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 0.2 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/ cm²)	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/ cm²)	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 (V/m) = $\frac{\sqrt{30 \times P \times G}}{d}$ Power Density: *Pd* (W/m²) = $\frac{E^2}{377}$

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=0.31m, 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 UNII Band:

Antenna Type : Dipole Ant.

Conducted Power for IEEE 802.11ac VHT20 : 27.73dBm

Distance (m)	Directional Gain (dBi)	Antenna Gain (numeric)	Average Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			(dBm)	(mW)			
0.31	8.18	6.5784	27.7340	593.4673	0.323448	1	Complies

Note: $DirectionalGain = 10 \cdot \log\left[\frac{\sum_{i=1}^{N_{ANT}}\left\{\sum_{k=1}^{N_{SS}} g_{i,k}\right\}^2}{N_{ANT}}\right]$

For 5GHz ISM Band:

Antenna Type : Dipole Ant.

Conducted Power for IEEE 802.11ac VHT20: 27.72dBm

Distance (m)	Directional Gain (dBi)	Antenna Gain (numeric)	Average Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			(dBm)	(mW)			
0.31	8.24	6.6699	27.7218	591.8097	0.327032	1	Complies

Note: $DirectionalGain = 10 \cdot \log\left[\frac{\sum_{i=1}^{N_{ANT}}\left\{\sum_{k=1}^{N_{SS}} g_{i,k}\right\}^2}{N_{ANT}}\right]$

For 2.4GHz Band:

Antenna Type : Dipole Ant.

Conducted Power for IEEE 802.11ac VHT20: 28.51 dBm

Distance (m)	Directional Gain (dBi)	Antenna Gain (numeric)	verage Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			(dBm)	(mW)			
0.31	7.37	5.4591	28.5072	709.1252	0.320724	1	Complies

Note: $DirectionalGain = 10 \cdot \log\left[\frac{\sum_{i=1}^{N_{ANT}}\left\{\sum_{k=1}^{N_{SS}} g_{i,k}\right\}^2}{N_{ANT}}\right]$

Conclusion:

Both of the WLAN 2.4GHz+5GHz band1+5GHz band4 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 0.320724/1+0.320724/1+0.327032/1=0.96848 , which is less than "1".

This confirmed that the device comply with FCC 1.1310 MPE limit.