

waveshare ESP32-S3 1.28inch Display B

Waveshare ESP32-S3 Development Board with 1.28-inch Round LCD Display User Manual

Model: ESP32-S3 1.28inch Display B | Brand: Waveshare

1. INTRODUCTION

The Waveshare ESP32-S3-LCD-1.28 is a high-performance microcontroller development board designed for a wide range of applications. It integrates a 1.28-inch round LCD screen, a lithium battery charging chip, and a six-axis sensor (accelerometer and gyroscope). The board utilizes the ESP32-S3R2 system-on-chip (SoC), offering low-power Wi-Fi and BLE5.0 capabilities, along with external 16MB Flash and 2MB PSRAM. Its hardware encryption accelerators, Random Number Generator (RNG), Hash-based Message Authentication Code (HMAC), and Digital Signature module address modern IoT security requirements. Multiple low-power operating modes make it suitable for IoT, mobile devices, wearable electronics, and smart home applications.



Figure 1: Waveshare ESP32-S3 Development Board with 1.28-inch Round LCD Display and included screwdriver.

2. KEY FEATURES

- **Processor:** Equipped with an Xtensa 32-bit LX7 dual-core processor, operating at up to 240MHz.
- **Wireless Connectivity:** Supports 2.4GHz Wi-Fi (802.11 b/g/n) and Bluetooth 5 (BLE) with an onboard antenna.
- **Memory:** Built-in 512KB SRAM and 384KB ROM, with onboard 2MB PSRAM and an external 16MB Flash memory.
- **Display:** Features a 1.28-inch round IPS LCD panel with 240×240 resolution and 65K colors, driven by the GC9A01A display chip.
- **Enclosure:** Adopts a CNC metal case with an Acrylic dull-polish bottom plate.
- **Sensors:** Onboard QMI8658 6-axis IMU (3-axis accelerometer and 3-axis gyroscope) for motion detection.
- **Power Management:** Onboard 3.7V lithium battery recharge/discharge header.
- **Connectivity:** Type-C connector for power and data, and GPIO headers for flexible pin function configuration.
- **Low Power:** Supports flexible clock and module power supply settings for optimized power consumption.

ESP32-S3-LCD-1.28-B

Embedded GC9A01 Display Driver Chip, adopts CNC metal case



Type-C Port



32-bit LX7
Dual-core Processor



CNC Metal Case



1.28" LCD



240×240 Pixels



65K Color

Figure 2: Overview of the Waveshare ESP32-S3 Development Board's main features.

CNC Metal Case

Adopts CNC Metal Case With Acrylic Dull-Polish Bottom Plate



Figure 3: Detailed view of the CNC metal case and acrylic bottom plate.

3. ONBOARD COMPONENTS

The development board integrates various components to provide comprehensive functionality. Refer to the diagram below for component identification:



Figure 4: Labeled components on the Waveshare ESP32-S3 Development Board.

1. **ESP32-S3R2:** The SoC with Wi-Fi and Bluetooth, up to 240MHz operating frequency, with onboard 2MB PSRAM.
2. **W25Q128JVS1Q:** 16MB NOR-Flash.
3. **QMI8658:** 6-axis IMU includes a 3-axis gyroscope and a 3-axis accelerometer.
4. **ME6217C33M5G:** 800mA output, low dropout, high rejection rate.
5. **CH343P:** USB to UART chip.
6. **ETA6096:** High-efficiency Lithium battery recharge manager.
7. **1.27mm pitch headers:** Adapting multiple GPIO pins.
8. **BOOT button:** Press it before resetting to enter download mode.
9. **RESET button.**

10. **MX1.25 battery header:** MX1.25 2P connector, for 3.7V Lithium battery, supports charging and discharging.
11. **USB Type-C connector:** For programming and log printing.
12. **2.4GHz ceramic antenna.**

4. GPIO Pinout

The ESP32-S3 Development Board provides 30 multi-function GPIO pins, allowing for flexible development and integration with various peripherals. The pin functions can be configured as needed.

