

waveshare ESP32-P4-POE-ETH-KIT-A

Waveshare ESP32-P4-ETH Development Board User Manual

Model: ESP32-P4-POE-ETH-KIT-A

1. INTRODUCTION

The Waveshare ESP32-P4-ETH is a high-performance development board based on the ESP32-P4 chip. It is designed for various applications requiring advanced processing power, rich human-machine interfaces, and versatile connectivity. This manual provides essential information for setting up, operating, and maintaining your development board.

Key features include:

- High-performance MCU with RISC-V 32-bit dual-core and single-core processors.
- Memory and Storage: 128 KB HP ROM, 16 KB LP ROM, 768 KB HP L2MEM, 32 KB LP SRAM, and 8 KB TCM.
- Image and Voice Processing: Supports JPEG codecs, Pixel Processing Accelerator (PPA), Image Signal Processor (ISP), and H.264 video encoder.
- Integrated Peripherals: MIPI-CSI, MIPI-DSI, USB 2.0 OTG, Ethernet, SDIO 3.0 TF card slot, microphone, and speaker header.
- Security Features: Secure Boot, Flash Encryption, cryptographic accelerators, TRNG, and hardware access protection.

2. PACKAGE CONTENTS

Verify that all items listed below are included in your package. The specific components may vary slightly depending on the kit version (e.g., KIT-A or KIT-B).

