

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 : April 21, 2009

Order Number: GETEC-C1-09-087

Test Report S/N : GETEC-E3-09-040

Test Site : Gumi College EMC Center

FCC Registration Number: (100749, 443957)

FCC ID

OZ5URCMX880Z

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
(ZIGBEE built in RF remote controller)

Model Name : MX-880Z

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



CONTENTS

1. GENERAL INFORMATION	4
2. INTRODUCTION	5
3. PRODUCT INFORMATION	6
3.1 DESCRIPTION OF EUT.....	6
3.2 SUPPORT EQUIPMENT / CABLES USED	7
3.3 MODIFICATION ITEM(S).....	7
4. ANTENNA REQUIREMENT - §15.203	7
4.1 DESCRIPTION OF ANTENNA.....	7
5. DESCRIPTION OF TESTS.....	8
5.1 TEST CONDITION.....	8
5.2 CONDUCTED EMISSION	9
5.3 RADIATED EMISSION.....	10
6. CONDUCTED EMISSION.....	11
6.1 OPERATING ENVIRONMENT	11
6.2 TEST SET-UP.....	11
6.3 MEASUREMENT UNCERTAINTY	11
6.4 LIMIT	12
6.5 TEST EQUIPMENT USED	12
6.6 TEST DATA FOR POWER LINE CONDUCTED EMISSION.....	13
7. MAXIMUM PEAK OUTPUT POWER MEASUREMENT	15
7.1 OPERATING ENVIRONMENT	15
7.2 TEST SET-UP (LAYOUT).....	15
7.3 LIMIT	15
7.4 TEST EQUIPMENT USED	15
7.5 TEST RESULT OF MAXIMUM PEAK OUTPUT POWER.....	15
8. POWER SPECTRAL DENSITY MEASUREMENT	17
8.1 OPERATING ENVIRONMENT	17
8.2 TEST SET-UP (LAYOUT).....	17
8.3 LIMIT	17
8.4 TEST EQUIPMENT USED	17
8.5 TEST RESULT OF MAXIMUM PEAK OUTPUT POWER.....	17
9. 6DB SPECTRUM BANDWIDTH MEASUREMENT	21
9.1 OPERATING ENVIRONMENT	21
9.2 TEST SET-UP (LAYOUT).....	21
9.3 LIMIT	21
9.4 TEST EQUIPMENT USED	21
9.5 TEST RESULT OF MAXIMUM PEAK OUTPUT POWER.....	21
10. RADIATED EMISSION	25



10.1 OPERATING ENVIRONMENT	25
10.2 TEST SET-UP.....	25
10.3 MEASUREMENT UNCERTAINTY	25
10.4 LIMIT	26
10.5 TEST EQUIPMENT USED	26
10.6 RADIATED EMISSION TEST DATA	27
11. BAND EDGE RADIATED EMISSION	30
11.1 OPERATING ENVIRONMENT.....	30
11.2 TEST SET-UP.....	30
11.3 LIMIT	30
11.4 TEST EQUIPMENT USED	30
11.5 BAND EDGE RADIATED EMISSION TEST DATA.....	31
APPENDIX A - ATTESTATION STATEMENT	
APPENDIX B - ID LABEL	
APPENDIX C - BLOCK DIAGRAM	
APPENDIX D - SCHEMATIC DIAGRAM	
APPENDIX E - TEST SETUP PHOTOGRAPH	
APPENDIX F - EXTERNAL PHOTOGRAPH	
APPENDIX G - INTERNAL PHOTOGRAPH	
APPENDIX H - USER'S MANUAL	
APPENDIX I - OPERATIONAL DESCRIPTION	
APPENDIX J - ANTENNA SPECIFICATION	



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.** OZ5URCMX880Z
- **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
(ZIGBEE built in RF remote controller)
- **Power Source** AC 120 V/ 60 Hz, DC 3.7 V Li-ion Rechargeable Battery
- **Model Name** MX-880Z
- **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** April 13 ~ 20, 2009
- **Place of Test** **Gumi College EMC Center** (FCC Registration No.: 100749, 443957)
407, Bugok-Dong, Gumi-si, Gyeongsangbuk-Do, Korea
- **Test Report Number** GETEC-E3-09-040
- **Dates of Issue** April 21, 2009

EUT Type: RF Remote Controller

FCC ID.: OZ5URCMX880Z



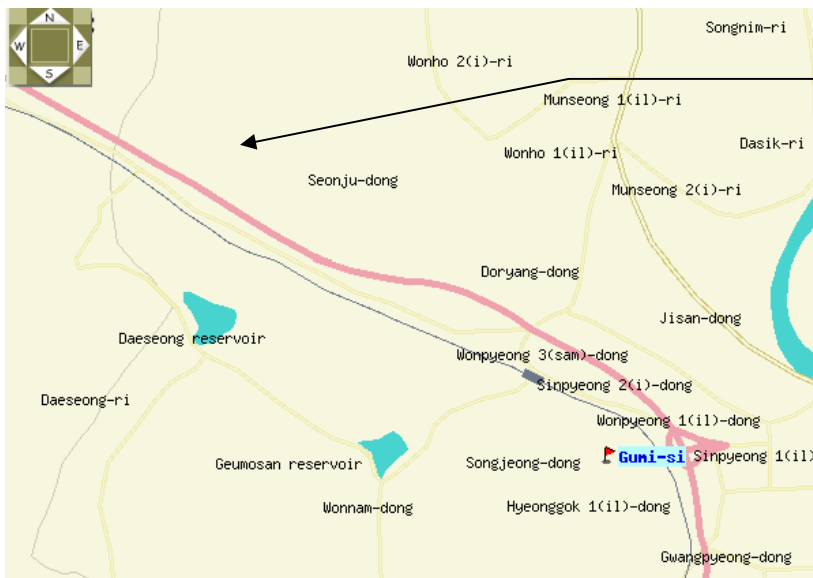
2. Introduction

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-880Z)**

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 FCC §2.948 according to ANSI C63.4 (2003)



