KOREA TESTING & RESEARCH INSTITUTE

Test Report issued under the responsibility of:
Korea Testing & Research Institute

TEST REPORT FCC Part 15 Subpart C § 15.247 FCC ID : YE4X1S	
Report Number. ..... : Date of issue..... : Total number of pages.....	FCC2013-0004 2013. 03. 29. 33 Pages
Tested by (name + signature) ..... :	Lee, Jae-Jun
Approved by (name + signature) ..... :	Hur, Gweon
Testing Laboratory ..... : Address ..... :	Korea Testing & Research Institute 66-6, Jeil-Ri, Yangji-Myun, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, Korea
Applicant' s name ..... : Address ..... :	Glosys Inc. #510, Venture Valley B/D, 958, Gosaek-Dong, Gwonseon-Gu, Suwon-Si, Gyeonggi-Do, Korea
Manufacturer' s name ..... : Address..... :	Glosys Inc. #510, Venture Valley B/D, 958, Gosaek-Dong, Gwonseon-Gu, Suwon-Si, Gyeonggi-Do, Korea
FCC ID..... :	YE4X1S
Standard..... :	FCC Part 15 Subpart C § 15.247
Test procedure ..... :	KTR-QM-01, KTR-QM-02, KTR-QM-03
Test Report Form No. ..... :	KTR-QI-Y013-F14
Test Report Form(s) Originator..... :	Korea Testing & Research Institute
Master TRF ..... :	Dated 2012-06
General remarks: The test results presented in this report relate only to the object tested. The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report. This report shall not be reproduced, except in full, without the written approval of the KTR's written approval. Testing Laboratory Homepage : www.ktr.or.kr	
Test item description	
Trade Mark..... :	Glosys
Manufacturer..... :	Glosys Inc.
Model/Type reference ..... :	X1S / AVN
Ratings..... :	d.c. 12 V

• Revision History

Report No.	Revision	Descripton	Issued Date
FCC2013-004	0	Initial issued of test report	Mar. 29. 2013

• Testing Location

66-6, Jeil-Ri, Yangji-Myun, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, Korea

• Tests Performed

FCC Part 15 Subpart C § 15.247

• Summary of testing

Section in FCC Rule	Test Item	Result
§ 15.247(b)(1)	Peak Output power	Pass
§ 15.247(a)(1)	Hopping Channel Separation	Pass
§ 15.247(a)(1)(iii)	Number of Hopping Channel	Pass
§ 15.247(a)(1)(iii)	Time of Occupancy(Dwell Time)	Pass
§ 15.247(a)(1)	20 dB Bandwidth	Pass
§ 15.247(a)(1)(iii)	Time of occupancy(Dwell time)	Pass
§ 15.247(d)	Conducted Spurious Emission & Band-edge	Pass
§ 15.205(a) & § 15.209	Radiated Spurious Emission & Band Edge	Pass
§ 15.203(a) & § 15.247(b)	Antenna Requirement	Pass

Statement;

The measurement procedures described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2003) and the guidance provided in FCC OET Public notice DA 00-705 were used in the measurement of the DUT.

Possible test case verdicts

- test case does not apply to the test object..... ....:	N/A
- test object does meet the requirement..... ....:	P (Pass)
- test object does not meet the requirement..... ....:	F (Fail)
Testing	
Date of receipt of test item..... .....:	2013. 03. 11.
Date (s) of performance of tests.....:	2013. 03. 18. ~ 2013. 03. 22.

FCC Part 15 Subpart C § 15.247

1.1 General Description

1.1.1 Laboratory information

The 10 m semi-anechoic chamber and/or EMC facilities are used for these testing.
These facilities were accredited by KOLAS,KC, KCC of Korea, FCC of USA and VCCI of Japan

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Registered No.
KOLAS : 111
KC : J
KCC & FCC : KR0030(Accredited Lab No.) / 503439
VCCI Reg. No. : C-2363, R-2183

1.1.2 Applicant Information

Applicant : Glosys Inc.
Address : #510, Venture Valley B/D, 958, Gosaek-Dong, Gwonseon-Gu, Suwon-Si, Gyeonggi-Do, Korea
Contact Person : Byung Bin Kong / R&D Director
Phone No. : +82-31-291-1450
Fax No. : +82-31-291-1451

1.1.3 Manufacturer Information

Applicant : Glosys Inc.
Address : #510, Venture Valley B/D, 958, Gosaek-Dong, Gwonseon-Gu, Suwon-Si, Gyeonggi-Do, Korea
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1.1.4 Description of EUT

Equipment under test	Car Audio Video Navigation System
Model name	X1S
Serial number	N/A
Frequency Range	2 402 ㎒ ~ 2 480 ㎒(Bluetooth BDR)
Modulation technique	GFSK
Number of channels	79(Bluetooth BDR)
Antenna type & gain	Integral(Chip antenna) // 3.438 ㏈i
Power source	d.c. 12 V

1.1.5 Test Frequency

	Low channel (Channel 00)	Middle channel (Channel 39)	High channel (Channel 78)
Frequency (㎒)	2 402	2 441	2 480

1.1.6 Information about variant model

N/A

1.1.7 Device Modification

N/A

2.0 Information about the FHSS characteristics

2.1 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 divide into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The normal hop is 1 600 hops/s.

2.2 Equal Hopping Frequency Use

All Bluetooth units participating in the piconet are time and hop-synchronized to the channel.

Example of a 79 hopping sequence in data mode:
40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 53, 35, 50, 65, 54, 67, 56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59, 72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75, 09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06, 01, 51, 03, 55, 05, 04

2.3 System Receiver Input Bandwidth

Each channel bandwidth is 1 ㎒

2.4 Equipment Description

15.247(a)(1) that rx input bandwidths shift frequencies in synchronization with the transmitted

15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information)

15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate it channels selection/ hopping sequence with other frequency hopping system for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

2.5 Test Result

2.5.1 Peak Output Power Measurement

2.5.2 Limit of Peak Output Power

§ 15.247(b), the maximum peak conducted output power of the intentional radiator shall not exceed the following :

(1) For frequency hopping systems operating in the band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 ㎒ ~ 5 850 ㎒ band : 1 Watts.

For all other frequency hopping systems in the 2 400 ㎒ ~ 2 483.5 ㎒ band : 0.125 Watts, the e.i.r.p shall not exceed 4 Watts.

2.5.3 Test Procedure

The testing follows FCC Public DA 00-705 Measurement Guidelines.

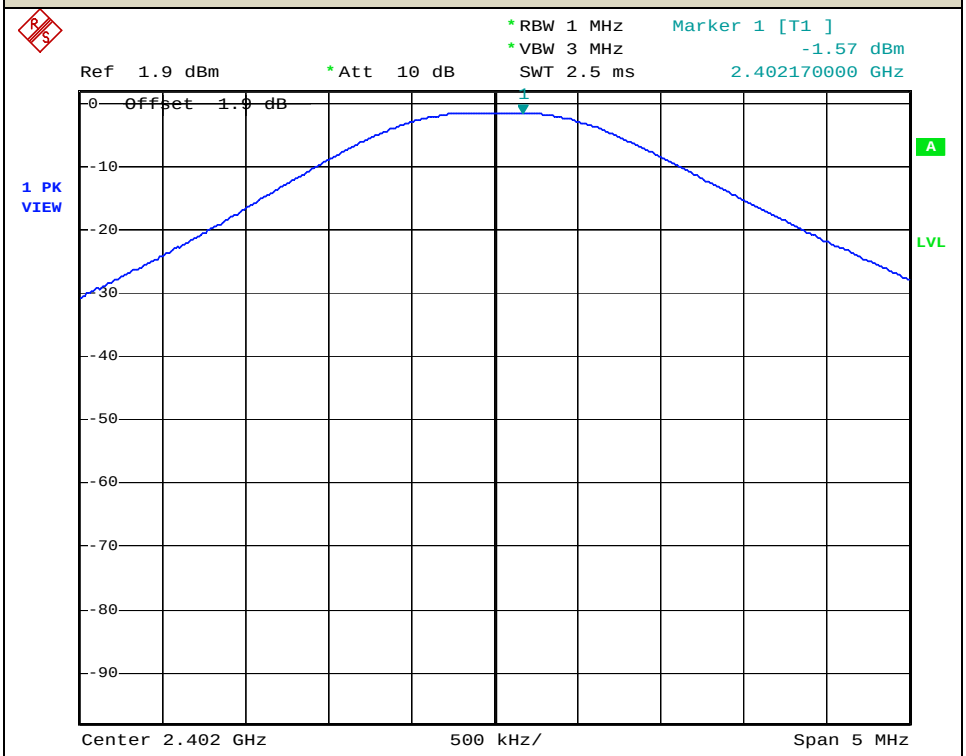
1. Place the EUT on the table, and then set it in the transmitting mode.
2. The RF Output of EUT is connected to the spectrum analyzer through a RF cable and an attenuator. The path loss is compensated to the results for each measurement.
3. Set the spectrum analyzer as follows :
   Center frequency: Low, middle and high channel
   Span = Approximately 5 times the 20 ㏈ bandwidth, centered on a hopping channel
   RBW ＞ the 20 ㏈ bandwidth of the emission being measured
   VBW ≥ RBW
   Sweep = Auto
   Detector function = peak
   Trace =max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Record the result as the peak output power in the test report.

2.5.4 Test Setup

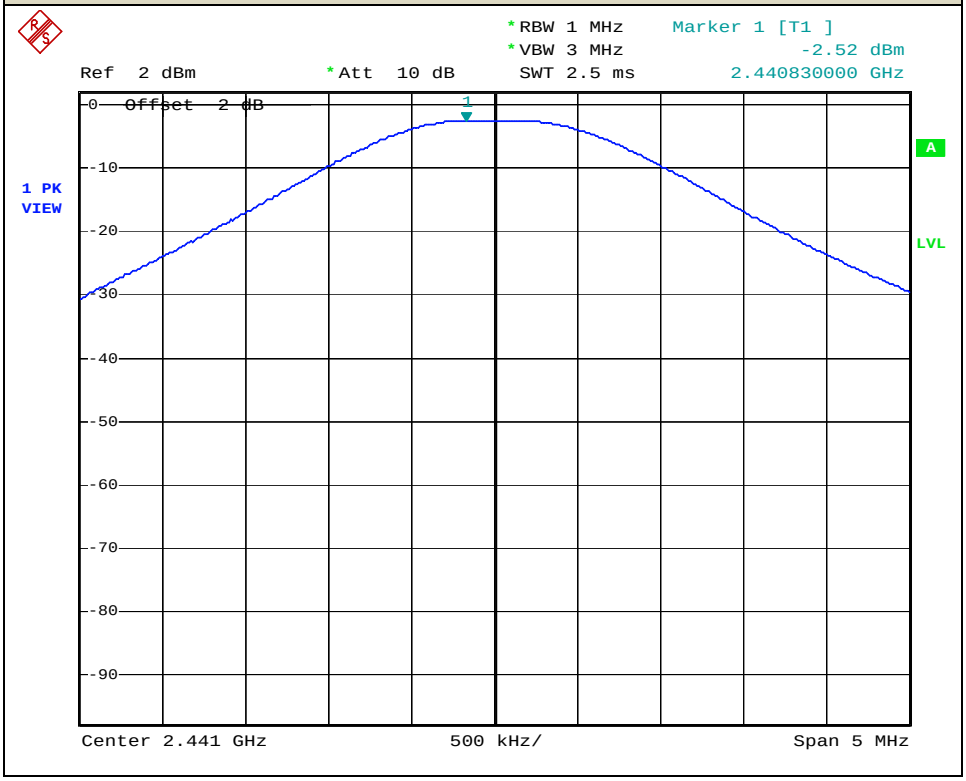
2.5.5 Test Result of Peak Output Power

GFSK(1 Mbps) Mode				
Channel	Frequency(㎒)	Peak Output Power(㏈ m)	Limit(㏈ m)	Verdict
00	2 402	-1.57	30	P
39	2 441	-2.52	30	P
78	2 480	-3.69	30	P

