

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

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

**Date of Issue : December 8, 2010**

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

**Order Number: GETEC-C1-10-181**

**Republic of Korea**

**Test Report Number: GETEC-E3-10-093**

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

**Test Site: Gumi College EMC Center**

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

**FCC ID. : OZ5URCMRX10**

**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 : Network Base Station**  
**Type of Authority : Certification**  
**Model Name : MRX-10**  
**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 Jeong, Engineer**  
**GUMI College EMC center**



**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**

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

- **FCC ID.** OZ5URCMRX10
- **Equipment Class** Digital Transmission System (DTS)
- **EUT Type** Network Base Station  
(ZIGBEE built in Network Base Station)
- **Model Name** MRX-10
- **Rule Part(s)** FCC Part 15, Subpart C-Intentional Radiator § 15.247
- **Test Method** Public Notice FCC97-114  
(Guidance on measurement for direct sequence spread spectrum systems)
- **Type of Authority** Certification
- **Test Procedure(s)** ANSI C63.4 (2003)
- **Dates of Test** November 20 ~ December 6, 2010
- **Place of Test** **Gumi College EMC Center** ( FCC Registration No.: 100749, 443957)  
407, Bugok-Dong, Gumi-si, Gyeongsangbuk-Do, Korea
- **Test Report Number** GETEC-E3-10-093
- **Dates of Issue** December 8, 2010

**EUT Type: Network Base Station**

**FCC ID.: OZ5URCMRX10**



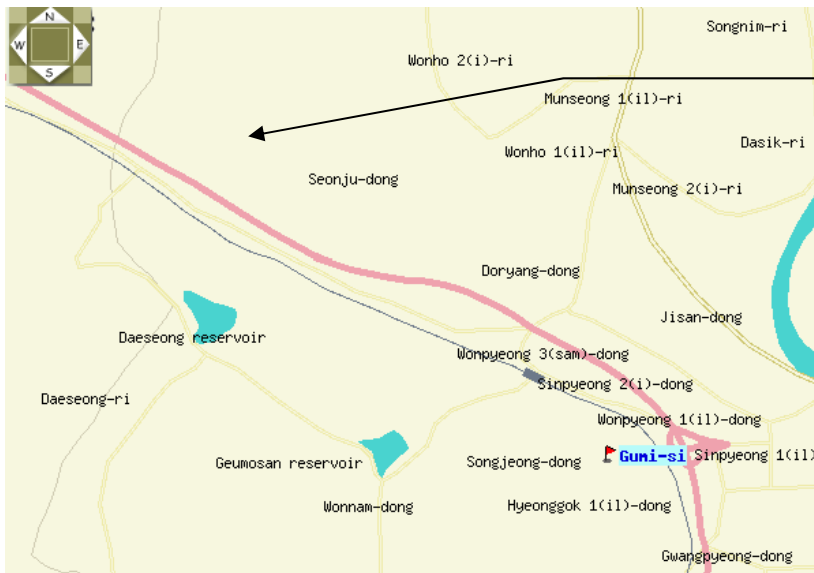
## 2. Introduction

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. Network Base Station (Model name: MRX-10)**

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 Daeje 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. Network Base Station**  
**(Model Name: MRX-10) FCC ID.: OZ5URCMRX10**

- **I/O Port** : DC 12 V, 2 A: Two (Programmable)  
 IR: Eight adjustable output  
 USB: One (for future use)  
 Ethernet: One 10/100 RJ45 port (Indicator 2 LED)  
 RS-232: Four, supporting TX, RX and GND  
 Sensor: Four, supporting video or voltage sensing (requires URC sensors)  
 Relays: NO, NC or COM
- **RF** : Frequency: 2.4 GHz (for MS-780)  
 Range: 50 to 100 feet, depending upon the environment
- **Power supply** : DC 12 V, 3.5 A External power supply
- **Size** : 1.7 inch(H) × 1.7 inch(W) × 1.7 inch(D)
- **Weight** : 2.05 kg

#### - Frequency List

Frequency Band [MHz]	Channel	Frequency [MHz]	Channel	Frequency [MHz]
2 400.0 – 2483.5	11	2 405	19	2 445
	12	2 410	20	2 450
	13	2 415	21	2 455
	14	2 420	22	2 460
	15	2 425	23	2 465
	16	2 430	24	2 470
	17	2 435	25	2 475
	18	2 440	26	2 480



### 3.2 Support Equipment / Cables used

#### 3.2.1 Used Support Equipment

Description	Manufacturer	Model Name	S/N & FCC ID.
Notebook PC	COMPAQ	N620c	S/N: CNU33509W8 FCC ID.: DoC
USB mouse	SAMSUNG	SMH-2100UB	S/N: TAKZ502638 X FCC ID.: N/A
IR sensor	OHSUNG ELECTRONICS CO., LTD.	N/A	S/N: N/A FCC ID.: N/A
Voltage power sensor	OHSUNG ELECTRONICS CO., LTD.	VS-100	S/N: N/A FCC ID.: N/A
IR remote controller	OHSUNG ELECTRONICS CO., LTD.	N/A	S/N: N/A FCC ID.: N/A
RF sensor	OHSUNG ELECTRONICS CO., LTD.	RFX-250	S/N: N/A FCC ID.: N/A
USB memory stick	LG Electronics Inc.	UM5 2GB	S/N: 003RLHUN37761 FCC ID.: N/A
RFTX-1	OHSUNG ELECTRONICS CO., LTD.	RFTX-1	S/N: N/A FCC ID.: N/A

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

#### 3.2.2 System configuration

Description	Manufacturer	Model Name	S/N & FCC ID.
AC/DC adapter <sup>1)</sup>	UNIVERSAL Remote Control	EA1050E-120	S/N: N/A FCC ID.: N/A

1) Input ratings: AC (100 – 240) V~, (50 – 60) Hz, 1.8 A / Output ratings: DC 12 V, 3.5 A



### 3.2.3 Used Cable(s)

<b>Cable Name</b>	<b>Condition</b>	<b>Description</b>
Power cable	Connected to the adapter	1.80 m unshielded
DC power cable	Connected to the EUT and adapter	1.20 m shielded with a ferrite core
IR sensor cable	Connected to the EUT and IR sensor	2.75 m unshielded
Sensor cable	Connected to the EUT and voltage power sensor	1.90 m unshielded
RS-232C in cable	Connected to the EUT and notebook PC	1.90 m shielded
IR in cable	Connected to the EUT and IR remote controller	0.20 m shielded
RF in cable	Connected to the EUT and RF sensor	1.90 m shielded
RFTX-1 cable	Connected to the ETU and RFTX-1	3.60 m shielded

### 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
- Test Mode(s):

Executed "Tera term (Copyright by T.Teranishi)" to control the EUT continuously transmit RF signal

Test Software Version	Tera term (Ver 4.64)		
Frequency	2 405 MHz	2 450 MHz	2 480 MHz
Transmit power level (0x00 ~ 0x12)	07(+ 3 dBm)	07(+3 dBm)	07(+ 3 dBm)

## 5. Antenna Requirement - §5.203

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 §5.203 with a built-in puck type 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. (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

