

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

*OF*

**Wall Mount Radio**

**MODEL No.: RV5090**

**BRAND NAME: LINEAR SERIES**

**FCC ID: ZGM-RV5090**

**REPORT NO: KAD130530100E**

**ISSUE DATE: July 04, 2013**

*Prepared for*

**MAGNADYNE CORPORATION  
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*Prepared by*

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## VERIFICATION OF COMPLIANCE

|                      |  |
|----------------------|--|
| Applicant:           | MAGNADYNE CORPORATION<br>1111 West Victory Street, Compton, CA. 90220, USA |
| Manufacturer:        | MAGNADYNE CORPORATION<br>1111 West Victory Street, Compton, CA. 90220, USA |
| Product Description: | Wall Mount Radio   |
| Brand Name:          | LINEAR SERIES  |
| Model Number:        | RV5090   |
| Serial Number:       | N/A  |
| Kind of Device:      | Bluetooth Ver. 2.1+EDR   |
| File Number:         | KAD130530100E  |
| Date of Test:        | May 30, 2013 to June 22, 2013  |

### 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**



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

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## 1. GENERAL INFORMATION

### 1.1 Product Description

The MAGNADYNE CORPORATION Model: RV5090 (referred to as the EUT in this report) The EUT is an short range, lower power, Wall Mount Radio designed as an Input Device. It is designed by way of utilizing the following modulation achieves the system operating.

A major technical descriptions of EUT is described as following:

- A). Operation Frequency: 2402-2480MHz
- B). Modulation: GFSK, DQPSK, 8DPSK
- C). Number of Channel: 79
- D). Channel space: 1MHz
- E). Rated RF Output Power: 1.53dBm
- F). Antenna Type: Internal PCB antenna
- G). Antenna GAIN: 4dBi
- H). Power Supply: DC 14.4V, 15A

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 DQPSK modulation is used.

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

This submittal(s) (test report) is intended for FCC ID: ZGM-RV5090 filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules and FCC Public Notice DA 00-705.

### 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 Number is 9444A.

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 with 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 $\text{dB}\mu\text{V/m}$ |
|-----------------|--------------------------------|-------------|---|
| 0.009-0.490     | 2400/F(kHz)                    | 300         | /   |
| 0.490-1.705     | 24000/F(kHz)                   | 30          | /   |
| 1.705-30.0      | 30                             | 30          | /   |
| 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**



**Table 2-1 Equipment Used in Tested System**

| Item | Equipment        | Mfr/Brand     | Model/Type No. | FCC ID     | Series No. | Note       |
|------|------------------|---------------|----------------|------------|------------|------------|
| 1.   | Wall Mount Radio | LINEAR SERIES | RV5090         | ZGM-RV5090 | N/A        | <b>EUT</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   | N/A       |
| §15.247(d),§15.209 | Radiated Emission             | Compliant |
| §15.203            | Antenna Requirement           | Compliant |
| §1.1310            | RF Exposure                   | Compliant |

Remark: The EUT is supplied by Battery, there is no need for AC Power Conducted Emission test to be performed on this product.

### 4. Description of test modes

The EUT (Wall Mount Radio) 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                                |

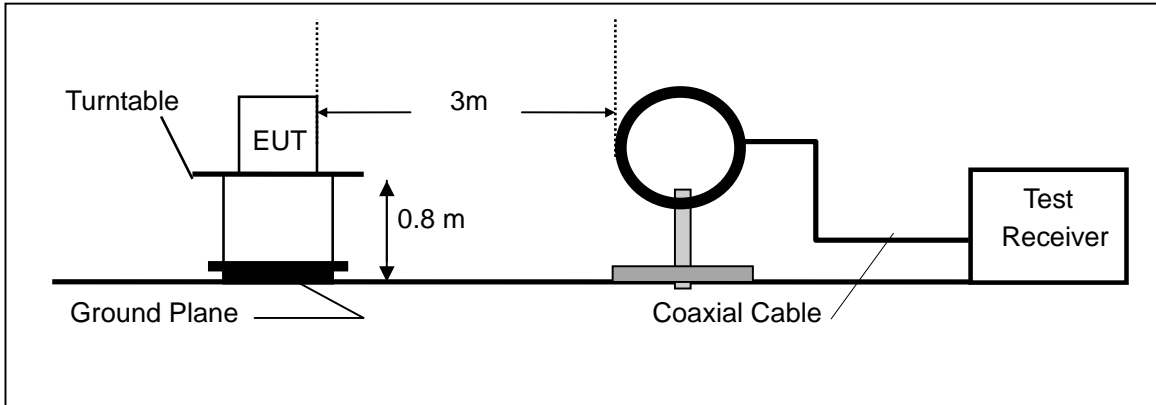
## 5. Radiated Emission Test

### 5.1 Measurement Procedure

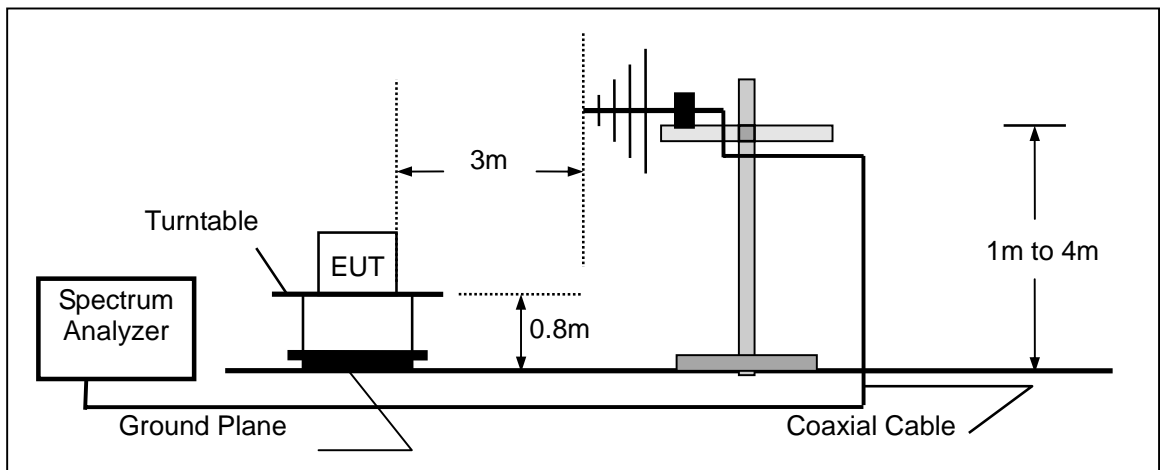
1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured were complete.
5. For range 9KHz~30MHz, The measured value is really too low to be recorded.

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

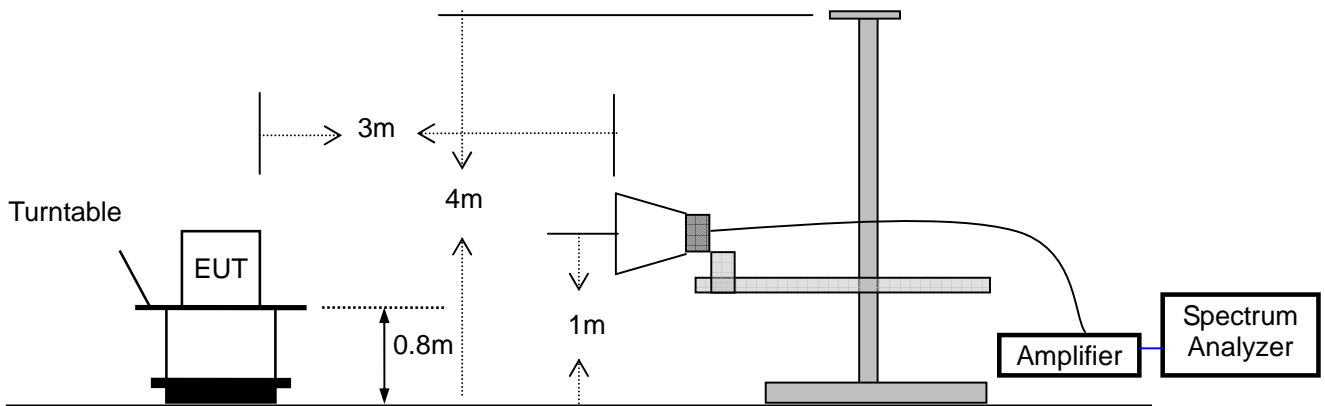
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



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



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



### 5.3 Measurement Equipment Used:

| EQUIPMENT TYPE    | MFR             | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-------------------|-----------------|--------------|---------------|------------|------------|
| Spectrum Analyzer | Rohde & Schwarz | FSP7         | 839511/010    | 05/29/2012 | 05/28/2013 |
| Spectrum Analyzer | HP              | E4407B       | 839840481     | 05/29/2012 | 05/28/2013 |
| EMI Test Receiver | Rohde & Schwarz | ESU          | 1302.6005.26  | 05/29/2012 | 05/28/2013 |
| Pre-Amplifier     | HP              | 8447D        | 2944A07999    | 05/29/2012 | 05/28/2013 |
| Bilog Antenna     | Schwarzbeck     | VULB9163     | 142           | 05/29/2012 | 05/28/2013 |
| Loop Antenna      | ARA             | PLA-1030/B   | 1029          | 05/29/2012 | 05/28/2013 |
| Horn Antenna      | Electro-Metrics | EM-6961      | 103314        | 05/29/2012 | 05/28/2013 |
| Horn Antenna      | Schwarzbeck     | BBHA 9120    | D143          | 05/29/2012 | 05/28/2013 |

### 5.4 Measurement Result

Operation Mode: TX Mode (CH1: 2402MHz) Test Date : June 06, 2013  
 Frequency Range: 30~1000MHz Temperature : 25 °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 |
|-------------|---------------|-------------------------|-------------------|-------------|------|
| 243.4000    | V             | 31.16                   | 46.00             | -14.84      | PK   |
| 265.7100    | V             | 31.80                   | 46.00             | -14.20      | PK   |
| 287.0500    | V             | 31.17                   | 46.00             | -14.83      | PK   |
| 442.2500    | V             | 31.34                   | 46.00             | -14.66      | PK   |
| 479.1100    | V             | 34.33                   | 46.00             | -11.67      | PK   |
| 515.9700    | V             | 34.98                   | 46.00             | -11.02      | PK   |
| 265.7100    | H             | 38.87                   | 46.00             | -7.13       | PK   |
| 287.0500    | H             | 36.89                   | 46.00             | -9.11       | PK   |
| 309.3600    | H             | 36.94                   | 46.00             | -9.06       | PK   |
| 331.6700    | H             | 37.15                   | 46.00             | -8.85       | PK   |
| 353.9800    | H             | 37.65                   | 46.00             | -8.35       | PK   |
| 376.2900    | H             | 38.73                   | 46.00             | -7.27       | 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 : June 06, 2013  
 Frequency Range: 30~1000MHz Temperature : 25 °C  
 Test Result: PASS Humidity : 50 %  
 Measured Distance: 3m Test By: Andy

| Freq.<br>(MHz) | Ant. Pol.<br>H/V | Emission Level<br>(dBuV/m) | Limit 3m<br>(dBuV/m) | Margin<br>(dB) | Note |
|----------------|------------------|----------------------------|----------------------|----------------|------|
| 243.4100       | V                | 31.14                      | 46.00                | -14.86         | PK   |
| 263.7300       | V                | 33.84                      | 46.00                | -12.16         | PK   |
| 282.0300       | V                | 31.32                      | 46.00                | -14.68         | PK   |
| 441.4200       | V                | 31.45                      | 46.00                | -14.55         | PK   |
| 473.1300       | V                | 34.35                      | 46.00                | -11.65         | PK   |
| 515.9600       | V                | 31.34                      | 46.00                | -14.66         | PK   |
| 264.4400       | H                | 38.43                      | 46.00                | -7.57          | PK   |
| 282.0300       | H                | 36.23                      | 46.00                | -9.77          | PK   |
| 319.3300       | H                | 36.95                      | 46.00                | -9.05          | PK   |
| 331.1700       | H                | 37.34                      | 46.00                | -8.66          | PK   |
| 353.9100       | H                | 37.64                      | 46.00                | -8.36          | PK   |
| 376.2200       | H                | 35.75                      | 46.00                | -10.25         | 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 : June 06, 2013  
Frequency Range: 30~1000MHz Temperature : 25 °C  
Test Result: PASS Humidity : 50 %  
Measured Distance: 3m Test By: Andy

| Freq.<br>(MHz) | Ant. Pol.<br>H/V | Emission Level<br>(dBUV/m) | Limit 3m<br>(dBUV/m) | Margin<br>(dB) | Note |
|----------------|------------------|----------------------------|----------------------|----------------|------|
| 243.4200       | V                | 32.14                      | 46.00                | -13.86         | PK   |
| 262.7600       | V                | 36.42                      | 46.00                | -9.58          | PK   |
| 287.7500       | V                | 32.56                      | 46.00                | -13.44         | PK   |
| 442.2300       | V                | 31.45                      | 46.00                | -14.55         | PK   |
| 474.1100       | V                | 34.56                      | 46.00                | -11.44         | PK   |
| 515.9700       | V                | 34.32                      | 46.00                | -11.68         | PK   |
| 265.3400       | H                | 38.22                      | 46.00                | -7.78          | PK   |
| 287.0700       | H                | 36.86                      | 46.00                | -9.14          | PK   |
| 309.3600       | H                | 36.65                      | 46.00                | -9.35          | PK   |
| 332.6500       | H                | 37.18                      | 46.00                | -8.82          | PK   |
| 353.4800       | H                | 37.55                      | 46.00                | -8.45          | PK   |
| 376.2200       | H                | 35.43                      | 46.00                | -10.57         | 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 : June 06, 2013  
 Frequency Range: 1-25GHz Temperature : 25 °C  
 Test Result: PASS Humidity : 50 %  
 Measured Distance: 3m Test By: Andy

| Freq.<br>(MHz) | Ant. Pol.<br>H/V | Emission Level(dBuV/m) |       | Limit 3m(dBuV/m) |    | Margin(dB) |        |
|----------------|------------------|------------------------|-------|------------------|----|------------|--------|
|                |                  | PK                     | AV    | PK               | AV | PK         | AV     |
| 2400           | V                | 56.22                  | 46.84 | 74               | 54 | -17.78     | -7.16  |
| 4804           | V                | 54.42                  | 47.83 | 74               | 54 | -19.58     | -6.17  |
| 7206           | V                | 58.54                  | 47.42 | 74               | 54 | -15.46     | -6.58  |
| 9608           | V                | 66.77                  | 47.84 | 74               | 54 | -7.23      | -6.16  |
| 12010          | V                | 57.24                  | 46.74 | 74               | 54 | -16.76     | -7.26  |
| 2400           | H                | 54.87                  | 46.73 | 74               | 54 | -19.13     | -7.27  |
| 4804           | H                | 58.52                  | 42.28 | 74               | 54 | -15.48     | -11.72 |
| 7206           | H                | 59.66                  | 47.53 | 74               | 54 | -14.34     | -6.47  |
| 9608           | H                | 52.86                  | 43.25 | 74               | 54 | -21.14     | -10.75 |
| 12010          | H                | 57.64                  | 45.52 | 74               | 54 | -16.36     | -8.48  |

