



FCC EVALUATION REPORT FOR CERTIFICATION

Manufacturer : OHSUNG ELECTRONICS CO., LTD

#181 Gongdan-Dong, Gumi, GyeongBuk

Republic of Korea

Attn : Mr. Kwang-Jae Ok / Team Leader of Q.C

Date of Issue : June 5, 2008

Test Report S/N : GETEC-E3-08-024

Test Site : Gumi College EMC Center

FCC Registration No.: (100749)

FCC ID

OZ5URCMX6000

APPLICANT

OHSUNG ELECTRONICS CO., LTD

Rule Part(s) : FCC Part 15 Subpart C-Intentional Radiator § 15.247

Test method : Public Notice FCC97-114
(Guidance on measurement for direct sequence spread spectrum systems)

EUT Type : RF Remote Controller

Equipment Class : Digital Transmission System (DTS)

EUT Type : RF Remote Controller
(WIFI built in RF remote controller)

Trade Name : UNIVERSAL remote control

Model No. : MX-6000

This equipment has been shown to be in compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4-2003

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the vest 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.

Tested by,

Reviewed by,

Jae-hoon Jeong, Senior Engineer
GUMI College EMC center

Tae-Sig Park, Technical Manger
GUMI College EMC center

CONTENTS

1. GENERAL INFORMATION	4
2. INTRODUCTION	5
3. PRODUCT INFORMATION	6
3.1 DESCRIPTION OF EUT.....	6
3.2 SUPPORT EQUIPMENT / CABLES USED	7
3.3 MODIFICATION ITEM(S).....	7
4. DESCRIPTION OF TESTS.....	8
4.1 TEST CONDITION.....	8
5. ANTENNA REQUIREMENT - §15.203	8
5.1 DESCRIPTION OF ANTENNA.....	8
5.2 CONDUCTED EMISSION.....	9
5.3 RADIATED EMISSION.....	10
6. CONDUCTED EMISSION.....	11
6.1 OPERATING ENVIRONMENT	11
6.2 TEST SET-UP.....	11
6.3 MEASUREMENT UNCERTAINTY	11
6.4 LIMIT	12
6.5 TEST EQUIPMENT USED	12
6.6 TEST DATA FOR POWER LINE CONDUCTED EMISSION.....	13
7. MAXIMUM PEAK OUTPUT POWER MEASUREMENT	15
7.1 OPERATING ENVIRONMENT	15
7.2 TEST SET-UP (LAYOUT).....	15
7.3 LIMIT	15
7.4 TEST EQUIPMENT USED	15
7.5 TEST RESULT OF MAXIMUM PEAK OUTPUT POWER.....	15
8. POWER SPECTRAL DENSITY MEASUREMENT	17
8.1 OPERATING ENVIRONMENT	17
8.2 TEST SET-UP (LAYOUT).....	17
8.3 LIMIT	17
8.4 TEST EQUIPMENT USED	17
8.5 TEST RESULT OF MAXIMUM PEAK OUTPUT POWER.....	17
9. 6DB SPECTRUM BANDWIDTH MEASUREMENT	22
9.1 OPERATING ENVIRONMENT	22
9.2 TEST SET-UP (LAYOUT).....	22
9.3 LIMIT	22
9.4 TEST EQUIPMENT USED	22
9.5 TEST RESULT OF MAXIMUM PEAK OUTPUT POWER.....	22
10. RADIATED EMISSION	27

10.1 OPERATING ENVIRONMENT27

10.2 TEST SET-UP.....27

10.3 MEASUREMENT UNCERTAINTY27

10.4 LIMIT28

10.5 TEST EQUIPMENT USED28

10.6 RADIATED EMISSION TEST DATA29

11. BAND EDGE RADIATED EMISSION34

11.1 OPERATING ENVIRONMENT.....34

11.2 TEST SET-UP34

11.3 LIMIT34

11.4 TEST EQUIPMENT USED34

11.5 BAND EDGE RADIATED EMISSION TEST DATA.....35

APPENDIX K – SAR TEST REPORT FOR WIFI

APPENDIX L – OPERATIONAL DESCRIPTION FOR WIFI

Scope: Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and / or unintentional radiators for compliance with technical rules and regulations of the Federal Communications Commission.

1. General Information

Applicant: OHSUNG ELECTRONICS CO., LTD.

Applicant Address: #181 Gongdan-Dong, Gumi-Si, Gyeongsangbuk-do, Korea

Manufacturer: OHSUNG ELECTRONICS CO., LTD

Manufacturer Address: #181 Gongdan-Dong, Gumi-Si, Gyeongsangbuk-do, Korea

Contact Person: Mr. Kwang-Jae Ok / Team Leader Q.C

Tel. & Fax No.: Tel No.: +82-54-468- 0831 Fax No.: +82-54- 461- 8368

- **FCC ID.** OZ5URCMX6000
- **Equipment Class** Digital Transmission System (DTS)
- **EUT Type** RF Remote Controller
(WIFI built in RF remote controller)
- **Power Source** AC 120V/ 60Hz, DC 3.7V Li-ion Rechargeable Battery
- **Model No.** MX-6000
- **Rule Part(s)** FCC Part 15, Subpart C-Intentional Radiator § 15.247
- **Test method** Public Notice FCC97-114
(Guidance on measurement for direct sequence spread spectrum systems)
- **Type of Authority** Certification
- **Test Procedure(s)** ANSI C63.4 (2003)
- **Dates of Test** June 3, 2008
- **Place of Test** **Gumi College EMC Center** (FCC Registration No.: 100749)
407, Bugok-Dong, Gumi-si, Gyeongsangbuk-Do, Korea
- **Test Report No.** GETEC-E3-08-024
- **Dates of Issue** June 5, 2008

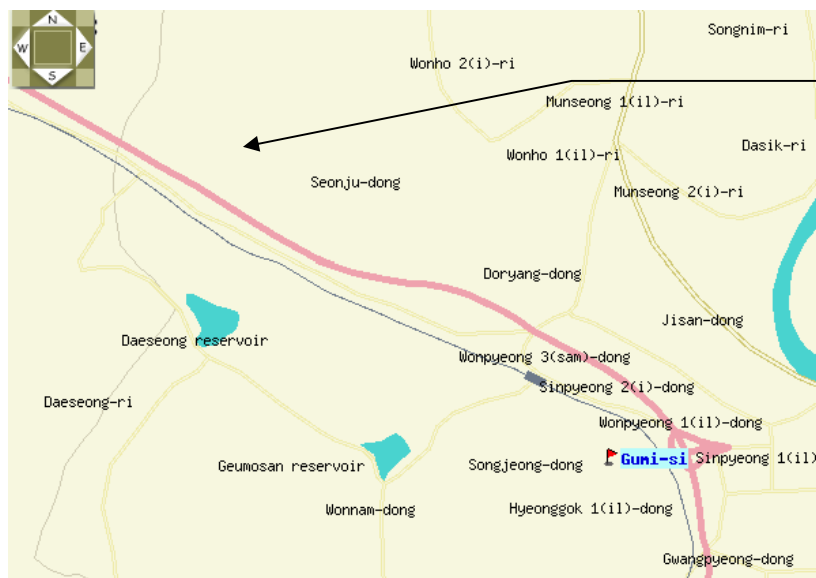
2. Introduction

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Nose Emissions From Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ASNI C63.4-2003) was used in determining radiated and conducted emissions emanating from **OHSUNG ELECTRONICS CO., LTD. RF Remote Controller (Model No.: MX-6000)**

These measurement tests were conducted at **Gumi College EMC Center**.

The site address is 407, Bugok-Dong, Gumi-si, Gyeongsangbuk-Do, Korea

This test site is one of the highest point of Gumi 1 college at about 200 kilometers away from Seoul city and 40 kilometers away from Daegu city. It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures. The detailed description of the measurement facility was found to be in compliance with the requirements of §2.948 according to ANSI C63.4 on October 19, 1992



GUMI COLLEGE EMC CENTER
407, Bugok-Dong, Gumi-si,
Gyeongsangbuk-Do 730-711, Korea
Tel: +82-54-440-1195~8
Fax: +82-54-440-1199

Fig 1. The map above shows the Gumi College in vicinity area.

3. Product Information

3.1 Description of EUT

The Equipment Under Test (EUT) is the **OHSUNG ELECTRONICS CO., LTD. WIFI built in RF Remote Controller (Model No.: MX-6000) FCC ID.:OZ5URCMX6000**

The Equipment is body-worn WIFI device and SAR test was conducted at “Nemko Korea (FCC Registration no. 97992)

See “Appendix K – SAR TEST REPORT FOR WIFI

Used AC/DC Adapter : KSD0600200W1US(UNIVERSAL remote control)
Input: AC 100-240V, 50/60Hz, 0.4A
Output: DC5V, 2.0A

Microprocessor: 533MHz ARM9	IR Learning: 20-455 kHz
RAM: 128Mbyte Mobile DDR	IR Range (Line of Sight via Infrared):
NAND: 64Mbyte	30-50 feet, depending on the envi-
LCD: 4.3 Inch Wide Screen (480 by 272)	ronment
LCD Backlighting by LED	RF Frequency: 418MHz
Sound: 2 x 1 watt	RF Range (radio frequency): 50 to
USB: 2.0	100 feet, depending upon the envi-
Devices - Supports up to 255	ronment
Devices with text, less with heavy	WiFi: IEEE 802.11 B (11Mps), G
graphics usage	(54Mps)
Pages - Supports up to 255 Pages on	Battery: Lithium Ion, 4800 mA hours
each Device with text, less with	Battery Capacity: 4 hours continu-
heavy graphics usage	ous use, 9 days standby
Learning Capability - Standard fre-	Battery Charging Time: 7 Hours
quencies (15kHz to 455kHz)	Dimensions: 7.5"Wide x 5.1"Deep
Macro Capability - Up to 255 steps	x 1.3"Height
each, however nesting is allowed	Weight (without AC Adapter):
	15 oz

Frequency Band	Channel No.	Frequency	Channel No.	Frequency
2400-2483.5MHz	1	2412 MHz	7	2442 MHz
	2	2417 MHz	8	2447 MHz
	3	2422 MHz	9	2452 MHz
	4	2427 MHz	10	2457 MHz
	5	2432 MHz	11	2462 MHz
	6	2437 MHz		

3.2 Support Equipment / Cables used

3.2.1 Used Support Equipment

Description	Manufacturer	Model No.	S/N & FCC ID
None	-	-	

See "Appendix F – Test Setup Photographs" for actual system test set-up

3.2.2 Used Cable(s)

Cable No.	Condition	Description
Adapter cable	Connected to the EUT	1.8m Unshielded

3.3 Modification Item(s)

-. None

4. Description of tests

4.1 Test Condition

The EUT was installed, arranged and operated in a manner that is most representative of equipment as typically used.

The measurements were carried out while varying operating modes and cable positions within typically arrangement to determine maximum emission level.

The representative and worst test mode(s) were noted in the test report.

Test Voltage / Frequency: AC 120V/ 60Hz

DC 3.7V Li-ion Rechargeable Battery

- Test Mode(s)

-. Executed “Marvell Labtool” to control the EUT continuously transmit RF signal

Test Software Version	Marvell labtool		
Frequency	2412MHz	2437MHz	2462MHz
IEEE 802.11b	15	15	15
IEEE 802.11g	15	15	15

5. Antenna Requirement - §15.203

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the applicant can be used with the device. The use of permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with this requirement.

5.1 Description of Antenna

The **OHSUNG ELECTRONICS CO., LTD RF Transmitter Universal Remote Control** comply with the requirement of §15.203 with a built-in looped antenna permanently attached to the transmitter.

5.2 Conducted Emission

The Line conducted emission test facility is inside a $4 \times 8 \times 2.5$ meter shielded enclosure.

