

Introduction to MicroPython for Raspberry Pi Pico Part 1 - Hardware

Hamilton Python Users Group
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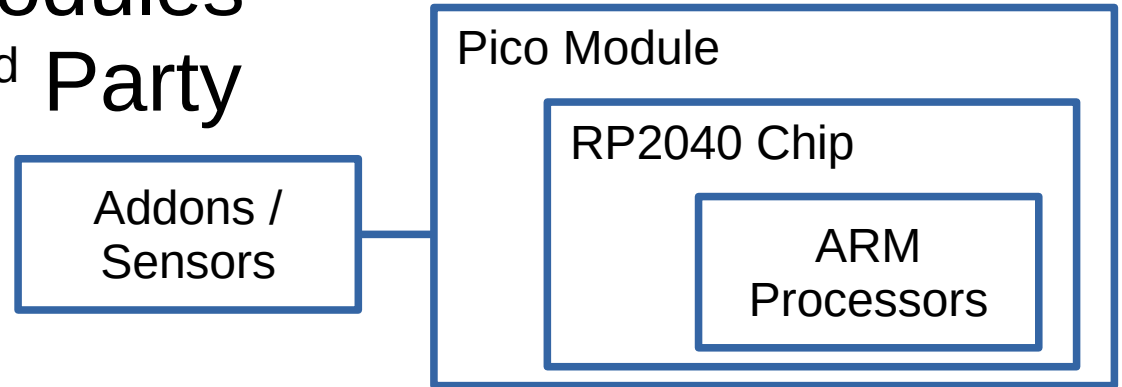
MicroPython for Raspberry Pi Pico

Hardware:

- ARM Cortex-M0+ Processor core
- Raspberry Pi RP2040 Microcontroller Chip
- Raspberry Pi Pico modules
- Pico Kits, Addons, 3rd Party

Software:

- C / C++
- MicroPython



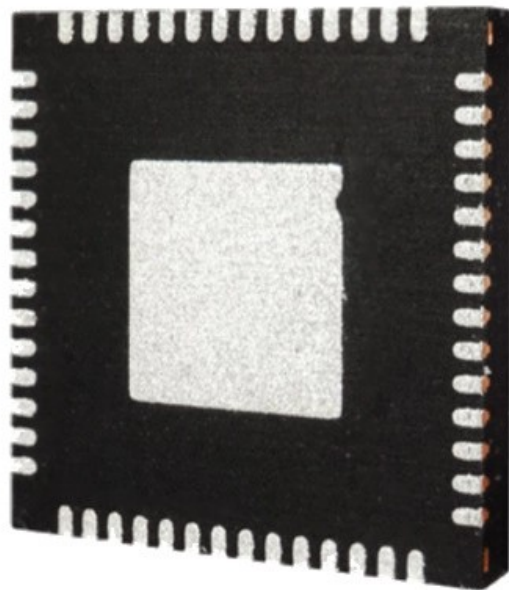
ARM - Cortex-M0+

- ARM Holdings. Formerly “Acorn RISC Machines” and “Advanced RISC Machines”.
- ARM creates and licenses its technology as intellectual property.

Cortex-M0+:

- 32-bit RISC ARM processor core
- Implements the ARMv6-M architecture
- Optimized superset of the Cortex-M0.
- Smallest ARM microcontrollers ,

Raspberry Pi RP2040 Chip



PB Tech / Element14 ~\$1.66

Designed by Raspberry Pi Ltd.
(~ not a Broadcom buy in)

- Dual ARM Cortex-M0+ @ 133MHz
- 264kB on-chip SRAM
- Support for up to 16MB of off-chip Flash memory via dedicated QSPI bus
- DMA controller
- Fully-connected AHB crossbar
- Interpolator and integer divider peripherals
- On-chip programmable LDO to generate core voltage of 1.1V
- 2 on-chip PLLs to generate USB and core clocks
- 30 GPIO pins, 4 of which can be used as analogue inputs

RP2040

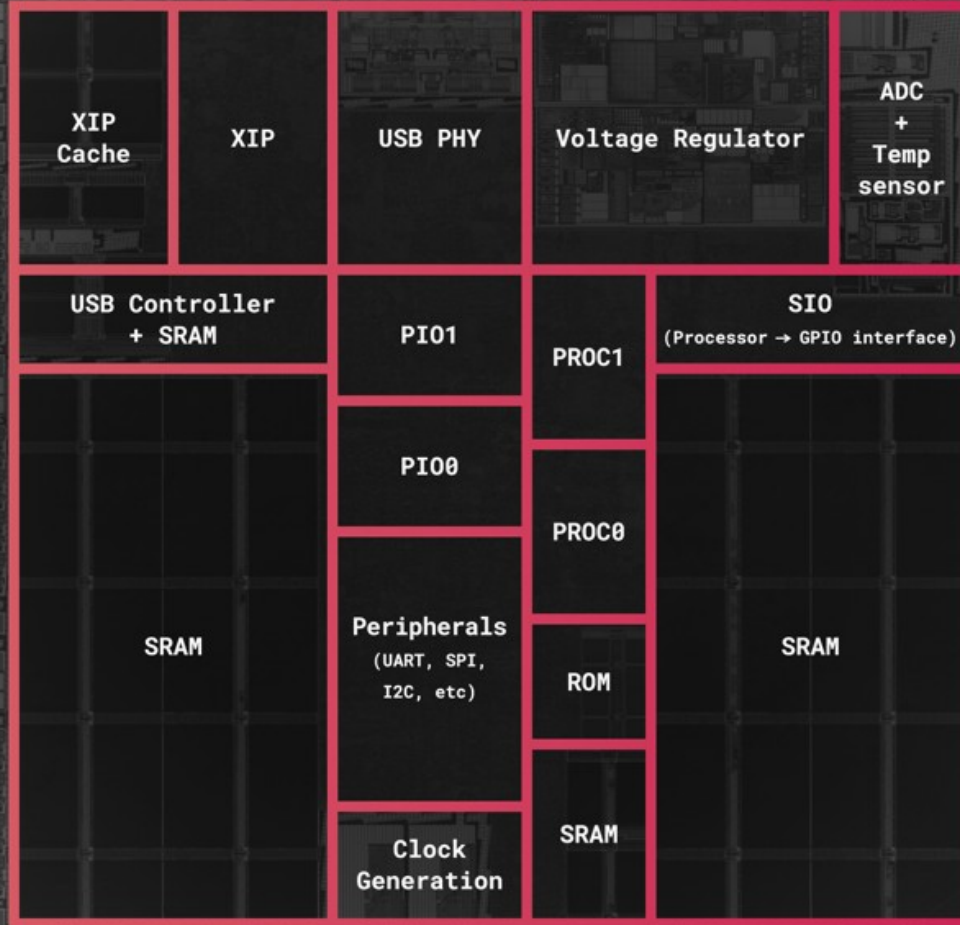
Peripherals:

- 2 UARTs
- 2 SPI controllers
- 2 I2C controllers
- 16 PWM channels
- USB 1.1 controller and PHY, with host and device support
- 8 PIO state machines

Abbreviations:

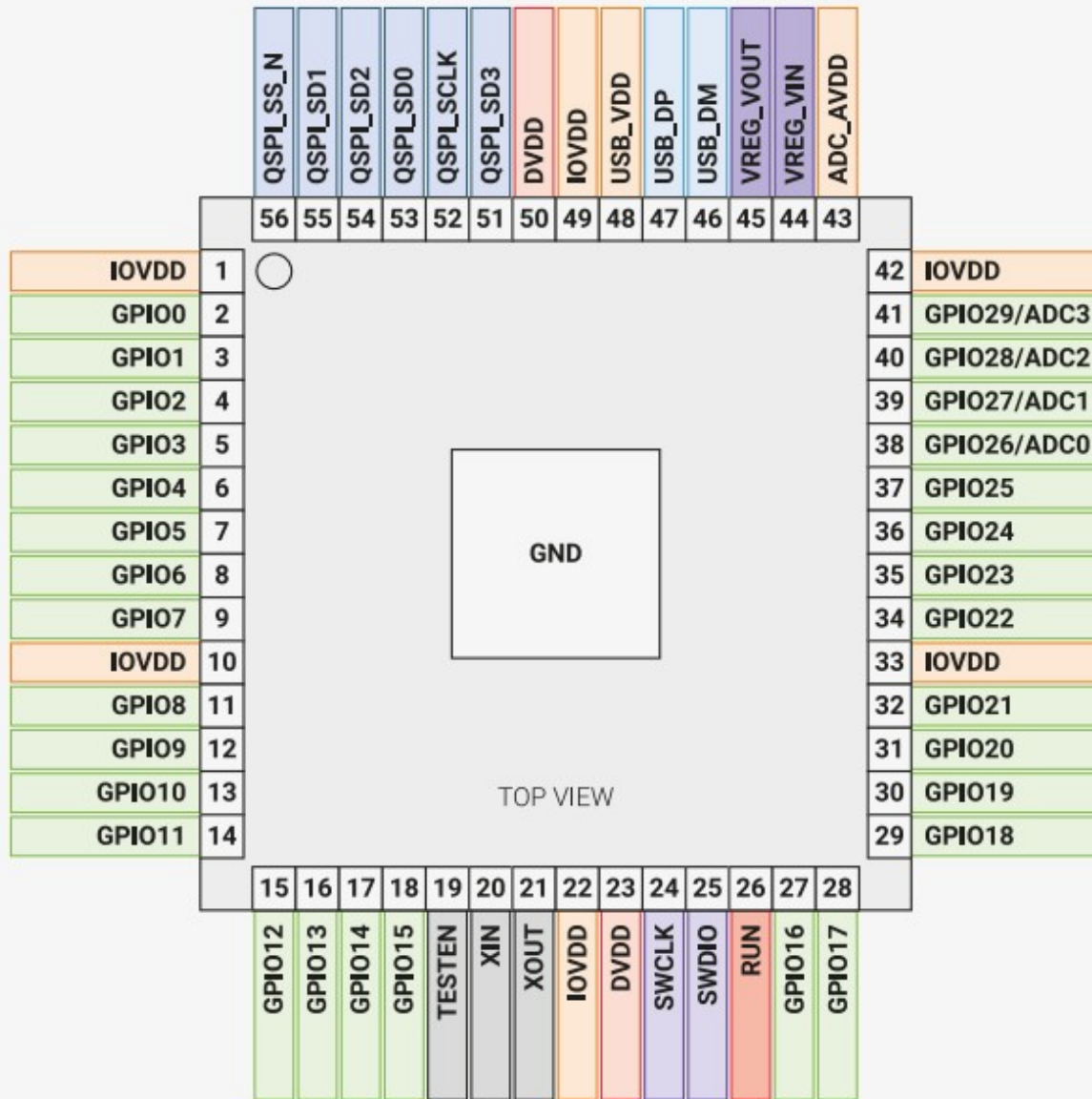
LDO Low DropOut Regulator
AHB Advanced High Performance Bus
PLL Phase Locked Loop
SPI Serial Peripheral Interface
GPIO General Purpose Input/Output
PIO Programmable Input/Output
PWM Pulse Width Modulation

