

# FCC PART 15 SUBPART C

## EMI MEASUREMENT AND TEST REPORT

For

**Ambit Microsystems Corporation**

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Tu Chen, Taipei Hsien 236, Taiwan, R.O.C.

**FCC ID: MCLAIRMPI350DE**

2003-07-15

|                                                                                                                                                                     |                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| <b>This Report Concerns:</b><br><input checked="" type="checkbox"/> Original Report                                                                                 | <b>Equipment Type:</b><br>Wireless MiniPCI Card |
| <b>Test Engineer:</b> Ling Zhang                                                |                                                 |
| <b>Report No.:</b> R0305081                                                                                                                                         |                                                 |
| <b>Test Date:</b> 2003-07-09, 2003-07-16                                                                                                                            |                                                 |
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**Note:** This test report is specially limited to the above client company and 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 endorsement by NVLAP or any agency of the U.S. Government.

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## 1 - GENERAL INFORMATION

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

The *AMBIT Microsystems Corporation's* Model: *AIR-MPI350DE* or the "EUT" as referred to in this report is a wireless MiniPCI Card.

The mini PCI card wireless LAN card provides RF modem functionality utilizing direct sequence spread spectrum technology for client applications in the ISM 2.4GHz RF frequency band. Supporting a Type IIIA mini PCI from factor, this product provides industry-standard PHY/MAC functionality per the standard of IEEE 802.11b at 1, 2, 5.5 & 11 Mb/s data rates. The design is based on the Intersil Prism 2.5 chipset. This product will be PCI 2.2 compliant, and will provide a standard Mini PCI Card Interface through the industry-standard 124-pin connector. The product interface utilizes bus mastering DMA for all packet data transfers across the system bus.

The EUT provides the following feature(s):

- Compatible with IEEE 802.11b high rate standard to provide wireless Ethernet speeds of 11Mbps data rate
- Modulation BPSK-1 Mbps, QPSK-2 Mbps, CCK 5.5 and 11 Mbps
- Allow auto fallback data rate for optimized reliability, throughput and transmission range
- Supports wireless data encryption with 128-bit WEP standard for security, EAP and LEAP security is addresses with WEP (up to 1024 bit) and other security management provisions as enabled by the firmware and the host driver.
- Dual diversity antenna connectors supported for the multi-path environment
- Frequency 2400-2500MHz, useable 2412-2484 MHz in 1 MHz steps
- External ON/OFF switch & indicator LEDs
- It is a bus mastering PCI interface with full support for power management including ACPI power states D0-D3, CAM, MaxPSP and Fast PSP.
- 4M flash was designed to allow for the PXE code (remote boot), which is a BIOS extension.

The EUT was installed in 7 different notebooks with 7 corresponding different antennas. The notebook and antenna list is as follows:

|              |                  |
|--------------|------------------|
| D800 NEWEB   | CA0-C            |
| D800 HITACHI | HFT04-DL01       |
| D600 NEWEB   | CA5-Q            |
| D600 Hitachi | HFT01-DL01       |
| D400 Neweb   | CAB-A            |
| C400 Neweb   | PPO3L            |
| C640 Foxonn  | BM2-CABLE-ME (?) |

\* The test data in this test report was good for the test sample only. It may have deviation for other test samples.

## 1.2 Objective

This type approval report is prepared on behalf of *Ambit Microsystems Corporation* in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules for Output Power, Antenna Requirements, 6 dB Bandwidth, power density, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Spurious Radiated Emission.

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

No related Submittal(s)/Grant(s).

## 1.4 Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-1992, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz and FCC97114 for Direct Sequence SS.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

## 1.5 Test Facility

The Open Area Test site used by BACL 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 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 radiated and AC line conducted test site criteria set forth in ANSI C63.4-1992.

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 scope of the accreditation covers the FCC Method – 47 CFR Part – Digital Devices, CISPER 22: 1997: Electromagnetic Interference – Limits and Methods of Measurement of Information Technology Equipment test methods.

**1.6 Test Equipment List**

| Manufacturer | Description                      | Model       | Serial Number | Cal. Due Date |
|--------------|----------------------------------|-------------|---------------|---------------|
| HP           | Spectrum Analyzer                | 8568B       | 2517A01610    | 2003-10-30    |
| HP           | Amplifier                        | 8447E       | 2944A07030    | 2004-06-28    |
| HP           | Quasi-Peak Adapter               | 85650A      | 2521A00718    | 2004-03-08    |
| Com-Power    | Biconical Antenna                | AB-100      | 14012         | 2003-09-05    |
| Com-Power    | Log Periodic Antenna             | AL-100      | 16005         | 2003-08-23    |
| Com-Power    | Log Periodic Antenna             | AB-900      | 15049         | 2004-05-01    |
| Agilent      | Spectrum Analyzer (9KHz – 40GHz) | 8564E       | 3943A01781    | 2003-08-01    |
| Agilent      | Spectrum Analyzer (9KHz – 50GHz) | 8565EC      | 3946A00131    | 2004-05-03    |
| HP           | Amplifier (1-26.5GHz)            | 8449B       | 3147A00400    | 2004-03-14    |
| A.H.System   | Horn Antenna (700MHz-18GHz)      | SAS-200/571 | 261           | 2004-05-31    |

**\* Statement of Traceability: Bay Area Compliance Laboratory Corp.** certifies that all calibration has been performed using suitable standards traceable to the NIST.

**1.7 Support Equipment List and Details**

| Manufacturer     | Description | Model | Serial Number | FCC ID |
|------------------|-------------|-------|---------------|--------|
| See Section 1.10 | Notebook    | ZI2   | N/A           | DOC    |
| HP               | Printer     | 2225C | N/A           | DOC    |

**1.8 External I/O Cabling List and Details**

| Cable Description      | Length (M) | Port/From                 | To      |
|------------------------|------------|---------------------------|---------|
| Shielded Printer Cable | 2.0        | Parallel Port/Notebook PC | Printer |

**1.9 Power Supply Information**

| Manufacturer | Description              | Model   | Serial Number | FCC ID |
|--------------|--------------------------|---------|---------------|--------|
| Dell         | AC Adapter/ Battery Pack | AA22850 | B3865604AF01B | DOC    |

**1.10 Host PC Configurations**

#1

| Manufacturer                | Description          | Model        | Serial Number | FCC ID |
|-----------------------------|----------------------|--------------|---------------|--------|
| Dell                        | Laptop Computer      | D800         | N/A           | DOC    |
| Neweb                       | Wireless LAN Antenna | CA0-C        | N/A           | DOC    |
| Intel                       | CPU                  | Pentium 4    | N/A           | N/A    |
| MSI Microstar International | Motherboard          | MS-6391VER.1 | N/A           | DOC    |
| Teac                        | Floppy drive         | FD2335HF     | N/A           | N/A    |

#2

| Manufacturer                | Description          | Model        | Serial Number | FCC ID |
|-----------------------------|----------------------|--------------|---------------|--------|
| Dell                        | Laptop Computer      | D800         | N/A           | DOC    |
| Hitachi                     | Wireless LAN Antenna | Hf04-DL01    | N/A           | DOC    |
| Intel                       | CPU                  | Pentium 4    | N/A           | N/A    |
| MSI Microstar International | Motherboard          | MS-6391VER.1 | N/A           | DOC    |
| Teac                        | Floppy drive         | FD2335HF     | N/A           | N/A    |

#3

| Manufacturer                | Description          | Model        | Serial Number | FCC ID |
|-----------------------------|----------------------|--------------|---------------|--------|
| Dell                        | Laptop Computer      | D600         | N/A           | DOC    |
| Neweb                       | Wireless LAN Antenna | CA5-Q        | N/A           | DOC    |
| Intel                       | CPU                  | Pentium 4    | N/A           | N/A    |
| MSI Microstar International | Motherboard          | MS-6391VER.1 | N/A           | DOC    |
| Teac                        | Floppy drive         | FD2335HF     | N/A           | N/A    |

#4

| Manufacturer                | Description          | Model        | Serial Number | FCC ID |
|-----------------------------|----------------------|--------------|---------------|--------|
| Dell                        | Laptop Computer      | D600         | N/A           | DOC    |
| Hitachi                     | Wireless LAN Antenna | HFT01-DL01   | N/A           | DOC    |
| Intel                       | CPU                  | Pentium 4    | N/A           | N/A    |
| MSI Microstar International | Motherboard          | MS-6391VER.1 | N/A           | DOC    |
| Teac                        | Floppy drive         | FD2335HF     | N/A           | N/A    |

#5

| Manufacturer                | Description          | Model        | Serial Number | FCC ID |
|-----------------------------|----------------------|--------------|---------------|--------|
| Dell                        | Laptop Computer      | D400         | N/A           | DOC    |
| Neweb                       | Wireless LAN Antenna | CAB-A        | N/A           | DOC    |
| Intel                       | CPU                  | Pentium 4    | N/A           | N/A    |
| MSI Microstar International | Motherboard          | MS-6391VER.1 | N/A           | DOC    |
| Teac                        | Floppy drive         | FD2335HF     | N/A           | N/A    |

#6

| Manufacturer                | Description          | Model        | Serial Number | FCC ID |
|-----------------------------|----------------------|--------------|---------------|--------|
| Dell                        | Laptop Computer      | C400         | N/A           | DOC    |
| Neweb                       | Wireless LAN Antenna | CZ3-A        | N/A           | DOC    |
| Intel                       | CPU                  | Pentium 4    | N/A           | N/A    |
| MSI Microstar International | Motherboard          | MS-6391VER.1 | N/A           | DOC    |
| Teac                        | Floppy drive         | FD2335HF     | N/A           | N/A    |

#7

| Manufacturer                | Description          | Model        | Serial Number | FCC ID |
|-----------------------------|----------------------|--------------|---------------|--------|
| Dell                        | Laptop Computer      | C640         | N/A           | DOC    |
| Foxonn                      | Wireless LAN Antenna | BM2-CABLE-ME | N/A           | DOC    |
| Intel                       | CPU                  | Pentium 4    | N/A           | N/A    |
| MSI Microstar International | Motherboard          | MS-6391VER.1 | N/A           | DOC    |
| Teac                        | Floppy drive         | FD2335HF     | N/A           | N/A    |



## 2 - SYSTEM TEST CONFIGURATION

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### 2.1 Justification

The host system was configured for testing in a typical fashion (as normally used by a typical user).

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

### 2.2 EUT Exercise Software

The EUT exercise program used during radiated and conducted testing was designed to exercise the system components in a manner similar to a typical use. The test software, provided by the customer, is started the Windows terminal program under the Windows 98/2000/ME/XP operating system.

Once loaded, set the Tx channel to low, mid and high for testing.

### 2.3 Special Accessories

As shown in section 2.7, all interface cables used for compliance testing are shielded. The notebook and the peripherals featured shielded metal connectors.

