

## ***FCC EVALUATION REPORT FOR CERTIFICATION***

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

**Date of Issue : June 3, 2010**

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

**Order Number: GETEC-C1-10-122**

**Republic of Korea**

**Test Report Number : GETEC-E3-10-063**

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

**Test Site : Gumi College EMC Center**

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

**FCC ID.: OZ5URCMX5000I**

**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)  
**Type of Authority : Certification**  
**Model Name : MX-5000i**  
**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,**

**Reviewed by,**

*Soon Hoon*

**Soon-Hoon Jeong, Engineer**  
**GUMI College EMC center**

*Jae-Hoon Jeong*

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



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

- **FCC ID.** OZ5URCMX5000I
- **Equipment Class** Digital Transmission System (DTS)
- **Test Method** Public Notice FCC97-114  
(Guidance on measurement for direct sequence spread spectrum systems)
- **EUT Type** RF remote controller  
(Wi-Fi built in RF remote controller)
- **Model Name** MX-5000i
- **Trade Name** UNIVERSAL remote control
- **Serial Number** Prototype
- **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 6 ~ 18, 2009
- **Place of Test** **Gumi College EMC Center** ( FCC Registration Number: 100749, 443957)  
407, Bugok-dong, Gumi-si, Gyeongbuk, Korea.
- **Test Report Number** GETEC-E3-10-063
- **Dates of Issue** June 3, 2010



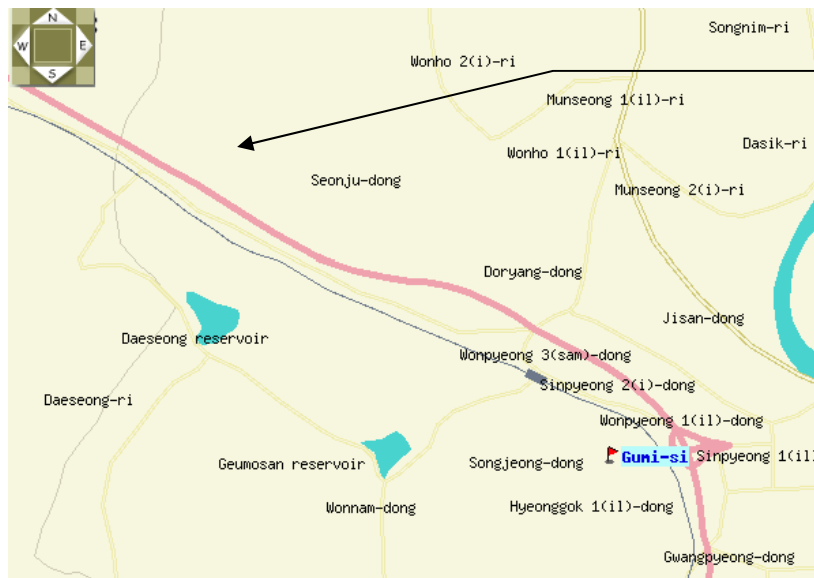
## 2. Introduction

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-5000i)**

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 km away from Seoul city and 40 km 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 (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-5000i) FCC ID.: OZ5URCMX5000I**

- **Used AC/DC Adapter** : Model Name: KSAD0600200W1US  
Manufacturer: UNIVERSAL remote control  
Input rating: AC (100-240) V, (50/60) Hz, 0.4 A  
Output rating: DC 6 V, 2.0 A  
Serial Number: R1808
- **Battery** : Rechargeable LITHIUM POLYMER BATTERY(DC 3.7 V, 2 400 mAh)
- **RF Frequency** : 433.92 MHz, 2.4 GHz
- **External Connector** : DC in, Charger Signal, USB
- **Crystal & Clock Frequency** : 133 MHz, 48 MHz, 12 MHz, 32.768 kHz, 8 MHz, 13.560 MHz on Main B'D
- **Number of Layer** : 6 Layers
- **Modulation type** : CCK, DQPSK, DBPSK for DSSS  
64QAM, 16QAM, QPSK, BPSK for OFDM
- **Modulation technology** : DSSS, OFDM
- **Transfer rate** : 802.11b: 11/5.5/2/1 Mbps  
802.11g: 54/48/36/24/18/12/9/6 Mbps

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



### 3.2 Support Equipment / Cables used

#### 3.2.1 Used Support Equipment

Description	Manufacturer	Model Name	S/N & FCC ID.
-	-	-	S/N: - FCC ID.: -

#### 3.2.2 System configuration

Description	Manufacturer	Model Name	S/N & FCC ID.
Charging Cradle	OHSUNG ELECTRONICS Co., Ltd.	MX-5000i	S/N: N/A FCC ID: DoC

#### 3.2.3 Used Cable(s)

Cable Name	Condition	Description
Adaptor(power) cable	Connected to the EUT(charging cradle)	1.86 m unshielded

See “Appendix E – Test Setup Photographs” for actual system test set-up

### 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 remote controller** comply with the requirement of §15.203 with a built-in loop 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)

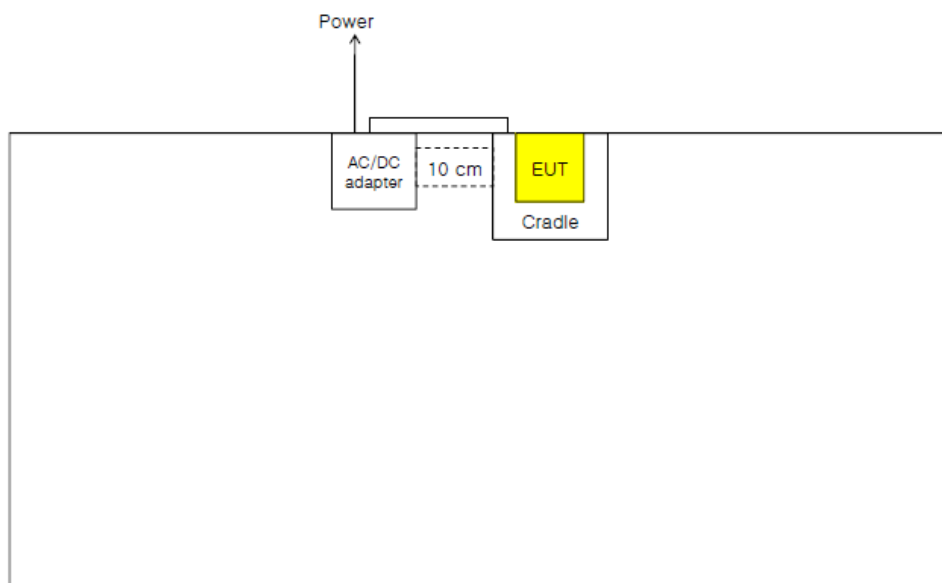
- Test Mode(s)

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

Test Software Version	TCMD Tool		
Frequency	2 412 MHz (1 CH)	2 437 MHz (6 CH)	2 462 MHz (11 CH)
IEEE 802.11 B	12	12	12
IEEE 802.11 G	6	6	6

Mode	Available channel	Tested channel	Modulation Technology	Modulation type	Data rate (Mbps)
IEEE 802.11 B	1 to 11	1, 6, 11	DSSS	DBPSK	11
IEEE 802.11 G	1 to 11	1, 6, 11	OFDM	BPSK	54

- Test configuration







## 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

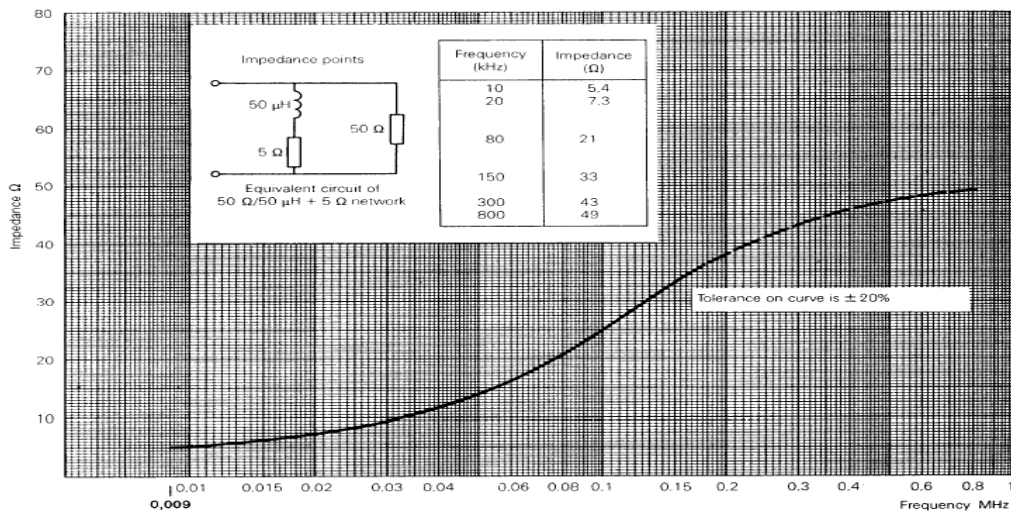


Fig 2. Impedance of LISN



### 5.3 Radiated Emission

Preliminary measurements were conducted 3 m 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.

Final measurements were made 3 m chamber (FCC registration No.: 443957) and/or 10 m OATS (FCC registration No.: 100749).

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 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 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

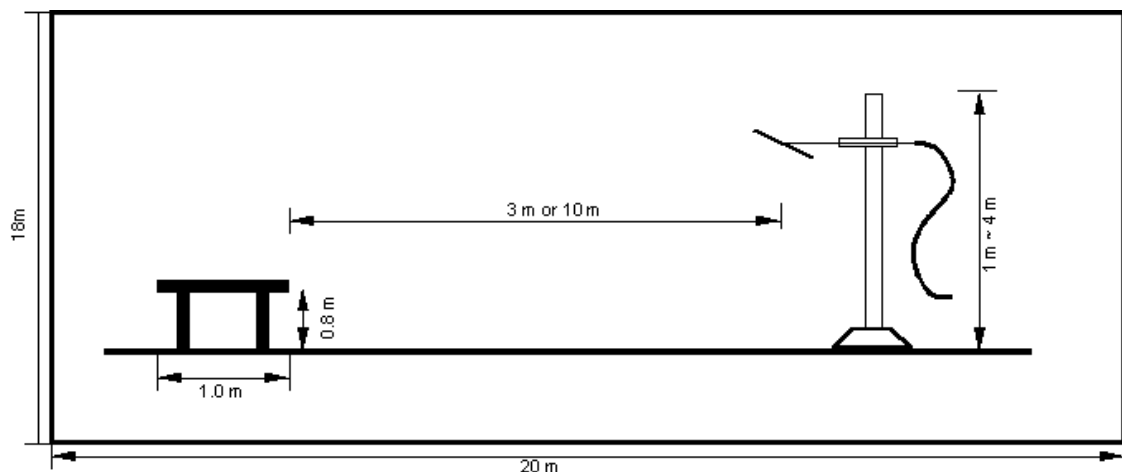


Fig 3. Dimensions of test site.



