

# Wearable Power Bank

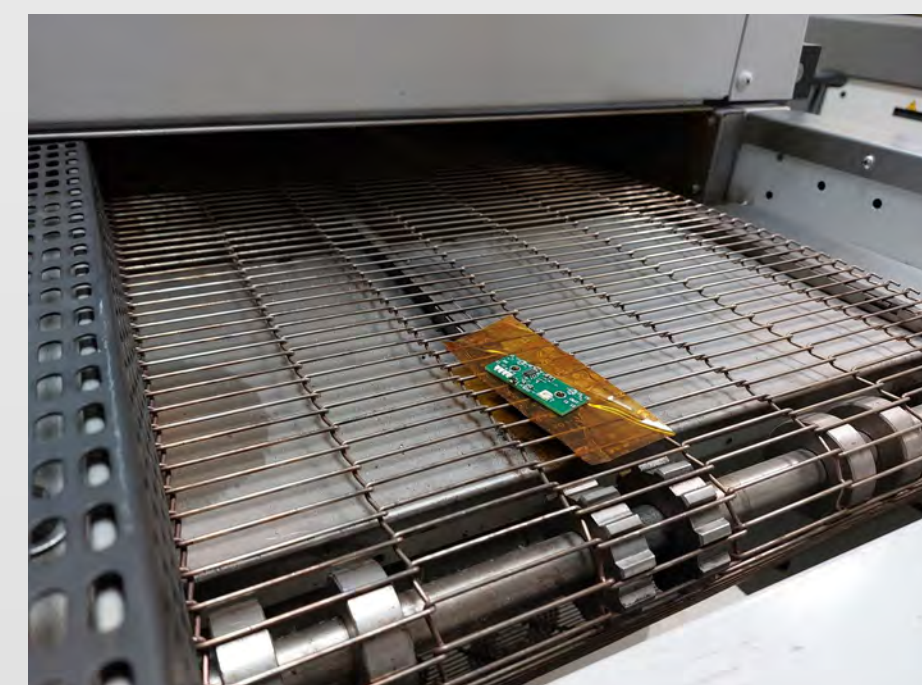
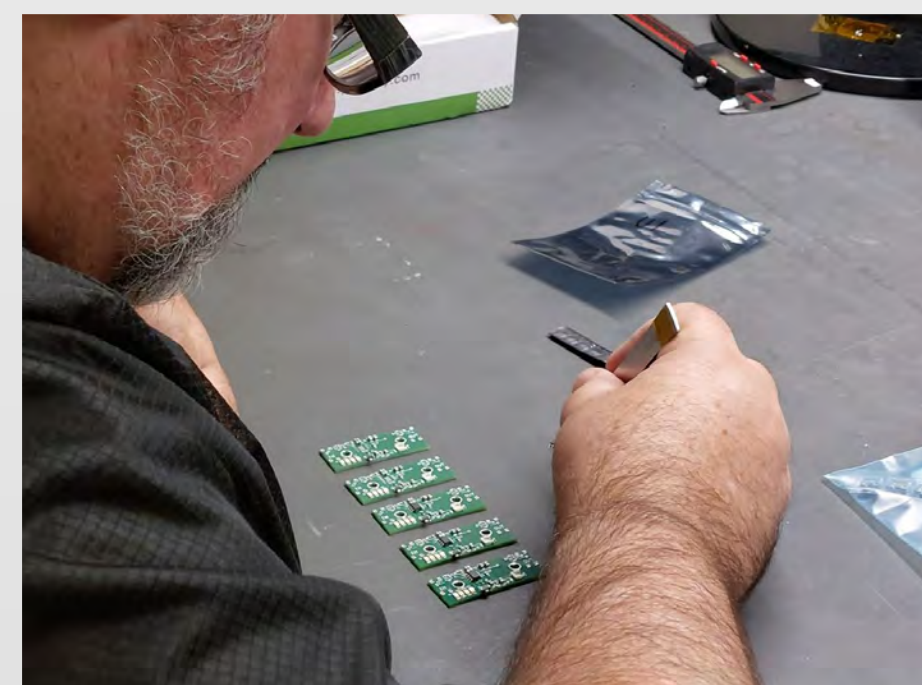
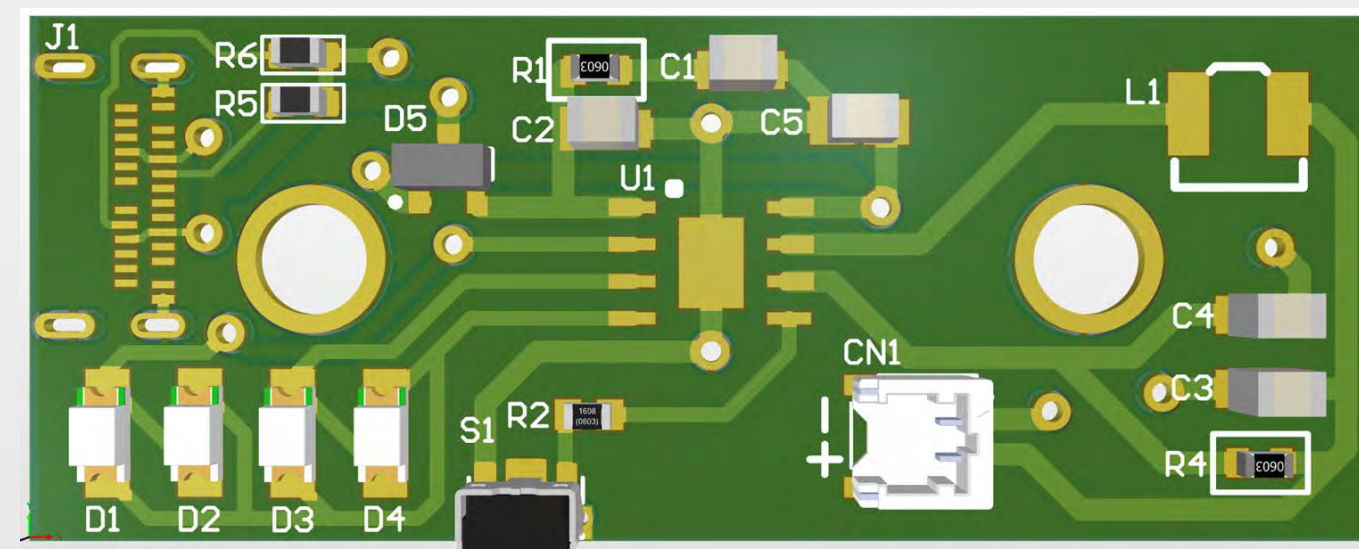
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## Introduction

