

MEGA4: 4-Port USB 3.1 PPPS Hub for Raspberry Pi 4B

User Manual (revision 1.00)

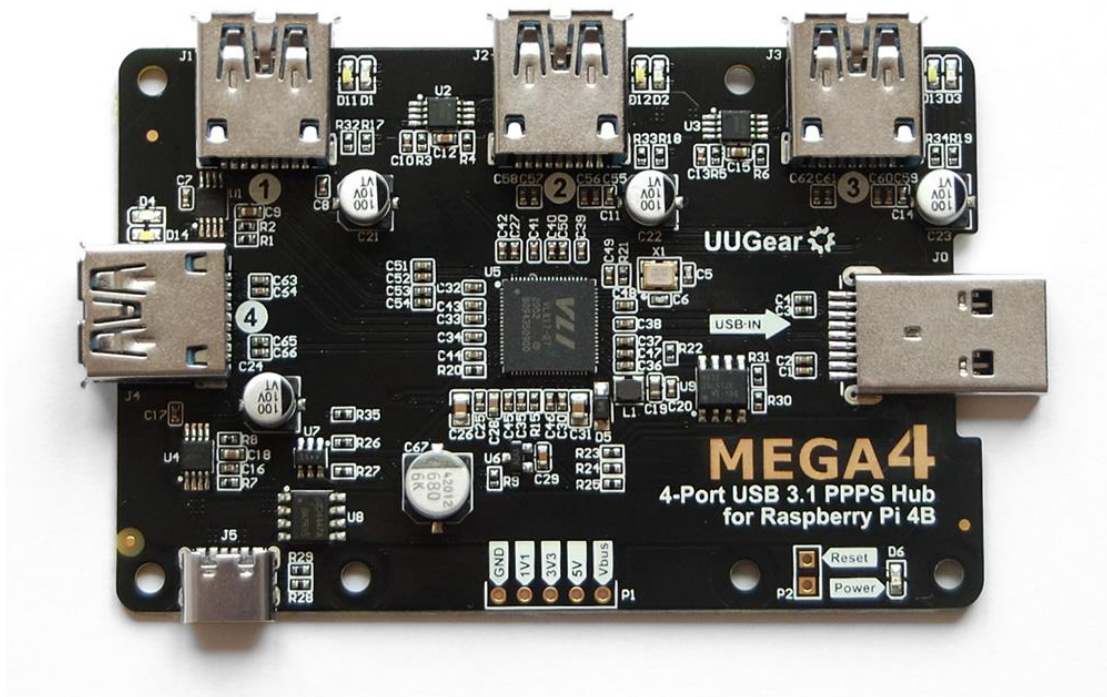
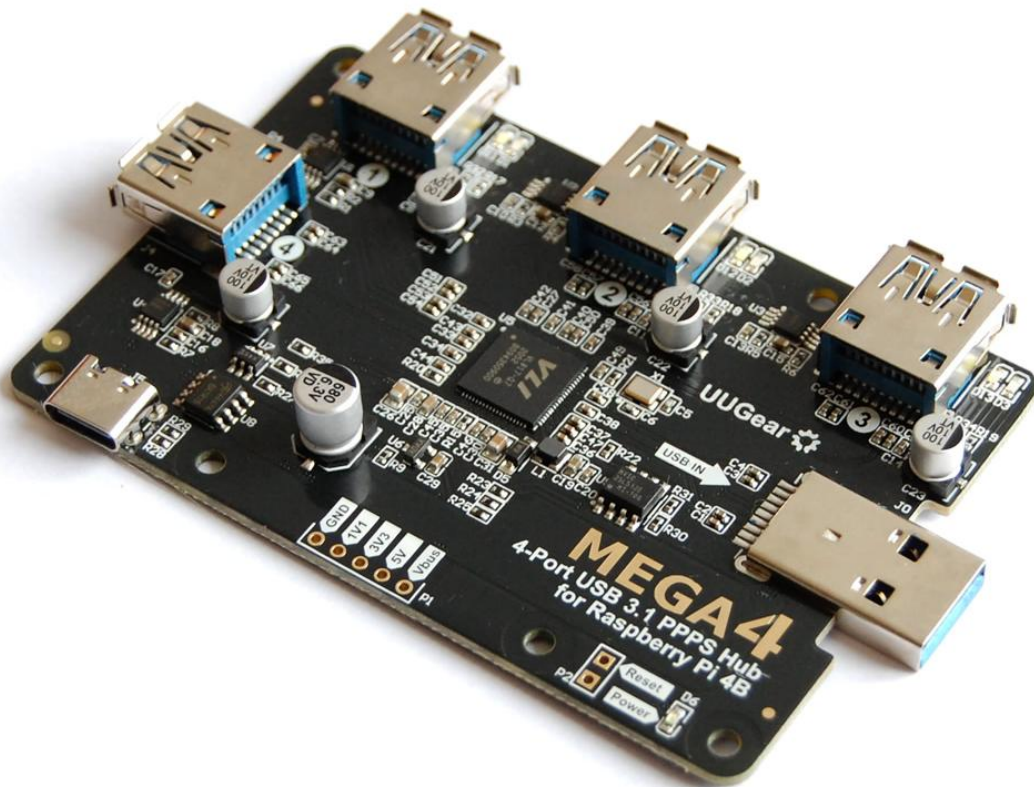


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Product Overview

MEGA4 is a 4-Port USB 3.1 PPS (Per-Port Power Switching) hub designed for Raspberry Pi 4B. It adds 4 more USB 3.1 ports to Raspberry Pi 4B, and the power on each port can be turned ON or OFF separately via software.



