

Firebeetle 2 Board ESP32-P4 Microcontroller Wiki - DFRobot

1. Product Description

1.1 Product Introduction

1.2 Features

1.3 Application Scenarios

2. Product Specifications

2.1 Product Parameters

2.2 On-board Function

Diagram

3. Tutorial - First Time Use

3.1 Arduino IDE Configuration

3.2 Select Development Board

3.3 LED Blinking



4. ESP32 General Tutorial

5. FLASH Download Tool Usage Tutorial

6. MicroPython Tutorial

7. PlatformIO Tutorial

8. ESP-IDF Tutorial

9. Related Documents

SKU:DFR1172 (<https://www.dfrobot.com/product-2915.html>)

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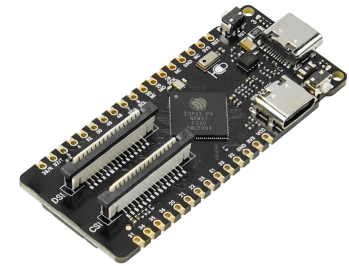
1. Product Description

1.1 Product Introduction

The FireBeetle 2 ESP32-P4 is a high-performance microcontroller (MCU) development board designed based on the ESP32-P4R32 chip. It has powerful processing capabilities in image processing, supporting up to 1080p@30fps video playback and 1080p@30fps image shooting. The development board integrates WiFi and Bluetooth functions, making it suitable for various HMI (Human-Machine Interface) application scenarios such as digital photo albums, home central control screens, intelligent security systems, and smart doorbells.

High-definition Large-screen Display

The FireBeetle 2 ESP32 P4 integrates an MIPI-DSI interface, which can be directly connected to the Raspberry Pi DSI series display screens. The built-in JPEG decoder of the ESP32-P4 is mainly used for efficiently parsing and decompressing JPEG format image data, while the pixel processing accelerator is specifically designed to improve the processing speed and quality of image data. Thanks to these hardware advantages, the development board significantly enhances the display performance of images and videos, supporting smooth playback at up to 720p@88fps or 1080p@30fps, bringing a good visual



experience of human-machine interaction to the project. Using the FireBeetle 2 ESP32 P4, a series of related projects such as digital photo albums, home central control screens, and multimedia advertisement displays can be created.

High-definition Camera Capture

The FireBeetle 2 ESP32 P4 integrates an MIPI-CSI interface, which can be directly connected to the Raspberry Pi CSI series cameras. The built-in JPEG encoder of the ESP32-P4 is responsible for efficiently compressing the original image data into JPEG format. The image signal processor performs real-time optimization and enhancement on the captured images, and the H264 video encoder ensures the real-time encoding of high-quality video streams. These features work together to greatly improve the image capture performance of the camera, supporting high-definition shooting at up to 720p@88fps or 1080p@30fps, enabling smooth shooting and video recording functions. Using the FireBeetle 2 ESP32 P4, various image capture and processing projects such as intelligent security systems, smart doorbells, and remote video conference cameras can be created.

Rich Expansion Interfaces

The FireBeetle 2 ESP32-P4 development board, with a size of only 25.4x60mm, exposes a rich and easy-to-use set of peripheral interfaces, reducing the difficulty of connecting external devices. The development board integrates the ESP32-C6 module, endowing the development board with wireless communication functions. The development board exposes a Type-C USB OTG 2.0 high-speed interface, which theoretically has a maximum data transmission speed of up to 480Mbps, enabling high-speed communication between the development board and USB devices. It has an on-board MIC, which can be used for sound collection and voice recognition. It also has an on-board TF card slot, which provides a convenient large-capacity storage solution for the project, enabling easy local storage and reading operations of media files such as pictures and videos.

