

# FCC PART 15.247

## EMI MEASUREMENT AND TEST REPORT

For

NMB TECHNOLOGIES CORP.

9730 Independence Ave.,  
Chatsworth, CA 91311

**FCC ID: AQ6-VGPWKB5**

<b>This Report Concerns:</b> <input checked="" type="checkbox"/> Original Report	<b>Product name:</b> 2.4GHz Wireless Keyboard
<b>Test Engineer:</b> James Ma	
<b>Report No.:</b> R0604034	
<b>Report Date:</b> 2006-4-19	
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## GENERAL INFORMATION

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### Product Description for Equipment Under Test (EUT)

The *NMB TECHNOLOGIES CORP.*, FCC ID: *AQ6-VGPWKB5*, or the “EUT” as referred to in this report is a 2.4GHz Wireless Keyboard, which measures approximately 381mmL x 96mmW x 30mmH. The EUT operates at the frequency range of 2402– 2479MHz, with maximum output power of 0.31 mW. The emission designator is 2M15G1D.

*\* The test data gathered are from a production sample, S/N: 147971711386, Revision: Rev. A, provided by the manufacturer.*

### EUT Photo



### Objective

This type approval report is prepared on behalf of *NMB TECHNOLOGIES CORP.* in accordance with Part 2, Subpart J, Part 15, Subparts A, B, C.

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

No Related Submittals

### Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2003.

### Test Facility

The Test site used by BACL Corp. to collect radiated and conducted emission measurement data is at it's facility in Sunnyvale, California, USA.

Test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI).

The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the test methods and procedures set forth in ANSI C63.4-2003& TIA/EIA-603.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations is attached hereinafter and can also be found at <http://ts.nist.gov/ts/htdocs/210/214/scopes/2001670.htm>

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## SYSTEM TEST CONFIGURATION

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### Justification

The EUT was configured for testing according to ANSI C63.4-2003.

The EUT was tested in the normal (native) operating mode to represent *worst-case* results during the final qualification test.

### Special Accessories

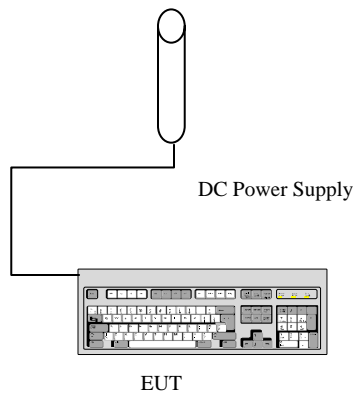
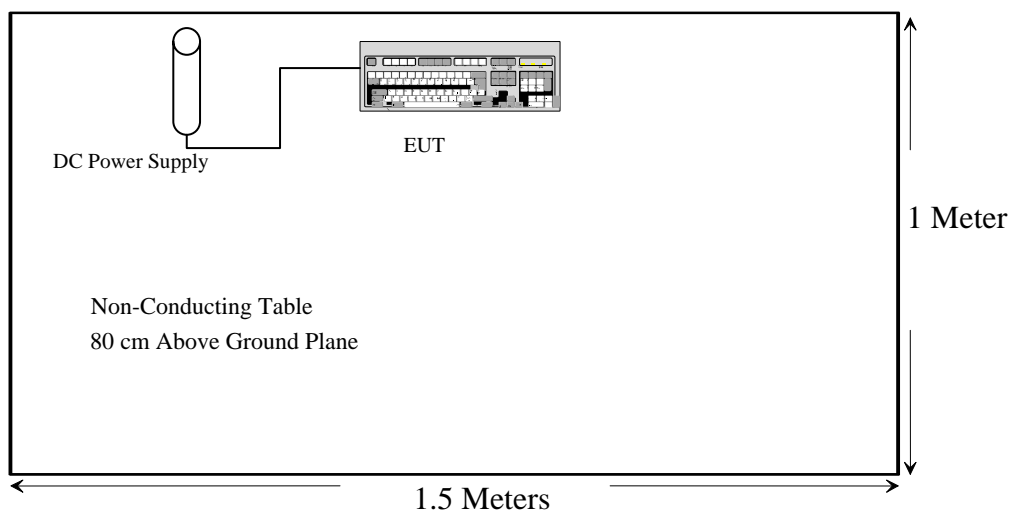
N/A

### Equipment Modifications

No modifications were made to the EUT.

### EUT Configuration Details

Manufacturer	Description	Model	Serial Number
NMB Technology	2.4GHz Wireless Keyboard	VGB-WKB3JP	147971711386

**Configuration of Test System****Test Setup Block Diagram**

**SUMMARY OF TEST RESULTS FOR FCC PART 15**

FCC RULES	DESCRIPTION OF TEST	RESULT
§2.1091	RF Exposure	Compliant
§15.203	Antenna Requirement	Compliant
§ 15.207 (a)	AC Conducted Emissions	N/A
§15.205	Restricted Band	Compliant
§15.209 (a)	Radiated Emission	Compliant*
§15.247 (a)(2)	6 dB Bandwidth	Compliant
§15.247 (b)(3)	Maximum Peak Output Power	Compliant
§ 15.247 (d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
§2.1051	Spurious Emission at Antenna Port	Compliant
§15.247 (e)	Peak Power Spectral Density	Compliant

\*: Test data are within the measurement uncertainty.



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## ANTENNA REQUIREMENT

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According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to § 15.247 (1), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The antenna connectors are designed with permanent attachment and no consideration of replacement.

The antenna gain = 2dBi (peak)

## **§15.205 & §15.209 - RADIATED EMISSION**

### **Measurement Uncertainty**

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at BACL is  $\pm 4.0$  dB.

### **Test Setup**

The radiated emission tests were performed in the open area 3-meter test site, using the setup in accordance with ANSI C63.4-2003. The specification used was the FCC 15 Subpart C limits.

### **Spectrum Analyzer Setup**

According to FCC Rules, 47 CFR §15.33 (a) (1), the system was tested to 25GHz. During the radiated emission test, the spectrum analyzer was set with the following configurations:

<b><i>Frequency Range</i></b>	<b><i>RBW</i></b>	<b><i>Video B/W</i></b>
Below 30MHz	10kHz	10kHz
30 – 1000MHz	100kHz	100kHz
Above 1000MHz	1MHz	1MHz

### **Test Procedure**

Maximizing procedure was performed on the six (6) highest provided emissions to ensure EUT compliance is with all installation combinations.

All data was recorded in the peak detection mode. Quasi-peak readings was performed only when an emission was found to be marginal (within -4 dB of specification limits), and are distinguished with a "Qp" in the data table.

### **Environmental Conditions**

Temperature:	25° C
Relative Humidity:	70%
ATM Pressure:	1025 mbar

*\*The testing was performed by James Ma on 2006-4-11.*

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Amplifier, Pre (.1 ~1300MHz)	8447D	2944A10198	2005-8-20
Agilent	Analyzer, Spectrum	E4446A	US44300386	2006-03-06
ETS-Lindgren	30MHz ~ 3 GHz Antenna	JB3	A020106-2/S006628	2006-2-14
A. H. Systems	Antenna, Horn, DRG	SAS-200/571	261	2005-4-20
HP	Pre, Amplifier (1 ~ 26.5 GHz)	8449B	3147A00400	2005-10-5

\* **Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

### Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Class B Limit}$$

### Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247, and had the worst margin of:

- 9.5 dB at 7206.0000 MHz in the **Vertical** polarization, Low Channel, 3 meters\*
- 11.2 dB at 7320.0000 MHz in the **Vertical** polarization, Middle Channel, 3 meters\*
- 12.9 dB at 7437.0000 MHz in the **Vertical** polarization, High Channel, 3 meters
- 18.1 dB at 1234.50 MHz in the **Horizontal** polarization, Unintentional Emission, 3 meters

\*The data was within the measurement of uncertainty.

