TEXAS STATE
INGRAM SCHOOL OF ENGINEERING

E2.06 – Field Mill

Jeff Kaczmarek, Ryan Haugstad, Cale Floyd
Sponsor: Dr. Karl Stephen

Description

- Field Mills are used to predict lightning by measuring the local electric field. While not a guarantee, before lightning strikes there is typically a change in the atmospheric electrostatic field.

- The Field Mill will be battery operated, weather resistant and power efficient as it measures the electrostatic field. This signal will be fed into the microcontroller where a reading is stored every second. These readings will then be saved on an SD card in .csv format and transmitted wirelessly .
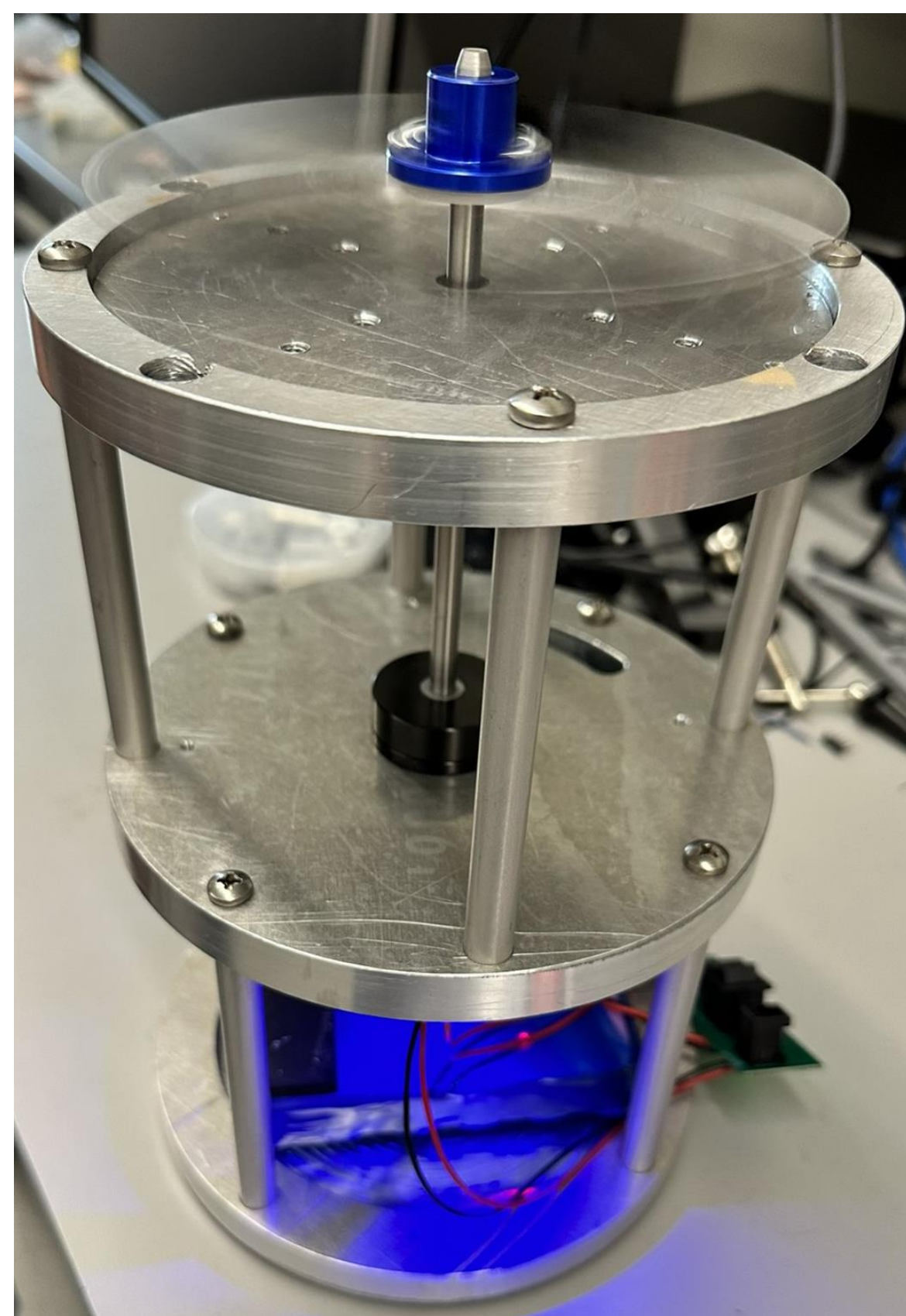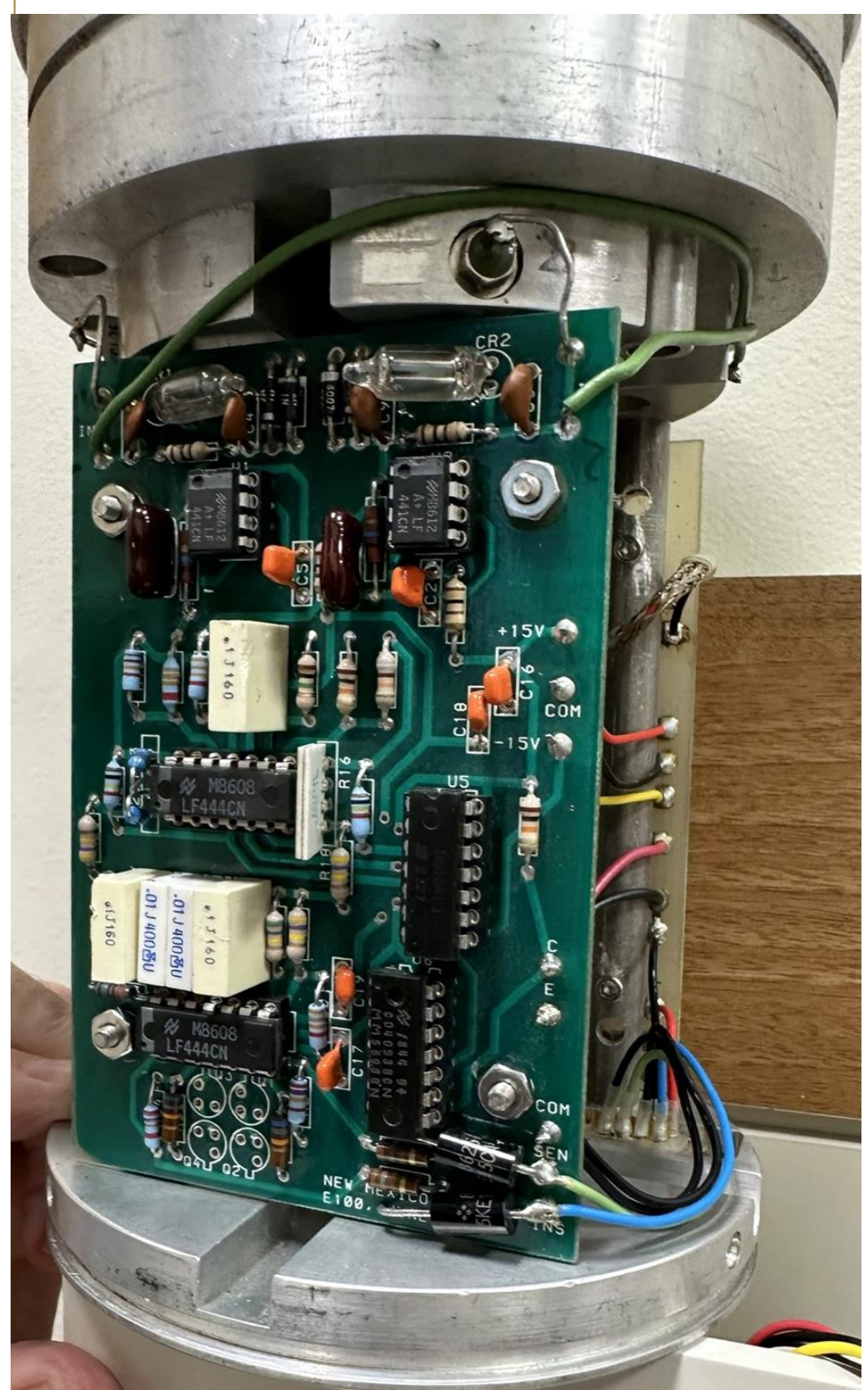
Project Requirements:
- Construct Electrostatic Field Mill
- Operates at 12V
- Measure Every Second and Record to an SD Card
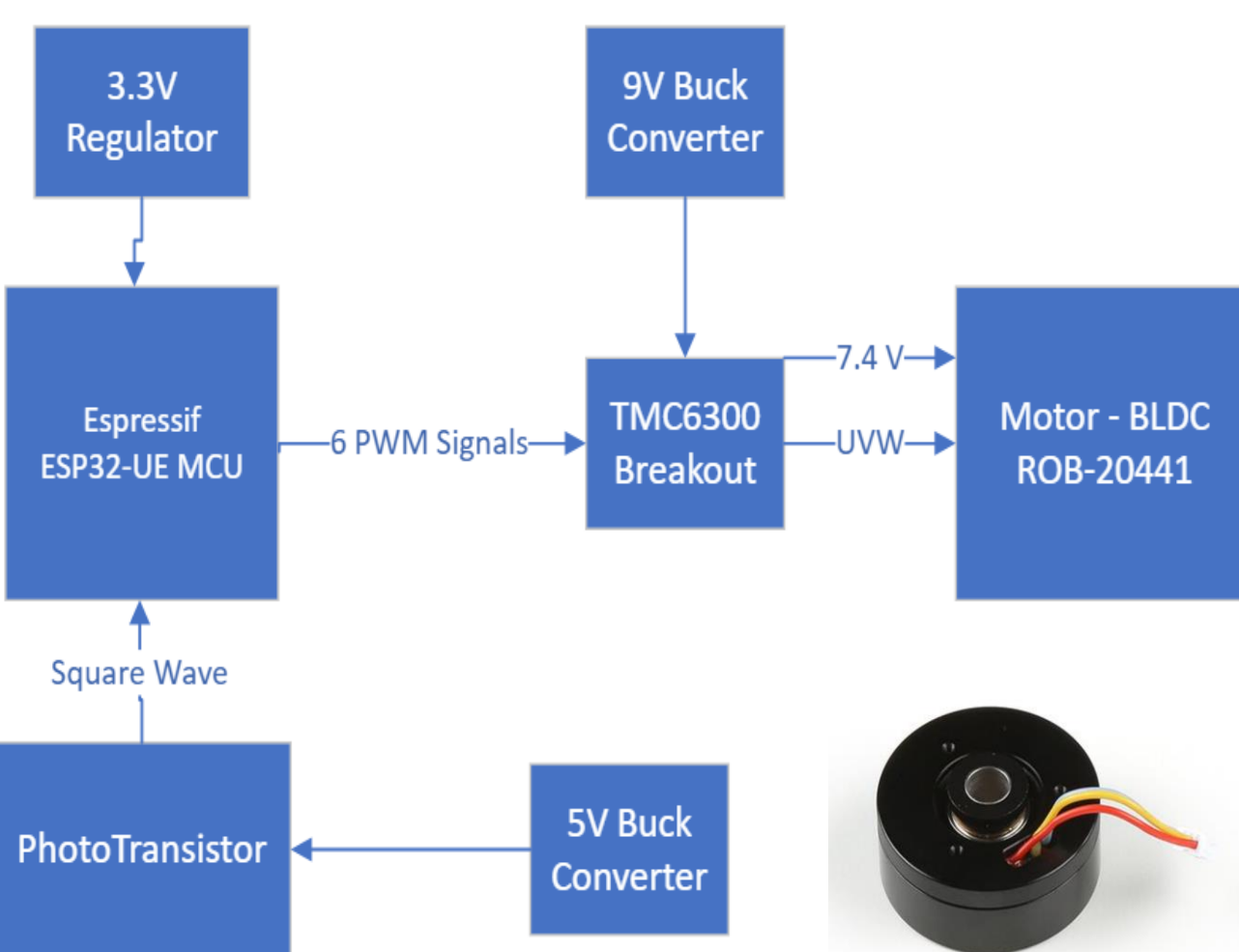- Calibrate Sensitivity and Characterize Accuracy