**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 : June 06, 2013  
 Frequency Range: 1-25GHz Temperature : 25 °C  
 Test Result: PASS Humidity : 50 %  
 Measured Distance: 3m Test By: Andy

| Freq.<br>(MHz) | Ant. Pol.<br>H/V | Emission Level(dBuV/m) |       | Limit 3m(dBuV/m) |    | Margin(dB) |        |
|----------------|------------------|------------------------|-------|------------------|----|------------|--------|
|                |                  | PK                     | AV    | PK               | AV | PK         | AV     |
| 4882           | V                | 54.23                  | 45.23 | 74               | 54 | -19.77     | -8.77  |
| 7323           | V                | 54.44                  | 45.56 | 74               | 54 | -19.56     | -8.44  |
| 9764           | V                | 54.32                  | 44.34 | 74               | 54 | -19.68     | -9.66  |
| 12205          | V                | 60.45                  | 43.83 | 74               | 54 | -13.55     | -10.17 |
| 4882           | H                | 59.43                  | 45.43 | 74               | 54 | -14.57     | -8.57  |
| 7323           | H                | 58.56                  | 42.45 | 74               | 54 | -15.44     | -11.55 |
| 9764           | H                | 55.34                  | 44.56 | 74               | 54 | -18.66     | -9.44  |
| 12205          | H                | 60.56                  | 43.55 | 74               | 54 | -13.44     | -10.45 |

**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.

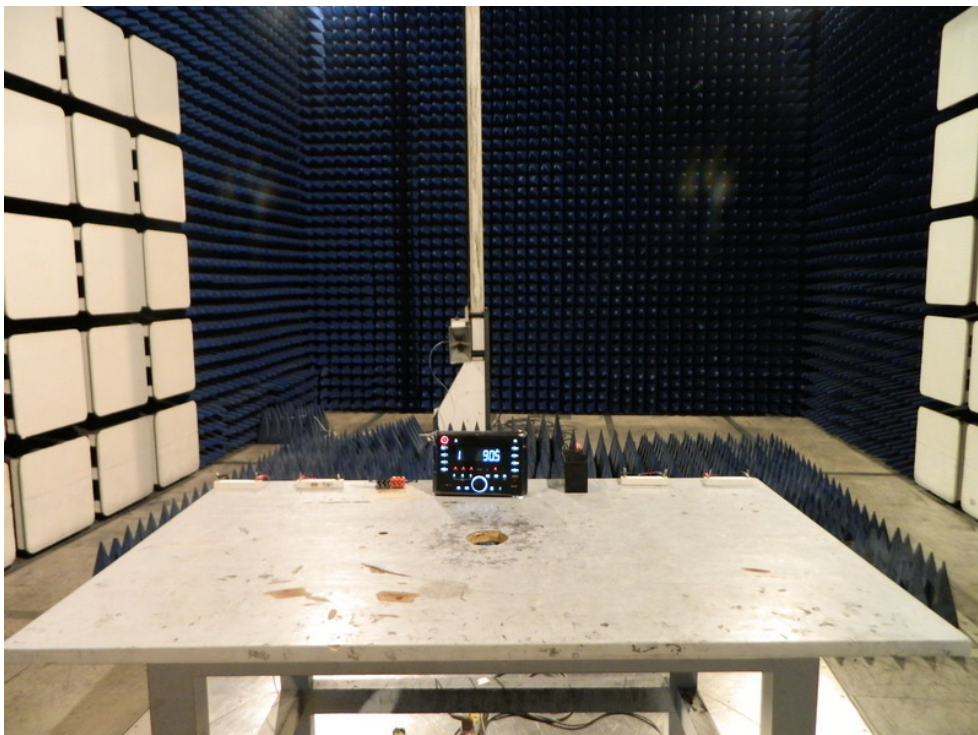
Operation Mode: TX Mode (CH79: 2480MHz) Test Date : June 06, 2013  
 Frequency Range: 1-25GHz Temperature : 25 °C  
 Test Result: PASS Humidity : 50 %  
 Measured Distance: 3m Test By: Andy

| Freq.<br>(MHz) | Ant. Pol.<br>H/V | Emission Level(dBuV/m) |       | Limit 3m(dBuV/m) |    | Margin(dB) |       |
|----------------|------------------|------------------------|-------|------------------|----|------------|-------|
|                |                  | PK                     | AV    | PK               | AV | PK         | AV    |
| 2483.5         | V                | 60.22                  | 46.34 | 74               | 54 | -13.78     | -7.66 |
| 4960           | V                | 53.66                  | 44.38 | 74               | 54 | -20.34     | -9.62 |
| 7440           | V                | 58.27                  | 45.48 | 74               | 54 | -15.73     | -8.52 |
| 9920           | V                | 59.88                  | 45.85 | 74               | 54 | -14.12     | -8.15 |
| 12400          | V                | 62.76                  | 46.53 | 74               | 54 | -11.24     | -7.47 |
| 2483.5         | H                | 61.78                  | 46.83 | 74               | 54 | -12.22     | -7.17 |
| 4960           | H                | 53.89                  | 48.32 | 74               | 54 | -20.11     | -5.68 |
| 7440           | H                | 52.67                  | 46.22 | 74               | 54 | -21.33     | -7.78 |
| 9920           | H                | 58.28                  | 45.78 | 74               | 54 | -15.72     | -8.22 |
| 12400          | H                | 62.78                  | 47.87 | 74               | 54 | -11.22     | -6.13 |

**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.

**5.5 Radiated Measurement Photos:**

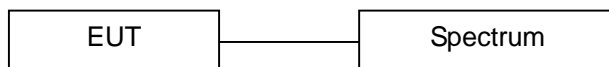


## 6. Channel Separation test

### 6.1 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.

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



### 6.3 Measurement Equipment Used:

Same as 5.3 Radiated Emission Measurement.

### 6.4 Measurement Results:

Refer to attached data chart.

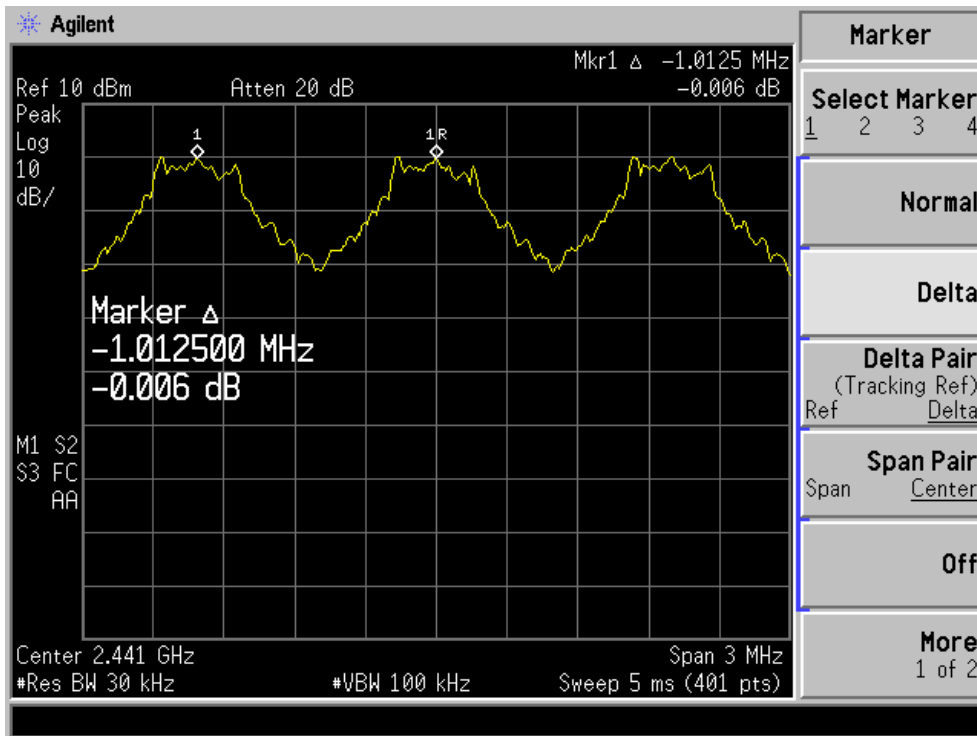
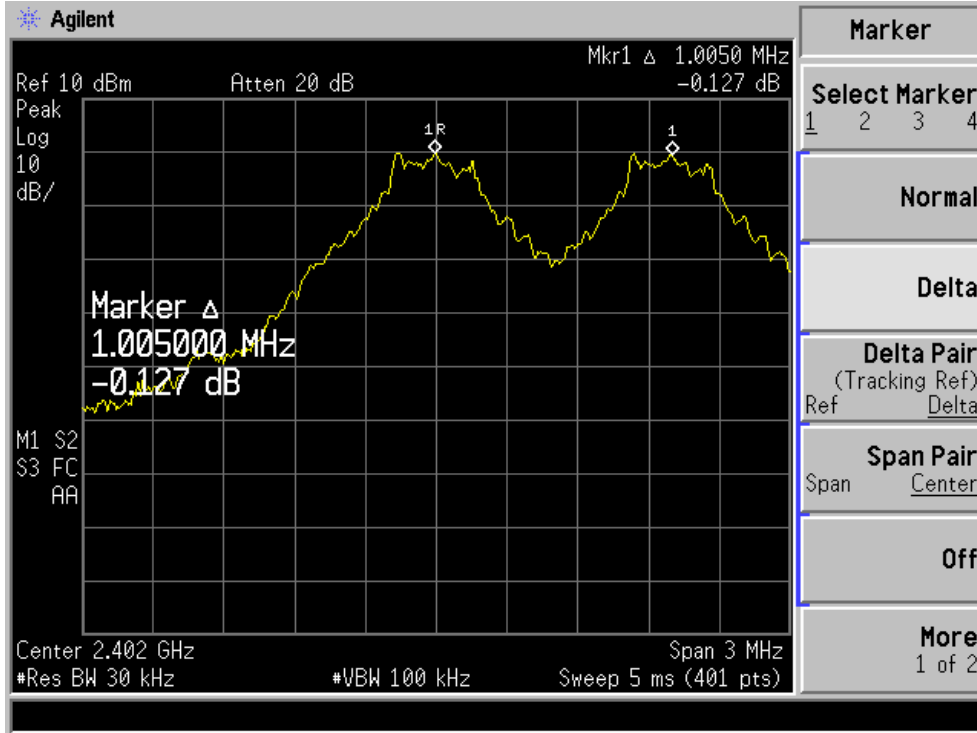
Spectrum Detector: PK                      Test Date : June 06, 2013  
Test By: Andy                              Temperature : 25 °C  
Test Result: PASS                         Humidity : 50 %

| Channel frequency (MHz) | Separation Read Value (KHz) | Separation Limit (KHz) | Data Rate |
|-------------------------|-----------------------------|------------------------|-----------|
| 2402                    | 1005                        | >943                   | 1Mbps     |
| 2441                    | 1012                        | >944                   | 1Mbps     |
| 2480                    | 1005                        | >946                   | 1Mbps     |
| 2402                    | 1005                        | >842                   | 2Mbps     |
| 2441                    | 1005                        | >844                   | 2Mbps     |
| 2480                    | 1005                        | >842                   | 2Mbps     |
| 2402                    | 1005                        | >846                   | 3Mbps     |
| 2441                    | 1005                        | >846                   | 3Mbps     |
| 2480                    | 1005                        | >846                   | 3Mbps     |

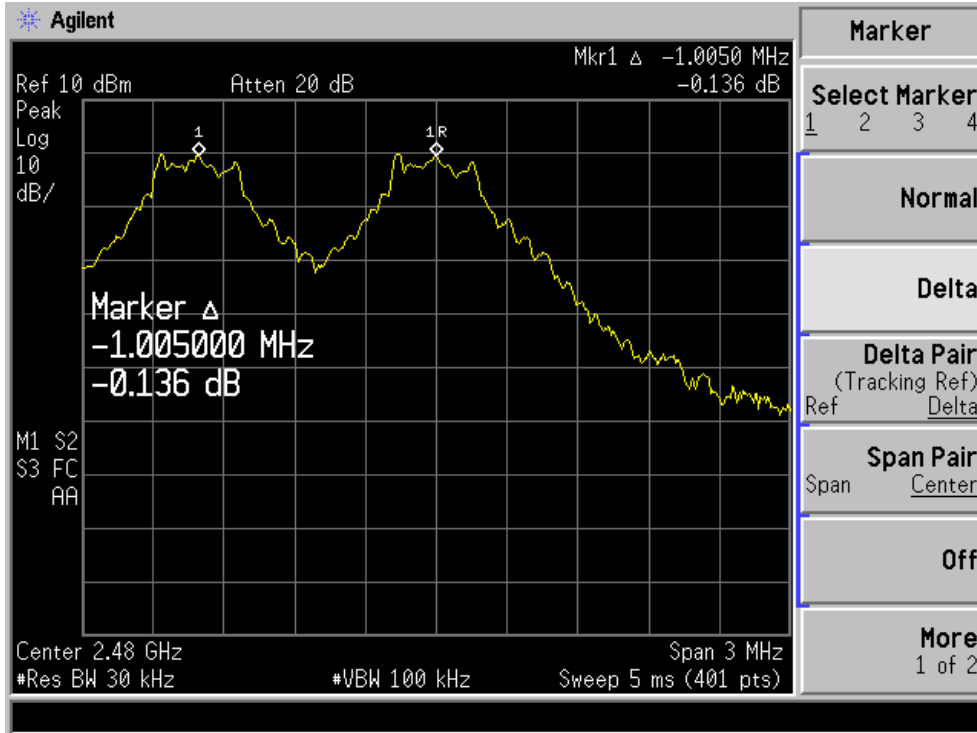
Remark:

1. The limit of data rates 2Mbps and 3Mbps is 2/3 of 20dB BW;

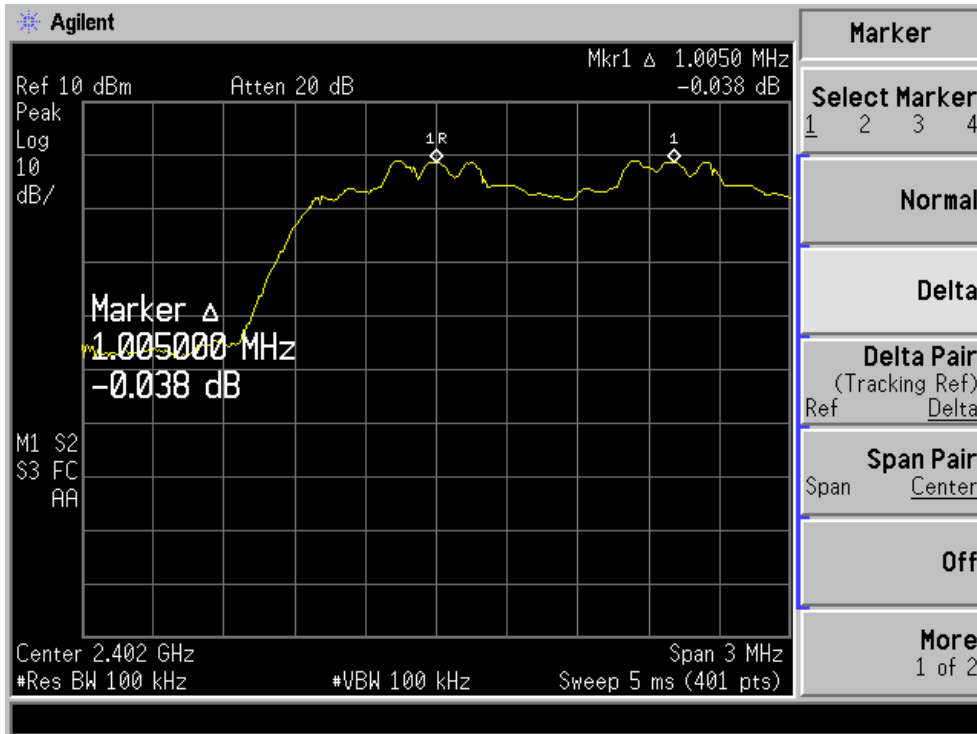
1Mbps:



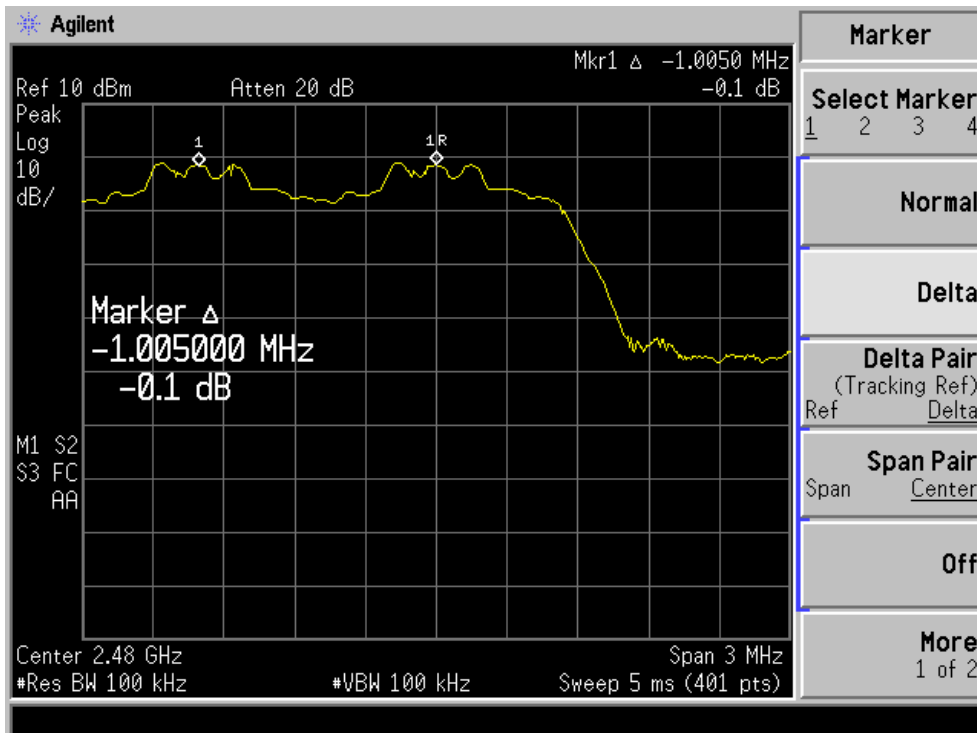
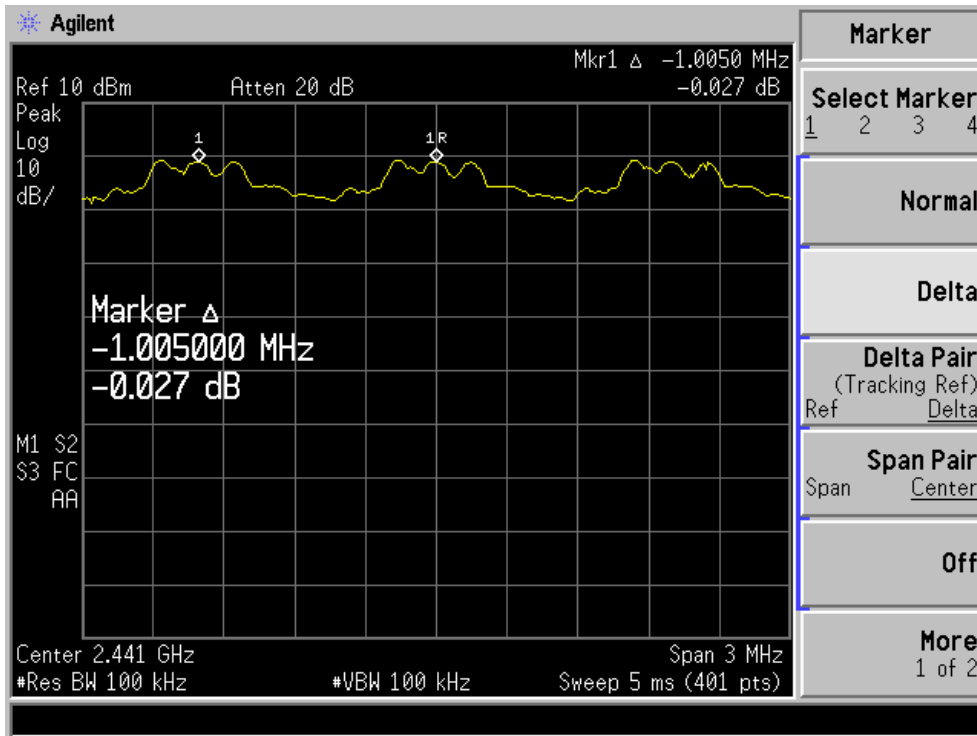




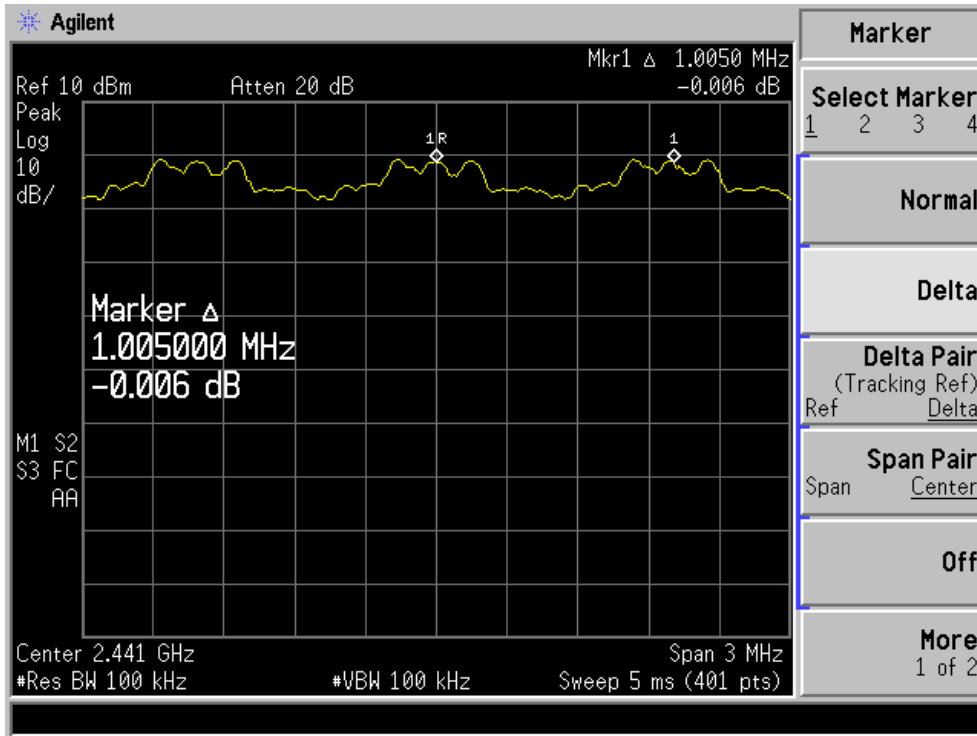
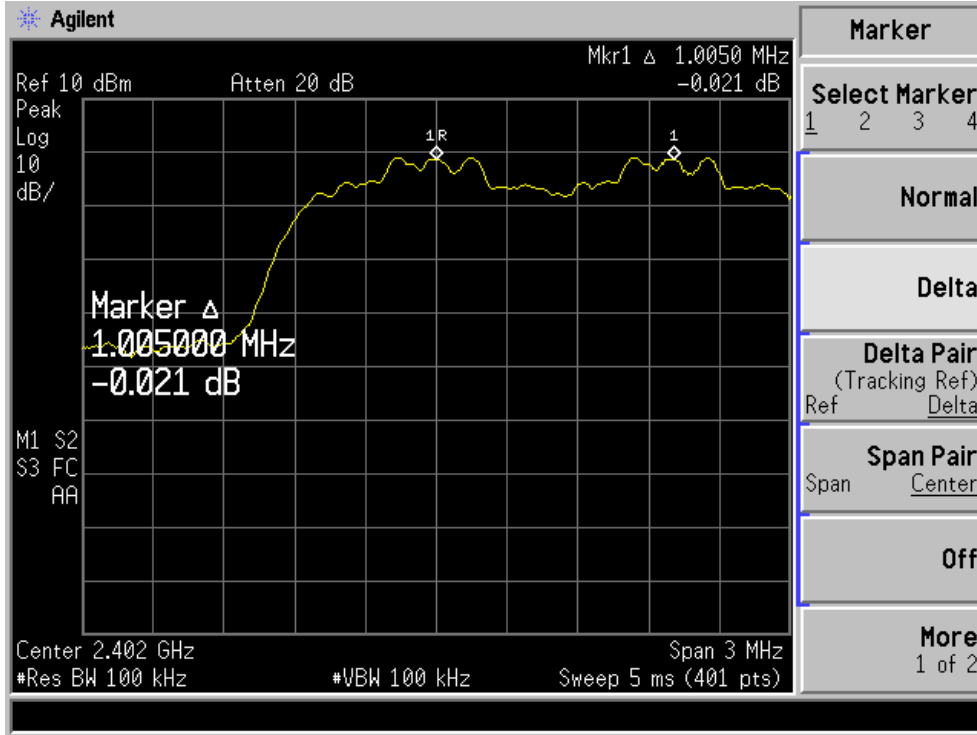
**2Mbps:**

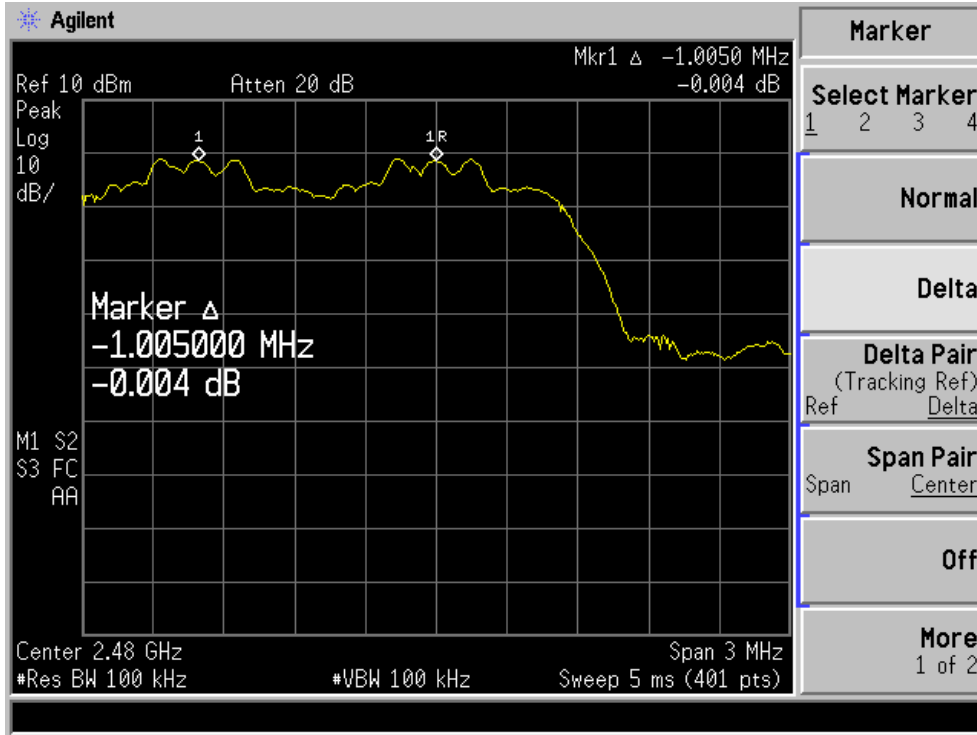






**3Mbps:**



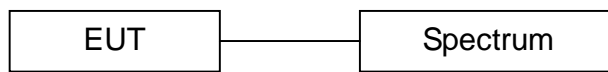


## 7. 20dB Bandwidth test

### 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.

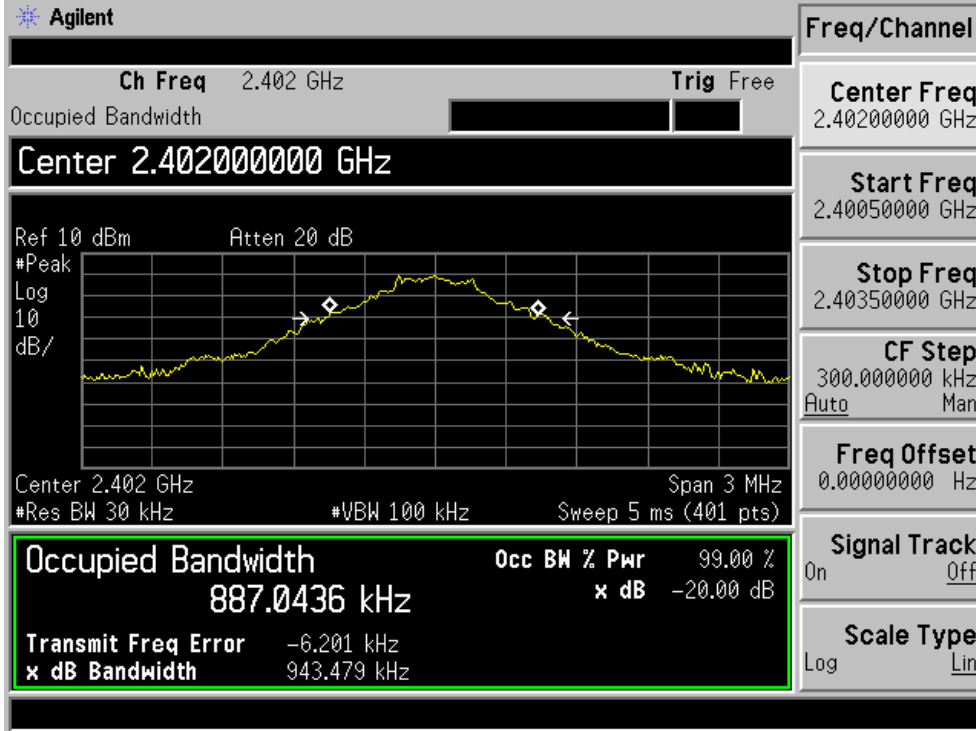
### 7.4 Measurement Results:

Refer to attached data chart.