**3 Meters Radiated Emission Test Data**

Indicated			Antenna	Antenna		Correction Factor			FCC 15.247		
Frequency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin	Comments
MHz	dBμV/m	Degree	Meter	H/V	dB	dB	dB	dBμV/m	dBμV/m	dB	
Low Channel											
2402.0000	85.6	150	2.0	v	28.2	1.5	36.2	79.1			Fund/Peak
2402.0000	79.1	100	2.3	h	28.2	1.5	36.2	72.6			Fund/Peak
2402.0000	84.2	150	2.0	v	28.2	1.5	36.2	77.7			Ave
2402.0000	78.6	100	2.3	h	28.2	1.5	36.2	72.1			Ave
4804.0000	40.0	270	2.4	v	32.1	1.9	34.4	39.6	74	-34.4	Peak
4804.0000	39.7	180	2.3	h	32.1	1.9	34.4	39.3	74	-34.7	Peak
4804.0000	31.5	270	2.4	v	32.1	1.9	34.4	31.1	54	-22.9	Ave
4804.0000	31.3	180	2.3	h	32.1	1.9	34.4	30.9	54	-23.1	Ave
7206.0000	45.2	30	2.0	v	37.6	4.2	36.9	50.1	74	-23.9	Peak
7206.0000	42.2	180	2.0	h	37.6	4.2	36.9	47.1	74	-26.9	Peak
7206.0000	39.6	30	2.0	v	37.6	4.2	36.9	44.5	54	-9.5	Ave
7206.0000	34.8	90	2.0	h	37.6	4.2	36.9	39.7	54	-14.3	Ave
Middle Channel											
2440.0000	83.3	220	1.3	v	28.2	1.5	36.2	76.8			Fund/Pe ak
2440.0000	77.6	90	1.8	h	28.2	1.5	36.2	71.1			Fund/Pe ak
2440.0000	83.0	220	1.3	v	28.2	1.5	36.2	76.5			Ave
2440.0000	77.2	90	1.8	h	28.2	1.5	36.2	70.7			Ave
4880.0000	40.5	270	2.4	v	32.1	1.9	34.4	40.1	74	-33.9	Peak
4880.0000	40.0	180	2.2	h	32.1	1.9	34.4	39.6	74	-34.4	Peak
4880.0000	32.0	270	2.4	v	32.1	1.9	34.4	31.6	54	-22.4	Ave
4880.0000	31.3	180	2.2	h	32.1	1.9	34.4	30.9	54	-23.1	Ave
7320.0000	45.2	170	2.0	v	37.6	4.2	36.9	50.1	74	-23.9	Peak
7320.0000	42.2	180	2.3	h	37.6	4.2	36.9	47.1	74	-26.9	Peak
7320.0000	37.7	170	2.0	v	37.6	4.2	36.9	42.6	54	-11.4	Ave
7320.0000	34.0	180	2.1	h	37.6	4.2	36.9	38.9	54	-15.1	Ave
High Channel											
2479.0000	83.5	160	1.0	v	28.2	1.5	36.2	77.0			Fund/Pe ak
2479.0000	80.7	0	1.2	h	28.2	1.5	36.2	74.2			Fund/Pe ak
2479.0000	83.0	160	1.0	v	28.2	1.5	36.2	76.5			Ave
2479.0000	80.3	0	1.2	h	28.2	1.5	36.2	73.8			Ave
4958.0000	43.3	180	1.0	v	32.1	1.9	34.4	42.9	74	-31.1	Peak
4958.0000	40.0	90	2.1	h	32.1	1.9	34.4	39.6	74	-34.4	Peak
4958.0000	35.3	180	1.0	v	32.1	1.9	34.4	34.9	54	-19.1	Ave
4958.0000	31.4	90	2.1	h	32.1	1.9	34.4	31.0	54	-23.0	Ave
7437.0000	44.2	270	2.4	v	37.6	4.2	36.9	49.1	74	-24.9	Peak
7437.0000	42.0	90	2.1	h	37.6	4.2	36.9	46.9	74	-27.1	Peak
7437.0000	36.2	270	2.4	v	37.6	4.2	36.9	41.1	54	-12.9	Ave
7437.0000	33.8	90	2.1	h	37.6	4.2	36.9	38.7	54	-15.3	Ave

## Unintentional Emission

30 MHz-2500 MHz

Frequency MHz	Indicated		Antenna Height Meter	Antenna		Correction Factor			FCC 15.247	
	Ampl. dBμV/m	Direction Degree		Polar H/V	Antenna dB	Cable Loss dB	Amp. dB	Corr. Ampl. dBμV/m	Limit dBμV/m	Margin dB
89.76	44.4	70	1.3	H	8.6	0.6	38.4	15.2	43.5	-28.3
169.53	44.1	75	1.3	H	13.0	0.7	38.4	19.4	43.5	-24.1
226.85	49.0	100	1.3	H	11.4	0.8	38.4	22.8	46	-23.2
470.10	34.6	110	1.5	H	16.8	1.3	38.3	14.4	46	-31.6
512.80	35.6	150	1.7	H	17.7	1.3	38.3	16.3	46	-29.7
900.20	37.9	200	1.5	H	22.1	1.9	38.3	23.6	46	-22.4
1234.50	46.8	200	1.6	H	24.7	2.2	38.4	35.3	74	-38.7
1234.50	45.6	200	1.6	H	24.7	2.2	38.4	34.1	54	-19.9
1481.50	46.8	200	1.6	H	26.4	2.4	38.3	37.3	74	-36.7
1481.50	45.4	200	1.6	H	26.4	2.4	38.3	35.9	54	-18.1
89.76	39.2	30	1.2	V	8.5	0.6	38.4	9.9	43.5	-33.6
169.53	35.6	90	1.5	V	12.5	0.7	38.4	10.4	43.5	-33.1
226.85	41.6	60	1.2	V	11.7	0.8	38.4	15.7	46	-30.3
470.10	33.6	70	1.4	V	16.7	1.3	38.3	13.3	46	-32.7
512.80	37.2	100	1.5	V	18.2	1.3	38.3	18.4	46	-27.6
980.20	38.3	100	1.5	V	24.0	1.9	38.3	25.9	54	-28.1
1234.50	47.4	120	1.2	V	25.0	2.2	38.4	36.2	74	-37.8
1234.50	46.7	120	1.2	V	25.0	2.2	38.4	35.5	54	-18.5
1481.50	44.8	120	1.2	V	27.2	2.4	38.3	36.1	74	-37.9
1481.5	43.6	120	1.2	V	27.2	2.4	38.3	34.9	54	-19.1

Note:

*\*The data was within the measurement of uncertainty.*

FUND: Fundamental

AVG: Average

## §15.247(a)(2) – 6 dB BANDWIDTH

### Standard Applicable

According to §15.247(a)(2), for digital modulation techniques, the minimum 6dB bandwidth shall be at least 500 kHz.

### Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. 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.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth. (6 dB bandwidth for DTS)
4. Repeat above procedures until all frequencies measured were complete.