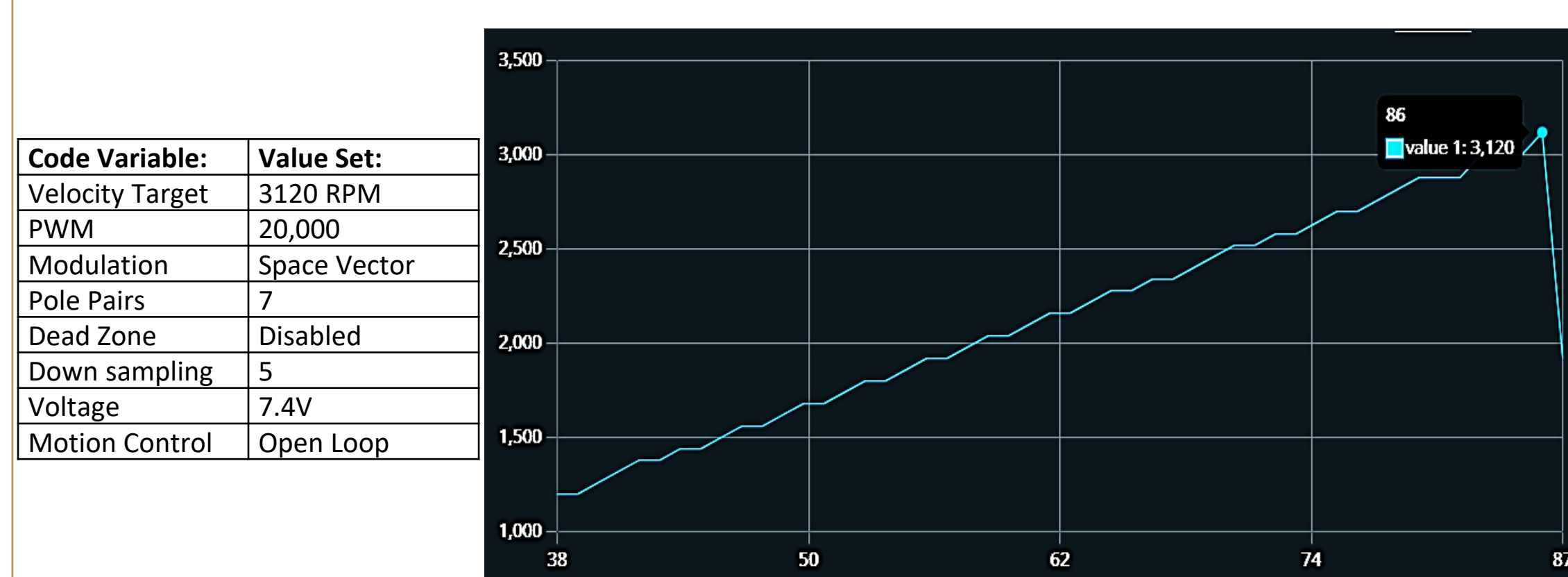### Project Expectations

Professional Product

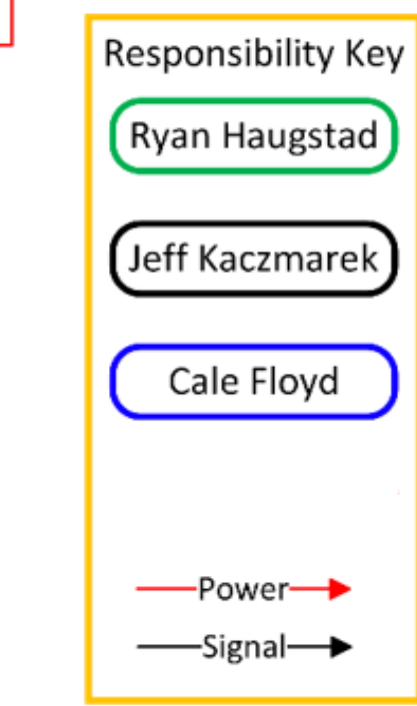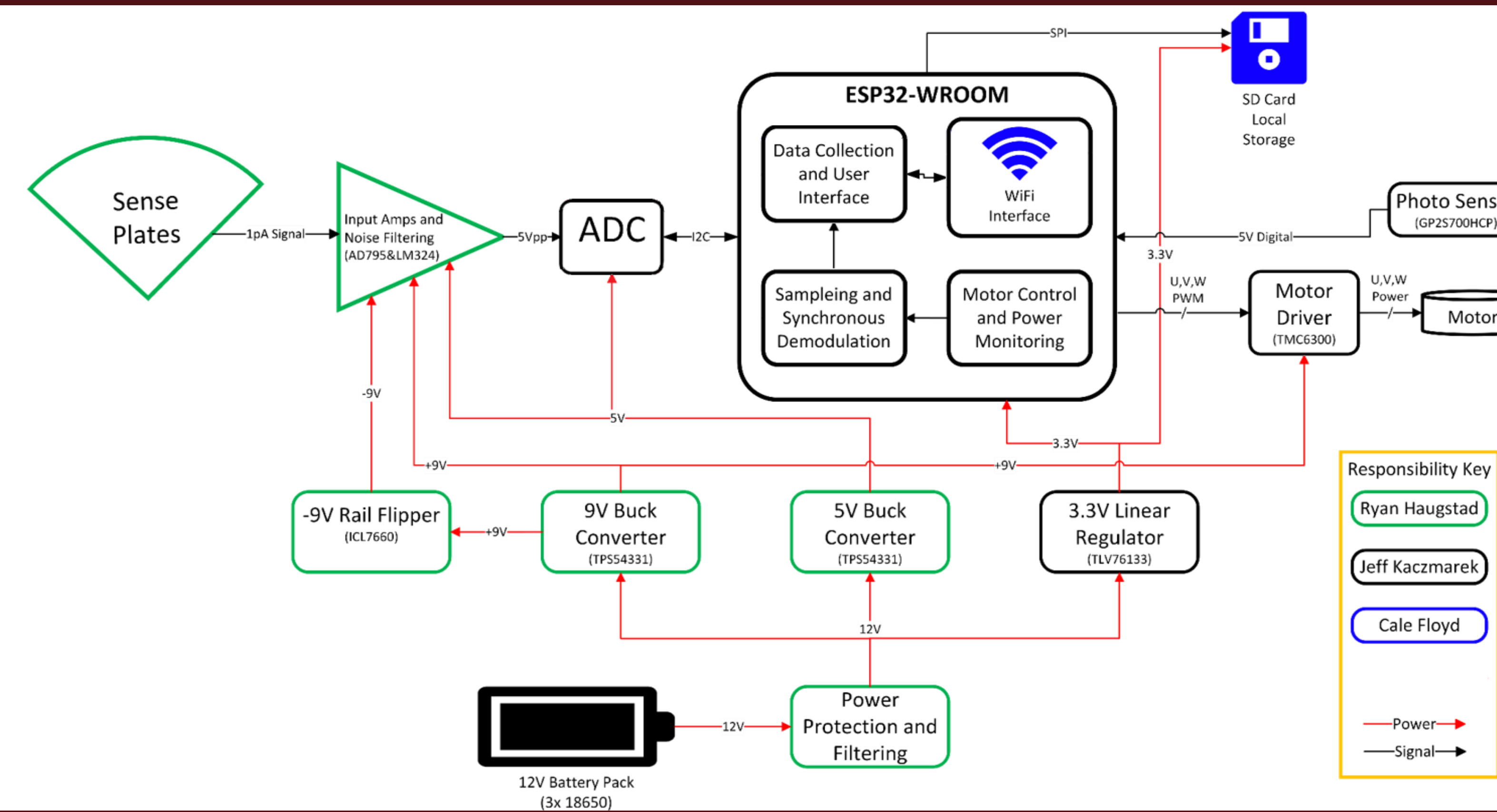**Texas State E2.06 Field Mill**

Motor and Phototransistor

- Brushless DC Motor (BLDC)
- Voltage/RPM Controlled Through TMC6300 Motor Driver
- Phototransistor Creates Square Wave Output from Motor Shaft

Code Variable:	Value Set:
Velocity Target	3120 RPM
PWM	20,000
Modulation	Space Vector
Pole Pairs	7
Dead Zone	Disabled
Down sampling	5
Voltage	7.4V
Motion Control	Open Loop

Block Diagram

ESP32-WROOM

Responsibility Key
- Ryan Haugstad
- Jeff Kaczmarek
- Cale Floyd
- Power
- Signal

Printed Circuit Assembly

Printed Circuit Board

- Full Surface Mount Design
- Flexible Build Options
- Efficient Power Supply Enables Longer Battery Life
- Dual Input Stages For Increased Sensitivity
- SD Card Data Storage
- WiFi Server Enabled

Analog Front End

- Extremely Low Leakage ESD Input Protection Diodes
- Low Noise Signal Amplification, 1pA Input Bias Current For Maximum Sensitivity.
- 70dBΩ + 54dB Overall Gain Enables Fair Weather Field Measurement
- 2 Pole Low Pass Filter For Greater Noise Rejection

Input ESD Protection | Transimpedance Amplifier | Gain Stages | Active Low-Pass Filter

