



# RF EXPOSURE REPORT

**REPORT NO.:** SA970423H02

**MODEL NO.:** WRT610N

**ACCORDING:** FCC Guidelines for Human Exposure  
IEEE C95.1

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# RF Exposure Measurement

## 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 <sup>2</sup> )	Average Time (minutes)
<b>(A)Limits For Occupational / Control Exposures</b>				
300-1500	...	...	F/300	6
1500-100,000	...	...	5	6
<b>(B)Limits For General Population / Uncontrolled Exposure</b>				
300-1500	...	...	F/1500	6
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  $mW/cm^2$

$P_{out}$  = output power to antenna in mW

$G$  = gain of antenna in linear scale

$\pi$  = 3.1416

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

$P_d$  is the limit of MPE,  $1 mW/cm^2$ . 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 20cm.

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

1. There three antennas provided to this EUT, please refer to the following table:

Transmitter Circuit	Antenna Type	For 2.4GHz Gain (dBi)	For 5GHz Gain (dBi)	Antenna Connector	Note
Chain(0)	PIFA	0.75	3	NA	TX & RX function
Chain(1)	PIFA	1.5	2.23	NA	TX & RX function
Chain(2)	PIFA	3.5	2.5	NA	Only RX function

### 6.2 Output Power Into Antenna & RF Exposure value at distance 20cm:

**For 15.247(2.4GHz) :**

**For Part 802.11b:**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2412	47.863	0.013	1.0
6	2437	63.096	0.018	1.0
11	2462	66.069	0.019	1.0

**For Part 802.11g:**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2412	113.778	0.032	1.0
6	2437	117.800	0.033	1.0
11	2462	89.336	0.025	1.0

#### **DRAFT 802.11n (20MHz) OFDM**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2412	111.188	0.031	1.0
6	2437	117.768	0.033	1.0
11	2462	90.377	0.025	1.0

#### **DRAFT 802.11n (40MHz) OFDM**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	2422	70.962	0.020	1.0
4	2437	113.778	0.032	1.0
7	2452	78.966	0.022	1.0



**For 15.247(5GHz) :**

**For Part 802.11a:**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	5745	123.352	0.049	1.0
3	5785	121.916	0.048	1.0
4	5805	123.352	0.049	1.0

**For DRAFT 802.11n (20MHz) OFDM:**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	5745	59.040	0.023	1.0
3	5785	77.810	0.031	1.0
4	5805	59.743	0.024	1.0

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

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	5755	70.267	0.028	1.0
3	5795	69.421	0.028	1.0

**For 15.407(5GHz) :**

**For Part 802.11a:**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	5180	28.746	0.011	1.0
2	5200	29.076	0.012	1.0
4	5240	27.073	0.011	1.0

**For DRAFT 802.11n (20MHz) OFDM:**

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	5180	17.755	0.007	1.0
2	5200	17.303	0.007	1.0
4	5240	21.611	0.009	1.0

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

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
1	5190	32.431	0.824	1.0
2	5230	30.563	0.776	1.0

**CONCLUSION:**

Both of the 11g and 11a can transmit simultaneously, the formula of calculated the MPE is:

$$CPD_1 / LPD_1 + CPD_2 / LPD_2 + \dots \text{etc.} < 1$$

**CPD = Calculation power density**

**LPD = Limit of power density**

Therefore, the calculation of this situation is  $0.033 / 1 + 0.824 / 1 = 0.857$ , which is less than the "1" limit.