

FCC EVALUATION REPORT FOR CERTIFICATION

Manufacturer : OHSUNG ELECTRONICS CO., LTD

#181 Gongdan-dong, Gumi-si, Gyeongbuk

Republic of Korea

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

Date of Issue : December 10, 2008

Test Report S/N : GETEC-E3-08-055

Test Site : Gumi College EMC Center

FCC Registration Number: (100749)

FCC ID

APPLICANT

OZ5URCMX6000I

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 (WIFI built in RF remote controller)
Model Name	: MX-6000i
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,


Jae-Hoon Jeong, Senior Engineer
GUMI College EMC center


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.** OZ5URCMX6000I
- **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
(WIFI built in RF remote controller)
- **Power Source** AC 120 V/ 60 Hz, DC 3.7 V Li-ion Rechargeable Battery
- **Model Name** MX-6000i
- **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** December 2 ~ 8, 2008
- **Place of Test** **Gumi College EMC Center** (FCC Registration No.: 100749)
407, Bugok-Dong, Gumi-si, Gyeongsangbuk-Do, Korea
- **Test Report Number** GETEC-E3-08-055
- **Dates of Issue** December 10, 2008

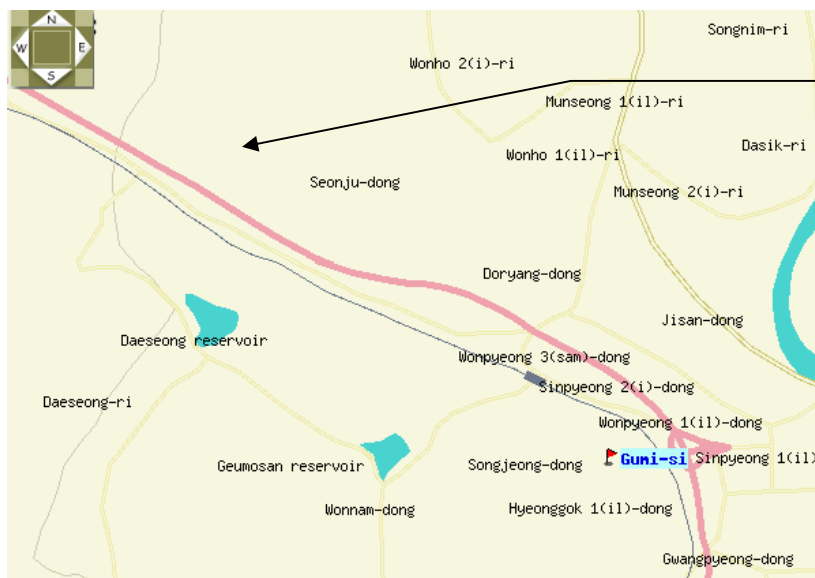
2. Introduction

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 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-6000i)**

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



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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. WIFI built in RF Remote Controller (Model Name: MX-6000i) FCC ID.: OZ5URCMX6000I**

This Report is for WIFI module the next report (No. GETEC-E3-08-064) 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

Microprocessor: 533MHz ARM9
 RAM: 128Mbyte Mobile DDR
 NAND: 64Mbyte
 LCD: 4.3 Inch Wide Screen (480 by 272)
 LCD Backlighting by LED
 Sound: 2 x 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 fre-
 quencies (15kHz to 455kHz)
 Macro Capability - Up to 255 steps
 each, however nesting is allowed

IR Learning: 20-455 kHz
 IR Range (Line of Sight via Infrared):
 30-50 feet, depending on the envi-
 ronment
 RF Frequency: 433.92MHz
 RF Range (radio frequency): 50 to
 100 feet, depending upon the envi-
 ronment
 WiFi: IEEE 802.11 B (11Mps), G
 (54Mps)
 Battery: Lithium Ion, 4800 mA hours
 Battery Capacity: 4 hours continu-
 ous use, 9 days standby
 Battery Charging Time: 7 Hours
 Dimensions: 7.5"Wide x 5.1"Deep
 x 1.3"Height
 Weight (without AC Adapter):
 15 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		

3.2 Support Equipment / Cables used

3.2.1 Used Support Equipment

Description	Manufacturer	Model Name	S/N & FCC ID
None	-	-	

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	1.84 m 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 120 V/ 60 Hz
DC 3.7 V Li-ion Rechargeable Battery

- Test Mode(s)
 - . Executed “Marvell Labtool” to control the EUT continuously transmit RF signal

Test Software Version	Marvell lab tool		
Frequency	2 412 MHz	2 437 MHz	2 462 MHz
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 m × 8 m × 2.5 m shielded enclosure.

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

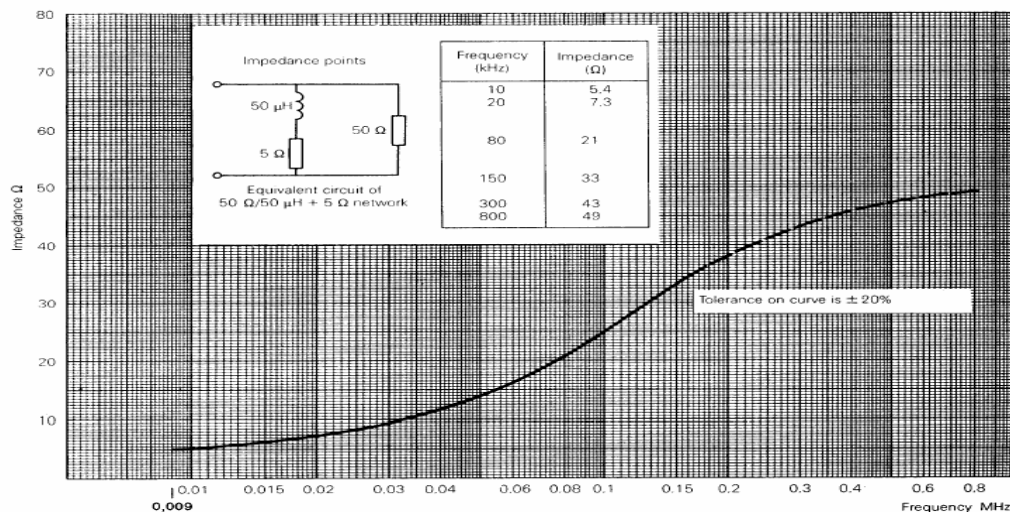


Fig 2. Impedance of LISN

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.

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

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

Final measurements were made outdoors at 3 m 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 120 kHz 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 0.8 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 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

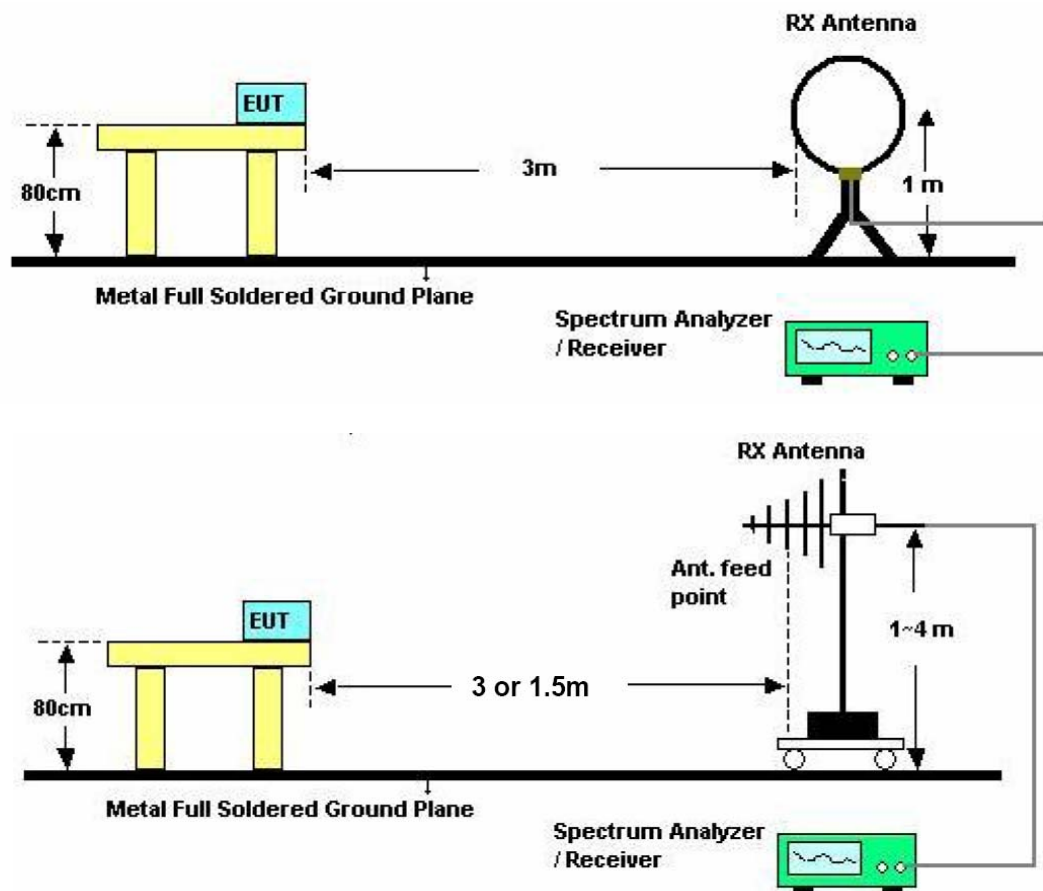


Fig 3. Dimensions of test site.

