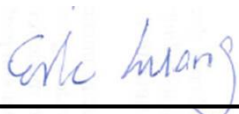


# RF Exposure Evaluation Report

APPLICANT : Nest Labs Inc.  
EQUIPMENT : Nest Hello  
MODEL NAME : A0077  
FCC ID : ZQANC51  
STANDARD : 47 CFR Part 2.1091

We, SPORTON INTERNATIONAL INC., would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091, and pass the limit. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.



Reviewed by: Eric Huang / Manager



Approved by: Jones Tsai / Manager



## SPORTON INTERNATIONAL INC.

No.52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Taoyuan City, Taiwan (R.O.C.)



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**Revision History**

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA733120-01	Rev. 01	Initial issue of report	Oct. 31, 2017
FA733120-01	Rev. 02	1. Revised the 15.4 frequency range. 2. Revised typo on section 5.1.	Nov. 06, 2017
FA733120-01	Rev. 03	Revised section 5.2.	Nov. 07, 2017
FA733120-01	Rev. 04	Revised section 5.1 & 5.2	Nov. 09, 2017



## **1. Administration Data**

### **1.1. Testing Laboratory**

Testing Laboratory	
Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978

Applicant	
Company Name	Nest Labs Inc.
Address	3400 Hillview Ave.Palo Alto, CA 94304 USA

## **2. Description of Equipment Under Test (EUT)**

Product Feature & Specification	
EUT Type	Nest Hello
Model Name	A0077
FCC ID	ZQANC51
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz 15.4: 2405 MHz ~ 2475 MHz
Mode	802.11a/b/g/n/ac HT20/HT40/VHT20/VHT40/VHT80 Bluetooth LE 15.4: BPSK
HW Version	A4

**Remark:** The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

**3. Maximum RF average output power among production units**

## &lt;Bluetooth&gt;

Mode / Band	Average Power (dBm)	Tune- up Limit (dBm)
	LE	
2.4 GHz Bluetooth	9.17	9.5

## &lt;15.4&gt;

Mode / Band	Average Power (dBm)	Tune- up Limit (dBm)
	BPSK	
2.4 GHz 15.4	20.6	21.0

**<WLAN (SISO)>**

2.4 GHz WLAN				
Mode	Average Power (dBm)		Tune- up Limit (dBm)	
	Ant 1	Ant 2	Ant 1	Ant 2
11b	20.82	21.72	21.0	22.0
11g	19.12	20.12	19.5	20.5
HT20	18.51	19.73	19.0	20.0
VHT20	18.49	19.74	18.5	20.0

5.2 GHz WLAN				
Mode	Average Power (dBm)		Tune- up Limit (dBm)	
	Ant 1	Ant 2	Ant 1	Ant 2
11a	18.28	18.38	18.5	18.5
HT20	18.23	17.95	18.5	18.0
HT40	17.72	17.58	18.0	18.0
VHT20	18.02	17.71	18.5	18.0
VHT40	17.67	17.49	18.0	17.5
VHT80	8.53	8.35	9.0	8.5

5.3 GHz WLAN				
Mode	Average Power (dBm)		Tune- up Limit (dBm)	
	Ant 1	Ant 2	Ant 1	Ant 2
11a	17.98	18.06	18.0	18.5
HT20	17.97	18.19	18.0	18.5
HT40	17.71	17.20	18.0	17.5
VHT20	17.76	17.95	18.0	18.0
VHT40	17.66	17.17	18.0	17.5
VHT80	10.92	10.70	11.0	11.0

5.5 GHz WLAN				
Mode	Average Power (dBm)		Tune- up Limit (dBm)	
	Ant 1	Ant 2	Ant 1	Ant 2
11a	17.92	17.55	18.0	18.0
HT20	18.04	17.19	18.5	17.5
HT40	17.14	16.22	17.5	16.5
VHT20	17.83	16.95	18.0	17.0
VHT40	17.09	16.10	17.5	16.5
VHT80	16.69	15.84	17.0	16.0