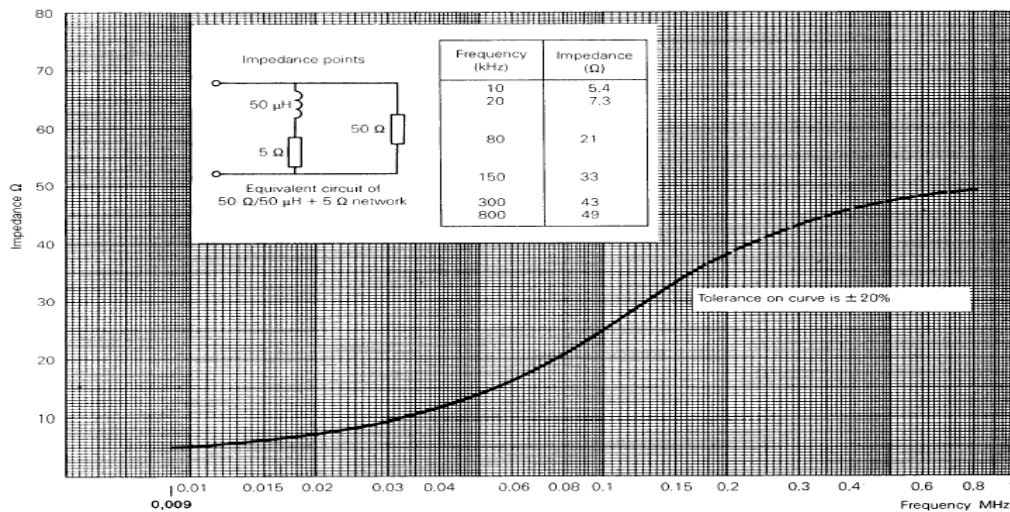


Fig 2. Impedance of LISN



### 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

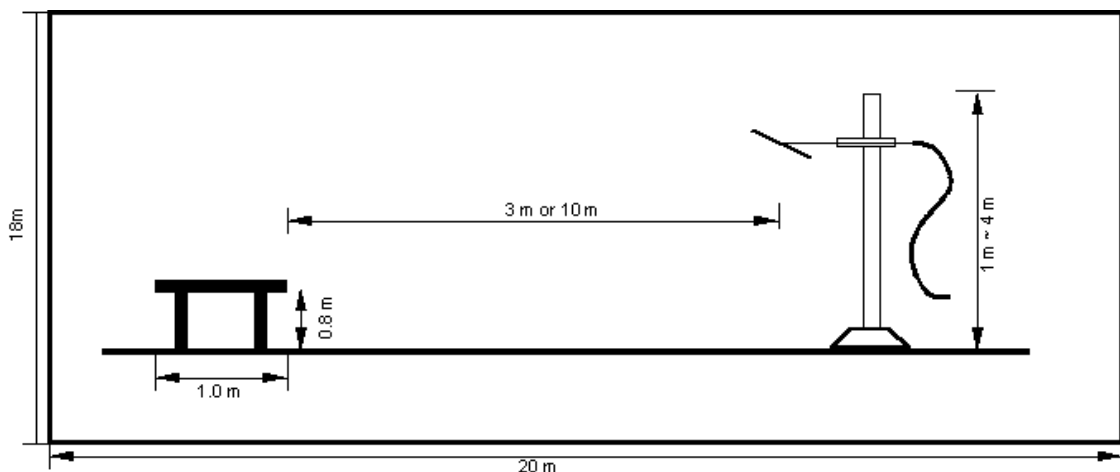


Fig 3. Dimensions of test site.



## 6. Conducted Emission

### 6.1 Operating Environment

Temperature : 24.0 °C  
Relative Humidity : 38.0 % 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)	± 2.71 dB	Confidence levels of 95 % (k=2)
Conducted emission (150 kHz ~ 30 MHz)	± 3.34 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

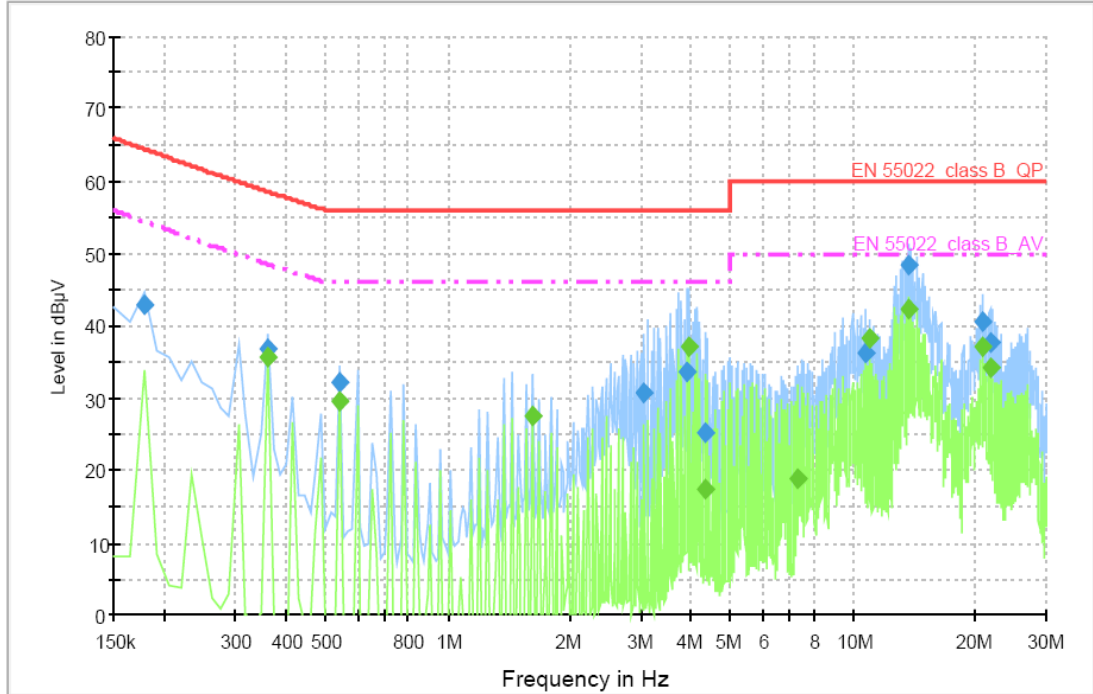
Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESCS30	Rohde & Schwarz	EMI test receiver	839809/003	12. 10. 2010
□- ESH3-Z5	Rohde & Schwarz	LISN	838979/020	12. 10. 2010
■ - ESH2-Z5	Rohde & Schwarz	LISN	829991/009	12. 10. 2010
□ - ISN T8	TESEQ. GmbH	ISN	24568	11. 09. 2011

#### 6.6 Test data for Conducted Emission

- Test Date : November, 20, 2010
- Reference Standard : Part 15 Subpart C, Sec. 15.207
- Channel : 802.15.4, 11ch
- Operating Condition : Zigbee RF transmitting mode
- Frequency rage : 0.15MHz ~ 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
0.178000	42.9	1000.000	9.000	GND	L1	10.1	21.6	64.5	
0.360000	36.8	1000.000	9.000	GND	L1	10.1	21.8	58.6	
0.542000	32.3	1000.000	9.000	GND	L1	10.1	23.7	56.0	
3.062000	30.6	1000.000	9.000	GND	L1	10.2	25.4	56.0	
3.902000	33.6	1000.000	9.000	GND	L1	10.3	22.4	56.0	
4.322000	25.1	1000.000	9.000	GND	L1	10.3	30.9	56.0	
10.734000	36.1	1000.000	9.000	GND	L1	10.6	23.9	60.0	
13.744000	48.3	1000.000	9.000	GND	L1	10.8	11.7	60.0	
20.800000	40.5	1000.000	9.000	GND	L1	11.3	19.5	60.0	
21.766000	37.7	1000.000	9.000	GND	L1	11.2	22.3	60.0	

