Raspberry Pi 5: The Everything Computer – Optimized

Chris Boross
Raspberry Pi Ltd

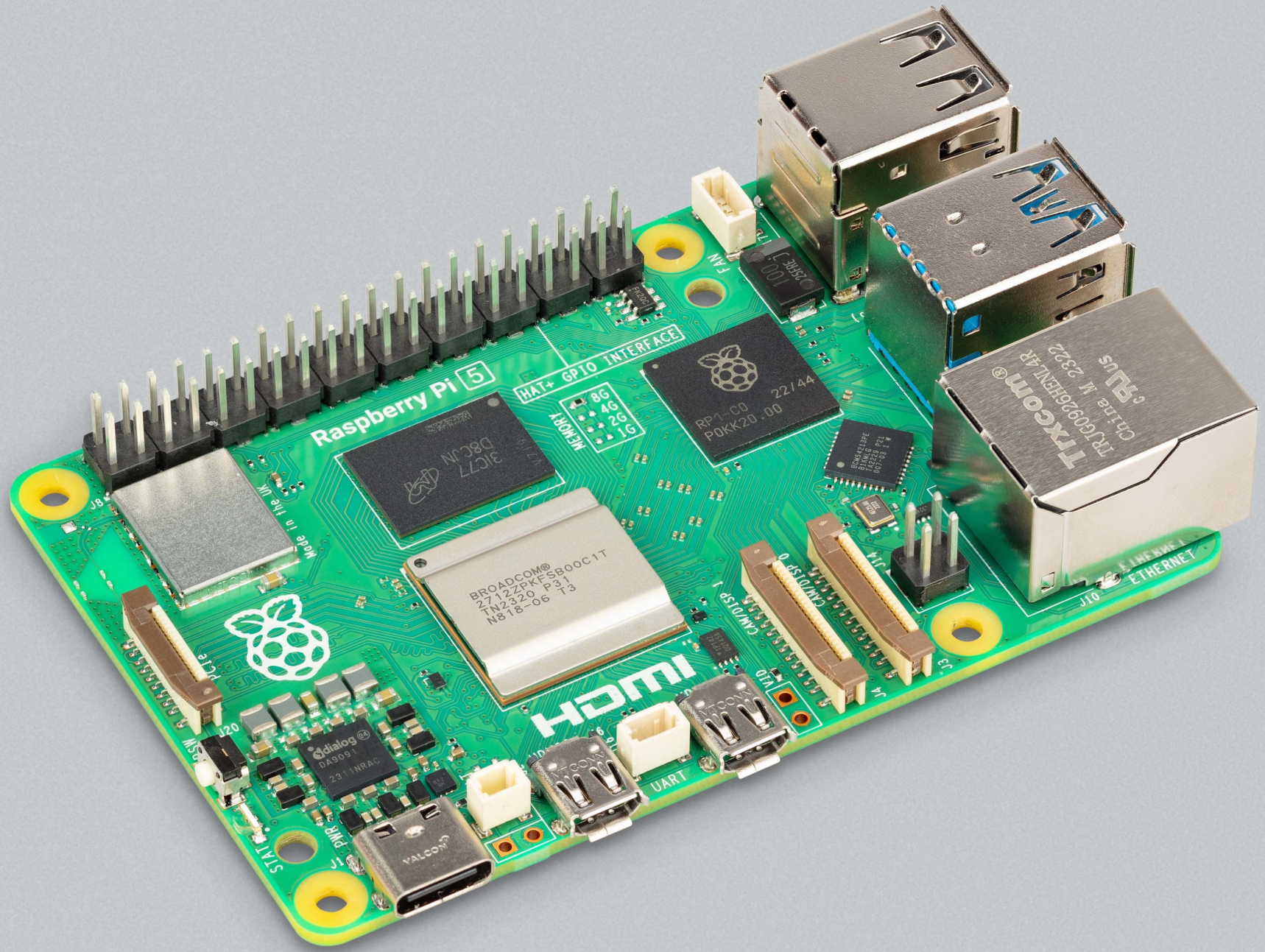
12th December 2023

Topics covered

- A little about me
- Raspberry Pi 5
- Compute Module 4
- RP2040 Microcontroller
- Q & A

A little about me

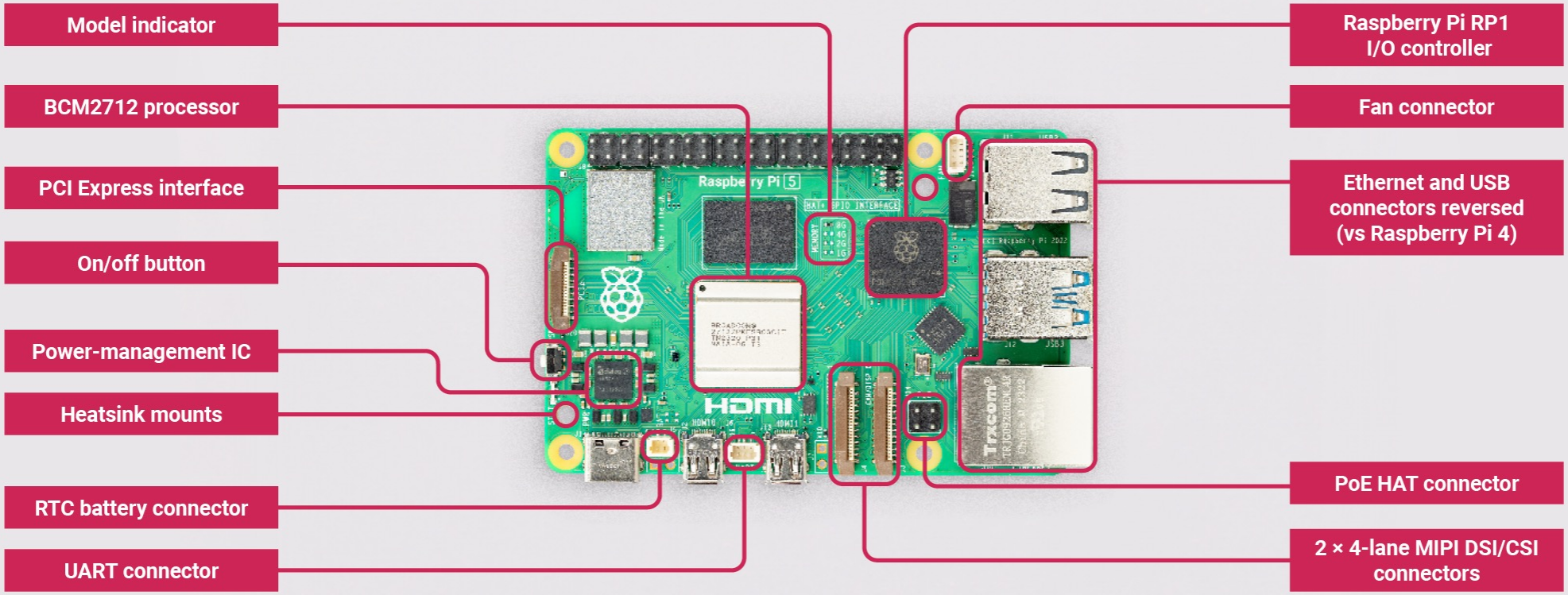
- Part of Raspberry Pi’s commercial team
- Based in California
- Semiconductors, networking technologies
- Consumer and industrial electronics
- Ex-Broadcom, Nest, Google, eero and Thread Group
- Dog is called Fritz


Raspberry Pi 5
HAT+ GPIO INTERFACE
8G
4G
2G
1G
MEMORY
RP1-C0
P0KK20.00
22/44
BROADCOM®
2712ZPKFSB00C1T
TN2320 P31
N818-06 T3
dialog
DA9091
2311NRAC
HDMI
UART
ETHERNET
FAN
CAM/DISP 0
CAM/DISP 1
Made in the UK

Raspberry Pi 5 comparison

	Raspberry Pi 4	Raspberry Pi 5	
CPU	Broadcom BCM2711, quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.8GHz	**Broadcom BCM2712, quad-core Cortex-A76 (ARM v8), 64-bit SoC @ 2.4GHz**	**2-3 × performance**
RAM	1GB, 2GB, 4GB, 8GB	**1GB, 2GB, 4GB, 8GB**	**4GB and 8GB only at launch**
Connectivity	2.4GHz and 5.0GHz 802.11ac wireless	2.4GHz and 5.0GHz 802.11ac wireless	
	Bluetooth 5.0, BLE	Bluetooth 5.0, BLE	
	Gigabit Ethernet	Gigabit Ethernet	
	N/A	**1 x PCIe 2.0 interface**	**High-speed peripheral interface (for SSDs etc)**
	2 × USB 3.0, 2 × USB 2.0 ports	**2 × USB 3.0 supporting simultaneous 5Gbps operation,** 2 × USB 2.0 ports	
	Standard 40-pin GPIO header	Standard 40-pin GPIO header	
	2 × micro HDMI ports (up to 4Kp60)	2 × micro HDMI ports (up to 4Kp60)	
	2-lane MIPI DSI, 2-lane MIPI CSI	**2 × 4-lane MIPI (DSI/CSI)**	
	4-pole stereo audio and composite video	**N/A**	
OS and data storage	microSD card slot	**microSD card slot with support for high-speed SDR104 mode**	**2 × interface speed**
Input power	5V/3A DC (via USB-C connector or GPIO)	**5V/5A DC (PD-enabled)**	**New Raspberry Pi power supply for launch**
PoE	Via separate PoE HAT	**Via separate new PoE HAT**	**Fully PoE 802.3at compliant**
Real Time Clock (RTC)	N/A	**RTC and RTC battery connector**	