The EUT was placed on a non-conducting 1.0 by 1.5 meter table, which is 0.8 meters in height and 0.4 meters away from the vertical wall of the shielded enclosure.

The EUT is powered from the Rohde & Schwarz LISN (ESH2-Z5) and the support equipment is powered from the Rohde & Schwarz LISN (ESH3-Z5). Powers to the LISN are filtered by high-current high insertion loss power line filter.

Sufficient time for 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 EMI test receiver (Rohde & Schwarz, ESCS30).

The EMI test receiver was scanned from 150kHz to 30MHz with 20msec sweep time to determine the frequency producing the maximum EME from the EUT. The frequency producing the maximum level was re-examined using Quasi-Peak mode of the EMI test receiver.

The bandwidth of Quasi-peak mode was set to 9kHz. Each emission was maximized consistent with typical applications by varying the configuration of the test sample. Interface cables were connected to the available interface ports of the test unit. The effect of varying the position of cables was investigated to find the configuration that produces maximum diagram emission. Excess cable lengths were bundled at center with 30 – 40 centi-meters.

Each EME reported was calibrated using the R/S signal generator

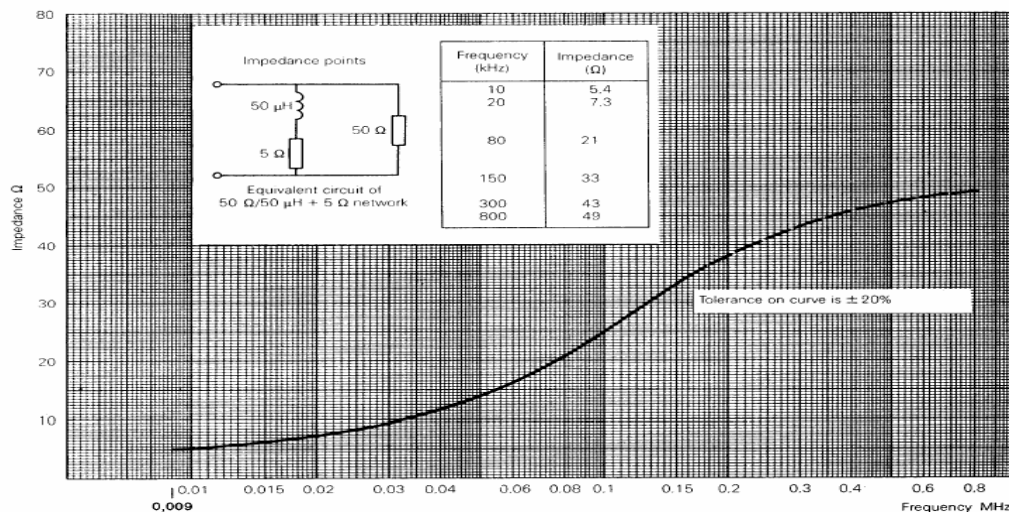


Fig 2. Impedance of LISN

5.3 Radiated Emission

Preliminary measurements were conducted 3m semi anechoic chamber using broadband antennas to determine the frequency producing the maximum EME. Appropriate precaution was taken to ensure that all EME from the EUT were maximized and investigated. The technology configuration, mode of operation and turntable azimuth with respect to antenna was note for each frequency found.

The spectrum was scanned from 9kHz to 30MHz using loop antenna(Rohde Schwarz, HFH2-Z2) and 30 to 1000MHz, using bicornical log antenna (Schwarzbeck, VULB9160).

Above 1GHz, horn antenna (Schwarzbeck, BBHA9120D / EMCO 3160) was used.

Final measurements were made outdoors at 3m-test range.

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 pre-scan measurements was re-examined and investigated using EMI test receiver. The detector function was set to CISPR quasi-peak mode average mode and the bandwidth of the receiver was set to 120kHz or 1MHz depending on the frequency or type of signal.

The EUT, support equipment and interconnecting cables were reconfigured to the setup producing the maximum emission for the frequency and were placed on top of a 0.8m high non-metallic 1.0×1.5 meter table.

The turntable containing the test sample was rotated; the antenna height was varied 1 to 4 meter and stopped at the azimuth or height producing the maximum emission.

Each EME reported was calibrated using the R/S signal generator

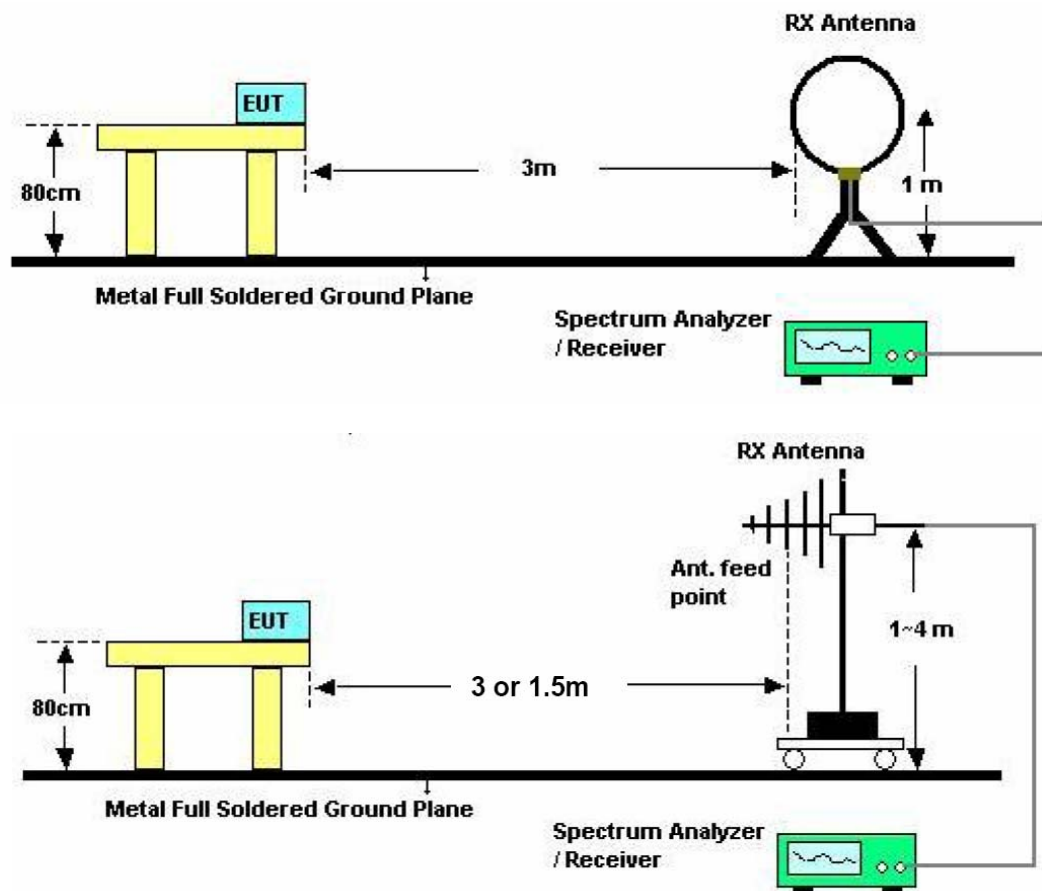


Fig 3. Dimensions of test site.

6. Conducted Emission

6.1 Operating environment

Temperature : 26 °C
Relative humidity : 47 %

6.2 Test set-up

The conducted emission measurements were performed in the shielded room.

The EUT was placed on wooden table, 0.8m heights above the floor, 0.4m from the reference ground plane (GRP) wall and 0.8m from AMN.

AMN is bonded on horizontal reference ground plane.

The ground plane, which was electrically bonded to the shield room, ground system and all power lines entering the shield room, were filtered.

6.3 Measurement uncertainty

The measurement uncertainty was calculated in accordance with ISO "Guide to the expression of uncertainty in measurement".

The measurement uncertainty was given with a confidence of 95%.

Contribution	Probability Distribution	Uncertainty (±dB)	
		Power Port	Communication port
Receiver specification	Rectangular	0.50	0.50
LISN coupling specification	Rectangular	1.50	
ISN coupling specification	Rectangular		1.50
Mismatch LISN VRC : $\Gamma_l =$ 0.20 ISN VRC : $\Gamma_l =$ 0.20 ATT VRC(IN) : $\Gamma_g =$ 0.03 Uncertainty limits $20\log(1 \pm \Gamma_l \Gamma_g)$	U-shaped	0.05 -0.05	0.05 -0.05
Mismatch Receiver VRC : $\Gamma_l =$ 0.09 ATT VRC : $\Gamma_g =$ 0.11 Uncertainty limits $20\log(1 \pm \Gamma_l \Gamma_g)$	U-shaped	0.09 -0.09	0.09 -0.09
System repeatability	Std Deviation	0.55	0.55
Cable and input attenuator calibration	Normal (k=2)	0.08	0.08
Repeatability of EUT			
Combined standard uncertainty $U_c(y)$	Normal	1.07 -1.07	1.07 -1.07
Extended uncertainty U	Normal (k=2)	2.15 -2.15	2.15 -2.15

6.4 Limit

RFI Conducted	FCC Limit(dB) Class B	
Freq. Range	Quasi-Peak	Average
150kHz – 0.5MHz	66 – 56*	56 – 46*
0.5MHz – 5MHz	56	46
5MHz – 30MHz	60	50
*Limits decreases linearly with the logarithm of frequency.		

6.5 Test equipment used

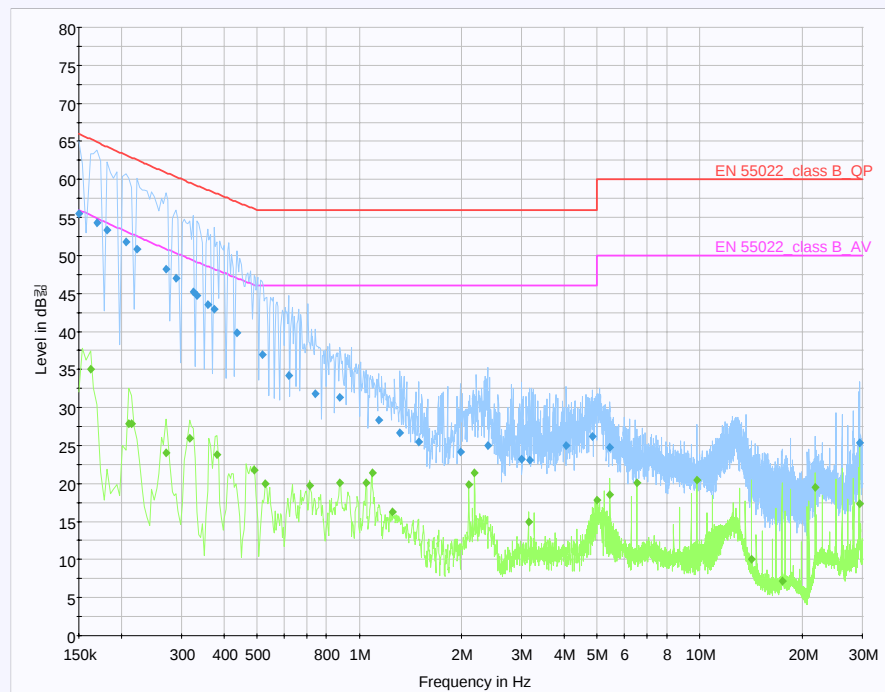
Model Number	Manufacturer	Description	Serial Number	Due to calibration
■ - ESCS30	Rohde & Schwarz	EMI test receiver	839809/003	12. 14. 2008
■ - ESH2-Z5	Rohde & Schwarz	Artificial mains network	829991/009	12. 13. 2008
□ - ESH3-Z5	Rohde & Schwarz	Artificial mains network	838979/020	12. 13. 2008

