



RF EXPOSURE REPORT

REPORT NO.: SA970915L09

MODEL NO.: WRT400N

ACCORDING: FCC Guidelines for Human Exposure
IEEE C95.1

APPLICANT: Cisco-Linksys LLC

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ISSUED BY: Bureau Veritas Consumer Products Services
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RF EXPOSURE MEASUREMENT (MOBILE DEVICE)

1. INTRODUCTION

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The Gain of the antenna used in this product is measured in a Fully Anechoic Chamber (FAC) calibrated for antenna measurement in ADT, and also the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

2. RF EXPOSURE LIMIT

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

| FREQUENCY RANGE (MHz) | ELECTRIC FIELD STRENGTH (V/m) | MAGNETIC FIELD STRENGTH (A/m) | POWER DENSITY (mW/cm ²) | AVERAGE TIME (minutes) |
|---|-------------------------------|-------------------------------|-------------------------------------|------------------------|
| (A)LIMITS FOR OCCUPATIONAL / CONTROL EXPOSURES | | | | |
| 300-1500 | ... | ... | F/300 | 6 |
| 1500-100,000 | ... | ... | 5 | 6 |
| (B)LIMITS FOR GENERAL POPULATION / UNCONTROLLED EXPOSURE | | | | |
| 300-1500 | ... | ... | F/1500 | 30 |
| 1500-100,000 | ... | ... | 1.0 | 30 |

F = Frequency in MHz



3. FRIIS FORMULA

Friis transmission formula : $P_d = (P_{out} * G) / (4 * \pi * r^2)$

where

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

R = distance between observation point and center of the radiator in cm

If we know the maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the MPE value at distance r .

Ref.: David K. Cheng, *Field and Wave Electromagnetics*, Second Edition,

Page 640, Eq. (11-133).

4. EUT OPERATING CONDITION

The software provided by Manufacturer enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

5. CLASSIFICATION

The antenna of this product, under normal use condition, is at least 20cm away from the body of the user. Warning statement to the user for keeping at least 20cm or more separation distance with the antenna should be included in users manual. So, this device is classified as **Mobile Device**.



6. TEST RESULTS

6.1 ANTENNA GAIN

The maximum Gain measured in Fully Anechoic Chamber is listed as below.

| Frequency Band (MHz) | Antenna Location | Maximum Gain |
|----------------------|------------------|------------------------------|
| 2400~2483.5 | Left front | 1.75 dBi or 1.49624(numeric) |
| | Right rear | 4.19 dBi or 2.62422(numeric) |
| 5150~5250 | Left rear | 2.93 dBi or 1.96336(numeric) |
| | Right front | 3.25 dBi or 2.11349(numeric) |
| 5725~5825 | Left rear | 4.35 dBi or 2.72270(numeric) |
| | Right front | 3.44 dBi or 2.20800(numeric) |

6.2 OUTPUT POWER INTO ANTENNA & RF EXPOSURE VALUE AT DISTANCE 20cm:

For 2.400 ~ 2.4385GHz band:

802.11b DSSS MODULATION:

| CHAN. | CHAN. FREQ. (MHz) | PEAK POWER OUTPUT (dBm) | | TOTAL PEAK POWER (mW) | TOTAL PEAK POWER (dBm) | POWER DENSITY (mW/CM ²) | LIMIT OF POWER DENSITY (mW/CM ²) |
|-------|-------------------|-------------------------|---------|-----------------------|------------------------|-------------------------------------|--|
| | | CHAIN 0 | CHAIN 1 | | | | |
| 1 | 2412 | 21.06 | 20.59 | 242.195 | 23.84 | 0.10074 | 1.000 |
| 6 | 2437 | 20.62 | 20.11 | 217.911 | 23.38 | 0.09075 | 1.000 |
| 11 | 2462 | 20.54 | 20.57 | 227.265 | 23.57 | 0.09306 | 1.000 |

