ODROID-C1

Quad Core Linux computer

Don't put up with the slow single core computer anymore.
If you are considering a tiny computer for general purpose computing, software development or as a project platform, the ODROID-C1 will give you a lot more satisfaction and fun with incredible performance for a very low price.

You can get more information from **ODROID Magazine**.

*** Amlogic Cortex-A5(ARMv7) 1.5Ghz quad core CPUs**
*** Mali-450 MP2 GPU (OpenGL ES 2.0/1.1 enabled for Linux and Android)**
*** 1Gbyte DDR3 SDRAM**
*** Gigabit Ethernet**
*** 40pin GPIOs**
*** eMMC4.5 HS200 Flash Storage slot / UHS-1 SDR50 MicroSD Card slot**
*** USB 2.0 Host x 4, USB OTG x 1,**
*** Infrared(IR) Receiver**
*** Ubuntu 14.04 or Android KitKat**

* You need additional MicroSD card or an eMMC module to install the OS. We recommend the eMMC module for much higher performance boosting.
* ODROID-C1 power must be supplied via DC-Jack. Micro-USB port is only for data communication. So you need a proper power supply.

STORY ABOUT THE ODROID-C1

We had received tons of requests for the following model of ODROID-W. So, we started survey for components for ODROID-W2. Finding out the right CPU was the key of this project. Our original target was similar cost and similar performance as ODROID-W. But we realised that we cannot make ODROID-W2 once we reached to Amlogic S805 quad core processor. The performance of Amlogic S805 ARM CortexA5 (ARMv7) 1.5Ghz quad core processor is outperforming Broadcom BCM2835 ARM11 700MHz.

Here is the comparisons to give you better understanding of ODROID-C1.

ODROID-C1 vs Raspberry Pi B+
Both are Linux-friendly, $35 ARM single-board computers for various applications and purposes.

Hardware Comparison
The ODROID-C1 has many advantages over the Raspberry Pi. The processor is an S805 1.5GHz Quad-core from Amlogic with 1GByte DDR3 RAM, Gigabit Ethernet and IR-receiver. The size of this computer is still only 85 x 56 mm with a weight of 40g, and offers silent operation, 2~3W average power usage, and instant portability, since it fits in a shirt pocket.

One powerful feature of the ODROID-C1 is the row of GPIO (general purpose input/output) pins along the edge of the device. These pins are a physical interface between the board and the outside world. The 40pin interface header includes SPI, I2C, UART, ADC and GPIO function.

An SD 3.01 standard compatible UHS-1 Micro-SD card, as well as the faster eMMC module, can be ordered with the ODROID-C1, and arrives with the popular Ubuntu operating system already installed. Insert the SD card into the slot, connect a monitor, a keyboard, a mouse, Ethernet and power cable, and that's all you need to do to use the ODROID-C1! Browse the web, play games, run office programs, edit photos, develop software, and watch videos right away.

The RTC, IR receiver and ADC features on the ODROID-C1 offer many options for building great DIY projects

	ODROID-C1	RPi Model-B+
CPU	Amlogic S805 SoC 4 x ARM Cortex-A5 1.5GHz ARMv7 Architecture @28nm wafer	Broadcom BCM2835 1 x ARM11 700MHz ARMv6 Architecture @40nm wafer
GPU	2 x ARM Mali450MP 600MHz	1 x VideoCore IV 250MHz
RAM	1GB 32bit DDR3 636MHz	512MB 32bit LP-DDR2 400MHz
Flash Storage	Micro-SD UHS-1@100Mhz/SDR50 or eMMC storage option	Micro-SD @50Mhz/SDR25, No eMMC storage option
USB2.0 Host	4 Ports	4 Ports
USB2.0 Device / OTG	1 Port for Linux USB Gadget driver	No
Ethernet/LAN	10/100/1000 Mbit/s	10/100 Mbit/s

