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 : YE4X2S	
Report Number.....: Date of issue .....: Total number of pages	FCC2014-0004 Apr. 14. 2014. 35 Pages
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Applicant' s name.....: Address.....:	Glosys Inc. #510, Venture Valley B/D, 40 Omokcheon-Ro 152 Beon-Gil, Gwonseon-Gu, Suwon-Si, Gyeonggi-Do, Korea
Manufacturer' s name ..... : Address.....:	Glosys Inc. #510, Venture Valley B/D, 40 Omokcheon-Ro 152 Beon-Gil, Gwonseon-Gu, Suwon-Si, Gyeonggi-Do, Korea
Test specification:	
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 .....:	X2S / Car Infortainment System Center
Ratings .....:	DC 12 V

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.....:	2014. 02. 19.
Date(s) of performance of tests.....:	2014. 03. 10. ~ 2014. 03. 28.

Summary of testing

Applied Standards

· FCC Part 15 Subpart C § 15.247

· FCC OET Public notice DA 00-705

· ANSI C63.4-2003

FCC Part 15 Subpart C § 15.247
Frequency Hopping Spread Spectrum System

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

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.

FCC Part 15 Subpart C § 15.247

1.0 General Description

1.1 Laboratory information & Description of EUT

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 : 011
KC : J
KCC & FCC : KR0030
VCCI Reg. No. : C-2363, R-2183

1.1.2 Description of EUT

Equipment under test	Car Infortainment System Center
Model name	X2S
Tx/Rx Operating frequency	2 402 MHz ~ 2 480 MHz
Modulation technique	FHSS(GFSK)
Number of channels	79
Antenna type	Chip antenna
Antenna gain	3.438 dBi
Power source	DC 12 V

1.1.3 Test Frequency

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

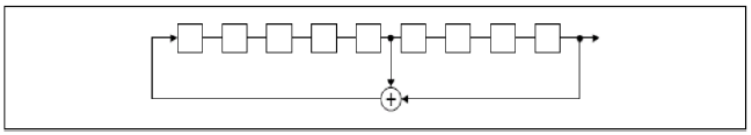
1.2 Information about the FHSS characteristics

1.2.1 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.

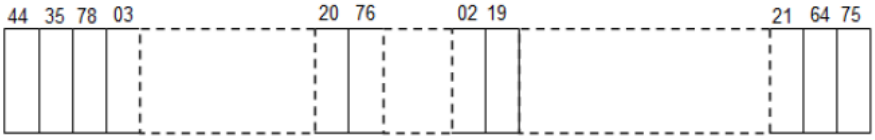
The Pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones.

- Number of shift register stages : 9
- Length of Pseudo-random sequence : 29-1 = 511 bits
- Longest sequence of zeros : 8 (non-inverted signal)



Linear Feedback Shift Register for generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



1.2.2 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

Each Frequency used equally on the average by each transmitter

1.2.3 System Receiver Input Bandwidth

Each channel bandwidth is 1 MHz.
The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

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.

2.0 Test results

2.1 Peak Output Power Measurement

Date of test	Mar.13.2014	
Laboratory Environment	Ambient temperature	17.5 ℃
	Relative humidity	39.5 %
Test site	RF Test room	

▣ 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 MHz ~ 5 850 MHz band : 1 Watts.

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

▣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 dB bandwidth, centered on a hopping channel
   RBW > the 20 dB bandwidth of the emission being measured
   VBW ≥ RBW
   Sweep = Auto
   Detector function = peak
   Trace =max hold
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.

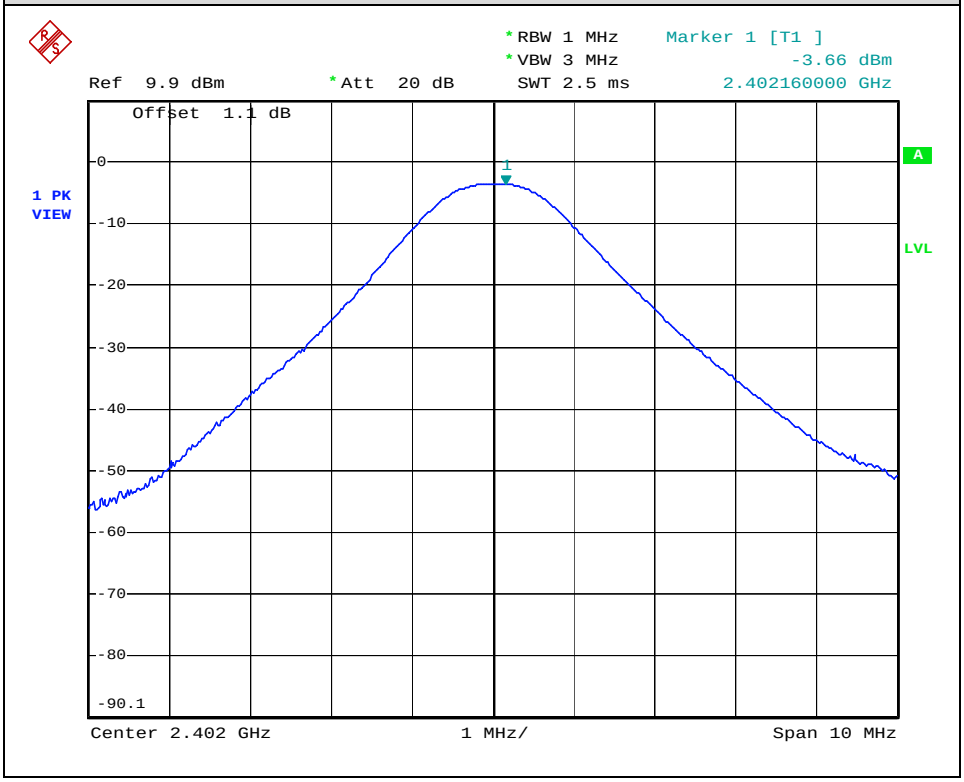
▣Test Setup

▣ Test Result of Peak Output Power

Channel	Frequency(MHz)	Peak Output Power(dBm)	Limit(dBm)
00	2 402	-3.66	30
39	2 441	-5.67	30
78	2 480	-7.62	30

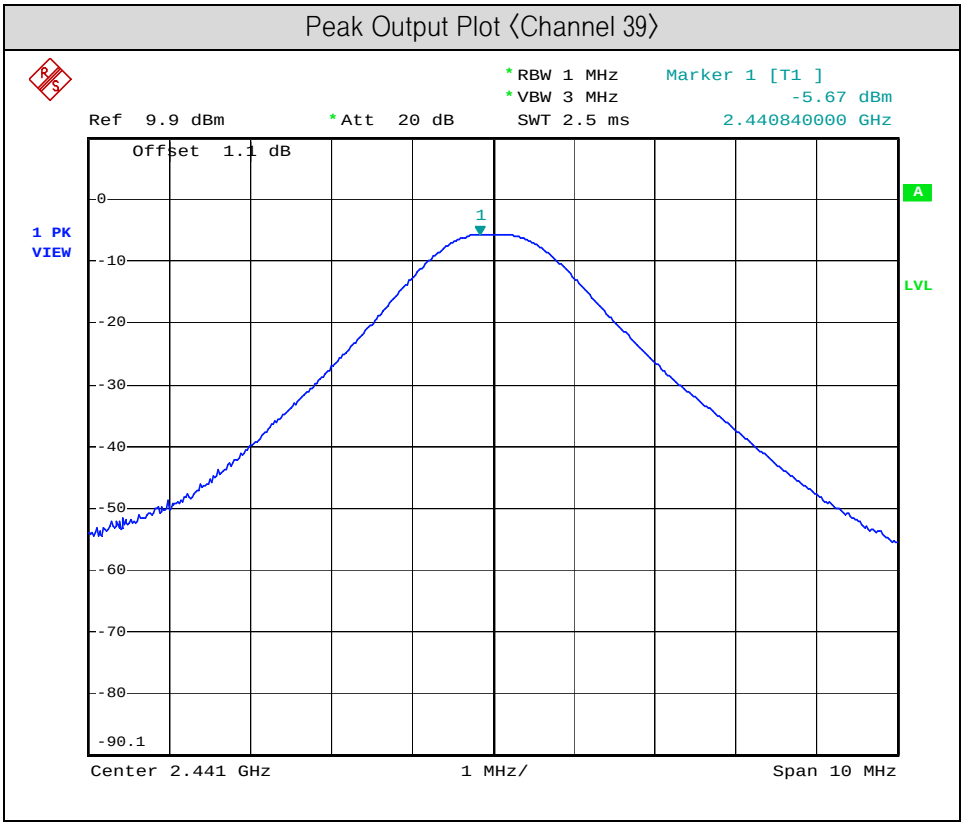
▣Test graph

Peak Output Plot 〈Channel 00〉



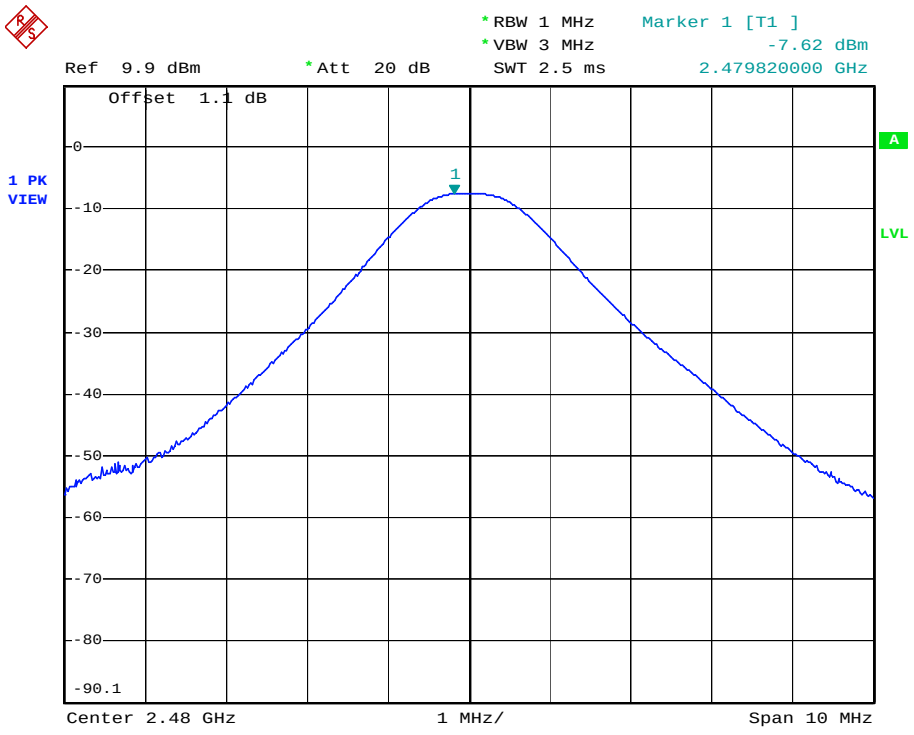
〈2 402 MHz〉

Peak Output Plot 〈Channel 39〉



〈2 441 MHz〉

Peak Output Plot 〈Channel 78〉



〈2 480 MHz〉

2.2 Hopping Channel Separation Measurement

Date of test	Mar.13.2014	
Laboratory Environment	Ambient temperature	17.5 ℃
	Relative humidity	39.5 %
Test site	RF Test room	

