

# RF Exposure Evaluation Declaration

Product Name : IP-STB  
Model No. : 3600X  
FCC ID : TC2-RCB8

Applicant : Roku Inc.

Address : 12980 Saratoga Ave, Suite D Saratoga, CA 95070

Date of Receipt : Dec. 25, 2015

Issued Date : Jan.19 , 2016

Report No. : 15C2073R-RF-US-P20V01

Report Version : V1.0

The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration of the equipment and evaluated measurement uncertainty herein.

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## Test Report Certification

Issued Date : Jan. 19, 2016

Report No. : 15C2073R-RF-US-P20V01



Product Name : IP-STB  
Applicant : Roku Inc.  
Address : 12980 Saratoga Ave, Suite D Saratoga, CA 95070  
Manufacturer : Ambit Mircosystems (Shanghai) LTD.  
Address : 1925, Nanle Road, Songjiang Export Processing Zone,  
Shanghai, China 201613  
Model No. : 3600X  
FCC ID : TC2-RCB8  
EUT Voltage : DC 5V  
Brand Name : Roku  
Applicable Standard : KDB 447498D01V06V02  
FCC Part1.1310(b)  
Test Result : Complied  
Performed Location : Suzhou EMC Laboratory  
No.99 Hongye Rd., Suzhou Industrial Park, Suzhou,  
215006, Jiangsu, China  
TEL: +86-512-6251-5088 / FAX: +86-512-6251-5098  
FCC Registration Number: 800392

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## Laboratory Information

We, **Quietek Corporation**, are an independent EMC and safety consultancy that was established the whole facility in our laboratories. The test facility has been accredited/accepted(audited or listed) by the following related bodies in compliance with ISO 17025, EN 45001 and specified testing scope:

|                      |          |                       |
|----------------------|----------|-----------------------|
| <b>Taiwan R.O.C.</b> | <b>:</b> | <b>BSMI, NCC, TAF</b> |
| <b>USA</b>           | <b>:</b> | <b>FCC</b>            |
| <b>Japan</b>         | <b>:</b> | <b>VCCI</b>           |
| <b>China</b>         | <b>:</b> | <b>CNAS</b>           |

The related certificate for our laboratories about the test site and management system can be downloaded from Quietek Corporation's Web Site : <http://www.quietek.com/english/about/certificates.aspx?bval=5>  
The address and introduction of Quietek Corporation's laboratories can be founded in our Web site : [http://www.quietek.com/index\\_en.aspx](http://www.quietek.com/index_en.aspx)

If you have any comments, Please don't hesitate to contact us. Our contact information is as below:

### **HsinChu Testing Laboratory :**

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### **LinKou Testing Laboratory :**

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TEL : +86-512-6251-5088 / FAX : 86-512-6251-5098 E-Mail : [service@quietek.com](mailto:service@quietek.com)

## History of This Test Report

| REPORT NO.            | VERSION | DESCRIPTION           | ISSUED DATE   |
|-----------------------|---------|-----------------------|---------------|
| 15C2073R-RF-US-P20V01 | V1.0    | Initial Issued Report | Jan. 19, 2016 |
|                       |         |                       |               |
|                       |         |                       |               |
|                       |         |                       |               |

## 1. RF Exposure Evaluation

### 1.1. Limits

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment 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) |
|-----------------------------------------------------------|-------------------------------|-------------------------------|-------------------------------------|------------------------|
| (A) Limits for Occupational/ Control Exposures            |                               |                               |                                     |                        |
| 300-1500                                                  | --                            | --                            | F/300                               | 6                      |
| 1500-100,000                                              | --                            | --                            | 5                                   | 6                      |
| (B) Limits for General Population/ Uncontrolled Exposures |                               |                               |                                     |                        |
| 300-1500                                                  | --                            | --                            | F/1500                              | 6                      |
| 1500-100,000                                              | --                            | --                            | 1                                   | 30                     |

F= Frequency in MHz

Friis Formula

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

Where

$P_d$  = power density in mW/cm<sup>2</sup>

$P_{out}$  = 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<sup>2</sup>. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

## 1.2. Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

The temperature and related humidity: 18°C and 78% RH.

