

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 0.5 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=0.5m, as well as the gain of the used antenna, the RF power density can be obtained.

1.3. Calculated Result and Limit

For 5GHz UNII Band: (15.407)

For Ant. 1:

Antenna Type : Loop Antenna

Max Conducted Power for IEEE 802.11n MCS8 20MHz A1+A5: 16.97dBm

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
6	3.9811	16.9700	49.7737	0.006311	1	Complies

For Ant. 2:

Antenna Type : Dipole Antenna

Max Conducted Power for IEEE 802.11n MCS8 20MHz A1+A5: 16.94dBm

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
3.26	2.1184	16.9400	49.4311	0.003335	1	Complies

For Ant. 3:

Antenna Type : Dual-Band MIMO Sector Antenna

Max Conducted Power for IEEE 802.11n MCS8 20MHz A1+A5: 14.03dBm

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
8.96	7.8705	14.0300	25.2930	0.006340	1	Complies

For Ant. 4:

Antenna Type : Dual-Band MIMO Directional Antenna

Max Conducted Power for IEEE 802.11n MCS8 40MHz A1+A5: 11.24dBm

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
11.76	14.9968	11.2400	13.3045	0.006354	1	Complies

For Ant. 6:

Antenna Type : Mast Mount Omnidirectional antennas

Max Conducted Power for IEEE 802.11n MCS8 40MHz A1+A5: 16.79dBm

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
4.01	2.5177	16.7900	47.7529	0.003829	1	Complies

For 5GHz ISM Band: (15.247)

For Ant. 1:

Antenna Type : Loop Antenna

Max Conducted Power for IEEE 802.11n MCS8 20MHz: 24.08dBm

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
6	3.9811	24.0805	255.8871	0.032443	1	Complies

For Ant. 2:

Antenna Type : Dipole Antenna

Max Conducted Power for IEEE 802.11n MCS8 20MHz A1 +A5: 22.19 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
3.26	2.1184	22.1905	165.5955	0.011172	1	Complies

For Ant. 3:

Antenna Type : Dual-Band MIMO Sector Antenna

Max Conducted Power for IEEE 802.11a A1 +A5: 22.19dBm

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
8.96	7.8705	22.1905	165.5955	0.041507	1	Complies

For Ant. 4:

Antenna Type : Dual-Band MIMO Directional Antenna

Max Conducted Power for IEEE 802.11n MCS8 20MHz A1 +A5: 22.19dBm

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
11.76	14.9968	22.1905	165.5955	0.079089	1	Complies

For Ant. 5:

Antenna Type : Dual Polarized Antenna

Max Conducted Power for IEEE 802.11n MCS8 20MHz A1 +A5: 16.47dBm

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
19.51	89.3305	16.4706	44.3672	0.126221	1	Complies

For Ant. 6:

Antenna Type : Mast Mount Omnidirectional antennas

Max Conducted Power for IEEE 802.11n MCS8 20MHz A1 +A5: 22.19dBm

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
4.01	2.5177	22.1905	165.5955	0.013278	1	Complies

For 2.4GHz Band:

For Ant. 1:

Antenna Type : Loop Antenna

Max Conducted Power for IEEE 802.11b B2+B6: 25.05dBm

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
3.6	2.2909	25.0456	319.5691	0.023315	1	Complies

For Ant. 2:

Antenna Type : Dipole Antenna

Max Conducted Power for IEEE 802.11n MCS8 20MHz B2+B6: 24.01 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
2.08	1.6144	24.0110	251.8278	0.012947	1	Complies

For Ant. 3:

Antenna Type : Dual-Band MIMO Sector Antenna

Max Conducted Power for IEEE 802.11n MCS8 20MHz B2+B6: 24.17dBm

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
7.08	5.1050	24.1745	261.4842	0.042512	1	Complies

For Ant. 4:

Antenna Type : Dual-Band MIMO Directional Antenna

Max Conducted Power for IEEE 802.11n MCS8 20MHz B2+B6: 24.17dBm

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
9.98	9.9541	24.1745	261.4842	0.082893	1	Complies

For Ant. 6:

Antenna Type : Mast Mount Omnidirectional antennas

Max Conducted Power for IEEE 802.11n MCS8 20MHz B2+B6: 25.04dBm

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
4.47	2.7990	25.0368	318.9204	0.028428	1	Complies

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 situation is **Ant. 4** $0.006354 / 1 + 0.082893 / 1 = 0.089247$, which is less than "1".

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