Digital Transmission System

FCC MEASUREMENT REPORT

FCC PART15 CERTIFICATION

PRODUCT	:	11b/g WLAN CF card
MODEL/TYPE NO	:	SWL-2600C
FCC ID	:	E2XSWL-2600C
TRADE NAME	:	SAMSUNG Electro-Mechanics Co., Ltd.
APPLICANT	:	SAMSUNG Electro-Mechanics Co., Ltd. 314, Maethan-3Dong, Paldal-Ku, Suwon, Korea, 442-743 Attn. : Jun-Hwan, Lim / Manager
FCC CLASSIFICATION	:	DTS Part 15 Digital Transmission System
FCC RULE PART(S)	:	FCC Part 15 Subpart C Section 15.247
FCC PROCEDURE	:	Certification
DATES OF TEST	:	March 16, 2005
DATES OF ISSUE	:	March 25, 2005
TEST REPORT No.	:	BWS-05-RF-0003
TEST LAB.	:	BWS TECH Inc. (Registration No. : 553281)

This Digital Transmission System has been tested in accordance with the measurement procedures specified in ANSI C63.4-2000 at the BWS TECH/EMC Test Laboratory and has been shown to be complied with the electromagnetic radiated emission limits specified in FCC Rule Part15 Subpart C Section15.247
I attest to the accuracy of data. All measurement herein was performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. The results of testing in this report apply to the product/system, which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

TaeHyun Nam
Chief of Laboratory Division
BWS TECH Inc.

BWS TECH Inc.
www.bws.co.kr
#294-9, Jungdae-Dong, Kwangju-Si, Kyunggi-Do, 464-080, Korea
TEL: +82 31 762 0124 FAX: +82 31 762 0126

TABLE OF CONTENTS

FCC TEST REPORT

Scope – *Measurement and determination of electromagnetic emission(EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC)*

1. General Information

Applicant

Company Name	:	SAMSUNG Electro-Mechanics Co., Ltd.
Company Address	:	314, Maethan-3Dong, Paldal-Ku, Suwon, Korea, 442-743
Phone/Fax	:	Phone : +82-31-210-6318 Fax: +82-31-210-3324

Manufacturer

Company Name	:	SAMSUNG Electro-Mechanics Co., Ltd.
Company Address	:	314, Maethan-3Dong, Paldal-Ku, Suwon, Korea, 442-743
Phone/Fax	:	Phone : +82-31-210-6318 Fax: +82-31-210-3324

- **EUT Type** : Digital Transmission System
- **Model Number** : SWL-2600C
- **FCC Identifier** : E2XSWL-2600C
- **S/N** :
- **Freq. Range** : 2400MHz ~ 2483.5MHz
- **Channel** : 11 channel
- **Modulation Method** : DSSS (BPSK, QPSK, CCK), OFDM (QAM)
- **FCC Rule Part(s)** : Part 15 Subpart C Section 15.247
- **Test Procedure** : ANSI C63.4-2000
- **Dates of Tests** : March 16, 2005
- **Place of Tests** : BWS TECH Inc.
  EMC Testing Lab (FCC Registration Number : 553281)
  #294-9, Jungdae-Dong, Kwangju-Si,
  Kyunggi-Do, 464-080, Korea
  TEL: +82-31-762-0124 FAX: +82-31-762-0126
- **Test Report No.** : BWS-05-RF-0003

2. Description of Test Facility

The measurement for radiated emission test were practiced at the open area test site of BWS TECH Inc. Measurement for conducted emission test were practiced at the semi EMC Anechoic Chamber test site of BWS TECH Inc. facility located at #294-9, Jungdae-Dong, Kwangju-Si, Kyunggi-Do, Korea. The site is constructed in conformance with the requirements of the ANSI C63.4-2000 and CISPR Publication 16. The BWS TECH measurement facility has been filed to the Commission with the FCC for 3 and 10-meter site configurations. Detailed description of test facility was found to be in compliance with the requirements of Section 2.948 FCC Rules according to the ANSI C63.4-1992 and registered to the Federal Communications Commission (Registration Number : 553281).

The measurement procedure described in American National Standard for Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C.63.4-2000) was used in determining radiated emissions from the SAMSUNG Electro-Mechanics Co., Ltd. 11b/g WLAN CF card Model : SWL-2600C.

3. Product Information

3.1 Equipment Description

The Equipment Under Test (EUT) is RF transmitter by the SAMSUNG Electro-Mechanics Co., Ltd. 11b/g WLAN CF card Model : SWL-2600C. (FCC ID : E2XSWL-2600C).

- The MagicLAN **SWL-2600C** are wireless LAN cards that provide wireless connection between computers.
- The MagicLAN is designed to operate with IEEE 802.11b/g (wireless LAN International Standard) wireless compliant radio cards and uses a CSMA/CA (Collision Sense Multiple Access with Collision Avoidance) algorithm as the media access scheme, which makes high speed communication (with minimal collision probability) possible.
- The MagicLAN supports DSSS (Direct Sequence Spread Spectrum) physical layer. This is a radio technique, which scrambles the data prior to transmission and uses a correlation technique on receiver to improve the signal to noise ratio and makes it possible to communicate in the office having a wall and a compartment.
- The MagicLAN supports various network software. The network driver is provided to support network software such as Windows 2000, Windows XP, and PPC2003.

3.2 General Specification

Card Standard & Mechanical Spec			
1.Card Standard		CF+ CompactFlash Specification Revision 2.0	
2. Form Factor		Type I	
3. Operating voltage		3.3 V	
4. Dimension		56.4㎜×42.8㎜×3.3㎜	
5. Weight		TBD	
RF Characteristics			
1.Specification Compliance		IEEE 802.11g Draft 7.1 (CSMA/CA)	
2. Data Rate & Modulation	ERP-DSSS/CCK	1Mbps(DBPSK) / 2Mbps(DQPSK) / 5.5, 11Mbps(CCK)	
	ERP-OFDM	6, 9Mbps(BPSK) / 12, 18Mbps(QPSK) / 24, 36Mbps(16-QAM) / 48, 54Mbps(64-QAM)	
3. TX output power	ERP-DSSS/CCK	1~11 Mbps	17.5 dBm
	ERP-OFDM	6 ~ 54 Mbps	15.0 dBm
4.RX Sensitivity	ERP-DSSS/CCK	11 Mbps 5.5 Mbps 2 Mbps 1 Mbps	-84 dBm -87 dBm -90 dBm -93 dBm
	ERP-OFDM	6 Mbps 9 Mbps 12 Mbps 18 Mbps 24 Mbps 36 Mbps 48 Mbps 54 Mbps	-88 dBm -86 dBm -85 dBm -83 dBm -80 dBm -77 dBm -72 dBm -70 dBm
5. Current consumption	TX	420 mA	
	RX	390 mA	
6. Coverage	ERP-DSSS/CCK	TBD	
	ERP-OFDM	TBD	
Environmental requirements			
1. Operating temperature		0 °C ~ +55 °C	
2. Storage temperature		-20 °C ~ +70 °C	
3. Operating humidity		0 % ~ 90 %(RH)	
OS Support & Configuration Utility			
1. OS Support		WinCE 4.2, PPC 2003	
2. Security		40(64) / 128 WEP, WPA Support	
Certifications & Regulatory Approvals			
TBD			
Antenna			
1. Type		PIFA Antenna	
2. Maximum Gain		2.67 dBi	

4. Description of Tests

4.1 Conducted Emission Measurement

Conducted emissions measurements were made in accordance with section 11, "Measurement of Information Technology Equipment" of ANSI C63.4-2000. The measurement were performed over the frequency range of 0.15MHz to 30MHz using a 50Ω/50uH LISN as the input transducer to a Spectrum Analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak" amplitude within a bandwidth of 10KHz or for "quasi-peak" within a bandwidth of 9KHz.

The line-conducted emission test is conducted inside a shielded anechoic chamber room with 1m x 1.5m x 0.8m wooden table, which is placed 40cm away from the vertical wall, and 1.5m away from the sidewall of the chamber room. Two LISNs are bonded to the shielded room. The EUT is powered from the PMM LISN and the support equipment is powered from the LISN. Power to the LISNs is filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner ϕ 1.2cm. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and these supply lines will be connected to the LISN. All interconnecting cables more than 1m were shortened by non-inductive bundling (serpentine fashion) to a 1m length. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the Spectrum Analyzer to determine the frequency producing the max. Emission from the EUT. The frequency producing the max. Level was reexamined using the detector function set to the CISPR Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0.45 to 30MHz. The bandwidth of the Spectrum Analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was maximized by switching power lines, varying the mode of operation or resolution, clock or data exchange speed, if applicable, whichever determined the worst-case emission. Each emission reported was calibrated using self-calibrating mode.

Photographs of the worst-case emission can be seen in photographs of conducted emission test setup.

4.2 Radiated Emission Measurement

Preliminary measurements were made at indoors 3-meter semi EMC Anechoic Chamber using broadband antennas, broadband amplifier, and spectrum analyzer to determine the emission frequencies producing the maximum EME.

Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configurations, mode of operation, turntable azimuth with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 to 1000MHz using bi-log antenna and above 1000MHz, linearly polarized double ridge horn antennas were used. Above 1GHz, linearly polarized double ridge horn antennas were used. The measurements were performed with three frequencies, which were selected as bottom, middle, and top frequency in the operating band. Emission level from the EUT with various configurations was examined on the spectrum analyzer connected with the RF amplifier and plotted graphically.

