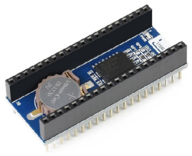
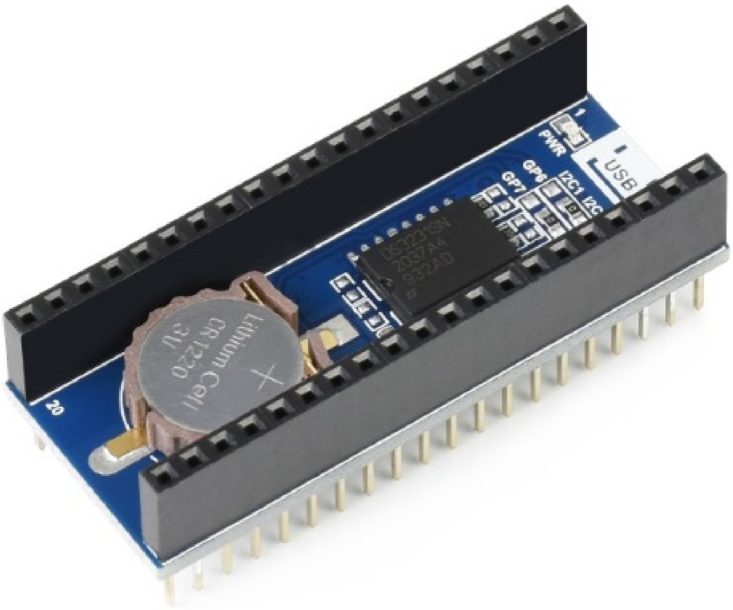


Waveshare Pico-RTC-DS3231 Precision RTC Module Instruction Manual

Contents

Waveshare Pico-RTC-DS3231 Precision RTC Module



Product Information

The Pico-RTC-DS3231 is an RTC expansion module specialized for Raspberry Pi Pico. It incorporates a high-precision RTC chip DS3231 and uses an I2C bus for communication. The module features a standard Raspberry Pi Pico header, supporting the Raspberry Pi Pico series. It also includes an onboard DS3231 chip with a backup battery holder, allowing real-time clock functionality. The RTC counts seconds, minutes, hours, dates of the month, month, day of the week, and year with leap-year compensation valid up to 2100. It offers optional formats of 24-hour or 12-hour with an AM/PM indicator. Additionally, the module provides 2 programmable alarm clocks and comes with online documentation for Raspberry Pi Pico C/C++ and MicroPython example demos.

Product Usage Instructions

Setup Environment:

1. For an application development environment for Pico on Raspberry Pi, please refer to the **RaspberryPiChapter**.
2. For the Windows environment setting, you can refer to **this link**. This tutorial uses the VScode IDE for development in a Windows environment.

Overview

The Pico-RTC-DS3231 is an RTC expansion module specialized for Raspberry Pi Pico. It incorporates high-precision RTC chip DS3231 and uses an I2C bus for communication. More external sensors are allowed to be connected thanks to the stackable design.

Pico RTC DS3231

Precision RTC Module for Raspberry Pi Pico, Onboard DS3231 Chip

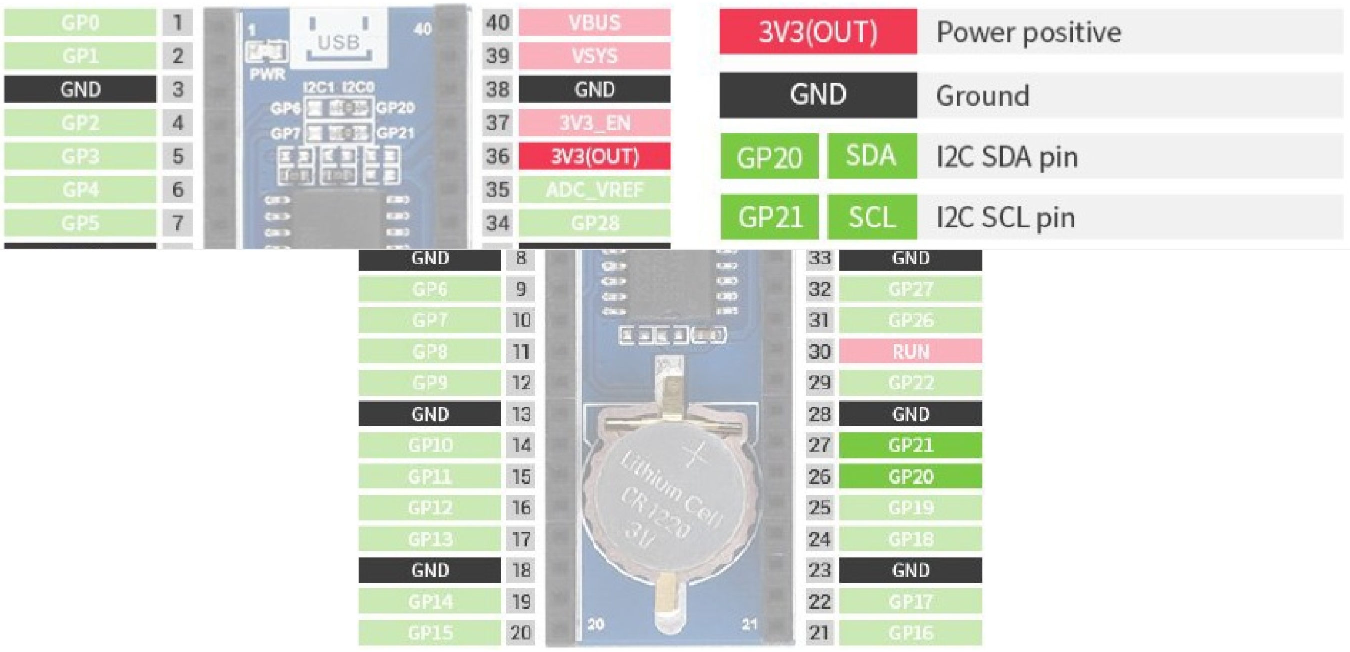
Features

- The Standard Raspberry Pi Pico header, supports the Raspberry Pi Pico series.
- Onboard high precision RTC chip DS3231, with backup battery holder.
- Real-Time Clock Counts Seconds, Minutes, Hours, Date of the Month,
- Month, Day of the Week, and Year with Leap-Year Compensation Valid Up to 2100.
- **Optional format:** 24-hour OR 12-hour with an AM/PM indicator. 2 x programable alarm clock.
- Provide online documentation (Raspberry Pi Pico C/C++ and MicroPython example demos).

