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! Unzip the ZIP file instead of opening the file in the ZIP file directly.

! Do not move, delete or rename files in the folder just unzipped.

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BLONWINER provides open source electronic products and services worldwide.

BLONWINER is committed to assist customers in their education of robotics, programming and electronic circuits so that they may transform their creative ideas into prototypes and new and innovative products. To this end, our services include but are not limited to:

- Educational and Entertaining Project Kits for Robots, Smart Cars and Drones
- Educational Kits to Learn Robotic Software Systems for Arduino, Raspberry Pi, and micro: bit
- Electronic Component Assortments, Electronic Modules and Specialized Tools
- **Product Development and Customization Services**

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Preface

Raspberry Pi Pico is a tiny, fast, and versatile board built using RP2040, a brand new microcontroller chip designed by Raspberry Pi in the UK. Supporting Python and C/C++ development, it is perfect for DIY projects. In this tutorial, we use Arduino to learn Pico. If you want to learn the Python version, please refer to another tutorial: [python_tutorial.pdf](#).

Using Arduino IDE as the development environment for Raspberry Pi Pico allows users to learn Pico better and more quickly, which is just like developing Arduino programs. In addition, resources such as Arduino's libraries can be directly used to greatly improve the efficiency of development.

If you haven't downloaded the related material for Raspberry Pi Pico tutorial, you can download it from this link:

https://github.com/BLONWINER/BLONWINER_Breakout_Board_for_Raspberry_Pi_Pico/archive/refs/heads/master.zip

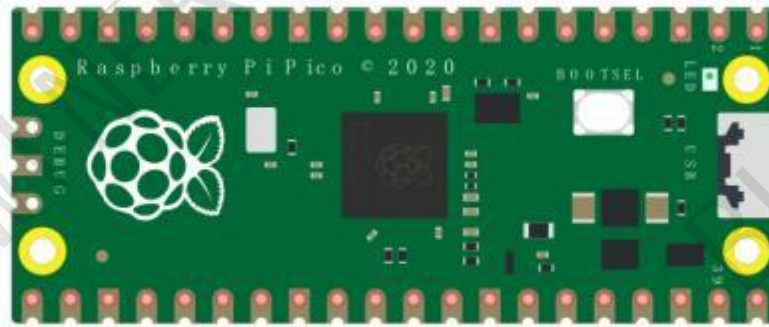
After completing the projects in this tutorial, you can also combine the components in different projects to make your own smart homes, smart car, robot, etc., bringing your imagination and creativity to life with Raspberry Pi Pico.

If you have any problems or difficulties using this product, please contact us for quick and free technical support: blonwiner@outlook.com

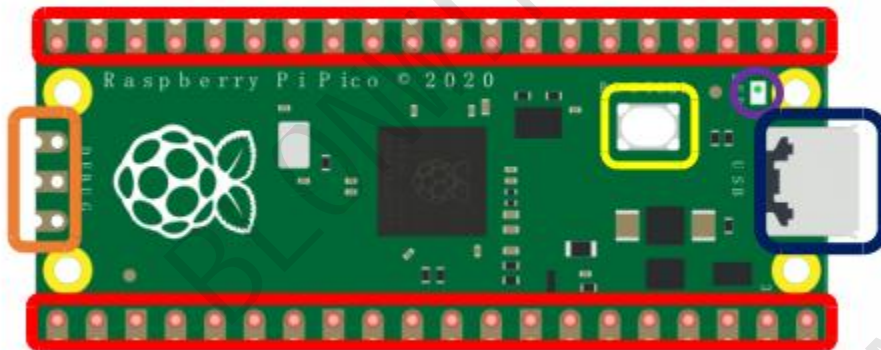
Raspberry Pi Pico






Raspberry Pi Pico applies to all chapters except Wireless in this tutorial.

Before learning Pico, we need to know about it. Below is an imitated diagram of Pico, which looks very similar to the actual Pico.

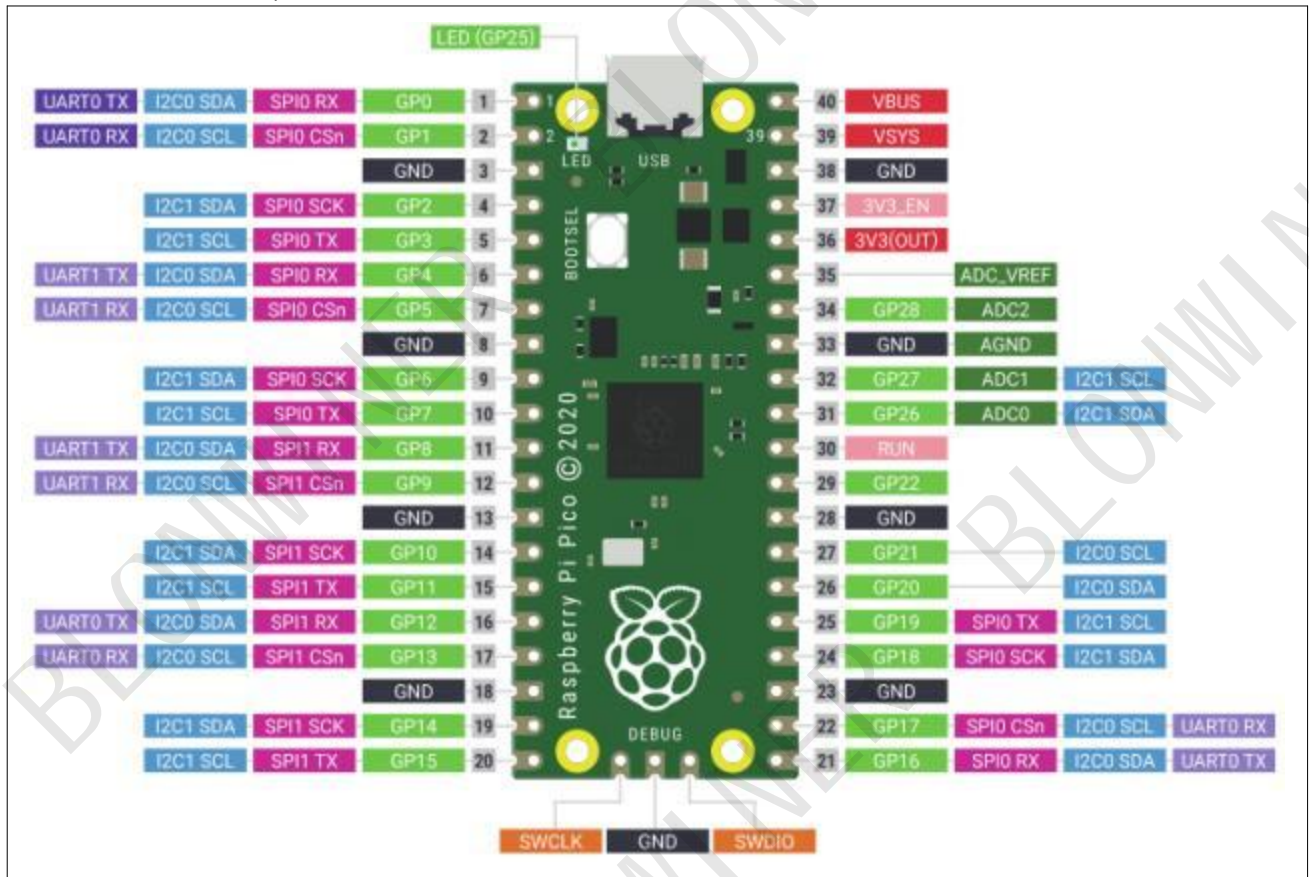












The hardware interfaces are distributed as follows:



Frame color	Description
	Pins
	BOOTSEL button
	USB port
	LED
	Debugging

Function definition of pins:



Color	Pins	Color	Pins
	GND		Power
	GPIO		ADC
	UART(default)		UART
	SPI		I2C
	System Control		Debugging

For details: <https://datasheets.raspberrypi.org/pico/pico-datasheet.pdf>

UART, I2C, SPI Default Pin

In Arduino IDE, the default pins of serial port are Pin0 and Pin1.

Note: Serial port is virtualized by RP2040. Therefore, when using the serial port, please enable the verification function of DTR. It can work under any baud rate.

