

### 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

CH	Frequency (MHz)	Average Power Output (dBm)				Required Limit
		Data Rate				
		1	2	5.5	11	
1	2412	<b>19.69</b>	19.44	19.39	19.18	1 Watt = 30 dBm
6	2437	18.30	18.08	17.85	17.67	1 Watt = 30 dBm
11	2462	18.21	17.89	17.68	17.68	1 Watt = 30 dBm

#### MPE Prediction (802.11b)

Prediction of MPE limit at a given distance

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

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

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 average output power at antenna input	19.69	(dBm)
Maximum average output power at antenna input	93.11078755	(mW)
Duty cycle:	100	(%)
Maximum Pav :	93.11078755	(mW)
Antenna gain (typical):	2	(dBi)
Maximum antenna gain:	1.584893192	(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)	0.029373	(mW/cm <sup>2</sup> )

#### Measurement Result

The predicted power density level at 20 cm is 0.029373mW/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**

CH	Frequency (MHz)	Average Power Output(dBm)								Required Limit
		Data Rate								
		6	9	12	18	24	36	48	54	
1	2412	15.32	15.13	15.11	15.02	14.73	14.68	14.40	14.35	1 Watt = 30 dBm
6	2437	15.70	15.41	15.17	15.07	15.05	14.84	14.81	14.52	1 Watt = 30 dBm
11	2462	<b>15.90</b>	15.81	15.57	15.44	15.23	15.14	15.09	14.94	1 Watt = 30 dBm

**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

Maximum average output power at antenna input	15.9	(dBm)
Maximum average output power at antenna input	38.9045145	(mW)
Duty cycle:	100	(%)
Maximum Pav :	38.9045145	(mW)
Antenna gain (typical):	2	(dBi)
Maximum antenna gain:	1.584893192	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2462	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.012273	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.012273mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2462MHz.

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802.11n\_20M

		Average Power Output(dBm)								Required Limit
CH	Frequency (MHz)	Data Rate								
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
1	2412	13.48	13.25	12.99	12.73	12.73	12.69	12.56	12.29	1 Watt = 30 dBm
6	2437	14.22	14.08	13.94	13.84	13.52	13.22	12.97	12.64	1 Watt = 30 dBm
11	2462	14.23	14.15	13.82	13.62	13.51	13.31	13.31	13.04	1 Watt = 30 dBm

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

Maximum average output power at antenna input	14.23	(dBm)
Maximum average output power at antenna input	26.48500139	(mW)
Duty cycle:	100	(%)
Maximum Pav :	26.48500139	(mW)
Antenna gain (typical):	2	(dBi)
Maximum antenna gain:	1.584893192	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2462	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.008355	(mW/cm <sup>2</sup> )

Measurement Result

The predicted power density level at 20 cm is 0.008355mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2462MHz.

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802.11n\_40M

		Average Power Output(dBm)								
CH	Frequency (MHz)	Data Rate							Required Limit	
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6		MCS7
1	2422	11.42	11.13	11.06	11.01	11.00	10.97	10.91	10.85	1 Watt = 30 dBm
6	2437	10.61	10.30	10.05	9.85	9.72	9.59	9.31	9.19	1 Watt = 30 dBm
11	2452	10.47	10.45	10.44	10.24	9.96	9.79	9.56	9.30	1 Watt = 30 dBm

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

Maximum average output power at antenna input	11.42	(dBm)
Maximum average output power at antenna input	13.86755829	(mW)
Duty cycle:	100	(%)
Maximum Pav :	13.86755829	(mW)
Antenna gain (typical):	2	(dBi)
Maximum antenna gain:	1.584893192	(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)	0.004375	(mW/cm <sup>2</sup> )

Measurement Result

The predicted power density level at 20 cm is 0.004375mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2422MHz.

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