

## **FCC EVALUATION REPORT FOR CERTIFICATION**

**Manufacturer : OHSUNG ELECTRONICS CO., LTD.**

**Date of Issue : June 2, 2009**

**#181 Gongdan-dong, Gumi-si, Gyeongbuk**

**Order Number: GETEC-C1-09-119**

**Republic of Korea**

**Test Report S/N : GETEC-E3-09-067**

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

**Test Site : Gumi College EMC Center**

**FCC Registration Number: (100749, 443957)**

**FCC ID**

**OZ5URCMX5000**

**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)

**Equipment Class : Digital Transmission System (DTS)**

**EUT Type : RF Remote Controller**  
(WI-FI built in RF remote controller)

**Model Name : MX-5000**

**Trade Name : UNIVERSAL remote control**

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,



**Jae-Hoon Jeong, Senior Engineer**  
**GUMI College EMC center**

Reviewed by,



**Tae-Sig Park, Technical Manger**  
**GUMI College EMC center**



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**APPENDIX K - 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, Gyeongbuk, Republic of Korea.**

**Manufacturer: OHSUNG ELECTRONICS CO., LTD.**

**Manufacturer Address: #181 Gongdan-dong, Gumi-si, Gyeongbuk, Republic of Korea.**

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

**Tel Number: +82-54-468- 0831 Fax Number: +82-54- 461- 8368**

- **FCC ID.** OZ5URCMX5000
- **Test method** Public Notice FCC97-114  
(Guidance on measurement for direct sequence spread spectrum systems)
- **Equipment Class** Digital Transmission System (DTS)
- **EUT Type** RF Remote Controller  
(WI-FI built in RF remote controller)
- **Power Source** AC 120 V/ 60 Hz,  
DC 3.7 V / 2400 mAh Rechargeable Lithium Polymer Battery
- **Model Name** MX-5000
- **Trade Name** UNIVERSAL remote control
- **Rule Part(s)** FCC Part 15, Subpart C-Intentional Radiator § 15.247
- **Type of Authority** Certification
- **Test Procedure(s)** ANSI C63.4 (2003)
- **Dates of Test** May 20 ~ 21, 2009
- **Place of Test** **Gumi College EMC Center** ( FCC Registration No.: 100749, 443957)  
407, Bugok-dong, Gumi-si, Gyeongbuk, Korea.
- **Test Report Number** GETEC-E3-09-067
- **Dates of Issue** June 2, 2009

**EUT Type: RF Remote Controller**

**FCC ID.: OZ5URCMX5000**



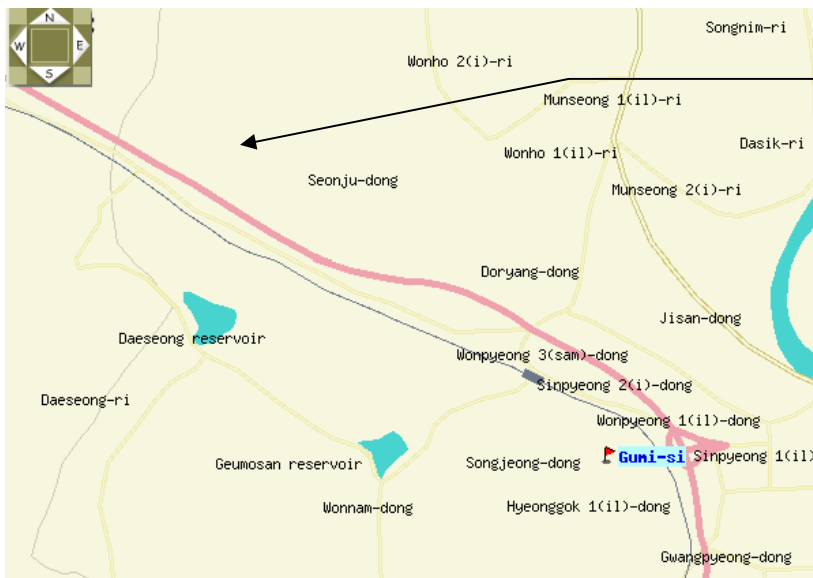
## 2. Introduction

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 9 kHz to 40 GHz (ASNI C63.4-2003) was used in determining radiated and conducted emissions emanating from **OHSUNG ELECTRONICS CO., LTD. RF Remote Controller (Model Name: MX-5000)**

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

The site address is 407, Bugok-dong, Gumi-si, Gyeongbuk, 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 FCC §2.948 according to ANSI C63.4 (2003)



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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. WI-FI built in RF Remote Controller (Model Name: MX-5000) FCC ID.: OZ5URCMX5000**

This Report is for Wi-Fi module the next report (No. GETEC-E3-09-073) is for SAR Evaluation.

- Used AC/DC Adapter** : KSAD0600200W1US(UNIVERSAL remote control)  
 Input: AC (100-240) V, (50/60) Hz, 0.4 A  
 Output: DC 6 V, 2.0 A
- External Connector** : USB, DC in, Charger signal
- Crystal & Clock Frequency** : 133 MHz,48 MHz, 12 MHz,32.768 kHz,8 MHz ,  
 13.0625 MHz on Main board B'D
- Number of Layer** : 6 Layer

Microprocessor: 533MHz ARM9  
 RAM: 128Mbyte Mobile DDR  
 NAND: 64Mbyte  
 LCD: 2.8 Inch Screen (240 by 320)  
 LCD Backlighting by LED  
 Sound: mono 1 watt  
 USB: 2.0  
 Devices - Supports up to 255 Devices with text, less with heavy graphics usage  
 Pages - Supports up to 255 Pages on each Device with text, less with heavy graphics usage  
 Learning Capability - Standard frequencies (20kHz to 455kHz)  
 Macro Capability - Up to 255 steps each, however nesting is allowed

IR Range (Line of Sight via Infrared):  
 30-50 feet, depending on the environment  
 RF Frequency: 418MHz  
 RF Range (radio frequency): 50 to 100 feet, depending upon the environment  
 Wi-Fi: IEEE 802.11 B (11Mps), G (54Mps)  
 Battery: Lithium Ion, 2400mAh  
 Battery Capacity: 4 hours continuous use, 9 days standby  
 Battery Charging Time: 5 Hours  
 Dimensions: 8.8" Height x 2.3" Wide x 0.9 Thick  
 Battery Warranty : 1 Year  
 Weight (without AC Adapter): 7.8 oz

Frequency Band	Channel Number	Frequency	Channel Number	Frequency
2 400 ~ 2 483.5 MHz	1	2 412 MHz	7	2 442 MHz
	2	2 417 MHz	8	2 447 MHz
	3	2 422 MHz	9	2 452 MHz
	4	2 427 MHz	10	2 457 MHz
	5	2 432 MHz	11	2 462 MHz
	6	2 437 MHz		

**EUT Type: RF Remote Controller**

**FCC ID.: OZ5URCMX5000**



### 3.2 Support Equipment / Cables used

#### 3.2.1 Used Support Equipment

Description	Manufacturer	Model Name	S/N & FCC ID
Cradle	Universal Remote Control Inc.	MX-5000 cradle	S/N: A903-1888A FCC ID: DoC

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

#### 3.2.2 Used Cable(s)

Cable Number	Condition	Description
Adapter cable	Connected to the EUT	1.95 m unshielded

### 3.3 Modification Item(s)

-. None

## 4. 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.

### 4.1 Description of Antenna

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



## 5. Description of tests

### 5.1 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 120 V / 60 Hz  
DC 3.7 V / 2400 mAh Rechargeable Lithium Polymer Battery

- Test Mode(s)
  - Executed "TCMD (TCMD made by MMC IC)" to control the EUT continuously transmit RF signal

Test Software Version	TCMD tool		
Frequency	2 412 MHz	2 437 MHz	2 462 MHz
IEEE 802.11 B&G	18	18	18





## 5.2 Conducted Emission

The Line conducted emission test facility is inside a 4 m × 8 m × 2.5 m shielded enclosure. (FCC Registration No.: 100749)

The EUT was placed on a non-conducting 1.0 m by 1.5 m table, which is 0.8 m in height and 0.4 m 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 150 kHz to 30 MHz with 20 ms 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 9 kHz. 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 cm ~ 40 cm.

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

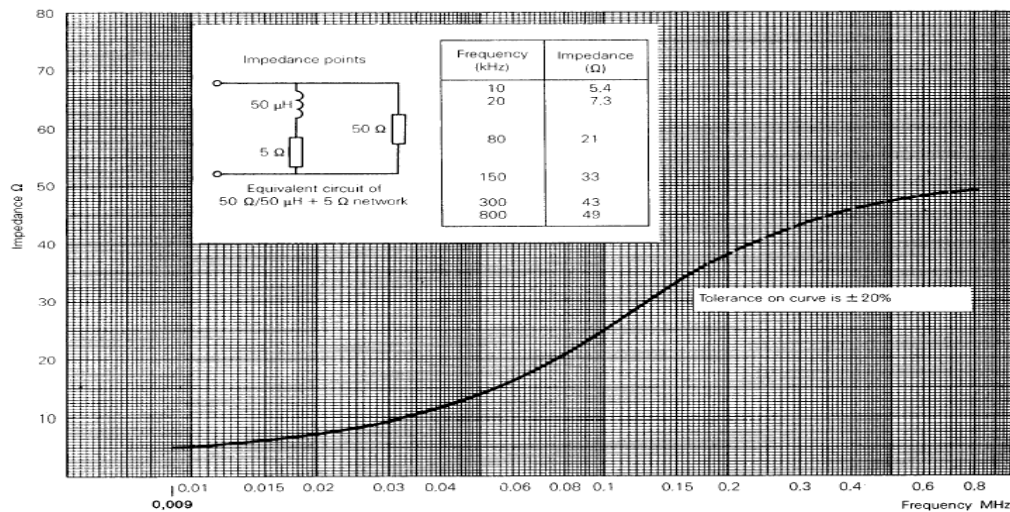


Fig 2. Impedance of LISN



### 5.3 Radiated Emission

The measurements were conducted in a 3 m anechoic chamber (FCC Registration No.: 443957) 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 noted for each frequency found.

The spectrum was scanned from 30 to 1000 MHz, using a biconical log antenna (Schwarzbeck, VULB9160).