▣ Limit of Hopping Channel Separation

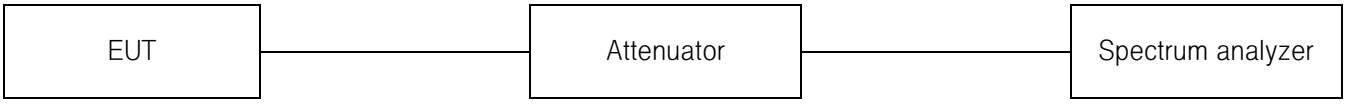
§ 15.247(a)(1), Frequency hopping system operating in 2 400 MHz ~ 2 483.5 MHz . Band may have hopping channel carrier frequencies that are separated by 25 kHz or two-third of 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

▣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

▣ Test Setup

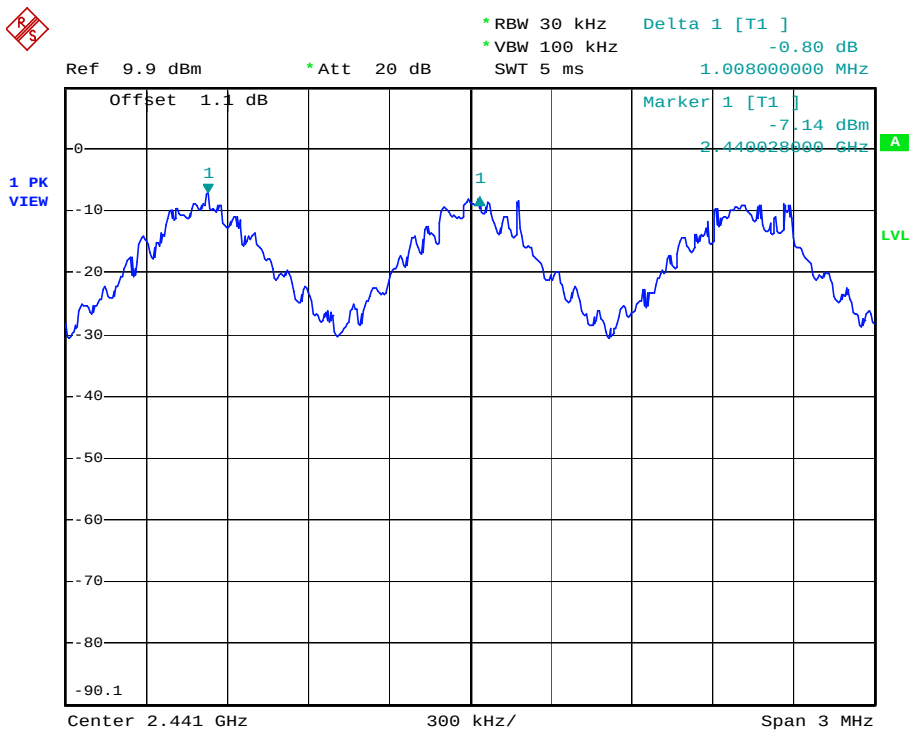


▣ Test Result of Hopping Channel Separation

Channel	Frequency(MHz)	Adjacent Hopping Channel Separation(kHz)	Two-third of 20 dB bandwidth (kHz)	Minimum Bandwidth(kHz)
39	2 441	1 008	626	25

■Test graph

Hopping Channel Separation Plot 〈Channel 39〉



〈2 441 MHz〉

2.3 Number of Hopping Channel Measurement

Date of test	Mar.13.2014	
Laboratory Environment	Ambient temperature	17.5 ℃
	Relative humidity	39.5 %
Test site	RF Test room	

▣ Limit of Number of Hopping Frequency

§ 15.247(a)(1)(iii), Frequency hopping systems in the 2 400 MHz ~ 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

▣ 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 MHz (Start) ~ 2 441.5 MHz (Stop), 2 441.5 MHz (Start) ~ 2 483.5 MHz (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.

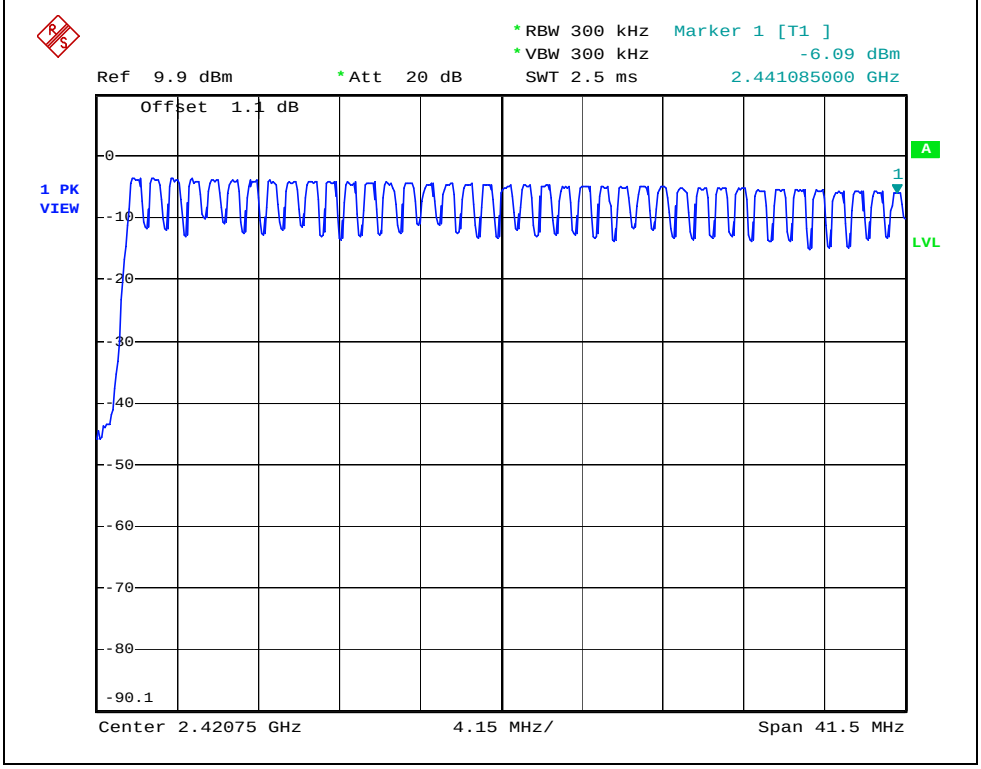
▣ Test Setup

▣ Test Result of Number of Hopping Frequency

Frequency(MHz)	Number of Hopping Frequency	Limit(Channels)
2 402 ~ 2 480	79	≥15

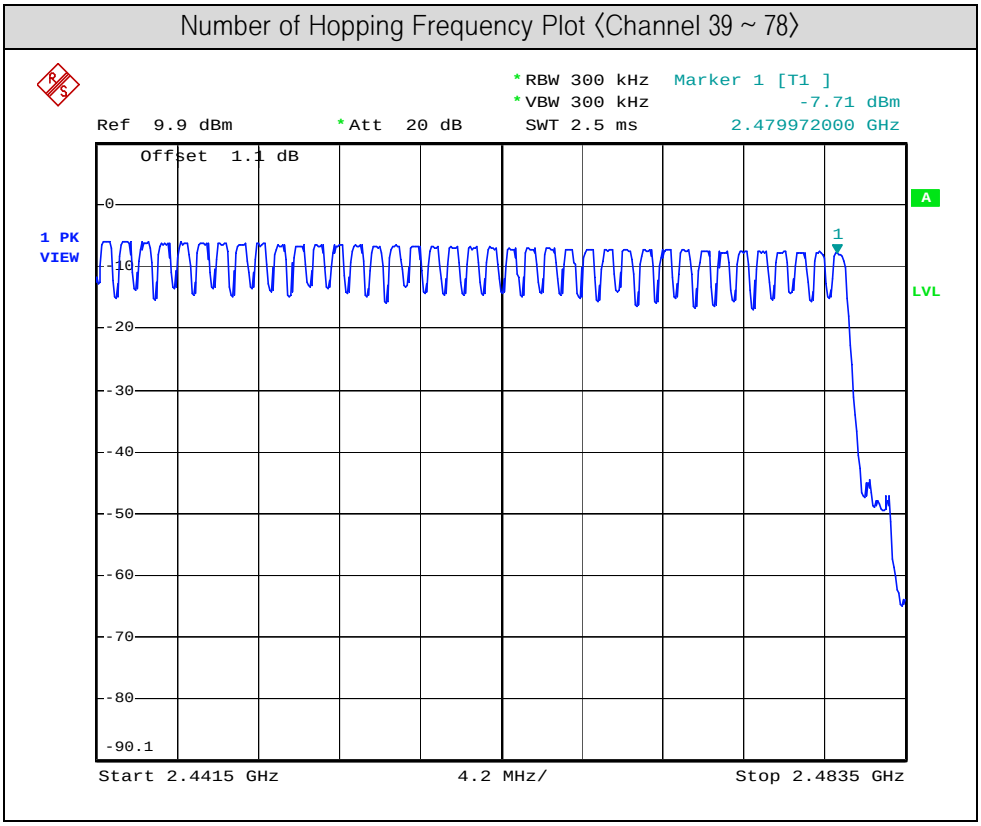
▣Test graph

Number of Hopping Frequency Plot 〈Channel 00 ~ 39〉



〈2 400 MHz ~ 2 441.5 MHz〉

Number of Hopping Frequency Plot 〈Channel 39 ~ 78〉



〈2 441.5 MHz ~ 2 483.5 MHz〉

2.4 Time of Occupancy(Dwell Time) Measurement

Date of test	Mar.13.2014	
Laboratory Environment	Ambient temperature	17.5 ℃
	Relative humidity	39.5 %
Test site	RF Test room	

▣ Limit of Time of Occupancy(Dwell Time)

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

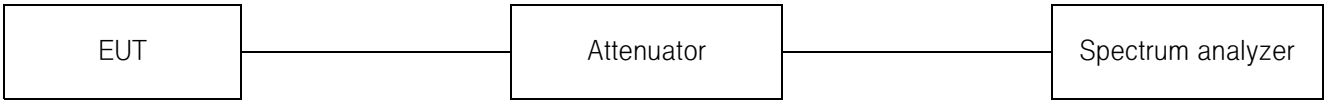
▣ Test Procedure

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 MHz
   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.