RP2040 Layout



RP2040 Chip

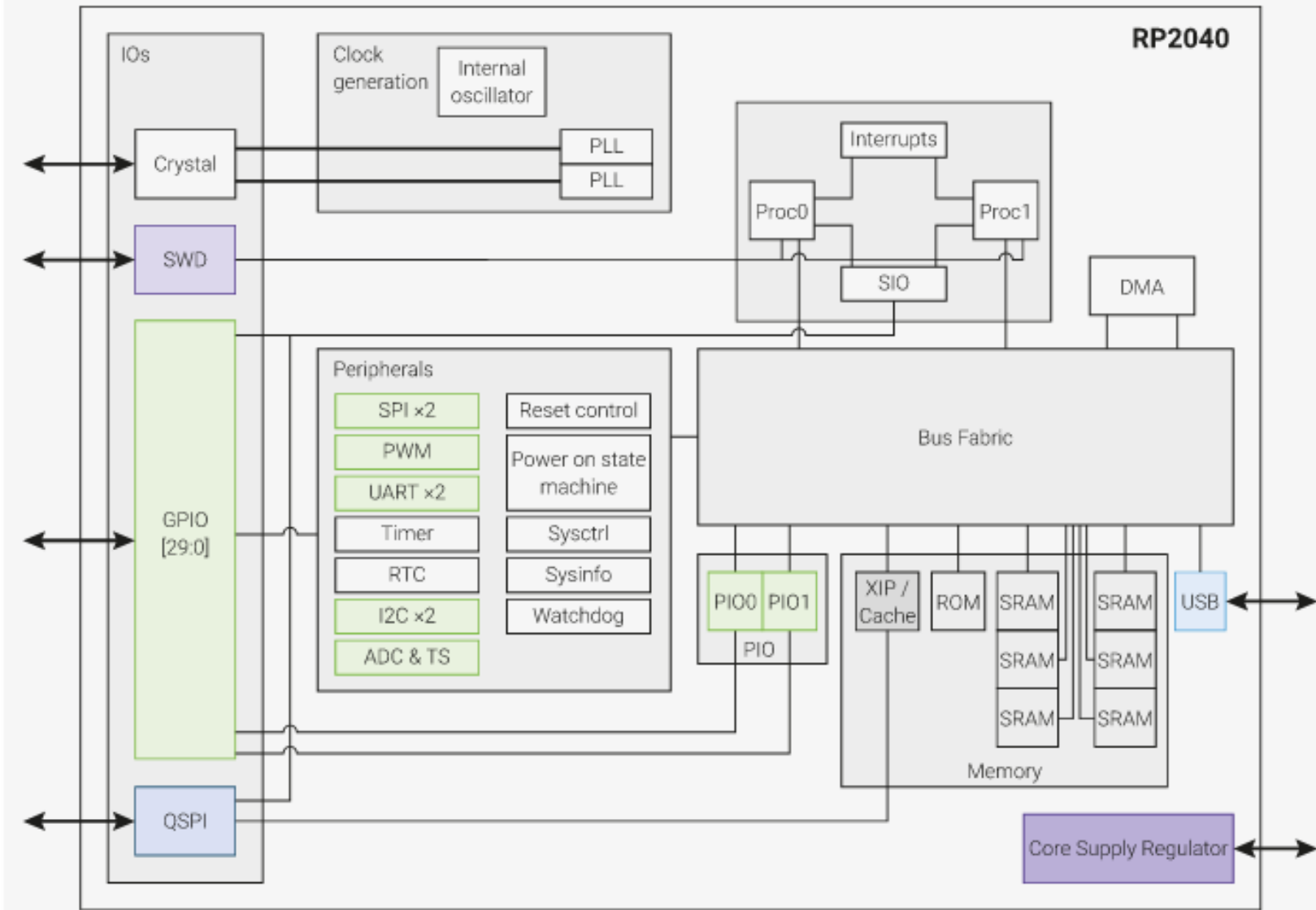
- 4 x 14 pin = 56 pins
- QFN-56 surface mount device
- 30 GPIO – 0 to 29
- 3.3V for the I/O
- 1.1V for the chip's digital core



QFN Quad Flat No-leads

RP2040

- RP
-



RP2040 – Model Numbering Scheme

- Manufacturer – Raspberry Pi
- Number of processor cores (2)
- Loosely which type of processor (M0+)
- $\text{floor}(\log_2(\text{ram} / 16\text{k}))$
- $\text{floor}(\log_2(\text{nonvolatile} / 16\text{k}))$ or 0 if no onboard nonvolatile storage

```
>>> math.floor(math.log2(256000/16000))
```

4

RP 2 0 4 0

Raspberry Pi

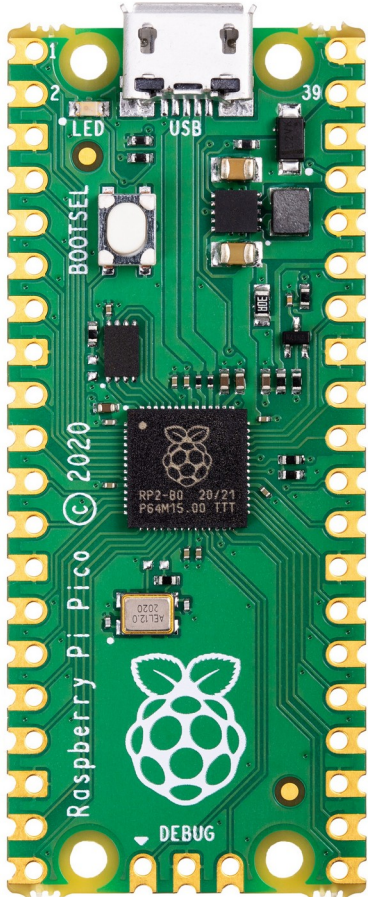
Number of cores

Type of core (e.g. M0+)

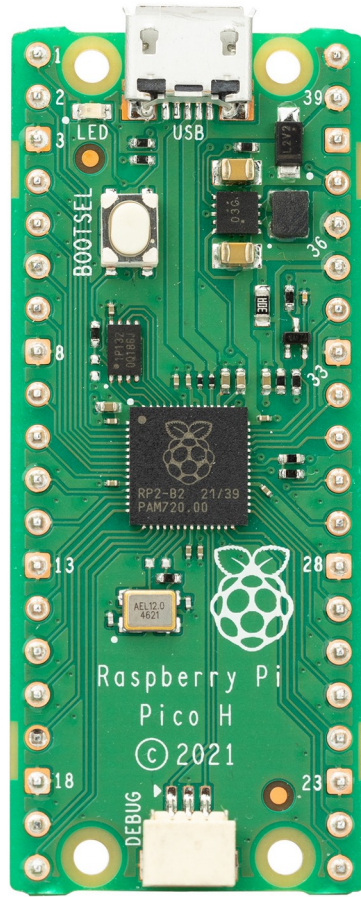
$\text{floor}(\log_2(\text{ram} / 16\text{k}))$

$\text{floor}(\log_2(\text{nonvolatile} / 16\text{k}))$

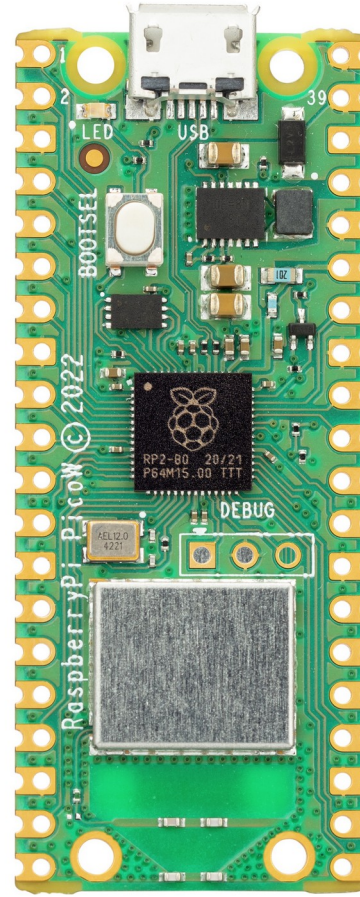
Raspberry Pi Pico - family of RP2040-based boards



