Waveshare RP2350-Plus-16MB-M

Waveshare RP2350-Plus Development Board User Manual

Model: RP2350-Plus-16MB-M | Brand: Waveshare

1. Introduction

The Waveshare RP2350-Plus Development Board is a high-performance, Pico-like microcontroller unit (MCU) board designed around the Raspberry Pi RP2350A chip. This advanced chip features a unique dual-core and dual-architecture design, incorporating both an Arm Cortex-M33 processor and a Hazard 3 RISC-V processor, capable of flexible clock speeds up to 150 MHz.

Equipped with 520KB of Static RAM and 16MB of on-board Flash memory, the RP2350-Plus offers ample resources for a wide range of embedded projects. Its compact design, Type-C USB connector, and lithium battery recharge/discharge header make it versatile for both desktop development and mobile applications.

This manual provides essential information for setting up, operating, and maintaining your RP2350-Plus Development Board, along with detailed specifications and troubleshooting tips.

2. Package Contents

Upon opening the package, please verify that all components are present and in good condition. The standard package for the RP2350-Plus-16MB-M includes:

- 1x RP2350-Plus-16MB Development Board with pre-soldered header

Package Content

RP2350-Plus-16MB with pre-soldered header x1

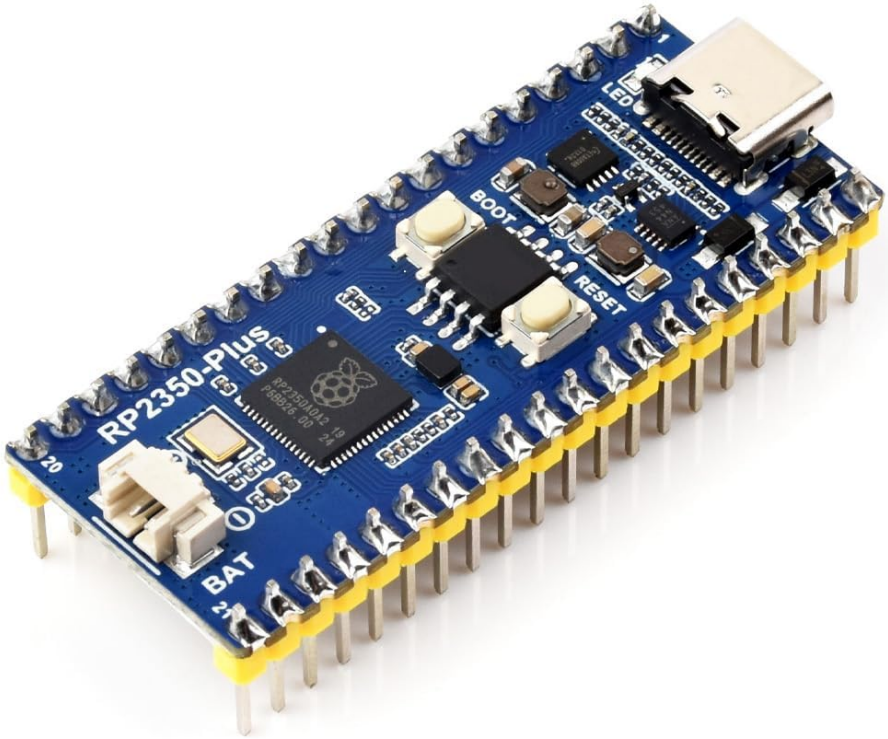


Figure 2.1: RP2350-Plus-16MB with pre-soldered header as included in the package.

3. Product Overview

3.1 Key Features

- **Microcontroller:** Raspberry Pi RP2350A dual-core (Arm Cortex-M33 and Hazard 3 RISC-V) up to 150 MHz.
- **Memory:** 520KB SRAM, 16MB on-board Flash memory.
- **Connectivity:** USB 1.1 with device and host support via Type-C connector.
- **Power Management:** Lithium battery recharge/discharge header, onboard DC-DC chip MP28164 (max 2A load).
- **GPIO:** 26 multi-function GPIO pins.
- **Peripherals:** 2x SPI, 2x I2C, 2x UART, 4x 12-bit ADC, 16x controllable PWM channels.
- **Programming:** Drag-and-drop programming via USB mass storage.
- **Additional Features:** Low-power sleep and dormant modes, accurate clock and timer, temperature sensor, accelerated floating-point libraries, 12x Programmable I/O (PIO) state machines.