## 6. Conducted Emission

### 6.1 Operating Environment

Temperature : 25.0 °C  
Relative Humidity : 41.0 % 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 & ISN.

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)	± 2.69 dB	Confidence levels of 95 % ( $k = 2$ )
Conducted emission (150 kHz ~ 30 MHz)	± 4.16 dB	Confidence levels of 95 % ( $k = 2$ )



#### 6.4 Limit

RFI Conducted	FCC Limit(dB $\mu$ V/m) 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

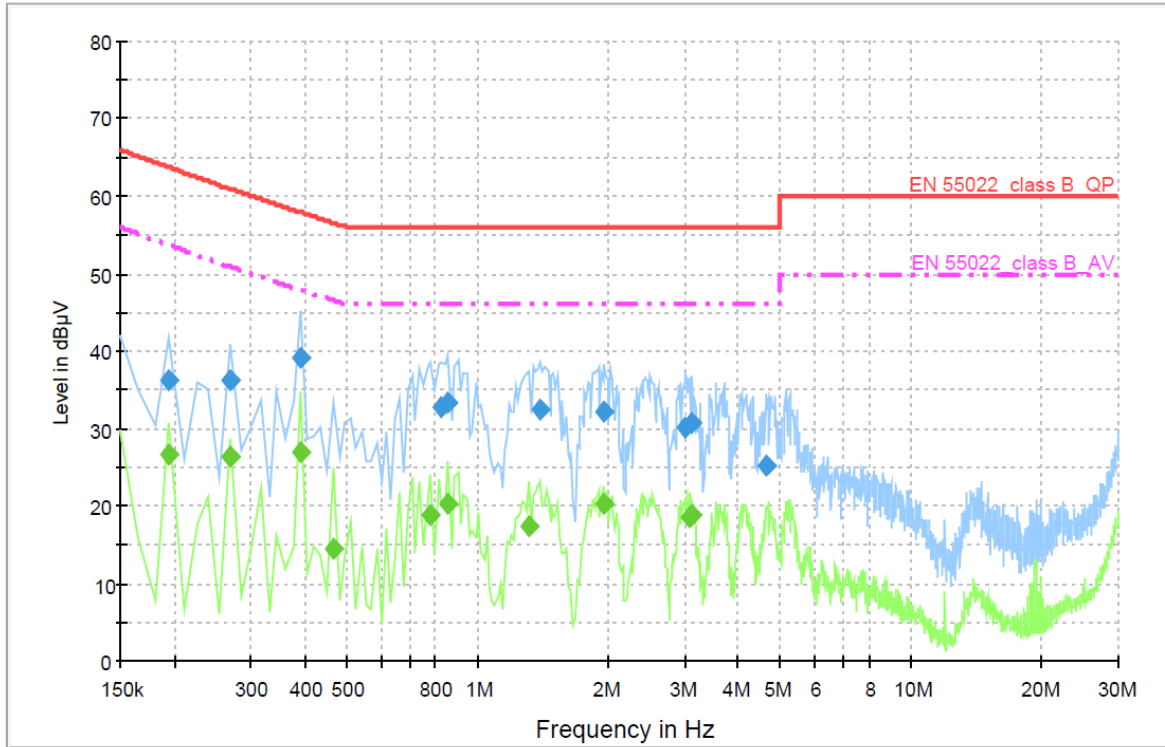
Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESCS30	Rohde & Schwarz	EMI Test Receiver	839809/003	12. 10. 2010
□ - ESH3-Z5	Rohde & Schwarz	LISN	838979/020	12. 10. 2010
■ - ESH2-Z5	Rohde & Schwarz	LISN	829991/009	12. 10. 2010
□ - ISN T8	TESEQ. GmbH	Impedance Network	24568	10. 16. 2010

#### 6.6 Test data for Conducted Emission

- Test Date : May 6, 2010
- 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

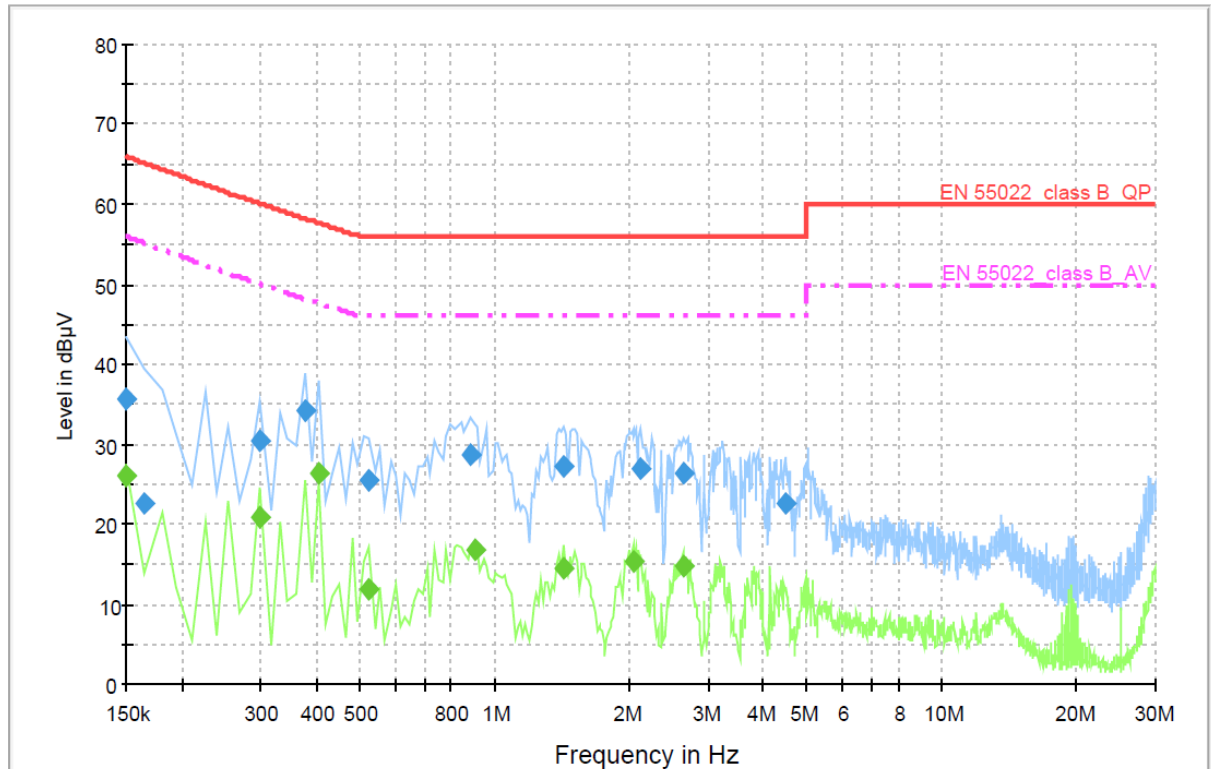
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.195000	36.3	1000.000	9.000	GND	L1	10.0	27.4	63.7	
0.270000	36.3	1000.000	9.000	GND	L1	10.0	24.6	60.9	
0.390000	39.0	1000.000	9.000	GND	L1	10.0	18.9	57.9	
0.825000	32.7	1000.000	9.000	GND	L1	10.0	23.3	56.0	
0.855000	33.5	1000.000	9.000	GND	L1	10.0	22.5	56.0	
1.395000	32.5	1000.000	9.000	GND	L1	10.1	23.5	56.0	
1.965000	32.1	1000.000	9.000	GND	L1	10.1	23.9	56.0	
3.015000	30.1	1000.000	9.000	GND	L1	10.1	25.9	56.0	
3.135000	30.7	1000.000	9.000	GND	L1	10.1	25.4	56.0	
4.635000	25.2	1000.000	9.000	GND	L1	10.2	30.8	56.0	

### Final Measurement Detector 2

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.195000	26.7	1000.000	9.000	GND	L1	10.0	27.0	53.7	
0.270000	26.5	1000.000	9.000	GND	L1	10.0	24.4	50.9	
0.390000	26.9	1000.000	9.000	GND	L1	10.0	21.0	47.9	
0.465000	14.5	1000.000	9.000	GND	L1	10.0	32.0	46.5	
0.780000	19.0	1000.000	9.000	GND	L1	10.0	27.0	46.0	
0.855000	20.3	1000.000	9.000	GND	L1	10.0	25.7	46.0	
1.320000	17.3	1000.000	9.000	GND	L1	10.1	28.7	46.0	
1.950000	20.2	1000.000	9.000	GND	L1	10.1	25.8	46.0	
3.090000	18.6	1000.000	9.000	GND	L1	10.1	27.4	46.0	
3.135000	18.9	1000.000	9.000	GND	L1	10.1	27.1	46.0	



## 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
0.150000	35.5	1000.000	9.000	GND	N	10.0	30.5	66.0	
0.165000	22.6	1000.000	9.000	GND	N	10.0	42.5	65.1	
0.300000	30.4	1000.000	9.000	GND	N	10.0	29.6	60.0	
0.375000	34.2	1000.000	9.000	GND	N	10.0	24.0	58.2	
0.525000	25.5	1000.000	9.000	GND	N	10.0	30.5	56.0	
0.885000	28.8	1000.000	9.000	GND	N	10.0	27.2	56.0	
1.425000	27.3	1000.000	9.000	GND	N	10.1	28.7	56.0	
2.115000	26.9	1000.000	9.000	GND	N	10.1	29.1	56.0	
2.655000	26.3	1000.000	9.000	GND	N	10.1	29.7	56.0	
4.455000	22.7	1000.000	9.000	GND	N	10.2	33.3	56.0	

### Final Measurement Detector 2

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.150000	26.1	1000.000	9.000	GND	N	10.0	30.0	56.0	
0.300000	21.0	1000.000	9.000	GND	N	10.0	29.0	50.0	
0.405000	26.4	1000.000	9.000	GND	N	10.0	21.2	47.6	
0.525000	11.9	1000.000	9.000	GND	N	10.0	34.1	46.0	
0.900000	16.8	1000.000	9.000	GND	N	10.0	29.2	46.0	
1.425000	14.5	1000.000	9.000	GND	N	10.1	31.5	46.0	
2.040000	15.4	1000.000	9.000	GND	N	10.1	30.6	46.0	
2.640000	14.7	1000.000	9.000	GND	N	10.1	31.3	46.0	

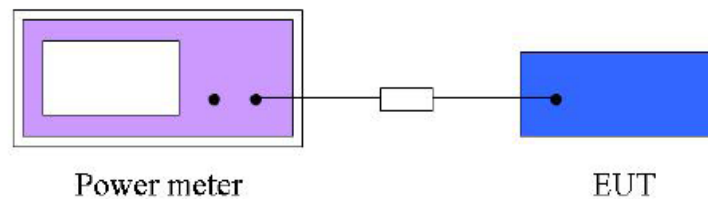


## 7. Maximum Peak Output Power Measurement

### 7.1 Operating environment

Temperature : 23.0 °C  
Relative humidity : 40.0 % R.H.