Specification

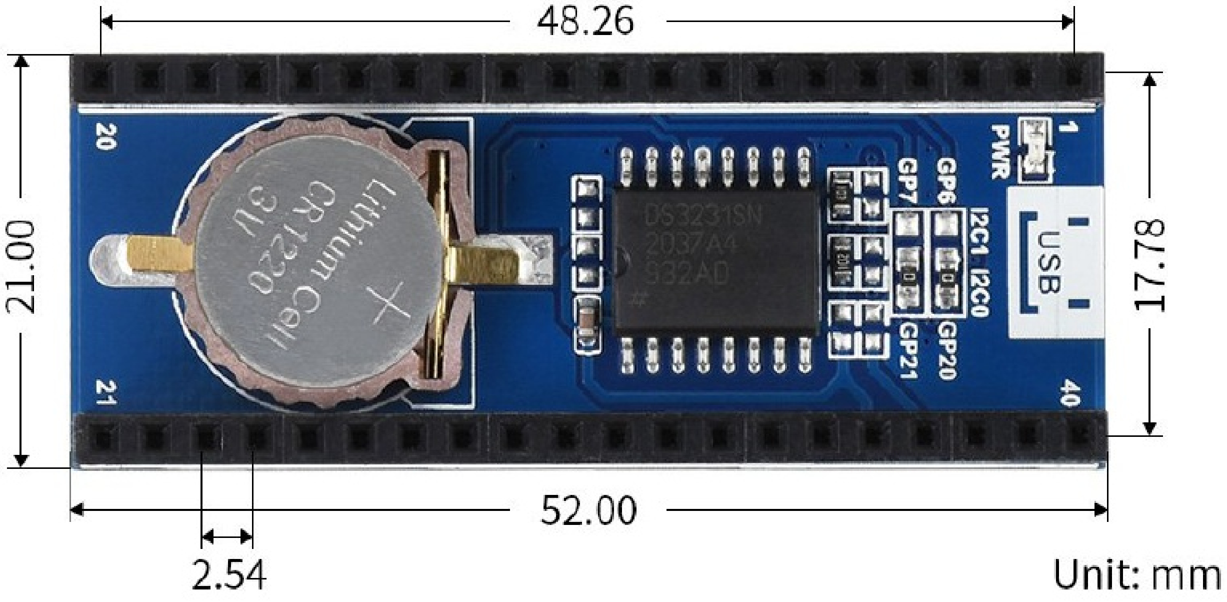
- **Operating voltage:** 3.3V
- **Backup battery voltage:** 2.3V~5.5V
- **Operating temperature:** -40°C ~ 85°C
- **Power consumption:** 100nA (sustains data and clock information)

Pinout



3V3(OUT)		Power positive
GND		Ground
GP20	SDA	I2C SDA pin
GP21	SCL	I2C SCL pin

Dimensions



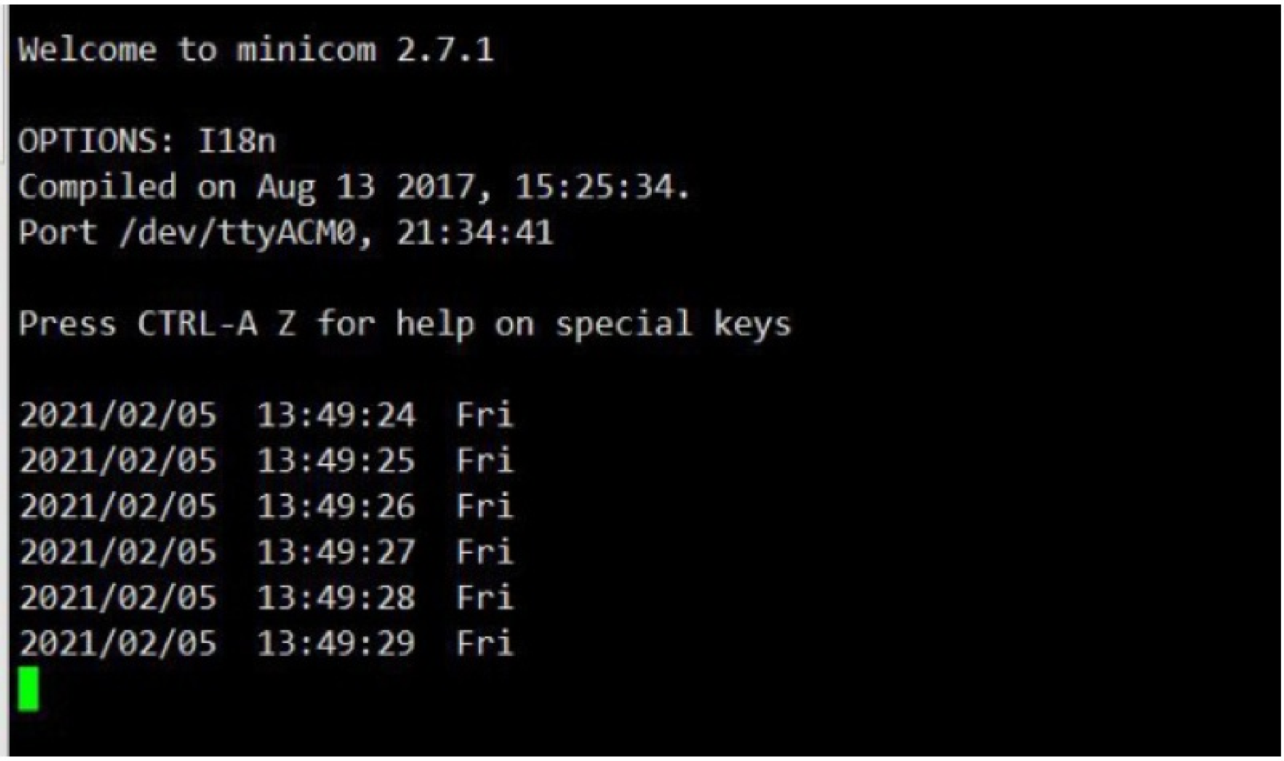
User Guide

Setup environment

1. For an application development environment for Pico on Raspberry Pi, please refer to the Raspberry Pi Chapter .
2. For the Windows environment setting, you can refer to link . This tutorial uses the VScode IDE for development in a Windows environment.

Raspberry Pi

1. Log in Raspberry Pi With SSH or press Ctrl+Alt+T at the same time while using the screen to open the terminal.
2. Download and unzip the demo codes to the directory Pico C/C++ SDK. Reference tutorial for users who have not yet installed the SDK.
    - **Note:** That the directory of SDK may be different for different users, you need t o check the actual directory. Generally, it should be ~/pico/. wget -P ~/pico https://files.waveshare.com/upload/2/26/Pico-rtc-ds3231_code.zipcd. ~/picounzip Pico-rtc-ds3231_code.zip
3. Hold the BOOTSEL button of Pico, and connect the USB interface of Pico to Raspberry Pi then release the button.
4. Compile and run the pico-rtc-ds3231 examples: cd ~/pico/pico-rtc-ds3231_code/c/build/ cmake ..mak sudo mount /dev/sda1 /mnt/pico && sudo cp rtc.uf2 /mnt/pico/ && sudo sync && sud o umount /mnt/pico && sleep 2 && sudo minicom -b 115200 -o -D /dev/ttyACM0
5. Open a terminal and use minicom to check the sensor’s information.