UART

Function	Default
UART_BAUDRATE	X
UART_BITS	8
UART_STOP	1
UART_TX	Pin 0
UART_RX	Pin 1

I2C

Function	Default
I2C Frequency	400000
I2C_SDA	Pin 4
I2C_SCL	Pin 5

SPI

Function	Default
SPI_BAUDRATE	1000000
SPI_POLARITY	0
SPI_PHASE	0
SPI_BITS	8
SPI_FIRSTBIT	MSB
SPI_SCK	Pin 18
SPI_MOSI	Pin 19
SPI_MISO	Pin 16
SPI_SS	Pin 17

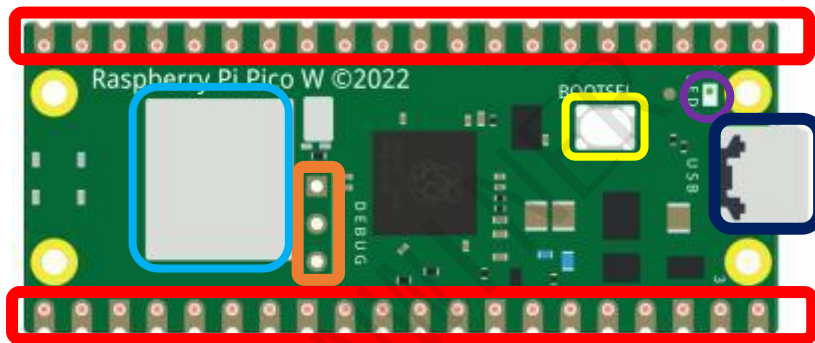
Raspberry Pi Pico W







Raspberry Pi Pico W applies to all chapters in this tutorial.

Raspberry Pi Pico W adds CYW43439 as the WiFi function on the basis of Raspberry Pi Pico. It is connected to RP2040 chip through SPI interface.

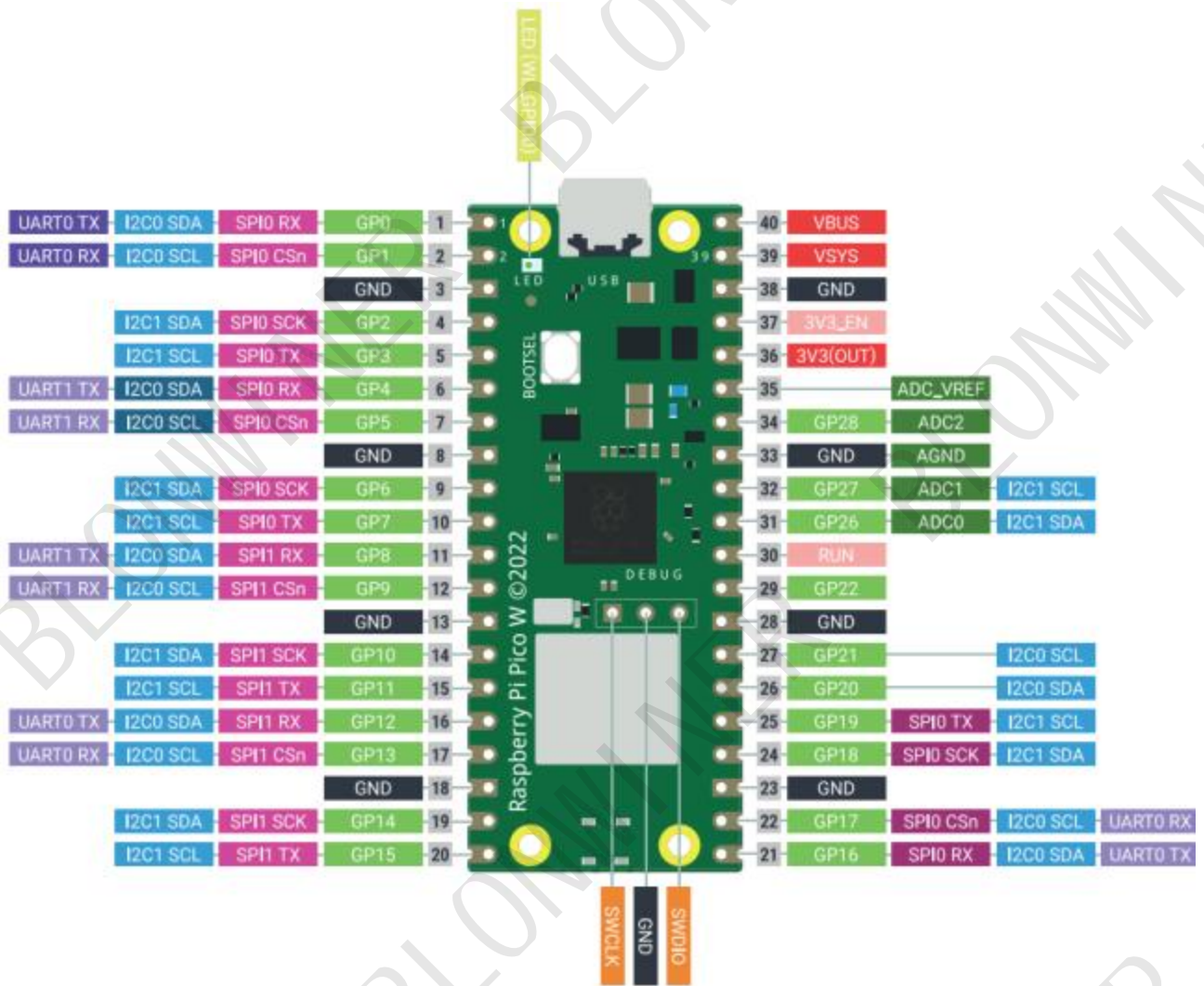










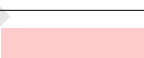

The hardware interfaces are distributed as follows:



Frame color	Description
	Pins
	BOOTSE button
	USB port
	LED
	Debugging
	Wireless

Function definition of pins:



Color	Pins	Color	Pins
	GND		Power
	GPIO		ADC
	UART(default)		UART
	SPI		I2C
	System Control		Debugging

For details: <https://datasheets.raspberrypi.com/picow/pico-w-datasheet.pdf>

UART, I2C, SPI, Wireless Default Pin

In Arduino IDE, the default pins of serial port are Pin0 and Pin1.

Note: Serial port is virtualized by RP2040. Therefore, when using the serial port, please enable the verification function of DTR. It can work under any baud rate.

UART

Function	Default
UART_BAUDRATE	X
UART_BITS	8
UART_STOP	1
UART_TX	Pin 0
UART_RX	Pin 1

I2C

Function	Default
I2C Frequency	400000
I2C_SDA	Pin 4
I2C_SCL	Pin 5

SPI

Function	Default
SPI_BAUDRATE	1000000
SPI_POLARITY	0
SPI_PHASE	0
SPI_BITS	8
SPI_FIRSTBIT	MSB
SPI_SCK	Pin 18
SPI_MOSI	Pin 19
SPI_MISO	Pin 16
SPI_SS	Pin 17

Wireless

Function	Default
WL_ON	GPIO23
WL_D	GPIO24
WL_CLK	GPIO29_ADC
WL_CS	GPIO25

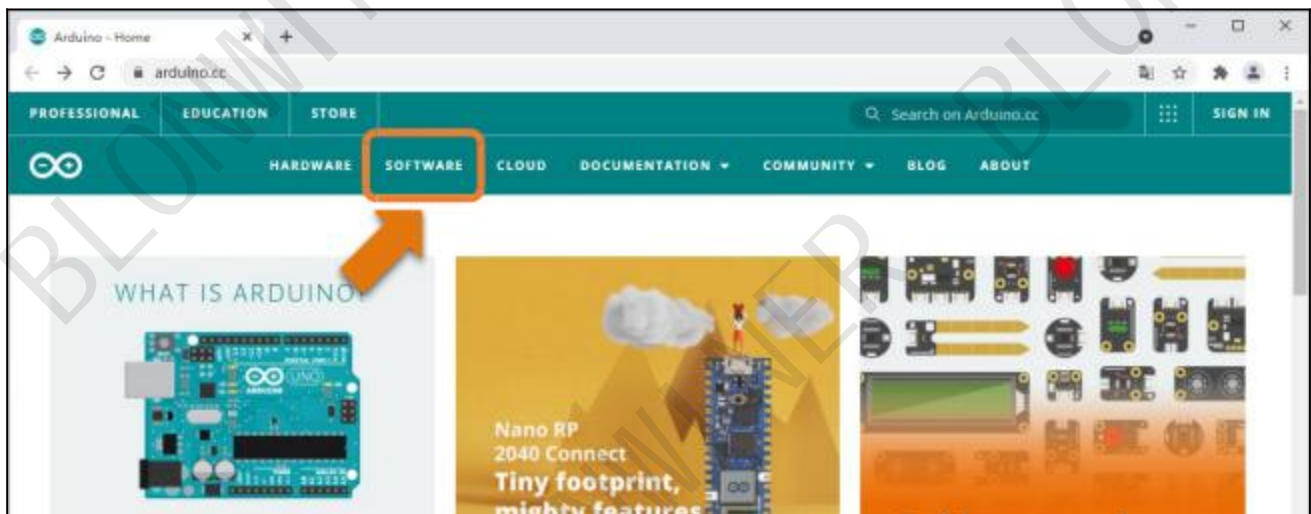
Chapter 0 Getting Ready (Important)

Before starting building the projects, you need to make some preparation first, which is so crucial that you must not skip.

Programming Software

Arduino Software (IDE) is used to write and upload the code for Arduino Board.

First, install Arduino Software (IDE): visit <https://www.arduino.cc>, click "Download" to enter the download page.



