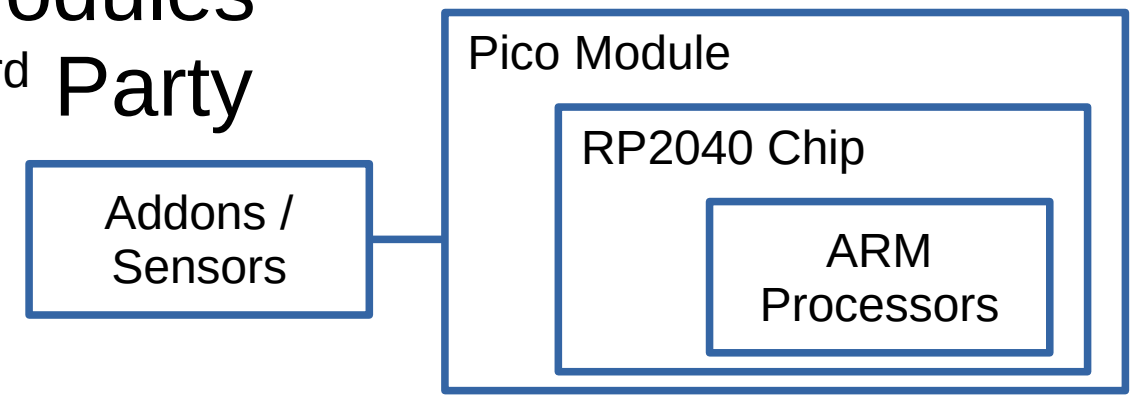
Introduction to MicroPython for Raspberry Pi Pico
Part 1 - Hardware

Hamilton Python Users Group
12 Dec 2022
Ian Stewart

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

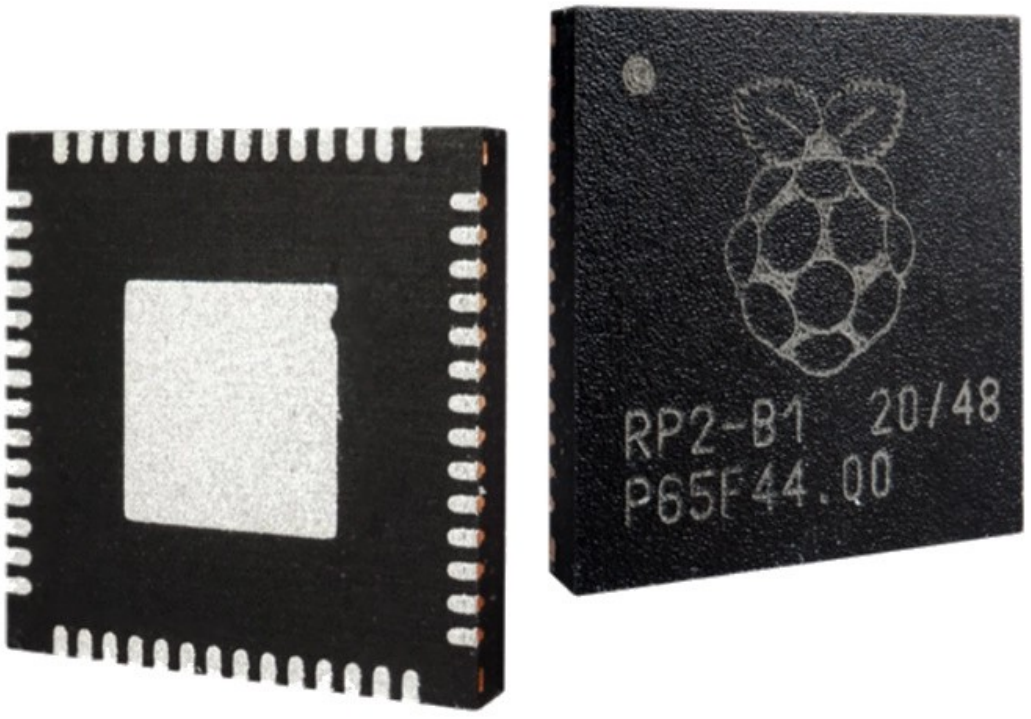
ARM - Cortex-M0+

- 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)

RP2040

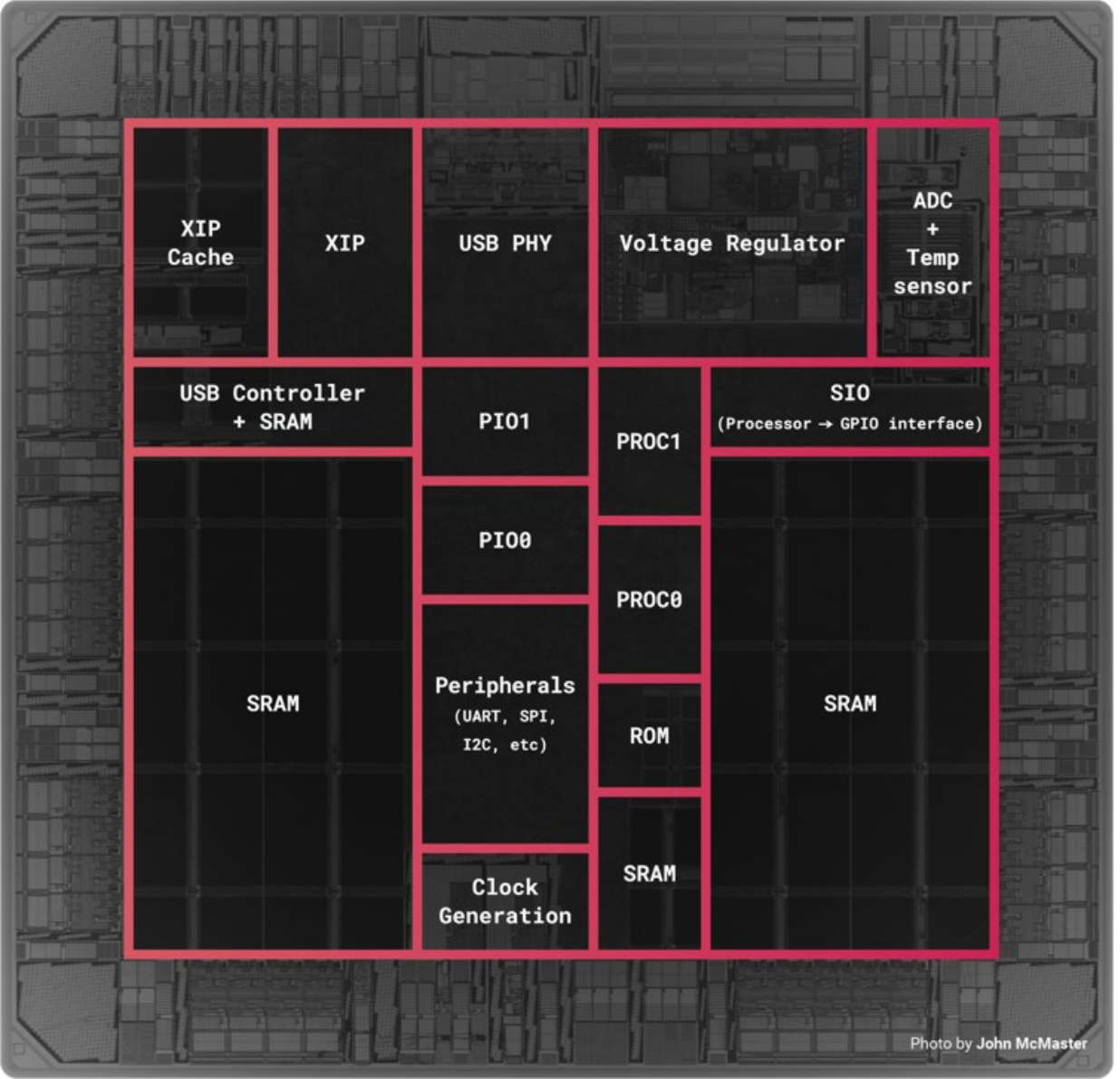
- Dual ARM Cortex-M0+ @ 133MHz
- 264kB on-chip SRAM
- Support for up to 16MB of off-chip Flash memory via dedicated QSPI bus
- DMA controller
- Fully-connected AHB crossbar
- Interpolator and integer divider peripherals
- On-chip programmable LDO to generate core voltage of 1.1V
- 2 on-chip PLLs to generate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

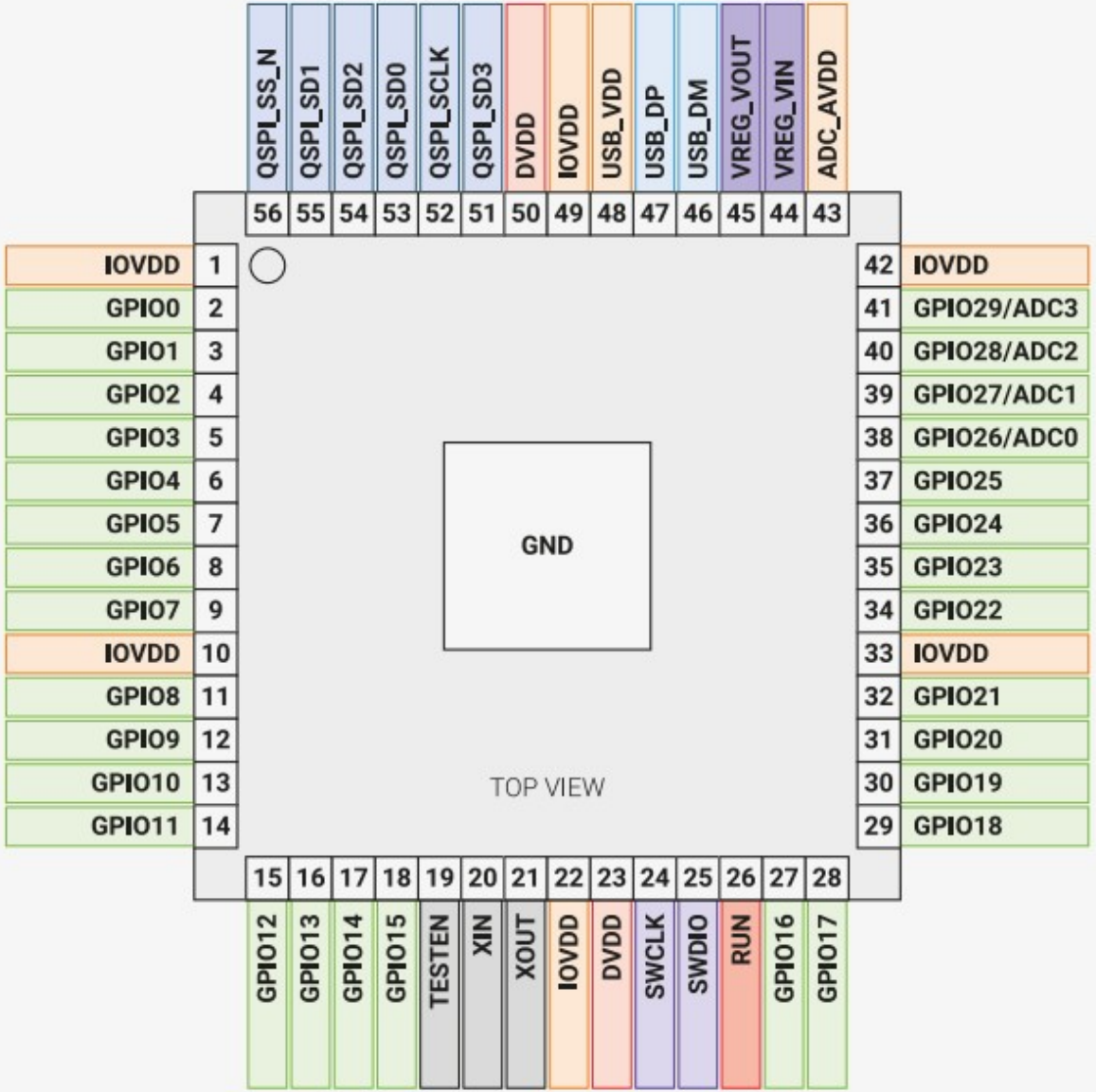
Peripherals:

- 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 Perfromance Bus
PLL Phase Locked Loop
SPI Serial Peripheral Interface
GPIO General Purpose Input/Output
PIO Programmable Input/Output
PWM Pulse Width Modulation

RP2040 Layout





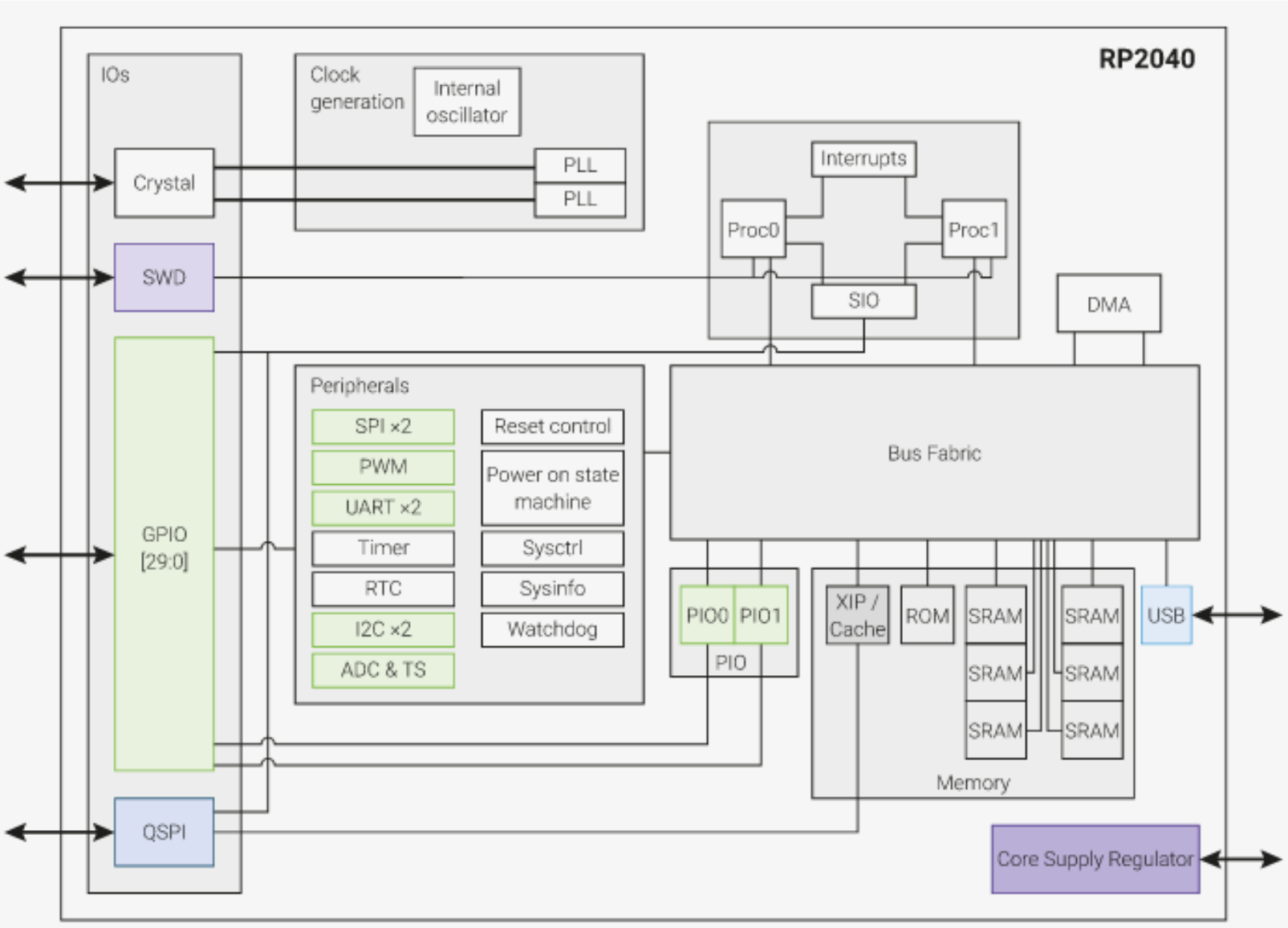
RP2040 Chip

- 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

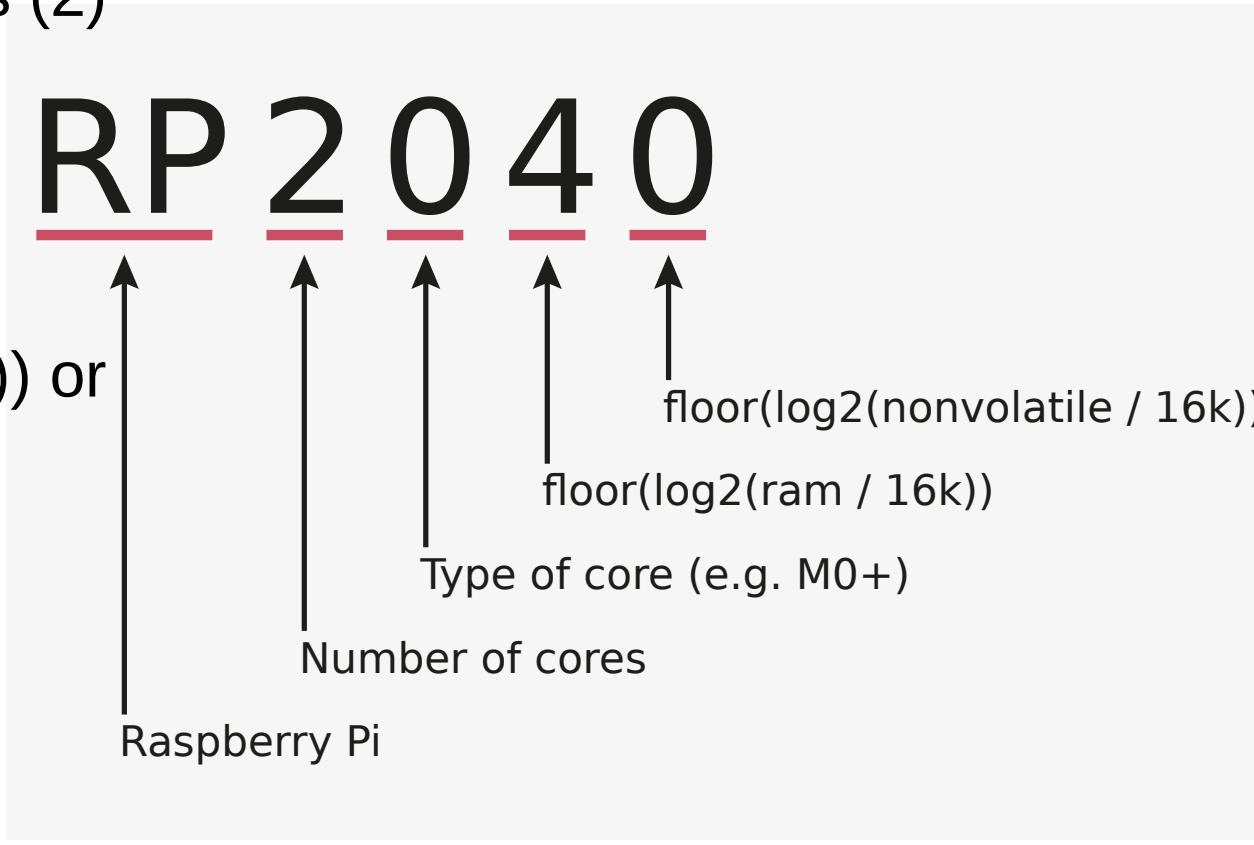
RP2040

- RP
-


RP2040
IOs
Crystal
SWD
GPIO
[29:0]
QSPI
Clock
generation
Internal
oscillator
PLL
PLL
Interrupts
Proc0
Proc1
SIO
DMA
Peripherals
SPI ×2
PWM
UART ×2
Timer
RTC
I2C ×2
ADC & TS
Reset control
Power on state
machine
Sysctrl
Sysinfo
Watchdog
Bus Fabric
PIO0
PIO1
PIO
XIP /
Cache
ROM
SRAM
SRAM
SRAM
SRAM
SRAM
SRAM
Memory
USB
Core Supply Regulator