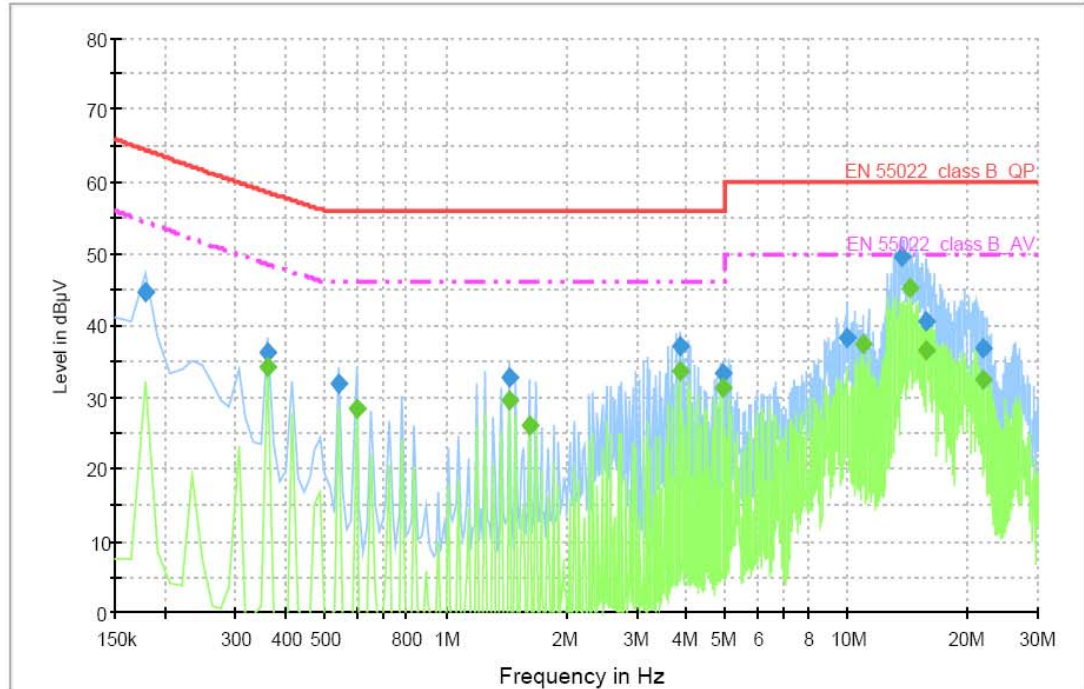
### Final Measurement Detector 2

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.360000	35.7	1000.000	9.000	GND	L1	10.1	12.8	48.5	
0.542000	29.5	1000.000	9.000	GND	L1	10.1	16.5	46.0	
1.620000	27.7	1000.000	9.000	GND	L1	10.1	18.3	46.0	
3.958000	37.0	1000.000	9.000	GND	L1	10.3	9.0	46.0	
4.322000	17.4	1000.000	9.000	GND	L1	10.3	28.6	46.0	
7.318000	18.8	1000.000	9.000	GND	L1	10.5	31.2	50.0	
11.028000	38.2	1000.000	9.000	GND	L1	10.6	11.8	50.0	
13.744000	42.3	1000.000	9.000	GND	L1	10.8	7.7	50.0	
20.800000	37.1	1000.000	9.000	GND	L1	11.3	12.9	50.0	
21.766000	34.3	1000.000	9.000	GND	L1	11.2	15.7	50.0	

< Fig 4. Conducted emission result (Live line) >



### 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
0.178000	44.7	1000.000	9.000	GND	N	10.1	19.8	64.5	
0.360000	36.3	1000.000	9.000	GND	N	10.1	22.3	58.6	
0.542000	32.0	1000.000	9.000	GND	N	10.1	24.0	56.0	
1.438000	32.9	1000.000	9.000	GND	N	10.1	23.1	56.0	
3.832000	37.1	1000.000	9.000	GND	N	10.3	18.9	56.0	
4.910000	33.2	1000.000	9.000	GND	N	10.4	22.8	56.0	
10.062000	38.3	1000.000	9.000	GND	N	10.5	21.7	60.0	
13.744000	49.4	1000.000	9.000	GND	N	10.7	10.6	60.0	
15.872000	40.7	1000.000	9.000	GND	N	10.8	19.3	60.0	
21.864000	36.9	1000.000	9.000	GND	N	10.9	23.1	60.0	

#### Final Measurement Detector 2

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.360000	34.2	1000.000	9.000	GND	N	10.1	14.3	48.5	
0.598000	28.5	1000.000	9.000	GND	N	10.1	17.5	46.0	
1.438000	29.5	1000.000	9.000	GND	N	10.1	16.5	46.0	
1.620000	26.0	1000.000	9.000	GND	N	10.1	20.0	46.0	
3.832000	33.5	1000.000	9.000	GND	N	10.3	12.5	46.0	
4.910000	31.4	1000.000	9.000	GND	N	10.4	14.6	46.0	
11.028000	37.5	1000.000	9.000	GND	N	10.6	12.5	50.0	
14.430000	45.3	1000.000	9.000	GND	N	10.8	4.7	50.0	
15.872000	36.5	1000.000	9.000	GND	N	10.8	13.5	50.0	
21.766000	32.6	1000.000	9.000	GND	N	10.9	17.4	50.0	

< Fig 5. Conducted emission result (Neutral line) >

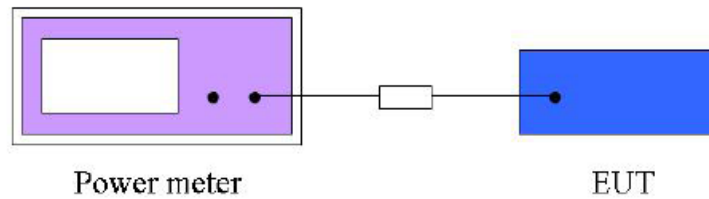


## 7. Maximum Peak Output Power Measurement

### 7.1 Operating environment

Temperature : 24.0 °C  
 Relative Humidity : 44.0 % 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	12.11.2010
■ - NRV-Z32	Rohde & Schwarz	Power sensor	100062	10.20.2011

### 7.5 Test Result

- Test Date : December 6, 2010  
 - Reference Standard : Part 15 Subpart C, Sec. 15.247(b)(3)  
 - Channel : 802.15.4 (11ch / 20ch / 26ch)  
 - Operating Condition : Zigbee RF transmitting mode  
 - Power Source : AC 120 V / 60 Hz

#### Parameter

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

#### Configuration IEEE 802.15.4

Channel	Frequency	Conducted Power (dBm)	Conducted Power (mW)	Max. Limit (dBm)	Result
11	2 405 MHz	16.45	44.5	30.00	Complies
20	2 450 MHz	16.55	44.8	30.00	Complies
26	2 480 MHz	16.61	45.9	30.00	Complies



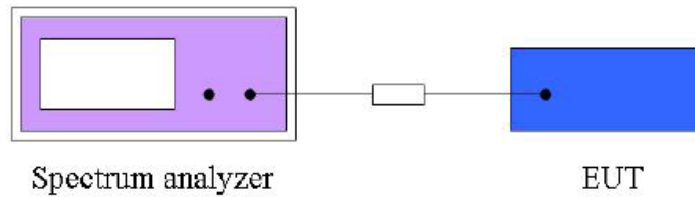


## 8. Power Spectral Density Measurement

### 8.1 Operating Environment

Temperature : 24.0 °C  
 Relative Humidity : 44.0 % 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
■ - ESIB26	Rohde & Schwarz	EMI test receiver	830482/010	12.11.2010

