

## 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 <sup>2</sup> )	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 <sup>2</sup> )	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

Cable loss = 0		Peak Power Output				
CH	Frequency (MHz)	Data Rate				Required Limit
		1	2	5.5	11	
1	2412	19.10	19.08	19.05	19.03	1 Watt = 30 dBm
6	2437	18.38	18.35	18.32	18.29	1 Watt = 30 dBm
11	2462	18.32	18.29	18.27	18.24	1 Watt = 30 dBm

*\*Note: Measured by power meter, cable loss as 11.4dB 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

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

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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Maximum peak output power at antenna input terminal:	19.10	(dBm)
Maximum peak output power at antenna input terminal:	81.28305162	(mW)
Duty cycle:	100	(%)
Maximum Pav :	81.28305162	(mW)
Antenna gain (typical):	1.28	(dBi)
Maximum antenna gain:	1.342764961	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2412	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.021725	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.021725mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2412MHz.

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# 802.11g

Cable loss = 0		Peak Power Output								
CH	Frequency (MHz)	Data Rate								Required Limit
		6	9	12	18	24	36	48	54	
1	2412	23.90	23.86	23.82	23.78	23.75	23.71	23.67	23.63	1 Watt = 30 dBm
6	2437	23.85	23.81	23.76	23.72	23.68	23.64	23.59	23.55	1 Watt = 30 dBm
11	2462	22.96	22.92	22.88	22.84	22.79	22.75	22.71	22.67	1 Watt = 30 dBm

\*Note: Measured by power meter, cable loss as 11.4dB 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

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

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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Maximum peak output power at antenna input terminal:	23.9	(dBm)
Maximum peak output power at antenna input terminal:	245.4708916	(mW)
Duty cycle:	100	(%)
Maximum Pav :	245.4708916	(mW)
Antenna gain (typical):	1.28	(dBi)
Maximum antenna gain:	1.342764961	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2412	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.065607	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.065607mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2412MHz.

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### 802.11n\_20M

Cable loss = 0		Peak Power Output								
CH	Frequency (MHz)	Data Rate								Required Limit
		6.5	13	19.5	26	39	52	58.5	65	
1	2412	22.49	22.45	22.42	22.38	22.35	22.31	22.28	22.24	1 Watt = 30 dBm
6	2437	22.36	22.32	22.27	22.23	22.19	22.15	22.10	22.06	1 Watt = 30 dBm
11	2462	22.29	22.25	22.22	22.18	22.14	22.10	22.07	22.03	1 Watt = 30 dBm

*\*Note: Measured by power meter, cable loss as 11.4dB 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

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

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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Maximum peak output power at antenna input terminal:	22.49	(dBm)
Maximum peak output power at antenna input terminal:	177.4189481	(mW)
Duty cycle:	100	(%)
Maximum Pav :	177.4189481	(mW)
Antenna gain (typical):	1.28	(dBi)
Maximum antenna gain:	1.342764961	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2412	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.047419	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.047419mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2412MHz.

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## 802.11n\_40M

Cable loss = 0		Peak Power Output								Required Limit
CH	Frequency (MHz)	Data Rate								
		6.5	13	19.5	26	39	52	58.5	65	
1	2422	22.12	22.08	22.04	22.00	21.95	21.91	21.87	21.83	1 Watt = 30 dBm
4	2437	22.22	22.18	22.13	22.09	22.05	22.01	21.96	21.92	1 Watt = 30 dBm
7	2452	21.08	21.04	21.00	20.96	20.92	20.88	20.84	20.80	1 Watt = 30 dBm

*\*Note: Measured by power meter, cable loss as 11.4dB 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

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

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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Maximum peak output power at antenna input terminal:	22.22	(dBm)
Maximum peak output power at antenna input terminal:	166.7247213	(mW)
Duty cycle:	100	(%)
Maximum Pav :	166.7247213	(mW)
Antenna gain (typical):	1.28	(dBi)
Maximum antenna gain:	1.342764961	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2437	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.044561	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.044561mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2437MHz.

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