

## 9. MAXIMUM PERMISSIBLE EXPOSURE

### RF Exposure Limit

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

Limits for Maximum Permissible Exposure (MPE)

| Frequency<br>Range(MHz)                                          | Electric Field<br>Strength(V/m) | Magnetic Field<br>Strength(A/m) | Power Density<br>(mW/cm <sup>2</sup> ) | Averaging Time<br>(Minutes) |
|------------------------------------------------------------------|---------------------------------|---------------------------------|----------------------------------------|-----------------------------|
| <b>(A) Limits for occupational / Contral Exposure</b>            |                                 |                                 |                                        |                             |
| 30 - 300                                                         | 61.4                            | 0.163                           | 1                                      | 6                           |
| 300 - 1500                                                       | ...                             | ...                             | F/300                                  | 6                           |
| 1500 - 100000                                                    | ...                             | ...                             | 5                                      | 6                           |
| <b>(B) Limits for General Population / Uncontrolled Exposure</b> |                                 |                                 |                                        |                             |
| 30 - 300                                                         | 27.5                            | 0.073                           | 0.2                                    | 30                          |
| 300 - 1500                                                       | ...                             | ...                             | F/1500                                 | 30                          |
| 1500 - 100000                                                    | ...                             | ...                             | 1                                      | 30                          |

F = Frequency (MHz)

### Fries formula

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

$$r = \sqrt{((P_{out} * G) / 4 * \pi * P_d)}$$

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 center of the radiator in cm

$P_d$  is the limit of MPE, 1 mW/cm<sup>2</sup>. If we know the Maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the Maximum distance r where the MPE limit is reached and Power density at prediction frequency.

## TEST DATA

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### Test Result :

The maximum antenna gain is **0.6 dBi or 1.15(Numeric)**.

|                                                              |                         |
|--------------------------------------------------------------|-------------------------|
| Maximum peak output power at antenna input terminal:         | 20.77 (dBm)             |
| Maximum peak output power at antenna input terminal:         | 119.40 (mW)             |
| Antenna gain(typical):                                       | 0.60 (dBi)              |
| Maximum antenna gain:                                        | 1.15 (numeric)          |
| Prediction distance:                                         | 20 (cm)                 |
| Prediction frequency:                                        | 2437 (MHz)              |
| MPE limit for uncontrolled exposure at prediction frequency: | 1 (mW/cm <sup>2</sup> ) |
| Maximum allowable antenna gain:                              | 16.24 (dBi)             |
| Maximum Distance:                                            | 3.30 (cm)               |

**Power density at prediction frequency : 0.027273 (mW/cm<sup>2</sup>)**

**Test result: PASS**