

USB-C 5V Power Supply Project V1

Mukhtar Suleman

Objective:

This project was one of my first exercise in designing and manufacturing a small, functional printed circuit board (PCB).

The goal was simple but essential:

- **create a basic 5V USB-C power supply outputting through a reliable connector.** I focused on correctly handling USB-C negotiation for 5V output and building a clean, compact starting point for future, more complex projects.

Inspired by this Youtube video - <https://www.youtube.com/watch?v=8RiLKnczvs&t=5163s> -



Design Logic: Part1

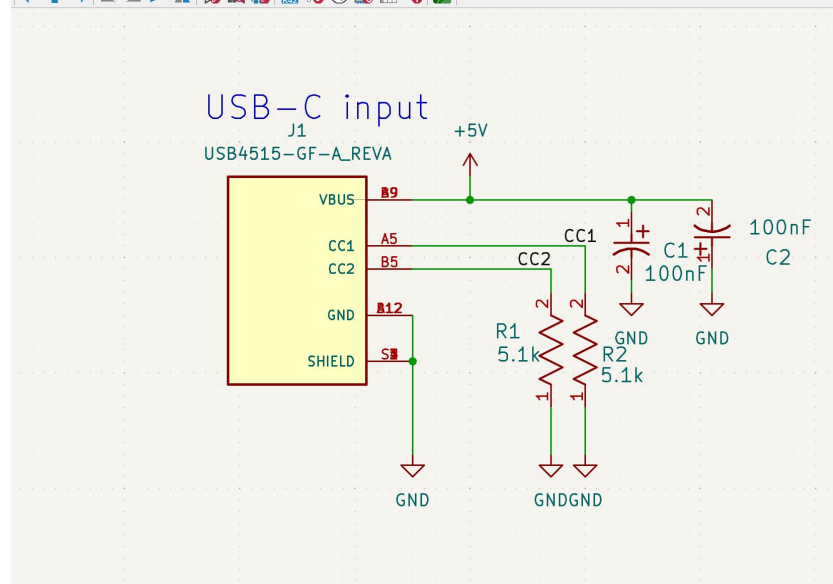
USB-C Input Logic and CC Line Handling

Connector Setup:

- VBUS pins (power) are tied together.
- GND pins are tied together.
- CC1 and CC2 lines are pulled down through **5.1kΩ resistors** to GND.

Why use 5.1kΩ pull-downs?

- In USB-C, the **device (sink)** connects **5.1kΩ pull-down resistors** to each CC pin.
- Meanwhile, the **charger (source)** already has internal pull-up resistors (R_p), which set how much current is available.
- This setup forms a **voltage divider** between source and sink on the CC lines.



VBUS always delivers **5V** (unless explicitly negotiated otherwise)

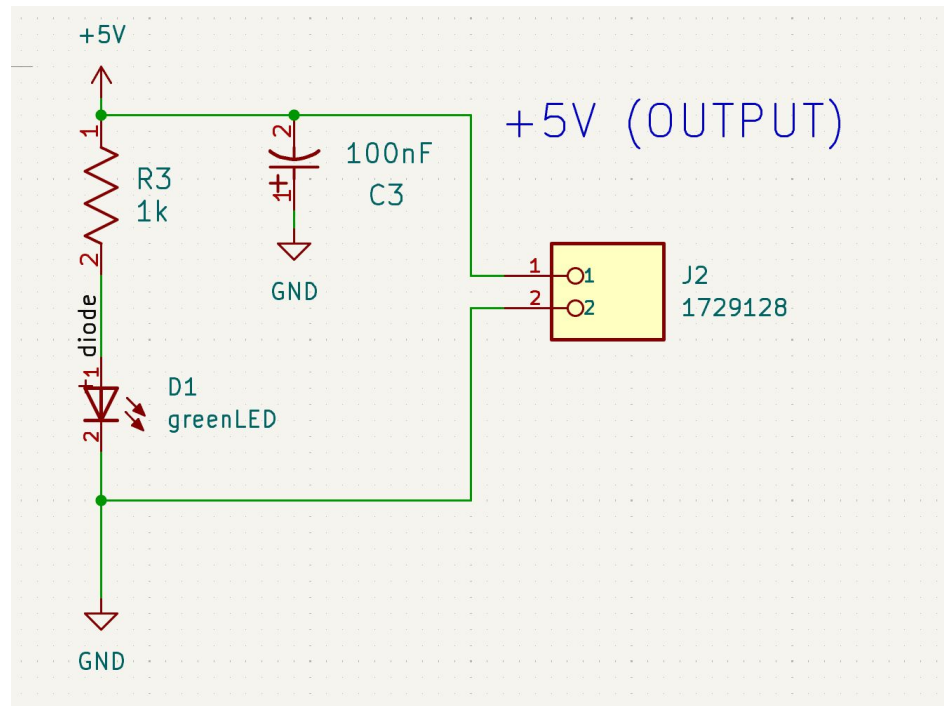
From the USB-C standard:

- 5V at default current (typically 500mA or up to 900mA)

Output Delivery Terminal Block

PCB Logic:

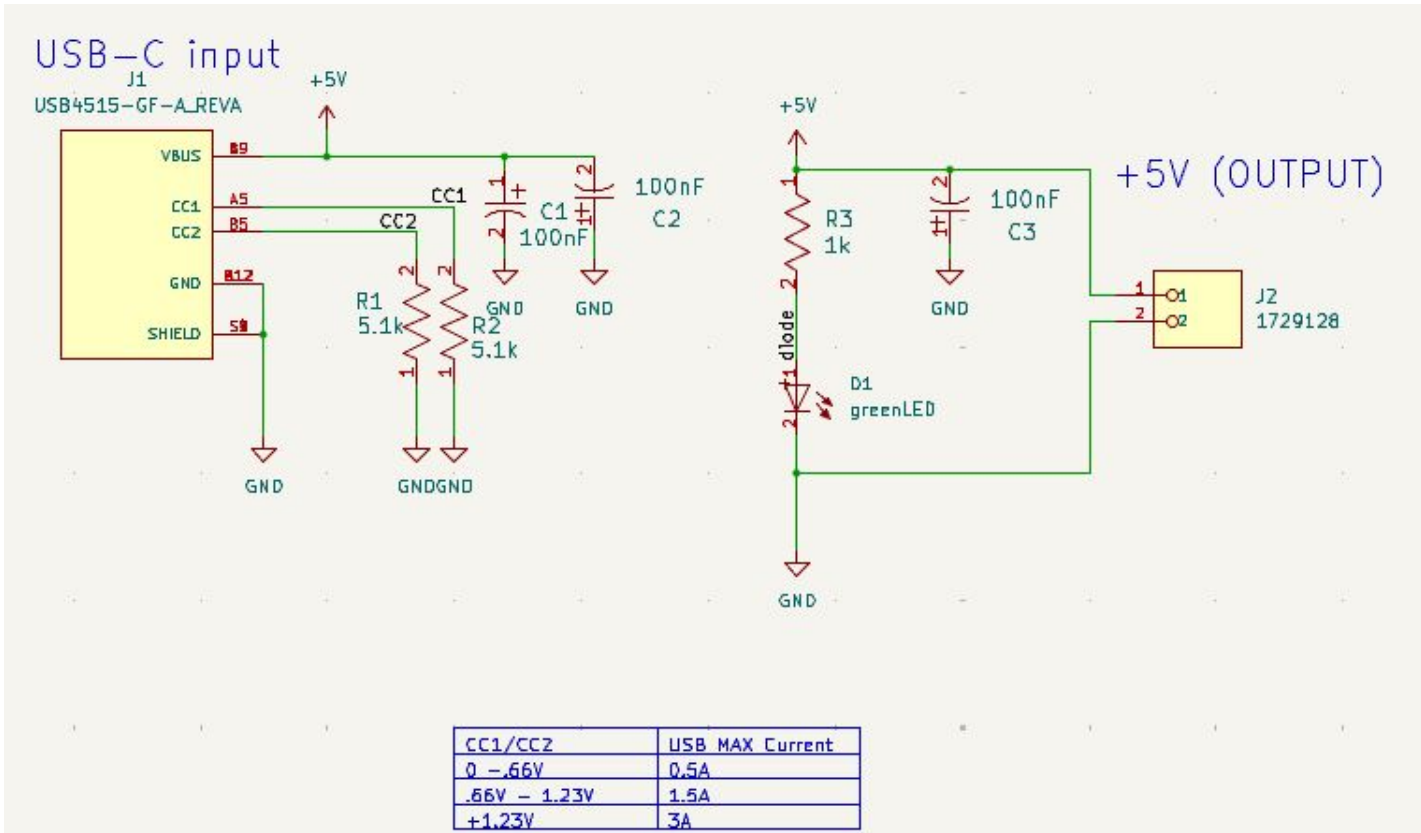
- +5V (VBUS) line from the USB-C connector is directly routed across the board to the output Phoenix Contact 1729128 connector.
- No active switching or regulation — it's a **pass-through** of the 5V VBUS from USB-C.