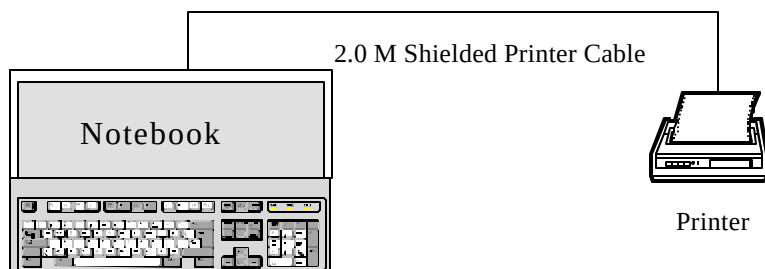
### 2.4 Schematics / Block Diagram

Please refer to Appendix A.

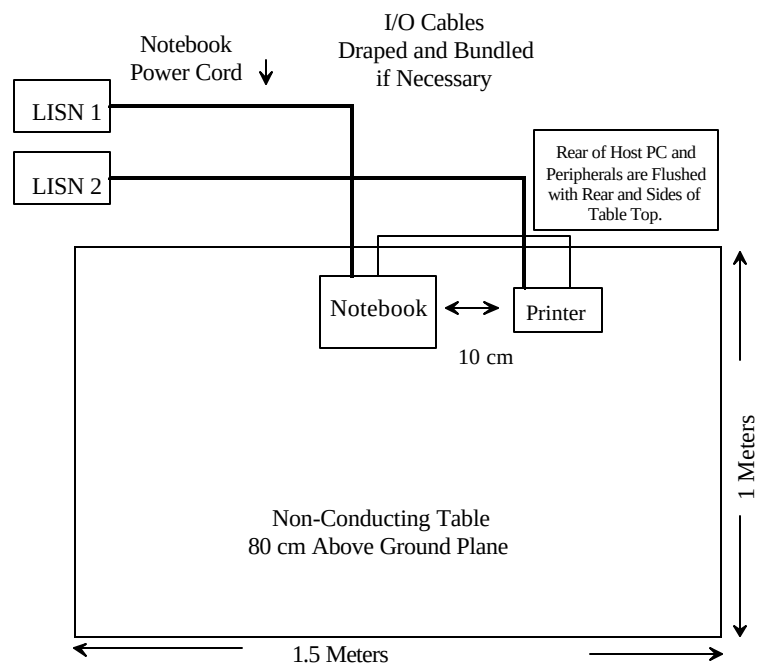
### 2.5 Equipment Modifications

No modifications were made by BACL to ensure the EUT to comply with the applicable limits and requirements.

### 2.6 Configuration of Test System



## 2.7 Test Setup Block Diagram



### 3 - SUMMARY OF TEST RESULTS

| FCC RULES       | DESCRIPTION OF TEST                      | RESULT    | REFERENCE  |
|-----------------|------------------------------------------|-----------|------------|
| §15.203         | Antenna Requirement                      | Compliant | Section 9  |
| § 15.205        | Restricted Bands                         | Compliant | Section 10 |
| §15.207 (a)     | Conducted Emission                       | Compliant | Section 11 |
| §15.209 (a)     | Radiated Emission                        | Compliant | Section 10 |
| §15.209 (a)     | Spurious Emission                        | Compliant | Section 6  |
| §15.247 (a) (2) | 6 dB Bandwidth                           | Compliant | Section 5  |
| §15.247 (b) (3) | Maximum Peak Output Power                | Compliant | Section 4  |
| § 15.247 (c)    | 100 kHz Bandwidth of Frequency Band Edge | Compliant | Section 8  |
| §15.247 (d)     | Peak Power Spectral Density              | Compliant | Section 7  |

## 4 - CONDUCTED OUTPUT POWER MEASUREMENT

### 4.1 Standard Applicable

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

### 4.2 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.
3. The peak power will be obtained by adding the bandwidth correction factor,  $10\log(\text{BW 6dB} / \text{RBW})$  to the peak power reading at  $\text{RBW} = 2.0 \text{ MHz}$  of the spectrum analyzer.

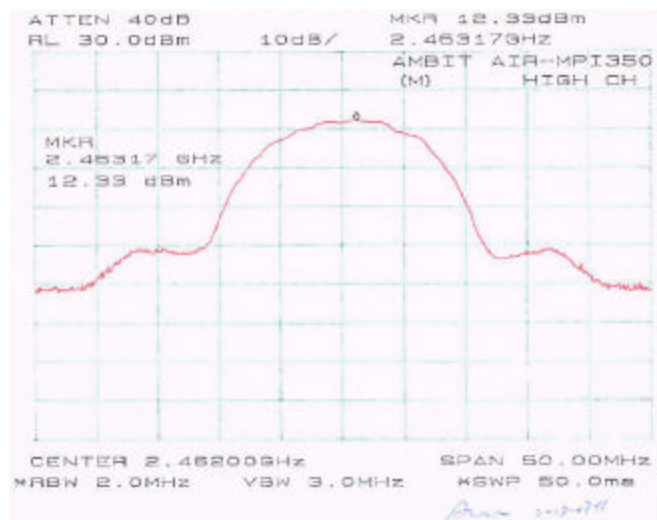
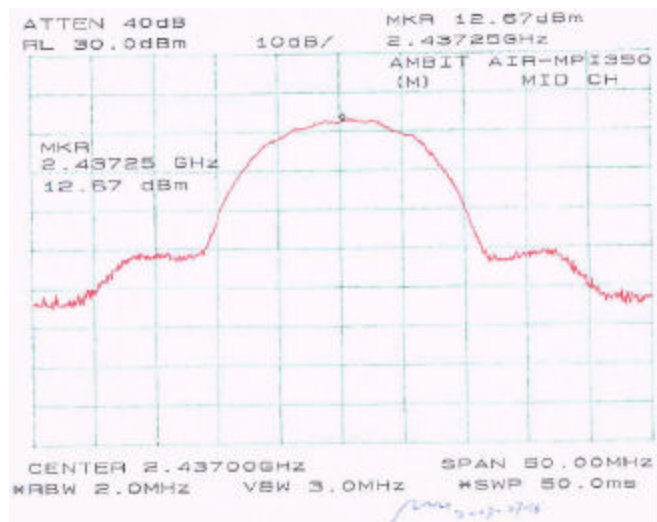
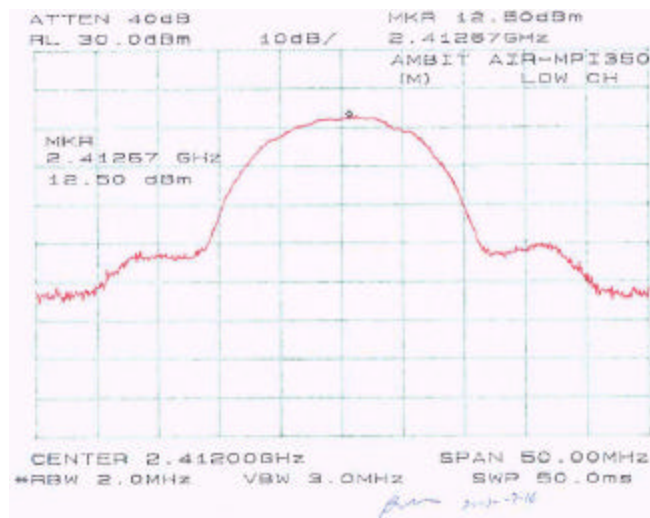
### 4.3 Test Equipment

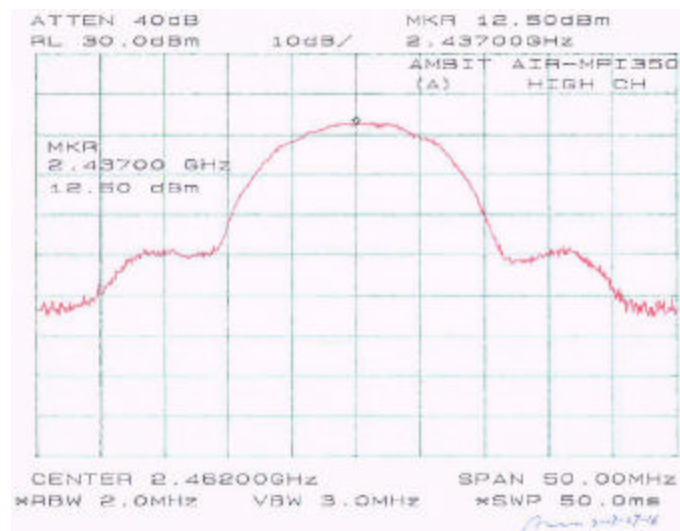
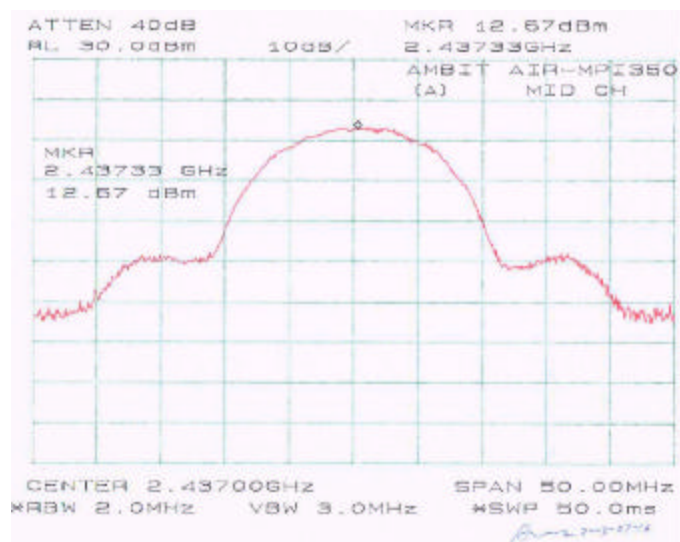
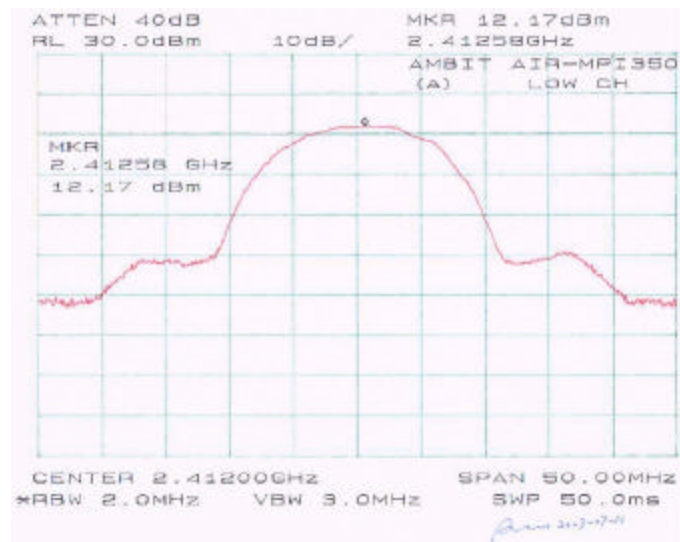
| Manufacturer | Model No. | Serial No.        | Calibration Due Date |
|--------------|-----------|-------------------|----------------------|
| HP           | 8564E     | Spectrum Analyzer | 2003-12-06           |

