



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:

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

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:

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

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

Notice in Installation Manual:

While installing and operating this transmitter and antenna combination the radio frequency exposure limit of $1\text{mW}/\text{cm}^2$ may be exceeded at distances close to the antennas installed. Therefore, the user must maintain a minimum distance of 5 cm from the antenna at all time.

The table below identifies the distances where the $1\text{mW}/\text{cm}^2$ exposure limits may be exceeded during continuous transmission using the external antenna

TABLE 10-1: RF EXPOSURE SEPARATION DISTANCE

ANTENNA TYPE	EIRP Gemini 2 antenna (dBm)	ANTENNA GAIN	CALCULATED RF EXPOSURE SEPARATION DISTANCE (cm)	MINIMUM RF EXPOSURE SEPARATION DISTANCE (cm)
Patch (GEMINI 2) Internal antenna	15.0	0.68	1.6	20.0