



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

EUT	802.11n, Dual Band 2T2R Wireless LAN USB Module
Model	WN4516R
Trade Name	LITE-ON
Frequency band (Operating)	☒ Bluetooth 2.1 + EDR / 4.0: 2402 ~ 2480 MHz 802.11b/g/n HT20: 2.412GHz ~ 2.462GHz 802.11n HT40: 2.422GHz ~ 2.452GHz 802.11a: 5150 ~ 5250MHz / 5725 ~ 5850MHz 802.11 HT20: 5150 ~ 5250MHz / 5725 ~ 5850MHz 802.11 HT40: 5150 ~ 5250MHz / 5725 ~ 5850MHz 802.11AC HT80: 5170 ~ 5330 MHz / 5490 ~ 5815 MHz ☐ Others
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation) ☐ Others
Exposure classification	☐ Occupational/Controlled exposure ($S = 5\text{mW}/\text{cm}^2$) ☒ General Population/Uncontrolled exposure ($S=1\text{mW}/\text{cm}^2$)
Antenna Specification	5GHz: Antenna Gain : 4.60 dBi (Numeric gain 2.88) 2.4GHz: Antenna Gain : 2.20 dBi (Numeric gain 1.66)
Maximum Average output power	IEEE 802.11b Mode: 15.95 dBm (39.355 mW) IEEE 802.11g Mode: 15.48 dBm (35.318 mW) IEEE 802.11n HT 20 Mode 18.20 dBm (66.069 mW) IEEE 802.11n HT 40 Mode 13.99 dBm (25.061 mW) IEEE 802.11a Mode: 15.27 dBm (33.651 mW) IEEE 802.11n HT20 Mode: 18.25 dBm (66.834 mW) IEEE 802.11n HT40 Mode: 18.19 dBm (65.917 mW)



Maximum Tune up Power	IEEE 802.11b Mode: 17.50 dBm (56.234 mW) IEEE 802.11g Mode: 17.00 dBm (50.119 mW) IEEE 802.11n HT 20 Mode 20.00 dBm (100.000 mW) IEEE 802.11n HT 40 Mode 15.50 dBm (35.481 mW) IEEE 802.11a Mode: 17.00 dBm (50.119 mW) IEEE 802.11n HT20 Mode: 20.00 dBm (100.000 mW) IEEE 802.11n HT40 Mode: 20.00 dBm (100.000 mW)
Evaluation applied	☒ MPE Evaluation* ☐ SAR Evaluation ☐ N/A



Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	2015/02/12	Initial Issue	ALL	Doris Chu



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:

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

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

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

Where d = Distance in cm

P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²

**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 / cm²

IEEE 802.11b mode:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm ²	Limit (mW/cm2)
11	2462	56.234	1.66	20	0.0186	1

IEEE 802.11g mode:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm ²	Limit (mW/cm2)
6	2437	50.119	1.66	20	0.0166	1

IEEE 802.11n HT20 mode:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm ²	Limit (mW/cm2)
11	2462	100	1.66	20	0.0330	1

IEEE 802.11n HT40 mode:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm ²	Limit (mW/cm2)
6	2437	35.481	1.66	20	0.0117	1

IEEE 802.11a mode:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm ²	Limit (mW/cm2)
116	5580	50.119	2.88	20	0.0287	1

IEEE 802.11a HT20 mode:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm ²	Limit (mW/cm2)
48	5240	100	2.88	20	0.0573	1

IEEE 802.11a HT40 mode:

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm ²	Limit (mW/cm2)
134	5670	100	2.88	20	0.0573	1