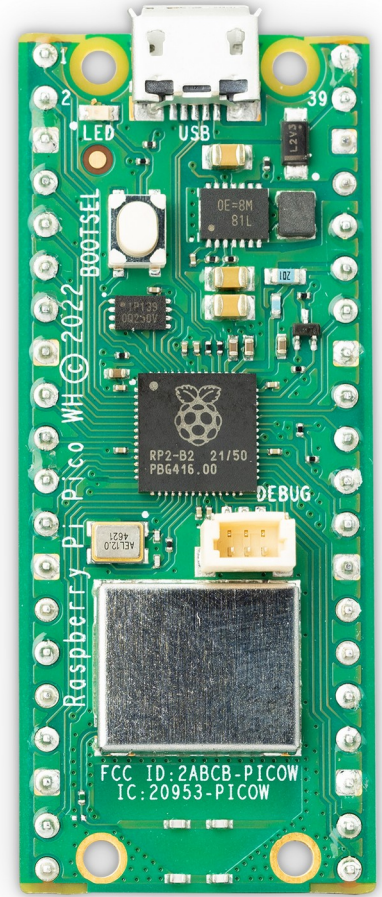
Pico \$8



Pico H \$10

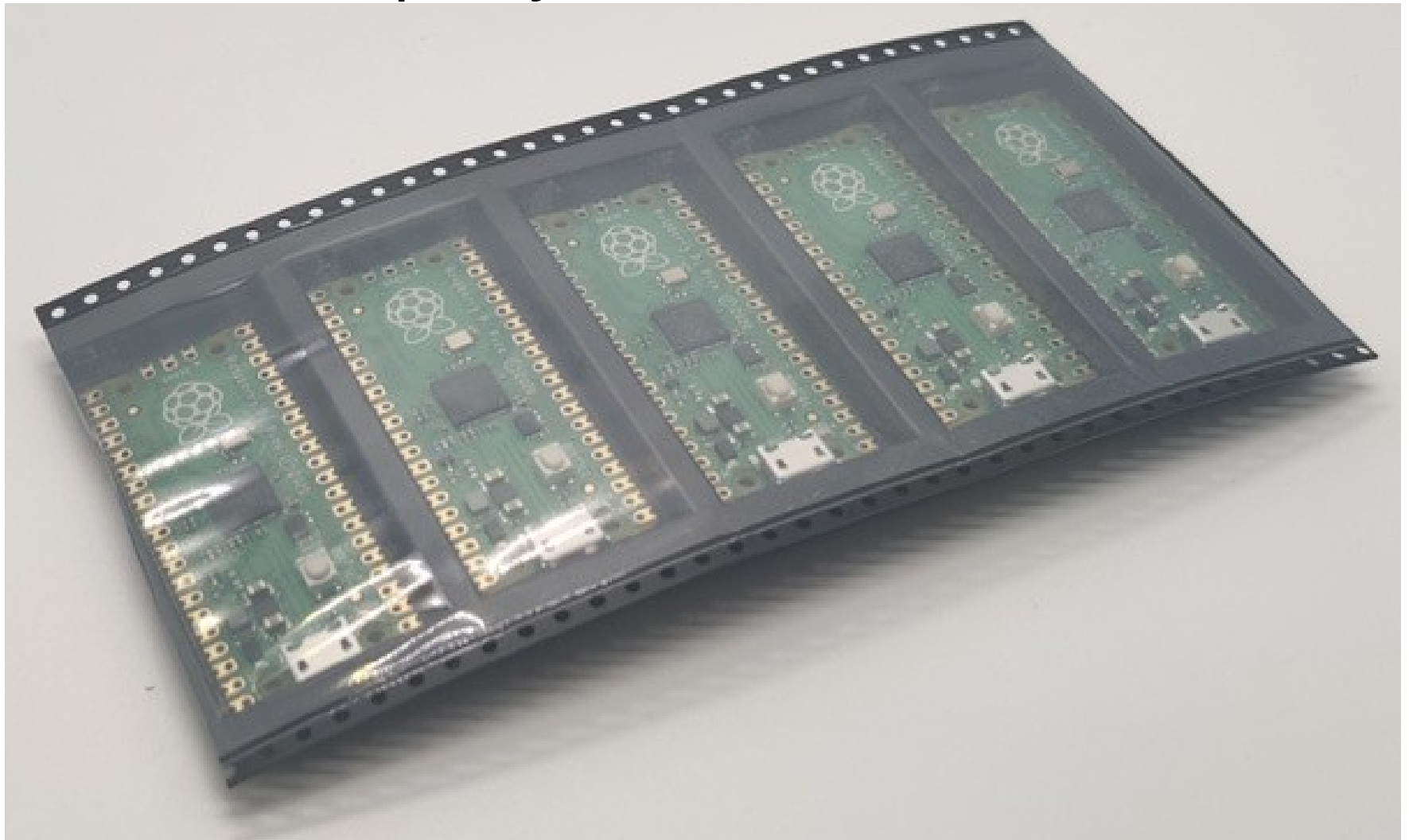


Pico W \$12



Pico WH ?

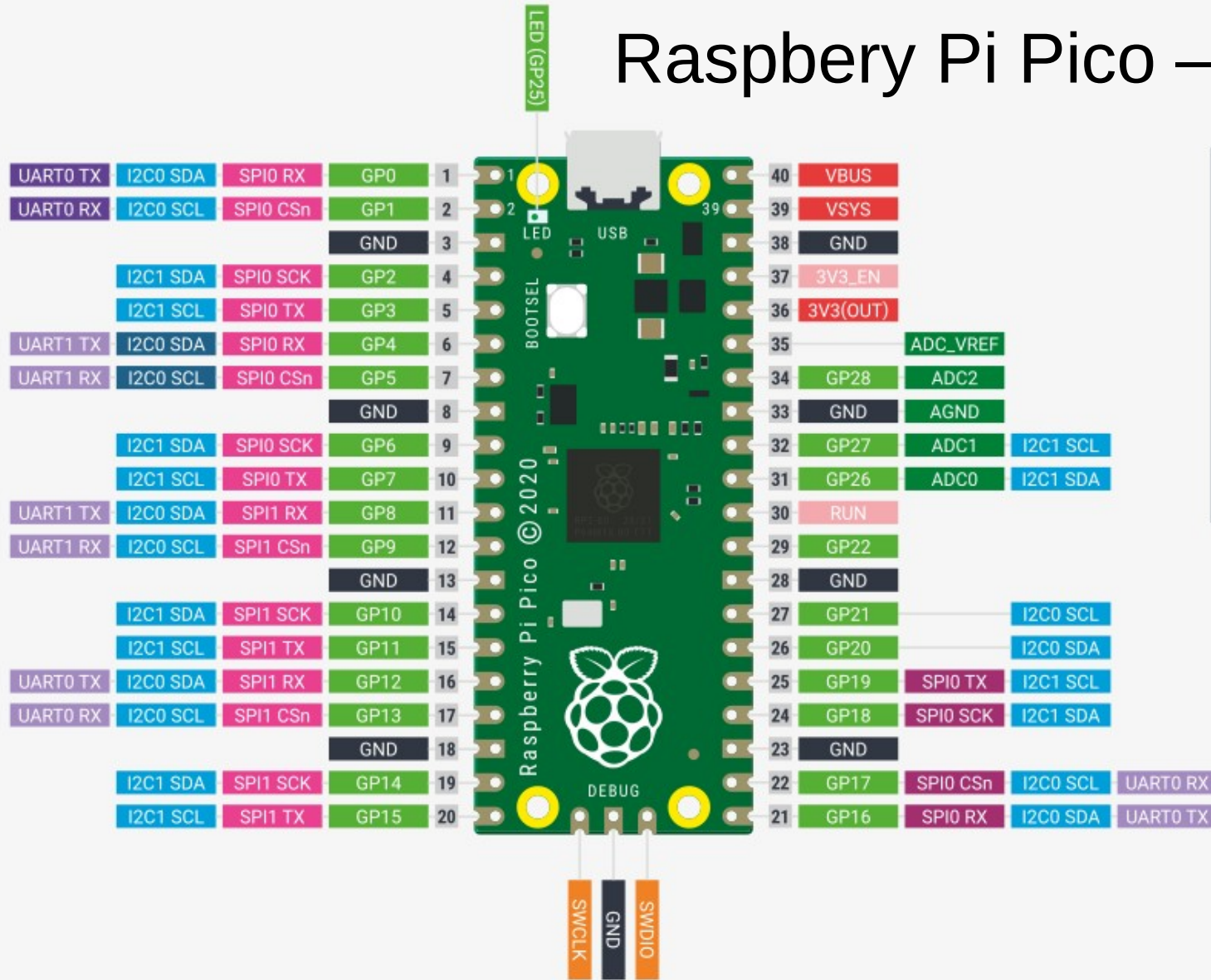
Raspberry Pi Pico – 5 Pack.



