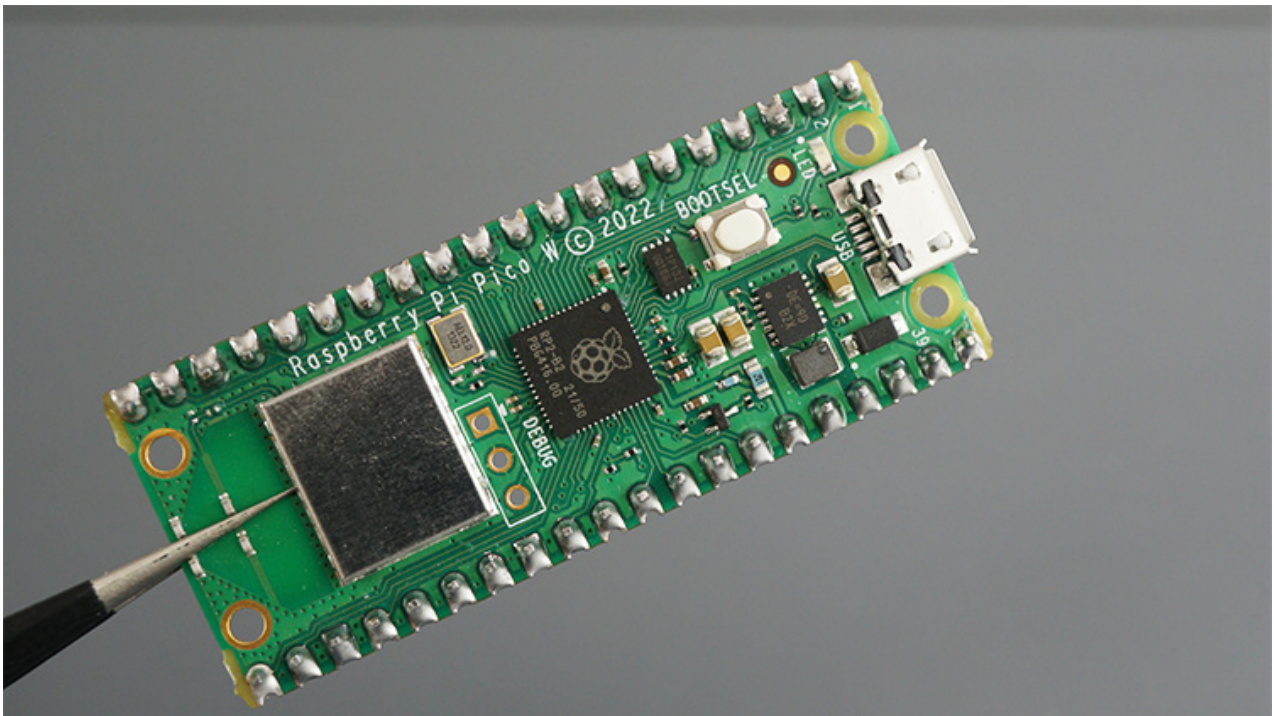


Raspberry Pi Pico and Pico W Pinout Guide: GPIOs Explained

This article goes into detail about the Raspberry Pi Pico and Pico W pinout. The Raspberry Pi Pico comes with 40 pins that can be used to connect electronic components like LEDs, motors, and sensors. Learn what each pin does, what it can be used for, and its specific functions.

Introducing the Raspberry Pi Pico GPIOs

The Raspberry Pi Pico and Raspberry Pi Pico W have a row of 20 pins on each side, which makes a total of 40 pins. Of those 40 pins, 26 are programmable GPIOs that you can use to connect peripherals like LEDs, motors, and sensors, or even establish a communication with other microcontroller boards.



The Raspberry Pi Pico GPIOs are labeled on the back. When you use the Raspberry Pi Pico on a breadboard, it might be difficult to identify each pin. So, it's handy to always have a pinout diagram.

The Raspberry Pi Pico comes with 40 pins, 26 of which are programmable GPIOs that you can use to connect peripherals.

The Raspberry Pi Pico supports the following peripheral interfaces on its GPIOs:

The Raspberry Pi Pico GPIOs run at 3.3V.

