

# RF Exposure Measurement

## 1. Introduction

### The maximum Gain measured in Fully Anechoic Chamber

Because this device is transmitting the high power signal, it is regarded specially as a dangerous band for its heating harmfulness to the human body. The manufacturer whose product is working in this frequency band is obligatory to prove the harmfulness of his product.

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The Gain of the antenna used in this product is measured in a Fully Anechoic Chamber (FAC), and 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,

## 2. Classification

MODE: WLAN , BT

The antenna of the product, under normal use condition, is at least 20cm away from the body of the user. Warning statement for keeping 20cm separation distance and the prohibition of operating next to a person has been printed on the user's manual. So, this product is classified as the Mobile Device.

## 3. 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) – Class A

| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength(A/m) | Power Density (mW/cm <sup>2</sup> ) | Average Time (minutes) |
|-----------------------|-------------------------------|------------------------------|-------------------------------------|------------------------|
| 0.3 – 3.0             | 614                           | 1.63                         | *(100)                              | 6                      |
| 3.0 – 30              | 1842/f                        | 4.89/f                       | *(900/f <sup>2</sup> )              | 6                      |
| 30 – 300              | 61.4                          | 0.163                        | 1.0                                 | 6                      |
| 300 – 1500            |                               |                              | F/300                               | 6                      |
| 1500 – 100,000        |                               |                              | 5                                   | 6                      |

### LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE) – Class B

| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength(A/m) | Power Density (mW/cm <sup>2</sup> ) | Average Time (minutes) |
|-----------------------|-------------------------------|------------------------------|-------------------------------------|------------------------|
| 0.3 – 1.34            | 614                           | 1.63                         | *(100)                              | 30                     |
| 1.34 – 30             | 824/f                         | 2.19/f                       | *(180/f <sup>2</sup> )              | 30                     |
| 30 – 300              | 27.5                          | 0.073                        | 0.2                                 | 30                     |
| 300 – 1500            | –                             | –                            | F/1500                              | 30                     |
| 1500 – 100,000        | –                             | –                            | 1.0                                 | 30                     |

F = Frequency in MHz      \* = Plane-wave equivalent power density

## 4. Friis Formula

$$R = \sqrt{\frac{PG}{4\pi S}}$$

The maximum Gain measured in Fully Anechoic Chamber

BT : 4.109 dBi or 2.576 (nematic)

WLAN : 6.657 dBi or 4.631 (nematic)

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

G = gain of antenna in linear scale

$\pi = 3.1416$

MODE: WLAN , BT

$P_d$  is the limit of MPE,  $1\text{mW}/\text{cm}^2$ . If we know the maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance  $r$  where the MPE limit is reached.

The software provided by Manufacturer enabled the EUT to transmit with max power at lowest, middle and highest channel individually.

## 5. Test Results

The maximum Gain measured in Fully Anechoic Chamber

| Band | dBi       | nemeric         |
|------|-----------|-----------------|
| BT   | 4.109 dBi | 2.576 (nemeric) |
| WLAN | 6.657 dBi | 4.631 (numeric) |

### 5.2 Output Power into Antenna & Power Density (1mW/cm2) :

MODE: BT

| Channel   | Channel Frequency (MHz) | Output Power to Antenna (mW) | Power Density (mW/cm2) |
|-----------|-------------------------|------------------------------|------------------------|
| First ch  | 2402.00                 | 0.012                        | 0.000006               |
| Middle ch | 2442.00                 | 0.013                        | 0.000007               |
| Last ch   | 2480.00                 | 0.013                        | 0.000007               |

MODE: WLAN

| Channel   | Channel Frequency (MHz) | Output Power to Antenna (mW) | Power Density (mW/cm2) |
|-----------|-------------------------|------------------------------|------------------------|
| First ch  | 2412.00                 | 4.100                        | 0.004                  |
| Middle ch | 2442.00                 | 4.100                        | 0.002                  |
| Last ch   | 2462.00                 | 4.200                        | 0.002                  |

\* Worst case is 802.11b

| Max Calculations for simultaneous | Power Density (mW/cm2) |
|-----------------------------------|------------------------|
|                                   | 0.004                  |