



ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

Test report file number : E058R-057

Applicant : Bluebird Soft Inc.
Address : 558-5, Sinsa-dong, Gangnam-gu, Seoul, Korea

Manufacturer : Bluebird Soft Inc.
Address : 558-5, Sinsa-dong, Gangnam-gu, Seoul Korea

Type of Equipment : INDUSTRIAL PDA with Bluetooth and WLAN 802.11b

FCC ID. : SS4BIP5X00

Model Name : BIP-5000

Serial number : None

Total page of Report : 65 pages (including this page)

Date of Incoming : June 21, 2005


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SUMMARY

The equipment complies with the regulation; **FCC Part 15 Subpart C Section 15.247.**

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

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**1. VERIFICATION OF COMPLIANCE**

APPLICANT : Bluebird Soft Inc.
ADDRESS : 558-5, Sinsa-dong, Gangnam-gu, Seoul, Korea
CONTACT PERSON : Myung-Hoon, Kim / Assistant Quality Manager
TELEPHONE NO : +82-1588-1363
FCC ID : SS4BIP5X00
MODEL NO/NAME : BIP-5000
SERIAL NUMBER : N/A
DATE : August 25, 2005

EQUIPMENT CLASS	<i>DSS – PART 15 SPREAD SPECTRUM TRANSMITTER DTS – DIGITAL TRNSMISSION SYSTEM</i>
KIND OF EQUIPMENT	INDUSTRIAL PDA with Bluetooth and WLAN 802.11b
THIS REPORT CONCERNS	ORIGINAL GRANT
MEASUREMENT PROCEDURES	ANSI C63.4/2003
TYPE OF EQUIPMENT TESTED	PRE-PRODUCTION
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	CERTIFICATION
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	NONE
FINAL TEST WAS CONDUCTED ON	3 METER(S) OPEN AREA TEST SITE

- This device has shown compliance with the conducted emissions limits in 15.207 adopted under FCC 02-107 (ET Docket 98-80). The device may be marketed after July 11, 2005 and is not affected by the 15.37(j) transition provisions.
- The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (1)	Carrier Frequency Separation	Met the Limit / PASS
15.247 (a) (1) (iii)	Minimum Number of Hopping Channels	Met the Limit / PASS
15.247 (a) (1) (iii)	Average Time of Occupancy	Met the Limit / PASS
15.247 (a) (2)	Minimum 6dB Bandwidth	Met the Limit / PASS
15.247 (b) (3)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (b) (5)	Radio Frequency Exposure Level	Met the Limit / PASS
15.247 (c)	100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (c)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.247 (d)	Peak Power Spectral Density	Met the Limit / PASS
15.209 and 15.109	Radiated Emission Limits	Met the Limit / PASS
15.207 and 15.107	Conducted Limits	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / PASS

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in section 2.1.

2.5 Test Methodology

Radiated testing was performed according to the procedures in ANSI C63.4/2003. Radiated testing was performed at a distance of 3 meters from EUT to the antenna.

2.6 Test Facility

The Electromagnetic compatibility measurement facilities are located on at 426-1 Daessangryung-Ri, Chowol-Myeon, Gwangju-Si, Gyeonggi-Do 464-080 Korea. Description details of test facilities were submitted to the Federal Communications Commission on January 18, 2002 (Registration Number: 92819 and 340658), accredited by KOLAS (Korea Laboratory Accreditation Scheme, No: 85) and approved by TUV, DNV, SEMKO and MIC (Ministry of Information and Communications in Korea) according to the requirement of ISO17025.



3. GENERAL INFORMATION

3.1 Product Description

The Bluebird Soft Inc., Model BIP-5000 (referred to as the EUT in this report) is an INDUSTRIAL PDA with Bluetooth and WLAN 802.11b, which has bar code reader, a CCD Camera module, and a cradle for battery charging, and data uploading/downloading using USB cable. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	INDUSTRIAL PDA with Bluetooth and WLAN 802.11b
OPERATING FREQUENCY	Bluetooth: 2402~2480 MHz WLAN: 2412-2472 MHz
OUTPUT POWER	Bluetooth: -4.3dBm WLAN: 16.8dBm
DATA TRANSFER RATE	Bluetooth: 723.2 Kbps WLAN: 1, 2, 5.5, and 11 Mbps
CHANNEL	Bluetooth: 79 Channels WLAN: 11 Channels
MODULATION TYPE	Bluetooth: FHSS WLAN: DSSS
ANTENNA	WLAN: Helical Type, Bluetooth: SMT Chip Type
ANTENNA GAIN	WLAN: -0.74dBi, Bluetooth: 2.0dBi
USED 802.11b WLAN MODULE	MFR: Samsung Electro-Mechanics Co., Ltd.
	Model No: SWL-2450C
LIST OF EACH OSC. OR CRYSTAL. FREQ.(FREQ.>=1MHz)	13.0, 14.7456, 24.576, and 26 MHz
NUMBER OF LAYER	Main Board: 8 Layers
POWER REQUIREMENT	AC 100~240Vac, 2.4A from AC/DC Adapter Model Name: PW118KA0503N52, MFR: Ault Korea Corp. Rechargeable and Removable 3.7V Battery
EXTERNAL CONNECTOR	PDA: Earphone, Cradle: USB Port

3.2 Alternative type(s)/model(s); also covered by this test report.

No other model differences have been mentioned.

4. EUT MODIFICATIONS

None



5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
802.11b WLAN Module	Samaung	SWL-2450C	N/A
Main Board	Bluebird Soft Inc	ROADBEE	N/A
Camera Module	N/A	N/A	N/A
Barcode Reader	Symbol Technologies Inc	SE-923-1000A	N/A
Key Board	Bluebird Soft Inc	Bip-5000	N/A
LCD Module	N/A	TD035STEB1	N/A

5.3 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	FCC ID	Description	Connected to
BIP-5000	Bluebird Soft Inc.	SS4BIP5X00	INDUSTRIAL PDA with Bluetooth and WLAN 802.11b (EUT)	HOST
CRA-5000	Hwail Electronics	N/A	Cradle for the EUT	EUT
PW118KA0503N52	Ault Korea Corp.	N/A	AC/DC Adapter for EUT	EUT
Latitude D505	Dell	DoC	Notebook P.C. (HOST)	EUT
ISA11-050240TI	TPI Tech Power	N/A	AC/DC Adapter for HOST	HOST
020-0470	Cardinal	GDE0196	Modem	HOST
2225C	HP	DS16XU2225	Printer	HOST

5.4 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting and receiving mode is programmed. For final testing, WLAN was set at Low Channel (2412MHz), Middle Channel (2437MHz), and High Channel (2462MHz) with 11Mbps data rate and Bluetooth was set at Low Channel (2402MHz), Middle Channel (2441MHz), and High Channel (2480MHz). To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

For test for digital part of the EUT, the USB port of the cradle was connected to a personal computer and then the EUT continuously transferred data to the personal computer during the test.



5.5 Configuration of Test System

Line Conducted Test: The power cord of the EUT was connected to LISN. All supporting equipments were connected to another LISN. Preliminary Power lines Conducted Emission tests were performed by using the procedure in ANSI C63.4/2003 7.2.3 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.4/2003 8.3.1.1 and 13.1.4.1 to determine the worse operating conditions. Final radiated emission tests were conducted at 3meter open area test site.
The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.6 Antenna Requirement

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

Antenna Construction:

The transmitter antenna of the EUT is installed inside of the EUT, so no consideration of replacement by the user.



6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Tests, the following operating mode was investigated

Operation Mode	The Worse operating condition (Please check one only)
Stand-by mode	
Charging mode	
TX mode	X

6.2 General Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Stand-by mode	
Charging mode	
TX mode	X

7. TEST DATA FOR 802.11b WLAN MODE

7.1 MINIMUM 6dB BANDWIDTH

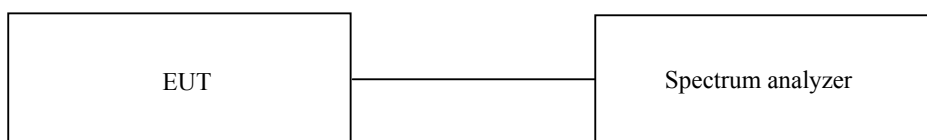
7.1.1 Operating environment

Temperature : 23°C

Relative humidity : 36 %

7.1.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 6dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.



7.1.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Due Cal
■ -	8564E	HP	Spectrum Analyzer	3650A00756	July 19, 2006

All test equipment used is calibrated on a regular basis.



7.1.4 Test data

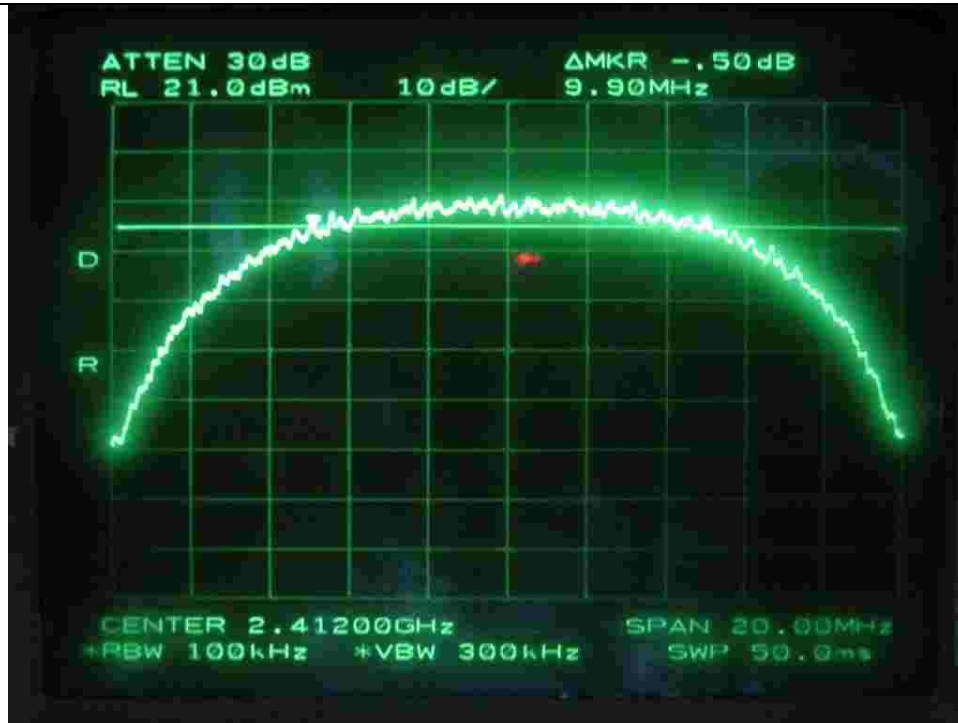
- Test Date : July 05, 2005
- Test Result : Pass

CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2412	9900	500	9400
Middle	2437	9830	500	9330
High	2462	9930	500	9430

Remark: See next page for an overview sweep performed with peak detector.

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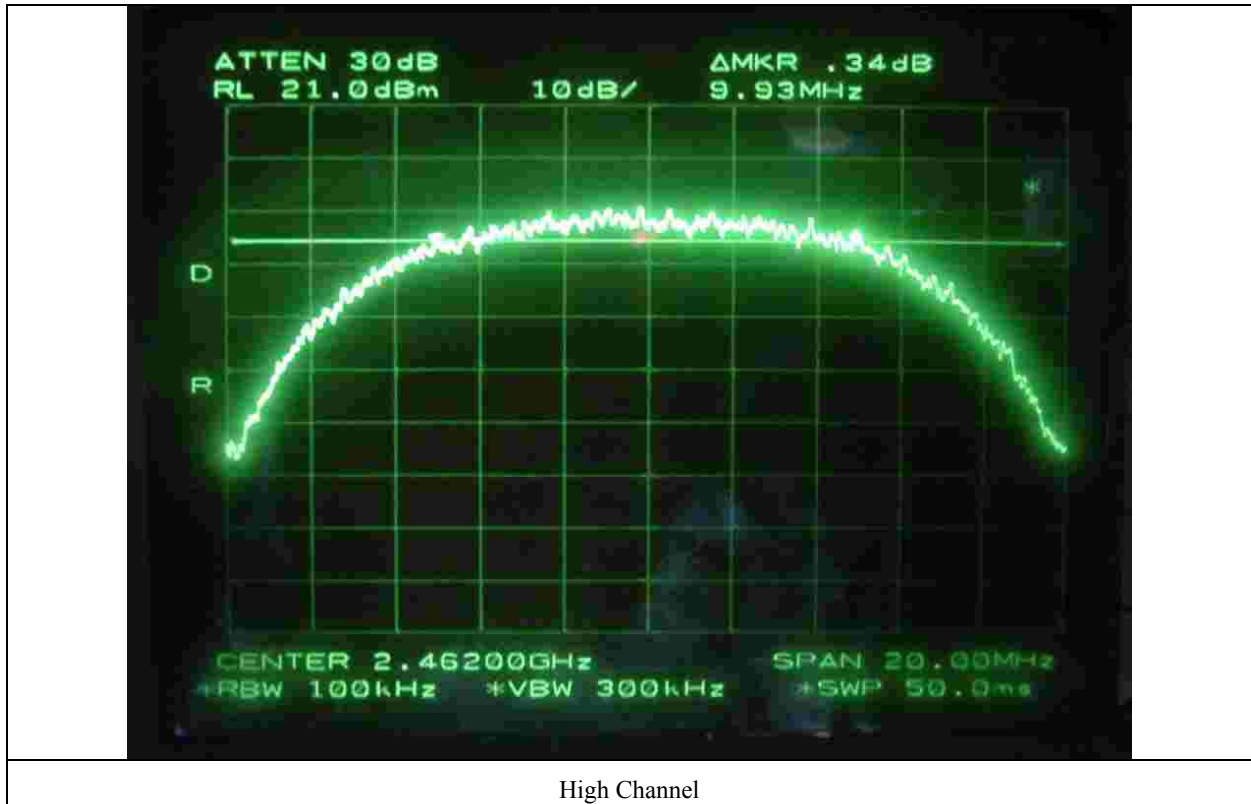
Tested by: Ki-Hong, Nam / Test Engineer



Low Channel



Middle Channel



7.2. MAXIMUM PEAK OUTPUT POWER

7.2.1 Operating environment

Temperature : 23°C

Relative humidity : 36 %

7.2.2 Test set-up

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The spectrum analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth. The EUT was operating in transmit mode at the appropriate center frequency.



7.2.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due Cal
■ - 8564E	HP	Spectrum Analyzer	3650A00756	July 19, 2006

All test equipment used is calibrated on a regular basis.

