

Raspberry Pi

An ARM/Linux box for \$25. Take a byte!



The Raspberry Pi Foundation

Abstract. *The Raspberry Pi is a credit card sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of stimulating the teaching of basic computer science in schools.*

The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor (The firmware includes a number of “Turbo” modes so that the user can attempt overclocking, up-to 1 GHz, without affecting the warranty), VideoCore IV GPU, and originally shipped with 256 megabytes of RAM, later upgraded to 512MB. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and long-term storage. The Foundation’s goal is to offer two versions, priced at US\$ 25 and US\$ 35. The Foundation started accepting orders for the higher priced model on 29 February 2012.

The Foundation provides Debian and Arch Linux ARM distributions for download. Also planned are tools for supporting Python as the main programming language [1], with support for BBC BASIC, (using the “Brandy Basic” clone), C, and Perl.

1 Hardware

Initial sales are of the Model B, with plans to release the Model A sometime later. Model A has one USB port and no Ethernet controller, and will cost less than the Model B with two USB ports and a 10/100 Ethernet controller.

Though the Model A doesn’t have an RJ45 Ethernet port, it can connect to a network by using a user-supplied USB Ethernet or Wi-Fi adapter. There is in reality no difference between a model A with an external Ethernet adapter and a model

B with one built in, because the Ethernet port of the model B is actually a built-in USB Ethernet adapter. As is typical of modern computers, generic USB keyboards and mice are compatible with the *Raspberry Pi*.



The *Raspberry Pi* does not come with a real-time clock, so an OS must use a network time server, or ask the user for time information at boot time to get access to time and date for file time and date stamping. However, a real-time clock (such as the DS1307) with battery backup can be added via the I²C interface. On 20 April 2012 the schematics for the Model-A and Model-B were released by the *Raspberry Pi* foundation (see Fig. 1).

Hardware accelerated video (H.264) encoding became available on 24 August 2012 when it became known that the existing license also covered encoding. Previously it was thought that encoding would be added with the release of the announced camera module¹. At the same time the Raspberry Pi Foundation released two additional

¹“[Raspberry Pi Camera module](#),” Paul Jurczak. [Raspberrypi.org](#).

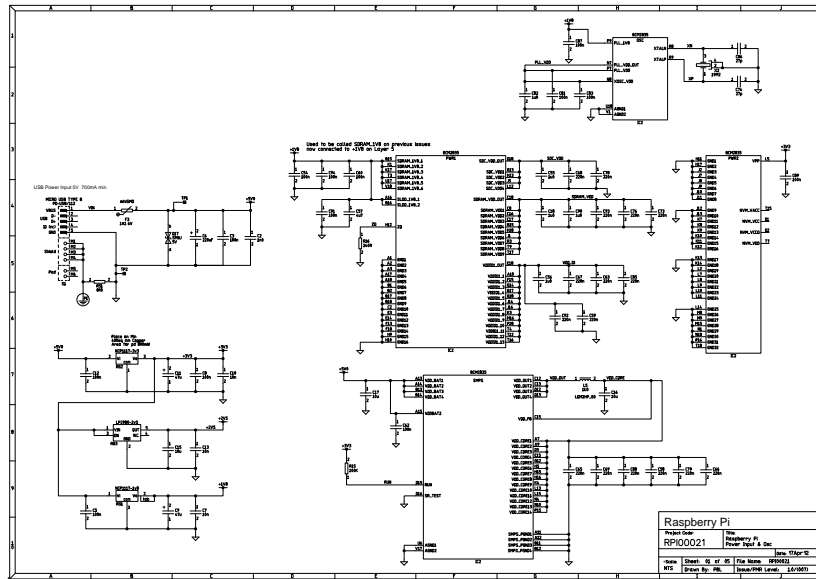


Figure 1: Raspberry Pi's schematics

codecs that can be bought separately, MPEG-2 and Microsoft's VC-1. Also it was announced that the Pi will support CEC, enabling it to be controlled with the television's remote control.

2 Specifications

See Tab. 1.

3 Software

The *Raspberry Pi* uses Linux kernel-based operating systems. Raspbian, a Debian-based free operating system optimized for the *Raspberry Pi* hardware, is the current recommended system, released in July 2012.

The GPU hardware is accessed via a firmware image which is loaded into the GPU at boot time from the SD-card. The firmware image is known as the binary blob, while the associated Linux drivers are closed source. Application software use calls to closed source run-time libraries which in turn calls an open source driver inside the Linux kernel. The API of the kernel driver is specific for these closed libraries. Video applications

use OpenMAX, 3D applications use OpenGL ES and 2D applications use OpenVG which both in turn use EGL. OpenMAX and EGL use the open source kernel driver in turn.

On 19 February 2012, the *Raspberry Pi* Foundation released its first proof of concept SD card image that could be loaded onto an SD card to produce a preliminary operating system. The image was based upon Debian 6.0 (*Squeeze*), with the LXDE desktop and the Midori browser, plus various programming tools. The image also runs on QEMU allowing the *Raspberry Pi* to be emulated on various other platforms.

On 8 March, The Raspberry Pi Foundation released *Raspberry Pi* Fedora Remix, at the time its recommended Linux distribution, which was developed at Seneca College in Canada. The Foundation intends to create an App Store website for people to exchange programs.

Slackware ARM (formerly ARMEdslack) version 13.37 and later runs on the *Raspberry Pi* without modification. The 128–224 MB of available memory on the *Raspberry Pi* is twice the minimum requirement of 64 MB needed to run Slackware Linux on an ARM or i386 system. (While Slackware can load and run a GUI, it was designed

	Model A	Model B
Target Price	US\$25	US\$35
SoC	Broadcom BCM2835 (CPU, GPU, DSP, SDRAM, and single USB port)	
CPU	700 MHz ARM1176JZF-S core (ARM11 family)	
GPU	Composite RCA (PAL and NTSC), HDMI (rev 1.3 & 1.4), raw LCD Panels via DSI 14 HDMI resolutions from 640 × 350 to 1920 × 1200 plus various PAL and NTSC standards.	
Memory (SDRAM) (Shared with GPU)	256 MB	512 MB

Table 1: Specifications for the various Raspberry Pi models

to be run from the shell.) The Fluxbox window manager running under the X Window System requires an additional 48 MB of RAM.

In addition, work is being done on system-specific light Linux distributions such as IPFire, OpenELEC, Raspbmc and the XBMC open source digital media center.

4 Operating systems

This is a list of operating systems running, ported or in the process of being ported to *Raspberry Pi*:

Full OS:

- Android 4.0 (Ice Cream Sandwich)
- Arch Linux ARM
- Debian Squeeze
- FreeBSD
- Gentoo Linux
- Google Chrome OS
- NetBSD
- RISC OS

5 Use

As of January 2012, inquiries about the board in the United Kingdom have been received from schools in both the state and independent sectors, with around five times as much interest from the latter.

Contents

1 Hardware	1
2 Specifications	2
3 Software	2
4 Operating systems	3
5 Use	3

List of Figures

1 Raspberry Pi's schematics	2
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References

- [1] Simon Monk. *Programming the Raspberry Pi: Getting Started with Python*. Tab Electronics, 2012.
- [2] Eben Upton and Gareth Halfacree. *Raspberry Pi User Guide*. John Wiley & Sons, 2012.

Index

Fedora Remix
distribution, **2**

I²C interface, **1**

RJ45
ethernet port, **1**