### 4.4 Measurement Result

| Antenna   | Frequency (MHz) | Peak Output Power (dBm) | Correction Factor (dBm) | Corrected Factor (dBm) | Output Power (W) | Standard (W)       | Result    |
|-----------|-----------------|-------------------------|-------------------------|------------------------|------------------|--------------------|-----------|
| Main      | 2412            | 12.50                   | 8.0                     | 20.50                  | 112.20           | $\leq 1 \text{ W}$ | Compliant |
|           | 2437            | 12.67                   | 8.0                     | 20.67                  | 116.68           | $\leq 1 \text{ W}$ | Compliant |
|           | 2462            | 12.33                   | 8.0                     | 20.33                  | 107.89           | $\leq 1 \text{ W}$ | Compliant |
| Auxiliary | 2412            | 12.17                   | 8.0                     | 20.17                  | 103.99           | $\leq 1 \text{ W}$ | Compliant |
|           | 2437            | 12.67                   | 8.0                     | 20.67                  | 116.68           | $\leq 1 \text{ W}$ | Compliant |
|           | 2462            | 12.50                   | 8.0                     | 20.50                  | 112.20           | $\leq 1 \text{ W}$ | Compliant |

Note: Correction Factor =  $10 \log (\text{BW6dB}/\text{RBW}) = 10 \log (17/2.0) = 9.3 \text{ dBm}$





## 5 – 6 DB BANDWIDTH

### 5.1 Standard Applicable

According to §15.247(a)(2), for systems using digital modulation techniques operate in 2400 – 2483.5MHz, the minimum 6dB bandwidth shall be at least 500 kHz.

### 5.2 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.
4. Repeat above procedures until all frequencies measured were complete.

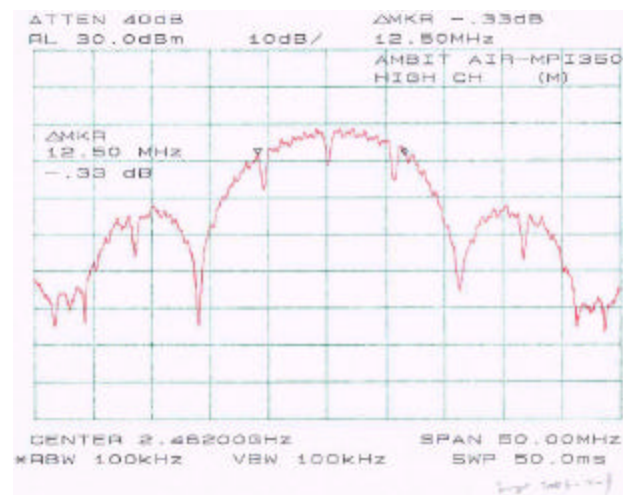
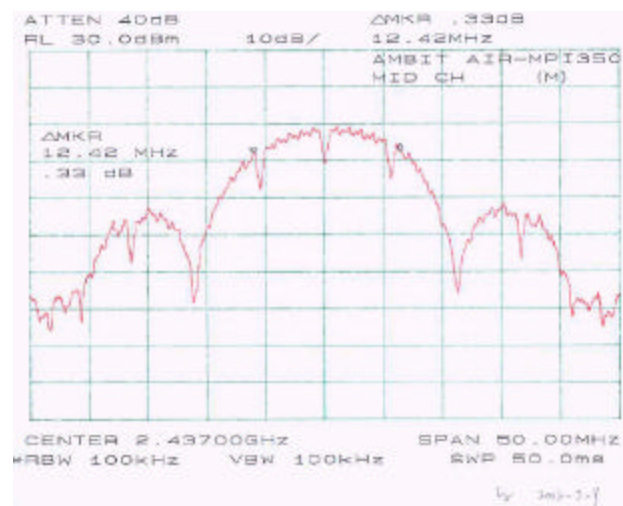
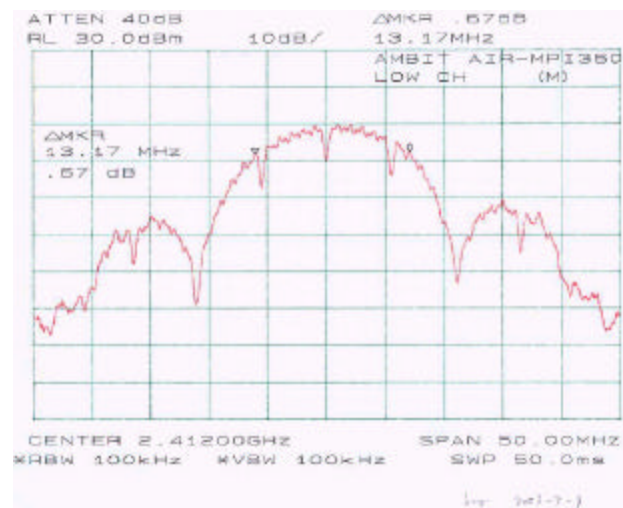
### 5.3 Test Equipment

| Manufacturer | Model No. | Serial No.        | Calibration Due Date |
|--------------|-----------|-------------------|----------------------|
| HP           | 8564E     | Spectrum Analyzer | 2003-12-06           |

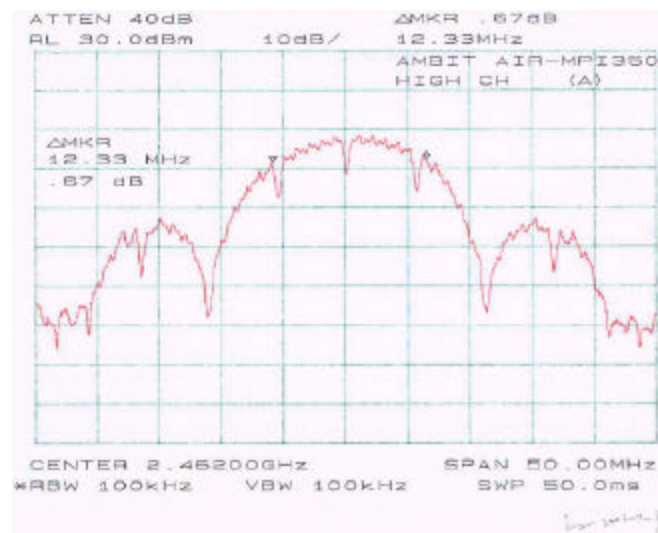
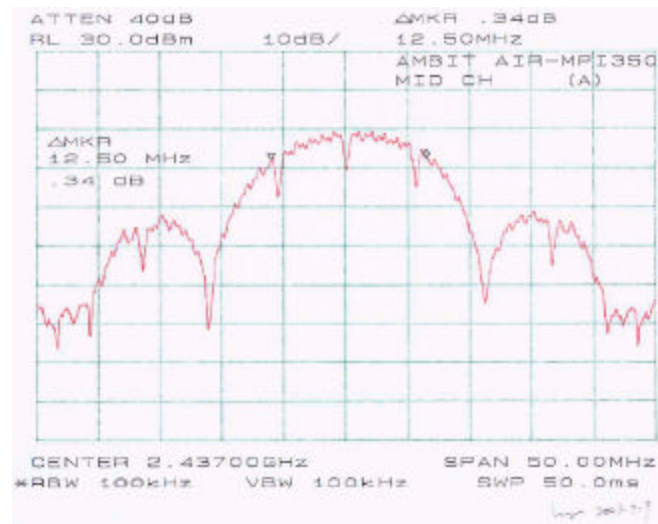
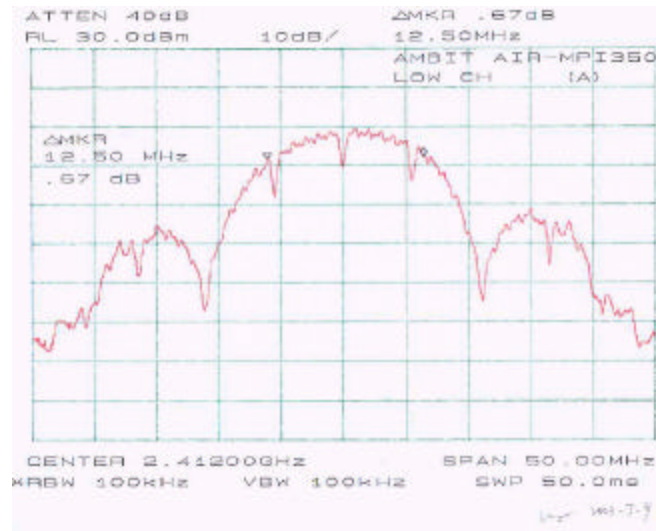
### 5.4 Measurement Result

Please refer to following pages for plots of 6 dB Bandwidth.

| Antenna   | Frequency (MHz) | Measured (MHz) | Standard (kHz) | Result    |
|-----------|-----------------|----------------|----------------|-----------|
| Main      | 2412            | 13.17          | ≥ 500          | Compliant |
|           | 2437            | 12.42          | ≥ 500          | Compliant |
|           | 2462            | 12.50          | ≥ 500          | Compliant |
| Auxiliary | 2412            | 12.50          | ≥ 500          | Compliant |
|           | 2437            | 12.50          | ≥ 500          | Compliant |
|           | 2462            | 12.33          | ≥ 500          | Compliant |







## 6 - SPURIOUS EMISSION AT ANTENNA TERMINAL

### 6.1 Standard Applicable

According to §15.209 (a), except as provided elsewhere in the subpart of 15.209, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz)  | Measurement                          |                      |
|------------------|--------------------------------------|----------------------|
|                  | Field strength<br>(microvolts/meter) | distance<br>(meters) |
| 0.009-0.490..... | 2400/F(kHz)                          | 300                  |
| 0.490-1.705..... | 24000/F(kHz)                         | 30                   |
| 1.705-30.0.....  | 30                                   | 30                   |
| 30-88.....       | 100 **                               | 3                    |
| 88-216.....      | 150 **                               | 3                    |
| 216-960.....     | 200 **                               | 3                    |
| Above 960.....   | 500                                  | 3                    |

\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.