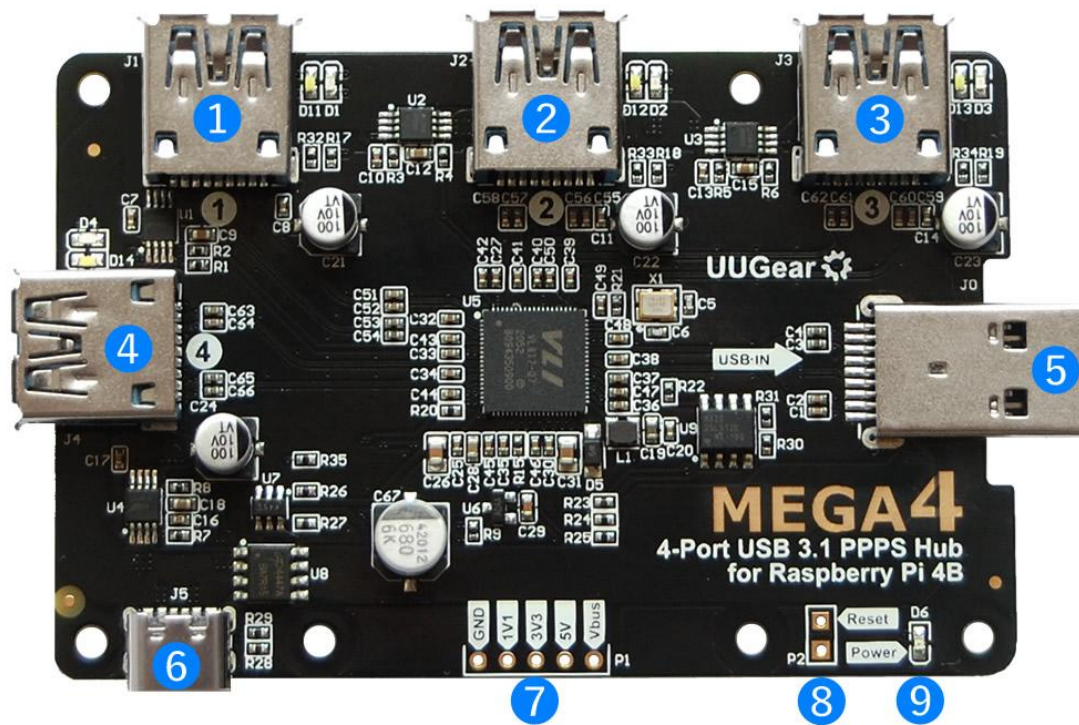
MEGA4 has the same board size as Raspberry Pi 4B, and can be mounted underneath. The U-shaped adapter (included) can make data and power connection between MEGA4 and Raspberry Pi.

MEGA4 is also a powered hub and you can connect 5V power supply to its USB type C connector and significantly increase its current output ability.

You can turn on/off the power on each USB port via the software or via UUGear Web Interface (UWI) on PC, Tablet or Smartphone.

Although MEGA4 is designed for Raspberry Pi 4B, you can use it as a USB 3.1 hub on other computers. You may want to use a USB3.1 extension cable for the connection.

The picture below shows how the board look like:

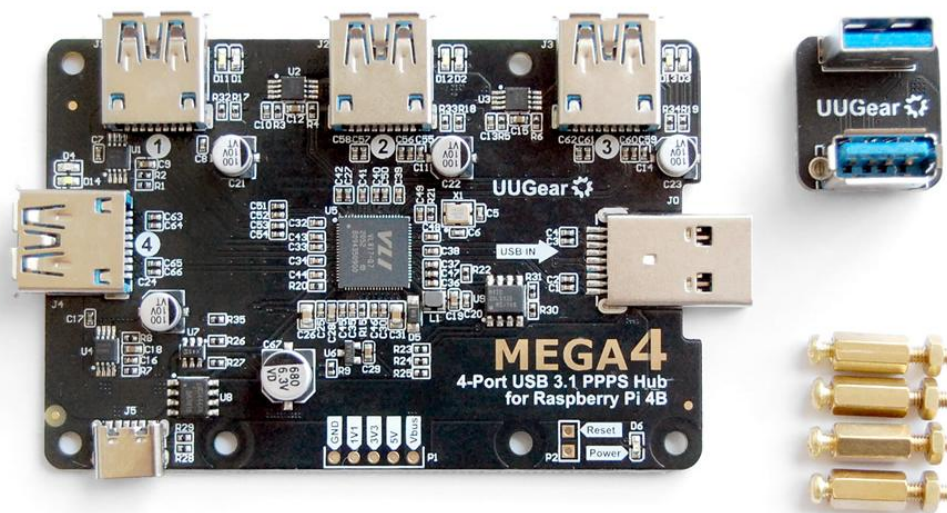


- 1~4) Downstream USB port with white LED as power indicator and blue LED as activity indicator
- 5) Upstream USB port
- 6) USB type C power in (DC 5V)
- 7) Voltages header
- 8) Reset header
- 9) Red LED as power indicator for the whole board

