

Product Reference Manual

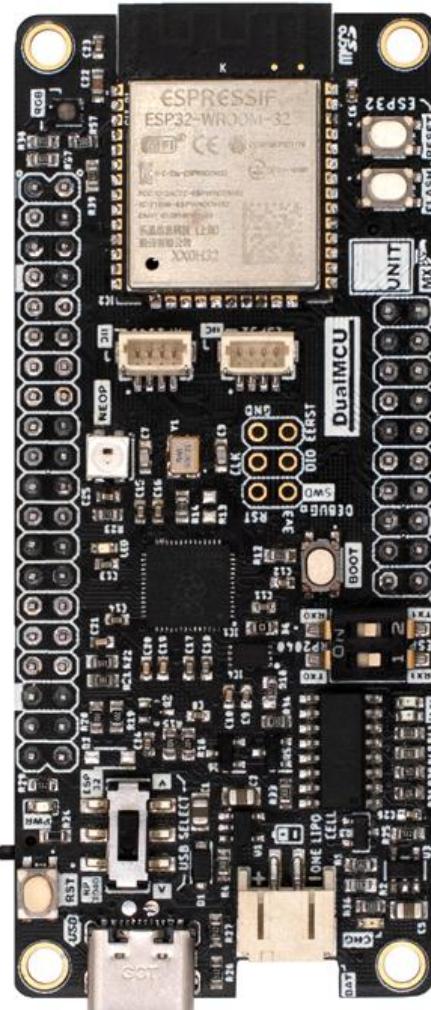
Description

Unit DualMCU brings the Raspberry Pi RP2040 microcontroller plus an Espressif ESP32 WROOM chip in a simple one module, make the most of the dual core 32-bit Arm® Cortex®-M0+ to make Internet of Things projects with Bluetooth® and Wi-Fi connectivity.

DualMCU has been thought of as a mix between two 32-bit microprocessors: a Raspberry RP2040 cortex M0+ running at 133 Mhz and an Espressif ESP32 running up to 240 MHz, in this way we implement all the power of both microcontrollers in a single development card. With a PCB size of 36mm x 84mm and using surface mount technology, four programmable cores with wireless functions and features are found with very low power consumption.

Both microcontrollers can communicate via serial protocol by simply activating a 2-way DIP SWITCH, for example, we can program the ESP32 as a wireless co-processor to provide the RP2040 microcontroller with WIFI or BLUETOOTH communication. For programming, there is a mechanical selector that allows us to select which MCU connects using a single USB type C connector.

Interconnect an unlimited number of I2C devices using its STEMMA, QWIIC and GROVE compatible JST-SH I2C connectors and dive into real-world projects with the onboard RGB 2020 and WS2812B LED.



With over 46 general purpose pins (GPIO), DualMCU exposes most output ports of both microcontrollers via pin headers and JST-SH connectors (STEMMA, QWIIC and GROVE I2C compatible). It has more common peripherals such as: UART, I2C, SPI, PWM, ADC, Touch and state machines. The multiple forms of connection to sensors, actuators or even between both microcontrollers will only be limited by your creativity.

Among its available connectors, it has a Micro SD socket for high-capacity memories (up to 64 GB tested) directly connected to the ESP32 microcontroller through SPI communication.

Optionally, the ATECC608A can be incorporated and used for authentication tasks, which can be accessed by both MCUs through selection pads for I2C communication.

The DualMCU also features a 3.7V LiPO battery charging system making it ideal for applications that require a portable and rechargeable wireless system. Battery charging is done through its USB Type-C connector or through an external source such as a solar cell connected by its dedicated VIN pin for external power sources.

Applications.

Internet of Things (IoT), prototyping, machine learning, evaluation & development.

Support.

DualMCU is supported in the Arduino development environment and Python Integrated Development Environment (IDE) such as Thonny via an interactive prompt (REPL) to execute commands immediately in mycropython and circuitpython programming language.

Features

Raspberry Pi RP2040 Microcontroller

- 133MHz 32bit Dual Core Arm® Cortex®-M0+
- 264kB on-chip SRAM
- Direct Memory Access (DMA) controller
- Support for up to 16MB of off-chip Flash memory via dedicated QSPI bus
- Programmable IO (PIO) for extended peripheral support
- 30 GPIO pins, 4 of which can be used as analog inputs
- 4 channel ADC with internal temperature sensor, 0.5 MSa/s, 12-bit conversion
- 16 PWM channels
- SWD Debugging
- 2 UARTs
- 2 SPI controllers
- 2 I2C controllers
- 8 PIO state machines
- USB 1.1 controller and PHY, with host and device support
- 2 on-chip PLLs to generate USB and core clock
- 40nm process node
- Multiple low power mode support
- Internal Voltage Regulator to supply the core voltage
- Advanced High-performance Bus (AHB)/Advanced Peripheral Bus (APB)

Memory

- W25Q16JVUXIQ 2MB NOR Flash
- 532MHz Quad SPI
- 66MB/S continuous data transfer rate
- 100K program/erase cycles
- More than 20-year data retention

Espressif ESP32 WROOM 32

Wi-Fi/Bluetooth® Module

- 240MHz 32bit Dual Core Xtensa LX6
- 520kB on-chip SRAM
- 448 Kbyte ROM for booting and core functions
- 8 MB Integrated SPI flash
- 1 kbit EFUSE (non-erasable memory) for MAC addresses, module configuration, Flash-Encryption, and Chip-ID
- IEEE 802.11b/g/n (802.11n up to 150 Mbps) single-band 2.4 GHz Wi-Fi operation, center frequency range of operating channel (2412 ~ 2484 MHz)
- Bluetooth® 4.2 BR/EDR and Bluetooth LE specification, NZIF receiver with -97 dBm sensitivity, Class-1, class-2 and class-3 transmitter, AFH
- +12 dBm transmitting power, the internal PCB antenna in the module eliminates the need for an external antenna
- ADC, I2C, SDIO, QSPI, UART, I2S, Two-Wire Automotive Interface (TWAI®), compatible with ISO11898-1 (CAN Specification 2.0)
- On-chip Hall Sensor

WS2812B LED

- RGB NeoPixel for full color indication
- Connected to RP2040 GPIO

RGB LED

- Common Anode
- Connected to ESP32 GPIO

Builtin LED

- LED for general purpose blinking, connected to RP2040 GPIO25

MicroSD CARD

- Connected to ESP32 vía VSPI

ATECC608A (do not populate component)

- Authentication chip connected to RP2040 or ESP32 accessed by both MCUs through selection pads for I2C communication

I/O

44 x GPIO pins with following capabilities:

- 11 of which can be used as 12-bit ADC - Analog to Digital Converter inputs (4 from RP2040 and 7 in the ESP32 microcontroller)
- 42 of which can be used as Digital Pin (26 from RP2040 and 16 in the ESP32 microcontroller)
- 3 x UART peripherals (2 UARTs in the RP2040 and 1 in the ESP32)
- 2 x SPI (one from RP2040 and one in the ESP32)
- 3 x I2C (Two of which have a JST-1.0 mm pitch on-board connectors, compatible with STEMMA QT, QWIIC and GROVE devices with no soldering)
- All 26 digital pins of RP2040 can be driven by the PWM block with a maximum of 16 controllable PWM outputs
- All ESP32 pins digital outputs can be used as PWM pins (GPIOs 36 and 39 can't generate PWM)
- 3 x Capacitive Touch Sensor from ESP32 microcontroller
- ESP32 CAN 2.0

Power

- 3.3 v LDO 600 mA
- 3.3V Power/enable pin
- VUSB Output /VIN (3.2 - 6 V) Pin
- Built in 200mA+ lipoly charger with charging status indicator LED

Connector

- 2 x I2C JST-SH (1 mm pitch)
- 1 microSD Card Holder
- 1 USB Type C
- 1 JST-SH Battery Connector (2 mm pitch)

Switch

- Power Switch
- USB Communication Selector
- DIP Switch for UART communication
- Reset button and Bootloader select button for RP2040 quick restarts (no unplugging-replugging to relaunch code)
- ESP32 Reset button and Flash/Boot button for manually entering flash mode

OSC

- 12 MHz crystal for perfect timing

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9.1 Schematic

1 The Board

1.1 Accessories

USB type C cable

40-pin 2.54mm male headers

20-pin 2.54mm male headers

2 Ratings

2.1 Recommended Operating Conditions

Symbol	Description	Min	Typ	Max	Unit
V_{IN}	Input voltage from VIN pin	4	5	6	V
V_{BUS}	Input voltage from USB connector	4.6	5	5.5	V
V_{USB}	Output voltage from VUSB pin	4.4	4.8	5.2	V
V_{BAT}	Output battery voltage	3.2	3.7V	4.25	V
V_{3v3}	3.3V output to user application	3.25	3.3	3.35	V
I_{3v3}	3v3 output current (including onboard IC)	600	-	-	mA
V_{IH} (RP2040)	Input high-level voltage	2	-	3.6	V
V_{IL} (RP2040)	Input low-level voltage	-0.3	-	0.8	V
I_{OH Max} (RP2040)	Current at VDD-0.4v, output set high			8	mA
I_{OL Max} (RP2040)	Current at VSS+0.4v, output set low			8	mA
V_{OH} (RP2040)	Output high voltage, 8 mA	2.62	-	3.3	v
V_{OL} (RP2040)	Output low voltage. 8 mA	0	-	0.5	V
R_{PU} (RP2040)	Pull-Up Resistance	50	-	80	kΩ
R_{PD} (RP2040)	Pull-Down Resistance	50	-	80	kΩ
I_{IOVDD_MAX} (RP2040)	Maximum Total IOVDD current*			50	mA

IIOVSS_MAX (RP2040)	Maximum Total VSS current due to IO (IIOVSS)**			50	mA
TOP (RP2040)	Operating temperature	-20	-	80	°C
VIH (ESP32)	Input high-level voltage	2.475	-	3.6	V
VIL (ESP32)	Input low-level voltage	-0.3	-	0.825	V
IOH Max (ESP32)	Current at VDD=3.3V, VOH >=2.64V, output set high***			40	mA
IOL Max (ESP32)	Current at VDD = 3.3 V, VOL =0.495 V, output set low			28	mA
VOH (ESP32)	Output high voltage	2.64	-	3.3	V
VOL (ESP32)	Output low voltage	-	-	0.33	V
RPU (ESP32)	Pull-Up Resistance	-	45	-	kΩ
RPD (ESP32)	Pull-Down Resistance	-	45	-	kΩ
TOP (ESP32)	Operating temperature	-40	-	85	°C

* Sum of all current being sourced by GPIO and QSPI pins

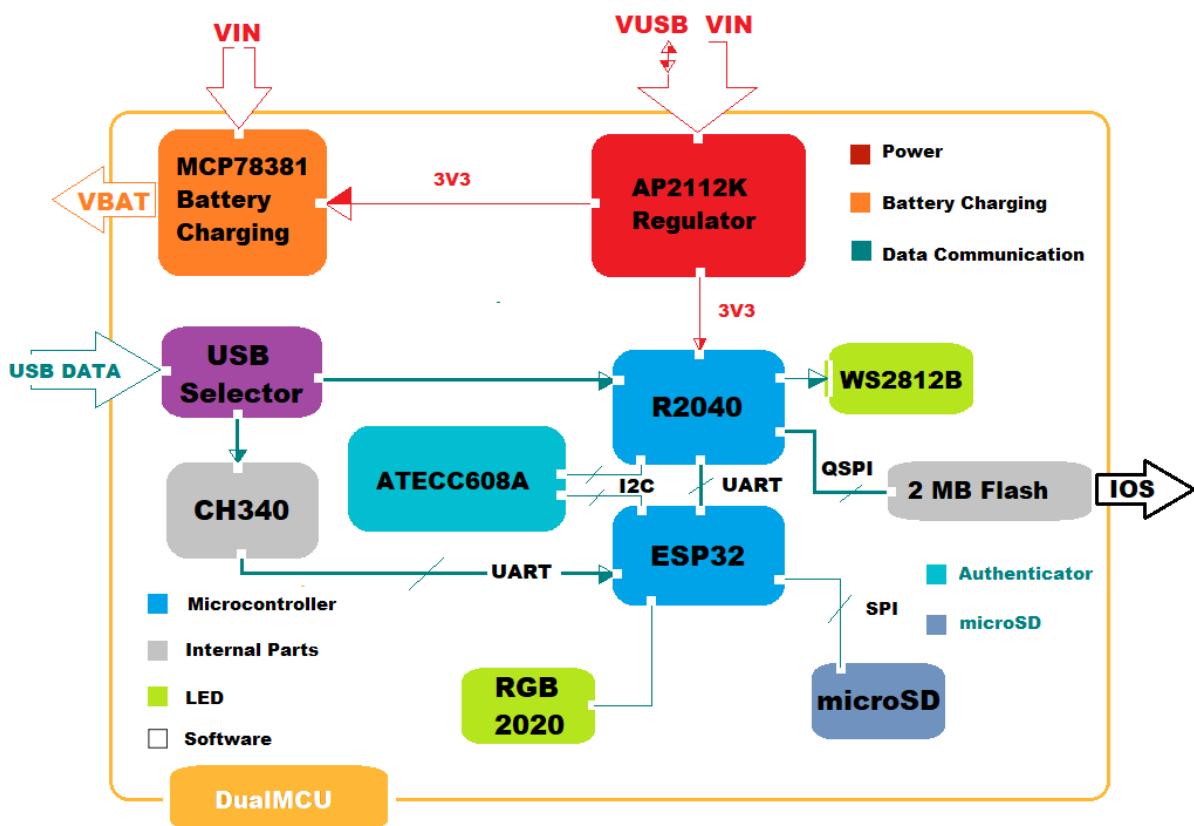
**Sum of all current being sunk into GPIO and QSPI pins

***Per-pin current sourced in the same domain is gradually reduced from around 40 mA to around 29 mA,
VOH>=2.64 V, as the number of current-source pins increases

3 Functional Overview

The RP2040 microcontroller alongside with the ESP32 MCU and the on-board leds and on-boards connectors, provides opportunities for low-power Internet of Things (IoT) development and whatever your microcontroller application, from motor control to machine learning, from digital audio to automotive, the DualMCU RP2040 & ESP32 has the performance, feature set, and support to make your product fly.