The anatomy of Raspberry Pi 5



Model indicator

BCM2712 processor

PCI Express interface

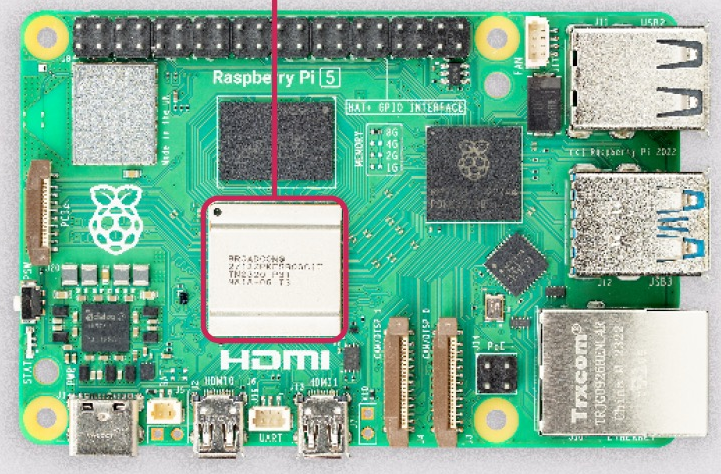
On/off button

Power-management IC

Heatsink mounts

RTC battery connector

UART connector



Raspberry Pi RP1 I/O controller

Fan connector

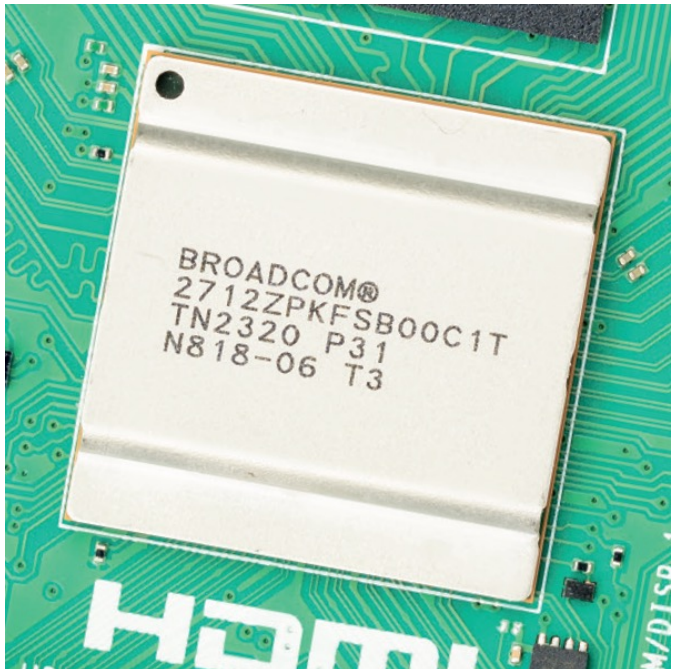
Ethernet and USB connectors reversed (vs Raspberry Pi 4)

PoE HAT connector

2 × 4-lane MIPI DSI/CSI connectors

Broadcom BCM2712

- Quad-core Arm Cortex-A76 @ 2.4GHz
  - ARMv8-A ISA
  - 64KByte I and D caches
  - 512KB L2 per core, 2MB shared L3
- New Raspberry Pi-developed ISP
- Improved HVS and display pipeline
  - Dual 4Kp60 support
- VideoCore VII V3D
  - ~2-2.5× faster
  - OpenGL ES 3.1, Vulkan 1.3
- 4Kp60 HEVC hardware decode



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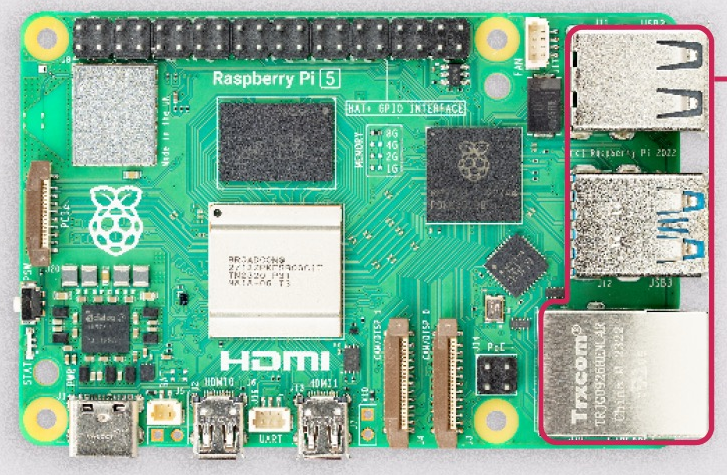

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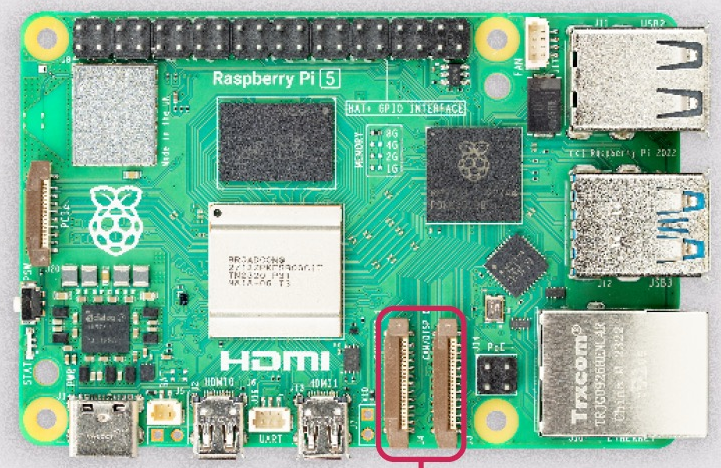

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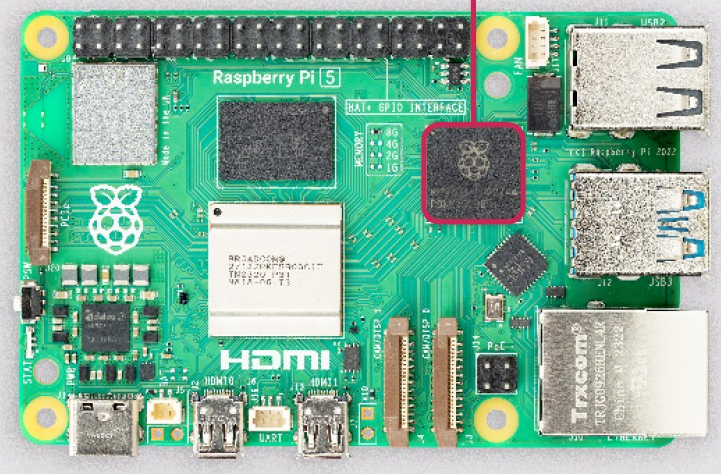

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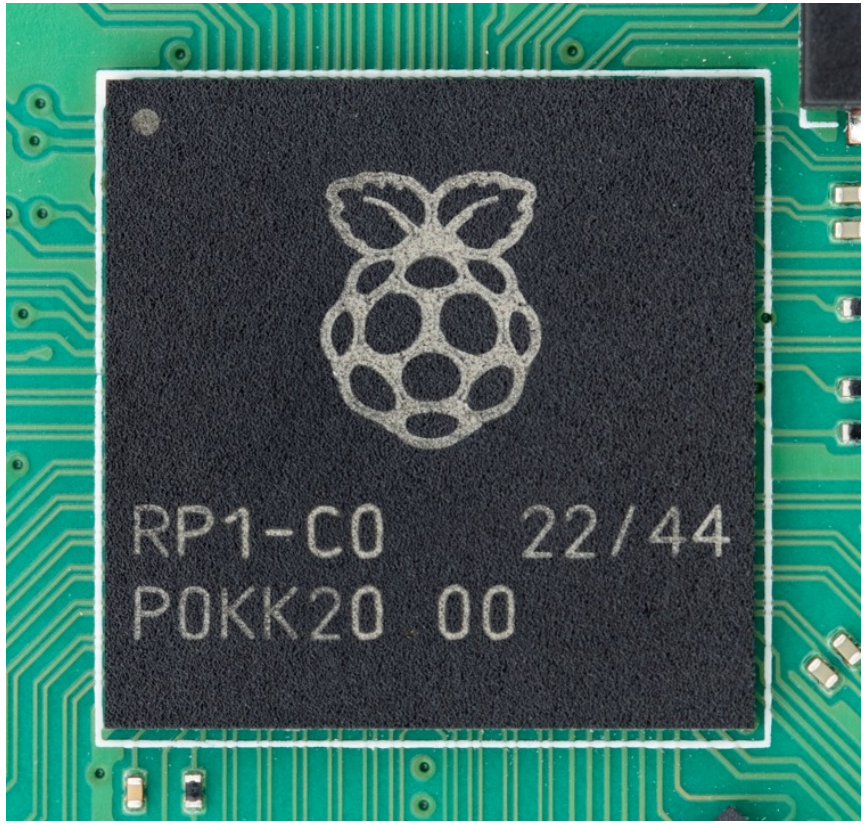
RP1 – I/O Controller