Package Content

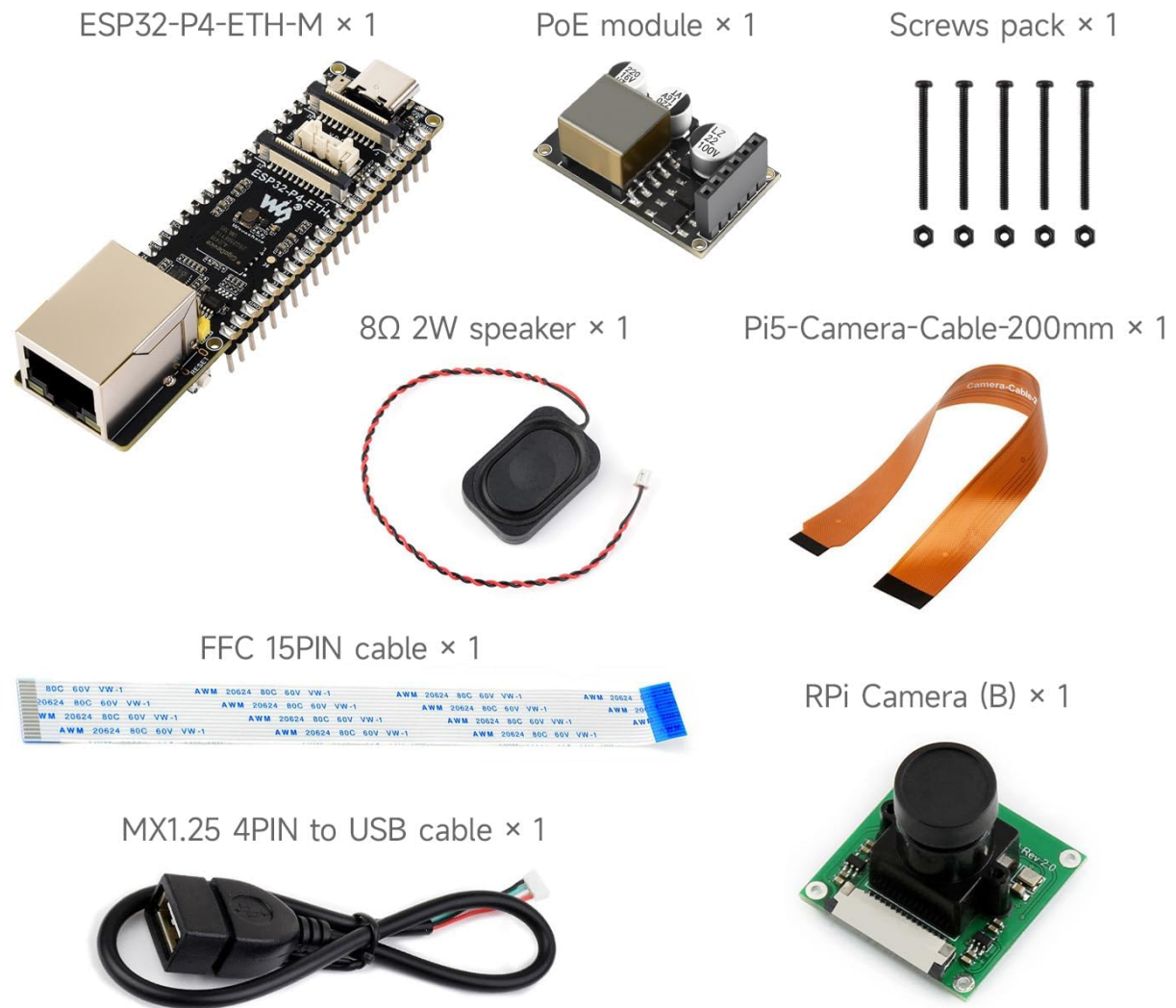


Figure 2.1: Included components for the ESP32-P4-POE-ETH-KIT-A.

- ESP32-P4-ETH-M Development Board (with pre-soldered headers)
- PoE module
- Screws pack
- 8Ω 2W speaker
- Pi5-Camera-Cable-200mm
- FFC 15PIN cable
- MX1.25 4PIN to USB cable
- RPi Camera (B)

3. SPECIFICATIONS

The following table details the technical specifications of the Waveshare ESP32-P4-ETH Development Board and its bundled components.