▣ Test Setup



▣ Test Result of Time of Occupancy(Dwell Time)

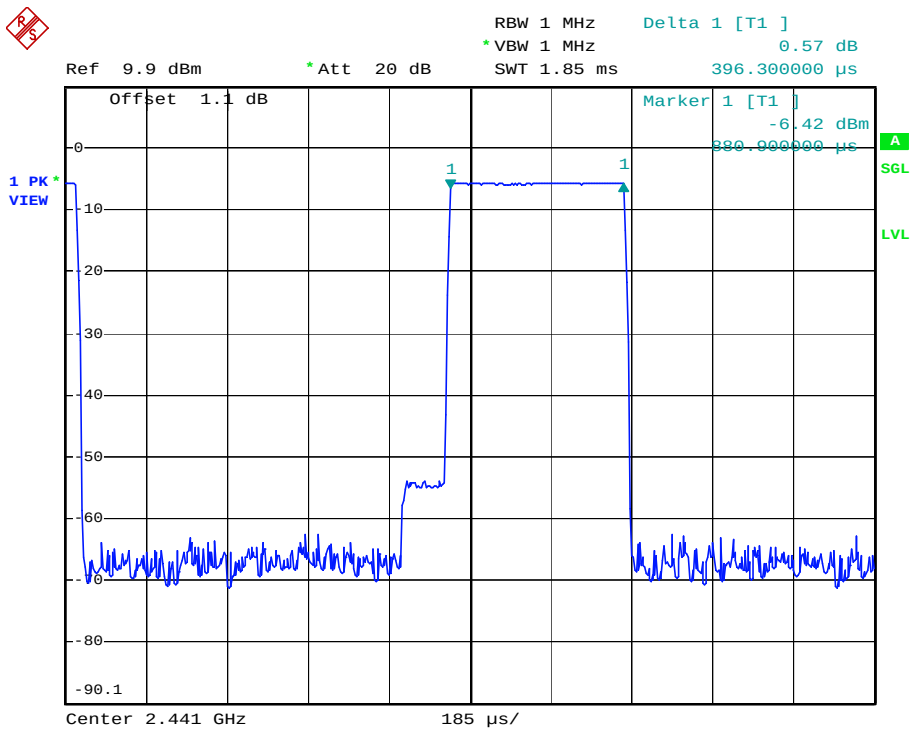
• Time of occupancy on the TX channel in 31.6 sec
= time domain slot length × (hop rate ÷ number of hop per channel) × 31.6

Packet type	Frequency (MHz)	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	1.649	263.84	400
DH5	2 441	2.909	310.29	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) = 263.84 (ms)
DH5: Dwell time (ms) × [(1 600 ÷ 6) ÷ 79] × 31.6(s) = 310.29 (ms)

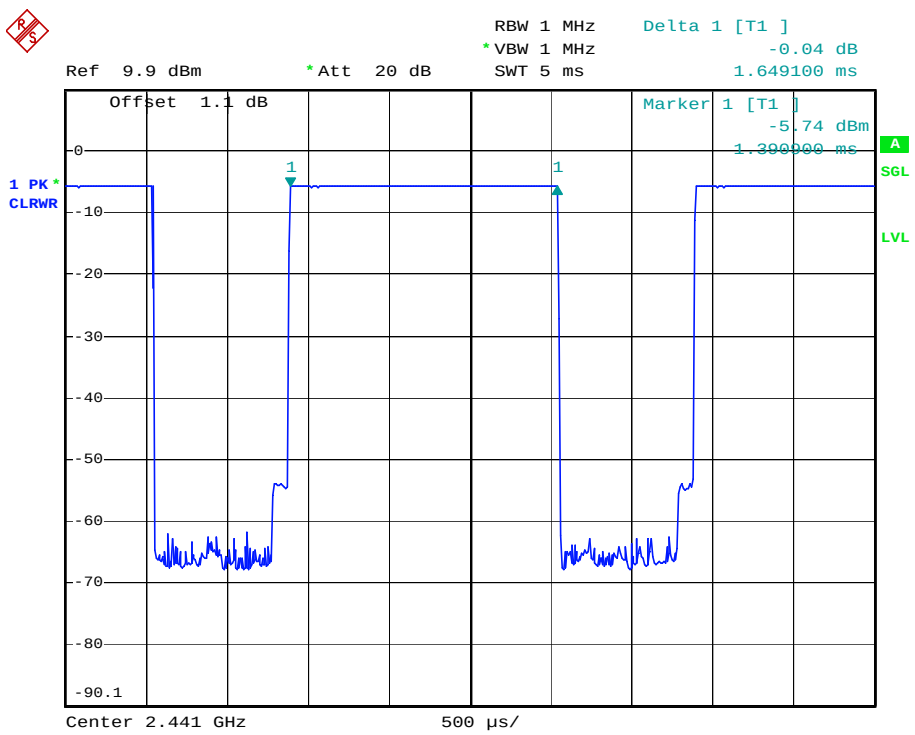
■Test graph

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



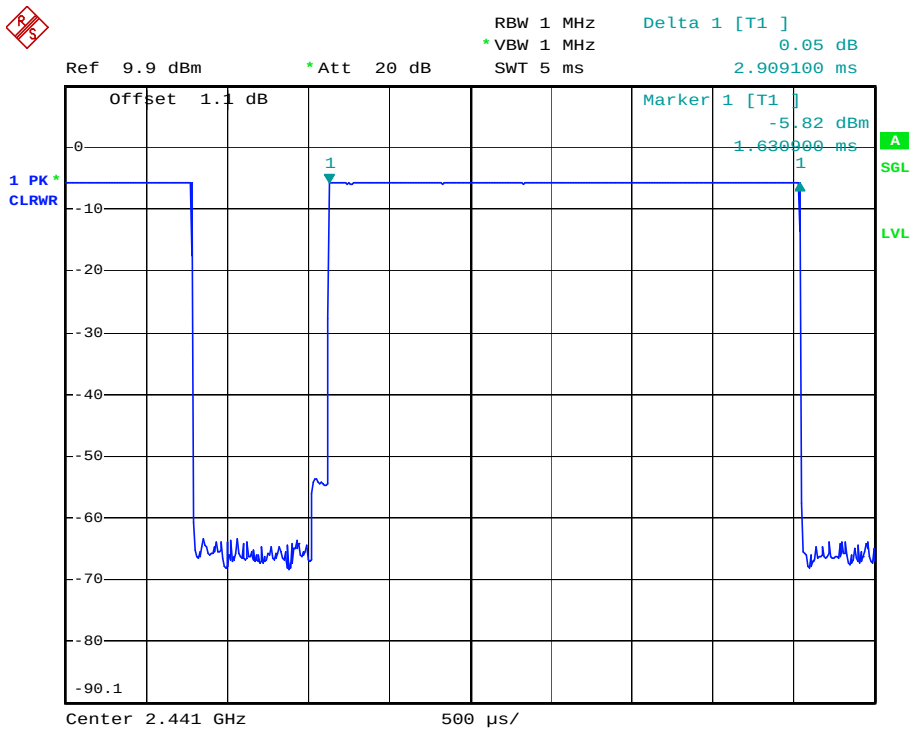
〈DH1〉

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



〈DH3〉

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



〈DH5〉

2.5 20 dB Bandwidth Measurement

Date of test	Mar.13.2014	
Laboratory Environment	Ambient temperature	17.5 ℃
	Relative humidity	39.5 %
Test site	RF Test room	

▣ Limit of 20 dB Bandwidth

N/A

▣ 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.

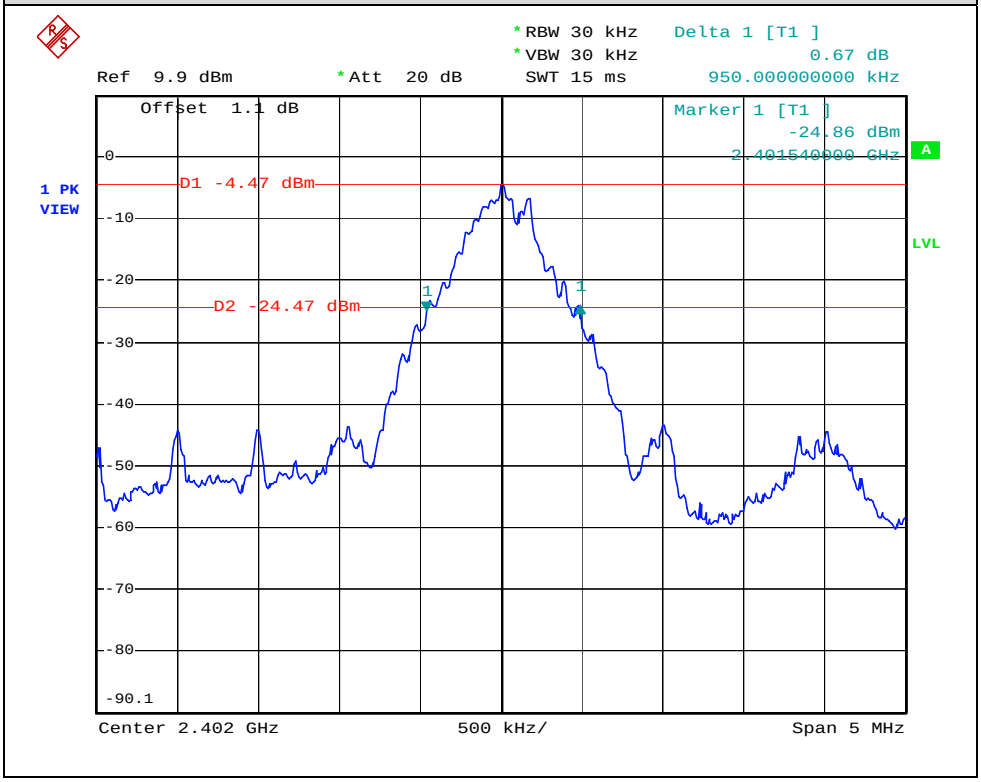
▣ Test Setup

▣ Test Result of 20 dB Bandwidth

Channel	Frequency(MHz)	20 dB Bandwidth(MHz)
00	2 402	0.950
39	2 441	0.940
78	2 480	0.940

