

1 Human Exposure Assessment

1.1 Maximum Permissible Exposure

1.1.1 Limit of Maximum Permissible Exposure

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 ²)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	F/300	6
1500-100,000	-	-	5	6
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 ²)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	F/1500	30
1500-100,000	-	-	1.0	30
Note 1: f = frequency in MHz ; *Plane-wave equivalent power density				
Note 2: For the applicable limit, see FCC 1.1310				

1.1.2 MPE Calculation Method

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d}$$

E = Electric field (V/m)

G = EUT Antenna numeric gain (numeric)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

$$\text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

P = RF output power (W)

d = Separation distance between radiator and human body (m)

1.1.3 Result of Maximum Permissible Exposure

We select one module to test because power of only one module is maximum.

Two modules can work in 2.4GHz or 5GHz together, but they never work at the same channel.

When two modules work in the same band, the transmit power will reduce 3 dB for each one.

RF General Information 2400 MHz – 2483.5 MHz						
Frequency Range (MHz)	IEEE Std. 802.11 Protocol	Ch. Frequency (MHz)	Channel Number	Number of Transmit Chains (N _{TX})	RF Output Power (dBm)	Co-location
2400-2483.5	b	2412-2462	1-11 [11]	2	22.82	Yes
2400-2483.5	g	2412-2462	1-11 [11]	2	21.87	Yes
2400-2483.5	n (HT20)	2412-2462	1-11 [11]	2	21.38	Yes
2400-2483.5	n (HT40)	2422-2452	3-9 [7]	2	17.83	Yes
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.						

RF General Information 5150 MHz – 5250 MHz						
Frequency Range (MHz)	IEEE Std. 802.11 Protocol	Ch. Frequency (MHz)	Channel Number	Number of Transmit Chains (N _{TX})	RF Output Power (dBm)	Co-location
5150-5250	a	5180-5240	36-48 [4]	2	16.89	Yes
5150-5250	n (HT20)	5180-5240	36-48 [4]	2	16.87	Yes
5150-5250	n (HT40)	5190-5230	38-46 [2]	2	16.80	Yes
5150-5250	ac (VHT20)	5180-5240	36-48 [4]	2	16.84	Yes
5150-5250	ac (VHT40)	5190-5230	38-46 [2]	2	16.83	Yes
5150-5250	ac (VHT80)	5210	48 [1]	2	14.77	Yes
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.						

RF General Information 5725 MHz – 5850 MHz						
Frequency Range (MHz)	IEEE Std. 802.11 Protocol	Ch. Frequency (MHz)	Channel Number	Number of Transmit Chains (N _{TX})	RF Output Power (dBm)	Co-location
5725-5850	a	5745-5825	149-165 [5]	2	19.60	Yes
5725-5850	n (HT20)	5745-5825	149-165 [5]	2	19.53	Yes
5725-5850	n (HT40)	5755-5795	151-159 [2]	2	17.62	Yes
5725-5850	ac (VHT20)	5745-5825	149-165 [5]	2	19.54	Yes
5725-5850	ac (VHT40)	5755-5795	151-159 [2]	2	17.63	Yes
5725-5850	ac (VHT80)	5775	155 [1]	2	13.27	Yes
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.						



Worst Maximum RF Output Power Result							
Exposure Environment		General Population / Uncontrolled Exposure					
Separation Distance (cm)		20					
Condition		RF Output Power (dBm)					
Modulation Mode	N _{TX}	Chain Port 1	Chain Port 2	Sum Chain	DG (dBi)	EIRP Power	PD (S) (mW/cm ²)
2.4GHz WLAN	2	19.84	19.78	22.82	2.3	25.12	0.0647
5GHz WLAN	2	16.84	16.32	19.60	5	24.60	0.0574
Co-location Total							0.1221
Maximum Permissible Exposure Limit (mW/cm ²)							1
Note 1: N _{TX} = Number of Transmit Chains							