

Exposure of humans to RF fields - FCC ID: TCJ-M4DBDAUU

The product under test is a UHF bi-directional amplifier (repeater) that can transmit between 406.1 – 512 MHz

Testing in this report has been carried out in the 450 – 470 MHz band and in the 470 – 490 MHz band however this assessment has been carried out on 406.1 MHz as a worst case as the composite power is identical across the operating range of the system.

At this point the type of antennas and coax to be used have not been defined.

For the purposes of the Exposure of humans to RF fields evaluation it will be assumed that the connecting cables are short and have no associated losses and high gain directional antennas have been used which have a gain of at least 10 dBi when the amplifier is operating with a duty cycle of 100% when the composite power is set to a maximum of +37 dBm (5 watts).

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 limits for maximum permissible exposure (MPE) have been calculated below for a worst case at 406.1 MHz

- Occupational /Controlled exposure is $f/300$ which gives a limit of 1.354 mW/cm²
- General Population / Uncontrolled exposure is $f/1500$ which gives a limit of 0.271 mW/cm²

Minimum safe distances have been calculated below.

For a Controlled Environment

$$\text{Power Density} = 1.354 \text{ mW/cm}^2 = E^2/3770$$

$$E = \sqrt{1.354 \times 3770}$$

$$E = 71.4 \text{ V/m}$$

For an Uncontrolled Environment

$$\text{Power Density} = 0.271 \text{ mW/cm}^2 = E^2/3770$$

$$E = \sqrt{0.271 \times 3770}$$

$$E = 32.0 \text{ V/m}$$

The rated maximum transmitter composite power = 5 W (+37 dBm).

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

The antenna gain has been assumed to +10 dBi which equates to a numeric gain of 10.

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:

$$FS = (\sqrt{30 * P * G * DC}) / D$$

For Uncontrolled environments, the minimum distance is:

$$D = (\sqrt{30 * P * G * DC}) / FS$$

$$P = 5 \text{ W}$$

$$FS = E = 71.4 \text{ V/m}$$

$$G = 10$$

$$DC = 1$$

$$D = (\sqrt{30 * 5 * 10 * 1}) / 71.4$$

$$D = 0.542 \text{ m or } 54.2 \text{ cm}$$

For Controlled environments, the minimum distance is:

$$D = (\sqrt{30 * P * G * DC}) / FS$$

$$P = 5 \text{ W}$$

$$FS = E = 32.0 \text{ V/m}$$

$$G = 10$$

$$DC = 1$$

$$D = (\sqrt{30 * 5 * 10 * 1}) / 32.0$$

$$D = 1.210 \text{ m or } 121.0 \text{ cm}$$

Result: Complies if the safe distances shown above are applied based upon the assumptions presented.