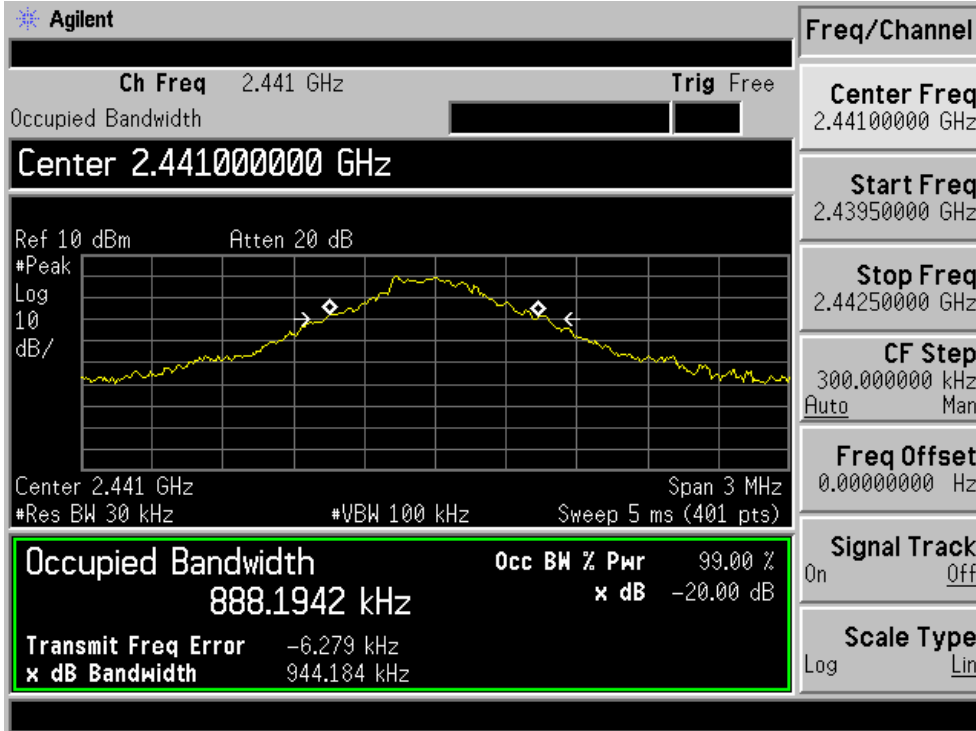
|                    |      |               |               |
|--------------------|------|---------------|---------------|
| Spectrum Detector: | PK   | Test Date :   | June 06, 2013 |
| Test By:           | Andy | Temperature : | 25 °C         |
| Test Result:       | PASS | Humidity :    | 50 %          |

| Operating Mode | Channel frequency (MHz) | 20dB Down BW(kHz) |
|----------------|-------------------------|-------------------|
| op-mode 1      | 2402                    | 943               |
| op-mode 2      | 2441                    | 944               |
| op-mode 3      | 2480                    | 946               |
| op-mode 6      | 2402                    | 1269              |
| op-mode 7      | 2441                    | 1269              |
| op-mode 8      | 2480                    | 1269              |
| op-mode 10     | 2402                    | 1264              |
| op-mode 11     | 2441                    | 1266              |
| op-mode 12     | 2480                    | 1263              |

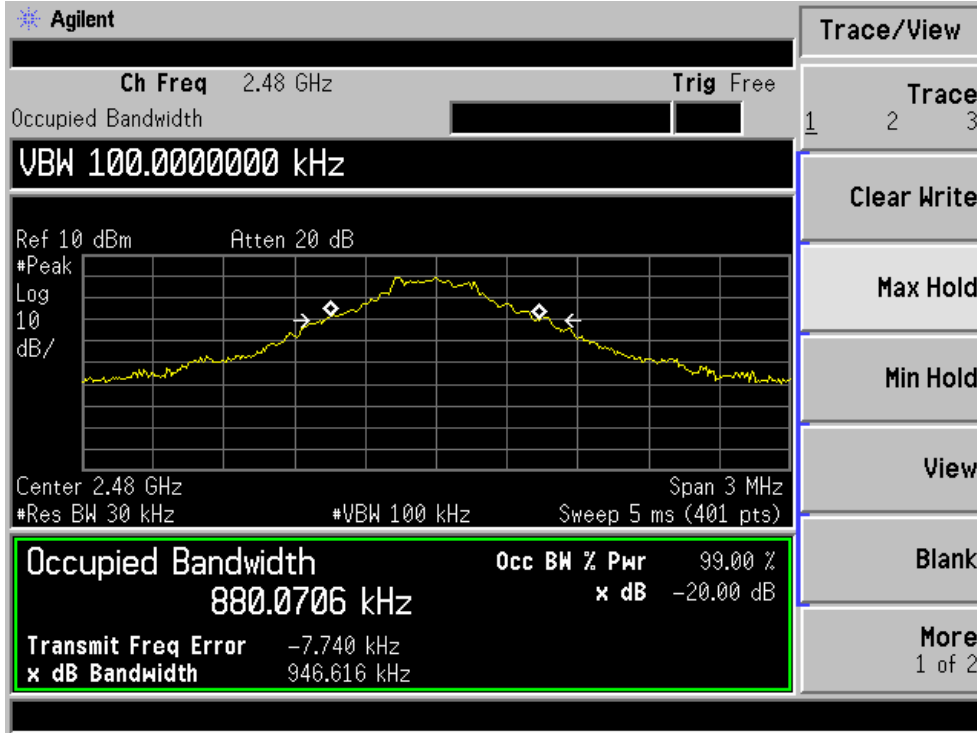
Op-mode 1:



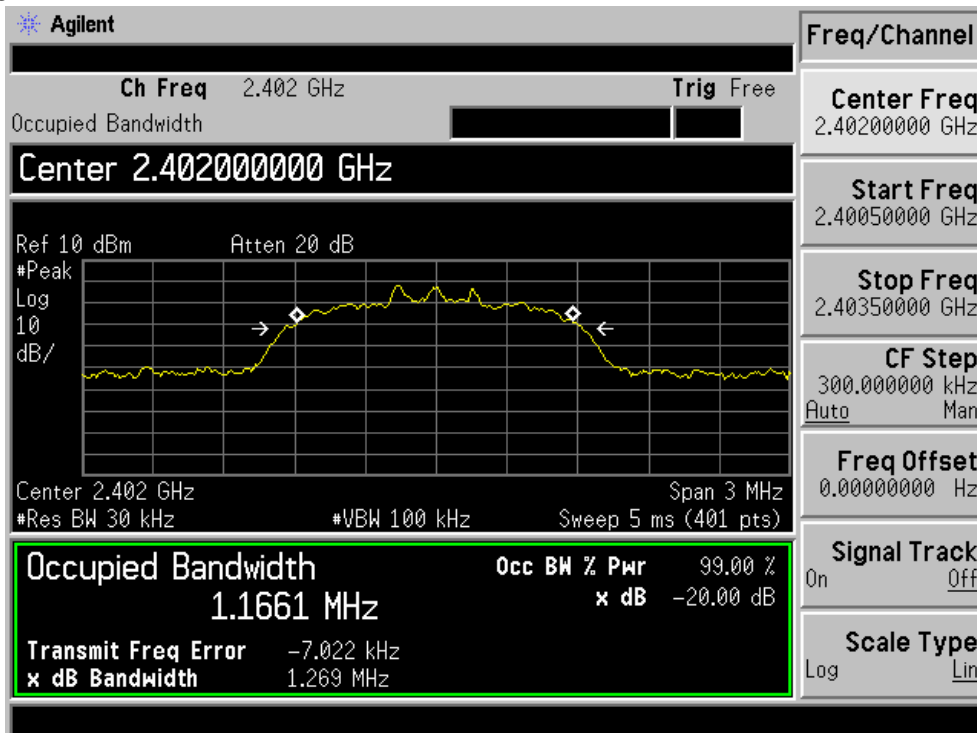
Op-mode 2:



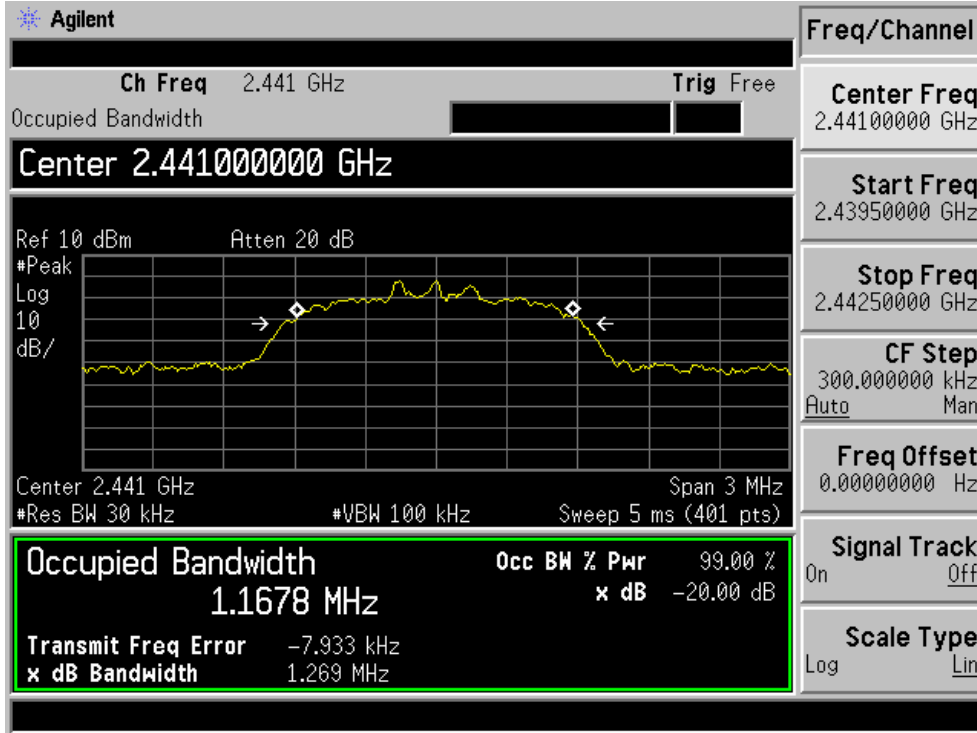
Op-mode 3:



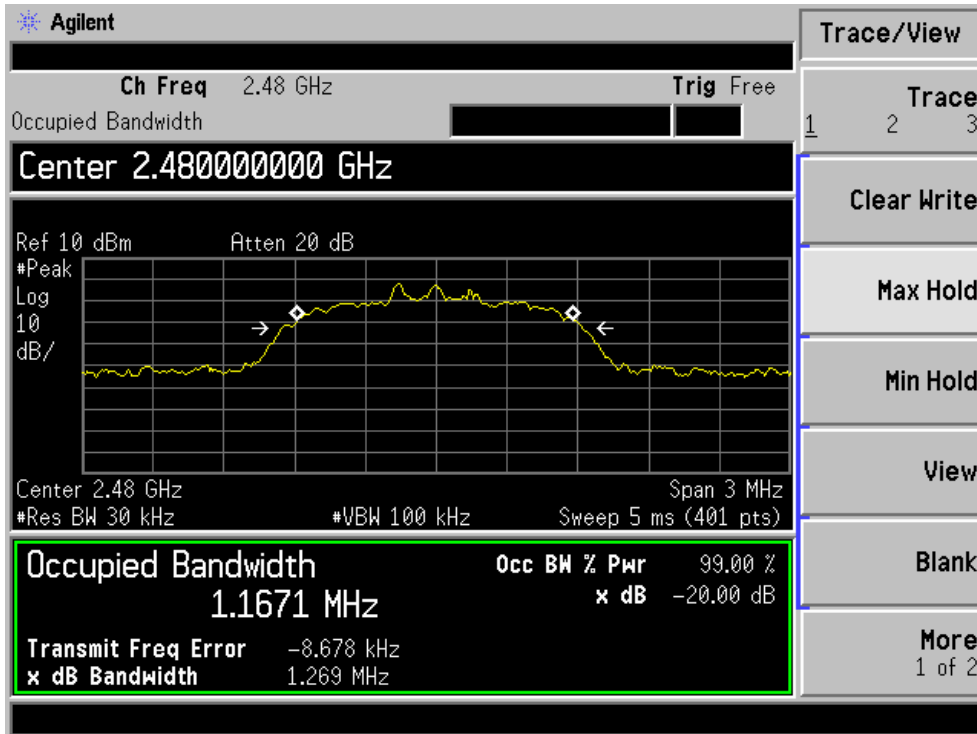
Op-mode 6:



