

# RF Exposure Evaluation Report

APPLICANT : Espressif Systems (Shanghai) Co.,Ltd.  
EQUIPMENT : 2.4GHz Wi-Fi & BT IoT Module  
BRAND NAME : ESPRESSIF  
MODEL NAME : ESP32-S3-MINI-1  
FCC ID : 2AC7Z-ESPS3MINI1  
STANDARD : 47 CFR Part 2.1091  
FCC KDB 447498 D01 v06

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.

*Tony Zhang*

Reviewed by: Tony Zhang / Supervisor

*Kat Yin*

Approved by: Kat Yin / Manager



**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   |
|------------|---------|-------------------------|---------------|
| FA1N0918   | Rev. 01 | Initial issue of report | Feb. 14, 2022 |
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## **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<br>Jiangsu Province 215300 People's Republic of China<br>TEL : +86-512-57900158<br>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-S3-MINI-1                                                         |
| FCC ID                                                                                                                                          | 2AC7Z-ESPS3MINI1                                                        |
| Wireless Technology and Frequency Range                                                                                                         | WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz<br>Bluetooth: 2402 MHz ~ 2480 MHz |
| Mode                                                                                                                                            | WLAN 2.4GHz : 802.11b/g/n/ HT20/ HT40<br>Bluetooth LE                   |
| Antenna Type                                                                                                                                    | Bluetooth: PCB Antenna<br>WLAN: PCB Antenna                             |
| Antenna gain                                                                                                                                    | WLAN antenna with 4.54dBi<br>Bluetooth antenna with 4.54dBi             |
| HW Version                                                                                                                                      | V1.1                                                                    |
| SW Version                                                                                                                                      | v1.1.3.4                                                                |
| EUT Stage                                                                                                                                       | Identical Prototype                                                     |
| <b>Remark:</b>                                                                                                                                  |                                                                         |
| 1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description. |                                                                         |

| 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 Tune Up power among production units****<Bluetooth>**

| Mode         | Maximum Average Power (dBm) |
|--------------|-----------------------------|
| Bluetooth LE | 10.0                        |

**<WLAN 2.4GHz Mode>**

| Mode   |              | Maximum Average Power (dBm) |
|--------|--------------|-----------------------------|
| 2.4GHz | 802.11b      | 20.00                       |
|        | 802.11g      | 19.00                       |
|        | 802.11n-HT20 | 18.00                       |
|        | 802.11n-HT40 | 17.00                       |

#### 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 <sup>2</sup> ) | Averaging time (minutes) |
|----------------------------------------------------------------|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| <b>(A) Limits for Occupational/Controlled Exposures</b>        |                               |                               |                                     |                          |
| 0.3-3.0                                                        | 614                           | 1.63                          | *(100)                              | 6                        |
| 3.0-30                                                         | 1842/f                        | 4.89/f                        | *(900/f <sup>2</sup> )              | 6                        |
| 30-300                                                         | 61.4                          | 0.163                         | 1.0                                 | 6                        |
| 300-1500                                                       |                               |                               | f/300                               | 6                        |
| 1500-100,000                                                   |                               |                               | 5                                   | 6                        |
| <b>(B) Limits for General Population/Uncontrolled Exposure</b> |                               |                               |                                     |                          |
| 0.3-1.34                                                       | 614                           | 1.63                          | *(100)                              | 30                       |
| 1.34-30                                                        | 824/f                         | 2.19/f                        | *(180/f <sup>2</sup> )              | 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 <sup>2</sup> ) | Limit (mW/cm <sup>2</sup> ) |
|-------------|-----------------|--------------------|---------------------|--------------------|------------------|-------------------|---------------------------------------------|-----------------------------|
| 2.4GHz WLAN | 2412            | 4.54               | 20.00               | 24.54              | 0.28             | 284.45            | 0.057                                       | 1.000                       |
| Bluetooth   | 2402            | 4.54               | 10.00               | 14.54              | 0.03             | 28.44             | 0.006                                       | 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 and Bluetooth cannot transmit simultaneously.

### **Conclusion:**

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

-----THE END-----