Marine and Naval Technological Advancements for Robotic AutonomY (MANTA RAY) Health Monitoring for Autonomous Surface Vehicle (ASV)

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Team MANTA RAY Mission

Team MANTA RAY is an interdisciplinary project dedicated to creating, maintaining, and expanding a network of marine robots for seafloor mapping and underwater perception. The network began as just the Autonomous Surface Vehicle (ASV) and Unpiloted Underwater Vehicle (UUV) but has expanded to include a prototype of the ASV, known as TUPPS, and two kinds of remotely operated vehicles, known as GUPPS and KRILL. With these systems, students work to improve communication between vehicles, develop autonomous behaviors and algorithms, and upgrade existing mechanical systems to improve precision and performance.

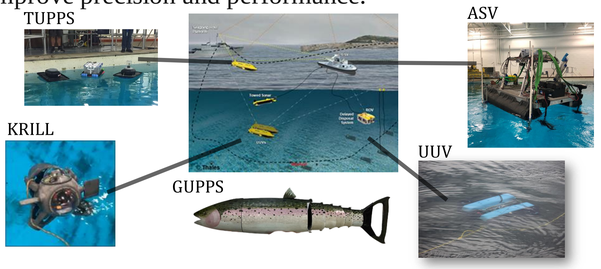


Figure 1: MANTARAY Mission

EE Mission

Problem: The ground station has no awareness of electrical conditions of the vehicle in the field

Solution: To transmit real time information on current, voltage, temperature, and battery conditions through existing communication channels

Circuit Design

- Temperature Sense:
  - OPA333AID
  - 9904F TMP61
- Current Sense:
  - TL031ACD
  - 2N3904
- Voltage Sense:
  - TL031ACD
  - 2N3904

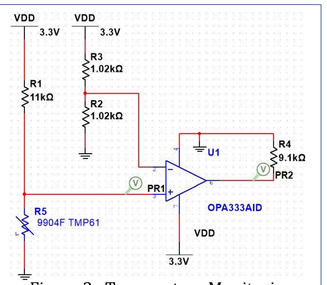


Figure 2: Temperature Monitoring

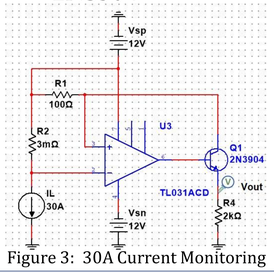


Figure 3: 30A Current Monitoring

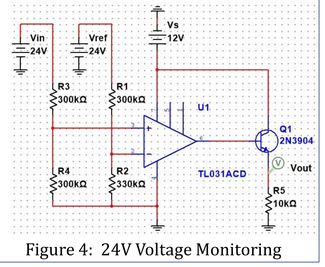


Figure 4: 24V Voltage Monitoring

Simulation and Test Results

Temperature Monitoring

- Voltage switches at approximately 38 °C

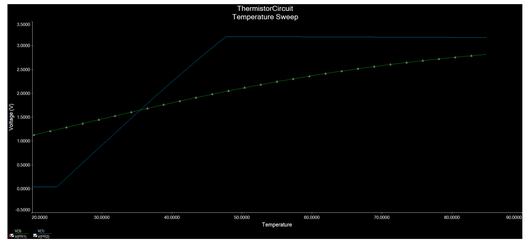
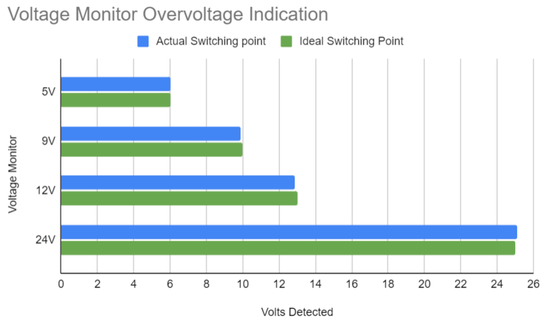


Figure 5: Temperature Sweep Simulation

Voltage Monitoring

- Indicates overvoltage conditions for 5, 9, 12, and, 24 volt supplies
- Voltage output switches from ~0.1 to 10V almost instantaneously for specified point



Current Monitoring

- Sensors designed for 30A and 100A max
- Volt reading linearly increases with current

