SPORTON International Inc.

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FCC RADIO TEST REPORT

Applicant's company	TITAN ELECTRONICS INC.
Applicant Address	RM.7, 11F No. 398, Huan-Pei Rd., Chung Li, Taoyuan Hsien, Taiwan, R.O.C.
FCC ID	K4LNETCOM123
Manufacturer's company	TITAN ELECTRONICS INC.
Manufacturer Address	RM.7, 11F No. 398, Huan-Pei Rd., Chung Li, Taoyuan Hsien, Taiwan, R.O.C.

Product Name	Wireless Net Com
Brand Name	TITAN
Model Name	NetCom 123 WLAN / NetCom 121 WLAN
Test Freq. Range	2400 ~ 2483.5MHz
Test Rule Part(s)	47 CFR FCC Part 15 Subpart C
Receive Date	June 17, 2005
Test Date	July 04, 2005

Statement

Test result included is only for the 802.11b/g part of the product.

The test result in this report refers exclusively to the presented test model / sample.

Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.

The measurements and test results shown in this test report were made in accordance with the procedures and found in compliance with the limit given in ANSI C63.4-2003 and 47 CFR FCC Part 15 Subpart C.

The test equipment used to perform the test is calibrated and traceable to NML/ROC or NIST/USA.

Wayne Hsu / Spuervisor

1190
ILAC MRA

Table of Contents

History of This Test Report

Original Issue Date: July 12, 2005

Report No.: FR560913

■ No additional attachment.

□ Additional attachment were issued as following record:

Attachment No.	Issue Date	Description

1. INTRODUCTION

IEEE 802.11b and IEEE 802.11g configurations were supported in this EUT. EUT is a Wireless Net Com with 802.11b/g wireless solution. During testing, EUT carried outside enclosure of host in worst assessment. Tests were performed in all two configurations. The test results for configuration IEEE 802.11b and IEEE 802.11g are reported in this test report.

Test results and procedures were in compliance and were performed in accordance with Federal Communications Commission (FCC) 47 CFR FCC Part 15 Subpart C standards/regulations:

Sections/Parts	Description
Section 15.203	Antenna Requirements
Section 15.204	External RF Power Amplifiers and Antenna Modifications
Section 15.205	Restricted Bands of Operation
Section 15.207	AC Power Line Conducted Emissions
Section 15.209	Radiated Emissions (General Requirements)
Section 15.247	Frequency Hopping and Digitally Modulated Intentional Radiators
Section 15.247(a)(2)	6dB Spectrum Bandwidth
Section 15.247(b)/(c)	Antenna Requirements
Section 15.247(b)(3)	Maximum Peak Conducted Output Power
Section 15.247(e)	Power Spectral Density
Section 15.247(d)	Band Edge Emissions
Section 15.247(d)	Out of Band Emissions
Section 15.247(i)	Maximum Permissible Exposure
FCC Public Notices	DA-02-2138
FCC Orders	FCC-04-165

2. GENERAL INFORMATION

2.1. Product Details

Items	Description
Product Type	Wireless Net Com
Radio Type	Intentional Transceiver
Power Type	Power Adapter & Host (Notebook)
Interface Type	Mini-PCI / RJ-45 / RS232

2.2. Accessories

Adaptor 1	
AC Adaptor Brand	Without AC Adapter (Not Applicable)
AC Adapter Model	MKD-48121000
AC Adapter Rating	120Vac / 0.3A / 2 pin
Others	

2.3. Antenna Information

Ant.	Brand	Model Name	Antenna Type	Connector	Gain(dBi)
1	Long Cheng	F1B-003404-52	SMA-Swivel Antenna	Reversed-SMA	2.00

2.4. Technical Specifications

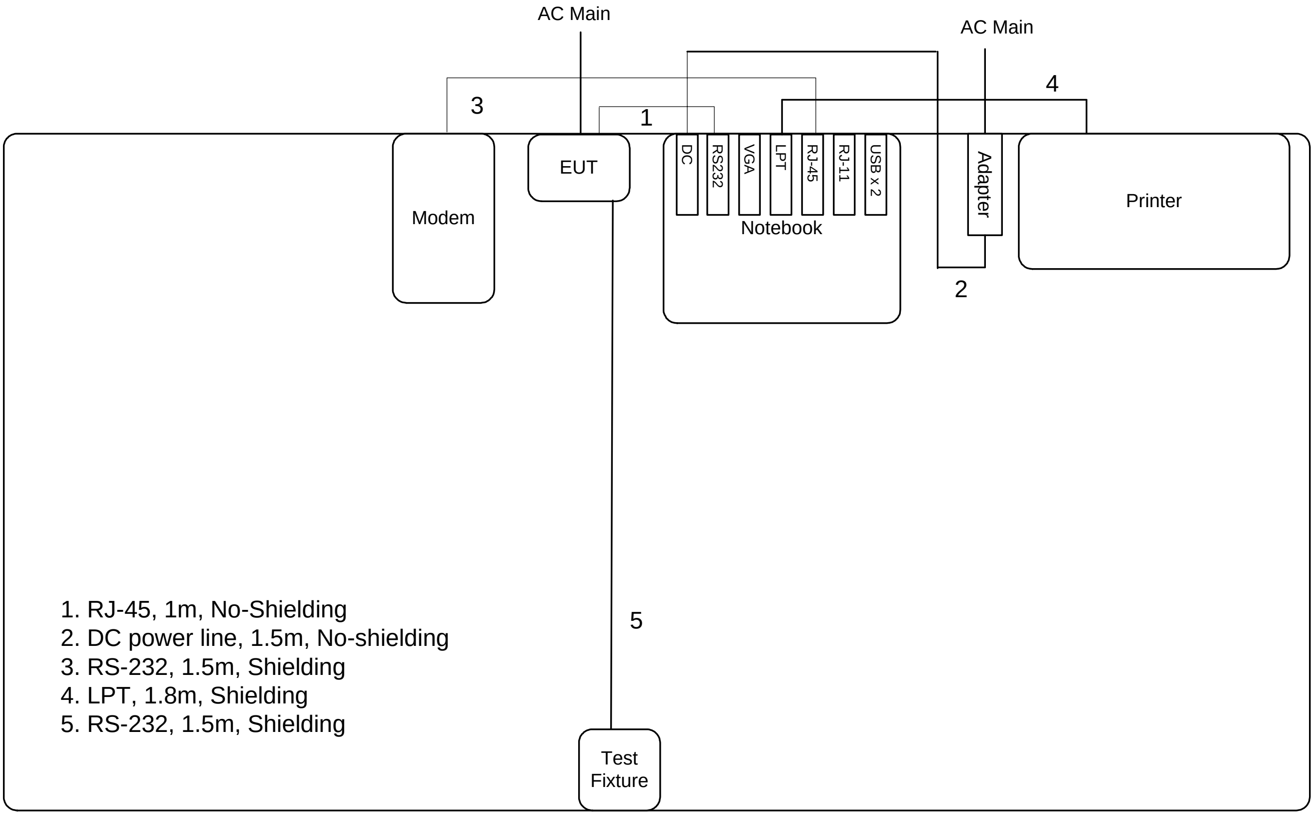
Items	Description
Modulation Type	DSSS for 802.11b, OFDM for 802.11b/g
IEEE 802.11b	DBPSK - 1Mbps DQPSK - 2Mbps CCK - 5.5Mbps, 11Mbps
IEEE 802.11g	BPSK - 6Mbps, 9Mbps QPSK - 12Mbps, 18Mbps 16QAM - 24Mbps, 36Mbps 64QAM - 48Mbps, 54Mbps
Frequency Range	2.4 -2483.5 GHz for 11b/g
Number of Channels	11 for 11b/11g
Max. Output Power (Conducted)	802.11b = 15.38 dBm 802.11g = 15.03 dBm
Channel Space	5MHz (for 11b/11g)
Power Supply	12 Vdc from AC adapter

Frequency Allocation for 802.11b/g

Frequency Band	Channel No.	Frequency
2400~2483.5 MHz Ch1~Ch11 for USA/ Canada/Taiwan	1	2412 MHz
	2	2417 MHz
	3	2422 MHz
	4	2427 MHz
	5	2432 MHz
	6	2437 MHz
	7	2442 MHz
	8	2447 MHz
	9	2452 MHz
	10	2457 MHz
	11	2462 MHz

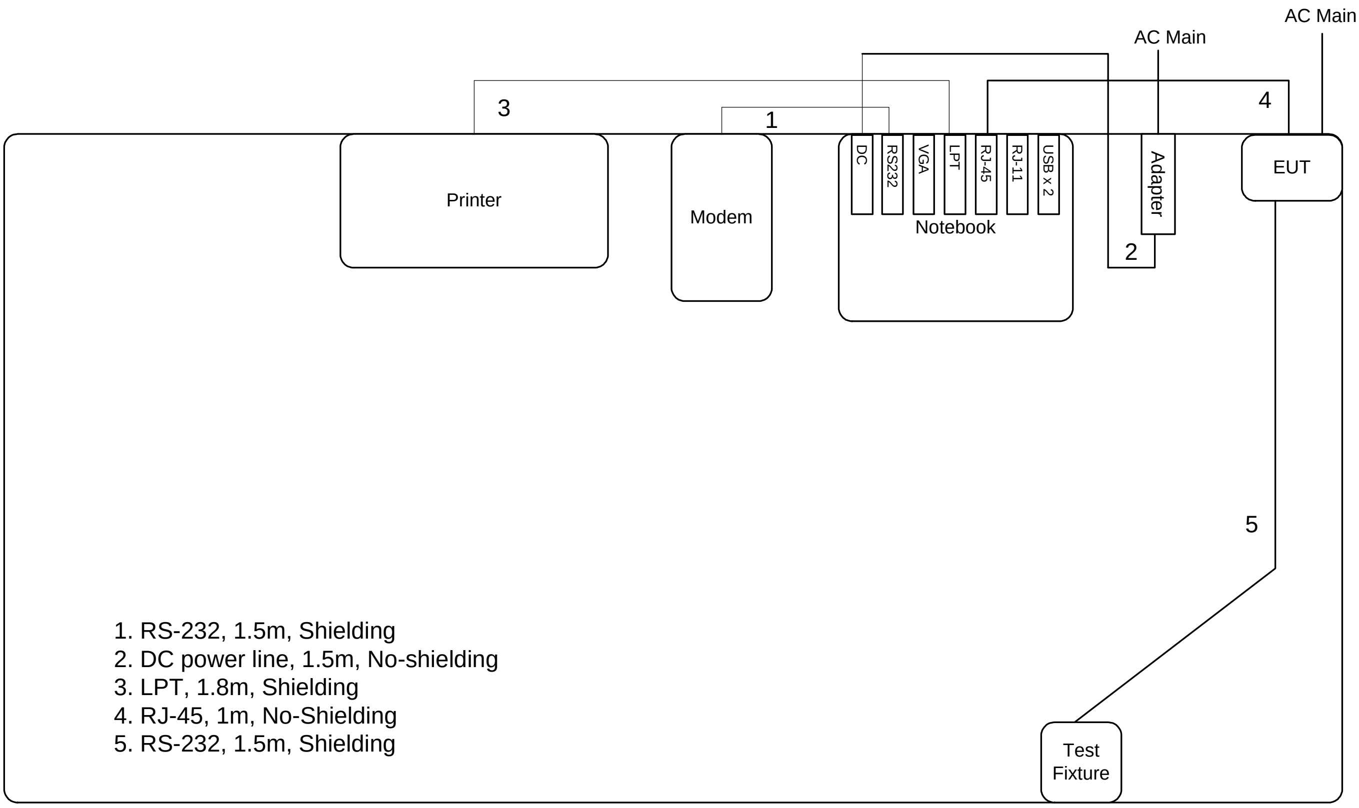
2.5. Test Configuration

Radiation Emissions Test Configuration



1. RJ-45, 1m, No-Shielding
2. DC power line, 1.5m, No-shielding
3. RS-232, 1.5m, Shielding
4. LPT, 1.8m, Shielding
5. RS-232, 1.5m, Shielding

AC Power Line Conduction Emissions Test Configuration



2.6. Support Equipment

Radiation Emissions Test Configuration

Support Unit	Brand	Model	FCC ID
Notebook	DELL	PP01L	DoC
Printer	EPSON	LQ-680	DoC
Modem	ACEEX	DM-1414	IFAXDM1414

AC Power Line Conduction Emissions Test Configuration

Support Unit	Brand	Model	FCC ID
Notebook	DELL	PP01L	DoC
Printer	EPSON	LQ-680	DoC
Modem	ACEEX	DM-1414	IFAXDM1414

2.7. Test Software (Setting)

During testing, Channel & Power Controlling Software was used. This was provided by the manufacturer and is able to let the test engineer select the operating channel as well as the RF output power. The parameters for channel selection is trying to offer the test engineer the ability to fix the operating channel for testing, both normal data and continuously transmitting modes are allowed, and that for RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Power Parameters of IEEE 802.11b/g

Test Software Version	ART		
Frequency	2412 MHz	2437 MHz	2462 MHz
IEEE 802.11b DSSS	18	19	19
IEEE 802.11g OFDM	18	18	18

2.8. Test Procedure

Emissions measurements were performed in accordance with the procedures of ANSI C63.4-2003, Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz .

3. GENERAL INFORMATION OF FACILITY

3.1. Test Location

Test Site No.	Site Category	Location	FCC Reg. No.	IC File No.	VCCI Reg. No
03CH03-HY	SAC	Hwa Ya	101377	IC 4088	-
CO04-HY	SAC	Hwa Ya			-
	SAC	Hwa Ya			
	SAC	Hwa Ya			

Open Area Test Site (OATS); Semi Anechoic Chamber (SAC); Fully Anechoic Chamber (FAC).

Please refer section 7 for Test Site Address.

3.2. CNLA Accreditation

SPORTON International Inc. is accredited in Taiwan by the Chinese National Laboratory Accreditation (CNLA). The current full scope of accreditation can be found on the CNLA website: www.cnla.org.tw. Emissions, immunity and SAR standards are included.

CNLA is the Chinese national laboratory accreditation body and SPORTON International Inc. has been accredited to operate in accordance with the IEC/ISO17025 requirements. A major requirement for accreditation is the assessment of the company and its personnel as being technically competent in testing to the standards. This requires fully documented test procedures, continued calibration of all equipment to the National Standard at the National Measurements Laboratory (NML) and an internal quality system to ISO 9002. Mutual recognition agreements has been accepted between CNLA, the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A2LA)

3.3. Test Equipment Calibration

All measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent CNLA registered laboratory such as Electronics Testing Center, Taiwan (ETC) or the National Measurement Laboratory (NML). All equipment calibration is traceable to Chinese national standards at the National Measurements Laboratory. The reference antenna calibration was performed by NML and the working antennas (biconical, log-periodic and horn) was calibrated by the CNLA approved procedures. The complete list of test equipment used for the measurements, including calibration dates and traceability is contained in section 6 of this report.

4. SUMMARY OF THE TEST RESULTS

Applied Standard: 47 CFR FCC Part 15 Subpart C			
Part	**Rule Section**	**Description of Test**	**Result**
5.1	15.207	AC Power Line Conducted Emissions	Complies
5.2	15.247(b)(3)	Maximum Peak Conducted Output Power	Complies
5.3	15.247(e)	Power Spectral Density	Complies
5.4	15.247(a)(2)	6dB Spectrum Bandwidth	Complies
5.5	15.209	Radiated Emissions (General Requirements)	Complies
5.5	15.247(d)	Out of Band Emissions	Complies
5.6	15.247(d)	Band Edge Emissions	Complies
5.7	15.203/15.247(b)/(c)	Antenna Requirements	Complies
5.8	15.247(i)	Maximum Permissible Exposure	Complies

5. TEST RESULT

5.1. AC Power Line Conducted Emissions Measurement

5.1.1. Applicable Standard

47 CFR FCC Part 15 Subpart C, section 15.207: For a Low-power Radio-frequency Device which is designed to be connected to the 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 below limits table.

Frequency (MHz)	QP Limit (dBuV)	AV Limit (dBuV)
0.15~0.5	66~56	56~46
0.5~5	56	46
5~30	60	50

5.1.2. Measuring Instruments

Please refer to section 6 in this report.

5.1.3. Major Test Instruments Setting

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 KHz

5.1.4. Test Procedures

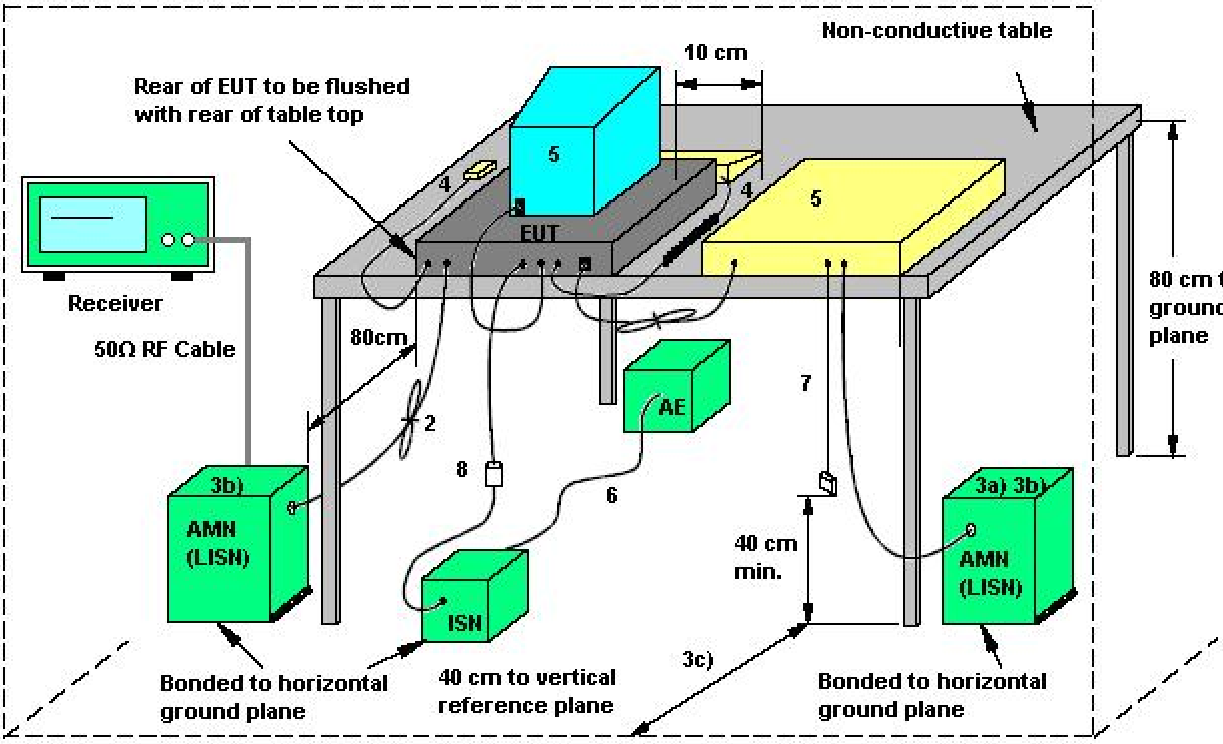
1. Configure the EUT according to ANSI C63.4. The EUT or host of EUT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT or host of EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connected to the other LISNs. The LISN should provide 50uH/50ohms coupling impedance.
4. The frequency range from 150 KHz to 30 MHz was searched.
5. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. The measurement has to be done between each power line and ground at the power terminal.

