



## APPENDIX I

### RADIO FREQUENCY EXPOSURE

#### LIMIT

According to §15.247(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

#### EUT Specification

<b>EUT</b>	Wireless 802.11N DUAL BAND MINI PCI MODULE
<b>Frequency band (Operating)</b>	<input checked="" type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input type="checkbox"/> WLAN: 5.745GHz ~ 5.825GHz <input type="checkbox"/> Others: <u>Bluetooth: 2.402GHz ~ 2.480GHz</u>
<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>	<input type="checkbox"/> Occupational/Controlled exposure (S = 5mW/cm <sup>2</sup> ) <input checked="" type="checkbox"/> General Population/Uncontrolled exposure (S=1mW/cm <sup>2</sup> )
<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>	IEEE 802.11b mode: 20.99 dBm (125.60mW) IEEE 802.11g mode: 17.88 dBm (61.38mW) draft 802.11n Standard-20 MHz Channel mode: 21.94 dBm (156.31mW) draft 802.11n Wide-40 MHz Channel mode: 23.11 dBm (204.64mW)
<b>Antenna gain (Max)</b>	Dipole Antenna / 2.4GHz: Gain: 1.8 dBi (Numeric gain: 1.51) PCB Antenna / 2.4GHz: Gain: -1.1 dBi (Numeric gain: 0.77)
<b>Evaluation applied</b>	<input checked="" type="checkbox"/> MPE Evaluation* <input type="checkbox"/> SAR Evaluation <input type="checkbox"/> N/A

#### **Remark:**

1. The maximum output power is 23.11dBm (204.64mW) at 2422MHz (with 1.51 numeric antenna gain.)
2. DTS device is not subject to routine RF evaluation; MPE estimate is used to justify the compliance.
3. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is 1.0 mW/cm<sup>2</sup> 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:

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

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = d \text{ (m)} / 100$$

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**

EUT output power = 204.64mW

Numeric Antenna gain = 1.51

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>

$$\rightarrow \text{Power density} = 0.06149 \text{ mW / cm}^2$$

(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.)



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<b>Frequency band (Operating)</b>	<input type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input checked="" type="checkbox"/> WLAN: 5.745GHz ~ 5.825GHz <input type="checkbox"/> Others: <u>Bluetooth: 2.402GHz ~ 2.480GHz</u>
<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>	<input type="checkbox"/> Occupational/Controlled exposure (S = 5mW/cm <sup>2</sup> ) <input checked="" type="checkbox"/> General Population/Uncontrolled exposure (S=1mW/cm <sup>2</sup> )
<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>	IEEE 802.11a mode: 16.41 dBm (43.75mW) draft 802.11n Standard-20 MHz Channel mode: 17.53 dBm (56.62mW) draft 802.11n Wide-40 MHz Channel mode: 17.38 dBm (54.70mW)
<b>Antenna gain (Max)</b>	Dipole Antenna /5.0GHz: 1.3 dBi (Numeric gain: 1.34) PCB Antenna / 5.0GHz: -2.6 dBi (Numeric gain: 0.54)
<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>17.53dBm (56.62mW) at 5785MHz (with 1.34 numeric antenna gain.)</u> 2. DTS device is not subject to routine RF evaluation; MPE estimate is used to justify the compliance. 3. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is 1.0 mW/cm <sup>2</sup> 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:

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

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = d \text{ (m)} / 100$$

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**

EUT output power = 56.62mW

Numeric Antenna gain = 1.34

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>

$$\rightarrow \text{Power density} = 0.0151 \text{ mW / cm}^2$$

(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.)