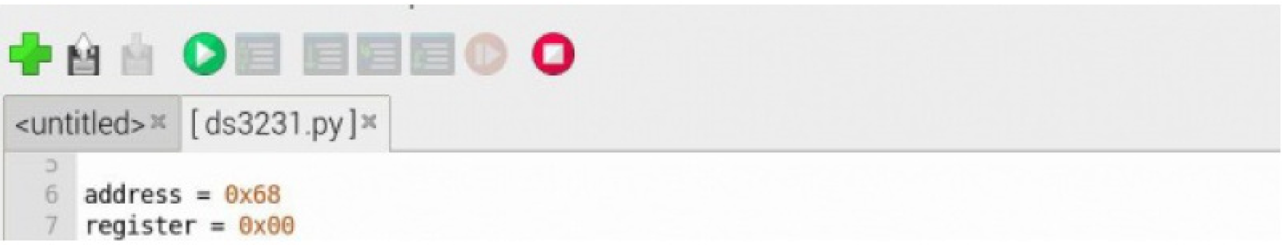
```
Welcome to minicom 2.7.1

OPTIONS: I18n
Compiled on Aug 13 2017, 15:25:34.
Port /dev/ttyACM0, 21:34:41

Press CTRL-A Z for help on special keys

2021/02/05  13:49:24  Fri
2021/02/05  13:49:25  Fri
2021/02/05  13:49:26  Fri
2021/02/05  13:49:27  Fri
2021/02/05  13:49:28  Fri
2021/02/05  13:49:29  Fri
```

python

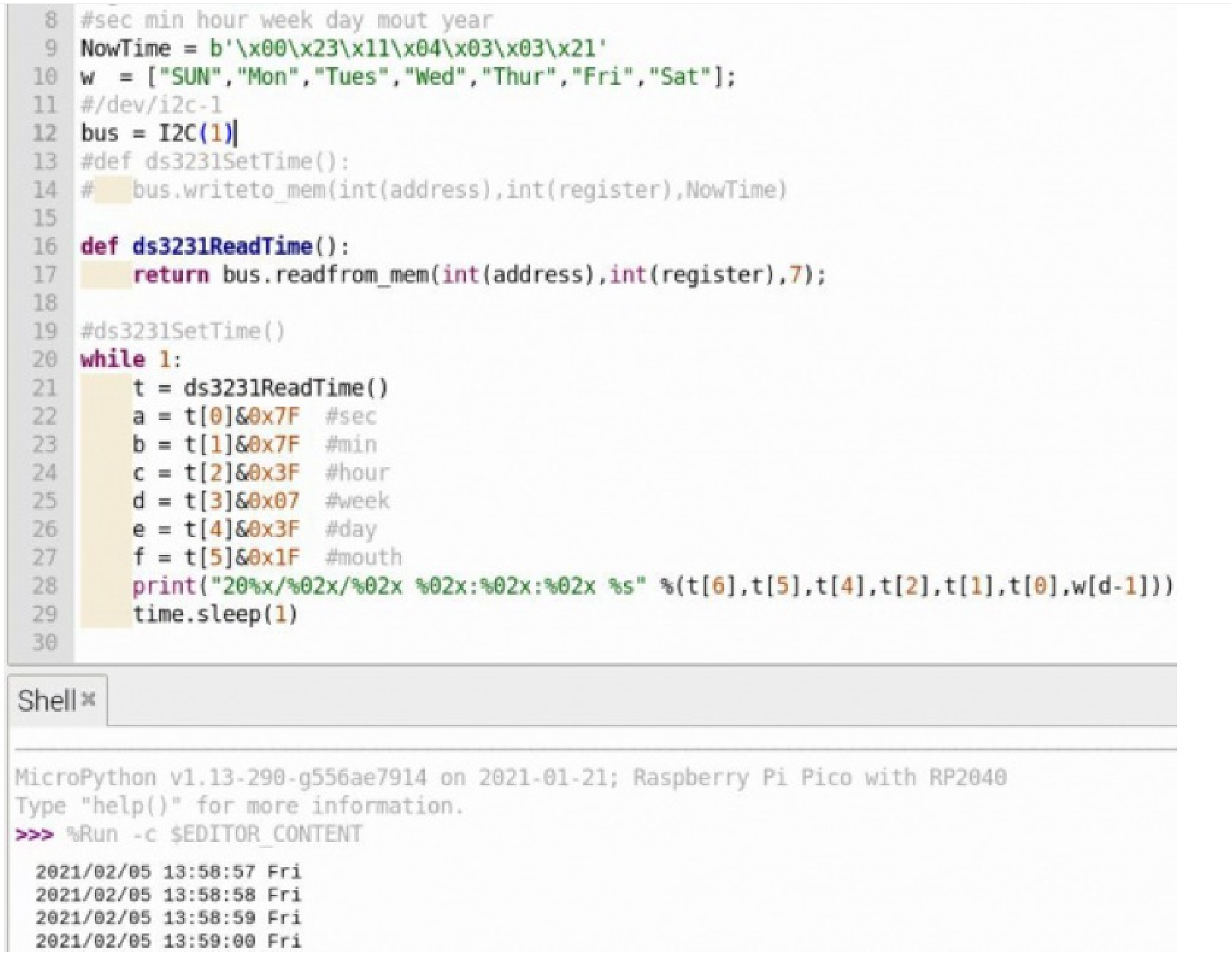
1. Refer to Raspberry Pi’s guides to setup Micropython firmware for Pico.
2. Open the Thonny IDE, drag the demo to IDE, and run on Pico as below.

   Pico-10DOF-IMU005.jpg

   Pico-RTC-DS3231005.jpg
3. Click the “run” icon to run the MicroPython demo codes.



```
address = 0x68
register = 0x00
```



```
#sec min hour week day mout year
NowTime = b'\x00\x23\x11\x04\x03\x03\x21'
w  = ["SUN","Mon","Tues","Wed","Thur","Fri","Sat"];
#/dev/i2c-1
bus = I2C(1)
#def ds3231SetTime():
#    bus.writeto_mem(int(address),int(register),NowTime)

def ds3231ReadTime():
    return bus.readfrom_mem(int(address),int(register),7);

#ds3231SetTime()
while 1:
    t = ds3231ReadTime()
    a = t[0]&0x7F  #sec
    b = t[1]&0x7F  #min
    c = t[2]&0x3F  #hour
    d = t[3]&0x07  #week
    e = t[4]&0x3F  #day
    f = t[5]&0x1F  #mouth
    print("20%x/%02x/%02x %02x:%02x:%02x %s" %(t[6],t[5],t[4],t[2],t[1],t[0],w[d-1]))
    time.sleep(1)
```

```
MicroPython v1.13-290-g556ae7914 on 2021-01-21; Raspberry Pi Pico with RP2040
Type "help()" for more information.
>>> %Run -c $EDITOR_CONTENT

  2021/02/05 13:58:57 Fri
  2021/02/05 13:58:58 Fri
  2021/02/05 13:58:59 Fri
  2021/02/05 13:59:00 Fri
```

Windows

- Download and unzip the demo to your Windows desktop, refer to Raspberry
- Pi's guides to set up the Windows software environment settings.
- Press and hold the BOOTSEL button of Pico, connect the USB of Pico to the PC with a MicroUSB cable. Import c or Python program into Pico to make it run.
- Use the serial tool to view the virtual serial port of Pico's USB enumeration to check the print information, the DTR needs to be opened, and the baud rate is 115200, as shown in the picture below:

Pico-RTC-DS3231007 (1).jpg

Others

- The LED light are not used by default, if you need to use it, you can solder a 0R resistor on the R8 position. Click to view the schematic diagram .
- The INT pin of DS3231 is not used by default. if you need to use it, you can solder the 0R resistor on the R5, R6, and R7 positions. Click to view the schematic diagram .
- Solder the R5 resistor, connect the INT pin to the GP3 pin of Pico, to detect the output status of the DS3231 alarm clock.
- Solder the R6 resistor, connect the INT pin to the 3V3_EN pin of Pico, to turn off the Pico power when the DS3231 alarm clock outputs low level.