Our goal was to design a power bank that can provide enough charge to make a few phone calls in an emergency situation. Key features are compatibility with Apple Watch bands, an attached charging cable and water resistance. Additional features that were considered were compatibility with a carabiner, self recharging, and an attached retractable charging cable. This project consisted of 4 main parts, the circuit and battery, case, retractable cable, and testing.

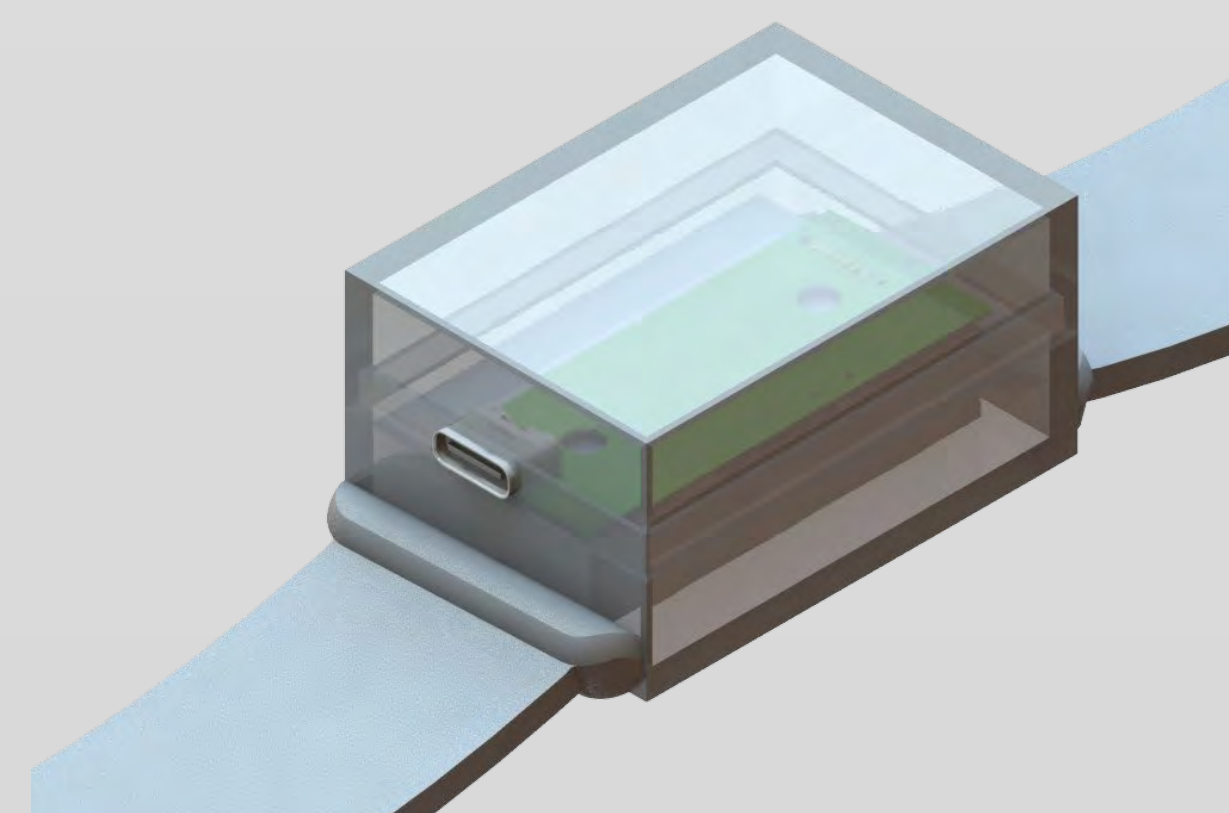
## Circuit and Battery

The circuit is designed around an integrated circuit designed to simplify power management and battery protection. Custom PCBs were designed and manufactured to meet our specific needs. The battery has a capacity of 650 mAh and is UL 1642 certified for user safety.



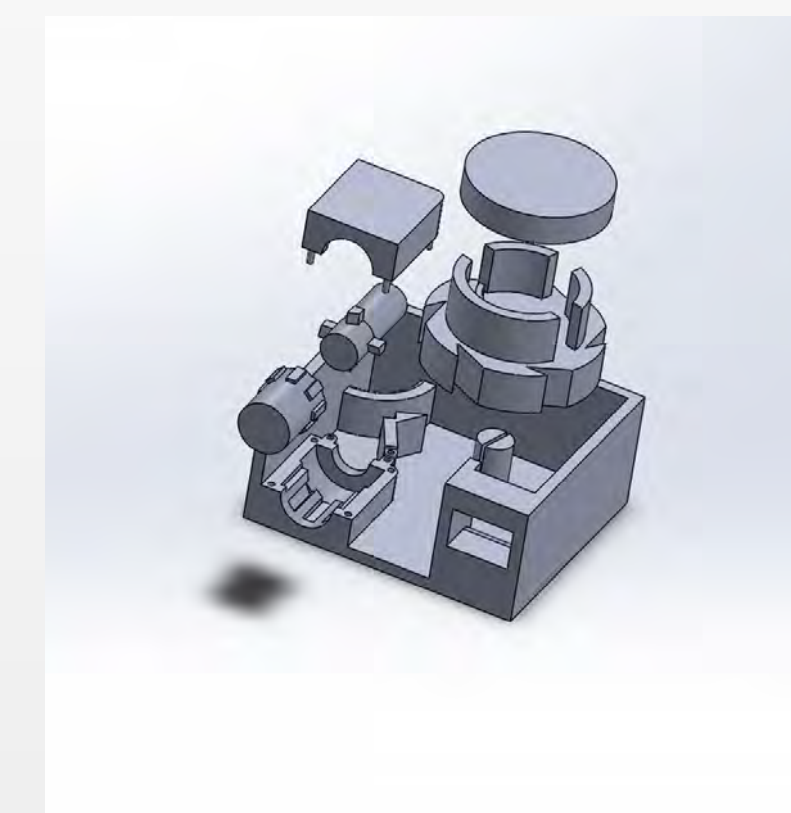
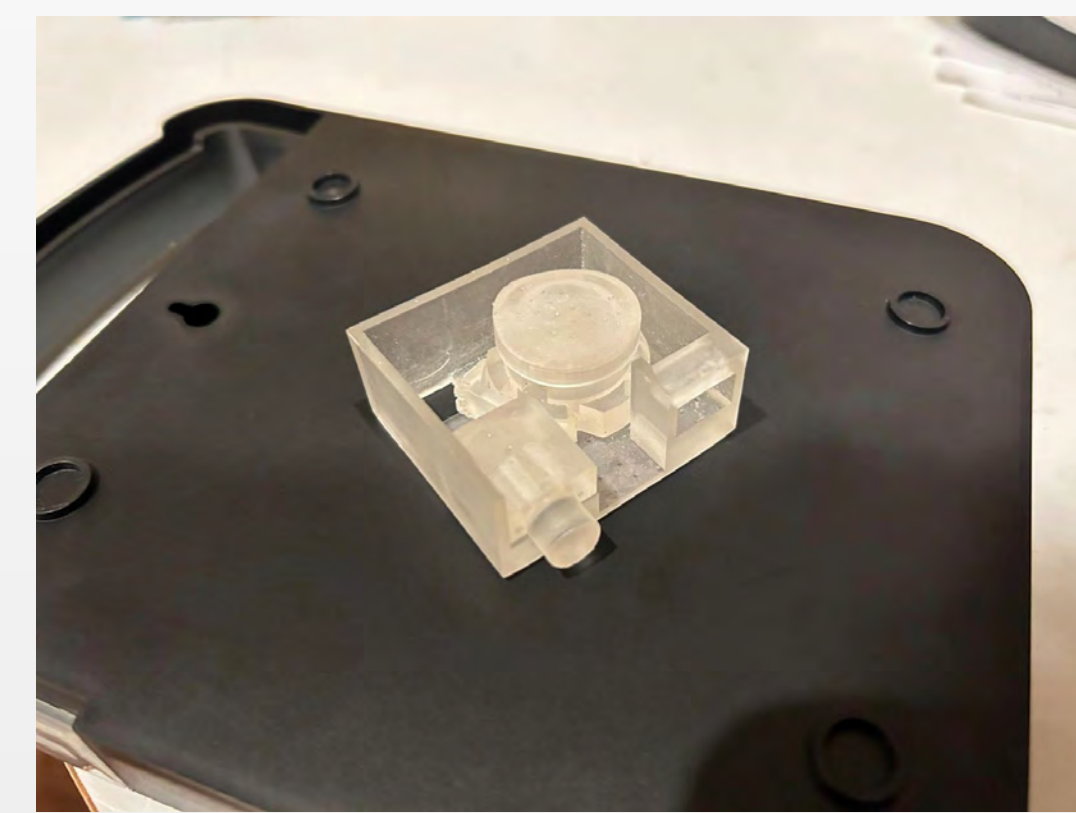
## Case

