RF Exposure Evaluation Report

APPLICANT	:	Espressif Systems (Shanghai) Co.,Ltd.
EQUIPMENT	:	2.4GHz&5GHz Wifi&BLE&Zigbee module
BRAND NAME	:	ESPRESSIF
MODEL NAME	:	ESP32-C5-WROOM-1
FCC ID	:	2AC7Z-ESPC5WROOM1
STANDARD	:	47 CFR Part 2.1091 FCC KDB 447498 D01 v06

The product evaluation date was started from Apr. 09, 2025 and completed on Apr. 09, 2025. We, Sporton International Inc. (Kunshan), 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 Inc. (Kunshan), the test report shall not be reproduced except in full.

Si Zhang

Approved by: Si Zhang

ACCREDITED Cert #5145.02

Sporton International Inc. (Kunshan)
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People's Republic of China

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA512010	Rev. 01	Initial issue of report.	Jun. 27, 2025

1. Administration Data

1.1. Testing Laboratory

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Testing Laboratory			
Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR01-KS	CN1257	314309

Applicant	
Company Name	Espressif Systems (Shanghai) Co.,Ltd.
Address	Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China

Manufacturer	
Company Name	Espressif Systems (Shanghai) Co.,Ltd.
Address	Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China

2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	2.4GHz&5GHz Wifi&BLE&Zigbee module
Brand Name	ESPRESSIF
Model Name	ESP32-C5-WROOM-1
FCC ID	2AC7Z-ESPC5WROOM1
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/Thread: 2405 MHz ~ 2480 MHz
Mode	WLAN 2.4GHz 802.11b/g/n/ax HT20/HT40/HE20 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac/ax VHT20/HE20 Bluetooth LE ZigBee/Thread: O-QPSK
Antenna Gain	WLAN2.4GHz/Bluetooth: 3.62 dBi WLAN5.2GHz: 3.07 dBi WLAN5.3GHz: 1.93 dBi WLAN5.5GHz: 3.43 dBi WLAN5.8GHz: 2.80 dBi ZigBee/Thread: 3.62 dBi
Antenna Type	WLAN/Bluetooth: PCB Antenna ZigBee/Thread: PCB Antenna
HW Version	V1
SW Version	V0
EUT Stage	Identical Prototype
Remark: 1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description. 2. Since ZigBee mode and Thread mode support exactly the same frequency span, and Thread mode power level is same as ZigBee mode power level, so only ZigBee mode was chosen to perform standalone power density calculation.	

Comments and Explanations:
1. The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification. 2. The maximum RF output tune up power, antenna gain also the safe distance used for evaluate RF exposure were declared by manufacturer.

3. Maximum RF average output tune up power among production units

<WLAN 2.4GHz >

Mode		Maximum Average Power (dBm)
2.4GHz	802.11b	19.00
	802.11g	19.00
	802.11n-HT20	18.50
	802.11n-HT40	17.00
	802.11ax-HE20	18.50

< Bluetooth>

Mode	Maximum Average Power (dBm)
Bluetooth LE	21.00

<ZigBee/Thread>

Mode		Maximum Average power(dBm)
2.4GHz	ZigBee	17.00
	Thread	17.00

<WLAN 5GHz >

Mode		Maximum Average Power (dBm)
5.2GHz	802.11a	19.00
	802.11n-HT20	19.00
	802.11n-HT40	18.50
	802.11ac-VHT20	19.00
	802.11ax-HE20	19.00
5.3GHz	802.11a	19.00
	802.11n-HT20	19.00
	802.11n-HT40	18.50
	802.11ac-VHT20	19.00
	802.1111ax-HE20	19.00
5.5GHz	802.11a	19.00
	802.11n-HT20	19.00
	802.11n-HT40	18.50
	802.11ac-VHT20	19.00
	802.1111ax-HE20	19.00
5.8GHz	802.11a	19.00
	802.11n-HT20	19.00
	802.11n-HT40	18.50
	802.11ac-VHT20	19.00
	802.1111ax-HE20	19.00

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 EIRP (dBm)	Maximum EIRP (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm^2)	Limit (mW/cm^2)
2.4GHz WLAN	2412.0	3.62	19.00	22.620	0.183	182.810	0.036	1.000
5.2GHz WLAN	5180.0	3.07	19.00	22.070	0.161	161.065	0.032	1.000
5.3GHz WLAN	5260.0	1.93	19.00	20.930	0.124	123.880	0.025	1.000
5.5GHz WLAN	5500.0	3.43	19.00	22.430	0.175	174.985	0.035	1.000
5.8GHz WLAN	5745.0	2.80	19.00	21.800	0.151	151.356	0.030	1.000
Bluetooth	2402.0	3.62	21.00	24.620	0.290	289.734	0.058	1.000
Zigbee/Thread	2405.0	3.62	17.00	20.620	0.115	115.345	0.023	1.000

Note:
1. For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band.
2. Chose the maximum power to do MPE analysis.
3. According to the EUT characteristic, WLAN 2.4GHz (or 5GHz) and Bluetooth can't transmit simultaneously.
4. According to the EUT characteristic, Zigbee (or Thread) and WLAN can't transmit simultaneously.
5. According to the EUT characteristic, Zigbee (or Thread) and Bluetooth can't transmit simultaneously.
6. According to the EUT characteristic, WLAN 2.4GHz and WLAN 5GHz can't transmit simultaneously.

Conclusion:

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

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