FCC PART 15.247

EMI MEASUREMENT AND TEST REPORT

For

HON HAI PRECISION IND. CO., LTD.

HSINCHU SCIENCE PARK BRANCH OFFICE
5F-1, 5 Hsin-An Road, Hsinchu, Science-Based Industrial Park, Taiwan, R.O.C.

FCC ID: MCLT60N871

This Report Concerns:	**Equipment Type:**
☒ Original Report	802.11 b/g MiniPCI Module

Test Engineer:	Ming Jing /
Report No.:	R0405203
Report Date:	2004-06-08
Reviewed By:	Ling Zhang /
Prepared By:	Bay Area Compliance Laboratory Corporation (BACL) 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164

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GENERAL INFORMATION

Product Description for Equipment Under Test (EUT)

The *HON HAI PRECISION IND. CO., LTD.'s*, model: *T60N871*, or the "EUT" as referred to in this report is an 802.11b/g MiniPCI Module which measures approximately 2.4"L x 1.7"W x 0.1"H.

The EUT transmitted with a total of 9 antennas respectively. The plat form names of antennas are listed as follows:

1. CL5X-OD113
2. CL5X-OD137
3. Jay normal
4. Jay wide
5. Kestral
6. Kite (ECQ60)
7. Yuhina wide
8. ZI6-OD113
9. ZI6-OD137

For details of the antenna information, please refer to the exhibit of antenna spec.

Among the 9 antennas, the Kite (ECQ60) antenna is the worse case one, on which the test was performed.

The EUT was installed in the Acer notebook computer, model: CQ60.

** The test data gathered are from a production sample, S/N: IPC001-01, provided by the manufacturer.*

Objective

This type approval report is prepared on behalf of *HON HAI PRECISION IND. CO., LTD.* in accordance with Part 2, Subpart J, Part 15, Subparts A , B and C of the Federal Communication Commissions rules.

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

Related Submittal(s)/Grant(s)

No Related Submittals.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2001, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

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

Test Facility

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

Test site at BACL has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2001.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The scope of the accreditation covers the FCC Method – 47 CFR Part – Digital Devices, CISPER 22: 1997: Electromagnetic Interference – Limits and Methods of Measurement of Information Technology Equipment test methods.

SYSTEM TEST CONFIGURATION

Justification

The host system was configured for testing according to ANSI C63.4-2001.

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

EUT Exercise Software

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

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

Special Accessories

As shown in following test block diagram, all interface cables used for compliance testing are shielded. The notebook PC and the peripherals featured shielded metal connectors.

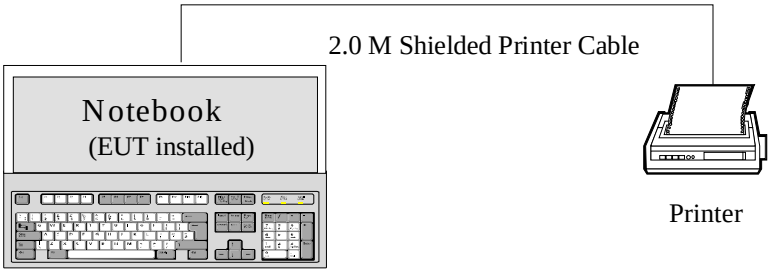
Schematics / Block Diagram

Please refer to Appendix A.

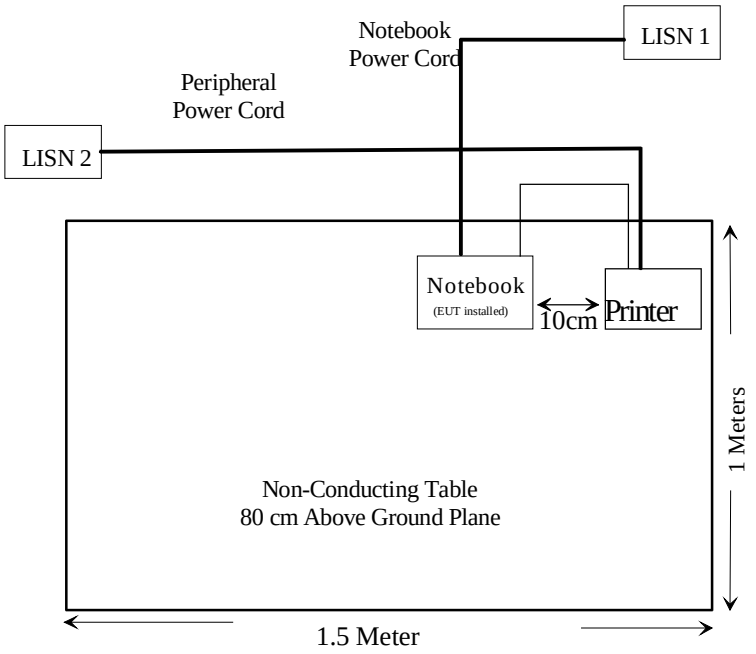
Equipment Modifications

No modifications were made to the EUT.

Configuration of Test System



Test Setup Block Diagram



Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
Acer	Notebook PC	CQ60	N/A	DOC
HP	Printer	2225C	N/A	DOC

External I/O Cabling List and Details

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

Power Supply Information

Manufacturer	Description	Model	Serial Number	FCC ID
Liteon	AC Adapter	PA-1750-02	N/A	DOC

SUMMARY OF TEST RESULTS

Results reported relate only to the product tested, serial number: *T60N871-001*.

FCC RULES	DESCRIPTION OF TEST	RESULT
§2.1091	RF Exposure	Pass
§15.203	Antenna Requirement	Pass
§ 15.207 (a)	Conducted Emissions	Pass
§15.209 (a)	Spurious Emission	Pass
§15.247 (a)(2)	6 dB Bandwidth	Pass
§15.247 (b)(3)	Maximum Peak Output Power	Pass
§ 15.247 (c)	100 kHz Bandwidth of Frequency Band Edge	Pass
§15.247 (d)	Peak Power Spectral Density	Pass
§15.205	Restricted Band	Pass

§1.1307(b)(1) & §2.1091 - RF EXPOSURE

According to §15.247(b)(5) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

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

f = frequency in MHz
* = Plane-wave equivalent power density

MPE Prediction

Predication of MPE limit at a given distance

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

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

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal: 21.6 (dBm)
Maximum peak output power at antenna input terminal: 144.54 (mW)
Prediction distance: 20 (cm)
Predication frequency: 2400 (MHz)
Antenna Gain (typical): 3.3 (dBi)
antenna gain: 2.14 (numeric)
Power density at predication frequency at 20 cm: 0.06(mW/cm^2)

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

Test Result

The EUT is a mobile device. The power density level at 20 cm is 0.06 mW/cm^2, which is below the uncontrolled exposure limit of 1.0mW/cm^2 at 2400 MHz.

§15.203 - ANTENNA REQUIREMENT

Standard Applicable

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

And according to § 15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The antenna for this device is a permanently attached Antenna which is installed inside of notebook PC case.

§15.207(a) - CONDUCTED EMISSIONS

Measurement Uncertainty

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

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

EUT Setup

The measurement was performed in the shield room, using the same setup per ANSI C63.4-2001 measurement procedure. The specification used was FCC 15 Subpart B limits.

The spacing between the peripherals was 10 centimeters.

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

Spectrum Analyzer Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30Mhz.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
Rohde & Schwarz	Artificial LISN	ESH2-Z5	871884/039	2004-03-28
Rohde & Schwarz	EMI Test Receiver	ESCS30	100176	2004-05-06

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

Test Procedure

During the conducted emission test, the power cord of the host system was connected to the auxiliary outlet of the first LISN.

Maximizing procedure was performed on the six (6) highest emissions of each modes tested to ensure EUT is compliant with all installation combination.

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

Summary of Test Results

According to the recorded data in following table, the EUT complies with the FCC Conducted margin for a Class B device, with the *worst* margin reading of:

-15.9 dB at 18.000 in the Neutral mode

Environmental Conditions

Temperature:	26° C
Relative Humidity:	52%
ATM Pressure:	1032 mbar

The testing was performed by Ming Jin on 2004-06-04.

Conducted Emissions Test Data

LINE CONDUCTED EMISSIONS				FCC PART 15 CLASS B	
Frequency MHz	Amplitude dBμV	Detector Qp/Ave/Peak	Phase Line/Neutral	Limit dBμV	Margin dB
18.000	34.1	AVG	Neutral	50	-15.9
17.800	42.3	QP	Neutral	60	-17.7
10.800	30.1	AVG	Line	50	-19.9
0.600	25.8	AVG	Line	46	-20.2
1.530	23.2	AVG	Neutral	46	-22.8
0.175	42.4	QP	Line	66	-23.6
10.800	35.2	QP	Line	60	-24.8
0.600	30.4	QP	Line	56	-25.6
0.185	40.2	QP	Neutral	66	-25.8
1.530	29.8	QP	Neutral	56	-26.2
0.185	26.3	AVG	Neutral	56	-29.7
0.175	23.5	AVG	Line	56	-32.5

Plot of Conducted Emissions Test Data

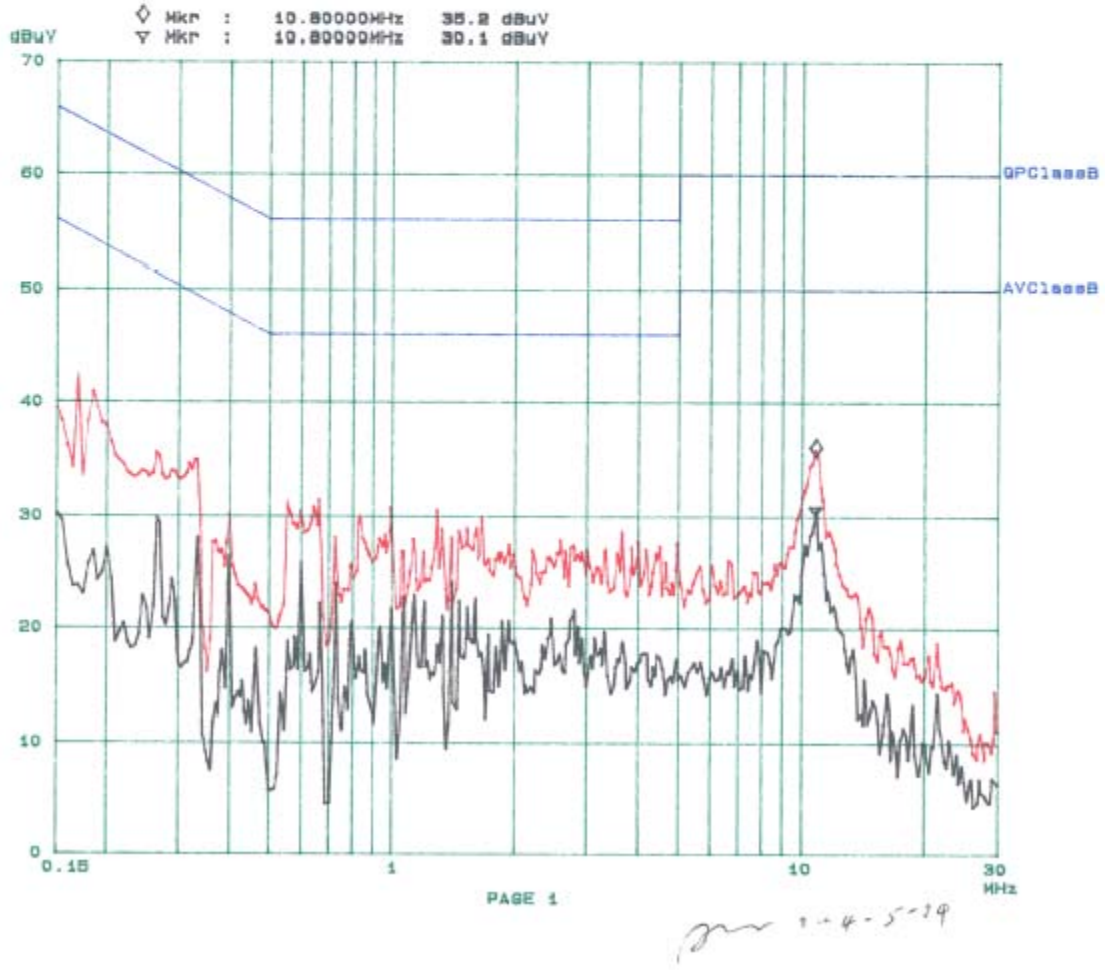
Plot(s) of Conducted Emissions Test Data is presented hereinafter as reference.

