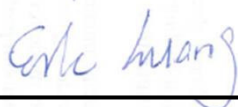


RF Exposure Evaluation Report

APPLICANT : Nest Labs Inc.
EQUIPMENT : Nest Cam IQ
MODEL NAME : A0053
FCC ID : ZQANC31
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.)



Table of Contents

1. ADMINISTRATION DATA 4

 1.1. Testing Laboratory 4

2. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT) 4

3. MAXIMUM RF AVERAGE OUTPUT POWER AMONG PRODUCTION UNITS 5

4. RF EXPOSURE LIMIT INTRODUCTION 9

5. RADIO FREQUENCY RADIATION EXPOSURE EVALUATION 10

 5.1. Standalone Power Density Calculation 10

 5.2. Collocated Power Density Calculation..... 11



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 Cam IQ
Model Name	A0053
FCC ID	ZQANC31
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 Zigbee: 2405 MHz~2475 MHz
Mode	802.11a/b/g/n/ac HT20/HT40/VHT20/VHT40/VHT80 Bluetooth LE Zigbee: BPSK
HW Version	EVT2



3. Maximum RF average output power among production units

<Bluetooth>

Mode / Band	Average Power (dBm)	Tune- up Limit (dBm)
	LE	
2.4 GHz Bluetooth	9.14	9.5

<Zigbee>

Mode / Band	Average Power (dBm)	Tune- up Limit (dBm)
	BPSK	
2.4 GHz Zigbee	20.54	21



<WLAN (SISO)>

2.4 GHz WLAN				
Mode	Average Power (dBm)		Tune- up Limit (dBm)	
	Ant 1	Ant 2	Ant 1	Ant 2
11b	22.43	22.45	22.5	22.5
11g	19.84	19.85	20.0	20.0
HT20	19.52	19.63	20.0	20.0
VHT20	19.51	19.60	20.0	20.0

5.2 GHz WLAN				
Mode	Average Power (dBm)		Tune- up Limit (dBm)	
	Ant 1	Ant 2	Ant 1	Ant 2
11a	19.67	19.76	20.0	20.0
HT20	19.12	19.00	19.5	19.5
HT40	18.98	18.91	19.0	19.0
VHT20	18.73	18.97	19.0	19.0
VHT40	18.97	18.90	19.0	19.0
VHT80	11.90	11.85	12.0	12.0

5.3 GHz WLAN				
Mode	Average Power (dBm)		Tune- up Limit (dBm)	
	Ant 1	Ant 2	Ant 1	Ant 2
11a	19.57	19.73	20.0	20.0
HT20	19.59	19.63	20.0	20.0
HT40	17.90	17.64	18.0	18.0
VHT20	19.58	19.62	20.0	20.0
VHT40	17.88	17.56	18.0	18.0
VHT80	12.25	12.25	12.5	12.5

5.5 GHz WLAN				
Mode	Average Power (dBm)		Tune- up Limit (dBm)	
	Ant 1	Ant 2	Ant 1	Ant 2
11a	20.12	18.99	20.5	19.0
HT20	20.26	19.32	20.5	19.5
HT40	20.12	18.98	20.5	19.0
VHT20	19.20	19.29	19.5	19.5
VHT40	19.97	18.90	20.0	19.0
VHT80	19.50	18.90	20.0	19.0

5.8 GHz WLAN				
Mode	Average Power (dBm)		Tune- up Limit (dBm)	
	Ant 1	Ant 2	Ant 1	Ant 2
11a	20.41	20.10	20.5	20.5
HT20	20.33	20.10	20.5	20.5
HT40	19.76	20.03	20.0	20.5
VHT20	19.64	20.08	20.0	20.5
VHT40	19.71	20.00	20.0	20.5
VHT80	18.38	18.34	18.5	18.5



<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	19.84	19.92	22.89	20.0	20.0	23.0
HT20	19.50	19.74	22.64	20.0	20.0	23.0
VHT20	19.53	19.64	22.60	20.0	20.0	23.0

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	19.84	19.66	22.76	20.0	20.0	23.0
HT20	19.24	18.97	22.12	19.5	19.0	22.5
HT40	19.09	18.83	21.98	19.5	19.0	22.0
VHT20	19.18	18.93	22.07	19.5	19.0	22.5
VHT40	19.00	18.91	21.97	19.5	19.0	22.0
VHT80	12.25	11.77	15.02	12.5	12.0	15.5

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	19.80	19.65	22.73	20.0	20.0	23.0
HT20	19.89	19.57	22.74	20.0	20.0	23.0
HT40	17.98	17.78	20.90	18.0	18.0	21.0
VHT20	19.85	19.64	22.76	20.0	20.0	23.0
VHT40	18.02	17.71	20.88	18.5	18.0	21.0
VHT80	12.50	12.01	15.27	13.0	12.5	15.5

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	20.66	19.51	23.13	21.0	20.0	23.5
HT20	20.90	19.51	23.27	21.0	20.0	23.5
HT40	20.57	19.66	23.15	21.0	20.0	23.5
VHT20	20.18	19.42	22.83	20.5	19.5	23.0
VHT40	20.49	19.53	23.04	20.5	20.0	23.5
VHT80	20.13	18.90	22.57	20.5	19.0	23.0

