# FCC §1.1307 (b) (1) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### **Applicable Standard**

According to subpart 1.1307 (b)(1), 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.

| Limits for occupational/Controlled Exposure |                                     |                                     |                                           |                                |  |  |  |  |  |
|---------------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------------|--------------------------------|--|--|--|--|--|
| Frequency<br>Range<br>(MHz)                 | Electric Field<br>Strength<br>(V/m) | Magnetic Field<br>Strength<br>(A/m) | Power<br>Density<br>(mW/cm <sup>2</sup> ) | Averaging<br>Time<br>(Minutes) |  |  |  |  |  |
| 0.3-1.34                                    | 614                                 | 1.63                                | *(100)                                    | 6                              |  |  |  |  |  |
| 1.34-30                                     | 1842/f                              | 4.89/f                              | *(900/f <sup>2</sup> )                    | 6                              |  |  |  |  |  |
| 30-300                                      | 61.4                                | 0.163                               | 1.0                                       | 6                              |  |  |  |  |  |
| 300-1500                                    | /                                   | /                                   | f/300                                     | 6                              |  |  |  |  |  |
| 1500-100,000                                | /                                   | /                                   | 5.0                                       | 6                              |  |  |  |  |  |

Limits for Occupational/Controlled Exposure

f = frequency in MHz

\* = Plane-wave equivalent power density

#### Result

#### **Calculated Formulary:**

Predication of MPE limit at a given distance

$$\mathbf{S} = \frac{PG}{4\pi R^2}$$

S = 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:

$$\sum_{i} \frac{S_i}{S_{Limit,i}} \leq 1$$

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Worst case as below:

| Frequency<br>(MHz) | Antenna Gain |           | Tune up<br>Conducted Power |          | Tune up<br>Average<br>power | Evaluation<br>Distance | Power<br>Density      | MPE Limit<br>(mW/cm <sup>2</sup> ) |
|--------------------|--------------|-----------|----------------------------|----------|-----------------------------|------------------------|-----------------------|------------------------------------|
|                    | (dBi)        | (numeric) | (dBm)                      | (mW)     | (mW)                        | (cm)                   | (mW/cm <sup>-</sup> ) |                                    |
| 824-849            | 1.0          | 1.26      | 33.5                       | 2238.72  | 279.84                      | 40                     | 0.02                  | 2.75                               |
| 1850-1910          | 3.5          | 2.24      | 29.5                       | 891.25   | 111.41                      | 40                     | 0.01                  | 5.00                               |
| 400-470            | 3.5          | 2.24      | 43.5                       | 22387.21 | 11193.61                    | 40                     | 1.25                  | 1.33                               |

Note:

For GSM mode, the Time-base average power was consideration, Average power as below: GSM850: 2238.72\*(1/8)mW=279.84mW. PCS1900: 891.25\*(1/8)mW=111.41mW.

For DMR mode, the duty cycle of 50% was consideration, Average power as below: 22387.21\*50%mW=11193.61mW.

Simultaneous transmitting consideration: GSM850 and DMR, or PCS1900 and DMR

The ratio=MPE/limit<sub>824MHz</sub>+MPE/limit<sub>410MHz</sub>= $0.02/2.75+1.25/1.33=0.95 \le 1.0$ , simultaneous exposure is not required.

The ratio=MPE/limit<sub>1850MHz</sub>+MPE/limit<sub>410MHz</sub>= $0.01/5.00+1.25/1.33=0.94 \le 1.0$ , simultaneous exposure is not required.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 40 cm from nearby persons to antenna.

## **Result: Compliance**