### 7.2 Test set-up (Layout)



### 7.3 Limit

For systems using digital modulation in the (2 400.0 ~ 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. 11. 2010
■ -	NRV-Z32	Rohde & Schwarz	Power sensor	100062	10. 15. 2010

### 7.5 Test result of Maximum Peak Output Power

- Test Date : May 18, 2010  
- 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 : DC 3.7 V supplied from the 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	17.52	30.00	Complies
6	2 437 MHz	18.10	30.00	Complies
11	2 462 MHz	17.57	30.00	Complies

**Configuration IEEE 802.11g**

Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2 412 MHz	15.91	30.00	Complies
6	2 437 MHz	16.43	30.00	Complies
11	2 462 MHz	16.47	30.00	Complies







**Configuration IEEE 802.11b**

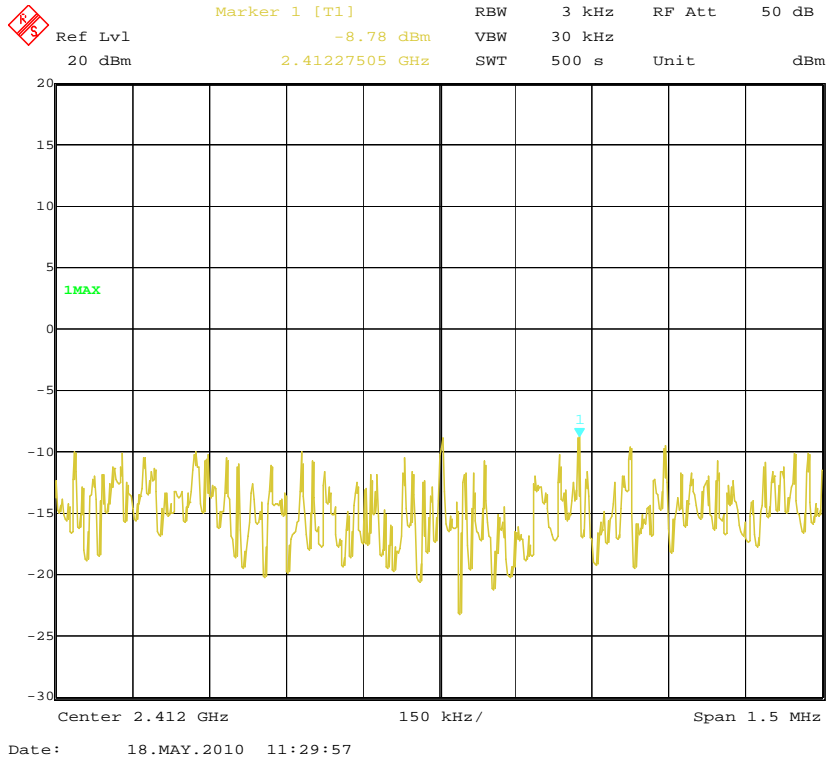
Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2 412 MHz	-8.78	8.00	Complies
6	2 437 MHz	-8.48	8.00	Complies
11	2 462 MHz	-9.04	8.00	Complies

**Configuration IEEE 802.11g**

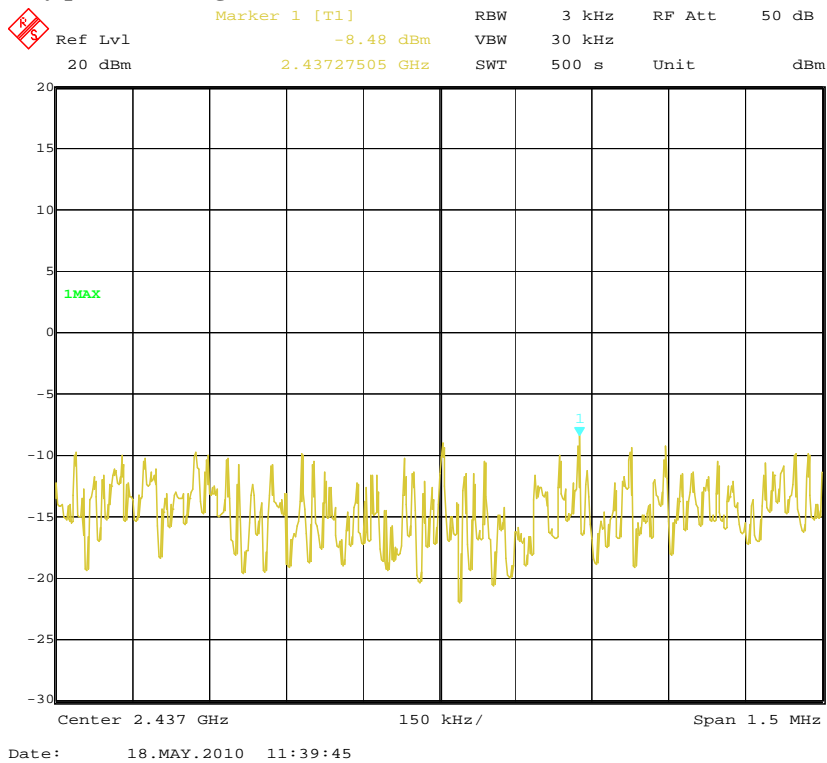
Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2 412 MHz	-14.41	8.00	Complies
6	2 437 MHz	-15.46	8.00	Complies
11	2 462 MHz	-15.66	8.00	Complies



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

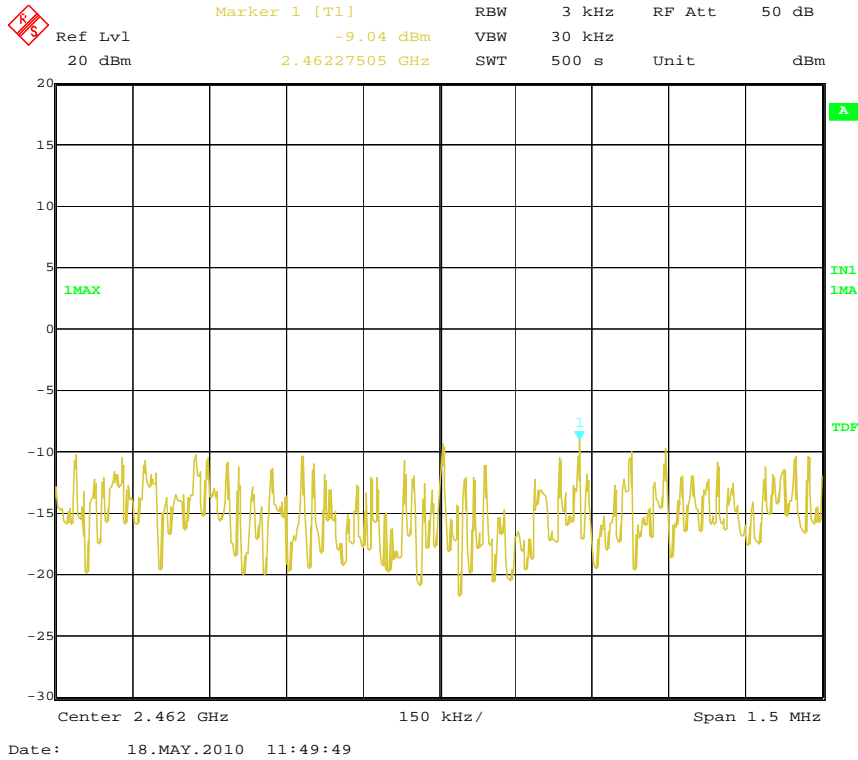


### Power Density plot on Configuration IEEE 802.11b / 2 437 MHz

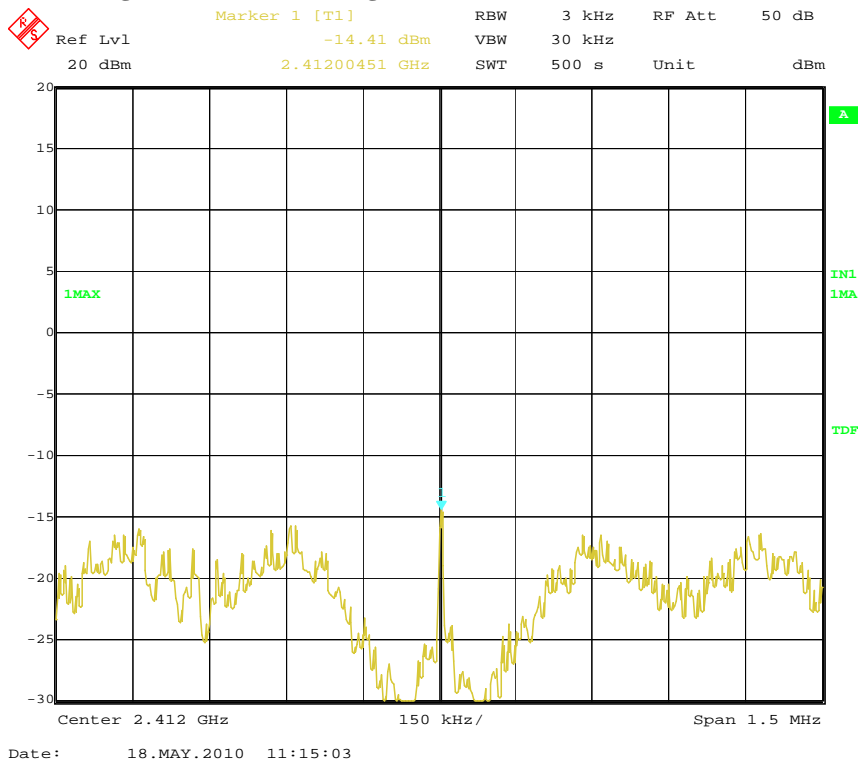




### Power Density Plot on Configuration IEEE 802.11b / 2 462 MHz



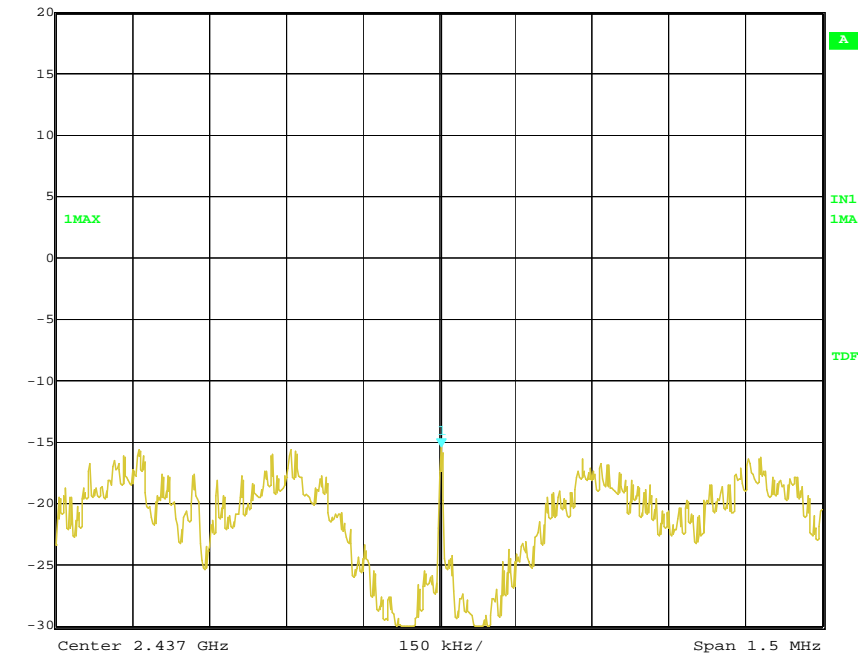
### Power Density Plot on Configuration IEEE 802.11g / 2 412 MHz





