

RF Exposure Evaluation – Maximum Permissible Exposure (MPE)

1. Introduction

This document attempts to prove the safety of radiation generated by RF devices to the human body. The limit for Maximum Permissible Exposure (MPE), specified in FCC 1.1310, is listed below. The power generated by this product is measured by a power meter. Through use of the Friis transmission formula and the maximum gain of the antenna, the distance from the product at which compliance with the MPE limit is achieved may be calculated.

2. RF Exposure Limit

According to FCC 1.1310: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures				
30-300	61.4	0.163	1.0	6
300-1500	...	...	F/300	6
1500-100,000	...	...	5	6
(B) Limits For General Population / Uncontrolled Exposure				
30-300	27.5	0.073	0.2	30
300-1500	...	...	F/1500	30
1500-100,000	...	...	1.0	30

F = Frequency in MHz

3. Friis Formula

Friis transmission formula: $P_d = (P_{out} * G) / (4\pi r^2)$

Where:

P_d = power density in mW/cm² (MPE limit), P_{out} = output power to antenna in mW, G = gain of antenna in linear scale, $p = 3.1416$, r = distance between observation point and center of the radiator in cm

Ref.: David K. Cheng, Field and Wave Electromagnetic, Second Edition, Page 640, Eq. (11.133)

4. EUT Operating Condition

Software provided by the client enabled the EUT to transmit and receive data at lowest, middle, and highest channels individually.

5. Measurement Results

Frequency (MHz)	Level (dBm)	Max Gain of Antenna *(manufacture Recommend Provide Antenna)	P _{out} *G (mW)	Distance (cm)	MPE (mW/cm ²)	Limit
2405	16.25	4.1 dBi	108.39	20	0.022	1
2440	16.01	4.1 dBi	102.57	20	0.020	1
2475	17.44	4.1 dBi	142.56	20	0.028	1

* refer A3 to A5 pages

6. Conclusion

The device meets the ZigBee Module 20cm separation distance as specified in Section 2.1091 of the FCC Rules. An appropriate RF exposure compliance statement will be placed in the user's manual.

NURI TELECOM Co., Ltd.

APPROVAL SHEET

NO	MODEL	FREQUENCY	Confirm
1	HW-2450M4-SMA	2.4GHz-2.483GHz	



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ANTENNA SPECIFICATION

1. Model: HW – 2450M4 – SMA

2. APPLICATION:

This specification is provided for 2.4 GHz MAGNET WHIP ARRAY ANTENNA

3. ANTENNA used condition

☐ Portable ☒ Fixing ☐ Movement ☒ Out-door ☒ In-door ☒ Etc

4. ANTENNA Drawing

Attached Drawing paper.

5. Electronic specification and performance

Satisfied next data with real used or similar environment conditions.

No.	ELECTRICAL DATA	SPECIFICATIONS	REMARK
5. 1	FREQUENCY RANGE	2.4 GHz – 2.483 GHz	
5. 2	RESONANCE FREQUENCY	2.441 GHz	
5. 3	IMPEDANCE	50 Ω NOMINAL	
5. 4	V . S . W . R	LESS THAN 1:2.0	
5. 5	GAIN	4 ± 0.5 dBi	
5. 6	RADIATION PATTERN	OMNI - DIRECTIONAL	
5. 7	POLARIZATION	VERTICAL	

6. Hardware specification and mechanical

No.	MECHANICAL	SPECIFICATIONS	REMARK
6. 1	ELEMENT	Φ 0.8 PWG	
6. 2	SLEEVE	URETHANE	BLACK-COLOR
6. 3	CONNECTOR	SMA(Male)	GOLD-PLATING
6. 4	ANTENNA TOTAL LENGTH	180.5 ± 2.0 mm	
6. 5	RG-174 COAX CABLE LENGTH	500 ± 30 mm	BLACK-COLOR

DQ No.	HW-0504271	Modify No.		Write	Wan-choul. Lee
Supply to	NURI TELECOM	Date	2005.04.27.	approval	Chang-gi. Nam