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

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



3. Product Information

3.1 Description of EUT

The Equipment under Test (EUT) is the **OHSUNG ELECTRONICS CO., LTD. ZIGBEE built in RF Remote Controller (Model Name: MX-880Z) FCC ID.: OZ5URCMX880Z**

Used AC/DC Adapter : TESA5G1-050010d2-1 (UNIVERSAL remote control)
 Input: AC (100-240) V, (50/60) Hz, 0.2 A
 Output: DC 5.0 V, 1.0 A

Specifications

Memory - 32 Megabits of Flash Memory Total (28 Megabits for User Configuration)

Customization Capability - Up to 48 devices and up to 8 pages each for a total of 384 pages.

Learning Capability - Standard frequencies (15kHz to 460kHz)

Macro Capability - Up to 255 steps each

IR Range (Line of Sight via Infrared): 30-50 feet, depending on the environment

RF Range (radio frequency): 50 to 100 feet, depending upon the environment

RF Frequency: 2.4GHz

Weight: 6.9 ounces (with battery loaded)

Size: 8" H x 2.25" W x 1.25" D

Battery: Lithium Ion rechargeable battery included

Frequency Band	Channel Number	Frequency	Channel Number	Frequency
2 400 ~ 2 483.5 MHz	11	2 405 MHz	19	2 445 MHz
	12	2 410 MHz	20	2 450 MHz
	13	2 415 MHz	21	2 455 MHz
	14	2 420 MHz	22	2 460 MHz
	15	2 425 MHz	23	2 465 MHz
	16	2 430 MHz	24	2 470 MHz
	17	2 435 MHz	25	2 475 MHz
	18	2 440 MHz	26	2 480 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	1.95 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 Li-ion Rechargeable Battery

- Test Mode(s)
 - . Executed “ESD (Embedded system development tools made by OHSUNG ELECTRONICS CO., LTD)” to control the EUT continuously transmit RF signal

Test Software Version	ESD tool		
Frequency	2 405 MHz	2 440MHz	2 480 MHz
IEEE 802.15.4	0x00	0x00	0x00



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

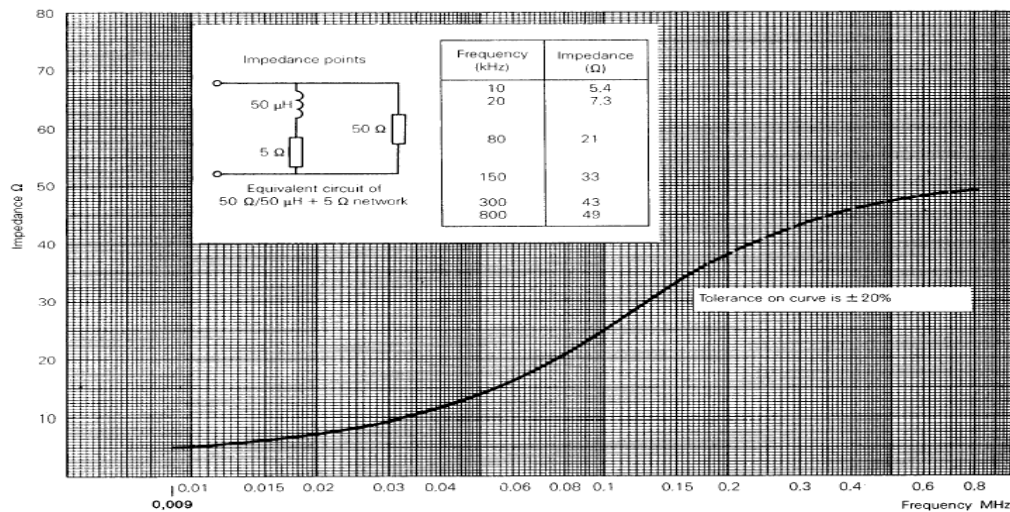


Fig 2. Impedance of LISN



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

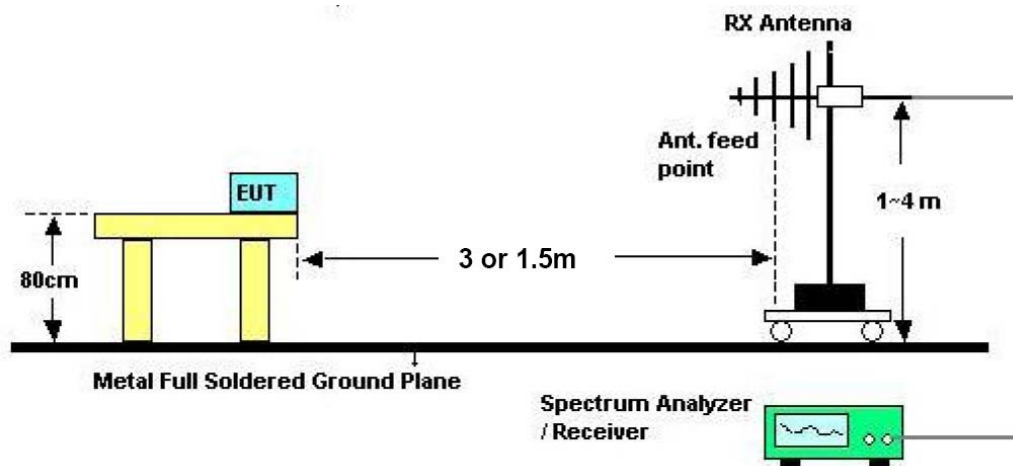


Fig 3. Dimensions of test site.



