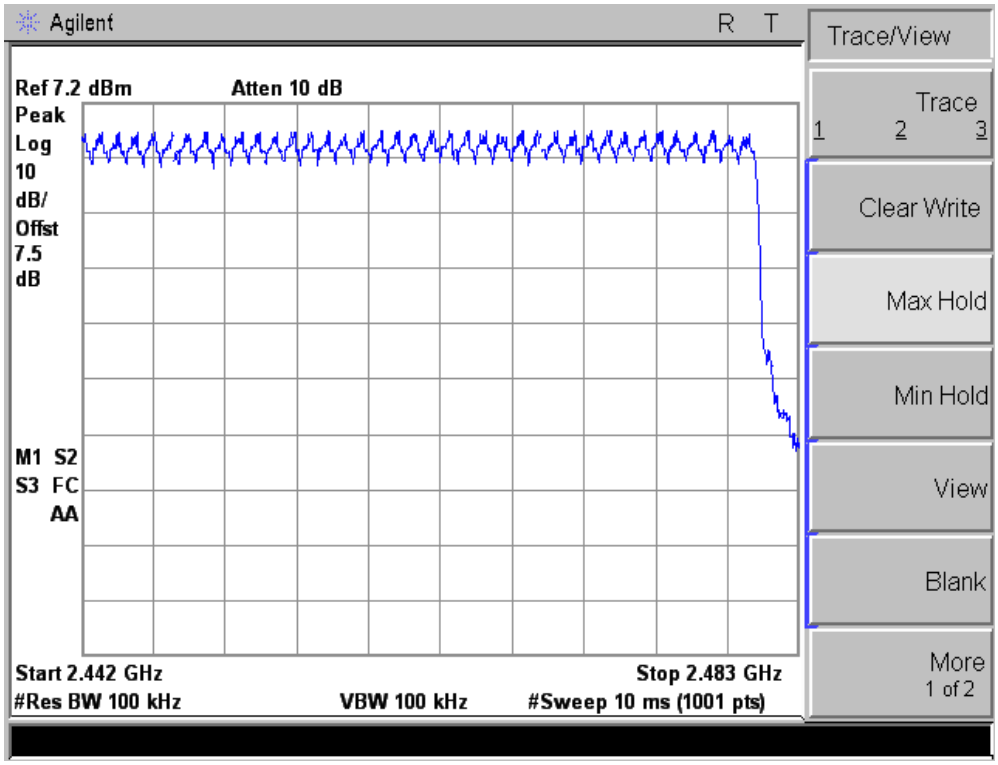
– Number of hopping channel (GFSK) –



– Number of hopping channel (GFSK) –



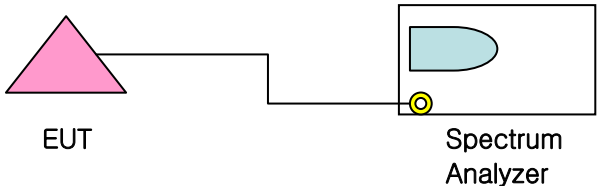
– Number of hopping channel (8DPSK) –



– Number of hopping channel (8DPSK) –

4.6. Dwell Time

4.6.1. Test Setup Layout



4.6.2. Test Condition & Limit

- Set the spectrum analyzer to zero span mode and RBW, VBW = 3 MHz.
- Frequency hopping systems in the 2,400-2,483.5 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. Since the Bluetooth technology uses 79 channels this period is calculated to be 31.6 seconds.

The dwell time is calculated by:
Dwell time = time domain slot length x (hop rate / number of hopping per channel) x 31.6 with:

4.6.3. Test result

* Operation Mode : GFSK

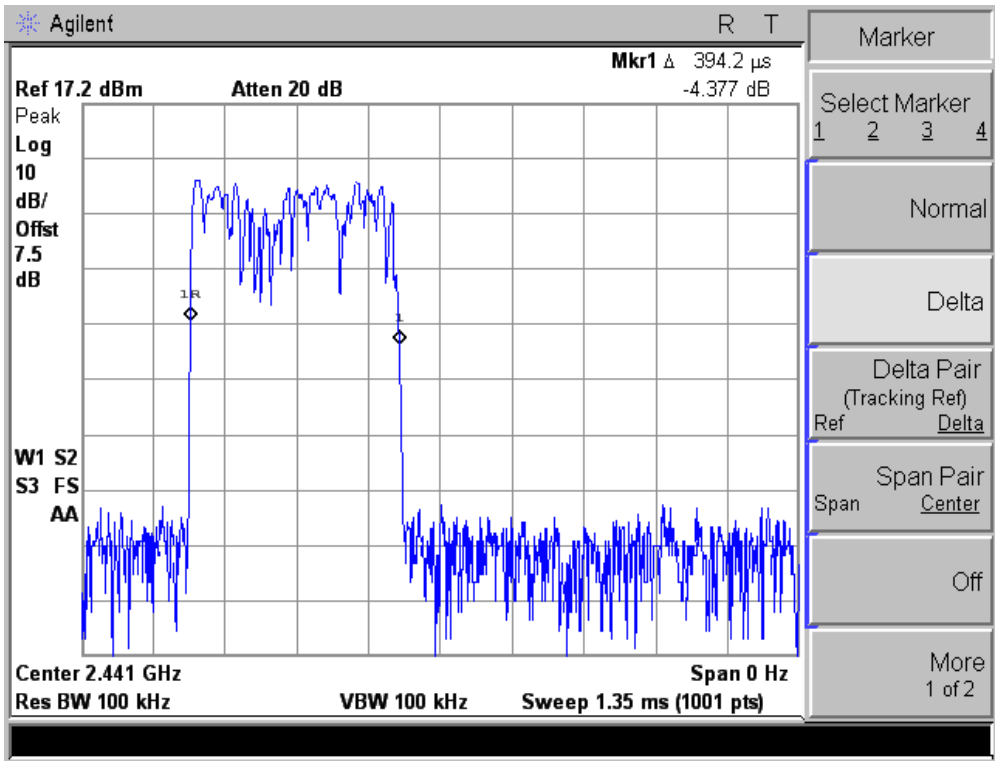
DH1 : 0.394 * (1600/2)/79 * 31.6 = 126.1 (ms) DH3 : 1.649 * (1600/4)/79 * 31.6 = 263.8 (ms)
DH5 : 2.916 * (1600/6)/79 * 31.6 = 311.0 (ms)

Channels	Type slot length(ms)	Dwell time (ms)	Limits (msec)	Packet type	Verdict
Mid	0.394	126.1	≤ 400	DH1	Pass
Mid	1.649	263.8	≤ 400	DH3	Pass
Mid	2.916	311.0	≤ 400	DH5	Pass

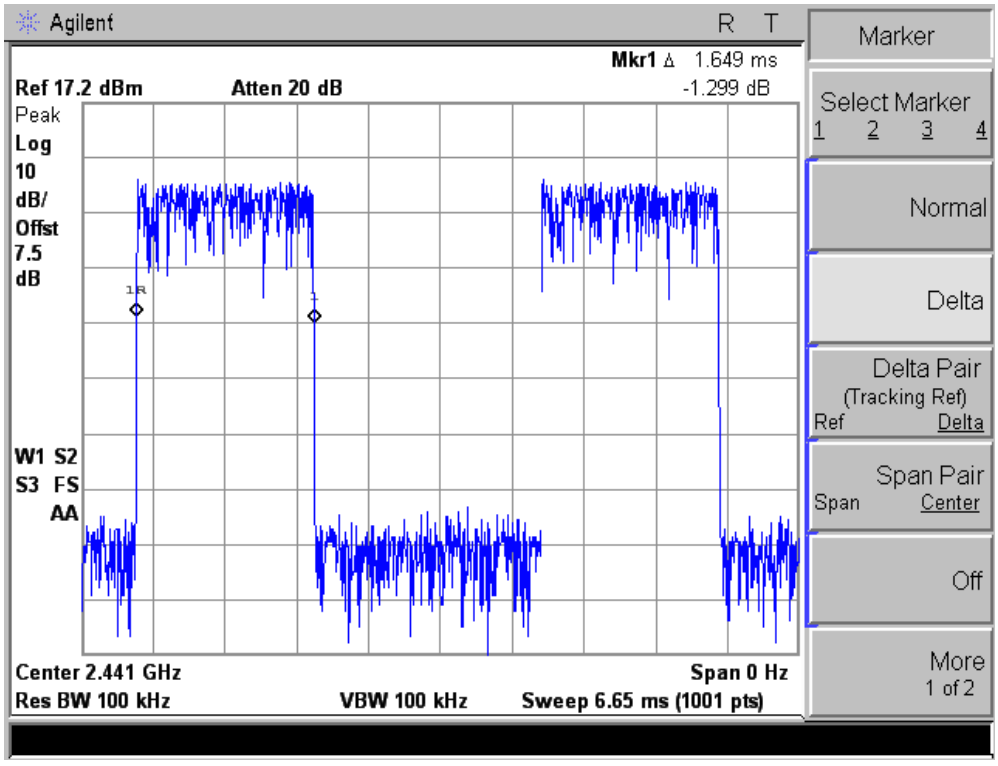
* Operation Mode : 8DPSK

3-DH1 : 0.414 * (1600/2)/79 * 31.6 = 132.5 (ms) 3-DH3 : 1.654 * (1600/4)/79 * 31.6 = 264.6 (ms)
3-DH5 : 2.914 * (1600/6)/79 * 31.6 = 310.8 (ms)

