

# ESP32-P4

## esp-dev-kits Documentation



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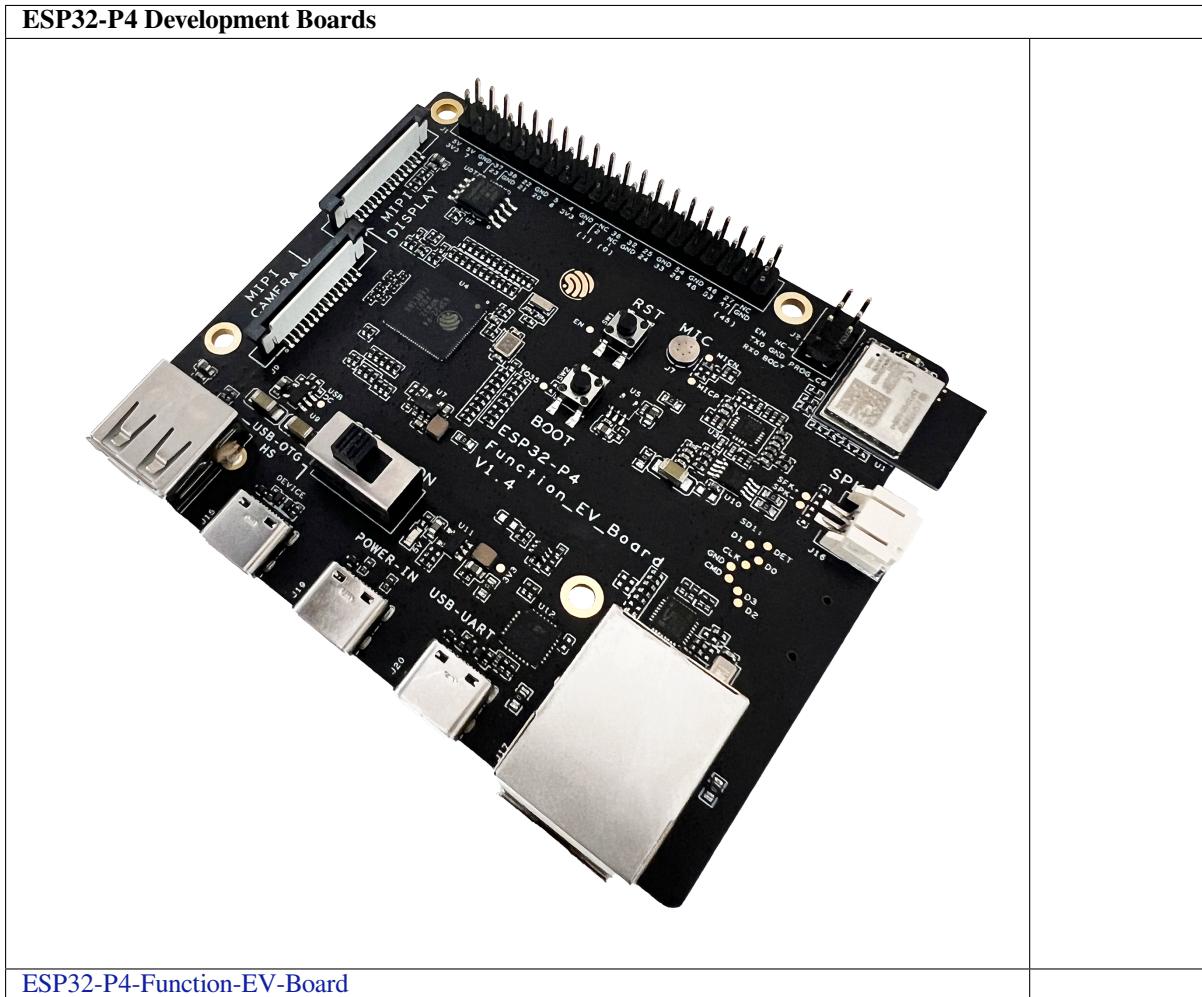


This document provides detailed user guides and examples for ESP32-P4 series development boards.