Power

- Battery has 6000 mAh
- Runs at ~1A
- Should last 5-10 hours in the field

Meet the Team

Jeff Kaczmarek	Ryan Haugstad	Cale Floyd

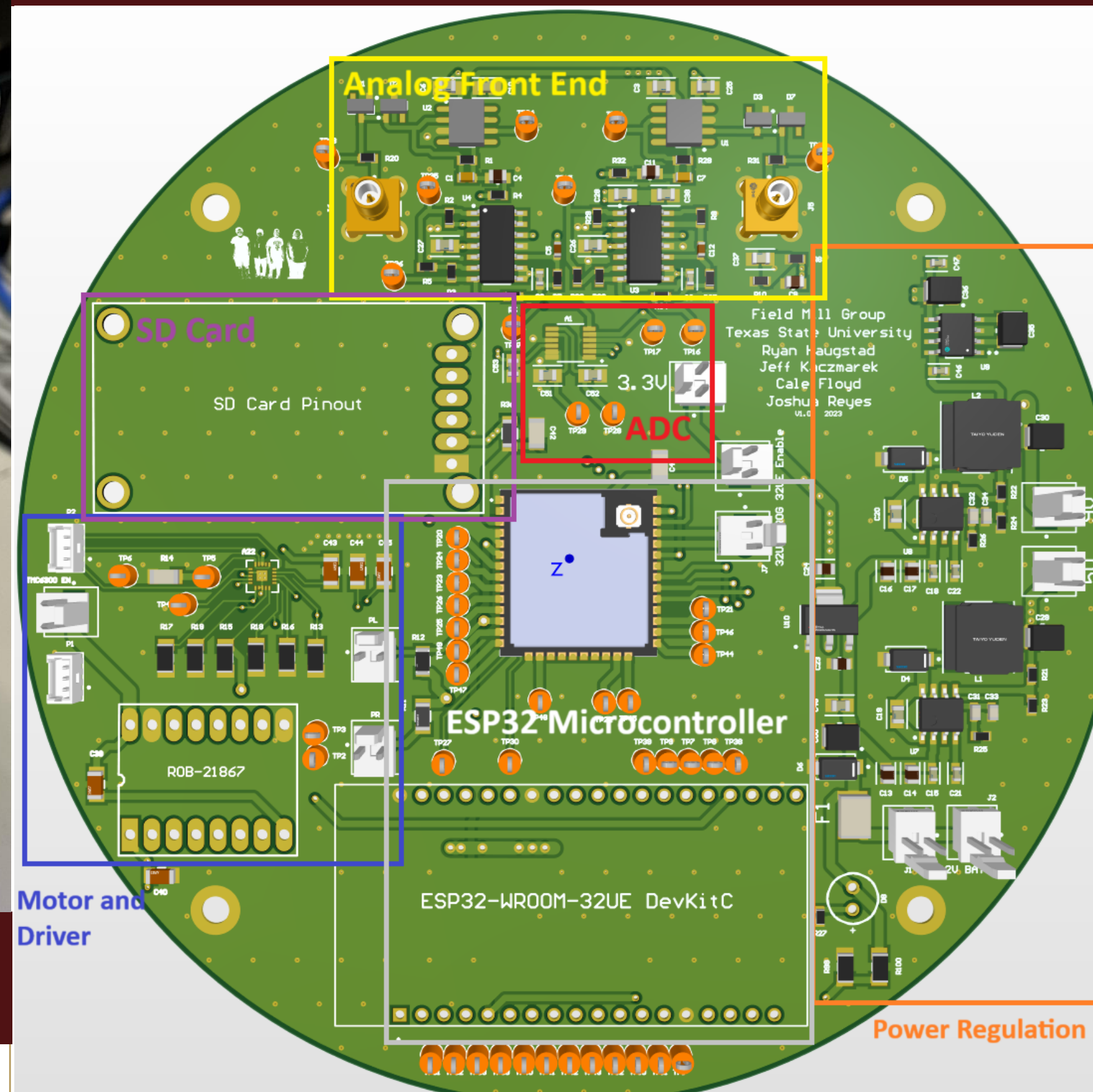## Subsystems

Jeff Kaczmarek - Project Manager, Motor and Sensors, PCB, Power, Wireless Server, Digital Conversion and Synchronous Demodulation

