

MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Standard Applicable

According to § 1.1307(b)(1), system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

(a) Limits for Occupational / Controlled Exposure

| Frequency range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/cm ²) | Averaging Times E ² , H ² or S (minutes) |
|--------------------------|---|---|--|--|
| 0.3-3.0 | 614 | 1.63 | (100)* | 6 |
| 3.0-30 | 1842/f | 4.89/f | (900/f)* | 6 |
| 30-300 | 61.4 | 0.163 | 1.0 | 6 |
| 300-1500 | | | F/300 | 6 |
| 1500-100000 | | | 5 | 6 |

(b) Limits for General Population / Uncontrolled Exposure

| Frequency range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/cm ²) | Averaging Times E ² , H ² or S (minutes) |
|--------------------------|---|---|--|--|
| 0.3-1.34 | 614 | 1.63 | (100)* | 30 |
| 1.34-30 | 824/f | 2.19/f | (180/f)* | 30 |
| 30-300 | 27.5 | 0.073 | 0.2 | 30 |
| 300-1500 | | | F/1500 | 30 |
| 1500-100000 | | | 1 | 30 |

Note: f = frequency in MHz: * = Plane-wave equivalents power density

MPE Calculation Method

$$S = (P \cdot G) / (4 \cdot \pi \cdot R^2)$$

S = 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 (in appropriate units, e.g., cm)

MPE Calculation Result

Base on the device is able to transmit simultaneously using both its transmitters, the maximum peak output power is 13.66dBm for Wi-Fi transmitter (Tx frequency: 2412~2462MHz), the maximum peak output power is very low for RFID transmitter (Tx frequency: 2451.15MHz), and the field strength of the fundamental of the RFID transmitter is 91.7dBuV only, the radiation emission of RFID transmitter is ignored relative to the output power of the 13.66dBm, and all antenna in the product shall be at least 20cm from user and nearby persons, so the MPE calculation as follows:

Maximum peak output power at antenna input terminal: 11.6413(mW)

Prediction distance: 20 (cm)

Prediction frequency: 2412 (MHz)

Antenna gain (typical): 3 (dBi)

Antenna gain (numeric): 2 (numeric)

The worst case is power density at prediction frequency at 20cm: 0.004632 (mw/cm²)

MPE limit for general population exposure at prediction frequency: 1 (mw/cm²)

$$0.004632 \text{ (mw/cm}^2\text{)} < 1 \text{ (mw/cm}^2\text{)}$$

And

RF Output Power

Tx frequency range: 2412~2462MHz

Antenna-to-tissue separation: 20 cm

Maximum Output Power: 13.66dBm(23.2274mW)

Maximum Duty Factor: 100%

$$60/f(\text{GHz}) \text{ mW} = 24.37 \text{ mW}$$

Source-based time-averaged conducted output power is 23.2274 mW =< 60/f

So the transmitter is comply the RF exposure requirements and the SAR in not required.