

Product

XIAO ESP32S3 Sense Plus

Introduction

Seeed Studio XIAO Series are diminutive development boards, sharing a similar hardware structure, where the size is literally thumb-sized. The code name "XIAO" here represents its half feature "Tiny", and the other half will be "Puissant". Seeed Studio XIAO ESP32S3 Sense integrates camera sensor, digital microphone and SD card supporting. Combining embedded ML computing power and photography capability, this development board can be your great tool to get started with intelligent voice and vision AI.

Feature



XIAO Premium 3pcs Pack
with Pin-Headers

Seeed Studio
XIAO in 3pc Pack
Tiny, Powerful, XIAO. A collection of powerful thumb-sized development boards tailor-made for space-conscious projects requiring wireless connectivity. As the smallest Arduino-compatible MCU, they are extensive for your next tinyML and AI projects.

3pcs
Elegant safety packaging

Included 6pcs Pin Headers

10% OFF
10% Discount & Free Shipping

- **Powerful MCU Board:** Incorporate the ESP32S3 32-bit, dual-core, Xtensa processor chip operating up to 240 MHz, mounted multiple development ports, Arduino / MicroPython supported
- **Advanced Functionality:** Detachable OV2640 camera sensor for 1600*1200 resolution, compatible with OV5640 camera sensor, integrating additional **digital microphone**
- **Great Memory for more Possibilities:** Offer 8MB PSRAM and 8MB FLASH, supporting SD card slot for external 32GB FAT memory
- **Outstanding RF performance:** Support 2.4GHz Wi-Fi and BLE dual wireless communication, support 100m+ remote communication when connected with U.FL antenna
- **Thumb-sized Compact Design:** 21 x 17.8mm, adopting the classic form factor of XIAO, suitable for space-limited projects like wearable devices
- **Pretrained AI model from **SenseCraft AI** for no-code deployment**

Note

XIAO SoM User Manual open-sources all hardware and software materials of XIAO providing professional product design guidelines to help you accelerate ideas off the ground streamline product design providing a seamless experience from module selection to mass production. You can check [here](#) to see more info.

Starter Kit with free Course for all Electronics Neophytes and Enthusiasts

Seeed Studio has provided the *Grove Starter Kit* along with *free and detailed courses* for you quickly get started with microcontrollers and electronics, regarding all the Seeed Studio XIAO boards, promising you a great learning experience.

Not only programming but also electronics knowledge is not required, you will be taken step by step, from understanding the basic concepts to exercising the simple projects individually, finally being able to build complex, interesting, wearable projects on your own, owing a practical electronic product prototype from the course.



You can have access to the *Seeed Studio Grove ecosystem* by connecting it to the compatible *Seeed Studio XIAO expansion board*. We have developed more than *400 Grove modules*, covering a wide range of applications that can fulfill various needs. Get started and explore the infinite possibilities of the Seeed Studio XIAO series!

Application Scenarios



Sensor Hub



IoT & Smart Home



Robotics



SWD debug



Wearables



More to Explore...

If you are interested in programming embedded machine learning, we have [Codecraft](#) visual programming that can help you quickly start your own TinyML project. And we have set up a [#tinyml](#) channel on our Discord server, please click to join for 24/7 making, sharing, discussing, and helping each other out.

We already have 8 XIAO products based on different solutions in the XIAO family, to help you better understand the differences and choose the most suitable part for your projects, please refer to the [Seeed Studio XIAO Series Page](#).

Specification

| | | |
|------------------|---|---|
| Item | Seeed Studio XIAO ESP32S3 | Seeed Studio XIAO ESP32S3 Sense |
| Processor | ESP32-S3R8 Xtensa LX7 dual-core,32-bit processor that operates at up to 240 MHZ | |
| Wireless | Complete 2.4GHz Wi-Fi subsystem BLE: Bluetooth 5.0, Bluetooth mesh | |
| Built-in Sensors | / | oV2640 camera sensor for 1600*1200 Digital Microphone |
| Memory | On-chip 8M PSRAM & 8MB Flash | On-chip 8M PSRAM & 8MB Flash Onboard SD Card Slot, supporting 32GB FAT |
| Interface | 1x UART,1x IIC,1x IIS,1x SPI,11xGPIOs (PWM), 9x ADC,1x User LED,1x Charge LED 1x Reset button,1x Boot button | 1x UART,1x IIC,1x IIS,1x SPI,11x GPIOs (PWM),9xADC, 1x User LED, 1x Charge LED,1x B2B Connector(with 2 additional GPIOs) 1x Reset button, 1x Boot button |
| Dimensions | 21 x 17.8mm | 21 x 17.8 x 15mm (with expansion board) |
| Power | Input voltage (Type-C): 5V Input voltage (BAT): 4.2V | |
| | Circuit operating Voltage (ready to operate): - Type-C:5V@19mA - BAT: 3.8V@22mA | Circuit operating Voltage (ready to operate): -Type-C: 5V@38.3mA - BAT: 3.8V@43.2mA (with expansion board) |
| | / | Webcam Web application: - Type-C: - - Average power consumption: |