6. Conducted Emission

6.1 Operating environment

Temperature : 23 °C
Relative humidity : 37 % 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 Number	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

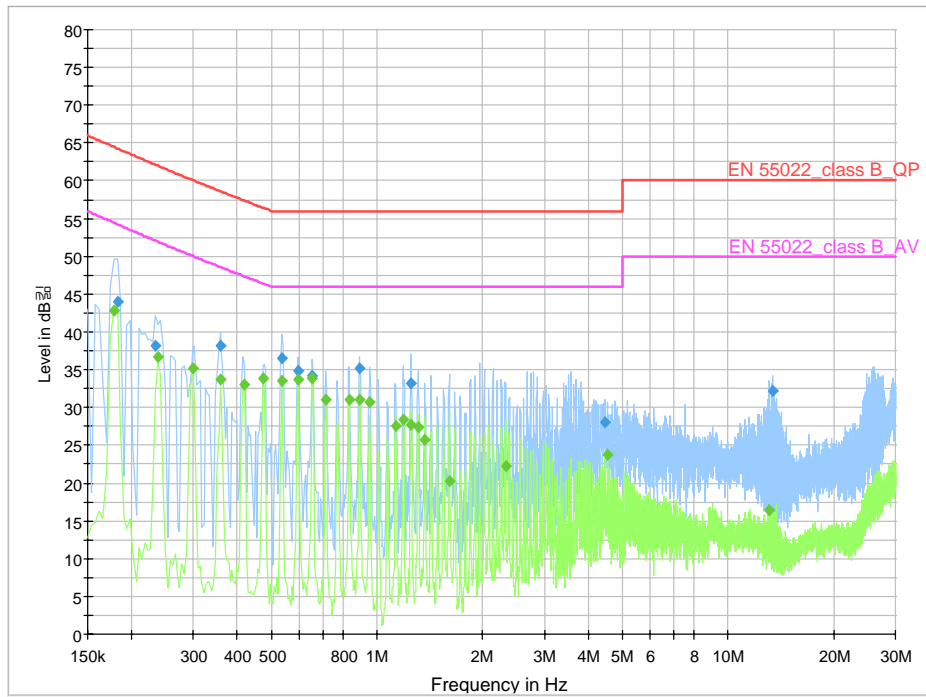


6.6 Test data for power line conducted emission

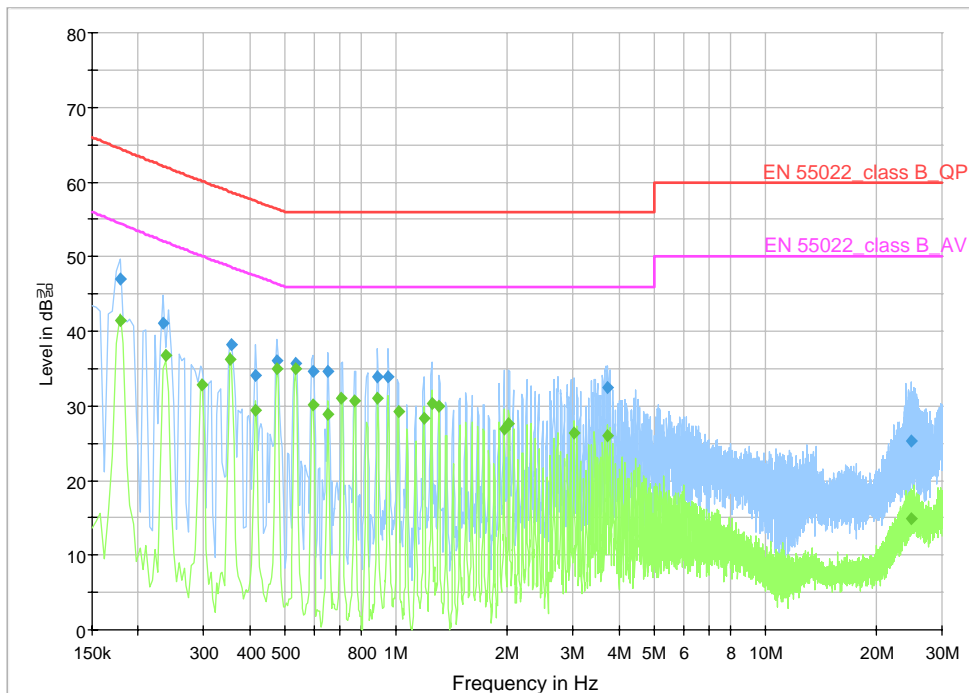
- Test Date : April 13, 2009
- Reference standard : Part 15 Subpart C, Sec. 15.207
- Channel : 802.15.4, 11ch
- Operating condition : Zigbee RF transmitting mode
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz