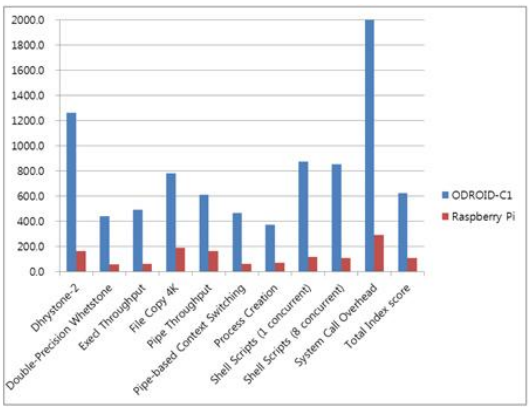
Video Output	HDMI	HDMI / Composite RCA
Audio Output	HDMI	HDMI / 3.5mm Jack
Camera Input	USB 720p	MIPI CSI 1080p
Real Time Clock	YES (On-board RTC)	No(unless using an add-on module)
IR Receiver	YES (On-board IR Sensor)	No(unless using an add-on module)
IO Expansion	40pin port (GPIO/UART/SPI/I2C/ADC)	40pin port (GPIO/UART/SPI/I2C/I2S)
ADC	10bit SAR 2 channels	No(unless using an add-on board)
Size	85 x 56mm (3.35" x 2.2")	85 x 56mm (3.35" x 2.2")
Weight	40g (1.41 oz)	42g (1.48 oz)
Price	$35	$35

Computing performance comparison

We ran a simple, popular benchmark called Unix-Bench (version 5.1.3) to compare the performance of the two boards. Tests were done using several manufacturer-provided images based on a clean install, and the "apt-get update && apt-get upgrade" commands were first run to ensure that both boards was up-to-date.

The RPi was clocked at 800Mhz using a Sandisk UHS-1 8GB SDCard running the Debian Wheezy OS. The C1 was clocked at 1.5Ghz using an 16GB eMMC with Ubuntu 14.04 OS. Both units were powered by a 5V/2A power supply and connected to the 1920x1080 HDMI output. Note that in order to utilize all four cores in the C1, the "./run –c 4" command was used.

Benchmarks(Index Score)	RPi Model B+	ODROID-C1	Ratio
Dhrystone-2 using register variables	162.1	1262.8	7.8
Double-Precision Whetstone	56.2	439.6	7.8
Execl Throughput	61.6	489.4	7.9
File Copy 4K bufsize, 8000 maxblocks	187.9	778.4	4.1
Pipe Throughput	164.1	610.4	3.7
Pipe-based Context Switching	62.7	467.0	7.4
Process Creation	68.2	371.8	5.5
Shell Scripts (1 concurrent)	117.2	874.4	7.5
Shell Scripts (8 concurrent)	106.2	853.8	8.0
System Call Overhead	290.5	1999.7	6.9
Total Index Score	109.8	622.3	5.7



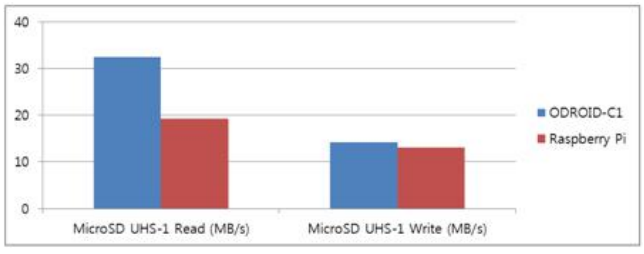
The results show that the Dhrystone-2 benchmark is about 8 times faster on the C1. File I/O benchmark is about 4 times faster because of the faster storage speed of the eMMC module. Overall performance test result show that the C1 is approximately 6 times faster than the RPi, even though the price of C1 is exactly same.

Storage I/O comparison

To obtain the results in the storage I/O comparison graph, type the following lines at a command prompt. The first command tests the write speed, and the second command tests the read speed:

$ dd if=/dev/zero of=test.tmp oflag=direct bs=500K count=1024

$ dd if=test.tmp of=/dev/null iflag=direct bs=500K count=1024



Media access performance	RPi Model B+	ODROID-C1
eMMC Read (MB/s)	NA	62.2
eMMC Write (MB/s)	NA	25.1
MicroSD UHS-1 Read (MB/s)	19.2	32.5
MicroSD UHS-1 Write (MB/s)	13.1	14.2

If you use the eMMC storage, you can get about two to three times faster storage I/O read performance. However, an affordable microSD UHS-1 card can still achieve reasonably fast speeds thanks to the advanced SD 3.01 host controller in the S805 processor. The MicroSD card read performance on C1 is still about 1.7 times faster then RPi if you use the UHS-1 memory card.