6. Conducted Emission

6.1 Operating environment

Temperature : 25 °C
Relative humidity : 40 % 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	
Freq. Range	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

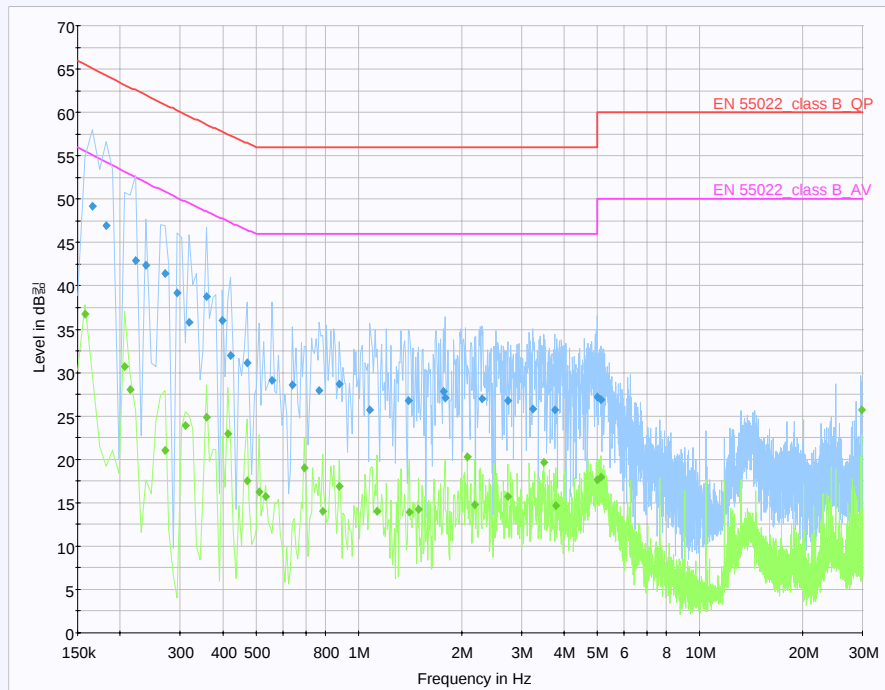
Model Number	Manufacturer	Description	Serial Number	Due to calibration
■ - ESCS30	Rohde & Schwarz	EMI test receiver	839809/003	12. 14. 2008
■ - ESH2-Z5	Rohde & Schwarz	Artificial mains network	829991/009	12. 13. 2008
□ - ESH3-Z5	Rohde & Schwarz	Artificial mains network	838979/020	12. 13. 2008

6.6 Test data for power line conducted emission

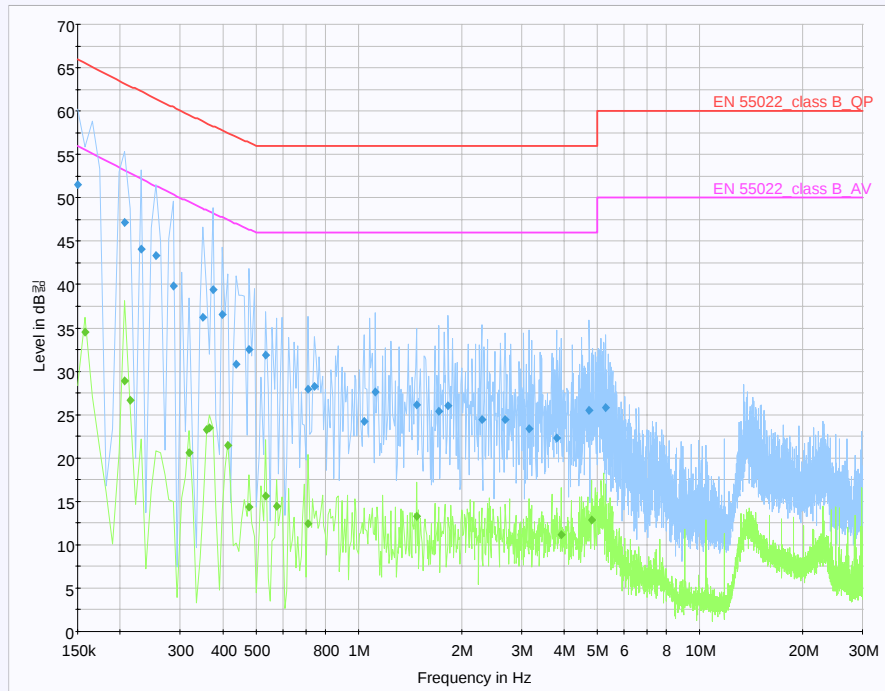
-. Test Date : December 2, 2008
 -. Reference standard : Part 15 Subpart C, Sec. 15.207
 -. Channel : 802.11b, 1ch
 -. Operating condition : WIFI RF transmitting mode
 -. Resolution bandwidth : 9 kHz
 -. Frequency range : 0.15 MHz ~ 30 MHz

Frequency (MHz)	Insertion Loss	Cable Loss	Line	Q.P[dB μ V]			A.V[dB μ V]			Margin[dB]	
				Limit	Reading	Result	Limit	Reading	Result	Q.P	A.V
0.150	0.12	-0.16	N	66.00	51.54	51.50	56.00	34.54	34.50	14.50	21.50
0.230	0.13	-0.16	N	62.44	44.13	44.10	52.44	26.73	26.70	18.34	25.74
0.270	0.13	-0.15	L1	61.11	41.42	41.40	51.11	21.12	21.10	19.71	30.01
0.358	0.14	-0.14	L1	58.77	38.70	38.70	48.77	24.80	24.80	20.07	23.97
0.422	0.14	-0.14	L1	57.40	32.00	32.00	47.40	23.00	23.00	25.40	24.40
0.478	0.17	-0.13	N	56.37	32.46	32.50	46.37	14.36	14.40	23.87	31.97
0.534	0.17	-0.13	N	56.00	31.86	31.90	46.00	15.56	15.60	24.10	30.40
0.742	0.15	-0.13	N	56.00	28.28	28.30	46.00	12.38	12.40	27.70	33.60
1.078	0.15	-0.13	L1	56.00	25.68	25.70	46.00	13.98	14.00	30.30	32.00
1.790	0.17	-0.09	L1	56.00	26.92	27.00	46.00	14.22	14.30	29.00	31.70
2.734	0.20	-0.11	L1	56.00	26.71	26.80	46.00	15.61	15.70	29.20	30.30
3.230	0.21	-0.11	L1	56.00	25.70	25.80	46.00	19.60	19.70	30.20	26.30
4.998	0.26	-0.06	L1	56.00	27.00	27.20	46.00	17.50	17.70	28.80	28.30
5.134	0.26	-0.06	L1	60.00	26.60	26.80	50.00	17.80	18.00	33.20	32.00

*Comment : Line : L1(line 1), L2(line2), L3(line 3), N(neutral)
 Q.P:Quasi-peak, A.V : Average
 Insertion Loss : Insertion Loss of LISN
 Cable Loss : Cable Loss + Pulse Limiter Insertion loss value
 "<<" : The margin is more than 30 dB



(Phase: Line)



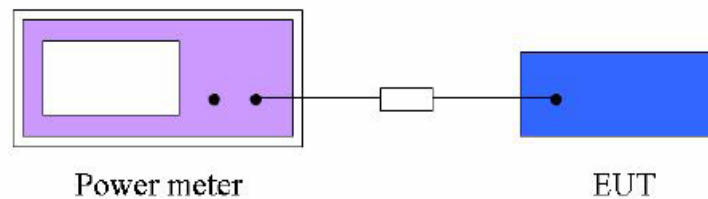
(Phase: Neutral)

7. Maximum Peak Output Power Measurement

7.1 Operating environment

Temperature : 27 °C
Relative humidity : 23 %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 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 : December 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 120 V/ 60 Hz, DC 3.7 V Li-ion Rechargeable 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	15.35	30.00	Complies
6	2 437 MHz	14.16	30.00	Complies
11	2 462 MHz	13.31	30.00	Complies

