

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

### **Applicable Standard**

According to subpart 15.247(i) 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) | 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)   |                          |                                     |                                 |
| BLE             | 2402-2480             | 3.28         | 2.13      | -7.00                   | 0.20   | 20                       | 0.0001                              | 1.00                            |
| GPRS/EGPRS 850  | 824-849               | 1.79         | 1.51      | 27.50                   | 562.34 | 20                       | 0.1689                              | 0.55                            |
| GPRS/EGPRS 1900 | 1850~1910             | 1.44         | 1.39      | 26.50                   | 446.68 | 20                       | 0.1238                              | 1.00                            |
| LTE Band 2      | 1850~1910             | 1.44         | 1.39      | 25.00                   | 316.23 | 20                       | 0.0876                              | 1.00                            |
| LTE Band 4      | 1710~1755             | 1.58         | 1.44      | 25.00                   | 316.23 | 20                       | 0.0905                              | 1.00                            |
| LTE Band 5      | 824-849               | 1.79         | 1.51      | 25.00                   | 316.23 | 20                       | 0.0950                              | 0.55                            |
| LTE Band 12     | 699~716               | 2.12         | 1.63      | 25.00                   | 316.23 | 20                       | 0.1025                              | 0.47                            |
| LTE Band 13     | 777~787               | 2.79         | 1.90      | 25.00                   | 316.23 | 20                       | 0.1196                              | 0.52                            |
| LTE Band 25     | 1850~1915             | 1.44         | 1.39      | 25.00                   | 316.23 | 20                       | 0.0876                              | 1.00                            |
| LTE Band 26     | 814-849               | 1.79         | 1.51      | 25.00                   | 316.23 | 20                       | 0.0950                              | 0.54                            |
| LTE Band 66     | 1710-1780             | 1.58         | 1.44      | 25.00                   | 316.23 | 20                       | 0.0905                              | 1.00                            |
| LTE Band 85     | 698-716               | 2.12         | 1.63      | 25.00                   | 316.23 | 20                       | 0.1025                              | 0.47                            |
| NB-IOT Band 2   | 1850~1910             | 1.44         | 1.39      | 25.00                   | 316.23 | 20                       | 0.0876                              | 1.00                            |
| NB-IOT Band 4   | 1710~1755             | 1.58         | 1.44      | 25.00                   | 316.23 | 20                       | 0.0905                              | 1.00                            |
| NB-IOT Band 5   | 824-849               | 1.79         | 1.51      | 25.00                   | 316.23 | 20                       | 0.0950                              | 0.55                            |
| NB-IOT Band 12  | 699~716               | 2.12         | 1.63      | 25.00                   | 316.23 | 20                       | 0.1025                              | 0.47                            |
| NB-IOT Band 13  | 777~787               | 2.79         | 1.90      | 25.00                   | 316.23 | 20                       | 0.1196                              | 0.52                            |
| NB-IOT Band 25  | 1850~1915             | 1.44         | 1.39      | 25.00                   | 316.23 | 20                       | 0.0876                              | 1.00                            |
| NB-IOT Band 66  | 1710-1780             | 1.58         | 1.44      | 25.00                   | 316.23 | 20                       | 0.0905                              | 1.00                            |
| NB-IOT Band 71  | 663-698               | 1.47         | 1.40      | 25.00                   | 316.23 | 20                       | 0.0882                              | 0.44                            |
| NB-IOT Band 85  | 698-716               | 2.12         | 1.63      | 25.00                   | 316.23 | 20                       | 0.1025                              | 0.47                            |

**Note:**

- 1). For the above tune up power were declared by the manufacturer.
- 2) The LTE module FCC ID: XMR202005BG95M5
- 3) BLE and GSM/LTE can transmit simultaneously, the worst condition is BLE & GSM850 as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0001/1.00 + 0.1689/0.55 = 0.0001 + 0.3071 = 0.3072 < 1.0$$

(4) 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 |

**Note 1:**

The target output power:

GPRS 850: Tune-up maximum power: 1 slot 32.5dBm, 2 slots 32.5dBm, 3 slots 31.5dBm, 4 slots 30.5dBm, tune-up max time based Ave. power 27.5dBm;

GPRS 1900: Tune-up maximum power: 1 slot 30.0dBm, 2 slots 30.0dBm, 3 slots 30.0dBm, 4 slots 29.50dBm, tune-up max time based Ave. power 26.50dBm.

EGPRS 850: Tune-up maximum power: 1 slot 27.0dBm, 2 slots 27.0dBm, 3 slots 26.5dBm, 4 slots 26.5dBm, tune-up max time based Ave. power 23.5dBm;

EGPRS 1900: Tune-up maximum power: 1 slot 26.5dBm, 2 slots 26.0dBm, 3 slots 26.0dBm, 4 slots 26.0dBm, tune-up max time based Ave. power 23dBm;

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