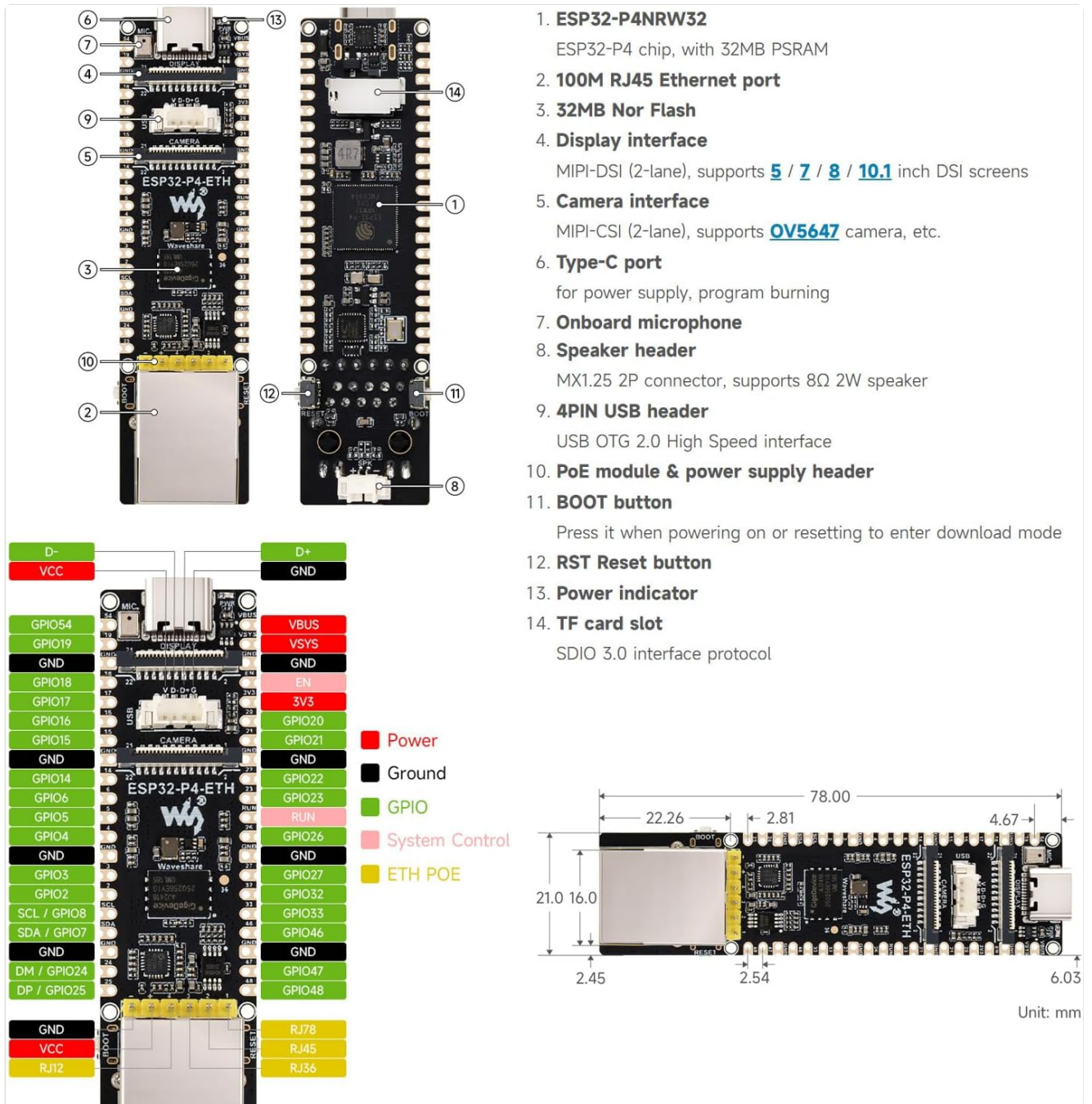


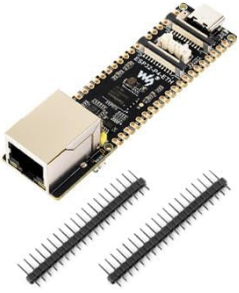
Figure 3.1: ESP32-P4-ETH Board Layout and Dimensions.

Feature	Description
Brand	Waveshare
Model Name	ESP32-P4-POE-ETH-KIT-A
MCU	RISC-V 32-bit dual-core and single-core processors
Memory	128 KB HP ROM, 16 KB LP ROM, 768 KB HP L2MEM, 32 KB LP SRAM, 8 KB TCM, 32MB PSRAM
Flash	32MB Nor Flash
Ethernet Port	100 Mbps RJ45
Display Interface	MIPI-DSI (2-lane) for 5/7/8/10.1 inch DSI screens

Feature	Description
Camera Interface	MIPI-CSI (2-lane) supports OV5647 camera
USB Port	USB 2.0 OTG Type-C
Audio	Onboard microphone, Speaker header (MX1.25 2P connector, supports 8Ω 2W speaker)
Storage	TF card slot (SDIO 3.0 interface)
Power Supply	USB Type-C, PoE (with optional PoE module)
GPIOs	Adapting 2*20 GPIO headers with 27 remaining programmable GPIOs
Dimensions	78.00 mm x 21.0 mm (approximate, refer to diagram for details)

Raspberry Pi Camera (B) Specifications

ESP32-P4-ETH
(Standard version)

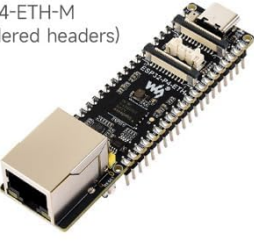


ESP32-P4-ETH-M
(With pre-soldered headers)



ESP32-P4-POE-ETH

ESP32-P4-ETH-M
(With pre-soldered headers)



PoE module



Screws pack



ESP32-P4-ETH-M
(With pre-soldered headers)



Screws pack



Speaker



PRi Camera (B)



PoE module



Pi5-Camera-Cable-200mm



MX1.25 4PIN to USB cable



ESP32-P4-ETH-M
(With pre-soldered headers)



Speaker



PRi Camera (B)



PoE module



Pi5-Camera-Cable-200mm



MX1.25 4PIN to USB cable



10.1-DSI-TOUCH-A



DSI cable



FFC 15PIN cable



MX1.25 2PIN to MX2.54 3PIN cable



MX1.25 2PIN to MX1.25 4PIN cable



Screws pack



Figure 3.2: Raspberry Pi Camera (B) details.

Feature	Description
Sensor	OV5647
Pixels	5MP
CMOS Size	1/4 inch
Aperture	F2.0
Focal Length	6mm
Field of View	60.6°
Night Vision	Not Supported
Focusing	Manual Focus

4. SETUP

This section guides you through the initial setup of your ESP32-P4-ETH Development Board and its peripherals.

4.1 Power Supply

The board supports two power supply methods:

- **USB Type-C:** Connect a 5V USB power adapter to the USB Type-C port on the board.
- **PoE (Power over Ethernet):** If using the optional PoE module, connect it to the board and then connect an 802.3af-compliant PoE router or switch to the RJ45 Ethernet port. This provides both network connection and power through a single Ethernet cable.