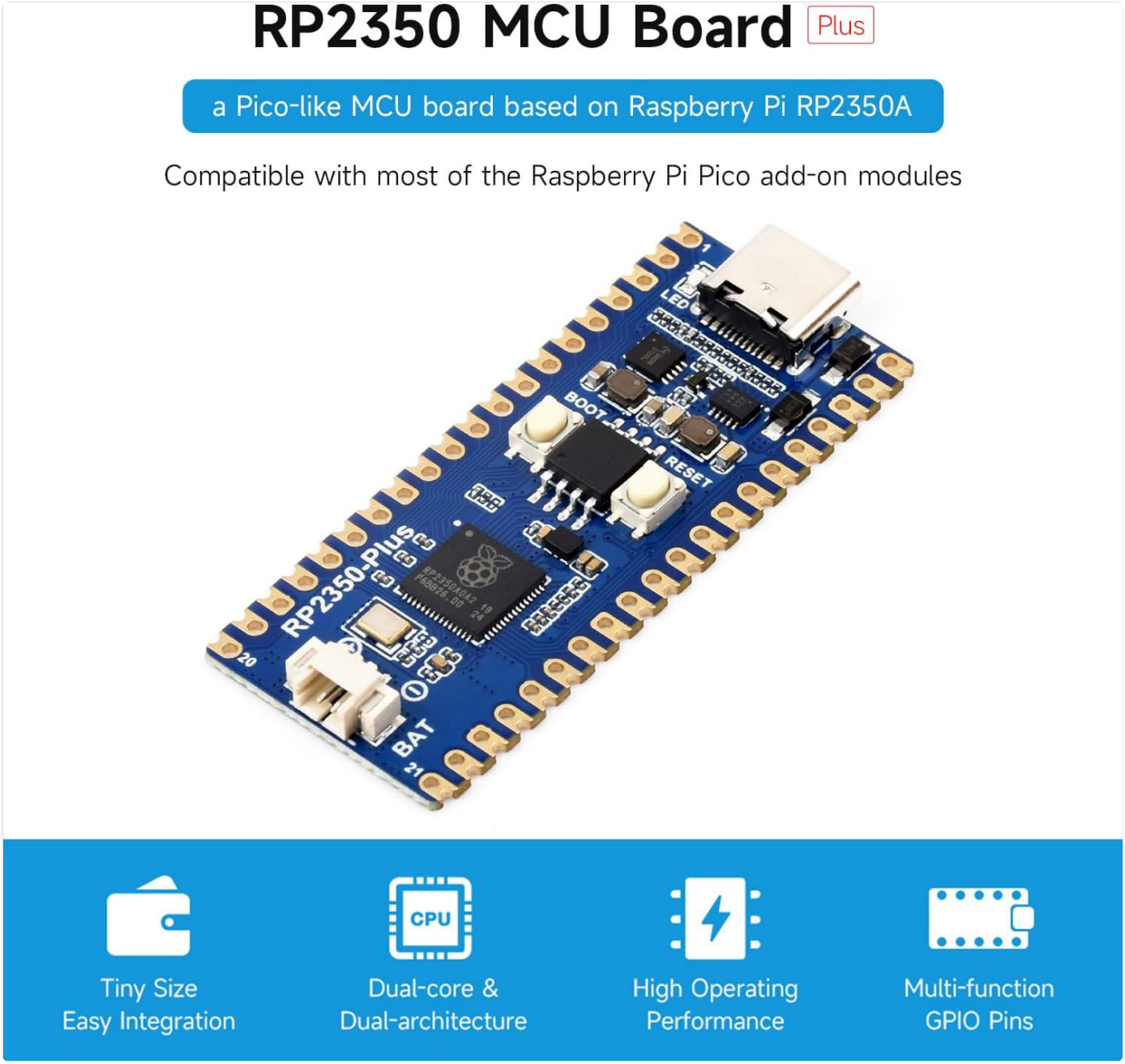
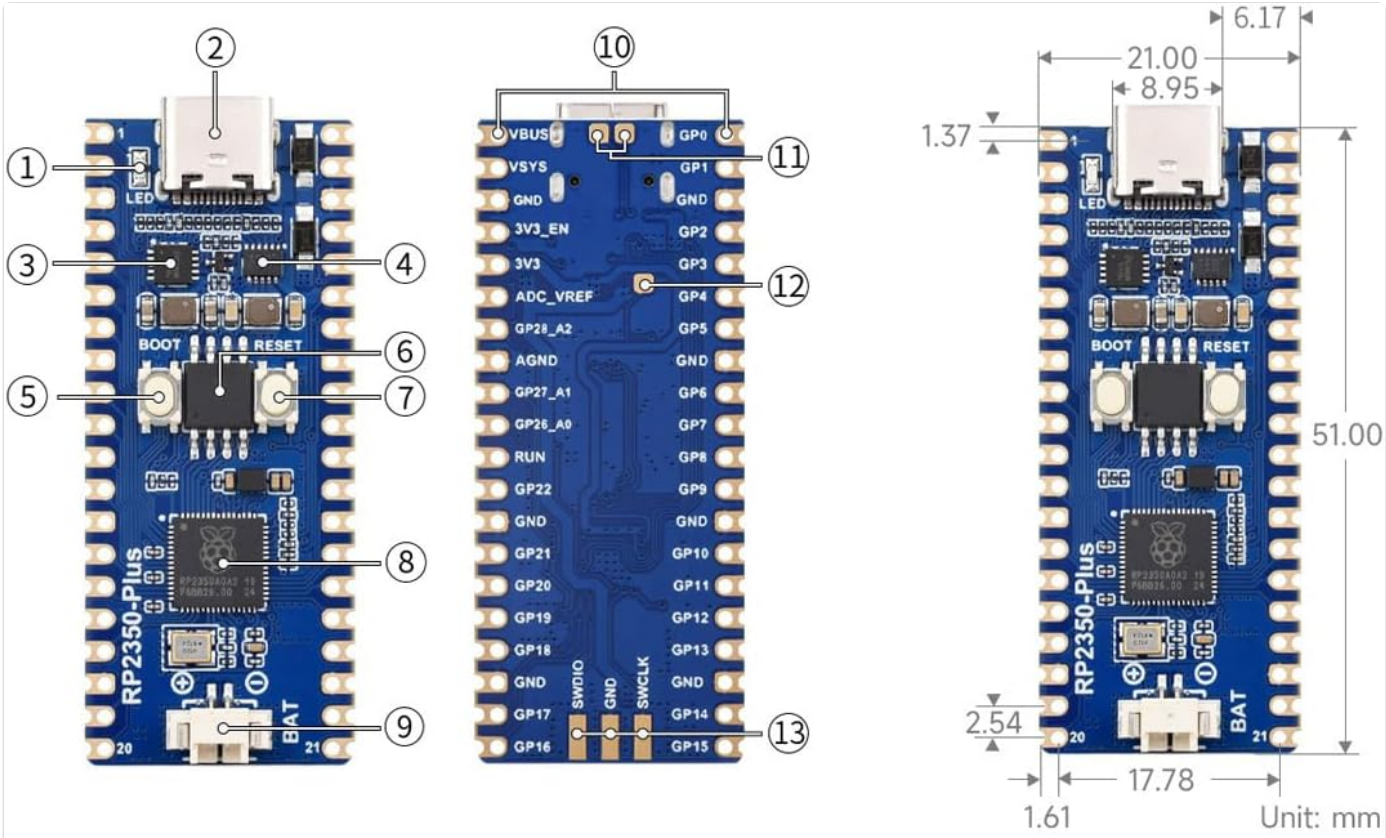


