RF Exposure Report

Report Number:	**208726-3** **Revision Level: 2**
Client:	**Comma.ai, inc.**
	3900 Harney St., San Diego, CA92110
Equipment Under Test:	**2.4/5 GHz WiFi module**
Model Name:	**LightningHard SOM**
Model Number:	**N/A**
FCC ID:	**2BFC6-LIGHTNINGH**
Module Model:	**N/A**
Contains FCC ID:	**N/A**
Applicable Standards:	**47 CFR §§ 2.1091**
	FCC KDB 447498 D01 General RF Exposure Guidance v06
	FCC OET Bulletin 65
Report issued on:	**June 20, 2024**
Result:	**Compliant**

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER: 3212.01
Report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

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1 General Information

1.1 *Client Information*

Name:	Comma.ai, inc.
Address:	3900 Harney St.
City, State, Zip, Country:	San Diego, CA92110, USA

1.2 *Test Laboratory*

Name:	SGS North America, Inc.
Address:	12310 World Trade Drive, Suite 106/107
City, State, Zip, Country:	San Diego, CA 92128, USA
Accrediting Body:	A2LA
Type of lab:	Testing Laboratory
Certificate Number:	1935.01

1.3 *General Information of EUT*

Type of Product:	2.4/5 GHz WiFi module
Model Number:	LightningHard SOM
Serial Number:	N/A
Module Models:	N/A
Frequency Ranges:	2412 – 2462 MHz (WLAN 2.4GHz) 5180 – 5240 MHz (WLAN 5GHz U-NII-1) 5260 – 5320 MHz (WLAN 5GHz U-NII-2A) 5500 – 5700 MHz (WLAN 5GHz U-NII-2C) 5745 – 5825 MHz (WLAN 5GHz U-NII-3)
Antenna Gain:	PCB Omnidirectional Antenna (TE 2344654-7) peak gain 2.4GHz:1.5dBi* peak gain 5GHz: 5.7 dBi*
Max Conducted Output Power:	WLAN 2.4GHz, 802.11b NOHT: 8.93 dBm WLAN 2.4GHz, 802.11b CCK: 10.02 dBm WLAN 2.4GHz, 802.11g: 12.48 dBm WLAN 2.4GHz, 802.11n20: 12.34 dBm WLAN 2.4GHz, 802.11n40: 11.17 dBm WLAN 5GHz U-NII-1: 17.29 dBm WLAN 5GHz U-NII-2A: 17.15 dBm WLAN 5GHz U-NII-2C: 16.56 dBm WLAN 5GHz U-NII-3: 13.01 dBm

*Data was not measured by SGS laboratory and therefore SGS is not responsible for accuracy. Data obtained via customer, specification sheet, previous filing or other.

1.4 *Operating Modes and Conditions*

Maximum power levels were utilized for all calculations. Simultaneous transmission is not possible.

2 RF Exposure

2.1 *Test Results*

Test Description	Product Specific Standard	Test Result
RF Exposure	FCC Part 1.1310	Compliant

2.2 *Test Method*

The formula below calculates power density.

$$S = \frac{PG}{4\pi R^2} \qquad \text{Or} \qquad S = \frac{EIRP}{4\pi R^2}$$

Where;
S = Power density (mW/cm^2)
P = Maximum sourced based average power delivered to antenna port (mW)
G = Maximum power gain of the antenna in the direction of interest relative to an isotropic radiator (dBi) (numerical value)
R = Distance between by-stander and antenna (cm)
EIRP = Equivalent (or effective) isotropically radiated power

2.3 *Limits*

The table below shows the limits applicable for equipment subject to FCC §15.247 and §2.1091.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power Density (mW/cm^2)	Averaging Time (Minutes)
0.3 – 1.34	614	20.4	*(100)	30
1.34 - 30	824/f	26.97	*($180/f^2$)	30
30 - 300	27.5	33.62	0.2	30
300 - 1500	/	/	f/1500	30
1500 – 100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

2.4 *Single transmission RF Exposure Levels (mW/cm²)*

2.4 GHz band, IEEE 802.11b NOHT mode

Freq. (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm²)	MPE Limit (mW/cm²)
	(dBi)	numerical	(dBm)	(mW)			
2437	1.5	1.41	8.93	7.82	20	0.002	1

2.4 GHz band, IEEE 802.11b CCK mode

Freq. (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm²)	MPE Limit (mW/cm²)
	(dBi)	numerical	(dBm)	(mW)			
2437	1.5	1.41	10.02	10.05	20	0.003	1

2.4 GHz band, IEEE 802.11g mode

Freq. (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm²)	MPE Limit (mW/cm²)
	(dBi)	numerical	(dBm)	(mW)			
2462	1.5	1.41	12.48	17.70	20	0.005	1

2.4 GHz band, IEEE 802.11n20 mode

Freq. (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm²)	MPE Limit (mW/cm²)
	(dBi)	numerical	(dBm)	(mW)			
2462	1.5	1.41	12.34	17.14	20	0.005	1

2.4 GHz band, IEEE 802.11n40 mode

Freq. (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm²)	MPE Limit (mW/cm²)
	(dBi)	numerical	(dBm)	(mW)			
2452	1.5	1.41	11.17	13.09	20	0.004	1

5 GHz band, UNII1 band

Freq. (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm²)	MPE Limit (mW/cm²)
	(dBi)	numerical	(dBm)	(mW)			
5240	5.7	3.72	17.29	53.58	20	0.040	1

5 GHz band, UNII2A band

Freq. (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm²)	MPE Limit (mW/cm²)
	(dBi)	numerical	(dBm)	(mW)			
5280	5.7	3.72	17.15	51.88	20	0.038	1

5 GHz band, UNII2C band

Freq. (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm²)	MPE Limit (mW/cm²)
	(dBi)	numerical	(dBm)	(mW)			
5600	5.7	3.72	16.56	45.29	20	0.033	1

5 GHz band, UNII3 band

Freq. (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm²)	MPE Limit (mW/cm²)
	(dBi)	numerical	(dBm)	(mW)			
5795	5.7	3.72	13.01	20.00	20	0.015	1

2.5 *Simultaneous Conditions*

N/A

3 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	May 15, 2024
1	Removed 2.1093 from cover page and corrected 5720 MHz to 5700 MHz in chapter 1.3	June 14, 2024
2	Corrected the max. antenna gain for 2.4 GHz to 1.5 dBi	June 20, 2024