802.11g OFDM MODULATION:

| CHAN. | CHAN. FREQ. (MHz) | PEAK POWER OUTPUT (dBm) | | TOTAL PEAK POWER (mW) | TOTAL PEAK POWER (dBm) | POWER DENSITY (mW/CM ²) | LIMIT OF POWER DENSITY (mW/CM ²) |
|-------|-------------------|-------------------------|---------|-----------------------|------------------------|-------------------------------------|--|
| | | CHAIN 0 | CHAIN 1 | | | | |
| 1 | 2412 | 23.03 | 23.11 | 405.554 | 26.08 | 0.16580 | 1.000 |
| 6 | 2437 | 23.09 | 23.08 | 406.940 | 26.10 | 0.16684 | 1.000 |
| 11 | 2462 | 22.55 | 22.58 | 361.021 | 25.58 | 0.14783 | 1.000 |

DRAFT 802.11n (20MHz) OFDM MODULATION:

| CHAN. | CHAN. FREQ. (MHz) | PEAK POWER OUTPUT (dBm) | | TOTAL PEAK POWER (mW) | TOTAL PEAK POWER (dBm) | POWER DENSITY (mW/CM ²) | LIMIT OF POWER DENSITY (mW/CM ²) |
|-------|-------------------|-------------------------|---------|-----------------------|------------------------|-------------------------------------|--|
| | | CHAIN 0 | CHAIN 1 | | | | |
| 1 | 2412 | 22.05 | 22.08 | 321.760 | 25.08 | 0.13175 | 1.000 |
| 6 | 2437 | 23.09 | 23.05 | 405.541 | 26.08 | 0.16643 | 1.000 |
| 11 | 2462 | 22.03 | 22.02 | 318.809 | 25.04 | 0.13071 | 1.000 |

**DRAFT 802.11n (40MHz) OFDM MODULATION:**

| CHAN. | CHAN. FREQ. (MHz) | PEAK POWER OUTPUT (dBm) | | TOTAL PEAK POWER (mW) | TOTAL PEAK POWER (dBm) | POWER DENSITY (mW/CM ²) | LIMIT OF POWER DENSITY (mW/CM ²) |
|-------|-------------------|-------------------------|---------|-----------------------|------------------------|-------------------------------------|--|
| | | CHAIN 0 | CHAIN 1 | | | | |
| 1 | 2422 | 20.03 | 20.57 | 214.718 | 23.32 | 0.08651 | 1.000 |
| 4 | 2437 | 21.06 | 21.03 | 254.409 | 24.06 | 0.10437 | 1.000 |
| 7 | 2452 | 19.58 | 19.51 | 180.113 | 22.56 | 0.07399 | 1.000 |

For 5.150 ~ 5.250GHz band:**802.11a OFDM MODULATION:**

| CHAN. | CHAN. FREQ. (MHz) | PEAK POWER OUTPUT (dBm) | | TOTAL PEAK POWER (mW) | TOTAL PEAK POWER (dBm) | POWER DENSITY (mW/CM ²) | LIMIT OF POWER DENSITY (mW/CM ²) |
|-------|-------------------|-------------------------|---------|-----------------------|------------------------|-------------------------------------|--|
| | | CHAIN 0 | CHAIN 1 | | | | |
| 36 | 5180 | 13.56 | 12.55 | 40.687 | 16.09 | 0.01653 | 1.000 |
| 40 | 5200 | 13.61 | 12.57 | 41.033 | 16.13 | 0.01667 | 1.000 |
| 48 | 5240 | 13.52 | 12.52 | 40.355 | 16.06 | 0.01639 | 1.000 |

DRAFT 802.11n (20MHz) OFDM MODULATION:

| CHAN. | CHAN. FREQ. (MHz) | PEAK POWER OUTPUT (dBm) | | TOTAL PEAK POWER (mW) | TOTAL PEAK POWER (dBm) | POWER DENSITY (mW/CM ²) | LIMIT OF POWER DENSITY (mW/CM ²) |
|-------|-------------------|-------------------------|---------|-----------------------|------------------------|-------------------------------------|--|
| | | CHAIN 0 | CHAIN 1 | | | | |
| 36 | 5180 | 13.54 | 12.55 | 40.583 | 16.08 | 0.01648 | 1.000 |
| 40 | 5200 | 13.57 | 12.56 | 40.781 | 16.10 | 0.01656 | 1.000 |
| 48 | 5240 | 13.55 | 12.52 | 40.511 | 16.08 | 0.01646 | 1.000 |