Final measurements were made outdoors open site at 3-meter test range using biconical and log periodic, Horn antenna. The output from the antenna was connected, via a preselector or a preamplifier, to the input of the EMI Measuring Receiver and Spectrum analyzer (for above 25GHz). The detector function was set to the quasi-peak or peak mode as appropriate. The measurement bandwidth on the Field strength receiver was set to at least 120kHz (1MHz for measurement above 1GHz), with all post-detector filtering no less than 10 times the measurement bandwidth. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.

Each frequency found during preliminary measurement was examined and investigated as the same set up and configuration which produced the maximum emission The EUT, support equipment and interconnecting cables were configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0.8-meter high non-metallic 1m x 1.5 meter table. The turntable containing the system was rotated and the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission.

Varying the mode of operating frequencies of the EUT maximized each emission. The system was tested in all the three orthogonal planes and changing the polarity of the antenna. The worst-case emissions are recorded in the data tables. If necessary, the radiated emission measurement could be performed at a closer distance to ensure higher accuracy and the results were extrapolated to the specified distance using an inverse linear distance extrapolation factor (20dB/decade) as per section 15.31(f).

Photographs of the worst-case emission test setup can be seen in Appendix A.

5. Test Condition

5.1 Test Configuration

The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the EUT and the supported equipments were installed to meet FCC requirement and operated in a manner, which tends to maximize its emission level in a typical application.

Radiated Emission Test

Preliminary radiated emission tests were conducted using the procedure in ANSI C63.4/2000 Clause 8.3.1.1 to determine the worst operating condition. Final radiated emission tests were measured at 3-meter open field test site. To complete the test configuration required by the FCC, the EUT was tested in all three orthogonal planes.

5.2 EUT operation

EUT was tested according to the following operation modes provided by the specifications given by the manufacturer, and reported the worst emissions.

5.3 Peripherals / Support Equipment Used

Following peripheral devices and interface cables were connected during the measurement:

Type of Peripheral Equipment Used:

Description	Model Name	Serial No.	Manufacturer	FCC ID
EUT	SWL-2600C	TCKRNA-453387725	SAMSUNG Electro-Mechanics Co., Ltd.	E2XSWL-2600C
PDA	HSTNH-H02C	TWC44507T9	HEWLETT-PACKARD COMPANY	-
Cradle	HSTNH-F02X	374529-001	HEWLETT-PACKARD COMPANY	-
AC/DC Adapter	ADP-10SB	5836801YLQV08C	DELTA ELECTRONICS, INC.	-

Type of Cables Used:

Device from	Device to	Type of Cable	Length(m)	Type of shield
-	-	-	-	-

6. TEST RESULTS

Summary of Test Results

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum emission of the EUT are reported.

FCC Rule	Description of Test	Limit	Result
15.207	Power Line Conducted Emission	Various	Pass
15.247(a)	6dB Bandwidth	More than 500kHz	Pass
15.247(b)	Maximum Peak Output Power	Less than 30dBm	Pass
15.209 15.231	Radiated Emission	Various	Pass
15.247(c)	Conducted Emission & 100kHz Bandwidth of Frequency Band Edges	More than 20dBc	Pass
15.247(d)	Power Spectral Density	Less than 8dBm	Pass
15.203	Antenna Requirement	Less than 6dBi	Pass
1.1307 1.1310 2.1091 2.1093	RF Exposure	1mW/Cm^2	Pass

The data collected shows that the SAMSUNG Electro-Mechanics Co., Ltd. 11b/g WLAN CF card (SWL-2600C) complies with technical requirements of the Part 15.247 of the FCC Rules.

Note : Modification to EUT

The device tested is not modified anything, mechanical or circuits to improve EMI status during a measurement. No EMI suppression device(s) was added and/or modified.

6.1 Power Line Conducted Emission

Frequency Range of Test	:	150 kHz to 30 MHz
Test Standard	:	FCC Part15 Subpart C Section 15.207
Operating Condition	:	The EUT was operated at transmitting condition continuously during the test.
Temperature/Humidity	:	23.5 °C/ 53 %

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

Power Line Conducted Emission Test Data (802.11b Mode)

Detector Mode ; CISPR Quasi Peak mode (6dB Bandwidth : 9kHz)

Freq [MHz]	Correcton		Phase [H/N]	Quasi-Peak Mode			Average Mode		
	AMN	C.L		Limit	Reading	Emission Level	Limit	Reading	Emission Level
				[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]
0.151	0.06	0.03	H	66.00	54.80	54.89	56.00	17.50	17.59
0.210	0.07	0.10	N	64.30	50.80	50.97	54.30	43.50	43.67
0.300	0.08	0.22	N	61.70	42.80	43.10	51.70	11.20	11.50
0.311	0.08	0.22	N	61.40	45.90	46.20	51.40	41.10	41.40
0.421	0.08	0.26	N	58.30	43.40	43.74	48.30	7.80	8.14
0.442	0.08	0.26	H	57.70	44.00	44.34	47.70	39.00	39.34
0.839	0.08	0.30	N	56.00	47.60	47.98	46.00	39.60	39.98
0.990	0.04	0.38	H		48.30	48.72		40.20	40.62
2.107	0.03	0.56	N		52.80	53.39		38.00	38.59
2.212	0.03	0.56	N		52.30	52.89		38.40	38.99
4.743	0.04	0.84	N		50.40	51.28		33.50	34.38
4.951	0.05	0.86	H		51.80	52.71		37.40	38.31
5.110	0.05	0.87	N	60.00	49.30	50.22	50.00	32.30	33.22
5.210	0.05	0.88	H		52.20	53.13		37.40	38.33
5.410	0.05	0.88	N		49.10	50.03		33.70	34.63
5.770	0.06	0.89	H		47.00	47.95		32.80	33.75
5.910	0.06	0.90	H		46.90	47.86		32.20	33.16
6.470	0.05	0.93	H		42.80	43.78		28.50	29.48

NOTES :

1. *H : Hot Line , N :Neutral Line*
2. *Emission Level = Reading + Correction Factor*
3. *Measurements were performed at the AC Power Inlet of the host PC with the EUT plugged in the frequency band of 150kHz ~30MHz*

Tested by ***Choi, Chang-Young***

Power Line Conducted Emission Test Data (802.11g Mode)

Detector Mode ; CISPR Quasi Peak mode (6dB Bandwidth : 9kHz)

