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.

The product operates in the frequency band 452.000 MHz to 455.000 MHz. For worst case MPE calculations, 452.000 MHz has been selected.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3–3.0	614	1.63	*100	6
3.0–30	1842/f	4.89/f	*900/f^2	6
30–300	61.4	0.163	1.0	6
300–1,500			f/300	6
1,500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*100	30
1.34–30	824/f	2.19/f	*180/f^2	30
30–300	27.5	0.073	0.2	30
300–1,500			f/1500	30
1,500–100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

Limits for maximum permissible exposure (MPE)

- General Population / Uncontrolled exposure is f/1500. At 452.0 MHz, the calculated limit is 0.3 mW/cm^2

- Occupational /Controlled exposure is f/300. At 452.0 MHz, the calculated limit is 1.5mW/cm^2

Minimum safe distances have been calculated below.

For Uncontrolled Environment

At 452.0 MHz, Power Density = (452.0/1500)=0.30 mW/cm^2 = $E^2/3770$

E= √ 0.3*3770

E = 33.6 V/m

For Controlled Environment

At 452.0 MHz, Power Density = (452.0/300)=1.50 mW/cm^2 = E^2/3770

E= √ 1.50*3770

E = 75.4 V/m

The rated maximum transmitter power = 250 Watts (+54 dBm).

A worst case scenario duty cycle of 100% has been used for the calculations.

The client has declared that the antenna is chosen by the customer depending on the required coverage. Unity gain has been used to make the assessment.

The minimum distance from the antenna at which the MPE is met is calculated from the following

Field strength in V/m (FS),
Transmit power in watts (P)
Transmit antenna gain (G)
Transmitter duty cycle (DC)
Separation distance in metres (D)

The calculation is as follows:

FS = (√ (30 * P * G * DC)) / D

Therefore

a) For Uncontrolled environments, the minimum distance is:

D = (√ (30 * P * G * DC)) / FS

D = (√ (30 * 250 * 1.0 * 1.0)) / 33.6

D = 2.6 metres

a) For Controlled environments, the minimum distance is:

D = (√ (30 * P * G * DC)) / FS

D = (√ (30 * 250 * 1.0 * 1.0)) / 75.4

D = 1.15 metres

Result: Complies if a safe distance shown in the calculations above is followed.