

# 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 <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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## 1.2 Maximum Permissible Exposure (MPE) Evaluation

Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)
2412	16.03	0.0401	1
2437	15.87	0.0386	1
2462	15.81	0.0381	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

Average output power at antenna input terminal:	16.03	(dBm)
Average output power at antenna input terminal:	40.086672	(mW)
Duty cycle:	95.01	(%)
Maximum Pav :	38.086347	(mW)
Antenna gain (Maximum):	4.28	(dBi)
Antenna gain (linear):	2.6791683	(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)	0.0203105	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.0203 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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Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)
2412	9.62	0.0092	1
2437	<b>9.73</b>	0.0094	1
2462	9.25	0.0084	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

Average output power at antenna input terminal:	<b>9.73</b>	(dBm)
Average output power at antenna input terminal:	9.3972331	(mW)
Duty cycle:	<b>94.84</b>	(%)
Maximum Pav :	8.9123359	(mW)
Antenna gain (Maximum):	<b>4.28</b>	(dBi)
Antenna gain (linear):	2.6791683	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	<b>2437</b>	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.0047527	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.0048 mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2437MHz.

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Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)
2412	10.72	0.0118	0.743
2437	<b>12.17</b>	0.0165	0.743
2462	11.98	0.0158	0.743

### MPE Prediction (802.11\_n20 MIMO)

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

$$\text{MIMO gain} = G + (10 \log N) = 4.28 + 3.01 = 7.29 \text{ dBm}$$

Average output power at antenna input terminal:	12.17	(dBm)
Average output power at antenna input terminal:	16.481624	(mW)
Duty cycle:	95.45	(%)
Maximum Pav :	15.73171	(mW)
Antenna gain (Maximum):	7.29	(dBi)
Antenna gain (linear):	5.3579666	(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)	0.0167775	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.0168 mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2437MHz.

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Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)
2422	10.64	0.0116	0.743
2437	<b>11.45</b>	0.0140	0.743
2452	11.25	0.0133	0.743

### MPE Prediction (802.11n\_n40 MIMO)

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

$$\text{MIMO gain} = G + (10 \log N) = 4.28 + 3.01 = 7.29 \text{ dBm}$$

Average output power at antenna input terminal:	11.45	(dBm)
Average output power at antenna input terminal:	13.963684	(mW)
Duty cycle:	90.67	(%)
Maximum Pav :	12.660872	(mW)
Antenna gain (Maximum):	7.29	(dBi)
Antenna gain (linear):	5.3579666	(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)	0.0135025	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.0135 mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2437MHz.

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