

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

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802.11a Max. output power

802.11a_MIMO

CH	Frequency (MHz)	Data Rate	AVERAGE POWER (dBm)				TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
			CH 0	CH 1	CH 2	CH 3				
36	5180	MCS24	12.41	12.06	12.59	12.9	18.52	71.141	30	PASS
44	5220	MCS24	22.87	21.34	21.46	21.14	27.78	599.762	30	PASS
48	5240	MCS24	22.91	21.35	21.41	21.11	27.78	599.371	30	PASS
149	5745	MCS24	22.78	22.76	23.03	22.27	28.74	748.034	30	PASS
157	5785	MCS24	22.02	22.38	22.53	21.81	28.21	662.968	30	PASS
165	5825	MCS24	21.95	22.21	22.45	22.21	28.23	665.150	30	PASS

MPE Prediction (802.11a 5150~5250)

Max. output power including tune-up tolerancel:	27.78	(dBm)
Max. output power including tune-up tolerancel:	599.79108	(mW)
Duty cycle:	80.66	(%)
Maximum Pav :	483.79148	(mW)
Peak Antenna gain (Maximum):	4.58	(dBi)
Peak Antenna gain (linear):	2.8707806	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5220	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.276	(mW/cm ²)
Measurement Result		
The predicted power density level at 20 cm is 0.276 mW/cm ² .		
This is below the uncontrolled exposure limit of 1 mW/cm ² at 5220MHz.		

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MPE Prediction (802.11a 5725~5850)

Max. output power including tune-up tolerancel:	28.74	(dBm)
Max. output power including tune-up tolerancel:	748.1695	(mW)
Duty cycle:	80.66	(%)
Maximum Pav :	603.47352	(mW)
Peak Antenna gain (Maximum):	4.58	(dBi)
Peak Antenna gain (linear):	2.8707806	(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)	0.345	(mW/cm^2)
Measurement Result		
The predicted power density level at 20 cm is 0.345 mW/cm2.		
This is below the uncontrolled exposure limit of 1 mW/cm2 at 5745MHz.		

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802.11n_HT20M Max. output power**802.11n_HT20_MIMO**

CH	Frequency (MHz)	Data Rate	AVERAGE POWER (dBm)				TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
			CH 0	CH 1	CH 2	CH3				
36	5180	MCS24	13.14	12.86	13.29	13.63	19.26	84.324	30	PASS
44	5220	MCS24	22.87	23.08	22.98	22.88	28.97	789.576	30	PASS
48	5240	MCS24	22.81	22.98	22.94	22.86	28.92	779.580	30	PASS
149	5745	MCS24	22.98	22.62	23.03	22.76	28.87	771.128	30	PASS
157	5785	MCS24	22.71	23.05	23.02	22.57	28.86	769.639	30	PASS
165	5825	MCS24	21.78	22.83	22.55	22.81	28.53	713.400	30	PASS

MPE Prediction (802.11n_HT20 5150~5250)

MIMO gain= $G+(10 \log N)= 4.58+3.01= 7.59\text{dBm}$

Max. output power including tune-up tolerancel:	28.97	(dBm)
Max. output power including tune-up tolerancel:	788.86012	(mW)
Duty cycle:	52.04	(%)
Maximum Pav :	410.52281	(mW)
Peak Antenna gain (Maximum):	7.59	(dBi)
Peak Antenna gain (linear):	5.7411646	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5220	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.469	(mW/cm ²)
Measurement Result		
The predicted power density level at 20 cm is 0.469 mW/cm ² .		
This is below the uncontrolled exposure limit of 1 mW/cm ² at 5220MHz.		

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MPE Prediction (802.11n_HT20 5725~5850)

MIMO gain= $G+(10 \log N)= 4.58+3.01= 7.59\text{dBm}$

Max. output power including tune-up tolerancel:	28.87	(dBm)
Max. output power including tune-up tolerancel:	770.90347	(mW)
Duty cycle:	52.04	(%)
Maximum Pav :	401.17817	(mW)
Peak Antenna gain (Maximum):	7.59	(dBi)
Peak Antenna gain (linear):	5.7411646	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5745	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.458	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.458 mW/cm².

