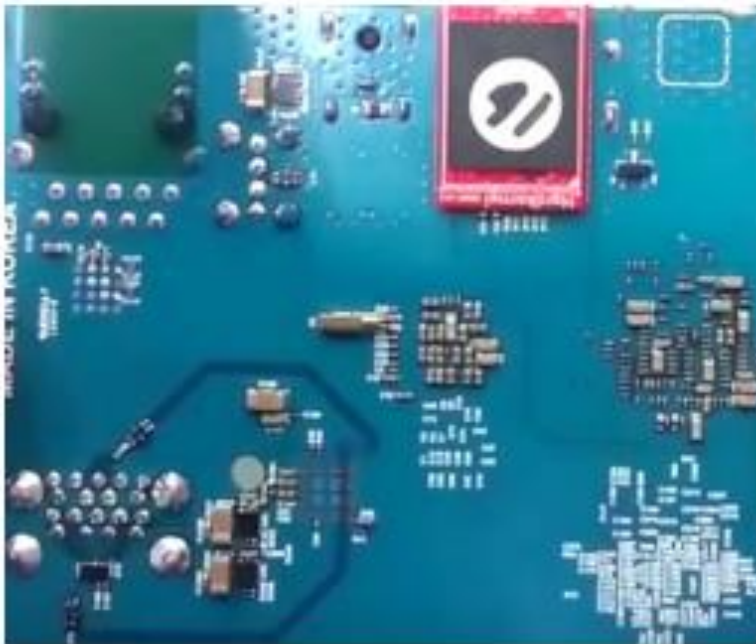


eMMC Module

Align the eMMC module and the eMMC connector on the XU4 board, using the white rectangle on the PCB as a guide. The female portion of the eMMC module should line up with the male connector on the board. Slowly push it in until it clicks in place. Be gentle. If you are unable to push it in, it may be misaligned. Recheck and turn the eMMC module if you notice a wrong insertion direction. The writing on the card will be exposed after insertion. The image below depicts how the eMMC module appears after it is mounted.



XU4 closeup with eMMC module attached

How to recovery the eMMC boot loader.

The boot loader is placed on the Boot Partition (Hidden Partition) in the eMMC memory. (C1 model doesn't use the Hidden partition).
When it is corrupted or you want to use the eMMC to other different board, you must

install the proper boot loader in the eMMC.
Note that you must have a micro-SD card to do the recovery process.

Recovering with Recovery image

1. Download [Recovery Image](#) file.
2. Prepare a microSD card and flash the downloaded image. flashing → [refer this link](#)
3. Connect both the eMMC and **MicroSD** to XU3/XU4
4. Set the dip-switches or slide-switch on XU3/XU4 to “SD boot mode”. If you have XU3, [refer this link](#)
5. Connect Power and watch the LED status
6. The blue and red LEDs are solid on. This may take 40seconds ~ 3minutes. After recovery process, blue LED will be flashing like a heartbeat. And remove the power supply.
7. Set the dip-switchs or slide-switch back to eMMC boot mode.
8. Remove the microSD card.
9. Proceed with normal power up with your peripherals attached.
10. After checking the Android on eMMC, you can install other Linux OS images on the eMMC later.

Recovering eMMC with Micro SD card and USB-UART kit

This instruction requires [USB-UART](#) and terminal application on your desktop.


1. Set the switch (SW1) to boot with **MicroSD** on the board
2. Insert the Micro SD flashed with booting image into its slot and power on. You must stop at U-boot once the board is started.
3. Invoke the commands below to copy the boot loader image from Micro SD to eMMC. Once copying is done, set the switch (SW) to see if the board can boot with eMMC.


```
4. Exynos5422 # run copy_uboot_sd2emmc
```


Index of /eMMCModule

Name	Last modified	Size	Description
 Parent Directory		-	
 EMMC BD 0.3.pdf	2014-10-08 14:04	360K	