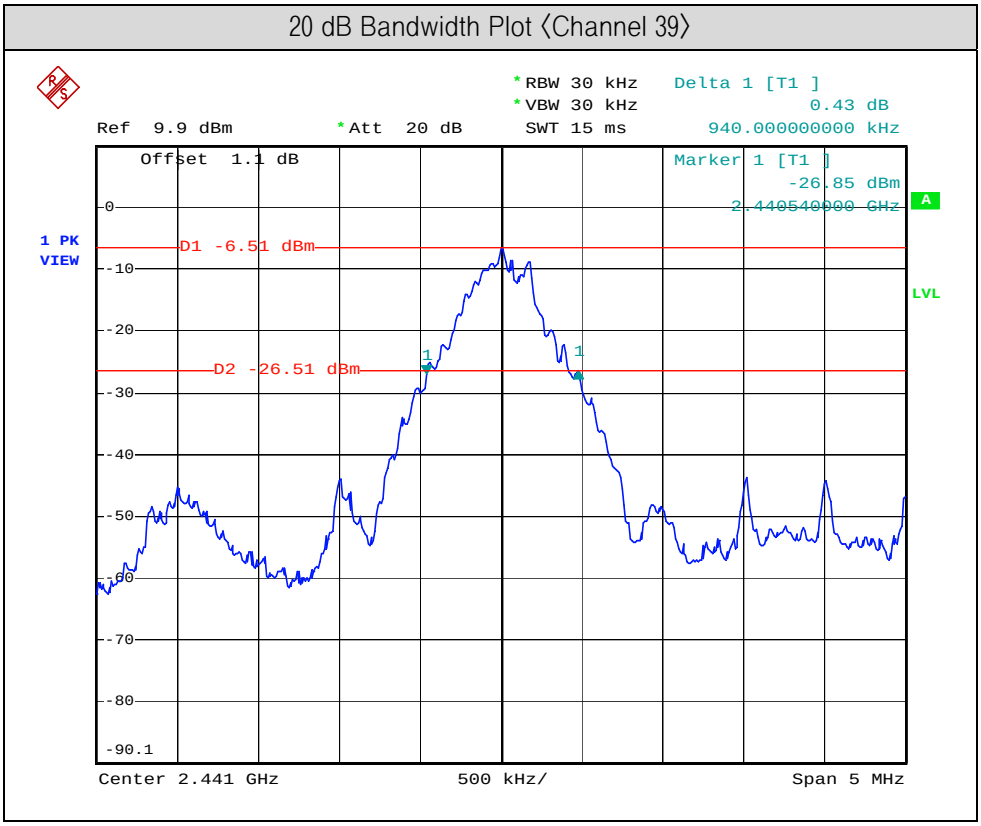
▣Test graph

20 dB Bandwidth Plot 〈Channel 00〉



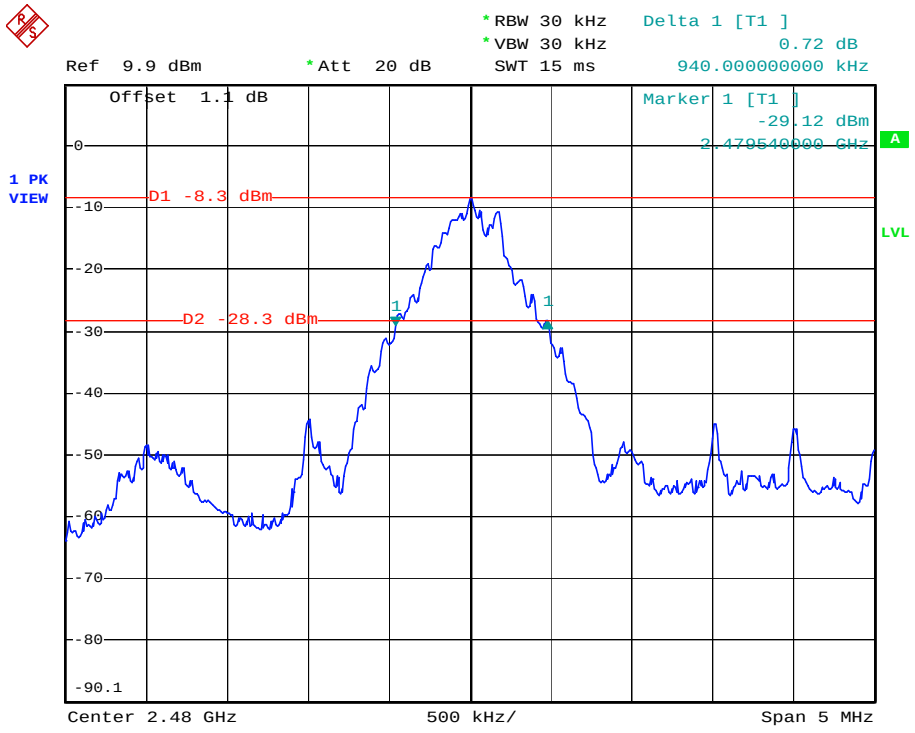
〈2 402 MHz〉

20 dB Bandwidth Plot 〈Channel 39〉



〈2 441 MHz〉

20 dB Bandwidth Plot 〈Channel 78〉



〈2 480 MHz〉

2.6 Conducted Spurious Emission & Band-edge Measurement

Date of test	Mar.13.2014	
Laboratory Environment	Ambient temperature	17.5 ℃
	Relative humidity	39.5 %
Test site	RF Test room	

▣ 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))

▣ 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.

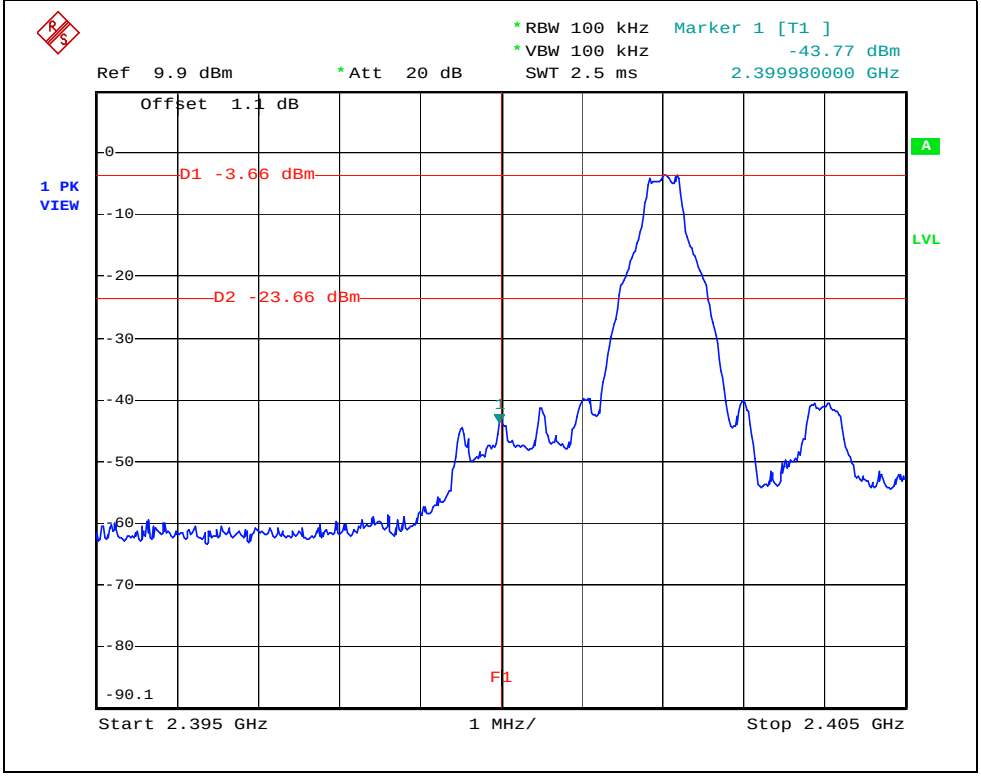
▣ Test Procedure for Spurious RF Conducted Emissions

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

▣ Test Setup

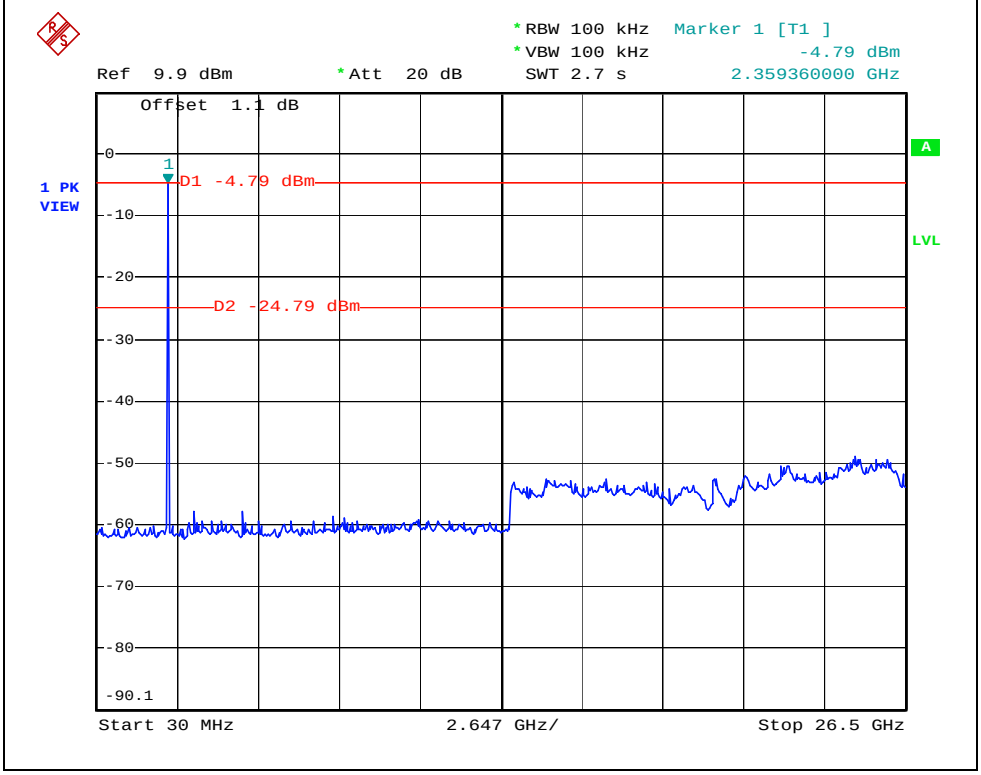
▣ Test Result & Graph of Conducted Spurious Emission & Band-edge

