

**ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT  
INTENTIONAL RADIATOR CERTIFICATION TO  
FCC PART 15 SUBPART C REQUIREMENT**

*OF*

**PHONE STATION**

**MODEL No.: iSP0A**

**BRAND NAME: ION**

**FCC ID: Y40-ISP0A**

**REPORT NO.: KAD111031059F**

**ISSUE DATE: December 26, 2011**

*Prepared for*

**ION AUDIO LLC**

**200 Scenic View Drive, Suite 201, Cumberland, RI 02864, U.S.A**

*Prepared by*

**DONGGUAN EMTEK CO., LTD.**

**No.281, Guantai Road, Nancheng District,  
Dongguan, Guangdong, China**

**TEL: 86-769-22807078**

**FAX: 86-769-22807079**

## VERIFICATION OF COMPLIANCE

Applicant:	ION AUDIO LLC 200 Scenic View Drive, Suite 201, Cumberland, RI 02864, U.S.A
Manufacturer:	INTEGRITY ELECTRONIC CO., LTD. No.68, Huanghe Rd., Fenghuanggang, Tangxia Township, Dongguan City, Guangdong Province, China
Product Description:	PHONE STATION
Brand Name:	ION
Model Number:	iSP0A
Serial Number:	N/A
Kind of Device:	Bluetooth Ver. 2.1+EDR
File Number:	KAD111031059F
Date of Test:	October 31, 2011 to December 23, 2011

### We hereby certify that:

The above equipment was tested by DONGGUAN EMTEK CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4 (2009) and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247.

The test results of this report relate only to the tested sample identified in this report.

*Approved By*



---

*Sam Lv / Q.A. Manager*  
**DONGGUAN EMTEK CO., LTD.**

## Table of Contents

<b>1.</b>	<b>GENERAL INFORMATION .....</b>	<b>5</b>
1.1	PRODUCT DESCRIPTION.....	5
1.2	RELATED SUBMITTAL(S) / GRANT (S) .....	5
1.3	TEST METHODOLOGY .....	5
1.4	SPECIAL ACCESSORIES .....	5
1.5	EQUIPMENT MODIFICATIONS .....	5
1.6	TEST FACILITY .....	6
<b>2.</b>	<b>SYSTEM TEST CONFIGURATION .....</b>	<b>7</b>
2.1	EUT CONFIGURATION .....	7
2.2	EUT EXERCISE .....	7
2.3	TEST PROCEDURE .....	7
2.4	LIMITATION .....	7
2.5	CONFIGURATION OF TESTED SYSTEM .....	11
<b>3.</b>	<b>SUMMARY OF TEST RESULTS .....</b>	<b>12</b>
<b>4.</b>	<b>DESCRIPTION OF TEST MODES .....</b>	<b>12</b>
<b>5.</b>	<b>AC POWER CONDUCTED EMISSIONS TEST .....</b>	<b>13</b>
5.1	MEASUREMENT PROCEDURE:.....	13
5.2	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) .....	13
5.3	MEASUREMENT EQUIPMENT USED: .....	13
5.4	MEASUREMENT RESULT:.....	13
5.5	CONDUCTED MEASUREMENT PHOTOS:.....	16
<b>6.</b>	<b>RADIATED EMISSION TEST .....</b>	<b>17</b>
6.1	MEASUREMENT PROCEDURE.....	17
6.2	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) .....	18
6.3	MEASUREMENT EQUIPMENT USED: .....	19
6.4	MEASUREMENT RESULT .....	19
6.5	RADIATED MEASUREMENT PHOTOS:.....	27
<b>7.</b>	<b>CHANNEL SEPARATION TEST .....</b>	<b>28</b>
7.1	MEASUREMENT PROCEDURE.....	28
7.2	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) .....	28
7.3	MEASUREMENT EQUIPMENT USED: .....	28
7.4	MEASUREMENT RESULTS:.....	28
<b>8.</b>	<b>20DB BANDWIDTH TEST .....</b>	<b>30</b>
8.1	MEASUREMENT PROCEDURE.....	30
8.2	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) .....	30
8.3	MEASUREMENT EQUIPMENT USED: .....	30
8.4	MEASUREMENT RESULTS:.....	30

<b>9.</b>	<b>QUANTITY OF HOPPING CHANNEL TEST.....</b>	<b>36</b>
9.1	MEASUREMENT PROCEDURE.....	36
9.2	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) .....	36
9.3	MEASUREMENT EQUIPMENT USED: .....	36
9.4	MEASUREMENT RESULTS:.....	36
<b>10.</b>	<b>TIME OF OCCUPANCY (DWELL TIME) TEST .....</b>	<b>37</b>
10.1	TEST DESCRIPTION .....	37
10.2	TEST REQUIREMENTS / LIMITS .....	37
10.3	TEST PROTOCOL .....	37
10.4	TEST RESULT: DWELL TIME.....	37
<b>11.</b>	<b>M AX IMUM PEAK OUTPUT POWER TEST .....</b>	<b>40</b>
11.1	MEASUREMENT PROCEDURE.....	40
11.2	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) .....	40
11.3	MEASUREMENT EQUIPMENT USED: .....	40
11.4	MEASUREMENT RESULTS:.....	41
<b>12.</b>	<b>BAND EDGE TEST .....</b>	<b>46</b>
12.1	MEASUREMENT PROCEDURE.....	46
12.2	TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) .....	46
12.3	MEASUREMENT EQUIPMENT USED: .....	46
12.4	MEASUREMENT RESULTS:.....	47
<b>13.</b>	<b>ANTENNA APPLICATION.....</b>	<b>51</b>
13.1	ANTENNA REQUIREMENT .....	51
13.2	RESULT .....	51
<b>14.</b>	<b>RF EXPOSURE EVALUATION .....</b>	<b>52</b>
14.1	FRIIS TRANSMISSION FORMULA: $P_D=(P_{OUT}*G)/(4*\pi*R^2)$ .....	52
14.2	MEASUREMENT RESULT.....	52

## 1. GENERAL INFORMATION

### 1.1 Product Description

The ION AUDIO LLC Model: iSP0A (referred to as the EUT in this report) The EUT is an short range, lower power, PHONE STATION designed as an Input Device. It is designed by way of utilizing the GFSK,  $\pi/4$ DQPSK, 8DPSK modulation achieves the system operating.

A major technical descriptions of EUT is described as following:

- A). Operation Frequency: 2402-2480MHz
- B). Modulation: GFSK,  $\pi/4$ DQPSK, 8DPSK
- C). Number of Channel: 79
- D). Channel space: 1MHz
- E). Rated RF Output Power: 3.61dBm
- F). Antenna Type: Internal PCB antenna
- G). Power Supply: Input: AC 100-240V, 50/60Hz, 0.2A  
Output: DC 5V, 1A
- H). Antenna Gain: 2402MHz: -4.14dBi  
2441MHz: -2.26dBi  
2480MHz: -1.32dBi

The basic data rate of 1Mbps uses GFSK modulation and the enhanced data rate uses PSK modulation. For the enhanced data rate of 3Mbps 8DPSK modulation and of 2Mbps  $\pi/4$ DQPSK modulation is used.

### 1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: Y4O-ISP0A filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules. The composite system (receiver) is compliance with Subpart B is authorized under a DoC procedure.

### 1.3 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4 (2009). Radiated testing was performed at an antenna to EUT distance 3 meters.

### 1.4 Special Accessories

Not available for this EUT intended for grant.

### 1.5 Equipment Modifications

Not available for this EUT intended for grant.

## 1.6 Test Facility

### Site Description

EMC Lab. : Accredited by FCC, Aug. 18, 2011  
The Certificate Number is 247565.

Accredited by Industry Canada, January 13, 2011  
The Certificate Registration Number. is 46405-9444

Name of Firm : DONGGUAN EMTEK CO., LTD.

Site Location : No.281, Guantai Road, Nancheng District,  
Dongguan, Guangdong, China

## 2. System Test Configuration

### 2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

### 2.2 EUT Exercise

The Transmitter was operated in the normal operating mode. the Tx frequency was fixed which was for the purpose of the measurements.

### 2.3 Test Procedure

#### 2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4-2009. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode.

#### 2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter(EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.4-2009.

### 2.4 Limitation

#### (1) Channel Separation test

FCC Part 15, Subpart C Section 15.247(a)(1). Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 Bandwidth of the hopping channel, whichever is greater.

Frequency Range (MHz)	Limit(kHz)
902-928	>25kHz
2400-2483.5	>25kHz
5725-5850	>25kHz

**(2) 20dB Bandwidth**

Frequency Range(MHz)	Quantity of Hopping Channel	Limit(kHz)			
		50	25	15	75
	902-928	<250	>250	NA	NA
	2400-2483.5	NA	NA	>1000	<1000

**(3) Quantity of Hopping Channel**

FCC Part 15, Subpart C Section 15.247

Frequency Range (MHz)	Limit(Quantity of Hopping Channel)			
	20dB bandwidth <250kHz	20dB bandwidth >250kHz	20dB bandwidth <1MHz	20dB bandwidth >1MHz
902-928	50	25	NA	NA
2400-2483.5	NA	NA	15	15
5725-5850	NA	NA	75	NA

**(4) Time of Occupancy(Dwell Time)**

FCC Part 15, Subpart C Section 15.247

Frequency Range (MHz)	LIMIT(rms)		
	20dB bandwidth <250kHz(50Channel)	20dB bandwidth >250kHz(25Channel)	20dB bandwidth <1MHz(75Channel)
902-928	400(20S)	400(10S)	NA
2400-2483.5	NA	NA	400(30S)
5725-5850	NA	NA	400(30S)

**Note:** The “()”is all channel’s average time of occupancy.

**(5) Maximum Peak Output Power**

FCC Part 15, Subpart C Section 15.247

Frequency Range (MHz)	Quantity of Hopping Channel	LIMIT(W)			
		50	25	15	75
902-928		1(30dBm)	0.125(21dBm)	NA	NA
2400-2483.5		NA	NA	0.125(21dBm)	1(30dBm)
5725-5850		NA	NA	NA	1(30dBm)



### (6) Band edge

FCC Part15, Subpart C Section 15.247, In any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, attenuation below the general limits specified in section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a).

Operating Frequency Range(MHz)	Spurious emission frequency	Limit Peak power ration to emission(dBc)	Emission level(dBuV/m)
902-928	<902	>20	NA
	>928	>20	NA
	960-1240	NA	54
2400-2483.5	<2400	>20	NA
	>2483.5-2500	NA	54
5725-5850	<5350-5460	NA	54
	<5725	>20	NA
	>5850	>20	NA

### (7) Conducted Emission

Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

**Note:**

1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

**(8) Radiated Emission**

FCC Part 15, Subpart C Section 15.209 limit of radiated emission for frequency below 1000GHz. The emissions from an intentional radiator shall not exceed the field strength level specified in the following table:

Frequency (MHz)	Field strength $\mu\text{V/m}$	Distance(m)	Field strength at 3m $\text{dB}\mu\text{V/m}$
30-88	100	3	40
88-216	150	3	43.5
216-960	200	3	46
Above 960	500	3	54

Remark: 1. Emission level in  $\text{dB}\mu\text{V/m}=20 \log (\mu\text{V/m})$   
 2. Measurement was performed at an antenna to the closed point of EUT distance of meters.

**FCC Part 15, Section 15.35(b) limit of radiated emission for frequency above 1000MHz**

Frequency(MHz)	Class A( $\text{dB}\mu\text{V/m}$ )(at 3m)		Class B( $\text{dB}\mu\text{V/m}$ )(at 3m)	
	PEAK	AVERAGE	PEAK	AVERAGE
Above 1000	80.0	60.0	74.0	54.0

FCC Part 15, Subpart C Section 15.249. The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Frequency(MHz)	Filed Strength of Fundamental(at 3m)		Filed Strength of Harmonics(at 3m)	
	PEAK	AVERAGE	PEAK	AVERAGE
902-928	114	94	74.0	54.0
2400-2483.5	114	94	74.0	54.0
5725-5875	114	94	74.0	54.0
24000-24250	128	108	88.0	68.0

## 2.5 Configuration of Tested System

**Fig. 2-1 Configuration of Tested System**

EUT

Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	FCC ID	Series No.	Note
1.	PHONE STATION	ION	iSP0A	Y4O-ISP0A	N/A	<b><i>EUT</i></b>

**Note:**

- (1) Unless otherwise denoted as EUT in 『Remark』 column , device(s) used in tested system is a support equipment.

### 3. Summary of Test Results

FCC Rules	Description Of Test	Result
§ 15.247(a)(1)	Channel Separation test	Compliant
§ 15.247(a)(1)	20dB Bandwidth	Compliant
§ 15.247(a)(1)(iii)	Quantity of Hopping Channel	Compliant
§ 15.247(a)(1)(iii)	Time of Occupancy(Dwell Time)	Compliant
§ 15.247(b)	Max Peak output Power test	Compliant
§ 15.247(d)	Band edge test	Compliant
§ 15.207	AC Power Conducted Emission	Compliant
§ 15.247(d), § 15.209	Radiated Emission	Compliant
§ 15.203	Antenna Requirement	Compliant
§ 1.1310	RF Exposure	Compliant

### 4. Description of test modes

The EUT (PHONE STATION) has been tested under normal operating condition.

