



## **OKFCC 47 CFR PART 15 SUBPART C**

### **TEST REPORT**

**For**

**Shuttle XPC (Wireless 802.11a+b+g)**

**Trade Name: Shuttle**

**Model: Xyy0yy (y=0~9)**

*Issued to*

**UNIWILL COMPUTER CORP.  
3F, No.43, Wu Chiuan Rd, Wu Cu Ind., Park,  
Taipei, Taiwan, R.O.C.**

*Issued by*

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## 1. TEST RESULT CERTIFICATION

**Applicant:** UNIWILL COMPUTER CORP.  
3F, No.43, Wu Chiuang Rd., Wu Cu Ind, Park,  
Taipei, Taiwan, R.O.C.

**Equipment Under Test:** Shuttle XPC (Wireless 802.11a+b+g)

**Trade Name:** Shuttle

**Model:** Xyy0yy (y=0~9)

**Date of Test:** March 20 ~ April 25, 2006

| APPLICABLE STANDARDS         |                         |
|------------------------------|-------------------------|
| STANDARD                     | TEST RESULT             |
| FCC 47 CFR Part 15 Subpart C | No non-compliance noted |

### We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4: 2003 and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247.

The test results of this report relate only to the tested sample EUT identified in this report.

Approved by:

Gavin Lim  
Section Manager  
Compliance Certification Services Inc.

Reviewed by:

Amanda Wu  
Section Manager  
Compliance Certification Services Inc.



## 2. EUT DESCRIPTION

|                              |                                                                                                                                                                            |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product</b>               | Shuttle XPC (Wireless 802.11a+b+g)                                                                                                                                         |
| <b>Trade Name</b>            | Shuttle                                                                                                                                                                    |
| <b>Model</b>                 | Xyy0yy (y=0~9)                                                                                                                                                             |
| <b>Model Discrepancy</b>     | 1. All the specification and layout are identical except they come with different model numbers.<br>2. “y” could be 0-9 to denote different color of enclosure.            |
| <b>Power Supply</b>          | LI SHIN INTERNATIONAL ENTERPRISE CORP. / 0227A20120<br>I/P: AC 100-240V, 2.0A, 50-60Hz<br>O/P: DC 20V, 6.0A                                                                |
| <b>Frequency Range</b>       | IEEE 802.11a: 5.745~5.825 GHz<br>IEEE 802.11b/g: 2.412~2.462 GHz                                                                                                           |
| <b>Transmit Power</b>        | IEEE 802.11a: 15.84 dBm<br>IEEE 802.11b: 16.32 dBm<br>IEEE 802.11g: 16.07 dBm                                                                                              |
| <b>Modulation Technique</b>  | IEEE 802.11a: OFDM (QPSK, BPSK, 16-QAM, 64-QAM)<br>IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK)<br>IEEE 802.11g: DSSS (CCK, DQPSK, DBPSK) +<br>OFDM (QPSK, BPSK, 16-QAM, 64-QAM) |
| <b>Transmit Data Rate</b>    | IEEE 802.11a: 54, 48, 36, 24, 18, 12, 9, 6 Mbps<br>IEEE 802.11b: 11, 5.5, 2, 1 Mbps<br>IEEE 802.11g: 54, 48, 36, 24, 18, 12, 11, 9, 6, 5.5, 2, 1Mbps                       |
| <b>Number of Channels</b>    | IEEE 802.11a: 5 Channels<br>IEEE 802.11b/g: 11 Channels                                                                                                                    |
| <b>Antenna Specification</b> | IEEE 802.11a: PCB antenna / Gain: 1.91 dBi<br>IEEE 802.11b/g: PCB antenna / Gain: 0.56 dBi                                                                                 |

**Remark:**

1. The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC ID: **SAZ-3945ABGXPCIA** filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.



### **3. TEST METHODOLOGY**

The tests documented in this report were performed in accordance with ANSI C63.4 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209 and 15.247.

#### **3.1 EUT CONFIGURATION**

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

#### **3.2 EUT EXERCISE**

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

#### **3.3 GENERAL TEST PROCEDURES**

##### **Conducted Emissions**

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

##### **Radiated Emissions**

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 13.1.4.1 of ANSI C63.4.



### 3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

- (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz                        | MHz                   | MHz             | GHz              |
|----------------------------|-----------------------|-----------------|------------------|
| 0.090 - 0.110              | 16.42 - 16.423        | 399.9 - 410     | 4.5 - 5.15       |
| <sup>1</sup> 0.495 - 0.505 | 16.69475 - 16.69525   | 608 - 614       | 5.35 - 5.46      |
| 2.1735 - 2.1905            | 16.80425 - 16.80475   | 960 - 1240      | 7.25 - 7.75      |
| 4.125 - 4.128              | 25.5 - 25.67          | 1300 - 1427     | 8.025 - 8.5      |
| 4.17725 - 4.17775          | 37.5 - 38.25          | 1435 - 1626.5   | 9.0 - 9.2        |
| 4.20725 - 4.20775          | 73 - 74.6             | 1645.5 - 1646.5 | 9.3 - 9.5        |
| 6.215 - 6.218              | 74.8 - 75.2           | 1660 - 1710     | 10.6 - 12.7      |
| 6.26775 - 6.26825          | 108 - 121.94          | 1718.8 - 1722.2 | 13.25 - 13.4     |
| 6.31175 - 6.31225          | 123 - 138             | 2200 - 2300     | 14.47 - 14.5     |
| 8.291 - 8.294              | 149.9 - 150.05        | 2310 - 2390     | 15.35 - 16.2     |
| 8.362 - 8.366              | 156.52475 - 156.52525 | 2483.5 - 2500   | 17.7 - 21.4      |
| 8.37625 - 8.38675          | 156.7 - 156.9         | 2655 - 2900     | 22.01 - 23.12    |
| 8.41425 - 8.41475          | 162.0125 - 167.17     | 3260 - 3267     | 23.6 - 24.0      |
| 12.29 - 12.293             | 167.72 - 173.2        | 3332 - 3339     | 31.2 - 31.8      |
| 12.51975 - 12.52025        | 240 - 285             | 3345.8 - 3358   | 36.43 - 36.5     |
| 12.57675 - 12.57725        | 322 - 335.4           | 3600 - 4400     | ( <sup>2</sup> ) |
| 13.36 - 13.41              |                       |                 |                  |

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

- (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

### 3.5 DESCRIPTION OF TEST MODES

The EUT (model: Xyy0yy (y=0~9)) had been tested under operating condition.

Software used to control the EUT for staying in continuous transmitting mode was programmed.

After verification, all tests were carried out with the worst case test modes as shown below except radiated spurious emission below 1GHz, which worst case was in normal link mode only.

IEEE802.11a:

Channel Low(5745MHz), Channel Mid(5785MHz) and Channel High(5825MHz) with 6Mbps data rate were chosen for full testing.

IEEE802.11b:

Channel Low(2412MHz), Channel Mid(2437MHz) and Channel High(2462MHz) with 1Mbps data rate were chosen for full testing.

IEEE802.11g:

Channel Low(2412MHz), Channel Mid(2437MHz) and Channel High(2462MHz) with 6Mbps data rate were chosen for full testing.



## 4. INSTRUMENT CALIBRATION

### 4.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

### 4.2 MEASUREMENT EQUIPMENT USED

#### Equipment Used for Emissions Measurement

**Remark:** Each piece of equipment is scheduled for calibration once a year.

| Conducted Emissions Test Site |              |        |               |                 |
|-------------------------------|--------------|--------|---------------|-----------------|
| Name of Equipment             | Manufacturer | Model  | Serial Number | Calibration Due |
| Spectrum Analyzer             | Agilent      | E4446A | MY43360131    | 01/18/2007      |

| Open Area Test Site # 3 |                 |                |               |                 |
|-------------------------|-----------------|----------------|---------------|-----------------|
| Name of Equipment       | Manufacturer    | Model          | Serial Number | Calibration Due |
| EMI Test Receiver       | R&S             | ESVS20         | 838804/004    | 01/18/2007      |
| Spectrum Analyzer       | R&S             | FSP30          | 100112        | 09/12/2006      |
| Spectrum Analyzer       | Agilent         | E4446A         | MY43360131    | 01/18/2007      |
| Pre-Amplifier           | MITEC           | AFS42-00102650 | 924206        | N.C.R.          |
| Pre-Amplifier           | MITEC           | AMF-6F-260400  | 945377        | N.C.R.          |
| Bilog Antenna           | SCHWAZBECK      | VULB9163       | 145           | 07/05/2006      |
| Horn Antenna            | EMCO            | 3115           | 00022250      | 04/16/2007      |
| Horn-Antenna            | TRC             | HA-1201A       | 02            | 07/04/2006      |
| Horn-Antenna            | TRC             | HA-1301A       | 02            | 07/04/2006      |
| Turn Table              | EMCO            | 2081-1.21      | 9709-1885     | N.C.R.          |
| Antenna Tower           | EMCO            | 2075-2         | 9707-2060     | N.C.R.          |
| Controller              | EMCO            | 2090           | 9709-1256     | N.C.R.          |
| RF Switch               | ANRITSU         | MP59B          | M53867        | N.C.R.          |
| Site NSA                | CCS             | N/A            | N/A           | 09/06/2006      |
| Test S/W                | LABVIEW (V 6.1) |                |               |                 |

**Remark:** The measurement uncertainty is less than +/- 2.16dB, which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.

| Powerline Conducted Emissions Test Site |                    |        |               |                 |
|-----------------------------------------|--------------------|--------|---------------|-----------------|
| Name of Equipment                       | Manufacturer       | Model  | Serial Number | Calibration Due |
| EMI TEST RECEIVER<br>9kHz-30MHz         | ROHDE &<br>SCHWARZ | ESHS30 | 828144/003    | 09/27/2006      |
| TWO-LINE V-NETWORK<br>9kHz-30MHz        | SCHAFFNER          | NNB41  | 03/10013      | 06/12/2006      |
| LISN 10kHz-100MHz                       | EMCO               | 3825/2 | 9106-1809     | 03/20/2007      |
| Test S/W                                | LABVIEW (V 6.1)    |        |               |                 |

**Remark:** The measurement uncertainty is less than +/- 2.81dB, which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.



## **5. FACILITIES AND ACCREDITATIONS**

### **5.1 FACILITIES**

All measurement facilities used to collect the measurement data are located at

☐ No.199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.

Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029

☒ No.11, Wugong 6th Rd., Wugu Industrial Park, Taipei Hsien 248, Taiwan

Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045

☒ No.81-1, Lane 210, Bade 2nd Rd., Luchu Hsiang, Taoyuan Hsien 338, Taiwan

Tel: 886-3-324-0332 / Fax: 886-3-324-5235

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

### **5.2 EQUIPMENT**

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

### 5.3 TABLE OF ACCREDITATIONS AND LISTINGS

| Country | Agency          | Scope of Accreditation                                                                                                                                                                                                                                                                                                                                                                               | Logo                                                                                                                                                                                        |
|---------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| USA     | A2LA            | EN 55011, EN 55014-1/2, CISPR 11, CISPR 14-1/2, EN 55022, EN 55015, CISPR 22, CISPR 15, AS/NZS 3548, VCCI V3 (2001), CFR 47, FCC Part 15/18, CNS 13783-1, CNS 13439, CNS 13438, CNS 13803, CNS 14115, EN 55024, IEC 801-2, IEC 801-3, IEC 801-4, IEC/EN 61000-3-2, EIC/EN 61000-3-3, IEC/EN 61000-4-2/3/4/5/6/8/11, EN 50081-1/ EN 61000-6-3, EN 50081-2/EN 61000-6-4, EN 50081-2/EN 61000-6-1: 2001 | <br>0824-01                                                                                              |
| USA     | FCC             | 3/10 meter Open Area Test Sites (93105, 90471) / 3M Semi Anechoic Chamber (965860) to perform FCC Part 15/18 measurements                                                                                                                                                                                                                                                                            | <br>93105, 90471<br>965860                                                                               |
| Japan   | VCCI            | 3/10 meter Open Area Test Sites to perform conducted/radiated measurements                                                                                                                                                                                                                                                                                                                           | <br>R-393/1066/725/879<br>C-402/747/912                                                                  |
| Norway  | NEMKO           | EN 50081-1/2, EN 50082-1/2, IEC 61000-6-1/2, EN 50091-2, EN 50130-4, EN 55011, EN 55013, EN 55014-1/2, EN 55015, EN 55022, EN 55024, EN 61000-3-2/3, EN 61326-1, IEC 61000-4-2/3/4/5/6/8/11, EN 60601-1-2, EN 300 328, EN 300 422-2, EN 301 419-1, EN 301 489-01/03/07/08/09/17, EN 301 419-2/3, EN 300 454-2, EN 301 357-2                                                                          | <br>ELA 124a<br>ELA 124b<br>ELA 124c                                                                     |
| Taiwan  | TAF             | EN 300 328, EN 300 220-1, EN 300 220-2, EN 300 220-3, 47 CFR FCC Part 15 Subpart C, EN 61000-3-2, EN 61000-3-3, CNS 13439, CNS 13783-1, CNS 14115, CNS 13438, AS/NZS CISPR 22, CNS 13022-1, IEC 61000-4-2/3/4/5/6/8/11, CNS 13022-2/3                                                                                                                                                                |                                                                                                        |
| Taiwan  | BSMI            | CNS 13438, CNS 13783-1, CNS 13439, CNS 14115                                                                                                                                                                                                                                                                                                                                                         | <br>SL2-IS-E-0014<br>SL2-IN-E-0014<br>SL2-A1-E-0014<br>SL2-R1-E-0014<br>SL2-R2-E-0014<br>SL2-L1-E-0014 |
| Canada  | Industry Canada | 3/10 meter Open Area Test Sites (IC 3991-3, IC 3991-4) / 3M Semi Anechoic Chamber (IC 6106) to perform RSS 212 Issue 1                                                                                                                                                                                                                                                                               | <br>IC 3991-3<br>IC 3991-4<br>IC 6106                                                                  |

\* No part of this report may be used to claim or imply product endorsement by A2LA or any agency of the US Government.



## 6. SETUP OF EQUIPMENT UNDER TEST

### 6.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

### 6.2 SUPPORT EQUIPMENT

| No. | Device Type                                          | Brand     | Model         | Series No.       | FCC ID       | Data Cable                       | Power Cord       |
|-----|------------------------------------------------------|-----------|---------------|------------------|--------------|----------------------------------|------------------|
| 1.  | LCD Monitor                                          | LG        | L1740PQ       | 503KGXA2K858     | BEJL17NU     | Unshielded, 1.8m<br>With 2 cores | Unshielded, 1.8m |
| 2.  | USB Keyboard                                         | Compaq    | KU-9978       | B463AOAGALT097   | FCC DoC      | Shielded, 1.8m                   | N/A              |
| 3.  | USB Mouse                                            | HP        | MO19UCA       | 20440964         | FCC DoC      | Shielded, 1.8m                   | N/A              |
| 4.  | USB 2.0<br>External HDD                              | TeraSyS   | F12-U         | A0100214-31d0014 | FCC DoC      | Shielded, 1.8m                   | Shielded, 1.8m   |
| 5.  | USB 2.0<br>External HDD                              | TeraSyS   | F12-U         | A0100214-31d0028 | FCC DoC      | Shielded, 1.8m                   | Shielded, 1.8m   |
| 6.  | USB 2.0<br>External HDD                              | TeraSyS   | F12-U         | A0100214-2Bq0039 | FCC DoC      | Shielded, 1.8m                   | Shielded, 1.8m   |
| 7.  | USB 2.0 & 1394<br>External HDD                       | TeraSyS   | F12-UF(COMBO) | A0100215-420014  | FCC DoC      | Shielded, 1.8m                   | Shielded, 1.8m   |
| 8.  | Walkman                                              | Panasonic | RQ-L10        | HB004471         | FCC DoC      | Unshielded, 1.8m                 | N/A              |
| 9.  | Headset                                              | LABTEC    | 980180-0121   | N/A              | FCC DoC      | Unshielded, 1.8m                 | N/A              |
| 10. | Super a/g 108Mbps<br>Wireless Lan Router<br>(Remote) | PLANEX    | BLW-04SAG     | 40DDA0421        | SJ9-BLW54SAG | N/A                              | Unshielded, 1.8m |

**Remark:**

- All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.*
- Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.*



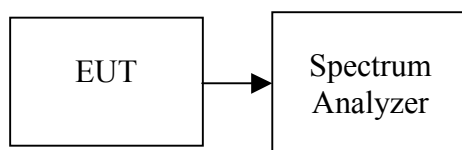
## **7. FCC PART 15.247 REQUIREMENTS**

### **7.16dB BANDWIDTH**

#### **LIMIT**

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

#### **Test Configuration**



#### **TEST PROCEDURE**

1. Place the EUT on the table and set it in the 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. Set the spectrum analyzer as RBW = 100kHz, VBW = RBW, Span = 50MHz
4. Mark the peak frequency and -6dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.



## **TEST RESULTS**

*No non-compliance noted*

### **Test Data**

#### **Test mode: IEEE 802.11b**

| Channel | Frequency<br>(MHz) | Bandwidth<br>(kHz) | Limit<br>(kHz) | Result |
|---------|--------------------|--------------------|----------------|--------|
| Low     | 2412               | 8670               | >500           | PASS   |
| Mid     | 2437               | 9080               |                | PASS   |
| High    | 2462               | 8500               |                | PASS   |

#### **Test mode: IEEE 802.11g**

| Channel | Frequency<br>(MHz) | Bandwidth<br>(kHz) | Limit<br>(kHz) | Result |
|---------|--------------------|--------------------|----------------|--------|
| Low     | 2412               | 16500              | >500           | PASS   |
| Mid     | 2437               | 16670              |                | PASS   |
| High    | 2462               | 16420              |                | PASS   |

#### **Test mode: IEEE 802.11a**

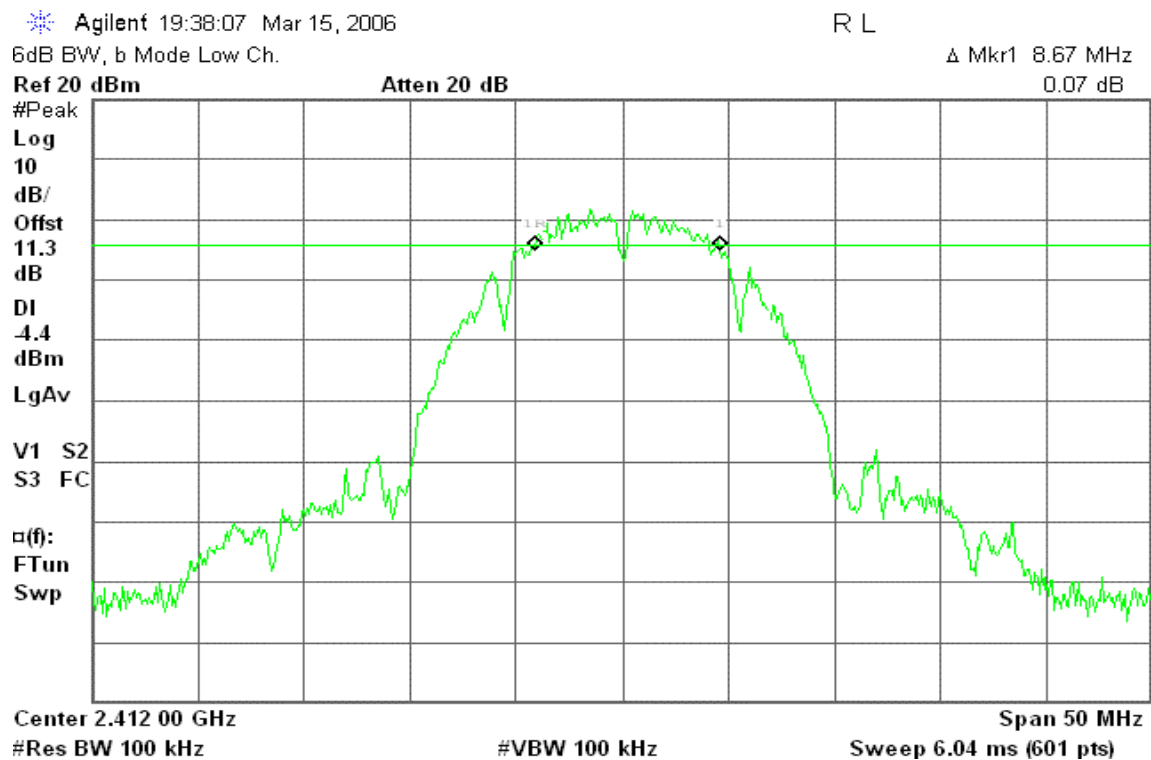
| Channel | Frequency<br>(MHz) | Bandwidth<br>(kHz) | Limit<br>(kHz) | Result |
|---------|--------------------|--------------------|----------------|--------|
| Low     | 5745               | 16500              | >500           | PASS   |
| Mid     | 5785               | 16330              |                | PASS   |
| High    | 5825               | 16500              |                | PASS   |



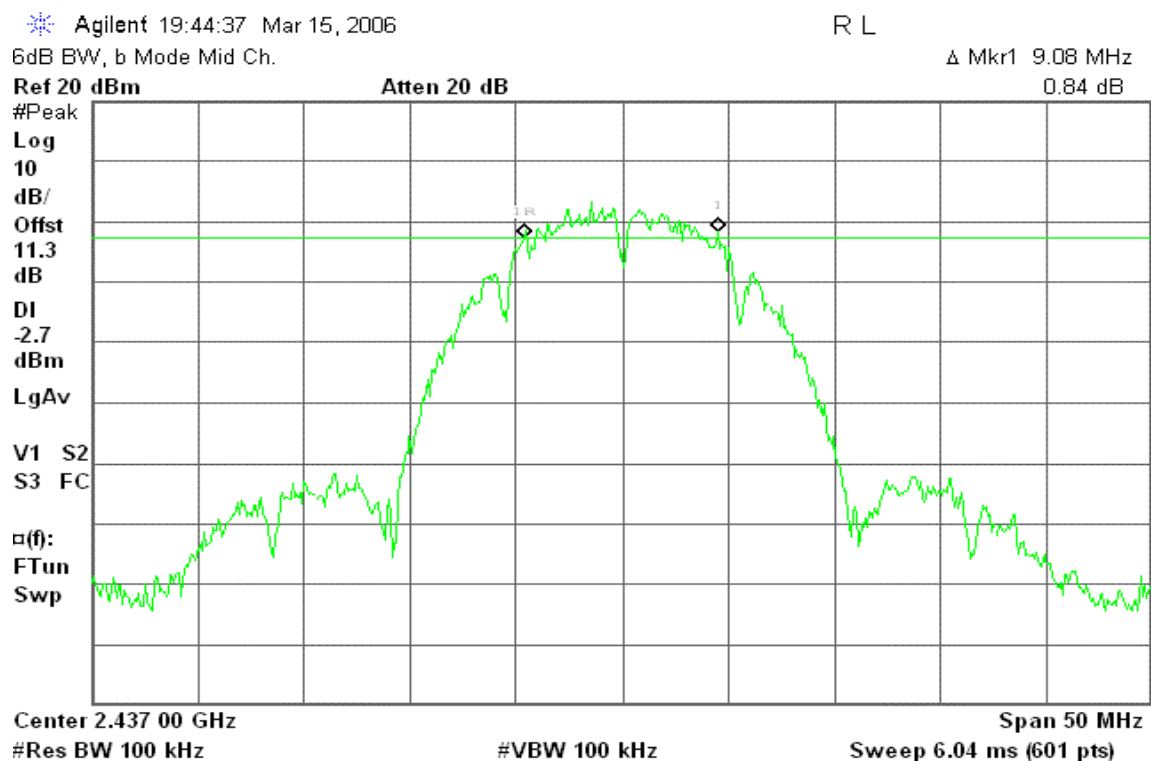
## Test Plot

### IEEE 802.11b

#### CH Low



#### CH Mid





## CH High

Agilent 19:50:33 Mar 15, 2006

R L

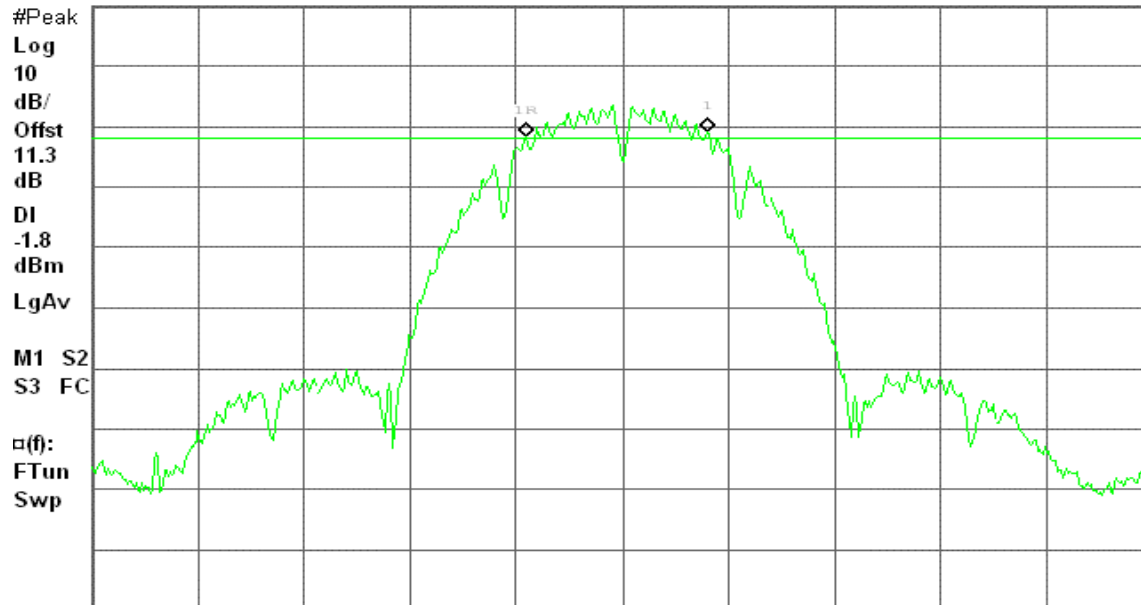
6dB BW, b Mode High Ch.

