**RF Exposure Technical Brief**

This Technical Brief calculates the minimum separation distance from an antenna, connected to the subject base station, such that the power density values listed in RSS-102, Radio Frequency (RF) Exposure Compliance of Radiocommunications Apparatus (All Frequency Bands) Table 4.2 and Table 4.4 are not exceeded. The analysis is for a typical installation using a structure mounted antenna.

Within the frequency range that the subject equipment operates, 851 MHz – 870 MHz, the maximum permitted exposure limit for uncontrolled environments is a power density of 2 $W/m^2$ and the maximum permitted exposure limit for controlled environments is 10 $W/m^2$. Within this frequency range the permitted exposure limit is frequency independent. Table 1 lists the maximum permitted exposure limits by environment type for the subject equipment.

**Table 1 - Maximum Permissible Exposure Limits**

| | Uncontrolled Environment | Controlled Environment |
|---|---|---|
| Frequency | 851-869 MHz | 851-869 MHz |
| Limit | 5.67 $W/m^2$ | 28.4 $W/m^2$ |

**Example Calculations for GTR8000, 800 MHz Transmitter:**

The example configuration is a single frequency site, with minimal RF network losses, considered to be zero for this example, between the transmitter output connector and the antenna input connector. The antenna has an omni directional pattern in the horizontal plane and a 13 degree beamwidth in the vertical plane. The largest dimension of the antenna is mounted in a vertical orientation. A low gain antenna was selected to realize a short antenna length which results in a higher power density over the analyzed surface area. This configuration results in a conservative separation distance, i.e., larger distance.

**Table 2 - Transmitter Configuration**

| | |
|---|---|
| Frequency | 851-869 MHz |
| Base Station Output Power | 100 W |
| RF Network Loss | 0 dB |
| Antenna Type RFS BMR6-O-B1 | 6 dBd / 8.1 dBi (Omni) |
| Antenna length | 1.68 m |

Using Equation 1 the spatially averaged plane-wave equivalent power densities parallel to the antenna in the vertical plane may be estimated by dividing the net input power to the antenna by the surface area of an imaginary cylinder at a distance *R* from the antenna, with the height of the cylinder equal to the length of the antenna[1].

$$S = \frac{Pnet}{2\pi Rh} \qquad (1)$$

[1] Federal Communications Commission Office of Engineering & Technology, OET Bulletin 65, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 97-01, page 32, Tell's cylindrical model.

Where:

$S$ = power density, W/m$^2$

$Pnet$ = net input power to the antenna, W

$R$ = radial distance from the antenna, m

$h$ = height of the antenna, m

The minimum separation distance can be found by solving Equation 1 for $R$ and setting $S$ to the maximum power density for the environment per Table 1.

**Uncontrolled environment:**

$$R = \frac{Pnet}{2\pi hS} = \frac{100}{2\pi \times 1.68 \times 2} = 1.67 \text{ m} \quad (2)$$

**Controlled environment:**

$$R = \frac{Pnet}{2\pi hS} = \frac{100}{2\pi \times 1.68 \times 10} = 0.33 \text{ m} \quad (3)$$

For the example site configuration the minimum separation distance for an uncontrolled environment is 1.67 m and the minimum separation distance for the controlled environment is 0.33 m.