

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_Main

CH	Frequency (MHz)	Data Rate	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
36	5180	MCS0	14.81	30.269	23.98	PASS
44	5220	MCS0	14.87	30.690	23.98	PASS
48	5240	MCS0	14.80	30.200	23.98	PASS
149	5745	MCS0	14.84	30.479	30	PASS
157	5785	MCS0	14.81	30.269	30	PASS
165	5825	MCS0	14.85	30.549	30	PASS

MPE Prediction (802.11a 5150~5250)

Max. output power including tune-up tolerancel:	14.87	(dBm)
Max. output power including tune-up tolerancel:	30.69022	(mW)
Duty cycle:	95.16	(%)
Maximum Pav :	29.204813	(mW)
Peak Antenna gain (Maximum):	5.53	(dBi)
Peak Antenna gain (linear):	3.5727284	(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)	0.021	(mW/cm ²)
Measurement Result		
The predicted power density level at 20 cm is 0.021 mW/cm ² .		
This is below the uncontrolled exposure limit of 1 mW/cm ² at 5220MHz.		

MPE Prediction (802.11a 5725~5850)

Max. output power including tune-up tolerancel:	14.85	(dBm)
Max. output power including tune-up tolerancel:	30.549211	(mW)
Duty cycle:	95.16	(%)
Maximum Pav :	29.070629	(mW)
Peak Antenna gain (Maximum):	5.5	(dBi)
Peak Antenna gain (linear):	3.5481339	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5825	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
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/cm ² .		
This is below the uncontrolled exposure limit of 1 mW/cm ² at 5825MHz.		

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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				
36	5180	MCS16	10.44	9.81	10.09	14.89	30.848	19.68	PASS
44	5220	MCS16	10.49	9.94	10.13	14.96	31.361	19.68	PASS
48	5240	MCS16	10.44	9.9	10.14	14.94	31.166	19.68	PASS
149	5745	MCS16	10.93	9.36	9.84	14.87	30.656	25.73	PASS
157	5785	MCS16	10.76	9.26	9.82	14.76	29.940	25.73	PASS
165	5825	MCS16	10.79	9.27	9.9	14.80	30.220	25.73	PASS

MPE Prediction (802.11n_HT20 5150~5250)

MIMO gain= $G+(10 \log N)= 5.53+4.77= 10.3\text{dBm}$

Max. output power including tune-up tolerancel:	14.96	(dBm)
Max. output power including tune-up tolerancel:	31.332857	(mW)
Duty cycle:	87.08	(%)
Maximum Pav :	27.284652	(mW)
Peak Antenna gain (Maximum):	10.3	(dBi)
Peak Antenna gain (linear):	10.715193	(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)	0.058	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.058 mW/cm².

This is below the uncontrolled exposure limit of 1 mW/cm² at 5220MHz.

MPE Prediction (802.11n_HT20 5725~5850)

MIMO gain= $G+(10 \log N)= 5.50+4.77= 10.27\text{dBm}$

Max. output power including tune-up tolerancel:	14.87	(dBm)
Max. output power including tune-up tolerancel:	30.69022	(mW)
Duty cycle:	87.08	(%)
Maximum Pav :	26.725043	(mW)
Peak Antenna gain (Maximum):	10.27	(dBi)
Peak Antenna gain (linear):	10.64143	(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)	0.057	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.057 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				
38	5190	MCS16	10.11	9.51	10.59	14.86	30.645	19.68	PASS
46	5230	MCS16	10.31	9.69	10.6	14.99	31.533	19.68	PASS
151	5755	MCS16	10.65	9.61	10.31	14.98	31.496	25.73	PASS
159	5795	MCS16	10.58	9.37	10.32	14.89	30.843	25.73	PASS

MPE Prediction (802.11n_HT40 5150~5250)

MIMO gain= $G+(10 \log N)= 5.53+4.77= 10.3\text{dBm}$

Max. output power including tune-up tolerancel:	14.99	(dBm)
Max. output power including tune-up tolerancel:	31.550046	(mW)
Duty cycle:	78.22	(%)
Maximum Pav :	24.678446	(mW)
Peak Antenna gain (Maximum):	10.3	(dBi)
Peak Antenna gain (linear):	10.715193	(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)	0.053	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.053 mW/cm².

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

MPE Prediction (802.11n_HT40 5725~5850)

MIMO gain= $G+(10 \log N)= 5.50+4.77= 10.27\text{dBm}$

Average output power at antenna input terminal:	14.98	(dBm)
Average output power at antenna input terminal:	31.477483	(mW)
Duty cycle:	78.22	(%)
Maximum Pav :	24.621687	(mW)
Peak Antenna gain (Maximum):	10.27	(dBi)
Peak Antenna gain (linear):	10.64143	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	5755	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.052	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.052 mW/cm².

This is below the uncontrolled exposure limit of 1 mW/cm² at 5755MHz.

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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				
42	5210	MCS0	10.63	9.57	10.35	14.98	31.458	19.68	PASS
155	5775	MCS0	10.45	9.38	10.37	14.86	30.651	25.73	PASS

MPE Prediction (802.11ac_VHT80 5150~5250)

MIMO gain= $G+(10 \log N)= 5.53+4.77= 10.3\text{dBm}$

Average output power at antenna input terminal:	14.98	(dBm)
Average output power at antenna input terminal:	31.477483	(mW)
Duty cycle:	92.45	(%)
Maximum Pav :	29.100933	(mW)
Peak Antenna gain (Maximum):	10.3	(dBi)
Peak Antenna gain (linear):	10.715193	(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)	0.062	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.062 mW/cm².

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

MPE Prediction (802.11ac_VHT80 5725~5850)

MIMO gain= $G+(10 \log N)= 5.50+4.77= 10.27\text{dBm}$

Average output power at antenna input terminal:	14.86	(dBm)
Average output power at antenna input terminal:	30.619634	(mW)
Duty cycle:	92.45	(%)
Maximum Pav :	28.307852	(mW)
Peak Antenna gain (Maximum):	10.27	(dBi)
Peak Antenna gain (linear):	10.64143	(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)	0.060	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.06 mW/cm².

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

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