

## 6. Band Edge

### 6.1. Test Equipment

#### RF Conducted Measurement

The following test equipments are used during the band edge tests:

Equipment	Manufacturer	Model No./Serial No.	Last Cal.
Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2010
Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2010
X Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2011

#### RF Radiated Measurement:

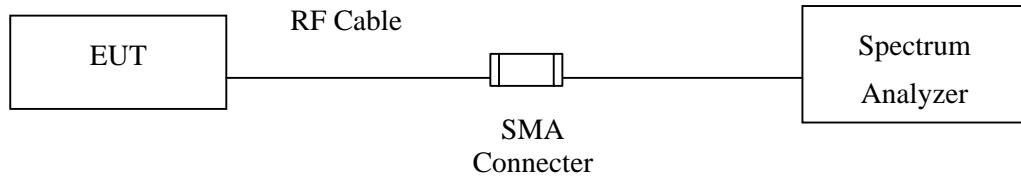
The following test equipments are used during the band edge tests:

Test Site	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
☒Site # 3	Bilog Antenna	Schaffner Chase	CBL6112B/2673	Sep., 2010
	X Horn Antenna	Schwarzbeck	BBHA9120D/D305	Sep., 2010
	Horn Antenna	Schwarzbeck	BBHA9170/208	Jul., 2010
	X Pre-Amplifier	Agilent	8447D/2944A09549	Sep., 2010
	X Spectrum Analyzer	Agilent	E4407B / US39440758	May, 2011
	Test Receiver	R & S	ESCS 30/ 825442/018	Sep., 2010
	X Coaxial Cable	QuieTek	QTK-CABLE/ CAB5	Feb., 2011
	X Controller	QuieTek	QTK-CONTROLLER/ CTRL3	N/A
	X Coaxial Switch	Anritsu	MP59B/6200265729	N/A

Note: 1. All equipments are calibrated every one year.  
 2. The test instruments marked by "X" are used to measure the final test results.

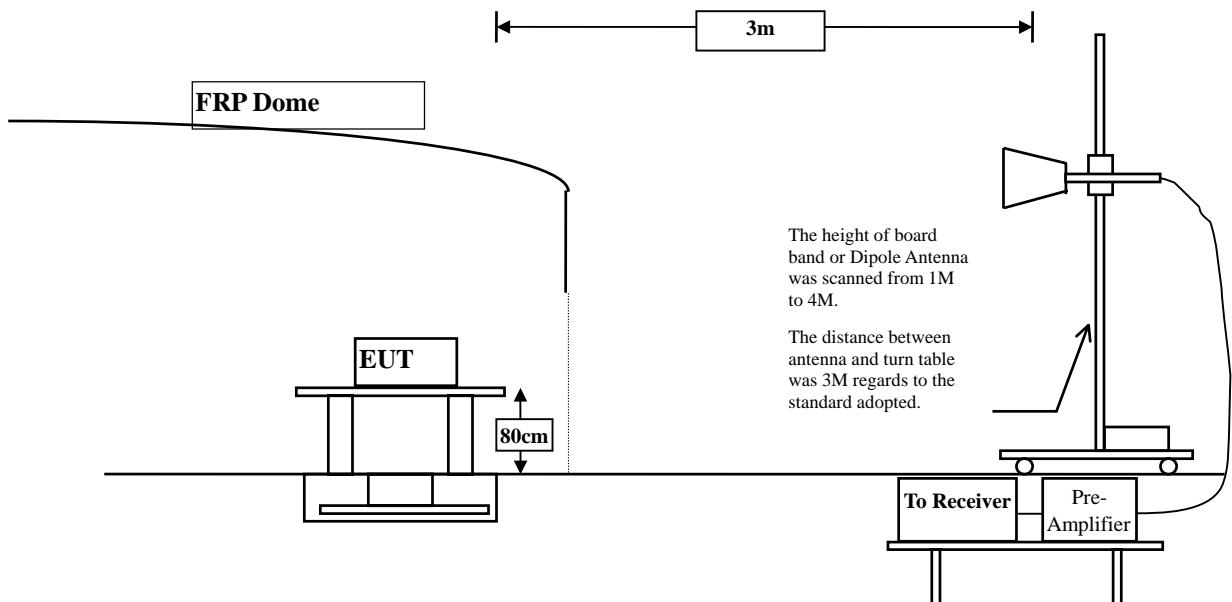
## 6.2. Test Setup

### RF Conducted Measurement



### RF Radiated Measurement:

Above 1GHz



### **6.3. Limit**

In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. 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) (see Section 15.205(c)).

### **6.4. Test Procedure**

The EUT and its simulators are placed on a turn table which is 0.8 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.4:2009 on radiated measurement.

The bandwidth below 1GHz setting on the field strength meter is 120 kHz, above 1GHz are 1 MHz. The EUT was setup to ANSI C63.4, 2009; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

### **6.5. Uncertainty**

± 3.9 dB above 1GHz

± 3.8 dB below 1GHz

## 6.6. Test Result of Band Edge

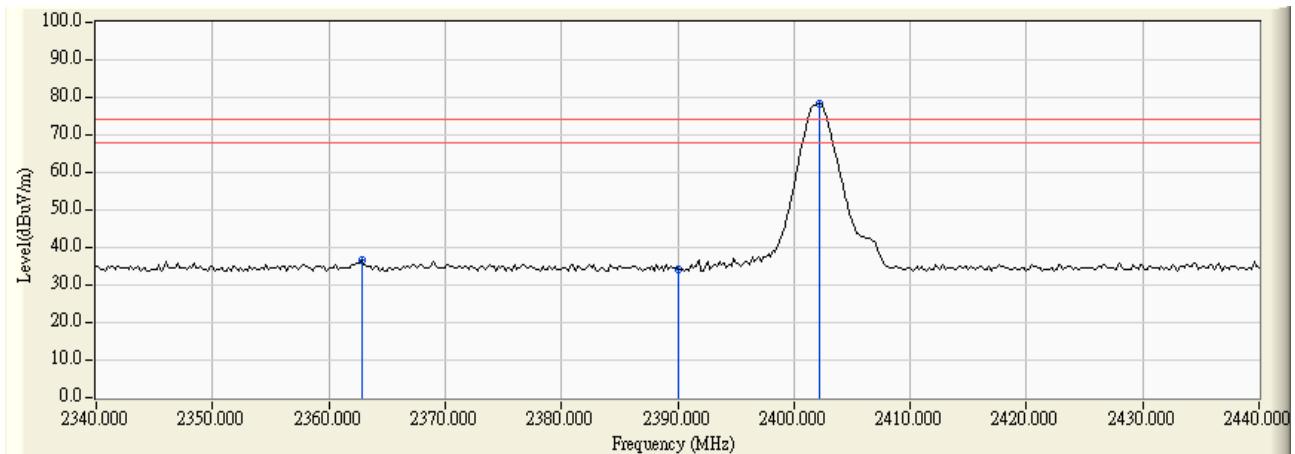
Product : IPC  
Test Item : Band Edge  
Test Site : No.3 OATS  
Test Mode : Mode 1: Transmit - 1Mbps (GFSK) (2402MHz)

### RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
00 (Peak)	2362.800	-1.238	37.970	36.732	74.000	54.00	Pass
00 (Peak)	2390.000	-1.131	35.487	34.356	74.000	54.00	Pass
00 (Peak)	2402.200	-1.072	79.221	78.150	--	--	Pass

Figure Channel 00:

Horizontal (Peak)

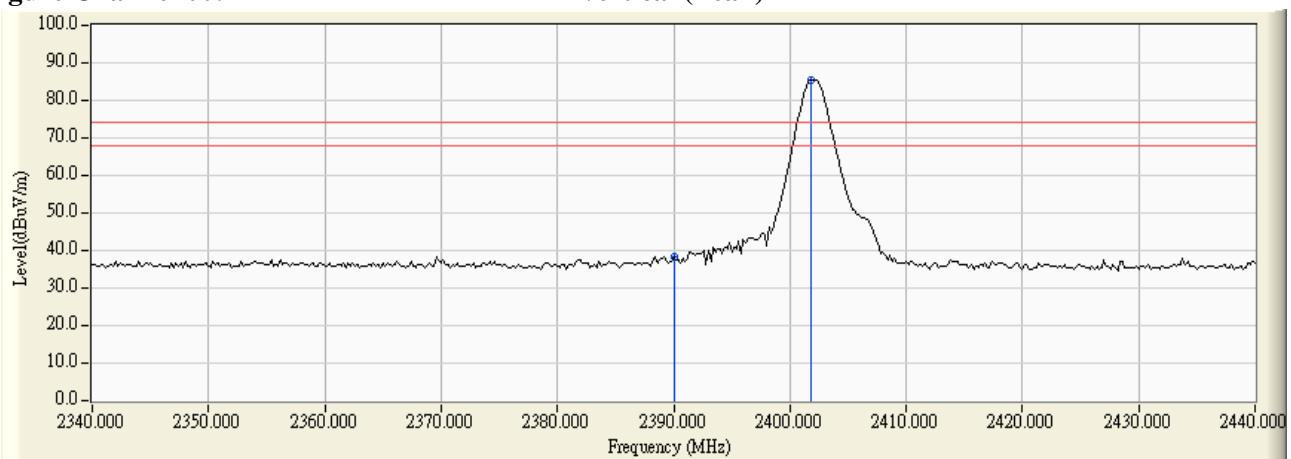


Note: RBW=1MHz, VBW=1MHz, Sweep=500ms

Product : IPC  
Test Item : Band Edge  
Test Site : No.3 OATS  
Test Mode : Mode 1: Transmit - 1Mbps (GFSK) (2402MHz)

**RF Radiated Measurement (Vertical):**

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
00 (Peak)	2390.000	-1.725	40.128	38.403	74.00	54.00	Pass
00 (Peak)	2401.800	-1.729	87.233	85.504	--	--	Pass

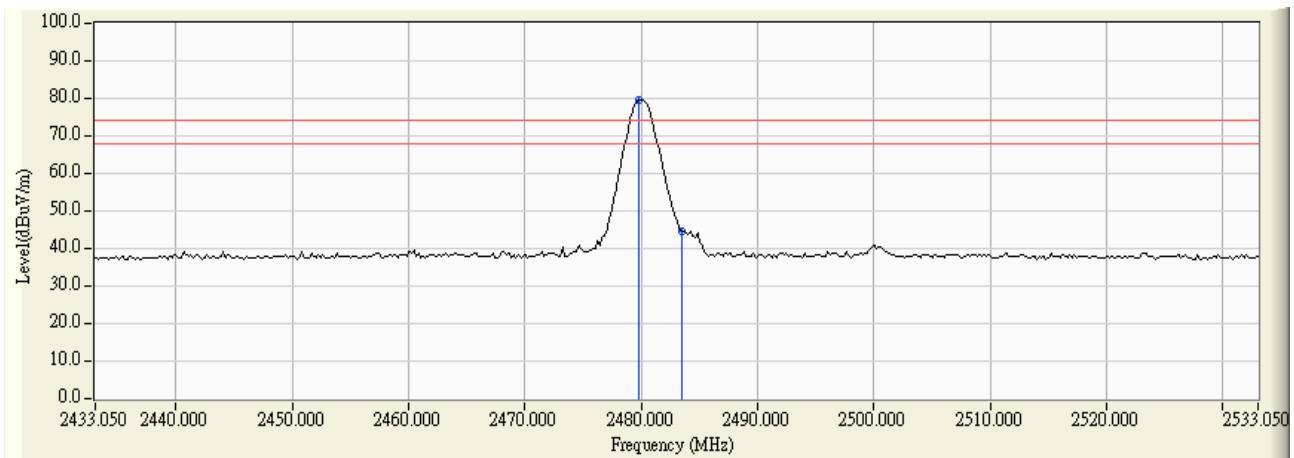
**Figure Channel 00:****Vertical (Peak)**