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
0.178	0.12	9.81	N	64.57	37.07	47.00	54.57	31.47	41.40	17.57	13.17
0.234	0.13	9.79	N	62.30	31.08	41.00	52.30	26.88	36.80	21.30	15.50
0.358	0.15	9.86	N	58.77	28.29	38.30	48.77	26.29	36.30	20.47	12.47
0.538	0.15	9.80	L1	56.00	26.45	36.40	46.00	25.05	35.00	19.60	11.00
0.594	0.15	9.77	L1	56.00	24.88	34.80	46.00	23.68	33.60	21.20	12.40
0.654	0.15	9.77	N	56.00	24.78	34.70	46.00	18.98	28.90	21.30	17.10
0.890	0.15	9.77	L1	56.00	25.28	35.20	46.00	21.08	31.00	20.80	15.00
3.734	0.24	9.86	N	56.00	22.30	32.40	46.00	15.90	26.00	23.60	20.00
13.430	0.53	10.09	L1	60.00	21.58	32.20	50.00	5.78	16.40	27.80	33.60

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



(Phase: Line)



(Phase: Neutral)

EUT Type: RF Remote Controller

FCC ID.: OZ5URCMX880Z

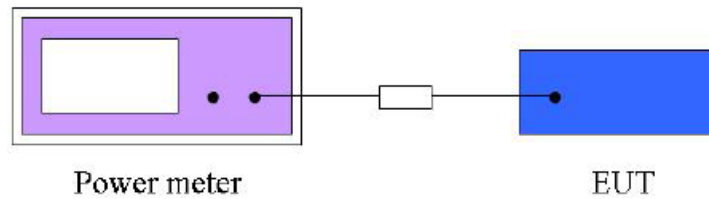


7. Maximum Peak Output Power Measurement

7.1 Operating environment

Temperature : 26 °C
Relative humidity : 34 %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. 2009
■ -	NRV-Z32	Rohde & Schwarz	Power sensor	100062	12.14. 2009

7.5 Test result of Maximum Peak Output Power

- Test Date : April 18, 2009
- Reference standard : Part 15 Subpart C, Sec. 15.247(b)(3)
- Channel : 802.15.4 (11ch / 18ch / 26ch)
- Operating condition : Zigbee 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 802.15.4

Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
11	2 405 MHz	-0.63	30.00	Complies
18	2 440 MHz	0.10	30.00	Complies
26	2 480 MHz	1.08	30.00	Complies

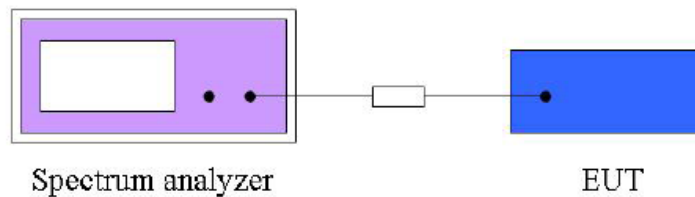


8. Power Spectral Density Measurement

8.1 Operating environment

Temperature : 26 °C
Relative humidity : 34 %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 : April 18, 2009
- Reference standard : Part 15 Subpart C, Sec. 15.247(e)
- Channel : 802.15.4 (11ch / 18ch / 26ch)
- Operating condition : Zigbee 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

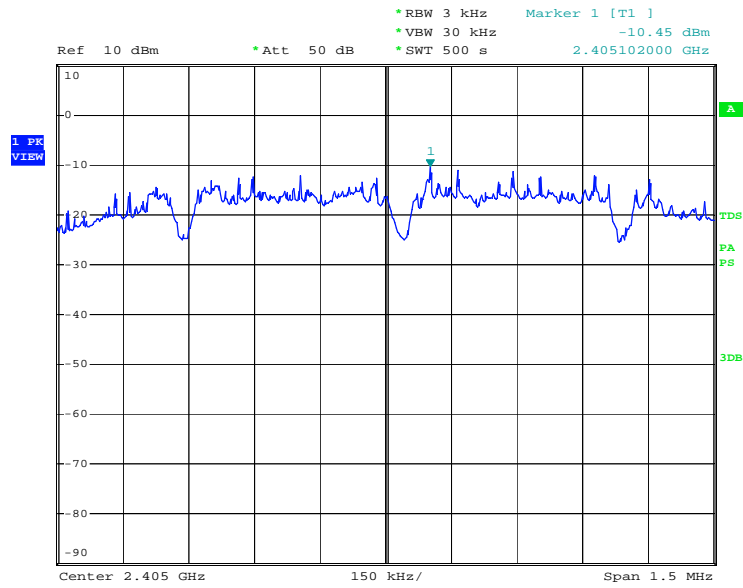


Configuration IEEE 802.15.4

Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
11	2 405 MHz	-10.45	8.00	Complies
18	2 440 MHz	-9.49	8.00	Complies
26	2 480 MHz	-8.51	8.00	Complies



