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/ 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=0.2m, 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 Zigbee:

Antenna Type : Dipole Antenna

Conducted Power for IEEE 802.15.4 ZigBee: 0.68 dBm

Distance (m)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			(dBm)	(mW)			
0.2	-2.50	0.5623	0.6800	1.1695	0.000131	1	**Complies**

For 3G Module (FCC ID: XPYLISAU200):

Frequency range: 850 MHz

Antenna Type: Dipole Antenna (-0.13 dBi)

Max Conducted Power: 23.15 dBm

EIRP power (dBm)	EIRP power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)
23.02	200.4472	0.039898	0.57

Frequency range: 1900 MHz

Antenna Type: Dipole Antenna (-0.13 dBi)

Max Conducted Power: 23.73 dBm

EIRP power (dBm)	EIRP power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)
23.60	229.0868	0.045598	1

Conclusion:

Both of the Zigbee and 3G 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

(1) Zigbee + 3G (850MHz) = 0.000131 / 1 + 0.039898 / 0.57 = 0.070127

(2) Zigbee + 3G (1900MHz) = 0.000131 / 1 + 0.045598 / 1 = 0.045729

Therefore, the worst-case situation is **Zigbee + 3G (850MHz)**, which is less than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.