E1.06 – Field Mill

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Description

- Field Mills are used to predict lightning in a general area. 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.
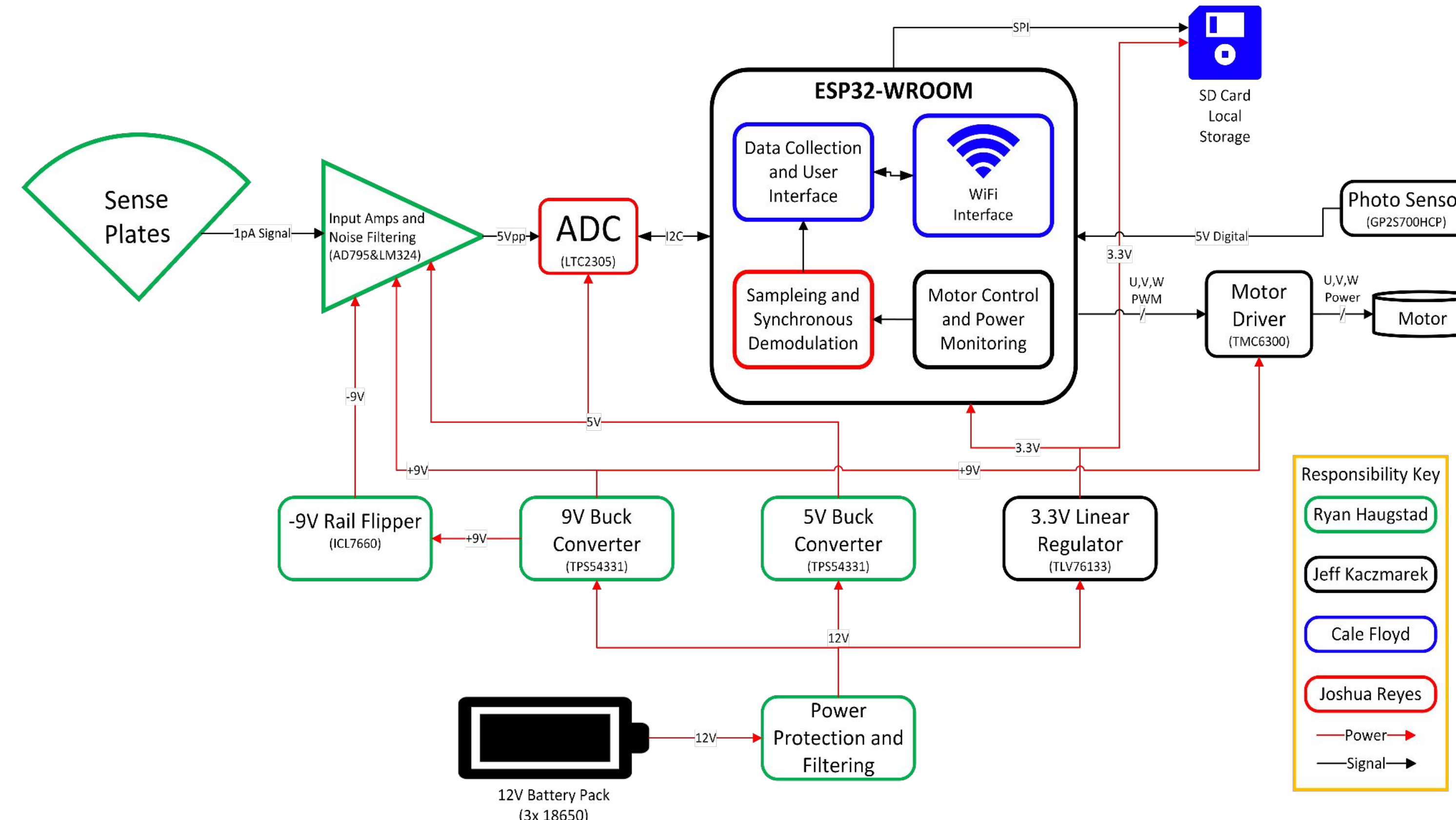