5.1.5. Test Mode(s)

No significant differences in emissions were observed in the initial investigations for all the 802.11b/g configurations. Final testing was performed for 802.11g configuration while the transmitter was continuously operated on channel 6 (2437 MHz) with the modulation rate of 6 Mbps (BPSK). The following table is a list of the test modes.

Mode	Description
1	Adapter 1 (Model: MKD-48)

5.1.6. Test Setup Layout



AMN = Artificial mains network (LISN)
AE = Associated equipment
EUT = Equipment under test
ISN = Impedance stabilization network

1) If cables, which hang closer than 40 cm to the horizontal metal groundplane, cannot be shortened to appropriate length, the excess shall be folded back and forth forming a bundle 30 cm to 40 cm long.

2) Excess mains cord shall be bundled in the centre or shortened to appropriate length.

3) EUT is connected to one artificial mains network (AMN). All AMNs and ISNs may alternatively be connected to a vertical reference plane or metal wall.

a) All other units of a system are powered from a second AMN. A multiple outlet strip can be used for multiple mains cords.

b) AMN and ISN are 80 cm from the EUT and at least 80 cm from other units and other metal planes.

c) Mains cords and signal cables shall be positioned for their entire lengths, as far as possible, at 40 cm from the vertical reference plane.

4) Cables of hand operated devices, such as keyboards, mouses, etc. shall be placed as for normal usage.

5) Peripherals shall be placed at a distance of 10 cm from each other and from the controller, except for the monitor which, if this is an acceptable installation practice, shall be placed directly on the top of the controller.

6) I/O signal cable intended for external connection.

7) The end of the I/O signal cables which are not connected to an AE may be terminated, if required, using correct terminating impedance.

8) If used, the current probe shall be placed at 0,1 m from the ISN.

5.1.7. Test Deviation

The measurement uncertainty is 2.26dB. Test methods have no deviations with original standard.

5.1.8. Calculation of Voltage Levels

Measurements are reported in units of dB relative to one microvolt. (dBμV).

The voltage levels were automatically measured in software and compared to the test limit. The method of calculation was as follows:

Level = Read Level + LISN Factor + Cable Loss

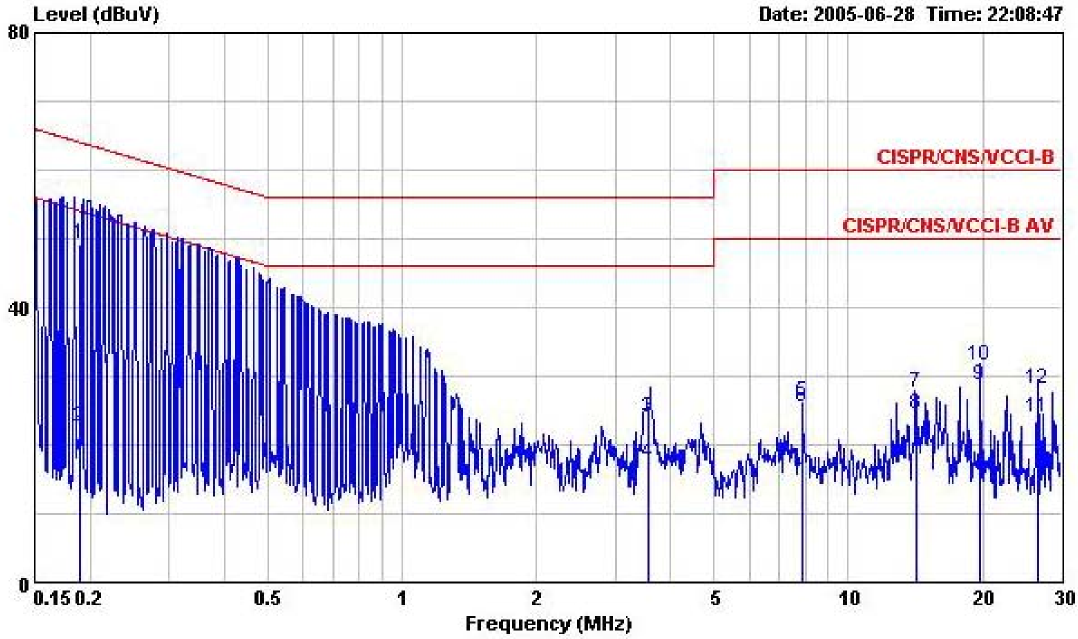
5.1.9. Test Data Requirement

Test data records were performed in accordance with the following ANSI C63.4-2003. The frequency and amplitude of the six highest ac powerline conducted emissions relative to the limit, and the operating frequency or frequency to which the EUT is tuned (if appropriate), shall be reported for each current-carrying conductor of the power cords associated with the EUT system (each cord normally contain-ing two or more current-carrying conductors depending on the power system used), unless such Emissions are more than 20 dB below the limit. If less than six Emissions are within 20 dB of the limit, the noise level of the measuring instrument at representative frequencies shall be reported. The specific conductor of the powerline cord for each of the reported Emissions shall be identified. Measure the 6 highest emissions with respect to the limit on each current carrying conductor of each power cord associated with the EUT. Then report the 6 highest emissions with respect to the limit from among all the measurements identifying the frequency and specific current carrying conductor identified with the emissions.

5.1.10. Results of AC Power Line Conducted Emissions Measurement

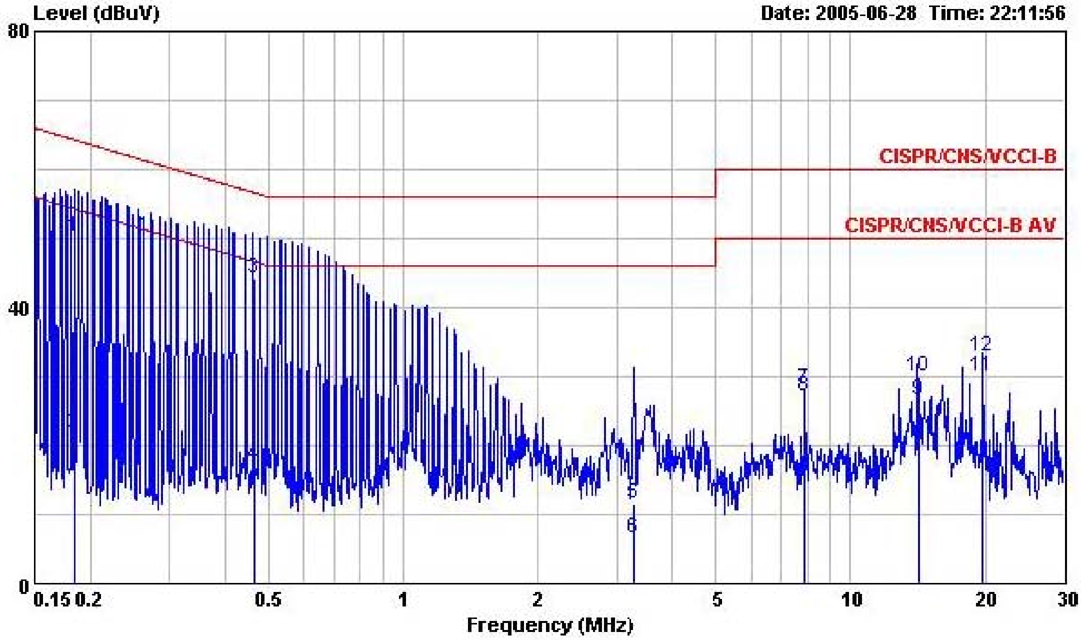
Test Site	CO04-HY
Temperature	24℃
Humidity	48%
Test Engineer	Sky Wu
Test Voltage	120 Vac

Line to Ground



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.1894300	49.24	-14.82	64.06	48.92	0.06	0.26	QP
2	0.1894300	22.71	-31.35	54.06	22.39	0.06	0.26	Average
3	3.579	24.00	-32.00	56.00	23.52	0.19	0.29	QP
4	3.579	17.42	-28.58	46.00	16.94	0.19	0.29	Average
5	7.878	26.42	-33.58	60.00	25.95	0.21	0.26	QP
6	7.878	25.58	-24.42	50.00	25.11	0.21	0.26	Average
7	14.151	27.64	-32.36	60.00	26.28	0.21	1.15	QP
8	14.151	24.52	-25.48	50.00	23.16	0.21	1.15	Average
9	19.708	28.79	-21.21	50.00	28.07	0.31	0.41	Average
10	19.708	31.60	-28.40	60.00	30.88	0.31	0.41	QP
11	26.487	23.92	-26.08	50.00	23.12	0.37	0.43	Average
12	26.487	28.04	-31.96	60.00	27.24	0.37	0.43	QP

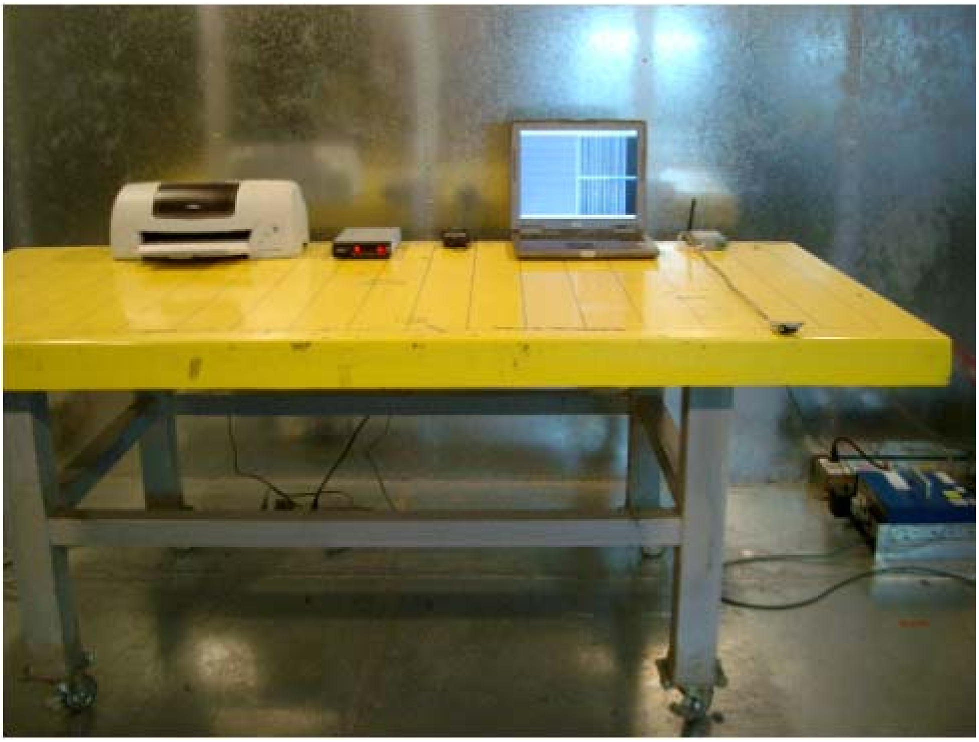
Neutral to Ground



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.1844300	50.29	-13.99	64.28	49.89	0.11	0.29	QP
2	0.1844300	21.78	-32.50	54.28	21.38	0.11	0.29	Average
3	0.4625020	44.23	-12.42	56.65	43.89	0.11	0.23	QP
4	0.4625020	17.20	-29.45	46.65	16.86	0.11	0.23	Average
5	3.281	11.60	-44.40	56.00	11.09	0.23	0.28	QP
6	3.281	6.68	-39.32	46.00	6.17	0.23	0.28	Average
7	7.879	28.16	-31.84	60.00	27.60	0.30	0.26	QP
8	7.879	26.99	-23.01	50.00	26.43	0.30	0.26	Average
9	14.151	26.70	-23.30	50.00	25.22	0.33	1.15	Average
10	14.151	30.05	-29.95	60.00	28.57	0.33	1.15	QP
11	19.709	30.07	-19.93	50.00	29.23	0.43	0.41	Average
12	19.709	32.94	-27.06	60.00	32.10	0.43	0.41	QP

5.1.11. Photographs of Conducted Emissions Test Configuration

FRONT VIEW



REAR VIEW

5.2. Maximum Peak Output Power Measurement

5.2.1. Applicable Standard

47 CFR FCC Part 15 Subpart C, section 15.247(b)(3): For systems using digital modulation in the 2400-2483.5MHz and 5725-5850MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

5.2.2. Measuring Instruments

Please refer to section 6 in this report.

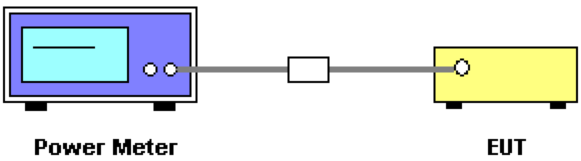
5.2.3. Major Test Instruments Setting

Power Meter Parameter	Setting
Filter No.	Auto
Measurement time	0.135 s ~ 26 s
Used Peak Sensor	NRV-Z32 (model 04)

5.2.4. Test Procedures

1. The transmitter output (antenna port) was connected to the power meter.
2. Turn on the EUT and power meter and then record the peak power value.
3. Repeat above procedures on low, middle, high channels needed to be tested.

5.2.5. Test Setup Layout



5.2.6. Test Deviation

The measurement uncertainty is 1.5dB. Test methods have no deviation with original standard.

5.2.7. Test Mode(s)

The worst case of test result for 11Mbps (CCK) of DSSS IEEE 802.11b and 6Mbps (BPSK) of OFDM IEEE 802.11g was shown in this test report. The following table is a list of the test modes.

Mode	IEEE 802.11b			IEEE 802.11g		
Channel	1	6	11	1	6	11
Freqeency (MHz)	2412	2437	2462	2412	2437	2462

5.2.8. Test Result

Test Site	TH01-HY
Temperature	27℃
Humidity	60%
Test Engineer	Sam Lee

Configuration IEEE 802.11b

Frequency	Conducted Power (dBm)	Conducted Power (W)	Max. Limit (dBm)	Max. Limit (W)	Result
2412 MHz	14.97	0.0314	30.00	1.0000	Complies
2437 MHz	15.38	0.0345	30.00	1.0000	Complies
2462 MHz	15.22	0.0333	30.00	1.0000	Complies

Configuration IEEE 802.11g

Frequency	Conducted Power (dBm)	Conducted Power (W)	Max. Limit (dBm)	Max. Limit (W)	Result
2412 MHz	14.96	0.0313	30.00	1.0000	Complies
2437 MHz	15.03	0.0318	30.00	1.0000	Complies
2462 MHz	14.82	0.0303	30.00	1.0000	Complies

5.3. Power Spectral Density Measurement

5.3.1. Applicable Standard

47 CFR FCC Part 15 Subpart C, section 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.

5.3.2. Measuring Instruments

Please refer to section 6 in this report.

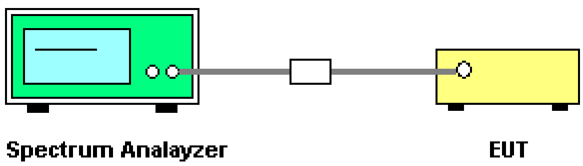
5.3.3. Major Test Instruments Setting

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	1.5MHz
RB	3 kHz
VB	30 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	500s

5.3.4. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyser.
2. Set RBW of spectrum analyzer to 3kHz and VBW to 30kHz. Set Detector to Peak, Trace to Max Hold.
3. Mark the frequency with maximum peak power as the center of the display of the spectrum.
4. Set the span to 1.5MHz and the sweep time to 500s and record the maximum peak value.

5.3.5. Test Setup Layout



5.3.6. Test Deviation

The measurement uncertainty is 1.5dB. Test methods have on deviation with original standard.

5.3.7. Test Mode(s)

The worst case of test result for 11Mbps (CCK) of DSSS IEEE 802.11b and 6Mbps (BPSK) of OFDM IEEE 802.11g was shown in this test report. The following table is a list of the test modes.

Mode	IEEE 802.11b			IEEE 802.11g		
Channel	1	6	11	1	6	11
Freqeency (MHz)	2412	2437	2462	2412	2437	2462

5.3.8. Test Result

Test Site	TH01-HY
Temperature	27℃
Humidity	60%
Test Engineer	Sam Lee

Configuration IEEE 802.11b

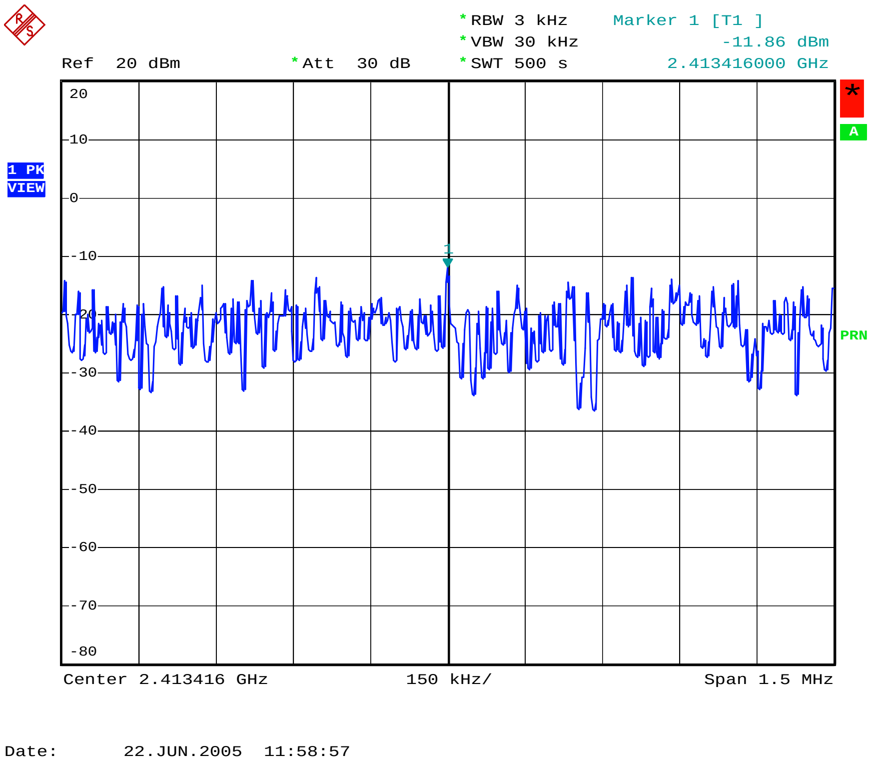
Frequency	Power Density (dBm)	Max. Limit (dBm)	Result
2412 MHz	-11.86	8.00	Complies
2437 MHz	-11.52	8.00	Complies
2462 MHz	-11.52	8.00	Complies

