

## MPE Calculations

Systems operating under the provision of 47 CFR 1.1307(b)(1) shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the FCC guidelines.

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the user or nearby persons and can therefore be considered a mobile transmitter per 47 CFR 2.1091(b). The MPE calculation for this exposure is shown below.

### Using the Hitachi Antennas:

The peak radiated output power (EIRP) is calculated as follows:

$$\begin{aligned} \text{EIRP} &= P + G \\ \text{EIRP} &= 16.73 \text{ dBm} + 0.11 \text{ dBi} \\ \text{EIRP} &= 16.84 \text{ dBm} (48.32 \text{ mW}) \end{aligned}$$

Where

P = Power input to the antenna (mW).  
G = Power gain of the antenna (dBi)

Power density at the specific separation:

$$\begin{aligned} S &= PG/(4R^2\pi) \\ S &= (47.1 \times 1.026) / (4 \times 20^2 \times \pi) \\ S &= 0.009 \text{ mW/cm}^2 \end{aligned}$$

Where

S = Maximum power density (mW/cm<sup>2</sup>)  
P = Power input to the antenna (mW).  
G = Numeric power gain of the antenna  
R = Distance to the center of the radiation of the antenna (20cm = limit for MPE)

The maximum permissible exposure (MPE) for the general population is 1mW/cm<sup>2</sup>.

The power density at 20cm does not exceed the 1mW/cm<sup>2</sup> limit. Therefore, the exposure condition is compliant with FCC rules.

Estimated safe separation:

$$\begin{aligned} R &= \sqrt{PG/4\pi} \\ R &= \sqrt{(47.1 \times 1.026) / 4\pi} \\ R &= 1.96 \text{ cm} \end{aligned}$$

Where

P = Power input to the antenna (mW).  
G = Numeric power gain of the antenna  
R = The safe estimated separation that the user must maintain from the antenna (cm)

The numeric gain (G) of the antenna with a gain specified in dB is determined by:

$$\begin{aligned} G &= \text{Log}^{-1} (\text{dB antenna gain}/10) \\ G &= \text{Log}^{-1} (0.11 \text{ dBi}/10) \\ G &= 1.026 \end{aligned}$$

### **Using the Ethertronic Antennas:**

The peak radiated output power (EIRP) is calculated as follows:

$$\text{EIRP} = P + G$$

$$\text{EIRP} = 16.73 \text{ dBm} + 1.18 \text{ dBi}$$

$$\text{EIRP} = 17.91 \text{ dBm (61.80 mW)}$$

Where

P = Power input to the antenna (mW).

G = Power gain of the antenna (dBi)

Power density at the specific separation:

$$S = PG/(4R^2\pi)$$

$$S = (47.1 \times 1.312) / (4 \times 20^2 \times \pi)$$

$$S = 0.012 \text{ mW/cm}^2$$

Where

S = Maximum power density (mW/cm<sup>2</sup>)

P = Power input to the antenna (mW).

G = Numeric power gain of the antenna

R = Distance to the center of the radiation of the antenna (20cm = limit for MPE)

The maximum permissible exposure (MPE) for the general population is 1mW/cm<sup>2</sup>.

The power density at 20cm does not exceed the 1mW/cm<sup>2</sup> limit. Therefore, the exposure condition is compliant with FCC rules.

Estimated safe separation:

$$R = \sqrt{PG/4\pi}$$

$$R = \sqrt{(47.1 \times 1.312) / 4\pi}$$

$$R = 2.22 \text{ cm}$$

Where

P = Power input to the antenna (mW).

G = Numeric power gain of the antenna

R = The safe estimated separation that the user must maintain from the antenna (cm)

The numeric gain (G) of the antenna with a gain specified in dB is determined by:

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

$$G = \text{Log}^{-1} (1.18 \text{ dBi}/10)$$

$$G = 1.312$$