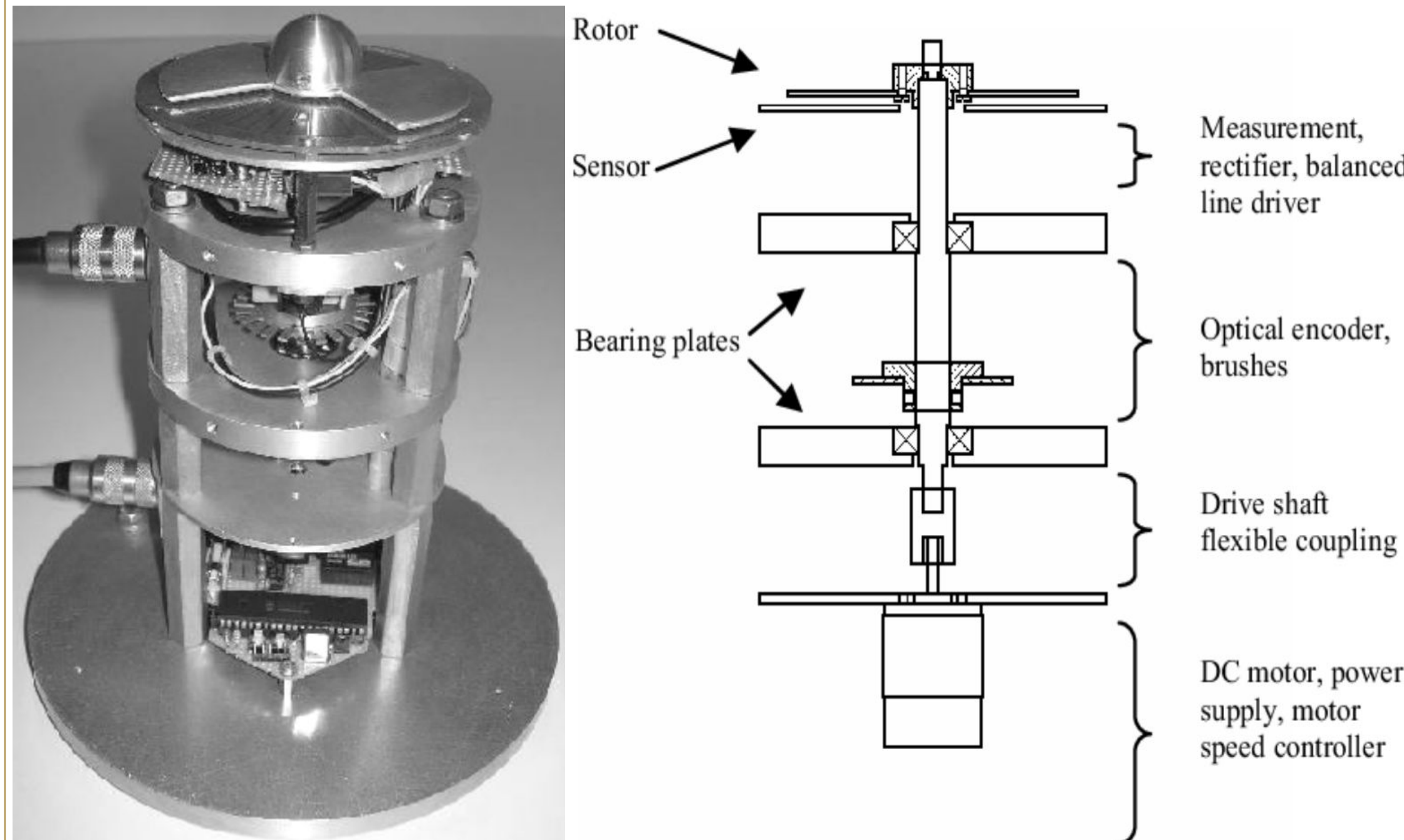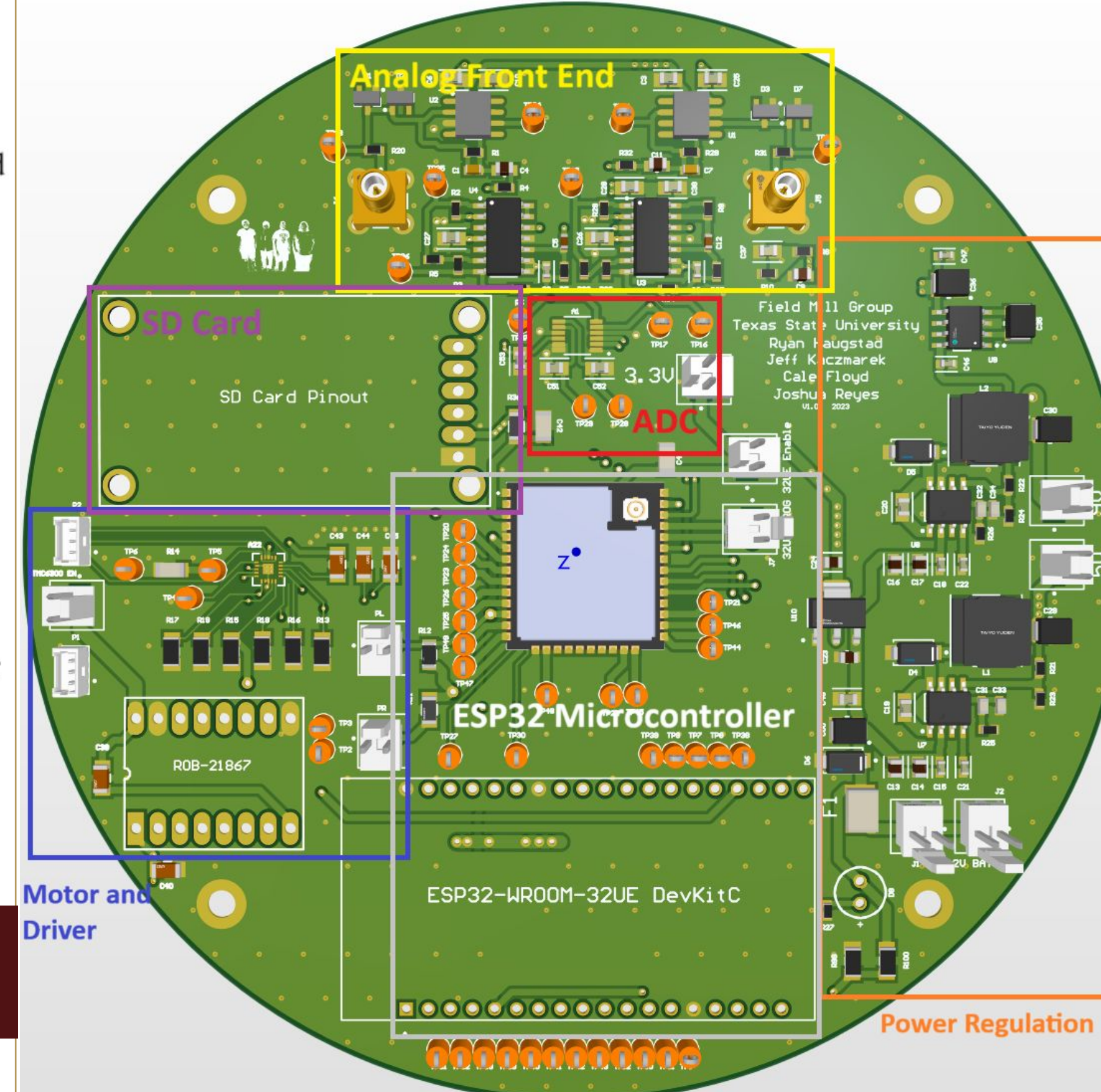
Project Requirements

