My Previous Work

Bao Nguyen

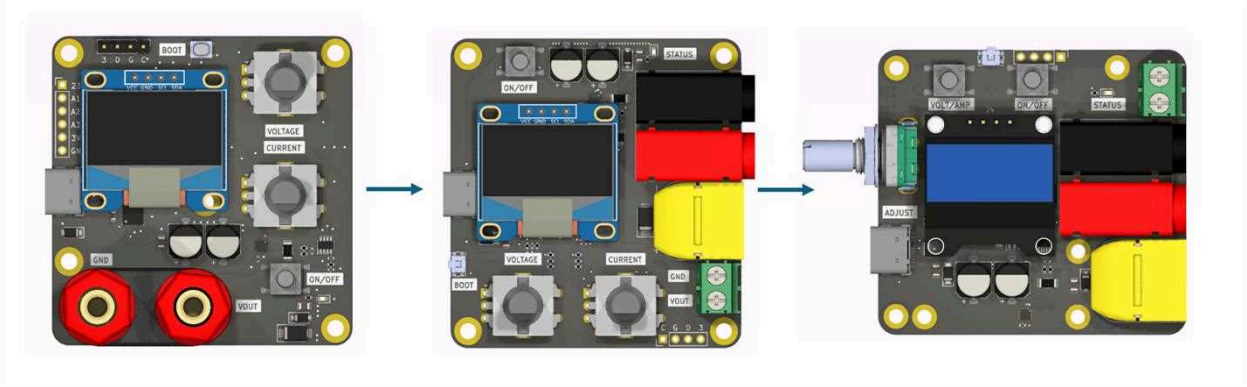
2024 - USB-C Portable Bench Power Supply

Description:

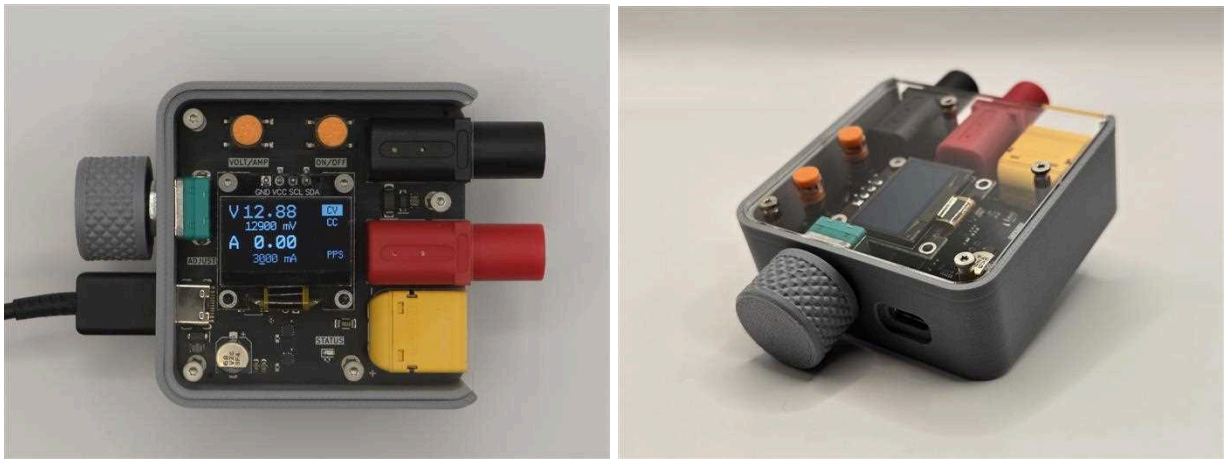
The device is built around the Programmable Power Supply (PPS) mode introduced in 2015. Originally designed for improved battery charging in smartphones, PPS allows devices to set precise voltage and current levels, making it ideal for bench power supply applications. The USB-C bench power supply is an upgrade from PicoPD with an OLED and some user interface. The firmware was developed using a combination of custom libraries and open-sourced libraries from other developers.

Challenges:

- Multiple iteration of component layout for manufacturability and user suggestion.
- Multiple case iteration for manufacturability
- Firmware development in C++ with documentation for open source release.
- Stress test and feature test like short circuit, over voltage, inductive spike ….



