Waveshare ESP32-S3

Waveshare ESP32-S3 3.5-inch Capacitive Touch Display User Manual

Model: ESP32-S3-Touch-LCD-3.5

Introduction

This manual provides essential information for setting up, operating, and maintaining your Waveshare ESP32-S3 3.5-inch Capacitive Touch Display. This development board integrates a powerful ESP32-S3R8 processor with a vibrant 3.5-inch IPS display, offering Wi-Fi, Bluetooth 5, and various peripheral interfaces for a wide range of applications. Please read this manual thoroughly before use to ensure proper functionality and to maximize the potential of your device.

Package Content

Verify that all items listed below are included in your package.

Figure 1: Package Contents. This image displays the ESP32-S3-Touch-LCD-3.5 development board and the included 6 Ohm 1W speaker, which connects via a white JST connector.

- 1x ESP32-S3-Touch-LCD-3.5 Development Board
- 1x 6Ω 1W Speaker

Product Overview and Features

The Waveshare ESP32-S3-Touch-LCD-3.5 is a high-performance, highly integrated MCU board designed for rapid development and integration. It features a 3.5-inch capacitive touch IPS display, comprehensive power management, a 6-axis IMU, and various connectivity options.

Figure 2: ESP32-S3-Touch-LCD-3.5 Overview. This image illustrates the main components and features of the development board, including the CPU, camera interface, onboard antenna, programmable buttons, RTC chip, 6-axis IMU, display driver, touch chip, IPS panel, TF card slot, PMU, and audio capabilities.

Key Features:

- **Processor:** Equipped with ESP32-S3R8 Xtensa 32-bit LX7 dual-core processor, up to 240MHz main frequency.
- **Connectivity:** Supports 2.4GHz Wi-Fi (802.11 b/g/n) and Bluetooth 5 (LE) with an onboard antenna.
- **Memory:** Built-in 512KB of SRAM and 384KB ROM, with onboard 8MB PSRAM and an external 16MB Flash memory.
- **Display:** 3.5-inch capacitive touch IPS display with 320 × 480 resolution and 262K colors, utilizing ST7796 display driver and FT6336 capacitive touch chip.
- **Motion Sensing:** Onboard QMI8658 6-axis IMU (3-axis accelerometer and 3-axis gyroscope) for motion detection.
- **Power Management:** AXP2101 for efficient power management, supporting battery charging, voltage regulation, and 3.7V MX1.25 Lithium battery.
- **Expansion:** TF card slot, onboard camera interface (OV2640/OV5640 compatible), and multiple I/O options (I2C, UART, USB, GPIO).
- **RTC:** PCF85063 RTC chip with reserved RTC battery header.
- **User Interface:** PWR and BOOT programmable buttons.