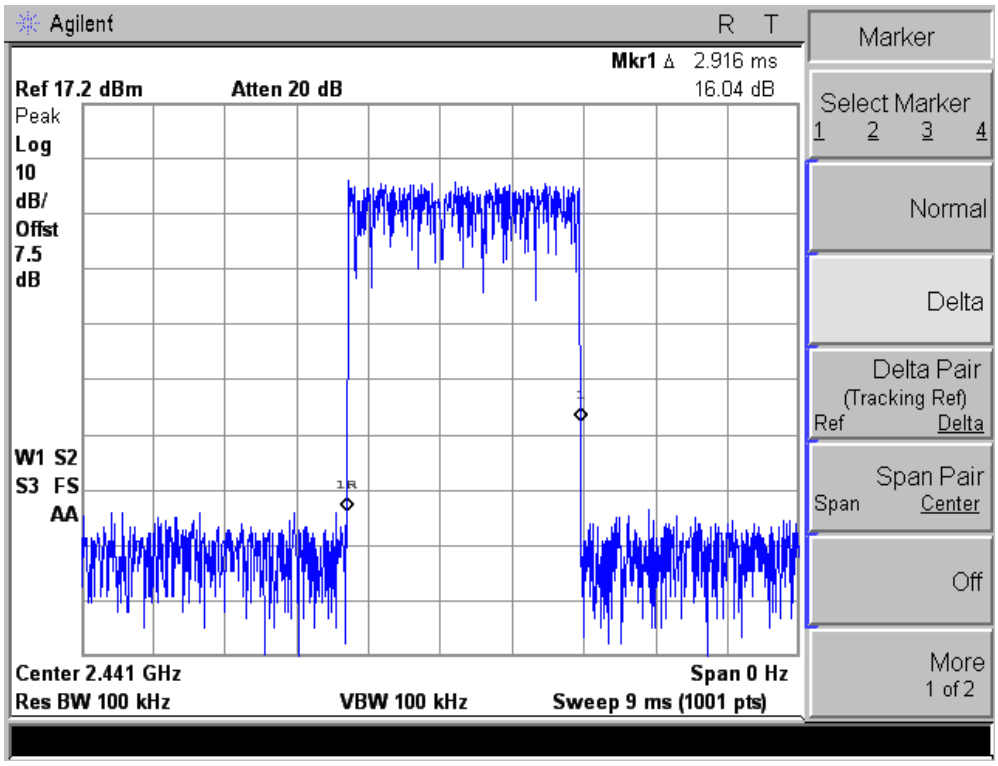
Channels	Type slot length(ms)	Dwell time (ms)	Limits (msec)	Packet type	Verdict
Mid	0.414	132.5	≤ 400	3-DH1	Pass
Mid	1.654	264.6	≤ 400	3-DH3	Pass
Mid	2.914	310.8	≤ 400	3-DH5	Pass



