

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/ 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=1m, 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. For 5GHz Band

<For Mode 1 (Ant. 1)>:

For 5GHz ISM Band: (15.247)

Antenna Type : Sector Antenna

Max Conducted Power for IEEE 802.11an MCS8 20MHz J2+J4: 20.59 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
15.00	31.6228	20.5863	114.4548	0.028817	1	Complies

<For Mode 2 (Ant. 2)>:

For 5GHz ISM Band: (15.247)

Antenna Type : Dipole Antenna

Max Conducted Power for IEEE 802.11an MCS8 20MHz J2+J4: 27.56 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
22.00	158.4893	27.5615	570.3548	0.719707	1	Complies

<For Mode 4 (Ant. 4)>:

For 5GHz ISM Band: (15.247)

Antenna Type : Sector Antenna

Max Conducted Power for IEEE 802.11a J2+J3+J4: 28.60 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
4.00	2.5119	28.6017	724.7165	0.014494	1	Complies

<For Mode 6 (Ant. 6)>:

For 5GHz ISM Band: (15.247)

Antenna Type : Omni Antenna

Max Conducted Power for IEEE 802.11an MCS8 20MHz J2+J3+J4: 25.48 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
9.00	7.9433	25.4765	352.9023	0.022318	1	Complies

<For Mode 7 (Ant. 7)>:

For 5GHz ISM Band: (15.247)

Antenna Type : Omni Antenna

Max Conducted Power for IEEE 802.11an MCS8 20MHz J2+J3+J4: 28.22 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
4.00	2.5119	28.2166	663.2264	0.013264	1	Complies

1.3.2. For 2.4GHz Band

<For Mode 3 (Ant. 3)>:

Antenna Type : Panel Antenna

Max Conducted Power for IEEE 802.11b J2+J3+J4: 25.44 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
17.5	56.2341	25.4425	350.1489	0.156770	1	Complies

<For Mode 4 (Ant. 4)>:

Antenna Type : Sector Antenna

Max Conducted Power for IEEE 802.11n MCS8 20MHz J2+J3+J4: 28.90 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
4.5	2.8184	28.9018	776.5653	0.017426	1	Complies

<For Mode 5 (Ant. 5)>:

Antenna Type : Omni Antenna

Max Conducted Power for IEEE 802.11n MCS8 20MHz J2+J3+J4: 25.03 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
9.5	8.9125	25.0255	318.0936	0.022572	1	Complies

<For Mode 7 (Ant. 7)>:

Antenna Type : Omni Antenna

Max Conducted Power for IEEE 802.11g J2+J3+J4: 29.42 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
4.5	2.8184	29.4219	875.3578	0.019642	1	Complies

1.3.3. For 5GHz & 2.4GHz Band Co-Location

CONCLUSION:

Both of the WLAN 2.4GHz Band and WLAN 5GHz Band 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 (ANT3-2.4GHz + ANT2-5GHz) situation is $0.15677 / 1 + 0.719707 / 1 = 0.8764$, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.