The casing was designed around the self-designed PCB and the battery to assist with water resistance, while minimizing volume. Watch band connectors on the side of the casing are compatible with Apple Watch bands, which allows users to swap them to any desired color or style. The final version of the casing was 3D printed with resin.

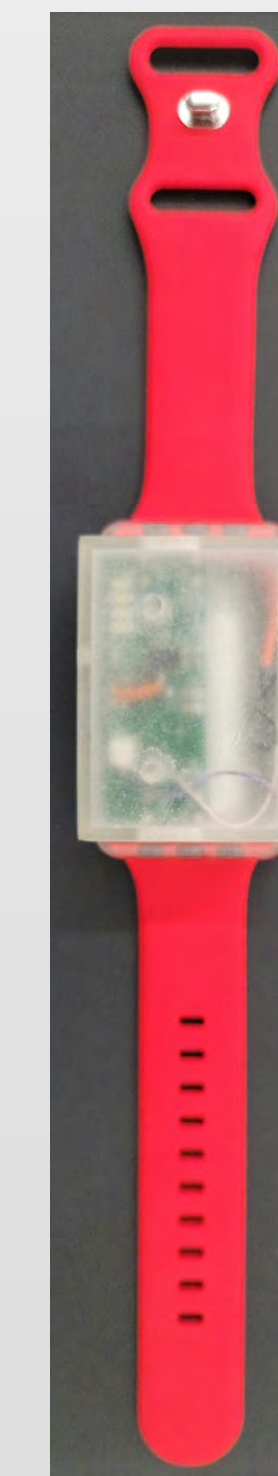


## Retractable Charging Cable

The retractable charging cable is included in the design as an accessory and can be attached magnetically. The design was inspired by similar devices (intended to keep a cord coiled when not in use), but a toggle functionality was added. The pieces comprising the assembly consist of custom designed parts, a tension spring, a compression spring and a clock spring. The final version of the custom parts were 3D printed using resin.