Figure 3.1: RP2350-Plus MCU Board overview.

3.2 Board Layout and Components

Familiarize yourself with the various components and pinouts of the RP2350-Plus board. This section details the key elements for proper usage and connection.



1. **LED**
   user LED (not power indicator)
2. **USB Type-C connector**
3. **ETA6096**
   high efficiency Lithium battery recharge manager
4. **MP28164**
   high efficiency DC-DC buck-boost chip
5. **BOOT button**
   press it when resetting to enter download mode
6. **On-board flash memory**
   4MB: W25Q32JVSSIQ
   16MB: W25Q128JVSIQ
7. **RESET button**
8. **RP2350A**
   Dual-core and dual-architecture design, up to 150 MHz operating frequency
9. **Battery header**
   MX1.25 header, for 3.7V Lithium battery, allows recharging the battery and powering the board at the same time
10. **Pinout**
    compatible with Raspberry Pi Pico 2
11. **USB test points**
    connecting to USB interface
12. **BOOT test point**
    connecting to BOOT button
13. **DEBUG points**

Figure 3.2: Detailed board layout with numbered components, GPIO pinout, and dimensions.

Key Components Reference:

1. **LED:** User LED (not power indicator).
2. **USB Type-C connector:** For power, data, and programming.
3. **ETA6096:** High efficiency Lithium battery recharge manager.
4. **MP28164:** High efficiency DC-DC buck-boost chip.
5. **BOOT button:** Press when resetting to enter download mode.
6. **On-board Flash memory:** 16MB (W25Q128JVSIQ).
7. **RESET button:** Resets the microcontroller.
8. **RP2350A:** Dual-core and dual-architecture design, up to 150 MHz operating frequency.
9. **Battery header:** MX1.25 header for 3.7V Lithium battery, allows recharging the battery and powering the board at the same time.

10. **Pinout:** Compatible with Raspberry Pi Pico 2.
11. **USB test points:** Connecting to USB interface.
12. **BOOT test point:** Connecting to BOOT button.
13. **DEBUG points:** For debugging purposes.

