

5 FCC §2.1093, §1.1310(d) (3) & ISED RSS-102 - RF Exposure

5.1 Applicable Standards

As per FCC §1.1310(d) (3), At operating frequencies above 6 GHz, the MPE limits listed in Table 1 in paragraph (e)(1) of this section shall be used in all cases to evaluate the environmental impact of human exposure to RF radiation as specified in §1.1307(b) of this part.

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.

According to ISED RSS-102 Issue 5 Section 3, devices operating above 6 GHz regardless of the separation distance shall undergo an RF exposure evaluation.

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

| Frequency Range (MHz) | Electric Field (V/m rms) | Magnetic Field (A/m rms) | Power Density (W/m ²) | Reference Period (minutes) |
|--|--------------------------|-------------------------------|-----------------------------------|----------------------------|
| 0.003-10 | 83 | 90 | - | Instantaneous * |
| 0.1-10 | - | $0.73/f$ | - | 6 ** |
| 1.1-10 | $87/f^{0.5}$ | - | - | 6 ** |
| 10-20 | 27.46 | 0.0728 | -2 | 6 |
| 20-48 | $58.07/f^{0.25}$ | $0.1540/f^{0.25}$ | $8.944/f^{0.5}$ | 6 |
| 48-300 | 22.06 | 0.05852 | 1.291 | 6 |
| 300-6000 | $3.142 f^{0.3417}$ | $0.008335 f^{0.3417}$ | $0.02619 f^{0.6834}$ | 6 |
| 6000-15000 | 61.4 | 0.163 | 10 | 6 |
| 15000-150000 | 61.4 | 0.163 | 10 | $616000/f^{1.2}$ |
| 150000-300000 | $0.158 f^{0.5}$ | $4.21 \times 10^{-4} f^{0.5}$ | $6.67 \times 10^{-5} f$ | $616000/f^{1.2}$ |
| Note: f is frequency in MHz. * Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR). | | | | |

5.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

5.3 MPE Results for the FCC and IC

| | |
|---|----------------|
| <u>Maximum output power at antenna input terminal (dBm):</u> | <u>-44.77</u> |
| <u>Maximum output power at antenna input terminal (mW):</u> | <u>0.00003</u> |
| <u>Prediction distance (cm):</u> | <u>0.5</u> |
| <u>Prediction frequency (MHz):</u> | <u>6988.8</u> |
| <u>Maximum Antenna Gain, typical (dBi):</u> | <u>3</u> |
| <u>Maximum Antenna Gain (numeric):</u> | <u>2</u> |
| <u>Power density of prediction frequency at 0.5 cm (mW/cm²):</u> | <u>0.00002</u> |
| <u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u> | <u>1.0</u> |
| <u>Power density of prediction frequency at 0.5 cm (W/m²):</u> | <u>0.0002</u> |
| <u>IC MPE limit for uncontrolled exposure at prediction frequency (W/m²):</u> | <u>10</u> |

The device is compliant with the FCC requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 0.5 cm is 0.00002 mW/cm². Limit is 1.0 mW/cm².

The device is compliant with the IC requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 0.5 cm is 0.0002 W/m². Limit is 10 W/m².

Worst Case Colocation MPE Calculation: BLE and UWB:

| | Radio | Max Conducted Power (dBm) | Evaluated Distance (cm) | Worst-Case Exposure Level | Limit | Worst-Case Ratios | Sum of Ratios | Limit |
|------------|-------|---------------------------|-------------------------|---------------------------|------------------------|-------------------|---------------|-------|
| Worst Case | | | | | | | | |
| FCC | BLE | 3.46 | 0.5 | 0.092W/kg | 1.6 W/kg | 0.06% | 0.06% | 100% |
| | UWB | -44.77 | 0.5 | 0.00002mW/cm ² | 1.0 mW/cm ² | 0.00002% | | |
| IC | BLE | 3.46 | 0.5 | 0.092W/kg | 1.6 W/kg | 0.06% | 0.06% | 100% |
| | UWB | -44.77 | 0.5 | 0.0002W/m ² | 10 W/m ² | 0.00002% | | |

Note: The BLE calculation for Colocation evaluation was determined using the standalone SAR value estimation defined in section 4.3.2.b.1 of KDB 447498 D01 General RF Exposure Guidance v06.