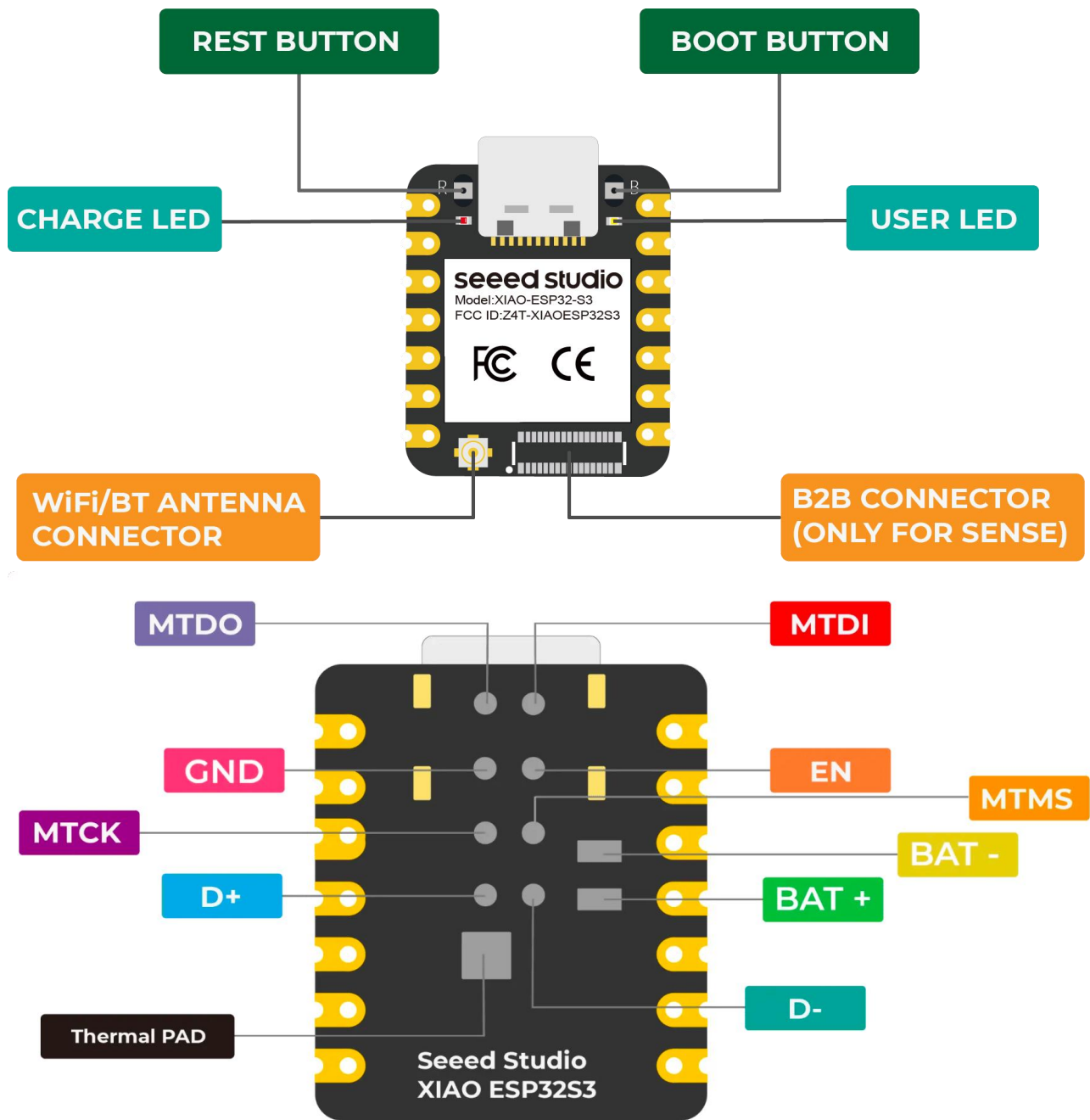
| | | |
|---|---|---|
| | | 5V/138mA - - Photo moment: 5V/341mA - Battery: - - Average power consumption: 3.8V/154mA - - Photo moment: 3.8V/304mA |
| | / | Microphone recording & SD card writing:- Type-C: - - Average power consumption: 5V/46.5mA - - Peak power consumption: 5V/89.6mA - Battery: - - Average power consumption: 3.8V/54.4mA - - Peak power consumption: 3.8V/108mA |
| | Charging battery current: 100mA | Charging battery current: 100mA |
| Low Power Consumption Model (Supply Power: 3.8V) | Modem-sleep Model:~ 25mA Light-sleep Model: ~ 2 mA Deep Sleep Model:~14 μ A | Modem-sleep Model: ~44mA Light-sleep Model: ~5mA Deep Sleep Model: ~3mA |
| Wi-Fi Enabled Power Consumption | Active Model: ~ 100 mA | Active Model: ~ 110 mA (with expansion board) |
| BLE Enabled Power Consumption | Active Model: ~85 mA | Active Model: ~ 102 mA (with expansion board) |
| Working Temperature | -40°C ~65°C | |