$\Delta$  Mkr1 8.50 MHz

Ref 20 dBm

Atten 20 dB

0.79 dB



Center 2.462 00 GHz

Span 50 MHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 6.04 ms (601 pts)

## IEEE 802.11g

### CH Low

Agilent 19:58:34 Mar 15, 2006

R L

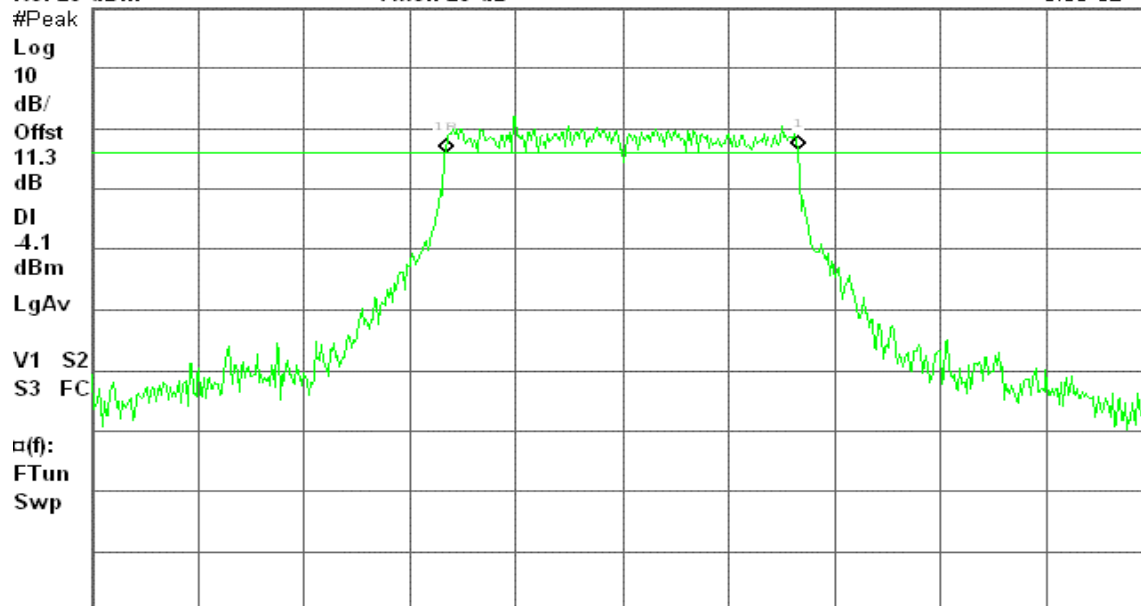
6dB BW, g Mode Low Ch.

$\Delta$  Mkr1 16.50 MHz

Ref 20 dBm

Atten 20 dB

0.50 dB



Center 2.412 00 GHz

Span 50 MHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 6.04 ms (601 pts)



## CH Mid

Agilent 20:04:43 Mar 15, 2006

R L

6dB BW, g Mode Mid Ch.

$\Delta$  Mkr1 16.67 MHz

Ref 20 dBm

Atten 20 dB

-0.35 dB

#Peak

Log

10

dB/

Offst

11.3

dB

DI

-8.2

dBm

LgAv

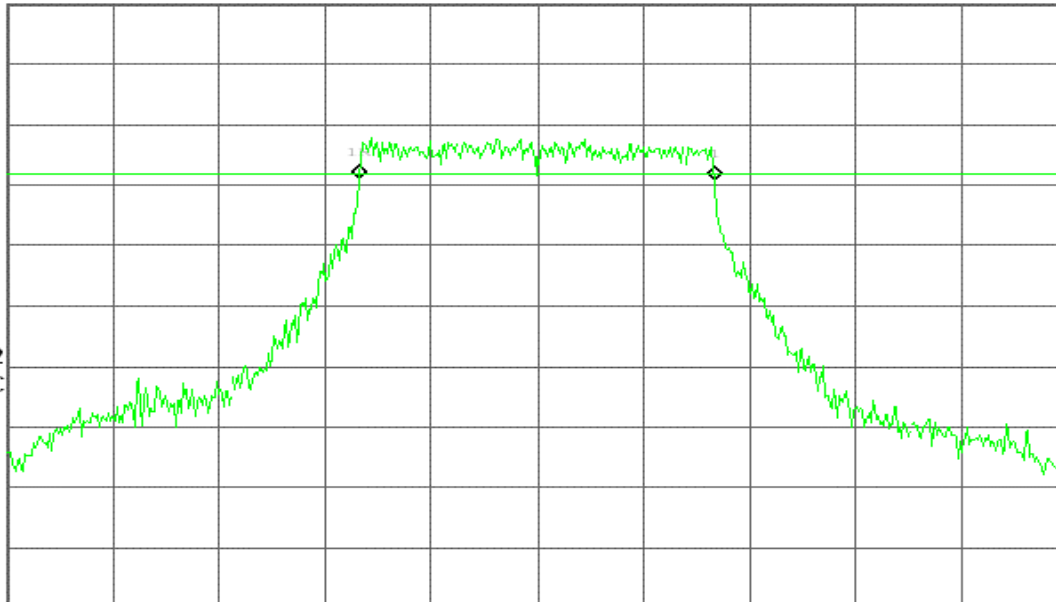
V1 S2

S3 FC

$\alpha(f)$ :

FTun

Swp



Center 2.437 00 GHz

Span 50 MHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 6.04 ms (601 pts)

## CH High

Agilent 20:10:11 Mar 15, 2006

R L

6dB BW, g Mode High Ch.

$\Delta$  Mkr1 16.42 MHz

Ref 20 dBm

Atten 20 dB

0.78 dB

#Peak

Log

10

dB/

Offst

11.3

dB

DI

-5.9

dBm

LgAv

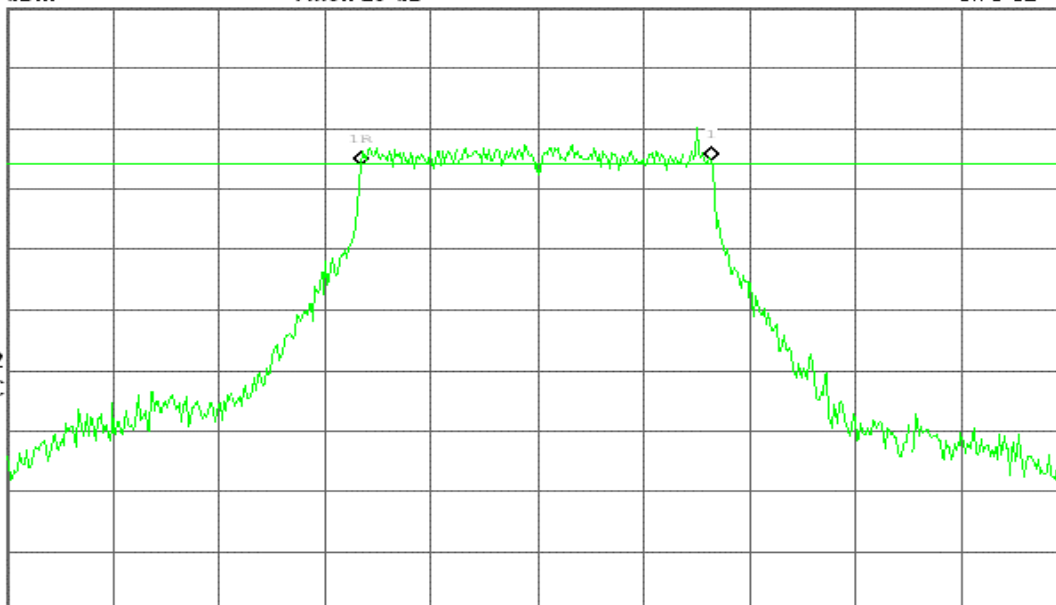
V1 S2

S3 FC

$\alpha(f)$ :

FTun

Swp



Center 2.462 00 GHz

Span 50 MHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 6.04 ms (601 pts)



## IEEE 802.11a

### CH Low

Agilent 15:55:42 Apr 25, 2006

R L

6dB BW, a Mode Low Ch.

$\Delta$  Mkr1 16.50 MHz

Ref 20 dBm

Atten 20 dB

0.54 dB

#Peak

Log

10

dB/

Offst

12

dB

DI

-6.7

dBm

LgAv

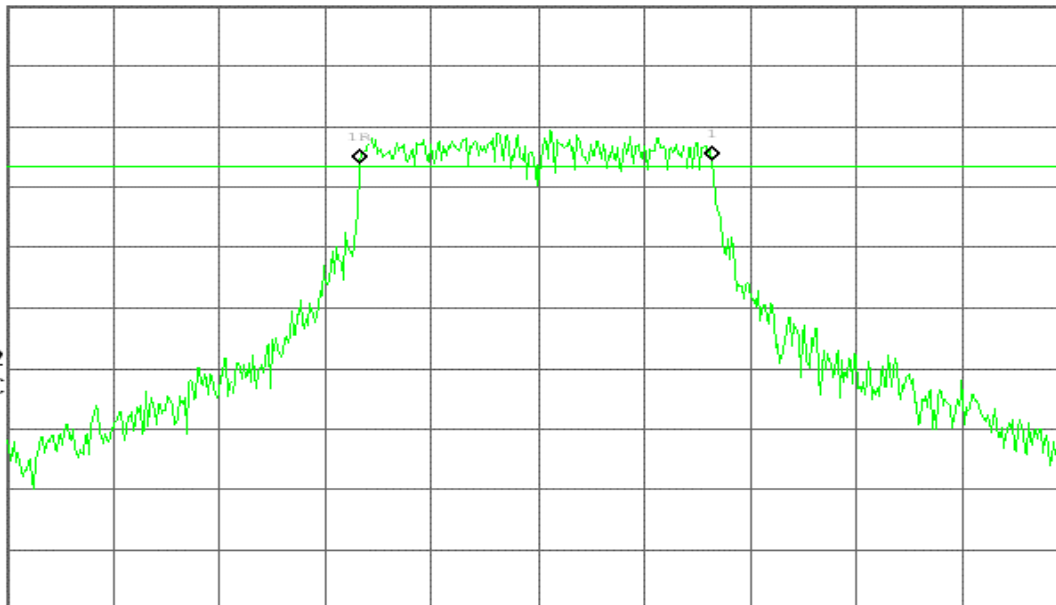
V1 S2

S3 FC

$\alpha(f)$ :

FTun

Swp



Center 5.745 00 GHz

Span 50 MHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 6.04 ms (601 pts)

### CH Mid

Agilent 16:02:31 Apr 25, 2006

R L

6dB BW, a Mode Mid Ch.

$\Delta$  Mkr1 16.33 MHz

Ref 20 dBm

Atten 20 dB

0.09 dB

#Peak

Log

10

dB/

Offst

12

dB

DI

-2.6

dBm

LgAv

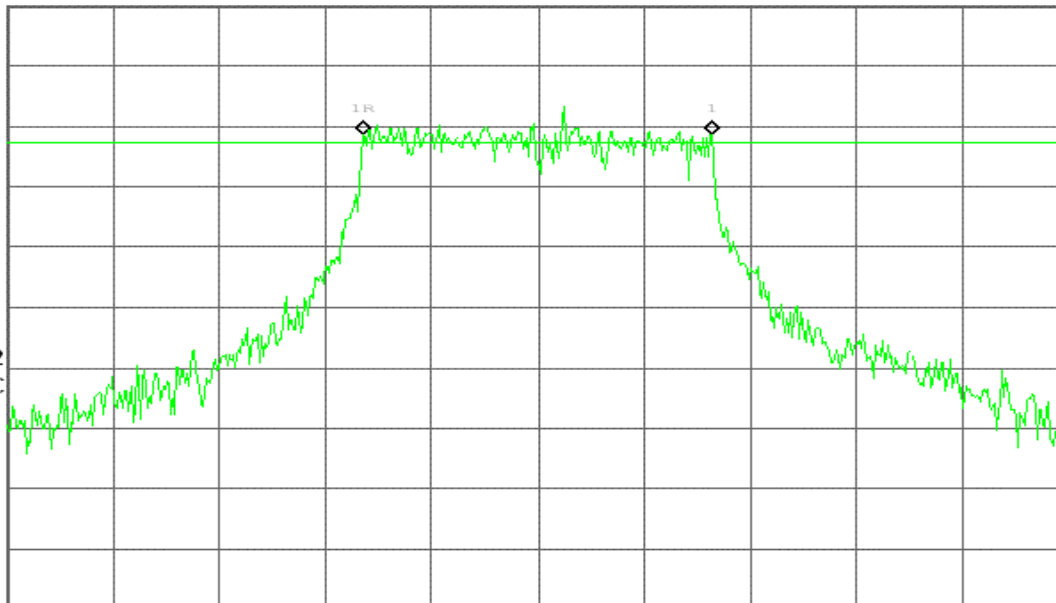
V1 S2

S3 FC

$\alpha(f)$ :

FTun

Swp



Center 5.785 00 GHz

Span 50 MHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 6.04 ms (601 pts)



## CH High

Agilent 16:12:52 Apr 25, 2006

R L

6dB BW, a Mode High Ch.

$\Delta$  Mkr1 16.50 MHz

Ref 20 dBm

Atten 20 dB

-1.08 dB

#Peak

Log

10

dB/

Offst

12

dB

DI

-8.3

dBm

LgAv

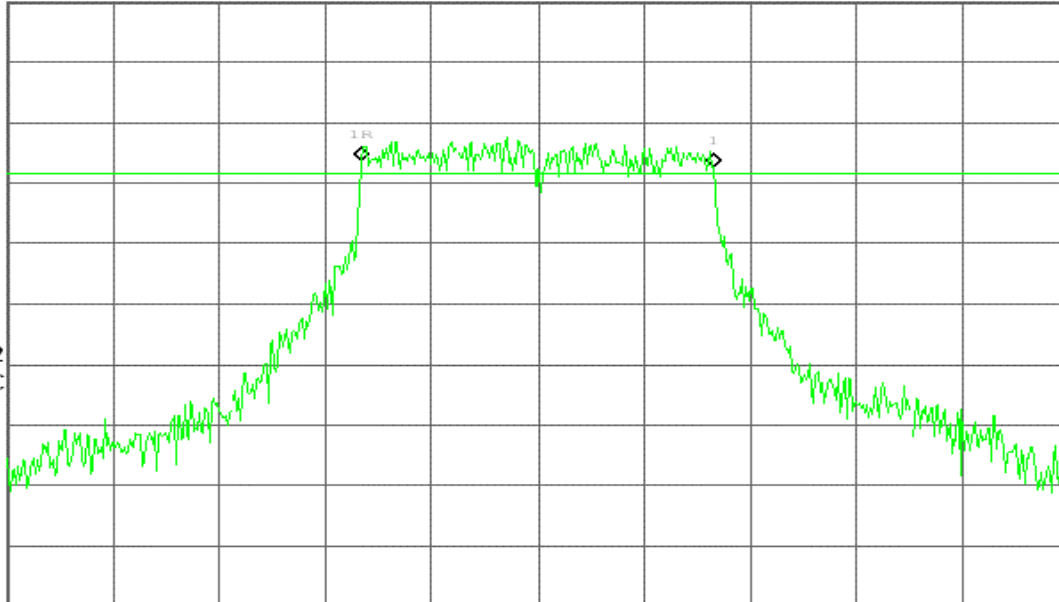
V1 S2

S3 FC

$\alpha(f)$ :

FTun

Swp



Center 5.825 00 GHz

Span 50 MHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 6.04 ms (601 pts)



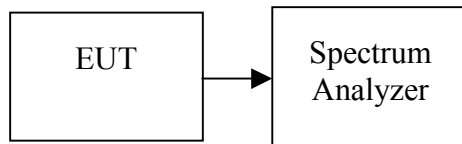
## 7.2 PEAK POWER

### LIMIT

The maximum peak output power of the intentional radiator shall not exceed the following:

1. According to §15.247(b)(3), for systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz: 1 Watt.
2. According to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### Test Configuration



### TEST PROCEDURE

The transmitter output is connected to the Spectrum analyzer. The Spectrum analyzer is set to the peak power detection.

**TEST RESULTS***No non-compliance noted.***Test Data****Test mode: IEEE 802.11b**

| Channel | Frequency (MHz) | Output Power (dBm) | Output Power (W) | Limit (W) | Result |
|---------|-----------------|--------------------|------------------|-----------|--------|
| Low     | 2412            | 16.01              | 0.0399           | 1         | PASS   |
| Mid     | 2437            | 16.32              | 0.0429           |           | PASS   |
| High    | 2462            | 15.19              | 0.0330           |           | PASS   |

**Test mode: IEEE 802.11g**

| Channel | Frequency (MHz) | Output Power (dBm) | Output Power (W) | Limit (W) | Result |
|---------|-----------------|--------------------|------------------|-----------|--------|
| Low     | 2412            | 15.72              | 0.0373           | 1         | PASS   |
| Mid     | 2437            | 16.07              | 0.0405           |           | PASS   |
| High    | 2462            | 15.67              | 0.0369           |           | PASS   |

**Test mode: IEEE 802.11a**

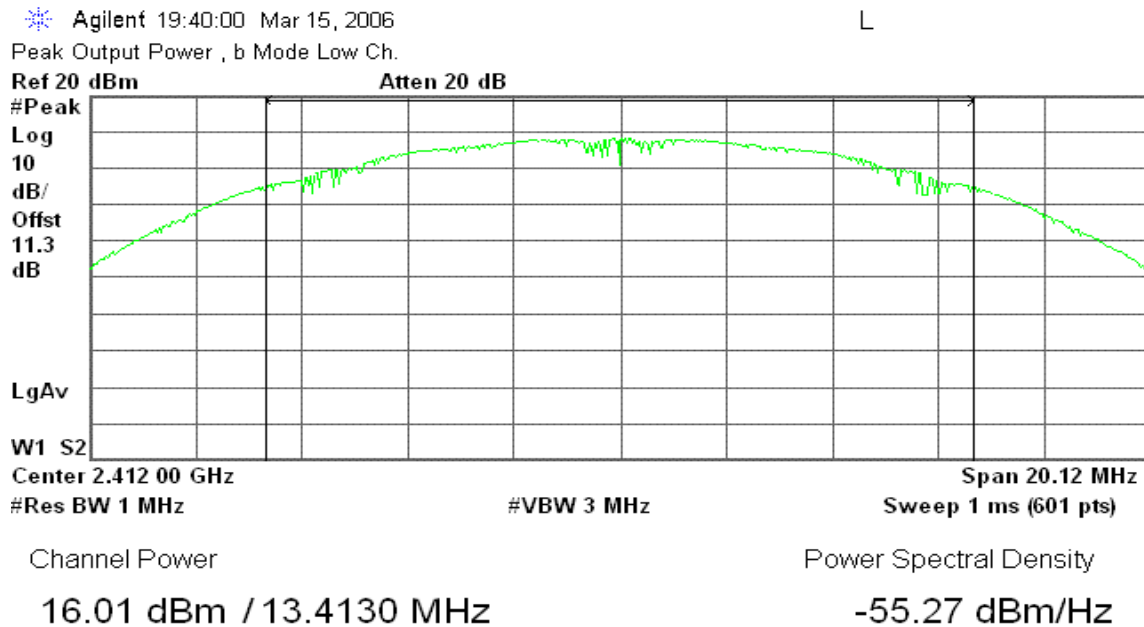
| Channel | Frequency (MHz) | Output Power (dBm) | Output Power (W) | Limit (W) | Result |
|---------|-----------------|--------------------|------------------|-----------|--------|
| Low     | 5745            | 15.24              | 0.0334           | 1         | PASS   |
| Mid     | 5785            | 14.98              | 0.0315           |           | PASS   |
| High    | 5825            | 15.84              | 0.0384           |           | PASS   |



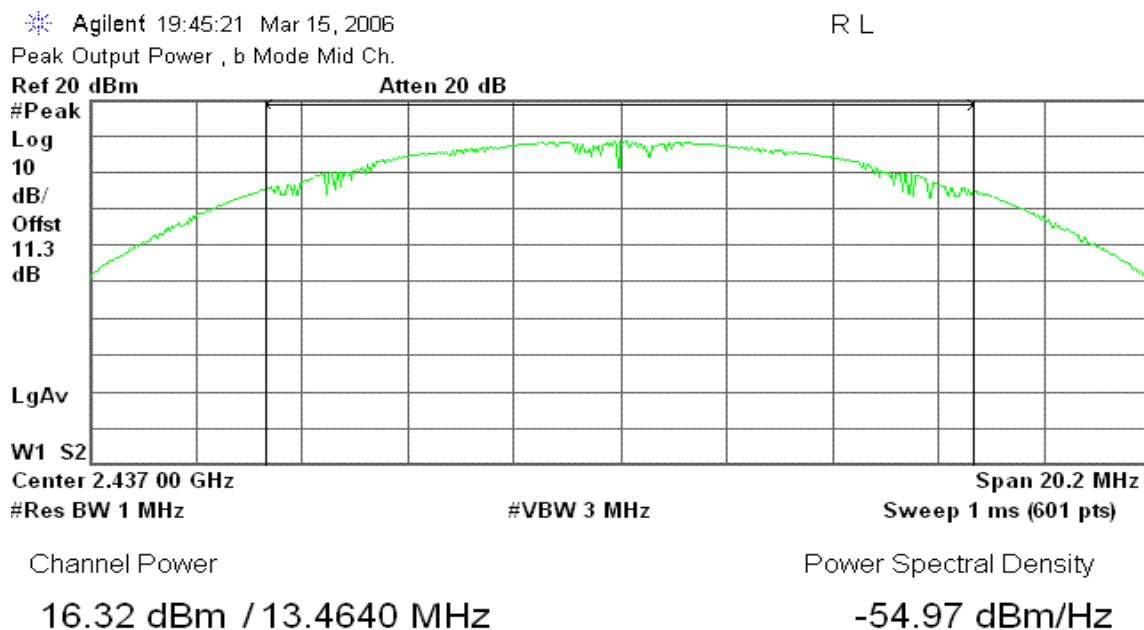
## Test Plot

### IEEE 802.11b

#### CH Low



#### CH Mid





## CH High

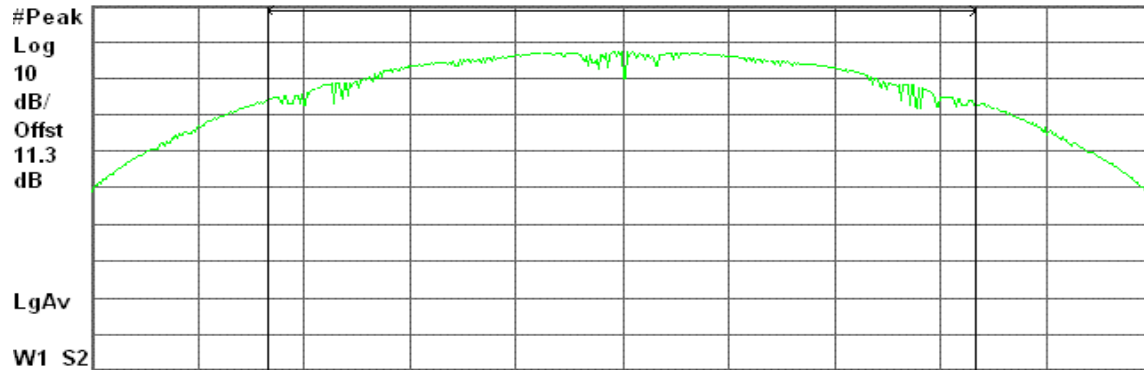
Agilent 19:51:44 Mar 15, 2006

R L

Peak Output Power , b Mode High Ch.

Ref 20 dBm

Atten 20 dB



Center 2.462 00 GHz

Span 20.37 MHz

#Res BW 1 MHz

#VBW 3 MHz

Sweep 1 ms (601 pts)

Channel Power

Power Spectral Density

15.19 dBm / 13.5770 MHz

-56.14 dBm/Hz

## IEEE 802.11g

### CH Low

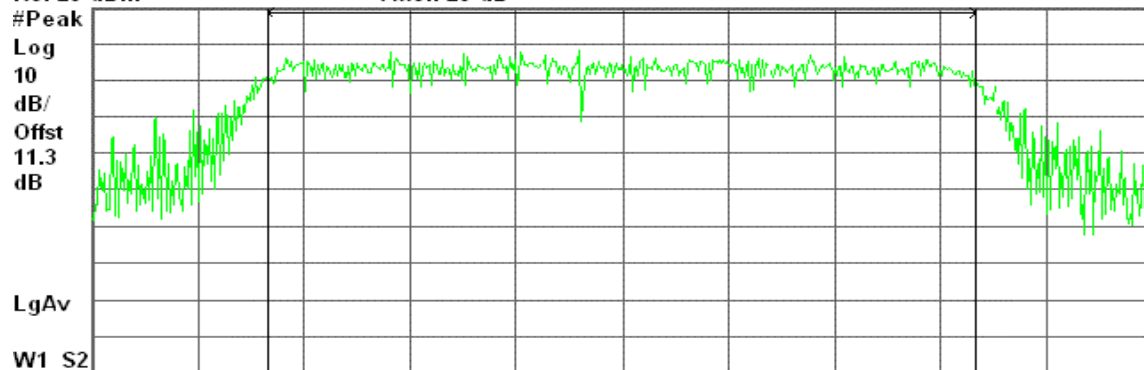
Agilent 20:00:15 Mar 15, 2006

R L

Peak Output Power , g Mode Low Ch.

Ref 20 dBm

Atten 20 dB



Center 2.412 00 GHz

Span 25.1 MHz

#Res BW 1 MHz

#VBW 3 MHz

Sweep 1 ms (601 pts)

Channel Power

Power Spectral Density

15.72 dBm / 16.7330 MHz

-56.51 dBm/Hz



## CH Mid

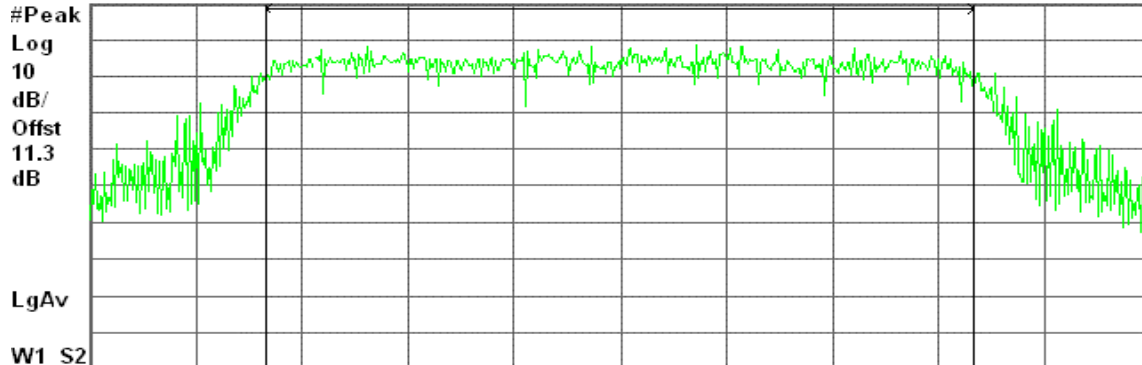
Agilent 20:05:27 Mar 15, 2006

R L

Peak Output Power , g Mode Mid Ch.