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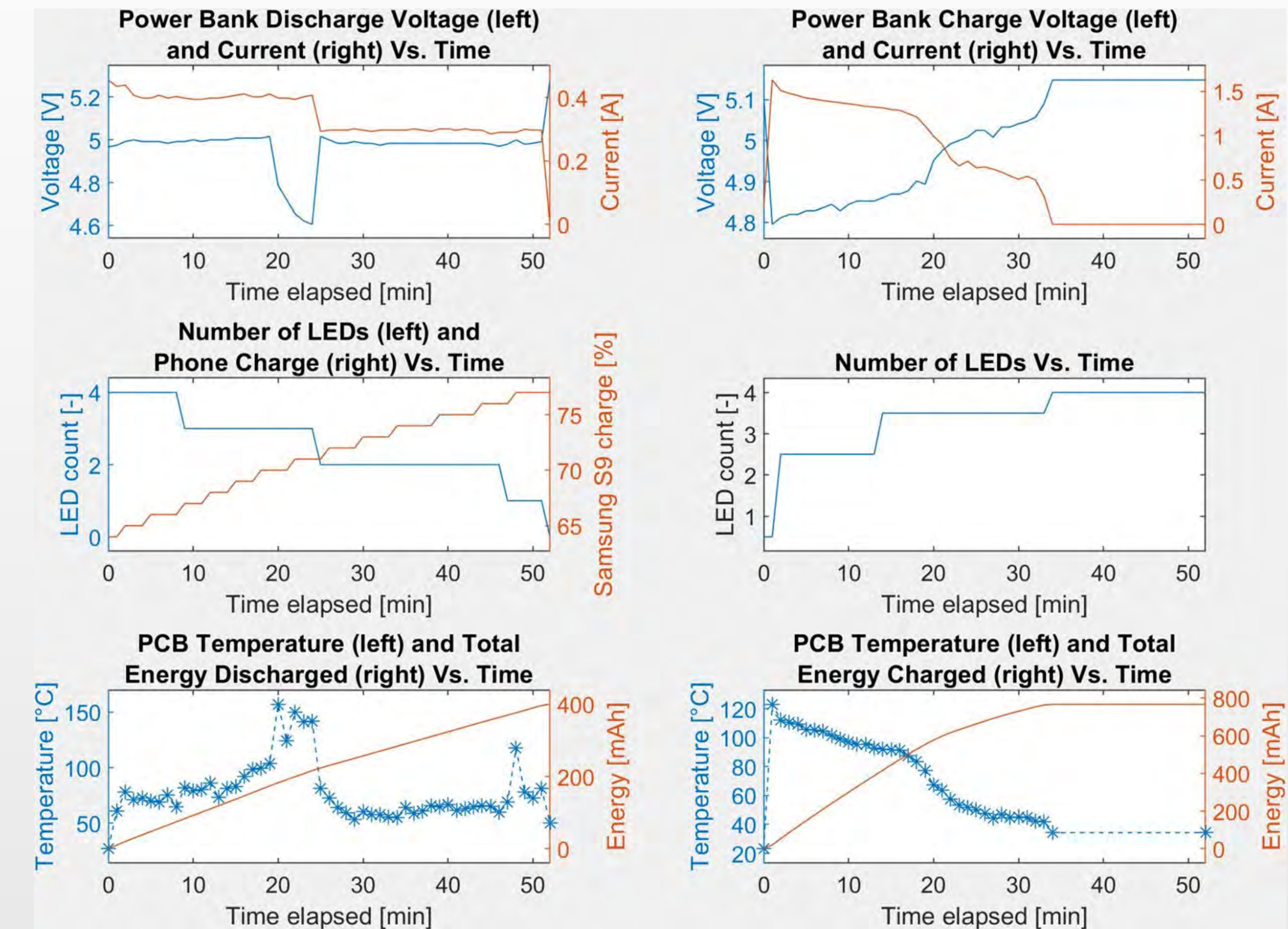


## Critical Metrics

Metrics	Marginal	Ideal	Achieved
Max Temperature	<43°C	<40°C	31°C
Output Power	2W	10W	1.7W
IP Certification	IPX4	IPX8	-
Weight	<85g	<50g	54g
Battery Capacity	500mAh	1750mAh	650mAh
Volume	55.0cm <sup>3</sup>	18.3cm <sup>3</sup>	45.9cm <sup>3</sup>

## Charging and Discharging

Testing results from the final (functional) circuit are shown below. Voltage and current, power bank LED count and phone charge percentage, as well as cumulative energy and board temperature are plotted.



## IPX8 Rated Conditions

The power bank with the IP rated port can withstand being submerged in water at depth of 1.2 meters for 45 minutes, if the water temperature is 40 degrees Celsius. This allows the power bank to be worn in wet weather, in baths, and in pools shallower than 1.2 meters.

## Conclusion

Ultimately, our group succeeded in providing a product that met our sponsoring company's demands. Our power bank with two USB-C ports can successfully charge a phone, recharge with a power adapter, have a carabiner attached, and have a magnetically attached retractable charging cable. Furthermore, we succeeded in making our product compatible with Apple Watch bands. In addition, the team made progress towards reducing the power bank to a single IP rated USB-C port for discharging and charging. The case design for the single port power bank is water resistant. The group considers the project with such achievements to be a success.