

# Project Apollo

## Why

- Ventilators need oxygen! (typical  $\text{FiO}_2$  0.3 ... 1)
- Oxygen generation is a big problem in developing countries.
  - No established infrastructure.
  - Oxygen bottles are expensive
- People are already looking at alternative (local) ways for producing oxygen

## What it is

- Goal of the Apollo prototype = enabling people around the world to build the prototype ASAP
- Focus = Simplicity and speed of build
  - Open source, off-the-shelf materials
  - Very low cost (aspirational target = \$100 for 5 liters/min @ 90%)
- Final goal = Enable people to iterate and publish their own designs in the community

## How to build it

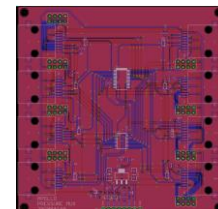
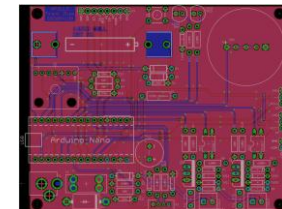
- Follow the published build [documentation](#)
- Buy/source the materials (check out the [BOM](#))
- Build the prototype
- Validate  $\text{O}_2$  concentration and flow. Use a **good** reference  $\text{O}_2$  and flow sensor for calibration
- Think about risk analysis and assessment: [template for Apollo-derived design](#)
- Document and iterate your own design. Publish your findings to the community!

## Collaborations

- Helpful Engineering, Oxikit, Public Invention, Quick2space.org, Microsoft Garage

## Documentation

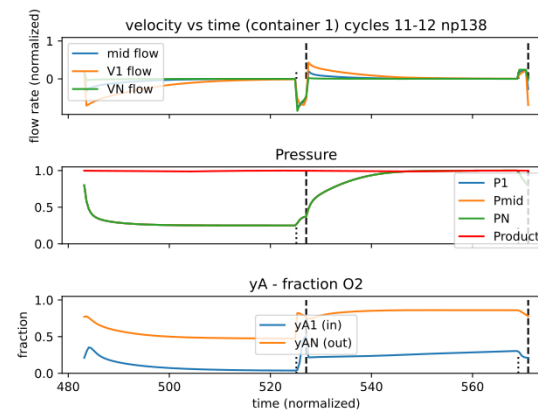
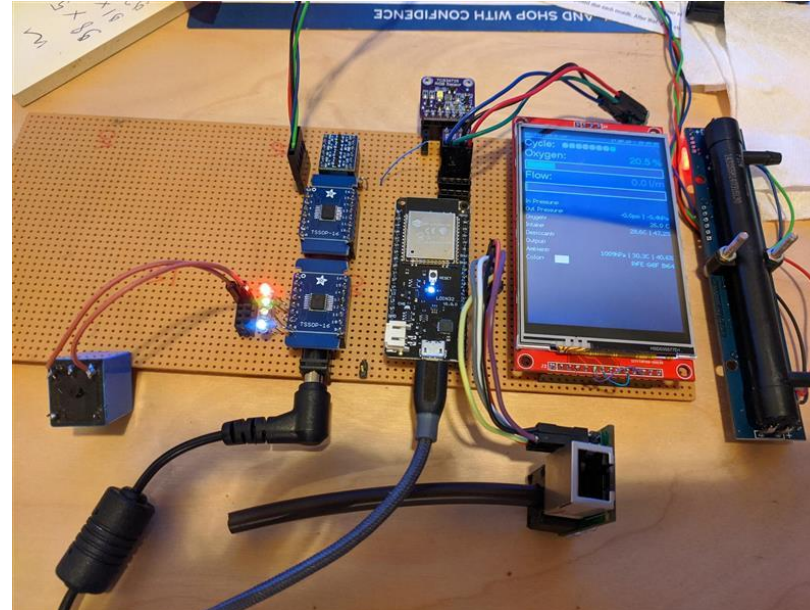
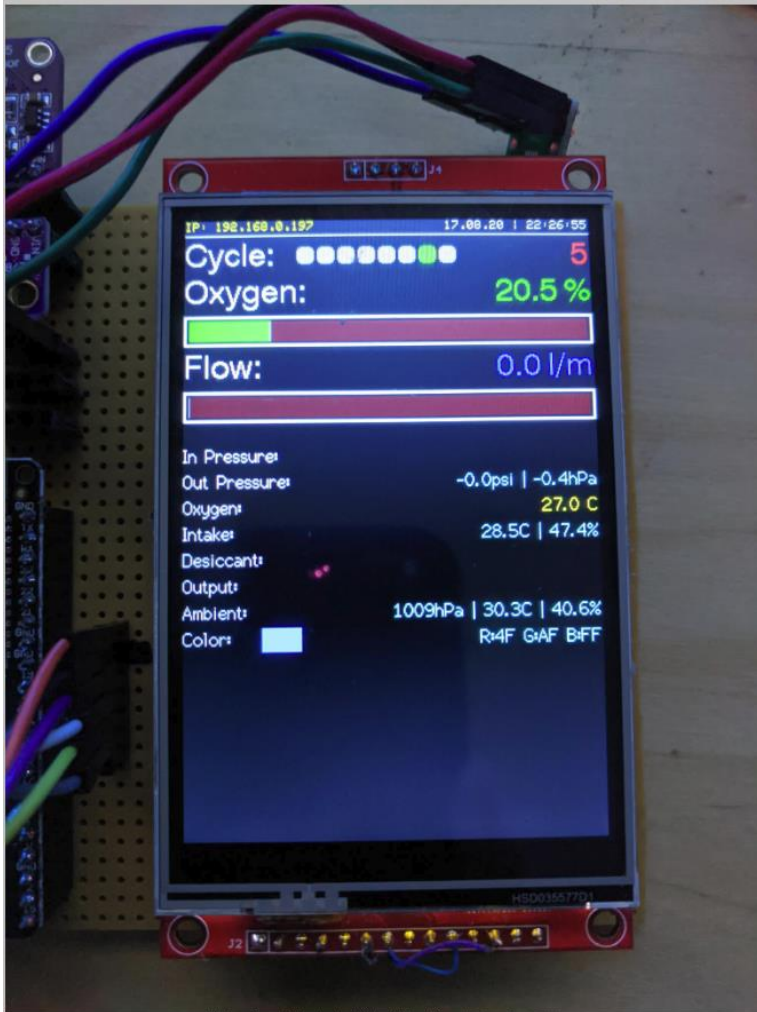
- <http://project-apollo.org>