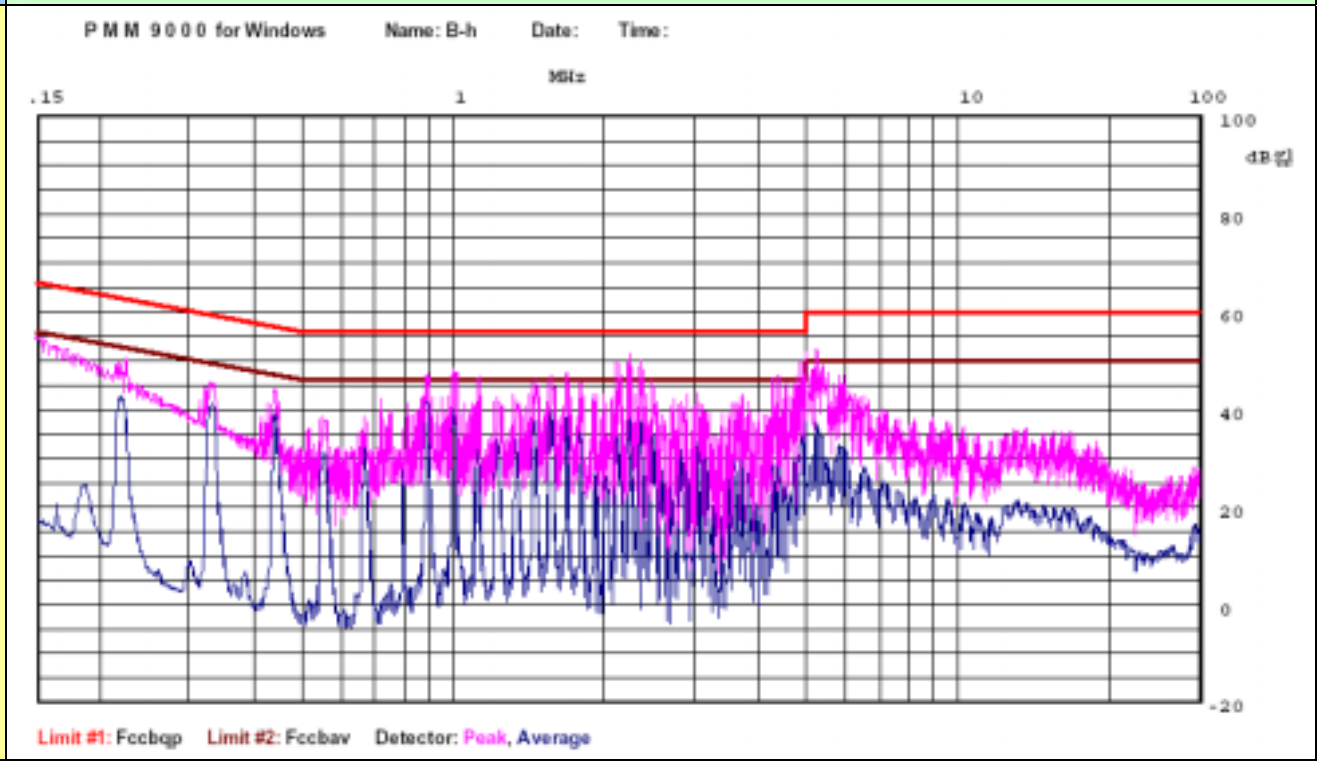
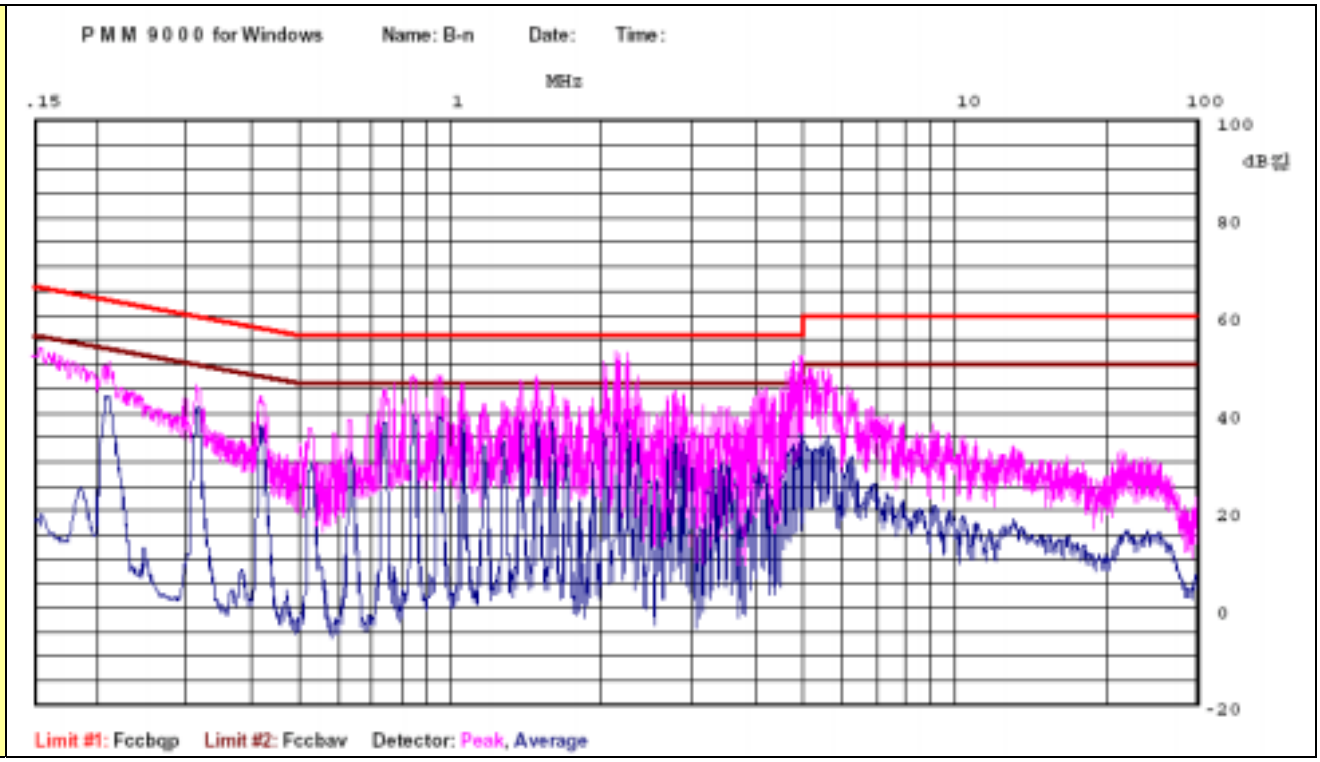
Freq [MHz]	Correcton		Phase [H/N]	Quasi-Peak Mode			Aberage Mode		
	AMN	C.L		Limit	Reading	Emission Level	Limit	Reading	Emission Level
				[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]
0.156	0.06	0.03	N	65.90	54.10	54.19	55.90	30.50	30.59
0.185	0.06	0.03	H	65.00	53.20	53.29	55.00	43.20	43.29
0.279	0.07	0.16	H	62.40	46.10	46.33	52.40	40.80	41.03
0.356	0.08	0.24	H	60.10	41.40	41.72	50.10	3.00	3.32
0.392	0.08	0.24	N	59.10	43.10	43.42	49.10	36.60	36.92
0.489	0.07	0.28	N	56.40	36.20	36.55	46.40	28.70	29.05
1.298	0.04	0.44	H	56.00	47.80	48.28	46.00	38.80	39.28
1.850	0.03	0.53	H		48.70	49.26		35.00	35.56
1.973	0.03	0.54	N		51.70	52.27		36.70	37.27
2.326	0.03	0.57	H		46.80	47.40		32.80	33.40
2.425	0.03	0.57	H		47.10	47.70		34.00	34.60
4.940	0.05	0.86	N		51.00	51.91		35.50	36.41
5.090	0.05	0.87	N	60.00	51.40	52.32	50.00	36.50	37.42
5.300	0.05	0.88	N		50.70	51.63		35.20	36.13
5.480	0.05	0.88	H		48.50	49.43		34.70	35.63
5.680	0.06	0.89	N		47.80	48.75		33.40	34.35
5.920	0.06	0.90	N		47.20	48.16		34.10	35.06
6.290	0.05	0.92	N		44.70	45.67		31.50	32.47

NOTES :

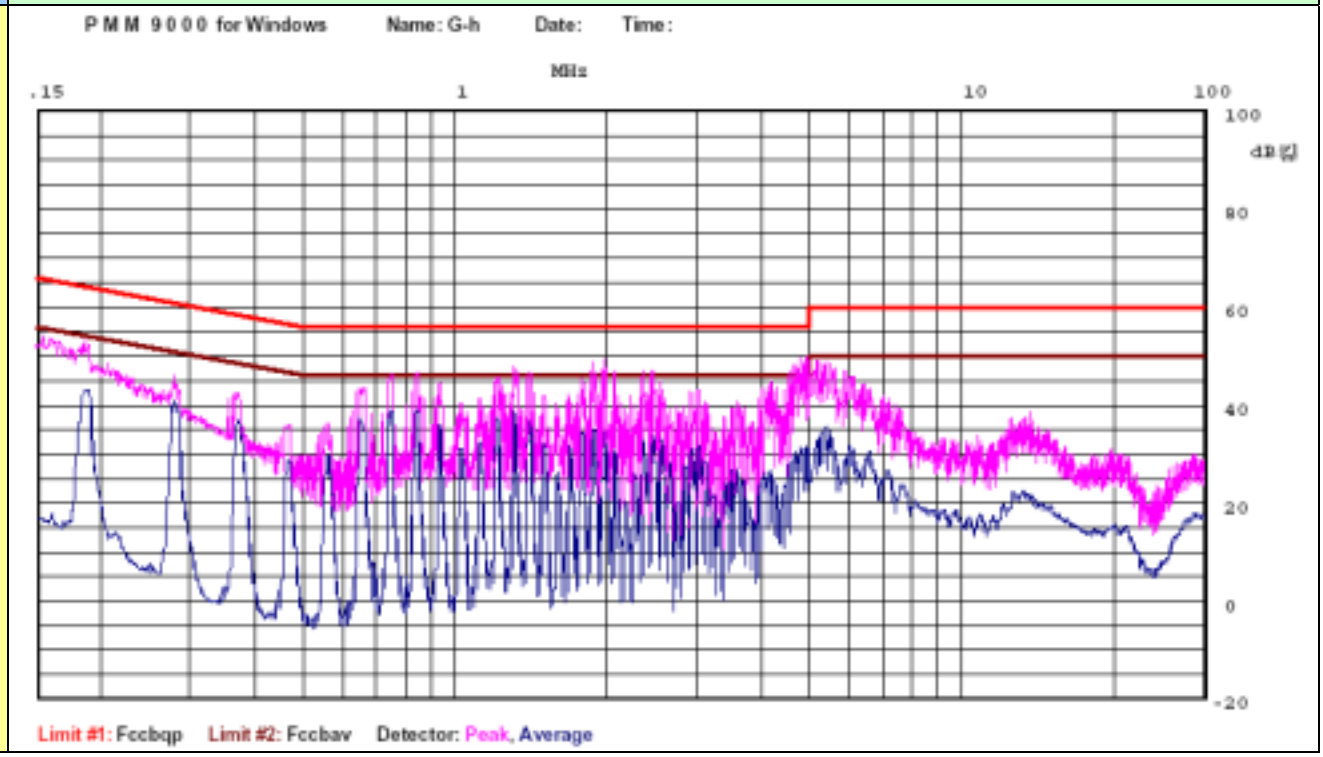
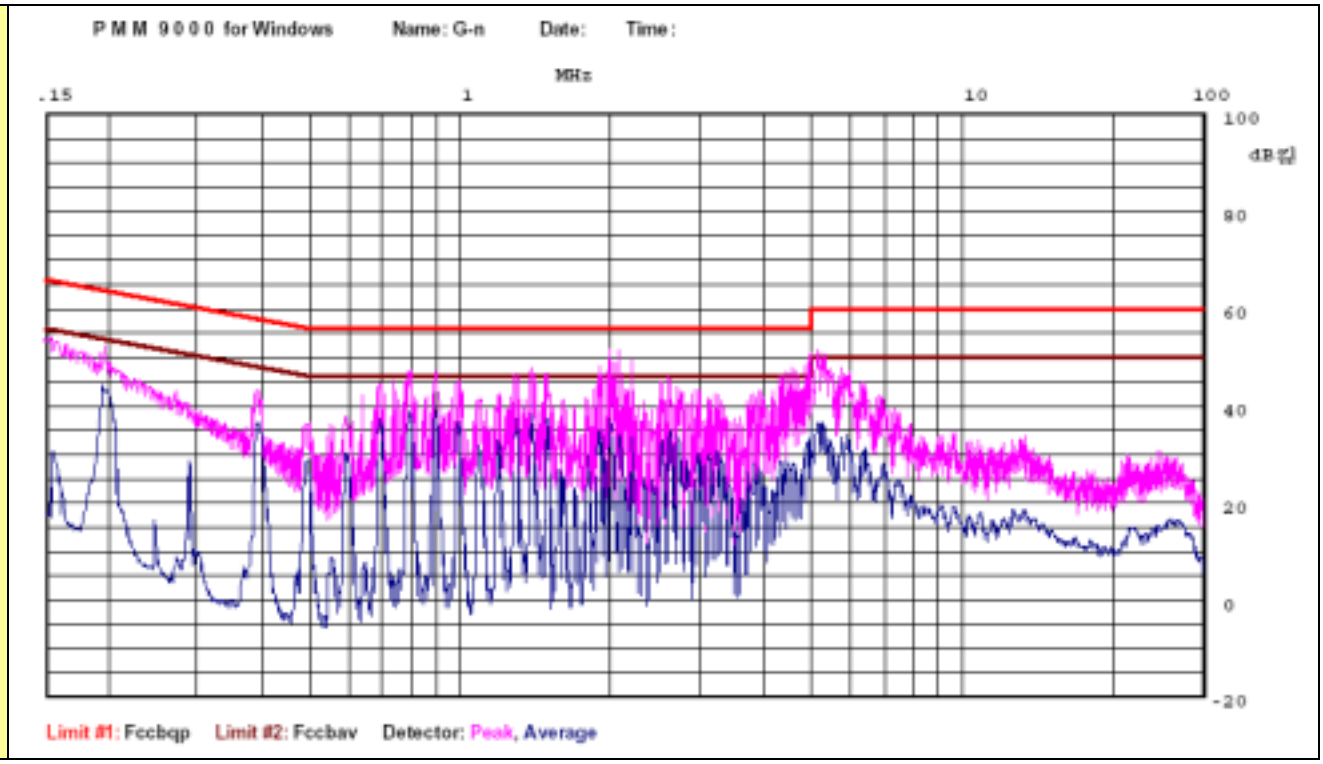
4. *H : Hot Line , N :Neutral Line*
5. *Emission Level = Reading + Correction Factor*
6. *Measurements were performed at the AC Power Inlet of the host PC with the EUT plugged in the frequency band of 150kHz ~30MHz*