Ref 20 dBm

Atten 20 dB



Center 2.437 00 GHz

Span 25.19 MHz

#Res BW 1 MHz

#VBW 3 MHz

Sweep 1 ms (601 pts)

Channel Power

Power Spectral Density

16.07 dBm / 16.7940 MHz

-56.18 dBm/Hz

## CH High

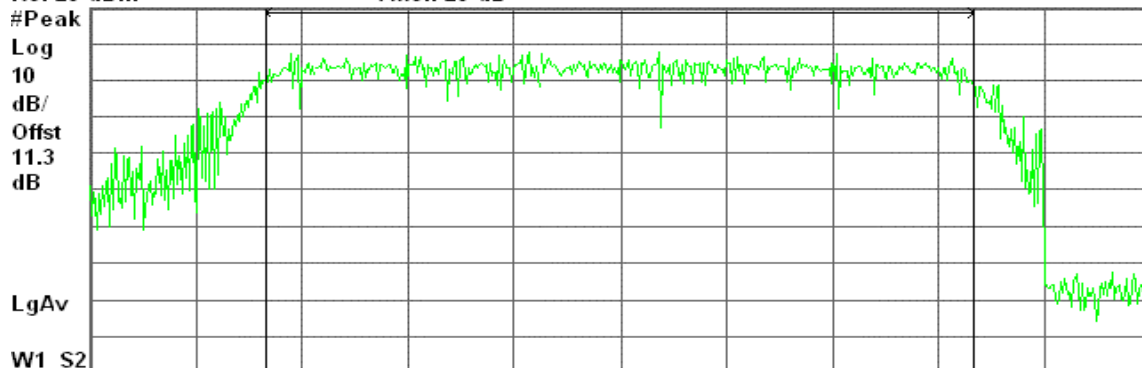
Agilent 20:10:59 Mar 15, 2006

R L

Peak Output Power , g Mode High Ch.

Ref 20 dBm

Atten 20 dB



Center 2.462 00 GHz

Span 25.15 MHz

#Res BW 1 MHz

#VBW 3 MHz

Sweep 1 ms (601 pts)

Channel Power

Power Spectral Density

15.67 dBm / 16.7660 MHz

-56.57 dBm/Hz



## IEEE 802.11a

### CH Low

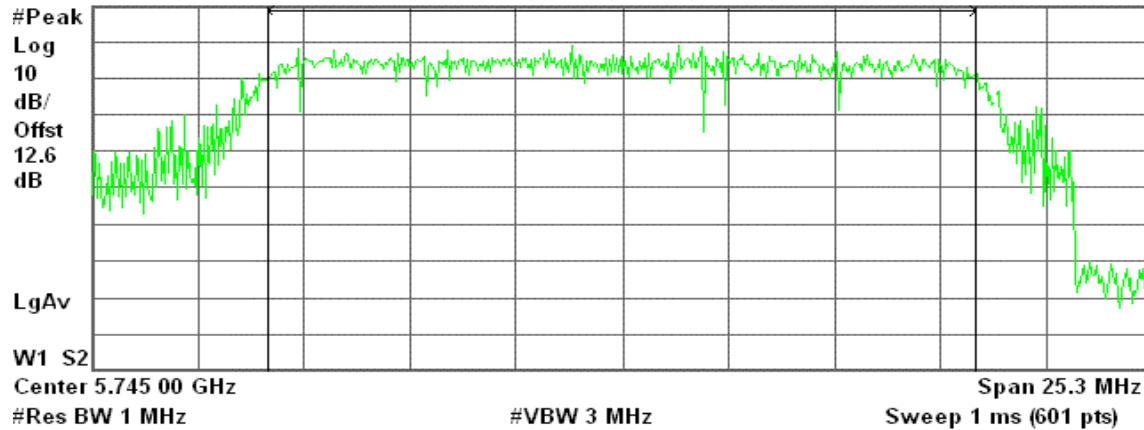
Agilent 15:57:50 Apr 25, 2006

L

Peak Output Power, a Mode Low Ch.

Ref 20 dBm

Atten 20 dB



Channel Power

Power Spectral Density

15.24 dBm / 16.8640 MHz

-56.03 dBm/Hz

### CH Mid

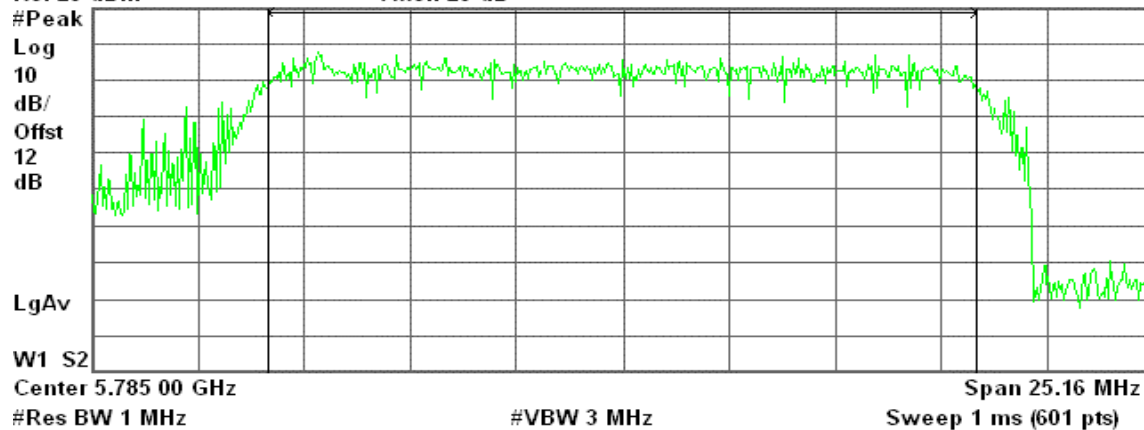
Agilent 16:06:13 Apr 25, 2006

R L

Peak Output Power, a Mode Mid Ch.

Ref 20 dBm

Atten 20 dB



Channel Power

Power Spectral Density

14.98 dBm / 16.7760 MHz

-57.27 dBm/Hz



## CH High

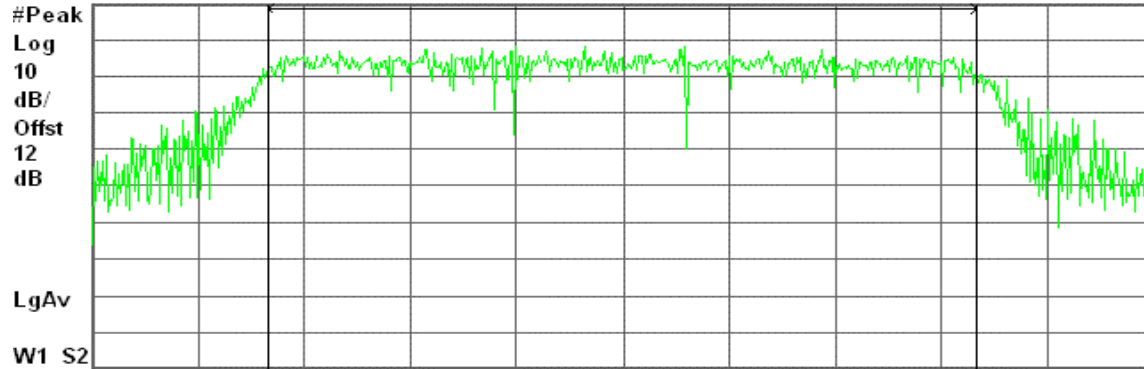
Agilent 16:13:44 Apr 25, 2006

R L

Peak Output Power , a Mode High Ch.

Ref 20 dBm

Atten 20 dB



Center 5.825 00 GHz

Span 24.95 MHz

#Res BW 1 MHz

#VBW 3 MHz

Sweep 1 ms (601 pts)

Channel Power

Power Spectral Density

15.84 dBm / 16.6340 MHz

-56.37 dBm/Hz

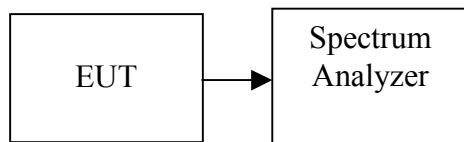


## **7.3 AVERAGE POWER**

### **LIMIT**

None; for reporting purposes only.

### **Test Configuration**



### **TEST PROCEDURE**

The transmitter output is connected to the Spectrum analyzer. The Spectrum analyzer is set to the average power detection.

**TEST RESULTS**

*No non-compliance noted.*

**Test Data****Test mode: IEEE 802.11b**

| Channel | Frequency<br>(MHz) | Output Power<br>(dBm) | Output Power<br>(W) |
|---------|--------------------|-----------------------|---------------------|
| Low     | 2412               | 13.45                 | 0.0221              |
| Mid     | 2437               | 13.81                 | 0.0240              |
| High    | 2462               | 12.49                 | 0.0177              |

**Test mode: IEEE 802.11g**

| Channel | Frequency<br>(MHz) | Output Power<br>(dBm) | Output Power<br>(W) |
|---------|--------------------|-----------------------|---------------------|
| Low     | 2412               | 12.53                 | 0.0179              |
| Mid     | 2437               | 12.77                 | 0.0189              |
| High    | 2462               | 12.21                 | 0.0166              |

**Test mode: IEEE 802.11a**

| Channel | Frequency<br>(MHz) | Output Power<br>(dBm) | Output Power<br>(W) |
|---------|--------------------|-----------------------|---------------------|
| Low     | 5745               | 13.42                 | 0.0220              |
| Mid     | 5785               | 11.75                 | 0.0150              |
| High    | 5825               | 12.23                 | 0.0167              |



## Test Plot

### IEEE 802.11b

#### CH Low

Agilent 19:40:34 Mar 15, 2006

R T

AVG Output Power , b Mode Low Ch.

Ref 30 dBm

Atten 30 dB



Center 2.412 00 GHz

Span 20.12 MHz

#Res BW 1 MHz

#VBW 3 MHz

Sweep 1 ms (601 pts)

Channel Power

Power Spectral Density

13.45 dBm / 13.4130 MHz

-57.83 dBm/Hz

#### CH Mid

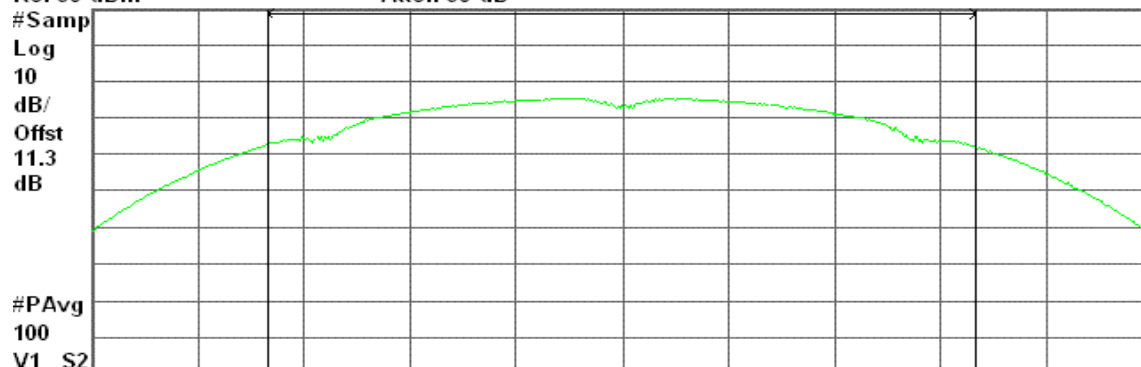
Agilent 19:45:55 Mar 15, 2006

R L

AVG Output Power , b Mode Mid Ch.

Ref 30 dBm

Atten 30 dB



Center 2.437 00 GHz

Span 20.2 MHz

#Res BW 1 MHz

#VBW 3 MHz

Sweep 1 ms (601 pts)

Channel Power

Power Spectral Density

13.81 dBm / 13.4640 MHz

-57.48 dBm/Hz



## CH High

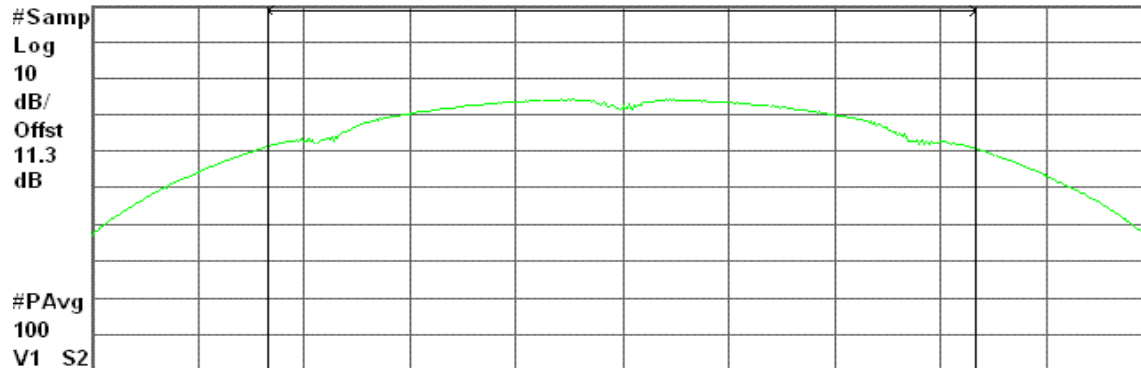
Agilent 19:52:25 Mar 15, 2006

R L

AVG Output Power, b Mode High Ch.

Ref 30 dBm

Atten 30 dB



Channel Power

12.49 dBm / 13.5770 MHz

Power Spectral Density

-58.84 dBm/Hz

## IEEE 802.11g

### CH Low

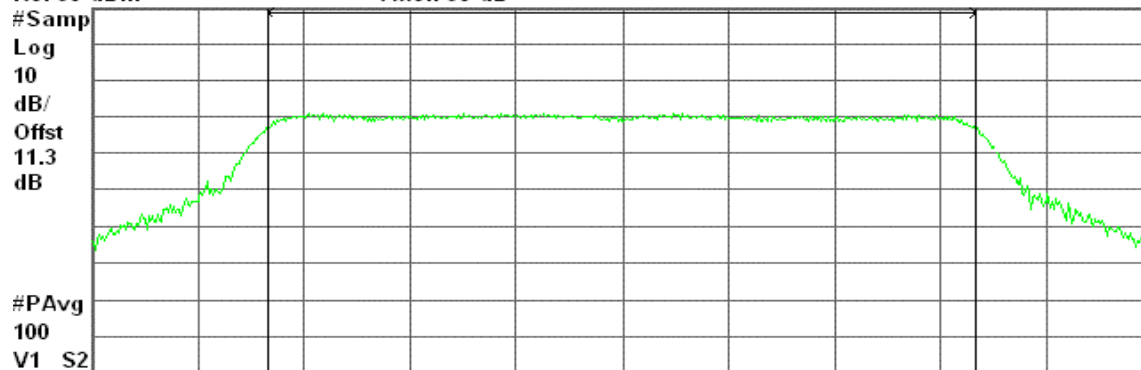
Agilent 20:00:45 Mar 15, 2006

R L

AVG Output Power, g Mode Low Ch.

Ref 30 dBm

Atten 30 dB



Channel Power

12.53 dBm / 16.7330 MHz

Power Spectral Density

-59.70 dBm/Hz



## CH Mid

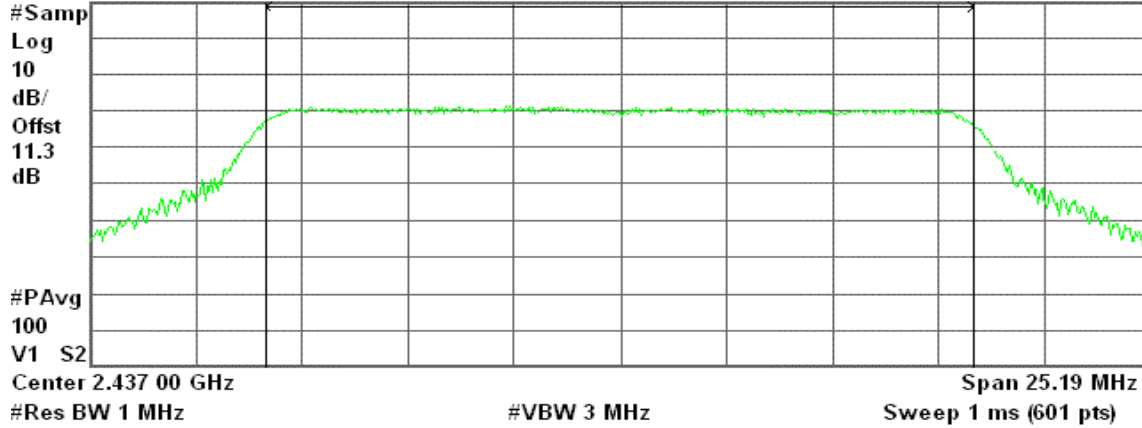
Agilent 20:05:58 Mar 15, 2006

R L

AVG Output Power , g Mode Mid Ch.

Ref 30 dBm

Atten 30 dB



Channel Power

Power Spectral Density

12.77 dBm / 16.7940 MHz

-59.48 dBm/Hz

## CH High

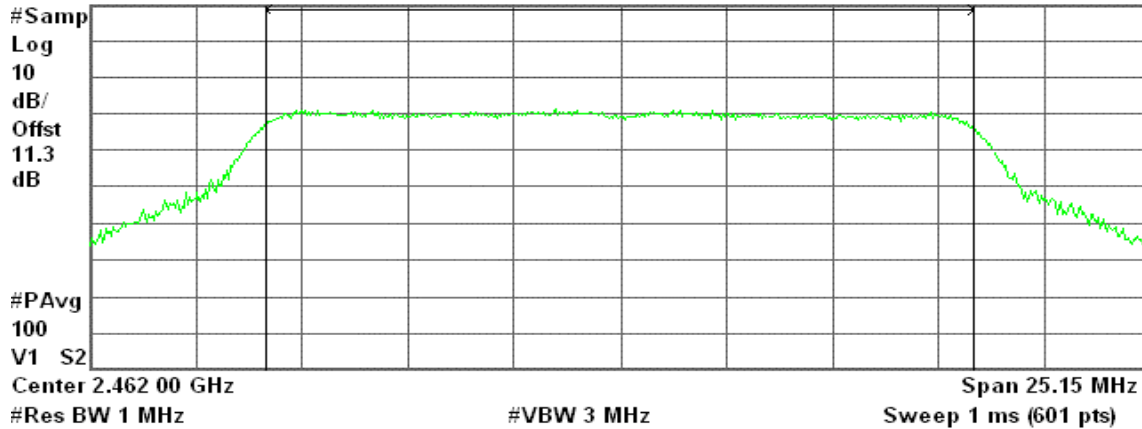
Agilent 20:11:43 Mar 15, 2006

R L

AVG Output Power , g Mode High Ch.

Ref 30 dBm

Atten 30 dB



Channel Power

Power Spectral Density

12.21 dBm / 16.7660 MHz

-60.03 dBm/Hz



## IEEE 802.11a

### CH Low

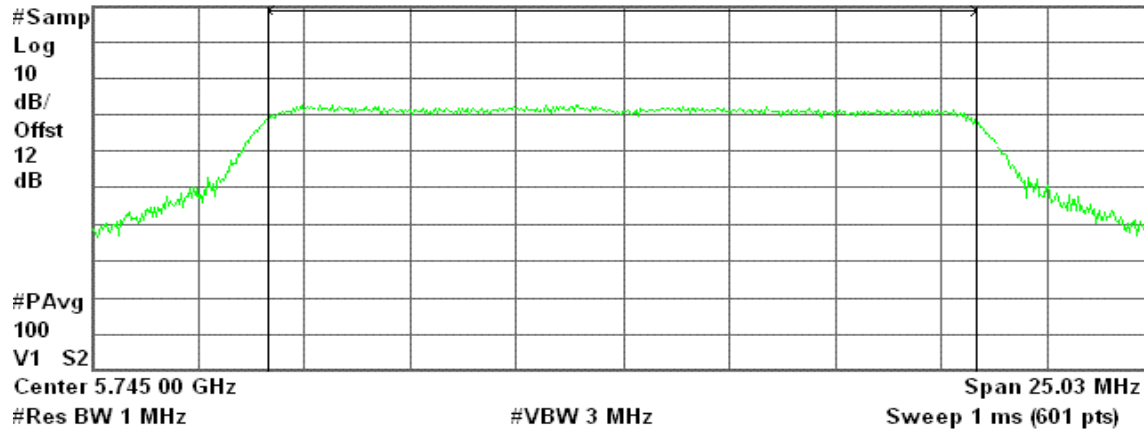
Agilent 15:58:20 Apr 25, 2006

R L

AVG Output Power , a Mode Low Ch.

Ref 30 dBm

Atten 30 dB



Channel Power

13.42 dBm / 16.6880 MHz

Power Spectral Density

-58.80 dBm/Hz

### CH Mid

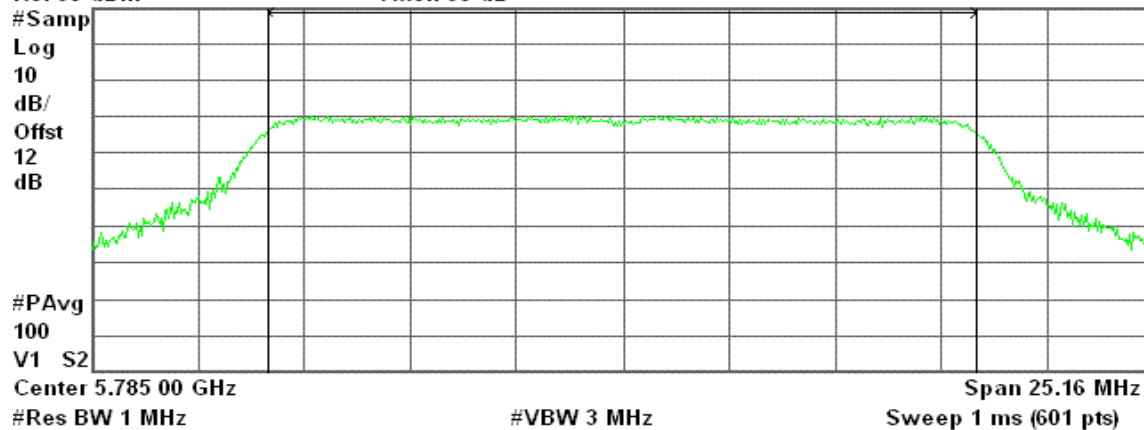
Agilent 16:06:51 Apr 25, 2006

R L

AVG Output Power , a Mode Mid Ch.

Ref 30 dBm

Atten 30 dB



Channel Power

11.75 dBm / 16.7760 MHz

Power Spectral Density

-60.49 dBm/Hz



## CH High

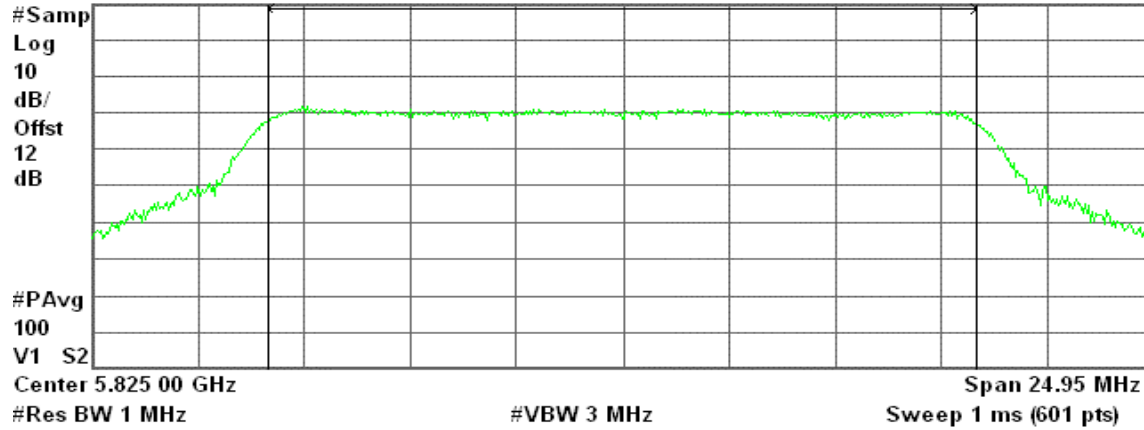
Agilent 16:14:15 Apr 25, 2006

R L

AVG Output Power , a Mode High Ch.

Ref 30 dBm

Atten 30 dB



Channel Power

12.23 dBm / 16.6340 MHz

Power Spectral Density

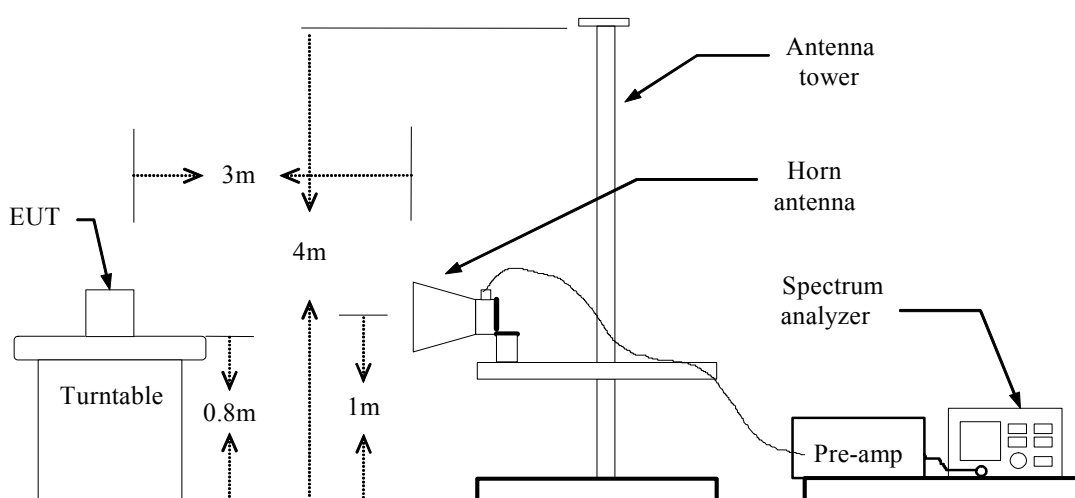
-59.98 dBm/Hz

## 7.4BAND EDGES MEASUREMENT

### LIMIT

According to §15.247(d), 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, provided the transmitter demonstrates compliance with the peak conducted power limits. 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 Section 15.205(c)).

### Test Configuration



### TEST PROCEDURE

1. The EUT is placed on a turntable, which is 0.8m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
  - (a) PEAK: RBW=VBW=1MHz / Sweep=AUTO
  - (b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

### TEST RESULTS

Refer to attach spectrum analyzer data chart.