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**Note:** For the full list of Espressif development boards, please go to [ESP DevKits](#).

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# Chapter 1

## ESP32-P4-Function-EV-Board

ESP32-P4-Function-EV-Board is a multimedia development board based on the ESP32-P4 chip. ESP32-P4 chip features a dual-core 400 MHz RISC-V processor and supports up to 32 MB PSRAM. In addition, ESP32-P4 supports USB 2.0 specification, MIPI-CSI/DSI, H264 Encoder, and various other peripherals. With all of its outstanding features, the board is an ideal choice for developing low-cost, high-performance, low-power network-connected audio and video products.

### 1.1 ESP32-P4-Function-EV-Board

This user guide will help you get started with ESP32-P4-Function-EV-Board and will also provide more in-depth information.

ESP32-P4-Function-EV-Board is a multimedia development board based on the ESP32-P4 chip. ESP32-P4 chip features a dual-core 400 MHz RISC-V processor and supports up to 32 MB PSRAM. In addition, ESP32-P4 supports USB 2.0 specification, MIPI-CSI/DSI, H264 Encoder, and various other peripherals. With all of its outstanding features, the board is an ideal choice for developing low-cost, high-performance, low-power network-connected audio and video products.

The 2.4 GHz Wi-Fi 6 & Bluetooth 5 (LE) module ESP32-C6-MINI-1 serves as the Wi-Fi and Bluetooth module of the board. The board also includes a 7-inch capacitive touch screen with a resolution of 1024 x 600 and a 2MP camera with MIPI CSI, enriching the user interaction experience. The development board is suitable for prototyping a wide range of products, including visual doorbells, network cameras, smart home central control screens, LCD electronic price tags, two-wheel vehicle dashboards, etc.

Most of the I/O pins are broken out to the pin headers for easy interfacing. Developers can connect peripherals with jumper wires.

The document consists of the following major sections:

- *Getting Started*: Overview of ESP32-P4-Function-EV-Board and hardware/software setup instructions to get started.
- *Hardware Reference*: More detailed information about the ESP32-P4-Function-EV-Board's hardware.
- *Hardware Revision Details*: Revision history, known issues, and links to user guides for previous versions (if any) of ESP32-P4-Function-EV-Board.
- *Related Documents*: Links to related documentation.

#### 1.1.1 Getting Started

This section provides a brief introduction to ESP32-P4-Function-EV-Board, instructions on how to do the initial hardware setup and how to flash firmware onto it.

