

MPE Analysis Report

The Equipment-Under-Test (EUT) NODE 2 is a Wireless Streaming Music Player. The EUT contains both WLAN (WiFi) and Bluetooth modules. The Bluetooth module has Bluetooth 4.0 BLE and Bluetooth 3.0 features. The EUT can accept analog audio signal, digital audio signal and wireless audio signal via Bluetooth devices. An iOS/Android apps Bluesound installed in Smartphone can act as the remote control of the EUT. The EUT is powered by 100-240VAC.

WiFi Module

Antenna Type: Internal, Integral

Antenna Gain: 2dBi

| Operating mode | Nominal Conducted Power | Production Tolerance | Modulation Type |
|----------------|-------------------------|----------------------|-----------------|
| 802.11b | 13.68 dBm | +/- 3dB | DSSS |
| 802.11g | 12.86 dBm | +/- 3dB | OFDM |
| 802.11n (HT20) | 12.56 dBm | +/- 3dB | mcs0 |
| 802.11n (HT40) | 10.18 dBm | +/- 3dB | mcs0 |

Bluetooth Module

Antenna Type: Internal, Integral

Antenna Gain: 2dBi

| Operating mode | Nominal Conducted Power | Production Tolerance | Modulation Type |
|-------------------|---------------------------------|----------------------|-----------------|
| Bluetooth 4.0 BLE | 6.98 dBm | +/- 3dB | GFSK |
| Operating mode | Nominal Radiated Field Strength | Production Tolerance | Modulation Type |
| Bluetooth 3.0 | 100.8 dB μ V/m at 3m | +/- 3dB | GFSK |

For Maximum Permissible Exposure (MPE) evaluation of the NODE 2, 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 WLAN (WiFi), maximum conducted power measured within its production tolerance was 16.68dBm (maximum). The antenna gain is 2 dBi = 1.58 (num gain) 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 conducted power = 16.68dBm (46.56mW)

The radiated (EIRP) source-based time-averaging output power (with antenna gain)
= $(46.56 * 1 * 1.58)$ mW
= 73.6 mW

The power density at 20 cm from the antenna
= $EIRP / 4\pi R^2$
= 0.015 mW cm⁻²

2) For the Bluetooth 4.0 BLE, maximum conducted power measured within its production tolerance was 9.98dBm (maximum). The antenna gain is 2 dBi = 1.58 (num gain) 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 conducted power = 9.98dBm (9.95mW)

The radiated (EIRP) source-based time-averaging output power (with antenna gain)
= $(9.95 * 1 * 1.58)$ mW
= 15.7 mW

The power density at 20 cm from the antenna
= $EIRP / 4\pi R^2$
= 0.003 mW cm⁻²

3) For the Bluetooth 3.0, maximum field strength measured within its production tolerance (FS) was 103.8 dB μ V/m (maximum). 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 = $(FS * D)^2 / 30 = 7.2$ mW

The radiated (EIRP) source-based time-averaging output power
= $(7.2 * 1)$ mW
= 7.2 mW

The power density at 20 cm from the antenna
= $EIRP / 4\pi R^2$
= 0.0014 mW cm⁻²

In the frequency range of 1,500 - 100,000MHz, the MPE limit is 1.0 mW/cm² 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 product at least 20cm from nearby persons.”

In addition, for this product with multiple transmitter and antenna (Bluetooth and WiFi), the requirement of Simultaneous Transmission evaluation has also been considered and has complied with the following conditions of the worse case;

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

Thus,

$$\begin{array}{ccc} 0.015 /1 & + & 0.003/1 \\ \text{WiFi} & & \text{Bluetooth 4.0 BLE} \end{array} = 0.018 \leq 1$$

It is concluded that no Simultaneous Transmission evaluation is required.