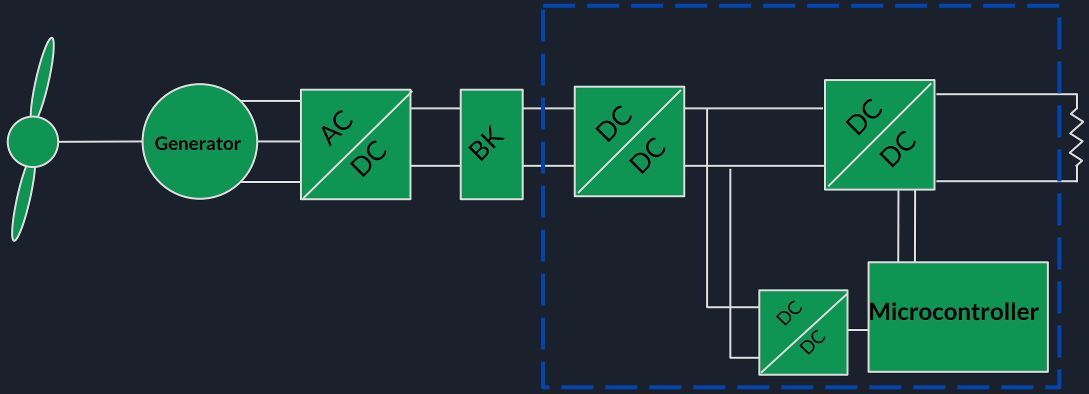
CWC 2020: DC-DC Converter

Booster Pack:
Humoud Abdulmalek
Mohammed Almutairi
Nigel Grey

Presenter: Mohammed

Introduction

- Clients
  - Dr. Venkata Yaramasu
  - Mr. David Willy
- Mentor
  - Jason Foster
- Project
  - Collegiate Wind Competition 2020
  - DC-DC Boost converter



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Timeline & Responsibilities

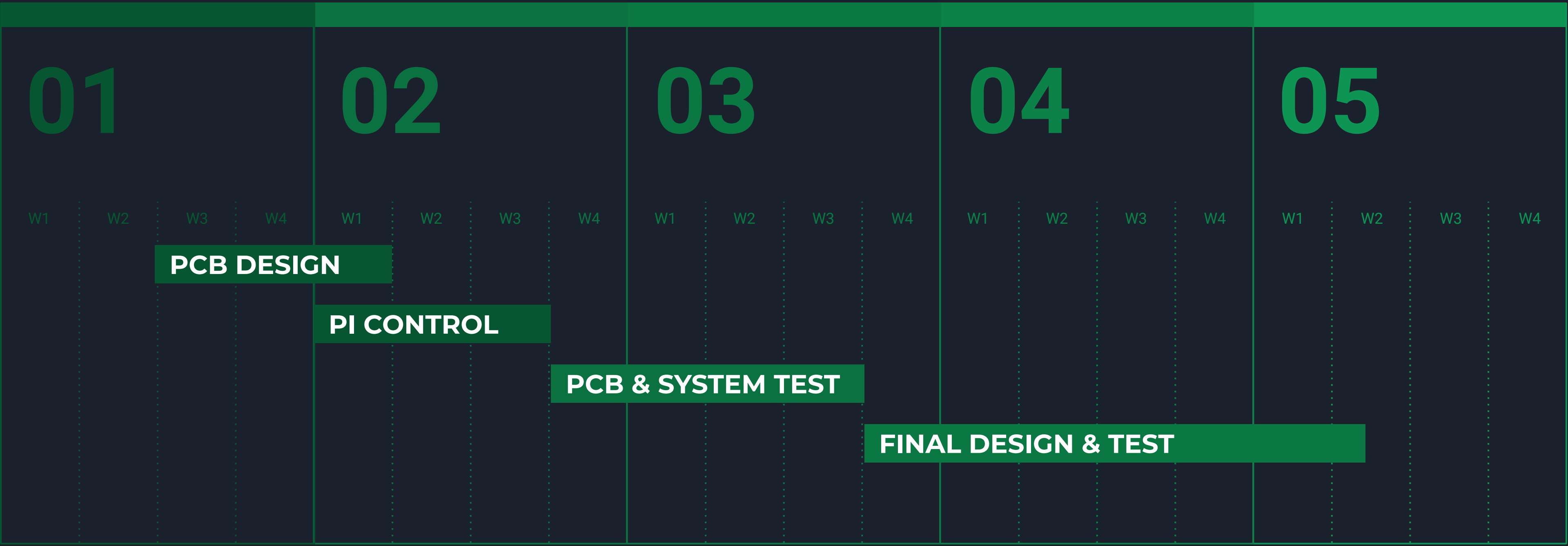
Project Overview

Project Management	Converter System	Control System
• Define project scope • Define schedule • Manage team and collaborator roles	• Design, build, and test DC-DC converter • Integrate AC-DC converter with DC-DC converter • Create mechanical to electrical system interface	• Design state machines • Collaborate to program all sense/control circuitry

Presenter: Nigel

Spring 2020 Project Overview

January 13th - May 8th



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Spring 2020 Project Overview

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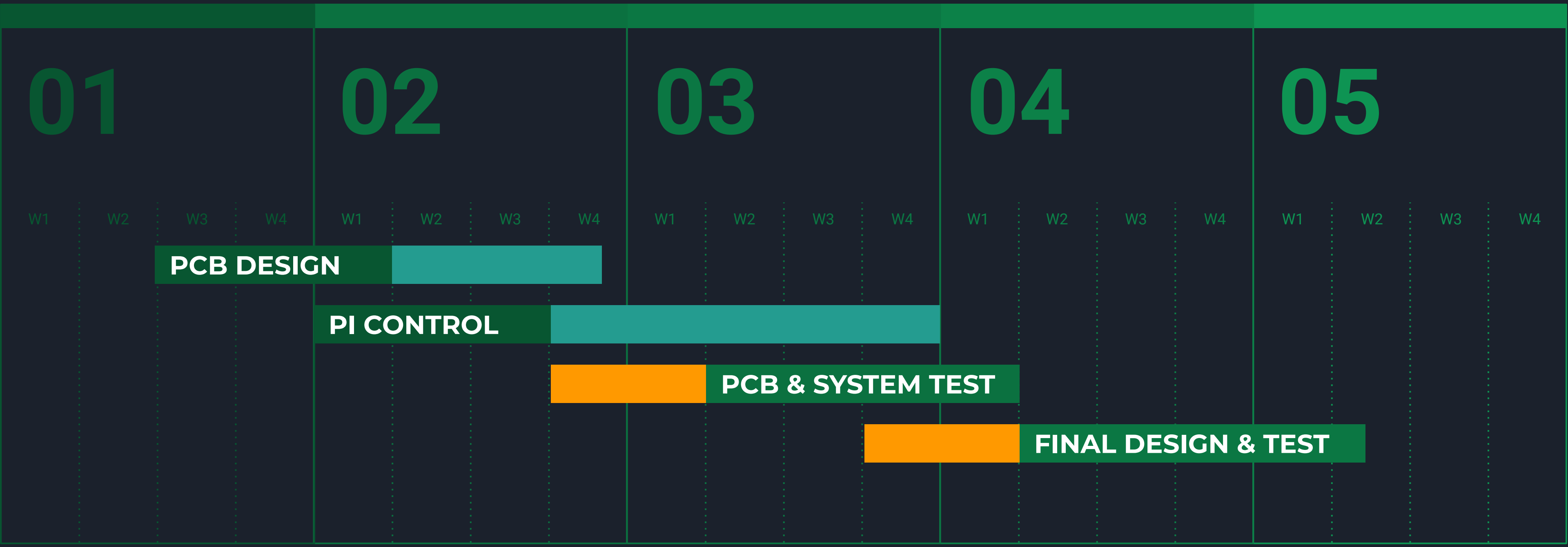