Bay Area Compliance Laboratory Corp 02. Jun 04 17:25
Class B

EUT: T60N871
Manuf: Hon Hai
Op Cond: Normal
Operator: Ming
Comment: L

Scan Settings (3 Ranges)

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



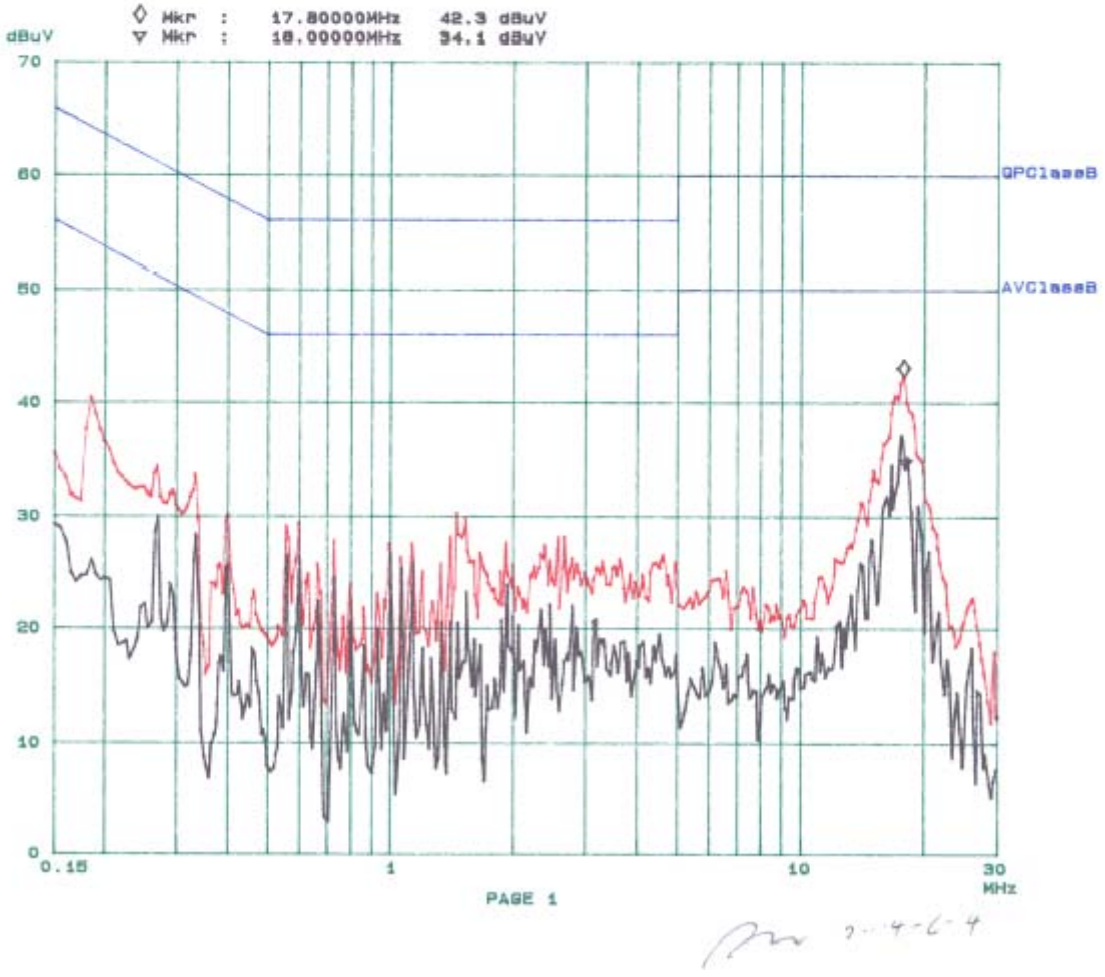
1-4-5-19

Bay Area Compliance Laboratory Corp 02. Jun 04 16:52
Class B

EUT: T60N871
Manuf: Hon Hai
Op Cond: Normal
Operator: Ming
Comment: N

Scan Settings (3 Ranges)

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



2-4-6-4

§15.209(a) - SPURIOUS EMISSION

Standard Applicable

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

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

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

Measurement Procedure

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

Equipment Lists

Manufacturer	Model No.	Description	Calibration Date
HP	8565EC	Spectrum Analyzer	2003-06-30

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

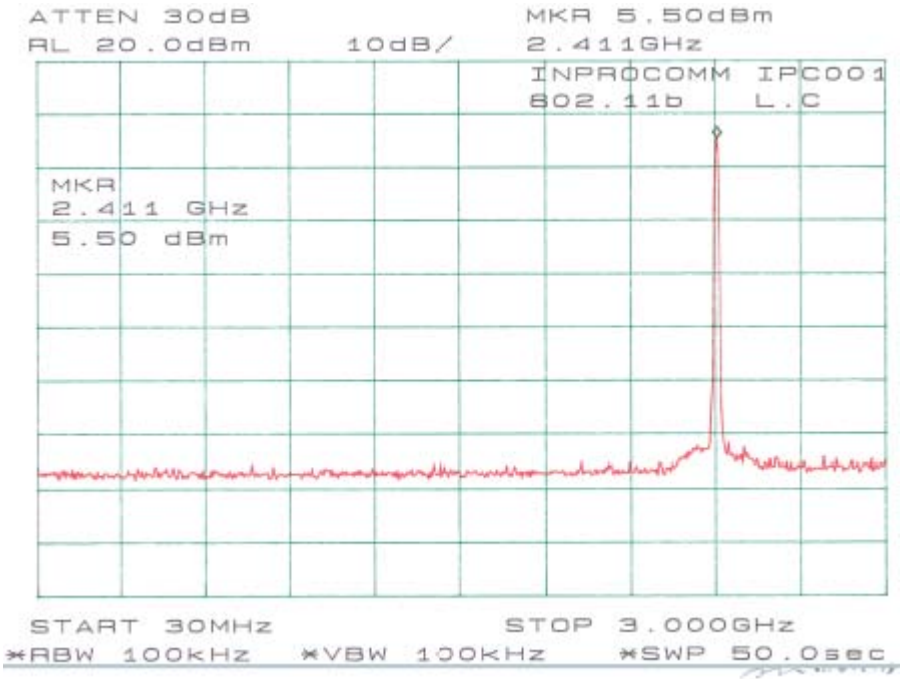
Measurement Result

Please refer to following pages for plots of spurious emission.