Package Content

Each package of MEGA4 contains:

- MEGA4 board x 1
- U-shaped adapter x 1
- M2.5 x 10+6mm Copper Standoff x 4
- M2.5 screws x 4
- M2.5 nuts x 4



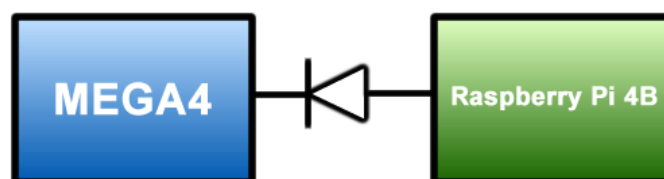
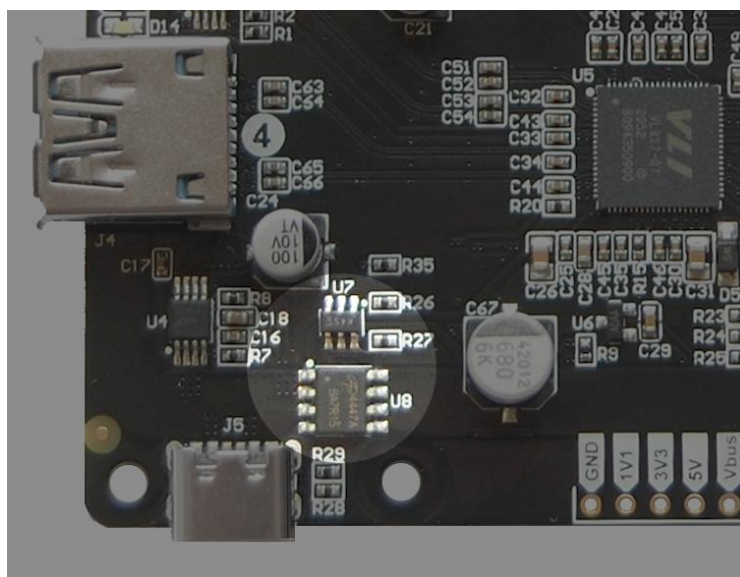
Specifications

Dimension:	85mmx 56mm x 9mm (USB plug is 7mm protrude)
Weight	29g (net weight without any accessory)
USB Hub Controller	VL817 Q7 (firmware rev 90.23)
Per-Port Power Switch	AP2511 (datasheet)
Ideal Diode MOSFET	AO4447 (datasheet)
Standards	<p>USB 3.1 Gen1 (USB 3.0), 2.0 and 1.1 compatibility</p> <p>Multiple Transaction Translator (MTT)</p> <p>Per-Port Power Switching (PPPS)</p> <p>Per-Port Over Current Protection</p>
Data Speed	<p>USB v3.1 Gen 1: up to 5 Gbps</p> <p>USB v2.0: up to 480 Mbps</p> <p>USB v1.1: up to 12 Mbps</p>
USB Ports	<p>Upstream: 1 (A-type USB 3.0 plug)</p> <p>Downstream: 4 (A-type USB 3.0 female connector)</p>
Output Current	<p>Bus powered only: up to 1.2A in total (limited by Raspberry Pi 4B)</p> <p>With supplemental power supply: up to 5A in total, and 2.5A per port (also depends on the power supply)</p>
Static Current	64mA
Operating Temperature	0°C~70°C
Humidity	0~80% RH, no condensing

No Back-Power

Back-power (or back feeding power) here means the USB hub provides electronic power to Raspberry Pi. Because Raspberry Pi 4B does not like back feeding power, **MEGA4 does not support back-power** either.

On MEGA4 board, there is an "ideal diode" implemented with MOSFET (AO4447). This "ideal diode" connects the V_{bus} on Raspberry Pi 4B's USB 3.1 port and the 5V trace on MEGA4. Hence MEGA4 can draw current from Raspberry Pi 4B and get powered.



MEGA4 has a USB type C connector, which allows you to connect a supplemental 5V power supply to increase MEGA4's current output ability. Because of the existence of "ideal diode", the power provided via USB type C connector will not be fed to Raspberry Pi 4B.

About PPS (Per-Port Power Switching)

The concept was firstly introduced in USB 2.0 specification, that a USB hub can advertise three different kinds of power switching on its USB ports:

- no power switching
- ganged power switching (turn on/off all ports together)
- per-port power switching (turn on/off port individually)

The last one is what PPS stands for. This information can be found if you run command "sudo lsusb -v".

Although PPS is included in USB standard for very long time, it is rather difficult to find a USB hub in the market that actually supports PPS.

MEGA4 supports PPS (Per-Port Power Switching).

