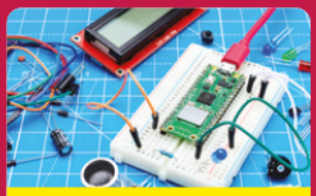
THE *Official* RASPBERRY PI HANDBOOK 2023

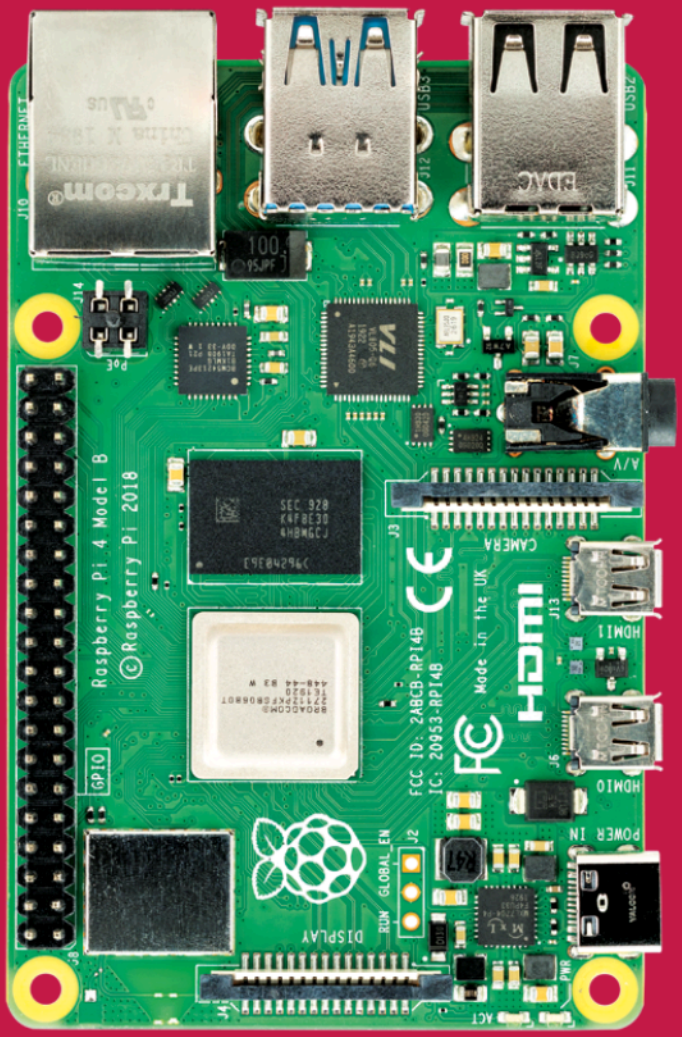
Create a classic **arcade cabinet**

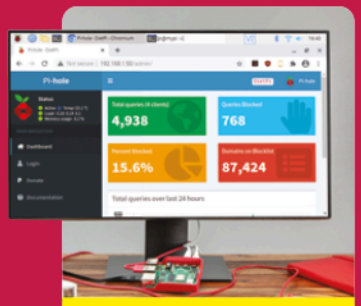
Code your own games **with Scratch & Python**