### Environmental Conditions

Temperature:	25° C
Relative Humidity:	70%
ATM Pressure:	1025 mbar

*\*The testing was performed by James Ma on 2006-4-11.*

### Test Equipment List and Details

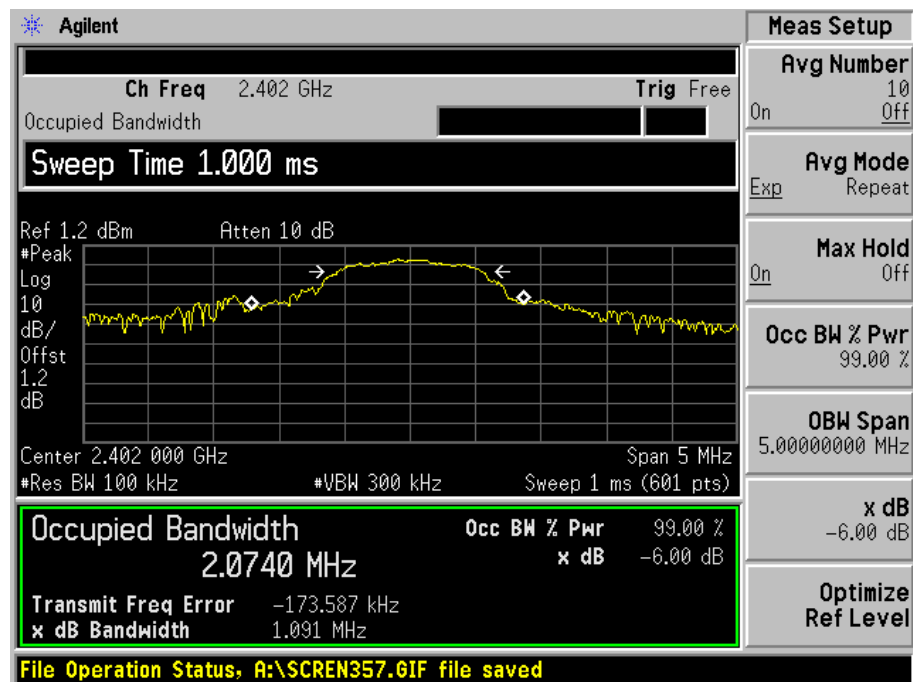
Manufacturer	Description	Model	Serial Number	Cal. Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2006-03-06

**\* Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

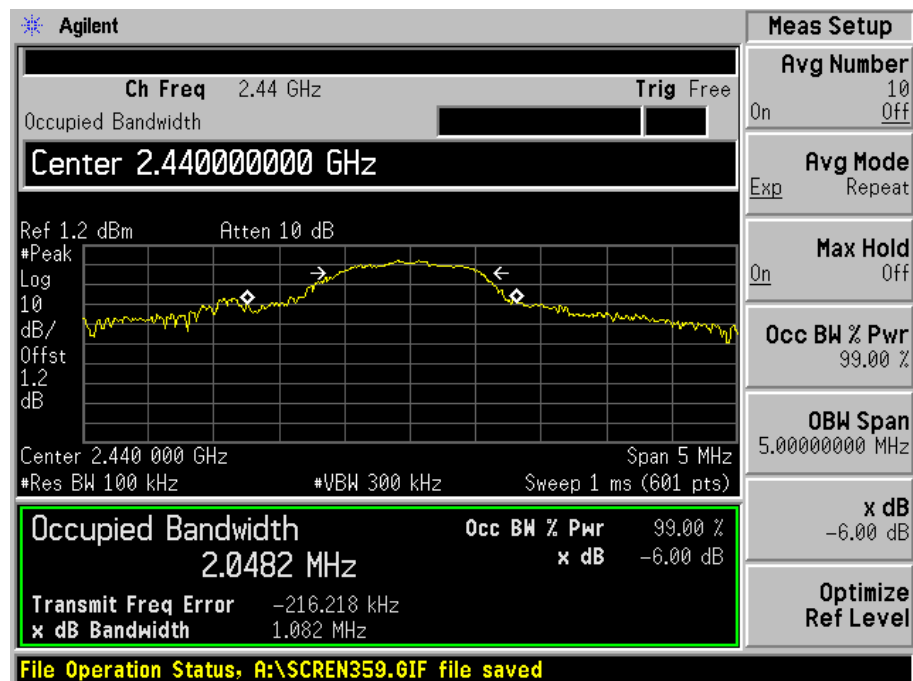
### Test Result

Channel	Frequency MHz	Channel Bandwidth (MHz)	Limit KHz	Result
Low	2402	1.091	>500	Pass
Mid	2440	1.082	>500	Pass
High	2479	1.089	>500	Pass

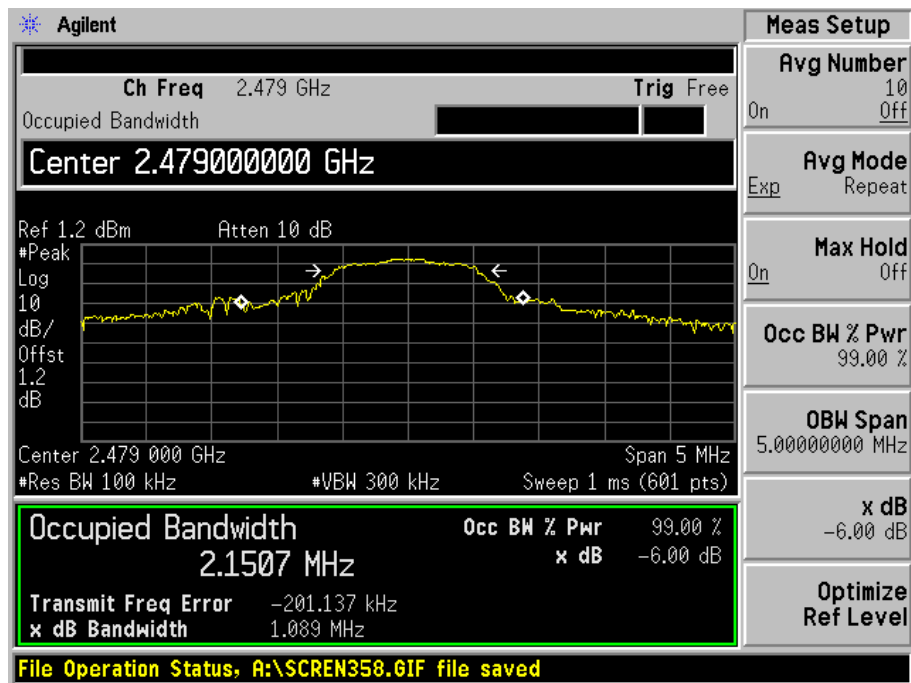
## Low Channel



## Mid. Channel



## High Channel





## §15.247 (b) (3) - MAXIMUM PEAK OUTPUT POWER

### Standard Applicable

According to §15.247(b) (3), for systems using digital modulation in 2400-2483.5 MHz: 1 Watt. Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