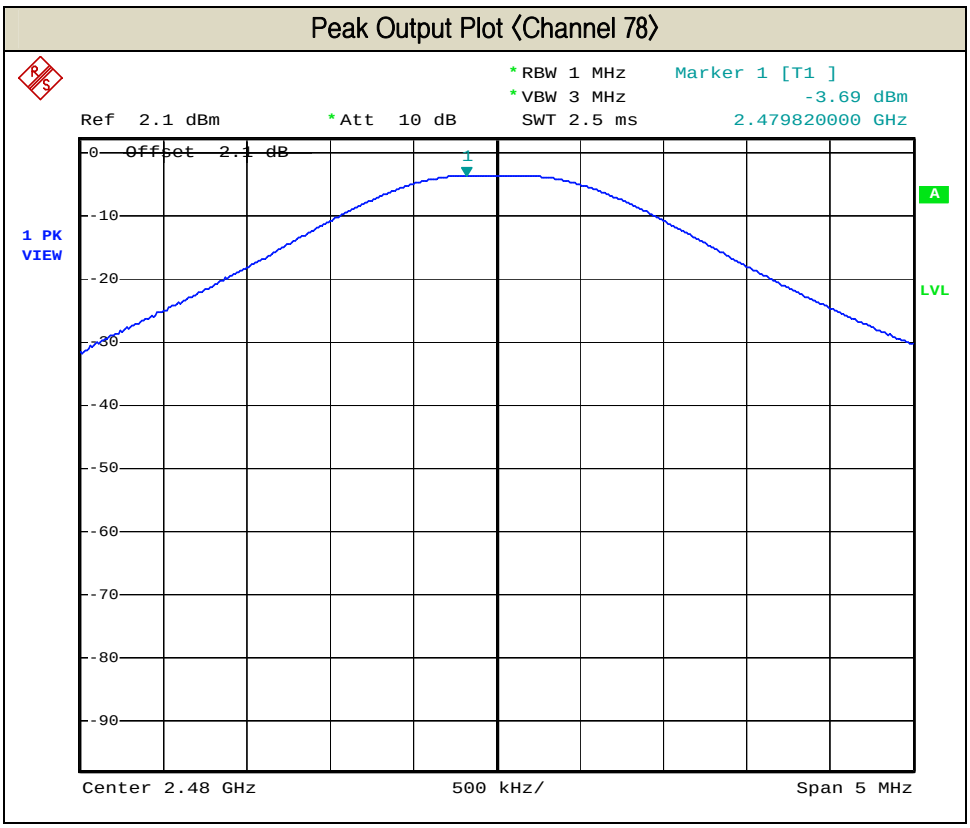
Peak Output Plot 〈Channel 00〉



Peak Output Plot 〈Channel 39〉



Peak Output Plot 〈Channel 78〉



2.6 Hopping Channel Separation Measurement

2.6.1 Limit of Hopping Channel Separation

§ 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 kHz 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 ㎽.

2.6.2 Test Procedure

The testing follows FCC Public DA 00-705 Measurement Guidelines.

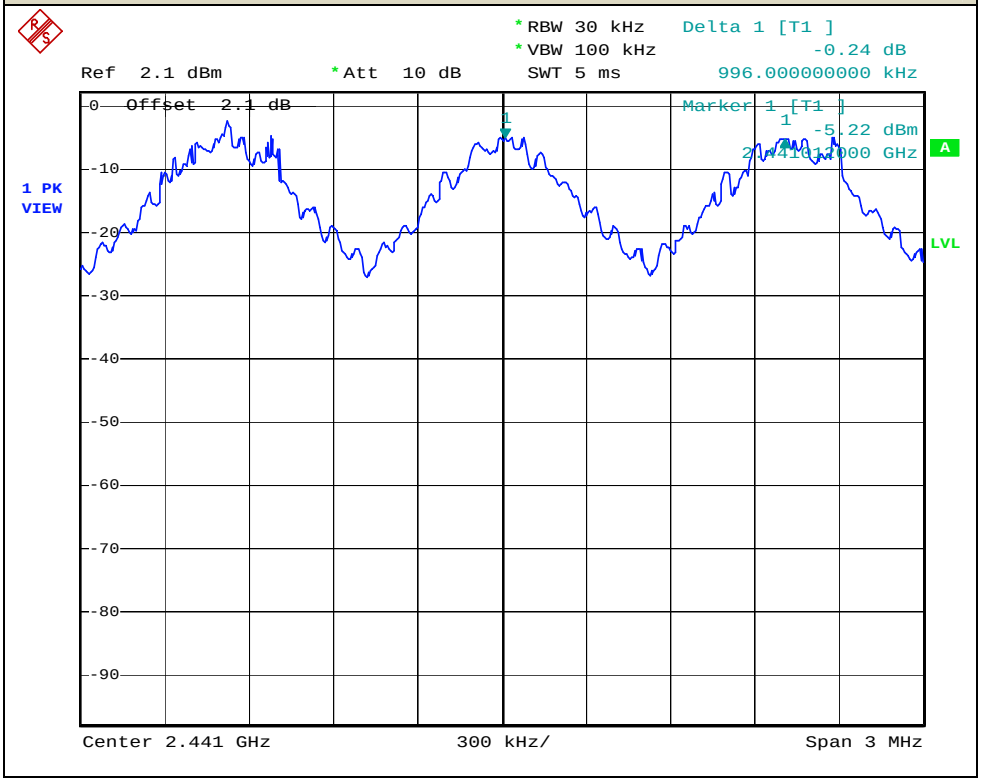
1. Place the EUT on the table, and then set it in the transmitting mode.
2. The RF Output of EUT is connected to the spectrum analyzer through a RF cable and an attenuator.
   The path loss is compensated to the results for each measurement.
3. Set the spectrum analyzer as follows :
   Center frequency : Middle of hopping channel
   Span = Wide enough to capture the peaks of two adjacent channels
   RBW ≥ 1% of the span
   VBW ≥ RBW
   Sweep = Auto
   Detector function = peak
   Trace =max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to determine the separation between the peaks of the adjacent channels. Record the result as the hopping channel separation in the test report.

2.6.3 Test Setup

2.6.4 Test Result of Hopping Channel Separation

GFSK(1 Mbps) Mode					
Channel (Middle)	Frequency(㎒)	Adjacent Hopping Channel Separation(kHz)	Two-third of 20 ㏈ bandwidth (kHz)	Minimum Bandwidth(kHz)	Verdict
39	2 441	996	620	25	P

Hopping Channel Separation Plot 〈Channel 39〉



2.7 Number of Hopping Channel Measurement

2.7.1 Limit of Number of Hopping Frequency

§ 15.247(a)(1)(iii), Frequency hopping systems in the 2 400 ㎒ ~ 2 483.5 ㎒ 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.

2.7.2 Test Procedure

The testing follows FCC Public DA 00-705 Measurement Guidelines.

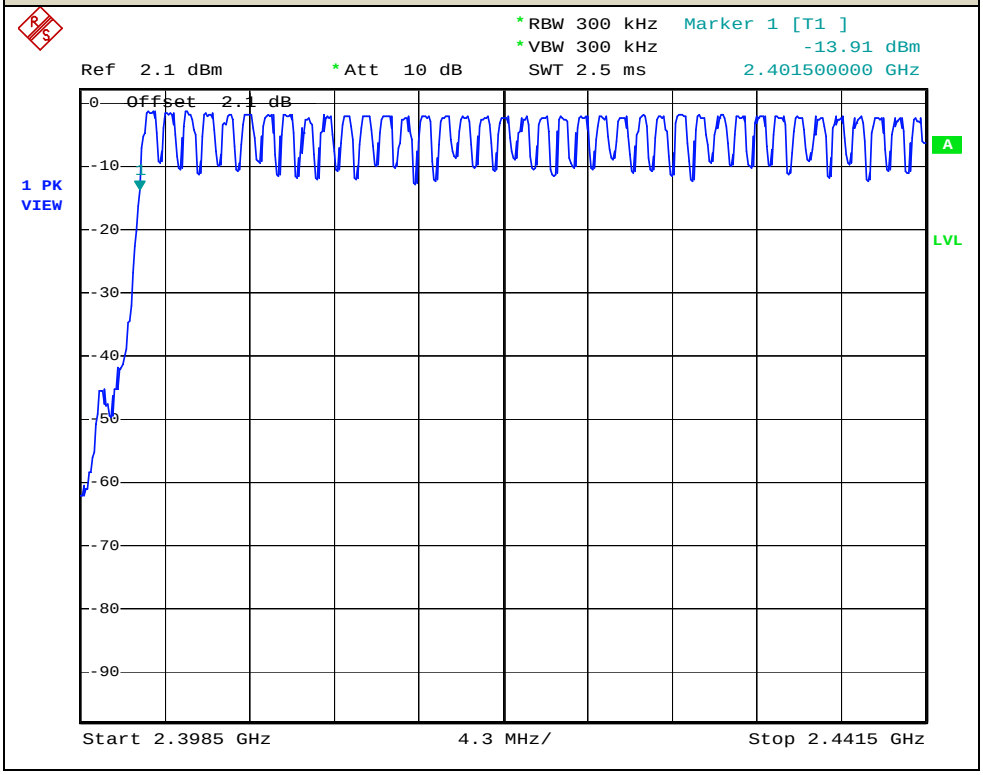
1. Place the EUT on the table, and then set it in the transmitting mode.
2. The RF Output of EUT is connected to the spectrum analyzer through a RF cable and an attenuator.
   The path loss is compensated to the results for each measurement.
3. The EUT must have its hopping function enabled.
4. Set the spectrum analyzer as follows :
   Frequency : 2 400 ㎒(Start) ~ 2 441.5 ㎒(Stop), 2 441.5 ㎒(Start) ~ 2 483.5 ㎒(Stop)
   Span = the frequency band of operation
   RBW ≥ 1% of the span
   VBW ≥ RBW
   Sweep = Auto
   Detector function = peak
   Trace =max hold
5. Max hold and view.
6. Allow the trace to stabilize. Record the number of hopping channels in the test report.

2.7.3 Test Setup

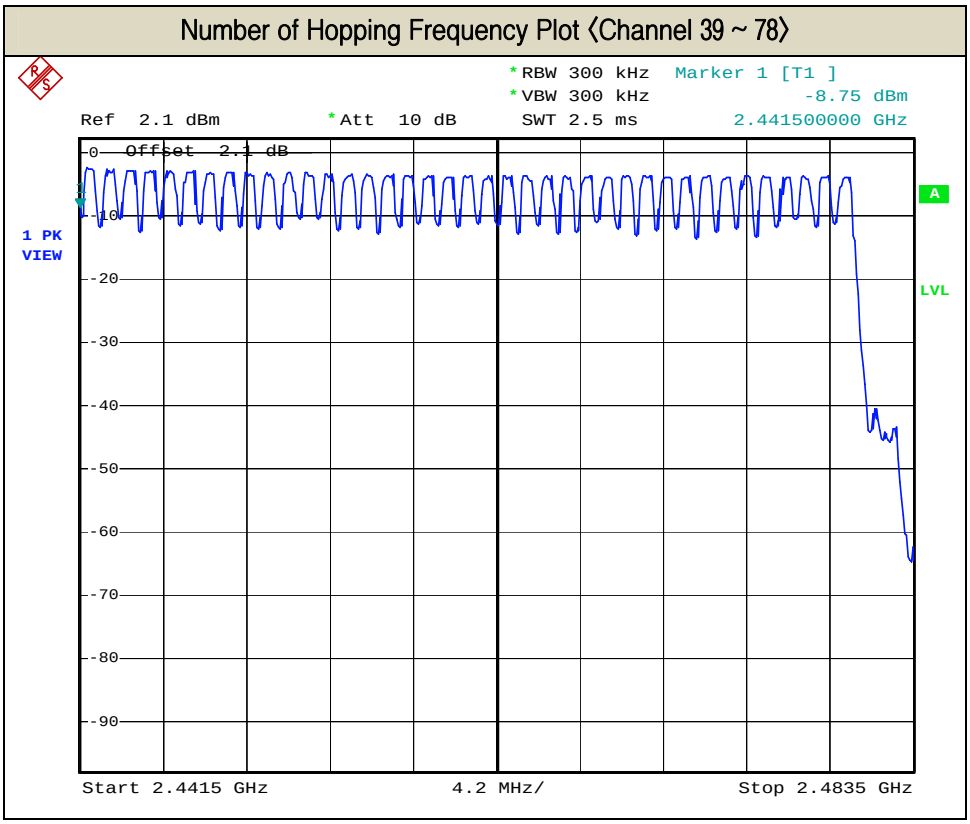
2.7.4 Test Result of Number of Hopping Frequency

GFSK(1 Mbps) Mode			
Frequency(㎒)	Number of Hopping Frequency	Limit	Verdict
2 402 ~ 2 480	79	≥15	P

Number of Hopping Frequency Plot 〈Channel 00 ~ 39〉



Number of Hopping Frequency Plot 〈Channel 39 ~ 78〉



2.8 Time of Occupancy(Dwell Time) Measurement

2.8.1 Limit of Time of Occupancy(Dwell Time)

§ 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ㎒ ~ 2 483.5 ㎒ band, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a period of 31.6 seconds.

2.8.2 Test Procedure

The testing follows FCC Public DA 00-705 Measurement Guidelines.

1. Place the EUT on the table, and then set it in the transmitting mode.
2. The RF Output of EUT is connected to the spectrum analyzer through a RF cable and an attenuator.
   The path loss is compensated to the results for each measurement.
3. The EUT must have its hopping function enabled.
4. Set the spectrum analyzer as follows :
   Span = Zero span, centered on a hopping channel
   RBW = 1 ㎒
   VBW ≥ RBW
   Sweep = as necessary to capture the entire dwell time per hopping channel
   Detector function = peak
   Trace =max hold
5. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., date rate, modulation format, etc.), repeat this test for each variation.