Hardware Overview

Note

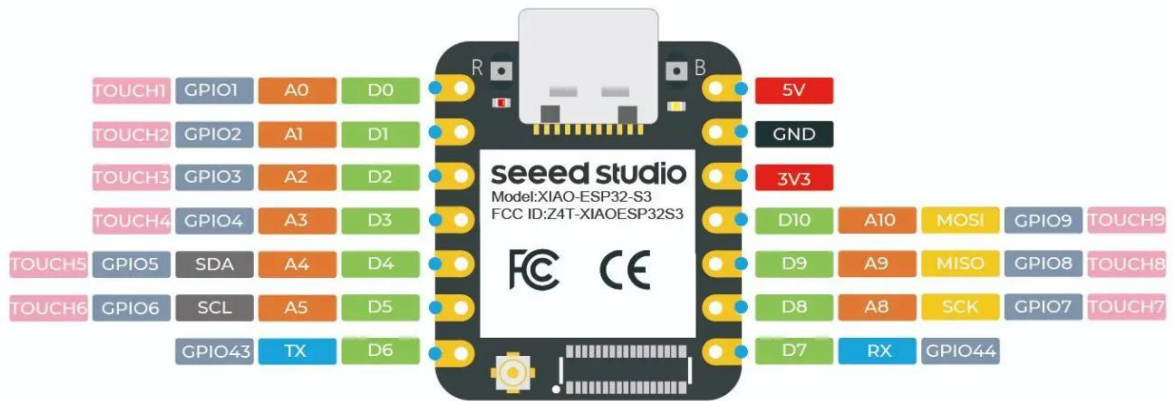
There are two additional GPIO on the plug-in camera sensor board linking to the microphone. If you want to apply these two external IO, the microphone should not be used at the same time.

