

# 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

The worst case of Average power: refer to section 6.5 for detail measurement date.

802.11b

Cable loss = 0		Output Power		Limit (dBm)
CH	Frequency (MHz)	Detector		
		PK (dBm)	AV (dBm)	
1	2412	17.74	13.48	30
7	2442	17.60	13.35	
11	2462	17.42	13.22	

### MPE Prediction (802.11b)

Prediction of MPE limit at a given distance

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

$$S = \frac{PG}{4R^2}$$

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	13.48	(dBm)
Maximum Average output power at antenna input	22.28435149	(mW)
Duty cycle:	100	(%)
Maximum Pav :	22.28435149	(mW)
Antenna gain (typical):	4.95	(dBi)
Maximum antenna gain:	3.126079367	(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)	0.0138660	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.0138660 mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2412MHz.

The worst case of Average power: refer to section 6.5 for detail measurement date.

Average Measurement

2\*2 MIMO

Channel	Frequency (MHz)	Output Chain (dBm)		Combine Output Power (dBm)	Limit(dBm)	Result	
		Chain A	chain B				
AN HT20	1	2412	9.29	9.23	12.27	30	Pass
	7	2442	9.09	9.15	12.13	30	Pass
	11	2462	8.59	8.63	11.62	30	Pass
AN HT40	3	2422	8.48	8.44	11.47	30	Pass
	7	2442	8.20	8.26	11.24	30	Pass
	9	2452	7.93	7.98	10.97	30	Pass

**MPE Prediction (802.11n HT20)**

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

MIMO Chain A

Maximum average output power at antenna input	9.29	(dBm)
Maximum Average output power at antenna input	8.49180475	(mW)
Duty cycle:	100	(%)
Maximum Pav :	8.49180475	(mW)
Antenna gain (typical):	4.95	(dBi)
Maximum antenna gain:	3.126079367	(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)	0.0052838	(mW/cm <sup>2</sup> )

## MIMO Chain B

Maximum average output power at antenna input	9.23	(dBm)
Maximum Average output power at antenna input	8.375292821	(mW)
Duty cycle:	100	(%)
Maximum Pav :	8.375292821	(mW)
Antenna gain (typical):	4.95	(dBi)
Maximum antenna gain:	3.126079367	(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)	0.0052114	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.0052838 mW/cm<sup>2</sup>, 0.0052114 mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2412MHz.

*Remark: The worst case of which power is higher between hT20, and hT40 is deduced, and shown on the test report*

The worst case of Average power: refer to section 6.5 for detail measurement date.

Zigbee

Cable loss = 0		Output Power		Limit (dBm)
CH	Frequency (MHz)	Detector		
		PK (dBm)	AV (dBm)	
11	2405	4.6	4.52	30
18	2440	4.9	5.02	
26	2480	5.43	5.35	

**MPE Prediction (Zigbee)**

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	5.35	(dBm)
Maximum Average output power at antenna input	3.427677865	(mW)
Duty cycle:	100	(%)
Maximum Pav :	3.427677865	(mW)
Antenna gain (typical):	2.72	(dBi)
Maximum antenna gain:	1.87068214	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2480	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.0012763	(mW/cm <sup>2</sup> )

**Measurement Result**

The predicted power density level at 20 cm is 0.0012763 mW/cm<sup>2</sup>. This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2480MHz.