Note:

1. The current chip version is "revision v1.0" with a main frequency configured at 360MHz.

1. Product Description

1.1 Product Introduction

1.2 Features

1.3 Application Scenarios

2. Product Specifications

2.1 Product Parameters

2.2 On-board Function Diagram

3. Tutorial - First Time Use

3.1 Arduino IDE Configuration

3.2 Select Development Board

3.3 LED Blinking



4. ESP32 General Tutorial

5. FLASH Download Tool Usage Tutorial

6. MicroPython Tutorial

7. PlatformIO Tutorial

8. ESP-IDF Tutorial

9. Related Documents

2. MIPI-CSI and AI features are only available under ESP-IDF and not currently supported in Arduino.

1.2 Features

- Dual-core RISC-V 360MHz + Single-core RISC-V 40MHz processor
- Supports single-precision FPU and AI extensions
- On-board MIPI-DSI interface, supporting up to 720p@88fps or 1080p@30fps image display
- On-board MIPI-CSI interface, supporting up to 720p@88fps or 1080p@30fps image capture
- Integrates the ESP32-C6 module, supporting WiFi and Bluetooth communication
- Integrates rich and easy-to-use expansion interfaces: USB OTG 2.0, MIC, TF card slot

1.3 Application Scenarios

- AI camera
- Surveillance camera
- AI peephole viewer
- Tracking gimbal
- Smart home control panel
- Digital photo frame
- Multimedia advertising player

2. Product Specifications

2.1 Product Parameters

Basic Parameters

- Operating voltage: 3.3V

1. Product Description

1.1 Product Introduction

1.2 Features

1.3 Application Scenarios

2. Product Specifications

2.1 Product Parameters

2.2 On-board Function

Diagram

3. Tutorial - First Time Use

3.1 Arduino IDE Configuration

3.2 Select Development Board

3.3 LED Blinking

4. ESP32 General Tutorial

5. FLASH Download Tool

Usage Tutorial

6. MicroPython Tutorial

7. PlatformIO Tutorial

8. ESP-IDF Tutorial

9. Related Documents

1. Product Description

1.1 Product Introduction

1.2 Features

1.3 Application Scenarios

2. Product Specifications

2.1 Product Parameters

2.2 On-board Function Diagram

3. Tutorial - First Time Use

3.1 Arduino IDE Configuration

3.2 Select Development Board

3.3 LED Blinking

>

4. ESP32 General Tutorial

5. FLASH Download Tool Usage Tutorial

6. MicroPython Tutorial

7. PlatformIO Tutorial

8. ESP-IDF Tutorial

9. Related Documents

- Type-C input voltage: 5V DC
- VCC input voltage: 5V DC
- Operating temperature: -10~60°C
- Module size: 25.4x60mm

Hardware Information

- HP Core: RISC-V 32-bit Dual-core Microprocessor, 360 MHz
- LP Core: RISC-V 32-bit Single-core Microprocessor, 40 MHz
- 32MB PSRAM
- Flash: 16MB
- 768 KB HP L2MEM
- 32 KB LP SRAM
- 128KB HP ROM
- 16KB LP ROM

Wi-Fi

- WIFI Protocol: IEEE 802.11b/g/n/ax
- IEEE 802.11ax (20 MHz-only non-AP mode)
- WIFI Bandwidth: The 2.4 GHz band supports 20 MHz and 40 MHz bandwidths
- WIFI Modes: Station mode, SoftAP mode, SoftAP+Station mode, and promiscuous mode
- WIFI Frequency: 2.4GHz
- Frame Aggregation: TX/RX A-MPDU, TX/RX A-MSDU

Bluetooth

- Bluetooth Protocol: Bluetooth 5
- Bluetooth Frequencies: 125 Kbps, 500 Kbps, 1 Mbps, 2 Mbps

