

## FCC §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### Applicable Standard

According to subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

#### Limits for General Population/Uncontrolled Exposure

| Limits for General Population/Uncontrolled Exposure |                               |                               |                                     |                          |
|-----------------------------------------------------|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Frequency Range (MHz)                               | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm <sup>2</sup> ) | Averaging Time (Minutes) |
| 0.3-1.34                                            | 614                           | 1.63                          | *(100)                              | 30                       |
| 1.34-30                                             | 824/f                         | 2.19/f                        | *(180/f <sup>2</sup> )              | 30                       |
| 30-300                                              | 27.5                          | 0.073                         | 0.2                                 | 30                       |
| 300-1500                                            | /                             | /                             | f/1500                              | 30                       |
| 1500-100,000                                        | /                             | /                             | 1.0                                 | 30                       |

f = frequency in MHz

\* = Plane-wave equivalent power density

### Result

#### Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

| Mode | Frequency<br>(MHz) | Antenna Gain <sup>#</sup> | Tune up output<br>power <sup>#</sup> | Evaluation<br>Distance<br>(cm) | Power<br>Density<br>(mW/cm <sup>2</sup> ) | MPE<br>Limit<br>(mW/cm <sup>2</sup> ) |
|------|--------------------|---------------------------|--------------------------------------|--------------------------------|-------------------------------------------|---------------------------------------|
|      |                    | (dBi)                     | (dBm)                                |                                |                                           |                                       |
| BLE  | 2402-2480          | 2.88                      | 0.5                                  | 20                             | 0.0004                                    | 1                                     |

Note: The antenna gain and tune up output power was provided by applicant, BLE and NFC cannot transmit simultaneously.

| Mode | Frequency<br>(MHz) | Tune up output<br>power <sup>#</sup> | Evaluation<br>Distance<br>(cm) | Power<br>Density<br>(mW/cm <sup>2</sup> ) | MPE Limit<br>(mW/cm <sup>2</sup> ) |
|------|--------------------|--------------------------------------|--------------------------------|-------------------------------------------|------------------------------------|
|      |                    | (dBm)                                |                                |                                           |                                    |
| NFC  | 13.56              | -23                                  | 20                             | 0.000001                                  | 0.98                               |

Note: the maximum E-field strength is 71.68dBuV/m@3m=-23.52dBm

**Result: Compliant**