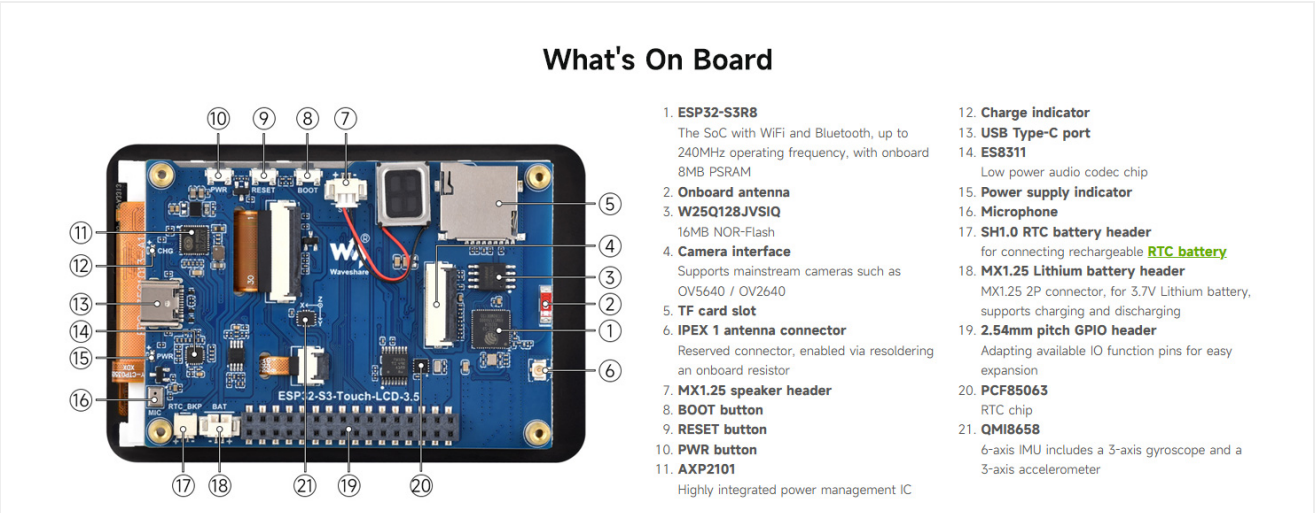

Figure 3: Onboard Components. This diagram labels key components on the ESP32-S3-Touch-LCD-3.5 board, including the ESP32-S3R8 SoC, NOR-Flash, camera interface, TF card slot, speaker header, buttons, AXP2101 PMIC, charge indicator, USB Type-C port, ES8311 audio codec, microphone, RTC battery header, Lithium battery header, GPIO header, PCF85063 RTC chip, and QMI8658 IMU.

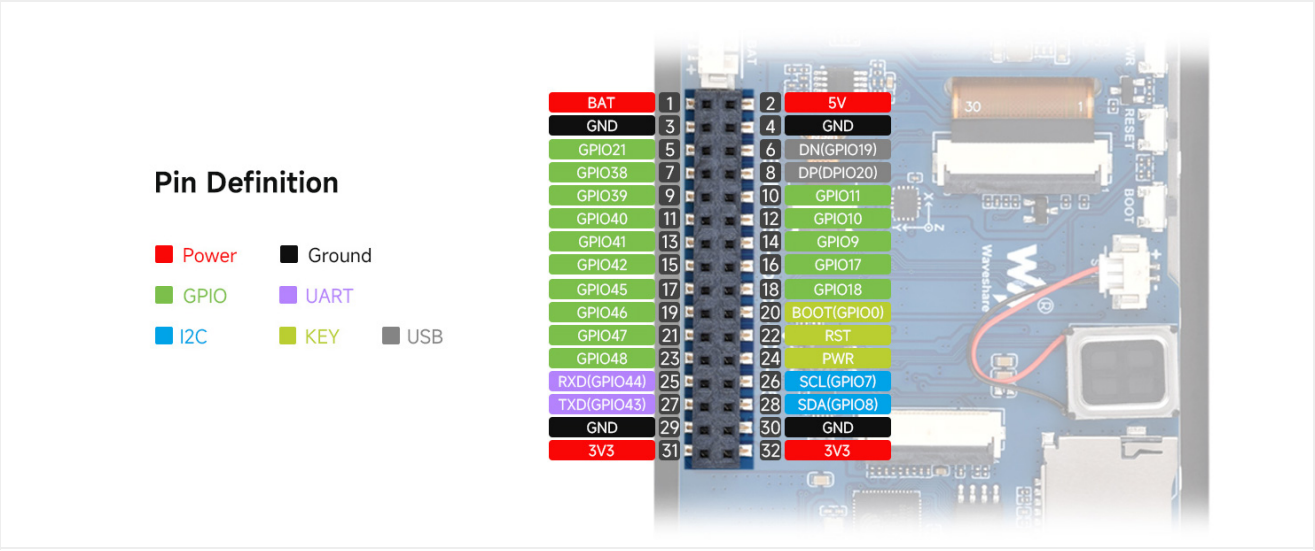

Figure 4: Pin Definition. This image provides a detailed pinout diagram, categorizing pins by function (Power, Ground, GPIO, UART, I2C, Key, USB) for easy reference during development.

Setup

This section outlines the basic steps to get your ESP32-S3-Touch-LCD-3.5 ready for development.

1. Initial Connection

1. **Connect Speaker:** If using the included speaker, connect its JST connector to the corresponding header on the board (MX1.25 speaker header).
2. **Power Supply:** Connect the board to a computer using a USB Type-C cable. This will power the device and allow for data communication.
3. **Driver Installation:** Depending on your operating system, you may need to install USB-to-serial drivers. Refer to the official Waveshare Wiki for specific driver requirements and installation guides.

2. Development Environment Setup

The ESP32-S3-Touch-LCD-3.5 supports various development environments, including ESP-IDF and Arduino IDE.

- **ESP-IDF:** For advanced users, the Espressif IoT Development Framework (ESP-IDF) provides a robust toolchain for C/C++ development. Detailed setup instructions are available on the Espressif website and the Waveshare Wiki.
- **Arduino IDE:** For ease of use, the Arduino IDE can be configured to support ESP32 boards. Install the ESP32 board package through the Arduino Boards Manager.

