1 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

1.1 Standard Applicable

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This is a Mobile device, the MPE is required.

According to §1.1310 and §2.1093 RF exposure is calculated.

Limits for Maximum Permissive Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
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
1500-15000	/	/	1.0	30

F = frequency in MHz

* = Plane-wave equipment power density

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

802.11a Max. output power

802.11a_Main

CH	Frequency (MHz)	Data Rate	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
36	5180	MCS0	**13.98**	**25.003**	23.98	PASS
44	5220	MCS0	13.96	24.889	23.98	PASS
48	5240	MCS0	13.92	24.660	23.98	PASS
52	5260	MCS0	13.76	23.768	23.98 or 11+10log(B) = 24.54	PASS
60	5300	MCS0	**13.78**	**23.878**	23.98 or 11+10log(B) = 23.92	PASS
64	5320	MCS0	13.70	23.442	23.98 or 11+10log(B) = 24.01	PASS
100	5500	MCS0	11.49	14.093	23.98 or 11+10log(B) = 23.84	PASS
116	5580	MCS0	**13.71**	**23.496**	23.98 or 11+10log(B) = 23.89	PASS
140	5700	MCS0	12.33	17.100	23.98 or 11+10log(B) = 23.79	PASS
149	5745	MCS0	13.94	24.774	30	PASS
157	5785	MCS0	**13.98**	**25.003**	30	PASS
165	5825	MCS0	13.86	24.322	30	PASS

MPE Prediction (802.11a 5150~5250)

Average output power at antenna input terminal:	13.98	(dBm)
Average output power at antenna input terminal:	25.003454	(mW)
Duty cycle:	95.2	(%)
Maximum Pav :	23.803288	(mW)
Peak Antenna gain (Maximum):	5.35	(dBi)
Peak Antenna gain (linear):	3.4276779	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5180	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.016	(mW/cm^2)

Measurement Result
The predicted power density level at 20 cm is 0.016 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5180MHz.

MPE Prediction (802.11a 5250~5350)

Average output power at antenna input terminal:	13.78	(dBm)
Average output power at antenna input terminal:	23.878113	(mW)
Duty cycle:	95.2	(%)
Maximum Pav :	22.731963	(mW)
Peak Antenna gain (Maximum):	5.35	(dBi)
Peak Antenna gain (linear):	3.4276779	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5300	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.016	(mW/cm^2)

Measurement Result
The predicted power density level at 20 cm is 0.016 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5300MHz.

MPE Prediction (802.11a 5470~5725)

Average output power at antenna input terminal:	13.71	(dBm)
Average output power at antenna input terminal:	23.496328	(mW)
Duty cycle:	95.2	(%)
Maximum Pav :	22.368504	(mW)
Peak Antenna gain (Maximum):	4.05	(dBi)
Peak Antenna gain (linear):	2.5409727	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5580	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.011	(mW/cm^2)

Measurement Result
The predicted power density level at 20 cm is 0.011 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5580MHz.

MPE Prediction (802.11a 5725~5850)

Average output power at antenna input terminal:	13.98	(dBm)
Average output power at antenna input terminal:	25.003454	(mW)
Duty cycle:	95.2	(%)
Maximum Pav :	23.803288	(mW)
Peak Antenna gain (Maximum):	4.57	(dBi)
Peak Antenna gain (linear):	2.864178	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5785	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.014	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.014 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 5785MHz.

802.11n_HT20M Max. output power

802.11n_HT20_MIMO

CH	Frequency (MHz)	Data Rate	RAGE POWER (d		TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
			CH 0	CH 1				
36	5180	MCS8	9.72	9.65	12.70	18.601	21.62	PASS
44	5220	MCS8	9.69	9.62	12.67	18.473	21.62	PASS
48	5240	MCS8	9.98	9.91	**12.96**	**19.749**	21.62	PASS
52	5260	MCS8	9.99	9.89	12.95	19.727	21.62 or 11+10log(B) = 23.94	PASS
60	5300	MCS8	10.04	9.88	**12.97**	**19.820**	21.62 or 11+10log(B) = 23.93	PASS
64	5320	MCS8	9.98	9.77	12.89	19.438	21.62 or 11+10log(B) = 23.95	PASS
100	5500	MCS8	9.94	9.65	12.81	19.089	22.92 or 11+10log(B) = 23.99	PASS
116	5580	MCS8	10.28	9.61	**12.97**	**19.807**	22.92 or 11+10log(B) = 23.95	PASS
140	5700	MCS8	10.27	9.34	12.84	19.232	22.92 or 11+10log(B) = 23.95	PASS
149	5745	MCS8	10.23	9.27	**12.79**	**18.997**	28.42	PASS
157	5785	MCS8	10.22	9.21	12.75	18.856	28.42	PASS
165	5825	MCS8	10.14	9.23	12.72	18.703	28.42	PASS

