Seeed Studio XIAO ESP32 S3 Sense

Seeed Studio XIAO ESP32 S3 Sense User Manual

Model: ESP32-S3 Sense

Brand: Seeed Studio

1. Introduction

The Seeed Studio XIAO ESP32 S3 Sense is a compact and versatile microcontroller unit (MCU) board designed for Internet of Things (IoT) and embedded machine learning (ML) applications. It integrates a powerful ESP32-S3 chip, offering 2.4GHz Wi-Fi and BLE 5.0 connectivity. This board features a detachable OV2640 camera sensor, a digital microphone, and ample memory with 8MB PSRAM and 8MB Flash, along with an SD card slot for expanded storage. Its small form factor makes it suitable for space-constrained projects.

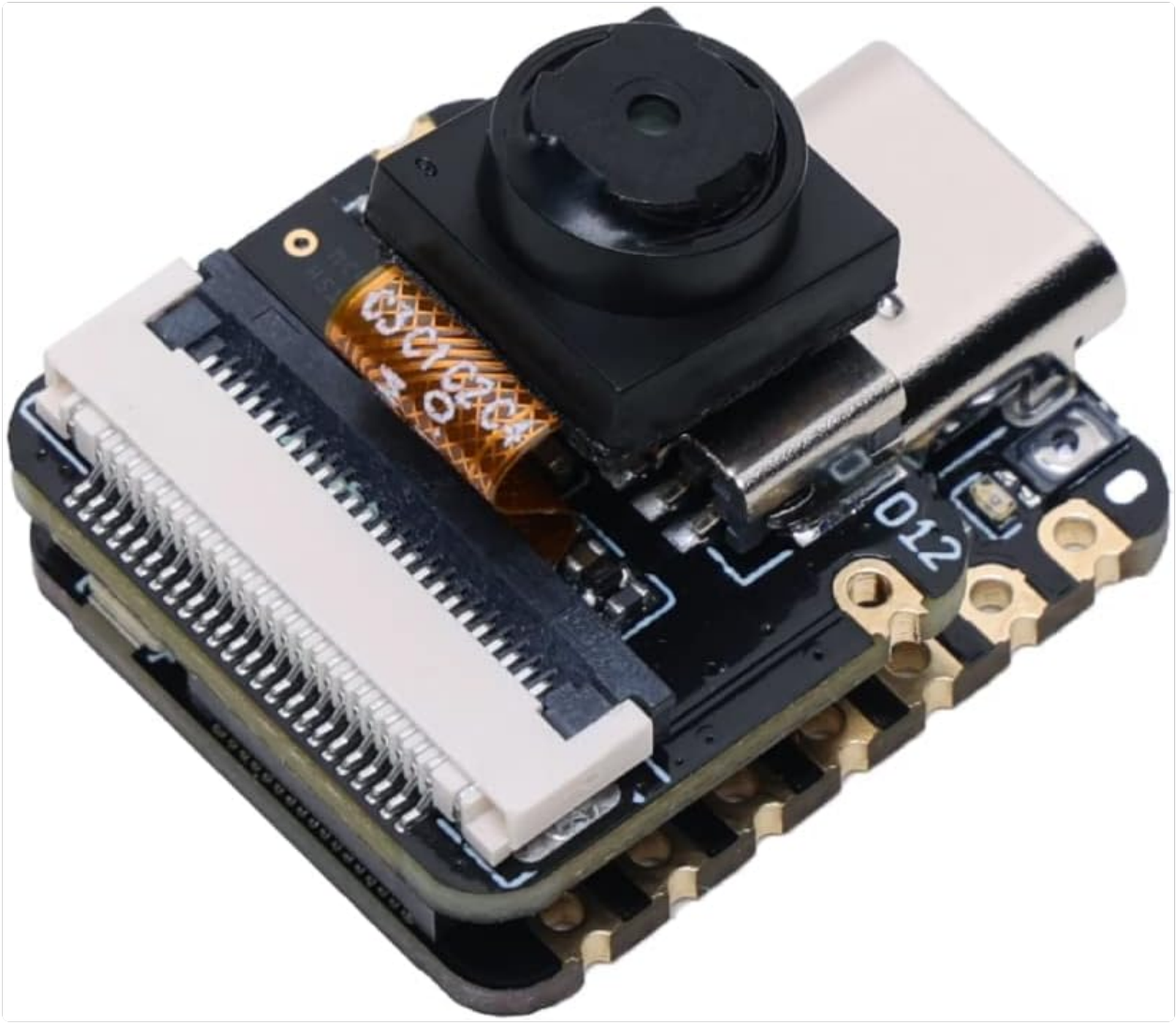

Figure 1: Seeed Studio XIAO ESP32 S3 Sense development board with camera module attached.