Design iteration



Final version

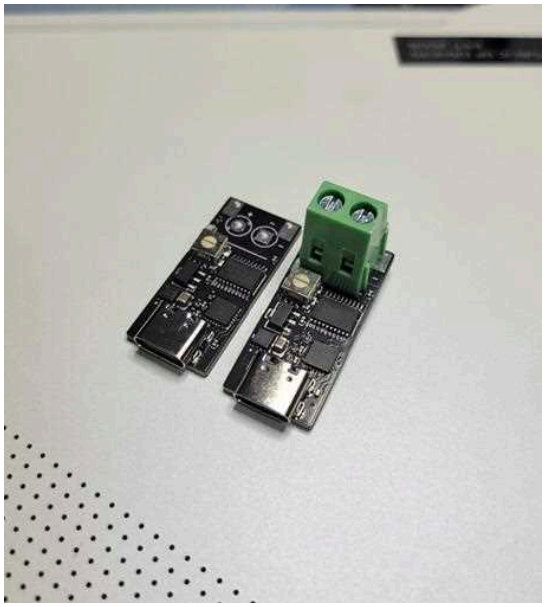
2024 - USB-PD Trigger Board

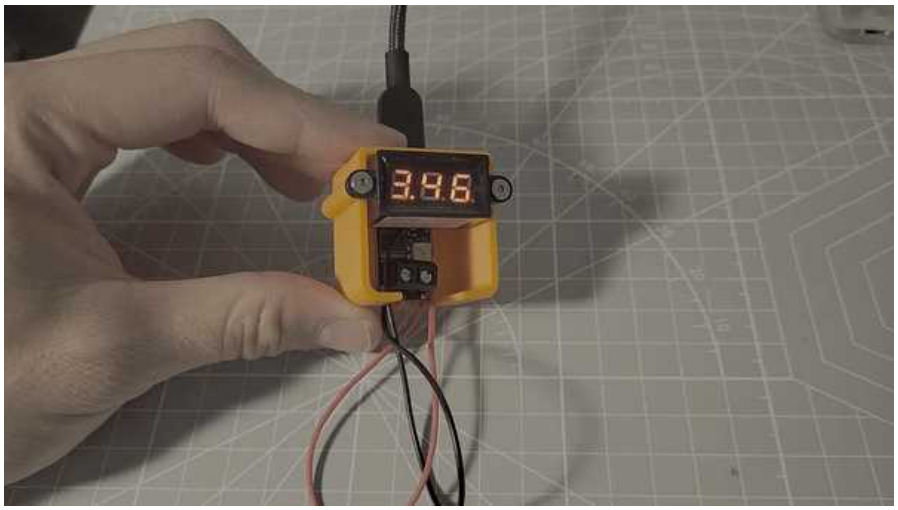
Description:

Continuing work from PicoPD, this board is ready to be used as a standard trigger board. Design on the same AP33772 IC and combined with a low cost STM32G0 microcontroller. The board has one LDO, AP33772, micro-controller and a potentiometer. Pair with a cheap voltmeter and you have a portable bench power supply.

Challenges:

- Optilize cost by picking the lowest cost component that just meet the requirement
- Design jig for mass programming
- Work with manufacture for low volume production run of 100 units.