Learn electronics **with Pico W**

Make & Build **with Zero 2 W**





Set up a home **network ad-blocker**

The best robots **you can make!**

200 Pages of Inspirational Projects!

FROM THE MAKERS OF The MagPi THE OFFICIAL RASPBERRY PI MAGAZINE

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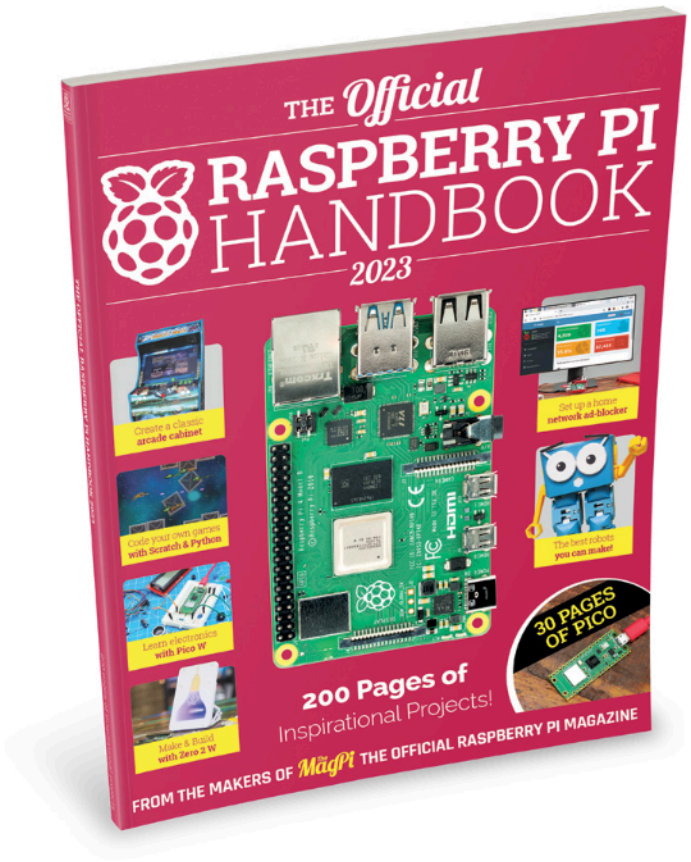
POWERED BY Raspberry Pi



WELCOME!

You hold in your hands the latest and greatest edition of The Official Raspberry Pi Handbook, absolutely crammed with everything we could fit into the pages of this book, covering everything from an incredible ceiling orrery that tracks the motion of the planets to electronic starter kits for Raspberry Pi Pico.

Speaking of Pico, the incredible microcontroller has been upgraded so it now includes a wireless chip. It was great before but now it can natively get data from the internet or over your network for some amazing IoT projects. We've got a guide to what's new, and how to use it for your electronic project ideas.

We've carefully selected projects to show off the broad range of uses Raspberry Pi and Pico can have, whether you're just starting out with a little coding, or looking for your next big project. I believe something in here will truly inspire you make something wonderful.

Happy making, folks.

Rob Zwetsloot

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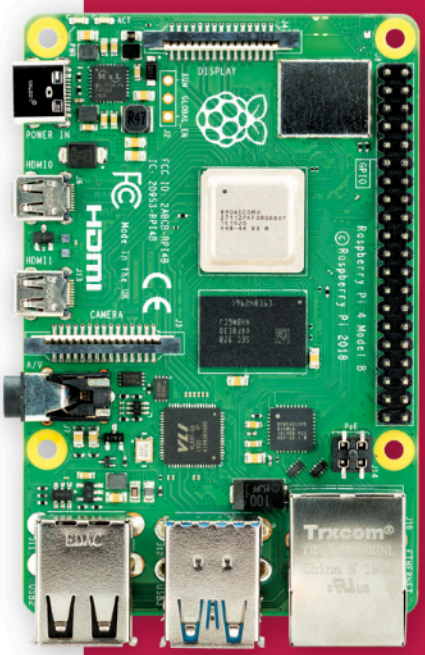

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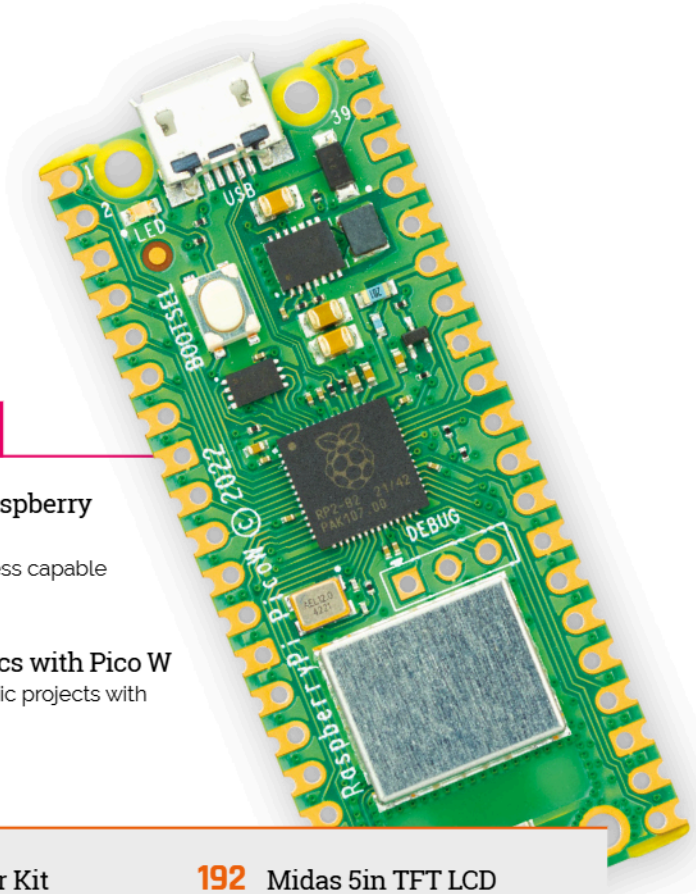