### 6.2 Measurement Procedure

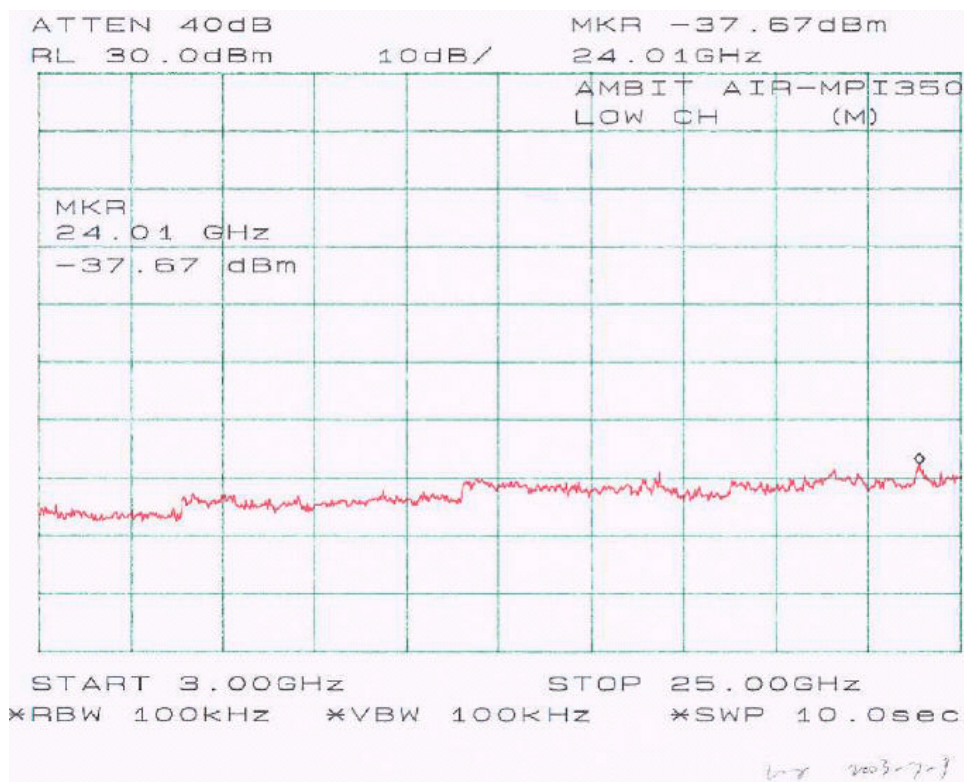
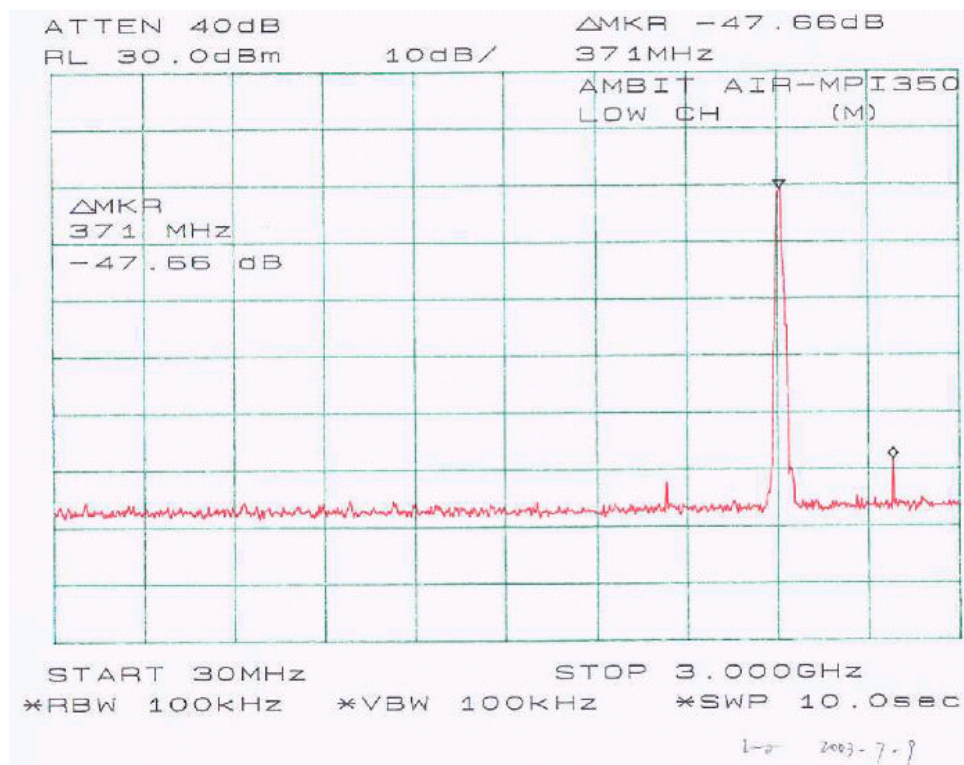
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument 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.

### 6.3 Test Equipment

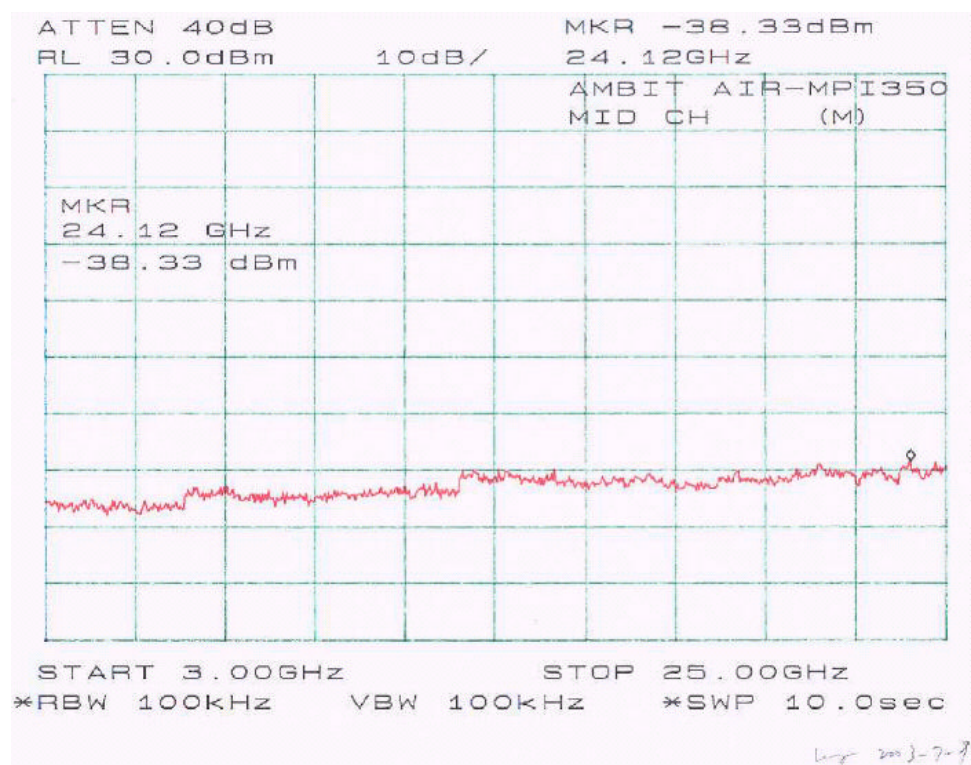
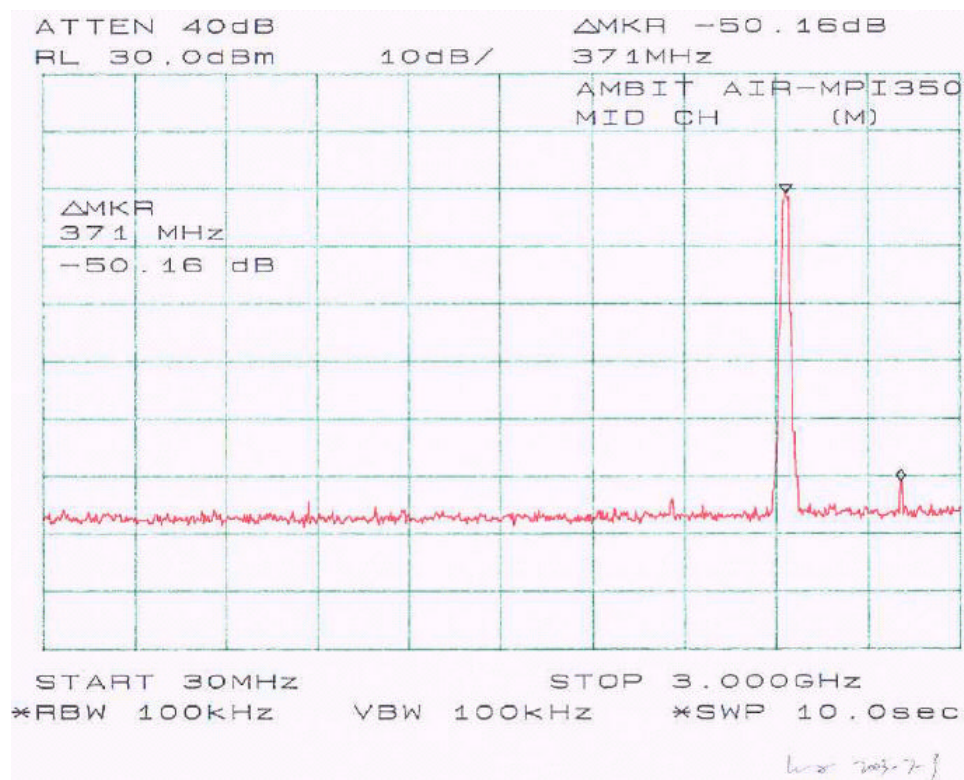
| Manufacturer | Model No. | Serial No.        | Calibration Due Date |
|--------------|-----------|-------------------|----------------------|
| HP           | 8564E     | Spectrum Analyzer | 2003-12-06           |

