

FCC 15.247

EMI MEASUREMENT AND TEST REPORT

For

**RAE Systems, Inc**

1339 Moffett Park Dr.  
Sunnyvale, CA 94089

|                          |
|--------------------------|
| <b>FCC ID: SU3RM2420</b> |
|--------------------------|

|                                                                                                                                                                     |                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| <b>This Report Concerns:</b><br><input checked="" type="checkbox"/> Original Report                                                                                 | <b>Equipment Type:</b><br>802.15.4 Radio Communication<br>Module |
| <b>Test Engineer:</b> Ming Jin                                                  |                                                                  |
| <b>Report No.:</b> R0501063                                                                                                                                         |                                                                  |
| <b>Report Date:</b> 2005-02-10                                                                                                                                      |                                                                  |
| <b>Reviewed By:</b> Daniel Deng                                                  |                                                                  |
| <b>Prepared By:</b> Bay Area Compliance Laboratory Corporation (BACL)<br>230 Commercial Street<br>Sunnyvale, CA 94085<br>Tel: (408) 732-9162<br>Fax: (408) 732 9164 |                                                                  |

**Note:** The test report is specially limited to the above company and the product model only. It may not be duplicated without prior written consent of Bay Area Compliance Laboratory Corporation. This report **must not** be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the US Government.

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## GENERAL INFORMATION

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

The RAE Systems, Inc's product, FCC ID: SU3RM2420, Model: RM2420 or the "EUT" as referred to this report is 802.15.4 Radio Communication Module which measures approximately 255mmL x 175mmW x 153mmH. The EUT operates at the frequency range of 2405– 2480MHz, with maximum output power of 1mW.

*\* The test data gathered are from typical production sample, serial number: 000D6F0000002E2A, provided by the manufacturer.*

### Objective

This type approval report is prepared on behalf of RAE Systems, Inc in accordance with Part 2, Subpart J, Part 15, Subparts A, B, C of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC 15.247 rules for the DTS:

- Antenna Requirement
- AC Line Conduction
- 6 dB Bandwidth
- RF Output Power
- 100 kHz Bandwidth of Frequency Band Edge
- Peak Power Spectral Density
- Spurious Emission
- Spurious Emission at Antenna Port
- RF Exposure

### 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 Open Area Test site used by BACL Corp. to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, 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.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 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 can be found at <http://ts.nist.gov/ts/htdocs/210/214/scopes/2001670.htm>

## SYSTEM TEST CONFIGURATION

### Justification

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

The final qualification test was performed with the EUT operating at normal mode.

### Block Diagram

Please refer to Exhibit D.

### Equipment Modifications

No modifications were made to the EUT.

### Support Equipment List and Details

| Manufacturer | Description | Model         | Serial Number | FCC ID |
|--------------|-------------|---------------|---------------|--------|
| Compaq       | Laptop PC   | Presario 2100 | N/A           | N/A    |
| RAE          | Power board | N/A           | N/A           | N/A    |

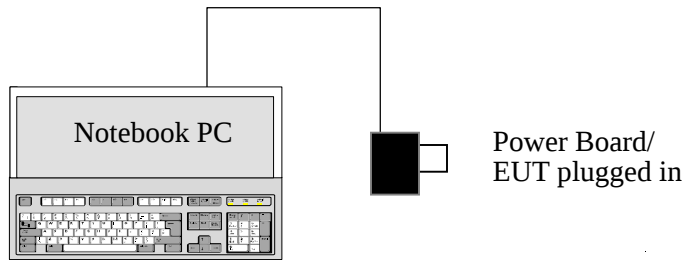
### Power Supply Information

| Manufacturer | Description | Model | Serial Number | FCC ID |
|--------------|-------------|-------|---------------|--------|
| RAE          | Power board | N/A   | N/A           | DOC    |

### Interface Ports and Cabling

| Cable Description | Length (M) | From                     | To                         |
|-------------------|------------|--------------------------|----------------------------|
|                   |            | J1 Connector /EUT        | J9 Connector / Power Board |
| Shielded Cable    | 0.3        | RSS232 Port /Power board | RSS232 Port / Laptop PC    |

## Configuration of Test System



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

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| FCC RULES              | DESCRIPTION OF TEST                      | RESULT    |
|------------------------|------------------------------------------|-----------|
| §2.1093, §15.247(b)(4) | RF Exposure Requirement                  | Compliant |
| §15.203                | Antenna Requirement                      | Compliant |
| § 15.207(a)            | AC Line Conduction                       | Compliant |
| § 15.205 & § 15.209    | Radiated Emission                        | Compliant |
| §15.247(a)(2)          | 6 dB Bandwidth                           | Compliant |
| §15.247(b)(3)          | RF Output Power                          | Compliant |
| § 15.247(c)            | 100 kHz Bandwidth of Frequency Band Edge | Compliant |
| §15.247(d)             | Peak Power Spectral Density              | Compliant |
| §2.1051                | Spurious Emission at Antenna Port        | Compliant |

## §1.1307(b)(1) & §2.1093 - RF EXPOSURE

According to §15.247(b)(4) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

According to §1.1310 and §2.1093 RF exposure is calculated.

### Limits for General Population/Uncontrolled Exposure

| Frequency Range (MHz)                               | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm <sup>2</sup> ) | Averaging Time (minute) |
|-----------------------------------------------------|-------------------------------|-------------------------------|-------------------------------------|-------------------------|
| Limits for General Population/Uncontrolled Exposure |                               |                               |                                     |                         |
| 0.3-1.34                                            | 614                           | 1.63                          | *(100)                              | 30                      |
| 1.34-30                                             | 824/f                         | 2.19/f                        | *(180/f <sup>2</sup> )              | 30                      |
| 30-300                                              | 27.5                          | 0.073                         | 0.2                                 | 30                      |
| 300-1500                                            | /                             | /                             | f/1500                              | 30                      |
| 1500-100,000                                        | /                             | /                             | 1.0                                 | 30                      |

f = frequency in MHz

\* = Plane-wave equivalent power density

### MPE Prediction

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal: 0 (dBm)

Maximum peak output power at antenna input terminal: 1 (mW)

Predication frequency: 2400 (MHz)

Antenna Gain (typical): 2 (dBi)

antenna gain: 1.58 (numeric)

Prediction distance: 2.5 (cm)

Power density at predication frequency at 2.5 cm: 0.02 (mW/cm<sup>2</sup>)

MPE limit for uncontrolled exposure at prediction frequency: 1.0 (mW/cm<sup>2</sup>)

### Test Result

The EUT is a portable device. The Power density at predication frequency at 2.5 cm is 0.02 mW/cm<sup>2</sup> within the limit of 1.0 mW/cm<sup>2</sup>.

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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 gain of antenna used for transmitting is 2 dBi. It is an external antenna.

## §15.207(a) - CONDUCTED EMISSION

### Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, and LISN.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement at BACL is  $\pm 2.4$  dB.

### Test Setup

The measurement was performed at shield room, using the same setup per ANSI C63.4 – 2003 measurement procedure. The specification used was FCC Class B limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The Notebook PC was connected with LISN-1.

### Receiver Setup

The receiver was set to investigate the spectrum from 150 kHz to 30MHz.