Interface Pins

1. Product Description

1.1 Product Introduction

1.2 Features

1.3 Application Scenarios

2. Product Specifications

2.1 Product Parameters

2.2 On-board Function Diagram

3. Tutorial - First Time Use

3.1 Arduino IDE Configuration

3.2 Select Development Board

3.3 LED Blinking



4. ESP32 General Tutorial

5. FLASH Download Tool Usage Tutorial

6. MicroPython Tutorial

7. PlatformIO Tutorial

8. ESP-IDF Tutorial

9. Related Documents

- Digital I/O x24
- 2-channel MIPI CSI x1
- 2-channel MIPI DSI x1
- UART x5
- LP UART x1
- I2C x2
- LP I2C x1
- I3C x1
- I2S x3
- LP I2S x1
- SPI x2
- LP SPI x1
- High-speed USB OTG 2.0 x1
- SDIO2.0 x1
- TOUCH 4 channels
- LED PWM Controller with 8 channels
- Infrared Transceiver: Transmit channels x5, Receive channels x5
- 1 × 12-bit SAR ADC, 7 channels

Note: The functional pins are multiplexed, and the above number of interfaces is the maximum value.

2.2 On-board Function Diagram

1. Product Description

1.1 Product Introduction

1.2 Features

1.3 Application Scenarios

2. Product Specifications

2.1 Product Parameters

2.2 On-board Function Diagram

3. Tutorial - First Time Use

3.1 Arduino IDE Configuration

3.2 Select Development Board

3.3 LED Blinking

4. ESP32 General Tutorial

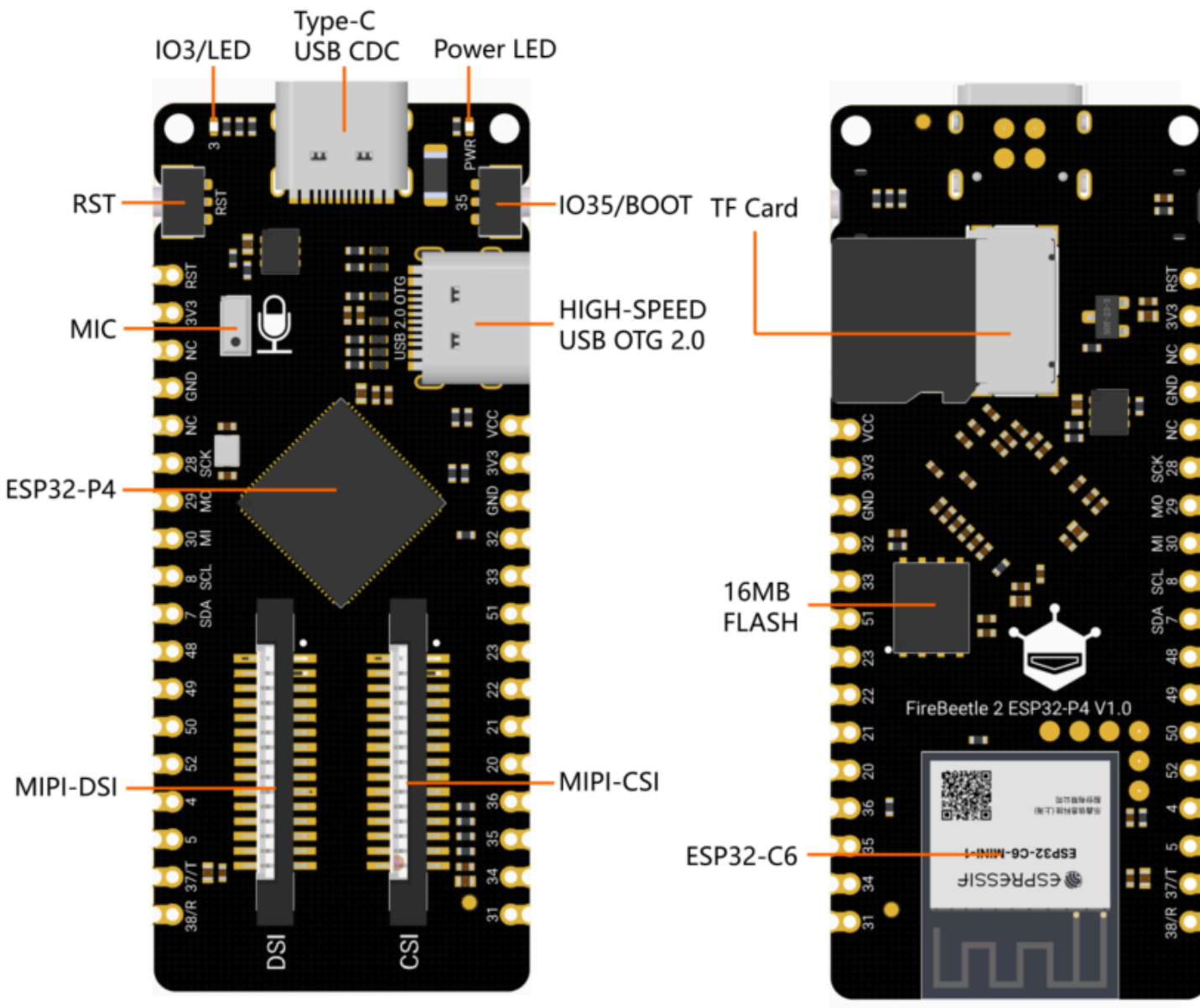