## 1.3. Test Result of RF Exposure Evaluation

|           |   |                        |
|-----------|---|------------------------|
| Product   | : | IP-STB                 |
| Test Item | : | RF Exposure Evaluation |
| Test Site | : | AC-6                   |

### ● Antenna Gain:

| Antenna No. | Manufacturer        | Model No.           | Peak Gain                              | Directional Gain   |
|-------------|---------------------|---------------------|----------------------------------------|--------------------|
| Antenna 1   | TDK-EPC Corporation | ANT016008LCD2442MA1 | 2.38dBi for 2.4GHz<br>5.54dBi for 5GHz | 5.39dBi for 2.4GHz |
| Antenna 2   | TDK-EPC Corporation | ANT016008LCD2442MA1 | 2.38dBi for 2.4GHz<br>5.54dBi for 5GHz | 8.55dBi for 5GHz   |

Not: Directional gain =  $G_{ANT} + 10 \log(N_{ANT})$  dBi

Note: 1: The EUT has two WIFI antennas, and each port has same gain, they transmit signals are correlated with each other.

(1) 2.4G WIFI Directional gain for Calculation is:

$$\text{Directional gain} = G_{ANT} + \text{Array Gain} \approx 5.39\text{dBi}$$

(2) 5G WIFI Directional gain for Calculation is:

$$\text{Directional gain} = G_{ANT} + \text{Array Gain} \approx 8.55\text{dBi}$$

- Output Power into Antenna & RF Exposure Evaluation Distance:

### Standalone modes

#### 2.4GHz:

| Test Mode      | Frequency Band (MHz) | Maximum Output Power to Antenna (dBm) | Antenna Gain (dBi) | Power Density at R = 20 cm (mW/cm <sup>2</sup> ) |
|----------------|----------------------|---------------------------------------|--------------------|--------------------------------------------------|
| 802.11b        | 2412 - 2462          | 21.85                                 | 2.38               | 0.052690                                         |
| 802.11g        | 2412 - 2462          | 21.74                                 | 2.38               | 0.051372                                         |
| 802.11n(20MHz) | 2412 - 2462          | 21.95                                 | 2.38               | 0.053918                                         |
| 802.11n(40MHz) | 2422 - 2452          | 24.61                                 | 5.39               | 0.198944                                         |

#### 5GHz:

| Test Mode      | Frequency Band (MHz) | Maximum Output Power to Antenna (dBm) | Antenna Gain (dBi) | Power Density at R = 20 cm (mW/cm <sup>2</sup> ) |
|----------------|----------------------|---------------------------------------|--------------------|--------------------------------------------------|
| 802.11a        | 5180 - 5240          | 16.48                                 | 5.54               | 0.031676                                         |
|                | 5745 - 5825          | 15.95                                 | 5.54               | 0.028037                                         |
| 802.11n(20MHz) | 5180 - 5240          | 18.23                                 | 8.55               | 0.094783                                         |
|                | 5745 - 5825          | 17.52                                 | 8.55               | 0.080488                                         |
| 802.11n(40MHz) | 5190 - 5230          | 19.39                                 | 8.55               | 0.123803                                         |
|                | 5755 - 5795          | 15.83                                 | 8.55               | 0.054542                                         |

**Simultaneous transmission:**

| Test Mode                               | Frequency Band (MHz) | Maximum Output Power to Antenna (dBm) | Antenna Gain (dBi) | Power Density at R = 20 cm (mW/cm <sup>2</sup> ) |
|-----------------------------------------|----------------------|---------------------------------------|--------------------|--------------------------------------------------|
| 802.11n(40MHz)                          | 2422 - 2452          | 24.61                                 | 5.39               | 0.053918                                         |
| 802.11n(40MHz)                          | 5190 - 5230          | 19.39                                 | 8.55               | 0.123803                                         |
| Simultaneous transmission power density |                      |                                       |                    | 0.177721                                         |

So according to transmission formula:  $P_d = (P_{out} * G) / (4 * \pi * r^2)$  and the power density limit according to KDB 447498D01V06V02 and FCC Part1.1310(b), the limit is 1mW/cm<sup>2</sup>

**Safety Distance Calculation Formula:**

The power flux:

$$S = \frac{P * G_{(\theta, \phi)}}{4 * \pi * r^2}$$

So safety distance as following:

$$r = \sqrt{\frac{P * G}{4 * \pi * S}}$$

P = input power of the antenna

G = antenna gain relative to an isotropic antenna

$\theta, \phi$  = elevation and azimuth angles.

r = distance from the antenna to the point of investigation

| Test Mode      | Frequency Range (MHz) | Maximum EIRP (dBm) | Limit of Power Density S(mW/cm <sup>2</sup> ) | Safety Distance r(cm) |
|----------------|-----------------------|--------------------|-----------------------------------------------|-----------------------|
| 802.11n(40MHz) | 2422 - 2452           | 30.00              | 1                                             | 11.36                 |
| 802.11n(40MHz) | 5190 - 5230           | 27.94              | 1                                             |                       |

Note: The safety distance is 11.36cm for the router without any other radio equipment.

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