### Measurement Procedure

1. Place the EUT on the turntable and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

### Environmental Conditions

Temperature:	27° C
Relative Humidity:	70%
ATM Pressure:	1025 mbar

*\*The testing was performed by James Ma on 2006-4-11.*

### Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2006-03-06

**\* Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

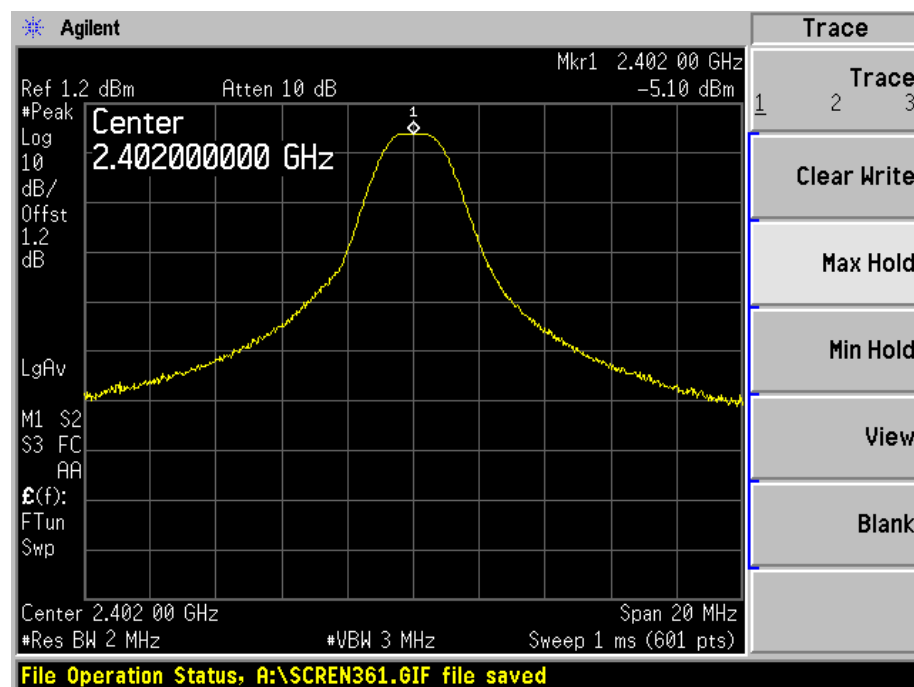
## Test Result

Channel	Frequency MHz	Max Peak Output Power		Limit (mW)	Result
		(dBm)	(mW)		
Low	2402	-5.10	0.31	1000	pass
Mid	2440	-5.94	0.25	1000	pass
High	2479	-5.24	0.30	1000	pass

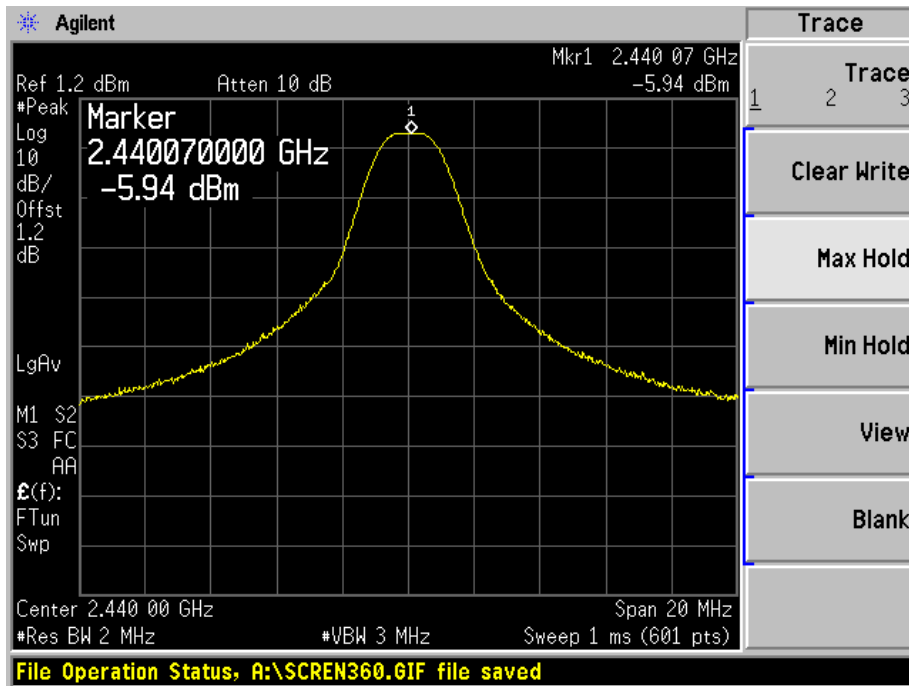
### Plots of Maximum Peak Output Power

Please see the following plots

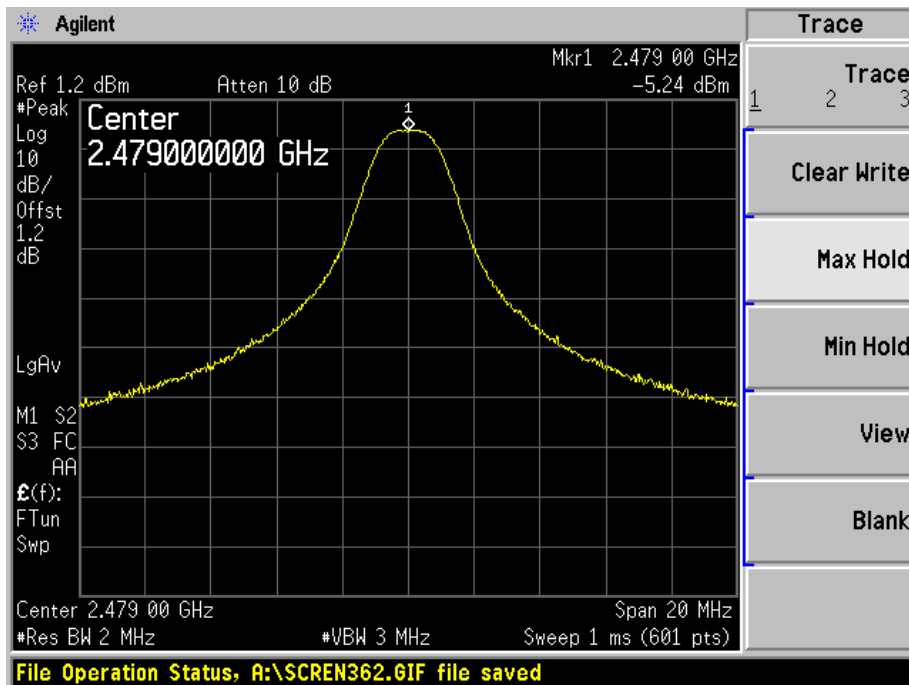
### Low Channel



## Middle Channel



## High Channel



## §15.247 (d) - 100 KHZ BANDWIDTH OF BAND EDGES

### Standard Applicable

According to §15.247(d), 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 §15.209(a) is not required.

### Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

### Environmental Conditions

Temperature:	25° C
Relative Humidity:	70%
ATM Pressure:	1025 mbar

*\*The testing was performed by James Ma on 2006-4-11.*

### Test Equipment

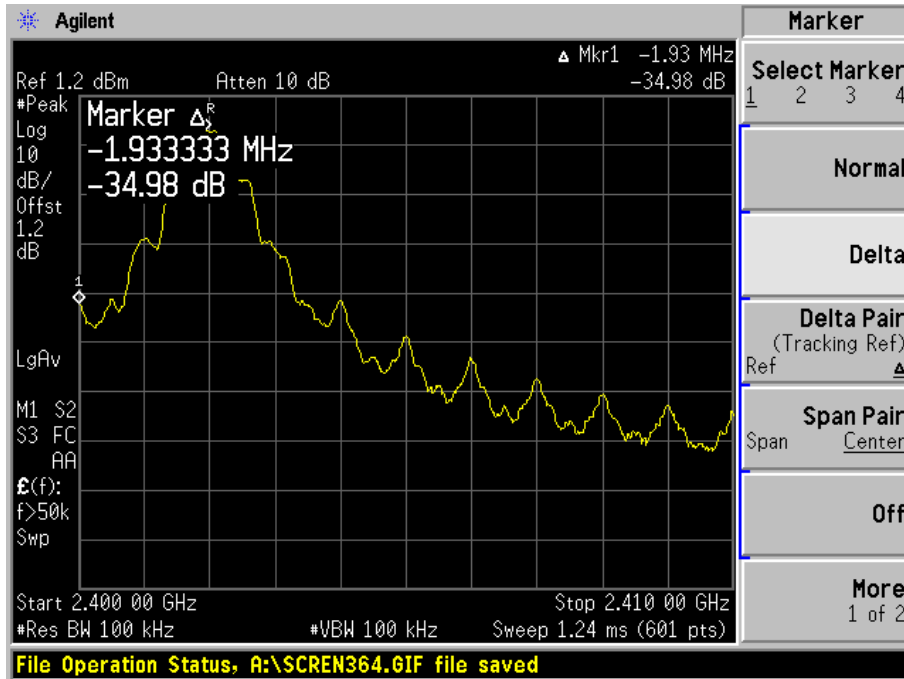
Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2006-03-06

**\* Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

## Test Result

Please refer to following pages for plots of band edge.