• The Bluetooth has 3 type of payload DH1, DH3, DH5. The hopping rate is insisted of 1 600 per second.

2.8.3 Test Setup

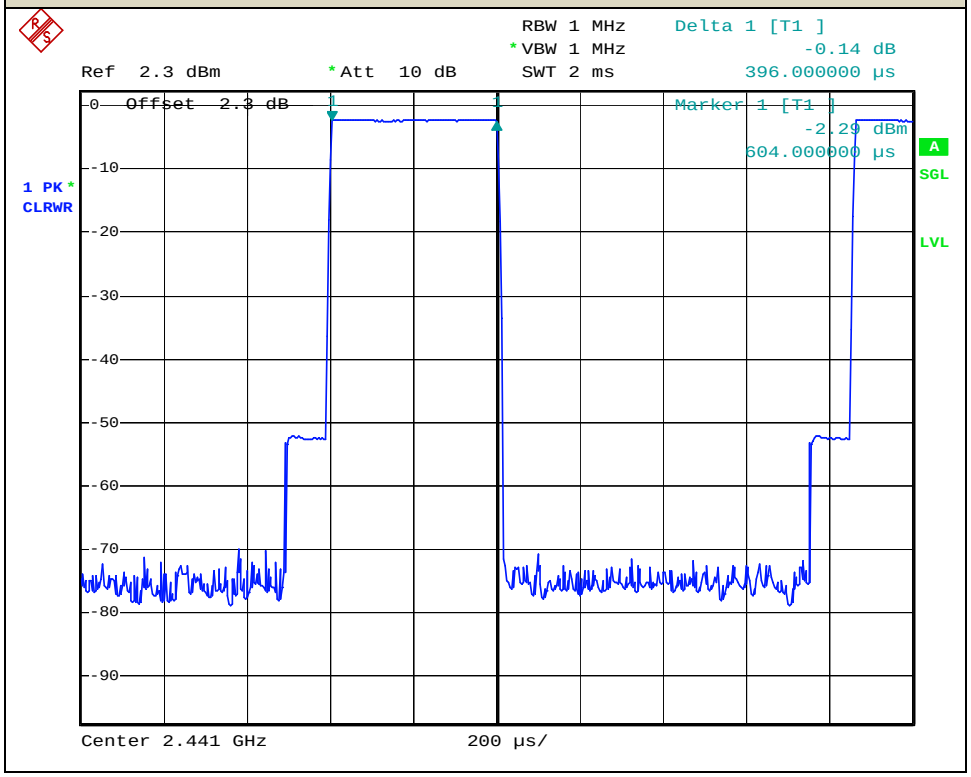
2.8.4 Test Result of Number of Hopping Frequency

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

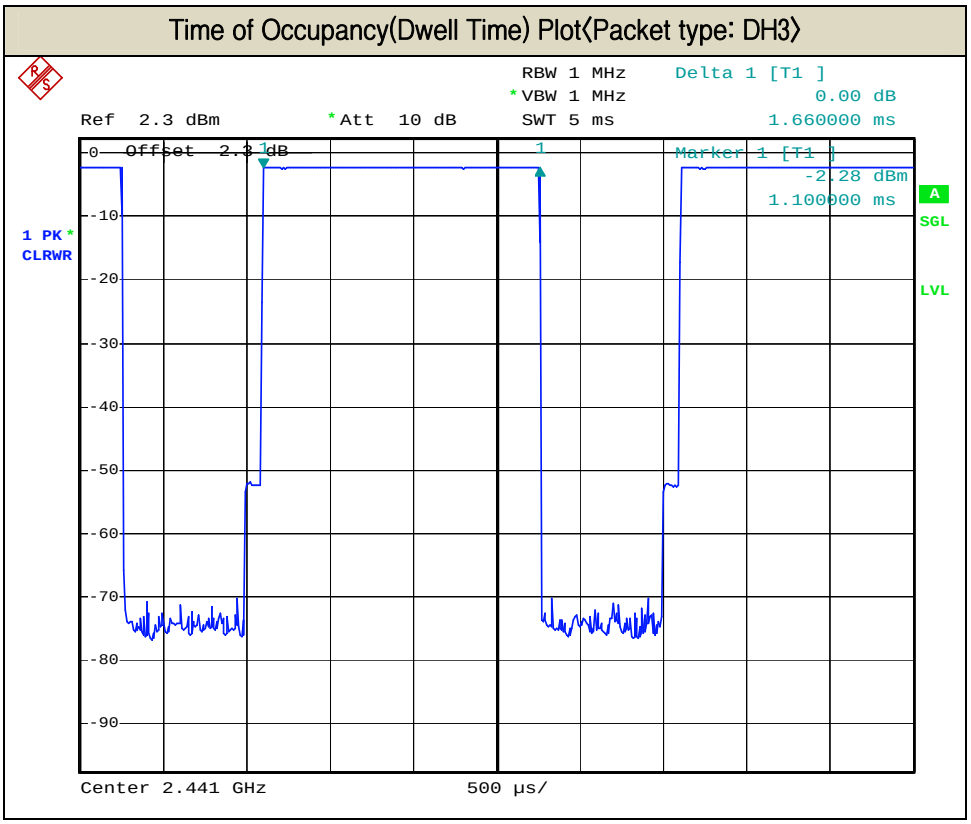
GFSK(1 Mbps) Mode				
Packet type	Frequency (㎒)	Dwell time (ms)	Time of occupancy on the Tx channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx channel in 31.6 sec (ms)
DH1	2 441	0.396	126.72	400
DH3	2 441	1.660	265.60	400
DH5	2 441	2.900	309.33	400

Note :
DH1: Dwell time (ms) × [(1 600 ÷ 2) ÷ 79] × 31.6(s) = 126.72 (ms)
DH3: Dwell time (ms) × [(1 600 ÷ 4) ÷ 79] × 31.6(s) = 265.60 (ms)
DH5: Dwell time (ms) × [(1 600 ÷ 6) ÷ 79] × 31.6(s) = 309.33 (ms)

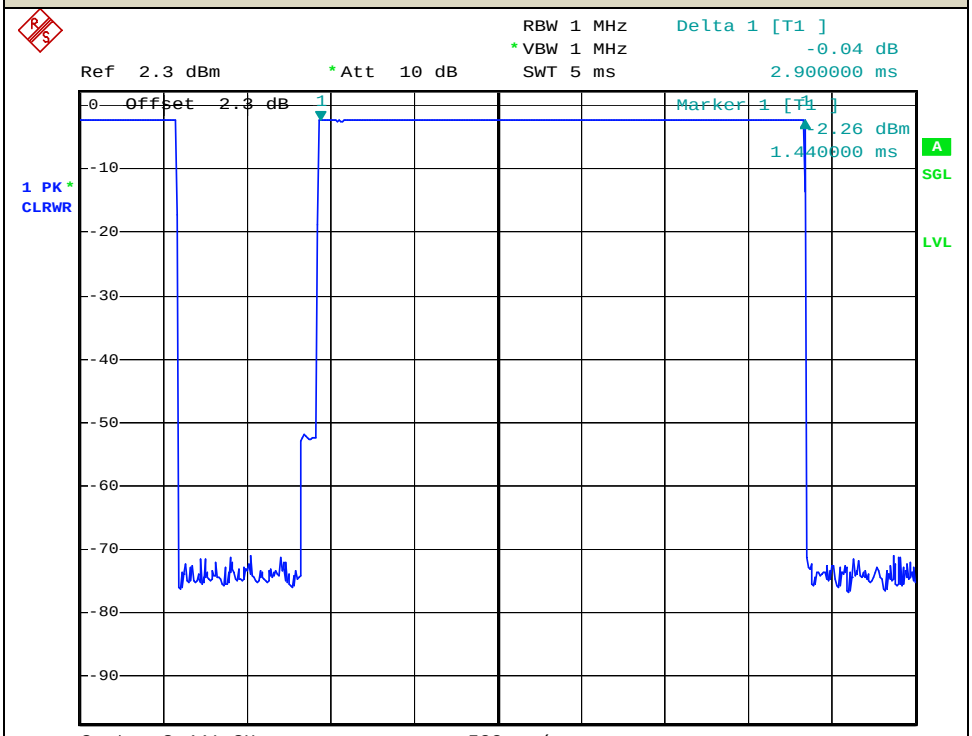
Time of Occupancy(Dwell Time) Plot〈Packet type: DH1〉



Time of Occupancy(Dwell Time) Plot〈Packet type: DH3〉



Time of Occupancy(Dwell Time) Plot〈Packet type: DH5〉



2.9 20 dB Bandwidth Measurement

2.9.1 Limit of 20 dB Bandwidth

N/A

2.9.2 Test Procedure

The testing follows FCC Public DA 00-705 Measurement Guidelines.

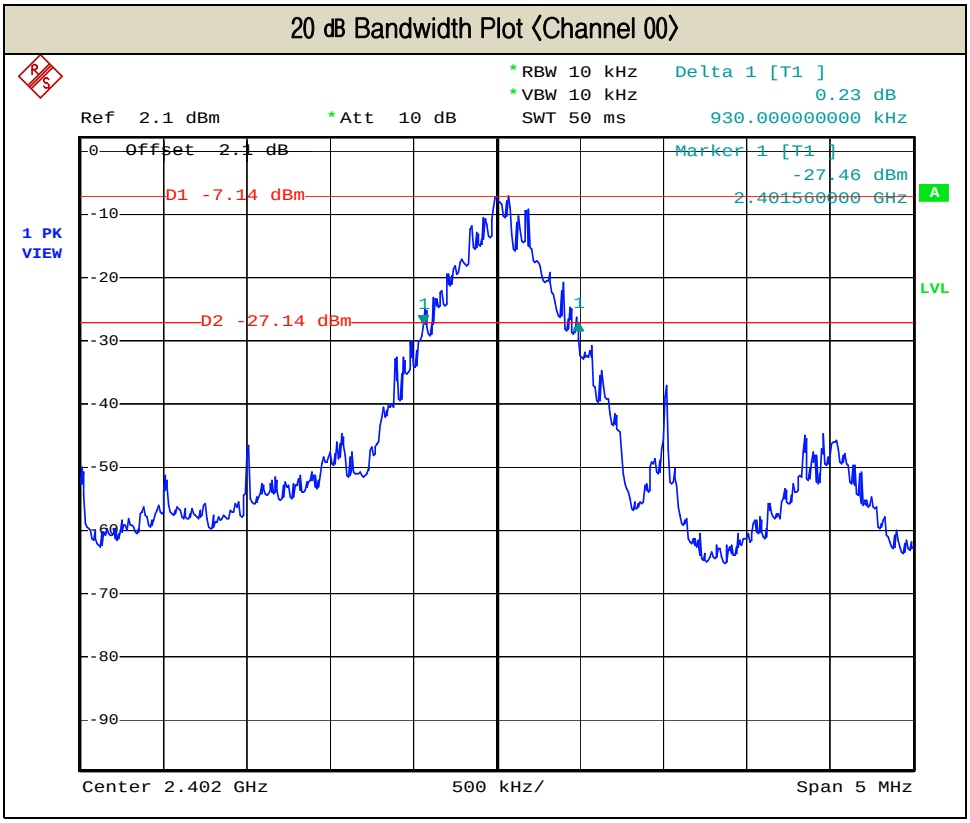
1. Place the EUT on the table, and then set it in the transmitting mode.
2. The RF Output of EUT is connected to the spectrum analyzer through a RF cable and an attenuator. The path loss is compensated to the results for each measurement.
3. The EUT must have its hopping function enabled.
4. Set the spectrum analyzer as follows :
   Center frequency: Low, middle and high channel
   Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
   RBW ≥ 1% of the 20 dB Bandwidth
   VBW ≥ RBW
   Sweep = Auto
   Detector function = peak
   Trace =max hold
5. The marker-to-peak function is to set the mark to the peak of the emission. Allow the trance to stabilize. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point 20 dB bandwidth of the emission.
6. Record the 20 dB bandwidth of the emission in the test report.

