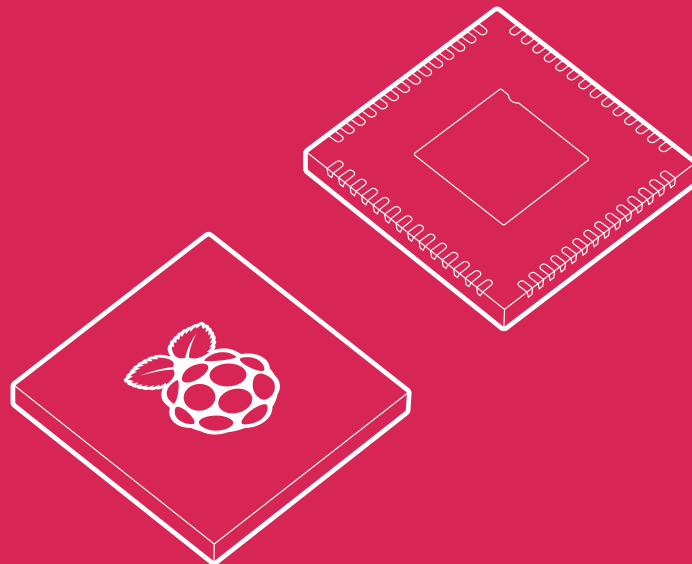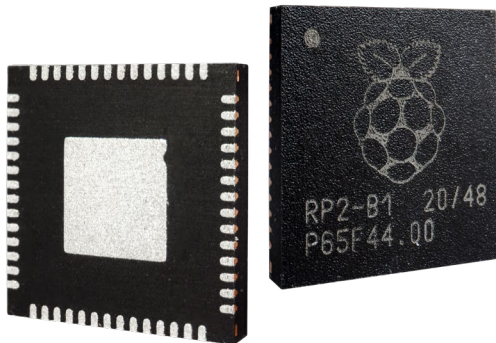# Raspberry Pi RP2040

Published August 2022

Overview

Microcontrollers connect the world of software to the world of hardware. They allow developers to write software that interacts with the physical world in the same deterministic, cycle-accurate manner as digital logic. They occupy the bottom left corner of the price/performance space, outselling more powerful computing devices. They are the workhorses that power the digital transformation of our world.

RP2040 is the debut microcontroller from Raspberry Pi. It brings our signature values of high performance, low cost, and ease of use to the microcontroller space.

With a large on-chip memory, symmetric dual-core processor complex, deterministic bus fabric, and rich peripheral set augmented with our unique Programmable I/O (PIO) subsystem, RP2040 provides professional users with unrivalled power and flexibility. With detailed documentation, a polished MicroPython port, and a UF2 bootloader in ROM, it has the lowest possible barrier to entry for beginner and hobbyist users.

RP2040 is a stateless device, with support for cached execute-in-place from external QSPI memory. This design decision allows you to choose the appropriate density of non-volatile storage for your application, and to benefit from the low pricing of commodity Flash parts.

RP2040 is manufactured on a modern 40 nm process node, delivering high performance, low dynamic power consumption, and low leakage, with a variety of low-power modes to support extended-duration operation on battery power.

Whatever your microcontroller application — from machine learning to motor control, from agriculture to audio — RP2040 has the performance, feature set, and support to make your product fly.

Key features

CPU: Dual ARM Cortex-M0+ @ 133 MHz

Memory: 264kB on-chip SRAM in six independent banks
                    Support for up to 16MB of off-chip Flash memory via
                    dedicated QSPI bus

Architecture: DMA controller
                    Fully connected AHB crossbar
                    Interpolator and integer divider peripherals
                    On-chip programmable LDO to generate core voltage
                    Two on-chip PLLs to generate USB and core clocks

Interfacing: 30 GPIO pins, four of which can be used as
                    analogue inputs

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

Package: 7 × 7 mm QFN-56 package

Product lifetime: Raspberry Pi understands the value to customers of long term
                    availability of product and therefore aims to continue supply
                    for as long as practically possible. We expect RP2040 to
                    remain in production until at least January 2041.

Compliance: RP2040 is compliant to Moisture Sensitivity Level 1.
                    RP2040 is compliant to the requirement of REACH Substances
                    of Very High Concern (SVHC) that ECHA announced on 25
                    June 2020.
                    RP2040 is compliant to the requirement and standard of
                    Controlled Environment-related Substance of RoHS directive
   (EU) 2011/65/EU and directive (EU) 2015/863.

Full details can be found in the [RP2040 datasheet](#).

