

Electric Vehicle Optimization Team 2

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Background

- Cabin electronics drain semi-truck batteries
- Cold weather conditions reduce battery output
- Hotel System of Charging

- Sponsor presented the design team with two major problems:
 - Current range is unsatisfactory
 - Cannot operate in -29°C (-20°F)

Goal Statement:

- “To increase the current range and operable conditions of the electric vehicle by utilizing a secondary power source in efforts to apply this to semi-trucks.”

Objectives

- Increase the lower temperature limit to -29°C
- Document current system
- Incorporate generator
- Integrate a battery monitoring system
- Model design for ISX-15 diesel engine.
- Ensure the vehicle can charge while running.

System Diagram

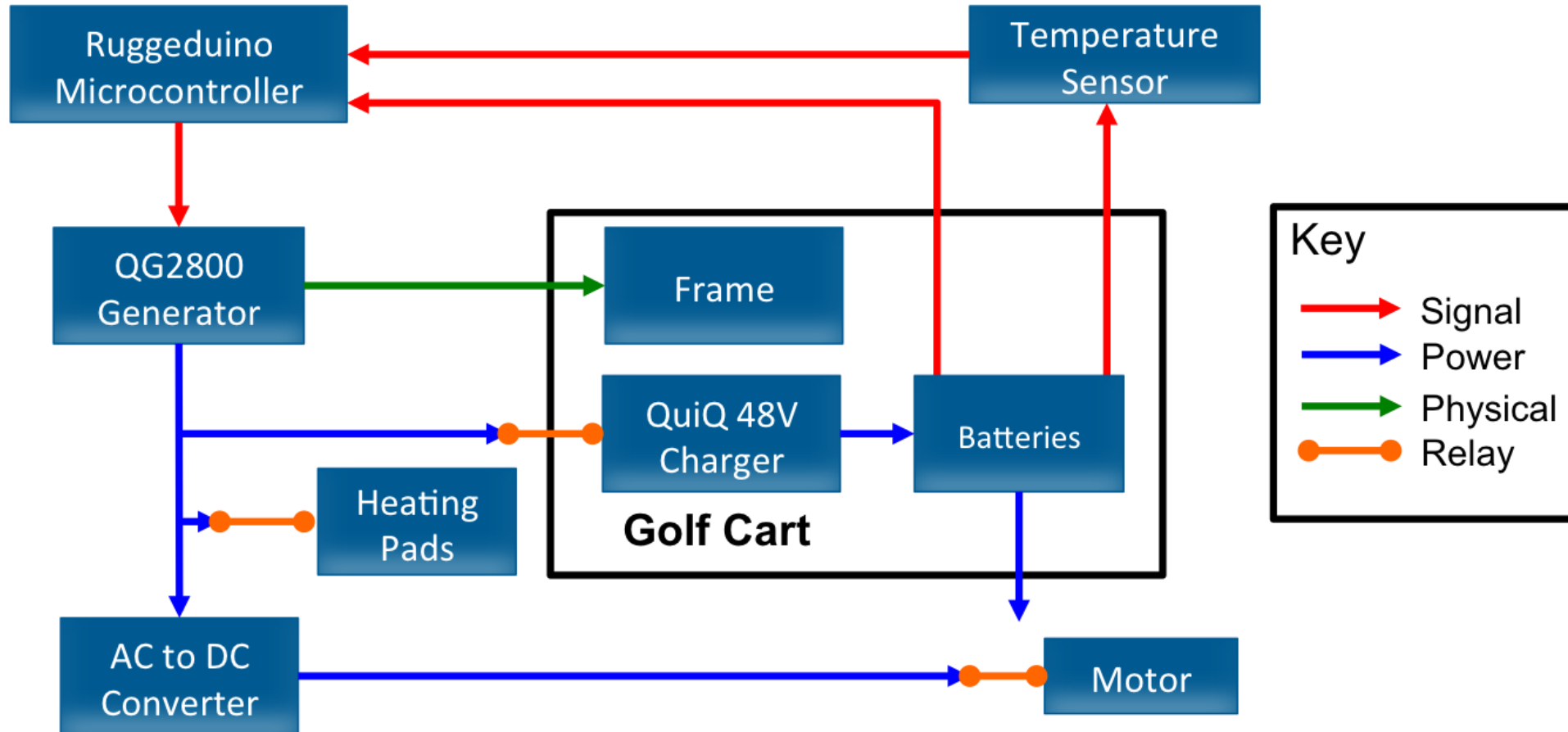


Figure X: Simplified system diagram of intended design.