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

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802.11n_HT40M Max. output power

802.11n_HT40_MIMO

CH	Frequency (MHz)	Data Rate	AVERAGE POWER (dBm)				TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
			CH 0	CH 1	CH 2	CH3				
38	5190	MCS24	16.31	16.59	16.06	15.85	22.23	167.184	30	PASS
46	5230	MCS24	22.83	23.05	22.93	22.91	28.95	785.473	30	PASS
151	5755	MCS24	21.96	22.08	22.01	21.88	28.00	631.497	30	PASS
159	5795	MCS24	22.77	23.23	23.22	23	29.08	809.032	30	PASS

MPE Prediction (802.11n_HT40 5150~5250)

MIMO gain= $G+(10 \log N)=4.58+3.01=7.59\text{dBm}$

Max. output power including tune-up tolerancel:	28.95	(dBm)
Max. output power including tune-up tolerancel:	785.23563	(mW)
Duty cycle:	37.73	(%)
Maximum Pav :	296.2694	(mW)
Peak Antenna gain (Maximum):	7.59	(dBi)
Peak Antenna gain (linear):	5.7411646	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5230	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.339	(mW/cm ²)
Measurement Result		
The predicted power density level at 20 cm is 0.339 mW/cm ² .		
This is below the uncontrolled exposure limit of 1 mW/cm ² at 5230MHz.		

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MPE Prediction (802.11n_HT40 5725~5850)**MIMO gain= $G+(10 \log N)= 4.58+3.01= 7.59\text{dBm}$**

Average output power at antenna input terminal:	29.08	(dBm)
Average output power at antenna input terminal:	809.0959	(mW)
Duty cycle:	37.73	(%)
Maximum Pav :	305.27188	(mW)
Peak Antenna gain (Maximum):	7.59	(dBi)
Peak Antenna gain (linear):	5.7411646	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5795	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.349	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.349 mW/cm².

This is below the uncontrolled exposure limit of 1 mW/cm² at 5795MHz.

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802.11ac VHT80M Max. output power

802.11ac_VHT80_MIMO

CH	Frequency (MHz)	Data Rate	AVERAGE POWER (dBm)				TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
			CH 0	CH 1	CH 2	CH 3				
42	5210	MCS0	14.02	14.18	14.29	14.02	20.15	103.505	30	PASS
155	5775	MCS0	16.93	17.28	17.45	16.82	23.15	206.448	30	PASS

MPE Prediction (802.11ac_VHT80 5150~5250)

MIMO gain= $G+(10 \log N)= 4.58+3.01= 7.59\text{dBm}$

Average output power at antenna input terminal:	20.15	(dBm)
Average output power at antenna input terminal:	103.51422	(mW)
Duty cycle:	26.76	(%)
Maximum Pav :	27.700404	(mW)
Peak Antenna gain (Maximum):	7.59	(dBi)
Peak Antenna gain (linear):	5.7411646	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5210	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.032	(mW/cm ²)
Measurement Result		
The predicted power density level at 20 cm is 0.032 mW/cm ² .		
This is below the uncontrolled exposure limit of 1 mW/cm ² at 5210MHz.		

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MPE Prediction (802.11ac_VHT80 5725~5850)**MIMO gain= $G+(10 \log N)= 4.58+3.01= 7.59\text{dBm}$**

Average output power at antenna input terminal:	23.15	(dBm)
Average output power at antenna input terminal:	206.53802	(mW)
Duty cycle:	26.76	(%)
Maximum Pav :	55.269573	(mW)
Peak Antenna gain (Maximum):	7.59	(dBi)
Peak Antenna gain (linear):	5.7411646	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5775	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.063	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.063 mW/cm².

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

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