3.3 GPIO Pinout

The RP2350-Plus features 26 multi-function GPIO pins, offering flexible development and integration. Refer to the pinout diagram for detailed assignments and capabilities.

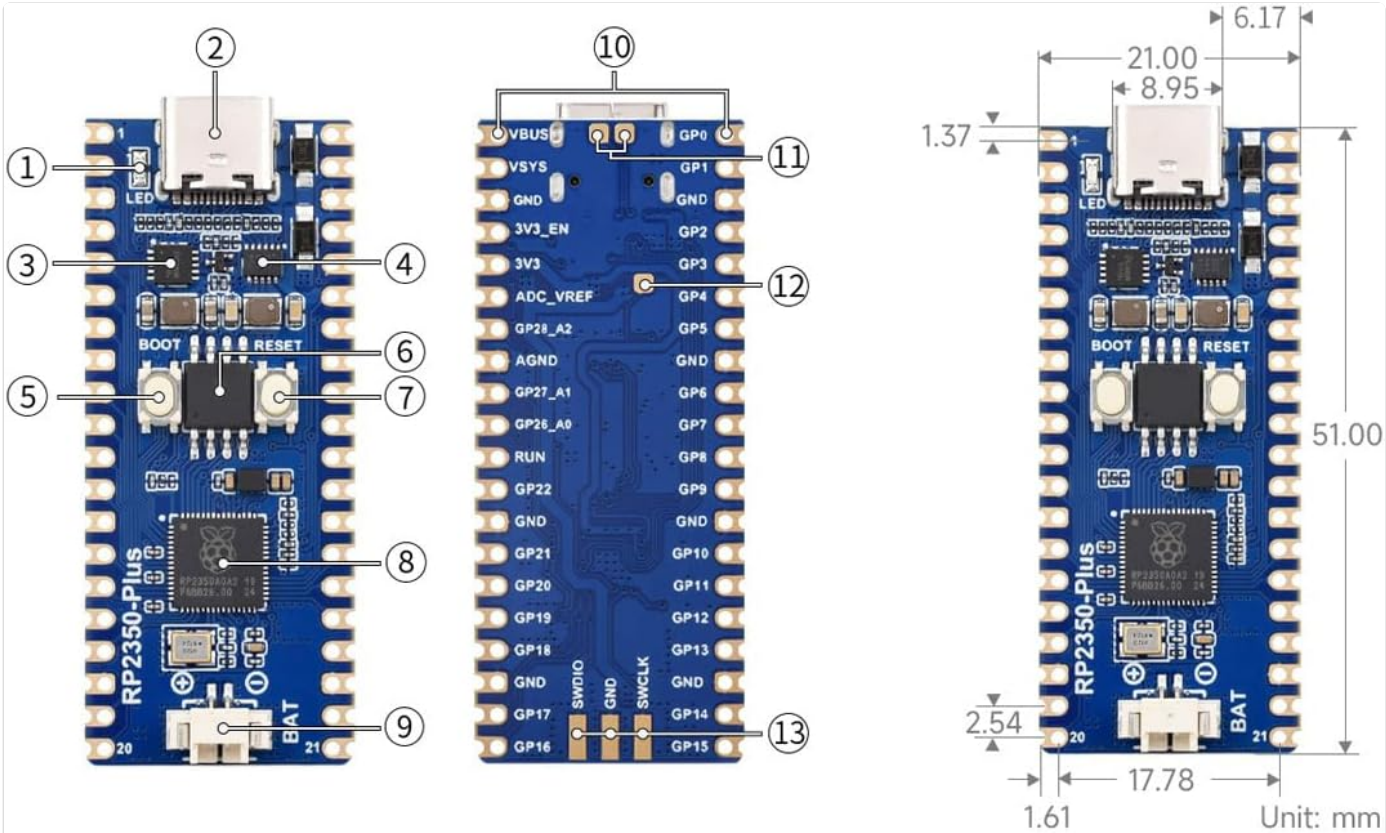


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Figure 3.3: GPIO Pinout Diagram.

3.4 Outline Dimensions

The physical dimensions of the RP2350-Plus board are provided below for integration into your projects.