Not everyone needs PPS, but it is very useful in some specific cases:

Remotely Reset a USB Device

Some USB devices have their quirks and they might not work correctly after a long run. After a lot of efforts on troubleshooting, people may find the most simple way to make the device work again is to reset it (unplug and plug it back). Unfortunately this cannot be done when the device is in a remote site, and it is a typical scenario that PPS can help.

If you have a USB hub that supports PPS (let's say MEGA4), and that hub is connected to a computer that has network access (let's say Raspberry Pi 4B), then you can turn on/off every port on the hub remotely. If you turn off a port and later turn it on again, the USB device connected to that port will get a full power cycle and hence will get reset.

Save Energy

Some USB devices are power hungry. You may not want to turn on all USB devices all the time, especially when your system is powered by battery. If the device is connected to a USB hub that supports PPS, you can turn it off when you don't need it, and that will save energy.

About Output Current

If you do not connect a dedicated power supply to MEGA4's USB type C connector, it will get powered from Raspberry Pi 4B's USB bus. In such case it can draw current up to 1.2A and its total output current will not exceed that limit.

If you want to connect some high-current devices to MEGA4, you should connect a 5V power supply to its USB type C connector. In such case the total output current mainly depends on your power supply, however please keep in mind the USB type C connector is rated as 5A. Also there is a per-port current limit 2.5A, which comes from the per-port power switch (AP2511).

About MTT and STT

A USB hub may have two possible ways for organizing Transaction Translators (TTs). It could have one TT for all downstream ports that have USB devices attached (which is called Single Transaction Translator, STT), or it could have one TT for each downstream port (which is called Multiple Transaction Translator, MTT) .

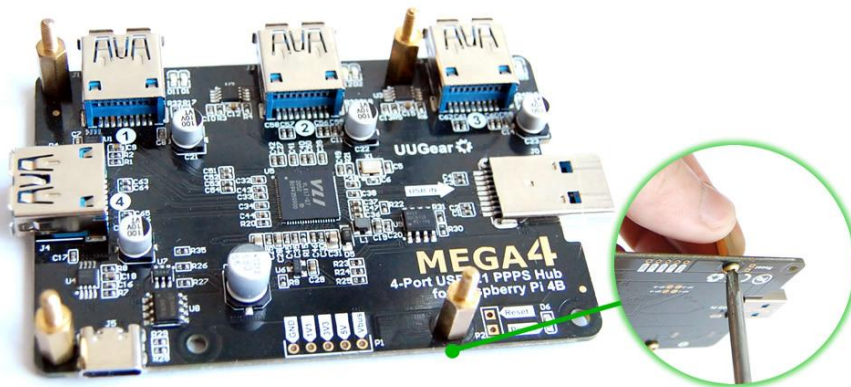
With Single Transaction Translator (STT), connecting one USB 1.1 device to the hub will force all ports to process data with USB 1.1 standard, thus slowing down all USB devices on the same USB hub. While with Multiple Transaction Translator (MTT), each downstream port has its own transaction translator to provide the best USB performance no matter what class of USB device is connected.

So MTT is better than STT, if the higher price is acceptable.

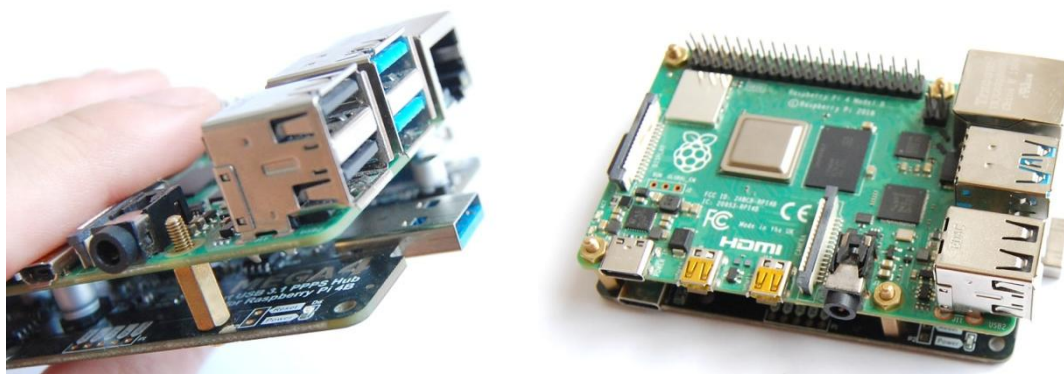
MEGA4 has Multiple Transaction Translator (MTT).

