

## **FCC §1.1310& §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE)**

### **Applicable Standard**

According to subpart §2.1091 and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
<b>Frequency Range (MHz)</b>	<b>Electric Field Strength (V/m)</b>	<b>Magnetic Field Strength (A/m)</b>	<b>Power Density (mW/cm<sup>2</sup>)</b>	<b>Averaging Time (minutes)</b>
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;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$  = power density (in appropriate units, e.g. mW/cm<sup>2</sup>);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

**Calculated Data:**

Mode	Frequency Range (MHz)	Maximum Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
		(dBi)	(numeric)	(dBm)	(mW)			
Wi-Fi	2412-2462	2.00	1.58	22.00	158.49	20	0.0498	1.00
	2422-2452	2.00	1.58	19.00	79.43	20	0.0250	1.00
BLE	2402-2480	2.00	1.58	3.00	2.00	20	0.0006	1.00
Bluetooth	2402-2480	2.00	1.58	7.00	5.01	20	0.0016	1.00
Zigbee	2405~2475	2.00	1.58	5.00	3.16	20	0.0010	1.00

Note: Wi-Fi and BT/BLE cannot transmit simultaneously.

Wi-Fi & Zigbee or BT/BLE & Zigbee can transmit simultaneously; the worst condition is 802.11g of Wi-Fi and Zigbee as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0498/1.00 + 0.0010/1.00 = 0.0508 < 1.0$$

**Conclusion:** The device meet FCC MPE at 20 cm distance.