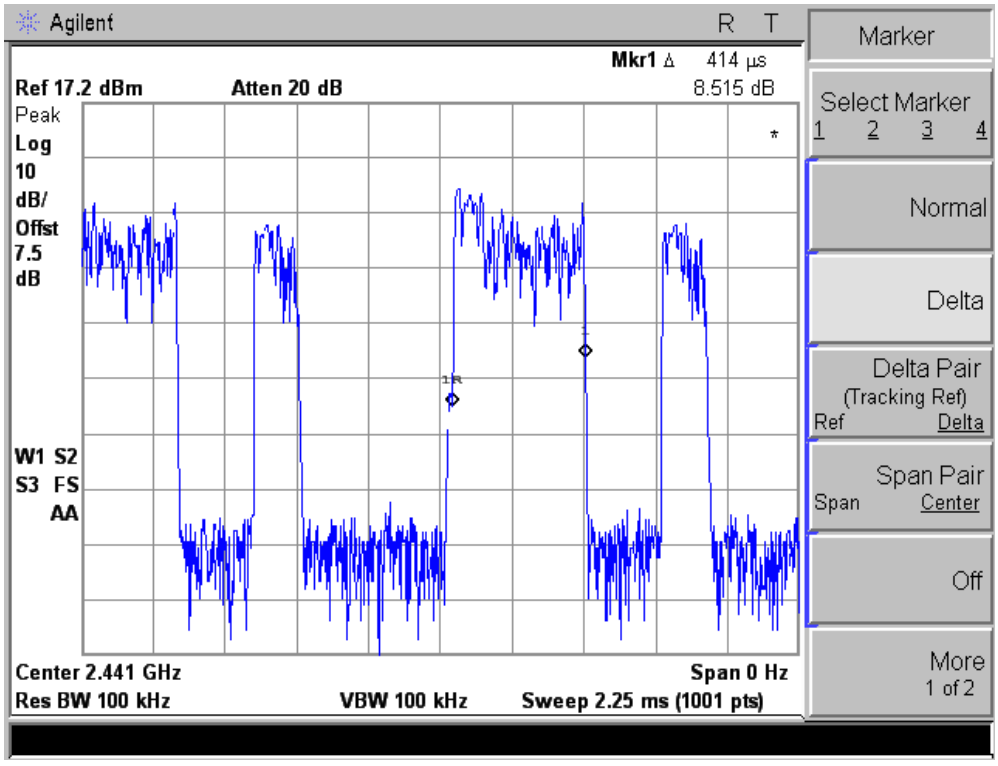
– DH1 packet type (GFSK) –



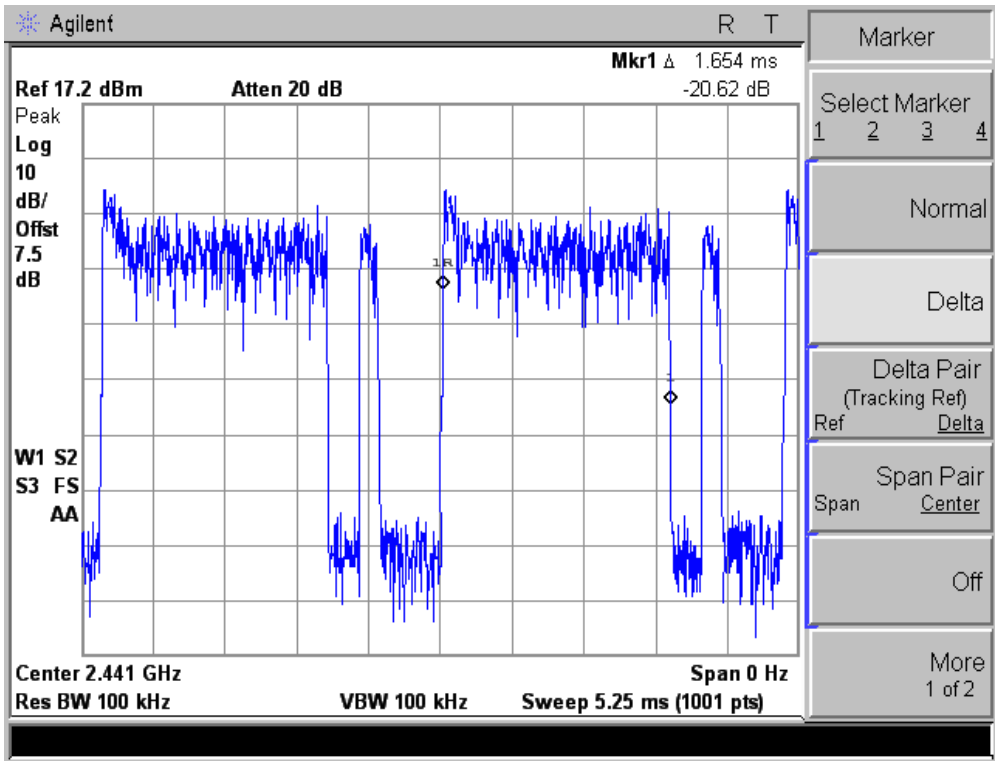
– DH3 packet type (GFSK) –



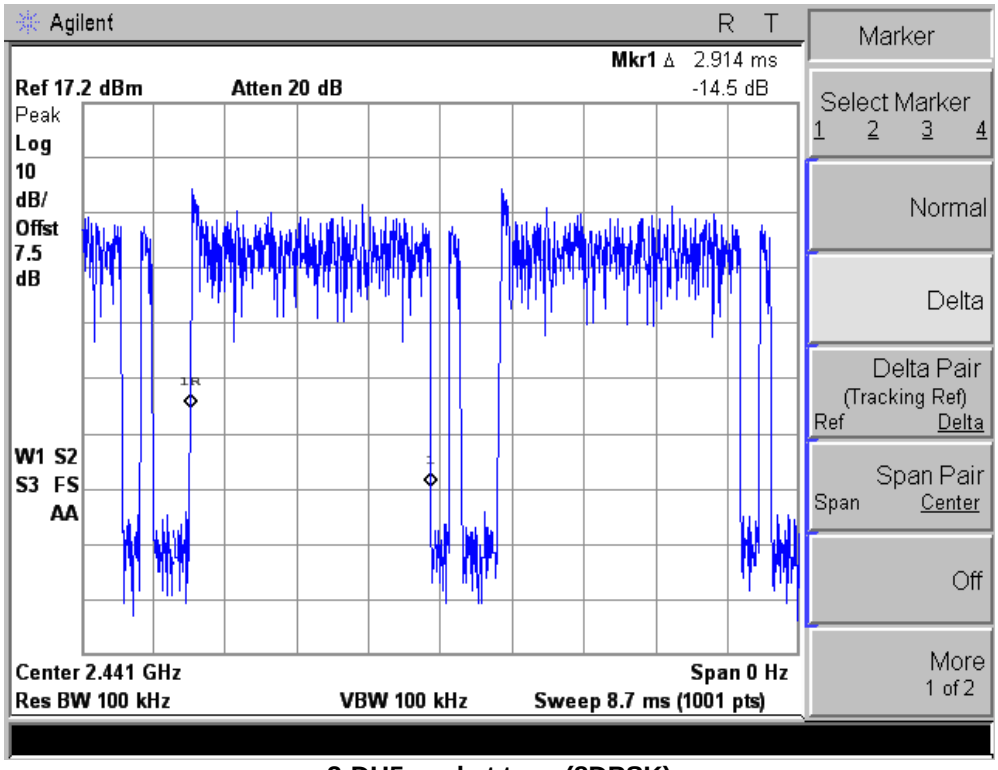
– DH5 packet type (GFSK) –



– 3-DH1 packet type (8DPSK) –



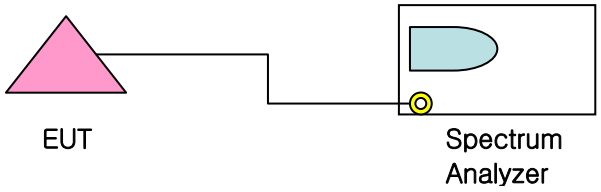
– 3-DH3 packet type (8DPSK) –



– 3-DH5 packet type (8DPSK) –

4.7. Conducted Spurious Emission

4.7.1. Test Setup Layout



4.7.2. Test Condition & Limit

- Set the spectrum analyzer as RBW, VBW = 100 kHz
- The reference value for the measurement of the spurious RF conducted emissions is determined during the test “band edge compliance” (cf. chapter 4.5). This value is used to calculate the 20 dBc limit.
- 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.

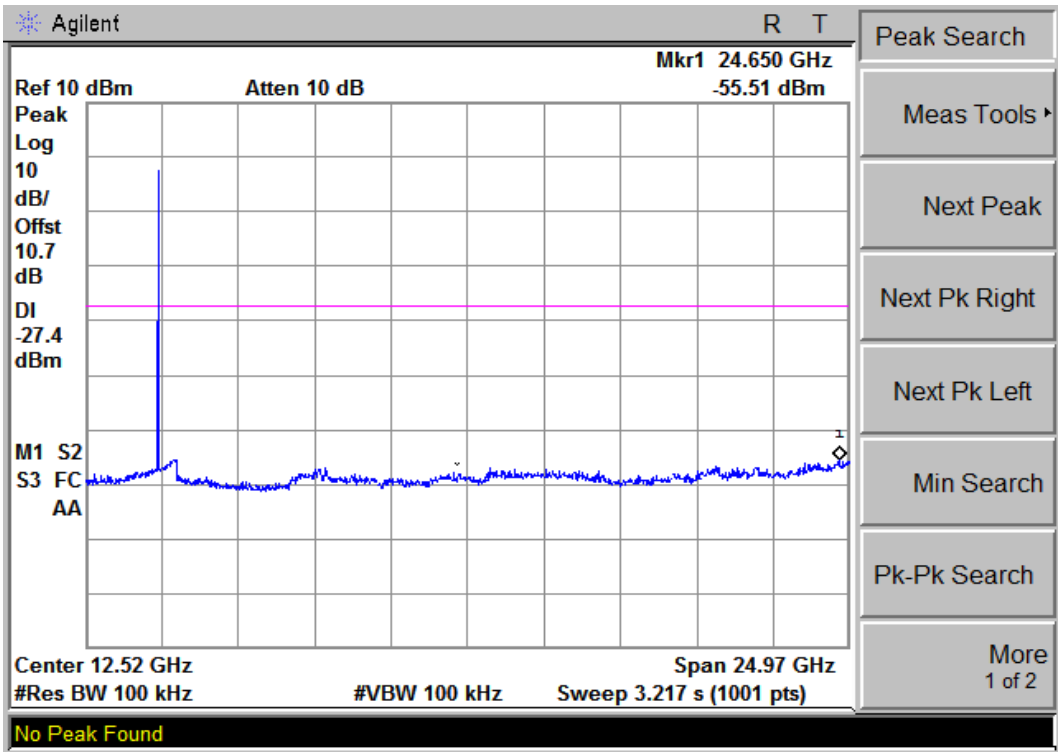
4.7.3. Test result

* Operation Mode : GFSK

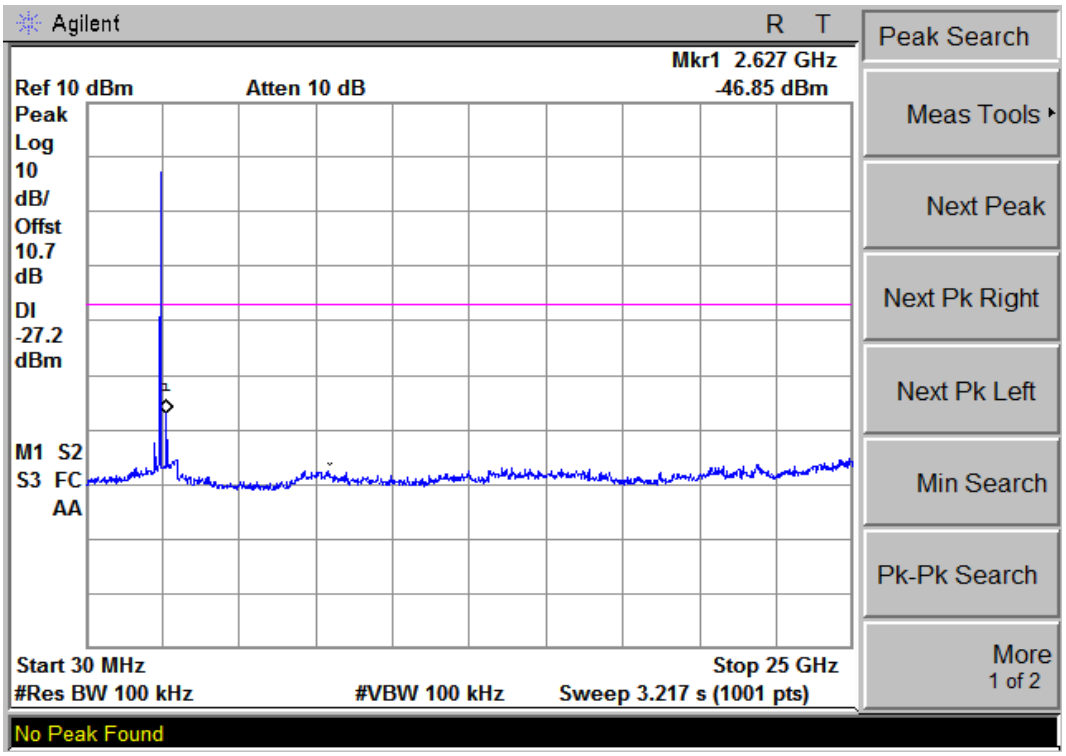
Channels	Frequency (MHz)	Result (dBc)	Limit (dBc)	Verdict
Low	2,402	40 >	20	Pass
Mid	2,441	40 >	20	Pass
High	2,480	40 >	20	Pass