30 × Multi-Function GPIO Pins

Configurable Pin Function, Allows Flexible Development And Integration



H1

H2

GP 36	1		2	GP 46	GND	20		19	GND
GP 35	3		4	GP 45	VSYS	18		17	ADC_AVDD
GP 34	5		6	GP 42	GP 6	16		15	BOOT
GP 33	7		8	GP 41	GP 7	14		13	RUN
GP 21	9		10	GP 40	GP 8	12		11	GP 0
GP 18	11		12	GP 39	GP 9	10		9	GP 1
GP 17	13		14	GP 38	GP 10	8		7	GP 2
GP 16	15		16	GP 37	GP 11	6		5	GP 3
GP 15	17		18	VSYS	GP 12	4		3	GP 4
GP 14	19		20	GND	GP 13	2		1	GP 5

■ Power
 ■ Ground
 ■ GPIO
 ■ System Control

GP 1	BAT_ADC	Battery Voltage Acquisition Pin	Biased by resistors to 1/2 value of the battery voltage		
GP 6	IMU_SDA	I2C SDA	GP 11	LCD_DIN	LCD MOSI
GP 7	IMU_SCL	I2C SCL	GP 12	LCD_RST	LCD Reset
GP 8	LCD_DC	LCD Command/Data Selection	GP 40	LCD_BL	LCD Backlight Control
GP 9	LCD_CS	LCD Chip Selection	GP 47	IMU_INT1	QMI8658C INT1
GP 10	LCD_CLK	LCD CLK	GP 48	IMU_INT2	QMI8658C INT2

Figure 5: GPIO Pinout for the Waveshare ESP32-S3 Development Board.

Key pin functions include:

- **BAT_ADC (GP1):** Battery Voltage Acquisition Pin (biased by resistors to 1/2 value of battery voltage).
- **IMU_SDA (GP6), IMU_SCL (GP7):** I2C communication for the QMI8658 IMU.
- **LCD_DC (GP8), LCD_CS (GP9), LCD_CLK (GP10), LCD_DIN (GP11), LCD_RST (GP12), LCD_BL (GP40):** Pins for controlling the 1.28-inch LCD display.
- **IMU_INT1 (GP47), IMU_INT2 (GP48):** Interrupt pins for the QMI8658 IMU.
- **RXD (GPIO44), TXD (GPIO43):** UART communication pins.
- Various other GPIO pins (GP0-GP5, GP13-GP19, GP21, GP33-GP36, GP39, GP41, GP42, GP45, GP46) for general purpose input/output.

5. SETUP AND DEVELOPMENT ENVIRONMENT

To begin development with the Waveshare ESP32-S3-LCD-1.28, you will typically need to set up a development environment. The Arduino IDE is a common choice for its ease of use and extensive library support.

5.1. Software Installation (Arduino IDE)

1. **Install Arduino IDE:** Download and install the Arduino IDE from the official Arduino website (www.arduino.cc/en/software).
2. **Install ESP32 Board Package:**
 - Open Arduino IDE, go to **File > Preferences**.
 - In the "Additional Boards Manager URLs" field, add:
`https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json`
 - Go to **Tools > Board > Boards Manager...**
 - Search for "esp32" and install the "esp32 by Espressif Systems" package.
3. **Install Required Libraries:**
 - The Waveshare documentation typically provides specific versions of libraries like TFT_eSPI and LVGL. It is recommended to use the versions specified in the official Waveshare documentation to ensure compatibility.
 - Go to **Sketch > Include Library > Manage Libraries...**
 - Search for and install the necessary libraries (e.g., TFT_eSPI, LVGL, etc.) as per Waveshare's instructions.

5.2. Important Notes for Setup

- **Arduino IDE Version:** Some users have reported issues with the latest versions of the ESP32 board management software and libraries. If you encounter problems, try using the specific versions recommended in the Waveshare documentation (e.g., version 2.0.12 for the ESP32 board).
- **Library Compatibility:** Verify that all required libraries (e.g., TFT_eSPI, LVGL) are installed and are compatible with your chosen ESP32 board package version.
- **Entering Download Mode:** To flash new code, press the **BOOT** button before resetting the device.

6. OPERATING THE DEVICE

The ESP32-S3 Development Board offers various operational modes and interactive features, primarily through its 1.28-inch round LCD display and integrated wireless capabilities.