Tested by ***Choi, Chang-Young***

Plots of Power Line Conducted Emission (802.11b Mode)

Mode	Plot
Hot	
Neutral	

Plots of Power Line Conducted Emission (802.11g Mode)

Mode	Plot
Hot	
Neutral	

6.2 6dB Bandwidth

Test Standard	:	FCC Part15 Subpart C Section 15.247(a),(2)
Operating Condition	:	The EUT was operated at transmitting condition continuously during the test.
Temperature/Humidity	:	23.5 °C/ 53 %

6dB Bandwidth Test Data

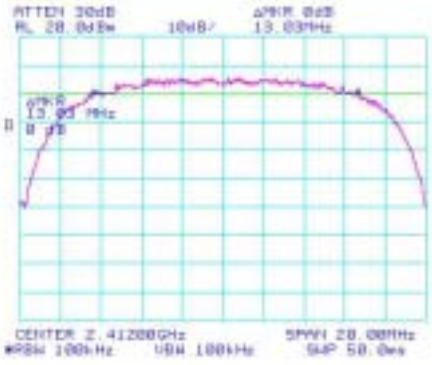
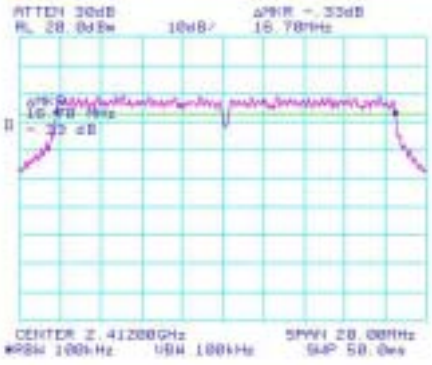
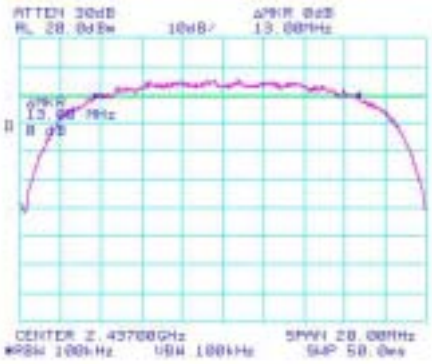
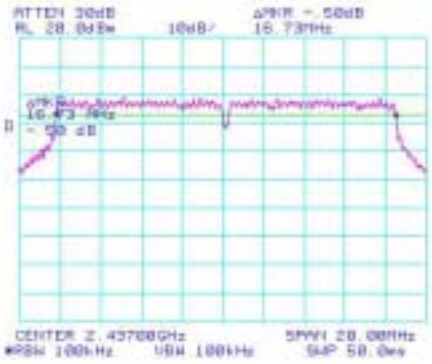
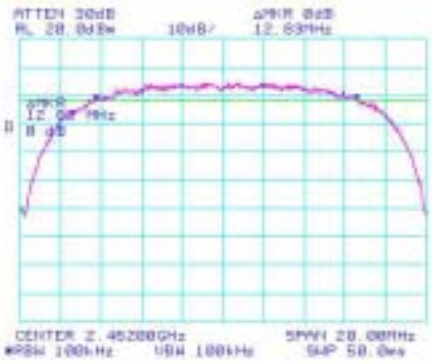
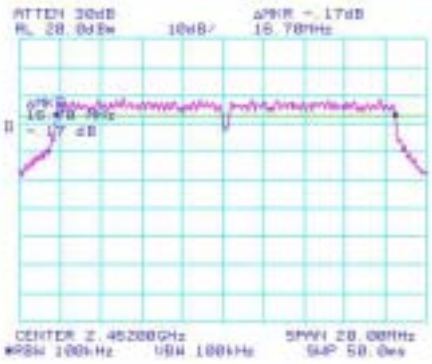
Frequency (MHz)	6dB Bandwidth (kHz)		Limit
	802.11b (DSSS)	802.11g (OFDM)	
2412	13030	16700	More than 500kHz
2437	13000	16730	
2462	12830	16700	

NOTES :

1. *Measure 6dB bandwidth of relevant channel using Spectrum Analyzer.*
2. *RBW 100kHz, VBW 100kHz, Sweep Time 50ms.*
3. *6dB less than both bandwidth than maximum peak power.*

Tested by ***Choi, Chang-Young***

Plots of 6dB Bandwidth

Frequency	802.11b (DSSS)	802.11g (OFDM)
2412MHz		
2437MHz		
2462MHz		

6.3 Maximum Peak Output Power

Test Standard	:	FCC Part15 Subpart C Section 15.247(b),(1)
Operating Condition	:	The EUT was operated at transmitting condition continuously during the test.
Temperature/Humidity	:	23.5 °C/ 53 %

Maximum Peak Output Power Test Data

Frequency (MHz)	Maximum Peak Output Power (dBm)		Limit
	802.11b (DSSS)	802.11g (OFDM)	
2412	17.4	14.7	Less than 30dBm
2437	16.9	13.9	
2462	16.5	13.7	

NOTES :

1. Measure Maximum Peak Output of relevant channel using Power Meter.

Tested by ***Choi, Chang-Young***

6.4 Radiated Emission

Test Standard : FCC Part15 Subpart C Section 15.247(c)

Operating Condition : The EUT was operated at transmitting condition continuously during the test.

Temperature/Humidity : 23.5 °C/ 53 %

Radiated Emission Test Data (Below 1GHz)

1. 802.11b Low Channel (2412MHz)

Frequency [MHz]	Reading [dBμV]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss [dB]	Limit [dBμV/m]	Emission Level [dBμV/m]	Margin [dB]
456.64	14.73	V	16.80	4.81	40.00	36.35	-3.65

2. 802.11b Middle Channel (2437MHz)

Frequency [MHz]	Reading [dBμV]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss [dB]	Limit [dBμV/m]	Emission Level [dBμV/m]	Margin [dB]
481.64	14.19	V	17.27	4.97	40.00	36.43	-3.57

3. 802.11b High Channel (2462MHz)

Frequency [MHz]	Reading [dBμV]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss [dB]	Limit [dBμV/m]	Emission Level [dBμV/m]	Margin [dB]
506.64	12.29	V	17.92	5.12	40.00	35.34	-4.66

4. 802.11g Low Channel (2412MHz)

Frequency [MHz]	Reading [dBμV]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss [dB]	Limit [dBμV/m]	Emission Level [dBμV/m]	Margin [dB]
456.64	13.85	V	16.80	4.81	40.00	35.47	-4.53

5. 802.11g Middle Channel (2437MHz)

Frequency [MHz]	Reading [dBμV]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss [dB]	Limit [dBμV/m]	Emission Level [dBμV/m]	Margin [dB]
481.64	13.12	V	17.27	4.97	40.00	35.36	-4.64

6. 802.11g High Channel (2462MHz)

Frequency [MHz]	Reading [dBμV]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss [dB]	Limit [dBμV/m]	Emission Level [dBμV/m]	Margin [dB]
506.64	11.52	V	17.92	5.12	40.00	34.57	-5.43

Radiated Emission Test Data (Above 1GHz)

1. 802.11b Low Channel (2412MHz)

