

# 1 RF Exposure Report

## 1.1 RF Exposure Measurement

The limit for Maximum Permissible Exposure (MPE) specified in FCC Part 1 Subpart I 1.1310 & RSS 102 issue 5 is followed. The gain of the antennas used in the product is extracted from the Antenna data sheets provided and also the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis Transmission formula is far field assumption, the calculated result of that is an over-prediction for near field power density. It is taken as worst case to specify the safety range.

## 1.2 RF Exposure Limit

According to FCC Part 1 Subpart I 1.1310 & RSS 102 Issue 5: The criteria listed in the following table shall be used to evaluate the environmental impact of the human exposure to radio-frequency (RF) radiation as specified in 1.1307 (b)

**Table 1: Limits for Maximum Permissible Exposure (MPE)**

| Frequency Range<br>(MHz)                              | Electric Field<br>Strength (V/m) | Magnetic Field<br>Strength (A/m) | Power Density<br>(mW/cm <sup>2</sup> ) |
|---|----------------------------------|----------------------------------|--|
| Limits for Occupational / controlled Exposures        |                                  |                                  |  |
| 300 - 1500  | --                               | --                               | F/300                                  |
| 1500 – 100000   | --                               | --                               | 5.0                                    |
| Limits for General population / Uncontrolled Exposure |                                  |                                  |  |
| 300 - 1500  | --                               | --                               | F/1500                                 |
| 1500 – 100000   | --                               | --                               | 1.0                                    |

F= Frequency in MHz

### 1.2.1 Friss Formula

Friss Transmission Formula:  $P_d = (P_{out} * G) / (4 * \pi * r^2)$

Where

$P_d$  = power density in mW/cm<sup>2</sup>

$P_{out}$  = output power to antenna in mW

$G$  = gain of antenna in linear scale

$\pi$  = 3.1416

$R$  = Distance between observation point and the center of radiator in cm

If we know the maximum gain of the antenna and the total output power to the antenna, through calculation, we will know MPE value at distance 20cm.

### 1.2.2 EUT Operation condition

EUT was enabled to transmit and receive at lowest, middle and highest channels.

### 1.2.3 Classification

The antenna of this product, under normal use condition, is at least 20cm away from the body of the user. Warning statement to the user for keeping at least 20cm or more separation distance from the antenna should be included in the User manual. So, this device is classified as Mobile device.

Note:  $\pm 1$  dB tune up value is considered for MPE calculation, this value was declared by manufacturer

Protocol: ZigBee

Data Rate: 250 kbps

Antenna Gain: -2 dBi = 0.63 (linear gain), 8 dBi = 6.31 (linear gain) and 14 dBi = 25.12 (linear gain)

**Table 2: Test Results for Maximum Permissible Exposure**

| Antenna Gain (dBi) | Power level setting (dBm) | Channel (MHz) | Maximum Pout (dBm) | Tune up Value in (dB) | Output Power to Antenna (mW) | Power Density (mW/cm <sup>2</sup> ) | Limit (mW/cm <sup>2</sup> ) |
|--------------------|---------------------------|---------------|--------------------|-----------------------|------------------------------|-------------------------------------|-----------------------------|
| -2                 | 16                        | 2475          | 16.59              | 1                     | 57.4120                      | 0.007205                            | 1.000                       |
| 8                  | 10                        | 2475          | 11.38              | 1                     | 17.2981                      | 0.021711                            |                             |
| 14                 | 6                         | 2475          | 6.37               | 1                     | 05.4575                      | 0.027269                            |                             |

\*\*\*END OF APPENDIX\*\*\*