Mount MEGA4 under Raspberry Pi 4B

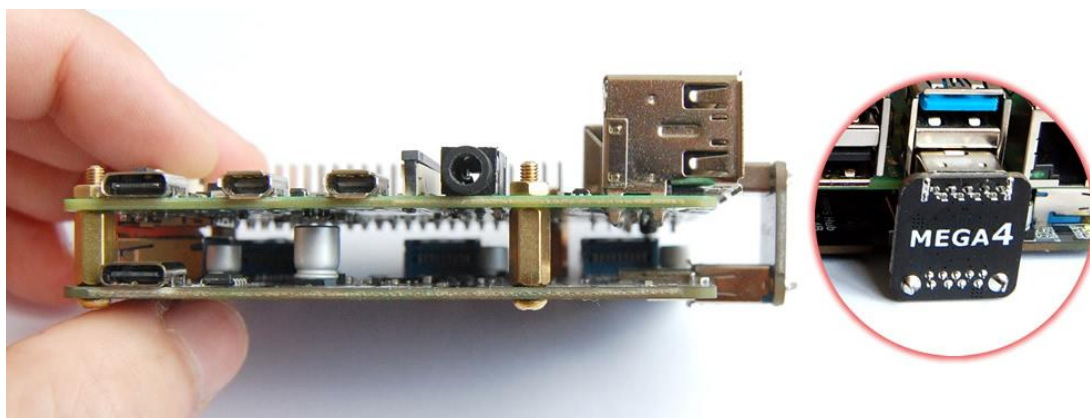
The recommended way to use MEGA4 is to mount it under your Raspberry Pi 4B. The first step is to put the 4 copper standoffs on the board and secure them with the copper screws.



Then you can put your Raspberry Pi 4B on top, and secure it with the copper nuts.



The last step is to plug in the U-shaped adapter and finish the connection.



Connect Power Supply

Because MEGA4 can draw power from Raspberry Pi 4B (via the "ideal diode"), it can work without connecting supplemental power supply, as long as the USB devices on MEGA4 do not consume more than 1.2A current in total. In such case you can just connect 5V power supply to your Raspberry Pi 4B.



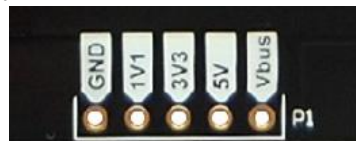
If you are going to connect some power hungry devices to MEGA4, it is better to connect another 5V power supply to MEGA4. This will significantly increase its ability of outputting high current.



Voltages Header and Reset Header

There is a voltages header (P1) on the edge, which breaks out some important voltages on the board.

- Vbus: the voltage from Raspberry Pi's USB bus
- 5V: the main power for the hub (direct connects to USB type C)
- 3V3: the 3.3V used by VL817
- 1V1: the 1.1V used by VL817



The voltages header can be used to:

- test the device
- provide voltages to external devices (for very low current devices only).
- connect a 5V supplemental power supply (between 5V and GND).

There is also a reset header (P2), which will fully reset the hub when the two pins in this header are shorted for a moment. It is mainly for testing/debugging purpose. If you want, you can also make your very own reset button with this header.



Software Installation and Usage

You can use MEGA4 as a USB 3.1 hub without installing any software, however if you wish to turn on/off the power on each USB port, you will need to use the software.

MEGA4's software is a wrapper of [uhubctl](#), and it provides intuitive interface for controlling the power on each USB port, and also allows you to control your MEGA4 via UUGear Web Interface (UWI).

To install the software, please run the two commands below. Doing so in home directory is recommended.

```
pi@raspberrypi:~ $ wget https://www.uugear.com/repo/MEGA4/install.sh
pi@raspberrypi ~ $ sudo sh install.sh
```

The installation script will install the software in "mega4" directory and it will also install UUGear Web Interface (UWI) in "uwi" directory. After the installation you should reboot your Pi so the UWI server will be running in the background.

The installation script needs to run with sudo because it will also disable "USB auto suspend" by modifying the /boot/cmdline.txt file.

Interactive BASH Script

You can enter the "mega4" directory and run the mega4.sh (with sudo):

```
pi@raspberrypi ~ $ cd mega4
pi@raspberrypi:~/mega4 $ sudo ./mega4.sh
```

Please don't forget to use sudo when running mega4.sh, because uhubctl needs sudo to work properly. This interactive script will list all your MEGA4 devices.

In the middle of the device you will find the ID of the hub ("1-1.2" on the picture below).

If any USB port is turned off, you will see "OFF" text under the port number, otherwise you will see "ON" instead. If there is a USB device connected to a port, that port will have a label "*ON", meaning the port also has USB activity.

The picture below shows how it looks like:

```
MEGA4: 4-Port USB3.1 PPPS Hub for Raspberry Pi 4B
< Version 1.00 >

  1 *ON  2 ON  3 ON
  4 ON  Hub: 1-1.2  To: RPi

Now you can:
1. Turn port power ON...
2. Turn port power OFF...
3. Exit
What do you want to do? (1-3) █
```

Here you can input "1" and then specify the port(s) you want to turn ON. You can use comma to separate multiple ports, or use '-' to specify a range. Some examples:

- **1** (will turn on port 1)
- **1,3** (will turn on port 1 and port 3)
- **1-3** (will turn on port 1, port 2 and port 3)

You can also input "2" and then specify the port(s) you want to turn OFF. Again you can use comma to specify multiple ports, or use '-' to specify a range.