Note: RBW=1MHz, VBW=1MHz, Sweep=500ms

Product : IPC  
Test Item : Band Edge  
Test Site : No.3 OATS  
Test Mode : Mode 1: Transmit - 1Mbps (GFSK) (2480MHz)

**RF Radiated Measurement (Horizontal):**

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
78 (Peak)	2479.850	-0.581	79.980	79.399	--	--	Pass
78 (Peak)	2483.500	-0.558	45.249	44.691	74.00	54.00	Pass

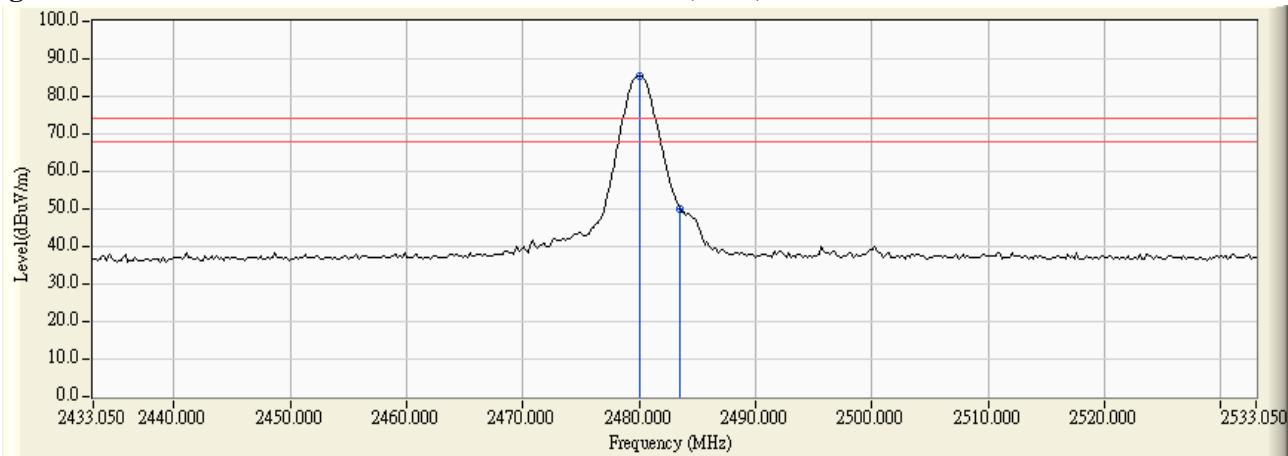
**Figure Channel 78:****Horizontal (Peak)**

Note: RBW=1MHz, VBW=1MHz, Sweep=500ms

Product : IPC  
Test Item : Band Edge  
Test Site : No.3 OATS  
Test Mode : Mode 1: Transmit - 1Mbps (GFSK) (2480MHz)

**RF Radiated Measurement (Vertical):**

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
78 (Peak)	2480.050	-1.324	86.619	85.295	--	--	Pass
78 (Peak)	2483.500	-1.305	51.464	50.159	74.00	54.00	Pass

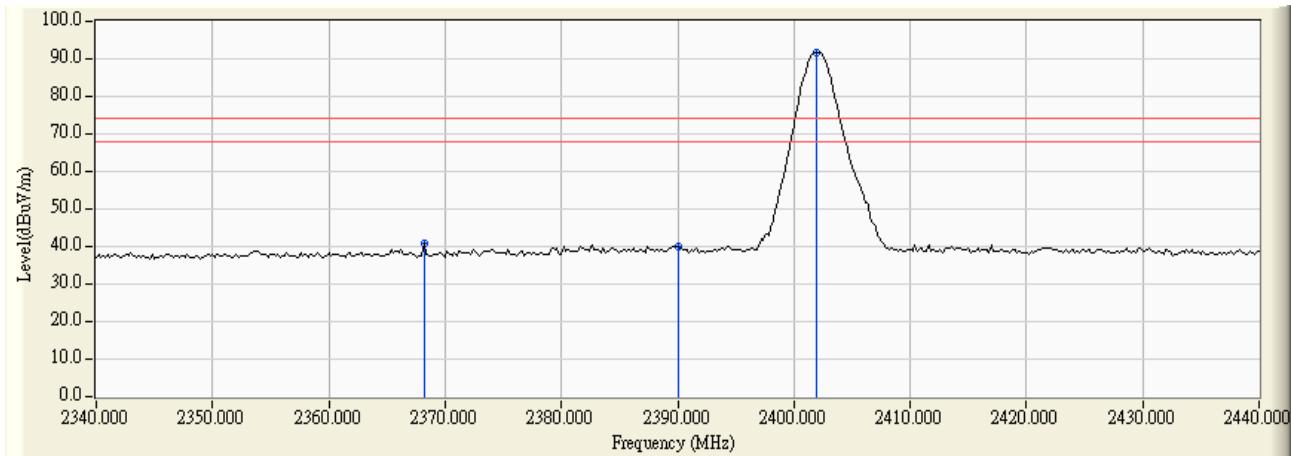
**Figure Channel 78:****Vertical (Peak)**

Note: RBW=1MHz, VBW=1MHz, Sweep=500ms

Product : IPC  
Test Item : Band Edge  
Test Site : No.3 OATS  
Test Mode : Mode 2: Transmit - 3Mbps (8DPSK) (2402MHz)

**RF Radiated Measurement (Horizontal):**

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
00 (Peak)	2368.200	-1.216	42.112	40.896	74.00	54.00	Pass
00 (Peak)	2390.000	-1.131	41.123	39.992	74.00	54.00	Pass
00 (Peak)	2402.000	-1.073	92.877	91.805	--	--	Pass

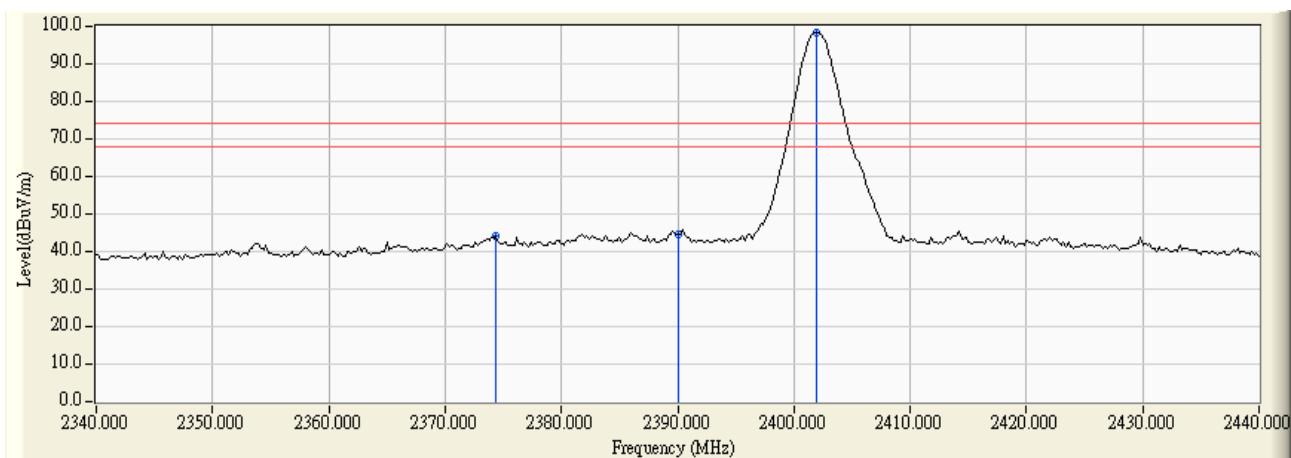
**Figure Channel 00:****Horizontal (Peak)**

Note: RBW=1MHz, VBW=1MHz, Sweep=500ms

Product : IPC  
 Test Item : Band Edge  
 Test Site : No.3 OATS  
 Test Mode : Mode 2: Transmit - 3Mbps (8DPSK) (2402MHz)

**RF Radiated Measurement (Vertical):**

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
00 (Peak)	2374.400	-1.652	45.957	44.305	74.00	54.00	Pass
00 (Peak)	2390.000	-1.725	46.102	44.377	74.00	54.00	Pass
00 (Peak)	2402.000	-1.729	100.052	98.323	--	--	Pass

**Figure Channel 00:**
**Vertical (Peak)**


Note: RBW=1MHz, VBW=1MHz, Sweep=500ms

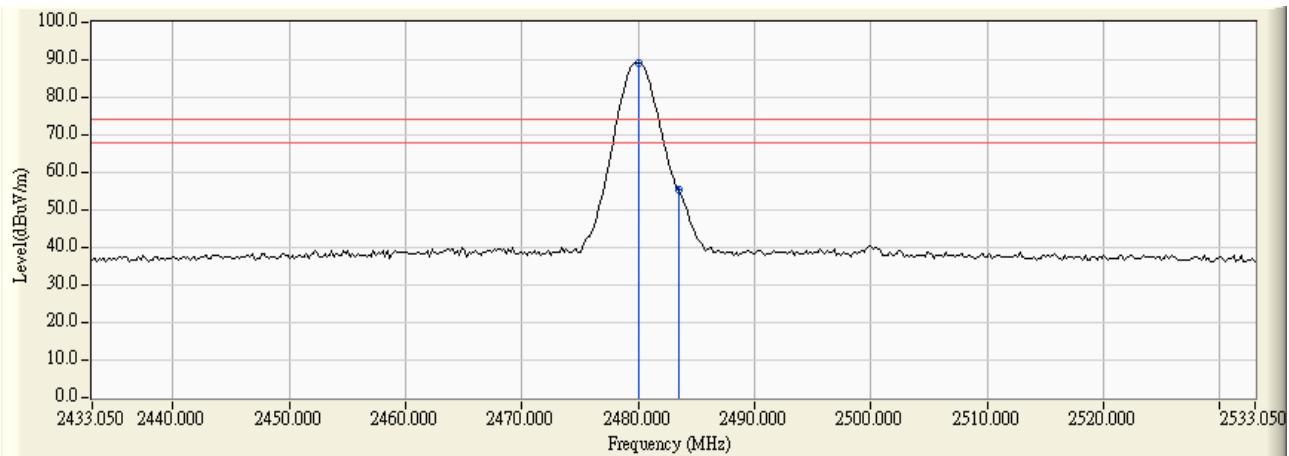
Product : IPC  
 Test Item : Band Edge  
 Test Site : No.3 OATS  
 Test Mode : Mode 2: Transmit - 3Mbps (8DPSK) (2480MHz)

**RF Radiated Measurement (Horizontal):**

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
78 (Peak)	2480.050	-0.580	89.828	89.248	--	--	Pass
78 (Peak)	2483.500	-0.558	55.829	55.271	74.00	54.00	Pass
78 (Average)	2483.500	-0.558	43.994	43.436	74.00	54.00	Pass