### Low Channel



### High Channel



## §2.1051 - SPURIOUS EMISSION AT ANTENNA PORT

### Standard Applicable

According to §15.209 (f) and §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit.

### Measurement Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on a bench without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set the SA on Max-Hold Mode, and then keep the EUT in transmitting mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View mode and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

### Environmental Conditions

Temperature:	25° C
Relative Humidity:	68%
ATM Pressure:	1025 mbar

*\*The testing was performed by James Ma on 2006-4-11.*

### Test Equipment

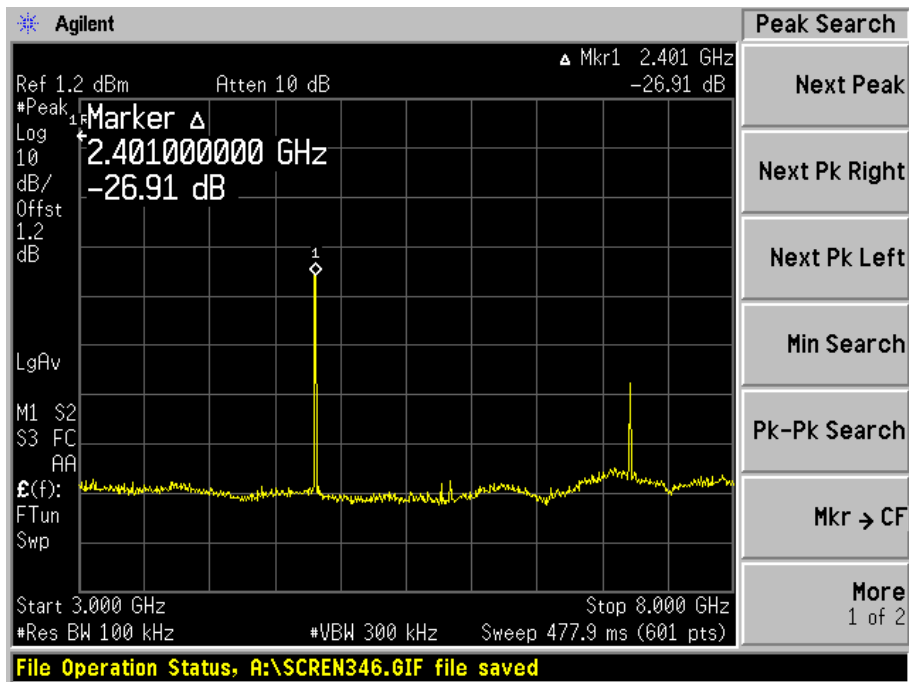
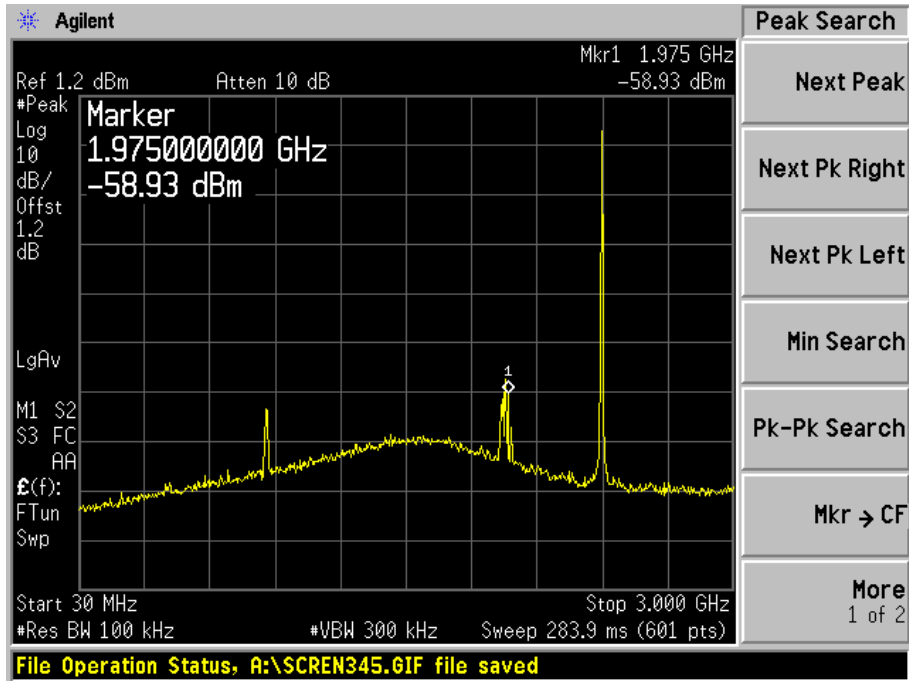
Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2006-03-06

**\* Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

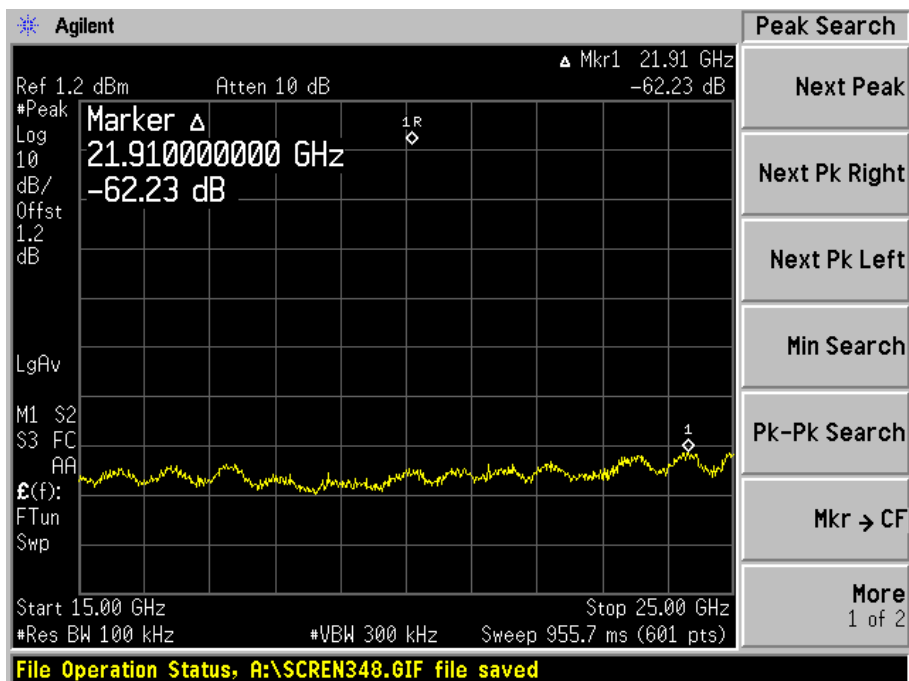
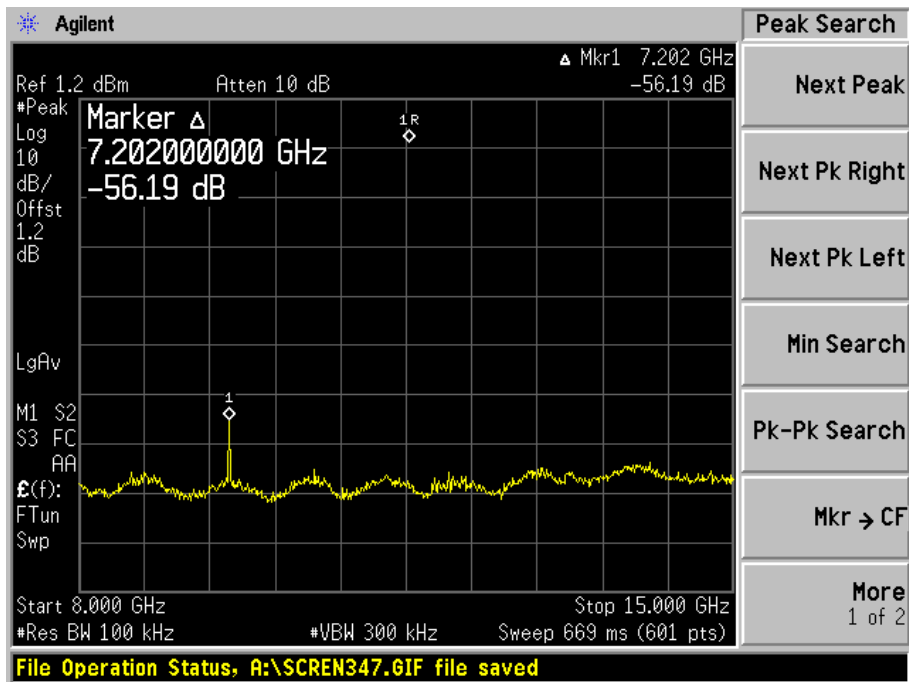
## Test Result