* Operation Mode : 8DPSK

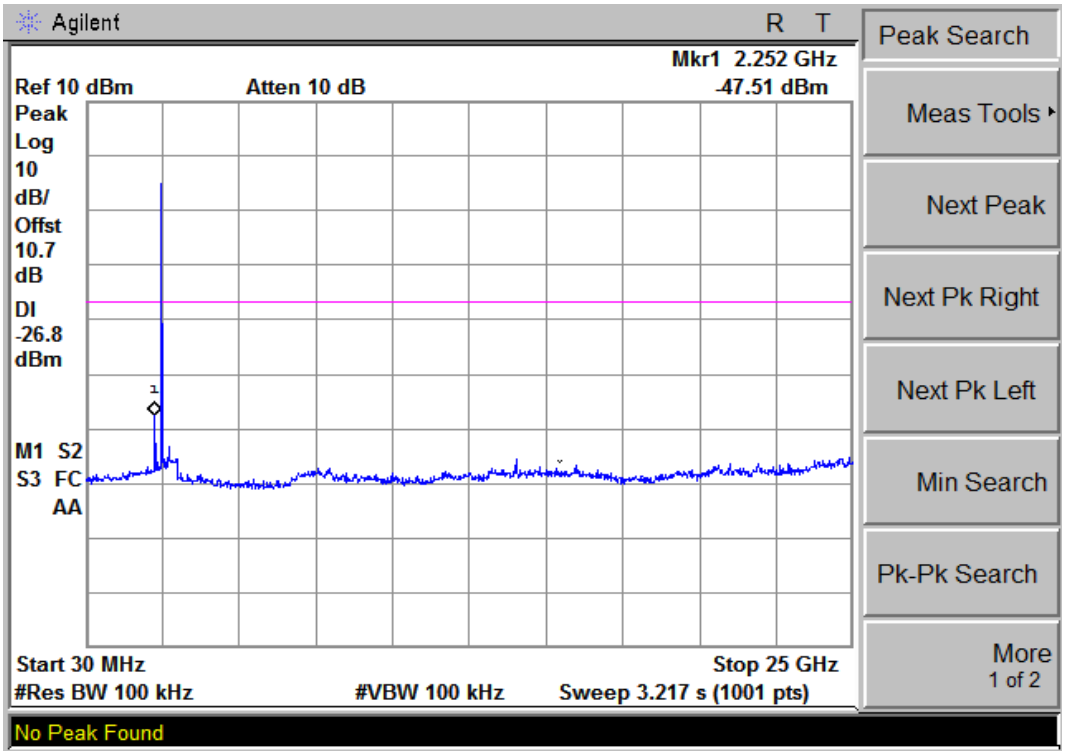
Channels	Frequency (MHz)	Result (dBc)	Limit (dBc)	Verdict
Low	2,402	40 >	20	Pass
Mid	2,441	40 >	20	Pass
High	2,480	40 >	20	Pass