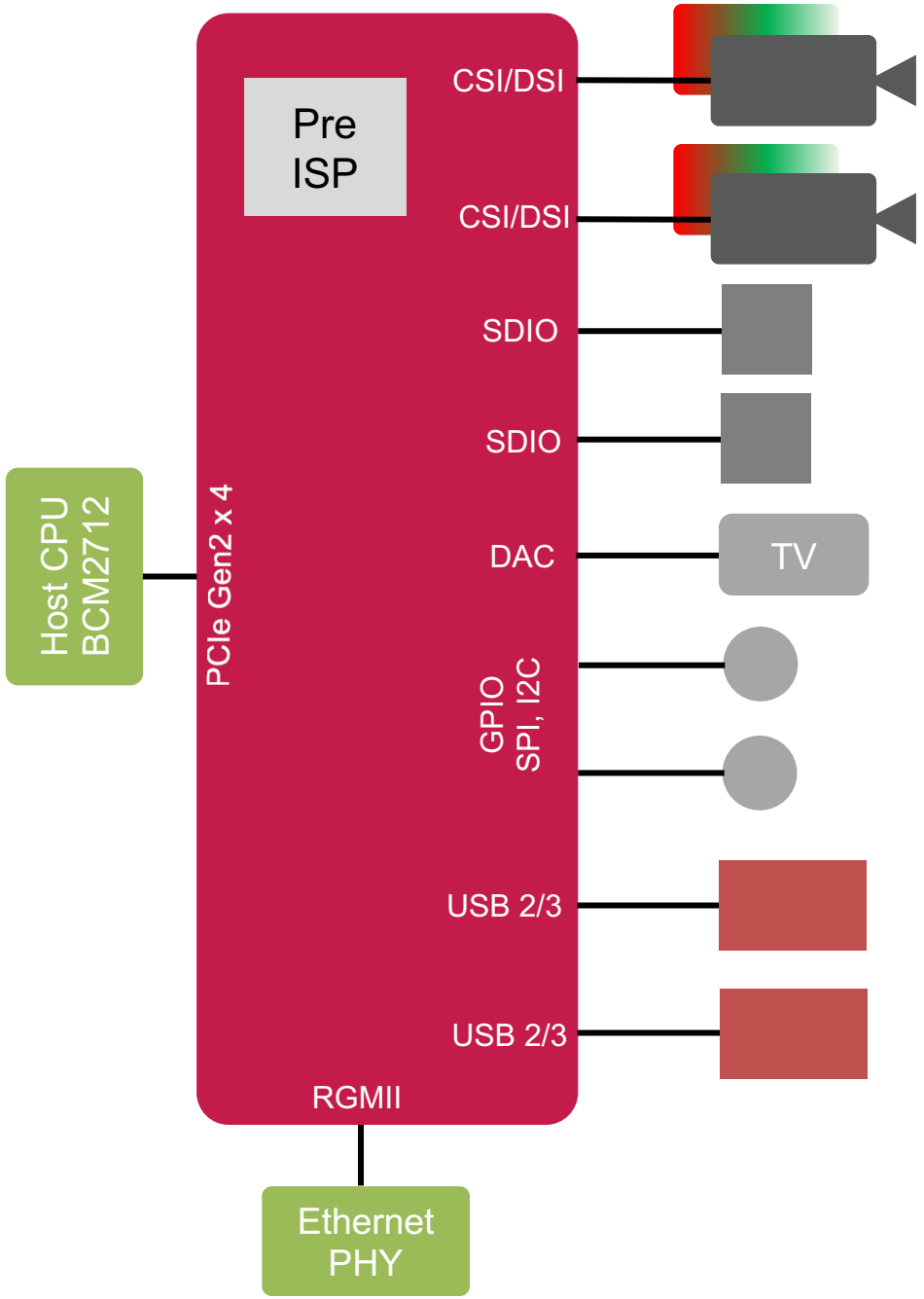
Raspberry Pi 5 is the first full-size Raspberry Pi computer to use silicon developed in-house at Raspberry Pi

The RP1 “southbridge” provides the majority of the I/O capabilities for Raspberry Pi 5

Pushing most system I/O onto a separate southbridge allows the main SoC to be simpler: Reducing cost, risk and timescales

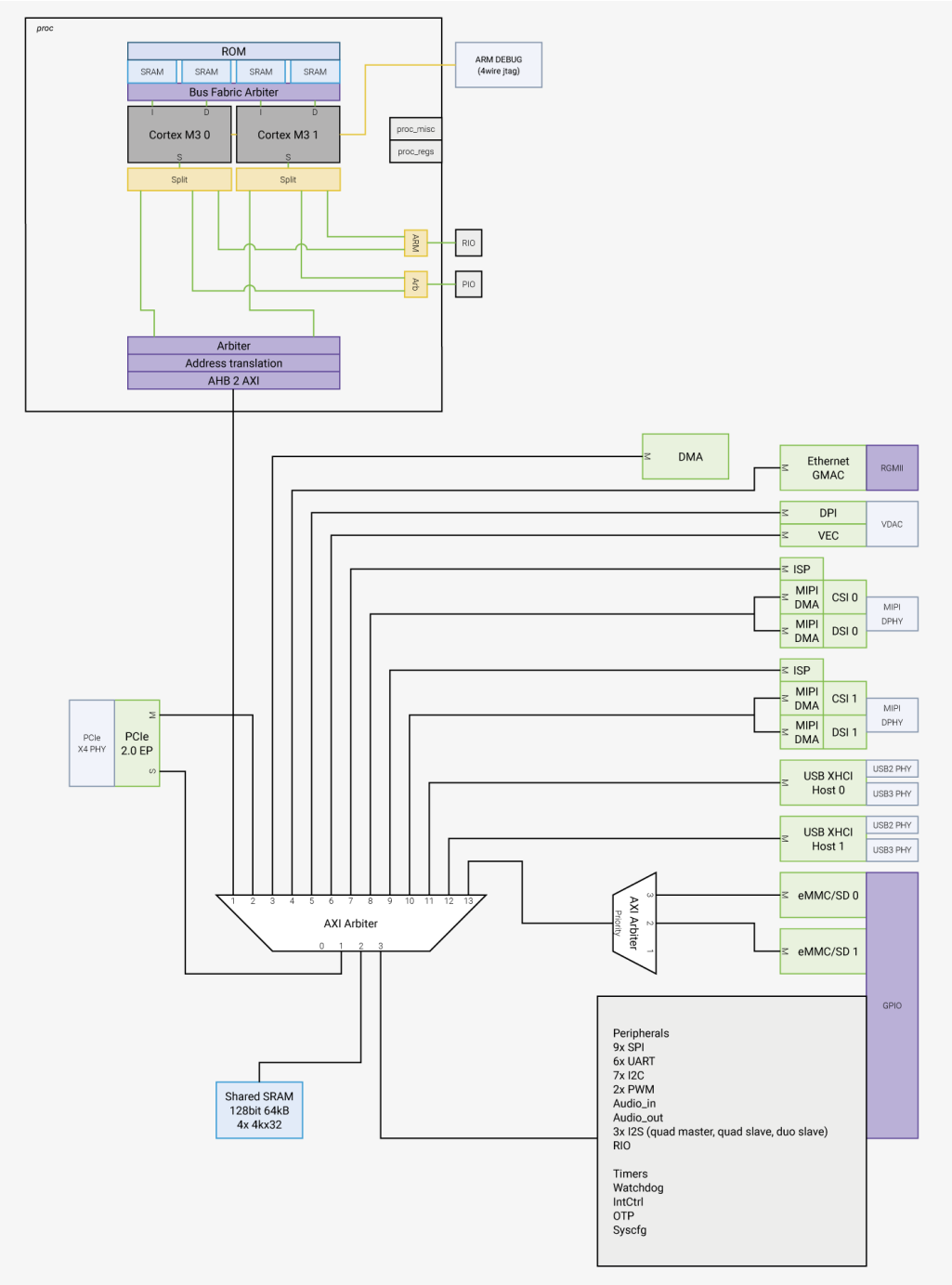
RP1 – I/O Controller

- 4-lane PCIe 2.0 endpoint
- Gigabit Ethernet MAC
  - Connection to external PHY using RGMII
- 2 × USB 3 host controllers
  - Each has 1 × USB 3 and 1 × USB 2 port
  - More than double the usable USB bandwidth vs Pi 4
- MIPI transceivers (4-lane, supporting DSI and CSI-2)
- Video DAC (3-channel, supporting PAL/NTSC and VGA)
  - Only one channel (composite) used on Pi 5
- Low-speed peripherals (SPI, UART, I2C, PWM, GPIO, I2S)
- Delta Sigma PWM audio out
- 12 × 12mm, 0.65mm-pitch BGA
  - Very optimised ballout