- Construct Electrostatic Field Mill
- Operates at 12V
- Measure Every Second and Record to an SD Card
- Calibrate Sensitivity and Characterize Accuracy

Motor and Phototransistor

6 PWM Signals

- Brushless DC Motor (BLDC)
- Voltage/RPM Controlled Through TMC6300 Motor Driver
- Phototransistor Limited to 3mm
- Phototransistor Creates Square Wave Output from Motor Shaft

Block Diagram

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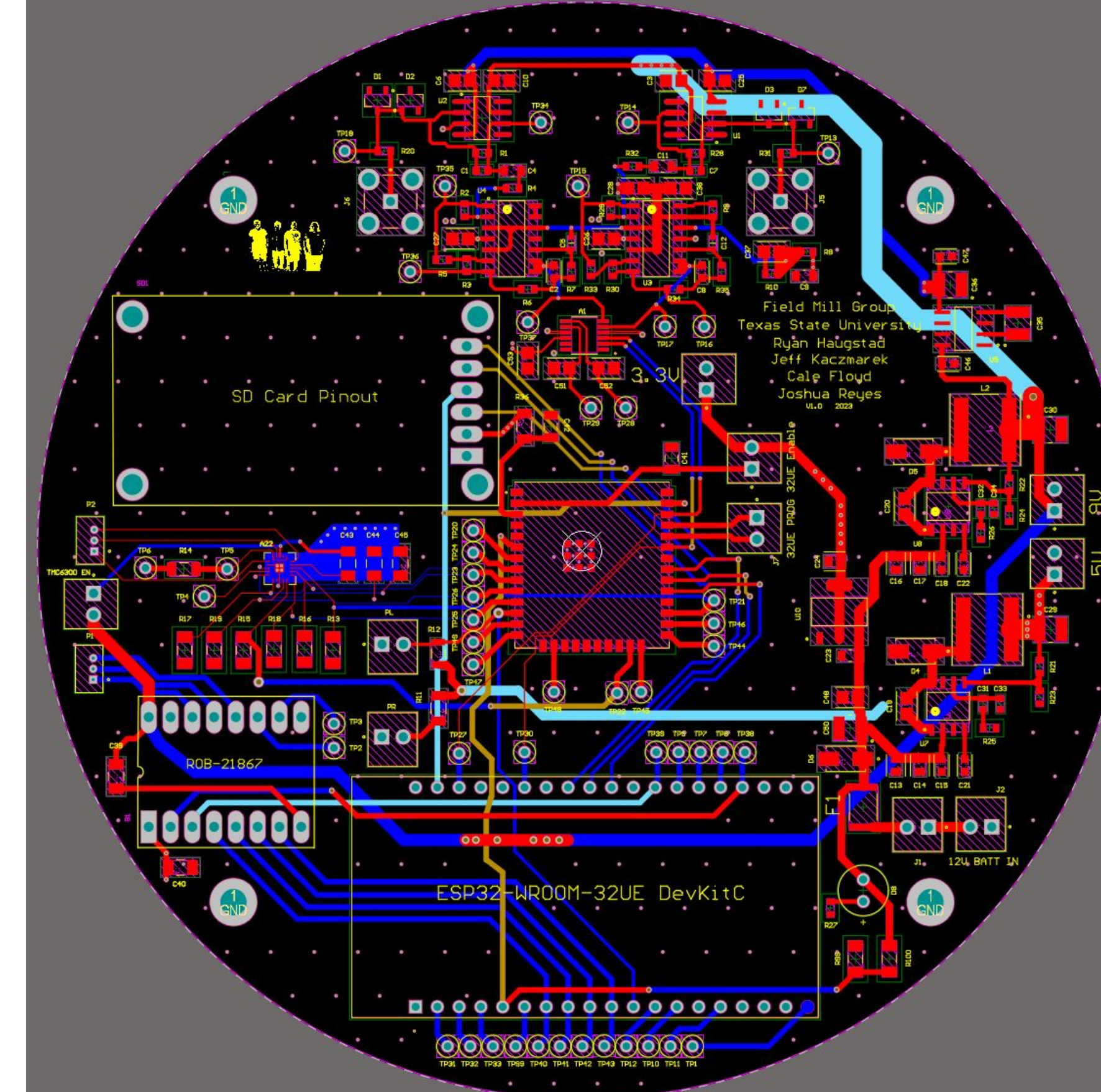- Cale Floyd
- Joshua Reyes
- Power
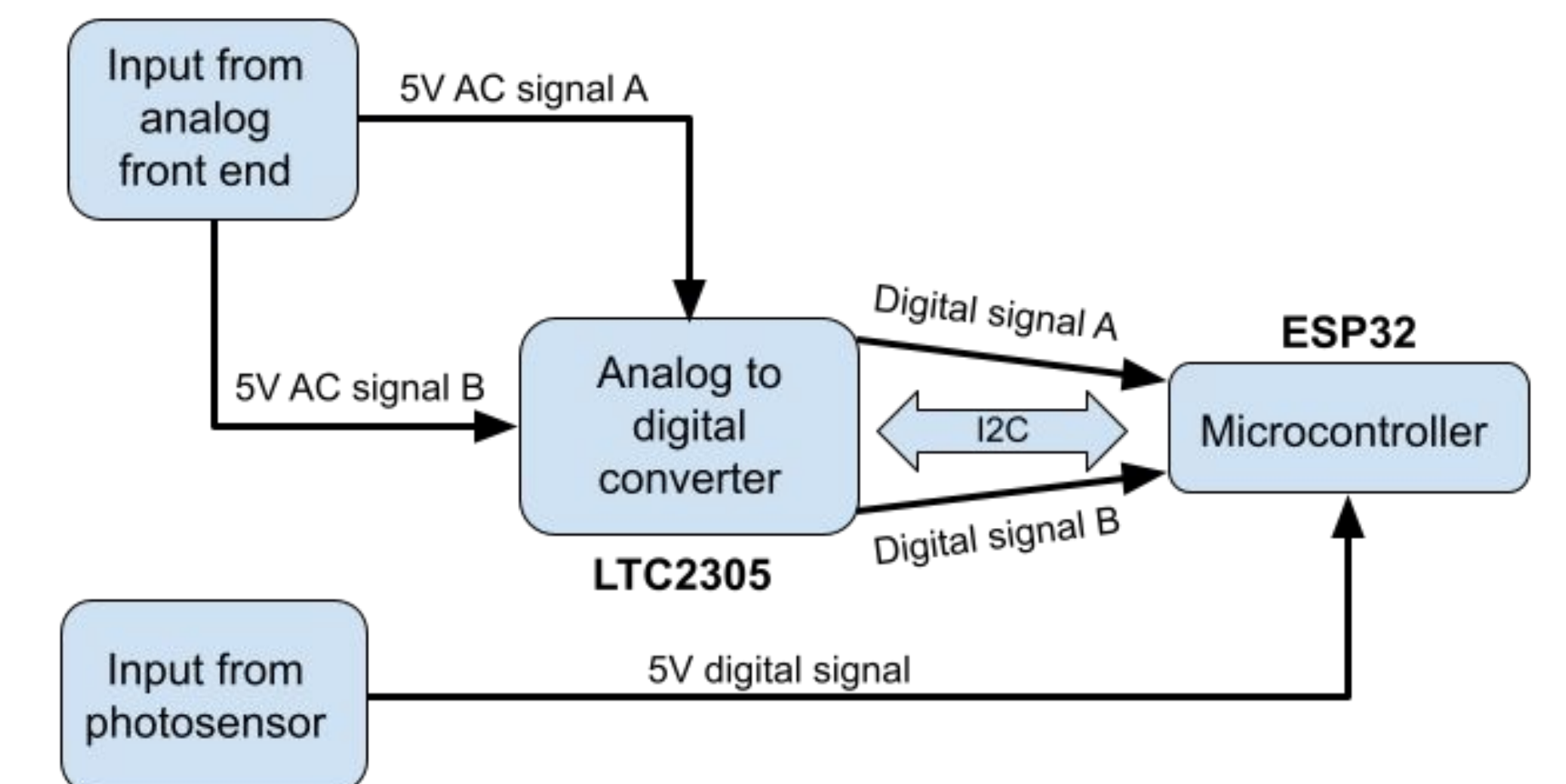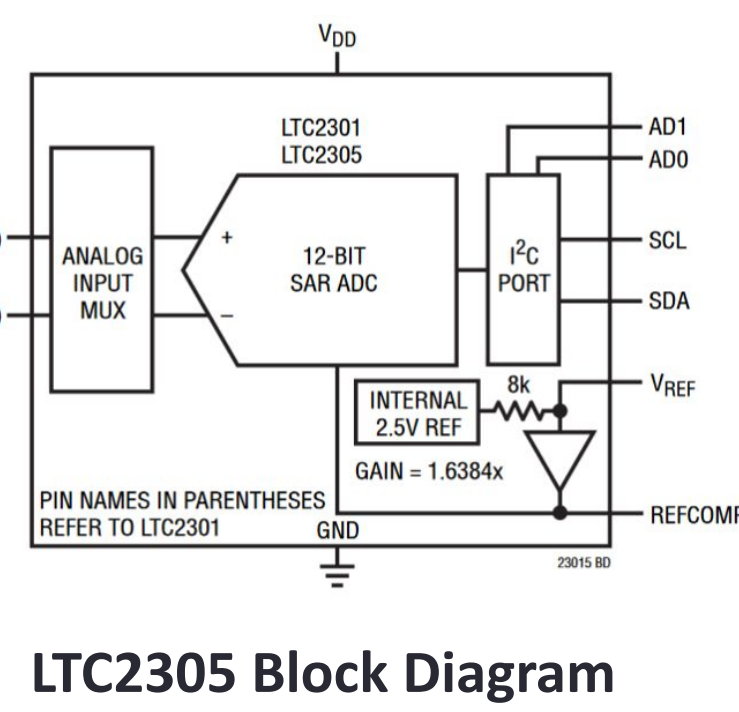- Signal