Pinout
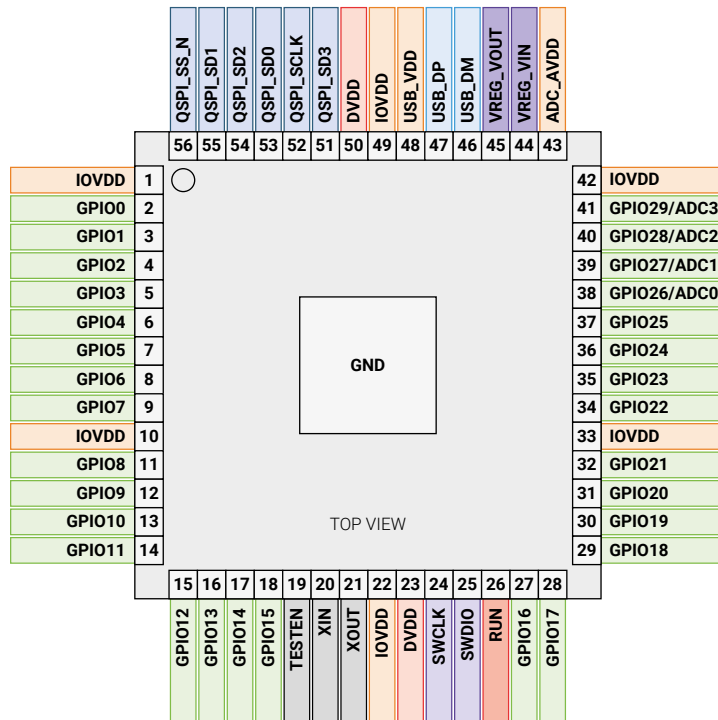
GPIOx — General-purpose digital input and output

GPIOx/ADCy — General-purpose digital input and output, with analogue-to-digital converter function

QSPIx — Interface to an SPI, Dual-SPI or Quad-SPI Flash device, with execute-in-place support

USB_DM and USB_DP — USB controller, supporting full-speed device and full-/low-speed host

XIN and XOUT — Connect a crystal to RP2040's crystal oscillator

RUN — Global asynchronous reset pin; reset when driven low, run when driven high

SWCLK and SWDIO — Access to the internal Serial Wire Debug multi-drop bus; provides debug access to both processors

TESTEN — Factory test mode pin

GND — Single external ground connection, bonded to a number of internal ground pads on the RP2040 die

IOVDD — Power supply for digital GPIOs, nominal voltage 1.8 V to 3.3 V

USB_VDD — Power supply for internal internal USB full-speed PHY, nominal voltage 3.3 V

ADC_AVDD — Power supply for analogue-to-digital converter, nominal voltage 3.3 V

VREG_VIN — Power input for the internal core voltage regulator, nominal voltage 1.8 V to 3.3 V

VREG_VOUT — Power output for the internal core voltage regulator, nominal voltage 1.1 V, 100 mA max current

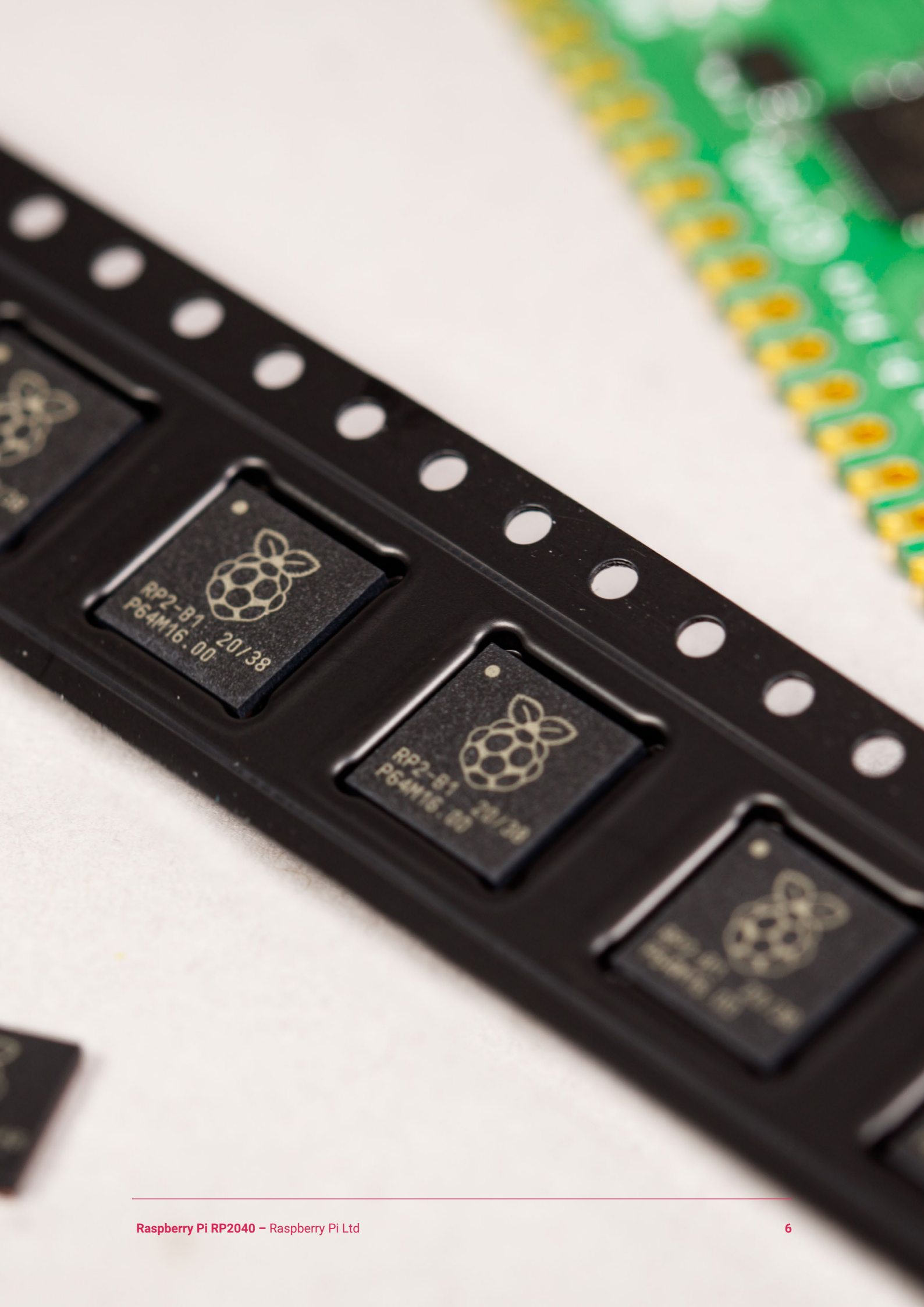**DVDD** — Digital core power supply, nominal voltage 1.1 V