Conducted Spurious Emission & Band-edge Plot〈Channel 00〉



〈2 402 MHz〉

Conducted Spurious Emission & Band-edge Plot〈Channel 00〉



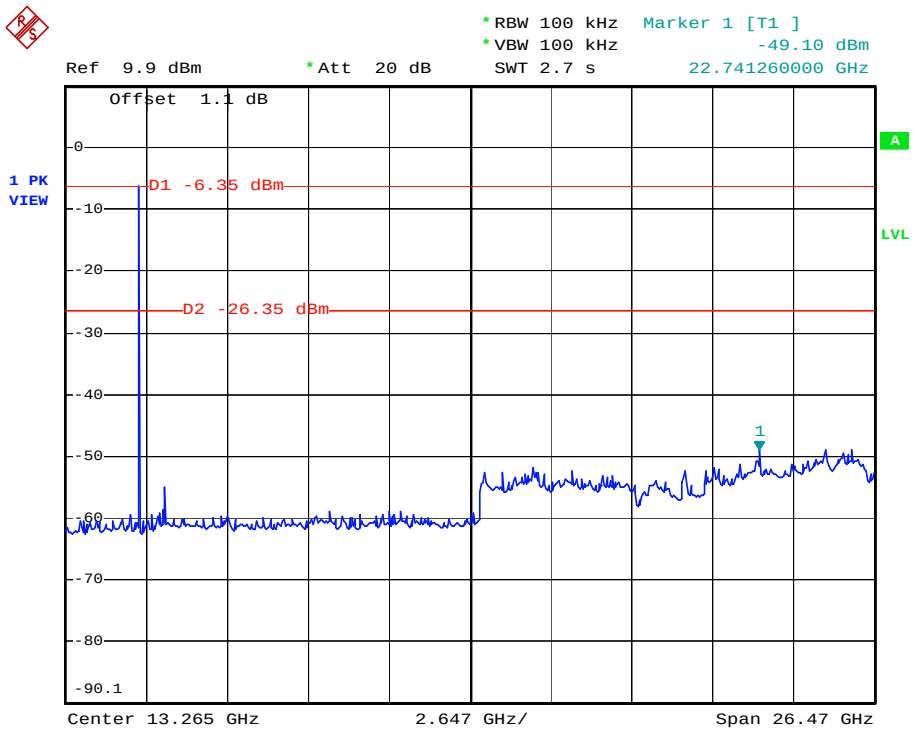
〈2 402 MHz〉

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

N/A

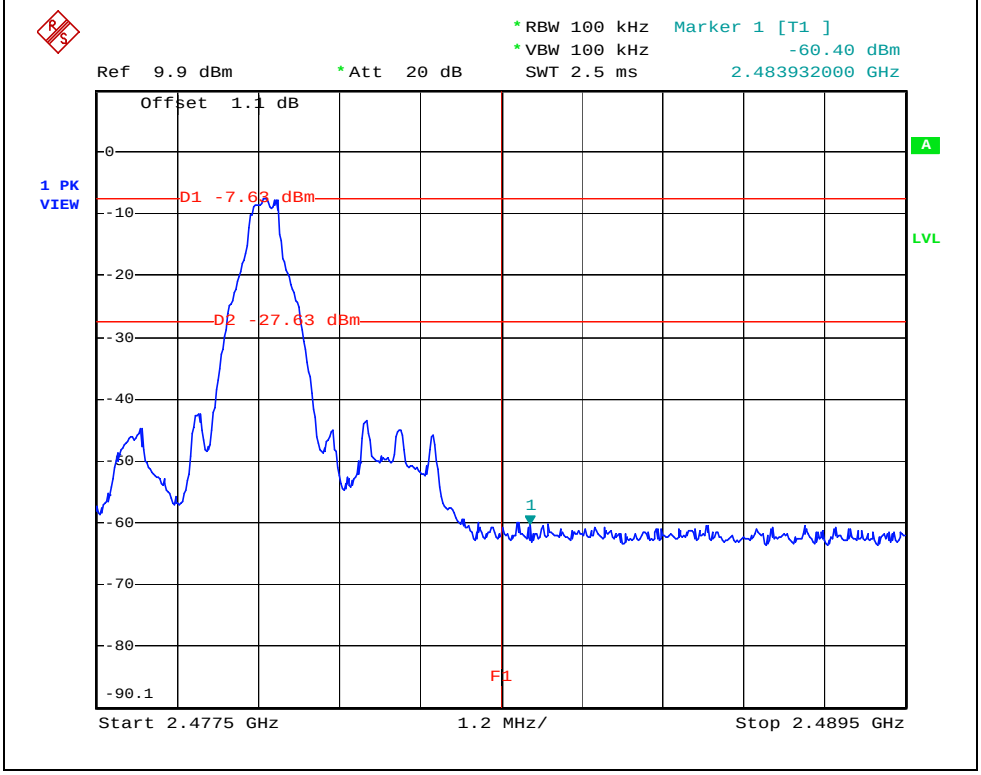
〈2 441 MHz〉

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



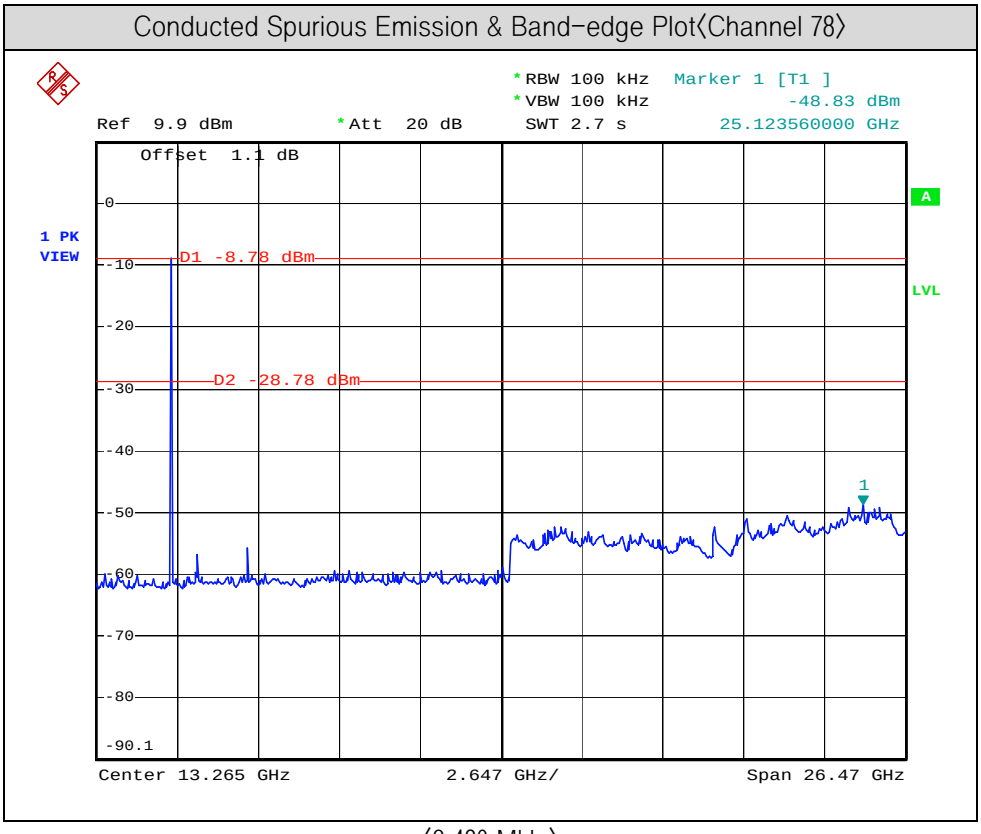
〈2 441 MHz〉

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



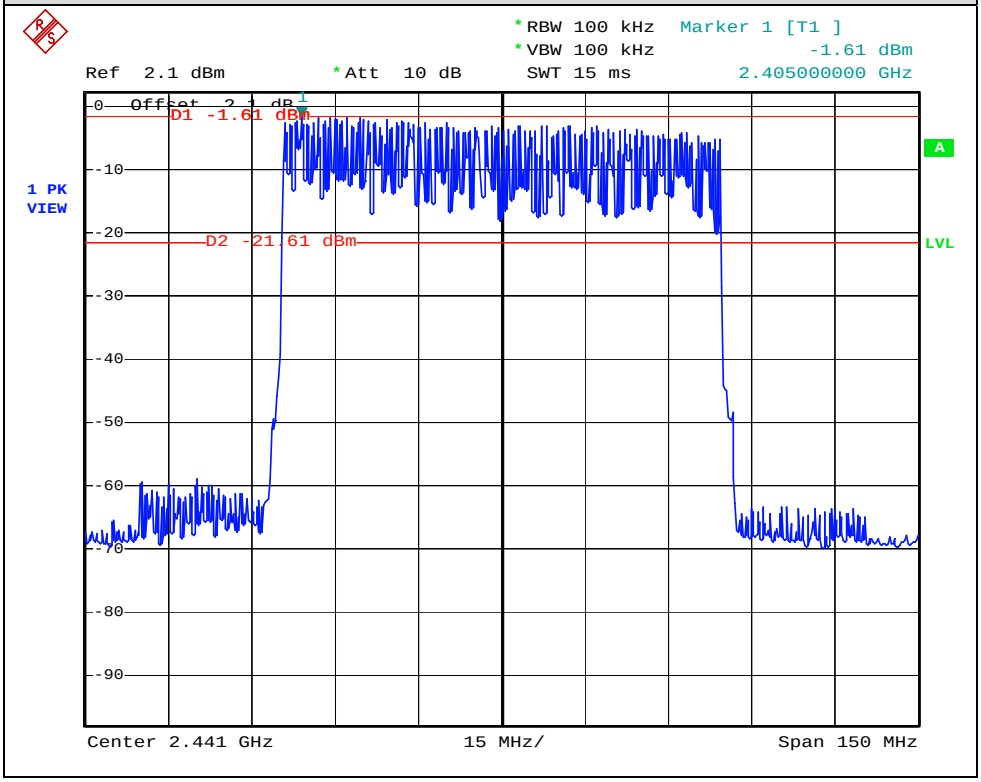
〈2 480 MHz〉

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



〈2 480 MHz〉

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



2.7 Radiated Spurious Emission & Band Edge Measurement

Date of test	Mar.25.2014	
Laboratory Environment	Ambient temperature	22.3 ℃
	Relative humidity	39.8 %
Test site	10m Anechoic chamber	