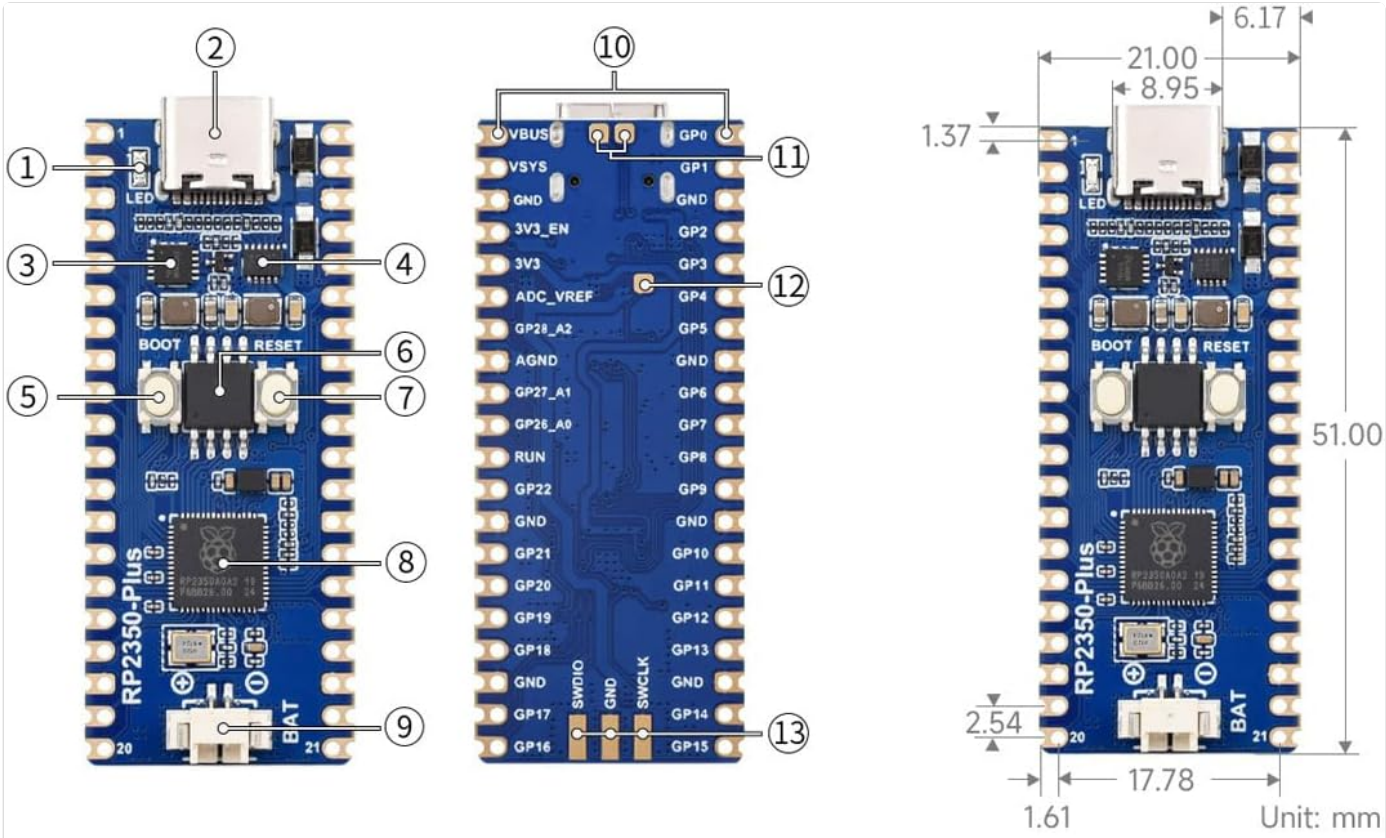

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Figure 3.4: Outline Dimensions (Unit: mm).

4. Setup Guide

4.1 Initial Connection

1. Connect the RP2350-Plus board to your computer using a standard USB Type-C cable.
2. The board should be recognized as a mass storage device (like a USB drive) when in bootloader mode. To enter bootloader mode, hold down the **BOOT** button while plugging in the USB cable, then release the**BOOT** button.
3. If the board is not recognized, ensure your USB cable supports data transfer and is not just a charging cable.

4.2 Software Setup

The RP2350-Plus supports development using C/C++ SDK and MicroPython, offering flexibility for various programming needs.

