

MPE Analysis Report

The Equipment Under Test (EUT) is a Wi-Fi, BT, BLE and RFID Transceiver for an audio player.

For Wi-Fi portion, the Equipment Under Test (EUT) operates at frequency range of 2412MHz to 2462MHz with 11 channels and 2422MHz to 2452MHz with 9 channels. For BT Portion, it operates at frequency range of 2402.000 MHz to 2480.000 MHz with 79 channels, the channels are separated with 1MHz spacing. For BLE Portion, it operates at frequency range of 2402.000 MHz to 2480.000 MHz with 40 channels, the channels are separated with 2MHz spacing. For RFID Portion, it operates at a single channel, 13.56MHz. Wi-Fi and RFID portions can be functioned simultaneously while BT and BLE portions are disabled when Wi-Fi and RFID portions are functioning and vice versa. The EUT is powered by 1 x 3.7V Lithium-ion Battery or USB port.

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 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:

Bluetooth Portion

Antenna Type: Internal, integral
Antenna Gain: 4.896dBi

Operating Mode	Nominal Power	Range of Peak Conducted Power
Bluetooth Classic	-1.2dBm	-10dBm to 10dBm
Bluetooth BLE	-1.9dBm	-10dBm to 10dBm

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	17.1dBm	11dBm to 27dBm
802.11g	14.9dBm	11dBm to 27dBm
802.11n(HT20)	14.4dBm	11dBm to 27dBm
802.11n(HT40)	14.2dBm	11dBm to 27dBm

An internal, integral antenna has been used.
Antenna Gain: 4.896dBi

RFID portion

Antenna Type: Internal, integral

Antenna Gain: 0dBi

Range of Peak Conducted Power: -50dBm to 0dBm

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 Bluetooth portion, maximum conducted power was 10dBm. 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:

$$\text{The radiated power} = 10\text{dBm} + 4.896\text{dBi} = 14.896\text{dBm} \text{ (30.87 mW)}$$

$$\begin{aligned} \text{The radiated (EIRP) source-based time-averaging output power} \\ &= (30.87 * 1) \text{ mW} \\ &= 30.87 \text{ mW} \end{aligned}$$

$$\begin{aligned} \text{The power density at 20 cm from the antenna} \\ &= \text{EIRP} / 4\pi R^2 \\ &= 0.006141 \text{ mW cm}^{-2} \end{aligned}$$

2) For the Wi-Fi portion, maximum conducted power was 27dBm. 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:

$$\text{The radiated power} = 27\text{dBm} + 4.896\text{dBi} = 31.896\text{dBm} \text{ (1547.39 mW)}$$

$$\begin{aligned} \text{The radiated (EIRP) source-based time-averaging output power} \\ &= (1547.39 * 1) \text{ mW} \\ &= 1547.39 \text{ mW} \end{aligned}$$

$$\begin{aligned} \text{The power density at 20 cm from the antenna} \\ &= \text{EIRP} / 4\pi R^2 \\ &= 0.307843 \text{ mW cm}^{-2} \end{aligned}$$

3) For RFID portion, maximum conducted power was 0 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:

The radiated power = 0dBm + 0dBi = 0dBm (1 mW)

The radiated (EIRP) source-based time-averaging output power
= (1 * 1) mW
= 1 mW

The power density at 20 cm from the antenna
= EIRP / $4\pi R^2$
= 0.000199 mW cm⁻²

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 (Wi-Fi portion and RFID portion), the requirement of Simultaneous Transmission evaluation has also been considered and has complied with the following conditions of the worst case;

$$MPE1/Limit1 + MPE2/Limit2 \leq 1$$

Thus,

$$\begin{array}{ccccc} 0.000199 / 1 & + & 0.307843 / 1 & = & 0.308042 \\ \text{RFID portion} & & \text{Wi-Fi portion} & & \end{array}$$

It is concluded that no Simultaneous Transmission evaluation is required.