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

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 an EMI test receiver. The detector function was set to CISPR quasi-peak mode average mode and the bandwidth of the receiver was set to 120 kHz or 1 MHz 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 0.8 m high non-metallic 1.0 m × 1.5 m table.

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

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

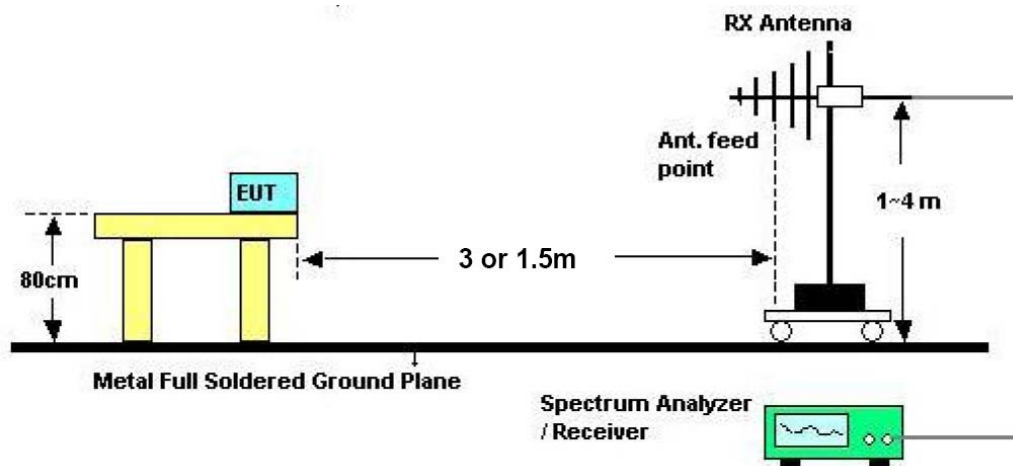


Fig 3. Dimensions of test site.



## 6. Conducted Emission

### 6.1 Operating environment

Temperature : 24 °C  
Relative humidity : 48 % R.H

### 6.2 Test set-up

The conducted emission measurements were performed in the shielded room.

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

Test items	Uncertainty	Remark
Conducted emission (9 kHz ~ 150 kHz)	± 2.97 dB	Confidence levels of 95 % (k=2)
Conducted emission (150 kHz ~ 30 MHz)	± 4.05 dB	Confidence levels of 95 % (k=2)



#### 6.4 Limit

RFI Conducted	FCC Limit(dB) Class B	
	Quasi-Peak	Average
150 kHz ~ 0.5 MHz	66 ~ 56*	56 ~ 46*
0.5 MHz ~ 5 MHz	56	46
5 MHz ~ 30 MHz	60	50

\*Limits decreases linearly with the logarithm of frequency.

#### 6.5 Test equipment used

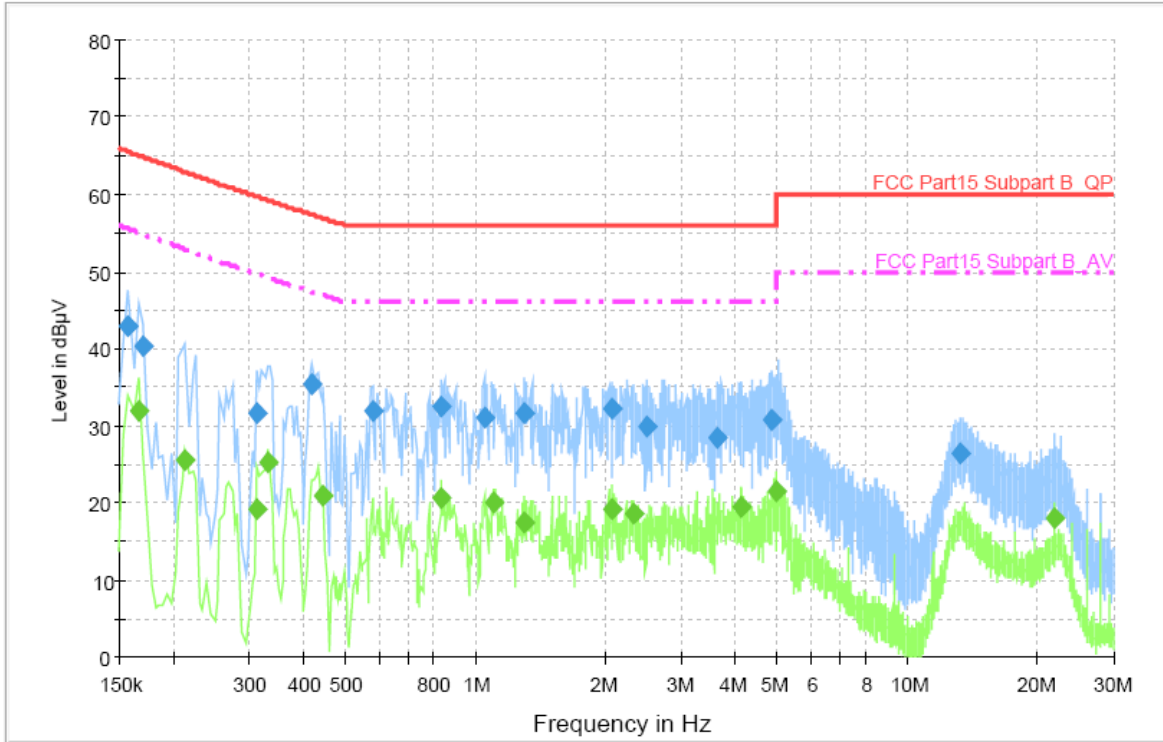
Model Name	Manufacturer	Description	Serial Number	Due to calibration
■ - ESCS30	Rohde & Schwarz	EMI test receiver	839809/003	12. 14. 2009
■ - ESH2-Z5	Rohde & Schwarz	Artificial mains network	829991/009	12. 13. 2009
□ - ESH3-Z5	Rohde & Schwarz	Artificial mains network	838979/020	12. 13. 2009

#### 6.6 Test data for power line conducted emission

- Test Date : May 21, 2009
- Reference standard : Part 15 Subpart C, Sec. 15.207
- Channel : 802.11b, 1ch
- Operating condition : Wi-Fi RF transmitting mode
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz



## Voltage with 4-Line-LISN\_L1



### Final Measurement Detector 1

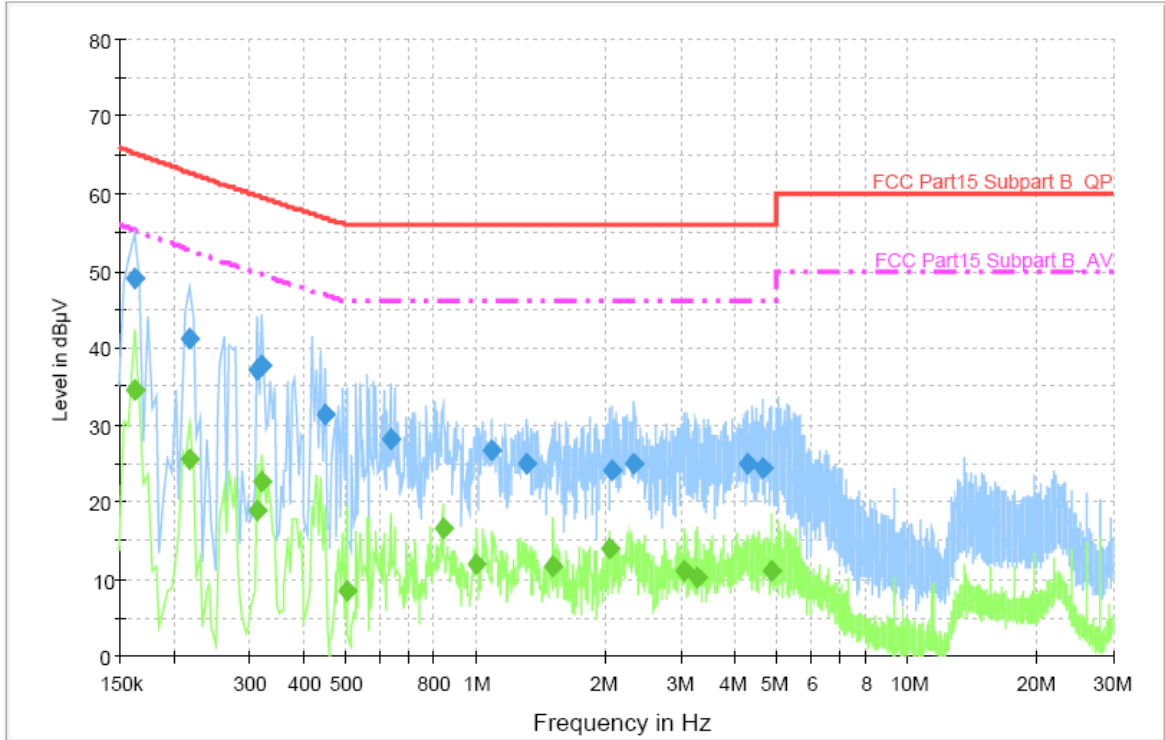
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.158000	43.0	1000.000	9.000	GND	L1	9.9	22.5	65.5	
0.170000	40.3	1000.000	9.000	GND	L1	9.9	24.6	64.9	
0.314000	31.7	1000.000	9.000	GND	L1	10.0	28.0	59.7	
0.418000	35.5	1000.000	9.000	GND	L1	10.0	21.9	57.4	
0.578000	31.9	1000.000	9.000	GND	L1	10.0	24.1	56.0	
0.834000	32.4	1000.000	9.000	GND	L1	10.0	23.6	56.0	
1.050000	31.0	1000.000	9.000	GND	L1	10.0	25.0	56.0	
1.298000	31.7	1000.000	9.000	GND	L1	10.0	24.3	56.0	
2.078000	32.2	1000.000	9.000	GND	L1	10.1	23.8	56.0	
2.506000	29.9	1000.000	9.000	GND	L1	10.1	26.1	56.0	
3.638000	28.4	1000.000	9.000	GND	L1	10.1	27.6	56.0	
4.886000	30.7	1000.000	9.000	GND	L1	10.2	25.3	56.0	
13.230000	26.3	1000.000	9.000	GND	L1	10.5	33.7	60.0	