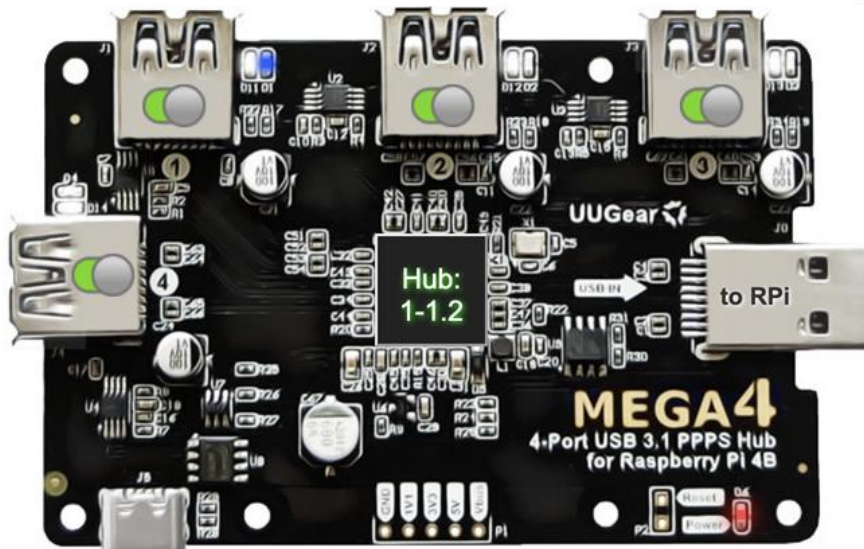
Remarks: if you have multiple MEGA4 hubs daisy-chained, the software will list all of them and each of them has its own ID. In such case you will also need to specify the hub you want to control, before specifying the port(s).

UUGear Web Interface (UWI)

You can also monitor and control your MEGA4 device(s) via UUGear Web Interface (UWI). With default settings you should be able to access your MEGA4 with address <http://raspberrypi:8000/mega4/> on web browser, however if your Raspberry Pi has been configured to a different host name, you need to specify the correct host name (or IP address) in the [uwi.conf](#) file (in "uwi" directory).

MEGA4

You can find your MEGA4 hub(s) below:



UUGear Web Interface V1.02

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The UWI page will list all your MEGA4 devices, and here you can see the status of every port (powered or not, has USB activity or not). There is a virtual power button on every USB port, so that you can turn on/off its power.

You can also click the round button on the top-right corner, so it will automatically refresh the state of your MEGA4 device.

Remarks: turning off the power of a port may take longer than you expected (UWI will block your input for a few seconds until it is done), because the device driver in Linux kernel is surprised by USB device being turned off and automatically tries to power it back on. The workaround is to use the `-r` option with `uhubctl` to keep turning the port off until the kernel gives up (as mentioned in [uhubctl's FAQ](#)). This works but it makes the turning off process longer than expected.

Remarks: if you have multiple MEGA4 hubs daisy-chained, the port that connects to another MEGA4 device cannot be turned off. You will see its virtual button gets disabled.

Daisy-Chaining MEGA4 Devices

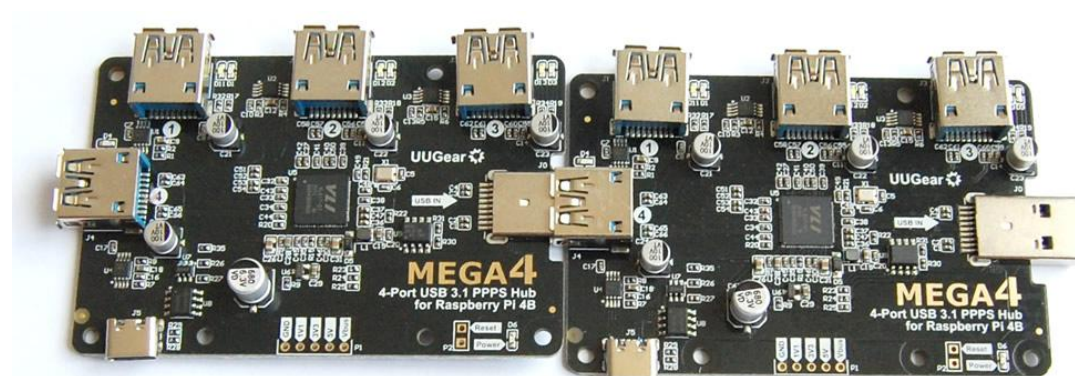
MEGA4 is a USB hub, and it can be daisy-chained like other USB hubs.

By daisy-chaining the device you can build a network of USB ports. In theory you can have a up to 127 USB ports in the network, and that includes all those ports used for creating the network tree. Also the network can have up to 7 tiers, which includes the root hub and the device at the end of the chain.

Remarks: each MEGA4 will draw rather high current during the initialization. When two or more MEGA4 devices are daisy-chained, it is strongly recommended to connect another 5V power supply to the USB type C connector on the first MEGA4 board, otherwise the initialization may fail and you will see the LED indicators keep blinking.