### Test Equipment List and Details

| Manufacturer    | Description          | Model   | Serial Number | Cal. Date  |
|-----------------|----------------------|---------|---------------|------------|
| Rohde & Schwarz | LISN                 | ESH2-Z5 | 871884/039    | 2004-08-16 |
| Rohde & Schwarz | EMI Test Receiver    | ESCS30  | 100176        | 2004-09-15 |
| Fluke           | Calibrated Voltmeter | 189     | 18485-38      | 2004-07-18 |

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

### Test Procedure

During the conducted emission test, the power cord of the host system was connected to the mains outlet of the LISN-1.

Maximizing procedure were performed on the six (6) highest emissions of the EUT.

All data was recorded in the peak detection mode, quasi-peak and average. Quasi-Peak readings are distinguished with an "QP". Average readings are distinguished with an "Ave".

## Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 13° C     |
| Relative Humidity: | 82%       |
| ATM Pressure:      | 1018 mbar |

The testing was performed by Ming Jin on 2005-01-10.

## Summary of Test Results

According to the data in section 8.6, the EUT complied with the FCC 15.247, and had the worst margin of:

**-5.8 dB at 1.740 MHz in the Line conductor**

## Conducted Emissions Test Data

| LINE CONDUCTED EMISSIONS |                   |                         |                       | FCC CLASS B   |              |
|--------------------------|-------------------|-------------------------|-----------------------|---------------|--------------|
| Frequency<br>MHz         | Amplitude<br>dBμV | Detector<br>Qp/Ave/Peak | Phase<br>Line/Neutral | Limit<br>dBμV | Margin<br>dB |
| 1.740                    | 40.2              | AVE                     | Line                  | 46            | -5.8         |
| 0.400                    | 43.8              | AVE                     | Line                  | 53            | -9.2         |
| 0.400                    | 49.4              | QP                      | Line                  | 63            | -13.6        |
| 1.740                    | 41.1              | QP                      | Line                  | 56            | -14.9        |
| 26.500                   | 33.9              | AVE                     | Line                  | 50            | -16.1        |
| 0.400                    | 44.1              | QP                      | Neutral               | 63            | -18.9        |
| 0.400                    | 33.3              | AVE                     | Neutral               | 53            | -19.7        |
| 2.030                    | 32.9              | QP                      | Neutral               | 56            | -23.1        |
| 26.400                   | 35.1              | QP                      | Line                  | 60            | -24.9        |
| 26.400                   | 34.2              | QP                      | Neutral               | 60            | -25.8        |
| 2.030                    | 20.0              | AVE                     | Neutral               | 46            | -26.0        |
| 26.500                   | 22.0              | AVE                     | Neutral               | 50            | -28.0        |

## Plot of Conducted Emissions Test Data

Plot(s) of Conducted Emissions Test Data is presented in the following page as reference.

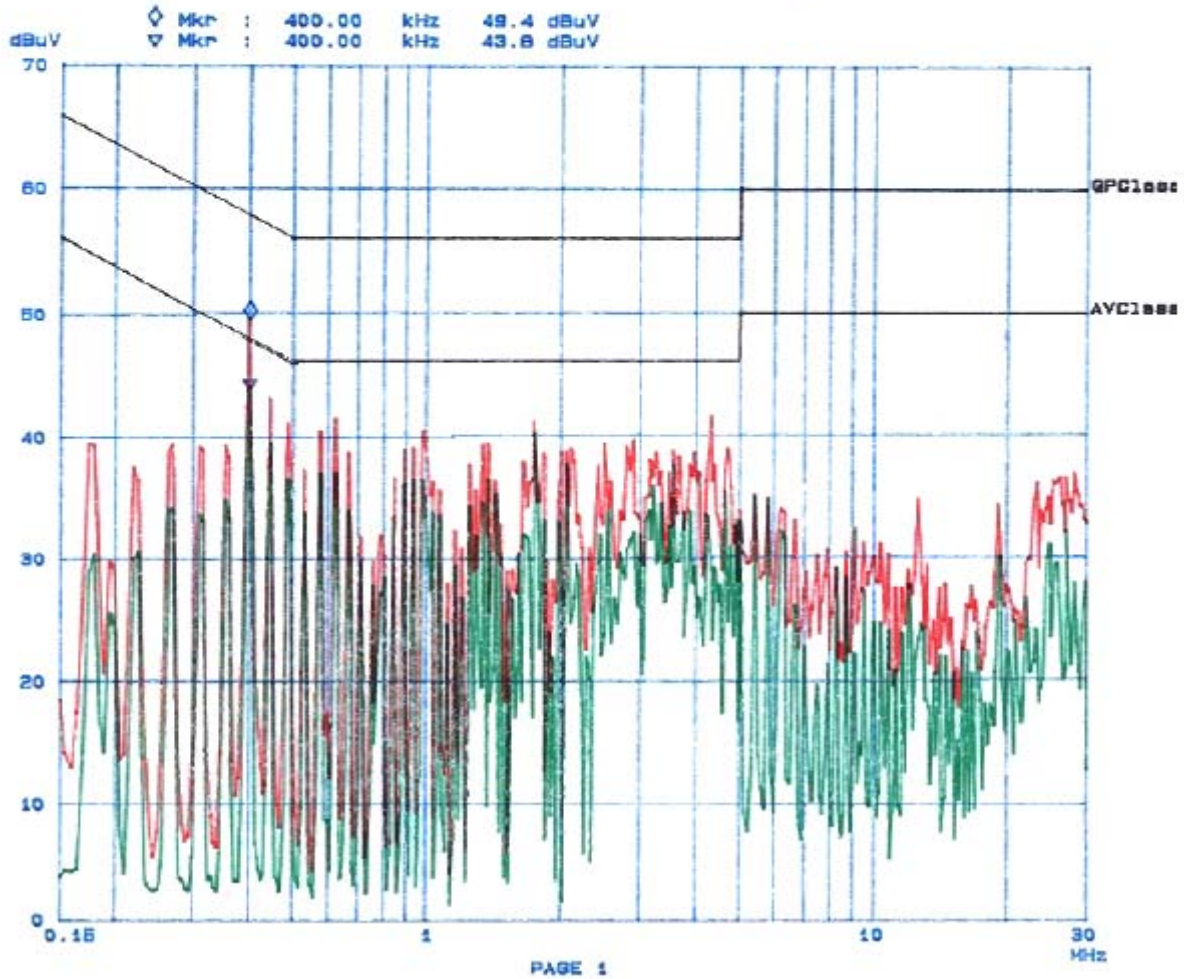
BayArea Compliance Laboratory Corp  
Class B

10. Jan 08 15:01

EUT: RM2420  
Manuf: RAE  
Op Cond: Normal  
Operator: Ming  
Comment: L

## Scan Settings (3 Ranges)

| Frequencies |      |      | Receiver Settings |          |        |         |        |
|-------------|------|------|-------------------|----------|--------|---------|--------|
| Start       | Stop | Step | IF BW             | Detector | M-Time | Atten   | Preamp |
| 150k        | 1M   | 5k   | 9k                | QP+AV    | 20ms   | 15dB LN | OFF    |
| 1M          | 5M   | 10k  | 9k                | QP+AV    | 1ms    | 15dB LN | OFF    |
| 5M          | 30M  | 100k | 9k                | QP+AV    | 1ms    | 15dB LN | OFF    |