Frequency [GHz]	Reading [dBμV]		Ant.Factor [dB]	Amp Gain [dB]	Cable Loss [dB]	Emission Level [dBμV/m]		Limit [dBμV/m]		Margin [dB]	
	Peak	Average				Peak	Average	Peak	Average	Peak	Average
1.665	53.69	-	24.90	36.70	8.30	50.19	-	74.00	54.00	-23.81	-
1.820	51.10	-	25.83	35.60	8.50	49.83	-	74.00	54.00	-24.17	-
2.244	51.10		27.58	35.60	8.70	51.78	-	74.00	54.00	-22.22	-
2.320	55.68	47.38	27.61	35.60	8.80	56.49	48.19	74.00	54.00	-17.51	-5.81
2.358	50.02	-	27.61	35.60	8.80	50.83	-	74.00	54.00	-23.17	-
2.560	45.20	-	27.81	35.60	9.00	46.41	-	74.00	54.00	-27.59	-
2.618	49.98	-	27.89	35.60	9.10	51.37	-	74.00	54.00	-22.63	-

2. 802.11b Middle Channel (2437MHz)

Frequency [GHz]	Reading [dBμV]		Ant.Factor [dB]	Amp Gain [dB]	Cable Loss [dB]	Emission Level [dBμV/m]		Limit [dBμV/m]		Margin [dB]	
	Peak	Average				Peak	Average	Peak	Average	Peak	Average
1.700	53.72	-	24.98	36.50	8.30	50.50	-	74.00	54.00	-23.5	-
1.821	50.96	-	25.83	35.60	8.50	49.69	-	74.00	54.00	-24.31	-
2.244	52.64	-	27.58	35.60	8.70	53.32	-	74.00	54.00	-20.68	-
2.258	56.17	47.57	27.60	35.60	8.80	56.97	48.37	74.00	54.00	-17.03	-5.63
2.320	47.86	-	27.61	35.60	8.80	48.67	-	74.00	54.00	-25.33	-
2.560	45.36	-	27.81	35.60	9.00	46.57	-	74.00	54.00	-27.43	-
2.618	51.04	-	27.89	35.60	9.10	52.43	-	74.00	54.00	-21.57	-

3. 802.11b High Channel (2462MHz)

Frequency [GHz]	Reading [dBμV]		Ant.Factor [dB]	Amp Gain [dB]	Cable Loss [dB]	Emission Level [dBμV/m]		Limit [dBμV/m]		Margin [dB]	
	Peak	Average				Peak	Average	Peak	Average	Peak	Average
1.783	53.02	-	25.29	36.20	8.40	50.51	-	74.00	54.00	-23.49	-
1.820	52.40	-	25.83	35.60	8.50	51.13	-	74.00	54.00	-22.87	-
2.244	50.03	-	27.58	35.60	8.70	50.71	-	74.00	54.00	-23.29	-
2.304	57.30	48.91	27.60	35.60	8.80	58.10	49.71	74.00	54.00	-15.90	-4.29
2.320	52.94	-	27.61	35.60	8.80	53.75	-	74.00	54.00	-20.25	-
2.615	54.08	45.56	27.85	35.60	9.10	55.43	46.91	74.00	54.00	-18.57	-7.09
2.655	44.61	-	27.89	35.60	9.10	46.00	-	74.00	54.00	-28.00	-

4. 802.11g Low Channel (2412MHz)

Frequency [GHz]	Reading [dBμV]		Ant.Factor [dB]	Amp Gain [dB]	Cable Loss [dB]	Emission Level [dBμV/m]		Limit [dBμV/m]		Margin [dB]	
	Peak	Average				Peak	Average	Peak	Average	Peak	Average
1.661	43.90	-	24.90	36.70	8.30	40.40	-	74.00	54.00	-33.6	-
1.820	49.58	-	25.83	35.60	8.50	48.31	-	74.00	54.00	-25.69	-
2.240	51.82		27.58	35.60	8.70	52.50	-	74.00	54.00	-21.5	-
2.320	55.90	47.52	27.61	35.60	8.80	56.71	48.33	74.00	54.00	-17.29	-5.67
2.358	47.74	-	27.61	35.60	8.80	48.55	-	74.00	54.00	-25.45	-
2.611	46.26	-	27.85	35.60	9.10	47.61	-	74.00	54.00	-26.39	-
2.656	51.48	-	27.89	35.60	9.10	52.87	-	74.00	54.00	-21.13	-

5. 802.11g Middle Channel (2437MHz)

Frequency [GHz]	Reading [dBμV]		Ant.Factor [dB]	Amp Gain [dB]	Cable Loss [dB]	Emission Level [dBμV/m]		Limit [dBμV/m]		Margin [dB]	
	Peak	Average				Peak	Average	Peak	Average	Peak	Average
1.700	44.56	-	24.98	36.50	8.30	41.34	-	74.00	54.00	-32.66	-
1.820	50.74	-	25.83	35.60	8.50	49.47	-	74.00	54.00	-24.53	-
2.244	49.87	-	27.58	35.60	8.70	50.55	-	74.00	54.00	-23.45	-
2.264	49.58	-	27.60	35.60	8.80	50.38	-	74.00	54.00	-23.62	-
2.320	55.74	46.66	27.61	35.60	8.80	56.55	47.47	74.00	54.00	-17.45	-6.53
2.560	42.43	-	27.81	35.60	9.00	43.64	-	74.00	54.00	-30.36	-
2.655	50.48	-	27.89	35.60	9.10	51.87	-	74.00	54.00	-22.13	-

6. 802.11g High Channel (2462MHz)

Frequency [GHz]	Reading [dBμV]		Ant.Factor [dB]	Amp Gain [dB]	Cable Loss [dB]	Emission Level [dBμV/m]		Limit [dBμV/m]		Margin [dB]	
	Peak	Average				Peak	Average	Peak	Average	Peak	Average
1.736	44.00	-	25.29	36.20	8.40	41.49	-	74.00	54.00	-32.51	-
1.821	52.10	-	25.83	35.60	8.50	50.83	-	74.00	54.00	-23.17	-
2.244	49.80	-	27.58	35.60	8.70	50.48	-	74.00	54.00	-23.52	-
2.305	46.07	47.54	27.60	35.60	8.80	46.87	48.34	74.00	54.00	-27.13	-5.66
2.320	54.90	46.52	27.61	35.60	8.80	55.71	47.33	74.00	54.00	-18.29	-6.67
2.613	50.62	-	27.85	35.60	9.10	51.97	-	74.00	54.00	-22.03	-
2.656	51.84	-	27.89	35.60	9.10	53.23	-	74.00	54.00	-20.77	-

NOTES :

1. *All modes of operation were investigated and the worst-case emissions are reported.*
2. *AF = Antenna Factor CL = Cable Loss F/S = Field Strength*
3. *POL H = Horizontal POL V = Vertical*

Tested by ***Choi, Chang Young***

6.5 Conducted Emission

Test Standard : FCC Part15 Subpart C Section 15.247(c)

Operating Condition : The EUT was operated at transmitting condition continuously during the test.

Temperature/Humidity : 23.5 °C/ 53 %

Conducted Emission Test Data

1. 802.11b Low Channel (2412MHz)

Test Range	Attenuation (dBc)	Plot	Result
30MHz ~ 2.3GHz	« 20dBc	6.5.1.1	Pass
2.3GHz ~ 2.4GHz	« 20dBc	6.5.1.2	Pass
2.4835GHz ~ 3GHz	« 20dBc	6.5.1.3	Pass
3GHz ~ 26.5GHz	« 20dBc	6.5.1.4	Pass

2. 802.11b Middle Channel (2437MHz)

Test Range	Attenuation (dBc)	Plot	Result
30MHz ~ .24GHz	« 20dBc	6.5.2.1	Pass
2.4835GHz ~ 3GHz	« 20dBc	6.5.2.2	Pass
3GHz ~ 26.5GHz	« 20dBc	6.5.2.3	Pass

3. 802.11b High Channel (2462MHz)

Test Range	Attenuation (dBc)	Plot	Result
30MHz ~ 2.4GHz	« 20dBc	6.5.3.1	Pass
2.4835GHz ~ 3GHz	« 20dBc	6.5.3.2	Pass
3GHz ~ 26.5GHz	« 20dBc	6.5.3.3	Pass

4. 802.11g Low Channel (2412MHz)

Test Range	Attenuation (dBc)	Plot	Result
30MHz ~ 2.3GHz	« 20dBc	6.5.4.1	Pass
2.3GHz ~ 2.4GHz	« 20dBc	6.5.4.2	Pass
2.4835GHz ~ 3GHz	« 20dBc	6.5.4.3	Pass
3GHz ~ 26.5GHz	« 20dBc	6.5.4.4	Pass

5. 802.11g Middle Channel (2437MHz)

Test Range	Attenuation (dBc)	Plot	Result
30MHz ~ .24GHz	« 20dBc	6.5.5.1	Pass
2.4835GHz ~ 3GHz	« 20dBc	6.5.5.2	Pass
3GHz ~ 26.5GHz	« 20dBc	6.5.5.3	Pass

6. 802.11g High Channel (2462MHz)

Test Range	Attenuation (dBc)	Plot	Result
30MHz ~ .24GHz	« 20dBc	6.5.6.1	Pass
2.4835GHz ~ 3GHz	« 20dBc	6.5.6.2	Pass
3GHz ~ 26.5GHz	« 20dBc	6.5.6.3	Pass

NOTES :