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

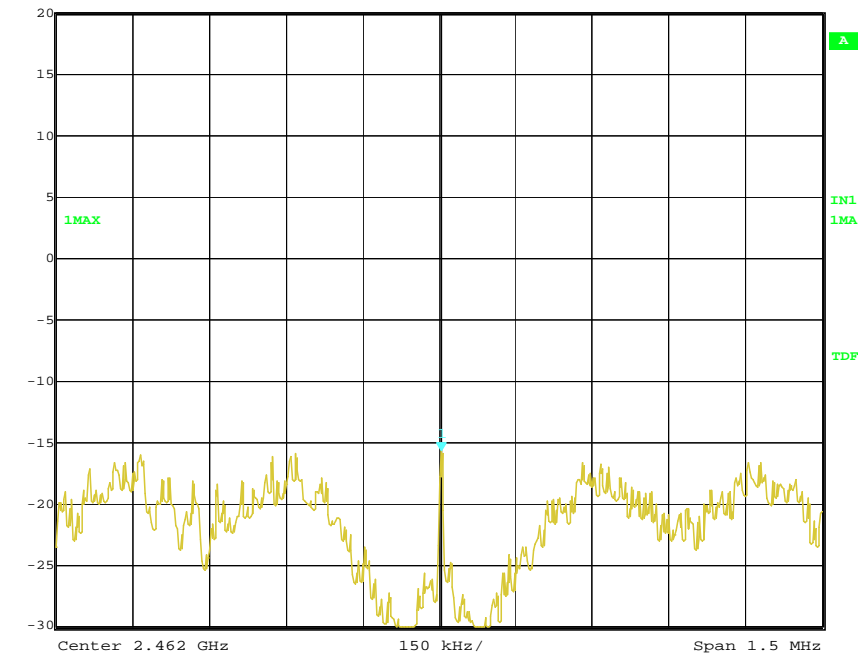
Marker 1 [T1] RBW 3 kHz RF Att 50 dB  
Ref Lvl -15.46 dBm VBW 30 kHz  
20 dBm 2.43700451 GHz SWT 500 s Unit dBm



Date: 18.MAY.2010 10:58:55

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

Marker 1 [T1] RBW 3 kHz RF Att 50 dB  
Ref Lvl -15.66 dBm VBW 30 kHz  
20 dBm 2.46200451 GHz SWT 500 s Unit dBm



Date: 18.MAY.2010 10:45:44

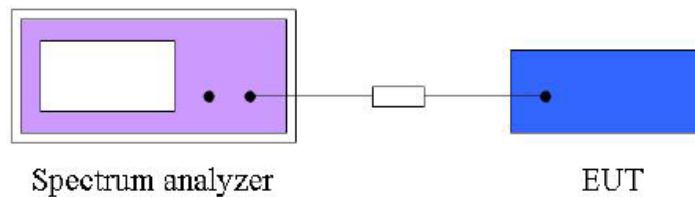


## 9. 6 dB Spectrum bandwidth Measurement

### 9.1 Operating environment

Temperature : 23.0 °C  
Relative humidity : 40.0 % R.H.

### 9.2 Test set-up (Layout)



### 9.3 Limit

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

### 9.4 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESIB26	Rohde & Schwarz	EMI test receiver	830482/010	12. 11. 2010

### 9.5 Test result of Maximum Peak Output Power

- Test Date : May 18, 2010  
- Reference standard : Part 15 Subpart C, Sec. 15.247(a)(2)  
- Channel : 802.11b(1ch / 6ch / 11ch) ; 802.11g(1ch / 6ch / 11ch)  
- Operating condition : Wi-Fi RF transmitting mode  
- Power Source : DC 3.7 V supplied from the lithium polymer battery

#### Spectrum Parameter

- Attenuation : Auto  
- Span frequency : >6 dB bandwidth  
- Resolution band width : 100 kHz  
- Video bandwidth : 300 kHz  
- Detector : Peak  
- Trace : Maxhold  
- Sweep time : Auto



**Configuration IEEE 802.11b**

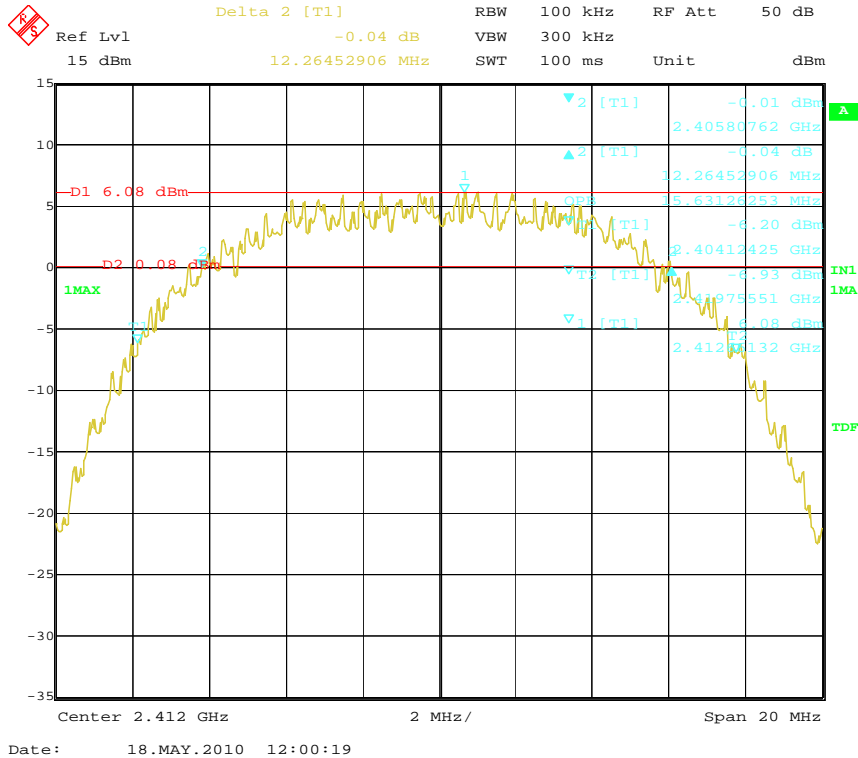
Channel	Frequency	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	Min. Limit (kHz)	Result
1	2 412 MHz	12.26	15.63	500	Complies
6	2 437 MHz	12.22	15.67	500	Complies
11	2 462 MHz	12.22	15.71	500	Complies

**Configuration IEEE 802.11g**

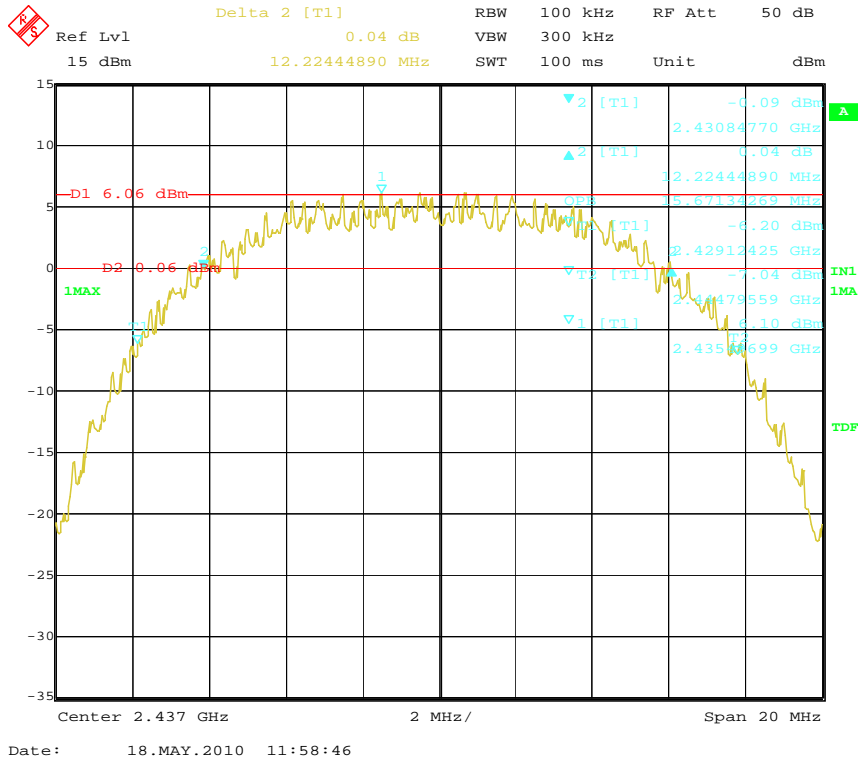
Channel	Frequency	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	Min. Limit (kHz)	Result
1	2 412 MHz	16.59	16.53	500	Complies
6	2 437 MHz	16.59	16.59	500	Complies
11	2 462 MHz	16.55	16.51	500	Complies