5. FLASH Download Tool Usage Tutorial

6. MicroPython Tutorial

7. PlatformIO Tutorial

8. ESP-IDF Tutorial

9. Related Documents



- **Type-C USB CDC:** Type-C USB programming and debugging interface
- **IO3/LED:** Onboard LED pin

1. Product Description

1.1 Product Introduction

1.2 Features

1.3 Application Scenarios

2. Product Specifications

2.1 Product Parameters

2.2 On-board Function Diagram

3. Tutorial - First Time Use

3.1 Arduino IDE Configuration

3.2 Select Development Board

3.3 LED Blinking



4. ESP32 General Tutorial

5. FLASH Download Tool Usage Tutorial

6. MicroPython Tutorial

7. PlatformIO Tutorial

8. ESP-IDF Tutorial

9. Related Documents

- **Power LED:** Motherboard power indicator light
- **RST:** Reset button
- **IO35/BOOT:** IO pin/BOOT button
- **MIC:** PDM microphone
- **HIGH-SPEED USB OTG 2.0:** Type-C high-speed USB OTG 2.0
- **ESP32-P4:** ESP32-P4 chip
- **MIPI-DSI:** Two-channel MIPI-DSI screen (compatible with the pin sequence of Raspberry Pi 4B screen)
- **MIPI-CSI:** Two-channel MIPI-DSI screen (compatible with the pin sequence of Raspberry Pi 4B camera)
- **TF Card:** TF card slot
- **16MB FLASH:** 16MB Flash storage
- **ESP32-C6:** ESP32-C6-MINI-1 module, connected to P4 via SDIO, used for expanding WiFi and Bluetooth