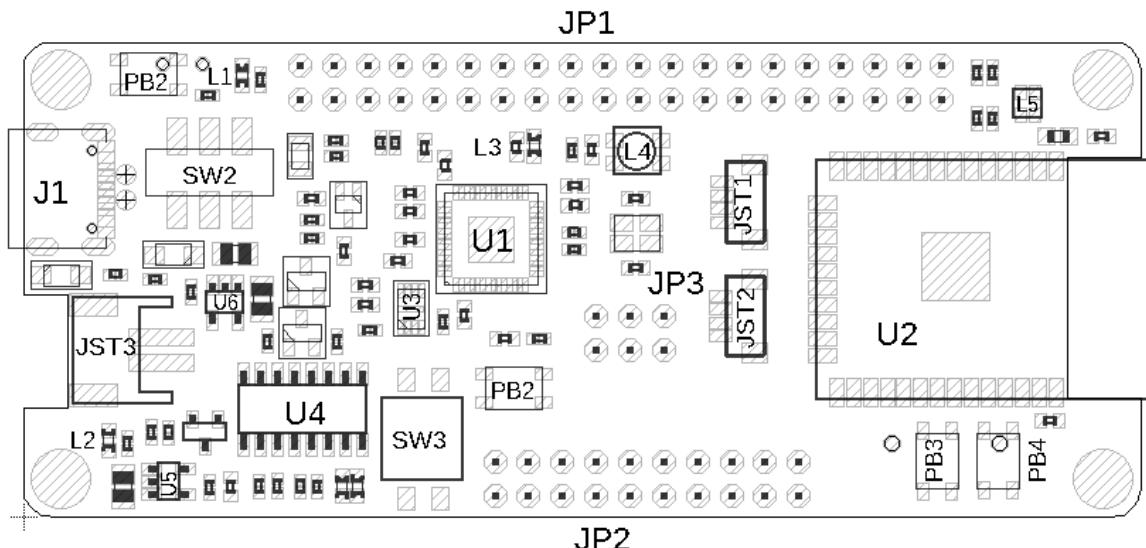
3.1 Block Diagram



Block Diagram of DualMCU RP2040 + ESP32

3.2 Board Topology

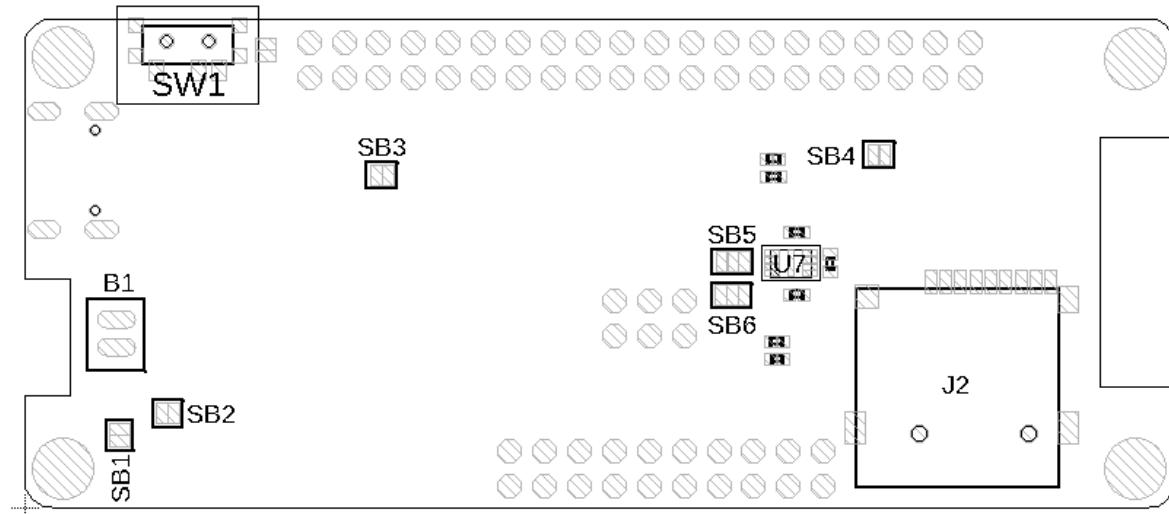
Front View



Front View of DualMCU RP2040 + ESP32 Topology

Ref.	Description	Ref.	Description
U1	Raspberry pi RP2040 Microcontroller	U4	CH340C USB bus convert IC
U2	Espressif ESP32 WROOM Wi-Fi/Bluetooth® Module	U5	MCP73831 Battery Charge Management IC
U3	W25Q16JVUXIQ 2MB Flash IC	U6	AP2112K 3v3 LDO Voltage Regulator
L1	Power On LED	L2	Charge LED
L3	Builtin LED	L4	WS2812B LED
L5	RGB 2020 LED	J1	Male USB Type C Connector
PB1	RP2040 Reset Button	PB2	RP2040 Boot Button
PB3	ESP32 Flash Button	PB4	ESP32 Reset Button
JP1	RP2040 GPIO Header	JP2	ESP32 GPIO Header
JP3	RP2040 (SWD) Debug Header	JST1	RP2040 I2C JST Connector
JST2	ESP32 I2C JST Conector	JST3	JST Connector for LiPo Battery
SW2	USB Communication Selector	SW3	UART DIP Switch

Back view



Back View of DualMCU RP2040 + ESP32 Topology

Ref.	Description	Ref.	Description
U7	ATECC608A-MAHDA-T Crypto IC	J2	Micro SD Card Connector
SW1	Power Switch	SB1	Charge LED Solder Bridge (disconnected)
SB2	VBUS Sense Solder Bridge (disconnected)	SB3	Steps ADC3 Leakage Solder Bridge (disconnected)
SB4	ESP32 Reset Solder Bridge (disconnected)	SB5	SCL Signal Selector Solder Bridge for ATECC608A-MAHDA-T (disconnected)
SB6	SDA Signal Selector Solder Bridge for ATECC608A-MAHDA-T (disconnected)	B1	Lipo Battery Solder Pads

3.3 Processor

The DualMCU is powered by a revolution of the Raspberry Pi RP2040 silicon microcontroller (U1) manufactured on a modern 40nm process node is the debut microcontroller from Raspberry Pi and it brings signature values of high performance and ease of use to the microcontroller space.

With a large on-chip memory, six independent banks of 264 KB SRAM, direct memory access, two symmetric Arm® Cortex®-M0+ clocked at 133MHz, deterministic bus fabric and

rich peripheral set augmented with a unique Programmable I/O (PIO) subsystem, Serial wire debug (SWD) available from boot through the integrated JP3 header, a USB 1.1 device interface implemented for uploading code and 2MB of off-chip Flash memory via dedicated QSPI bus on the RP2040, all these outstanding features provide professional users with unrivalled power and flexibility.

The RP2040 controls the peripherals and digital pins, as well as analog pins (A0-A3). The I2C JST connections (SDA) and (SCL) are used for connecting to the onboard peripherals and are optionally pulled up with a 4.7 kΩ resistor.

Wi-Fi and Bluetooth® connectivity is provided by the Espressif ESP32 WROOM-32 (U2)

3.4 Wi-Fi/Bluetooth® Connectivity module, clocked up 240 MHz and 512 KB on-chip SRAM and 4 MB integrated SPI Flash memory. Multiple programmable GPIOs, ADC, I2C, UART, Capacitive Touch Sensor and Two-Wire Automotive Interface (TWAI®), compatible with ISO11898-1 (CAN Specification 2.0) are exposed via JP2 y JP1 pin headers.

The ESP32 module includes a dual core Xtensa LX6 CPU that can also be programmed independently of the RP2040 through the USB mechanical selector (SW2) via a CH340C USB bus convert IC (U4).

3.5 External Memory

The RP2040 (U1) has access to an external 2 MB of flash memory (U3) via a QSPI interface. All the application code and data must be stored in an external flash chip. Six dedicated pins are used to communicate with a separate QSPI flash, using execute-in-place (XIP) technology to run code directly from flash without needing to copy it to RAM first.

3.6 Cryptography IC

Optionally, the ATECC608A can be incorporated and used for authentication tasks, which can be accessed by both MCUs through selection pads for I2C communication. The ATECC608A Cryptographic IC (U7) provides secure boot capabilities alongside SHA and AES-128 encryption/decryption support for security in Smart Home and Industrial IoT (IIoT) applications.

3.7 RGB LED

The common anode RGB LED (L5) is also controlled by the ESP32 module such that the LED is on when the digital state is LOW and off when the digital state is HIGH.

3.8 WS2812B LED

The WS2812B (L4) led is an intelligent control RGB NeoPixel for full color indication integrated in a 3535 component package and is connected to RP2040 at pins GPIO16 for power enable and GPIO17 for intelligent digital port (DI).

3.9 MicroSD Card Socket

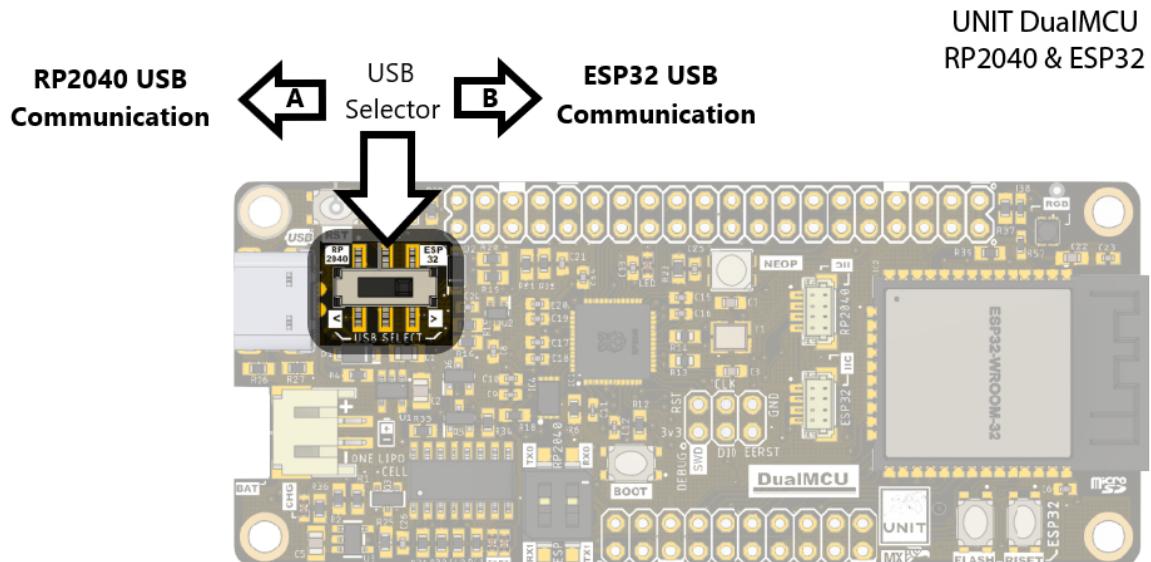
The DualMCU interfaces a microSD card with ESP32 using the microSD card socket connected via an SPI interface. Using a microSD card becomes very handy for applications where we need to store files that are larger than the size of SPIFF (flash file system) of ESP32.