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



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

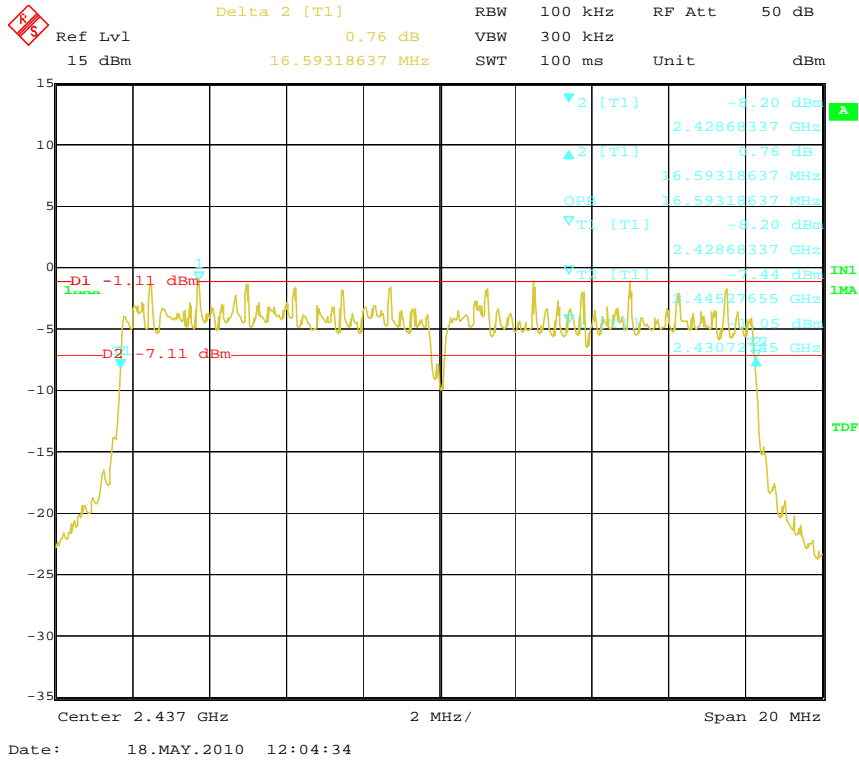




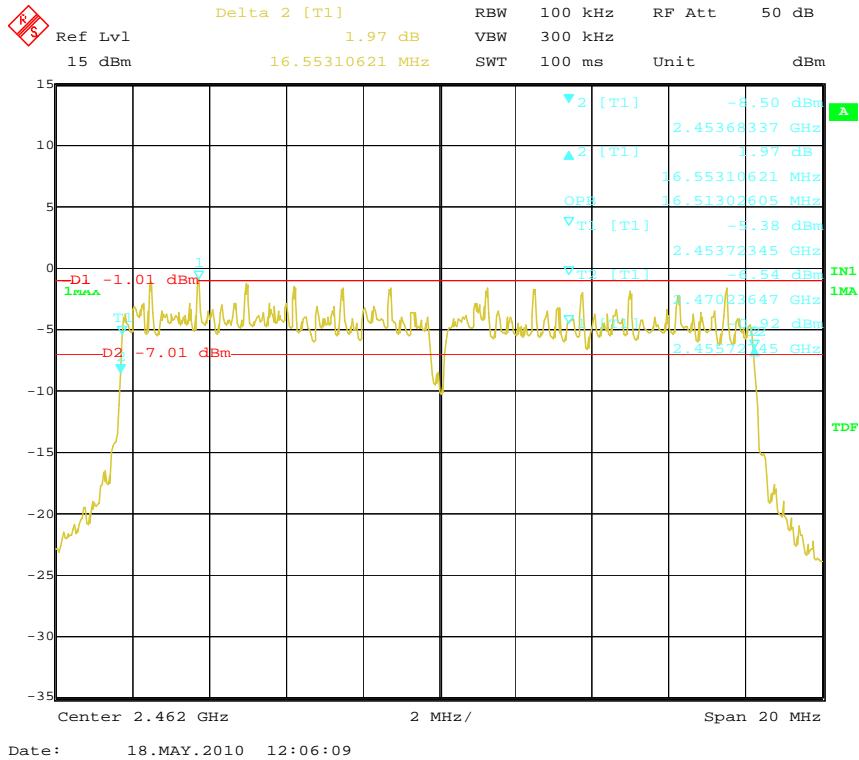




### 6 dB Bandwidth Plot on Configuration IEEE 802.11b / 2 437 MHz



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





## 10. Radiated Emission

### 10.1 Operating environment

Temperature : 23.0 °C  
Relative humidity : 40.0 % R.H.

### 10.2 Test set-up

A preliminary and final measurement was at 3 m anechoic chamber.

The EUT was placed on a non-conductive turntable approximately 0.8 m 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 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(Anechoic chamber)	Uncertainty	Remark
Radiated emission (30 MHz ~ 300 MHz, 3 m, Vertical)	± 4.32 dB	Confidence levels of 95 % ( $k = 2$ )
Radiated emission (30 MHz ~ 300 MHz, 3 m, Horizontal)	± 4.21 dB	Confidence levels of 95 % ( $k = 2$ )
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Vertical)	± 3.96 dB	Confidence levels of 95 % ( $k = 2$ )
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Horizontal)	± 3.97 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

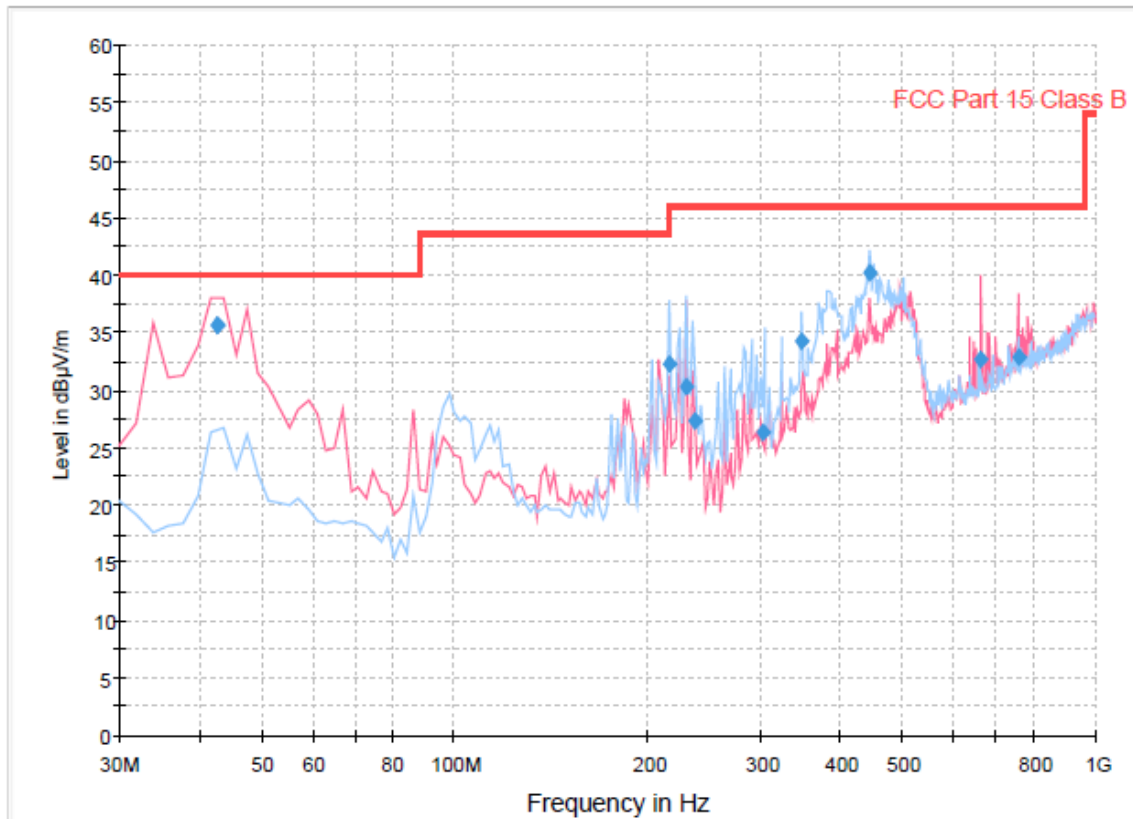
Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESIB26	Rohde & Schwarz	EMI test receiver	830482/010	12. 11. 2010
■ - VULB9160	Schwarzbeck	Bi-log antenna	3193	03. 15. 2012
■ - MCU066	maturo GmbH	Position Controller	1390306	N/A
■ - TT2.5SI	maturo GmbH	Turntable	1390307	N/A
■ - AM4.0	maturo GmbH	Antenna Mast	1390308	N/A
■ - BBHA9120D	Schwarzbeck	Horn antenna	207	12. 22. 2011
■ - BBHA9120D	Schwarzbeck	Horn antenna	597	12. 18. 2010
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258943	11.12. 2010
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258942	11.12. 2010

#### 10.6 Radiated emission test data

- Test Date : May 18, 2010
- 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 : DC 3.7 V supplied from the 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)
42.683327	35.7	1000.0	120.000	100.0	V	0.0	13.2	4.3	40.0
42.707214	35.7	1000.0	120.000	100.0	V	51.0	13.2	4.3	40.0
216.633226	32.4	1000.0	120.000	156.0	H	104.0	12.5	13.6	46.0
229.960441	30.2	1000.0	120.000	130.0	H	246.0	13.2	15.8	46.0
236.632104	27.2	1000.0	120.000	113.0	H	228.0	13.6	18.8	46.0
303.308176	26.4	1000.0	120.000	100.0	H	228.0	16.4	19.6	46.0
347.977595	34.3	1000.0	120.000	100.0	H	146.0	17.6	11.7	46.0
443.748096	40.2	1000.0	120.000	100.0	H	76.0	20.6	5.8	46.0
663.287415	32.6	1000.0	120.000	131.0	V	186.0	25.6	13.4	46.0
756.594028	32.8	1000.0	120.000	100.0	V	112.0	27.6	13.2	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.

Red trace: Vertical polarization

Blue trace: Horizontal polarization

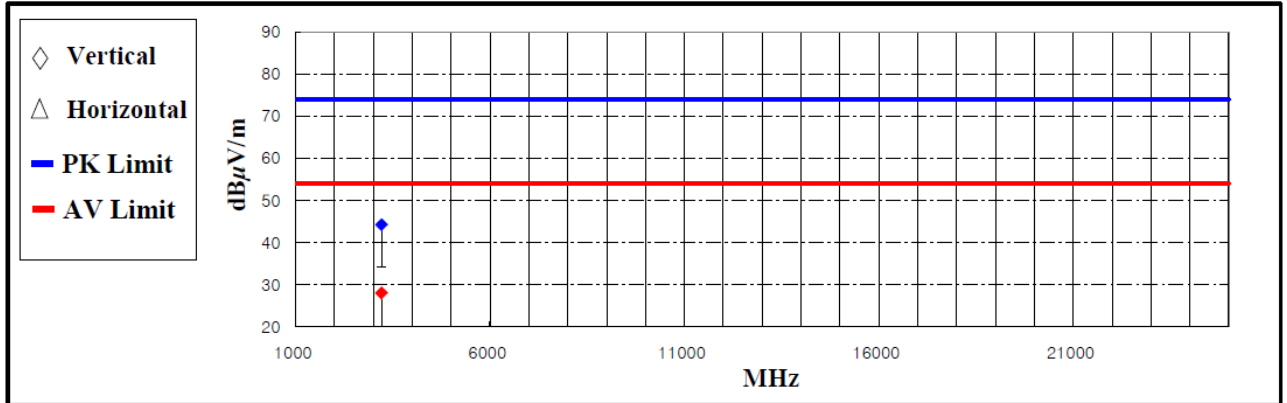
Emission level (dBµV/m) = 20 log Emission level (µV/m).