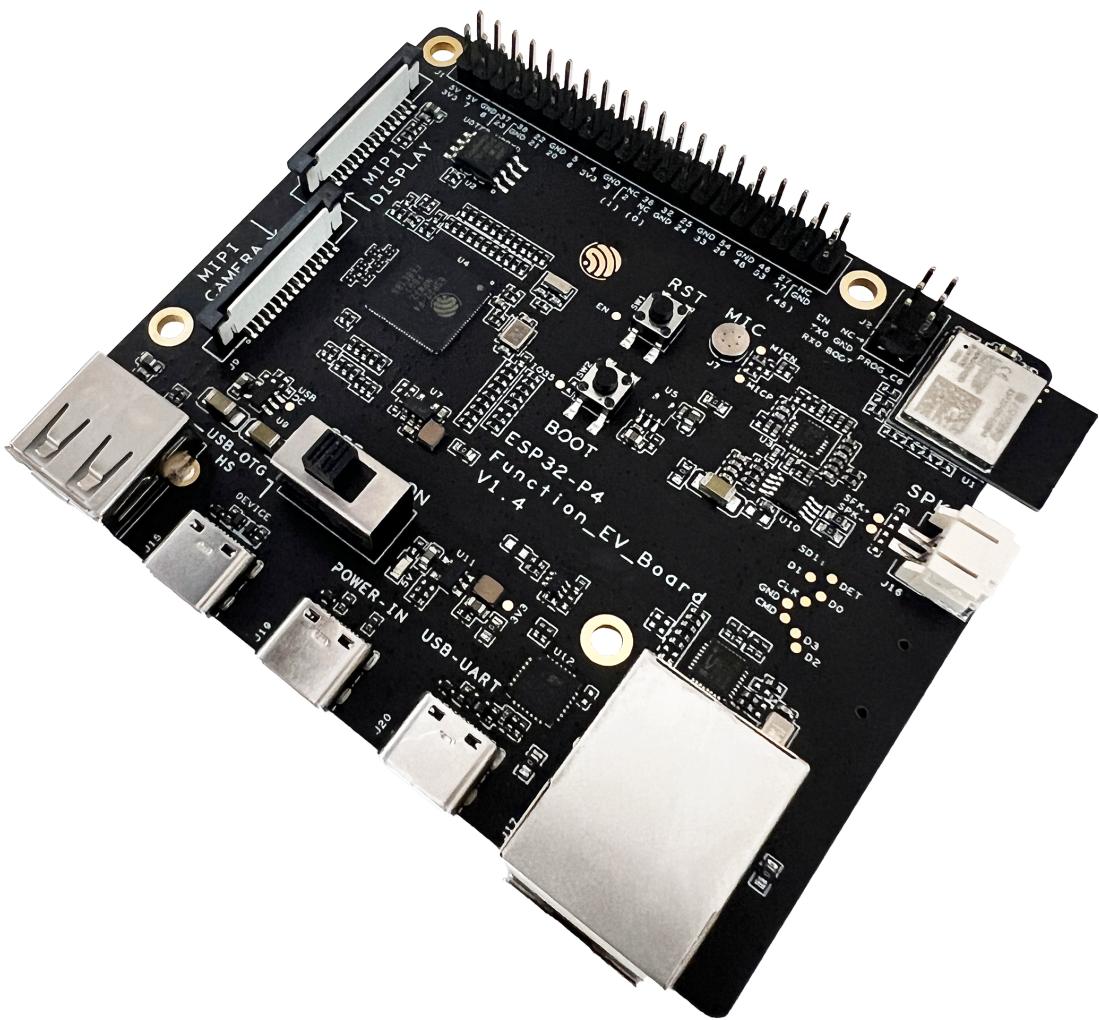


Fig. 1: ESP32-P4-Function-EV-Board

### Description of Components

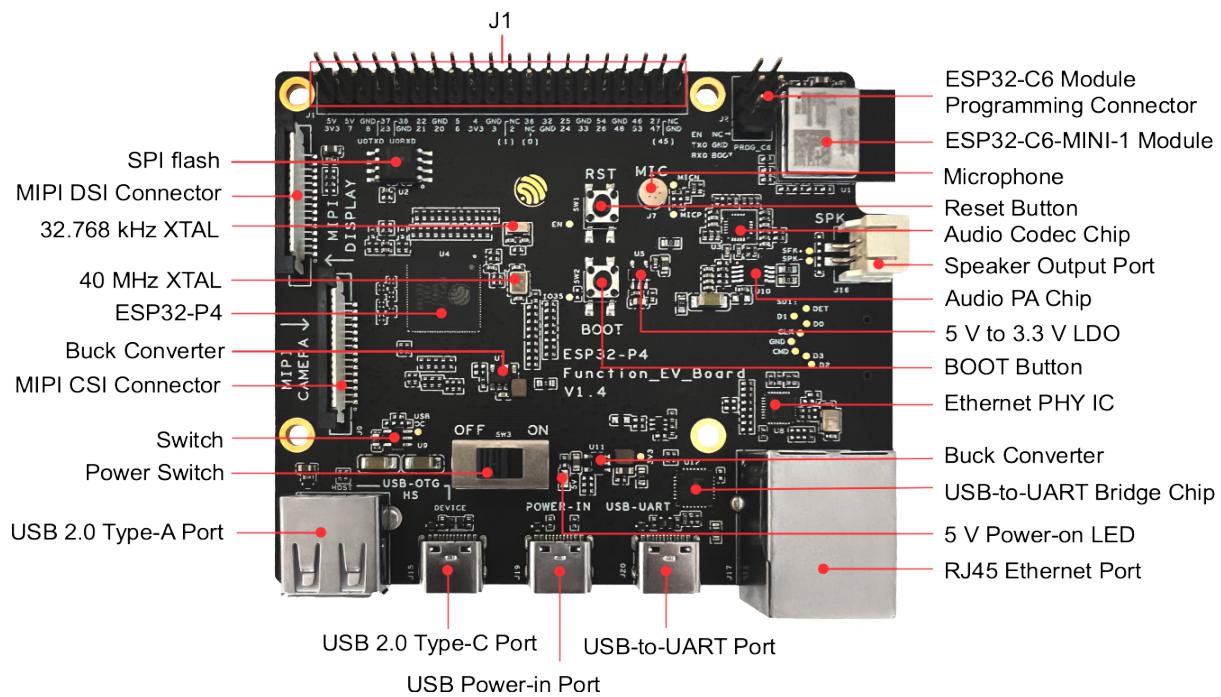


Fig. 2: ESP32-P4-Function-EV-Board - front (click to enlarge)