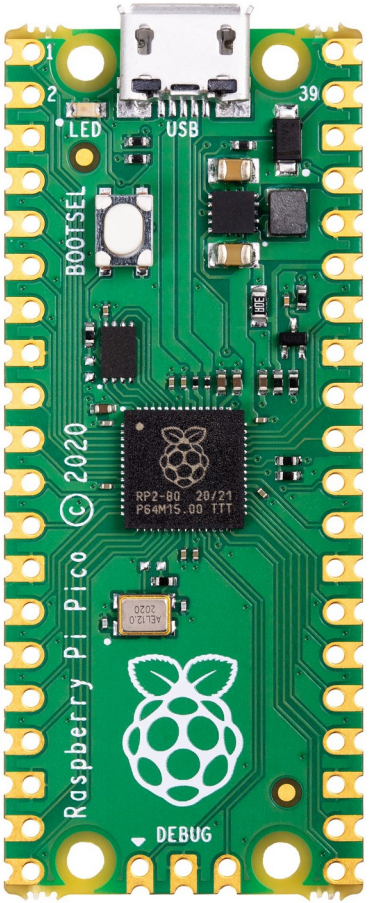
RP2040 – Model Numbering Scheme

- Manfacturer – Raspberry Pi
- Number of processor cores (2)
- Loosely which type of processor (M0+)
- floor(log2(ram / 16k))
- floor(log2(nonvolatile / 16k)) or 0 if no onboard nonvolatile storage

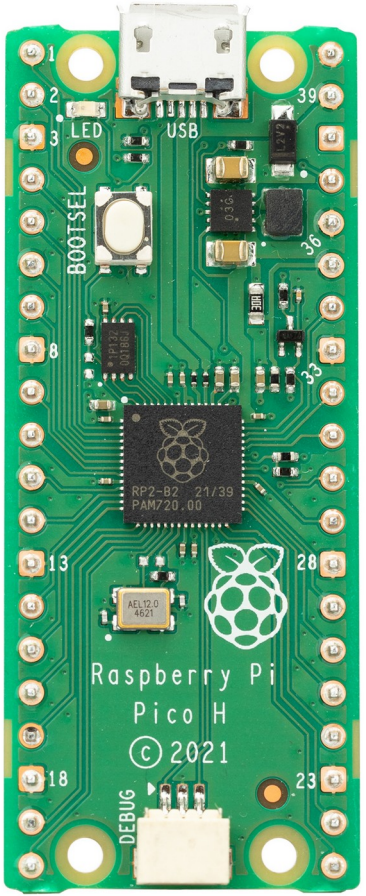



```
>>> math.floor(math.log2(256000/16000))
```

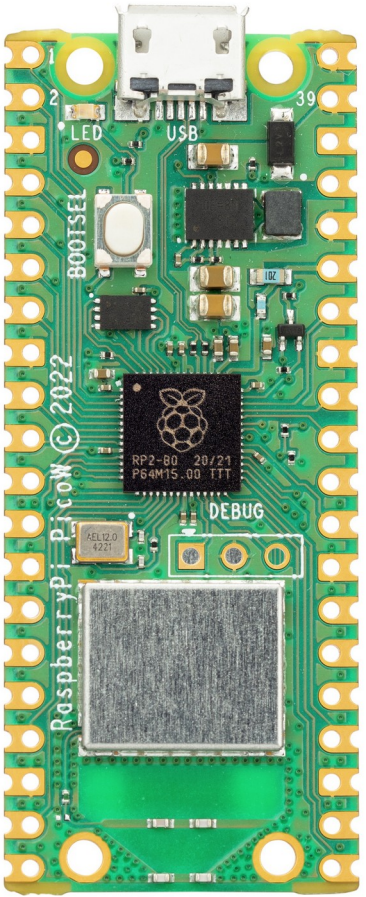
Raspbery Pi Pico - family of RP2040-based boards



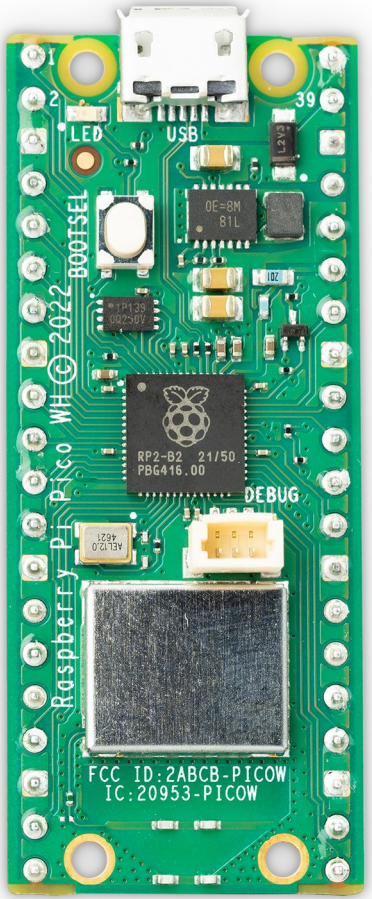
Pico $8



Pico H $10

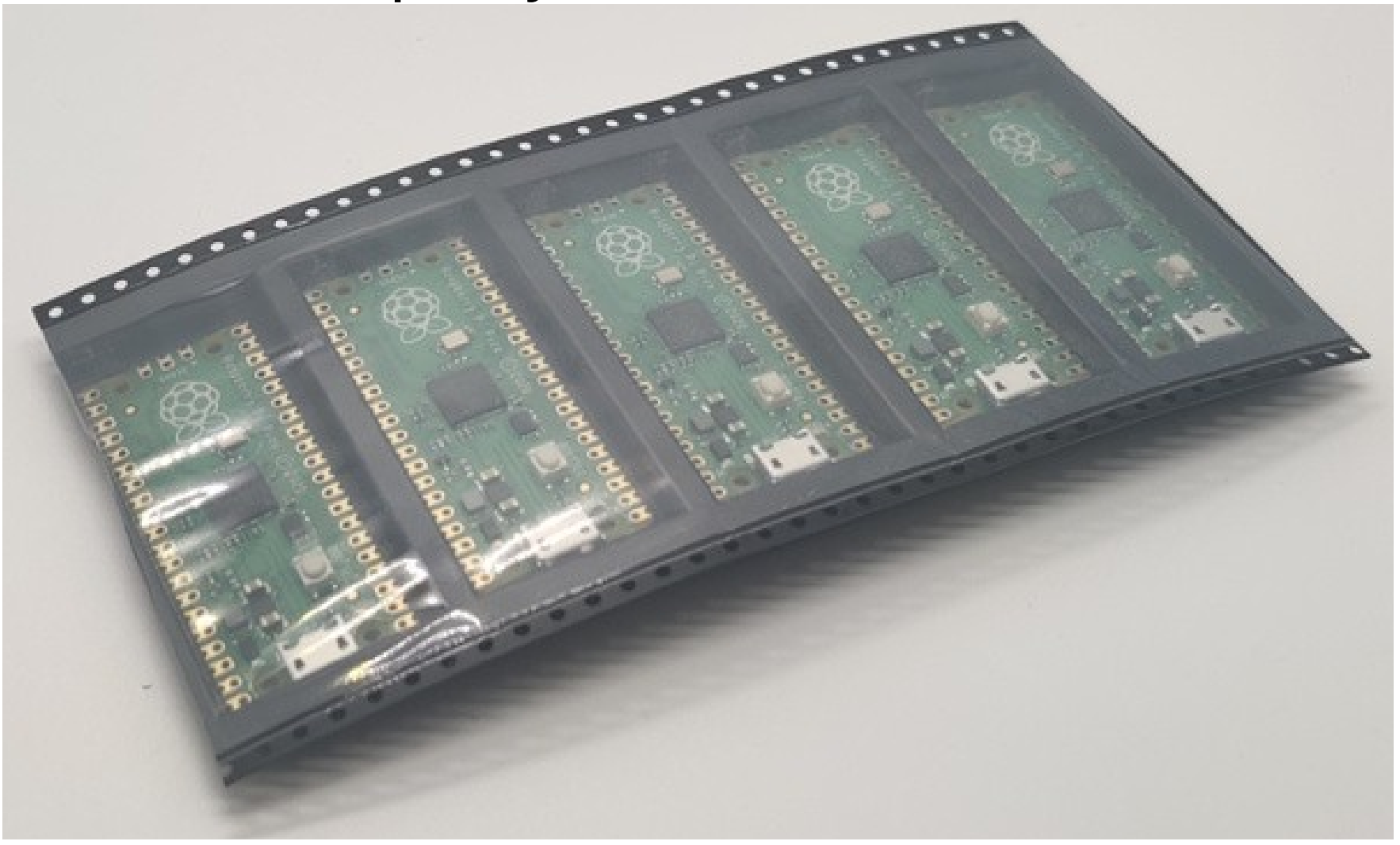


Pico W $12



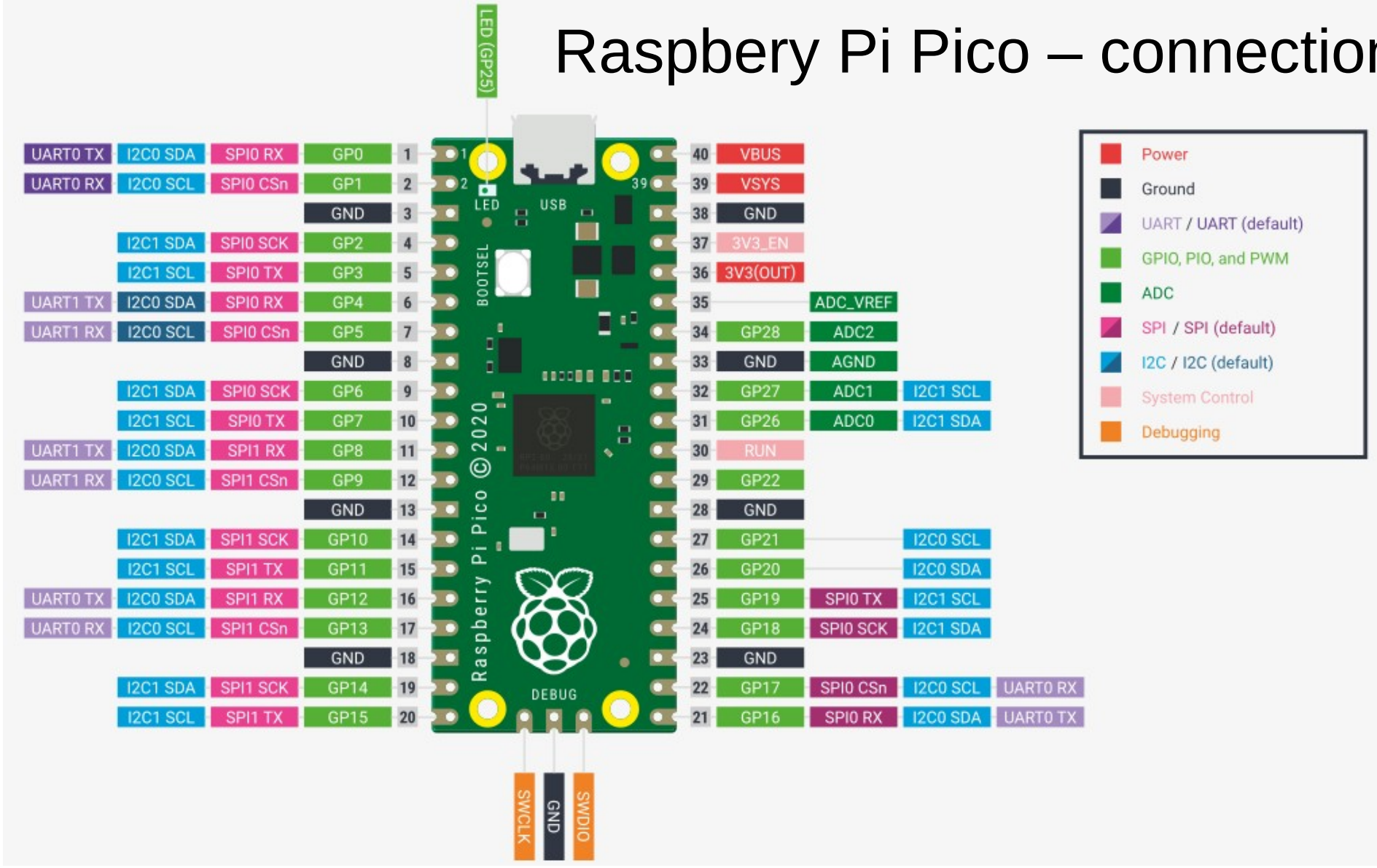
Pico WH ?