 [EMMC_ODROID.pdf](#) 2014-10-15 12:00 484K

 [EMMC_ODROID.png](#) 2014-11-04 10:48 806K

 [EMMC_REV0.4.pdf](#) 2017-11-16 18:05 165K

 [eMMC_Reader.png](#) 2014-10-08 14:04 261K

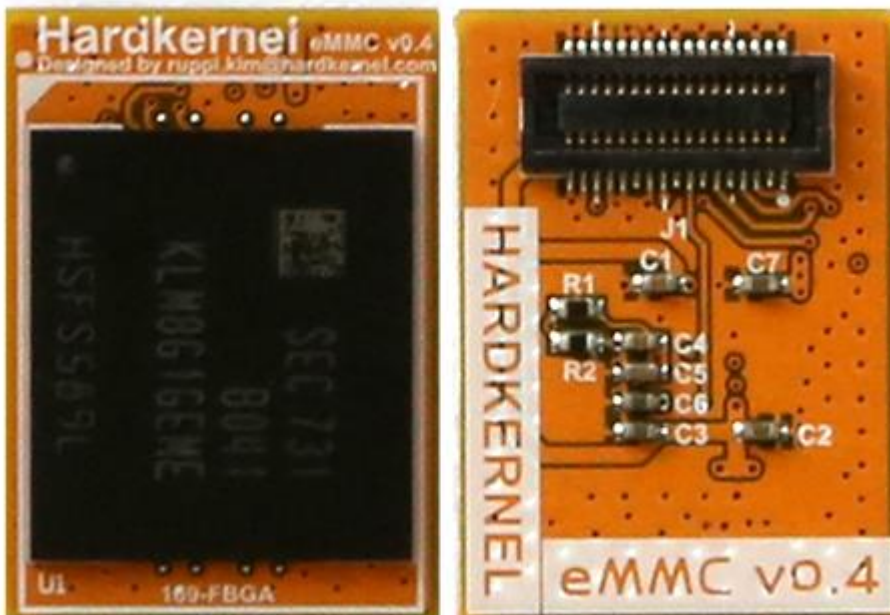
Apache/2.4.18 (Ubuntu) Server at dn.odroid.com Port 443

Reference Chart

- Check the eMMC module compatibility.
- If the OS on your eMMC is corrupted or the eMMC has a wrong boot loader, reinstall a proper boot loader on the eMMC via [eMMC Recovery](#).
- The **Orange** eMMC modules work with ODROID-Co/C1/C1+/C2/XU4/**H2/N2**.
- The **Black** eMMC modules work with ODROID-Co/C1/C1+/C2/**H2/N2**.
- The **Red** eMMC modules work with ODROID-Co/C1/C1+/C2/XU4/**H2/N2**.

Orange eMMC module

The Orange eMMC module uses Samsung eMMC 5.1 chipset. We started to ship it from October 2017.



It works with C1/C2/XU4/H2/N2 series with a proper OS. The latest official OS images all work fine.

Orange eMMC module schematics : [eMMC PCB Rev 0.4](#)

If you want to use the Orange eMMC with XU4 platforms stably, the Kernel version must be higher than 4.9.58 or 4.14.6.

Orange eMMC compatibility status with XU4 series OS images



OS image	Image file information	Status
Ubuntu 18.04 Mate	ubuntu-18.04-4.14-mate-odroid-xu4-20180501.img	OK
Ubuntu 18.04 Minimal	ubuntu-18.04-4.14-minimal-odroid-xu4-20180531.img	OK
Ubuntu 16.04 Mate	ubuntu-16.04.3-4.14-mate-odroid-xu4-20171212.img	OK
Ubuntu 16.04 Minimal	ubuntu-16.04.3-4.14-minimal-odroid-xu4-20171213.img	OK
Android 7.1.1	Alpha-1.1_14.11.17	OK
Android TV 7.1.1	Alpha-1.0_20.11.17	OK
Android 4.4.4	Android 4.4.4 (v5.8)	OK
Debian Jessie	Debian-Jessie-1.1.4-20171121-XU3+XU4.img	OK
ODROID Game Station Turbo(OGST)	ODROID-GameStation-Turbo-3.9.5-20171115-XU3+XU4-Jessie.img	OK

OS image	Image file information	Status
Armbian	All Armbian variants starting with version 5.35	OK
OMV	OMV_3_0_92_Odroidxu4_4.9.61	OK
DietPi	DietPi_OdroidXU4-armv7-(Jessie).7z 22-Nov-2017	OK
Yocto project		Untested
Kali-Linux	Kali 2018.2	OK
Arch-Linux		Untested
ROS		Untested
Lakka	Lakka-OdroidXU3.arm-2.1-rc6.img.gz	OK
Batocera	batocera-5.12-xu4-20171214.img.gz	OK
RecalBox	recalbox (17.11.10.2)	OK
RetroPie	ORA(Odroid Retro Arena) 1.5x	OK

How to distinguish the Sandisk eMMC ver 5.1 from the 5.0

The eMMCs from Sandisk will be version up to 5.1 with slightly faster data transfer speed starting from 20th of July 2017.

