FCC Part 15 Subpart B&C §15.247

Test Report

Equipment Under Test	**Car Audio**
Model Name	**AGC-1035BU**
Applicant	**MOVON CORPORATION**
FCC ID	**YRN-AGC-1035BU**
Manufacturer	**DAEWOO IS CORPORATION.**
Date of Test(s)	**2011.11.30 ~ 2011.12.15**
Date of Issue	**2011.12.15**

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

Issue to	Issue by
DAEWOO IS CORPORATION 7F, NamkwangCentlex Bldg., 440-4Cheongcheon2-dong, Bupyeong-gu, Incheon-si, Korea Tel.: +82 +32363 3079 Fax: +82 +32 363 3120	MOVON CORPORATION 194-1, Geumeo-ri, Pogok-eup, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 449-812 Tel.: +82 +31 338 8837 Fax: +82 +31 338 8847

Revision history

Revision	Date of issue	Description	Revised by
--	Dec 13, 2011	Initial	--

Table of contents

1. Attestation of test results

1.1.Details of applicant

Applicant	:	DAEWOO IS CORPORATION
Address	:	7F, NamkwangCentlex Bldg., 440-4, Cheongcheon2-dong, Bupyeong-gu, Incheon-si, Korea
Contact Person	:	Jungjin Hong
Telephone	:	+82 32 363 3079
Fax	:	+82 32 363 3120

1.2. Summary of test results

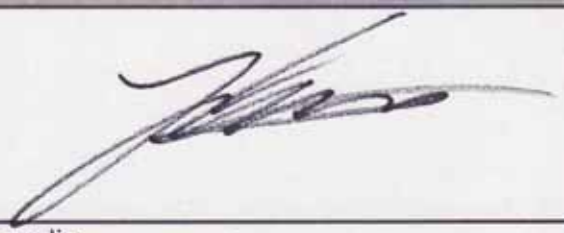
The EUT has been tested according to the following specifications;

Section in FCC part 15	Description	Result
§15.205(a) §15.209 §15.247(d)	Transmitter radiated spurious emissions, Conducted spurious emission	C
§15.109(a)	Receiver radiated spurious emission	C
§15.247(a)(1)	20 dB bandwidth and 99 % bandwidth	C
§15.247(b)(1)	Maximum peak output power	C
§15.247(a)(1)	Frequency separation	C
§15.247(a)(1)(iii)	Number of hopping frequency	C
§15.247(a)(1)(iii)	Time of occupancy(Dwell time)	C
§15.247(i) §1.1307(b)(1)	RF exposure evaluation	C

※ Abbreviation

C Complied
N/A Not applicable
F Fail

Approval Signatories

Test and Report Completed by :	Report Approval by :
	
Raymond Kim Test Engineer MOVON CORPORATION	Issac Jin Technical Manager MOVON CORPORATION

2. EUT Description

Kind of product	Car Audio
Model	AGC-1035BU
Serial Number	N/A
Power supply	DC 14.40 V
Frequency range	2 402 ㎒ ~ 2 480 ㎒
Modulation technique	GFSK,8DPSK
Number of channels	79
Operating conditions	- 20℃ ~ + 55℃
Antenna gain	-4.19 dBi(Max.)

2.1. Details of modification

None

3. Information about the FHSS characteristics

3.1. Pseudorandom frequency hopping sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1600 hops/s.

3.2. Medium access protocol

The manufacturer declares that the device uses Bluetooth protocol.
It confirmed that Medium access protocol is implemented.

3.3.Occupied hops while the equipment is operating

While the equipment is operating (transmitting and/or receiving) each channel of the hopping sequence is occupied at least once during four times the product of the dwell time per hop and the number of channels.

4. Measurement equipment

Equipment	Manufacturer	Model	Calibrationdue.
EMI Test Receiver	R&S	ESIB26	2011-12-27
Signal Generator	R&S	SMR27	2011-12-27
Spectrum Analyzer	R&S	FSV-40	2012-10-06
Bluetooth Tester	TESCON	TC-3000B	2012-10-06
Power Meter	Agilent	E4416A	2012-10-06
Power Sensor	Agilent	9327A	2012-10-07
Double Redge Horn Antenna	R&S	HF906	2012-12-17
Horn Antenna	A.H.SYSTEMS	SAS-572	2013-09-07
Ultra Broadband Antenna	R&S	HL562	2013-12-13
Power Amplifier	MITEQ	AM-1431	2012-10-07
Power Amplifier	MITEQ	AFS43-01002600	2012-10-07
High Pass Filter	Wainwright	WHK3.0/18G-10SS	2012-10-06
DC Power Supply	HP	6674A	2012-10-07
EMI Receiver	LIG Nex1	ER-30	2012-02-16
Artificial Network	R&S	ESH3-Z5	2011-12-27
Controller	INNCO	CO2000	N/A
Antenna Master	INNCO	MA4000	N/A

※Remark;
Support equipment

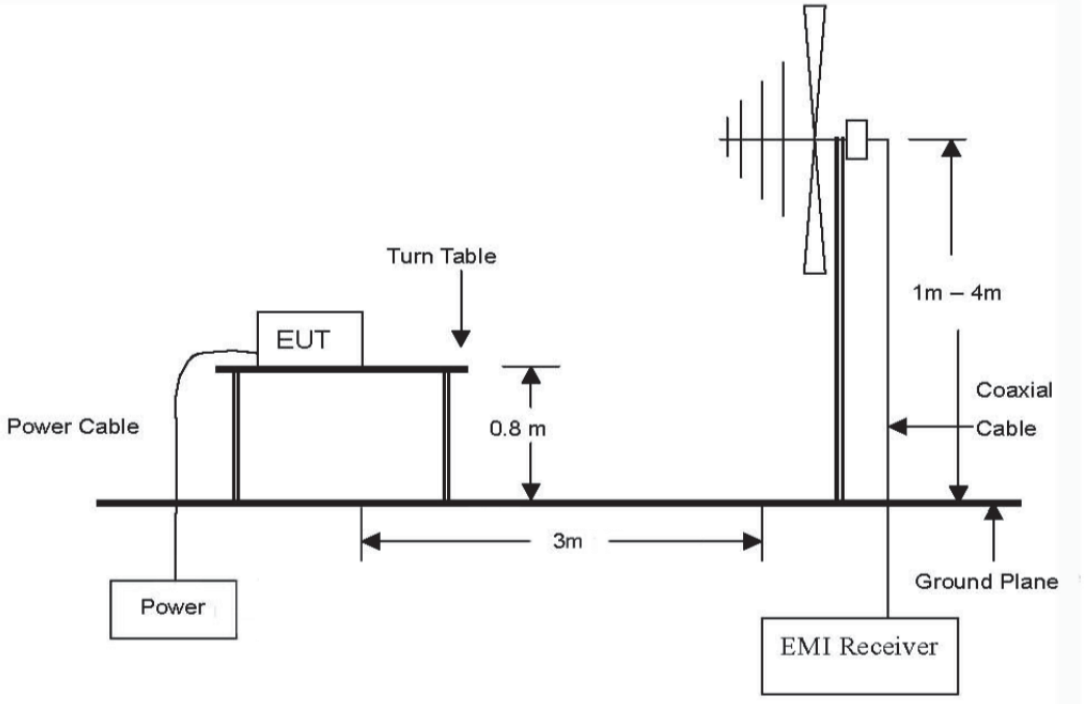
Description	Manufacturer	Model	Serial number
Notebook computer	Samsung Electronics.	SENS P30	W3179RFX300144N

5. Transmitter radiated spurious emissions and conducted spurious emissions

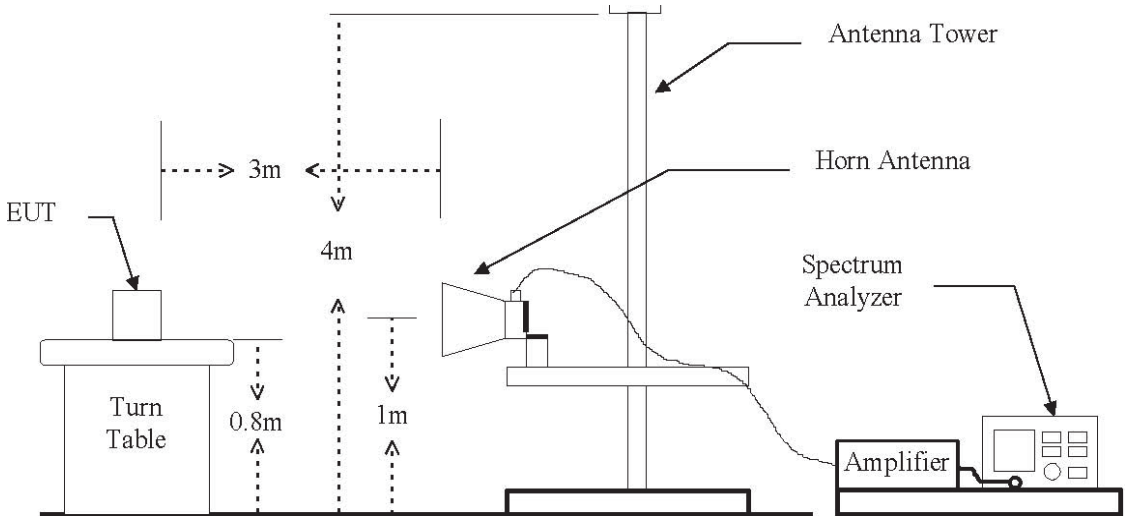
5.1. Test setup

5.1.1. Transmitter radiated spurious emissions

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to 24 ㎓ emissions.



5.2. Limit

According to §15.247(d), in any 100 ㎑ 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 ㏈ below that in the 100 ㎑ bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement , provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval , as permitted under paragraph(b)(3) of this section , the attenuation required under this paragraph shall be 30 ㏈ instead of 20 ㏈. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 15.109(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (㎒)	Distance (Meters)	Radiated (㏈㎶/m)	Radiated (㎶/m)
30 - 88	3	40.0	100
88 – 216	3	43.5	150
216 – 960	3	46.0	200
Above 960	3	54.0	500

5.3. Test procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

5.3.1. Test procedures for radiated spurious emissions

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 ㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meters away from the interference-receiving antenna.
3. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10 ㏈ lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 ㏈ margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

※ Remark;

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 ㎑ for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 ㎓.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection and frequency above 1 ㎓.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 ㎒z and the video bandwidth is 10 ㎐ for Average detection (AV) at frequency above 1 ㎓.

5.3.2. Test procedures for conducted spurious emissions

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=100 ㎑,VBW=100 ㎑.

5.4. Test result

Ambient temperature: 23℃
Relative humidity: 46 % R.H.

5.4.1. Spurious radiated emission

The frequency spectrum from 30 ㎒ to 1 000 ㎒ was investigated. Emission levels are not reported muchlower than the limits by over 40 ㏈. All reading values are peak values.
To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Operation mode: GFSK
A. Low channel (2 402 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.	Ant. factor (㏈/m)	CL (dB)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
129.13	27.97	Peak	H	11.18	0.86	40.01	43.50	3.49
259.32	26.60	Peak	H	11.57	1.15	39.32	46.00	6.68
Above 260.00								

B. Middle channel (2 441 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.	Ant. factor (㏈/m)	CL (dB)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
129.13	29.27	Peak	H	11.18	0.86	41.31	43.50	2.19
259.32	27.20	Peak	H	11.57	1.15	39.92	46.00	6.08
Above 260.00								

C. High channel (2 480 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.	Ant. factor (㏈/m)	CL (dB)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
129.13	26.84	Peak	H	11.18	0.86	38.88	43.50	4.62
259.32	27.84	Peak	H	11.57	1.15	40.56	46.00	5.44
Above 260.00								

※ Remark
1. Actual = Reading + Ant. factor + Amp + CL (Cable loss)

Operation mode: 8DPSK

A. Low channel (2 402 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
129.13	27.41	Peak	H	11.18	0.86	39.45	43.50	4.05
259.32	26.53	Peak	H	11.57	1.15	39.25	46.00	6.75
Above 260.00								

B. Middle channel (2 441 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
129.13	27.50	Peak	H	11.18	0.86	39.54	43.50	3.96
259.32	27.39	Peak	H	11.57	1.15	40.11	46.00	5.89
Above 260.00								

C. High channel (2 480 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
129.13	28.21	Peak	H	11.18	0.86	40.25	43.50	3.25
259.32	28.50	Peak	H	11.57	1.15	41.22	46.00	4.78
Above 260.00								

※ Remark

1. Actual = Reading + Ant. factor + Amp + CL(Cable loss)

5.4.2. Spurious radiated emission

The frequency spectrum above 1 000 ㎒was investigated. Emission levels are not reported much lower thanthe limits by over 40 ㏈.