Raspberry Pi Pico Pinout Diagram

The following picture shows the Raspberry Pi Pico pinout (which functions are supported by each pin).

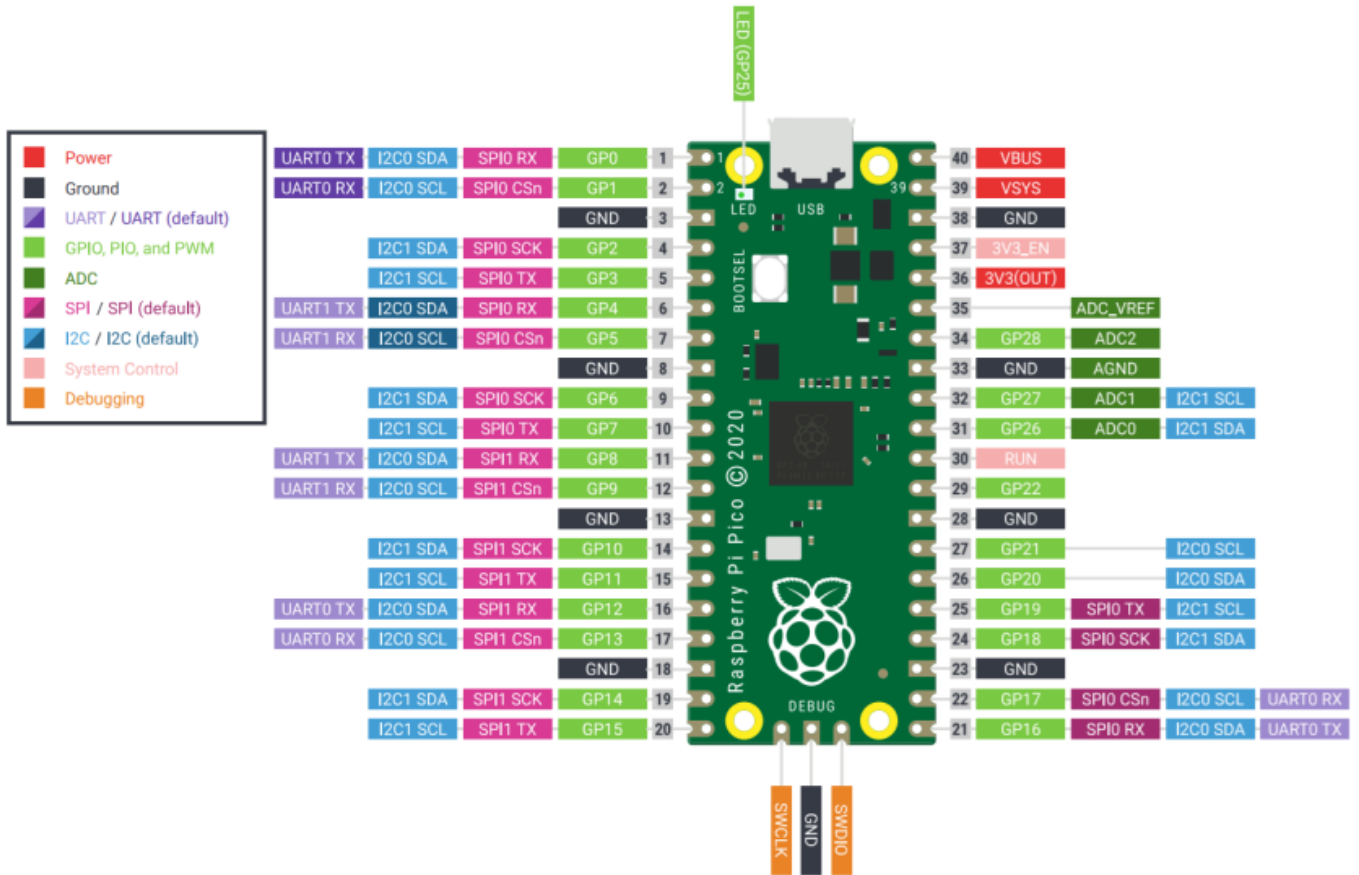


Image source: [raspberrypi.com](https://www.raspberrypi.com)

Raspberry Pi Pico W Pinout Diagram

The following picture shows the Raspberry Pi Pico W pinout (which functions are supported by each pin).