Please refer to the following plots.

### Low Channel

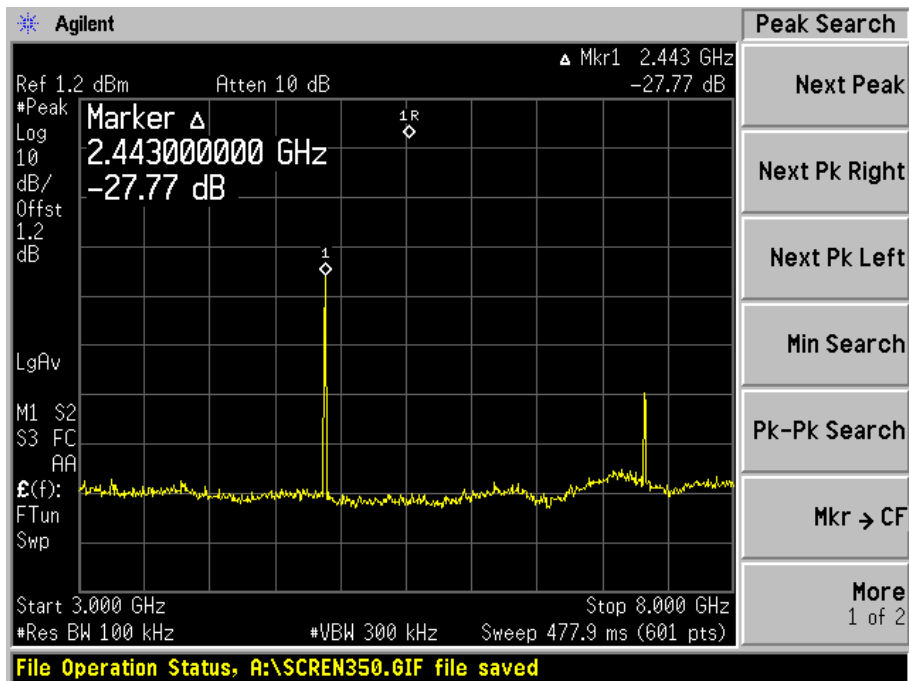
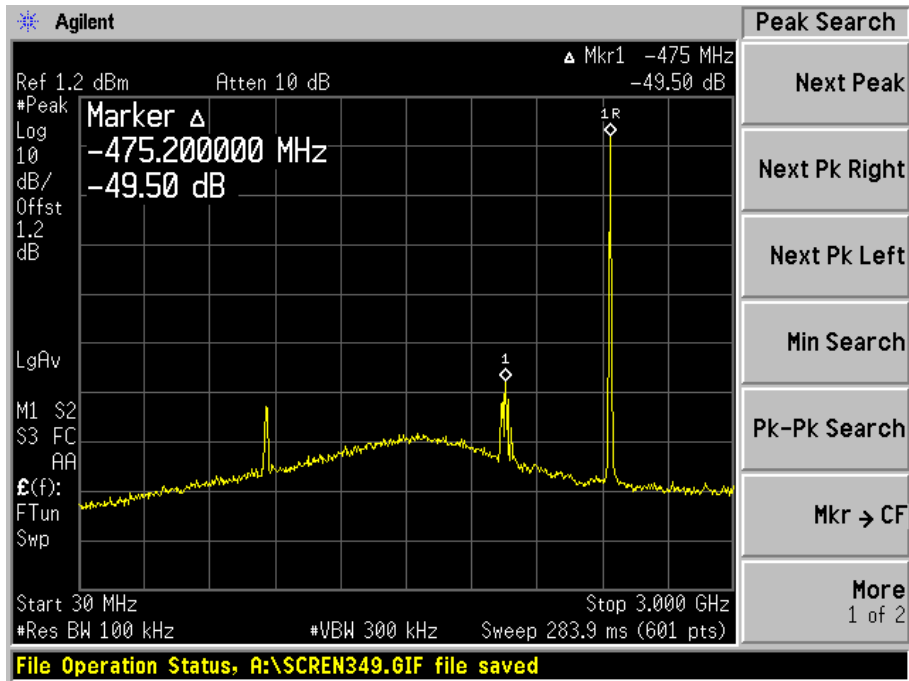