This EUT is a FHSS system, we use blue test to control the EUT with parallel port, Let EUT hopping on and transmit at every channel with highest power, Only output power use conducted method, others are using radiated method. After sirfdemo330R1 send the command to EUT, it can be removed, and the EUT keep hopping. 79 Channels are provided by EUT. The operating modes of the EUTs used for testing are described as follows:

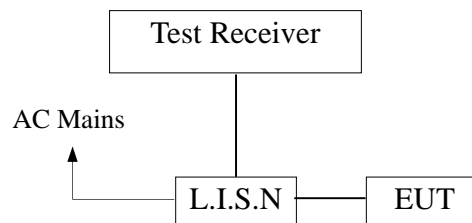
Op. Mode	Description of Operating Modes	Remarks
op-mode 1	The EUT transmits on 2402 MHz	Basic data rate 1 Mbps
op-mode 2	The EUT transmits on 2441 MHz	Basic data rate 1 Mbps
op-mode 3	The EUT transmits on 2480 MHz	Basic data rate 1 Mbps
op-mode 4	The EUT is in hopping mode	The EUT is hopping on 79 channels, Basic data rate 1Mbps
op-mode 6	The EUT transmits on 2402 MHz	Enhanced data rate 3 Mbps
op-mode 7	The EUT transmits on 2441 MHz	Enhanced data rate 3 Mbps
op-mode 8	The EUT transmits on 2480 MHz	Enhanced data rate 3 Mbps
op-mode 10	The EUT transmits on 2402 MHz	Enhanced data rate 2 Mbps
op-mode 11	The EUT transmits on 2441 MHz	Enhanced data rate 2 Mbps
op-mode 12	The EUT transmits on 2480 MHz	Enhanced data rate 2 Mbps

## 5. AC Power Conducted Emissions Test

### 5.1 Measurement Procedure:

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

### 5.2 Test SET-UP (Block Diagram of Configuration)



### 5.3 Measurement Equipment Used:

Conducted Emission Test Site # 4					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Receiver	Rohde&Schwarz	ESCS30	100018	05/29/2011	05/29/2012
L.I.S.N.	Rohde&Schwarz	ENV216	100017	05/29/2011	05/29/2012
RF Switching Unit	CDS	RSU-M2	38401	05/29/2011	05/29/2012

### 5.4 Measurement Result:

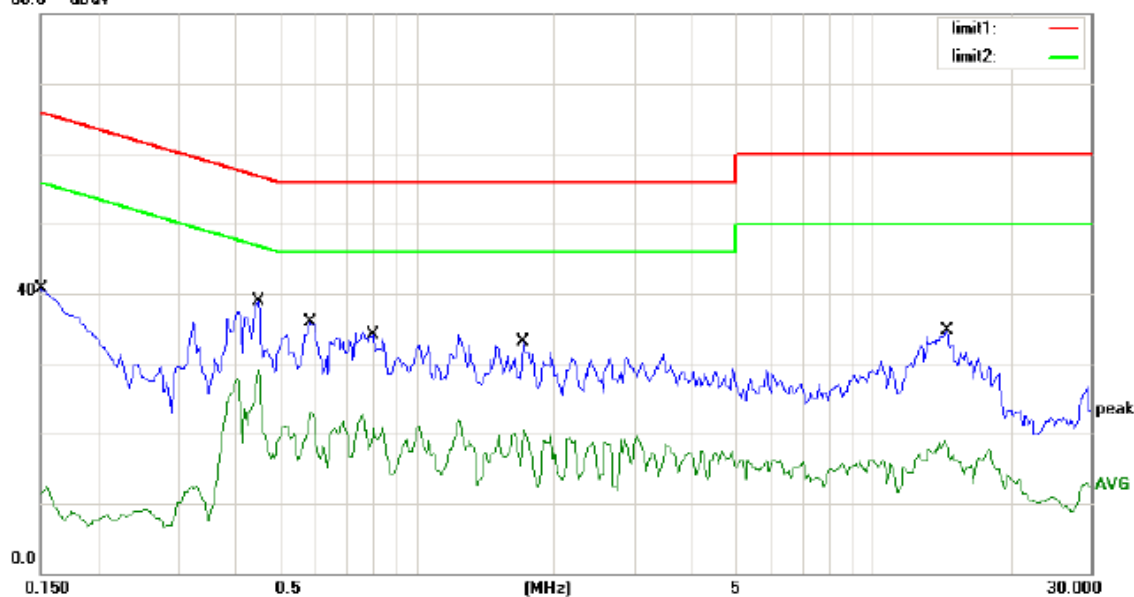
# Conducted Emission Measurement

File :ISP0A  
80.0 dBuV

Data :#3

Date: 2011/11/04

Time: 19:33:03



Site site #1

Phase: L1

Temperature: 25

Limit: (CE)FCC PART 15 class B\_QP

Power: AC 120V/60Hz

Humidity: 50 %

EUT: PHONE STATION

M/N: ISP0A

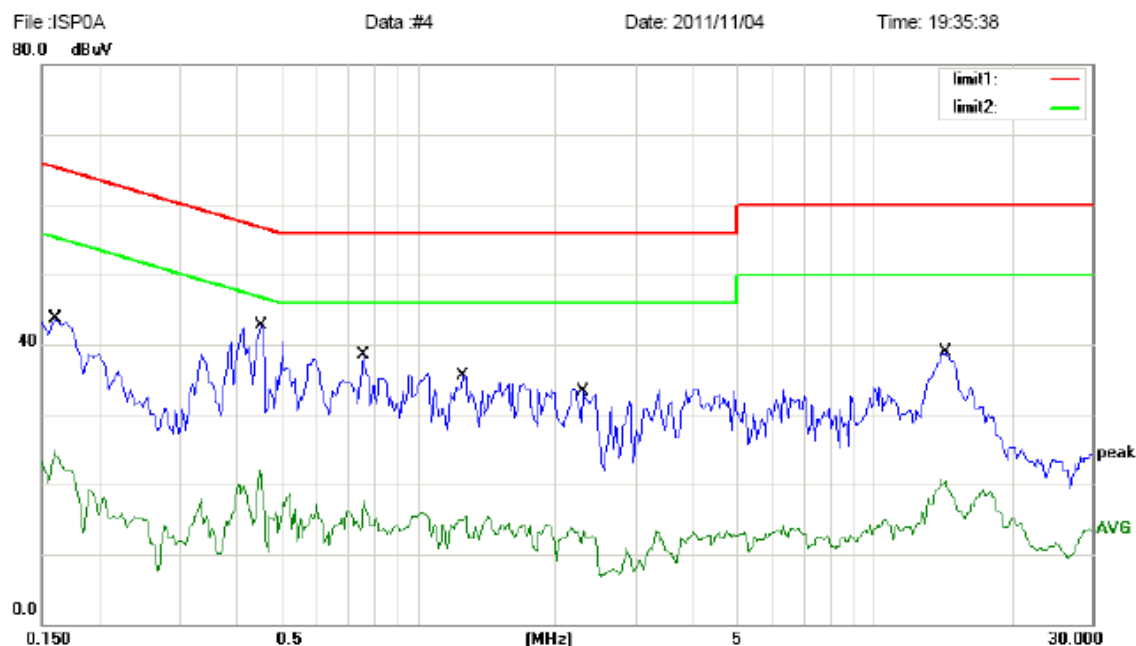
Mode: BT Connect

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1500	40.72	0.00	40.72	66.00	-25.28	QP	
2		0.1500	12.44	0.00	12.44	56.00	-43.56	AVG	
3		0.4500	38.91	0.00	38.91	56.88	-17.97	QP	
4	*	0.4500	29.02	0.00	29.02	46.88	-17.86	AVG	
5		0.5916	35.72	0.00	35.72	56.00	-20.28	QP	
6		0.5916	22.98	0.00	22.98	46.00	-23.02	AVG	
7		0.8050	34.18	0.00	34.18	56.00	-21.82	QP	
8		0.8050	22.75	0.00	22.75	46.00	-23.25	AVG	
9		1.7100	33.17	0.00	33.17	56.00	-22.83	QP	
10		1.7100	20.57	0.00	20.57	46.00	-25.43	AVG	
11		14.5250	34.69	0.00	34.69	60.00	-25.31	QP	
12		14.5250	18.94	0.00	18.94	50.00	-31.06	AVG	

\*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver. Operator:

# Conducted Emission Measurement



Site site #1 Phase: **N** Temperature: 25  
 Limit: (CE)FCC PART 15 class B\_QP Power: AC 120V/60Hz Humidity: 50 %  
 EUT: PHONE STATION  
 M/N: ISP0A  
 Mode: BT Connect  
 Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1600	43.80	0.00	43.80	65.46	-21.66	QP	
2		0.1600	24.81	0.00	24.81	55.46	-30.65	AVG	
3	*	0.4550	42.63	0.00	42.63	56.78	-14.15	QP	
4		0.4550	22.14	0.00	22.14	46.78	-24.64	AVG	
5		0.7600	38.41	0.00	38.41	56.00	-17.59	QP	
6		0.7600	17.63	0.00	17.63	46.00	-28.37	AVG	
7		1.2550	35.54	0.00	35.54	56.00	-20.46	QP	
8		1.2550	15.53	0.00	15.53	46.00	-30.47	AVG	
9		2.3000	33.24	0.00	33.24	56.00	-22.76	QP	
10		2.3000	13.83	0.00	13.83	46.00	-32.17	AVG	
11		14.3000	38.81	0.00	38.81	60.00	-21.19	QP	
12		14.3000	20.68	0.00	20.68	50.00	-29.32	AVG	

\*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver. Operator:

### 5.5 Conducted Measurement Photos:





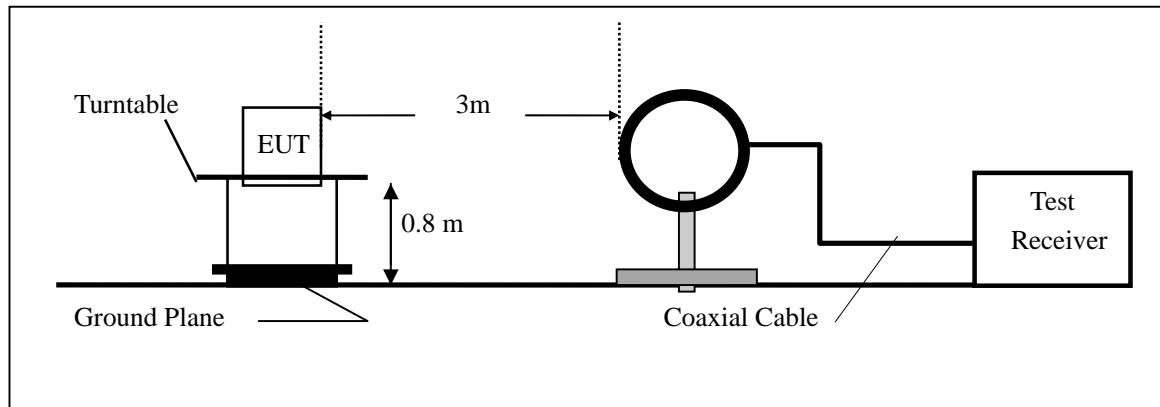
## **6. Radiated Emission Test**

### **6.1 Measurement Procedure**

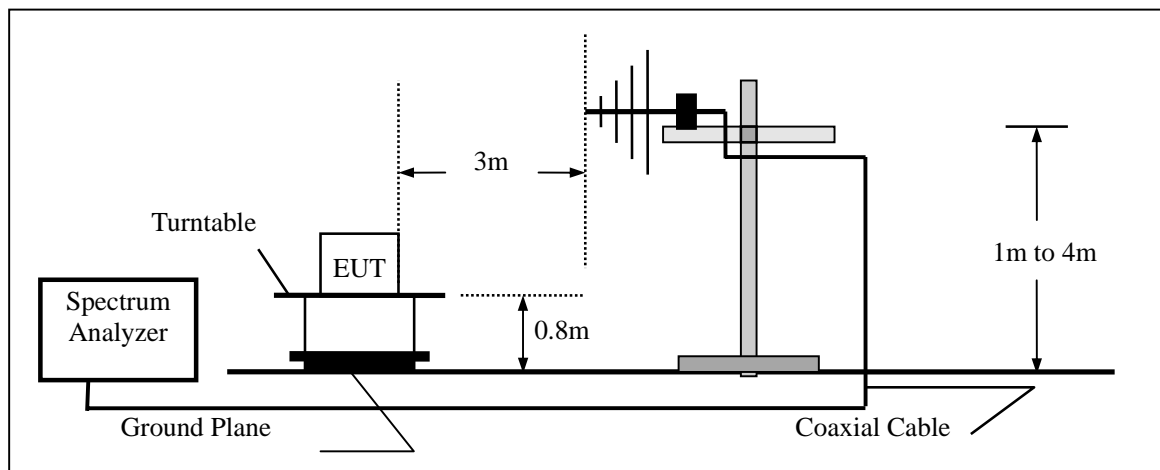
- 1 The EUT was placed on a turn table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured were complete.

## 6.2 Test SET-UP (Block Diagram of Configuration)

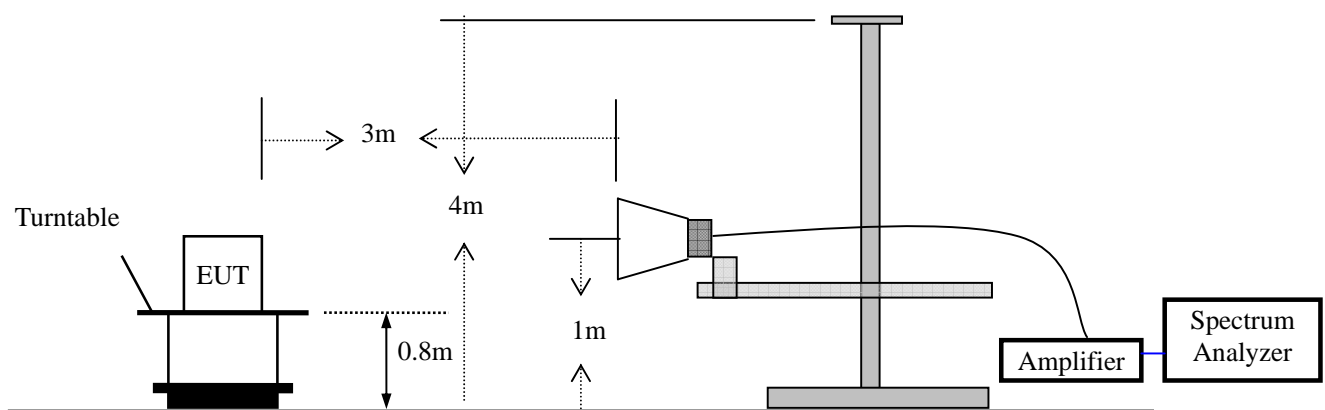
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



### 6.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSP7	839511/010	05/29/2011	05/29/2012
Spectrum Analyzer	HP	E4407B	839840481	05/29/2011	05/29/2012
EMI Test Receiver	Rohde & Schwarz	ESU	1302.6005.26	05/29/2011	05/29/2012
Pre-Amplifier	HP	8447D	2944A07999	05/29/2011	05/29/2012
Bilog Antenna	Schwarzbeck	VULB9163	142	05/29/2011	05/29/2012
Loop Antenna	ARA	PLA-1030/B	1029	05/29/2011	05/29/2012
Horn Antenna	Electro-Metrics	EM-6961	103314	05/29/2011	05/29/2012
Horn Antenna	Schwarzbeck	BBHA 9120	D143	05/29/2011	05/29/2012

### 6.4 Measurement Result

Operation Mode: RX Mode (CH40: 2441MHz) Test Date : December 21, 2011  
Frequency Range: 30~1000MHz Temperature : 20 °C  
Test Result: PASS Humidity : 50 %  
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Margin (dB)	Note
63.950	V	30.04	40.00	-9.96	PK
137.670	V	26.94	43.50	-16.56	PK
159.225	V	27.29	43.50	-16.21	PK
399.570	V	31.07	46.00	-14.93	PK
579.020	V	38.65	46.00	-7.35	PK
674.080	V	40.29	46.00	-5.71	PK
224.000	H	27.26	46.00	-18.74	PK
303.540	H	27.19	46.00	-18.81	PK
560.590	H	41.06	46.00	-4.94	PK
577.080	H	40.27	46.00	-5.73	PK
695.420	H	36.40	46.00	-9.60	PK
706.090	H	37.81	46.00	-8.19	PK

- Note:**
- (1) All Readings are Peak Value and AV;
  - (2) Emission Level= Reading Level+ Probe Factor +Cable Loss;
  - (3) The average measurement was not performed when the peak measured data under the limit of average detection;
  - (4) The results of low and high channel are as same as middle channel.
  - (5) The results of different data rate(1Mbps, 2Mbps, 3Mbps) are the same.