RP1 internal architecture

- TSMC 40LP
- Dual ARM M3 CPUs
- PIO block (Not available to host yet)
- 64KByte SRAM
- 8 channel DMA for slower peripherals
- 5 channel ADC (4 inputs + temp)
- High bandwidth AXI busses



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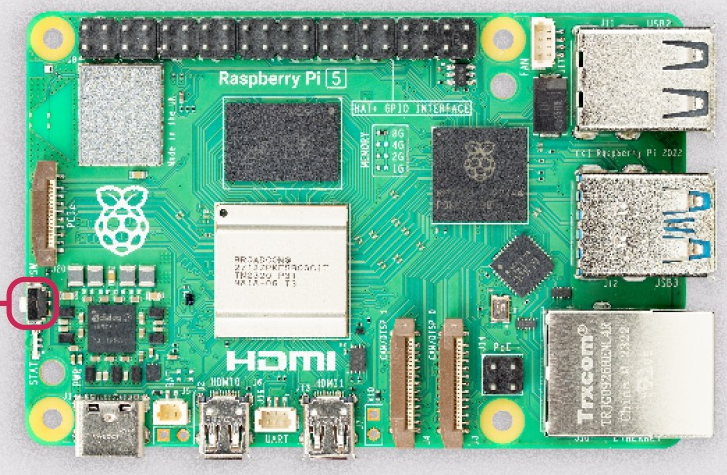

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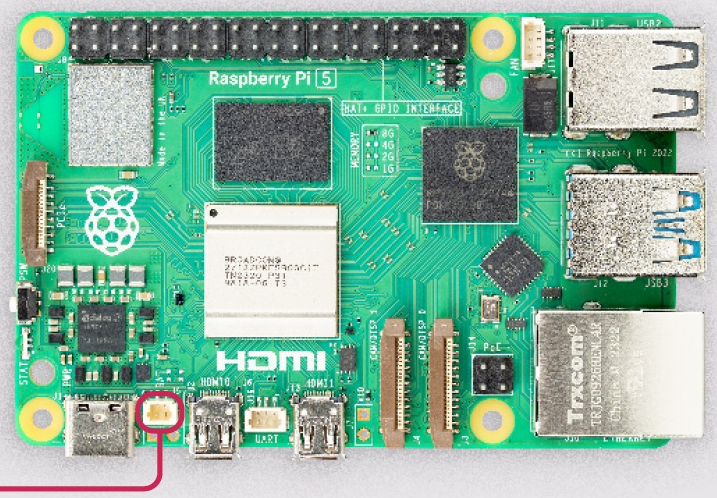

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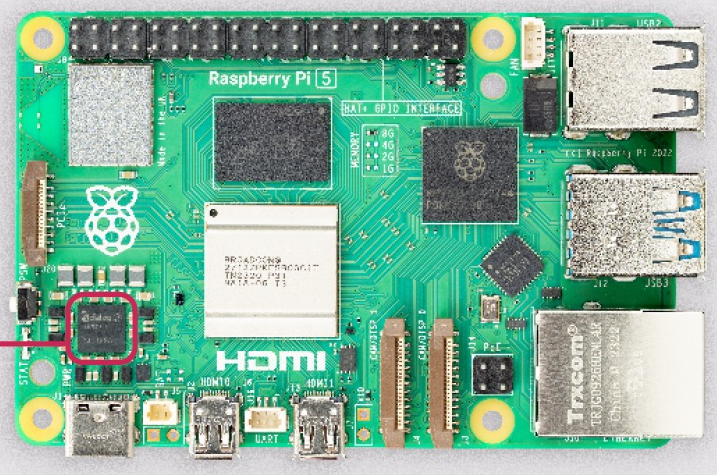

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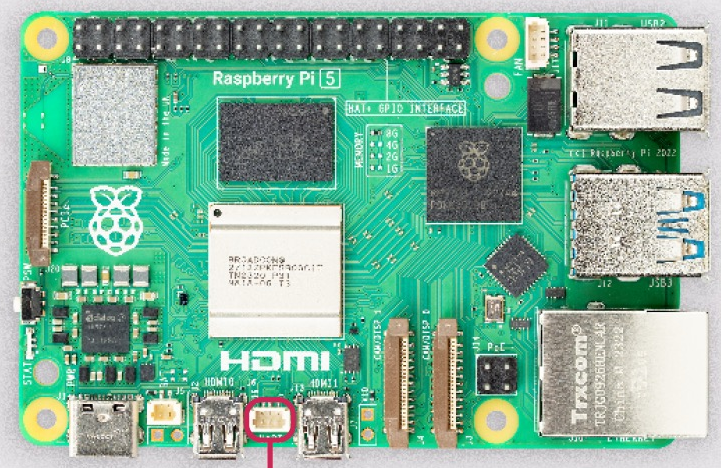

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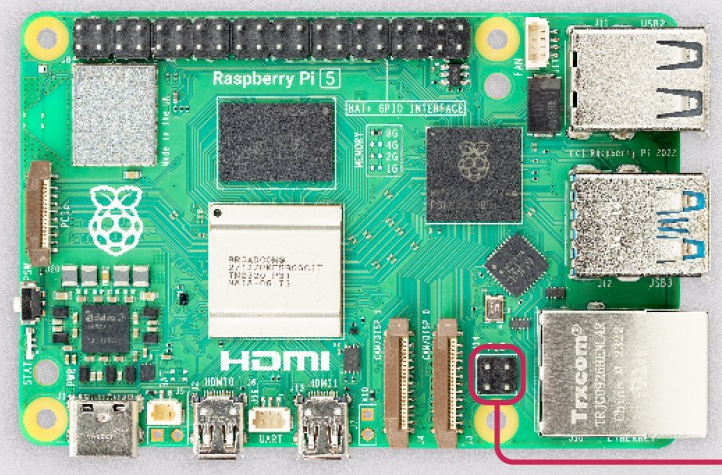

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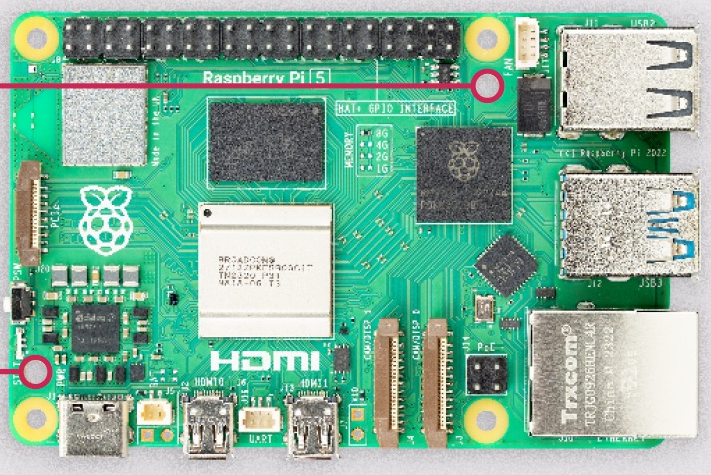

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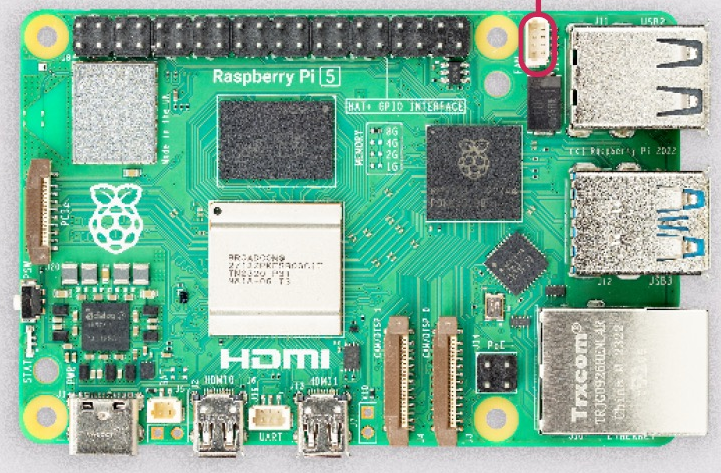