3. Tutorial - First Time Use

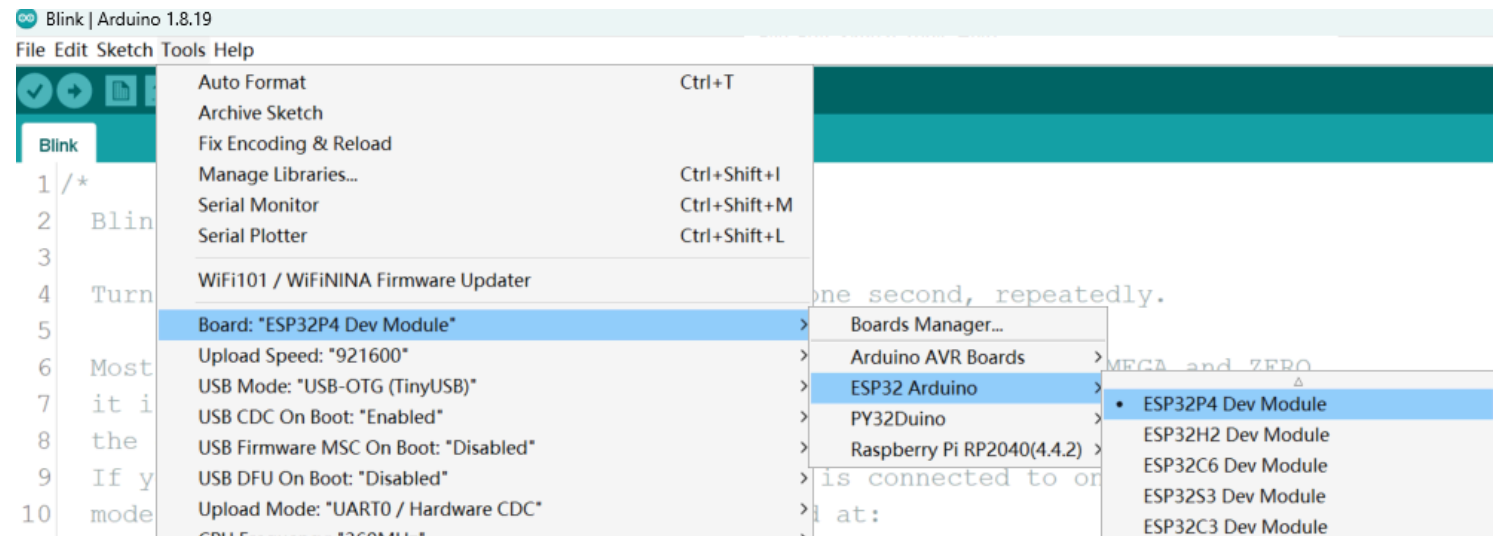
3.1 Arduino IDE Configuration

When you use the ESP32 for the first time, you need to know the following steps:

1. Add the ESP32 development board in Arduino IDE (How to add the ESP32 board to Arduino IDE? (https://wiki.dfrobot.com/Add_ESP32_board_to_Arduino_IDE))
2. Select the development board and serial port
3. Burn the program

3.2 Select Development Board

- Click Tools->Board, select "ESP32P4 Dev Module".



- The development board needs to be set before burning the code:
 - USB CDC On Boot:
 - Enabled: Print serial port data through the USB interface
 - Disabled: Print serial port data through TX and RX
 - Partition Scheme: Disk partitioning scheme. Please select the appropriate storage space according to the Flash of the development board.
 - Port: Development board port (Just make sure the COM number is correct, which has nothing to do with the subsequent chip model.)

