MPE Calculation - FCC ID :2ABCB-RPI4B

The FCC requires that the calculated MPE be equal to or less than a given limit dependent on frequency at a distance of 20 cm from a device to the body of a user.

The transmitter operation for the Raspberry Pi 4 covers the 2.4GHz and 5GHz operating bands.

Simultaneous transmission is not supported between any of the transmitters

The following FCC Rule Parts are applicable:

Part 1.1310 – Radiofrequency radiation exposure limits
Part 2.1091(c) – Radiofrequency radiation exposure evaluation: mobile devices

CALCULATION

The following far field power density equation is applicable:

$$S = EIRP/4 \pi R^2$$

Where S = Power density

EIRP = Effective Isotropically Radiated Power (EIRP = P x G)

P = Conducted Transmitter Power

G = Antenna Gain (relative to an isotropic radiator)

R = distance to the centre of radiation of the antenna (safe operating distance)

Calculation for 2.4GHz BT (BDR/ EDR worst case):

Values:

Transmitter frequency range = 2402 – 2480MHz

P = 4.8dBm

G = 3.5dBi (x 2.24)

EIRP = 8.3dBm (6.76mW)

R = 20cm

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of FCC Rule Part 1.1310 for 2.4GHz

S_{req1} = 1.0 mW/cm^2

Calculation:

$S = EIRP/4 \pi R^2$

$= 6.76/(12.56 \times 20^2)$

$= 6.76/(5024)$

$S_1 = 0.0013$

(Equivalent to 0.73cm safe operating distance)

Calculation for 2.4GHz WLAN

Values:

Transmitter frequency range = 2412 – 2462MHz

P = 13.4dBm

G = 3.5dBi

EIRP = 16.9dBm = 49.0mW

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of FCC Rule Part 1.1310 for 1900MHz for 2.4GHz

$S_{req2} = 1.0$ mW/cm^2

Calculation:

$S = EIRP/4 \pi R^2$

$= 49/(12.56 \times 20^2)$

$= 49/(5024)$

$S_2 = 0.0097$

(Equivalent to 2.0cm safe operating distance)

Calculation for 5.0GHz WLAN

Values:

Transmitter frequency range = 5170 - 5825MHz

P = 14.5dBm

G = 2.3dBi

EIRP = 16.8dBm = 47.9mW

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of FCC Rule Part 1.1310 for 1900MHz for 5GHz

S_{req3} = 1.0 mW/cm^2

Calculation:

$S = EIRP/4 \pi R^2$

$= 47.9/(12.56 \times 20^2)$

$= 47.9/(5024)$

S_3 = 0.0095

(Equivalent to 1.95cm safe operating distance)

Conclusion

The required 20cm RF exposure limits for General Population/ Uncontrolled Exposure FCC Rule Part 1.1310 limits will not be exceeded for the Raspberry Pi 4 using antennas having a maximum gain of 3.5dBi (2.4GHz) and 2.3dBi (5GHz).