

## 14. FCC MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### 14.1 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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## 14.2 Maximum Permissible Exposure (MPE) Evaluation (Worst Case)

802.11g Main						
CH	Frequency (MHz)	Data Rate	Peak Output Power (dBm)	Peak Output Power (mW)	Limit	RESULT
1	2412	6	22.69	185.78	1 Watt = 30.00 dBm	PASS
6	2437	6	<b>23.84</b>	<b>242.10</b>	1 Watt = 30.00 dBm	PASS
11	2462	6	22.48	177.01	1 Watt = 30.00 dBm	PASS
802.11g Main						
CH	Frequency (MHz)	Data Rate	Avg. Output Power (dBm)	Avg. Output Power (mW)	Limit	RESULT
1	2412	6	14.78	30.06	1 Watt = 30.00 dBm	PASS
6	2437	6	<b>16.48</b>	<b>44.46</b>	1 Watt = 30.00 dBm	PASS
11	2462	6	13.83	24.15	1 Watt = 30.00 dBm	PASS

### MPE Prediction (802.11g 2412~2462)

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

Max. output power including tune-up tolerancel:	<b>16.48</b>	(dBm)
Max. output power including tune-up tolerancel:	44.463127	(mW)
Duty cycle:	<b>100</b>	(%)
Maximum Pav :	44.463127	(mW)
Peak Antenna gain (Maximum):	<b>3.36</b>	(dBi)
Peak Antenna gain (linear):	2.1677041	(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)	0.019	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.019 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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# 802.11n\_HT20M MIMO

CH	Frequency (MHz)	Data Rate	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Total Peak Output Power (mW)	Limit	RESULT
			CH 0	CH 1				
1	2412	MCS8	21.88	21.65	24.78	300.39	1 Watt = 29.73 dBm	PASS
6	2437	MCS8	21.65	21.53	24.60	288.45	1 Watt = 29.73 dBm	PASS
11	2462	MCS8	21.69	21.61	24.66	292.45	1 Watt = 29.73 dBm	PASS

# 802.11n\_HT20M MIMO

CH	Frequency (MHz)	Data Rate	Avg. Output Power (dBm)		Avg. Output Power (dBm)	Avg. Output Power (mW)	Limit	RESULT
			CH 0	CH 1				
1	2412	MCS8	13.30	13.60	16.46	44.29	1 Watt = 29.73 dBm	PASS
6	2437	MCS8	13.31	13.51	16.42	43.87	1 Watt = 29.73 dBm	PASS
11	2462	MCS8	13.27	13.57	16.43	43.98	1 Watt = 29.73 dBm	PASS

## MPE Prediction (802.11n\_HT20 2412~2462)

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

**MIMO Gain: 3.36+3.01=6.37dBi**

Max. output power including tune-up tolerancel:	16.46	(dBm)
Max. output power including tune-up tolerancel:	44.258837	(mW)
Duty cycle:	100	(%)
Maximum Pav :	44.258837	(mW)
Peak Antenna gain (Maximum):	6.37	(dBi)
Peak Antenna gain (linear):	4.3351088	(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)	0.038	(mW/cm <sup>2</sup> )

## Measurement Result

The predicted power density level at 20 cm is 0.038 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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## Maximum Permissible Exposure (MPE) Evaluation (worst case)

802.11n_HT40M MIMO								
CH	Frequency (MHz)	Data Rate	Peak Output Power (dBm)		Total Peak Output Power (dBm)	Total Peak Output Power (mW)	Limit	RESULT
			CH 0	CH 1				
3	2422	MCS8	19.91	14.73	21.06	127.67	1 Watt = 29.63 dBm	PASS
6	2437	MCS8	21.64	22.04	24.85	305.84	1 Watt = 29.63 dBm	PASS
9	2452	MCS8	21.73	22.08	<b>24.92</b>	310.37	1 Watt = 29.63 dBm	PASS
802.11n_HT40M MIMO								
CH	Frequency (MHz)	Data Rate	Avg. Output Power (dBm)		Avg. Output Power (dBm)	Avg. Output Power (mW)	Limit	RESULT
			CH 0	CH 1				
3	2422	MCS8	10.62	6.65	12.08	16.16	1 Watt = 29.63 dBm	PASS
6	2437	MCS8	13.08	13.48	16.29	42.61	1 Watt = 29.63 dBm	PASS
9	2452	MCS8	13.16	13.61	<b>16.40</b>	43.66	1 Watt = 29.63 dBm	PASS

### MPE Prediction (802.11n\_HT40 2422~2452)

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

**MIMO Gain: 3.36+3.01=6.37dBi**

Max. output power including tune-up tolerancel:	<b>16.40</b>	(dBm)
Max. output power including tune-up tolerancel:	43.651583	(mW)
Duty cycle:	<b>100</b>	(%)
Maximum Pav :	43.651583	(mW)
Peak Antenna gain (Maximum):	<b>6.37</b>	(dBi)
Peak Antenna gain (linear):	4.3351088	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	<b>2452</b>	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm <sup>2</sup> )
Power density at predication frequency at 20 (cm)	0.038	(mW/cm <sup>2</sup> )

### Measurement Result

The predicted power density level at 20 cm is 0.038 mW/cm<sup>2</sup>.

This is below the uncontrolled exposure limit of 1 mW/cm<sup>2</sup> at 2452MHz.

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