Configuration IEEE 802.11g

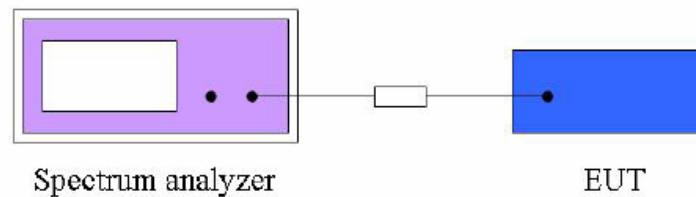
Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2 412 MHz	17.98	30.00	Complies
6	2 437 MHz	17.64	30.00	Complies
11	2 462 MHz	16.24	30.00	Complies

8. Power Spectral Density Measurement

8.1 Operating environment

Temperature : 24 °C
Relative humidity : 25 %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. 2008

8.5 Test result of Maximum Peak Output Power

- Test Date : December 4, 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 120 V/ 60 Hz, DC 3.7 V Li-ion Rechargeable 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

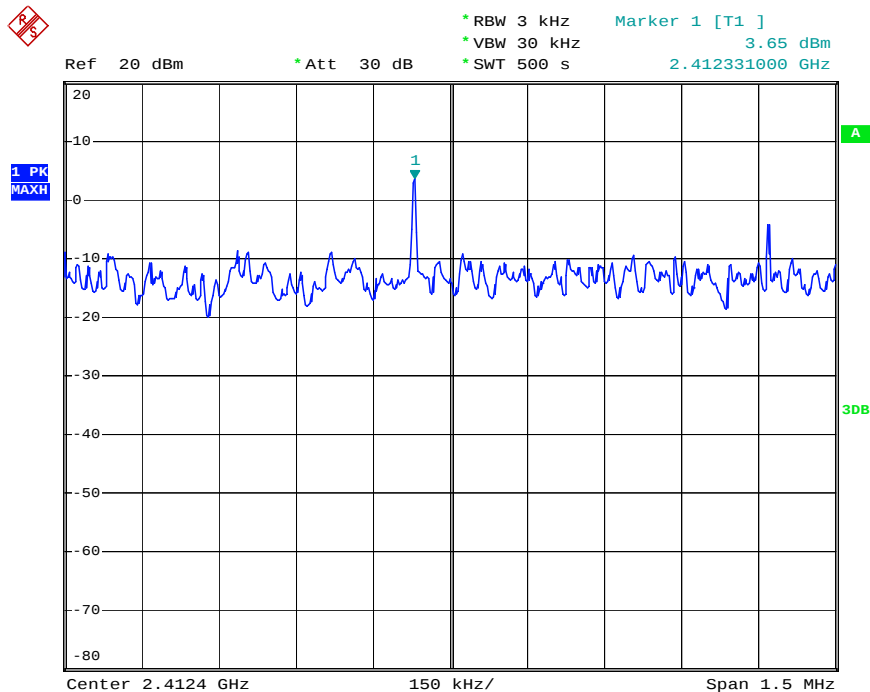
Configuration IEEE 802.11b

Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2 412 MHz	3.65	8.00	Complies
6	2 437 MHz	2.94	8.00	Complies
11	2 462 MHz	1.90	8.00	Complies

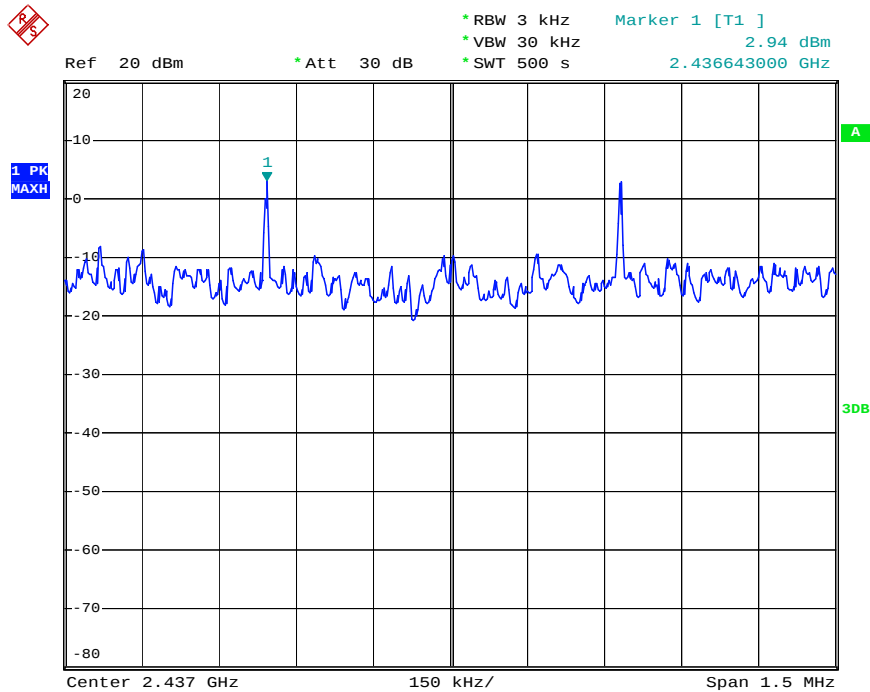
Configuration IEEE 802.11g

Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
1	2 412 MHz	-16.33	8.00	Complies
6	2 437 MHz	-16.65	8.00	Complies
11	2 462 MHz	-17.24	8.00	Complies

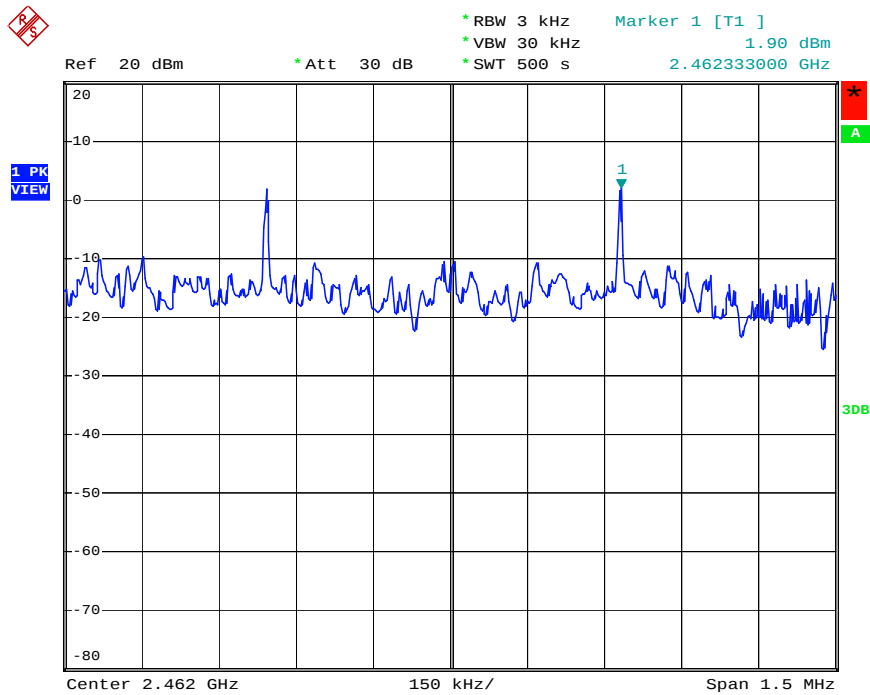
Power Density Plot on configuration IEEE 802.11b / 2 412 MHz



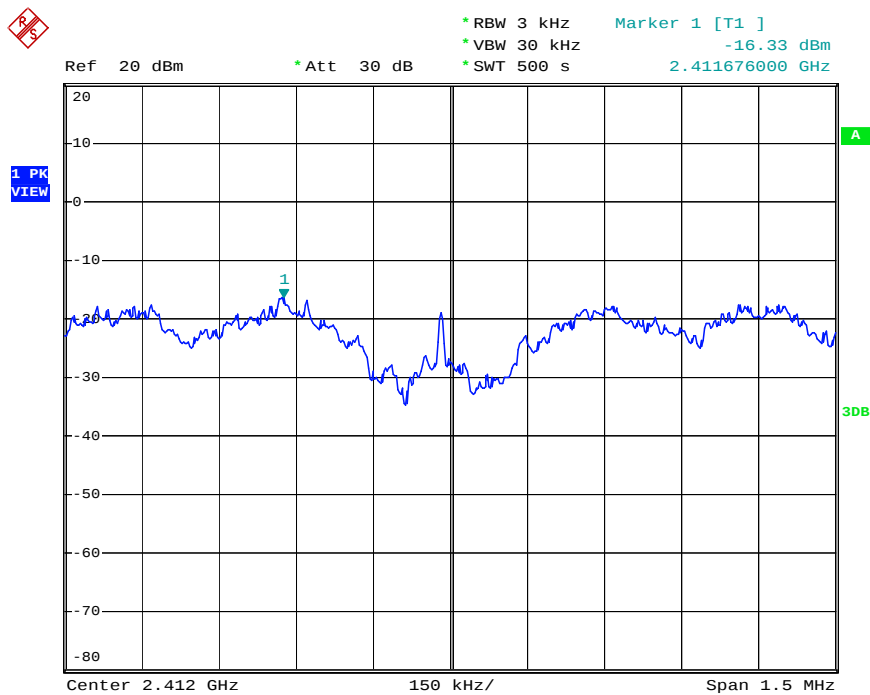
Power Density plot on Configuration IEEE 802.11b / 2 437 MHz



