RF Exposure Evaluation Report

APPLICANT	:	**LITE-ON Technology Corp.**
EQUIPMENT	:	**802.11 a/b/g/n/ac 2T2R+BT V4.2LE combo module**
BRAND NAME	:	**LITE-ON**
MODEL NAME	:	**WCBN3510A**
FCC ID	:	**PPQ-WCBN3510A**
STANDARD	:	**47 CFR Part 2.1091** **FCC KDB 447498 D01 v06**

The product was installed into Lenovo Smart Display (Brand Name: Lenovo, Model Name: Lenovo SD-8501F) during test.

We, Sporton International (Kunshan) Inc., would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091 and FCC KDB 447498 D01 v06, and pass the limit. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.

Mark Qu

Approved by: Mark Qu / Manager

NVLAP TESTING
NVLAP LAB CODE 600155-0

Sporton International (Kunshan) Inc.
No.3-2 Ping-Xiang Rd, Kunshan Development Zone Kunshan City Jiangsu Province 215335 China

Table of Contents

Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA820813	Rev. 01	Initial issue of report	Apr. 28, 2018

1. Administration Data

1.1. Testing Laboratory

Testing Laboratory	
Test Site	Sporton International (Kunshan) Inc.
Test Site Location	No.3-2 Ping-Xiang Rd, Kunshan Development Zone Kunshan City Jiangsu Province 215335 China TEL : +86-512-57900158 FAX : +86-512-57900958

Applicant	
Company Name	LITE-ON Technology Corp.
Address	Bldg. C, 90, Chien 1 Road, Chung Ho, New Taipei City 23585, Taiwan, R.O.C

Manufacturer	
Company Name	LITE-ON TECHNOLOGY (Changzhou) CO., LTD
Address	A9 Building, No.88 Yanghu Road, Wujin Hi-Tech Industrial Development Zone, Changzhou City, Jiangsu Province 213100 China

2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	802.11 a/b/g/n/ac 2T2R+BT V4.2LE combo module
Brand Name	LITE-ON
Model Name	WCBN3510A
FCC ID	PPQ-WCBN3510A
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 ~ 5700 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 2.4GHz 802.11ac VHT20/VHT40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80 Bluetooth v2.1+EDR, Bluetooth v4.2 LE
WLAN Antenna Function for Transmitter	

	Ant.1	Ant.2
802.11a/b/g/n/ac SISO	V	V
802.11a/b/g/n/ac MIMO	V	V

Antenna Type	WLAN : PIFA Antenna Bluetooth : PIFA Antenna
Antenna Gain	**<WLAN>:**

	Ant.1	Ant.2
WLAN 2.4GHz	2.85 dBi	3.35 dBi
WLAN 5.2GHz	4.13 dBi	3.33 dBi
WLAN 5.3GHz	3.32 dBi	3.33 dBi
WLAN 5.5GHz	3.97 dBi	4.12 dBi
WLAN 5.8GHz	3.81 dBi	4.13 dBi

<Bluetooth>: 2.86 dBi

EUT Stage	Identical Prototype

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

Host Feature & Specification	
Equipment Name	Lenovo Smart Display
Brand Name	Lenovo
Model Name	Lenovo SD-8501F
Applicant	**Lenovo (Shanghai) Electronics Technology Co., Ltd.** NO.68 BUILDING, 199 FENJU RD, China (Shanghai) Pilot Free Trade Zone, Shanghai, 200131 China
Manufacturer	**Lenovo PC HK Limited** 23/F, Lincoln House, Taikoo Place, 979 King's Road, Quarry Bay Hong Kong

3. Maximum RF average output power among production units

<WLAN 2.4GHz>

Mode			Maximum Average Power (dBm)
2.4GHz WLAN	802.11b	CH 1	19.00
		CH 6	19.50
		CH 11	20.50
	802.11g	CH 1	19.50
		CH 2	20.50
		CH 6	20.50
		CH 10	18.50
		CH 11	17.50
	802.11n HT20	CH 1	19.50
		CH 2	19.50
		CH 6	20.50
		CH 10	18.00
		CH 11	18.00
	802.11n HT40	CH 3	15.50
		CH 4	14.50
		CH 6	16.50
		CH 8	14.50
		CH 9	12.50
	802.11ac VHT20	CH 1	19.50
		CH 2	19.50
		CH 6	20.50
		CH 10	18.00
		CH 11	18.00
	802.11ac VHT40	CH 3	15.50
		CH 4	14.50
		CH 6	16.50
		CH 8	14.50
		CH 9	12.50

Note: Above power is MIMO power, MIMO Power is higher than SISO power, so only chose MIMO power to do exposure evaluation.