Operation Mode: RX Mode (CH40: 2441MHz) Test Date : December 21, 2011  
Frequency Range: 1-25GHz Temperature : 20 °C  
Test Result: PASS Humidity : 50 %  
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4882	V	58.49	42.60	74.00	54.00	-15.51	-11.40
7323	V	56.13	44.77	74.00	54.00	-17.87	-9.23
9764	V	57.94	42.06	74.00	54.00	-16.06	-11.94
12205	V	59.30	39.96	74.00	54.00	-14.70	-14.04
4882	H	59.25	42.59	74.00	54.00	-14.75	-11.41
7323	H	56.85	43.15	74.00	54.00	-17.15	-10.85
9764	H	57.16	41.09	74.00	54.00	-16.84	-12.91
12205	H	58.44	38.24	74.00	54.00	-15.56	-15.76

**Other harmonics emissions are lower than 20dB below the allowable limit.**

**Note:** (1) All Readings are Peak Value and AV.  
(2) Emission Level= Reading Level+ Probe Factor +Cable Loss.  
(3) The average measurement was not performed when the peak measured data under the limit of average detection;  
(4) The results of low and high channel are as same as middle channel.  
(5) The results of different data rate(1Mbps, 2Mbps, 3Mbps) are the same.

Operation Mode: TX Mode (CH1: 2402MHz) Test Date : December 21, 2011  
Frequency Range: 30~1000MHz Temperature : 20 °C  
Test Result: PASS Humidity : 50 %  
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level (dBUV/m)	Limit 3m (dBUV/m)	Margin (dB)	Note
67.290	V	28.04	40.00	-11.96	PK
135.610	V	29.71	43.50	-13.79	PK
157.210	V	27.92	43.50	-15.58	PK
396.540	V	31.07	46.00	-14.93	PK
583.120	V	38.65	46.00	-7.35	PK
676.380	V	40.29	46.00	-5.71	PK
226.040	H	27.26	46.00	-18.74	PK
306.240	H	27.19	46.00	-18.81	PK
566.290	H	39.06	46.00	-6.94	PK
579.180	H	38.25	46.00	-7.75	PK
694.320	H	36.44	46.00	-9.56	PK
712.090	H	38.11	46.00	-7.89	PK

- Note:**
- (1) All Readings are Peak Value.
  - (2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
  - (3) The average measurement was not performed when the peak measured data under the limit of average detection.
  - (4) The results of different data rate(1Mbps, 2Mbps, 3Mbps) are the same.

Operation Mode: TX Mode (CH40: 2441MHz) Test Date : December 21, 2011  
Frequency Range: 30~1000MHz Temperature : 20 °C  
Test Result: PASS Humidity : 50 %  
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level (dBUV/m)	Limit 3m (dBUV/m)	Margin (dB)	Note
67.450	V	28.40	40.00	-11.60	PK
135.120	V	27.49	43.50	-16.01	PK
156.240	V	27.92	43.50	-15.58	PK
396.180	V	32.77	46.00	-13.23	PK
578.200	V	36.65	46.00	-9.35	PK
672.180	V	38.03	46.00	-7.97	PK
224.000	H	32.62	46.00	-13.38	PK
303.520	H	34.11	46.00	-11.89	PK
564.290	H	36.06	46.00	-9.94	PK
571.080	H	38.27	46.00	-7.73	PK
697.420	H	36.49	46.00	-9.51	PK
706.990	H	37.11	46.00	-8.89	PK

- Note:**
- (1) All Readings are Peak Value.
  - (2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
  - (3) The average measurement was not performed when the peak measured data under the limit of average detection.
  - (4) The results of different data rate(1Mbps, 2Mbps, 3Mbps) are the same.

Operation Mode: TX Mode (CH79: 2480MHz) Test Date : December 21, 2011  
Frequency Range: 30~1000MHz Temperature : 20 °C  
Test Result: PASS Humidity : 50 %  
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Margin (dB)	Note
63.550	V	29.41	40.00	-10.59	PK
142.370	V	28.49	43.50	-15.01	PK
157.125	V	27.89	43.50	-15.61	PK
398.560	V	32.34	46.00	-13.66	PK
574.720	V	36.24	46.00	-9.76	PK
671.800	V	37.69	46.00	-8.31	PK
225.100	H	32.24	46.00	-13.76	PK
306.040	H	36.47	46.00	-9.53	PK
563.390	H	38.68	46.00	-7.32	PK
574.620	H	39.07	46.00	-6.93	PK
698.120	H	36.12	46.00	-9.88	PK
708.290	H	37.88	46.00	-8.12	PK

- Note:**
- (1) All Readings are Peak Value.
  - (2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
  - (3) The average measurement was not performed when the peak measured data under the limit of average detection.
  - (4) The results of different data rate(1Mbps, 2Mbps, 3Mbps) are the same.

Operation Mode: TX Mode (CH1: 2402MHz) Test Date : December 21, 2011  
Frequency Range: 1-25GHz Temperature : 20 °C  
Test Result: PASS Humidity : 50 %  
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
2400	V	58.14	46.14	74.00	54.00	-15.86	-7.86
4804	V	61.53	45.89	74.00	54.00	-12.47	-8.11
7206	V	56.87	42.70	74.00	54.00	-17.13	-11.30
9608	V	55.39	42.59	74.00	54.00	-18.61	-11.41
12010	V	56.20	43.81	74.00	54.00	-17.80	-10.19
2400	H	59.21	46.39	74.00	54.00	-14.79	-7.61
4804	H	56.34	42.55	74.00	54.00	-17.66	-11.45
7206	H	60.09	42.71	74.00	54.00	-13.91	-11.29
9608	H	58.51	44.25	74.00	54.00	-15.49	-9.75
12010	H	56.42	42.93	74.00	54.00	-17.58	-11.07

**Other harmonics emissions are lower than 20dB below the allowable limit.**

- Note:**
- (1) All Readings are Peak Value and AV.
  - (2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
  - (3) The average measurement was not performed when the peak measured data under the limit of average detection.
  - (4) The results of different data rate(1Mbps, 2Mbps, 3Mbps) are the same.



Operation Mode: TX Mode (CH40: 2441MHz) Test Date : December 21, 2011  
Frequency Range: 1-25GHz Temperature : 20 °C  
Test Result: PASS Humidity : 50 %  
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
4882	V	60.39	44.19	74.00	54.00	-13.61	-9.81
7323	V	57.11	43.22	74.00	54.00	-16.89	-10.78
9764	V	56.87	43.69	74.00	54.00	-17.13	-10.31
12205	V	57.20	41.51	74.00	54.00	-16.80	-12.49
4882	H	61.37	43.72	74.00	54.00	-12.63	-10.28
7323	H	58.81	43.22	74.00	54.00	-15.19	-10.78
9764	H	56.19	42.08	74.00	54.00	-17.81	-11.92
12205	H	57.33	43.34	74.00	54.00	-16.67	-10.66

**Other harmonics emissions are lower than 20dB below the allowable limit.**

- Note:**
- (1) All Readings are Peak Value and AV.
  - (2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
  - (3) The average measurement was not performed when the peak measured data under the limit of average detection.
  - (4) The results of different data rate(1Mbps, 2Mbps, 3Mbps) are the same.

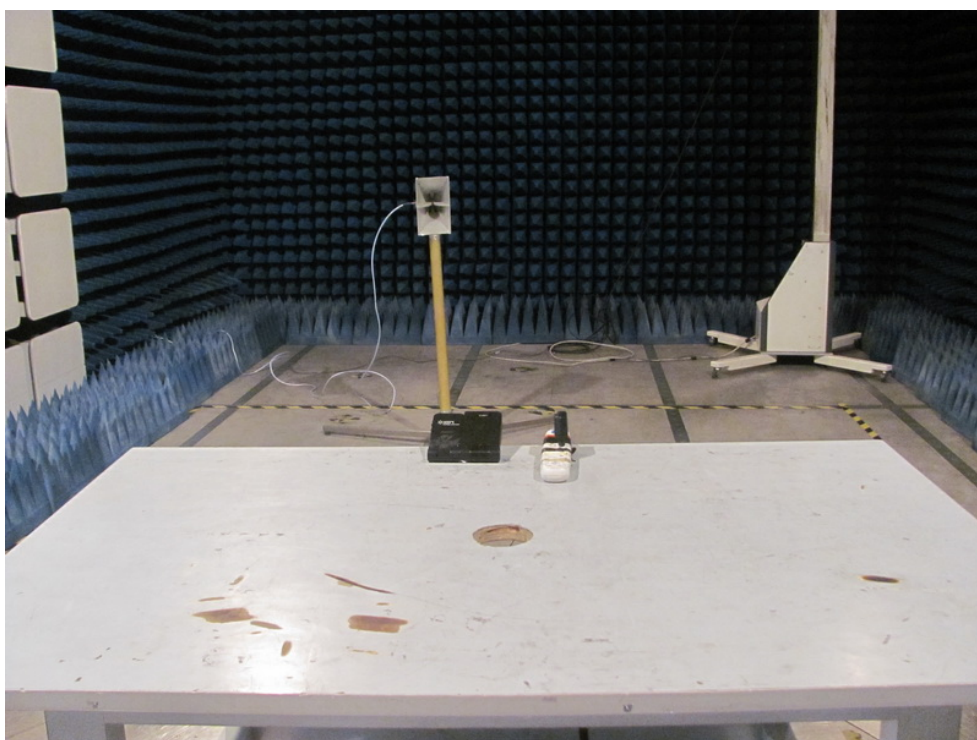
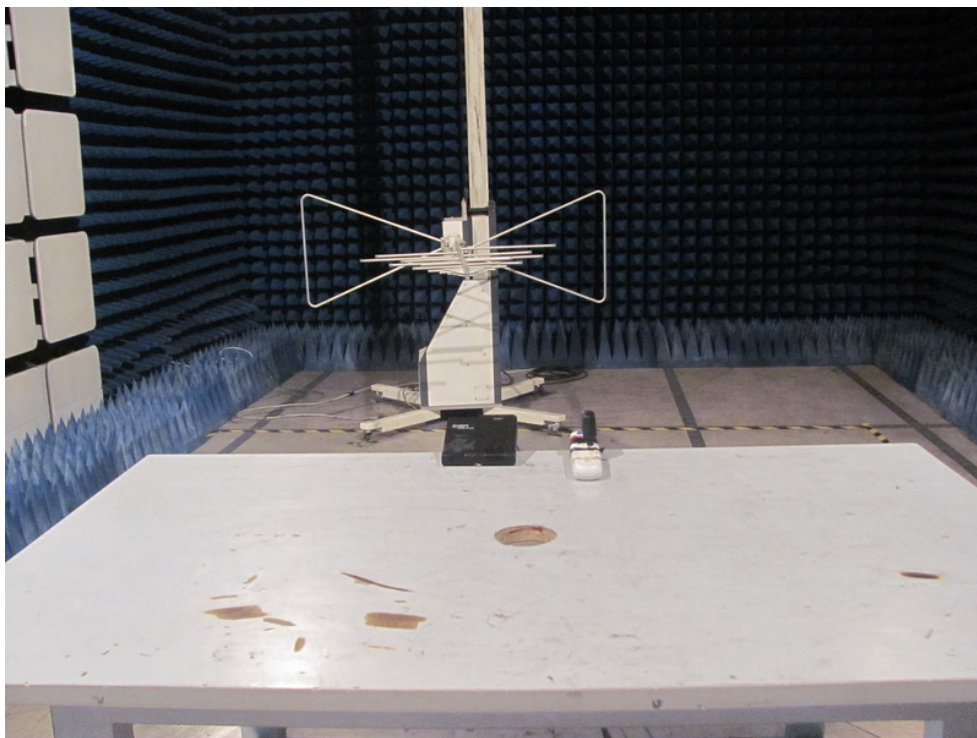
Operation Mode: TX Mode (CH79: 2480MHz) Test Date : December 21, 2011  
Frequency Range: 1-25GHz Temperature : 20 °C  
Test Result: PASS Humidity : 50 %  
Measured Distance: 3m Test By: Andy

Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
2480	V	63.88	46.55	74.00	54.00	-10.12	-7.45
4960	V	59.99	45.21	74.00	54.00	-14.01	-8.79
7440	V	56.71	42.02	74.00	54.00	-17.29	-11.98
9920	V	57.45	43.27	74.00	54.00	-16.55	-10.73
12400	V	52.49	40.54	74.00	54.00	-21.51	-13.46
2480	H	61.14	45.32	74.00	54.00	-12.86	-8.68
4960	H	55.29	42.71	74.00	54.00	-18.71	-11.29
7440	H	57.77	44.83	74.00	54.00	-16.23	-9.17
9920	H	54.45	43.20	74.00	54.00	-19.55	-10.80
12400	H	52.29	41.44	74.00	54.00	-21.71	-12.56

**Other harmonics emissions are lower than 20dB below the allowable limit.**

- Note:**
- (1) All Readings are Peak Value and AV.
  - (2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
  - (3) The average measurement was not performed when the peak measured data under the limit of average detection.
  - (4) The results of different data rate(1Mbps, 2Mbps, 3Mbps) are the same.

### 6.5 Radiated Measurement Photos:

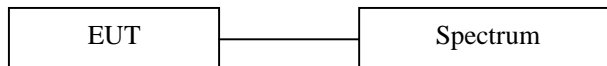


## 7. Channel Separation test

### 7.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

### 7.2 Test SET-UP (Block Diagram of Configuration)



### 7.3 Measurement Equipment Used:

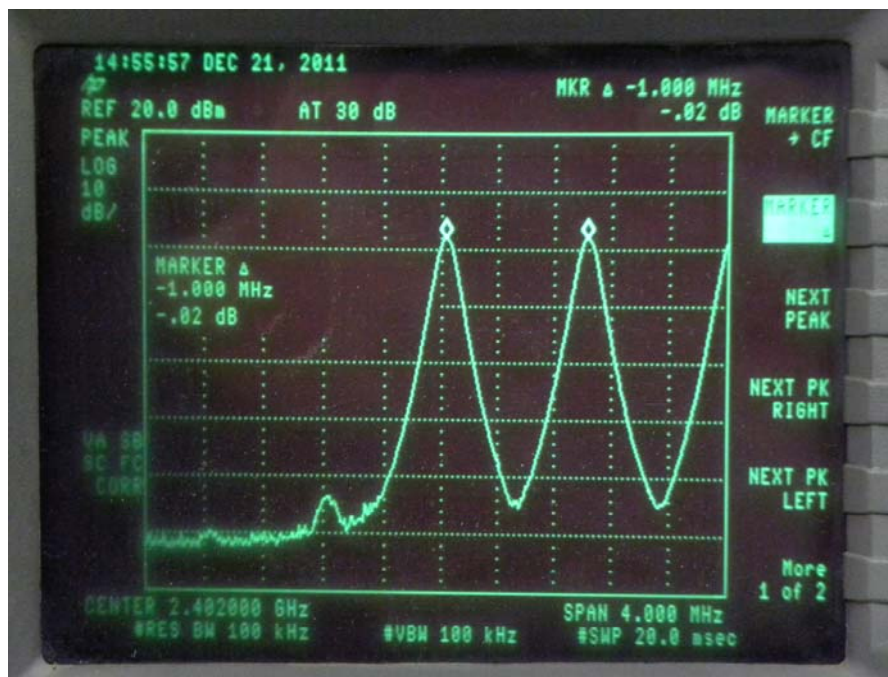
Same as 5.3 Radiated Emission Measurement.

