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 value listed in RSS-102 (Issue 6), Radio Frequency (RF) Exposure Compliance of Radiocommunications Apparatus (All Frequency Bands) Table 7 and Table 8, are not exceeded.

The analysis is for a typical installation using a structure mounted antenna.

Within the frequency range that the subject equipment operates, 768 MHz – 776 MHz the permitted exposure limit is frequency dependent.

Table 1 lists the maximum permitted exposure limits for the lowest and highest operating frequencies. The smaller maximum permissible exposure limit will be used for the computation because it requires a larger separation distance from the antenna to the exposed person.

Table 1 - Maximum Permissible Exposure Limits

	Controlled Environment	
Frequency	768 MHz	776 MHz
Limit	17.9 W/m^2	18.0 W/m^2

Example Calculations for DBR M12, 700 MHz Transmitter:

The example configuration is a multicarrier site with 6 channels transmitting at 90W, with minimal RF network losses, set to 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 in the vertical plane. A 10 dBd gain antenna was selected as representative of the structure mounted infrastructure antennas used in the 700 MHz band.

Table 2 - Transmitter Configuration

Frequency	768 - 776 MHz
Base Station Output Power	540 W
RF Network Loss	0 dB
Antenna Type: Amphenol BPS10-O-B1	10 dBd / 12.1 dBi (Omni)
Antenna length	4.26 m

Controlled Environment: Cylindrical Method

Using Equation 1 the spatially averaged plane-wave equivalent power density parallel to the antenna in the vertical plane is 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].

[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.

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

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 smaller maximum power density for the environment per Table 1.

$$R = \frac{Pnet}{2\pi hS} = \frac{540}{2\pi \times 4.26 \times 17.9} = 1.12 \text{ m} \quad (2)$$

For the example site configuration the minimum separation distance for a controlled environment is 1.12 m.