Propane Tank Mount

Generator Battery and Power Supply Mount

Power Supply Cap

Testing Conducted

- **Replace on board charger**
 - Fully charge batteries
 - Determine voltage vs. temperature of the batteries
 - More Testing Required

Voltage vs. Temperature Relationship

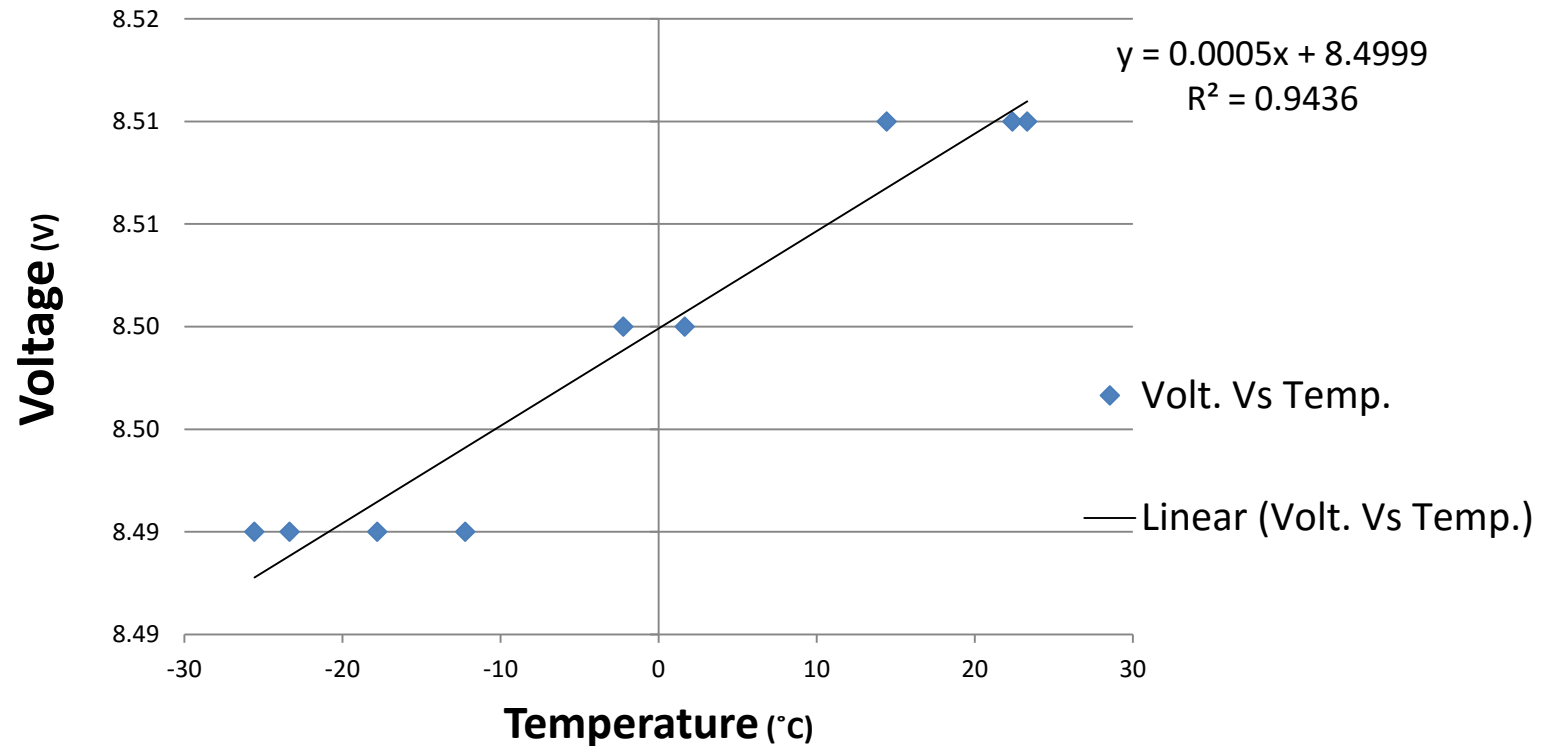


Figure X: Plot of the measured voltage of a charged battery at corresponding temperatures