DSI Capacitive Touchscreen

Optional For DSI Capacitive Touch Display, IPS Screen, Optical Bonding Toughened Glass Panel, With 178° Wide Viewing Angle.
Supports 10-Point Touch, Provides Clear Image And Excellent Visual Experience



* the DSI LCD is only included in the
ESP32-P4-POE-ETH-KIT-B

MODEL	10.1-DSI-TOUCH-A
RESOLUTION	800 × 1280 (H × V)
COMMUNICATION INTERFACE	MIPI-DSI (2-lane)
BRIGHTNESS	400cd/m ² (supports customization for 1000cd/m ² high brightness version)
TOUCH CHIP	GT9271
OUTLINE DIMENSION	147.0 × 239.0 (mm)
DISPLAY AREA	135.36 × 216.58 (mm)
PIXEL SIZE	0.1692 (H) × 0.1692 (V) (mm)
CONTRAST RATIO	800:1
OPERATION TEMPERATURE	0°C ~ 60°C

Raspberry Pi Camera (B)

5MP | Manual Focus

Compatible With Raspberry Pi Series Boards



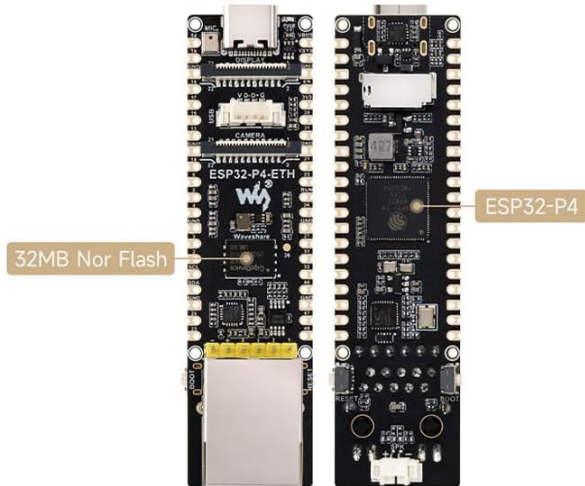
SENSOR	OV5647	CMOS SIZE	1/4inch
PIXELS	5MP	APERTURE	F2.0
FOCAL LENGTH	6mm	FIELD OF VIEW	60.6°
NIGHT VISION FUNCTION	Not Supported	FOCUSING	Manual Focus

* for reference only, please refer to the package content for detailed part list.

Figure 4.1: Power Supply Options.

Highly Integrated And Powerful Performance

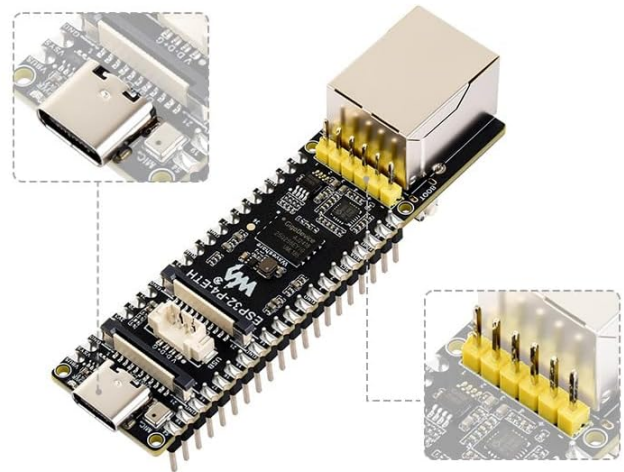
Adopts ESP32-P4 Module, Onboard 32MB Nor Flash