1. Product Description

1.1 Product Introduction

1.2 Features

1.3 Application Scenarios

2. Product Specifications

2.1 Product Parameters

2.2 On-board Function

Diagram

3. Tutorial - First Time Use

3.1 Arduino IDE Configuration

3.2 Select Development Board

3.3 LED Blinking

4. ESP32 General Tutorial

5. FLASH Download Tool

Usage Tutorial

6. MicroPython Tutorial

7. PlatformIO Tutorial

8. ESP-IDF Tutorial

9. Related Documents

1. Product Description

1.1 Product Introduction

1.2 Features

1.3 Application Scenarios

2. Product Specifications

2.1 Product Parameters

2.2 On-board Function Diagram

3. Tutorial - First Time Use

3.1 Arduino IDE Configuration

3.2 Select Development Board

3.3 LED Blinking

> 4. ESP32 General Tutorial

5. FLASH Download Tool Usage Tutorial

6. MicroPython Tutorial

7. PlatformIO Tutorial

8. ESP-IDF Tutorial

9. Related Documents

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Archive Sketch

Fix Encoding & Reload

Manage Libraries... Ctrl+Shift+I

Serial Monitor Ctrl+Shift+M

Serial Plotter Ctrl+Shift+L

WiFi101 / Wi-FiNINA Firmware Updater

Board: "ESP32P4 Dev Module" >

Upload Speed: "921600" >

USB Mode: "Hardware CDC and JTAG" >

USB CDC On Boot: "Enabled" >

USB Firmware MSC On Boot: "Disabled" >

USB DFU On Boot: "Disabled" >

Upload Mode: "UART0 / Hardware CDC" >

CPU Frequency: "360MHz" >

Flash Frequency: "80MHz" >

Flash Mode: "QIO" >

Flash Size: "16MB (128Mb)" >

Partition Scheme: "16M Flash (3MB APP/9.9MB FATFS)" >

Core Debug Level: "Debug" >

PSRAM: "Enabled" >

Erase All Flash Before Sketch Upload: "Disabled" >

JTAG Adapter: "Disabled" >

https://wiki.dfrobot.com/SKU_DFR1172_FireBeetle_2_Board_ESP32_P4

9/13

1. Product Description

1.1 Product Introduction

1.2 Features

1.3 Application Scenarios

2. Product Specifications

2.1 Product Parameters

2.2 On-board Function

Diagram

3. Tutorial - First Time Use

3.1 Arduino IDE Configuration

3.2 Select Development Board

3.3 LED Blinking

4. ESP32 General Tutorial

5. FLASH Download Tool

Usage Tutorial

6. MicroPython Tutorial

7. PlatformIO Tutorial

8. ESP-IDF Tutorial

9. Related Documents

18	by C	Port	>
19		Get Board Info	
20	This	Programmer	>
21		Burn Bootloader	

3.3 LED Blinking

- Copy the code into the window and click "**Upload**" to upload the code.

```
int led = 3;
void setup() {
  pinMode(led,OUTPUT);
}

void loop() {
  digitalWrite(led,HIGH);
  delay(1000);
  digitalWrite(led,LOW);
  delay(1000);
}
```