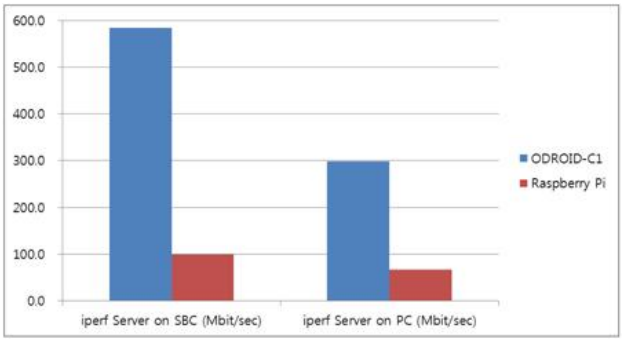
Ethernet IO comparison

To replicate the results in the Ethernet comparison graph, type the following lines at a command prompt:
Server agent on the C1 and Client agent on the host PC
ruppi@ruppi-desktop:~$ iperf -c 192.168.2.10 -P 10
[SUM] 0.0-10.0 sec 700 MBytes 584 Mbits/sec

Server agent on the host PC and Client agent on the C1
odroid@odroid:~# iperf -c 192.168.2.2 -P 10
[SUM] 0.0-10.1 sec 351 MBytes 292 Mbits/sec

Server agent on the RPi and Client agent on the host PC
ruppi@ruppi-desktop:~$ iperf -c 192.168.2.11 -P 10
[SUM] 0.0-10.3 sec 121 MBytes 98.6 Mbits/sec

Server agent on the host PC and Client agent on the RPi
pi@raspberrypi:~$ iperf -c 192.168.2.2 -P 10
[SUM] 0.0-10.3 sec 81.6 MBytes 66.6 Mbits/sec



Thanks to the Gigabit Ethernet available on the ODROID-C1, the network performance of C1 is an impressive four to six times faster than Raspberry Pi.

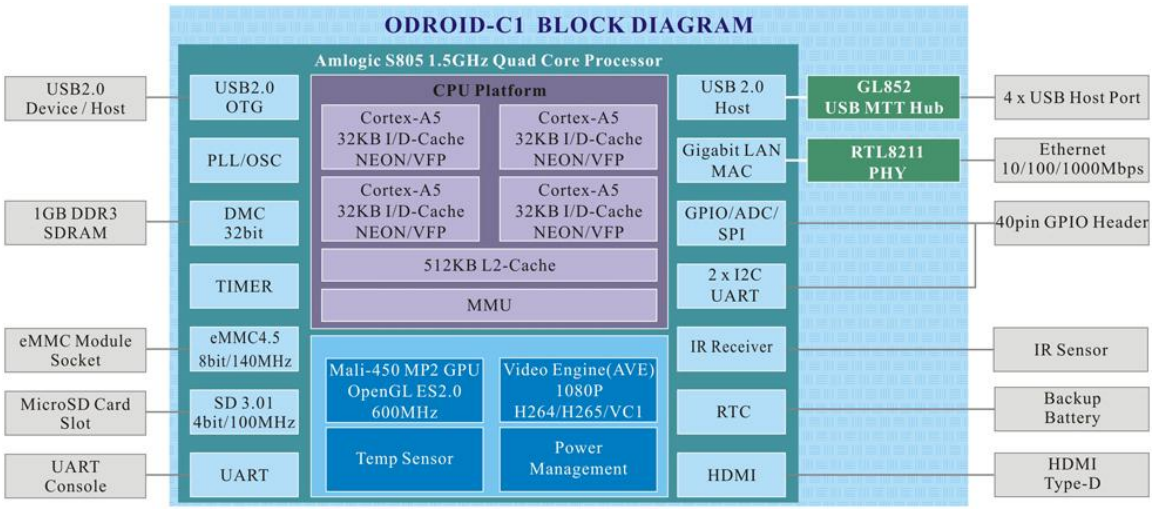
As one can see from the testing results, the quad-core 1.5GHz ODROID-C1 can easily outperform the single-core 700MHz Raspberry Pi board, even when the Raspberry Pi is overclocked. Many test results show four to seven times more performance from the ODROID-C1 platform. Even though both platforms are Linux-friendly computing devices, the performance to cost ratio is much higher with the ODROID-C1. If you are considering a tiny computer for general purpose computing, software development, or as a project platform, the ODROID-C1 will give you a lot more satisfaction and fun with incredible performance for a very low price.