6.6 Test data for power line conducted emission

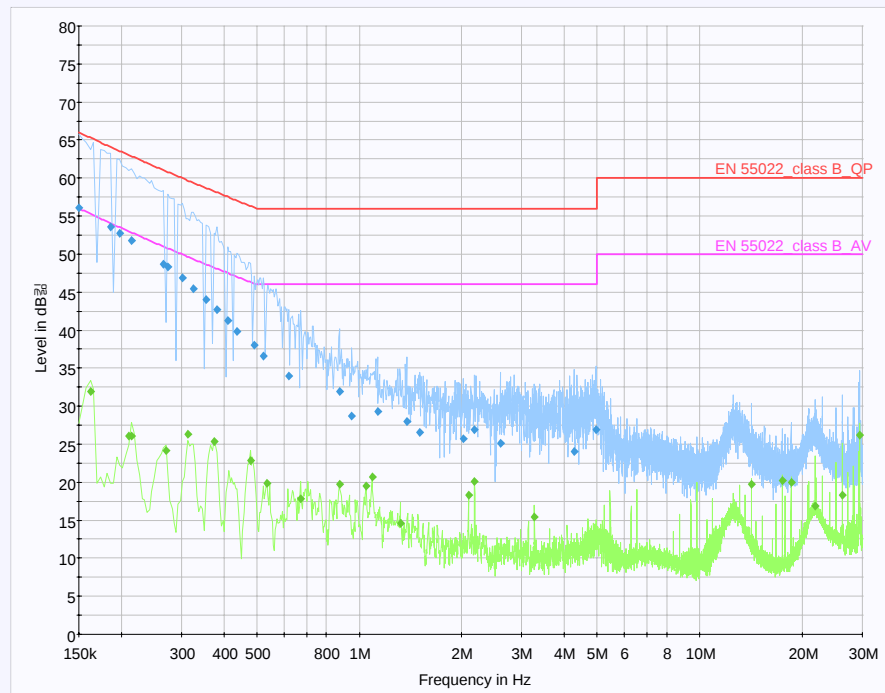
-. Test Date : June 3, 2008
 -. Reference standard : Part 15 Subpart C, Sec. 15.207
 -. Channel : 802.11g, 6ch
 -. Operating condition : WIFI RF transmitting mode
 -. Resolution bandwidth : 9 kHz
 -. Frequency range : 0.15 MHz ~ 30 MHz

Frequency (MHz)	Insertion Loss	Cable Loss	Pol.	Quasi-Peak[dBuV]			Average[dBuV]			Margin[dBuV]	
				Limit	Reading	Result	Limit	Reading	Result	Quasi	Average
0.274	0.13	-0.19	N	61.00	48.3	48.24	51.00	24.1	24.04	12.75	26.95
0.326	0.14	-0.16	N	59.55	45.4	45.38	49.55	26.3	26.28	14.17	23.27
0.354	0.15	-0.15	N	58.87	44.0	44.00	48.87	25.3	25.30	14.87	23.57
0.438	0.16	-0.14	N	57.10	39.9	39.92	47.10	22.9	22.92	17.18	24.18
0.518	0.15	-0.18	L1	56.00	37.0	36.96	46.00	20.0	19.96	19.04	26.04
0.622	0.14	-0.23	L1	56.00	34.2	34.11	46.00	18.4	18.31	21.89	27.69
0.874	0.15	-0.23	N	56.00	31.9	31.82	46.00	19.7	19.62	24.18	26.38
1.130	0.15	-0.24	N	56.00	29.3	29.21	46.00	19.5	19.41	26.79	26.59
2.178	0.19	-0.29	N	56.00	26.9	26.80	46.00	20.1	20.00	29.20	26.00

*Comment : Pol : L1 (Live), N(Neut)
 Insertion Loss : Insertion Loss of LISN
 Cable Loss : Cable Loss + Pulse Limiter Insertion loss value



(Phase: Line)



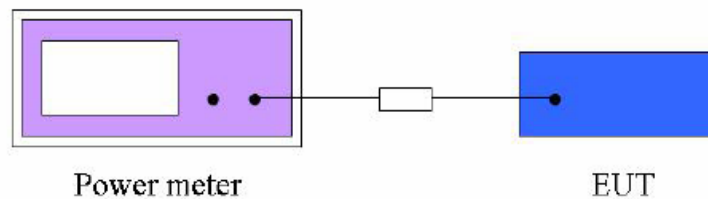
(Phase: Neutral)

7. Maximum Peak Output Power Measurement

7.1 Operating environment

Temperature : 26 °C
Relative humidity : 47 %

7.2 Test set-up (Layout)



7.3 Limit

For systems using digital modulation in the 2400~2483.5MHz, the limit for peak output power is 30dBm. The limit has to be reduced by the amount in dB that the gain of the antenna exceeds 6dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

7.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ -	NRVD	Rohde & Schwarz	Power meter	837794/048	12.14. 2008
■ -	NRV-Z32	Rohde & Schwarz	Power sensor	100062	12.14. 2008

7.5 Test result of Maximum Peak Output Power

- Test Date : June 3, 2008
 - Reference standard : Part 15 Subpart C, Sec. 15.247(b)(3)
 - Channel : 802.11b(1ch / 6ch / 11ch) ; 802.11g(1ch / 6ch / 11ch)
 - Operating condition : WIFI RF transmitting mode
 - Power Source : AC 120V/ 60Hz, DC 3.7V Li-ion Rechargeable battery

Parameter

- Filter no : Auto
 - Measurement time : 0.135s ~ 26s

Configuration IEEE 802.11b

Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2412 MHz	16.71	30.00	Complies
6	2437 MHz	16.08	30.00	Complies
11	2462 MHz	15.45	30.00	Complies

Configuration IEEE 802.11g

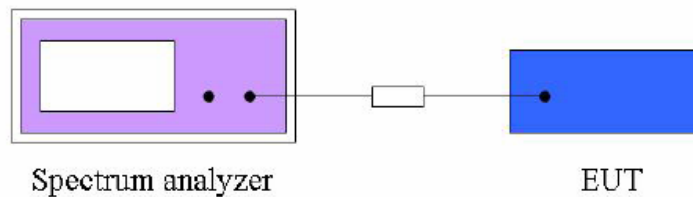
Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2412 MHz	16.93	30.00	Complies
6	2437 MHz	16.21	30.00	Complies
11	2462 MHz	15.50	30.00	Complies

8. Power Spectral Density Measurement

8.1 Operating environment

Temperature : 26 °C
Relative humidity : 47 %

8.2 Test set-up (Layout)



8.3 Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

8.4 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2008

8.5 Test result of Maximum Peak Output Power

- Test Date : June 3, 2008
 - Reference standard : Part 15 Subpart C, Sec. 15.247(e)
 - Channel : 802.11b(1ch / 6ch / 11ch) ; 802.11g(1ch / 6ch / 11ch)
 - Operating condition : WIFI RF transmitting mode
 - Power Source : AC 120V/ 60Hz, DC 3.7V Li-ion Rechargeable battery

Spectrum Parameter

- Attenuation : Auto
 - Span frequency : 1.5MHz
 - Resolution band width : 3kHz
 - Video band with : 30kHz
 - Trace : Maxhold
 - Sweep time : 500s

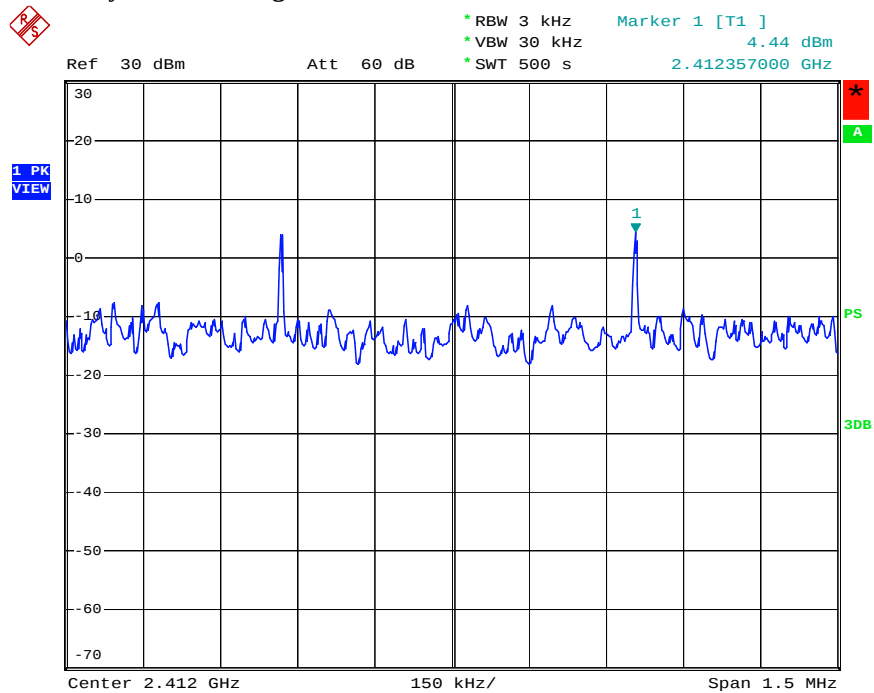
Configuration IEEE 802.11b

Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2412 MHz	4.44	8.00	Complies
6	2437 MHz	3.18	8.00	Complies
11	2462 MHz	2.47	8.00	Complies

Configuration IEEE 802.11g

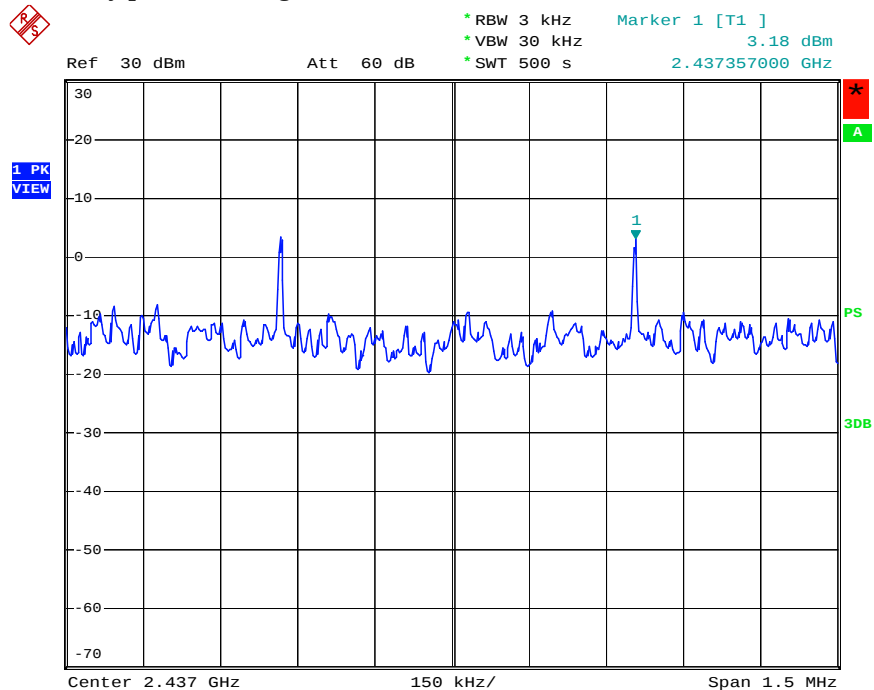
Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2412 MHz	-15.44	8.00	Complies
6	2437 MHz	-16.35	8.00	Complies
11	2462 MHz	-16.88	8.00	Complies