# Project Apollo – latest progress

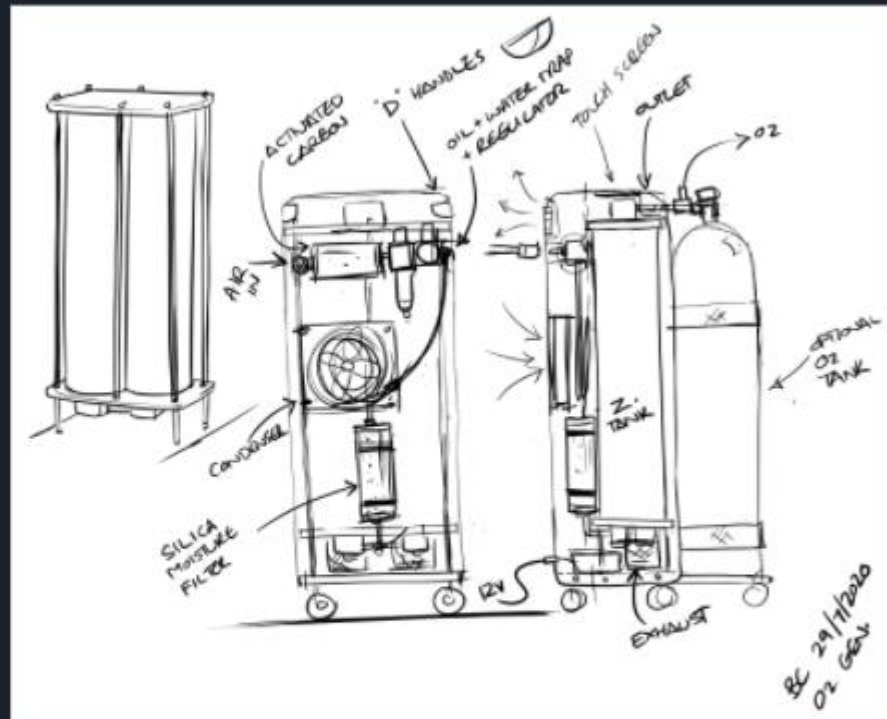
- Next version
  - Focused on safety, user experience and maintainability
  - O2 compatible materials in the oxygen path
  - Dedicated PCB controller board, sensor integration, valve operational sensing
    - 3" TFT touch screen for diagnostic messages, medical-grade buzzer
    - Auto-tuning (valve timing, auto-adjusts to changes in compressed air input pressure)
- Status
  - Mechanical design
    - Focus on FDA approval and manufacturing
    - Please see project "Oxygen Concentrator" from Public Invention (@Ben Coombs)
  - Software prototypes for Apollo v4 – working
    - Simulation software
      - "device in the loop" optimization strategies – tested and delivering close to theoretical
    - Can control Apollo for O2 generation and basic optimization
    - WiFi and Bluetooth integration TBD
  - Hardware design
    - Sensor selection - Sensors for pressure, humidity, temperature – selected and tested
    - Valve board – schematic in review, PCB in progress
    - Controller board – schematic in review, PCB in progress
    - Sensor board – schematic in progress, PCB in progress (inspired from Apollo v3)