Configuration IEEE 802.11g

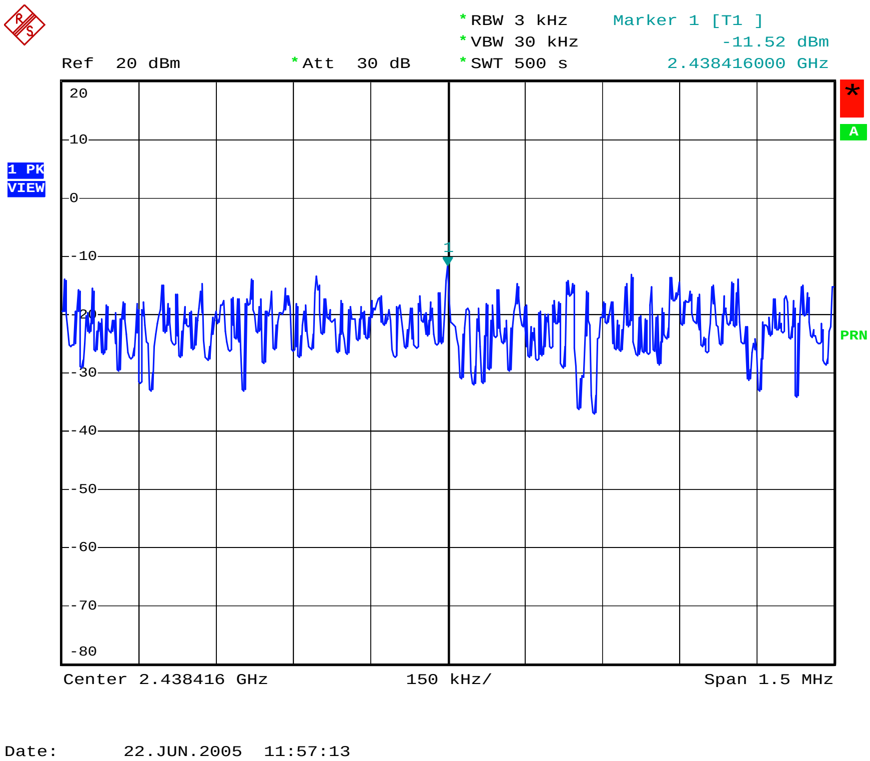
Frequency	Power Density (dBm)	Max. Limit (dBm)	Result
2412 MHz	-19.86	8.00	Complies
2437 MHz	-20.52	8.00	Complies
2462 MHz	-20.77	8.00	Complies

5.3.9. Power Density Plots

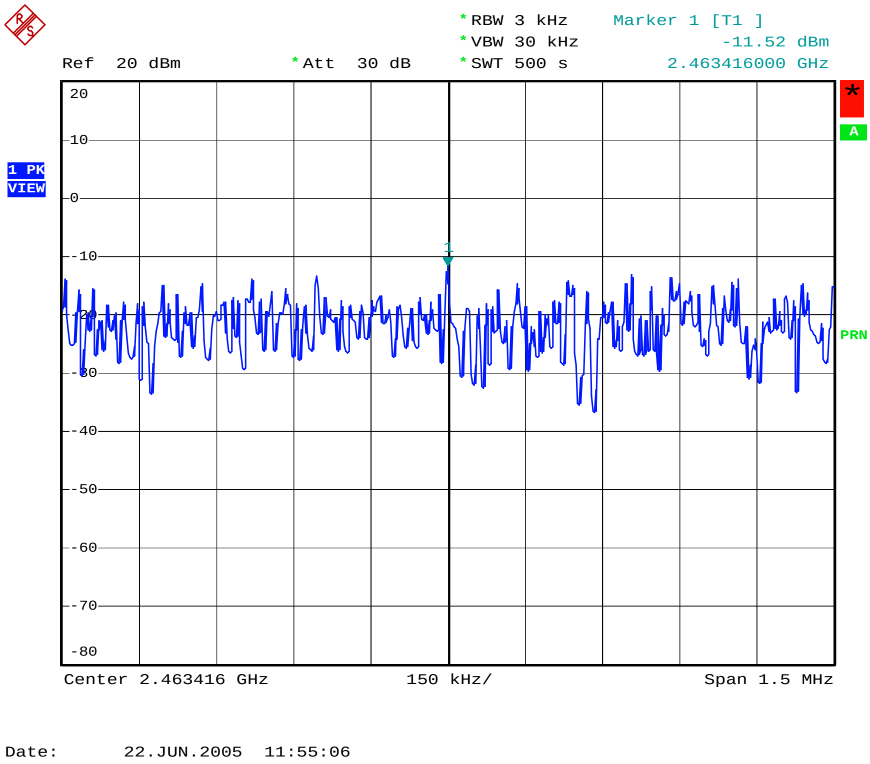
Power Density Plot on Configuration IEEE 802.11b / 2412 MHz



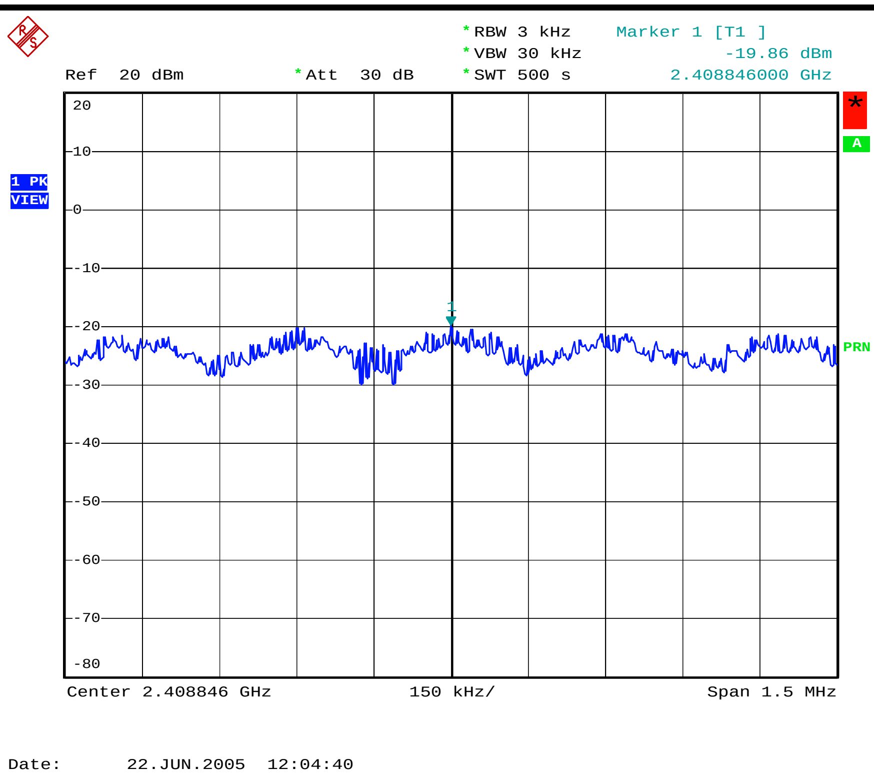
Power Density Plot on Configuration IEEE 802.11b / 2437 MHz



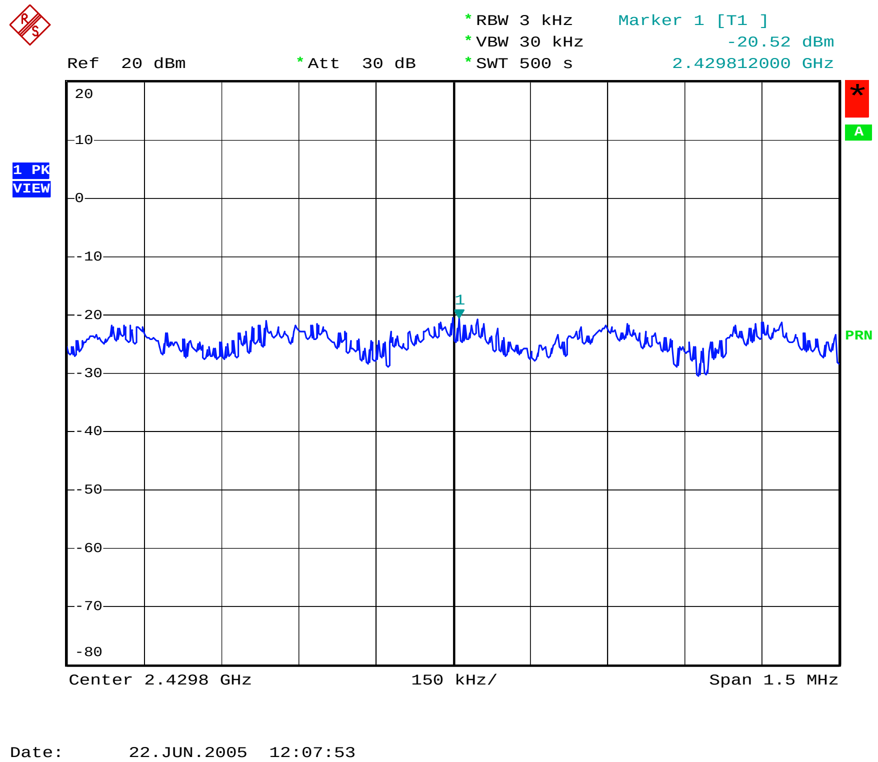
Power Density Plot on Configuration IEEE 802.11b / 2462 MHz



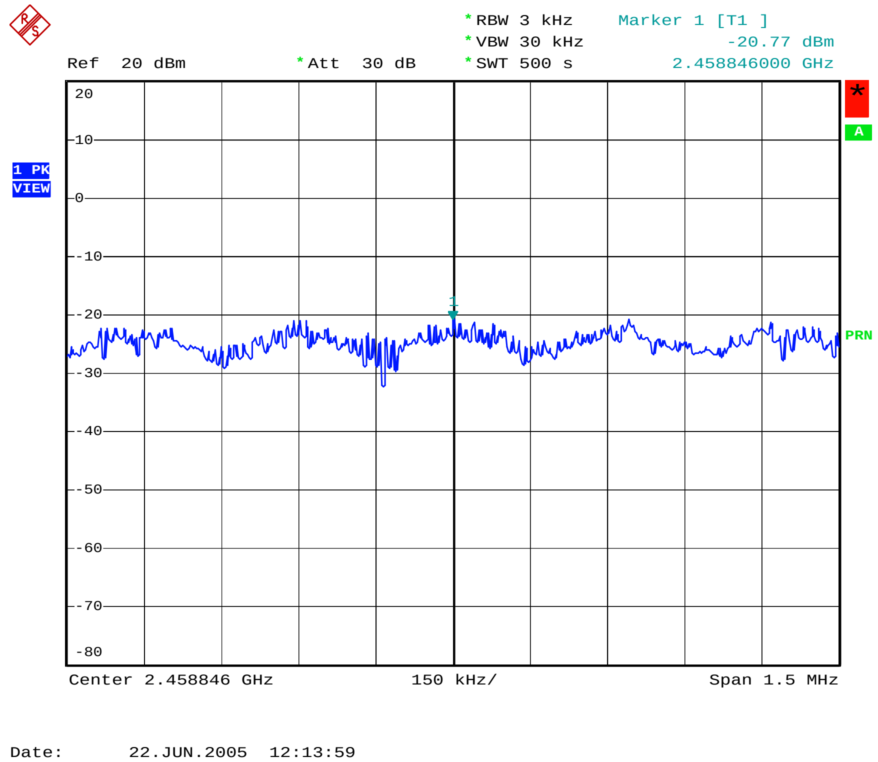
Power Density Plot on Configuration IEEE 802.11g / 2412 MHz



Power Density Plot on Configuration IEEE 802.11g / 2437 MHz



Power Density Plot on Configuration IEEE 802.11g / 2462 MHz



5.4. 6dB Spectrum Bandwidth Measurement

5.4.1. Applicable Standard

47 CFR FCC Part 15 Subpart C, section 15.247(a)(2): For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

In ANSI C63.4-2003, the resolution bandwidth of the measuring instrument shall be set to a value greater than 5% of the bandwidth requirements. When no bandwidth requirements are specified, the minimum resolution band-width of the measuring instrument is given in the following:

Fundamental Frequency	Minimum Resolution Bandwidth
9 kHz to 30 MHz	1 kHz
30 to 1000 MHz	10 kHz
1000 MHz to 40 GHz	100 kHz

5.4.2. Measuring Instruments

Please refer to section 6 in this report.

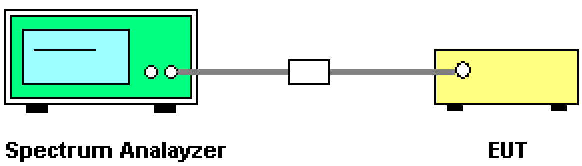
5.4.3. Major Test Instruments Setting

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> 6dB Bandwidth
RB	100 kHz
VB	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.4.4. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.
2. The resolution bandwidth of 100 kHz and the video bandwidth of 100 kHz were used
3. The 6 dB bandwidth was measured while the transmitter continuously transmitted on a low, middle and high frequency channel.

5.4.5. Test Setup Layout



5.4.6. Test Deviation

The measurement uncertainty is 10^{-7}. Test methods have no deviations with original standard.

5.4.7. Test Mode(s)

The worst case of test result for 11Mbps (CCK) of DSSS IEEE 802.11b and 6Mbps (BPSK) of OFDM IEEE 802.11g was shown in this test report. The following table is a list of the test modes.

Mode	IEEE 802.11b			IEEE 802.11g		
Channel	1	6	11	1	6	11
Freqeency (MHz)	2412	2437	2462	2412	2437	2462

5.4.8. Test Result

Test Site	TH01-HY
Temperature	27℃
Humidity	60%
Test Engineer	Sam Lee

Configuration IEEE 802.11b

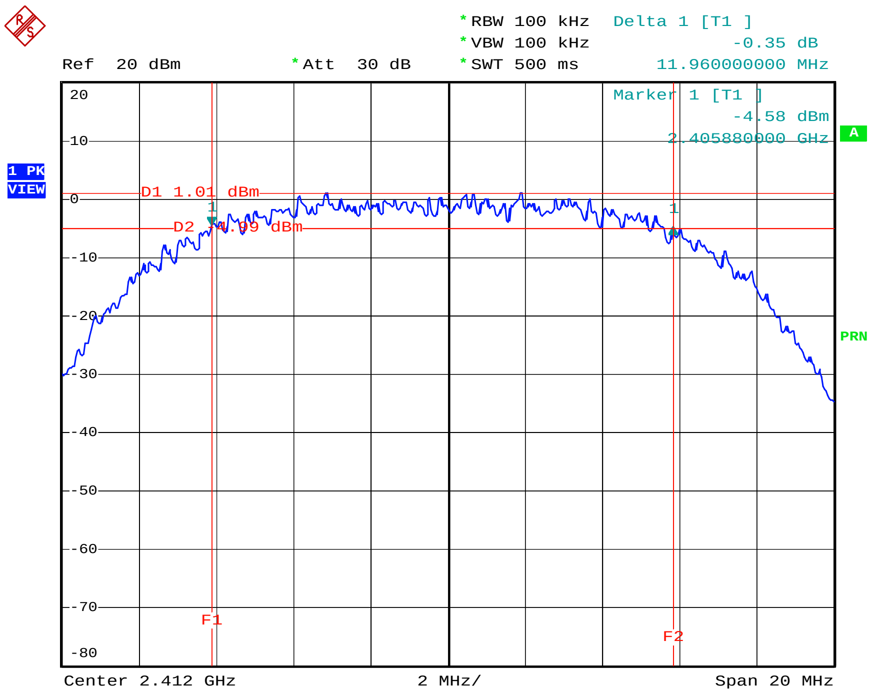
Frequency	6dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Min. Limit (kHz)	Test Result
2412 MHz	11.96	-	500	Complies
2437 MHz	11.96	-	500	Complies
2462 MHz	11.96	-	500	Complies

Configuration IEEE 802.11g

Frequency	6dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Min. Limit (kHz)	Test Result
2412 MHz	16.52	-	500	Complies
2437 MHz	16.52	-	500	Complies
2462 MHz	16.52	-	500	Complies