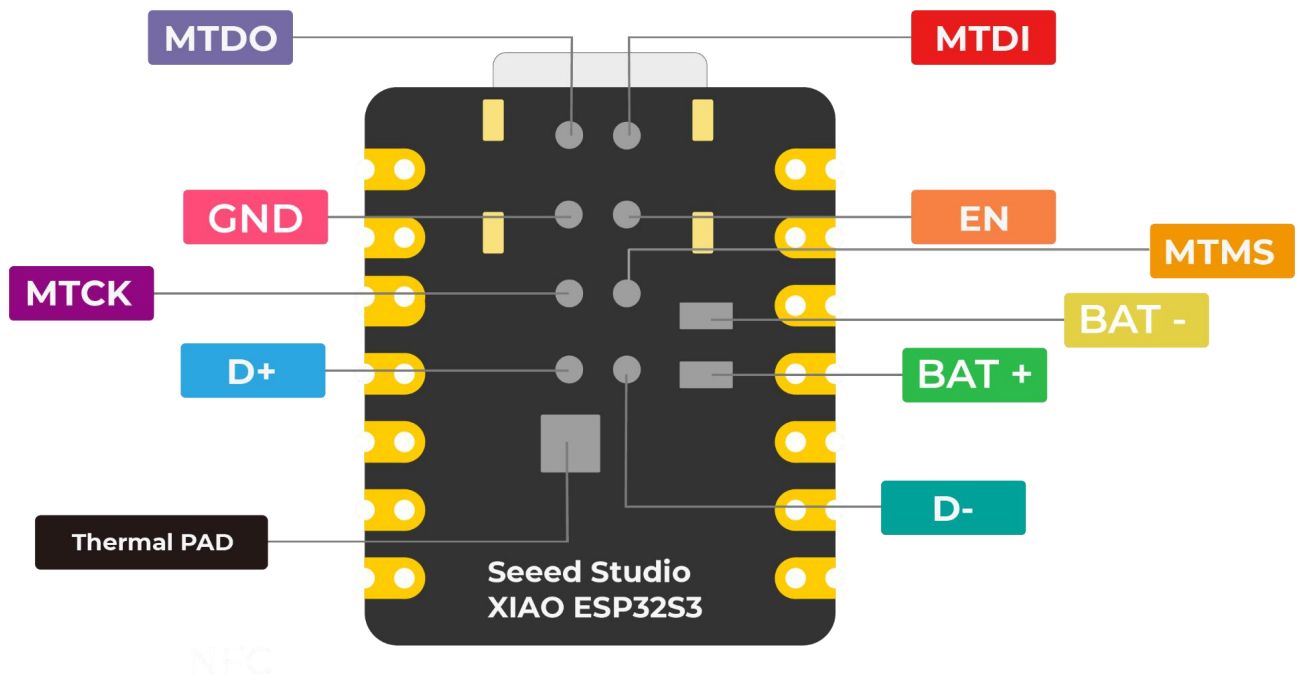
- *Onboard*



• PinOut

FRONT





Application

- *Image processing*
- *Speech Recognition*
- *Video Monitoring*
- *Wearable devices*
- *Smart Homes*
- *Health monitoring*
- *Education*
- *Low-Power(LP) networking*
- *Rapid prototyping*

Documents

[OV2640 Camera Datasheet](#)

[ESP32-S3 Datasheet](#)

[TinyML Case Studies](#)

[XIAO Reference Design](#)

[3D Printing "Case" Studies](#)

[3D Printing Purple shell \(top\)](#)

[3D Printing Purple shell \(bottom\)](#)

ECCN/HTS



| | |
|----------|------------|
| HSCODE | 8517180050 |
| USHSCODE | 8543708800 |
| UPC | |
| EUHSCODE | 8543709099 |
| COO | CHINA |
| | |

Part List

| | |
|-----------------------------|----|
| XIAO ESP32S3 | x1 |
| Plug-in camera sensor board | x1 |
| Aluminum Heat Sink For XIAO | x2 |
| 7 Pin Header | x2 |

| | |
|---------|----|
| Antenna | x1 |
|---------|----|

Note: From September 2, Seeed Studio XIAO ESP32S3 Sense from the CN warehouse will include 2 free aluminum heat sinks. Please note that shipments from the overseas warehouse are still the old version without heat sinks. We will send the new version to the overseas warehouse as soon as possible.

*Join Seeed's Affiliate Program and earn rewards by sharing products on your website, YouTube, Hackster, and more. **Sign up today!***

FCC Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment

***RF warning for Mobile device:**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

The OEM must certify the final end product to comply with unintentional radiators (FCC Sections 15.107 and 15.109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID: Z4T-XIAOESP32S3P".

Additionally, the following statement should be included on the label and in the final product's user manual:

"This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interferences, and

(2) this device must accept any interference received, including interference that may cause undesired operation." The module is limited to installation in applications. Separate approval is required for all other operating configurations, including portable configuration with respect to Part 2.1093 and different antenna configurations. A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end - use operational conditions, including simultaneous transmission operations. When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application. When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together. This Module is full modular approval, it is limited to OEM installation ONLY. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change. (OEM) Integrator has to assure compliance of the entire end product include the integrated Module.