# Prototyping effort – electronics, software

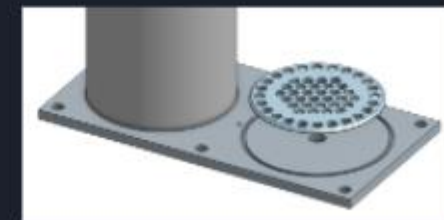
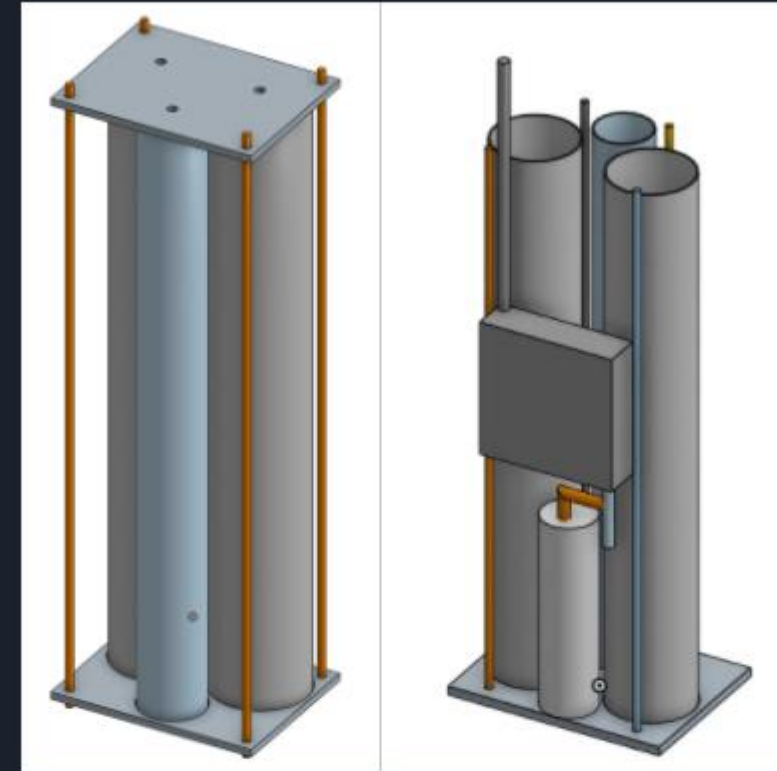