### 7.4 Measurement Results:

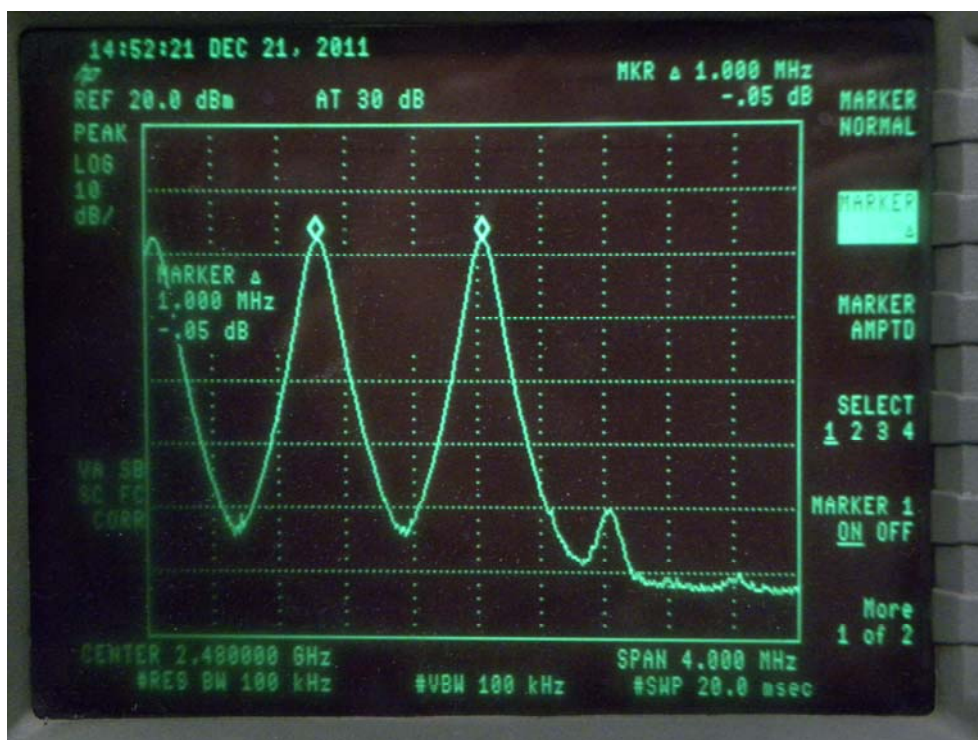
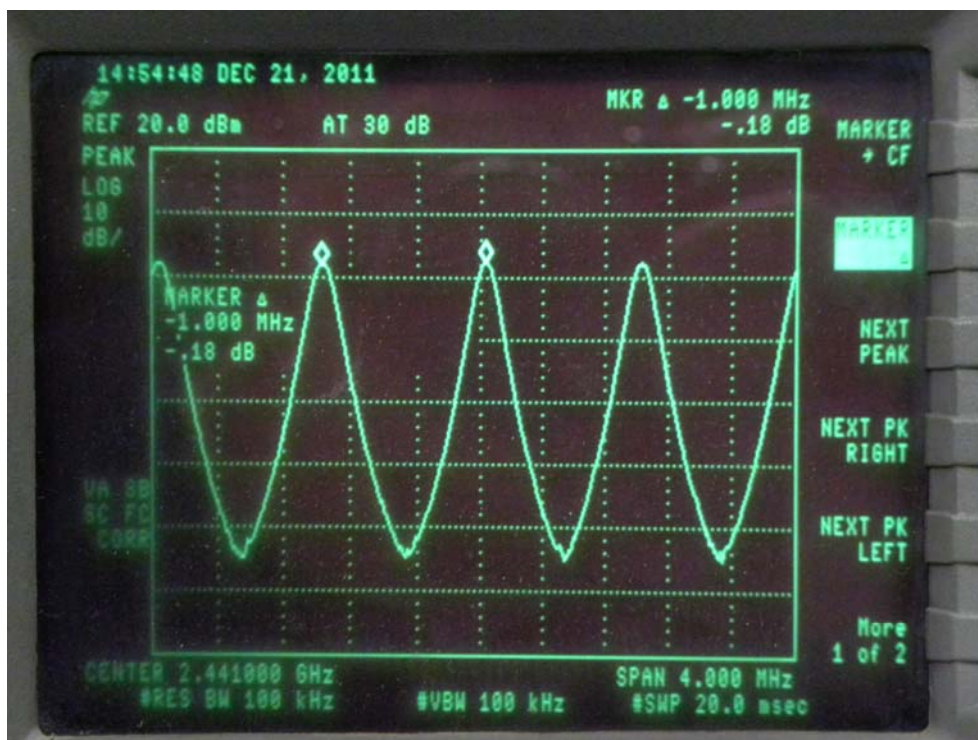
Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	December 21, 2011
Test By:	Andy	Temperature :	20 °C
Test Result:	PASS	Humidity :	50 %

Operating Mode	Channel frequency (MHz)	Separation Read Value (KHz)	Separation Limit (KHz)
op-mode 4	2402	1000	>246.67
op-mode 4	2441	1000	>253.33
op-mode 4	2480	1000	>253.33





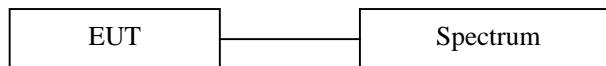


## 8. 20dB Bandwidth test

### 8.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

### 8.2 Test SET-UP (Block Diagram of Configuration)



### 8.3 Measurement Equipment Used:

Same as 5.3 Radiated Emission Measurement.

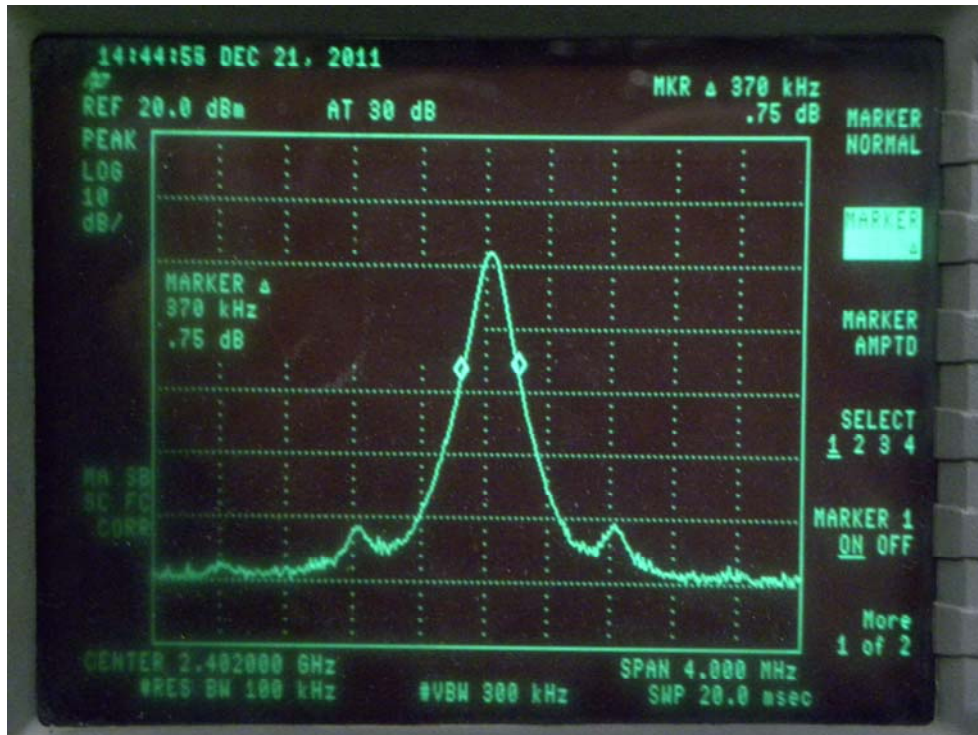
### 8.4 Measurement Results:

Refer to attached data chart.

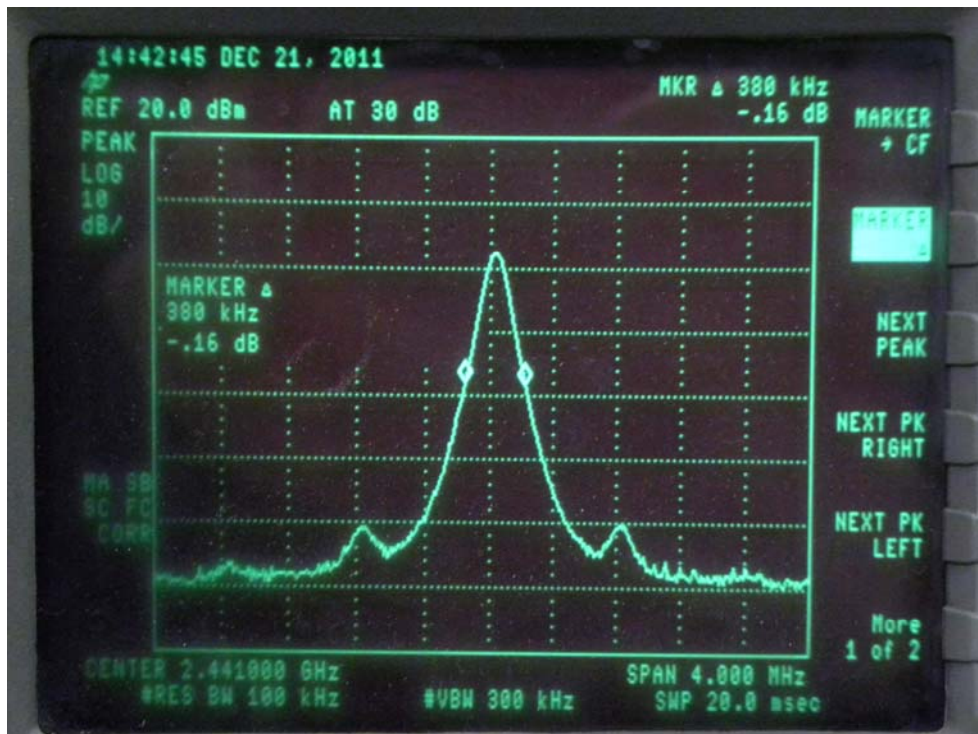
Spectrum Detector:	PK	Test Date :	December 21, 2011
Test By:	Andy	Temperature :	20 °C
Test Result:	PASS	Humidity :	48 %

Operating Mode	Channel frequency (MHz)	20dB Down BW(kHz)
op-mode 1	2402	370
op-mode 2	2441	380
op-mode 3	2480	380
op-mode 6	2402	380
op-mode 7	2441	360
op-mode 8	2480	360
op-mode 10	2402	380
op-mode 11	2441	360
op-mode 12	2480	360

op-mode 1:

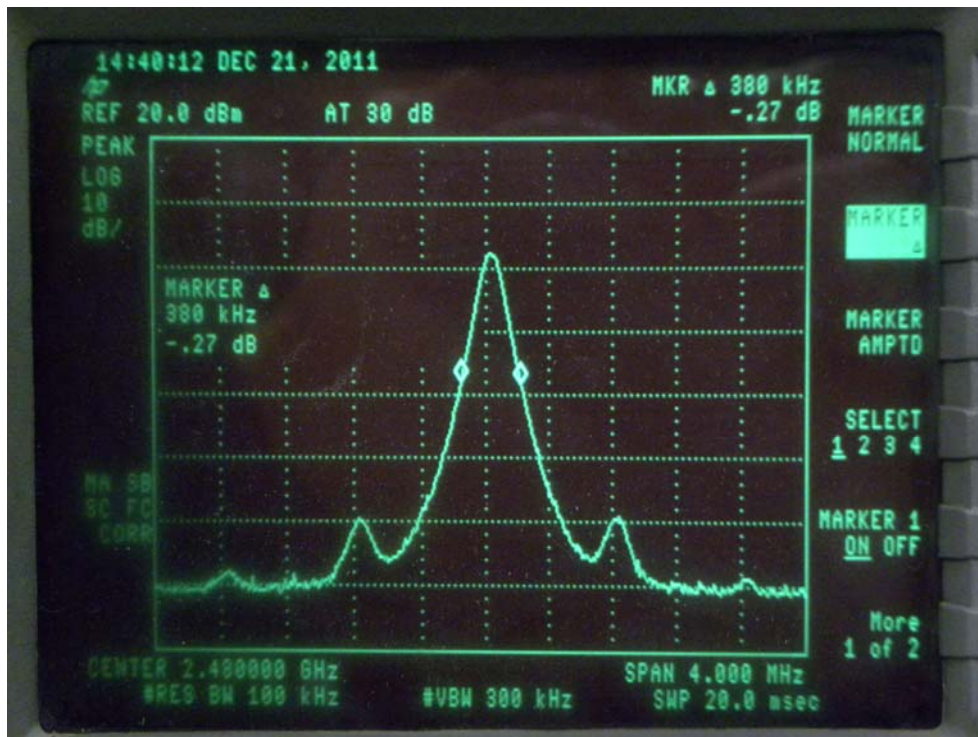


op-mode 2:

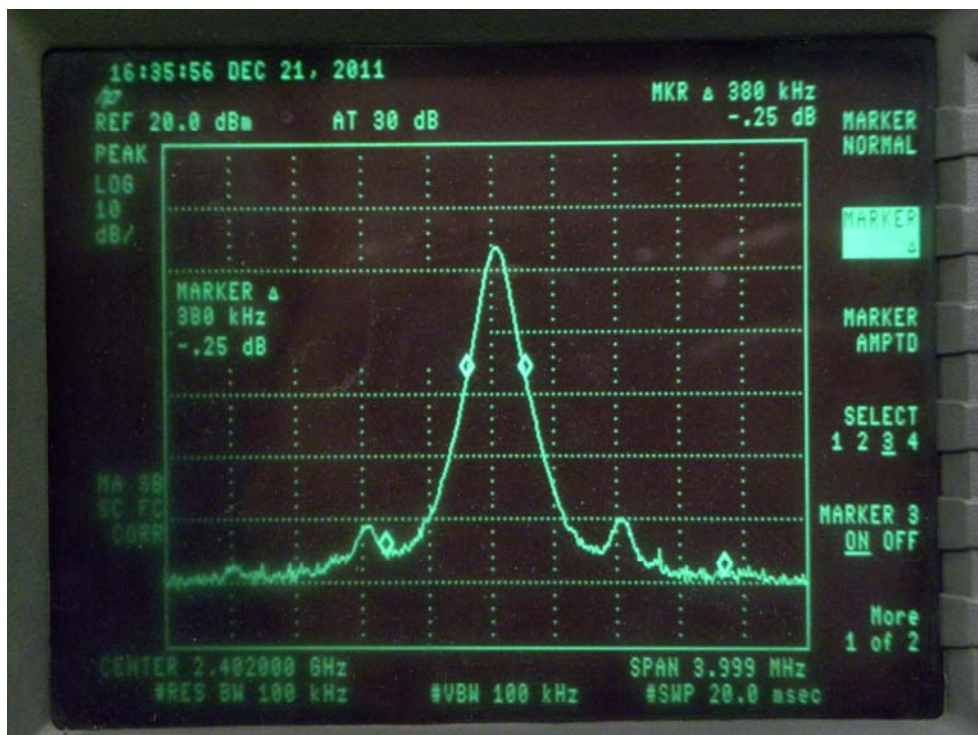




op-mode 3:

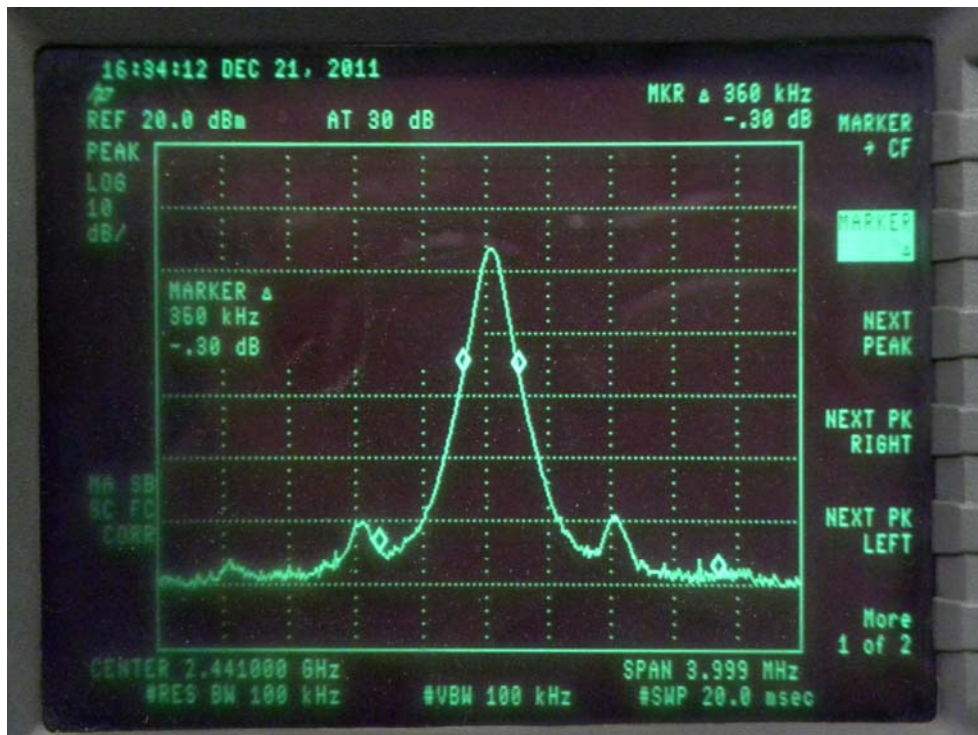


op-mode 6:

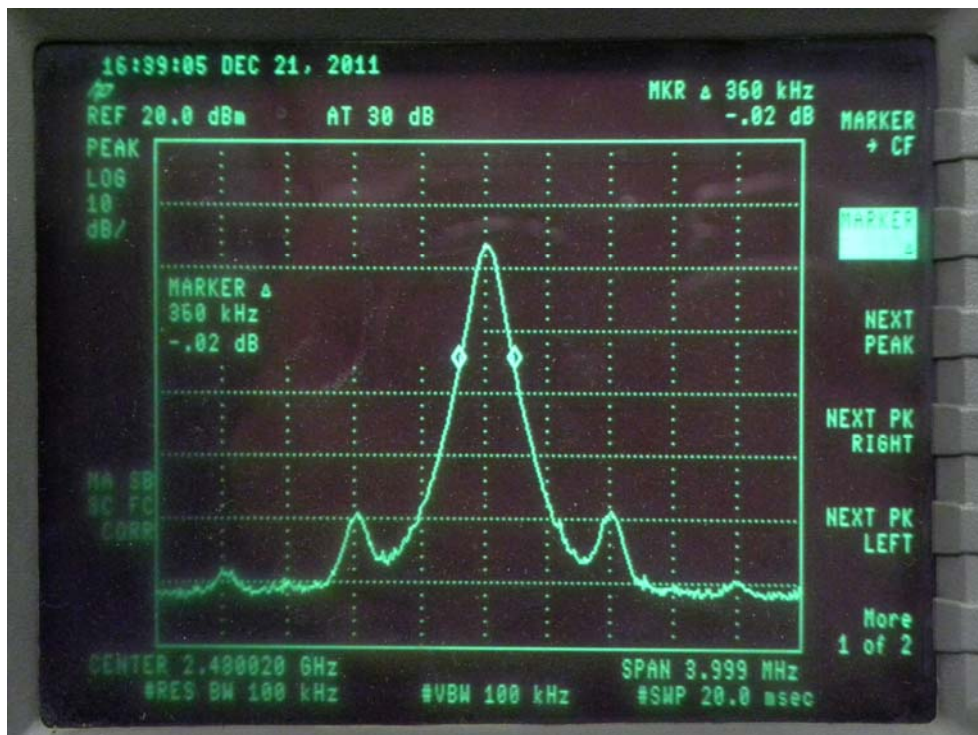




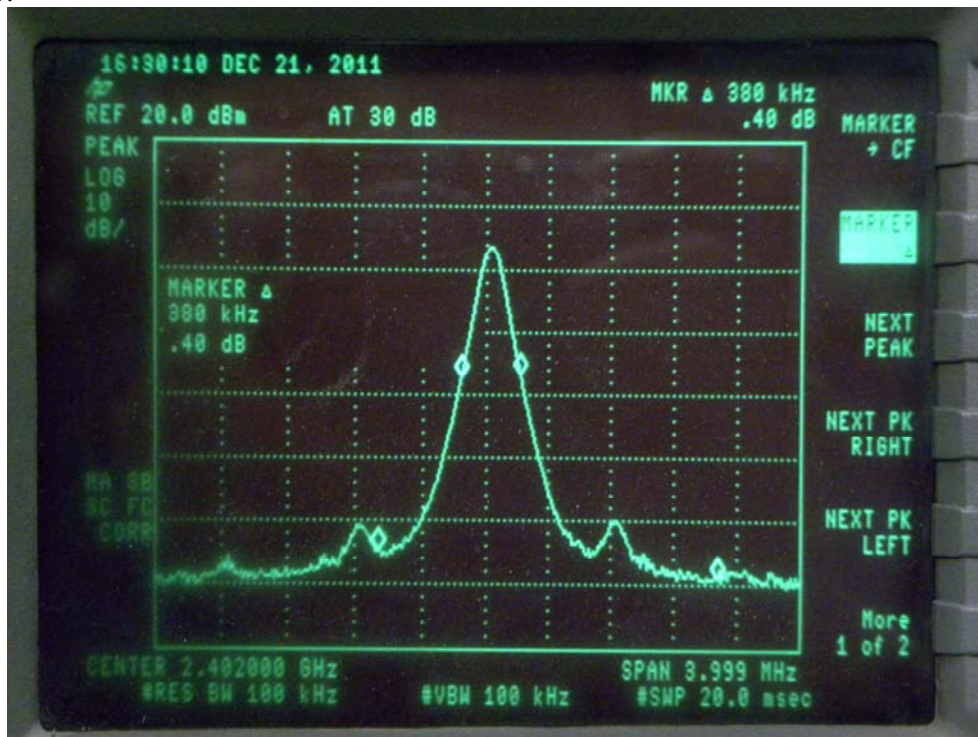
op-mode 7:



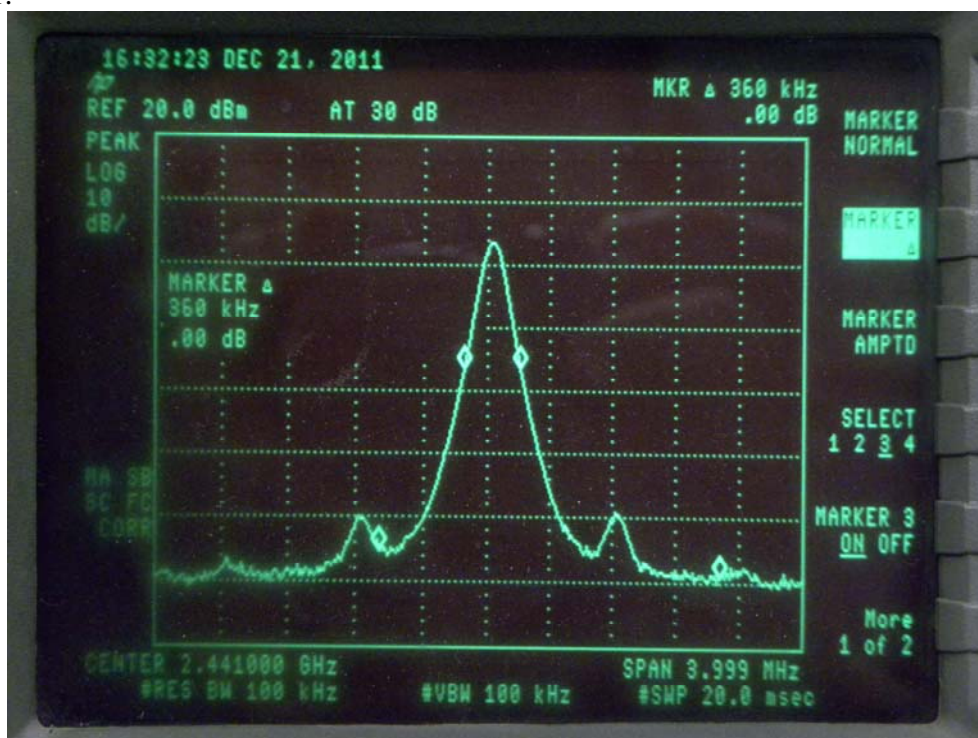
op-mode 8:



op-mode 10:

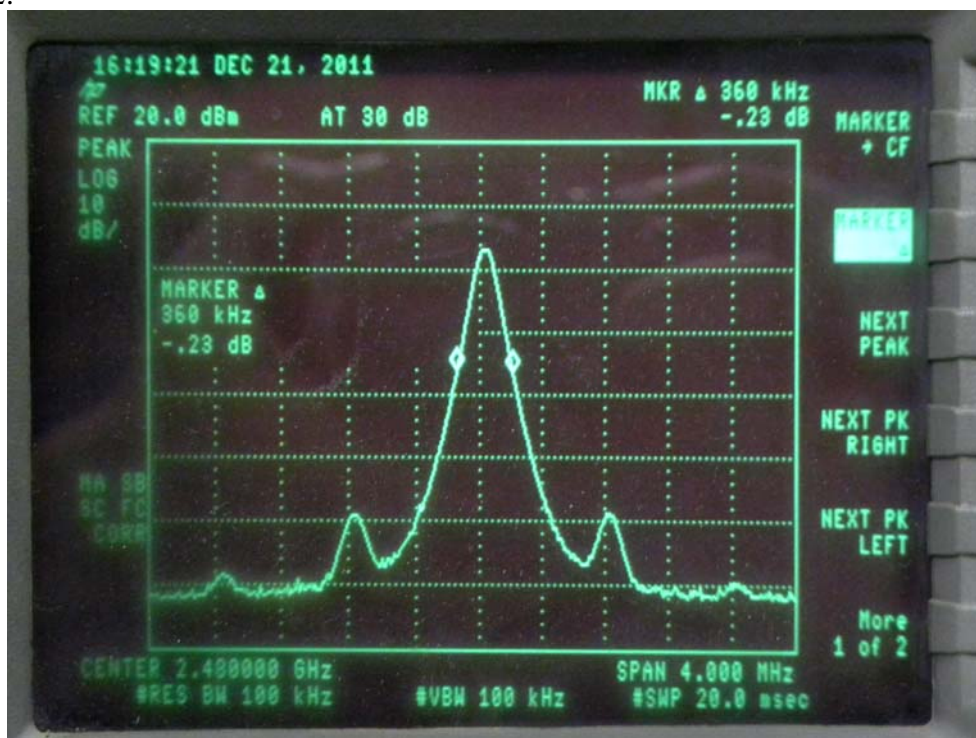


op-mode 11:





op-mode 12:

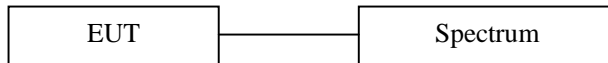


## 9. Quantity of Hopping Channel Test

### 9.1 Measurement Procedure

The EUT was operating in hopping mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

### 9.2 Test SET-UP (Block Diagram of Configuration)



### 9.3 Measurement Equipment Used:

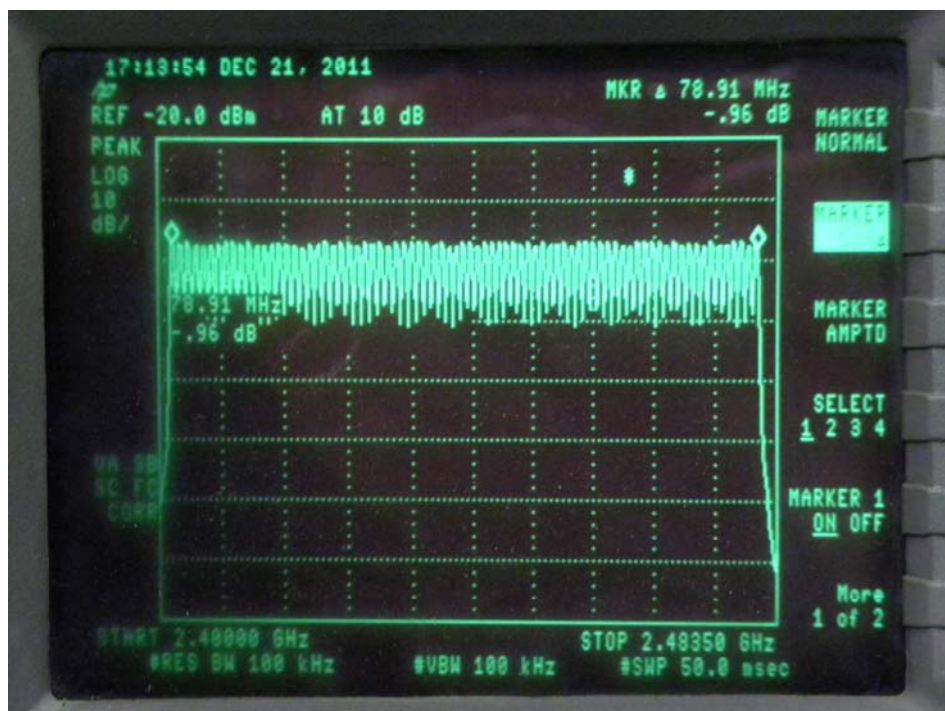
Same as 5.3 Radiated Emission Measurement.

### 9.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	November 21, 2011
Test By:	Andy	Temperature :	20 °C
Test Result:	PASS	Humidity :	50 %

Operating Mode	Hopping Channel Frequency Range	Quantity of Hopping Channel	Quantity of Hopping Channel
op-mode 4	2402-2480	79	> 15



## 10. Time of Occupancy (Dwell Time) test

### 10.1 Test Description

The Equipment Under Test (EUT) was set up to perform the dwell time measurements. The EUT was connected to the spectrum analyzer via a short coax cable. The dwell time is calculated by:

$$\text{Dwell time} = \text{time slot length} * \text{hop rate} / \text{number of hopping channels} * 31.6\text{s}$$

with:

- hop rate =  $1600 * 1/\text{s}$  for DH1 packets =  $1600 \text{ s}^{-1}$
- hop rate =  $1600/3 * 1/\text{s}$  for DH3 packets =  $533.33 \text{ s}^{-1}$
- hop rate =  $1600/5 * 1/\text{s}$  for DH5 packets =  $320 \text{ s}^{-1}$
- number of hopping channels = 79
- $31.6 \text{ s} = 0.4 \text{ seconds multiplied by the number of hopping channels} = 0.4 \text{ s} * 79$

The highest value of the dwell time is reported.

### 10.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (1) (iii)

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Since the Bluetooth technology uses 79 channels this period is calculated to be 31.6seconds. Refer to attached data chart.