Physical specification
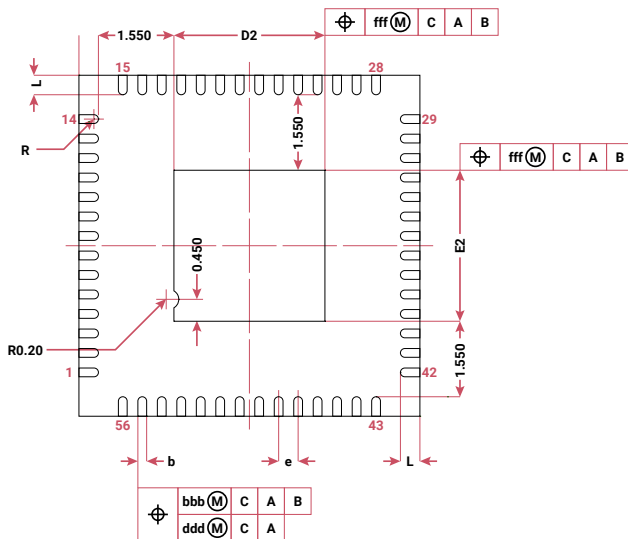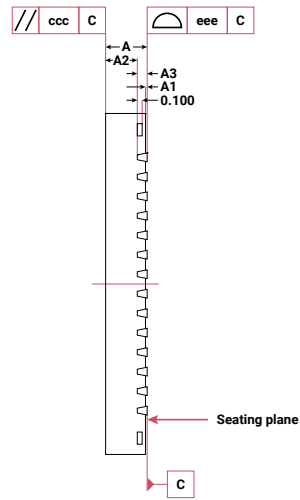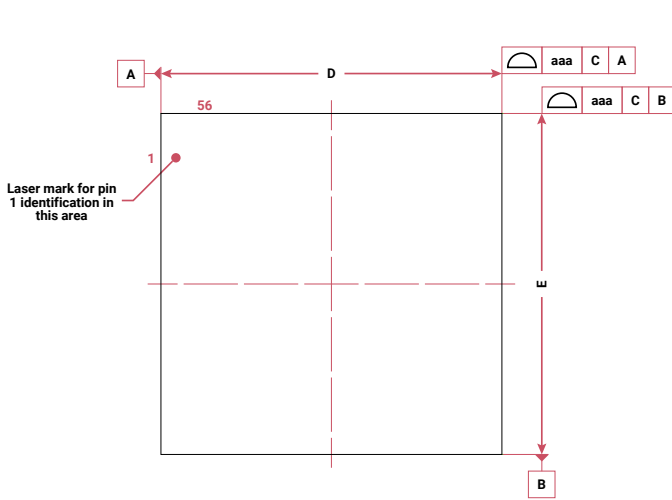
Symbol	Millimetre			Inch		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	0.900	-	-	0.035
A1	0.000	-	0.050	0.000	-	0.002
A2	-	0.650	0.700	-	0.026	0.028
A3	0.203 REF			0.008 REF		
b	0.130	0.180	0.230	0.005	0.007	0.009
D	7 BSC			0.276 BSC		
D2	3.00	3.100	3.200	0.118	0.122	0.126
E	7 BSC			0.276 BSC		
E2	3.00	3.100	3.200	0.118	0.122	0.126
L	0.300	0.400	0.500	0.012	0.016	0.020
e	0.400 BSC			0.016 BSC		
R	0.065	-	-	0.003	-	-
Tolerances of form and position						
aaa	0.100			0.004		
bbb	0.070			0.003		
ccc	0.100			0.004		
ddd	0.050			0.002		
eee	0.080			0.003		
fff	0.100			0.004		

SAFETY INSTRUCTIONS

To avoid malfunction of or damage to this product, please observe the following:

- Anti-static precautions should be taken when handling, to prevent damage by the discharge of electrical energy

- Do not expose to water or moisture

- Hand creams and lotions containing silicone must not be used, since they can cause solderability and epoxy adhesion problems