Raspbery Pi Pico – 5 Pack.

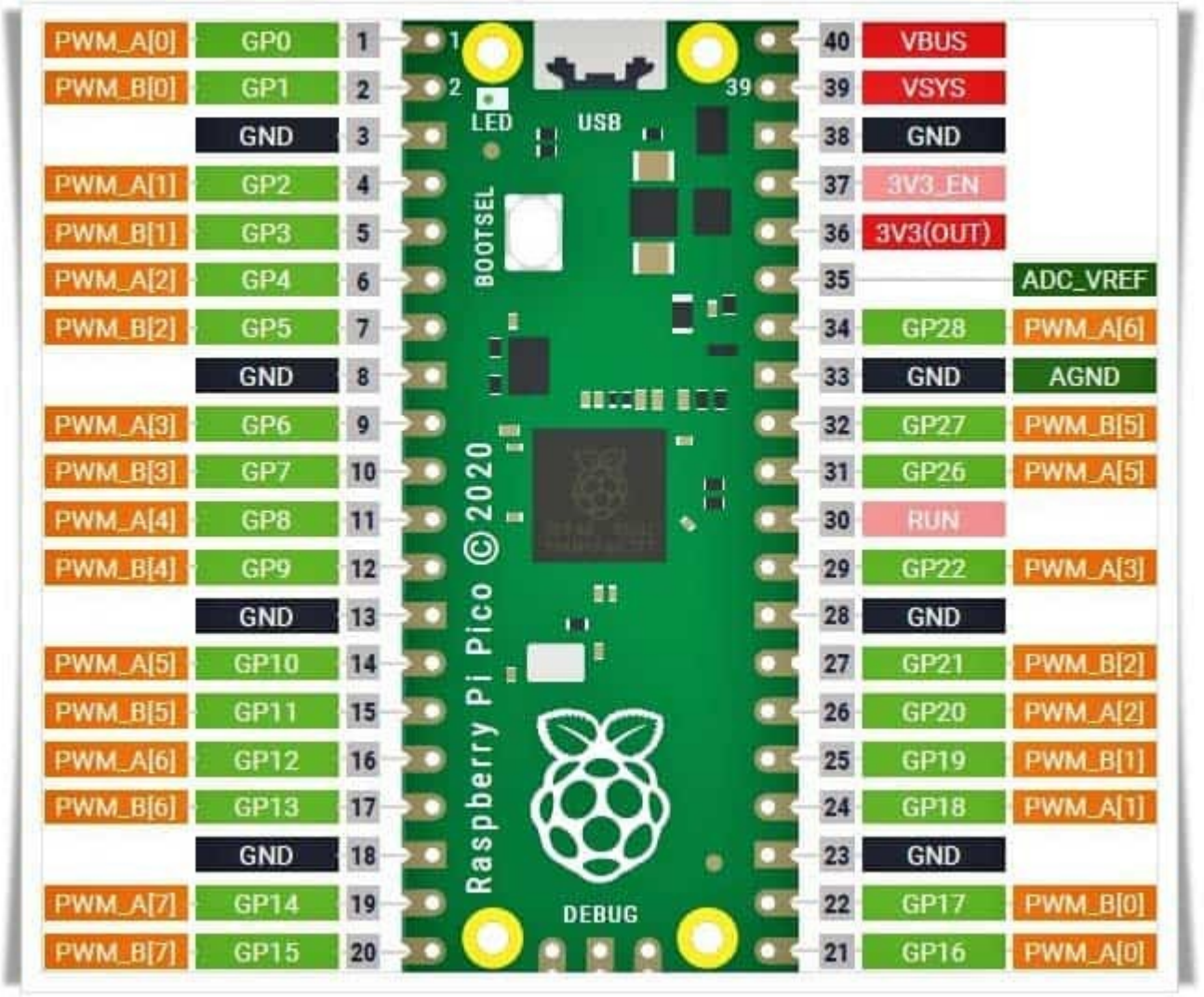


Raspbery Pi Pico – On a roll

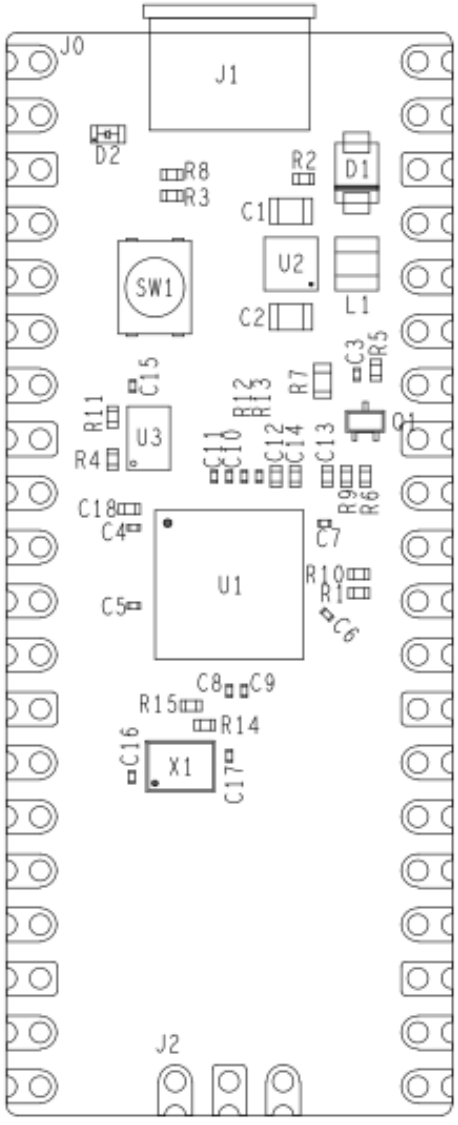
Raspbery Pi Pico – connections



Raspbery Pi Pico - family of RP2040-based boards



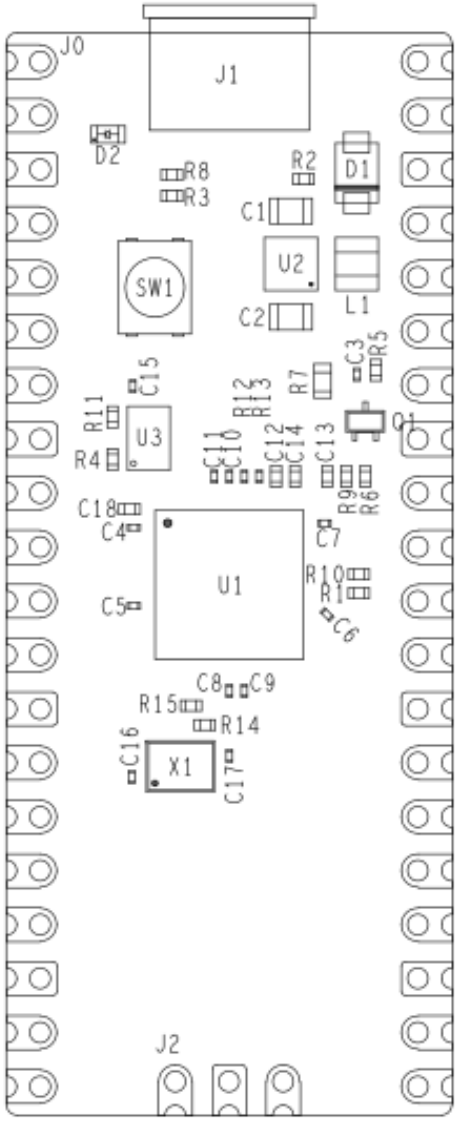
PWM



Raspbery Pi Pico

Operating Temp Max85°C
Operating Temp Min-20°C
VBUS5V ± 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	2.5x 2.5	Richtek	Buck-Boost Switching Regulator IC Positive Fixed 3.3V
U3	W25Q16JVUXIQ	2x3	Winbond	16M-bit 2M x 8 6ns
X1	12MHz	3.2x 2.5	AEL	Crystal Oscillator

