

Senior Design Group 36

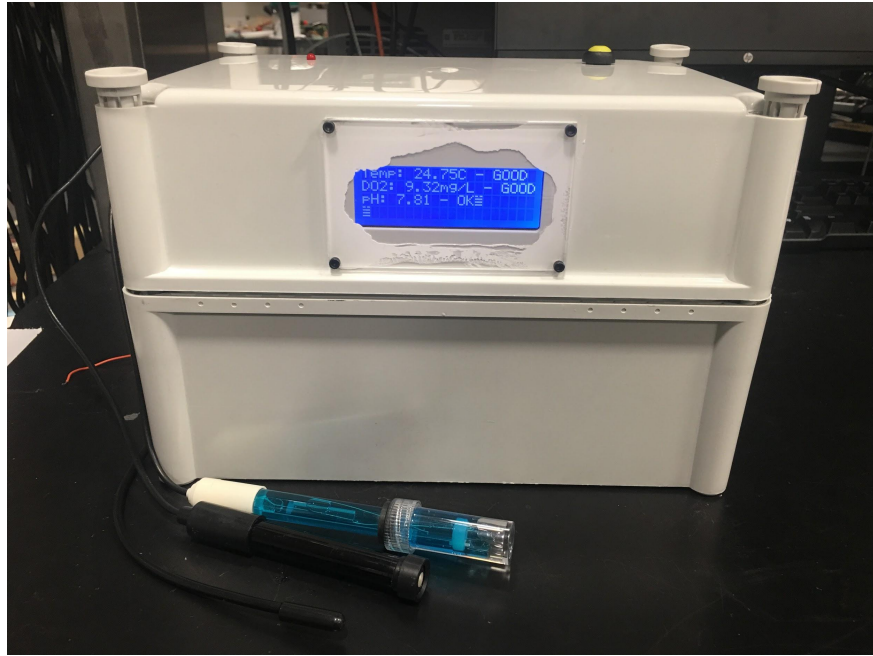
Solar Powered Hydroponics Sensing System

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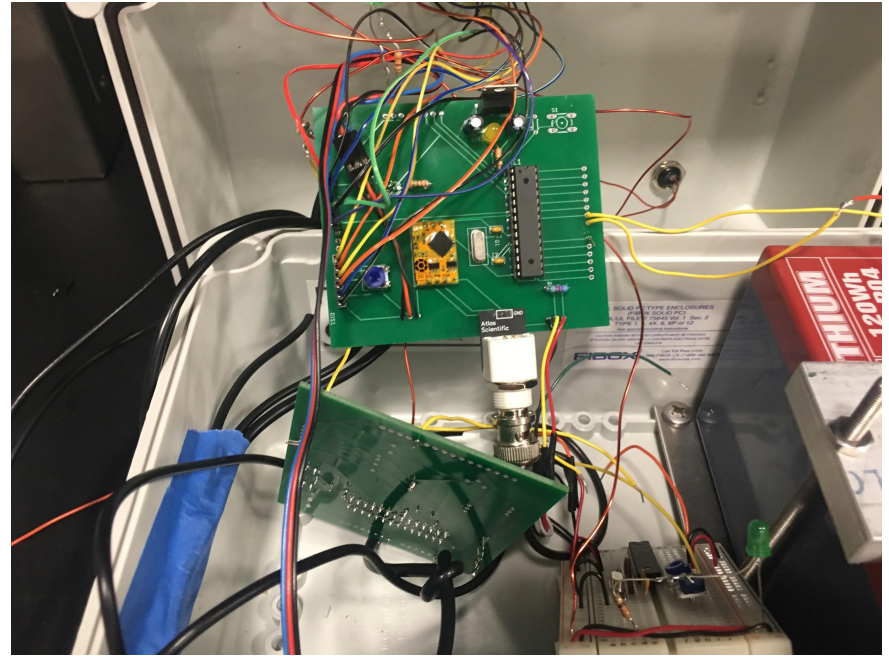
Introduction

