



Simple way to use USB Type-C to get 5V at up to 3A (15W)

[Kristof_2649](#) #1 June 19, 2020, 9:01pm

What I'm writing about today is a simple way to get 5V at up to 3A, *power supply permitting* using the USB Type-C standards for current sinking end devices from just two resistors on the USB-C connector on your end device, otherwise known as Upward Facing Port (UFP)

This communication goes both ways, USB Type-C standards also has a specification standard for the power source, or Downward Facing Port (DFP) using two resistors to tell your end device what amount of current can be sourced, but we're not really getting into that.

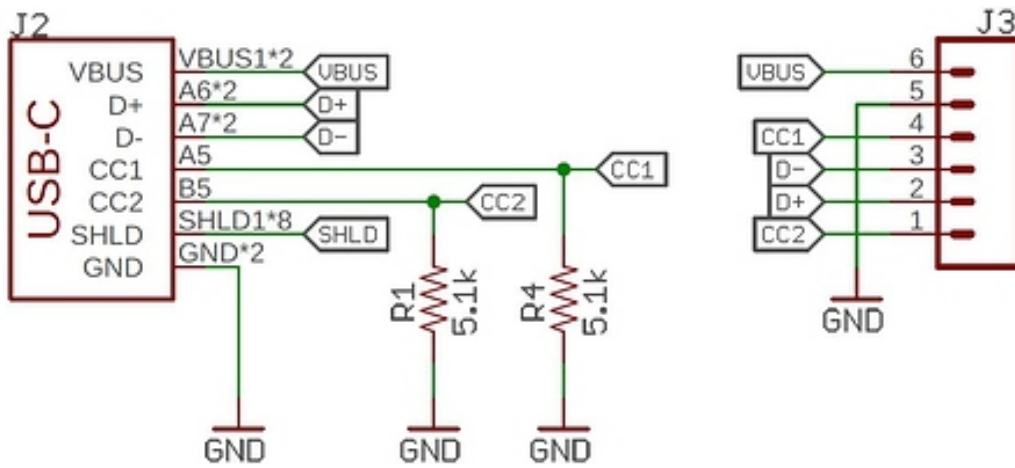
Also USB Power Delivery(PD) has a standard digital handshake devices and their power sources can use to negotiate to raise the power above 5V for higher wattage and current, that's separate from this and we're not going to talk about that neither.

What I'm telling you is just slap two 5.1K 1% resistors on both the CC lines tied to ground on the connector of your end device and now you got 5V at up to 3 Amps and let 'er buck.

To illustrate this as an example Sparkfun has a USB-C breakout board that has the two resistors needed to pull up to 3A from the USB-C source power supply, here's the part and the schematic:



[1568-1958-ND](#) -Sparkfun USB-C Breakout Board

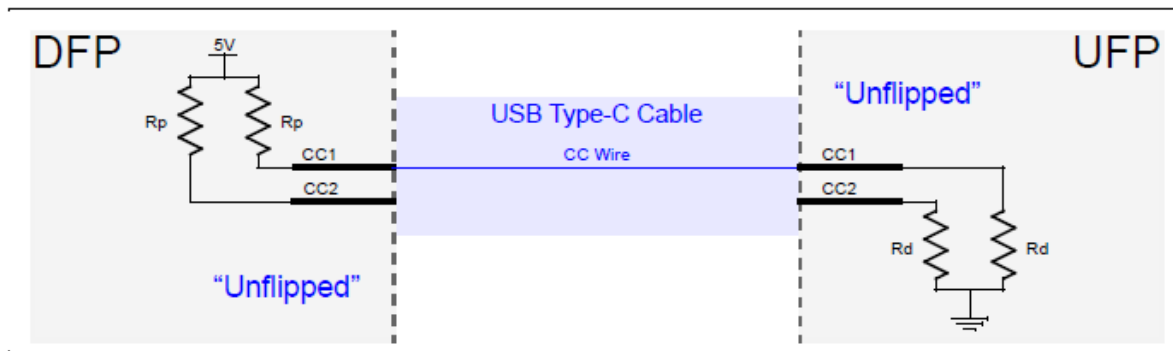


Just make sure you got a USB-C cable and power source that can handle 15W, unless you're feeling lucky.