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



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

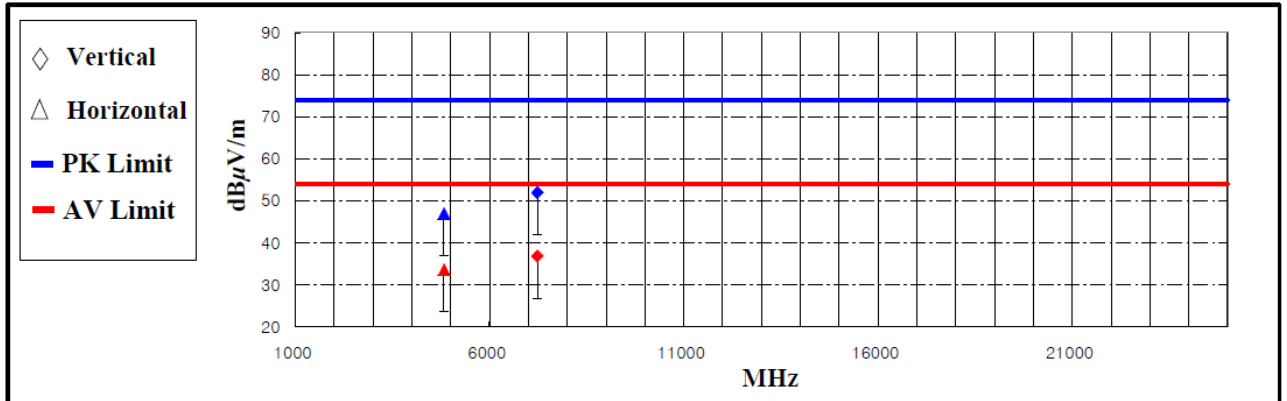
Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF (dB/m)	AMP / CL (dB)	Test Result (dB $\mu$ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average							
3215.82	58.95	42.75	28.84	-43.59	44.20	28.00	74.00	54.00	29.80	26.00	V	100	97



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

(802.11 B, 1 CH.)

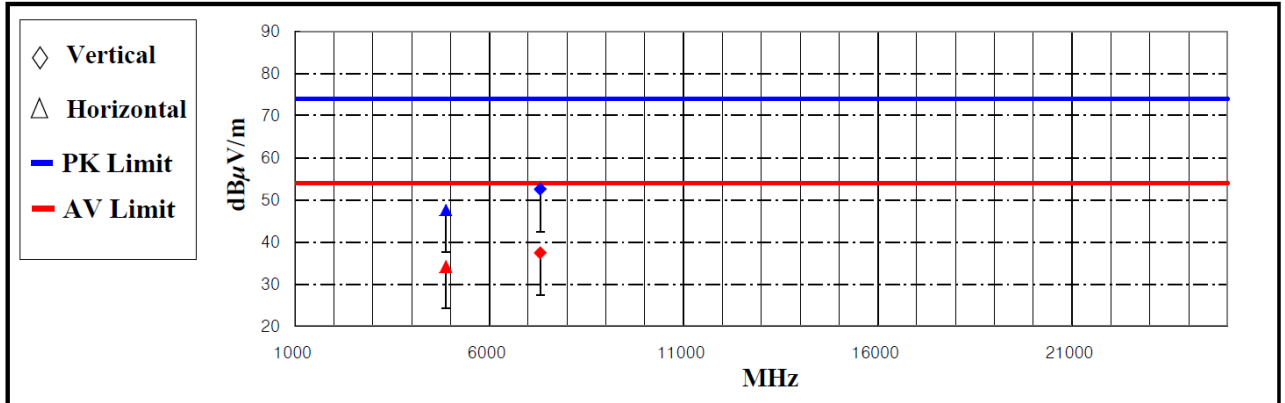
Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF (dB/m)	AMP / CL (dB)	Test Result (dB $\mu$ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average							
4824.00	59.05	45.65	31.24	-43.29	47.00	33.60	74.00	54.00	27.00	20.40	H	173	98
7236.00	57.92	42.82	35.80	-41.82	51.90	36.80	74.00	54.00	22.10	17.20	V	189	161





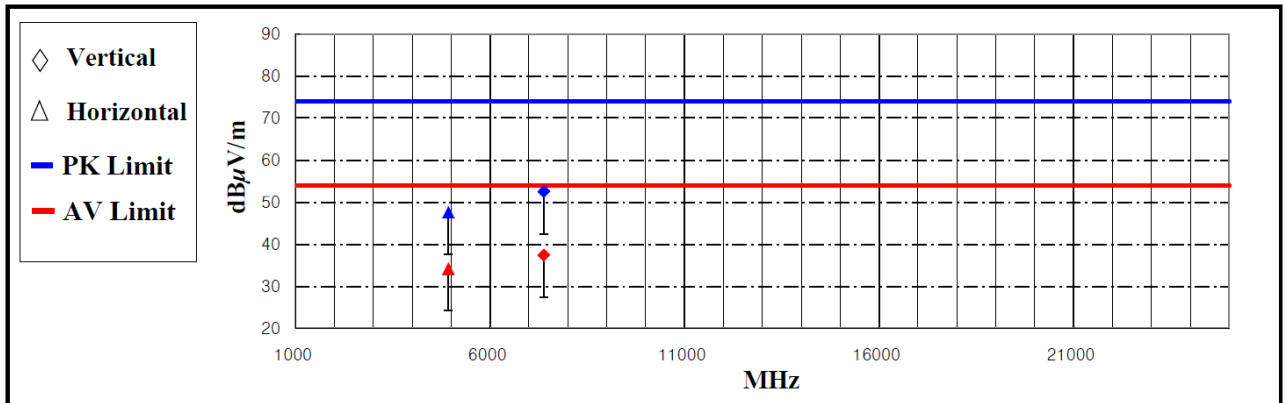
**(802.11 B, 6 CH.)**

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	59.37	45.97	31.32	-43.09	47.60	34.20	74.00	54.00	26.40	19.80	H	170	95
7311.00	58.34	43.24	35.94	-41.78	52.50	37.40	74.00	54.00	21.50	16.60	V	169	158



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

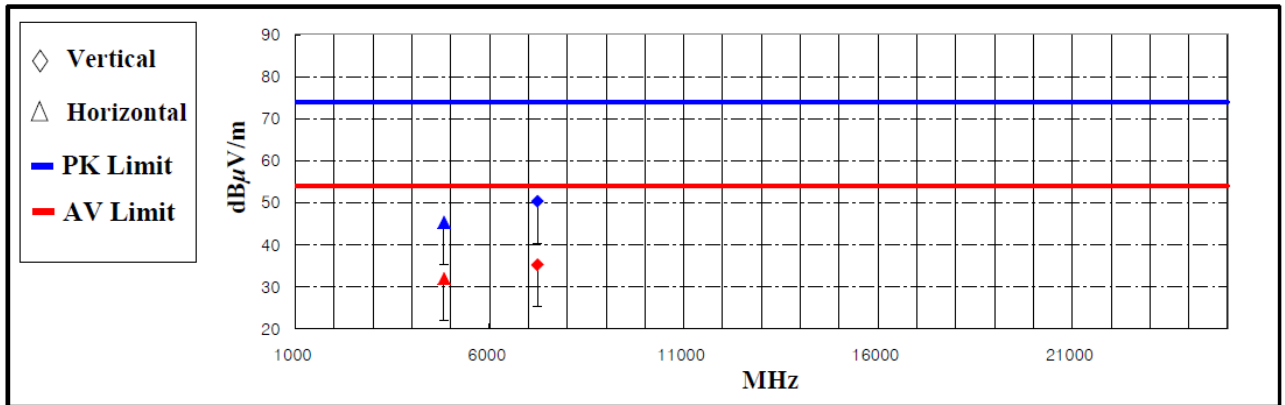
Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF (dB/m)	AMP / CL (dB)	Test Result (dB $\mu$ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average							
4924.00	59.18	45.78	31.41	-42.99	47.60	34.20	74.00	54.00	26.40	19.80	H	172	88
7386.00	58.16	43.06	36.08	-41.74	52.50	37.40	74.00	54.00	21.50	16.60	V	165	173





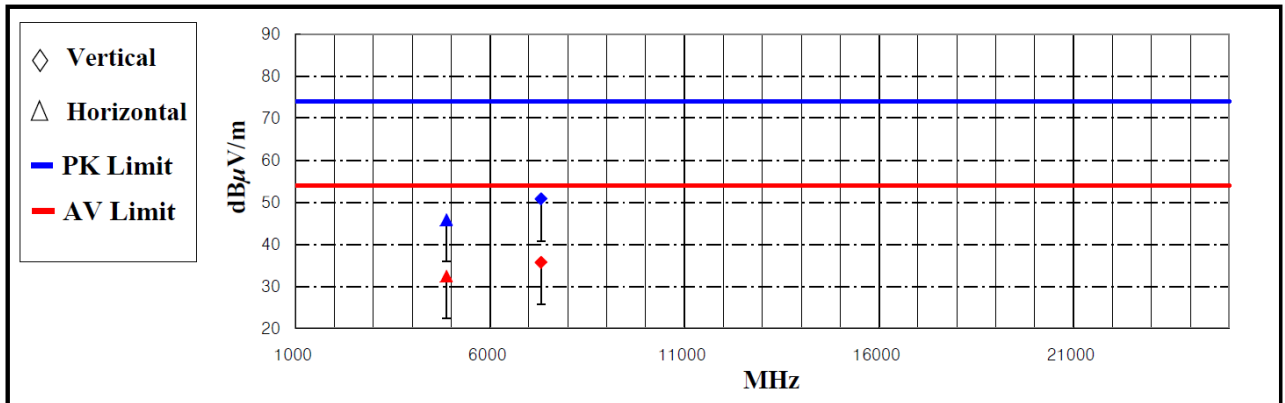
**(802.11 G, 1 CH.)**

Frequency (MHz)	Measurement Level						Limit (dBμ V/m)		Margin (dB)		Positioning System		
	Reading Value (dBμ V/m)		AF	AMP / CL	Test Result (dBμ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average	(dB/m)	(dB)	Peak	Average							
4824.00	57.45	44.05	31.24	-43.29	45.40	32.00	74.00	54.00	28.60	22.00	H	172	97
7236.00	56.32	41.22	35.80	-41.82	50.30	35.20	74.00	54.00	23.70	18.80	V	190	160