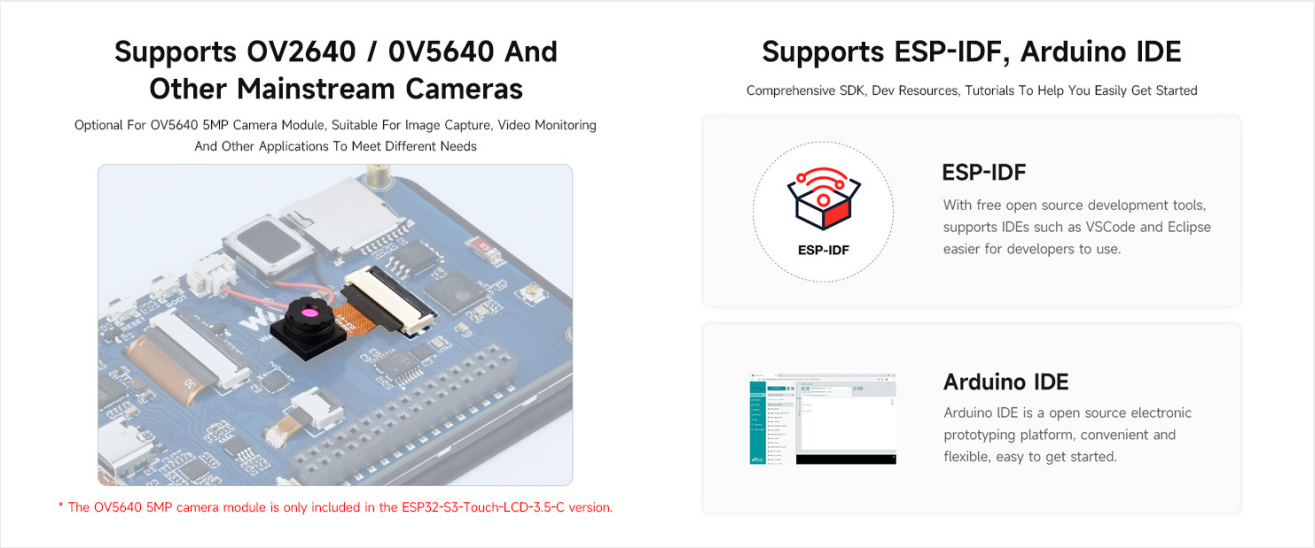

Figure 5: Development Environment Support. This image highlights the compatibility with ESP-IDF and Arduino IDE, providing flexibility for developers. It also shows the capacitive touch functionality and support for OV2640/OV5640 cameras.

3. Firmware Upload

Once your development environment is set up, you can upload your code to the ESP32-S3-Touch-LCD-3.5. Typically, this involves selecting the correct board and COM port in your IDE and clicking the upload button. Refer to specific IDE documentation or the Waveshare Wiki for detailed programming guides and example code.

Operating Instructions

The operation of the ESP32-S3-Touch-LCD-3.5 is primarily determined by the firmware loaded onto it. This section provides general guidance.

Display and Touch

The 3.5-inch IPS display offers a wide viewing angle and vibrant colors. The capacitive touch panel allows for interactive applications. Your custom firmware will define how the display renders information and how touch inputs are processed.

Figure 6: IPS Display and Capacitive Touch. This image demonstrates the excellent display performance with a 178-degree wide viewing angle and the responsive capacitive touch interface, suitable for human-machine interaction.

Wi-Fi and Bluetooth

Utilize the integrated 2.4GHz Wi-Fi and Bluetooth 5 (LE) for wireless communication. This enables network connectivity, data transfer, and interaction with other Bluetooth-enabled devices. Firmware examples often include Wi-Fi station/AP modes and Bluetooth GATT services.

Figure 7: Audio and Wireless Connectivity. This image highlights the onboard audio codec for high-quality audio processing (playback and input) and the integrated 2.4GHz Wi-Fi and Bluetooth 5 (LE) support for versatile wireless communication.

AI Speech Interaction

The board supports AI speech interaction, allowing access to online large model platforms such as DeepSeek and Doubao. This functionality typically requires specific firmware and internet connectivity.

Figure 8: AI Speech Interaction. This diagram demonstrates the process of AI speech interaction, where the device captures voice input, sends it to an online large model platform for analysis, and receives a spoken or displayed response.

Maintenance

Proper maintenance ensures the longevity and reliable operation of your ESP32-S3-Touch-LCD-3.5.