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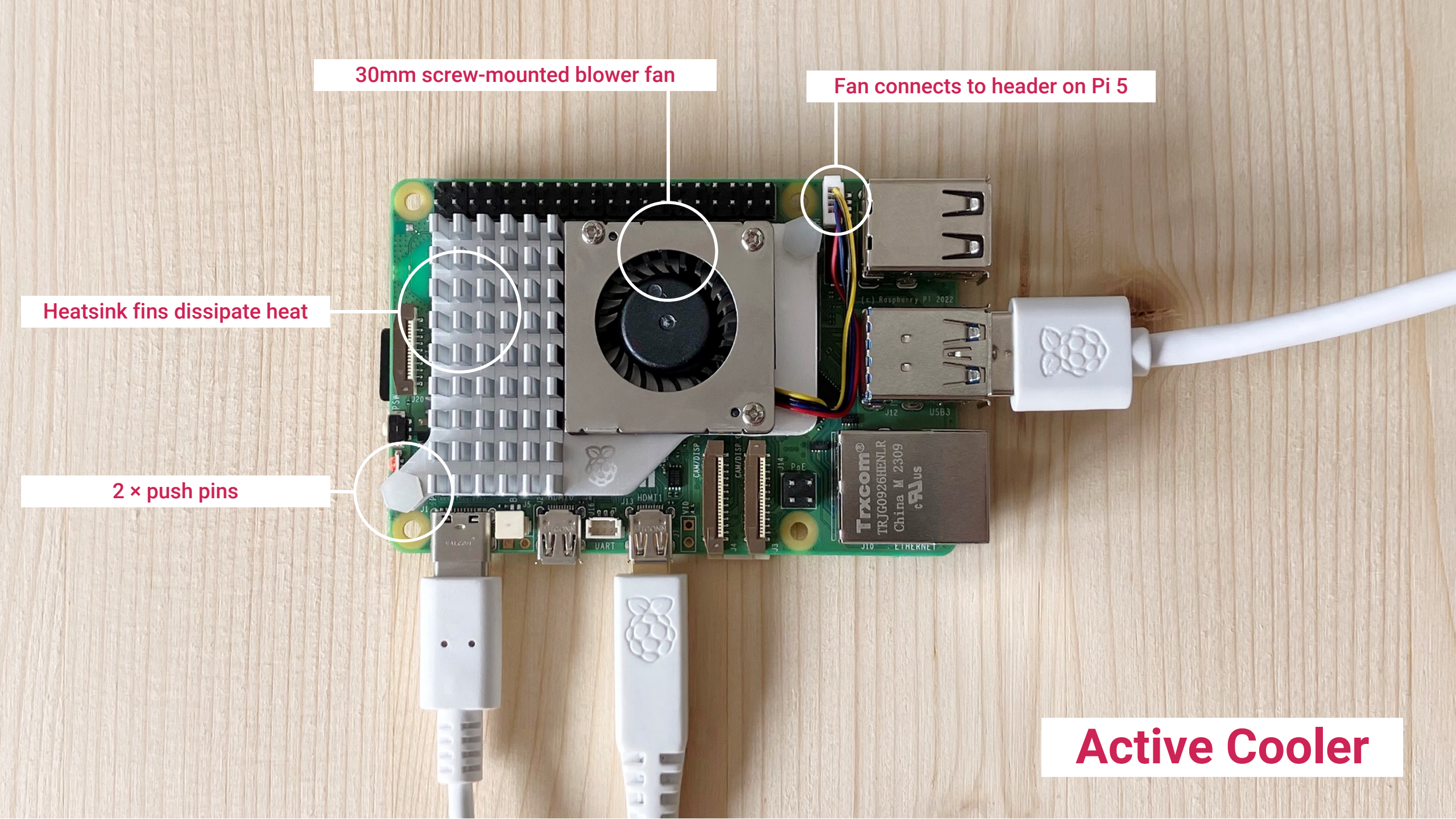
Raspberry Pi Active Cooler
For Raspberry Pi 5
Pre-applied thermal gap pads
contact CPU, Wi-Fi, and PMIC
Laser-etched logo
Active Cooler


30mm screw-mounted blower fan
Fan connects to header on Pi 5
Heatsink fins dissipate heat
2 × push pins
Active Cooler

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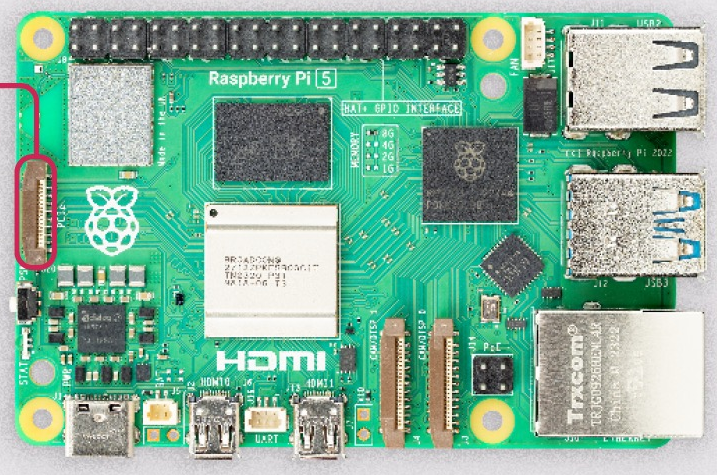

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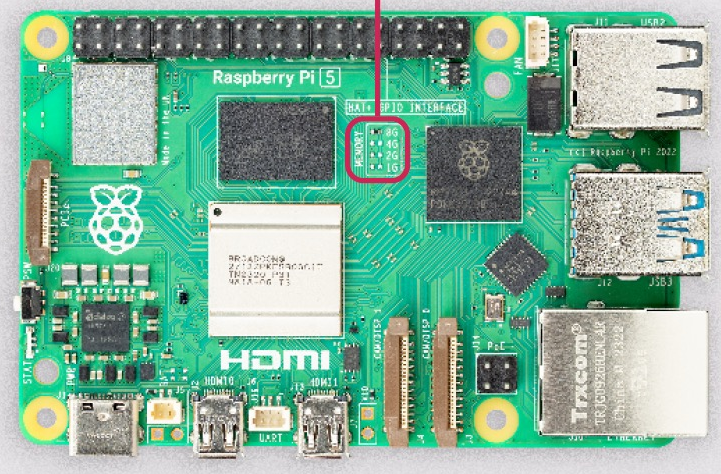