**Figure Channel 78:**

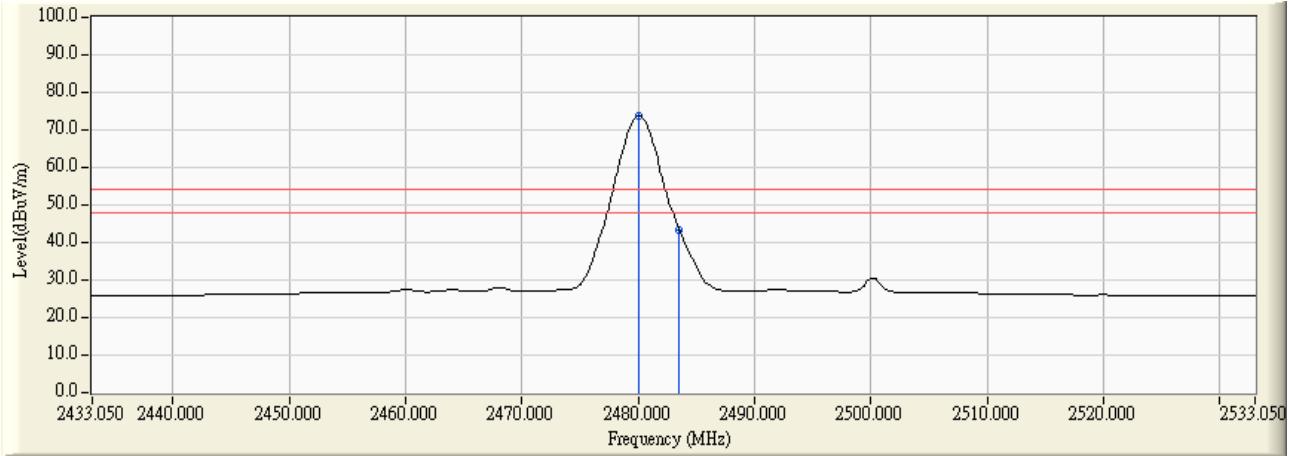
**Horizontal (Peak)**



Note: RBW=1MHz, VBW=1MHz, Sweep=500ms

**Figure Channel 78:**

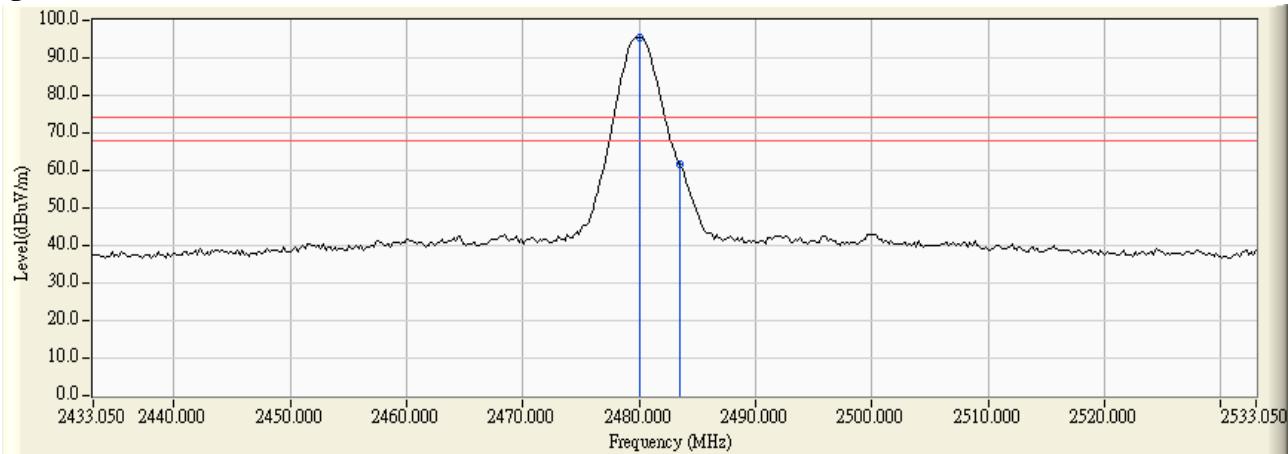
**Horizontal (Average)**



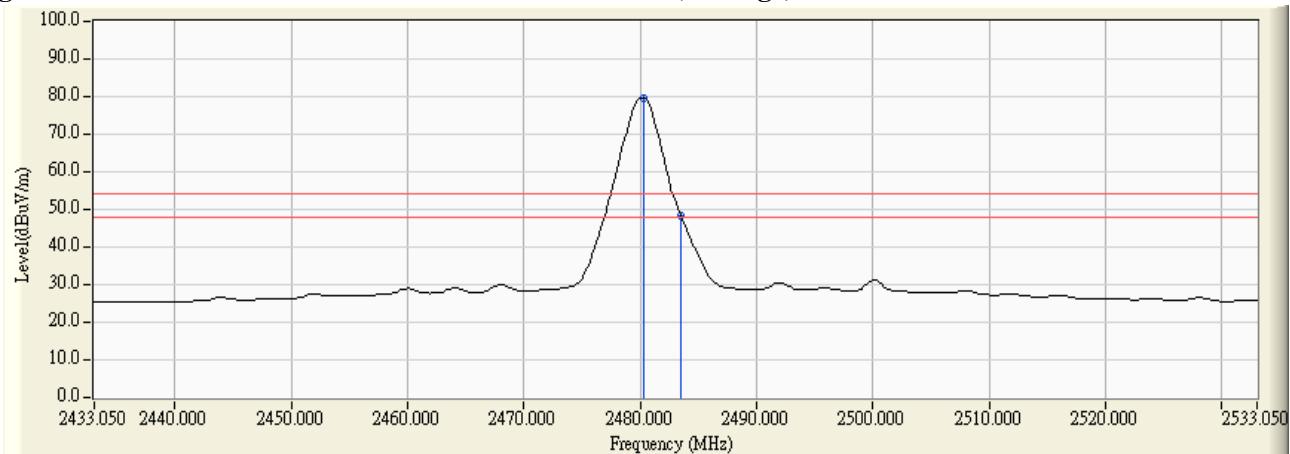
Product : IPC  
 Test Item : Band Edge  
 Test Site : No.3 OATS  
 Test Mode : Mode 2: Transmit - 3Mbps (8DPSK) (2480MHz)

**RF Radiated Measurement (Vertical):**

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
78 (Peak)	2480.050	-1.324	96.929	95.605	--	--	Pass
78 (Peak)	2483.500	-1.305	62.871	61.566	74.00	54.00	Pass
78 (Average)	2483.500	-1.305	49.709	48.404	74.00	54.00	Pass

**Figure Channel 78:**
**Vertical (Peak)**


Note: RBW=1MHz, VBW=1MHz, Sweep=500ms

**Figure Channel 78:**
**Vertical (Average)**


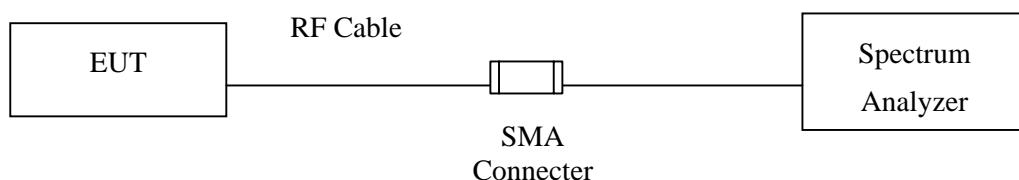
## 7. Channel Number

### 7.1. Test Equipment

Equipment	Manufacturer	Model No./Serial No.	Last Cal.
Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2010
Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2010
X Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2010

Note: 1. All equipments are calibrated every one year.  
2. The test instruments marked by "X" are used to measure the final test results.

### 7.2. Test Setup



### 7.3. Limit

Frequency hopping systems operating in the 2400-2483.5 MHz bands shall use at least 15 hopping frequencies.

### 7.4. Test Procedure

The EUT was setup to ANSI C63.4, 2009; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

### 7.5. Uncertainty

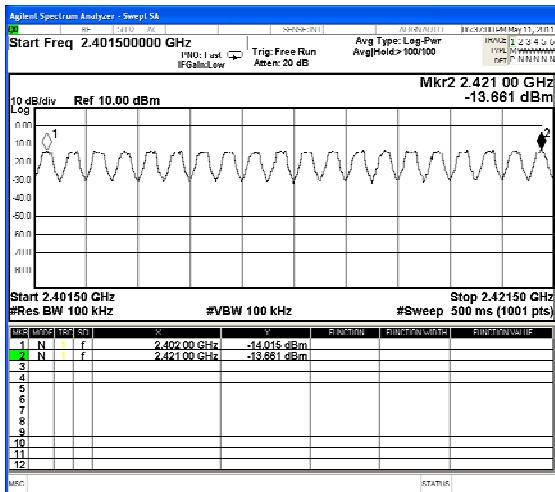
N/A

## 7.6. Test Result of Channel Number

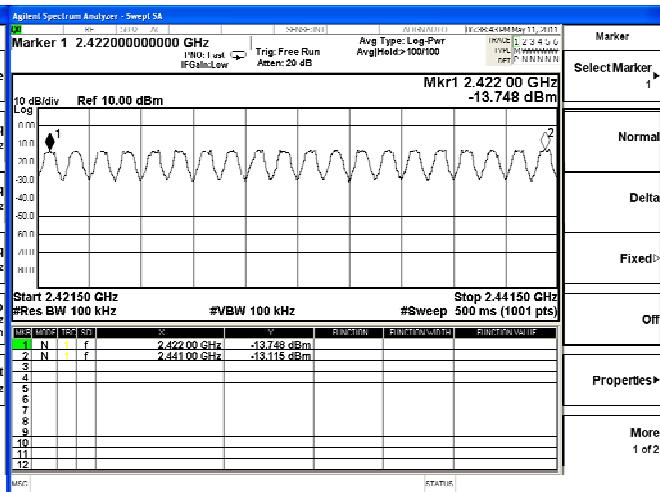
Product : IPC  
Test Item : Channel Number  
Test Site : No.3 OATS  
Test Mode : Mode 1: Transmit - 1Mbps (GFSK)

Frequency Range (MHz)	Measurement (Hopping Channel)	Required Limit (Hopping Channel)	Result
2402 ~ 2480	79	>15	Pass

**2402-2421MHz**

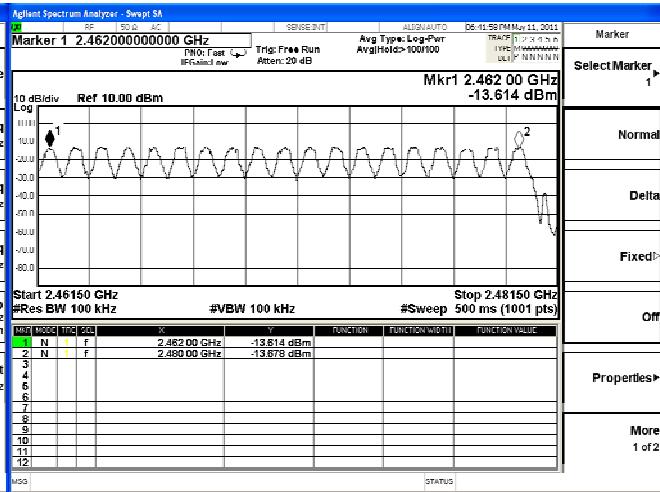
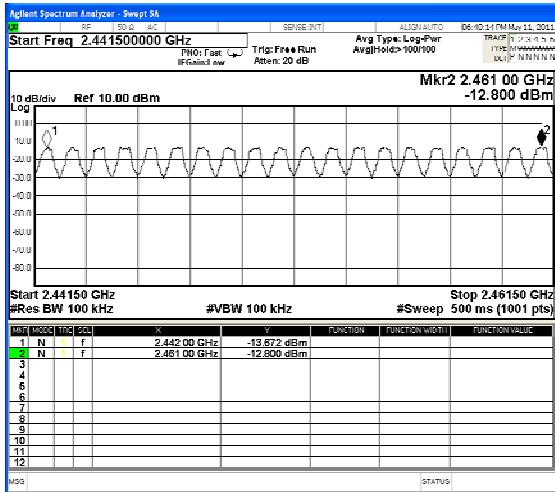