**7.2.4 Test data**

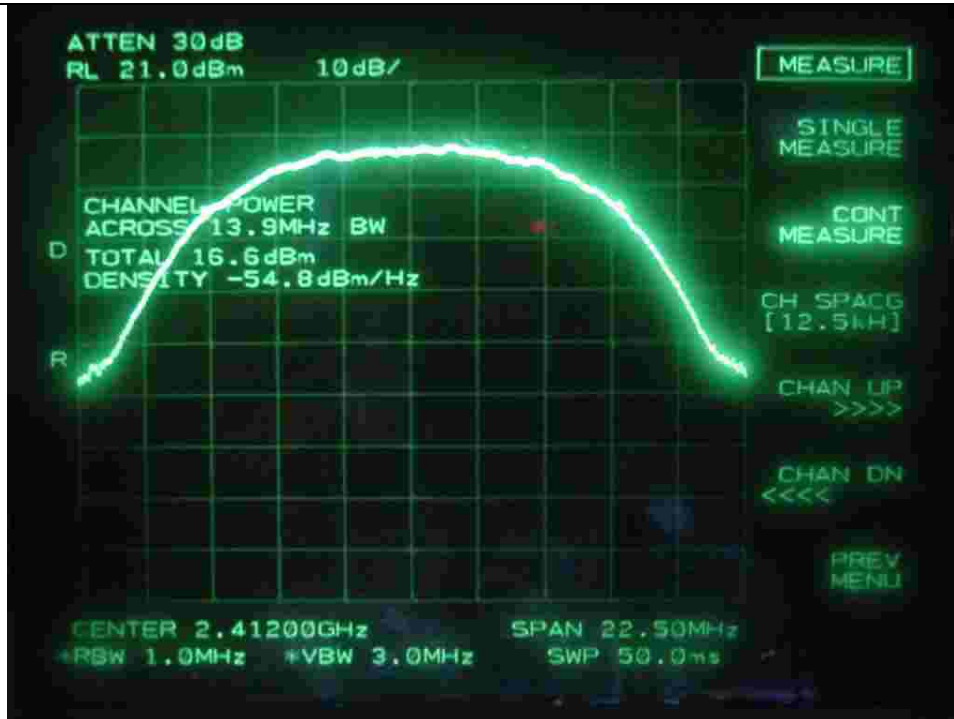
- Test Date : July 05, 2005

- Test Result : Pass

CHANNEL	FREQUENCY (MHz)	99% Occupied Bandwidth (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2412	13.88	16.6	30.0	-13.4
Middle	2437	13.91	16.8	30.0	-13.2
High	2462	13.95	16.1	30.0	-13.9

Remark: See next page for an overview sweep performed with peak detector.

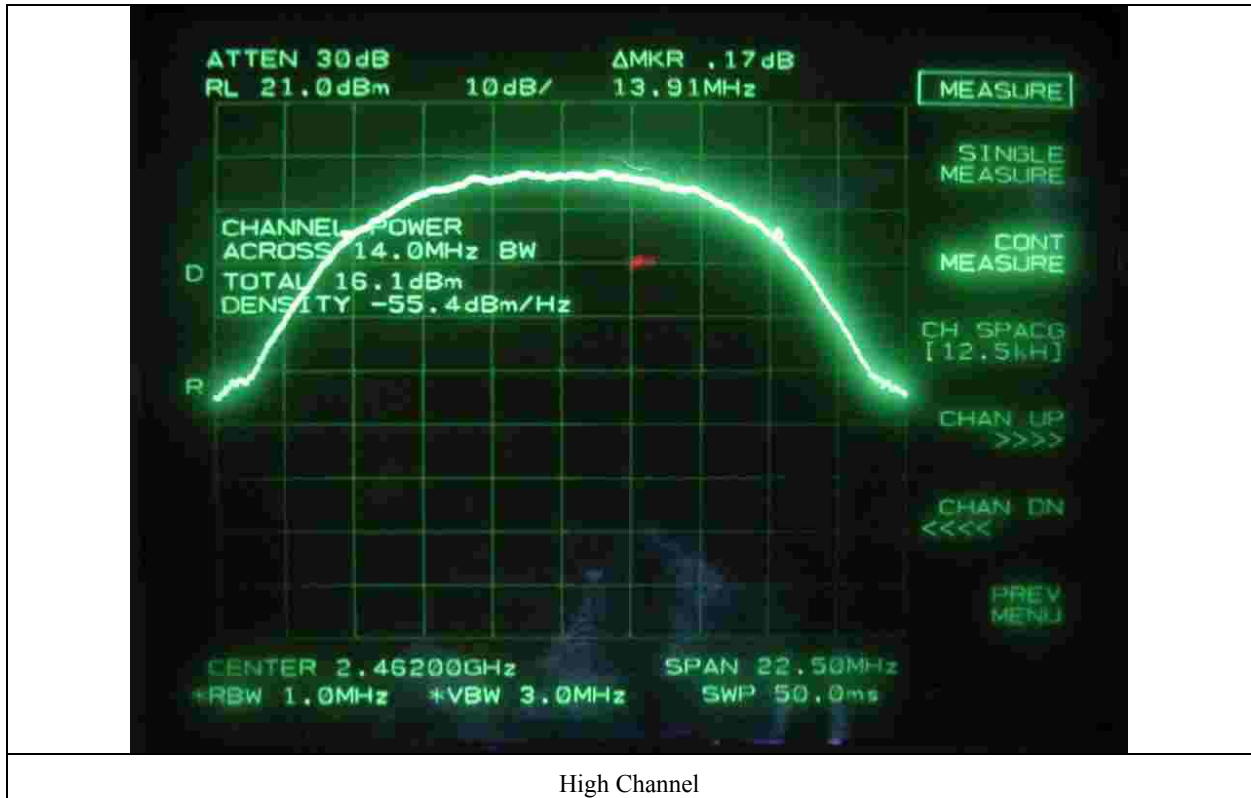
Tested by: Ki-Hong, Nam / Test Engineer



Low Channel



Middle Channel



7.3 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

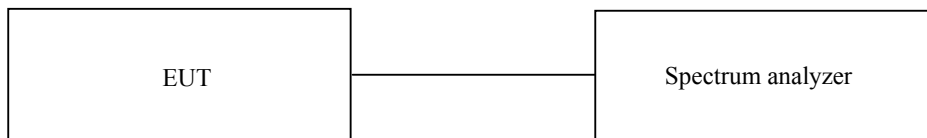
7.3.1 Operating environment

Temperature : 23°C

Relative humidity : 36 %

7.3.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.



7.3.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3meters, open-field test site. The EUT was placed on a non-conductive turntable approximately 0.8 meters above the ground plane.

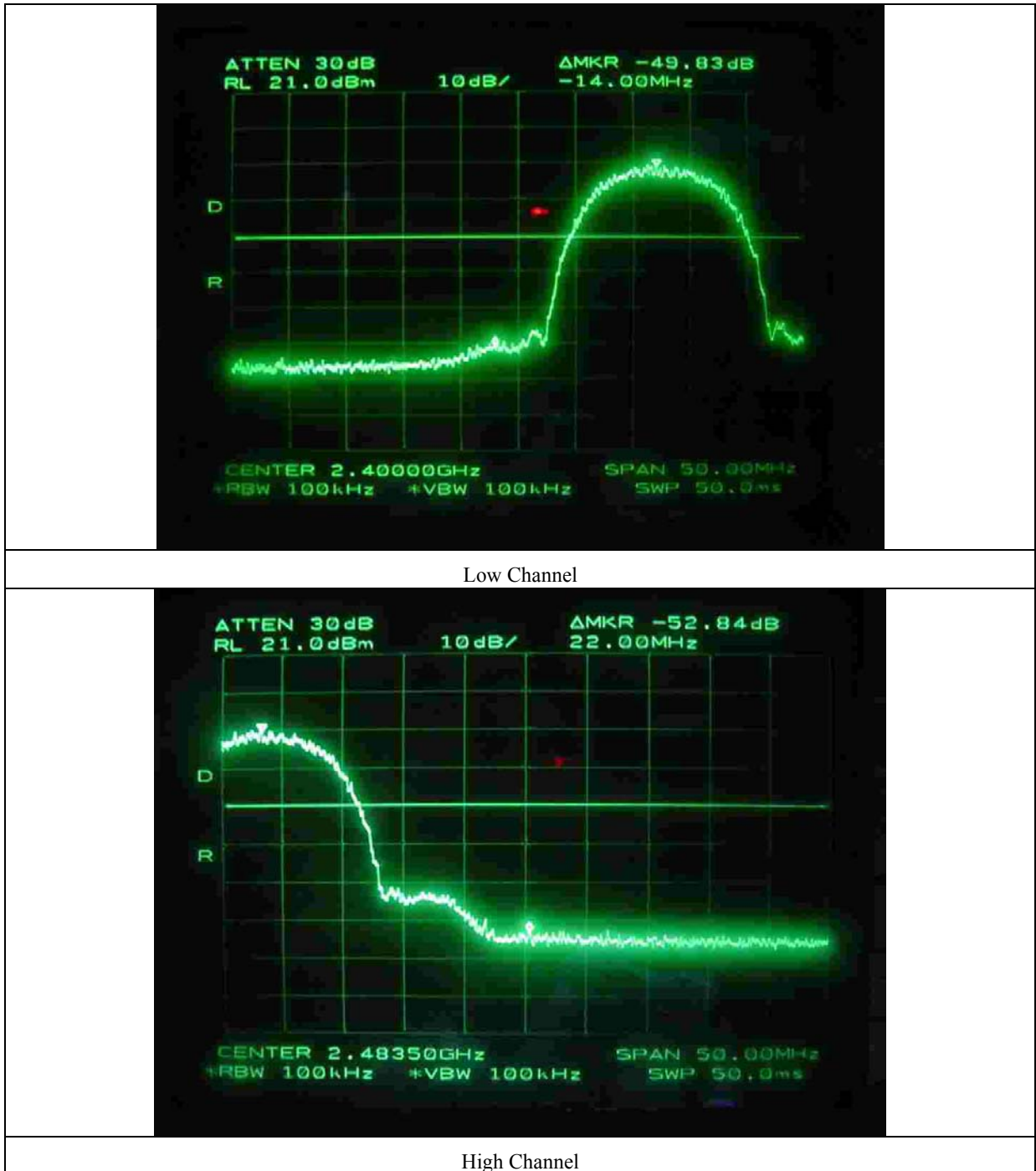
The frequency spectrum from 30MHz to 25GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 and 4.0 meters in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

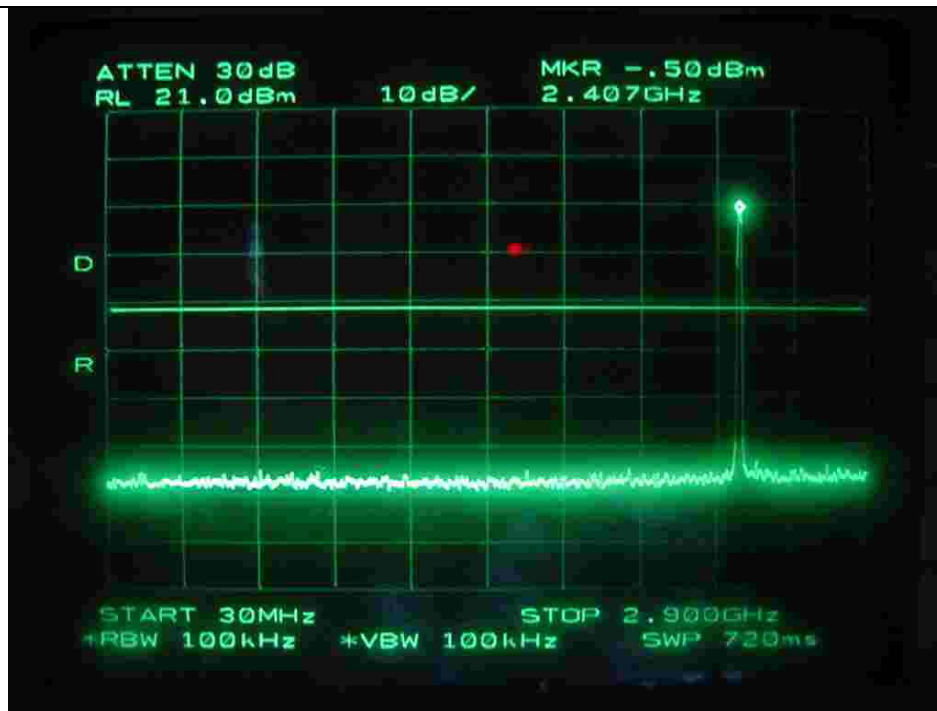
7.3.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Due Cal.
■ -	8564E	Hewlett-Packard	Spectrum Analyzer	3650A00756	July 19, 2006
■ -	8449B	Hewlett-Packard	Preamplifier	3008A00833	June 19, 2006
□ -	83051A	Agilent	Preamplifier	3950M00201	June 10, 2005
■ -	F-40-5000-RF	RLC Electronics	Highpass Filter	0425	June 19, 2006
■ -	MA220	HD	Turn Table	N/A	N/A
■ -	HD240	HD	Antenna Mast	N/A	N/A
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	June 6, 2006
■ -	YSE 500B	YoungShin Eng.	Frequency Converter	950413001	N/A
■ -	ETCR-10	DaeHa	Automatic Voltage Com.	N/A	N/A

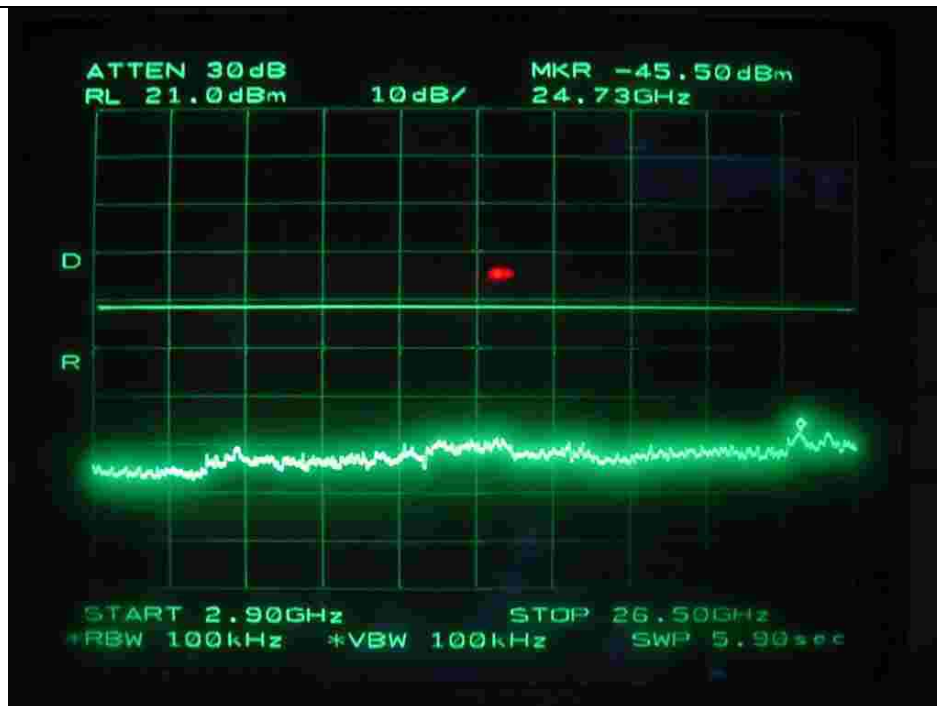
All test equipment used is calibrated on a regular basis.