2.9.3 Test Setup

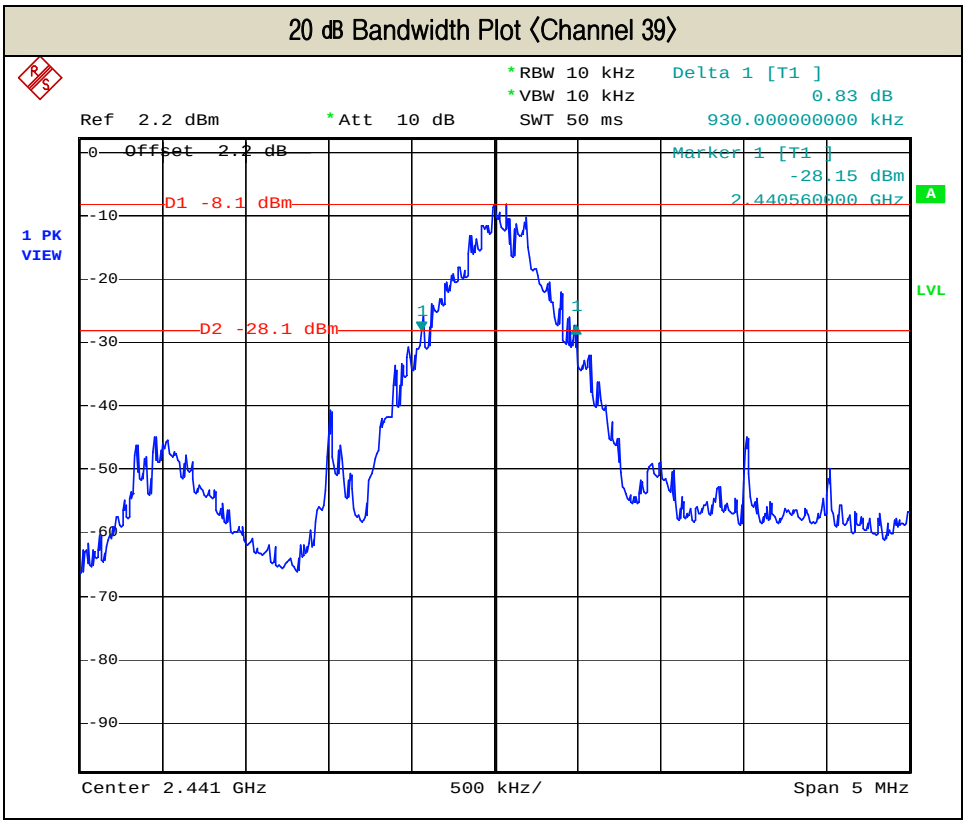
2.9.4 Test Result of 20 dB Bandwidth

GFSK(1 Mbps) Mode		
Channel	Frequency(㎒)	20 dB Bandwidth(㎒)
00	2 402	0.930
39	2 441	0.930
78	2 480	0.930

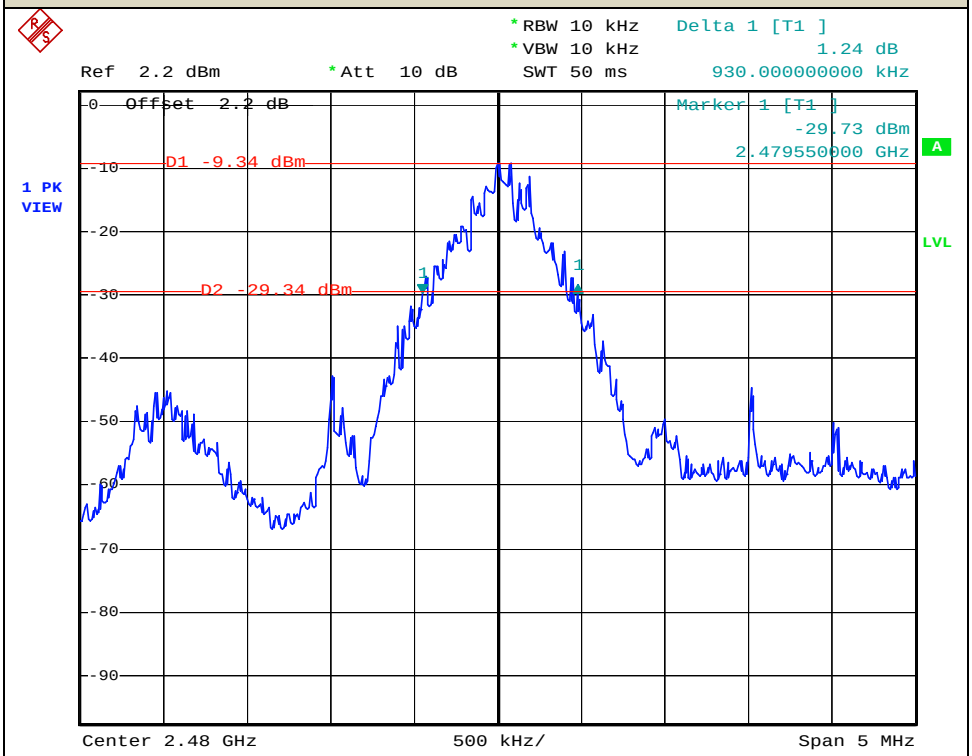
20 dB Bandwidth Plot <Channel 00>



20 dB Bandwidth Plot <Channel 39>



20 dB Bandwidth Plot 〈Channel 78〉



2.10 Conducted Spurious Emission & Band-edge Measurement

2.10.1 Limit of Conducted Spurious Emission & Band-edge Measurement

§ 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, 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 dB instead of 20 dB. 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))

2.10.2 Test Procedure for Band-edge Compliance of RF Conducted Emissions

The testing follows FCC Public DA 00-705 Measurement Guidelines.

1. Place the EUT on the table, and then set it in the transmitting mode.
2. The RF Output of EUT is connected to the spectrum analyzer through a RF cable and an attenuator.
   The path loss is compensated to the results for each measurement.
3. Set the spectrum analyzer as follows :
   Center frequency: Low, middle and high channel
   Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge,
   as well as any modulation products which fall outside of the authorized band of operation.
   RBW = 100 kHz
   VBW ≥ RBW
   Sweep = Auto
   Detector function = peak
   Trace =max hold
   • All harmonics and spurious must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
4. Record the result in the test report.

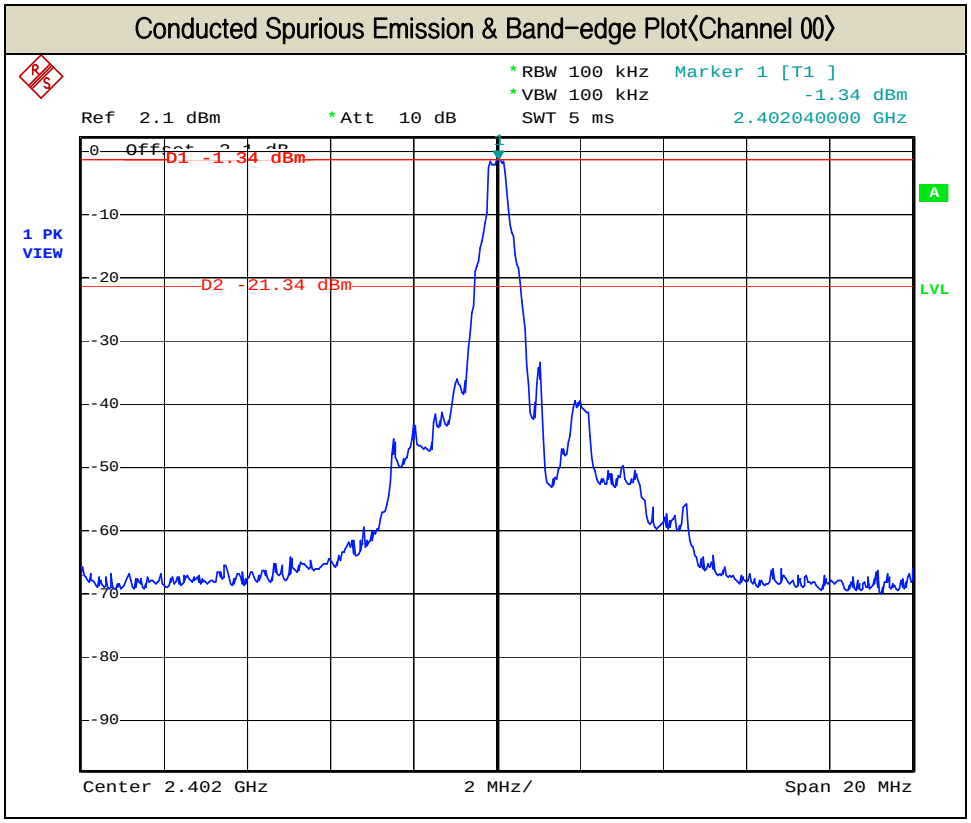
2.10.3 Test Procedure for Spurious RF Conducted Emissions

1. The RF Output of EUT is connected to the spectrum analyzer through a RF cable and an attenuator.
   The path loss is compensated to the results for each measurement.
2. Set the spectrum analyzer as follows :
   RBW = 100 kHz
   VBW ≥ RBW
   Sweep = Auto
   Detector function = peak
   Trace = max hold

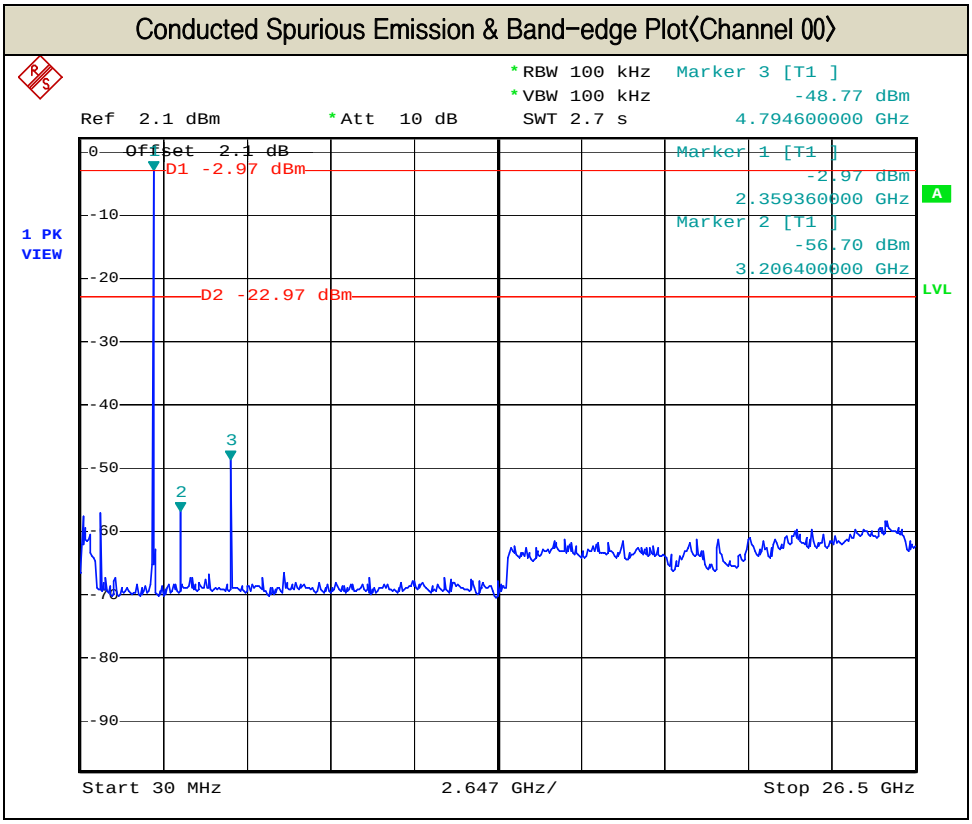
2.10.4 Test Setup

2.10.5 Test Result of Conducted Spurious Emission & Band-edge

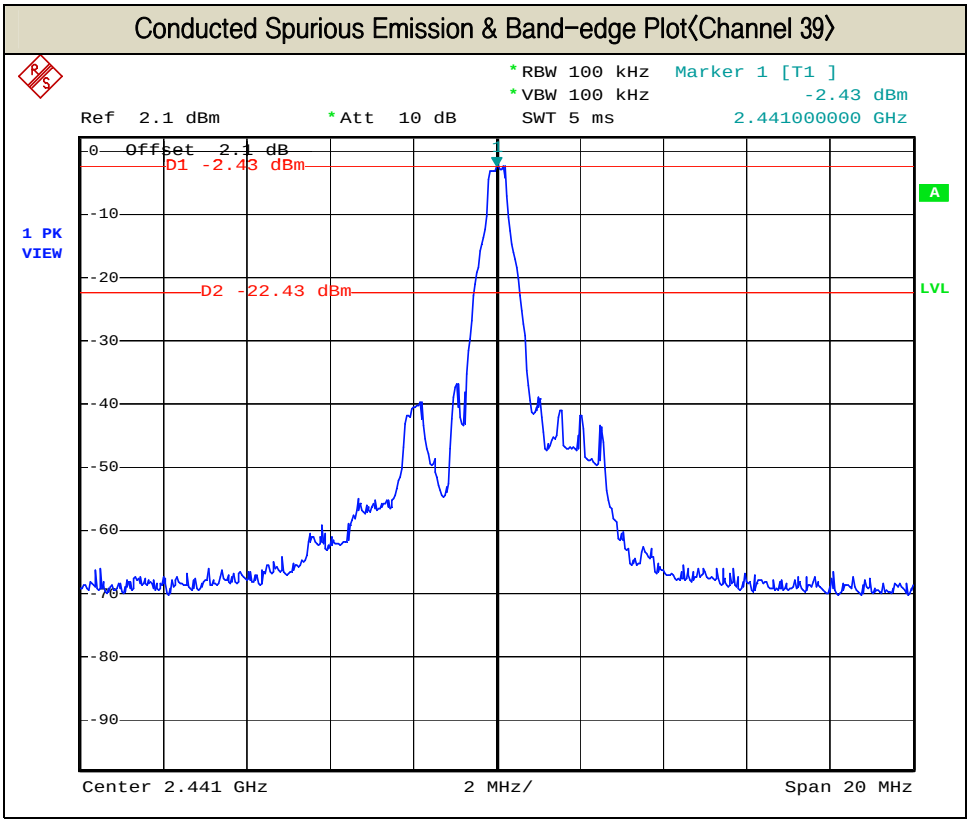
Conducted Spurious Emission & Band-edge Plot(Channel 00)