Direct Daisy-Chaining

Because the upstream port on MEGA4 is a USB 3 male connector (plug), the device can be directly daisy-chained like this:

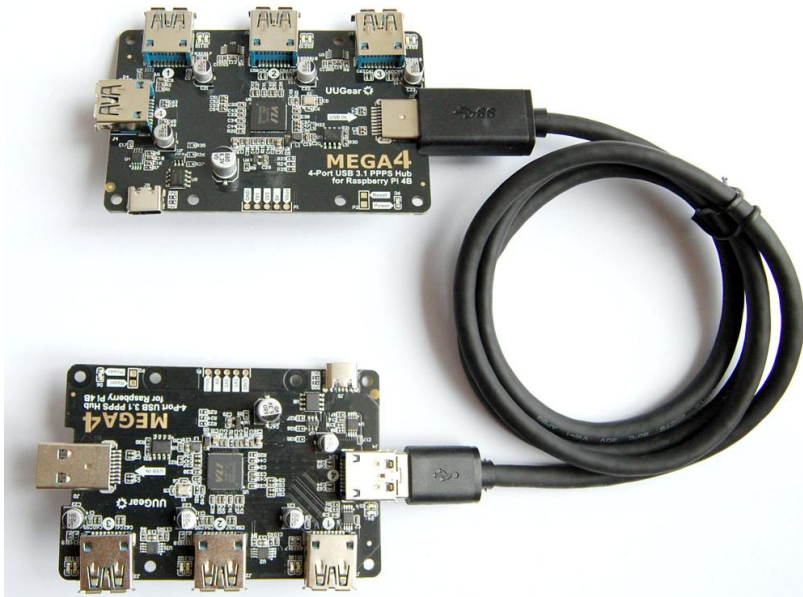


This is simple and straightforward, but it will be hated by perfectionists because the two boards are not well aligned, and they are not even on the same plane!

But still, this kind of chaining can be used for quick testing or prototyping. If the whole system will be placed in a case and the hubs do not need to expose their USB ports, this can also be an acceptable way for chaining.

Chaining via USB 3 Extension Cable

You can also use a USB 3 extension cable to finish the chaining. MEGA4's upstream port can be easily connected with the extension cable.

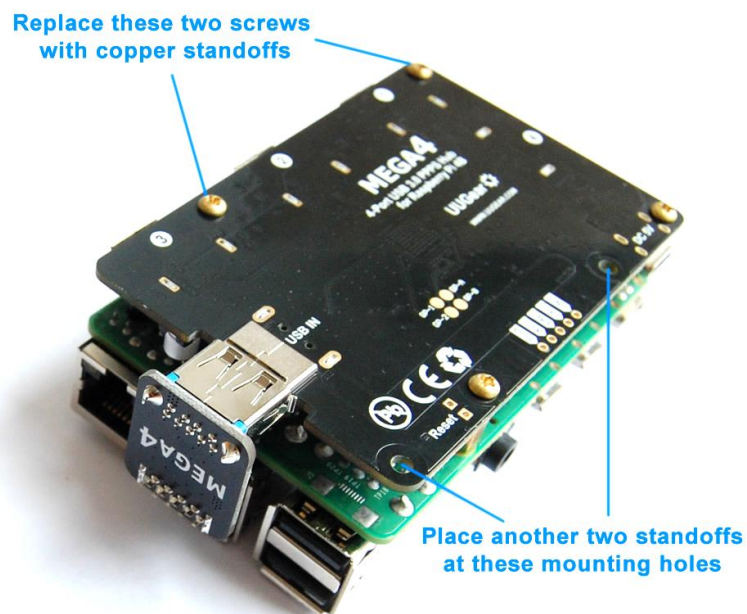


Please make sure to use USB 3 extension cable. If you use USB 2 extension cable instead, the hub can be recognized, but it will work as a USB 2.0 hub.

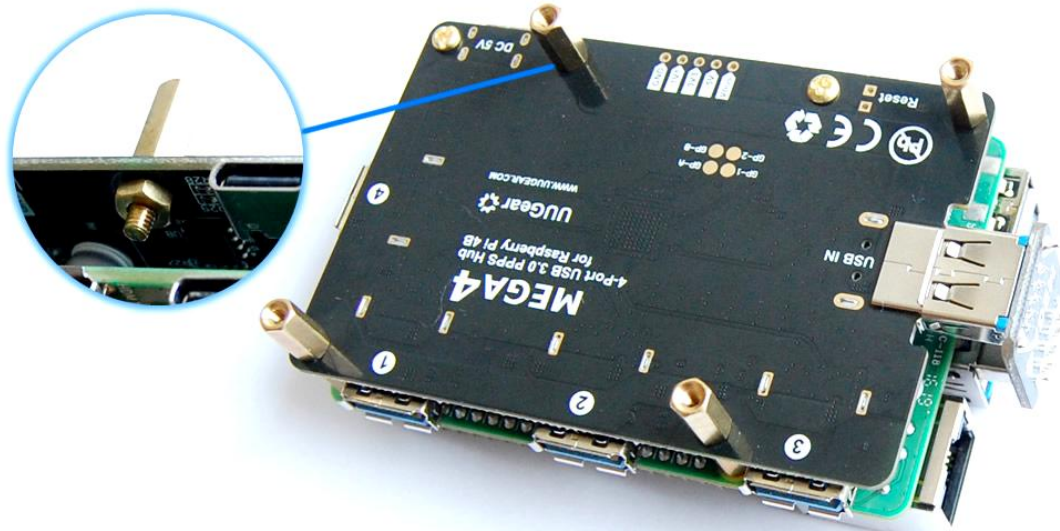
You can also connect MEGA4 to other computers via USB extension cable.