The key components of the board are described in a clockwise direction.

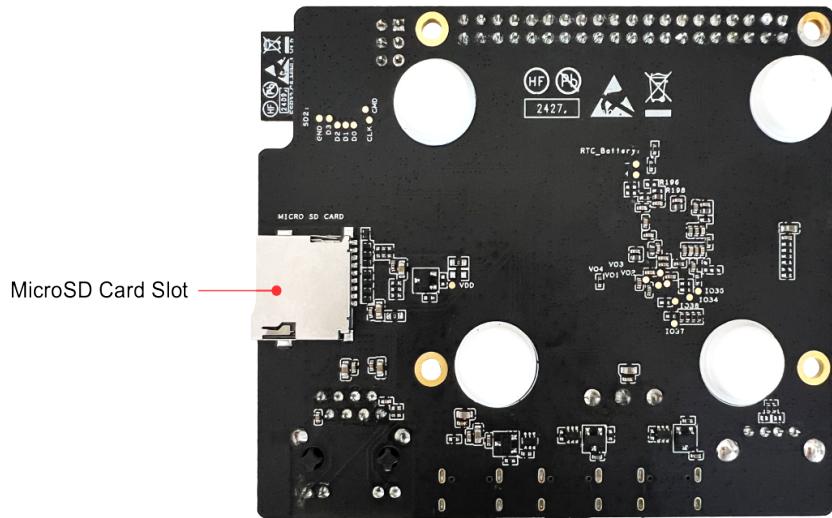


Fig. 3: ESP32-P4-Function-EV-Board - back (click to enlarge)