<WLAN 5GHz>

Mode			Maximum Average Power (dBm)
5.2GHz WLAN	802.11a	CH 36	18.00
		CH 40	22.50
		CH 44	22.50
		CH 48	22.50
	802.11n HT20	CH 36	19.00
		CH 40	22.00
		CH 44	22.50
		CH 48	22.50
	802.11n HT40	CH 38	10.50
		CH 46	22.00
	802.11ac VHT20	CH 36	19.00
		CH 40	22.00
		CH 44	22.50
		CH 48	22.50
	802.11ac VHT40	CH 38	10.50
		CH 46	22.00
	802.11ac VHT80	CH 42	10.50
5.3GHz WLAN	802.11a	CH 52	22.00
		CH 56	23.00
		CH 60	23.00
		CH 64	19.00
	802.11n HT20	CH 52	22.00
		CH 56	23.00
		CH 60	23.00
		CH 64	18.50
	802.11n HT40	CH 54	22.50
		CH 62	13.50
	802.11ac VHT20	CH 52	22.00
		CH 56	23.00
		CH 60	23.00
		CH 64	18.50
	802.11ac VHT40	CH 54	22.50
		CH 62	13.50
	802.11ac VHT80	CH 58	12.00

Mode			Maximum Average Power (dBm)
5.5GHz WLAN	802.11a	CH 100	16.50
		CH 104	18.00
		CH 108	23.50
		CH 112	23.00
		CH 116	23.50
		CH 132	20.50
		CH 136	20.00
		CH 140	15.00
	802.11n HT20	CH 100	16.50
		CH 104	16.50
		CH 108	23.50
		CH 112	23.50
		CH 116	23.50
		CH 132	20.00
		CH 136	19.50
		CH 140	16.50
	802.11n HT40	CH 102	16.50
		CH 110	23.50
		CH 134	19.50
	802.11ac VHT20	CH 100	16.50
		CH 104	16.50
		CH 108	23.50
		CH 112	23.50
		CH 116	23.50
		CH 132	20.00
		CH 136	19.50
		CH 140	16.50
	802.11ac VHT40	CH 102	16.50
		CH 110	23.50
		CH 134	19.50
	802.11ac VHT80	CH 106	12.50
		CH 122	24.00
5.8GHz WLAN	802.11a	CH 149	26.00
		CH 153	26.00
		CH 157	26.00
		CH 161	26.00
		CH 165	26.50
	802.11n HT20	CH 149	25.50
		CH 153	25.50
		CH 157	26.00
		CH 161	26.00
		CH 165	26.50
	802.11n HT40	CH 151	25.50
		CH 159	26.00
	802.11ac VHT20	CH 149	25.50
		CH 153	25.50
		CH 157	26.00
		CH 161	26.00
		CH 165	26.50
	802.11ac VHT40	CH 151	25.50
		CH 159	26.00
	802.11ac VHT80	CH 155	23.50

Note: Above power is MIMO power, MIMO Power is higher than SISO power, so only chose MIMO power to do exposure evaluation.

<Bluetooth>

Mode			Maximum Average Power (dBm)
Bluetooth v2.1+EDR	1Mbps	CH 00	11.00
		CH 39	11.50
		CH 78	13.00
	2Mbps	CH 00	8.00
		CH 39	8.50
		CH 78	9.50
	3Mbps	CH 00	8.00
		CH 39	8.50
		CH 78	9.50
Bluetooth v4.2 LE		CH 00	2.50
		CH 19	4.00
		CH 39	5.50

