

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	1,842 / f	4.89 / f	(900 / f ²)*	6
30-300	61.4	0.163	1.0	6
300-1,500	-	-	F/300	6
1,500-100,000	-	-	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
300-1,500	-	-	F/1500	30
1,500-100,000	-	-	1.0	30
Note 1: f = frequency in MHz ; *Plane-wave equivalent power density				
Note 2: For the applicable limit, see FCC 1.1310				



RF Field Strength Limits for Controlled Use Devices (Controlled Environment)				
Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Averaging Time (minutes)
0.003-1	600	4.9	-	6
1-10	600/ <i>f</i>	4.9/ <i>f</i>	-	6
10-30	60	4.9/ <i>f</i>	-	6
30-300	60	0.163	10*	6
300-1,500	3.54 <i>f</i> ^{0.5}	0.0094 <i>f</i> ^{0.5}	<i>f</i> /30	6
1,500-15,000	137	0.364	50	6
15,000-150,000	137	0.364	50	616000/ <i>f</i> ^{1.2}
150,000-300,000	0.354 <i>f</i> ^{0.5}	9.4 × 10 ⁻⁴ <i>f</i> ^{0.5}	3.33 × 10 ⁻⁴ <i>f</i>	616000/ <i>f</i> ^{1.2}
RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)				
Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Averaging Time (minutes)
0.003-1	280	2.19	-	6
1-10	280/ <i>f</i>	2.19/ <i>f</i>	-	6
10-30	28	2.19/ <i>f</i>	-	6
30-300	28	0.073	2*	6
300-1,500	1.585 <i>f</i> ^{0.5}	0.0042 <i>f</i> ^{0.5}	<i>f</i> /150	6
1,500-15,000	61.4	0.163	10	6
15,000-150,000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150,000-300,000	0.158 <i>f</i> ^{0.5}	4.21 × 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 × 10 ⁻⁵ <i>f</i>	616000/ <i>f</i> ^{1.2}
Note 1: <i>f</i> is frequency in MHz.				
Note 2: For the applicable limit, see IC RSS-102				

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	1,842 / f	4.89 / f	(900 / f ²)*	6
30-300	61.4	0.163	1.0	6
300-1,500	-	-	F/300	6
1,500-100,000	-	-	5.0	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)
0.3-3.0	614	1.63	(100)*	30
3-30	1,842 / f	4.89 / f	(180/f ²)*	30
30-300	27.5	0.073	1.0	30
300-1,500	-	-	F/1500	30
1,500-100,000	-	-	1.0	30
Note 1: f = frequency in MHz ; *Plane-wave equivalent power density				
Note 2: For the applicable limit, see NCC LP0002 Section 5.20.2				

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

RF General Information						
Frequency Range (MHz)	IEEE Std. 802.11	Ch. Freq. (MHz)	Channel Number	Transmit Chains (N _{TX})	RF Output Power (dBm)	Co-location
5150-5250	a	5180-5240	36-48 [4]	2	22.13	Yes
5250-5350		5260-5320	52-64 [4]	2	21.52	Yes
5470-5725		5500-5700	100-140 [8]	2	21.19	Yes
5725-5850		5745-5825	149-165 [5]	2	24.23	Yes
5150-5250	n (HT20)	5180-5240	36-48 [4]	2	22.11	Yes
5250-5350		5260-5320	52-64 [4]	2	21.76	Yes
5470-5725		5500-5700	100-140 [8]	2	21.38	Yes
5725-5850		5745-5825	149-165 [5]	2	24.15	Yes
5150-5250	n (HT40)	5190-5230	38-46 [2]	2	23.75	Yes
5250-5350		5270-5310	54-62 [2]	2	22.57	Yes
5470-5725		5510-5670	102-134 [3]	2	22.49	Yes
5725-5850		5755-5795	151-159 [2]	2	23.75	Yes

Note 1: RF output power specifies that Maximum Conducted Output Power.
Note 2: Co-location, Co-location is generally defined as simultaneously transmitting (co-transmitting) antennas within 20 cm of each other. (i.e., EUT has simultaneously co-transmitting that operating 2.4GHz and 5GHz.)

Worst Maximum RF Output Power Result								
Exposure Environment			General Population / Uncontrolled Exposure					
Separation Distance (cm)			20					
Power Level		1	RF Output Power (dBm)					
Frequency Range (MHz)	Modulation Mode	N _{TX}	Chain-Port 1	Chain-Port 2	Sum Chain	Gain (dBi)	EIRP Power	PD (S) (mW/cm ²)
5150-5250	802.11n (HT40)	2	20.54	20.93	23.75	1.64	25.39	0.06882
5250-5350	802.11n (HT40)	2	19.54	19.57	22.57	1.64	24.21	0.05247
5470-5725	802.11n (HT40)	2	19.66	19.30	22.49	1.64	24.13	0.05152
5725-5850	802.11a	2	20.88	21.54	24.23	1.64	25.87	0.07692
Maximum Permissible Exposure Limit (mW/cm ²)								1

Note 1: N_{TX} = Number of Transmit Chains



RF General Information						
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	BR / EDR	2402-2480	0-78 [79]	1	7.14	Yes
2400-2483.5	v4.0 LE	2402-2480	0-39 [40]	1	6.72	Yes
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.						
Note 2: Co-location, Co-location is generally defined as simultaneously transmitting (co-transmitting) antennas within 20 cm of each other. (i.e., EUT has simultaneously co-transmitting that operating 2.4GHz and 5GHz.)						

Worst Maximum Permissible Exposure Result					
Exposure Environment		General Population / Uncontrolled Exposure			
Separation Distance (cm)		20			
Condition		RF Output Power (dBm)			
Modulation Mode	Freq. (MHz)	RF Output Power	Antenna Gain (dBi)	EIRP Power	PD (S) (W/m ²)
BR-1Mbps	2480	7.14	2.26	9.40	0.00182
LE-1Mbps	2480	6.72	2.26	8.98	0.01835
Maximum Permissible Exposure Limit (mW/cm ²)					1