

# MPE Calculation

**§ 1.1310:** The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

## Part 1.1310 Limits for Maximum Permissible Exposure (MPE)

| Frequency range<br>(MHz)                                       | Electric field<br>strength<br>(V/m) | Magnetic field<br>strength<br>(A/m) | Power density<br>(mW/cm <sup>2</sup> ) | Averaging time<br>(minutes) |
|----------------------------------------------------------------|-------------------------------------|-------------------------------------|----------------------------------------|-----------------------------|
| <b>(A) Limits for Occupational/Controlled Exposures</b>        |                                     |                                     |                                        |                             |
| 0.3–3.0 .....                                                  | 614                                 | 1.63                                | *(100)                                 | 6                           |
| 3.0–30 .....                                                   | 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                                      | 6                           |
| <b>(B) Limits for General Population/Uncontrolled Exposure</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

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

## 1.1 Test Procedure

An MPE evaluation for was performed in order to show that the device was compliant with §2.1091. The maximum power density was calculated for each transmitter at a separation distance of 20cm.

For each transmitter the maximum RF exposure at a 20 cm distance using the formula:

$$ConductedPower_{mW} = 10^{ConductedPower(dBm)/10}$$

$$PowerDensity = \frac{ConductedPower_{mW} \times Ant.Gain}{4\pi \times (20_{cm})^2}$$



## 1.2 Results:

The following calculations show that the total power density from each transmitter at 20cm is less than the limit for general population / un-controlled exposure.

### CDMA Cell Band Transmitter:

| Cell Band                       | Value  | Unit               | Comments                                                                   |
|---------------------------------|--------|--------------------|----------------------------------------------------------------------------|
| Frequency                       | 825    | MHz                |                                                                            |
| Distance                        | 20     | cm                 |                                                                            |
| Maximum Scaled Power            | 25     | dBm                | Maximum Conducted Power                                                    |
| TX Antenna Gain                 | -1.1   | dBi                | From Antenna Data Sheet                                                    |
| Source Based Duty Cycle         | 100    | %                  | Percent of time transmitter is active                                      |
| EIRP                            | 23.9   | dBm                | Maximum Scaled Power x Antenna Gain                                        |
| Source Based Output Power       | 23.9   | dBm                | EIRP x Duty Cycle                                                          |
| Power Density @ Distance        | 0.0488 | mW/cm <sup>2</sup> | (Source Based Output Power, mW) / (4 $\pi$ x (distance, cm) <sup>2</sup> ) |
| FCC Limit                       | 0.5500 | mW/cm <sup>2</sup> | .0007 x f <sup>1</sup>                                                     |
| Ratio of Power Density to Limit | 0.0888 |                    | Power Density / FCC Limit                                                  |

### CDMA PCS Band Transmitter:

| PCS Band                        | Value  | Unit               | Comments                                                                   |
|---------------------------------|--------|--------------------|----------------------------------------------------------------------------|
| Frequency                       | 1900   | MHz                |                                                                            |
| Distance                        | 20     | cm                 |                                                                            |
| Maximum Scaled Power            | 25     | dBm                | Maximum Conducted Power                                                    |
| TX Antenna Gain                 | -0.1   | dBi                | From Antenna Data Sheet                                                    |
| Source Based Duty Cycle         | 100    | %                  | Percent of time transmitter is active                                      |
| EIRP                            | 24.9   | dBm                | Maximum Scaled Power x Antenna Gain                                        |
| Source Based Output Power       | 24.9   | dBm                | EIRP x Duty Cycle                                                          |
| Power Density @ Distance        | 0.0615 | mW/cm <sup>2</sup> | (Source Based Output Power, mW) / (4 $\pi$ x (distance, cm) <sup>2</sup> ) |
| FCC Limit                       | 1.0000 | mW/cm <sup>2</sup> | 1. x f <sup>0</sup>                                                        |
| Ratio of Power Density to Limit | 0.0615 |                    | Power Density / FCC Limit                                                  |