3.10 Power Switch

The toggle power switch (SW1) provides the utility to turn the DualMCU ON or OFF and allows battery charging even when the power switch is in the off position.

3.11 Mechanical selector for the USB Communication

The mechanical USB selector (SW2) allows the programming and serial USB communication from one MCU at the time with only one USB Type-C connector.



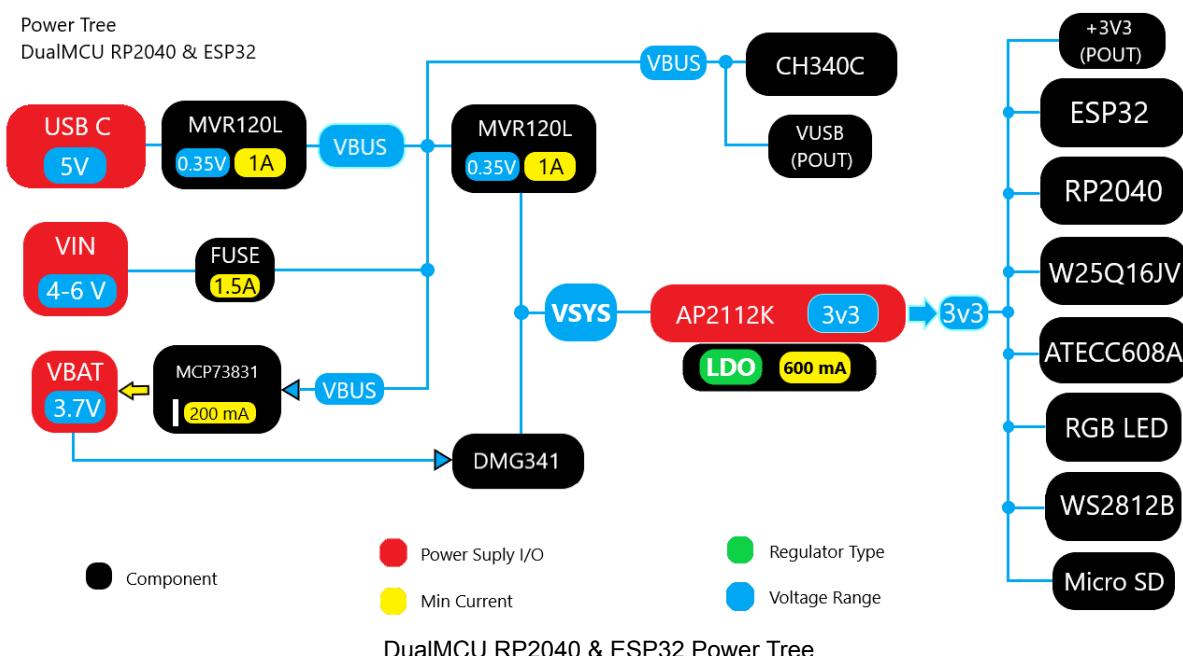
Positions for the mechanical USB selector

3.12 DIP Switch for UART Communication

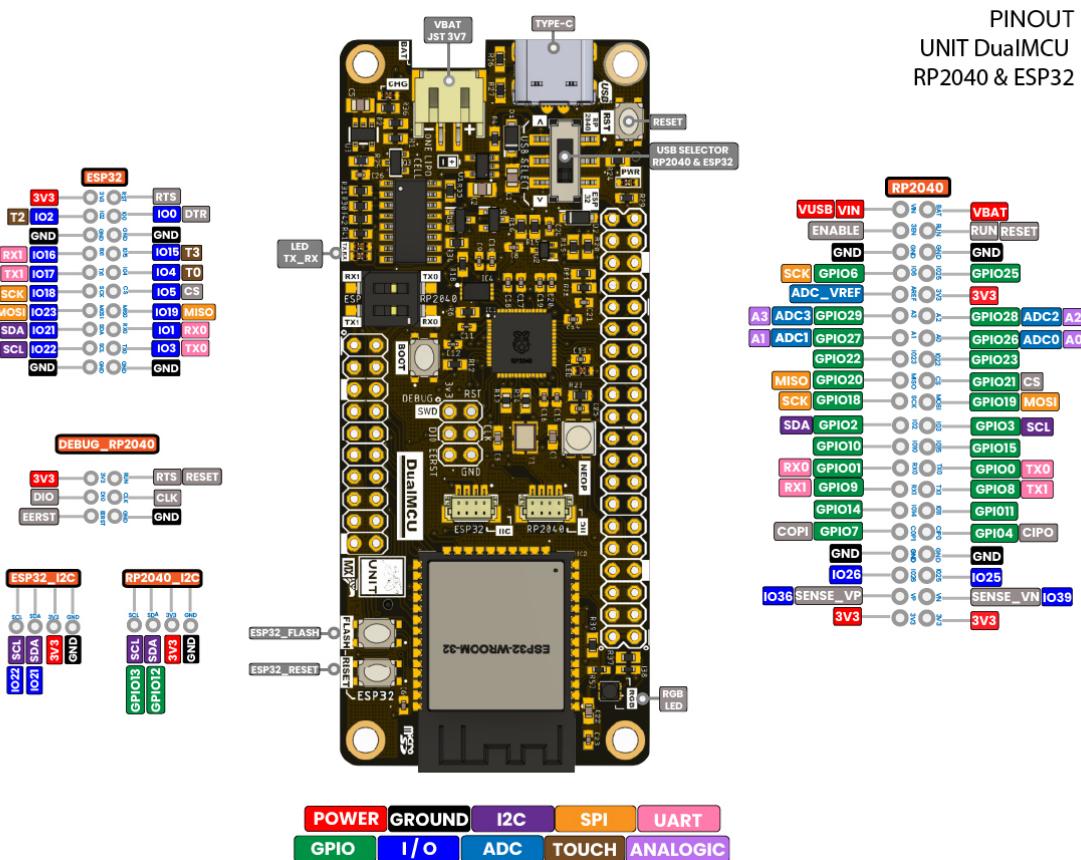
The DIP switch (SW3) allows the UART communication between both MCUs, connecting RP2040-UART0 (Tx_GPIO0 & Rx_GPIO1) to ESP32-UART1 (RX_IO17 & TX_IO16) respectively.

3.13 Power Tree

The DualMCU can be powered by either the USB-C port (J1) or alternatively via VIN on JP1. The VIN pin also delivers the USB voltage from J1 (approx 4.8 V) when the external power supply on the VIN does not exist. An AP2112K LDO Voltage Regulator provides 3V3 to the RP2040 and ESP32 microcontrollers and all other peripherals. The maximum voltage supply for VIN is 6 V and the nominal current of AP2112K is 600 mA.



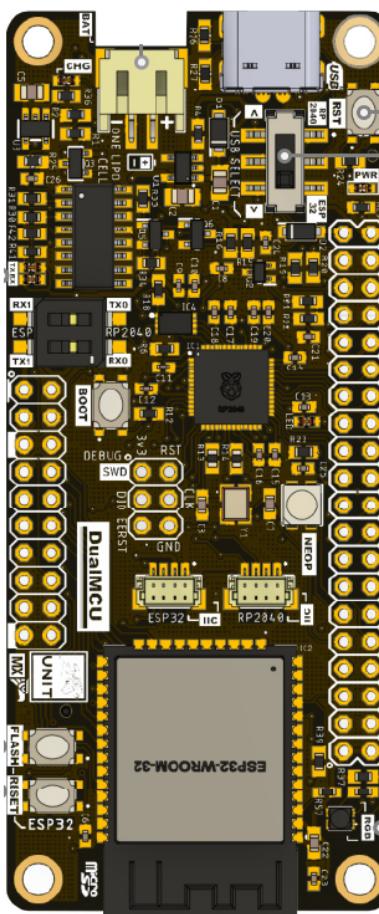
4 Connector Pinouts



DualMCU RP2040&ESP32 General Pinout

4.1 J1 USB-C

Pin	Function	Type	Description
2 , 11	VBUS	Power	5V USB Power
A7 , B7	D-	Differential	USB differential data-
A6 , A6	D+	Differential	USB differential data+
1 , 12	GND	Power	Ground



JP1

PINOUT
UNIT DualMCU
RP2040 & ESP32

RP2040	
40	1
VUSB VIN	VBAT
ENABLE	RUN RESET
GND	GND
SCK GPIO6	GPIO25
ADC_VREF	3V3
A3 ADC3 GPIO29	GPIO28 ADC2 A2
A1 ADC1 GPIO27	GPIO26 ADC0 A0
GPIO22	GPIO23
MISO GPIO20	GPIO21 CS
SCK GPIO18	GPIO19 MOSI
SDA GPIO2	GPIO3 SCL
GPIO10	GPIO15
RX0 GPIO01	GPIO0 TX0
RX1 GPIO9	GPIO8 TX1
GPIO14	GPIO11
COPi GPIO7	GPIO4 CIPO
GND	GND
IO26	IO25
IO36 SENSE_VP	SENSE_VN IO39
3V3	3V3

POWER GROUND I2C SPI UART
GPIO I/O ADC TOUCH ANALOGIC

DualMCU RP2040&ESP32 JP1 Pinout

4.2 JP1

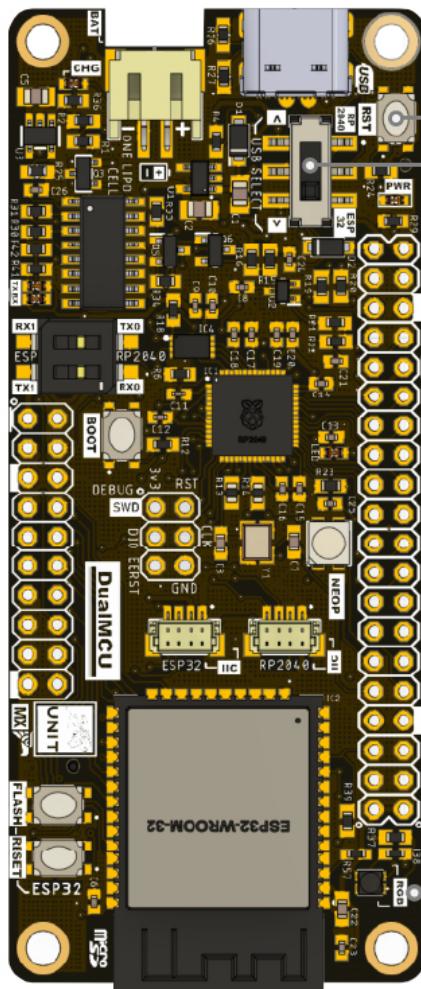
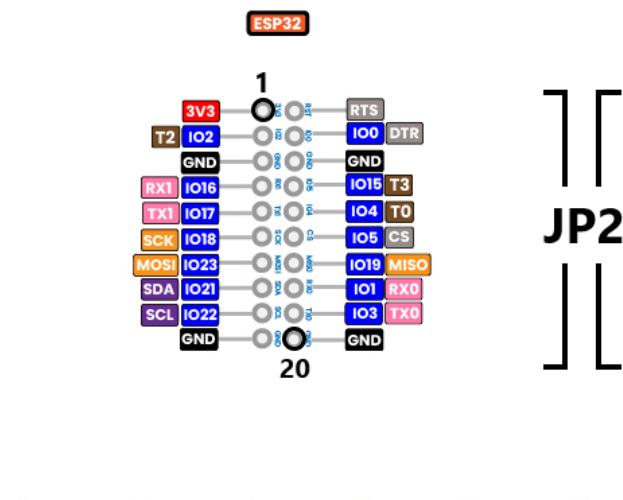
Pin	Function	Type	Description
1	3v3	Power	3.3V Power
2	3v3	Power	3.3V Power
3	VN	Analog	ESP32 Sense Vp, ADC1-CH3, RTC_GPIO3, GPIO39
4	VP	Analog	ESP32 Sense Vn, ADC1-CH0 RTC_GPIO0, GPIO36
5	IO25	Analog, RTC, Digital	ESP32: DAC1/ ADC2-CH8/ RTC_GPIO6/ GPIO25