## Low Channel

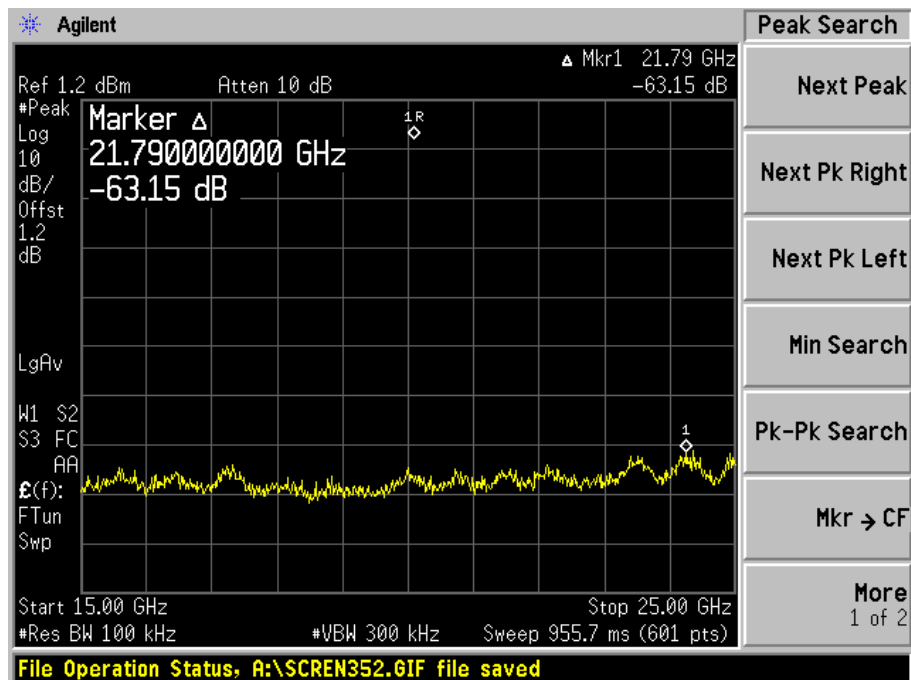
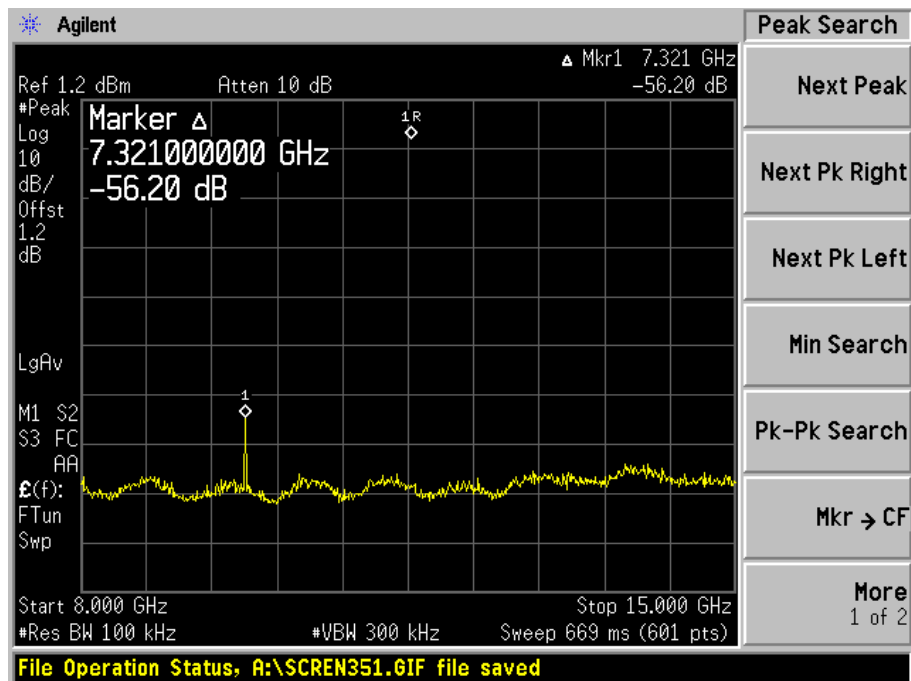




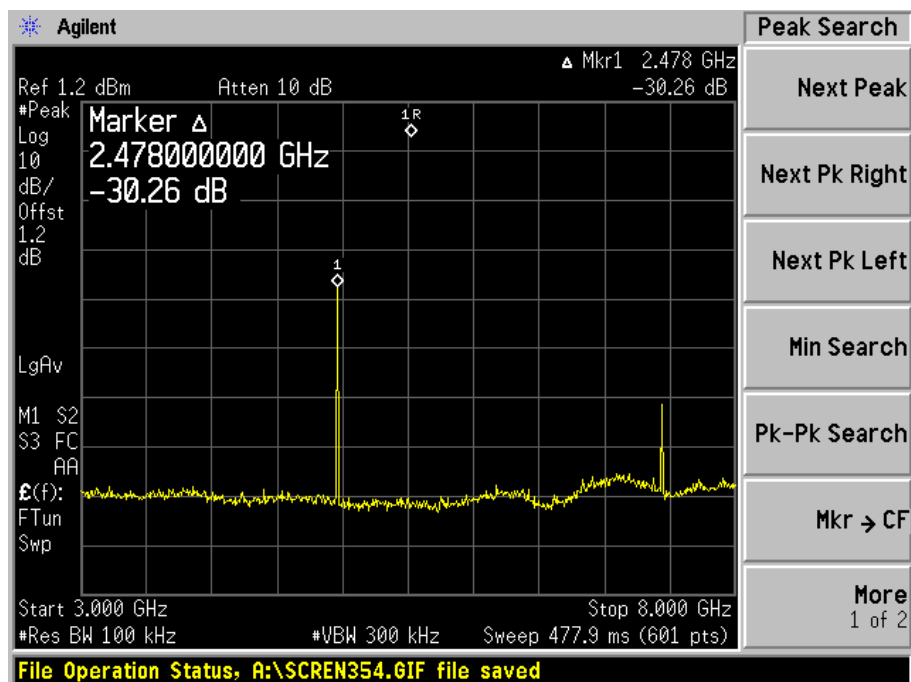
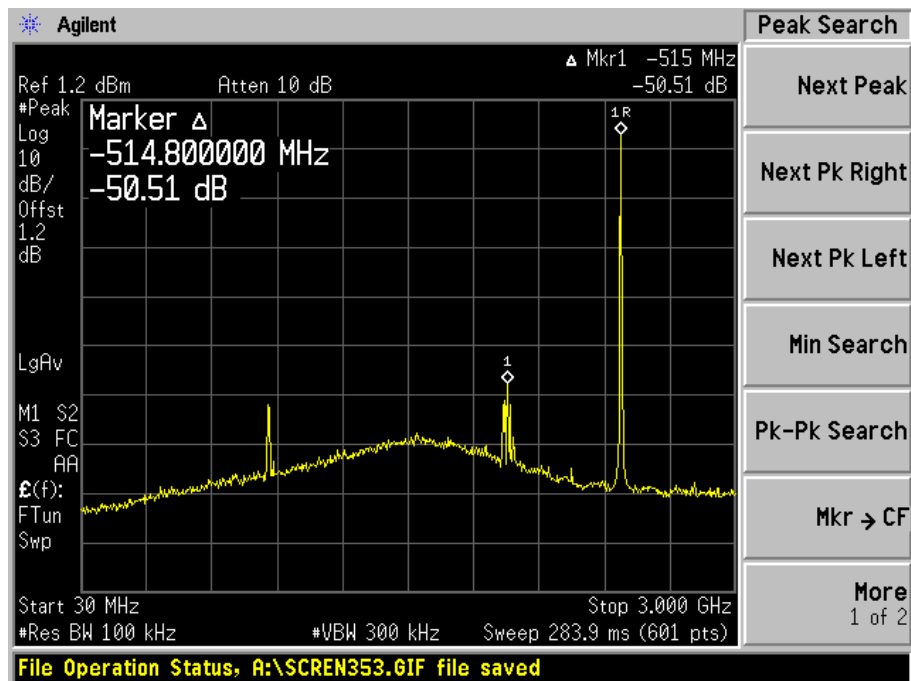
## Middle Channel