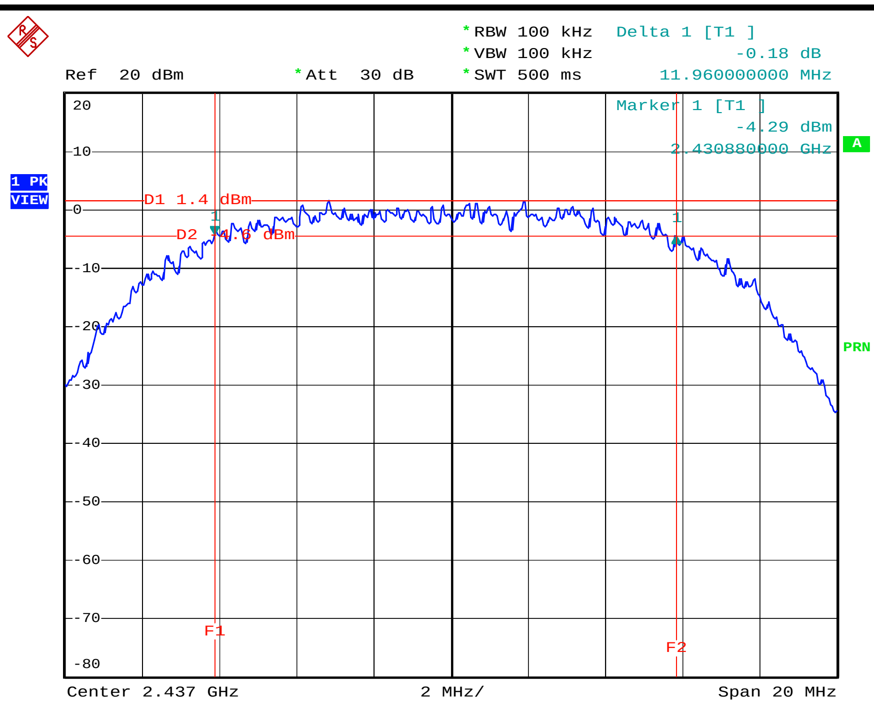
5.4.9. 6 dB Bandwidth Plots

6 dB Bandwidth Plot on Configuration IEEE 802.11b / 2412 MHz



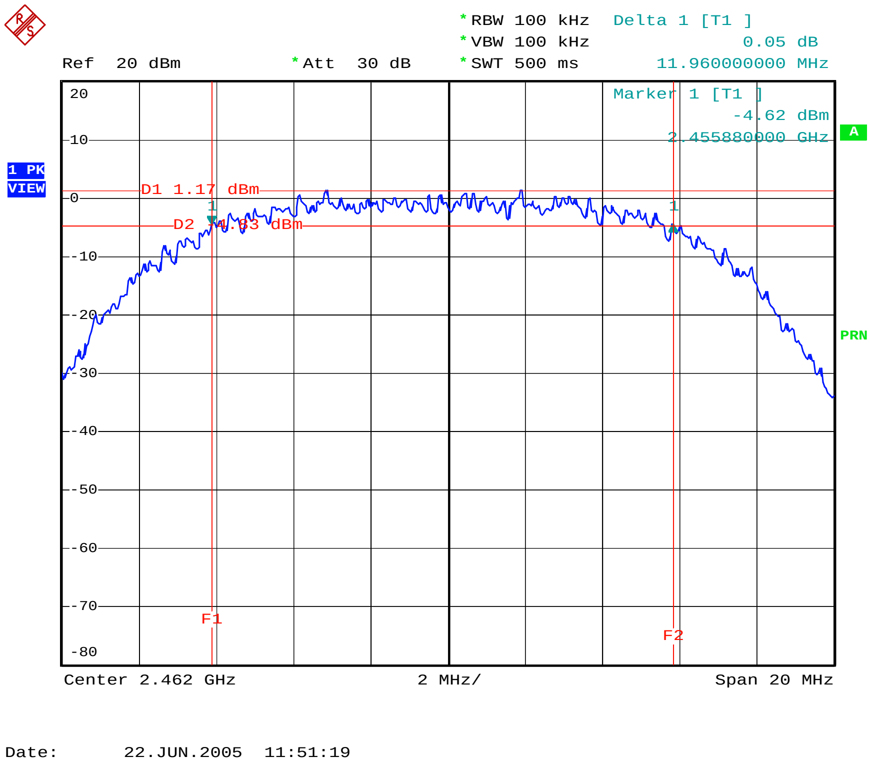
Date: 22.JUN.2005 11:44:01

6 dB Bandwidth Plot on Configuration IEEE 802.11b / 2437 MHz

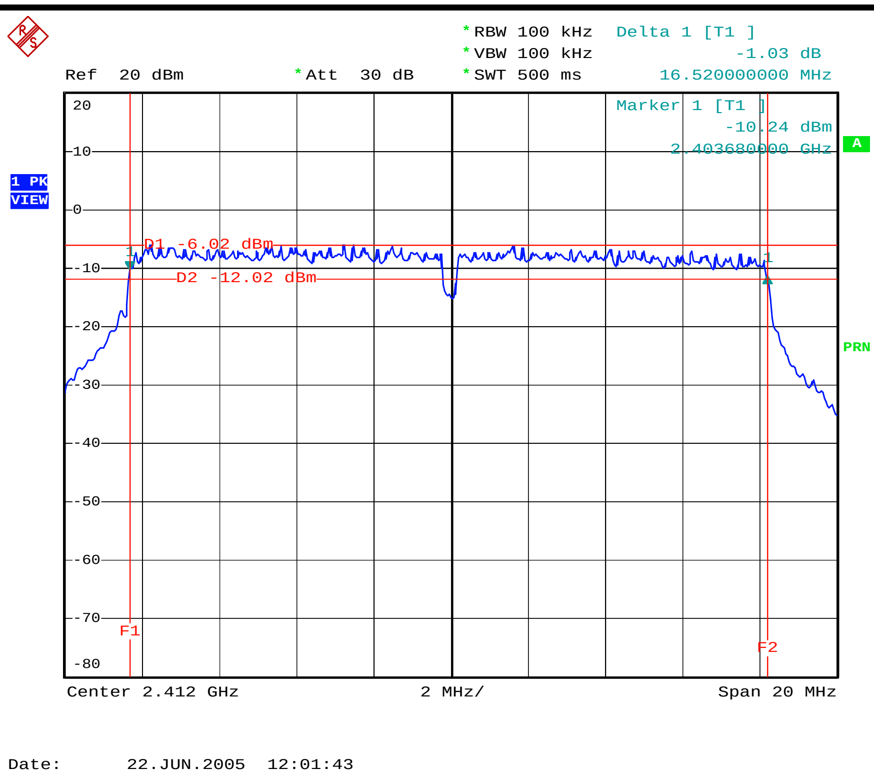


Date: 22.JUN.2005 11:50:04

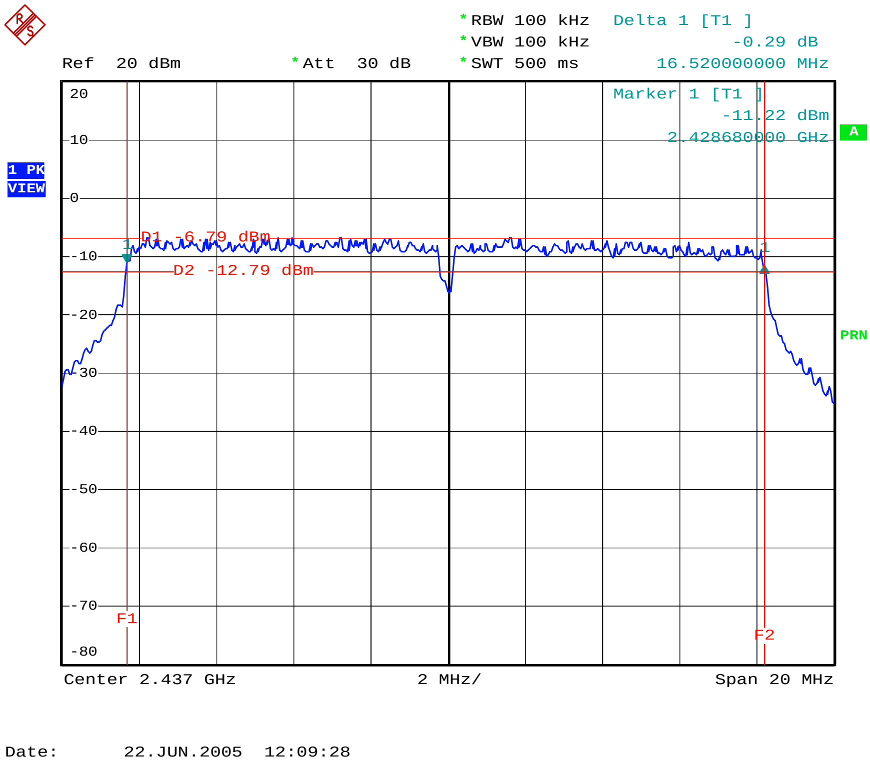
6 dB Bandwidth Plot on Configuration IEEE 802.11b / 2462 MHz



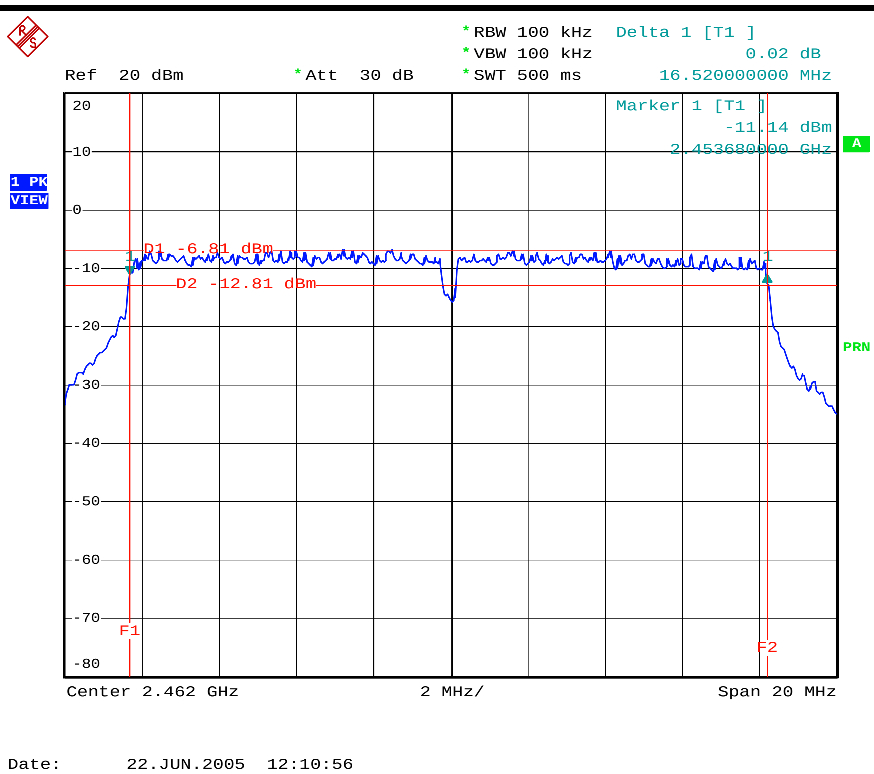
6 dB Bandwidth Plot on Configuration IEEE 802.11g / 2412 MHz



6 dB Bandwidth Plot on Configuration IEEE 802.11g / 2437 MHz



6 dB Bandwidth Plot on Configuration IEEE 802.11g / 2462 MHz



5.5. Radiated Emissions Measurement

5.5.1. Applicable Standard

47 CFR FCC Part 15 Subpart C, section 15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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 that fall in the restricted bands, as defined in section 15.205, must also comply with the radiated emissions limits specified in section 15.209.

5.5.2. Measuring Instruments

Please refer to section 6 in this report.

5.5.3. Major Test Instruments Setting

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB	1 MHz / 1MHz for Peak
RB / VB	1 MHz / 10Hz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

5.5.4. Test Procedures

For radiated emissions below 30MHz

1. Configure the EUT according to ANSI C63.4. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the loop receiving antenna mounted antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the receiving antenna was fixed at one meter above ground to find the maximum emissions field strength.
4. Set the test-receiver system to QP Detect Function with specified bandwidth under Maximum Hold Mode.

For radiated emissions above 30MHz

1. Configure the EUT according to ANSI C63.4. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and RBW for peak reading. Then 1MHz RBW and 10Hz VBW for average reading in spectrum analyzer.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

5.5.5. Test Mode(s)

For radiated emissions below 1GHz

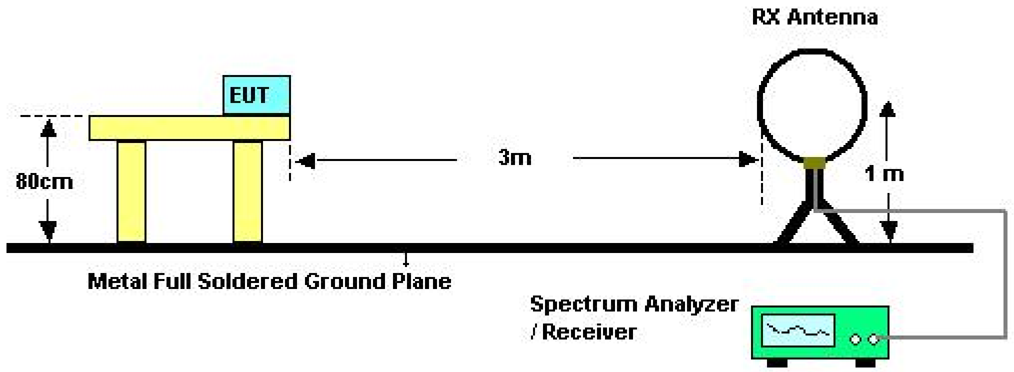
Only middle channel test result of IEEE 802.11g OFDM/BPSK configuration with 6Mbps data rate was shown in this test report since there is no significant difference on different channel and moduation.

For radiated emissions above 1GHz

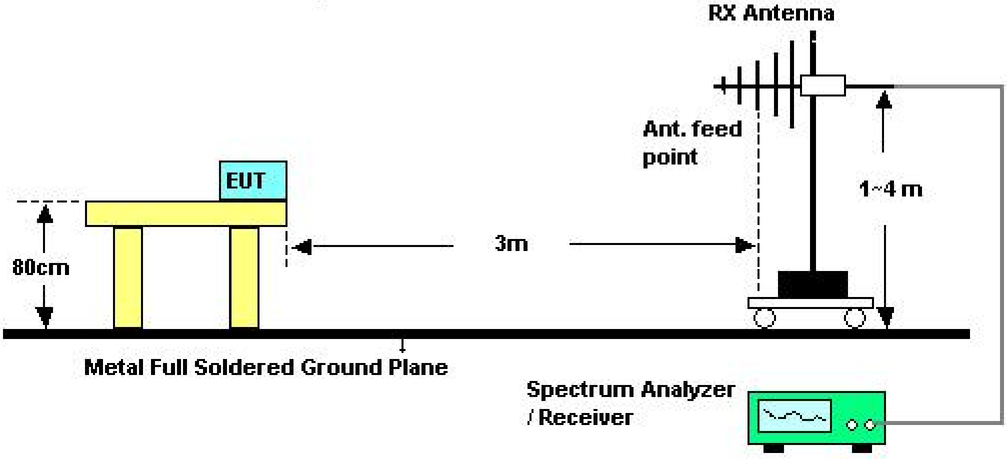
Emissions of each modulation has been investigated. Test result for 11Mbps (CCK) of DSSS IEEE 802.11b and 6Mbps (BPSK) of OFDM IEEE 802.11g was shown in this test report. Measurements have been done on 3 channels: low (channel 1, 2412 MHz), middle (channel 6, 2437 MHz) and high (Channel 11, 2462 MHz) channels are in 2.4GHz band. Since the 2.4GHz external antennas are all in the same type, so only one antenna with highest gain has to be tested. So, there are 2 test modes for emissions above 1GHz:

5.5.6. Test Setup Layout

For radiated emissions below 30MHz



For radiated emissions above 30MHz



5.5.7. Test Deviation

The measurement uncertainty is 2.54dB. Test methods have no deviations with original standard.

5.5.8. Calculation of Voltage Levels

Measurements are reported in units of dB relative to one microvolt per metre (dBμV/m).

The field strength was calculated automatically by the software using all the pre-stored calibration data. The method of calculation is shown below:

E = V + AF – G + L Where:

E = Radiated Field Strength in dBμV/m.

V = EMI Receiver Voltage in dBμV. (measured value)

AF = Antenna Factor in dB(m^{-1}). (stored as a data array)

G = Preamplifier Gain in dB. (stored as a data array)

L = Cable insertion loss in dB. (stored as a data array of Insertion Loss versus frequency)

Level = Read Level + Factor.

Factor = AF – G + L.

When measurement frequency was below 30MHz, the results shall be extrapolated to the specified distance using an extrapolation factor of 40 dB/decade. If measurement frequency was above 30MHz, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade.

When pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. So duty factor is show below:

duty factor = 20 x $\log_{10}$(duty cycle) = –6.9dB

Average value = Peak value + duty factor

5.5.9. Test Data Requirement

Test data records were performed in accordance with the following ANSI C63.4-2003. For intentional radiators, for each of the frequencies to which the device is tuned, the frequency and amplitude of the highest fundamental emissions, the frequency and amplitude of the three highest harmonic or spurious emissions relative to the limit, and the frequency and amplitude of the three highest restricted band emissions relative to the limit shall be reported.

5.5.10. Results of Radiated Emissions Below 1GHz

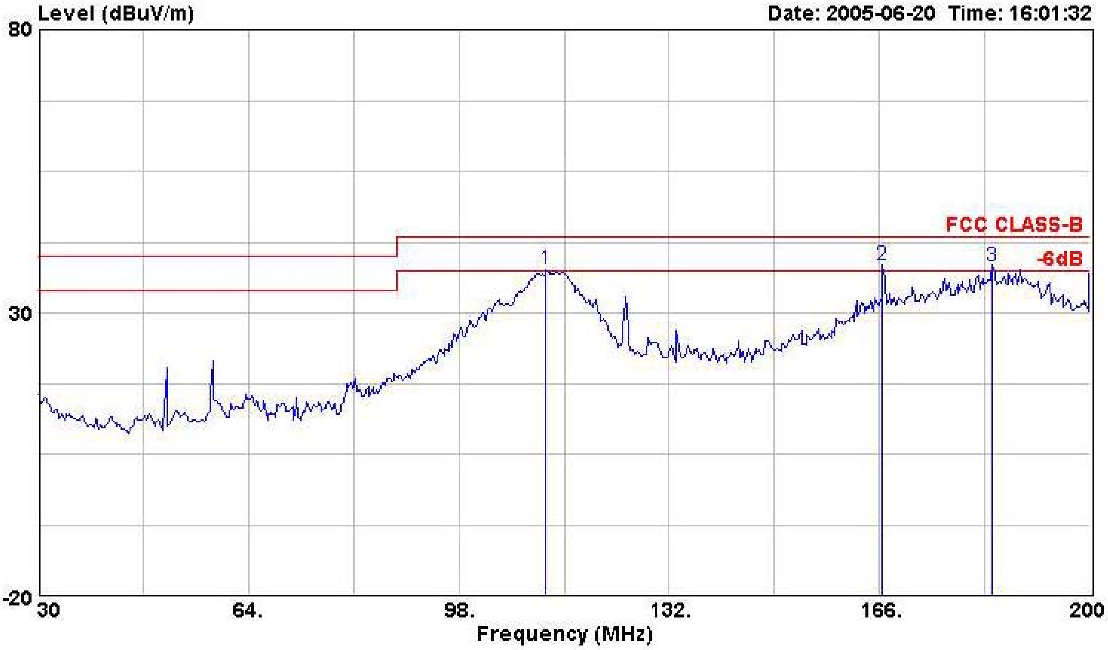
Test Site	03CH03-HY
Temperature	27℃
Humidity	60%
Test Engineer	Ted Chiu

Note:

Results for the radiated measurement below 30MHz, no emissions found and caused by the EUT. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

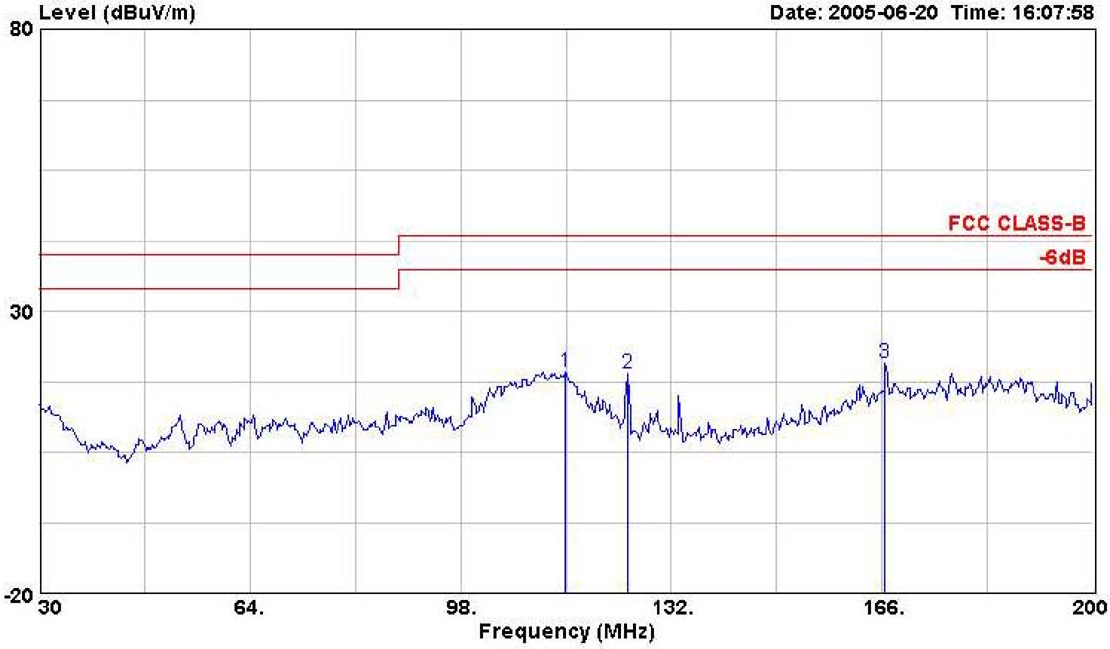
IEEE 802.11g OFDM (channel 6, 2437 MHz)