1. Product Description

1.1 Product Introduction

1.2 Features

1.3 Application Scenarios

2. Product Specifications

2.1 Product Parameters

2.2 On-board Function

Diagram

3. Tutorial - First Time Use

3.1 Arduino IDE Configuration

3.2 Select Development Board

3.3 LED Blinking



4. ESP32 General Tutorial

5. FLASH Download Tool

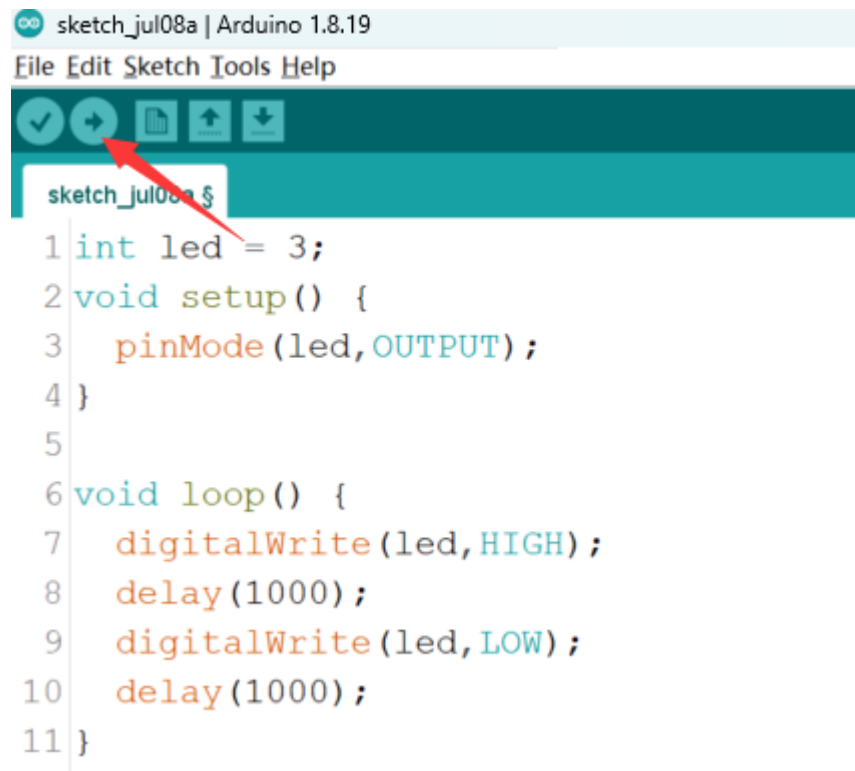
Usage Tutorial

6. MicroPython Tutorial

7. PlatformIO Tutorial

8. ESP-IDF Tutorial

9. Related Documents



- Wait for the burning to complete, and you can see the on-board LED light start to flash.
 - If the LED light does not flash, reset the development board.
 - If the burning fails, please check Frequently Asked Questions ().



4. ESP32 General Tutorial

ESP32 General Tutorial (https://wiki.dfrobot.com/ESP32_General_Tutorial)

5. FLASH Download Tool Usage Tutorial

FLASH Download Tool Usage Tutorial (https://wiki.dfrobot.com/FLASH_Download_Tool_Usage_Tutorial)

6. MicroPython Tutorial

MicroPython Tutorial (https://wiki.dfrobot.com/ESP32_MicroPython_Usage_Tutorial)

MicroPython Application Example
(https://wiki.dfrobot.com/SKU_DFR1172_MicroPython_Application_Example)

7. PlatformIO Tutorial

PlatformIO Tutorial (https://wiki.dfrobot.com/ESP32_Platform_IO)

8. ESP-IDF Tutorial

ESP-IDF Tutorial (https://wiki.dfrobot.com/ESP32_ESP_IDF_Tutorial)

9. Related Documents

- ESP32-P4 Datasheet
(<https://dfimg.dfrobot.com/62d52567aa9508d63a4247a1/wikien/30ca0837adaac2d5c26640d7b8e377fe.pdf>)
- FireBeetle 2 ESP32-P4 Schematic
(<https://dfimg.dfrobot.com/62d52567aa9508d63a4247a1/wikien/2c8f76e7e0765939716e3c7bda0983de.pdf>)
- Dimension drawing
(<https://dfimg.dfrobot.com/62d52567aa9508d63a4247a1/wikien/3a371c5840b11cb82977383dc047>)

1. Product Description

1.1 Product Introduction

1.2 Features

1.3 Application Scenarios

2. Product Specifications

2.1 Product Parameters

2.2 On-board Function

Diagram

3. Tutorial - First Time Use

3.1 Arduino IDE Configuration

3.2 Select Development Board

3.3 LED Blinking

4. ESP32 General Tutorial

5. FLASH Download Tool Usage Tutorial

6. MicroPython Tutorial

7. PlatformIO Tutorial

8. ESP-IDF Tutorial

9. Related Documents

1. Product Description

1.1 Product Introduction

1.2 Features

1.3 Application Scenarios

2. Product Specifications

2.1 Product Parameters

2.2 On-board Function Diagram

3. Tutorial - First Time Use

3.1 Arduino IDE Configuration

3.2 Select Development Board

3.3 LED Blinking



4. ESP32 General Tutorial

5. FLASH Download Tool Usage Tutorial

6. MicroPython Tutorial

7. PlatformIO Tutorial

8. ESP-IDF Tutorial

9. Related Documents

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- FireBeetle 2 ESP32-P4 IO Expansion Schematic
(<https://dfimg.dfrobot.com/62d52567aa9508d63a4247a1/wikien/8c795896f10c41b93a857cfbc51600d9.pdf>)
- FireBeetle 2 ESP32-P4 IO Expansion Dimension Drawing
(<https://dfimg.dfrobot.com/62d52567aa9508d63a4247a1/wikien/fa6c796b0080a2e74530028ca6d9336d.pdf>)
- MIC Datasheet
(<https://dfimg.dfrobot.com/5d57611a3416442fa39bffca/wiki/d2c58ceeebf0ab6a527b0c37c0ef525e.pdf>)

Back to Top 