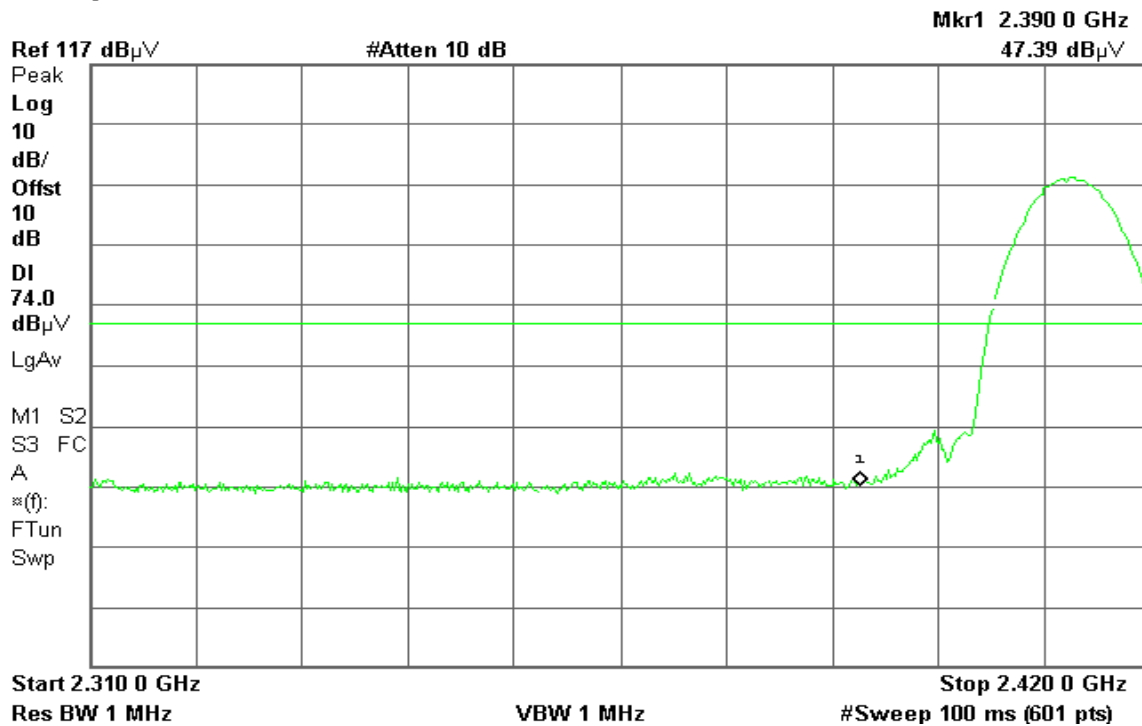
## Band Edges (IEEE 802.11b / CH Low)

Detector mode: Peak

Polarity: Vertical

Agilent 11:20:07 Mar 20, 2006

T

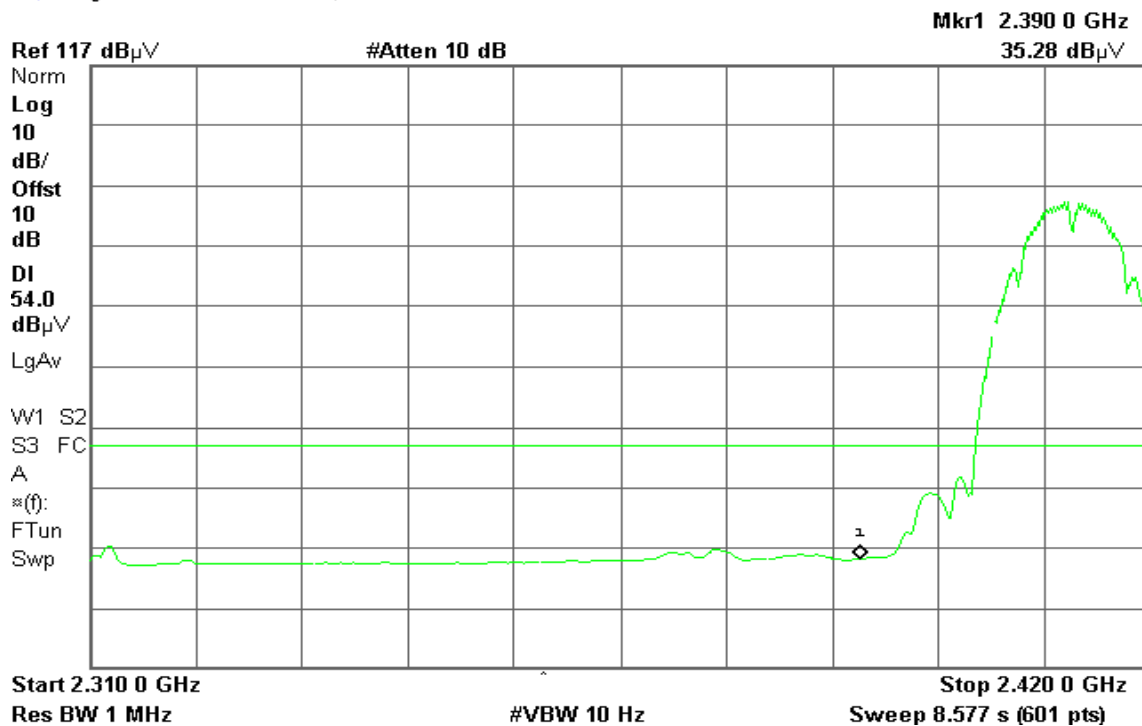


Detector mode: Average

Polarity: Vertical

Agilent 11:20:46 Mar 20, 2006

T



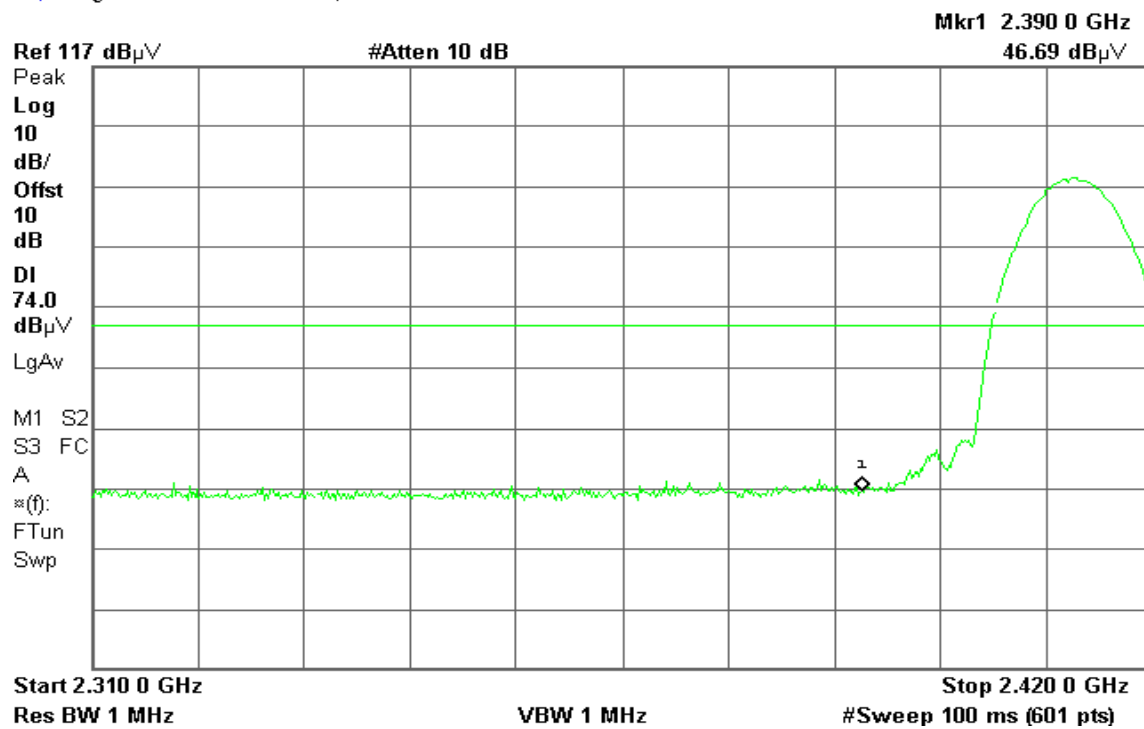


Detector mode: Peak

Polarity: Horizontal

Agilent 11:26:23 Mar 20, 2006

T

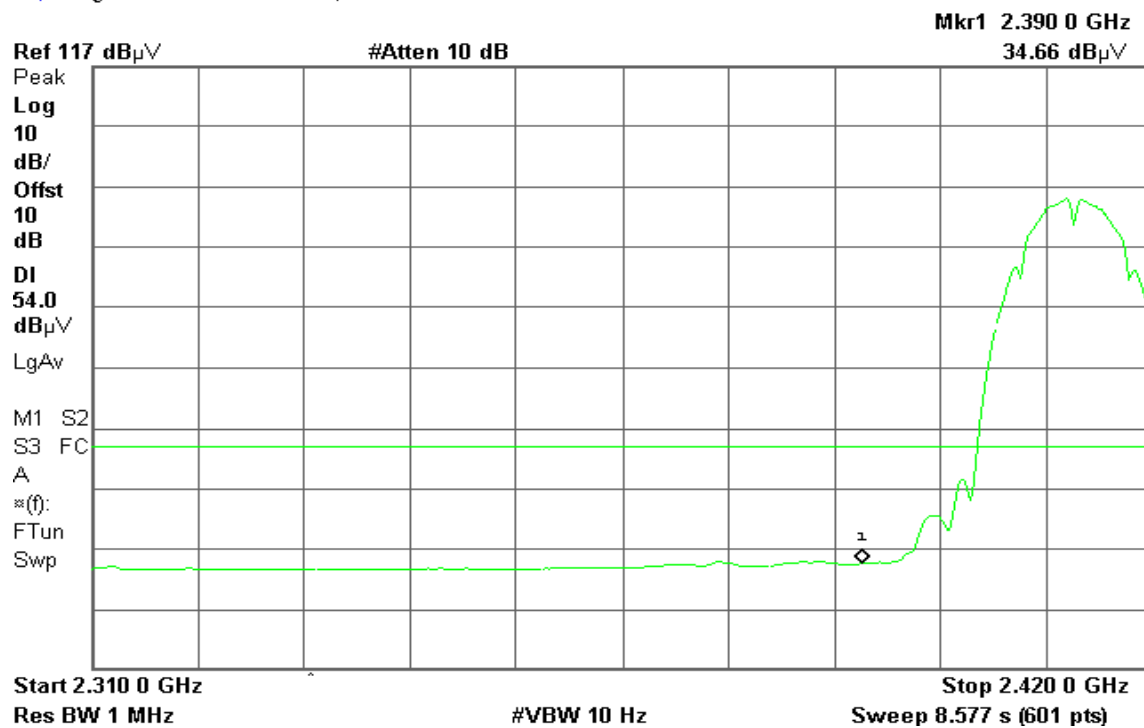


Detector mode: Average

Polarity: Horizontal

Agilent 11:27:41 Mar 20, 2006

T





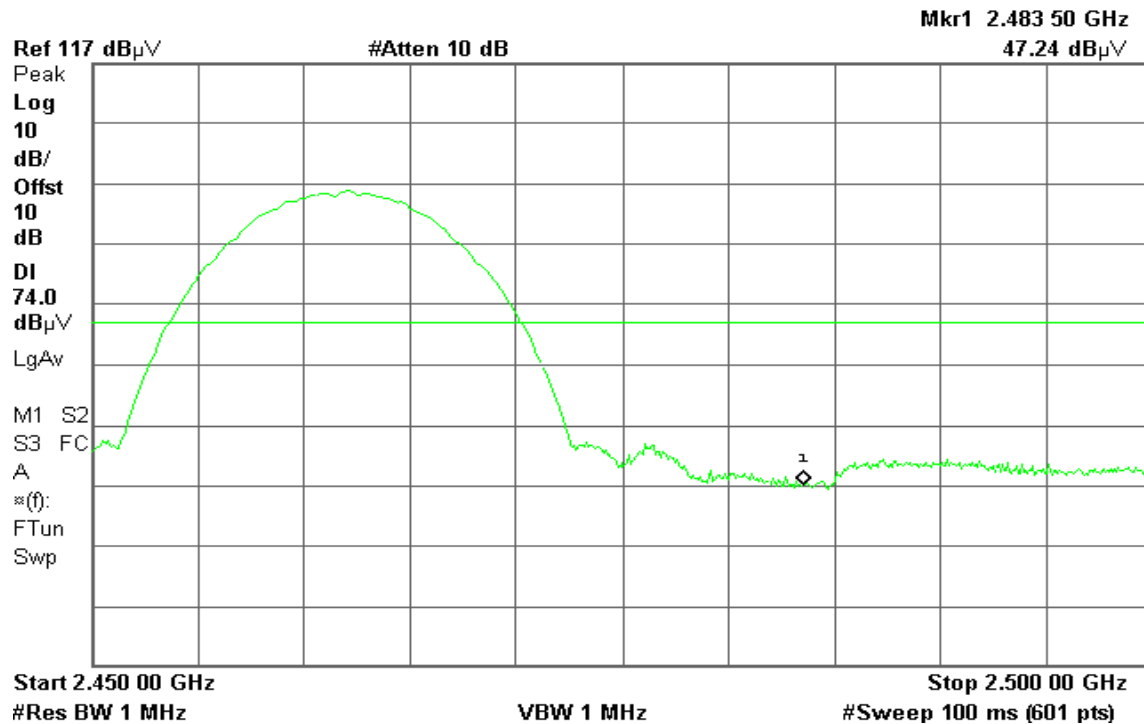
## Band Edges (IEEE 802.11b / CH High)

Detector mode: Peak

Polarity: Vertical

Agilent 11:35:26 Mar 20, 2006

T

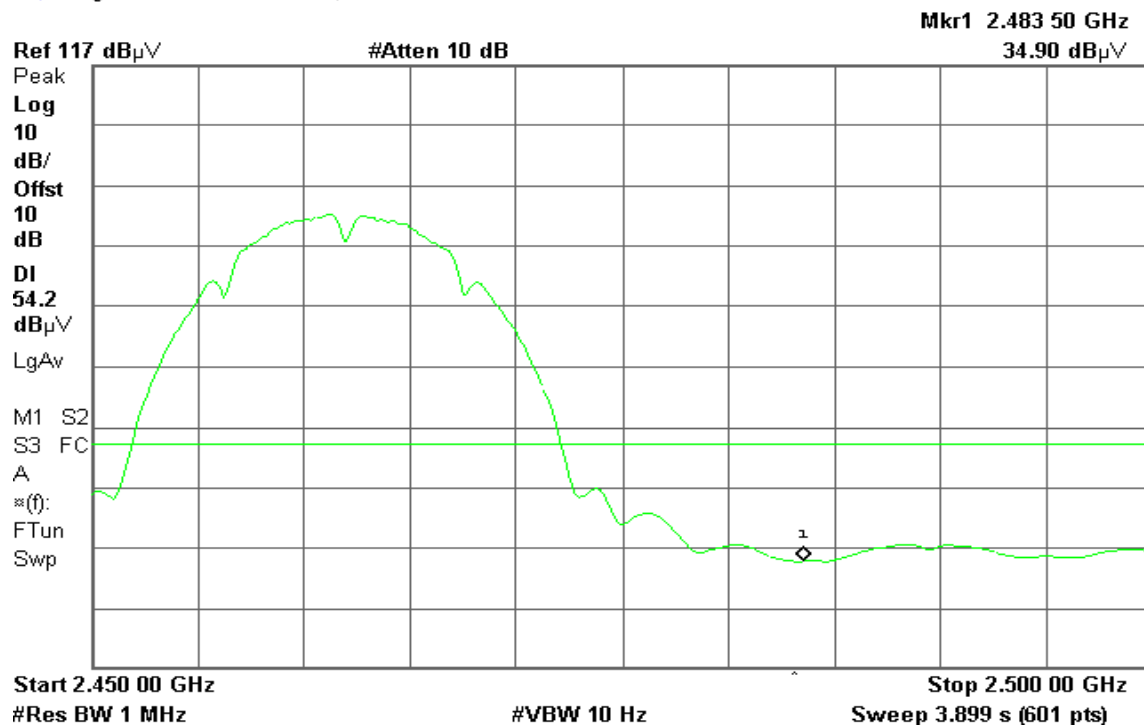


Detector mode: Average

Polarity: Vertical

Agilent 11:35:57 Mar 20, 2006

T



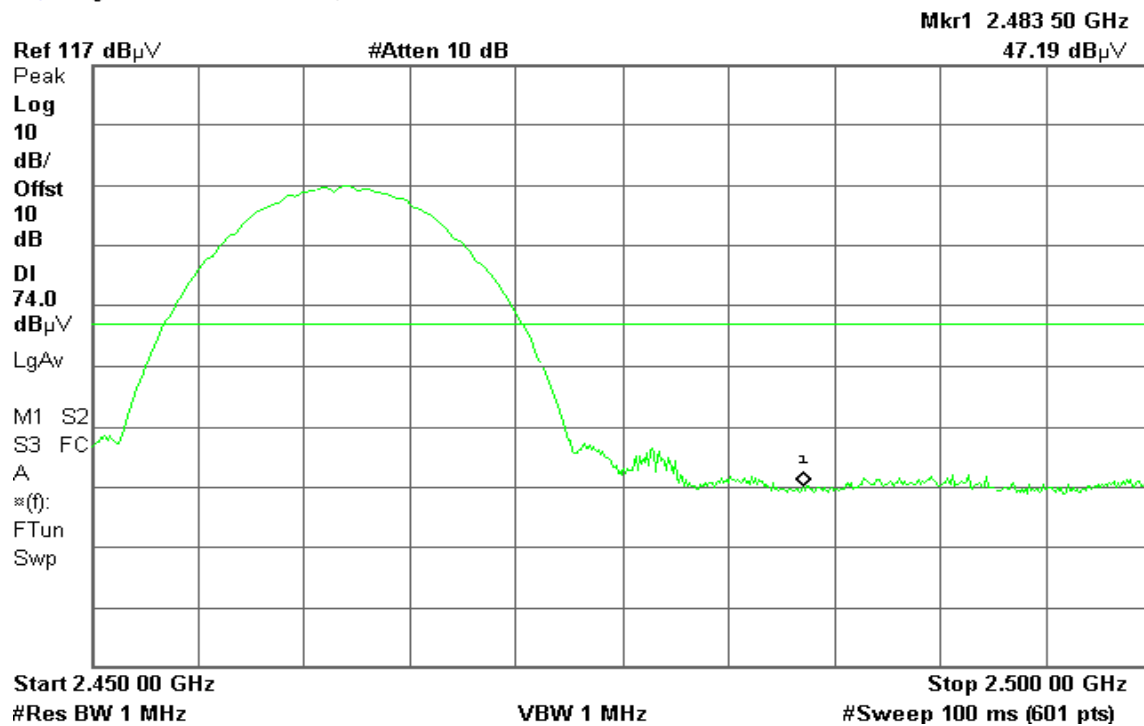


Detector mode: Peak

Polarity: Horizontal

Agilent 11:33:15 Mar 20, 2006

T

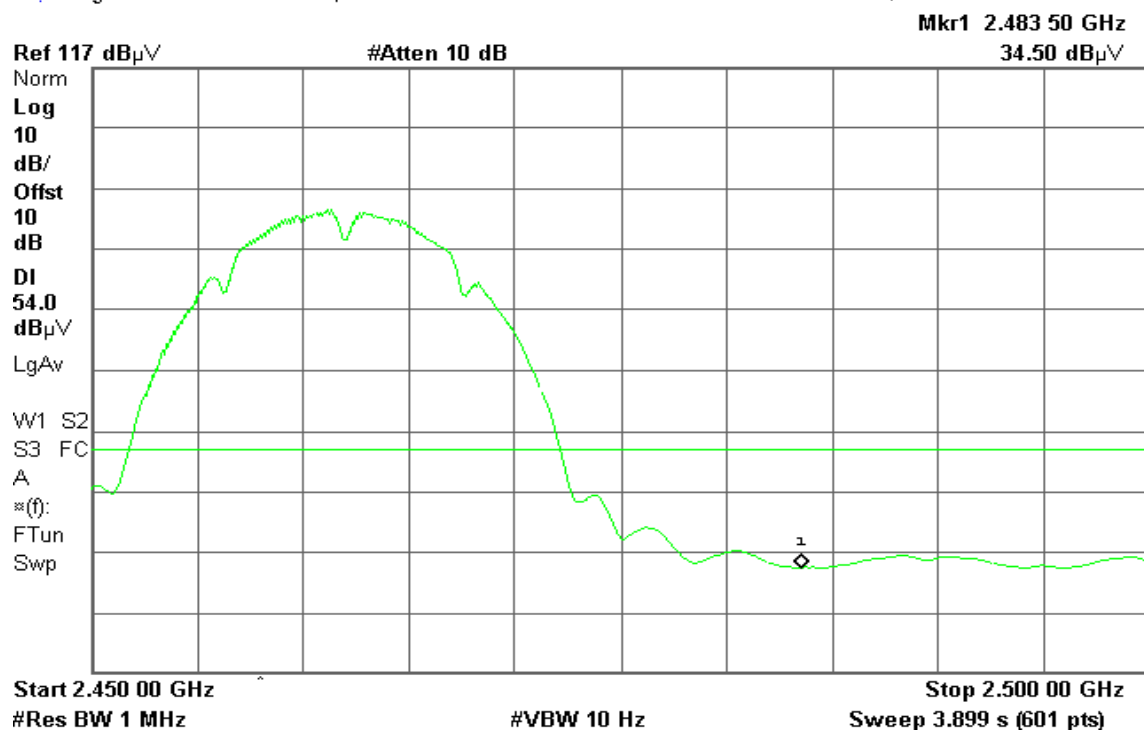


Detector mode: Average

Polarity: Horizontal

Agilent 11:32:42 Mar 20, 2006

T





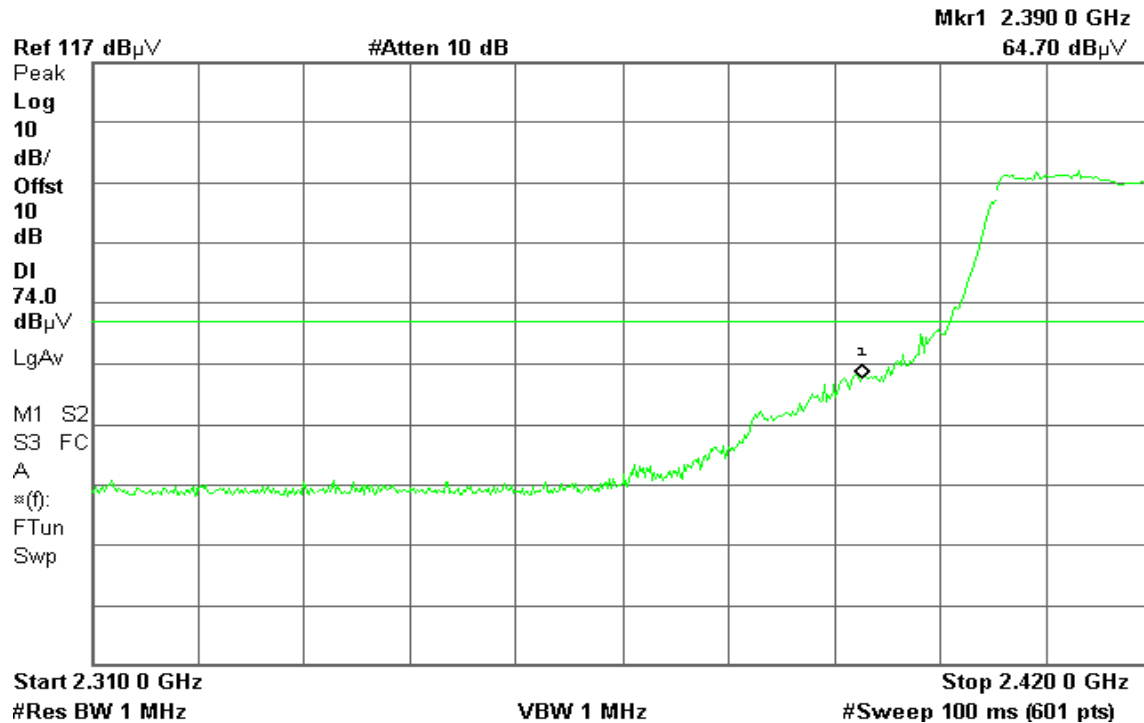
## Band Edges (IEEE 802.11g / CH Low)

