

9. 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	Wireless 802.11N DUAL BAND MINI PCI MODULE
Frequency band (Operating)	<input type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input checked="" type="checkbox"/> WLAN: 5.15GHz ~ 5.35GHz <input type="checkbox"/> WLAN: 5.725GHz ~ 5.850GHz <input type="checkbox"/> Bluetooth: 2.402 GHz ~ 2.482 GHz <input type="checkbox"/> Others:
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	IEEE 802.11a mode: 12.11 dBm (16.26mW) draft 802.11n Standard-20 MHz Channel mode: 13.77 dBm (23.82mW) draft 802.11n Wide-40 MHz Channel mode: 13.48 dBm (22.28mW)
Antenna gain (Max)	Dipole Antenna: 1.3 dBi (Numeric gain: 1.35) PCB Antenna: -2.6 dBi (including cable loss) (Numeric gain: 0.55)
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 13.77dBm (23.82mW) at 5270MHz (with 1.35 numeric antenna gain.)
2. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is 1.0 mW/cm² 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 / 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

EUT output power = 23.82mW

Numeric Antenna gain = 1.35

\Rightarrow Power density = 0.0064 mW / 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.)

**EUT Specification**

EUT	Wireless 802.11N DUAL BAND MINI PCI MODULE
Frequency band (Operating)	<input type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input type="checkbox"/> WLAN: 5.15GHz ~ 5.35GHz <input checked="" type="checkbox"/> WLAN: 5.47GHz ~ 5.725GHz <input type="checkbox"/> WLAN: 5.725GHz ~ 5.850GHz <input type="checkbox"/> Bluetooth: 2.402 GHz ~ 2.482 GHz <input type="checkbox"/> Others: _____
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	IEEE 802.11a mode: 13.08 dBm (20.32mW)
Antenna gain (Max)	Dipole Antenna: 1.3 dBi (Numeric gain: 1.35) PCB Antenna: -2.6 dBi (including cable loss) (Numeric gain: 0.55)
Evaluation applied	<input checked="" type="checkbox"/> MPE Evaluation* <input type="checkbox"/> SAR Evaluation <input type="checkbox"/> N/A
Remark:	
3. The maximum output power is <u>13.08dBm (20.32mW)</u> at <u>5600MHz</u> (with <u>1.35 numeric antenna gain</u> .)	
4. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is <u>1.0 mW/cm²</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 / 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

EUT output power = 20.32mW

Numeric Antenna gain = 1.35

\Rightarrow Power density = 0.0055 mW / 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.)