Raspberry Pi Pico

Reviews

GET STARTED WITH RASPBERRY PI

Set up your Raspberry Pi computer with Raspberry Pi OS, the latest version of the operating system and discover all the new features. By **Phil King**

Whichever model of Raspberry Pi you have, it is part of the most creative computer family on Earth. With a Raspberry Pi, you can hack, make, and build all kinds of different things. It could be a digital camera, a retro games console, or a home media centre. You could even control a sensor on board the International Space Station if you submit an entry for the Astro Pi missions (**astro-pi.org**).

In this guide, we show you how to get started with Raspberry Pi using the new Debian 'Bullseye' edition of Raspberry Pi OS, as well as connecting and controlling some basic electronics.

USING RASPBERRY PI OS (BULLSEYE)

Explore the latest version of the default operating system

To make a Raspberry Pi work, you'll need to install an operating system. Unless your Raspberry Pi came with one already preloaded onto a microSD card, you'll have to write the OS to the card.

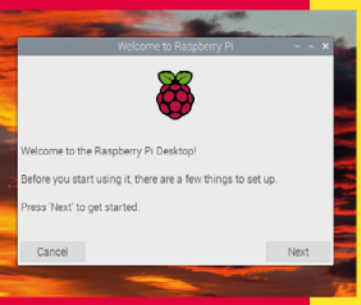
While other operating systems are available for Raspberry Pi (check out our feature in *The MagPi* #111, **magpi.cc/111**), the official one is Raspberry Pi OS, which has recently been updated to the 'Bullseye' version of Debian Linux.

It's easy to install Raspberry Pi OS onto a microSD card using the Raspberry Pi Imager tool – download it on another computer (Windows, Mac, or Linux) from **magpi.cc/imager**. See the 'Installing Raspberry Pi OS' box for details.

> You'll need to install an operating system

Upon inserting the microSD card with the OS on it into your Raspberry Pi's slot and powering up, it will first expand the file system before booting to the Raspberry Pi OS desktop. The Welcome to Raspberry Pi wizard will take you through configuration options including language and time zone, prompt you to change the default password, ask whether all of the taskbar fits on the screen, and prompt you to connect to your wireless router by entering its password.

You'll also be asked if you want to check for and install any software updates, which you can do or skip for now. With setup complete, you'll be prompted to hit Restart to reboot your Raspberry Pi. This time it'll boot straight to the desktop, without the wizard, and be ready to use.



▲ Upon first booting up Raspberry Pi OS, a welcome wizard will guide you through some configuration options

Explore the desktop

Like most operating systems, the standard version of Raspberry Pi OS comes with a desktop interface that you can navigate with a connected mouse.

The default web browser in Raspberry Pi OS is Chromium, although you can install others such as Firefox ESR, Midori, Vivaldi, and Puffin.

Chromium is the basis for Google Chrome, so you may well find its user interface very familiar. There's an Omnibox where you can enter web addresses or search terms. The default search engine is DuckDuckGo, which is focused on preserving the privacy of searchers, but can be changed in the Settings (after clicking on the three dots icon in the top right).

One drawback is that you can't sync your Google account in Chromium to use the same bookmarks and settings that you have in Chrome; Firefox is an alternative browser that enables cross-platform syncing. Other than that, most features are present, including the ability to add extensions from the Chrome Web Store and also to group tabs together. You can also install web apps for some sites such as YouTube, by clicking the option that appears on the right side of the Omnibox.