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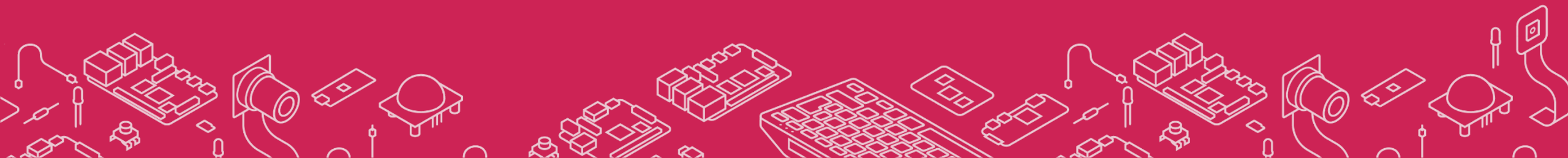
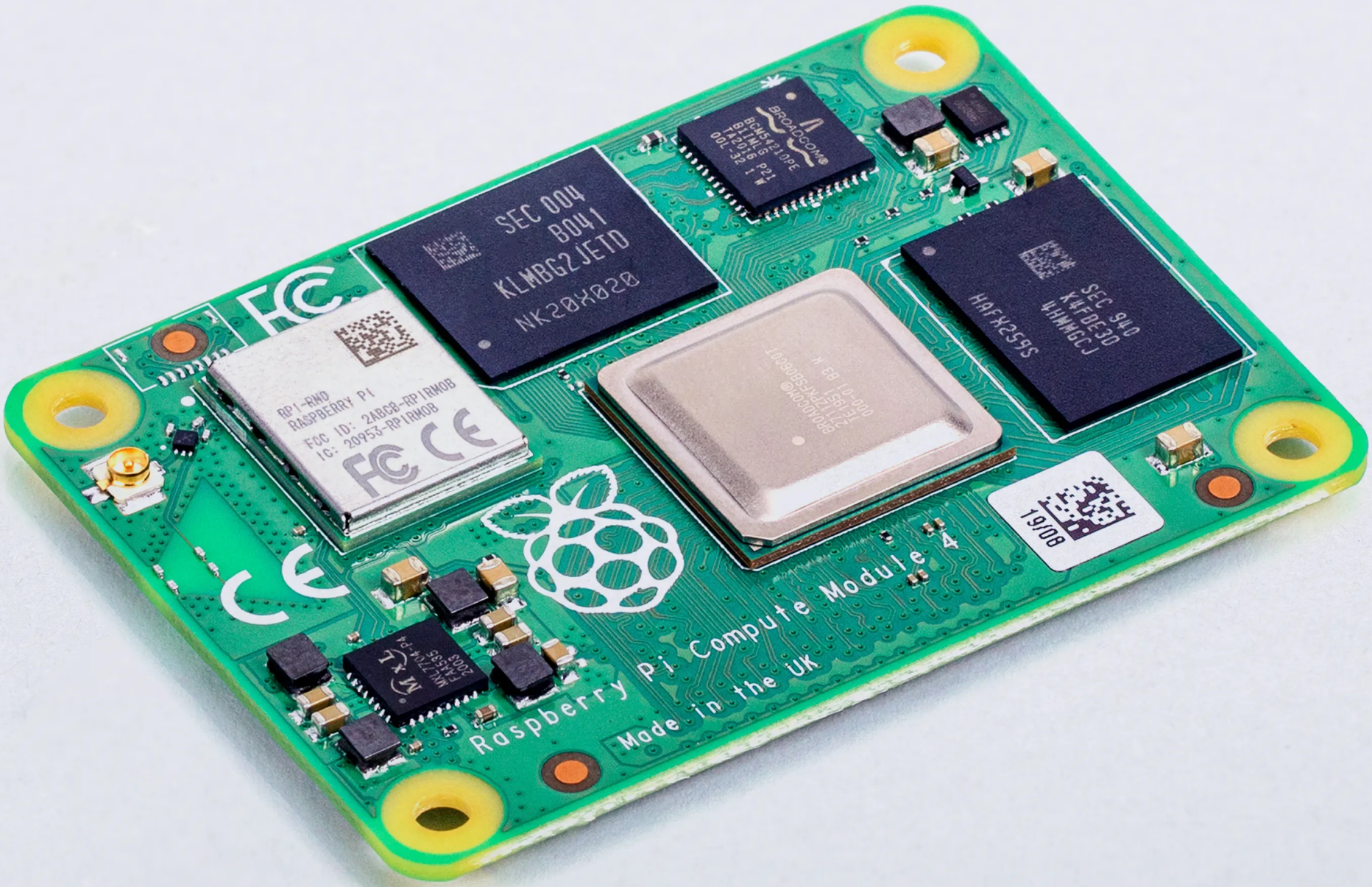
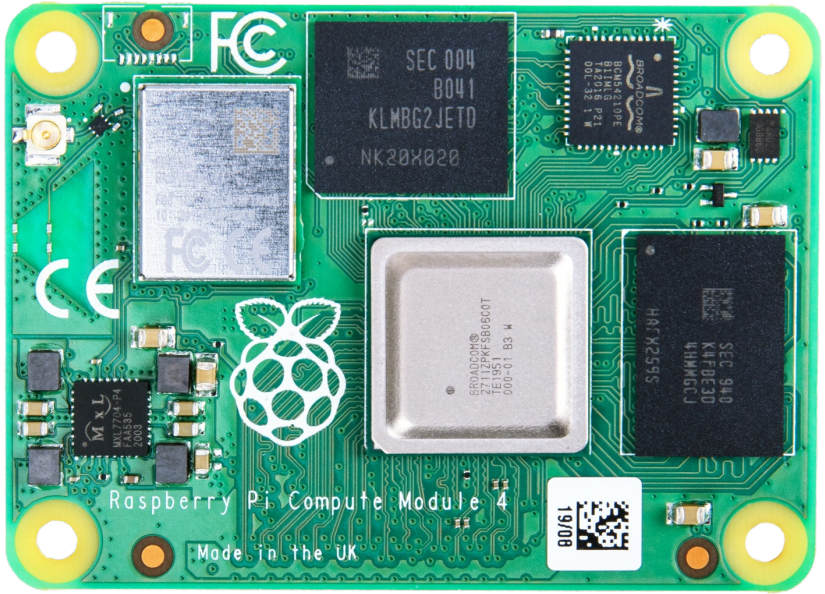
Compute Module 4



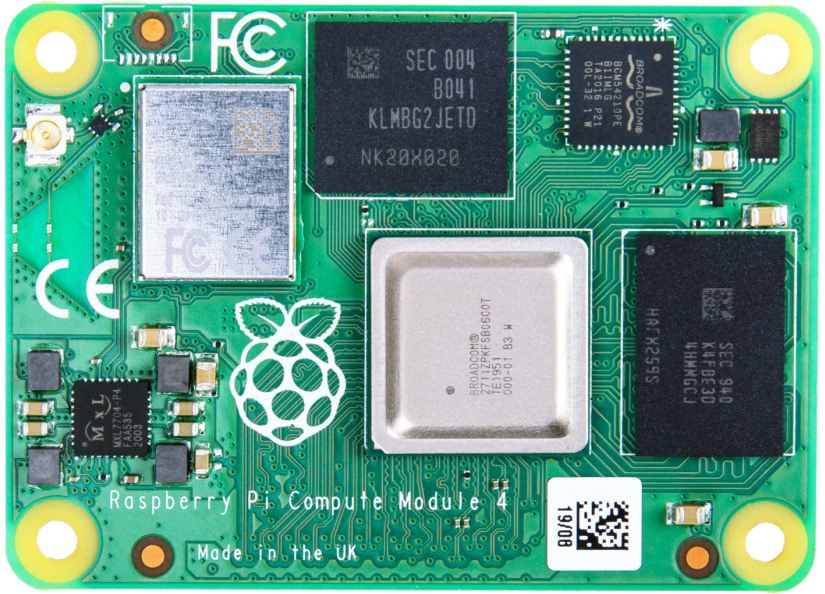

SEC 004
B041
KLMBG2JETD
NK20X020
RPI-RMD
RASPBERRY PI
FCC ID: 2ABCB-RPIRMOB
IC: 20953-RPIRMOB
SEC 940
K4F8E3D
4HMMGCJ
HAFX259S
19/08
Raspberry Pi Compute Module 4
Made in the UK

Raspberry Pi Compute Module 4



- Raspberry Pi OS
  - Based on Debian Bookworm
  - Tools for programming and provisioning
- BCM2711, quad core Cortex-A72 64-bit SoC @ 1.5GHz
- Small Footprint 55mm × 40mm × 4.7mm module
  - 4 × M2.5 mounting holes
- Single +5V PSU input
- Options for 1GB, 2GB, 4GB or 8GB LPDDR4-3200 SDRAM with ECC
- Options for 0GB (CM4Lite), 8GB, 16GB, or 32GB eMMC flash memory
  - Peak eMMC bandwidth 100MByte/S

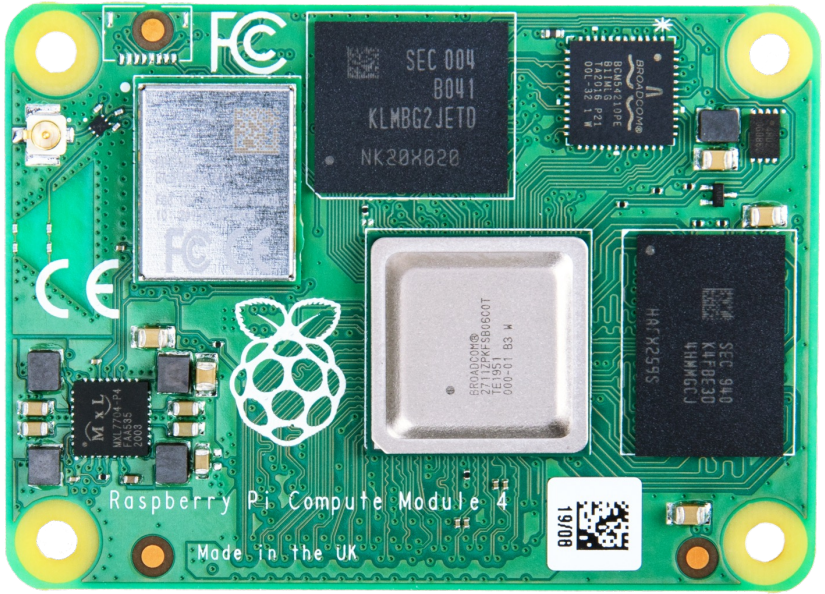
Raspberry Pi Compute Module 4

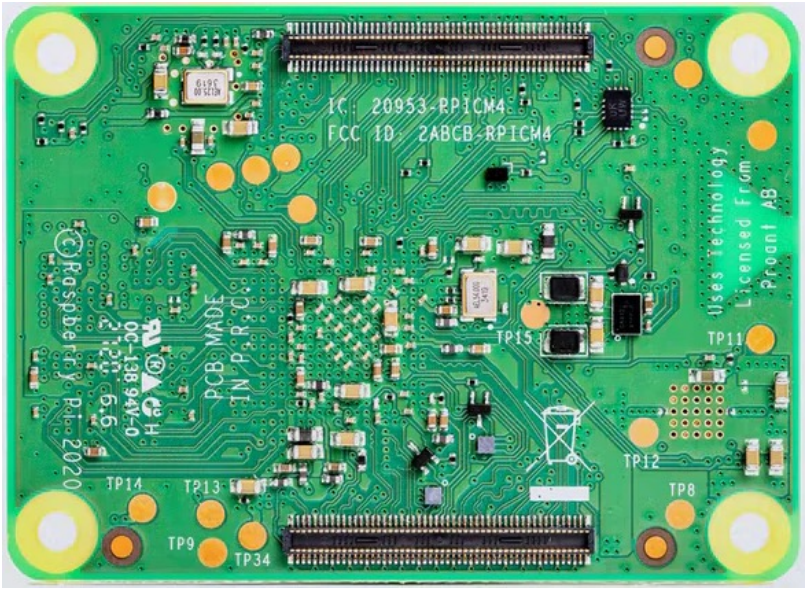


- Option for certified radio module with:
  - Dual-band 2.4 GHz, 5.0 GHz IEEE 802.11 b/g/n/ac wireless
  - Bluetooth 5.0, BLE
  - Electronic switch to select between PCB trace or external antenna
- Gigabit Ethernet PHY supporting IEEE 1588
- 1 × PCIe 1-lane Host, Gen 2 (5Gbps)
- 1 × USB 2.0 port (high speed)
- 28 × GPIO supporting either 1.8V or 3.3V signaling and peripheral options:
  - Up to 5 × UART ◦ Up to 5 × I2C
  - Up to 5 × SPI
  - 1 × SDIO interface
  - 1 × DPI (parallel RGB display)
  - 1 × PCM
  - Up to 2× PWM channels
  - Up to 3× GPCLK outputs

