RF Exposure Evaluation Report

APPLICANT	:	Espressif Systems (Shanghai) Co.,Ltd.
EQUIPMENT	:	2.4GHz Wi-Fi & BT IoT Module
BRAND NAME	:	ESPRESSIF
MODEL NAME	:	ESP32-C6-MINI-1
FCC ID	:	2AC7Z-ESPC6MINI1
STANDARD	:	47 CFR Part 2.1091 FCC KDB 447498 D01 V06

The product evaluation date was started from Aug. 16, 2023 and completed on Aug. 29, 2023. 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

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
FA330803	Rev. 01	Initial issue of report.	Sep. 01, 2023

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 FAX : +86-512-57900958		
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 Wi-Fi & BT IoT Module
Brand Name	ESPRESSIF
Model Name	ESP32-C6-MINI-1
FCC ID	2AC7Z-ESPC6MINI1
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz ZigBee/Thread: 2405 MHz ~ 2480 MHz
Mode	WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 2.4GHz 802.11ax HE20 Bluetooth LE ZigBee/Thread: O-QPSK
Antenna Gain	WLAN2.4GHz/Bluetooth: 3.96 dBi ZigBee/Thread: 3.96 dBi
Antenna Type	PCB Antenna
HW Version	V1.0
SW Version	v1.1.3.4
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 less than 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

<2.4GHz WLAN >

Mode		Maximum Average Power (dBm)
2.4GHz	802.11b	22.00
	802.11g	21.00
	802.11n-HT20	19.00
	802.11n-HT40	18.00
	802.11ax-HE20	19.00

<Bluetooth>

Mode	Maximum Average Power (dBm)
Bluetooth LE	20.00

<ZigBee/Thread>

Mode		Maximum Average power(dBm)
2.4GHz	ZigBee	20.00
	Thread	6.00

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)	Average EIRP (mW)	Power Density at 20cm (mW/cm^2)	Limit (mW/cm^2)
Bluetooth	2402.0	3.96	20.00	23.960	248.886	0.050	1.000
2.4GHz WLAN	2412.0	3.96	22.00	25.960	394.457	0.079	1.000
ZigBee	2405.0	3.96	20.00	23.960	248.886	0.050	1.000

Note:
1. For conservativeness, the lowest uplink 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, Bluetooth and WLAN2.4GHz cannot transmit simultaneously; ZigBee/Thread and Bluetooth/WLAN2.4GHz cannot 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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