3D Field Mill PCB

- Fully Surface Mount Design For Compactness
- Flexible Build Options
- Efficient Power Supplies Enables Long Battery Life
- Dual Input Stages For Increased Sensitivity
- SD Card Data Storage
- WiFi Server Enabled

2D Field Mill PCB

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

Power

- Highly Efficient Buck Converters Provide Roughly 12 Hour Run Time
- Low Power Components
- Battery has 3800 mAh

Meet the Team

| Jeff Kaczmarek | Joshua Reyes | Ryan Haugstad | Cale Floyd |

D2 Expectations

- Enclosure Completed by MFGE Team
- All SubSystems Complete and Installed in Enclosure
- Characterization, Power Tests, and Calibration Complete
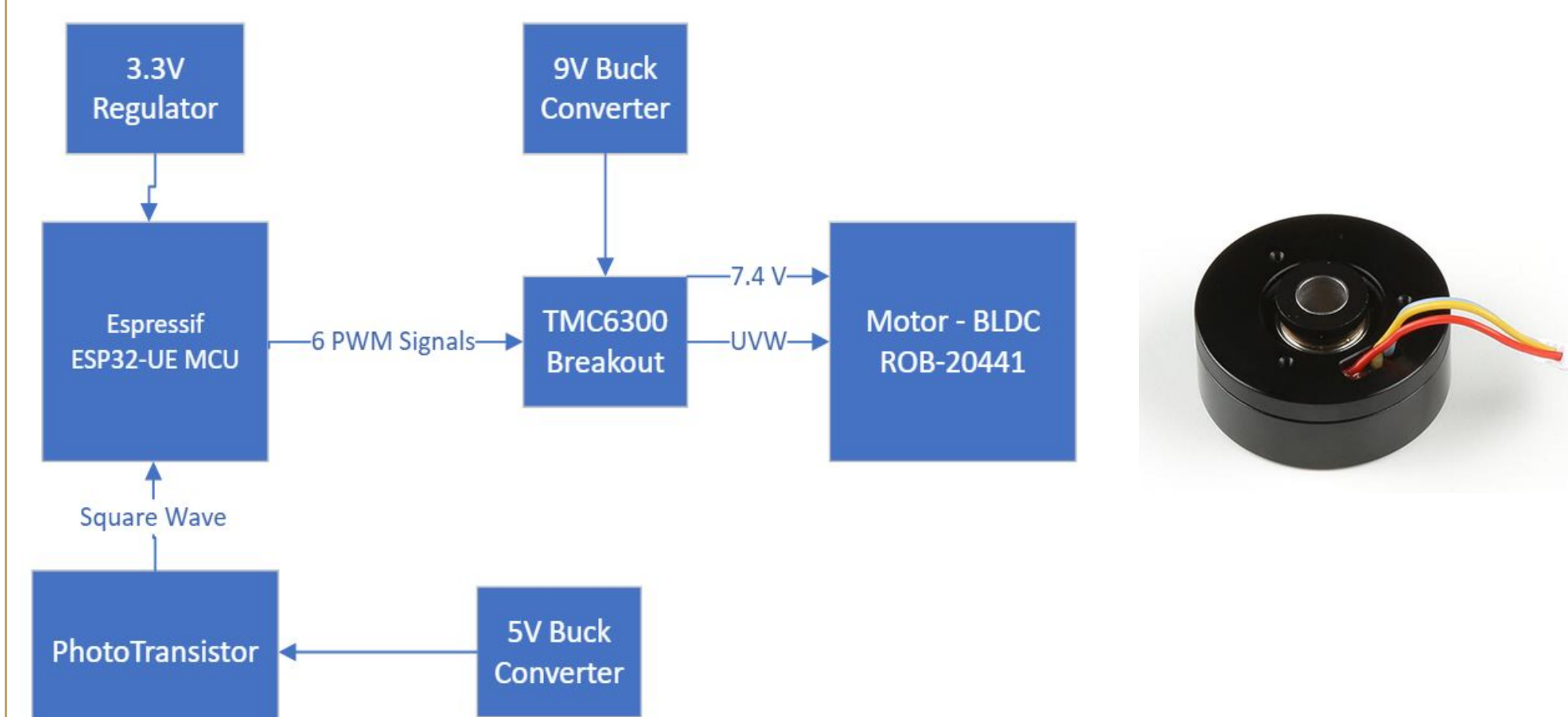- ESP32 Server Outputs Electric Field Data Over WiFi