Select and download corresponding installer according to your operating system. If you are a windows user, please select the "Windows Installer" to download to install the driver correctly.

Legacy IDE (1.8.X)

A screenshot of the Arduino IDE 1.8.19 download page. The page features the Arduino logo and the title 'Arduino IDE 1.8.19'. Below the title, there is a description of the IDE and a link to the 'Getting Started' page for installation instructions. On the right side, there is a 'DOWNLOAD OPTIONS' section with a red arrow pointing to the 'Windows' option. The options include 'Windows' (Win 7 and newer), 'Windows ZIP file', 'Windows app' (Win 8.1 or 10), 'Linux' (32 bits, 64 bits, ARM 32 bits, ARM 64 bits), and 'Mac OS X' (10.10 or newer). There are also links for 'Release Notes' and 'Checksums (sha512)'.

Arduino IDE 1.8.19

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board.

Refer to the [Getting Started](#) page for Installation instructions.

SOURCE CODE

Active development of the Arduino software is [hosted by GitHub](#). See the instructions for [building the code](#). Latest release source code archives are available [here](#). The archives are PGP-signed so they can be verified using [this](#) gpg key.

DOWNLOAD OPTIONS

- Windows** Win 7 and newer
- Windows** ZIP file
- Windows app** Win 8.1 or 10 [Get](#)
- Linux** 32 bits
- Linux** 64 bits
- Linux** ARM 32 bits
- Linux** ARM 64 bits
- Mac OS X** 10.10 or newer

[Release Notes](#)

[Checksums \(sha512\)](#)

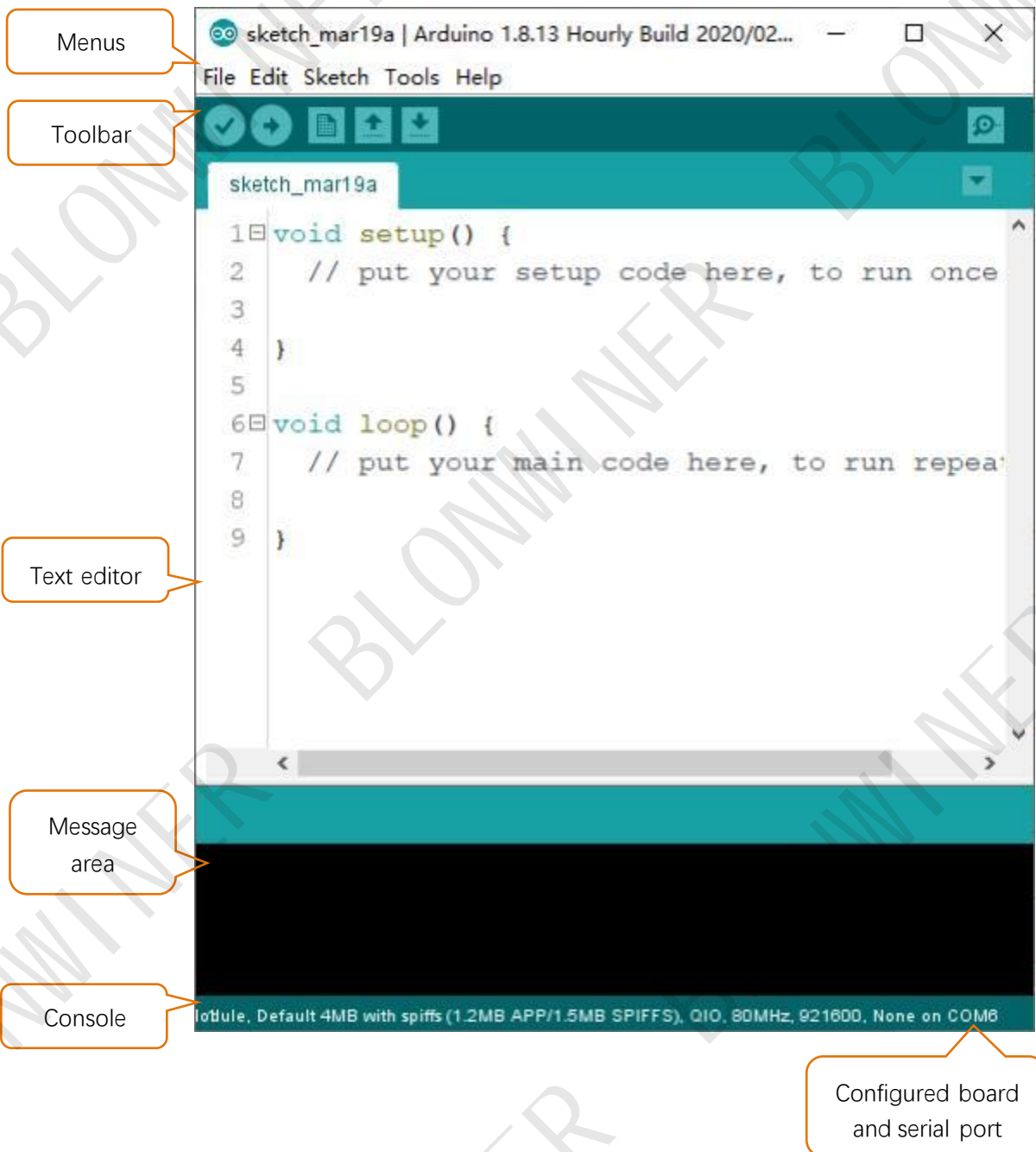
After the download completes, run the installer. For Windows users, there may pop up an installation dialog

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box of driver during the installation process. When it pops up, please allow the installation. After installation is complete, an Arduino Software shortcut will be generated in the desktop. Run the Arduino Software.



The interface of Arduino Software is as follows:



Programs written with Arduino Software (IDE) are called **sketches**. These sketches are written in the text editor and saved with the file extension **.ino**. The editor has features for cutting/pasting and searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right-hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.



Verify

Check your code for compile errors .



Upload

Compile your code and upload them to the configured board.



New

Create a new sketch.



Open

Present a menu of all the sketches in your sketchbook. Clicking one will open it within the current window and overwrite its content.



Save

Save your sketch.



Serial Monitor

Open the serial monitor.

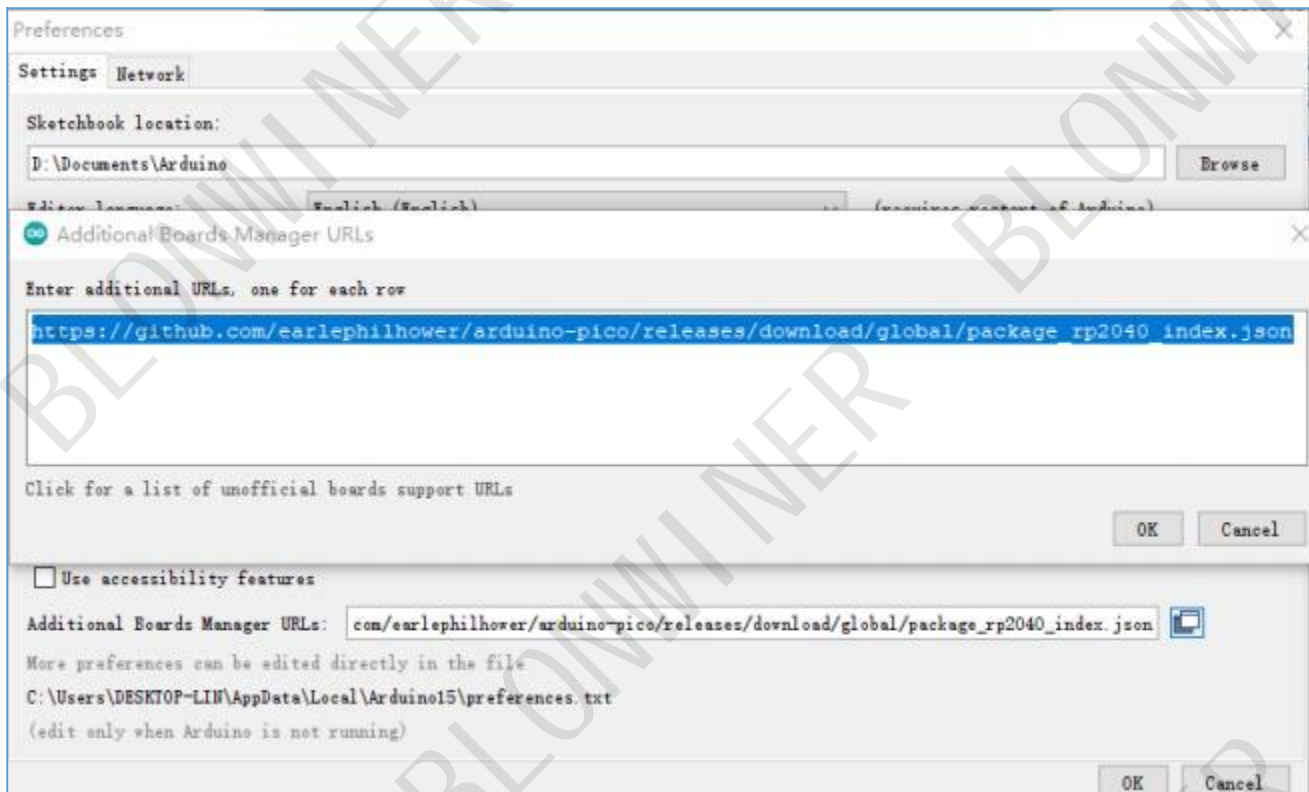
Additional commands are found within the five menus: File, Edit, Sketch, Tools, Help. The menus are context sensitive, which means only those items relevant to the work currently being carried out are available.