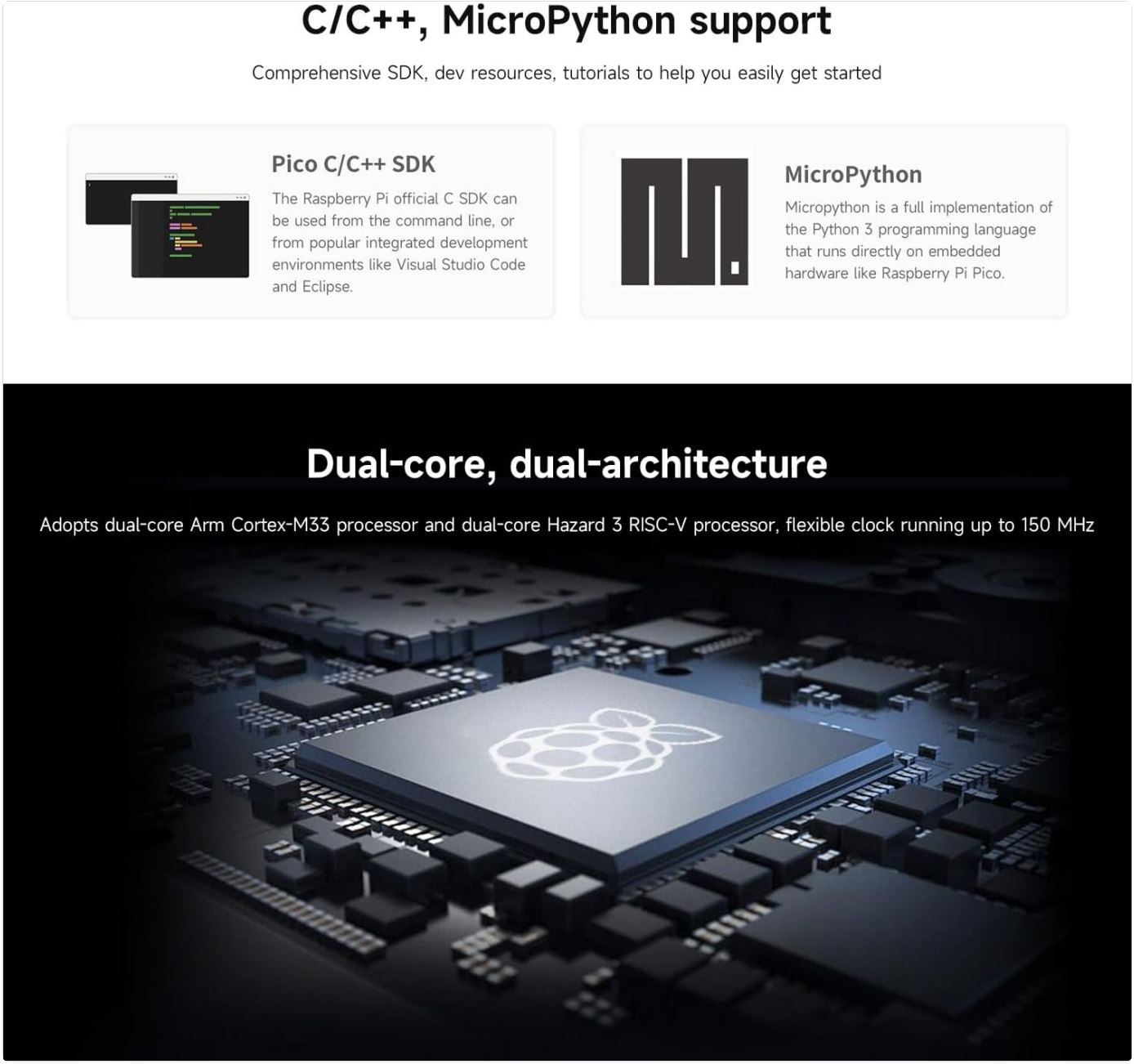


Figure 4.1: C/C++, MicroPython support.

4.2.1 C/C++ Development

For C/C++ development, you can use the official Raspberry Pi Pico C/C++ SDK. This SDK can be utilized from the command line or integrated development environments (IDEs) such as Visual Studio Code and Eclipse. Refer to the official Raspberry Pi Pico documentation for detailed setup instructions for the C/C++ SDK.

4.2.2 MicroPython Development

MicroPython is a lean and efficient implementation of the Python 3 programming language that runs directly on embedded hardware like the RP2350-Plus. To get started with MicroPython:

1. Download the appropriate MicroPython UF2 firmware file for the RP2350-Plus from the Waveshare wiki or official MicroPython website.
2. Enter bootloader mode (hold **BOOT** and plug in USB).
3. Drag and drop the downloaded UF2 file onto the RPI-RP2 mass storage device that appears. The board will automatically reboot into MicroPython.
4. Use an IDE like Thonny to connect to the board and begin programming.

5. Operating Instructions

5.1 Programming the Board

The RP2350-Plus supports drag-and-drop programming, making it easy to upload new firmware or MicroPython scripts:

1. Ensure the board is in bootloader mode (hold **BOOT** button while connecting USB, then release). A removable drive named "RPI-RP2" will appear on your computer.
2. Locate your compiled firmware (.uf2 file for MicroPython or C/C++).
3. Drag and drop the .uf2 file onto the "RPI-RP2" drive.
4. The board will automatically disconnect, flash the new firmware, and then reboot.

5.2 Using GPIO and Peripherals

The 26 multi-function GPIO pins can be configured for various purposes, including digital input/output, analog input (ADC), and specialized functions like SPI, I2C, UART, and PWM. Refer to the pinout diagram (Figure 3.3) and the specific SDK documentation for detailed programming examples and pin assignments.

