Exposure of humans to RF fields

The product under test is a UHF bi-directional amplifier (repeater) that transmits in the 406.1 – 430.0 MHz band and the 500.0 – 512.0 MHz.

At this point the type of antennas and coax to be used hav4 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 all 16 channels are operating with the power is set to maximum, +25 dBm (316 mW), which gives a composite power of +37 dBm (5 W).

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 1.353 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
Power Density = 1.353 mW/cm2 = E2/3770
E= $\sqrt{}$ 1.353*3770
E = 71.4 V/m

For an Uncontrolled Environment
Power Density = 0.271 mW/cm2 = E2/3770
E= $\sqrt{}$ 0.271*3770
E = 32.0 V/m

The rated maximum channel power = 0.316 W (+25 dBm).

The client has stated that the composite power of the device is 5 watts (+37 dBm)

The rated power of each channel is 316 mW (+25.0) dBm and 16 channels are in use which gives a composite power of +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 = (√ (30 * P * G * DC)) / D

For Uncontrolled environments, the minimum distance is:

D = (√ (30 * P * G * DC)) / FS
P = 0.316 W x 16 = 5 Watts
FS = E = 71.4 V/m
G = 10
DC = 1
D = (√ (30 * 5 * 10 * 1)) / 71.4
D = 0.542 m or 54.2 cm

For Controlled environments, the minimum distance is:

D = (√ (30 * P * G * DC)) / FS
P = 0.316 W x 16 = 5 Watts
FS = E = 32.0 V/m
G = 10
DC = 1
D = (√ (30 * 5 * 10 * 1)) / 32.0
D = 1.21 m or 121 cm

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