Environmental Conditions

Temperature:	26° C
Relative Humidity:	52%
ATM Pressure:	1032 mbar

The testing was performed by Ming Jin on 2004-05-28.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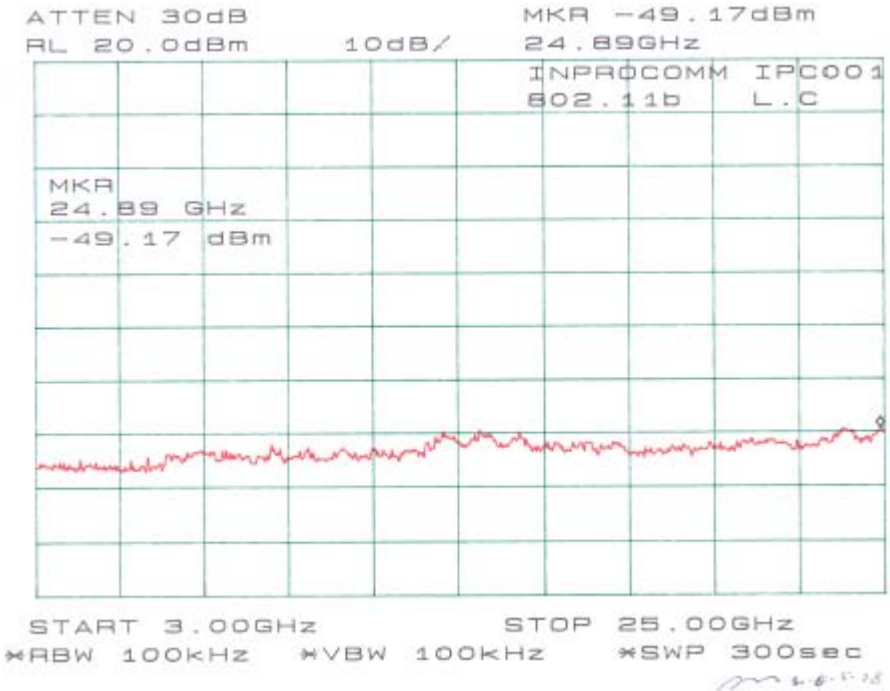
RL 20.0dBm
10dB/
MKR 5.50dBm
2.411GHz
INPROCOMM IPC001
802.11b L.C
MKR
2.411 GHz
5.50 dBm
START 30MHz
STOP 3.000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 50.0sec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10dB/
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24.89GHz
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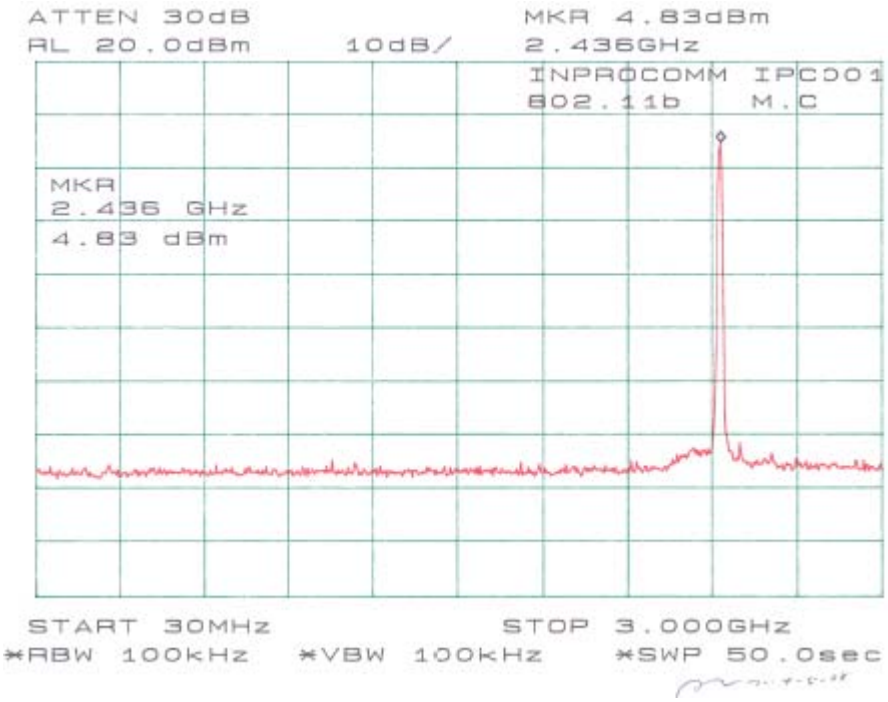
802.11b L.C
MKR
24.89 GHz
-49.17 dBm
START 3.00GHz
STOP 25.00GHz
*RBW 100kHz
*VBW 100kHz
*SWP 300sec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10dB/
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2.436GHz
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802.11b M.C
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4.83 dBm
START 30MHz
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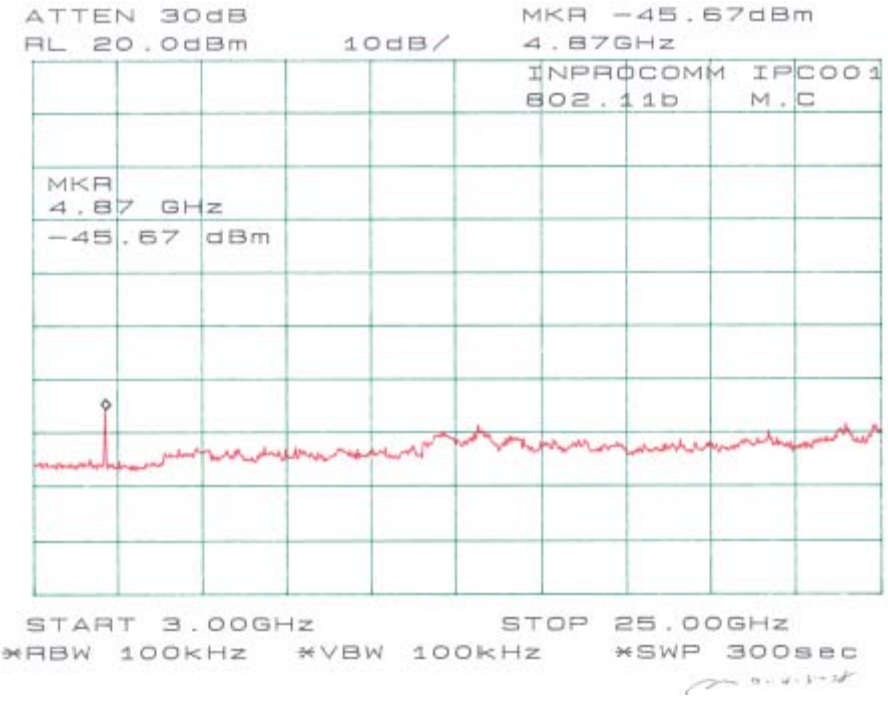
*VBW 100kHz
*SWP 50.0sec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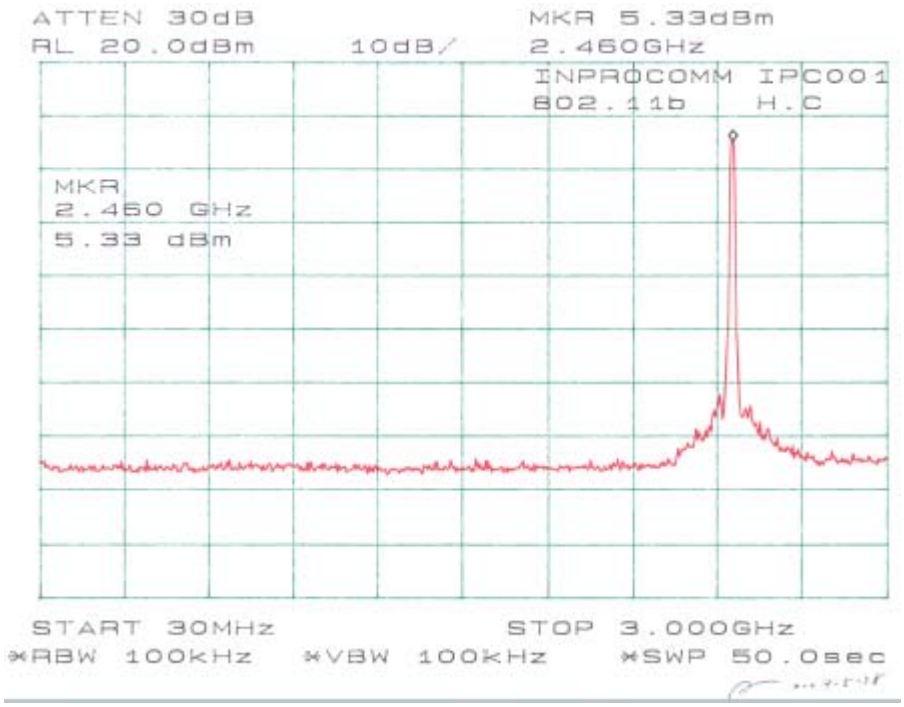
10dB/
MKR -45.67dBm
4.87GHz
INPRODCOMM IPCD01
802.11b M.C
MKR
4.87 GHz
-45.67 dBm
START 3.00GHz
STOP 25.00GHz
*RBW 100kHz
*VBW 100kHz
*SWP 300sec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10dB/
MKR 5.33dBm
2.460GHz
INPROCOMM IPC001
802.11b H.C
MKR
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5.33 dBm
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STOP 3.000GHz
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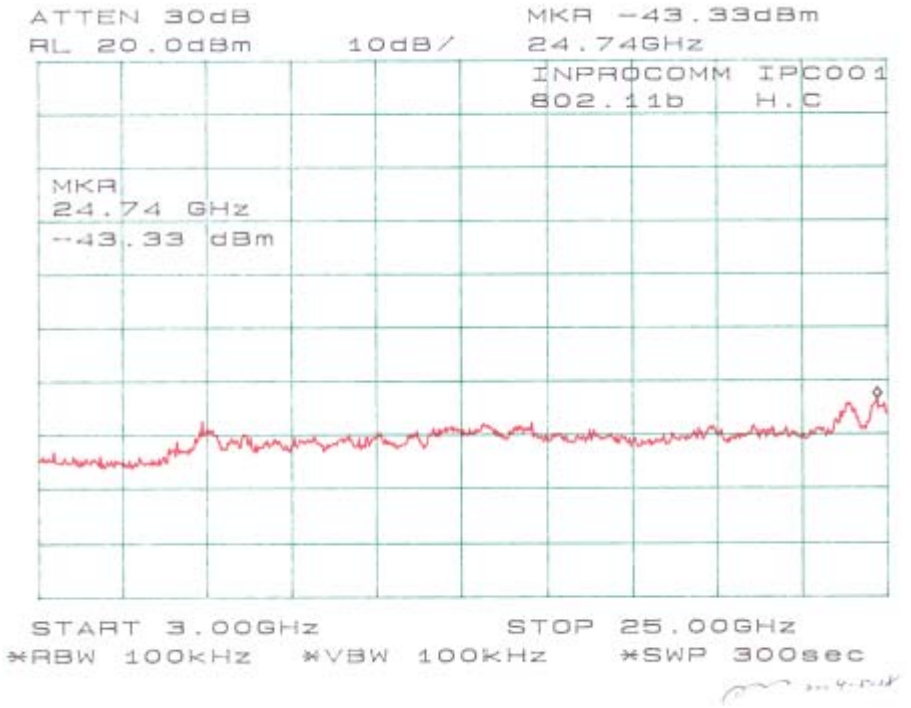
*VBW 100kHz
*SWP 50.0sec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INPROCOMM IPC001
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MKR
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-43.33 dBm
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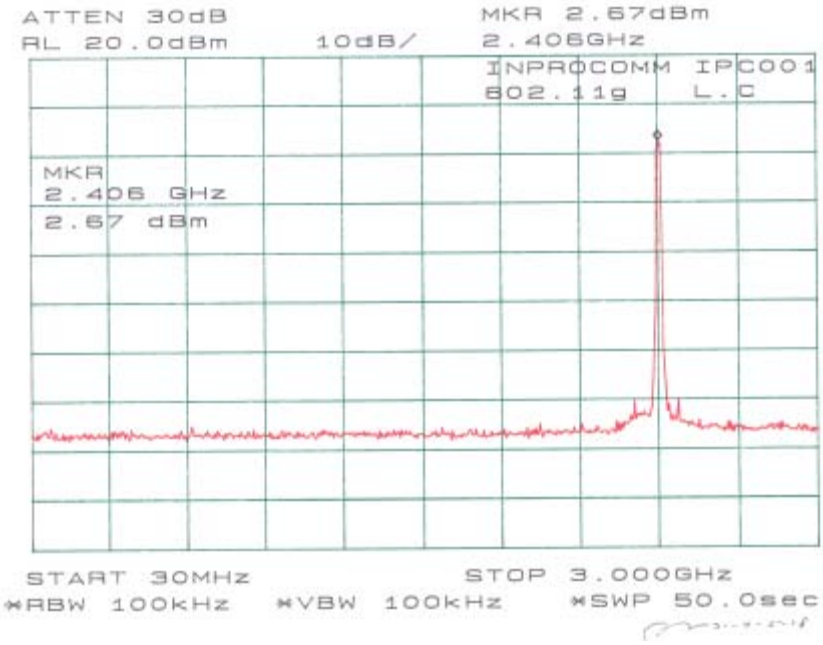
*VBW 100kHz
*SWP 300sec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RL 20.0dBm
10dB/
MKR 2.67dBm
2.406GHz
INPROCOMM IPC001
802.11g L.C
MKR
2.406 GHz
2.67 dBm
START 30MHz
STOP 3.000GHz
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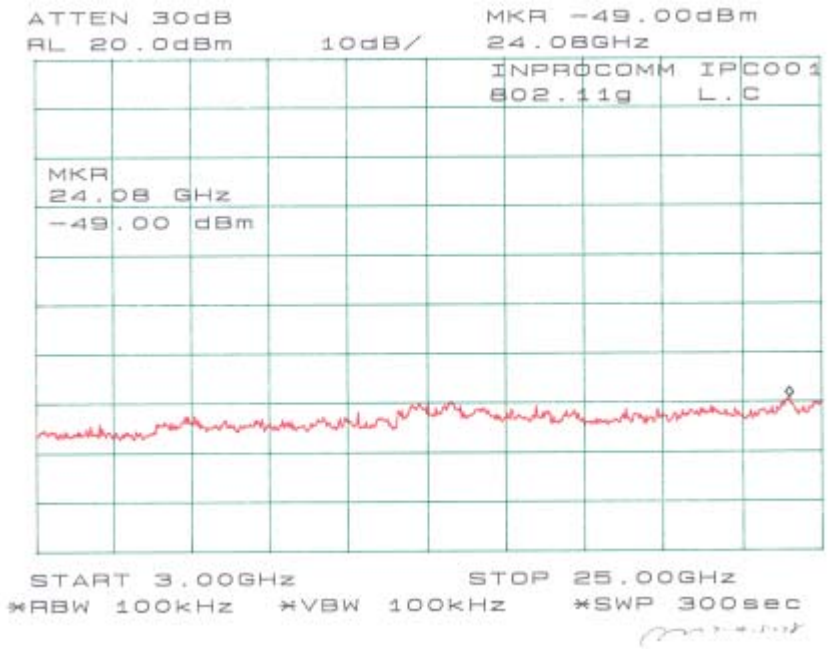
#VBW 100kHz
#SWP 50.0sec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-49.00 dBm
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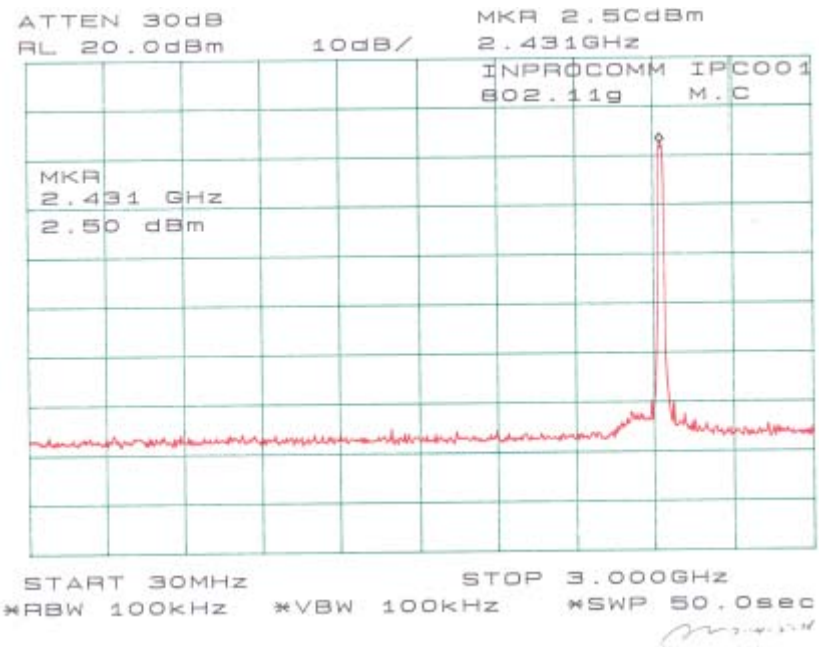
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10dB/
MKR 2.5CdBm
2.431GHz
INPROCOMM IPC001
802.11g M.C
MKR
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2.50 dBm
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STOP 3.000GHz
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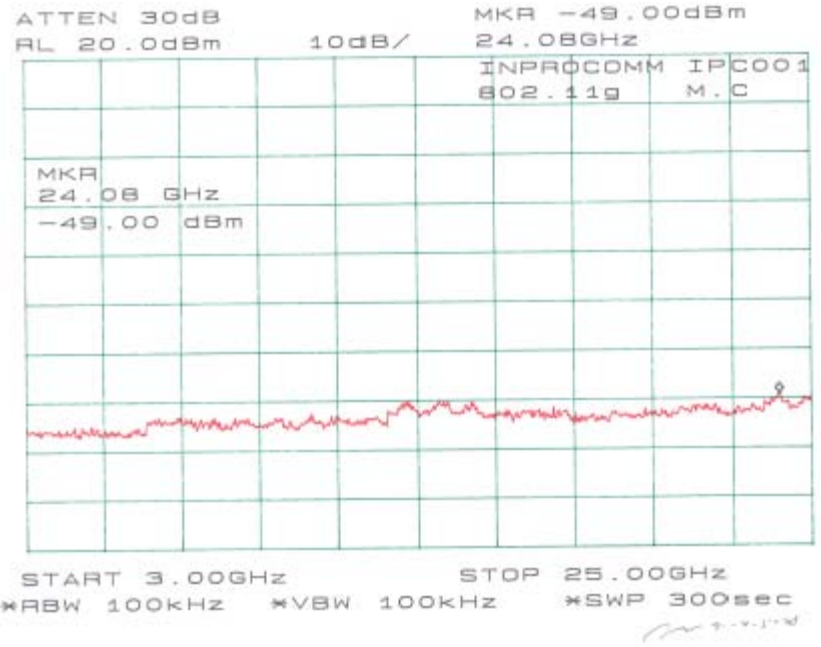
*VBW 100kHz
*SWP 50.0sec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RL 20.0dBm
10dB/
MKR -49.00dBm
24.08GHz
INPROCOMM IPC001
802.11g M.C
MKR
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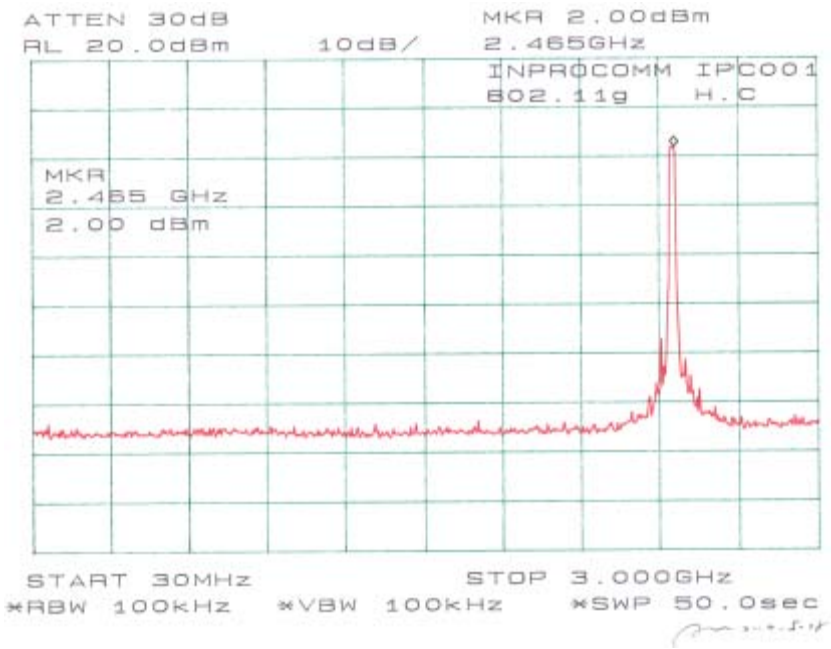
-49.00 dBm
START 3.00GHz
STOP 25.00GHz
*RBW 100kHz
*VBW 100kHz
*SWP 300sec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10dB/
MKR 2.00dBm
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INPRCOMM IPC001
802.11g H.C
MKR
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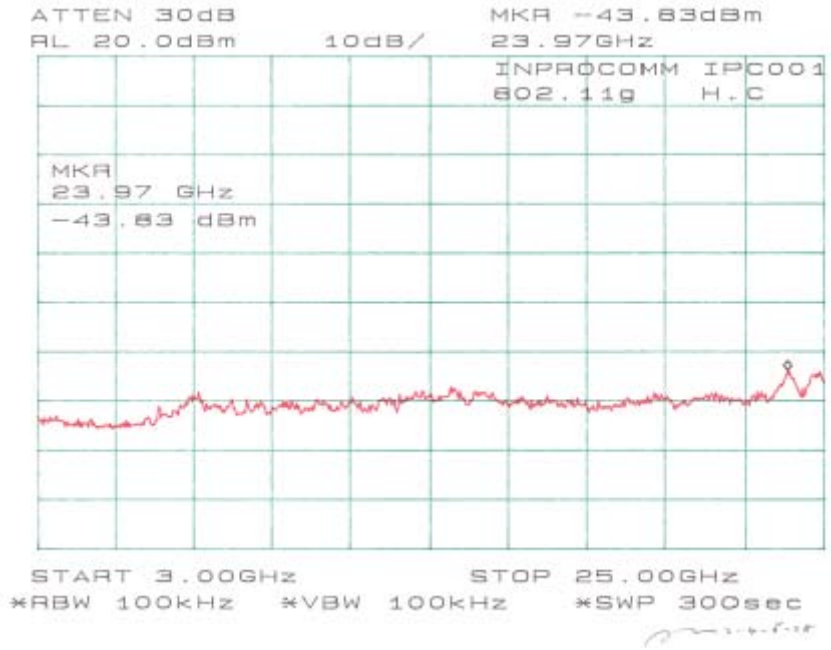
2.00 dBm
START 30MHz
STOP 3.000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 50.0sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -43.83dBm
23.97GHz
INPRCOMM IPC001
802.11g H.C
MKR
23.97 GHz
-43.83 dBm
START 3.00GHz
STOP 25.00GHz
*RBW 100kHz
*VBW 100kHz
*SWP 300sec