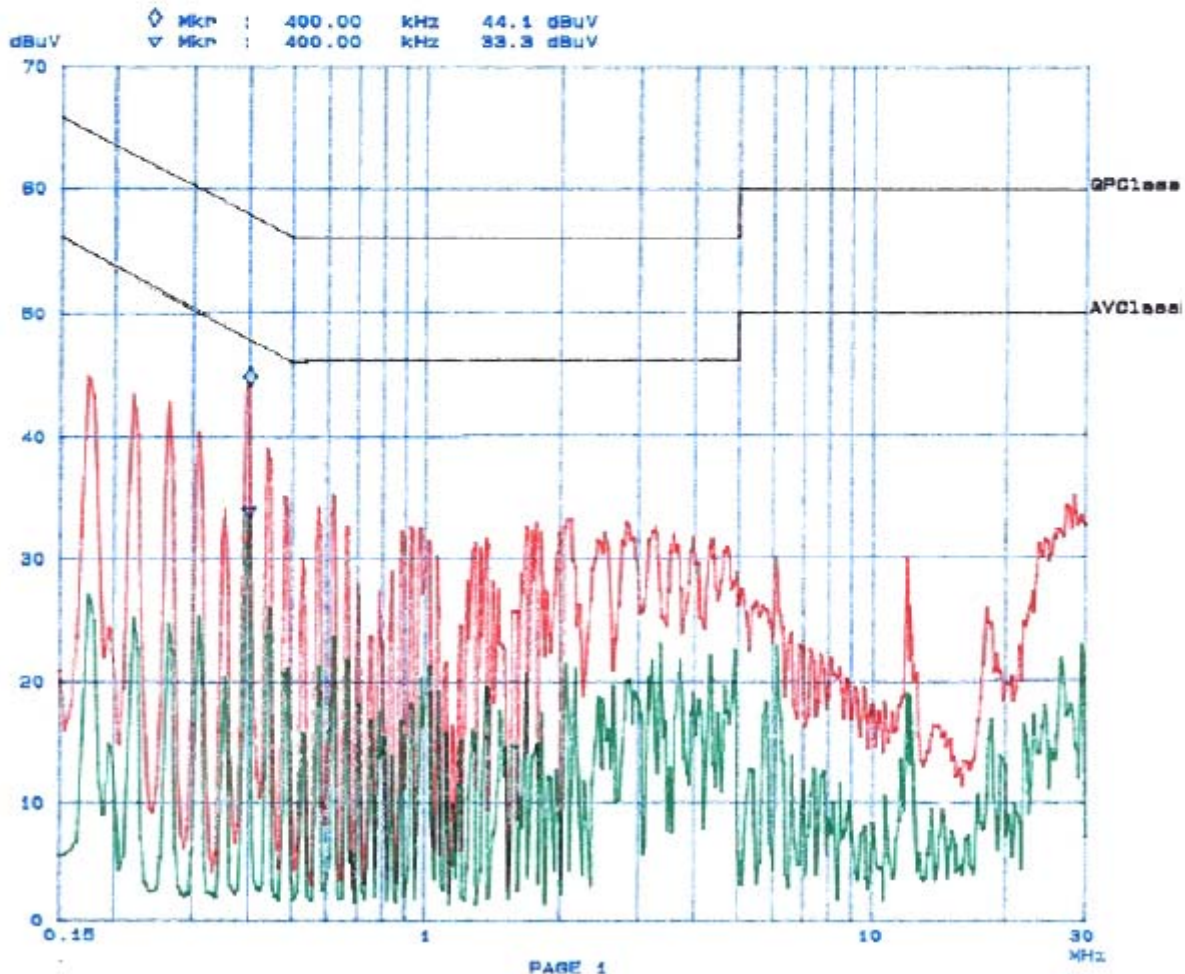
BayArea Compliance Laboratory Corp  
Class B

10. Jan 05 14:34

EUT: RM2420  
Manuf: RAE  
Op Cond: NOP881  
Operator: Ming  
Comment: N

## Scan Settings (3 Ranges)

| Frequencies |      |      | Receiver Settings |          |        |         |         |
|-------------|------|------|-------------------|----------|--------|---------|---------|
| Start       | Stop | Step | IF BW             | Detector | M-Time | Atten   | Preampl |
| 150k        | 1M   | 5k   | 9k                | QP+AV    | 20ms   | 15dB LN | OFF     |
| 1M          | 5M   | 10k  | 9k                | QP+AV    | 1ms    | 15dB LN | OFF     |
| 5M          | 30M  | 100k | 9k                | QP+AV    | 1ms    | 15dB LN | OFF     |



## §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 analyzer, 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.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The EUT was connected to support board, which powered by the AC adapter. And the AC adapter was connected with 120Vac/60Hz power source.

### 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:

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

For average measurement: RBW = 1 MHz, VBW = 10Hz.

### Test Equipment List and Details

| <b>Manufacturer</b> | <b>Description</b>        | <b>Model</b> | <b>Serial Number</b> | <b>Cal. Date</b> |
|---------------------|---------------------------|--------------|----------------------|------------------|
| HP                  | Amplifier, Pre, microwave | 8449B        | 3147A00400           | 2004-03-14       |
| HP                  | Amplifier, Pre            | 8447E        | 1937A01057           | 2004-08-04       |
| HP                  | Analyzer, Spectrum        | 8565EC       | 3946A00131           | 2004-06-30       |
| ETS                 | Antenna, Biconical        | 3110B        | 9603-2315            | 2004-01-11       |
| A.R.A.              | Antenna, Horn, DRG        | DRG-118/A    | 1132                 | 2004-09-30       |
| A. H. Systems       | Antenna, Horn, DRG        | SAS-200/571  | 2455-261             | 2004-08-01       |
| ETS                 | Antenna, logperiodic      | 3148         | 0004-1155            | 2004-10-11       |

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

## Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 13° C     |
| Relative Humidity: | 82%       |
| ATM Pressure:      | 1018 mbar |

*The testing was performed by Ming Jin on 2005-01-07.*

## Test Procedure

For the radiated emissions test, both the laptop and all peripheral power cords were connected to the AC floor outlet since the power supply used in the laptop did not provide an accessory power outlet.

Maximizing procedure was performed on the six (6) highest 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.

## 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 in section 10.7, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.207, and 15.247, and had the worst margin of:

**-18.5 dB at 4810.0000 MHz in the Vertical polarization, Low Channel.**

**-18.3 dB at 4880.0000 MHz in the Vertical polarization, Mid Channel.**

**-18.7 dB at 4960.0000 MHz in the Vertical polarization, High Channel.**

**-5.0 dB at 492.69 MHz in the Horizontal polarization, Unintentional Emission.**

| Indicated      |        |           | Antenna | Antenna |         | Correction Factor |      |             | FCC 15 Subpart C |        |           |
|----------------|--------|-----------|---------|---------|---------|-------------------|------|-------------|------------------|--------|-----------|
| 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    |        |           |         |         |         |                   |      |             |                  |        |           |
| 2405.00        | 94.2   | 90        | 1.5     | v       | 28.1    | 2.0               | 35.5 | 88.8        |                  |        | Fund/Peak |
| 2405.00        | 93.6   | 90        | 1.6     | h       | 28.1    | 2.0               | 35.5 | 88.2        |                  |        | Fund/Peak |
| 2405.00        | 37.4   | 90        | 1.5     | v       | 28.1    | 2.0               | 35.5 | 32.0        |                  |        | Fund/Ave. |
| 2405.00        | 36.8   | 90        | 1.6     | h       | 28.1    | 2.0               | 35.5 | 31.4        |                  |        | Fund/Ave. |
| 4810.00        | 54.5   | 30        | 1.5     | v       | 32.5    | 3.1               | 34.6 | 55.5        | 74               | -18.5  | Peak      |
| 7215.00        | 31.5   | 60        | 1.2     | v       | 34.1    | 3.4               | 34.5 | 34.5        | 54               | -19.5  | Ave.      |
| 4810.00        | 32.4   | 30        | 1.5     | v       | 32.5    | 3.1               | 34.6 | 33.4        | 54               | -20.6  | Ave.      |
| 7215.00        | 30.2   | 110       | 1.5     | h       | 34.1    | 3.4               | 34.5 | 33.2        | 54               | -20.8  | Ave.      |
| 4810.00        | 31.8   | 120       | 1.8     | h       | 32.5    | 3.1               | 34.6 | 32.8        | 54               | -21.2  | Ave.      |
| 2390.00        | 57.3   | 90        | 1.5     | v       | 28.1    | 2.0               | 35.5 | 51.9        | 74               | -22.1  | Peak      |
| 2390.00        | 36.7   | 90        | 1.5     | v       | 28.1    | 2.0               | 35.5 | 31.3        | 54               | -22.7  | Ave.      |
| 7215.00        | 47.8   | 60        | 1.2     | v       | 34.1    | 3.4               | 34.5 | 50.8        | 74               | -23.2  | Peak      |
| 2390.00        | 55.1   | 90        | 1.6     | h       | 28.1    | 2.0               | 35.5 | 49.7        | 74               | -24.3  | Peak      |
| 4810.00        | 48.3   | 120       | 1.8     | h       | 32.5    | 3.1               | 34.6 | 49.3        | 74               | -24.7  | Peak      |
| 2390.00        | 34.3   | 90        | 1.6     | h       | 28.1    | 2.0               | 35.5 | 28.9        | 54               | -25.1  | Ave.      |
| 7215.00        | 42.1   | 110       | 1.5     | h       | 34.1    | 3.4               | 34.5 | 45.1        | 74               | -28.9  | Peak      |
| Middle Channel |        |           |         |         |         |                   |      |             |                  |        |           |
| 2440.00        | 94.5   | 60        | 1.6     | v       | 28.1    | 2.0               | 35.5 | 89.1        |                  |        | Fund/Peak |
| 2440.00        | 93.8   | 0         | 1.5     | h       | 28.1    | 2.0               | 35.5 | 88.4        |                  |        | Fund/Peak |
| 2440.00        | 37.7   | 60        | 1.6     | v       | 28.1    | 2.0               | 35.5 | 32.3        |                  |        | Fund/Ave. |
| 2440.00        | 36.9   | 0         | 1.5     | h       | 28.1    | 2.0               | 35.5 | 31.5        |                  |        | Fund/Ave. |
| 4880.00        | 54.7   | 45        | 1.2     | v       | 32.5    | 3.1               | 34.6 | 55.7        | 74               | -18.3  | Peak      |
| 7320.00        | 31.7   | 90        | 1.6     | v       | 34.1    | 3.4               | 34.5 | 34.7        | 54               | -19.3  | Ave.      |
| 4880.00        | 32.6   | 45        | 1.2     | v       | 32.5    | 3.1               | 34.6 | 33.6        | 54               | -20.4  | Ave.      |
| 7320.00        | 30.5   | 310       | 1.8     | h       | 34.1    | 3.4               | 34.5 | 33.5        | 54               | -20.5  | Ave.      |
| 4880.00        | 31.9   | 120       | 1.5     | h       | 32.5    | 3.1               | 34.6 | 32.9        | 54               | -21.1  | Ave.      |
| 7320.00        | 48.2   | 90        | 1.6     | v       | 34.1    | 3.4               | 34.5 | 51.2        | 74               | -22.8  | Peak      |
| 4880.00        | 48.5   | 120       | 1.5     | h       | 32.5    | 3.1               | 34.6 | 49.5        | 74               | -24.5  | Peak      |
| 7320.00        | 42.3   | 310       | 1.8     | h       | 34.1    | 3.4               | 34.5 | 45.3        | 74               | -28.7  | Peak      |

| High Channel           |      |     |     |   |      |     |      |      |      |       |           |
|------------------------|------|-----|-----|---|------|-----|------|------|------|-------|-----------|
| 2480.00                | 93.8 | 90  | 1.6 | v | 28.1 | 2.0 | 35.5 | 88.4 |      |       | Fund/Peak |
| 2480.00                | 93.1 | 110 | 1.5 | h | 28.1 | 2.0 | 35.5 | 87.7 |      |       | Fund/Peak |
| 2480.00                | 36.9 | 90  | 1.6 | v | 28.1 | 2.0 | 35.5 | 31.5 |      |       | Fund/Ave. |
| 2480.00                | 36.2 | 110 | 1.5 | h | 28.1 | 2.0 | 35.5 | 30.8 |      |       | Fund/Ave. |
| 4960.00                | 54.3 | 180 | 1.8 | v | 32.5 | 3.1 | 34.6 | 55.3 | 74   | -18.7 | Peak      |
| 7440.00                | 31.3 | 0   | 1.6 | v | 34.1 | 3.4 | 34.5 | 34.3 | 54   | -19.7 | Ave.      |
| 4960.00                | 32.2 | 180 | 1.8 | v | 32.5 | 3.1 | 34.6 | 33.2 | 54   | -20.8 | Ave.      |
| 7440.00                | 30.1 | 310 | 1.2 | h | 34.1 | 3.4 | 34.5 | 33.1 | 54   | -20.9 | Ave.      |
| 4960.00                | 31.6 | 290 | 1.5 | h | 32.5 | 3.1 | 34.6 | 32.6 | 54   | -21.4 | Ave.      |
| 2483.50                | 56.8 | 90  | 1.6 | v | 28.1 | 2.0 | 35.5 | 51.4 | 74   | -22.6 | Peak      |
| 2483.50                | 36.4 | 90  | 1.6 | v | 28.1 | 2.0 | 35.5 | 31.0 | 54   | -23.0 | Ave.      |
| 7440.00                | 47.5 | 0   | 1.6 | v | 34.1 | 3.4 | 34.5 | 50.5 | 74   | -23.5 | Peak      |
| 2483.50                | 54.7 | 110 | 1.5 | h | 28.1 | 2.0 | 35.5 | 49.3 | 74   | -24.7 | Peak      |
| 4960.00                | 48.1 | 290 | 1.5 | h | 32.5 | 3.1 | 34.6 | 49.1 | 74   | -24.9 | Peak      |
| 2483.50                | 34.1 | 110 | 1.5 | h | 28.1 | 2.0 | 35.5 | 28.7 | 54   | -25.3 | Ave.      |
| 7440.00                | 41.9 | 310 | 1.2 | h | 34.1 | 3.4 | 34.5 | 44.9 | 74   | -29.1 | Peak      |
| Unintentional Emission |      |     |     |   |      |     |      |      |      |       |           |
| 492.69                 | 48.1 | 120 | 1.2 | h | 17.6 | 3.1 | 27.8 | 41.0 | 46   | -5.0  |           |
| 536.34                 | 47.9 | 310 | 1.5 | h | 17.9 | 3.0 | 28.0 | 40.8 | 46   | -5.2  |           |
| 169.68                 | 50.8 | 210 | 1.5 | v | 12.9 | 1.9 | 27.5 | 38.1 | 43.5 | -5.4  |           |
| 670.21                 | 46.3 | 60  | 1.2 | v | 18.1 | 3.3 | 27.7 | 40.0 | 46   | -6.0  |           |
| 218.18                 | 52.4 | 90  | 1.5 | v | 11.8 | 2.2 | 27.2 | 39.2 | 46   | -6.8  |           |
| 90.20                  | 48.9 | 290 | 1.5 | h | 10.1 | 1.3 | 28.1 | 32.2 | 40   | -7.8  |           |
| 303.10                 | 47.5 | 0   | 1.5 | v | 14.4 | 2.3 | 26.9 | 37.3 | 46   | -8.7  |           |
| 116.33                 | 49.3 | 15  | 1.5 | v | 11.5 | 1.6 | 27.9 | 34.5 | 43.5 | -9.0  |           |
| 76.56                  | 47.7 | 60  | 1.6 | v | 9.5  | 1.2 | 28.1 | 30.3 | 40   | -9.7  |           |