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Operation mode: GFSK

A. Low channel (2 402 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.	Ant. factor (㏈/m)	Amp+CL (dB)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
2 390.00*	63.25	Peak	V	28.29	-38.59	52.95	74.00	21.05
2 390.00*	54.24	Average	V	28.29	-38.59	43.94	54.00	10.06
2 390.00*	65.11	Peak	H	28.29	-38.59	54.81	74.00	19.19
2 390.00*	55.27	Average	H	28.29	-38.59	44.97	54.00	9.03
No other emissions were detected at a level greater than 20dB below limit.								
Above 4 900.00	Not detected							

B. Middle channel (2 441 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.	Ant. factor (㏈/m)	Amp+CL (dB)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
No other emissions were detected at a level greater than 20dB below limit.								
Above 4 900.00	Not detected							

C. High channel (2 480 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
2 483.50*	71.58	Peak	V	28.29	-38.59	61.28	74.00	12.72
2 483.50*	54.36	Average	V	28.29	-38.59	44.06	54.00	9.94
2 483.50*	65.25	Peak	H	28.29	-38.59	54.95	74.00	19.05
2 483.50*	54.10	Average	H	28.29	-38.59	43.80	54.00	10.20
No other emissions were detected at a level greater than 20dB below limit.								
Above 5 000.00	Not detected							

Operation mode: 8DPSK

A. Low channel (2 402 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
2 390.00*	65.87	Peak	V	28.29	-38.59	55.57	74.00	18.43
2 390.00*	54.25	Average	V	28.29	-38.59	43.95	54.00	10.05
2 390.00*	64.35	Peak	H	28.29	-38.59	54.05	74.00	19.95
2 390.00*	56.58	Average	H	28.29	-38.59	46.28	54.00	7.72
No other emissions were detected at a level greater than 20dB below limit.								
Above 4 900.00	Not detected							

B. Middle channel (2 441 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.								
Above 4 900.00	Not detected							

C. High channel (2 480 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
2 483.50*	71.25	Peak	V	28.29	-38.59	60.95	74.00	13.05
2 483.50*	54.38	Average	V	28.29	-38.59	44.08	54.00	9.92
2 483.50*	66.58	Peak	H	28.29	-38.59	56.28	74.00	17.72
2 483.50*	57.25	Average	H	28.29	-38.59	46.95	54.00	7.05
No other emissions were detected at a level greater than 20dB below limit.								
Above 5 000.00	Not detected							

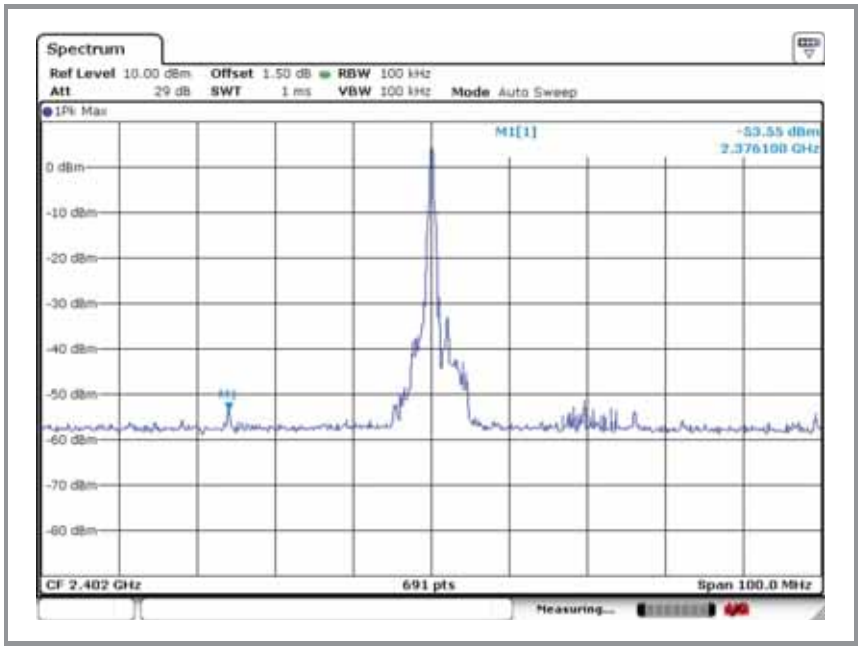
※ Remark

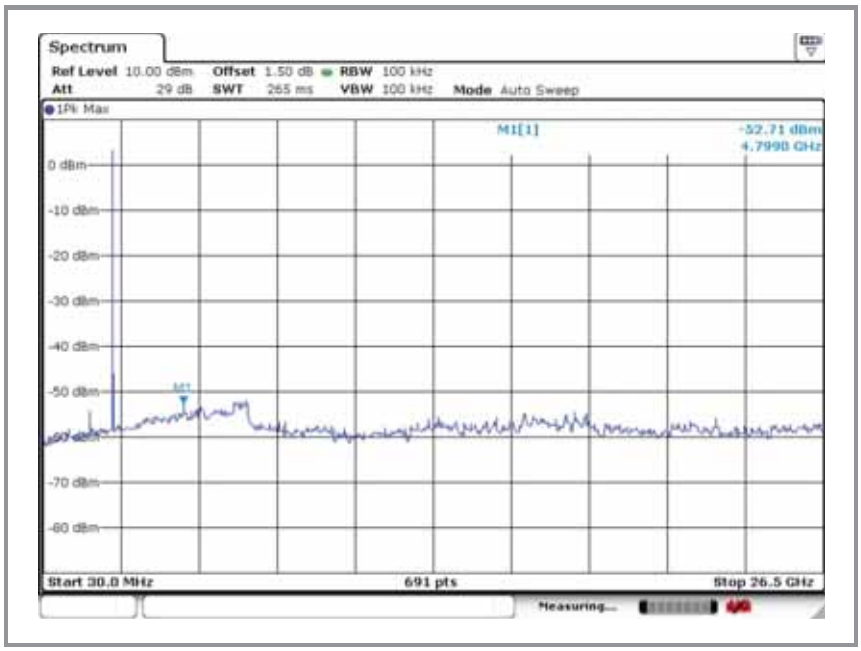
1. "*" means the restricted band.
2. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental Frequency.
3. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument usingpeak/average detector mode.
4. Average test would be performed if the peak result were greater than the average limit.
5. Actual = Reading + Ant. factor + Amp + CL (Cable loss)

5.4.3. Spurious RF conducted emissions: Plot of spurious RF conducted emission

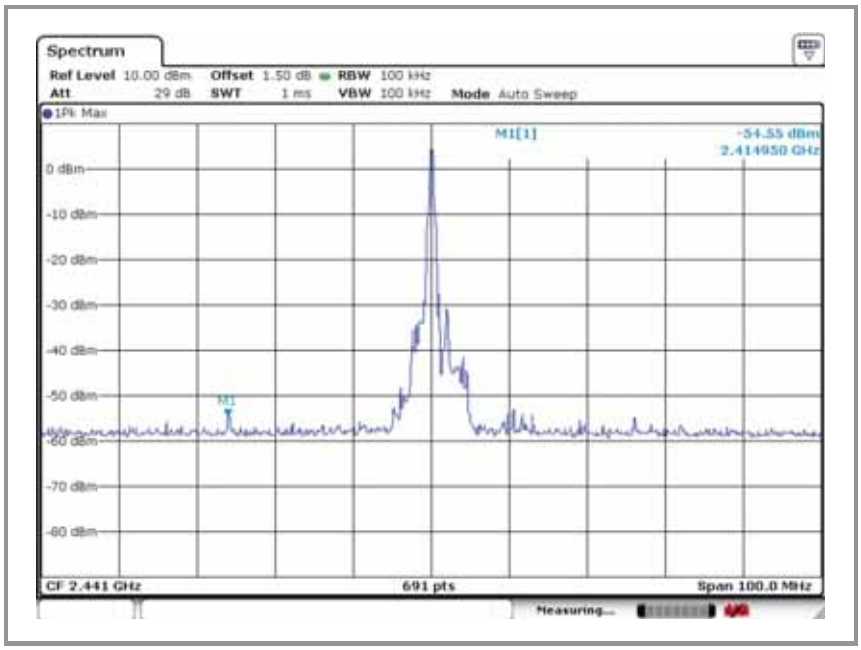
Operation mode: GFSK,

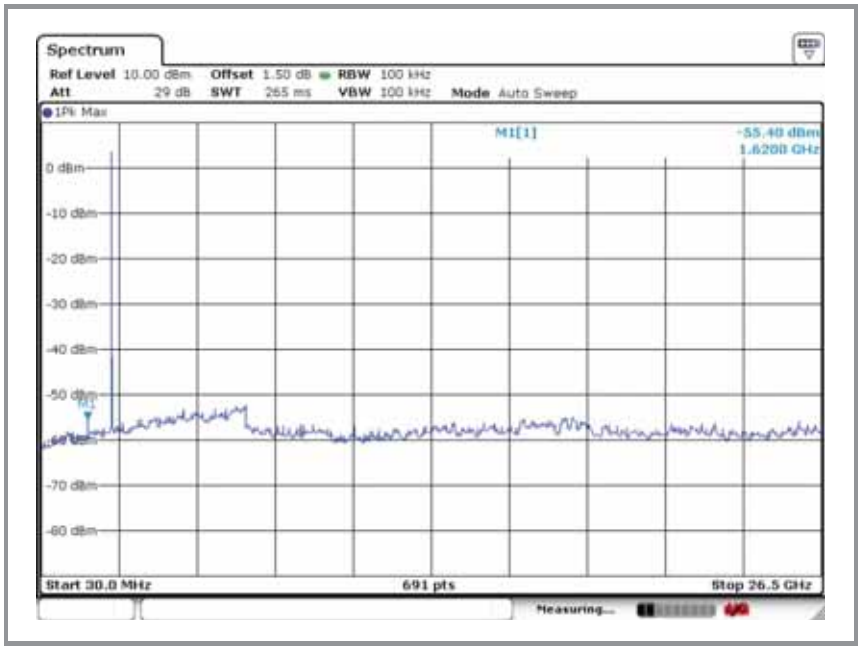
A. Low channel(2 402 ㎒)



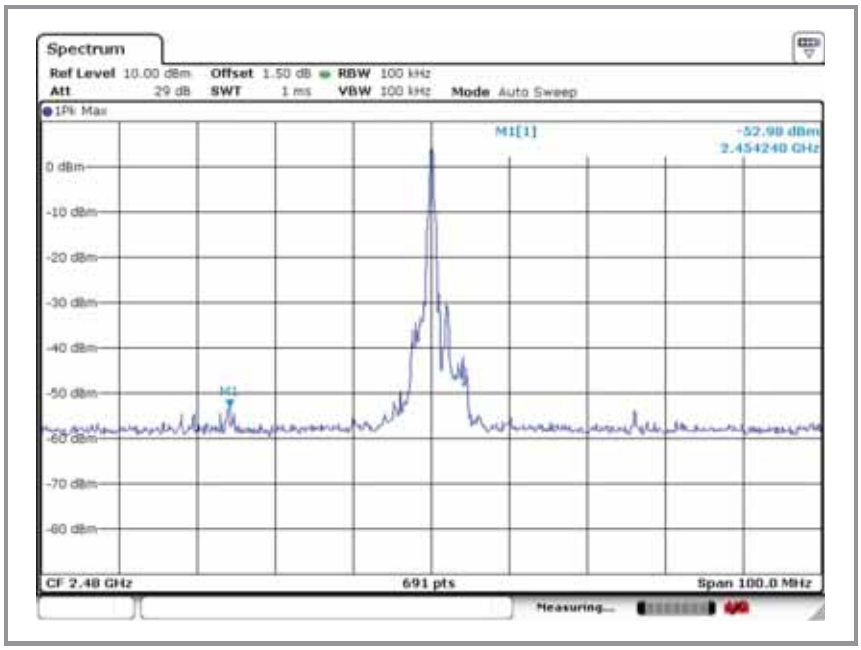


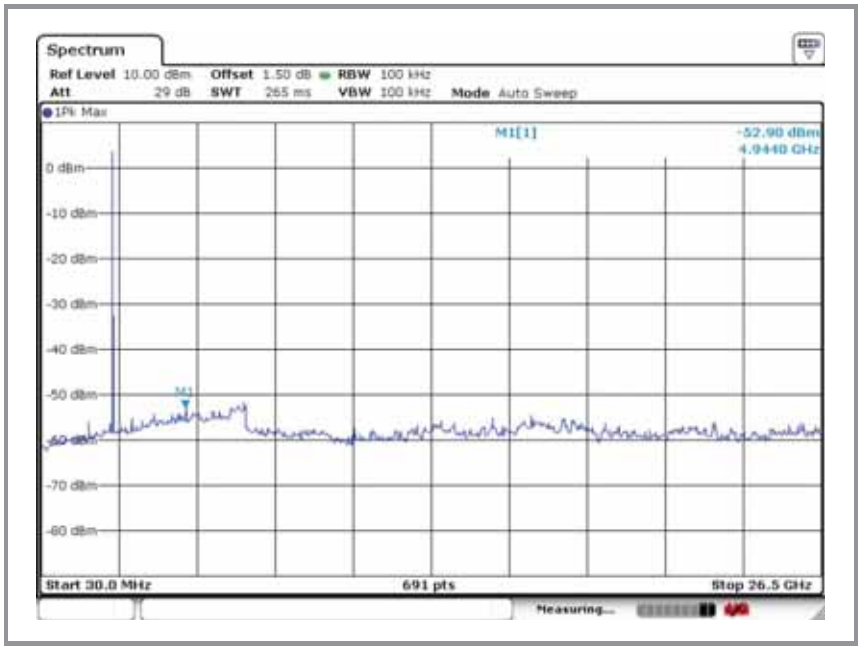
B. Middle channel(2 441 ㎒)