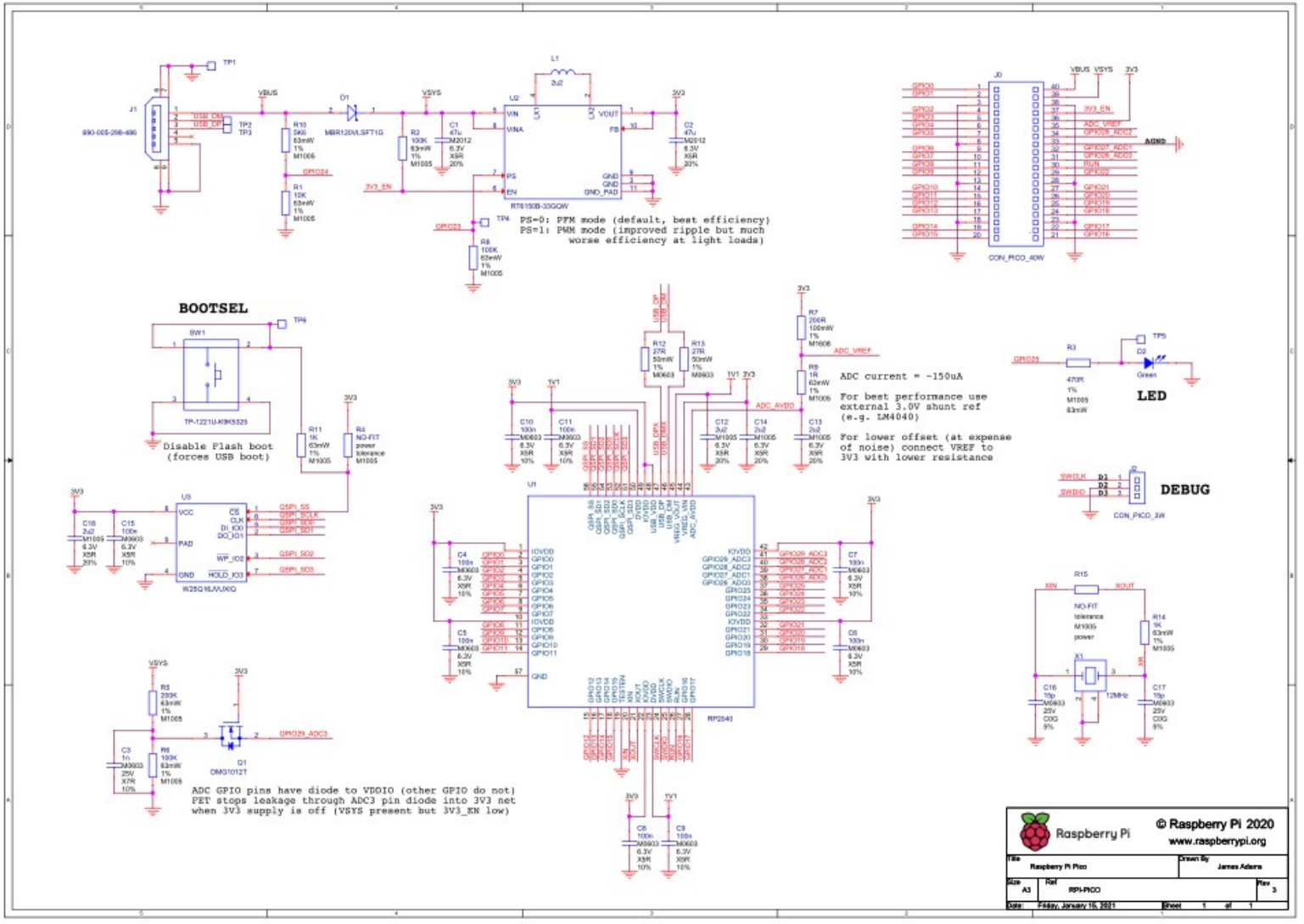


Raspbery Pi Pico – Components

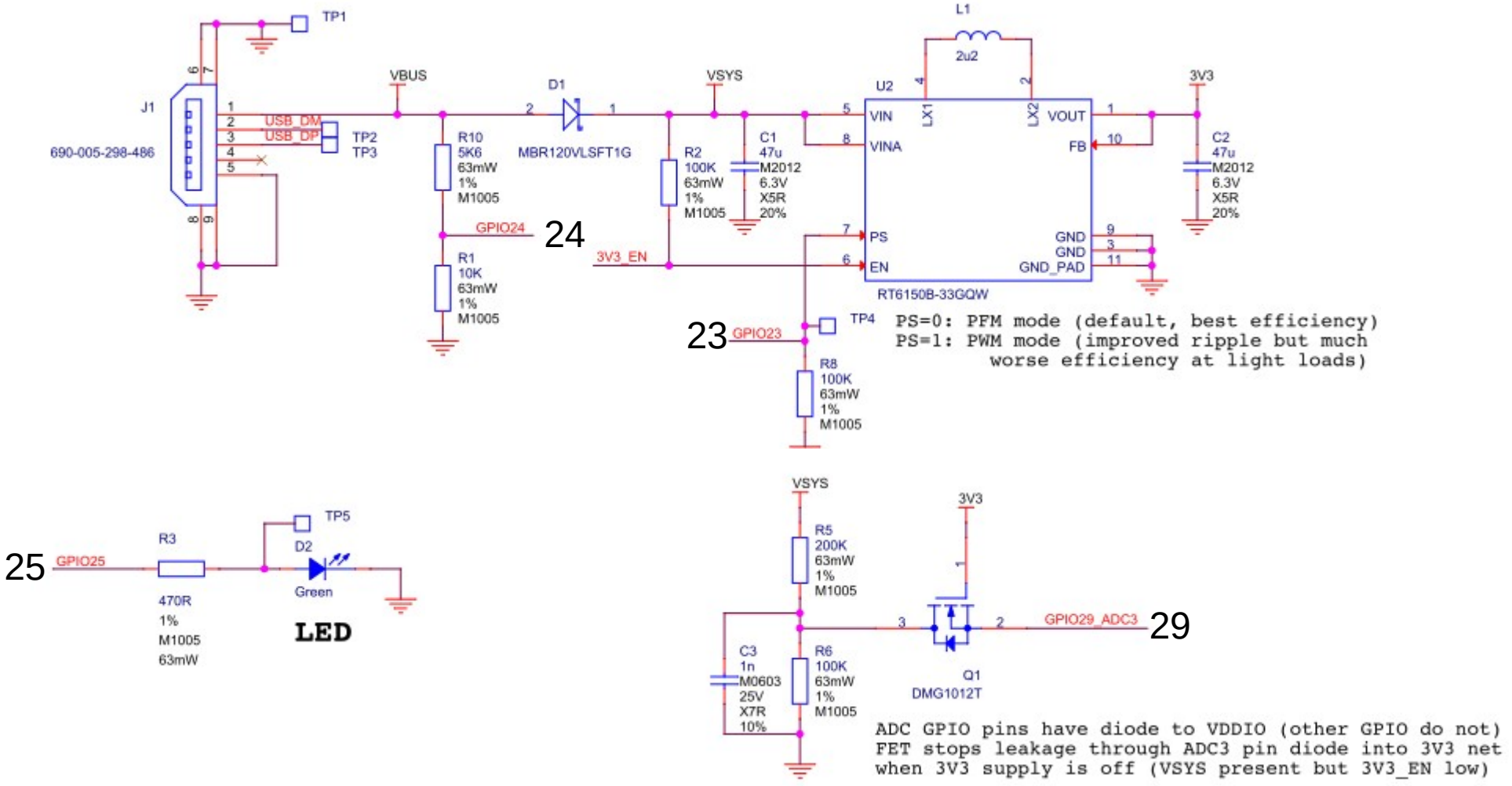
- 3 x ICs: RP2040, +3.3V Regulator, 2MB Flash
- 18 x Capacitors
- 1 x Crystal (12MHz)
- 2 x Diodes (1 x LED)
- 1 x Mosfet
- 1 x Inductor
- 15 x Resistors
- 1 x Switch

- 6 x Test Points

Raspbery Pi Pico – Schematic

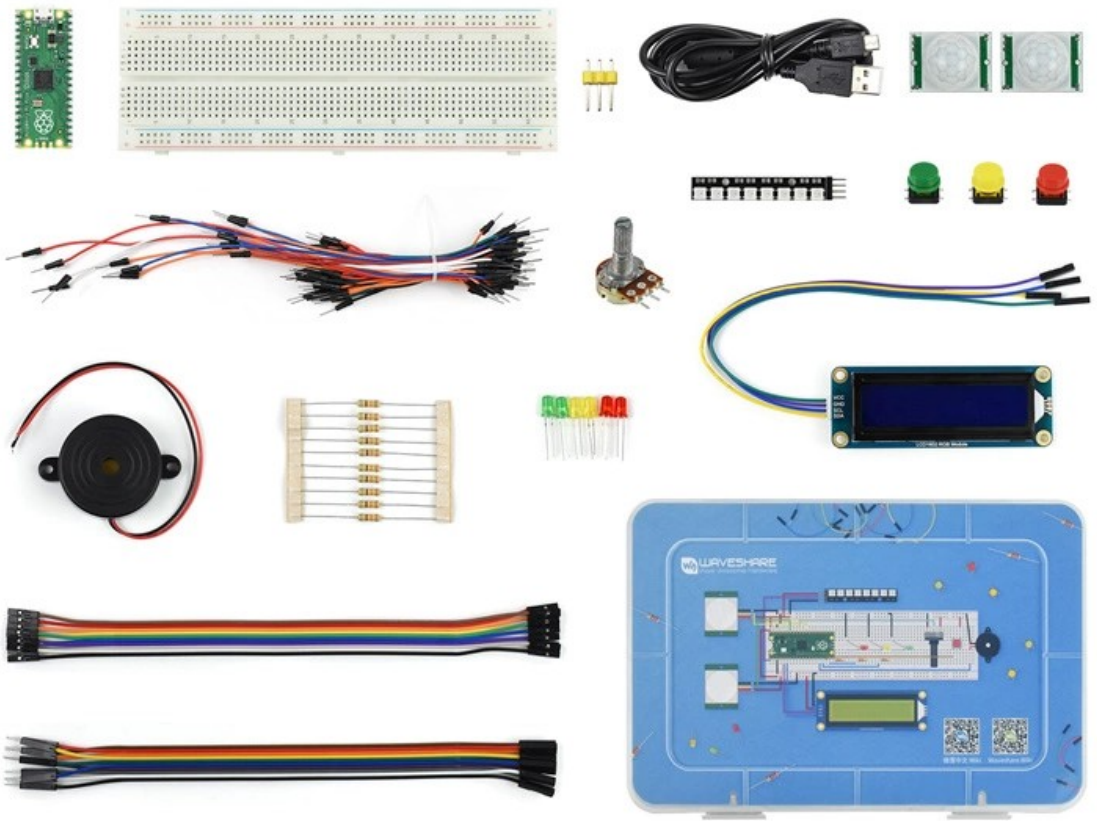


Raspbery Pi Pico – RP2040 GPIO used by Pico



ADC4 – Monitor CPU Temperature internal to RP2040

Raspbery Pi Pico – addons / evaluation kits



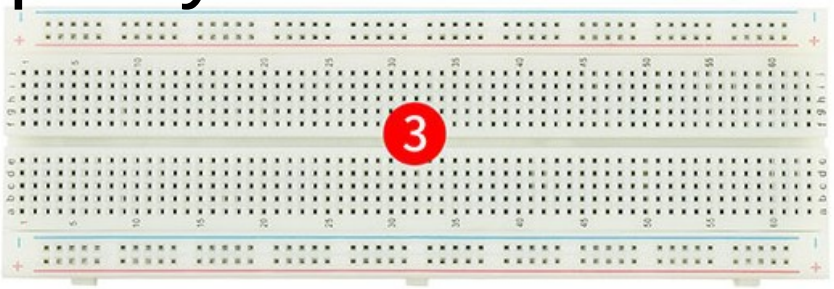
Kit Contents:

- 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

Raspbery Pi Pico – addons / evaluation kits

1



4

2

5

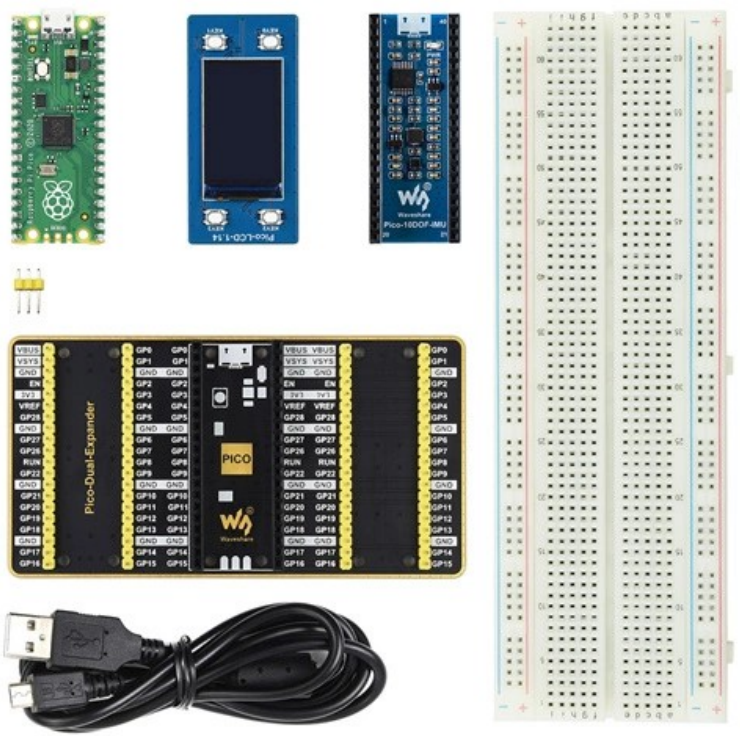
6

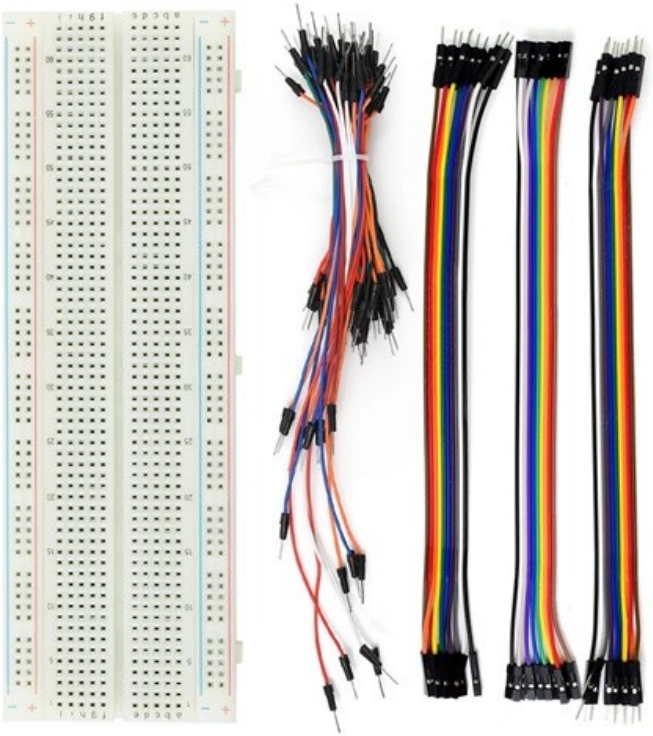
Sensors:

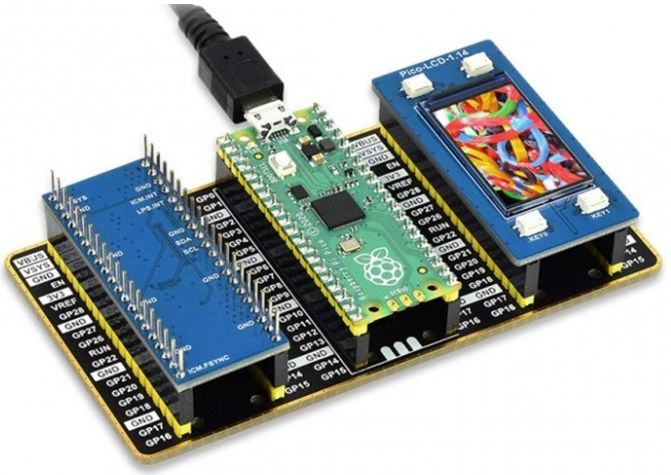
- MQ-5 Gas
- Color
- Flame
- Hall
- Infrared Reflective
- Laser
- Moisture
- Rotation
- Sound
- Temperature-Humidity
- Tilt
- UV
- Liquid Level

Sensor Kit Development & Expansion Boards Kit Pack $110

Raspbery Pi Pico – addons / evaluation kits

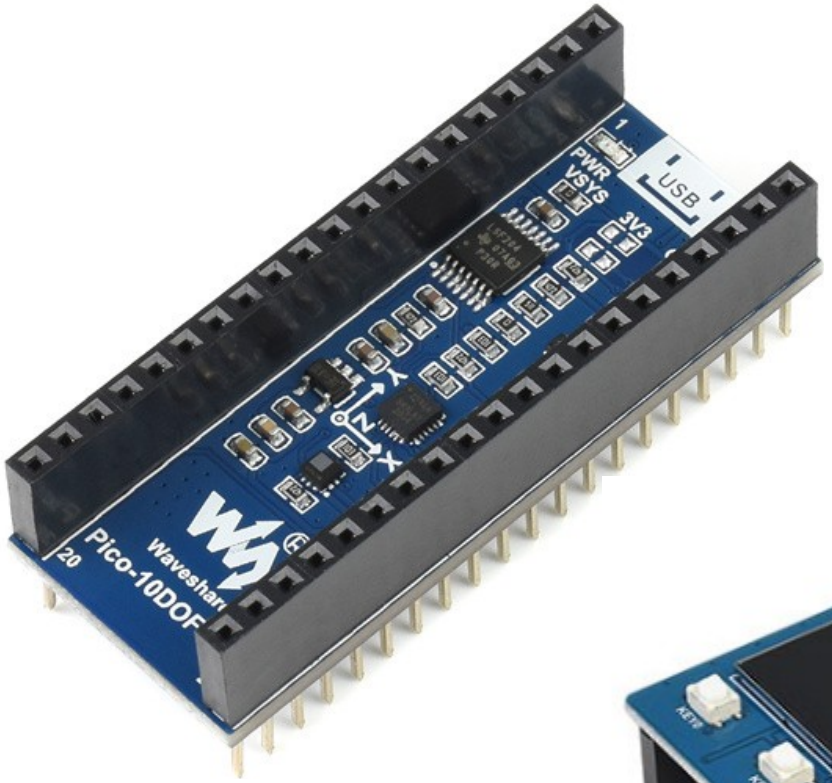


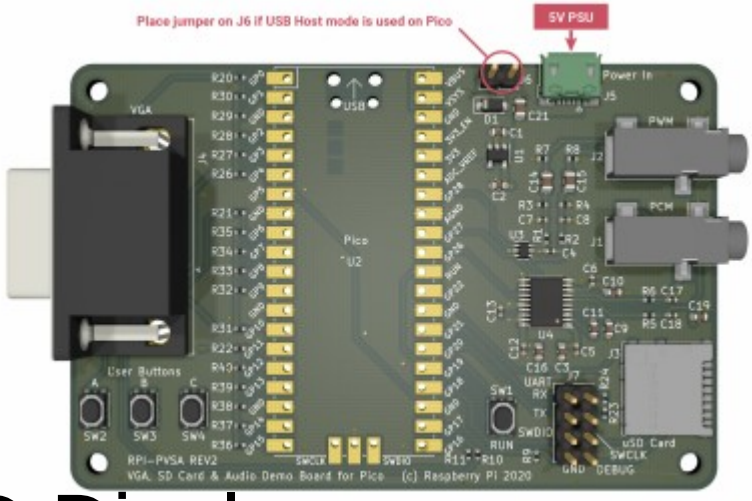




Evaluation Kit Type B The Pico + Colour LCD + IMU Sensor + GPIO Expander $100

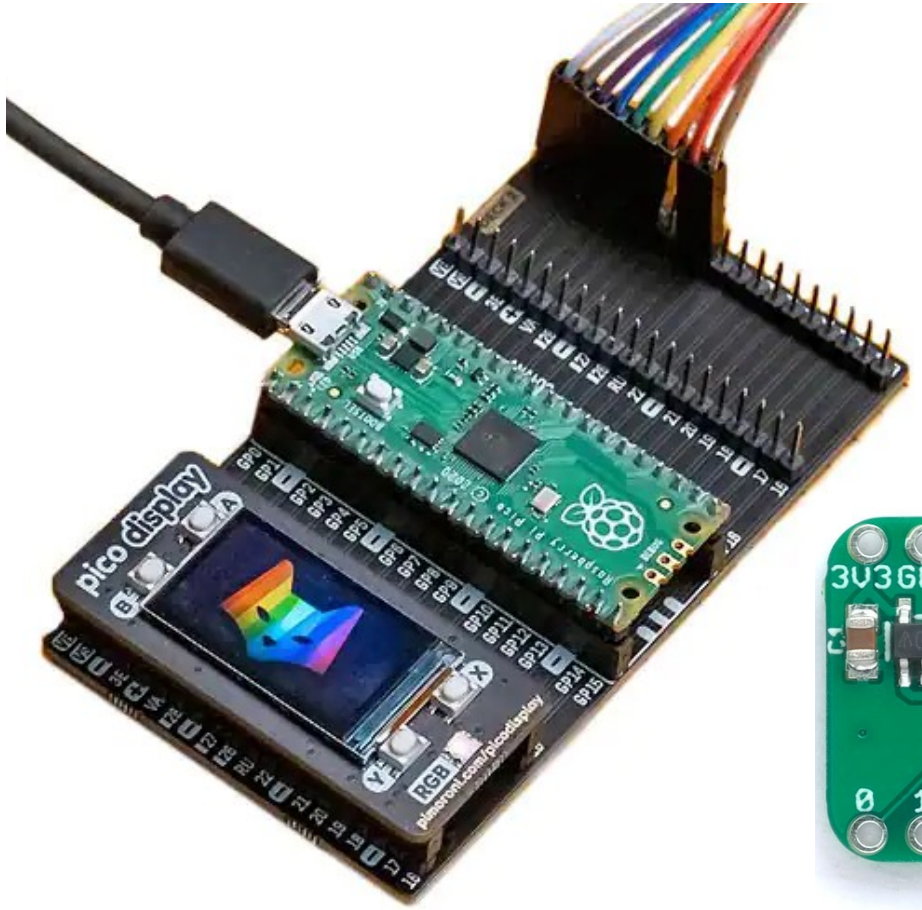
Raspbery Pi Pico – addons / evaluation kits