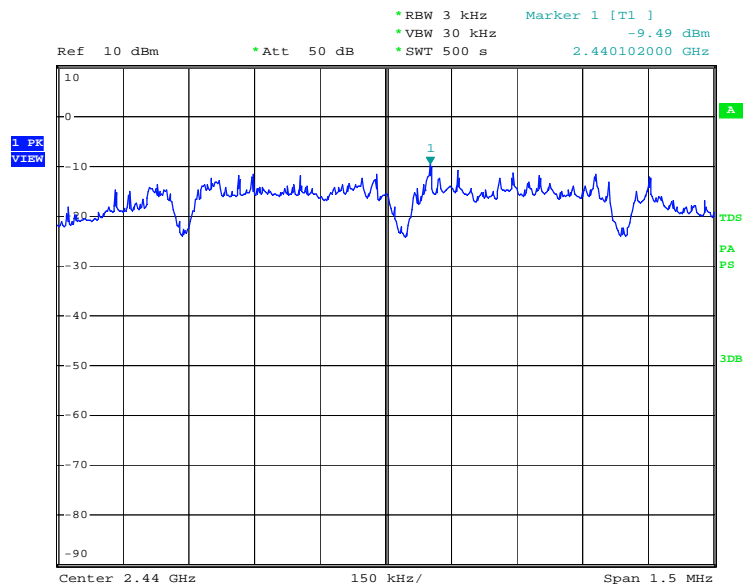
Power Density Plot on configuration IEEE 802.15.4 / 2 405 MHz



MX-880Z

Date: 18.APR.2009 15:17:32

Power Density plot on Configuration IEEE 802.15.4 / 2 440 MHz

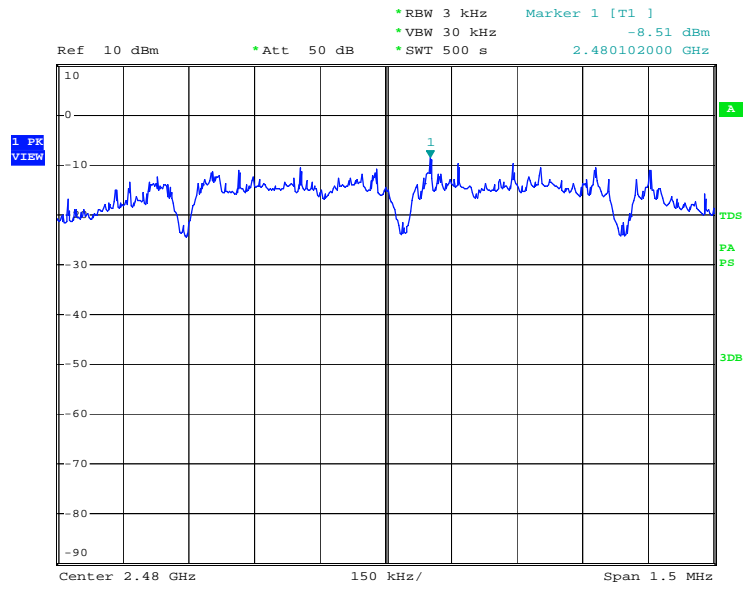


MX-880Z

Date: 18.APR.2009 15:41:36



Power Density Plot on Configuration IEEE 802.15.4 / 2 480 MHz



MX-880Z

Date: 18.APR.2009 16:13:52

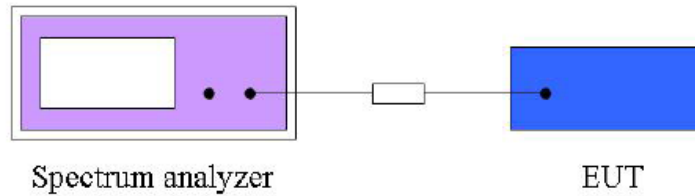


9. 6dB Spectrum bandwidth Measurement

9.1 Operating environment

Temperature : 26 °C
 Relative humidity : 34 %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. 2009

9.5 Test result of Maximum Peak Output Power

- Test Date : April 18, 2009
 - Reference standard : Part 15 Subpart C, Sec. 15.247(a)(2)
 - Channel : 802.15.4 (11ch / 18ch / 26ch)
 - Operating condition : Zigbee 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

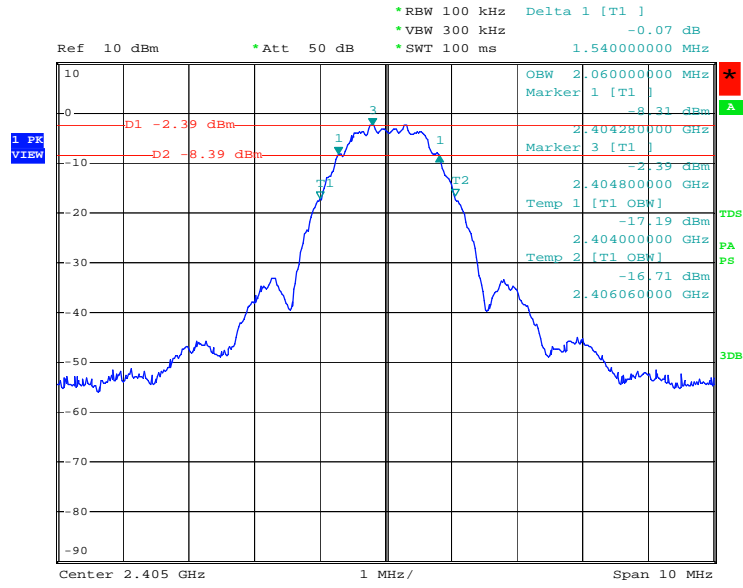


Configuration IEEE 802.15.4

Channel	Frequency	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	Min. Limit (kHz)	Result
11	2 405 MHz	1.54	2.06	500	Complies
18	2 440 MHz	1.52	2.06	500	Complies
26	2 480 MHz	1.54	2.06	500	Complies