2422-2441MHz



**2442-2461MHz**

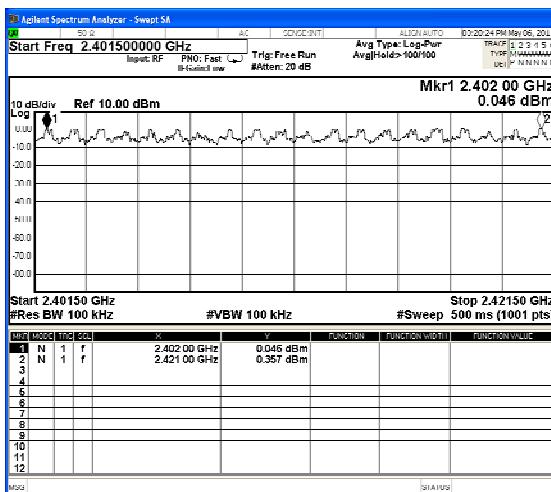
2462-2480MHz



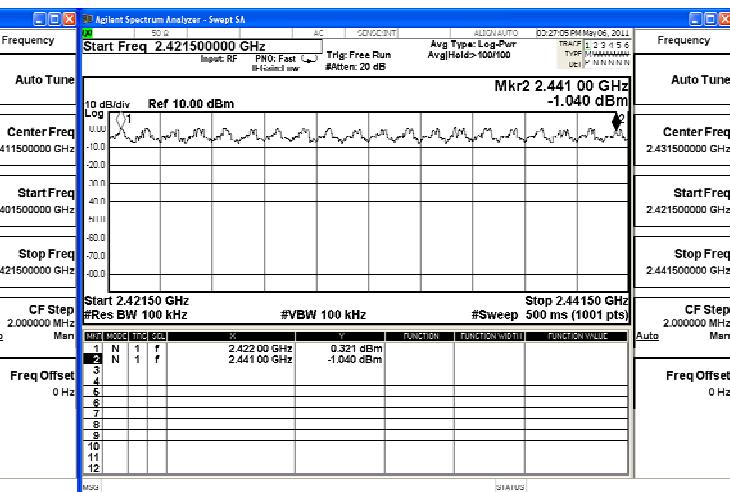
Product : IPC  
 Test Item : Channel Number  
 Test Site : No.3 OATS  
 Test Mode : Mode 2: Transmit - 3Mbps (8DPSK)

Frequency Range (MHz)	Measurement (Hopping Channel)	Required Limit (Hopping Channel)	Result
2402 ~ 2480	79	>15	Pass

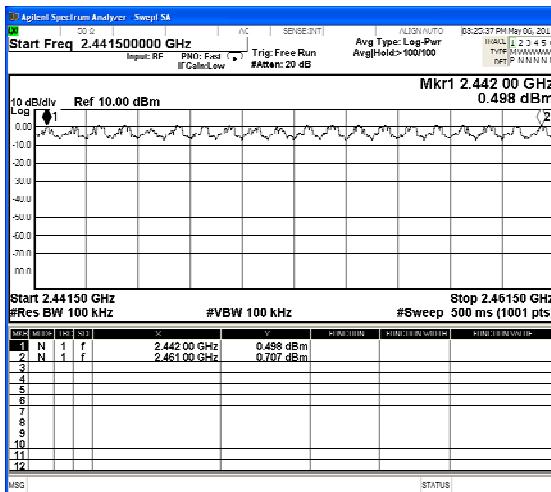
### 2402-2421MHz



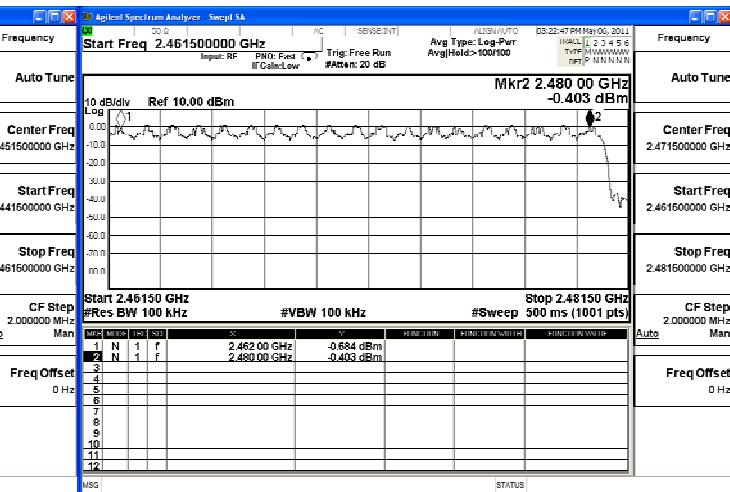
### 2422-2441MHz



### 2442-2461MHz



### 2462-2480MHz



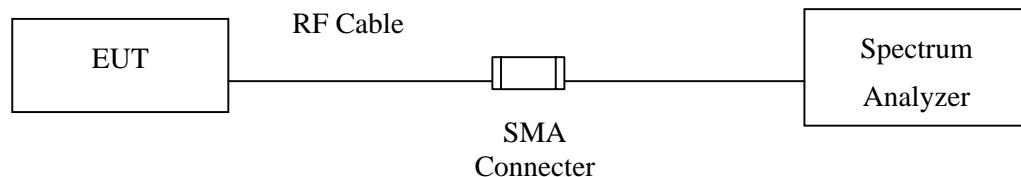
## 8. Channel Separation

### 8.1. Test Equipment

Equipment	Manufacturer	Model No./Serial No.	Last Cal.
Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2010
Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2010
X Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2011

Note: 1. All equipments are calibrated every one year.  
2. The test instruments mark by “X” are used to measure the final test results.

### 8.2. Test Setup



### 8.3. Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

### 8.4. Test Procedure

The EUT was setup to ANSI C63.4, 2009; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

### 8.5. Uncertainty

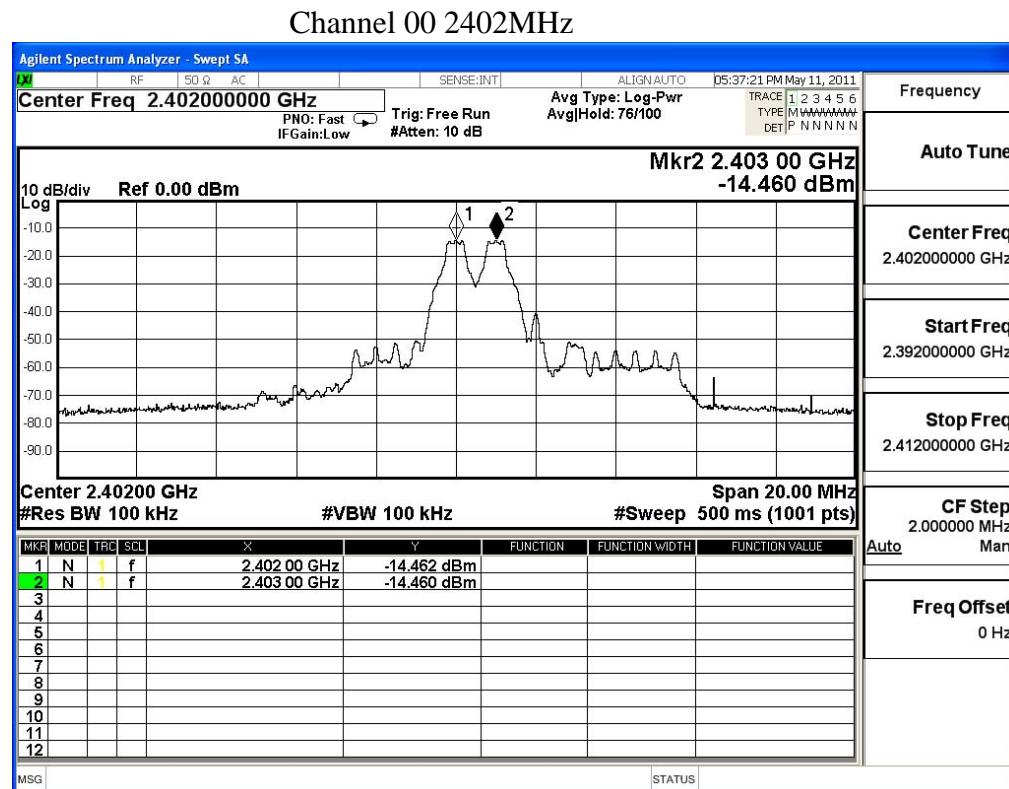
± 150Hz

## 8.6. Test Result of Channel Separation

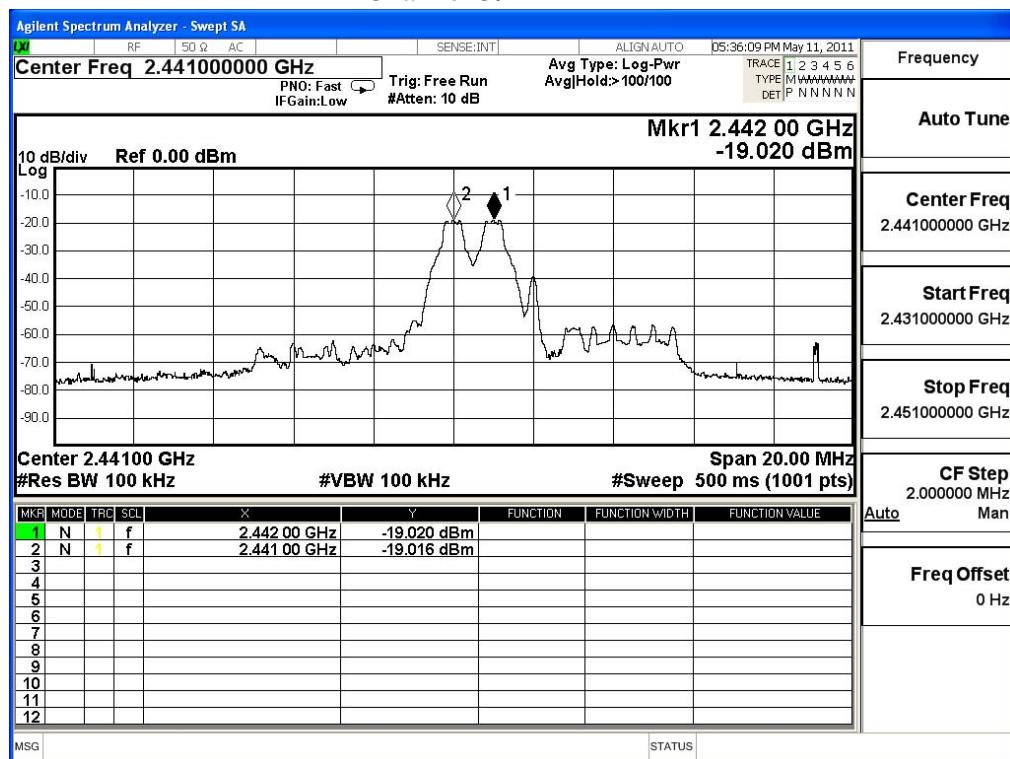
Product : IPC  
 Test Item : Channel Separation  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit - 1Mbps (GFSK)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Limit (kHz)	Limit of (2/3)*20dB Bandwidth (kHz)	Result
00	2402	1000	>25 kHz	753.3	Pass
39	2441	1000	>25 kHz	760.0	Pass
78	2480	1000	>25 kHz	760.0	Pass