Digital Signal Processing

- LTC2305 Analog to Digital Converter (ADC)
- 12-bit resolution vs 8-bit microcontroller built-in ADC
- I2C communication between ADC and microcontroller
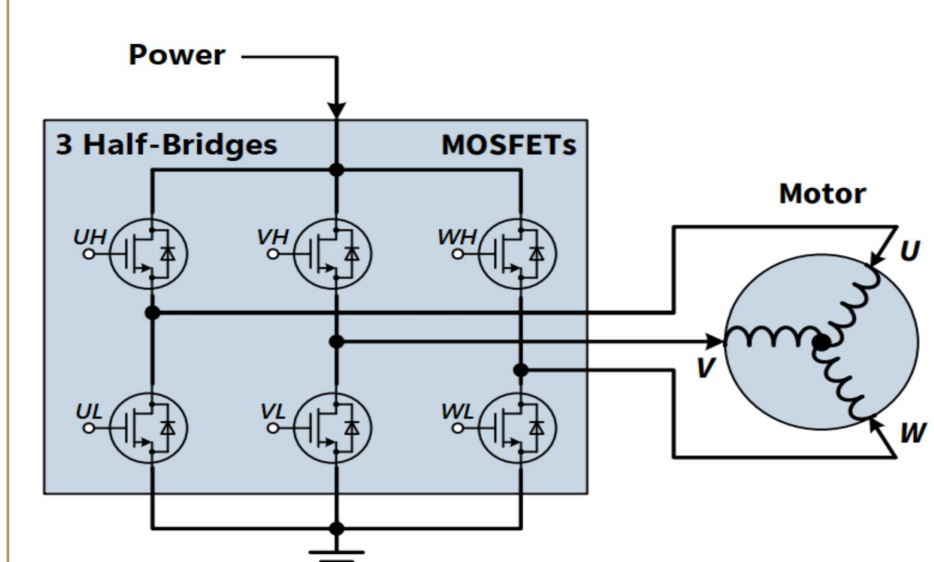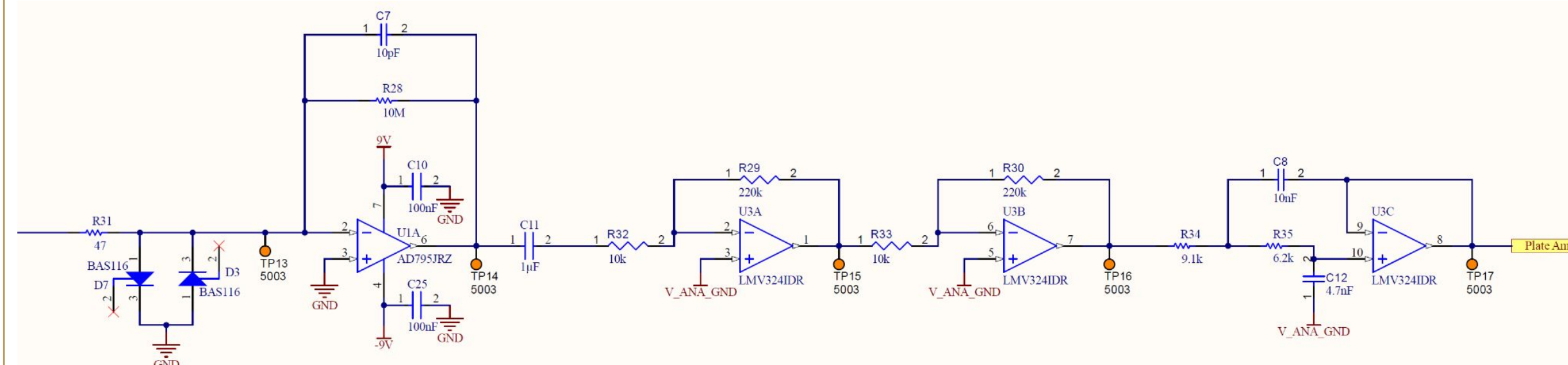