Power Density Plot on configuration IEEE 802.11b / 2412MHz



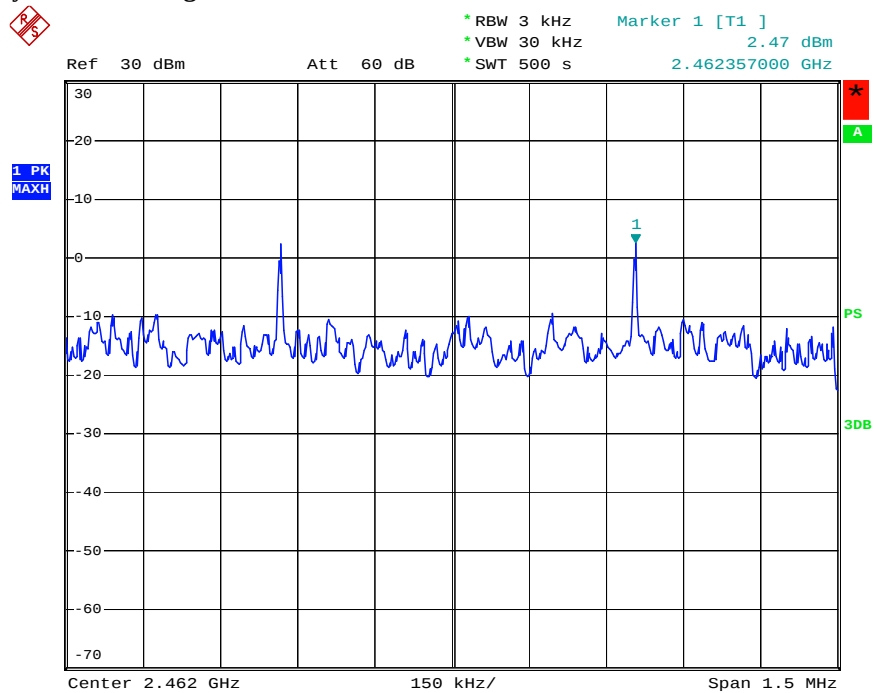
Date: 3.JUN.2008 15:30:13

Power Density plot on Configuration IEEE 802.11b / 2437MHz



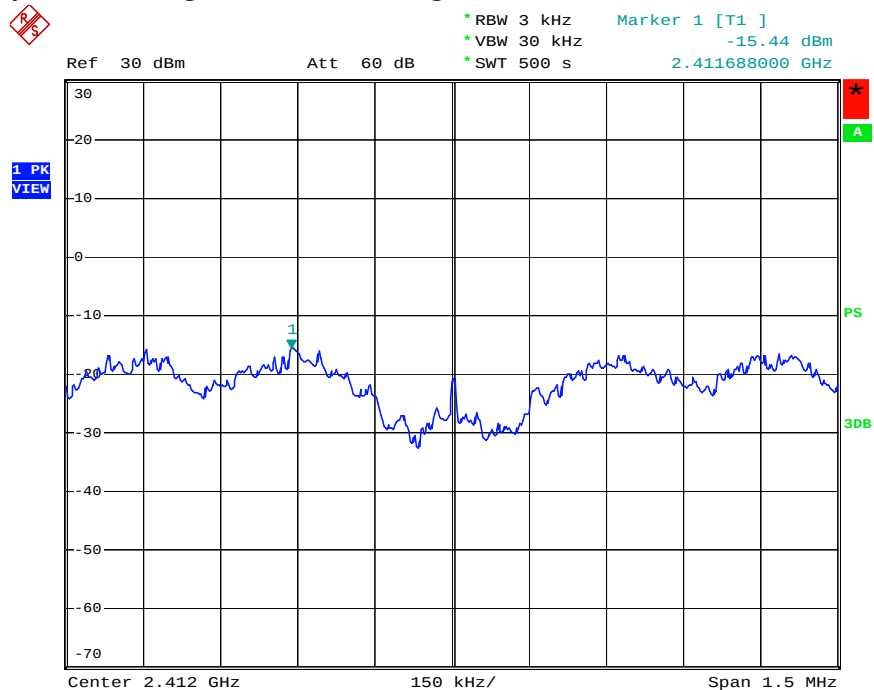
Date: 3.JUN.2008 15:41:55

Power Density Plot on Configuration IEEE 802.11b / 2462MHz



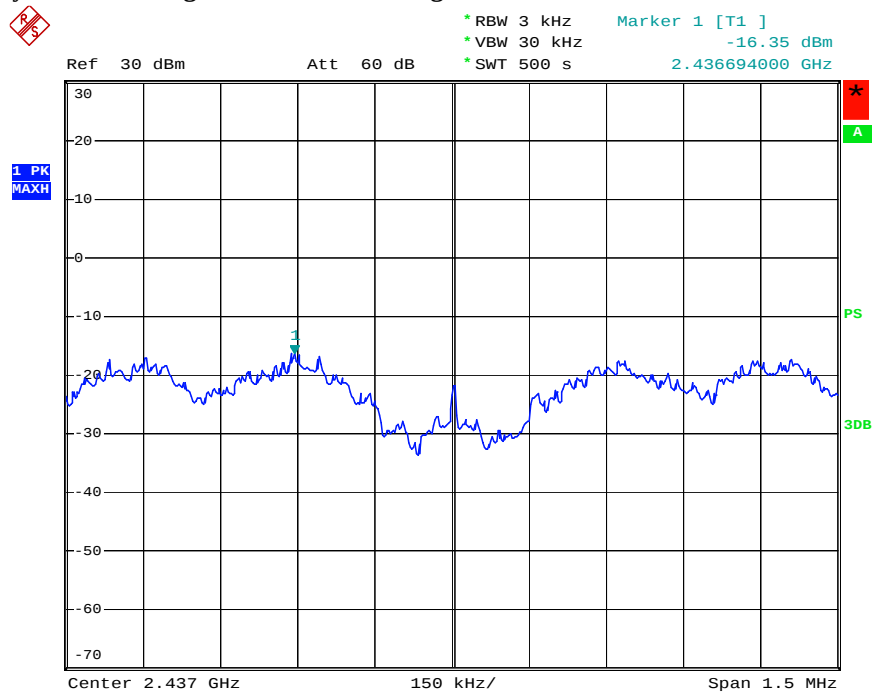
Date: 3.JUN.2008 15:07:18

Power Density Plot on Configuration IEEE 802.11g / 2412MHz



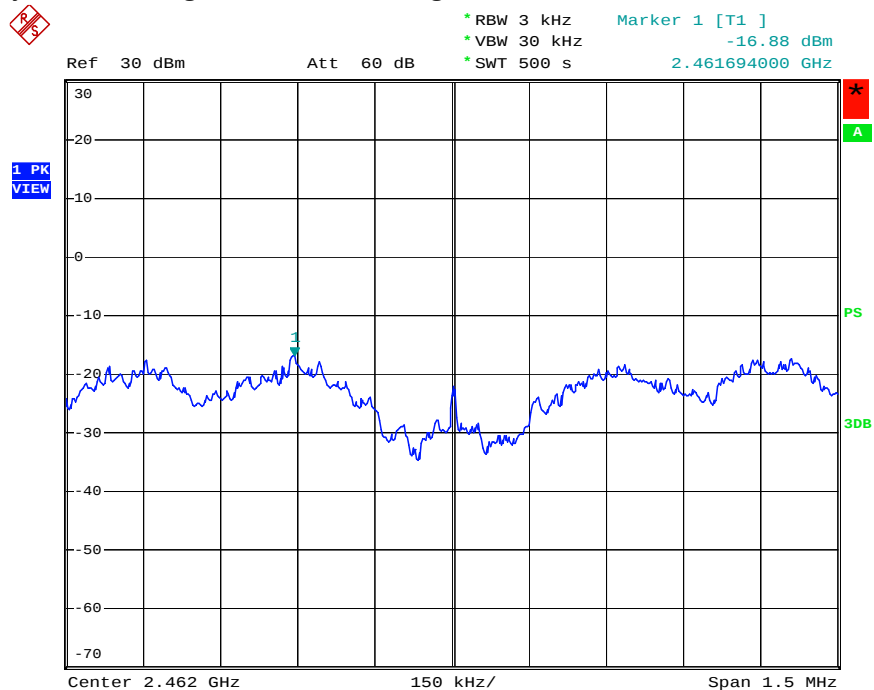
Date: 3.JUN.2008 14:40:51

Power Density Plot on Configuration IEEE 802.11g / 2437MHz



Date: 3.JUN.2008 14:50:11

Power Density Plot on Configuration IEEE 802.11g / 2462MHz



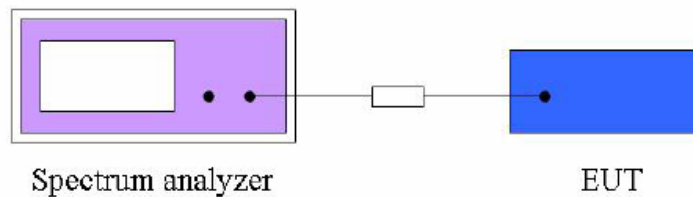
Date: 3.JUN.2008 14:58:22

9. 6dB Spectrum bandwidth Measurement

9.1 Operating environment

Temperature : 26 °C
Relative humidity : 47 %

9.2 Test set-up (Layout)



9.3 Limit

For digital modulation systems, the minimum 6dB bandwidth shall be at least 500kHz

9.4 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2008

9.5 Test result of Maximum Peak Output Power

- Test Date : June 3, 2008
 - Reference standard : Part 15 Subpart C, Sec. 15.247(a)(2)
 - Channel : 802.11b(1ch / 6ch / 11ch) ; 802.11g(1ch / 6ch / 11ch)
 - Operating condition : WIFI RF transmitting mode
 - Power Source : AC 120V/ 60Hz, DC 3.7V Li-ion Rechargeable battery

Spectrum Parameter

- Attenuation : Auto
 - Span frequency : >6dB bandwidth
 - Resolution band width : 100kHz
 - Video band with : 100kHz
 - Detector : Peak
 - Trace : Maxhold
 - Sweep time : Auto

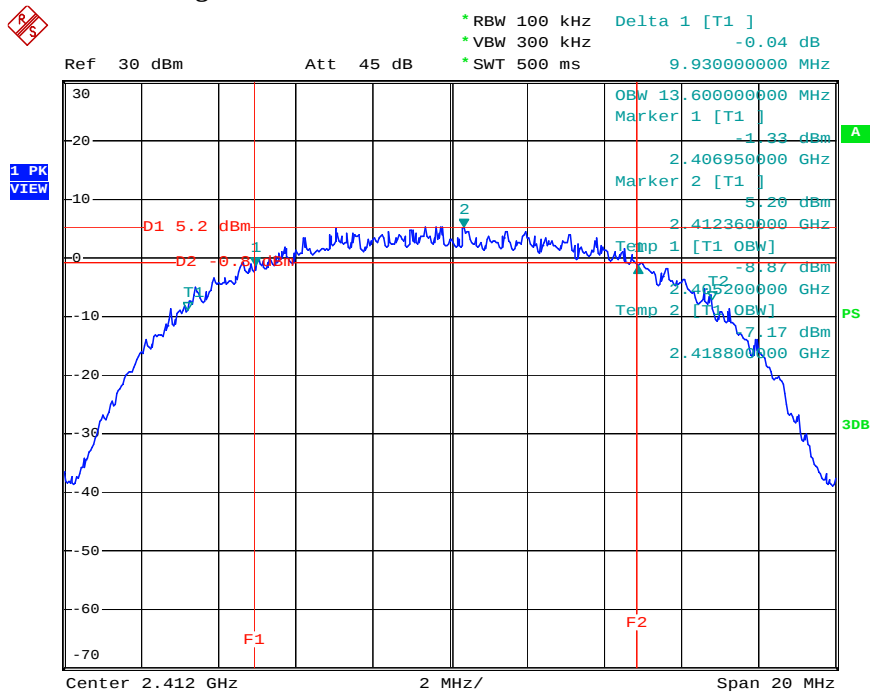
Configuration IEEE 802.11b

Channel	Frequency	6dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Min. Limit (kHz)	Result
1	2412 MHz	9.93	13.60	500	Complies
6	2437 MHz	10.28	13.64	500	Complies
11	2462 MHz	9.64	13.68	500	Complies