SPECIFICATIONS

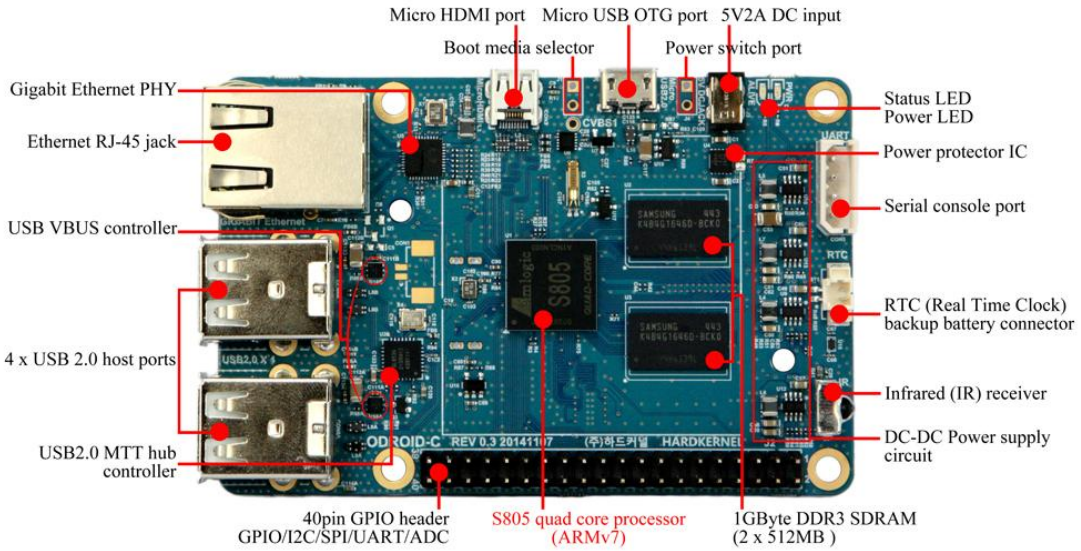
Processor	Amlogic S805 SoC ARM Cortex-A5 (ARMv7) 1.5GHz Quad Core ARMv7 architecture @28nm wafer
Memory	1Gbyte DDR3 RAM 636Mhz
3D Accelerator	ARM Mali-450 MP2 OpenGL ES 2.0 / 1.1
Flash Storage	eMMC Module Socket : eMMC module (option) MicroSD Card Slot : 8 or 16GB MicroSD UHS-1 (option)
USB2.0 Host	High speed standard A type connector x 4 ports
USB2.0 Device/OTG	High Speed USB standard A type connector x 1 port
Ethernet/LAN	10/100/1000Mbps Ethernet with RJ-45 Jack (Auto-MDIX support)
Video Output	HDMI
Audio Output	HDMI
Camera Input	USB 720p(option)
Real Time Clock	On-board RTC function with a backup battery connector
IO Expansion	40pins
WiFi	USB IEEE 802.11b/g/n 1T1R WLAN with Antenna (USB module) (option)
Power	5V 2A Power (option)
System Software	Ubuntu 14.04 + OpenGL ES on Kernel 3.10 LTS Android 4.4.x on Kernel 3.10 LTS Full source code is accessible via our Github.
PCB Size	85 x 56 x 18 mm approx. (Weight : 40 gram)