Installation of Development Board Support Package

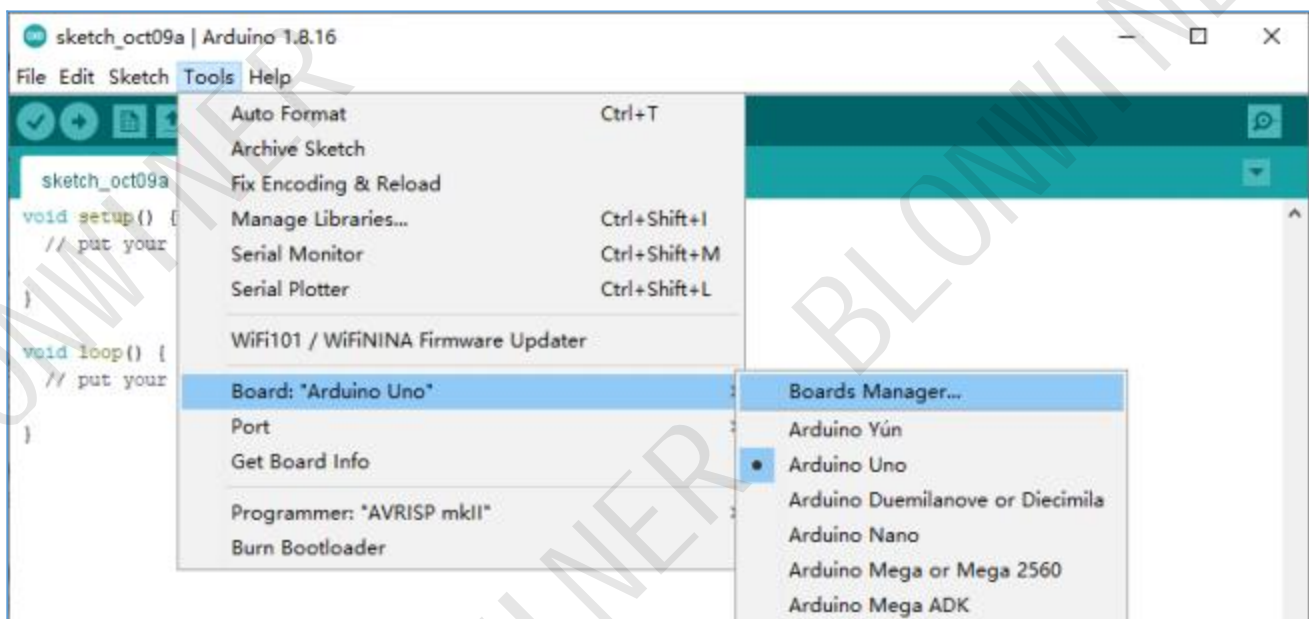
- 1, Make sure your network is of good connection.
- 2, Open Arduino IDE, and click File>Preference. In new pop-up window, find "Additional Boards Manager URLs", and replace with a new line:

https://github.com/earlephilhower/arduino-pico/releases/download/global/package_rp2040_index.json

As shown below:

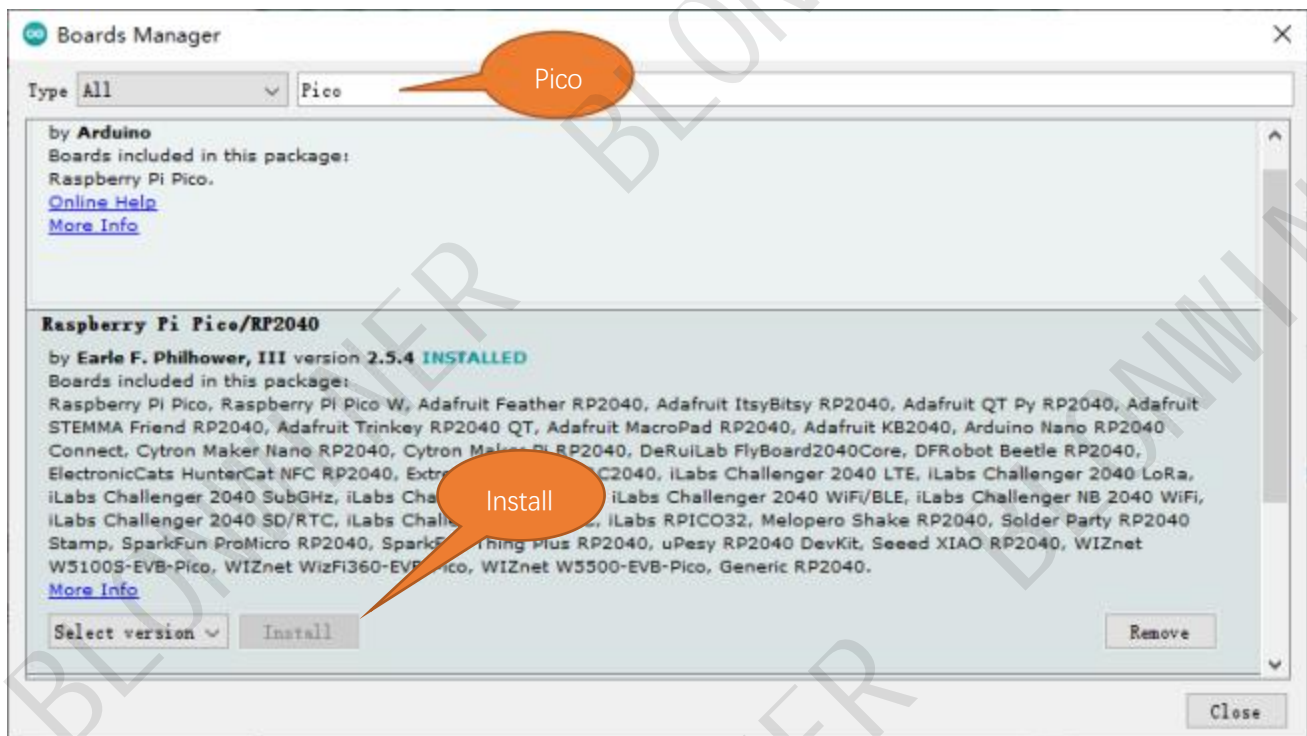


- 3, Open Arduino IDE. Click Tools>**Board**>**Boards Manager...** on the menu bar.



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4, Enter Pico in the searching box, and select "Raspberry Pi Pico/RP2040" and click on Install.

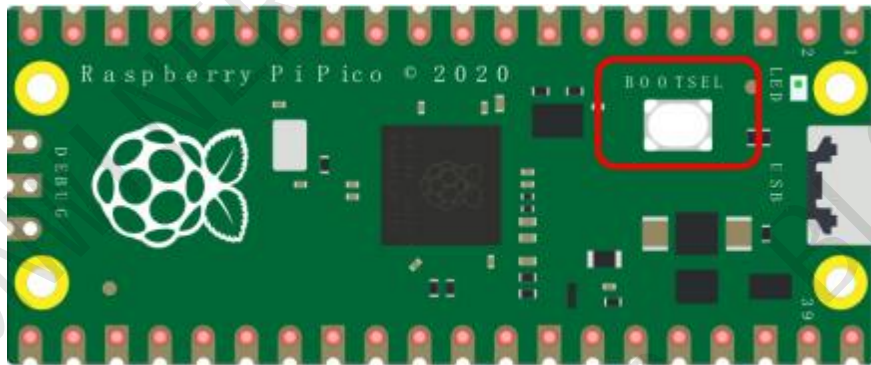


5, Click Yes in the pop-up "**dpinst-amd64.exe**" installation window. (Without it, you will fail to communicate with Arduino.) Thus far, we have finished installing the development support package.