Configuration IEEE 802.11g

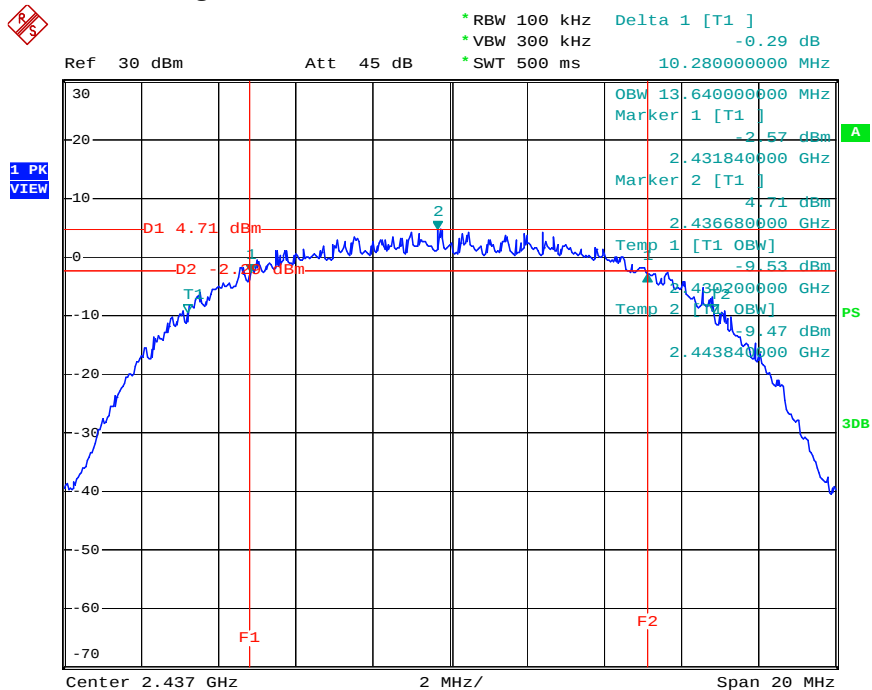
Channel	Frequency	6dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Min. Limit (kHz)	Result
1	2412 MHz	9.93	13.60	500	Complies
6	2437 MHz	10.28	13.64	500	Complies
11	2462 MHz	9.64	13.68	500	Complies

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



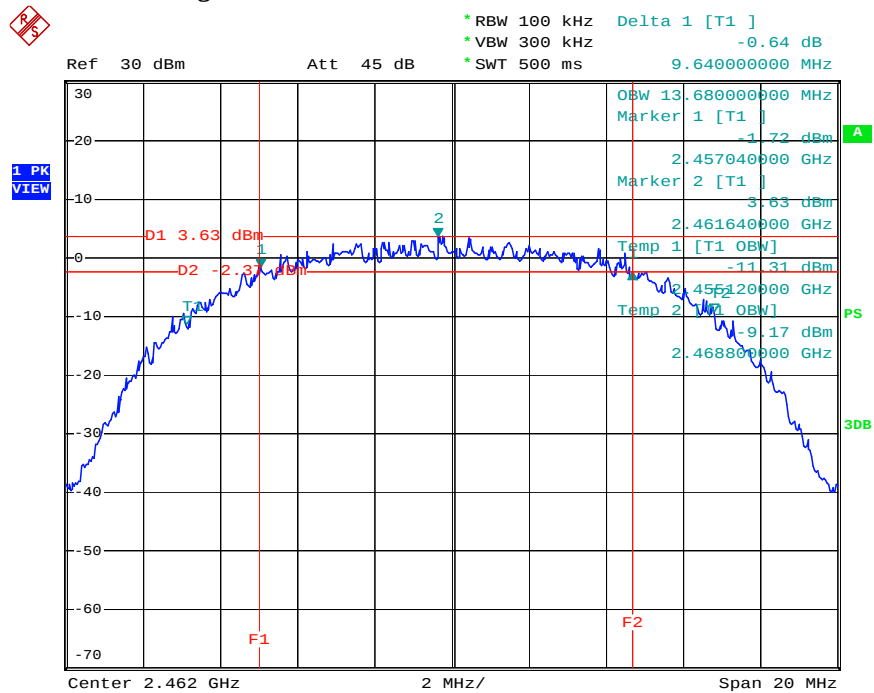
Date: 3.JUN.2008 16:06:49

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



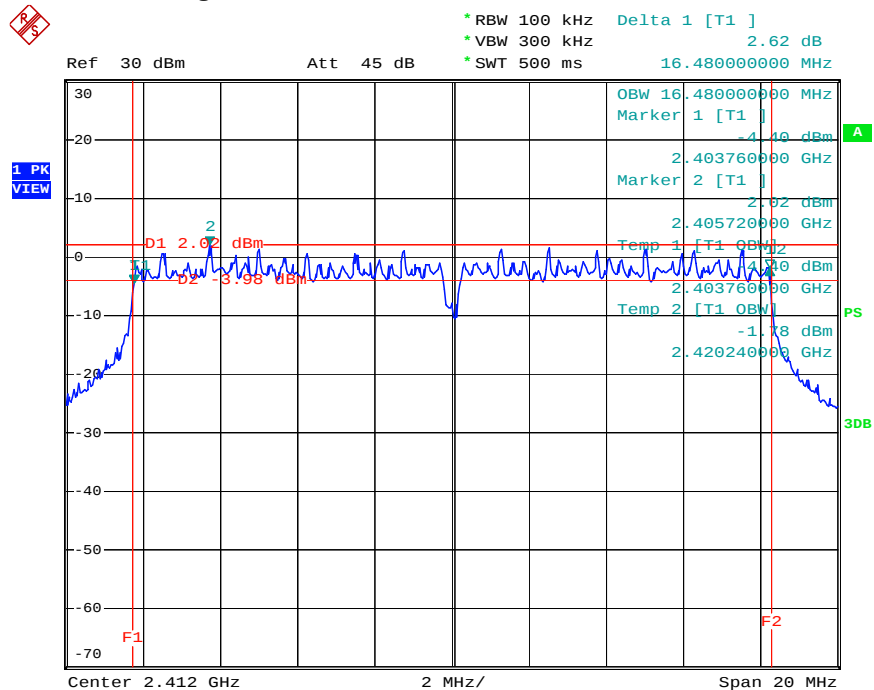
Date: 3.JUN.2008 16:10:03

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



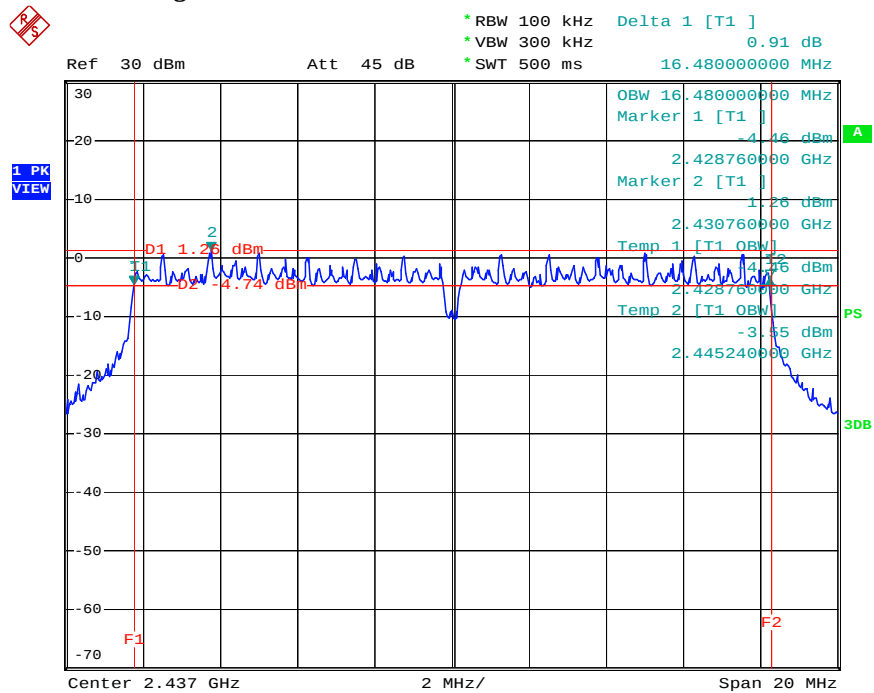
Date: 3.JUN.2008 16:13:03

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



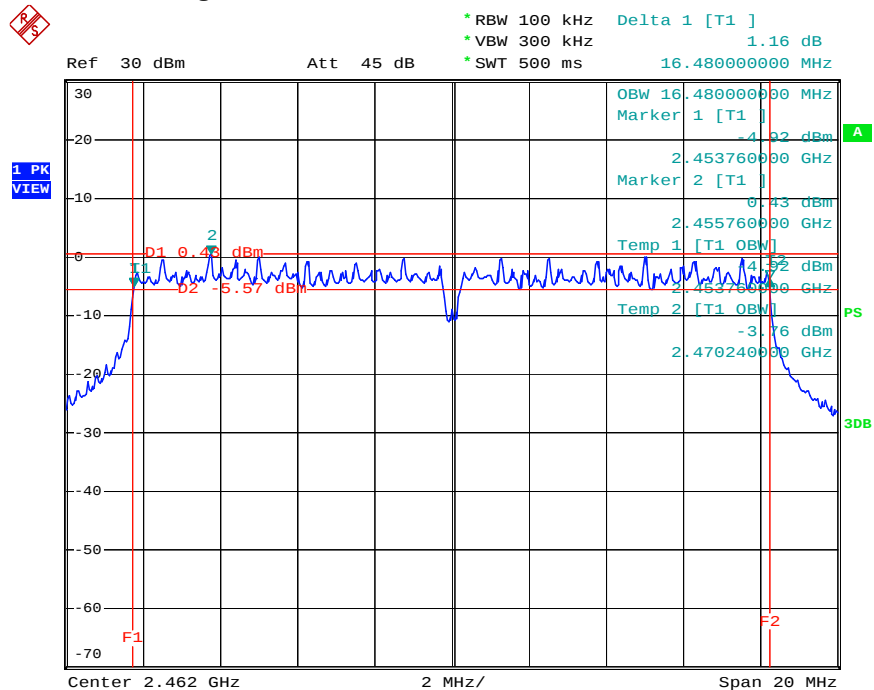
Date: 3.JUN.2008 16:26:44

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



Date: 3.JUN.2008 16:23:34

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



Date: 3.JUN.2008 16:20:40

10. Radiated Emission

10.1 Operating environment

Temperature : 26°C
Relative humidity : 40 %

10.2 Test set-up

A preliminary scan with peak mode was performed in the semi anechoic chamber using the procedure in ANSI C63.4/2003 13.1.4.1 and found frequency for open area test site.

The formal radiated emission was measured at 3m-distance open area test site.

The EUT was placed on a non-conductive turntable approximately 0.8 meters above the ground plane.

The turntable with EUT 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 Measurement uncertainty

The measurement uncertainty was calculated in accordance with ISO “Guide to the expression of uncertainty in measurement”.

The measurement uncertainty was given with a confidence of 95%.