Key Component	Description
J1	All available GPIO pins are broken out to the header block J1 for easy interfacing. For more details, see <a href="#">Header Block</a> .
ESP32-C6 Module Programming Connector	The connector can be used with ESP-Prog or other UART tools to flash firmware onto the ESP32-C6 module.
ESP32-C6-MINI-1 Module	This module serves as the Wi-Fi and Bluetooth communication module for the board.
Microphone	Onboard microphone connected to the interface of Audio Codec Chip.
Reset Button	Resets the board.
Audio Codec Chip	ES8311 is a low-power mono audio codec chip. It includes a single-channel ADC, a single-channel DAC, a low-noise pre-amplifier, a headphone driver, digital sound effects, analog mixing, and gain functions. It interfaces with the ESP32-P4 chip over I2S and I2C buses to provide hardware audio processing independent of the audio application.
Speaker Output Port	This port is used to connect a speaker. The maximum output power can drive a $4\ \Omega$ , 3 W speaker. The pin spacing is 2.00 mm (0.08").
Audio PA Chip	NS4150B is an EMI-compliant, 3 W mono Class D audio power amplifier that amplifies audio signals from the audio codec chip to drive speakers.
5 V to 3.3 V LDO	A power regulator that converts a 5 V supply to a 3.3 V output.
BOOT Button	The boot mode control button. Press the <b>Reset Button</b> while holding down the <b>Boot Button</b> to reset ESP32-P4 and enter firmware download mode. Firmware can then be downloaded to SPI flash via the USB-to-UART Port.
Ethernet PHY IC	Ethernet PHY chip connected to the ESP32-P4 EMAC RMII interface and RJ45 Ethernet Port.
Buck Converter	A buck DC-DC converter for the 3.3 V power supply.
USB-to-UART Bridge Chip	CP2102N is a single USB-to-UART bridge chip connected to the ESP32-P4 UART0 interface, CHIP_PU, and GPIO35 (strapping pin). It provides transfer rates up to 3 Mbps for firmware downloading and debugging, supporting the automatic download functionality.
5 V Power-on LED	This LED lights up when the board is powered through any USB Type-C port.
RJ45 Ethernet Port	An Ethernet Port supporting 10/100 Mbps adaptive.
USB-to-UART Port	The USB Type-C port can be used to power the board, flash firmware to the chip, and communicate with the ESP32-P4 chip via the USB-to-UART Bridge Chip.
Espressif Systems	Release master
USB Power-in Port	The USB Type-C port used to power the board.
USB 2.0 Type-C Port	The USB 2.0 Type-C Port is connected to the USB 2.0 OTG High-Speed interface of ESP32-P4, compliant with the USB 2.0 specification. When com-

## Accessories

Optionally, the following accessories are included in the package:

- LCD and its accessories (optional)
  - 7-inch capacitive touch screen with a resolution of 1024 x 600
  - LCD adapter board
  - Accessories bag, including DuPont wires, ribbon cable for LCD, long standoffs (20 mm in length), and short standoffs (8 mm in length)
- Camera and its accessories (optional)
  - 2MP camera with MIPI CSI
  - Camera adapter board
  - Ribbon cable for camera

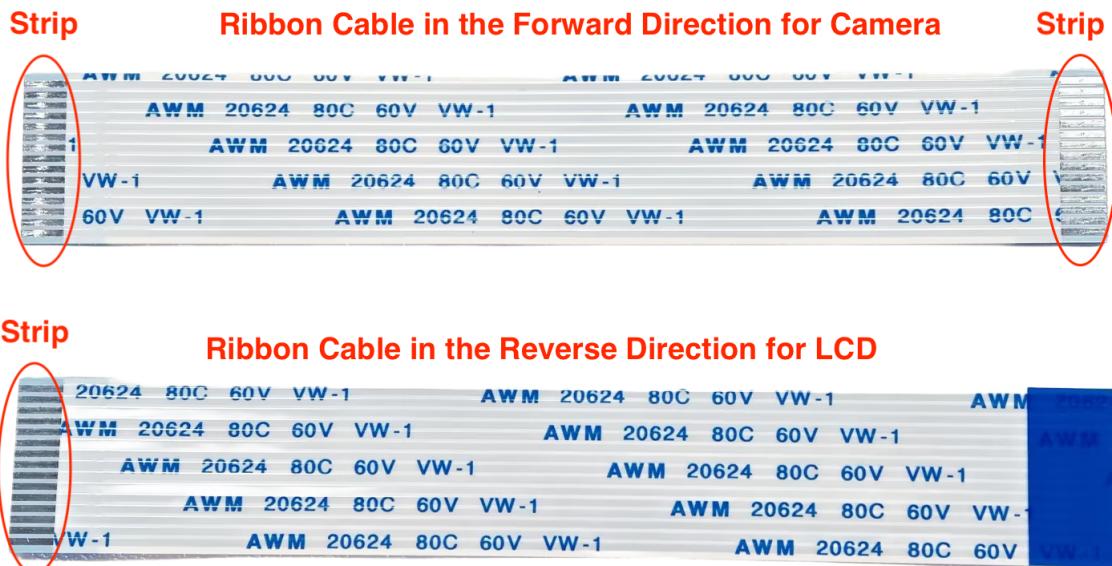


Fig. 4: Ribbon Cables in Forward and Reverse Directions

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**Note:** Please note that the ribbon cable in the **forward direction**, whose strips at the two ends are on the same side, should be used for the **camera**; the ribbon cable in the **reverse direction**, whose strips at the two ends are on different sides, should be used for the **LCD**.

