

## APPENDIX A: RF EXPOSURE CALCULATIONS FOR HIGH GAIN ANTENNAS

From FCC 1.1310 table 1A, the maximum permissible RF exposure for an uncontrolled environment is  $1\text{mW}/\text{cm}^2$ . The Electric field generated for a  $1\text{mW}/\text{cm}^2$  exposure (S) is calculated as follows:

$$S = E^2/Z$$

where:

S = Power density

E = Electric field

Z = Impedance.

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

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

The impedance of free space is 377 ohms, where E and H fields are perpendicular.  
Thus:

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

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

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

### Example using the Stub Omni-directional antenna

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

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

$$G = \text{Log}^{-1} 0.215 = 1.64$$

The following tables represent the RF exposure separation distance. The value shown in Table 11-1 was calculated from the defacto EIRP (=antenna gain+power output). The value shown in Table 11-2 was calculated from the radiated EIRP measurement. The tables represent the typical RF distance and the worst-case configuration based on the antenna specification provided from the manufacturer.

**TABLE 12-1: RF EXPOSURE SEPARATION DISTANCE FROM DEFACTO EIRP**

ANTENNA TYPE	EIRP (dBm)	ANTENNA GAIN (dBi)	CALCULATED RF EXPOSURE SEPARATION DISTANCE (cm)	MINIMUM RF EXPOSURE SEPARATION DISTANCE (cm)
5dBi antenna	34.4	5.0	14.8	20
3dBi antenna	32.4	3.0	11.7	20

**TABLE 12-2: RF EXPOSURE SEPARATION DISTANCE FROM MEASURED EIRP**

ANTENNA TYPE	EIRP (dBm)	ANTENNA GAIN (dBi)	CALCULATED RF EXPOSURE SEPARATION DISTANCE (cm)	MINIMUM RF EXPOSURE SEPARATION DISTANCE (cm)
5dBi antenna	34	5.0	14.1	20
3dBi antenna	32	3.0	11.2	20