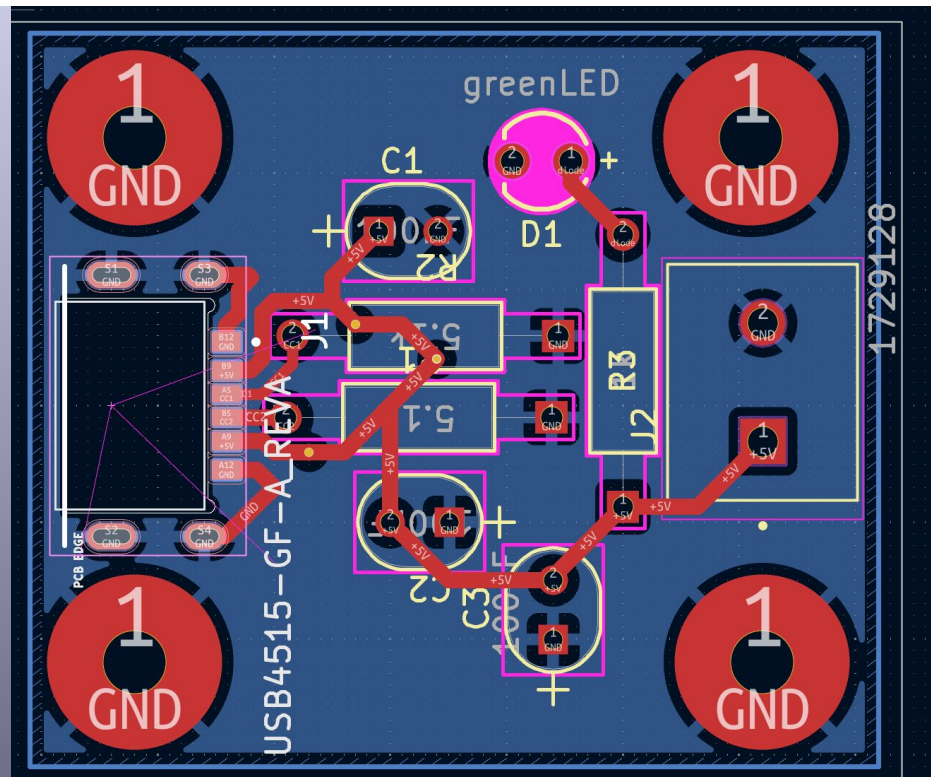
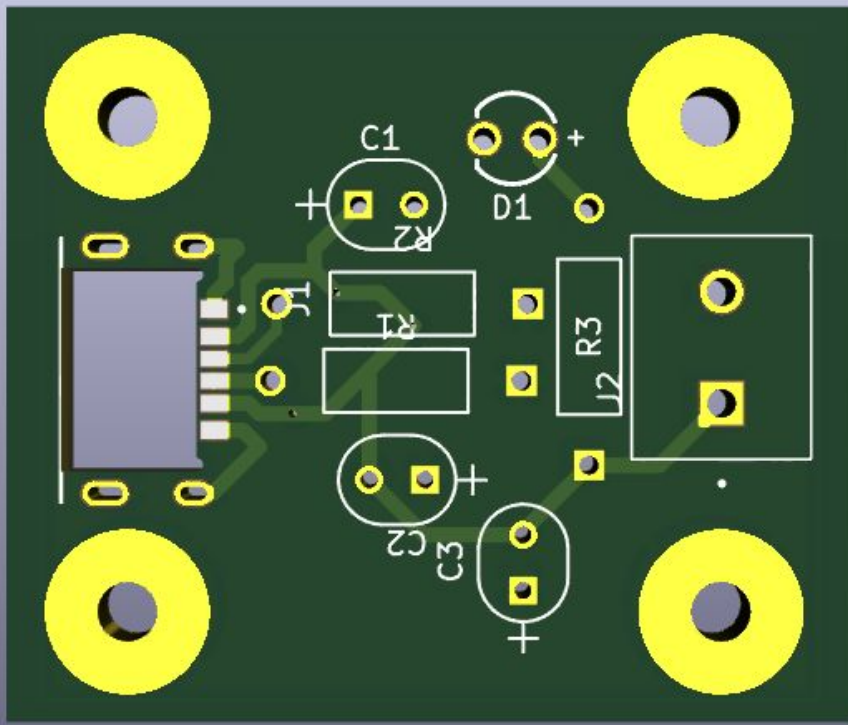
Full Schematic/Summary

Summary:

- Once USB-C is plugged into a live source
- The 5.1kΩ pull-down tells the source "I'm a basic sink".
- The source sees this and delivers 5V at **default current**
- **+5V is delivered to the terminal block output** without any additional negotiation or circuitry.



PCB



TESTING

COMING SOON...

Lessons learned

Understanding USB-C Power Delivery Negotiation:

- **Key Insight:** Initially, I thought the **advertised current on the CC line** directly translated to the amount of current available at the output terminal. However, I quickly learned that **the current on the CC line is actually a signal to the sink device**, not the actual charging current.
- **Takeaway:** This differentiation is crucial for designing USB-C systems. The power available at the output is ultimately determined by the source device and the pull-up resistors, not by the CC signaling current directly.

Importance of Pull-Down Resistors:

- **Key Insight:** The **5.1k Ω pull-down resistors** are essential for enabling the USB-C source to detect the sink device and advertise power accordingly. These resistors act as a signal to the charger that the device is requesting default USB power, ensuring correct power negotiation.
- **Takeaway:** Pull-down resistors are vital for proper USB-C functionality, and their correct sizing ensures reliable communication between devices, preventing confusion in power delivery.

Cites

<https://hackaday.com/2023/01/04/all-about-usb-c-resistors-and-emarkers/>