7.3.5. Test data for conducted emission

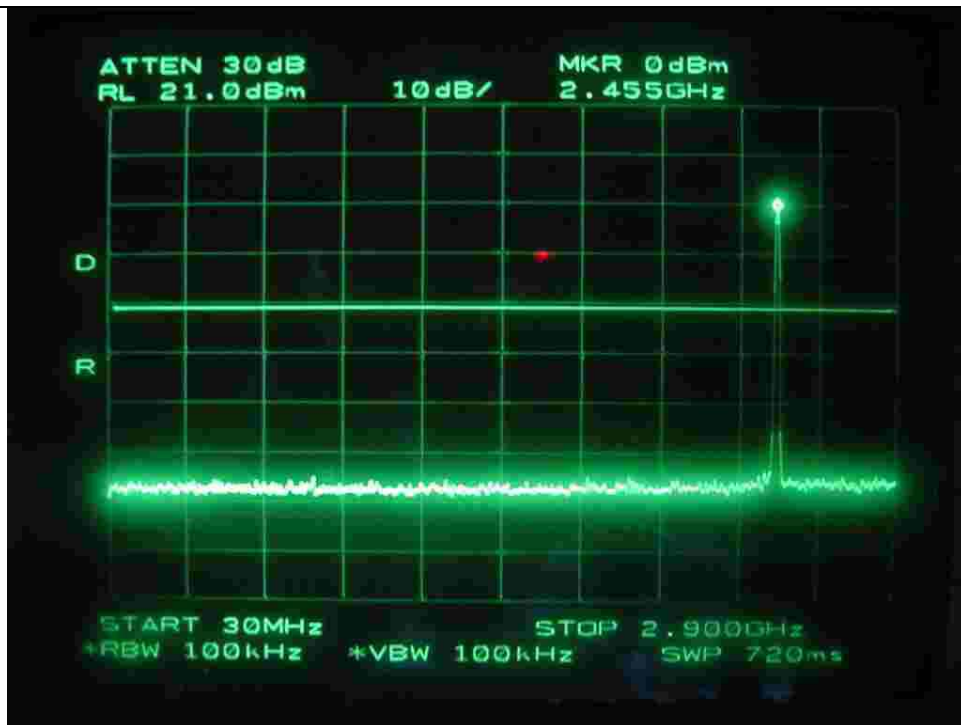




Low Channel



Low Channel



High Channel



High Channel



7.3.6. Test data for radiated emission

7.3.6.1 Operating condition: 802.11b Mode

7.3.6.1.1 Radiated Emission which fall in the Restricted Band

- Test Date : July 7, 2005
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10Hz for Average Mode
- Frequency range : 1 GHz ~ 25GHz
- Measurement distance : 3m
- Operating Condition : Low / High Channel
- Result : PASSED BY -23.63 dB at High Channel

Frequency (MHz)	Reading (dBuV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Dist. Factor	Total (dBuV/m)	Limits (dBuV/m)	Margin (dB)
Test Data for Low Channel										
2388.75	38.67	Peak	H	27.64	1.33	26.1		41.54	74.0	-32.46
	39.33	Peak	V					42.20	74.0	-31.80
	26.50	Average	H					29.37	54.0	-24.63
	27.50	Average	V					30.37	54.0	-23.63
Test Data for High Channel										
2486.08	38.00	Peak	H	27.59	1.33	26.1		40.81	74.0	-33.18
	38.83	Peak	V					41.65	74.0	-32.35
	26.33	Average	H					29.15	54.0	-24.85
	27.17	Average	V					29.99	54.0	-24.01

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

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Tested by: Ki-Hong, Nam / Test Engineer



7.3.6.1.2 Spurious & Harmonic Radiated Emission

- Test Date : July 7, 2005
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 1 MHz for Peak Mode, 10Hz for Average Mode
- Frequency range : 1 GHz ~ 25 GHz
- Measurement distance : 3m
- Result : PASSED BY -6.94 dB at High Channel

Frequency (MHz)	Reading (dBuV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Dist. Factor	Total (dBuV/m)	Limits (dBuV/m)	Margin (dB)
Test Data for Low Channel										
2412.33	77.33	Peak	H	27.62	1.33			106.18	-	
	85.50	Peak	V					114.45	-	
4824.05*	38.67	Peak	V	31.30	2.67	26.10		46.54	74.00	-27.46
	29.50	Average	V					37.37	54.00	-16.63
7236.12*	37.00	Peak	V	36.54	5.83	26.20		52.17	74.00	-20.83
	28.83	Average	V					45.00	54.00	-9.00
Test Data for Middle Channel										
2437.07	80.67	Peak	H	27.61	1.33			109.61	-	
	86.17	Peak	V					115.11	-	
4874.22*	38.67	Peak	V	31.37	2.67	26.10		46.61	74.00	-27.39
	28.33	Average	V					36.27	54.00	-17.73
7311.05*	38.50	Peak	V	36.56	6.50	26.10		55.46	74.00	-18.54
	28.50	Average	V					45.46	54.00	-8.54

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "*" Frequency fall in restricted band



-Continued

Frequency (MHz)	Reading (dBuV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Dist. Factor	Total (dBuV/m)	Limits (dBuV/m)	Margin (dB)
Test Data for High Channel										
2462.58	79.33	Peak	H	27.60	1.33			108.26	-	
	87.17	Peak	V					116.10	-	
4924.17*	37.33	Peak	V	31.44	2.67	26.10		45.34	74.00	-28.66
	28.50	Average	V					36.51	54.00	-17.49
7386.09*	35.83	Peak	V	36.59	8.67	26.20		54.89	74.00	-19.11
	28.00	Average	V					47.06	54.00	-6.94

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "*" Frequency fall in restricted band

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Tested by: Ki-Hong, Nam / Test Engineer

7.4. PEAK POWER SPECTRUL DENSITY

7.4.1 Operating environment

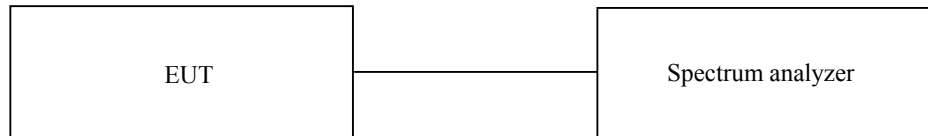
Temperature : 23°C

Relative humidity : 36 %

7.4.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 3 kHz, the video bandwidth is set to 3 times the resolution bandwidth, and sweep time was set to span / 3 kHz. The sweep time was allowed to be longer than span / 3 kHz for a full response of the mixer in the spectrum analyzer.

The maximum level from the EUT in a 3 kHz bandwidth was measured with above condition.



7.4.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due Cal
■ - 8564E	HP	Spectrum Analyzer	3650A00756	July 19, 2006

All test equipment used is calibrated on a regular basis.



7.4.4 Test data

- Test Date : July 5, 2005
- Test Result : Pass

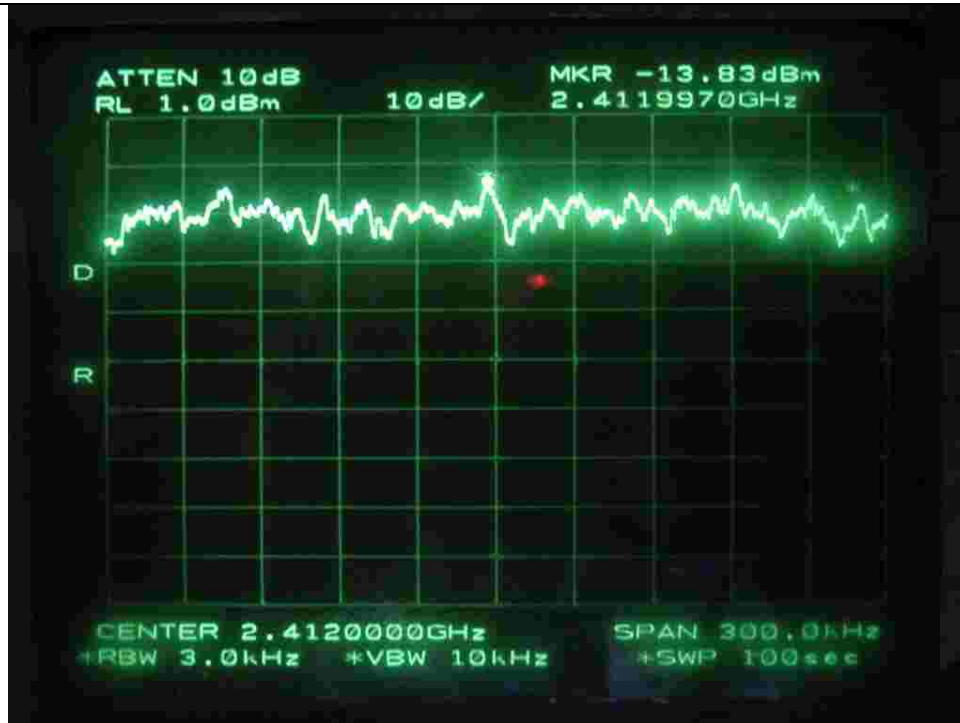
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2412	-13.83	8	-21.83
Middle	2437	-12.67	8	-20.67
High	2462	-12.83	8	-20.83

Remark: See next page for an overview sweep performed with peak detector.

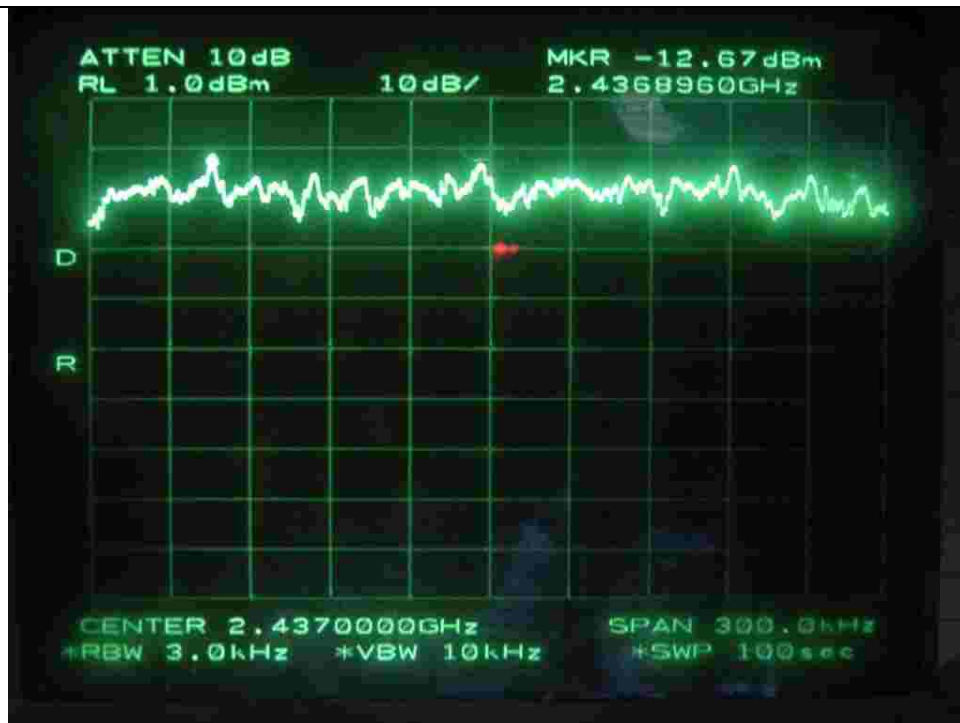
Remark: See next page for measurement data.

기홍

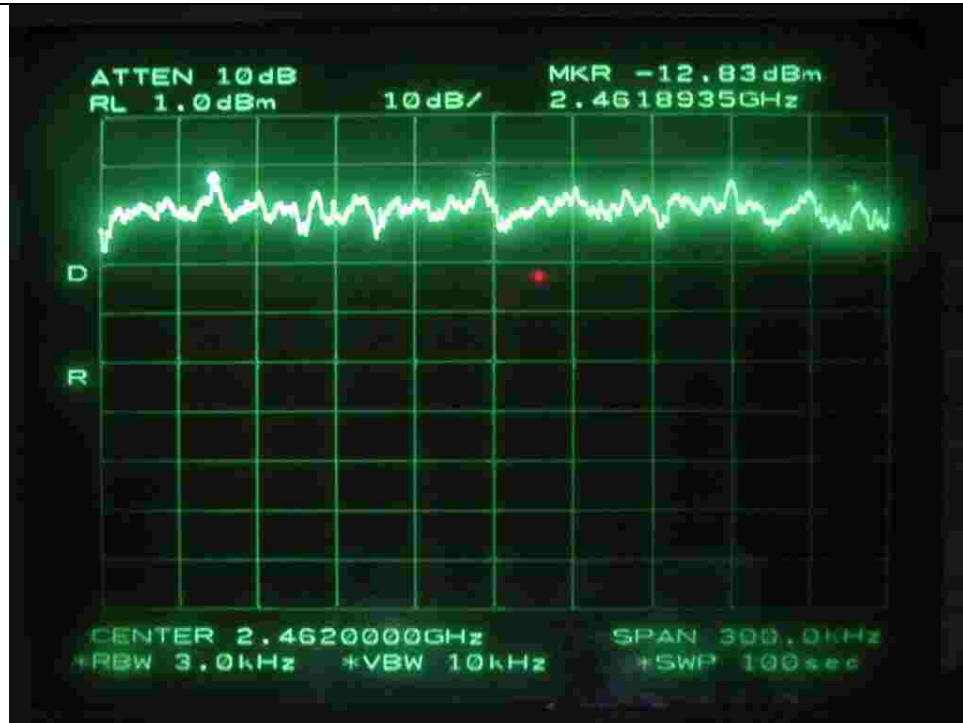
Tested by: Ki-Hong, Nam / Test Engineer



Low Channel



Middle Channel



High Channel



8. TEST DATA FOR BLUETOOTH MODE

8.1. 20dB BANDWIDTH

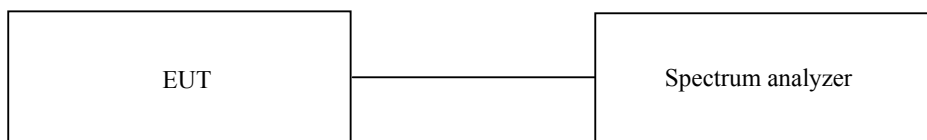
8.1.1 Operating environment

Temperature : 23°C

Relative humidity : 49 %

8.1.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 10 kHz, and peak detection was used. The 20dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 20 dB.



8.1.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due Cal
■ - 8564E	HP	Spectrum Analyzer	3650A00756	July 19, 2006

All test equipment used is calibrated on a regular basis.