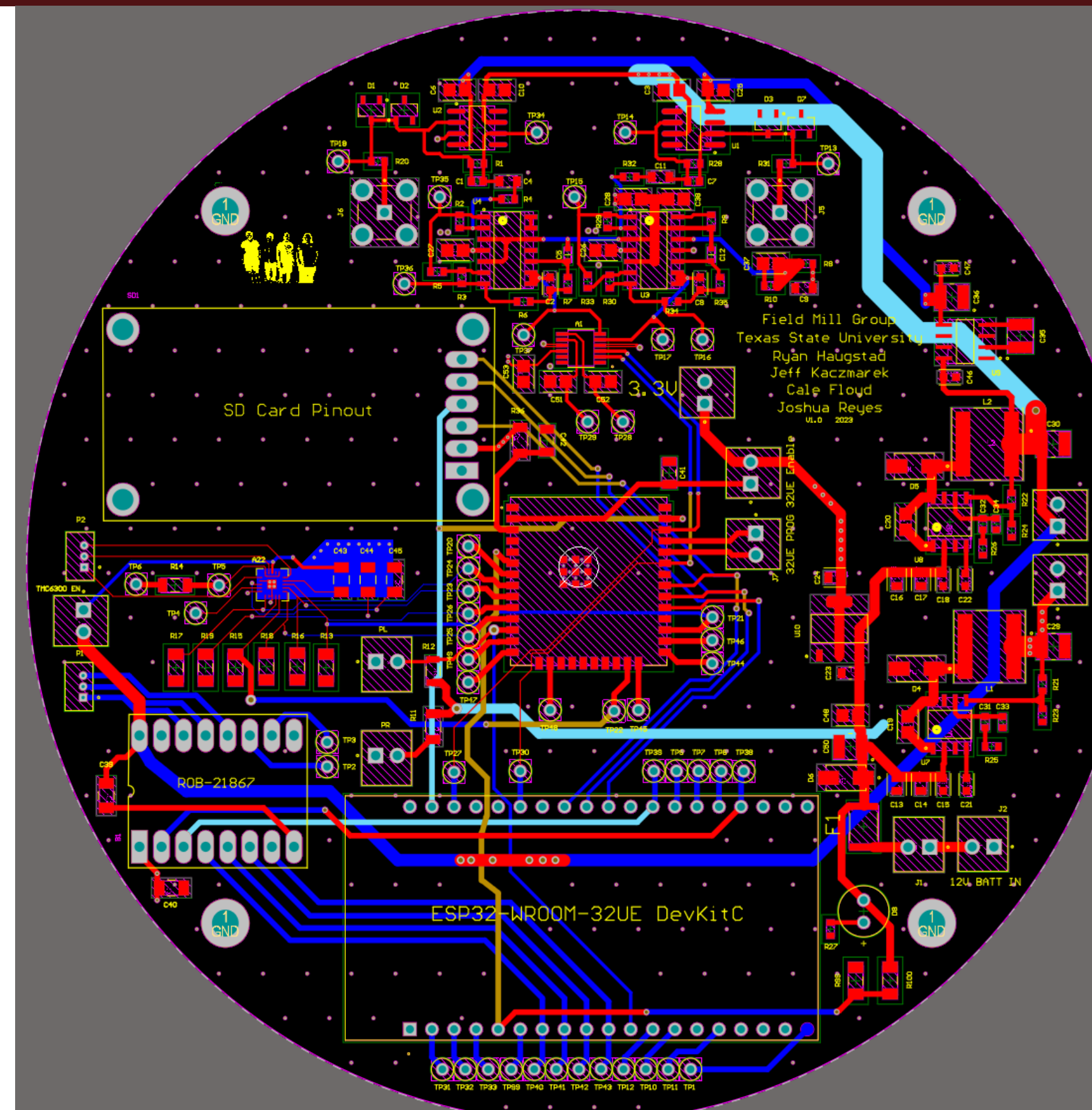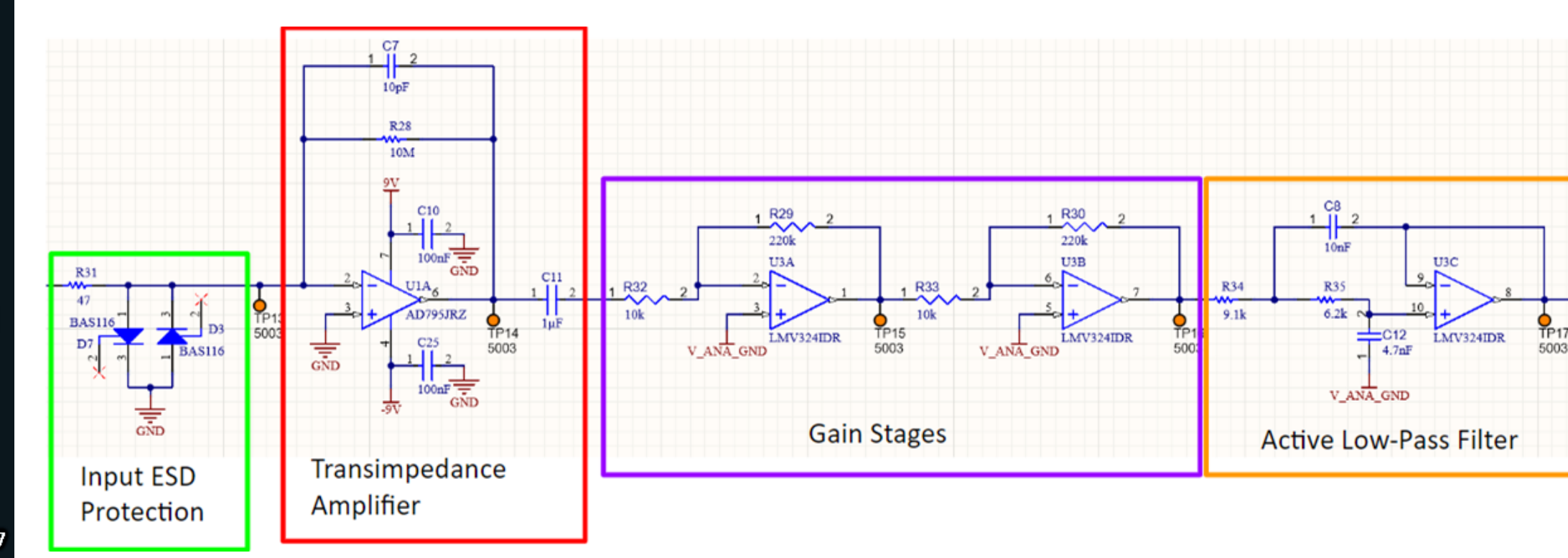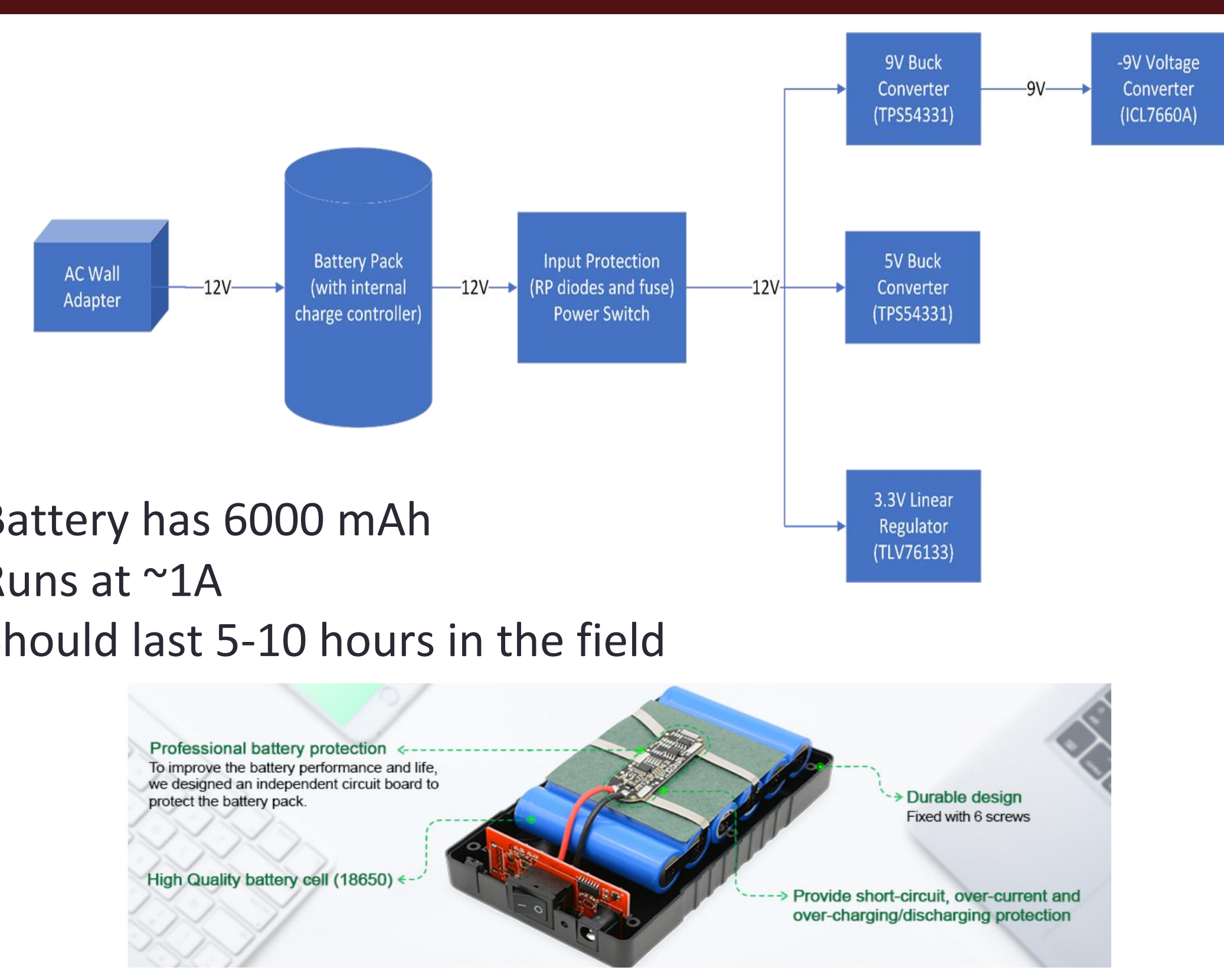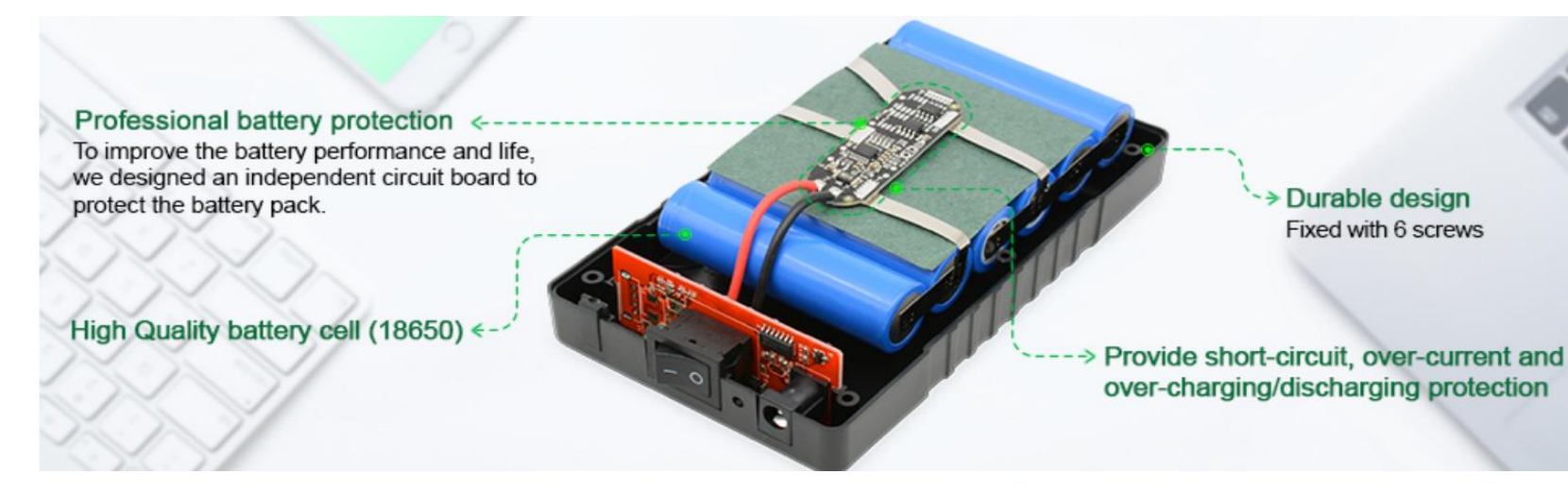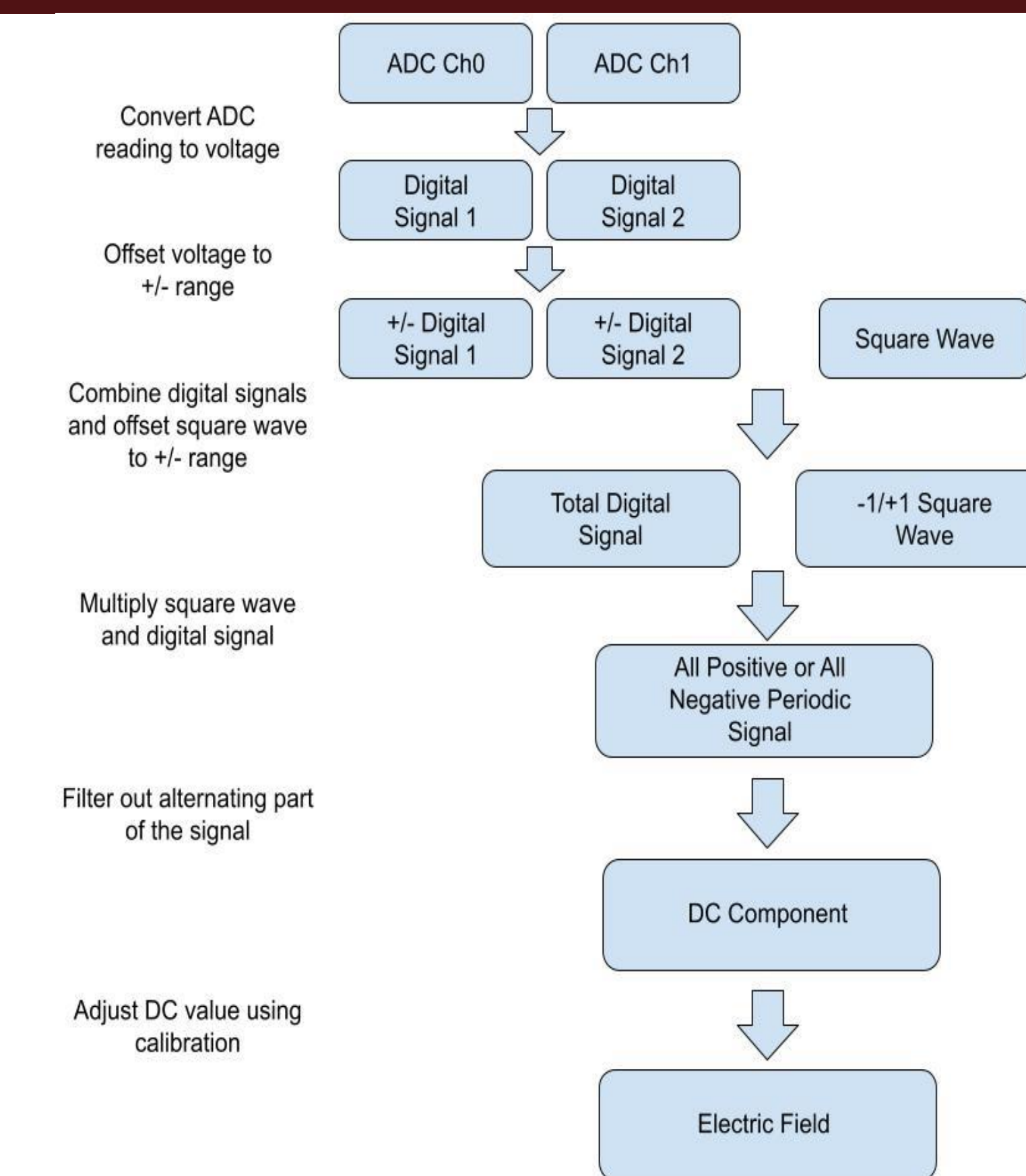**Ryan Haugstad** - Analog Front End, PCB and Power, Structure

Cale Floyd - Data Output and Storage

Synchronous Demodulation

- 12-bit resolution
- Dual Channel
- Chopper blades create square wave
- Square wave fully rectifies sine wave inputs
- Rectified output then changes with polarity of input

Data Storage

- 32GB MicroSD
- MicroSD Card Adapter Breakout Board
- Stored as a .csv timestamped file