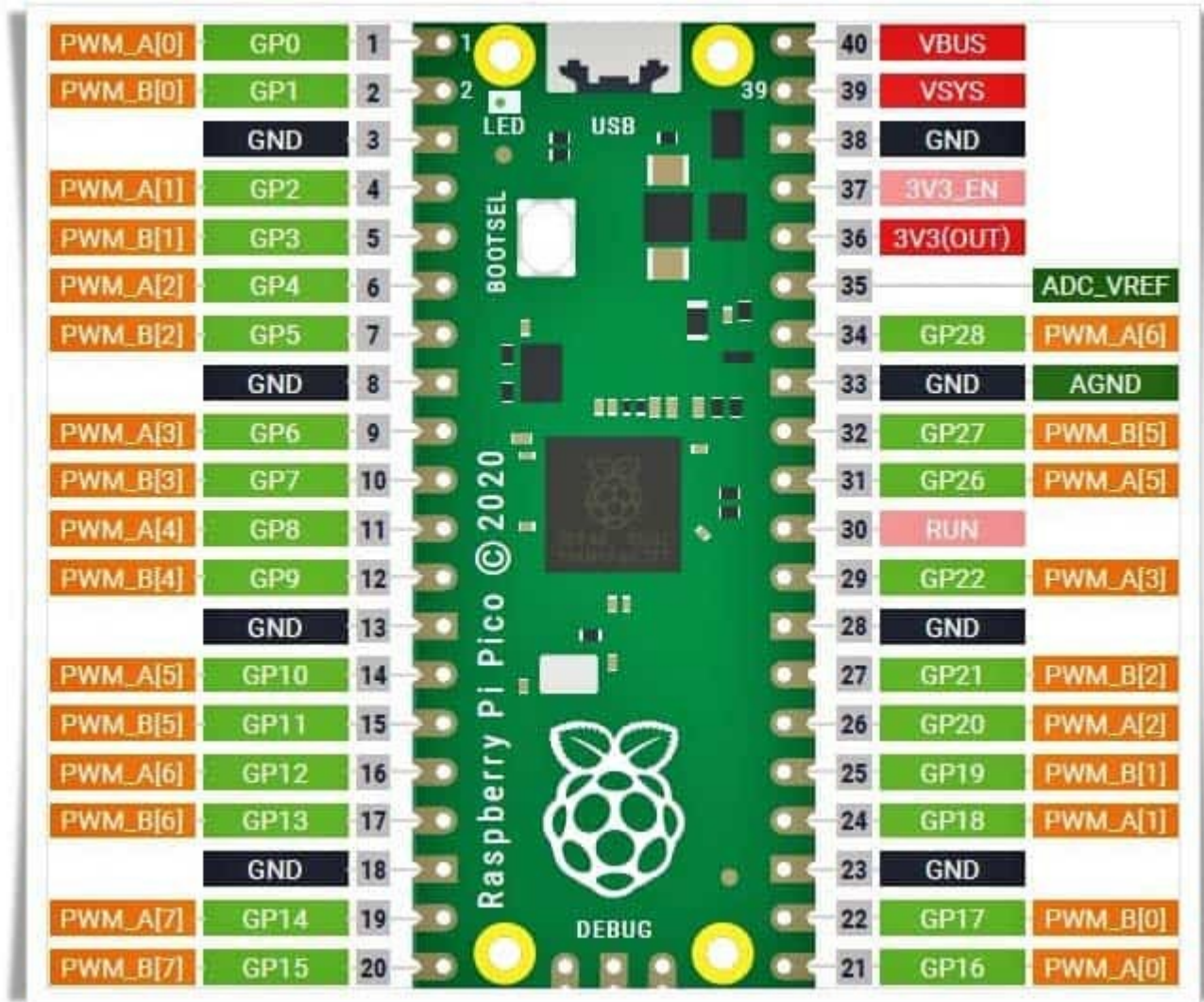
Raspberry Pi Pico – On a roll



Raspberry Pi Pico – connections



Raspberry Pi Pico - family of RP2040-based boards



PWM



Operating Temp Min-20°C

VBUS5V \pm 10%.

VSYS Min 1.8V

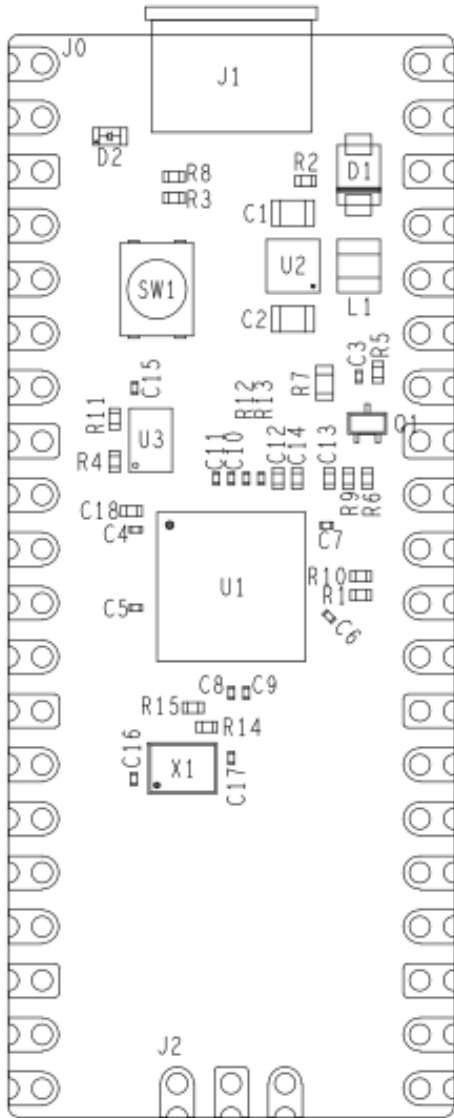
VSYS Max 5.5V

Current @5V < 100mA

Current Sleep Mode @5V 1.4mA

Size 51mm x 21mm

	Model	Size	Vendor	Description
U1	RP2040	7x7	Raspberry Pi	32-bit dual ARM Cortex-M0+ microcontroller
U2	RT6150B-33GQW	2.5x2.5	Richtek	Buck-Boost Switching Regulator IC Positive Fixed 3.3V
U3	W25Q16J VUXIQ	2x3	Winbond	16M-bit 2M x 8 6ns
X1	12MHz	3.2x2.5	AEL	Crystal Oscillator



Raspberry Pi Pico – Components

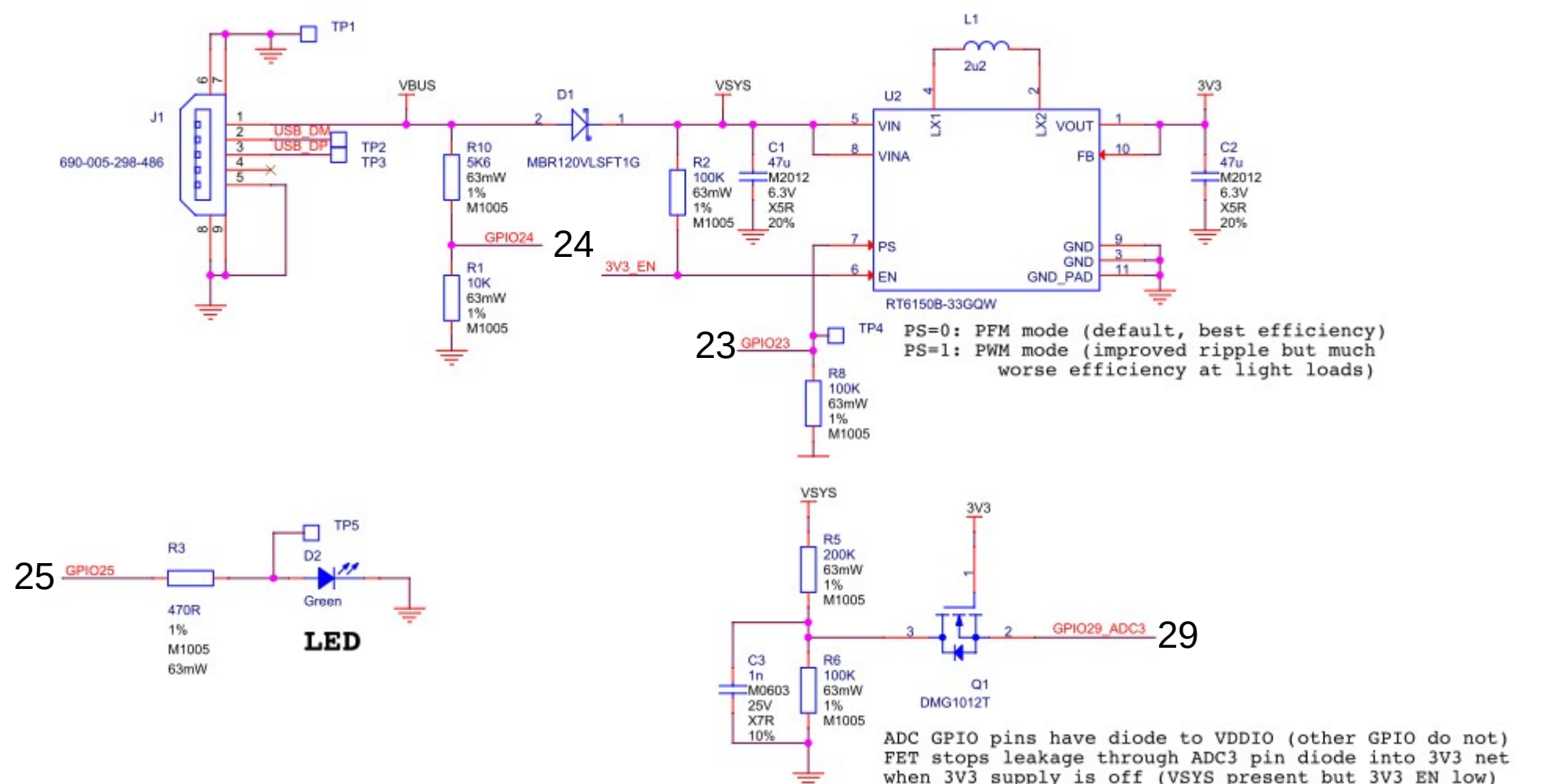
- 3 x ICs: RP2040, +3.3V Regulator, 2MB Flash
- 18 x Capacitors
- 1 x Crystal (12MHz)
- 2 x Diodes (1 x LED)
- 1 x Mosfet
- 1 x Inductor
- 15 x Resistors
- 1 x Switch
- 6 x Test Points

The image shows a detailed PCB layout for a Raspberry Pi Zero W. The layout includes various components such as the USB-C port, power management ICs, the main processor, and various passive components. The layout is color-coded and includes labels for components and their values. A bill of materials table is located at the bottom right of the image.