### 7.5 Test Result

- Test Date : December 6, 2010  
 - Reference Standard : Part 15 Subpart C, Sec. 15.247(e)  
 - Channel : 802.15.4 (11ch / 20ch / 26ch)  
 - Operating Condition : Zigbee RF transmitting mode  
 - Power Source : AC 120 V / 60 Hz , AC/DC Adaptor ( DC 12 V, 3.5 A)

#### Spectrum Parameter

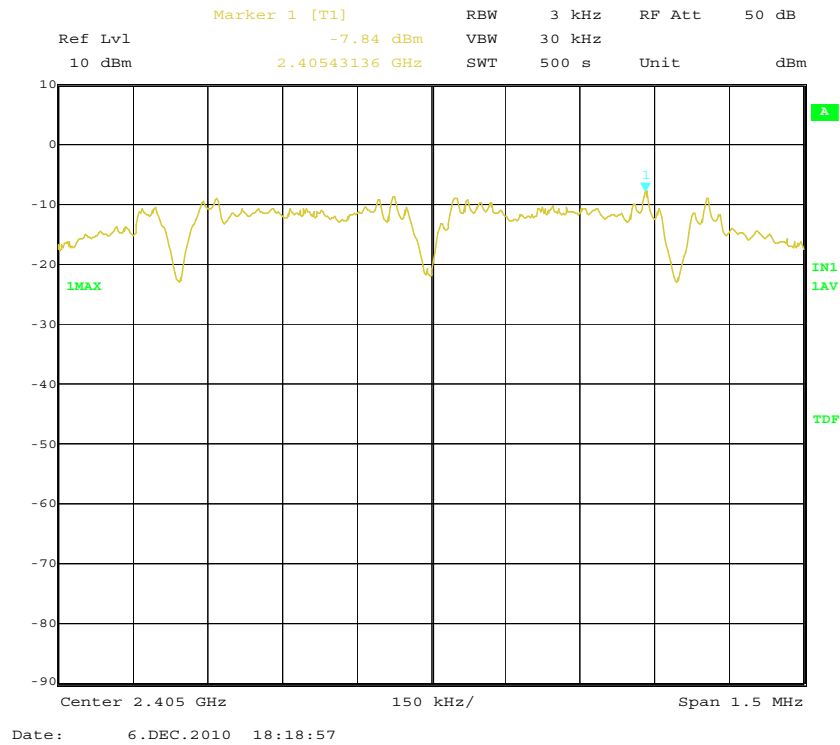
- Attenuation : Auto  
 - Span frequency : 1.5 MHz  
 - Resolution band width : 3 kHz  
 - Video band with : 30 kHz  
 - Sweep time : 500 s

#### Configuration IEEE 802.15.4

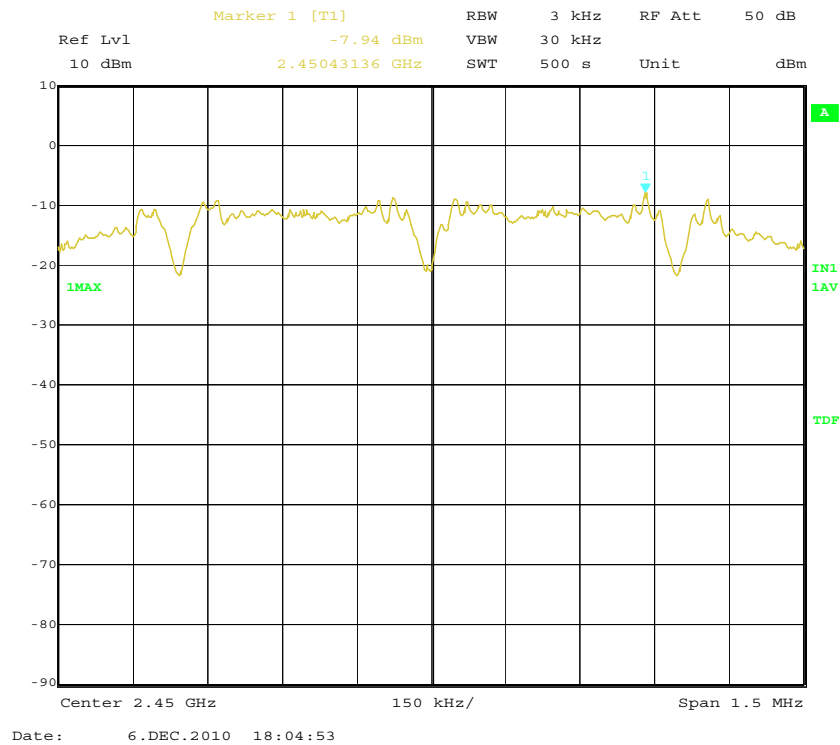
Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
11	2 405 MHz	-7.84	8.00	Complies
20	2 450 MHz	-7.94	8.00	Complies
26	2 480 MHz	-8.00	8.00	Complies



### Power Density Plot on configuration IEEE 802.15.4 / 2 405 MHz

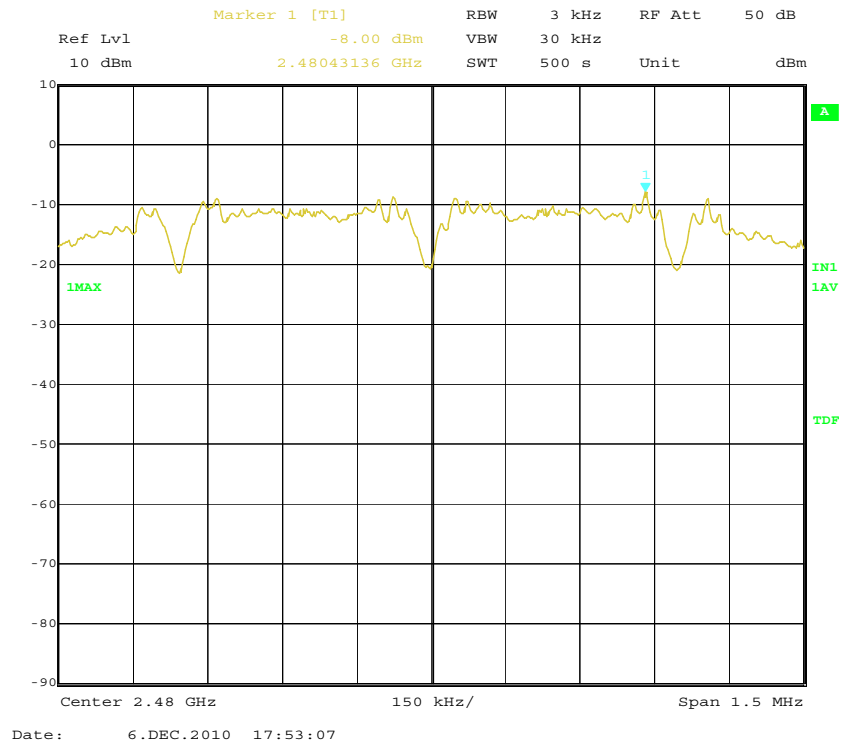


### Power Density Plot on configuration IEEE 802.15.4 / 2 450 MHz





**Power Density Plot on configuration IEEE 802.15.4 / 2 480 MHz**



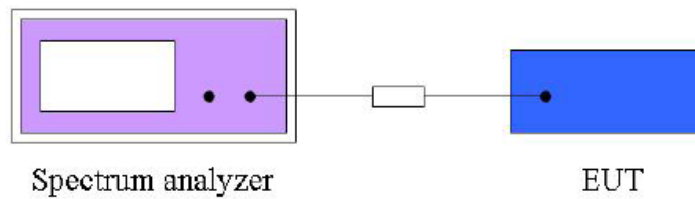


## 9. 6 dB Spectrum bandwidth Measurement

### 9.1 Operating environment

Temperature : 24.0 °C  
 Relative Humidity : 44.0 % 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 Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESIB26	Rohde & Schwarz	EMI test receiver	830482/010	12. 11. 2010