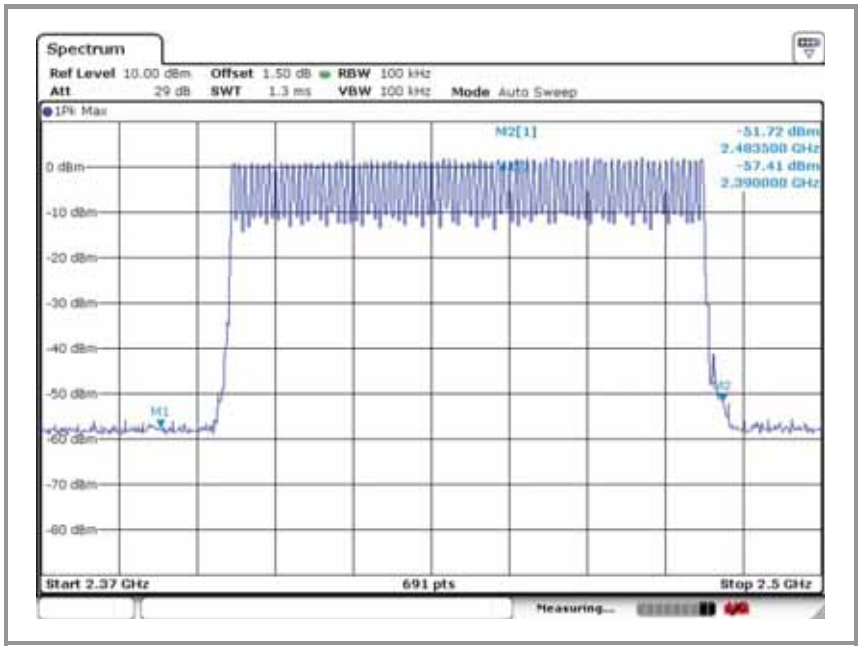


C. High channel(2 480 ㎒)



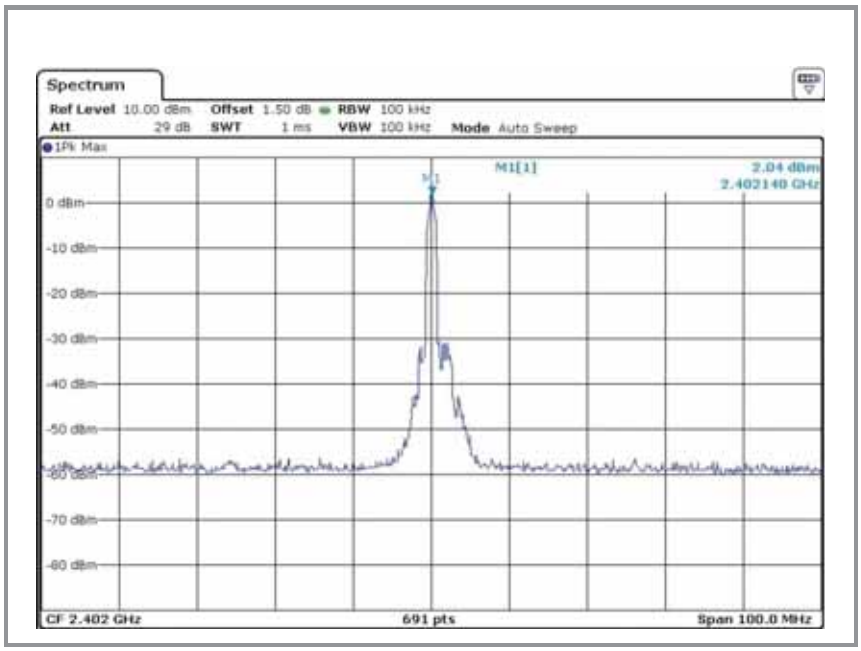


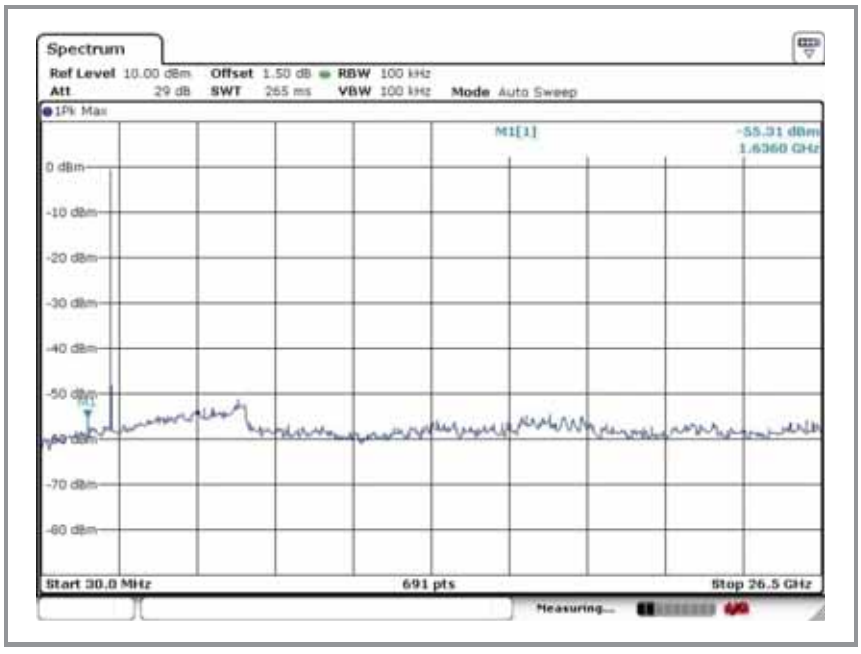
D. Band edge at hopping mode



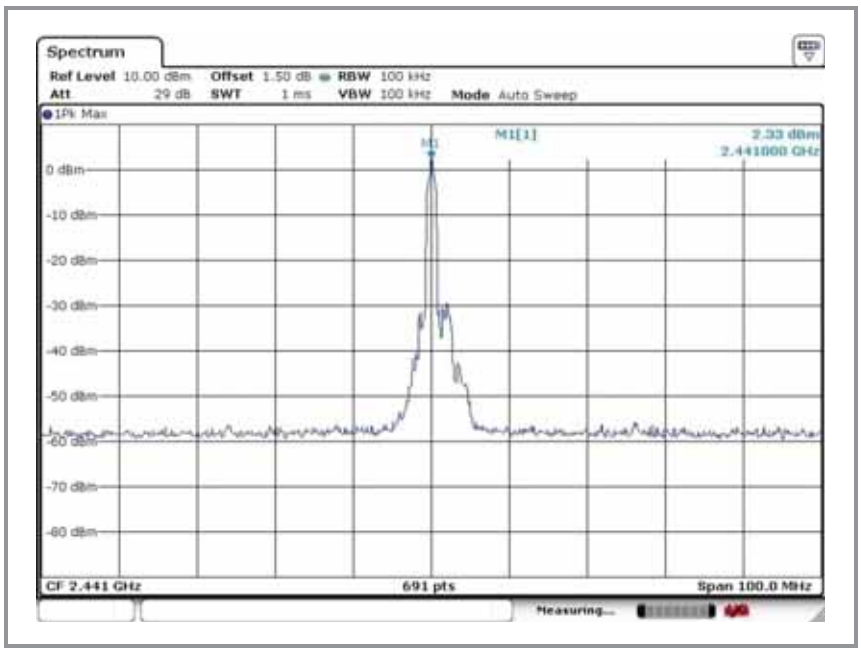
Operation mode:8DPSK

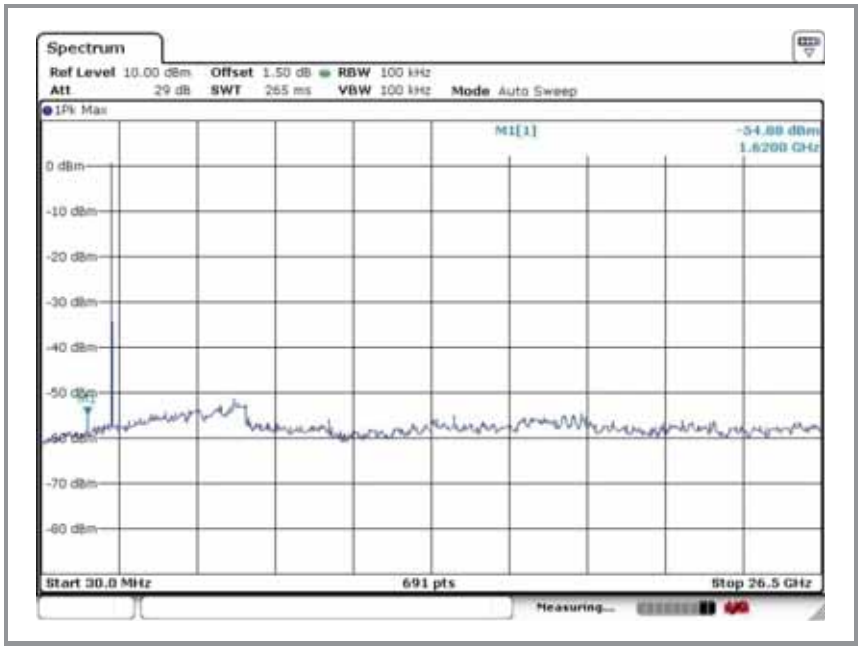
A. Low channel(2 402 ㎒)



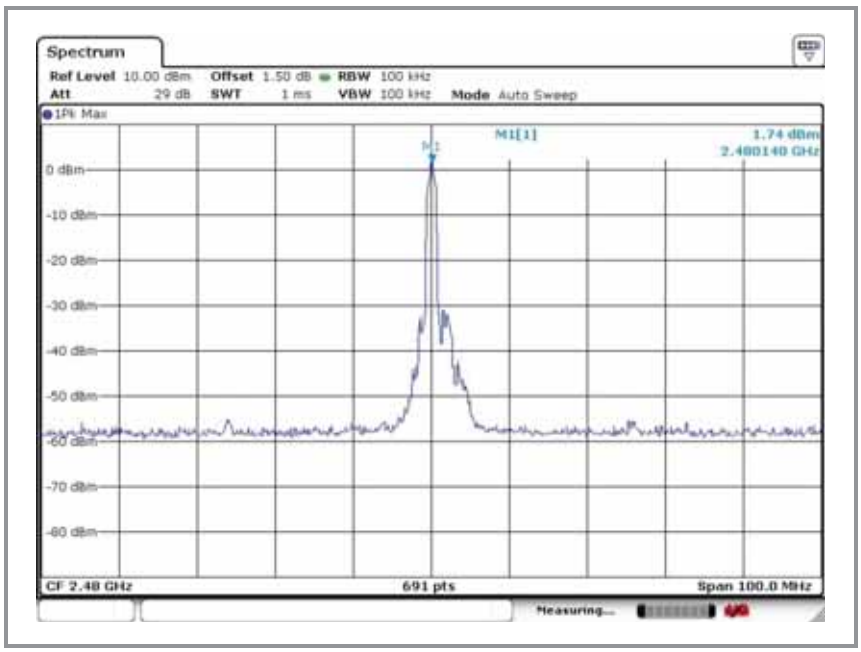


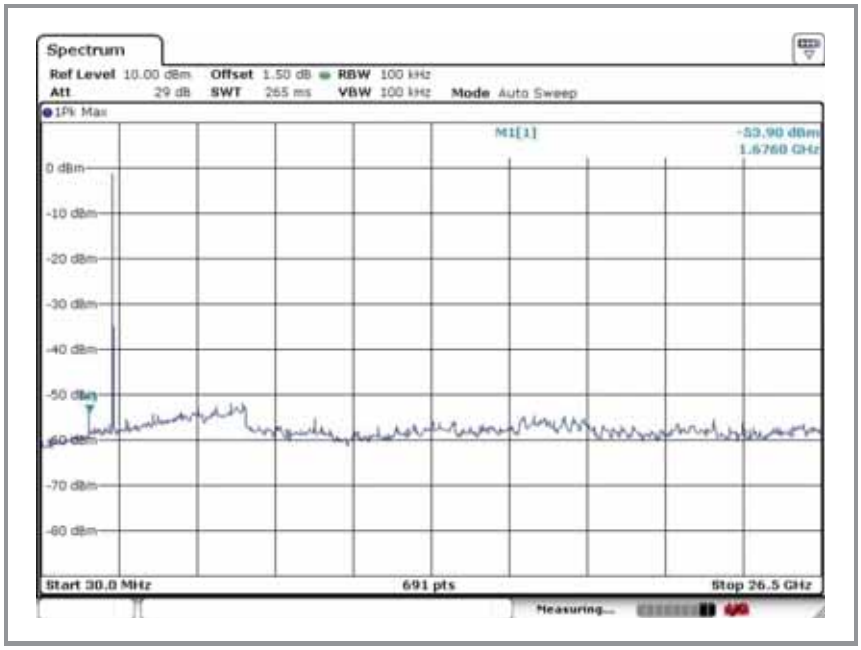
B. Middle channel(2 441 ㎒)



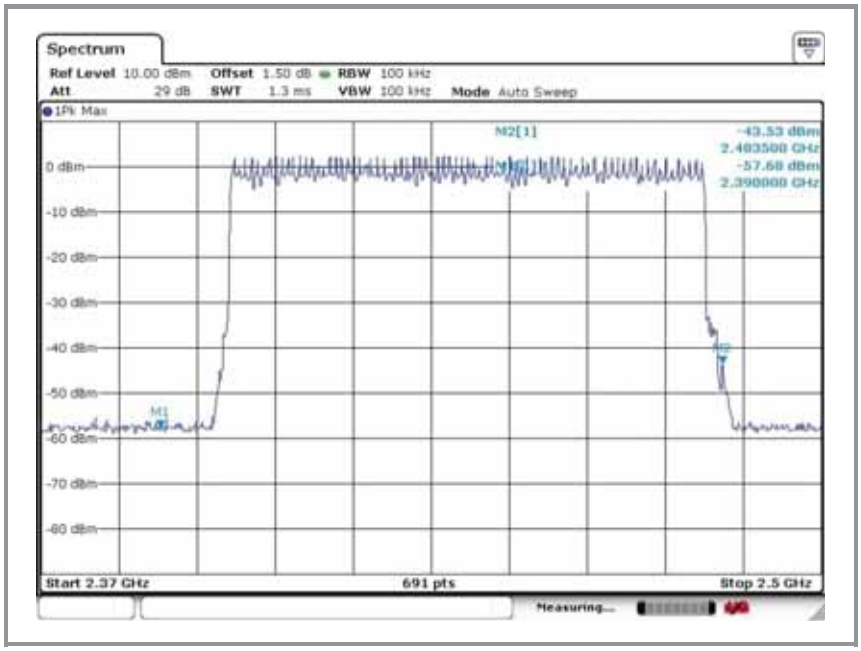


C. High channel(2 480 ㎒)





D. Band edge at hopping mode



6. Receiver radiated spurious emissions

6.1. Test setup

Same as clause 5.1.