- Partnership with Living Positive Kenya to improve tilapia fish farming operations
- Problem: To provide developing countries with a economically viable solar powered fish farm kit
- Solution: Automate water quality testing to increase production and better integrate solar power

Physical Design



Outside View of Sensing Kit with Sensors



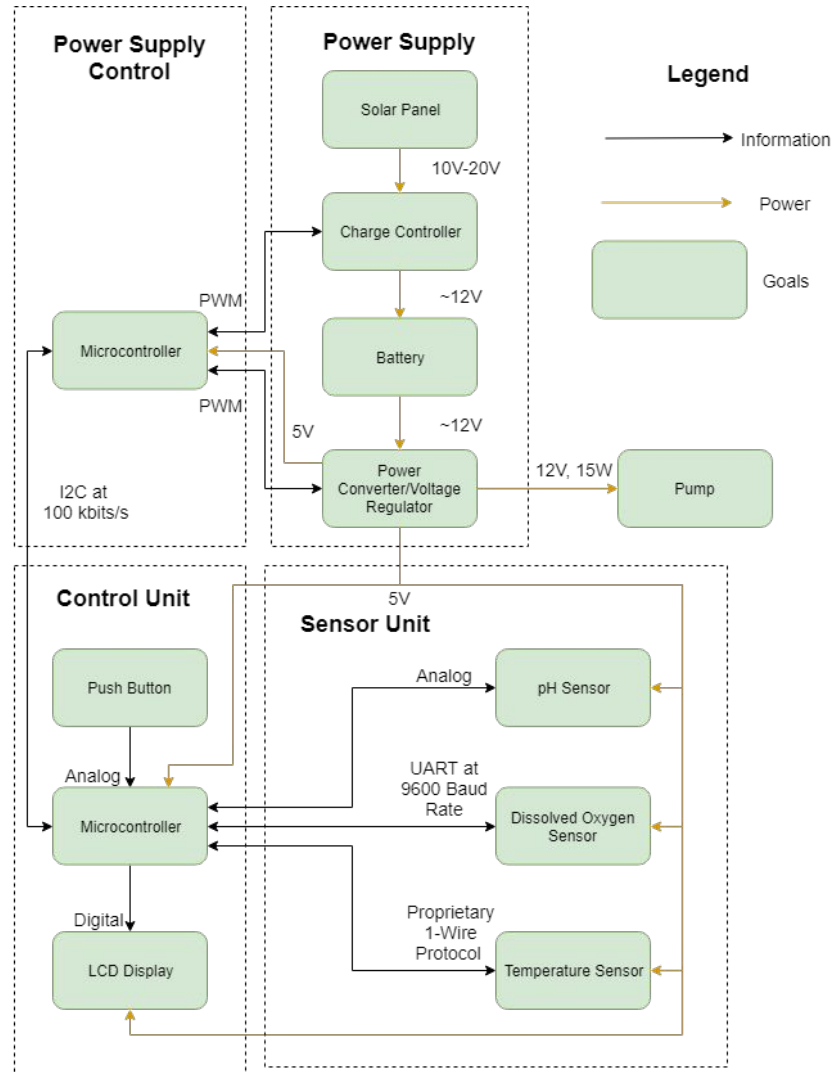
Inside View of Kit with Sensing PCB and Battery