Stacking Multiple MEGA4 Devices

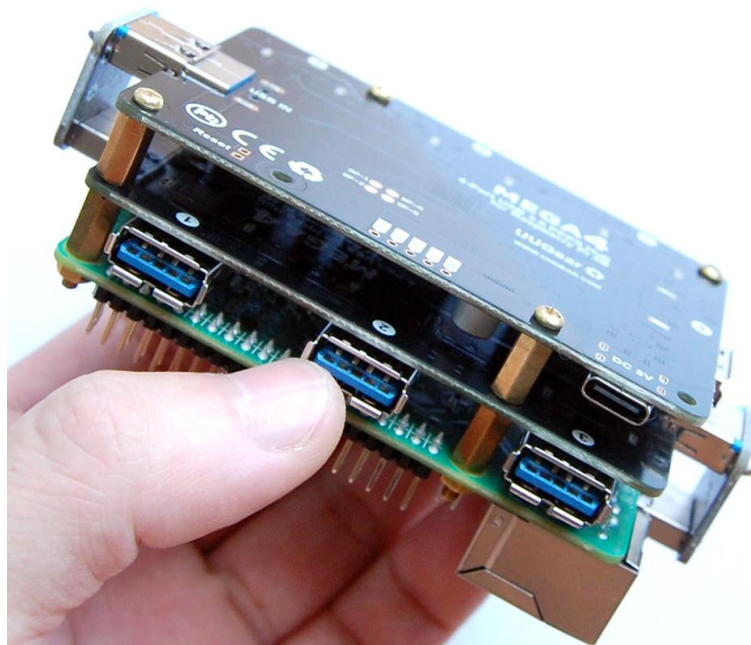
This is the recommended way to chain multiple MEGA4 devices together. It is elegant and doesn't need any extra accessory. Assume you have mounted a MEGA4 device under Raspberry Pi 4B, and now you want to mount another.



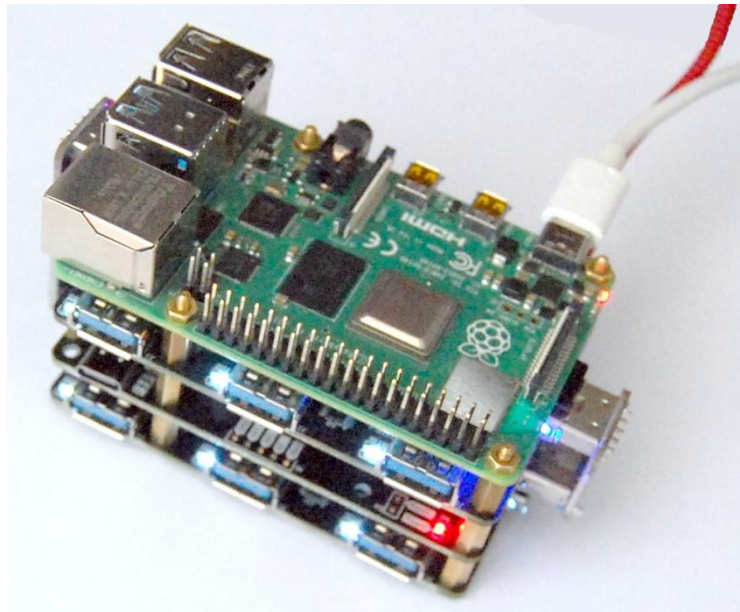
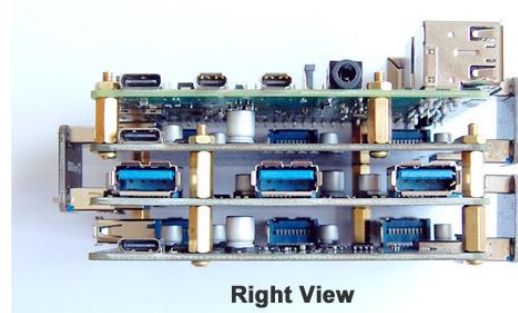
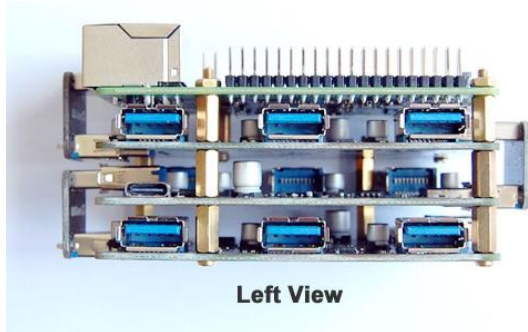
The first step is to replace two screws with copper standoffs (from another package of MEGA4), and place other two standoffs on the free mounting holes, as marked in picture above. You will need to use two copper nuts to fix the newly placed standoffs, as shown in picture below:



Then you can place the second MEGA4 device on it, and make sure the upstream port (USB IN) aligns to port 4 of the first MEGA4 device. You can use copper screws to secure the second board and then use the U-shaped adapter to connect two MEGA4 devices. Now you are all set!



What if you want to mount more? The idea will be the same, but starting from the third MEGA4 device, you don't change the positions of copper standoffs, and you just replace the copper screws with standoffs in place.



Revision History

Revision	Date	Description
1.00	2021.07.30	Initial revision