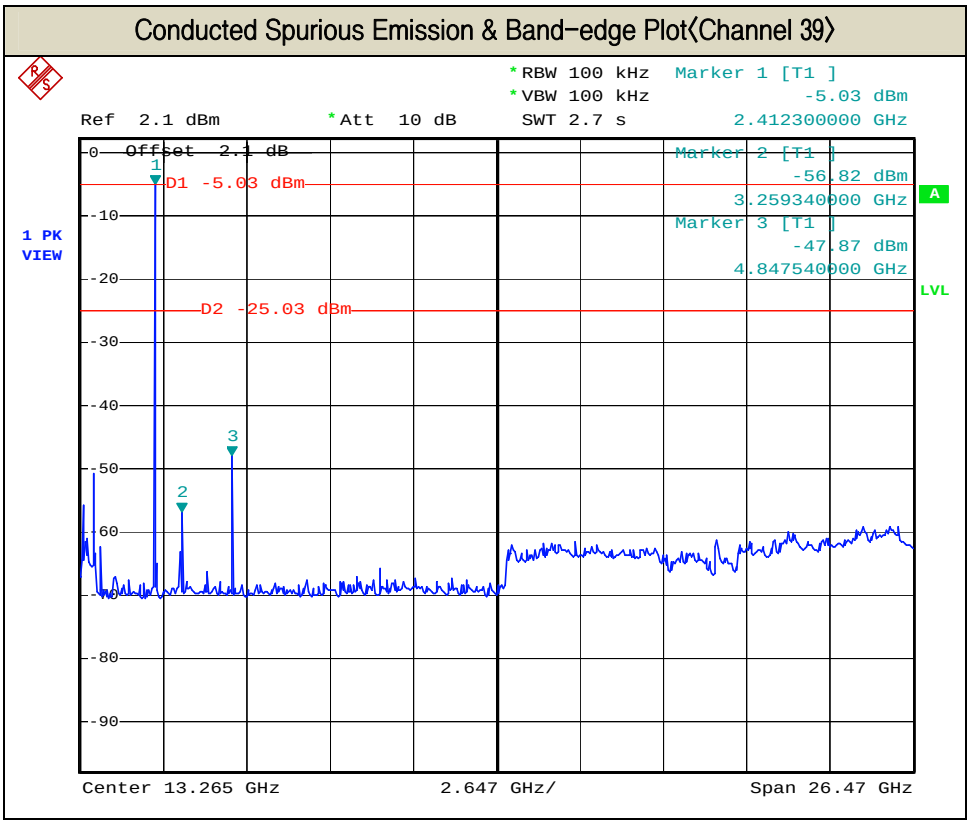
Conducted Spurious Emission & Band-edge Plot(Channel 00)



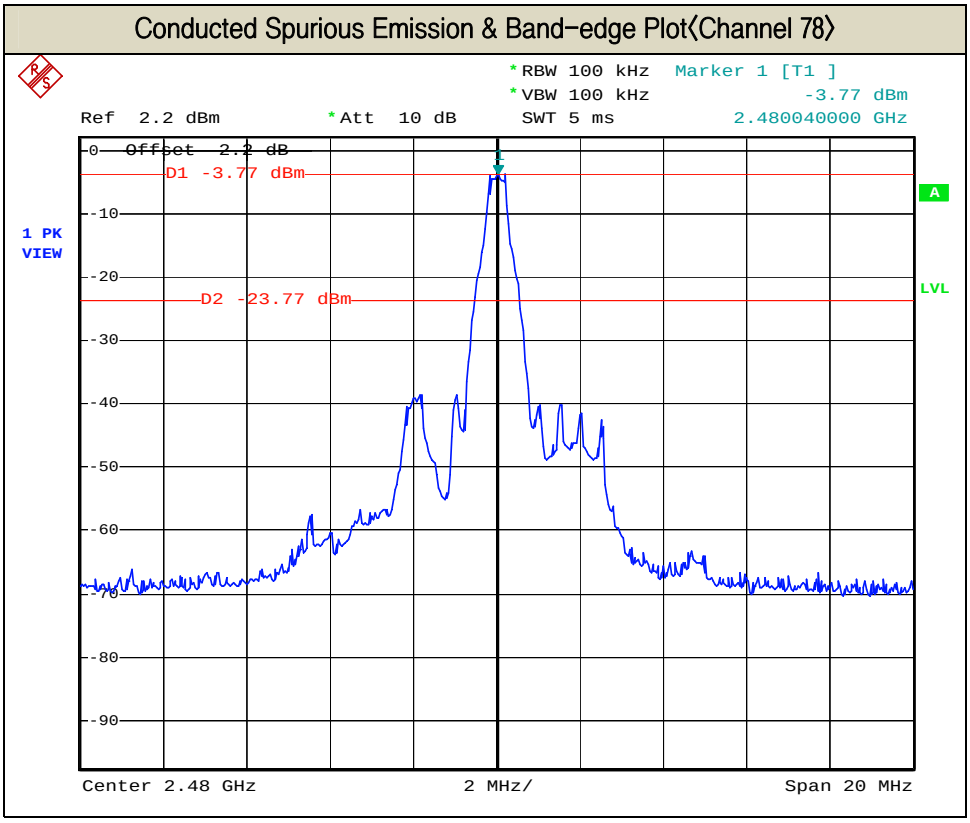
Conducted Spurious Emission & Band-edge Plot〈Channel 39〉



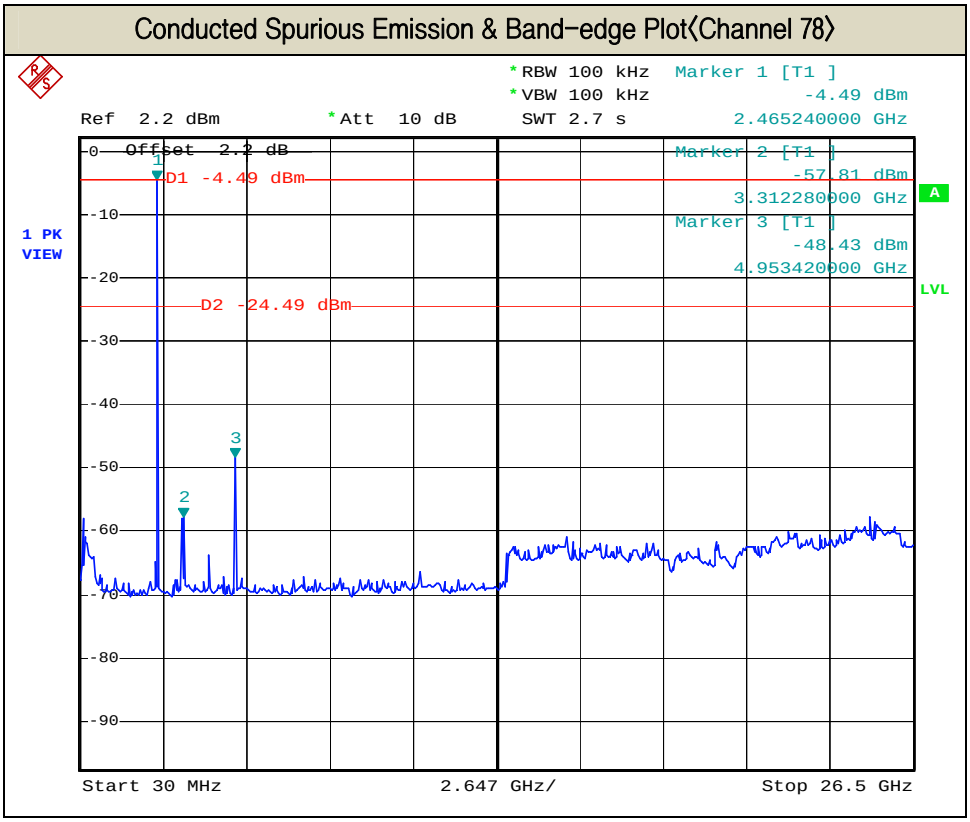
Conducted Spurious Emission & Band-edge Plot〈Channel 39〉



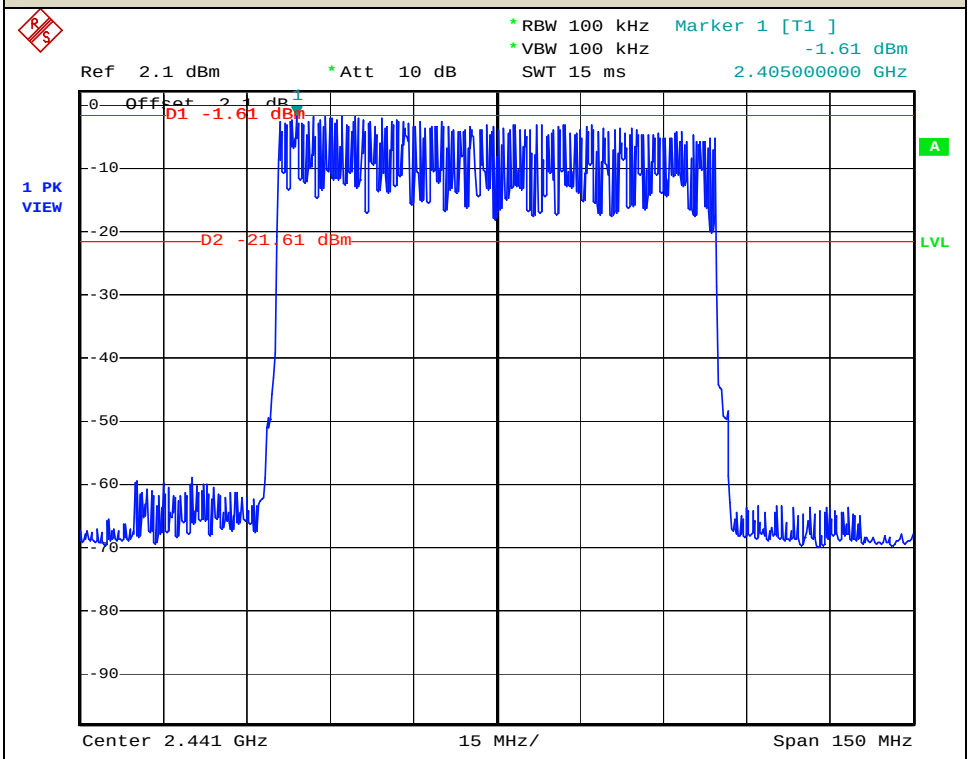
Conducted Spurious Emission & Band-edge Plot〈Channel 78〉



Conducted Spurious Emission & Band-edge Plot〈Channel 78〉



Conducted Spurious Emission & Band-edge Emission Plot〈Hopping〉



2.11 Radiated Spurious Emission & Band Edge Measurement

2.11.1 Limit of Conducted Spurious Emission & Band-edge Measurement

§ 15.209(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 (m)	Radiated (㎶/m)
0.009 ~ 0.490	300	2400 / F(kHz)
0.490 ~ 1.705	30	24000 / F(kHz)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

**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 ㎒, 76 ㎒ ~ 88 ㎒, 174 ㎒ ~ 216 ㎒ or 470 ㎒ ~ 806 ㎒. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections § 15.231 and § 15.241.

2.11.2 Test Procedure

The testing follows the guidelines in Spurious Radiated Emissions of FCC Public DA 00-705 Measurement Guidelines and the guidelines in ANSI C63.4-2003

1. The EUT was placed on the top of a rotating table 0.8 meter 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 meter 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 emissions, 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 value 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 methods as specified and then reported in a data sheet.

NOTE :

All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

[9 kHz to 30 ㎒]

Set the spectrum analyzer as follows :

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 200 ㎐ for Quasi-peak detection (QP) at frequency below 9 ㎑~ 150 ㎑.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 9 kHz for Quasi-peak detection (QP) at frequency below 150 ㎑~ 30 ㎒.

