FCC Maximum Permissible Exposure Guidelines

In 1996, the FCC adopted new guidelines for evaluating environmental effects of RF emissions. The set limits for Maximum Permissible Exposure (MPE) to RF energy in the 2.4 GHz band, where the RadioWire Modem operates, is set at 5 mW/cm^2 for Occupational/Controlled Exposures and 1 mW/cm^2 for General Population/Uncontrolled Exposure. Occupational/Controlled limits apply in situations where persons are exposed as a consequence of their employment, provided that those persons are fully aware of the potential for exposure and can exercise control of their exposure. Uncontrolled Exposure applies to situations where the general public may be exposed and may not be fully aware of the potential for exposure or can not exercise control over their exposure.

The RadioWire Modem (RWM) should be installed by a competent technical person who understands the potential for exposure and can exercise proper judgement during the installation of this product.

Radio Connect Corporation (RCC) recommends that the RWM be installed in a location where members of the general population cannot walk into the direct RF path or touch the antenna. This is necessary both to ensure a reliable connection and to avoid unnecessary exposure to RF emissions.

RCC recommends that the installation of the RadioWire Equipment is done with the equipment off to eliminate the risk of unnecessary exposure to RF energy. When fine tuning the direction of the antenna, keep your RF exposure time to a minimum if you need to place hands or other body parts in locations listed in the special cases below. Normal installation of this product is possible without exposure to RF levels in excess of MPE limits for Controlled Exposure.

With installation per RCC recommendations, the RadioWire Modem does not generate power density levels in excess of the MPE Limits for General Population/Uncontrolled Exposure. Be aware of the situations where the limits for Occupational/Controlled Exposures are approached or exceeded. These are:

- Maximum Permissible Exposure (MPE) limits for Uncontrolled Exposure is exceeded for distances closer than 22.4 cm (9 inches) from the helical antenna within the 35^o beamwidth.

- MPE limits for Controlled Exposure is exceeded for distances closer than 10 cm (4 inches) from the helical antenna within the 35^o beamwidth.

- MPE limits for Controlled Exposure can be exceeded in the area between the reflecting surface of both the 0.6m and 1m dish and the actively radiating antenna.

- For the 0.6 meter dish, the MPE limits for Uncontrolled Exposure is exceeded on the reflecting surface of the dish.

As noted above, RCC recommends that this equipment be installed so these situations are not generally possible.

Worksheet for Calculating Minimum Safe Distance from RCC Antennas

Power Density in mW = S

Power input to antenna in mW = P

Gain of antenna in direction of interest relative to isotropic radiator = G

Distance to antenna in cm = R

$$G_l(dBi) := 10^{\frac{dBi}{10}}$$

$$mW(dBm) := 10^{\frac{dBm}{10}}$$

Power Density as a function of Power, Gain and Distance

$$S(P, G, R) := P \cdot \frac{G}{4 \cdot \pi \cdot R^2}$$

$$R := 6.3 .. 50$$

$$P := mW(24)$$

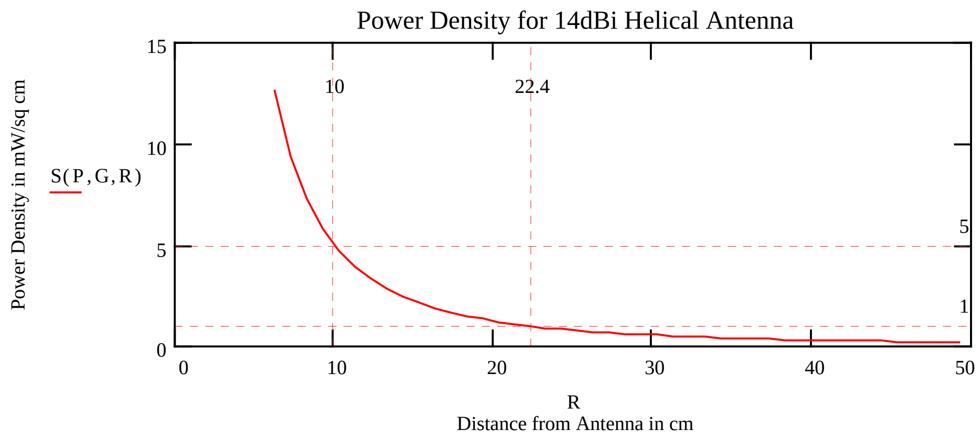
$$G := G_l(14)$$

$$P = 251.189$$

= +24 dBm

$$G = 25.119$$

= 14 dBi



The maximum power density on surface of dish antenna is:

Maximum power density at antenna surface = S_s

Power fed to antenna = P

Physical area of the antenna aperature = A

Surface area of parabola given by:

$$SA_p(d,h) := \frac{2}{3}\cdot\pi\cdot\frac{d}{h^2}\cdot\left[\left(\frac{d^2}{16}+h^2\right)^{\frac{3}{2}}-\left(\frac{d}{4}\right)^3\right]$$

$$SA_p\left(24, 4\cdot\frac{6.75}{.65}\right) = 2.147\cdot 10^3$$

sq in

$$S_s(P, A) := 4\cdot\frac{P}{A}$$

Power density on surface of .6m dish

$$S_s\left(mW(24), SA_p\left(24, 4\cdot\frac{6.75}{.65}\right)\right)\cdot 2.54^2 = 3.019$$

1 m dish will have even less power per area

mW/sq cm

$$S_s\left[mW(24), SA_p\left[100, 4\cdot\left(\frac{.8}{.5}\right)\right]\right]\cdot 2.54^2 = 0.812$$

mW/sq cm

Worst case power density in near field

$$\eta := .75$$

aperature efficiency factor, typically 0.5 - 0.75

$$D := 50..120$$

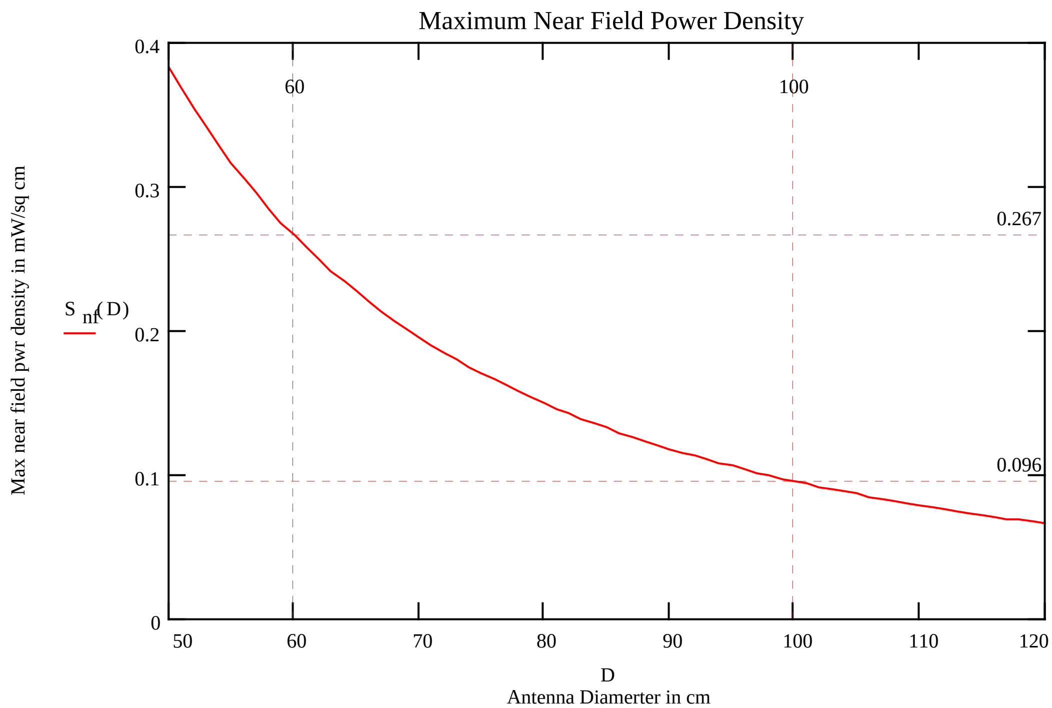
$$P = 251.189$$

mW

$$S_{nf}(D) := \frac{16\cdot\eta\cdot P}{\pi\cdot D^2}$$

$$S_{nf}(60) = 0.267$$

$$S_{nf}(100) = 0.096$$



Where does the Far Field region start for our dish antennas?