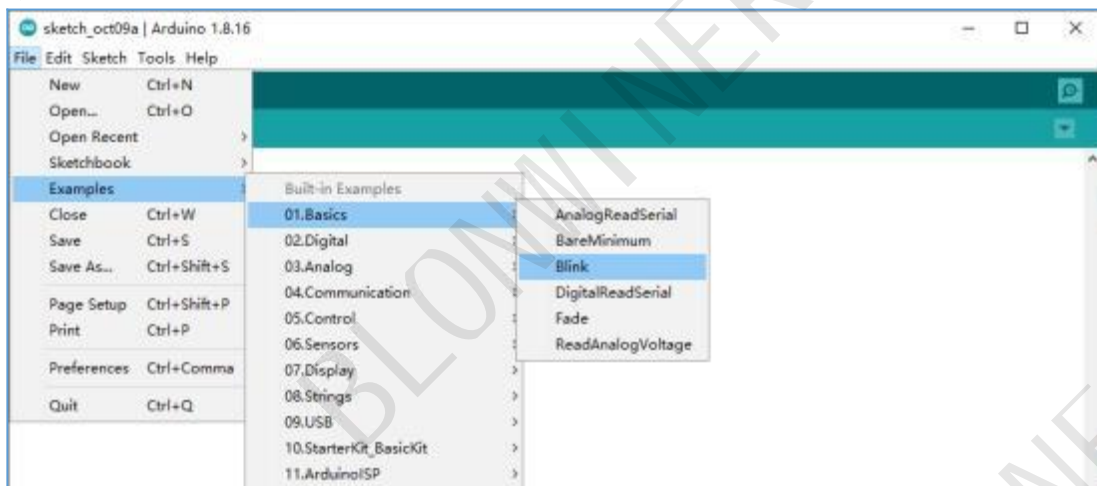
Uploading Aduino-compatible Firmware for Pico

If your Pico is new and you want to use Arduino to learn and develop, you need to upload an Aduino-compatible Firmware for it. Please refer to the following steps to cinfofigure.

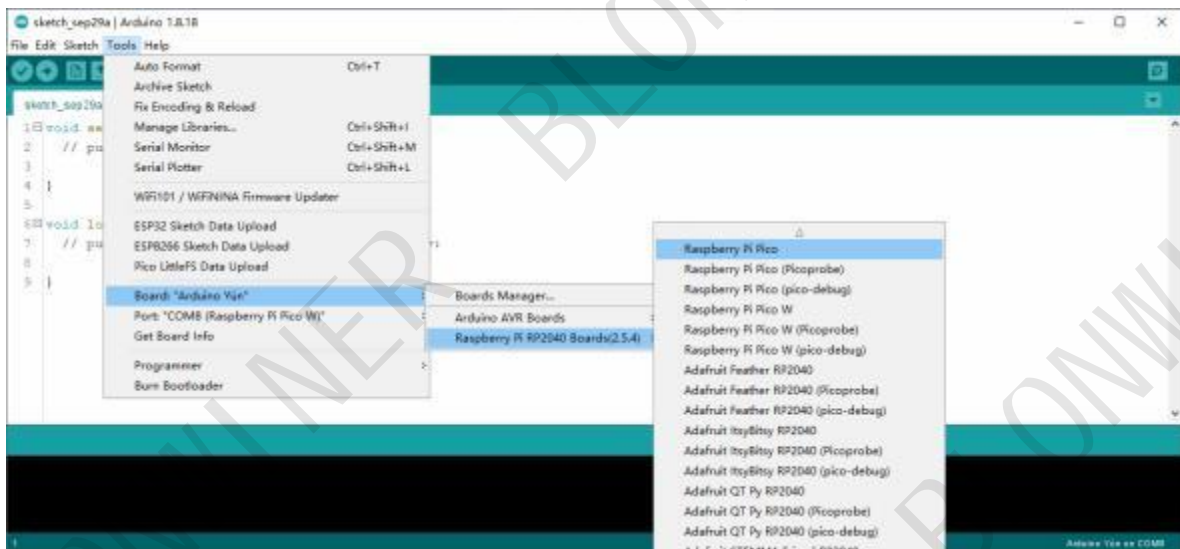
1, Disconnect Pico from computer. Keep pressing the white button (BOOTSEL) on Pico, and connect Pico to computer before releasing the button. (Note: Be sure to keep pressing the button before powering the Pico, otherwise the firmware will not download successfully)



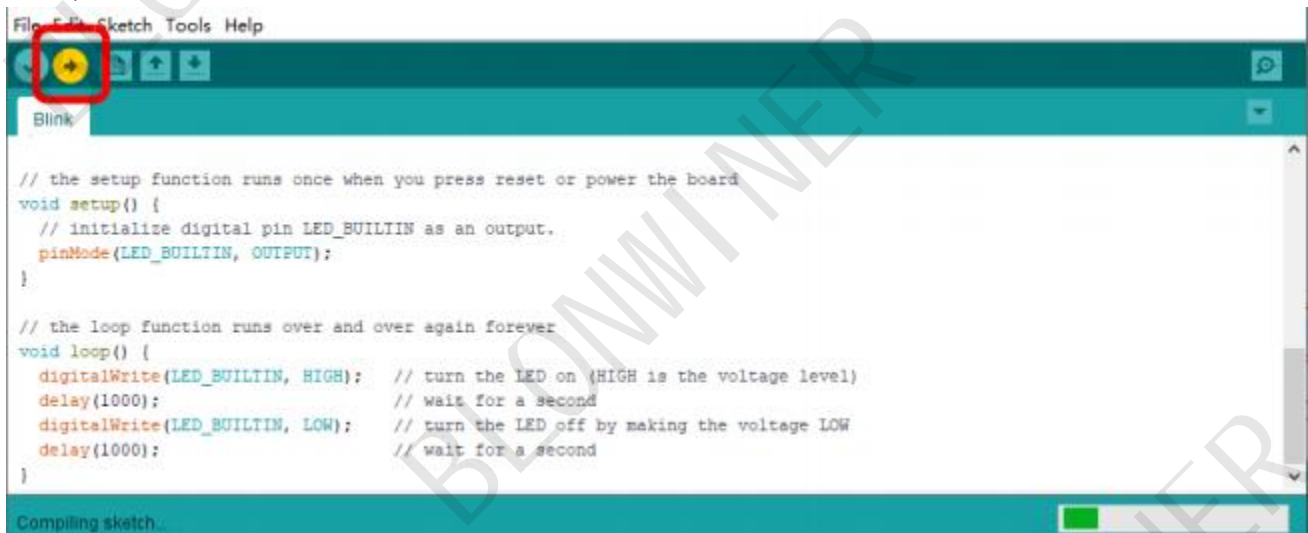
2, Open Arduino IDE. Click File>Examples>01.Basics>Blink.



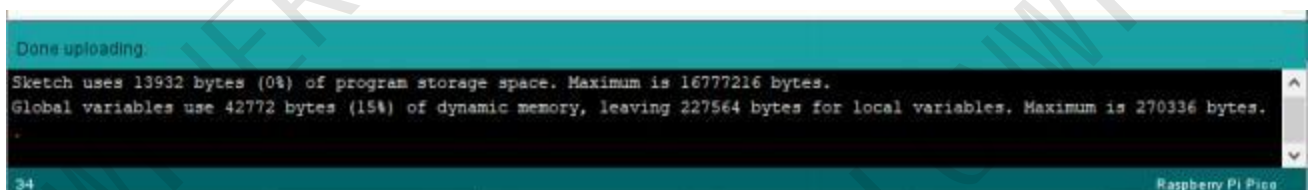
3, Click **Tools>Board>Raspberry Pi RP2040 Boards>Raspberry Pi Pico**.



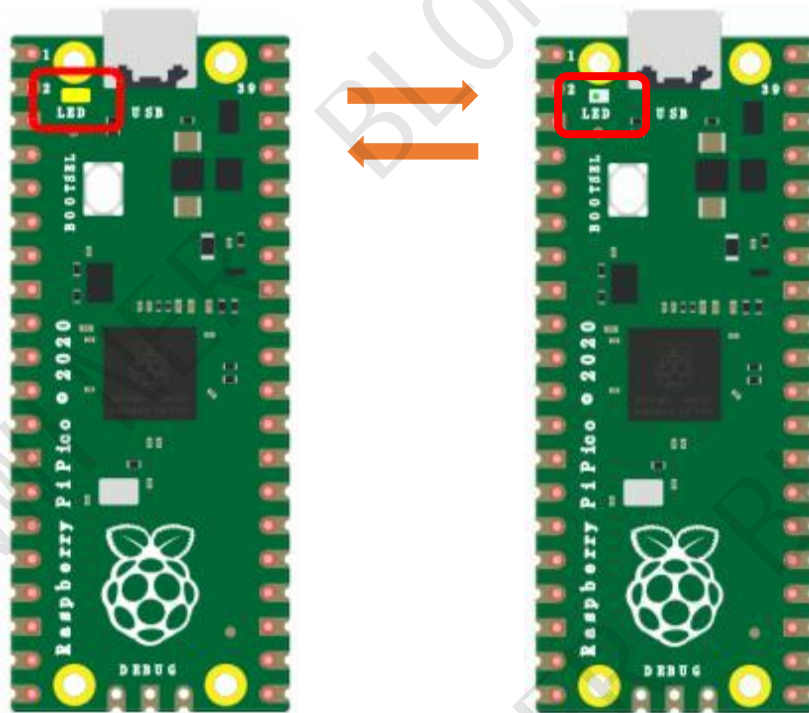
4, Upload sketch to Pico.