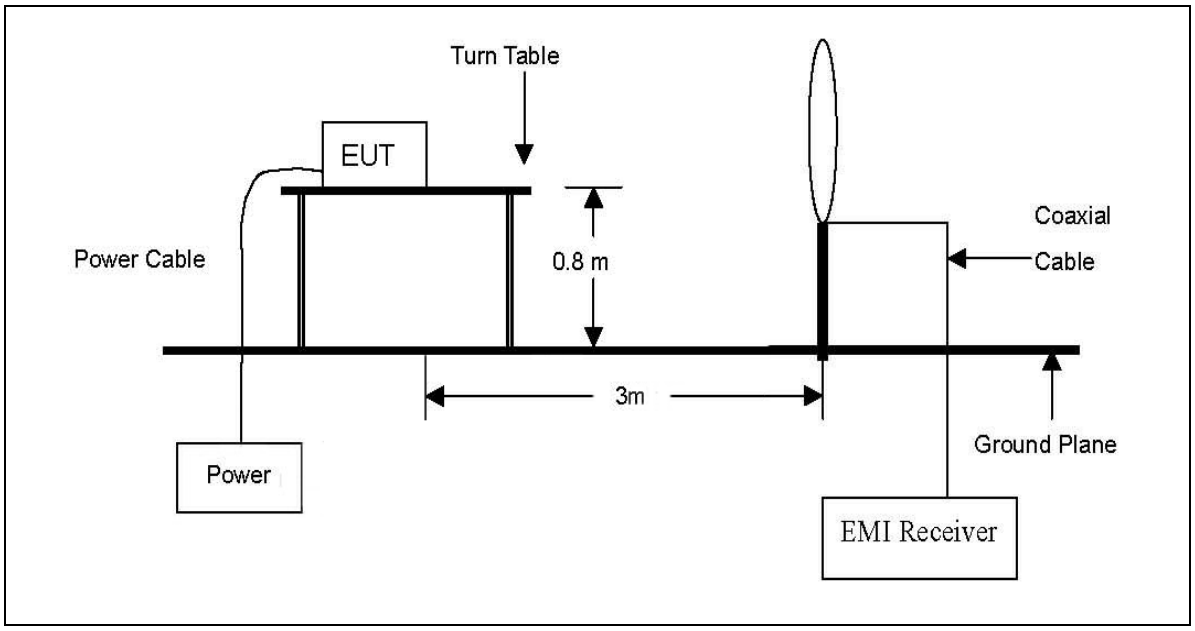
[30 ㎒ to 1 ㎓ and 1 ㎓ to 24 ㎓]

Set the spectrum analyzer as follows :

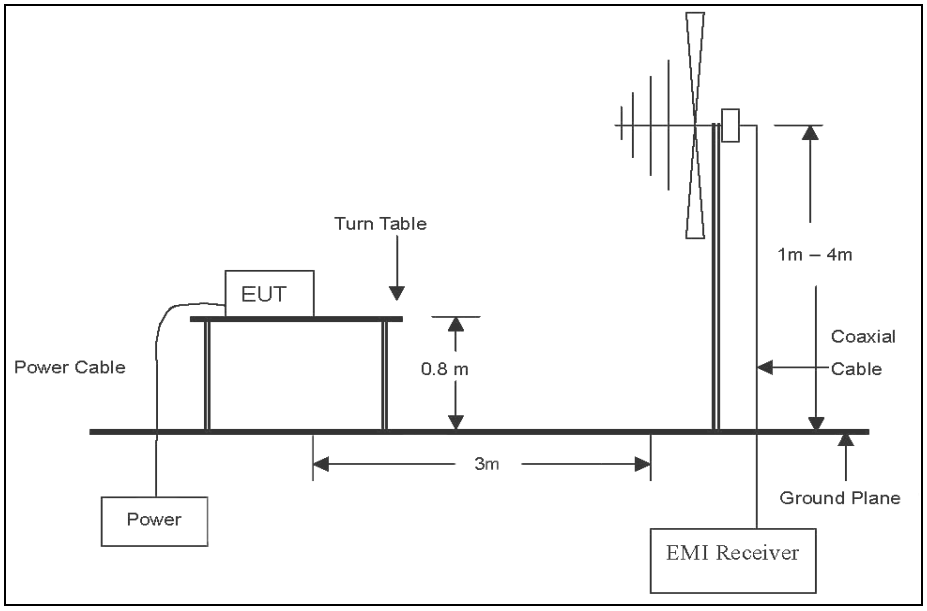
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 120 kHz for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 ㎓.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection at frequency above 1 ㎓.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

2.11.3 Test Setup

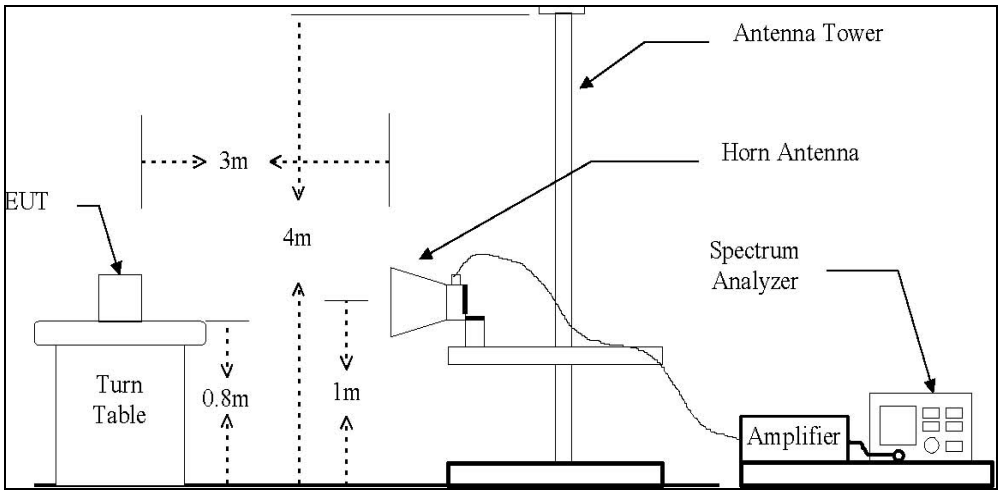
• The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 ㎒ Emissions.(For radiated emissions below 30 ㎒)



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



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



2.11.4 Test Result

The frequency spectrum from 9 kHz to 30 ㎒ was investigated.

GFSK(1 Mbps) Mode								
Radiated emissions		Ant.	Correction factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	F_d (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Below 30	Not detected	-	-	-	-	-	-	-

※ Remark

1. All spurious emission at channels are almost the same below 30 ㎒, so that high channel was chosen at representative in final test.
2. Actual = Reading + Ant. factor + Cable loss + F_d
3. $F_d = 40\log(D_m / D_s)$

   Where:

   F_d = Distance factor in dB

   D_m = Measurement distance in meters

   D_s = Specification distance in meters

The frequency spectrum from 30 ㎒ to 1 000 ㎒ was investigated.

GFSK(1 Mbps) Mode							
Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
153.900	25.62	V	13.15	1.93	40.7	43.5	2.8
156.000	24.77	H	13.27	1.96	40.0	43.5	3.5
205.200	26.94	V	10.02	2.24	39.2	43.5	4.3
302.400	22.16	H	13.93	2.71	38.8	46.0	7.2
439.200	17.39	H	17.17	3.33	37.9	46.0	8.1
667.800	13.45	V	21.42	4.33	39.2	46.0	6.8
834.400	7.57	H	23.56	4.97	36.1	46.0	9.9

※ Remark

1. All spurious emission at channels are almost the same below 1 ㎓, so that middle channel was chosen at representative in final test.
2. Actual = Reading + Ant. factor + Amp + CL (Cable loss)
3. Detector mode: Quasi peak
4. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

The frequency spectrum from 1 ㎓ to 25 ㎓ was investigated. No Emissions were found above 20 dB below the limit.

GFSK(1 Mbps) Mode〈Channel 00〉								
Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 313.2	53.07	Peak	V	27.18	-35.60	44.65	74.00	29.35
2 322.4	48.32	Peak	H	27.18	-35.62	39.88	74.00	34.12
2 323.7	34.20	Average	H	27.18	-35.62	25.76	54.00	28.24
2 324.0	36.57	Average	V	27.18	-35.62	28.13	54.00	25.87
2 346.4	53.61	Peak	V	27.20	-35.65	45.16	74.00	28.84
2 354.5	33.78	Average	V	27.20	-35.65	25.33	54.00	28.67
2 355.0	32.96	Average	H	27.20	-35.65	24.51	54.00	29.49
2 365.6	47.35	Peak	H	27.23	-35.68	38.90	74.00	35.10
2 399.9	57.44	Average	V	28.11	-35.77	49.78	54.00	4.22
2 399.9	58.30	Average	H	28.11	-35.77	50.64	54.00	3.36
2 399.9	68.23	Peak	V	28.11	-35.77	60.57	74.00	13.43
2 399.9	71.51	Peak	H	28.11	-35.77	63.85	74.00	10.15
4 804.0	52.53	Peak	H	33.51	-30.96	55.08	74.00	18.92
4 804.0	49.99	Peak	V	33.51	-30.96	52.54	74.00	21.46
4 804.0	46.30	Average	H	33.51	-30.96	48.85	54.00	5.15
4 804.0	45.20	Average	V	33.51	-30.96	47.75	54.00	6.25

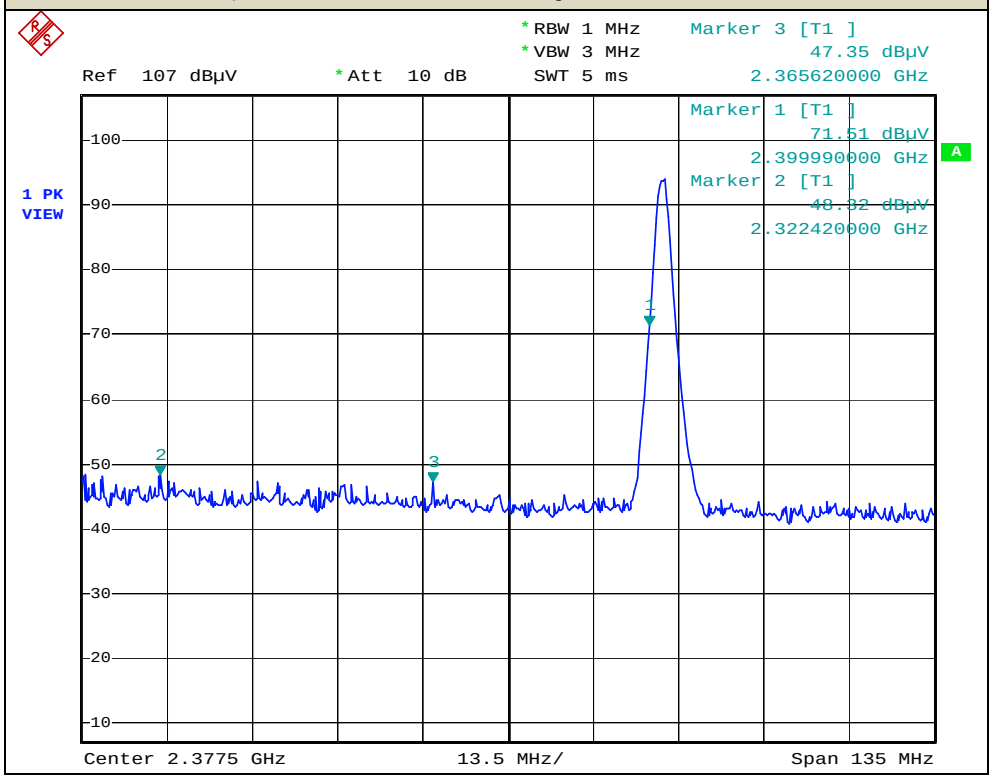
GFSK(1 Mbps) Mode〈Channel 39〉								
Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 884.0	52.16	Peak	H	33.44	-30.83	54.77	74.00	19.23
4 884.0	49.46	Peak	V	33.44	-30.83	52.07	74.00	21.93
4 884.0	44.30	Average	H	33.44	-30.83	46.91	54.00	7.09
4 884.0	42.14	Average	V	33.44	-30.83	44.75	54.00	9.25

GFSK(1 Mbps) Mode〈Channel 78〉								
Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 483.7	52.98	Peak	H	28.34	-35.09	46.23	74.00	27.22
2 483.7	51.70	Peak	V	28.34	-35.09	44.95	74.00	29.05
2 483.7	41.93	Average	H	28.34	-35.09	35.18	54.00	18.82
2 483.7	38.35	Average	V	28.34	-35.09	31.60	54.00	22.40
2 515.6	31.99	Average	H	28.39	-34.99	25.39	54.00	28.61
2 515.6	31.81	Average	V	28.39	-34.99	25.21	54.00	28.79
2 517.2	44.82	Peak	V	28.39	-34.99	38.22	74.00	35.78
2 518.8	45.40	Peak	H	28.39	-34.99	38.80	74.00	35.20
2 560.1	43.00	Peak	V	28.44	-34.86	36.58	74.00	37.42
2 560.1	36.21	Average	V	28.44	-34.86	29.79	54.00	24.21
2 560.1	34.46	Average	H	28.44	-34.86	28.04	54.00	25.96
2 563.6	46.64	Peak	H	28.44	-34.86	40.22	74.00	33.78
4 960.0	50.40	Peak	H	33.41	-30.67	53.14	74.00	20.86
4 960.0	51.50	Peak	V	33.41	-30.67	54.24	74.00	19.76
4 960.0	40.76	Average	H	33.41	-30.67	43.50	54.00	10.50
4 960.0	44.68	Average	V	33.41	-30.67	47.42	54.00	6.58