# Mechanical Design



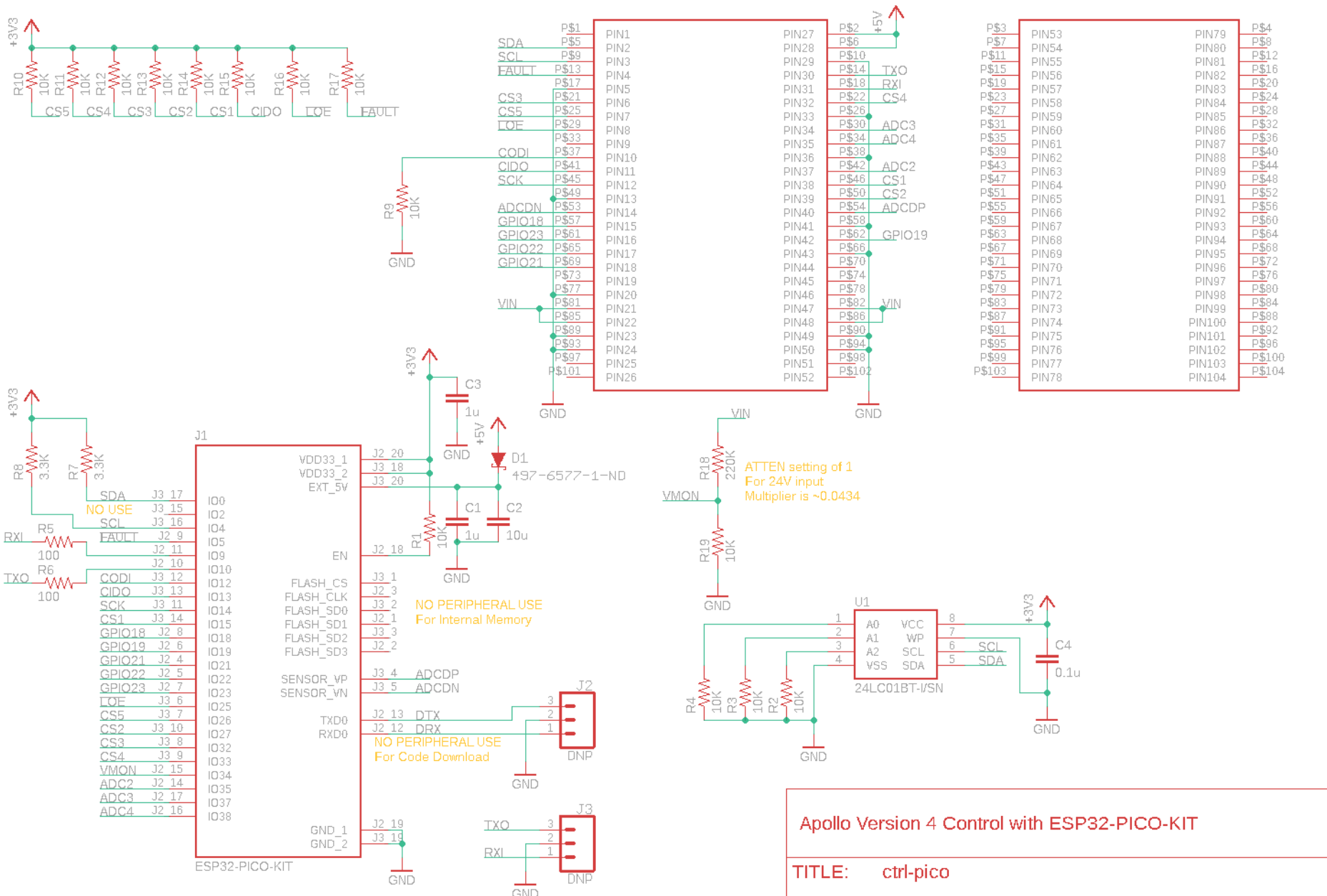
- Runs off 24V power supply and a compressed air source.
- Built in air filtration to produce medical grade air.
- Rugged plastic body with handles and wheels.
- Durable aluminium pressure vessels.
- Reliable, long-life parts that are easy to service.