High-Level Requirements

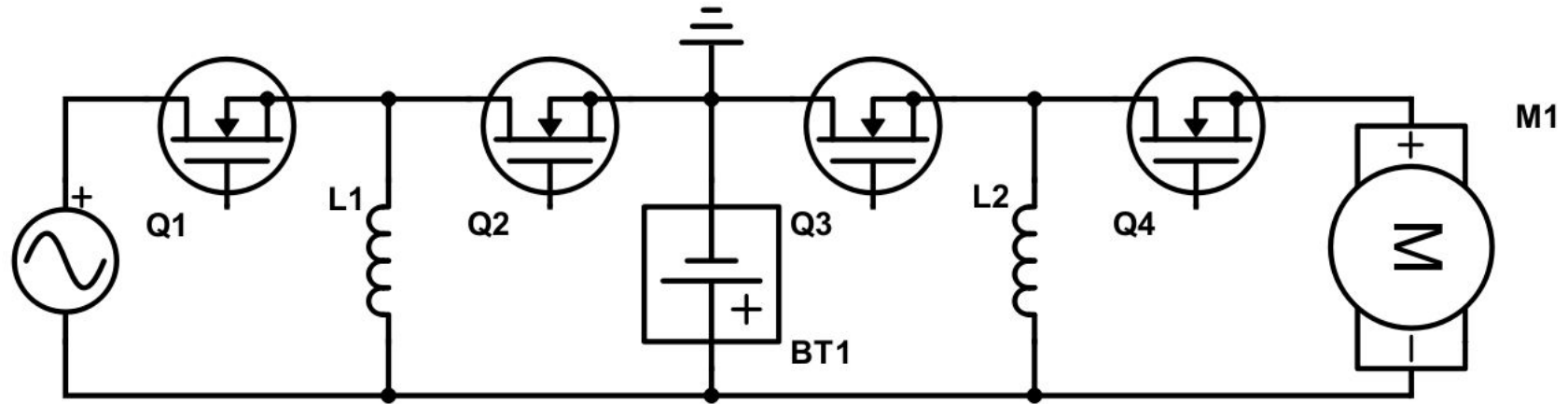
1. Quickly be able to determine if the levels of the pH, dissolved oxygen, and temperature are out of range
2. The microcontroller should trigger the aqua pump to re-oxygenate the water
3. Kit will be completely solar powered and have 12 hour battery operation

Block Diagram

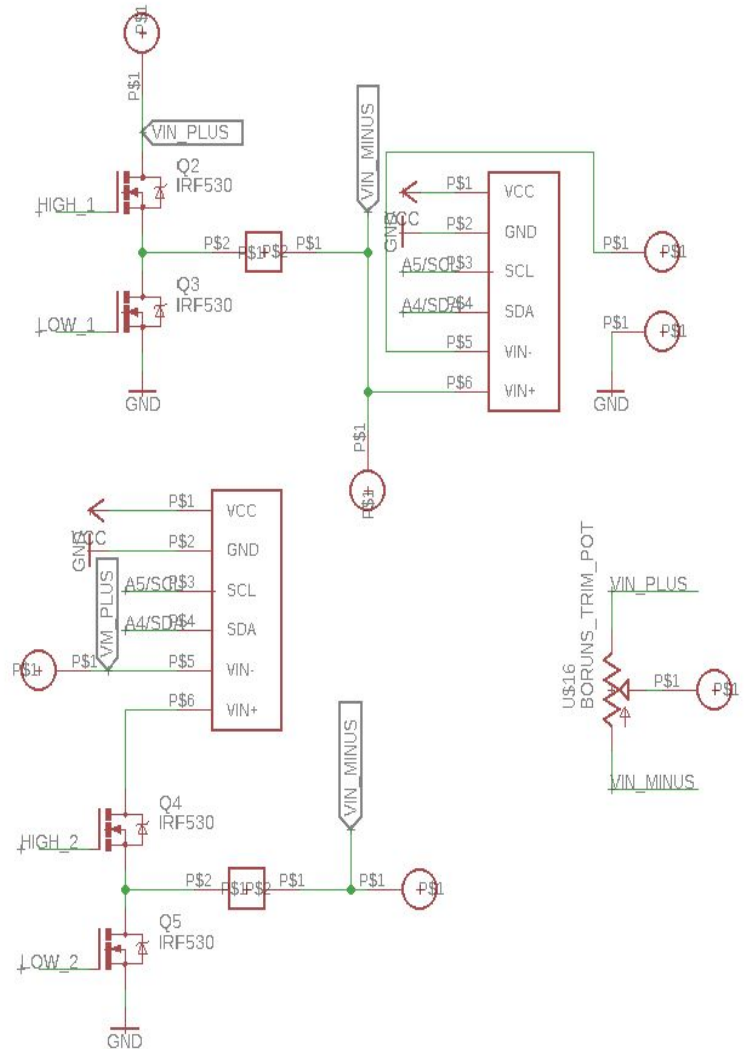
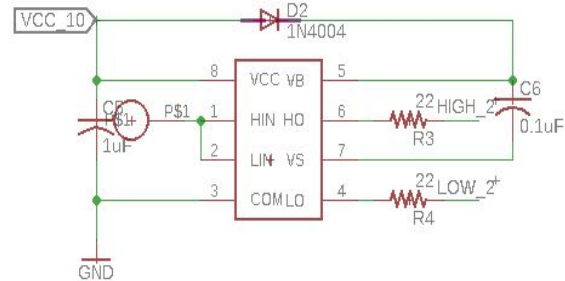
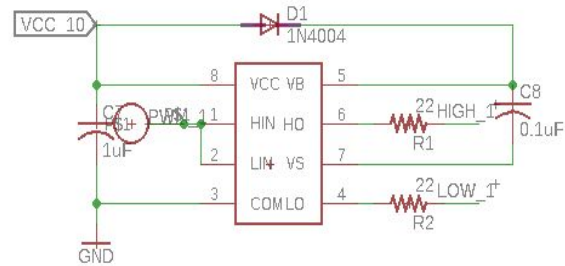
- Modular Design
- Fully Functioning Control and Sensor Units