### 9.5 Test result

- Test Date : December 6, 2010
- Reference Standard : Part 15 Subpart C, Sec. 15.247(a)(2)
- Channel : 802.15.4 (11ch / 20ch / 26ch)
- Operating Condition : Zigbee RF transmitting mode
- Power Source : AC 120 V / 60 Hz

#### Spectrum Parameter

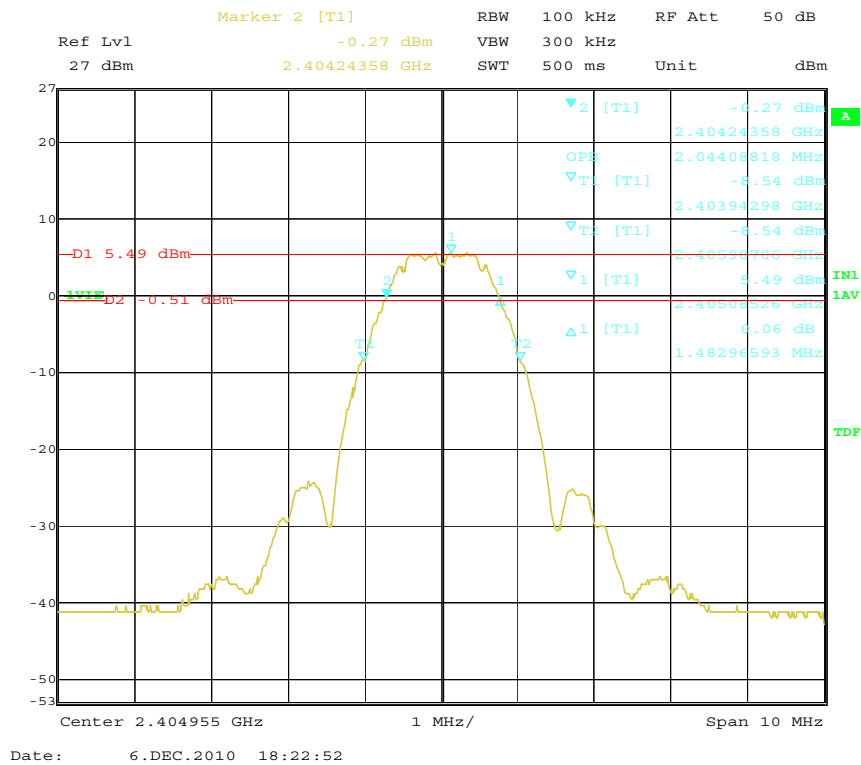
- Attenuation : Auto
- Span frequency : > 6 dB bandwidth
- Resolution band width : 100 kHz
- Video band with : 300 kHz
- Detector : Peak
- Trace : Maxhold
- Sweep time : Auto

#### Configuration IEEE 802.15.4

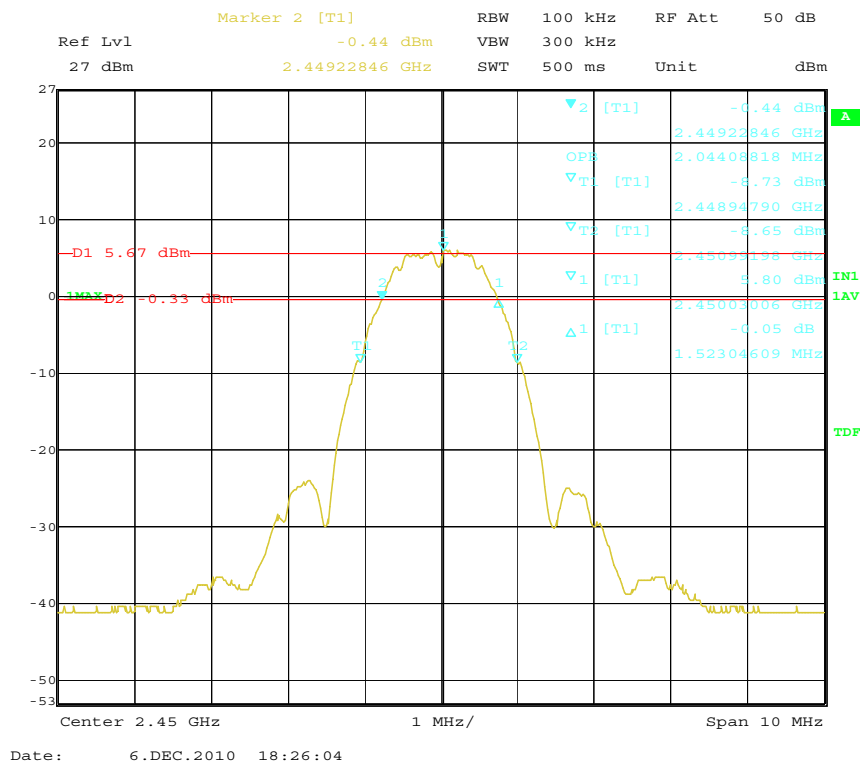
Channel	Frequency	6 dB Bandwidth (MHz)	99 % Occupied bandwidth (MHz)	Min. Limit (kHz)	Result
11	2 405 MHz	1.48	2.04	500	Complies
20	2 450 MHz	1.52	2.04	500	Complies
26	2 480 MHz	1.48	2.06	500	Complies