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## Start Application Development

Before powering up your ESP32-P4-Function-EV-Board, please make sure that it is in good condition with no obvious signs of damage.

### Required Hardware

- ESP32-P4-Function-EV-Board
- USB cables
- Computer running Windows, Linux, or macOS

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**Note:** Be sure to use a good quality USB cable. Some cables are for charging only and do not provide the needed data lines nor work for programming the boards.

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## Optional Hardware

- MicroSD card

**Hardware Setup** Connect the ESP32-P4-Function-EV-Board to your computer using a USB cable. The board can be powered through any of the USB Type-C ports. The USB-to-UART Port is recommended for flashing firmware and debugging.

To connect the LCD, follow these steps:

1. Secure the development board to the LCD adapter board by attaching the short copper standoffs (8 mm in length) to the four standoff posts at the center of the LCD adapter board.
2. Connect the J3 header of the LCD adapter board to the MIPI DSI connector on the ESP32-P4-Function-EV-Board using the LCD ribbon cable (**reverse direction**). Note that the LCD adapter board is already connected to the LCD.
3. Use a DuPont wire to connect the RST\_LCD pin of the J6 header of the LCD adapter board to the GPIO27 pin of the J1 header on the ESP32-P4-Function-EV-Board. The RST\_LCD pin can be configured via software, with GPIO27 set as the default.
4. Use a DuPont wire to connect the PWM pin of the J6 header of the LCD adapter board to the GPIO26 pin of the J1 header on the ESP32-P4-Function-EV-Board. The PWM pin can be configured via software, with GPIO26 set as the default.
5. It is recommended to power the LCD by connecting a USB cable to the J1 header of the LCD adapter board. If this is not feasible, connect the 5V and GND pins of the LCD adapter board to corresponding pins on the J1 header of the ESP32-P4-Function-EV-Board, provided that the development board has sufficient power supply.
6. Attach the long copper standoffs (20 mm in length) to the four standoff posts on the periphery of the LCD adapter board to allow the LCD to stand upright.

In summary, the LCD adapter board and ESP32-P4-Function-EV-Board are connected via the following pins:

LCD Adapter Board	ESP32-P4-Function-EV
J3 header	MIPI DSI connector
RST_LCD pin of J6 header	GPIO27 pin of J1 header
PWM pin of J6 header	GPIO26 pin of J1 header
5V pin of J6 header	5V pin of J1 header
GND pin of J6 header	GND pin of J1 header

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### Note:

- If you power the LCD adapter board by connecting a USB cable to its J1 header, you do not need to connect its 5V and GND pins to the corresponding pins on the development board.
  - To use the camera, connect the camera adapter board to the MIPI CSI connector on the development board using the camera ribbon cable (**forward direction**).
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**Software Setup** To set up your development environment and flash an application example onto your board, please follow the instructions in [ESP-IDF Get Started](#).

You can find examples for ESP32-P4-Function-EV by accessing [Examples](#). To configure project options, enter `idf.py menuconfig` in the example directory.

### 1.1.2 Hardware Reference

#### Block Diagram

The block diagram below shows the components of ESP32-P4-Function-EV-Board and their interconnections.

