Small size without compromise

# BSC MPE Evaluation

## 1. Purpose

Provides an evaluation for the Maximum Permissible Exposure (MPE) of the BSC System.

## 2. Applicable Standards

The criteria listed in in the table 1 below shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in § 1.1307(b) of this part within the frequency range of 100 kHz to 6 GHz.

Table 1 to § 1.1310(e)(1)—Limits for Maximum Permissible Exposure (MPE)

| Frequency range (MHz) | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density ($mW/cm^2$) | Averaging time (minutes) |
|---|---|---|---|---|
| (i) Limits for Occupational/Controlled Exposure | | | | |
| 0.3–3.0 | 614 | 1.63 | *(100) | ≤6 |
| 3.0–30 | 1842/f | 4.89/f | *($900/f^2$) | <6 |
| 30–300 | 61.4 | 0.163 | 1.0 | <6 |
| 300–1,500 | | | f/300 | <6 |
| 1,500–100,000 | | | 5 | <6 |
| (ii) Limits for General Population/Uncontrolled Exposure | | | | |
| 0.3–1.34 | 614 | 1.63 | *(100) | <30 |
| 1.34–30 | 824/f | 2.19/f | *($180/f^2$) | <30 |
| 30–300 | 27.5 | 0.073 | 0.2 | <30 |
| 300–1,500 | | | f/1500 | <30 |
| 1,500–100,000 | | | 1.0 | <30 |

f = frequency in MHz. * = Plane-wave equivalent power density.

## 3. MPE Calculation

The maximum power density was calculated for each transmitter at a separation distance of 20cm. The formula for this calculation is given below.

$$PowerDensity = \frac{ConductedPower_{mW} * AntGain}{4\pi * (20_{cm})^2}$$

The conducted power is the maximum power of the transmitter, and the antenna gain is approximated using a conservative estimate.

## 4. Results

The device contains a pre-certified WiFi/BLE module, a wireless Qi charging system, and an NFC transmitter for close range data communication. The Qi system cannot operate simultaneously with the NFC system. Both the Qi transmitter and the NFC transmitter use inductive coils, which have very low antenna gain in the far field that is difficult to determine. For the purposes of these calculations, a conservative antenna gain of 0 dBi is used (from experiment, the actual antenna gain is much lower than this estimate).

The pre-certified WiFi/BLE module has FCC ID 2AEMI-P2. According to its MPE report, the total MPE of this module is **0.05767**.

For the Qi system, the maximum allowed power density is 100 mW/cm$^2$. Using the conservative estimate for antenna gain and the a maximum conducted power of 10 W, the maximum power density of this transmitter is

$$\frac{10000}{4 * \pi * 20^2} = 1.99\ mW/cm^2$$

This means that the MPE for the Qi system is 1.99/100 = **0.0199.**

For the NFC system, the maximum allowed power density is 180/f$^2$ = 180/(13.56)$^2$ = 0.9789 mW/cm$^2$. Using the same conservative estimate for the inductive coil and the maximum conducted power of 420 mW, the maximum power density of this transmitter is

$$\frac{420}{4 * \pi * 20^2} = 0.0836\ mW/cm^2$$

This means that the MPE for the NFC system is 0.0836/0.9789 = **0.0854.**

The NFC and Qi systems cannot operate simultaneously, so the MPE of the BSC system is given by the sum of the MPE of the pre-certified module and the MPE of the NFC system. The means the final MPE value is

(MPE, 2AEMI-P2) + (MPE, NFC) = 0.05767 + 0.0854 = **0.1431 < 1,** which is less than the limit of 1.