Circuit Diagram

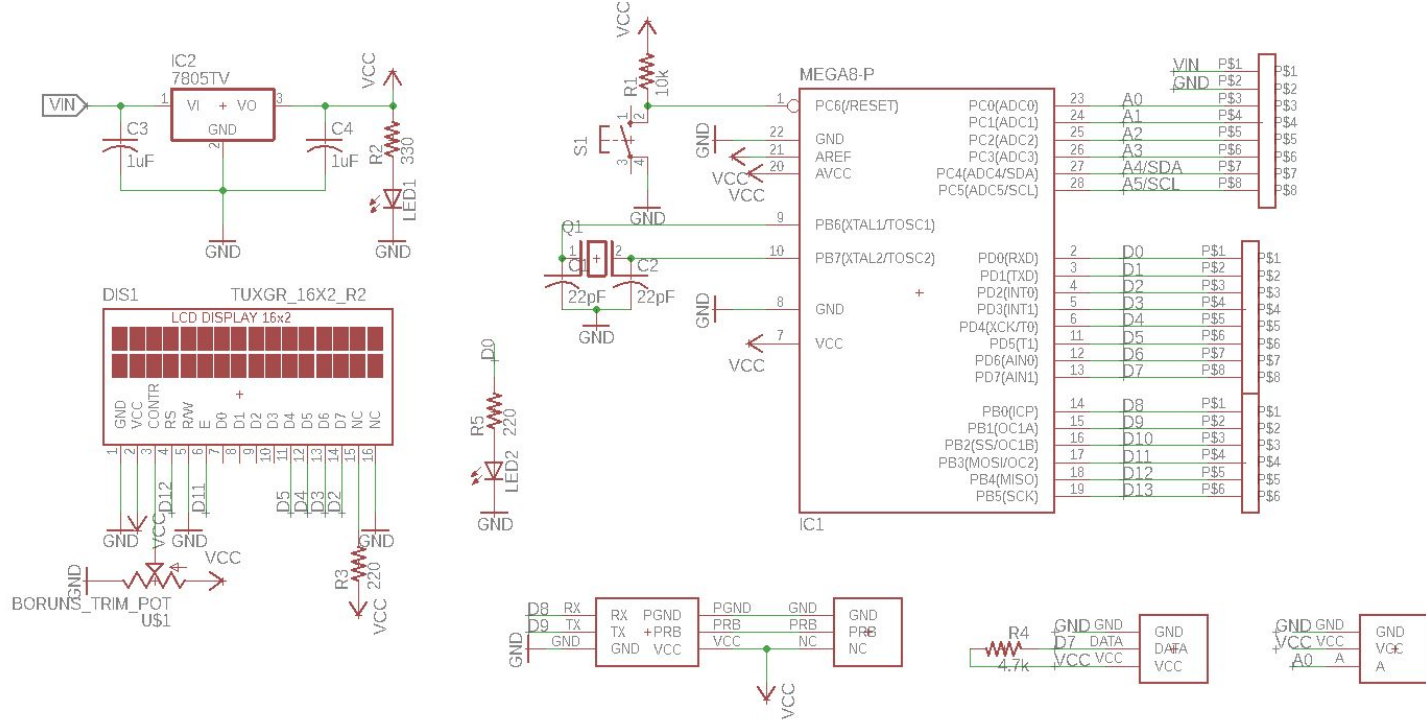


Design



Buck-Boost Converter Schematics

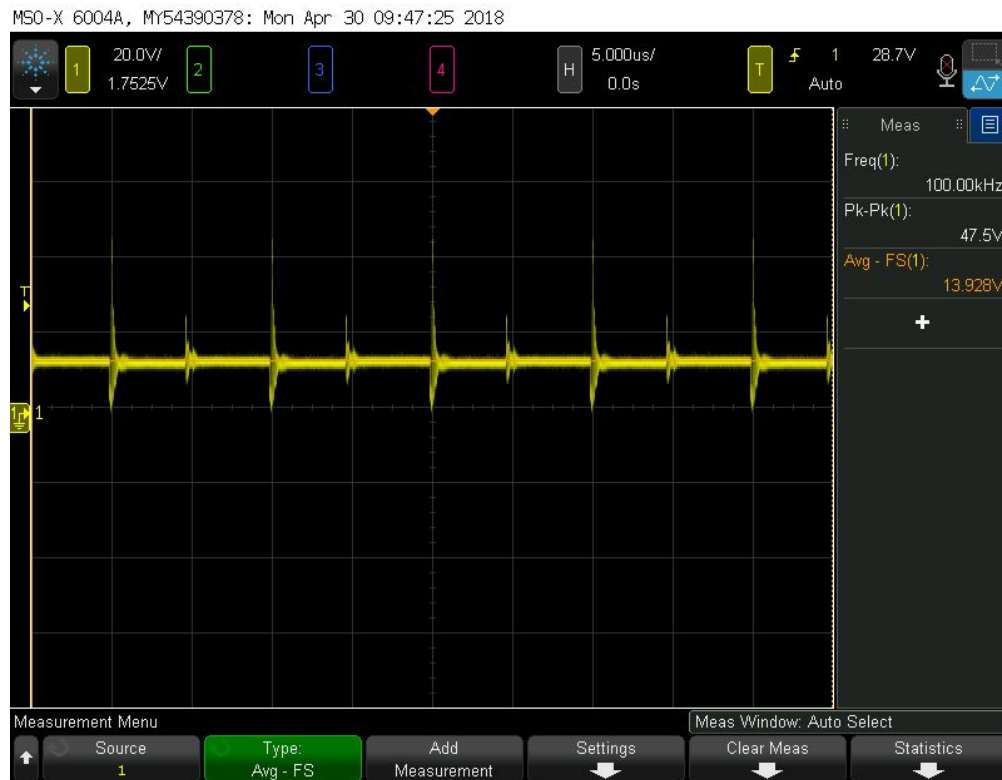
