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 1mW/cm$^{2.}$ 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 transmitter output power and solving for d,

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

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 12-1 was calculated from the defacto EIRP (=antenna gain+power output). The value shown in Table 12-2 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 by 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)
6dBi antenna	33	6.0	12.6.	20
9dBi antenna	36	9.0	17.7	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)
6dBi antenna	32.9	6.0	12.4	20
9dBi antenna	35.9	9.0	17.4	20