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

Frequency (MHz)	Measurement Level						Limit (dBμ V/m)		Margin (dB)		Positioning System		
	Reading Value (dBμ V/m)		AF	AMP / CL	Test Result (dBμ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average	(dB/m)	(dB)	Peak	Average							
4874.00	57.67	44.27	31.32	-43.09	45.90	32.50	74.00	54.00	28.10	21.50	H	168	90
7311.00	56.64	41.54	35.94	-41.78	50.80	35.70	74.00	54.00	23.20	18.30	V	170	160

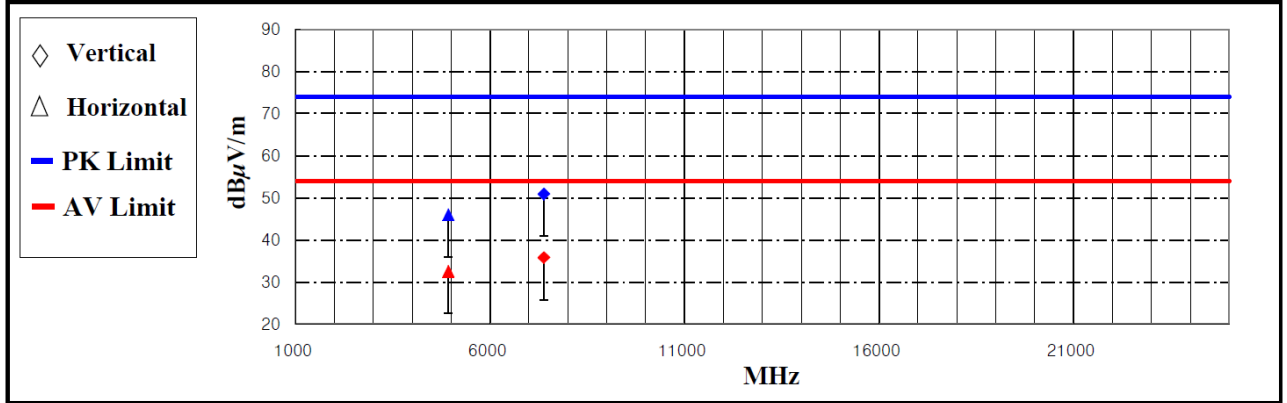






**(802.11 G, 11 CH.)**

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	57.58	44.18	31.41	-42.99	46.00	32.60	74.00	54.00	28.00	21.40	H	171	88
7386.00	56.56	41.46	36.08	-41.74	50.90	35.80	74.00	54.00	23.10	18.20	V	166	173



**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: 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
■ - ESIB26	Rohde & Schwarz	EMI test receiver	830482/010	12. 11. 2010
■ - VULB9160	Schwarzbeck	Bi-log antenna	3193	03. 15. 2012
■ - MCU066	matur0 GmbH	Position Controller	1390306	N/A
■ - TT2.5SI	matur0 GmbH	Turntable	1390307	N/A
■ - AM4.0	matur0 GmbH	Antenna Mast	1390308	N/A
■ - BBHA9120D	Schwarzbeck	Horn antenna	207	12. 22. 2011
■ - BBHA9120D	Schwarzbeck	Horn antenna	597	12. 18. 2010
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258943	11.12. 2010
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258942	11.12. 2010



### 11.5 Band Edge Radiated emission test data

- Test Date : May 18, 2010
- 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 : DC 3.7 V supplied from the 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 (dBμV/m)		Margin (dB)		Positioning System		
	Reading Value (dBμV)		AF (dB/m)	AMP / CL (dB)	Test Result (dBμV/m)						Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average	Peak	Average					
2412.00	122.69	110.79	27.02	-44.38	105.33	93.43	74.00	54.00	-	-	-	-	-
2386.69	74.98	63.08	26.95	-44.37	57.56	45.66	74.00	54.00	16.44	8.34	-	-	-

#### 802.11b, 11ch

Frequency (MHz)	Measurement Level						Limit (dBμV/m)		Margin (dB)		Positioning System		
	Reading Value (dBμV)		AF (dB/m)	AMP / CL (dB)	Test Result (dBμV/m)						Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average	Peak	Average					
2462.00	122.10	110.20	27.15	-44.24	105.01	93.11	74.00	54.00	-	-	-	-	-
2488.46	71.89	59.99	27.22	-44.16	54.95	43.05	74.00	54.00	19.05	10.95	-	-	-

#### 802.11g, 1ch

Frequency (MHz)	Measurement Level						Limit (dBμV/m)		Margin (dB)		Positioning System		
	Reading Value (dBμV)		AF (dB/m)	AMP / CL (dB)	Test Result (dBμV/m)						Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average	Peak	Average					
2412.00	116.06	104.16	27.02	-44.38	98.70	86.80	74.00	54.00	-	-	-	-	-
2390.00	71.62	59.72	26.96	-44.38	54.20	42.30	74.00	54.00	19.80	11.70	-	-	-

#### 802.11g, 11ch

Frequency (MHz)	Measurement Level						Limit (dBμV/m)		Margin (dB)		Positioning System		
	Reading Value (dBμV)		AF (dB/m)	AMP / CL (dB)	Test Result (dBμV/m)						Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average	Peak	Average					
2462.00	115.78	103.88	27.15	-44.24	98.69	86.79	74.00	54.00	-	-	-	-	-
2483.50	71.82	59.92	27.21	-44.17	54.86	42.96	74.00	54.00	19.14	11.04	-	-	-

Note:

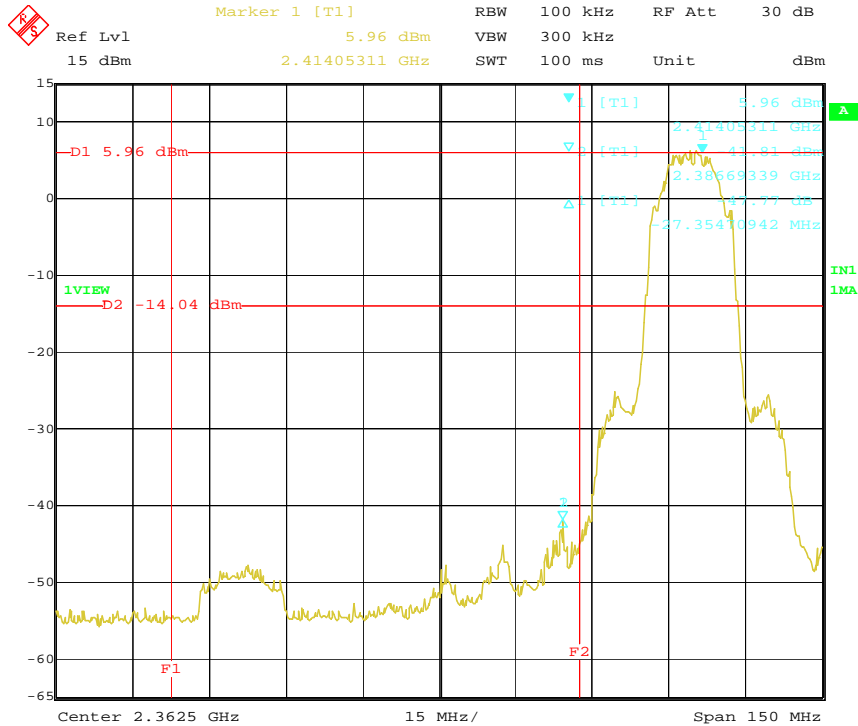
The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.

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

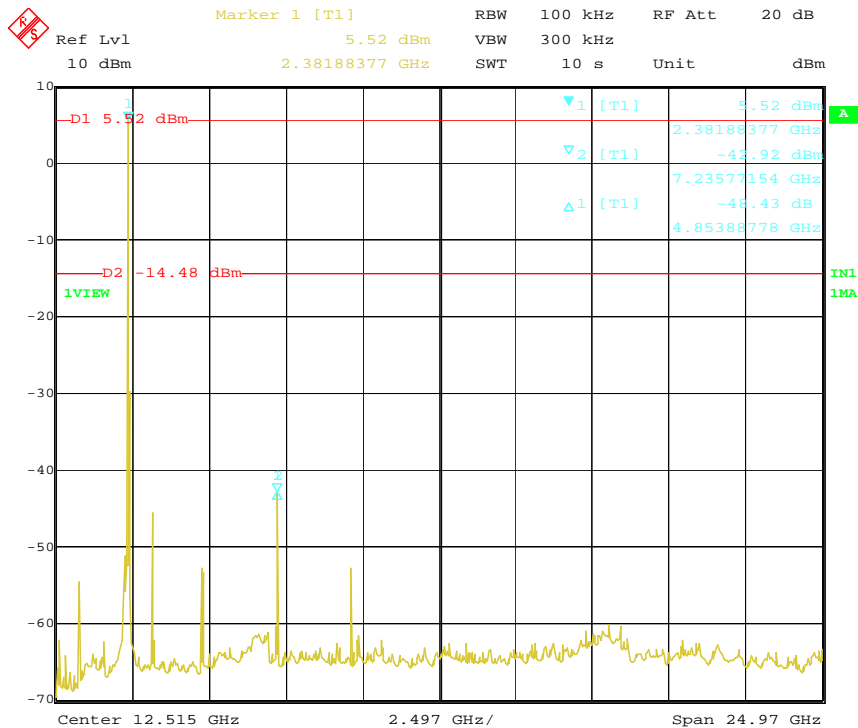
Corrected Reading: Reading value + AF (Antenna Factor) +AMP/CL (Cable Loss + Preamp factor) = Test result