▣ Limit of Radiated 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 (MHz)	Distance (m)	Radiated (uV/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 MHz ~ 72 MHz, 76 MHz ~ 88 MHz, 174 MHz ~ 216 MHz or 470 MHz ~ 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections § 15.231 and § 15.241.

▣ 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 1GHz, 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 1GHz, 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 dB 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 dB 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 MHz]

Set the spectrum analyzer as follows :

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

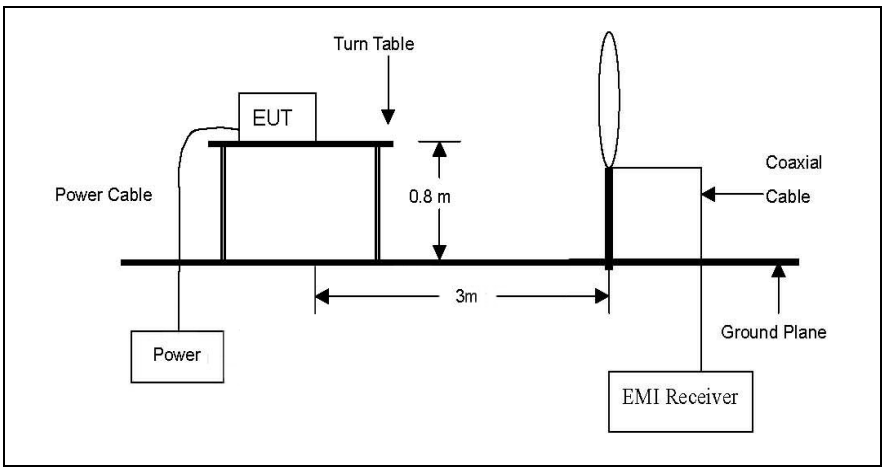
[30 MHz to 1 GHz and 1 GHz to 24 GHz]

Set the spectrum analyzer as follows :

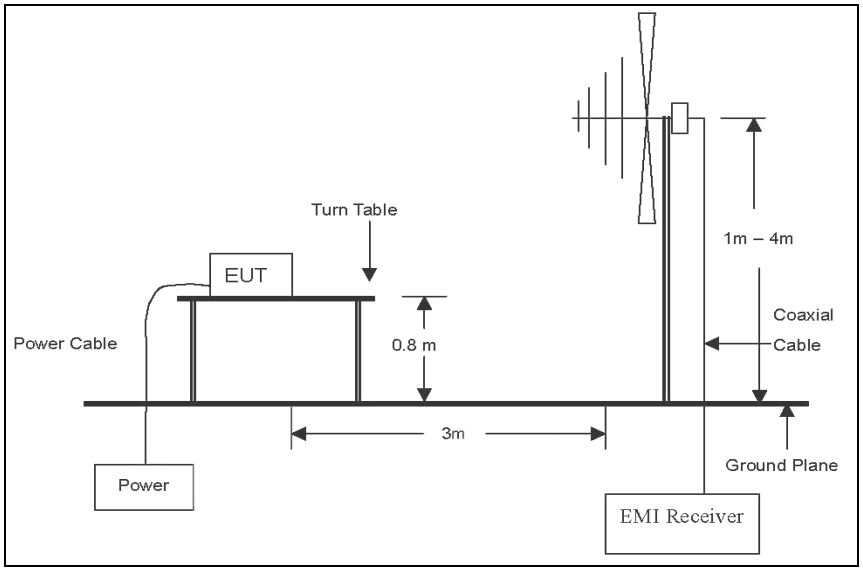
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 120 kHz for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection at frequency above 1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

▣ Test Setup

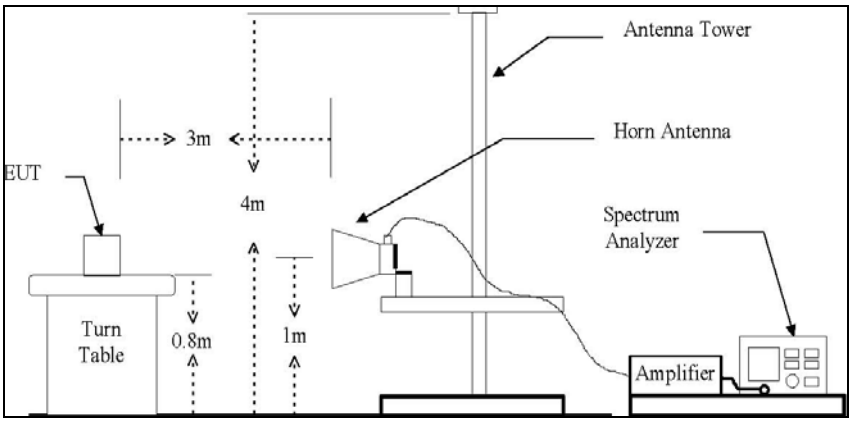
• The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.(For radiated emissions below 30 MHz)



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



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



▣ Test Result of Radiated Spurious Emission & Band Edge

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

Radiated emissions		Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dBuV)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	F_d (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Below 30	Not detected	–	–	–	–	–	–	–

※ Remark

1. All spurious emission at channels are almost the same below 30 MHz, so that high channel was chosen at representative in final test.
2. Actual = Reading + Ant. factor + Cable loss + F_d
3. $F_d = 20\log(D_m / D_s)$

   Where:

   F_d = Distance factor in dB

   D_m = Measurement distance in meters

   D_s = Specification distance in meters

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

Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBuV)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
135.80	21.33	V	13.64	1.63	36.59	43.50	6.91
143.20	20.69	V	14.25	1.63	36.57	43.50	6.93
146.40	19.86	V	14.34	1.66	35.86	43.50	7.64
400.70	17.47	V	16.98	2.40	36.85	46.00	9.15
400.70	23.66	H	16.98	2.40	43.04	46.00	2.96
409.20	15.58	H	17.16	2.40	35.14	46.00	10.86
751.10	12.01	H	22.86	2.48	37.36	46.00	8.64
810.90	12.61	H	23.61	1.70	37.92	46.00	8.08
870.70	8.84	H	24.23	1.78	34.85	46.00	11.15

※ Remark

1. All spurious emission at channels are almost the same below 1 GHz, 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 GHz to 25 GHz was investigated.

〈Channel 00〉								
Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 343.3	49.62	Peak	V	27.74	-35.01	42.35	74.00	31.65
2 350.1	37.91	Average	V	27.77	-34.97	30.70	54.00	23.30
2 350.1	47.72	Peak	H	27.77	-34.97	40.51	74.00	33.49
2 350.1	36.98	Average	H	27.18	-34.97	29.77	54.00	24.23
2 377.9	48.51	Peak	V	27.82	-34.90	41.42	74.00	32.58
2 377.9	36.74	Average	V	27.82	-34.90	29.65	54.00	24.35
2 377.9	46.54	Peak	H	27.82	-34.90	39.45	74.00	34.55
2 377.9	36.88	Average	H	27.82	-34.90	29.79	54.00	24.21
2 399.7	49.13	Peak	V	27.87	-34.85	42.16	74.00	31.84
2 399.7	51.60	Peak	H	27.87	-34.85	44.63	74.00	29.37
2 399.7	40.32	Average	V	27.87	-34.85	33.35	54.00	20.65
2 399.7	42.60	Average	H	27.87	-34.85	42.60	54.00	18.37
4 802.0	51.60	Peak	V	32.88	-29.40	54.54	74.00	19.46
4 802.0	50.77	Peak	H	32.88	-29.40	54.25	74.00	19.75
4 802.0	40.50	Average	V	32.88	-29.40	43.44	54.00	10.56
4 802.0	37.75	Average	H	32.88	-29.40	41.23	54.00	12.77

Mode〈Channel 39〉								
Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4 884.0	51.77	Peak	H	32.84	-29.96	54.65	74.00	19.35
4 884.0	48.46	Peak	V	32.84	-29.96	51.34	74.00	22.66
4 884.0	38.22	Average	H	32.84	-29.96	41.10	54.00	12.90
4 884.0	38.86	Average	V	32.84	-29.96	41.74	54.00	12.26

