

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 Yokowo (Pumpkin) Antennas @ 5 GHz Range with highest output power:

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

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

$$\text{EIRP} = 23.30 \text{ dBm} + 2.95 \text{ dBi}$$

$$\text{EIRP} = 26.25 \text{ dBm} (421.69 \text{ mW})$$

Where

P = Power input to the antenna (mW).

G = Power gain of the antenna (dBi)

Power density at the specific separation:

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

$$S = (213.80 \times 1.97) / (4 \times 20^2 \times \pi)$$

$$S = 0.083 \text{ mW/cm}^2$$

Where

S = Maximum power density (mW/cm^2)

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 1 mW/cm^2 .

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

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

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

$$G = \text{Log}^{-1} (2.95 \text{ dBi}/10)$$

$$G = 1.97$$

Using the Yokowo (Pumpkin) Antennas @ 2.4 GHz Range with highest output power:

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

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

$$\text{EIRP} = 24.10 \text{ dBm} + 2.31 \text{ dBi}$$

$$\text{EIRP} = 26.41 \text{ dBm} (437.52 \text{ mW})$$

Where

P = Power input to the antenna (mW).

G = Power gain of the antenna (dBi)

Power density at the specific separation:

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

$$S = (257.10 \times 1.70) / (4 \times 20^2 \times \pi)$$

$$S = 0.087 \text{ mW/cm}^2$$

Where

S = Maximum power density (mW/cm^2)

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^2 .

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

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

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

$$G = \text{Log}^{-1} (2.31 \text{ dBi}/10)$$

$$G = 1.70$$

Using the Yokowo (Mint) Antennas @ 5 GHz Range with highest output power:

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

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

$$\text{EIRP} = 23.30 \text{ dBm} + 1.45 \text{ dBi}$$

$$\text{EIRP} = 24.75 \text{ dBm} (298.53 \text{ mW})$$

Where

P = Power input to the antenna (mW).

G = Power gain of the antenna (dBi)

Power density at the specific separation:

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

$$S = (213.80 \times 1.39) / (4 \times 20^2 \times \pi)$$

$$S = 0.059 \text{ mW/cm}^2$$

Where

S = Maximum power density (mW/cm^2)

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^2 .

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

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

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

$$G = \text{Log}^{-1} (1.45 \text{ dBi}/10)$$

$$G = 1.39$$

Using the Yokowo (Mint) Antennas @ 2.4 GHz Range with highest output power:

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

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

$$\text{EIRP} = 24.10 \text{ dBm} + 2.85 \text{ dBi}$$

$$\text{EIRP} = 26.95 \text{ dBm} (495.45 \text{ mW})$$

Where

P = Power input to the antenna (mW).

G = Power gain of the antenna (dBi)

Power density at the specific separation:

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

$$S = (257.04 \times 1.92) / (4 \times 20^2 \times \pi)$$

$$S = 0.098 \text{ mW/cm}^2$$

Where

S = Maximum power density (mW/cm^2)

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^2 .

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

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

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

$$G = \text{Log}^{-1} (2.85 \text{ dBi}/10)$$

$$G = 1.92$$

Using the Fujitsu (Emilia) Antennas @ 5 GHz Range with highest output power:

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

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

$$\text{EIRP} = 23.30 \text{ dBm} + 1.18 \text{ dBi}$$

$$\text{EIRP} = 24.48 \text{ dBm} (280.54 \text{ mW})$$

Where

P = Power input to the antenna (mW).

G = Power gain of the antenna (dBi)

Power density at the specific separation:

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

$$S = (213.80 \times 1.31) / (4 \times 20^2 \times \pi)$$

$$S = 0.056 \text{ mW/cm}^2$$

Where

S = Maximum power density (mW/cm^2)

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^2 .

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

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

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

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

$$G = 1.31$$

Using the Fujitsu (Emilia) Antennas @ 2.4 GHz Range with highest output power:

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

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

$$\text{EIRP} = 24.10 \text{ dBm} + 1.06 \text{ dBi}$$

$$\text{EIRP} = 25.16 \text{ dBm} (328.09 \text{ mW})$$

Where

P = Power input to the antenna (mW).

G = Power gain of the antenna (dBi)

Power density at the specific separation:

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

$$S = (257.04 \times 1.27) / (4 \times 20^2 \times \pi)$$

$$S = 0.065 \text{ mW/cm}^2$$

Where

S = Maximum power density (mW/cm^2)

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^2 .

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

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

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

$$G = \text{Log}^{-1} (1.06 \text{ dBi}/10)$$

$$G = 1.27$$

Using the Foxconn (Jakarta) Antennas @ 5 GHz Range with highest output power:

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

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

$$\text{EIRP} = 23.30 \text{ dBm} + (-1.05) \text{ dBi}$$

$$\text{EIRP} = 22.25 \text{ dBm} (167.88 \text{ mW})$$

Where

P = Power input to the antenna (mW).

G = Power gain of the antenna (dBi)

Power density at the specific separation:

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

$$S = (213.80 \times 0.79) / (4 \times 20^2 \times \pi)$$

$$S = 0.034 \text{ mW/cm}^2$$

Where

S = Maximum power density (mW/cm^2)

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^2 .

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

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

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

$$G = \text{Log}^{-1} (-1.05 \text{ dBi}/10)$$

$$G = 0.79$$

Using the Foxconn (Jakarta) Antennas @ 2.4 GHz Range with highest output power:

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

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

$$\text{EIRP} = 24.10 \text{ dBm} + 2.51 \text{ dBi}$$

$$\text{EIRP} = 26.61 \text{ dBm} (458.14 \text{ mW})$$

Where

P = Power input to the antenna (mW).

G = Power gain of the antenna (dBi)

Power density at the specific separation:

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

$$S = (257.04 \times 1.78) / (4 \times 20^2 \times \pi)$$

$$S = 0.091 \text{ mW/cm}^2$$

Where

S = Maximum power density (mW/cm^2)

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^2 .

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

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

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

$$G = \text{Log}^{-1} (2.51 \text{ dBi}/10)$$

$$G = 1.78$$