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 table represents the RF exposure separation distance. The value shown in Table 11-1 was calculated from the defacto EIRP (= antenna gain + power output - cable loss). The table represents the typical RF distance and the worst-case configuration based on the antenna specification provided from the manufacturer.

TABLE 11-1: RF EXPOSURE SEPARATION DISTANCE FROM DEFACTO EIRP

Antenna Part # & Antenna Type	Minimum Cable Length (dB loss) Between Antenna & Power Amplifier for LMR 600/LMR 400	EIRP (dBm)	Antenna Gain (dBi)	Calculated RF Exposure Separation Distance (cm)	Minimum RF Exposure Separation Distance (cm)
ANT-O2412 Omni directional	150' /98' (6.6 dB)	32.4	12	11.8	20 cm
ANT-O2409 Omni directional	75'/49' (3.3 dB)	32.7	9	12.2	20 cm
ANT-O2408 Omni directional	50' /33' (2.2 dB)	32.8	8	12.3	20 cm
ANT-P2419 Patch	300'/195' (13.2 dB)	32.8	19	12.3	200 cm
ANT-P2418 Patch	265'/172' (11.7 dB)	33.3	18	13.0	200 cm
ANT-P2415 Patch	157'/102' (6.9 dB)	35.1	15	16.0	200 cm
ANT-P2413 Patch	95'/62' (4.2 dB)	35.8	13	17.4	200 cm
ANT-P2412 Patch	73'/47' (3.2 dB)	35.8	12	17.4	200 cm
ANT-G2418 Grid	250'/162' (11.0 dB)	34	18	14.1	200 cm
ANT-G2424 Grid	300'/195' (13.2 dB)	37.8	24	21.9	200 cm
ANT-D2421 Dish	100'/65' (4.4 dB)	43.1	20.5	40.3	200 cm