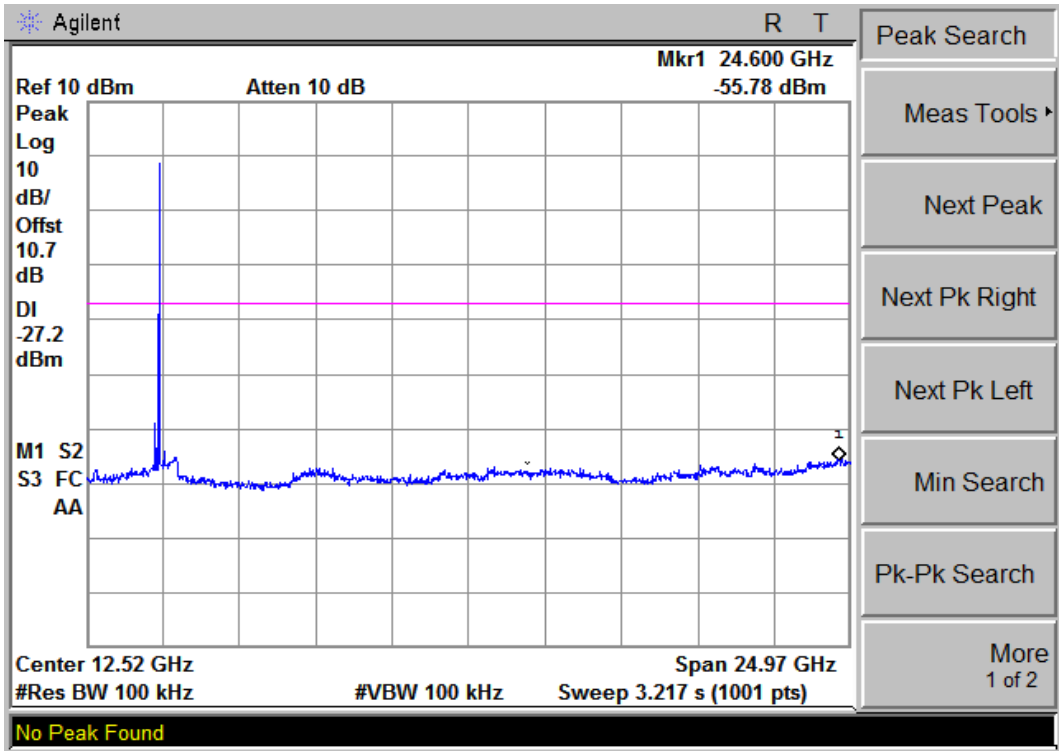
– Low channel (GFSK) –



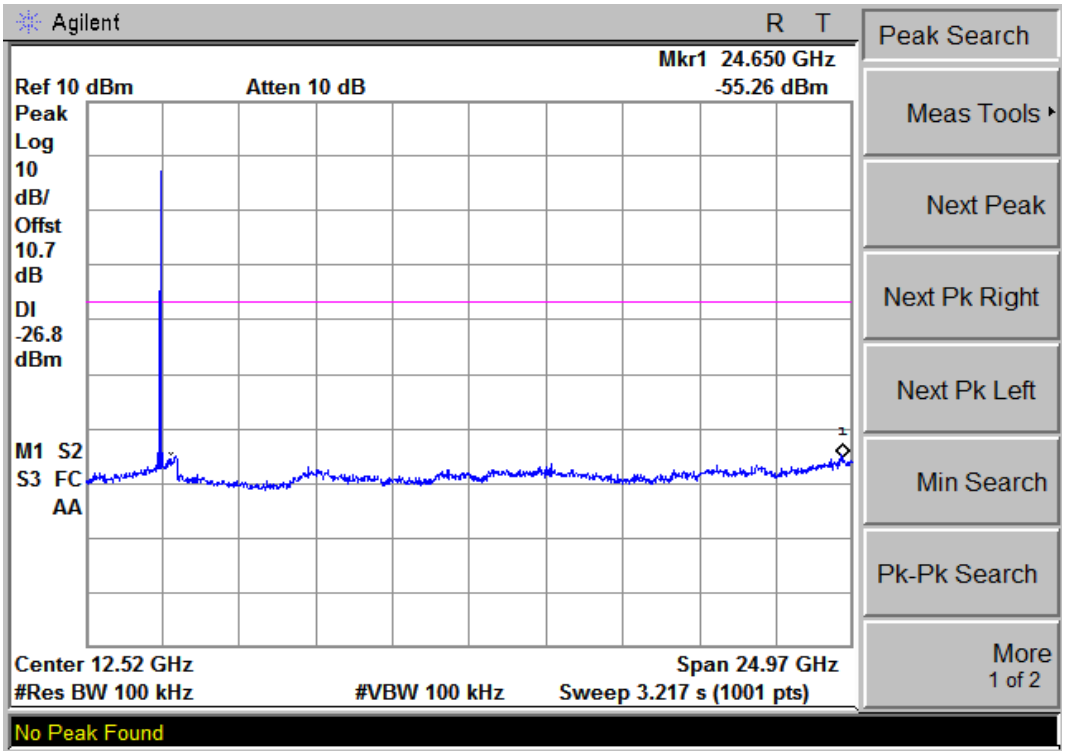
– Mid channel (GFSK) –



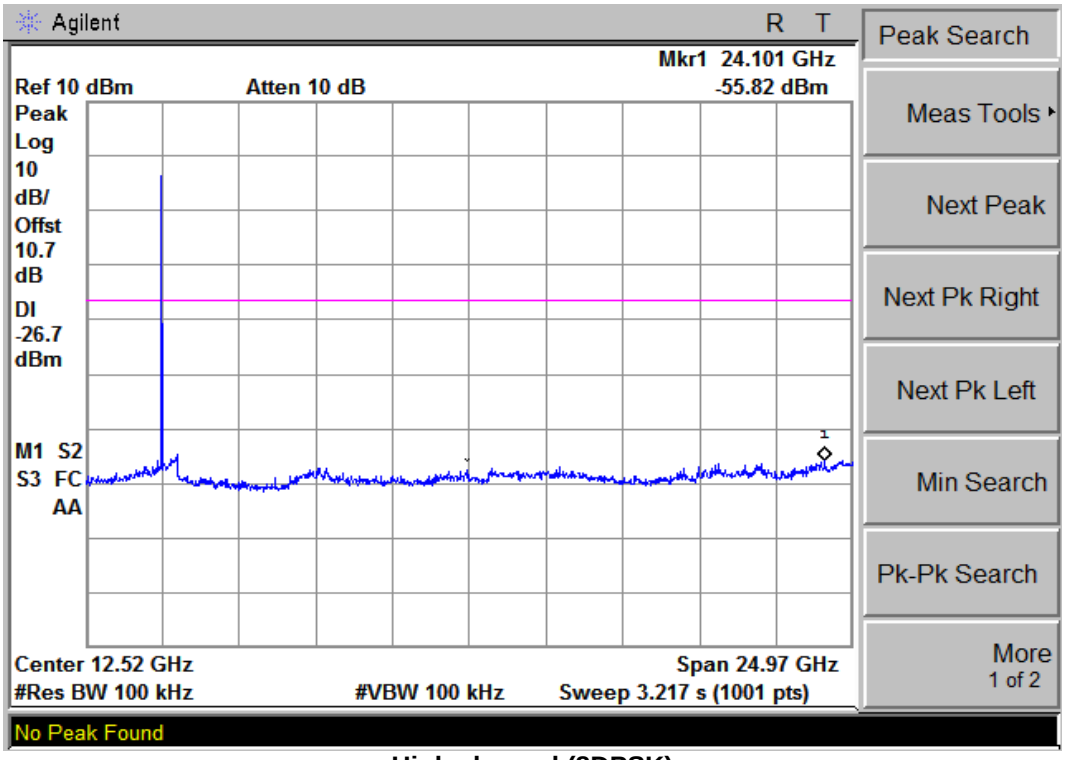
– High channel (GFSK) –



– Low channel (8DPSK) –



– Mid channel (8DPSK) –



– High channel (8DPSK) –

4.8. Radiated Spurious Emissions

4.8.1. Test Procedure

4.8.1.1 Preliminary Testing for Reference

Preliminary testing was performed in a KTL absorber-lined room to determine the emission characteristics of the EUT. The EUT was placed on the wooden table which has dimensions of 0.8 meters in height, 1 meter in length and 1.5 meters in width. Receiving antenna (Biconi-Log antenna : 30 to 1000 MHz or Horn Antenna : 1 to 40 GHz) was placed at the distance of 3 meter from the EUT.

An attempt was made to maximize the emission level with the various configurations of the EUT. Emission levels from the EUT with various configurations were examined on a spectrum analyzer connected with a RF amplifier and graphed.
The emission was within the illumination area of the 3 dB beam width of the antenna so that the maximum emission from the EUT is measured.

4.8.1.2 Final Radiated Emission Test at an Absorber-Lined Room

The final measurement of radiated field strength was carried out in a KTL Absorber-Lined Room that was listed up at FCC according to the "Radiated Emissions Testing" procedure specified by ANSI C63.4.

Based on the test results in preliminary test, measurement was made in same test set up and configuration which produced maximum emission level. Receiving antenna was installed at 3-meter distance from the EUT, and was connected to an EMI receiver.

Turntable was rotated through 360 degrees and receiving antenna height was varied from 1 to 4 meters above the ground plane to read maximum emission level. Receiving antenna polarization was changed vertical and horizontal. The worst value was recorded.

If necessary, the radiated emission measurements could be performed at a closer distance than specified distance to ensure higher accuracy and their results were extrapolated to the specified distance using an inverse linear distance extrapolation factor (20 dB/decade) as per Section 15.31(f).

The maximum emission level from the EUT occurred in such configuration as shown in the following photograph.

Tested in x, y, z axis and worst case results are reported

The maximum frequency range measuring with the spectrum from 30 MHz to 40 GHz is investigated with the transmitter

4.8.2. Limits

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz
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])
13.36 - 13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2] Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:
Frequency Field Strength Measurement Distance (MHz) (microvolts/meter) (meters)

Frequency (MHz)	Field Strength (microvolts/meter)	Distance (Meters)
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200**	3
above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

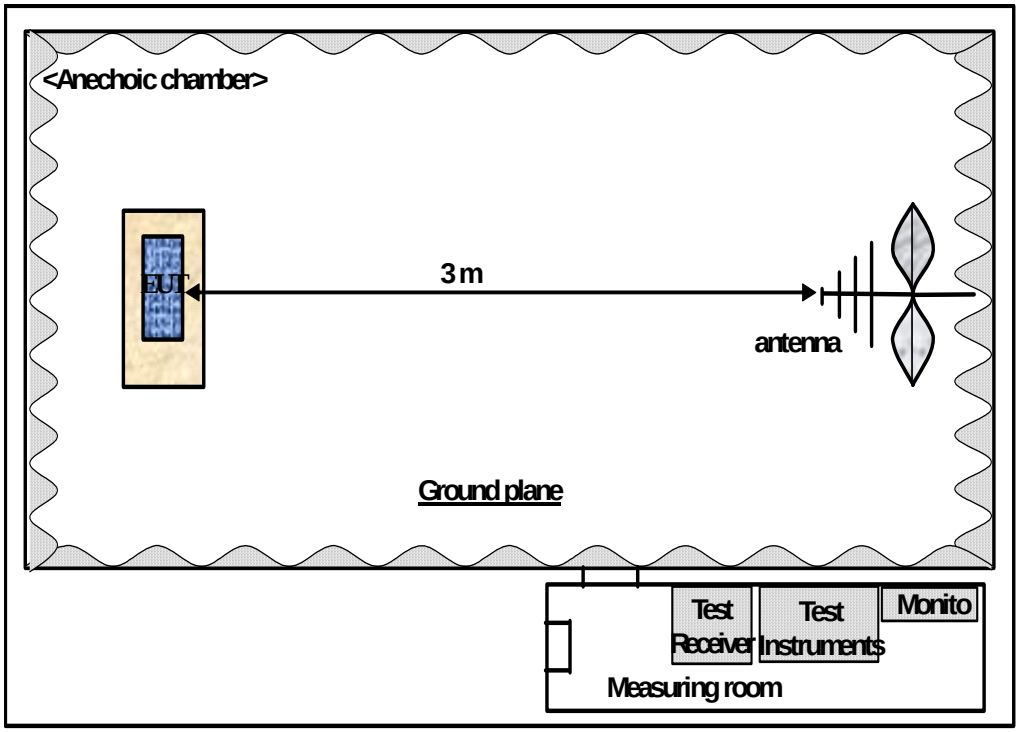
4.8.3. Sample Calculation

The emission level measured in decibels above one microvolt (dBμV) was following sample calculation.