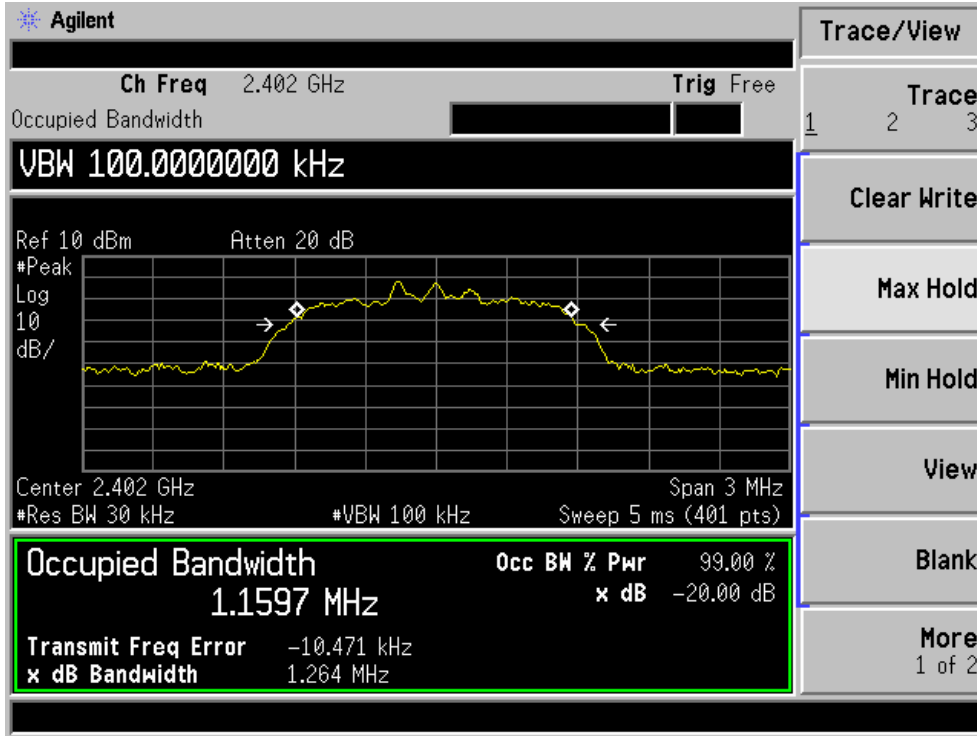
Op-mode 7:



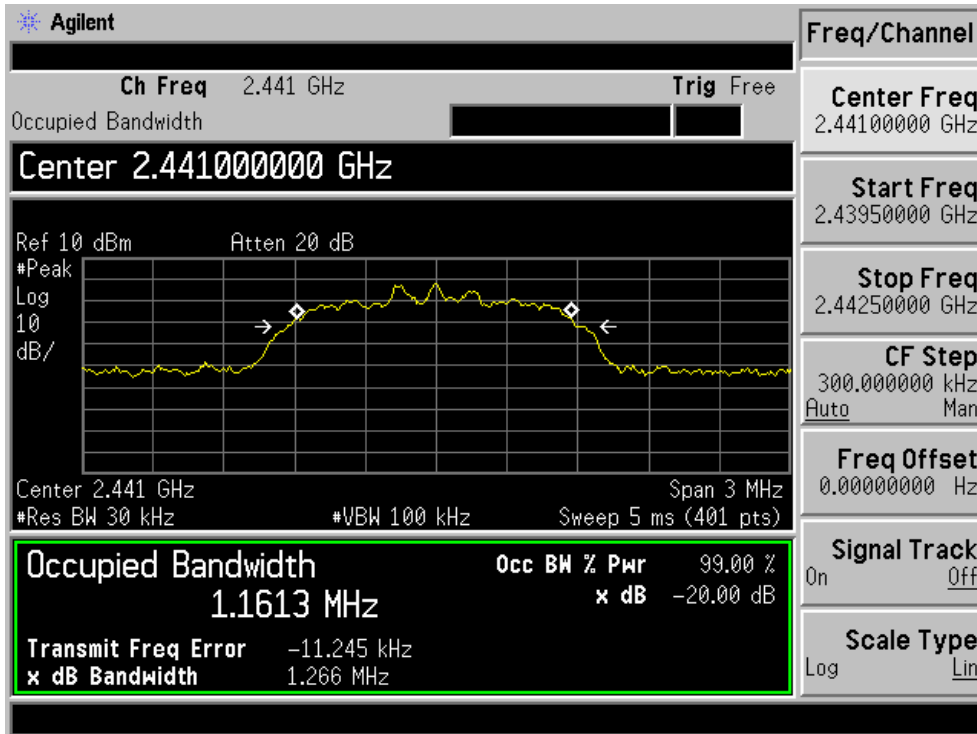
Op-mode 8:



Op-mode 10:

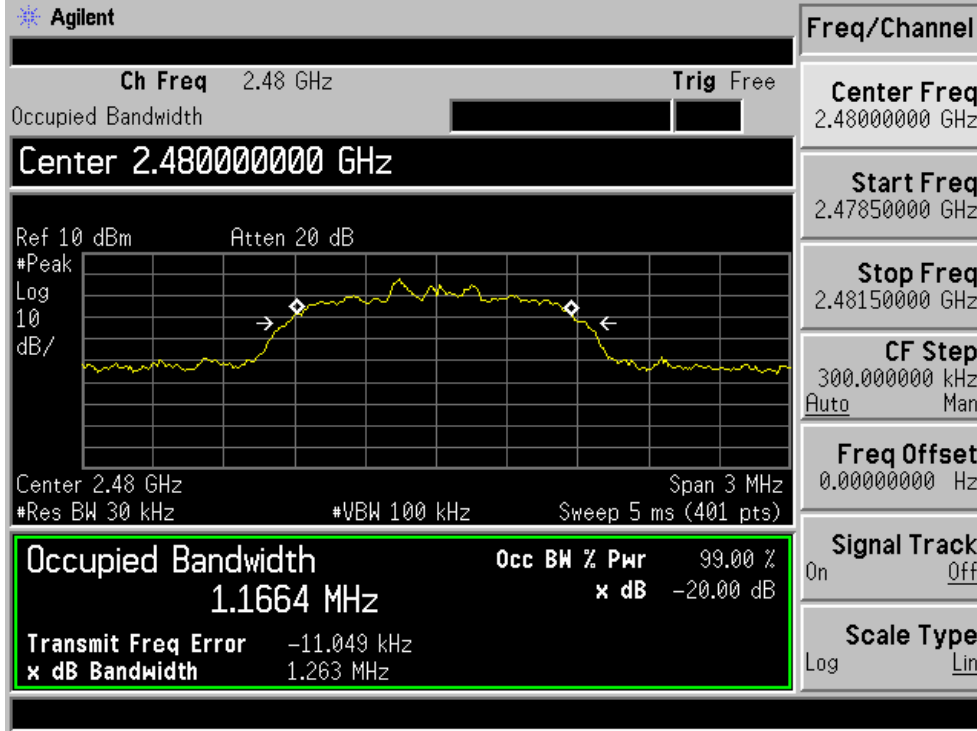


Op-mode 11:





Op-mode 12:

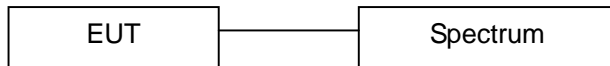


## 8. Quantity of Hopping Channel Test

### 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:

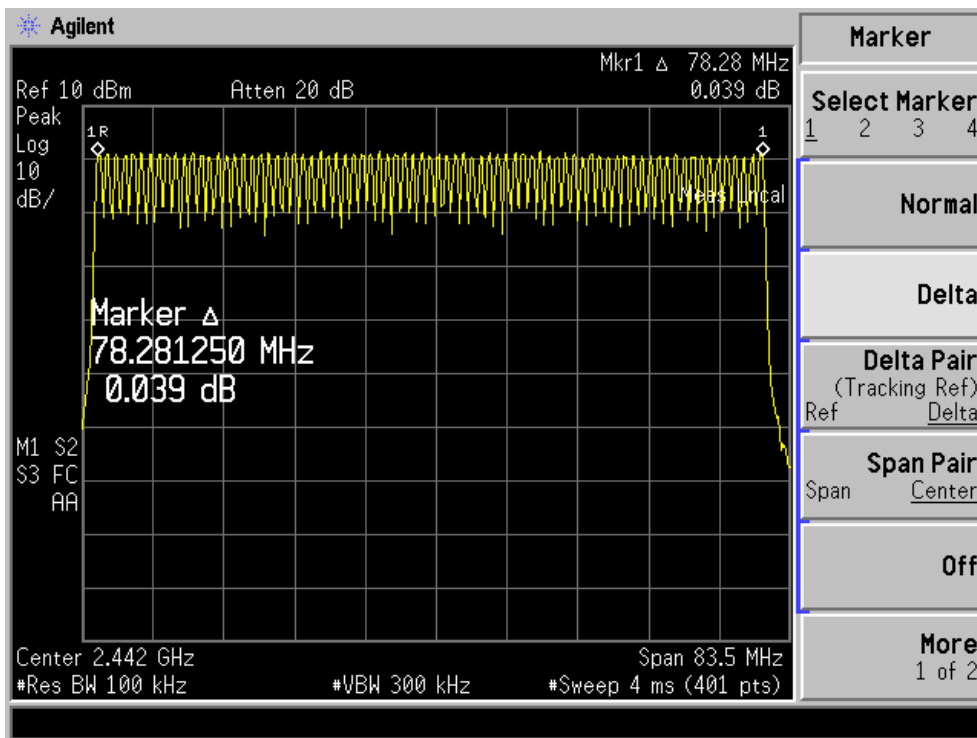
Same as 5.3 Radiated Emission Measurement.

### 8.4 Measurement Results:

Refer to attached data chart.

|                    |      |               |               |
|--------------------|------|---------------|---------------|
| Spectrum Detector: | PK   | Test Date :   | June 06, 2013 |
| Test By:           | Andy | Temperature : | 25 °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                         |



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

### 9.1 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.

### 9.2 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.

### 9.3 Test Protocol

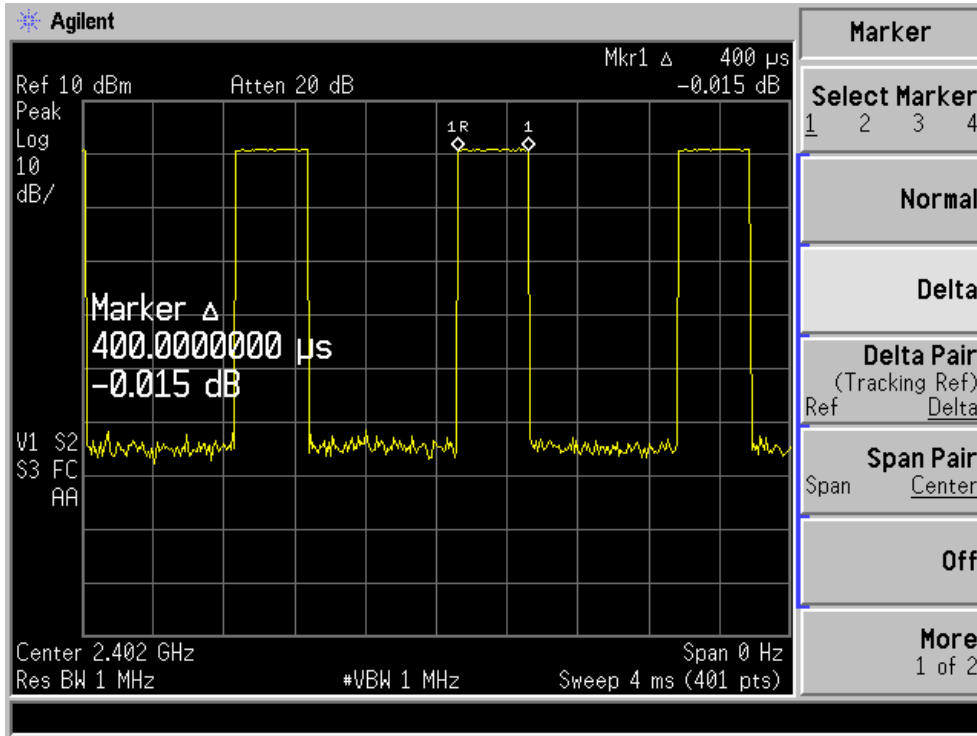
| Packet type | Time slot length(ms) | Dwell time                          | Dwell time(ms) |
|-------------|----------------------|-------------------------------------|----------------|
| DH1         | 0.400                | time slot length *1600/1 /79 * 31.6 | 256            |
| DH3         | 1.660                | time slot length *1600/3 /79 * 31.6 | 354            |
| DH5         | 2.910                | time slot length *1600/5 /79 * 31.6 | 372.48         |

Remark:

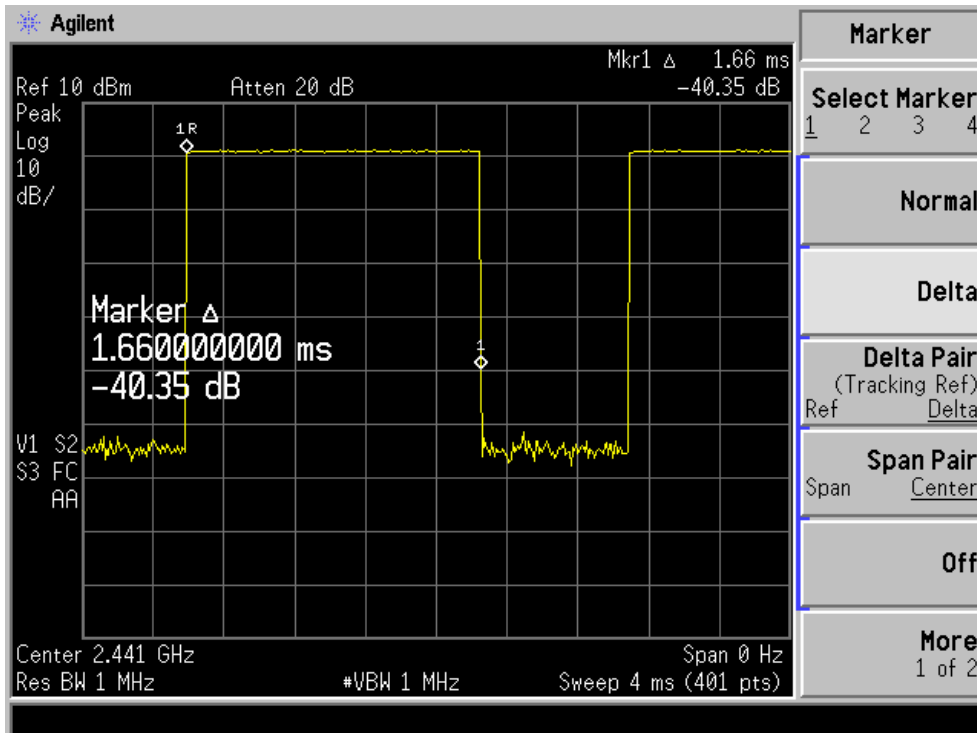
1. The results of different data rate(1Mbps, 2Mbps, 3Mbps) are the same.

