



9 FCC PART 1 & 2 §1.1307; 1.1310; 2.1091; 2.1093 RF EXPOSURE CALCULATIONS FOR HIGH GAIN ANTENNAS

From FCC 1.1310 table 1A, the maximum permissible RF exposure for an uncontrolled environment is 1mW/cm². The Electric field generated for a 1mW/cm² exposure (S) is calculated as follows:

$$S = E^2/Z$$

where:

S = Power density

E = Electric field

Z = Impedance.

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

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

The impedance of free space is 337 ohms, where E and H fields are perpendicular.

Thus:

$$E = \sqrt{10 \times 337} = 61.4 \text{ V/m which is equivalent to } 1\text{mW/cm}^2$$

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

- 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 1mW/cm² may be exceeded at distances close to the antennas installed. Therefore, the user must maintain a minimum distance of 20 cm from the antenna at all time.

The table below identifies the distances where the 1mW/cm² exposure limits may be exceeded during continuous transmission using the external antenna

TABLE 9-1: RF EXPOSURE SEPARATION DISTANCE

| Antenna Type | Gain (dBi) | Gain Numeric | Power Output (mW) | Calculated RF Exposure Separation Distance (cm) | Minimum RF Exposure Separation Distance (cm) |
|--------------|------------|--------------|-------------------|---|--|
| Dipole | 0.5 | 1.1 | 31.0 | 1.6 | 20 |
| Microstrip | -1.8 | 0.6 | 31.0 | 1.2 | 20 |