Figure 2. The pinout of the Pico W Rev3 board

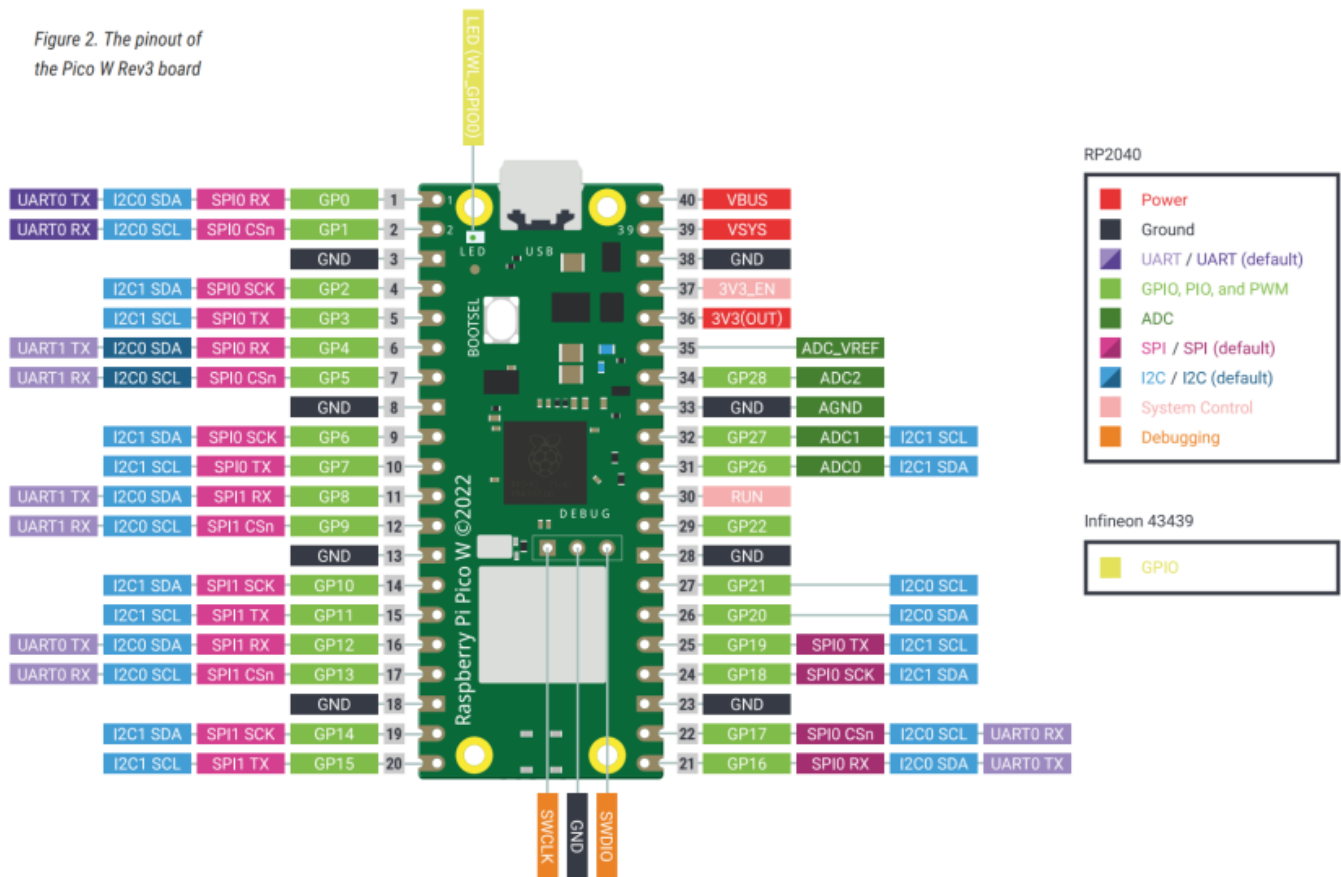


Image source: raspberrypi.com

Power Pins

The Raspberry Pi Pico has several power pins, 3V3 (OUT), VSYS, and VBUS marked as red on the pinout diagrams.

