

FCC RF Exposure Requirements

General information:

Device category: Mobile per Part 2.1091
Environment: Controlled Exposure

Mobile devices that operate under Part 90 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if they operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more. However, compliance with the power density limits of 1.1310 is not required.

Antenna:

The manufacturer does specify an antenna. The antenna is mounted to a train locomotive vehicle and has a gain of 0 dBi.

This device has provisions for operation in a vehicle, or a fixed location.

Configuration	Antenna p/n	Type	Max. Gain (dBi)
Locomotive	Any	omni	0

Operating configuration and exposure conditions:

The conducted output power is 30 Watts. The transceiver transmits data that is controlled by software and has a fixed maximum duty cycle of 25%. The manufacturer also markets this device only for occupation use as it is being used on a locomotive.

- Vehicle Operation: A typical vehicle installation consists of an antenna system with a coaxial cable of the type RG 58 which has a loss of 1dB for a length of 15 feet.

- Part 2.1091 states that devices are excluded from routine evaluation if the EIRP is less than 2.46Watt (or 1.5WERP).

MPE Calculation:

The minimum separation distance is calculated as follows:

The limit for occupation/controlled exposure environment above 300 MHz is $f/300 \text{ mW/cm}^2$.

Channel frequency: 400-470 MHz
The conducted power output is 30 watt.
The coax loss was taken as 1 dB.
Antenna gain was taken as 0 dBi
25% transmit time in 6 minutes

$W := 30$ power in Watts

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

$E := 7.5$ exposure time in minutes

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

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

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

$W_{exp} = 7.5$ Watts

$PC = 25$ % on time

$P_o := 7500$ mWatts

$f := 440$ Frequency in MHz

$dBd := -2.15$ antenna gain in dBd

$$S := \frac{f}{300} \quad \text{power density limit for controlled exposure}$$

$G_1 := dBd + 2.15$ gain in dBi

$$S = 1.467$$

$G_1 = 0$ dBi

$CL := 1.0$ dB coax loss

$$G := G_1 - CL$$

$$G_n := 10^{\frac{G}{10}} \quad \text{gain numeric}$$

$G_n = 0.794$ dB

$$R := \sqrt{\frac{(P_o \cdot G_n)}{(4 \cdot \pi \cdot S)}}$$

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

$R = 17.979$ distance in centimeters
required for compliance

$$\text{inches} = 7.078$$

Conclusion:

The device complies with the MPE requirements by providing a safe separation distance of 20 cm between the antenna, including any radiating structure, and any persons when normally operated .