### 10.3 Test Protocol

Packet type	Time slot length(ms)	Dwell time	Dwell time(ms)
DH1	0.396	time slot length *1600/1 /79 * 31.6	253.44
DH3	1.668	time slot length *1600/3 /79 * 31.6	355.84
DH5	2.888	time slot length *1600/5 /79 * 31.6	369.66

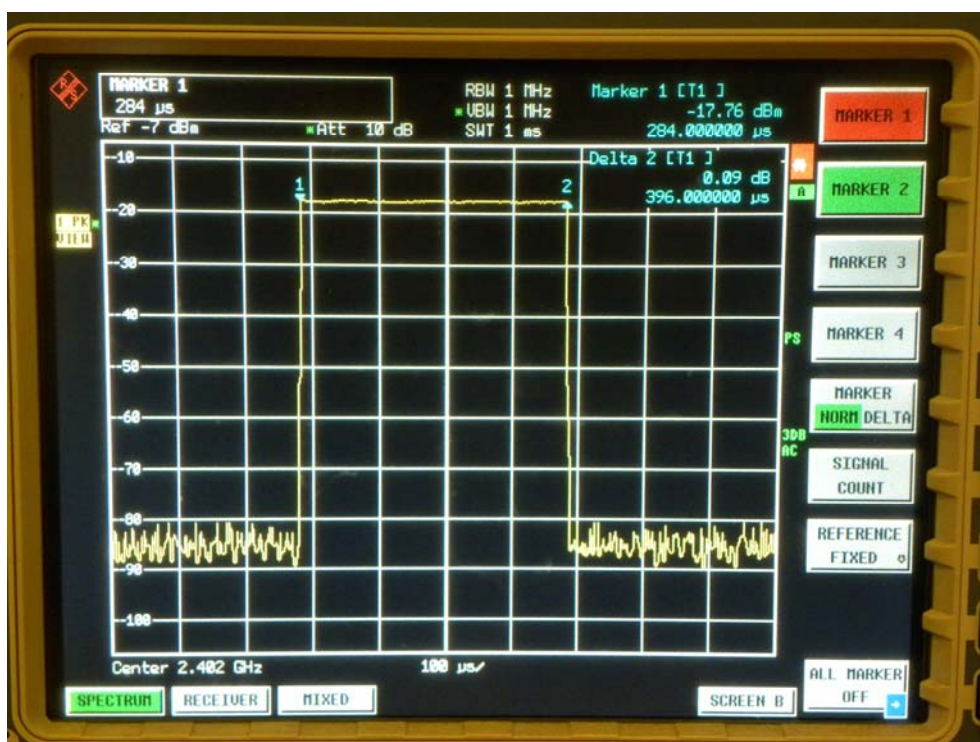
Remark:

1. The results of different data rate(1Mbps, 2Mbps, 3Mbps) are the same.

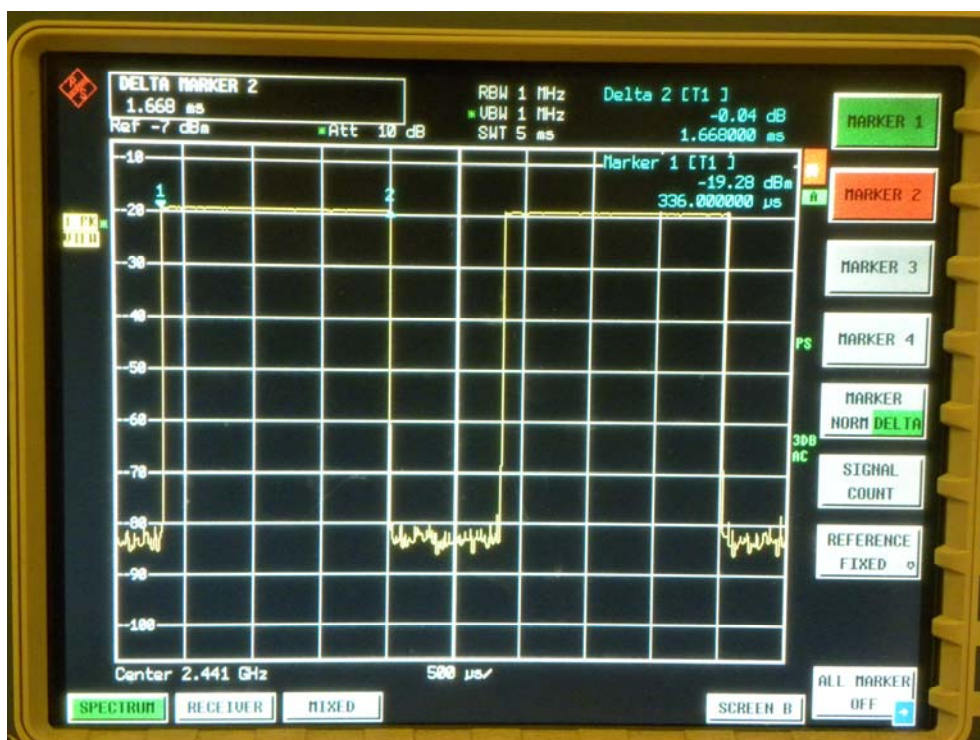
### 10.4 Test result: Dwell time

PASS.

DH1:

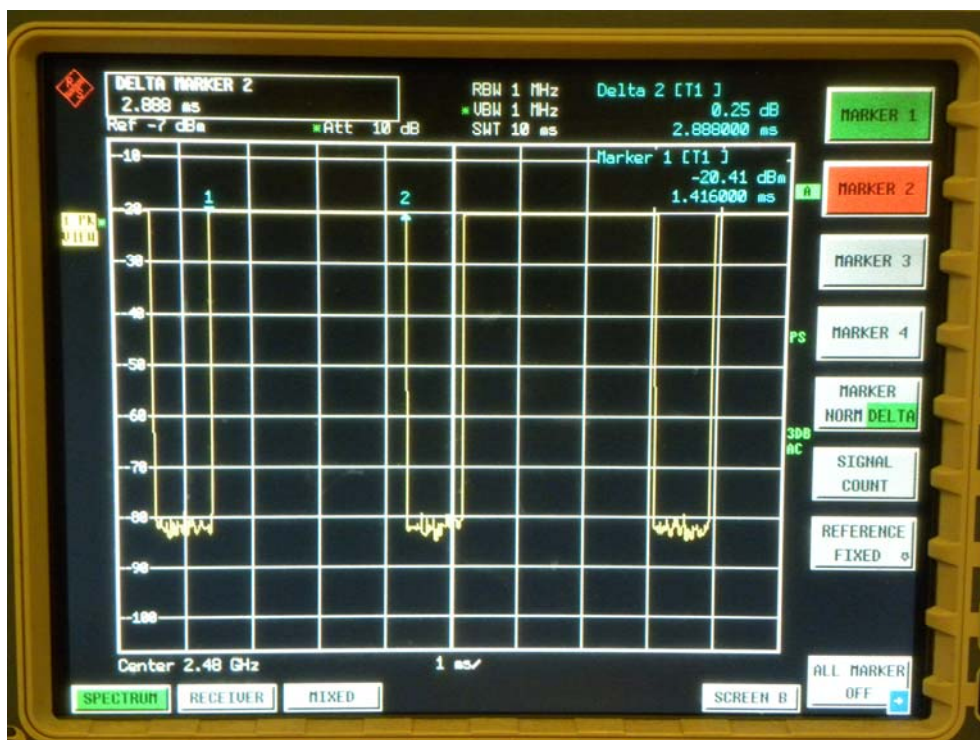


DH3:





DH5:

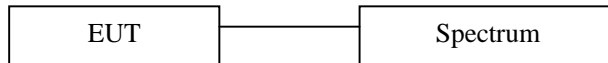


## 11. MAXIMUM PEAK OUTPUT POWER TEST

### 11.1 Measurement Procedure

- Check the calibration of the measuring instrument(SA) using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- The center frequency of the spectrum analyzer is set to the fundamental frequency and using proper RBW and VBW setting.
- Measure the captured power within the band and recording the plot.
- Repeat above procedures until all frequencies required were complete.

### 11.2 Test SET-UP (Block Diagram of Configuration)



### 11.3 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Rohde & Schwarz	FSP7	839511/010	05/29/2011	05/29/2012



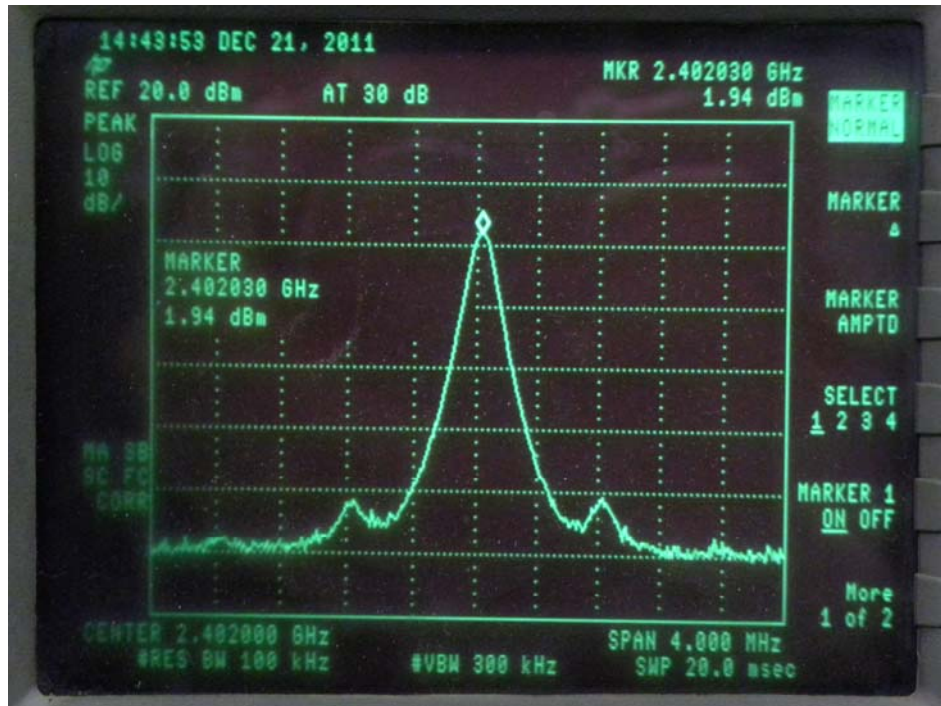
#### 11.4 Measurement Results:

Refer to attached data chart.

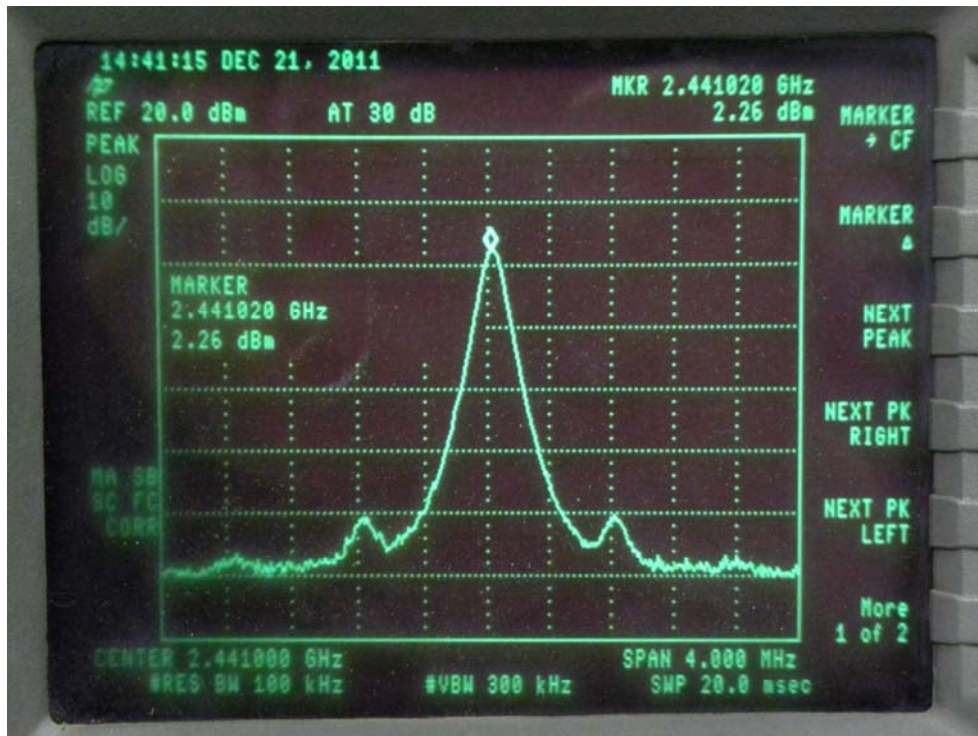
Spectrum Detector:	PK	Test Date :	December 21, 2011
Test By:	Andy	Temperature :	20 °C
Test Result:	PASS	Humidity :	48 %

Operating Mode	Channel Frequency (MHz)	Peak Power output(mW)	Peak Power output(dBm)	Peak Power Limit(mW)	Pass/Fail
op-mode 1	2402	1.563	1.94	125	PASS
op-mode 2	2441	1.683	2.26	125	PASS
op-mode 3	2480	1.667	2.22	125	PASS
op-mode 6	2402	2.223	3.47	125	PASS
op-mode 7	2441	2.249	3.52	125	PASS
op-mode 8	2480	2.286	3.59	125	PASS
op-mode 10	2402	2.296	3.61	125	PASS
op-mode 11	2441	2.234	3.49	125	PASS
op-mode 12	2480	2.153	3.33	125	PASS

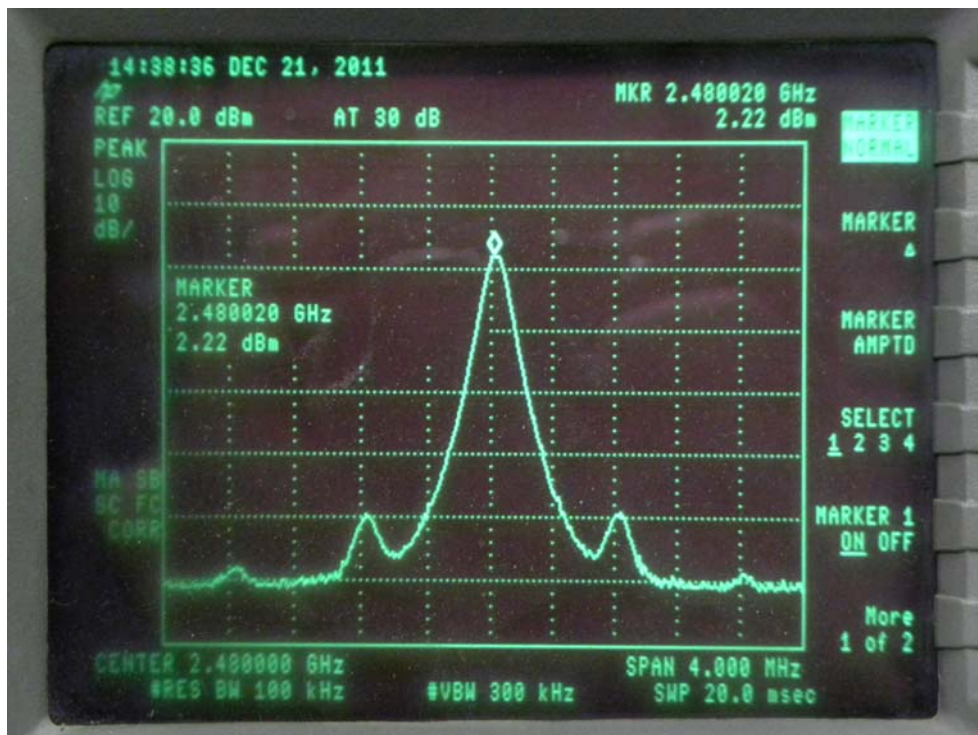
op-mode 1:



op-mode 2:

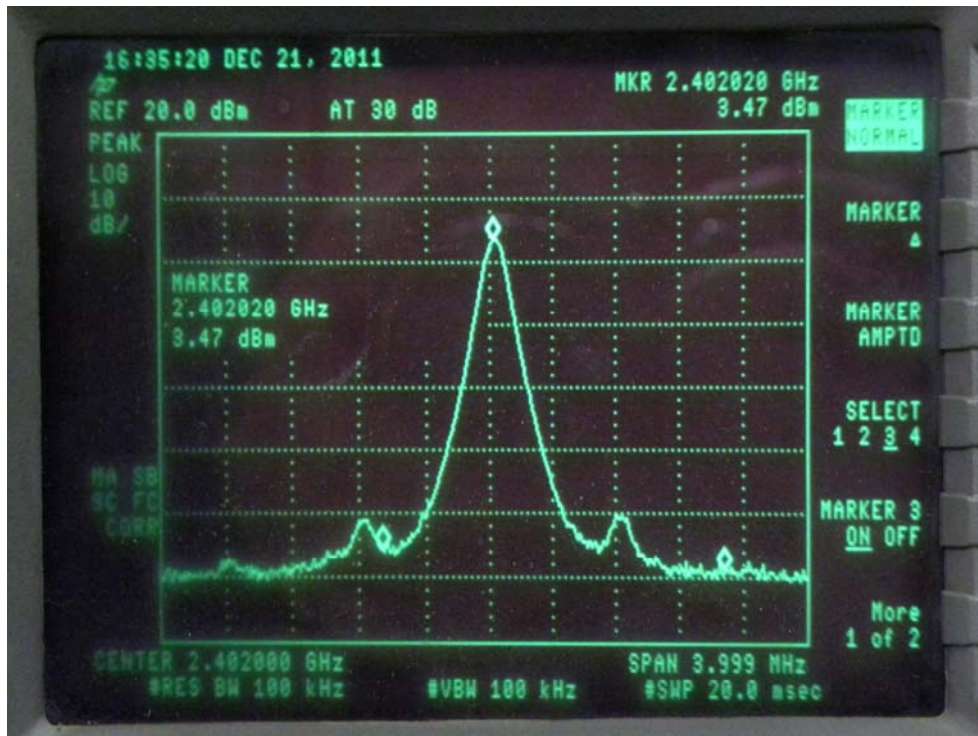


op-mode 3:

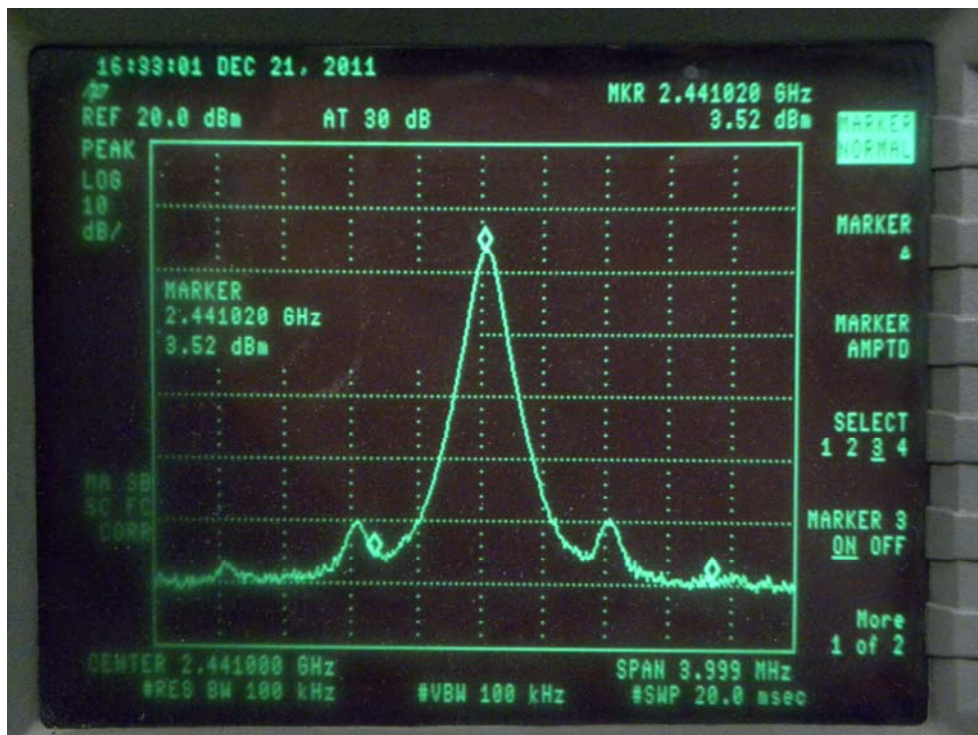




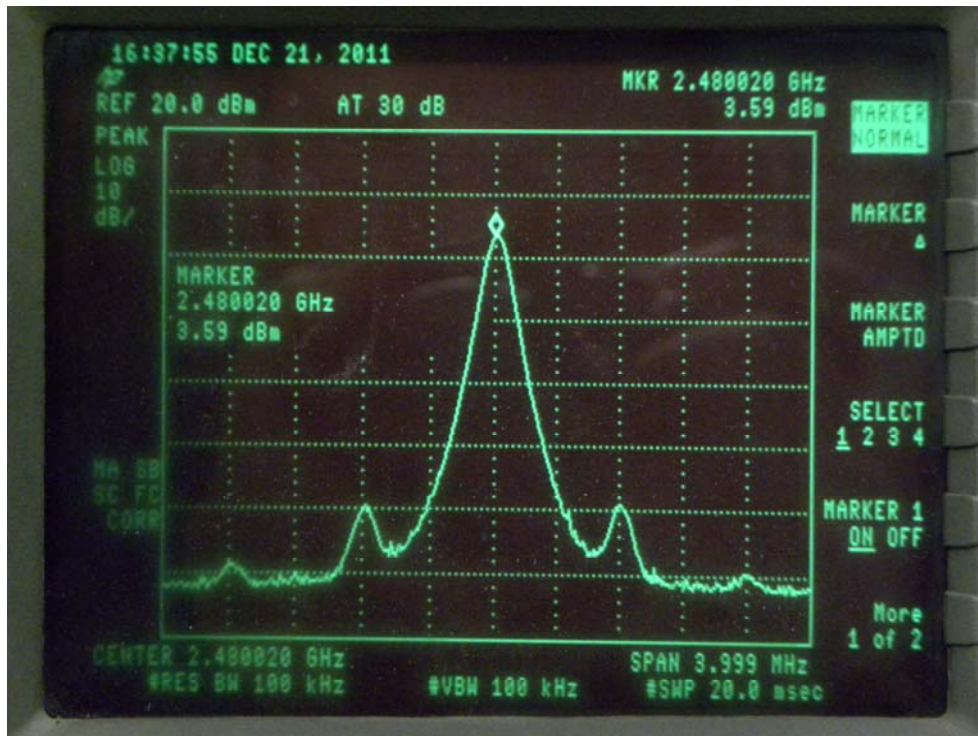
op-mode 6:



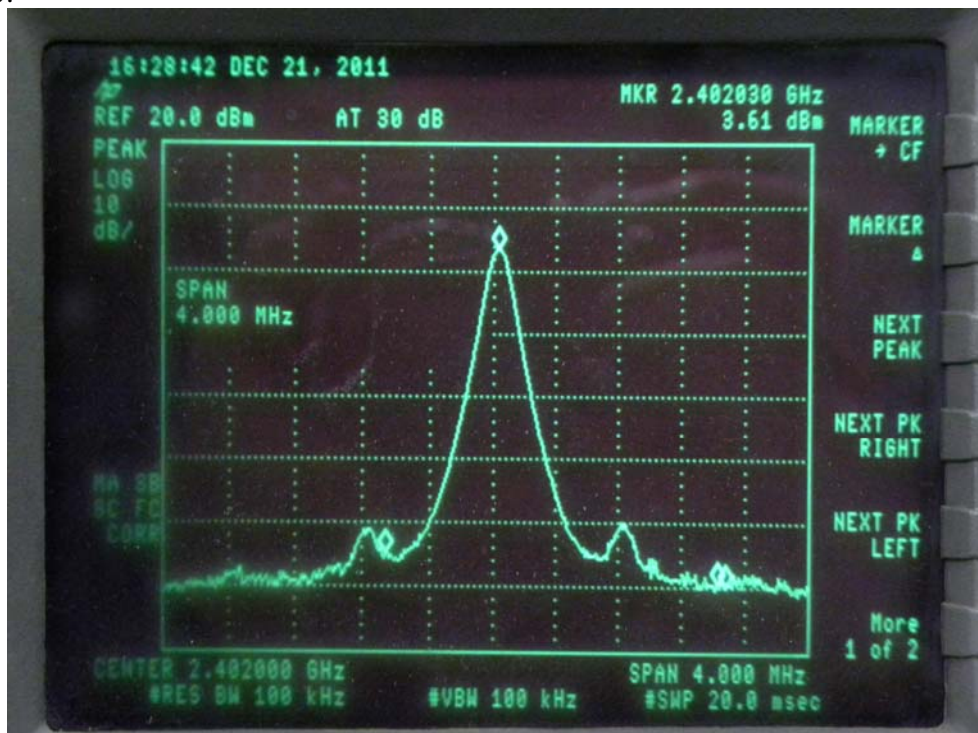
op-mode 7:



op-mode 8:

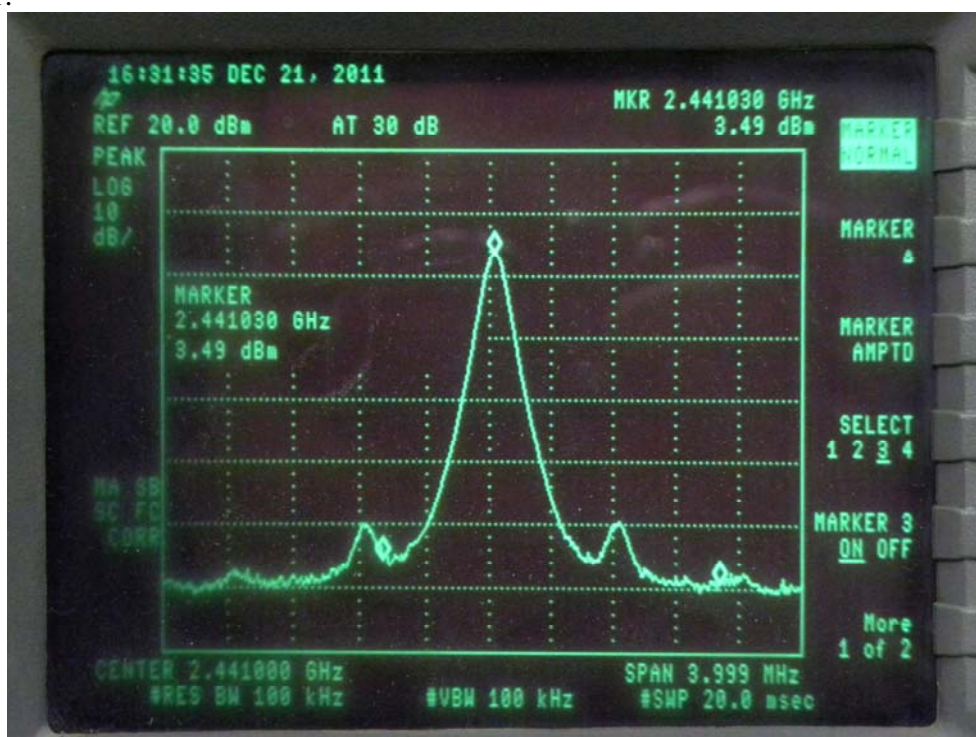


op-mode 10:

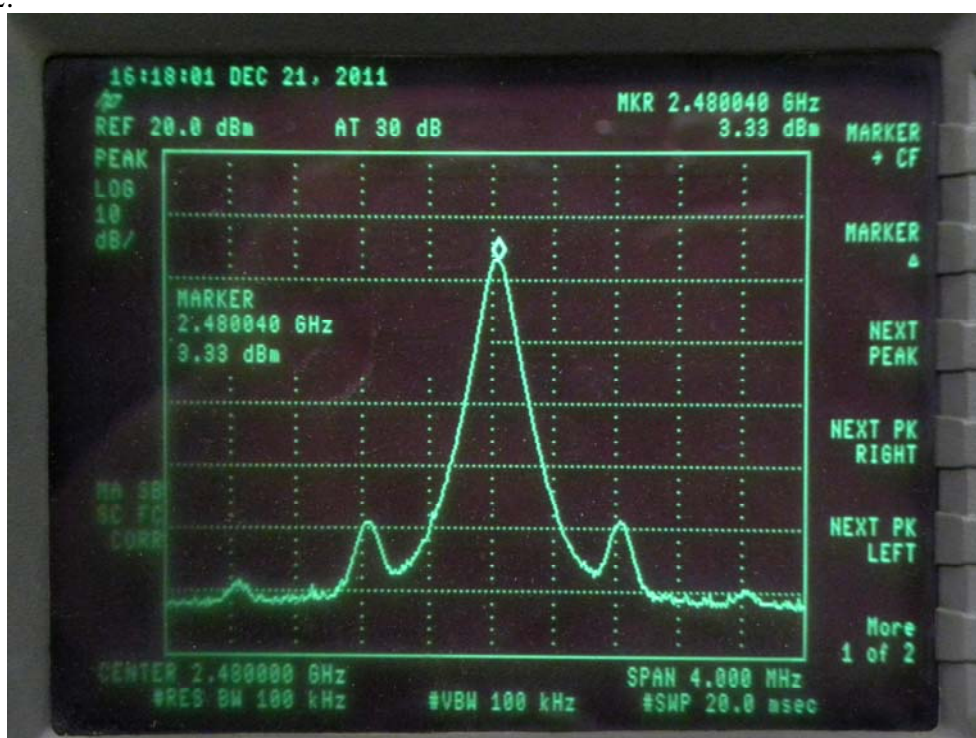




op-mode 11:



op-mode 12:



## **12. Band EDGE test**

### **12.1 Measurement Procedure**

1. The EUT was Operating in hopping mode or could be controlled its channel. Printed out test result from the spectrum by hard copy function.
2. The EUT was placed on a turn table which is 0.8m above ground plane.
3. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
4. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
5. Repeat above procedures until all frequency measured were complete.

### **12.2 Test SET-UP (Block Diagram of Configuration)**

Same as 5.2 Radiated Emission Set-up.

### **12.3 Measurement Equipment Used:**

Same as 5.3 Radiated Emission Measurement.