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	21.10	19.65	23.44	21.5	20.0	23.5
HT20	21.03	19.48	23.33	21.5	19.5	23.5
HT40	20.81	19.31	23.14	21.0	19.5	23.5
VHT20	20.86	19.24	23.14	21.0	19.5	23.5
VHT40	20.84	19.19	23.11	21.0	19.5	23.5
VHT80	18.40	18.35	21.38	18.5	18.5	21.5

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



<WLAN (STBC)>

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
HT20	20.52	20.77	23.66	21.0	21.0	24.0
VHT20	20.57	20.66	23.63	21.0	21.0	24.0

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
HT20	19.26	19.18	22.23	19.5	19.5	22.5
HT40	19.19	18.71	21.97	19.5	19.0	22.0
VHT20	19.33	19.10	22.22	19.5	19.5	22.5
VHT40	19.08	18.78	21.95	19.5	19.0	22.0
VHT80	12.32	11.91	15.13	12.5	12.0	15.5

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
HT20	19.92	19.71	22.82	20.0	20.0	23.0
HT40	19.11	18.81	21.98	19.5	19.0	22.0
VHT20	19.71	19.63	22.68	20.0	20.0	23.0
VHT40	19.12	18.78	21.97	19.5	19.0	22.0
VHT80	14.01	13.22	16.64	14.5	13.5	17.0

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
HT20	21.01	19.54	23.35	21.5	20.0	23.5
HT40	20.76	19.74	23.29	21.0	20.0	23.5
VHT20	20.89	19.35	23.19	21.0	19.5	23.5
VHT40	20.52	19.30	22.96	21.0	19.5	23.0
VHT80	19.98	19.28	22.65	20.0	19.5	23.0

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
HT20	21.08	19.56	23.39	21.5	20.0	23.5
HT40	20.84	19.37	23.18	21.0	19.5	23.5
VHT20	20.99	19.43	23.29	21.0	19.5	23.5
VHT40	20.78	19.28	23.11	21.0	19.5	23.5
VHT80	18.66	18.44	21.56	19.0	18.5	22.0

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 ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f ²)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) 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

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	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Maximum EIRP (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm ²)	Limit (mW/cm ²)	Power Density / Limit
Bluetooth	0.58	9.50	10.080	0.010	10.186	0.002	1.000	0.002
Zigbee	-0.04	21.00	20.960	0.125	124.738	0.025	1.000	0.025
2.4GHz WLAN Ant 1+2 (MIMO/CDD)	0.73	23.00	23.730	0.236	236.048	0.047	1.000	0.047
5.2GHz WLAN Ant 1+2 (MIMO/CDD)	1.97	23.00	24.970	0.314	314.051	0.063	1.000	0.063
5.3GHz WLAN Ant 1+2 (MIMO/CDD)	1.59	23.00	24.590	0.288	287.740	0.057	1.000	0.057
5.5GHz WLAN Ant 1+2 (MIMO/CDD)	2.00	23.50	25.500	0.355	354.813	0.071	1.000	0.071
5.8GHz WLAN Ant 1+2 (MIMO/CDD)	2.71	23.50	26.210	0.418	417.830	0.083	1.000	0.083
2.4GHz WLAN Ant 1+2 (MIMO/STBC)	0.73	24.00	24.730	0.297	297.167	0.059	1.000	0.059
5.2GHz WLAN Ant 1+2 (MIMO/STBC)	1.97	22.50	24.470	0.280	279.898	0.056	1.000	0.056
5.3GHz WLAN Ant 1+2 (MIMO/STBC)	1.59	23.00	24.590	0.288	287.740	0.057	1.000	0.057
5.5GHz WLAN Ant 1+2 (MIMO/STBC)	2.00	23.50	25.500	0.355	354.813	0.071	1.000	0.071
5.8GHz WLAN Ant 1+2 (MIMO/STBC)	2.71	23.50	26.210	0.418	417.830	0.083	1.000	0.083

Note:

1. In the above table have assessed Bluetooth, Zigbee, 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 Zigbee can transmit simultaneously

State 2 : 5GHz WLAN and Zigbee can transmit simultaneously

State 3 : 5GHz WLAN and Bluetooth can transmit simultaneously

<state 1 : Bluetooth with Zigbee >

Bluetooth Power Density / Limit	Zigbee Power Density / Limit	Σ (Power Density / Limit) of Bluetooth + Zigbee
0.002	0.025	0.027

<state 2 : 5GHz WLAN with Zigbee >

5GHz WLAN Ant 1 + 2 Power Density / Limit	Zigbee Power Density / Limit	Σ (Power Density / Limit) of 5GHz WLAN + Zigbee
0.083	0.025	0.108

<state 3 : 5GHz WLAN with Bluetooth >

5GHz WLAN Ant 1 + 2 Power Density / Limit	Bluetooth Power Density / Limit	Σ (Power Density / Limit) of 5GHz WLAN + Bluetooth
0.083	0.002	0.085

Note:

1. The power density of 5GHz WLAN Ant 1+2 is select higher value of CDD or STBC.
2. Σ (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.
3. 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.