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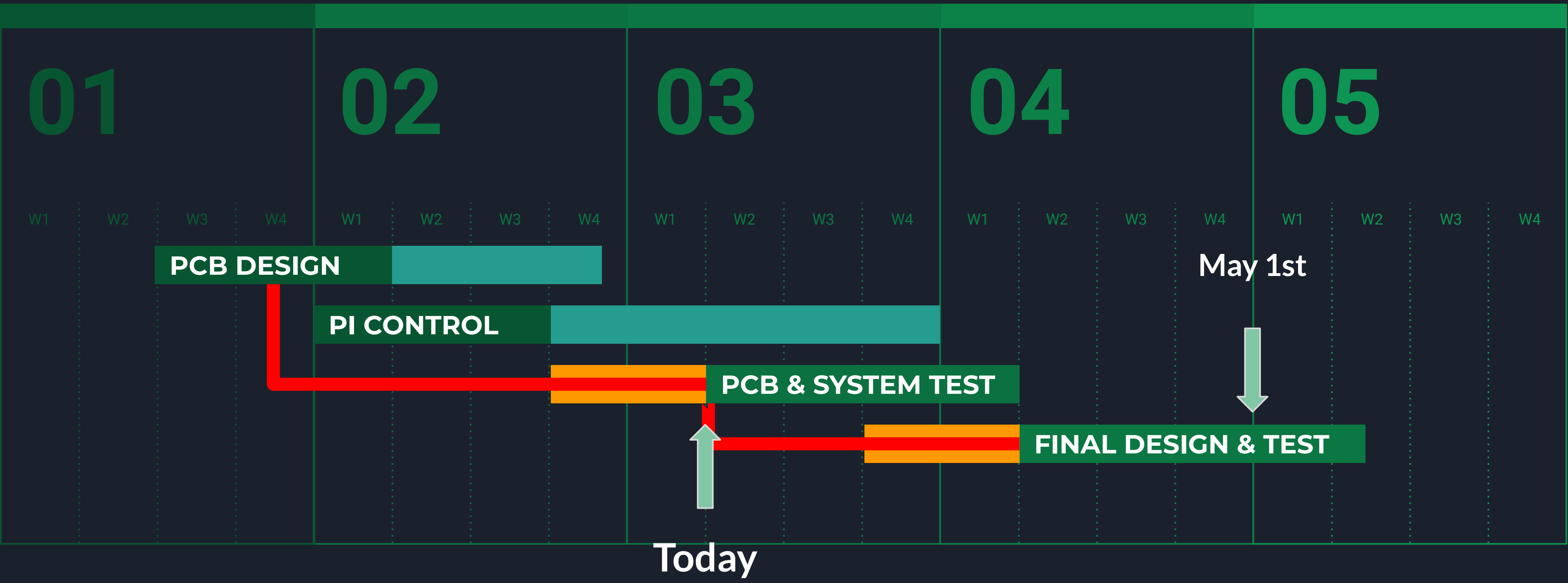

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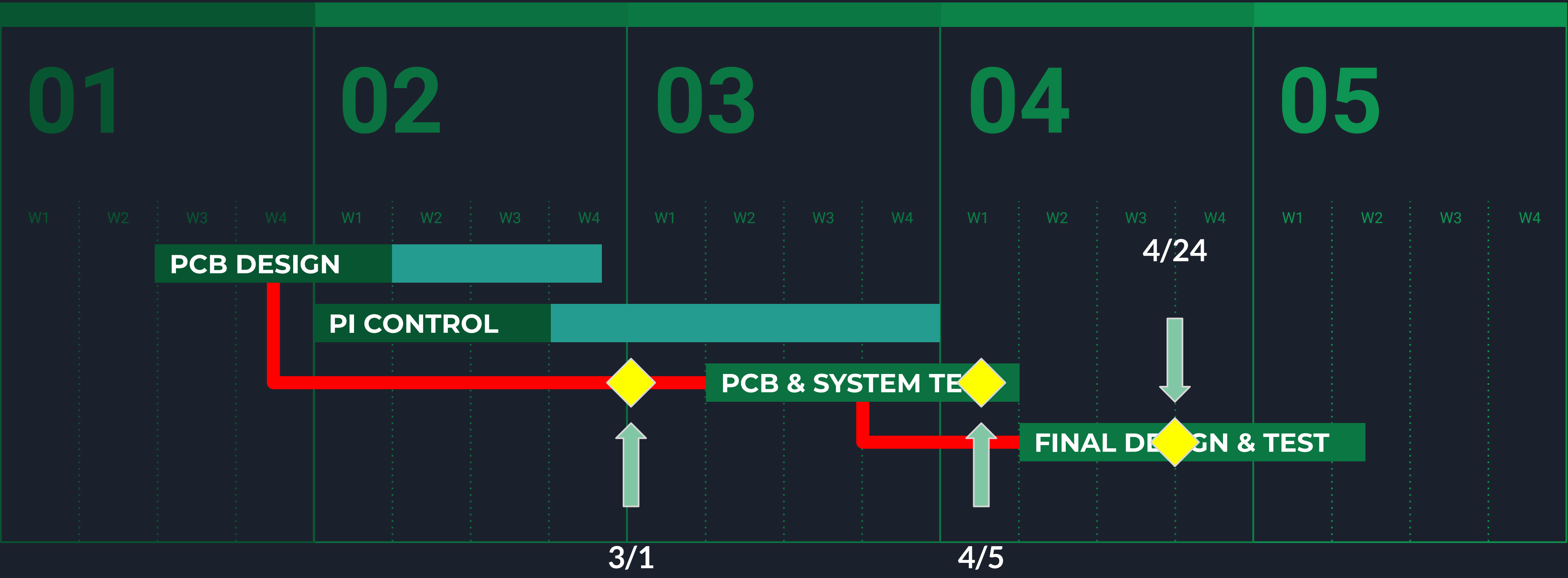