Testing Conducted

■ Voltage Monitoring

- Typical Operating Voltages at RT
 - 0% Charge: 48V*
 - 100% Charge: 52V*
- Sensor Resolution: $\pm 0.06V$
- $\Delta 1\%$ Charge : 0.04V

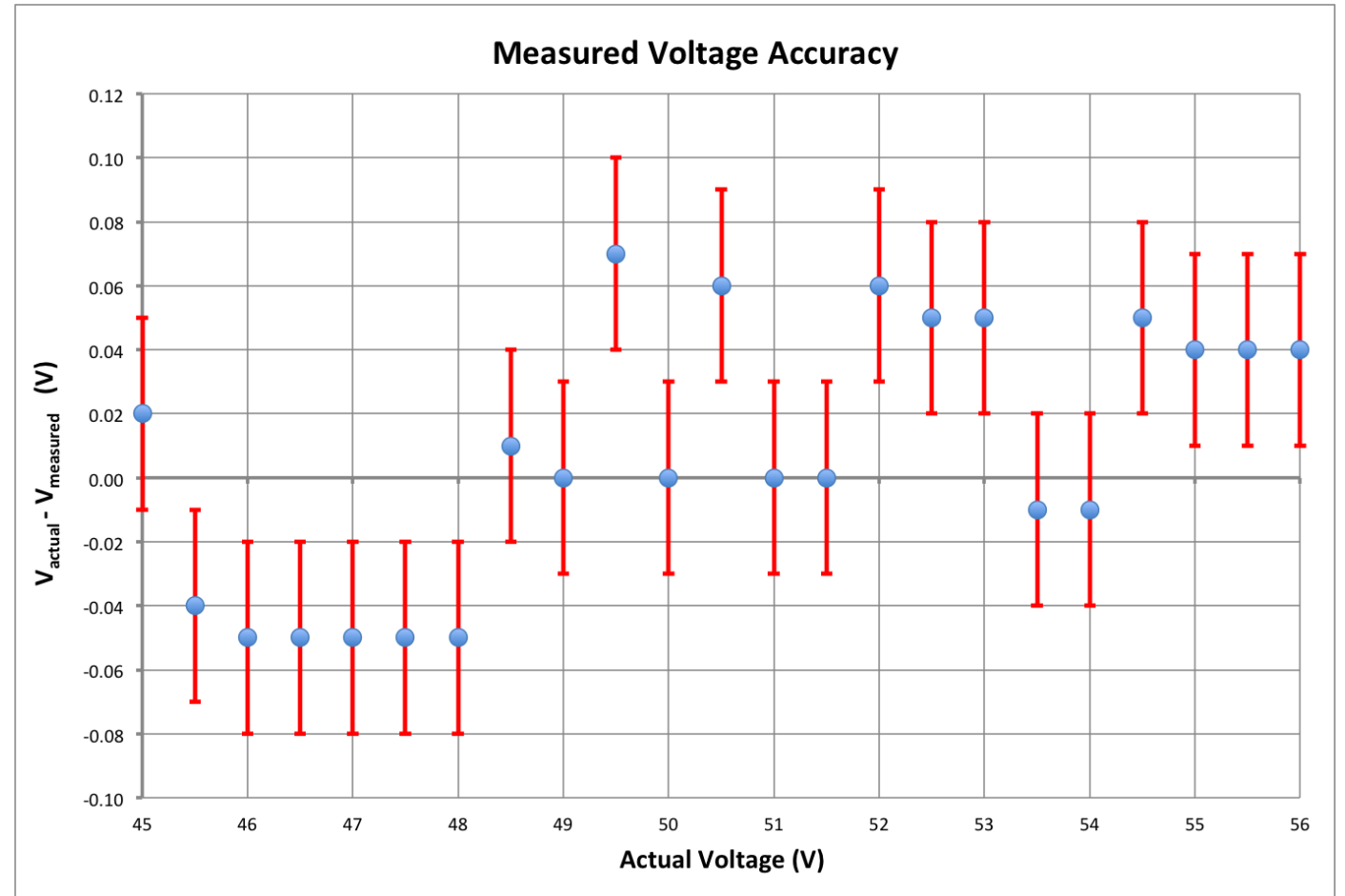


Figure X: Plot of the difference between the measured voltage and the actual voltage, with the error bars in red.