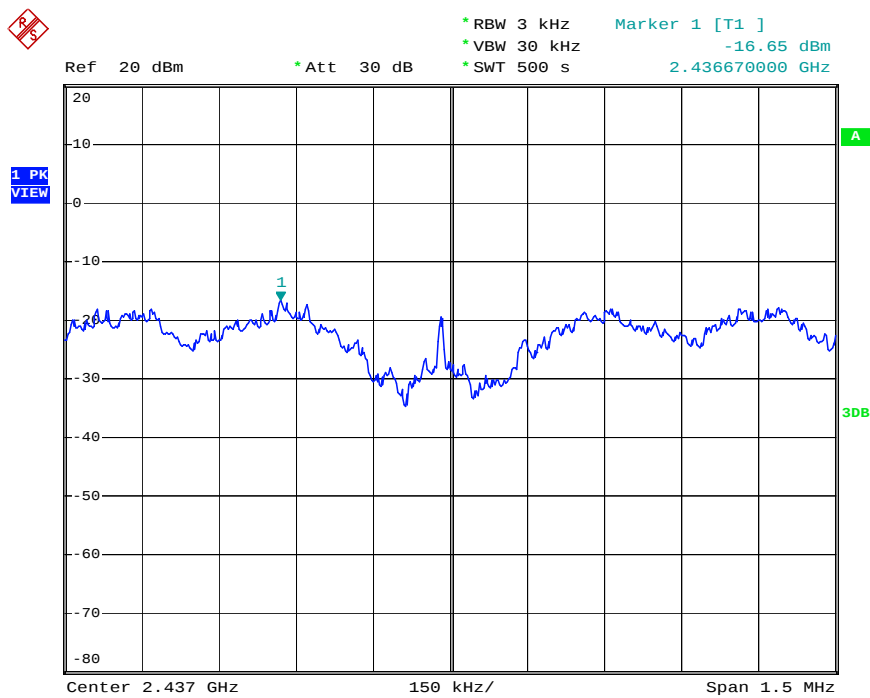
Power Density Plot on Configuration IEEE 802.11b / 2 462 MHz



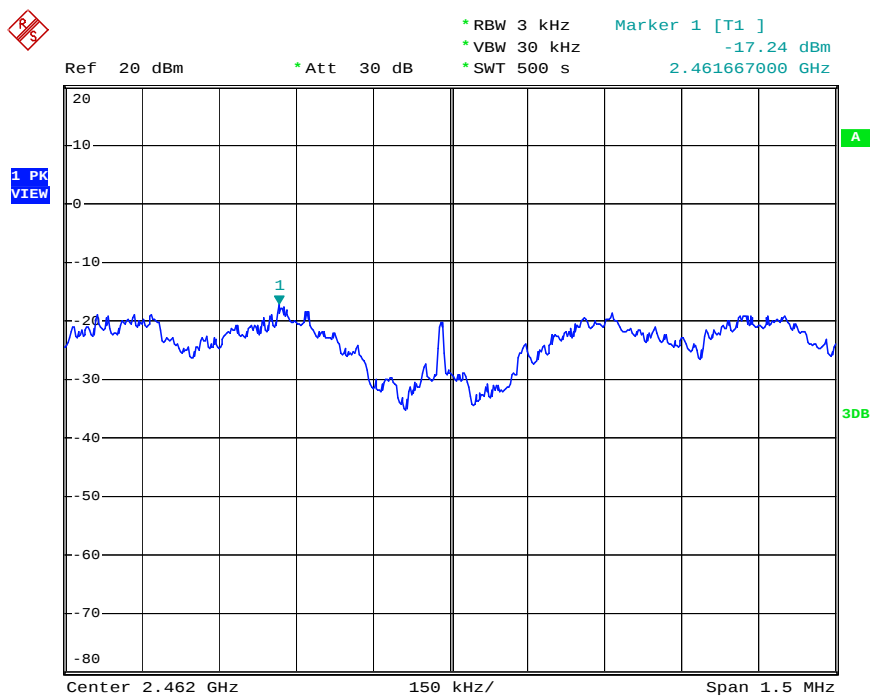
Power Density Plot on Configuration IEEE 802.11g / 2 412 MHz



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



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

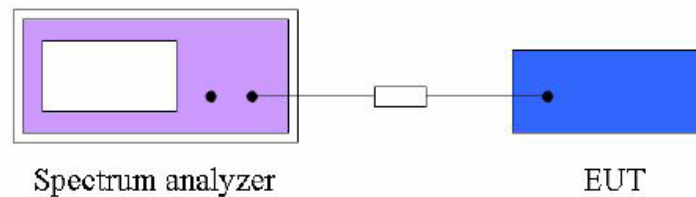


9. 6dB Spectrum bandwidth Measurement

9.1 Operating environment

Temperature : 24 °C
Relative humidity : 25 %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
■ - ESI	Rohde & Schwarz	EMI test receiver	830482/010	12. 14. 2008

9.5 Test result of Maximum Peak Output Power

- Test Date : December 4, 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 120 V/ 60 Hz, DC 3.7 V Li-ion Rechargeable battery

Spectrum Parameter

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

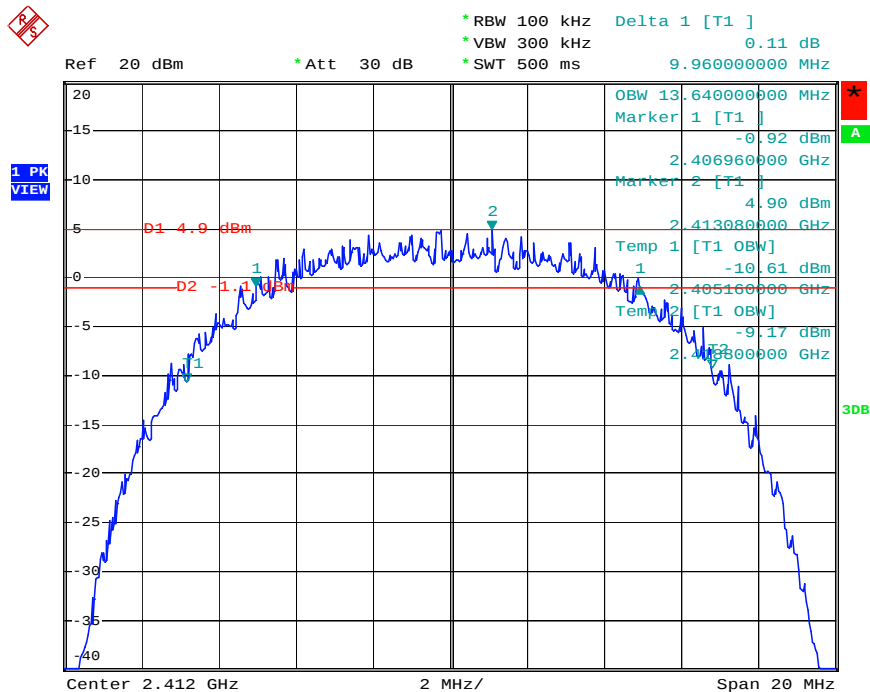
Configuration IEEE 802.11b

Channel	Frequency	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	Min. Limit (kHz)	Result
1	2 412 MHz	9.96	13.64	500	Complies
6	2 437 MHz	9.72	13.68	500	Complies
11	2 462 MHz	9.56	13.64	500	Complies