6.1.1.Receiver radiated spurious emissions

Same as clause 5.1.1

6.2.Limit

According to §15.109(a), Except for Class A digital devices, the field strength of radiated emission fromunintentional radiator at a distance of 3 m shall not exceed the following values:

Frequency (㎒)	Distance (Meters)	Radiated (dB㎶/m)	Radiated (㎶/m)
30 - 88	3	40.0	100
88 – 216	3	43.5	150
216 – 960	3	46.0	200
Above 960	3	54.0	500

6.3.Test procedures

Same as clause 2.3.

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

6.3.1.Test procedures for radiated spurious emissions

Same as Clause 5.3.1.

6.4.Test results

Ambient temperature: 23℃
Relative humidity: 46 % R.H.

6.4.1.Spurious radiated emission.

The frequency spectrum from 30 ㎒ to 26.5 ㎓ was investigated. Emission levels are not reported muchlower than the limits by over 40 ㏈. All reading values are peak values.
To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Operation mode: GFSK
A. Low channel(2 402 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.	Ant. factor (㏈/m)	CL (dB)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
129.13	26.15	Peak	H	11.18	0.86	38.25	43.50	5.25
259.32	25.34	Peak	H	11.57	1.15	38.84	46.00	7.16
Above 960.00	Not detected							

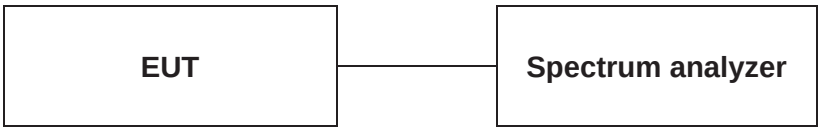
Operation mode: 8DPSK
A. Low channel(2 402 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.	Ant. factor (㏈/m)	CL (dB)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
129.13	26.15	Peak	H	11.18	0.86	39.28	43.50	4.22
259.32	25.34	Peak	H	11.57	1.15	40.54	46.00	5.46
Above 960.00	Not detected							

※ Remark:
1. All spurious emission at channels are almost the same from 30 ㎒ to 26.5 ㎓, so that the low channel was chosen at representative in final test.
2. Actual = Reading + Ant. factor + CL (Cable loss)

7. *20 dB bandwidth measurement & 99 % bandwidth measurement*

7.1. Test setup



7.2. Limit

Not applicable

7.3. Test procedure

1. The 20 dB band width was measured with a spectrum analyzer connected to RF antenna connector(conducted measurement) while EUT was operating in transmit mode at the appropriate centerfrequency. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.Display Line and Marker Delta functions, the 20 dBband width of the emission was determined.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 10 ㎑,VBW = 10 ㎑, Span = 5 ㎒.

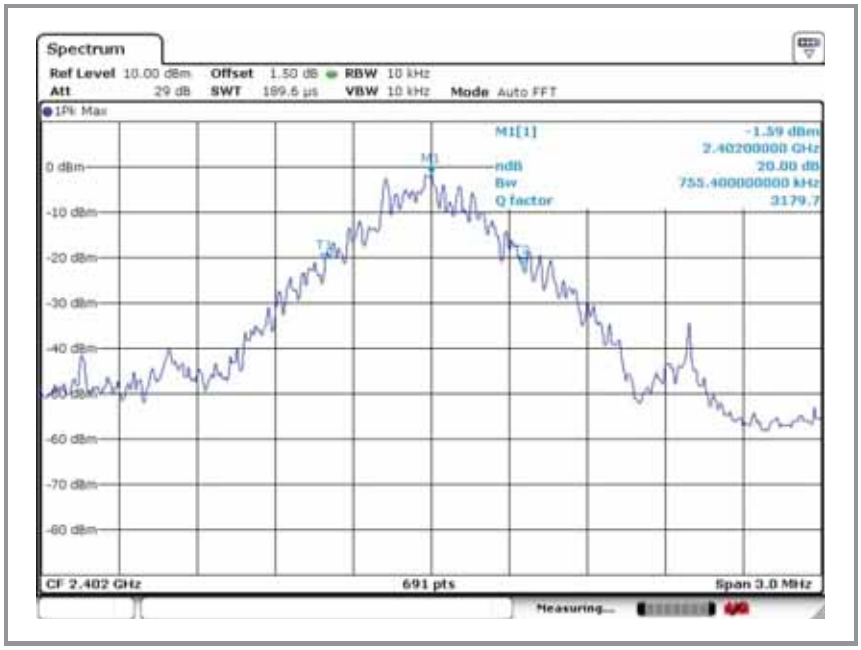
7.4. Test results

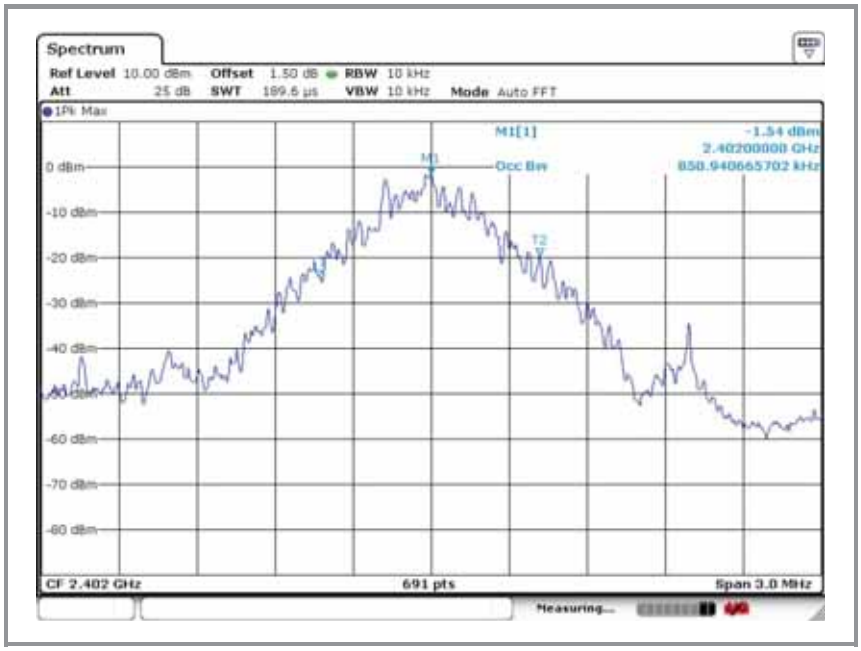
Ambient temperature: 23℃
Relative humidity: 46 % R.H.

Operation mode	Frequency(㎒)	20 dB bandwidth(㎒)	99 % bandwidth(㎒)
GFSK	2 402	0.755	0.851
	2 441	0.760	0.855
	2 480	0.760	0.855
8DPSK	2 402	1.126	1.177
	2 441	1.126	1.177
	2 480	1.121	1.177

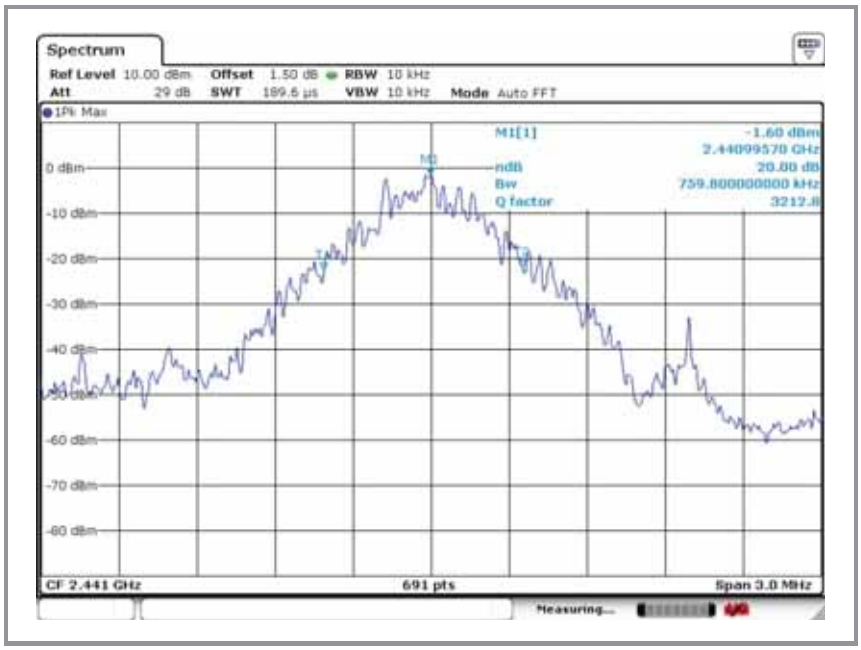
Operation mode: GFSK

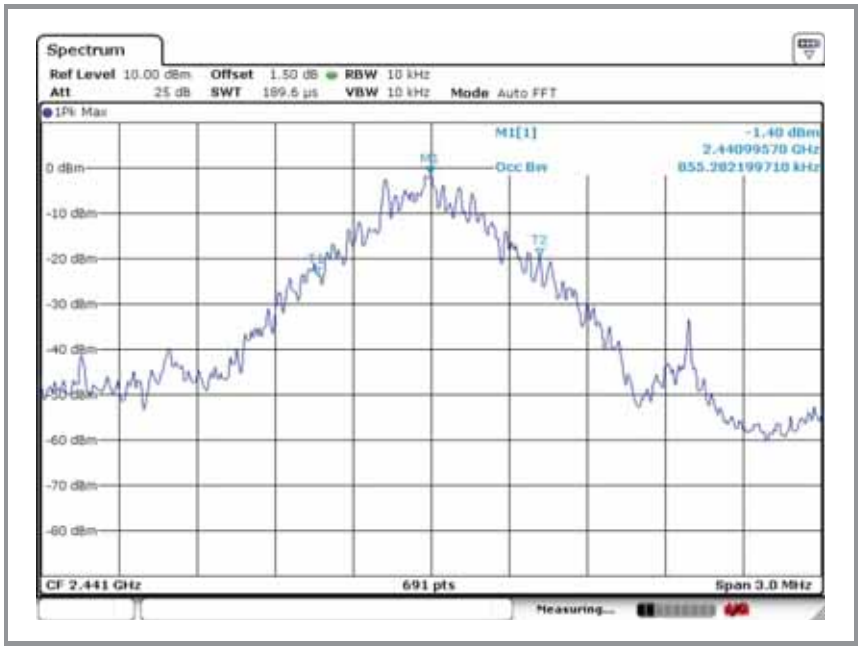
A. Low channel(2 402 ㎒)– 20 ㏈ bandwidth & 99 % bandwidth