6	IO26	Analog, RTC, Digital	ESP32: DAC2/ ADC2-CH9/ RTC_GPIO7/ GPIO26
7	GND	Power	Ground
8	GND	Power	Ground
9	CIPO	Digital	RP2040: digital pin GPIO4/ Controller In, Peripheral Out
10	COPI	Digital	RP2040: digital pin GPIO7/ Controller Out, Peripheral In
11	IO11	Digital	RP2040: digital pin GPIO11
12	IO14	Digital	RP2040: digital pin GPIO14
13	TX1	Digital	RP2040: digital pin GPIO8/ UART1_TX_PIN
14	RX1	Digital	RP2040: digital pin GPIO9/ UART1_RX_PIN
15	TX0	Digital	RP2040: digital pin GPIO0/ UART0_TX_PIN
16	RX0	Digital	RP2040: digital pin GPIO1/ UART0_RX_PIN
17	IO15	Digital	RP2040: digital pin GPIO15
18	IO10	Digital	RP2040: digital pin GPIO10
19	IO3	Digital	RP2040: digital pin GPIO03/SCL_1
20	IO2	Digital	RP2040: digital pin GPIO02/SDA_1
21	MOSI	Digital	RP2040: digital pin GPIO19/SPI
22	SCK	Digital	RP2040: digital pin GPIO18/SPI
23	CS	Digital	RP2040: digital pin GPIO21/SPI
24	MISO	Digital	RP2040: digital pin GPIO20/SPI
25	IO23	Digital	RP2040: digital pin GPIO23

26	IO22	Digital	RP2040: digital pin GPIO22
27	A0	Analog/Digital	RP2040: analog pin GPIO26
28	A1	Analog/Digital	RP2040: analog pin GPIO27
29	A2	Analog/Digital	RP2040: analog pin GPIO28
30	A3	Analog/Digital	RP2040: analog pin GPIO29
31	3v3	Power	3.3V Power
32	AREF	Analog	NC
33	IO25	Digital	RP2040: digital pin GPIO25
34	IO6	Digital	RP2040: digital pin GPIO06
35	GND	Power	Ground
36	GND	Power	Ground
37	RUN/RESET	Digital	RP2040: Reset
38	3EN	Digital	AP2112K: Enable
39	VBAT	Power	Battery Voltage Output
40	VUSB	Power	VUSB: Output Pin / Input Pin

Each UART can be connected to a number of GPIO pins as defined in the GPIO muxing table in Section 2.19.2 of RP2040 official datasheet: <https://datasheets.raspberrypi.com/rp2040/rp2040-datasheet.pdf>.

PINOUT
UNIT DualMCU
RP2040 & ESP32



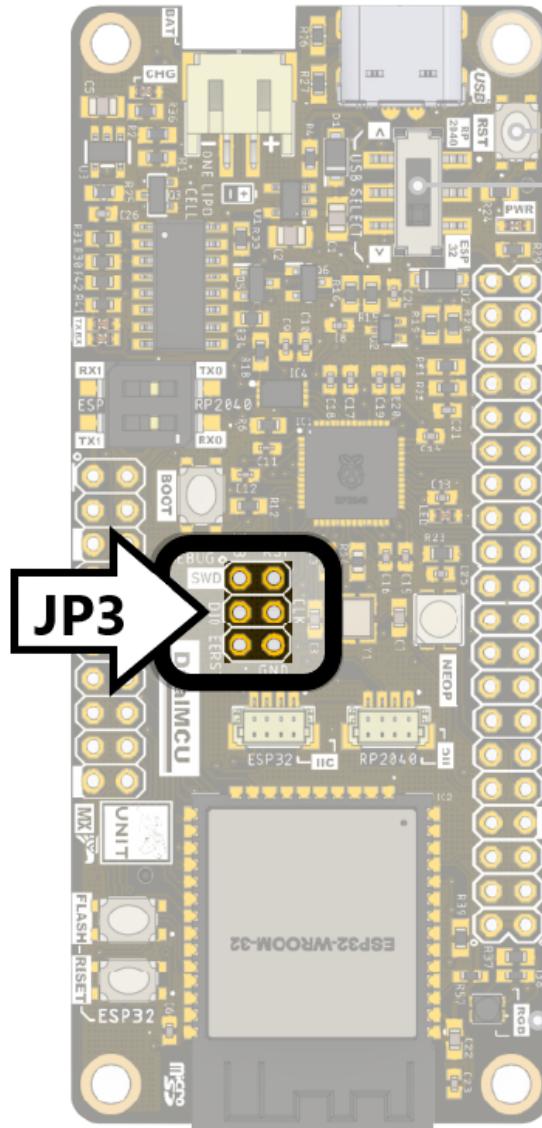
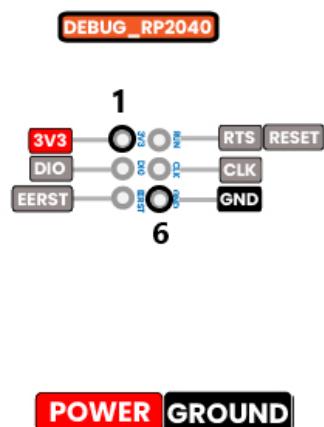
DualMCU RP2040&ESP32 JP2 Pinout

4.3 JP2

Pin	Function	Type	Description
1	3v3	Power	3.3V Power
2	RST	Digital	ESP32: Reset
3	IO2	Analog, Digital	ESP32: ADC2-CH2, GPIO2, TOUCH T2, RTC_GPIO12
4	IO0	Digital	ESP32:DTR, GPIO0
5	GND	Power	Ground
6	GND	Power	Ground

7	RX1	Digital	ESP32: UART2 - RXD, GPIO16
8	IO15	Analog, Digital	ESP32: ADC2-CH3, GPIO15, TOUCH T3, RTC_GPIO13
9	TX1	Digital	ESP32: UART2 - TXD, GPIO17
10	IO4	Analog, Digital	ESP32: ADC2-CH0, GPIO15, TOUCH T0, RTC_GPIO10
11	SCK	Digital	ESP32: SPI-SCK, GPIO18
12	CS	Digital	ESP32: SPI-CS, GPIO05
13	MOSI	Digital	ESP32: SPI-MOSI, GPIO23
14	MISO	Digital	ESP32: SPI-MISO, GPIO19
15	SDA	Digital	ESP32: I2C-SDA, GPIO21
16	RX0	Digital	ESP32: UART0 - RXD, GPIO1
17	SCL	Digital	ESP32: I2C-SCL, GPIO22
18	TX0	Digital	ESP32: UART0 - TXD, GPIO3
19	GND	Power	Ground
20	GND	Power	Ground

PINOUT
UNIT DualMCU
RP2040 & ESP32

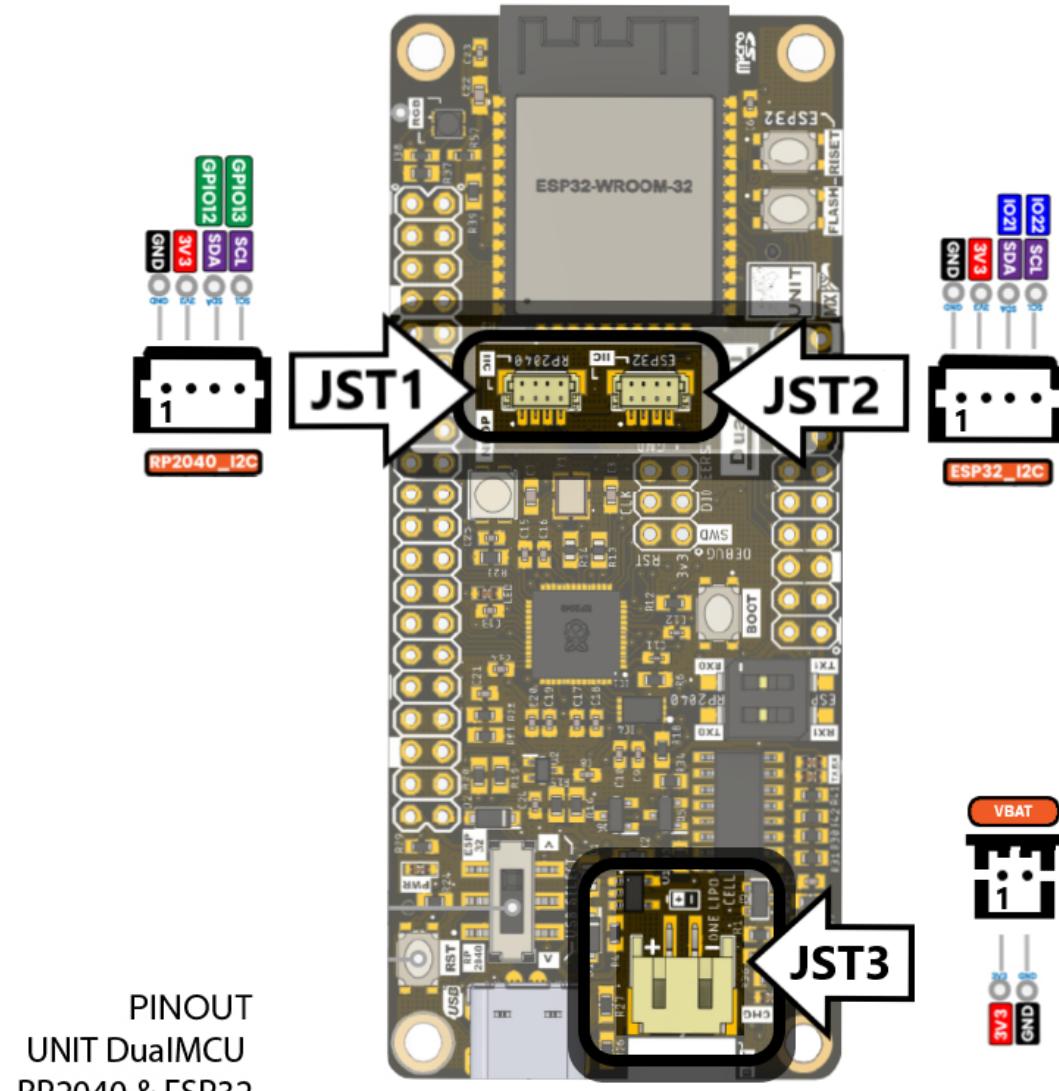


DualMCU RP2040&ESP32 JP3 Pinout

4.4 RP2040 SWD JP3

Pin	Function	Type	Description
1	3v3	Power	3.3V Power
2	RUN/RESET	Digital	RP2040: Reset
3	SWDIO	Digital	Serial Wire Debug
4	SWCLK	Digital	Serial Wire Debug
5	QSPI_SS	Digital	Bootsel
6	GND	Power	Ground

POWER GROUND I2C GPIO I/O



DualMCU RP2040&ESP32 I2C and Battery Connectors Pinout

4.5 RP2040 I2C JST1

Pin	Function	Type	Description
1	GND	Power	Ground
2	3v3	Power	3.3V Power
3	SDA	Digital	RP2040: digital pin GPIO12/SDA_0
4	SCL	Digital	RP2040: digital pin GPIO13/SCL_0

4.6 ESP32 I2C JST2

Pin	Function	Type	Description
1	GND	Power	Ground
2	3v3	Power	3.3V Power
3	SDA	Digital	ESP32: I2C-SDA, GPIO21
4	SCL	Digital	ESP32: I2C-SCL, GPIO22

4.7 JST3 Battery Connector

Pin	Function	Type	Description
1	VBAT	Power	Positive voltage for the optional lipoly battery
2	GND	Power	Ground