1. All modes of operation were investigated and the worst-case emissions are reported.

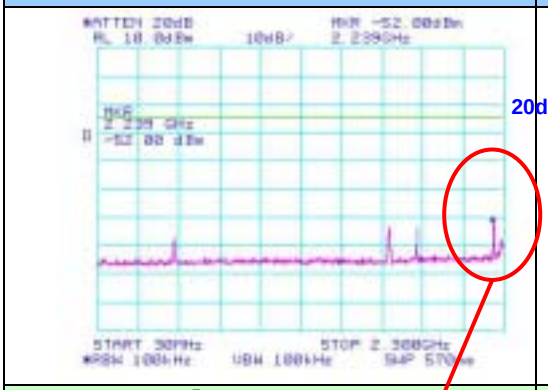
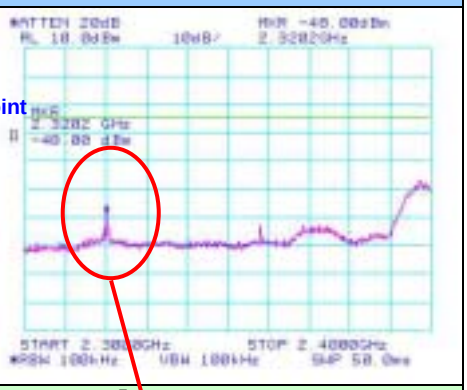
Tested by ***Choi, Chang-Young***

Plots of Conducted Emission

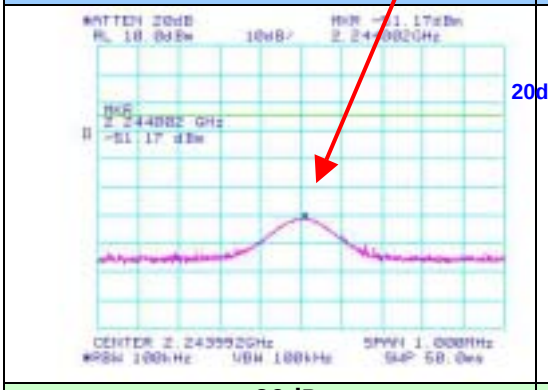
802.11b

Low Channel

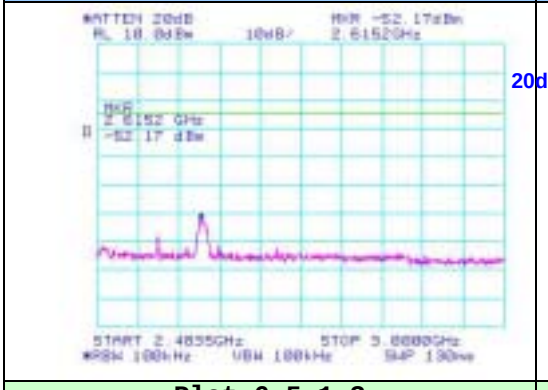
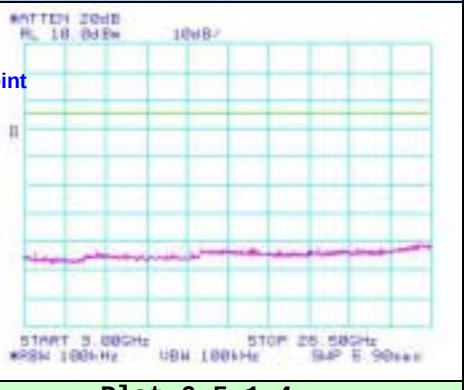
2412MHz

30MHz ~ 2.3GHz	2.3GHz ~ 2.4GHz
	
Plot 6.5.1.1	Plot 6.5.1.2

20dBc point

2.244GHz	2.320GHz
	
<< 20dBc	<< 20dBc

20dBc point

2.4835GHz ~ 3GHz	3GHz ~ 26.5GHz
	
Plot 6.5.1.3	Plot 6.5.1.4

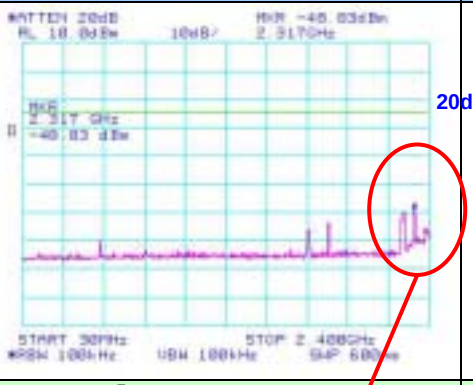
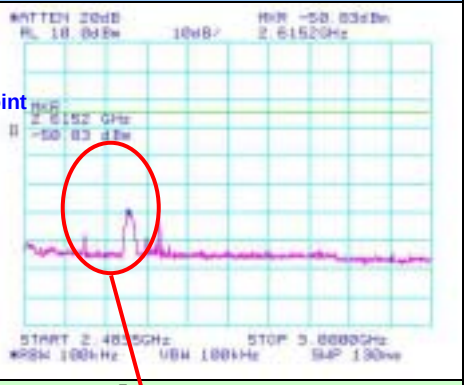
20dBc point

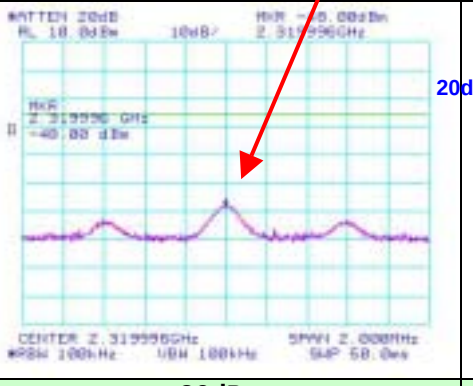
Plots of Conducted Emission

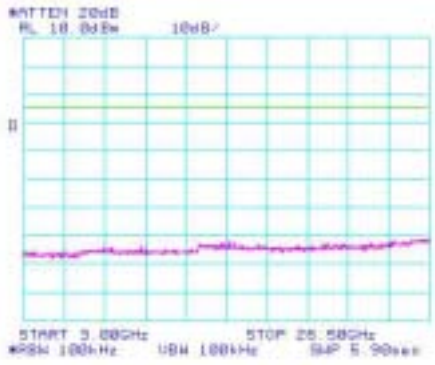
802.11b

Middle Channel

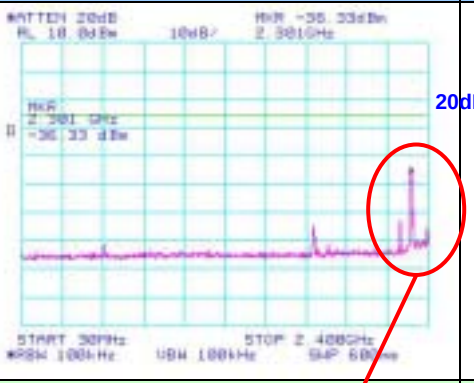
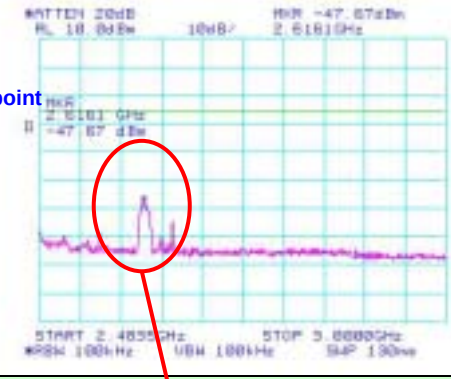
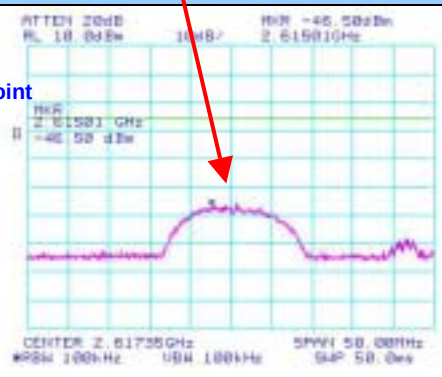
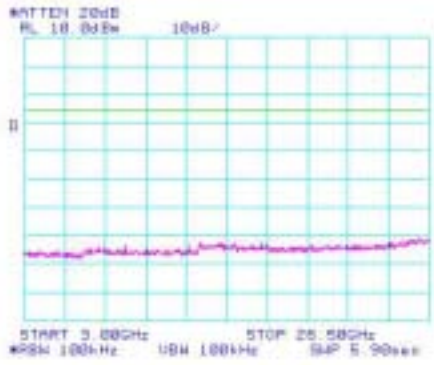
2437MHz

30MHz ~ 2.4GHz	2.4835GHz ~ 3GHz
	
Plot 6.5.2.1	Plot 6.5.2.2

2.320GHz	2.655GHz
	
<< 20dBc	<< 20dBc

3GHz ~ 26.5GHz

Plot 6.5.2.3

Plots of Conducted Emission

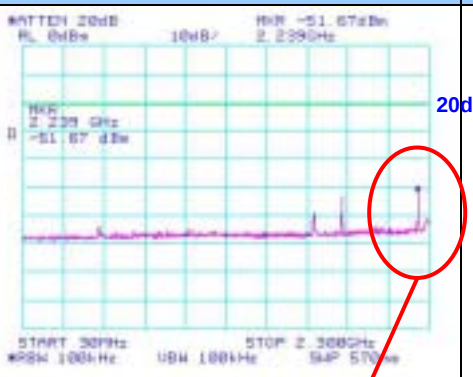
	30MHz ~ 2.4GHz	2.4835GHz ~ 3GHz
802.11b High Channel 2462MHz		
	Plot 6.5.3.1	Plot 6.5.3.2
	2.303GHz	2.615GHz
		
