

# Appendix B. Maximum Permissible Exposure

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# Maximum Permissible Exposure

# 1.1. Applicable Standard

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 levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.25 m normally can be maintained between the user and the device.

(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/ cm²)	Averaging Time  E  <sup>2</sup> , H  <sup>2</sup> 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
1500-100,000			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/ cm²)	Averaging Time  E  <sup>2</sup> , H  <sup>2</sup> 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
1500-100,000			1.0	30

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

#### 1.2. MPE Calculation Method

E (V/m) = 
$$\frac{\sqrt{30 \times P \times G}}{d}$$
 Power Density:  $Pd$  (W/m²) =  $\frac{E^2}{377}$ 

 $\mathbf{E}$  = Electric field (V/m)

P = Average RF output power (W)

G = EUT Antenna numeric gain (numeric)

**d** = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

From the EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

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# 1.3. Calculated Result and Limit

For 5GHz UNII Band:

Antenna Type: PIFA Antenna

Max Conducted Power for IEEE 802.11a: 13.38dBm

Directional Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
4.30	2.6915	13.3800	21.7771	0.011667	1	Complies

Note: Directional Antenna Gain = Test Antenna Gain + 10 log (Antenna quantity)

For 5GHz ISM Band:

Antenna Type: PIFA Antenna

Max Conducted Power for IEEE 802.11a: 13.25dBm

Directional Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (\$) (mW/cm²)	Test Result
4.30	2.6915	13.2500	21.1349	0.011323	1	Complies

Note: Directional Antenna Gain = Test Antenna Gain + 10 log (Antenna quantity)

For 2.4GHz Band:

Antenna Type: PIFA Antenna

Max Conducted Power for IEEE 802.11b: 15.82 dBm

Directional Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (\$) (mW/cm²)	Test Result
3	1.9953	15.8200	38.1944	0.015169	1	Complies

Note: Directional Antenna Gain = Test Antenna Gain + 10 log (Antenna quantity)

For Bluetooth 1.0:

Antenna Type: PIFA Antenna

Max Conducted Power for Bluetooth: 9.32 dBm

Antenna Gair (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
3	1.9953	9.3200	8.5507	0.003396	1	Complies

For Bluetooth 2.1+EDR:

Antenna Type: PIFA Antenna

Max Conducted Power for Bluetooth: 9.50 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
3	1.9953	9.5000	8.9125	0.003540	1	Complies

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# For Bluetooth 4.0:

Antenna Type: PIFA Antenna

Max Conducted Power for Bluetooth: 7.80 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (\$) (mW/cm²)	Test Result
3	1.9953	7.8000	6.0256	0.002393	1	Complies

#### **CONCULSION:**

Both of the WLAN 5GHz Band and Bluetooth can transmit simultaneously, the formula of calculated the MPE is:

CPD1 / LPD1 + CPD2 / LPD2 + .....etc. < 1

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is 0.011667 / 1 + 0.003540 / 1 = 0.015207, which isless than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

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