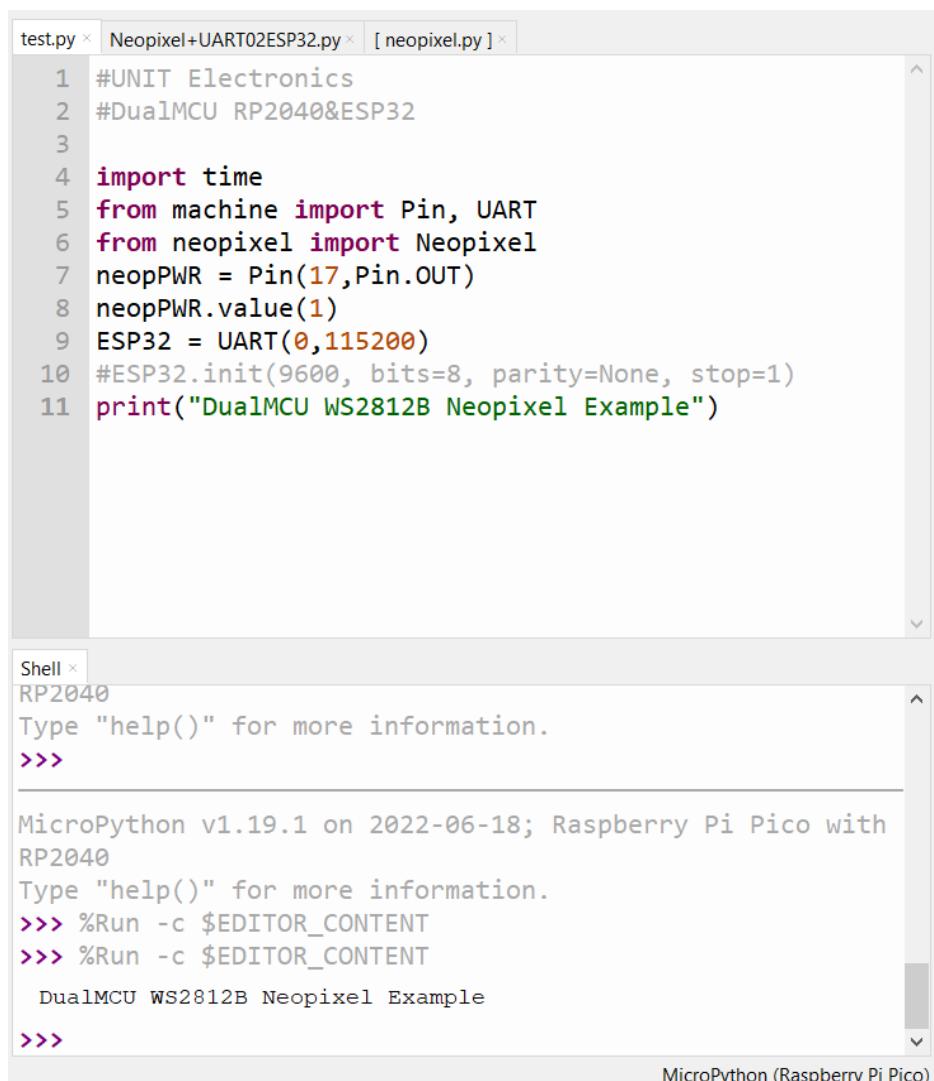
5 Board Operation

If you want to program your UNIT® DualMCU while offline you need to install the Thonny[1] or Arduino[2] IDE. To connect the DualMCU to your computer, you'll need a USB-C cable. This also provides power to the board, as indicated by the Power On LED.

5.1 Getting Started with Micropython - Thonny IDE

What is Thonny used for?

Thonny is a free Python Integrated Development Environment (IDE) that was especially designed with the beginner Pythonista in mind.



The screenshot shows the Thonny IDE interface. At the top, there are three tabs: "test.py", "Neopixel+UART02ESP32.py", and "[neopixel.py]". The "test.py" tab contains the following code:

```

1 #UNIT Electronics
2 #DualMCU RP2040&ESP32
3
4 import time
5 from machine import Pin, UART
6 from neopixel import Neopixel
7 neopPWR = Pin(17,Pin.OUT)
8 neopPWR.value(1)
9 ESP32 = UART(0,115200)
10 #ESP32.init(9600, bits=8, parity=None, stop=1)
11 print("DualMCU WS2812B Neopixel Example")

```

Below the code editor is a "Shell" tab labeled "RP2040". The shell output shows:

```

Type "help()" for more information.
>>>

MicroPython v1.19.1 on 2022-06-18; Raspberry Pi Pico with
RP2040
Type "help()" for more information.
>>> %Run -c $EDITOR_CONTENT
>>> %Run -c $EDITOR_CONTENT
DualMCU WS2812B Neopixel Example
>>>

```

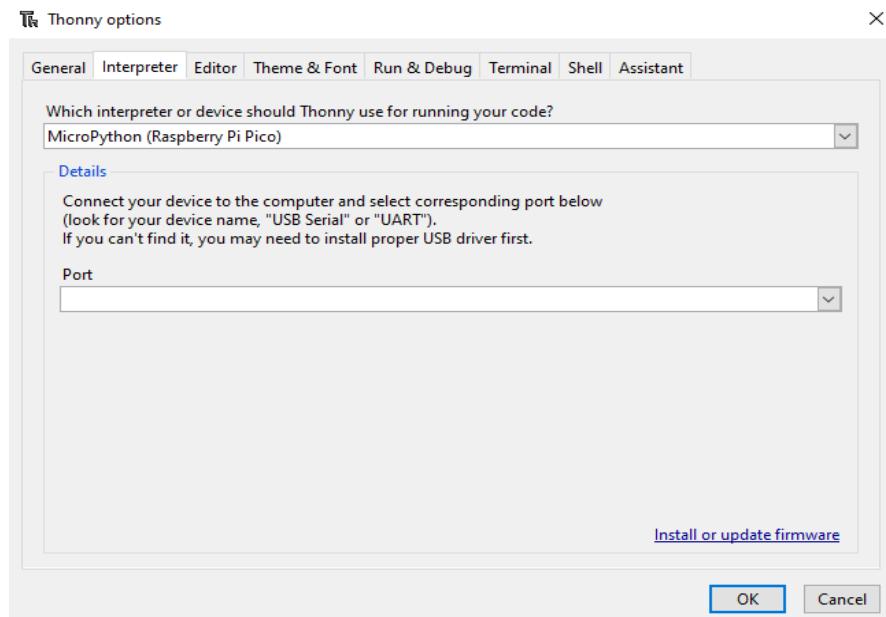
At the bottom right of the shell window, it says "MicroPython (Raspberry Pi Pico)".

First you need to install the [Thonny Environment IDE](#) on your system.

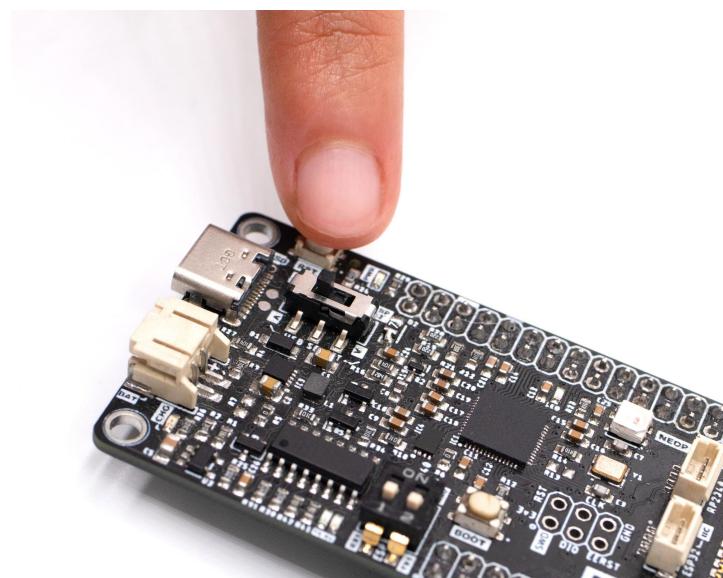
5.2 Steps to run micropython interpreter on the RP2040.

- Once installed Thonny IDE on your operating system:

Head to the menu and select: Run > Select Interpreter.... This will open a new window for the Thonny options. In the Interpreter tab, select MicroPython (Raspberry Pi Pico) as the interpreter.

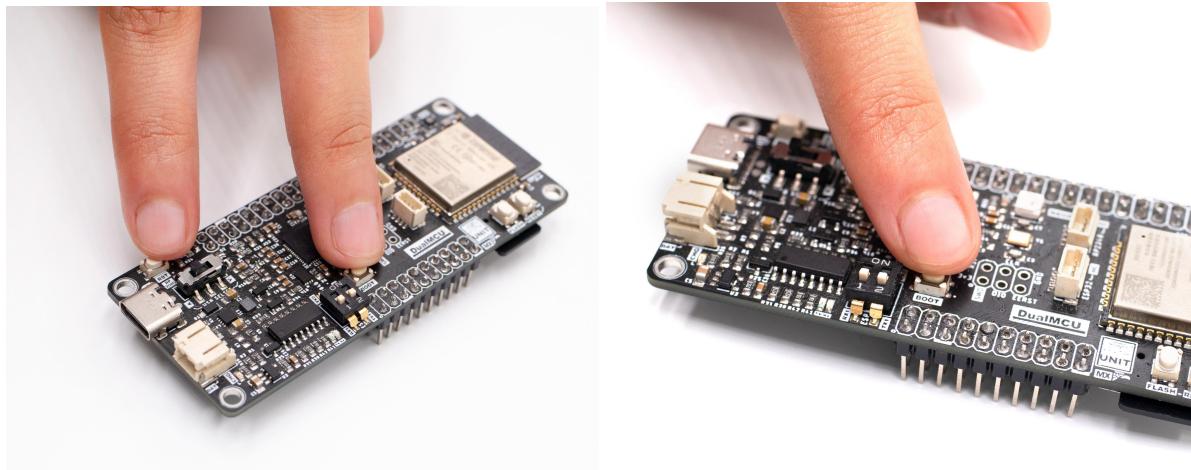


- To download the Micropython firmware on the RP2040, plug the USB-C cable into the DualMCU, move the mechanical USB selector to the “A” position (see section: 3.11 Mechanical selector for the USB Communication) and press and hold the RP2040 reset button (PB1), you can find it onboard with the label “RST”.



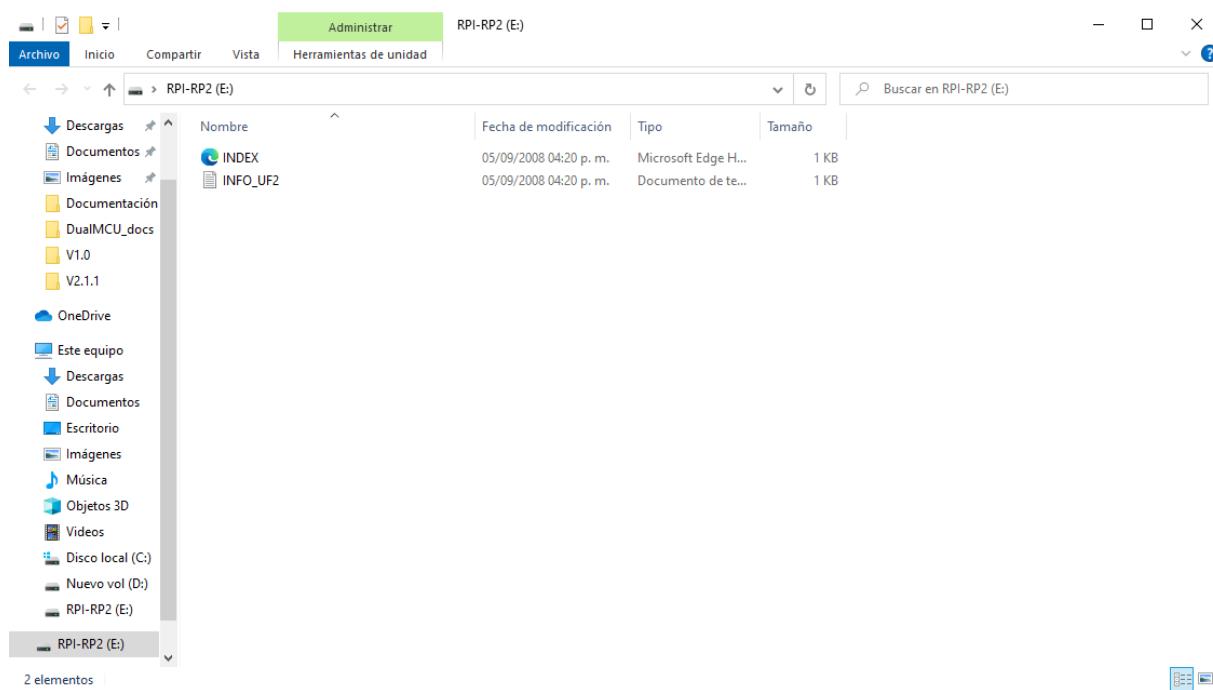
DualMCU “RP2040 Reset Button”

With the other hand, press and hold the RP2040 boot button (PB2) labeled “BOOT” and release the reset button (PB1) “RST”.



