

## FCC §1.1307& §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) 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 §1.1310 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);

### Calculated Data:

Calculation maximum antenna gain based on ERP/EIRP

| Mode                | Max Tune-up power (dBm) | ERP/EIRP Limit (dBm) | Max Antenna Gain (dBi) |
|---------------------|-------------------------|----------------------|------------------------|
| GSM 850/ GPRS 850   | 33.00                   | 38.45                | 5.45                   |
| GSM 1900/ GPRS 1900 | 30.00                   | 33.00                | 3.00                   |

Calculation maximum antenna gain based on MPE

| Mode              | Frequency Range (MHz) | MPE Limit (mW/cm <sup>2</sup> ) | Tune-up Power Source Based Time Average Power |        | Evaluation Distance (cm) | Antenna Gain |           | Power Density (mW/cm <sup>2</sup> ) |
|-------------------|-----------------------|---------------------------------|-----------------------------------------------|--------|--------------------------|--------------|-----------|-------------------------------------|
|                   |                       |                                 | (dBm)                                         | (mW)   |                          | (dBi)        | (numeric) |                                     |
| GSM850/ GPRS 850  | 824.2-848.8           | 0.549                           | 27                                            | 501.19 | 20                       | 7.40         | 5.50      | 0.548                               |
| GSM1900/ GPRS1900 | 1850.2-1909.8         | 1.000                           | 25                                            | 316.23 | 20                       | 12.01        | 15.89     | 0.999                               |

**Note:**

The target output power:

GSM 850: 32.5±0.5dBm, Maximum power 33dBm, Max Average Time-base power 24dBm;

GSM 1900: 29±1dBm, Maximum power 30dBm, Max Average Time-base power 21dBm;

GPRS 850: 1 slot 32.5±0.5dBm, 2 slots 31.5±0.5dBm, 3 slots 30.5±0.5dBm, 4 slots 29.5±0.5dBm

Max Average Time-base power 27dBm;

GPRS 1900: 1 slot 29±1dBm, 2slots 28±1dBm, 3 slots 27.5±0.5dBm, 4 slots 27.5±0.5dBm

Max Average Time-base power 25dBm.

| Number of Time slot                                  | 1     | 2     | 3        | 4     |
|------------------------------------------------------|-------|-------|----------|-------|
| Duty Cycle                                           | 1:8   | 1:4   | 1:2.67   | 1:2   |
| 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   | 5.45                         |
| GSM 1900/ GPRS 1900 | 3.00                         |

**Result:** To meet RF exposure & ERP/ERIP, the maximum net gain of antennas allowed are 5.45dBi @ GSM 850/GPRS 850, 3.00 dBi @ GSM 1900/GPRS 1900. 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.