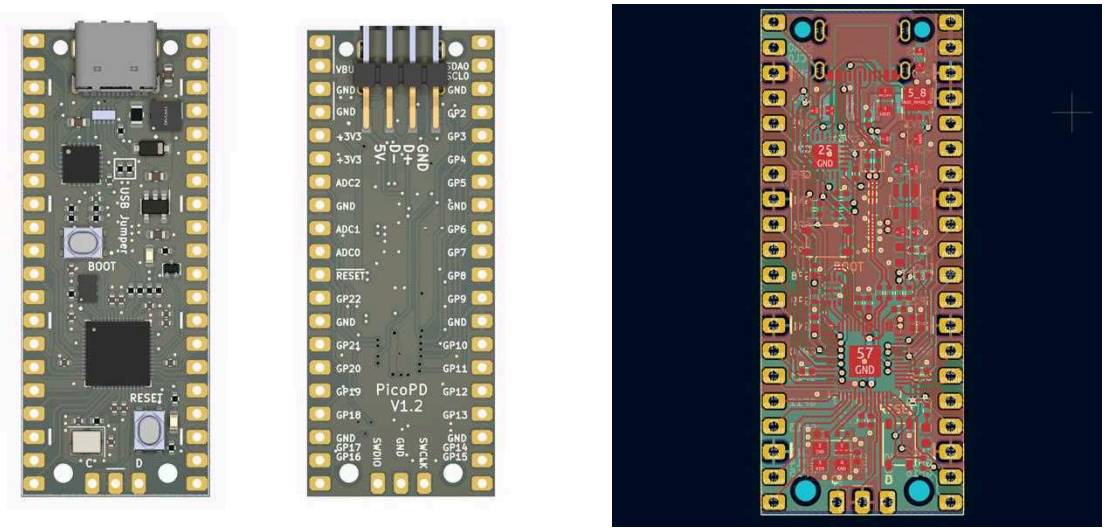
Bench power supply

2023 - PicoPD Development Board
Description:
USB-PD 3.0 released a special mode call Programmable Power Supply (PPS). This mode was designed for smartphone charging as a way to reduce heat when fast charging. The device can request the exact voltage required down to 20mV increment with current limit, thus reducing the additional buck/boost stage on the device when charging the battery.

In 2023, there was no easy to use board or IC that had been released as Open-source to tap into this mode. So PicoPD was designed as a way for people to prototype more with USB-PD beside buying cheap voltage triggers and combining them with a buck converter on Amazon. The board utilizes AP33772 IC to handle all of the Power Delivery negotiation. Example applications are custom battery charger, bench power supply, motor driver ….. The board, AP33772 library, and example firmware is provided as open source.
Link to [PicoPD project]

Challenges:

- Learn how to use KiCad with experience from Altium and Eagle Cad
- C++ library development for AP33772 based on Arduino Framework as little as possible
- ESD protection relearn
- USB 2.0 impedance requirement



PicoPD

2022 - Mini Soldering HotBar

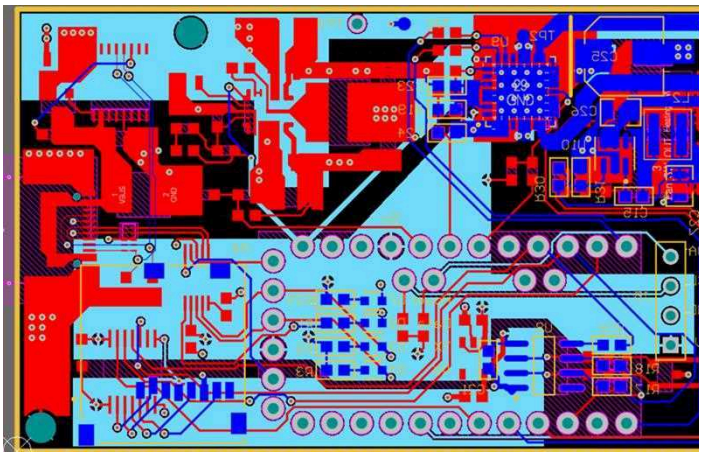
Description:

Mini Soldering Hotbar is a power control board that is designed to drive a voice coil, a 5V Fan, a 35W heating element, and a K-type thermocouple. The user interface includes a single push-button and a mini OLED screen for status display. The first version of the board utilize Atmel328P (Arduino Pro Mini) as the brain for a quick transition from the Arduino Platform to PCB. The 2nd version utilizes RaspberryPi Foundation's new IC RP2040 for higher performance and flash size. The system is powered from a single USB-C port at 100W max. The software is written in C/C++ based on the Arduino framework to ensure long-term support and ease of modification.

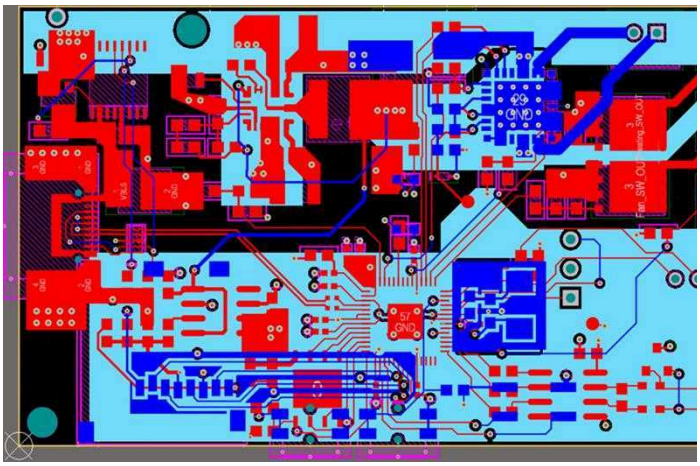
Challenges:

- Symbol, footprint capture and layout in Altium Design for 4 layers board.
- Firmware development with 6+ open-source libraries. First time utilize a state machine with more than 5 states.
- Troubleshooting K-type thermocouple issue when sensor touches other components.