8.1.4 Test data

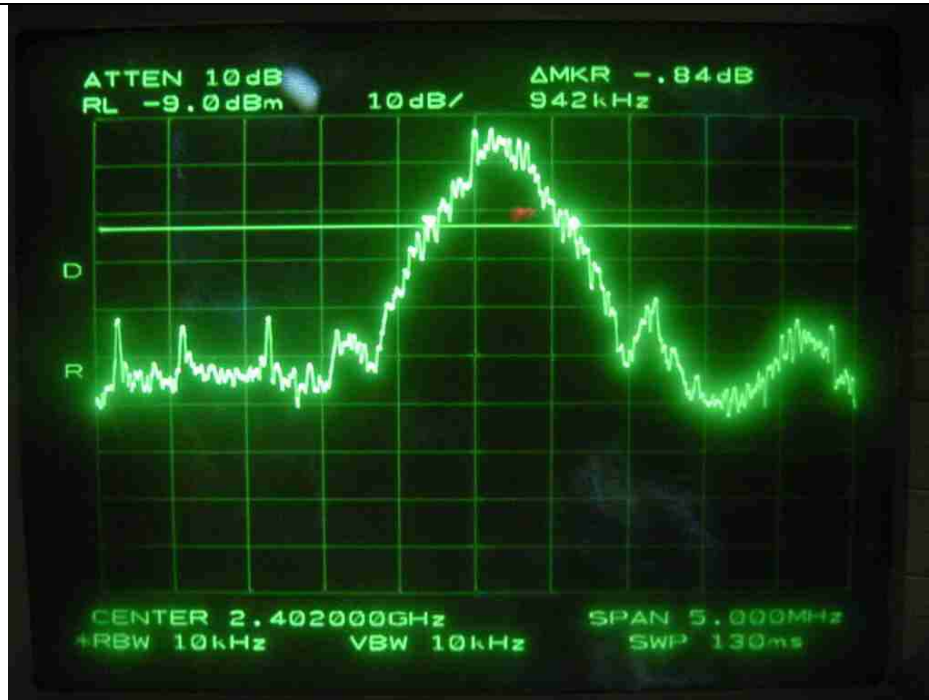
- Test Date : July 19, 2005

- Test Result : Pass

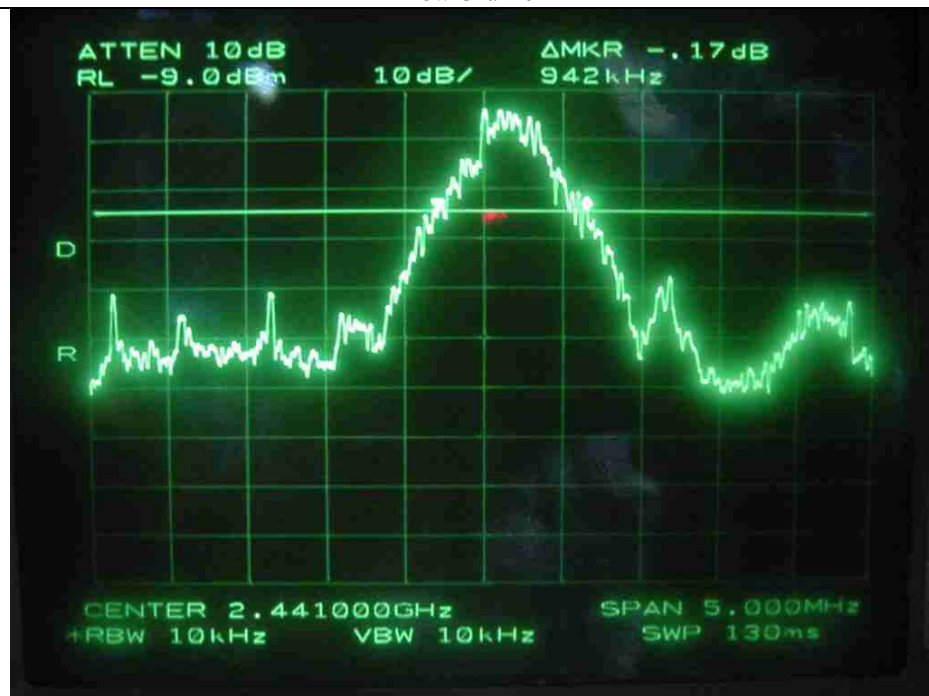
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2402	942	1000	-58
Middle	2441	942	1000	-58
High	2480	933	1000	-67

Remark: See next page for an overview sweep performed with peak detector.

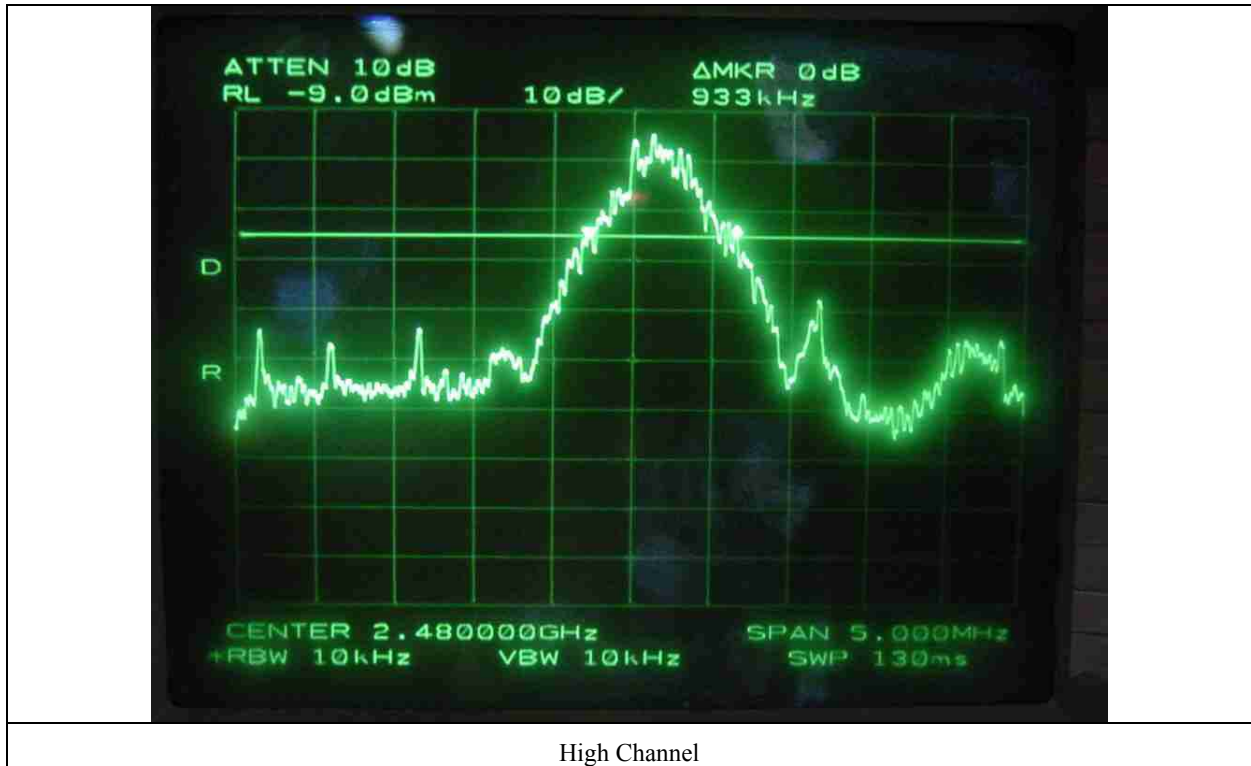
Tested by: Ki-Hong, Nam / Test Engineer



Low Channel



Middle Channel



8.2. HOPPING FREQUENCY SEPARATION

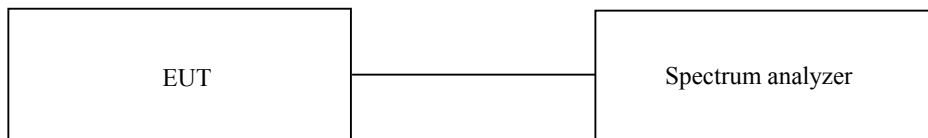
8.2.1 Operating environment

Temperature : 23°C

Relative humidity : 49 %

8.2.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 10 MHz. The analyzer is set to peak hold , then a pseudo-random hopping sequence of the transmitter is captured. The mark delta function was used to measure the frequency separation between two adjacent hopping channels.



8.2.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due Cal
■ - 8564E	HP	Spectrum Analyzer	3650A00756	July 19, 2006

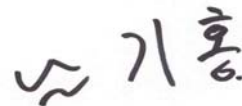
All test equipment used is calibrated on a regular basis.

8.2.4 Test data

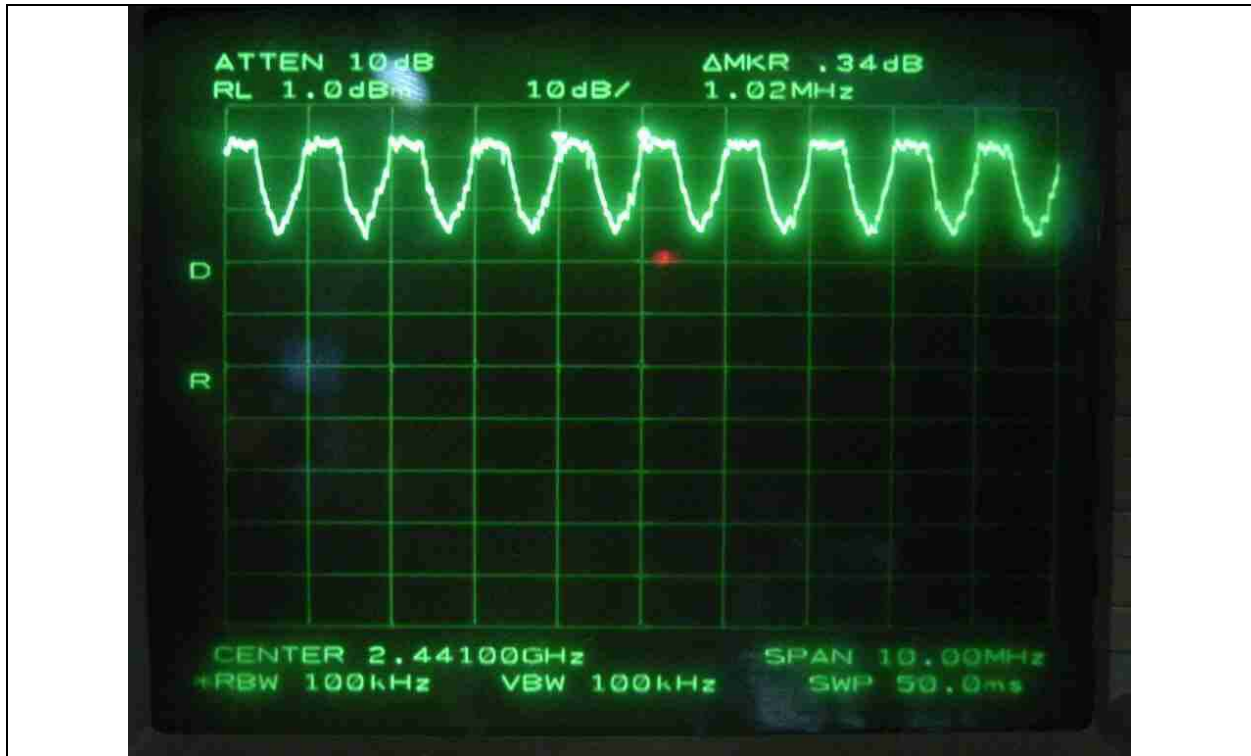
-. Test Date : July 19, 2005

-. Test Result : Pass

MEASURED VLAUE (kHz)	LIMIT, 20dB Bandwidth (kHz)	MARGIN (kHz)
1020	942	-78



Tested by: Ki-Hong, Nam / Test Engineer



8.3. NUMBER OF HOPPING CHANNELS

8.3.1 Operating environment

Temperature : 23°C

Relative humidity : 49 %

8.3.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 100 MHz and the resolution bandwidth is set to 1 MHz. The analyzer is set to peak hold and then complete pseudo-random hopping sequence of the transmitter is captured.



8.3.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due Cal
■ - 8564E	HP	Spectrum Analyzer	3650A00756	July 19, 2006

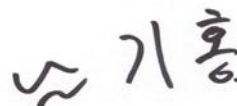
All test equipment used is calibrated on a regular basis.

