
MAXIMUM PERMISSIBLE EXPOSURE FOR SUBPART C 2.4 GHz BAND

Calculations

Given

$$E = \sqrt{(30 * P * G) / d}$$

and

$$S = E^2 / 3770$$

where

E = Field Strength in Volts / Meter

P = Power in Watts

G = Numeric antenna gain

d = distance in meters

S = Power Density in milliwatts / square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields

$$d = \sqrt{((30 * P * G) / (3770 * S))}$$

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = 100 * d \text{ (m)}$$

yields

$$d = 100 \sqrt{((30 * (P/1000) * G) / (3770 * S))}$$

$$d = 0.282 * \sqrt{(P * G / S)}$$

where

d = distance in cm

P = Power in mW

G = Numeric Antenna Gain

S = Power Density in mW / cm²P (mW) = 10^{^(P(dBm)/10)} andG (numeric) = 10^{^(G(dBi)/10)}

MAXIMUM PERMISSIBLE EXPOSURE FOR SUBPART C 2.4 GHz BAND (continued)

yields

$$d = 0.282 \cdot 10^{((P+G)/20)} \sqrt{S} \quad \text{Equation (1)}$$

where

d = MPE safe distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW / cm²

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields

$$d = \sqrt{((30 \cdot P \cdot G) / (3770 \cdot S))}$$

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and} \\ d \text{ (cm)} = 100 \cdot d \text{ (m)}$$

yields

$$d = 100 \sqrt{((30 \cdot (P/1000) \cdot G) / (3770 \cdot S))} \\ d = 0.282 \cdot \sqrt{(P \cdot G / S)}$$

where

d = distance in cm
P = Power in mW
G = Numeric Antenna Gain
S = Power Density in mW / cm²

Results

EUT output power = 21.99 dBm

Antenna Gain = 4.0 dBi

S = 1.0 mW / cm² from 1.1310 Table 1

Substituting these parameters into equation (1) above:

MPE Safe Distance = 5.6 centimeters

Note: For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.