Design



Control Unit Schematic

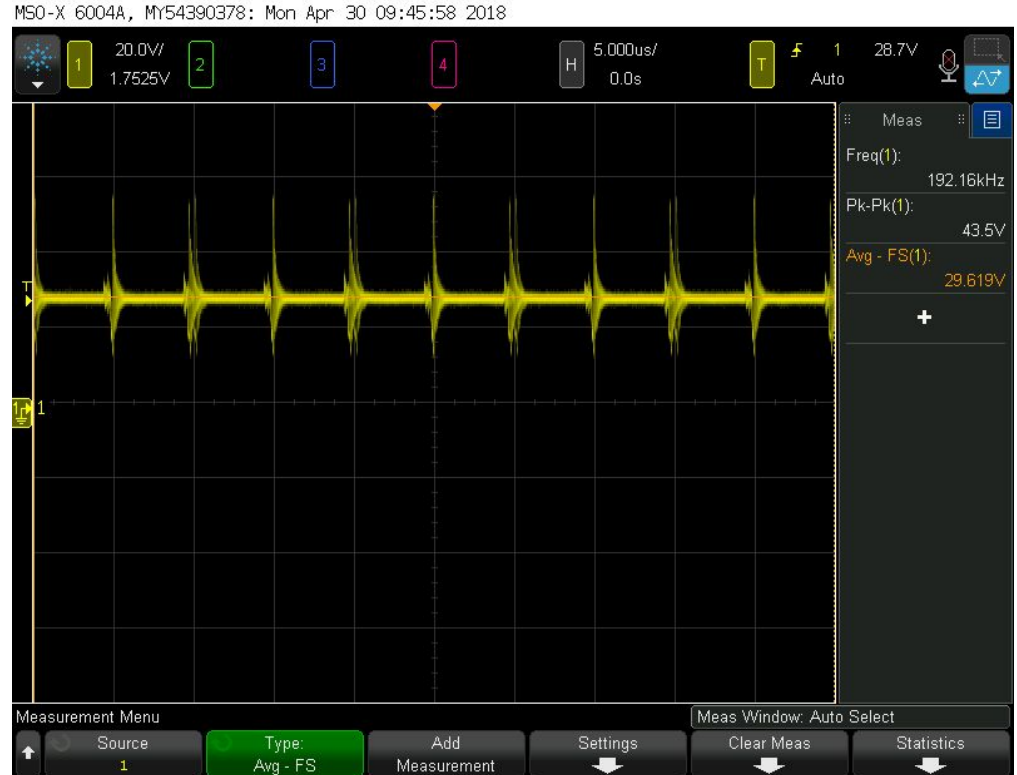
Battery Charging Converter (14.8V Output)

