

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

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Maximum Permissible Exposure (MPE) Evaluation

802.11b_MIMO										
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)				Max. Output include tune up tolerance Power (dBm)	Max. Output include tune up tolerance Power (mW)	Limit	RESULT
			CH 0	CH 1	CH 2	CH 3				
1	2412	1	20.29	20.15	19.72	19.80	26.02	399.68	1 Watt = 30.00 dBm	PASS
6	2437	1	23.09	22.67	22.32	22.13	28.59	722.54	1 Watt = 30.00 dBm	PASS
11	2462	1	19.51	19.30	19.38	19.25	25.38	345.28	1 Watt = 30.00 dBm	PASS

MPE Prediction (802.11b 2412~2462)

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

Max. output power including tune-up tolerance:	28.59	(dBm)
Max. output power including tune-up tolerance:	722.7698	(mW)
Duty cycle:	96	(%)
Maximum Pav :	693.85901	(mW)
Peak Antenna gain (Maximum):	3.57	(dBi)
Peak Antenna gain (linear):	2.2750974	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2437	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.314	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.314 mW/cm².

This is below the uncontrolled exposure limit of 1 mW/cm² at 2437MHz.

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802.11g_MIMO

CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)				Max. Output include tune up tolerance Power (dBm)	Max. Output include tune up tolerance Power (mW)	Limit	RESULT
			CH 0	CH 1	CH 2	CH3				
1	2412	6	14.68	14.82	14.38	14.64	20.65	116.24	1 Watt = 30.00 dBm	PASS
6	2437	6	20.94	21.51	21.36	21.60	27.38	547.06	1 Watt = 30.00 dBm	PASS
11	2462	6	16.94	16.81	17.00	17.09	22.98	198.69	1 Watt = 30.00 dBm	PASS

MPE Prediction (802.11g 2412~2462)

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

Max. output power including tune-up tolerance:	27.38	(dBm)
Max. output power including tune-up tolerance:	547.01596	(mW)
Duty cycle:	81	(%)
Maximum Pav :	443.08293	(mW)
Peak Antenna gain (Maximum):	3.57	(dBi)
Peak Antenna gain (linear):	2.2750974	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2437	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm^2)
Power density at predication frequency at 20 (cm)	0.201	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.201 mW/cm².

This is below the uncontrolled exposure limit of 1 mW/cm² at 2437MHz.

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802.11n_HT20M MIMO

CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)				Max. Output include tune up tolerance Power (dBm)	Max. Output include tune up tolerance Power (mW)	Limit			RESULT
			CH 0	CH 1	CH 2	CH3						
1	2412	MCS2 4	15.79	15.75	15.68	15.60	21.73	148.81	1 Watt =	30.00	dBm	PASS
6	2437	MCS2 4	21.32	21.59	21.01	21.46	27.37	545.87	1 Watt =	30.00	dBm	PASS
11	2462	MCS2 4	17.43	17.14	17.09	17.36	23.28	212.71	1 Watt =	30.00	dBm	PASS

MPE Prediction (802.11n20 2412~2462)

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

MIMO gain= Directional gain = $10 \log [(10(G_1/20) + 10(G_2/20) + \dots + 10(G_{N/20}))^2 / N_{ANT}] = 6.58 \text{ dBi}$

Max. output power including tune-up tolerance:	27.37	(dBm)
Max. output power including tune-up tolerance:	545.75786	(mW)
Duty cycle:	52	(%)
Maximum Pav :	283.79409	(mW)
Peak Antenna gain (Maximum):	6.58	(dBi)
Peak Antenna gain (linear):	4.5498806	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2437	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm^2)
Power density at predication frequency at 20 (cm)	0.257	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.257 mW/cm².

This is below the uncontrolled exposure limit of 1 mW/cm² at 2437MHz.

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802.11n_HT40M MIMO

CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)				Max. Output include tune up tolerance Power (dBm)	Max. Output include tune up tolerance Power (mW)	Limit			RESULT
			CH 0	CH 1	CH 2	CH3						
3	2422	MCS2	13.93	14.00	13.47	14.14	19.91	98.01	1 Watt =	30.00	dBm	PASS
6	2437	MCS2	21.06	21.76	21.15	21.71	27.45	556.18	1 Watt =	30.00	dBm	PASS
9	2452	MCS2	16.02	16.11	16.35	16.24	22.20	166.05	1 Watt =	30.00	dBm	PASS

MPE Prediction (802.11n40 2412~2452)

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

$$\text{MIMO gain} = \text{Directional gain} = 10 \log [(10(G1/20) + 10(G2/20) + \dots + 10(GN/20))_2 / N_{\text{ANT}}] = 6.58 \text{dBi}$$

Max. output power including tune-up tolerance:	27.45	(dBm)
Max. output power including tune-up tolerance:	555.90426	(mW)
Duty cycle:	40	(%)
Maximum Pav :	222.3617	(mW)
Peak Antenna gain (Maximum):	6.58	(dBi)
Peak Antenna gain (linear):	4.5498806	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2437	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm^2)
Power density at predication frequency at 20 (cm)	0.201	(mW/cm^2)

Measurement Result

 The predicted power density level at 20 cm is 0.201 mW/cm².

 This is below the uncontrolled exposure limit of 1 mW/cm² at 2437MHz.

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