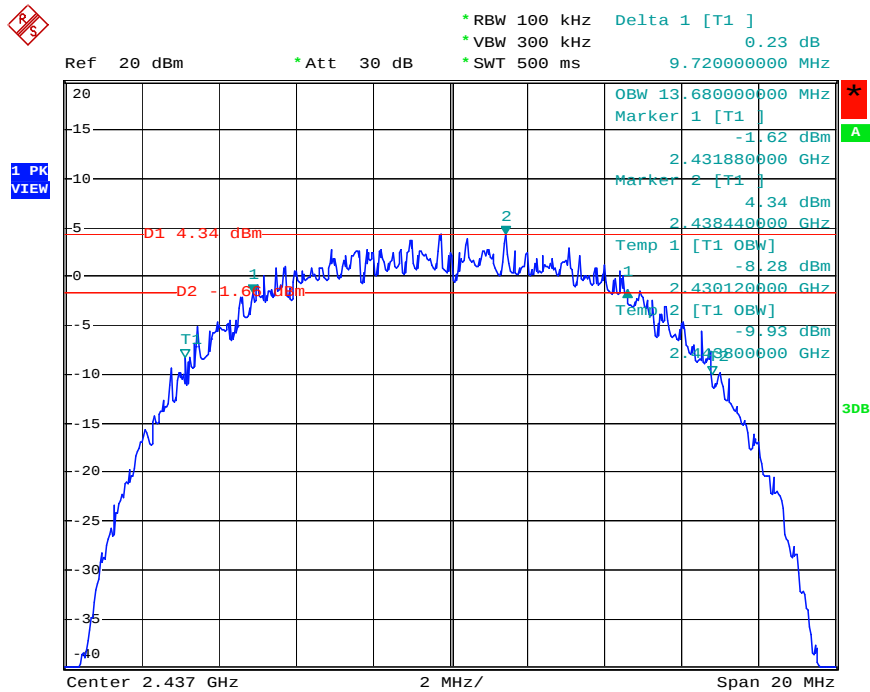
Configuration IEEE 802.11g

Channel	Frequency	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	Min. Limit (kHz)	Result
1	2 412 MHz	16.48	16.44	500	Complies
6	2 437 MHz	16.52	16.44	500	Complies
11	2 462 MHz	16.52	16.48	500	Complies

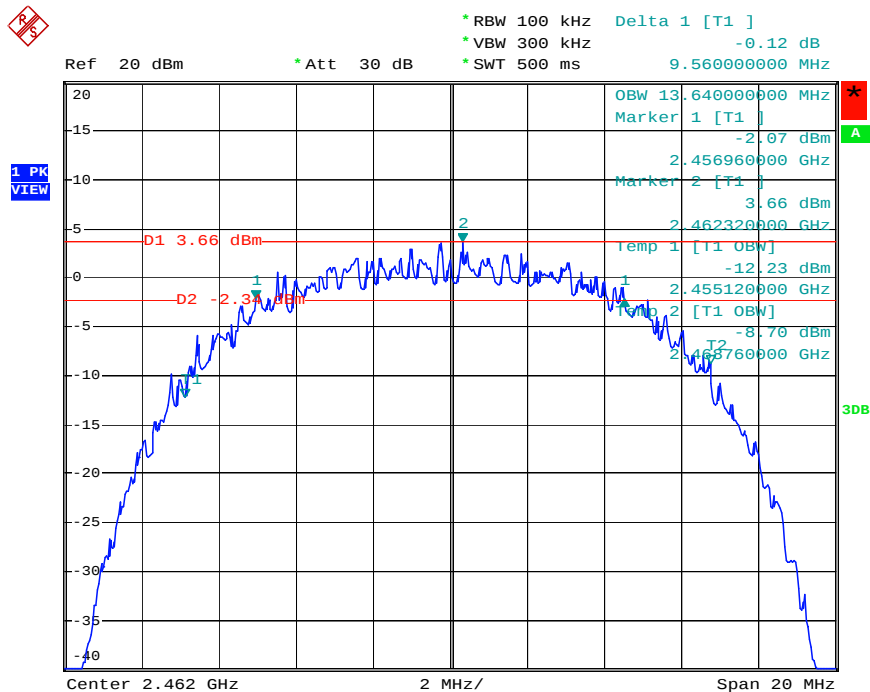
6dB Bandwidth Plot on Configuration IEEE 802.11b / 2 412 MHz



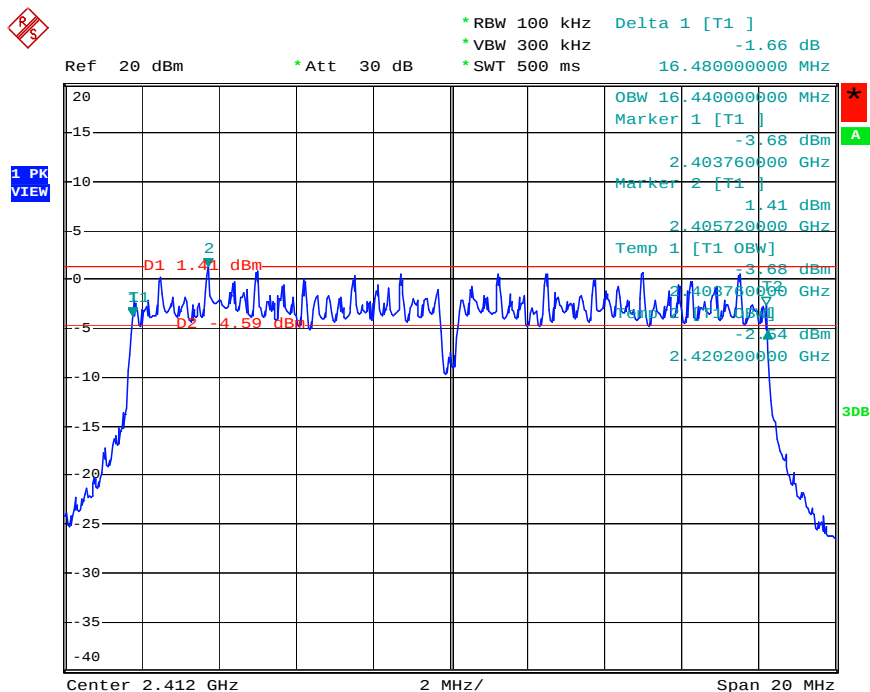
6dB Bandwidth Plot on Configuration IEEE 802.11b / 2 437 MHz



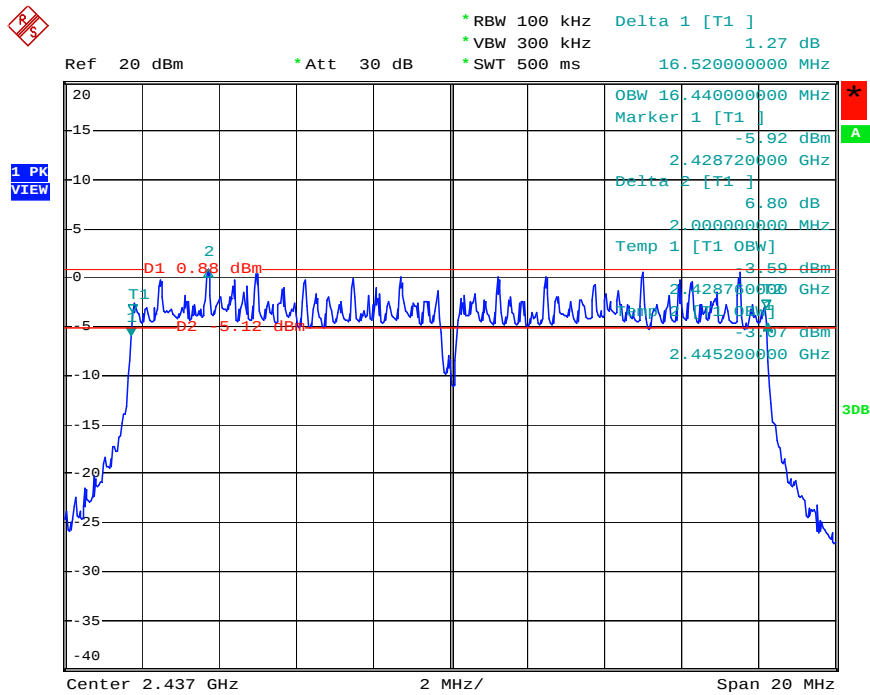
6dB Bandwidth Plot on Configuration IEEE 802.11b / 2 462 MHz



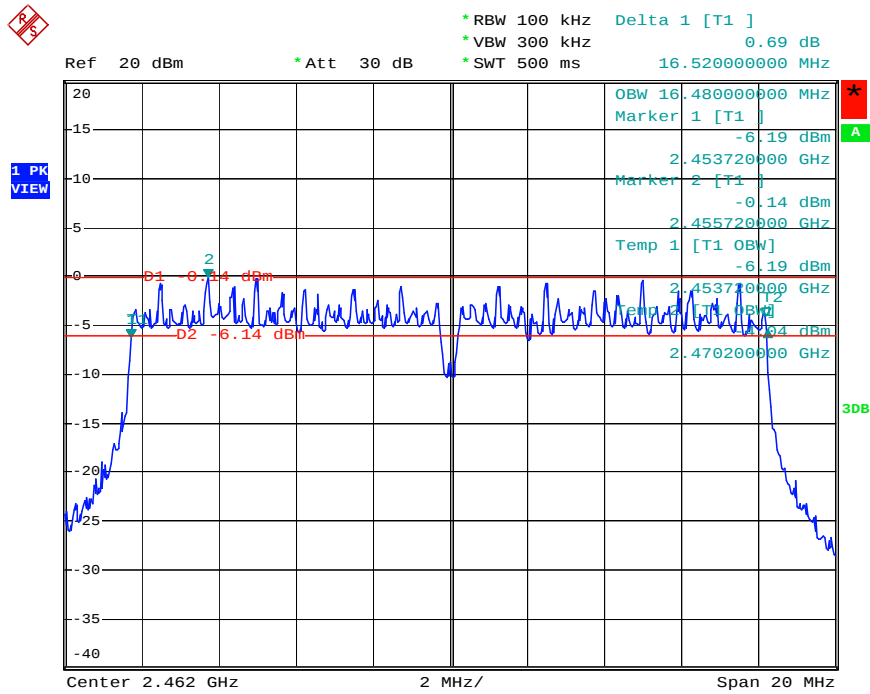
6dB Bandwidth Plot on Configuration IEEE 802.11b / 2 412 MHz



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



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



10. Radiated Emission

10.1 Operating environment

Temperature : 25 °C
Relative humidity : 26 %R.H

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 %.