8.3.4 Test data

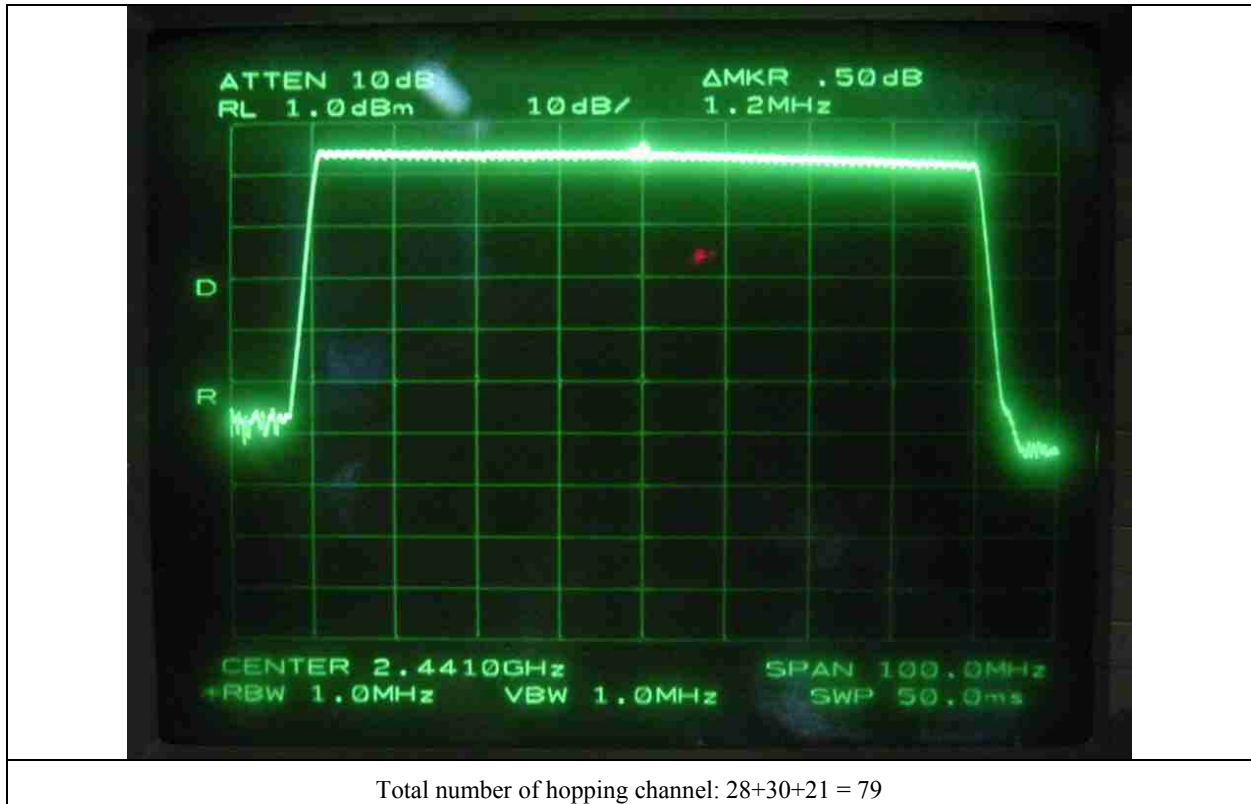
-. Test Date : July 19, 2005

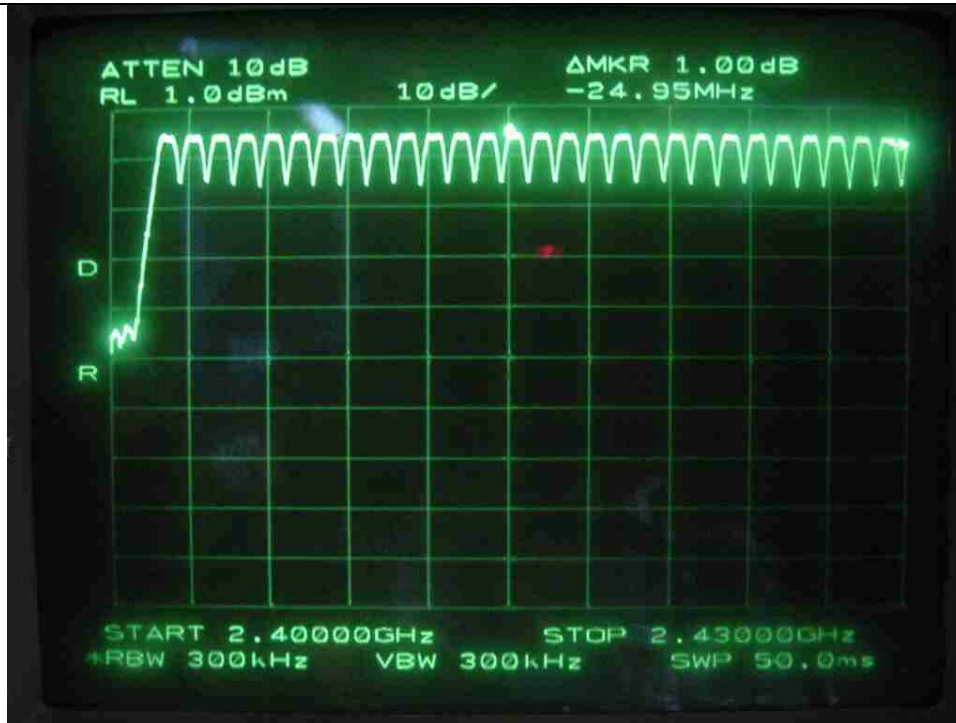
-. Test Result : Pass

MEASURED VLAUE (Number)	LIMIT (Number)	MARGIN (Number)
79	Minimum of 75	4

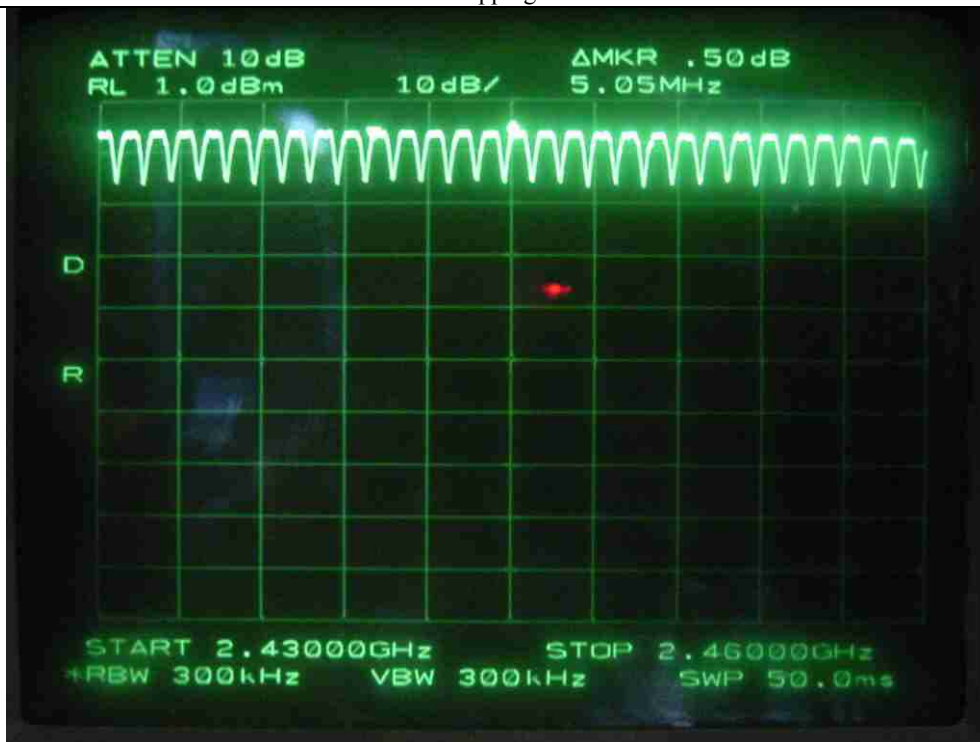


Tested by: Ki-Hong, Nam / Test Engineer

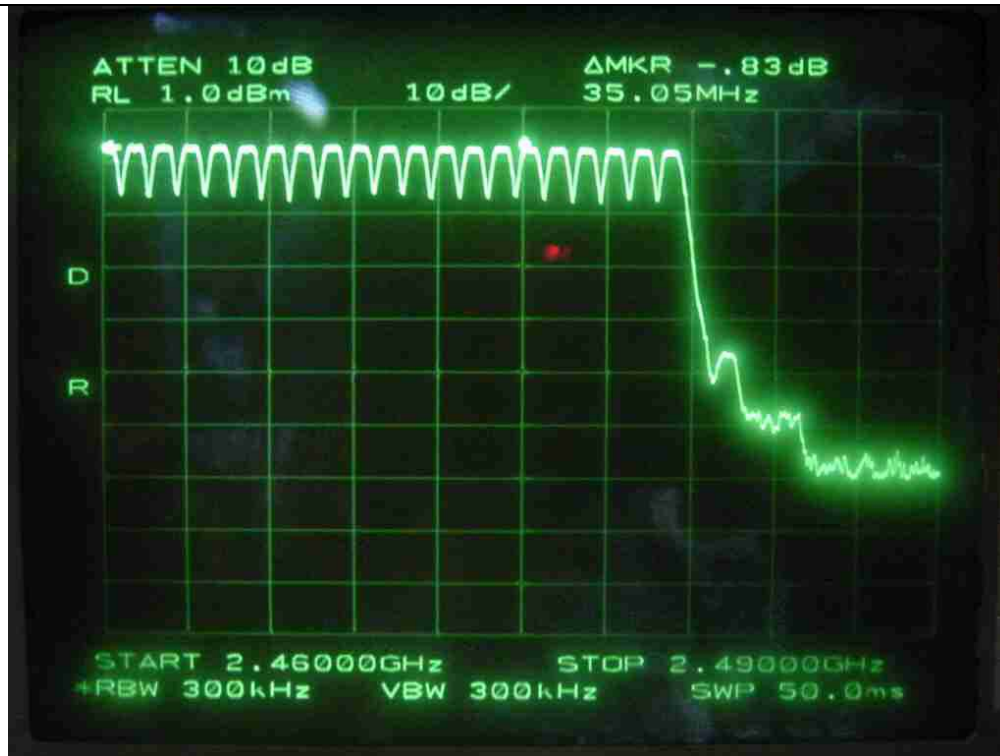




Number of hopping channel: 28



Number of hopping channel: 30



Number of hopping channel: 21

8.4 TIME OF OCCUPANCY

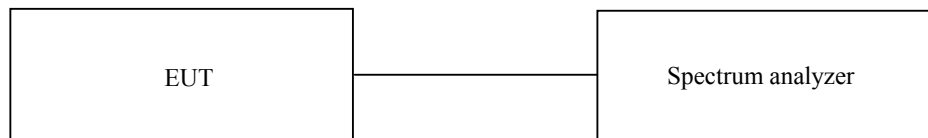
8.4.1 Operating environment

Temperature : 23°C

Relative humidity : 49 %

8.4.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The transmitter is set to operate in its normal frequency hopping mode. The center frequency of the spectrum analyzer is set to one of hopping channels near the center of the operating band and span is set to zero Hz. The sweep time is set to display one complete pulse. The mark delta function is used to measure the duration of the pulses.



8.4.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due Cal
■ - 8564E	HP	Spectrum Analyzer	3650A00756	July 19, 2006

All test equipment used is calibrated on a regular basis.

8.4.4 Test data

- Test Date : July 19, 2005

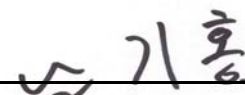
The system makes worst case 1600 hops per second or 1 time slot has a length of 625us with 79 channels.

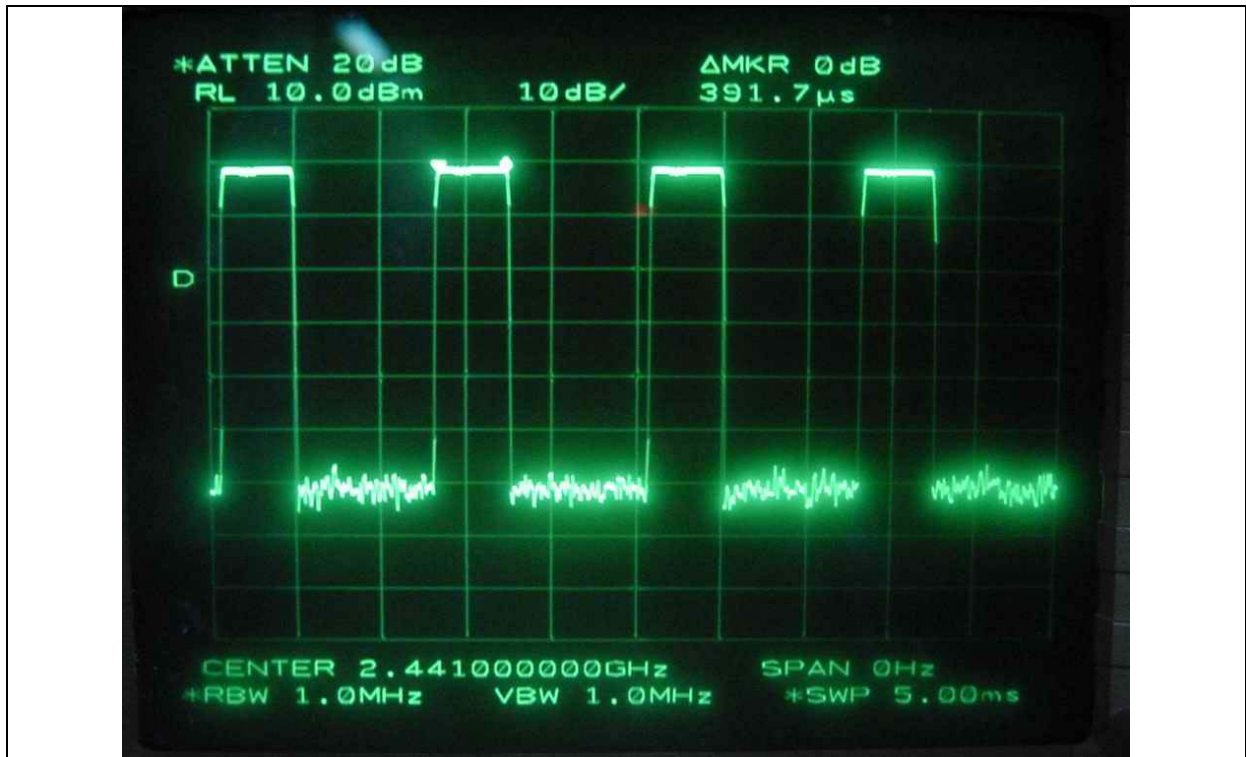
For DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and DH5 packet needs 5 times slots for transmitting and 1 time slot for receiving. So The EUT has each channel for 10.13 times per second ($=1600/2/79$) for DH1, and 5.06 times ($=1600/4/79$) for DH3, and 3.38 times ($=1600/6/79$) for DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (ms)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.392	10.13	31.6	125.48	400	PASS
DH3	1.63	5.06	31.6	260.63	400	PASS
DH5	2.87	3.38	31.6	306.53	400	PASS

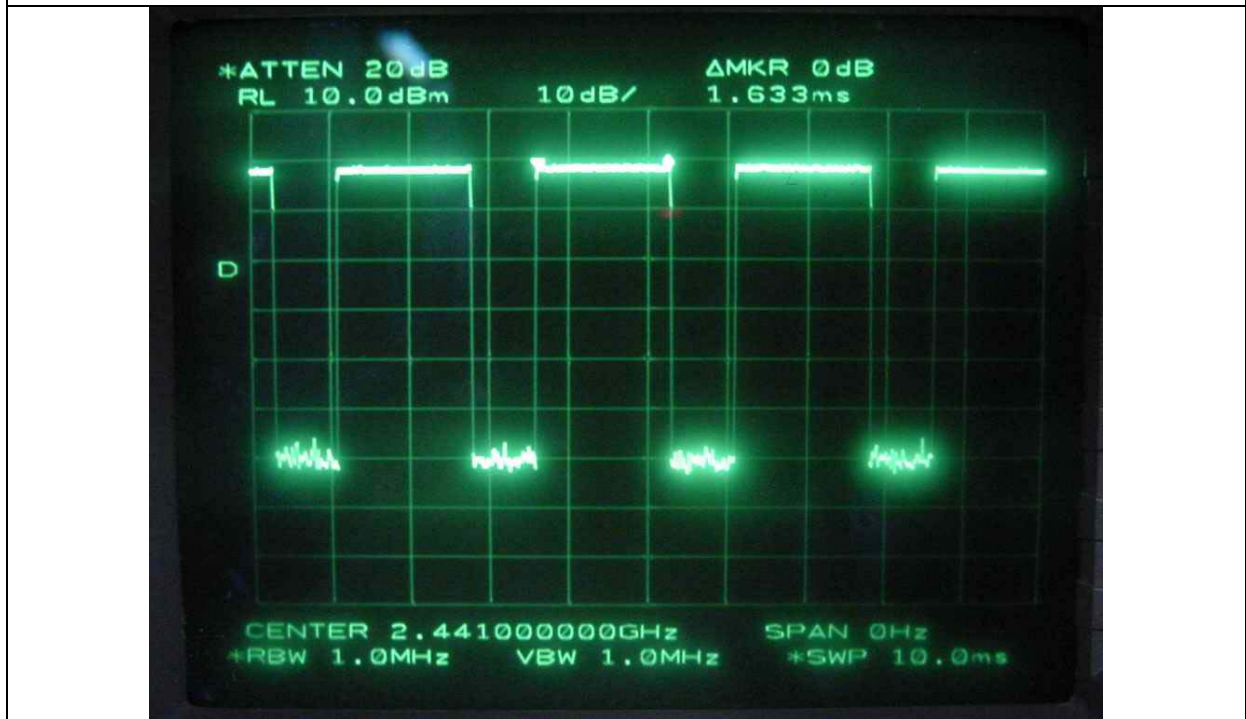
Total dwell time is calculated as following.

Total Dwell Time = Pulse time * Hops per second with channels * period time

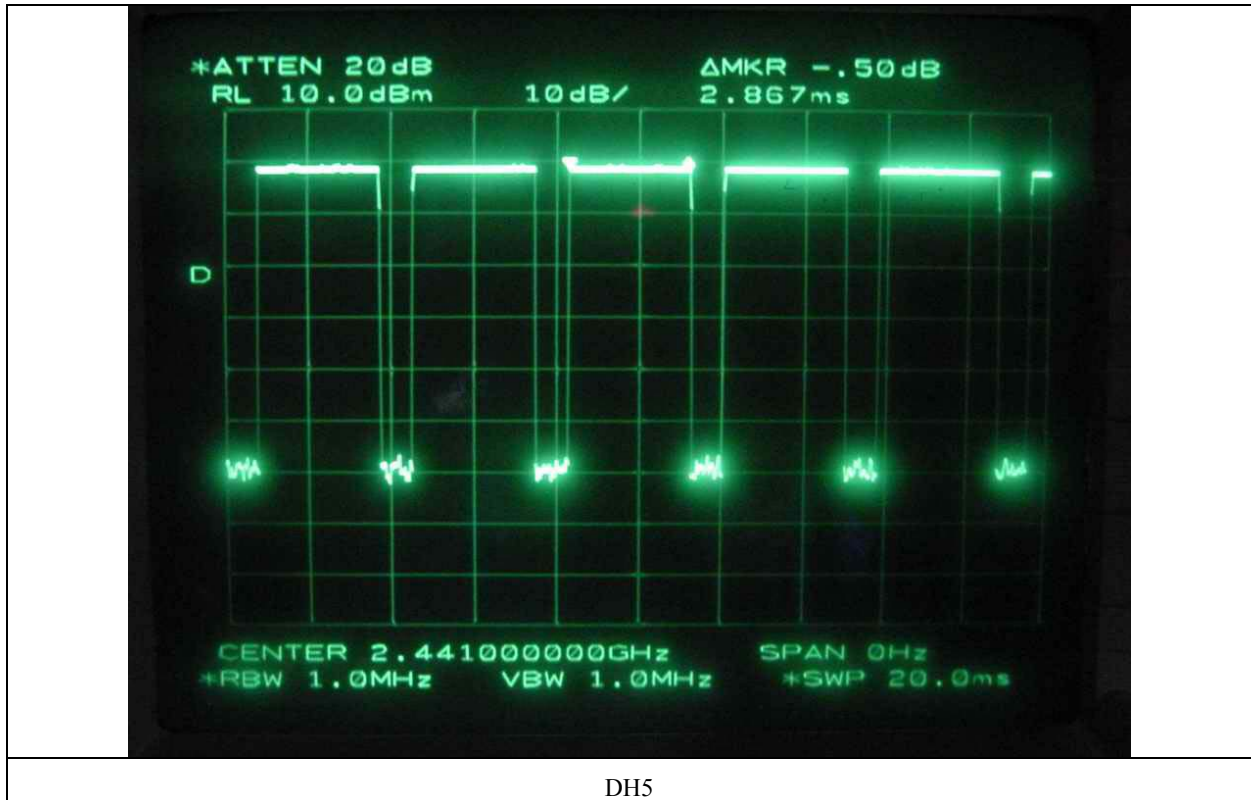

Tested by: Ki-Hong, Nam / Test Engineer



DH1



DH3



8.5 MAXIMUM PEAK OUTPUT POWER

8.5.1 Operating environment

Temperature : 25°C

Relative humidity : 51 %

8.5.2 Test set-up

The maximum peak output power was measured with the power meter connected to the antenna output of the EUT. The EUT was operating in transmit mode at the appropriate center frequency.