Horizontal Polarization



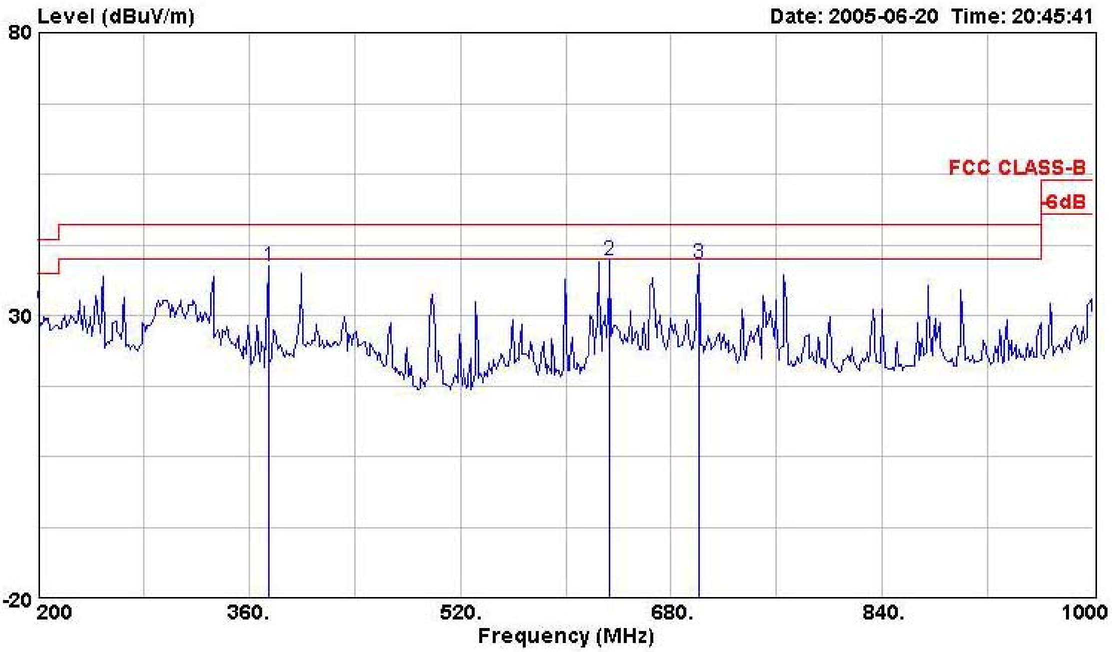
	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1 !	112.110	37.73	-5.77	56.22	43.50	-18.49	1.04	30.29	Peak
2 !	166.510	38.44	-5.06	53.96	43.50	-15.52	1.28	30.11	Peak
3 !	184.190	38.30	-5.20	52.55	43.50	-14.25	1.27	30.05	Peak

Vertical Polarization



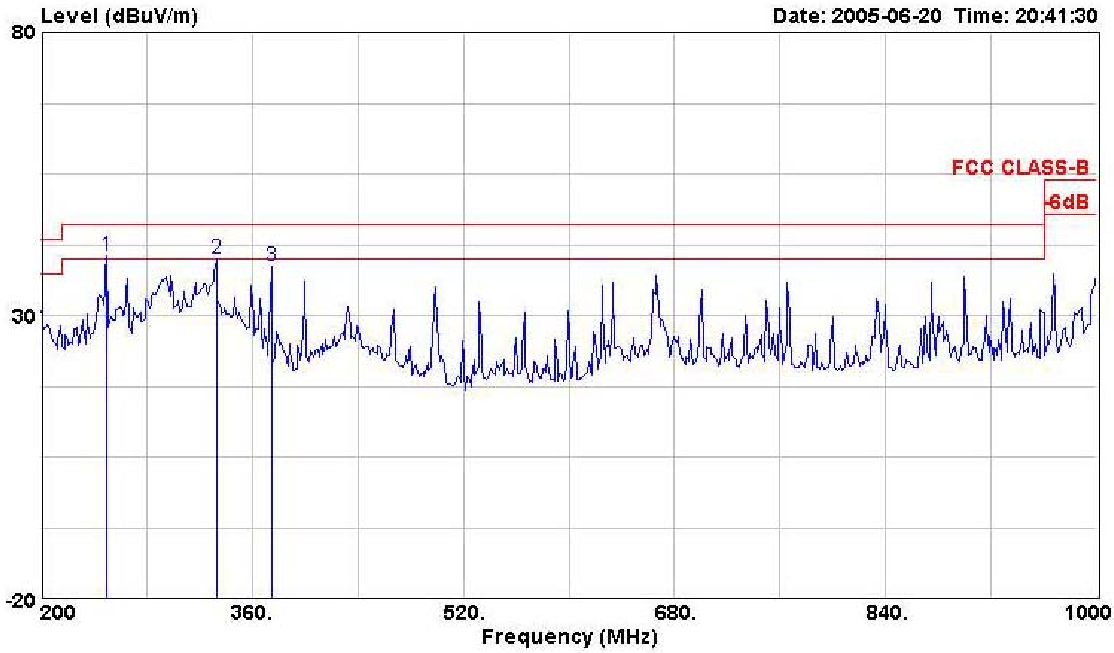
	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	114.830	19.23	-24.27	48.46	43.50	-29.23	1.06	30.29	Peak
2	124.860	18.87	-24.63	48.23	43.50	-29.36	1.11	30.47	Peak
3	166.510	20.89	-22.61	49.72	43.50	-28.83	1.28	30.11	Peak

Horizontal Polarization



	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	374.400	38.64	-7.36	51.78	46.00	-13.14	1.87	31.05	Peak
2	633.600	39.75	-6.25	47.48	46.00	-7.73	2.46	30.69	Peak
3	700.800	39.19	-6.81	46.55	46.00	-7.36	2.57	30.65	Peak

Vertical Polarization



	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1 !	249.600	40.62	-5.38	57.28	46.00	-16.66	1.53	30.49	Peak
2 !	332.800	40.11	-5.89	54.40	46.00	-14.29	1.77	30.84	Peak
3	374.400	38.64	-7.36	51.78	46.00	-13.14	1.87	31.05	Peak

5.5.11. Results for Radiated Emissions above 1GHz

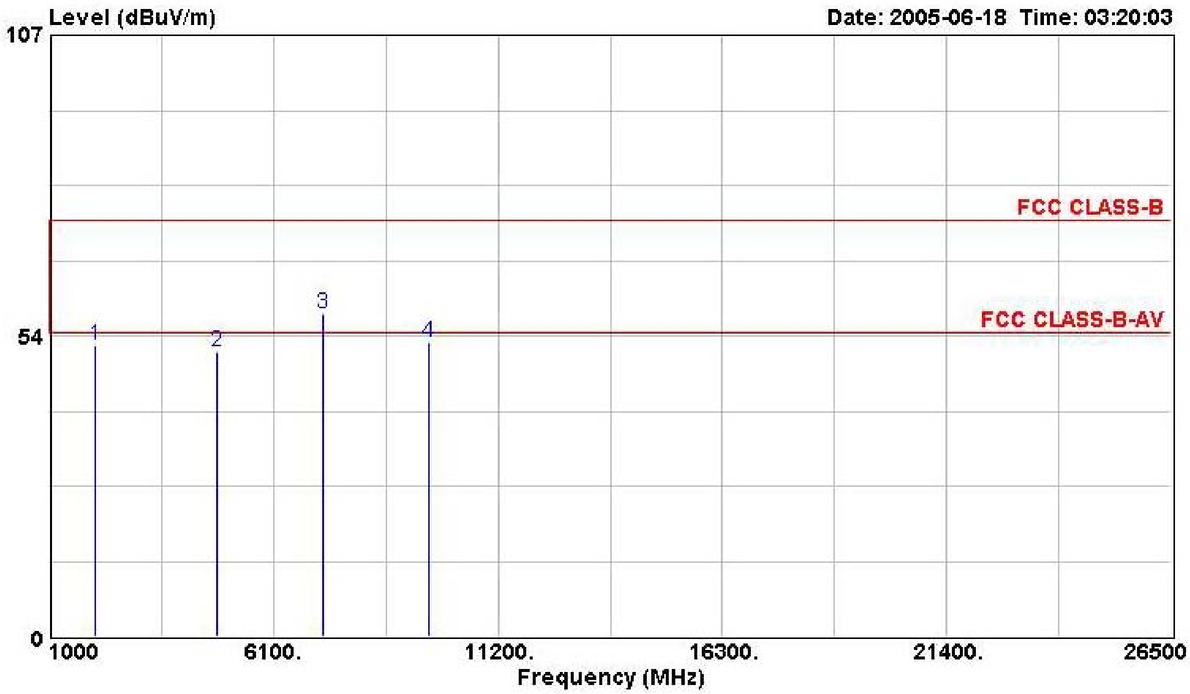
Test Site	03CH03-HY
Temperature	27℃
Humidity	60%
Test Engineer	Ted Chiu

Note:

If any spurious emissions are in non-restriction bands, these emissions comply with 20dB down of fundamental emissions. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

IEEE 802.11b DSSS (channel 1, 2412 MHz)

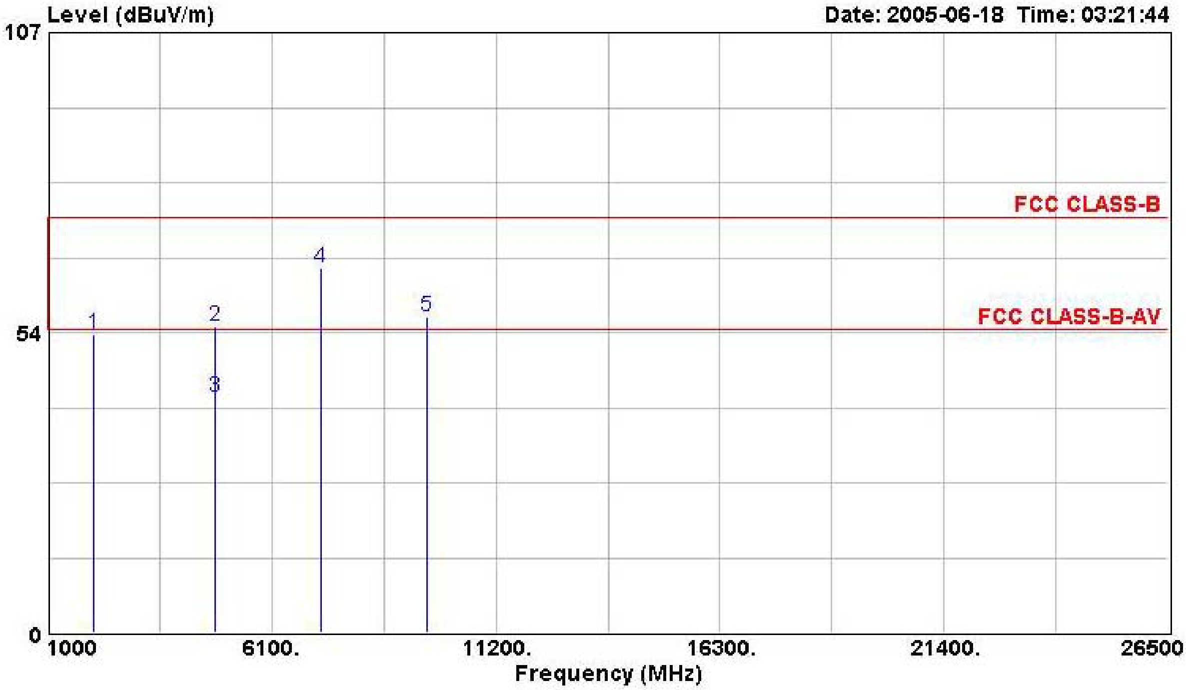
Horizontal Polarization



	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2038.000	51.93	-22.07	55.37	74.00	-3.44	1.73	32.73	Peak
2	4824.000	50.61	-23.39	47.19	74.00	3.42	2.84	32.54	PEAK
3	7228.000	57.33	-16.67	50.17	74.00	7.16	3.62	32.40	PEAK
4	9648.000	52.31	-21.69	43.34	74.00	8.96	4.01	33.42	PEAK

Item 3 is on un-restricted band, so the limit is -20dBc for such emission.

Vertical Polarization

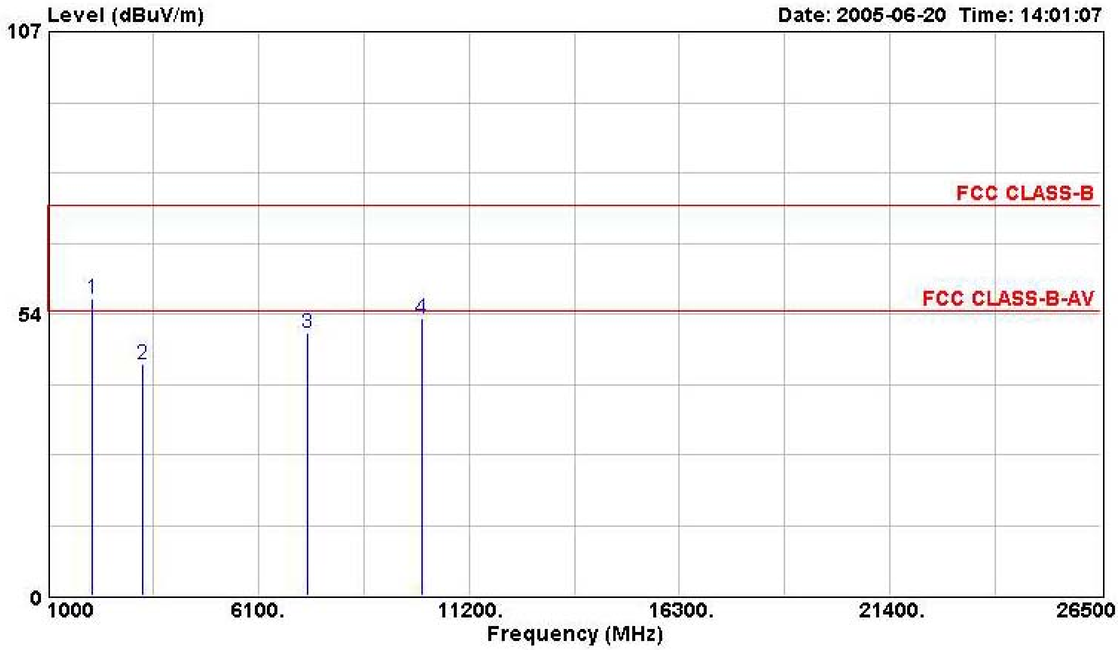


	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2038.000	53.32	-20.68	56.76	74.00	-3.44	1.73	32.73	Peak
2	4824.000	54.60	-19.40	51.18	74.00	3.42	2.84	32.54	PEAK
3	4824.000	42.07	-11.93	38.65	54.00	3.42	2.84	32.54	Average
4	7232.000	65.18	-8.82	57.98	74.00	7.20	3.62	32.40	PEAK
5	9648.000	56.29	-17.71	47.32	74.00	8.96	4.01	33.42	PEAK

Item 4 is on un-restricted band, so the limit is -20dBc for such emission.

IEEE 802.11b DSSS (channel 6, 2437 MHz)

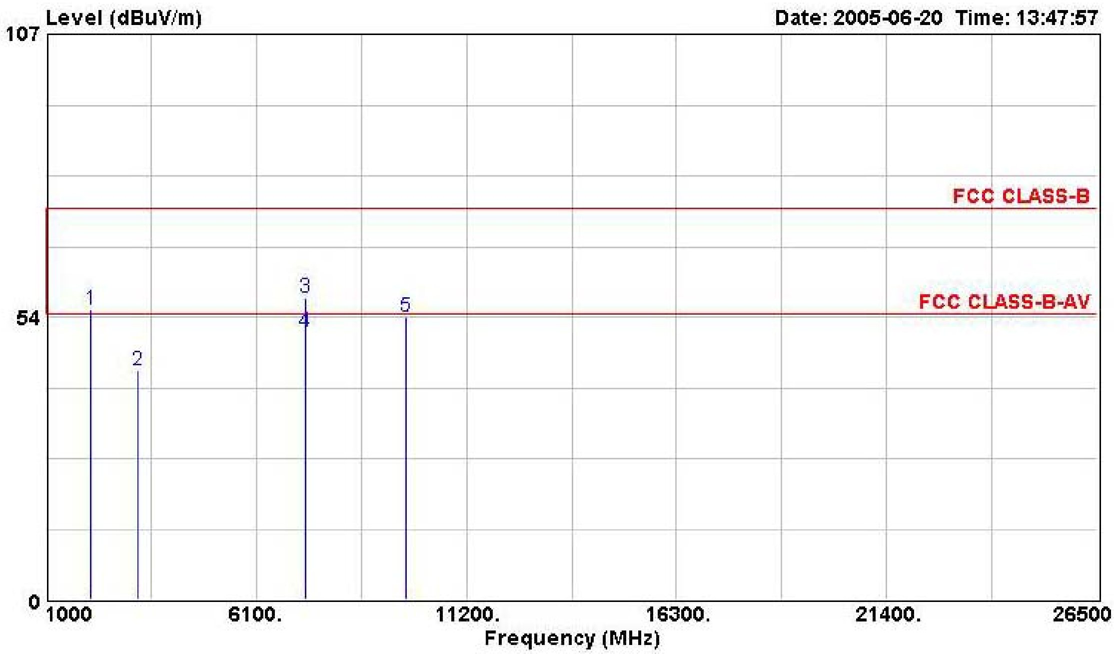
Horizontal Polarization



	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2060.000	56.20	-17.80	59.62	74.00	-3.41	1.75	32.76	PEAK
2	3296.000	43.81	-30.19	43.47	74.00	0.34	2.29	32.69	PEAK
3	7308.000	49.85	-24.15	42.61	74.00	7.24	3.65	32.56	PEAK
4	10044.000	52.62	-21.38	43.05	74.00	9.57	4.01	33.42	PEAK

Item 1 is on un-restricted band, so the limit is -20dBc for such emission.