### Final Measurement Detector 2

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.166000	31.8	1000.000	9.000	GND	L1	9.9	23.3	55.1	
0.214000	25.6	1000.000	9.000	GND	L1	9.9	27.2	52.8	
0.314000	19.3	1000.000	9.000	GND	L1	10.0	30.3	49.6	
0.330000	25.3	1000.000	9.000	GND	L1	10.0	23.9	49.2	
0.446000	21.0	1000.000	9.000	GND	L1	10.0	25.9	46.9	
0.834000	20.7	1000.000	9.000	GND	L1	10.0	25.3	46.0	
1.098000	20.1	1000.000	9.000	GND	L1	10.0	25.9	46.0	
1.302000	17.3	1000.000	9.000	GND	L1	10.0	28.7	46.0	
2.078000	19.1	1000.000	9.000	GND	L1	10.1	26.9	46.0	
2.334000	18.7	1000.000	9.000	GND	L1	10.1	27.3	46.0	
4.146000	19.3	1000.000	9.000	GND	L1	10.2	26.7	46.0	
4.986000	21.5	1000.000	9.000	GND	L1	10.2	24.5	46.0	
21.874000	17.9	1000.000	9.000	GND	L1	10.9	32.1	50.0	



## Voltage with 4-Line-LISN\_N



### Final Measurement Detector 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.162000	48.9	1000.000	9.000	GND	N	9.9	16.4	65.3	
0.218000	41.1	1000.000	9.000	GND	N	9.9	21.6	62.7	
0.314000	37.0	1000.000	9.000	GND	N	10.0	22.7	59.7	
0.322000	37.7	1000.000	9.000	GND	N	10.0	21.8	59.5	
0.450000	31.4	1000.000	9.000	GND	N	10.0	25.4	56.8	
0.634000	28.0	1000.000	9.000	GND	N	10.0	28.0	56.0	
1.090000	26.7	1000.000	9.000	GND	N	10.0	29.3	56.0	
1.322000	24.9	1000.000	9.000	GND	N	10.0	31.1	56.0	
2.066000	24.0	1000.000	9.000	GND	N	10.1	32.0	56.0	
2.342000	25.0	1000.000	9.000	GND	N	10.1	31.0	56.0	
4.274000	24.9	1000.000	9.000	GND	N	10.2	31.1	56.0	
4.638000	24.5	1000.000	9.000	GND	N	10.2	31.5	56.0	

### Final Measurement Detector 2

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.162000	34.5	1000.000	9.000	GND	N	9.9	20.8	55.3	
0.218000	25.4	1000.000	9.000	GND	N	9.9	27.3	52.7	
0.314000	18.9	1000.000	9.000	GND	N	10.0	30.7	49.6	
0.322000	22.6	1000.000	9.000	GND	N	10.0	26.8	49.4	
0.502000	8.4	1000.000	9.000	GND	N	10.0	37.6	46.0	
0.842000	16.5	1000.000	9.000	GND	N	10.0	29.5	46.0	
1.010000	11.8	1000.000	9.000	GND	N	10.0	34.2	46.0	
1.518000	11.5	1000.000	9.000	GND	N	10.1	34.5	46.0	
2.054000	13.8	1000.000	9.000	GND	N	10.1	32.2	46.0	
3.038000	10.9	1000.000	9.000	GND	N	10.1	35.1	46.0	
3.266000	10.0	1000.000	9.000	GND	N	10.1	36.0	46.0	
4.846000	11.1	1000.000	9.000	GND	N	10.2	34.9	46.0	

(Phase: Line)

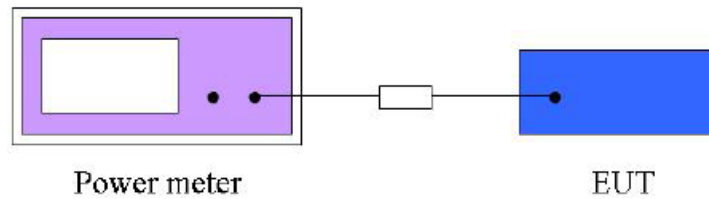


## 7. Maximum Peak Output Power Measurement

### 7.1 Operating environment

Temperature : 23 °C  
 Relative humidity : 40 %R.H

### 7.2 Test set-up (Layout)



### 7.3 Limit

For systems using digital modulation in the (2 400~2 483.5) MHz, the limit for peak output power is 30 dBm. The limit has to be reduced by the amount in dB that the gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

### 7.4 Test equipment used

	Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ -	NRVD	Rohde & Schwarz	Power meter	837794/048	12.14. 2009
■ -	NRV-Z32	Rohde & Schwarz	Power sensor	100062	12.14. 2009

### 7.5 Test result of Maximum Peak Output Power

- Test Date : May 20, 2009  
 - Reference standard : Part 15 Subpart C, Sec. 15.247(b)(3)  
 - Channel : 802.11b(1ch / 6ch / 11ch) ; 802.11g(1ch / 6ch / 11ch)  
 - Operating condition : Wi-Fi RF transmitting mode  
 - Power Source : AC 120 V/ 60 Hz, DC 3.7 V / 2400 mAh Rechargeable Lithium Polymer Battery

#### Parameter

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



**Configuration IEEE 802.11b**

Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2 412 MHz	20.32	30.00	Complies
6	2 437 MHz	19.71	30.00	Complies
11	2 462 MHz	19.04	30.00	Complies

**Configuration IEEE 802.11g**

Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2 412 MHz	20.66	30.00	Complies
6	2 437 MHz	20.60	30.00	Complies
11	2 462 MHz	20.08	30.00	Complies



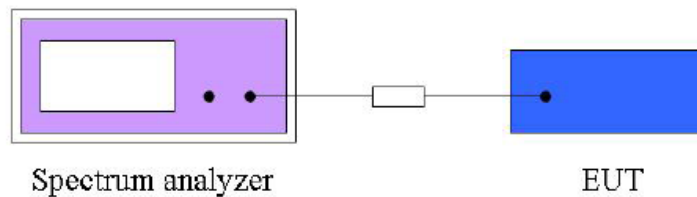


## 8. Power Spectral Density Measurement

### 8.1 Operating environment

Temperature : 23 °C  
Relative humidity : 40 %R.H

### 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. 2009

### 8.5 Test result of Maximum Peak Output Power

- Test Date : May 20, 2009  
- Reference standard : Part 15 Subpart C, Sec. 15.247(e)  
- Channel : 802.11b(1ch / 6ch / 11ch) ; 802.11g(1ch / 6ch / 11ch)  
- Operating condition : Wi-Fi RF transmitting mode  
- Power Source : AC 120 V / 60 Hz, DC 3.7 V / 2400 mAh Rechargeable Lithium Polymer Battery

#### Spectrum Parameter

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



**Configuration IEEE 802.11b**

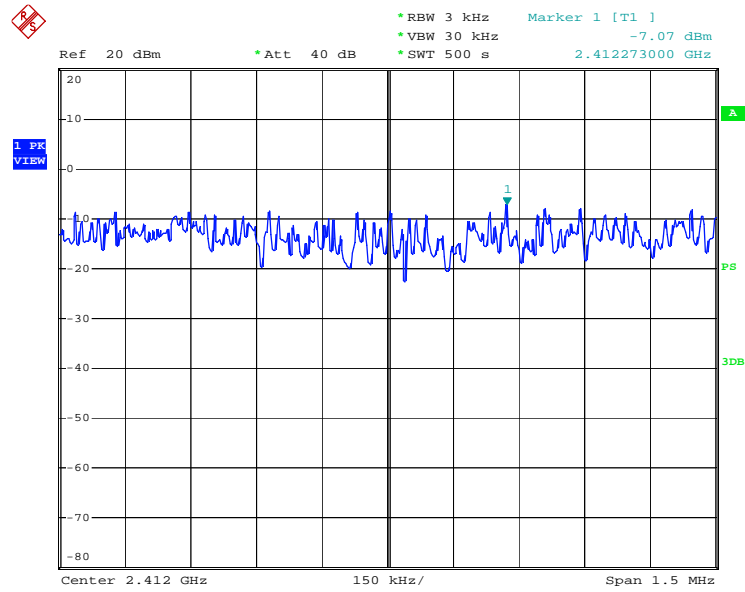
Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2 412 MHz	-7.07	8.00	Complies
6	2 437 MHz	-8.10	8.00	Complies
11	2 462 MHz	-8.92	8.00	Complies

**Configuration IEEE 802.11g**

Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2 412 MHz	-10.16	8.00	Complies
6	2 437 MHz	-10.55	8.00	Complies
11	2 462 MHz	-11.43	8.00	Complies



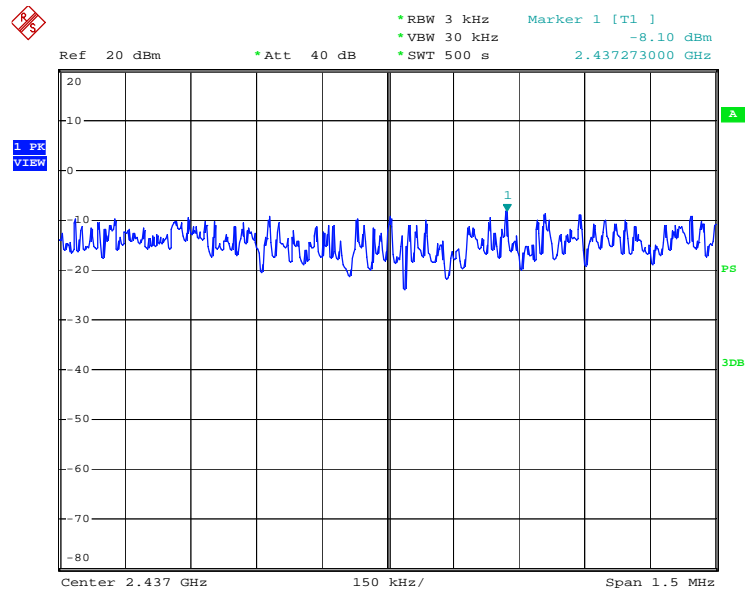
### Power Density Plot on configuration IEEE 802.11b / 2 412 MHz



