

MPE Analysis Report

The Equipment Under Test (EUT) is a 2.4GHz Wi-Fi, 5GHz Wi-Fi and 2.4GHz Bluetooth BLE (1Mbps) Transceiver for a Desk Fan. The EUT is powered by 120VAC.

For Maximum Permissible Exposure (MPE) evaluation of the unit, the maximum power density at 20 cm from this transmitter shall be less than the General Population / Uncontrolled MPE limit in OET Bulletin 65 and meet the requirement listed in KDB447498 D04 v01.

For the 2.4GHz and 5GHz RF portion of the unit, the measured powers among all the measured channels were within its production tolerance. The maximum source-based time-averaging duty factor is 100%. From these data and its operating configuration, the exposed power density at a distance (R) of 20 cm from the center of radiation of the antenna can be calculated according to OET Bulletin 65 as follow:

BLE Portion

Antenna Type: Internal, integral

Antenna Gain: 3.09dBi

Nominal Conducted Power: 2.037dBm

Range of Peak Conducted Power: 0dBm to 4dBm

2.4GHz Wi-Fi Portion

The Wi-Fi portion was tested in according with the following power output and in actual application the below limit shall not be exceeded.

Operating Mode	Nominal Power	Range of Peak Conducted Power
802.11b	16.941dBm	14dBm to 18dBm
802.11g	16.280dBm	11dBm to 18dBm
802.11n(HT20)	16.411dBm	11dBm to 18dBm

An internal, integral antenna has been used.

Antenna Gain: 3.09dBi

5GHz Wi-Fi Portion

The Wi-Fi portion was tested in according with the following power output and in actual application the below limit shall not be exceeded.

Operating Mode	Nominal Power	Range of RMS Conducted Power
802.11a	15.718dBm	12dBm to 16dBm
802.11n(HT20)	15.883dBm	12dBm to 16dBm

An internal, integral antenna has been used.

Antenna Gain: 4.41dBi

For Maximum Permissible Exposure (MPE) evaluation of the EUT, the maximum power density at 20 cm from this mobile transmitter shall be less than the General Population / Uncontrolled MPE limit in OET Bulletin 65.

1) For the BLE portion, maximum conducted power was 4dBm. The distance (D) between the antenna and the equipment under test (EUT) was 3 meters. And the maximum source-based time-averaging duty factor is 100%. From these data, the exposed power density at a distance (R) of 20cm from the center of radiation of the antenna can be calculated according to OET Bulletin 65 as follow:

$$\text{The radiated power} = 4\text{dBm} + 3.09\text{dBi} = 7.09\text{dBm} (5.12 \text{ mW})$$

$$\begin{aligned} \text{The radiated (EIRP) source-based time-averaging output power} \\ &= (5.12 * 1) \text{ mW} \\ &= 5.12 \text{ mW} \end{aligned}$$

$$\begin{aligned} \text{The power density at 20 cm from the antenna} \\ &= \text{EIRP} / 4\pi R^2 \\ &= 0.001019 \text{ mW cm}^{-2} \end{aligned}$$

2) For the 2.4GHz Wi-Fi portion, maximum conducted power was 18dBm. The distance (D) between the antenna and the equipment under test (EUT) was 3 meters. And the maximum source-based time-averaging duty factor is 100%. From these data, the exposed power density at a distance (R) of 20cm from the center of radiation of the antenna can be calculated according to OET Bulletin 65 as follow:

$$\text{The radiated power} = 18\text{dBm} + 3.09\text{dBi} = 21.09\text{dBm} (128.53 \text{ mW})$$

$$\begin{aligned} \text{The radiated (EIRP) source-based time-averaging output power} \\ &= (128.53 * 1) \text{ mW} \\ &= 128.53 \text{ mW} \end{aligned}$$

$$\begin{aligned} \text{The power density at 20 cm from the antenna} \\ &= \text{EIRP} / 4\pi R^2 \\ &= 0.025570 \text{ mW cm}^{-2} \end{aligned}$$

3) For 5GHz Wi-Fi portion, maximum conducted power was 16 dBm. The distance (D) between the antenna and the equipment under test (EUT) was 3 meters. And the maximum source-based time-averaging duty factor is 100%. From these data, the exposed power density at a distance (R) of 20cm from the center of radiation of the antenna can be calculated according to OET Bulletin 65 as follow:

$$\text{The radiated power} = 16\text{dBm} + 4.41\text{dBi} = 20.41\text{dBm} (109.90 \text{ mW})$$

$$\begin{aligned} \text{The radiated (EIRP) source-based time-averaging output power} \\ &= (109.90 * 1) \text{ mW} \\ &= 109.90 \text{ mW} \end{aligned}$$

$$\begin{aligned} \text{The power density at 20 cm from the antenna} \\ &= \text{EIRP} / 4\pi R^2 \\ &= 0.021864 \text{ mW cm}^{-2} \end{aligned}$$

In the frequency range of 1,500 - 100,000MHz, the MPE limit is 1.0 mWcm⁻² for general population and uncontrolled exposure. As the measured power density at 20cm from the transmitter is lower than the MPE limit, the compliance to the MPE limit can be ensured by indicating the minimum 20cm separation between the transmitter's radiating structures and body of the user or nearby persons. The following RF exposure statement is proposed to be included in the user manual:

“ FCC RF Radiation Exposure Statement

Caution: To maintain compliance with the FCC’s RF exposure guidelines, place the unit at least 20cm from nearby persons.”

In addition, for this product with multiple transmitter and antenna (BLE portion and 2.4GHz Wi-Fi portion; BLE portion and 5GHz Wi-Fi portion), the requirement of Simultaneous Transmission evaluation has also been considered and has complied with the following conditions of the worst case;

$$\text{MPE1/Limit1} + \text{MPE2/Limit2} \leq 1$$

Thus,

$$\begin{array}{llll} 0.001019 / 1 & + & 0.025570 / 1 & = 0.026589 \\ \text{BLE portion} & & \text{2.4GHz Wi-Fi portion} & \end{array}$$

$$\begin{array}{llll} 0.001019 / 1 & + & 0.021864 / 1 & = 0.022883 \\ \text{BLE portion} & & \text{5GHz Wi-Fi portion} & \end{array}$$

It is concluded that no Simultaneous Transmission evaluation is required.