For example ;

	Measured Value at 2332.50 MHz	37.69 dBμV
	Antenna Factor, Cable loss & Preamplifier	26.33 dB
=	Radiated Emission	64.02μV/m

4.8.4. Measurement Configuration



4.8.5. Restricted Band-edge Test Results (Bluetooth)

Test distance : 3m

Frequency (MHz)	Antenna Pol.	Bandwidth Detector	Reading level	Correction factor(dB)	Level Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Plane X/Y/Z
GFSK - Lower side band-edge – 2402 MHz									
2332.50	H	1000, Peak	37.69	26.33	64.02	74.0	9.98	Peak	X
2332.50	H	1000, Peak	23.62	26.62	50.24	54.0	3.76	Average	X
GFSK - Higher side band-edge – 2480 MHz									
2496.74	H	1000,Peak	36.63	26.71	63.34	74.0	10.66	Peak	X
2496.74	H	1000, Peak	23.62	26.71	50.33	54.0	3.67	Average	X

Level Corrected = Reading level + Correction factor (dB/m)
Correction factor = Antenna factor + Cable loss – Pre-amplifier (when using a pre-amplifier)

Note
1. Measurement was done over the Restricted Bands. The EUT was rotated and the antenna was changed to a range of height of from 1 m to 4 m above the ground plane for maximum response.
2. Pre-amplifier was used.
3. Test results include the rotation of the EUT through three orthogonal axes to determine the maximum emission.
4. If the peak measured values are lower than average limits, average measurements are not performed.
5. RBW/VBW settings for Peak Detection: RBW =1 MHz, VBW= 1MHz
6. RBW/VBW settings for Average Detection: RBW =1 MHz, VBW= 10Hz

Remark
1. Noise floor of 30 ~ 1000 MHz : <20 dBuV at 3m distance
2. Noise floor of 1000 ~ 5000 MHz : <40 dBuV at 3m distance
3. Noise floor of 5000 ~ 25000 MHz : <50 dBuV at 3m distance

Test distance : 3m

Frequency (MHz)	Antenna Pol.	Bandwidth Detector	Reading level	Correction factor(dB)	Level Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Plane X/Y/Z
8DPSK - Lower side band-edge – 2402 MHz									
2340.07	H	1000, Peak	36.45	26.62	63.07	74.0	10.93	Peak	X
2340.07	H	1000, Peak	23.20	26.62	49.82	54.0	4.18	Average	X
8DPSK - Higher side band-edge – 2480 MHz									
2496.52	H	1000, Peak	36.20	26.71	62.91	74.0	11.09	Peak	X
2496.52	H	1000, Peak	23.34	26.71	50.05	54.0	3.95	Average	X

Level Corrected = Reading level + Correction factor (dB/m)
Correction factor = Antenna factor + Cable loss – Pre-amplifier (when using a pre-amplifier)

Note
1. Measurement was done over the Restricted Bands. The EUT was rotated and the antenna was changed to a range of height of from 1 m to 4 m above the ground plane for maximum response.
2. Pre-amplifier was used.
3. Test results include the rotation of the EUT through three orthogonal axes to determine the maximum emission.
4. If the peak measured values are lower than average limits, average measurements are not performed.
5. RBW/VBW settings for Peak Detection: RBW =1 MHz, VBW= 1MHz
6. RBW/VBW settings for Average Detection: RBW =1 MHz, VBW= 10Hz

Remark
1. Noise floor of 30 ~ 1000 MHz : <20 dBuV at 3m distance
2. Noise floor of 1000 ~ 5000 MHz : <40 dBuV at 3m distance
3. Noise floor of 5000 ~ 25000 MHz : <50 dBuV at 3m distance

4.8.6. Spurious Emission Test Results (Bluetooth)

4.8.6.1 Spurious Radiated Emission (Worst case configuration, 30 MHz ~ 1 GHz)

Test mode: GFSK, 8DPSK

Frequency (MHz)	Antenna Pol.	Bandwidth	Reading level [Quasi-Peak]	Correction factor(dB)	Level Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plane X/Y/Z
-								
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Level Corrected = Reading level + Correction factor (dB/m)
Correction factor = Antenna factor + Cable loss – Pre-amplifier (when using a pre-amplifier)

Note 1. Measurement was done over the frequency range from 30 MHz to 1 GHz. The EUT was rotated and the antenna was changed to a range of height of from 1 m to 4 m above the ground plane for maximum response.
2. Testing is include the rotation of the EUT through three orthogonal axes to determine the maximum emission.
3. Any emission values 20dB lower than the limit are not recorded.
4. RBW/VBW settings for Quasi-Peak Detection: RBW/VBW=120 kHz

Remark 1. Noise floor of 30 ~ 1000 MHz : <20 dBuV at 3m distance
2. Noise floor of 1000 ~ 5000 MHz : <40 dBuV at 3m distance
3. Noise floor of 5000 ~ 25000 MHz : <45 dBuV at 3m distance

4.8.6.2 Spurious Radiated Emission (1 GHz ~ 25 GHz)

BT mode : GFSK

Frequency (MHz)	Antenna Pol.	Bandwidth Detector	Reading level	Correction factor(dB)	Level Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Plane X/Y/Z
Lowest channel Ch. 0									
7206	V	1000, Peak	35.61	21.58	57.19	74.0	16.81	Peak	X
7206	V	1000, Peak	21.43	21.58	43.01	54.0	10.99	Average	X
Middle channel Ch. 39									
7323	V	1000, Peak	36.50	20.62	57.12	74.0	16.88	Peak	X
7323	V	1000, Peak	21.32	20.62	41.94	54.0	12.06	Average	X
Highest channel Ch. 79									
-	-	-	-	-	-	-	-	-	-
-									

Level Corrected = Reading level + Correction factor (dB/m)
Correction factor = Antenna factor + Cable loss – Pre-amplifier (when using a pre-amplifier)

Note
1. Measurement was done over the frequency range from 1GHz to 10th harmonic. The EUT was rotated and the antenna was changed to a range of height of from 1 m to 4 m above the ground plane for maximum response.
2. Pre-amplifier was used in the range between 1 ~ 25 GHz.
3. Test results include the rotation of the EUT through three orthogonal axes to determine the maximum emission.
4. If the peak measured values are lower than average limits, average measurements are not performed.
5. Any emission values 20dB lower than the limit are not recorded.
6. RBW/VBW settings for Peak Detection: RBW =1 MHz, VBW= 1MHz
7. RBW/VBW settings for Average Detection: RBW =1 MHz, VBW= 10Hz

Remark
1. Noise floor of 30 ~ 1000 MHz : <20 dBuV at 3m distance
2. Noise floor of 1000 ~ 5000 MHz : <40 dBuV at 3m distance
3. Noise floor of 5000 ~ 25000 MHz : <50 dBuV at 3m distance

BT mode : 8DPSK

Frequency (MHz)	Antenna Pol.	Bandwidth Detector	Reading level	Correction factor(dB)	Level Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Plane X/Y/Z
Lowest channel Ch. 0									
4804	H	1000, Peak	38.93	17.02	55.95	74.0	18.05	Peak	X
4804	H	1000, Peak	30.15	17.02	47.17	54.0	6.83	Average	X
Lowest channel Ch. 39									
4882	H	1000, Peak	39.53	15.74	55.27	74.0	18.73	Peak	X
4882	H	1000, Peak	31.05	15.74	46.79	54.0	7.21	Average	X
Lowest channel Ch. 79									
-	-	-	-	-	-	-	-	-	-

Level Corrected = Reading level + Correction factor (dB/m)
Correction factor = Antenna factor + Cable loss – Pre-amplifier (when using a pre-amplifier)