§15.209 - SPURIOUS RADIATED EMISSION

Measurement Uncertainty

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

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

According to §15.205, 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
[1]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 – 12.57725	240 – 285	3345.8 – 3358	36.43 – 36.5
13.36 – 13.41	322 – 335.4	3600 – 4400	([2])

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510MHz
[2] Above 38.6

Except as provided in paragraph (d) and (e), the filed 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 1000MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000MHz, 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.

According to §15.209, the device shall meet radiated emission general requirements.

Except for Class A device, the filed strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of Emission (MHz)	Field Strength (Microvolts/meter)	(dBμV/meter)
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

EUT Setup

The radiated emission tests were performed in the open area 3-meter test site, using the setup accordance with the ANSI C63.4-2001. The specification used was the FCC 15.209 limits.

The spacing between the peripherals was 10 centimeters.

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

Spectrum Analyzer Setup

According to FCC Rules, 47 CFR, Section 15.33, the frequency was investigated from 30 to 25000 MHz.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

Frequency Range	***RBW***	***Video B/W***
Below 30MHz	10kHz	10kHz
30 – 1000MHz	100kHz	100kHz
Above 1000MHz	1MHz	1MHz

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Amplifier, Microwave	8449B	3147A00400	2004-03-14
HP	Amplifier, Pre	8447E	1937A01057	2003-08-04
HP	Amplifier, Pre	8447E	1937A01046	2003-08-02
HP	Analyzer, Spectrum	8565EC	3946A00131	2003-06-30
ETS	Antenna, Biconical	3110B	9603-2315	2003-10-11
A.R.A.	Antenna, Horn, DRG	DRG-118/A	1132	2003-09-30
A. H. Systems	Antenna, Horn, DRG	SAS-200/571	2455-261	2003-08-01
ETS	Antenna, logperiodic	3148	0004-1155	2003-10-11
EMCO	Antenna, Loop, H-Field Gain/AF	6512	00029604	2004-02-12

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

Test Procedure

For the radiated emissions test, the EUT, and all support equipment power cords was connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

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

Corrected Amplitude & Margin Calculation

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

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

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

Margin = Corr. Ampl. - FCC 15.209 Limit

Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.207 and 15.247, and had the worst margin of:

Environmental Conditions

Temperature:	26° C
Relative Humidity:	52%
ATM Pressure:	1032 mbar

The testing was performed by Ming Jin on 2004-05-28.

802.11b:

-19.1 dB at **4824.00 MHz** in the **Vertical** polarization, Low Channel

-19.3 dB at **4874.00 MHz** in the **Vertical** polarization, Middle Channel

-19.4 dB at **4924.00 MHz** in the **Vertical** polarization, High Channel

-12.8 dB at **31.4 MHz** in the **Horizontal** polarization, High Channel

802.11g:

-19.2 dB at **4824.00 MHz** in the **Vertical** polarization, Low Channel

-19.4 dB at **4874.00 MHz** in the **Vertical** polarization, Middle Channel

-19.5 dB at **4924.00 MHz** in the **Vertical** polarization, High Channel

-13.5 dB at **31.40 MHz** in the **Horizontal** polarization, High Channel

Radiated Emission Test Result for 802.11b

INDICATED			TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 SUBPART C	
Frequency MHz	Ampl. dBμV/m	Comments	Angle Degree	Height Meter	Polar H/ V	Antenna dBμV/m	Cable DB	Amp. DB	Corr. Ampl. dBμV/m	Limit dBμV/m	Margin dB
Low Channel, 1-25GHz											
2412.00	93.6	Fund/Peak	290	1.5	v	28.1	3.4	35.2	89.9		
2412.00	92.9	Fund/Peak	270	1.8	h	28.1	3.4	35.2	89.2		
2412.00	83.3	Fund/Ave	290	1.5	v	28.1	3.4	35.2	79.6		
2412.00	82.7	Fund/Ave	270	1.8	h	28.1	3.4	35.2	79.0		
4824.00	30.5	Ave	120	1.2	v	32.5	4.9	33.0	34.9	54	-19.1
4824.00	30.2	Ave	60	1.5	h	32.5	4.9	33.0	34.6	54	-19.4
2390.00	33.4	Ave	210	1.5	v	28.1	3.4	35.1	29.8	54	-24.3
2390.00	32.9	Ave	90	1.5	h	28.1	3.4	35.1	29.3	54	-24.8
4824.00	43.4	Peak	120	1.2	v	32.5	4.9	33.0	47.8	74	-26.2
4824.00	42.9	Peak	60	1.5	h	32.5	4.9	33.0	47.3	74	-26.7
2390.00	45.5	Peak	210	1.5	v	28.1	3.4	35.1	41.9	74	-32.2
2390.00	44.6	Peak	90	1.5	h	28.1	3.4	35.1	41.0	74	-33.1
Middle Channel, 1-25GHz											
2437.00	92.6	Fund/Peak	180	1.2	v	28.1	3.4	35.2	88.9		
2437.00	92.3	Fund/Peak	30	1.5	h	28.1	3.4	35.2	88.6		
2437.00	82.5	Fund/Ave	180	1.2	v	28.1	3.4	35.2	78.8		
2437.00	82.2	Fund/Ave	30	1.5	h	28.1	3.4	35.2	78.5		
4874.00	30.3	Ave	90	1.5	v	32.5	4.9	33.0	34.7	54	-19.3
4874.00	30.1	Ave	45	1.2	h	32.5	4.9	33.0	34.5	54	-19.5
4874.00	43.2	Peak	90	1.5	v	32.5	4.9	33.0	47.6	74	-26.4
4874.00	42.7	Peak	45	1.2	h	32.5	4.9	33.0	47.1	74	-26.9
High Channel, 1-25GHz											
2462.00	92.2	Fund/Peak	60	1.8	v	28.1	3.4	35.2	88.5		
2462.00	91.8	Fund/Peak	180	1.5	h	28.1	3.4	35.2	88.1		
2462.00	82.3	Fund/Ave	60	1.8	v	28.1	3.4	35.2	78.6		
2462.00	82.1	Fund/Ave	180	1.5	h	28.1	3.4	35.2	78.4		
4924.00	30.2	Ave	0	1.2	v	32.5	4.9	33.0	34.6	54	-19.4
4924.00	29.8	Ave	310	1.5	h	32.5	4.9	33.0	34.2	54	-19.8
2483.50	33.6	Ave	90	1.6	v	28.1	3.4	36.1	29.0	54	-25.1
2483.50	33.1	Ave	120	1.8	h	28.1	3.4	36.1	28.5	54	-25.6
4924.00	43.9	Peak	0	1.2	v	32.5	4.9	33.0	48.3	74	-25.7
4924.00	42.7	Peak	310	1.5	h	32.5	4.9	33.0	47.1	74	-26.9
2483.50	45.7	Peak	90	1.6	v	28.1	3.4	36.1	41.1	74	-33.0
2483.50	44.9	Peak	120	1.8	h	28.1	3.4	36.1	40.3	74	-33.8