Two Power Supply Methods

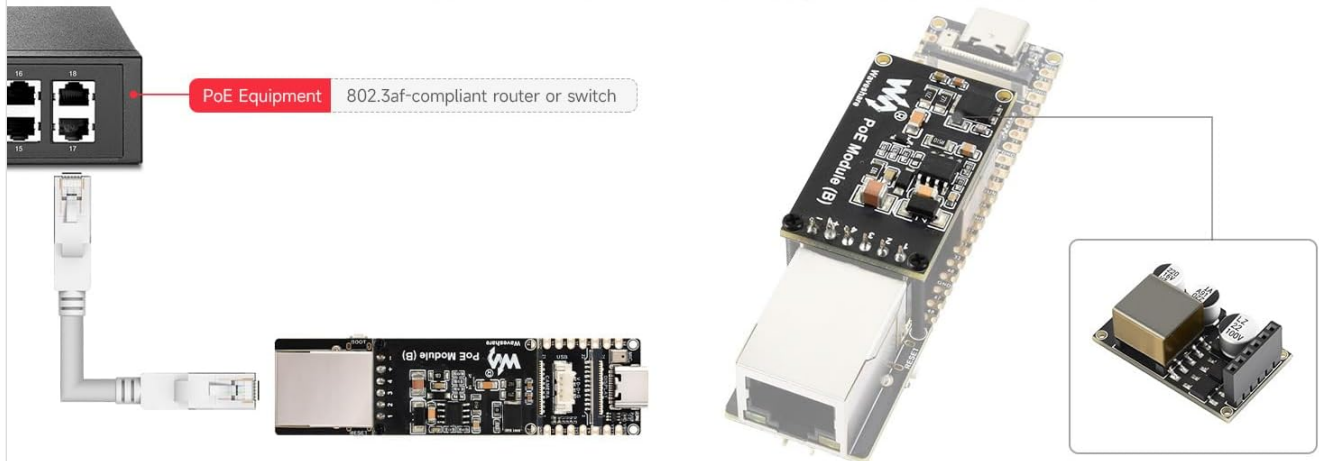
Supports Both PoE* And USB Type-C Power Supply

* the PoE module is required.



Optional For PoE Module, Supports PoE Power Supply

Provides Both Network Connection And Power Supply In Only One Ethernet Cable



* the PoE module is optional, and the switch in the picture above is NOT included.

Figure 4.2: PoE Module Connection.

4.2 Peripheral Connections

Connect the camera, speaker, and other peripherals as required for your application. Refer to the connection examples below for guidance.

Development Board Introduction

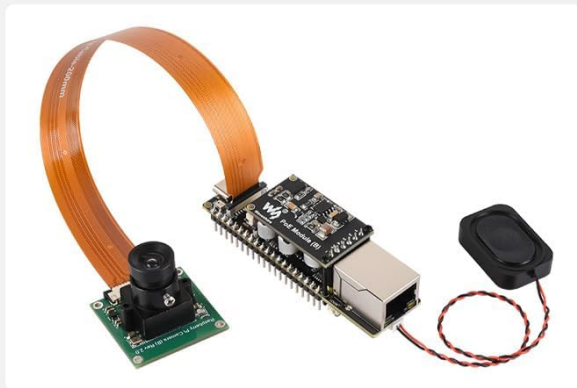
This product is a multimedia development board based on ESP32-P4. It features rich Human-Machine interfaces, including MIPI-CSI (with integrated Image Signal Processor), MIPI-DSI, SPI, I2S, I2C, LED PWM, MCPWM, RMT, ADC, UART, TWAI, etc. Additionally, it supports USB OTG 2.0 HS, Ethernet port and onboard 40PIN GPIO header which is compatible with some Raspberry Pi Pico HATs, enabling a wider range of application adaptability.

The ESP32-P4 adopts a dual-core RISC-V processor and supports up to 32MB PSRAM, featuring USB 2.0, MIPI-CSI / DSI, H.264 encoder, and other peripherals, meeting the needs for low-cost, high-performance, and low-power multimedia development. It also integrates a Digital Signature Peripheral and a dedicated Key Management Unit, ensuring secure data and operations. Specifically designed for high-performance and high-security applications, the ESP32-P4-ETH meets the requirements of Human-Machine interaction, efficient edge computing, and IO expansion.

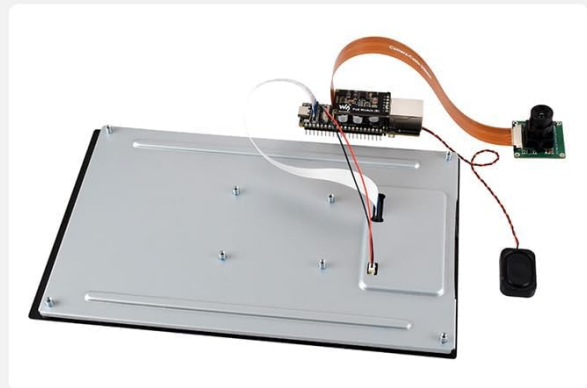
Key features include:

- High-performance MCU with 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 voice processing capability. Provides image and voice processing interfaces including JPEG codecs, Pixel Processing Accelerator (PPA), Image Signal Processor (ISP) and H.264 video encoder
- 32MB PSRAM in the chip's package, onboard 32MB Nor Flash
- Commonly used peripherals such as MIPI-CSI, MIPI-DSI, USB 2.0 OTG, Ethernet, SDIO 3.0 TF card slot, microphone, speaker header, etc.
- Adapting 2*20 GPIO headers with 27 x remaining programmable GPIOs
- Security features: Secure Boot, Flash Encryption, cryptographic accelerators, and TRNG. Additionally, hardware access protection mechanisms help to enable Access Permission Management and Privilege Separation

Kit Connection Examples



ESP32-P4-POE-ETH-KIT-A



ESP32-P4-POE-ETH-KIT-B

Figure 4.3: Kit Connection Examples (KIT-A).

- **Camera:** Connect the RPi Camera (B) to the MIPI-CSI interface using the provided camera cable.
- **Speaker:** Connect the 8Ω 2W speaker to the speaker header on the board.
- **Display (Optional):** If using a DSI display (e.g., 10.1-DSI-TOUCH-A, typically included in KIT-B), connect it to the MIPI-DSI interface.

5. OPERATING INSTRUCTIONS

Once the board is powered and peripherals are connected, you can begin developing and operating your applications.

5.1 Initial Boot and Programming

- Connect the board to your computer via the USB Type-C port for power and data communication.
- To enter download mode for programming, press the **BOOT** button while powering on or resetting the board.
- Refer to the official Waveshare Wiki resources for detailed programming guides and SDK information. A link to the Wiki can be found on the Waveshare store page.

5.2 AI Speech Interaction

The ESP32-P4-ETH board supports AI speech interaction, allowing access to online large model platforms such as DeepSeek and Doubao. This functionality utilizes the onboard microphone and can output responses via a connected DSI display or speaker.

