Roku Inc. FCC ID: TC2-R1031

# 4 FCC §2.1091 & §15.407(f) - RF Exposure

## 4.1 Applicable Standards

According to FCC §15.407(f) and §1.1307(b)(1), 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 level in excess of the Commission's guidelines.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (minutes)				
Limits for General Population/Uncontrolled Exposure								
0.3-1.34	614	1.63	* (100)	30				
1.34-30	824/f	2.19/f	$*(180/f^2)$	30				
30-300	27.5	0.073	0.2	30				
300-1500	/	/	f/1500	30				
1500-100,000	/	/	1.0	30				

f = frequency in MHz

## **4.2** MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

<sup>\* =</sup> Plane-wave equivalent power density

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#### 4.3 **MPE Results**

### Radio 1

#### 5 GHz Wi-Fi

Maximum output power at antenna input terminal (dBm): 21.91 Tuned up maximum output power at antenna input terminal (dBm): 22.91 Tuned up maximum output power at antenna input terminal (mW): 195.4339 Prediction distance (cm): 20 Prediction frequency (MHz): 5745 Maximum Antenna Gain, typical (dBi): 2.6 Maximum Antenna Gain (numeric): 1.82 0.0708 Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>): FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>): 1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0708 mW/cm<sup>2</sup>. Limit is 1.0 mW/cm<sup>2</sup>.

### 2.4 GHz Wi-Fi

Maximum peak output power at antenna input terminal (dBm): 22.47 Tuned up maximum output power at antenna input terminal (dBm): 23.47 Tuned up maximum output power at antenna input terminal (mW): 222.331 Prediction distance (cm): 20 Prediction frequency (MHz): 2437 Maximum Antenna Gain, typical (dBi): 1.8 Maximum Antenna Gain (numeric): 1.51 Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>): 0.0670 FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>): 1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0670 mW/cm<sup>2</sup>. Limit is 1.0 mW/cm<sup>2</sup>.

#### Radio 2

#### 5 GHz Wi-Fi

Maximum output power at antenna input terminal (dBm):				
Tuned up maximum output power at antenna input terminal (dBm):	20.18			
Tuned up maximum output power at antenna input terminal (mW):	104.232			
Prediction distance (cm):	<u>20</u>			
<u>Prediction frequency (MHz):</u>	<u>5745</u>			
Maximum Antenna Gain, typical (dBi):	<u>2.6</u>			
Maximum Antenna Gain (numeric):	1.82			
Power density of prediction frequency at 20.0 cm (mW/cm <sup>2</sup> ):	0.0378			
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm <sup>2</sup> ):	<u>1.0</u>			

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The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0378 mW/cm<sup>2</sup>. Limit is 1.0 mW/cm<sup>2</sup>.

### 2.4 GHz Wi-Fi

Maximum peak output power at antenna input terminal (dBm): 22.02 Tuned up maximum output power at antenna input terminal (dBm): 23.02 Tuned up maximum output power at antenna input terminal (mW): 200.45 Prediction distance (cm): 20 Prediction frequency (MHz): 2412 Maximum Antenna Gain, typical (dBi): 1.8 Maximum Antenna Gain (numeric): 1.51 Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>): 0.0604 FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>): 1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0604 mW/cm<sup>2</sup>. Limit is 1.0 mW/cm<sup>2</sup>.

### 2.4 GHz Classic Bluetooth

Maximum peak output power at antenna input terminal (dBm): 12.81 Tuned up maximum output power at antenna input terminal (dBm): 13.81 Tuned up maximum output power at antenna input terminal (mW): 24.04 Prediction distance (cm): 20 Prediction frequency (MHz): 2402 Maximum Antenna Gain, typical (dBi): 1.8 Maximum Antenna Gain (numeric): 1.51 Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>): 0.00724 FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>): 1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.00724mW/cm<sup>2</sup>. Limit is 1.0 mW/cm<sup>2</sup>.

## Worst case colocation Radio 1 5 GHz Wi-Fi, Radio 2 2.4 GHz Wi-Fi and 2.4 GHz Classic Bluetooth:

Frequency Band	Tuned up Max Conducted Power(dBm)	Evaluated Distance (cm)	Worst- Case MPE (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Worst- Case MPE Ratios	Sum of MPE Ratios	Limit		
Worst Case									
Radio 1 5 GHz WiFi	22.91	20	0.0708	1.0	7.08%	13.844%	100%		
Radio 2 2.4 GHz WiFi	23.02	20	0.0604	1.0	6.04%				
2.4 GHz Classic BT	13.81	20	0.00724	1.0	0.724%				