8.5.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due Cal
■ - 8564E	HP	Spectrum Analyzer	3650A00756	July 19, 2006

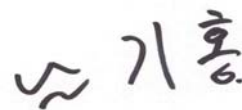
All test equipment used is calibrated on a regular basis.

8.5.4 Test data

-. Test Date : July 20, 2005

-. Test Result : Pass

CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2402	-4.33	30.0	-34.33
Middle	2441	-5.33	30.0	-35.23
High	2480	-7.17	30.0	-37.17



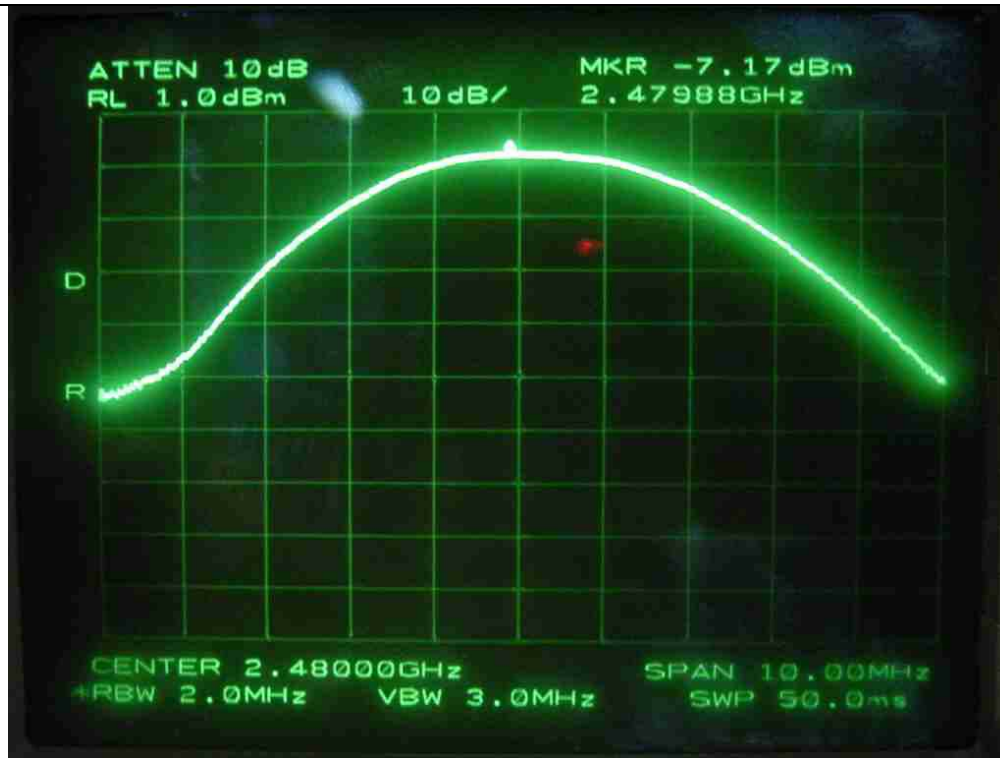
Tested by: Ki-Hong, Nam / Test Engineer



Low Channel



Middle Channel



High Channel

8.6 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

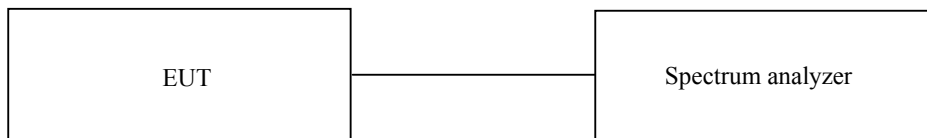
8.6.1 Operating environment

Temperature : 25°C

Relative humidity : 51 %

8.6.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.



8.6.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3meters, open-field test site. The EUT was placed on a non-conductive turntable approximately 0.8 meters above the ground plane.

The frequency spectrum from 30MHz to 25GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 and 4.0 meters in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

8.6.4 Test equipment used

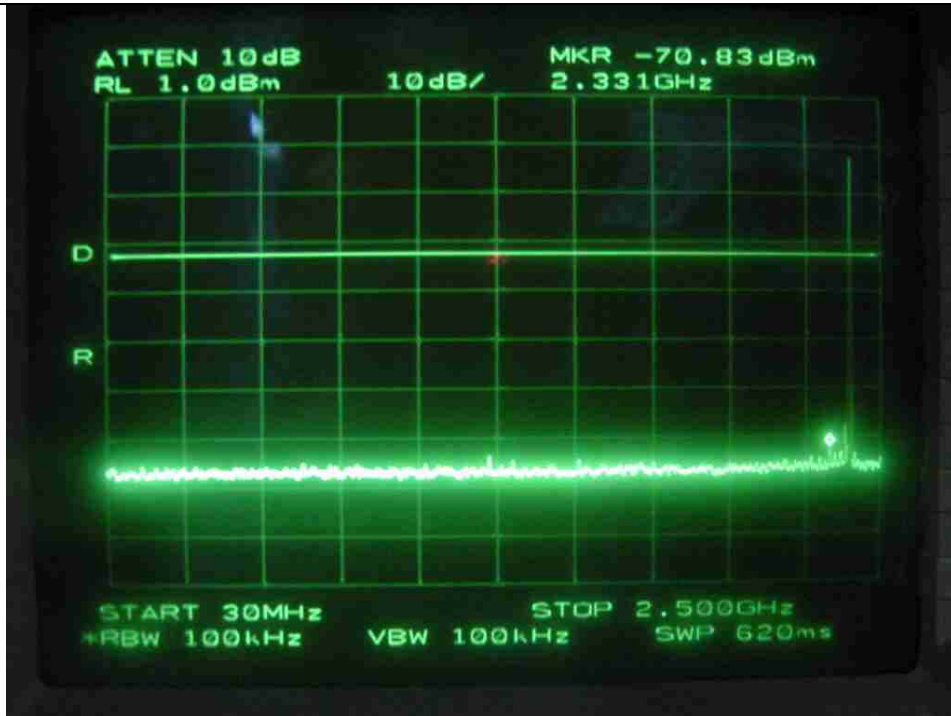
	Model Number	Manufacturer	Description	Serial Number	Due Cal.
■ -	8564E	Hewlett-Packard	Spectrum Analyzer	3650A00756	July 19, 2006
■ -	8449B	Hewlett-Packard	Preamplifier	3008A00833	June 10, 2006
■ -	83051A	Agilent	Preamplifier	3950M00201	June 10, 2006
■ -	F-40-5000-RF	RLC Electronics	Highpass Filter	0425	June 19, 2006
■ -	MA220	HD	Turn Table	N/A	N/A
■ -	HD240	HD	Antenna Mast	N/A	N/A
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	June 6, 2006
■ -	YSE 500B	YoungShin Eng.	Frequency Converter	950413001	N/A
■ -	ETCR-10	DaeHa	Automatic Voltage Com.	N/A	N/A

All test equipment used is calibrated on a regular basis.