MX-5000

Date: 20.MAY.2009 12:38:38

### Power Density plot on Configuration IEEE 802.11b / 2 437 MHz

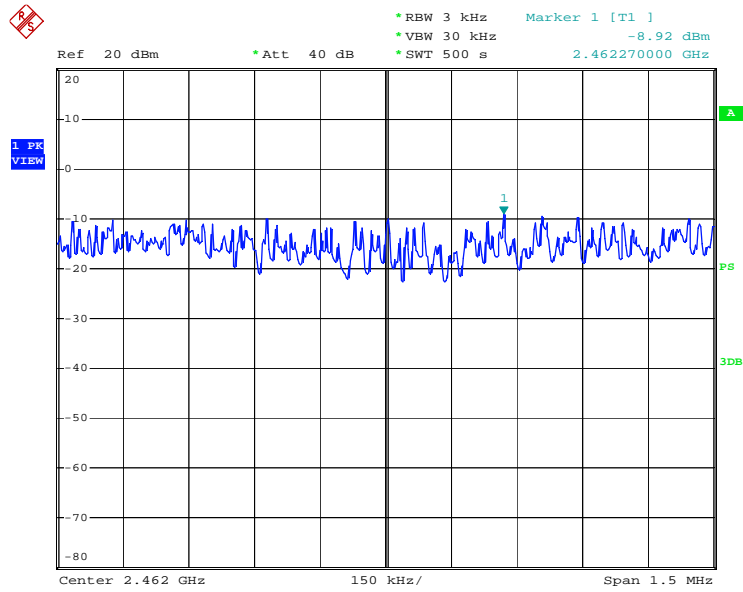


MX-5000

Date: 20.MAY.2009 13:44:28



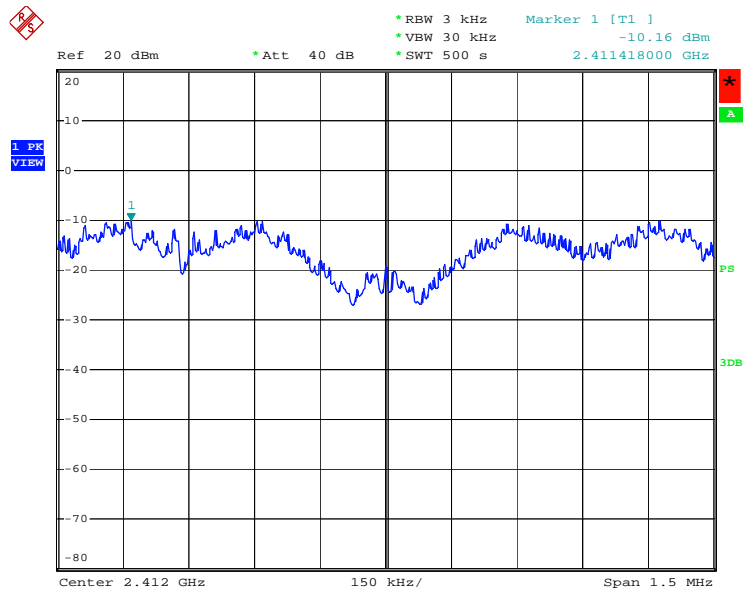
### Power Density Plot on Configuration IEEE 802.11b / 2 462 MHz



MX-5000

Date: 20.MAY.2009 14:29:10

### Power Density Plot on Configuration IEEE 802.11g / 2 412 MHz

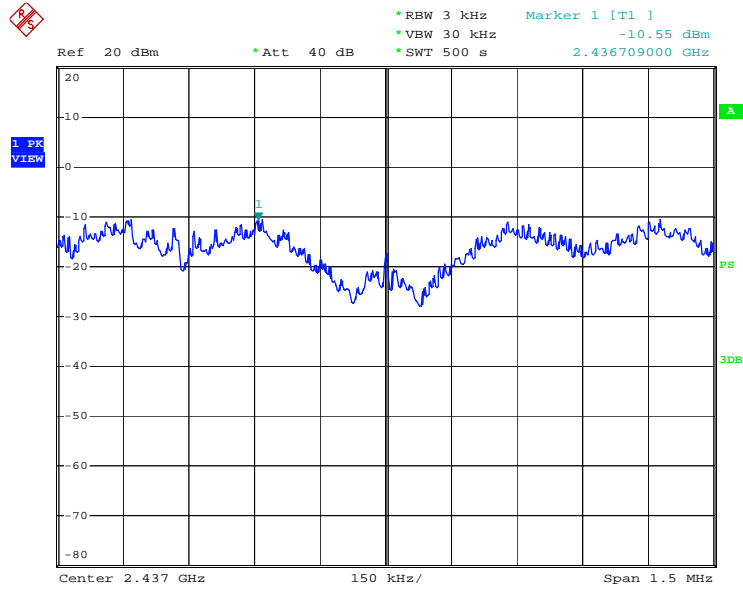


MX-5000

Date: 20.MAY.2009 15:36:06



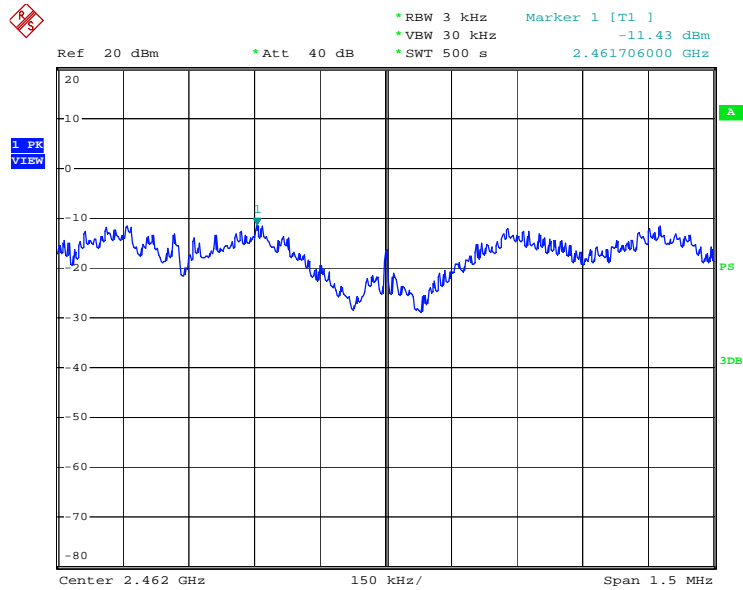
### Power Density Plot on Configuration IEEE 802.11g / 2 437 MHz



MX-5000

Date: 20.MAY.2009 15:25:10

### Power Density Plot on Configuration IEEE 802.11g / 2 462 MHz



MX-5000

Date: 20.MAY.2009 14:51:23





**Configuration IEEE 802.11b**

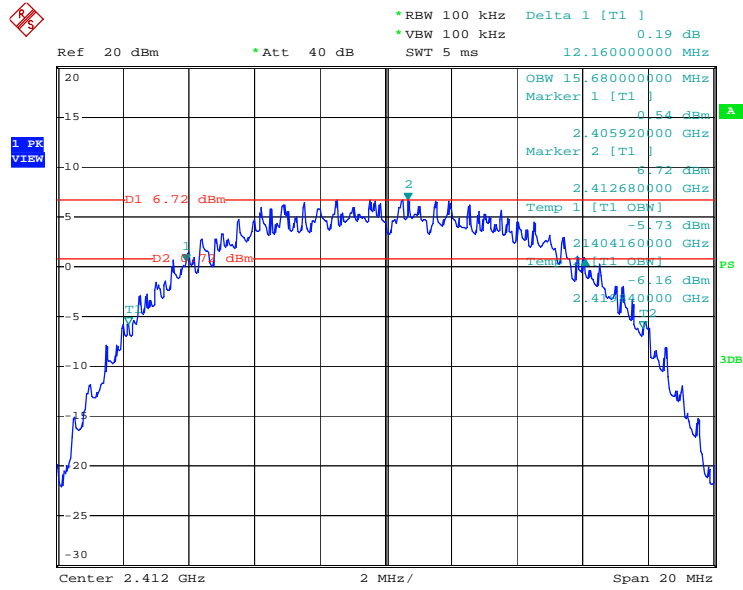
Channel	Frequency	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	Min. Limit (kHz)	Result
1	2 412 MHz	12.16	15.68	500	Complies
6	2 437 MHz	12.08	15.64	500	Complies
11	2 462 MHz	12.20	15.64	500	Complies

**Configuration IEEE 802.11g**

Channel	Frequency	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	Min. Limit (kHz)	Result
1	2 412 MHz	16.53	16.52	500	Complies
6	2 437 MHz	16.56	16.52	500	Complies
11	2 462 MHz	16.48	16.52	500	Complies