	<< 20dBc	<< 20dBc
	3GHz ~ 26.5GHz	
		
	Plot 6.5.3.3	

Plots of Conducted Emission

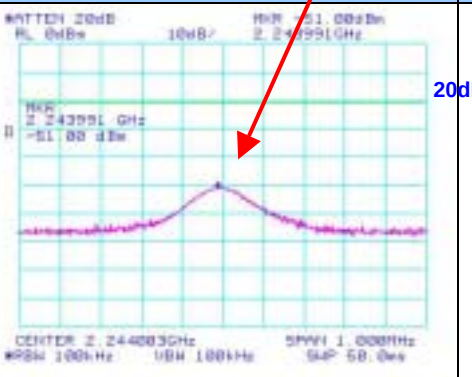
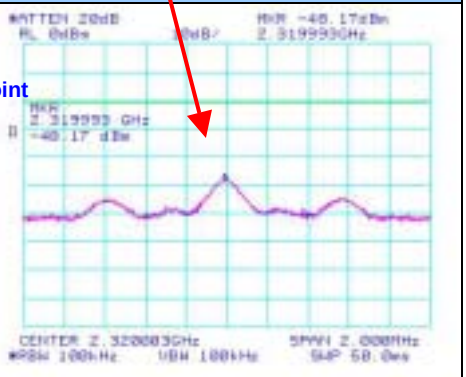
802.11g

Low Channel

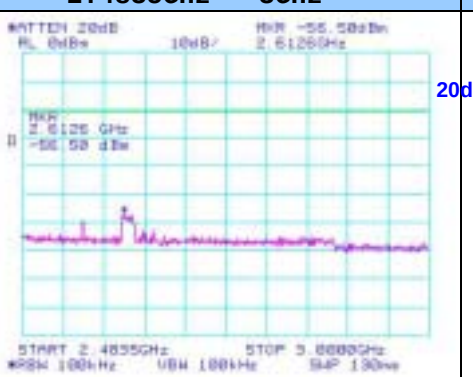
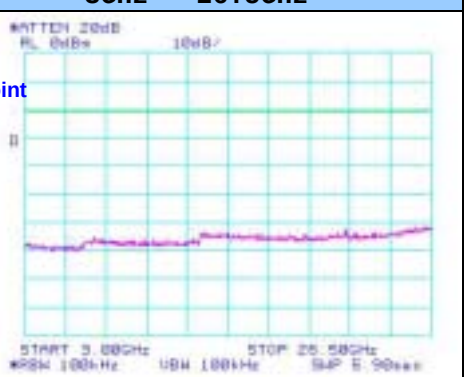
2412MHz

30MHz ~ 2.3GHz	2.3GHz ~ 2.4GHz
	
Plot 6.5.4.1	Plot 6.5.4.2

20dBc point

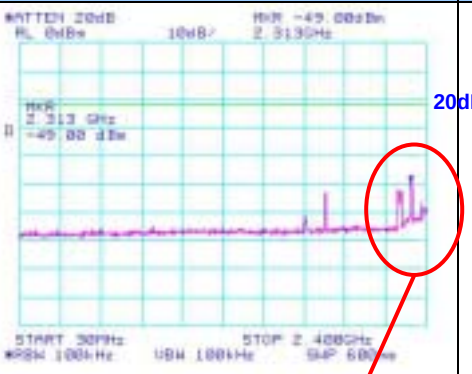
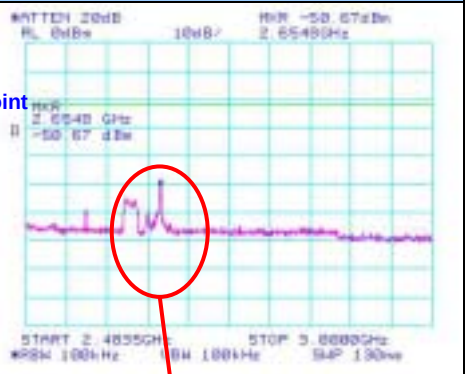
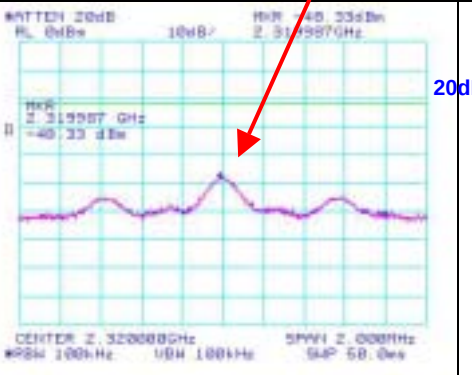
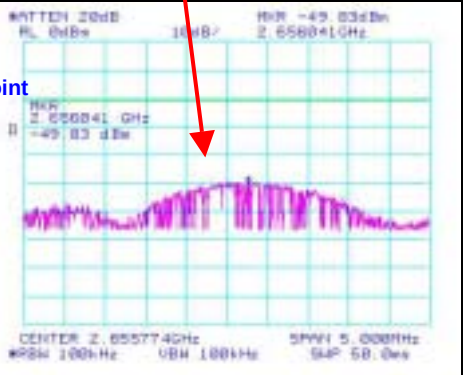
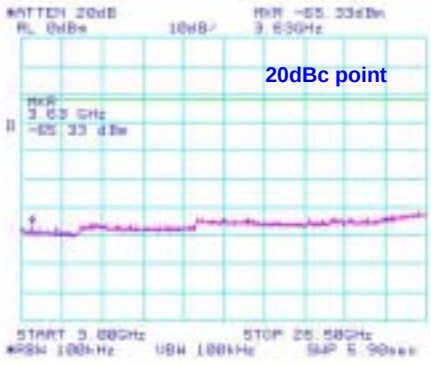
2.244GHz	2.320GHz
	
<< 20dBc	<< 20dBc

20dBc point

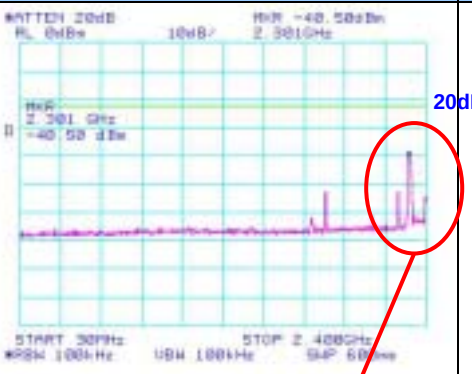
2.4835GHz ~ 3GHz	3GHz ~ 26.5GHz
	
Plot 6.5.4.3	Plot 6.5.4.4

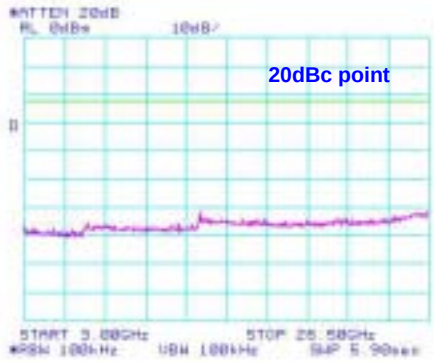
20dBc point

Plots of Conducted Emission

	30MHz ~ 2.4GHz	2.4835GHz ~ 3GHz
802.11g Middle Channel 2437MHz		
	Plot 6.5.5.1	Plot 6.5.5.2
	2.320GHz	2.656GHz
		
	<< 20dBc	<< 20dBc
	3GHz ~ 26.5GHz	
		
	Plot 6.5.5.3	

Plots of Conducted Emission

	30MHz ~ 2.4GHz	2.4835GHz ~ 3GHz
802.11g High Channel 2462MHz		
	Plot 6.5.6.1	Plot 6.5.6.2
	2.305GHz	**2.656GHz**
		
	<< 20dBc	<< 20dBc

3GHz ~ 26.5GHz

Plot 6.5.6.3

6.6 100kHz Bandwidth of Frequency Band Edge

Test Standard	:	FCC Part15 Subpart C Section 15.247(c)
Operating Condition	:	The EUT was operated at transmitting condition continuously during the test.
Temperature/Humidity	:	22.0 °C/ 41 %

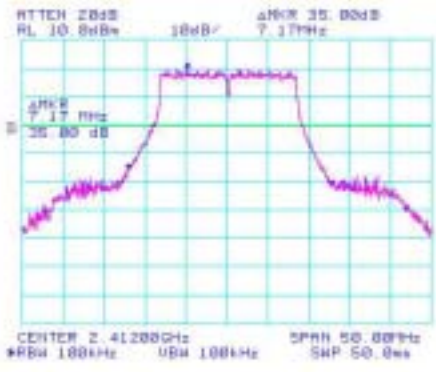
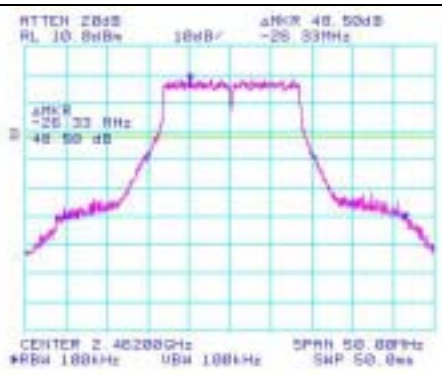
100kHz Bandwidth of Frequency Band Edge Test Data

Frequency (MHz)	Maximum Peak Output Power (dBc)		Limit
	802.11b (DSSS)	802.11g (OFDM)	
2412	41.17	35.00	Less than 20dBc
2462	59.17	48.50	

NOTES :

1. Measure 100kHz bandwidth of Frequency Band Edge of relevant channel using Spectrum Analyzer.

Plots of 100kHz Bandwidth of Frequency Band Edge

Frequency	802.11b (DSSS)	802.11g (OFDM)
2412MHz		
2462MHz		

Tested by ***Choi, Chang-Young***

6.7 Peak Power Spectral Density

Test Standard	:	FCC Part15 Subpart C Section 15.247(d)
Operating Condition	:	The EUT was operated at transmitting condition continuously during the test.
Temperature/Humidity	:	22.0 °C/ 41 %