Note:

Note:

- 1) FUND: Fundamental
- 2) AVG: Average
- 3) The level is too low to be tested for frequencies above fourth harmonic

## §2.1051 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

### Standard Applicable

Requirements: CFR 47, § 2.1051.

The spectrum was to be investigated to the tenth harmonics of the highest fundamental frequency as specified in § 2.1057.

### Measurement Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10<sup>th</sup> harmonic.

### Equipment Lists

| Manufacturer | Description       | Model   | Serial Number | Cal. Date    |
|--------------|-------------------|---------|---------------|--------------|
| HP           | Spectrum Analyzer | HP8564E | 3943A01781    | 2004-10-04   |
| HP           | Plotter           | HP7470A | 2541A49659    | Not Required |

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

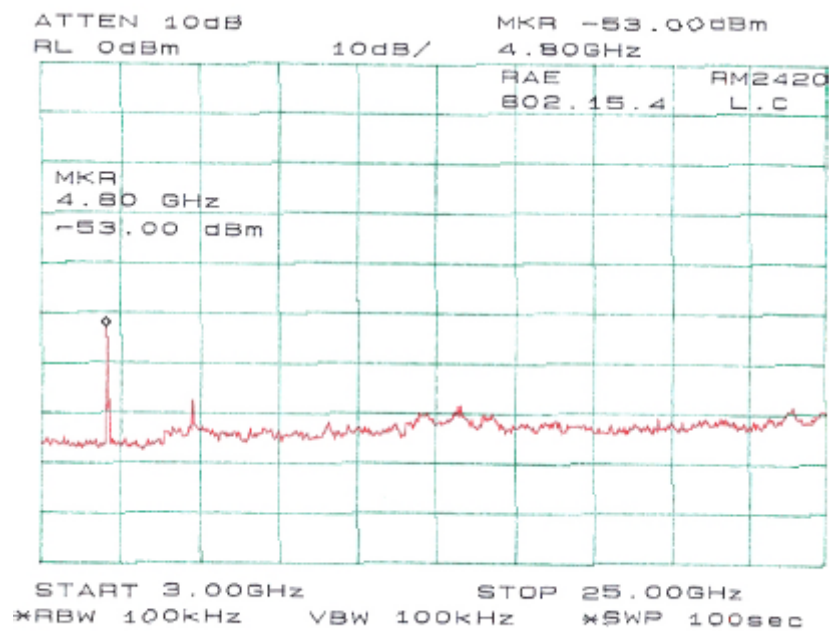
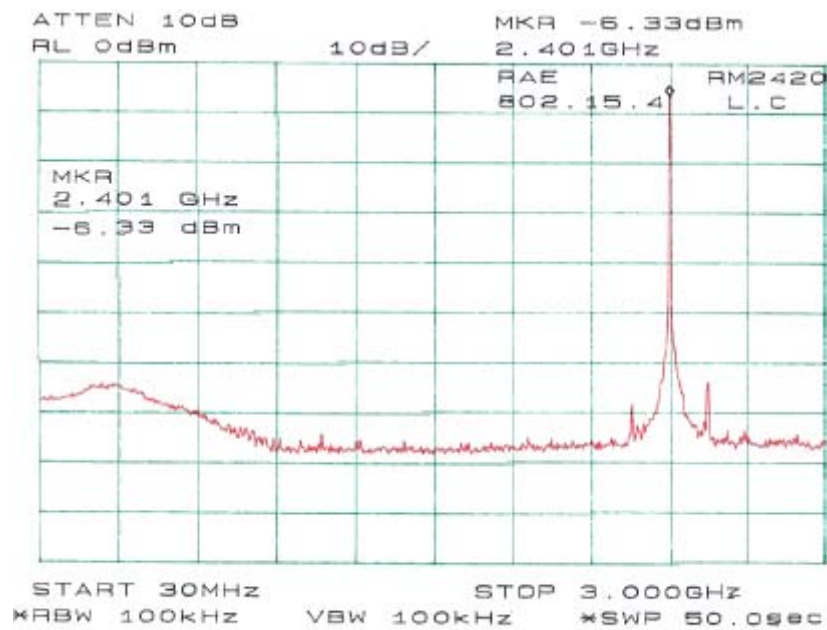
### Measurement Result

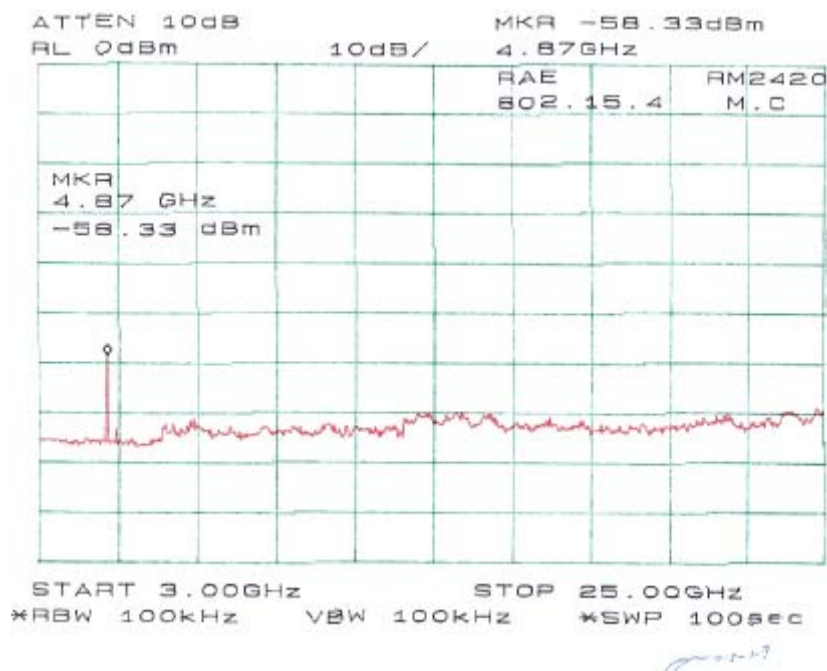
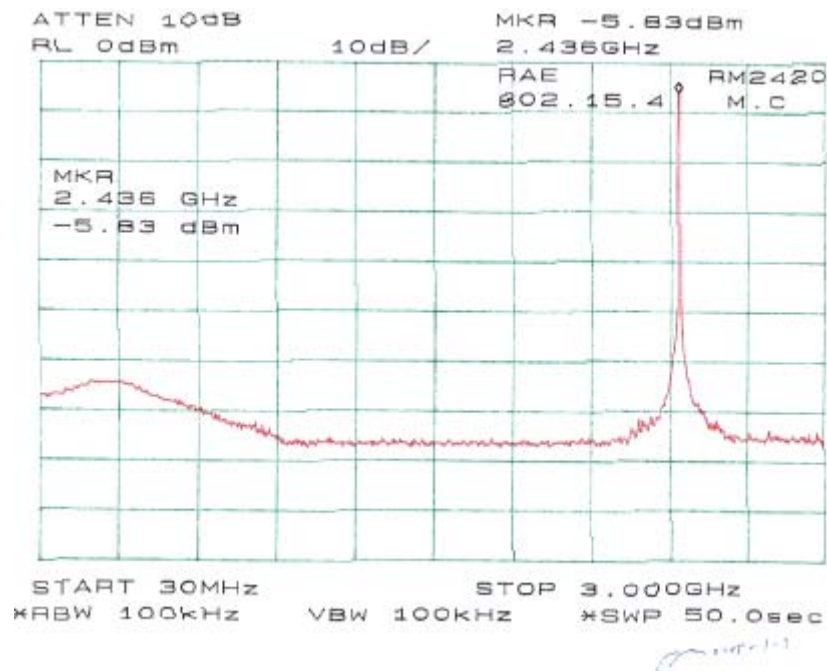
#### Environmental Conditions

