

# 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

## 1.2 MAXIMUM PERMISSIBLE EXPOSURE (MPE) EVALUATION

### 802.11b (Aux)

		Peak Power Output (dBm)	
CH	Frequency (MHz)	Data Rate	Required Limit
		1	
1	2412	24.76	1 Watt = 30 dBm
6	2437	24.47	1 Watt = 30 dBm
11	2462	24.73	1 Watt = 30 dBm

		Average Power Output (dBm)	
CH	Frequency (MHz)	Data Rate	Required Limit
		1	
1	2412	21.97	1 Watt = 30 dBm
6	2437	21.87	1 Watt = 30 dBm
11	2462	21.99	1 Watt = 30 dBm

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

### MPE Prediction (802.11b (Main) )

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 average output power at antenna input	21.99	(dBm)
Maximum average output power at antenna input	158.1248039	(mW)
Duty cycle:	100	(%)
Maximum Pav :	158.1248039	(mW)
Antenna gain (typical):	2.36	(dBi)
Maximum antenna gain:	1.721868575	(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)	0.054194	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.05419mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2462MHz.

**802.11g (Aux)**

		Peak Power Output (dBm)	
CH	Frequency (MHz)	Data Rate	Required Limit
		6	
1	2412	24.72	1 Watt = 30 dBm
6	2437	24.83	1 Watt = 30 dBm
11	2462	24.64	1 Watt = 30 dBm

		Average Power Output (dBm)	
CH	Frequency (MHz)	Data Rate	Required Limit
		6	
1	2412	14.86	1 Watt = 30 dBm
6	2437	14.69	1 Watt = 30 dBm
11	2462	14.50	1 Watt = 30 dBm

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

**MPE Prediction (802.11g (Main) )**

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 average output power at antenna input	14.86	(dBm)
Maximum average output power at antenna input	30.61963434	(mW)
Duty cycle:	100	(%)
Maximum Pav :	30.61963434	(mW)
Antenna gain (typical):	2.36	(dBi)
Maximum antenna gain:	1.721868575	(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)	0.010494	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.0105mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2412MHz.

**802.11n\_20M (MIMO Chain 0+1)**

		Peak Power Output (dBm)	
CH	Frequency (MHz)	Data Rate	Required Limit
		MCS8	
1	2412	26.69	1 Watt = 30 dBm
6	2437	26.61	1 Watt = 30 dBm
11	2462	26.42	1 Watt = 30 dBm

		Average Power Output (dBm)	
CH	Frequency (MHz)	Data Rate	Required Limit
		MCS8	
1	2412	16.20	1 Watt = 30 dBm
6	2437	16.13	1 Watt = 30 dBm
11	2462	15.93	1 Watt = 30 dBm

*\*Note: Measured by power meter, cable loss as 14dB that offsets on the power meter.*

**MPE Prediction (802.11 n\_20M (MIMO Chain 0+1) )**

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 average output power at antenna input	16.2	(dBm)
Maximum average output power at antenna input	41.68693835	(mW)
Duty cycle:	100	(%)
Maximum Pav :	41.68693835	(mW)
Antenna gain (typical):	4.57	(dBi)
Maximum antenna gain:	2.86417797	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2412	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.023766	(mW/cm^2)

**Measurement Result**

The predicted power density level at 20 cm is 0.0238mW/cm2. This is below the uncontrolled exposure limit of 1mW/cm2 at 2412MHz.

**802.11n\_40M (MIMO Chain 0+1)**

		Peak Power Output (dBm)	
CH	Frequency (MHz)	Data Rate	Required Limit
		MCS8	
1	2422	26.59	1 Watt = 30 dBm
6	2437	26.49	1 Watt = 30 dBm
11	2452	26.48	1 Watt = 30 dBm

		Average Power Output (dBm)	
CH	Frequency (MHz)	Data Rate	Required Limit
		MCS8	
1	2422	15.91	1 Watt = 30 dBm
6	2437	15.74	1 Watt = 30 dBm
11	2452	15.88	1 Watt = 30 dBm

*\*Note: Measured by power meter, cable loss as 14dB that offsets on the power meter.*



**MPE Prediction (802.11 n\_40M (MIMO Chain 0+1) )**

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 average output power at antenna input	15.91	(dBm)
Maximum average output power at antenna input	38.99419867	(mW)
Duty cycle:	100	(%)
Maximum Pav :	38.99419867	(mW)
Antenna gain (typical):	4.59	(dBi)
Maximum antenna gain:	2.877398415	(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)	0.022333	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.0223mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1mW/cm<sup>2</sup> at 2452MHz.