## 12.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	December 21, 2011
Test By:	Andy	Temperature :	20 °C
Test Result:	PASS	Humidity :	50 %

### 1. Conducted Test

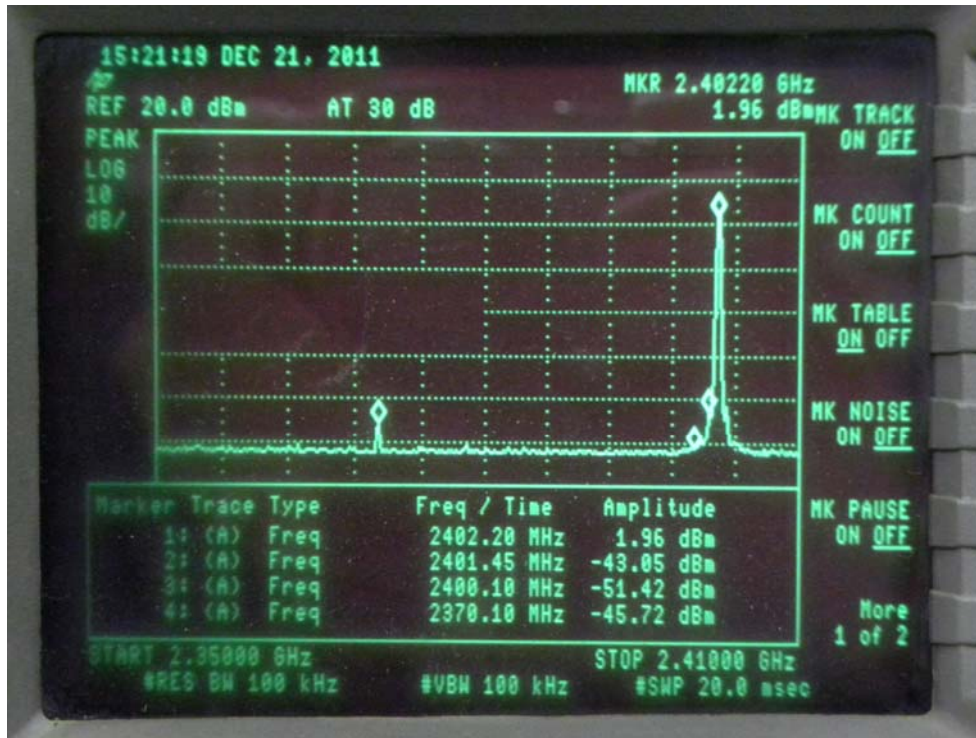
Frequency (MHz)	Operating Mode	Peak Power Output(dBm)	Emission read Value(dBm)	Result of Band edge(dBc)	Band edge Limit(dBc)
<2400	op-mode 1	1.96	-45.72	47.68	>20dBc
	op-mode 6	3.15	-44.58	47.73	>20dBc
	op-mode 10	3.54	-44.79	48.33	>20dBc
>2483.5	op-mode 3	2.08	-48.64	50.72	>20dBc
	op-mode 8	3.40	-48.33	51.73	>20dBc
	op-mode 12	3.25	-48.80	52.05	>20dBc

### 2. Radiated emission Test

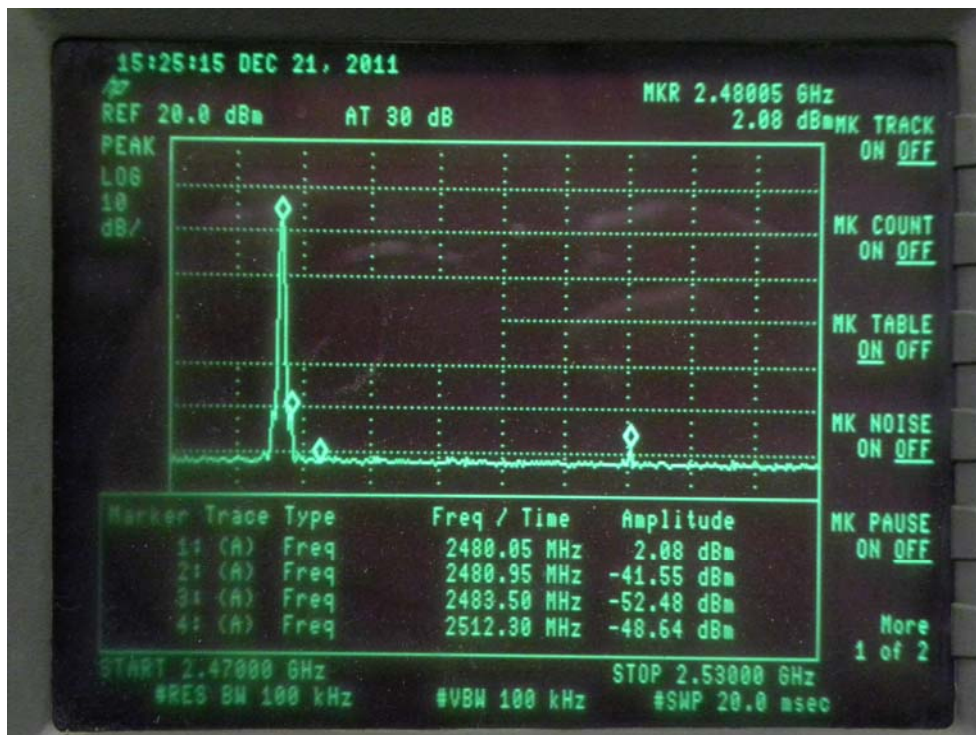
Frequency (MHz)	Operating Mode	Antenna polarization (H/V)	Emission (dBuV/m)		Band edge Limit (dBuV/m)	
			PK	AV	PK	AV
<2400	op-mode 1	V	51.09	38.22	74.00	54.00
	op-mode 6	V	52.54	39.51	74.00	54.00
	op-mode 10	V	48.78	37.49	74.00	54.00
>2483.5	op-mode 3	V	48.25	36.87	74.00	54.00
	op-mode 8	V	50.93	38.89	74.00	54.00
	op-mode 12	V	49.31	37.10	74.00	54.00

Remark: The results of Horizontal polarization and Vertical polarization are same.

op-mode 1:

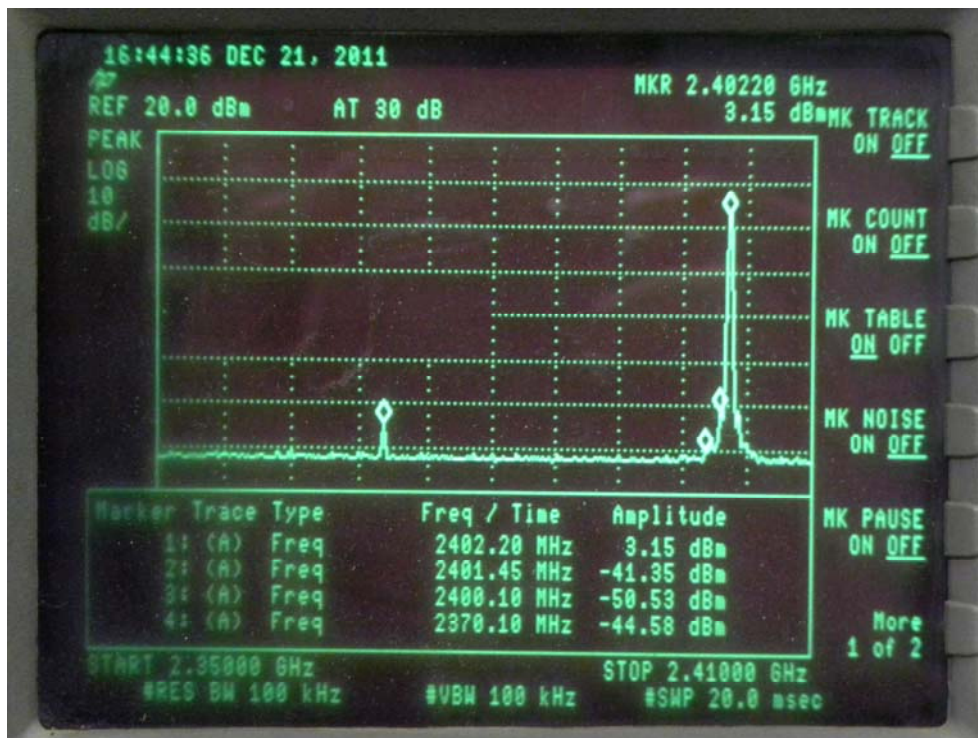


op-mode 3:





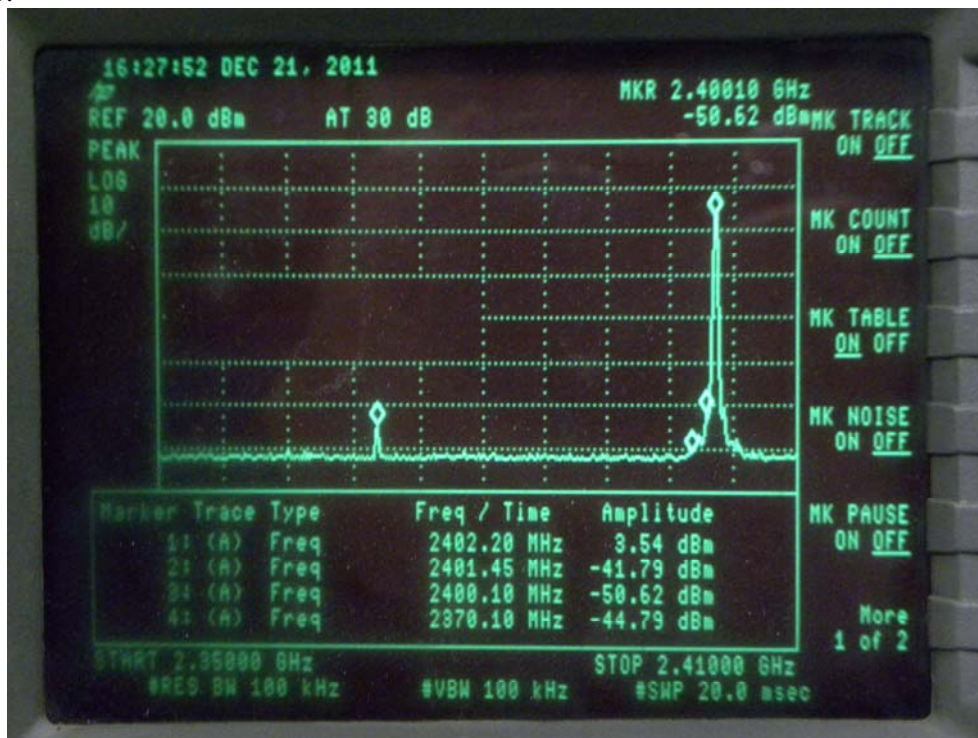
op-mode 6:



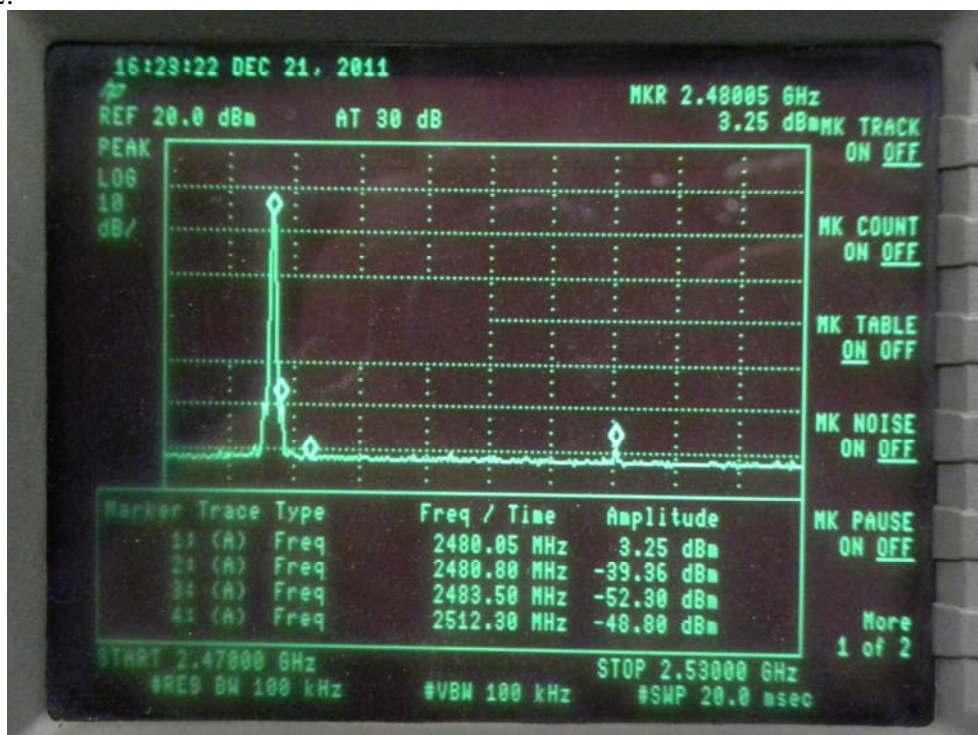
op-mode 8:



op-mode 10:



op-mode 12:



## 13. Antenna Application

### 13.1 Antenna requirement

The EUT'S antenna is met the requirement of FCC part 15C section 15.203 and 15.240.

FCC part 15C section 15.247 requirements:

Systems operating in the 2402-2480MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

### 13.2 Result

The EUT's antenna used a chip antenna and integrated on PCB, The results of antenna's gain are as follows and meets the requirement.

Frequency	Gain(dBi)
2402MHz	-4.14
2441MHz	-2.26
2480MHz	-1.32

## 14. RF EXPOSURE EVALUATION

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

Limits for Maximum Permissible Exposure(MPE)

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density(mW/cm <sup>2</sup> )	Average Time
<b>(A) Limits for Occupational/Control Exposures</b>				
<b>300-1500</b>	--	--	<b>F/300</b>	<b>6</b>
<b>1500-100000</b>	--	--	<b>5</b>	<b>6</b>
<b>(B) Limits for General Population/Uncontrol Exposures</b>				
<b>300-1500</b>	--	--	<b>F/1500</b>	<b>6</b>
<b>1500-100000</b>	--	--	<b>1</b>	<b>30</b>

### 14.1 Friis transmission formula: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where

$P_d$ = Power density in mW/cm<sup>2</sup>

$P_{out}$ =output power to antenna in Mw

$G$ = gain of antenna in linear scale

$\pi$ =3.1416

$R$ = distance between observation point and center of the radiator in cm

$P_d$  the limit of MPE, 1mW/cm<sup>2</sup>. If we know the maximum gain of the antenna and total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

### 14.2 Measurement Result.

Operating Mode	Channel Frequency (MHz)	Output Peak power (mW)	Antenna Gain (dBi)	Power density at 20cm (mW/ cm <sup>2</sup> )	Power density Limits (mW/cm <sup>2</sup> )
op-mode 1	2402	1.563	-4.14	1.199E-04	1
op-mode 2	2441	1.683	-2.26	1.990E-04	1
op-mode 3	2480	1.667	-1.32	2.447E-04	1
op-mode 6	2402	2.223	-4.14	1.705E-04	1
op-mode 7	2441	2.249	-2.26	2.659E-04	1
op-mode 8	2480	2.286	-1.32	3.356E-04	1
op-mode 10	2402	2.296	-4.14	1.761E-04	1
op-mode 11	2441	2.234	-2.26	2.641E-04	1
op-mode 12	2480	2.153	-1.32	3.161E-04	1