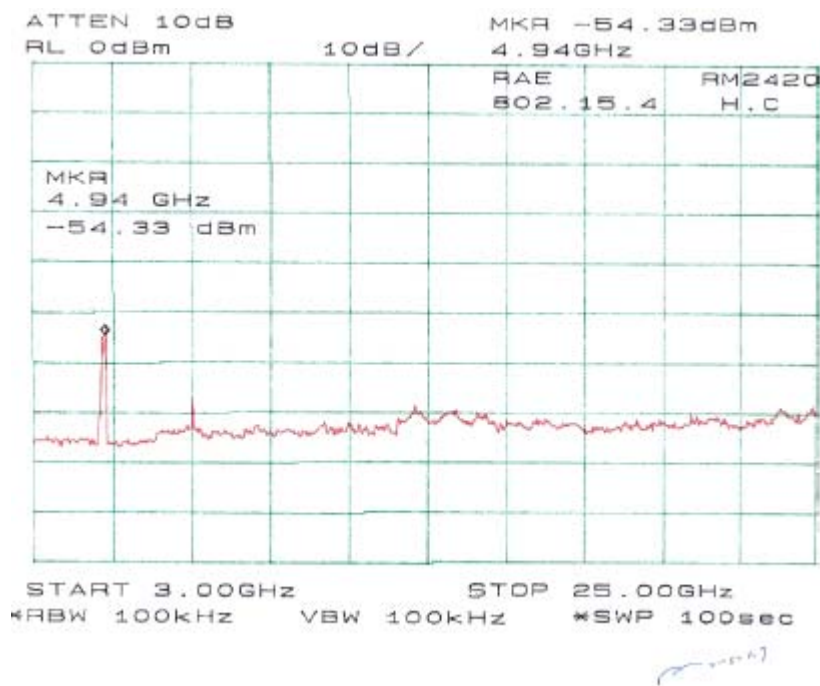
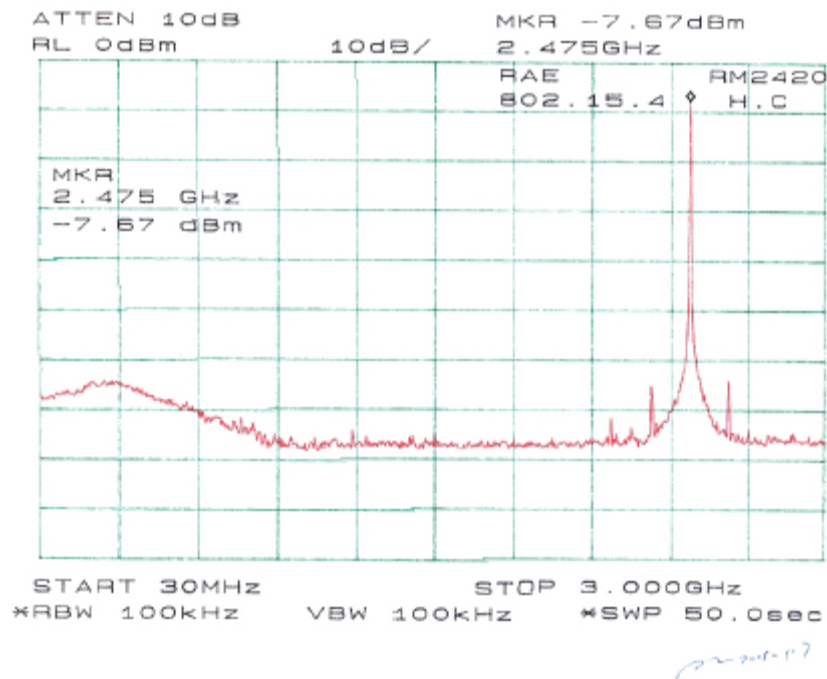
|                    |           |
|--------------------|-----------|
| Temperature:       | 18° C     |
| Relative Humidity: | 37%       |
| ATM Pressure:      | 1032 mbar |

*The testing was performed by Ming Jin on 2005-01-07.*

Please refer to following pages for plots of spurious emission.







## §15.247(a)(2) – 6 dB BANDWIDTH

### Standard Applicable

According to §15.247(a)(2), for direct sequence systems, 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.

### Equipment Lists

| Manufacturer | Model No. | Description       | Calibration Date |
|--------------|-----------|-------------------|------------------|
| HP           | 8565EC    | Spectrum Analyzer | 2004-08-06       |