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 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 : 3 m
- Spectrum resolution bandwidth(6dB) : 200 Hz / 9 kHz / 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 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	-	-	-	-	-	<<	-	-	-

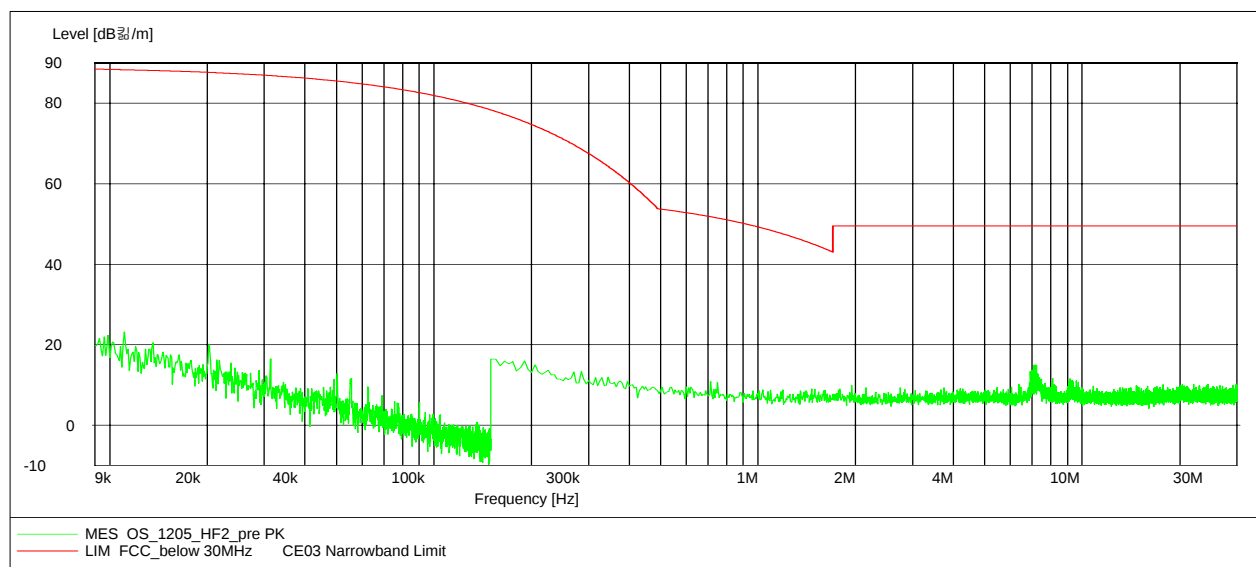
Note: “H”: Horizontal, “V”: Vertical

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);

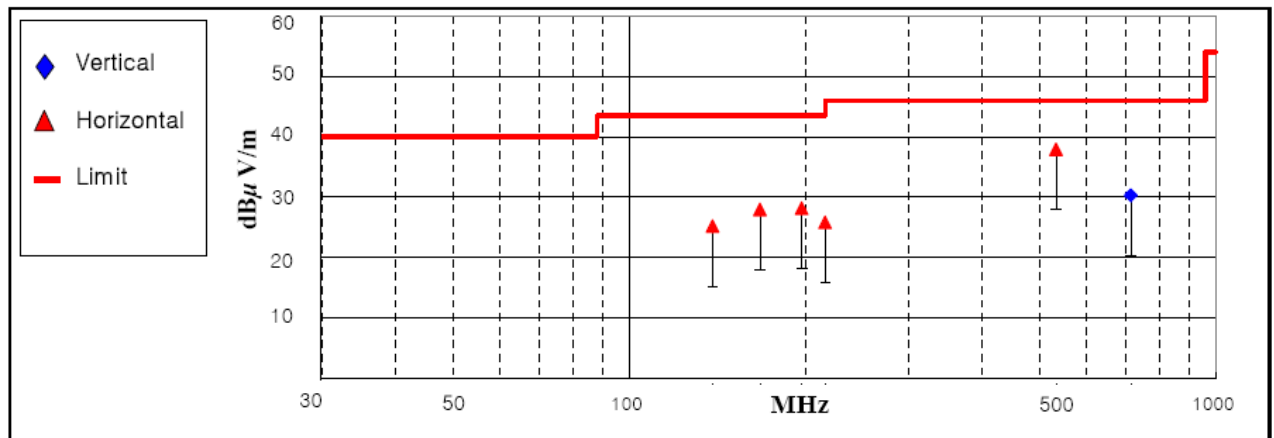
Limit line = specific limits (dB μ V) + distance extrapolation factor

*Preliminary scan data (under WIFI operating)



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

Frequency (MHz)	Measurement Level				Limit (dB μ V/m)	Margin (dB)	Positioning System		
	Reading	Antenna	Cable	Test Result			Pol.	Height	Angle
	Value(dB μ V)	Factor(dB/m)	Loss(dB)	(dB μ V/m)			(H/V)	(cm)	(°)
138.59	10.78	11.17	3.23	25.18	43.50	18.32	H	185	100
166.91	12.12	12.29	3.53	27.94	43.50	15.56	H	229	112
196.57	10.80	13.46	3.85	28.11	43.50	15.39	H	200	48
215.53	7.55	14.14	4.09	25.78	43.50	17.72	H	275	103
534.11	13.62	17.40	6.87	37.89	46.00	8.11	H	195	102
716.16	1.83	20.43	8.00	30.26	46.00	15.74	V	100	230



Note:

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

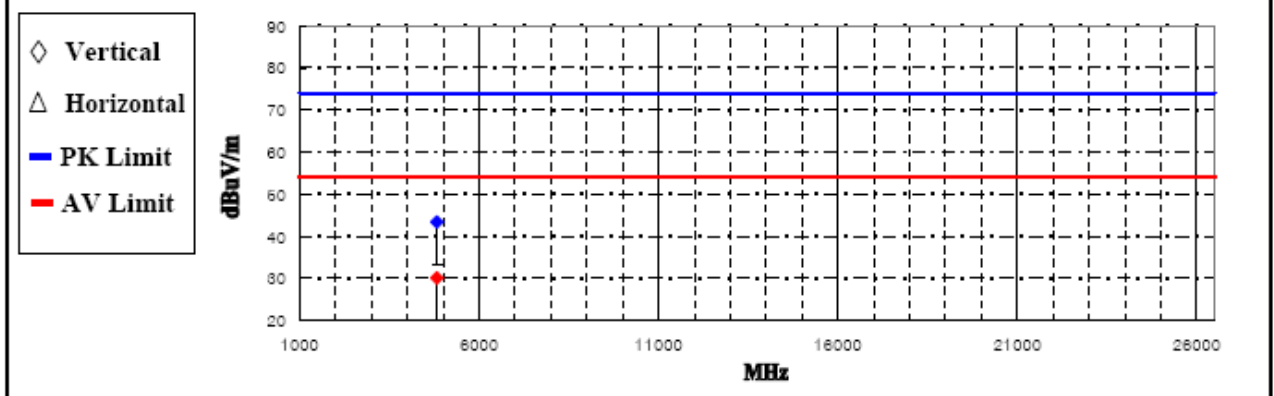
Emission level (dB μ V/m) = 20 log Emission level(μ V/m).

