

Appendix B. 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 0.2 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 = 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=0.29m, as well as the gain of the used antenna, the RF power density can be obtained.

1.3. Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

For 5GHz Band 1:

Antenna Type : Dipole Antenna

Conducted Power for IEEE 802.11ac MCS0/Nss1 VHT20: 25.19dBm

Distance (m)	Directional Gain (dBi)	Antenna Gain (numeric)	The maximum combined Average Output Power		Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
			(dBm)	(mW)			
0.29	8.67	7.3641	25.1884	330.2510	0.230239	1	Complies

Note: Directional gain = $10 \cdot \log \left[\frac{\sum_{j=1}^{N_{\text{sig}}} \left\{ \sum_{k=1}^{N_{\text{ss}}} g_{j,k} \right\}^2}{N_{\text{ANT}}} \right]$

For 5GHz Band 4:

Antenna Type : Dipole Antenna

Conducted Power for IEEE 802.11ac MCS0/Nss1 VHT40: 25.93dBm

Distance (m)	Directional Gain (dBi)	Antenna Gain (numeric)	The maximum combined Average Output Power		Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
			(dBm)	(mW)			
0.29	8.67	7.3641	25.9285	391.6058	0.273014	1	Complies

Note: Directional gain = $10 \cdot \log \left[\frac{\sum_{j=1}^{N_{\text{sig}}} \left\{ \sum_{k=1}^{N_{\text{ss}}} g_{j,k} \right\}^2}{N_{\text{ANT}}} \right]$

For 2.4GHz Band:

Antenna Type : Dipole Antenna

Conducted Power for IEEE 802.11n MCS0 HT20 : 29.01dBm

Distance (m)	Directional Gain (dBi)	Antenna Gain (numeric)	The maximum combined Average Output Power		Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
			(dBm)	(mW)			
0.29	6.97	4.9788	29.0054	795.3077	0.374861	1	Complies

Note: Directional gain = $10 \cdot \log \left[\frac{\sum_{j=1}^{N_{\text{sig}}} \left\{ \sum_{k=1}^{N_{\text{ss}}} g_{j,k} \right\}^2}{N_{\text{ANT}}} \right]$

Conclusion:

Both of the 2.4GHz WLAN function, 5GHz Band 1 WLAN function and 5GHz Band 4 WLAN function can transmit simultaneously, the formula of calculated the MPE is:

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

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is $0.374861 / 1 + 0.230239 / 1 + 0.273014 / 1 = 0.878114$, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.