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

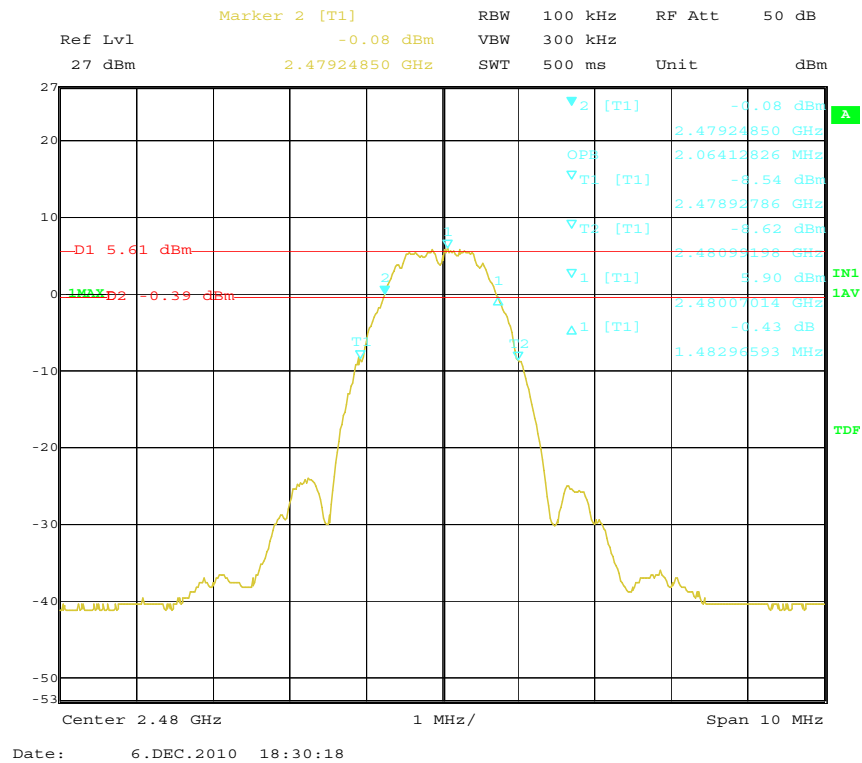


### 6 dB Bandwidth Plot on Configuration IEEE 802.15.4 / 2 450 MHz





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



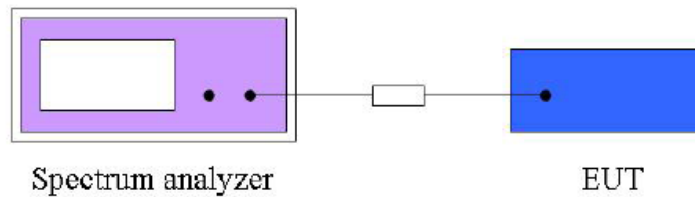


## 10. Band Edge Measurement

### 10.1 Operating environment

Temperature : 24.0  
 Relative humidity : 44.0 %R.H

### 10.2 Test set-up (Lay-out)



### 10.3 Limit

Below -20 dB of the highest emission level of operating band (in 100 kHz resolution band width)

### 10.4 Test equipment used

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

### 10.5 Test Result

- Test Date : December 5, 2010  
 - 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

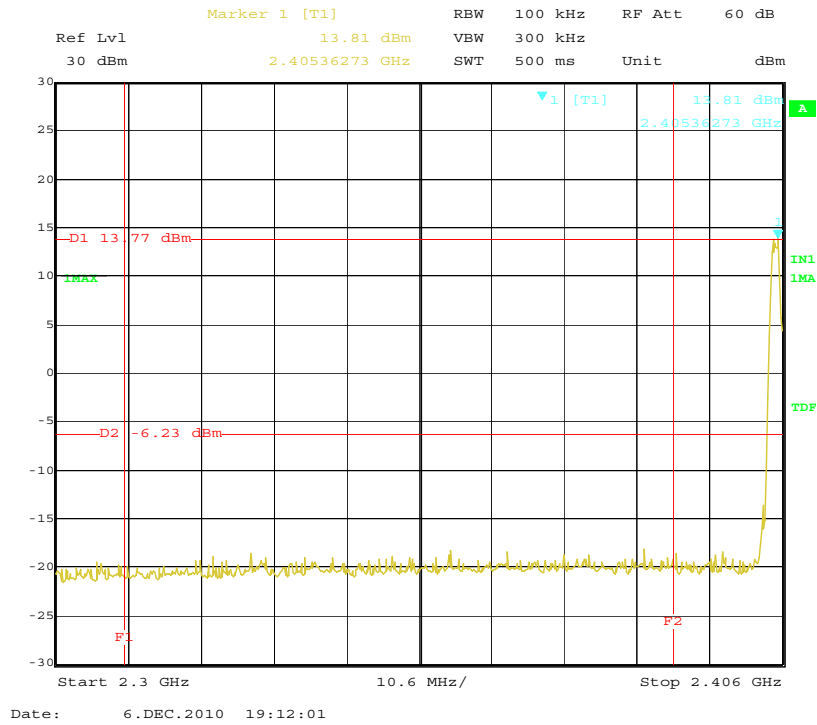
The spectrum plots are attached on the following 8 images, D1 line indicates the highest level, D2 line indicates the 20 dB offset below D1. It shows compliance with the requirement in part 15.247(d)

#### Spectrum Parameter

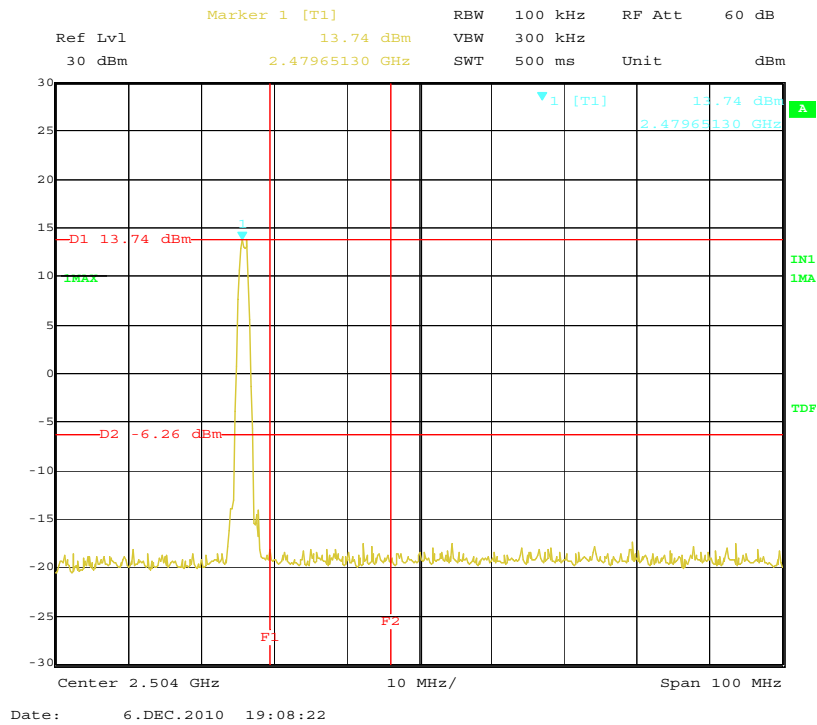
- Attenuation : Auto  
 - Resolution bandwidth : 100 kHz  
 - Video bandwidth : 100 kHz



**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**







## 11. Radiated Emission

### 11.1 Operating Environment

Temperature : 24.0 °C  
 Relative Humidity : 43.0 % R.H.

### 11.2 Test set-up

The formal radiated emission was measured at 3 m distance 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.

### 11.3 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 (Semi anechoic chamber)	Uncertainty	Remark
Radiated emission (30 MHz ~ 300 MHz, 3 m, Vertical)	± 4.09 dB	Confidence levels of 95 % ( $k = 2$ )
Radiated emission (30 MHz ~ 300 MHz, 3 m, Horizontal)	± 3.78 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)	± 4.11 dB	Confidence levels of 95 % ( $k = 2$ )

### 11.4 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	2400/F (kHz)	300
0.490 ~ 1.705	2400/F (kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3



### 11.5 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	Broadband test 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
■ - 3160-09	ETS LINDGREN	Horn antenna	LM3423	04. 06. 2011
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258942	11. 12. 2011
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258943	11. 12. 2011