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

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

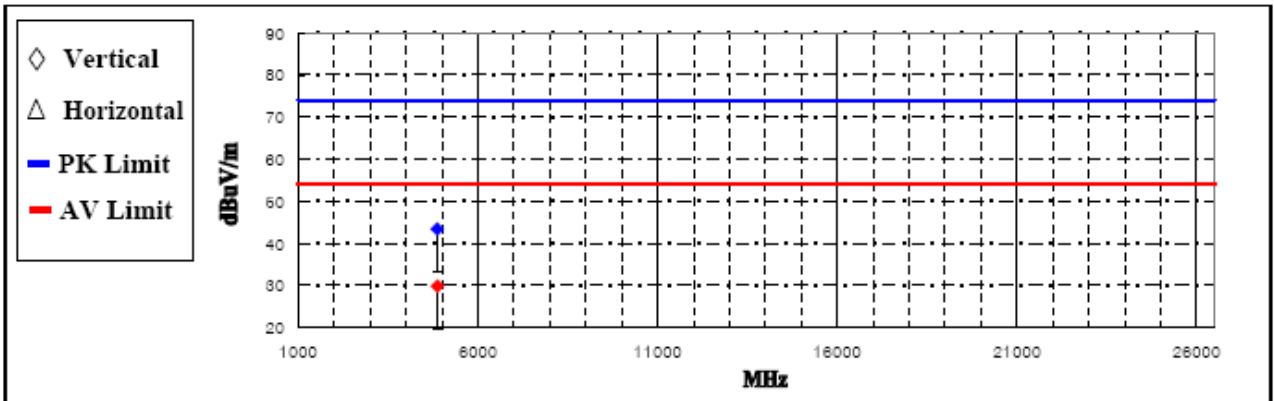
(802.11b, 1ch)

Frequency (MHz)	Measurement Level						Limit (dBuV/m)		Margin (dB)		Positioning System		
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)						Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	Peak	Average	(H/V)	(cm)	(deg)		
	4824	70.2	56.9	31.4	-58.2	43.4	30.1	74.0	54.0	30.6	23.9	V	102



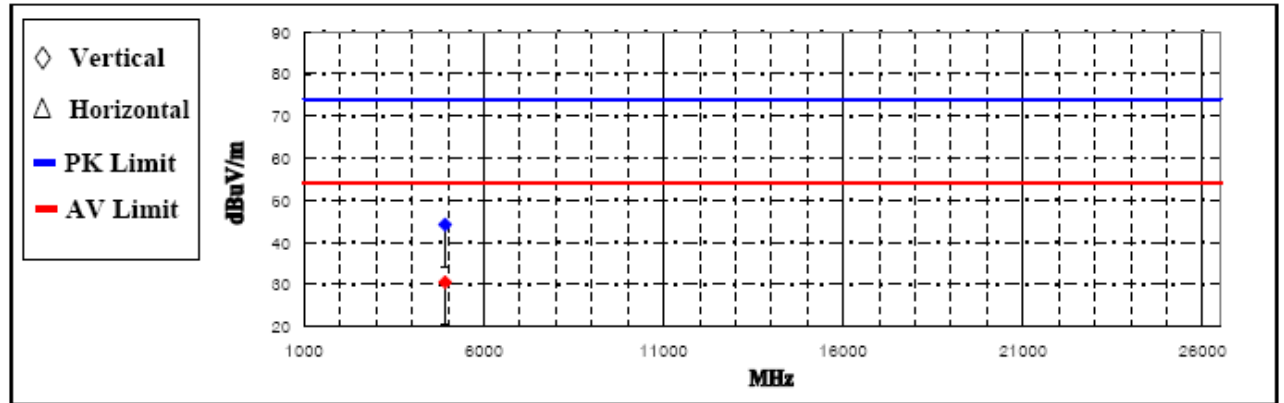
(802.11b, 6ch)

Frequency (MHz)	Measurement Level						Limit (dBuV/m)		Margin (dB)		Positioning System		
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)						Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	Peak	Average	Peak	Average	(H/V)	(cm)	(deg)
4874	70.7	57.1	31.5	-58.8	43.4	29.8	74.0	54.0	30.6	24.2	V	92	101



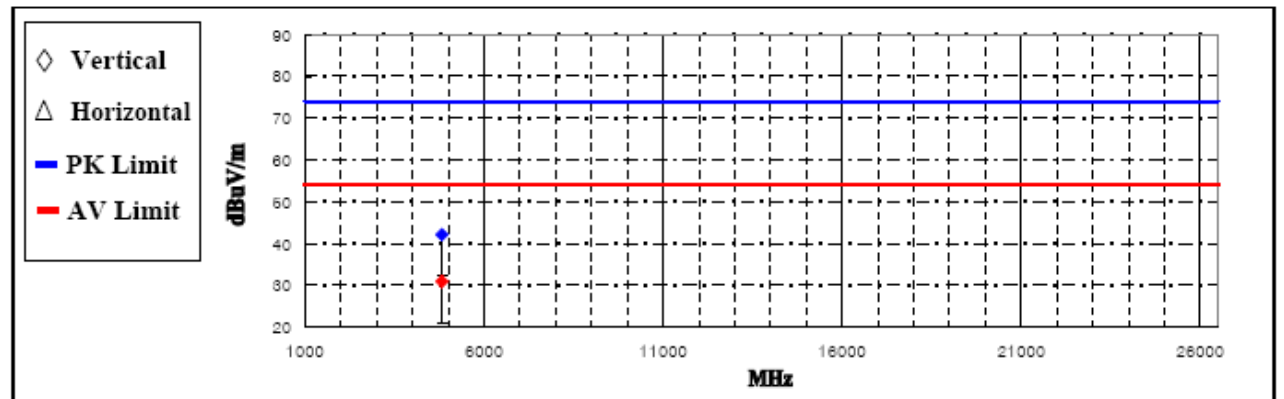
(802.11b, 11ch)

Frequency (MHz)	Measurement Level						Limit (dBuV/m)		Margin (dB)		Positioning System		
	Reading Value (dBuV/m)		AF (dB/m)	AMP / CL (dB)	Test Result (dBuV/m)						Pol. (H/V)	Height (cm)	Angle (deg)
	Peak	Average			Peak	Average	Peak	Average	Peak	Average			
	4924	72.0	58.3	31.6	-59.4	44.2	30.5	74.0	54.0	29.8	23.5	V	100



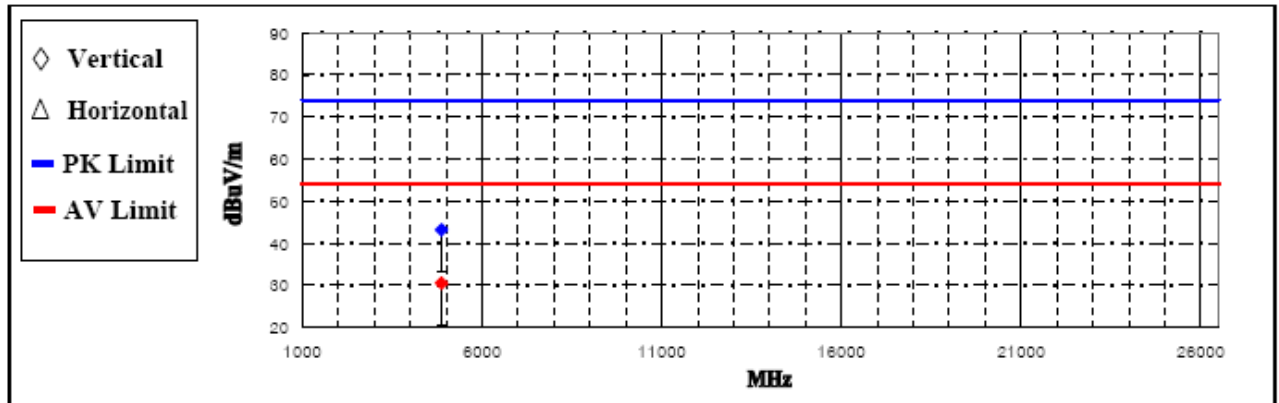
(802.11g, 1ch)

Frequency (MHz)	Measurement Level						Limit (dBuV/m)		Margin (dB)		Positioning System		
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)						Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average	(H/V)	(cm)	(deg)				
	4824	68.9	57.7	31.4	-58.2	42.1	30.9	74.0	54.0	31.9	23.1	V	105



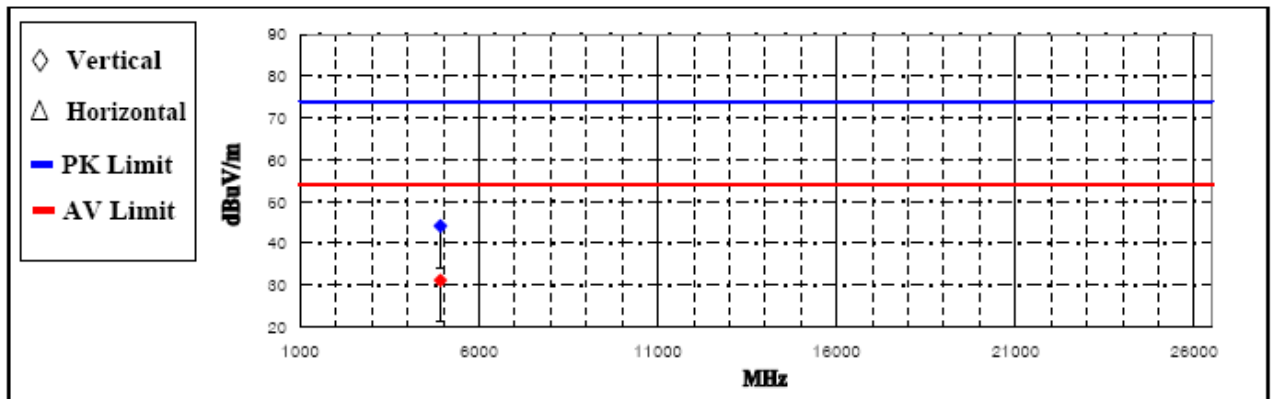
(802.11g, 6ch)