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

### Measurement Result

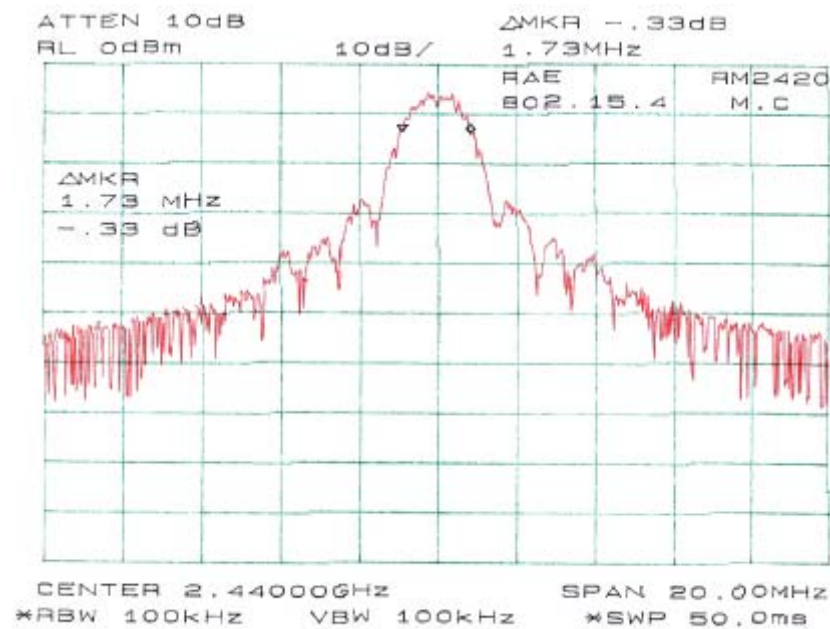
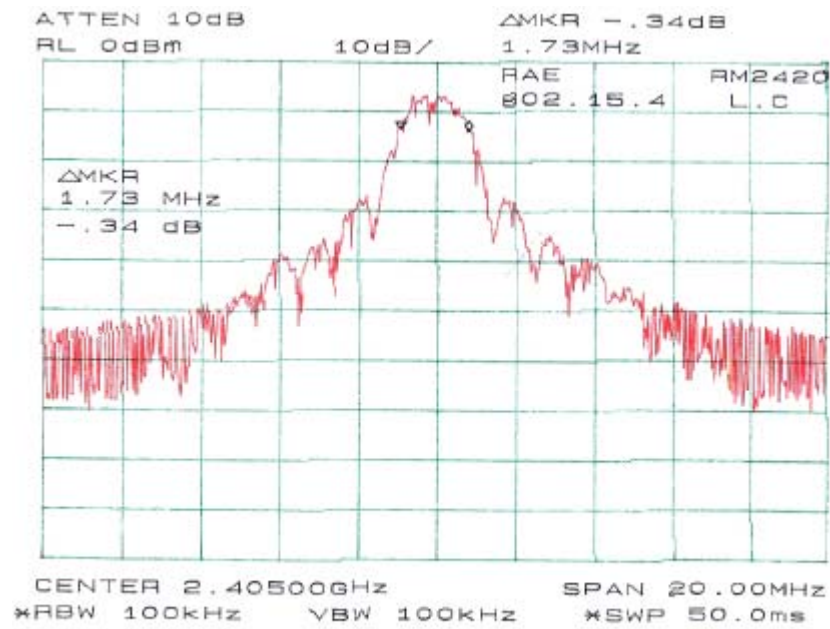
#### Environmental Conditions

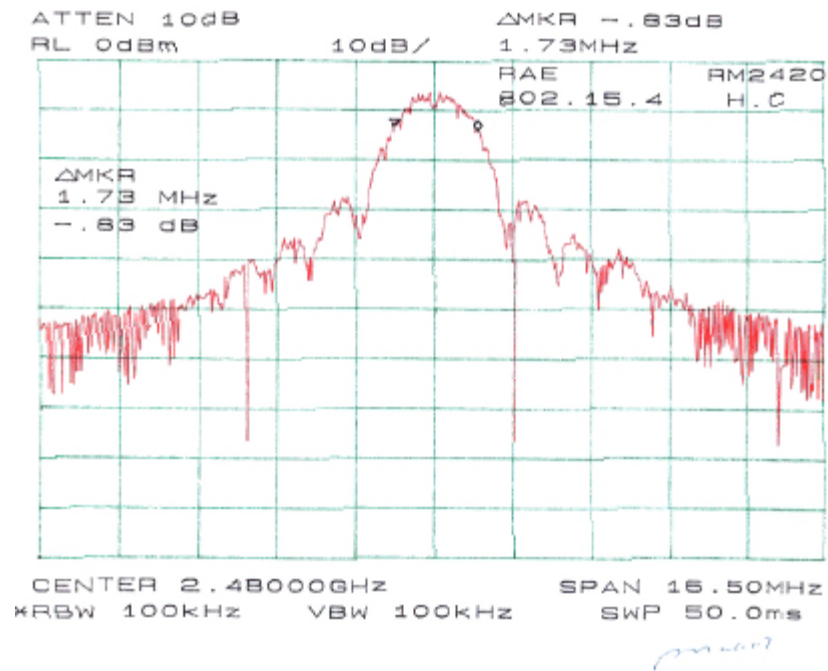
|                    |           |
|--------------------|-----------|
| Temperature:       | 18° C     |
| Relative Humidity: | 37%       |
| ATM Pressure:      | 1032 mbar |

The testing was performed by Ming Jin on 2005-01-07.

### Test Result

| Channel | Frequency (MHz) | Measured (MHz) | Standard (kHz) | Result    |
|---------|-----------------|----------------|----------------|-----------|
| Low     | 2405            | 1.73 MHz       | ≥ 500          | Compliant |
| Mid     | 2440            | 1.73 MHz       | ≥ 500          | Compliant |
| High    | 2480            | 1.73 MHz       | ≥ 500          | Compliant |





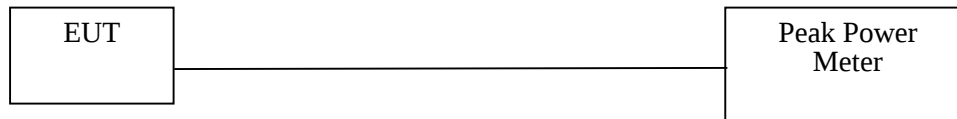
## §15.247(b)(3) - PEAK OUTPUT POWER MEASUREMENT

### Standard Applicable

According to §15.247(b) (3), for systems using digital modulation in 2400-2483.5 MHz: 1 Watt

### Measurement Procedure

1. Place the EUT on a bench 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 a Peak Power Meter.



### Equipment Lists

| Manufacturer | Model No. | Description      | Calibration Date |
|--------------|-----------|------------------|------------------|
| HP           | 432A      | Peak Power Meter | 2004-09-26       |

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

### Measurement Result

#### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 18° C     |
| Relative Humidity: | 37%       |
| ATM Pressure:      | 1032 mbar |

*The testing was performed by Ming Jin on 2005-01-07.*

802.15.4

| Channel | Frequency<br>MHz | Peak RF Power<br>dBm | Peak RF Power<br>mW | Limit      |
|---------|------------------|----------------------|---------------------|------------|
| Low     | 2405             | -0.03                | 0.99                | 1W (30dBm) |
| Mid     | 2440             | 0                    | 1                   | 1W (30dBm) |
| High    | 2480             | -0.07                | 0.98                | 1W (30dBm) |

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

### Standard Applicable

According to §15.247(c), in *any* 100 kHz bandwidth outside the frequency bands 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) see §15.205(c)).