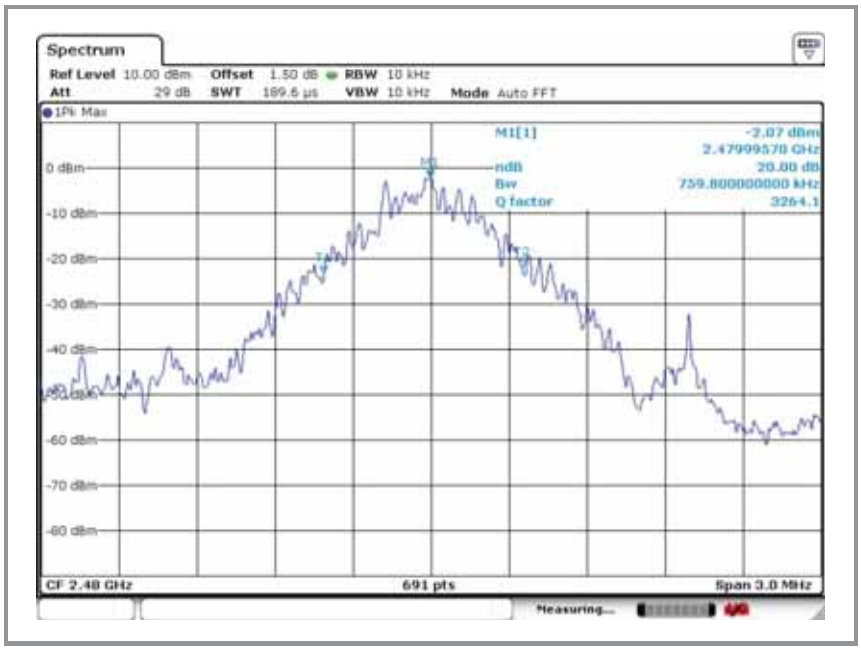


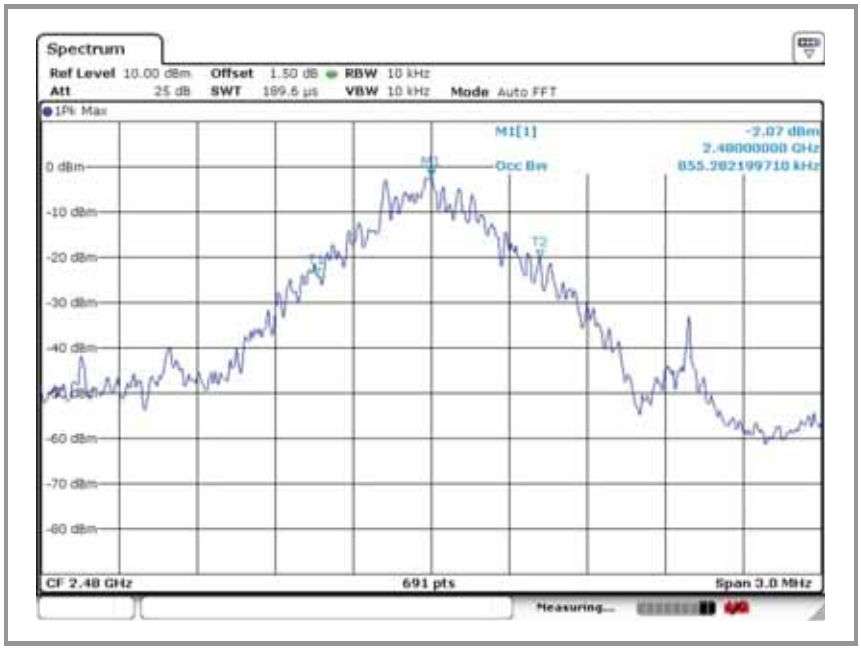
B. Middle channel(2 441 ㎒)– 20 ㏈ bandwidth & 99 % bandwidth





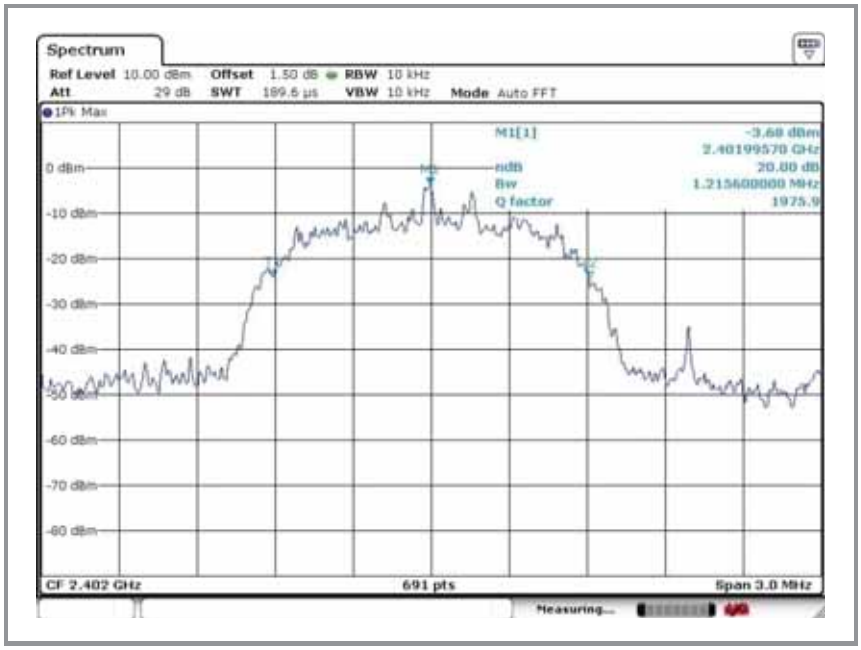
C. High channel(2 480 ㎒)– 20 ㏈ bandwidth & 99 % bandwidth

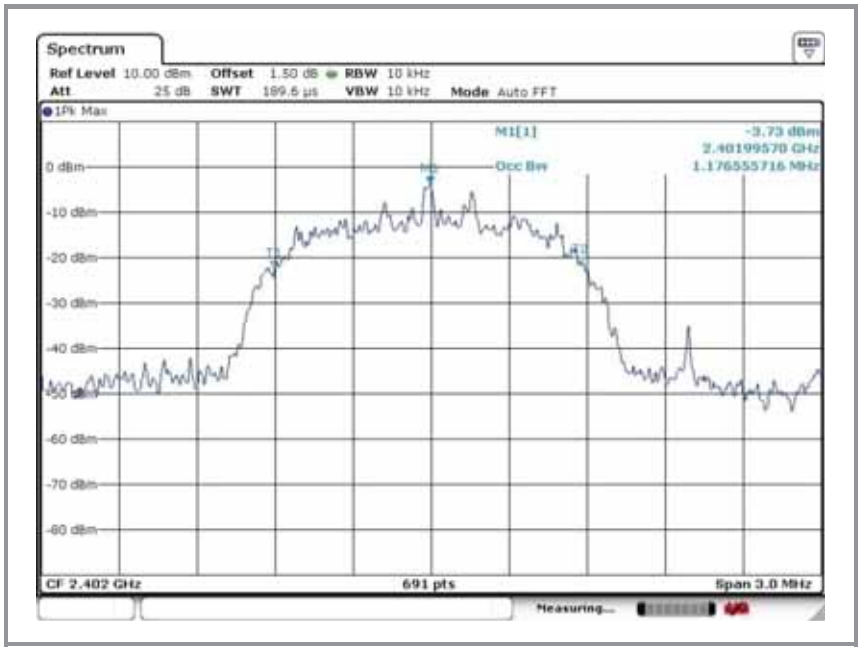




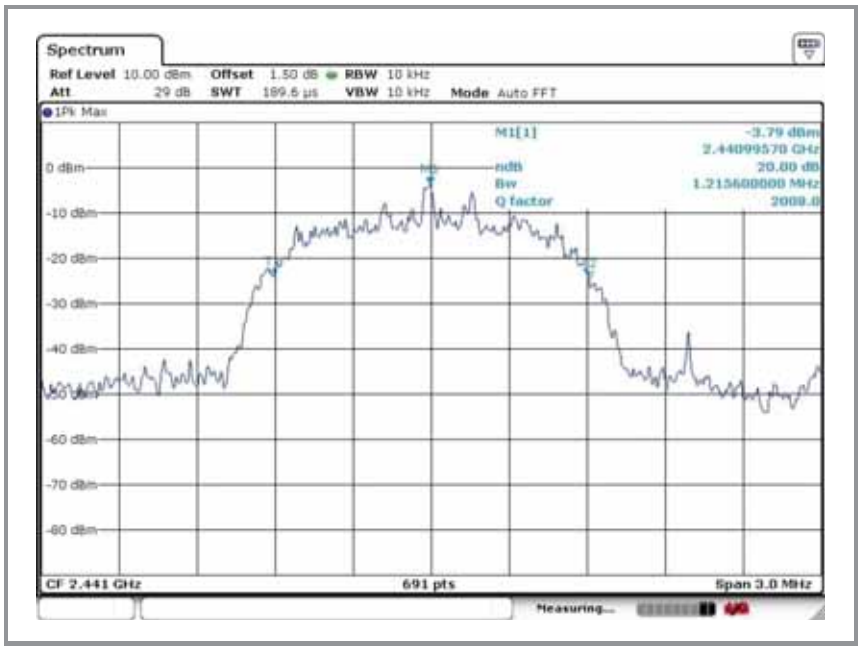
Operation mode: 8DPSK

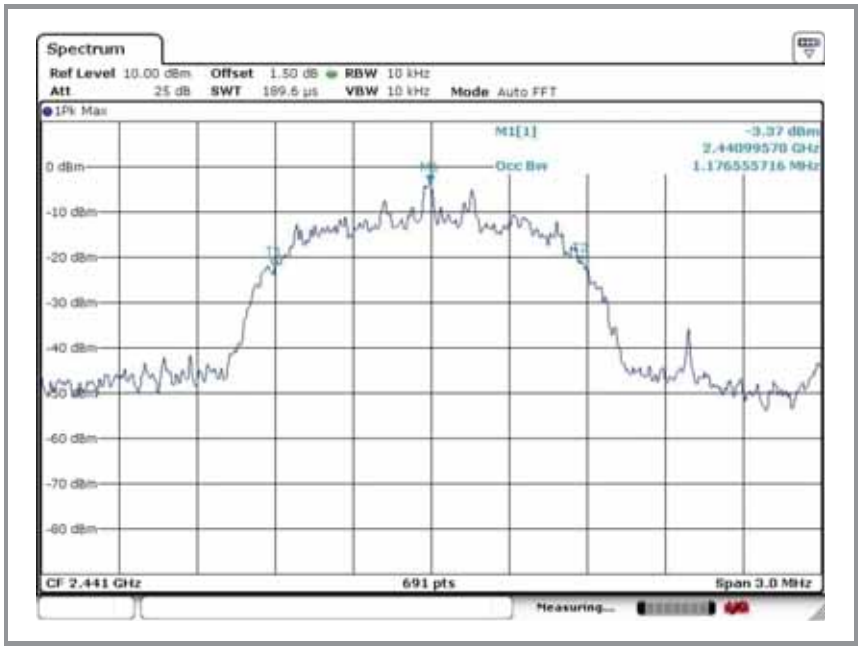
A. Low channel(2 402 ㎒)– 20 ㏈ bandwidth & 99 % bandwidth



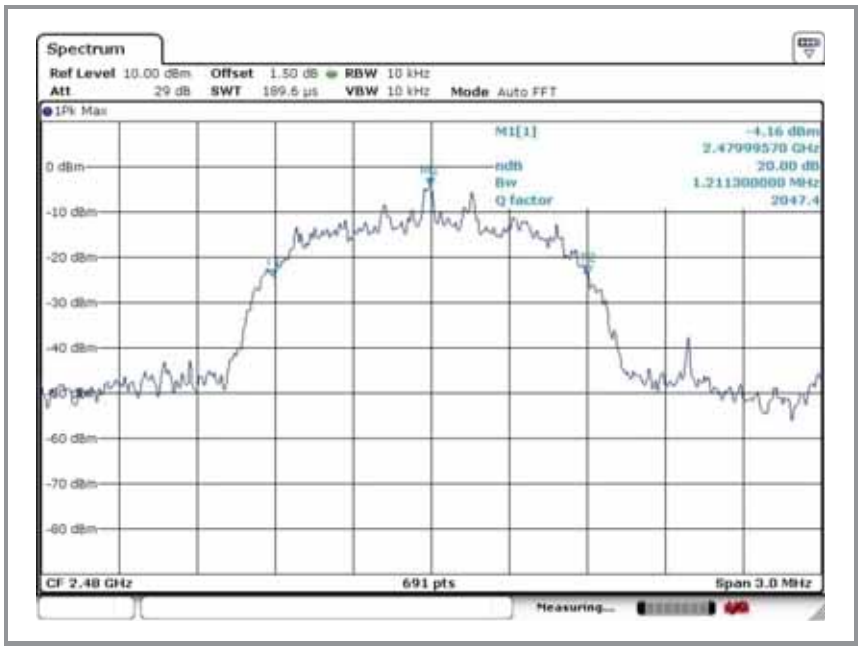


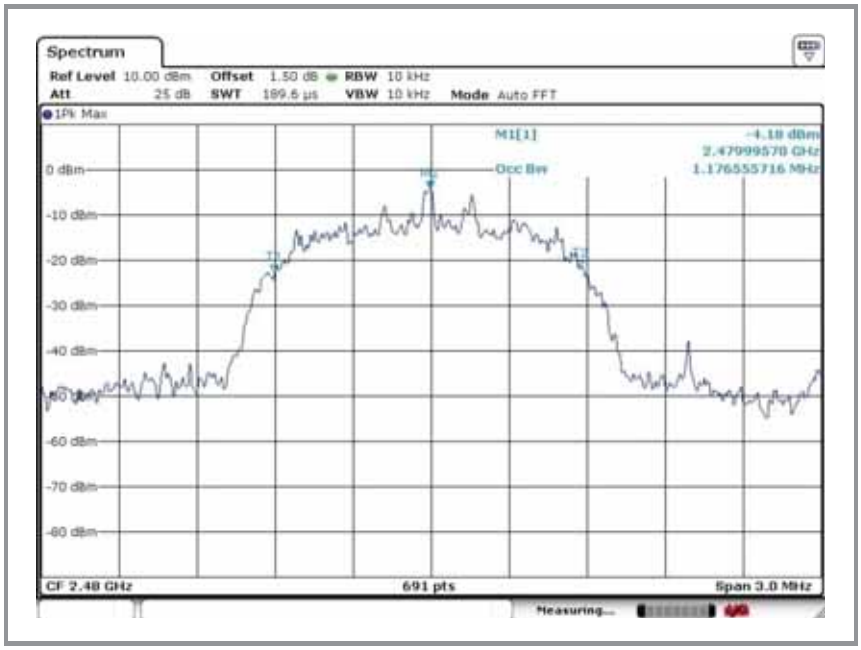
B. Middle channel(2 441 ㎒)– 20 ㏈ bandwidth & 99 % bandwidth





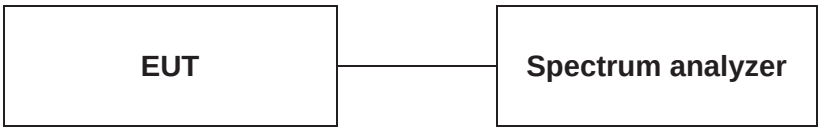
C. High channel(2 480 ㎒)– 20 ㏈ bandwidth & 99 % bandwidth





8. Maximum peak output power measurement

8.1. Test setup.



8.2. Limit

The maximum peak output power of the intentional radiator shall not exceed the following:

1. §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by aminimum of 25 ㎑or the 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided thesystems operate with an output power no greater than 125 ㎽
2. §15.247(b)(1), For frequency hopping systems operating in the 2400–2483.5 ㎒ employing at least 75non-overlapping hopping channels, and all frequency hopping systems in the 5725–5805 ㎒ band: 1Watt.