Indicated			Table	Antenna		Correction Factor			FCC 15 Subpart B	
Frequency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin
MHz	dBμV/m	Degree	Meter	H/V	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB
31.40	40.2	180	1.5	h	14.9	0.8	28.7	27.2	40	-12.8
45.03	38.7	0	1.2	h	11.1	1.1	28.5	22.4	40	-17.7
236.71	41.5	290	1.5	v	12.6	2.2	28.5	27.8	46	-18.2
304.52	39.6	130	1.6	h	14.4	2.3	28.2	28.1	46	-17.9
347.96	41.8	210	1.2	v	15.4	2.3	28.2	31.3	46	-14.7

FUND = Fundamental
AVG = average

Radiated Emission Test Result for 802.11g

INDICATED			TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 SUBPART C	
Frequency MHz	Ampl. dBμV/m	Comments	Angle Degree	Height Meter	Polar H/V	Antenna dBμV/m	Cable DB	Amp. DB	Corr. Ampl. dBμV/m	Limit dBμV/m	Margin dB
Low Channel, 1-25GHz											
2412.00	93.5	Fund/Peak	60	1.8	v	28.1	3.4	35.2	89.8		
2412.00	93.3	Fund/Peak	110	1.5	h	28.1	3.4	35.2	89.6		
2412.00	77.8	Fund/Ave	60	1.8	v	28.1	3.4	35.2	74.1		
2412.00	77.4	Fund/Ave	110	1.5	h	28.1	3.4	35.2	73.7		
4824.00	30.4	Ave	150	1.2	v	32.5	4.9	33.0	34.8	54	-19.2
4824.00	30.1	Ave	210	1.5	h	32.5	4.9	33.0	34.5	54	-19.5
2390.00	33.2	Ave	210	1.6	v	28.1	3.4	35.1	29.6	54	-24.5
2390.00	32.7	Ave	90	1.5	h	28.1	3.4	35.1	29.1	54	-25.0
4824.00	43.3	Peak	150	1.2	v	32.5	4.9	33.0	47.7	74	-26.3
4824.00	42.7	Peak	210	1.5	h	32.5	4.9	33.0	47.1	74	-26.9
2390.00	45.3	Peak	210	1.6	v	28.1	3.4	35.1	41.7	74	-32.4
2390.00	44.5	Peak	90	1.5	h	28.1	3.4	35.1	40.9	74	-33.2
Middle Channel, 1-25GHz											
2437.00	92.5	Fund/Peak	230	1.5	v	28.1	3.4	35.2	88.8		
2437.00	92.2	Fund/Peak	60	1.6	h	28.1	3.4	35.2	88.5		
2437.00	82.3	Fund/Ave	230	1.5	v	28.1	3.4	35.2	78.6		
2437.00	82.1	Fund/Ave	60	1.6	h	28.1	3.4	35.2	78.4		
4874.00	30.2	Ave	180	1.5	v	32.5	4.9	33.0	34.6	54	-19.4
4874.00	30.0	Ave	0	1.2	h	32.5	4.9	33.0	34.4	54	-19.6
4874.00	42.9	Peak	180	1.5	v	32.5	4.9	33.0	47.3	74	-26.7
4874.00	42.6	Peak	0	1.2	h	32.5	4.9	33.0	47.0	74	-27.0
High Channel, 1-25GHz											
2462.00	92.1	Fund/Peak	130	1.2	v	28.1	3.4	35.2	88.4		
2462.00	91.6	Fund/Peak	0	1.5	h	28.1	3.4	35.2	87.9		
2462.00	82.2	Fund/Ave	130	1.2	v	28.1	3.4	35.2	78.5		
2462.00	81.9	Fund/Ave	0	1.5	h	28.1	3.4	35.2	78.2		
4924.00	30.1	Ave	45	1.2	v	32.5	4.9	33.0	34.5	54	-19.5
4924.00	29.7	Ave	330	1.5	h	32.5	4.9	33.0	34.1	54	-19.9
2483.50	33.5	Ave	90	1.6	v	28.1	3.4	36.1	28.9	54	-25.2
4924.00	43.7	Peak	45	1.2	v	32.5	4.9	33.0	48.1	74	-25.9
2483.50	32.8	Ave	110	1.8	h	28.1	3.4	36.1	28.2	54	-25.9
4924.00	42.5	Peak	330	1.5	h	32.5	4.9	33.0	46.9	74	-27.1
2483.50	45.5	Peak	180	1.6	v	28.1	3.4	36.1	40.9	74	-33.2
2483.50	44.6	Peak	110	1.8	h	28.1	3.4	36.1	40.0	74	-34.1

Indicated			Table	Antenna		Correction Factor			FCC 15 Subpart B	
Frequency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin
MHz	dBμV/m	Degree	Meter	H/V	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB
31.40	39.5	180	1.5	h	14.9	0.8	28.7	26.5	40	-13.5
347.96	38.3	210	1.2	v	15.4	2.3	28.2	27.8	46	-18.2
236.71	41.2	290	1.5	v	12.6	2.2	28.5	27.5	46	-18.5
304.52	38.9	130	1.6	h	14.4	2.3	28.2	27.4	46	-18.6
45.03	37.6	0	1.2	h	11.1	1.1	28.5	21.3	40	-18.8

FUND = Fundamental
AVG = average

§15.247(a)(2) – 6 DB BANDWIDTH

Standard Applicable

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

Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth. (6 dB bandwidth for DTS)
4. Repeat above procedures until all frequencies measured were complete.

Equipment Lists

Manufacturer	Model No.	Description	Calibration Date
HP	8565EC	Spectrum Analyzer	2003-06-30

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

Measurement Result

Environmental Conditions

Temperature:	26° C
Relative Humidity:	52%
ATM Pressure:	1032 mbar

The testing was performed by Ming Jin on 2004-05-28.

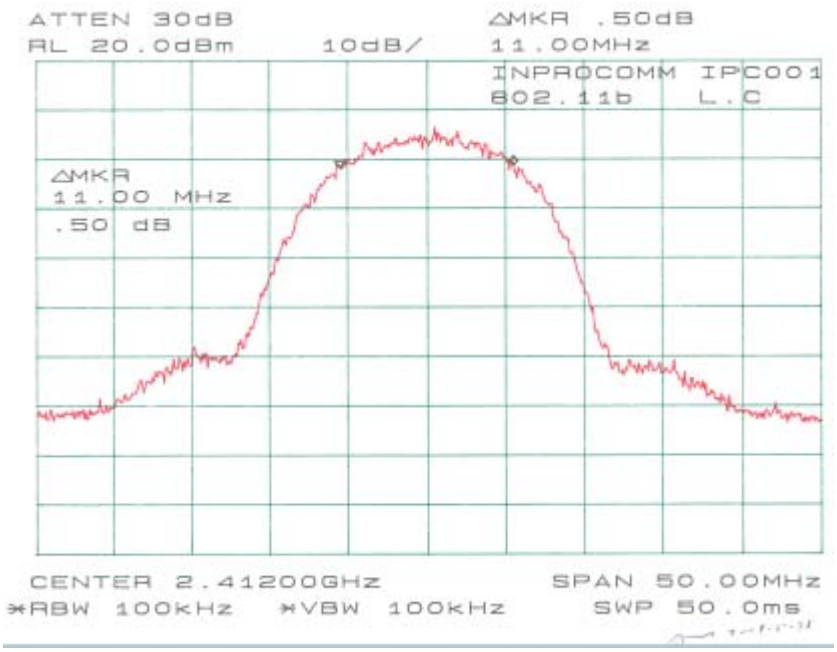
Test Result

802.11b

Channel	Frequency (MHz)	Measured (MHz)	Measured (kHz)	Standard (kHz)	Result
Low	2412	11.00	11000	≥ 500	Pass
Mid	2437	11.83	11830	≥ 500	Pass
High	2462	11.00	11000	≥ 500	Pass

