RF Exposure Requirements

General information:

FCCID:
Device category: Fixed as described in Part 2.1091
Environment: Uncontrolled Exposure

Fixed devices that operate under Part 90 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization.

Antenna:

The manufacturer does not specify an antenna. A typical fix mounted antenna has a gain of 3 dBi.

This device has provisions for operation only in fixed locations.

Configuration	Antenna p/n	Type	Max. Gain (dBi)
fixed	Any	omni	3

Operating configuration and exposure conditions:

The conducted output power is 120 Watts. Although in a typical setting the use qualifies for a duty cycle factor of approximately 50%. The RF exposure calculation will be taken using 100% since in repeater operation the true duty factor can possibly exceed 50%. The manufacturer also markets this device only for occupation use. But, typical installations do not allow for controlled exposure.

- A typical fixed installation consists of an antenna system with a coaxial cable of the type RG 213U which has a loss of 1.5 dB for a length of 30 feet at UHF frequencies.

MPE Calculation:

The minimum separation distance is calculated as follows:

$$E(V/m) = \frac{\sqrt{30 \times P \times G}}{d} \qquad \text{Power density: } P_d(mW/cm^2) = \frac{E^2}{3770}$$

The limit for an uncontrolled exposure environment above 300 MHz is determined by the formula S = f/1500 and at 450 MHz is 0.3 mW/cm^2.

Frequency: 450-512 MHz
The conducted power output is 120 watts.
The coax loss was taken as 1.5 dB.
Antenna gain was taken as 3 dBi
100% talk time in 30 minutes
Power Density = S= 0.3 mW/cm^2

$W := 120.0$ power in Watts

$D := 1$ Duty Factor in decimal % (1=100%)

1 for FM
0.6 for SSB

$E := 30$ exposure time in minutes

$U := 30$ (use 6 for controlled and 30 for uncontrolled)

$$Wexp := W \cdot D \cdot \left(\frac{E}{U}\right)$$

$$PC := \left(\frac{E}{U}\right) \cdot 100$$

$Wexp = 120$ Watts

$PC = 100$ % on time

$Po := 120000$ mWatts

$f := 450$ Frequency in MHz

$dBd := 0.85$ antenna gain in dBd

$$S := \frac{f}{1500}$$ power density limit for uncontrolled exposure

$G1 := dBd + 2.15$ gain in dBi

$G1 = 3$ dBi

$CL := 1.5$ dB coax loss

$$S = 0.3 \quad \frac{mW}{cm^2}$$

$G := G1 - CL$

General population
S is 1 between 1500 and 100k MHz
S is f/1500 for 300 to 1500 MHz
S is 0.2 between 30 and 300 MHz

$$Gn := 10^{\frac{G}{10}}$$ gain numeric

Occupational
S is 1 between 30 and 300 MHz
S is f/300 between 300 and 1500 MHz
S is 5 between 1500 and 100k MHz
(See 47 CFR 1.1310)

$Gn = 1.413$

$$R := \sqrt{\frac{(Po \cdot Gn)}{(4 \cdot \pi \cdot S)}}$$

$$inches := \frac{R}{2.54}$$

$R = 212.044$ distance in centimeters required for compliance

$inches = 83.482$

$$ft := \frac{inches}{12}$$

$ft = 6.957$

Conclusion:

Using the criteria above to comply with the MPE requirements a safe separation distance of 2.2 m or approximately 7 ft is required between the antenna, including any radiating structure, and any persons when normally operated.