

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

### **Applicable Standard**

According to subpart 15.247 (i) and subpart 1.1310, 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

<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

### **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 (worst case):**

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	2.42	1.75	23.50	223.87	20	<b>0.0779</b>	1.00
BLE	2402-2480	2.42	1.75	8.50	7.08	20	0.0025	1.00
Bluetooth	2402-2480	2.42	1.75	10.00	10.00	20	0.0035	1.00

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)			
GPRS 850	824.2-848.8	1.82	1.52	26.00	398.11	20	<b>0.1204</b>	<b>0.55</b>
GPRS 1900	1850.2-1909.8	1.82	1.52	22.24	167.49	20	0.0507	1.00

**Note 1:**

GPRS 850: Tune-up maximum output power with 4 slots is 29.00 dBm, so the tune-up time based Ave. power compared to slotted Ave. power is 26.00dBm.

GPRS 1900: Tune-up maximum output power with 3 slots is 26.50 dBm, so the tune-up time based Ave. power compared to slotted Ave. power is 22.24 dBm.

Number of Time slot	1	2	3	4
Duty Cycle	1:8	1:4	1:2.66	1:2
Time based Ave. power compared to slotted Ave. power	-9 dB	-6 dB	-4.26 dB	-3 dB

**Note 2:**

Wi-Fi and BT/BLE cannot transmit simultaneously.

Wi-Fi & GPRS or BT/BLE & GPRS can transmit simultaneously; the worst condition is Wi-Fi & GPRS 850 as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0779/1.00 + 0.1204/0.55 = 0.2968 < 1.0$$

**Conclusion:** The device meets MPE at distance 20cm.