The 3V3(OUT) pin provides a 3.3V power output that can be useful to power external circuits.

The VBUS (USB Power Input) is the micro-USB input voltage. So, if you're powering the Raspberry Pi Pico via the USB port using 5V, you'll get 5V on the VBUS pin.

VSYS (External Power Input) is the main system input voltage. This means this pin allows for an external power supply to be connected to provide power to the board if you're not using the micro-USB input. VSYS minimum input is 1.8V and maximum is 5.5V.

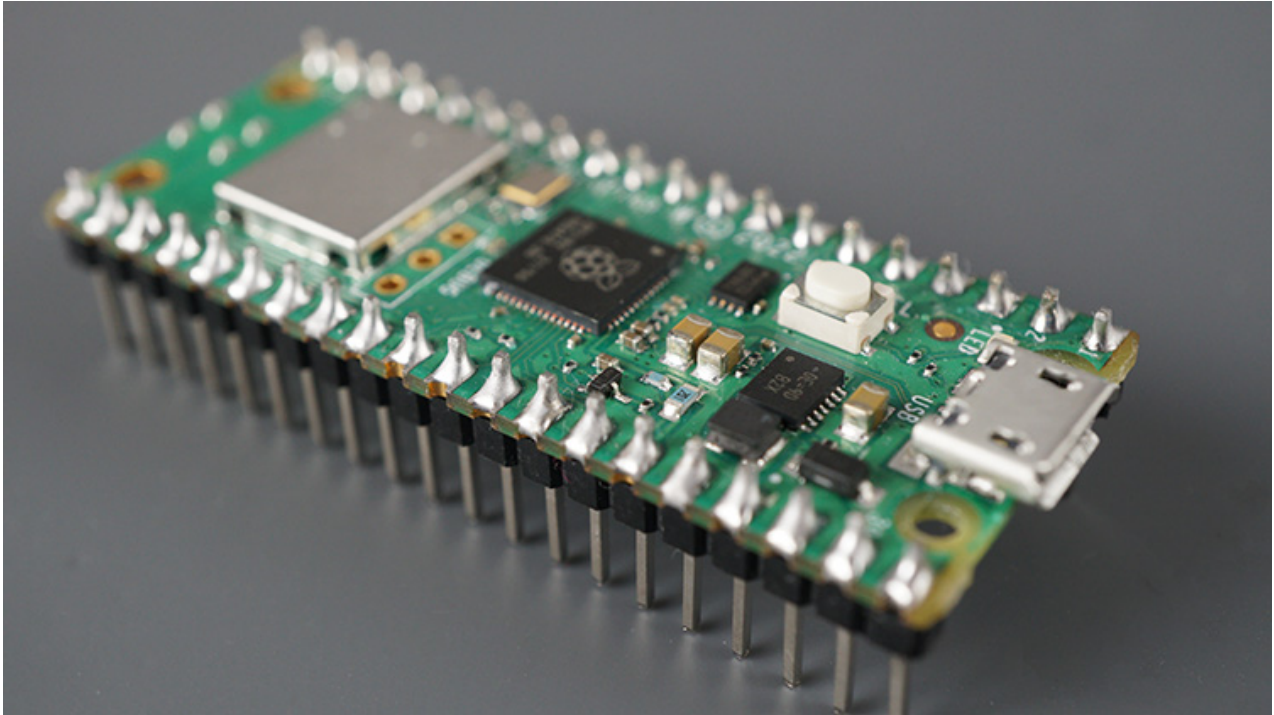
The GND pins are colored in black in the diagram.

There are other power pins for special cases:

- **3V3_EN:** connects to the board SMPS enable pin, which is the same as saying it is responsible for a hardware power on/off (hardware reset)—set to LOW to reset;
- **ADC_REF:** ADC pin power supply voltage;
- **AGND:** GND reference for the ADC pins;
- **RUN:** this is the enable pin; set to LOW to reset the microcontroller chip RP2040 (software reset).

General Purpose Input/Output Pins

The Raspberry Pi Pico comes with 40 pins, 26 of which are programmable GPIOs (general-purpose input/output pins) that you can use to connect peripherals.