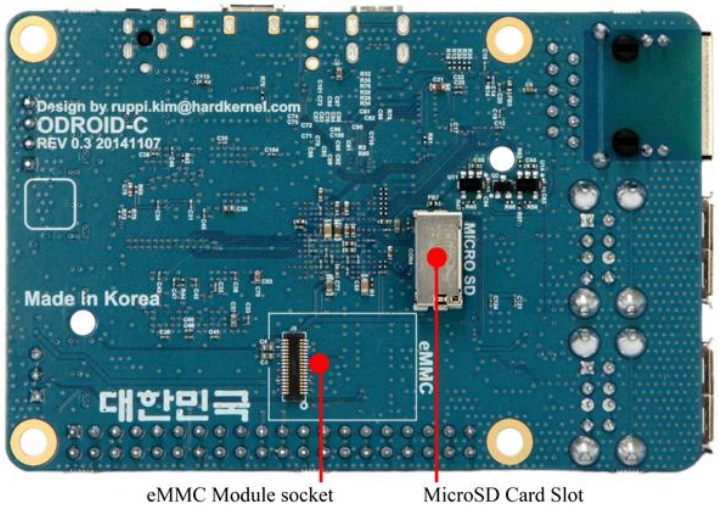
WiKi : **http://odroid.com/dokuwiki/doku.php?id=en:odroid-c1**
FULL SCHEMATICS : **Download HERE**
ODROID-C1 PCB Mechanical drawings (AutoCAD format) : **Download HERE**

BLOCK DIAGRAM



BOARD DETAIL





ODROID-C1

Processor	Amlogic S805 : Quad Core Cortex™-A5 processor with Dual Core Mali-450 GPU
RAM	Samsung K4B4G1646D : 1GByte DDR3 32bit RAM (512MByte x 2pcs)
eMMC module socket	8GB/64GB : Toshiba eMMC 16GB/32GB : Sandisk iNAND Extreme The eMMC storage access time is 2-3 times faster than the SD card. You can purchase 4 size options: 8GB, 16GB, 32GB and 64GB. Using an eMMC module will increase speed and responsiveness, similar to the way in which upgrading to a Solid State Drive (SSD) in a typical PC also improves performance over a mechanical hard drive (HDD).
Micro Secure Digital (MicroSD) Card slot	There are two different methods of storage for the operating system. One is by using a MicroSD Card and another is using an eMMC module, which is normally used for external storage for smartphones and digital cameras. The ODROID-C1 can utilize the newer UHS-1 SD model, which is about 2 times faster than a normal class 10 card. Note that there are some cards which needs additional booting delay time around 30 seconds. According to our test, most Sandisk Micro-SD cards don't cause the booting delay. We will make a compatibility list soon.
5V2A DC input	This is for 5V power input, with an inner diameter of 0.8mm, and an outer diameter of 2.5mm. The ODROID-C1 consumes less than 0.5A in most cases, but it can climb to 2A if many passive USB peripherals are attached directly to the main board.
USB host ports	There are four USB 2.0 host ports. You can plug a keyboard, mouse, WiFi adapter, storage or many other devices into these ports. You can also charge your smartphone with it! If you need more than 4 ports, you can use a powered external USB hub to reduce the power load on the main device.
Micro HDMI port	To minimize the size of the board, we used the Type-D micro-HDMI connector.
Ethernet RJ-45 jack	The standard RJ45 Ethernet port for LAN connection supports 10/100/1000 Mbps speed Green — Flashes when there is 100Mbps connectivity Yellow — Flashes when there is 1000Mbps connectivity
Status / Power LEDs	The ODROID-C1 has four indicator LEDs that provide visual feedback Red — Power — Hooked up to 5V power Blue — Alive — Solid light : u-boot is running, Flashing : Kernel is running (hear beat)
Infrared (IR) receiver	This is a remote control receiver module that can accept standard 37.9Khz carrier frequency based wireless data.
Micro USB OTG port	You can use the standard micro-USB connector with Linux Gadget drivers on your host PC, which means that the resources in the ODROID-C1 can be shared with typical PCs. You can also add a micro-USB to HOST connector if you need an additional USB host port. Note that this port cannot be used for power input.
General Purpose Input and Output (GPIO) ports	These 40pin GPIO port can be used as GPIO/I2C/SPI/UART/ADC for electronics and robotics. The 40 GPIO pins on an ODROID-C1 are a great way to interface with physical devices like buttons and LEDs using a lightweight Linux controller. If you're a C/C++ or Python developer, there's a useful library called WiringPi that handles interfacing with the pins. We've already ported the WiringPi v2 library to ODROID-C1. Please note that pins #37, #38 and #40 are not compatible with Raspberry Pi B+ 40pin header. Those pins are dedicated for Analog input function.
Serial console port	Connecting to a PC gives access to the Linux console. You can see the log of the boot, or to log in to the C1 to change the video or network settings. Note that this serial UART uses a 3.3 volt interface. We recommend the USB-UART module kit from Hardkernel.
RTC (Real Time Clock) backup battery connector	If you want to add a RTC functions for logging or keeping time when offline, just connect a backup battery. All of the RTC circuits are included on the ODROID-C1 by default.
Gigabit Ethernet PHY	Realtek RTL8211F is a highly integrated Ethernet transceiver that complies with 10Base-T, 100Base-TX, and 1000Base-T IEEE 802.3 standards.
USB MTT hub controller	GENESYS LOGIC GL852G is used to implement the 4-port Hub function which fully complies with Universal Serial Bus Specification Revision 2.0.
USB VBUS controller	NCP380 Protection IC for USB power supply from OnSemi.
Boot media selector	If this port is opened, the first boot media is always eMMC. If this port is closed, the first boot media is always SD-card.
Power switch port	You can add a slide switch or rocker switch on this port if you want to implement a hardware on/off switch. If this port is closed, the power is off. If this port is opened, the power is on.
Power supply circuit	Discrete DC-DC converters LDOs are used for CPU/DRAM/IO power supply.
Power protector IC	NCP372 Over-voltage, Over-current, Reverse-voltage protection IC from OnSemi.