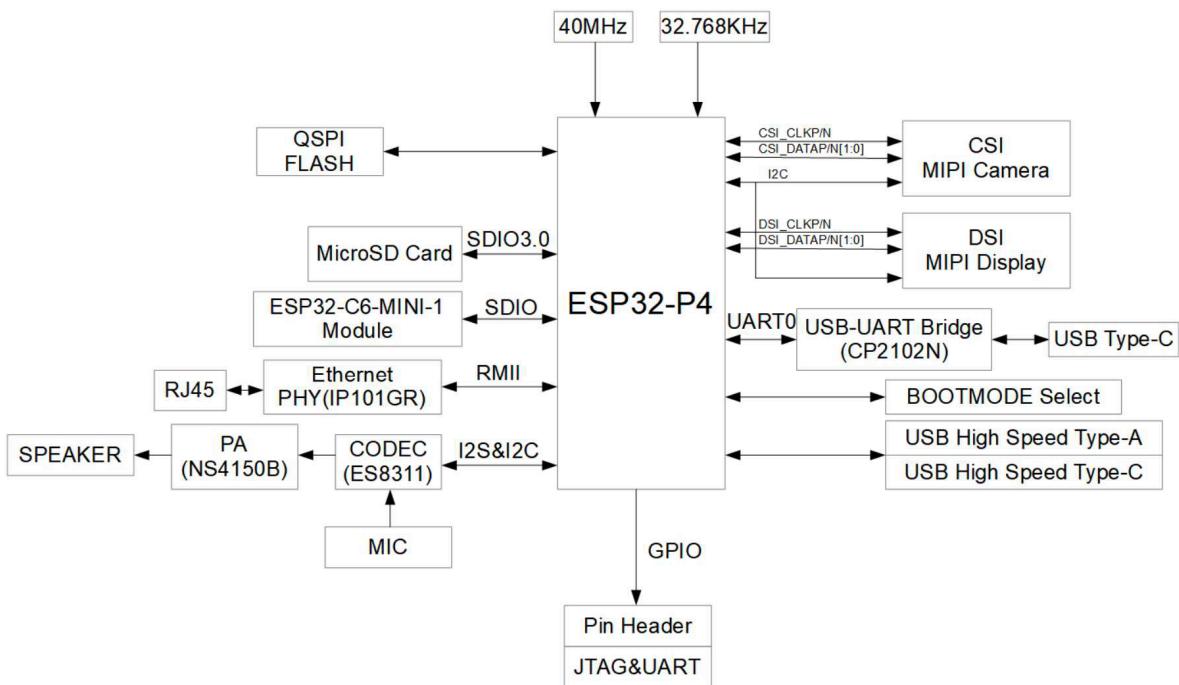


Fig. 5: ESP32-P4-Function-EV-Board (click to enlarge)

### Power Supply Options

Power can be supplied through any of the following ports:

- USB 2.0 Type-C Port
- USB Power-in Port
- USB-to-UART Port

If the USB cable used for debugging cannot provide enough current, you can connect the board to a power adapter via any available USB Type-C port.

### Header Block

The tables below provide the **Name** and **Function** of the pin header J1 of the board. The pin header names are shown in Figure [ESP32-P4-Function-EV-Board - front \(click to enlarge\)](#). The numbering is the same as in the [ESP32-P4-Function-EV-Board Schematic](#).

No.	Name	Type	Page 10, 1	Function
1	3V3	P		3.3 V power supply
2	5V	P		5 V power supply
3	7	I/O/T		GPIO7
4	5V	P		5 V power supply
5	8	I/O/T		GPIO8
6	GND	GND		Ground
7	23	I/O/T		GPIO23
8	37	I/O/T		U0TXD, GPIO37
9	GND	GND		Ground
10	38	I/O/T		U0RXD, GPIO38
11	21	I/O/T		GPIO21
12	22	I/O/T		GPIO22