MPE Prediction (802.11n_HT20 5150~5250)

MIMO gain= G+(10 logN)= 5.35+3.01=8.36dBm

Average output power at antenna input terminal:	12.96	(dBm)
Average output power at antenna input terminal:	19.769696	(mW)
Duty cycle:	94.9	(%)
Maximum Pav :	18.761442	(mW)
Peak Antenna gain (Maximum):	8.36	(dBi)
Peak Antenna gain (linear):	6.8548823	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5240	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.026	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.026 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 5240MHz.

MPE Prediction (802.11n_HT20 5250~5350)

MIMO gain= G+(10 logN)= 5.35+3.01= 8.36dBm

Average output power at antenna input terminal:	12.97	(dBm)
Average output power at antenna input terminal:	19.81527	(mW)
Duty cycle:	94.9	(%)
Maximum Pav :	18.804691	(mW)
Peak Antenna gain (Maximum):	8.36	(dBi)
Peak Antenna gain (linear):	6.8548823	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5300	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.026	(mW/cm^2)

Measurement Result
The predicted power density level at 20 cm is 0.026 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5300MHz.

MPE Prediction (802.11n_HT20 5470~5725)

MIMO gain= G+(10 logN)= 4.05+3.01= 7.06dBm

Average output power at antenna input terminal:	12.97	(dBm)
Average output power at antenna input terminal:	19.81527	(mW)
Duty cycle:	94.9	(%)
Maximum Pav :	18.804691	(mW)
Peak Antenna gain (Maximum):	7.06	(dBi)
Peak Antenna gain (linear):	5.0815944	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5580	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.019	(mW/cm^2)

Measurement Result
The predicted power density level at 20 cm is 0.019 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5580MHz.

MPE Prediction (802.11n_HT20 5725~5850)

MIMO gain= G+(10 logN)= 4.57+3.01= 7.58dBm

Average output power at antenna input terminal:	12.79	(dBm)
Average output power at antenna input terminal:	19.010783	(mW)
Duty cycle:	94.9	(%)
Maximum Pav :	18.041233	(mW)
Peak Antenna gain (Maximum):	7.58	(dBi)
Peak Antenna gain (linear):	5.7279603	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5745	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.021	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.021 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 5745MHz.

802.11n_HT40M Max. output power

802.11n_HT40_MIMO

CH	Frequency (MHz)	Data Rate	RAGE POWER (d		TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
			CH 0	CH 1				
38	5190	MCS8	8.61	8.59	11.61	14.489	21.62	PASS
46	5230	MCS8	8.66	8.58	**11.63**	**14.556**	21.62	PASS
54	5270	MCS8	8.61	8.53	11.58	14.390	21.62 or 11+10log(B) = 27.02	PASS
62	5310	MCS8	8.93	8.88	**11.92**	**15.543**	21.62 or 11+10log(B) = 27.17	PASS
102	5510	MCS8	9.17	8.66	11.93	15.606	22.92 or 11+10log(B) = 27.16	PASS
110	5550	MCS8	9.32	8.59	**11.98**	**15.778**	22.92 or 11+10log(B) = 27.03	PASS
134	5670	MCS8	9.22	8.38	11.83	15.243	22.92 or 11+10log(B) = 27.20	PASS
151	5755	MCS8	9.19	8.36	**11.81**	**15.153**	28.42	PASS
159	5795	MCS8	9.08	8.33	11.73	14.899	28.42	PASS

MPE Prediction (802.11n_HT40 5150~5250)

MIMO gain= G+(10 logN)= 5.35+3.01= 8.36dBm

Average output power at antenna input terminal:	11.63	(dBm)
Average output power at antenna input terminal:	14.554591	(mW)
Duty cycle:	90.44	(%)
Maximum Pav :	13.163172	(mW)
Peak Antenna gain (Maximum):	8.36	(dBi)
Peak Antenna gain (linear):	6.8548823	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5230	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.018	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.018 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 5230MHz.