DRAFT 802.11n (40MHz) OFDM MODULATION:

| CHAN. | CHAN. FREQ. (MHz) | PEAK POWER OUTPUT (dBm) | | TOTAL PEAK POWER (mW) | TOTAL PEAK POWER (dBm) | POWER DENSITY (mW/CM ²) | LIMIT OF POWER DENSITY (mW/CM ²) |
|-------|-------------------|-------------------------|---------|-----------------------|------------------------|-------------------------------------|--|
| | | CHAIN 0 | CHAIN 1 | | | | |
| 38 | 5190 | 13.51 | 12.53 | 40.345 | 16.06 | 0.01639 | 1.000 |
| 46 | 5230 | 13.54 | 12.56 | 40.625 | 16.09 | 0.01650 | 1.000 |



For 5.725 ~ 5.850GHz band:

802.11a OFDM MODULATION:

| CHAN. | CHAN. FREQ. (MHz) | PEAK POWER OUTPUT (dBm) | | TOTAL PEAK POWER (mW) | TOTAL PEAK POWER (dBm) | POWER DENSITY (mW/CM ²) | LIMIT OF POWER DENSITY (mW/CM ²) |
|-------|-------------------|-------------------------|---------|-----------------------|------------------------|-------------------------------------|--|
| | | CHAIN 0 | CHAIN 1 | | | | |
| 149 | 5745 | 23.54 | 25.07 | 547.310 | 27.38 | 0.27332 | 1.000 |
| 157 | 5785 | 23.59 | 24.62 | 518.294 | 27.15 | 0.25734 | 1.000 |
| 165 | 5825 | 22.06 | 23.04 | 362.067 | 25.59 | 0.17966 | 1.000 |

DRAFT 802.11n (20MHz) OFDM MODULATION:

| CHAN. | CHAN. FREQ. (MHz) | PEAK POWER OUTPUT (dBm) | | TOTAL PEAK POWER (mW) | TOTAL PEAK POWER (dBm) | POWER DENSITY (mW/CM ²) | LIMIT OF POWER DENSITY (mW/CM ²) |
|-------|-------------------|-------------------------|---------|-----------------------|------------------------|-------------------------------------|--|
| | | CHAIN 0 | CHAIN 1 | | | | |
| 149 | 5745 | 23.57 | 25.06 | 548.137 | 27.39 | 0.27361 | 1.000 |
| 157 | 5785 | 23.53 | 24.52 | 508.563 | 27.06 | 0.25239 | 1.000 |
| 165 | 5825 | 22.09 | 23.08 | 365.044 | 25.62 | 0.18116 | 1.000 |

DRAFT 802.11n (40MHz) OFDM MODULATION:

| CHAN. | CHAN. FREQ. (MHz) | PEAK POWER OUTPUT (dBm) | | TOTAL PEAK POWER (mW) | TOTAL PEAK POWER (dBm) | POWER DENSITY (mW/CM ²) | LIMIT OF POWER DENSITY (mW/CM ²) |
|-------|-------------------|-------------------------|---------|-----------------------|------------------------|-------------------------------------|--|
| | | CHAIN 0 | CHAIN 1 | | | | |
| 151 | 5755 | 24.08 | 25.08 | 577.965 | 27.62 | 0.28686 | 1.000 |
| 159 | 5795 | 24.03 | 25.05 | 572.819 | 27.58 | 0.28438 | 1.000 |

CONCLUSION:

The EUT can transmit 2.4GHz & 5.0GHz simultaneously, the formula of calculated the MPE is:

$$CPD1 / LPD1 + CPD2 / LPD2 + \dots \text{etc.} < 1$$

CPD = Calculation power density

LPD = Limit of power density

$$\text{Maximum MPE of WLAN 2.4G} + \text{Maximum MPE of WLAN 5.0G} = 0.16684 + 0.28686 = 0.4537$$

Therefore, the maximum calculation of this situation is 0.4537, which is less than the "1" limit.