

Average Power P [W] Antenna Gain G Wave length [m] for frequency f [MHz]

$$P := 10 \qquad G := 2 \qquad f := 118 \qquad \lambda := \frac{3 \cdot 10^8}{f \cdot 10^6} \qquad \lambda = 2.542$$

Maximum dimension of antenna D [m] Transition region Rnf [m]

$$D := 1 \qquad Rnf := \frac{D^2}{4 \cdot \lambda} \qquad Rnf = 0.098$$

Far field (Fraunhofer) distance, > Rf [m]

$$Rf := 2 \cdot \frac{D^2}{\lambda} \qquad Rf = 0.787$$

Power density, So [W/m²] at Rf distance

$$So := \frac{P \cdot G}{4 \cdot \pi \cdot Rf^2} \qquad So = 2.572$$

Declared distance r=0.5 [m]

$$r := 0.5 \qquad k := \frac{Rf}{r} \qquad k = 1.573$$

The power density in the transition region (between Rf and Rnf) is assumed as proportional to the distance from the antenna, so the field Sa in the declared distance is calculated as:

$$Sa := k \cdot So \qquad Sa = 4.046 \left[\frac{W}{m^2} \right]$$

For duty cycle kd=1/4 and max transmitting time of about 30s, the limiting power density S=kd*Sa

$$kd := \frac{1}{4} \qquad S := kd \cdot Sa \qquad S = 1.012 \left[\frac{W}{m^2} \right]$$

FCC MPE Limits for General Population/Uncontrolled Exposure
and frequency range 30-300 [MHz]

$$MPE := 2 \left[\frac{W}{m^2} \right]$$

As a result, the declared field exposure is below the required limit.

$$S < MPE$$

The second method uses the approximations of near field presented in [3].

For half wave dipol and monopol antennas, according to equations (4-13,14,15) and Figure 4.22, the normalized correction factors for electric (k_e) and magnetic (k_m) fields, normalized to 1.5 wavelength, are approximated as:

$$R := 1.5 \cdot \lambda \quad \frac{r}{R} = 0.131$$

$$k_e := 13 \quad k_m := 10$$

$$S_n := \frac{P \cdot G}{4 \cdot \pi \cdot R^2} \cdot kd$$

Electric and magnetic fields for S_n plain wave are calculated as

$$E_n := \sqrt{377 \cdot S_n} \quad E_n = 3.212 \left[\frac{V}{m} \right]$$

$$H_n := \frac{E_n}{377} \quad H_n = 0.009 \left[\frac{A}{m} \right]$$

After near field correction

$$E := k_e \cdot E_n \quad H := k_m \cdot H_n$$

$$E = 41.751 \left[\frac{V}{m} \right] \quad H = 0.085 \left[\frac{A}{m} \right]$$

The maximum electric and magnetic fields exposure limits, in accordance with OET Bulletin 65 of FCC limit 10 [W/m²] are specified as:

$$E_{max} := 61.4 \left[\frac{V}{m} \right] \quad H_{max} := 0.163 \left[\frac{A}{m} \right]$$

Also in this case, the declared field exposure is below the required limit.

$$E < E_{max} \quad H < H_{max}$$

References:

- [1] Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, OET Bulletin 65, Edition 97-01
- [2] <https://www.mwrf.com/markets/industrial/article/21848689/determining-the-safe-distance-from-a-reflector-antenna>
- [3] A. Farrar and E. Chang, Procedures for Calculating Field Intensities of Antennas, 1987