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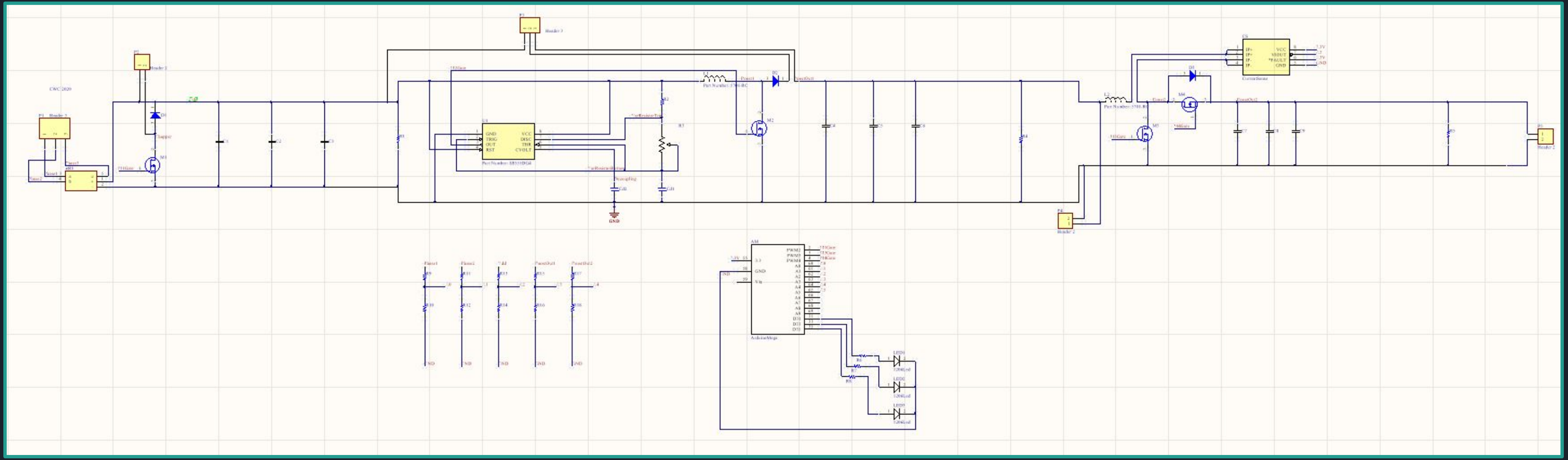
Converter System: Overview

January 13th - February 20th



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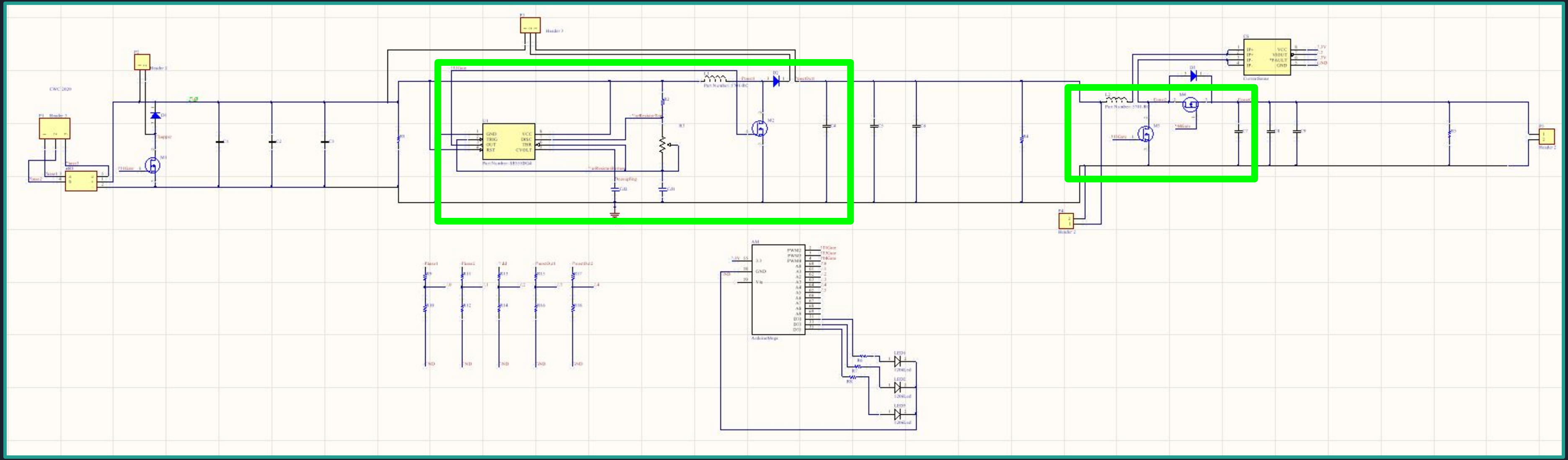

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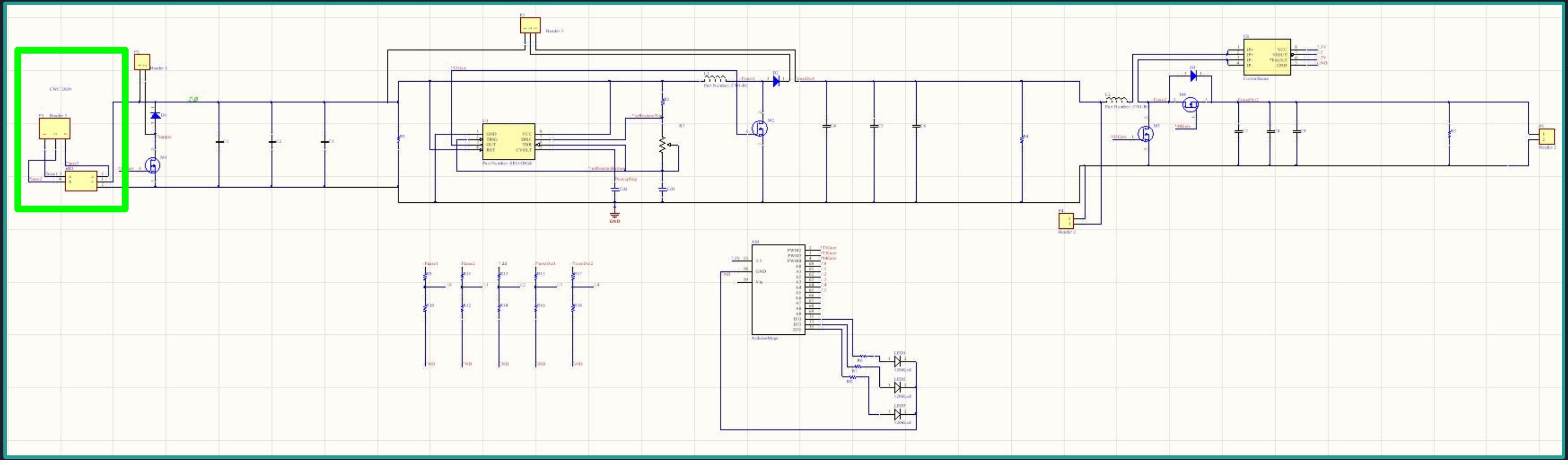