Vertical Polarization



	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2060.000	54.97	-19.03	58.38	74.00	-3.41	1.75	32.76	PEAK
2	3216.000	43.44	-30.56	43.30	74.00	0.14	2.27	32.69	PEAK
3	7300.000	57.27	-16.73	50.03	74.00	7.24	3.65	32.56	PEAK
4	7300.000	50.73	-3.27	43.49	54.00	7.24	3.65	32.56	Average
5	9732.000	53.57	-20.43	44.47	74.00	9.10	4.00	33.43	PEAK

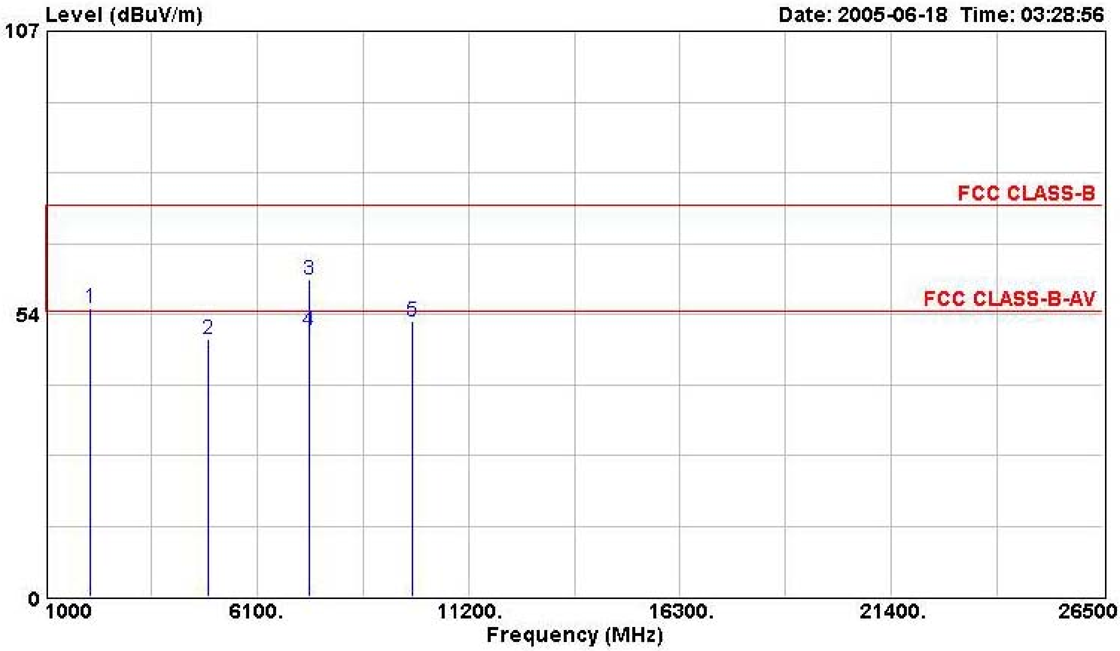
Item 1 is on un-restricted band, so the limit is -20dBc for such emission.

IEEE 802.11b DSSS (Channel 11, 2462 MHz)

Horizontal Polarization

	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2086.000	53.95	-20.05	57.33	74.00	-3.38	1.75	32.79	Peak
2	4924.000	45.61	-28.39	41.98	74.00	3.63	2.89	32.55	PEAK
3	7380.000	51.68	-22.32	44.40	74.00	7.27	3.68	32.71	PEAK
4	7380.000	41.54	-12.46	34.27	54.00	7.27	3.68	32.71	Average
5	10104.000	51.14	-22.86	41.50	74.00	9.64	4.04	33.38	PEAK

Vertical Polarization

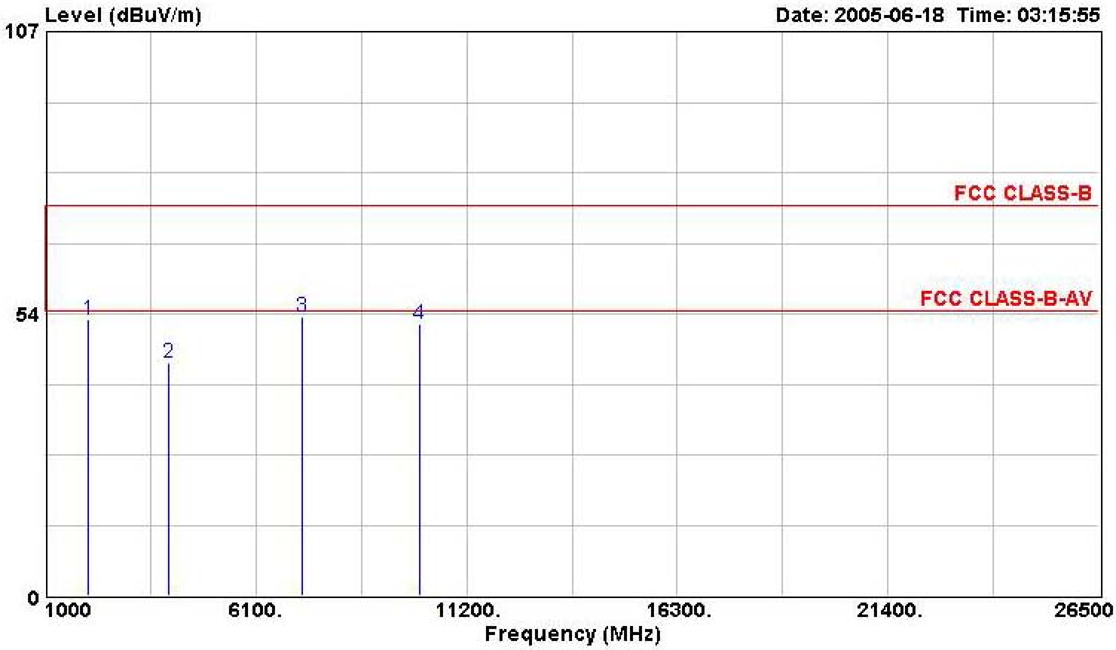


	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2086.000	54.67	-19.33	58.05	74.00	-3.38	1.75	32.79	Peak
2	4924.000	48.67	-25.33	45.04	74.00	3.63	2.89	32.55	PEAK
3	7380.000	59.96	-14.04	52.68	74.00	7.27	3.68	32.71	PEAK
4	7380.000	50.42	-3.58	43.15	54.00	7.27	3.68	32.71	Average
5	9848.000	52.06	-21.94	42.80	74.00	9.26	3.99	33.45	PEAK

Item 1 is on un-restricted band, so the limit is -20dBc for such emission.

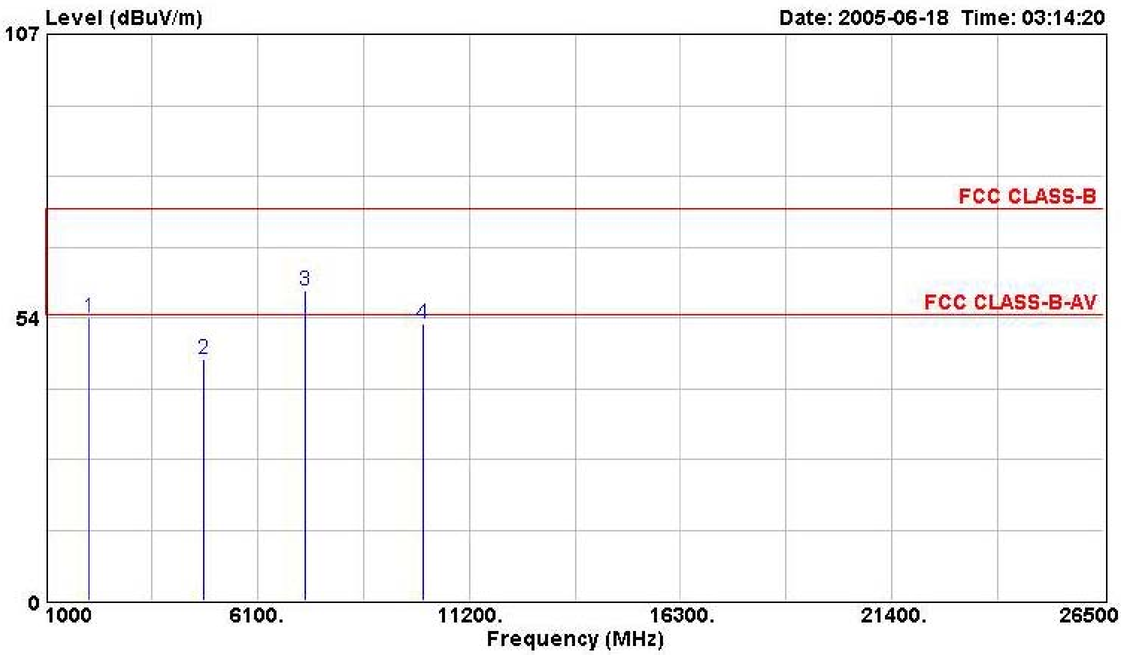
IEEE 802.11g OFDM (channel 1, 2412 MHz)

Horizontal Polarization



	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2038.000	52.34	-21.66	55.78	74.00	-3.44	1.73	32.73	Peak
2	3976.000	44.33	-29.67	42.10	74.00	2.23	2.48	32.80	PEAK
3	7232.000	53.04	-20.96	45.84	74.00	7.20	3.62	32.40	PEAK
4	10060.000	51.60	-22.40	42.03	74.00	9.57	4.01	33.42	PEAK

Vertical Polarization

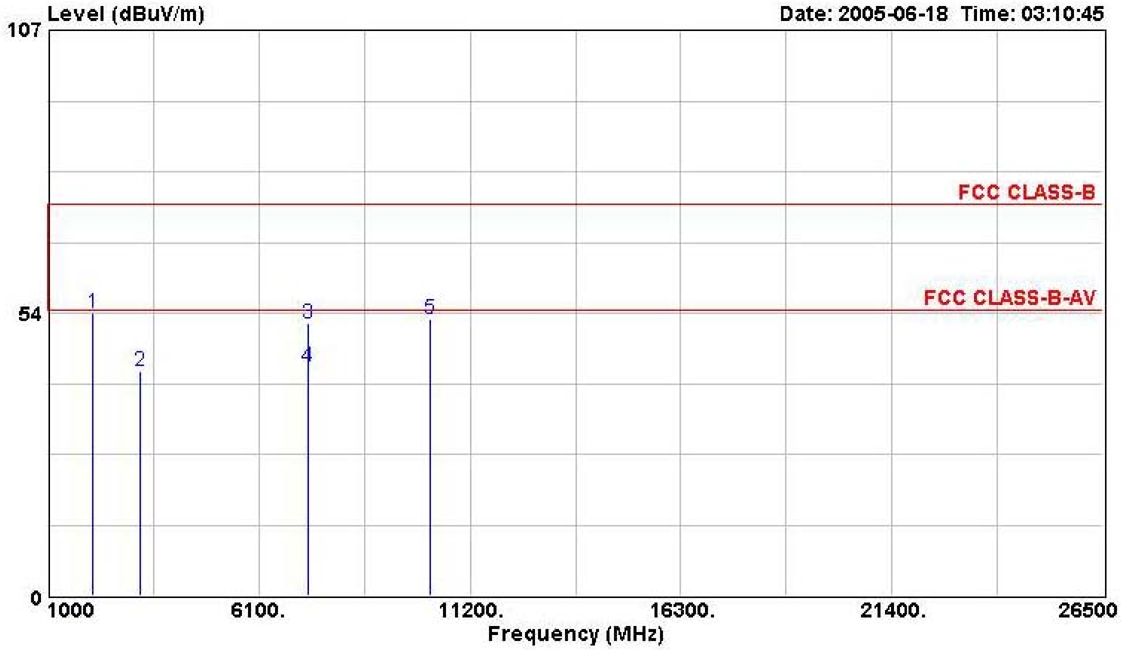


	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2038.000	53.48	-20.52	56.92	74.00	-3.44	1.73	32.73	Peak
2	4828.000	45.55	-28.45	42.13	74.00	3.42	2.84	32.54	PEAK
3	7240.000	58.56	-15.44	51.42	74.00	7.15	3.62	32.46	PEAK
4	10108.000	52.29	-21.71	42.62	74.00	9.67	4.07	33.38	PEAK

Item 3 is on un-restricted band, so the limit is -20dBc for such emission.

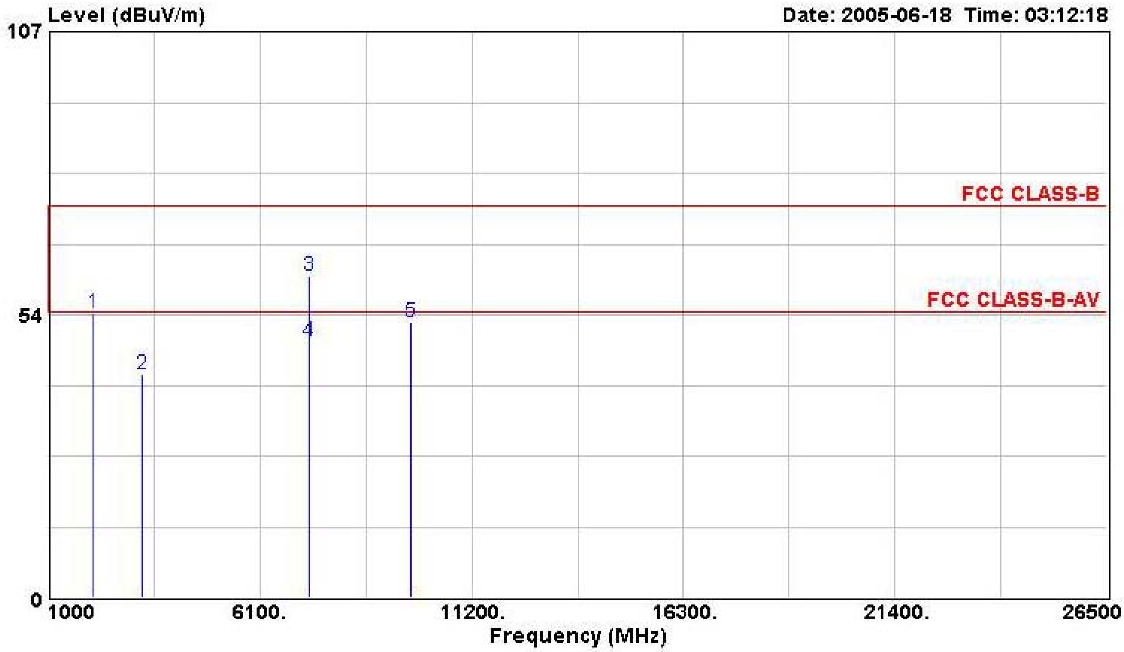
IEEE 802.11g OFDM (channel 6, 2437 MHz)

Horizontal Polarization



	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2062.000	53.55	-20.45	56.96	74.00	-3.41	1.75	32.76	Peak
2	3240.000	42.61	-31.39	42.39	74.00	0.21	2.27	32.69	PEAK
3	7304.000	51.56	-22.44	44.33	74.00	7.24	3.65	32.56	PEAK
4	7304.000	43.29	-10.71	36.05	54.00	7.24	3.65	32.56	Average
5	10256.000	52.49	-21.51	42.60	74.00	9.88	4.17	33.24	PEAK

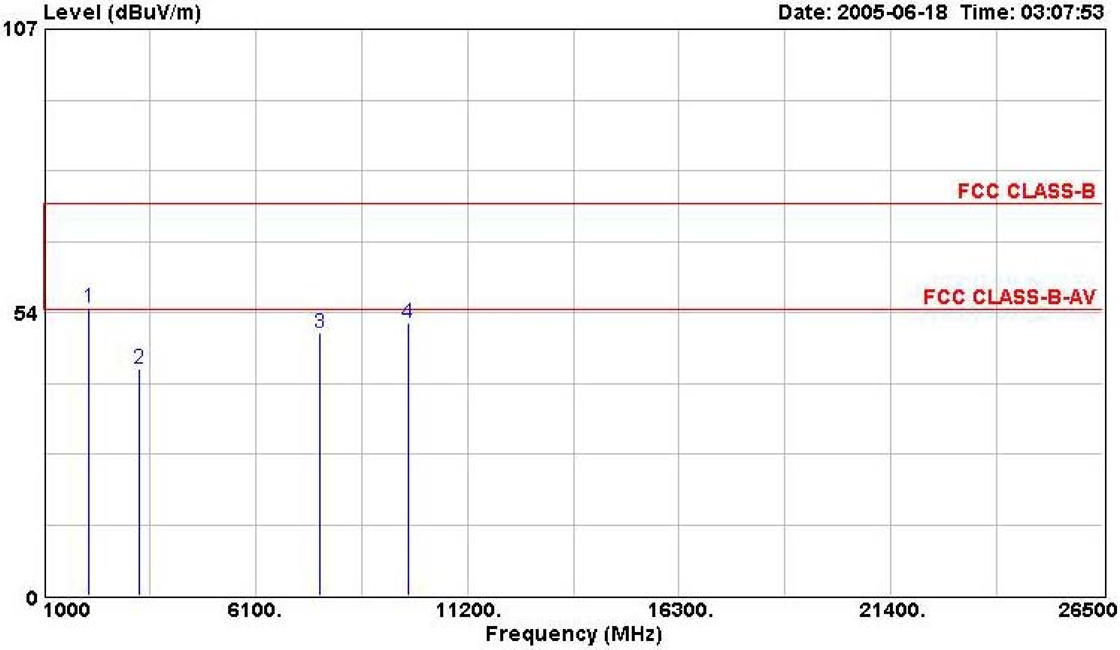
Vertical Polarization



	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2062.000	53.78	-20.22	57.19	74.00	-3.41	1.75	32.76	Peak
2	3268.000	42.20	-31.80	41.94	74.00	0.26	2.28	32.69	PEAK
3	7308.000	60.85	-13.15	53.61	74.00	7.24	3.65	32.56	PEAK
4	7308.000	48.49	-5.51	41.25	54.00	7.24	3.65	32.56	Average
5	9756.000	52.20	-21.80	43.07	74.00	9.13	4.00	33.44	PEAK

IEEE 802.11g OFDM (Channel 11, 2462 MHz)

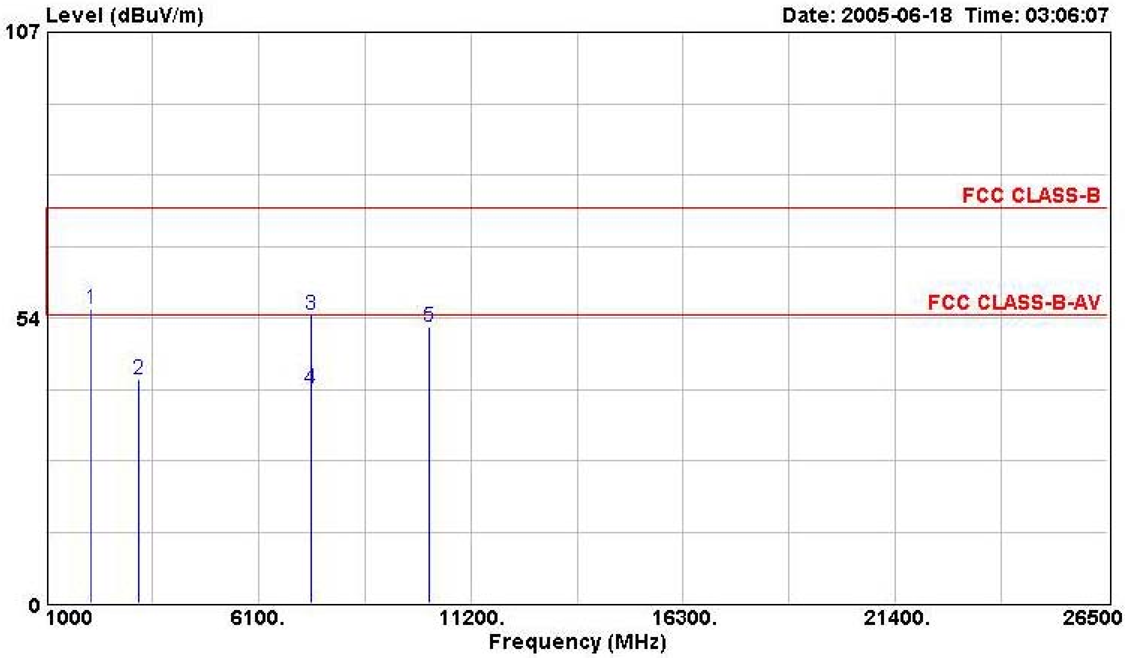
Horizontal Polarization



	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2086.000	54.38	-19.62	57.76	74.00	-3.38	1.75	32.79	Peak
2	3308.000	42.93	-31.07	42.55	74.00	0.38	2.29	32.69	PEAK
3	7656.000	49.49	-24.51	41.93	74.00	7.56	3.77	32.97	PEAK
4	9780.000	51.58	-22.42	42.43	74.00	9.15	3.99	33.44	PEAK

Item 1 is on un-restricted band, so the limit is -20dBc for such emission.

