

## **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:**

Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Output Power		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	MPE ratio
		(dBi)	(numeric)	(dBm)	(mW)				
Wi-Fi 802.11b	2412~2462	5.00	3.16	12.00	15.85	20	0.0100	1.00	0.0100
Wi-Fi 802.11g		5.00	3.16	15.00	31.62	20	0.0199	1.00	0.0199
Wi-Fi 802.11n-HT20		5.00	3.16	18.00	63.10	20	0.0397	1.00	<b>0.0397</b>
LTE Band 2	1850~1910	4.00	2.51	24.00	251.19	20	0.1255	1.00	0.1255
LTE Band 4	1710~1755	4.00	2.51	23.00	199.53	20	0.0997	1.00	0.0997
LTE Band 5	824~849	4.00	2.51	24.00	251.19	20	0.1255	0.55	0.2282
LTE Band 12	699~716	4.00	2.51	24.00	251.19	20	0.1255	0.47	0.2670
LTE Band 13	777~787	4.00	2.51	24.00	251.19	20	0.1255	0.52	0.2414
LTE Band 26	814~849	4.00	2.51	24.00	251.19	20	0.1255	0.55	0.2282
GPRS 850	824~849	4.00	2.51	27.50	562.36	20	0.2810	0.55	<b>0.5109</b>
GPRS 1900	1850~1910	4.00	2.51	26.50	446.68	20	0.2232	1.00	0.2232

**Note:**

(1) The target output powers are all declared by the Manufacturer.

(2) The LTE module FCC ID: XMR201707BG96.

(3) For GPRS/EGPRS Mode, the time based average power is relevant, the difference in between depends on the duty cycle of the TDMA signal.

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	-4.25 dB	-3 dB

GPRS: Maximum target output power with 4 slots are 30.5dBm@ GPRS850 and 29.5dBm@GPRS1900, so the time based Ave. power compared to slotted Ave. power are 27.5 dBm@ GPRS850 and 26.5 dBm@GPRS1900

(4) Wi-Fi and GPRS can transmit simultaneously; the worst condition is 802.11n-HT20 of Wi-Fi and GPRS850 4 slot as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0397 + 0.5109 = 0.5506 < 1.0$$

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