- Solder the R7 resistor, connect the INT pin to the RUN pin of the Pico, to reset Pico when DS3231 alarm clock outputs low level.

Resource

- **Document**
  - Schematic
  - DS3231 Datasheet
- **Demo codes**
  - Demo codes
- **Development Software**
  - Thonny Python IDE (Windows V3.3.3)
  - Zimo221.7z
  - Image2Lcd.7z

Pico Quick Start

Download Firmware

- MicroPython Firmware Download
- C_Blink Firmware Download [Expand]

Video Tutorial [Expand]

- Pico Tutorial I – Basic Introduction
- Pico Tutorial II – GPIO [Expand]
- Pico Tutorial III – PWM [Expand]
- Pico Tutorial IV – ADC [Expand]
- Pico Tutorial V – UART [Expand]
- Pico Tutorial VI – To be continued… [Expand]

MicroPython Series

- MicroPython machine.Pin Function
- MicroPython machine.PWM Function
- MicroPython machine.ADC Function
- MicroPython machine.UART Function
- MicroPython machine.I2C Function
- MicroPython machine.SPI Function
- MicroPython rp2.StateMachine

C/C++ Series

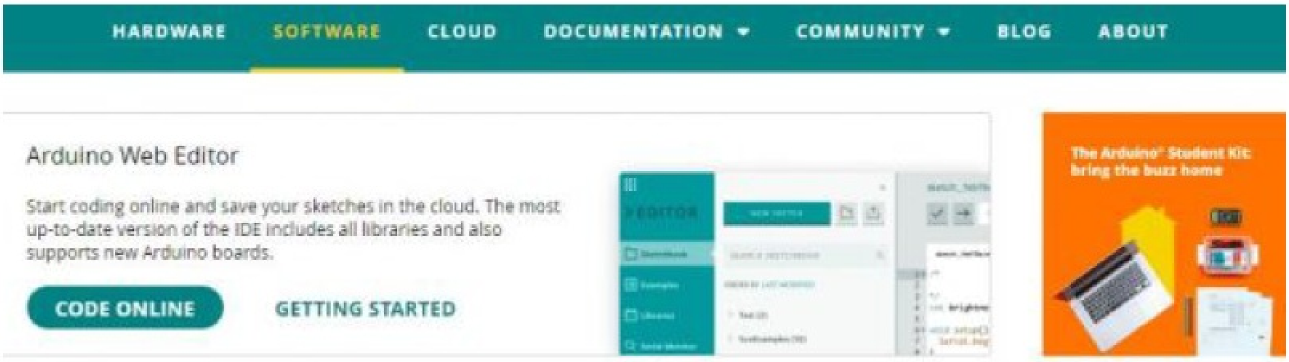
- C/C++ Windows Tutorial 1 – Environment Setting

- C/C++ Windows Tutorial 1 – Create New Project

Arduino IDE Series

Install Arduino IDE

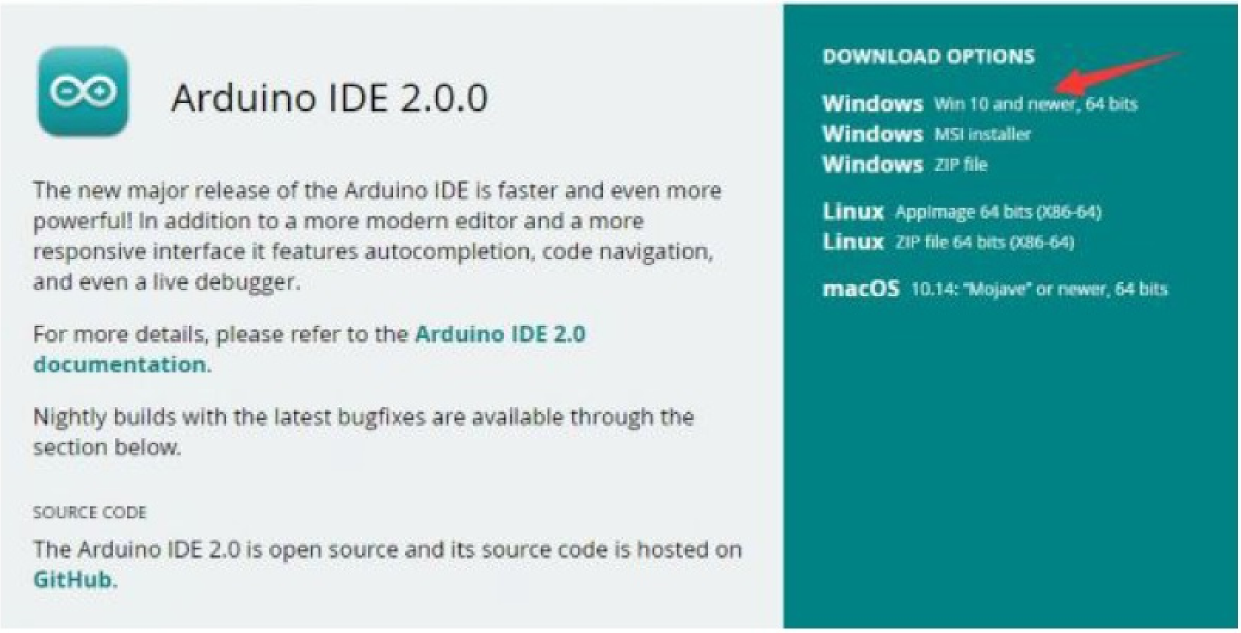
1. Download the Arduino IDE installation package from the Arduino website .



Arduino Web Editor

Start coding online and save your sketches in the cloud. The most up-to-date version of the IDE includes all libraries and also supports new Arduino boards.

- **DOWNLOAD**



Arduino IDE 2.0.0

The new major release of the Arduino IDE is faster and even more powerful! In addition to a more modern editor and a more responsive interface it features autocompletion, code navigation, and even a live debugger.

For more details, please refer to the **Arduino IDE 2.0 documentation.**

Nightly builds with the latest bugfixes are available through the section below.

