

## ESP32-P4-Module

### Wi-Fi 6 and Bluetooth Module Support

The ESP32-P4-Module is a high-performance, multi-functional embedded core system module. Its design is centred around the ESP32P4C6/ESP32P4C5 Core board.

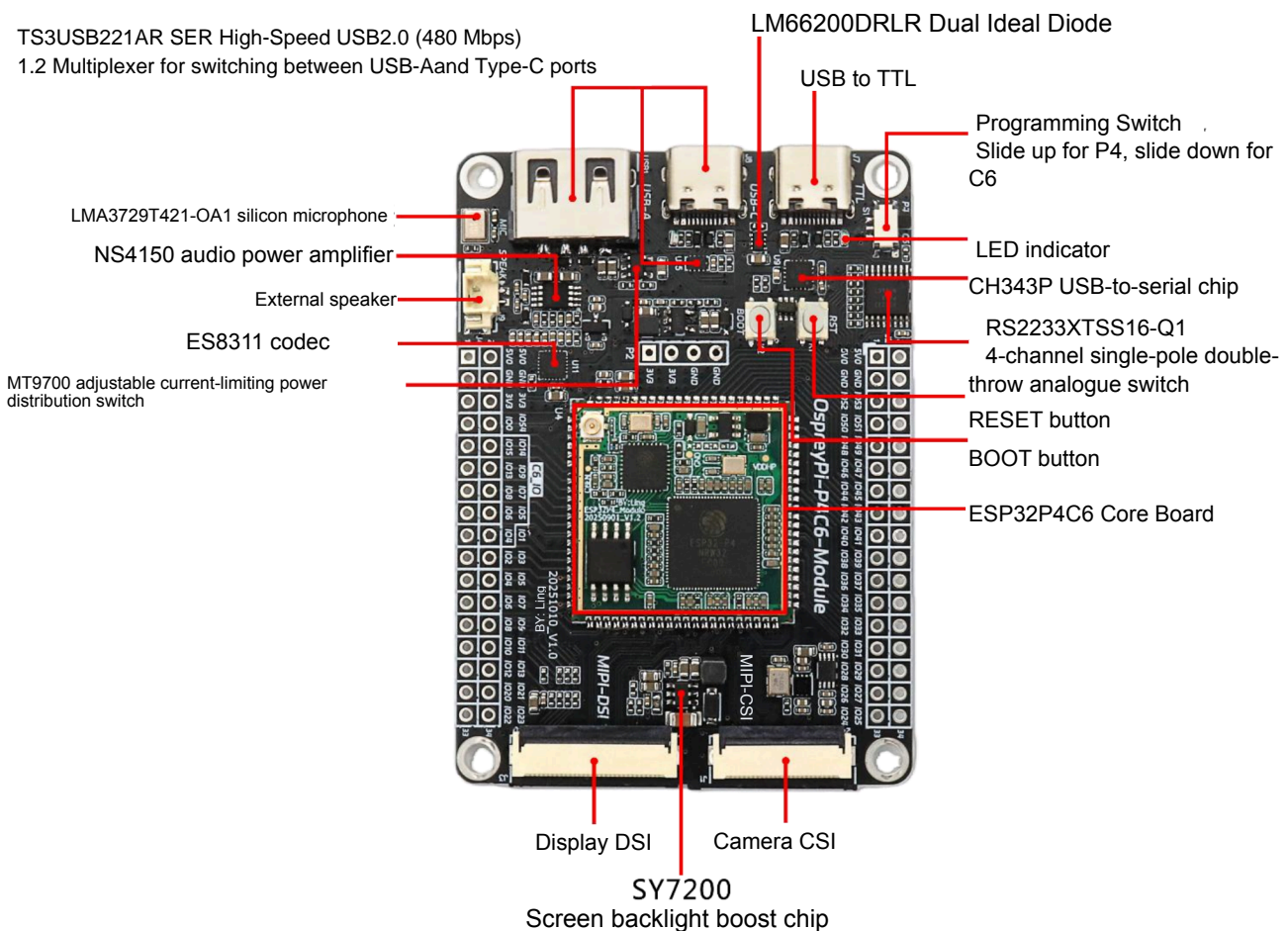
This module features an extensive array of peripheral interfaces and functional units, including camera, display, audio, USB, and various power protection circuits. Engineered for advanced IoT applications demanding complex HMI, multimedia processing, multi-protocol wireless connectivity, and high-speed data communication, it significantly streamlines product development. The module offers a highly integrated, stable, and reliable development platform for AIoT, multimedia processing, industrial control, and sophisticated HMI applications.

