

FCC §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to §2.1091 and §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

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/cm²) | 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:

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

Calculated Data:**For LTE mode:**

| Mode | Frequency Range (MHz) | Max Antenna Gain | | Target Output Power | | Evaluation Distance (cm) | Power Density (mW/cm ²) | MPE Limit (mW/cm ²) |
|-------------|-----------------------|------------------|-----------|---------------------|--------|--------------------------|-------------------------------------|---------------------------------|
| | | (dBi) | (numeric) | (dBm) | (mW) | | | |
| LTE Band 5 | 824-849 | 2.70 | 1.86 | 22 | 158.49 | 20 | 0.0587 | 0.55 |
| LTE Band 41 | 2516-2670 | 3.70 | 2.34 | 23 | 199.53 | 20 | 0.0930 | 1.00 |

For Wi-Fi mode:

| Mode | Frequency Range (MHz) | Antenna Gain | | Tune-up Conducted Power | | Evaluation Distance (cm) | Power Density (mW/cm ²) | MPE Limit (mW/cm ²) |
|--------------|-----------------------|--------------|-----------|-------------------------|-------|--------------------------|-------------------------------------|---------------------------------|
| | | (dBi) | (numeric) | (dBm) | (mW) | | | |
| 802.11b | 2412-2462 | 2.20 | 1.66 | 17.00 | 50.12 | 20 | 0.0165 | 1.00 |
| 802.11g | | 2.20 | 1.66 | 16.00 | 39.81 | 20 | 0.0131 | 1.00 |
| 802.11n-HT20 | | 2.20 | 1.66 | 15.00 | 31.62 | 20 | 0.0104 | 1.00 |
| 802.11n-HT40 | 2422-2452 | 2.20 | 1.66 | 15.00 | 31.62 | 20 | 0.0104 | 1.00 |

| Mode | Frequency (MHz) | Antenna Gain | | Conducted output power | | Evaluation Distance (cm) | Power Density (mW/cm ²) | MPE Limit (mW/cm ²) |
|--------------|-----------------|--------------|-----------|------------------------|-------|--------------------------|-------------------------------------|---------------------------------|
| | | (dBi) | (numeric) | (dBm) | (mW) | | | |
| 802.11a | 5150-5250 | 2.20 | 1.66 | 14.00 | 25.12 | 20 | 0.0083 | 1.00 |
| 802.11n-HT20 | | 2.20 | 1.66 | 15.00 | 31.62 | 20 | 0.0104 | 1.00 |
| 802.11n-HT40 | | 2.20 | 1.66 | 15.00 | 31.62 | 20 | 0.0104 | 1.00 |
| 802.11a | 5725-5850 | 2.20 | 1.66 | 14.00 | 25.12 | 20 | 0.0083 | 1.00 |
| 802.11n-HT20 | | 2.20 | 1.66 | 15.00 | 31.62 | 20 | 0.0104 | 1.00 |
| 802.11n-HT40 | | 2.20 | 1.66 | 16.00 | 39.81 | 20 | 0.0131 | 1.00 |

Note:

- (1) The target output power was declared by the Manufacturer.
- (2) 2.4GWi-Fi and 5GWi-Fi cannot transmit simultaneously.
- (3) Wi-Fi and LTE can transmit simultaneously, The worst condition is 802.11b of 2.4G Wi-Fi and LTE Band 5, as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0165/1.00 + 0.0587/0.55 = 0.0165 + 0.1067 = 0.1232 < 1.0$$

Result: The device meet FCC MPE at 20 cm distance.