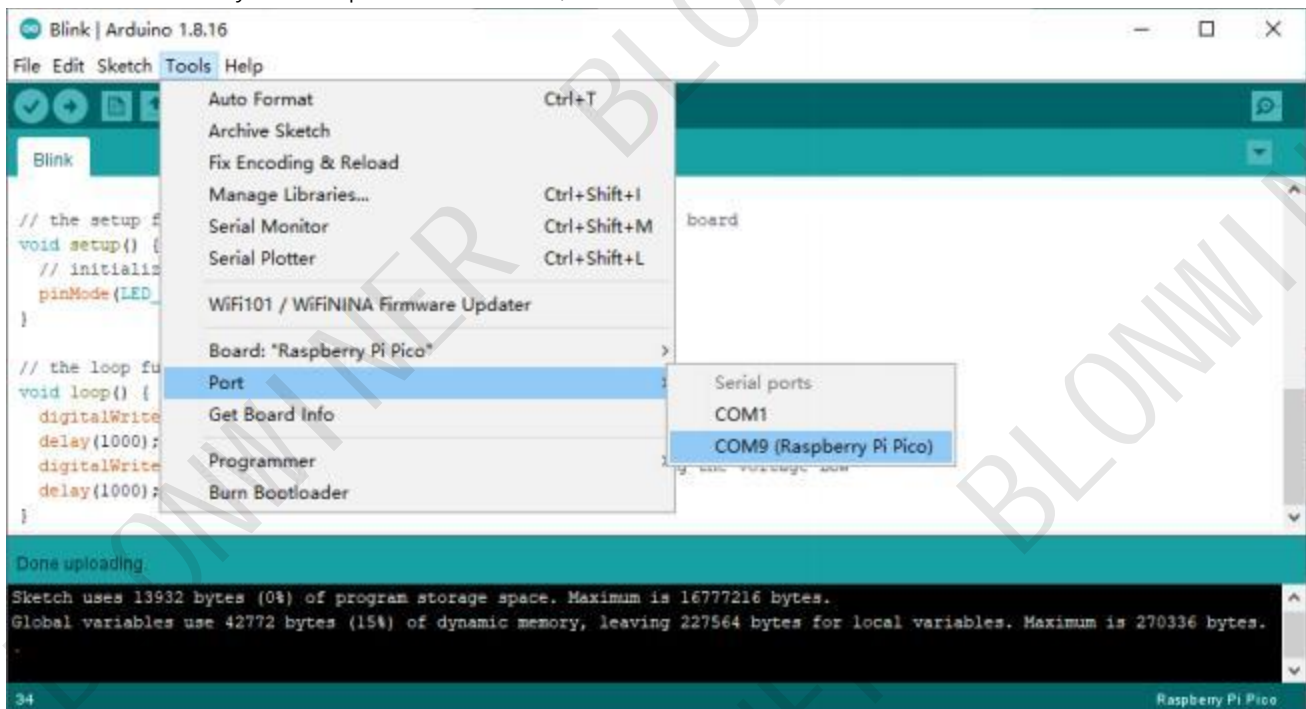
When the sketch finishes uploading, you can see the following prompt.



And the indicator on Pico starts to flash.



5, Click **Tools>Port>COMx(Raspberry Pi Pico)**. X of COMx varies from different computers. Please select the correct one on your computer. In our case, it is COM9.



Note:

1. At the first time you use Arduino to upload sketch for Pico, you don't need to select port. After that, each time before uploading sketch, please check whether the port has been selected; otherwise, the downloading may fail.
2. Sometimes when using, Pico may lose firmware due to the code and fail to work. At this point, you can upload firmware for Pico as mentioned above.

Chapter 1 LED (Important)

Note: Raspberry Pi Pico and Raspberry Pi Pico W only differ by wireless function, and are almost identical in other aspects. In this tutorial, except for the wireless function, other parts use Raspberry Pi Pico's map for tutorial demonstration.

This chapter is the Start Point in the journey to build and explore Pico electronic projects. We will start with simple "Blink" project.

Project 1.1 Blink

In this project, we will use Raspberry Pi Pico to control blinking a common LED.

If you haven't installed Arduino IDE, you can click [Here](#).

If you haven't uploaded firmware for Pico, you can click [Here](#) to upload.

Component List

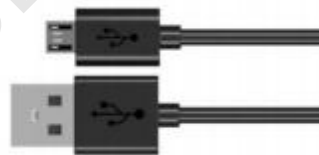
Raspberry Pi Pico (or Pico W) x1



or



USB cable x1



Power

Raspberry Pi Pico requires 5V power supply. You can either connect external 5V power supply to Vsys pin of Pico or connect a USB cable to the onboard USB base to power Pico.

In this tutorial, we use USB cable to power Pico and upload sketches.



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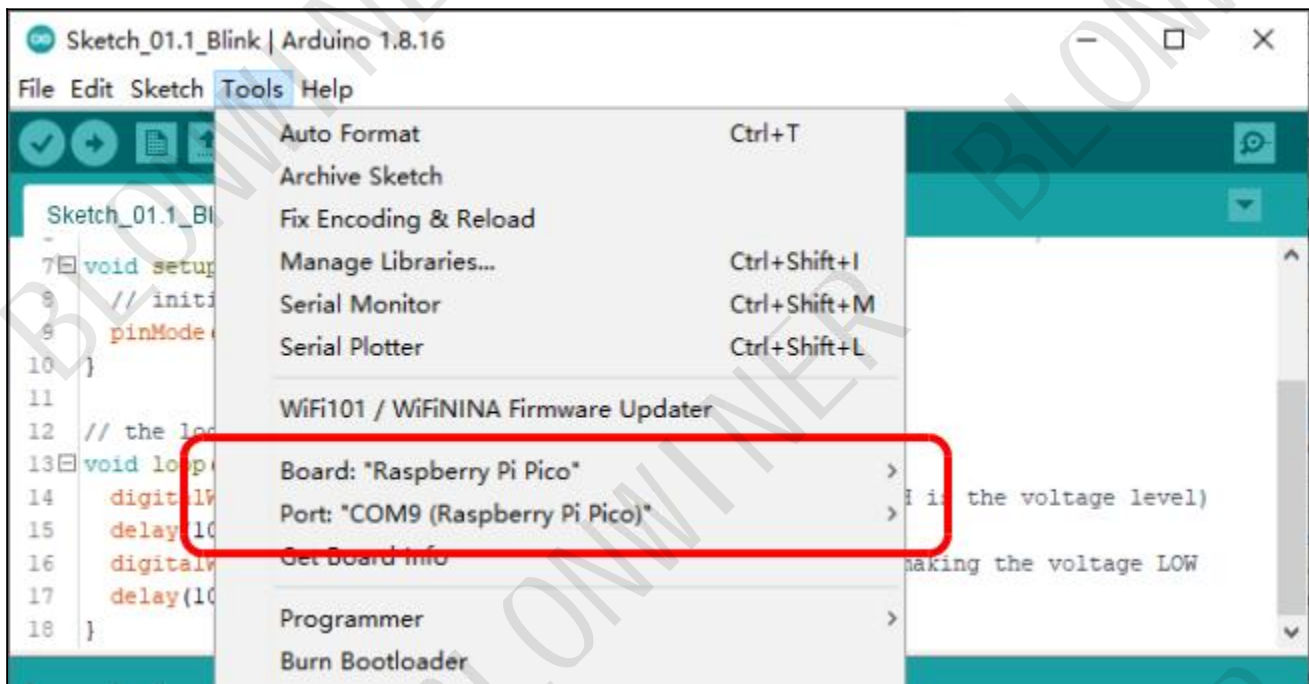
Sketch

The onboard LED of Raspberry Pi Pico is controlled by GP25. When GP25 outputs high level, LED lights up; When it outputs low, LED lights off. You can open the provided code:

C:\Sketches\Sketch_01.1_Blink.

Before uploading code to Pico, please check the configuration of Arduino IDE.