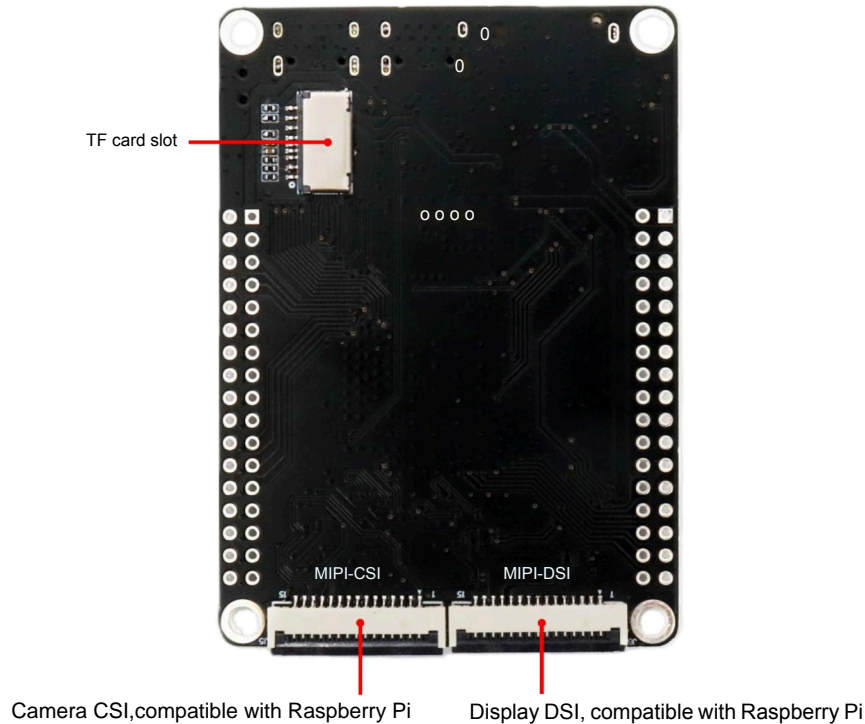
## Features

High-performance MCU featuring RISC-V 32-bit dual-core and single-core processors

- 128 KB HP ROM, 16 KB LP ROM, 768 KB HP L2MEM, 32 KB LP SRAM, 8 KB TCM
- Powerful image and audio processing capabilities, with interfaces including a JPEG codec, pixel processing accelerator (PPA), image signal processor (ISP) and H.264 video encoder.
- 32 MB PSRAM stacked within the chip package, with 16 MB of serial Flash integrated outside the package
- 2×2×17 pins are brought out on the board, providing access to the 55 remaining programmable GPIOs of the ESP32-P4, as well as 9 GPIOs from the ESP32-C6/ESP32-C5
- Security mechanisms: Secure boot, Flash encryption, hardware cryptographic accelerator and hardware random number generator. It also supports hardware access protection, enabling access policy management (APM) and privilege separation.