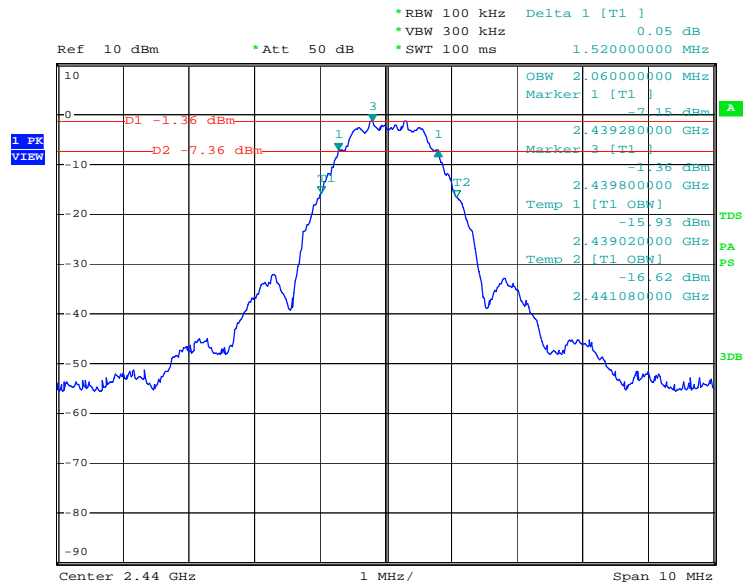
6dB Bandwidth Plot on Configuration IEEE 802.15.4 / 2 405 MHz



MX-880Z

Date: 18.APR.2009 14:48:13

6dB Bandwidth Plot on Configuration IEEE 802.15.4 / 2 440 MHz

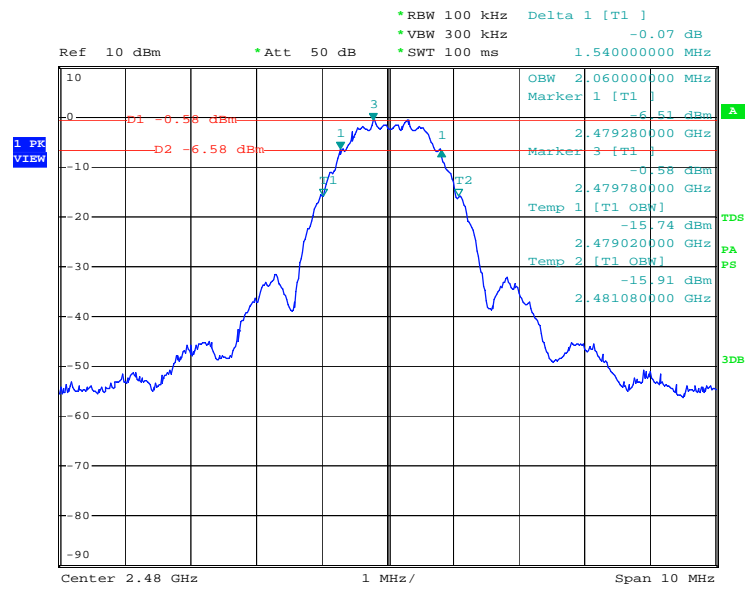


MX-880Z

Date: 18.APR.2009 14:46:17



6dB Bandwidth Plot on Configuration IEEE 802.15.4 / 2 480 MHz



MX-880Z
Date: 18.APR.2009 14:43:25



10. Radiated Emission

10.1 Operating environment

Temperature : 23 °C
Relative humidity : 35 %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 Number	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
■ - 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	12.20. 2010
■ - 3160	EMCO	Horn antenna	6741	12.26. 2009
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258943	N/A
■ - 8449B	Agient	Amplifier	3008A01828	N/A

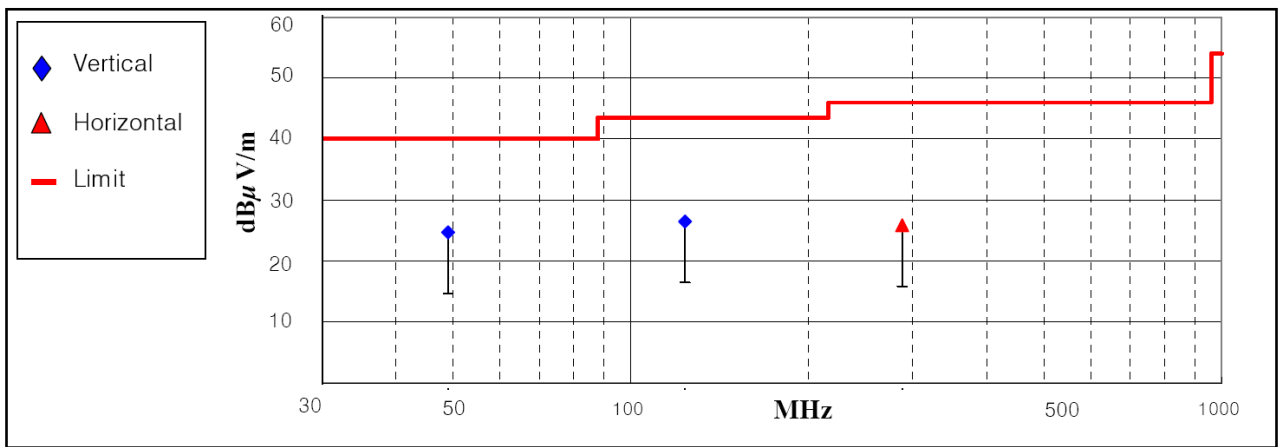


10.6 Radiated emission test data

- Test Date : April 13, 2009
- Reference standard : Part 15 Subpart C, Sec. 15.247(d)
- Channel : 802.15.4 (11ch / 18ch / 26ch)
- Operating condition : Zigbee 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 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 (30 MHz to 1 000 MHz)