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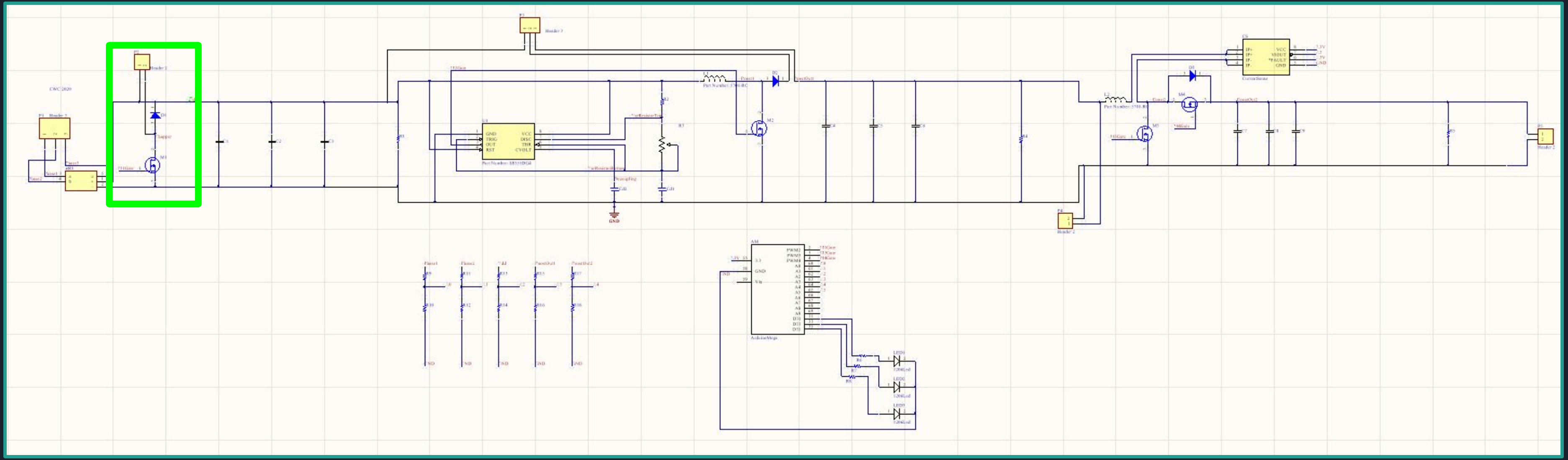

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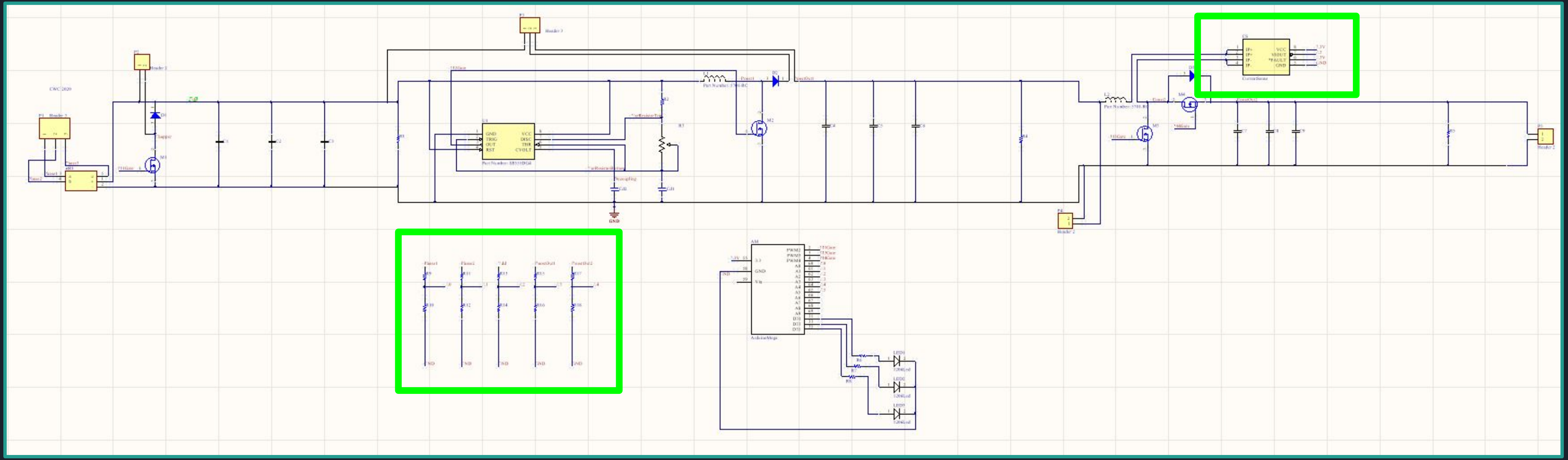

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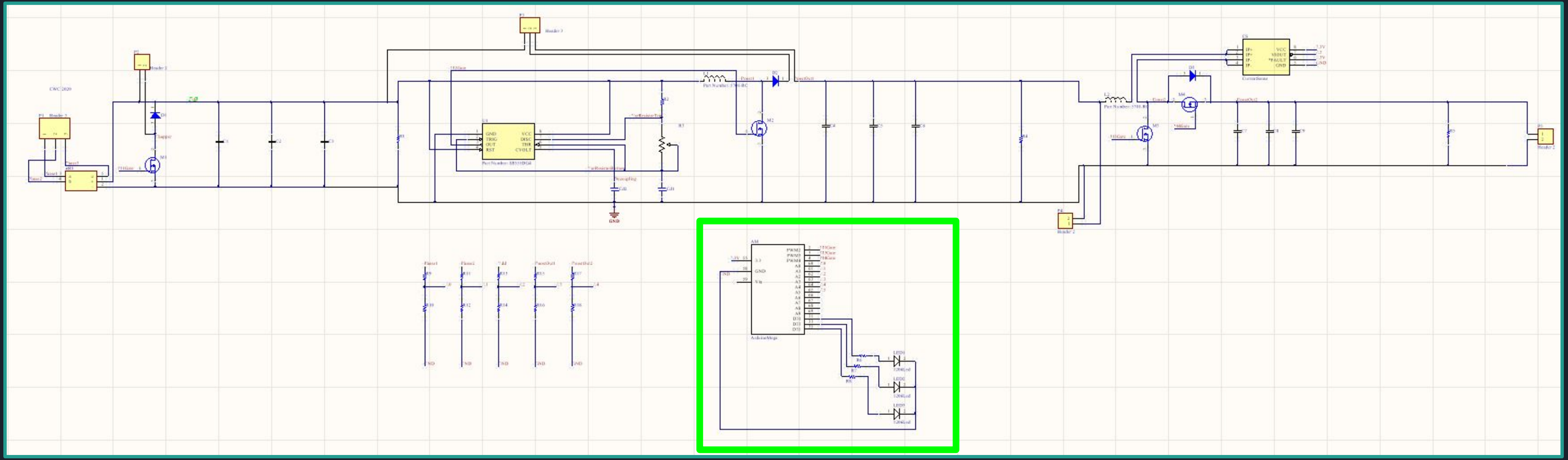