**9.4 Test result: Dwell time**  
**PASS.**

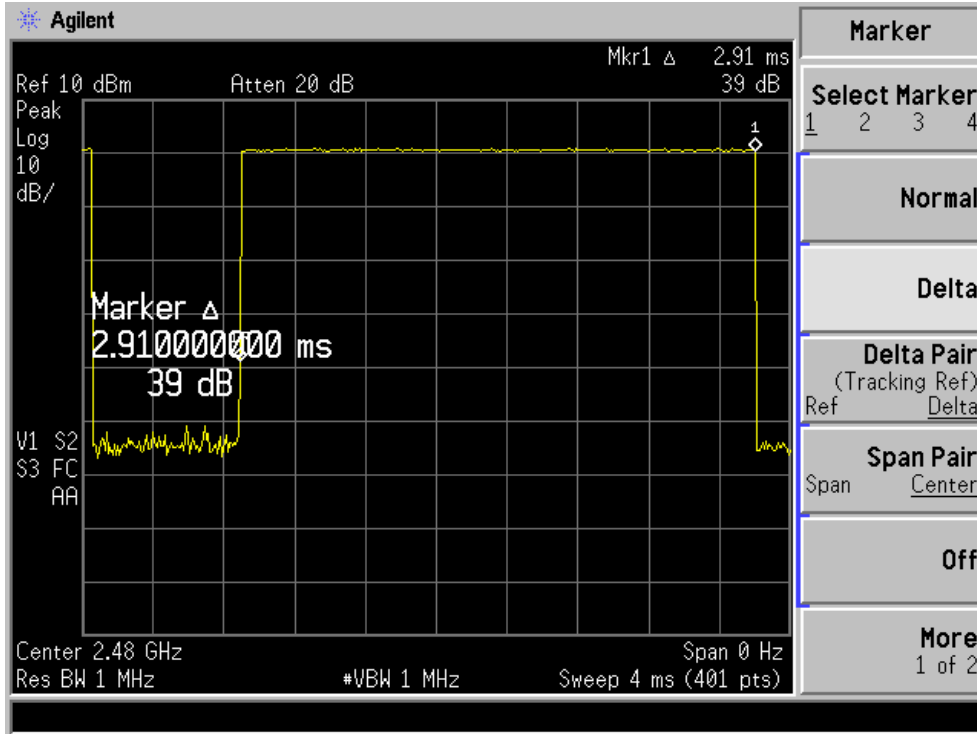
DH1:



DH3:



DH5:

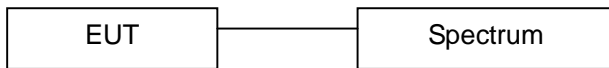


## 10. MAXIMUM PEAK OUTPUT POWER TEST

### 10.1 Measurement Procedure

- a. Check the calibration of the measuring instrument(SA) using either an internal calibrator or a known signal from an external generator.
- b. 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.
- c. The center frequency of the spectrum analyzer is set to the fundamental frequency and using proper RBW and VBW setting.
- d. Measure the captured power within the band and recording the plot.
- e. Repeat above procedures until all frequencies required were complete.

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



### 10.3 Measurement Equipment Used:

| EQUIPMENT TYPE    | MFR             | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-------------------|-----------------|--------------|---------------|------------|------------|
| Spectrum Analyzer | Rohde & Schwarz | FSP7         | 839511/010    | 05/29/2012 | 05/28/2013 |

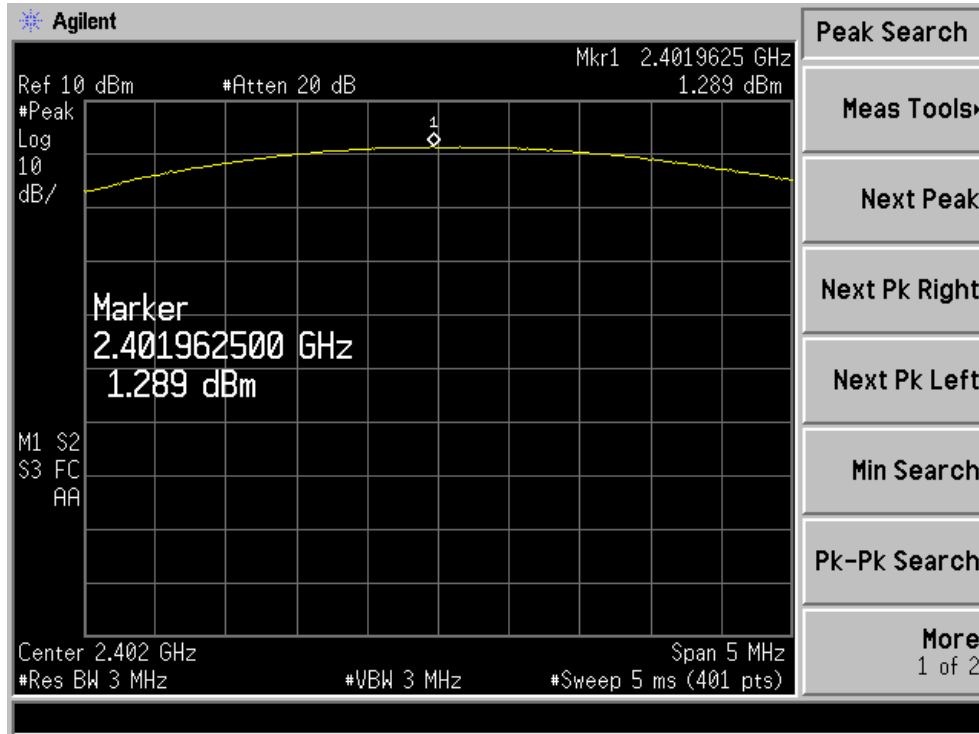
**10.4 Measurement Results:**

Refer to attached data chart.

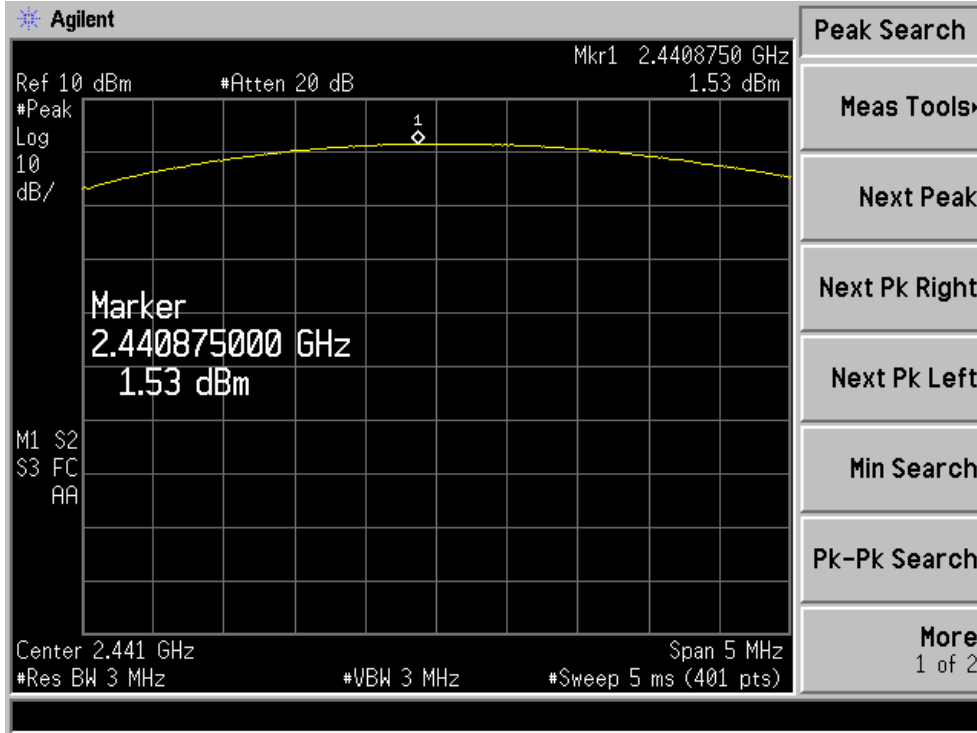
Spectrum Detector: PK    Test Date :                      June 06, 2013  
 Test By: Andy    Temperature :                      25 °C  
 Test Result: PASS    Humidity :                         50 %

| Operating Mode | Channel Frequency (MHz) | Peak Power output(mW) | Peak Power output(dBm) | Peak Power Limit(mW) | Pass/Fail |
|----------------|-------------------------|-----------------------|------------------------|----------------------|-----------|
| op-mode 1      | 2402                    | 1.346                 | 1.289                  | 125                  | PASS      |
| op-mode 2      | 2441                    | <b>1.422</b>          | <b>1.530</b>           | 125                  | PASS      |
| op-mode 3      | 2480                    | 1.337                 | 1.261                  | 125                  | PASS      |
| op-mode 6      | 2402                    | 0.902                 | -0.449                 | 125                  | PASS      |
| op-mode 7      | 2441                    | 0.948                 | -0.231                 | 125                  | PASS      |
| op-mode 8      | 2480                    | 0.869                 | -0.608                 | 125                  | PASS      |
| op-mode 10     | 2402                    | 0.966                 | -0.149                 | 125                  | PASS      |
| op-mode 11     | 2441                    | 0.998                 | -0.007                 | 125                  | PASS      |
| op-mode 12     | 2480                    | 0.934                 | -0.298                 | 125                  | PASS      |

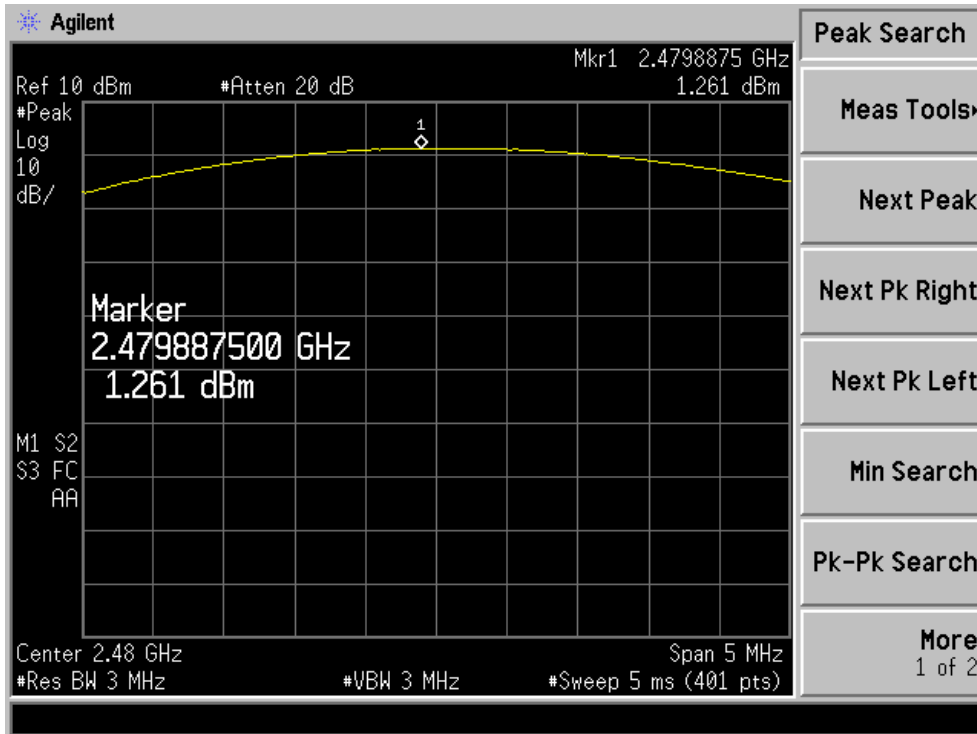
op-mode 1:



op-mode 2:

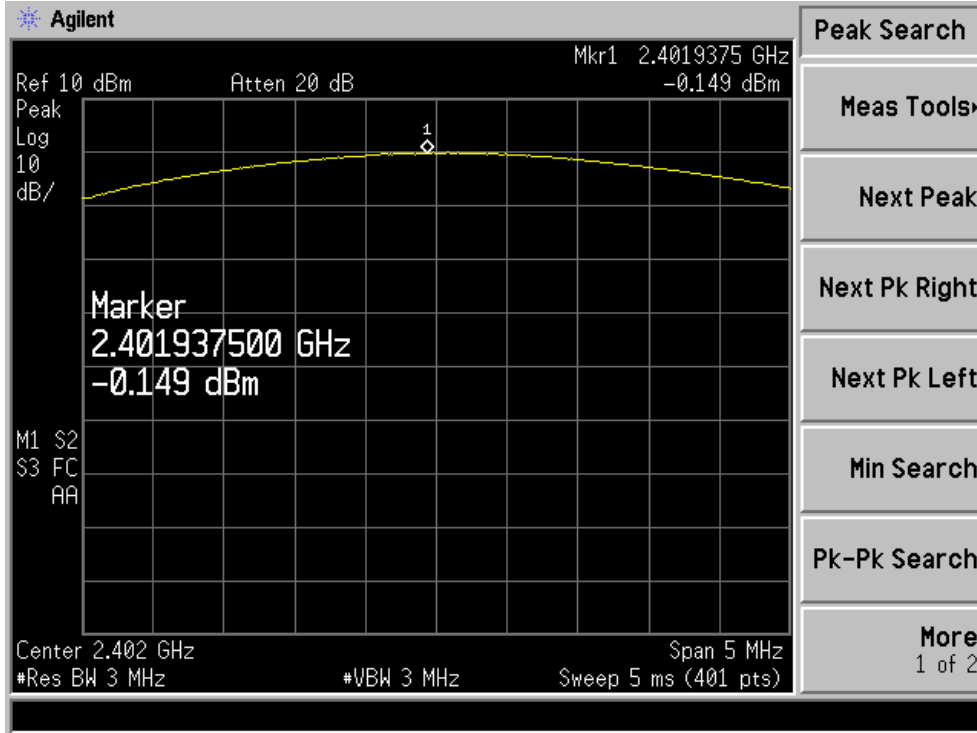


op-mode 3:

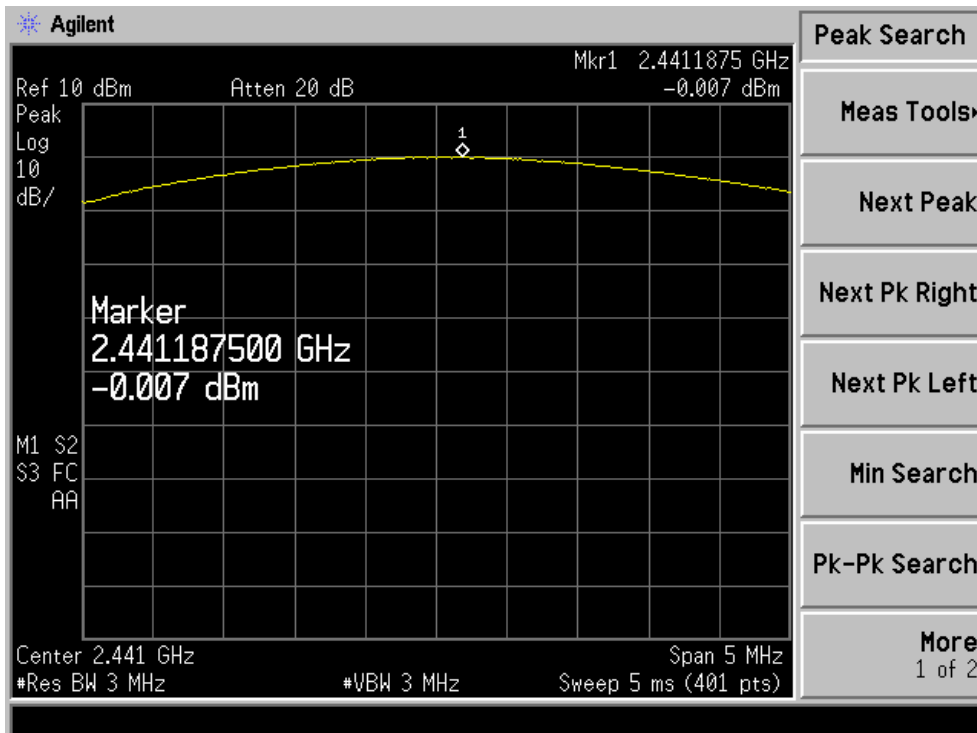




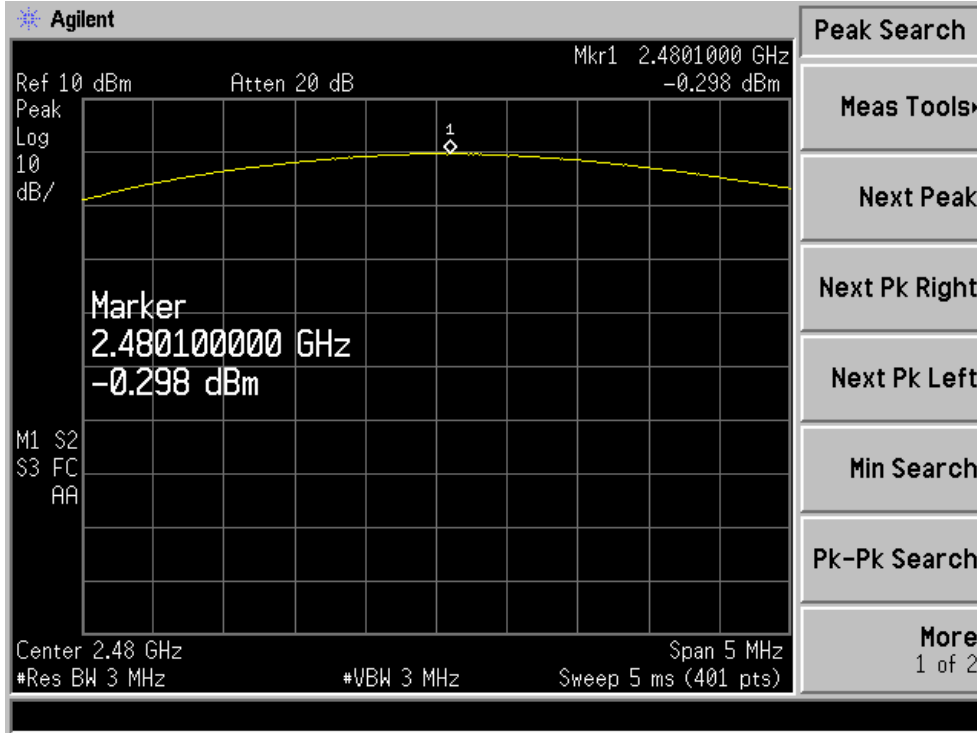
op-mode 6:



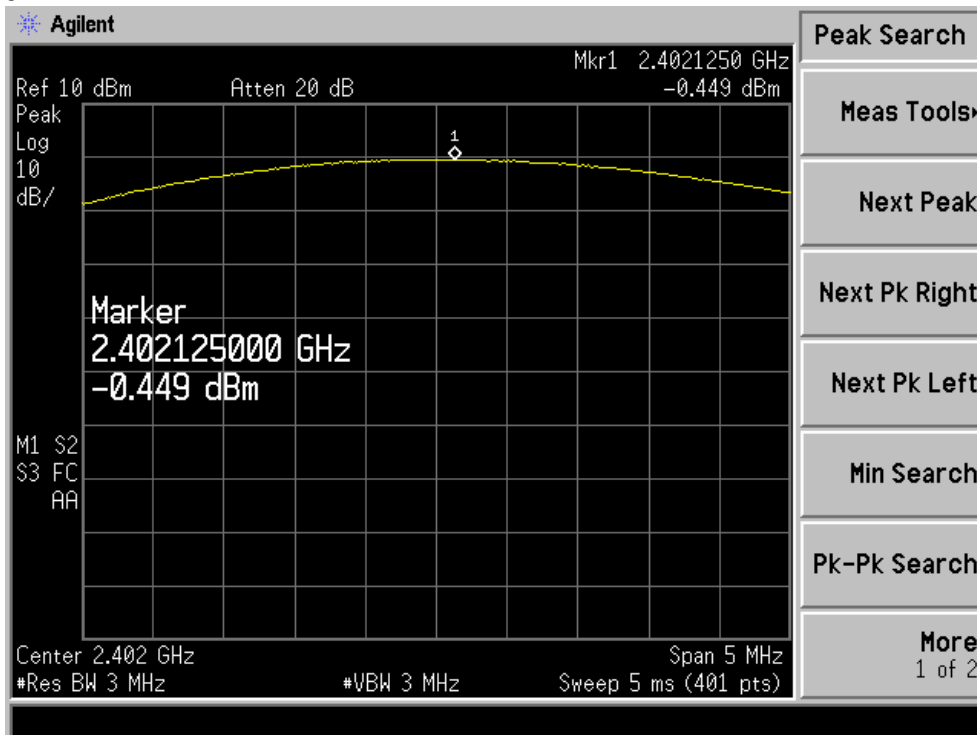
op-mode 7:



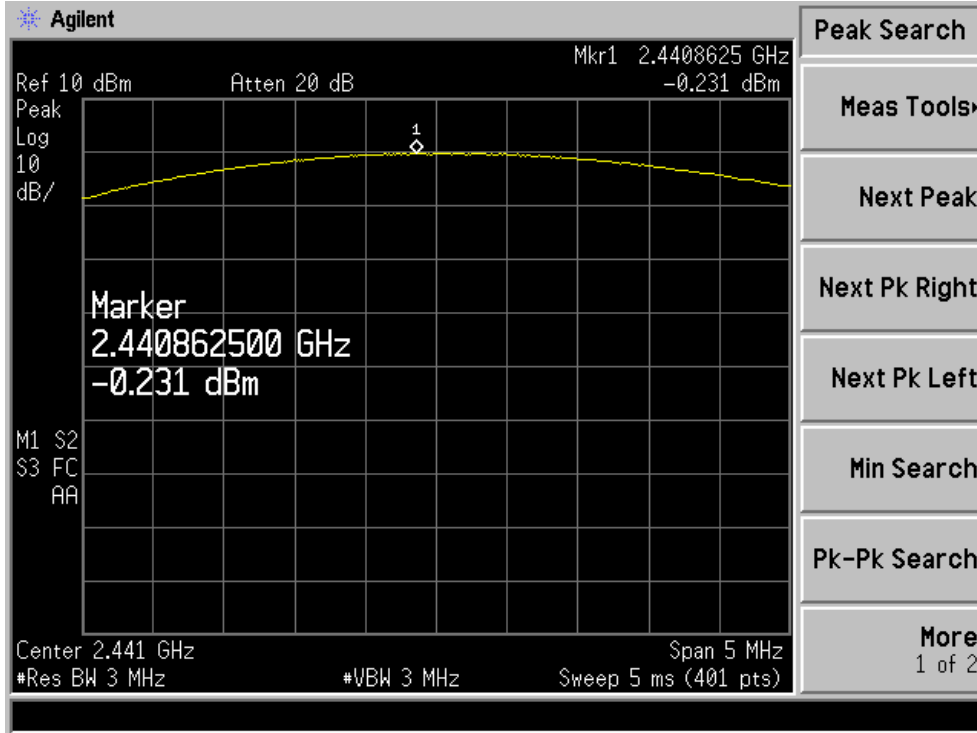
op-mode 8:



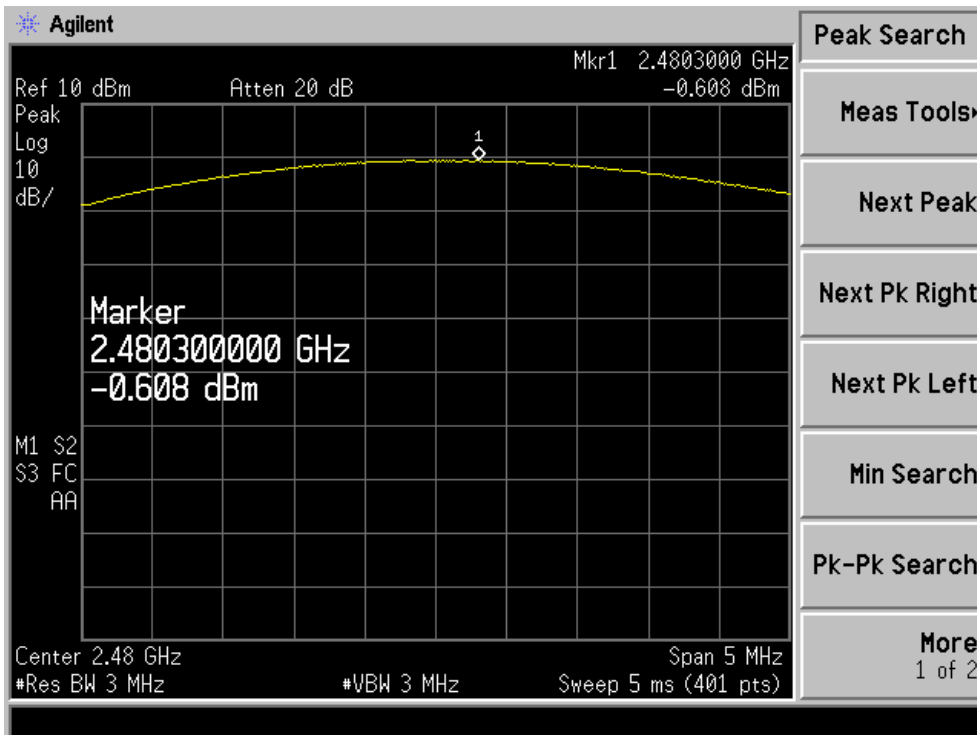
op-mode 10:



op-mode 11:



op-mode 12:



## **11. Band EDGE test**

### **11.1 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.

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

Same as 5.2 Radiated Emission Set-up.

### **11.3 Measurement Equipment Used:**

Same as 5.3 Radiated Emission Measurement.

### 11.4 Measurement Results:

Refer to attached data chart.

Spectrum Detector: PK                      Test Date :                      December 19, 2012  
 Test By: Andy                              Temperature :                      25 °C  
 Test Result: PASS                          Humidity :                          50 %

#### 1. Conducted Test

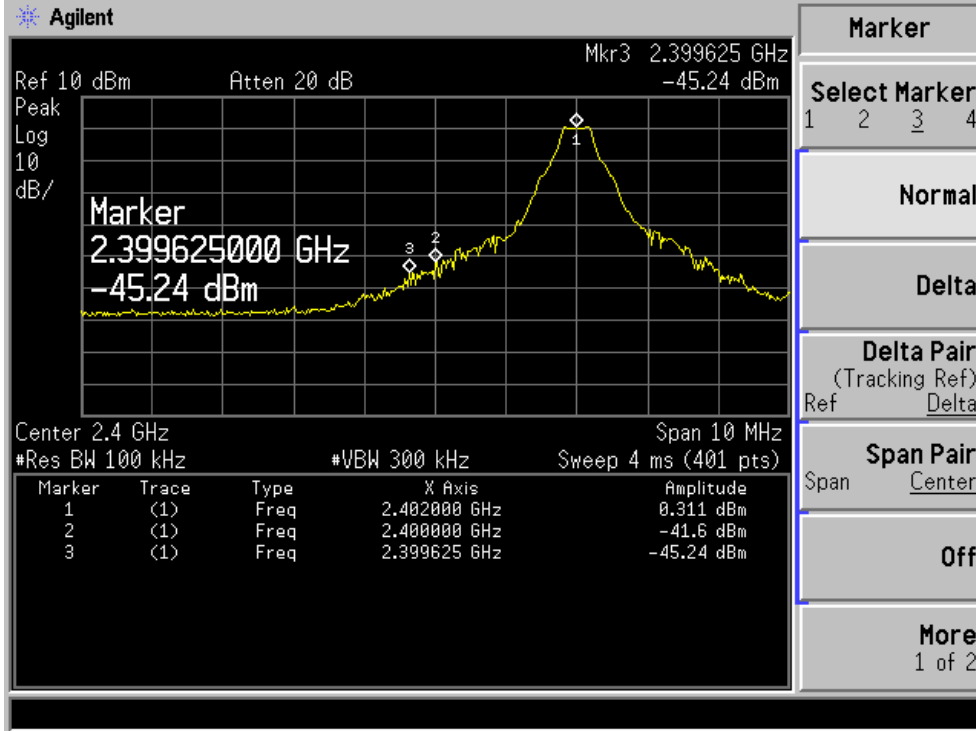
| Frequency (MHz) | Operating Mode | Peak Power Output(dBm) | Emission read Value(dBm) | Result of Band edge(dBc) | Band edge Limit(dBc) |
|-----------------|----------------|------------------------|--------------------------|--------------------------|----------------------|
| <2400           | op-mode 1      | 0.31                   | -45.24                   | 45.55                    | >20dBc               |
|                 | op-mode 6      | -1.27                  | -50.03                   | 48.76                    | >20dBc               |
|                 | op-mode 10     | -1.30                  | -49.21                   | 47.91                    | >20dBc               |
| >2483.5         | op-mode 3      | 0.24                   | -57.20                   | 57.44                    | >20dBc               |
|                 | op-mode 8      | -2.06                  | -57.59                   | 55.53                    | >20dBc               |
|                 | op-mode 12     | -1.48                  | -57.14                   | 55.66                    | >20dBc               |