Additional measurements (15B) and/or equipment authorizations (e.g. Verification) may need to be addressed depending on co-location or simultaneous transmission issues if applicable. (OEM) Integrator is reminded to assure that these installation

instructions will not be made available to the end user.

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

FCC Part 15 Subpart C 15.247 & 15.207 & 15.209 & 15.205

2.3 Specific operational use conditions

When installed in smart terminal products, the host manufacturer must negotiate with the module manufacturer on the final installation method in the system. The module can be used for mobile applications with a maximum 1.16 dBi antenna. The host manufacturer installing this module into their product must ensure that the final product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

The module should be installed and operated with minimum distance 20cm between the radiator & your body. and if RF exposure statement or module layout is changed, then the host product manufacturer required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization. When the host is a portable device, it is necessary to take a SAR test with your set mounting this module. Class II permissive change application is necessary using the SAR report. Please contact kevin (kevin@sziton.com). And an application for a Class II permissive change from a Mobile equipment to a Portable equipment is also required.

Note) Portable equipment : Equipment for which the spaces between human body and antenna are used within 20cm. Mobile equipment : Equipment used at position in which the spaces between human body and antenna exceeded 20cm.

1. According to the following requirements of the power supply DC3.3V, power up, about 3 seconds to to complete the initial.
2. iphone/Android mobile phone BT/WIFI function to open, search to the corresponding Wireless network adapter name (name can be changed according to customer production requirements), click the name of the BT/WIFI and select the connection.
3. open application software (need to install the company's specific application software development, application software interface can be customized according to customer's product requirements).

2.4 Limited module procedures

The module is a Single module.

| Requirement per 15.212 and KDB 996369 D01 | Explanation from Grantee (do not write yes/no, but explain why product complies/how it is achieved) |
|--|---|
| The radio elements must have the radio frequency circuitry shielded. Physical components and tuning capacitor(s) may be located external to the shield, but must be on the module assembly. | Has RF shielding. |
| The module must have buffered modulation/data inputs to ensure that the device will comply with Part 15 requirements with any type of input signal. | The modular have buffered modulation/data inputs. |
| The module must contain power supply regulation on the module. | The modular transmitter have its own power supply regulation.(DC 3.3V) |
| The module must contain a permanently attached antenna, or contain a unique antenna connector, and be marketed and operated only with specific antenna(s), per §§ 15.203, 15.204(b), 15.204(c), 15.212(a), 2.929(b). | Antenna restrictions are added in the manual.The antenna needs to be professionally installed. |
| The module must demonstrate compliance in a stand-alone configuration. | The module was tested in a stand-alone configuration, please refer to the Setup Photo for the detail |
| The module must be labeled with its permanently affixed FCC ID label, or use an electronic display (see KDB Publication 784748). | Please refer to label sample exhibit - host labeling is described in integration manual |
| The module must comply with all specific rules applicable to the transmitter, including all the conditions provided in the integration instructions by the grantee. | The required FCC rule has been fulfilled and all the instructions for the maintaining compliance have been clearly stated in the User Manual. |
| The module must comply with RF exposure requirements | The MPE evaluation with 20cm distance restriction is submitted for the compliance of RF Exposure requirement. |

2.5 Trace antenna designs

Please perform the Trace antenna design that followed the specifications of the antenna.

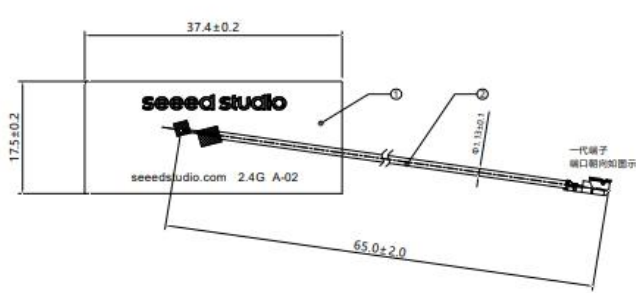
The concrete contents of a check are the following three points.

- 1) It is the same type as the antenna type of antenna specifications.Confirm the same size as the Gerber file.
- 2) An antenna gain is lower than a gain given in antenna specifications.Measure the gain, and confirm the peak gain is less than 1.16dBi.
- 3) The emission level is not getting worse. Measure the spurious, and confirm degradation of less than 3dB than spurious value of worst of report used for the application.