Doing it this way is a little sketchy. You can ask too much of a power source, such as a tablet, laptop or legacy power adapter, especially if you're using a USB-A Male to USB Type-C legacy adapter cable. Old power supplies/USB Hubs may not have current regulating capabilities so you could get into thermal shutdown cycling of the semiconductors, or possibly burney burney.

Ok, I lied about not getting into the current capabilities of your power source.

Here's how devices would normally talk to each other to avoid asking too much of a power source and letting the smoke out using resistors in cases where both the DFP and UFP devices follow the USB Type-C specification.



3.6 USB Type-C Current Advertisement

Both the upstream facing port and the downstream facing port must monitor the voltage on the CC1 and CC2 pins to determine if a valid R_p/R_d or R_p/R_a connection has been made. The USB Type-C™ specification defines the following voltage ranges:

TABLE 9: USB TYPE-C VOLTAGE RANGES

Current Advertisement	No Connection (Detached)	R_p / R_d Connection	R_p / R_a Connection
3A	>2.75V	2.60V - 0.85V	0.80V - 0.00V
1.5A	>1.65V	1.60V - 0.45V	0.40V - 0.00V
Default USB (500mA/900mA)	>1.65V	1.60V - 0.25V	0.20V - 0.00V

Once a valid connection is established, the upstream facing port (device) may be responsible for drawing the appropriate amount of maximum current.

Image Sources provided by Microchip Application Note: AN1953

Your power source, or DFP has resistor values for R_p . The end device, or UFP has resistor values for R_d . Normally your UFP and DFP would have methods of sensing the CC ports voltage to adapt and act accordingly.

Together they form a voltage divider that would give you the above R_p/R_d Connection voltages, so you could play around with the pull-up resistor values on your UFP for R_d if your circuit needs only 1.5A or 500mA. It should also be noted companies like TI, STMicroelectronics and Cypress have USB Type-C controller solutions that can do all of this for you.

Lower gauge wire and thin circuit board traces can't handle 3A, so pay attention to what you're doing inside that circuit. [Here's a 2.5A Fast Blow Fuse, just throwin' that out there, you know, no reason. Digi-Key PN: F6127CT-ND](#)

Along the lines of being a little sketchy, it's worth mentioning there are some less than reputable manufacturers out there that have used the USB Type-C standards outside of intended specification.

One thing that is not recommended to ever do is use or build USB-A Male to USB Type-C adapter cables that have the R_d resistor built in to spoof the specification to draw 3A. An

engineer over a Google has well documented the results of manufacturers that hack the USB Type-C spec to **negative results, sometimes catastrophic**.

It would not be advisable to go to market with a device that has the USB Type-C port and a resistor asking for 3A without ability to sense the CC Port voltage and draw less current if needed, especially because of how prevalent legacy adapters are currently in use, but if you built your circuit and know the capabilities of your power source, may your LEDs shine ever brighter and your lithiums charge faster.

If you want to get into USB-C Power Delivery to play around with getting higher voltages and wattages, here's an development board from Sparkfun that may suit your needs, good to up to 100W.



Sparkfun PN: DEV-15801 featuring STMicroelectronics part STUSB4500

If you want to know more about negotiating power on USB-C through passive methods and higher voltages utilizing the Power Delivery (PD) standard see Digi-Key article **Designing In USB Type-C and Using Power Delivery for Rapid Charging**