Frequency (MHz)	Measurement Level				Limit (dBμ V/m)	Margin (dBμ V/m)	Positioning System		
	Reading	Antenna	Cable	Test Result			Pol. (H/V)	Height (cm)	Angle (°)
	Value(dBμ V)	Factor(dB)	Loss(dB)	(dBμ V/m)					
49.08	13.54	9.16	1.98	24.68	40.00	15.32	V	115	187
123.48	12.70	10.81	2.96	26.47	43.50	17.03	V	130	254
288.00	3.28	17.61	4.96	25.85	46.00	20.15	H	120	227



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).

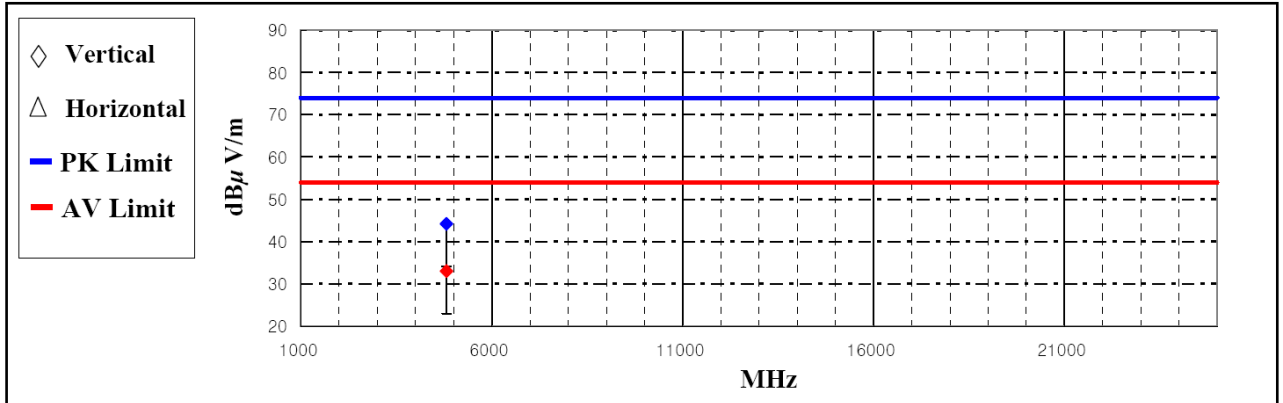
Corrected Reading: Antenna Factor + Cable Loss + Read value = Test result



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

(802.15.4, 11ch)

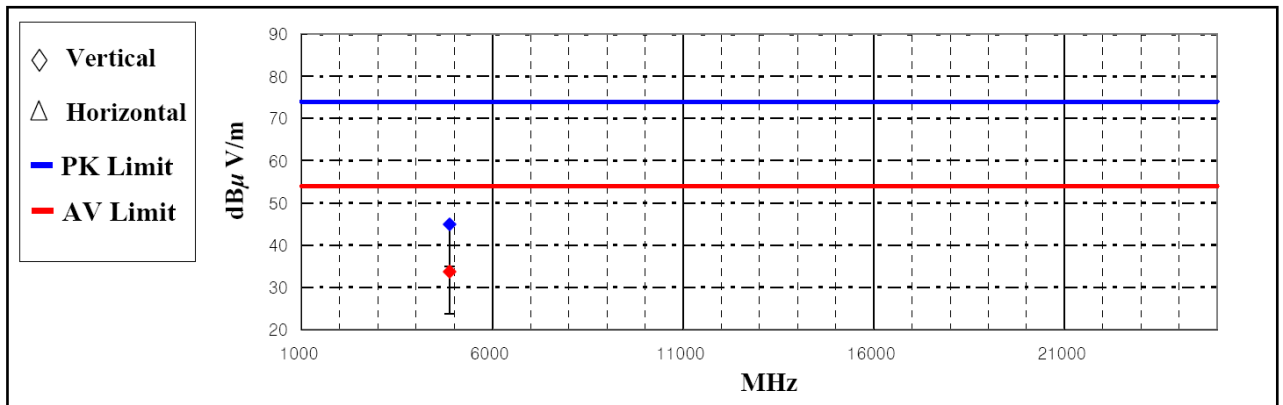
Frequency (MHz)	Measurement Level						Limit (dBμ V/m)		Margin (dB)		Positioning System		
	Reading Value (dBμ V/m)		AF (dB/m)	AMP / CL (dB)	Test Result (dBμ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average							
4810.00	46.64	35.44	31.36	-33.80	44.20	33.00	74.00	54.00	29.80	21.00	V	102	180



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

(802.15.4, 18ch)

Frequency (MHz)	Measurement Level						Limit (dBμ V/m)		Margin (dB)		Positioning System		
	Reading Value (dBμ V/m)		AF (dB/m)	AMP / CL (dB)	Test Result (dBμ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average			Peak	Average							
4880.00	47.59	36.31	31.52	-34.15	44.96	33.68	74.00	54.00	29.04	20.32	V	102	180