SOURCE CODE

The Arduino IDE 2.0 is open source and its source code is hosted on **GitHub.**

DOWNLOAD OPTIONS

Windows Win 10 and newer, 64 bits
Windows MSI installer
Windows ZIP file

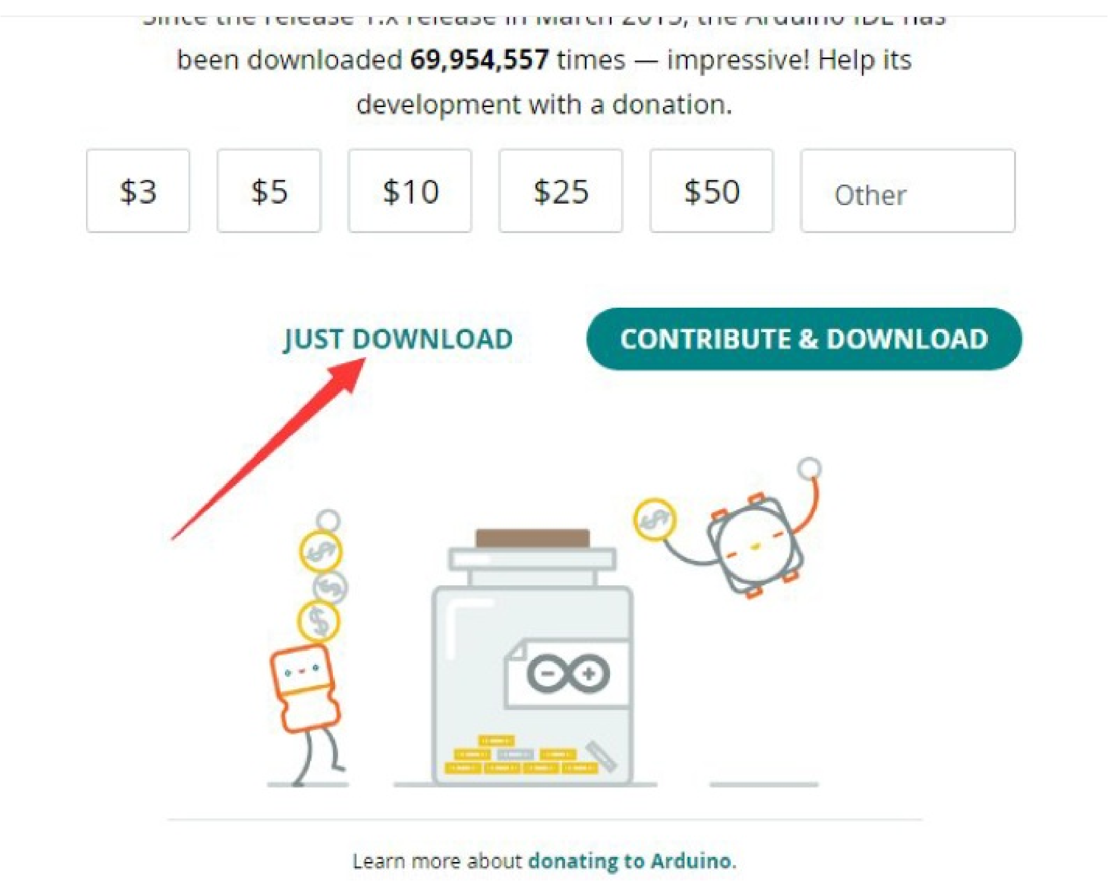
Linux AppImage 64 bits (X86-64)
Linux ZIP file 64 bits (X86-64)

macOS 10.14: "Mojave" or newer, 64 bits

2. Just click on “JUST DOWNLOAD”.

Support the Arduino IDE

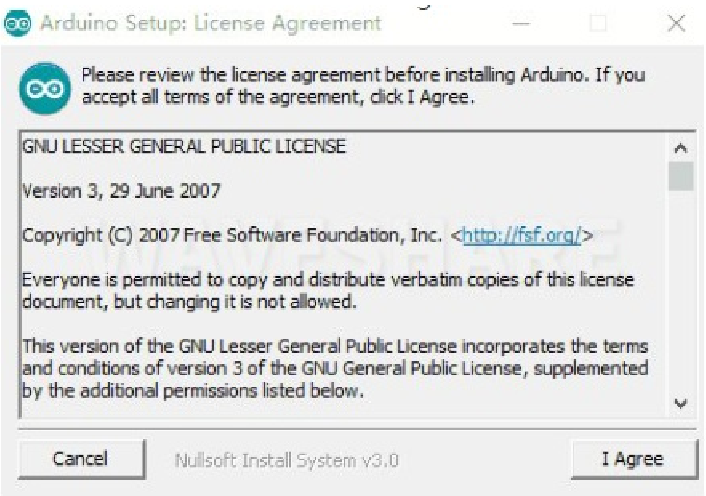
Since the release 1.x release in March 2015, the Arduino IDE has



Since the release 1.x release in March 2015, the Arduino IDE has been downloaded **69,954,557** times — impressive! Help its development with a donation.

Learn more about **donating to Arduino.**

3. Click to install after downloading.



Please review the license agreement before installing Arduino. If you accept all terms of the agreement, click I Agree.

GNU LESSER GENERAL PUBLIC LICENSE

Version 3, 29 June 2007

Copyright (C) 2007 Free Software Foundation, Inc. <http://fsf.org/>

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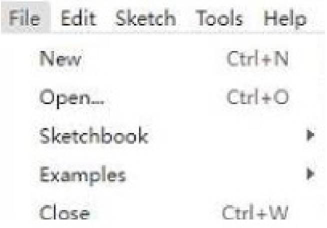
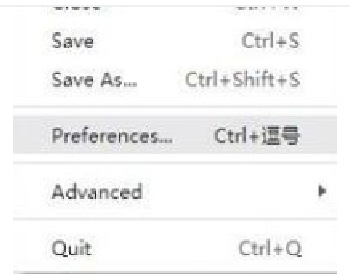
This version of the GNU Lesser General Public License incorporates the terms and conditions of version 3 of the GNU General Public License, supplemented by the additional permissions listed below.

4. **Note:** You will be prompted to install the driver during the installation process, we can click Install.

Install Arduino-Pico Core on Arduino IDE

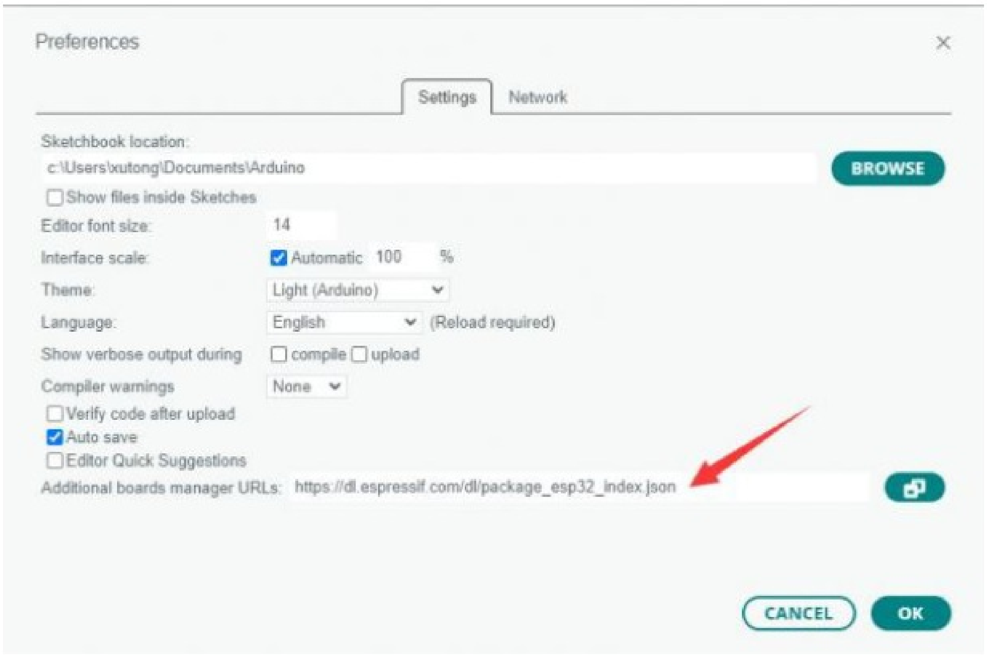
1. Open Arduino IDE, click the File on the left corner and choose “Preferences”.





