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 and RSS-102 Issue 4 this device has been defined as a mobile device whereby a distance of 0.2 m normally can be 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/ 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

(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/ 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: f = frequency in MHz ; *Plane-wave equivalent power density

1.2. MPE Calculation Method

E (V/m) = $\frac{\sqrt{30 \times P \times G}}{d}$ Power Density: *Pd* (W/m²) = $\frac{E^2}{377}$

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=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

1.3. Calculated Result and Limit

Antenna Type : Printed Antenna

<Ant. 1 connector >

Max Conducted Power for IEEE 802.11b (1TX) : 20.67 dBm

Test Mode	Test Freq (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2.4G	2462	3.22	2.0989	20.67	116.6810	0.0487	1	Complies

Note:

1. G = Antenna Gain (numeric) >> 10^(3.22/10) = 2.0989
2. P = dBm to mW >> 10^(20.67/10) = 116.6810 mW
3. D = Distance >> 0.2 m
4. E = $\sqrt{(30*P*G)}/d$ = $\sqrt{(30*244.9063}/0.2$ = 428.5787 V/m
5. PD(S) = (E^2/377)/10000 = ((428.5787^2)/377)/10000 = 0.0487 mW/cm²

<Ant. 2 connector >

Max Conducted Power for IEEE 802.11b (1TX) : 20.78 dBm

Test Mode	Test Freq (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2.4G	2462	3.09	2.0370	20.78	119.6741	0.0485	1	Complies

Note:

1. G = Antenna Gain (numeric) >> 10^(3.09/10) = 2.0370
2. P = dBm to mW >> 10^(20.78/10) = 119.6741 mW
3. D = Distance >> 0.2 m
4. E = $\sqrt{(30*P*G)}/d$ = $\sqrt{(30*243.7811}/0.2$ = 427.5930 V/m
5. PD(S) = (E^2/377)/10000 = ((427.5930^2)/377)/10000 = 0.0485 mW/cm²

<Ant. 1 connector >

Max Conducted Power for IEEE 802.11g (1TX) : 20.31 dBm

Test Mode	Test Freq (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2.4G	2437	3.32	2.1478	20.31	107.3989	0.0459	1	Complies

Note:

1. G = Antenna Gain (numeric) >> 10^(3.32/10) = 2.1478
2. P = dBm to mW >> 10^(20.31/10) = 107.3989 mW
3. D = Distance >> 0.2 m
4. E = $\sqrt{(30*P*G)}/d$ = $\sqrt{(30*230.6747}/0.2$ = 415.9399 V/m
5. PD(S) = (E^2/377)/10000 = ((415.9399^2)/377)/10000 = 0.0459 mW/cm²

<Ant. 2 connector >

Max Conducted Power for IEEE 802.11g (1TX) : 20.30 dBm

Test Mode	Test Freq (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2.4G	2437	3.26	2.1184	20.30	107.1519	0.0452	1	Complies

Note:

1. G = Antenna Gain (numeric) >> 10^(3.26/10) = 2.1184
2. P = dBm to mW >> 10^(20.30/10) = 107.1519 mW
3. D = Distance >> 0.2 m
4. E = $\sqrt{(30*P*G)}/d$ = $\sqrt{(30*226.9865}/0.2$ = 412.6013 V/m
5. PD(S) = (E^2/377)/10000 = ((412.6013^2)/377)/10000 = 0.0452 mW/cm²

<Ant. 1 + Ant. 2 connector >

Max Conducted Power for IEEE 802.11g (2TX) : 19.22 dBm

Test Mode	Test Freq (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2.4G	2412	3.30	2.1380	19.22	83.5603	0.0355	1	Complies

Note:

1. G = Antenna Gain (numeric) >> 10^(3.30/10) = 2.1380
2. P = dBm to mW >> 10^(19.22/10) = 83.5603 mW
3. D = Distance >> 0.2 m
4. E = $\sqrt{(30*P*G)}/d$ = $\sqrt{(30*178.6488}/0.2$ = 366.0418 V/m
5. PD(S) = (E^2/377)/10000 = ((366.0418^2)/377)/10000 = 0.0355 mW/cm²

<MCS0 - Ant. 1 connector >

Max Conducted Power for IEEE 802.11n 20MHz MCS0 (1TX) : 20.48 dBm

Test Mode	Test Freq (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2.4G	2437	3.32	2.1478	20.48	111.6863	0.0477	1	Complies

Note:

1. G = Antenna Gain (numeric) >> 10^(3.32/10) = 2.1478
2. P = dBm to mW >> 10^(20.48/10) = 111.6863 mW
3. D = Distance >> 0.2 m
4. E = $\sqrt{(30*P*G)}/d$ = $\sqrt{(30*239.8833}/0.2$ = 424.1609 V/m
5. PD(S) = (E^2/377)/10000 = ((424.1609^2)/377)/10000 = 0.0477 mW/cm²

<MCS0 - Ant. 2 connector >

Max Conducted Power for IEEE 802.11n 20MHz MCS0 (1TX) : 20.36 dBm

Test Mode	Test Freq (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2.4G	2437	3.26	2.1184	20.36	108.6426	0.0458	1	Complies