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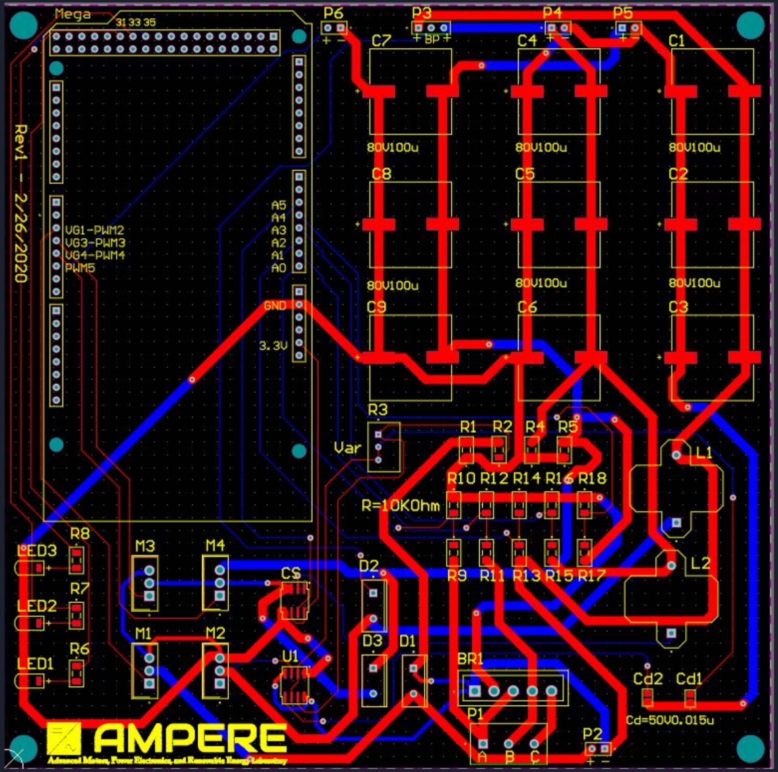
Converter System: PCB Integration

January 13th - March 1st

- Highly collaborative effort between our team and the Aux team
- Built custom footprints
- Labeled all components and connections
- Separated communication components from power components
- Developed net classes to define widths of power lines and communication lines



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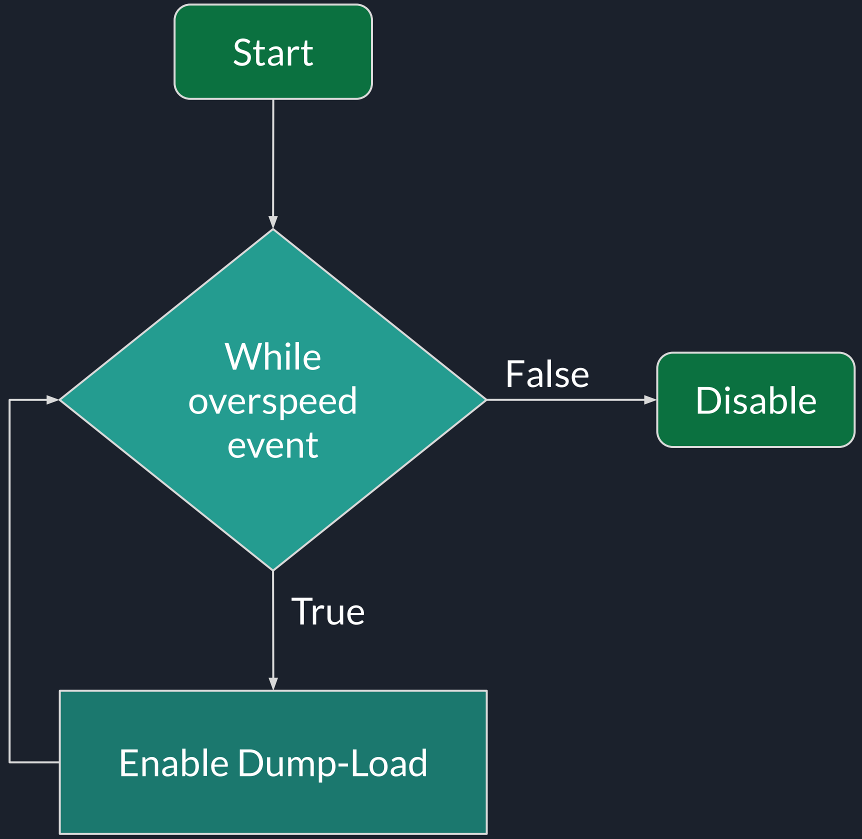
Control System: Overview

February 1st - April 1st

1. Dump-Load Circuit
2. Phase 1-2 Voltage Measurement
3. PI Controller
4. Current Sensor Measurement
5. Stage 2, 3, & 4 Voltage Measurements
6. Actuator Signal



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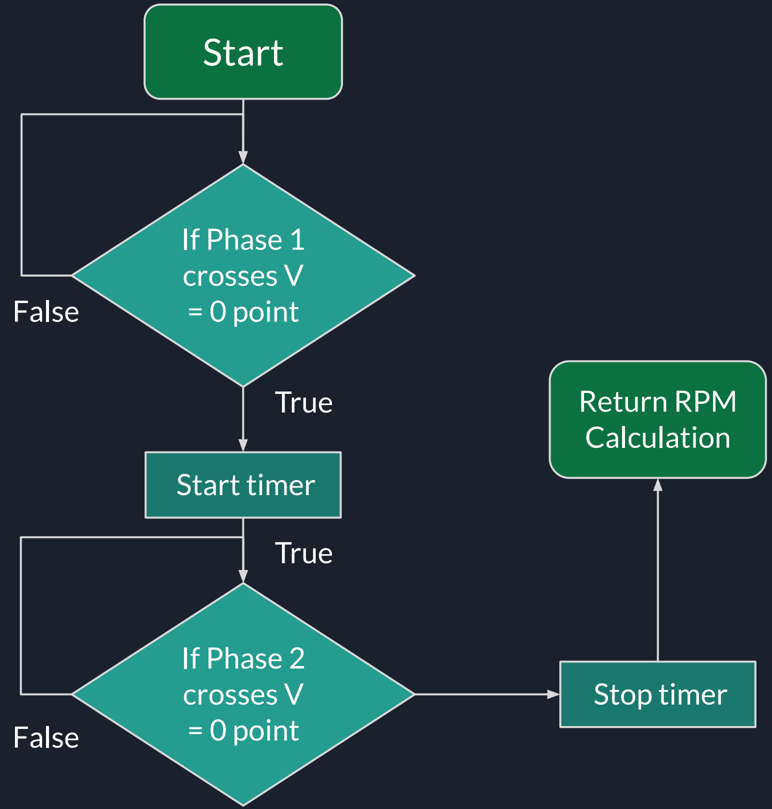