As shown in the figure below, the QR code is on the left side of the ver5.1 chipset while eMMC ver 5.0 has it on the right side.

eMMC 5.0	eMMC 5.1
 A photograph of a SanDisk eMMC 5.0 module. The module is black with a red border. The text on the module includes "SanDisk", "SDIN80W4-32G", "CHINA", and "7064DLER509". A yellow square highlights a small, illegible mark on the module.	 A photograph of a SanDisk eMMC 5.1 module. The module is black with a red border. The text on the module includes "SanDisk", "SDIN80Q4-32G", "CHINA", and "7137DPHARD97".

Old Kernel 3.10 should have this patch to make it work with XU4 series properly.

[Github](#)

[Github](#)

[Github](#)






eMMC modules for current running products 2016~

	Linux	Android
ODROID-C2		
ODROID-C1+ ODROID-C0 ODROID-C1		
ODROID-XU4 ODROID-XU3		

The Black eMMC modules work with only ODROID-C0/C1/C1+/C2/H2/N2.
Other Blue/Red eMMC modules work with all ODROID boards.

eMMC modules for old products

eMMC Module Reference Chart




	eMMC V4.5	eMMC V4.5	eMMC V5.0	eMMC V5.0	eMMC V4.5	eMMC V5.0
Android for U2/U3 Green						
	8GB	16GB	16GB	32GB	64GB	64GB
Ubuntu For U2/U3 Red						
	8GB	16GB	16GB	32GB	64GB	64GB
Android For X2 Yellow						
	8GB	16GB	16GB	32GB	64GB	64GB
Android For XU Blue						
	8GB	16GB	16GB	32GB	64GB	64GB
Ubuntu for XU3 Light Blue						
			16GB	32GB		64GB
Android For XU3 White						
			16GB	32GB		64GB
Ubuntu for C1 Pink						
	8GB		16GB	32GB		64GB
Android for C1 Light Green						
	8GB		16GB	32GB		64GB

Note: XU4 and XU3 have software compatibility each other.

Compatibility with USB3.0 to eMMC Reader

It is not related to their version or capacity but color.

Listed all kind of eMMC are **compatible** with USB3.0 to eMMC Reader.

RED	ORANGE	BLUE
		

Listed all kind of eMMC are **NOT compatible** with USB3.0 to eMMC Reader.

BLACK


Reference

eMMC Module & eMMC Reader Schematics

[Download old eMMC module Revision 0.3 schematics](#)

[Download Orange eMMC Module Revision 0.4 schematics](#)

[eMMC reader board schematics](#)

eMMC board dimensions : 18.5mm x 13.5mm

Gap between the PCBs : 1.1mm (Height of assembled B2B connectors)

eMMC connector specification

The connector is made by LS-Mtron Korea.

On the eMMC module, we've used the GB042-34S-H10 (Socket-34pin).

On the host board, we've used the GB042-34P-H10 (Plug-34pin).

[The connector specification is here](#)

Information about Sandisk eMMC (iDisk Extreme)

<http://www.sandisk.com/products/embedded/inand/inand-extreme>

Information about Samsung eMMC

<http://www.samsung.com/semiconductor/products/flash-storage/emmc/>

Information about Essencore eMMC (8GB eMMC is used for XU4)

<http://www.the-aio.com/emmcfeature>

Information about Toshiba eMMC

<https://toshiba.semicon-storage.com/us/product/memory/nand-flash/mlc-nand/emmc.html>

eMMC Read/Write test on ODROID-C2 HS400 mode

Unit : MByte/sec

		Samsung	Toshiba	Sandisk
8G	Write	45.4	21.9	N/A
8G	Read	113	148	N/A
16G	Write	80.1	N/A	25.6
16G	Read	126	N/A	153
32G	Write	124	N/A	98.7
32G	Read	125	N/A	153
64G	Write	124	83.7	107
64G	Read	124	153	153