- **Cleaning:** Use a soft, dry cloth to clean the display and board. Avoid abrasive cleaners or solvents. For stubborn smudges on the screen, a slightly damp microfiber cloth can be used, followed by a dry one.
- **Storage:** Store the device in a cool, dry environment, away from direct sunlight, extreme temperatures, and high humidity.
- **Handling:** Handle the board by its edges to avoid touching sensitive components. Static electricity can damage electronic components, so use anti-static precautions when working with the board.
- **Firmware Updates:** Regularly check the Waveshare Wiki for firmware updates and security patches to ensure optimal performance and security.
- **Battery Care:** If using a Lithium battery, follow standard battery safety guidelines. Avoid overcharging or deep discharging. Disconnect the battery if the device will be stored for an extended period.

Troubleshooting

This section addresses common issues you might encounter.

Device Not Powering On

- **Check USB Connection:** Ensure the USB Type-C cable is securely connected to both the board and a powered USB port on your computer or power adapter.
- **Power Source:** Verify that the USB port or power adapter is providing sufficient power (typically 5V).
- **Cable Integrity:** Try a different USB cable to rule out a faulty cable.

Display Not Working

- **Firmware:** Ensure that the loaded firmware includes display initialization code. A blank screen often indicates a software issue rather than hardware.
- **Connections:** While the display is integrated, ensure no physical damage to the screen or its connections.
- **Power:** Confirm the board is receiving adequate power.

Touch Screen Unresponsive/Inaccurate

- **Calibration:** Some applications or firmware may require touch screen calibration. Refer to your specific software documentation.
- **Firmware:** Verify that the touch driver (FT6336) is correctly initialized and configured in your firmware.
- **Physical Obstructions:** Ensure there are no foreign objects or debris on the screen surface interfering with touch detection.

Wi-Fi/Bluetooth Connectivity Issues

- **Antenna:** The board has an onboard antenna. Ensure it is not obstructed.
- **Firmware Configuration:** Double-check your firmware for correct Wi-Fi SSID, password, and Bluetooth service configurations.
- **Interference:** Reduce potential interference from other 2.4GHz devices.

For more detailed troubleshooting and community support, visit the official Waveshare Wiki or relevant ESP32 developer forums.

Specifications

Detailed technical specifications for the Waveshare ESP32-S3 3.5-inch Capacitive Touch Display.

Feature	Specification
Processor	ESP32-S3R8 Xtensa 32-bit LX7 dual-core (up to 240MHz)
Wireless Connectivity	2.4GHz Wi-Fi (802.11 b/g/n), Bluetooth 5 (LE)
Display	3.5-inch IPS, 320x480 resolution, 262K colors
Display Driver	ST7796
Touch Controller	FT6336 Capacitive Touch
IMU	QMI8658 6-axis (3-axis accelerometer, 3-axis gyroscope)
RAM	512KB SRAM, 384KB ROM, 8MB PSRAM
Flash Memory	16MB NOR-Flash
Power Management	AXP2101

Feature	Specification
RTC Chip	PCF85063
Camera Interface	DVP (OV2640/OV5640 compatible)
External Storage	TF card slot
Battery Support	3.7V MX1.25 Lithium battery
USB Interface	USB Type-C
Dimensions (Standard)	92.44 x 61.00 x 11.50 mm (approx.)
Item Weight	2.46 ounces