Detector mode: Peak

Polarity: Vertical

Agilent 11:51:42 Mar 20, 2006

R T

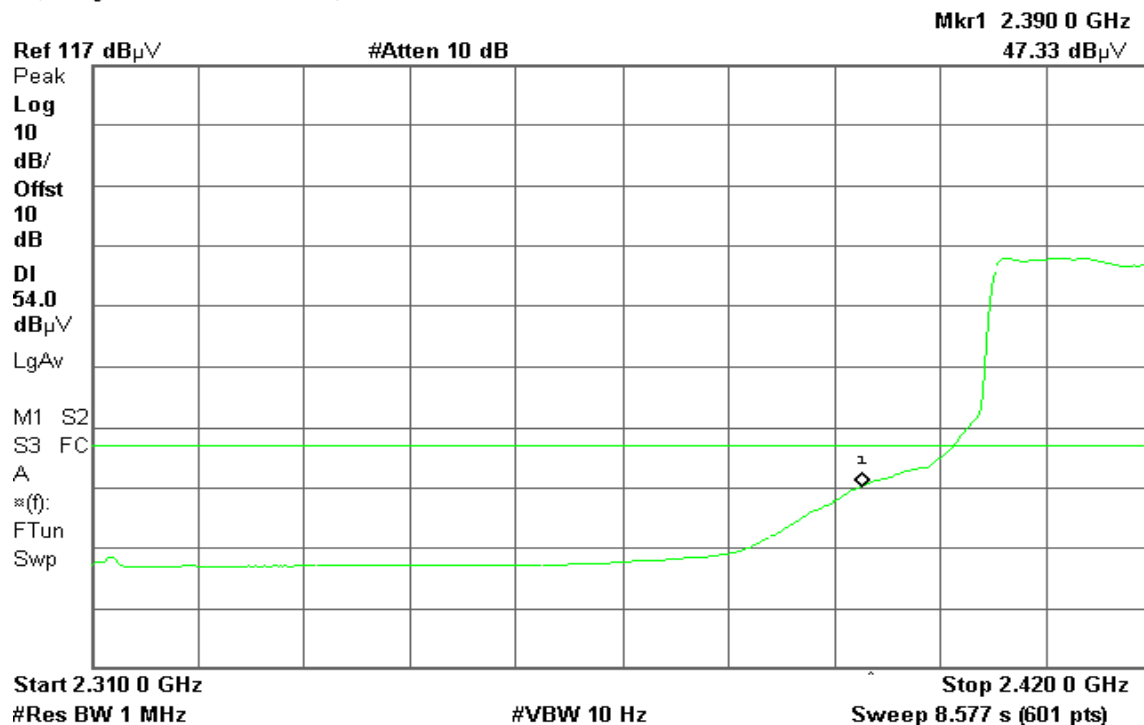


Detector mode: Average

Polarity: Vertical

Agilent 11:51:12 Mar 20, 2006

T



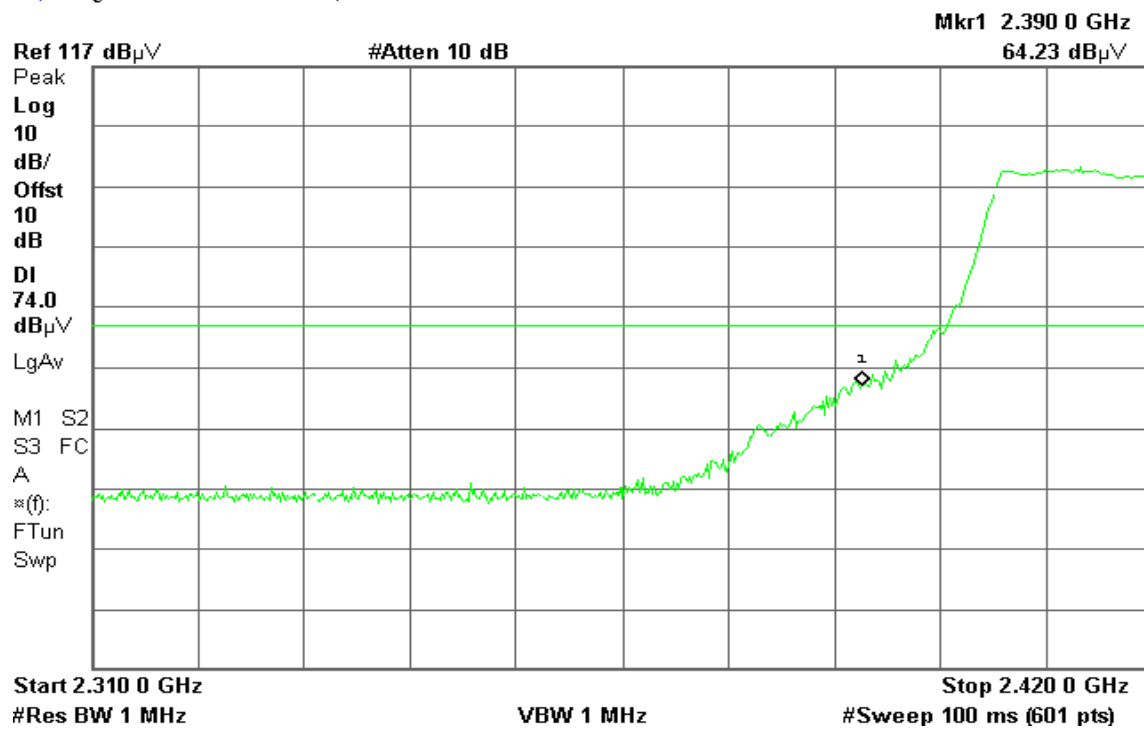


Detector mode: Peak

Polarity: Horizontal

Agilent 11:53:47 Mar 20, 2006

T

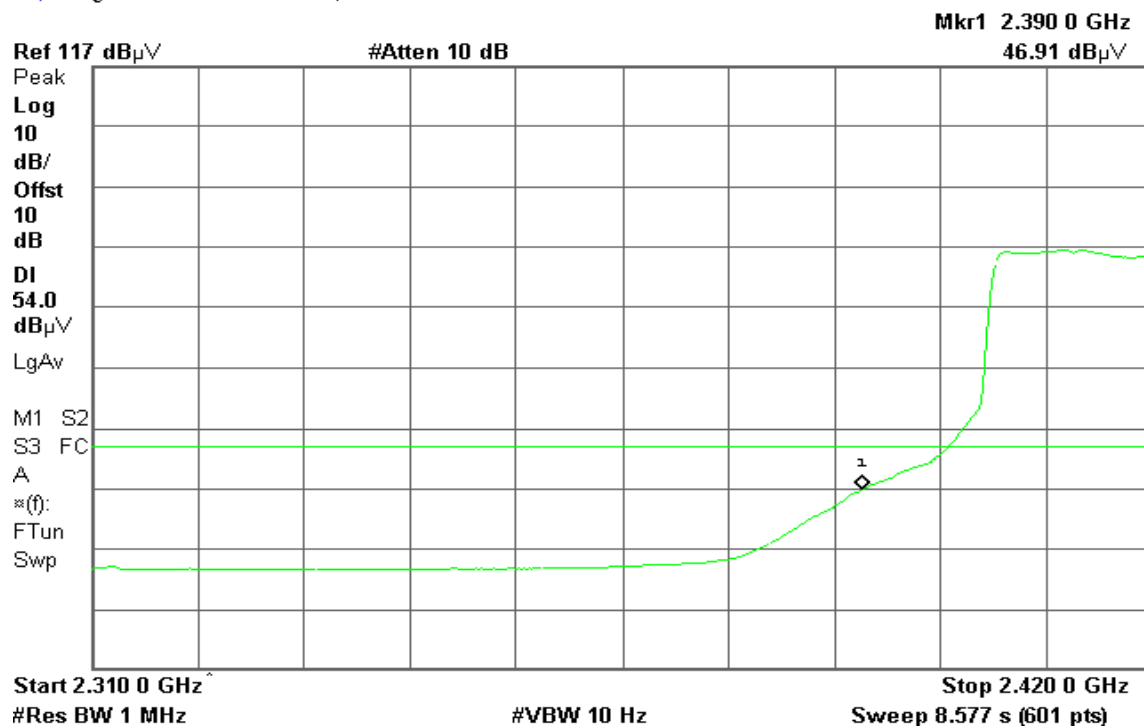


Detector mode: Average

Polarity: Horizontal

Agilent 11:53:26 Mar 20, 2006

T





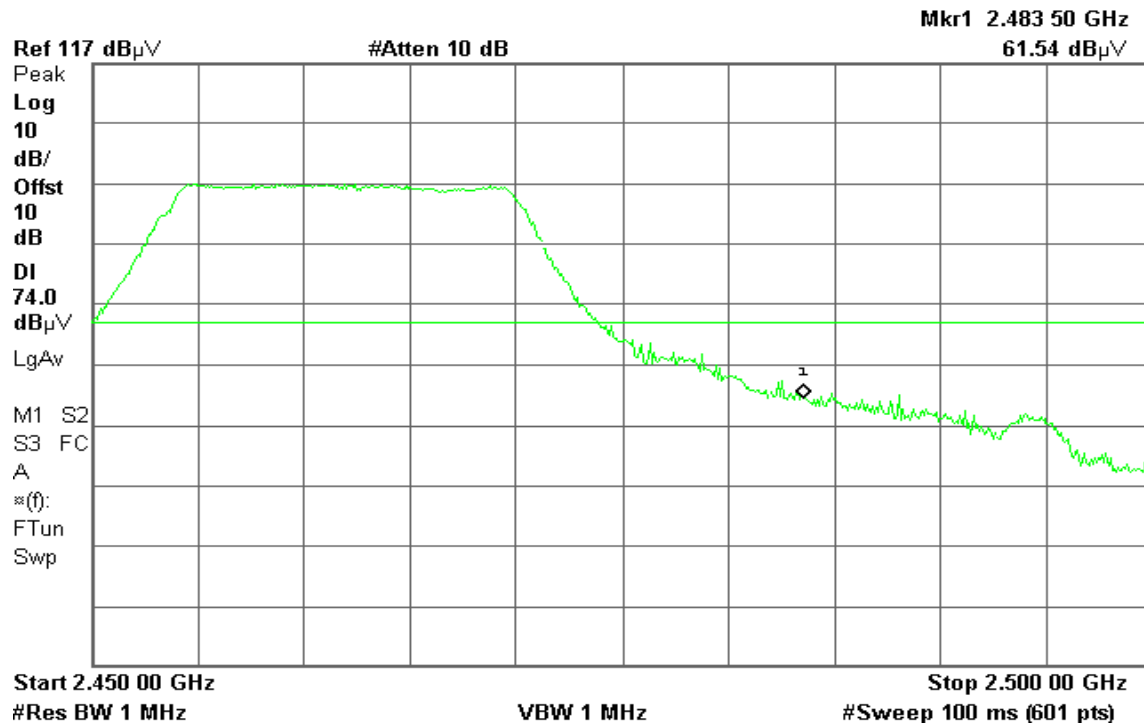
## Band Edges (IEEE 802.11g / CH High)

Detector mode: Peak

Polarity: Vertical

Agilent 11:47:41 Mar 20, 2006

T

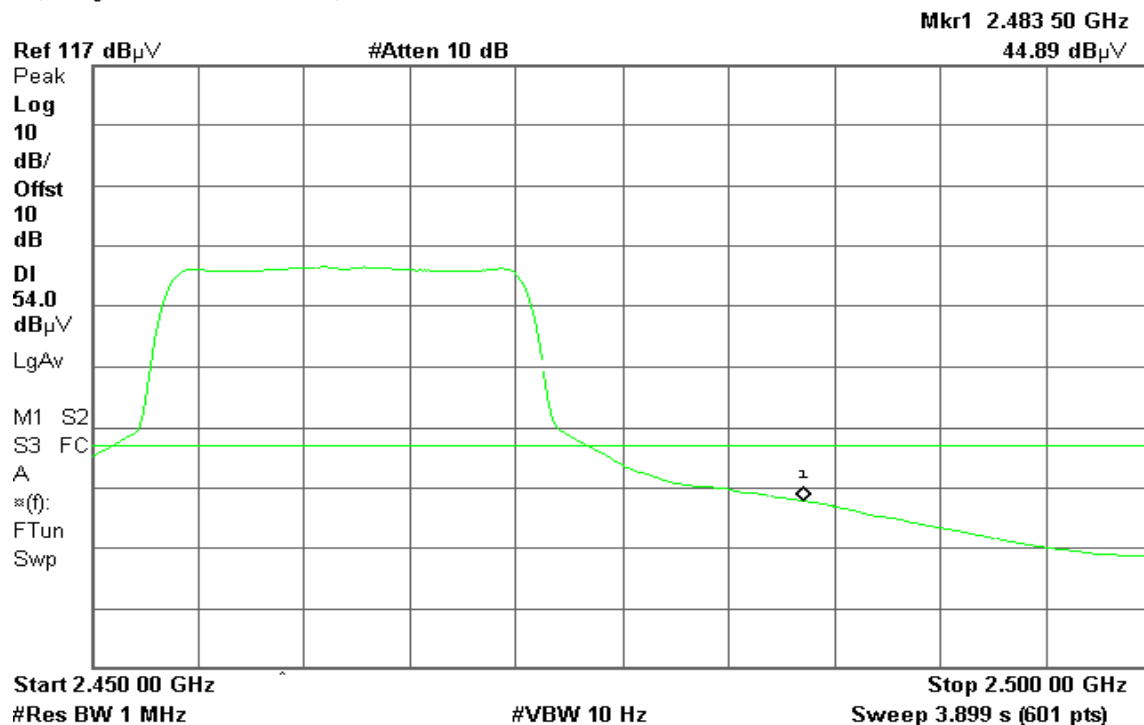


Detector mode: Average

Polarity: Vertical

Agilent 11:48:29 Mar 20, 2006

T



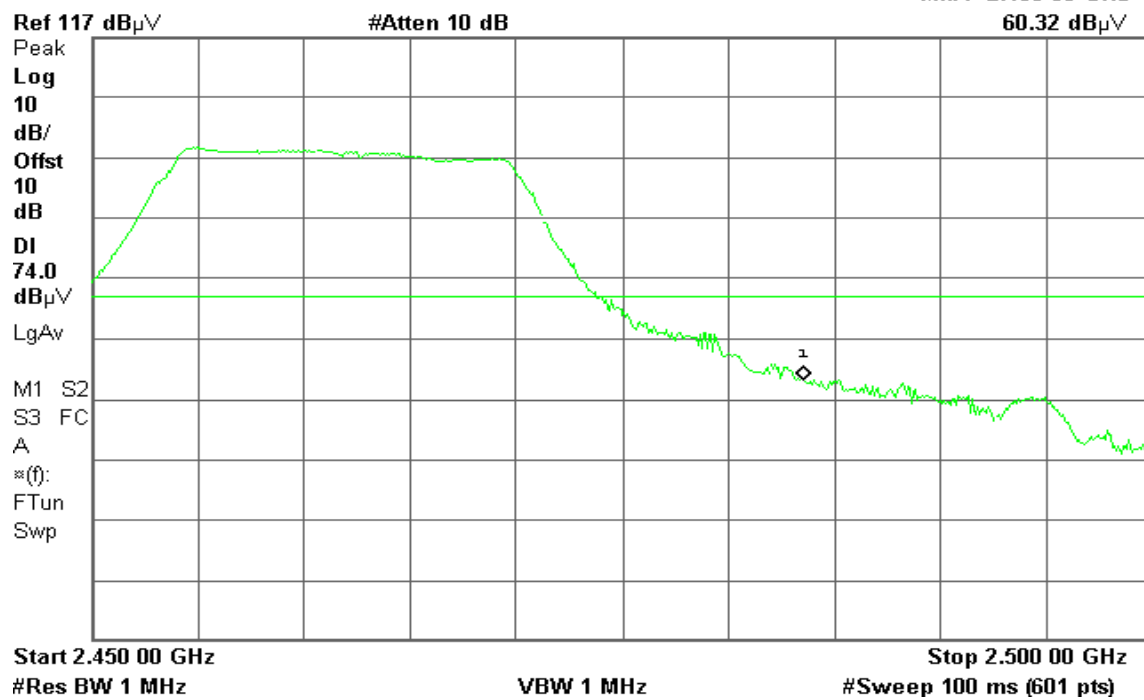


Detector mode: Peak

Polarity: Horizontal

Agilent 11:44:43 Mar 20, 2006

T

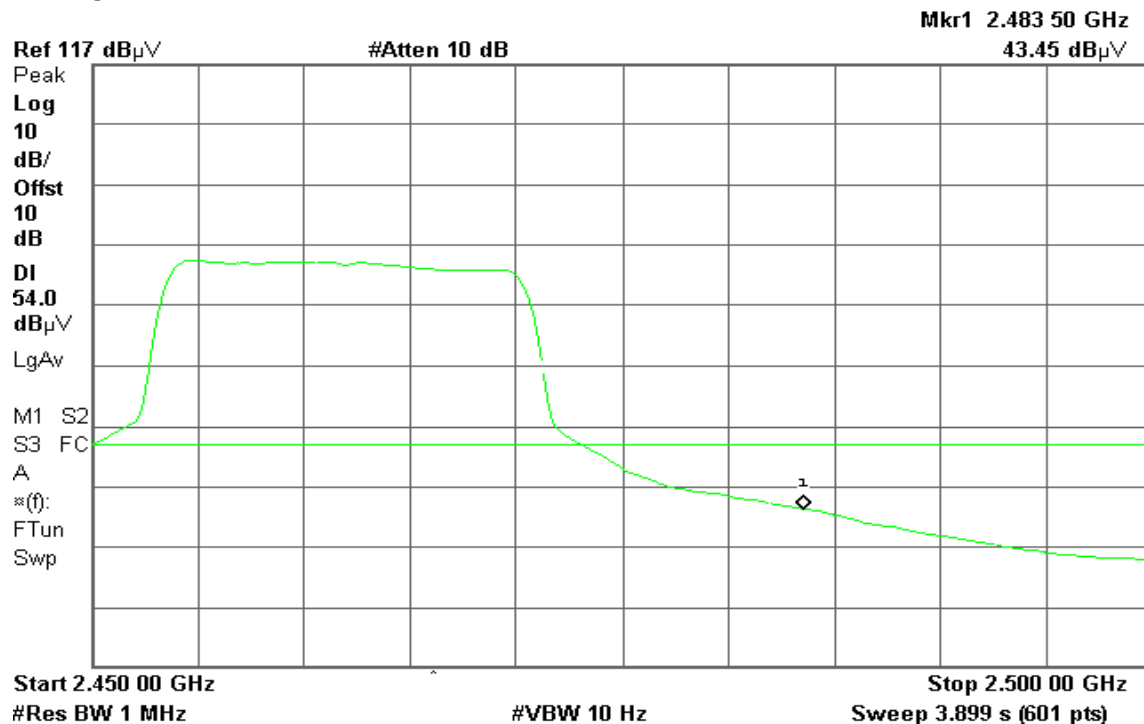


Detector mode: Average

Polarity: Horizontal

Agilent 11:45:17 Mar 20, 2006

T



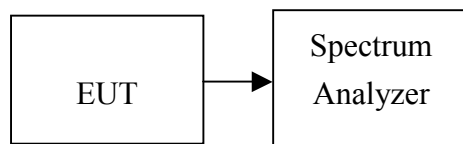


## **7.5 PEAK POWER SPECTRAL DENSITY**

### **LIMIT**

1. According to §15.247(e), for digitally modulated systems, the 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.
2. According to §15.247(f), the digital modulation operation of the hybrid system, with the frequency hopping turned off, shall comply with the power density requirements of paragraph (d) of this section.

### **Test Configuration**



### **TEST PROCEDURE**

1. Place the EUT on the table and set it in transmitting mode.  
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set the spectrum analyzer as RBW = 3kHz, VBW = 10kHz, Span = 300kHz, Sweep=100s.
3. Record the max. reading.
4. Repeat the above procedure until the measurements for all frequencies are completed.

**TEST RESULTS***No non-compliance noted***Test Data****Test mode: IEEE 802.11b**

| Channel | Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Result |
|---------|-----------------|------------|-------------|--------|
| Low     | 2412            | -12.40     | 8.00        | PASS   |
| Mid     | 2437            | -11.18     |             | PASS   |
| High    | 2462            | -12.81     |             | PASS   |

**Test mode: IEEE 802.11g**

| Channel | Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Result |
|---------|-----------------|------------|-------------|--------|
| Low     | 2412            | -8.63      | 8.00        | PASS   |
| Mid     | 2437            | -8.63      |             | PASS   |
| High    | 2462            | -8.84      |             | PASS   |

**Test mode: IEEE 802.11a**

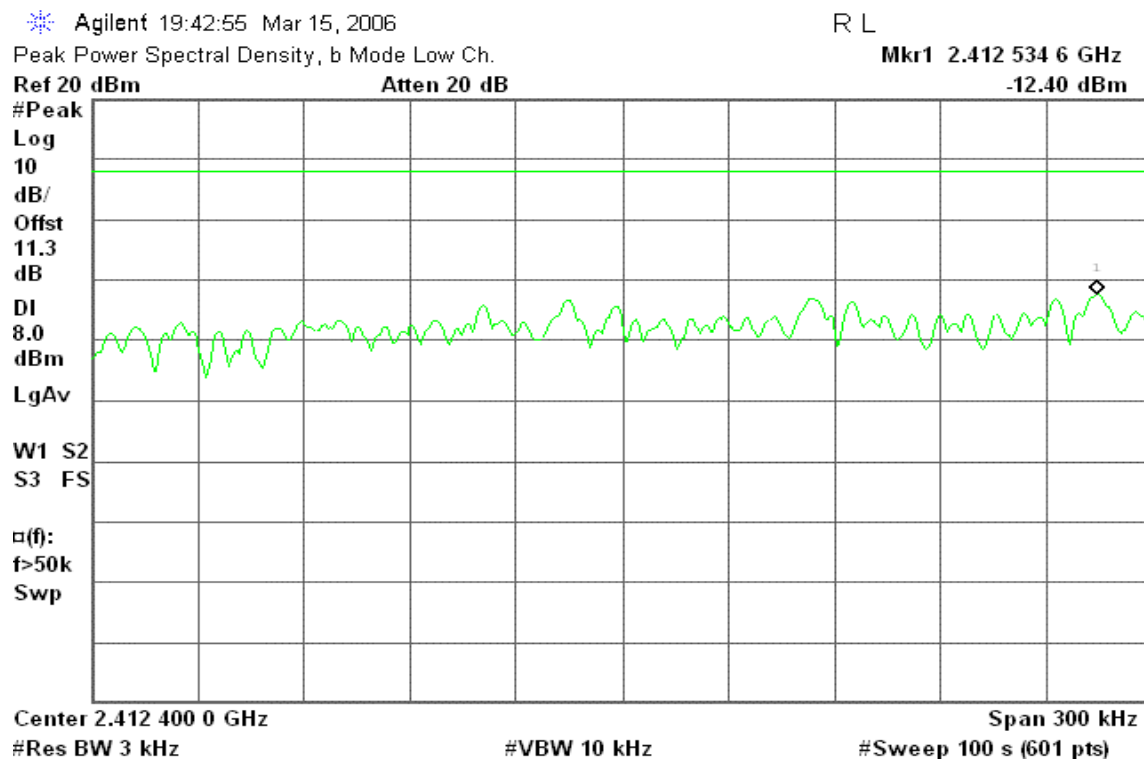
| Channel | Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Result |
|---------|-----------------|------------|-------------|--------|
| Low     | 5745            | -8.62      | 8.00        | PASS   |
| Mid     | 5785            | -9.57      |             | PASS   |
| High    | 5825            | -9.00      |             | PASS   |



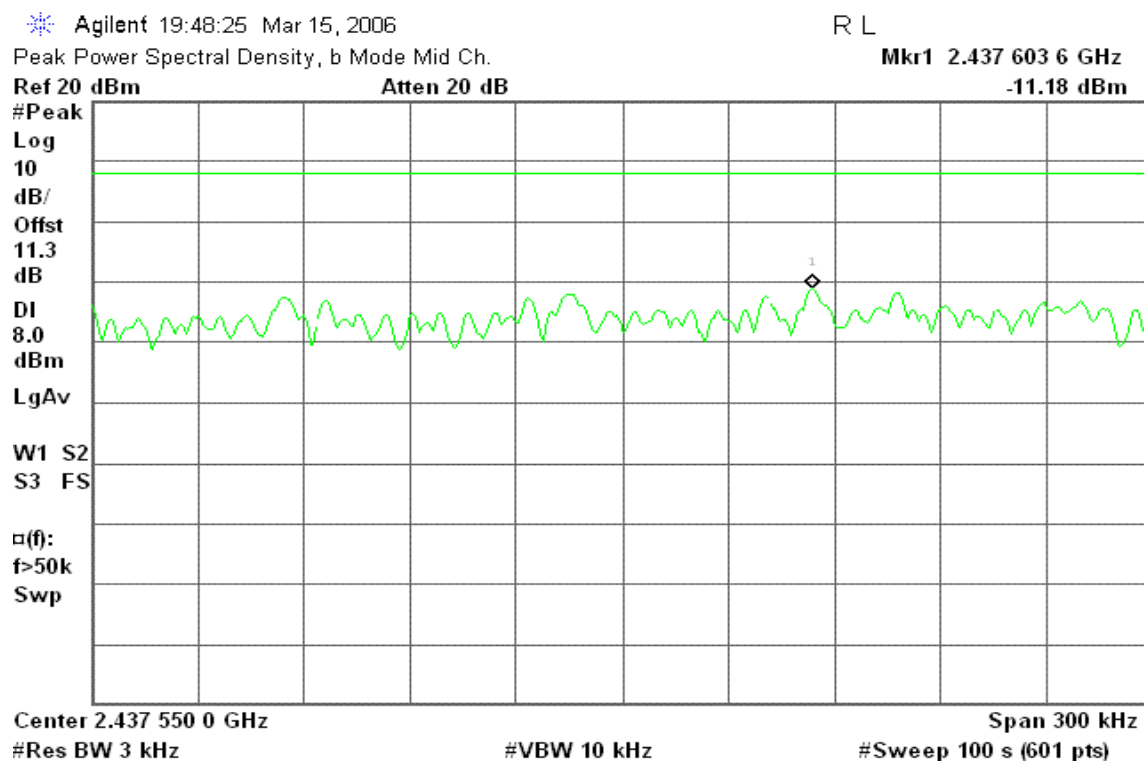
## Test Plot

### IEEE 802.11b

#### CH Low



#### CH Mid





## CH High

Agilent 19:54:55 Mar 15, 2006

R L

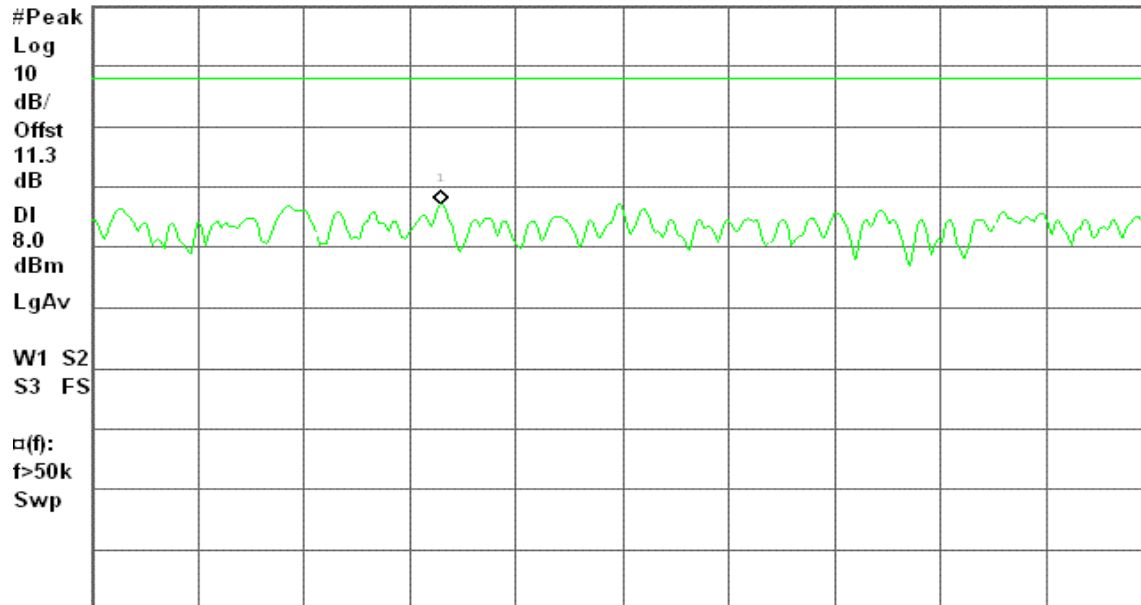
Peak Power Spectral Density, b Mode High Ch.

Mkr1 2.461 148 9 GHz

Ref 20 dBm

Atten 20 dB

-12.81 dBm



Center 2.461 200 0 GHz

Span 300 kHz

#Res BW 3 kHz

#VBW 10 kHz

#Sweep 100 s (601 pts)

## IEEE 802.11g

### CH Low

Agilent 20:03:02 Mar 15, 2006

R L

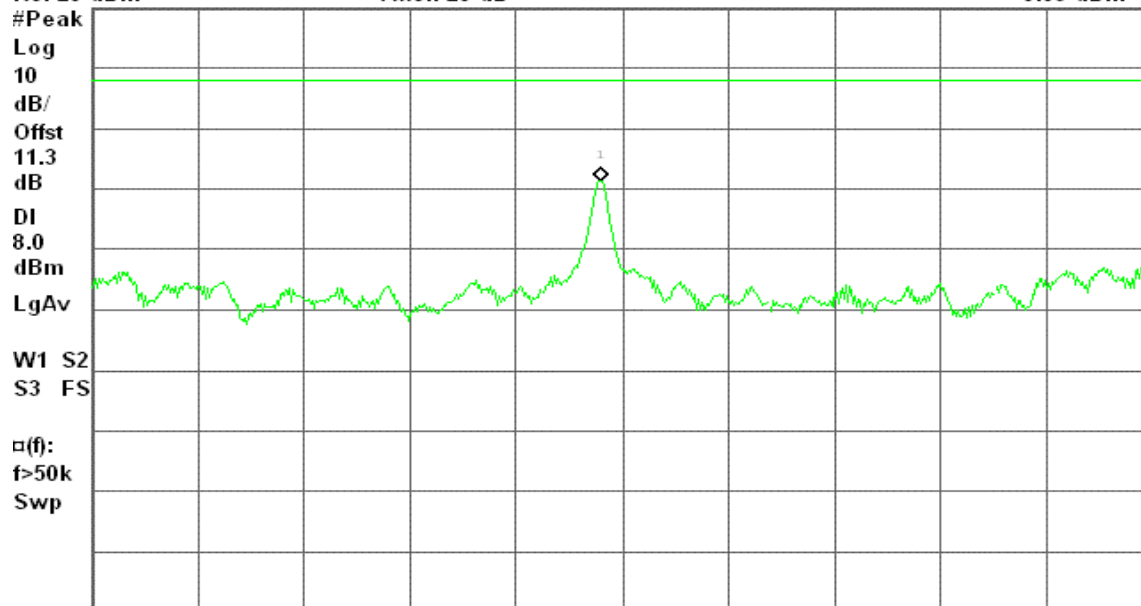
Peak Power Spectral Density, g Mode Low Ch.