8.3. Test procedure

1. The RF power output was measured with a Spectrum analyzer connected to the RF Antenna connector(conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency,A spectrum analyzer was used to record the shape of the transmit signal.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using;
   Span = approximately 5 times the 20 ㏈ bandwidth, centered on a hopping channel
   RBW ≥ 20㏈ BW, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold

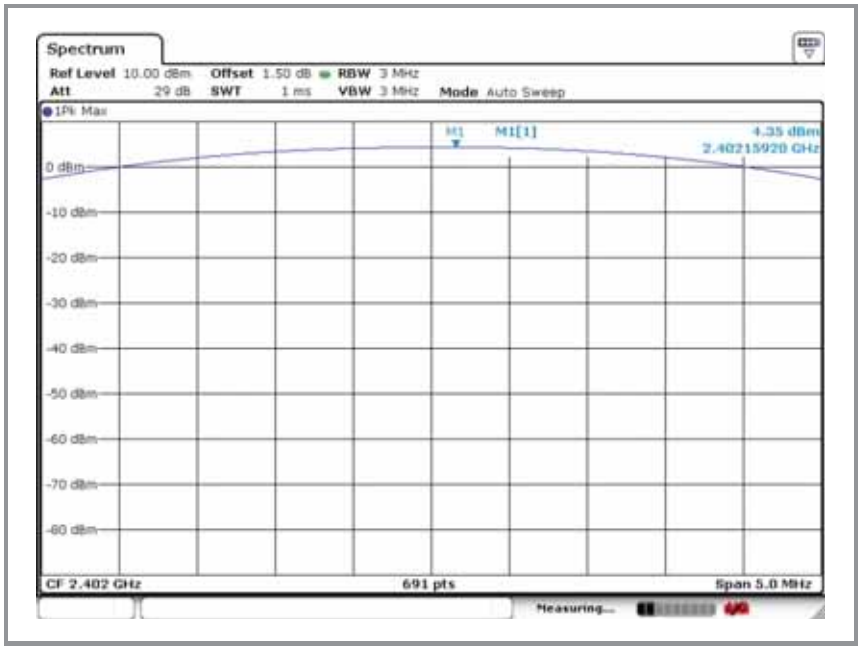
8.4. Test results

Ambient temperature: 23℃
Relative humidity: 46 % R.H.

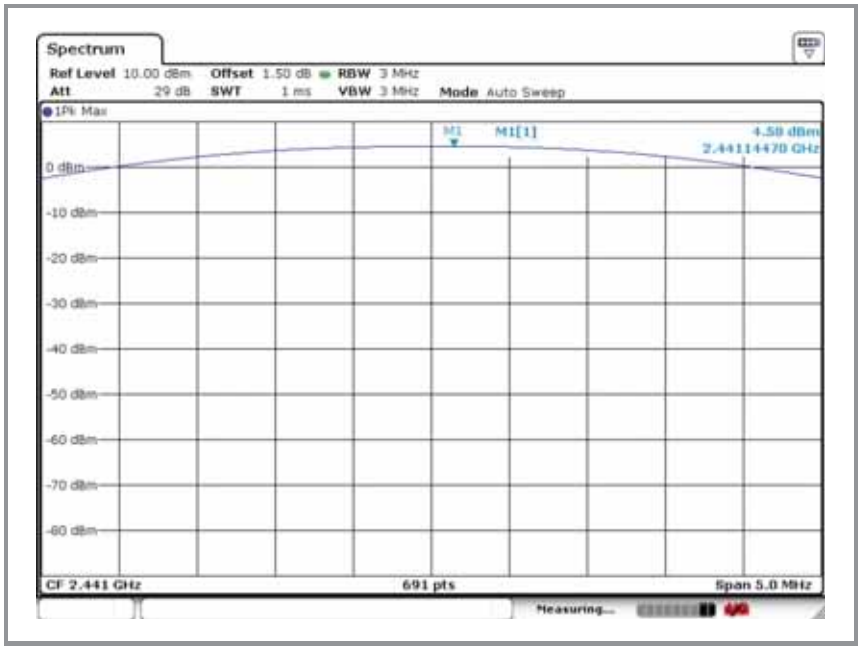
Operation mode	Frequency(㎒)	Peak output power(㏈m)	Limit(㏈m)
GFSK	2 402	4.35	30
	2 441	4.58	30
	2 480	4.08	30
8DPSK	2 402	3.16	30
	2 441	3.17	30
	2 480	2.83	30

Operation mode: GFSK

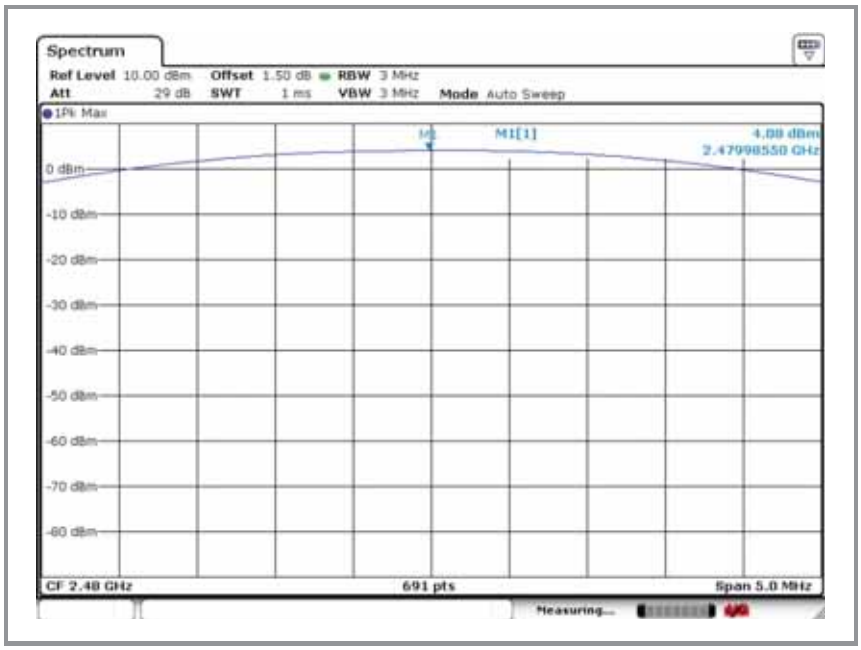
A. Low channel(2 402 ㎒)



B. Middle channel(2 441 ㎒)

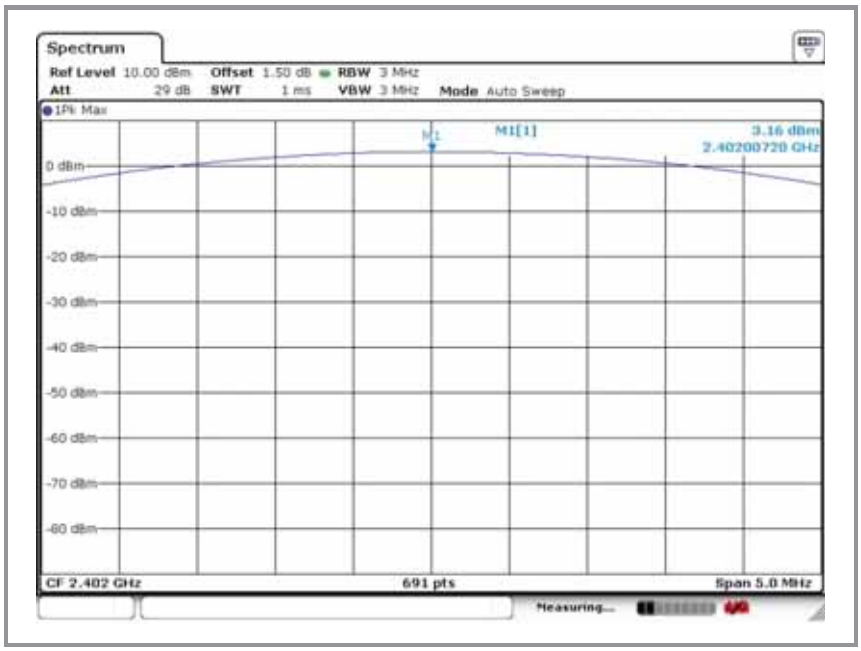


C. High channel(2 480 ㎒)

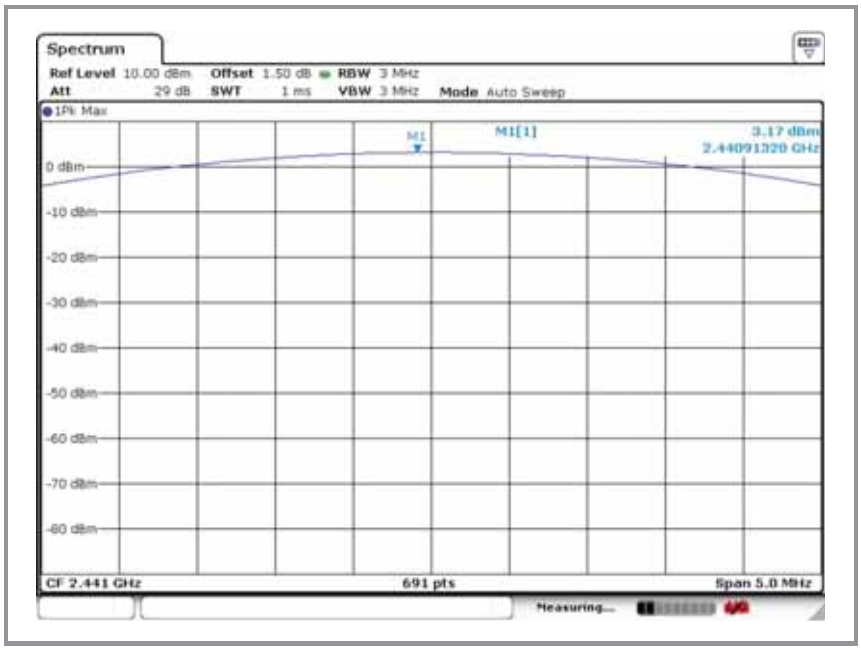


Operation mode: 8DPSK

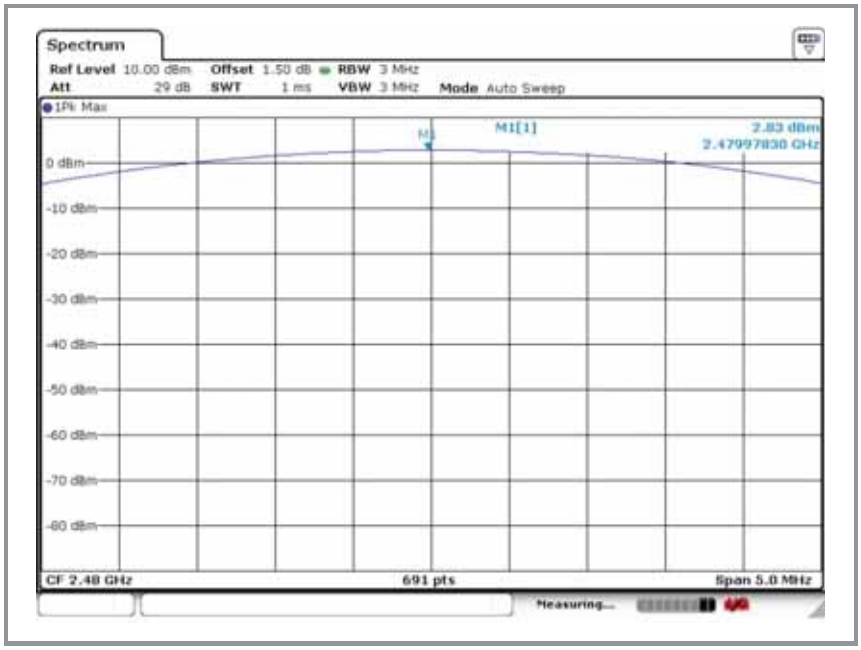
A. Low channel(2 402 ㎒)



B. Middle channel(2 441 ㎒)

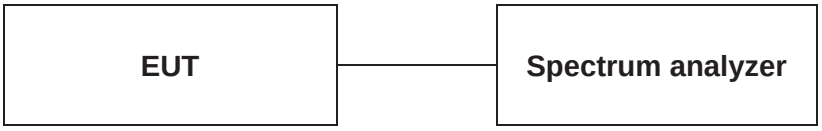


C. High channel(2 480 ㎒)



9. Hopping channel separation

9.1. Test setup



9.2. Limit

§15.247(a)(1) Frequency hopping system operating in 2 400 – 2 483.5 ㎒. Band may have hopping channel carrier frequencies that are separated by 25 ㎑ or two-third of 20 ㏈ bandwidth of the hopping channel,whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.