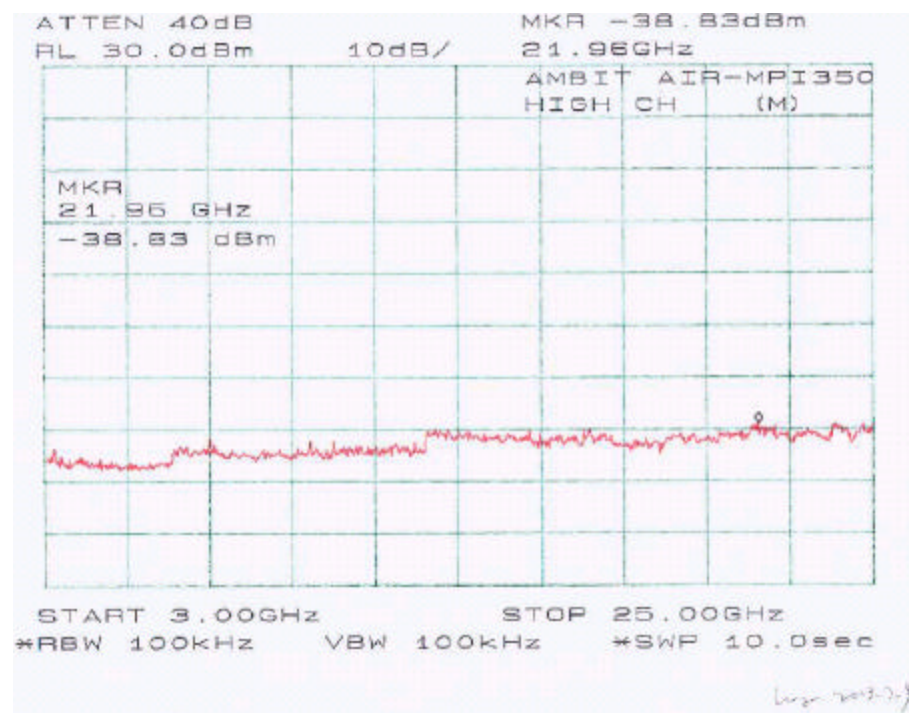
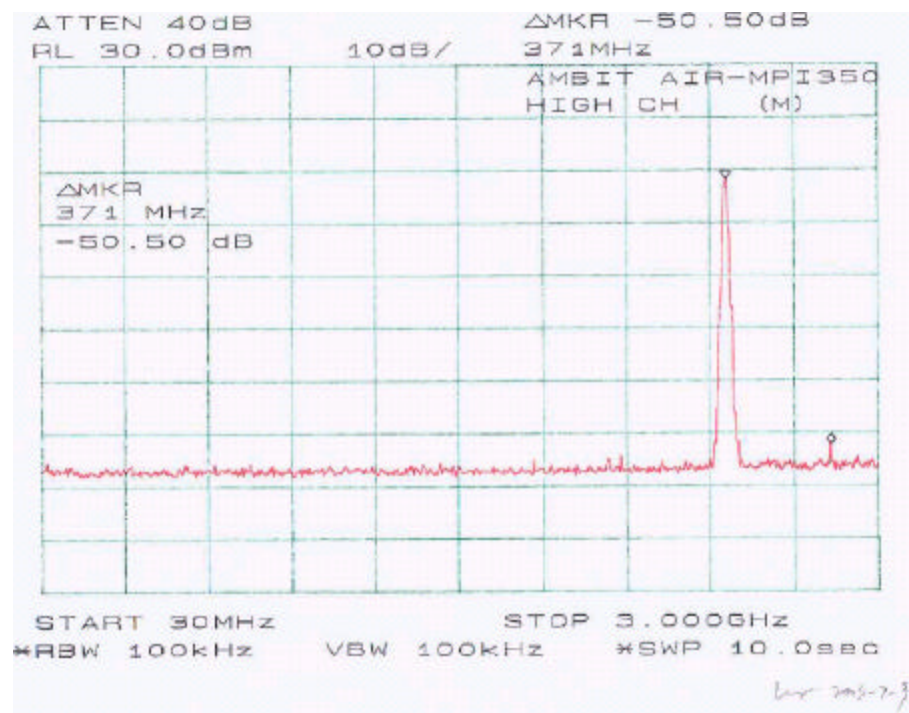
### 6.4 Measurement Result

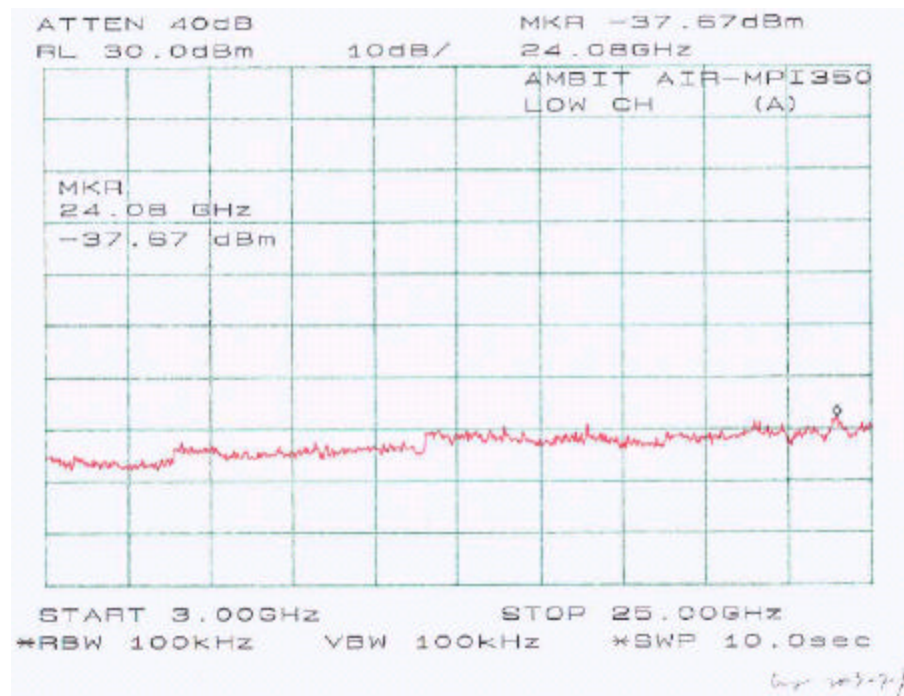
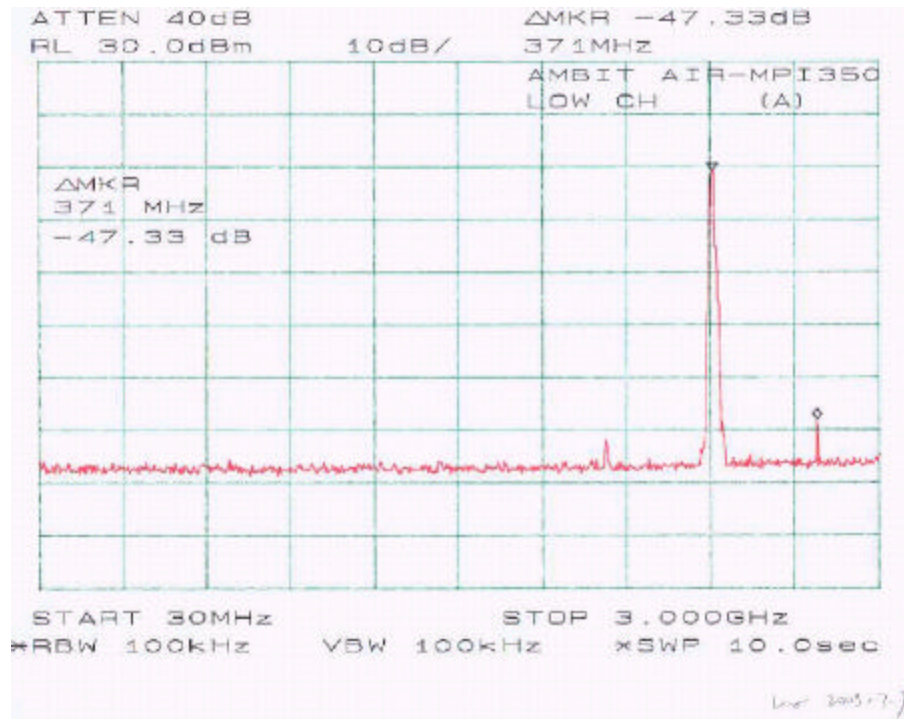
Please refer to following pages for plots of spurious emission.



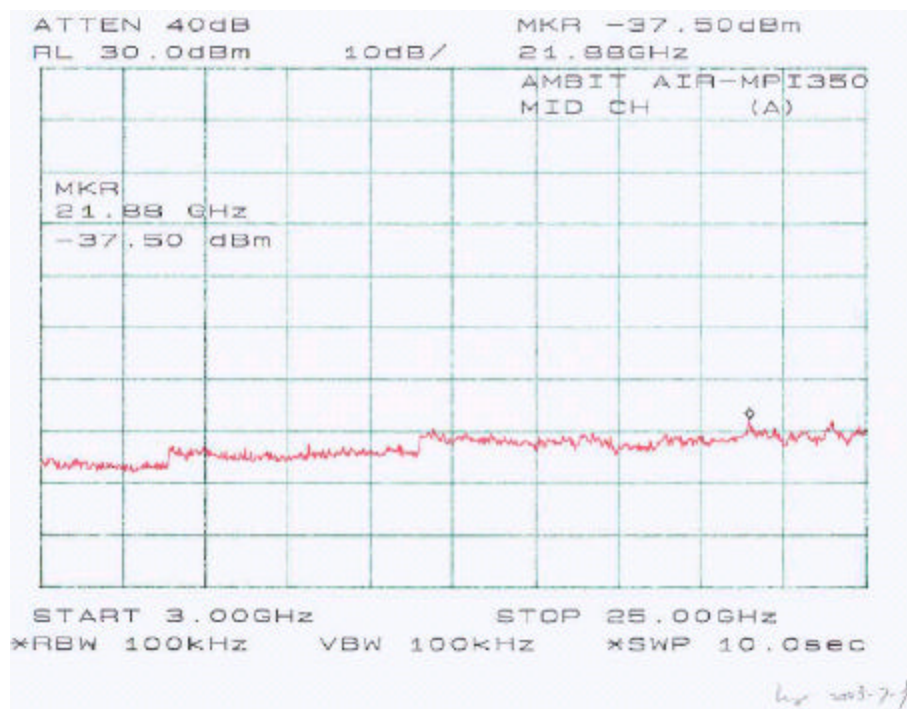
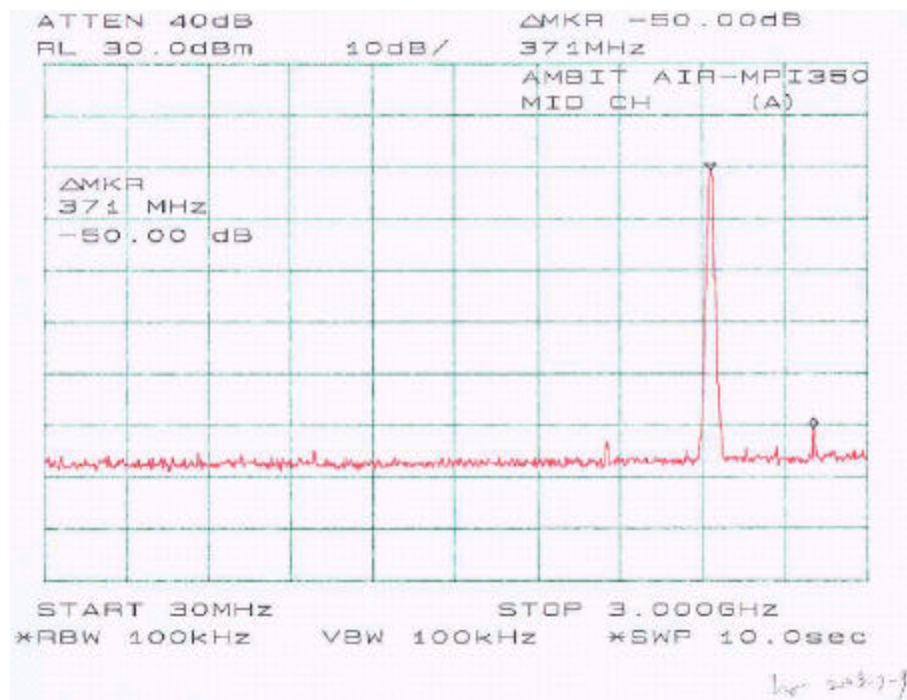