- **Digital I/O:** Control LEDs, read button states, etc.
- **Analog-to-Digital Converter (ADC):** Read analog sensor values. The board has 4x 12-bit ADC channels.
- **SPI, I2C, UART:** Communicate with external sensors, displays, and other modules.
- **PWM:** Control motor speeds, LED brightness, and generate audio signals. The board offers 16 controllable PWM channels.
- **PIO State Machines:** Utilize the 12 Programmable I/O (PIO) state machines for custom peripheral support and high-speed bit-banging.

5.3 Battery Operation

The RP2350-Plus includes a lithium battery recharge/discharge header (MX1.25) and an onboard ETA6096 chip, allowing it to be powered by and charge a 3.7V lithium battery. This feature is ideal for portable applications.

- Connect a compatible 3.7V lithium battery to the MX1.25 header.
- The board can be powered directly from the battery.
- When the board is connected via USB-C, the battery will automatically charge.
- Ensure correct polarity when connecting the battery to avoid damage.

6. Maintenance

To ensure the longevity and optimal performance of your Waveshare RP2350-Plus Development Board, follow these maintenance guidelines:

- **Handling:** Always handle the board by its edges to avoid touching components, especially the pins, which can be sensitive to static electricity.
- **Storage:** Store the board in an anti-static bag when not in use, and keep it in a dry, cool environment away from direct sunlight and extreme temperatures.
- **Cleaning:** If necessary, gently clean the board with a soft, dry brush or compressed air to remove dust. Avoid using liquids or abrasive cleaners.
- **Power Supply:** Use only appropriate power sources (USB-C or compatible 3.7V lithium battery). Do not exceed specified voltage limits.
- **Firmware Updates:** Regularly check the Waveshare official website or wiki for the latest firmware updates to benefit from bug fixes and new features.

7. Troubleshooting

This section addresses common issues you might encounter with your RP2350-Plus Development Board.

Problem	Possible Cause	Solution
Board not recognized by computer (no "RPI-RP2" drive).	• Not in bootloader mode. • Faulty USB cable (charging-only). • Driver issues (less common for mass storage).	• Ensure you hold the **BOOT** button while plugging in the USB cable, then release. • Try a different USB Type-C cable, preferably one known to support data transfer. • Try a different USB port on your computer.
Firmware upload fails or board doesn't reboot after drag-and-drop.	• Corrupted .uf2 file. • Insufficient power from USB port. • Board not in proper bootloader mode.	• Re-download the .uf2 file from a reliable source. • Try connecting to a powered USB hub or a different USB port. • Repeat the bootloader entry process carefully.
MicroPython/C++ code not running as expected.	• Syntax errors or logical bugs in code. • Incorrect pin assignments. • Missing libraries or dependencies.	• Review your code for errors. Use a debugger if available. • Double-check the pinout diagram (Figure 3.3) and your code's pin assignments. • Ensure all necessary libraries are installed and imported correctly. • Consult the Waveshare wiki or Raspberry Pi Pico documentation for specific programming examples.
Board gets hot during operation.	• Excessive current draw from peripherals. • Short circuit on the board or connected components. • Operating in a high ambient temperature.	• Disconnect all peripherals and test the board alone. • Check for any accidental shorts on your breadboard or custom PCB. • Ensure adequate ventilation around the board. • If the issue persists, discontinue use and contact support.

8. Specifications

Detailed technical specifications for the Waveshare RP2350-Plus Development Board:

Feature	Detail
Microcontroller	Raspberry Pi RP2350A (Dual-core Arm Cortex-M33 + Dual-core Hazard 3 RISC-V)
Clock Speed	Up to 150 MHz
SRAM	520KB

Feature	Detail
On-board Flash Memory	16MB (W25Q128JVSIQ)
USB Interface	USB 1.1 Host/Device, Type-C connector
GPIO Pins	26 multi-function GPIO pins
SPI	2x
I2C	2x
UART	2x
ADC	4x 12-bit ADC
PWM Channels	16 controllable PWM channels
PIO State Machines	12x
Power Management	Onboard DC-DC chip MP28164 (max 2A load), Lithium battery recharge/discharge header (MX1.25)
Operating Modes	Low-power sleep and dormant modes
Dimensions	51.00 mm x 17.78 mm (approx. 2.01 x 0.70 inches)
Weight	0.317 ounces (approx. 9 grams)
Manufacturer	Waveshare
Country of Origin	China

9. Support and Warranty

9.1 Technical Support

For technical assistance, detailed documentation, tutorials, and community forums, please visit the official Waveshare website or their product wiki. These resources provide comprehensive guides and solutions for common development challenges.