#### 2. Radiated emission Test

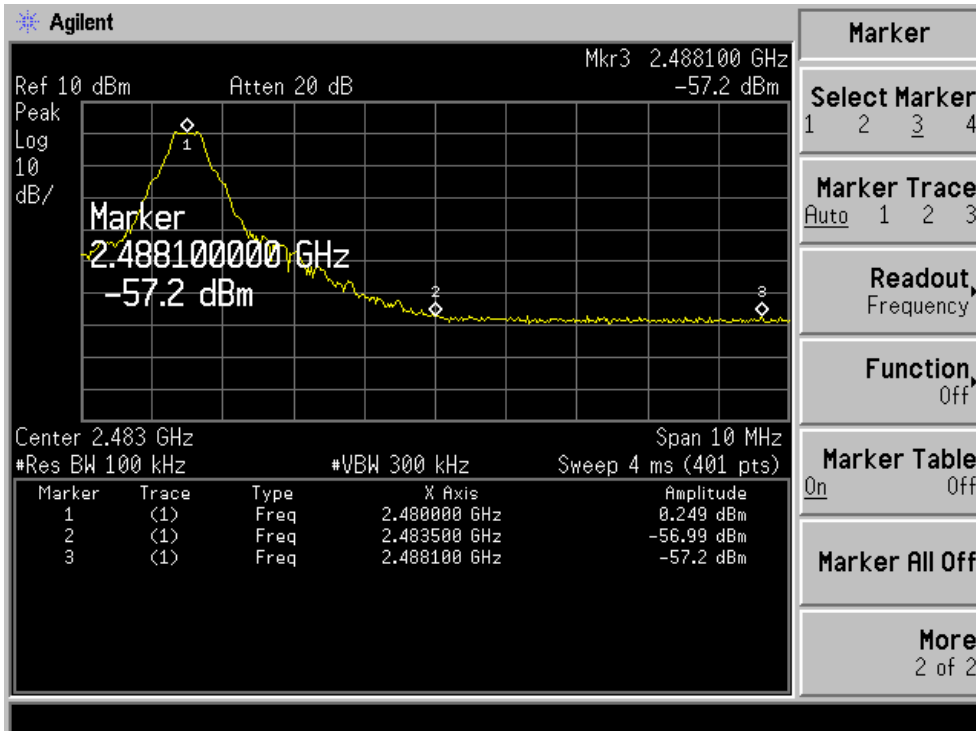
| Frequency (MHz) | Operating Mode | Antenna polarization (H/V) | Emission (dBuV/m) |       | Band edge Limit (dBuV/m) |       |
|-----------------|----------------|----------------------------|-------------------|-------|--------------------------|-------|
|                 |                |                            | PK                | AV    | PK                       | AV    |
| <2400           | op-mode 1      | V                          | 52.10             | 38.29 | 74.00                    | 54.00 |
|                 | op-mode 6      | V                          | 55.02             | 31.36 | 74.00                    | 54.00 |
|                 | op-mode 10     | V                          | 42.34             | 37.22 | 74.00                    | 54.00 |
| >2483.5         | op-mode 3      | V                          | 48.28             | 33.47 | 74.00                    | 54.00 |
|                 | op-mode 8      | V                          | 43.95             | 36.15 | 74.00                    | 54.00 |
|                 | op-mode 12     | V                          | 44.52             | 37.31 | 74.00                    | 54.00 |

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

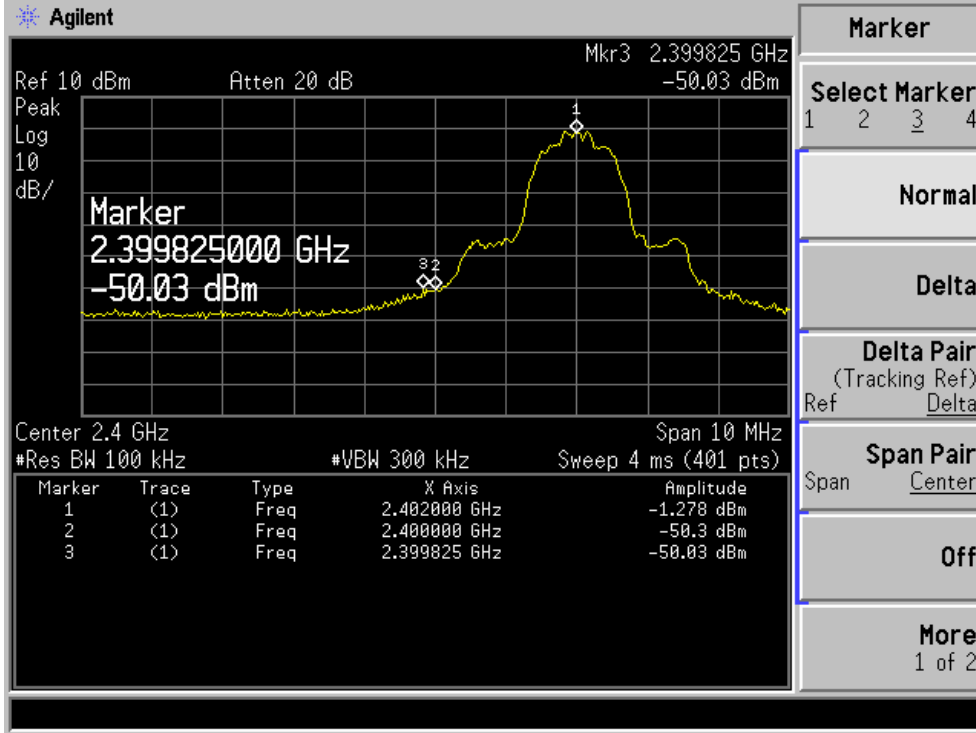
op-mode 1:



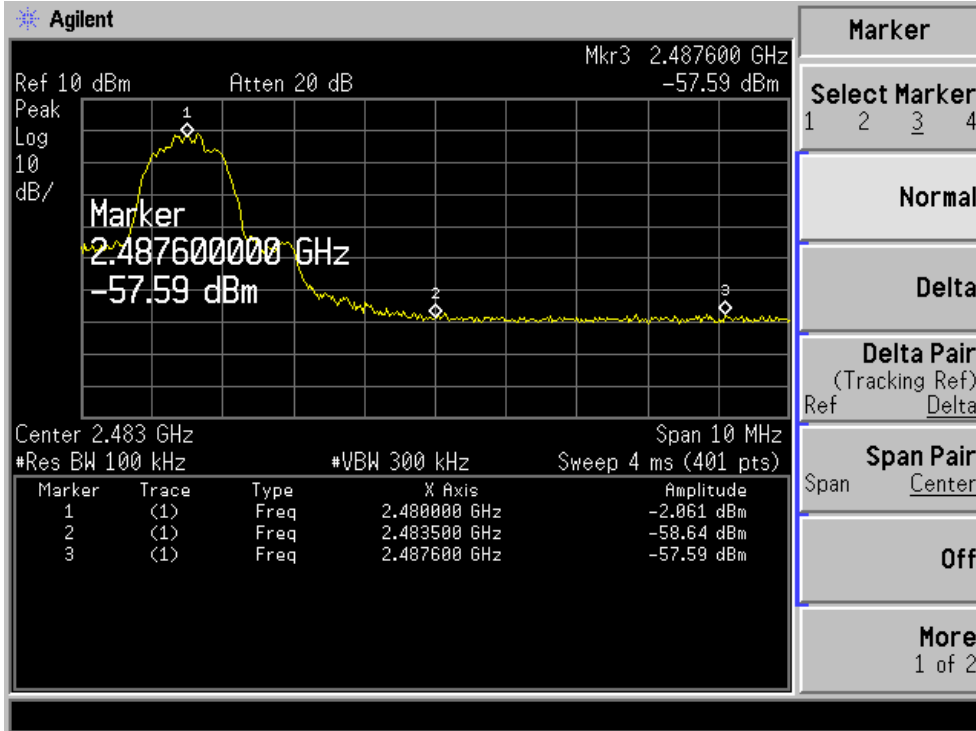
op-mode 3:



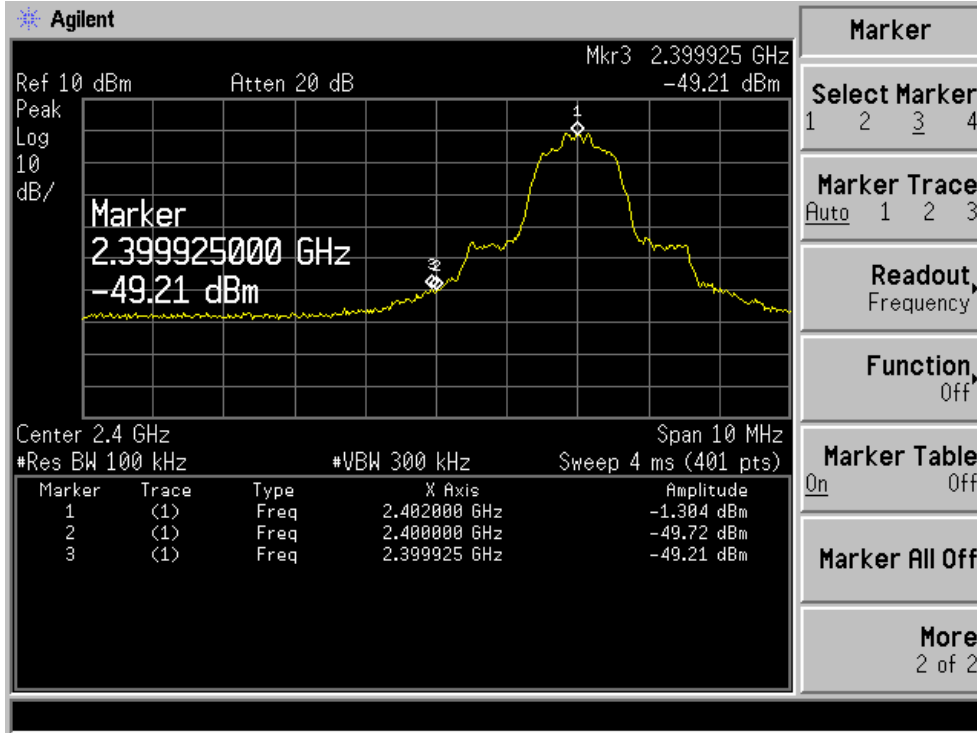
op-mode 6:



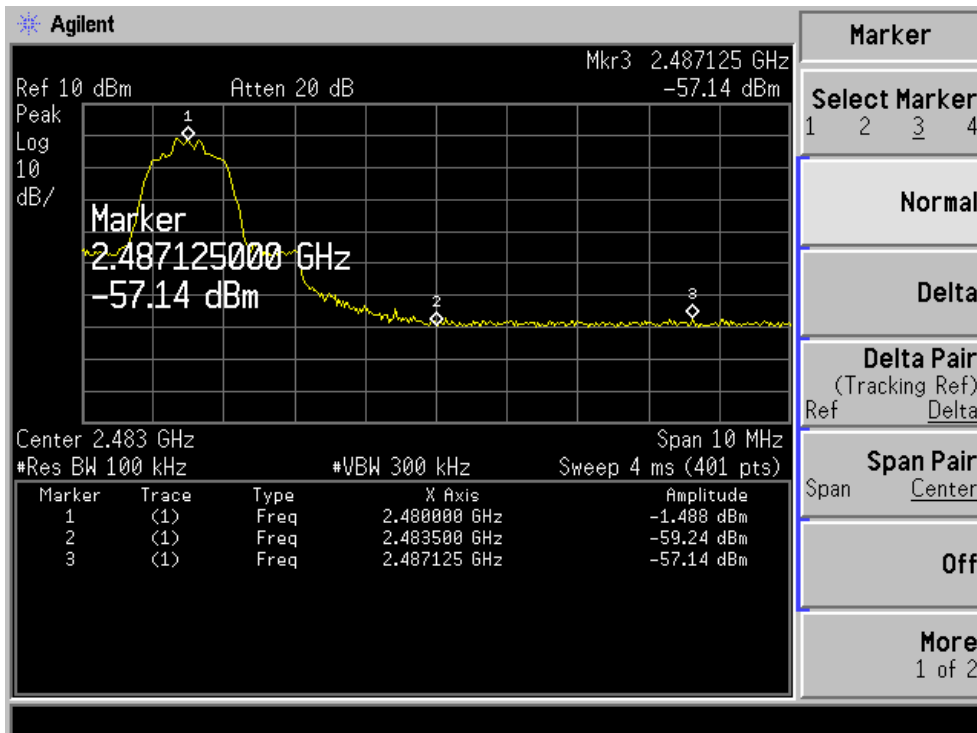
op-mode 8:



op-mode 10:



op-mode 12:





## **12. Antenna Application**

### **12.1 Antenna requirement**

The EUT'S antenna is met the requirement of FCC part 15C section 15.203 and 15.247.

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.

### **12.2 Result**

The EUT's antenna used a chip antenna and integrated on PCB, The antenna's gain is 4dBi and meets the requirement.

### 13. 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>         |                              |                              |                                    |              |
| 300-1500   | --                           | --                           | F/300                              | 6            |
| 1500-100000  | --                           | --                           | 5                                  | 6            |
| <b>(B) Limits for General Population/Uncontrol Exposures</b> |                              |                              |                                    |              |
| 300-1500   | --                           | --                           | F/1500                             | 6            |
| 1500-100000  | --                           | --                           | 1                                  | 30           |

#### 13.1 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.

#### 13.2 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                    | 1.346                  | 4                  | 4.25E-04                                     | 1  |
| op-mode 2      | 2441                    | <b>1.422</b>           | 4                  | 4.49E-04                                     | 1  |
| op-mode 3      | 2480                    | 1.337                  | 4                  | 4.22E-04                                     | 1  |
| op-mode 6      | 2402                    | 0.902                  | 4                  | 2.85E-04                                     | 1  |
| op-mode 7      | 2441                    | 0.948                  | 4                  | 2.99E-04                                     | 1  |
| op-mode 8      | 2480                    | 0.869                  | 4                  | 2.74E-04                                     | 1  |
| op-mode 10     | 2402                    | 0.966                  | 4                  | 3.05E-04                                     | 1  |
| op-mode 11     | 2441                    | 0.998                  | 4                  | 3.15E-04                                     | 1  |
| op-mode 12     | 2480                    | 0.934                  | 4                  | 2.95E-04                                     | 1  |

# APPENDIX I (Photos of EUT)

## General Appearance of the EUT