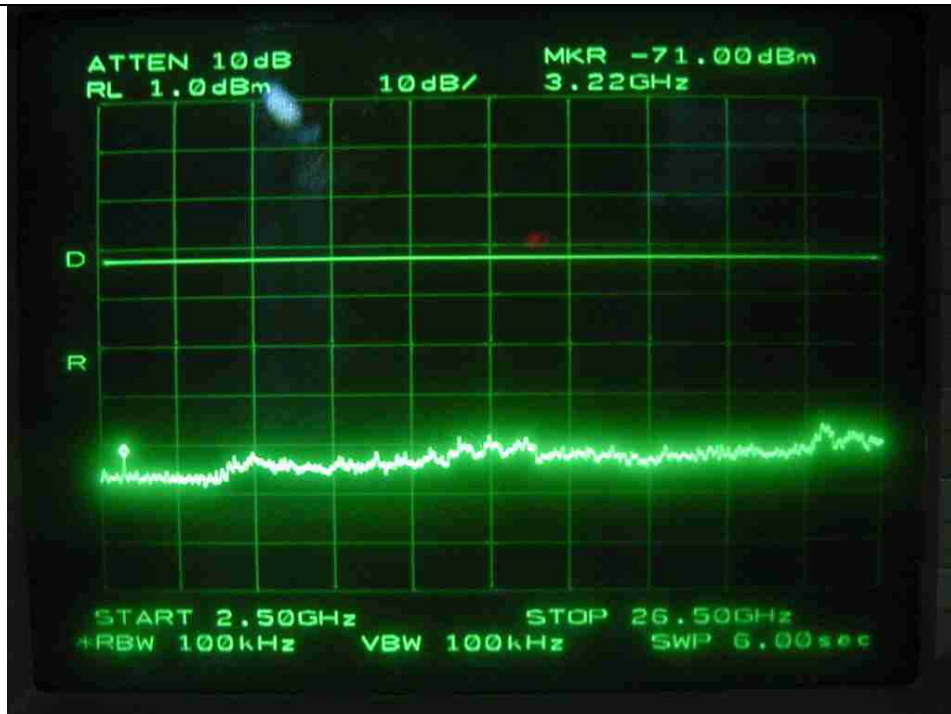
8.6.5. Test data

8.6.5.1. Test data for conducted emission

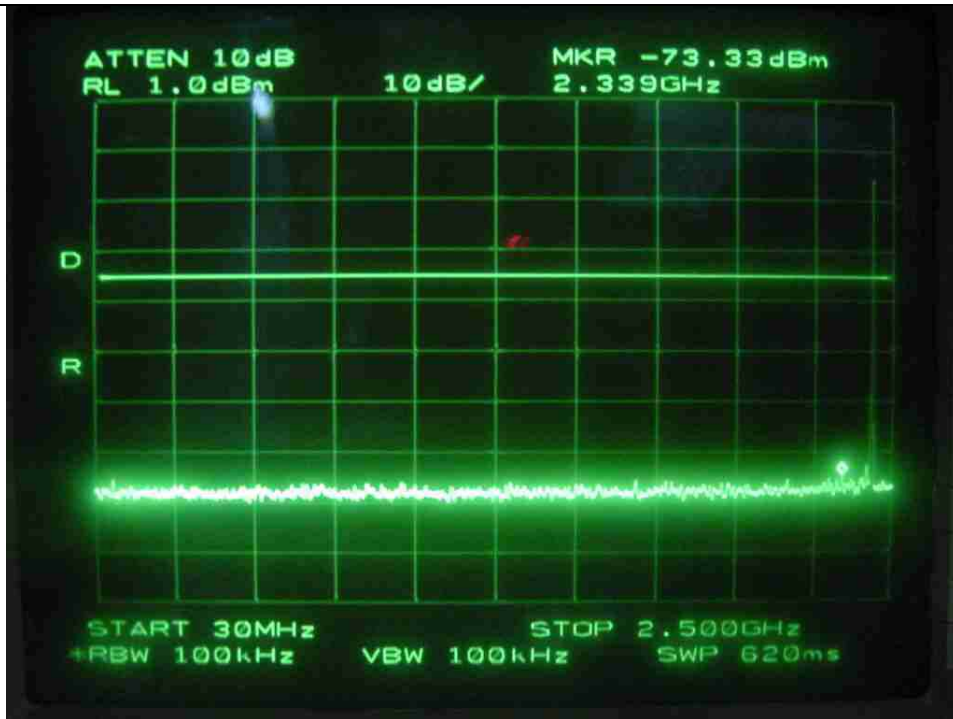




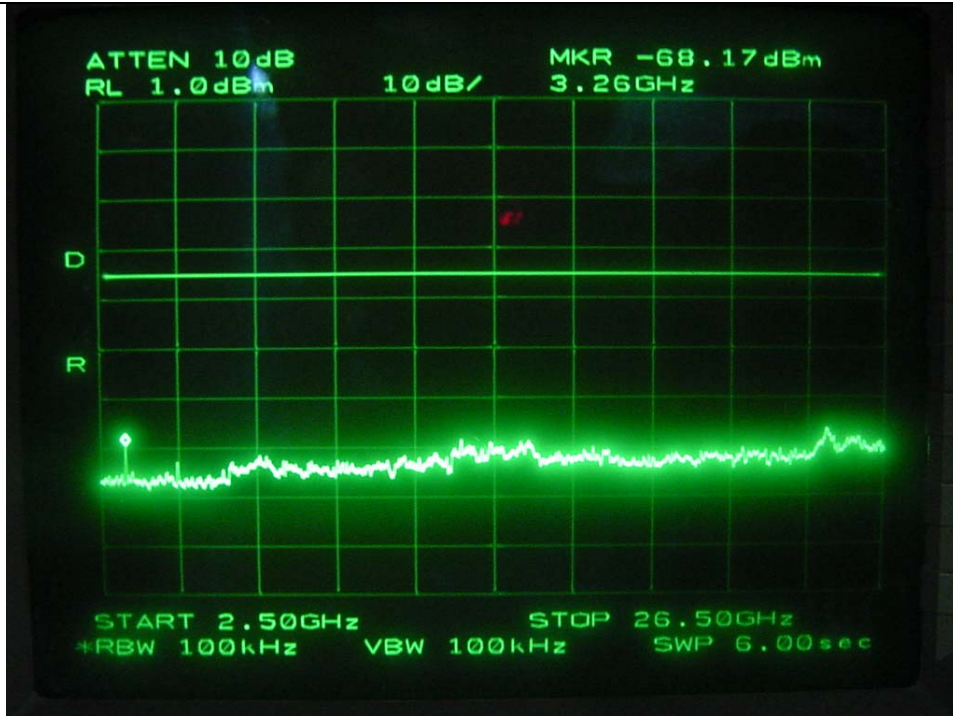
Low Channel



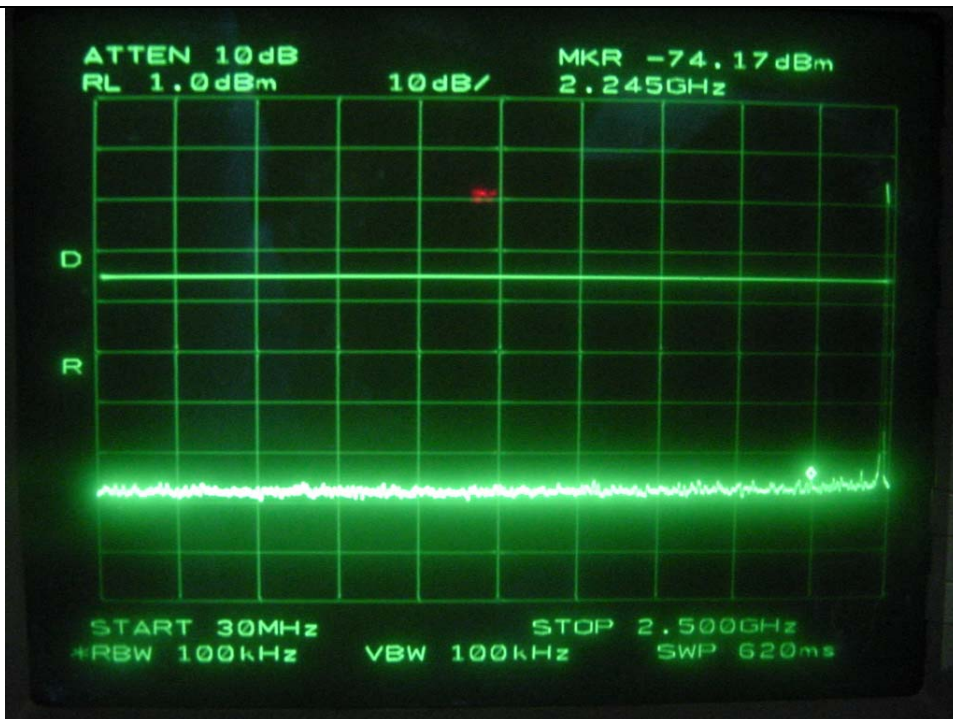
Low Channel



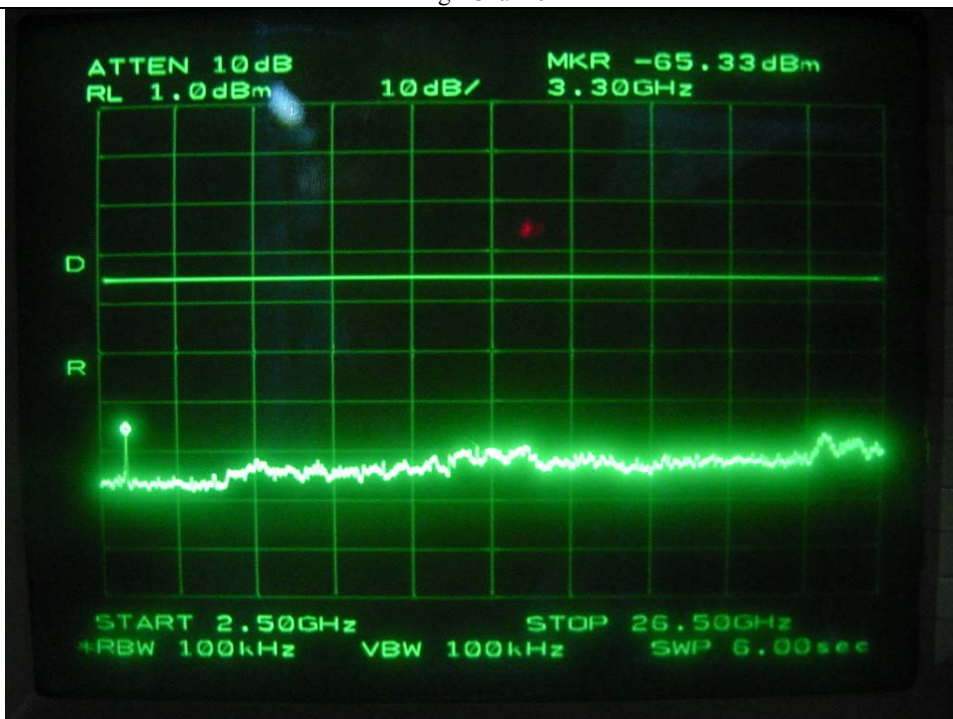
Middle Channel



Middle Channel



High Channel



High Channel



8.6.5.2. Test data for radiated emission

8.6.5.2.1. Radiated Emission which fall in the Restricted Band

- Test Date : August 16, 2005
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10Hz for Average Mode
- Frequency range : 1 GHz ~ 25GHz
- Measurement distance : 1m
- Operating Condition : Low / High Channel
- Result : PASSED

Frequency (MHz)	Reading (dBuV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Total (dBuV/m)	Limits (dBuV/m)	Margin (dB)
Test Data for Low Channel									
2310~2390	It was not observed any emission from the EUT.								
Test Data for High Channel									
2483.5~2500	It was not observed any emissions from the EUT.								

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

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Tested by: Ki-Hong, Nam / Test Engineer



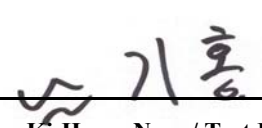
8.6.5.2.2. Spurious & Harmonic Radiated Emission

- Test Date : August 16, 2005
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 1 MHz for Peak Mode, 10Hz for Average Mode
- Frequency range : 1 GHz ~ 25 GHz
- Measurement distance : 1m
- Result : PASSED

Frequency (GHz)	Reading (dBuV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Total (dBuV/m)	Limits (dBuV/m)	Margin (dB)
Test Data for Low Channel									
It was not observed any emission from the EUT up to 25GHz.									
Test Data for Middle Channel									
It was not observed any emission from the EUT up to 25GHz.									
Test Data for High Channel									
It was not observed any emission from the EUT up to 25GHz.									

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "*" Frequency fall in restricted band


Tested by: Ki-Hong, Nam / Test Engineer



8.7 PEAK POWER SPECTRUL DENSITY

8.7.1 Operating environment

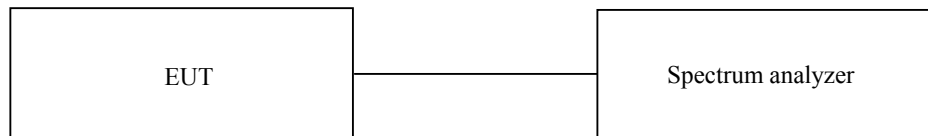
Temperature : 25°C

Relative humidity : 51 %

8.7.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 3 kHz, the video bandwidth is same as above resolution, and sweep time was set to span / 3 kHz. The sweep time was allowed to be longer than span / 3 kHz for a full response of the mixer in the spectrum analyzer.

The maximum level from the EUT in a 3 kHz bandwidth was measured with above condition.



8.7.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due Cal
■ - 8564E	HP	Spectrum Analyzer	3650A00756	July 19, 2006

All test equipment used is calibrated on a regular basis.

8.7.4 Test data

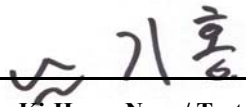
- Test Date : July 20, 2005

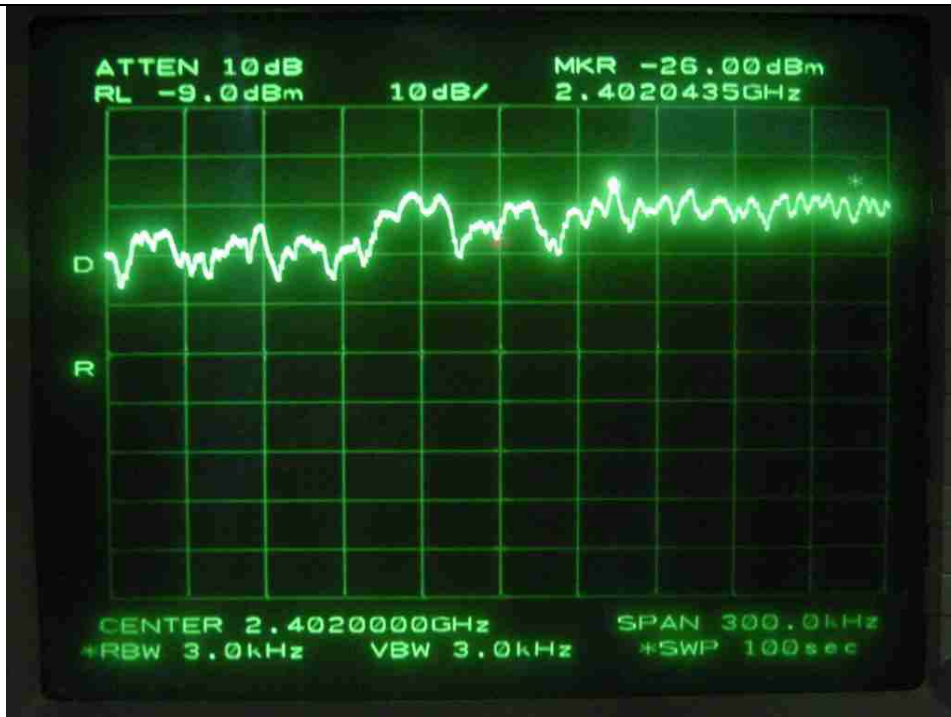
- Result : PASSED BY -34.00 dB at Low Channel

CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2402	-26.00	8.0	-34.00
Middle	2441	-27.33	8.0	-35.33
High	2480	-28.17	8.0	-36.17

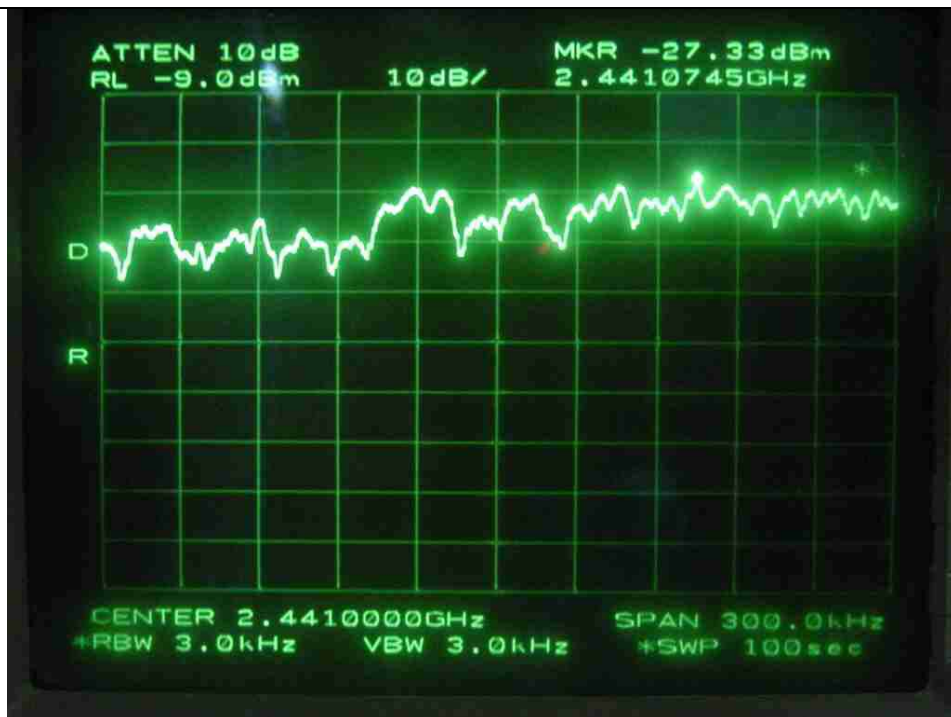
Tabulated test data for Peak Power Spectral Density.

Remark: See next page for measurement data.

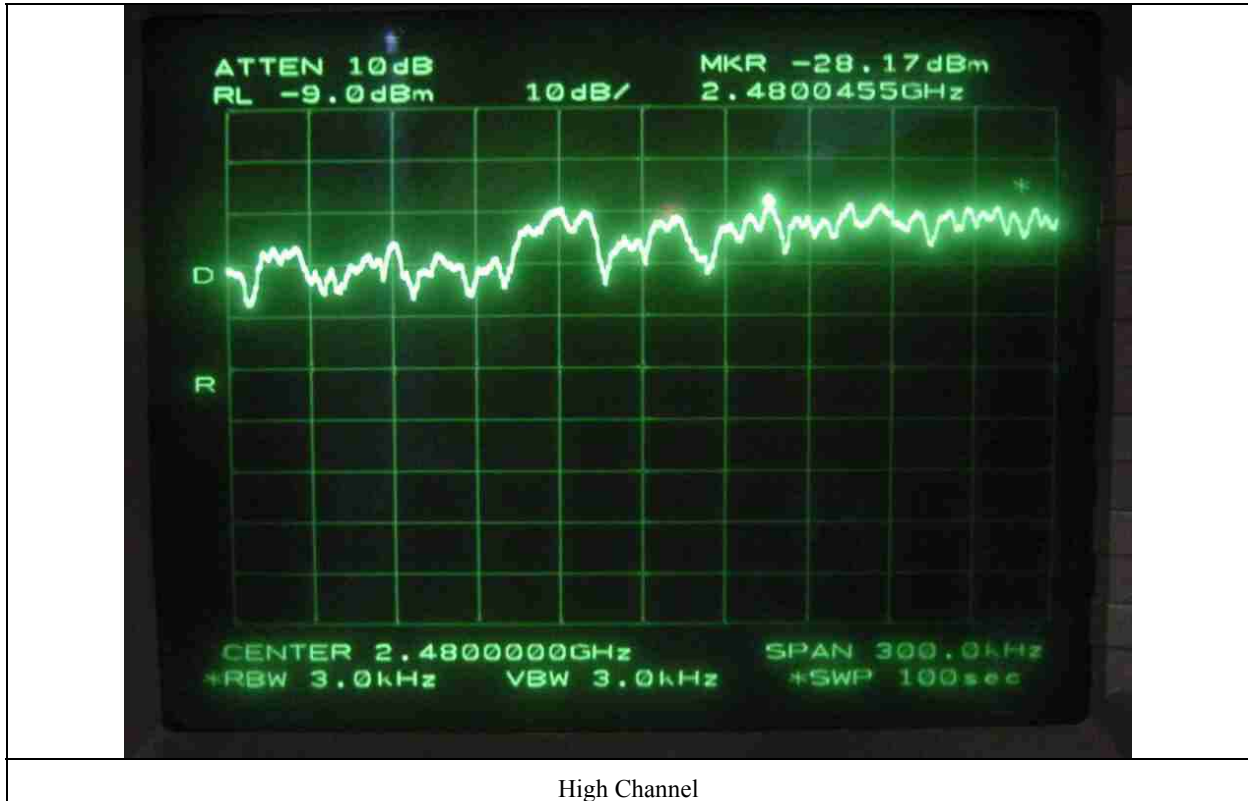

Tested by: Ki-Hong, Nam / Test Engineer



Low Channel



Middle Channel





9. RADIO FREQUENCY EXPOSURE

9.1 RF Exposure Limit

According to the FCC rule §1.1310, the limit for General Population/Uncontrolled exposure is 1mW/cm² for the device operating 1,500~100,000 MHz.