802.11g

Channel	Frequency (MHz)	Measured (MHz)	Measured (kHz)	Standard (kHz)	Result
Low	2412	16.50	16500	≥ 500	Pass
Mid	2437	16.75	16750	≥ 500	Pass
High	2462	16.75	16750	≥ 500	Pass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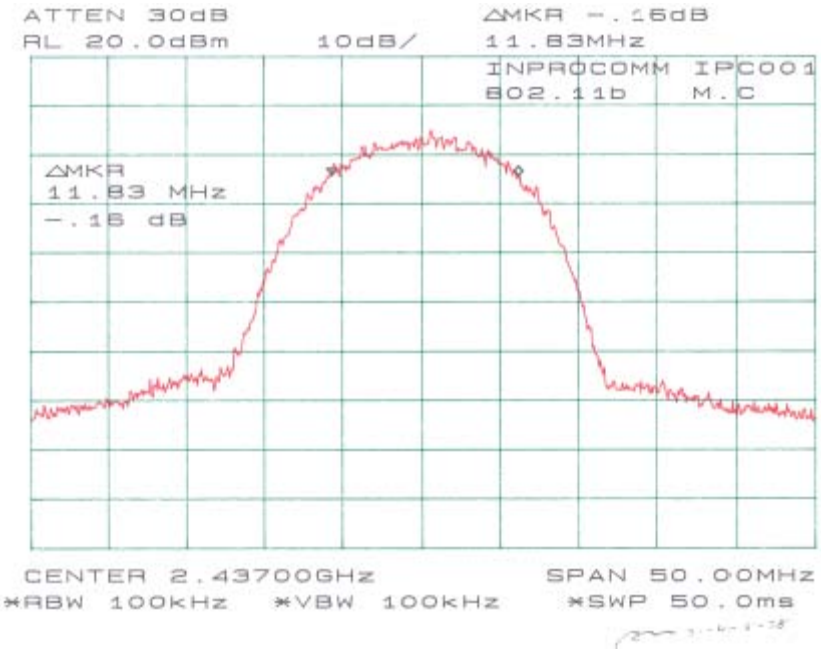
RL 20.0dBm
10dB/
ΔMKR .50dB
11.00MHz
INPROCOMM IPC001
802.11b L.C
ΔMKR
11.00 MHz
.50 dB
CENTER 2.41200GHz
SPAN 50.00MHz
*RBW 100kHz
*VBW 100kHz
SWP 50.0ms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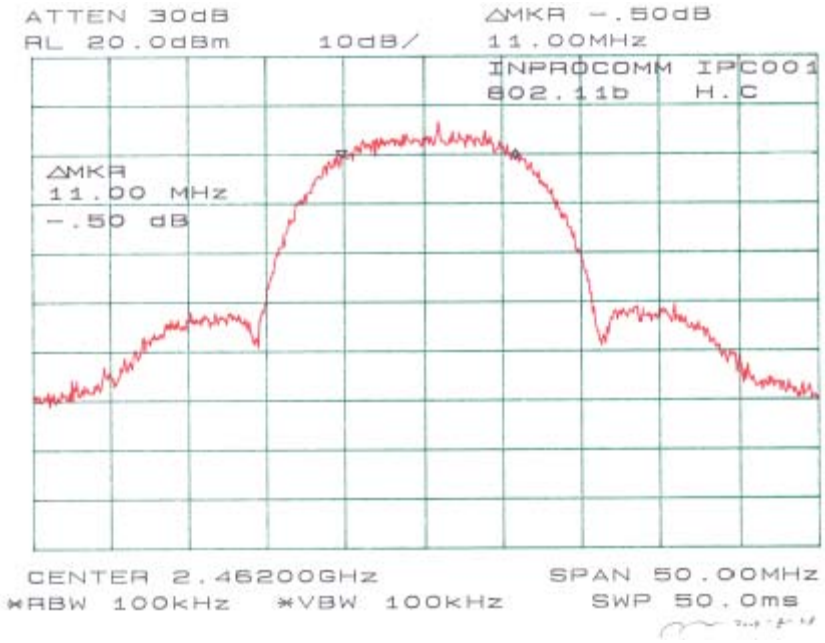
10dB/
ΔMKR -.16dB
11.83MHz
INPROCOMM IPC001
802.11b M.C
ΔMKR
11.83 MHz
-.16 dB
CENTER 2.43700GHz
SPAN 50.00MHz
*RBW 100kHz
*VBW 100kHz
*SWP 50.0ms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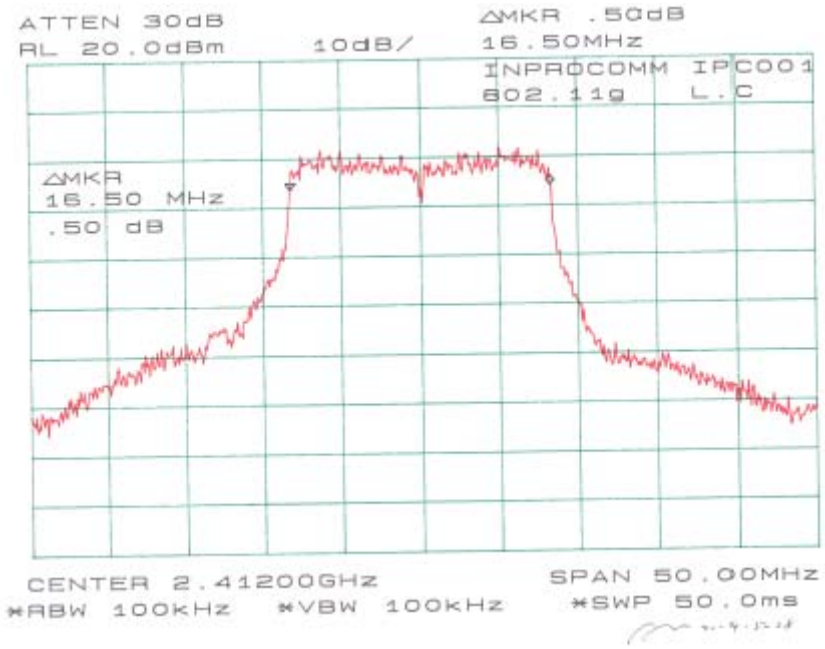
RL 20.0dBm
10dB/
ΔMKR -.50dB
11.00MHz
INPROCOMM IPC001
802.11b H.C
ΔMKR
11.00 MHz
-.50 dB
CENTER 2.46200GHz
SPAN 50.00MHz
*RBW 100kHz
*VBW 100kHz
SWP 50.0ms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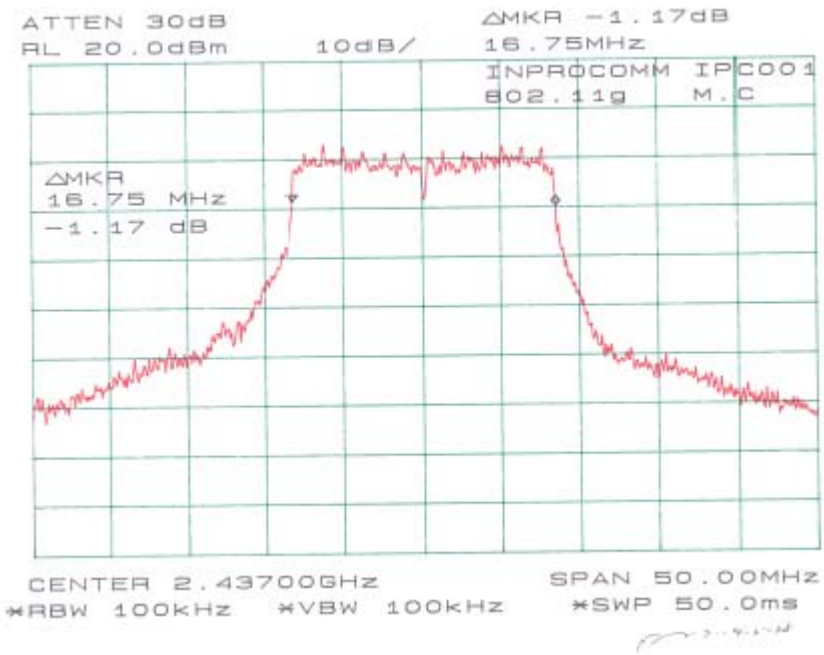
RL 20.0dBm
10dB/
ΔMKR .50dB
16.50MHz
INPROCOMM IPC001
802.11g L.C
ΔMKR
16.50 MHz
.50 dB
CENTER 2.41200GHz
SPAN 50.00MHz
*RBW 100kHz
*VBW 100kHz
*SWP 50.0ms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RL 20.0dBm
10dB/
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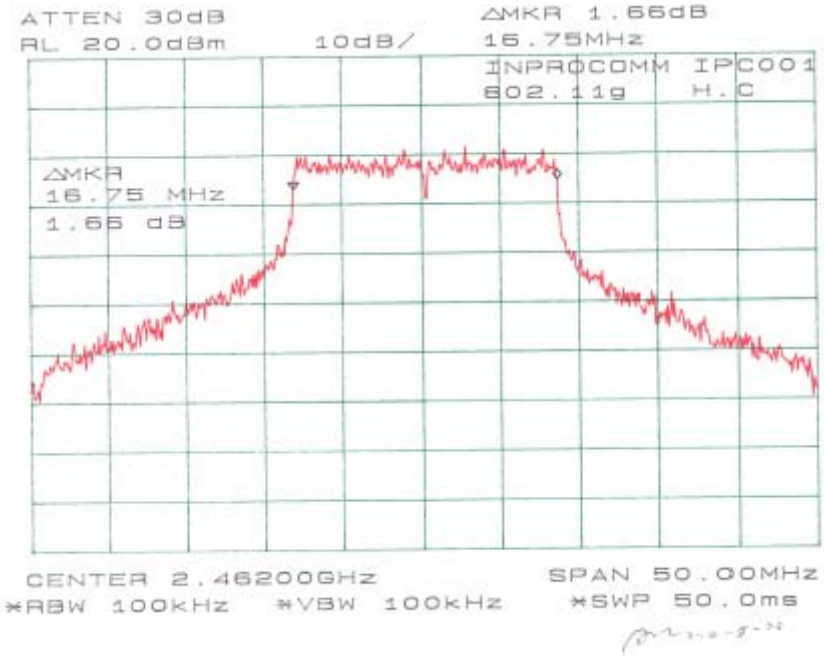
16.75MHz
INPROCOMM IPC001
802.11g M.C
ΔMKR
16.75 MHz
-1.17 dB
CENTER 2.43700GHz
SPAN 50.00MHz
*RBW 100kHz
*VBW 100kHz
*SWP 50.0ms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RL 20.0dBm
10dB/
ΔMKR 1.66dB
16.75MHz
INPROCOMM IPC001
802.11g H.C
ΔMKR
16.75 MHz
1.66 dB
CENTER 2.46200GHz
SPAN 50.00MHz
*RBW 100kHz
*VBW 100kHz
*SWP 50.0ms

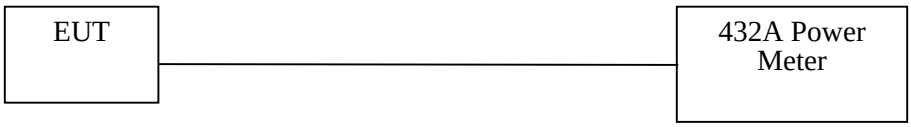
§15.247(b)(3) - PEAK OUTPUT POWER MEASUREMENT

Standard Applicable

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

Measurement Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to a power meter.
3. Add a correction factor to the display.



Equipment Lists

Manufacturer	Model No.	Description	Calibration Date
HP	432A	Power Meter	2003-09-26

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

Measurement Result

Environmental Conditions

Temperature:	26° C
Relative Humidity:	52%
ATM Pressure:	1032 mbar

The testing was performed by Ming Jin on 2004-05-28.

Output Power

802.11b

CH.	Frequency MHz	RF Power dBm	RF Power W	Limit W
Low	2412	21.3	0.135	1W (30dBm)
Mid	2437	21.5	0.141	1W (30dBm)
High	2462	21.2	0.132	1W (30dBm)

802.11g

CH.	Frequency MHz	RF Power dBm	RF Power mW	Limit W
Low	2412	21.4	0.138	1W (30dBm)
Mid	2437	21.6	0.145	1W (30dBm)
High	2462	21.3	0.135	1W (30dBm)

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

Standard Applicable

According to §15.247(c), in *any* 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) see §15.205(c)).

Measurement Procedure

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

Equipment Lists

Manufacturer	Model No.	Description	Calibration Date
HP	8565EC	Spectrum Analyzer	2003-06-30

