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

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

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. For 5GHz Band:

<For Antenna 1>:

Antenna Type : Dipole Antenna

Max Conducted Power for 802.11a Ant. 1-1 + Ant. 1-3 : 24.79 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
7	5.0119	24.7856	300.9988	0.300272	1	Complies

<For Antenna 2>:

Antenna Type : Embedded Antenna

Max Conducted Power for 802.11a Ant. 2-1 + Ant. 2-3 : 24.79 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
3.42	2.1979	24.7856	300.9988	0.131679	1	Complies

<For Antenna 3>:

Antenna Type : Patch Antenna

Max Conducted Power for 802.11a Ant. 3-1+ Ant. 3-3 : 24.79 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
3	1.9953	24.7856	300.9988	0.119541	1	Complies

<For Antenna 4>:

Antenna Type : Omni Antenna

Max Conducted Power for 802.11a Ant. 4-1 + Ant. 4-3 : 24.79 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
4.2	2.6303	24.7856	300.9988	0.157585	1	Complies

<For Antenna 5>:

Antenna Type : Panel Antenna

Max Conducted Power for 802.11a Ant. 5-1 + Ant. 5-3 : 24.79 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
5	3.1623	24.7856	300.9988	0.189459	1	Complies

<For Antenna 6>:

Antenna Type : Omni Antenna

Max Conducted Power for 802.11a Ant. 6-1 + Ant. 6-3 : 24.79 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
7	5.0119	24.7856	300.9988	0.300272	1	Complies

1.3.2. For 2.4GHz Band:

<For Antenna 1>:

Antenna Type : Dipole Antenna

Max Conducted Power for 802.11g Ant. 1-1 + Ant. 1-3 : 27.50 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
7	5.0119	27.4954	561.7424	0.560386	1	Complies

<For Antenna 2>:

Antenna Type : Embedded Antenna

Max Conducted Power for 802.11g Ant. 2-1 + Ant. 2-3 : 27.50 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2	1.5849	27.4954	561.7424	0.177210	1	Complies

<For Antenna 3>:

Antenna Type : Patch Antenna

Max Conducted Power for Draft n 20MHz Ant. 3-1 + Ant. 3-3 : 26.52 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
3.5	2.2387	26.5181	448.5455	0.199874	1	Complies

<For Antenna 4>:

Antenna Type : Omni Antenna

Max Conducted Power for IEEE 802.11b Ant. 4-1 + Ant. 4-3 : 26.31 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
3.3	2.1380	26.3100	427.5629	0.181949	1	Complies

<For Antenna 5>:

Antenna Type : Panel Antenna

Max Conducted Power for IEEE 802.11b Ant. 5-1 + Ant. 5-3 : 25.58 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
4.5	2.8184	25.5800	361.4099	0.202745	1	Complies

<For Antenna 6>:

Antenna Type : Omni Antenna

Max Conducted Power for Draft n 20MHz Ant. 6-1 + Ant. 6-3 : 26.11 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
4	2.5119	26.1081	408.1387	0.204060	1	Complies

1.3.3. For 5GHz & 2.4GHz Band (Co-Location):

<For Antenna 1>:

<5GHz>

Antenna Type : Dipole Antenna

Max Conducted Power for 802.11a Ant. 1-1 + Ant. 1-3 : 24.79 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
7	5.0119	24.7856	300.9988	0.300272	1	Complies

<2.4GHz>

Antenna Type : Dipole Antenna

Max Conducted Power for 802.11g Ant. 1-1 + Ant. 1-3 : 27.50 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
7	5.0119	27.4954	561.7424	0.560386	1	Complies

CONCULSION:

Both of the 5GHz and 2.4GHz can transmit simultaneously, the formula of calculatedthe MPE is:

CPD1 / LPD1 + CPD2 / LPD2 + ……etc. < 1

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is 0.300272 / 1 + 0.560386 / 1 = 0.860658, which isless than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

<For Antenna 2>:

<5GHz>

Antenna Type : Embedded Antenna

Max Conducted Power for 802.11a Ant. 2-1 + Ant. 2-3 : 24.79 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
3.42	2.1979	24.7856	300.9988	0.131679	1	Complies

<2.4GHz>

Antenna Type : Embedded Antenna

Max Conducted Power for 802.11g Ant. 2-1 + Ant. 2-3 : 27.50 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2	1.5849	27.4954	561.7424	0.177210	1	Complies

CONCULSION:

Both of the 5GHz and 2.4GHz can transmit simultaneously, the formula of calculatedthe MPE is:

CPD1 / LPD1 + CPD2 / LPD2 + ...etc. < 1

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is 0.131679 / 1 + 0.177210 / 1 = 0.308889, which isless than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

<For Antenna 3>:

<5GHz>

Antenna Type : Patch Antenna

Max Conducted Power for 802.11a Ant. 3-1+ Ant. 3-3 : 24.79 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
3	1.9953	24.7856	300.9988	0.119541	1	Complies

<2.4GHz>

Antenna Type : Patch Antenna

Max Conducted Power for Draft n 20MHz Ant. 3-1 + Ant. 3-3 : 26.52 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
3.5	2.2387	26.5181	448.5455	0.199874	1	Complies

CONCULSION:

Both of the 5GHz and 2.4GHz can transmit simultaneously, the formula of calculatedthe MPE is:

CPD1 / LPD1 + CPD2 / LPD2 + ……etc. < 1

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is 0.119541 / 1 +0.199874 / 1 = 0.319415, which isless than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

<For Antenna 4>:

<5GHz>

Antenna Type : Omni Antenna

Max Conducted Power for 802.11a Ant. 4-1 + Ant. 4-3 : 24.79 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
4.2	2.6303	24.7856	300.9988	0.157585	1	Complies

<2.4GHz>

Antenna Type : Omni Antenna

Max Conducted Power for IEEE 802.11b Ant. 4-1 + Ant. 4-3 : 26.31 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
3.3	2.1380	26.3100	427.5629	0.181949	1	Complies

CONCULSION:

Both of the 5GHz and 2.4GHz can transmit simultaneously, the formula of calculatedthe MPE is:

CPD1 / LPD1 + CPD2 / LPD2 + ……etc. < 1

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is 0.157585 / 1 + 0.181949 / 1 = 0.339534, which isless than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

<For Antenna 5>:

<5GHz>

Antenna Type : Panel Antenna

Max Conducted Power for 802.11a Ant. 5-1 + Ant. 5-3 : 24.79 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
5	3.1623	24.7856	300.9988	0.189459	1	Complies

<2.4GHz>

Antenna Type : Panel Antenna

Max Conducted Power for IEEE 802.11b Ant. 5-1 + Ant. 5-3 : 25.58 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
4.5	2.8184	25.5800	361.4099	0.202745	1	Complies

CONCULSION:

Both of the 5GHz and 2.4GHz can transmit simultaneously, the formula of calculatedthe MPE is:

CPD1 / LPD1 + CPD2 / LPD2 + ……etc. < 1

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is 0.189459 / 1 + 0.202745 / 1 = 0.392204, which isless than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

<For Antenna 6>:

<5GHz>

Antenna Type : Omni Antenna

Max Conducted Power for 802.11a Ant. 6-1 + Ant. 6-3 : 24.79 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
7	5.0119	24.7856	300.9988	0.300272	1	Complies

<2.4GHz>

Antenna Type : Omni Antenna

Max Conducted Power for Draft n 20MHz Ant. 6-1 + Ant. 6-3 : 26.11 dBm

Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
4	2.5119	26.1081	408.1387	0.204060	1	Complies

CONCULSION:

Both of the 5GHz and 2.4GHz can transmit simultaneously, the formula of calculatedthe MPE is:

CPD1 / LPD1 + CPD2 / LPD2 + ……etc. < 1

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is 0.300272 / 1 +0.204060 / 1 = 0.504332, which isless than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.