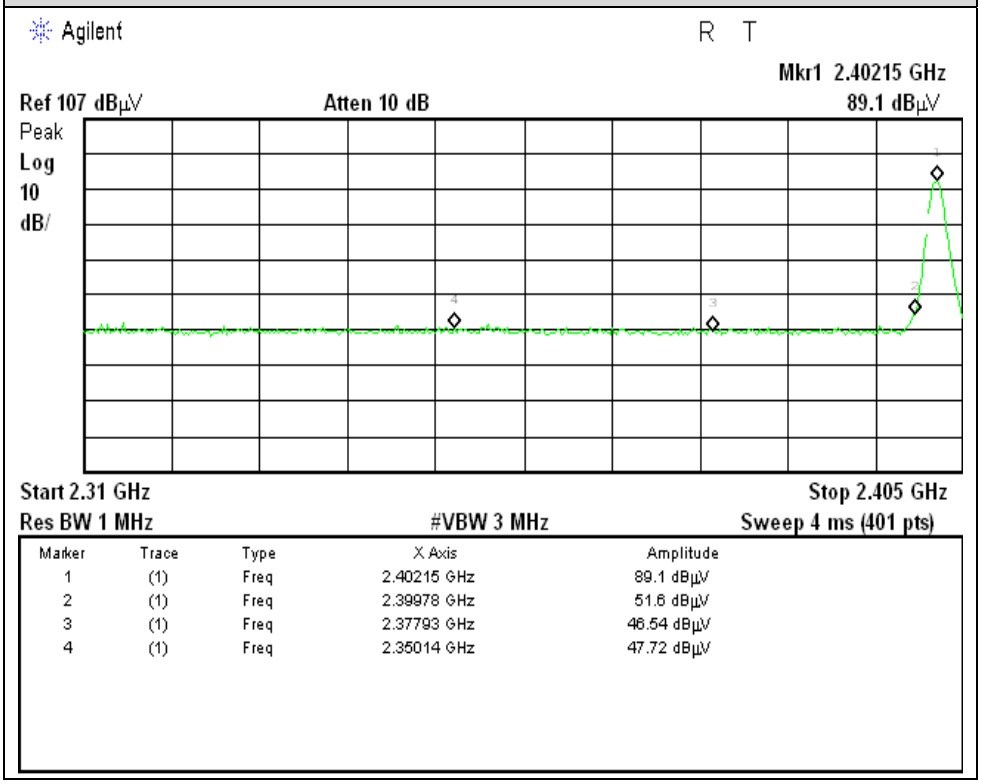
Mode〈Channel 78〉								
Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 489.5	46.05	Peak	V	28.12	-34.56	39.62	74.00	34.38
2 489.5	47.30	Peak	H	28.12	-34.56	40.87	74.00	33.13
2 489.5	36.85	Average	V	28.12	-34.56	30.42	54.00	23.58
2 489.5	36.99	Average	H	28.12	-34.56	30.56	54.00	23.44
2 492.3	44.84	Peak	V	28.15	-34.52	38.47	74.00	35.53
2 492.3	46.49	Peak	H	28.15	-34.52	40.12	74.00	33.88
2 492.3	36.87	Average	V	28.15	-34.52	30.50	54.00	23.50
2 492.3	36.99	Average	H	28.15	-34.52	30.62	54.00	23.38
4 960.0	49.38	Peak	V	32.81	-29.98	52.21	74.00	21.79
4 960.0	49.73	Peak	H	32.81	-29.98	52.56	74.00	21.44
4 960.0	38.68	Average	V	32.81	-29.98	41.51	54.00	12.49
4 960.0	37.96	Average	H	32.81	-29.98	40.79	54.00	13.21

※ Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1 000 MHz 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.

