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

**Production lifetime:**
RP2040 will remain in production until at least January 2030

**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](#).
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 specifications

Laser mark for pin 1 identification in this area

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