GPIO PINMAP

	ODROID-C1 40pin Layout									Power Pin Special Function GPIO/Special Function		
WiringPi GPIO#	Export GPIO#	ODROID-C PIN		Label	HEADER		Label	ODROID-C PIN		Export GPIO#	WiringPi GPIO#	
				3V3	1	2	5V0					
			I2CA_SDA	SDA1	3	4	5V0					
			I2CA_SCL	SCL1	5	6	GND					
7	83		GPIOY.BIT3	#83	7	8	TXD1	TXD_B		113		
				GND	9	10	RXD1	RXD_B		114		
0	88		GPIOY.BIT8	#88	11	12	#87	GPIOY.BIT7		87	1	
2	116		GPIOX.BIT19	#116	13	14	GND					
3	115		GPIOX.BIT18	#115	15	16	#104	GPIOX.BIT7		104	4	
				3V3	17	18	#102	GPIOX.BIT5		102	5	
12	107	MOSI	GPIOX.BIT10	MOSI	19	20	GND					
13	106	MISO	GPIOX.BIT9	MISO	21	22	#103	GPIOX.BIT6		103	6	
14	105	SCLK	GPIOX.BIT8	SCLK	23	24	CE0	GPIOX.BIT20	CE0	117	10	
				GND	25	26	#118	GPIOX.BIT21		118	11	
			I2CB_SDA	SDA2	27	28	SCL2	I2CB_SCL				
21	101		GPIOX.BIT4	#101	29	30	GND					
22	100		GPIOX.BIT3	#100	31	32	#99	GPIOX.BIT2		99	26	
23	108		GPIOX.BIT11	#108	33	34	GND					
24	97		GPIOX.BIT0	#97	35	36	#98	GPIOX.BIT1		98	27	
			ADC.AIN1	AIN1	37	38	1V8	1V8				
				GND	39	40	AIN0	ADC.AIN0				