Mkr1 2.411 993 5 GHz

Ref 20 dBm

Atten 20 dB

-8.63 dBm



Center 2.412 000 0 GHz

Span 300 kHz

#Res BW 3 kHz

#VBW 10 kHz

#Sweep 100 s (601 pts)



## CH Mid

Agilent 20:08:33 Mar 15, 2006

R L

Peak Power Spectral Density, g Mode Mid Ch.

Mkr1 2.436 994 5 GHz

Ref 20 dBm

Atten 20 dB

-8.63 dBm

#Peak

Log

10

dB/

Offst

11.3

dB

DI

8.0

dBm

LgAv

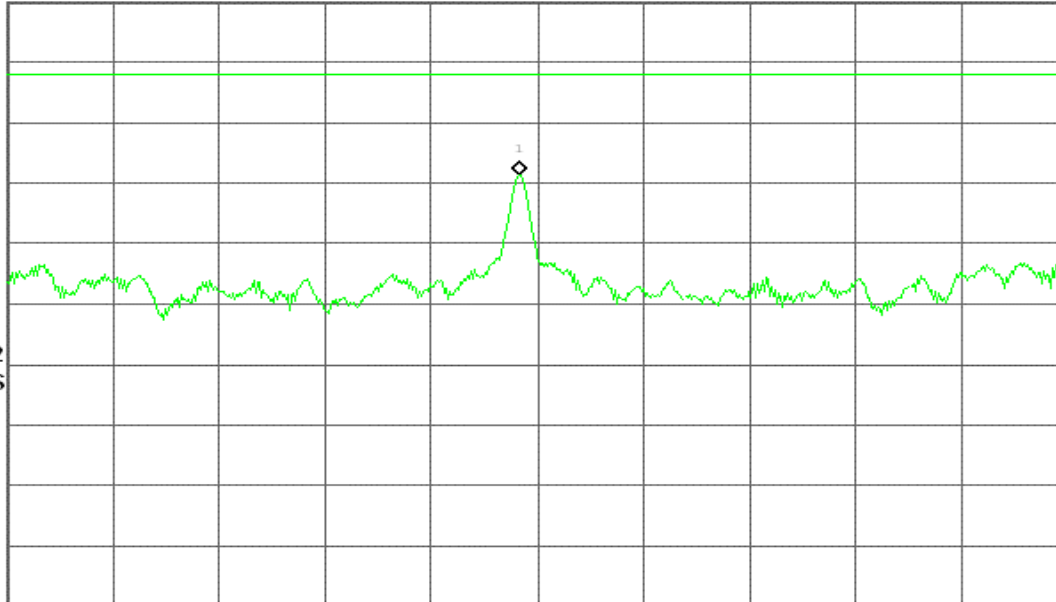
W1 S2

S3 FS

□(f):

f>50k

Swp



Center 2.437 000 0 GHz

Span 300 kHz

#Res BW 3 kHz

#VBW 10 kHz

#Sweep 100 s (601 pts)

## CH High

Agilent 20:14:18 Mar 15, 2006

R L

Peak Power Spectral Density, g Mode High Ch.

Mkr1 2.461 994 0 GHz

Ref 20 dBm

Atten 20 dB

-8.84 dBm

#Peak

Log

10

dB/

Offst

11.3

dB

DI

8.0

dBm

LgAv

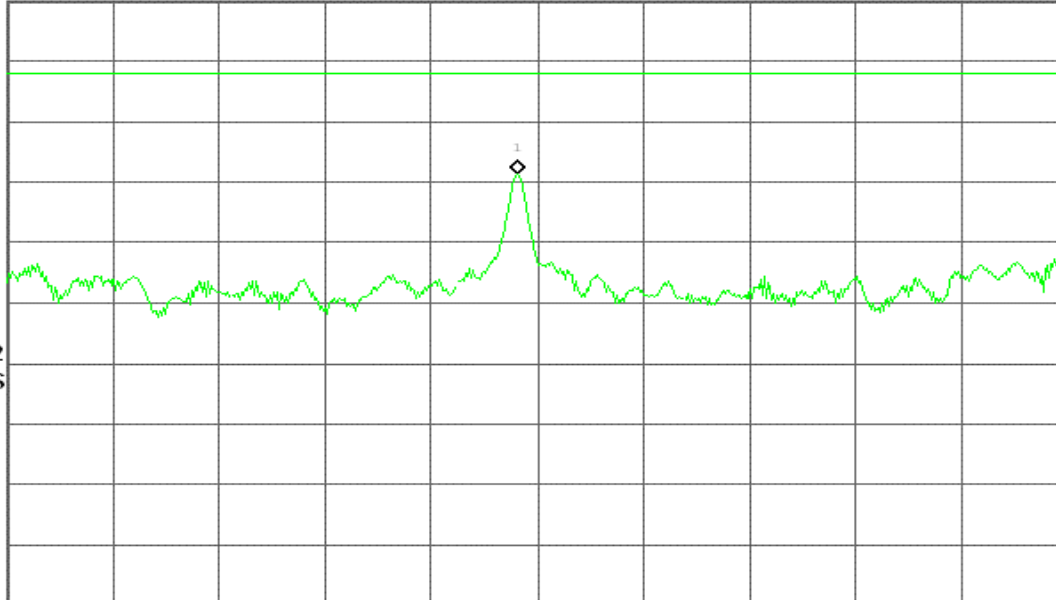
W1 S2

S3 FS

□(f):

f>50k

Swp



Center 2.462 000 0 GHz

Span 300 kHz

#Res BW 3 kHz

#VBW 10 kHz

#Sweep 100 s (601 pts)



## IEEE 802.11a

### CH Low

Agilent 16:00:36 Apr 25, 2006

R L

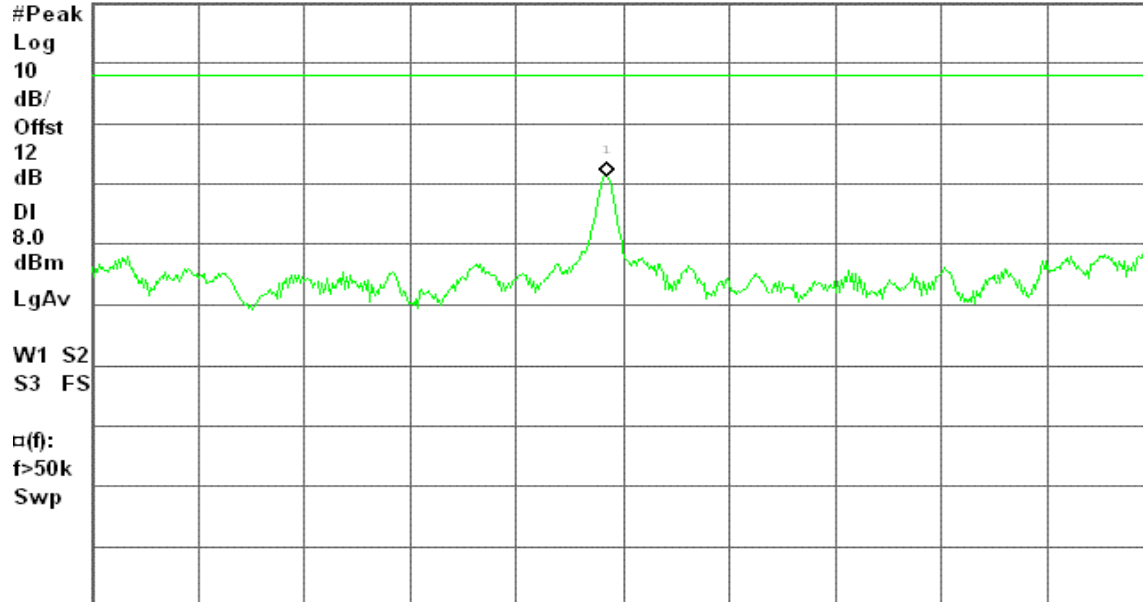
Peak Power Spectral Density, a Mode Low Ch.

Mkr1 5.744 995 0 GHz

Ref 20 dBm

Atten 20 dB

-8.62 dBm



Center 5.745 000 0 GHz

Span 300 kHz

#Res BW 3 kHz

#VBW 10 kHz

#Sweep 100 s (601 pts)

### CH Mid

Agilent 16:09:08 Apr 25, 2006

R L

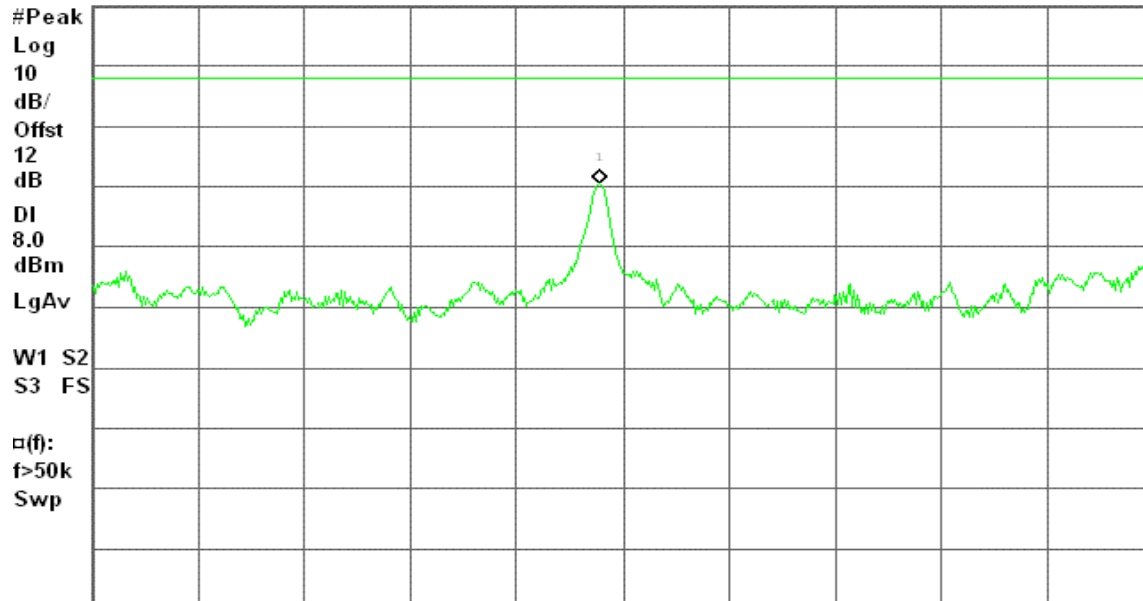
Peak Power Spectral Density, a Mode Mid Ch.

Mkr1 5.784 993 0 GHz

Ref 20 dBm

Atten 20 dB

-9.57 dBm



Center 5.785 000 0 GHz

Span 300 kHz

#Res BW 3 kHz

#VBW 10 kHz

#Sweep 100 s (601 pts)



## CH High

Agilent 16:16:28 Apr 25, 2006

R L

Peak Power Spectral Density, a Mode High Ch.

Mkr1 5.824 996 5 GHz

Ref 20 dBm

Atten 20 dB

-9.00 dBm

#Peak

Log

10

dB/

Offst

12

dB

DI

8.0

dBm

LgAv

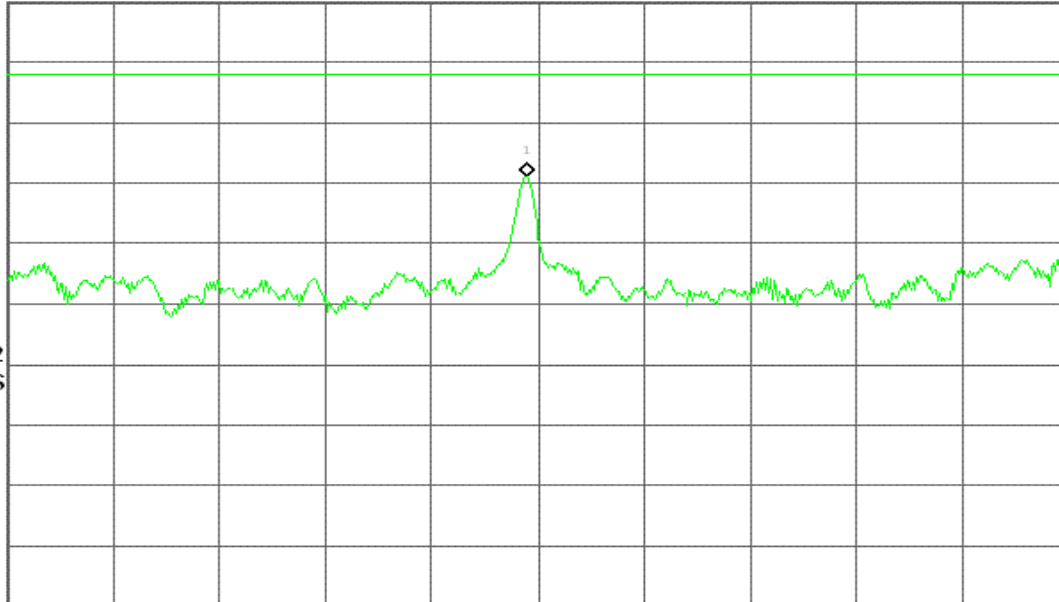
W1 S2

S3 FS

□(f):

f>50k

Swp



Center 5.825 000 0 GHz

Span 300 kHz

#Res BW 3 kHz

#VBW 10 kHz

#Sweep 100 s (601 pts)



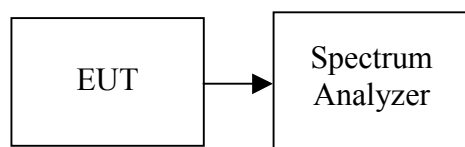
## 7.6 SPURIOUS EMISSIONS

### 7.6.1 Conducted Measurement

#### LIMIT

According to §15.247(d), 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, provided the transmitter demonstrates compliance with the peak conducted power limits. 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 Section 15.205(c)).

#### Test Configuration



#### TEST PROCEDURE

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 kHz.

Measurements are made over the 30MHz to 26GHz range for IEEE802.11b/g, 30MHz to 40GHz range for IEEE802.11a with the transmitter set to the lowest, middle, and highest channels.

#### TEST RESULTS

*No non-compliance noted.*



## Test Plot

### IEEE 802.11b / CH Low

30MHz ~ 26GHz

Agilent 19:43:49 Mar 15, 2006

L

Spurious, b Mode Low Ch.

Ref 20 dBm

Atten 20 dB

Mkr1 2.42 GHz

2.76 dBm

#Peak

Log

10

dB/

Offst

11.3

dB

DI

-17.2

dBm

LgAv

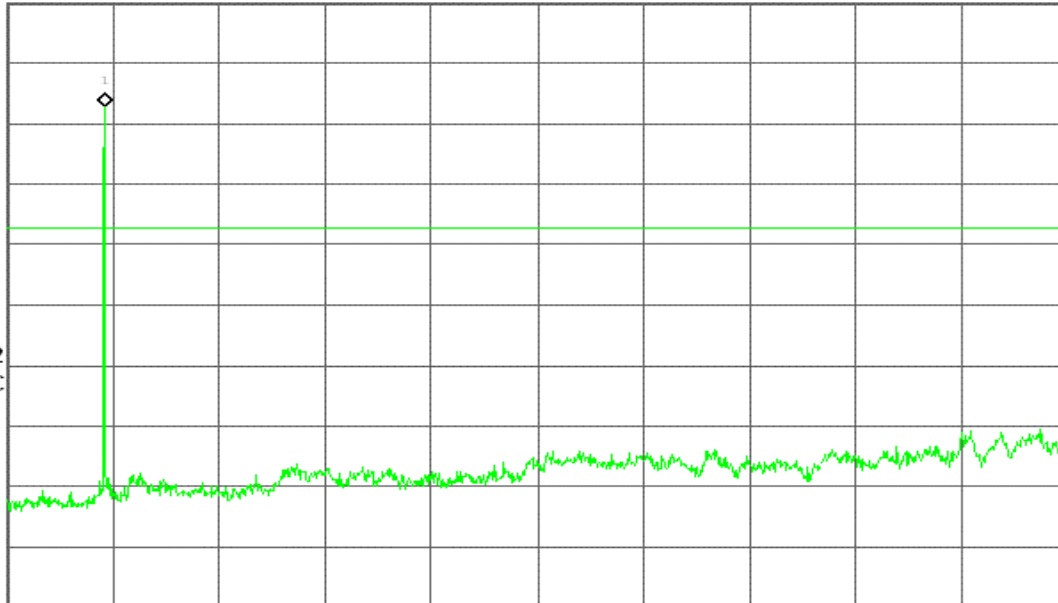
V1 S2

S3 FC

□(f):

FTun

Swp



Center 13.02 GHz

Span 25.97 GHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 3.131 s (1001 pts)

### IEEE 802.11b / CH Mid

30MHz ~ 26GHz

Agilent 19:49:13 Mar 15, 2006

L

Spurious, b Mode Mid Ch.

Ref 20 dBm

Atten 20 dB

Mkr1 2.45 GHz

1.58 dBm

#Peak

Log

10

dB/

Offst

11.3

dB

DI

-18.4

dBm

LgAv

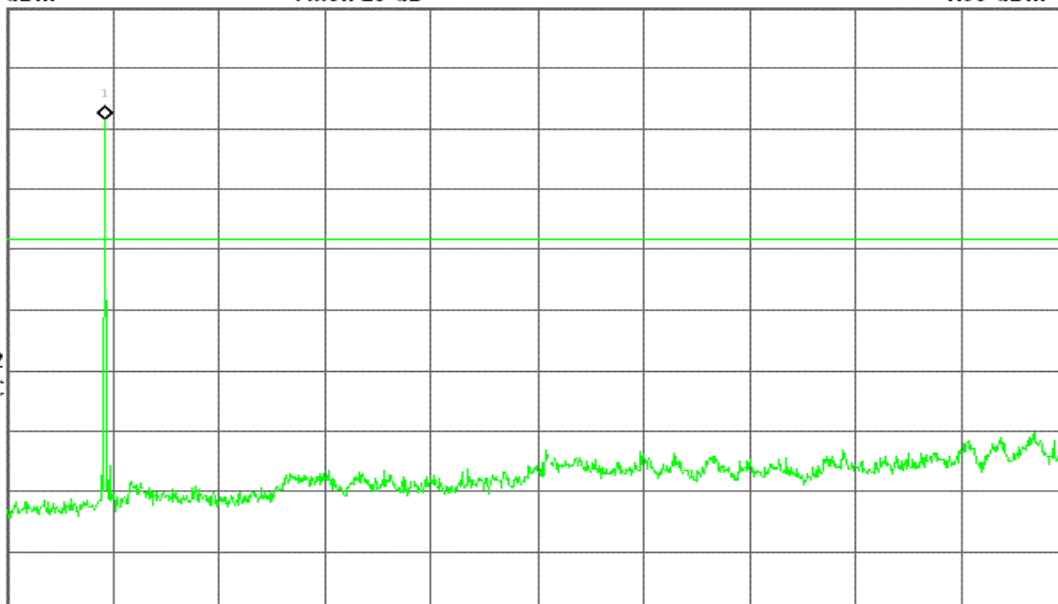
V1 S2

S3 FC

□(f):

FTun

Swp



Center 13.02 GHz

Span 25.97 GHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 3.131 s (1001 pts)



## IEEE 802.11b / CH High

30MHz ~ 26GHz

Agilent 19:55:45 Mar 15, 2006

L

Spurious, b Mode High Ch.

Mkr1 2.47 GHz

Ref 20 dBm

Atten 20 dB

2.47 dBm

#Peak

Log

10

dB/

Offst

11.3

dB

DI

-17.5

dBm

LgAv

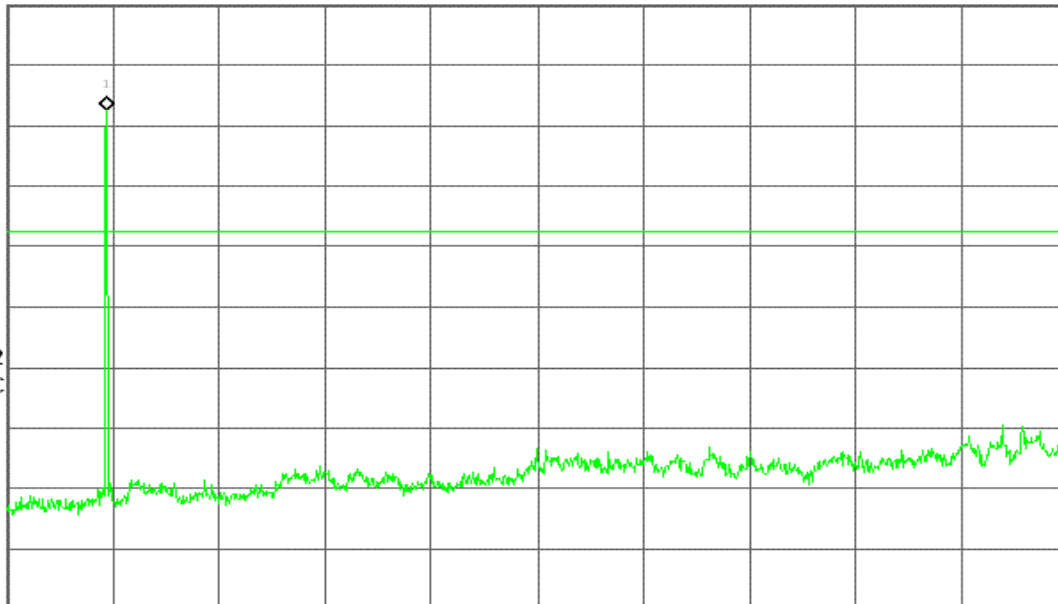
V1 S2

S3 FC

□(f):

FTun

Swp



Center 13.02 GHz

Span 25.97 GHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 3.131 s (1001 pts)

## IEEE 802.11g / CH Low

30MHz ~ 26GHz

Agilent 20:03:50 Mar 15, 2006

L

Spurious, g Mode Low Ch.

Mkr1 2.42 GHz

Ref 20 dBm

Atten 20 dB

-2.72 dBm

#Peak

Log

10

dB/

Offst

11.3

dB

DI

-22.7

dBm

LgAv

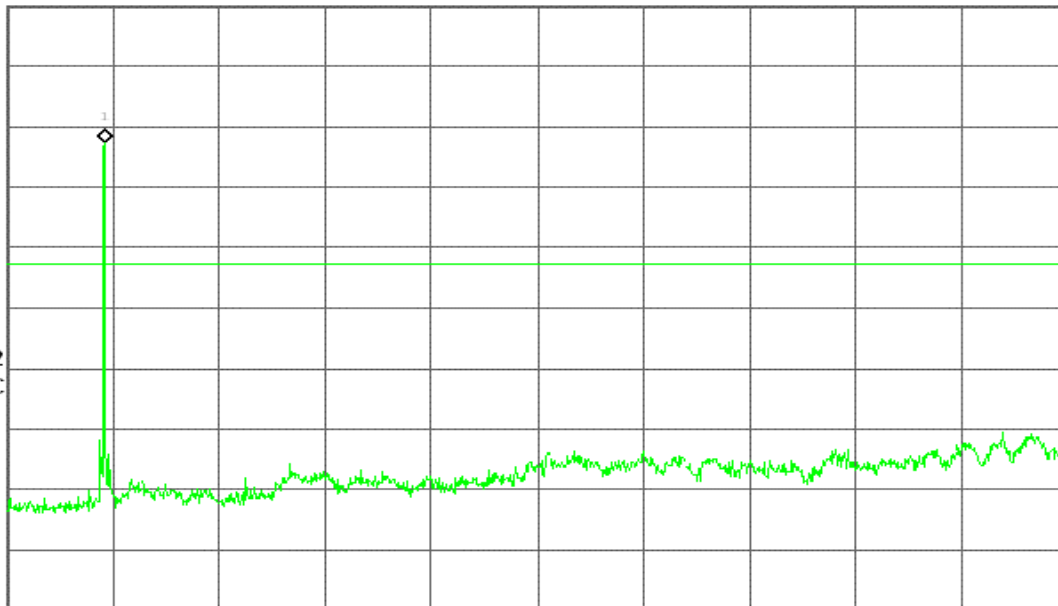
V1 S2

S3 FC

□(f):

FTun

Swp



Center 13.02 GHz

Span 25.97 GHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 3.131 s (1001 pts)



## IEEE 802.11g / CH Mid

30MHz ~ 26GHz

Agilent 20:09:20 Mar 15, 2006

L

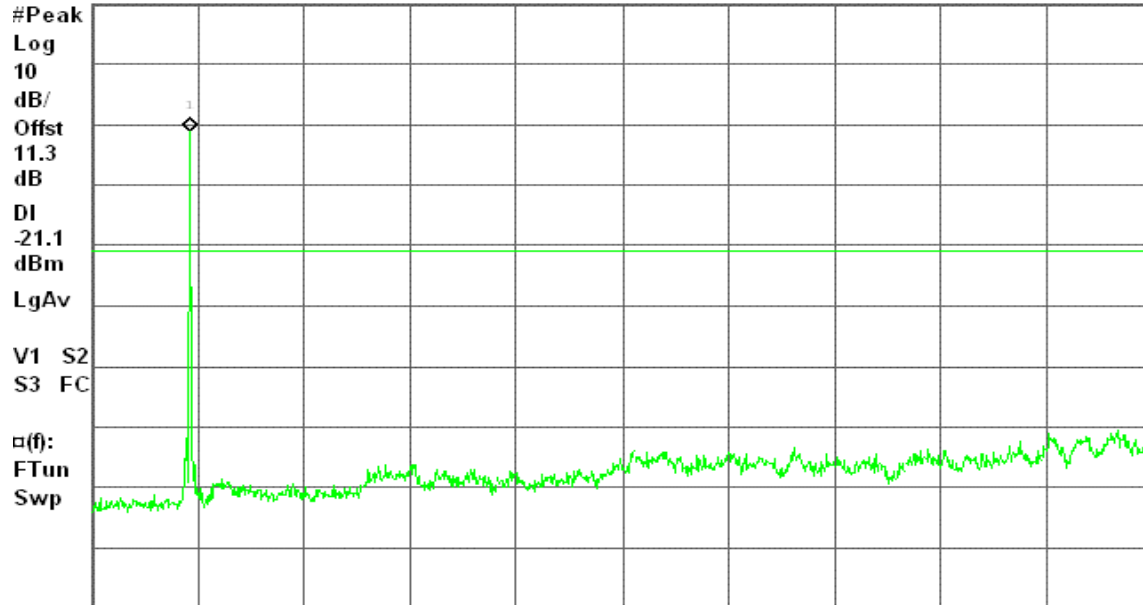
Spurious, g Mode Mid Ch.