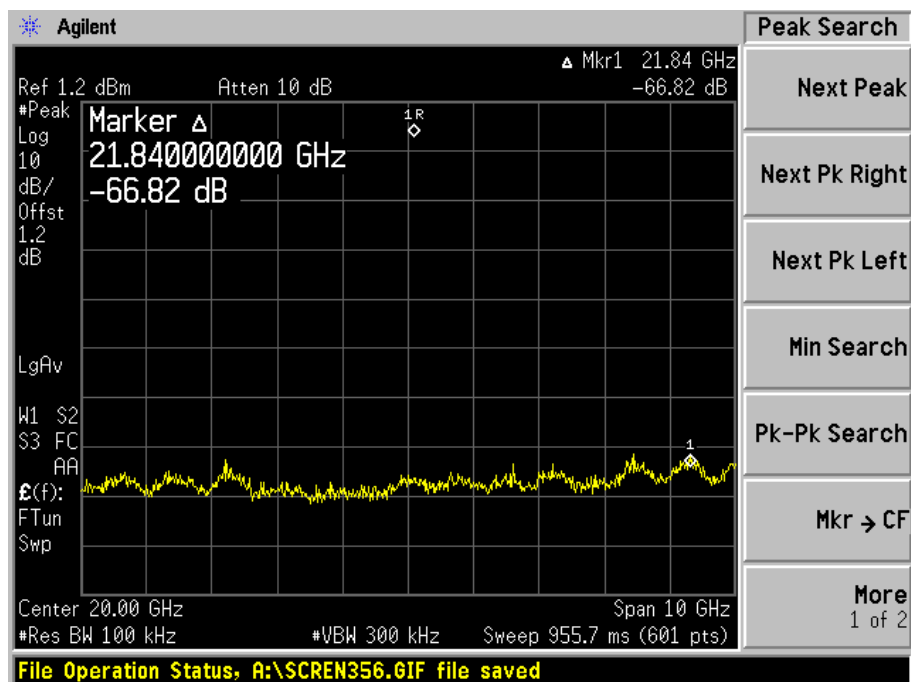
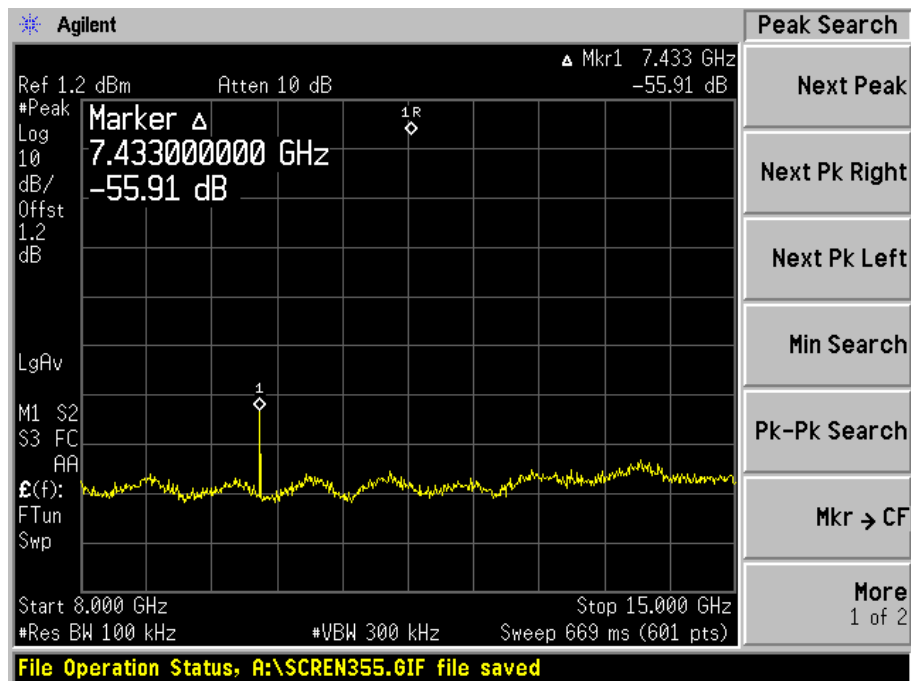
## Middle Channel



## High Channel



## High Channel



## §15.247(e) - POWER SPECTRAL DENSITY

### Standard Applicable

According to §15.247 (e), for direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to 1.5MHz span mode. And then, set RBW and VBW of spectrum analyzer to proper value. (DTS)
4. Repeat above procedures until all frequencies measured were complete.

### Environmental Conditions

Temperature:	25° C
Relative Humidity:	68%
ATM Pressure:	1025 mbar

*\*The testing was performed by James Ma on 2006-4-11.*

### Equipment Lists

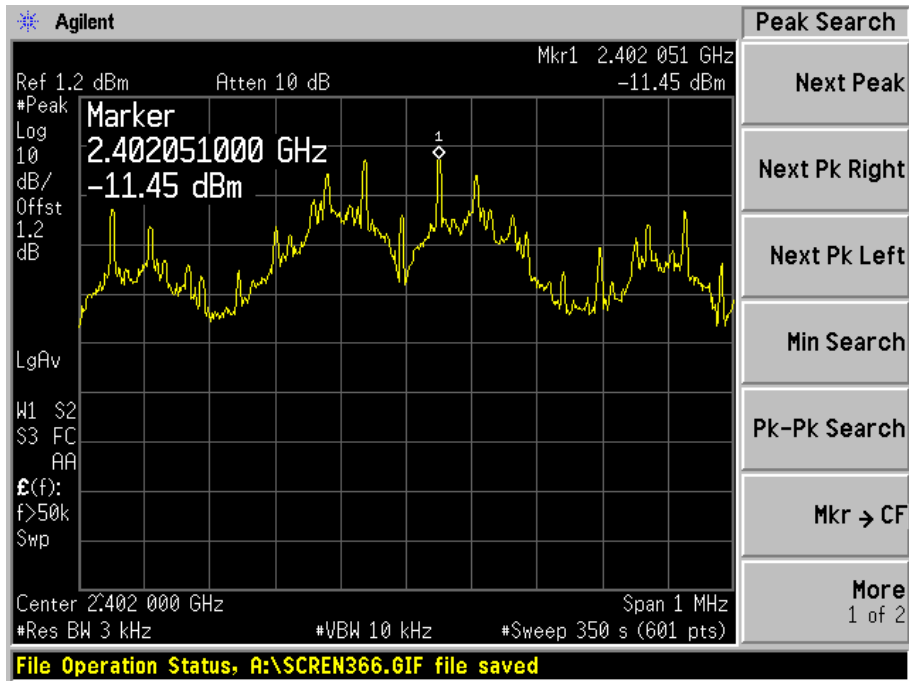
Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2006-03-06

**\* Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

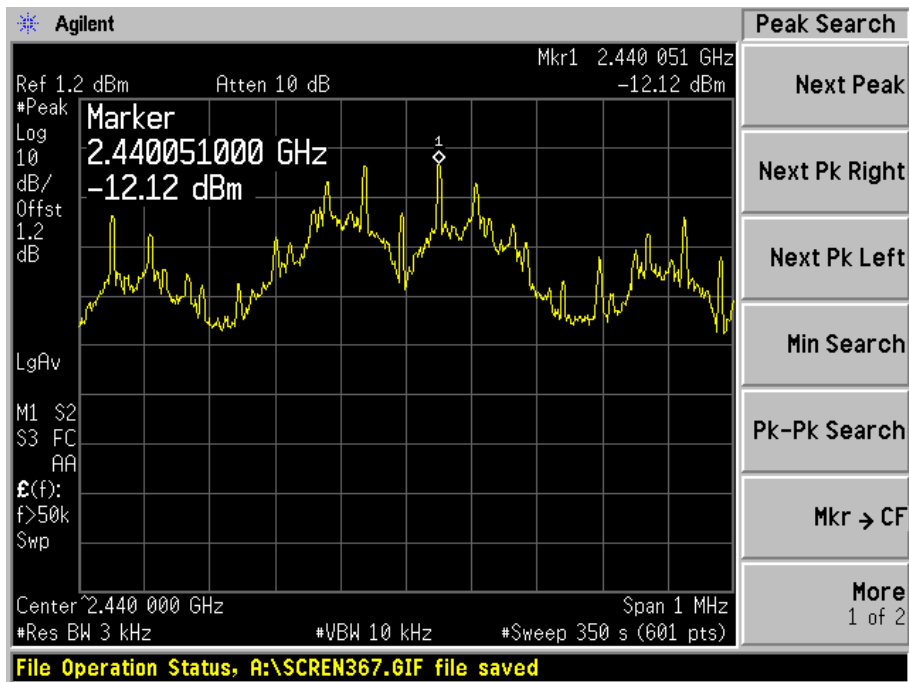
### Test Result

Channel	Frequency MHz	PSD dBm/3KHZ	Limit dBm/3KHZ	Result
Low	2402	-11.45	8	Pass
Mid	2440	-12.12	8	Pass
High	2479	-11.53	8	Pass

## Low Channel



## Mid. Channel



## High Channel