2. What's in the Box

- 1 x XIAO ESP32 S3 Sense Board

3. Key Features

- **Processor:** Incorporates the ESP32 S3 32-bit, dual-core, Xtensa processor chip, operating up to 240 MHz. Supports Arduino and MicroPython development.
- **Advanced Functionality:** Features a detachable OV2640 camera sensor for 1600x1200 resolution, compatible with the OV5640 camera sensor, and integrates a digital microphone.
- **Memory:** Offers 8MB PSRAM and 8MB FLASH. Includes an SD card slot for external 32GB FAT memory expansion.
- **RF Performance:** Supports 2.4GHz Wi-Fi and BLE dual wireless communication. Capable of 100m+ remote communication when connected with a U.FL antenna.
- **Compact Design:** Measures 21 x 17.5mm, adopting the classic XIAO form factor, suitable for space-limited projects such as wearable devices.

Figure 2: Overview of AI detection, microphone, and Micro SD card capabilities.

Figure 3: Detachable OV2640 camera sensor for high-resolution imaging and AI applications.

4. Hardware Overview

4.1 Board Components

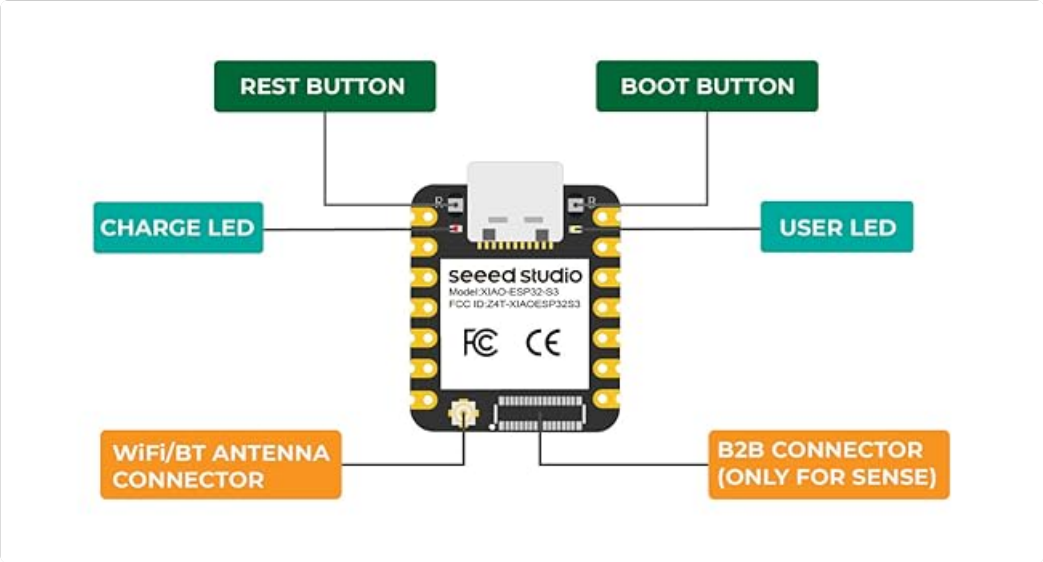

Figure 4: Key components of the XIAO ESP32 S3 Sense board.

4.2 Pinout Diagram

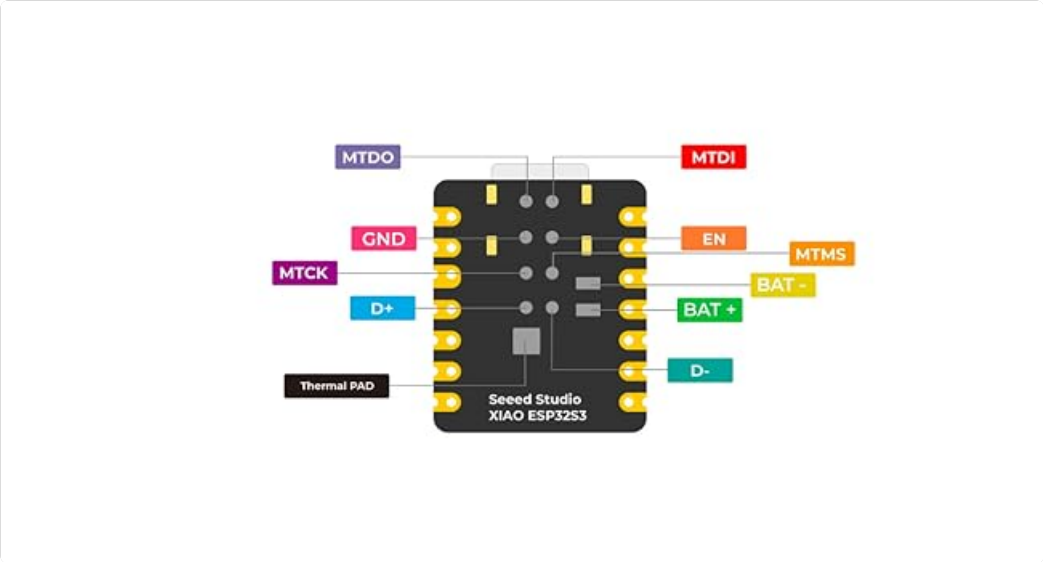

Figure 5: Pin assignments on the underside of the XIAO ESP32 S3 Sense board.