Peak Power Spectral Density Test Data

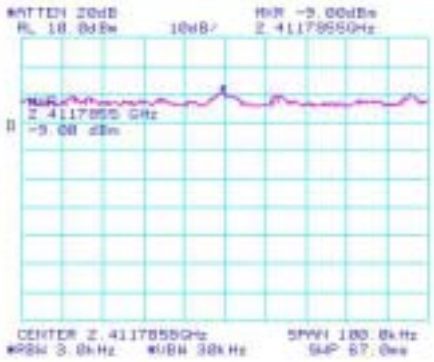
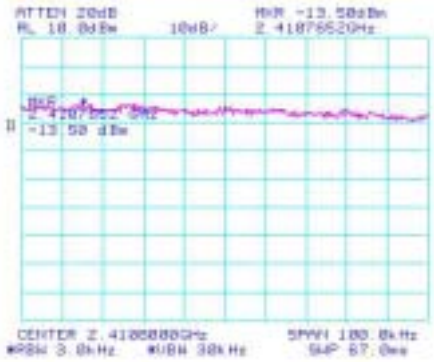
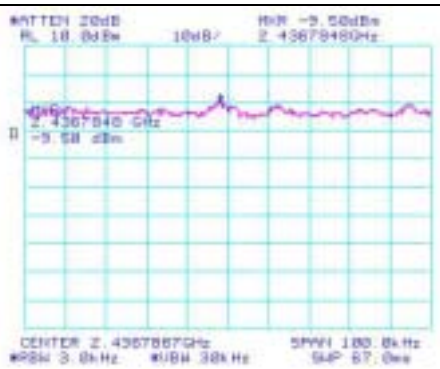
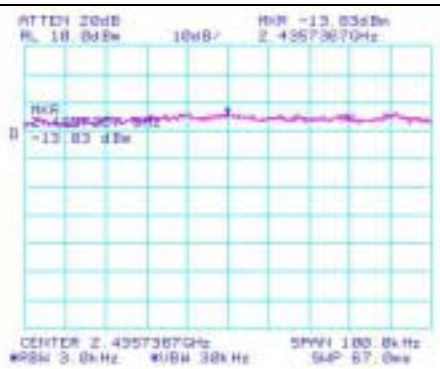
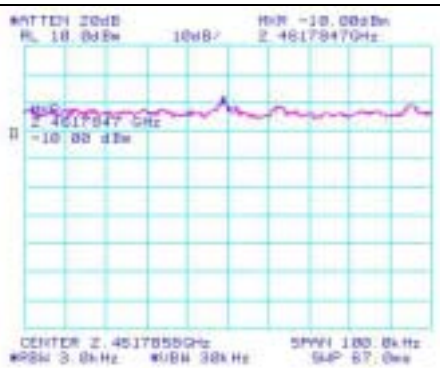
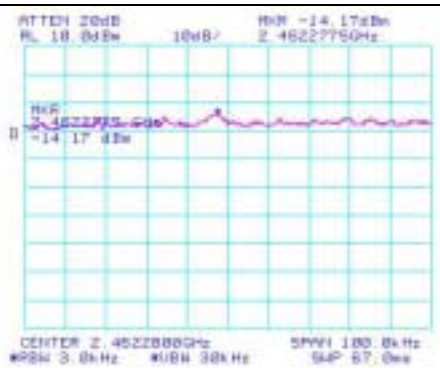
Frequency (MHz)	Peak Power Spectral Density (dBm)		Limit
	802.11b (DSSS)	802.11g (OFDM)	
2412	-9.00	-13.50	Less than 8dBm
2437	-9.50	-13.83	
2462	-10.00	-14.17	

NOTES :

1. *Measure Peak Power Spectral of relevant channel using Spectrum Analyzer.*
2. *RBW 3kHz, VBW 3kHz, Span 100kHz*
3. *Test Plot – Next Page*

Tested by ***Choi, Chang-Young***

Plots of Peak Power Spectral Density

Frequency	802.11b (DSSS)	802.11g (OFDM)
2412MHz		
2437MHz		
2462MHz		

6.8 RF Exposure Requirement

6.8.1 Method of Measurement

Spread spectrum transmitters operating under section 15.247 are categorically from routine environmental evaluation to demonstrating RF exposure compliance with respect to MPE and/or SAR limits.

These devices are not exempted from compliance does not exceed the Commission's RF exposure guidelines. Unless a device operates at substantially low power levels, with a low gain antenna(s), supporting information is generally needed to establish the various potential operating configurations and exposure conditions of a transmitter and its antenna(s) in order to determine compliance with the RF exposure guidelines.

In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.

Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits Any other RF exposure related issues that may affect MPE compliance.

6.8.2 Limits

FCC 1.1310:- The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm2)	Average Time (minutes)
(A) Limits for Occupational/Control Exposures				
1500 - 100000	-	-	5	6
(B) Limits for General Population/Uncontrolled Exposure				
1500 - 100000	**-**	**-**	**1.0**	**30**

6.8.3 Test Result

Frequency (MHz)		Output Power (dBm)	Antenna Gain (dBi)	Calculated EIRP (mWatt)	The time averaged power over 30 minutes (Watt)	Laboratory's Recommended Minimum RF Safety Distance r (Cm)	Power Density in mW/cm^2 at Formula When r=20Cm (mW/cm^2)
DSSS 802.11b	2412	17.7	2.67	108.89	108.89	2.94	0.0217
	2437	16.9	2.10	79.43	79.43	2.51	0.0158
	2462	16.5	2.30	75.86	75.86	2.46	0.0151
OFDM 802.11g	2412	14.7	2.67	54.58	54.58	2.08	0.0109
	2437	13.9	2.10	39.81	39.81	1.78	0.0079
	2462	13.7	2.30	39.81	39.81	1.78	0.0079

Calculation Method of RF Safety Distance:

$$S = \frac{PG}{4\pi r^2} = \frac{EIRP}{4\pi r^2}$$

P : power input to the antenna in mW
EIRP : Equivalent (effective) isotropic radiated power.
S : power density mW/cm2
G : numeric gain of antenna relative to isotropic radiator
R : distance to centre of radiation in cm

FCC radio frequency exposure limits may be exceeded at distances closer than r cm from the antenna of this device

$$r = \sqrt{\frac{PG}{4\pi S}} = \sqrt{\frac{EIRP}{4\pi S}}$$

Note :

1. *S = 1.0 mW/cm^2 for Limits for General Population/Uncontrolled Exposures.*
2. *The time averaged power over 30 minutes will be equaled Output Power.*
3. *Minimum calculated separation distance between antenna and persons required : 2.94Cm*
4. *The Power Density at a distance of 20Cm calculated from the formula is far below the limit of 1mW/cm^2.*
5. *So, RF exposure limit warning or SAR test are not required.*

Tested by ***Choi, Chang-Young***

7. TEST EQUIPMENTS LIST

The listing below denotes the test equipments utilized for the test(s).

Test Equipment	Model	Mfg.	Serial No.	Cal. Due Date
Spectrum Analyzer	8594E	H.P.	3911A08040	05-12-28
Spectrum Analyzer	E7403A	ADVANTEST	61720002	05-05-18
Receiver	ESH3	R & S	892580/014	05-08-30
Signal Generator	E4432B	H.P.	US40053157	06-03-10
Signal Generator	GT9000	GIGATRONICS	9604010	06-03-10
Power Meter	E4418A	H.P.	GB38272621	06-03-10
Power Sensor	8481A	H.P.	3318A92101	06-03-10
Audio Analyzer	8903B	H.P.	3011A09344	06-03-10
Modulation Analyzer	8901B	H.P.	3028A03124	06-03-10
Function Generator	FG-2002C	GOLD STAR	207095	06-01-13
Broadband Power Amplifier	100W 10000M 11	Amplifier Research	18649	05-12-29
Broadband Power Amplifier	75A220	Amplifier Research	15326	05-12-29
Preamplifier	8447E	H.P.	2945A02712	05-08-30
Preamplifier	8449B	H.P.	US39172380	05-08-30
Horn Antenna	BBHA 9120 D	Schwarz Beck	234	07-02-07
Horn Antenna	BBHA 9170	Schwarz Beck	157	07-02-07
Dipole Antenna	VDA6106A / UHA9105	Schaffner-chase	1277	05-09-12
Biconical Antenna	VHA9103	Schwarzbeck	-	06-02-04
Log Periodic Antenna	UPA6109	SCHAFFNER	1076	06-02-04
Attenuator	8325	BIRD	4572	06-03-10
Attenuator	RFA500NMF30	RFA500NMF30	9522	05-12-28
Termination	8173	BIRD	2501	-
Dual directional coupler	772D	H.P.	2839A00395	05-12-28
Dual directional coupler	778D	H.P.	1144A08477	05-10-15
LISN	L3-25	PMM	1110KT0403	05-04-06
LISN	LI-115	COM-POWER	8-920-20	05-10-27
Digital Oscilloscope	TDS3032	Tektronix	B081558	05-12-28
Turn-Table	JAC-2	JAEMC	-	-
Antenna Master	JAC-1	Daeil EMC	-	-
Plotter	7550A	H.P	2725A 75529	-
EMC Anechoic Chamber	-	SEMITECH	000815	
Temp/Humidity Chamber	-	Seo jin	-	05-09-03
Thermo Hygrograph	PC-5000TRH-II	SATO	-	-
BaroMeter	KEIRYOKI	SATO	564021	05-09-15
Slidacs	DeaKyong Slidacs	DeaKyong	-	-