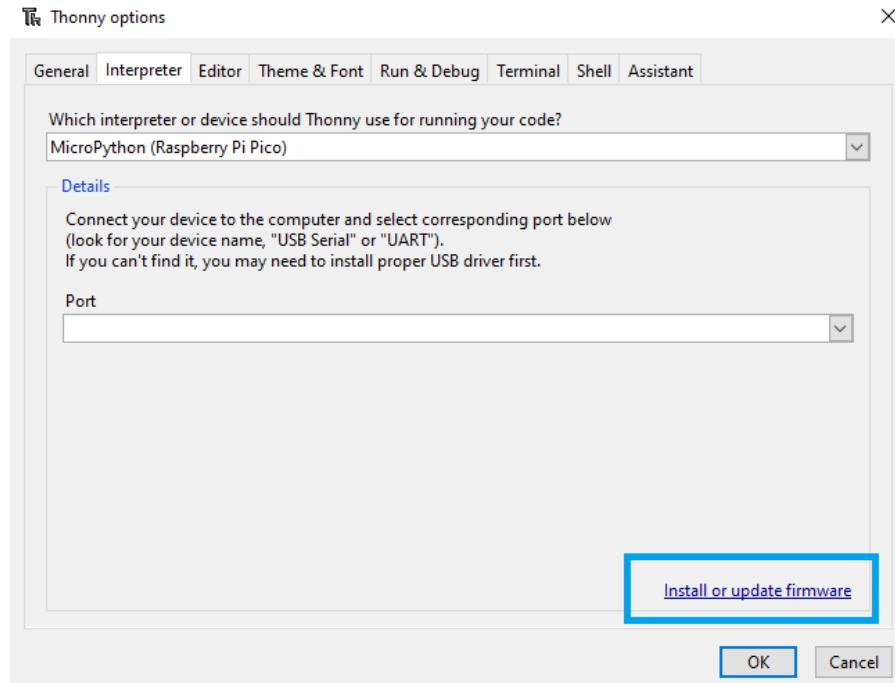
Press and hold the RP2040 “Boot and Reset buttons” to enter bootloader mode

The board should appear as a removable drive called **RPI-RP2**.

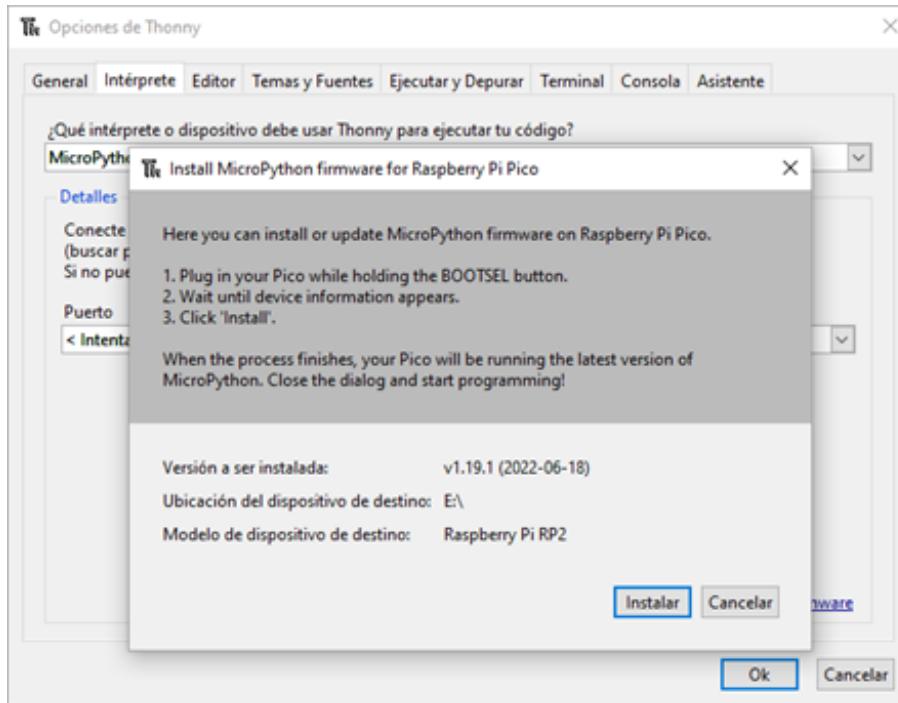


*Removable drive called **RPI-RP2***

- 3) Go to Thonny IDE and click on “*Install or Update firmware*” to start the firmware download from Raspberry Pi Pico.

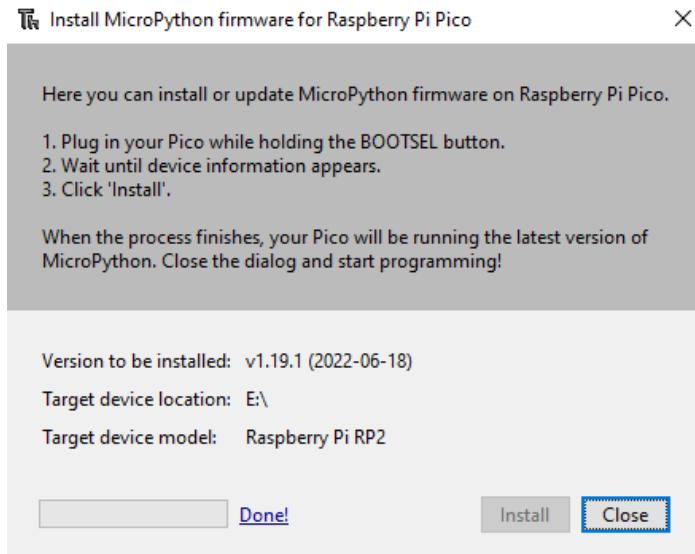


The following window should appear:



- 4) Then, click on “*install*”.

Once the micropython firmware download is finished, the message "Done!" will appear, indicating that the firmware load was done correctly, click on "Close" and the DualMCU ready to start loading our programs on the RP2040 chip.

**Note:**

You can also download the micropython firmware UF2 file from Raspberry pi source and then drag and drop into the removable drive “**RPI-RP2**”. The board will automatically reboot.

[Click to download the Micropython UF2 File](#)

5.3 Examples (Micropython)

The Raspberry Pi foundation makes available the necessary tools, documentation, and examples to get started with the RP2040. If you haven't already, look into the documentation on the Pico. We'll use this as a point of reference when using the RP2040 chip into the DualMCU board to fit your needs in this tutorial.

[Raspberry Pi: Pico Python SDK \(.pdf\)](#)

We'll be using the MicroPython examples from this repo using Thonny IDE.

[Github: Raspberry Pi - Micropython “Examples”](#)

5.4 Micropython hello world on the RP2040

- 1) In Thonny editor click File->New to open new python file and start writing the code in the editor:

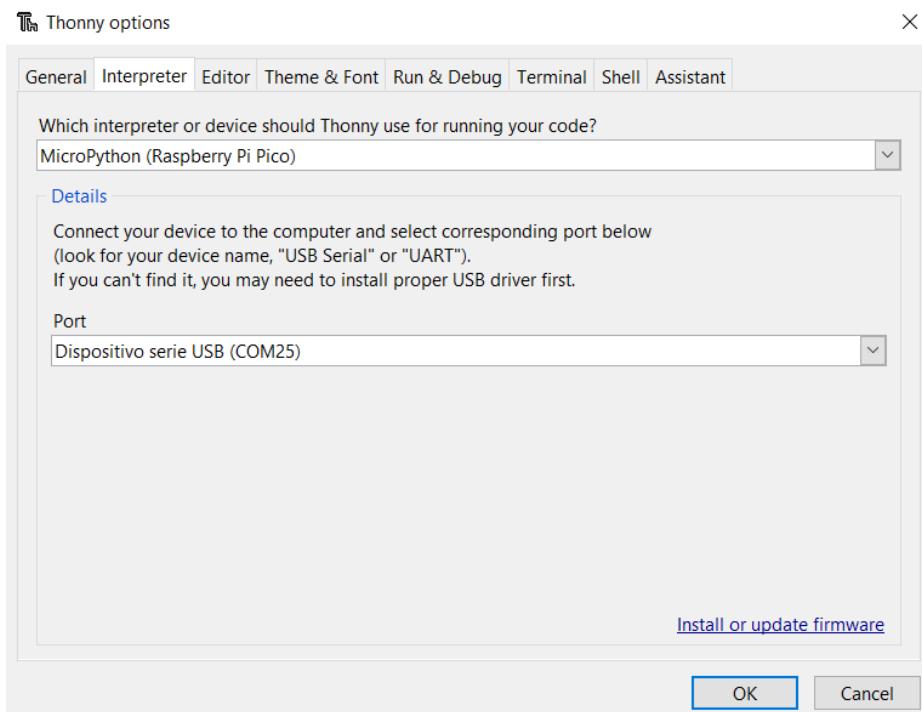
```
from machine import Pin
import utime

led_pin = Pin(25,Pin.OUT)

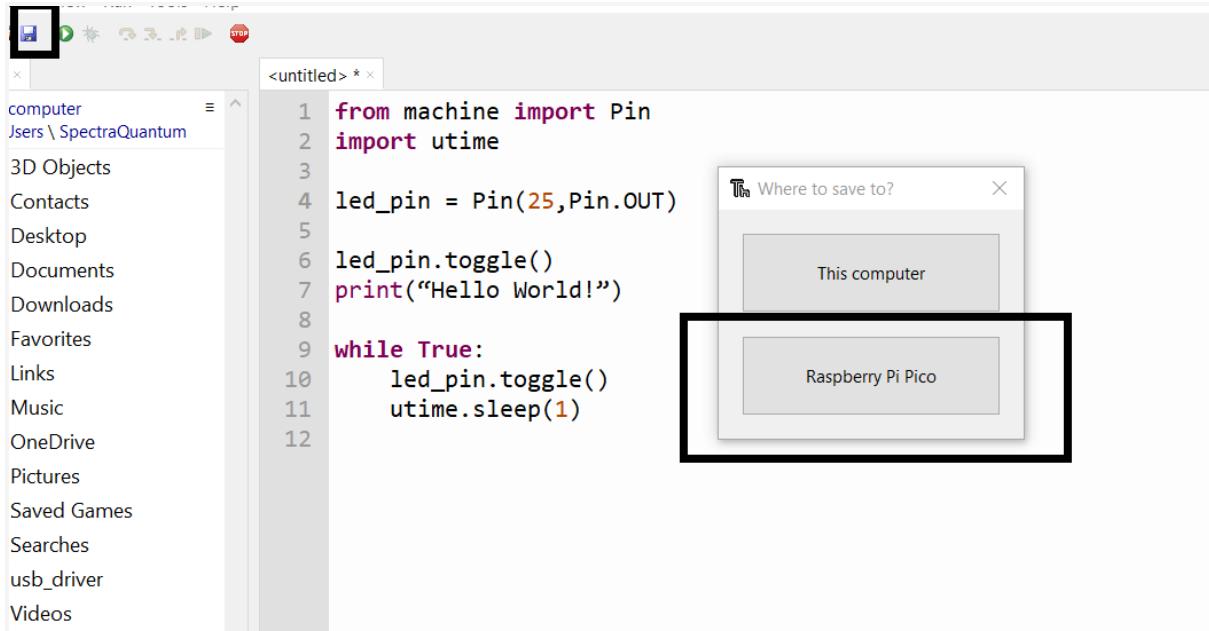
led_pin.toggle()
print("Hello World!")

while True:
    led_pin.toggle()
    utime.sleep(1)
```

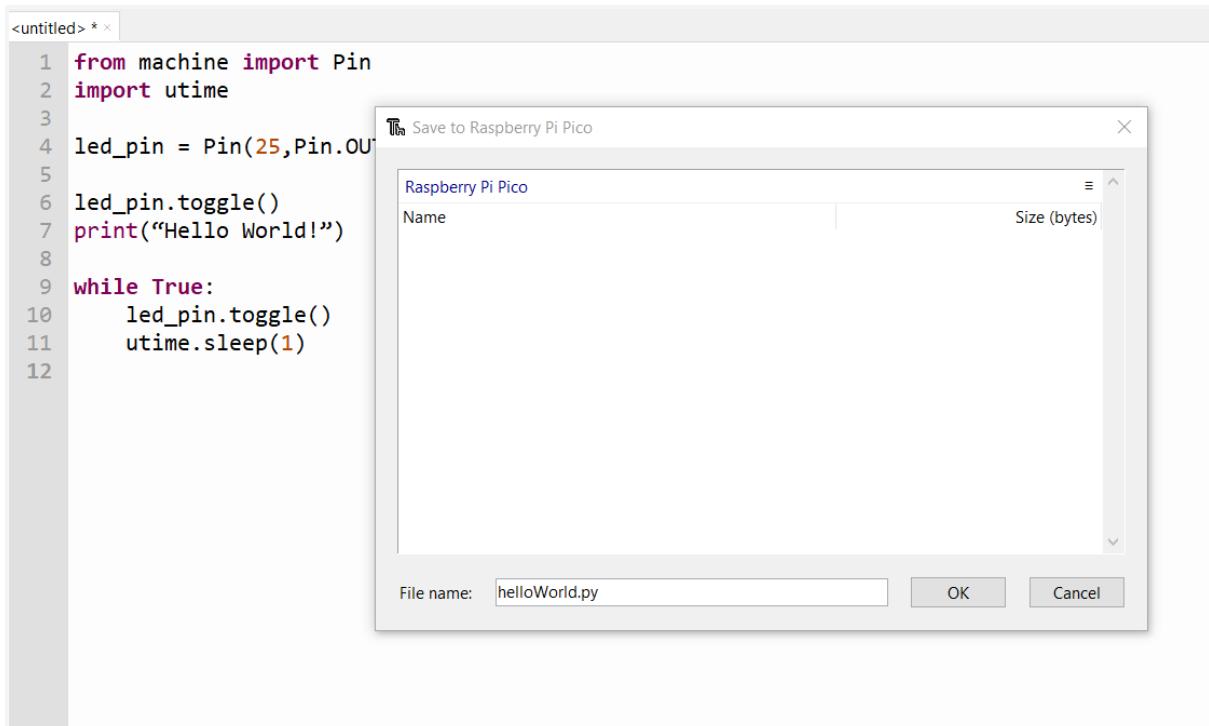
- 2) In the menu select: Run > Select Interpreter.... This will open a new window for the Thonny options. In the Interpreter tab, select MicroPython (Raspberry Pi Pico) as the interpreter and select the COM port with which your system recognizes the DualMCU for RP2040 (please make sure that the USB selector switch is in position "A", see section 3.11).