These pins are colored in a light green color on the diagrams. They are numbered from GPIO0 to GPIO29. Four of these pins are not exposed on the pin header but are dedicated to internal board functions: **GPIO23**, **GPIO24**, **GPIO25**, and **GPIO29**. See the following section.

GPIOs Dedicated to Internal Board Functions

There are GPIOs that are not exposed on the pin header, but that you can use to control or monitor internal board functions:

- GPIO29 internal ADC (ADC3) for measuring VSYS ([check the analog pins section](#))
- GPIO25 Connected to the built-in onboard LED (on the Pico) ([check this section](#))
- GPIO24 Indicator for VBUS presence
- GPIO23 Controls on-board SMPS (Switched Power Mode Supply)

PWM Pins

All Raspberry Pi Pico GPIOs can output PWM signals—they are marked in the diagrams in light green color.

The Raspberry Pi Pico has **8 independent PWM generators** called slices. Each slice has two channels (A and B), which makes a total of 16 PWM channels.

GPIO	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PWM Channel	0A	0B	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B	6A	6B	7A	7B
GPIO	16	17	18	19	20	21	22	23	24	25	26	27	28	29		
PWM Channel	0A	0B	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B	6A	6B		

The same PWM output can be selected on two GPIO pins; the same signal will appear on each GPIO.

Analog Pins

The Raspberry Pi Pico has a 12-bit ADC with four channels on a fixed set of pins (plus an extra internal temperature sensor). This means it can transform an analog signal into a digital signal as a number ranging from 0 to 4095.

It has five ADC channels, but only four are accessible on the GPIOs: GPIO26, GPIO27, GPIO28, and GPIO29.

The first three GPIOs (26, 27, and 28) can be used to read voltage from peripherals, while GPIO29 can be utilized to measure the voltage level of the VSYS supply on the Raspberry Pi Pico board (VSYS is the input voltage that powers the board).

The fifth ADC channel is connected to a built-in temperature sensor.

ADC Channel	GPIO	Function
ADC0	GPIO26	Read analog signals from peripherals
ADC1	GPIO27	Read analog signals from peripherals
ADC2	GPIO28	Read analog signals from peripherals
ADC3	GPIO29	Measure voltage level of VSYS power supply
ADC4	———	Read built-in temperature sensor

ADC0	GPIO26	Read analog signals from peripherals
ADC1	GPIO27	Read analog signals from peripherals
ADC2	GPIO28	Read analog signals from peripherals
ADC3	GPIO29	Measure voltage level of VSYS power supply
ADC4	———	Read built-in temperature sensor

In summary, here are the key features of the analog pins of the Raspberry Pi Pico board:

- **12-bit resolution** – transforms an analog signal into a value between 0 and 4095;
- **4 ADC channels** on external GPIOs;
- **GPIOs 26, 27, and 28** can be used to read output voltage from peripherals;
- **GPIO29** can measure the **input voltage that powers the board (VSYS)**;
- There's a **fifth ADC channel** that is connected to an **internal temperature sensor**.

I2C

There are two I2C peripherals available, named **I2C1** and **I2C0**. You can use two different buses (I2C1 and I2C2) simultaneously, but you can't use two I2C1 or two I2C2 at the same time. You can use I2C communication on any of the I2C pins available.

The default I2C pins are **GPIO 4 (SDA)** and **GPIO 5 (SCL)**.

The following table shows all the pins you can use for I2C communication.

I2C Controller	SDA GPIOs	SCL GPIOs
I2C0	GPIO0, GPIO4, GPIO8, GPIO12, GPIO16, GPIO20	GPIO1, GPIO5, GPIO9, GPIO13, GPIO17, GPIO21
I2C1	GPIO2, GPIO6, GPIO10, GPIO14, GPIO18, GPIO26	GPIO3, GPIO7, GPIO11, GPIO15, GPIO19, GPIO27

SPI

There are also two SPI peripherals available, **SPI0** and **SPI1**. You can use two SPI buses on different peripherals simultaneously, but you cannot use two buses on the same peripheral at the same time. You can use SPI on any of the available SPI pins, but the default are GPIO19 (TX), GPIO18 (SCK), GPIO17 (CS), and GPIO 16 (RX).

