



# RF EXPOSURE REPORT

**REPORT NO.:** SA990810E05B

**MODEL NO.:** 2050X

**FCC ID:** TC22050X

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

**APPLICANT:** Roku, LLC

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**ISSUED BY:** Bureau Veritas Consumer Products Services  
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**TEST LOCATION (1):** No. 81-1, Lu Liao Keng, 9th Ling,Wu Lung Tsuen,  
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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 our lab, 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	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  $mW/cm^2$

$P_{out}$  = 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. So, this device is classified as **Mobile Device**

## 6. TEST RESULTS

### 6.1 Antenna Gain

There are two antennas provided to this EUT, please refer to the following table:

Chain	Antenna Type	Antenna Connector	Antenna Gain (dBi)
Chain (0)	PCB Printed	NA	3
Chain (1)	PCB Printed	NA	3

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

### 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	229.1	0.091	1.0
6	2437	363.1	0.144	1.0
11	2462	204.2	0.081	1.0

### 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	260.8	0.104	1.0
6	2437	622.2	0.247	1.0
11	2462	279.3	0.111	1.0

### 802.11n (20MHz):

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	216.8	0.086	1.0
6	2437	628.6	0.250	1.0
11	2462	240.5	0.095	1.0

### 802.11n (40MHz):

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	202.3	0.080	1.0
4	2437	590.4	0.234	1.0
7	2452	221.9	0.088	1.0

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