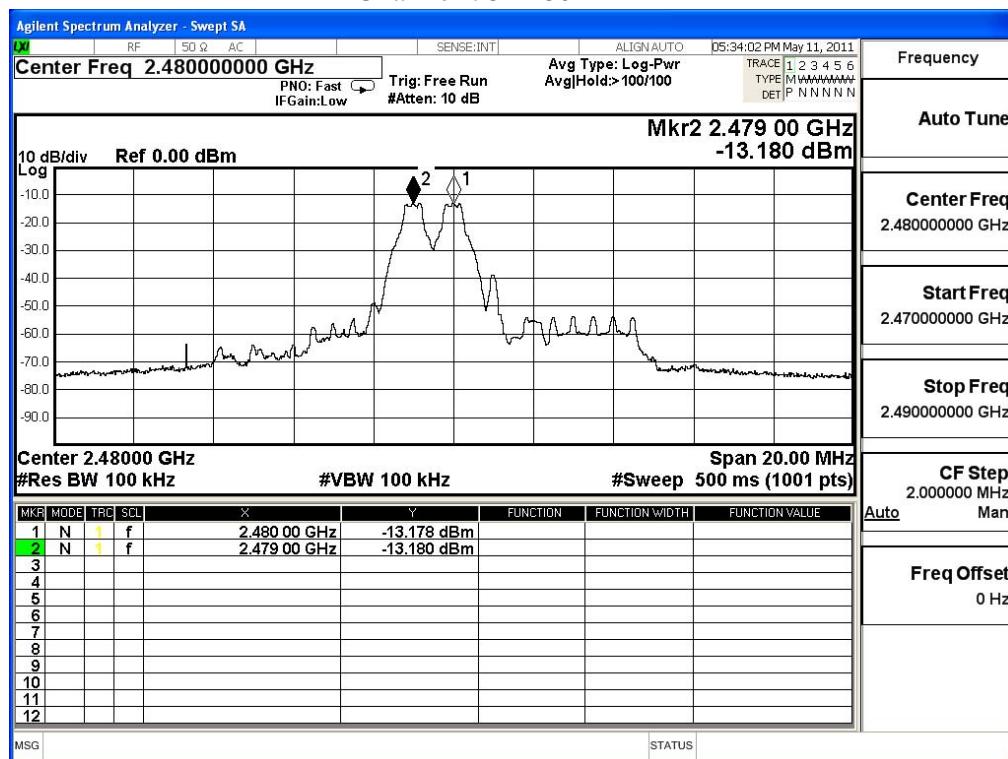
NOTE: The 20dB Bandwidth is refer to section 10.



### Channel 39 2441MHz



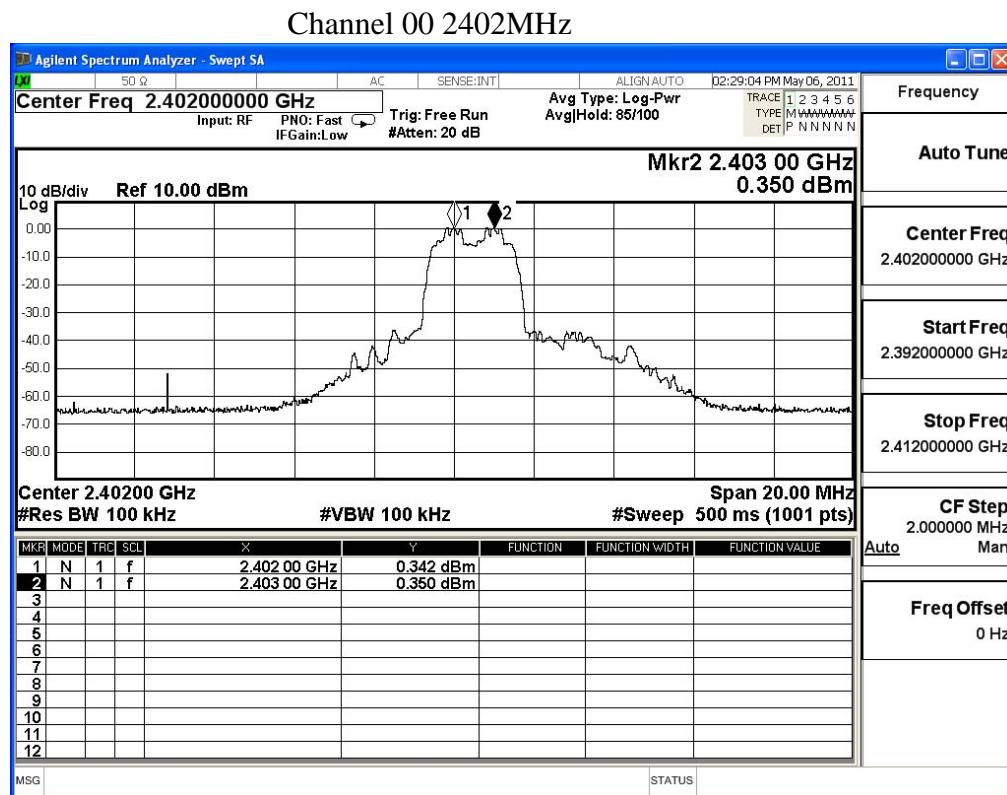
### Channel 78 2480 MHz



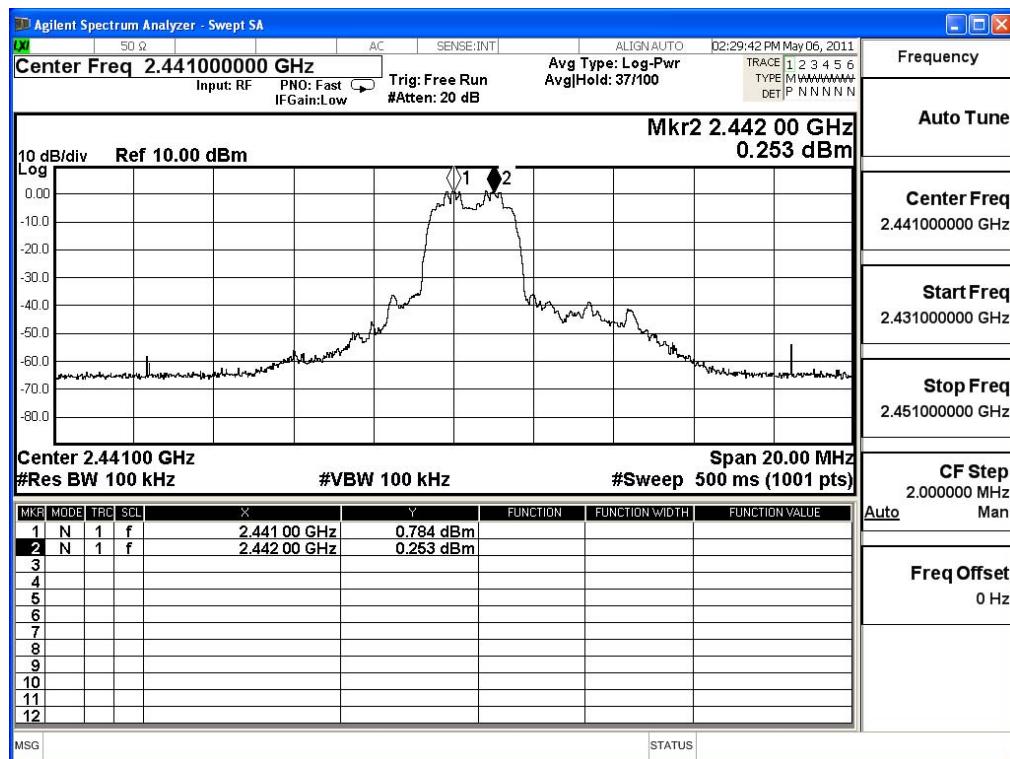
Product : IPC  
 Test Item : Channel Separation  
 Test Site : No.3 OATS  
 Test Mode : Mode 2: Transmit - 3Mbps (8DPSK)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Limit (kHz)	Limit of (2/3)*20dB Bandwidth (kHz)	Result
00	2402	1000	>25 kHz	926.7	Pass
39	2441	1000	>25 kHz	926.7	Pass
78	2480	1000	>25 kHz	926.7	Pass

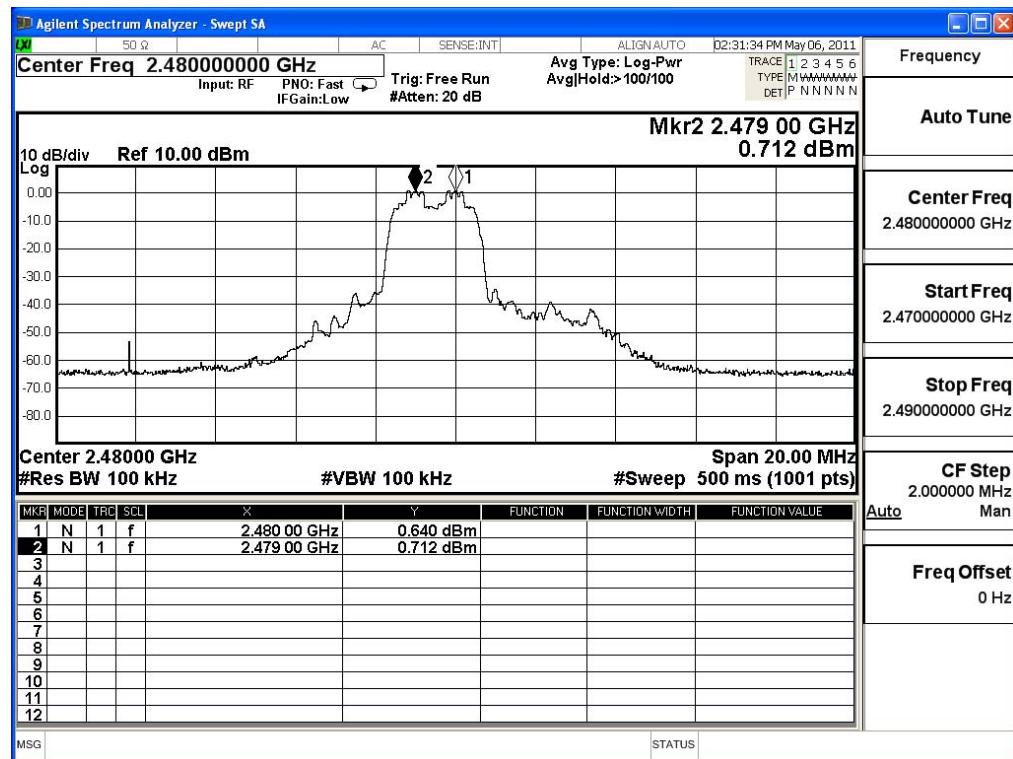
NOTE: The 20dB Bandwidth is refer to section 10.