Input: 20V at 3A
Output: 14.8V at 3A

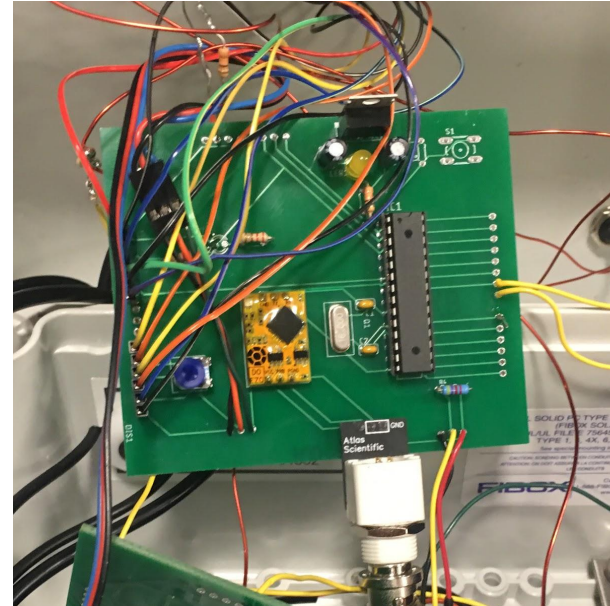
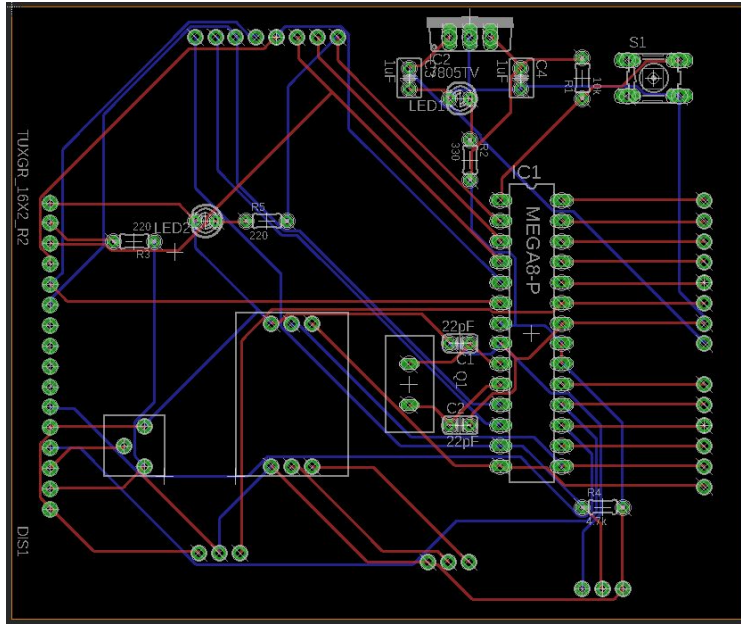