6.1. Display Interaction

The 1.28-inch round IPS LCD display provides a vibrant visual interface. Depending on the firmware loaded, it can

support touch functionality for interactive control. Users can navigate menus, adjust settings, and view data directly on the screen.

Your browser does not support the video tag.

Video 1: Demonstration of the Waveshare ESP32-S3 Development Board's display and touch functionality. Note: This video may feature a 1.85-inch display, which is a similar but larger model than the 1.28-inch display of this product.

6.2. Wireless Connectivity

The board's integrated 2.4GHz Wi-Fi and Bluetooth 5 (BLE) enable stable and efficient wireless communication. This allows for:

- Connecting to local networks for IoT applications.
- Bluetooth communication with other devices.
- Streaming audio (if a speaker is connected) via protocols like DLNA.

6.3. Voice Interaction

With an onboard microphone and audio decoding chip, the device can support voice interaction. This includes offline voice commands for controlling device functions (e.g., turning off backlight) and potential integration with AI models for more advanced applications.

Your browser does not support the video tag.

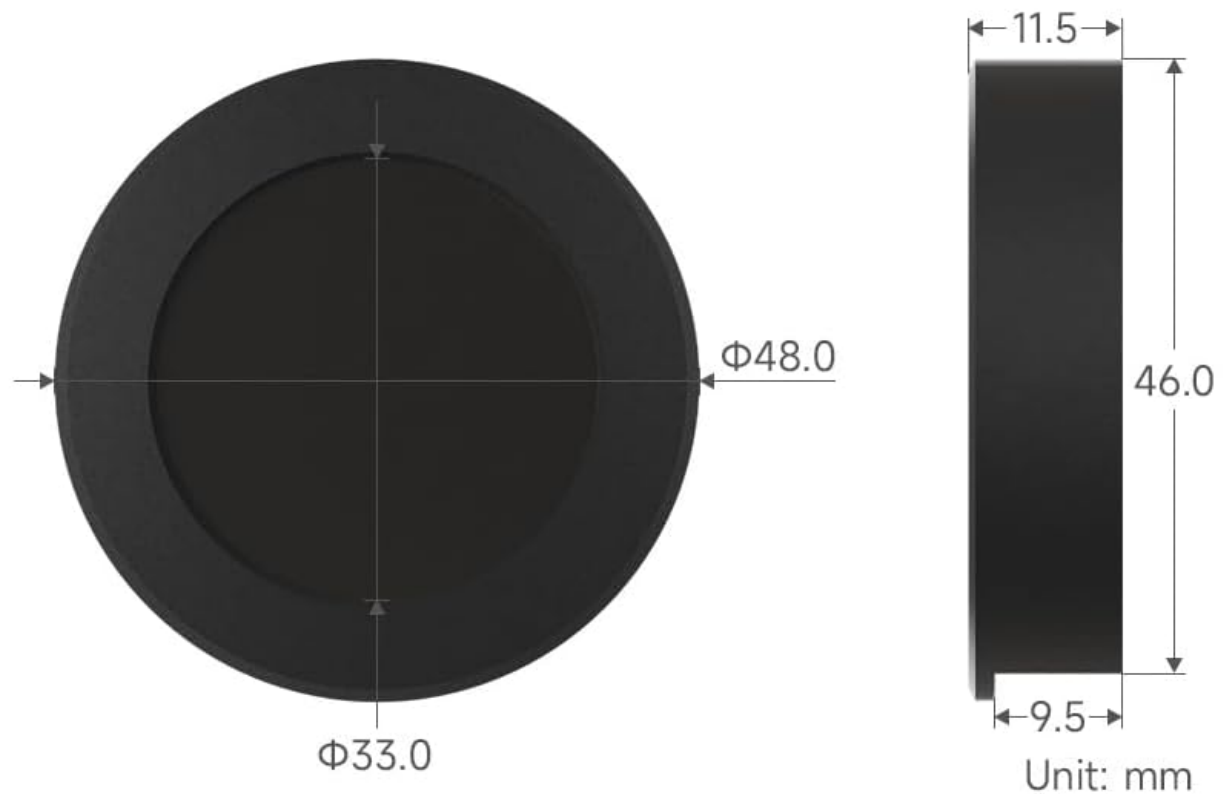
Video 2: Demonstration of voice control and music playback features. Note: This video may feature a 1.85-inch display, which is a similar but larger model than the 1.28-inch display of this product.