### Channel 39 2441MHz



### Channel 78 2480 MHz



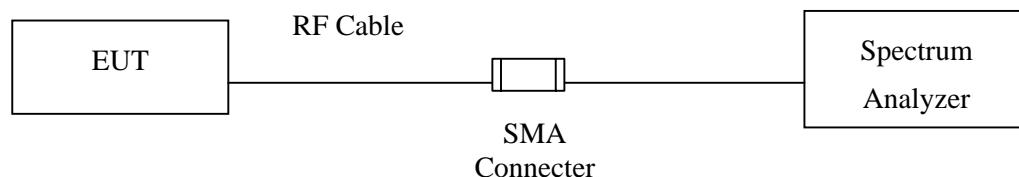
## 9. Dwell Time

### 9.1. Test Equipment

Equipment	Manufacturer	Model No./Serial No.	Last Cal.
Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2010
Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2010
X Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2011

Note: 1. All equipments are calibrated every one year.  
2. The test instruments marked by "X" are used to measure the final test results.

### 9.2. Test Setup



### 9.3. Limit

The dwell time shall be the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

### 9.4. Test Procedure

The EUT was setup to ANSI C63.4, 2009; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

### 9.5. Uncertainty

± 25msec

## 9.6. Test Result of Dwell Time

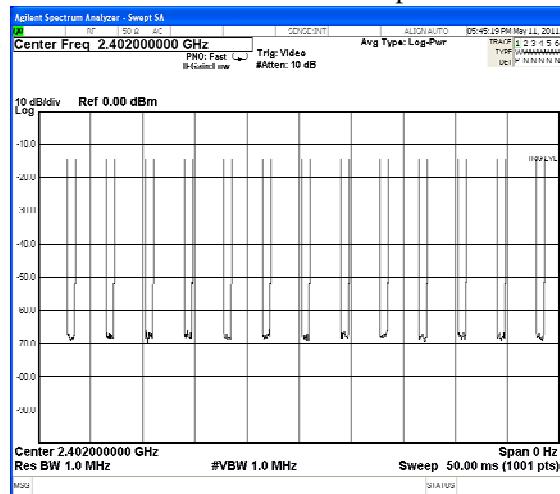
Product : IPC  
 Test Item : Dwell Time  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit - 1Mbps (GFSK) (Channel 00,39,78 -DH5)

Frequency (MHz)	Time slot length (ms)	Hopping of Number	Sweep time (ms)	Duty cycle	Dwell Time (Sec)	Limit (Sec)	Result
2402	2.900	14	50	0.81	0.325	0.4	Pass
2441	2.900	14	50	0.81	0.325	0.4	Pass
2480	2.900	14	50	0.81	0.325	0.4	Pass

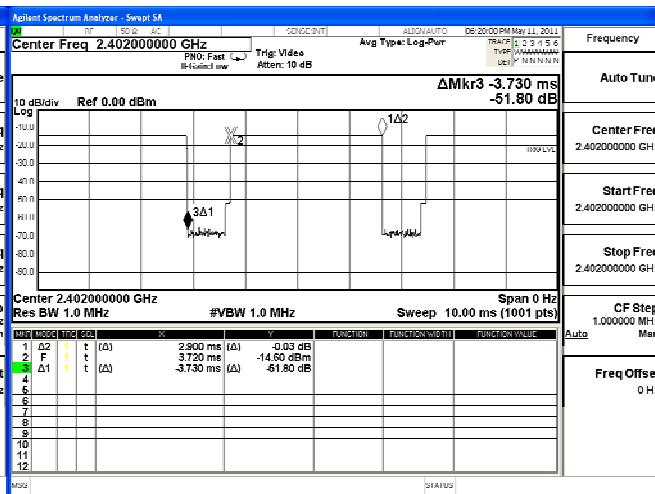
Duty cycle =((Time slot length(ms)\*Hopping of Number) / Sweep time (ms)

Dwell time = (Duty cycle /79) \* (79\*0.4)

CH 00 Time Interval between hops

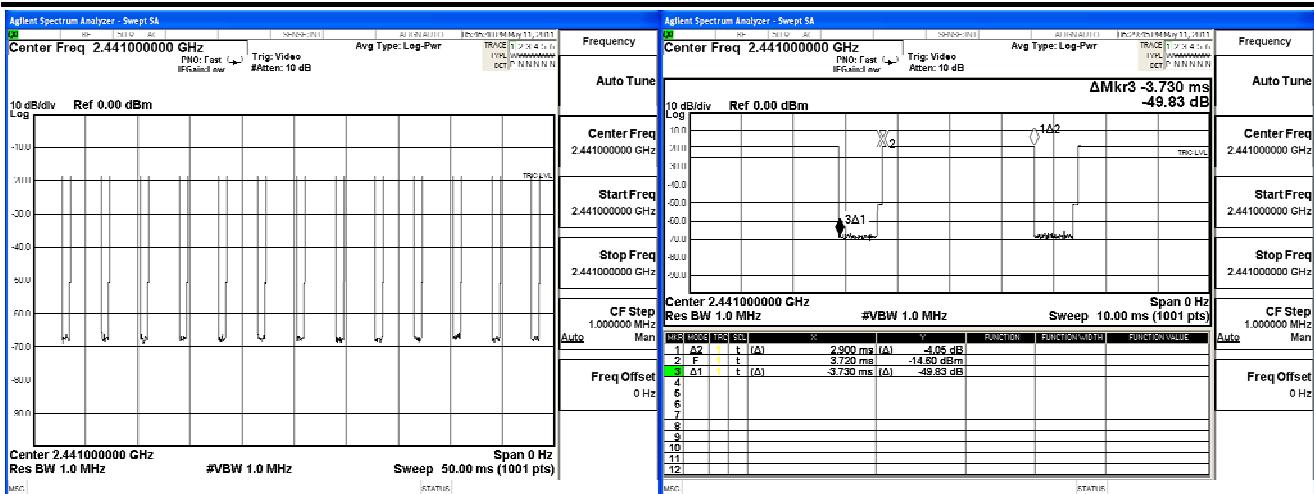


CH 00 Transmission Time

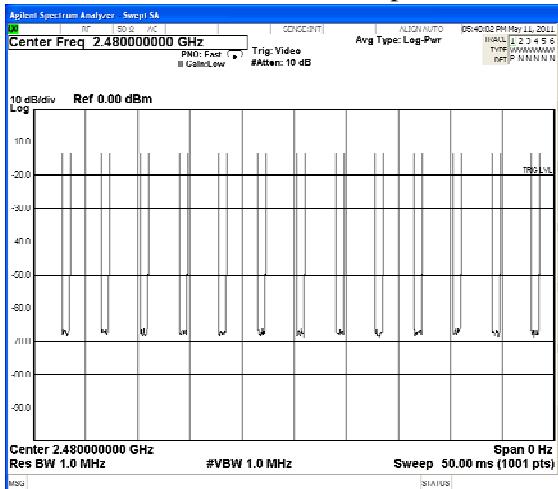


CH39 Time Interval between hops

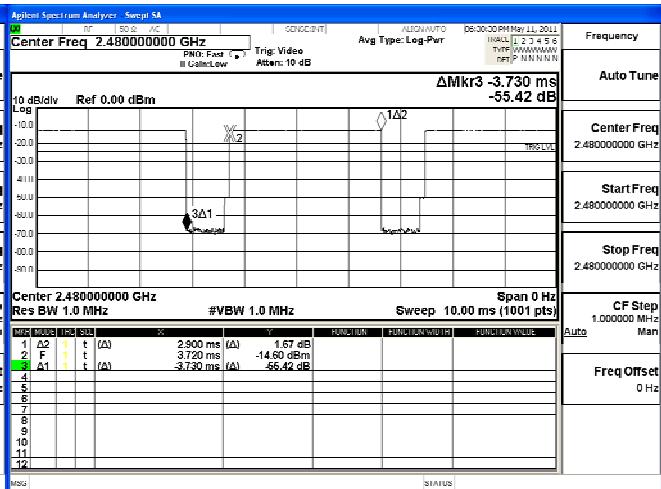
CH 39Transmission Time



### CH 78 Time Interval between hops



### CH 78 Transmission Time



### Note:

The dwell times of the packet type of DH1, DH3, and DH5 are tested. Only the worst case is shown on the report.

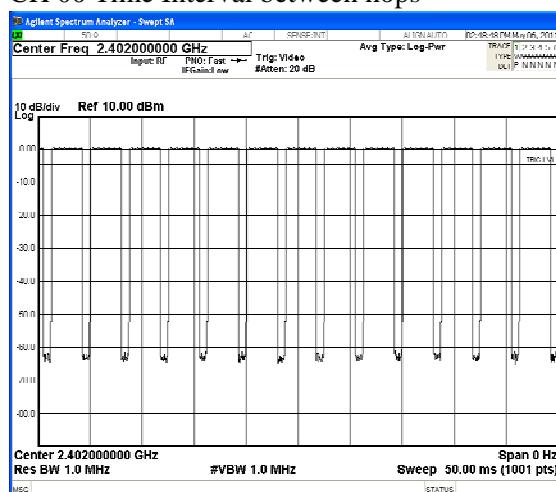
Product : IPC  
Test Item : Dwell Time  
Test Site : No.3 OATS  
Test Mode : Mode 2: Transmit - 3Mbps (8DPSK) (Channel 00,39,78 -DH5)

Frequency (MHz)	Time slot length (ms)	Hopping of Number	Sweep time (ms)	Duty cycle	Dwell Time (Sec)	Limit (Sec)	Result
2402	2.950	14	50	0.83	0.330	0.4	Pass
2441	2.950	14	50	0.83	0.330	0.4	Pass
2480	2.900	14	50	0.81	0.325	0.4	Pass