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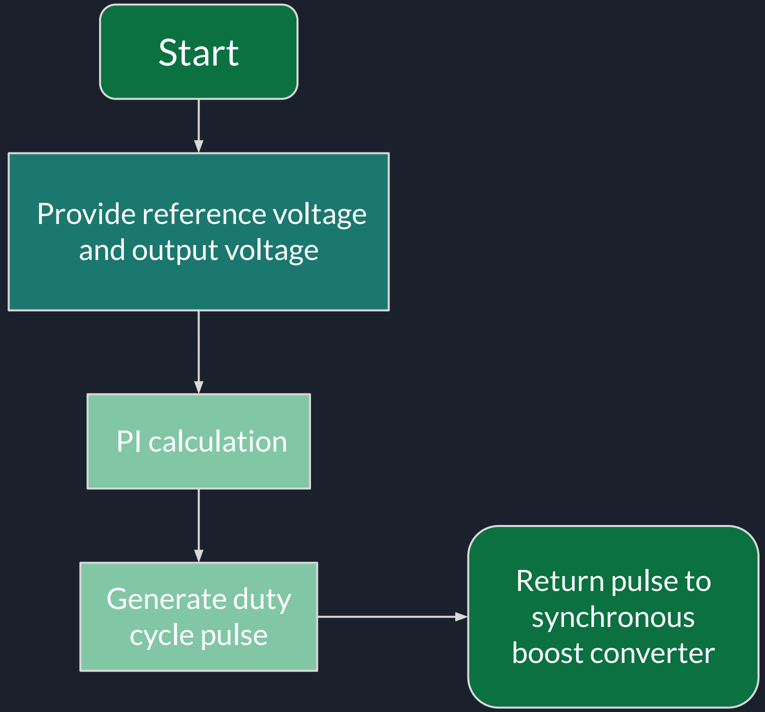

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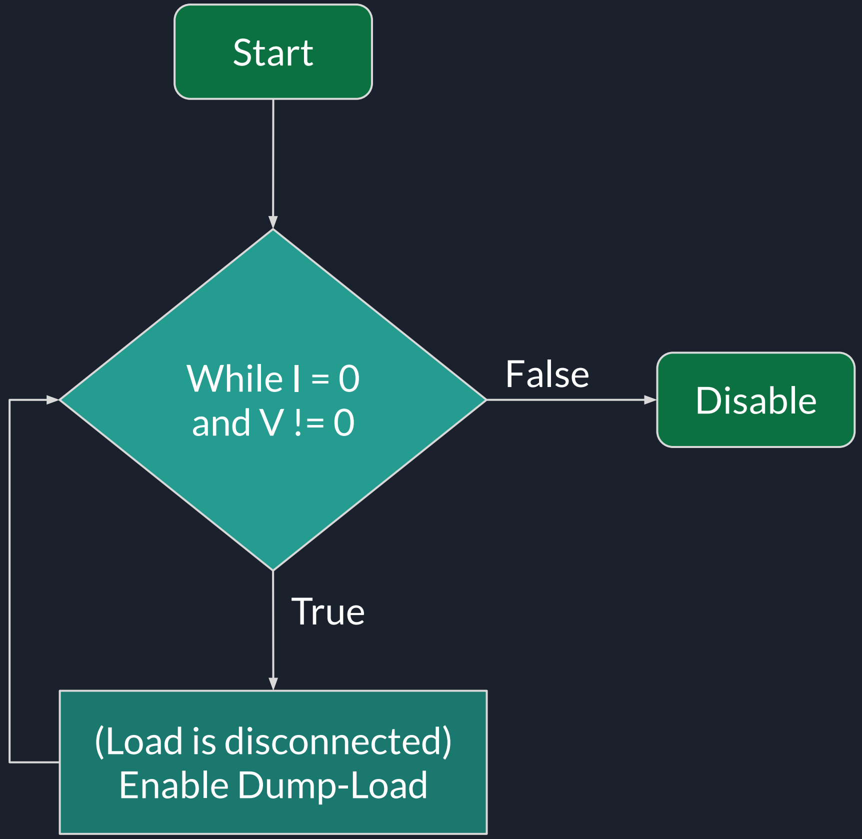

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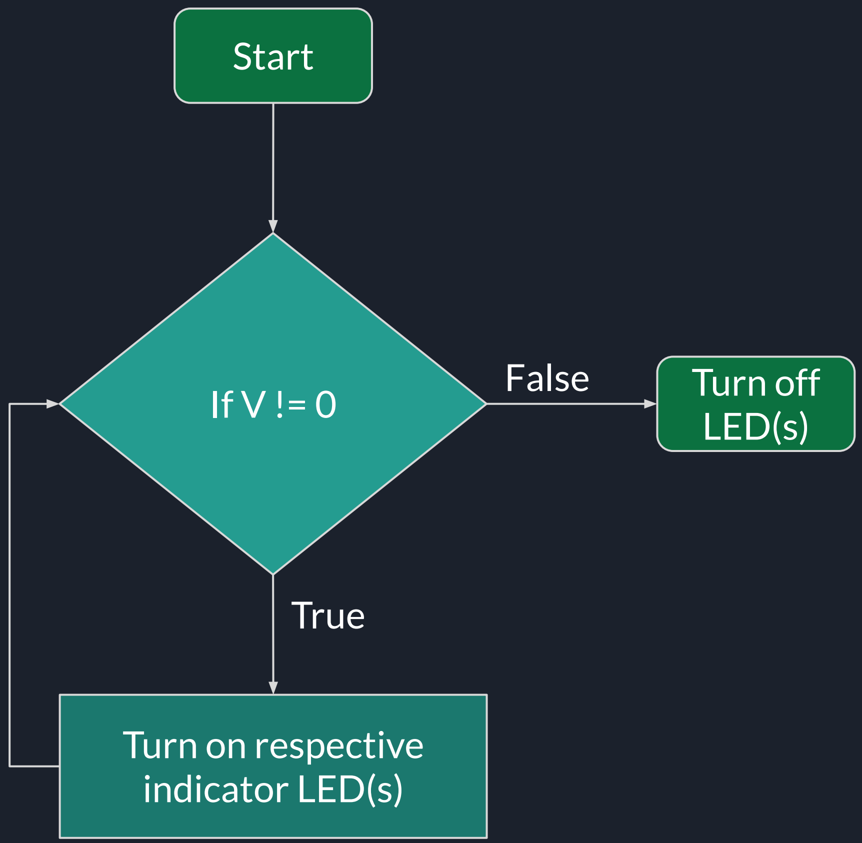