7. TECHNICAL SPECIFICATIONS

Attribute	Value
Model Name	ESP32-S3-LCD-1.28
Item Model Number	ESP32-S3 1.28inch Display B
Processor	Xtensa 32-bit LX7 dual-core
CPU Speed	Up to 240 MHz
RAM Memory Installed Size	2 MB (PSRAM)
Memory Storage Capacity	16 MB (Flash)
Display Type	Round IPS LCD
Display Size	1.28 inches (Φ32.4mm)
Display Resolution	240(H)RGB x 240(V)
Display Chip	GC9A01A
IMU Sensor	QMI8658 (16-bit Accelerometer & Gyroscope)
Wireless	2.4GHz Wi-Fi (802.11 b/g/n), Bluetooth 5 (BLE)
Connector	Type-C
Package Dimensions	4.14 x 3.2 x 0.8 inches

Attribute	Value
Item Weight	1.27 ounces
Manufacturer	Waveshare

Outline Dimensions



Notes

- When using the development board, pay attention to the ceramic antenna area and avoid covering the ceramic antenna with PCB boards, metal, or plastic components.
- The board is equipped with an efficient charging and discharging management chip, ETA6096, and an MX1.25 battery interface. The charging current is currently set to 1A, and users can change the charging current by replacing the R15 resistor. Connect a 3.7V single-cell lithium battery, and for more details, please refer to the [schematic diagram](#). It is recommended to use a 3.7V single-cell lithium battery with a capacity of 500mAh or below.
- To prevent overcharging and over-discharging of the battery, stop discharging when the fully charged 4.2V lithium battery discharges to 3.7V.

Figure 6: Outline dimensions of the Waveshare ESP32-S3 Development Board.

8. MAINTENANCE AND BATTERY USAGE

- **Antenna Area:** When using the development board, ensure that the ceramic antenna area is not covered by

PCB boards, metal, or plastic components to maintain optimal wireless performance.

- **Battery Charging:** The board is equipped with an efficient charging and discharging management chip (ETA6096). The charging current is factory-set to 1A. Users can adjust the charging current by replacing the R15 resistor.
- **Recommended Battery:** Connect a 3.7V single-cell lithium battery with a capacity of 500mAh or below. Refer to the schematic diagram for detailed connections.
- **Overcharge/Over-discharge Protection:** To prevent overcharging and over-discharging, stop discharging the battery when it reaches a fully charged 4.2V and stop charging when it discharges to 3.7V.
- **Lithium Polymer and Lithium-ion Batteries:** These batteries are very sensitive and can cause fire, personal injury, or property damage if not handled properly. Always store them in a safe place, away from flammable materials and out of reach of children.

9. TROUBLESHOOTING

- **Flashing Issues:** If you encounter difficulties flashing new code to the device, ensure you are using the correct version of the ESP32 board package in the Arduino IDE. Some users have found success with specific older versions (e.g., 2.0.12) rather than the latest.
- **Library Conflicts:** Verify that all required libraries (e.g., TFT_eSPI, LVGL) are installed and are compatible with your chosen ESP32 board package version. Refer to Waveshare's official documentation for recommended library versions.
- **GPIO Pin Access:** The 1.27mm pitch pin headers may require specific adapter boards for easy access. Ensure proper soldering and secure connections if using custom solutions. Note that adding adapter boards might prevent the back plate from being reattached without modification.
- **Wireless Connectivity Problems:** If Wi-Fi or Bluetooth is not functioning correctly, check that the 2.4GHz ceramic antenna area is clear of obstructions.

10. SUPPORT AND RESOURCES

For further assistance, detailed documentation, and community support, please refer to the official Waveshare resources:

- **Waveshare Official Website:** Visit www.waveshare.com for product pages, datasheets, and example code.
- **Waveshare Amazon Store:** Explore other Waveshare products and resources at their Amazon store: [Waveshare Store](#).
- **SDK and Documentation:** Waveshare provides comprehensive SDKs and open-source documentation tutorials to help developers integrate the board into their applications.