12V DC Pump Converter

Input: 20V at 3A
Output: 12V at 1A

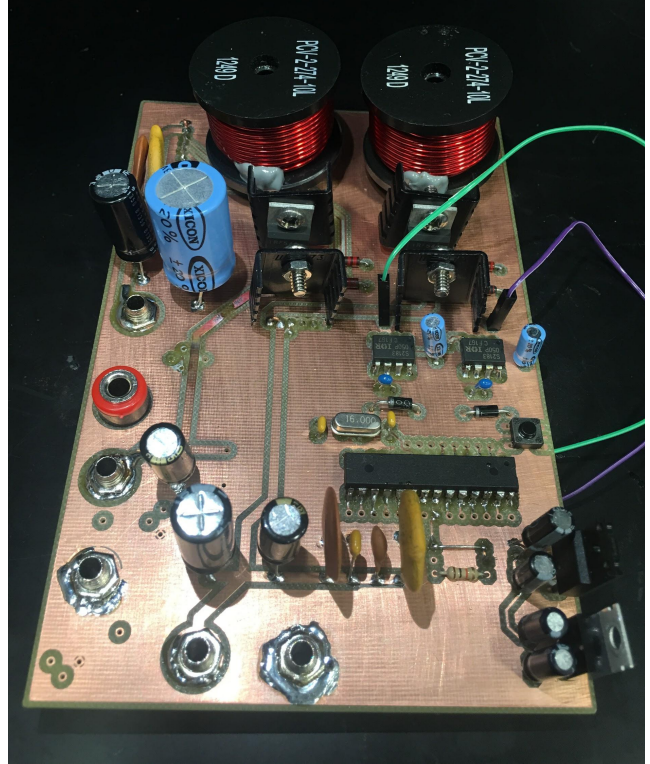


PCB Design



Sensing Unit PCB

Power Control PCB



Requirements and Verification

Requirements	Results
Input: 10-25V at 30W (simulates solar panels at inputs) Output: 14.5V +/-10% at 43.5W +/- 10% (simulates lithium battery)	Input: 20V at 3A Output: 14.8V at 3A * Varied input and output stayed constant within +/- 10%
Input: 11-15V (output of lithium battery) Output: 12V +/-5% at 15W (DC pump)	Input: 20V at 3A Output: 12V at 1A
LCD screen and LED alerts users when any levels of dissolved oxygen, pH, and/or temperature are outside of tolerance ranges	Dissolved Oxygen: +/- 0.4 mg/L pH: +/- 1.2 pH Temperature: +/- 2°C

Technical Challenges

- Solar charging integration
- PWM signal generation
- Accurate current sensing
- Water quality sensor accuracy under non-controlled conditions

Accomplishments

- Fully Functional Sensing Unit
- User Interface
- Pump Timing Logic
- Cascaded Buck-Boost Converters Rated 60W Each
- Battery Charging Capable

Conclusion and Future Work

- Technical Improvements:
 - Improvements on controls (either analog or digital) for the power electronics
 - Better integration of voltage and current sensors
 - MPPT for the solar panels
 - Improve converter ripple or changing the typology

Special Thanks:

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Yamuna Phal