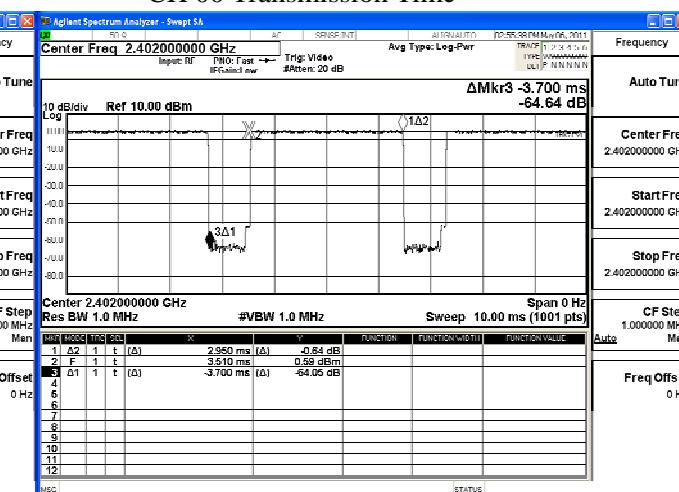
Duty cycle =((Time slot length(ms)\*Hopping of Number) / Sweep time (ms)

$$\text{Dwell time} = (\text{Duty cycle} / 79) * (79 * 0.4)$$

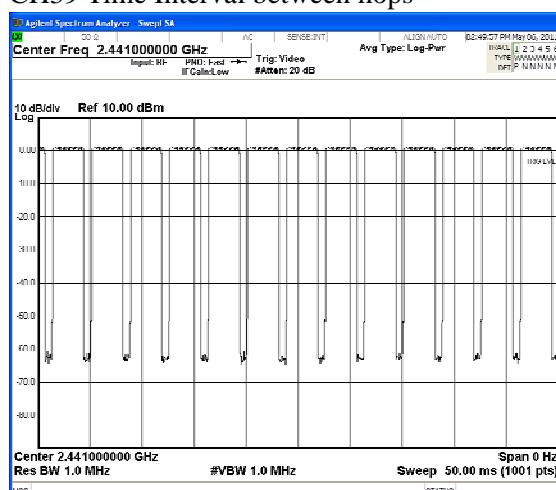
### CH 00 Time Interval between hops



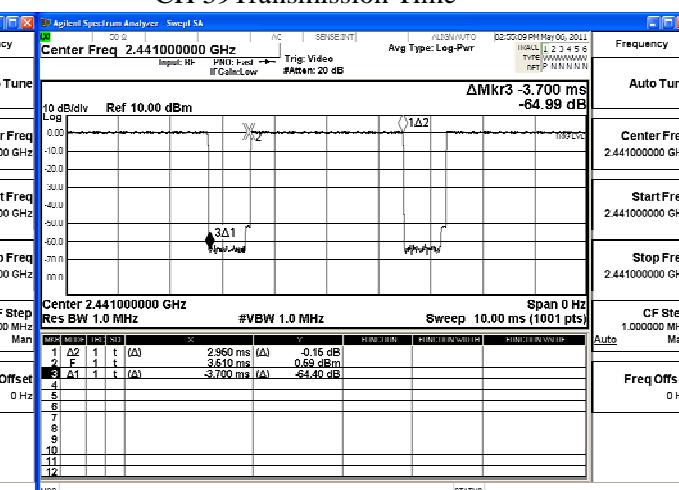
### CH 00 Transmission Time



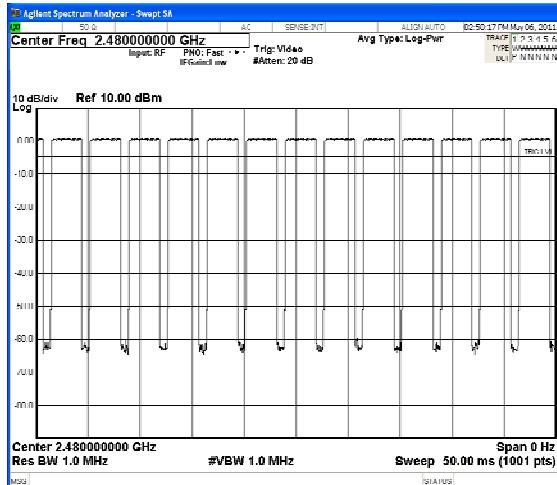
### CH39 Time Interval between hops



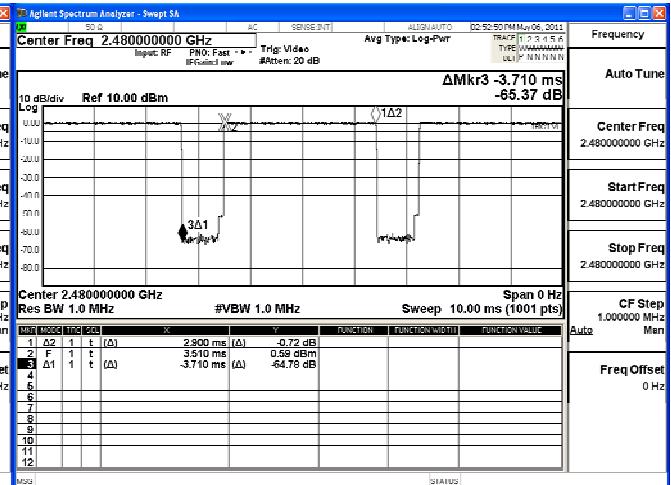
### CH 39 Transmission Time



## CH 78 Time Interval between hops



## CH 78 Transmission Time



### Note:

The dwell times of the packet type of DH1, DH3, and DH5 are tested. Only the worst case is shown on the report.

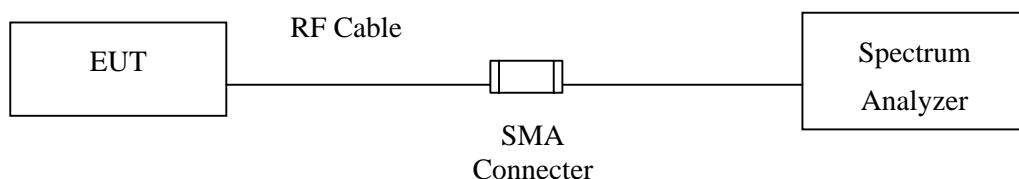
## 10. Occupied Bandwidth

### 10.1. Test Equipment

Equipment	Manufacturer	Model No./Serial No.	Last Cal.
Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2010
Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2010
X Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2011

Note: 1. All equipments are calibrated every one year.  
2. The test instruments marked by "X" are used to measure the final test results.

### 10.2. Test Setup



### 10.3. Limits

N/A

### 10.4. Test Procedure

The EUT was setup to ANSI C63.4, 2009; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

### 10.5. Uncertainty

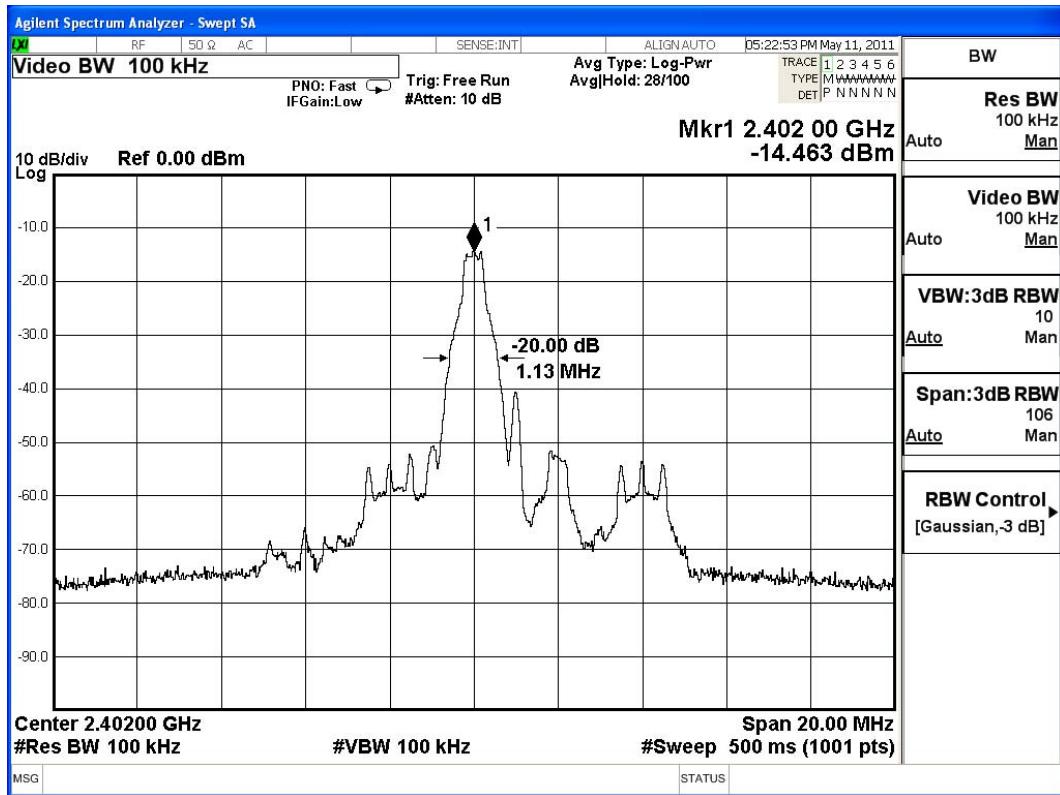
± 150Hz

## 10.6. Test Result of Occupied Bandwidth

Product : IPC  
 Test Item : Occupied Bandwidth Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit - 1Mbps (GFSK)(2402MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
00	2402	1130	--	NA

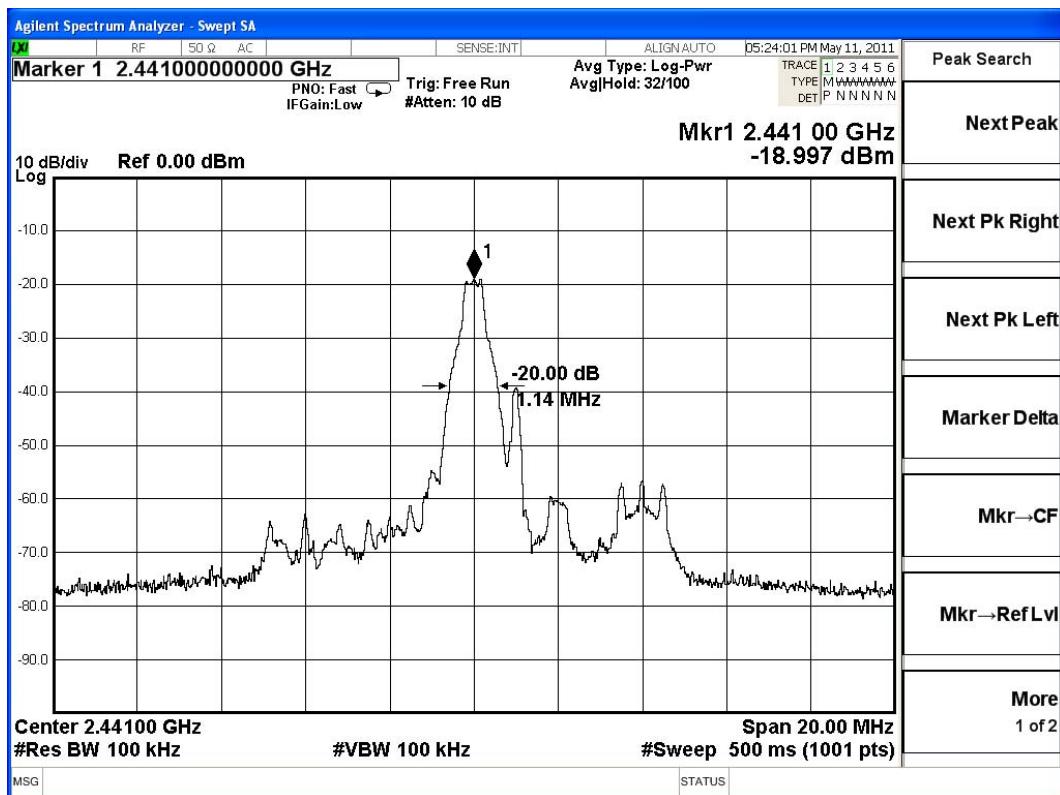
**Figure Channel 00:**



Product : IPC  
 Test Item : Occupied Bandwidth Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit - 1Mbps (GFSK)(2441MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
39	2441	1140	--	NA