Click Tools, make sure Board and Port are as follows:

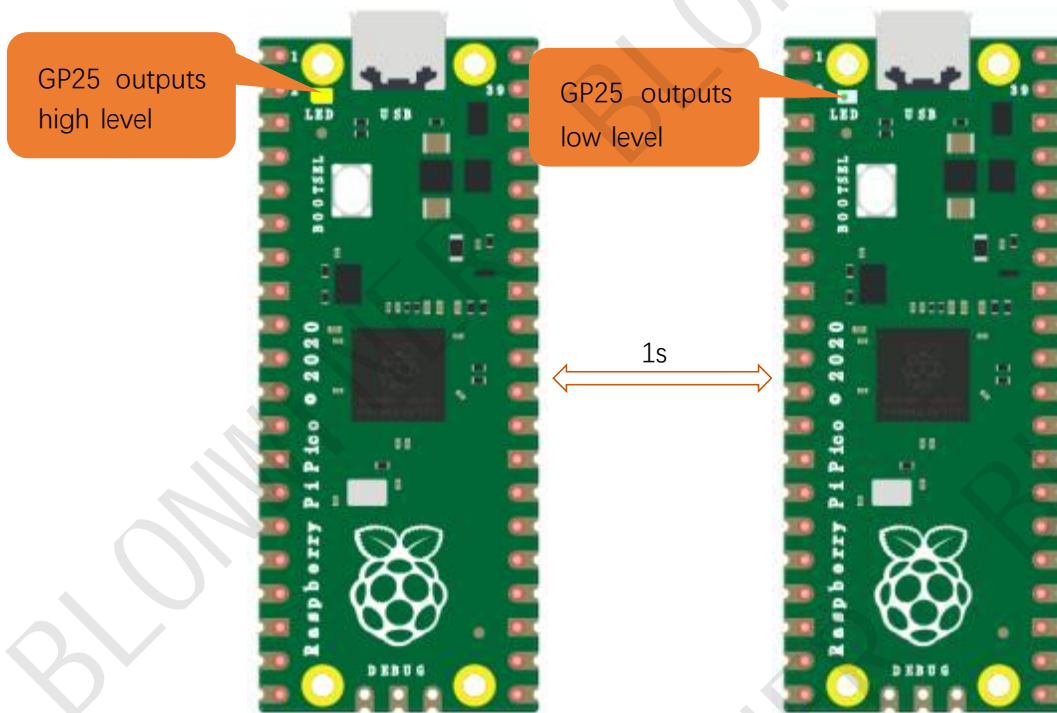


Click "Upload" to upload the sketch to Pico.



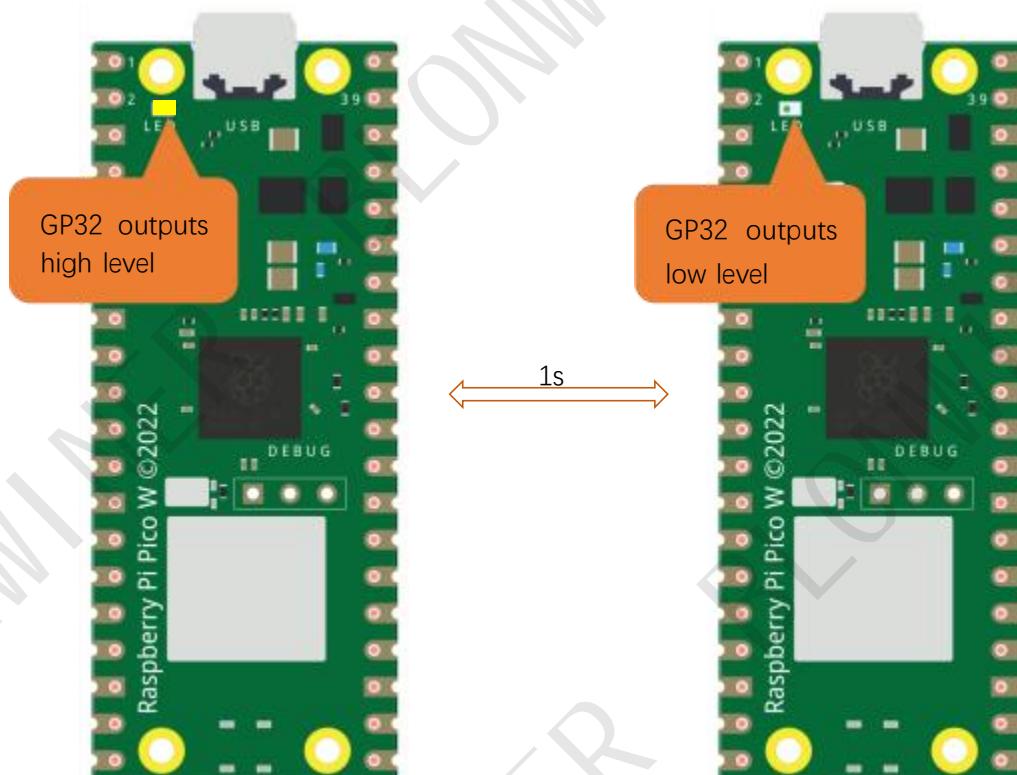
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Pico's on-board LED lights on and off every 1s, flashing cyclically.



Note: Pico's on-board LED is driven by GPIO25. Pico W's on-board LED uses WL_GPIO0, which is defined as GPIO32 on Arduino.

If you use Pico W, please change "# define LED_BUILTIN 25" to "# define LED_BUILTIN 32" in the code



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The following is the program code:

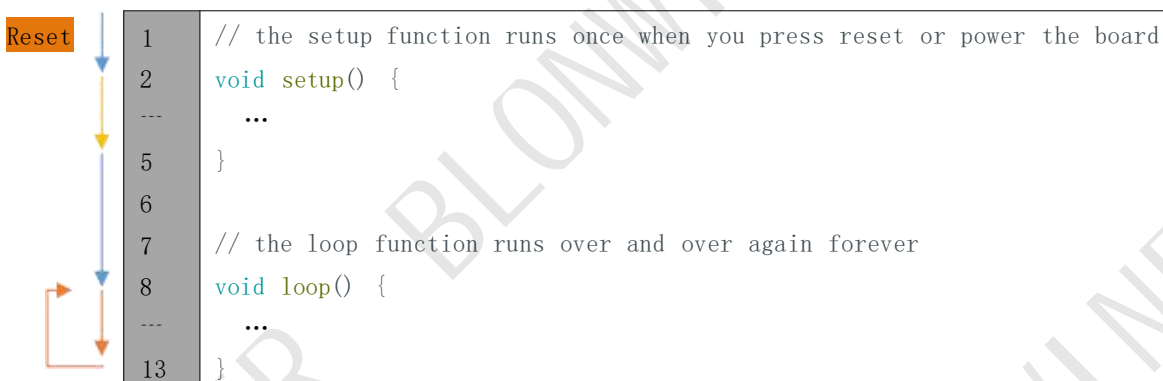
```

1  #define LED_BUILTIN 25
2
3  // the setup function runs once when you press reset or power the board
4  void setup() {
5      // initialize digital pin LED_BUILTIN as an output.
6      pinMode(LED_BUILTIN, OUTPUT);
7  }
8
9  // the loop function runs over and over again forever
10 void loop() {
11     digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is the voltage level)
12     delay(1000);                     // wait for a second
13     digitalWrite(LED_BUILTIN, LOW);  // turn the LED off by making the voltage LOW
14     delay(1000);                     // wait for a second
15 }
```

The Arduino IDE code usually contains two basic functions: void setup() and void loop().

After the board is reset, the setup() function will be executed firstly, and then the loop() function.

setup() function is generally used to write code to initialize the hardware. And loop() function is used to write code to achieve certain functions. loop() function is executed repeatedly. When the execution reaches the end of loop(), it will back to the beginning of loop() to run again.



In the circuit, GP25 of Pico is connected to the LED, so the LED pin is defined as 25.

```
1  #define LED_BUILTIN 25
```

This means that after this line of code, all LED_BUILTIN will be regarded as 25.

In the setup() function, first, we set the LED_BUILTIN as output mode, which can make the port output high or low level.

```
4  // initialize digital pin LED_BUILTIN as an output.
5  pinMode(LED_BUILTIN, OUTPUT);
```

Then, in the loop() function, set the LED_BUILTIN to output high level to make LED light up.

```
10 digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is the voltage level)
```

Wait for 1000ms, that is 1s. Delay() function is used to make control board wait for a moment before executing the next statement. The parameter indicates the number of milliseconds to wait for.

```
11 delay(1000); // wait for a second
```

Then set the LED_BUILTIN to output low level, and LED lights off. One second later, the execution of loop() function will be completed.

```
12    digitalWrite(LED_BUILTIN, LOW);    // turn the LED off by making the voltage LOW
13    delay(1000);                      // wait for a second
```

The loop() function is constantly being executed, so LED will keep blinking.

Reference

void pinMode(int pin, int mode) ;

Configures the specified pin to behave either as an input or an output.

Parameters

pin: the pin number to set the mode of LED.

mode: INPUT, OUTPUT, INPUT_PULLDOWN, or INPUT_PULLUP.

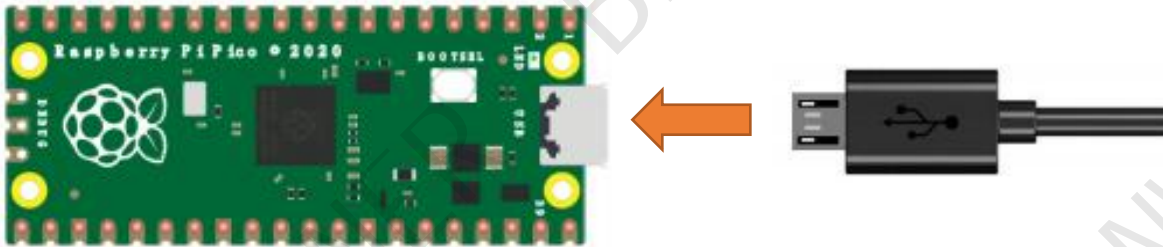
void digitalWrite (int pin, int value) ;

Writes the value HIGH or LOW (1 or 0) to the given pin which must have been previously set as an output.