continues on next page

Table 1 – continued from previous page

No.	Name	Type <sup>Page 10, 1</sup>	Function
13	20	I/O/T	GPIO20
14	GND	GND	Ground
15	6	I/O/T	GPIO6
16	5	I/O/T	GPIO5
17	3V3	P	3.3 V power supply
18	4	I/O/T	GPIO4
19	3	I/O/T	GPIO3
20	GND	GND	Ground
21	2	I/O/T	GPIO2
22	NC(1)	I/O/T	GPIO1 <sup>2</sup>
23	NC(0)	I/O/T	GPIO0 <sup>Page 10, 2</sup>
24	36	I/O/T	GPIO36
25	GND	GND	Ground
26	32	I/O/T	GPIO32
27	24	I/O/T	GPIO24
28	25	I/O/T	GPIO25
29	33	I/O/T	GPIO33
30	GND	GND	Ground
31	26	I/O/T	GPIO26
32	54	I/O/T	GPIO54
33	48	I/O/T	GPIO48
34	GND	GND	Ground
35	53	I/O/T	GPIO53
36	46	I/O/T	GPIO46
37	47	I/O/T	GPIO47
38	27	I/O/T	GPIO27
39	GND	GND	Ground
40	NC(45)	I/O/T	GPIO45 <sup>3</sup>

## J1

### 1.1.3 Hardware Revision Details

No previous versions available.

**Note:** The current version of the development board is v1.4, and the next version, v1.5, is in the verification stage. [ESP32-P4-Function-EV-Board Schematic v1.5.1](#) has been uploaded for your reference.

### 1.1.4 Related Documents

- [ESP32-P4-Function-EV-Board Schematic \(PDF\)](#)
- [ESP32-P4-Function-EV-Board Schematic v1.5.1 \(PDF\)](#)
- [ESP32-P4-Function-EV-Board PCB Layout \(PDF\)](#)
- [ESP32-P4-Function-EV-Board Dimensions \(PDF\)](#)
- [ESP32-P4-Function-EV-Board Dimensions source file \(DXF\)](#) - You can view it with [Autodesk Viewer](#) online
- [1.0K-GT-15PB Specification \(PDF\)](#)
- [Camera Datasheet \(PDF\)](#)
- [Display Datasheet \(PDF\)](#)

<sup>1</sup> P: Power supply; I: Input; O: Output; T: High impedance.

<sup>2</sup> GPIO0 and GPIO1 can be enabled by disabling the XTAL\_32K function, which can be achieved by moving R61 and R59 to R199 and R197, respectively.

<sup>3</sup> GPIO45 can be enabled by disabling the SD\_PWRn function, which can be achieved by moving R231 to R100.

- Datasheet of display driver chip [EK73217BCGA \(PDF\)](#)
- Datasheet of display driver chip [EK79007AD \(PDF\)](#)
- LCD Adapter Board Schematic ([PDF](#))
- LCD Adapter Board PCB Layout ([PDF](#))
- Camera Adapter Board Schematic ([PDF](#))
- Camera Adapter Board PCB Layout ([PDF](#))

For further design documentation for the board, please contact us at [sales@espressif.com](mailto:sales@espressif.com).



## Chapter 2

# Related Documentation and Resources

### 2.1 Developer Zone

- [ESP-IDF Programming Guide for ESP32-P4](#) –Extensive documentation for the ESP-IDF development framework.
- [ESP-IoT-Solution Programming Guide](#) - Extensive documentation for the ESP-IoT-Solution development framework.
- [ESP-FAQ](#) - A summary document of frequently asked questions released by Espressif.
- ESP-IDF and other development frameworks on GitHub.  
<https://github.com/espressif>
- ESP32 BBS Forum –Engineer-to-Engineer (E2E) Community for Espressif products where you can post questions, share knowledge, explore ideas, and help solve problems with fellow engineers.  
<https://esp32.com/>
- The ESP Journal –Best Practices, Articles, and Notes from Espressif folks.  
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<https://espressif.com/en/support/download/sdks-demos>

### 2.2 Products

- ESP32-P4 Series SoCs –Browse through all ESP32-P4 SoCs.  
<https://espressif.com/en/products/socs?id=ESP32-P4>
- ESP32-P4 Series Modules –Browse through all ESP32-P4-based modules.  
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<https://espressif.com/en/products/devkits?id=ESP32-P4>
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## **Chapter 3**

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