Mkr1 2.45 GHz

Ref 20 dBm

Atten 20 dB

-1.11 dBm



Center 13.02 GHz

Span 25.97 GHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 3.131 s (1001 pts)

## IEEE 802.11g / CH High

30MHz ~ 26GHz

Agilent 20:15:06 Mar 15, 2006

L

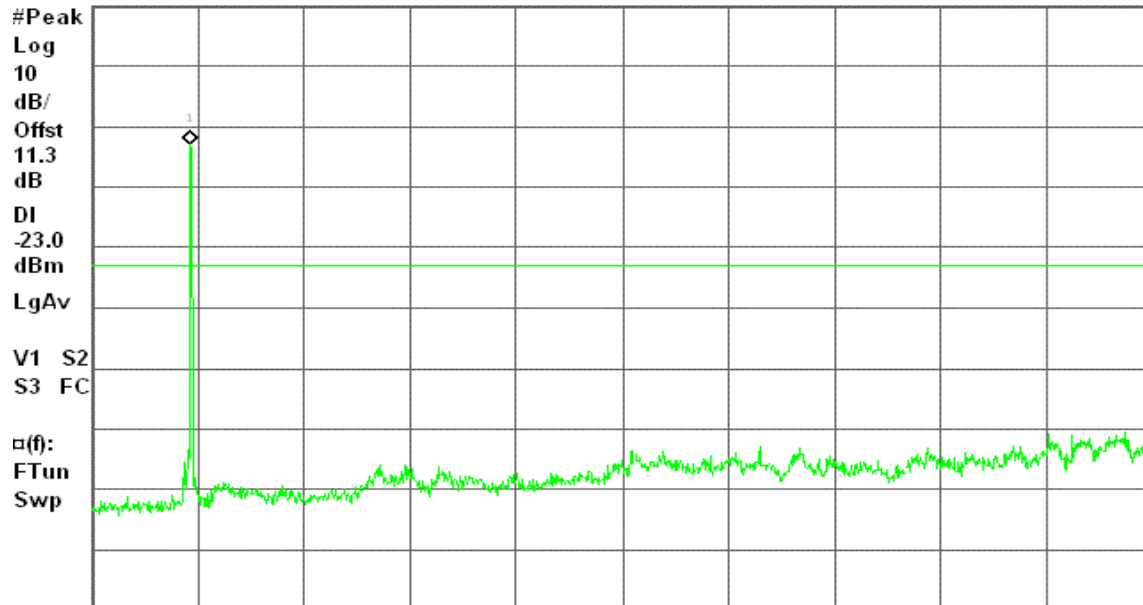
Spurious, g Mode High Ch.

Mkr1 2.45 GHz

Ref 20 dBm

Atten 20 dB

-3.03 dBm



Center 13.02 GHz

Span 25.97 GHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 3.131 s (1001 pts)



## IEEE 802.11a / CH Low

### 30MHz ~ 40GHz

Agilent 16:01:47 Apr 25, 2006

L

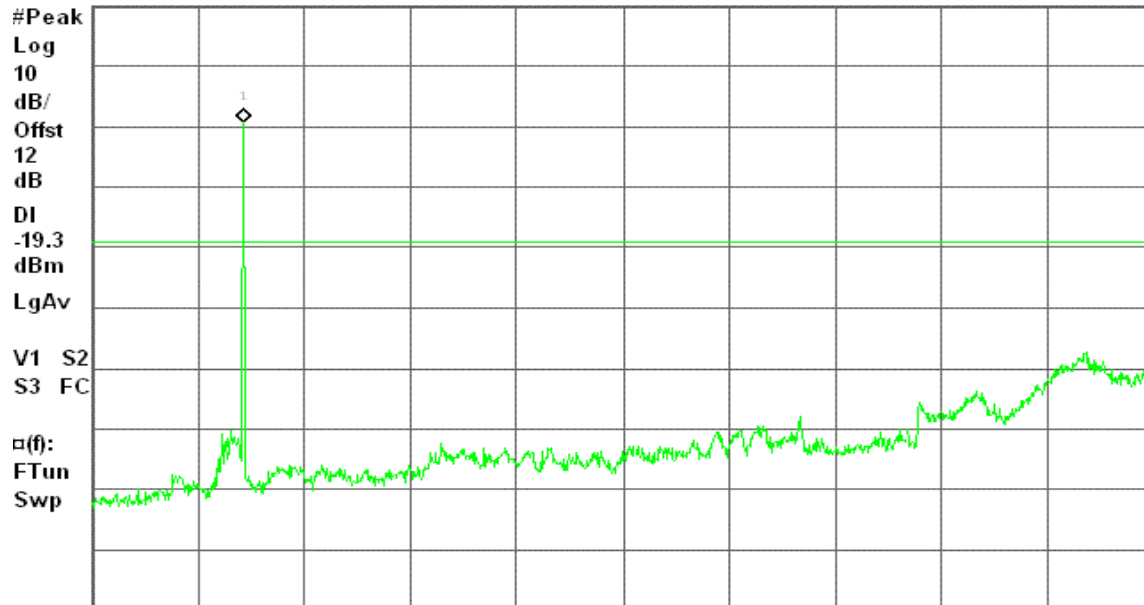
Spurious, a Mode Low Ch.

Mkr1 5.75 GHz

Ref 20 dBm

Atten 20 dB

0.74 dBm



Center 20.02 GHz

Span 39.97 GHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 4.819 s (1001 pts)

## IEEE 802.11a / CH Mid

### 30MHz ~ 40GHz

Agilent 16:10:27 Apr 25, 2006

L

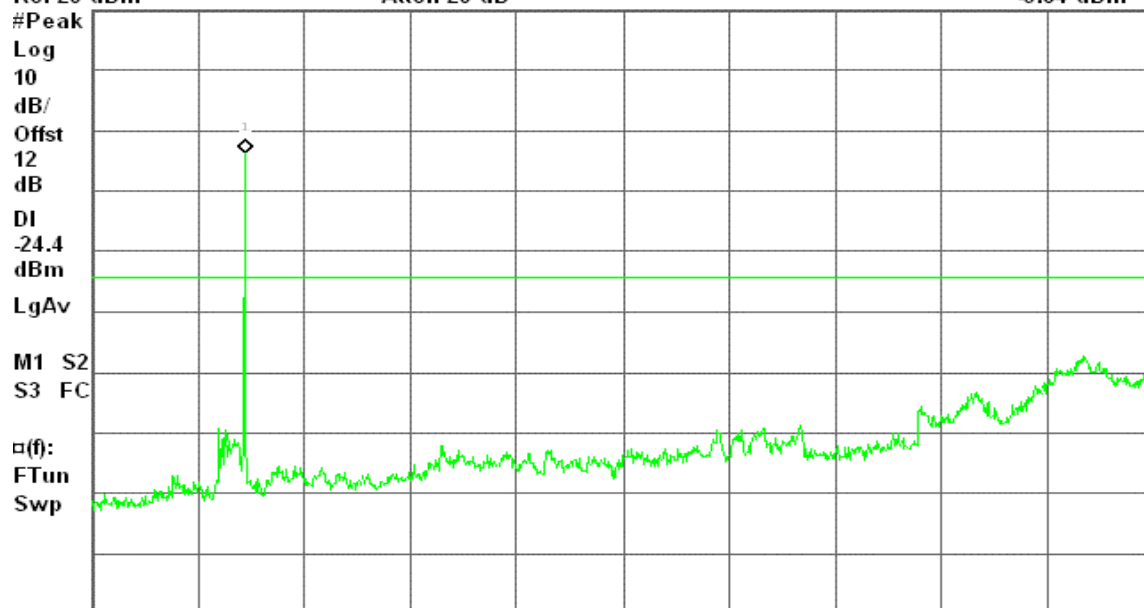
Spurious, a Mode Mid Ch.

Mkr1 5.79 GHz

Ref 20 dBm

Atten 20 dB

-3.84 dBm



Center 20.02 GHz

Span 39.97 GHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 4.819 s (1001 pts)



## IEEE 802.11a / CH High

30MHz ~ 40GHz

Agilent 16:17:37 Apr 25, 2006

L

Spurious, a Mode High Ch.

Mkr1 5.83 GHz

Ref 20 dBm

Atten 20 dB

0.44 dBm

#Peak

Log

10

dB/

Offst

12

dB

DI

-19.6

dBm

LgAv

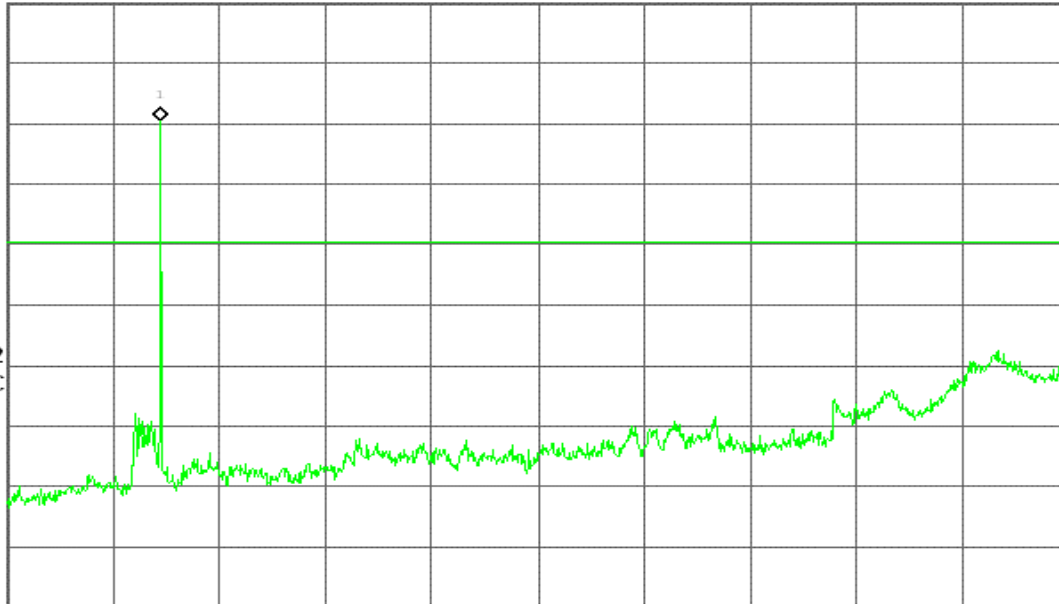
V1 S2

S3 FC

□(f):

FTun

Swp



Center 20.02 GHz

Span 39.97 GHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 4.819 s (1001 pts)



## 7.6.2 Radiated Emissions

### LIMIT

1. Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency<br>(MHz) | Field Strength<br>( $\mu\text{V/m}$ ) | Measurement Distance<br>(m) |
|--------------------|---------------------------------------|-----------------------------|
| 30-88              | 100*                                  | 3                           |
| 88-216             | 150*                                  | 3                           |
| 216-960            | 200*                                  | 3                           |
| Above 960          | 500                                   | 3                           |

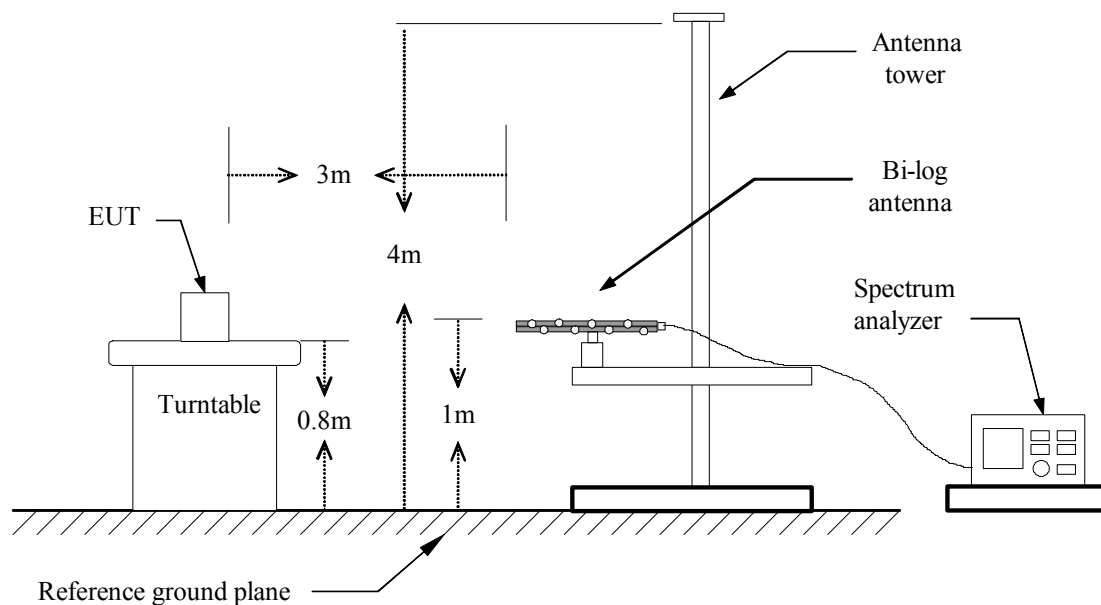
**Remark:** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections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

2. In the above emission table, the tighter limit applies at the band edges.

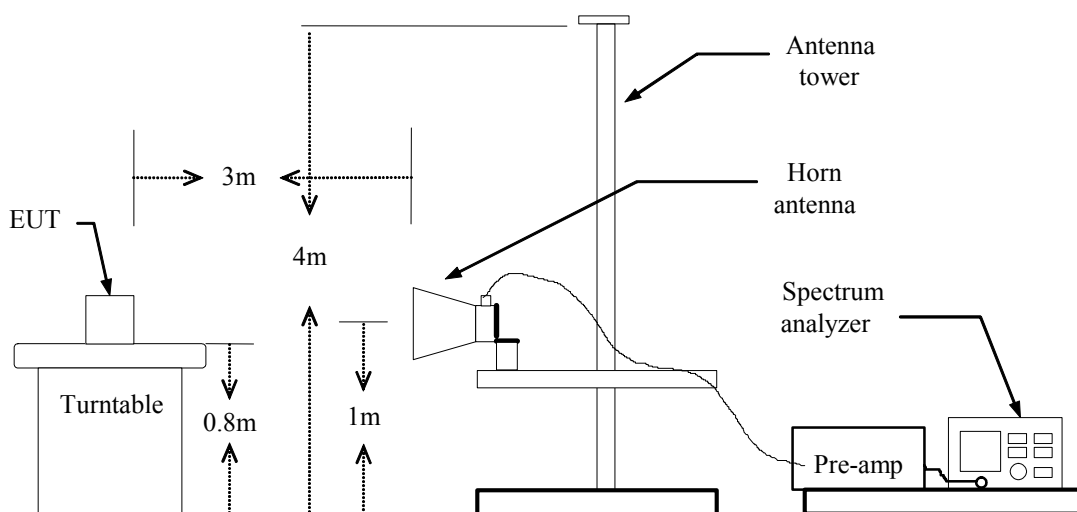
| Frequency<br>(MHz) | Field Strength<br>( $\mu\text{V/m}$ at 3-meter) | Field Strength<br>(dB $\mu\text{V/m}$ at 3-meter) |
|--------------------|-------------------------------------------------|---------------------------------------------------|
| 30-88              | 100                                             | 40                                                |
| 88-216             | 150                                             | 43.5                                              |
| 216-960            | 200                                             | 46                                                |
| Above 960          | 500                                             | 54                                                |

## Test Configuration

### **Below 1 GHz**



### **Above 1 GHz**





## **TEST PROCEDURE**

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:  
Below 1GHz:  
RBW=100kHz / VBW=300kHz / Sweep=AUTO  
Above 1GHz:  
(a) PEAK: RBW=VBW=1MHz / Sweep=AUTO  
(b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
7. Repeat above procedures until the measurements for all frequencies are complete.

**TEST RESULTS****Below 1 GHz****Operation Mode:** Normal Link**Test Date:** April 26, 2006**Temperature:** 26°C**Tested by:** Ryan Chen**Humidity:** 55% RH**Polarity:** Ver. / Hor.

| Frequency (MHz) | Ant.Pol. (H/V) | Reading (Peak) (dBuV) | Reading (QP) (dBuV) | Correction Factor (dB/m) | Result (Peak) (dBuV/m) | Result (QP) (dBuV/m) | Limit (QP) (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|---------------------|--------------------------|------------------------|----------------------|---------------------|-------------|--------|
| 344.08          | V              | 9.61                  | ---                 | 17.66                    | 27.27                  | ---                  | 46.00               | -18.73      | Peak   |
| 539.68          | V              | 1.76                  | ---                 | 21.69                    | 23.45                  | ---                  | 46.00               | -22.55      | Peak   |
| 639.00          | V              | 1.19                  | ---                 | 21.62                    | 22.81                  | ---                  | 46.00               | -23.19      | Peak   |
| 680.85          | V              | 8.02                  | ---                 | 22.93                    | 30.95                  | ---                  | 46.00               | -15.05      | Peak   |
| 739.60          | V              | 2.39                  | ---                 | 23.80                    | 26.20                  | ---                  | 46.00               | -19.80      | Peak   |
| 838.43          | V              | 3.60                  | ---                 | 24.15                    | 27.75                  | ---                  | 46.00               | -18.25      | Peak   |
| 345.63          | H              | 7.66                  | ---                 | 17.70                    | 25.36                  | ---                  | 46.00               | -20.64      | Peak   |
| 397.85          | H              | 10.28                 | ---                 | 18.38                    | 28.66                  | ---                  | 46.00               | -17.34      | Peak   |
| 539.69          | H              | 3.68                  | ---                 | 21.69                    | 25.37                  | ---                  | 46.00               | -20.63      | Peak   |
| 589.49          | H              | 4.51                  | ---                 | 22.65                    | 27.16                  | ---                  | 46.00               | -18.84      | Peak   |
| 637.14          | H              | 3.97                  | ---                 | 21.68                    | 25.65                  | ---                  | 46.00               | -20.35      | Peak   |
| 738.97          | H              | 5.53                  | ---                 | 23.80                    | 29.33                  | ---                  | 46.00               | -16.67      | Peak   |

**Remark:**

1. Measuring frequencies from 30 MHz to the 1GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.
3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).

**Above 1 GHz****Operation Mode:** Tx / IEEE 802.11b / CH Low**Test Date:** March 20, 2006**Temperature:** 24°C**Tested by:** Rex Lai**Humidity:** 55% RH**Polarity:** Ver. / Hor.

| Frequency (MHz) | Ant.Pol. (H/V) | Reading (Peak) (dBuV) | Reading (Average) (dBuV) | Correction Factor (dB/m) | Result (Peak) (dBuV/m) | Result (Average) (dBuV/m) | Limit (Peak) (dBuV/m) | Limit (Average) (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|--------------------------|--------------------------|------------------------|---------------------------|-----------------------|--------------------------|-------------|--------|
| 1690.00         | V              | 54.91                 | ---                      | -12.78                   | 42.14                  | ---                       | 74.00                 | 54.00                    | -11.86      | Peak   |
| 2493.33         | V              | 54.01                 | ---                      | -10.28                   | 43.73                  | ---                       | 74.00                 | 54.00                    | -10.27      | Peak   |
| 3000.00         | V              | 53.99                 | ---                      | -9.64                    | 44.35                  | ---                       | 74.00                 | 54.00                    | -9.65       | Peak   |
| 4825.00         | V              | 47.94                 | ---                      | -7.80                    | 40.15                  | ---                       | 74.00                 | 54.00                    | -13.85      | Peak   |
| 9650.00         | V              | 39.66                 | ---                      | -0.85                    | 38.81                  | ---                       | 74.00                 | 54.00                    | -15.19      | Peak   |
| 18000.00        | V              | 36.85                 | ---                      | 1.07                     | 37.92                  | ---                       | 74.00                 | 54.00                    | -16.08      | Peak   |
| 1040.00         | H              | 57.47                 | ---                      | -14.83                   | 42.64                  | ---                       | 74.00                 | 54.00                    | -11.36      | Peak   |
| 1430.00         | H              | 60.41                 | ---                      | -14.06                   | 46.36                  | ---                       | 74.00                 | 54.00                    | -7.64       | Peak   |
| 1626.67         | H              | 56.89                 | ---                      | -13.16                   | 43.73                  | ---                       | 74.00                 | 54.00                    | -10.27      | Peak   |
| 1950.00         | H              | 54.94                 | ---                      | -11.21                   | 43.73                  | ---                       | 74.00                 | 54.00                    | -10.27      | Peak   |
| 3000.00         | H              | 48.30                 | ---                      | -9.64                    | 38.66                  | ---                       | 74.00                 | 54.00                    | -15.34      | Peak   |
| 4825.00         | H              | 47.78                 | ---                      | -7.80                    | 39.98                  | ---                       | 74.00                 | 54.00                    | -14.02      | Peak   |

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** Tx / IEEE 802.11b / CH Mid**Test Date:** March 20, 2006**Temperature:** 24°C**Tested by:** Rex Lai**Humidity:** 55% RH**Polarity:** Ver. / Hor.

| Frequency (MHz) | Ant. Pol. (H/V) | Reading (Peak) (dBuV) | Reading (Average) (dBuV) | Correction Factor (dB/m) | Result (Peak) (dBuV/m) | Result (Average) (dBuV/m) | Limit (Peak) (dBuV/m) | Limit (Average) (dBuV/m) | Margin (dB) | Remark |
|-----------------|-----------------|-----------------------|--------------------------|--------------------------|------------------------|---------------------------|-----------------------|--------------------------|-------------|--------|
| 1300.00         | V               | 55.45                 | ---                      | -14.32                   | 41.14                  | ---                       | 74.00                 | 54.00                    | -12.86      | Peak   |
| 3000.00         | V               | 56.98                 | ---                      | -9.64                    | 47.34                  | ---                       | 74.00                 | 54.00                    | -6.66       | Peak   |
| 3000.00         | V               | 54.31                 | ---                      | -9.64                    | 44.67                  | ---                       | 74.00                 | 54.00                    | -9.33       | Peak   |
| 4500.00         | V               | 44.90                 | ---                      | -7.86                    | 37.04                  | ---                       | 74.00                 | 54.00                    | -16.96      | Peak   |
| 9750.00         | V               | 47.08                 | ---                      | -0.68                    | 46.40                  | ---                       | 74.00                 | 54.00                    | -7.60       | Peak   |
| 12183.33        | V               | 41.32                 | ---                      | -0.41                    | 40.91                  | ---                       | 74.00                 | 54.00                    | -13.09      | Peak   |
| 1430.00         | H               | 58.88                 | ---                      | -14.06                   | 44.82                  | ---                       | 74.00                 | 54.00                    | -9.18       | Peak   |
| 1560.00         | H               | 57.78                 | ---                      | -13.56                   | 44.22                  | ---                       | 74.00                 | 54.00                    | -9.78       | Peak   |
| 1626.67         | H               | 56.53                 | ---                      | -13.16                   | 43.38                  | ---                       | 74.00                 | 54.00                    | -10.62      | Peak   |
| 4875.00         | H               | 47.72                 | ---                      | -7.79                    | 39.93                  | ---                       | 74.00                 | 54.00                    | -14.07      | Peak   |
| 9750.00         | H               | 41.11                 | ---                      | -0.68                    | 40.43                  | ---                       | 74.00                 | 54.00                    | -13.57      | Peak   |
| 13150.00        | H               | 42.24                 | ---                      | -1.06                    | 41.18                  | ---                       | 74.00                 | 54.00                    | -12.82      | Peak   |

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.
6.  $\text{Margin (dB)} = \text{Remark result (dBuV/m)} - \text{Average limit (dBuV/m)}$ .

**Operation Mode:** Tx / IEEE 802.11b / CH High**Test Date:** March 20, 2006**Temperature:** 24°C**Tested by:** Rex Lai**Humidity:** 55% RH**Polarity:** Ver. / Hor.

| Frequency (MHz) | Ant. Pol. (H/V) | Reading (Peak) (dBuV) | Reading (Average) (dBuV) | Correction Factor (dB/m) | Result (Peak) (dBuV/m) | Result (Average) (dBuV/m) | Limit (Peak) (dBuV/m) | Limit (Average) (dBuV/m) | Margin (dB) | Remark |
|-----------------|-----------------|-----------------------|--------------------------|--------------------------|------------------------|---------------------------|-----------------------|--------------------------|-------------|--------|
| 3000.00         | V               | 57.28                 | ---                      | -9.64                    | 47.64                  | ---                       | 74.00                 | 54.00                    | -6.36       | Peak   |
| 3000.00         | V               | 54.16                 | ---                      | -9.64                    | 44.52                  | ---                       | 74.00                 | 54.00                    | -9.48       | Peak   |
| 7383.33         | V               | 46.31                 | ---                      | -5.59                    | 40.73                  | ---                       | 74.00                 | 54.00                    | -13.27      | Peak   |
| 9850.00         | V               | 45.40                 | ---                      | -0.51                    | 44.89                  | ---                       | 74.00                 | 54.00                    | -9.11       | Peak   |
| 12316.67        | V               | 43.48                 | ---                      | -0.48                    | 43.00                  | ---                       | 74.00                 | 54.00                    | -11.00      | Peak   |
| N/A             |                 |                       |                          |                          |                        |                           |                       |                          |             |        |
| 1430.00         | H               | 57.35                 | ---                      | -14.06                   | 43.29                  | ---                       | 74.00                 | 54.00                    | -10.71      | Peak   |
| 1626.67         | H               | 56.47                 | ---                      | -13.16                   | 43.31                  | ---                       | 74.00                 | 54.00                    | -10.69      | Peak   |
| 3000.00         | H               | 49.08                 | ---                      | -9.64                    | 39.44                  | ---                       | 74.00                 | 54.00                    | -14.56      | Peak   |
| 4925.00         | H               | 48.58                 | ---                      | -7.78                    | 40.80                  | ---                       | 74.00                 | 54.00                    | -13.20      | Peak   |
| 9850.00         | H               | 40.90                 | ---                      | -0.51                    | 40.39                  | ---                       | 74.00                 | 54.00                    | -13.61      | Peak   |
| N/A             |                 |                       |                          |                          |                        |                           |                       |                          |             |        |

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.
6.  $\text{Margin (dB)} = \text{Remark result (dBuV/m)} - \text{Average limit (dBuV/m)}$ .