Install extra software

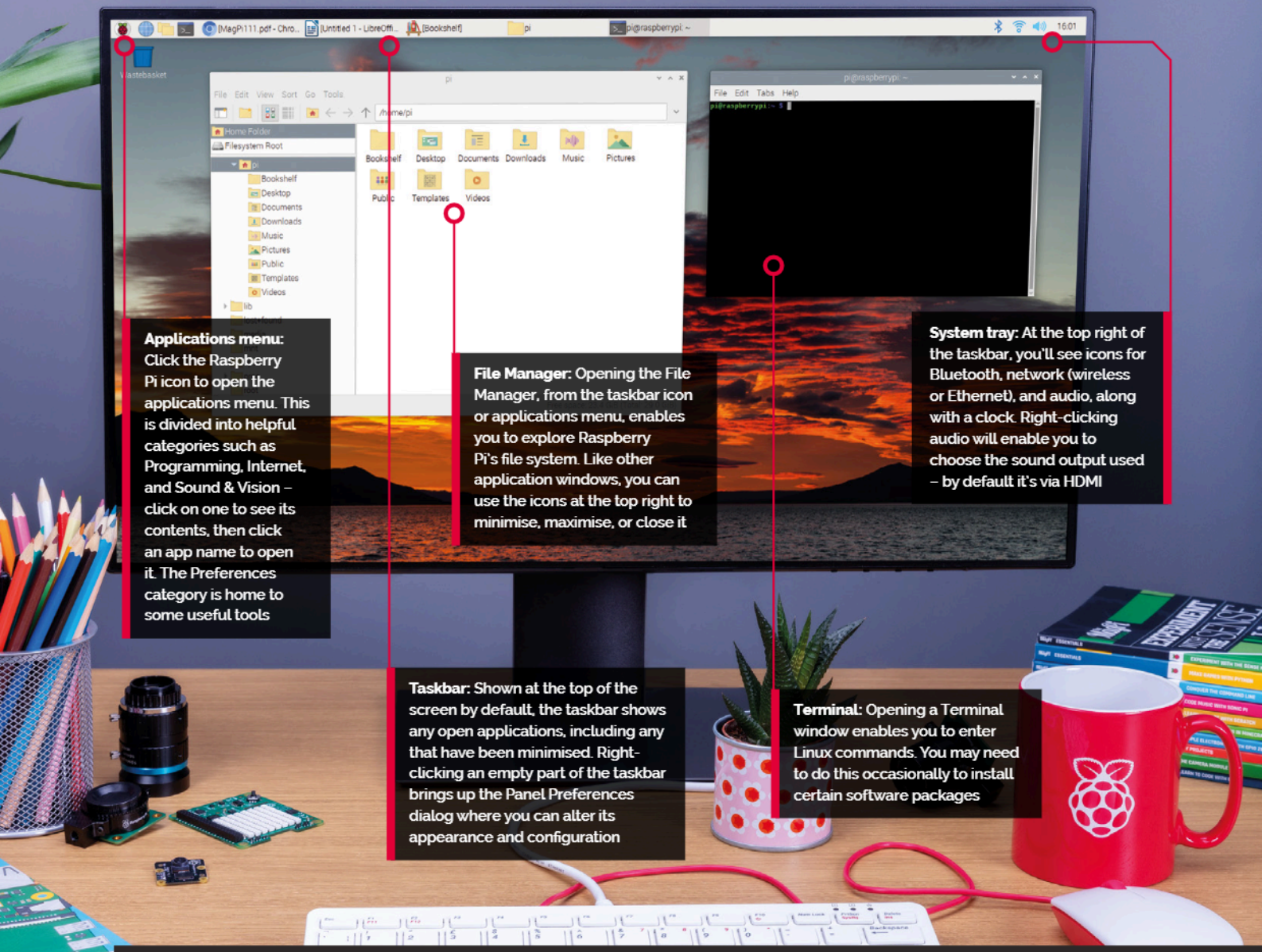
The standard Raspberry Pi OS only comes with a handful of core applications pre-installed – although there is a 'Full' version of the OS supplied with a lot more software (find it in Raspberry Pi Imager, under 'Raspberry Pi OS (other)').