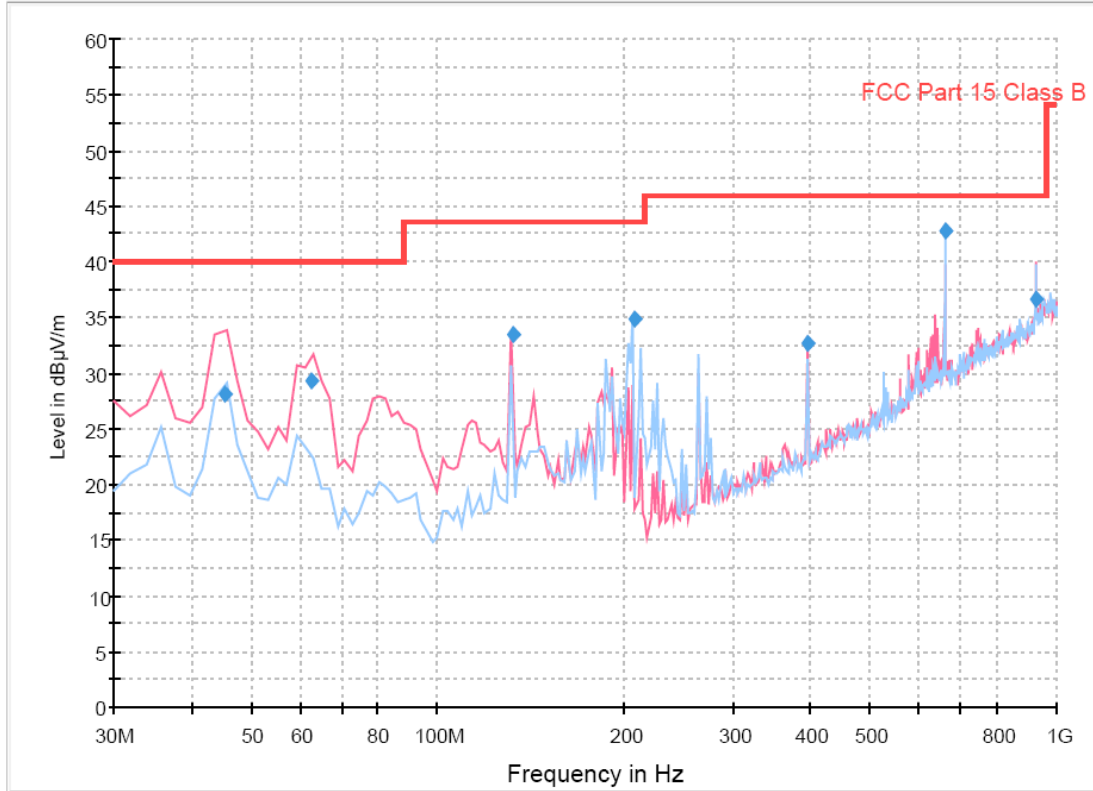
### 11.6 Radiated emission test data

- Test Date : December 2 ~ 6, 2010
- Reference standard : Part 15 Subpart C, Sec. 15.247(d)
- Channel : 802.15.4 (11ch / 20ch / 26ch)
- Operating condition : Zigbee RF transmitting mode
- Measuring distance : 3 m
- Spectrum resolution bandwidth(6dB) : 120 kHz / 1 MHz / 10 Hz / 100 kHz
- Detector mode : Peak detector mode / Quasi Peak detector mode / Average detector mode
- Power Source : AC 120 V / 60 Hz
- Note : 1.Through three orthogonal axes were investigated and the worst case is report



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

Radiated Emission\_below 1 GHz



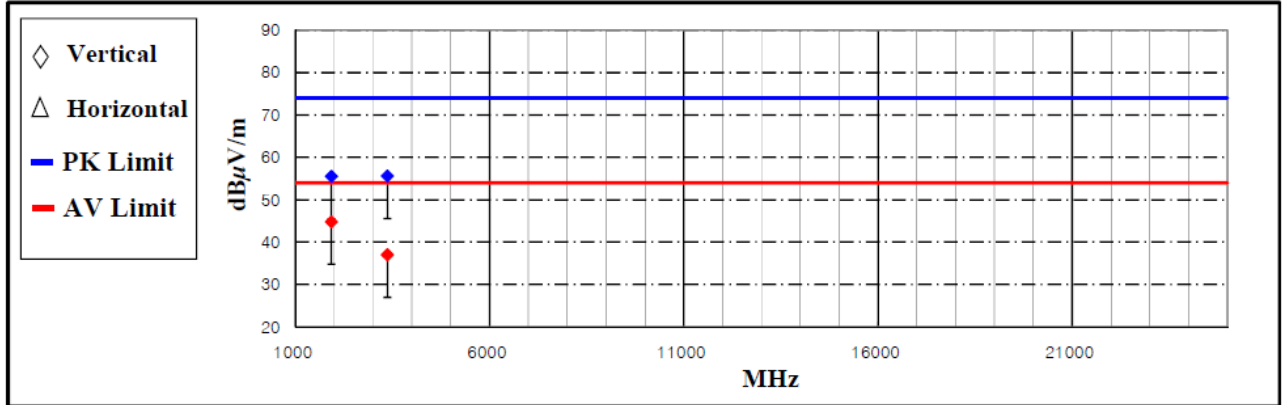
**Final Result 1**

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
45.491102	28.1	1000.0	120.000	100.0	V	311.0	13.4	11.9	40.0
62.666092	29.3	1000.0	120.000	100.0	V	88.0	13.0	10.7	40.0
132.102164	33.4	1000.0	120.000	100.0	V	133.0	14.3	10.1	43.5
207.473788	34.9	1000.0	120.000	116.0	H	25.0	12.2	8.6	43.5
396.294790	32.7	1000.0	120.000	159.0	V	3.0	19.1	13.3	46.0
660.623527	42.7	1000.0	120.000	100.0	H	241.0	25.9	3.3	46.0
924.632265	36.6	1000.0	120.000	100.0	V	99.0	30.5	9.4	46.0



**Worst case result of radiated emission (1 GHz to 25 GHz): GFSK**

Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF	AMP / CL	Test Result (dB $\mu$ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average	(dB/m)	(dB)	Peak	Average							
1924.05	67.52	56.82	25.86	-37.88	55.50	44.80	74.00	54.00	18.50	9.20	V	100	97
3366.92	61.61	43.01	29.02	-35.03	55.60	37.00	74.00	54.00	18.40	17.00	V	148	76



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

**Result of radiated emission (Band Edge)**

802.15.4, 11ch

Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V)		AF	AMP / CL	Test Result (dB $\mu$ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average	(dB/m)	(dB)	Peak	Average							
2405.00	118.91	106.81	27.00	-36.91	109.00	96.90	74.00	54.00	-	-	-	-	-
2390.00	62.93	53.53	26.96	-36.93	52.96	43.56	74.00	54.00	21.04	10.44	-	-	-

802.15.4, 26ch

Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V)		AF	AMP / CL	Test Result (dB $\mu$ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average	(dB/m)	(dB)	Peak	Average							
2480.00	116.39	104.19	27.20	-36.79	106.80	94.60	74.00	54.00	-	-	-	-	-
2483.50	62.86	52.23	27.21	-36.78	53.29	42.66	74.00	54.00	20.71	11.34	-	-	-

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

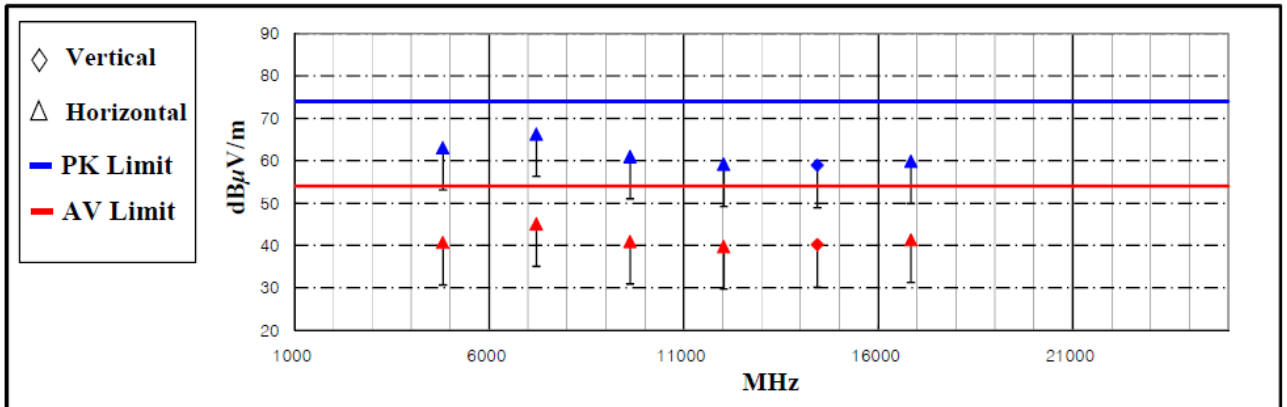
Corrected reading: Antenna factor + Cable loss + Preamplifier gain + Read value = Test result