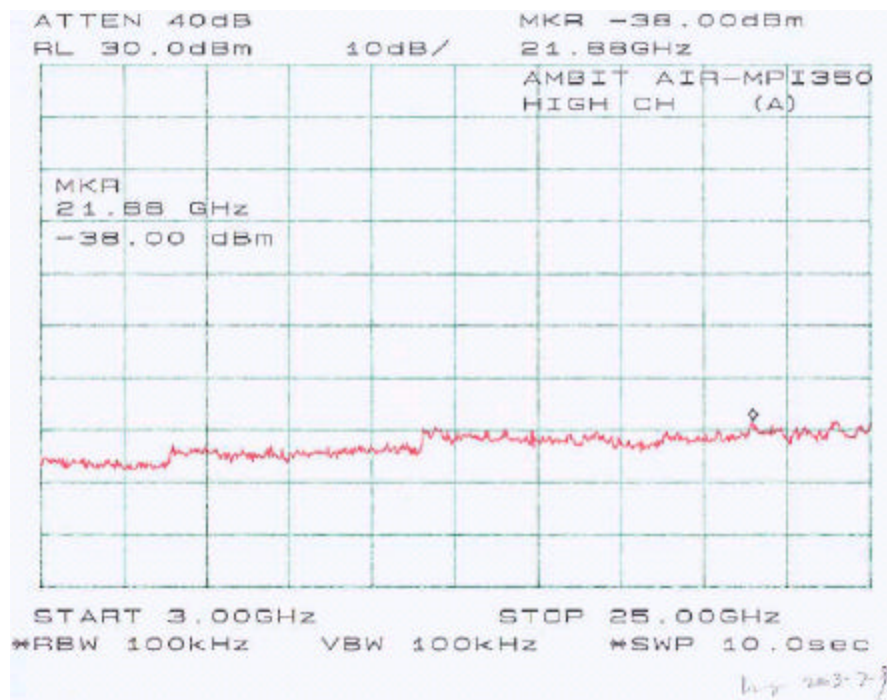
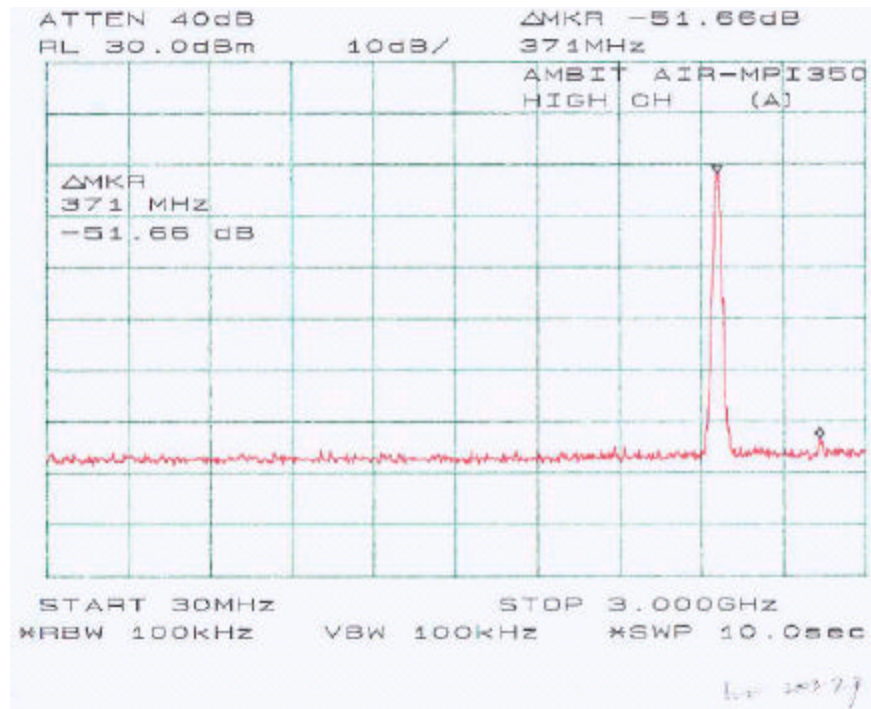














## 7 - PEAK POWER SPECTRAL DENSITY

### 7.1 Standard Applicable

According to §15.247 (d), digitally modulated 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.

### 7.2 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 6MHz span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Repeat above procedures until all frequencies measured were complete.

### 7.3 Test Equipment

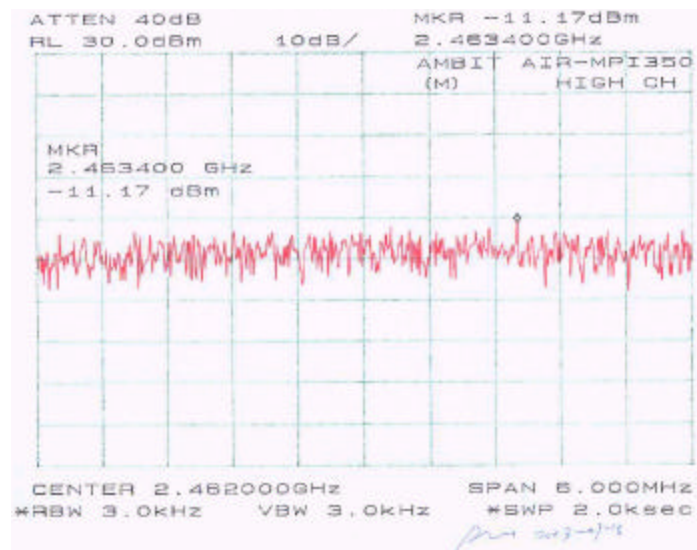
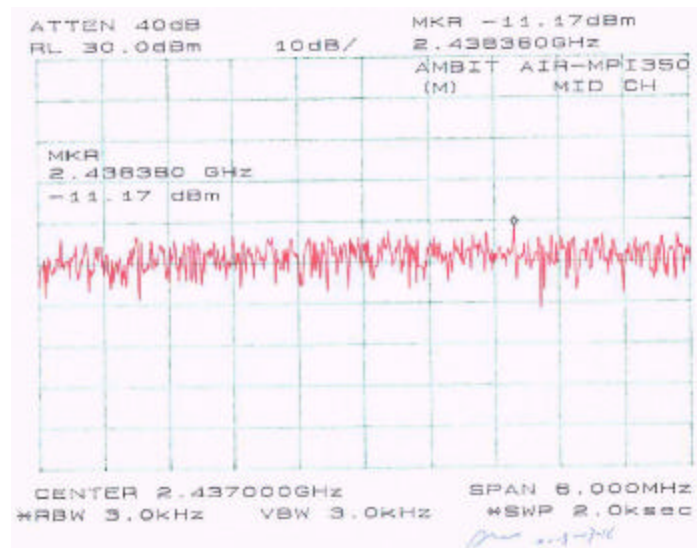
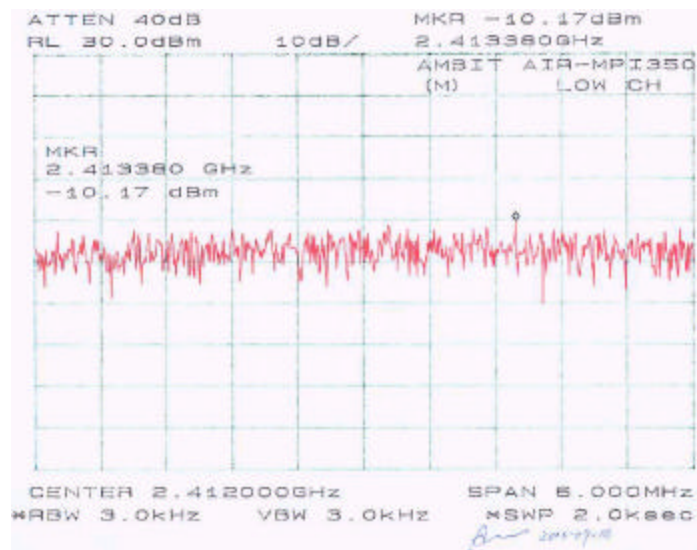
| Manufacturer | Model No. | Serial No.        | Calibration Due Date |
|--------------|-----------|-------------------|----------------------|
| HP           | 8564E     | Spectrum Analyzer | 2003-12-06           |

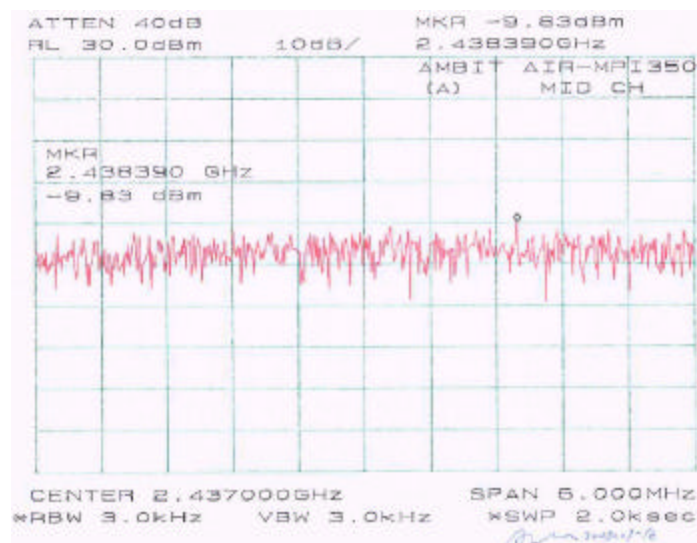
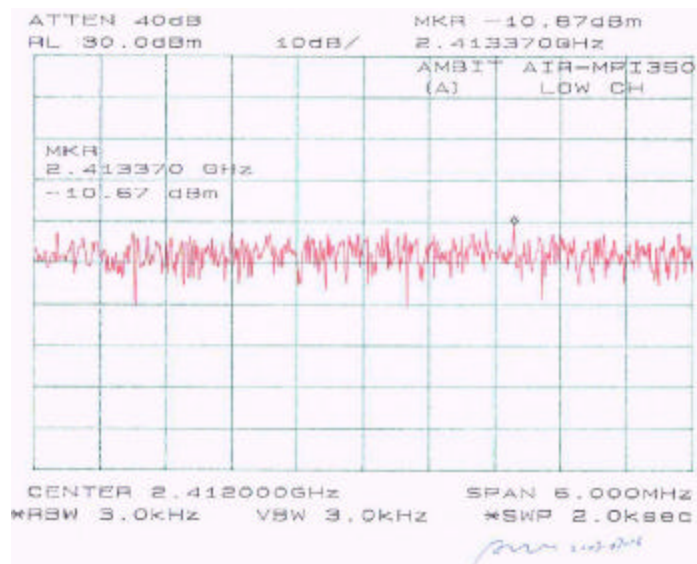
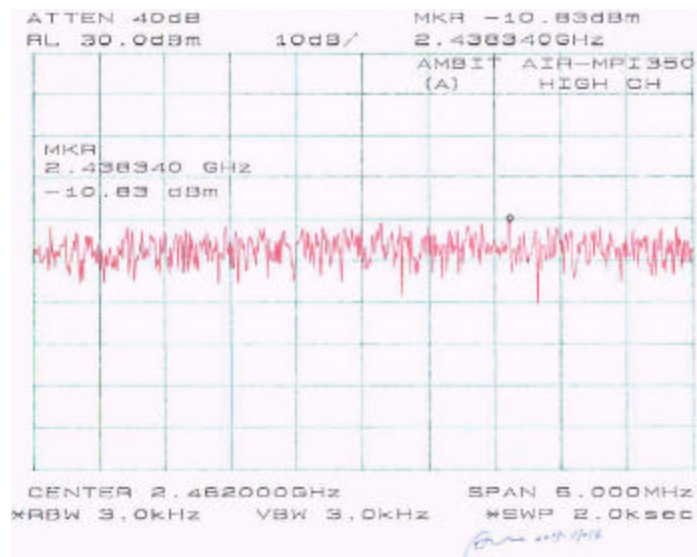
### 7.4 Measurement Results

|         | Frequency (MHz) | Peak Power Spectral Density | Standard (dBm) | Result    |
|---------|-----------------|-----------------------------|----------------|-----------|
| J1 Port | 2412            | -6.17                       | $\leq 8$       | Compliant |
|         | 2442            | -8.67                       | $\leq 8$       | Compliant |
|         | 2462            | -9.17                       | $\leq 8$       | Compliant |
| J2 Port | 2412            | -24.50                      | $\leq 8$       | Compliant |
|         | 2442            | -28.00                      | $\leq 8$       | Compliant |
|         | 2462            | -26.83                      | $\leq 8$       | Compliant |

### 7.5 Plot of Peak Power Spectral Density

Please refer to following pages for plots of peak power spectral density.