2. Add the following link in the additional development board manager URL, then click OK.

```
https://github.com/earlephilhower/arduino-pico/releases/download/globa
l/package_rp2040_index.json
```



Sketchbook location:
c:\Users\xutong\Documents\Arduino

□ Show files inside Sketches

Editor font size: 14

Interface scale: ☑ Automatic 100 %

Theme: Light (Arduino)

Language: English (Reload required)

Show verbose output during □ compile □ upload

Compiler warnings None

□ Verify code after upload

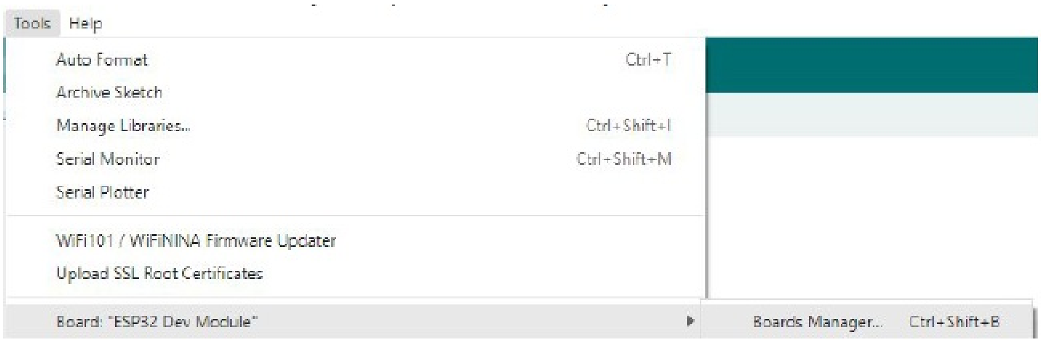
☑ Auto save

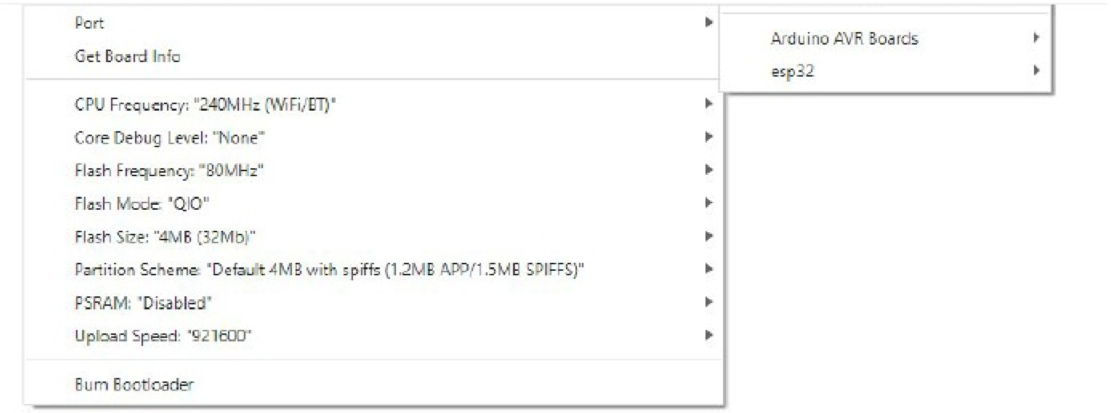
□ Editor Quick Suggestions

Additional boards manager URLs: https://dl.espressif.com/dl/package_esp32_index.json

- **Note:** If you already have the ESP8266 board URL, you can separate the URLs with commas like this:
- https://dl.espressif.com/dl/package_esp32_index.json,https://github.com/earlephilhower/arduino-pico/releases/download/global/package_rp2040_index.json.

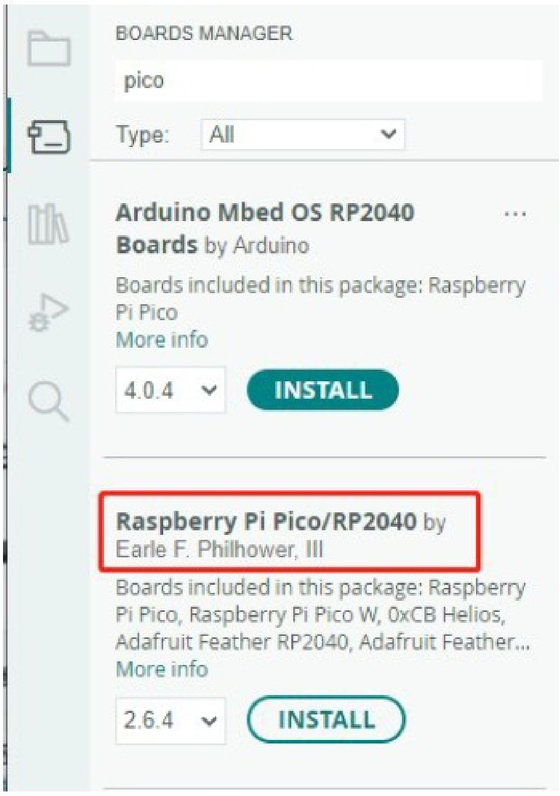
3. Click on Tools -> Dev Board -> Dev Board Manager -> Search for pico, it shows installed since my computer has already installed it.


Tools Help
Auto Format Ctrl+T
Archive Sketch
Manage Libraries... Ctrl+Shift+I
Serial Monitor Ctrl+Shift+M
Serial Plotter
WiFi101 / WiFiNINA Firmware Updater
Upload SSL Root Certificates
Board: "ESP32 Dev Module"
Boards Manager... Ctrl+Shift+B



Port
Get Board Info
CPU Frequency: "240MHz (WiFi/BT)"
Core Debug Level: "None"
Flash Frequency: "80MHz"
Flash Mode: "QIO"
Flash Size: "4MB (32Mb)"
Partition Scheme: "Default 4MB with spiffs (1.2MB APP/1.5MB SPIFFS)"
PSRAM: "Disabled"
Upload Speed: "921600"
Burn Bootloader

Arduino AVR Boards
esp32



BOARDS MANAGER

pico

Type: All

Arduino Mbed OS RP2040 Boards by Arduino

Boards included in this package: Raspberry Pi Pico

More info

4.0.4 INSTALL

Raspberry Pi Pico/RP2040 by Earle F. Philhower, III

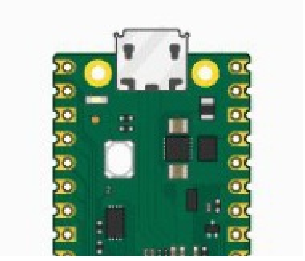
Boards included in this package: Raspberry Pi Pico, Raspberry Pi Pico W, 0xCB Helios, Adafruit Feather RP2040, Adafruit Feather...