Version 1



Version 2



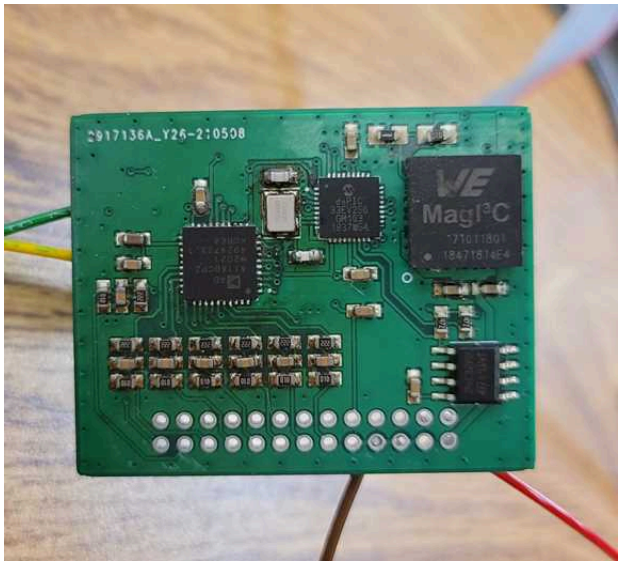
2021 - High-channel count ADC over CAN - CSI4.0

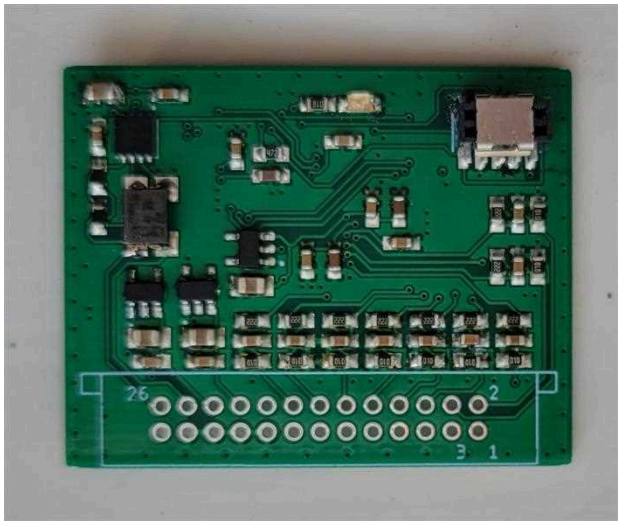
Description:

As one task of my capstone project, I was in charge of designing a 16-channel ADC to use with the existing CAN bus on an electrical racing car for the OSU Global Formula Racing Team. The AD4114 IC allows 16 single-ended channels or 8 fully differential channels that can be selected and gain adjusted through the CAN bus. The board is designed and tested to be fully functional with a footprint of 30mmx37.5mm. The biggest challenge was writing the library for the AD4114 that allows configuration in the register level for channel configuration.

Challenges:

- Selecting the ADC that met the team's requirement.
- Reading AD4114 datasheet to develop the library.
- Sourcing AD4114 during chip shortage.





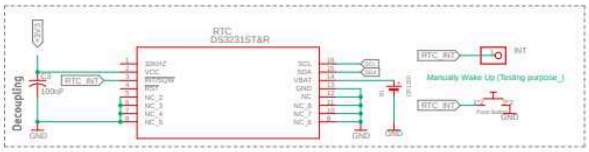
2020 – Hypnos – Power management + Datalogger + RTC

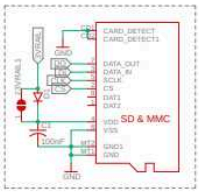
Description:

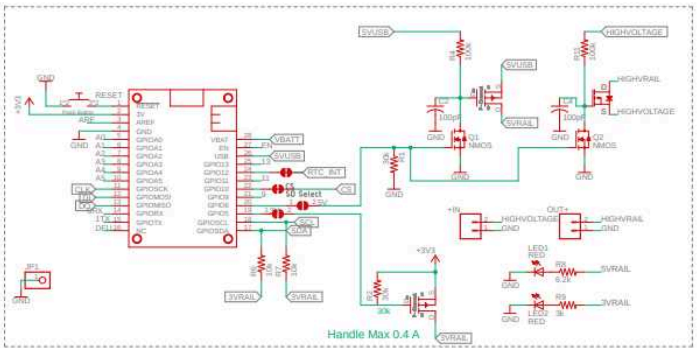
Hypnos board is an extension board for the popular Feather M0 platform. This board allows power cut off to the peripheral during the sleep cycle and microSD access. The accuracy of the sleep cycle is enhanced with the extremely accurate DS3231 RTC due to its integrated temperature-compensated crystal oscillator. I designed and tested the first 3 versions of the board and it is currently being used as the standard sleep circuit for Oregon State OPEnSLab for most of the active projects. We had one publication for this board on HardwareX article in 2021.

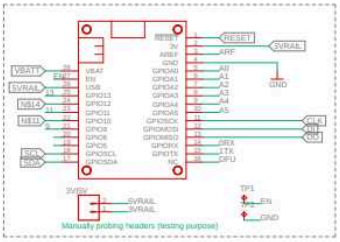
Challenge:

- First time ordering PCBA service from an US vendor.
- Learning how to use P-MOS as a high-side switch.