Note 1: Write/Read command for the eMMC benchmark.

```
$ dd if=/dev/zero of=test.tmp oflag=direct bs=1M count=1024
```

```
$ dd if=test.tmp of=/dev/null iflag=direct bs=1M
```

ODROID-C2 + Black eMMC Performance Test of File I/O

Test condition

ubuntu 16.04

kernel version : Linux odroid64 3.14.79-115

Test tool : iозone revision 3.429

iозone install & performance test

```
$ sudo apt install iозone3
```

```
$ iозone -e -I -a -s 100M -r 4k -r 16k -r 512k -r 1024k -r 16384k -i 0 -i 1 -i 2
```

```
/* 8G */
```

						random	random	
	kB	reclen	write	rewrite	read	reread	read	write
	102400	4	9290	13582	13570	13568	11900	8787

102400	16	10934	15680	27511	27484	25976	7699
102400	512	14943	23761	42163	42121	41361	15122
102400	1024	15140	28564	41951	41915	41196	16743
102400	16384	16559	24001	42308	42267	42287	28604

/* 16G */

						random	random	
	kB	reclen	write	rewrite	read	reread	read	write
102400	4	14602	14622	18102	17953	16768	14421	
102400	16	49363	49279	52902	52808	47450	48389	
102400	512	49779	49993	138268	138315	137171	48836	
102400	1024	50005	49870	137522	137709	136958	49027	
102400	16384	49861	50058	139358	139154	139299	50024	

/* 32G */

						random	random	
	kB	reclen	write	rewrite	read	reread	read	write
102400	4	14608	14670	18333	18343	17935	14624	
102400	16	58393	66157	56412	56766	55744	56371	
102400	512	80356	81074	136828	137132	137503	79224	
102400	1024	80464	81036	137368	137278	136896	79191	
102400	16384	80388	81070	139486	139612	139446	80560	

/* 64G */

						random	random	
	kB	reclen	write	rewrite	read	reread	read	write
102400	4	14240	14299	17619	17548	16012	14216	
102400	16	49991	57484	53245	53405	50001	59302	
102400	512	132316	135079	134154	134016	134208	129755	

```

102400    1024    132476    134966    133753    133840    133677    130054
102400    16384    135772    139140    136133    136019    135821    135107

/* 128G */

                                random    random
                                read      write
    kB  reclen    write  rewrite    read    reread    read    write
102400     4    14162    14152    18161    18184    17833    14200
102400    16    56527    64906    55057    55684    54492    66525
102400    512   131327   131444   137307   137040   137358   132500
102400    1024   131908   131896   137570   137495   136844   132365
102400    16384   136418   134070   139940   133304   121160   134002

```

Note 2:

Black eMMC module is made with Samsung eMMC chipset.

Red/Blue(normal) eMMC module is made with Sandisk or Toshiba or AIO chipset.

C1/Co/C1+/C2 works with Black and Red eMMC modules.

XU4/XU3/U3/X2/U2 do NOT work with Black eMMC module.

New 8GB eMMC test on XU4 Ubuntu

New 8GB eMMC Red PCB for XU4 model is based on Essencore/AIO's eMMC 5.0 technology.

Sequential speed with "dd" test

dd write : 15.1 MB/s

dd read : 104 MB/s

Random access(IOPS) speed test with 4k block.

Random write : io=993228KB, bw=9928.2KB/s, iops=2482

Random read : io=1479.1MB, bw=15149KB/s, iops=3787

eMMC vs SD card performance comparison on C2 Android

16GB eMMC Black PCB

16GB UHS-1 SDHC Card (Sandisk SDSDQAD-016G UHS-I 50 OEM model)

Cleanly flashed Android 5.1 V2.8 image and installed GApps Pico package.

eMMC booting time from power on event : 18~20 seconds

SDHC booting time from power on event : 32~35 seconds

Check points for system software developers

* Do not overwrite the hidden eMMC boot partition. If you have, go here to recover: [How to recover the eMMC boot loader.](#)

* eMMC must be partitioned like so;

—FAT16 partition with UUID 6E35-5356 (boot)

—EXT4 partition with UUID e139ce78-9841-40fe-8823-96a304a09859 (linux)

* Copy contents from Ubuntu image partitions to the boot and linux partitions using “cp -afpv source destination”

* Insert eMMC and boot normally.