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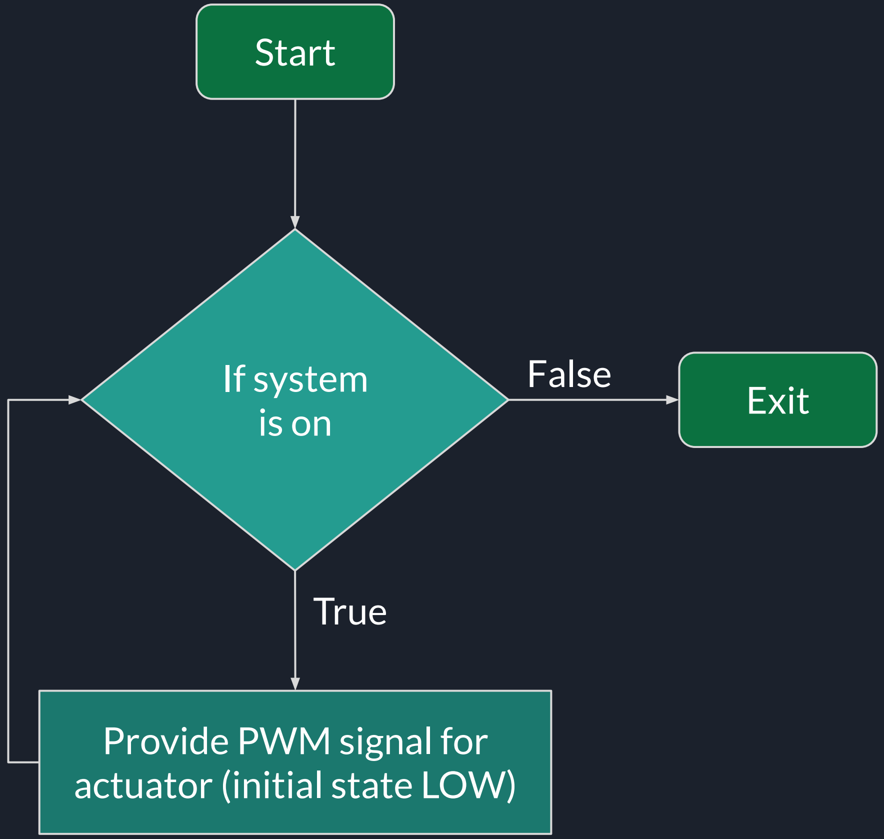

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Proportional Integral (PI) Control

February 4th - April 1st (No Dependency)

Tune PI → **Flash to Arduino** → **Test circuit**

Tune PI

- Test PI in Simulink
- Fine tune the controller
- Optimum Duty Cycle

Flash to Arduino

Export Simulink module to Arduino using:

- Hardware support package
- Simulink Embedded C Code

Test circuit

- Test simultaneous boost converter circuit with fixed input voltage and load
- Test with variable input and load

(Flexible deadline)

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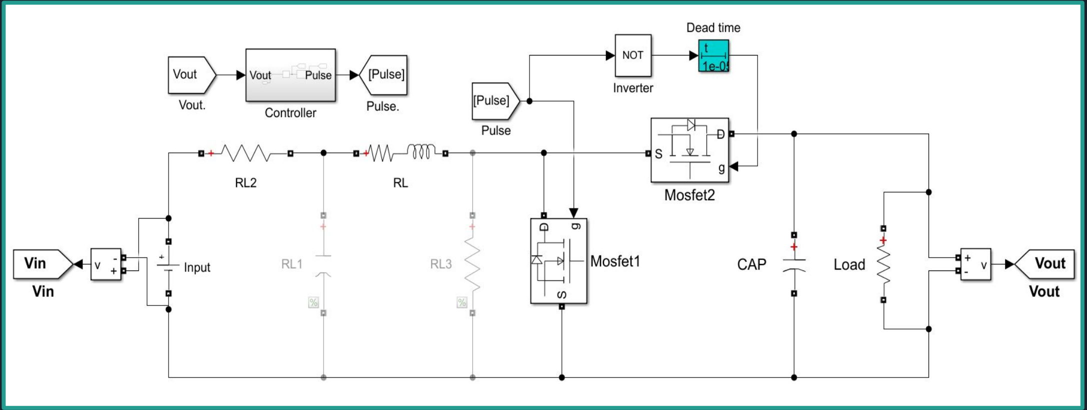
Tune PI Controller

February 4th - 19th

- Try different values for P & I to produce the optimum Duty Cycle
- Optimum Duty Cycle results in higher boost with minimum repels; **Vout = Vin / Do**



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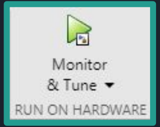
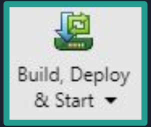
Flash to Arduino

February 4th - March 4th

- Get Simulink Support Package for Arduino Hardware
- The Embedded C Coder will generate [ert.tlc] C for the Arduino

- Use blocks from the Arduino library for pin mapping
- We can (Monitor and Tune) the design while the Arduino is connected to the computer or (Build, Deploy & Start) to upload the generated code to the Arduino





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PCB Test & System Integration

March 9th - April 5th

March 9th- 11th

PCB Soldering & Testing

- Solder components onto the PCB

March 6th - 13th

UGrad Registration & DR3 Group

- DC-DC & AUX team register as one team for UGrad

- DR3 Group assignment

March 11th - April 5th

Integrate PCB to the System & Test

- Integrate the PCB prototype to the entire system
- Perform a primary test for the system

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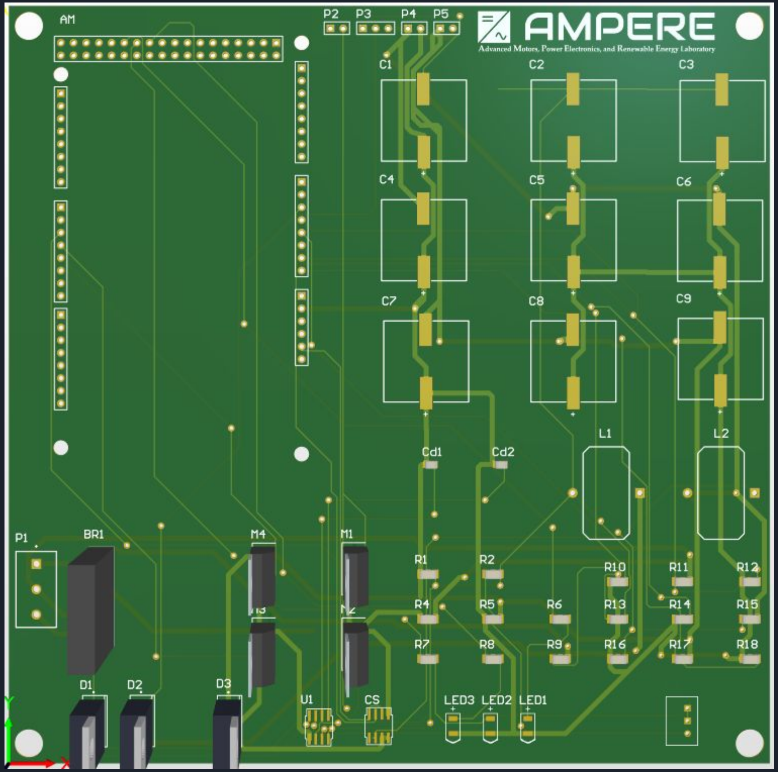
PCB Soldering & Test

