

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)*	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)*	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				

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
300-1500	3.54 <i>f</i> ^{0.5}	0.0094 <i>f</i> ^{0.5}	<i>f</i> /30	6
1500-15000	137	0.364	50	6
15000-150000	137	0.364	50	616000/ <i>f</i> ^{1.2}
150000-300000	0.354 <i>f</i> ^{0.5}	9.4 x 10 ⁻⁴ <i>f</i> ^{0.5}	3.33 x 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
300-1500	1.585 <i>f</i> ^{0.5}	0.0042 <i>f</i> ^{0.5}	<i>f</i> /150	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 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				

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 - (2400 MHz~2483.5 MHz)

Transmitter Chains & Receiver Chains Information					
IEEE Std. 802.11 Protocol	Number of Transmit Chains (N _{TX})	Number of Receive Chains (N _{RX})	Correlation Signals with Multiple N _{TX}	RF Output Power (dBm)	Co-location
b	1	1	N/A	15.57	Yes
g	1	1	N/A	18.03	Yes
n (HT20)	1	1	Uncorrelated	18.55	Yes
n (HT40)	1	1	Uncorrelated	18.46	Yes
n (HT20)	2	2	Uncorrelated	21.26	Yes
n (HT40)	2	2	Uncorrelated	21.90	Yes

Note 1: 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.)

Note 2: 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	Gain (dBi)	EIRP Power	PD (S) (mW/cm ²)
11B-20M	1	15.57	-	-	-1.37	14.20	0.00523
11G-20M	1	18.03	-	-	-1.37	16.66	0.00922
11N-(HT20)	1	18.55	-	-	-1.37	17.18	0.01039
11N-(HT40)	1	18.46	-	-	-1.37	17.09	0.01018
11N-(HT20)	2	19.14	17.14	21.26	-1.37	19.89	0.01942
11N-(HT40)	2	19.63	18.00	21.90	-1.37	20.53	0.02248
Maximum Permissible Exposure Limit (mW/cm²)							1

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

1.1.4 Result of Maximum Permissible Exposure - (5725 MHz~5850 MHz)

Transmitter Chains & Receiver Chains Information					
IEEE Std. 802.11 Protocol	Number of Transmit Chains (N _{TX})	Number of Receive Chains (N _{RX})	Correlation Signals with Multiple N _{TX}	RF Output Power (dBm)	Co-location
a	1	1	Correlated	16.45	Yes
n (HT20)	1	1	Uncorrelated	16.24	Yes
n (HT40)	1	1	Uncorrelated	16.48	Yes
n (HT20)	2	2	Uncorrelated	18.71	Yes
n (HT40)	2	2	Uncorrelated	19.15	Yes

Note 1: 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.)

Note 2: 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	Gain (dBi)	EIRP Power	PD (S) (mW/cm ²)
11A-20M	1	16.45	-	-	-5.42	11.03	0.00252
11N-(HT20)	1	16.24	-	-	-5.42	10.82	0.00240
11N-(HT40)	1	16.48	-	-	-5.42	11.06	0.00254
11N-(HT20)	2	15.99	15.38	18.71	-5.42	13.29	0.00424
11N-(HT40)	2	16.43	15.82	19.15	-5.42	13.73	0.00469
Maximum Permissible Exposure Limit (mW/cm²)							1

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

1.1.5 Result of Maximum Permissible Exposure - (5150~5350MHz/ 5470~5725MHz)

Transmitter Chains & Receiver Chains Information					
IEEE Std. 802.11 Protocol	Number of Transmit Chains (N _{TX})	Number of Receive Chains (N _{RX})	Correlation Signals with Multiple N _{TX}	RF Output Power (dBm)	Co-location
a	1	1	Correlated	16.48	Yes
n (HT20)	1	1	Uncorrelated	16.44	Yes
n (HT40)	1	1	Uncorrelated	16.43	Yes
n (HT20)	2	2	Uncorrelated	19.37	Yes
n (HT40)	2	2	Uncorrelated	18.43	Yes

Note 1: 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.)

Note 2: 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	Gain (dBi)	EIRP Power	PD (S) (mW/cm ²)
11A-20M	1	16.48	-	-	-5.42	11.06	0.00254
11N-(HT20)	1	16.44	-	-	-5.42	11.02	0.00252
11N-(HT40)	1	16.43	-	-	-5.42	11.01	0.00251
11N-(HT20)	2	16.31	16.41	19.37	-5.42	13.95	0.00494
11N-(HT40)	2	15.62	15.20	18.43	-5.42	13.01	0.00397
Maximum Permissible Exposure Limit (mW/cm ²)							1

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