Frequency (MHz)	Measurement Level						Limit (dBuV/m)		Margin (dB)		Positioning System		
	Reading Value (dBuV/m)		AF	AMP / CL	Test Result (dBuV/m)						Pol.	Height	Angle
	Peak	Average			(dB/m)	(dB)	Peak	Average	(H/V)	(cm)			
			Peak	Average							Peak	Average	Peak
4874	70.5	57.8	31.5	-58.8	43.2	30.5	74.0	54.0	30.8	23.5	V	105	96



(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	(H/V)	(cm)	(deg)				
	4924	72.0	59.0	31.6	-59.4	44.2	31.2	74.0	54.0	29.8	22.8	V	110



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 : 24 °C
Relative humidity : 28 %R.H

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 3 m 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 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 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 : December 8, 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 : 3 m
- Power Source : AC 120 V/ 60 Hz, DC 3.7 V 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	111.6	97.4	27.5	-38.0	101.1	86.9	-	-	-	-	-	-	
2390.0	68.6	53.3	27.4	-38.0	58.1	42.8	74.0	54.0	15.9	11.2	-	-	

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	Peak	Average	(H/V)	(cm)	(deg)
2462.0	110.6	96.4	27.7	-37.7	100.6	86.4	-	-	-	-	-	-	-
2483.5	69.1	54.4	27.7	-37.7	59.1	44.4	74.0	54.0	14.9	9.6	-	-	-

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	Peak	Average	(H/V)	(cm)	(deg)
2412.0	109.0	78.0	27.5	-38.0	98.5	67.5	-	-	-	-	-	-	-
2390.0	82.3	51.6	27.4	-38.0	71.8	41.1	74.0	54.0	2.2	12.9	-	-	-

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	107.5	76.8	27.7	-37.7	97.5	66.8	-	-	-	-	-	-	-
2483.5	81.5	48.8	27.7	-37.7	71.5	38.8	74.0	54.0	2.5	15.2	-	-	-

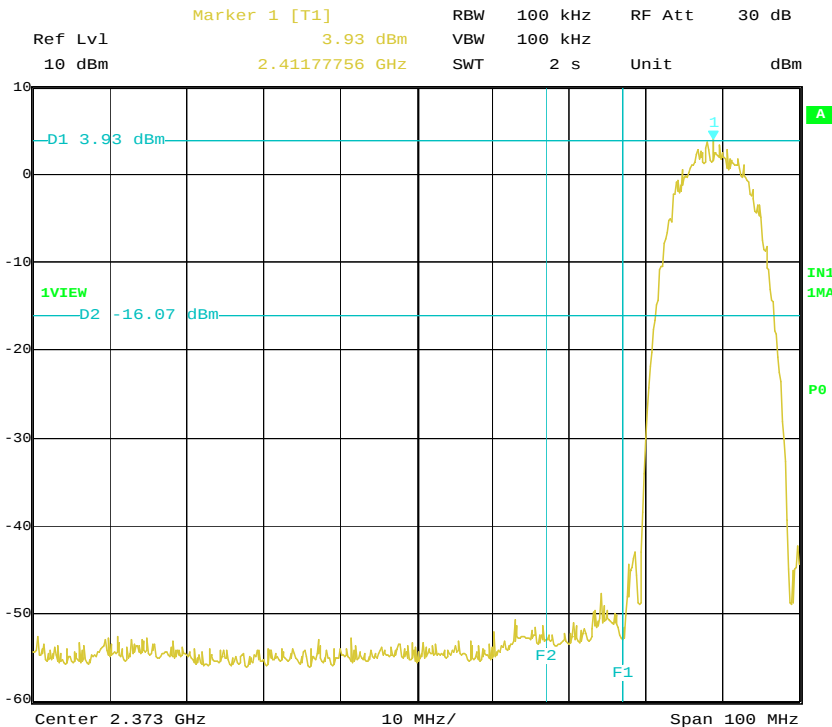
Note:

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

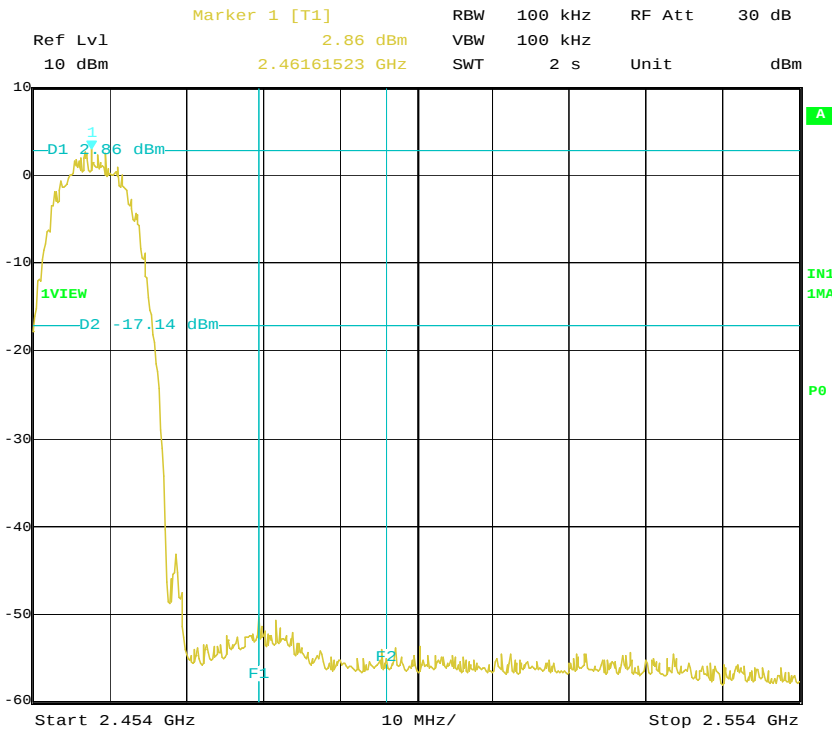
Emission level (dBuV/m) = 20 log Emission level(uV/m).

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

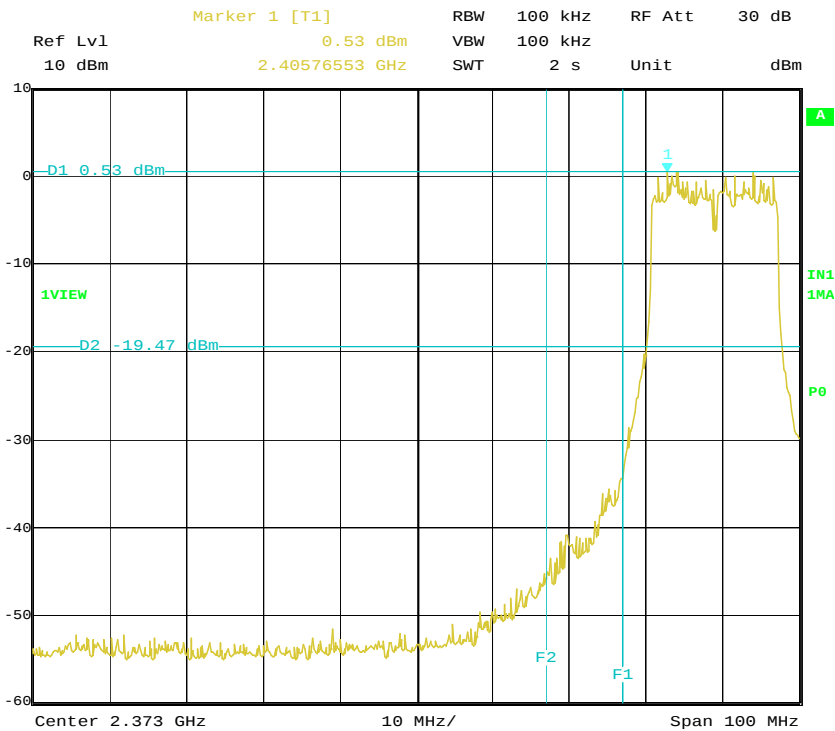
For Emission not in Restricted Band
Low Band Edge Plot on Configuration IEEE 802.11b / 2 412 MHz



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



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



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