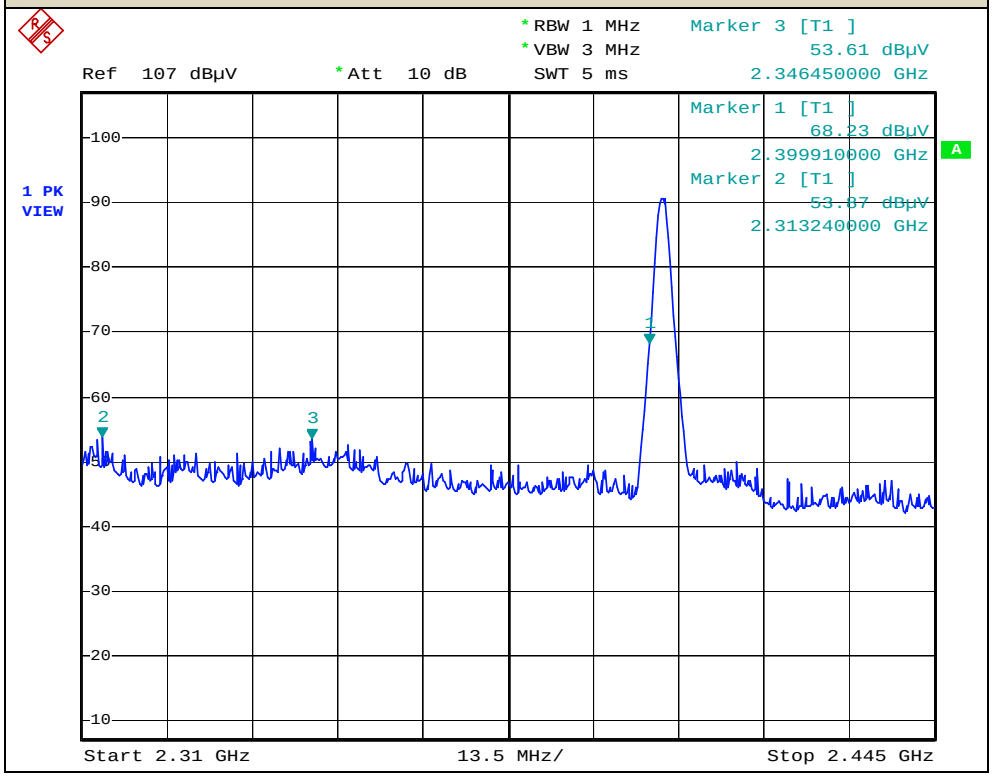
※ Remark

1. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + Ant. factor + Amp + CL (Cable loss)
5. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

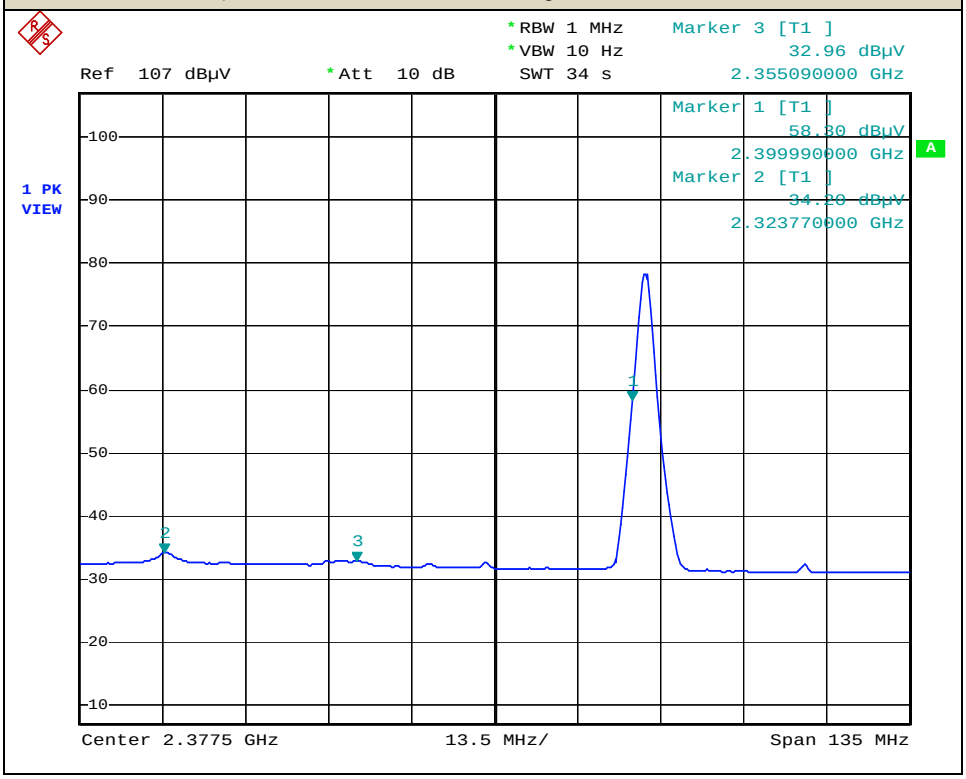
Radiated Spurious Emission & Band Edge Plot(Channel 00-Peak(H))



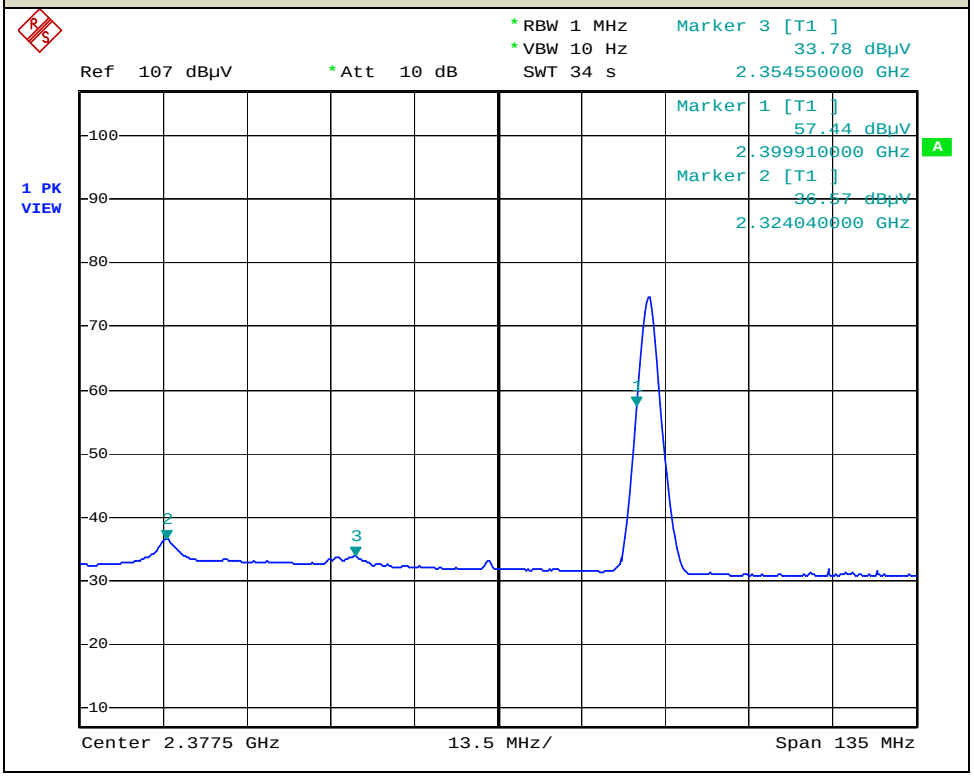
Radiated Spurious Emission & Band Edge Plot(Channel 00-Peak(V))



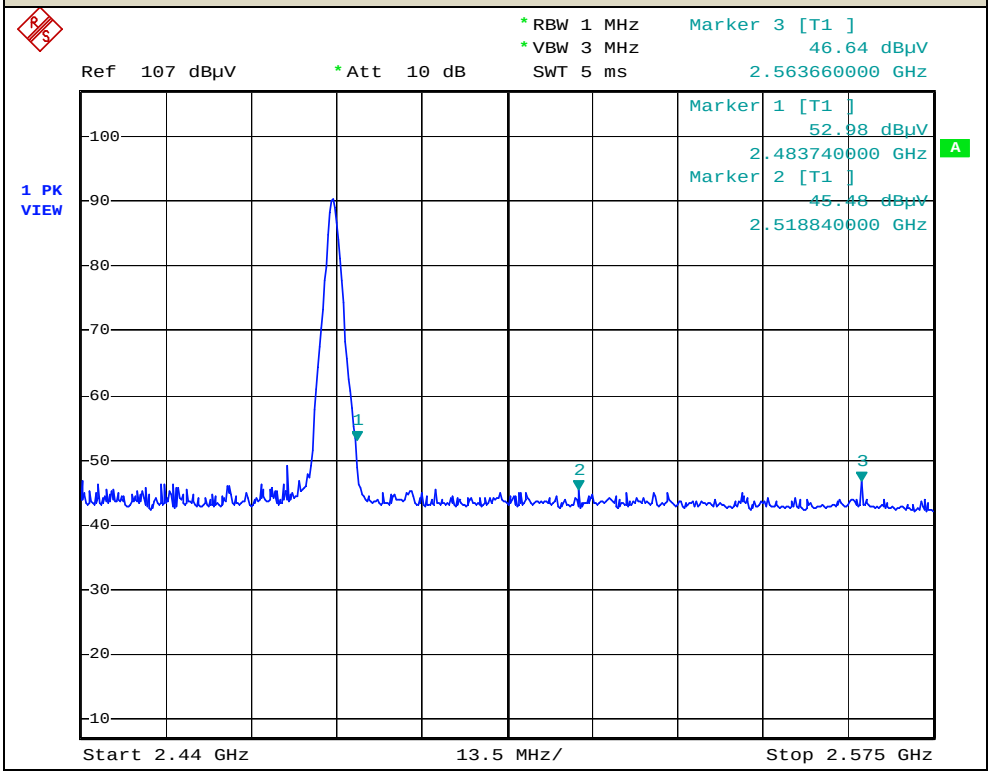
Radiated Spurious Emission & Band Edge Plot〈Channel 00-AVG(H)〉



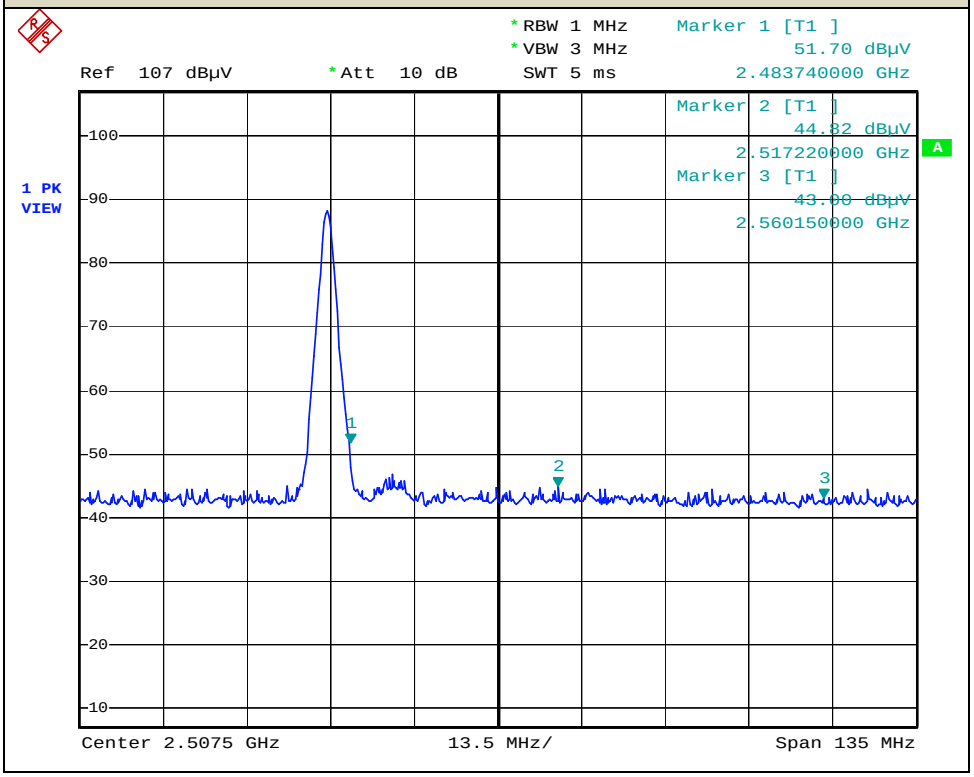
Radiated Spurious Emission & Band Edge Plot〈Channel 00-AVG(V)〉