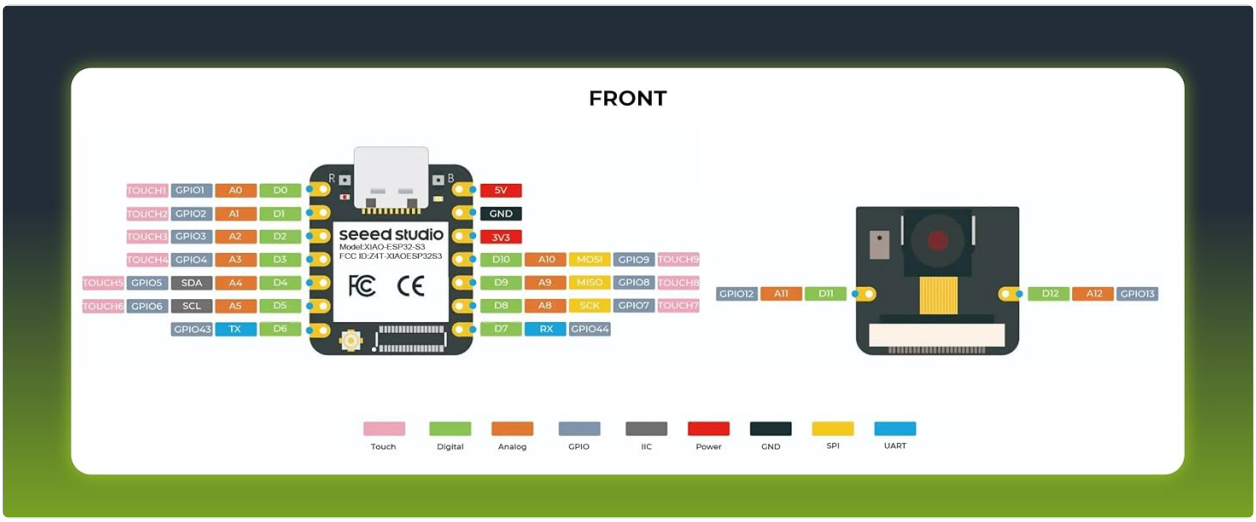

Figure 6: Comprehensive pinout diagram including camera module connections.

5. Setup Instructions

5.1 Initial Board Setup

1. **Connect the Camera Module:** Carefully align and connect the detachable OV2640 camera sensor to the designated connector on the XIAO ESP32 S3 Sense board.
2. **Attach the Antenna:** If using an external U.FL antenna for extended range, connect it to the U.FL connector on the board.
3. **Power Connection:** Connect the board to your computer using a USB Type-C cable. Ensure the cable supports data transfer.
4. **Driver Installation:** Your operating system may automatically install necessary drivers. If not, refer to the official Seeed Studio documentation for specific driver installation instructions for the ESP32-S3.
5. **IDE Setup:** Install your preferred Integrated Development Environment (IDE), such as Arduino IDE or PlatformIO. Configure it to support ESP32-S3 boards.

Figure 7: Components of the XIAO ESP32 S3 Sense before assembly.