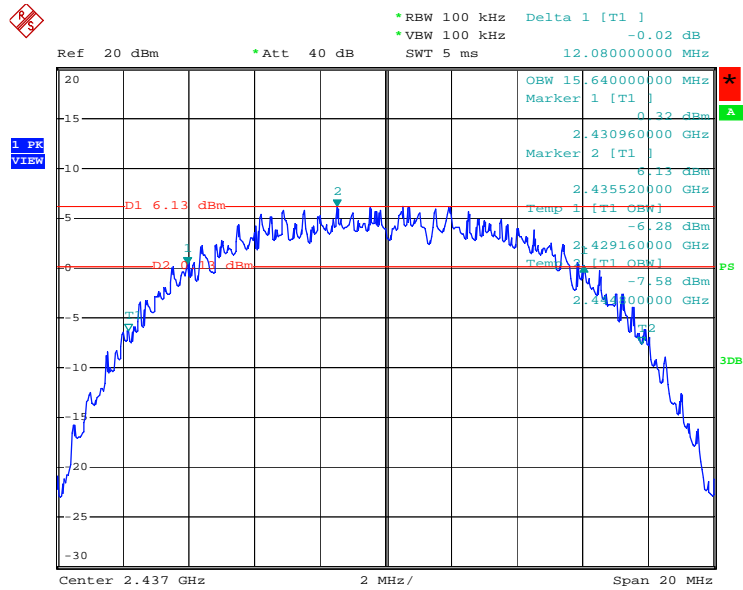


**6dB Bandwidth Plot on Configuration IEEE 802.11b / 2 412 MHz**



MX-5000  
 Date: 20.MAY.2009 15:53:31

**6dB Bandwidth Plot on Configuration IEEE 802.11b / 2 437 MHz**

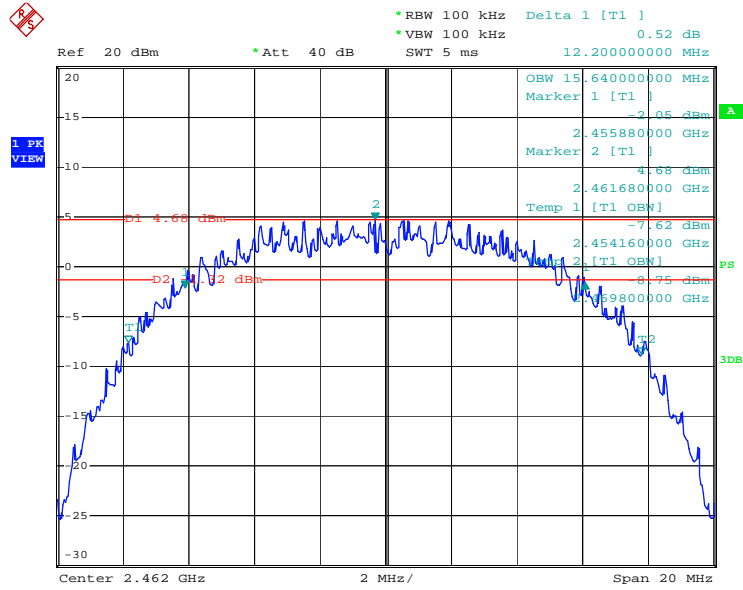


MX-5000  
 Date: 20.MAY.2009 15:50:24



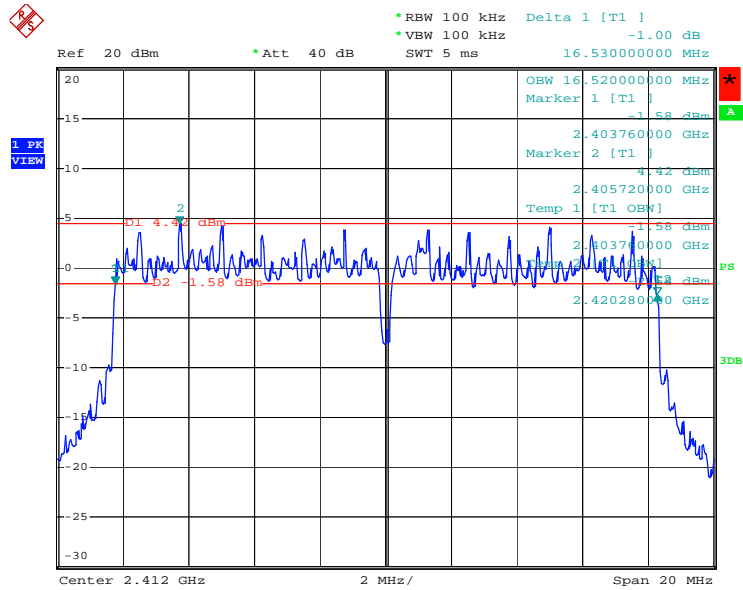


**6dB Bandwidth Plot on Configuration IEEE 802.11b / 2 462 MHz**



MX-5000  
 Date: 20.MAY.2009 15:48:26

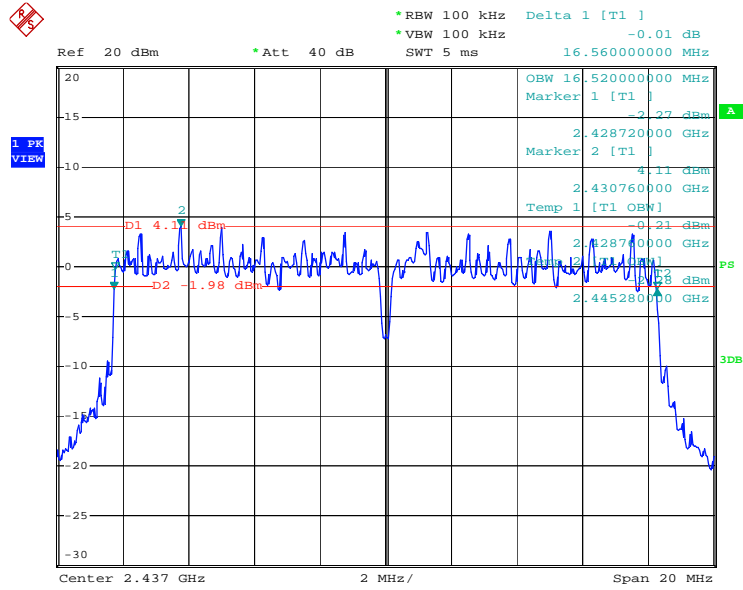
**6dB Bandwidth Plot on Configuration IEEE 802.11b / 2 412 MHz**



MX-5000  
 Date: 20.MAY.2009 15:41:01

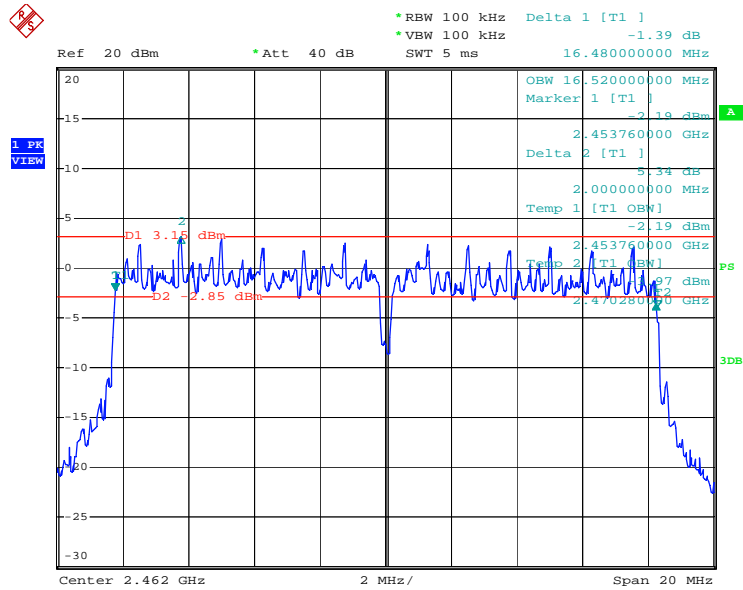


**6dB Bandwidth Plot on Configuration IEEE 802.11b / 2 437 MHz**



MX-5000  
 Date: 20.MAY.2009 15:43:00

**6dB Bandwidth Plot on Configuration IEEE 802.11b / 2 462 MHz**



MX-5000  
 Date: 20.MAY.2009 15:45:11



## 10. Radiated Emission

### 10.1 Operating environment

Temperature : 23 °C  
Relative humidity : 40 %R.H

### 10.2 Test set-up

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 %.

Test items	Uncertainty	Remark
Radiated emission (30 MHz ~ 300 MHz, 3 m, Vertical)	± 3.54 dB	Confidence levels of 95 % (k=2)
Radiated emission (30 MHz ~ 300 MHz, 3 m, Horizontal)	± 3.49 dB	Confidence levels of 95 % (k=2)
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Vertical)	± 3.85 dB	Confidence levels of 95 % (k=2)
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Horizontal)	± 3.76 dB	Confidence levels of 95 % (k=2)
Radiated emission (30 MHz ~ 300 MHz, 10 m, Vertical)	± 3.21 dB	Confidence levels of 95 % (k=2)
Radiated emission (30 MHz ~ 300 MHz, 10 m, Horizontal)	± 3.32 dB	Confidence levels of 95 % (k=2)
Radiated emission (300 MHz ~ 1 000 MHz, 10 m, Vertical)	± 3.77 dB	Confidence levels of 95 % (k=2)
Radiated emission (300 MHz ~ 1 000 MHz, 10 m, Horizontal)	± 3.84 dB	Confidence levels of 95 % (k=2)



#### 10.4 Limit

20 dB 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	2 400/F (kHz)	300
0.490~1.705	2 400/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

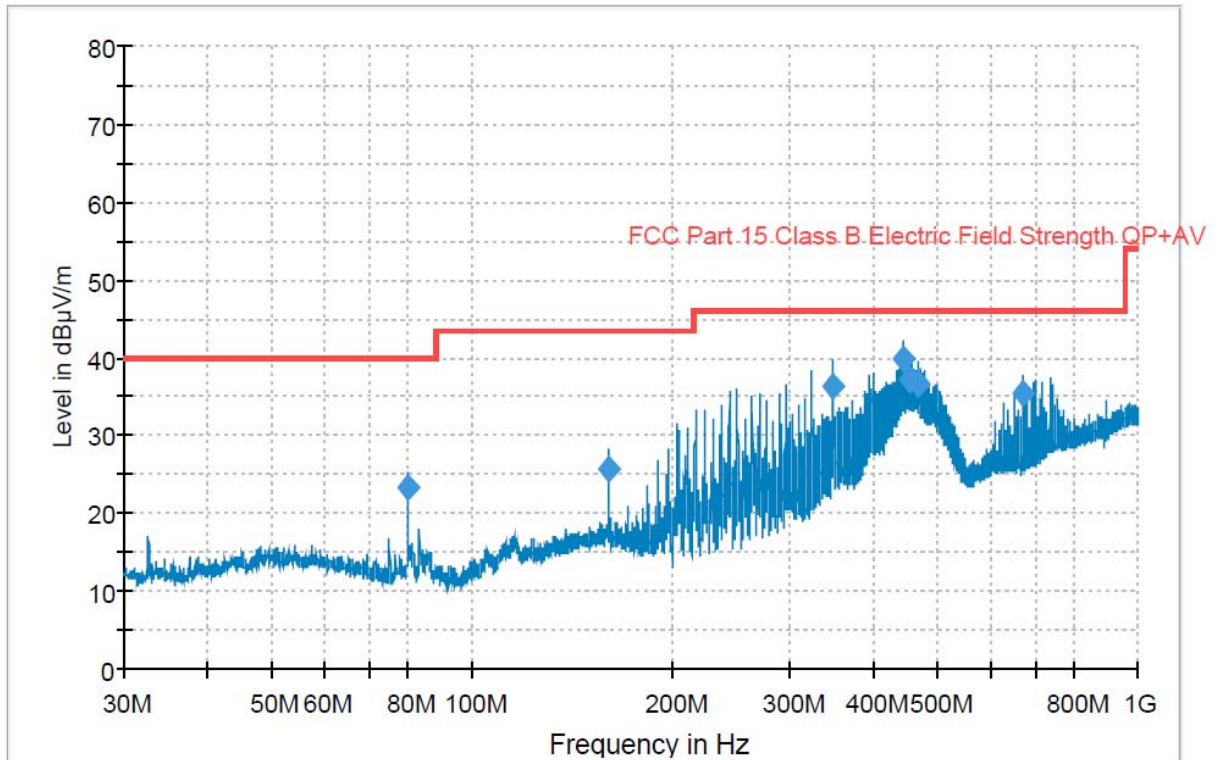
Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2009
■ - VULB3193	Schwarzbeck	Bi-log antenna	3193	12. 11. 2009
■ - MCU066	Maturo GmbH	Position Controller	1390306	N/A
■ - TT2.5SI	Maturo GmbH	Turntable	1390307	N/A
■ - AM4.0	Maturo GmbH	Antenna Mast	1390308	N/A
■ - BBHA9120D	Schwarzbeck	Horn antenna	207	12.26. 2009
■ - 3160	EMCO	Horn antenna	6741	12.26. 2009
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258943	11.11. 2009