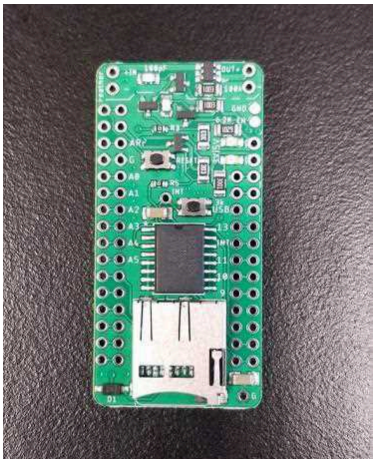






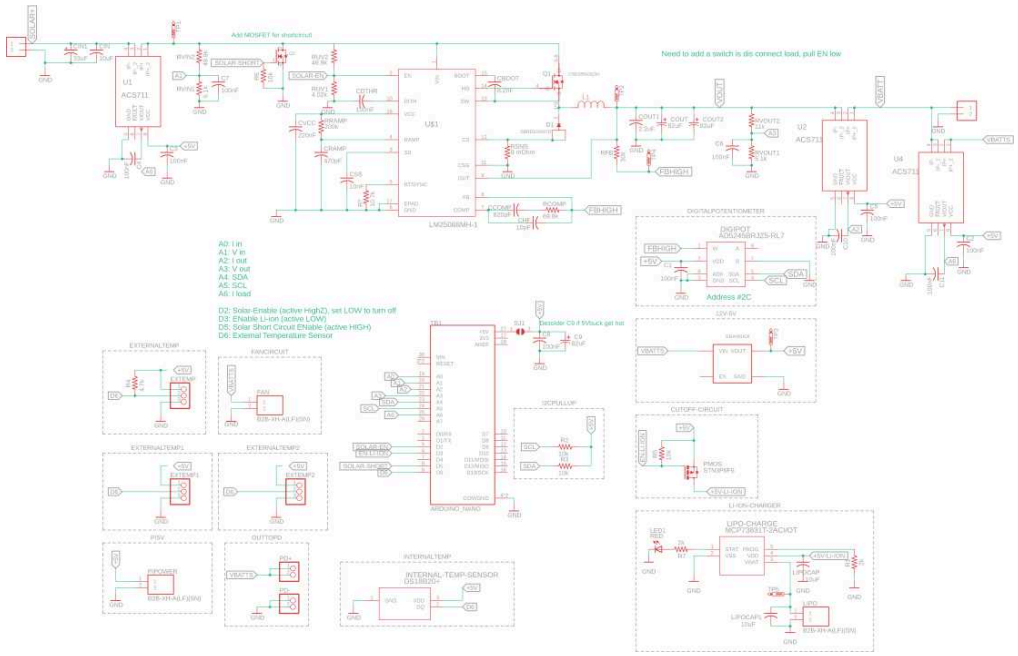


Fabricated and assembled in assembly house, Project Link

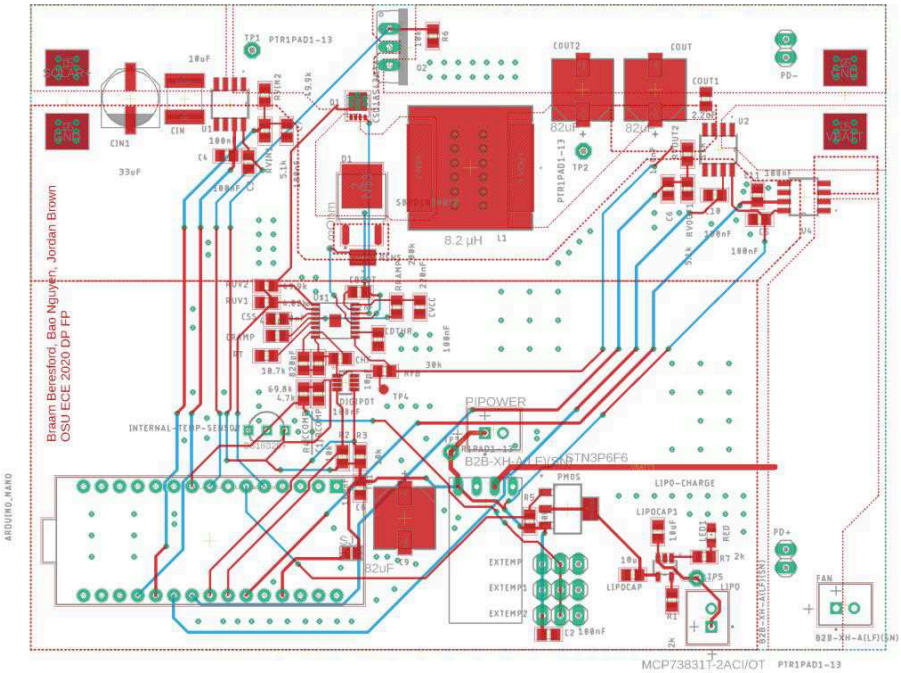


2020 – Solar Charge Controller - Classwork

Description: One of our Junior class work requires us to make a solar charger for a single 12V lead-acid battery. This board is designed to mimic the MPPT charging algorithm. The circuit features current sensors and voltage sense for both input and output power. The output voltage is controlled using an I2C digital potential meter to change the feedback voltage of the main buck converter. The circuit also features some MOSFETs for open circuits and short circuit tests for the solar panel characteristic. There is also an expansion card for this board to provide USB-C PD 3.0 power delivery. I was mentor my teammates on schematic captures and wrote the GUI software that ran on raspberry pi for charging status and self-test reports.

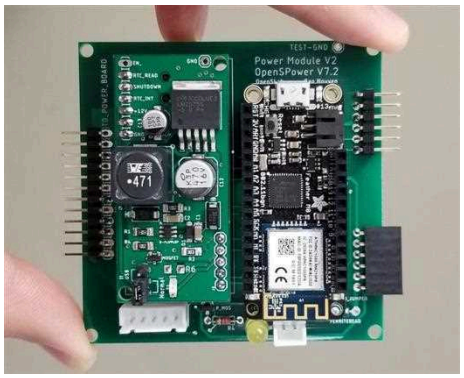


Rendered PCB: [Project Link]



2019 – eDNA Logic Module V2 + V3
Description: eDNA team decided that a modular approach will best suit the prototype style of the project. The brain of the system is the logic board, where we have a 5V power converter, deep sleep switch, RTC, micro SDcard and headers for Feather M0. There have been multiple revisions of the board to experiment with different converter ICs and layout styles.
Update: a newer revision has been released that removes the modular approach for the eDNA project after all components are tested to work and are stable.

Version 2



Version 3: [Project Link]

2019 – eDNA Power Module V1

Description: As a part of eDNA modularization approach, the power module is designed to control solenoid valves and motors for the machine. The board features high power shift registers with latching and H-bridges to control motors. The board was designed to be larger than needed to fit inside a pre-existing mechanical housing.