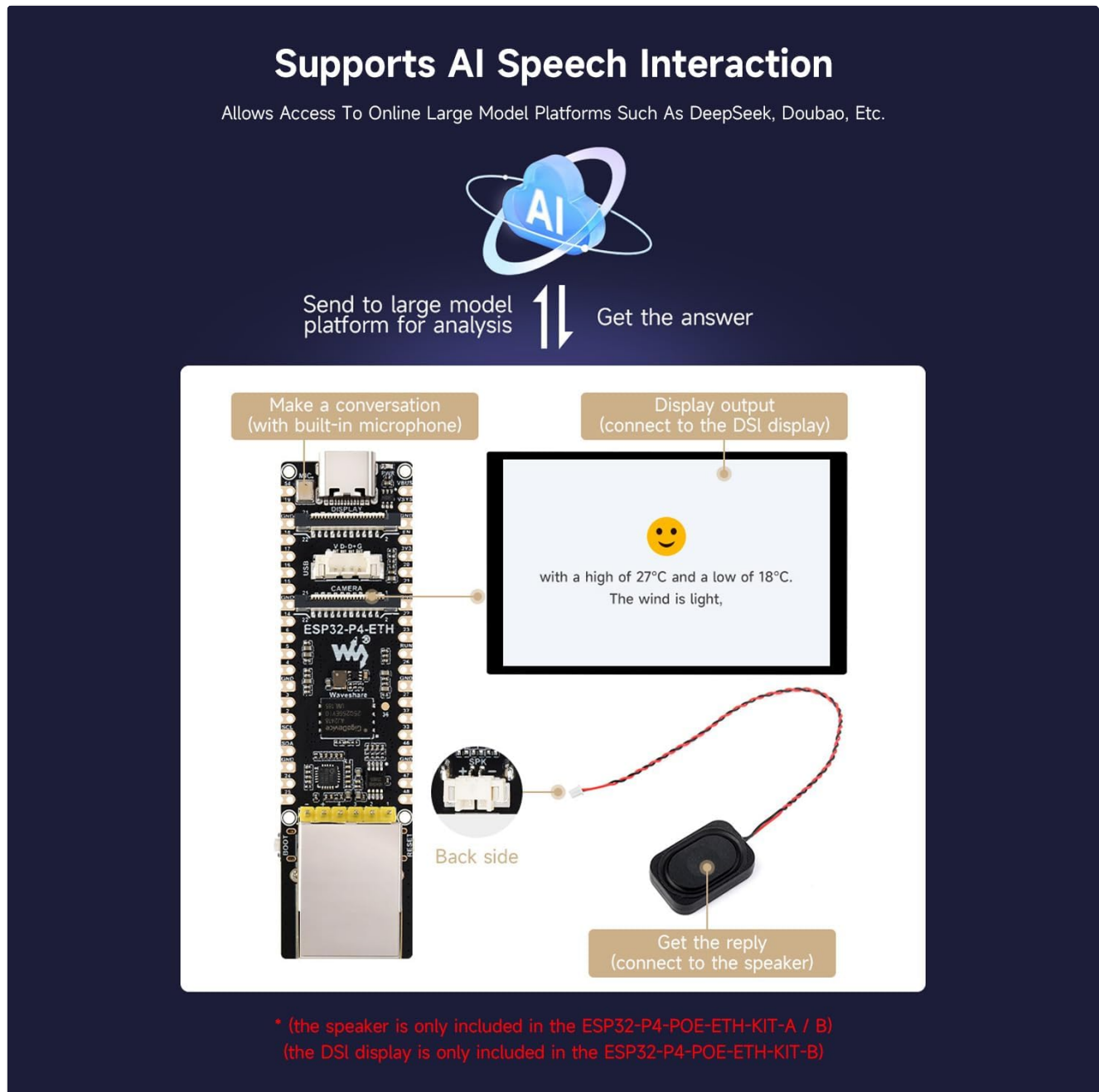


Figure 5.1: AI Speech Interaction Flow.

5.3 Ethernet Connectivity

The 100 Mbps RJ45 Ethernet port provides stable network connectivity for your applications. If using PoE, ensure your network infrastructure supports 802.3af standard.

6. MAINTENANCE

Proper maintenance ensures the longevity and reliable operation of your development board.

- **Cleaning:** Keep the board clean and free from dust and debris. Use a soft, dry brush or compressed air for cleaning. Avoid using liquids or solvents.

- **Storage:** Store the board in a dry, anti-static environment when not in use.
- **Handling:** Handle the board by its edges to avoid touching sensitive components. Use anti-static precautions (e.g., anti-static wrist strap) to prevent electrostatic discharge (ESD) damage.
- **Firmware Updates:** Regularly check the Waveshare Wiki for firmware updates and apply them as recommended to ensure optimal performance and security.

7. TROUBLESHOOTING

This section addresses common issues you might encounter with the ESP32-P4-ETH Development Board.

7.1 Power Issues

- **Board not powering on:** Ensure the USB Type-C cable is securely connected and the power source is active. If using PoE, verify the PoE module is correctly installed and the Ethernet switch provides PoE power. Check the power indicator LED on the board.
- **Intermittent power:** Check for loose connections or faulty cables. Try a different power adapter or USB cable.

7.2 Connectivity Issues

- **Ethernet not connecting:** Verify the Ethernet cable is properly connected to both the board and the network device. Ensure the network device is active and configured correctly. Check network settings in your software.
- **USB not recognized:** Ensure the USB cable is functional and connected to a working USB port on your computer. Install necessary drivers if prompted by your operating system.

7.3 Programming Issues

- **Failed to upload firmware:** Ensure the board is in download mode (press BOOT button during power-up/reset). Verify your development environment (e.g., ESP-IDF) is correctly set up and configured for the ESP32-P4. Check serial port selection.

8. WARRANTY AND SUPPORT

The Waveshare ESP32-P4-ETH Development Board comes with a **1-year warranty** from the manufacturer. For technical support, additional resources, and detailed documentation, please visit the official Waveshare Wiki page. You can find a link to the Wiki by visiting the [Waveshare Store on Amazon](#) and clicking the Wiki link.

Your browser does not support the video tag.

Video 8.1: Overview of the ESP32 P4 Series, providing general information about the development board's capabilities and features.

ASK A QUESTION ABOUT THIS MANUAL

Ask about setup, troubleshooting, compatibility, parts, safety, or missing instructions. Manuals+ will review the question and use this page's manual context to help answer it.

Name

Anonymous

Email

you@example.com

After a successful submission, we securely hash the supplied account or form email before sending it to Microsoft Advertising for conversion attribution. [Privacy details](#).

Question

Example: How do I reset this device or fix this error?

Details

Model number, symptoms, what you tried, or the section of the manual you are using.

Submit question