Sensor expansion module / LCD Displays

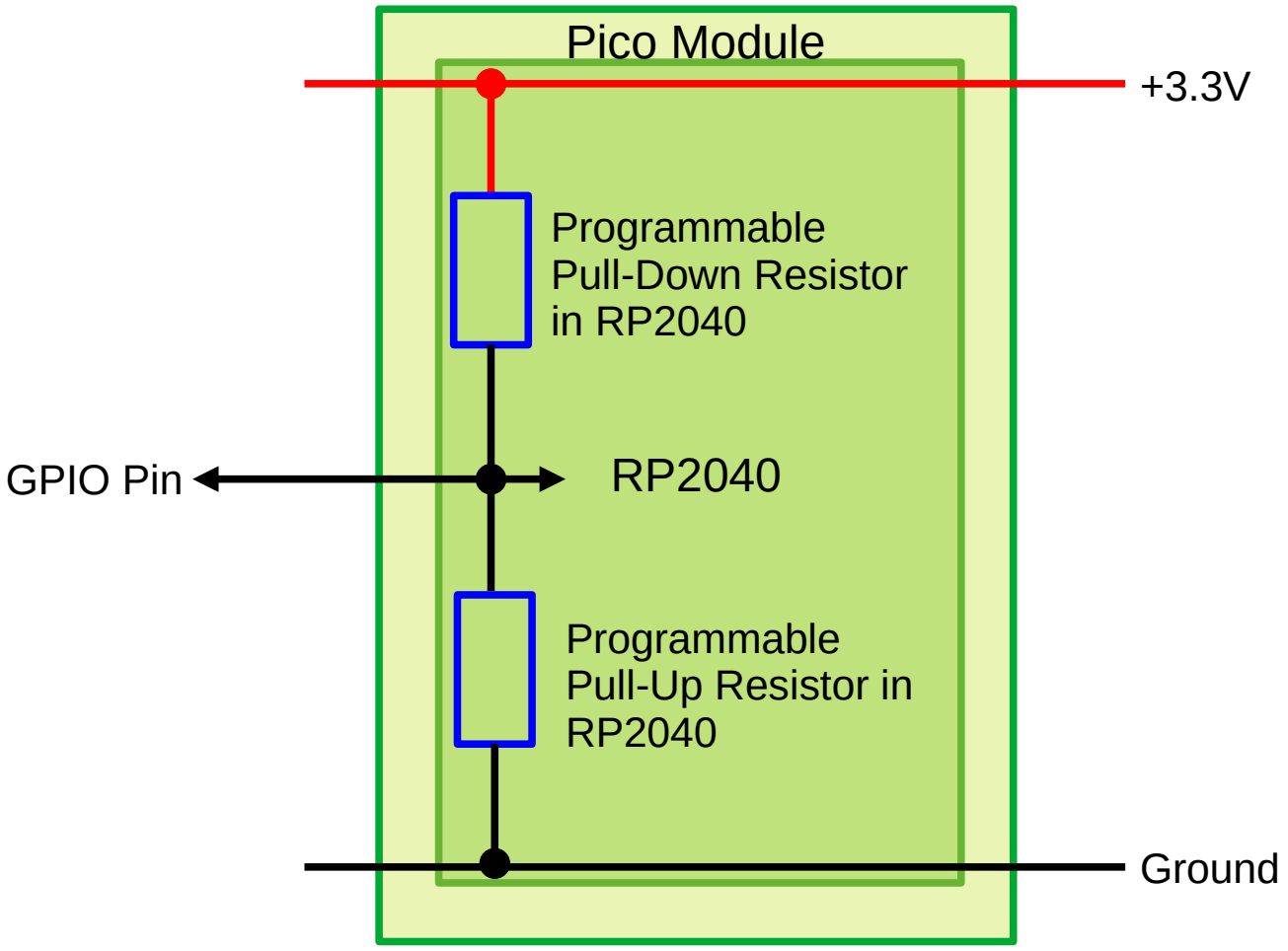
Raspbery Pi Pico – addons 3rd Party



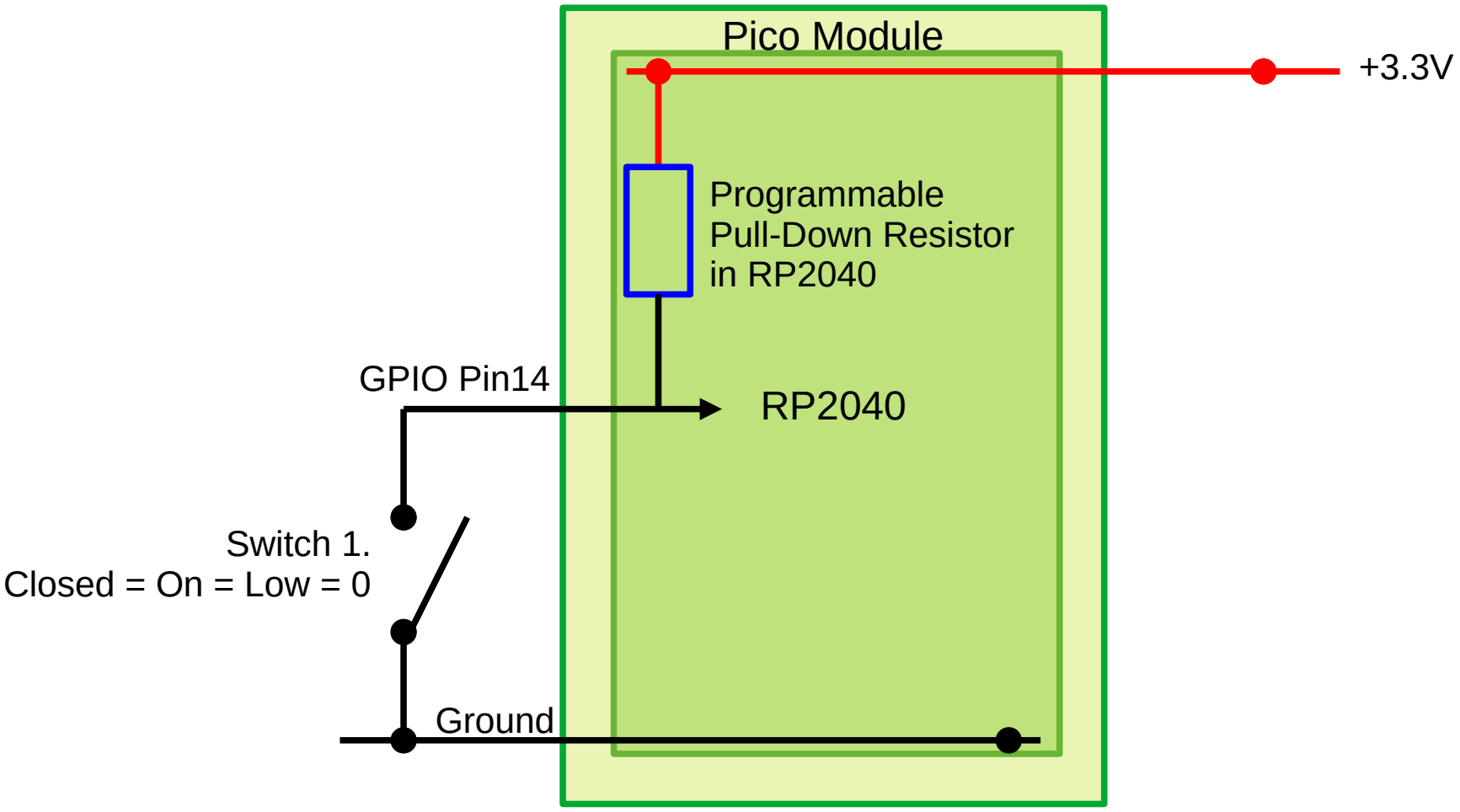
Manufacturer Pimoroni Ltd
Manufacturer Product Number PIM556
Description PICO OMNIBUS (DUAL EXPANDER)