MPE Prediction (802.11n_HT40 5250~5350)

MIMO gain= G+(10 logN)= 5.35+3.01= 8.36dBm

Average output power at antenna input terminal:	11.92	(dBm)
Average output power at antenna input terminal:	15.559656	(mW)
Duty cycle:	90.44	(%)
Maximum Pav :	14.072153	(mW)
Peak Antenna gain (Maximum):	8.36	(dBi)
Peak Antenna gain (linear):	6.8548823	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5310	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.019	(mW/cm^2)

Measurement Result
The predicted power density level at 20 cm is 0.019 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5310MHz.

MPE Prediction (802.11n_HT40 5470~5725)

MIMO gain= G+(10 logN)= 4.05+3.01= 7.06dBm

Average output power at antenna input terminal:	11.98	(dBm)
Average output power at antenna input terminal:	15.776113	(mW)
Duty cycle:	90.44	(%)
Maximum Pav :	14.267916	(mW)
Peak Antenna gain (Maximum):	7.06	(dBi)
Peak Antenna gain (linear):	5.0815944	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5550	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.014	(mW/cm^2)

Measurement Result
The predicted power density level at 20 cm is 0.014 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5550MHz.

MPE Prediction (802.11n_HT40 5725~5850)

MIMO gain= G+(10 logN)= 4.57+3.01= 7.58dBm

Average output power at antenna input terminal:	11.81	(dBm)
Average output power at antenna input terminal:	15.170504	(mW)
Duty cycle:	90.44	(%)
Maximum Pav :	13.720204	(mW)
Peak Antenna gain (Maximum):	7.58	(dBi)
Peak Antenna gain (linear):	5.7279603	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5755	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.016	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.016 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5755MHz.

802.11ac VHT80M Max. output power

802.11ac_VHT80_MIMO

CH	Frequency (MHz)	Data Rate	RAGE POWER (d		TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
			CH 0	CH 1				
42	5210	MCS8	5.94	5.63	8.80	7.582	21.62	PASS
58	5290	MCS8	5.94	5.63	8.80	7.582	21.62 or 11+10log(B) = 30.08	PASS
106	5530	MCS8	6.02	5.3	8.69	7.388	22.92 or 11+10log(B) = 30.07	PASS
122	5610	MCS8	6.41	5.28	8.89	7.748	22.92 or 11+10log(B) = 30.12	PASS
155	5775	MCS8	6.21	5.28	8.78	7.551	28.42	PASS

MPE Prediction (802.11ac_VHT80 5150~5250)

MIMO gain= G+(10 logN)= 5.35+3.01= 8.36dBm

Average output power at antenna input terminal:	8.80	(dBm)
Average output power at antenna input terminal:	7.5857758	(mW)
Duty cycle:	82.93	(%)
Maximum Pav :	6.2908838	(mW)
Peak Antenna gain (Maximum):	8.36	(dBi)
Peak Antenna gain (linear):	6.8548823	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5210	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.009	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.009 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 5210MHz.

MPE Prediction (802.11ac_VHT80 5250~5350)

MIMO gain= G+(10 logN)= 5.35+3.01= 8.36dBm

Average output power at antenna input terminal:	8.80	(dBm)
Average output power at antenna input terminal:	7.5857758	(mW)
Duty cycle:	82.93	(%)
Maximum Pav :	6.2908838	(mW)
Peak Antenna gain (Maximum):	8.36	(dBi)
Peak Antenna gain (linear):	6.8548823	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5290	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.009	(mW/cm^2)

Measurement Result
The predicted power density level at 20 cm is 0.009 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5290MHz.

MPE Prediction (802.11ac_VHT80 5470~5725)

MIMO gain= G+(10 logN)= 4.05+3.01= 7.06dBm

Average output power at antenna input terminal:	8.89	(dBm)
Average output power at antenna input terminal:	7.744618	(mW)
Duty cycle:	82.93	(%)
Maximum Pav :	6.4226117	(mW)
Peak Antenna gain (Maximum):	7.06	(dBi)
Peak Antenna gain (linear):	5.0815944	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5610	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.006	(mW/cm^2)

Measurement Result
The predicted power density level at 20 cm is 0.006 mW/cm2.
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5610MHz.

MPE Prediction (802.11ac_VHT80 5725~5850)

MIMO gain= G+(10 logN)= 4.57+3.01= 7.58dBm

Average output power at antenna input terminal:	8.78	(dBm)
Average output power at antenna input terminal:	7.5509223	(mW)
Duty cycle:	82.93	(%)
Maximum Pav :	6.2619798	(mW)
Peak Antenna gain (Maximum):	7.58	(dBi)
Peak Antenna gain (linear):	5.7279603	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5775	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.007	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.007 mW/cm2.

This is below the uncontrolled exposure limit of 1 mW/cm2 at 5775MHz.