Vertical Polarization

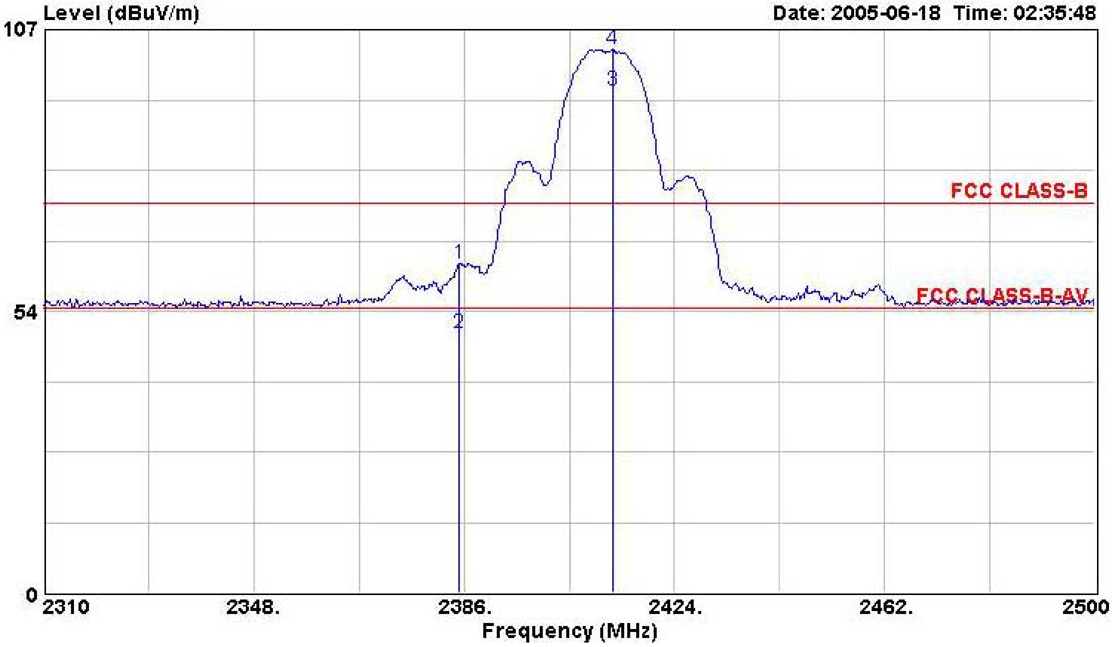


	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2086.000	55.25	-18.75	58.63	74.00	-3.38	1.75	32.79	Peak
2	3212.000	42.05	-31.95	41.93	74.00	0.13	2.26	32.69	PEAK
3	7380.000	53.99	-20.01	46.72	74.00	7.27	3.68	32.71	PEAK
4	7380.000	40.37	-13.63	33.10	54.00	7.27	3.68	32.71	Average
5	10216.000	51.84	-22.16	42.03	74.00	9.81	4.14	33.29	PEAK

Item 1 is on un-restricted band, so the limit is -20dBc for such emission.

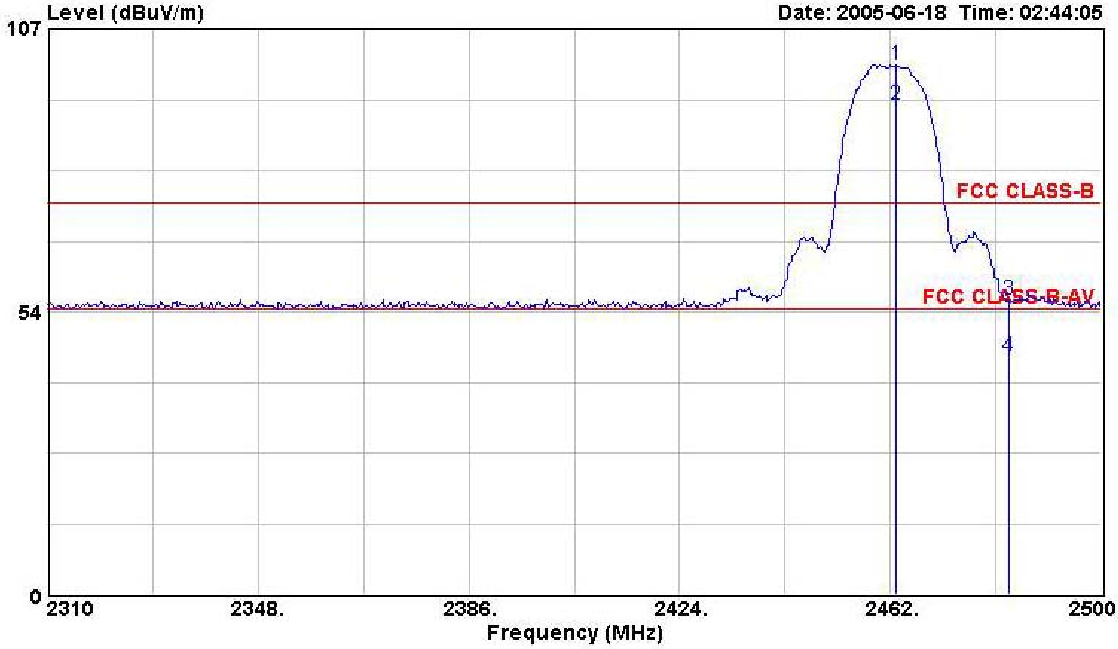
5.5.12. Results of Bandedge in Restriction Band

IEEE 802.11b DSSS (channel 1, 2412 MHz)



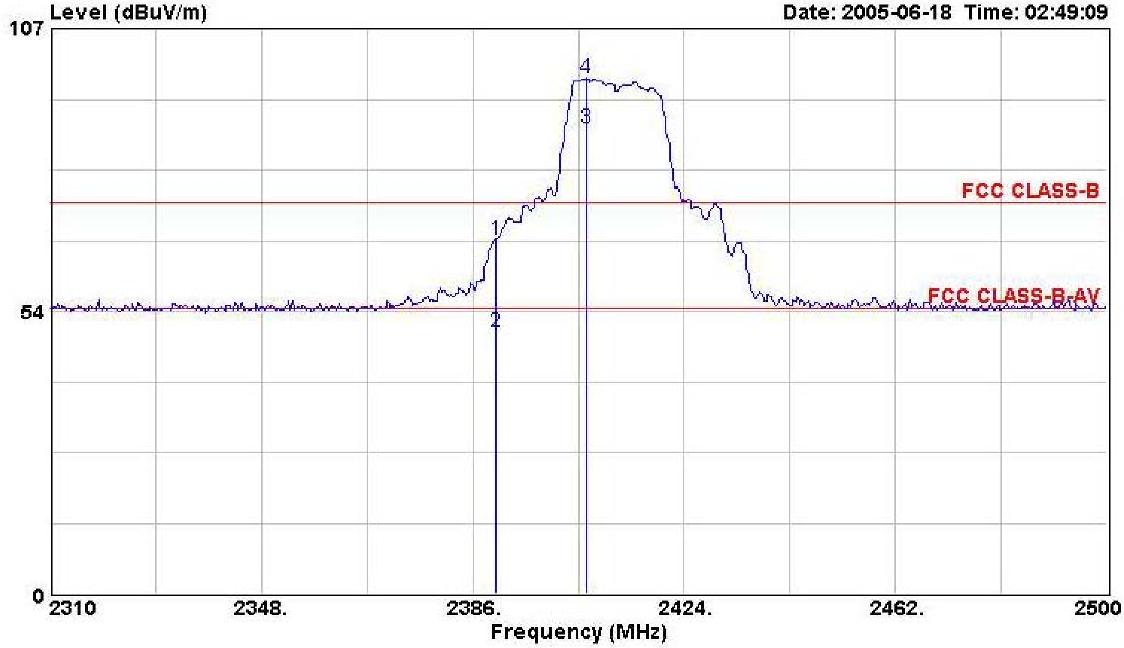
	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2385.050	62.48	-11.52	32.39	74.00	30.09	1.90	0.00	Peak
2	2385.050	49.42	-4.58	19.33	54.00	30.09	1.90	0.00	Average

IEEE 802.11b DSSS (Channel 11, 2462 MHz)



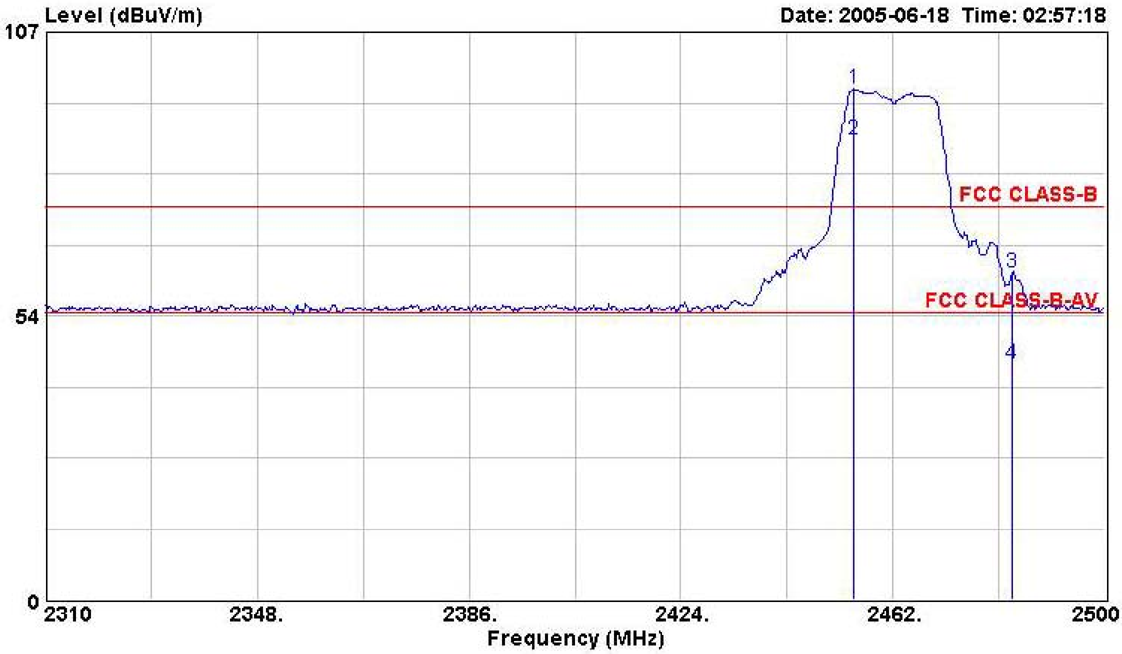
	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
3	2483.500	55.66	-18.34	25.33	74.00	30.33	1.96	0.00	Peak
4	2483.500	44.97	-9.03	14.64	54.00	30.33	1.96	0.00	Average

IEEE 802.11g OFDM (channel 1, 2412 MHz)



	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
1	2390.000	67.15	-6.85	37.03	74.00	30.12	1.90	0.00	Peak
2	2390.000	49.71	-4.29	19.59	54.00	30.12	1.90	0.00	Average

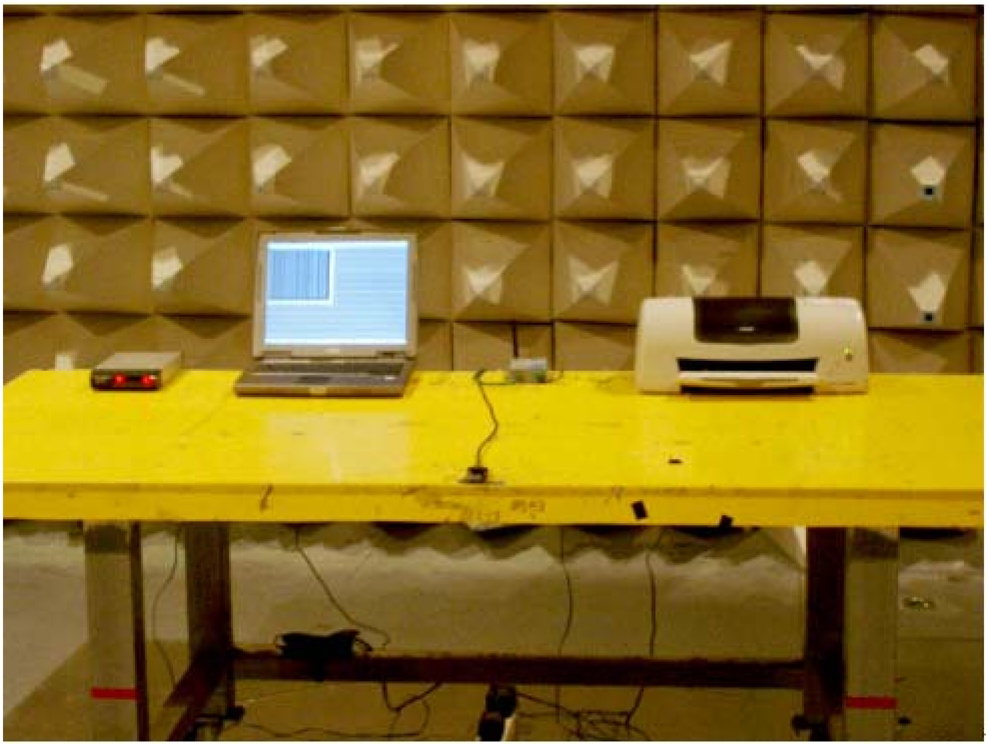
IEEE 802.11g OFDM (Channel 11, 2462 MHz)



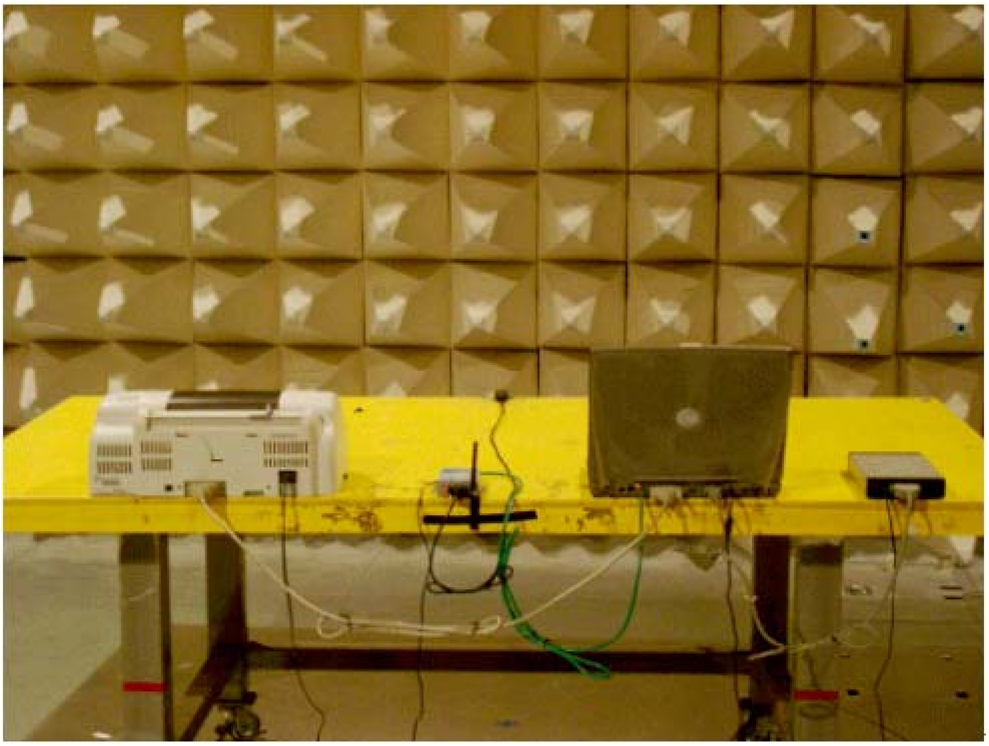
	Freq	Level	Over Limit	Read Level	Limit Line	Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV	dBuV/m	dB	dB	dB	
3	2483.500	61.67	-12.33	31.34	74.00	30.33	1.96	0.00	Peak
4	2483.500	44.38	-9.62	14.05	54.00	30.33	1.96	0.00	Average

5.5.13. Photographs of Radiated Emissions Test Configuration

FRONT VIEW



REAR VIEW



5.6. Band Edge Emissions Measurement

5.6.1. Applicable Standard

47 CFR FCC Part 15 Subpart C, section 15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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.

5.6.2. Measuring Instruments

Please refer to section 6 in this report.

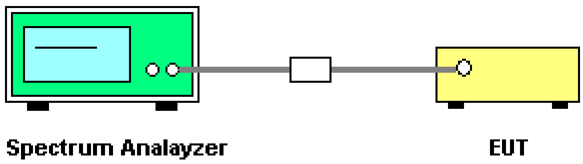
5.6.3. Major Test Instruments Setting

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	100MHz
RB	100 kHz
VB	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.6.4. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyser.
2. Set RBW of spectrum analyzer to 100kHz and VBW to 100kHz. Set Detector to Peak, Trace to Max Hold.
3. Mark the frequency with maximum peak level that is outside the frequency range in 47 CFR FCC Part 15 Subpart C, section 15.247.
4. This level shall be below 20 dB of the maximum power of the in band carrier.

5.6.5. Test Setup Layout



5.6.6. Test Deviation

The measurement uncertainty is 1.5dB. Test methods have on deviation with original standard.

5.6.7. Test Mode

The worst case of test result for 11Mbps (CCK) of DSSS IEEE 802.11b and 6Mbps (BPSK) of OFDM IEEE 802.11g was shown in this test report since they performed the worst emissions nature.

