RF Exposure and Transmitter Power Considerations for the Neeo Brain

FCC ID: 2AKK7-BR633601

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 Brain equipment operates in the 2.4 GHz band using WLAN, Bluetooth, Z-Wave and 6LowPAN technologies.

The following FCC Rule Parts and procedures are applicable:

Part 1.1310 – Radiofrequency radiation exposure limits

Part 2.1091 – Radiofrequency radiation exposure evaluation: mobile devices

KDB447498 D01 v06
Mobile and Portable Devices RF Exposure Procedures and Equipment Authorisation Policies

MPE CALCULATIONS

The MPE calculation used to calculate the safe operating distance for the user is:

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

Where   S = Power density

EIRP = Effective Isotropic 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)

For WLAN 2.4GHz
Values:

Transmitter frequency range = 2412 MHz to 2462MHz

Power = 19.0dBm (79.43mW) SISO

G = +0.5dBi

EIRP = 19.5dBm = 89.12mW

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:

> $S = 89.12/4 \pi R^2$
>
> $S = 89.12/(12.56 \times 20^2)$
>
> $S = 89.12/(5024)$
>
> S_1 = 0.018mW/ cm^2 (<1.0 mW/cm^2)

For BT 2.4GHz

Values:

Transmitter frequency range = 2402 MHz to 2480 MHz

Power = 10.0dBm (10.0mW)

G = +0.5dBi

EIRP = 10.5dBm (11.22mW)

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_{req2} = 1.0 mW/cm^2

Calculation:

> $S = EIRP/4 \pi R^2$
>
> $S = 11.22/(12.56 \times 20^2)$
>
> $S = 11.22/(5024)$
>
> S_2 = 0.0022mW/ cm^2 (<1.0 mW/cm^2)

For 6LowPAN 2.4GHz

Values:

Transmitter frequency range = 2405-2480MHz

Power = 15.1dBm (20.94mW)

G = +0.5dBi

EIRP = 15.6dBm (36.3mW)

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_{req3} = 1.0 mW/cm^2

Calculation:

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

$S = 36.3/(12.56 \times 20^2)$

$S = 36.3/(5024)$

S_3 = 0.0072 mW/ cm^2 (<1.0 mW/cm^2)

For Z-Wave 908MHz

Values:

Transmitter frequency range = 908MHz

Power = -1.7dBm (0.67mW)

G = -6.5dBi

EIRP = -8.2dBm (0.15mW)

R = 20cm

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of FCC Rule Part 1.1310 for 908MHz

S = f/1500 mW/cm^2 (f = operating frequency)

S_{req4} = 908/1500 = 0.61 mW/cm^2

Calculation:

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

$$S = 0.15/(12.56 \times 20^2)$$

$$S = 0.15/(5024)$$

$$S_4 = 3.0 \times 10^{-5} \text{ mW/ cm}^2 \ (<0.61 \text{ mW/cm}^2)$$

KDB447498 D01 v05 Section 7.2 SIMULTANEOUS TRANSMISSION CONSIDERATIONS

Worst case summation of calculated MPE ratios for 2.4GHz WLAN, BT, Z-Wave and 6LowPAN, simultaneously transmitting:

$$\text{ie: } \Sigma MPE_{ratios} = (S_1/ S_{req1}) + (S_2/ S_{req2}) + (S_3/ S_{req3}) + (S_4/ S_{req4})$$

$$= (0.018/1.0) + (0.0022/1.0) + (0.0072/1.0) + (0)$$

$$= 0.027$$

Σ of MPE ratios<1.0, so in accordance with KDB447498 Section 7.2, simultaneous transmission test exclusion applies for the WLAN, BT, Z-Wave and 6LowPAN transmitters.

Conclusion

The required 20cm RF exposure limits for General Population/ Uncontrolled Exposure will not be exceeded for the Brain using antennas having a maximum gain of 0.5 dBi for WLAN, BT and 6LowPAN and -6.5dBi for Z-Wave

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