



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

EUT	Computer				
Frequency band (Operating)	<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 type="checkbox"/> WLAN: 5725 MHz ~ 5850 MHz				
Device category	<input type="checkbox"/> Portable (<20cm separation) <input checked="" type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others: _____				
Exposure classification	General Population/Uncontrolled exposure ($S=1mW/cm^2$)				
Antenna diversity	<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				
Max. output power		Mode	Frequency Range (MHz)	Output Power (dBm)	Output Power (mW)
	UNII Band I	IEEE 802.11a	5180 – 5240	8.62	7.2778
		IEEE 802.11n HT 20 MHz	5180 – 5240	9.86	9.6828
		IEEE 802.11n HT 40 MHz	5190 ~ 5230	11.74	14.9279
	UNII Band II	IEEE 802.11a	5260 - 5320	13.11	20.4644
		IEEE 802.11n HT 20 MHz	5260 - 5320	16.21	41.7830
		IEEE 802.11n HT 40 MHz	5270 - 5310	14.94	31.1889
	UNII Band III	IEEE 802.11a	5500 - 5700	12.31	17.0216
		IEEE 802.11n HT 20 MHz	5500 – 5700	16.49	44.5656
		IEEE 802.11n HT 40 MHz	5510 - 5670	19.27	84.5279
Antenna gain (Max)	Antenna Gain: IEEE 802.11a: 1.98 dBi (Numeric gain: 1.57) MIMO: $10 \cdot \log(((10^{1.98 \text{ dBi}/20}) + 10^{(1.98 \text{ dBi}/20)})^2/2) = 4.99 \text{ dBi}$ (Numeric gain: 3.15)				
Evaluation applied	<input checked="" type="checkbox"/> MPE Evaluation* <input type="checkbox"/> SAR Evaluation <input type="checkbox"/> N/A				
Remark:					
1. The maximum output power is <u>19.27dBm (84.5279mW)</u> at <u>5670MHz</u> (with <u>3.15 numeric antenna gain.</u>) 2. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is 1.0 mW/cm^2 even if the calculation indicates that the power density would be larger.					

TEST RESULTS

No non-compliance noted.



Calculation

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

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 / cm²

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 / cm²



UNII Band I

IEEE 802.11a mode:

EUT output power = 7.2778 mW

Numeric Antenna gain = 1.57

→ Power density = 0.022738mW / cm²

IEEE 802.11n HT 20 MHz mode:

EUT output power = 9.6828 mW

Numeric Antenna gain = 3.15

→ Power density = 0.006070mW / cm²

IEEE 802.11n HT 40 MHz mode:

EUT output power = 14.9279mW

Numeric Antenna gain = 3.15

→ Power density = 0.009358mW / cm²

UNII Band II

IEEE 802.11a mode:

EUT output power = 20.4644 mW

Numeric Antenna gain = 1.57

→ Power density = 0.063937mW / cm²

IEEE 802.11n HT 20 MHz mode:

EUT output power = 41.783 mW

Numeric Antenna gain = 3.15

→ Power density = 0.026192mW / cm²

IEEE 802.11n HT 40 MHz mode:

EUT output power = 31.1889 mW

Numeric Antenna gain = 3.15

→ Power density = 0.019551mW / cm²



UNII Band III

IEEE 802.11a mode:

EUT output power = 17.0216 mW

Numeric Antenna gain = 1.57

→ Power density = 0.053181mW / cm²

IEEE 802.11n HT 20 MHz mode:

EUT output power = 44.5656 mW

Numeric Antenna gain = 3.15

→ Power density = 0.027936 mW / cm²

IEEE 802.11n HT 40 MHz mode:

EUT output power = 84.5279 mW

Numeric Antenna gain = 3.15

→ Power density = 0.052986mW / cm²

(For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm² even if the calculation indicates that the power density would be larger.)