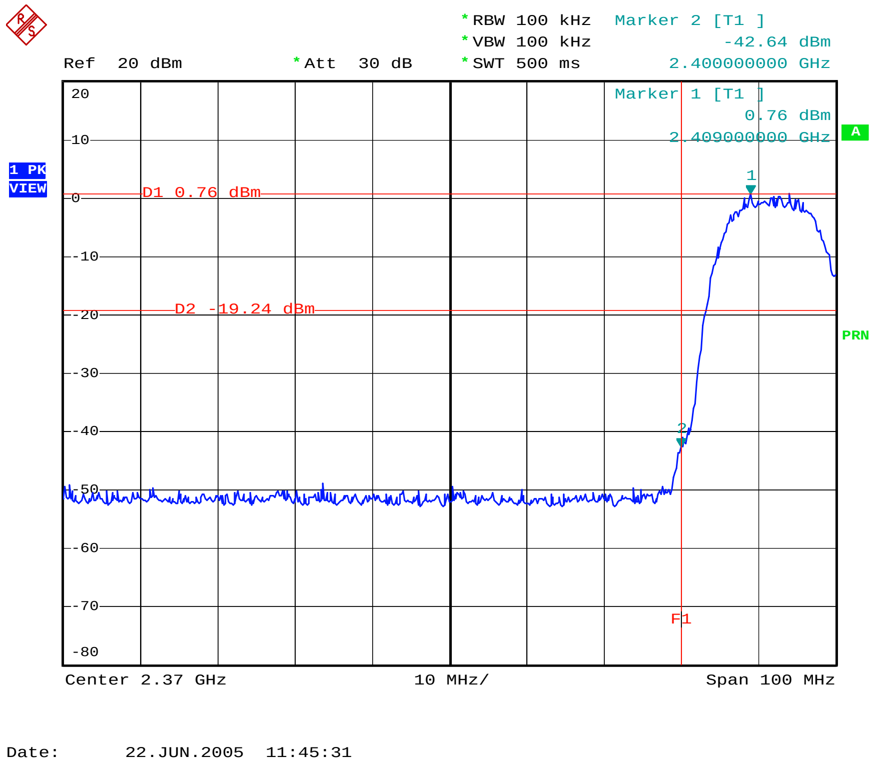
Mode Description
Left edge of Channel 1 for 802.11b configuration
Right edge of Channel 6 for 802.11b configuration
Left edge of Channel 1 for 802.11g configuration
Right edge of Channel 6 for 802.11g configuration

5.6.8. Test Result

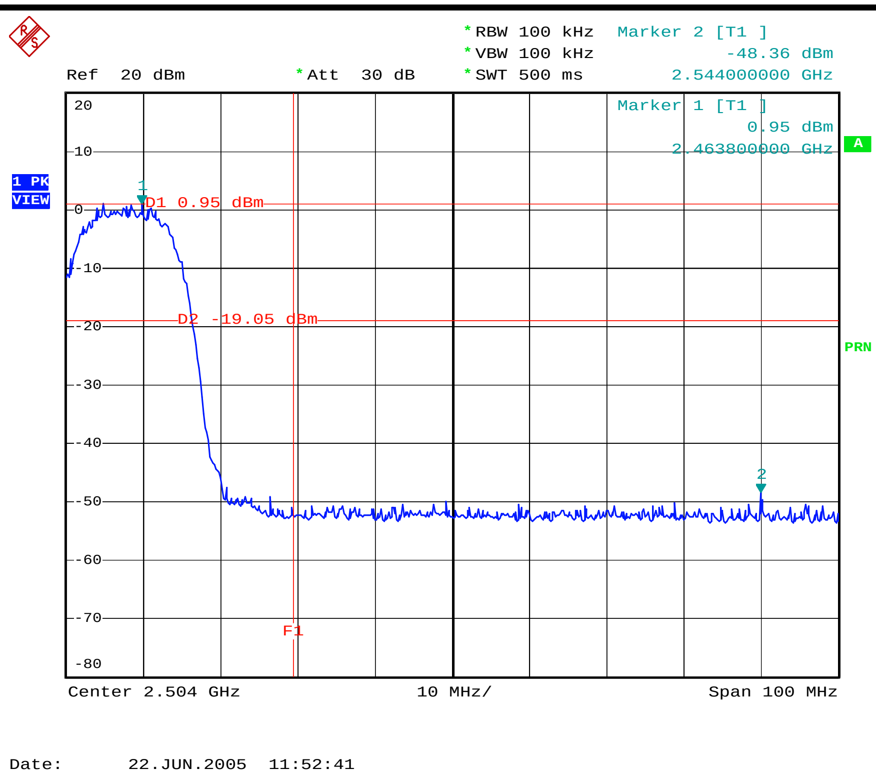
Test Site	TH01-HY 參考
Temperature	27℃
Humidity	60%
Test Engineer	Sam Lee

5.6.9. Bandedge Plots

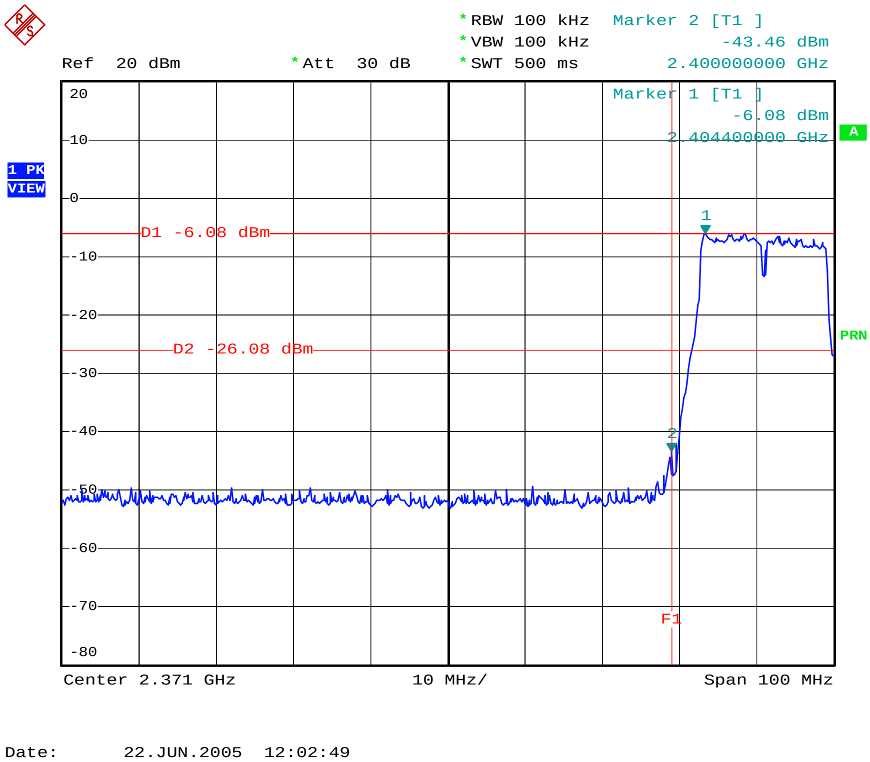
Low Bandedge Plot on Configuration IEEE 802.11b / 2412 MHz



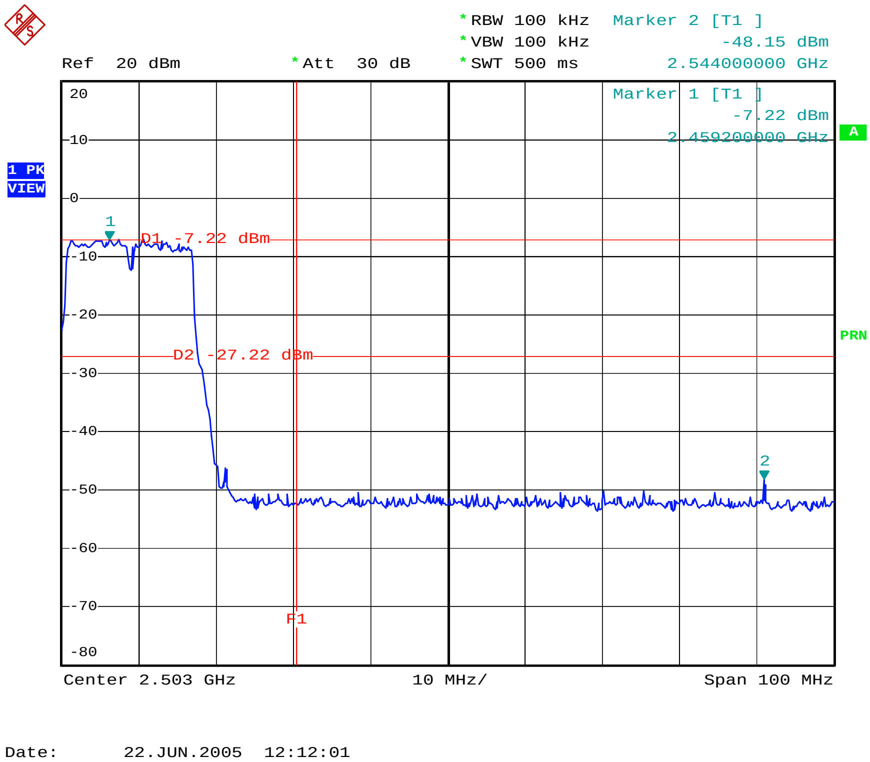
High Bandedge Plot on Configuration IEEE 802.11b / 2462 MHz



Low Bandedge Plot on Configuration IEEE 802.11g / 2412 MHz



High Bandedge Plot on Configuration IEEE 802.11g / 2462 MHz



5.7. Antenna Requirements

5.7.1. Applicable Standard

47 CFR FCC Part 15 Subpart C, section 15.203: The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the power limits in 47 CFR FCC Part 15 Subpart C, section 15.247(b)/(c):

Case 1: If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Case 2: If the intentional radiator is used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Case 3: If the transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously. The total output power conducted to the array or arrays that comprise the device, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi.

Case 4: If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emissions beam is subject to the power limit specified in **Case 3**. But If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in **Case 3**. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in **Case 3** of this section by more than 8 dB.

5.7.2. Antenna Connector Construction

Please refer to section 2.3 in this test report, all antenna connectors comply with 47 CFR FCC Part 15 Subpart C, section 15.203 requirements.

5.7.3. Antenna Gain and Use Condition

EUT complies with **Case 1** situation. Therefore peak conducted power limit shall not be degraded any more.

5.8. Maximum Permissible Exposure

5.8.1. Applicable Standard

47 CFR FCC Part 15 Subpart C, section 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 limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 20 cm normally can be maintained between the user and the device.

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm²)	Averaging Time $\|E\|^2,\|H\|^2$ or S (minutes)
0.3–3.0	614	1.63	(100)*	6
3.0–30	1842 / f	4.89 / f	(900 / f)*	6
30–300	61.4	0.163	1.0	6
300–1500			F/300	6
1500–100,000			5	6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm²)	Averaging Time $\|E\|^2,\|H\|^2$ or S (minutes)
0.3–1.34	614	1.63	(100)*	30
1.34–30	824/f	2.19/f	(180/f)*	30
30–300	27.5	0.073	0.2	30
300–1500			F/1500	30
1500–100,000			1.0	30

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

5.8.2. MPE Calculation Method

E (V/m) $= \dfrac{\sqrt{30 \times P \times G}}{d}$ Power Density: *Pd* (mW/cm²) $= \dfrac{E^2}{377}$

E = Electric field (V/m)

P = Peak RF output power (mW)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

From the peak EUT RF output power, the minimum mobile separation distance, d=20cm, as well as the gain of the used antenna, the RF power density can be obtained.

5.8.3. Calculated Result and Limit

Max Conducted Power for IEEE 802.11b/g : 20dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm^2)	Limit of Power Density (S) (mW/cm^2)	Test Result
2	1.5849	15.3800	34.5144	0.010888	1	Complies

6. List of Measuring Equipments

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMC Receiver	R&S	ESCS 30	100174	9kHz – 2.75GHz	Feb. 16, 2005	Conduction (CO04-HY)
LISN	MessTec	NNB-2/16Z	2001/004	9kHz – 30MHz	Apr. 20, 2005	Conduction (CO04-HY)
LISN (Support Unit)	MessTec	NNB-2/16Z	99041	9kHz – 30MHz	May. 05, 2005	Conduction (CO04-HY)
RF Cable-CON	UTIFLEX	3102-26886-4	CB049	9kHz – 30MHz	Apr. 20, 2005	Conduction (CO04-HY)
EMI Filter	LINDGREN	LRE-2030	2651	< 450 Hz	N/A	Conduction (CO04-HY)
3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	30MHz ~ 1GHz 3m	Jun. 16, 2005	Radiation (03CH03-HY)
Spectrum analyzer	R&S	FSP40	100004	9KHZ ~ 40GHz	Aug. 31, 2004	Radiation (03CH03-HY)
Amplifier	SCHAFFNER	CPA9231A	18667	9KHz ~ 2GHz	Jan. 10, 2005	Radiation (03CH03-HY)
Amplifier	Agilent	8449B	3008A02120	1GHz ~ 26.5GHz	May 31, 2005	Radiation (03CH03-HY)
Biconical Antenna	SCHWARZBECK	VHBB 9124	301	30MHz ~ 200MHz	Jul. 28, 2004	Radiation (03CH03-HY)
Log Antenna	SCHWARZBECK	VUSLP 9111	221	200MHz ~ 1GHz	Jul. 28, 2004	Radiation (03CH03-HY)
Horn Antenna	EMCO	3115	6741	1GHz ~ 18GHz	Apr. 22, 2005	Radiation (03CH03-HY)
RF Cable-R03m	Jye Bao	RG142	CB021	30MHz ~ 1GHz	Feb. 22, 2005	Radiation (03CH03-HY)
RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	1GHz ~ 40GHz	Dec.01, 2004	Radiation (03CH03-HY)
Turn Table	HD	DS 420	420/650/00	0 ~ 360 degree	N/A	Radiation (03CH03-HY)
Antenna Mast	HD	MA 240	240/560/00	1 m – 4 m	N/A	Radiation (03CH03-HY)
3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	30MHz ~ 1GHz 3m	Jun. 16, 2005	Radiation (03CH03-HY)
Amplifier	MITEQ	AMF-6F-260400	923364	26.5GHz ~ 40GHz	Jan. 05, 2004*	Radiation (03CH03-HY)
Loop Antenna	R&S	HFH2-Z2	860004/001	9kHz ~ 30MHz	May 24, 2004*	Radiation (03CH03-HY)
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA9170154	15GHz ~ 40GHz	Jun. 09, 2004*	Radiation (03CH03-HY)

Note: Calibration Interval of instruments listed above is one year.

*Calibration Interval of instruments listed above are two years.

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Spectrum analyzer	R&S	FSP30	100023	9kHz ~ 30GHx	Aug. 02, 2004	Conducted (TH01-HY)
Power meter	R&S	NRVS	100444	DC ~ 40GHz	Jun. 14, 2005	Conducted (TH01-HY)
Power sensor	R&S	NRV-Z55	100049	DC ~ 40GHz	Jun. 14, 2005	Conducted (TH01-HY)
Power Sensor	R&S	NRV-Z32	100057	30MHz ~ 6GHz	Apr. 28, 2005	Conducted (TH01-HY)
AC power source	HPC	HPA-500W	HPA-9100024	AC 0 ~ 300V	Apr. 21, 2005	Conducted (TH01-HY)
DC power source	G.W.	GPC-6030D	C671845	DC 1V ~ 60V	Nov. 28, 2004	Conducted (TH01-HY)
Temp. and Humidity Chamber	KSON	THS-C3L	612	N/A	Oct. 01, 2004	Conducted (TH01-HY)
RF CABLE-1m	Jye Bao	RG142	CB034-1m	20MHz ~ 7GHz	Jan. 01, 2005	Conducted (TH01-HY)
RF CABLE-2m	Jye Bao	RG142	CB035-2m	20MHz ~ 1GHz	Jan. 01, 2005	Conducted (TH01-HY)
Oscilloscope	Tektronix	TDS1012	CO38515	100MHz / 1GS/s	Apr. 15, 2005	Conducted (TH01-HY)

Note: Calibration Interval of instruments listed above is two year.

7. SPORTON COMPANY PROFILE

SPORTON Lab. was established in 1986 with one shielded room: the first private EMI test facility, offering local manufacturers an alternative EMI test familial apart from ERSO. In 1988, one 3M and 10M/3M open area test site were setup and also obtained official accreditation from FCC, VCCI and NEMKO. In 1993, a Safety laboratory was founded and obtained accreditation from UL of USA, CSA of Canada and TUV (Rhineland & PS) of Germany. In 1995, one EMC lab, including EMI and EMS test facilities was setup. In 1997, SPORTON Group has provided financial expense to relocate the headquarter to Orient Scientific Park in Taipei Hsien to offer more comprehensive, more qualified and better service to local suppliers and manufactures. In 1999, Safety Group and Component Group were setup. In 2001, SPORTON has established 3M/10M chamber in Hwa Ya Technology Park.

7.1. Test Location

SHIJR	ADD	:	6Fl., No. 106, Sec. 1, Shintai 5th Rd., Shijr City, Taipei, Taiwan 221, R.O.C.
	TEL	:	02-2696-2468
	FAX	:	02-2696-2255
HWA YA	ADD	:	No. 52, Hwa Ya 1st Rd., Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.
	TEL	:	03-327-3456
	FAX	:	03-318-0055
LINKOU	ADD	:	No. 30-2, Dingfu Tsuen, Linkou Shiang, Taipei, Taiwan 244, R.O.C
	TEL	:	02-2601-1640
	FAX	:	02-2601-1695
DUNGHU	ADD	:	No. 3, Lane 238, Kangle St., Neihu Chiu, Taipei, Taiwan 114, R.O.C.
	TEL	:	02-2631-4739
	FAX	:	02-2631-9740
JUNGHE	ADD	:	7Fl., No. 758, Jungjeng Rd., Junghe City, Taipei, Taiwan 235, R.O.C.
	TEL	:	02-8227-2020
	FAX	:	02-8227-2626
NEIHU	ADD	:	4Fl., No. 339, Hsin Hu 2nd Rd., Taipei 114, Taiwan, R.O.C.
	TEL	:	02-2794-8886
	FAX	:	02-2794-9777
JHUBEI	ADD	:	No.8, Lane 728, Bo-ai St., Jhubei City, Hsinchu County 302, Taiwan, R.O.C.
	TEL	:	03-656-9065
	FAX	:	03-656-9085

8. CNLA Certificate of Accreditation

Test Lab.	:	Sporton International Inc.
Accreditation Number	:	1190
Originally Accredited	:	2003/12/15
Effective Period	:	2003/12/15~2006/12/14
Accredited Scope	:	47 CFR FCC Part 15 Subpart C (9kHz~40GHz)

CNLA

Taiwan Accreditation Foundation

Chinese National Laboratory Accreditation

Certificate of Accreditation

Accreditation Criteria:	ISO 17025
Accreditation Number:	1190
Organization/Laboratory:	EMC & Wireless Communications Laboratory,Sporton International Inc.
Originally Accredited:	December 15, 2003
Effective Period:	December 15, 2003 To December 14, 2006
Accredited Scope:	Electrical Testing Field, 7 items, details shown in the following pages.
Specific Accreditation Program:	Recognition and Approval of Designated Laboratory for Commodities Inspection

President, Taiwan Accreditation Foundation
Date:July 19, 2004

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