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



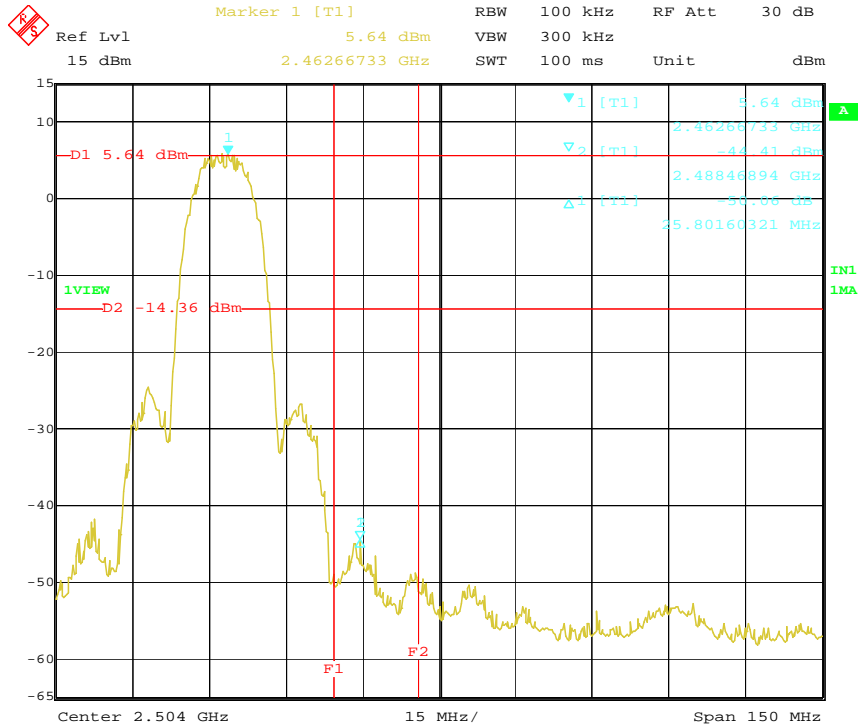
Date: 18.MAY.2010 12:21:04



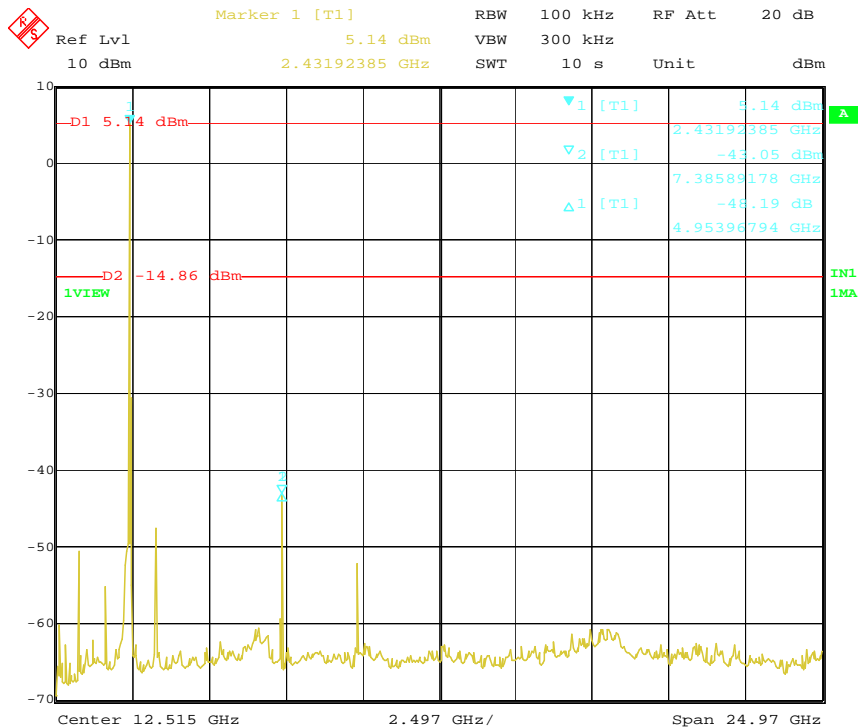
Date: 18.MAY.2010 12:22:17



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



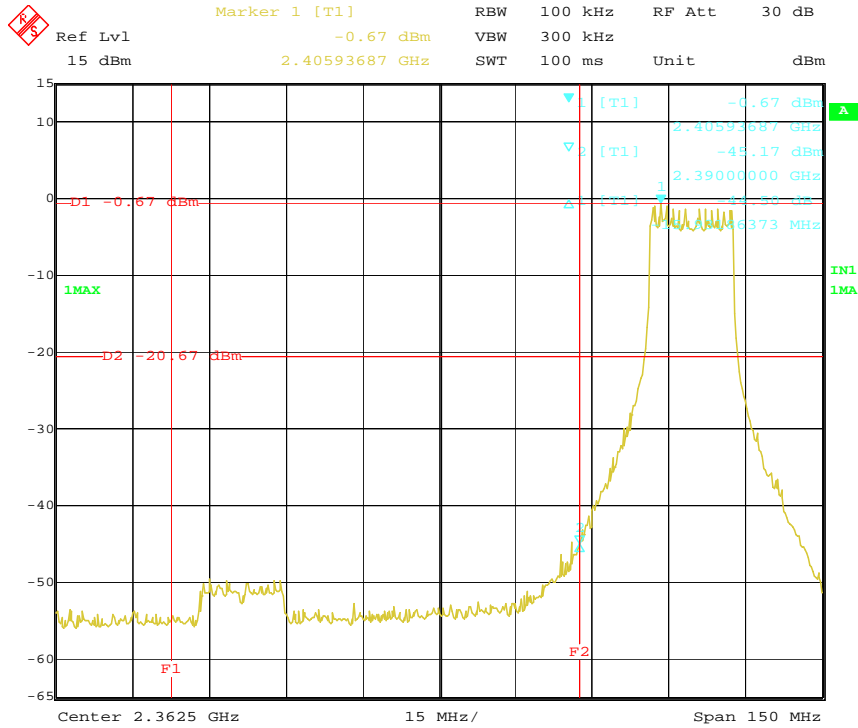
Date: 18.MAY.2010 12:24:48



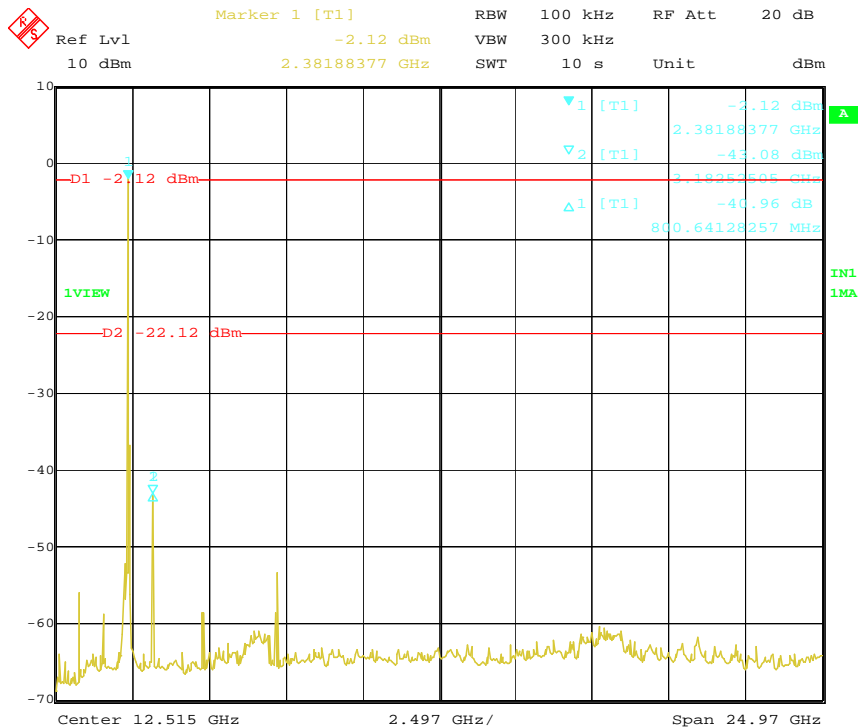
Date: 18.MAY.2010 12:23:38



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



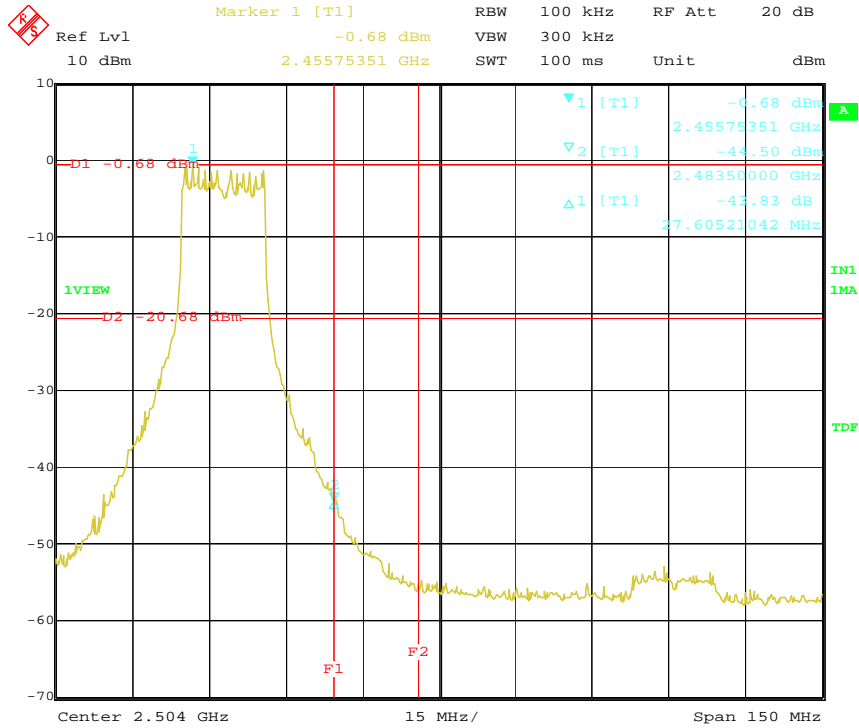
Date: 18.MAY.2010 12:19:17



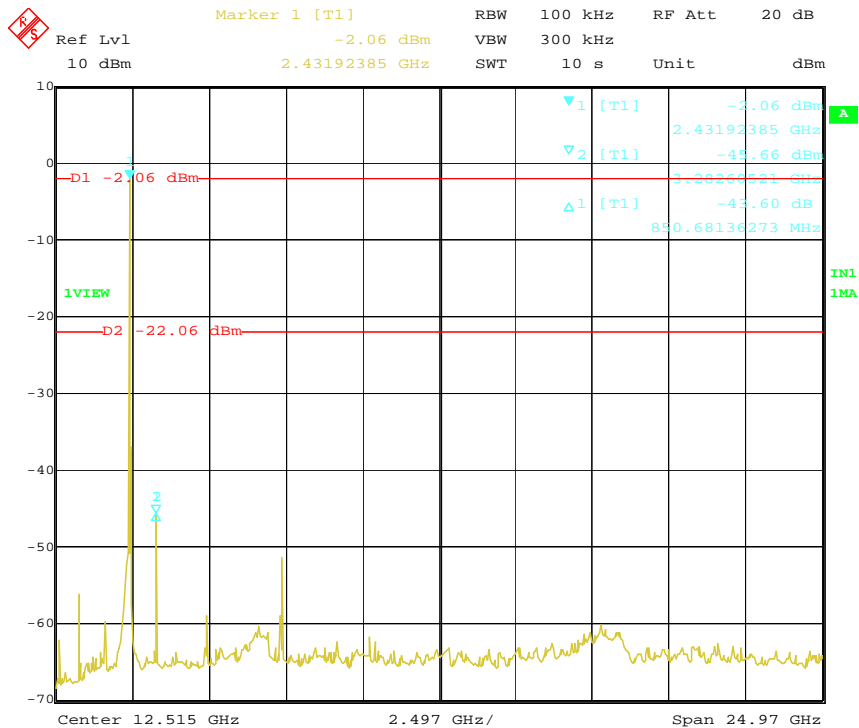
Date: 18.MAY.2010 12:16:45



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



Date: 18.MAY.2010 12:10:12



Date: 18.MAY.2010 12:15:07