### 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.

### Equipment Lists

| Manufacturer | Model No. | Description       | Calibration Date |
|--------------|-----------|-------------------|------------------|
| Agilent      | 8564E     | Spectrum Analyzer | 2004-10-04       |

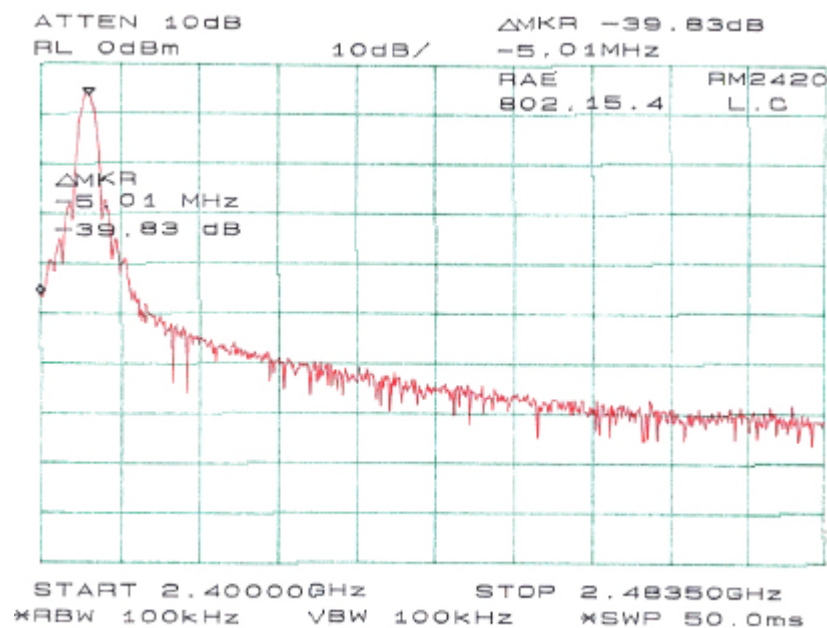
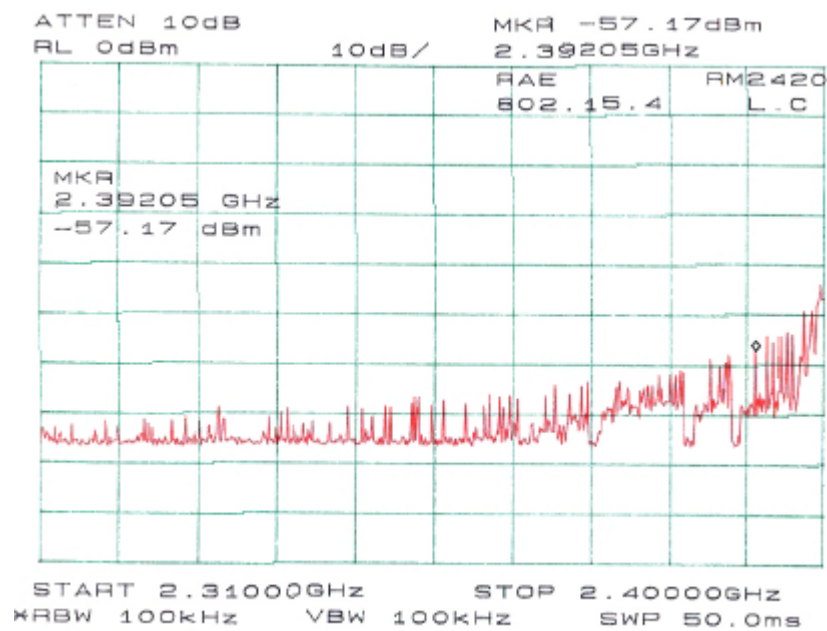
\* **Statement of Traceability:** **BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

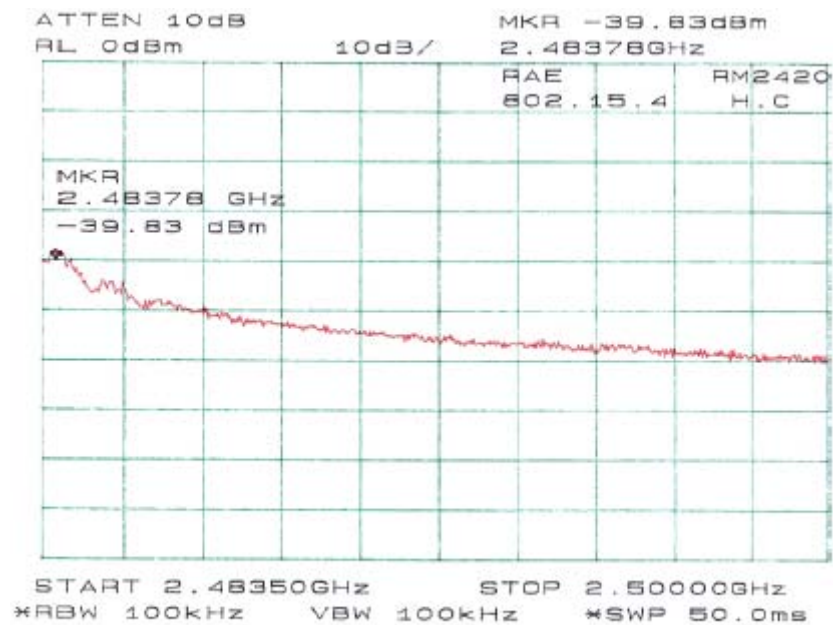
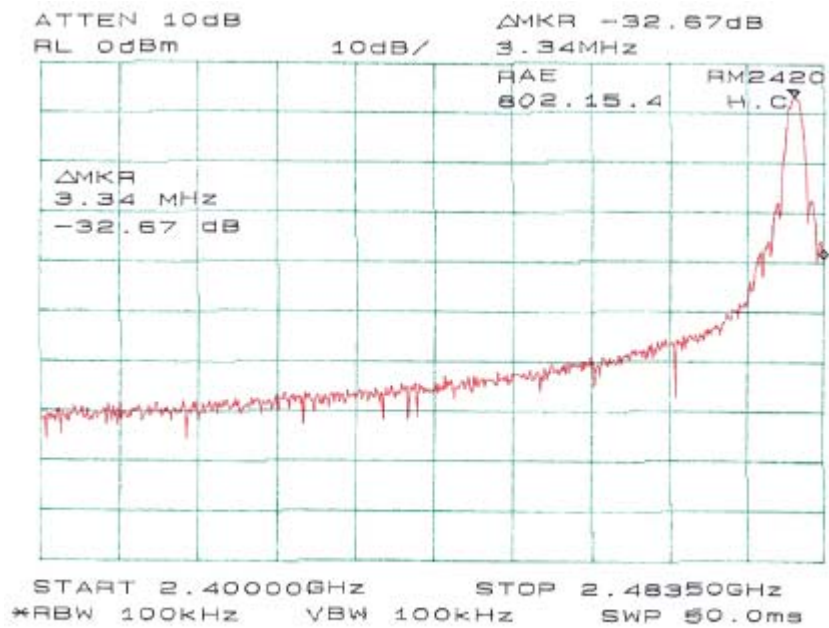
### Measure Results

#### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 18° C     |
| Relative Humidity: | 37%       |
| ATM Pressure:      | 1032 mbar |

*The testing was performed by Ming Jin on 2005-01-07.*





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**§15.247(d) & §15.407(a)(2) - POWER SPECTRAL DENSITY**

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**Standard Applicable**

According to §15.247 (d), 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 1MHz 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.

**Equipment Lists**

| Manufacturer | Model No. | Description       | Calibration Date |
|--------------|-----------|-------------------|------------------|
| Agilent      | 8564E     | Spectrum Analyzer | 2004-10-04       |

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

## Measurement Results

### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 18° C     |
| Relative Humidity: | 37%       |
| ATM Pressure:      | 1032 mbar |

The testing was performed by Ming Jing on 2005-01-07.

### Test Result

| Channel | Frequency (MHz) | Peak Power Spectral Density (dBm) | Standard (dBm) | Result    |
|---------|-----------------|-----------------------------------|----------------|-----------|
| Low     | 2405            | -12.50                            | $\leq 8$       | Compliant |
| Mid     | 2440            | -12.50                            | $\leq 8$       | Compliant |
| High    | 2480            | -13.33                            | $\leq 8$       | Compliant |