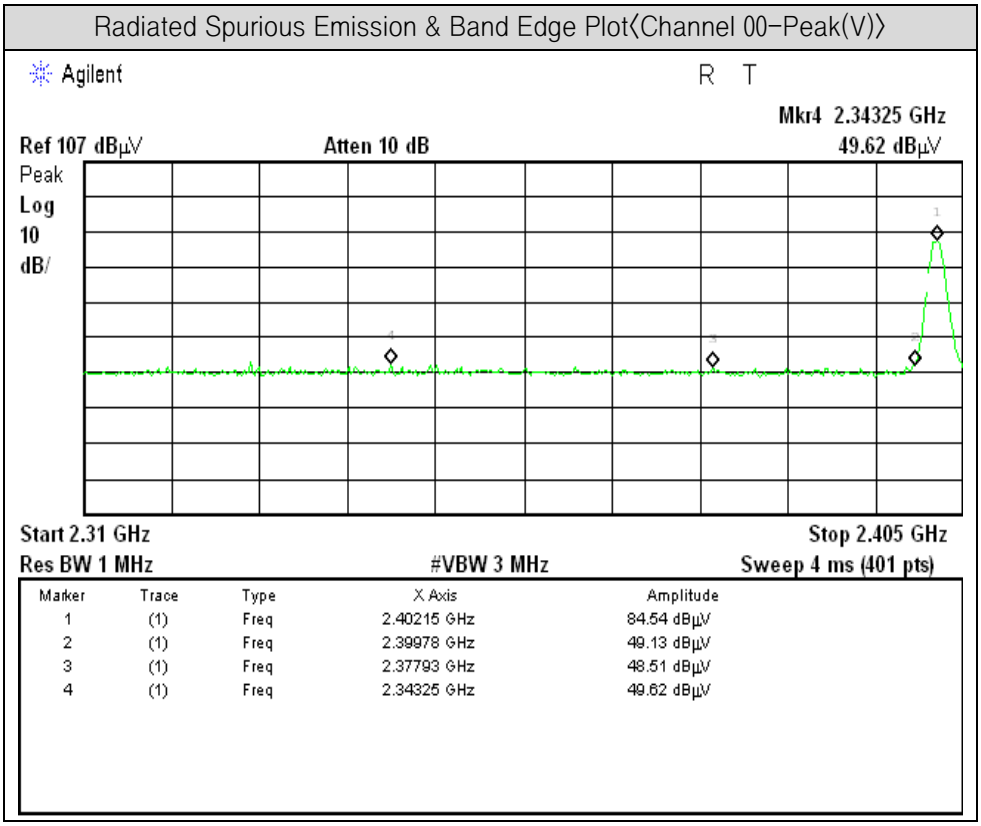
▣ Test Graph

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



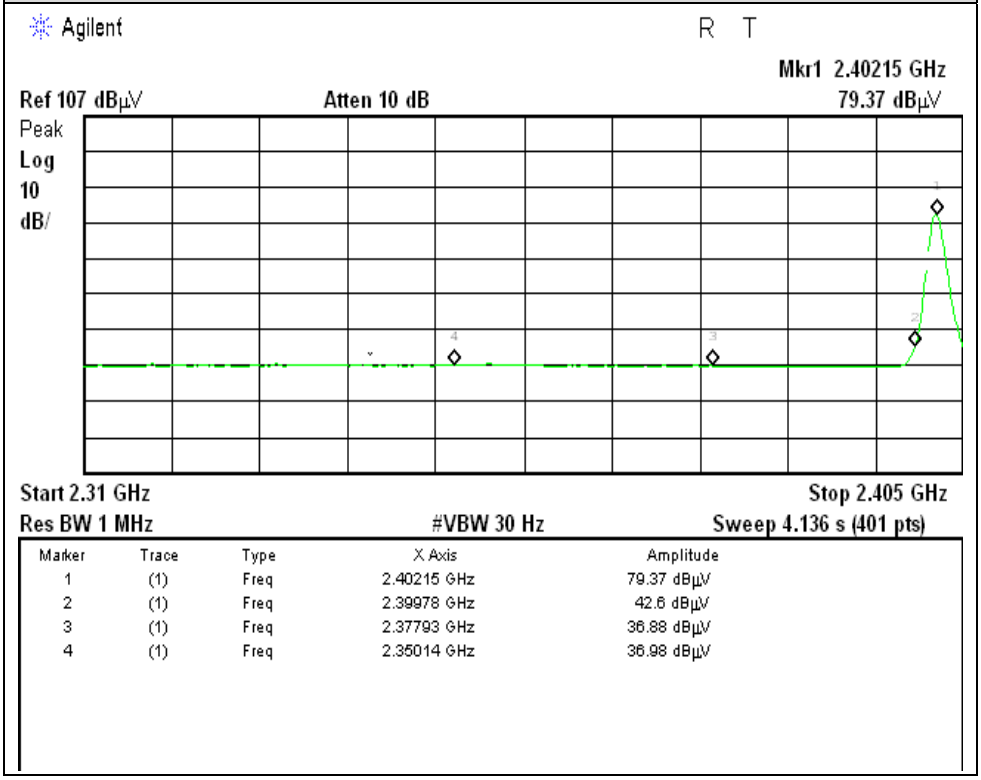
〈2 402 MHz〉

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



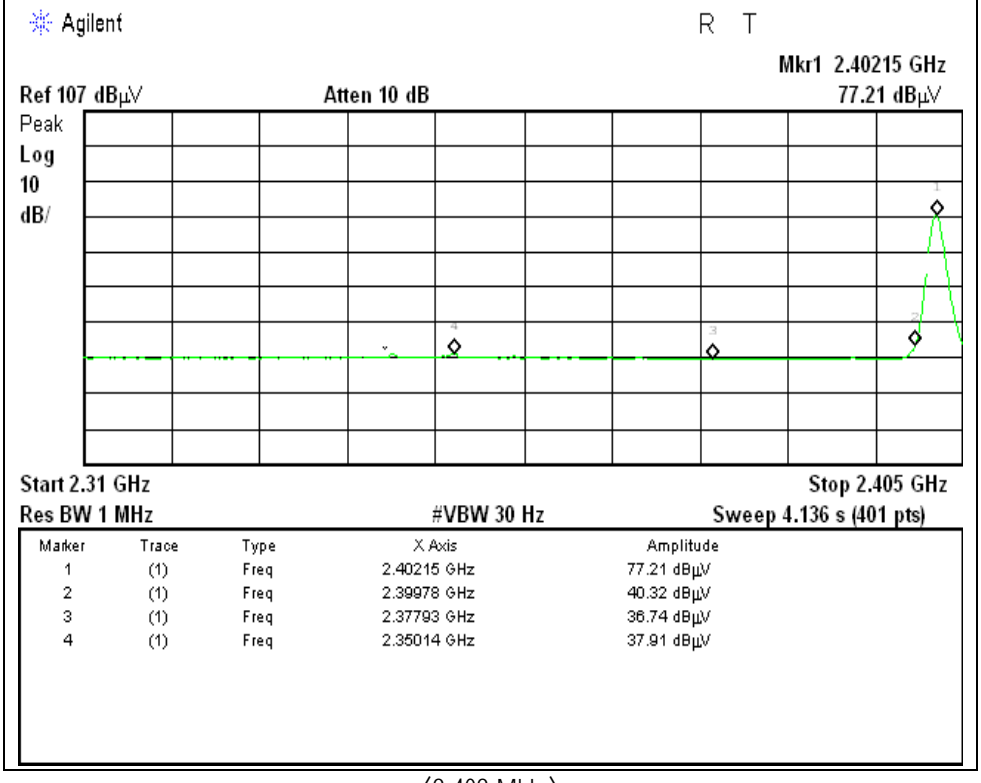
〈2 402 MHz〉

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



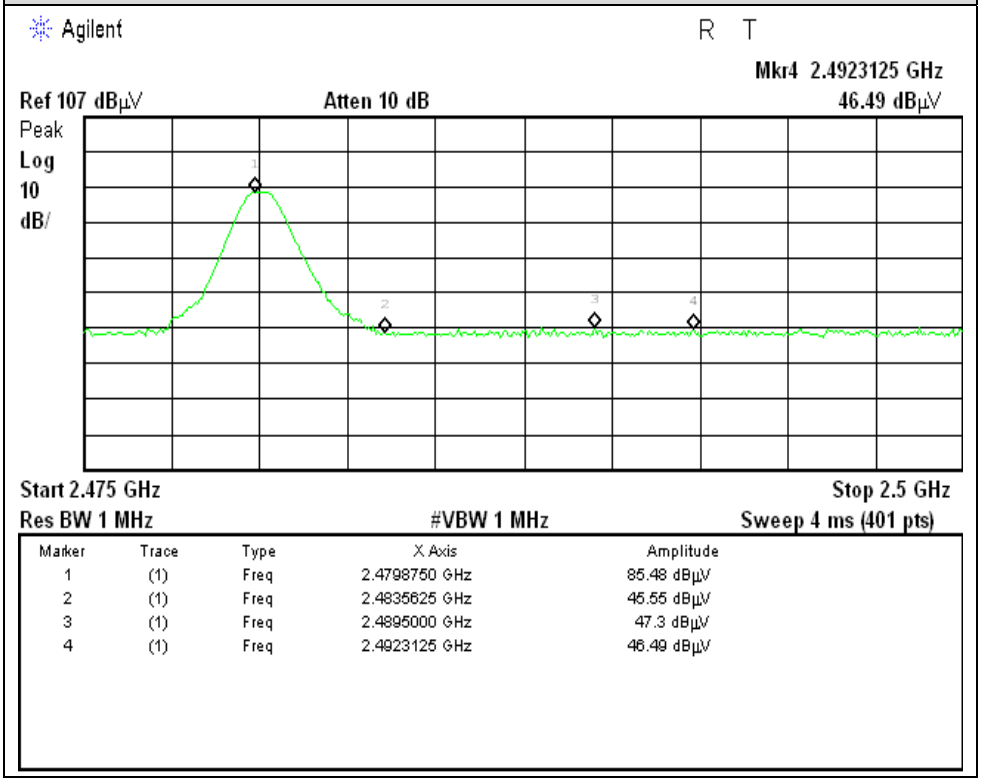
〈2 402 MHz〉

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



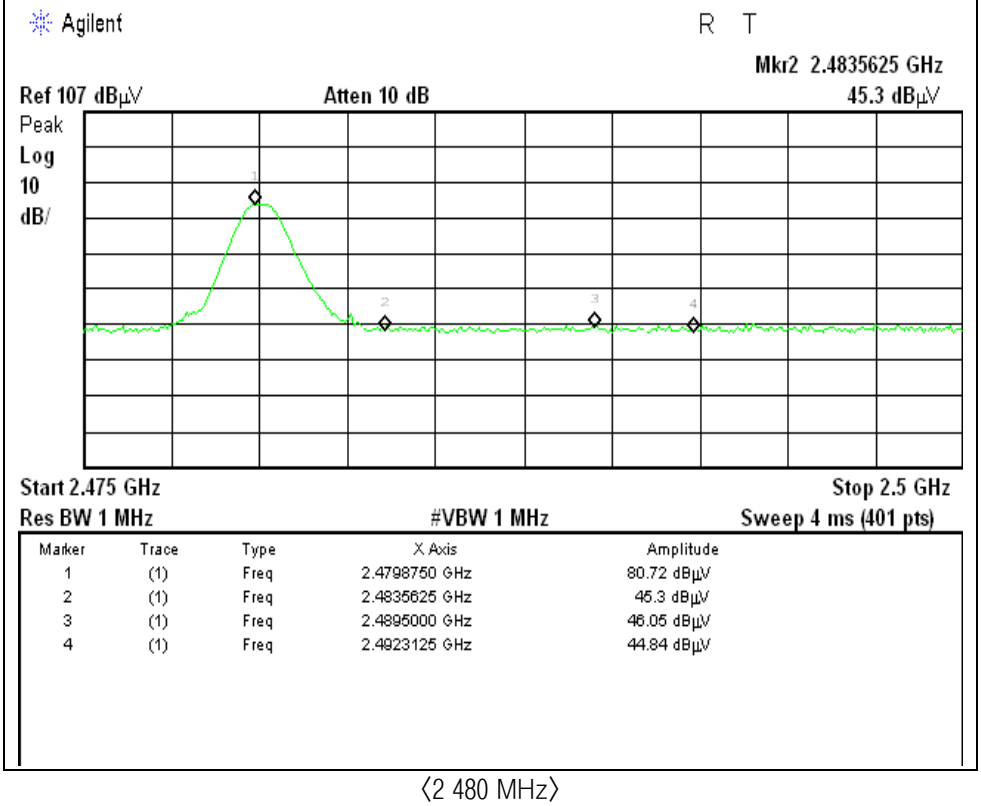
〈2 402 MHz〉

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



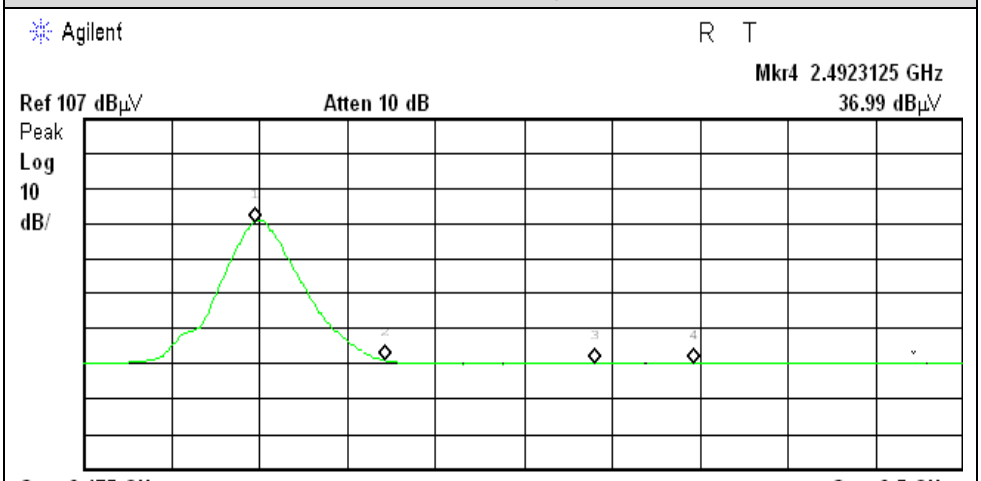
〈2 480 MHz〉

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



〈2 480 MHz〉

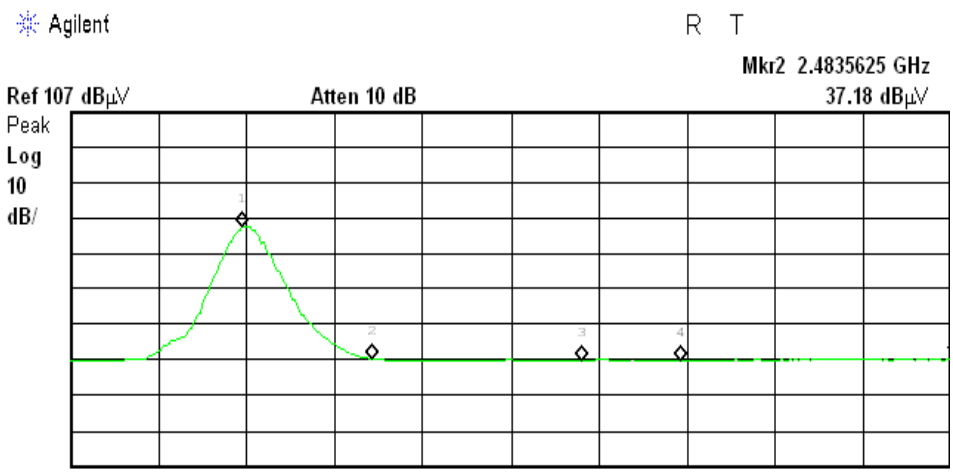
Radiated Spurious Emission & Band Edge Plot〈Channel 78-AVG(H)〉



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.4798750 GHz	77.35 dBµV
2	(1)	Freq	2.4835625 GHz	37.91 dBµV
3	(1)	Freq	2.4895000 GHz	36.99 dBµV
4	(1)	Freq	2.4923125 GHz	36.99 dBµV

〈2 480 MHz〉

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



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.4798750 GHz	74.39 dBµV
2	(1)	Freq	2.4835625 GHz	37.18 dBµV
3	(1)	Freq	2.4895000 GHz	36.85 dBµV
4	(1)	Freq	2.4923125 GHz	36.87 dBµV

〈2 480 MHz〉

2.8 Antenna Requirement

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

▣ Antenna Connected Construction

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

3.0 Used Test Equipment

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSP	837866/034	2013.08.08	2014.08.08
Spectrum Analyzer	Agilent	E7402A	US40240261	2014.03.13	2015.03.13
EMC Analyzer	Agilent	7405A	US39430154	2013.10.11	2014.10.11
Signal Generator	R&S	SMR40	100122	2014.01.17	2015.01.17
DC Power Supply	Agilent	6673A	MY41000334	2013.10.11	2014.10.11
Loop Antenna	R&S	HFH2-Z2	825841/008	2013.03.19	2015.03.19
Broad Band Antenna	Schwarzbeck	VULB9168	484	2013.07.19	2015.07.19
Horn Antenna	EMCO	3115	9811-5606	2013.09.05	2015.09.05
Antenna Mast	HD	MA240	-	-	-
Turn Table	HD	DT430S	-	-	-
Preamp	Testek	TK-PA18	120006	2013.06.07	2014.06.03
Highpass Filter	WAINWRIGHT	WHNX3.5/26.5 G-6SS	13	2013.06.18	2014.06.18
Laptop	Samsung Electronics	NT-RV520	HSGK91MCA00190D	-	-

4.0 Test Setup