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/f2)	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/f2)	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 ERP/EIRP (dBm)	Maximum output power Limit (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm2)	Limit (mW/cm^2)	Power Density / Limit
WLAN 2.4GHz 802.11b	2412	3.35	20.50	23.850	0.243	242.661	0.048	1.000	**0.048**
WLAN 2.4GHz 802.11g	2412	3.35	20.50	23.850	0.243	242.661	0.048	1.000	0.048
WLAN 2.4GHz 802.11n HT20	2412	3.35	20.50	23.850	0.243	242.661	0.048	1.000	0.048
WLAN 2.4GHz 802.11n HT40	2422	3.35	16.50	19.850	0.097	96.605	0.019	1.000	0.019
WLAN 2.4GHz 802.11ac VHT20	2412	3.35	20.50	23.850	0.243	242.661	0.048	1.000	0.048
WLAN 2.4GHz 802.11ac VHT40	2422	3.35	16.50	19.850	0.097	96.605	0.019	1.000	0.019
WLAN5.2GHz 802.11a	5180	4.13	22.50	26.630	0.460	460.257	0.092	1.000	0.092
WLAN5.2GHz 802.11n HT20	5180	4.13	22.50	26.630	0.460	460.257	0.092	1.000	0.092
WLAN5.2GHz 802.11n HT40	5190	4.13	22.00	26.130	0.410	410.204	0.082	1.000	0.082
WLAN5.2GHz 802.11ac VHT20	5180	4.13	22.50	26.630	0.460	460.257	0.092	1.000	0.092
WLAN5.2GHz 802.11ac VHT40	5190	4.13	22.00	26.130	0.410	410.204	0.082	1.000	0.082
WLAN5.2GHz 802.11ac VHT80	5210	4.13	10.50	14.630	0.029	29.040	0.006	1.000	0.006
WLAN5.3GHz 802.11a	5260	3.33	23.00	26.330	0.430	429.536	0.085	1.000	0.085
WLAN5.3GHz 802.11n HT20	5260	3.33	23.00	26.330	0.430	429.536	0.085	1.000	0.085
WLAN5.3GHz 802.11n HT40	5270	3.33	22.50	25.830	0.383	382.825	0.076	1.000	0.076
WLAN5.3GHz 802.11ac VHT20	5260	3.33	23.00	26.330	0.430	429.536	0.085	1.000	0.085
WLAN5.3GHz 802.11ac VHT40	5270	3.33	22.50	25.830	0.383	382.825	0.076	1.000	0.076
WLAN5.3GHz 802.11ac VHT80	5290	3.33	12.00	15.330	0.034	34.119	0.007	1.000	0.007
WLAN5.5GHz 802.11a	5500	4.12	23.50	27.620	0.578	578.096	0.115	1.000	0.115
WLAN5.5GHz 802.11n HT20	5500	4.12	23.50	27.620	0.578	578.096	0.115	1.000	0.115
WLAN5.5GHz 802.11n HT40	5510	4.12	23.50	27.620	0.578	578.096	0.115	1.000	0.115
WLAN5.5GHz 802.11ac VHT20	5500	4.12	23.50	27.620	0.578	578.096	0.115	1.000	0.115
WLAN5.5GHz 802.11ac VHT40	5510	4.12	23.50	27.620	0.578	578.096	0.115	1.000	0.115
WLAN5.5GHz 802.11ac VHT80	5530	4.12	24.00	28.120	0.649	648.634	0.129	1.000	0.129
WLAN5.8GHz 802.11a	5745	4.13	26.50	30.630	1.156	1156.112	0.230	1.000	0.230
WLAN5.8GHz 802.11n HT20	5745	4.13	26.50	30.630	1.156	1156.112	0.230	1.000	**0.230**
WLAN5.8GHz 802.11n HT40	5755	4.13	26.00	30.130	1.030	1030.386	0.205	1.000	0.205
WLAN5.8GHz 802.11ac VHT20	5745	4.13	26.50	30.630	1.156	1156.112	0.230	1.000	0.230
WLAN5.8GHz 802.11ac VHT40	5755	4.13	26.00	30.130	1.030	1030.386	0.205	1.000	0.205
WLAN5.8GHz 802.11ac VHT80	5775	4.13	23.50	27.630	0.579	579.429	0.115	1.000	0.115
Bluetooth	2402	2.86	13.00	15.860	0.039	38.548	0.008	1.000	**0.008**

Note:

1. For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band.
2. EUT will choose either WLAN 2.4GHz or WLAN 5GHz according to the network signal condition; therefore, 2.4GHz WLAN and 5GHz WLAN will not operate simultaneously at any moment.
3. Antenna 1 and antenna 2 with different antenna gain, we chose the higher gain to do exposure evaluation.

5.2. Collocated Power Density Calculation

Power Density / Limit			Σ(Power Density / Limit) of	
1	2	3	1+3	2+3
2.4GHz WLAN	5GHz WLAN	Bluetooth		
0.048	0.230	0.008	0.056	0.238

Note:

1. Σ(Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)].
2. Considering the collocation of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1.

Conclusion:

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