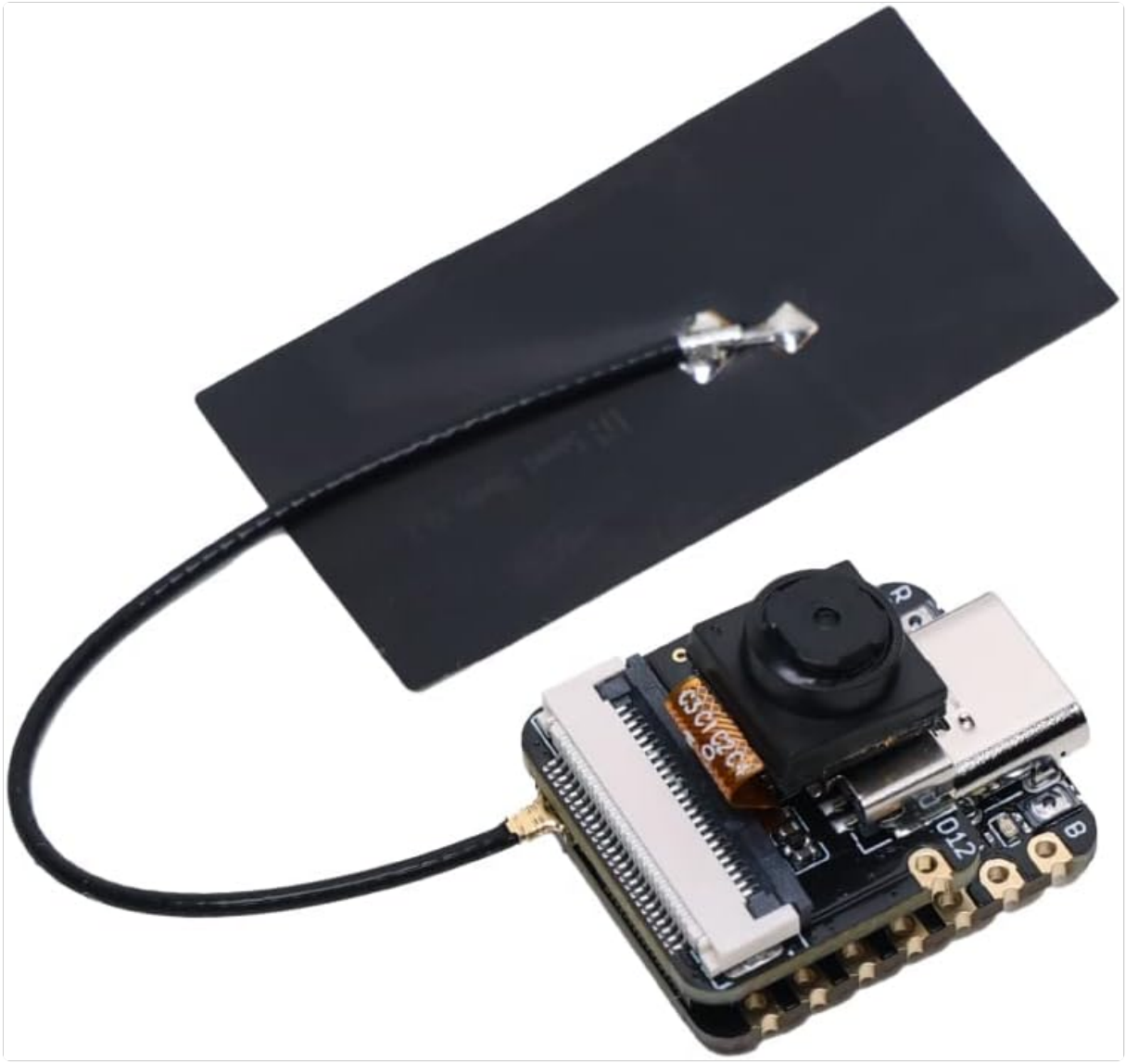

Figure 8: Fully assembled XIAO ESP32 S3 Sense with camera and antenna.

6. Operating Principles

6.1 Programming Environments

The XIAO ESP32 S3 Sense supports various programming environments, including:

- **Arduino IDE:** A popular choice for beginners and hobbyists, offering a simplified programming experience.
- **MicroPython:** Allows programming the board using Python, suitable for rapid prototyping and IoT applications.
- **PlatformIO:** A professional embedded development ecosystem that supports multiple platforms and frameworks, including ESP-IDF.
- **Zephyr:** A real-time operating system (RTOS) for embedded devices, offering advanced features for complex applications.

6.2 Wireless Communication

The integrated ESP32-S3 chip provides robust 2.4GHz Wi-Fi and Bluetooth Low Energy (BLE) 5.0 capabilities. These can be utilized for network connectivity, data transfer, and communication with other devices. Refer to the respective SDK documentation for detailed API usage.

6.3 Camera and Microphone Usage

The OV2640 camera sensor and digital microphone enable various applications such as image capture, video streaming, audio recording, and embedded machine learning for vision and voice recognition. Example code and libraries are typically available through the Seeed Studio documentation or community resources to facilitate their use.

7. Maintenance

- **Handling:** Handle the board with care to avoid electrostatic discharge. Use anti-static precautions when possible.
- **Cleaning:** Keep the board clean and free from dust and debris. Use a soft, dry brush or compressed air for cleaning. Avoid liquid cleaners.
- **Storage:** Store the board in a dry, cool environment, away from direct sunlight and extreme temperatures.
- **Firmware Updates:** Regularly check for firmware updates from Seeed Studio to ensure optimal performance and access to new features.

8. Troubleshooting

- **Board Not Detected:** Ensure the USB Type-C cable is functional and supports data transfer. Try a different USB port or cable. Verify that the correct drivers are installed.
- **Upload Errors:** If encountering issues uploading code, ensure the correct board and port are selected in your IDE. Sometimes, holding the BOOT button while connecting the USB cable or during upload can resolve issues.
- **Wi-Fi/BLE Connectivity Issues:** Check antenna connection. Verify network credentials and ensure the device is within range of the access point or Bluetooth device.
- **Camera/Microphone Not Functioning:** Ensure the camera module is securely connected. Verify that the correct libraries and example code are being used.
- **Overheating:** While normal operation may generate some heat, excessive heat could indicate a short circuit or improper power supply. Disconnect power immediately and inspect the board.