Contribution	Probability Distribution	Uncertainty (dB)			
		Biconical Ant.		Log-periodic Ant.	
		3m	10m	3m	10m
Ambient signal					
Antenna factor calibration	Normal (k=2)	0.50	0.50	0.50	0.50
Receiver specification	Rectangular	0.50	0.50	0.50	0.50
Antenna directivity	Rectangular	0.25	0.00	1.50	0.25
Antenna phase center variation	Rectangular	0.00	0.00	1.00	0.20
Antenna factor frequency interpolation	Rectangular	0.25	0.25	0.25	0.25
Measure distance variation	Rectangular	0.60	0.40	0.60	0.40
Site imperfections	Rectangular	-2.00	-2.40	2.50	2.40
Mismatch Receiver VRC : $\Gamma_l = 0.09$ Antenna VRC : $\Gamma_g = 0.43$ (Bi) 0.23 (Lp) Uncertainty limits $20\log(1 \pm \Gamma_l \Gamma_g)$	U-shaped	0.33 -0.35	0.33 -0.35	0.18 -0.18	0.18 -0.18
System repeatability	Std Deviation	0.82	0.82	0.79	0.79
Cable loss calibration	Normal (k=2)	0.09	0.09	0.09	0.09
Combined standard uncertainty $U_c(y)$	Normal	1.54 -1.54	1.70 -1.70	2.03 -2.03	1.68 -1.68
Extended uncertainty U	Normal (k=2)	3.09 -3.09	3.39 -3.40	4.05 -4.05	3.36 -3.36

10.4 Limit

20dB in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolt/meter)	Measurement Distance (meters)
0.009~0.490	2400/F (kHz)	300
0.490~1.705	2400/F (kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

10.5 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2008
■ - HK116	Rohde & Schwarz	Biconical ANT	832639/007	12. 28. 2009
■ - HL223	Rohde & Schwarz	Log-periodic antenna	835998/004	12. 28. 2009
■ - HD100	HD GmbH	Position Controller	100/692/01	N/A
■ - DS415S	HD GmbH	Turntable	415/657/01	N/A
■ - MA240	HD GmbH	Antenna Mast	240/565/01	N/A
■ - BBHA9120D	Schwarzbeck	Horn antenna	597	04.01. 2009
■ - 3160	EMCO	Horn antenna	6741	12.26. 2009
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258943	N/A
■ - 8449B	Agilent	Amplifier	3008A01828	N/A

10.6 Radiated emission test data

- Test Date : June 3, 2008
- Reference standard : Part 15 Subpart C, Sec. 15.247(d)
- Channel : 802.11b(1ch / 6ch / 11ch) ; 802.11g(1ch / 6ch / 11ch)
- Operating condition : WIFI RF transmitting mode
- Measuring distance : 3m
- Spectrum resolution bandwidth(6dB) : 200Hz / 9kHz / 120 kHz / 1 MHz
- Detector mode : Peak detector mode / Quasi Peak detector mode / Average detector mode
- Power Source : AC 120V/ 60Hz, DC 3.7V Li-ion Rechargeable battery
- Note : 1. Through three orthogonal axes were investigated and the worst case is report
2. The EUT was tested with new batteries.

Result of radiated emission (9 kHz to 30 MHz)

Frequency (MHz)	Measurement Level				Limit (dBuV/m)	Margin (dBuV/m)	Positioning System		
	Reading Value(dBuV)	Antenna Factor(dB)	Cable Loss(dB)	Test Result (dBuV/m)			Pol. (H/V)	Height (cm)	Angle (deg)
All frequency	-	-	-	-	-	<<	-	-	-

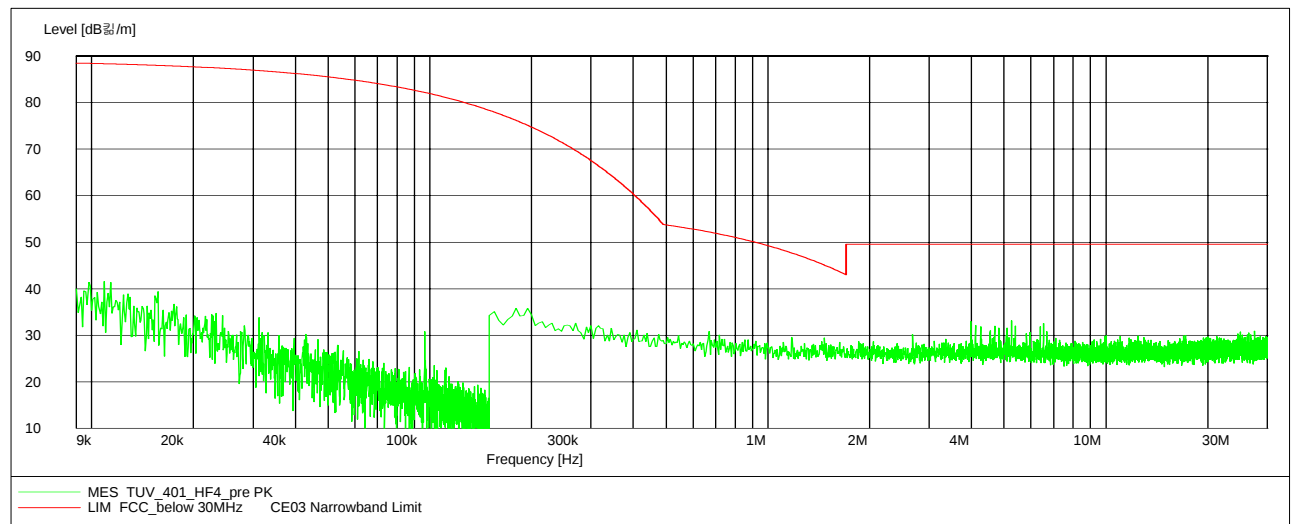
Note: "H": Horizontal, "V": Vertical

Note: "<<" means that the amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

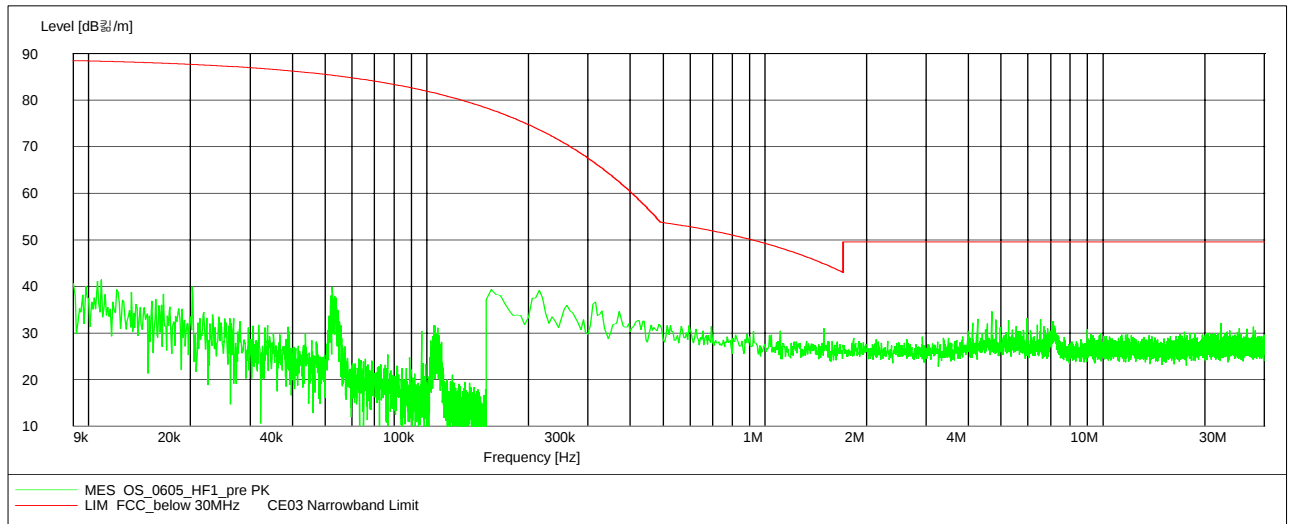
Distance extrapolation factor = $40 \log(\text{specific distance} / \text{test distance})$ (dB);

Limit line = specific limits (dB μ V) + distance extrapolation factor

*Ambient noise check (without EUT)

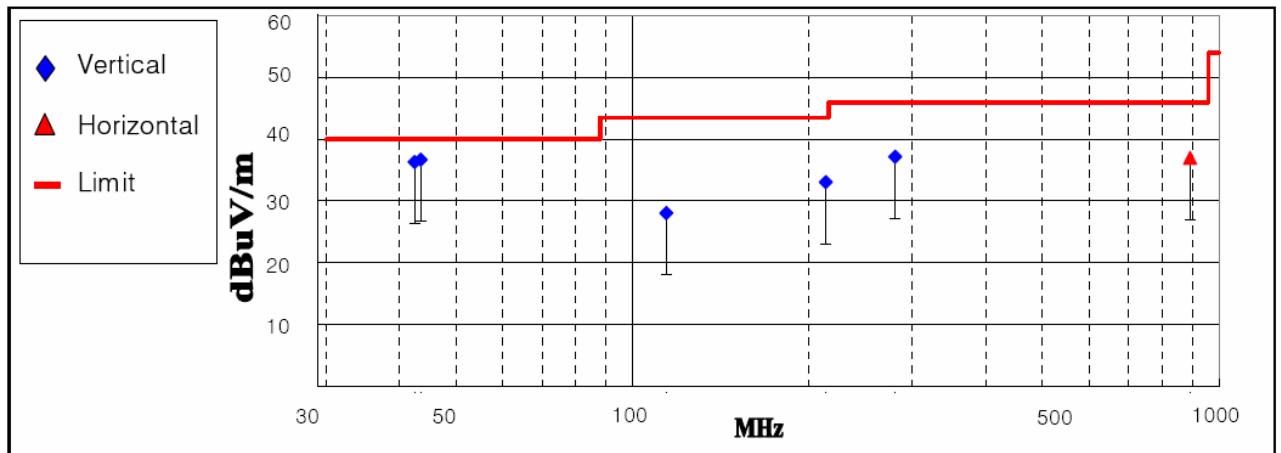


*Preliminary scan data (under WIFI operating)



Result of radiated emission (30 MHz to 1 000 MHz)

Frequency (MHz)	Measurement Level				Limit (dBμV/m)	Margin (dBμV/m)	Positioning System		
	Reading Value(dBuV)	Antenna Factor(dB)	Cable Loss(dB)	Test Result (dBμV/m)			Pol. (H/V)	Height (cm)	Angle (deg)
42.43	24.5	9.97	1.85	36.3	40.0	3.7	V	127	165
43.48	25.0	9.78	1.87	36.7	40.0	3.3	V	100	183
114.05	14.8	10.36	2.84	28.0	43.5	15.5	V	106	28
213.54	14.9	14.07	4.06	33.0	43.5	10.5	V	248	73
280.40	15.5	16.77	4.87	37.1	46.0	8.9	V	103	21
892.81	6.1	21.80	9.06	37.0	46.0	9.0	H	104	132



Note:

The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.