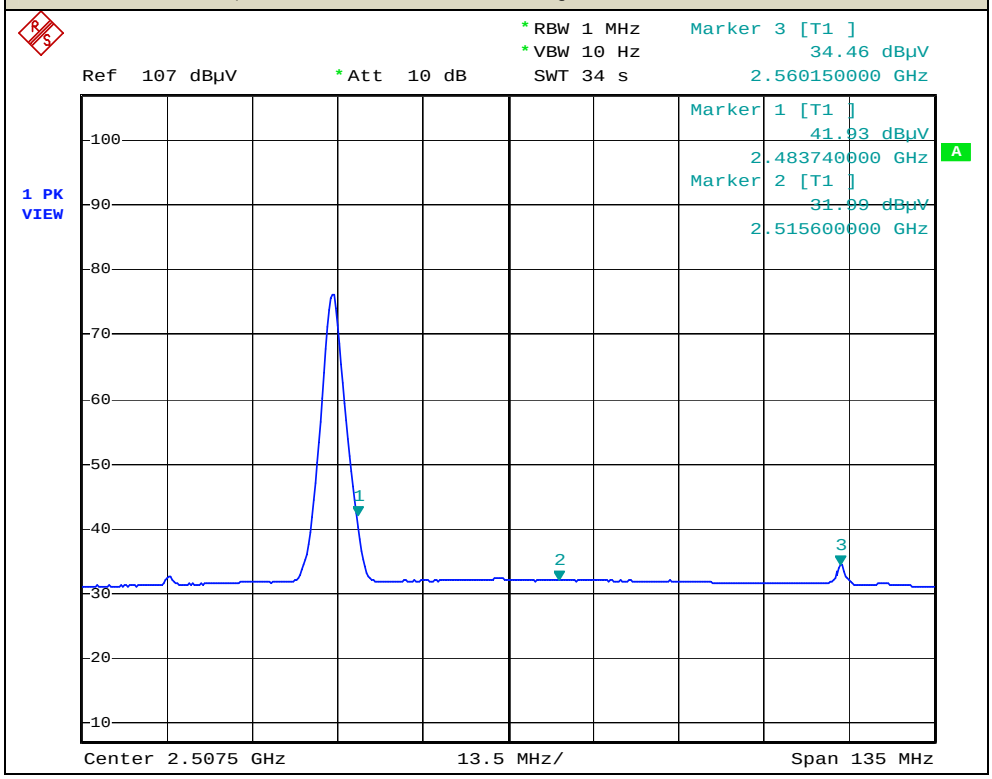
Radiated Spurious Emission & Band Edge Plot(Channel 78-Peak(H))



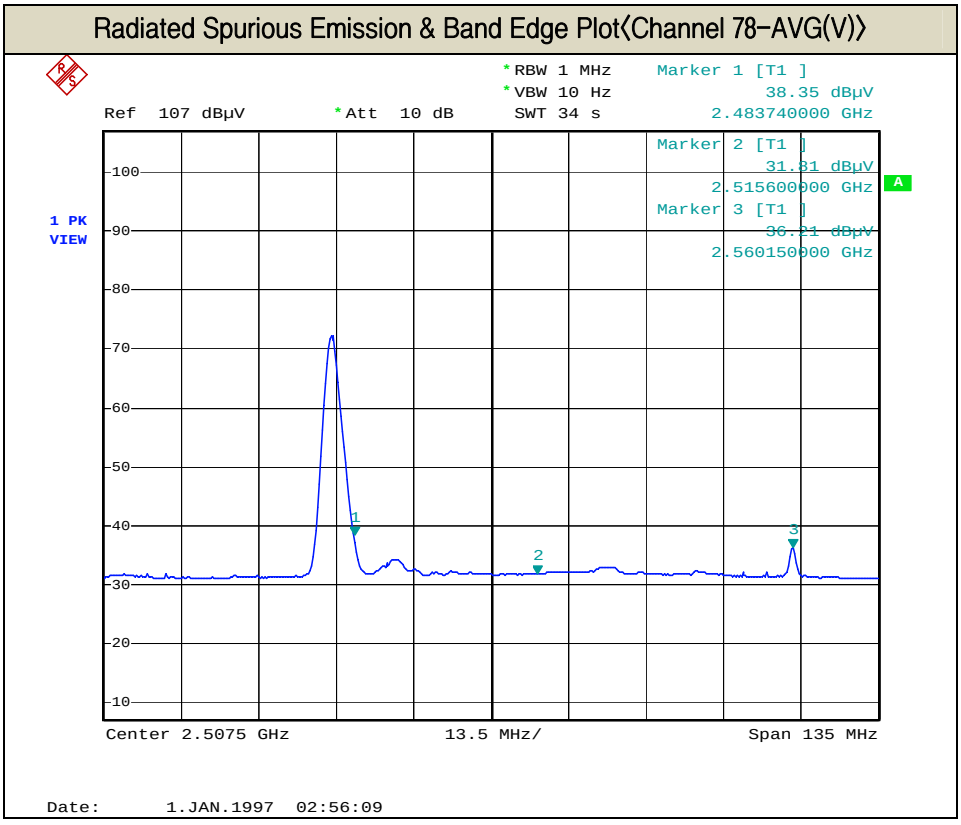
Radiated Spurious Emission & Band Edge Plot(Channel 78-Peak(V))



Radiated Spurious Emission & Band Edge Plot〈Channel 78-AVG(H)〉



Radiated Spurious Emission & Band Edge Plot〈Channel 78-AVG(V)〉



2.12 Antenna Requirement

2.12.1 Standard Applicable

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 6 dBi are used, the power shall be reduced by amount in dB that gain of the antenna exceeds 6 dBi.

2.12.2 Antenna Connected Construction

Antenna used in this EUT is integral type (Chip antenna) with gain of 3.438 dBi.

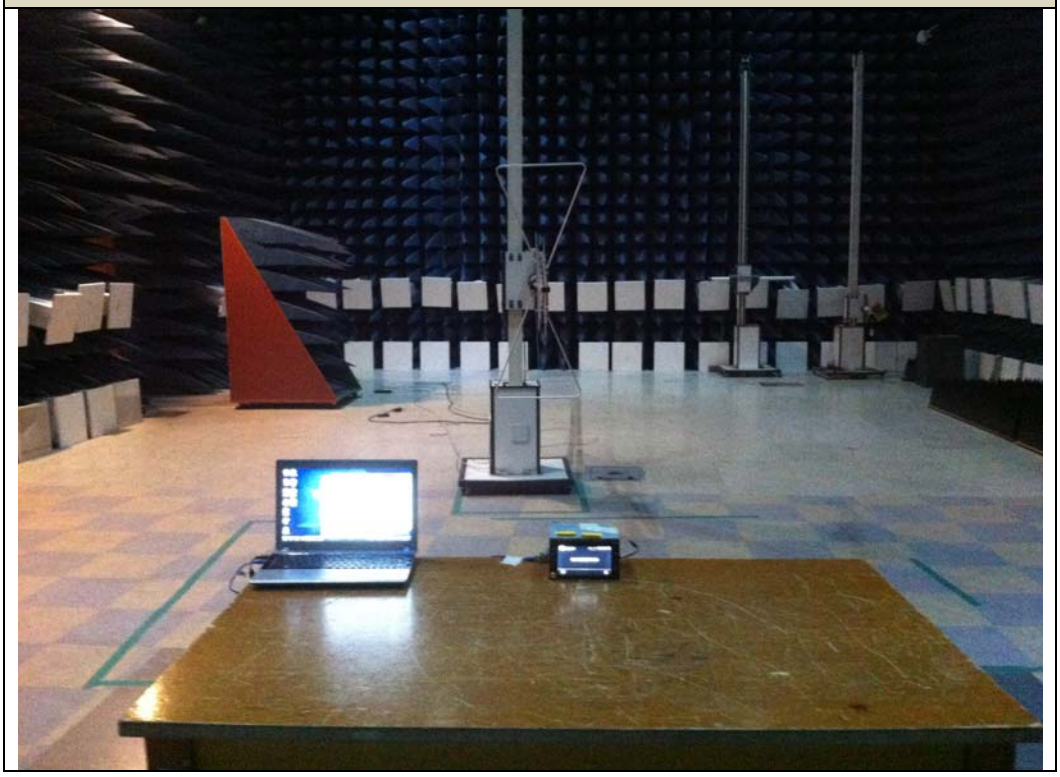
3.0 Test Equipment Used

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Test Receiver	R&S	ESCS30	100021	2012.07.06	2013.07.06
Spectrum Analyzer	R&S	FSP	837866/034	2012.08.12	2013.08.12
Spectrum Analyzer	Agilent	E7402A	US40240261	2013.03.13	2014.03.13
Signal Generator	R&S	SMP02	828269/001	2012.07.06	2013.07.06
Loop Antenna	R&S	HFH2-Z2	825841/008	2011.03.29	2013.03.29
Horn Antenna	EMCO	3115	9811-5606	2012.09.06	2013.09.06
Broad Band Antenna	Schwarzbeck	VULB9168	483	2013.03.06	2014.03.06
Antenna Mast	HD	MA240	-	-	-
Turn Table	HD	DT430S	-	-	-
DC Power Supply	Agilent	6673A	MY41000334	2012.10.17	2013.10.17
Preamp	TESTEK	TK-PA18	120006	2012.07.02	2013.07.02
High Pass Filter	Wainwright	WHNX 3.5/26.5G-6SS	1	2013.02.20	2014.02.20
Laptop(Notebook)	Samsung Electronics	NT-RV520	HSGK91MCA00190D	-	-

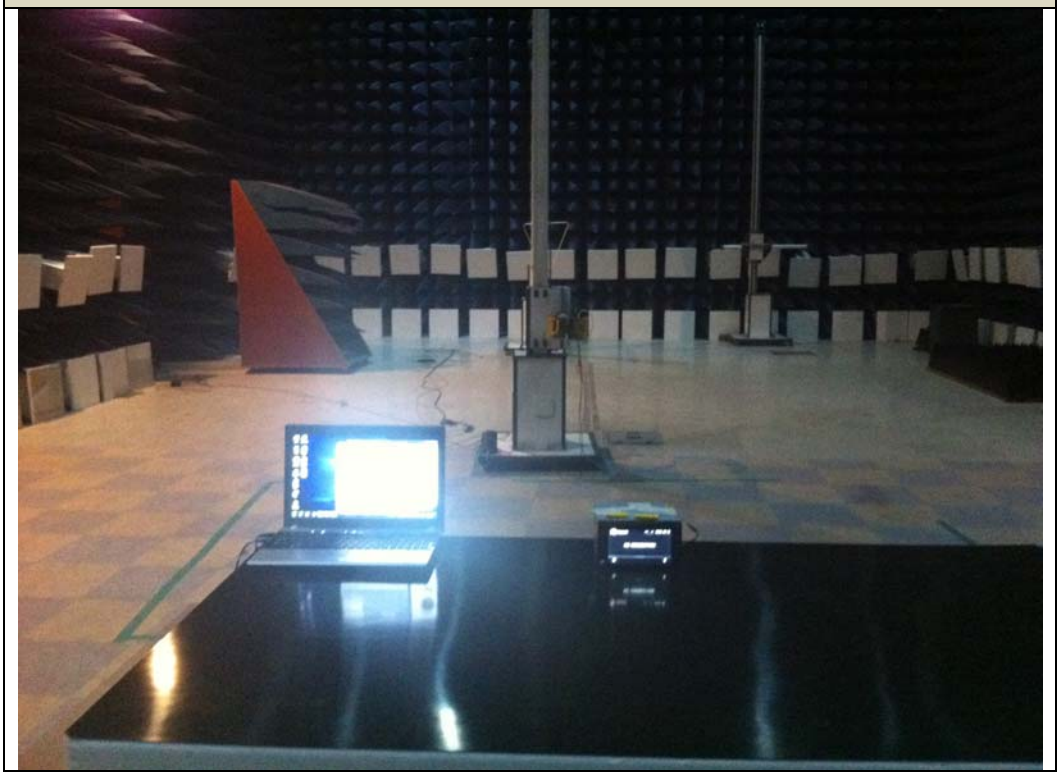
4.0 Test Setup Photo

Radiated Spurious Emission〈30 ㎒ to 1 ㎓〉

Radiated Spurious Emission〈30 ㎒ to 1 ㎓〉



Radiated Spurious Emission〈Above 1 ㎓〉



Radiated Spurious Emission〈Above 1 ㎓〉