Note:

1. G = Antenna Gain (numeric) >> 10^(3.26/10) = 2.1184
2. P = dBm to mW >> 10^(20.36/10) = 108.6426 mW
3. D = Distance >> 0.2 m
4. E = $\sqrt{(30*P*G)}/d$ = $\sqrt{(30*230.1442}/0.2$ = 415.4614 V/m
5. PD(S) = (E^2/377)/10000 = ((415.4614^2)/377)/10000 =0.0458 mW/cm²

<MCS0 - Ant. 1 + Ant. 2 connector >

Max Conducted Power for IEEE 802.11n 20MHz MCS0 (2TX) : 19.69 dBm

Test Mode	Test Freq (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2.4G	2412	3.30	2.1380	19.69	93.1108	0.0396	1	Complies

Note:

1. G = Antenna Gain (numeric) >> 10^(3.30/10) = 2.1380
2. P = dBm to mW >> 10^(19.69/10) = 93.1108 mW
3. D = Distance >> 0.2 m
4. E = $\sqrt{(30*P*G)}/d$ = $\sqrt{(30*199.0673}/0.2$ = 386.3942 V/m
5. PD(S) = (E^2/377)/10000 = ((386.3942^2)/377)/10000 = 0.0396 mW/cm²

<MCS8 - Ant. 1 + Ant. 2 connector >

Max Conducted Power for IEEE 802.11n 20MHz MCS0 (2TX) : 23.42 dBm

Test Mode	Test Freq (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2.4G	2437	3.32	2.1478	23.42	219.7860	0.0939	1	Complies

Note:

1. G = Antenna Gain (numeric) >> 10^(3.32/10) = 2.1478
2. P = dBm to mW >> 10^(23.42/10) = 219.7860 mW
3. D = Distance >> 0.2 m
4. E = $\sqrt{(30*P*G)}/d$ = $\sqrt{(30*472.0630}/0.2$ = 595.0187 V/m
5. PD(S) = (E^2/377)/10000 = ((595.0187^2)/377)/10000 = 0.0939 mW/cm^2

<MCS0 - Ant. 1 connector >

Max Conducted Power for IEEE 802.11n 40MHz MCS0 (1TX) : 17.15 dBm

Test Mode	Test Freq (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2.4G	2437	3.32	2.1478	17.15	51.8800	0.0222	1	Complies

Note:

1. G = Antenna Gain (numeric) >> 10^(3.32/10) = 2.1478
2. P = dBm to mW >> 10^(17.15/10) = 51.8800 mW
3. D = Distance >> 0.2 m
4. E = $\sqrt{(30*P*G)}/d$ = $\sqrt{(30*111.4295}/0.2$ = 289.0884 V/m
5. PD(S) = (E^2/377)/10000 = ((289.0884^2)/377)/10000 = 0.0222 mW/cm²

<MCS0 - Ant. 2 connector >

Max Conducted Power for IEEE 802.11n 40MHz MCS0 (1TX) : 17.32 dBm

Test Mode	Test Freq (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2.4G	2437	3.26	2.1184	17.32	53.9511	0.0227	1	Complies

Note:

1. G = Antenna Gain (numeric) >> 10^(3.26/10) = 2.1184
2. P = dBm to mW >> 10^(17.32/10) = 53.9511 mW
3. D = Distance >> 0.2 m
4. E = $\sqrt{(30*P*G)}/d$ = $\sqrt{(30*114.2878}/0.2$ = 292.7727 V/m
5. PD(S) = (E^2/377)/10000 = ((292.7727^2)/377)/10000 = 0.0227 mW/cm²

<MCS0 - Ant. 1 + Ant. 2 connector >

Max Conducted Power for IEEE 802.11n 40MHz MCS0 (2TX) : 19.26 dBm

Test Mode	Test Freq (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2.4G	2437	3.32	2.1478	19.26	84.3335	0.0360	1	Complies

Note:

1. G = Antenna Gain (numeric) >> 10^(3.32/10) = 2.1478
2. P = dBm to mW >> 10^(19.26/10) = 84.3335 mW
3. D = Distance >> 0.2 m
4. E = $\sqrt{(30*P*G)}/d$ = $\sqrt{(30*181.1340}/0.2$ = 368.5790 V/m
5. PD(S) = (E^2/377)/10000 = ((368.5790^2)/377)/10000 = 0.0360 mW/cm²

<MCS8 - Ant. 1 + Ant. 2 connector >

Max Conducted Power for IEEE 802.11n 40MHz MCS0 (2TX) : 20.29 dBm

Test Mode	Test Freq (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power (dBm)	Average Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
2.4G	2437	3.32	2.1478	20.29	106.9055	0.0457	1	Complies

Note:

1. G = Antenna Gain (numeric) >> 10^(3.32/10) = 2.1478
2. P = dBm to mW >> 10^(20.29/10) = 106.9055 mW
3. D = Distance >> 0.2 m
4. E = $\sqrt{(30*P*G)}/d$ = $\sqrt{(30*229.6149}/0.2$ = 414.9833 V/m
5. PD(S) = (E^2/377)/10000 = ((414.9833^2)/377)/10000 = 0.0457 mW/cm^2