9.3. Test procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signalfrom an external generator.
2. Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUTand connect it to measurement instrument. Then set it to any one convenient frequency within its operatingrange.
3. By using the max hold function record the separation of adjacent channels.
4. Measure the frequency difference of these two adjacent channels by spectrum analyzer mark function.And then plot the result on spectrum analyzer screen.
5. Repeat above procedures until all frequencies measured were complete.
6. Set center frequency of spectrum analyzer = middle of hopping channel.
7. Set the spectrum analyzer as RBW = 100 ㎑, VBW = 100 ㎑, Span = 5 ㎒ and Sweep = auto.

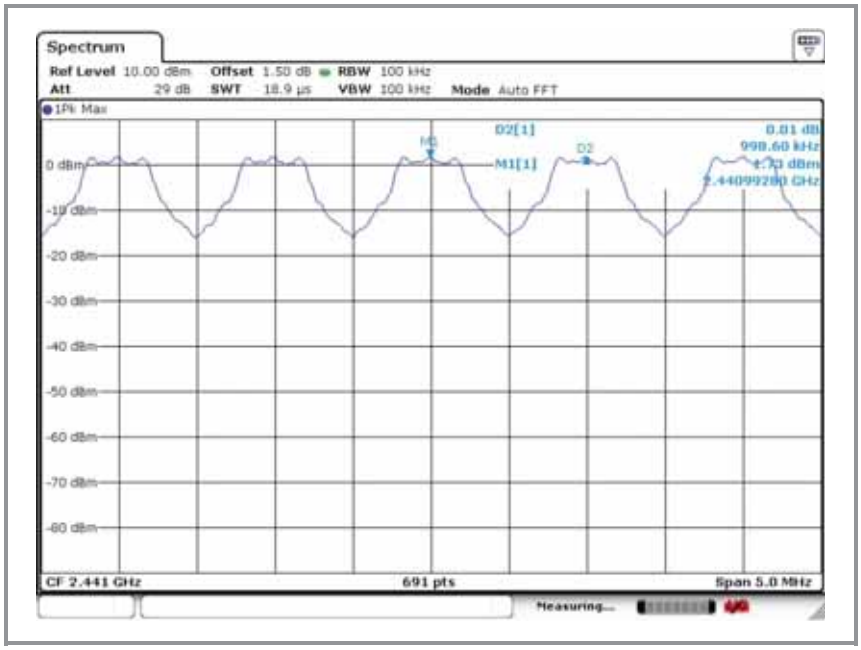
9.4. Test results

Ambient temperature: 23℃
Relative humidity: 46 % R.H.

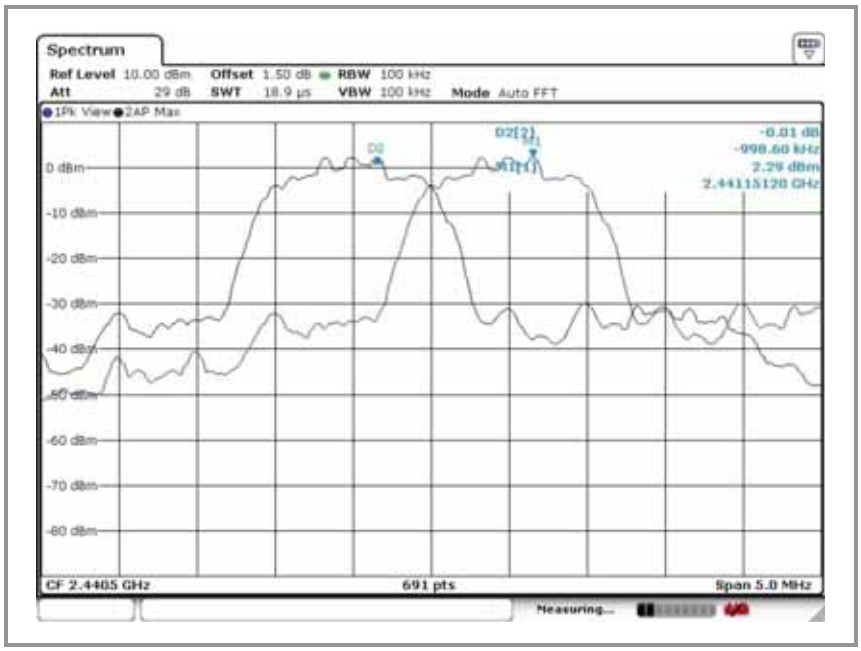
Operation mode	Frequency (㎒)	Adjacent hopping Channel separation (㎑)	Two-third of 20 ㏈ bandwidth (㎑)	Minimum bandwidth (㎑)
GFSK	2 441	1 000		25

※ Remark:
20 ㏈bandwidth measurement, the measured channel separation should be greater than two-third of 20 ㏈bandwidth or Minimum bandwidth.

Operation mode : GFSK



Operation mode: 8DPSK



10. Number of hopping frequency

10.1. Test setup

10.2. Limit

§15.247(a)(1)(iii) For frequency hopping system operating in the 2400-2483.5㎒ bands shall use at least15 hopping frequencies.

10.3. Test procedure

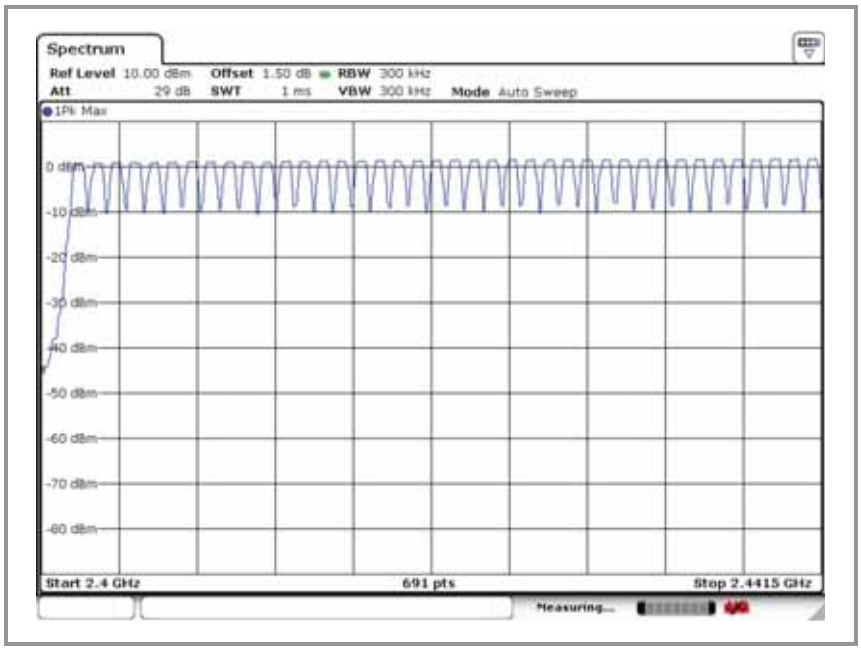
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna the port to theSpectrum analyzer
3. Set spectrum analyzer Start = 2400 ㎒, Stop = 2 441.5 ㎒, Sweep=auto and Start = 2 441.5 ㎒, Stop =2483.5 ㎒, Sweep = auto.
4. Set the spectrum analyzer as RBW, VBW=300 ㎑.
5. Max hold, view and count how many channel in the band.

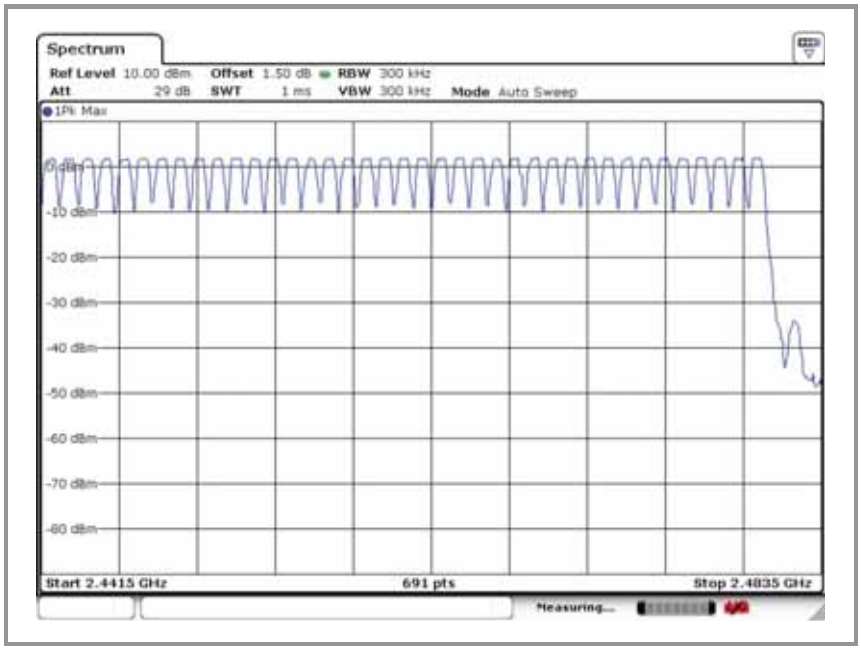
10.4. Test results

Ambient temperature: 23℃
Relative humidity: 46 % R.H.

Operation mode	Number of Hopping Frequency	Limit
GFSK	79	≥ 15

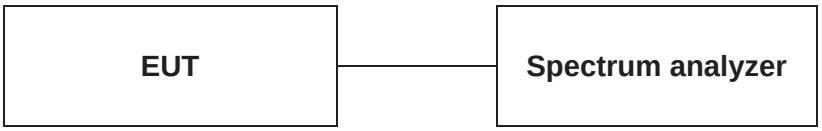
Operation mode: GFSK





11. Time of occupancy(Dwell time)

11.1. Test setup



11.2. Limit

§15.247(a)(1)(iii) For frequency hopping system operating in the 2 400 – 2 483.5 ㎒ band, theaverage timeof occupancy on any frequency shall not be greater than 0.4 second within a 31.6 second period.

A period time = 0.4(s) * 79 = 31.6(s)

11.3. Test procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signalfrom an external generator.
2. Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUTand connect its antenna terminal to measurement instrument via a low loss cable.
3. Adjust the center frequency of spectrum analyzer on any frequency be measured and set spectrumanalyzer to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission on the measured frequency. And then plot the result withtime difference of this time duration.
5. Repeat above procedures until all frequencies measured were complete.
6. The Bluetooth has 6 type of payload, DH1, DH3, DH5.The hopping rate is1 600 per second.

11.4. Test results

Ambient temperature: 23℃
Relative humidity: 46 % R.H.

