

Appendix C. Maximum Permissible Exposure

1. 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/ cm ²)	Averaging Time 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
1500-100,000			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/ cm ²)	Averaging Time 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
1500-100,000			1.0	30

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

1.2. MPE Calculation Method

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

E = Electric field (V/m)

P = Peak 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 peak 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.

1.3. Calculated Result and Limit

1.3.1. WLAN 5GHz Band (UNII) + Bluetooth

<For Bluetooth Function>

Antenna Type : Ant. A (Dipole Antenna)

Max Peak Output Power: -0.39 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
3.00	1.9953	-0.3900	0.9141	0.000363	1	Complies

<For WLAN Function>

For 5GHz UNII Band:

Antenna Type : Ant. A (Dipole Antenna)

Max Conducted Power for IEEE 802.11an MCS0 40MHz Ant. A-1 + Ant. A-2: 20.01dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5.00	3.1623	20.0132	100.3053	0.063136	1	Complies

CONCLUSION:

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

$$CPD1 / LPD1 + CPD2 / LPD2 + \dots \text{etc.} < 1$$

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is $0.000363 / 1 + 0.063136 / 1 = 0.063499$, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

<For Bluetooth Function>

Antenna Type : Ant. B (PIFA Antenna)

Max Peak Output Power: -0.39 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
3.5	2.2387	-0.3900	0.9141	0.000407	1	Complies

<For WLAN Function>

For 5GHz UNII Band:

Antenna Type : Ant. B (PIFA Antenna)

Max Conducted Power for IEEE 802.11an MCS0 40MHz Ant. B-1 + Ant. B-2: 20.01dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5.01	3.1696	20.0132	100.3053	0.063281	1	Complies

CONCLUSION:

Both of the WLAN 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 $0.000407 / 1 + 0.063281 / 1 = 0.063688$, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

1.3.2. WLAN 5GHz Band (ISM) + Bluetooth

<For Bluetooth Function>

Antenna Type : Ant. A (Dipole Antenna)

Max Peak Output Power: -0.39 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
3.00	1.9953	-0.3900	0.9141	0.000363	1	Complies

<For WLAN Function>

For 5GHz ISM Band:

Antenna Type : Ant. A (Dipole Antenna)

Max Conducted Power for IEEE 802.11an MCS0 40MHz Ant. A-1 + Ant. A-2: 19.86 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5.00	3.1623	19.8550	96.7171	0.060877	1	Complies

CONCLUSION:

Both of the WLAN 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 $0.000363 / 1 + 0.060877 / 1 = 0.061240$, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

<For Bluetooth Function>

Antenna Type : Ant. B (PIFA Antenna)

Max Peak Output Power: -0.39 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
3.5	2.2387	-0.3900	0.9141	0.000407	1	Complies

<For WLAN Function>

For 5GHz ISM Band:

Antenna Type : Ant. B (PIFA Antenna)

Max Conducted Power for IEEE 802.11an MCS0 40MHz Ant. B-1 + Ant. B-2: 19.86 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
5.01	3.1696	19.8550	96.7171	0.061017	1	Complies

CONCLUSION:

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

$$CPD1 / LPD1 + CPD2 / LPD2 + \dots \text{etc.} < 1$$

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is $0.000407 / 1 + 0.061017 / 1 = 0.061424$, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

1.3.3. WLAN 2.4GHz Band + Bluetooth

<For Bluetooth Function>

Antenna Type : Ant. A (Dipole Antenna)

Max Peak Output Power: -0.39 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
3.00	1.9953	-0.3900	0.9141	0.000363	1	Complies

<For WLAN Function>

Antenna Type : Ant. A (Dipole Antenna)

Max Conducted Power for IEEE 802.11a MCS0 20MHz Ant. A-1 + Ant. A-2: 23.83 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
3.00	1.9953	23.8301	241.5537	0.095932	1	Complies

CONCLUSION:

Both of the WLAN 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 $0.000363 / 1 + 0.095932 / 1 = 0.096295$, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

<For Bluetooth Function>

Antenna Type : Ant. B (PIFA Antenna)

Max Peak Output Power: -0.39 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
3.5	2.2387	-0.3900	0.9141	0.000407	1	Complies

<For WLAN Function>

Antenna Type : Ant. B (PIFA Antenna)

Max Conducted Power for IEEE 802.11a MCS0 20MHz Ant. B-1 + Ant. B-2: 24.56 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
3.5	2.2387	24.5592	285.7090	0.127313	1	Complies

CONCLUSION:

Both of the WLAN 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 $0.000407 / 1 + 0.127313 / 1 = 0.127720$, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.