For further assistance, consult the official Seeed Studio documentation and community forums.

9. Technical Specifications

Feature	Specification
Processor	ESP32-S3 (32-bit, dual-core, Xtensa)
CPU Speed	Up to 240 MHz
RAM	8MB PSRAM
Flash Memory	8MB
Wireless Connectivity	2.4GHz Wi-Fi, BLE 5.0
Camera Sensor	Detachable OV2640 (1600x1200 resolution), compatible with OV5640
Audio Input	Digital Microphone

Feature	Specification
External Storage	SD card slot (supports 32GB FAT)
Operating System Support	FreeRTOS
Dimensions (LxWxH)	0.83 x 0.69 x 0.83 inches (21 x 17.5 x 21 mm)
Item Weight	0.704 ounces
Power Input	USB Type-C, Battery Charge Supported

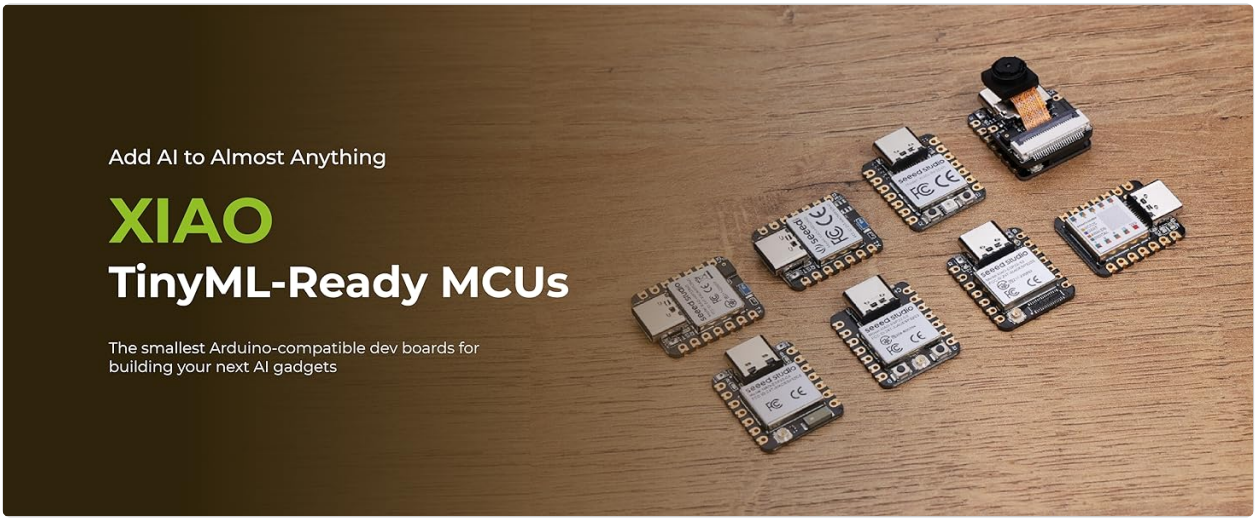

Figure 9: Seeed Studio XIAO Series Comparison Table.

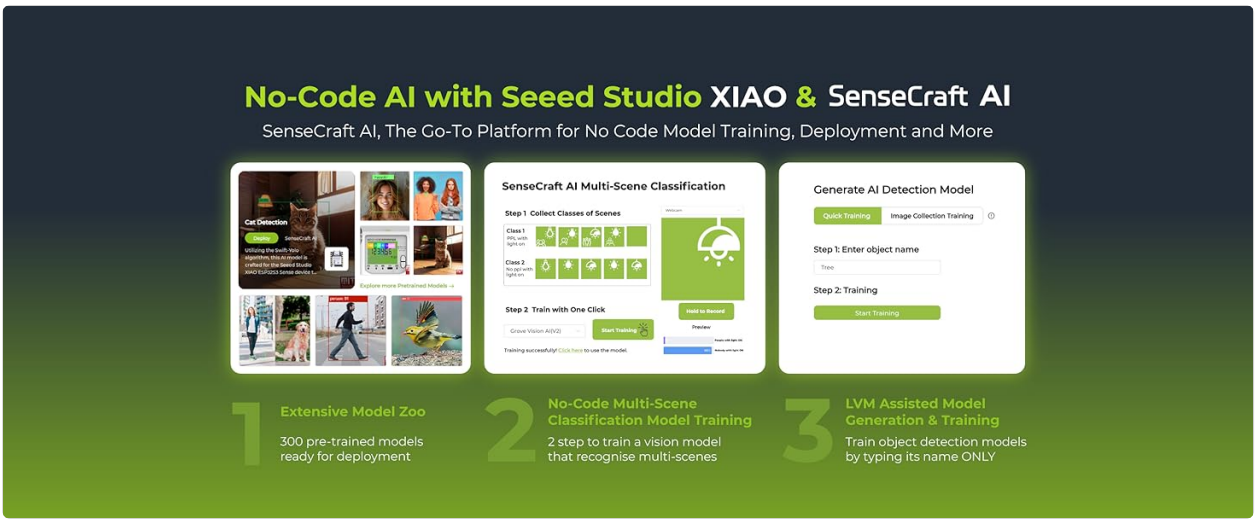

Figure 10: Detailed Specifications for XIAO ESP32S3 and XIAO ESP32S3 Sense.