$$\lambda := \frac{300 \cdot 10^6}{2.441 \cdot 10^9} \cdot 100$$

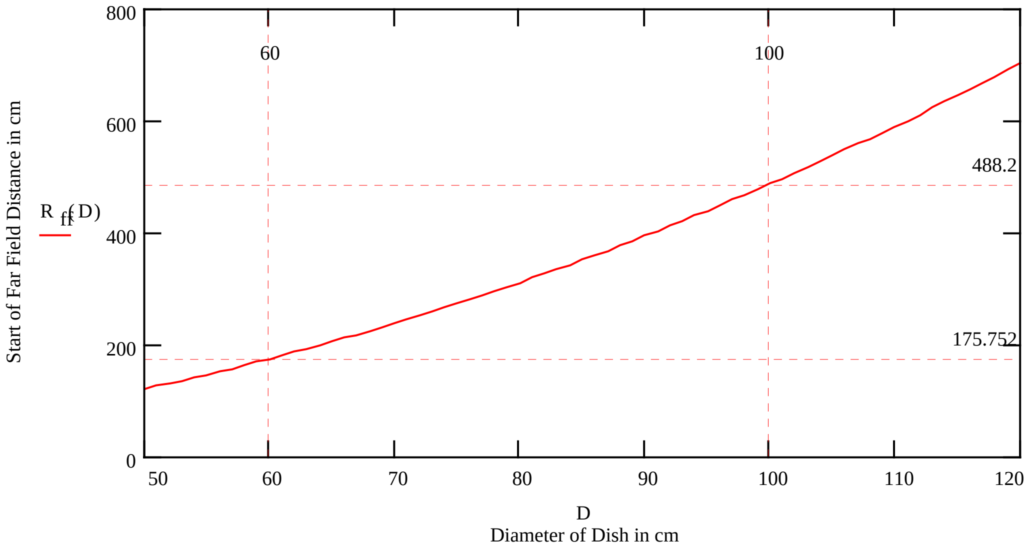
$D := 50..120$

$$R_{ff}(D) := \frac{.6 \cdot D^2}{\lambda}$$

$R_{ff}(60) = 175.752$

$R_{ff}(100) = 488.2$

Distance Where Far Field Starts



Power Density in far field for .6m and 1m dish

$P := mW(24)$

$P = 251.189$

mW