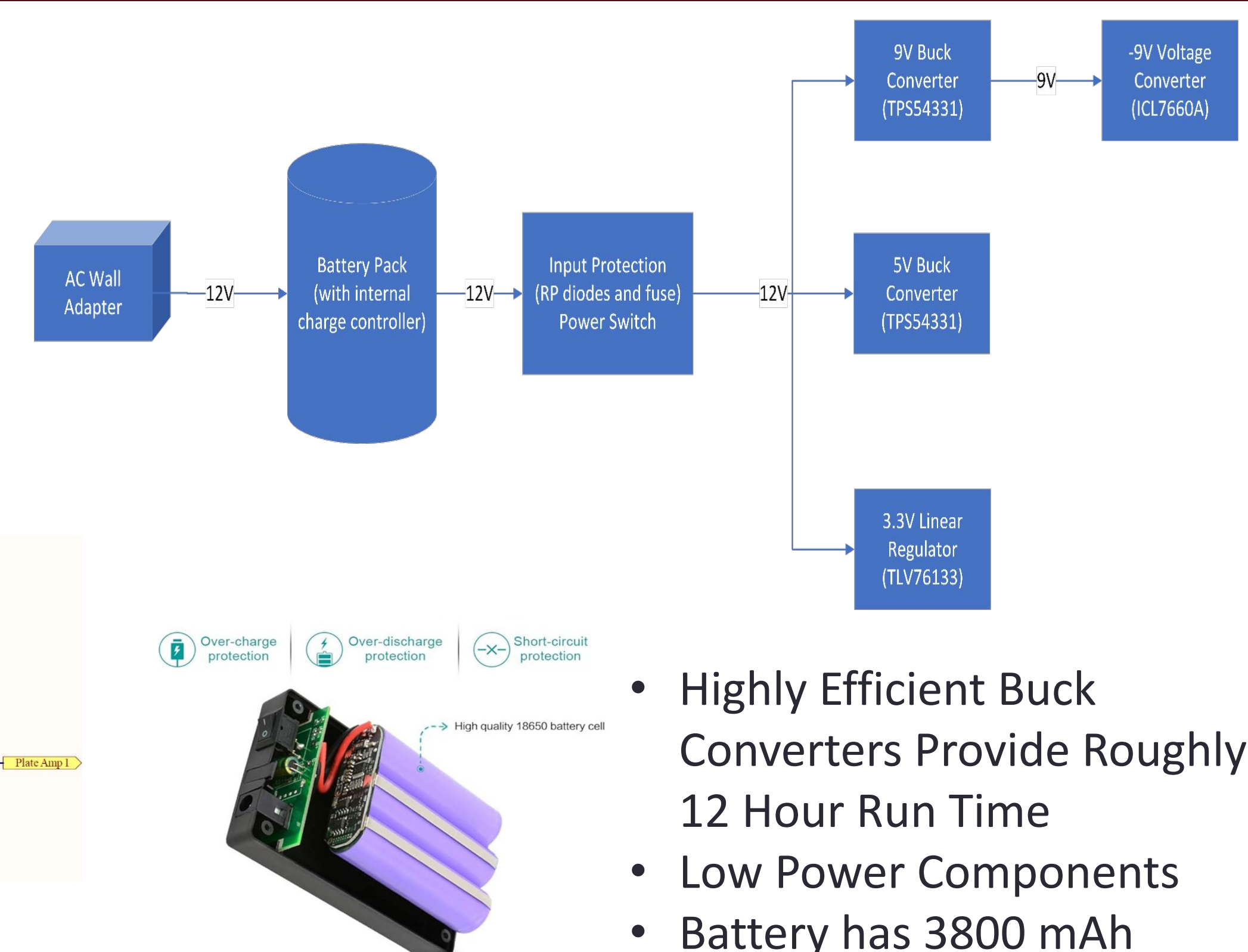- Demodulate ADC signal with square wave from photoresistor

LTC2305 Block Diagram

Data Acquisition

- 32GB MicroSD
- MicroSD Card Adapter Breakout Board
- Wifi Adapter
- Exported .CSV and Real-Time Graphical Data