

## 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 Power Table

Frequency (MHz)	Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2412.00	16.80	0.00	16.80	0.04786	1
2437.00	16.43	0.00	16.43	0.04395	1
2462.00	16.58	0.00	16.58	0.04550	1

### 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

Maximum peak output power at antenna input terminal:	16.80	(dBm)
Maximum peak output power at antenna input terminal:	47.86300923	(mW)
Duty cycle:	100	(%)
Maximum Pav :	47.86300923	(mW)
Antenna gain (typical):	4	(dBi)
Maximum antenna gain:	2.511886432	(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)	0.0239304	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.0239 mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2412MHz.

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### 802.11g Power Table

Frequency (MHz)	Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2412.00	21.60	0.00	21.60	0.14454	1
2437.00	21.11	0.00	21.11	0.12912	1
2462.00	21.23	0.00	21.23	0.13274	1

### 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

Maximum peak output power at antenna input terminal:	21.6	(dBm)
Maximum peak output power at antenna input terminal:	144.5439771	(mW)
Duty cycle:	100	(%)
Maximum Pav :	144.5439771	(mW)
Antenna gain (typical):	4	(dBi)
Maximum antenna gain:	2.511886432	(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)	0.0722687	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.0723 mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2412.

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### 802.11n\_20MHz Power Table (Worse case)

Frequency (MHz)	Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2412.00	23.69	0.00	23.69	0.23391	1
2437.00	23.76	0.00	23.76	0.23769	1
2462.00	23.42	0.00	23.42	0.17440	1

### MPE Prediction (802.11n\_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

Maximum peak output power at antenna input terminal:	23.76	(dBm)
Maximum peak output power at antenna input terminal:	237.6840287	(mW)
Duty cycle:	100	(%)
Maximum Pav :	237.6840287	(mW)
Antenna gain (typical):	4	(dBi)
Maximum antenna gain:	2.511886432	(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)	0.1188366	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.1188 mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2437.

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### 802.11n\_40MHz Power Table (Worse case)

Frequency (MHz)	Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2422.00	23.35	0.00	23.35	0.21641	1
2437.00	22.25	0.00	22.25	0.16777	1
2452.00	23.02	0.00	23.02	0.20050	1

### MPE Prediction (802.11n\_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

Maximum peak output power at antenna input terminal:	23.35	(dBm)
Maximum peak output power at antenna input terminal:	216.2718524	(mW)
Duty cycle:	100	(%)
Maximum Pav :	216.2718524	(mW)
Antenna gain (typical):	-0.22	(dBi)
Maximum antenna gain:	0.950604794	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2422	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.0409214	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.0409 mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2422.

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