Note
1. Measurement was done over the frequency range from 1GHz to 10th harmonic. The EUT was rotated and the antenna was changed to a range of height of from 1 m to 4 m above the ground plane for maximum response.
2. Pre-amplifier was used in the range between 1 ~ 25 GHz.
3. Test results include the rotation of the EUT through three orthogonal axes to determine the maximum emission.
4. If the peak measured values are lower than average limits, average measurements are not performed.
5. Any emission values 20dB lower than the limit are not recorded.
6. RBW/VBW settings for Peak Detection: RBW =1 MHz, VBW= 1MHz
7. RBW/VBW settings for Average Detection: RBW =1 MHz, VBW= 10Hz

Remark
1. Noise floor of 30 ~ 1000 MHz : <20 dBuV at 3m distance
2. Noise floor of 1000 ~ 5000 MHz : <40 dBuV at 3m distance
3. Noise floor of 5000 ~ 25000 MHz : <50 dBuV at 3m distance

4.9. Receiver Radiated Spurious Emissions

4.9.1. Test Procedure

Same as 4.8.1 Test procedure

4.9.2. Limits

Same as 4.8.2 Limits

4.9.1. Spurious Emission Test Results (Bluetooth)

4.9.1.1 Radiated Spurious Emission (Worst case configuration, 30 MHz ~ 1 GHz)

BT mode : GFSK/ 8DPSK

Frequency (MHz)	Antenna Pol.	Reading level	Correction factor(dB)	Level Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Plane X/Y/Z
-	-	-	-	-	-	-	-	-

Level Corrected = Reading level + Correction factor (dB/m)
Correction factor = Antenna factor + Cable loss – Pre-amplifier (when using a pre-amplifier)

Note 1. Measurement was done over the frequency range from 30 MHz to 1 GHz. The EUT was rotated and the antenna was changed to a range of height of from 1 m to 4 m above the ground plane for maximum response.
2. Testing is include the rotation of the EUT through three orthogonal axes to determine the maximum emission.
3. Any emission values below more than 20dB are not recorded.
4. RBW/VBW settings for Quasi-Peak Detection: RBW/VBW=120 kHz

Remark 1. Noise floor of 30 ~ 1000 MHz : <20 dBuV at 3m distance
2. Noise floor of 1000 ~ 5000 MHz : <40 dBuV at 3m distance
3. Noise floor of 5000 ~ 25000 MHz : <45 dBuV at 3m distance

4.9.1.2 Receiver Radiated Spurious Emission (1 GHz ~ 25 GHz)

BT mode : GFSK/ 8DPSK

Frequency (MHz)	Antenna Pol.	Reading level	Correction factor(dB)	Level Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Plane X/Y/Z
-	-	-	-	-	-	-	-	-

Level Corrected = Reading level + Correction factor (dB/m)
Correction factor = Antenna factor + Cable loss – Pre-amplifier (when using a pre-amplifier)

Note 1. Measurement was done over the frequency range from 1GHz to 10th harmonic. The EUT was rotated and the antenna was changed to a range of height of from 1 m to 4 m above the ground plane for maximum response.
2. Pre-amplifier was used in the range between 1 ~ 25 GHz.
3. Test results include the rotation of the EUT through three orthogonal axes to determine the maximum emission.
4. If the peak measured values are lower than average limits, average measurements are not performed.
5. Any emission values below more than 20 dB are not recorded.
6. RBW/VBW settings for Peak Detection: RBW =1 MHz, VBW= 1MHz
7. RBW/VBW settings for Average Detection: RBW =1 MHz, VBW= 10Hz

Remark 1. Noise floor of 30 ~ 1000 MHz : <20 dBuV at 3m distance
2. Noise floor of 1000 ~ 5000 MHz : <40 dBuV at 3m distance
3. Noise floor of 5000 ~ 25000 MHz : <50 dBuV at 3m distance

4.10. AC Conducted Emissions

4.10.1. Test Procedure

Conducted emission measurements on the EUT were performed by "AC Power Line Conducted Emissions Testing" procedure as per ANSI C63.4. The EUT was set up on a wooden table 0.8 meters height, 1.0 by 1.5 meters in size, placed in the shielded enclosed with a side of wall of which constituted a vertical conducting surface of 2.2 m x 3.1 m in size to maintain 40 cm from the rear of EUT

LISN(Line Impedance Stabilization Network, ROHDE & SCHWARZ, ESH3-Z5, 50 ohm / 50 μH) was installed and electrically boned to the conducting ground plane. The EUT was connected to the LISN using a typical power adapter.
One of two 50 ohm output terminals of the LISN was connected to the EMI Receiver (ROHDE & SCHWARZ, ESCI, 9 kHz to 3 GHz) and the other was terminated in 50 ohms. Measurements were again performed after interchanging such a connection oppositely.
The frequency range from 150 kHz to 30 MHz was examined and the remarkable frequencies were measured with Quasi-peak and Average values using the EMI receiver instrument (ROHDE & SCHWARZ, ESI, 9 kHz to 3 GHz ; Detector Function ; CISPR Quasi-Peak & Average). The 6 dB bandwidth of the Receiver was set to 9 kHz

The position of connecting cables of the EUT was changed to find the worst case configuration during measurements. The maximum emission level from the EUT occurred in such configuration as shown in the following photograph.

4.10.2. Limits

Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency (MHz)	Conducted Limits (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

- Decreases with the logarithm of the frequency.

4.10.3. Sample calculation

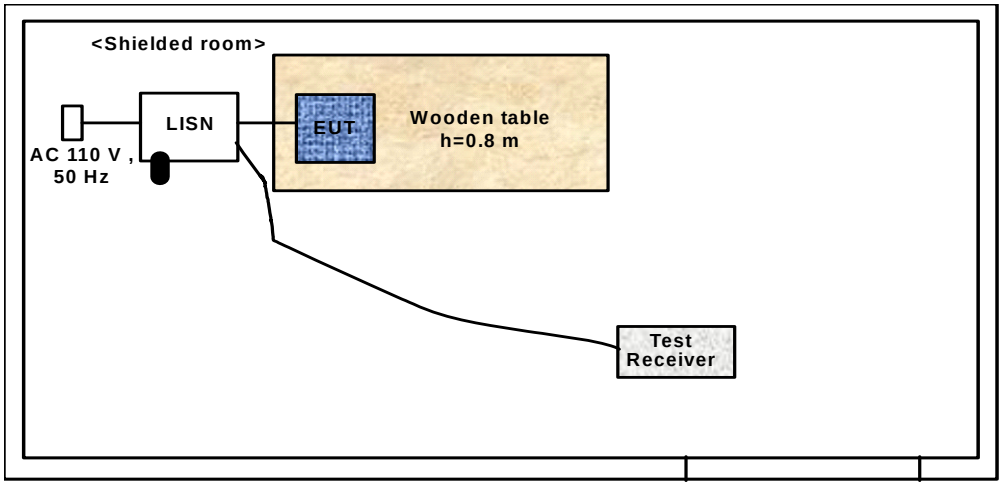
The emission level measured in decibels above one microvolt (dBμV) was converted into microvolt (μV) as shown in following sample calculation.

For example :

Measured Value at		0.2085 MHz	39.3 dBμV @ Q-Peak mode
+	Correct factor *		9.7 dB
=	Conducted Emission		49.0 dBμV

* Correct factor is adding RF cable loss and Attenuation

4.10.4. Photograph for the test configuration



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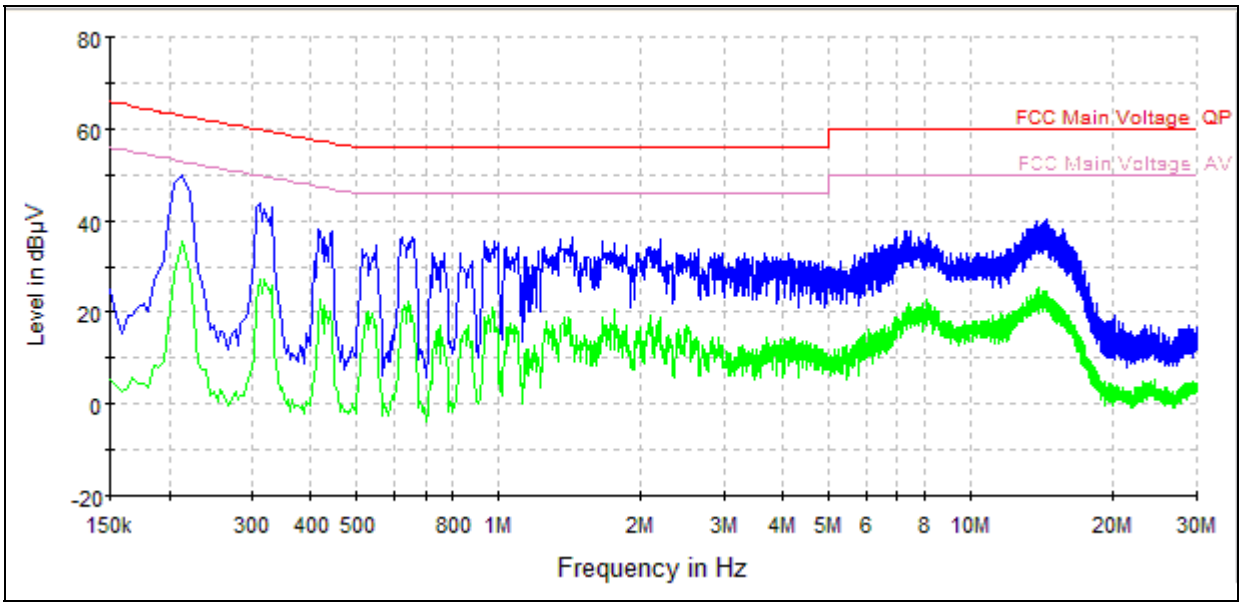
4.10.5. Test Results

