

Summation of RF exposure calculation

The "DCU2 PRO E US" unit contains a single modular approved transmitter FCC ID:NTAT210A, the Wi-Fi single modular transmitter FCC ID:2ACMW-MX6 and 2G/3G module FCC ID:RI7HE910NA. The "DCU2 PRO E US" unit is classified as mobile device.

1. Power density at 20 cm of original FCC ID:NTAT210A is 0.14 mW/cm^2

Limit for power density for general population/uncontrolled exposure is $f/1500 \text{ mW/cm}^2$ for 300 – 1500 MHz frequency range:

$$P = 902/1500 = 0.6 \text{ mW/cm}^2$$

The power density $P (\text{mW/cm}^2) = P_T / 4\pi r^2$ where

P_T is the transmitted power, equal to the peak transmitter output power 26.5 dBm plus maximum antenna gain 2 dBi, the maximum equivalent isotropically radiated power EIRP is

$$P_T = 26.5 \text{ dBm} + 2 \text{ dBi} = 28.5 \text{ dBm} = 708 \text{ mW.}$$

The power density at 20 cm (minimum safe distance, required for mobile devices), calculated as follows:

$$708 \text{ mW} / 4\pi (20 \text{ cm})^2 \approx 0.14 \text{ mW/cm}^2 < 0.6 \text{ mW/cm}^2$$

2. Wi-Fi module (2412-2462 MHz) FCC ID:2ACMW-MX6:

Limit for power density for general population/uncontrolled exposure is 1 mW/cm^2 for 2.4 GHz:

$$\text{The power density } P (\text{mW/cm}^2) = P_T / 4\pi r^2$$

P_T is the transmitted power, which is equal to the peak transmitter output power 21.83 dBm (0.1524 W) plus maximum antenna gain 1 dBi, the maximum equivalent isotropically radiated power EIRP is

$$P_T = 21.83 \text{ dBm} + 1 \text{ dBi} = 22.83 \text{ dBm} = 192 \text{ mW.}$$

The power density at 20 cm (minimum safe distance, required for mobile devices), calculated as follows:

$$192 \text{ mW} / 4\pi (20 \text{ cm})^2 = 0.04 \text{ mW/cm}^2 << 1 \text{ mW/cm}^2$$

3. Maximum conducted output power given in FCC ID:RI7HE910NA module grant is 1648 mW (32.17 dBm) in 824.2-848.8 MHz band.

Limit for power density is $f/1500 = 0.56 \text{ mW/cm}^2$ for 824-849 MHz for general population/uncontrolled exposure.

The maximum equivalent isotropically radiated power EIRP is

$$P_T = 32.17 \text{ dBm} + 2 \text{ dBi} = 34.17 \text{ dBm} = 2612 \text{ mW.}$$

According to Document: RF Exposure Info (Application FCC ID:RI7HE910NA at the FCC database) the Tx duty cycle is 12.5%. So, the equivalent average power is $2612 \text{ mW} \times \text{Duty cycle} = 327 \text{ mW}$.

The power density at 20 cm is calculated as follows:

$$327 / 4\pi (20 \text{ cm})^2 = 0.07 \text{ mW/cm}^2 < 0.56 \text{ mW/cm}^2$$

Summation

When all the antennas are at least 20 cm away from the user but individual antennas cannot be separated by 20 cm from each other, the following equation shall be fulfilled

$$\begin{aligned} S1/\text{Limit} + S2/\text{Limit} + S3/\text{Limit} &< 1, \text{ i.e.} \\ 0.14 \text{ mW/cm}^2 / 0.6 \text{ mW/cm}^2 + 0.04 \text{ mW/cm}^2 / 1 \text{ mW/cm}^2 + 0.07 \text{ mW/cm}^2 / 0.56 \text{ mW/cm}^2 &= 0.233 + 0.04 + 0.125 = \\ &= 0.398 < 1 \end{aligned}$$

Therefore, the "DCU2 PRO E US" unit including approved modules complies with FCC RF exposure limit for mobile device for general population.

General public cannot be exposed to dangerous RF level.