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

(802.15.4, 11ch)

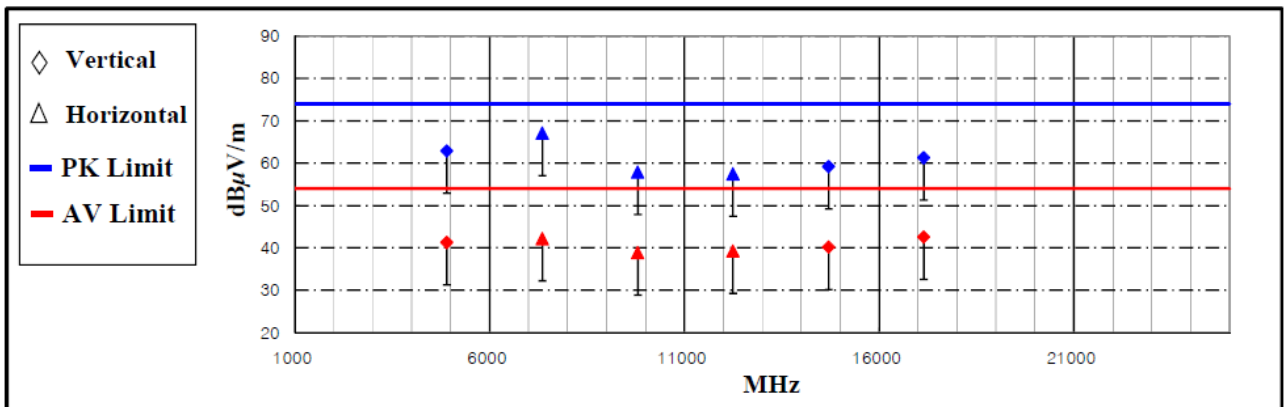
Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF	AMP / CL	Test Result (dB $\mu$ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average	(dB/m)	(dB)	Peak	Average							
4809.01	64.72	42.32	31.21	-32.83	63.10	40.70	74.00	54.00	10.90	13.30	H	139	300
7213.42	57.92	36.72	35.76	-27.38	66.30	45.10	74.00	54.00	7.70	8.90	H	148	294
9621.83	44.89	24.79	38.78	-22.67	61.00	40.90	74.00	54.00	13.00	13.10	H	1478	50
12027.44	41.74	22.24	39.26	-21.80	59.20	39.70	74.00	54.00	14.80	14.30	H	156	63
14433.11	37.57	18.87	42.46	-21.13	58.90	40.20	74.00	54.00	15.10	13.80	V	131	344
16838.72	38.40	19.80	39.84	-18.34	59.90	41.30	74.00	54.00	14.10	12.70	H	113	344



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

(802.15.4, 20ch)

Frequency (MHz)	Measurement Level						Limit (dB $\mu$ V/m)		Margin (dB)		Positioning System		
	Reading Value (dB $\mu$ V/m)		AF	AMP / CL	Test Result (dB $\mu$ V/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average	(dB/m)	(dB)	Peak	Average							
4899.19	64.29	42.69	31.37	-32.76	62.90	41.30	74.00	54.00	11.10	12.70	V	147	354
7351.66	58.20	33.30	36.02	-27.12	67.10	42.20	74.00	54.00	6.90	11.80	H	148	290
9801.79	41.05	22.05	39.08	-22.23	57.90	38.90	74.00	54.00	16.10	15.10	H	148	337
12247.52	39.92	21.72	39.20	-21.62	57.50	39.30	74.00	54.00	16.50	14.70	H	139	23
14703.25	37.42	18.42	42.73	-20.95	59.20	40.20	74.00	54.00	14.80	13.80	V	150	337
17146.51	37.63	18.93	41.77	-18.10	61.30	42.60	74.00	54.00	12.70	11.40	V	100	9

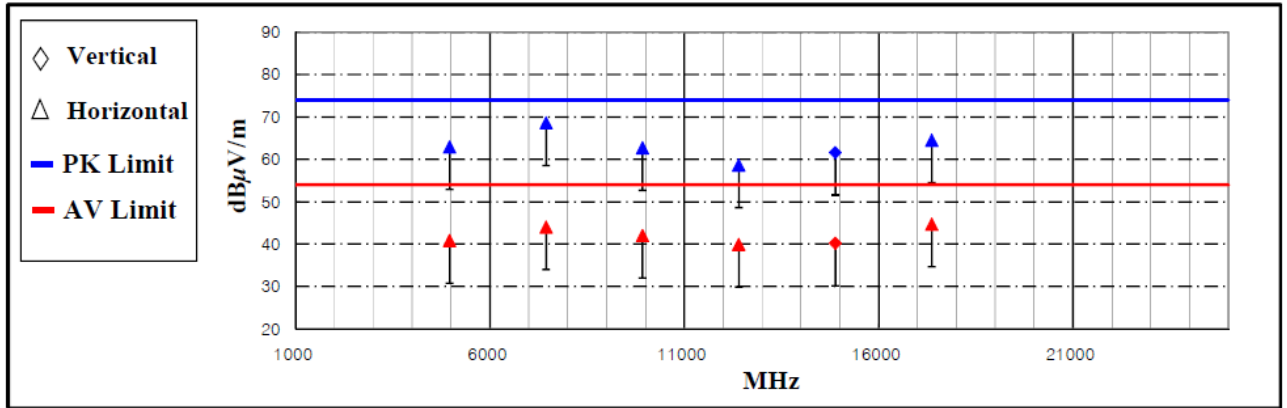


\*Comment : AMP/CL\_Cable loss value + AMP gain value  
 AF : Antenna factor value  
 Pol. : H(Horizontal), V(Vertical)



(802.15.4, 26ch)

Frequency (MHz)	Measurement Level						Limit (dBµV/m)		Margin (dB)		Positioning System		
	Reading Value (dBµV/m)		AF	AMP / CL	Test Result (dBµV/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average	(dB/m)	(dB)	Peak	Average							
4960.90	64.13	42.03	31.48	-32.71	62.90	40.80	74.00	54.00	11.10	13.20	H	139	302
7441.50	59.36	34.76	36.19	-26.95	68.60	44.00	74.00	54.00	5.40	10.00	H	147	328
9922.03	45.36	24.66	39.28	-21.94	62.70	42.00	74.00	54.00	11.30	12.00	H	156	335
12397.42	40.94	22.24	39.15	-21.49	58.60	39.90	74.00	54.00	15.40	14.10	H	131	308
14882.81	39.51	18.11	42.92	-20.83	61.60	40.20	74.00	54.00	12.40	13.80	V	139	344
17363.34	38.54	18.74	43.96	-18.00	64.50	44.70	74.00	54.00	9.50	9.30	H	113	323



\*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