#### 10.6 Radiated emission test data

- Test Date : May 20, 2009
- Reference standard : Part 15 Subpart C, Sec. 15.247(d)
- Channel : 802.11b(1ch / 6ch / 11ch) ; 802.11g(1ch / 6ch / 11ch)
- Operating condition : Wi-Fi RF transmitting mode
- Measuring distance : 3 m
- Spectrum resolution bandwidth(6dB) : 120 kHz / 1 MHz
- Detector mode : Peak detector mode / Quasi Peak detector mode / Average detector mode
- Power Source : AC 120 V/ 60 Hz, DC 3.7 V / 2400 mAh Rechargeable Lithium Polymer 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 (30 MHz to 1 000 MHz)**



**Final Result 1**

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
80.000000	23.2	1000.0	120.000	155.0	V	0.0	9.6	20.3	43.5
160.000000	25.8	1000.0	120.000	152.0	V	176.0	14.9	17.7	43.5
347.800000	36.4	1000.0	120.000	110.0	H	101.0	16.9	9.6	46.0
443.720000	39.9	1000.0	120.000	105.0	H	92.0	19.6	6.1	46.0
454.160000	37.3	1000.0	120.000	108.0	H	89.0	19.9	8.7	46.0
467.720000	36.5	1000.0	120.000	108.0	H	90.0	20.0	9.5	46.0
669.920000	35.4	1000.0	120.000	115.0	V	188.0	24.2	10.6	46.0

Note:

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

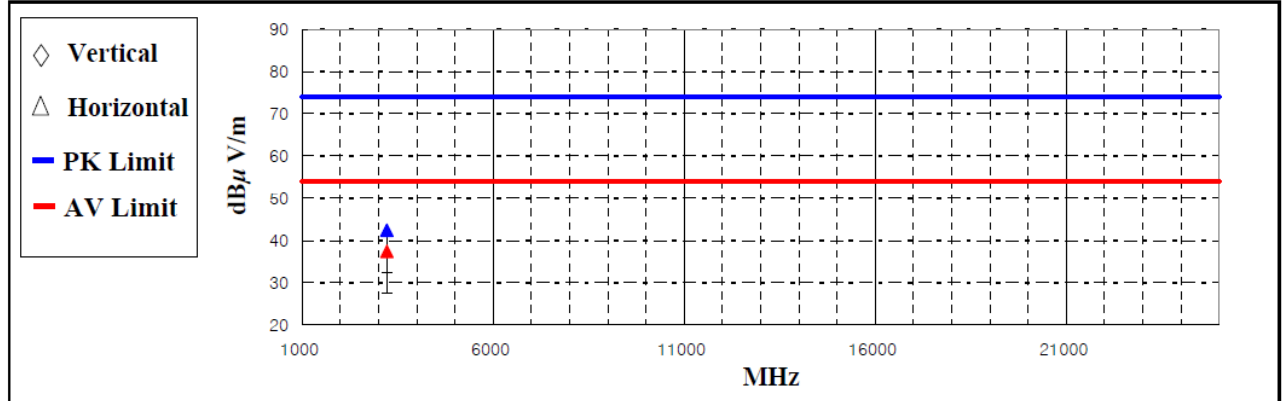
Emission level (dBµV/m) = 20 log Emission level (µV/m).

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



**Result of radiated emission (1 GHz to 25 GHz spurious)**

Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF (dB/m)	AMP / CL (dB)	Test Result (dB $\mu$ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average							
3216.00	49.92	44.92	28.68	-36.20	42.40	37.40	74.00	54.00	31.60	16.60	H	156	277

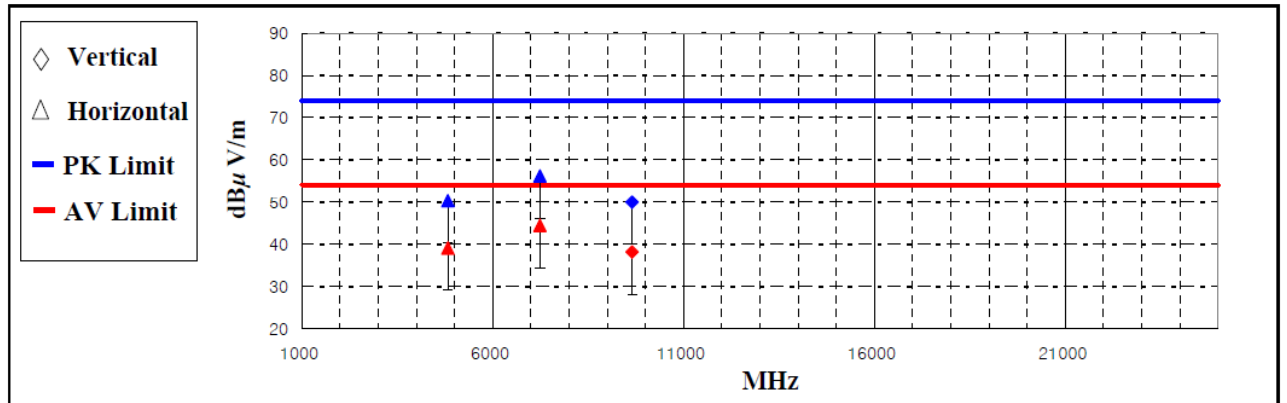


\*Comment : AMP/CL\_Cable loss value + AMP gain value  
 AF : Antenna factor value  
 Pol. : H(Horizontal), V(Vertical)

**Result of radiated emission (1 GHz to 10<sup>th</sup> harmonics)**

(802.11 B, 1 CH.)

Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF (dB/m)	AMP / CL (dB)	Test Result (dB $\mu$ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average							
4824.00	52.78	41.58	31.39	-33.87	50.30	39.10	74.00	54.00	23.70	14.90	H	145	95
7236.00	48.61	36.91	36.22	-28.63	56.20	44.50	74.00	54.00	17.80	9.50	H	153	187
9648.00	34.95	23.15	38.98	-23.93	50.00	38.20	74.00	54.00	24.00	15.80	V	156	4

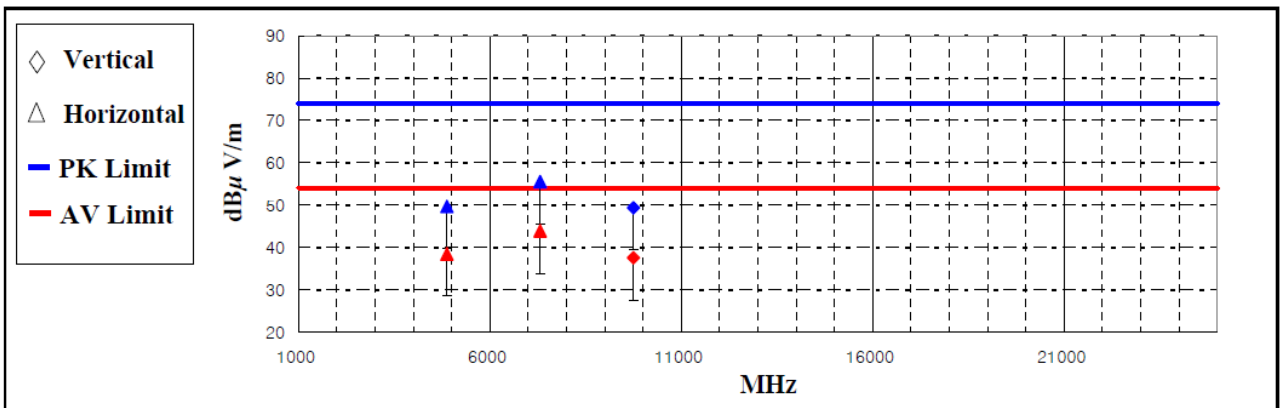


\*Comment : AMP/CL\_Cable loss value + AMP gain value  
 AF : Antenna factor value  
 Pol. : H(Horizontal), V(Vertical)



(802.11 B, 6 CH.)