5.8 GHz WLAN				
Mode	Average Power (dBm)		Tune- up Limit (dBm)	
	Ant 1	Ant 2	Ant 1	Ant 2
11a	16.84	15.07	17.0	15.5
HT20	17.06	15.34	17.5	15.5
HT40	16.87	15.42	17.0	15.5
VHT20	16.80	15.05	17.0	15.5
VHT40	16.82	15.32	17.0	15.5
VHT80	12.90	11.49	13.0	11.5

### <WLAN (CDD)>

2.4 GHz WLAN						
Mode	Average Power (dBm)			Tune- up Limit (dBm)		
	Ant 1	Ant 2	Ant 1+2	Ant 1	Ant 2	Ant 1+2
11g	19.16	20.17	22.71	19.5	20.5	23.0
HT20	18.56	19.81	22.24	19.0	20.0	22.5
VHT20	18.54	19.76	22.20	19.0	20.0	22.5

5.2 GHz WLAN						
Mode	Average Power (dBm)			Tune- up Limit (dBm)		
	Ant 1	Ant 2	Ant 1+2	Ant 1	Ant 2	Ant 1+2
11a	18.69	18.52	21.62	19.0	19.0	22.0
HT20	18.56	18.31	21.45	19.0	18.5	21.5
HT40	17.81	17.63	20.73	18.0	18.0	21.0
VHT20	18.32	18.06	21.20	18.5	18.5	21.5
VHT40	17.80	17.57	20.70	18.0	18.0	21.0
VHT80	8.82	8.53	11.68	9.0	9.0	12.0

5.3 GHz WLAN						
Mode	Average Power (dBm)			Tune- up Limit (dBm)		
	Ant 1	Ant 2	Ant 1+2	Ant 1	Ant 2	Ant 1+2
11a	18.41	18.21	21.32	18.5	18.5	21.5
HT20	18.29	18.26	21.28	18.5	18.5	21.5
HT40	17.85	17.60	20.74	18.0	18.0	21.0
VHT20	18.05	18.01	21.04	18.5	18.5	21.5
VHT40	17.82	17.55	20.70	18.0	18.0	21.0
VHT80	11.12	11.05	14.09	11.5	11.5	14.5

5.5 GHz WLAN						
Mode	Average Power (dBm)			Tune- up Limit (dBm)		
	Ant 1	Ant 2	Ant 1+2	Ant 1	Ant 2	Ant 1+2
11a	18.38	17.67	21.03	18.5	18.0	21.5
HT20	18.22	17.34	20.81	18.5	17.5	21.0
HT40	17.42	16.26	19.75	17.5	16.5	20.0
VHT20	17.98	17.09	20.57	18.0	17.5	21.0
VHT40	17.40	16.16	19.72	17.5	16.5	20.0
VHT80	17.02	15.90	19.50	17.5	16.0	20.0

5.8 GHz WLAN						
Mode	Average Power (dBm)			Tune- up Limit (dBm)		
	Ant 1	Ant 2	Ant 1+2	Ant 1	Ant 2	Ant 1+2
11a	16.87	15.10	19.04	17.0	15.5	19.5
HT20	17.09	15.37	19.32	17.5	15.5	19.5
HT40	16.89	15.43	19.23	17.0	15.5	19.5
VHT20	16.85	15.12	19.08	17.0	15.5	19.5
VHT40	16.85	15.36	19.18	17.0	15.5	19.5
VHT80	12.94	11.55	15.31	13.0	12.0	15.5

**Note :** Ant 1+2 average power is a combined result from sum of the power Ant 1 and Ant 2.



#### **4. RF Exposure Limit Introduction**

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(A) Limits for Occupational/Controlled Exposures</b>				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:

S = Power Density

P = Output Power at Antenna Terminals

G = Gain of Transmit Antenna (linear gain)