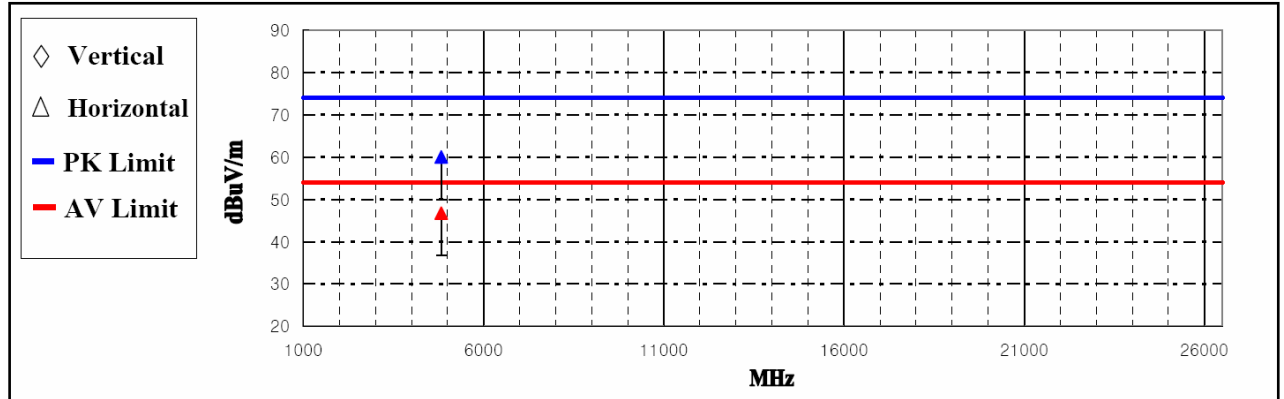
Emission level (dBμV/m) = 20 log Emission level(μV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read value = Test result

Result of radiated emission (1 GHz to 10th harmonics)

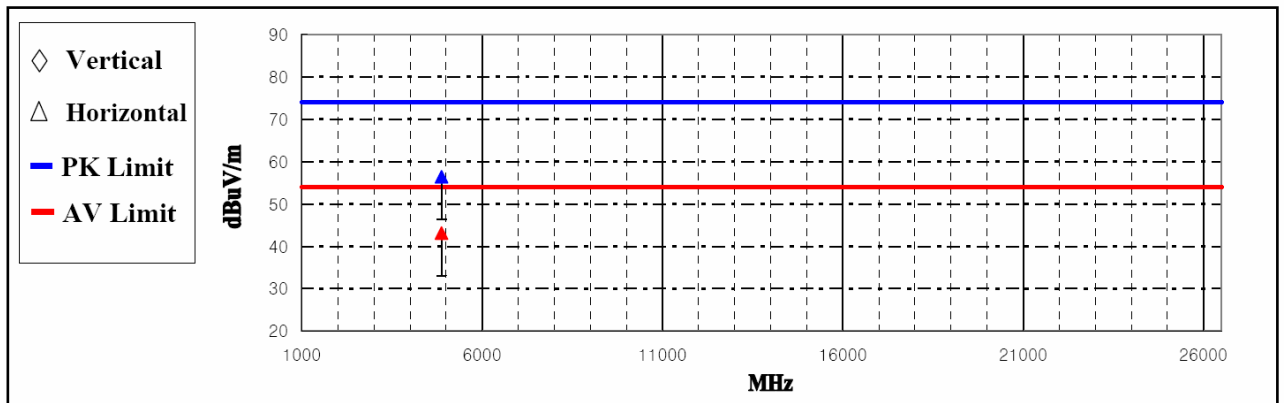
(802.11b, 1ch)

Frequency (MHz)	Measurement Level						Limit (dBuV/m)		Margin (dBuV/m)		Positioning System		
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)						Pol.	Height	Angle
	Peak	Average	(dB)	(dB)	Peak	Average	Peak	Average	Peak	Average	(H/V)	(cm)	(deg)
4824	86.8	73.5	31.4	-58.2	60.0	46.7	74.0	54.0	14.0	7.3	H	164	284



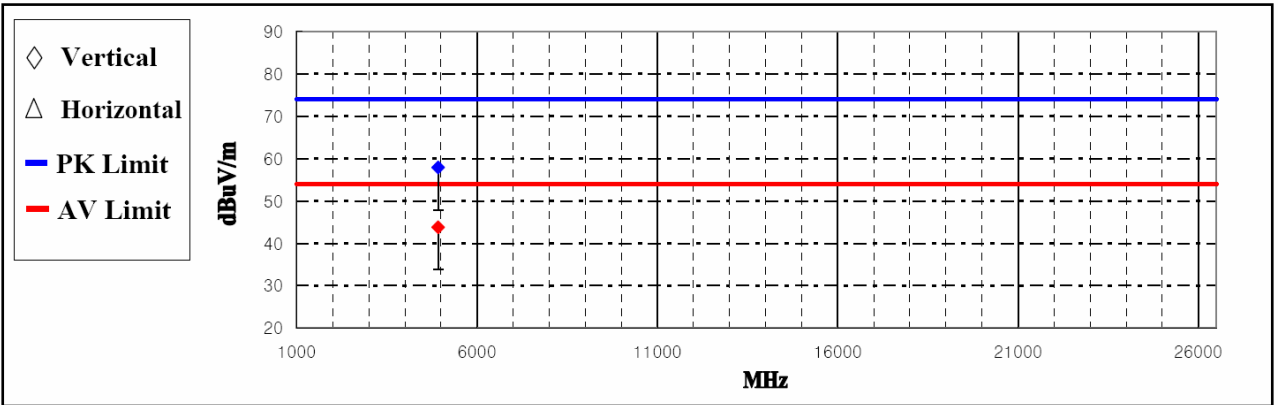
(802.11b, 6ch)

Frequency (MHz)	Measurement Level					Limit (dBuV/m)		Margin (dBuV/m)		Positioning System			
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)					Pol.	Height	Angle	
	Peak	Average	(dB)	(dB)	Peak	Average	Peak	Average	(H/V)	(cm)	(deg)		
4874	83.7	70.4	31.5	-58.8	56.4	43.1	74.0	54.0	17.6	10.9	H	116	198



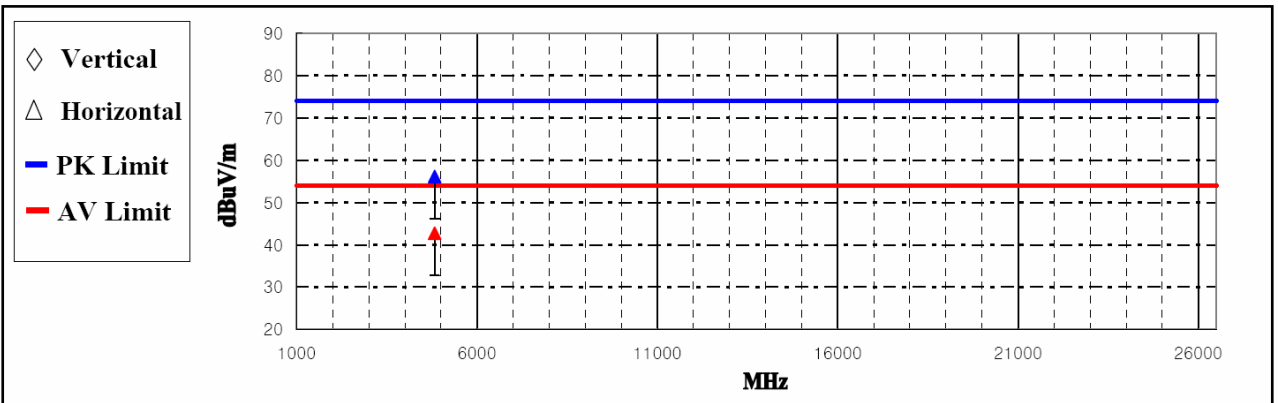
(802.11b, 11ch)

Frequency (MHz)	Measurement Level						Limit (dBuV/m)		Margin (dBuV/m)		Positioning System		
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)						Pol.	Height	Angle
	Peak	Average	(dB)	(dB)	Peak	Average	Peak	Average	(H/V)	(cm)	(deg)		
	4924	85.7	71.6	31.6	-59.4	57.9	43.8	74.0	54.0	16.1	10.2	V	124



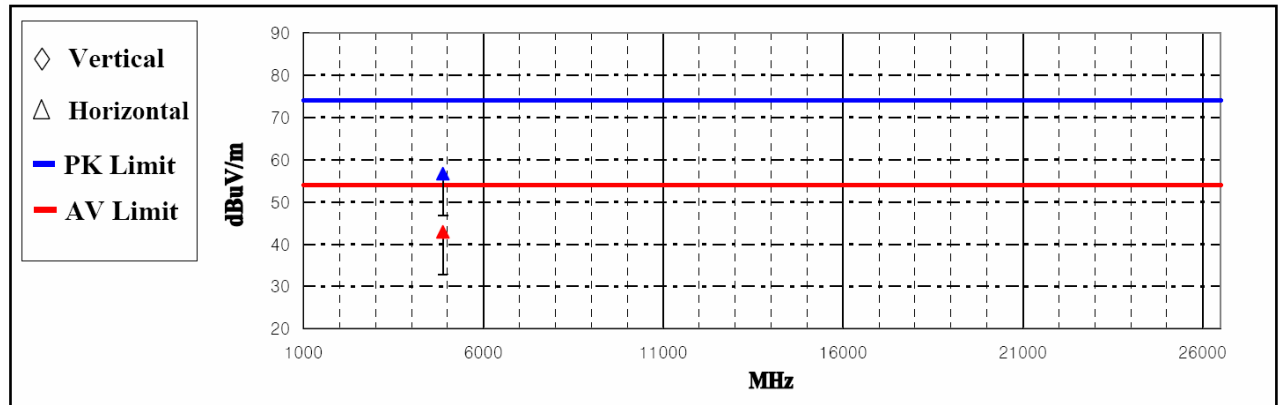
(802.11g, 1ch)

Frequency (MHz)	Measurement Level					Limit (dBuV/m)		Margin (dBuV/m)		Positioning System			
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)					Pol.	Height	Angle	
	Peak	Average	(dB)	(dB)	Peak	Average	Peak	Average	(H/V)	(cm)	(deg)		
4824	82.9	69.5	31.4	-58.2	56.1	42.7	74.0	54.0	17.9	11.3	H	127	0



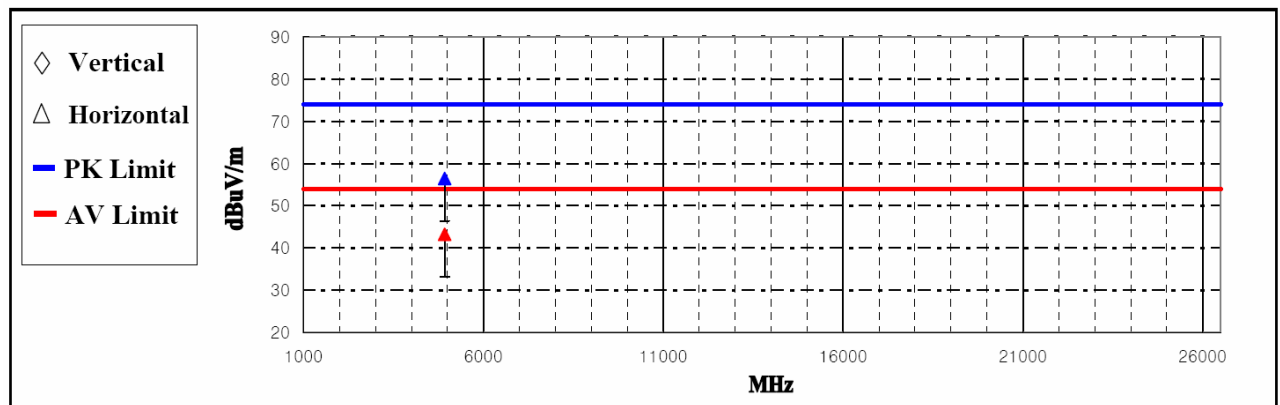
(802.11g, 6ch)

Frequency (MHz)	Measurement Level						Limit (dBuV/m)		Margin (dBuV/m)		Positioning System		
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)						Pol.	Height	Angle
	Peak	Average	(dB)	(dB)	Peak	Average	Peak	Average	(H/V)	(cm)	(deg)		
	4874	84.0	70.2	31.5	-58.8	56.7	42.9	74.0	54.0	17.3	11.1	H	139



(802.11g, 11ch)

Frequency (MHz)	Measurement Level					Limit (dBuV/m)		Margin (dBuV/m)		Positioning System			
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)					Pol.	Height	Angle	
	Peak	Average	(dB)	(dB)	Peak	Average	Peak	Average	(H/V)	(cm)	(deg)		
4924	84.2	71.0	31.6	-59.4	56.4	43.2	74.0	54.0	17.6	10.8	H	143	294



Note:

The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Reading value + AF (Antenna Factor) + AMP/CL (Cable Loss + Preamp factor) = Test result

11. Band Edge Radiated Emission

11.1 Operating environment

Temperature : 26°C
Relative humidity : 40 %

11.2 Test set-up

A preliminary scan with peak mode was performed in the semi anechoic chamber using the procedure in ANSI C63.4/2003 13.1.4.1 and found frequency for open area test site.