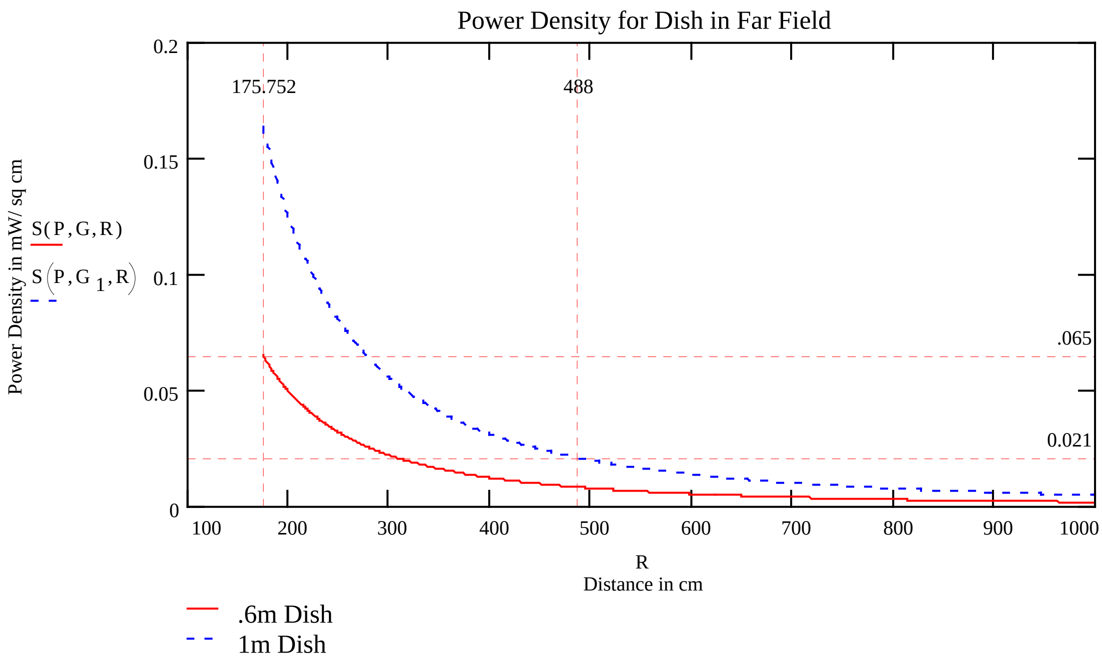
$R := 175..1000$

$G := G_l(20)$

$G = 100$

$S(P, G, 488) = 0.008$

$G_1 := G_l(24)$



mW

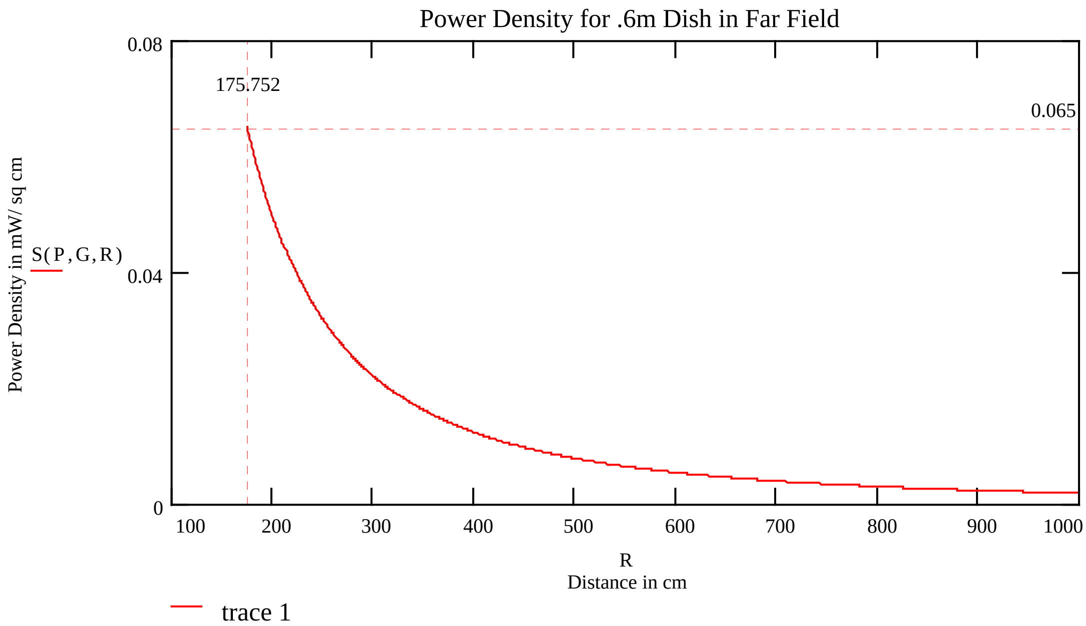
Power Density in far field for .6m dish

$P := mW(24)$

$P = 251.189$

$G := G_1(20)$

$G = 100$



R := 175.. 750

S(P, G, 175.752) = 0.065

Power Density in far field for 1m dish

P := mW(24)

