

## FCC §1.1307& §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### Applicable Standard

According to subpart §2.1091 and subpart §1.1307, 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) (§1.1307, §2.1091)

| (B) Limits for General Population/Uncontrolled Exposure |                               |                               |                                     |                          |
|---------------------------------------------------------|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Frequency Range (MHz)                                   | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm <sup>2</sup> ) | Averaging Time (minutes) |
| 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 §1.1307 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);

Calculated Data:

| Mode               | Max Turn-up power (dBm) | ERP/EIRP Limit (dBm) | Max Antenna Gain (dBi) |
|--------------------|-------------------------|----------------------|------------------------|
| GSM 850/GPRS 850   | 33.0                    | 38.45                | 5.45                   |
| EGPRS 850          | 26.0                    | 38.45                | 12.45                  |
| GSM 1900/GPRS 1900 | 30.5                    | 33                   | 2.5                    |
| EGPRS 1900         | 25.0                    | 33                   | 8.0                    |
| WCDMA Band V       | 24.0                    | 38.45                | 14.45                  |
| WCDMA Band II      | 22.5                    | 33                   | 10.5                   |
| LTE Band 2         | 22.0                    | 33                   | 11.0                   |
| LTE Band 4         | 23.0                    | 30                   | 7.0                    |
| LTE Band 5         | 23.0                    | 38.45                | 15.45                  |
| LTE Band 7         | 22.5                    | 33                   | 10.5                   |

| Mode                   | Frequency | Antenna Gain |           | Target Output Power |        | Evaluation Distance | Power Density         | MPE Limit             |
|------------------------|-----------|--------------|-----------|---------------------|--------|---------------------|-----------------------|-----------------------|
|                        | (MHz)     | (dBi)        | (numeric) | (dBm)               | (mW)   | (cm)                | (mW/cm <sup>2</sup> ) | (mW/cm <sup>2</sup> ) |
| GSM 850<br>/GPRS 850   | 824.2     | 5.41         | 3.48      | 29.0                | 794.33 | 20                  | 0.549                 | 0.549                 |
| EGPRS 850              | 824.2     | 11.41        | 13.84     | 23.0                | 199.53 | 20                  | 0.549                 | 0.549                 |
| GSM 1900<br>/GPRS 1900 | 1909.8    | 10.01        | 10.03     | 27.0                | 501.19 | 20                  | 1.000                 | 1.000                 |
| EGPRS 1900             | 1850.2    | 15.01        | 31.71     | 22.0                | 158.49 | 20                  | 1.000                 | 1.000                 |
| WCDMA<br>Band V        | 826.4     | 10.43        | 11.03     | 24                  | 251.19 | 20                  | 0.551                 | 0.551                 |
| WCDMA<br>Band II       | 1880.0    | 14.51        | 28.26     | 22.5                | 177.83 | 20                  | 1.000                 | 1.000                 |
| LTE Band 2             | 1880.0    | 15.01        | 31.71     | 22.0                | 158.49 | 20                  | 1.000                 | 1.000                 |
| LTE Band 4             | 1732.5    | 14.01        | 25.19     | 23.0                | 199.53 | 20                  | 1.000                 | 1.000                 |
| LTE Band 5             | 824.7     | 11.42        | 13.87     | 23                  | 199.53 | 20                  | 0.550                 | 0.550                 |
| LTE Band 7             | 2535.0    | 14.51        | 28.26     | 22.5                | 177.83 | 20                  | 1.000                 | 1.000                 |

**Note 1:**

The target output power:

GSM 850: Maximum output power with 1 slot is 33.0dBm, time based Ave. power is 24.0dBm;  
GPRS 850: Maximum output power with 4 slots is 32.0dBm, time based Ave. power is 29.0dBm;  
EGPRS 850: Maximum output power with 4 slots is 26.0dBm, time based Ave. power is 23.0dBm;  
GSM 1900: Maximum output power with 1 slot is 30.5dBm, time based Ave. power is 21.5dBm;  
GPRS 1900: Maximum output power with 4 slots is 30.0dBm, time based Ave. power is 27.0dBm;  
EGPRS 1900: Maximum output power with 4 slots is 25.0dBm, time based Ave. power is 22.0dBm;  
WCDMA Band V: 24.0dBm;  
WCDMA Band II: 22.5dBm;  
LTE Band2: 22.0dBm;  
LTE Band4: 23.0dBm;  
LTE Band5: 23.0dBm;  
LTE Band7: 22.5dBm,

which was declared by the manufacturer.

| Number of Time slot                                  | 1     | 2      | 3        | 4      |
|------------------------------------------------------|-------|--------|----------|--------|
| Duty Cycle                                           | 1:8.3 | 1:4.15 | 1:2.77   | 1:2.08 |
| Time based Ave. power compared to slotted Ave. power | -9 dB | -6 dB  | -4.26 dB | -3 dB  |

| Mode               | Max Allow Antenna Gain (dBi) |
|--------------------|------------------------------|
| GSM 850/GPRS 850   | 5.41                         |
| EGPRS 850          | 11.41                        |
| GSM 1900/GPRS 1900 | 2.5                          |
| EGPRS 1900         | 8.0                          |
| WCDMA Band V       | 10.43                        |
| WCDMA Band II      | 10.50                        |
| LTE Band 2         | 11.0                         |
| LTE Band 4         | 7.0                          |
| LTE Band 5         | 11.42                        |
| LTE Band 7         | 10.50                        |

**Note 2:**

To meet RF exposure & ERP/ERIP, the maximum net gain of antennas allowed are 5.41dBi @ GSM 850/ GPRS 850 , 11.41dBi @ EGPRS 850 , 2.5dBi @ GSM 1900/GPRS 1900 , 8.0dBi @ EGPRS 1900 , 10.43dBi @ WCDMA Band V , 10.50dBi @ WCDMA Band II , 11.0dBi @ LTE Band 2 , 7.0dBi @ LTE Band 4 , 11.42dBi @ LTE Band 5, 10.50dBi @ LTE Band 7. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.