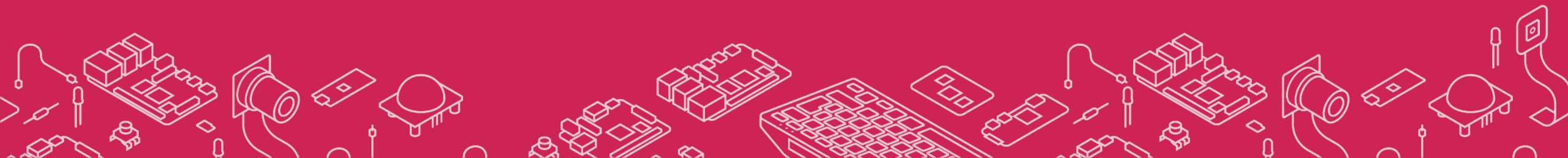
Raspberry Pi Compute Module 4

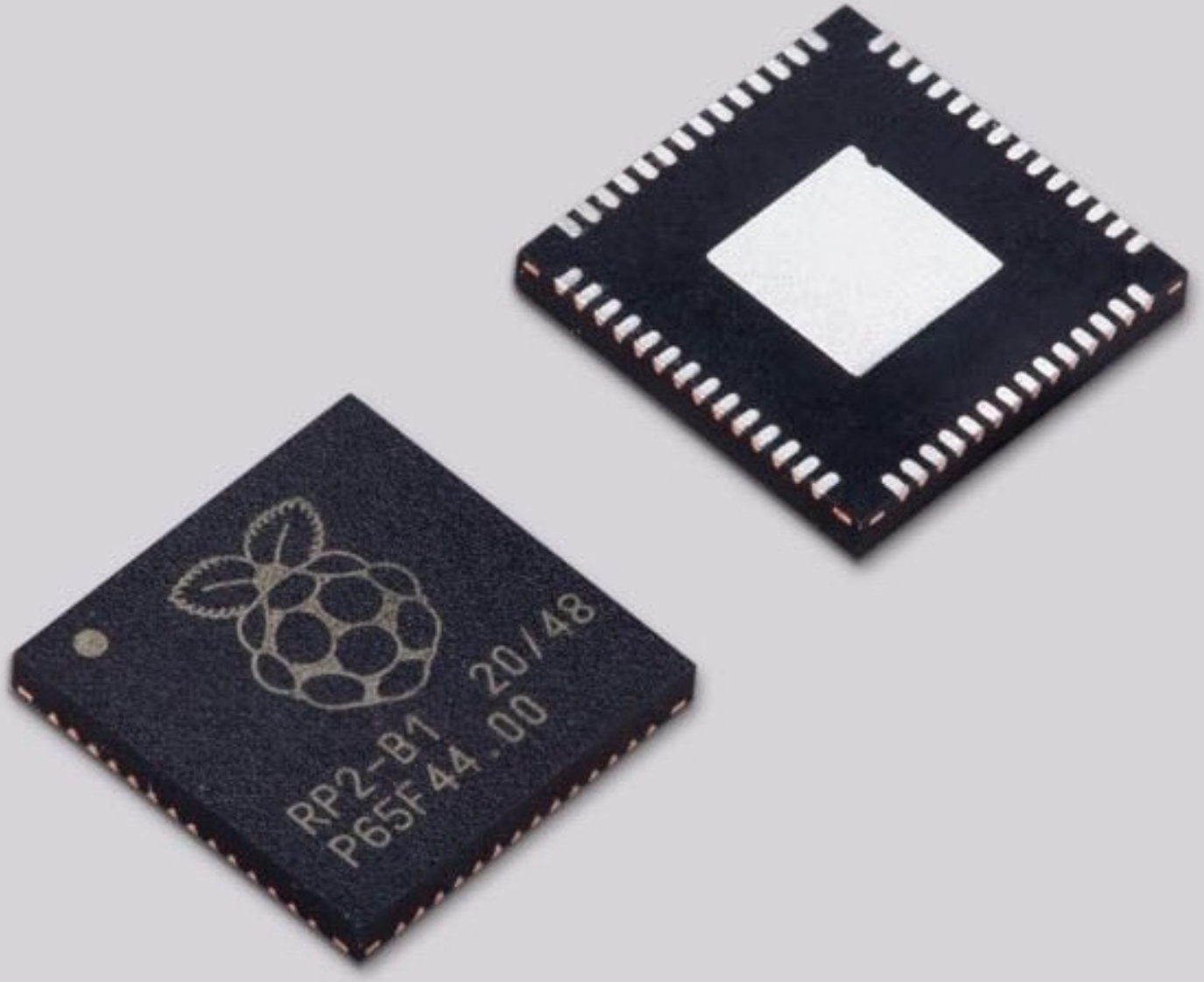
- 2 × HDMI 2.0 ports (up to 4Kp60 supported)
- MIPI DSI:
  - 1 × 2-lane MIPI DSI display port
  - 1 × 4-lane MIPI DSI display port
- MIPI CSI-2:
  - 1 × 2-lane MIPI CSI camera port
  - 1 × 4-lane MIPI CSI camera port
- H.265 (HEVC) (up to 4Kp60 decode)
  - H.264 (up to 1080p60 decode, 1080p30 encode)
- OpenGL ES 3.0 graphics





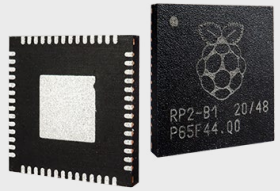
RP2040 Microcontroller




RP2-B1
P65F44.00
20/48

RP2040 – Microcontroller

- Designed by Raspberry Pi's in-house ASIC team
- Symmetric dual Arm Cortex-M0+ @ 133MHz
- 264kB on-chip SRAM in six independent banks
- Support for up to 16MB of off-chip flash memory via dedicated QSPI bus
- DMA controller
- Interpolator and integer divider peripherals
- On-chip programmable LDO to generate core voltage
- 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



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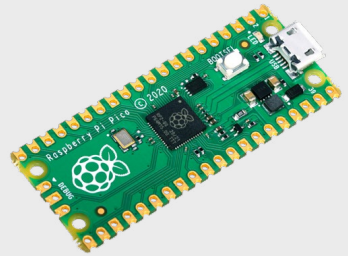
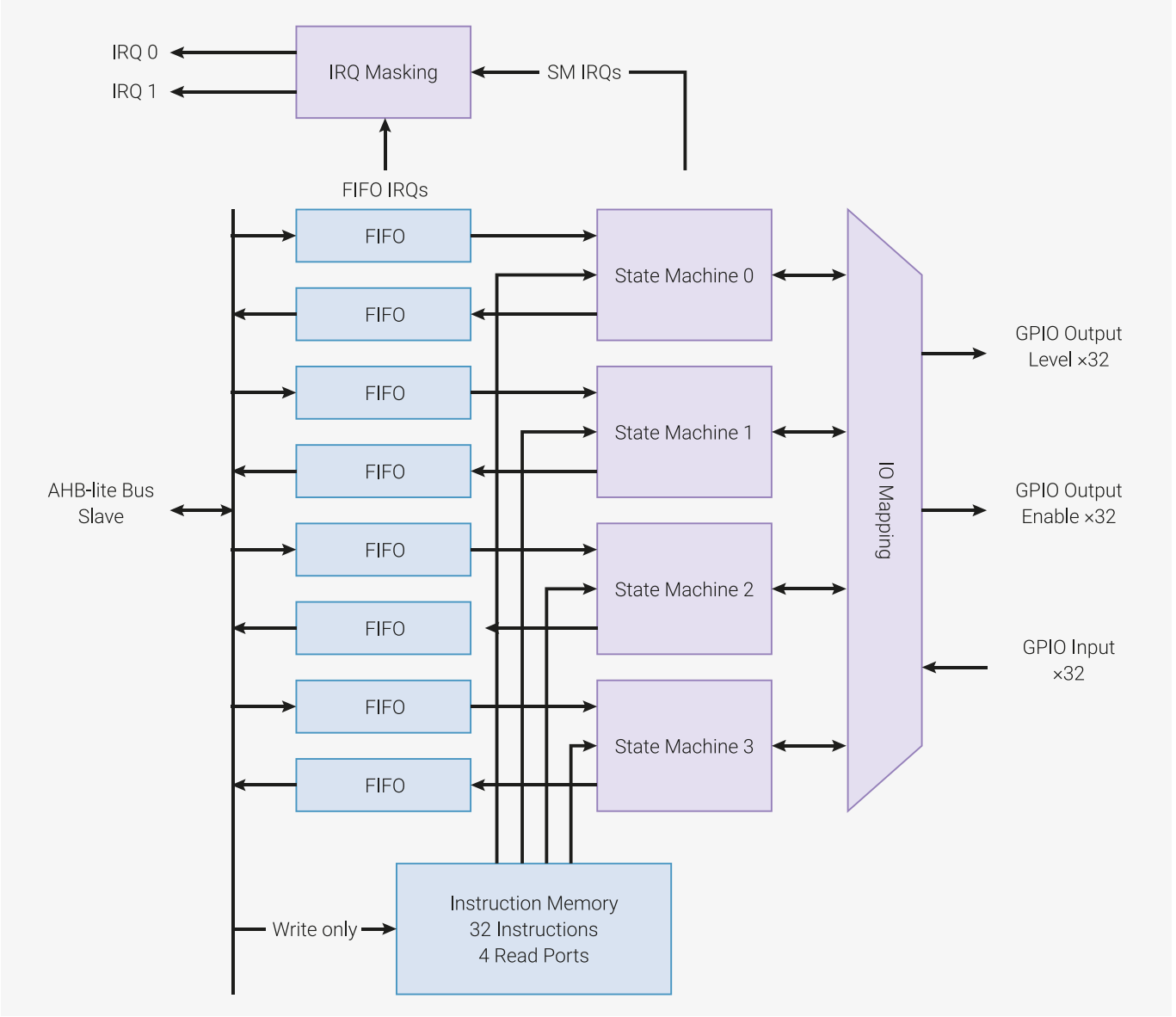


