Exposure of humans to RF fields

As per FCC KDB 447498 D01 and Section 2.1091 radio frequency transmitters are required to be operated in a manner that ensures the public is not exposed to RF energy levels.

Calculations have been made using the General Public/Uncontrolled Exposure limits that are defined in Section 1.1310.

Minimum safe distances have been calculated below.

Power density, $mW/cm^2 = E^2/3770$

- General Population / Uncontrolled exposure limit will be 0.28 mW/cm^2
(f/1500 = 421 MHz/1500)

As this radio can operate over the range of 421 - 512 MHz the lowest frequency of operation in the USA, which will give the worst case result, would be 421 MHz.

The minimum distance from the antenna at which the MPE is met is calculated from the equation relating field strength in V/m, transmit power in watts, transmit antenna gain, transmitter duty cycle and separation distance in metres:

Power Density = 0.28 $mW/cm^2 = E^2/3770$

$E = \sqrt{0.28*3770}$

E = 32.5 V/m

The rated maximum transmitter power = 10 watts (+40 dBm).

A duty cycle of 100% as the transmitter is a base station could possibly be operated for long periods of time.

The client has declared that this transmitter can be operated using a range of antennas with various gains, from 0 to 16 dBd, as detailed in the table below.

Antenna Gains (dBd)	Max Gain (dBi)	TX power (dBm)	EiRP (dBm)	EiRP (Watts)	E Limit (V/m)	Safe Distance (Metres)
0 to 4	6.15	40.0	46.15	41.2	32.5	1.08
4 to 8	10.15	40.0	50.15	103.5	32.5	1.71
8 to 12	14.15	40.0	54.15	260.0	32.5	2.72
12 to 16	18.15	40.0	58.15	653.1	32.5	4.31

A sample calculation for the safe distance would be:

$d = \sqrt{(30 * P * G*DC) / E}$

$d = \sqrt{(30 * 10 * 65.3 * 1.0) / 32.5}$

d = 4.31 metres or 431 cm

Result: Complies if the safe distances defined above are applied.

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