RF Exposure Calculations for BREEZECOM'S high gain Antennas

From FCC 1.1310 table 1A, the maximum permissible exposure for a controlled environment is 5mW/cm2. The controlled environment was chosen because the professional installer will be aware of potential RF exposure before installation. Breezecom's professional installation manual will contain information concerning RF exposure for the antennas to be installed.

The Electric field generated for a 5mW/cm2 exposure = S = E2/Z where S = Power density, E = Electric field, and Z = Impedance.

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

5mW/cm2 = 50 W/m2

$E = \sqrt{50 \times 377} = 137.3$ V/m

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 peak output power and solving for d,

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

Example using the Uni 24 directional antenna:

1. Uni 24 antenna-gain = 24dBi, Numeric gain G = 251.2, P=23.7 dBm = 234.4 mW, d = 30.6 cm assuming the peak power is constant. In frequency hopping spread spectrum transmitters, the output power averages out because the channels are hopping in a sequence. However the peak power is used when setting up initial output power during installation of the radio device per manufacturers specification in accordance with the commissions approved output power levels.
2. The dwell time produces an average power that equals the transmitter peak output power – the average factor of 11.7 dB. The average factor is 20 log 26.6/100 = -11.5. The average factor is 88.65% of 30 msec, the dwell time supplied by the manufacturer. Therefore the average power = 23.7 – 11.7 = 12 dBm = 15.84 mW. When this power is put into the equation, d = 8 cm. A statement will be placed in the professional installation manual with the following wording for each Amplifier/antenna type.

Notice:
While installing and operating this radio frequency device, transmitter / amplifier, and antenna combination the radio frequency exposure limits may be exceeded at distances closer from the antennas installed. The table below identifies the distances where the exposure limits may be exceeded. See the peak power exposure distance for each transmitter/amp/antenna combination.

Antenna Type	Gain (dBi)	Gain Numeric	Amp Peak output Power (mW)	Amp Average output Power (mW)	Peak Power Exposure Distance (cm)	Average Power Exposure Distance (cm)
Uni 24	24	251.2	234.4	15.84	30.6	8
Uni 21	21	125.9	234.4	15.84	21.7	5.6
Uni 18	18	63.1	251.2	17.0	15.9	4.1
Uni 16	16	39.8	234.4	15.84	12.2	3.2
Uni 16	16	39.8	446.7	30.2	15.1	4.4
Uni 13	13	20.0	446.7	30.2	11.9	3.1
Omni 12	12	15.8	251.2	17.0	7.9	2.1
Omni 8	8	6.3	446.7	30.2	6.7	1.9
Omni 6	6	4.0	446.7	30.2	5.3	1.4

Note: The average exposure distance limit is when the transmitter/amp is performing its hopping sequence.