R = Distance from Transmitting Antenna



## 5. Radio Frequency Radiation Exposure Evaluation

### 5.1. Standalone Power Density Calculation

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Maximum EIRP (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Power Density / Limit
Bluetooth	2402.0	0.82	9.50	10.320	0.011	10.765	0.002	1.000	0.002
15.4	2405.0	0.95	21.00	21.950	0.157	156.675	0.031	1.000	0.031
2.4GHz WLAN Ant 1 (SISO)	2412	0.82	21.00	21.820	0.152	152.055	0.030	1.000	0.030
5.2GHz WLAN Ant 1 (SISO)	5180	1.83	18.50	20.330	0.108	107.895	0.021	1.000	0.021
5.3GHz WLAN Ant 1 (SISO)	5260	1.83	18.00	19.830	0.096	96.161	0.019	1.000	0.019
5.5GHz WLAN Ant 1 (SISO)	5500	1.83	18.50	20.330	0.108	107.895	0.021	1.000	0.021
5.8GHz WLAN Ant 1 (SISO)	5745	1.83	17.50	19.330	0.086	85.704	0.017	1.000	0.017
2.4GHz WLAN Ant 2 (SISO)	2412	-0.16	22.00	21.840	0.153	152.757	0.030	1.000	0.030
5.2GHz WLAN Ant 2 (SISO)	5180	2.12	18.50	20.620	0.115	115.345	0.023	1.000	0.023
5.3GHz WLAN Ant 2 (SISO)	5260	2.12	18.50	20.620	0.115	115.345	0.023	1.000	0.023
5.5GHz WLAN Ant 2 (SISO)	5500	2.12	18.00	20.120	0.103	102.802	0.020	1.000	0.020
5.8GHz WLAN Ant 2 (SISO)	5745	2.12	15.50	17.620	0.058	57.810	0.012	1.000	0.012
2.4GHz WLAN Ant 1+2 (CDD)	2412	0.82	23.00	23.820	0.241	240.991	0.048	1.000	0.048
5.2GHz WLAN Ant 1+2 (CDD)	5180	2.12	22.00	24.120	0.258	258.226	0.051	1.000	0.051
5.3GHz WLAN Ant 1+2 (CDD)	5260	2.12	21.50	23.620	0.230	230.144	0.046	1.000	0.046
5.5GHz WLAN Ant 1+2 (CDD)	5500	2.12	21.50	23.620	0.230	230.144	0.046	1.000	0.046
5.8GHz WLAN Ant 1+2 (CDD)	5745	2.12	19.50	21.620	0.145	145.211	0.029	1.000	0.029

**Note:**

- In the above table have assessed Bluetooth, 15.4, 2.4GHz WLAN and 5GHz WLAN by referring to their maximum antenna gain and maximum power.



## **5.2. Collocated Power Density Calculation**

The device has three simultaneous transmission states as following.

State 1 : Bluetooth and 15.4 can transmit simultaneously

State 2 : 5GHz WLAN and 15.4 can transmit simultaneously

State 3 : 2.4GHz WLAN and 15.4 can transmit simultaneously

### **<state 1 : Bluetooth with 15.4 >**

Bluetooth Power Density / Limit	15.4 Power Density / Limit	$\Sigma$ (Power Density / Limit) of Bluetooth + 15.4
0.002	0.031	0.033

### **<state 2 : 5GHz WLAN with 15.4 >**

5GHz WLAN Power Density / Limit	15.4 Power Density / Limit	$\Sigma$ (Power Density / Limit) of 5GHz WLAN + 15.4
0.051	0.031	0.082

### **<state 3 : 2.4GHz WLAN with 15.4 >**

2.4GHz WLAN Power Density / Limit	15.4 Power Density / Limit	$\Sigma$ (Power Density / Limit) of 2.4GHz WLAN + 15.4
0.048	0.031	0.079

#### **Note:**

1.  $\Sigma$  (Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for state 1 / 2 / 3.
2. Considering the state 1 / 2 / 3 of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1, and MPE of these collocated transmitters is compliant.

## **Conclusion:**

According to 47 CFR §2.1091, the RF exposure analysis concludes that the RF Exposure is FCC compliant.