Bill of Materials Table:

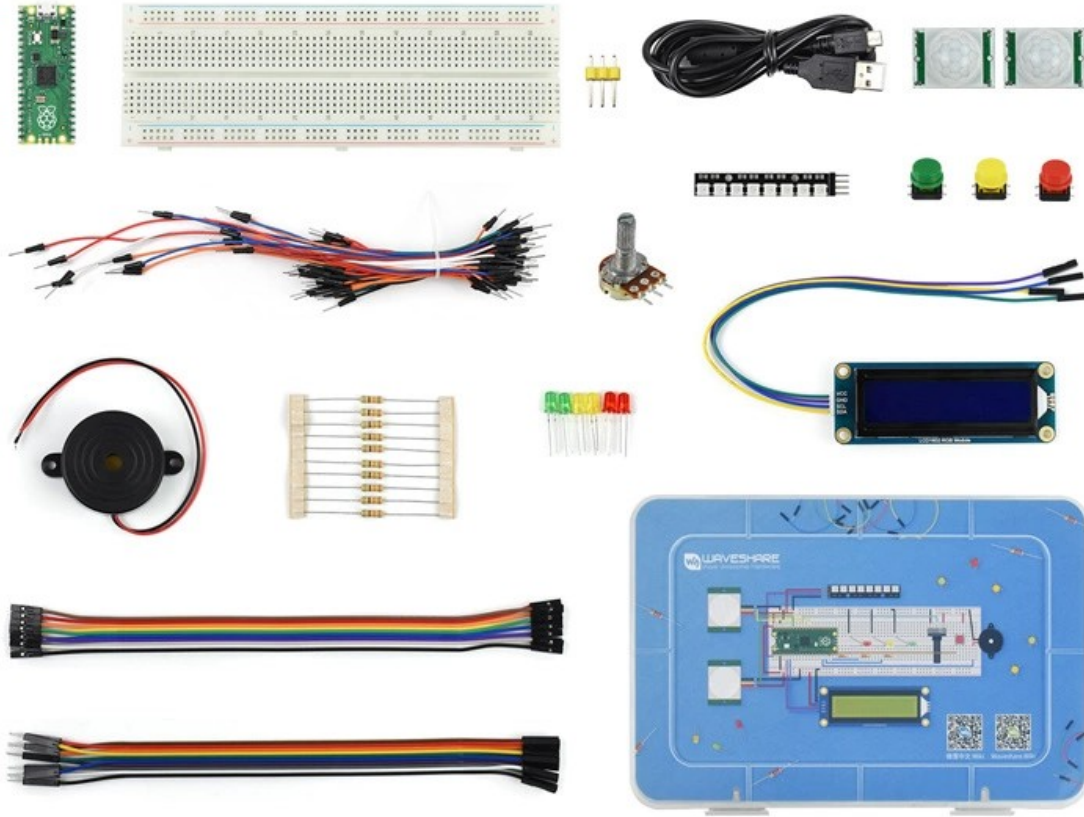
Ref	Part	Quantity	Notes
U1	RP2040	1	
U2	TP2301	1	
U3	TP2301	1	
U4	TP2301	1	
U5	TP2301	1	
U6	TP2301	1	
U7	TP2301	1	
U8	TP2301	1	
U9	TP2301	1	
U10	TP2301	1	
U11	TP2301	1	
U12	TP2301	1	
U13	TP2301	1	
U14	TP2301	1	
U15	TP2301	1	
U16	TP2301	1	
U17	TP2301	1	
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U19	TP2301	1	
U20	TP2301	1	
U21	TP2301	1	
U22	TP2301	1	
U23	TP2301	1	
U24	TP2301	1	
U25	TP2301	1	
U26	TP2301	1	
U27	TP2301	1	
U28	TP2301	1	
U29	TP2301	1	
U30	TP2301	1	
U31	TP2301	1	
U32	TP2301	1	
U33	TP2301	1	
U34	TP2301	1	
U35	TP2301	1	
U36	TP2301	1	
U37	TP2301	1	
U38	TP2301	1	
U39	TP2301	1	
U40	TP2301	1	
U41	TP2301	1	
U42	TP2301	1	
U43	TP2301	1	
U44	TP2301	1	
U45	TP2301	1	
U46	TP2301	1	
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U73	TP2301	1	
U74	TP2301	1	
U75	TP2301	1	
U76	TP2301	1	
U77	TP2301	1	
U78	TP2301	1	
U79	TP2301	1	
U80	TP2301	1	
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U88	TP2301	1	
U89	TP2301	1	
U90	TP2301	1	
U91	TP2301	1	
U92	TP2301	1	
U93	TP2301	1	
U94	TP2301	1	
U95	TP2301	1	
U96	TP2301	1	
U97	TP2301	1	
U98	TP2301	1	
U99	TP2301	1	
U100	TP2301	1	

Raspberry Pi Pico – RP2040 GPIO used by Pico



ADC4 – Monitor CPU Temperature internal to RP2040

Raspberry Pi Pico – addons / evaluation kits

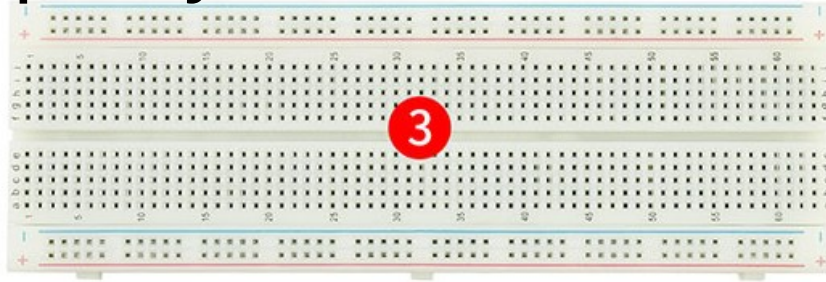


Kit Contents:

- Raspberry Pi Pico With Header
- LCD1602 RGB Module
- PIR motion sensor
- 8-Bit WS2812 RGB LED
- Alarm
- Single-joint potentiometer
- Round buttons
- 5mm LED
- 330R resistors
- Breadboard and wires
- Jumper wires
- Plastic box

Basic Entry - Level Kit MicroPython Programming Learning Kit \$73

Raspberry Pi Pico – addons / evaluation kits

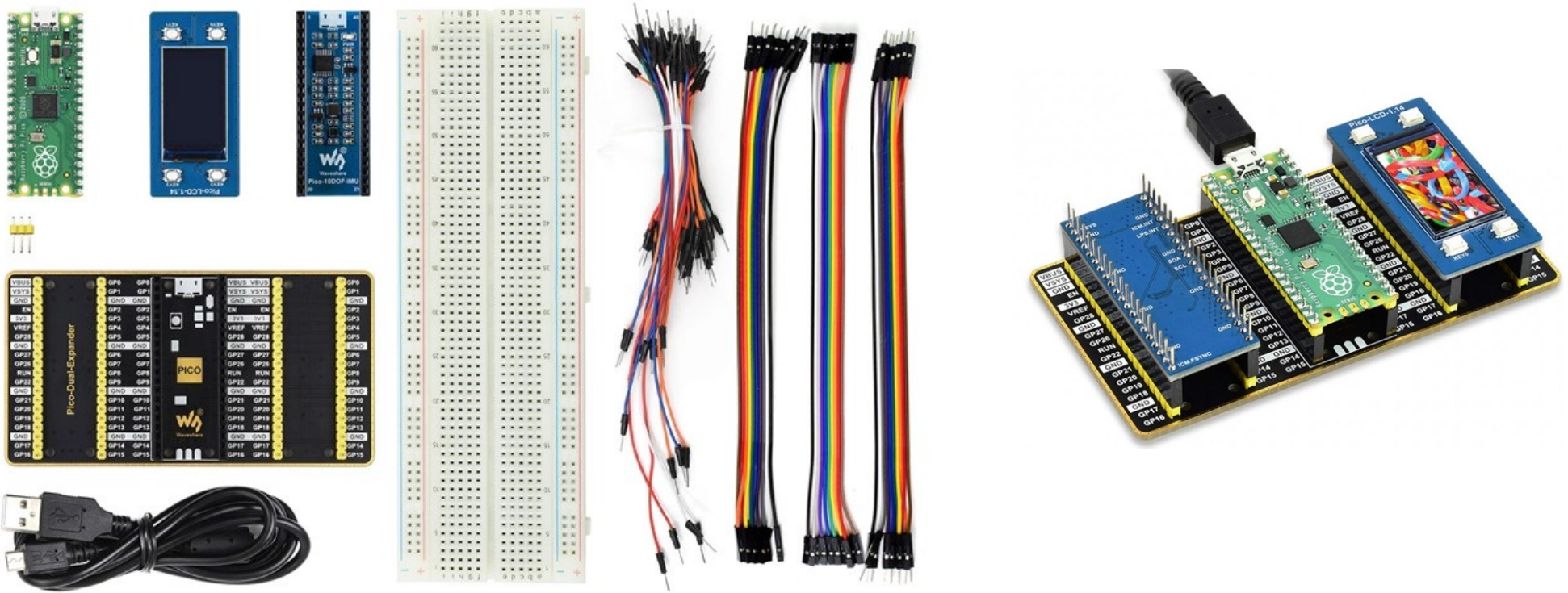


Sensors:

- MQ-5 Gas
- Color
- Flame
- Hall
- Infrared Reflective
- Laser
- Moisture
- Rotation
- Sound
- Temperature-Humidity
- Tilt
- UV
- Liquid Level

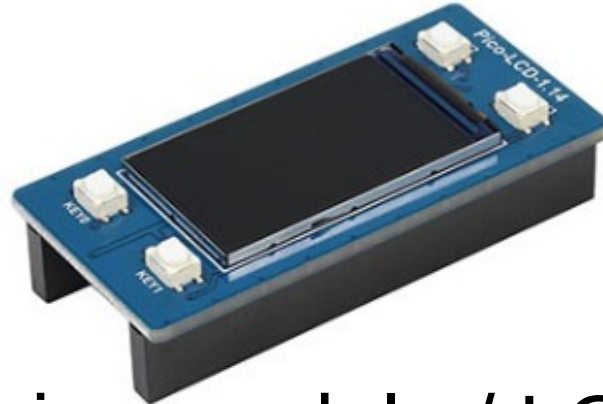
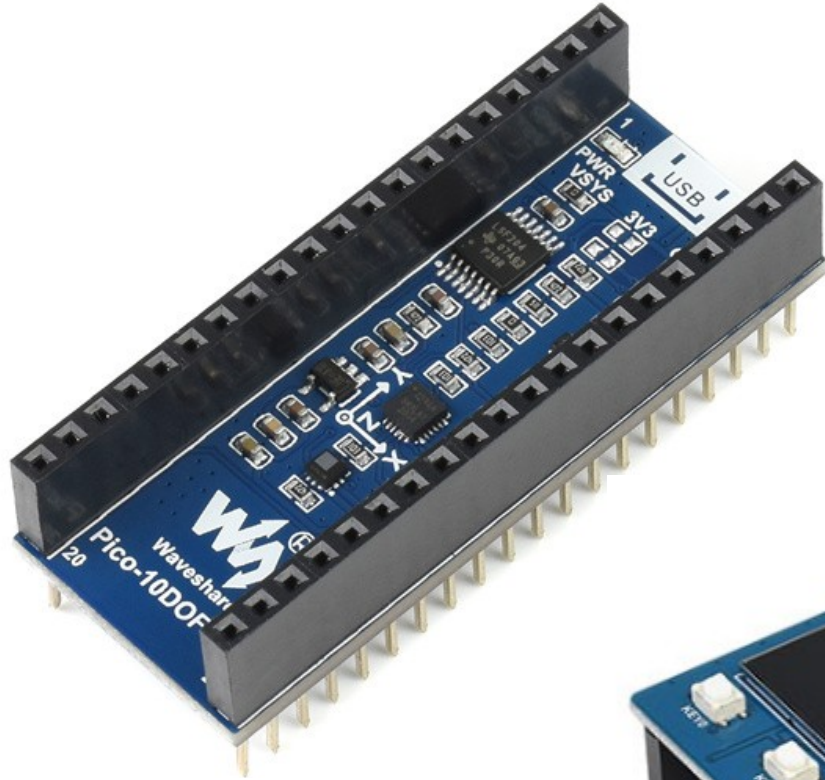
Sensor Kit Development & Expansion Boards Kit Pack \$110

Raspberry Pi Pico – addons / evaluation kits



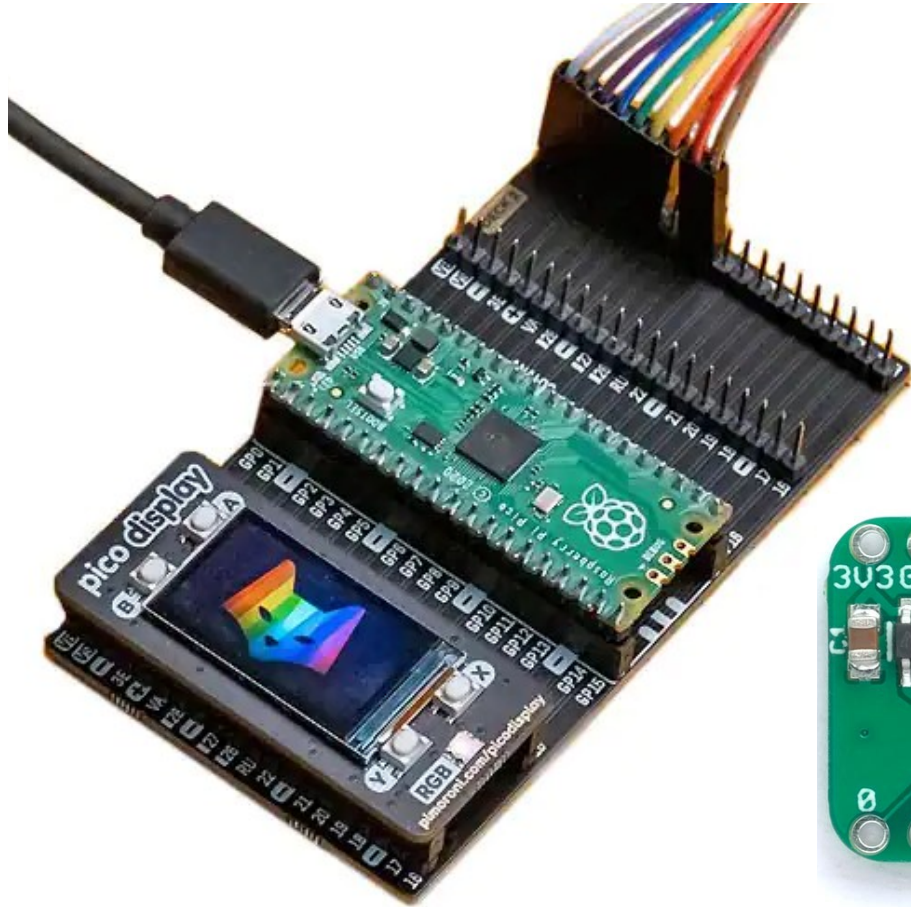
Evaluation Kit Type B The Pico + Colour LCD + IMU Sensor + GPIO Expander \$100