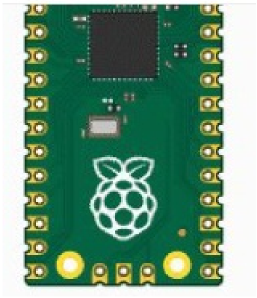
More info

2.6.4 INSTALL

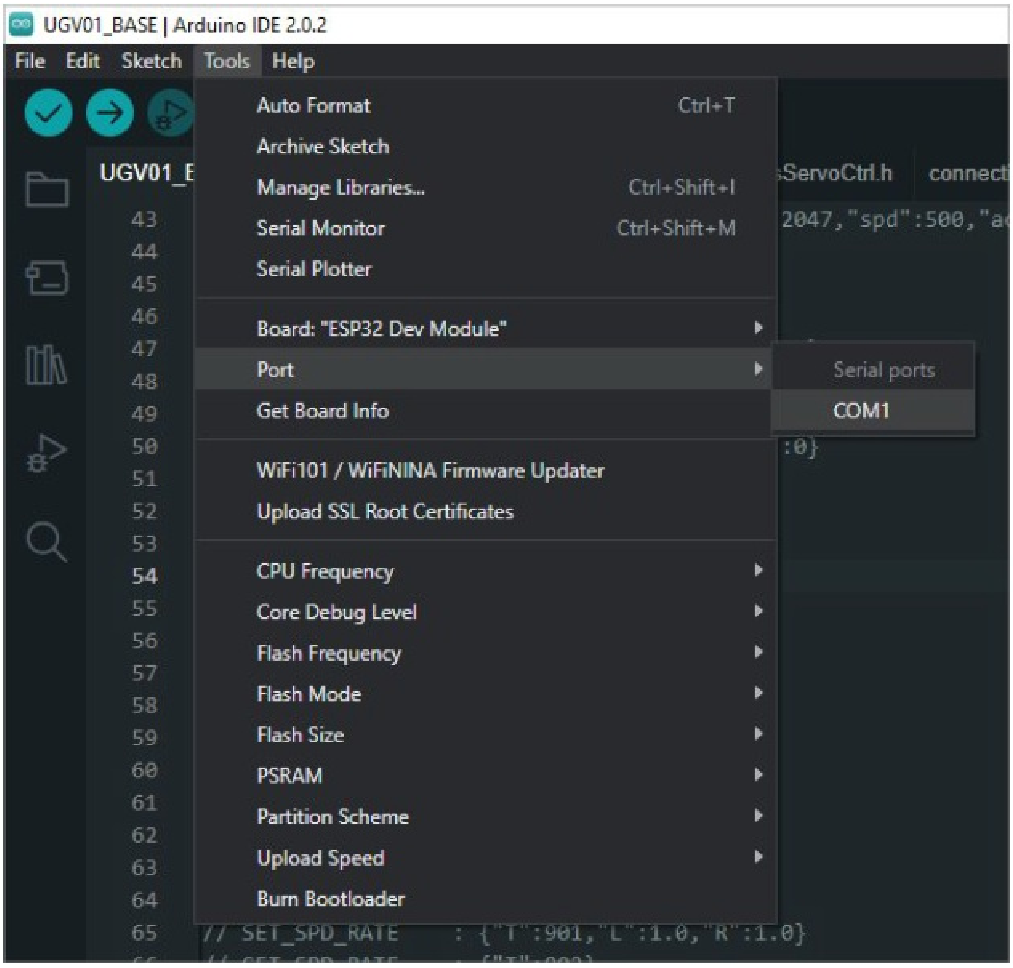
Upload Demo At the First Time

1. Press and hold the BOOTSET button on the Pico board, connect the Pico to the USB port of the computer via the Micro USB cable, and release the button when the computer recognizes a removable hard drive (RPI-RP2).

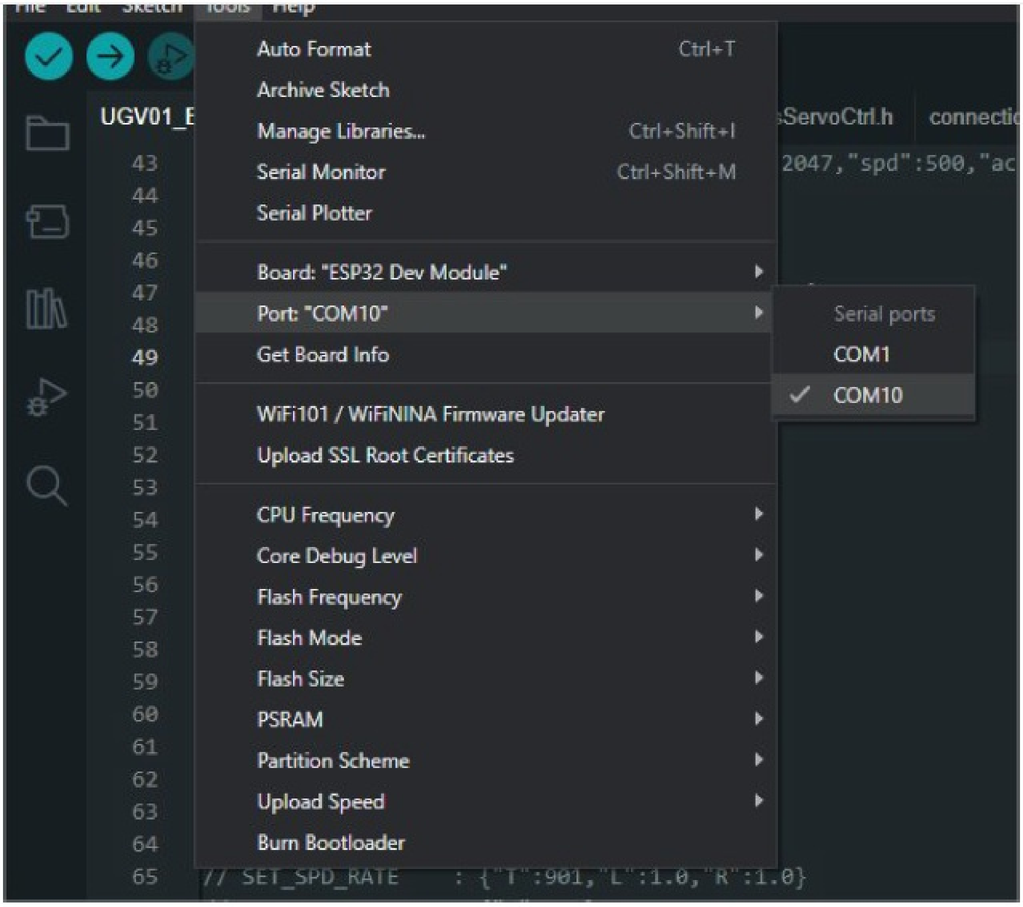




2. Download the demo, open arduino\PWM\D1-LED path under the D1-LED.ino.
3. Click Tools -> Port, remember the existing COM, do not need to click this COM (different computers show different COM, remember the existing COM on your computer).