10. Warranty and Support

Seeed Studio products are typically covered by a manufacturer's warranty. For specific warranty terms, return policies, and technical support, please refer to the official Seeed Studio website or contact their customer service directly. Online resources, including documentation, tutorials, and community forums, are also available for assistance.

Official Website: www.seeedstudio.com

Related Documents - XIAO ESP32 S3 Sense

	Seeed Studio XIAO Series Package and PCB Design Guide Detailed technical specifications and PCB design guidance for the Seeed Studio XIAO series of miniature development boards, including SAMD21, RP2040, nRF52840, nRF52840 Sense, and ESP32C3. Features include pinouts, land pattern dimensions, and integration information. Learn about Seeed Fusion services for PCB assembly.
	Seeed Studio XIAO ESP32C6 Product Details and Getting Started Guide Detailed information about the Seeed Studio XIAO ESP32C6, a powerful IoT development board featuring ESP32-C6 SoC, dual RISC-V processors, Wi-Fi 6, Bluetooth 5.3, Zigbee, and Thread. Includes features, specifications, and a getting started guide.
	SenseCAP Indicator User Manual - Seeed Studio Comprehensive user manual for the Seeed Studio SenseCAP Indicator, a 4-inch touch screen IoT development platform powered by ESP32-S3 and RP2040, featuring Wi-Fi, BLE, LoRa, and air quality monitoring capabilities.
	SenseCAP Indicator User Manual - Seeed Studio Comprehensive user manual for the Seeed Studio SenseCAP Indicator, an open-source IoT development platform featuring a 4-inch touch screen, ESP32 and RP2040 MCUs, and Wi-Fi/BLE/LoRa connectivity. Includes setup, features, specifications, and development tutorials.
	XIAO ESP32C3 Power Consumption Modes and Test Results A comprehensive guide to the power consumption modes of the Seeed Studio XIAO ESP32C3 microcontroller, detailing Active, Modem-sleep, Light-sleep, and Deep-sleep states with corresponding test results and configuration commands.
	Seeed Studio XIAO ePaper Display Board EE04 Technical Schematics Detailed technical schematics and block diagram for the Seeed Studio XIAO ePaper Display Board EE04. Covers power management, microcontroller integration, and e-ink display interfaces.


seeed studio

PRODUCT CHANGE NOTIFICATION

PCN#	PCN20250630-010	PCN ISSUE DATE	Jun 30, 2025

PCN TITLE

SKU#113991115, Seeed Studio XIAO ESP32-S3 Sense

SKU#102010635, Seeed Studio XIAO ESP32-S3 Sense Pre-Soldered

REVISION	CUSTOMER CONTACT

TYPE OF CHANGE

☐ Electrical Specification ☐ Part Number
☐ Mechanical Specification ☐ End of Life
☐ Firmware Specification ☒ Other
☐ Regulatory of Compliance

AFFECTED PART NUMBER(S)

Part Number	Name
113991115	Seeed Studio XIAO ESP32-S3 Sense
102010635	Seeed Studio XIAO ESP32-S3 Sense (Pre-Soldered)

CHANGE DESCRIPTION

Only replace the camera sensor from OV2640 to OV5640, with all other settings remaining unchanged.

Change FROM

Part Number	Name	Image
113991115	Seeed Studio XIAO ESP32-S3 Sense	
102010635	Seeed Studio XIAO ESP32-S3 Sense (Pre-Soldered)	

[pdf] Specifications

lisa li PCN XIAO ESP32 S3 Sense Series Camera Upgradefiles seeedstudio wiki SeeedStudio ESP32S3 res Upgrade |||

PRODUCT CHANGE NOTIFICATION PCN# PCN20250630-010 PCN ISSUE DATE PCN TITLE SKU#113991115, Seeed Studio XIAO ESP32-S3 Sense SKU#102010635, Seeed Studio XIAO ESP32-S3 Sense Pre-Soldered REVISION CUSTOMER CONTACT TYPE OF CHANGE Jun 30, 2025 Electrical Specification Mechanical Specification ...

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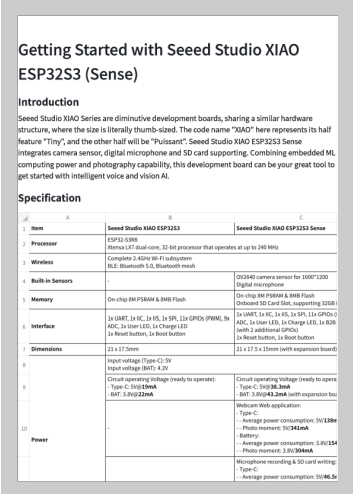
Getting Started with Seeed Studio XIAO ESP32S3 (Sense)

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.