3rd Party 40pin Board – 30 x GPIO

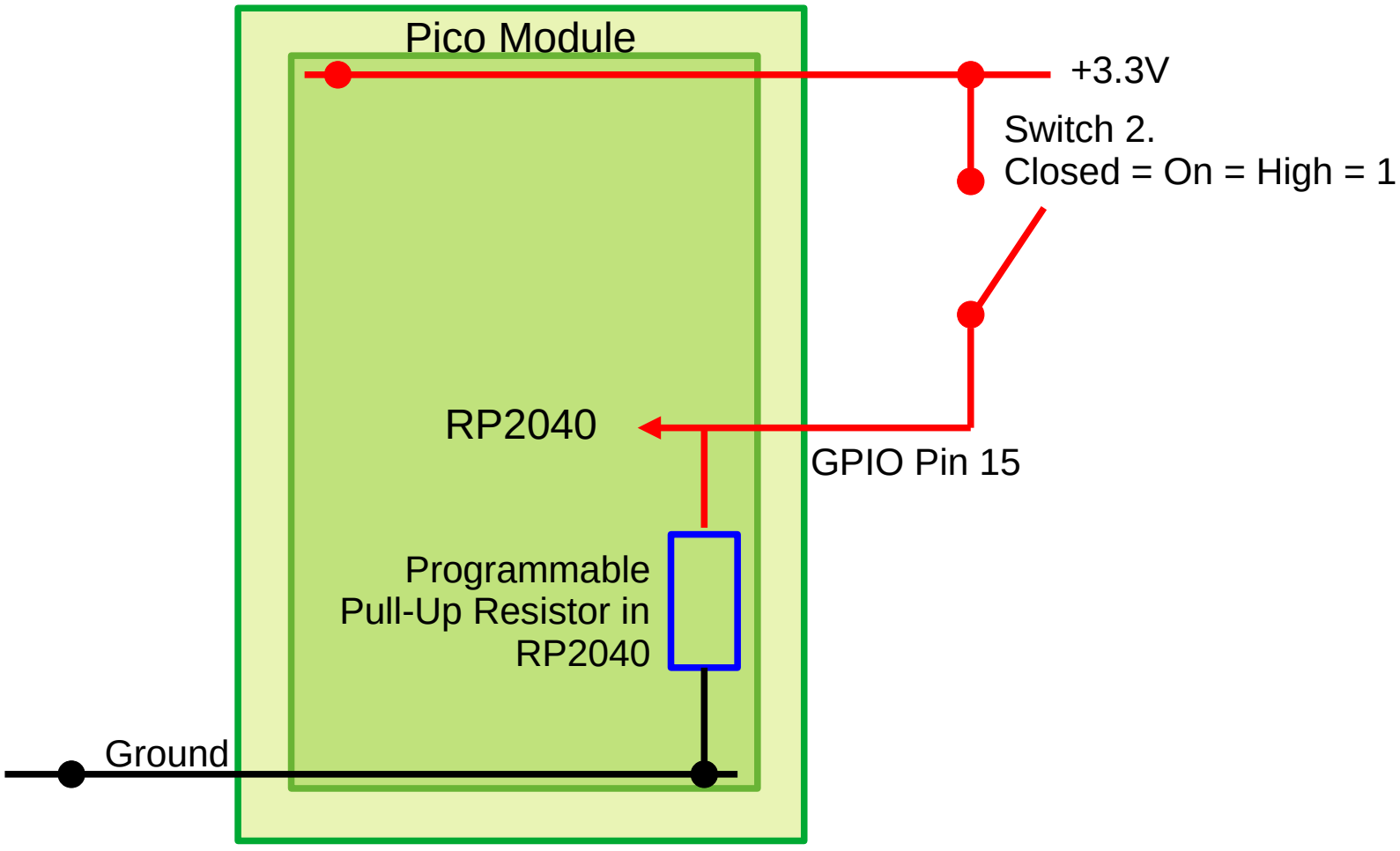
GPIO IN/OUT Circuits

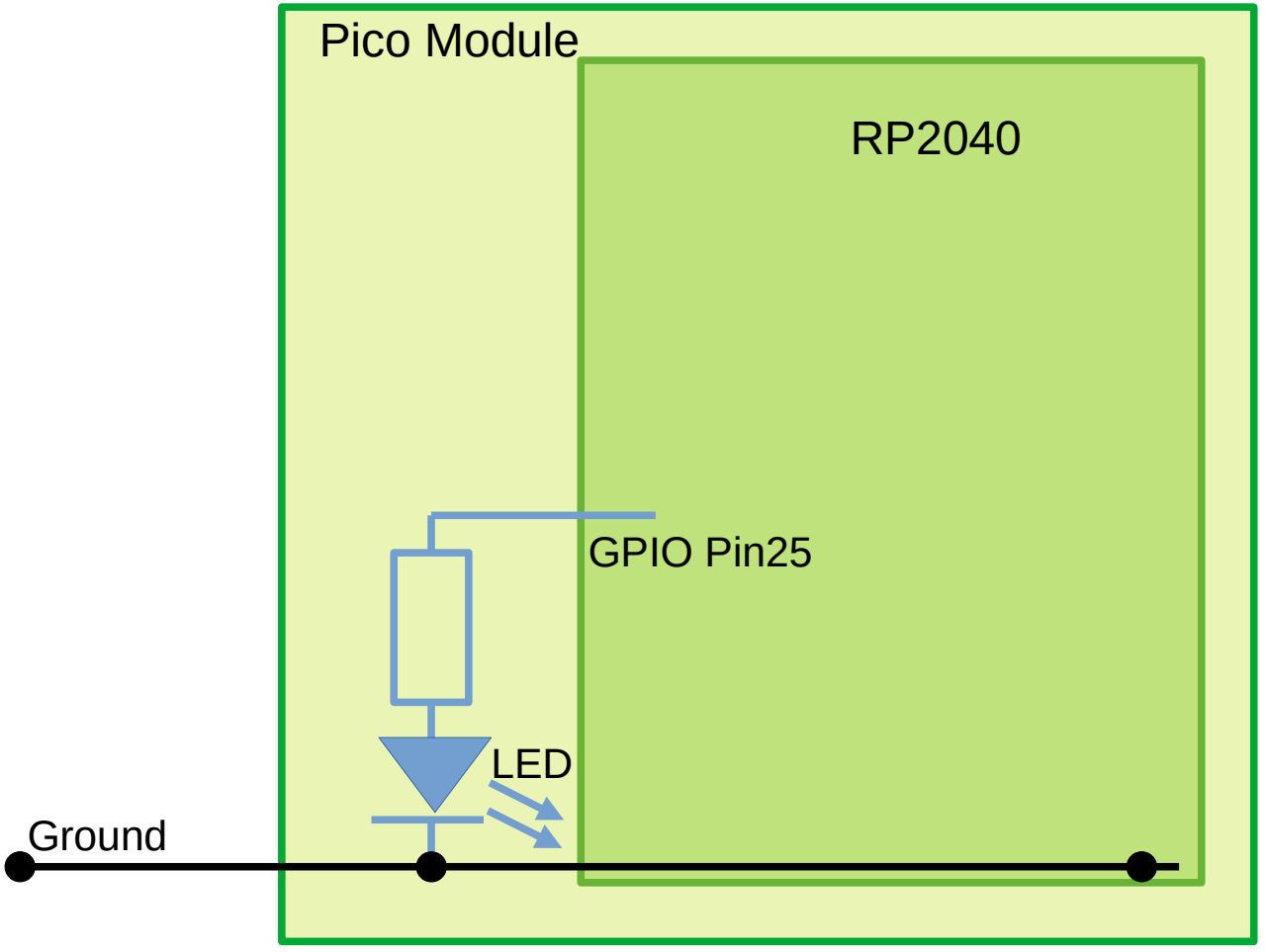


GPIO Pin IN Pull-Down

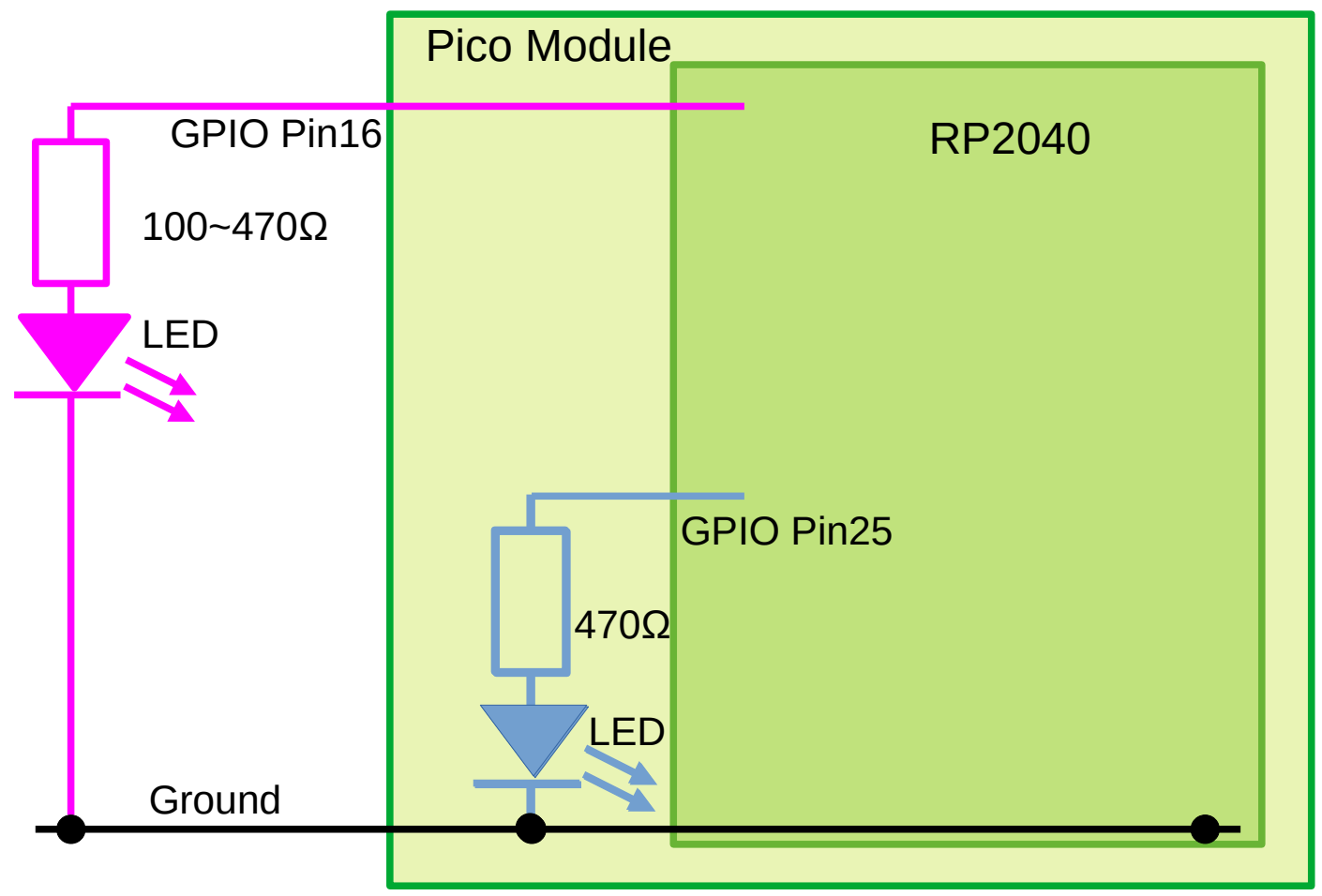


GPIO Pin IN Pull-Up





GPIO Pin OUT on Pico Module



GPIO Pin OUT on Pico Module.

GPIO Pin OUT External

Part 1 End.
Demo Hardware.