**Operation Mode:** Tx / IEEE 802.11g / CH Low**Test Date:** March 20, 2006**Temperature:** 24°C**Tested by:** Rex Lai**Humidity:** 55% RH**Polarity:** Ver. / Hor.

| Frequency (MHz) | Ant.Pol. (H/V) | Reading (Peak) (dBuV) | Reading (Average) (dBuV) | Correction Factor (dB/m) | Result (Peak) (dBuV/m) | Result (Average) (dBuV/m) | Limit (Peak) (dBuV/m) | Limit (Average) (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|--------------------------|--------------------------|------------------------|---------------------------|-----------------------|--------------------------|-------------|--------|
| 1300.00         | V              | 55.85                 | ---                      | -14.32                   | 41.54                  | ---                       | 74.00                 | 54.00                    | -12.46      | Peak   |
| 3000.00         | V              | 56.06                 | ---                      | -9.64                    | 46.42                  | ---                       | 74.00                 | 54.00                    | -7.58       | Peak   |
| 3000.00         | V              | 54.98                 | ---                      | -9.64                    | 45.34                  | ---                       | 74.00                 | 54.00                    | -8.66       | Peak   |
| 4500.00         | V              | 46.34                 | ---                      | -7.86                    | 38.48                  | ---                       | 74.00                 | 54.00                    | -15.52      | Peak   |
| N/A             |                |                       |                          |                          |                        |                           |                       |                          |             |        |
| 1430.00         | H              | 58.84                 | ---                      | -14.06                   | 44.78                  | ---                       | 74.00                 | 54.00                    | -9.22       | Peak   |
| 1560.00         | H              | 57.71                 | ---                      | -13.56                   | 44.15                  | ---                       | 74.00                 | 54.00                    | -9.85       | Peak   |
| 3000.00         | H              | 48.23                 | ---                      | -9.64                    | 38.59                  | ---                       | 74.00                 | 54.00                    | -15.41      | Peak   |
| 17083.33        | H              | 41.47                 | ---                      | 0.44                     | 41.90                  | ---                       | 74.00                 | 54.00                    | -12.10      | Peak   |
| N/A             |                |                       |                          |                          |                        |                           |                       |                          |             |        |

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.
6.  $\text{Margin (dB)} = \text{Remark result (dBuV/m)} - \text{Average limit (dBuV/m)}$ .

**Operation Mode:** Tx / IEEE 802.11g / CH Mid**Test Date:** March 20, 2006**Temperature:** 24°C**Tested by:** Rex Lai**Humidity:** 55% RH**Polarity:** Ver. / Hor.

| Frequency (MHz) | Ant.Pol. (H/V) | Reading (Peak) (dBuV) | Reading (Average) (dBuV) | Correction Factor (dB/m) | Result (Peak) (dBuV/m) | Result (Average) (dBuV/m) | Limit (Peak) (dBuV/m) | Limit (Average) (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|--------------------------|--------------------------|------------------------|---------------------------|-----------------------|--------------------------|-------------|--------|
| 1300.00         | V              | 56.49                 | ---                      | -14.32                   | 42.17                  | ---                       | 74.00                 | 54.00                    | -11.83      | Peak   |
| 3000.00         | V              | 55.58                 | ---                      | -9.64                    | 45.94                  | ---                       | 74.00                 | 54.00                    | -8.06       | Peak   |
| 3000.00         | V              | 53.86                 | ---                      | -9.64                    | 44.22                  | ---                       | 74.00                 | 54.00                    | -9.78       | Peak   |
| N/A             |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
| 1430.00         | H              | 58.12                 | ---                      | -14.06                   | 44.06                  | ---                       | 74.00                 | 54.00                    | -9.94       | Peak   |
| 1560.00         | H              | 56.93                 | ---                      | -13.56                   | 43.37                  | ---                       | 74.00                 | 54.00                    | -10.63      | Peak   |
| 1950.00         | H              | 55.29                 | ---                      | -11.21                   | 44.08                  | ---                       | 74.00                 | 54.00                    | -9.92       | Peak   |
| 3000.00         | H              | 48.44                 | ---                      | -9.64                    | 38.80                  | ---                       | 74.00                 | 54.00                    | -15.20      | Peak   |
| N/A             |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser; with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6.  $\text{Margin (dB)} = \text{Remark result (dBuV/m)} - \text{Average limit (dBuV/m)}$ .

**Operation Mode:** Tx / IEEE 802.11g / CH High**Test Date:** March 20, 2006**Temperature:** 24°C**Tested by:** Rex Lai**Humidity:** 55% RH**Polarity:** Ver. / Hor.

| Frequency (MHz) | Ant.Pol. (H/V) | Reading (Peak) (dBuV) | Reading (Average) (dBuV) | Correction Factor (dB/m) | Result (Peak) (dBuV/m) | Result (Average) (dBuV/m) | Limit (Peak) (dBuV/m) | Limit (Average) (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|--------------------------|--------------------------|------------------------|---------------------------|-----------------------|--------------------------|-------------|--------|
| 1300.00         | V              | 55.72                 | ---                      | -14.32                   | 41.40                  | ---                       | 74.00                 | 54.00                    | -12.60      | Peak   |
| 3000.00         | V              | 55.76                 | ---                      | -9.64                    | 46.12                  | ---                       | 74.00                 | 54.00                    | -7.88       | Peak   |
| 3000.00         | V              | 54.23                 | ---                      | -9.64                    | 44.59                  | ---                       | 74.00                 | 54.00                    | -9.41       | Peak   |
| 7391.67         | V              | 45.14                 | ---                      | -5.58                    | 39.56                  | ---                       | 74.00                 | 54.00                    | -14.44      | Peak   |
| 9850.00         | V              | 39.93                 | ---                      | -0.51                    | 39.42                  | ---                       | 74.00                 | 54.00                    | -14.58      | Peak   |
| 12316.67        | V              | 42.79                 | ---                      | -0.48                    | 42.32                  | ---                       | 74.00                 | 54.00                    | -11.68      | Peak   |
| 1430.00         | H              | 57.24                 | ---                      | -14.06                   | 43.19                  | ---                       | 74.00                 | 54.00                    | -10.81      | Peak   |
| 1560.00         | H              | 57.44                 | ---                      | -13.56                   | 43.88                  | ---                       | 74.00                 | 54.00                    | -10.12      | Peak   |
| 3000.00         | H              | 48.19                 | ---                      | -9.64                    | 38.55                  | ---                       | 74.00                 | 54.00                    | -15.45      | Peak   |
| 4925.00         | H              | 45.39                 | ---                      | -7.78                    | 37.61                  | ---                       | 74.00                 | 54.00                    | -16.39      | Peak   |
| N/A             |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.
6.  $\text{Margin (dB)} = \text{Remark result (dBuV/m)} - \text{Average limit (dBuV/m)}$ .

**Operation Mode:** Tx / IEEE 802.11a / CH Low**Test Date:** March 20, 2006**Temperature:** 24°C**Tested by:** Rex Lai**Humidity:** 55% RH**Polarity:** Ver. / Hor.

| Frequency (MHz) | Ant.Pol. (H/V) | Reading (Peak) (dBuV) | Reading (Average) (dBuV) | Correction Factor (dB/m) | Result (Peak) (dBuV/m) | Result (Average) (dBuV/m) | Limit (Peak) (dBuV/m) | Limit (Average) (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|--------------------------|--------------------------|------------------------|---------------------------|-----------------------|--------------------------|-------------|--------|
| 2995.00         | V              | 55.29                 | ---                      | -9.65                    | 45.65                  | ---                       | 74.00                 | 54.00                    | -8.35       | Peak   |
| 13116.67        | V              | 41.45                 | ---                      | -0.96                    | 40.49                  | ---                       | 74.00                 | 54.00                    | -13.51      | Peak   |
| 17233.33        | V              | 41.36                 | ---                      | 0.34                     | 41.69                  | ---                       | 74.00                 | 54.00                    | -12.31      | Peak   |
| N/A             |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
| 1560.00         | H              | 57.12                 | ---                      | -13.56                   | 43.56                  | ---                       | 74.00                 | 54.00                    | -10.44      | Peak   |
| N/A             |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser; with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6.  $\text{Margin (dB)} = \text{Remark result (dBuV/m)} - \text{Average limit (dBuV/m)}$ .

**Operation Mode:** Tx / IEEE 802.11a / CH Mid**Test Date:** March 20, 2006**Temperature:** 24°C**Tested by:** Rex Lai**Humidity:** 55% RH**Polarity:** Ver. / Hor.

| Frequency (MHz) | Ant.Pol. (H/V) | Reading (Peak) (dBuV) | Reading (Average) (dBuV) | Correction Factor (dB/m) | Result (Peak) (dBuV/m) | Result (Average) (dBuV/m) | Limit (Peak) (dBuV/m) | Limit (Average) (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|--------------------------|--------------------------|------------------------|---------------------------|-----------------------|--------------------------|-------------|--------|
| 2995.00         | V              | 54.59                 | ---                      | -9.65                    | 44.94                  | ---                       | 74.00                 | 54.00                    | -9.06       | Peak   |
| 4826.67         | V              | 57.06                 | ---                      | -7.79                    | 49.27                  | ---                       | 74.00                 | 54.00                    | -4.73       | Peak   |
| N/A             |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
| 4815.00         | H              | 59.53                 | ---                      | -7.80                    | 51.73                  | ---                       | 74.00                 | 54.00                    | -2.27       | Peak   |
| 5421.67         | H              | 58.44                 | ---                      | -7.41                    | 51.03                  | ---                       | 74.00                 | 54.00                    | -2.97       | Peak   |
| N/A             |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser; with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6.  $\text{Margin (dB)} = \text{Remark result (dBuV/m)} - \text{Average limit (dBuV/m)}$ .

**Operation Mode:** Tx / IEEE 802.11a / CH High**Test Date:** March 20, 2006**Temperature:** 24°C**Tested by:** Rex Lai**Humidity:** 55% RH**Polarity:** Ver. / Hor.

| Frequency (MHz) | Ant.Pol. (H/V) | Reading (Peak) (dBuV) | Reading (Average) (dBuV) | Correction Factor (dB/m) | Result (Peak) (dBuV/m) | Result (Average) (dBuV/m) | Limit (Peak) (dBuV/m) | Limit (Average) (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|--------------------------|--------------------------|------------------------|---------------------------|-----------------------|--------------------------|-------------|--------|
| 2995.00         | V              | 56.22                 | ---                      | -9.65                    | 46.58                  | ---                       | 74.00                 | 54.00                    | -7.42       | Peak   |
| 4850.00         | V              | 57.72                 | ---                      | -7.79                    | 49.93                  | ---                       | 74.00                 | 54.00                    | -4.07       | Peak   |
| 11650.00        | V              | 43.66                 | ---                      | 0.04                     | 43.69                  | ---                       | 74.00                 | 54.00                    | -10.31      | Peak   |
| 17466.67        | V              | 43.97                 | ---                      | 0.18                     | 44.15                  | ---                       | 74.00                 | 54.00                    | -9.85       | Peak   |
| N/A             |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
| 4850.00         | H              | 63.70                 | 57.67                    | -7.79                    | 55.91                  | 49.88                     | 74.00                 | 54.00                    | -4.12       | AVG    |
| 5468.33         | H              | 62.56                 | 50.89                    | -7.38                    | 55.18                  | 43.51                     | 74.00                 | 54.00                    | -10.49      | AVG    |
| N/A             |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |
|                 |                |                       |                          |                          |                        |                           |                       |                          |             |        |

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin > 20dB from the applicable limit) and considered that's already beyond the background noise floor.
6.  $\text{Margin (dB)} = \text{Remark result (dBuV/m)} - \text{Average limit (dBuV/m)}$ .



## 7.7 POWERLINE CONDUCTED EMISSIONS

### LIMIT

According to §15.207(a), except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency Range<br>(MHz) | Limits<br>(dB $\mu$ V) |           |
|--------------------------|------------------------|-----------|
|                          | Quasi-peak             | Average   |
| 0.15 to 0.50             | 66 to 56*              | 56 to 46* |
| 0.50 to 5                | 56                     | 46        |
| 5 to 30                  | 60                     | 50        |

\* Decreases with the logarithm of the frequency.

### Test Configuration

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

### TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

**TEST RESULTS**

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

**Test Data**

**Operation Mode:** Normal Link      **Test Date:** March 28, 2006  
**Temperature:** 25°C      **Tested by:** Ivan Tsai  
**Humidity:** 55% RH

| Freq. (MHz) | QP Reading (dBuV) | AV Reading (dBuV) | Corr. factor (dB) | QP Result (dBuV) | AV Result (dBuV) | QP Limit (dBuV) | AV Limit (dBuV) | QP Margin (dB) | AV Margin (dB) | Note |
|-------------|-------------------|-------------------|-------------------|------------------|------------------|-----------------|-----------------|----------------|----------------|------|
| 0.240       | 38.830            | 37.250            | 0.100             | 38.930           | 37.350           | 62.103          | 52.103          | -23.173        | -14.753        | L1   |
| 0.478       | 36.760            | 35.180            | 0.100             | 36.860           | 35.280           | 56.371          | 46.371          | -19.511        | -11.091        | L1   |
| 0.721       | 35.950            | 32.840            | 0.100             | 36.050           | 32.940           | 56.000          | 46.000          | -19.950        | -13.060        | L1   |
| 0.953       | 35.370            | 31.530            | 0.100             | 35.470           | 31.630           | 56.000          | 46.000          | -20.530        | -14.370        | L1   |
| 1.082       | 35.200            | 30.490            | 0.100             | 35.300           | 30.590           | 56.000          | 46.000          | -20.700        | -15.410        | L1   |
| 1.561       | 34.710            | 30.360            | 0.100             | 34.810           | 30.460           | 56.000          | 46.000          | -21.190        | -15.540        | L1   |
| 0.238       | 38.910            | 37.820            | 0.100             | 39.010           | 37.920           | 62.166          | 52.166          | -23.156        | -14.246        | L2   |
| 0.476       | 36.840            | 35.340            | 0.100             | 36.940           | 35.440           | 56.409          | 46.409          | -19.469        | -10.969        | L2   |
| 0.595       | 34.520            | 32.440            | 0.100             | 34.620           | 32.540           | 56.000          | 46.000          | -21.380        | -13.460        | L2   |
| 0.715       | 36.660            | 34.300            | 0.100             | 36.760           | 34.400           | 56.000          | 46.000          | -19.240        | -11.600        | L2   |
| 0.945       | 33.370            | 28.140            | 0.100             | 33.470           | 28.240           | 56.000          | 46.000          | -22.530        | -17.760        | L2   |
| 1.082       | 35.140            | 30.490            | 0.100             | 35.240           | 30.590           | 56.000          | 46.000          | -20.760        | -15.410        | L2   |

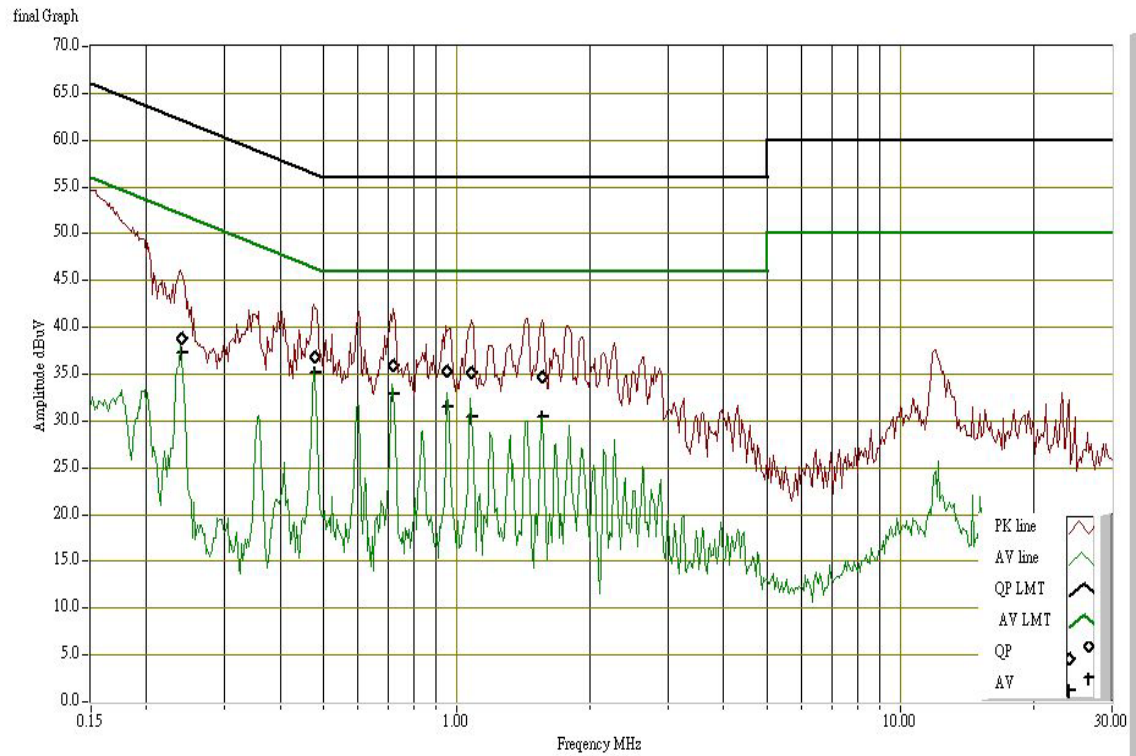
**Remark:**

1. Measuring frequencies from 0.15 MHz to 30MHz.
2. The emissions measured in frequency range from 0.15 MHz to 30MHz were made with an instrument using Quasi-peak detector and average detector.
3. The IF bandwidth of SPA between 0.15MHz to 30MHz was 10kHz; the IF bandwidth of Test Receiver between 0.15MHz to 30MHz was 9kHz.
4. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)

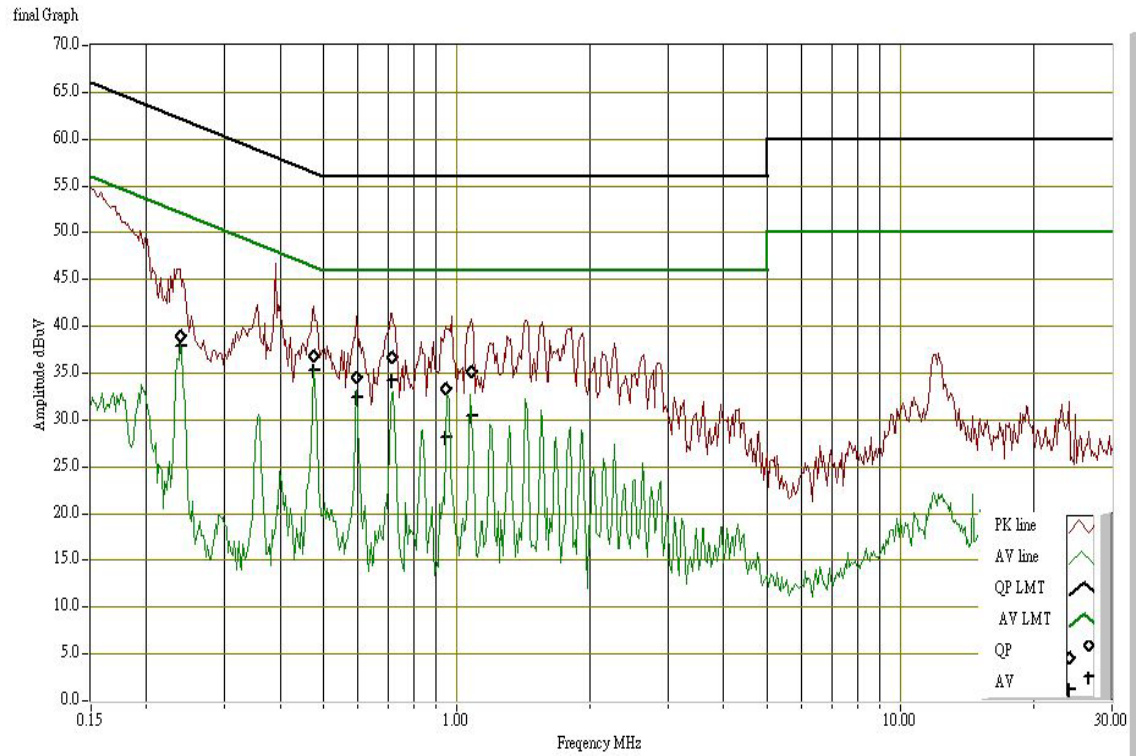


## Test Plots

### Conducted emissions (Line 1)



### Conducted emissions (Line 2)





## APPENDIX I

### RADIO FREQUENCY EXPOSURE

#### LIMIT

According to §15.247(i), 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 levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

#### EUT Specification

|                                   |                                                                                                                                                                                                                                           |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EUT</b>                        | Shuttle XPC (Wireless 802.11a+b+g)                                                                                                                                                                                                        |
| <b>Frequency band (Operating)</b> | <input checked="" type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz<br><input type="checkbox"/> WLAN: 5.725GHz ~ 5.850GHz<br><input type="checkbox"/> WLAN: 5.15GHz ~ 5.35GHz<br><input type="checkbox"/> Others: _____                         |
| <b>Device category</b>            | <input type="checkbox"/> Portable (<20cm separation)<br><input checked="" type="checkbox"/> Mobile (>20cm separation)<br><input type="checkbox"/> Others                                                                                  |
| <b>Exposure classification</b>    | <input type="checkbox"/> Occupational/Controlled exposure (S = 5mW/cm <sup>2</sup> )<br><input checked="" type="checkbox"/> General Population/Uncontrolled exposure (S=1mW/cm <sup>2</sup> )                                             |
| <b>Antenna diversity</b>          | <input type="checkbox"/> Single antenna<br><input checked="" type="checkbox"/> Multiple antennas<br><input type="checkbox"/> Tx diversity<br><input type="checkbox"/> Rx diversity<br><input checked="" type="checkbox"/> Tx/Rx diversity |
| <b>Max. output power</b>          | IEEE 802.11b: 16.32 dBm (42.85mW)<br>IEEE 802.11g: 16.07 dBm (40.46mW)                                                                                                                                                                    |
| <b>Antenna gain (Max)</b>         | 0.56 dBi (Numeric gain: 1.14)                                                                                                                                                                                                             |
| <b>Evaluation applied</b>         | <input checked="" type="checkbox"/> MPE Evaluation<br><input type="checkbox"/> SAR Evaluation<br><input type="checkbox"/> N/A                                                                                                             |

#### ***Remark:***

- The maximum output power is 16.32dBm (42.85mW) at 2437MHz (with 1.14 numeric antenna gain.)*
- DTS device is not subject to routine RF evaluation; MPE estimate is used to justify the compliance.*
- For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is 1.0 mW/cm<sup>2</sup> even if the calculation indicates that the power density would be larger.*

#### TEST RESULTS

*No non-compliance noted.*

**Calculation**

Given  $E = \frac{\sqrt{30 \times P \times G}}{d}$  &  $S = \frac{E^2}{3770}$

Where  $E$  = Field strength in Volts / meter

$P$  = Power in Watts

$G$  = Numeric antenna gain

$d$  = Distance in meters

$S$  = Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

$$P (mW) = P (W) / 1000 \text{ and}$$

$$d (cm) = d(m) / 100$$

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \text{Equation 1}$$

Where  $d$  = Distance in cm

$P$  = Power in mW

$G$  = Numeric antenna gain

$S$  = Power density in mW / cm<sup>2</sup>

**Maximum Permissible Exposure**

EUT output power = 42.85mW

Numeric Antenna gain = 1.14

Substituting the MPE safe distance using  $d = 20$  cm into Equation 1:

Yields

$$S = 0.000199 \times P \times G$$

Where  $P$  = Power in mW

$G$  = Numeric antenna gain

$S$  = Power density in mW / cm<sup>2</sup>

**→ Power density = 0.0097 mW / cm<sup>2</sup>**

(For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm<sup>2</sup> even if the calculation indicates that the power density would be larger.)



|                                   |                                                                                                                                                                                                                                           |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EUT</b>                        | Shuttle XPC (Wireless 802.11a+b+g)                                                                                                                                                                                                        |
| <b>Frequency band (Operating)</b> | <input type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz<br><input checked="" type="checkbox"/> WLAN: 5.725GHz ~ 5.850GHz<br><input type="checkbox"/> WLAN: 5.15GHz ~ 5.35GHz<br><input type="checkbox"/> Others: _____                         |
| <b>Device category</b>            | <input type="checkbox"/> Portable (<20cm separation)<br><input checked="" type="checkbox"/> Mobile (>20cm separation)<br><input type="checkbox"/> Others                                                                                  |
| <b>Exposure classification</b>    | <input type="checkbox"/> Occupational/Controlled exposure (S = 5mW/cm <sup>2</sup> )<br><input checked="" type="checkbox"/> General Population/Uncontrolled exposure (S=1mW/cm <sup>2</sup> )                                             |
| <b>Antenna diversity</b>          | <input type="checkbox"/> Single antenna<br><input checked="" type="checkbox"/> Multiple antennas<br><input type="checkbox"/> Tx diversity<br><input type="checkbox"/> Rx diversity<br><input checked="" type="checkbox"/> Tx/Rx diversity |
| <b>Max. output power</b>          | IEEE 802.11a: 15.84 dBm (38.37mW)                                                                                                                                                                                                         |
| <b>Antenna gain (Max)</b>         | 1.91 dBi (Numeric gain: 1.55)                                                                                                                                                                                                             |
| <b>Evaluation applied</b>         | <input checked="" type="checkbox"/> MPE Evaluation*<br><input type="checkbox"/> SAR Evaluation<br><input type="checkbox"/> N/A                                                                                                            |

**Remark:**

1. The maximum output power is 15.84dBm (38.37mW) at 5825MHz (with 1.55 numeric antenna gain.)
2. DTS device is not subject to routine RF evaluation; MPE estimate is used to justify the compliance.
3. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is 1.0 mW/cm<sup>2</sup> even if the calculation indicates that the power density would be larger.

**TEST RESULTS**

No non-compliance noted.

**Calculation**

Given  $E = \frac{\sqrt{30 \times P \times G}}{d}$  &  $S = \frac{E^2}{3770}$

Where  $E$  = Field strength in Volts / meter

$P$  = Power in Watts

$G$  = Numeric antenna gain

$d$  = Distance in meters

$S$  = Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

$$P (mW) = P (W) / 1000 \text{ and}$$

$$d (cm) = d(m) / 100$$

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \text{Equation 1}$$

Where  $d$  = Distance in cm

$P$  = Power in mW

$G$  = Numeric antenna gain

$S$  = Power density in mW / cm<sup>2</sup>

**Maximum Permissible Exposure**

EUT output power = 38.37mW

Numeric Antenna gain = 1.55

Substituting the MPE safe distance using  $d = 20$  cm into Equation 1:

Yields

$$S = 0.000199 \times P \times G$$

Where  $P$  = Power in mW

$G$  = Numeric antenna gain

$S$  = Power density in mW / cm<sup>2</sup>

**→ Power density = 0.0118 mW / cm<sup>2</sup>**

(For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm<sup>2</sup> even if the calculation indicates that the power density would be larger.)