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USB Type-Cを使用して5Vで最大3A（15W）を得る簡単な方法

todjiaa #2 April 23, 2021, 10:02am

Dear Kristof, thank you for sharing your knowledge with all us! I am not a pro in the electrical world, but always very much interested in doing some fun little projects! 😊 I have a bit of a problem I thought you might be able to help me to solve. Please would you be able to think of a solution for the following: I have a 5v 2.5A LED Light I want to get powered through a USB C PD battery bank. I tried so many different approaches and the best I can get is the light

working pretty stable, but at maximum of 70% brightness. The Power bank is Anker 10k with USB C PD. Bought a cable that goes from USB C to USB A and another cable that goes from USB A to DC 5.5mm that goes straight to the light. First I thought the battery is not good enough, then after reading a bit I started to feel the cable might have some resistors that are reducing the current which in result is not enough for the light. As an example I connected that same cable set I mentioned to my iPhone 11 Pro PD original charger as well as my mac book original charger and the light acts exactly the same as when it is connected to the battery bank. The iPhone charger output is 5v 3amp. This is why started thinking there might be something wrong with the cable. I am lost now! I would really appreciate if you can help me on this! I am more than happy to share some photos with detailed specification of everything. Just let me know if you need it and I will do so. Thank you so much in advance!

Kristof_2649 #3 April 23, 2021, 6:49pm

Hello Tobjiaa,

Thank you for your inquiry.

I'm not sure what you can expect with your USB-A side, but the USB Type C connector on that battery bank will be able to handle it no problem if you wire up the correct resistor to ground on both of the CC lines, two resistors in total.

If you want to learn a little about the USB-A side and different resistor protocols Benson Leung wrote up something on this subject:

USB Type-C™'s Configuration Channel | by Benson Leung | Medium

If I'm reading his interpretation correctly, for a legacy device adapter with a standard A receptacle you would be required to deploy a 5.1kOhm resistor from CC to Ground.

tobjiaa #4 April 25, 2021, 7:59am

Thank you Kristof! Appreciate your help! Will read that! All the best!

GlobTek-DR #5 April 25, 2021, 3:13pm

I am not sure that it is inadvisable to incorporate a resistor on a cable for R_p , especially for OEMs who need elevated power levels in their devices. I understand that it's very important to ensure that the power source which is connected to a cable with certain R_p resistor values for Current advertisement of 1.5A or 3.0A can handle it to prevent risk of fire.

GlobTek offers USB A to C cables on Digikey which advertise

1.5A: product listing [Cable Assemblies | USB Cables | DigiKey](#)

3.0A: product listing [Cable Assemblies | USB Cables | DigiKey](#)

These USB cables include warnings in the datasheets to ensure proper combinations to power sources and are also physically tagged with a warning and reminder on minimum power source requirements.

A suggestion to OEM users of these cables would be to add an additional tag indicating "This cable is only to be used with xxx device" and can be special ordered through Digikey as such as well.

Perhaps using up valuable system board space is not required in all applications.

GoNzCiD #6 May 6, 2021, 9:43pm

Is there any way to get up to 8A from USB-C? I know that the supply is 65W

PaulHutch #7 May 6, 2021, 10:10pm

Welcome to the forum.

USB is limited to 3A @ 5V when using the simple resistor method.

You can get up to 100W, 5A @ 20V, by using a special power delivery IC.

<https://www.ti.com/interface/usb/type-c-and-power-delivery/overview.html>



USB hardware | USB Power Delivery (USB PD)

In July 2012, the USB Promoters Group announced the finalization of the USB Power Delivery (PD) specification (USB PD rev. 1), an extension that specifies using certified PD aware USB cables with standard USB Type-A and Type-B connectors to deliver increased power (more than 7.5 W) to devices with greater power demands. Devices can request higher currents and supply voltages from compliant hosts – up to 2 A at 5 V (for a power consumption of up to 10 W), and optionally up to 3 A or 5 A at either...

1 Like

GlobTek-DR #8 May 7, 2021, 3:31pm

Hi, USB Type C connectors are generally not rated for 8A and may overheat or even catch fire in a worst case scenario. So, even though you can try to put it on a conventional 8A power supply, it may fry...it should not be done.

GoNzCiD #9 May 7, 2021, 3:47pm

Thanks. Understood... Then I switch the idea, and I'll use an external power supply to get 5V @ 8A.

GlobTek-DR #10 May 8, 2021, 3:54pm

Cool! Here is a list of GlobTek Power supplies available in stock @ Digikey in 5v 8A:
<https://r.globtek.info/3vSRBSs>

Good luck!!