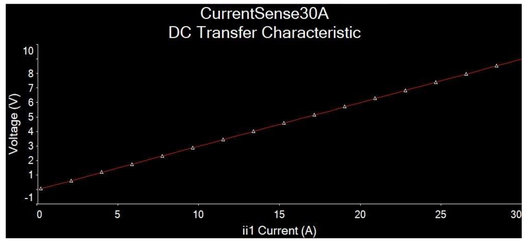


Figure 6: DC Current Sweep, 30A Sense Simulation

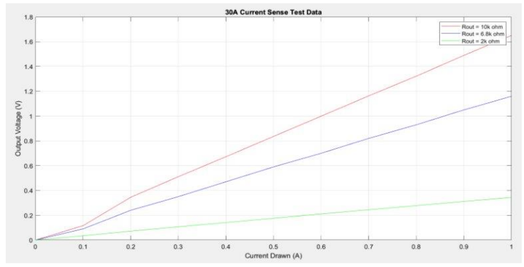


Figure 7: Current Sense Output Parameters Testing

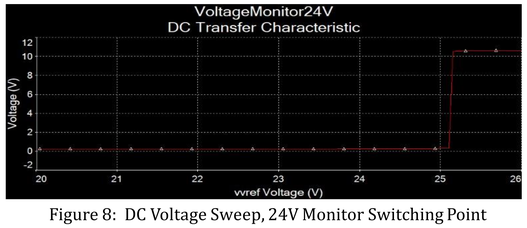


Figure 8: DC Voltage Sweep, 24V Monitor Switching Point

ASV Integration

Printed Circuit Boards

- Utilizes modular PCBs to measure either voltage, current, or temperature
- Mounting holes for installation into ASV

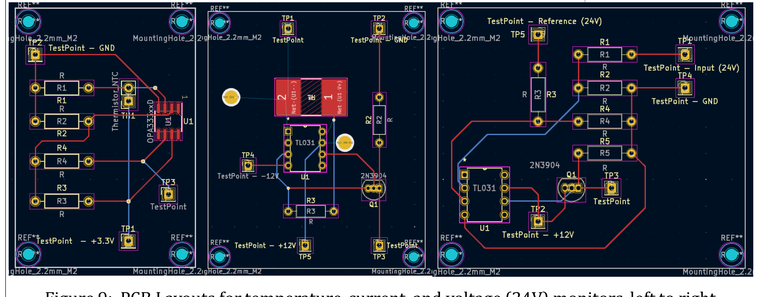


Figure 9: PCB Layouts for temperature, current, and voltage (24V) monitors, left to right

Real-Time Reading and Analysis

- Realized real-time voltage readings through Arduino's ADC

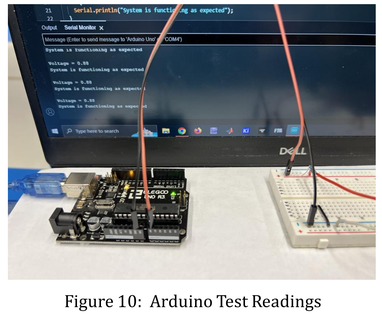


Figure 10: Arduino Test Readings

Objectives Accomplished

- Built voltage monitor PCBs to detect overvoltage conditions for 5, 9, 12, and 24V supplies
- Built temperature monitors to give advance warning of vehicle overheating and powering off
- Built current monitors for utilization in reading power consumption and motor current draw
- Interfaced with Arduino to organize data for transmission through Pixhawk
- Devised plan for current sense integration in ASV2 for battery monitoring

Future Plans

- Fully Integrate monitor systems into the ASV2, UUV, Krill, and other MANTA RAY vehicles.
- Further optimize PCB designs around new generation of vehicles
- Address power consumption, battery level, and battery life through coulomb counting

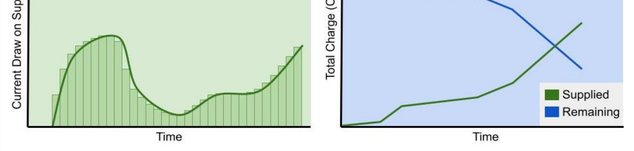


Figure 11: Coulomb Counting Through Current Monitoring Illustration

Acknowledgements

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