- 3) Head to the menu and select: File -> Save and choose “Raspberry Pi Pico”



- 4) Save the script with the name: “HelloWorld.py”



- 5) Hit the "Run current script" button or press (F5) key on the keyboard. In the Shell, you will see the following output:

MicroPython v1.19.1 on 2022-06-18; Raspberry Pi Pico with RP2040

Type "help()" for more information.

```
>>> %Run -c $EDITOR_CONTENT
```

Hello World!

And the on-board builtin led (L3) should be blinking!

Note:

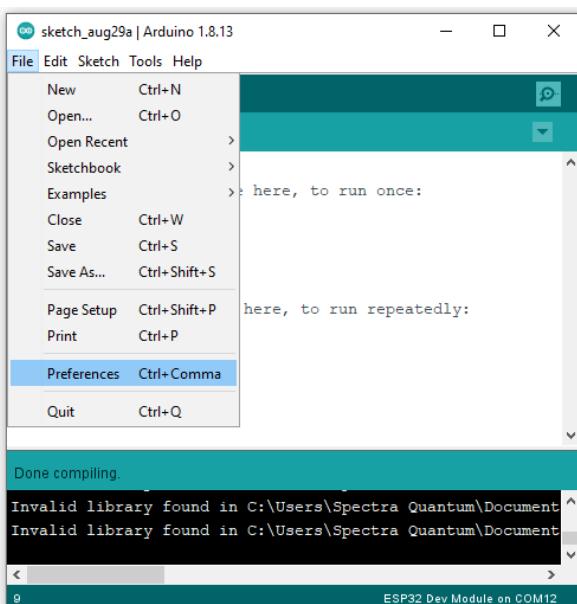
The ESP32 MCU can also be programmed from Thonny IDE and micropython, if you want to know how to do it, please visit the following repository:

<https://github.com/UNIT-Electronics/DualMCU-RP2040&ESP32-Micropython-Guide>

5.5 Getting Started with arduino IDE for ESP32 MCU

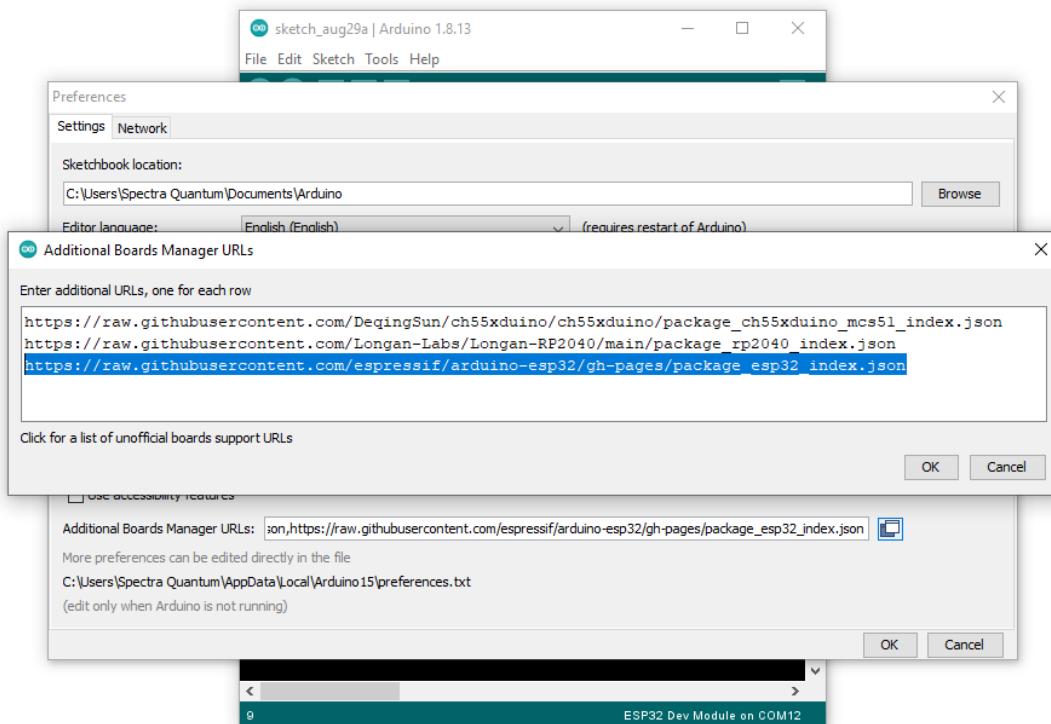
The Dual MCU could be programmed with the popular Arduino IDE, the language used is based on C and C++. The open-source Arduino Software makes it easy to write code and upload it to the board. The first thing is to have the [Arduino](#) environment installed.

- 1) Open the IDE and go to File -> Preferences:



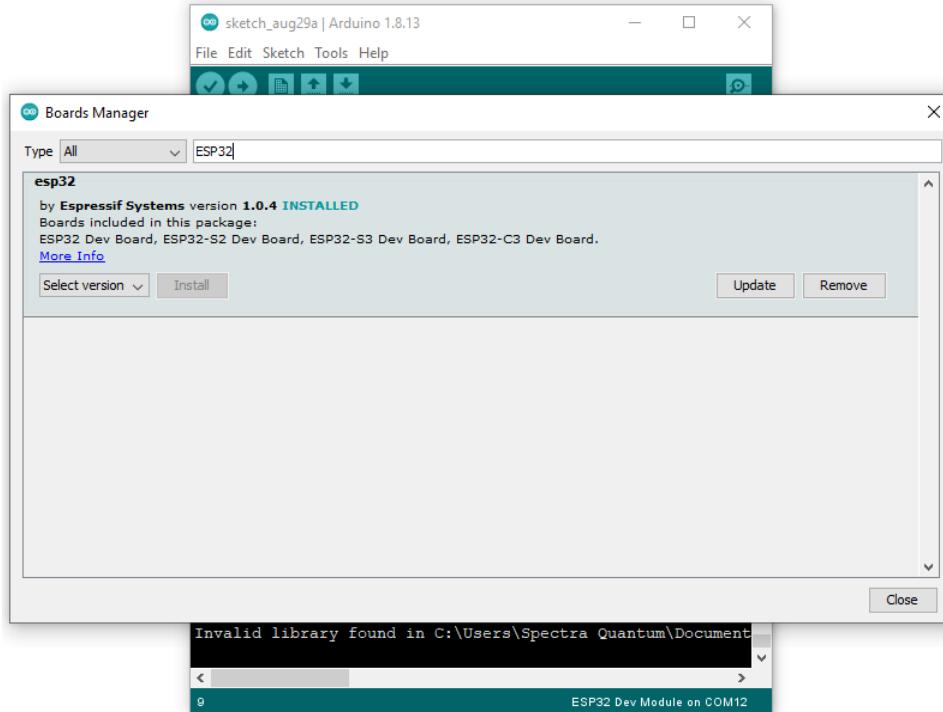
Into “Additional Board Manager URLs” field, add a coma and write the next URL:

https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json



Click the “Ok” button.

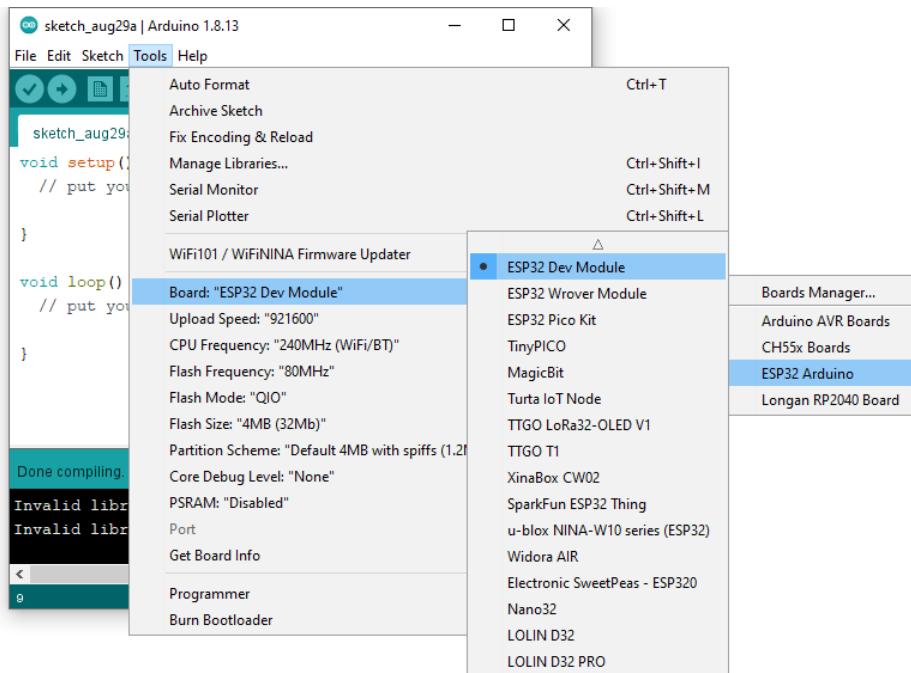
- 2) Head to the menu and select: **Tools -> Board -> Boards Manager** and type “ESP32” in the blank field, select the option “esp32 by Espressif Systems” and press “Install”: Wait a moment while the package should be installed and press “Close”



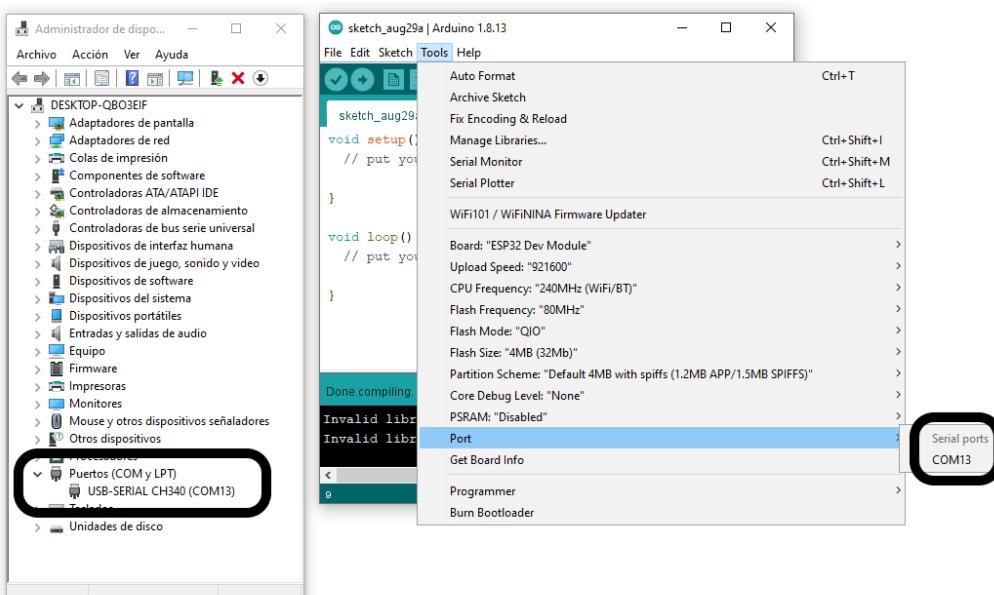
Now you can plug the Dual MCU into your computer (remember to move the USB selector to position “B” when programming ESP32 MCU, see section: 3.11).