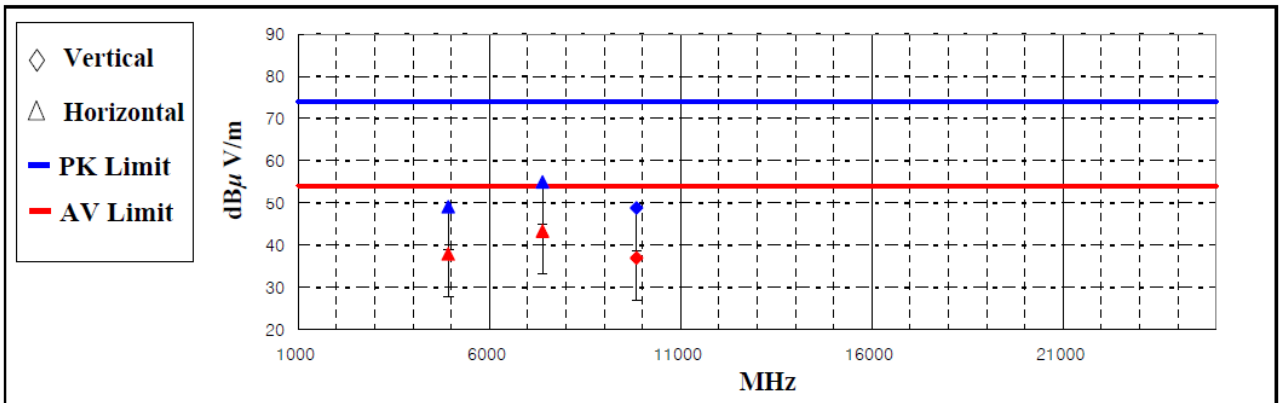
Frequency (MHz)	Measurement Level						Limit (dBμV/m)		Margin (dB)		Positioning System		
	Reading Value (dBμV/m)		AF (dB/m)	AMP / CL (dB)	Test Result (dBμV/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average							
4874.00	52.32	41.12	31.50	-34.12	49.70	38.50	74.00	54.00	24.30	15.50	H	145	95
7311.00	47.70	36.00	36.32	-28.42	55.60	43.90	74.00	54.00	18.40	10.10	H	153	187
9748.00	33.92	22.12	39.12	-23.64	49.40	37.60	74.00	54.00	24.60	16.40	V	156	4



\*Comment : AMP/CL\_Cable loss value + AMP gain value  
 AF : Antenna factor value  
 Pol. : H(Horizontal), V(Vertical)

(802.11 B, 11 CH.)

Frequency (MHz)	Measurement Level						Limit (dBμV/m)		Margin (dB)		Positioning System		
	Reading Value (dBμV/m)		AF (dB/m)	AMP / CL (dB)	Test Result (dBμV/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average							
4924.00	51.73	40.53	31.61	-34.24	49.10	37.90	74.00	54.00	24.90	16.10	H	145	95
7386.00	46.79	35.09	36.42	-28.21	55.00	43.30	74.00	54.00	19.00	10.70	H	153	187
9848.00	32.90	21.10	39.26	-23.36	48.80	37.00	74.00	54.00	25.20	17.00	V	156	4

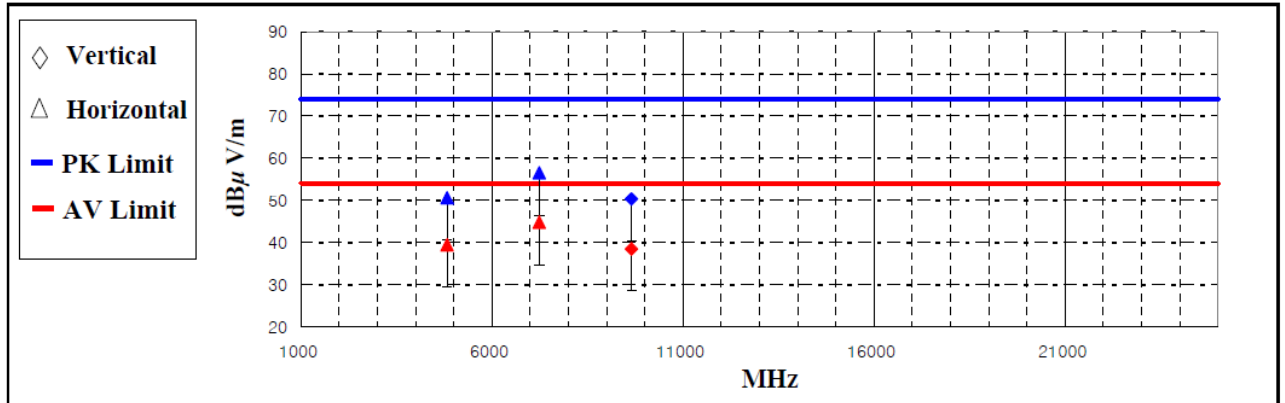


\*Comment : AMP/CL\_Cable loss value + AMP gain value  
 AF : Antenna factor value  
 Pol. : H(Horizontal), V(Vertical)



**(802.11 G, 1 CH.)**

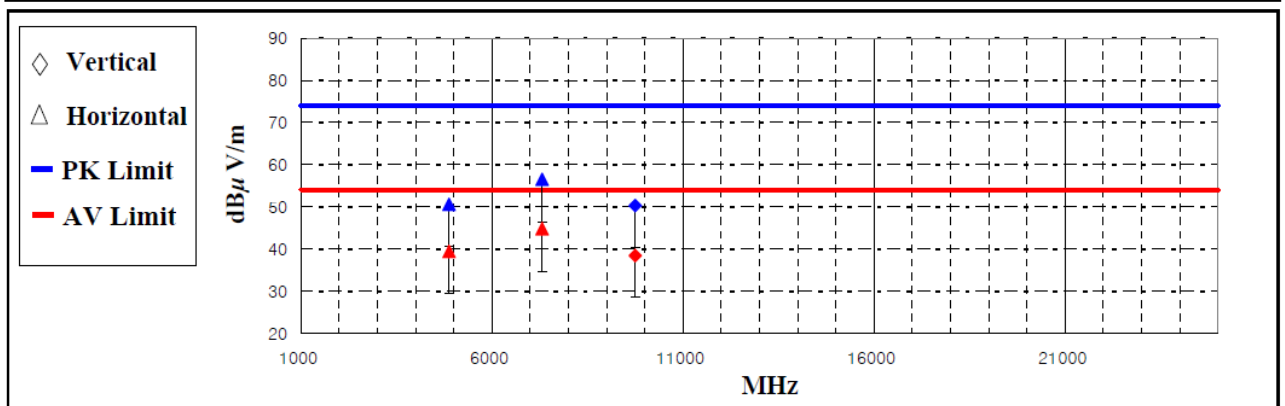
Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF (dB/m)	AMP / CL (dB)	Test Result (dB $\mu$ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average							
4824.00	53.08	41.88	31.39	-33.87	50.60	39.40	74.00	54.00	23.40	14.60	H	145	95
7236.00	48.91	37.21	36.22	-28.63	56.50	44.80	74.00	54.00	17.50	9.20	H	153	187
9648.00	35.25	23.45	38.98	-23.93	50.30	38.50	74.00	54.00	23.70	15.50	V	156	4



\*Comment : AMP/CL\_Cable loss value + AMP gain value  
 AF : Antenna factor value  
 Pol. : H(Horizontal), V(Vertical)

**(802.11 G, 6 CH.)**

Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF (dB/m)	AMP / CL (dB)	Test Result (dB $\mu$ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average							
4874.00	53.22	42.02	31.50	-34.12	50.60	39.40	74.00	54.00	23.40	14.60	H	145	95
7311.00	48.60	36.90	36.32	-28.42	56.50	44.80	74.00	54.00	17.50	9.20	H	153	187
9748.00	34.82	23.02	39.12	-23.64	50.30	38.50	74.00	54.00	23.70	15.50	V	156	4



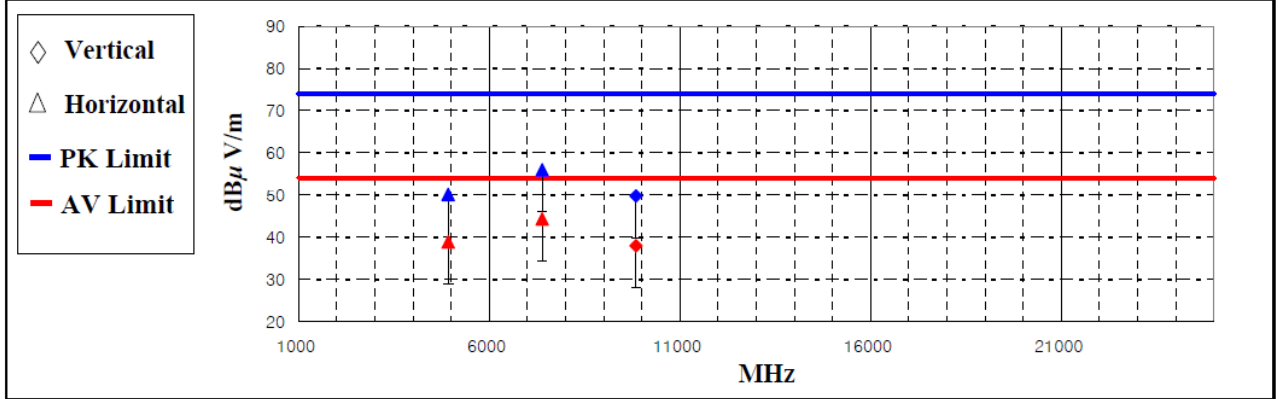
\*Comment : AMP/CL\_Cable loss value + AMP gain value  
 AF : Antenna factor value  
 Pol. : H(Horizontal), V(Vertical)





**(802.11 G, 11 CH.)**

Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF	AMP / CL	Test Result (dB $\mu$ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average	(dB/m)	(dB)	Peak	Average							
4924.00	52.73	41.53	31.61	-34.24	50.10	38.90	74.00	54.00	23.90	15.10	H	145	95
7386.00	47.79	36.09	36.42	-28.21	56.00	44.30	74.00	54.00	18.00	9.70	H	153	187
9848.00	33.90	22.10	39.26	-23.36	49.80	38.00	74.00	54.00	24.20	16.00	V	156	4



\*Comment : AMP/CL\_Cable loss value + AMP gain value  
 AF : Antenna factor value  
 Pol. : H(Horizontal), V(Vertical)

**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 (dB $\mu$ V/m) = 20 log Emission level( $\mu$ V/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 : 23 °C  
 Relative humidity : 40 %R.H.