9.2 EUT Description

Kind of EUT	INDUSTRIAL PDA with Bluetooth and WLAN 802.11b with Bluetooth and WLAN 802.11b
Operating Frequency Band	<input checked="" type="checkbox"/> WLAN: 2412 ~ 2462 MHz <input type="checkbox"/> WLAN: 5180 ~ 5320 MHz / 5500 ~ 5700 MHz <input type="checkbox"/> WLAN: 5745 ~ 5825 MHz <input checked="" type="checkbox"/> Bluetooth: 2402 ~ 2480MHz
Device Category	<input checked="" type="checkbox"/> Portable (<20cm separation) <input type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others
Max. Output Power	WLAN: 16.8 dBm (47.86mW) @ 2437MHz Bluetooth: -4.33 dBm (0.369mW) @2402MHz
Used Antenna	Single Antenna
Used Antenna Gain	WLAN: -0.74dBi Bluetooth: 2.0dBi
Exposure Evaluation Applied	<input type="checkbox"/> MPE <input type="checkbox"/> SAR <input checked="" type="checkbox"/> N/A

9.3 Test Result

According to the rule, §1.1307(b) (1) and §2.1093, PORTABLE devices using WLAN and Bluetooth technology according to §15.247 are exempt from the regulation.

Also, SAR evaluation is not required for the PORTABLE Device while its maximum output power is lower than threshold:
 $60/f(\text{GHz}) = 60/2.437 = 24.62\text{mW}$.

SO, THE DEVICE MEETS THE RF EXPOSURE REQUIREMENT.



10. RADIATED EMISSION TEST, Co-located Operation

10.1 Operating environment

Temperature : 28°C

Relative humidity : 56 %

10.2 Test set-up

The radiated emissions measurements were on the 3 meters, open-field test site. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30MHz to 1000MHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 and 4.0 meters in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

10.3 Operating Condition for Test Setup

During above testing, the WLAN and Bluetooth function of the EUT was operated simultaneously among the combination of the Bluetooth middle channel with WLAN low, middle and high channel.

10.4 Measurement uncertainty

Radiated emission electric field intensity, 30 MHz ~ 200 MHz : ±4.3 dB

Radiated emission electric field intensity, 200 MHz ~ 1000 MHz : ±4.1 dB

10.5 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Due Cal.
■ -	ESVS10	Rohde & Schwarz	EMI Test Receiver	827864/005	Dec. 13, 2005
■ -	85650A	Hewlett Packard	Quasi-Peak Adapter	3107A01542	Mar. 28, 2006
■ -	8568B	Hewlett-Packard	Spectrum Analyzer	3109A05456	Mar. 28, 2006
■ -	F-40-5000-RF	RLC Electronics	Highpass Filter	0425	June 19, 2006
■ -	83051A	Hewlett-Packard	Microwave Preamplifier	3950M00201	June 10, 2006
□ -	8449B	Hewlett-Packard	RF Amplifier	3008A00833	June 10, 2006
□ -	8447F	Hewlett-Packard	RF Amplifier	3113A04554	June 10, 2006
■ -	MA220	HD	Turn Table	N/A	N/A
■ -	HD240	HD	Antenna Mast	N/A	N/A
■ -	VHA9103	Schwarz beck	Biconical Antenna	91031852	Jan. 30, 2006
■ -	UHALP9018A	Schwarz beck	Log Periodic Antenna	62281001	Feb. 1, 2006
■ -	YSE 500B	YoungShin Eng.	Frequency Converter	950413001	N/A
■ -	ETCR-10	DaeHa	Automatic Voltage Com.	N/A	N/A

All test equipment used is calibrated on a regular basis.



10.6. Test data for co-location

10.6.1 Radiated Emission which fall in the Restricted Band

- Test Date : October 11, 2005
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10Hz for Average Mode
- Frequency range : 1 GHz ~ 40GHz
- Measurement distance : 3m
- Operating Condition : WLAN and Bluetooth was simultaneously operated at their low and high channel
- Result : PASSED BY -21.35 dB at High Channel

Frequency (MHz)	Reading (dBuV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Dist. Factor	Total (dBuV/m)	Limits (dBuV/m)	Margin (dB)
Test Data for Low Channel										
2388.75	41.50	Peak	H	27.64	1.33	26.10		44.37	74.0	-29.63
	40.26	Peak	V					43.13	74.0	-30.87
	27.33	Average	H					30.20	54.0	-23.80
	28.67	Average	V					31.54	54.0	-22.46
Test Data for High Channel										
2486.08	42.10	Peak	H	27.59	1.33	26.10		44.92	74.0	-29.08
	40.33	Peak	V					43.15	74.0	-30.85
	28.50	Average	H					31.32	54.0	-22.68
	29.83	Average	V					32.65	54.0	-21.35

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

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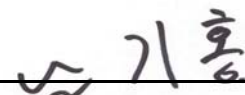
**10.6.2 Spurious & Harmonic Radiated Emission**

- Test Date : October 11, 2005
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 1 MHz for Peak Mode, 10Hz for Average Mode
- Frequency range : 1 GHz ~ 40 GHz
- Measurement distance : 3m
- Operating Condition : WLAN and Bluetooth was simultaneously operated at their max power
- Result : PASSED BY -5.70 dB

Frequency (GHz)	Reading (dBuV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Dist. Factor	Total (dBuV/m)	Limits (dBuV/m)	Margin (dB)
WLAN Low Channel + Bluetooth Middle Channel										
4824.05*	40.25	Peak	V	31.30	2.67	26.1		48.12	74.00	-25.88
	31.30	Average	V					39.17	54.00	-14.83
7236.12*	39.50	Peak	V	36.54	5.83	26.2		55.67	74.00	-18.33
	29.20	Average	V					45.37	54.00	-8.63
WLAN Middle Channel + Bluetooth Middle Channel										
4874.22*	42.20	Peak	V	31.37	2.67	26.1		50.14	74.00	-23.86
	30.50	Average	V					38.44	54.00	-15.56
7311.05*	40.63	Peak	V	36.56	6.50	26.1		57.59	74.00	-16.41
	29.85	Average	V					46.81	54.00	-7.19
WLAN High Channel + Bluetooth Middle Channel										
4924.17*	41.95	Peak	V	31.44	2.67	26.1		49.96	74.00	-24.04
	30.00	Average	V					38.01	54.00	-15.99
7386.09*	38.50	Peak	V	36.59	8.67	26.2		57.56	74.00	-16.44
	29.24	Average	V					48.30	54.00	-5.70

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "*" Frequency fall in restricted band


 Tested by: Ki-Hong, Nam / Test Engineer



11. RADIATED EMISSION TEST FOR COMPUTING DEVICE PERIPHERAL PART

11.1 Operating environment

Temperature : 28°C

Relative humidity : 56 %

11.2 Test set-up

The radiated emissions measurements were on the 3 meters, open-field test site. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30MHz to 1000MHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 and 4.0 meters in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

Test set-up photos are included in appendix VI.

11.3 Measurement uncertainty

Radiated emission electric field intensity, 30 MHz ~ 200 MHz : ±4.3 dB

Radiated emission electric field intensity, 200 MHz ~ 1000 MHz : ±4.1 dB

10.4 Test equipment used

10.5 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Due Cal.
■ -	ESVS10	Rohde & Schwarz	EMI Test Receiver	827864/005	Dec. 13, 2005
■ -	85650A	Hewlett Packard	Quasi-Peak Adapter	3107A01542	Mar. 28, 2006
■ -	8568B	Hewlett-Packard	Spectrum Analyzer	3109A05456	Mar. 28, 2006
■ -	85685A	Hewlett-Packard	RF Preselector	3107A01264	Mar. 28, 2006
□ -	8449B	Hewlett-Packard	RF Amplifier	3008A00833	June 10, 2006
□ -	8447F	Hewlett-Packard	RF Amplifier	3113A04554	June 10, 2005
■ -	MA220	HD	Turn Table	N/A	N/A
■ -	HD240	HD	Antenna Mast	N/A	N/A
■ -	VHA9103	Schwarz beck	Biconical Antenna	91031852	Jan. 30, 2006
■ -	UHALP9018A	Schwarz beck	Log Periodic Antenna	62281001	Feb. 1, 2006
■ -	YSE 500B	YoungShin Eng.	Frequency Converter	950413001	N/A
■ -	ETCR-10	DaeHa	Automatic Voltage Com.	N/A	N/A

All test equipment used is calibrated on a regular basis.

**11.5 Test data****11.5.1 Operating Mode: PC Communication Mode**

- Type of Test : FCC Class B
- Test Date : August 16, 2005
- Resolution bandwidth : 120 kHz
- Frequency range : 30MHz ~ 1000MHz
- Measurement distance : 3m
- Test result : Passed by -2.74 dB at 82.30 MHz

Frequency (MHz)	Reading (dBuV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBuV/m)	Limits (dBuV/m)	Margin (dB)
82.30	28.40	H	7.11	1.75	37.26	40.00	-2.74
117.21	23.12	H	12.57	1.97	37.66	43.50	-5.84
198.61	18.50	V	15.88	2.80	37.18	43.50	-6.32
258.69	20.71	H	17.27	3.43	41.41	46.00	-4.59
353.60	20.90	H	14.42	4.21	39.53	46.00	-6.47
532.90	18.40	H	18.04	5.37	41.81	46.00	-4.16

Tabulated test data for Radiated Electromagnetic Field

Remark: "H": Horizontal, "V": Vertical

PC Mode means the EUT was connected to a personal computer and then operating status was in uploading/downloading mode

Low, Middle and High channels were tested, but the worst emissions levels were recorded in this test report.

Tested by: Ki-Hong, Nam / Test Engineer



12. CONDUCTED EMISSION TEST

12.1 Operating environment

Temperature : 26°C

Relative humidity : 51 %

12.2 Test set-up

The conducted emission measurements of power line were performed in a shielded room. The EUT was placed on a wooden table, 0.8 meters height above the floor. Power was fed to the EUT through a 50 ohm/ 50 microhenry Line Impedance Stabilization Network (LISN). The ground plane was electrically bonded to the shield room ground system and all power lines entering the shield room were filtered.

12.3 Measurement uncertainty

Conducted emission, quasi-peak detect : ± 3.0 dB

Conducted emission, average detect : ± 3.0 dB

12.4 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due Cal.
■ - ESHS10	Rohde & Schwarz	EMI Test Receiver	834467/007	May 19, 2006
■ - NSLK8128	Schwarz beck	AMN	8128-216	June 7, 2006
■ - N/A	HanKook Shield room	Shield Room	N/A	N/A
■ - YSE 500B	YoungShin Eng.	Frequency Converter	950413001	N/A
■ - ETCR-10	DaeHa	Automatic Voltage Com.	N/A	N/A

All test equipment used is calibrated on a regular basis.



12.5 Test data

12.5.1 Operating condition: PC Communication Mode

- Type of Test : FCC Class B
- Test Date : October 31, 2005
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15MHz ~ 30MHz
- Test Result : PASSED BY -7.89dB at 0.20 MHz with Peak Detector

Frequency (MHz)	Line	Quasi-Peak (dBuV)			Margin (dB)	Average (dBuV)		Margin (dB)
		Emission level	Detect Mode	Limits		Emission level	Limits	
0.155	H	55.12	P	65.73	-10.61	-	-	-
0.160	N	54.58	P	65.46	-10.88	-	-	-
0.200	H	55.72	P	63.61	-7.89	39.78	53.61	-13.83
0.265	H	48.78	P	61.27	-12.49	-	-	-
2.405	H	42.67	P	56.00	-13.33	-	-	-
2.675	N	42.30	P	56.00	-13.70	-	-	-

Line Conducted Emissions Tabulated Data

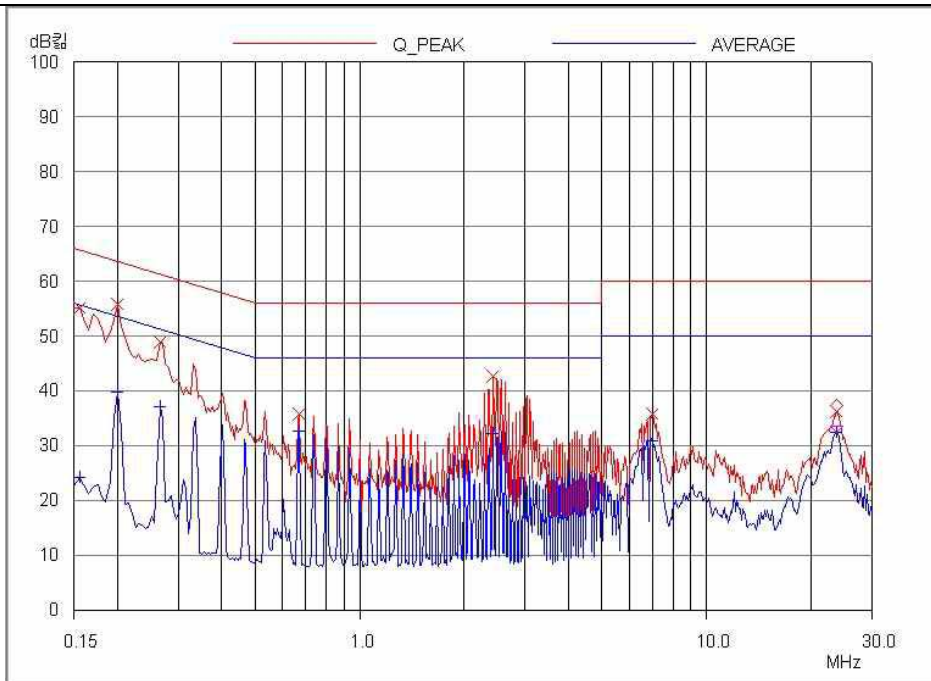
Remark : "H": Hot Line, "N": Neutral line, "P": Peak detect.

PDA means the EUT was communicated with Access Point and battery of the EUT was charged.

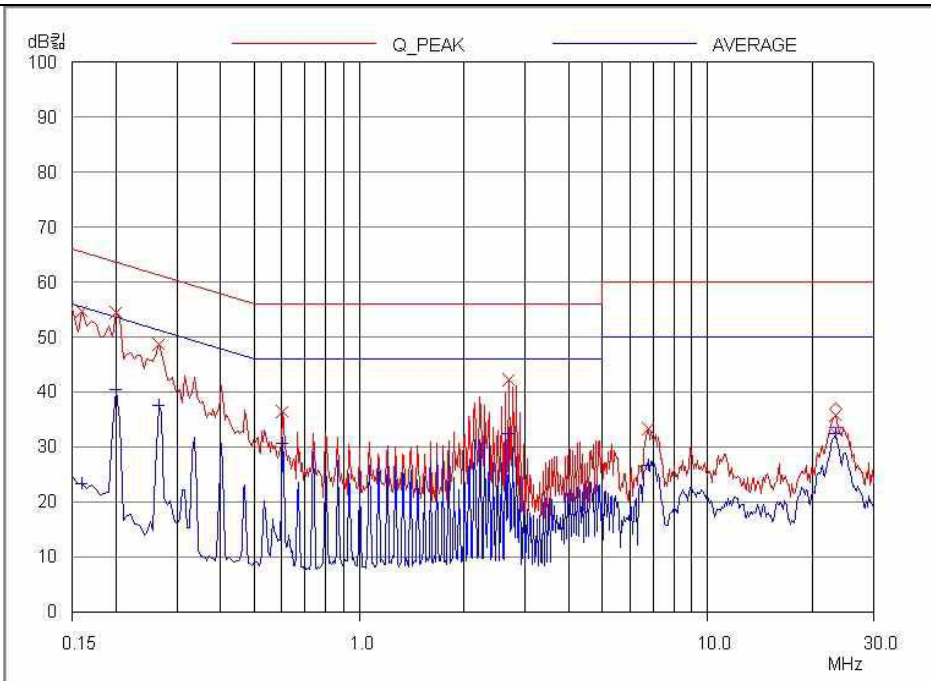
See next page for an overview sweep performed with peak and average mode detector.

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Tested by: Ki-Hong, Nam / Test Engineer



HOT LINE



NEUTRAL LINE