FPC antenna specification

You can see antenna size is 37.4±0.2mm*17.5±0.2mm* From below Specification.

| REV. | DESCRIPTION | APPD. | DATE |
|------|------------------|-------|------------|
| A | INITIAL RELEASED | Chen | 2024/10/08 |

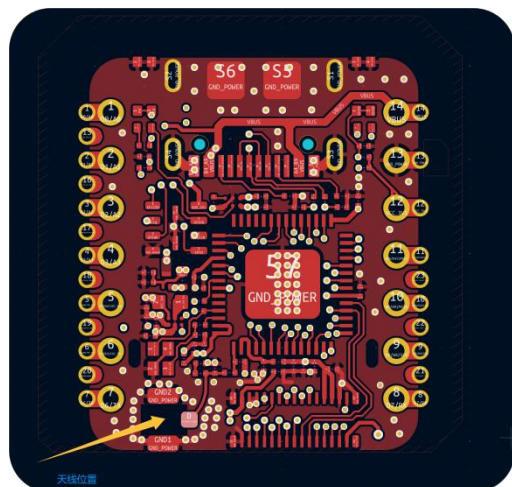


备注:

- 1.频率范围: 2400-2500MHz
- 2.阻抗:50Ω
- 3.驻波:≤4.5
- 4.最大增益:1.16dBi
- 5.最大效率:61.84%
- 6.线焊接后, 焊点总高度1.80mm MAX (含离型纸)
- 7.线极化:线极化
- 8.温度范围:-40℃- 85℃
- 9.各零件符合ROHS

| | | | | | | |
|-----|--------------|----------|-------|--------------|--------|--------|
| 2 | Coaxial Line | | Black | Φ1.13*65.0mm | 1 | |
| 1 | FPC | | Black | 37.4*17.5mm | 1 | |
| No. | Name | Material | Color | Treatment | Amount | Remark |

Please refer to the chart below for PCB size of RF line terminal.



Scrape a GND off the side of the ANT1,connect the FPC antenna to the PCB at the position of the ANT1 connector.

2.6 RF exposure considerations

The module complies with FCC radiation exposure limits set forth for an uncontrolled environment.The module should be installed and operated with minimum distance 20cm between the radiator & your body.

2.7 Antennas

This module has been approved to operate with the antenna types listed below, with the maximum permissible gain indicated.The module antenna requires professional installation, and the antenna type cannot be changed. The gain cannot exceed 1.16dBi.

| Frequency band | Antenna Type | Model Number | Max Gain |
|----------------|--------------|-------------------------------|-----------|
| 2400-2500MHz | FPC Antenna | XIAO ESP32S3 Sense Plus | 1.16(dBi) |

This device is intended only for host manufacturers under the following conditions: The transmitter module may not be co-located with any other transmitter or antenna; The module shall be only used with the External antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a 'unique' antenna coupler.

As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

2.8 Label and compliance information

Host product manufacturers need to provide a physical or e-label stating

"Contains FCC ID: Z4T-XIAOESP32S3P With their finished product.

2.9 Information on test modes and additional testing requirements

The module complies with FCC radiation exposure limits set forth for an uncontrolled environment. The module should be installed and operated with minimum distance 20cm between the radiator & your body. and if RF exposure statement or module layout is changed, then the host product manufacturer required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization. When the host is a portable device, it is necessary to take a SAR test with your set mounting this module. Class II permissive change application is necessary using the SAR report. Please contact kevin (kevin@sziton.com). And an application for a Class II permissive change from a Mobile equipment to a Portable equipment is also required.

Note) Portable equipment : Equipment for which the spaces between human body and antenna are used within 20cm. Mobile equipment : Equipment used at position in which the spaces between human body and antenna exceeded 20cm.

Host manufacturer must perform test of radiated & conducted emission and spurious emission, etc according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

Only when all the test results of test modes comply with FCC requirements, then the end product can be sold legally.

2.10 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 & 15.207 & 15.209 & 15.205 and that the host product manufacturer is responsible for compliance to any

other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

2.11 The user manual of the end product should include:

- a) Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.
- b) The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons.
- c) This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
- d) This device is restricted to indoor use.
- e) The antenna(s) used for this transmitter must not transmit simultaneously with any other antenna or transmitter.