## 8 - 100 KHZ BANDWIDTH OF BAND EDGES

### 8.1 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)).

### 8.2 Measurement Procedure

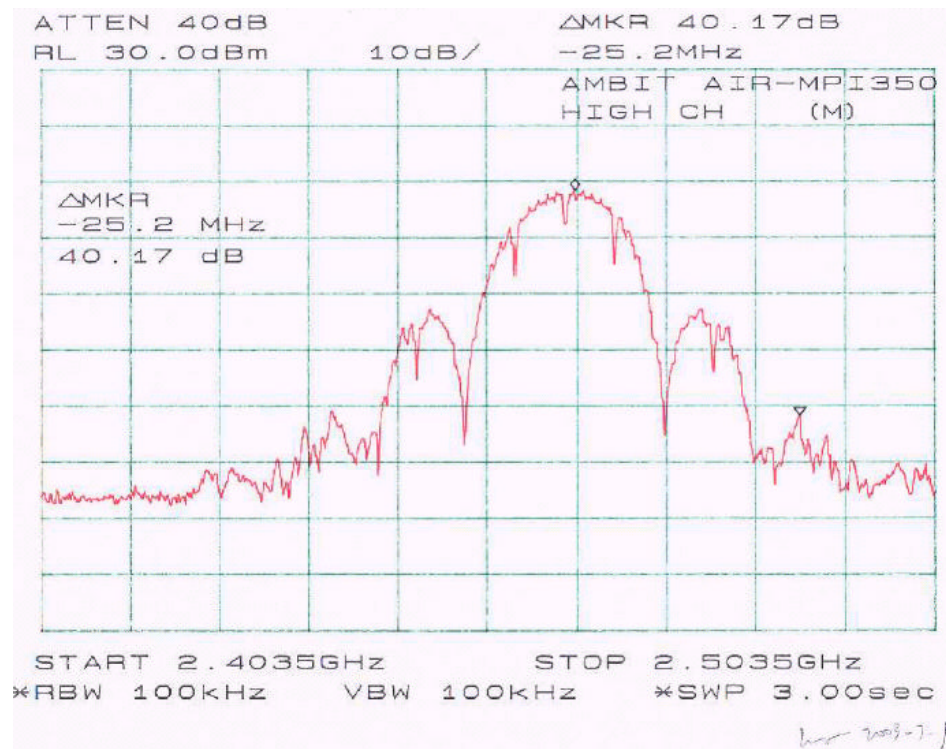
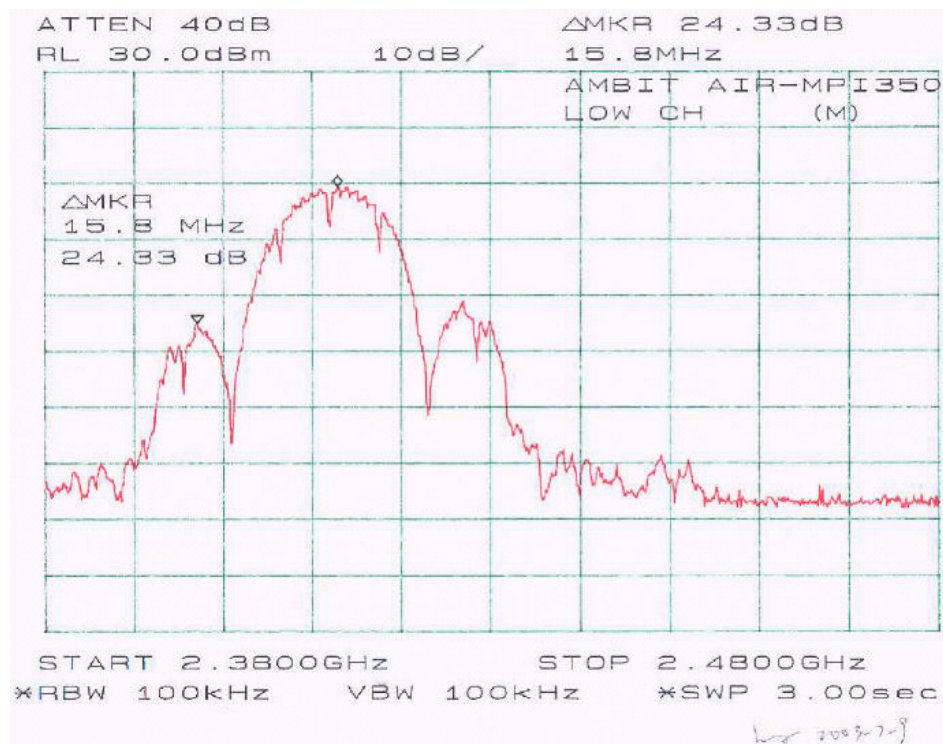
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then 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.

### 8.3 Test Equipment

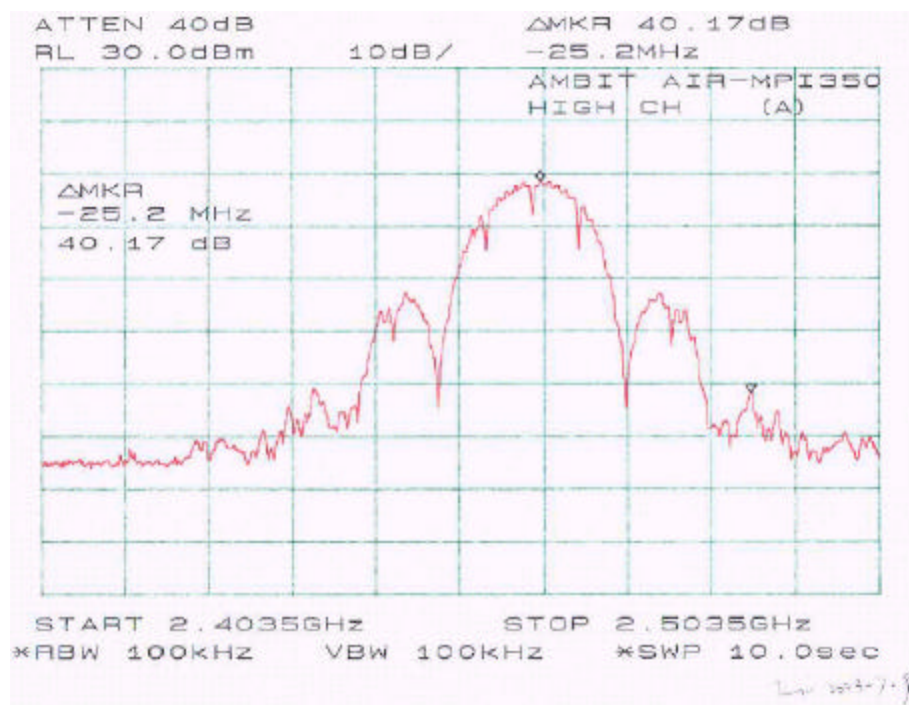
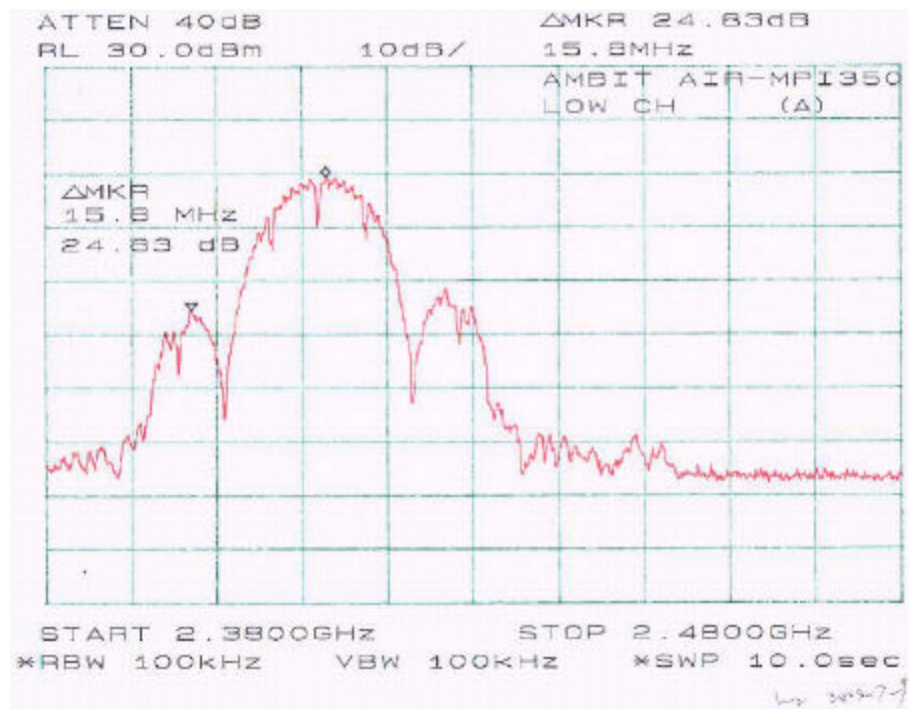
| Manufacturer | Model No. | Serial No.        | Calibration Due Date |
|--------------|-----------|-------------------|----------------------|
| HP           | 8564E     | Spectrum Analyzer | 2003-12-06           |

### 8.4 Measure Results

Please refer to following pages for plots of band edge.







## **9 - ANTENNA REQUIREMENT**

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### **9.1 Standard Applicable**

For intentional device, 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.