Time of occupancy on the TX channel in 31.6sec
= time domain slot length × (hop rate ÷ number of hop per channel) × 31.6

Operation mode: GFSK

Packet type	Frequency (㎒)	Dwell Time (㎳)	Time of occupancy onthe Txchannel in 31.6 sec (㎳)	Limit for time of occupancyon the Tx Channel in 31.6 sec (㎳)
DH1	2 441	0.530	169.60	400
DH3	2 441	1.791	286.56	400
DH5	2 441	3.067	327.16	400

※ Remark:
DH1: 0.530 (㎳) × [(1 600 ÷ 2) ÷79] ×31.6(s) = 169.60 (㎳)
DH3: 1.791 (㎳) × [(1 600 ÷ 4) ÷ 79] ×31.6(s) = 286.56 (㎳)
DH5: 3.067 (㎳) × [(1 600 ÷ 6) ÷ 79] ×31.6(s) = 327.16 (㎳)

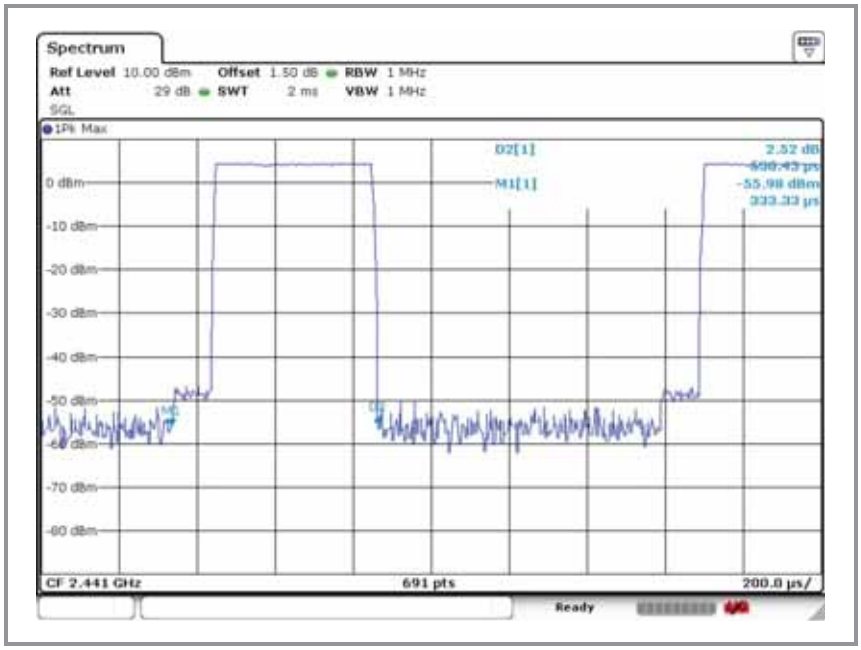
Operation mode: 8DPSK

Packet type	Frequency (㎒)	Dwell Time (㎳)	Time of occupancy onthe Txchannel in 31.6 sec (㎳)	Limit for time of occupancyon the Tx Channel in 31.6 sec (㎳)
DH1	2 441	0.408	130.56	400
DH3	2 441	1.755	280.80	400
DH5	2 441	2.957	315.42	400

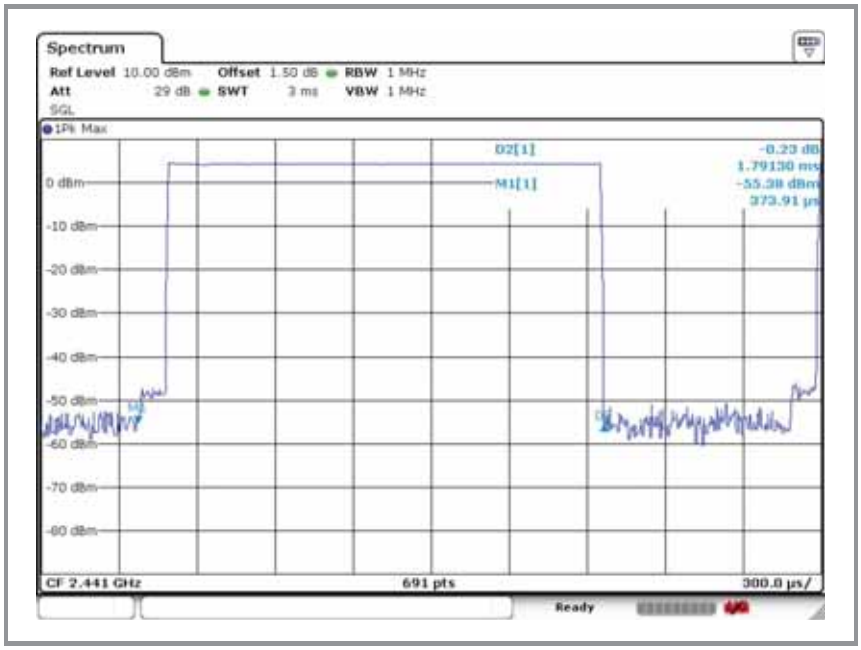
※ Remark:
DH1: 0.408 (㎳) × [(1 600 ÷ 2) ÷79] ×31.6(s) = 130.56 (㎳)
DH3: 1.755 (㎳) × [(1 600 ÷ 4) ÷ 79] ×31.6(s) = 280.80 (㎳)
DH5: 2.957 (㎳) × [(1 600 ÷ 6) ÷ 79] ×31.6(s) = 315.42 (㎳)

Operation mode: GFSK

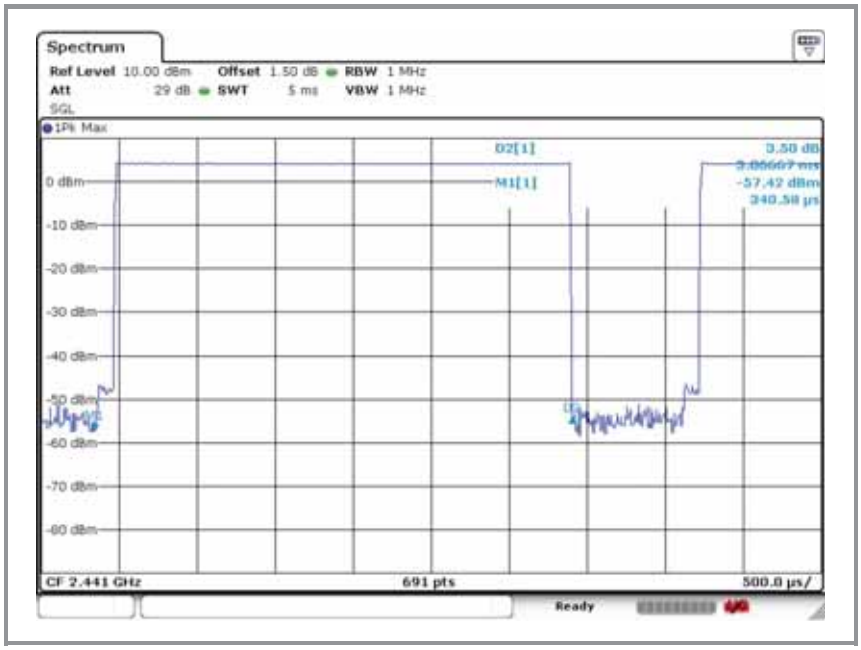
A. DH1



B. DH3

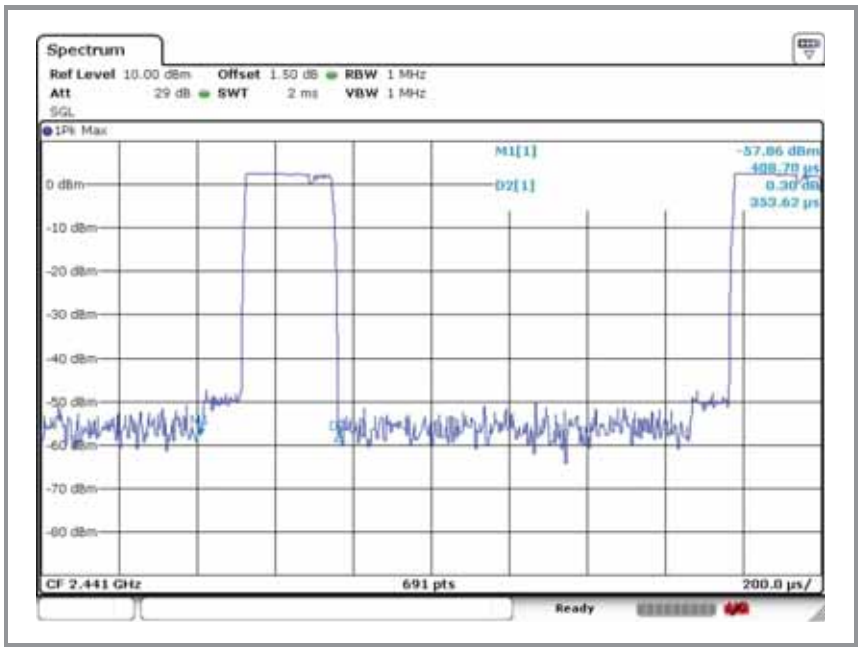


C. DH5

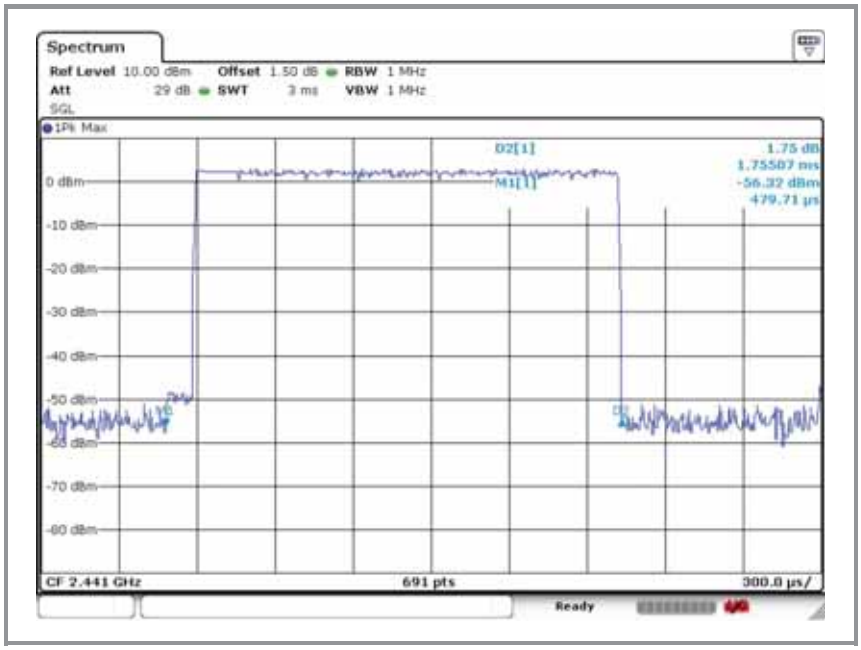


Operation mode: 8DPSK

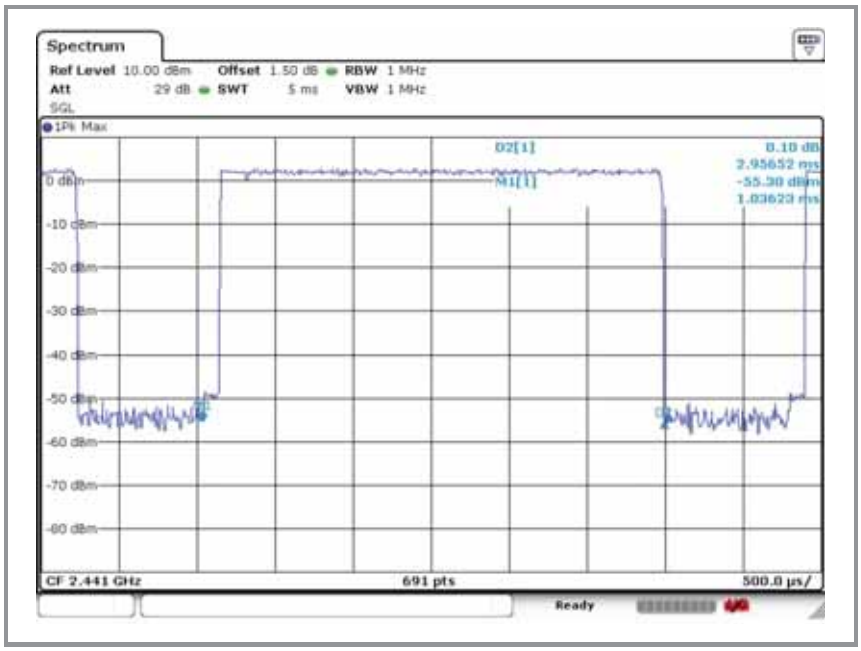
A. DH1



B. DH3



C. DH5



12. Antenna requirement

12.1.Standard Applicable

For intentional device, according to FCC 47 CFR Section §15.203, an intentional radiator shall be designedto 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 gain of the antenna exceeds 6 dBi.

12.2.Antenna Connected Construction

Antenna used in this product is Integral type (Chip Antenna) gain of 1.16 dBi.

13. RF exposure evaluation

13.1.Environmental evaluation and exposure limit according to FCC CFR 47 part 1,1.1307(b), 1.1310

According to FCC 1.1310 : The criteria listed in the following table shall be used to evaluate the environmentimpact of human exposure to radio frequency (RF) radiation as specified in §1.1307(b)

Limits for maximum permissible exposure (MPE)

Frequency range (㎒)	Electric field strength(V/m)	Magnetic field strength (A/m)	Power density (㎽/㎠)	Average time
(A) Limits for Occupational /Control exposures				
300 – 1500	--	--	F/300	6
1500 – 100000	--	--	5	6
(B) Limits for General Population/Uncontrol Exposures				
300 – 1500	--	--	F/1500	6
1500 – 100000	--	--	1	30

13.2.Friis transmission formula

$Pd = (Pout \times G)/(4 \times pi \times R^2)$

Where Pd = power density in ㎽/㎠
Pout = output power to antenna in ㎽
G = gain of antenna in linear scale
Pi = 3.1416
R = distance between observation point and center of the radiator in ㎝

Pd the limit of MPE, 1 ㎽/㎠. If we know the maximum gain of the antenna and the total power input to theantenna, through the calculation, we will know the distance where the MPE limit is reached.

13.3.Test result of RF exposure evaluation

Test Item ：RF Exposure evaluation data
Test Mode ：Normal operation

13.4.Output power into antenna & RF exposure evaluation distance

Operating mode	Frequency (㎒)	Output average power to antenna (dBm)	Antenna gain(dBi)	Powerdensity at 20 ㎝ (㎽/㎠)	Limit (㎽/㎠)
GFSK	2402	4.35	-4.19	0.000 21	1
	2441	4.58	-4.19	0.000 22	
	2480	4.08	-4.19	0.000 19	

※ Remark

The power density Pd (5th column) at a distance of 20 ㎝calculated from the friis transmission formula is far below the limit of 1 ㎽/㎠.