### 11.2 Test set-up

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 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed

### 11.3 Limit

20 dBc in any 100 kHz 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	2 044/F (kHz)	300
0.490~1.705	24 000/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 Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2009
■ - VULB3193	Schwarzbeck	Bi-log antenna	3193	12. 11. 2009
■ - MCU066	Maturo GmbH	Position Controller	1390306	N/A
■ - TT2.5SI	Maturo GmbH	Turntable	1390307	N/A
■ - AM4.0	Maturo GmbH	Antenna Mast	1390308	N/A
■ - BBHA9120D	Schwarzbeck	Horn antenna	207	12.26. 2009
■ - 3160	EMCO	Horn antenna	6741	12.26. 2009
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258943	11.11. 2009



### 11.5 Band Edge Radiated emission test data

- Test Date : May 20, 2009
- Reference standard : Part 15 Subpart C, Sec. 15.247(d)
- Channel : 802.11b(1ch / 6ch / 11ch) ; 802.11g(1ch / 6ch / 11ch)
- Operating condition : Wi-Fi RF transmitting mode
- Measuring distance : 3 m
- Power Source : AC 120 V/ 60 Hz, DC 3.7 V / 2400 mAh Rechargeable Lithium Polymer 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 (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF	AMP / CL	Test Result (dB $\mu$ V/m)						Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	Peak	Average	Peak	Average	(H/V)	(cm)	( $^{\circ}$ )
2412.00	114.65	101.35	27.51	-38.26	103.90	90.60	74.00	54.00	-	-	-	-	-
2385.40	68.28	14.98	27.43	-38.32	57.39	4.09	74.00	54.00	16.61	49.91	-	-	-

#### 802.11b, 11ch

Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF	AMP / CL	Test Result (dB $\mu$ V/m)						Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	Peak	Average	Peak	Average	(H/V)	(cm)	( $^{\circ}$ )
2462.00	113.00	99.70	27.67	-37.99	102.68	89.38	74.00	54.00	-	-	-	-	-
2486.60	68.90	55.60	27.74	-37.86	58.78	45.48	74.00	54.00	15.22	8.52	-	-	-

#### 802.11g, 1ch

Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF	AMP / CL	Test Result (dB $\mu$ V/m)						Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	Peak	Average	Peak	Average	(H/V)	(cm)	( $^{\circ}$ )
2412.00	114.65	101.35	27.51	-38.26	103.90	90.60	74.00	54.00	-	-	-	-	-
2390.00	76.35	63.05	27.44	-38.32	65.47	52.17	74.00	54.00	8.53	1.83	-	-	-

#### 802.11g, 11ch

Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF	AMP / CL	Test Result (dB $\mu$ V/m)						Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	Peak	Average	Peak	Average	(H/V)	(cm)	( $^{\circ}$ )
2462.00	113.98	100.68	27.67	-37.99	103.66	90.36	74.00	54.00	-	-	-	-	-
2483.50	74.72	61.42	27.73	-37.88	64.57	51.27	74.00	54.00	9.43	2.73	-	-	-

Note:

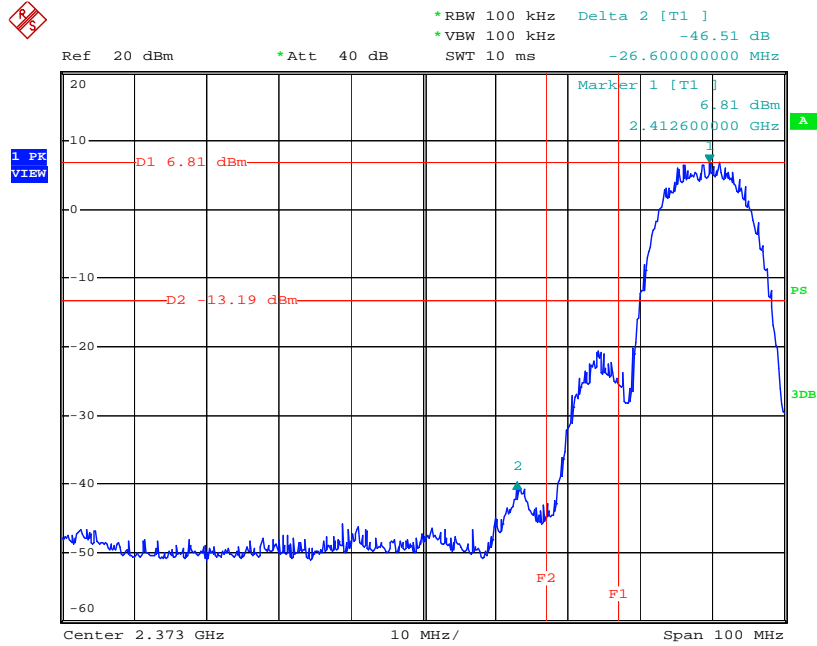
The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dB $\mu$ V/m) = 20 log Emission level ( $\mu$ V/m).

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



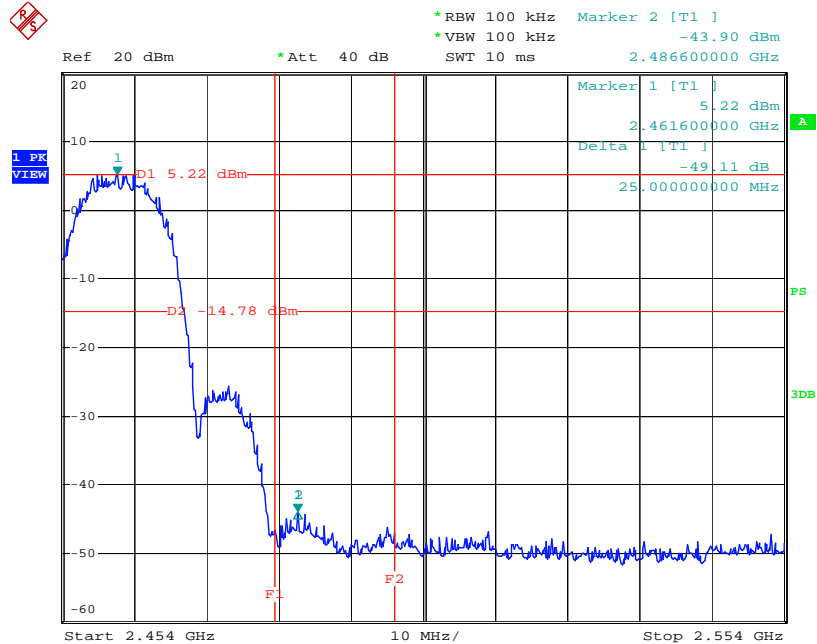
**For Emission not in Restricted Band**  
**Low Band Edge Plot on Configuration IEEE 802.11b / 2 412 MHz**



MX-5000

Date: 20.MAY.2009 15:59:34

**High Band Edge Plot on Configuration IEEE 802.11b / 2 462 MHz**

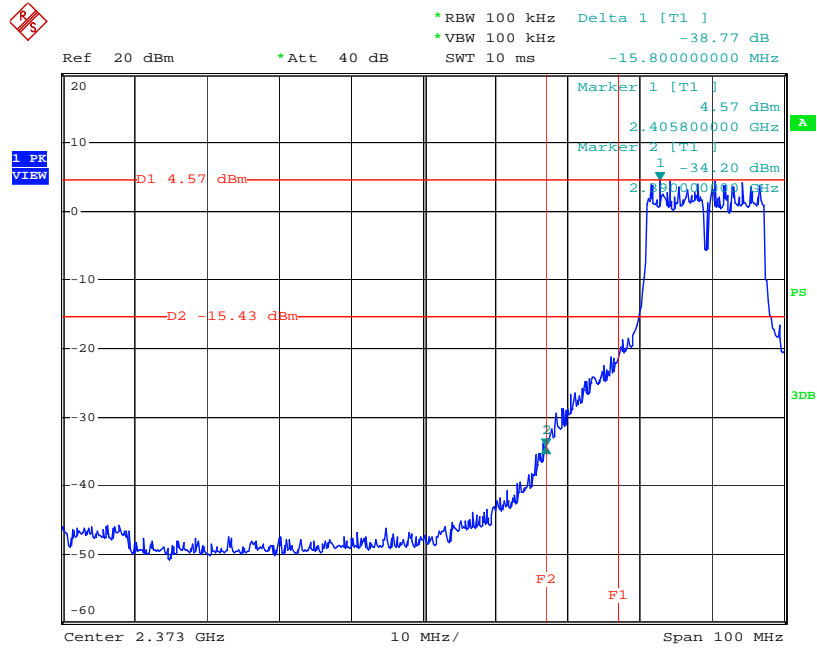


MX-5000

Date: 20.MAY.2009 16:07:39



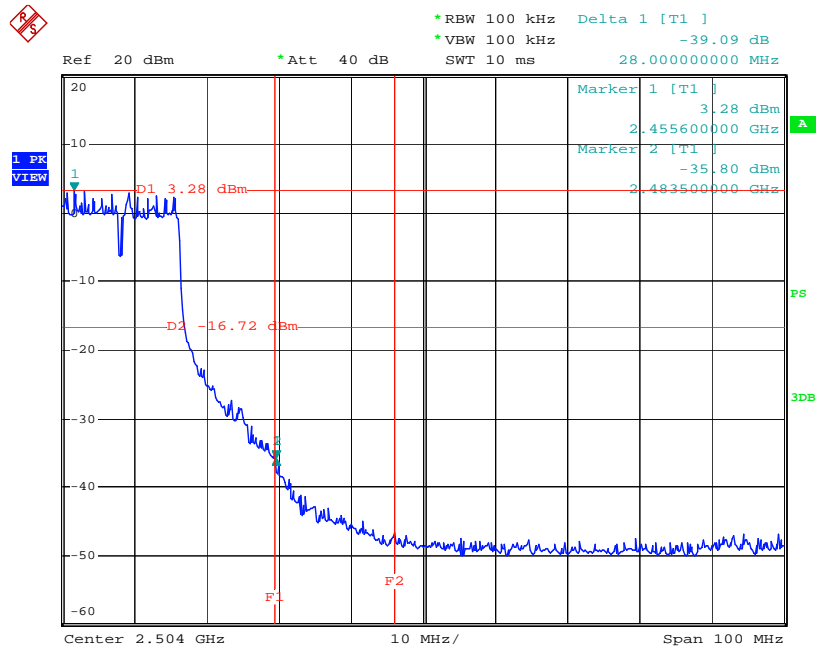
**Low Band Edge Plot on Configuration IEEE 802.11g / 2 412 MHz**



MX-5000

Date: 20.MAY.2009 16:38:36

**High Band Edge Plot on Con figuration IEEE 802.11g / 2 462 MHz**



MX-5000

Date: 20.MAY.2009 16:42:28