

4 FCC§15.247(i), §1.1310, § 2.1091 - Maximum Permissible Exposure (MPE)

4.1 Applicable Standard

According to subpart 15.247(i) and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission’s guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

| (B) Limits for General Population/Uncontrolled Exposure | | | | |
|---|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm ²) | Averaging Time (minutes) |
| 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 |
| 300–1500 | / | / | f/1500 | 30 |
| 1500–100,000 | / | / | 1.0 | 30 |

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

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary: Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

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);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

4.2 RF Exposure Evaluation Result

MPE evaluation:

| Mode | Frequency Range (MHz) | Antenna Gain | | Target Power | | Evaluation Distance (cm) | Power Density (mW/cm ²) | MPE Limit (mW/cm ²) |
|------------|-----------------------|--------------|-----------|--------------|---------|--------------------------|-------------------------------------|---------------------------------|
| | | (dBi) | (numeric) | (dBm) | (mW) | | | |
| LTE B2 | 1850-1910 | 2.58 | 1.811 | 23.00 | 199.526 | 20 | 0.0719 | 1 |
| LTE B4 | 1710-1755 | 2.58 | 1.811 | 22.00 | 158.489 | 20 | 0.0571 | 1 |
| LTE B12 | 699-716 | 1.15 | 1.303 | 24.00 | 251.189 | 20 | 0.0651 | 0.466 |
| BR+EDR | 2402-2480 | 4 | 2.512 | -4.00 | 0.398 | 20 | 0.0002 | 1 |
| BLE | 2402-2480 | 4 | 2.512 | 6.00 | 3.981 | 20 | 0.0020 | 1 |
| Wi-Fi 2.4G | 2412-2462 | 4 | 2.512 | 23.00 | 199.526 | 20 | 0.0997 | 1 |

Wi-Fi 2.4G and LTE B2 can transmit simultaneously:

$$=S_{\text{Wi-Fi 2.4G}}/S_{\text{limit-Wi-Fi 2.4G}} + S_{\text{LTE B12}}/S_{\text{limit-LTE B12}} = (0.0997/1) + (0.0651/0.466) = 0.0997 + 0.1397 = 0.2394 < 1.0$$

Result: MPE evaluation meet 20 cm the requirement of standard.