Raspberry Pi Pico – addons / evaluation kits



Sensor expansion module / LCD Displays

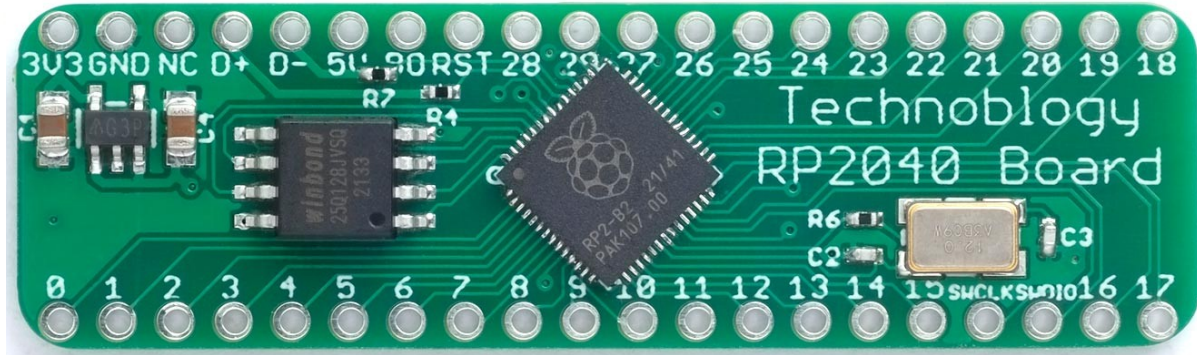
Raspberry Pi Pico – addons 3rd Party



Manufacturer Pimoroni Ltd

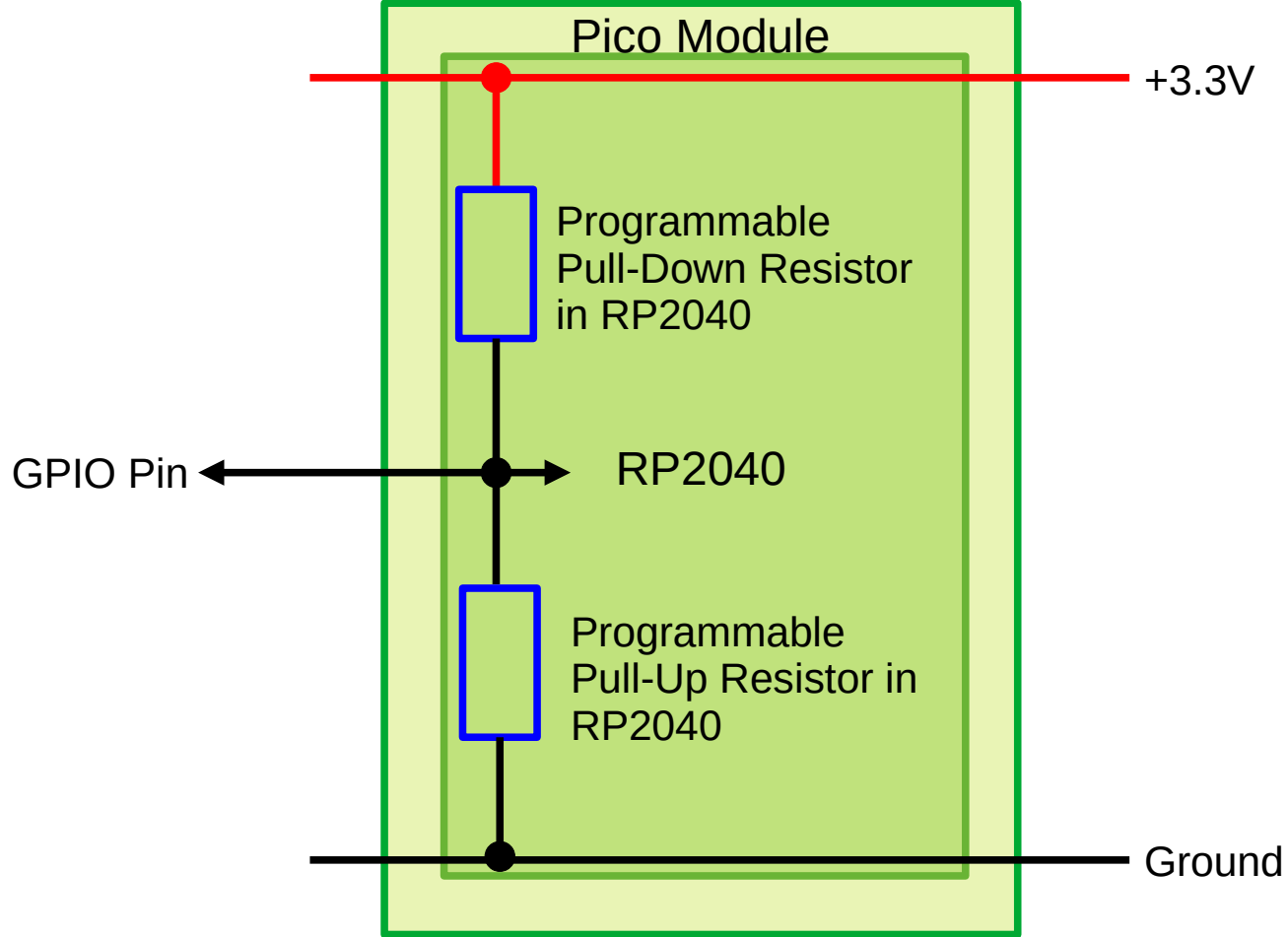
Manufacturer Product Number PIM556

Description PICO OMNIBUS (DUAL EXPANDER)

