

13 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

13.1 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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13.2 Maximum Permissible Exposure (MPE) Evaluation

802.11b

		Peak Power Output (dBm)				
CH	Frequency (MHz)	Data Rate				Required Limit
		1	2	5.5	11	
1	2412	16.48	16.44	16.31	16.17	1 Watt = 30 dBm
6	2437	16.40	16.30	16.32	16.31	1 Watt = 30 dBm
11	2462	16.52	16.49	16.50	16.44	1 Watt = 30 dBm
		Average Power Output (dBm)				
CH	Frequency (MHz)	Data Rate				Required Limit
		1	2	5.5	11	
1	2412	14.32	14.21	14.02	13.89	1 Watt = 30 dBm
6	2437	14.13	14.04	14.04	14.03	1 Watt = 30 dBm
11	2462	14.25	14.22	14.19	14.16	1 Watt = 30 dBm

*Note: Measured by power meter, cable loss as 11dB that offsets on the power meter.

MPE Prediction (802.11b)

Prediction of MPE limit at a given distance

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

$$S = \frac{PG}{4R^2}$$

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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Maximum peak avg output power at antenna input	16.52	(dBm)
Maximum peak avg output power at antenna input	44.87453899	(mW)
Duty cycle:	0.992	(%)
Maximum Pav :	0.445155427	(mW)
Antenna gain (typical):	4.13	(dBi)
Maximum antenna gain:	2.588212915	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2462	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.000229	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.000229mW/cm². This is below the uncontrolled exposure limit of 1mW/cm² at 2462MHz.

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802.11g

		Peak Power Output(dBm)								
CH	Frequency (MHz)	Data Rate								Required Limit
		6	9	12	18	24	36	48	54	
1	2412	19.15	19.01	18.89	18.07	19.09	19.06	18.63	19.00	1 Watt = 30 dBm
6	2437	19.16	19.01	18.92	18.27	19.08	19.04	18.81	19.02	1 Watt = 30 dBm
11	2462	19.44	19.14	19.21	18.38	19.24	19.12	18.88	19.04	1 Watt = 30 dBm
		Average Power Output(dBm)								
CH	Frequency (MHz)	Data Rate								Required Limit
		6	9	12	18	24	36	48	54	
1	2412	9.58	9.56	9.49	9.43	9.42	9.37	9.29	9.25	1 Watt = 30 dBm
6	2437	9.75	9.67	9.68	9.65	9.64	9.57	9.56	9.60	1 Watt = 30 dBm
11	2462	10.03	9.83	9.81	9.77	9.73	9.67	9.61	9.63	1 Watt = 30 dBm

*Note: Measured by power meter, cable loss as 11dB that offsets on the power meter.

MPE Prediction (802.11g)

Prediction of MPE limit at a given distance

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

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

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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Maximum peak avg output power at antenna input	19.44	(dBm)
Maximum peak avg output power at antenna input	87.90225168	(mW)
Duty cycle:	0.996	(%)
Maximum Pav :	0.875506427	(mW)
Antenna gain (typical):	4.13	(dBi)
Maximum antenna gain:	2.588212915	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2462	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.000451	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.000451mW/cm². This is below the uncontrolled exposure limit of 1mW/cm² at 2462MHz.

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802.11n_20M

		Peak Power Output(dBm)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
1	2412	18.53	18.45	18.41	18.17	18.42	18.26	18.18	18.41	1 Watt = 30 dBm
6	2437	19.23	19.18	19.14	18.40	18.72	18.60	18.54	18.51	1 Watt = 30 dBm
11	2462	18.97	18.94	18.82	18.55	18.76	18.72	18.68	18.63	1 Watt = 30 dBm
		Average Power Output(dBm)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
1	2412	9.35	9.31	9.28	9.26	9.25	9.21	9.23	9.20	1 Watt = 30 dBm
6	2437	9.95	9.80	9.81	9.66	9.60	9.58	9.54	9.54	1 Watt = 30 dBm
11	2462	9.86	9.84	9.77	9.69	9.64	9.67	9.64	9.61	1 Watt = 30 dBm

*Note: Measured by power meter, cable loss as 11dB that offsets on the power meter.

MPE Prediction (802.11 n_20M)

Prediction of MPE limit at a given distance

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

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

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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Maximum peak output power at antenna input terminal:	19.23	(dBm)
Maximum peak output power at antenna input terminal:	83.75292821	(mW)
Duty cycle:	0.986	(%)
Maximum Pav :	0.825803872	(mW)
Antenna gain (typical):	4.13	(dBi)
Maximum antenna gain:	2.588212915	(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)	0.000425	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.000425mW/cm². This is below the uncontrolled exposure limit of 1mW/cm² at 2437MHz.

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802.11n_40M

		Peak Power Output(dBm)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
3	2422	18.49	18.36	18.34	18.41	18.32	18.28	18.26	17.97	1 Watt = 30 dBm
6	2437	18.79	18.66	18.53	18.67	18.50	18.48	18.40	18.01	1 Watt = 30 dBm
9	2452	18.85	18.63	18.58	18.72	18.54	18.47	18.44	18.16	1 Watt = 30 dBm
		Average Power Output(dBm)								
CH	Frequency (MHz)	Data Rate								Required Limit
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
3	2422	9.20	9.17	9.16	9.12	9.10	9.06	9.08	9.08	1 Watt = 30 dBm
6	2437	9.48	9.43	9.35	9.28	9.30	9.25	9.24	9.15	1 Watt = 30 dBm
9	2452	9.57	9.44	9.41	9.38	9.35	9.32	9.31	9.33	1 Watt = 30 dBm

*Note: Measured by power meter, cable loss as 11dB that offsets on the power meter.

MPE Prediction (802.11 n_40M)

Prediction of MPE limit at a given distance

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

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

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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Maximum peak output power at antenna input terminal:	18.85	(dBm)
Maximum peak output power at antenna input terminal:	76.73614894	(mW)
Duty cycle:	0.988	(%)
Maximum Pav :	0.758153151	(mW)
Antenna gain (typical):	4.13	(dBi)
Maximum antenna gain:	2.588212915	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2452	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm ²)
Power density at predication frequency at 20 (cm)	0.000391	(mW/cm ²)

Measurement Result

The predicted power density level at 20 cm is 0.000391mW/cm². This is below the uncontrolled exposure limit of 1mW/cm² at 2452MHz.

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