

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 that distance of at least 0.25 m is normally 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 = 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=0.25m, 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 WLAN>

Antenna Type : PIFA Antenna

Conducted Power for IEEE 802.11g: 27.96 dBm

Distance (m)	Test Freq. (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	The maximum combined Average Output Power		Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
				(dBm)	(mW)			
0.25	2437	4.20	2.6303	27.9638	625.7179	0.209657	1	Complies

<For Zigbee>

Antenna Type : PIFA Antenna

Conducted Power for Zigbee: 21.29 dBm / Chain 3

Distance (m)	Test Freq. (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	The maximum combined Average Output Power		Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
				(dBm)	(mW)			
0.25	2405	2.30	1.6982	21.2900	134.5860	0.029116	1	Complies

Antenna Type : PIFA Antenna

Conducted Power for Zigbee: 21.55 dBm / Chain 4

Distance (m)	Test Freq. (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	The maximum combined Average Output Power		Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
				(dBm)	(mW)			
0.25	2405	4.80	3.0200	21.5500	142.8894	0.054971	1	Complies

<For WWAN>

FCC ID: R17HE910 / Antenna Type : PIFA Antenna

850 MHz frequency band							
Distance (m)	Bands	Frequency (MHz)	Antenna Gain (dBi)	Output Power (dBm)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
0.25	GSM 850	824.2	1.4	32.70	0.327439	0.55	Complies
		836.4		32.60	0.319986	0.56	Complies
		848.8		32.60	0.319986	0.57	Complies
	GPRS 850	824.2		33.00	0.350857	0.55	Complies
		836.4		32.90	0.342871	0.56	Complies
		848.8		32.90	0.342871	0.57	Complies
	EGPRS 850	824.2		29.90	0.171842	0.55	Complies
		836.4		29.80	0.167931	0.56	Complies
		848.8		29.80	0.167931	0.57	Complies
	WCDMA Band V	826.4		26.63	0.080934	0.55	Complies
		836.4		26.43	0.077291	0.56	Complies
		846.4		26.47	0.078006	0.56	Complies
1900 MHz frequency band							
Distance (m)	Bands	Frequency (MHz)	Antenna Gain (dBi)	Output Power (dBm)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
0.25	GSM 1900	1850.20	2.9	29.70	0.231809	1	Complies
		1880.00		29.60	0.226532		Complies
		1909.80		29.30	0.211412		Complies
	GPRS 1900	1850.20		29.90	0.242734		Complies
		1880.00		29.80	0.237209		Complies
		1909.80		29.50	0.221376		Complies
	EGPRS 1900	1850.20		28.60	0.179971		Complies
		1880.00		28.40	0.171842		Complies
		1909.80		28.30	0.167931		Complies
	WCDMA Band II	1852.40		26.39	0.108176		Complies
		1880.00		25.93	0.097304		Complies
		1907.60		25.59	0.089977		Complies
1700 MHz frequency band							
Distance (m)	Bands	Frequency (MHz)	Antenna Gain (dBi)	Output Power (dBm)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
0.25	WCDMA Band IV	1712.40	3.3	26.40	0.118886	1	Complies
		1740.00		26.30	0.116180		Complies
		1752.60		26.32	0.116716		Complies

FCC ID: XMR201312UC20 / Antenna Type : PIFA Antenna

Distance (m)	Bands	Frequency (MHz)	Antenna Gain (dBi)	Output Power (dBm)	Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
0.25	WCDMA Band V	826.4	1.4	23.50	0.039367	0.55	Complies
	WCDMA Band II	1907.6	2.9	23.50	0.055607	1	Complies

Conclusion:

The transmit simultaneously mode as below:

Mode 1. WLAN + Zigbee (chain 3) + Zigbee (chain 4)+ WWAN (FCC ID: RI7HE910)

Mode 2. WLAN + Zigbee (chain 3) + Zigbee (chain 4)+ WWAN (FCC ID: XMR201312UC20)

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

$$\text{Mode 1. } 0.209657 / 1 + 0.029116 / 1 + 0.054971 / 1 + 0.350857 / 0.55 = 0.931666$$

$$\text{Mode 2. } 0.209657 / 1 + 0.029116 / 1 + 0.054971 / 1 + 0.039367 / 0.55 = 0.365320$$

The result of all modes are less than "1". This confirmed that the device complies.