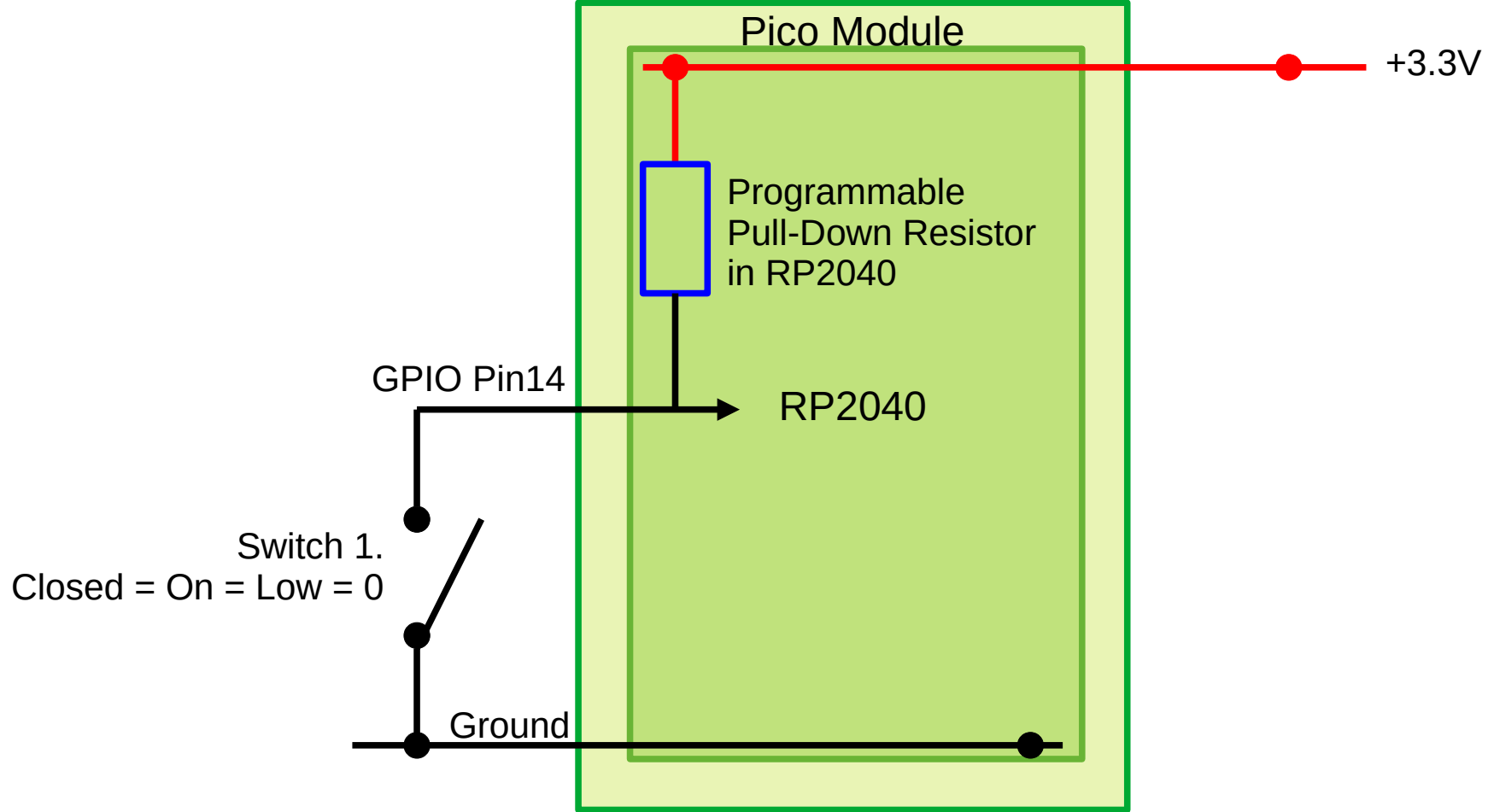


3rd Party 40pin Board – 30 x GPIO

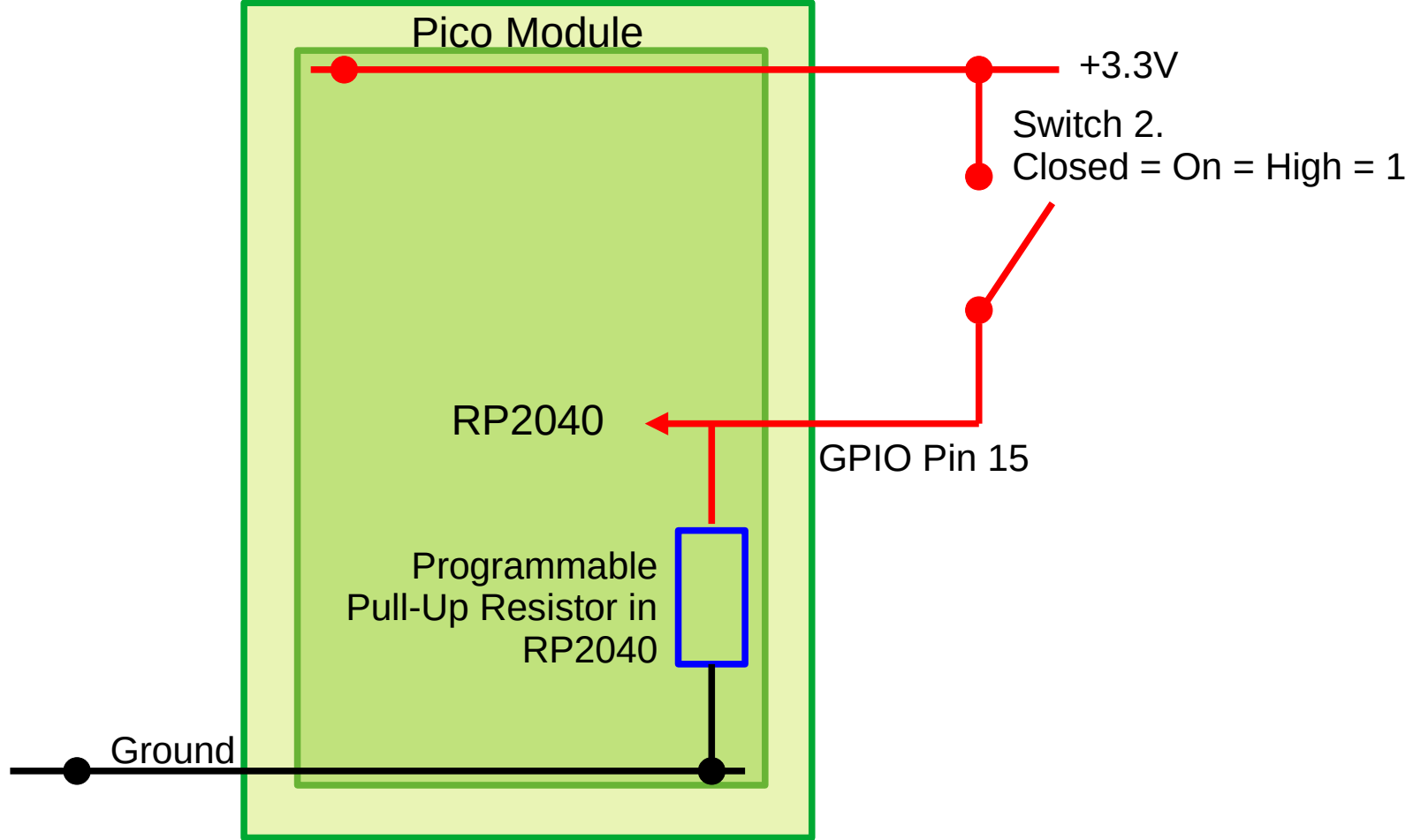
GPIO IN/OUT Circuits



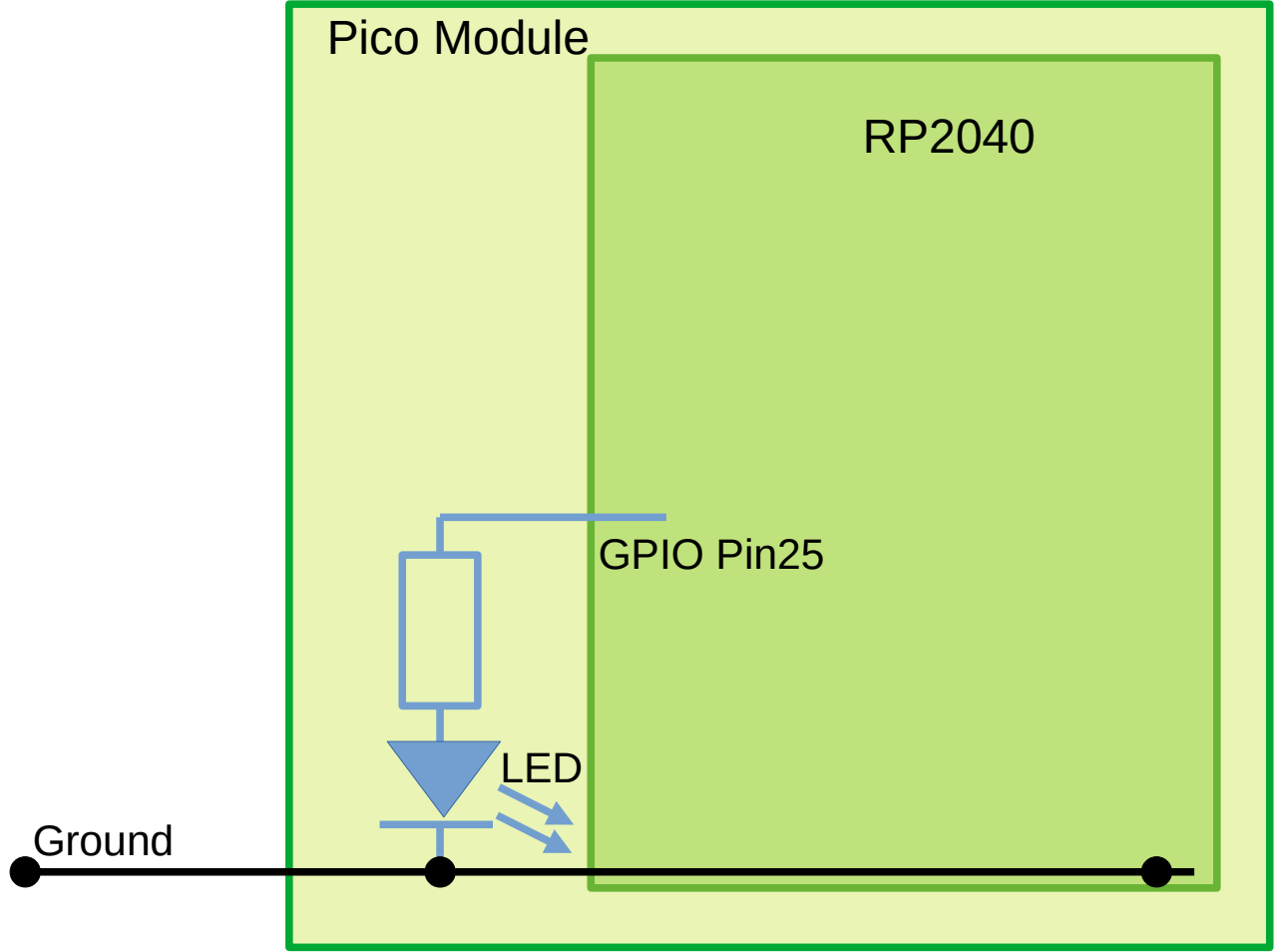
GPIO Pin IN Pull-Down

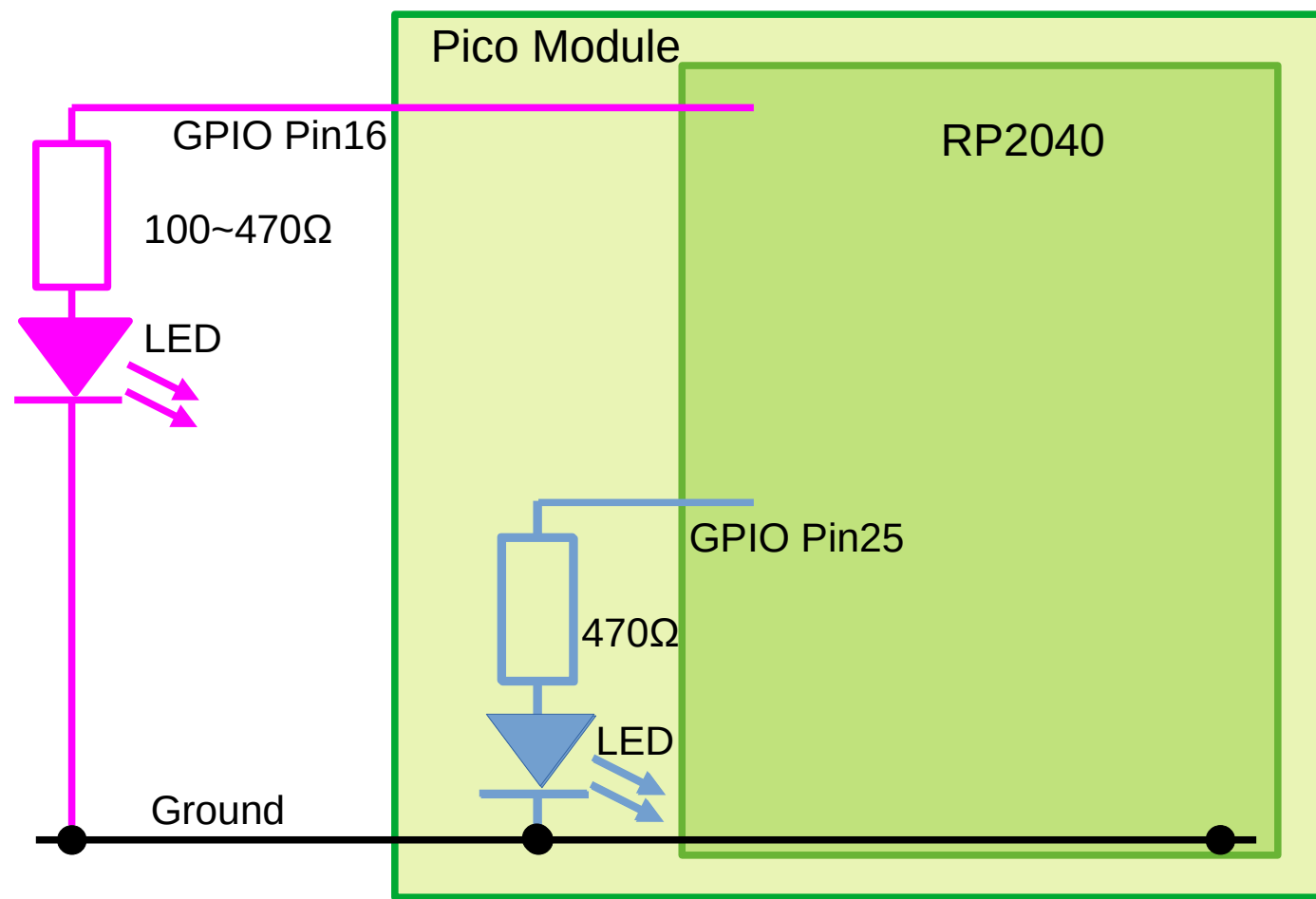


GPIO Pin IN Pull-Up



GPIO Pin OUT on Pico Module





GPIO Pin OUT
on Pico Module.

GPIO Pin OUT
External

Part 1 End.

Demo Hardware.