5.6 Hello world on the ESP32 from Arduino IDE

- 1) In the “Tools” menu, select: **Board -> ESP32 Arduino -> ESP32 Dev Module**



- 2) Connect the Dual MCU to your computer and go to the “Tools” menu and select the COM port for the DualMCU: (if you do not see the COM Port in your Arduino IDE, you need to install the [CH340C Driver](#))



- 3) In the text editor space start writing the following code:

```
#define LED_R 4
#define LED_G 26
#define LED_B 25

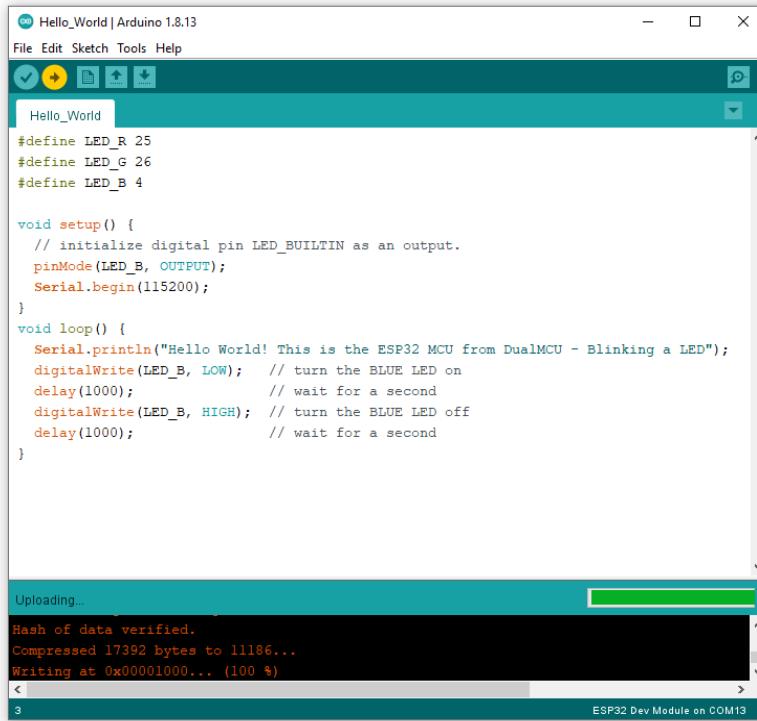
void setup() {
    // initialize digital pin LED_BUILTIN as an output.
    pinMode(LED_G, OUTPUT);
    Serial.begin(115200);
}

void loop() {
    Serial.println("Hello World! This is the ESP32 MCU from DualMCU - Blinking a LED");

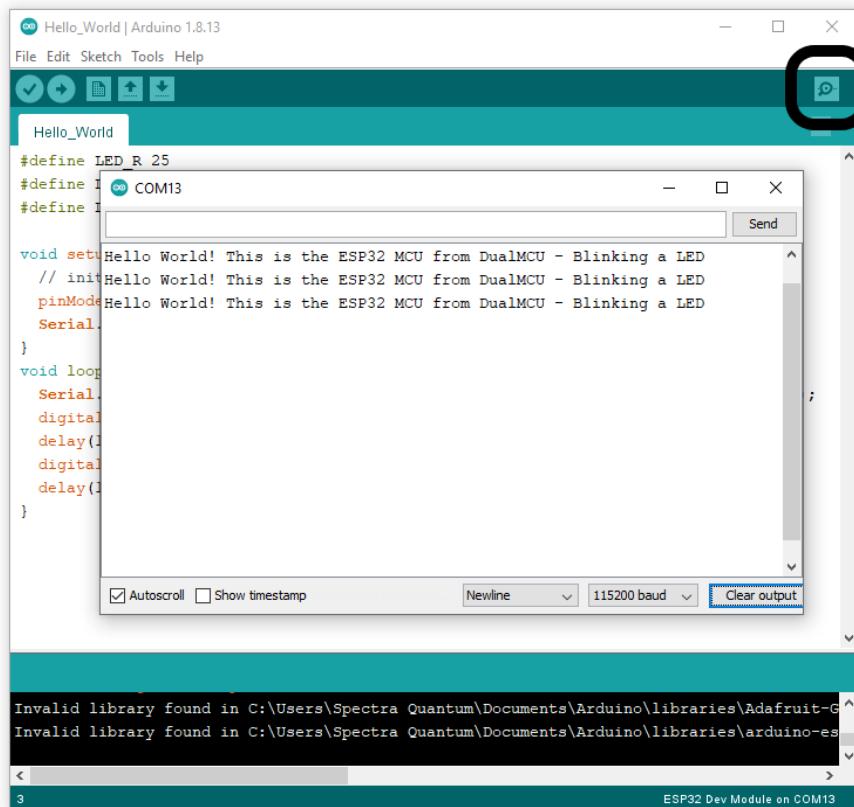
    digitalWrite(LED_G, LOW);      // turn the BLUE LED on
    delay(1000);                  // wait for a second
    digitalWrite(LED_G, HIGH);     // turn the BLUE LED off
    delay(1000);                  // wait for a second
}
```

- 4) Save the sketch as “Hello World” in the “**File**” menu and select: “**Save**”. Then click the upload button or press “CTRL + U” from keyboard to compile and upload the code to the ESP32 MCU:



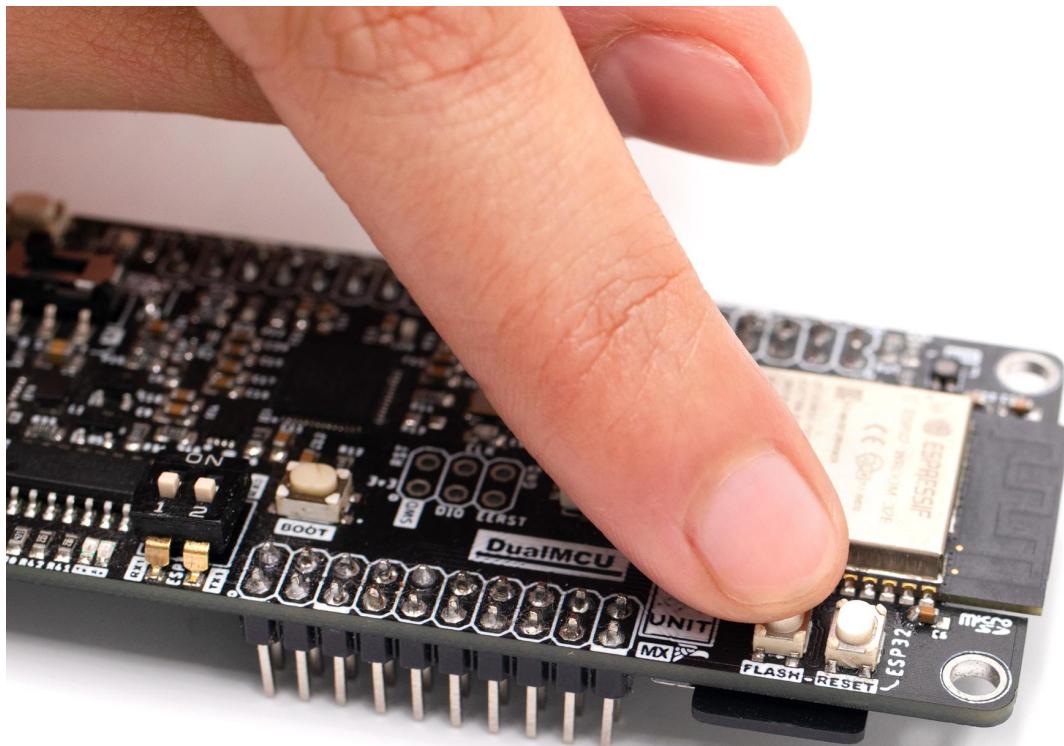


- Finally, open the arduino serial monitor, you will see a message printing every second and the BLUE LED on the DualMCU blinking!



Important!:

Sometimes it is necessary to press the “Flash Button (PB3)” on the DualMCU during code upload.



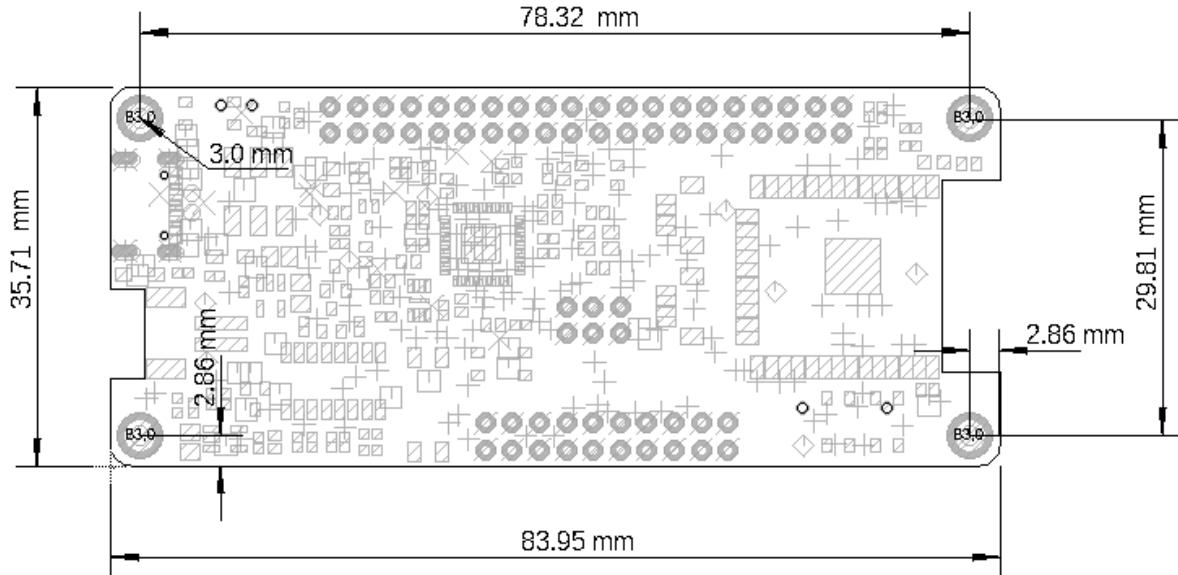
Press the ESP32 “Flash button” to start flashing the Arduino sketch

Note:

The RP2040 MCU can also be programmed from Arduino IDE, if you want to know how to do it, please visit the following repository:

<https://github.com/UNIT-Electronics/DualMCU-RP2040&ESP32-Arduino Programming>

6 Mechanical Information



Mechanical dimensions of DualMCU RP2040 + ESP32

7 Company Information

Company name	UNIT Electronics
Company website	https://uelectronics.com/
Company Address	Salvador 19, Cuauhtémoc, 06000 Mexico City, CDMX

8 Reference Documentation

Ref	Link
UNIT DualMCU Documentation	https://github.com/UNIT-Electronics/DualMCU
UNIT DualMCU Examples	https://github.com/UNIT-Electronics/DualMCU/tree/master/examples
Getting started with DualMCU RP2040 & ESP32 Micropython	https://github.com/UNIT-Electronics/DualMCU-RP2040&ESP32-Micropython-Guide

Getting started with DualMCU RP2040 & ESP32 Arduino IDE	https://github.com/UNIT-Electronics/DualMCU-RP2040&ESP32-Arduino-Programming
Getting started with DualMCU RP2040 C/C+ SDK	https://github.com/UNIT-Electronics/DualMCU-RP2040-Getting-started-with-C/C++-SDK
Thonny IDE	https://thonny.org/
Arduino IDE	https://www.arduino.cc/en/software
CH340 Driver	http://www.wch-ic.com/downloads/CH341SER_ZIP.html
Visual Studio Code	https://code.visualstudio.com/download
Raspberry Pi Pico RP2040 Documentation	https://www.raspberrypi.com/documentation/microcontrollers/
Raspberry Pi Pico Python SDK	https://datasheets.raspberrypi.com/pico/raspberry-pi-pico-python-sdk.pdf
raspberrypi/pico-micro python-examples	https://github.com/raspberrypi/pico-micropython-examples
Raspberry Pi Pico C/C++ SDK	https://www.raspberrypi.com/documentation/microcontrollers/c_sdk.html
raspberrypi/pico-C/C+-examples	https://github.com/raspberrypi/pico-examples
RP2040 Datasheet	https://datasheets.raspberrypi.com/rp2040/rp2040-datasheet.pdf
ESP32 WROOM 8MB	https://www.espressif.com/sites/default/files/documentation/esp32-wroom-32e_esp32-wroom-32ue_datasheet_en.pdf

9 Appendix

9.1 Schematic (https://github.com/UNIT-Electronics/DualMCU/blob/main/Hardware/UE0002_DualMCUv30_Schematic.pdf)