Specification

	Item	Seeed Studio XIAO ESP32S3	Seeed Studio XIAO ESP32S3 Sense
2	Processor	ESP32-S3R8 Xtensa LX7 dual-core, 32-bit processor that operates at up to 240 MHz	
3	Wireless	Complete 2.4GHz Wi-Fi subsystem BLE: Bluetooth 5.0, Bluetooth mesh	
4	Built-in Sensors		OV2640 camera sensor for 1600*1200 Digital microphone
5	Memory	On-chip 8M PSRAM & 8MB Flash	On-chip 8M PSRAM & 8MB Flash Onboard SD Card Slot, supporting 32GB
6	Interface	1x UART, 1x IIC, 1x IIS, 1x SPI, 11x GPIOs (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 (ADC, 1x User LED, 1x Charge LED, 1x RGB (with 2 additional GPIOs) 1x Reset button, 1x Boot button
7	Dimensions	21 x 17.5mm	21 x 17.5 x 15mm (with expansion board)
8		Input voltage (Type-C): 5V Input voltage (BAT): 4.2V	
9		Circuit operating Voltage (ready to operate): - Type-C: 5V@**39.3mA** - BAT: 3.8V@**22mA**	Circuit operating Voltage (ready to opera - Type-C: 5V@**38.3mA** - BAT: 3.8V@**43.2mA** (with expansion bo
10	Power	-	Webcam Web application: - Type-C: -- Average power consumption: 5V/**138** -- Photo moment: 5V/**341mA** - Battery: -- Average power consumption: 3.8V/**154** -- Photo moment: 3.8V/**304mA**
			Microphone recording & SD card writing: - Type-C: -- Average power consumption: 5V/**46.5**

[pdf] User Manual Quick Start Guide Specifications

User Manual Seeed Technology Co Ltd XIAOESP32S3 Z4T Z4TXIAOESP32S3 xiaoesp32s3

Getting Started with Seeed Studio XIAO ESP32S3 Sense 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 Pui...

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[pdf] Flyer

XIAO Seeed Studio tinyML Ready Platform The Series is a collection of thumb sized powerful microcontroller units MCUs tailor made for space conscious projects requiring high files seeedstudio Product Flyers |||

Seeed Studio XIAO, tinyML-Ready Platform Add AI to Almost Everything The Seeed Studio XIAO Series is a collection of thumb-sized, powerful microcontroller units MCUs tailor-made for space-conscious projects requiring high performance and wireless connectivity. Embodying the essence of popular har...

lang:en score:37 filesize: 5.97 M page_count: 2 document date: 2025-03-05


CTI 华测检测

Report No. : EED32P80440603 Page 1 of 7

RF Exposure Evaluation Report

Product	:	Seeed Studio XIAO ESP32S3, Seeed Studio XIAO ESP32S3 Sense
Trade mark	:	Seeed Studio
Model/Type reference	:	XIAO-ESP32-S3, XIAO-ESP32-S3-Sense
Serial Number	:	N/A
Report Number	:	EED32P80440603
FCC ID	:	Z4T-XIAOESP32S3
Date of Issue	:	Apr. 20, 2023
Test Standards	:	47 CFR Part 1.1307 47 CFR Part 1.1310 47 CFR Part 2.1091 47 CFR Part 2.1093 447498 D04 Interim General RF Exposure Guidance v01
Test result	:	PASS

Prepared for:
Seeed Technology Co., Ltd
9F, Building G3, TCL International E city, Zhongshanyuan Road, Nanshan, Shenzhen, China.
Prepared by:
Centre Testing International Group Co., Ltd.
Hongwei Industrial Zone, Bao'an 70 District, Shenzhen, Guangdong, China
TEL: +86-755-3368 3668
FAX: +86-755-3368 3385

Compiled by: Frazer Li — Reviewed by: Tom Chen
Approved by: Aaron Ma — Date: Apr. 20, 2023

[pdf] SAR Rating

HD 271 S1 LAB02 SAR Exclusion Seeed Technology Co Ltd XIAOESP32S3 Z4T Z4TXIAOESP32S3 xiaoesp32s3

Report No. : EED32P80440603 1 COVER PAGE Page 1 of 7 RF Exposure Evaluation Report Product Trade mark Model/Type reference Serial Number Report Number FCC ID Date of Issue Test Standards Test result : Seeed Studio XIAO ESP32S3, Seeed Studio XIAO ESP32S3 Sense : Seeed Studio : XIAO-ESP32-S3, XIAO...