## Component Overview

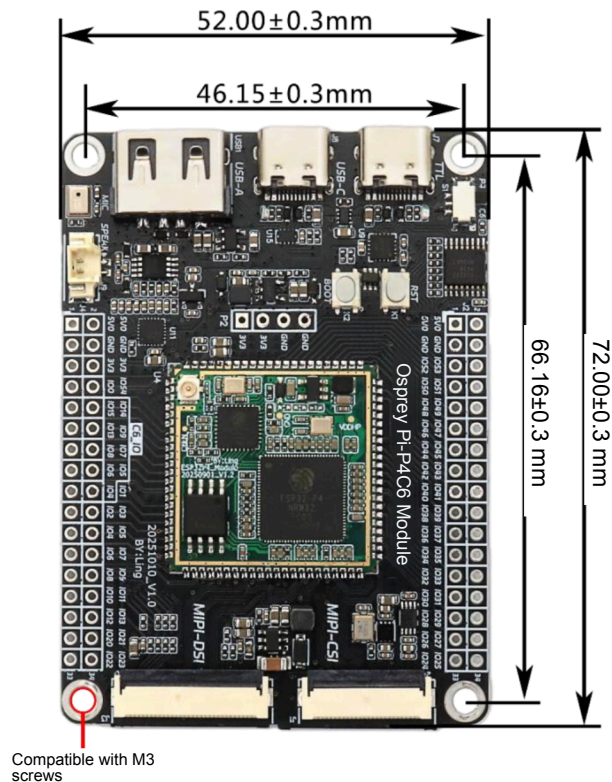




### Core Configuration

Category	Component	Function Description
Main Controller	ESP32P4C6 Core Board	ESP32-P4: High-performance Xtensa® or RISC-V application processor, clocked at up to 400 MHz, with a rich set of integrated peripherals. ESP32-C6: Wireless coprocessor supporting 2.4 GHz Wi-Fi 6, Bluetooth 5.0 (LE) and 802.15.4 (Zigbee/Thread).
	ESP32P4C5 Core Board	ESP32-P4: High-performance Xtensa® or RISC-V application processor, clocked at up to 400 MHz, with a rich set of integrated peripherals. ESP32-C5: Wireless coprocessor supporting dual-band 2.4 & 5 GHz Wi-Fi 6, Bluetooth 5 (LE) and IEEE 802.15.4 (Zigbee, Thread).
USB System	TS3USB221AR SER	High-speed USB 2.0 (480 Mbps) 1:2 multiplexer for switching between Type-C and USB-A interfaces.
Audio System	ES8311, NS4150, LMA3729T421-OA1	ES8311: Low-power, high-performance mono audio codec. NS4150: 3W mono Class D audio power amplifier for driving speakers. LMA3729T421-OA1: Silicon microphone for high-precision audio capture.
Display System	SY7200	High-efficiency screen backlight boost chip, providing constant-current drive for DSI displays.
Power Management	LM66200DRLR, MT9700	LM66200DRLR: Dual ideal diodes implementing OR-gate logic to prevent current backflow between different power inputs. MT9700: Adjustable current-limiting power distribution switch providing overcurrent and short-circuit protection for USB-A output ports.
Interfaces		Front: CSI camera interface (24-pin 0.5mm pitch, top-to-bottom), DSI display interface (30-pin 0.5mm pitch, top-to-bottom) supporting the YDP400BT001-V4 screen. Rear: MIPI-CSI (15-pin, 1.0 mm pitch, top/bottom connection, compatible with Raspberry Pi interface), MIPI-DSI (15-pin, 1.0 mm pitch, top/bottom connection, compatible with Raspberry Pi interface)

## Product Dimensions



## Required hardware

- 1 x ESP32-P4-module
- 1 x USB 2.0 cable (Standard Type-A to Micro-B)
- 1 x computer (Windows, Linux or macOS)

Note: Please ensure you use a suitable USB cable. Some cables are designed for charging only and cannot be used for data transfer or programming.

## Development and Debugging

Software setup: Use Visual Studio Code and ESP-IDF for configuration; the flash\_download\_tool can be used to download the firmware

Serial Debugging: Connect to a computer via the on-board USB-to-TTL interface (CH343); once the serial port is recognised in Device Manager, you can proceed with logging and debugging.

Firmware Download: Using the RS2323 emulation switch, you can select to flash firmware to either the ESP32-P4 or ESP32-C6 core

Software Development: Supports the ESP-IDF development framework, enabling the development of applications for the P4 core.

**Hardware Version**

Date	Version	Changes
20251023	V1.1	1. Initial release
20251024	V1.2	2. Optimised PCB,added power input TVS
20260228	V1.3	3. Set MIPI_CSI reset pull-up to 1.8V; use open-drain output for the I/O. 4. The base board supports both P4C6 and P4C5 modules.

**Schematic**