Waveshare Official Website: www.waveshare.com

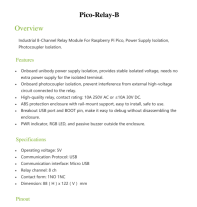
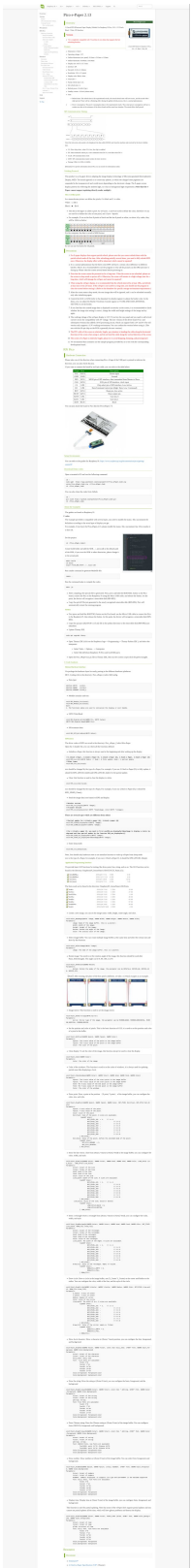
Look for the specific product page for the RP2350-Plus Development Board for the most up-to-date information and downloads.

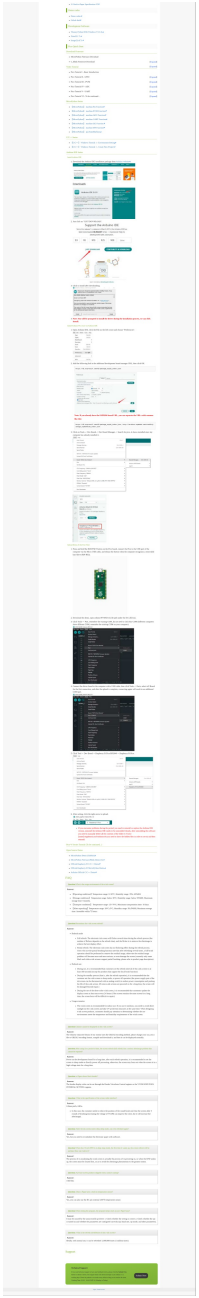
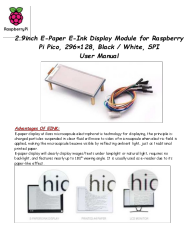
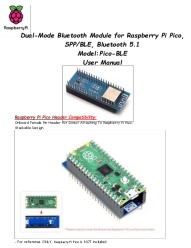
9.2 Warranty Information

Waveshare products typically come with a standard manufacturer's warranty covering defects in materials and workmanship. The specific terms and duration of the warranty may vary by region and product. Please retain your proof of purchase for warranty claims.

For detailed warranty terms and conditions, refer to the warranty policy section on the Waveshare official website or contact their customer service directly.

Related Documents - RP2350-Plus-16MB-M

	[Pico-Relay-B: 8-Channel Relay Module User Guide] User guide for the Waveshare Pico-Relay-B, an industrial 8-channel relay module for Raspberry Pi Pico. Learn about its features, specifications, setup, and programming with detailed instructions and examples.
	[Waveshare Pico e-Paper 2.13inch EPD Module for Raspberry Pi Pico: Development Guide & API] Detailed development guide for the Waveshare Pico e-Paper 2.13inch EPD module with Raspberry Pi Pico. Features include 250x122 resolution, SPI interface, C/C++ & MicroPython demo codes, and comprehensive API documentation.

	
	[2.9-inch E-Paper E-Ink Display Module for Raspberry Pi Pico User Manual] This user manual provides details on the 2.9-inch E-Paper E-Ink Display Module for Raspberry Pi Pico. It covers E-Ink technology advantages, compatibility with Raspberry Pi Pico, application examples, and pinout definitions. The module features a 296x128 resolution, Black/White display, and SPI interface.
	[Raspberry Pi Pico Dual-Mode Bluetooth Module (Pico-BLE) User Manual] User manual for the Waveshare Pico-BLE, a dual-mode Bluetooth 5.1 module designed for Raspberry Pi Pico, supporting SPP and BLE protocols. Features header compatibility and onboard antenna.

	[Waveshare Industrial 8-Channel Relay Module for Raspberry Pi Pico User Manual] User manual for the Waveshare Industrial 8-Channel Relay Module for Raspberry Pi Pico (Pico-Relay-B). Details features, compatibility, enclosure, and pinout for industrial control applications.
	[Waveshare Pico Servo Driver: 16-Channel Control for Raspberry Pi Pico] Discover the Waveshare Pico Servo Driver, a 16-channel, 16-bit resolution module designed to expand the capabilities of the Raspberry Pi Pico. This guide details its features, specifications, and setup for controlling multiple servos with precision.