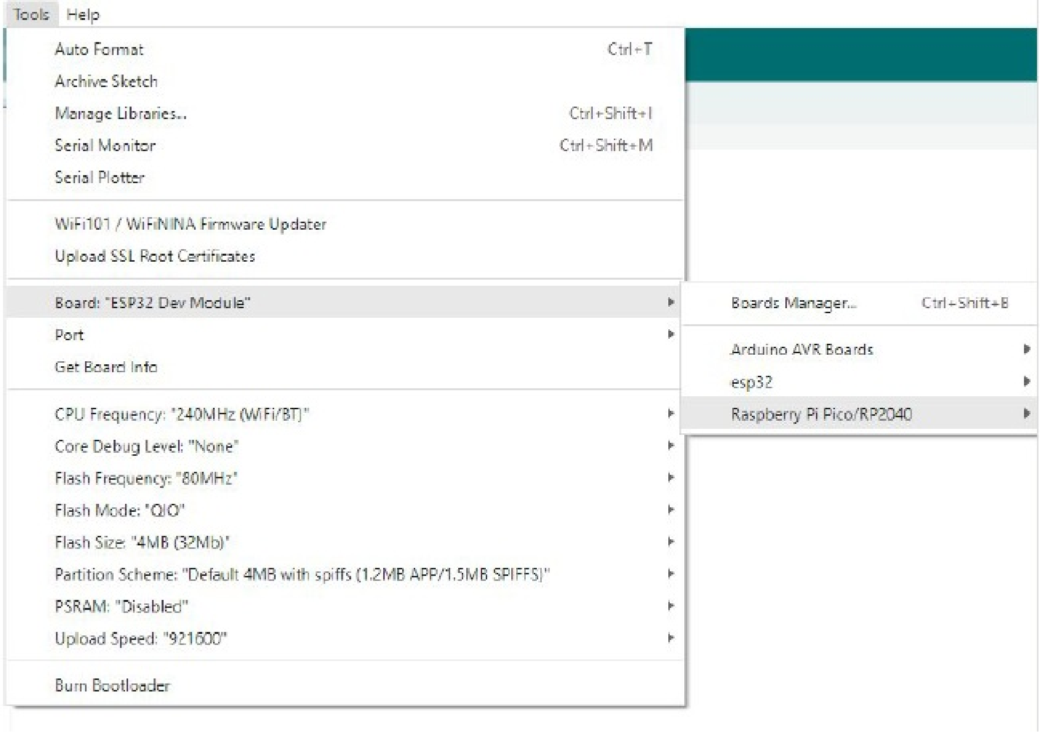


4. Connect the driver board to the computer with a USB cable, then click Tools – > Ports, select uf2 Board for the first connection, and after the upload is complete, connecting again will result in an additional COM port.

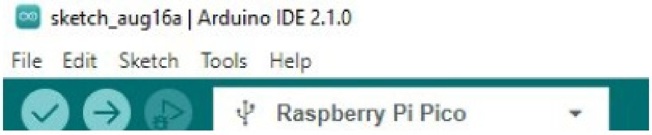


```
2047,"spd":500,"ac
// SET_SPD_RATE    : {"T":901,"L":1.0,"R":1.0}
```

5. Click Tool -> Dev Board -> Raspberry Pi Pico/RP2040 -> Raspberry Pi Pico.


Tools
Help
Auto Format Ctrl+T
Archive Sketch
Manage Libraries.. Ctrl+Shift+I
Serial Monitor Ctrl+Shift+M
Serial Plotter
WiFi101 / WiFiNINA Firmware Updater
Upload SSL Root Certificates
Board: "ESP32 Dev Module"
Port
Get Board Info
CPU Frequency: "240MHz (WiFi/BT)"
Core Debug Level: "None"
Flash Frequency: "80MHz"
Flash Mode: "QIO"
Flash Size: "4MB (32Mb)"
Partition Scheme: "Default 4MB with spiffs (1.2MB APP/1.5MB SPIFFS)"
PSRAM: "Disabled"
Upload Speed: "921600"
Burn Bootloader
Boards Manager... Ctrl+Shift+B
Arduino AVR Boards
esp32
Raspberry Pi Pico/RP2040

6. After setting, click the right arrow to upload.


sketch_aug16a | Arduino IDE 2.1.0
File Edit Sketch Tools Help
Raspberry Pi Pico

- If you encounter problems during the period, you need to reinstall or replace the Arduino IDE version, uninstall the Arduino IDE needs to be uninstalled cleanly, after uninstalling the software you need to manually delete all the contents of the folder C:\Users\ [name]\AppData\Local\Arduino15 (you need to show the hidden files in order to see it) and then reinstall.

Open Source Demo

- MicroPython Demo (GitHub)
- MicroPython Firmware/Blink Demo (C)
- Official Raspberry Pi C/C++ Demo
- Official Raspberry Pi MicroPython Demo
- Arduino Official C/C++ Demo

Support

Technical Support
Submit Now

- If you need technical support or have any feedback/review, please click the Submit Now button to submit a ticket, Our support team will check and reply to you within 1 to 2 working days.
- Please be patient as we make every effort to help you to resolve the issue.
- Working Time: 9 AM – 6 AM GMT+8 (Monday to Friday)

Documents / Resources

	Waveshare Pico-RTC-DS3231 Precision RTC Module [pdf] Instruction Manual Pico-RTC-DS3231 Precision RTC Module, Pico-RTC-DS3231, Precision RTC Module, RTC Module

References

- **GitHub - earlephilhower/arduino-pico: Raspberry Pi Pico Arduino core, for all RP2040 boards**
- **GitHub - raspberrypi/pico-examples**
- **GitHub - raspberrypi/pico-micropython-examples: Examples to accompany the "Raspberry Pi Pico Python SDK" book.**
- **GitHub - waveshareteam/Pico_MircoPython_Examples: Pico MircoPython**
- **Arduino - Home**
- **Precision RTC Module For Raspberry Pi Pico, Onboard DS3231 Chip | Pico-RTC-DS3231**
- **File:Pico Get Start.gif - Waveshare Wiki**
- **File:RoArm-M1 Tutorial II02.gif - Waveshare Wiki**
- **Log in Raspberry Pi terminal by SSH - Waveshare Wiki**
- **Waveshare Wiki**
- **Pico C/C++ Windows Tutorial 1 - Waveshare Wiki**

- Pico C/C++ Windows Tutorial 2 - Waveshare Wiki
- Raspberry Pi Pico - Waveshare Wiki