



## 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>                          | 802.11a/b/g/n/ac, 2T2R Wireless LAN USB2.0 Module                                                                                                                                                                                                                                                                                                                                        |        |           |
| <b>Model</b>                        | WN4505L                                                                                                                                                                                                                                                                                                                                                                                  |        |           |
| <b>RF Module</b>                    | Realtek                                                                                                                                                                                                                                                                                                                                                                                  | Model: | RTL8812AU |
| <b>Frequency band (Operating)</b>   | <input checked="" type="checkbox"/> 802.11b/g/n HT20: 2.412GHz ~ 2.462GHz<br>802.11n HT40: 2.422GHz ~ 2.452GHz<br>802.11a: 5150 ~ 5250MHz / 5725 ~ 5850MHz<br>802.11 HT20: 5150 ~ 5250MHz / 5725 ~ 5850MHz<br>802.11 HT40: 5150 ~ 5250MHz / 5725 ~ 5850MHz<br>802.11AC HT80: 5170 ~ 5330 MHz / 5490 ~ 5815 MHz<br><input type="checkbox"/> Others                                        |        |           |
| <b>Device category</b>              | <input type="checkbox"/> Portable (<20cm separation)<br><input checked="" type="checkbox"/> Mobile (>20cm separation)<br><input type="checkbox"/> Others                                                                                                                                                                                                                                 |        |           |
| <b>Exposure classification</b>      | <input type="checkbox"/> Occupational/Controlled exposure ( $S = 5\text{mW}/\text{cm}^2$ )<br><input checked="" type="checkbox"/> General Population/Uncontrolled exposure ( $S=1\text{mW}/\text{cm}^2$ )                                                                                                                                                                                |        |           |
| <b>Antenna Specification</b>        | 5GHz: Antenna Gain : 1.74 dBi (Numeric gain 1.49)<br>2.4GHz: Antenna Gain : 3.36 dBi (Numeric gain 2.17)                                                                                                                                                                                                                                                                                 |        |           |
| <b>Maximum Average output power</b> | IEEE 802.11b Mode: 17.60 dBm (57.544 mW)<br>IEEE 802.11g Mode: 17.70 dBm (58.884 mW)<br>IEEE 802.11n HT 20 Mode: 16.81 dBm (47.973 mW)<br>IEEE 802.11n HT 40 Mode: 17.14 dBm (51.761 mW)<br>IEEE 802.11a Mode: 19.60 dBm (91.201 mW)<br>IEEE 802.11n HT20 Mode: 18.15 dBm (65.313 mW)<br>IEEE 802.11n HT40 Mode: 18.14 dBm (65.163 mW)<br>IEEE 802.11ac HT80 Mode: 17.80 dBm (60.256 mW) |        |           |



|                                  |                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Maximum<br/>Tune up Power</b> | IEEE 802.11b Mode: 19.00 dBm (79.433 mW)<br>IEEE 802.11g Mode: 19.00 dBm (79.433 mW)<br>IEEE 802.11n HT 20 Mode: 18.00 dBm (63.096 mW)<br>IEEE 802.11n HT 40 Mode: 19.00 dBm (79.433 mW)<br>IEEE 802.11a Mode: 20.00 dBm (100.000 mW)<br>IEEE 802.11n HT20 Mode: 20.00 dBm (100.000 mW)<br>IEEE 802.11n HT40 Mode: 20.00 dBm (100.000 mW)<br>IEEE 802.11ac HT80 Mode: 19.50 dBm (89.125 mW) |
| <b>Evaluation applied</b>        | <input checked="" type="checkbox"/> MPE Evaluation*<br><input type="checkbox"/> SAR Evaluation<br><input type="checkbox"/> N/A                                                                                                                                                                                                                                                              |



## Revision History

| Rev. | Issue Date | Revisions     | Effect Page | Revised By  |
|------|------------|---------------|-------------|-------------|
| 00   | 2014/07/17 | Initial Issue | ALL         | Angel Cheng |



## **TEST RESULTS**

**No non-compliance noted.**

### **Calculation**

Given  $E = \frac{\sqrt{30 \times P \times G}}{d}$  &  $S = \frac{E^2}{377}$

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:

$$S = \frac{30 \times P \times G}{377d^2}$$

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

$$S = \frac{30 \times (P/1000) \times G}{377 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \textbf{Equation 1}$$

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:

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

Where  $P$  = Power in mW

$G$  = Numeric antenna gain

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

### **IEEE 802.11b mode:**

| Ch. | Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm <sup>2</sup> | Limit (mW/cm2) |
|-----|-----------|--------|-------------|--------|---------------------------------------|----------------|
| 6   | 2437      | 79.433 | 2.17        | 20     | 0.0343                                | 1              |

### **IEEE 802.11g mode:**

| Ch. | Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm <sup>2</sup> | Limit (mW/cm2) |
|-----|-----------|--------|-------------|--------|---------------------------------------|----------------|
| 6   | 2437      | 79.433 | 2.17        | 20     | 0.0343                                | 1              |

### **IEEE 802.11n HT20 mode:**

| Ch. | Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm <sup>2</sup> | Limit (mW/cm2) |
|-----|-----------|--------|-------------|--------|---------------------------------------|----------------|
| 6   | 2437      | 63.096 | 2.17        | 20     | 0.0272                                | 1              |

### **IEEE 802.11n HT40 mode:**

| Ch. | Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm <sup>2</sup> | Limit (mW/cm2) |
|-----|-----------|--------|-------------|--------|---------------------------------------|----------------|
| 9   | 2437      | 79.433 | 2.17        | 20     | 0.0343                                | 1              |

### **IEEE 802.11a mode:**

| Ch. | Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm <sup>2</sup> | Limit (mW/cm2) |
|-----|-----------|--------|-------------|--------|---------------------------------------|----------------|
| 64  | 5320      | 100    | 1.49        | 20     | 0.0297                                | 1              |

### **IEEE 802.11a HT20 mode:**

| Ch. | Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm <sup>2</sup> | Limit (mW/cm2) |
|-----|-----------|--------|-------------|--------|---------------------------------------|----------------|
| 64  | 5320      | 100    | 1.49        | 20     | 0.0297                                | 1              |

### **IEEE 802.11a HT40 mode:**

| Ch. | Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm <sup>2</sup> | Limit (mW/cm2) |
|-----|-----------|--------|-------------|--------|---------------------------------------|----------------|
| 110 | 5550      | 100    | 1.49        | 20     | 0.0297                                | 1              |

### **IEEE 802.11ac HT80 mode:**

| Ch. | Frq.(MHz) | P (mW) | Gain (num.) | D (cm) | Power density in mW / cm <sup>2</sup> | Limit (mW/cm2) |
|-----|-----------|--------|-------------|--------|---------------------------------------|----------------|
| 106 | 5530      | 89.125 | 1.49        | 20     | 0.0264                                | 1              |