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

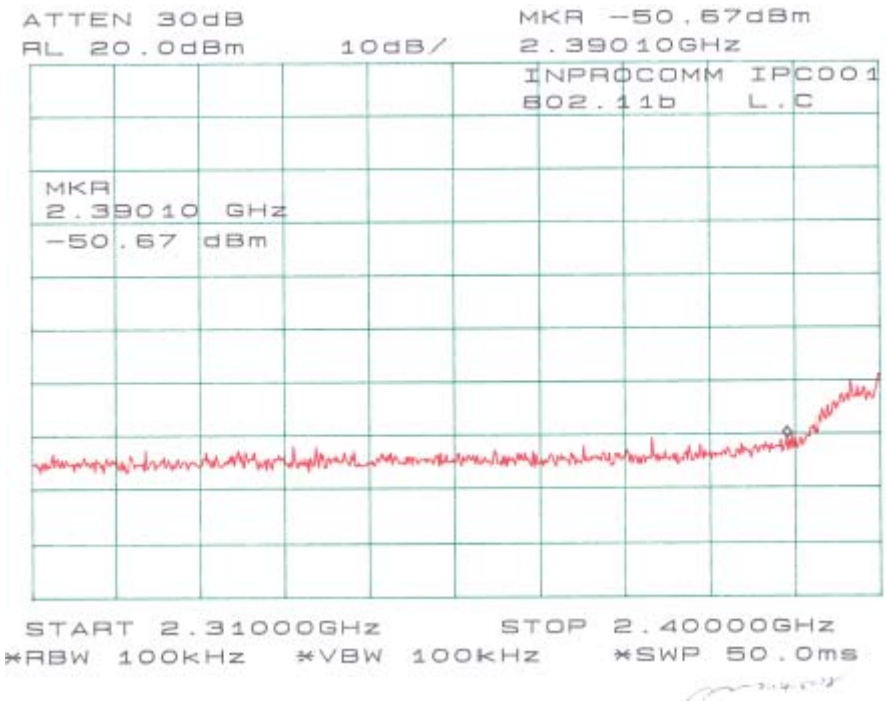
Measure Results

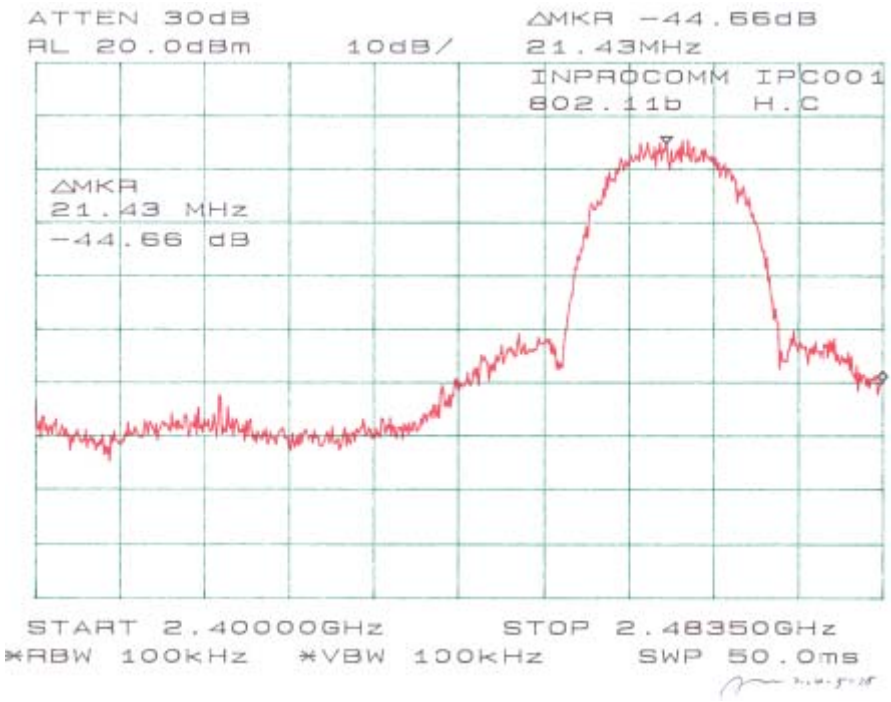
Environmental Conditions

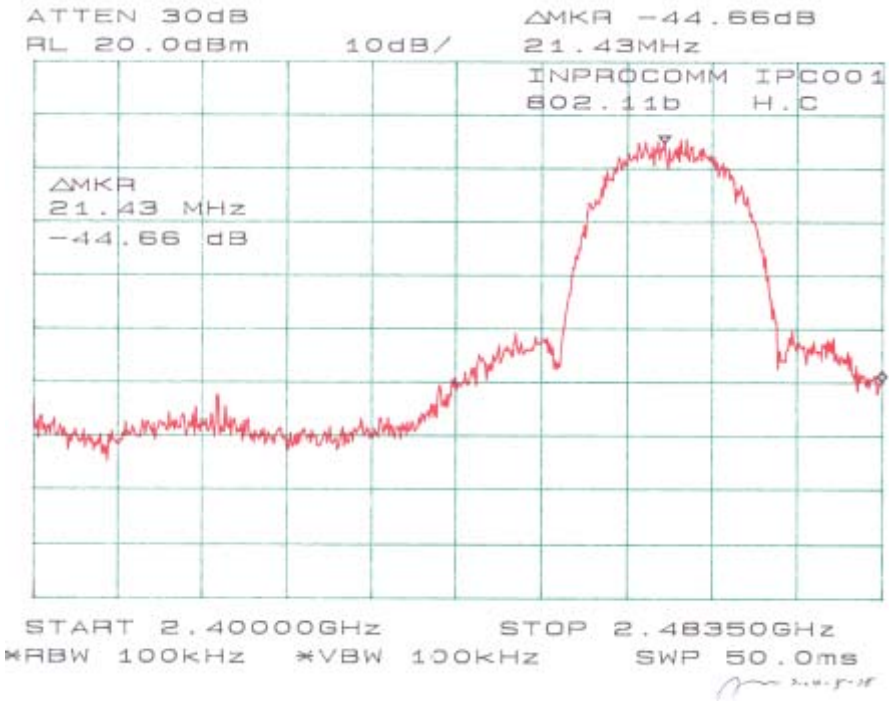
Temperature:	26° C
Relative Humidity:	52%
ATM Pressure:	1032 mbar

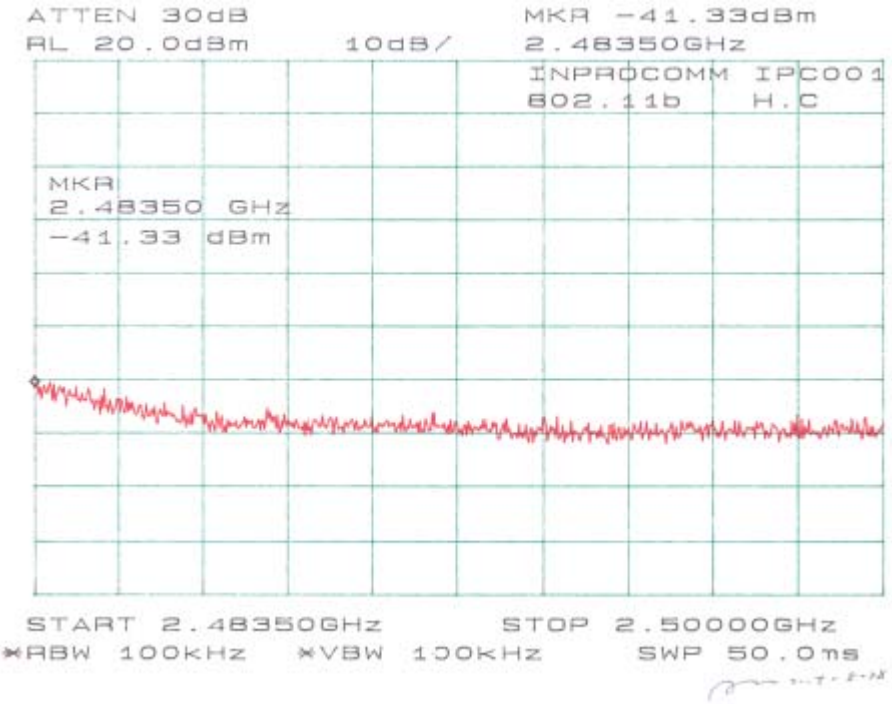
The testing was performed by Ming Jin on 2004-05-28.

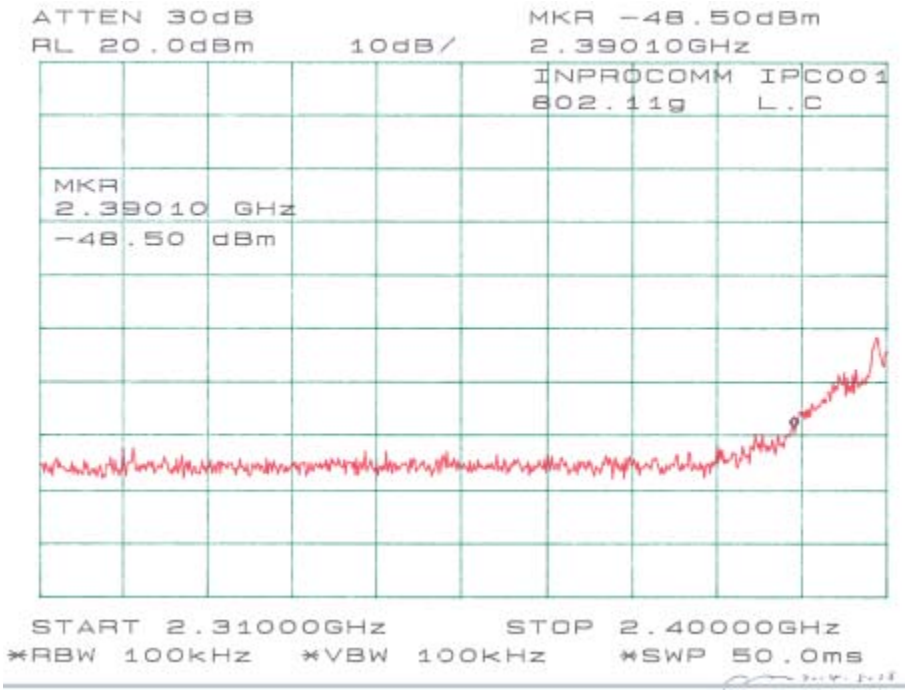
Please refer to following pages for plots of band edge.

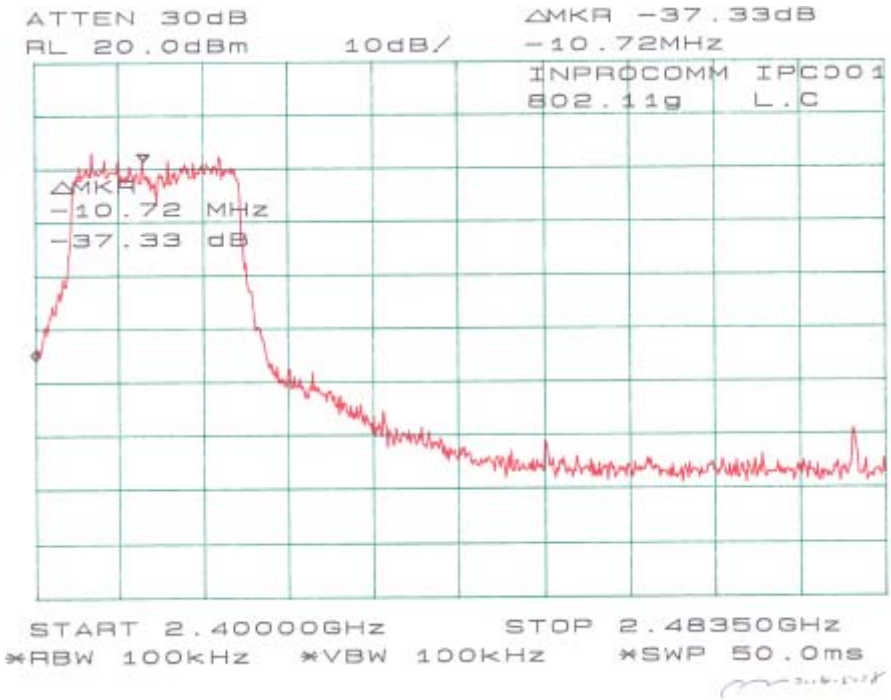

ATTEN 30dB
RL 20.0dBm
10dB/
MKR -50.67dBm
2.39010GHz
INPROCOMM IPC001
802.11b L.C
MKR
2.39010 GHz
-50.67 dBm
START 2.31000GHz
STOP 2.40000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 50.0ms

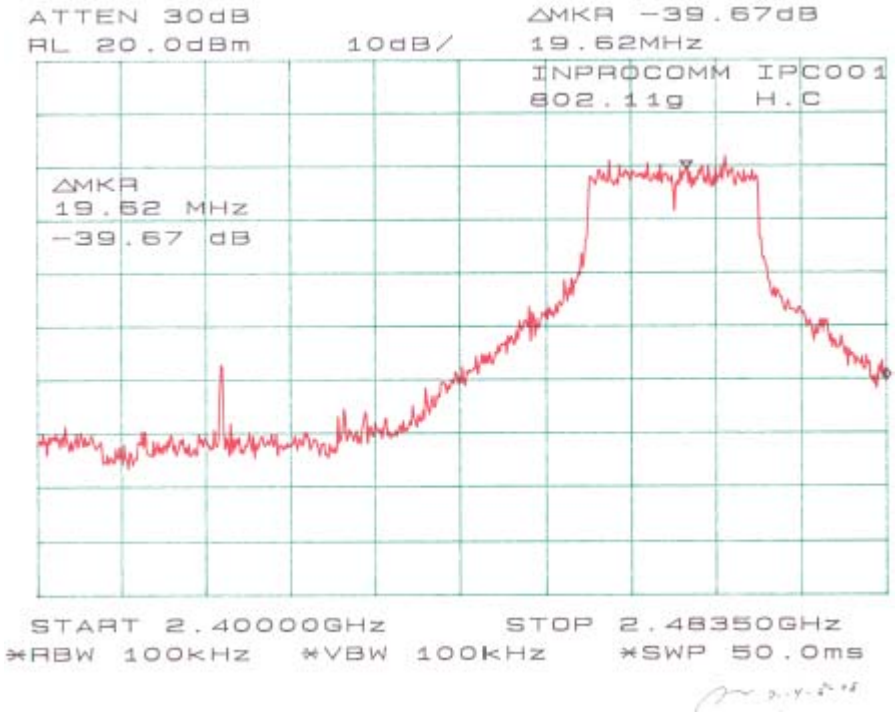

ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -44.66dB
21.43MHz
INPROCOMM IPC001
802.11b H.C
ΔMKR
21.43 MHz
-44.66 dB
START 2.40000GHz
STOP 2.48350GHz
*RBW 100kHz
*VBW 100kHz
SWP 50.0ms