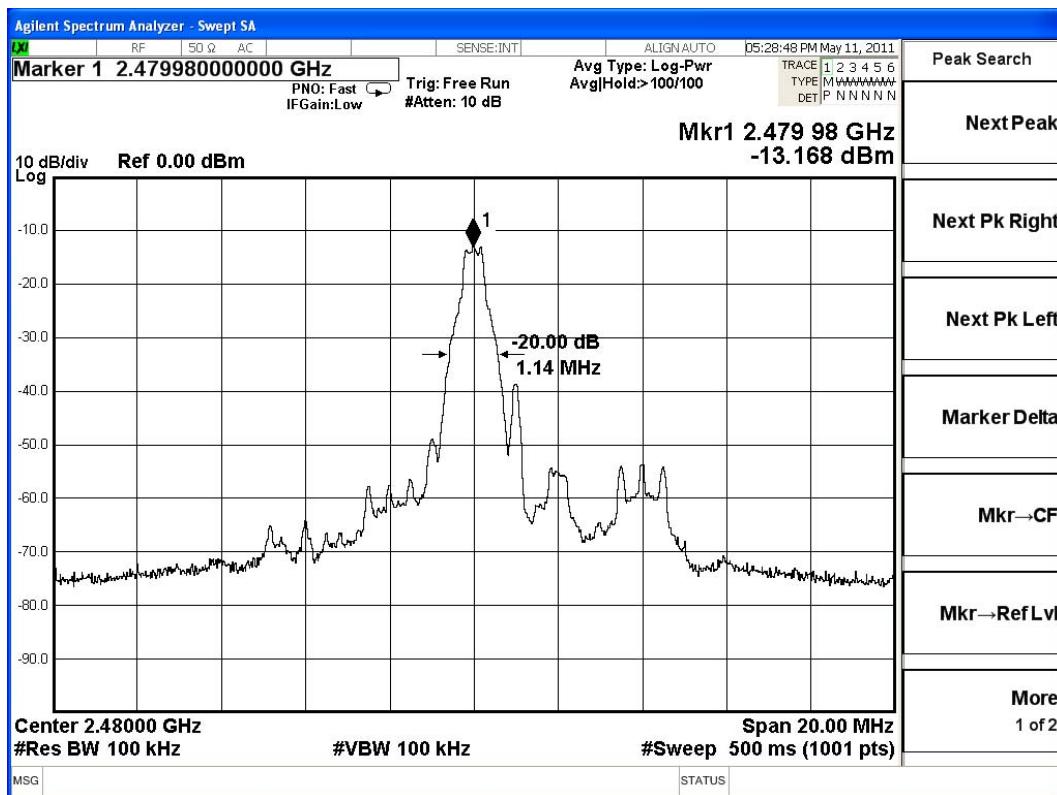
**Figure Channel 39:**



Product : IPC  
 Test Item : Occupied Bandwidth Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit - 1Mbps (GFSK)(2480MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
78	2480	1140	--	NA

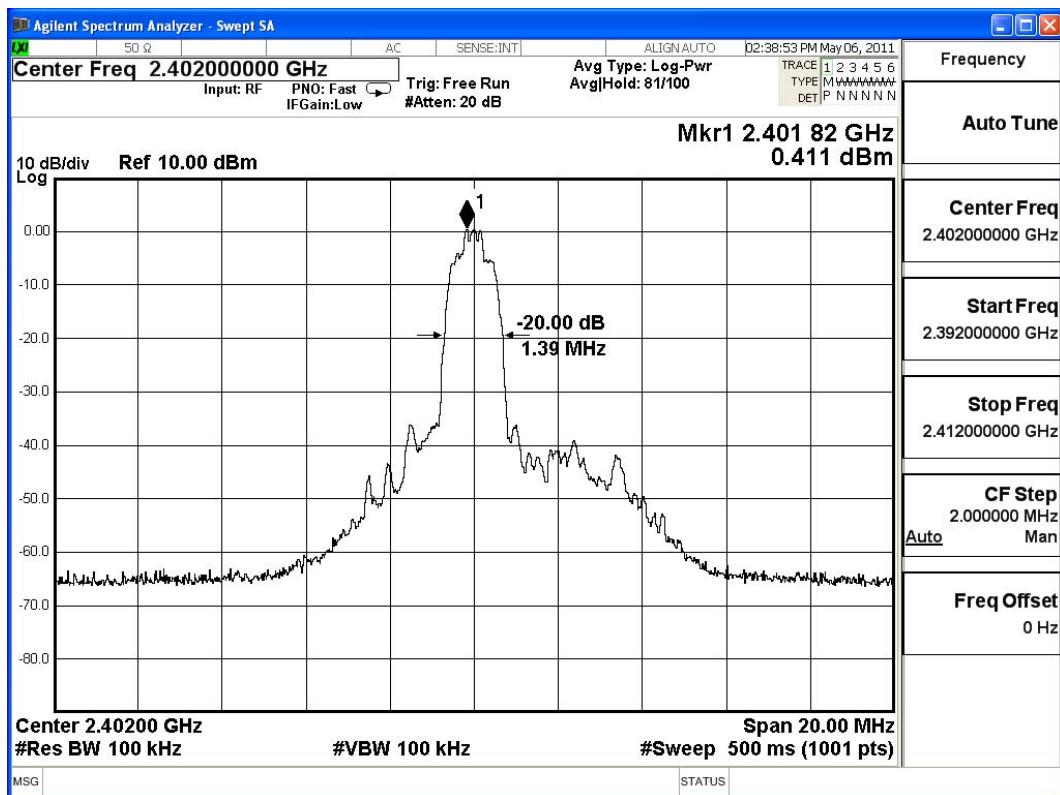
**Figure Channel 78:**



Product : IPC  
 Test Item : Occupied Bandwidth Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 2: Transmit - 3Mbps (8DPSK) (2402MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
00	2402	1390	--	NA

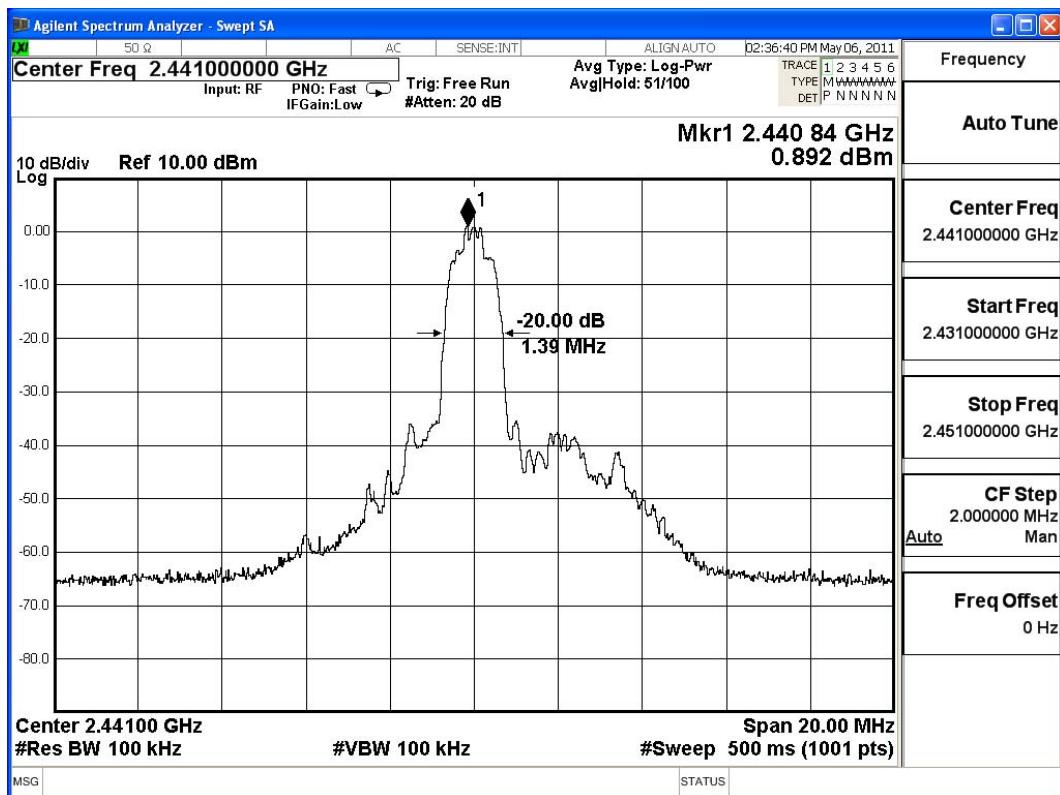
**Figure Channel 00:**



Product : IPC  
 Test Item : Occupied Bandwidth Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 2: Transmit - 3Mbps (8DPSK) (2441MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
39	2441	1390	--	NA

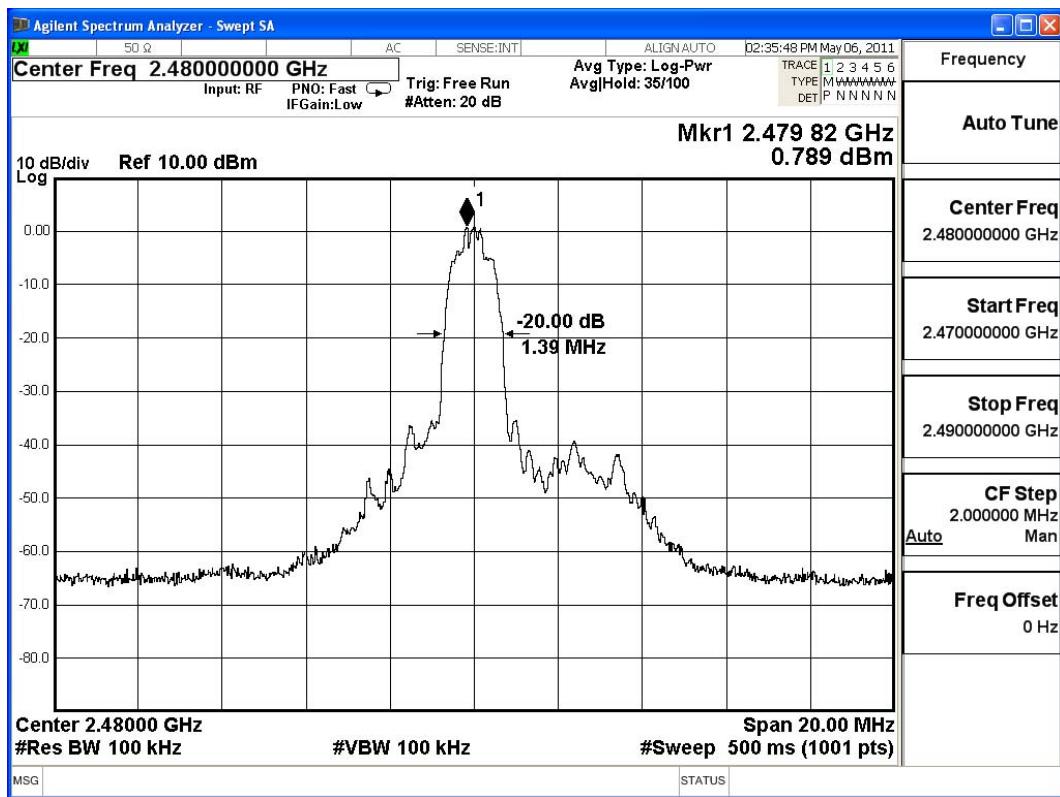
Figure Channel 39:



Product : IPC  
 Test Item : Occupied Bandwidth Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 2: Transmit - 3Mbps (8DPSK)(2480MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
78	2480	1390	--	NA

**Figure Channel 78:**



**11. EMI Reduction Method During Compliance Testing**

No modification was made during testing.

Attachment 1: EUT Test Photographs

## Attachment 2: EUT Detailed Photographs