RF Exposure Calculations for BREEZECOM'S High Gain Antennas

From FCC 1.1310 table 1A, the maximum permissible RF exposure for a controlled environment is $5mW/cm^2$ (S). In an uncontrolled environment, the maximum exposure is $1mW/cm^{2.}$ Whenever an amplifier is used, the professional installer will be made aware of potential RF exposure. The Installation Manual will contain information concerning RF exposure for the antennas to be installed. It will instruct the Installer to only install the antennas in controlled environment when an amplifier is used.

The Electric field generated for a $1mW/cm^2$ exposure (S) is calculated as follows:

$$S = E^2/Z$$

where:

S = Power density
E = Electric field
Z = Impedance.

$$E = \sqrt{S \times Z}$$

$1mW/cm^2 = 10\ W/m^2$

The impedance of free space is 337 ohms, where E and H fields are perpendicular.

Thus:

$$E = \sqrt{10 \times 377} = 61.4\ V/m$$ which is equivalent to $1mW/cm^2$

Using the relationship between Electric field E, Power in watts P, and distance in meters d, the corresponding Antenna numeric gain G and the Amplifier output power and solving for d,

$$d = \sqrt{\frac{P_{peak} \times 30 \times G}{E}}$$

Example using the Uni 24 directional antenna

1. The Numeric gain G of antenna with a gain specified in dB is determined by:

   $G = \text{Log}^{-1}(\text{dB gain}/10)$

   $G = \text{Log}^{-1}\ 24 = 251.2$

2. Uni-24 antenna-gain with a gain of 24 dB, the $1mW/cm^2$: distance is:

   P = 24 dBm (250 mW worst case)
   d = 70.7 cm

Notice in Installation Manual:

While installing and operating this radio frequency device, transmitter / amplifier, and antenna combination the radio frequency exposure limits of 1mW/cm^2 may be exceeded at distances close to the antennas installed. Therefore, when used with an amplifier the antenna must be installed in a controlled environment.

The table below identifies the distances where the 1mW/cm^2 exposure limits may be exceeded during continuos transmission. See the peak power exposure distance for each transmitter/amp/antenna combination.

Antenna Type	Gain (dBi)	Gain Numeric	Amp Peak output Power (mW)	Peak Power Exposure Distance (cm)
Uni 24	24	251.2	250	70.7
Uni 21	21	125.9	250	50.1
Uni 18	18	63.1	250	35.4
Uni 16	16	39.8	250	28.1
Uni 16	16	39.8	500	39.8
Uni 13	13	20.0	500	28.2
Omni 12	12	15.8	250	17.7
Omni 8	8	6.3	500	15.8
Omni 6	6	4.0	500	12.6

Note: During normal operation, the transmitter power is about 12 dB less then the peak power since the transmitter is on only a portion of the time. Thus the Exposure Distance are typically approximately ½ of the Peak Distances.