The formal radiated emission was measured at 3m-distance open area test site.

The EUT was placed on a non-conductive turntable approximately 0.8 meters above the ground plane.

The turntable with EUT 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

11.3 Limit

20dBc in any 100kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolt/meter)	Measurement Distance (meters)
0.009~0.490	2044/F (kHz)	300
0.490~1.705	24000/F (kHz)	30
1.705~30.0	30	30
30~80	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

11.4 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2008
■ - HK116	Rohde & Schwarz	Biconical ANT	832639/007	12. 28. 2009
■ - HL223	Rohde & Schwarz	Log-periodic antenna	835998/004	12. 28. 2009
■ - HD100	HD GmbH	Position Controller	100/692/01	N/A
■ - DS415S	HD GmbH	Turntable	415/657/01	N/A
■ - MA240	HD GmbH	Antenna Mast	240/565/01	N/A
■ - BBHA9120D	Schwarzbeck	Horn antenna	597	04.01. 2009
■ - 3160	EMCO	Horn antenna	6741	12.26. 2009
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258943	N/A
■ - 8449B	Agient	Amplifier	3008A01828	N/A

11.5 Band Edge Radiated emission test data

- Test Date : June 3, 2008
- Reference standard : Part 15 Subpart C, Sec. 15.247(d)
- Channel : 802.11b(1ch / 11ch) ; 802.11g(1ch / 11ch)
- Operating condition : WIFI RF transmitting mode
- Measuring distance : 3m
- Power Source : AC 120V/ 60Hz, DC 3.7V Li-ion Rechargeable battery
- Note : 1. Through three orthogonal axes were investigated and the worst case is report
2. The EUT was tested with new batteries.

Spectrum Parameter (RB : resolution band width / VB : video band width)

- Attenuation : Auto
- Span frequency : 100 MHz
- RB / VB (Emission in restricted band) : 1 MHz / 1 MHz for Peak, 1 MHz / 10 Hz for Average
- RB / VB (Emission in non-restricted band) : 100 kHz / 100 kHz for Peak

802.11b, 1ch

Frequency (MHz)	Measurement Level						Limit (dBuV/m)		Margin (dBuV/m)		Positioning System		
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)						Pol.	Height	Angle
	Peak	Average	(dB)	(dB)	Peak	Average	Peak	Average	(H/V)	(cm)	(deg)		
2412.0	114.1	100.3	27.5	-38.0	103.6	89.8	-	-	-	-	-	-	
2390.0	61.0	46.1	27.4	-38.0	50.5	35.6	74.0	54.0	23.5	18.4	-	-	-

802.11b, 11ch

Frequency (MHz)	Measurement Level						Limit (dBuV/m)		Margin (dBuV/m)		Positioning System		
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)						Pol.	Height	Angle
	Peak	Average	(dB)	(dB)	Peak	Average	Peak	Average	(H/V)	(cm)	(deg)		
2462.0	110.5	96.9	27.7	-37.7	100.5	86.9	-	-	-	-	-	-	
2483.5	61.3	47.8	27.7	-37.7	51.3	37.8	74.0	54.0	22.7	16.2	-	-	-

802.11g, 1ch

Frequency (MHz)	Measurement Level						Limit (dBuV/m)		Margin (dBuV/m)		Positioning System		
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)						Pol.	Height	Angle
	Peak	Average	(dB)	(dB)	Peak	Average	Peak	Average	(H/V)	(cm)	(deg)		
2412.0	110.6	84.3	27.5	-38.0	100.1	73.8	-	-	-	-	-	-	
2390.0	66.3	45.7	27.4	-38.0	55.8	35.2	74.0	54.0	18.2	18.8	-	-	

802.11g, 11ch

Frequency (MHz)	Measurement Level						Limit (dBuV/m)		Margin (dBuV/m)		Positioning System		
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)						Pol.	Height	Angle
	Peak	Average	(dB)	(dB)	Peak	Average	Peak	Average	Peak	Average	(H/V)	(cm)	(deg)
2462.0	107.0	81.1	27.7	-37.7	96.9	71.1	-	-	-	-	-	-	-
2483.5	69.0	47.1	27.7	-37.7	59.0	37.1	74.0	54.0	15.0	16.9	-	-	-

Note:

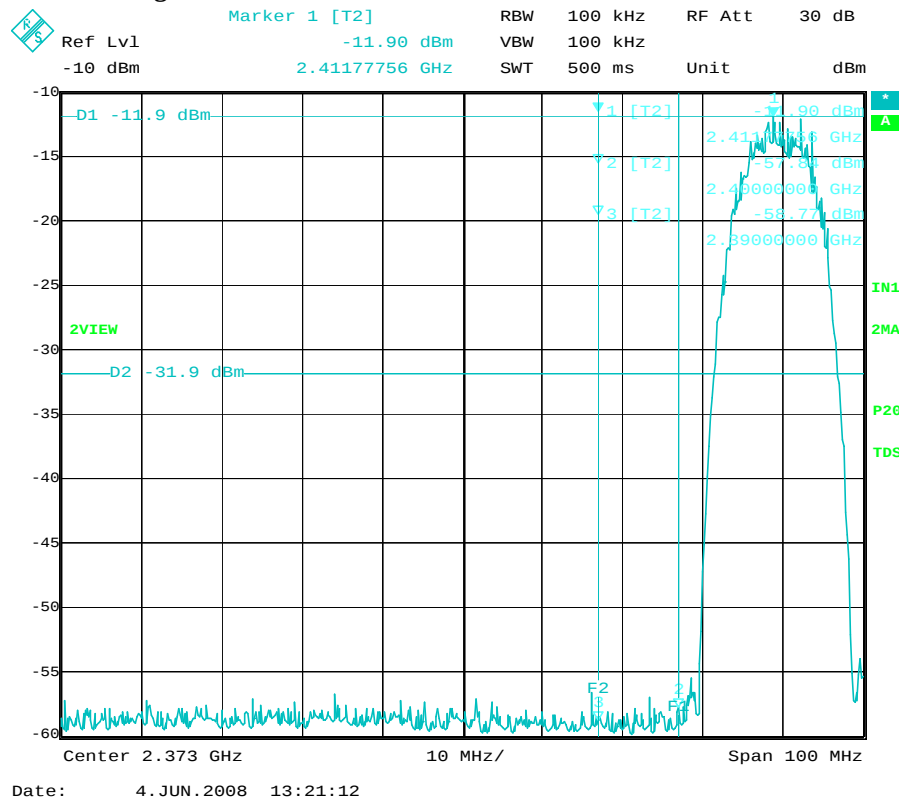
The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level(uV/m).

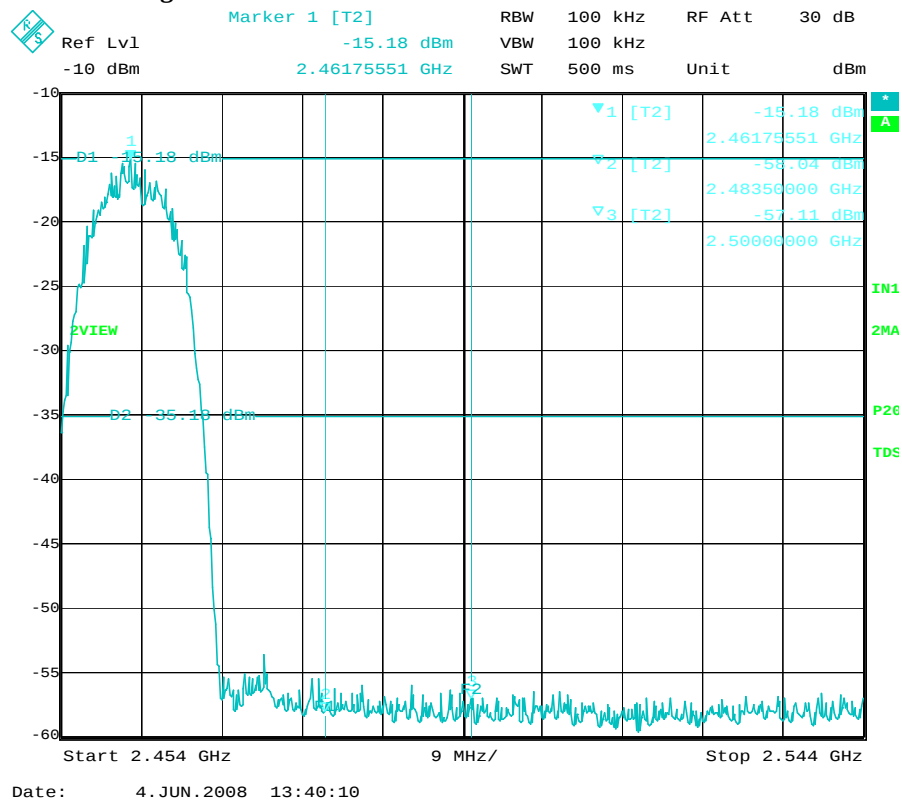
Corrected Reading: Reading value + AF(Antenna Factor) + AMP/CL (Cable Loss + Preamp factor) = Test result

For Emission not in Restricted Band

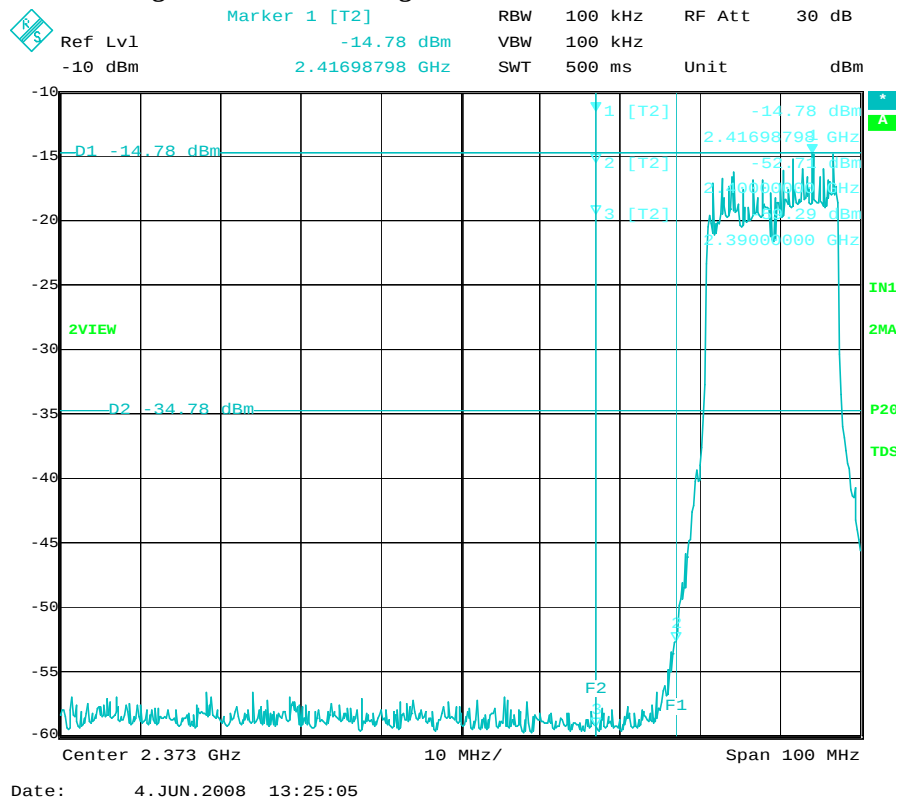
Low Band Edge Plot on Configuration IEEE 802.11b / 2412MHz



High Band Edge Plot on Configuration IEEE 802.11b / 2462MHz



Low Band Edge Plot on Configuration IEEE 802.11g / 2412MHz



High Band Edge Plot on Configuration IEEE 802.11g / 2462MHz