Raspberry Pi Pico Default SPI Pins: GPIO19 (MOSI/TX), GPIO18 (SCK), GPIO17 (CS) and GPIO 16 (MISO/RX)

The following table shows all the pins you can use for SPI communication:

SPI Controller	RX GPIOs (MISO)	TX GPIOs (MOSI)	CLK GPIOs	CS GPIOs
SPI0	GPIO0, GPIO4, GPIO16	GPIO3, GPIO7, GPIO19	GPIO2, GPIO6, GPIO18	GPIO1, GPIO5, GPIO17
SPI1	GPIO8, GPIO12	GPIO11, GPIO15	GPIO10, GPIO14	GPIO9, GPIO13

UART

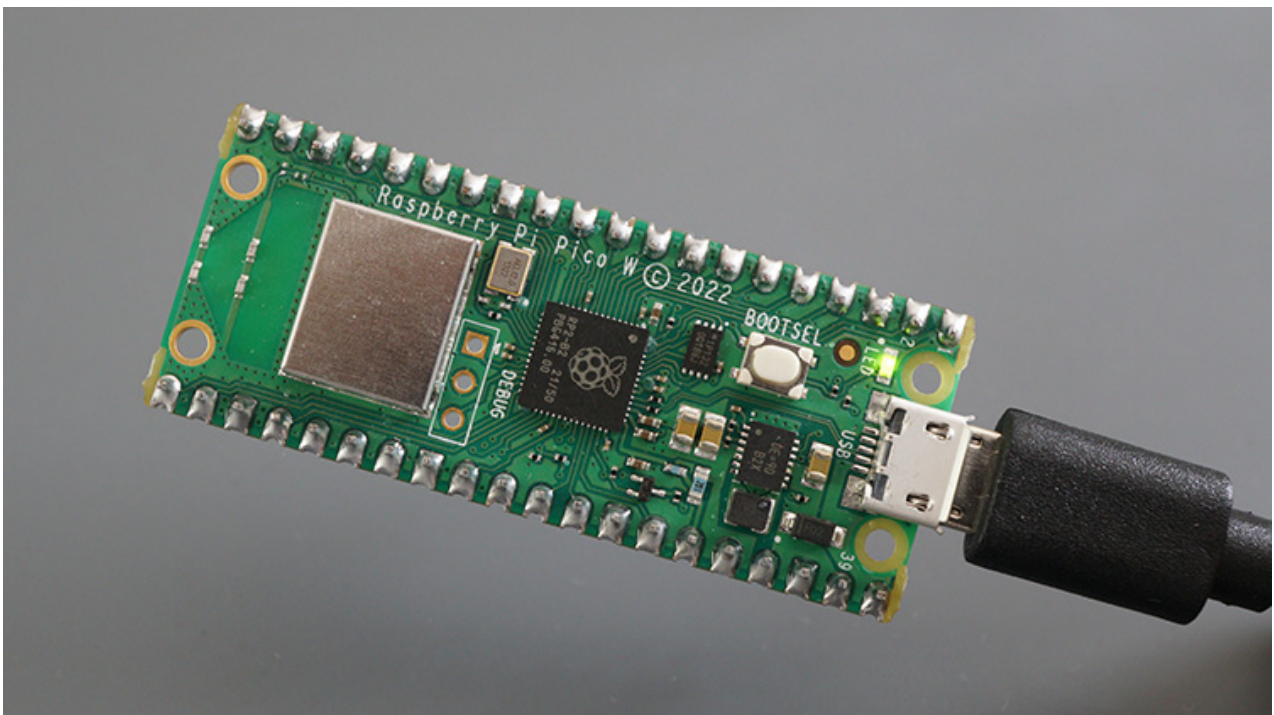
Similarly to I2C and SPI, there are two UART peripherals: **UART0** and **UART1**. You can use UART in any of the available pins, but GPIO0(TX) and GPIO1(RX) are the default UART pins.