lang:en score:33 filesize: 553.1 K page_count: 7 document date: 2023-04-20


CTI 华测检测

Report No. : EED32P80440601 Page 1 of 71

TEST REPORT

Product	:	Seeed Studio XIAO ESP32S3, Seeed Studio XIAO ESP32S3 Sense
Trade mark	:	Seeed Studio
Model/Type reference	:	XIAO-ESP32-S3, XIAO-ESP32-S3-Sense
Serial Number	:	N/A
Report Number	:	EED32P80440601
FCC ID	:	Z4T-XIAOESP32S3
Date of Issue	:	Apr. 20, 2023
Test Standards	:	47 CFR Part 15 Subpart C
Test result	:	PASS

Prepared for:
Seeed Technology Co., Ltd
9F, Building G3, TCL International E city, Zhongshanyuan Road, Nanshan, Shenzhen, China.
Prepared by:
Centre Testing International Group Co., Ltd.
Hongwei Industrial Zone, Bao'an 70 District, Shenzhen, Guangdong, China
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FAX: +86-755-3368 3385

Compiled by: Frazer Li — Reviewed by: Tom Chen
Approved by: Aaron Ma — Date: Apr. 20, 2023

[pdf] Test Report

HD 271 S1 Sheek Luo BLE Test Report Seeed Technology Co Ltd XIAOESP32S3 Z4T Z4TXIAOESP32S3 xiaoesp32s3

Report No. : EED32P80440601 Page 1 of 71 1 COVER PAGE TEST REPORT Product Trade mark Model/Type reference Serial Number Report Number FCC ID Date of Issue Test Standards Test result : Seeed Studio XIAO ESP32S3, Seeed Studio XIAO ESP32S3 Sense : Seeed Studio : XIAO-ESP32-S3, XIAO-ESP32-S3-Sense ...

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CTI 华测检测

Report No. : EED32P80440602 Page 1 of 72

TEST REPORT

Product	:	Seeed Studio XIAO ESP32S3, Seeed Studio XIAO ESP32S3 Sense
Trade mark	:	Seeed Studio
Model/Type reference	:	XIAO-ESP32-S3, XIAO-ESP32-S3-Sense
Serial Number	:	N/A
Report Number	:	EED32P80440602
FCC ID	:	Z4T-XIAOESP32S3
Date of Issue	:	Apr. 20, 2023
Test Standards	:	47 CFR Part 15 Subpart C
Test result	:	PASS

Prepared for:
Seeed Technology Co., Ltd
9F, Building G3, TCL International E city, Zhongshanyuan Road, Nanshan, Shenzhen, China.
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FAX: +86-755-3368 3385

Compiled by: Frazer Li — Reviewed by: Tom Chen
Approved by: Aaron Ma — Date: Apr. 20, 2023

[pdf] Test Report

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Report No. : EED32P80440602 Page 1 of 72 1 COVER PAGE TEST REPORT Product Trade mark Model/Type reference : Seeed Studio XIAO ESP32S3, Seeed Studio XIAO ESP32S3 Sense : Seeed Studio : XIAO-ESP32-S3, XIAO-ESP32-S3-Sense Serial Number Report Number FCC ID Date of Issue Test Standards Test result...

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[Seeed Studio 2025 AI]

Seeed Studio 2025 AI

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[Seeed Studio 2025 Product Catalog: AI Hardware, Edge Computing, and IoT Solutions]

Explore the Seeed Studio 2025 Product Catalog featuring AI hardware, sensor networks, edge computing solutions (NVIDIA Jetson, Raspberry Pi), SenseCraft software, and IoT devices. Discover open-source innovation for developers and industries.

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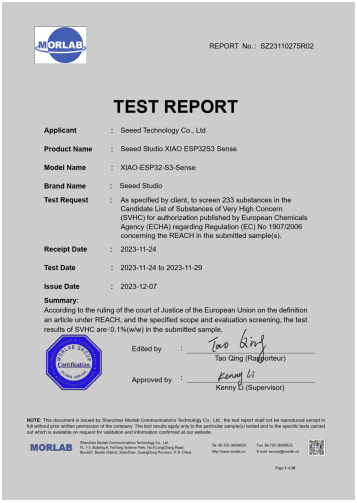

[pdf] Test Report

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REPORT No.SZ23110275R02 TEST REPORT Applicant : Seeed Technology Co., Ltd Product Name : Seeed Studio XIAO ESP32S3 Sense Model Name : XIAO-ESP32-S3-Sense Brand Name Test Request Receipt Date : Seeed Studio : As specified by client, to screen 233 substances in the Candidate List of Substance...

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Seeed Studio 2025 Catálogo de Productos: Hardware de IA, IoT y Edge Computing

Explore el Catálogo de Productos 2025 de Seeed Studio, presentando hardware de IA de vanguardia, soluciones IoT, computación en el borde, sensores, placas de desarrollo y software. Descubra innovaciones para industrias y creadores.

lang:es score:17 filesize: 13.51 M page_count: 99 document date: 2025-04-07