RF Exposure Requirements

General information:

Device category: Fixed as described in Part 2.1091(b)
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 or use.

Antenna:

The BS421 transceiver is designed for only antenna installation sites with outdoor fixed mounted locations. The manufacturer does not specify an antenna, but in fix mounted antenna installations they typically have gains to 3 dBi.

This device has provisions for operation only as a fixed mounted device, or a fixed location.

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

Operating configuration and exposure conditions:

The base stations conducted output power is 11 Watts. In base station operation the duty cycle can reach near 100 %. The manufacturer also markets this device only for occupation use. But, some installations may not control exposure other than separation distance.

- A typical fixed installation consists of an antenna system with a coaxial cable of the type ½ inch hardline which has a loss of 1 dB for a length of 50 feet at UHF frequencies. In most applications the coax loss will be negligible.

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 uncontrolled exposure environment above 300 MHz is f in MHz/1500 = mW/cm^2.

Frequency: 410 MHz
The conducted power output is 11 Watts.
The coax loss was taken as 0.0 dB.
Antenna gain was taken as 3 dBi
100% Duty Factor
Power Density = S= 0.273 mW/cm^2

$W := 11$ 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)

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

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

$Wexp = 11$ Watts

$PC = 100$ % on time

$Po := 11000$ mWatts

$dBd := 0.85$ antenna gain in dBd

$G1 := dBd + 2.15$ gain in dBi

$G1 = 3$ dBi

$CL := 0$ dB coax loss

$G := G1 - CL$

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

$Gn = 1.995$

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

$R = 79.936$ distance in centimeters required for compliance

$f := 410$ Frequency in MHz

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

$$S = 0.273 \quad \frac{mW}{cm^2}$$

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

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)

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

$inches = 31.471$

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

$ft = 2.623$

Conclusion:

The DAMM Cellular BS421 base stations are designed for systems using antennas mounted to outdoor permanent structures.

For a transmitter operating with the above criteria the separation distance should be no less than 80 cm or 2.7 ft between the antenna, including any radiating structure, and any persons when normally operated. This is for only a single transmitting carrier; other operating conditions should follow a procedure like that shown above and following the guidelines such as those in FCC document OET-65.