



# APPENDIX I RADIO FREQUENCY EXPOSURE

## LIMIT

According to §15.407(f), U-NII devices are subject to the radio frequency radiation exposure requirements specified in §§ 1.1307(b), 2.1091 and 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

## EUT Specification

<b>EUT</b>	Data Collection PC				
<b>Frequency band (Operating)</b>	<input type="checkbox"/> WLAN: 2412 MHz ~ 2462 MHz <input checked="" type="checkbox"/> WLAN: 5150 MHz ~ 5350 MHz <input checked="" type="checkbox"/> WLAN: 5500 MHz ~ 5700 MHz <input checked="" type="checkbox"/> WLAN: 5725 MHz ~ 5850 MHz				
<b>Device category</b>	<input type="checkbox"/> Portable (<20cm separation) <input checked="" type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others:				
<b>Exposure classification</b>	General Population/Uncontrolled exposure ( $S=1mW/cm^2$ )				
<b>Antenna diversity</b>	<input type="checkbox"/> Single antenna <input checked="" type="checkbox"/> Multiple antennas <input type="checkbox"/> Tx diversity <input type="checkbox"/> Rx diversity <input checked="" type="checkbox"/> Tx/Rx diversity				
<b>Max. output power</b>		<b>Mode</b>	<b>Frequency Range (MHz)</b>	<b>Output Power (dBm)</b>	<b>Output Power (mw)</b>
	UNII Band I	IEEE 802.11a	5180 – 5240	10.72	11.8032
		IEEE 802.11n HT 20 MHz	5180 – 5240	10.05	10.1158
		IEEE 802.11n HT 40 MHz	5190 ~ 5230	10.58	11.4288
	UNII Band II	IEEE 802.11a	5260 - 5320	12.14	16.3682
		IEEE 802.11n HT 20 MHz	5260 - 5320	16.30	42.6580
		IEEE 802.11n HT 40 MHz	5270 - 5310	14.75	29.8538
	UNII Band III	IEEE 802.11a	5500 - 5700	12.99	19.9067
		IEEE 802.11n HT 20 MHz	5500 – 5700	15.26	33.5738
		IEEE 802.11n HT 40 MHz	5510 - 5670	16.06	40.3645
<b>Antenna gain (Max)</b>	Antenna Gain: IEEE 802.11a: 5.36 dBi (Numeric gain: 3.43) MIMO: 5.36 dBi + 10 log (2) = 8.37 dBi (Numeric gain: 6.87)				
<b>Evaluation applied</b>	<input checked="" type="checkbox"/> MPE Evaluation* <input type="checkbox"/> SAR Evaluation <input type="checkbox"/> N/A				
<b>Remark:</b>					
1. The maximum output power is <u>16.30dBm (42.6580mW)</u> at <u>5260MHz</u> (with <u>6.69</u> numeric antenna gain.)					
2. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is <u>1.0 mW/cm<sup>2</sup></u> even if the calculation indicates that the power density would be larger.					

## TEST RESULTS

No non-compliance noted.

**Calculation**

$$\text{Given } E = \frac{\sqrt{30 \times P \times G}}{d} \quad \& \quad S = \frac{E^2}{3770}$$

Where  $E$  = Field strength in Volts / meter

$P$  = Power in Watts

$G$  = Numeric antenna gain

$d$  = Distance in meters

$S$  = Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770d^2}$$

Changing to units of mW and cm, using:

$P$  (mW) =  $P$  (W) / 1000 and

$d$  (cm) =  $d$  (m) / 100

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \text{Equation 1}$$

Where  $d$  = Distance in cm

$P$  = Power in mW

$G$  = Numeric antenna gain

$S$  = Power density in mW / cm<sup>2</sup>

**Maximum Permissible Exposure**

Substituting the MPE safe distance using  $d = 20$  cm into Equation 1:

Yields

$$S = 0.000199 \times P \times G$$

Where  $P$  = Power in mW

$G$  = Numeric antenna gain

$S$  = Power density in mW / cm<sup>2</sup>



## UNII Band I

### IEEE 802.11a mode:

EUT output power = 11.8032 mW

Numeric Antenna gain = 3.43

→ Power density = 0.0080571 mW / cm<sup>2</sup>

### IEEE 802.11n HT 20 MHz mode:

EUT output power = 10.1158 mW

Numeric Antenna gain = 6.87

→ Power density = 0.01383 mW / cm<sup>2</sup>

### IEEE 802.11n HT 40 MHz mode:

EUT output power = 11.3763mW

Numeric Antenna gain = 6.87

→ Power density = 0.015553 mW / cm<sup>2</sup>

## UNII Band II

### IEEE 802.11a mode:

EUT output power = 16.3682 mW

Numeric Antenna gain = 3.43

→ Power density = 0.011172 mW / cm<sup>2</sup>

### IEEE 802.11n HT 20 MHz mode:

EUT output power = 42.658 mW

Numeric Antenna gain = 6.87

→ Power density = 0.058319 mW / cm<sup>2</sup>

### IEEE 802.11n HT 40 MHz mode:

EUT output power = 29.8538mW

Numeric Antenna gain = 6.87

→ Power density = 0.040814 mW / cm<sup>2</sup>



### UNII Band III

#### IEEE 802.11a mode:

EUT output power = 19.9067 mW

Numeric Antenna gain = 3.43

→ Power density = 0.013588 mW / cm<sup>2</sup>

#### IEEE 802.11n HT 20 MHz mode:

EUT output power = 33.5738 mW

Numeric Antenna gain = 6.87

→ Power density = 0.045900 mW / cm<sup>2</sup>

#### IEEE 802.11n HT 40 MHz mode:

EUT output power = 40.3645 mW

Numeric Antenna gain = 6.87

→ Power density = 0.055184 mW / cm<sup>2</sup>

*(For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm<sup>2</sup> even if the calculation indicates that the power density would be larger.)*