<L1>



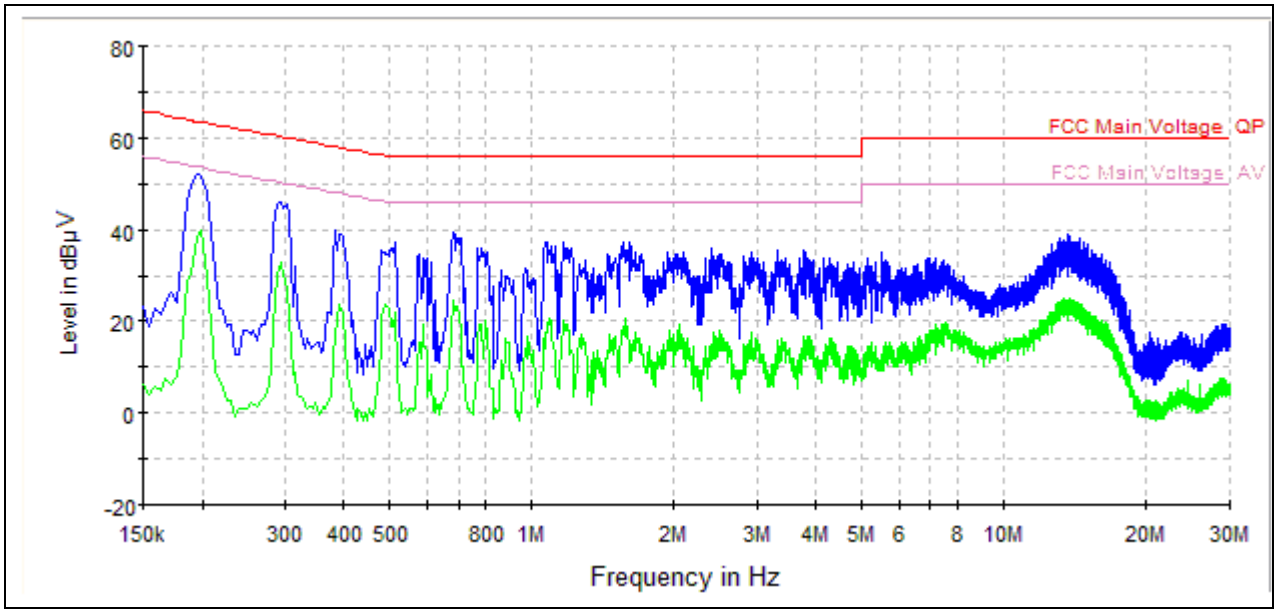
Final Result 1(L1-Quasi-Peak)

Frequency (MHz)	Quasi Peak (dBuV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)	Comment
0.208500	49.0	1000.0	9.000	L1	9.7	14.2	63.2	
0.312000	40.9	1000.0	9.000	L1	9.7	19.0	59.9	
0.658500	33.6	1000.0	9.000	L1	9.7	22.4	56.0	
1.432500	32.9	1000.0	9.000	L1	9.7	23.1	56.0	
1.432500	33.3	1000.0	9.000	L1	9.7	22.7	56.0	
1.432500	33.0	1000.0	9.000	L1	9.7	23.0	56.0	

Final Result 2(L1-Average)

Frequency (MHz)	Average (dBuV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)	Comment
0.208500	34.4	1000.0	9.000	L1	9.7	18.8	53.2	
0.312000	25.9	1000.0	9.000	L1	9.7	24.0	49.9	
0.658500	18.6	1000.0	9.000	L1	9.7	27.4	46.0	
1.432500	14.6	1000.0	9.000	L1	9.7	31.4	46.0	
1.432500	15.2	1000.0	9.000	L1	9.7	30.8	46.0	
1.432500	14.5	1000.0	9.000	L1	9.7	31.5	46.0	

<N>



Final Result 1(N-Quasi-Peak)

Frequency (MHz)	Quasi Peak (dBuV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)	Comment
0.195000	28.3	1000.0	9.000	N	9.9	35.5	63.8	
0.294000	21.2	1000.0	9.000	N	9.8	39.3	60.5	
0.384000	28.5	1000.0	9.000	N	10.0	29.6	58.1	
0.681000	28.6	1000.0	9.000	N	9.8	27.4	56.0	
1.554000	24.0	1000.0	9.000	N	9.9	32.0	56.0	
13.708500	30.3	1000.0	9.000	N	10.0	29.7	60.0	

Final Result 2(N-Average)

Frequency (MHz)	Average (dBuV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)	Comment
0.199500	12.1	1000.0	9.000	N	9.9	41.5	53.6	
0.294000	8.0	1000.0	9.000	N	9.8	42.4	50.4	
0.681000	11.5	1000.0	9.000	N	10.0	34.5	46.0	
1.576500	15.5	1000.0	9.000	N	9.8	30.5	46.0	
7.516500	16.6	1000.0	9.000	N	9.9	33.4	50.0	
13.798500	21.8	1000.0	9.000	N	10.0	28.2	50.0	

5. TEST EQUIPMENTS

No.	Equipment	Manufacturer	Model	S/N	Calibration Due date
1	Spectrum Analyzer	Agilent	E4407B	US41443316	03-11-2015
2	Synthesized Sweeper	HP	83620A	3250A01653	03-03-2015
3	Digital RF Signal Generator	Agilent	E4438C	US41460859	02-18-2015
4	Signal Generator	R&S	SMIQ O3	DE22348	02-14-2015
5	PSA Series Spectrum Analyzer	Agilent	E4448A	US44300484	02-19-2015
6	DC Power Supply	Agilent	E4356A	MY41000296	02-11-2015
7	DC Power Supply	Agilent	E3645A	MY40000851	02-11-2015
8	AC Power Supply	Agilent	6811B	MY41000446	02-07-2015
9	Oscilloscope	Agilent	DSO6054A	MY44001104	01-22-2015
10	Directional Coupler	Agilent	87300C	MY44300126	03-04-2015
11	Directional Coupler	Agilent	773D	MY28390213	03-04-2015
12	VHF Attenuator	HP	355D	2522A45959	03-04-2015
13	Coaxial Attenuator	Weinschel	56-20	N8527	03-04-2015
14	Coaxial Attenuator	Agilent	8491B	50109	03-04-2015
15	Power Divider	HP	11636A	09084	03-07-2015
16	Power Spliter	HP	11667A	21063	03-04-2015
17	Temp/Humidity Chamber	ESPEC	SH-641	92007482	01-14-2015
18	Function/Arbitrary Waveform Generator	Agilent	33250A	MY40015758	05-20-2014
19	EMI Receiver	R&S	ESIB26	100280	03-12-2015
20	Pre-Amplifier	HP	83017A	MY39500982	02-19-2015
21	Pre-Amplifier	SONA INSTRUMENT	310	284609	01-08-2015
22	Biconi-Log Antenna	Schwarzbeck	VULB9168	9168-181	05-14-2015
24	Double Ridge Wave Guide	ETS-Lindgren	3115	9012-3595	10-21-2014
25	Double Ridge Wave Guide	ETS-Lindgren	3116	2664	10-15-2014