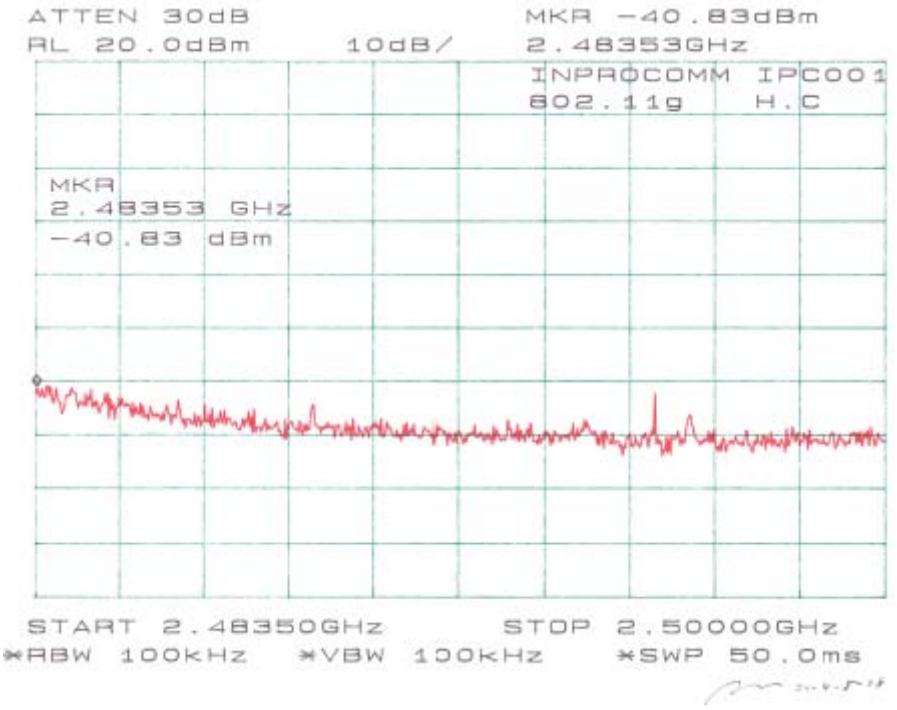

ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -44.66dB
21.43MHz
INPROCOMM IPC001
802.11b H.C
ΔMKR
21.43 MHz
-44.66 dB
START 2.40000GHz
STOP 2.48350GHz
*RBW 100kHz
*VBW 100kHz
SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -41.33dBm
2.48350GHz
INPROCOMM IPC001
802.11b H.C
MKR
2.48350 GHz
-41.33 dBm
START 2.48350GHz
STOP 2.50000GHz
*RBW 100kHz
*VBW 100kHz
SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -48.50dBm
2.39010GHz
INPROCOMM IPC001
802.11g L.C
MKR
2.39010 GHz
-48.50 dBm
START 2.31000GHz
STOP 2.40000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -37.33dB
-10.72MHz
INPROCOMM IPC001
802.11g L.C
ΔMKR
-10.72 MHz
-37.33 dB
START 2.40000GHz
STOP 2.48350GHz
*RBW 100kHz
*VBW 100kHz
*SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -39.67dB
19.62MHz
INPROCOMM IPC001
802.11g H.C
ΔMKR
19.62 MHz
-39.67 dB
START 2.40000GHz
STOP 2.48350GHz
*RBW 100kHz
*VBW 100kHz
*SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -40.83dBm
2.48353GHz
INPROCOMM IPC001
802.11g H.C
MKR
2.48353 GHz
-40.83 dBm
START 2.48350GHz
STOP 2.50000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 50.0ms

§15.247(d) - POWER SPECTRAL DENSITY

Standard Applicable

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

Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to 6MHz span mode. And then, set RBW and VBW of spectrum analyzer to proper value. (DTS)
4. Repeat above procedures until all frequencies measured were complete.

Equipment Lists

Manufacturer	Model No.	Description	Calibration Date
HP	8565EC	Spectrum Analyzer	2004-01-22

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

Measurement Results

Environmental Conditions

Temperature:	26° C
Relative Humidity:	52%
ATM Pressure:	1032 mbar

The testing was performed by Ming Jin on 2004-05-28.

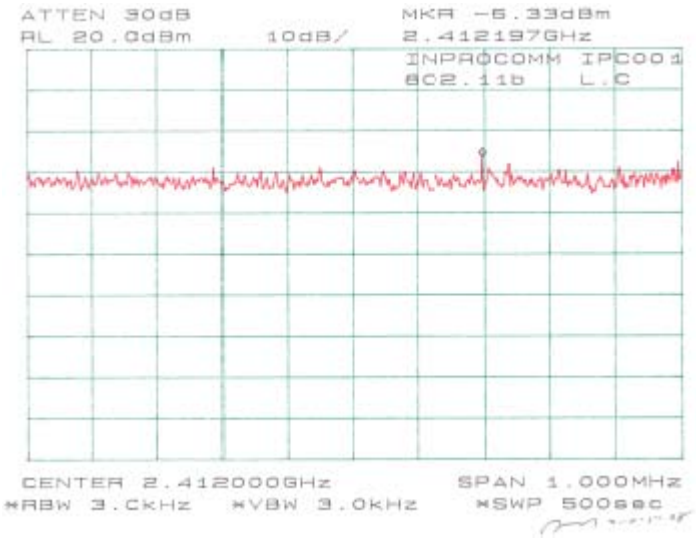
Test Result

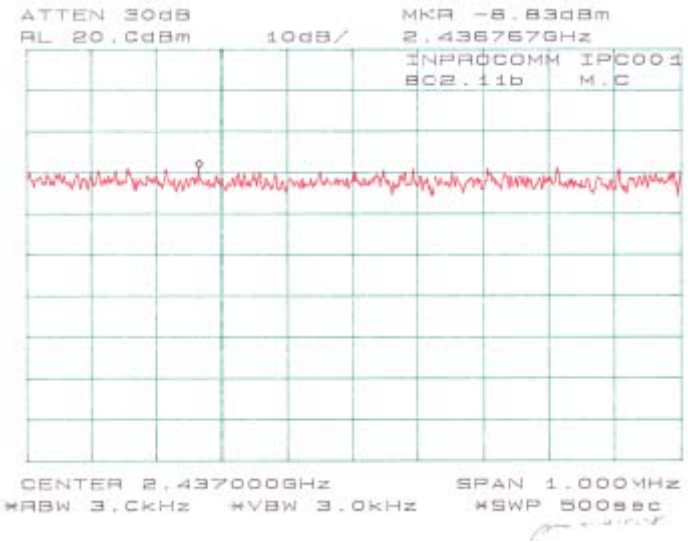
802.11b

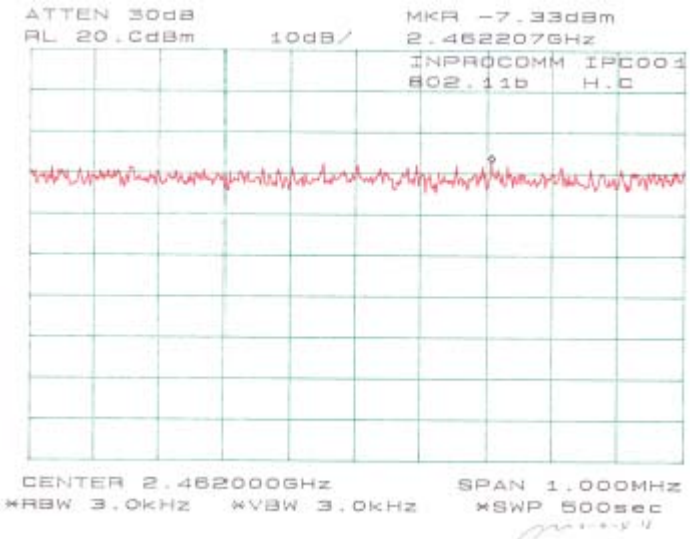
Channel	Frequency (MHz)	Peak Power Spectral Density (dBm)	Standard (dBm)	Result
Low	2412	-5.33	≤ 8	Pass
Mid	2437	-8.83	≤ 8	Pass
High	2462	-7.33	≤ 8	Pass

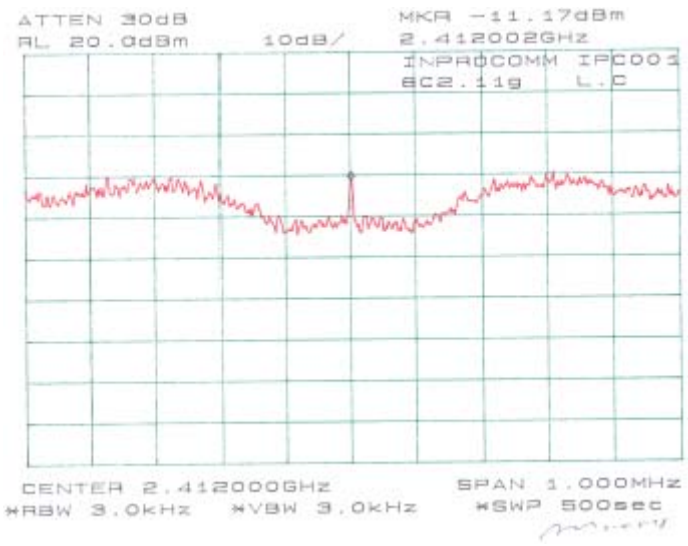
802.11g

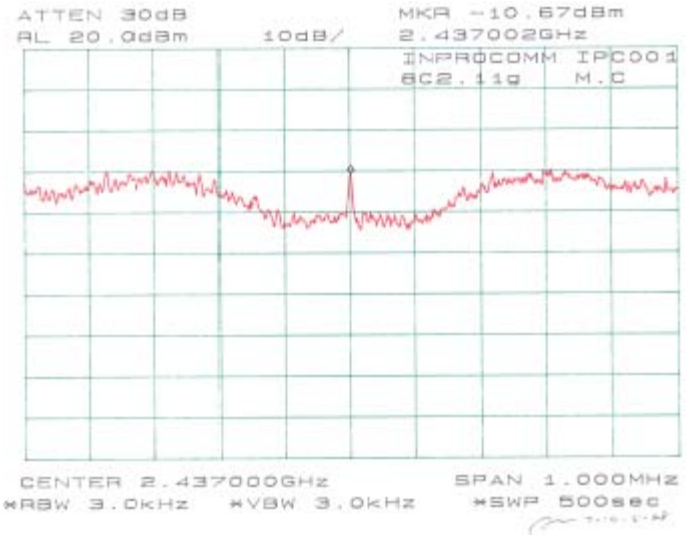
Channel	Frequency (MHz)	Peak Power Spectral Density (dBm)	Standard (dBm)	Result
Low	2412	-11.17	≤ 8	Pass
Mid	2437	-10.67	≤ 8	Pass
High	2462	-12.17	≤ 8	Pass


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -6.33dBm
2.412197GHz
INPRACOMM IPC001
802.11b L.C
CENTER 2.412000GHz
SPAN 1.000MHz
*RBW 3.0kHz
*VBW 3.0kHz
*SWP 500sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -8.83dBm
2.436767GHz
INPRACOMM IPC001
802.11b M.C
CENTER 2.437000GHz
SPAN 1.000MHz
*RBW 3.0kHz
*VBW 3.0kHz
*SWP 500sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -7.33dBm
2.462207GHz
INPRACOMM IPC001
802.11b H.C
CENTER 2.462000GHz
SPAN 1.000MHz
*RBW 3.0kHz
*VBW 3.0kHz
*SWP 500sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -11.17dBm
2.412002GHz
INPRCOMM IPC001
802.11g L.C
CENTER 2.412000GHz
SPAN 1.000MHz
*RBW 3.0kHz
*VBW 3.0kHz
*SWP 500sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -10.67dBm
2.437002GHz
INPRCOMM IPC001
802.11g M.C
CENTER 2.437000GHz
SPAN 1.000MHz
*RBW 3.0kHz
*VBW 3.0kHz
*SWP 500sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -12.17dBm
2.462002GHz
INPRCOMM IPC001
802.11g H.C
CENTER 2.462000GHz
SPAN 1.000MHz
*RBW 3.0kHz
*VBW 3.0kHz
*SWP 500sec