<https://github.com/PubInv/oxygen-concentrator>

# Conclusion

- Apollo
  - Open source oxygen concentrator with focus on low-cost
  - When Apollo v4 comes out we encourage everyone to build one!
- Please visit us at
  - <http://project-Apollo.org>
    - Github for designs, PCBs and software
  - <http://HelpfulEngineering.org>
    - Slack channel = #project-oxygen-concentrator



## Apollo Version 4 Control with ESP32-PICO-KIT

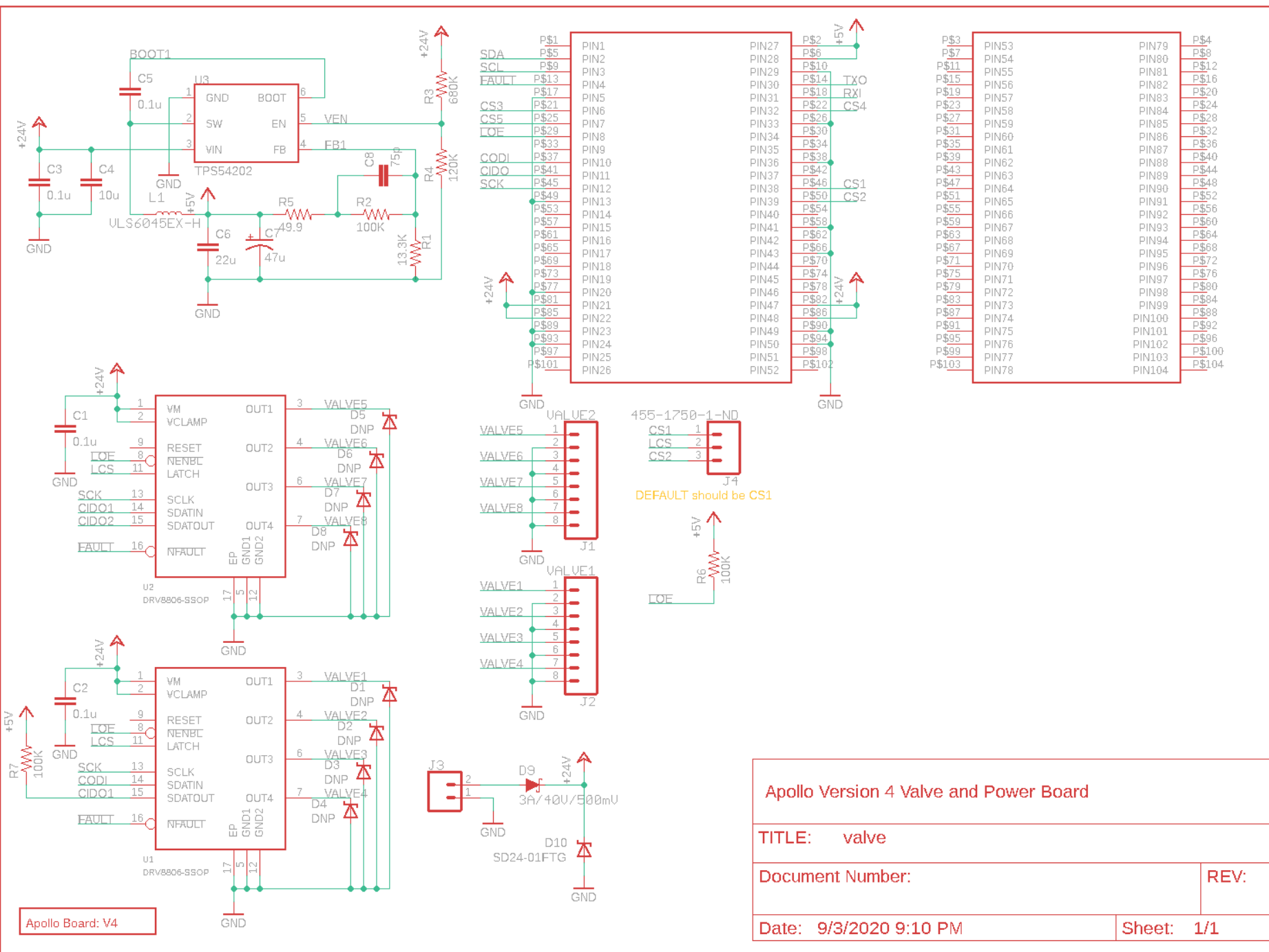
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Apollo Version 4 Valve and Power Board	
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