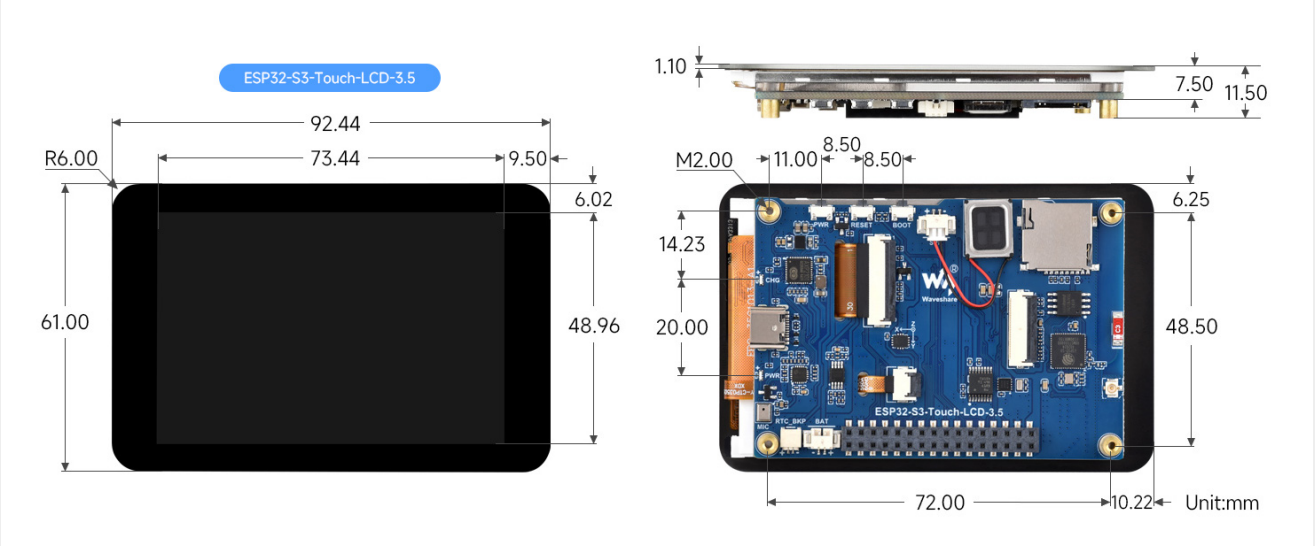

Figure 9: Standard Version Dimensions. This technical drawing provides precise measurements for the ESP32-S3-Touch-LCD-3.5 board without a case, in millimeters.

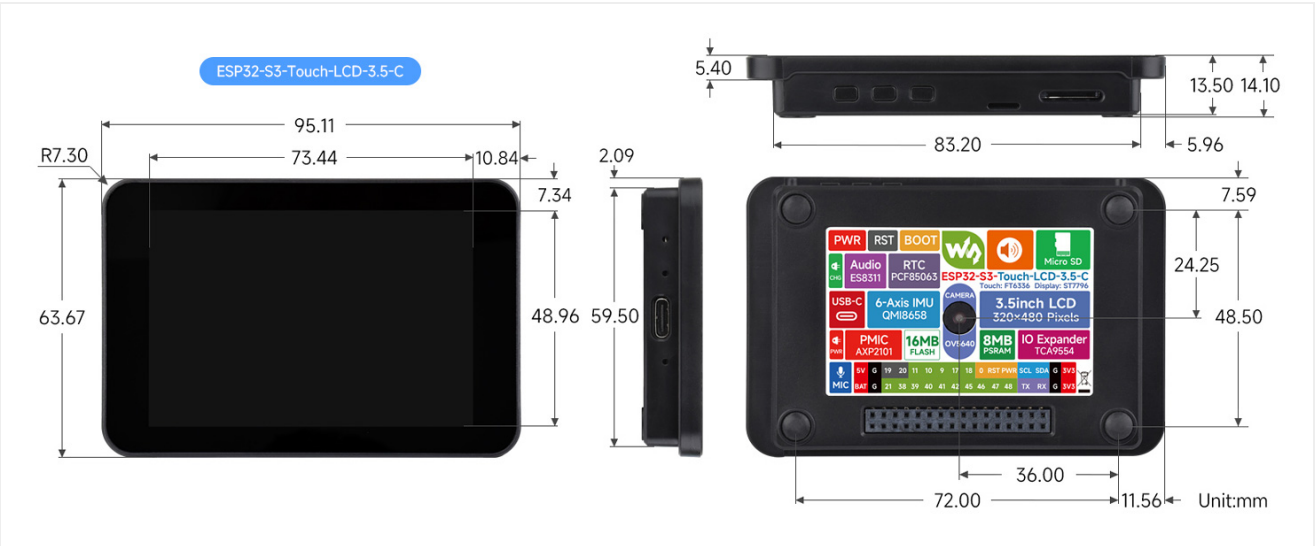

Figure 10: Cased Version Dimensions. This technical drawing provides precise measurements for the ESP32-S3-Touch-LCD-3.5-C board, which includes a protective case, in millimeters.

Warranty and Support

Waveshare products are designed for reliability and performance. For warranty information, please refer to the terms and conditions provided at the point of purchase or on the official Waveshare website. Technical support and additional resources, including detailed documentation, example code, and community forums, are available on the official Waveshare Wiki. We encourage users to consult these resources for in-depth information and assistance with their development projects.

Official Wiki Resources: For comprehensive guides, tutorials, and technical data, please visit the Waveshare official Wiki page. This resource is regularly updated and provides valuable information for developers.