### **9.2 Antenna Connected Construction**

The directional gains of the 7 antennas used for transmitting are from  $-0.87\text{dBi}$  to  $5.6\text{ dBi}$ , and the antenna connectors are designed with permanent attachment and no consideration of replacement.



## 10 - SPURIOUS RADIATED EMISSION

### 10.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties. 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.

### 10.2 EUT Setup

The radiated emission tests were performed in the open area 3-meter test site, using the setup in accordance with the ANSI C63.4-1992. 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 host PC system was connected with 120Vac/60Hz power source.

### 10.3 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                    |

### 10.4 Test Procedure

For the radiated emissions test, the Host PC system power cord was connected to the AC floor outlet since the power supply used in the EUT 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 $\mu$ V of specification limits), and are distinguished with a "Qp" in the data table.

## 10.5 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 $\mu$ V means the emission is 7dB $\mu$ V below the maximum limit for Subpart C. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Subpart C Limit}$$

## 10.6 Test Equipment

| Manufacturer | Model No. | Serial No.        | Calibration Due Date |
|--------------|-----------|-------------------|----------------------|
| HP           | 8564E     | Spectrum Analyzer | 2003-12-06           |

## 10.7 Summary of Test Results

According to the data in section 10.8, 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:

*D800 NEWEB:*

-3.7 dB at 4824.00 MHz in the **Vertical** polarization, Low Channel

-3.5 dB at 4874.00 MHz in the **Vertical** polarization, Middle Channel

-3.5 dB at 4924.00 MHz in the **Vertical** polarization, High Channel

-2.3 dB at 86.50 MHz in the **Vertical** polarization, Unintentional Emission

*D800 Hitachi:*

-6.1 dB at 4824.00 MHz in the **Vertical** polarization, Low Channel

-5.1 dB at 4874.00 MHz in the **Vertical** polarization, Middle Channel

-4.7 dB at 4924.00 MHz in the **Vertical** polarization, High Channel

-6.1 dB at 46.00 MHz in the **Horizontal** polarization, Unintentional Emission

*D600 NEWEB:*

-7.6 dB at 4824.00 MHz in the **Vertical** polarization, Low Channel

-3.8 dB at 4874.00 MHz in the **Vertical** polarization, Middle Channel

-3.4 dB at 7386.00 MHz in the **Vertical** polarization, High Channel

-2.7 dB at 46.50 MHz in the **Vertical** polarization, Unintentional Emission

*D600 Hitachi:*

- 3.4 dB at 4824.00 MHz in the **Vertical** polarization, Low Channel
- 8.1 dB at 4874.00 MHz in the **Vertical** polarization, Middle Channel
- 6.6 dB at 4924.00 MHz in the **Vertical** polarization, High Channel
- 4.1 dB at 131.80 MHz in the **horizontal** polarization, Unintentional Emission

*D400 NEWEB:*

- 2.6 dB at 4824.00 MHz in the **Horizontal** polarization, Low Channel
- 0.9 dB at 4874.00 MHz in the **Horizontal** polarization, Middle Channel
- 3.5 dB at 4924.00 MHz in the **Horizontal** polarization, High Channel
- 4.6 dB at 332.50 MHz in the **Vertical** polarization, Unintentional Emission

*C400 NEWEB:*

- 6.1 dB at 4824.00 MHz in the **Horizontal** polarization, Low Channel
- 9.9 dB at 7311.00 MHz in the **Horizontal** polarization, Middle Channel
- 8.1 dB at 4924.00 MHz in the **Horizontal** polarization, High Channel
- 2.3 dB at 86.50 MHz in the **Vertical** polarization, Unintentional Emission

*C640 NEWEB:*

- 9.9 dB at 7236.00 MHz in the **Horizontal** polarization, Low Channel
- 8.8 dB at 7311.00 MHz in the **Horizontal** polarization, Middle Channel
- 9.9 dB at 7386.00 MHz in the **Horizontal** polarization, High Channel
- 9.2 dB at 158.90 MHz in the **Horizontal** polarization, Unintentional Emission

**10.7.1 Test Data, D800 NEWB, 1 – 25 GHz**

| INDICATED        |                 |           | TABLE           | ANTENNA         |               | CORRECTION FACTOR |             |            | CORRECTED<br>AMPLITUDE | FCC 15<br>SUBPART C |              |
|------------------|-----------------|-----------|-----------------|-----------------|---------------|-------------------|-------------|------------|------------------------|---------------------|--------------|
| Frequency<br>MHz | Ampl.<br>dBμV/m | Comments  | Angle<br>Degree | Height<br>Meter | Polar<br>H/ V | Antenna<br>dBμV/m | Cable<br>DB | Amp.<br>DB | Corr. Ampl.<br>dBμV/m  | Limit<br>dBμV/m     | Margin<br>dB |
| Low Channel      |                 |           |                 |                 |               |                   |             |            |                        |                     |              |
| 2412.00          | 104.6           | Fund/Peak | 90              | 1.5             | v             | 28.1              | 3.4         | 35.2       | 100.9                  |                     |              |
| 2412.00          | 104.1           | Fund/Peak | 210             | 1.2             | h             | 28.1              | 3.4         | 35.2       | 100.4                  |                     |              |
| 2412.00          | 97.5            | Fund/Ave  | 90              | 1.5             | v             | 28.1              | 3.4         | 35.2       | 93.8                   |                     |              |
| 2412.00          | 96.7            | Fund/Ave  | 210             | 1.2             | h             | 28.1              | 3.4         | 35.2       | 93.0                   |                     |              |
| 4824.00          | 45.9            | Ave       | 280             | 1.5             | h             | 32.5              | 4.9         | 33.0       | 50.3                   | 54                  | -3.7         |
| 4824.00          | 44.7            | Ave       | 100             | 1.3             | v             | 32.5              | 4.9         | 33.0       | 49.1                   | 54                  | -4.9         |
| 7236.00          | 36.2            | Ave       | 115             | 1.2             | v             | 35.1              | 5.6         | 33.5       | 43.4                   | 54                  | -10.6        |
| 7236.00          | 36.0            | Ave       | 185             | 1.0             | h             | 35.1              | 5.6         | 33.5       | 43.2                   | 54                  | -10.8        |
| 4824.00          | 52.1            | Peak      | 280             | 1.5             | h             | 32.5              | 4.9         | 33.0       | 56.5                   | 74                  | -17.5        |
| 4824.00          | 51.9            | Peak      | 100             | 1.3             | v             | 32.5              | 4.9         | 33.0       | 56.3                   | 74                  | -17.7        |
| 7236.00          | 46.2            | Peak      | 115             | 1.2             | v             | 35.1              | 5.6         | 33.5       | 53.4                   | 74                  | -20.6        |
| 7236.00          | 45.5            | Peak      | 185             | 1.0             | h             | 35.1              | 5.6         | 33.5       | 52.7                   | 74                  | -21.3        |
| Middle Channel   |                 |           |                 |                 |               |                   |             |            |                        |                     |              |
| 2437.00          | 105.3           | Fund/Peak | 340.00          | 1.5             | v             | 28.1              | 3.4         | 35.2       | 101.6                  |                     |              |
| 2437.00          | 104.2           | Fund/Peak | 290             | 1.5             | h             | 28.1              | 3.4         | 35.2       | 101.6                  |                     |              |
| 2437.00          | 98.3            | Fund/Ave  | 340.00          | 1.5             | v             | 28.1              | 3.4         | 35.2       | 100.5                  |                     |              |
| 2437.00          | 96.3            | Fund/Ave  | 290             | 1.5             | h             | 28.1              | 3.4         | 35.2       | 94.6                   |                     |              |
| 4874.00          | 46.1            | Ave       | 270             | 1.6             | h             | 32.5              | 4.9         | 33.0       | 50.5                   | 54                  | -3.5         |
| 4874.00          | 43.2            | Ave       | 110             | 1.4             | v             | 32.5              | 4.9         | 33.0       | 47.6                   | 54                  | -6.4         |
| 7311.00          | 36.8            | Ave       | 120             | 1.0             | v             | 35.1              | 5.6         | 33.5       | 44.1                   | 54                  | -9.9         |
| 7311.00          | 36.8            | Ave       | 135             | 1.2             | h             | 35.1              | 5.6         | 33.5       | 44.1                   | 54                  | -9.9         |
| 4874.00          | 53.4            | Peak      | 270             | 1.6             | h             | 32.5              | 4.9         | 33.0       | 57.8                   | 74                  | -16.2        |
| 7311.00          | 48.3            | Peak      | 120             | 1.0             | v             | 35.1              | 5.6         | 33.5       | 55.6                   | 74                  | -18.4        |
| 4874.00          | 50.5            | Peak      | 110             | 1.4             | v             | 32.5              | 4.9         | 33.0       | 54.9                   | 74                  | -19.1        |
| 7311.00          | 46.5            | Peak      | 135             | 1.2             | h             | 35.1              | 5.6         | 33.5       | 53.7                   | 74                  | -20.3        |
| High Channel     |                 |           |                 |                 |               |                   |             |            |                        |                     |              |
| 2462.00          | 104.9           | Fund/Peak | 270             | 1.5             | v             | 28.1              | 3.4         | 35.2       | 102.0                  |                     |              |
| 2462.00          | 105.7           | Fund/Peak | 210             | 1.5             | h             | 28.1              | 3.4         | 35.2       | 93.5                   |                     |              |
| 2462.00          | 97.2            | Fund/Ave  | 270             | 1.5             | v             | 28.1              | 3.4         | 35.2       | 94.6                   |                     |              |
| 2462.00          | 98.3            | Fund/Ave  | 210             | 1.5             | h             | 28.1              | 3.4         | 35.2       | 93.5                   |                     |              |
| 4924.00          | 46.1            | Ave       | 275             | 1.5             | h             | 32.5              | 4.9         | 33.0       | 50.5                   | 54                  | -3.5         |
| 4924.00          | 45.2            | Ave       | 110             | 1.4             | v             | 32.5              | 4.9         | 33.0       | 49.6                   | 54                  | -4.4         |
| 7386.00          | 36.8            | Ave       | 135             | 1.2             | h             | 35.1              | 5.6         | 33.5       | 44.1                   | 54                  | -9.9         |
| 7386.00          | 36.5            | Ave       | 115             | 1.0             | v             | 35.1              | 5.6         | 33.5       | 43.7                   | 54                  | -10.3        |
| 4924.00          | 53.6            | Peak      | 275             | 1.5             | h             | 32.5              | 4.9         | 33.0       | 58.0                   | 74                  | -16.0        |
| 7386.00          | 50.5            | Peak      | 135             | 1.2             | h             | 35.1              | 5.6         | 33.5       | 57.7                   | 74                  | -16.3        |
| 4924.00          | 52.2            | Peak      | 110             | 1.4             | v             | 32.5              | 4.9         | 33.0       | 56.6                   | 74                  | -17.4        |
| 7386.00          | 47.2            | Peak      | 115             | 1.0             | v             | 35.1              | 5.6         | 33.5       | 54.4                   | 74                  | -19.6        |