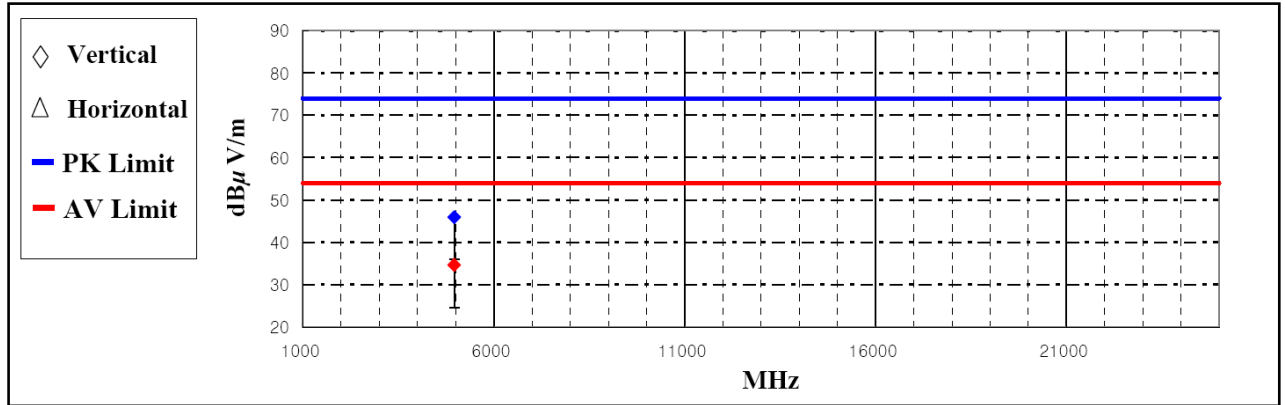


*Comment : AMP/CL_Cable loss value + AMP gain value
 AF : Antenna factor value
 Pol. : H(Horizontal), V(Vertical)



(802.15.4, 26ch)

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							
4960.00	48.45	37.17	31.70	-34.21	45.94	34.66	74.00	54.00	28.06	19.34	V	102	180



*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 (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 : 23°C
 Relative humidity : 35 %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 Number	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
■ - 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 : April 13, 2009
- Reference standard : Part 15 Subpart C, Sec. 15.247(d)
- Channel : 802.15.4 (11ch / 26ch)
- Operating condition : Zigbee 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

802.15.4, 11ch

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.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average					(H/V)	(cm)	(°)
2405.00	97.50	95.00	27.49	-38.29	86.70	84.20	74.00	54.00	-	-	-	-	-
2390.00	44.18	35.48	27.44	-38.32	33.30	24.60	74.00	54.00	40.70	29.40	-	-	-

802.15.4, 26ch

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.	Height	Angle
	Peak	Average	(dB/m)	(dB)	Peak	Average					(H/V)	(cm)	(°)
2480.00	98.59	94.25	27.72	-37.90	88.41	84.07	74.00	54.00	-	-	-	-	-
2483.50	58.45	54.95	27.73	-37.88	48.30	44.80	74.00	54.00	25.70	9.20	-	-	-

Note:

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

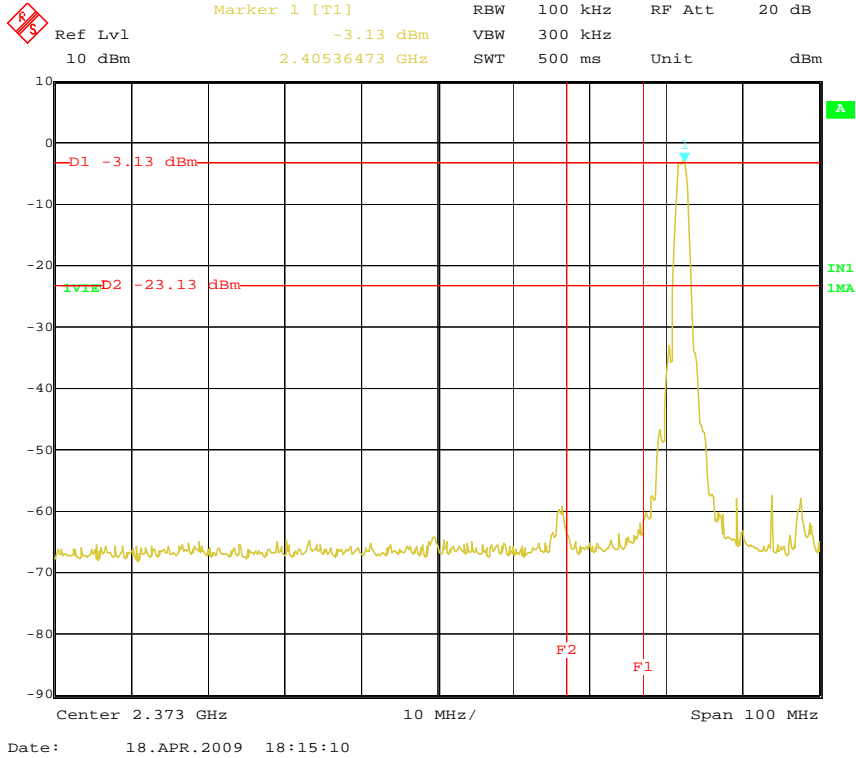
Emission level (dBμV/m) = 20 log Emission level (μV/m).

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



For Emission not in Restricted Band

Low Band Edge Plot on Configuration IEEE 802.15.4 / 2 405 MHz



High Band Edge Plot on Configuration IEEE 802.15.4 / 2 480 MHz