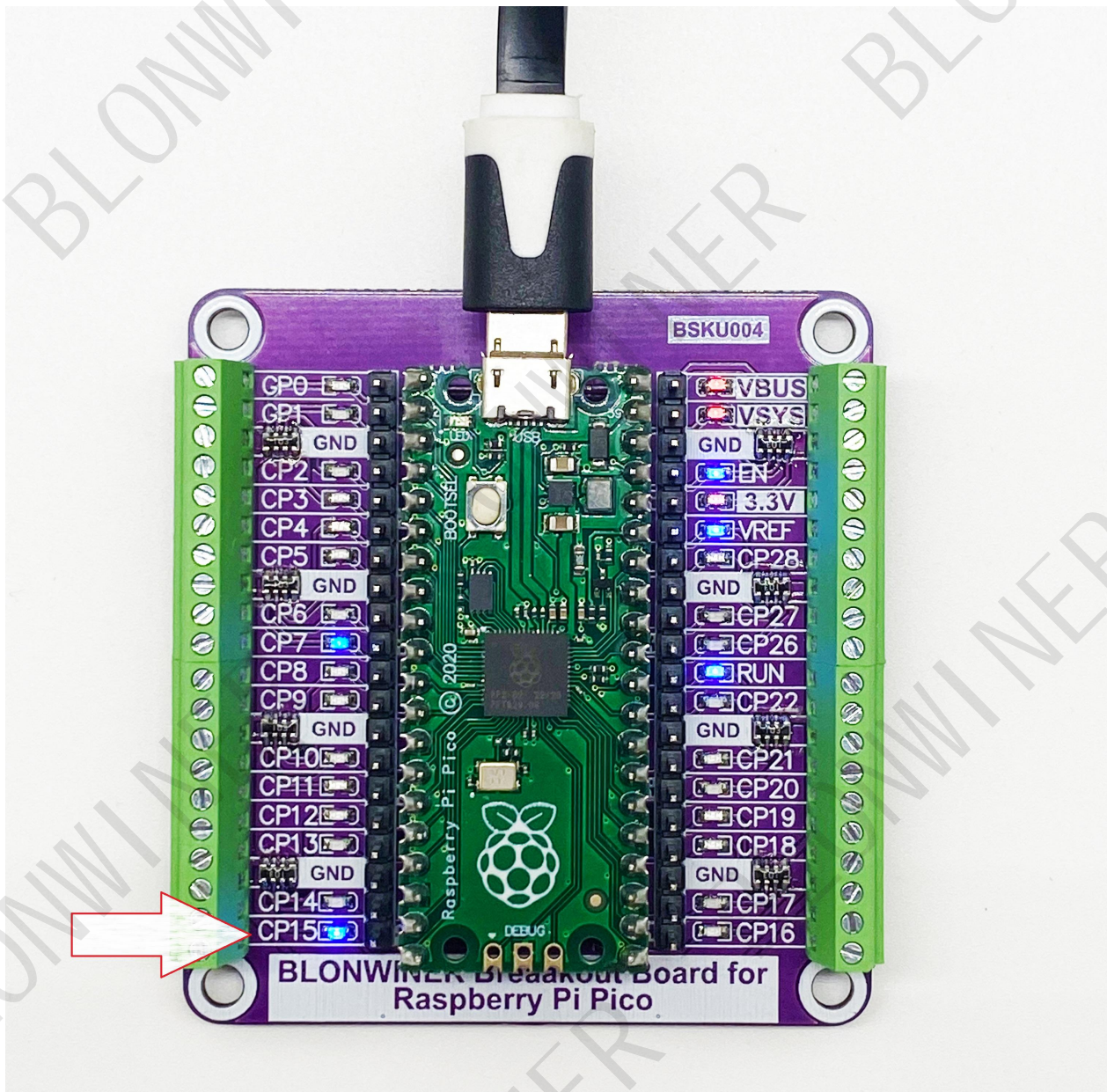
For more related functions, please refer to <https://www.arduino.cc/reference/en/>

Project 1.2 Blink

In this tutorial, we connect Raspberry Pi Pico and computer with a USB cable.



We will make GPIO15 blink.



Sketch

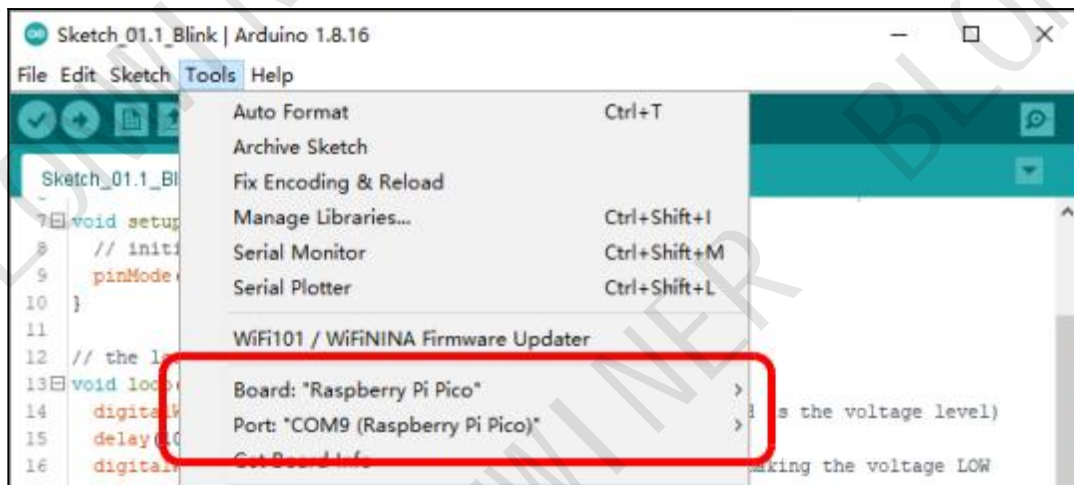
According to the circuit diagram, when GP15 of Pico outputs high level, LED lights up; when it outputs low, LED lights off. Therefore, we can make LED flash repeatedly by controlling GP15 to output high and low repeatedly.

You can open the provided code:

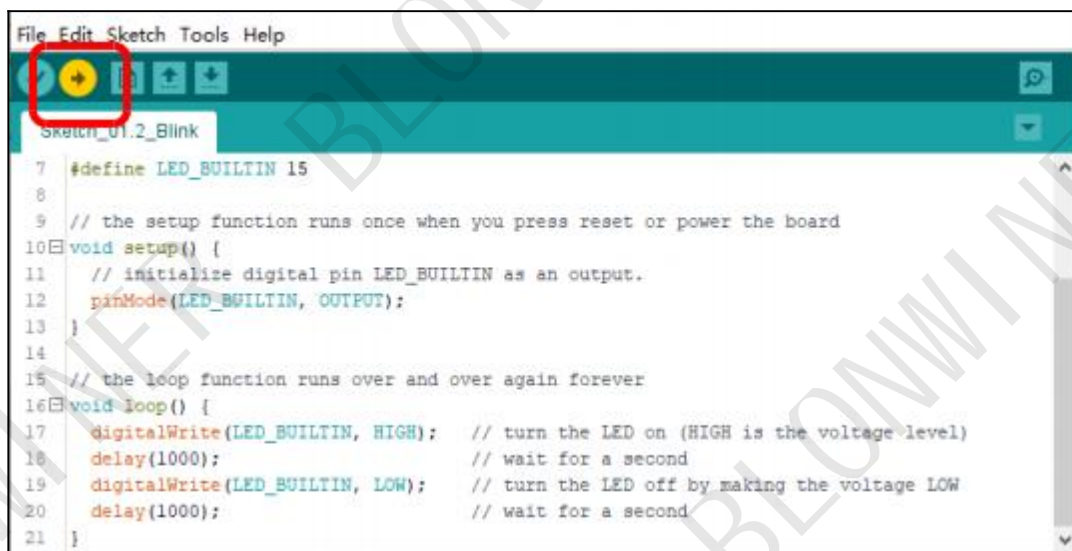
C:\Sketches\Sketch_01.2_Blink.

Before uploading code to Pico, please check the configuration of Arduino IDE.

Click Tools, make sure Board and Port are as follows:



Click "Upload" to upload the sketch to Pico.



Click "Upload". Download the code to Pico and then LED for pin15 in starts Blink.

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Any concerns? ✉ blonwiner@outlook.com

What's Next?

THANK YOU for participating in this learning experience!

We have reached the end of this Tutorial. If you find errors, omissions or you have suggestions and/or questions about the Tutorial or component contents of this Kit, please feel free to contact us:

blonwiner@outlook.com

We will make every effort to make changes and correct errors as soon as feasibly possible and publish a revised version.

If you want to learn more about Arduino, Raspberry Pi, Smart Cars, Robotics and other interesting products in science and technology, please continue to visit our website. We will continue to launch fun, cost-effective, innovative and exciting products.

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