Raspberry Pi Pico Default UART Pins: GPIO0(TX) and GPIO1(RX)

The following table shows all the pins you can use for UART:

UART Interface	TX GPIOs	RX GPIOs
UART0	GPIO0, GPIO12, GPIO16	GPIO1, GPIO13, GPIO17
UART1	GPIO4, GPIO8	GPIO5, GPIO9

Built-in LED



The Raspberry Pi Pico comes with a built-in onboard LED that is useful for testing and debugging purposes (see the green LED in the picture above). You can control the built-in LED via **GPIO25** (Raspberry Pi Pico).

- **Raspberry Pi Pico:** built-in LED connected to GPIO 25

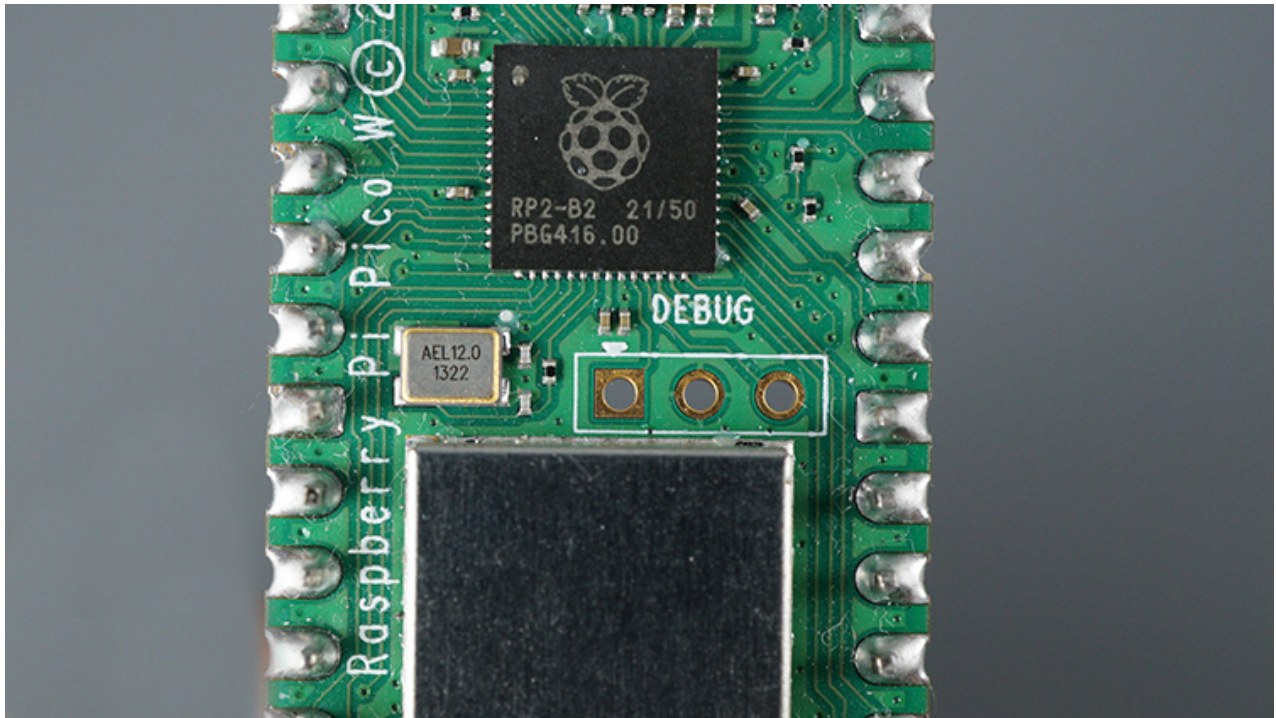
On the Raspberry Pi Pico W, usually you refer to it as 'LED' in MicroPython or LED_BUILTIN in Arduino IDE.

Onboard Temperature Sensor

As we've mentioned previously, the Raspberry Pi Pico comes with a built-in temperature sensor that you can read on **ADC4**.

Debugging Pins

The Raspberry Pi Pico comes with debug pins that you can use to connect to a Raspberry Pi Debug Probe for troubleshooting and debugging.



The pins are located in different places on the Pico and Pico W but act similarly. These pins are labeled as **SWDIO** (Serial Wire Debug I/O), **GND**, and **SWCL** (Serial Wire Debug Clock) at the back of the board.