March 9th - 11th

- Solder the surface mounted components (capacitors, resistors)
- Solder the thru-hole components by hand along with the Arduino interface pins
- Test to verify our system works as we expect



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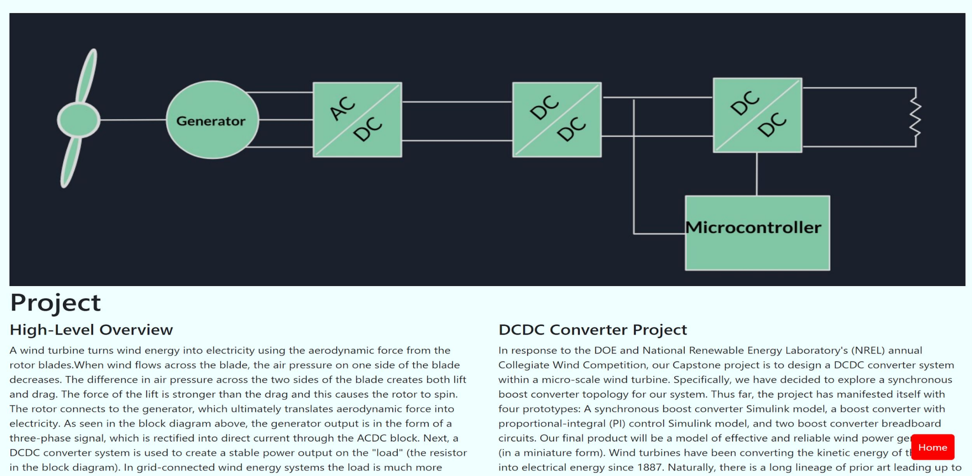
Website

January 31st - May 8th

- Created a website using HTML
- Styled using CSS & Bootstrap
- Used JavaScript to perform specific functions
- Completed the first two pages (Splash & Project description)
- Will work on the remaining pages in future



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CWC 2020 Rules

January 31st - May 8th

- Voltage must be kept constant and below 48V; we are designing for 20V
- The turbine base plate must be tied to earth ground w/ 100 kΩ resistor
- All external wired connections must be isolated

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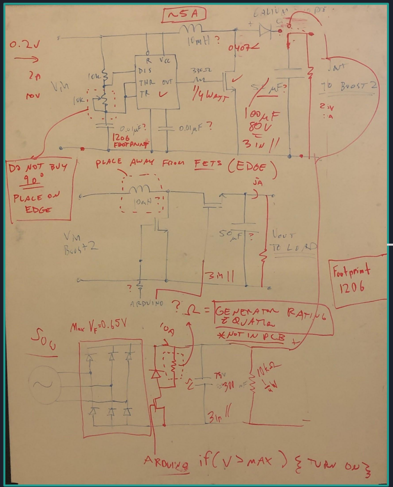
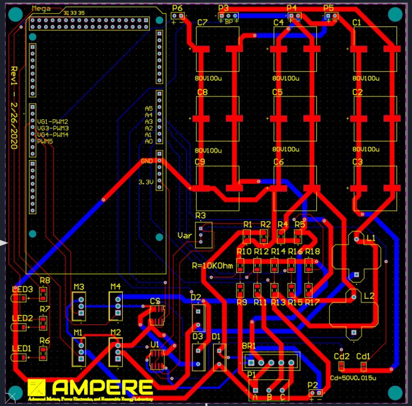
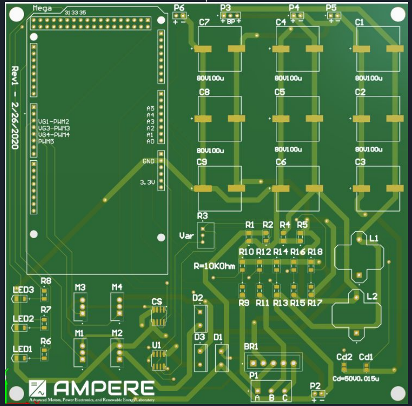
Conclusion

March 6th - May 8th

- We successfully progressed from the conceptual and simulated world to the physical
- Given the amount of effort and planning dedicated to our first PCB design, it is likely (*Dr. Yaramasu confirmed this*) we will not need to create second revision
- We have three PCBs and ample components, the main risk moving forward centers around the difficulty of running all control modules in parallel







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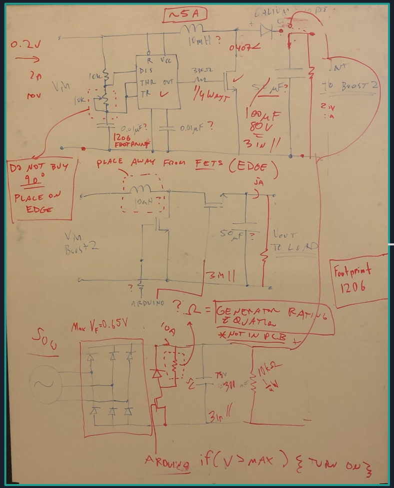
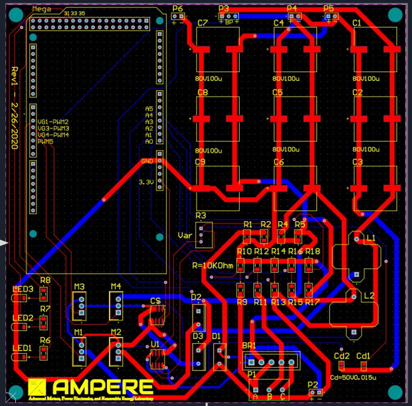
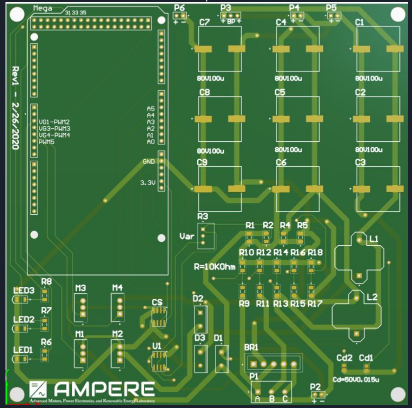
Conclusion

March 6th - May 8th

- Thank you! What questions do you have for us?







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