Raspberry Pi Pico

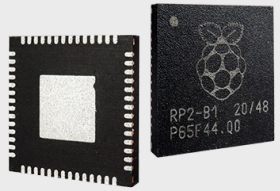
RP2040 – PIO

- Our Programmable I/O Accelerator
  - Designed in-house
- Two identical PIO blocks
  - Each has 4 state machines
- Designed for timing critical IO
  - WS2812B addressable LEDs
  - VGA/DVI-D
  - RMII
- General purpose IO
  - Parallel
  - I2S
  - SPI / QSPI / I2C / UART
  - On any GPIO pin!
- Lots of community PIO projects



RP2040 – SDKs and software

- C / C++ SDK
  - Libraries and tools
  - Debugging via GDB / SWD
  - Example apps, including Wireless LAN and Bluetooth
- Python SDK
  - MicroPython environment
- Built-in UF2 Bootloader
  - ”Drag and drop” programming of flash from your computer
- Amazing opensource projects from the community
  - Too many to list



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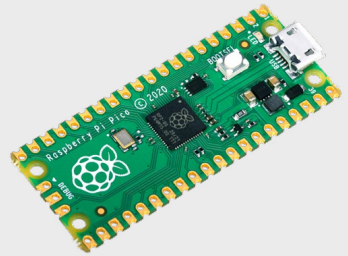
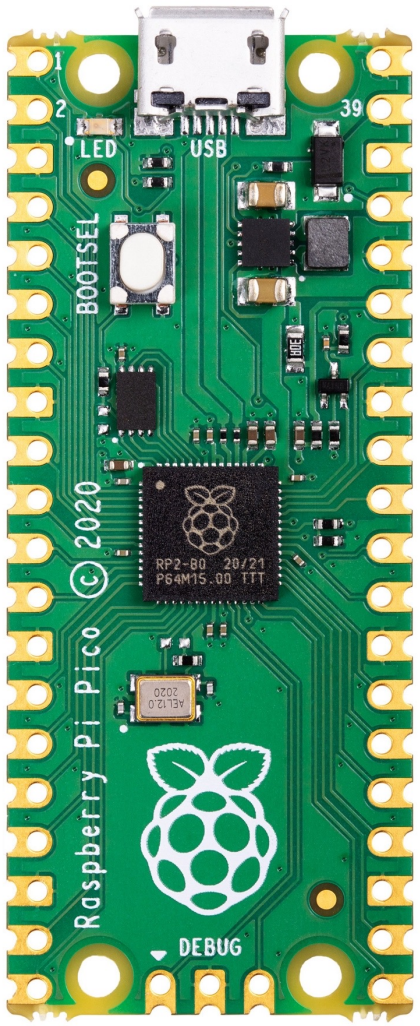


Raspberry Pi Pico



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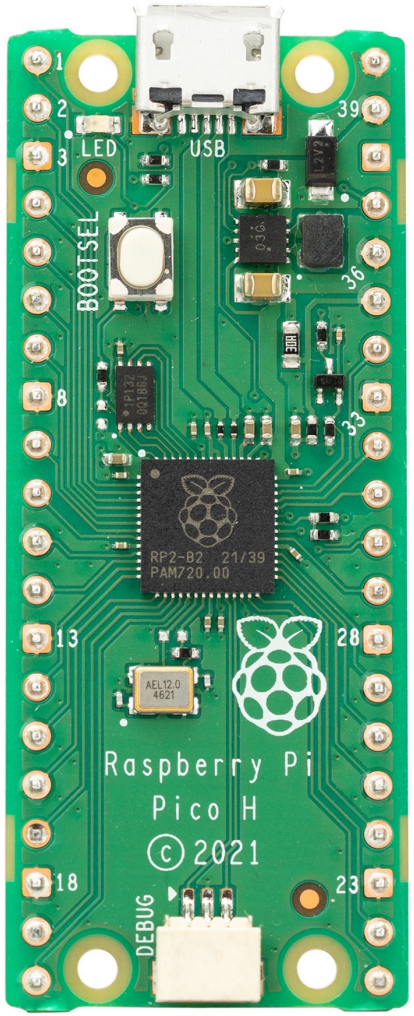

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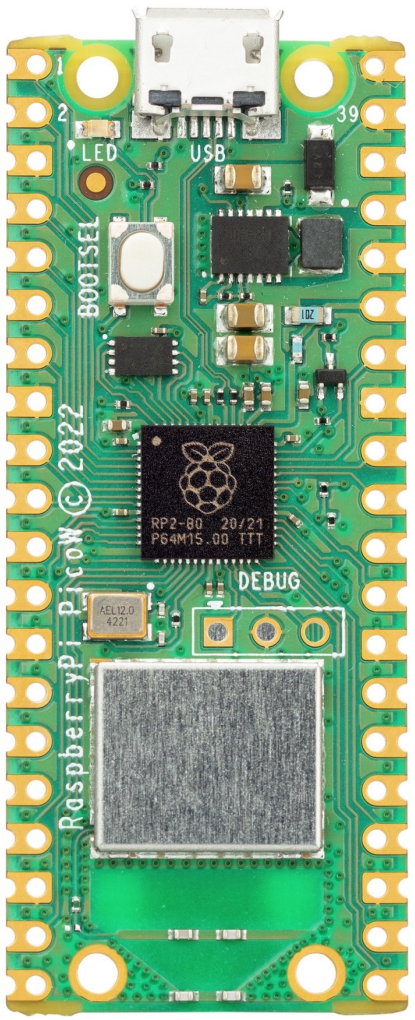

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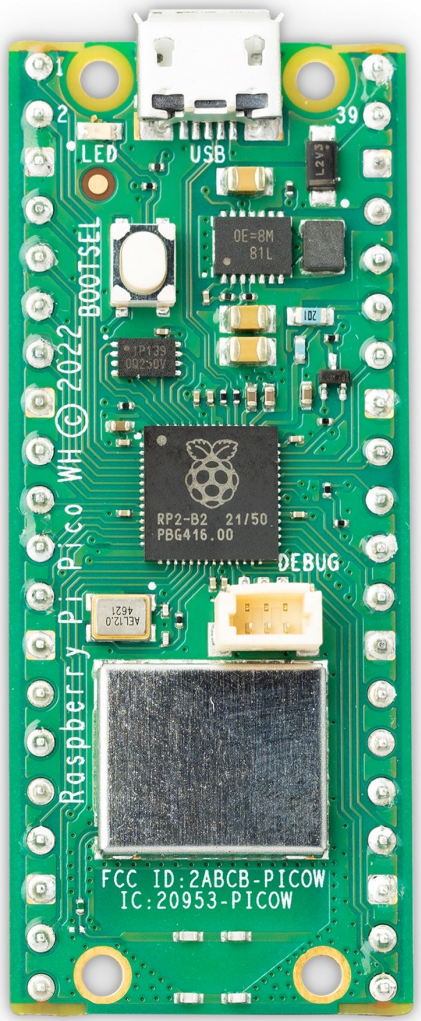

Pico WH

Thank you!

Questions & Answers