It's simple to install any extra software you want, however. By far the easiest way is to use the Recommended Software tool (Menu > Preferences > Recommended Software). You can then browse a range of applications; to install one, simply tick its box and click Apply.

Applications in Recommended Software include the Claws email client and the LibreOffice productivity suite. The latter features six applications: the Writer word processor, Calc spreadsheet, Impress presentation, Draw diagrams, Base database, and Math formula editor. It can load/save Microsoft Office documents too.

If you can't find what you need in Recommended Software, you will be able to install additional software packages using the Add/Remove Software tool, or by entering commands (such as `sudo apt install` and `sudo pip install`) in a Terminal window.

GET TO KNOW RASPBERRY PI OS' INTERFACE



Applications menu: Click the Raspberry Pi icon to open the applications menu. This is divided into helpful categories such as Programming, Internet, and Sound & Vision – click on one to see its contents, then click an app name to open it. The Preferences category is home to some useful tools

File Manager: Opening the File Manager, from the taskbar icon or applications menu, enables you to explore Raspberry Pi's file system. Like other application windows, you can use the icons at the top right to minimise, maximise, or close it

System tray: At the top right of the taskbar, you'll see icons for Bluetooth, network (wireless or Ethernet), and audio, along with a clock. Right-clicking audio will enable you to choose the sound output used – by default it's via HDMI

Taskbar: Shown at the top of the screen by default, the taskbar shows any open applications, including any that have been minimised. Right-clicking an empty part of the taskbar brings up the Panel Preferences dialog where you can alter its appearance and configuration

Terminal: Opening a Terminal window enables you to enter Linux commands. You may need to do this occasionally to install certain software packages

Installing Raspberry Pi OS

To install Raspberry Pi OS (or upgrade from an earlier version of Raspberry Pi OS to the latest 'Bullseye' edition), you will need to install a fresh version of the OS to your microSD card. Typically you'll do this using Raspberry Pi Imager (**magpi.cc/imager**) on a Windows, Apple Mac, or another Linux computer (including another Raspberry Pi). Open Raspberry Pi Imager on your other computer and insert your microSD card (using a USB adapter if needed). Click 'Choose OS' and select 'Raspberry Pi OS (32-bit)'.

Now click 'Choose Storage' and select your inserted microSD card (which may well be labelled as 'Generic STORAGE DEVICE Media' with its storage capacity). Click Write to download Raspberry Pi OS and copy the software to the microSD card.

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RASPBERRY PI OS BULLSEYE FAQ

Find out what's changed in the new version of Raspberry Pi OS

With the basics of the desktop GUI and core applications covered, let's take a look at some of the new features in Raspberry Pi OS Bullseye and the differences from previous versions.

How do I get Bullseye?

Get Raspberry Pi OS Bullseye by installing a fresh installation of the latest version of Raspberry Pi OS from Raspberry Pi Imager (**magpi.cc/imager**).

Can I upgrade from Buster to Bullseye?

You can't upgrade from Debian Buster to Debian Bullseye using `sudo apt full-upgrade` – this only takes you to the latest version of the current (i.e. 'Buster') operating system. You have to install Bullseye onto a fresh microSD card. If you have data on your Buster installation you want to keep, we recommend copying it to a separate drive and then back to the fresh Bullseye installation.

What if I want to get Buster?

Buster is now known as Raspberry Pi OS (Legacy) and is available from Raspberry Pi's Software page (**magpi.cc/buster**). It can also be found in Raspberry Pi Imager. Read more about Raspberry Pi OS (Legacy) in Gordon Hollingworth's blog post (**magpi.cc/legacy**).

How different does Bullseye look?

If you've used Raspberry Pi OS before, you'll immediately notice that the default wallpaper is different in Bullseye. If you like, you can change it in Preferences > Appearance Settings.

Another change you may notice is that desktop windows have a shadow effect on their borders, and animate as they open and close. Widgets and their tabs and buttons also look a little different.

In File Manager, the view modes have been simplified, with icon options to switch between icons or list mode. For more advanced options, you can use the View menu to zoom the icon size in/out and select thumbnail icon mode.

What's new in Bullseye?

One of the numerous under-the-hood changes in Raspberry Pi OS Bullseye is that the KMS (kernel mode setting) video driver is now