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/ 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
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 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/m2)**	**Averaging Time (minutes)**
0.003-1	600	4.9	-	6
1-10	600/f	4.9/f	-	6
10-30	60	4.9/f	-	6
30-300	60	0.163	10*	6
300-1500	3.54 f 0.5	0.0094 f 0.5	f/30	6
1500-15000	137	0.364	50	6
15000-150000	137	0.364	50	616000/f 1.2
150000-300000	0.354 f 0.5	9.4 x 10-4 f 0.5	3.33 x 10-4 f	616000/f 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/m2)**	**Averaging Time (minutes)**
0.003-1	280	2.19	-	6
1-10	280/f	2.19/f	-	6
10-30	28	2.19/f	-	6
30-300	28	0.073	2*	6
300-1500	1.585 $f^{0.5}$	0.0042 $f^{0.5}$	f/150	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/$f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 x 10^{-4} $f^{0.5}$	6.67 x 10^{-5} f	616000/$f^{1.2}$
Note 1: f is frequency in MHz. Note 2: For the applicable limit, see IC RSS-102				

1.1.2 MPE Calculation Method

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

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

E = Electric field (V/m)
P = 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 = $\frac{30 \times P \times G}{377 \times d^2}$

1.1.3 Result of Maximum Permissible Exposure (2.4G)

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	Correlated	17.73	N/A
g	1	1	Correlated	13.56	N/A
n (HT20)	2	2	Uncorrelated	18.24	N/A
n (HT40)	2	2	Uncorrelated	16.95	N/A
n (HT20)	3	3	Uncorrelated	18.90	N/A
n (HT40)	3	3	Uncorrelated	18.74	N/A

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						
Power Level	1	**RF Output Power (dBm)**						
Modulation Mode	**N_{TX}**	**Chain-Port 1**	**Chain-Port 2**	**Chain-Port 3**	**Sum Chain**	**Gain (dBi)**	**EIRP Power**	**PD (S) (mW/cm²)**
11B-20M	1	-	17.73	-	17.73	2.07	19.80	0.01900
11G-20M	1	-	13.56	-	13.56	2.07	15.63	0.00727
11N2.4G-20M	2	15.31	15.14	-	18.24	2.14	20.38	0.02169
11N2.4G-40M	2	14.16	13.70	-	16.95	2.14	19.09	0.01612
11N2.4G-20M	3	13.89	13.94	14.52	18.90	2.16	21.06	0.02539
11N2.4G-40M	3	13.95	13.74	14.26	18.74	2.16	20.90	0.02447
Maximum Permissible Exposure Limit (mW/cm²)								1

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

1.1.4 Result of Maximum Permissible Exposure (5.8G)

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	9.97	N/A
n(HT20	2	2	Uncorrelated	15.76	N/A
n(HT40)	2	2	Uncorrelated	14.91	N/A
n(HT20	3	3	Uncorrelated	14.77	N/A
n(HT40)	3	3	Uncorrelated	14.28	N/A
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						
Power Level	1	**RF Output Power (dBm)**						
Modulation Mode	**N_{TX}**	**Chain-Port 1**	**Chain-Port 2**	**Chain-Port 3**	**Sum Chain**	**Gain (dBi)**	**EIRP Power**	**PD (S) (mW/cm²)**
11A5.8G-20M	1	-	-	9.97	9.97	4.60	14.57	0.00569
11N5.8G-20M	2	12.49	12.99	-	15.76	4.51	20.27	0.02116
11N5.8G-40M	2	11.55	12.23	-	14.91	4.51	19.42	0.01698
11N5.8G-20M	3	9.10	10.41	10.37	14.77	4.54	19.31	0.01743
11N5.8G-40M	3	8.51	9.41	10.39	14.28	4.54	18.82	0.01515
Maximum Permissible Exposure Limit (mW/cm²)								1
Note 1: N_{TX} = Number of Transmit Chains								

1.1.5 Result of Maximum Permissible Exposure (5.2G~5.6G)

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]	1	11.11	N/A
5250-5350		5260-5320	52-64 [4]	1	10.87	
5470-5725		5500-5700	100-140 [8]	1	10.52	
5150-5250	n (HT20)	5180-5240	36-48 [4]	2	14.85	N/A
5250-5350		5260-5320	52-64 [4]	2	14.61	
5470-5725		5500-5700	100-140 [8]	2	15.82	
5150-5250	n (HT40)	5190-5230	38-46 [2]	2	16.22	N/A
5250-5350		5270-5310	54-62 [2]	2	15.88	
5470-5725		5510-5670	102-134 [3]	2	15.59	
5150-5250	n (HT20)	5180-5240	36-48 [4]	3	13.93	
5250-5350		5260-5320	52-64 [4]	3	15.17	
5470-5725		5500-5700	100-140 [8]	3	15.01	
5150-5250	n (HT40)	5190-5230	38-46 [2]	3	15.28	N/A
5250-5350		5270-5310	54-62 [2]	3	15.93	
5470-5725		5510-5670	102-134 [3]	3	15.84	

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	**N_{TX}**	**Chain-Port 1**	**Chain-Port 2**	**Chain-Port 3**	**Sum Chain**	**DG (dBi)**	**EIRP Power**	**PD (S) (W/m²)**
11A5.2G-20M	1	11.11	-	-	11.11	4.60	15.71	0.0074
11A5.3G-20M	1	10.87	-	-	10.87	4.60	15.47	0.0070
11A5.6G-20M	1	10.52	-	-	10.52	4.60	15.12	0.0065
11N5.2G-20M	2	11.94	11.73	-	14.85	4.51	19.36	0.0172
11N5.3G-20M	2	11.66	11.69	-	14.61	4.51	19.12	0.0163
11N5.6G-20M	2	12.77	12.84	-	15.82	4.51	20.33	0.0215
11N5.2G-40M	2	13.45	12.95	-	16.22	4.51	20.73	0.0235
11N5.3G-40M	2	12.82	12.92	-	15.88	4.51	20.39	0.0218
11N5.6G-40M	2	12.50	12.83	-	15.59	4.51	20.10	0.0204
11N5.2G-20M	3	9.45	8.62	9.37	13.93	4.54	18.47	0.0140
11N5.3G-20M	3	10.31	9.73	11.07	15.17	4.54	19.71	0.0186
11N5.6G-20M	3	9.64	10.06	10.92	15.01	4.54	19.55	0.0179
11N5.2G-40M	3	10.45	9.56	11.33	15.28	4.54	19.82	0.0191
11N5.3G-40M	3	11.16	10.75	11.54	15.93	4.54	20.47	0.0222
11N5.6G-40M	3	10.89	10.83	11.58	15.84	4.54	20.38	0.0217
Maximum Permissible Exposure Limit (mW/cm²)								1