P = 251.189

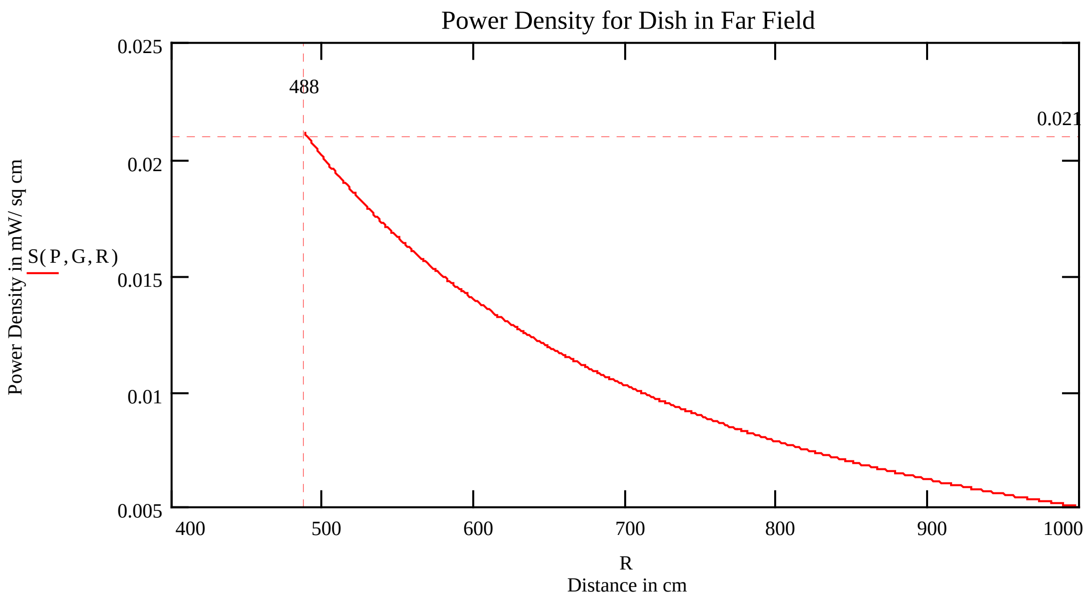
R := 488.. 1000

G := G_1(24)

G = 251.189

mW

S(P, G, 488) = 0.021



Worst case power density in near field

aperature efficiency factor, typically 0.5 - 0.75

$D := 50..120$

S

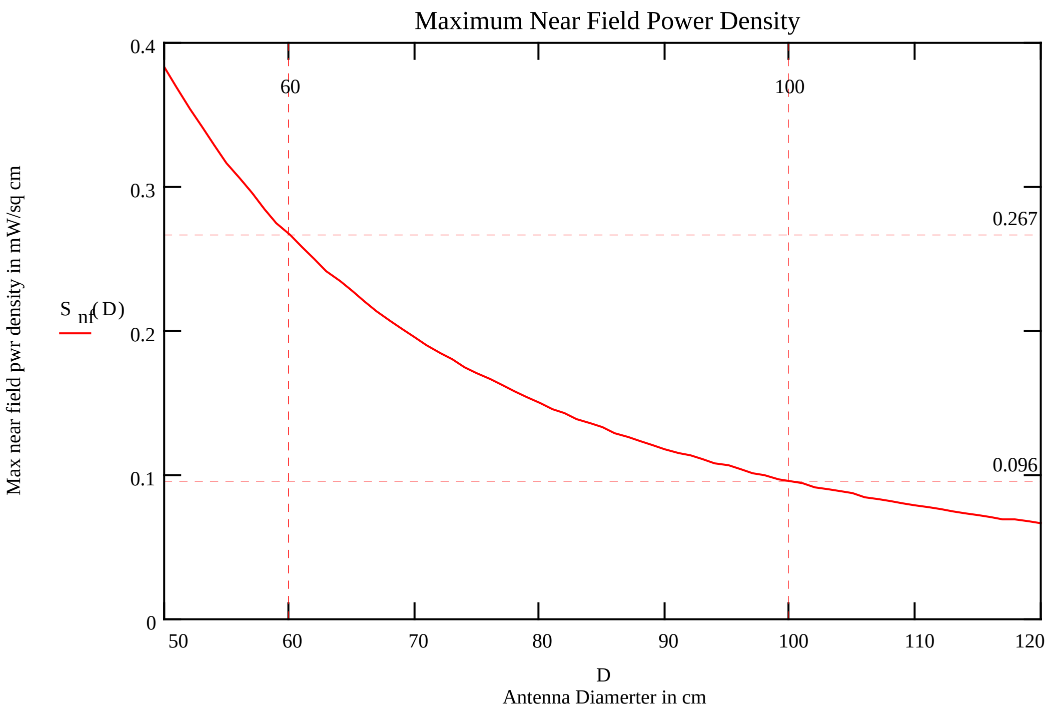
$P = 251.189$

mW

$$S_{nf}(D) := \frac{16 \cdot \eta \cdot P}{\pi \cdot D^2}$$

$S_{nf}(60) = 0.267$

$S_{nf}(100) = 0.096$



$\eta := .75$

$\lambda = 12.29$