Testing Conducted

■ Current Monitoring

- Typical Charger Output Current
 - 3.5A - 18A
- Sensor Resolution: $\pm 0.1A$
- Additional Testing Required

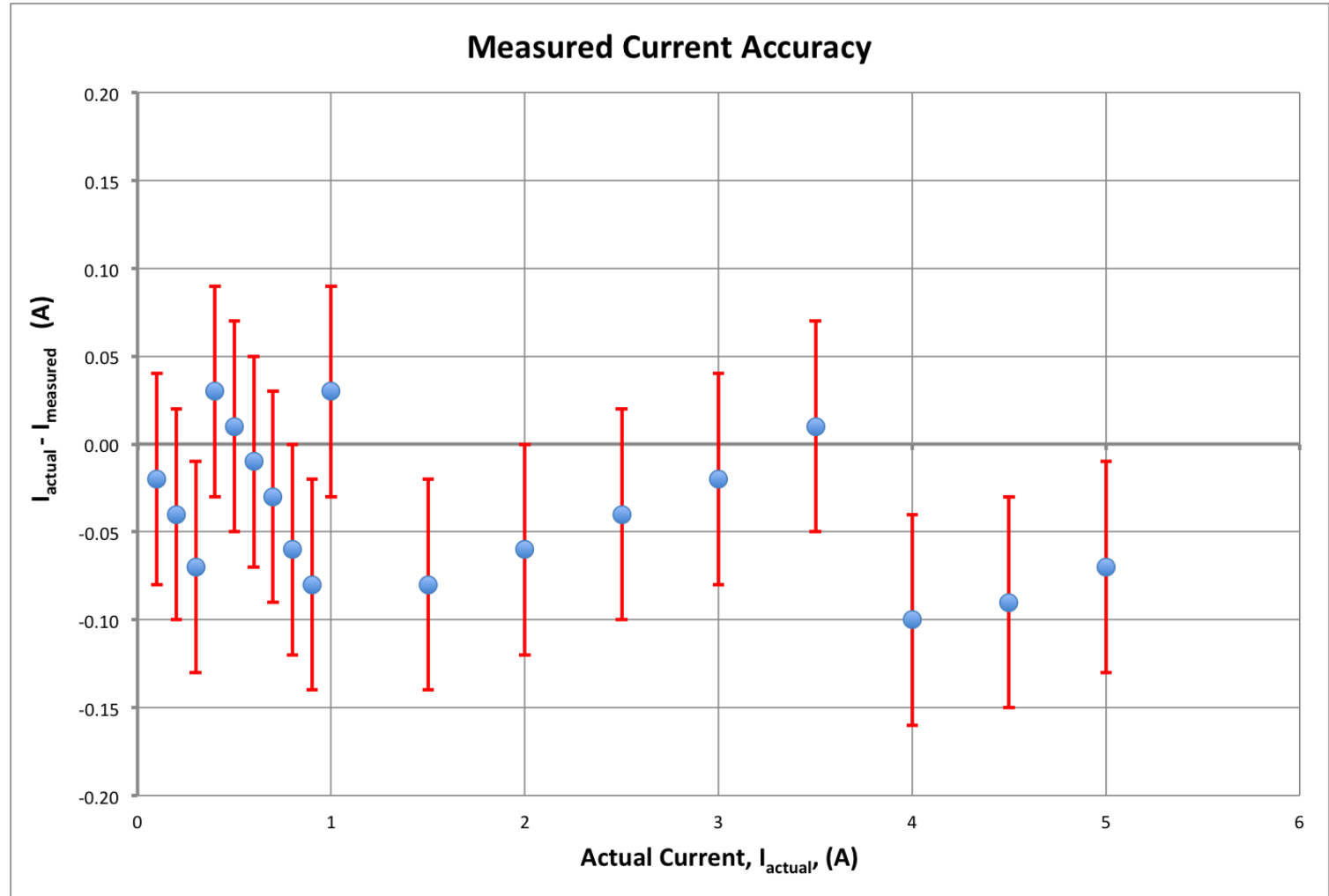


Figure X: Plot of the difference between the measured current and the actual voltage, with the error bars in red.

Testing Conducted

■ Temperature Monitoring

- Sensor Resolution: $\pm 2^{\circ}\text{C}$
- Slight increase in measured ambient temperature after exposed to cold.

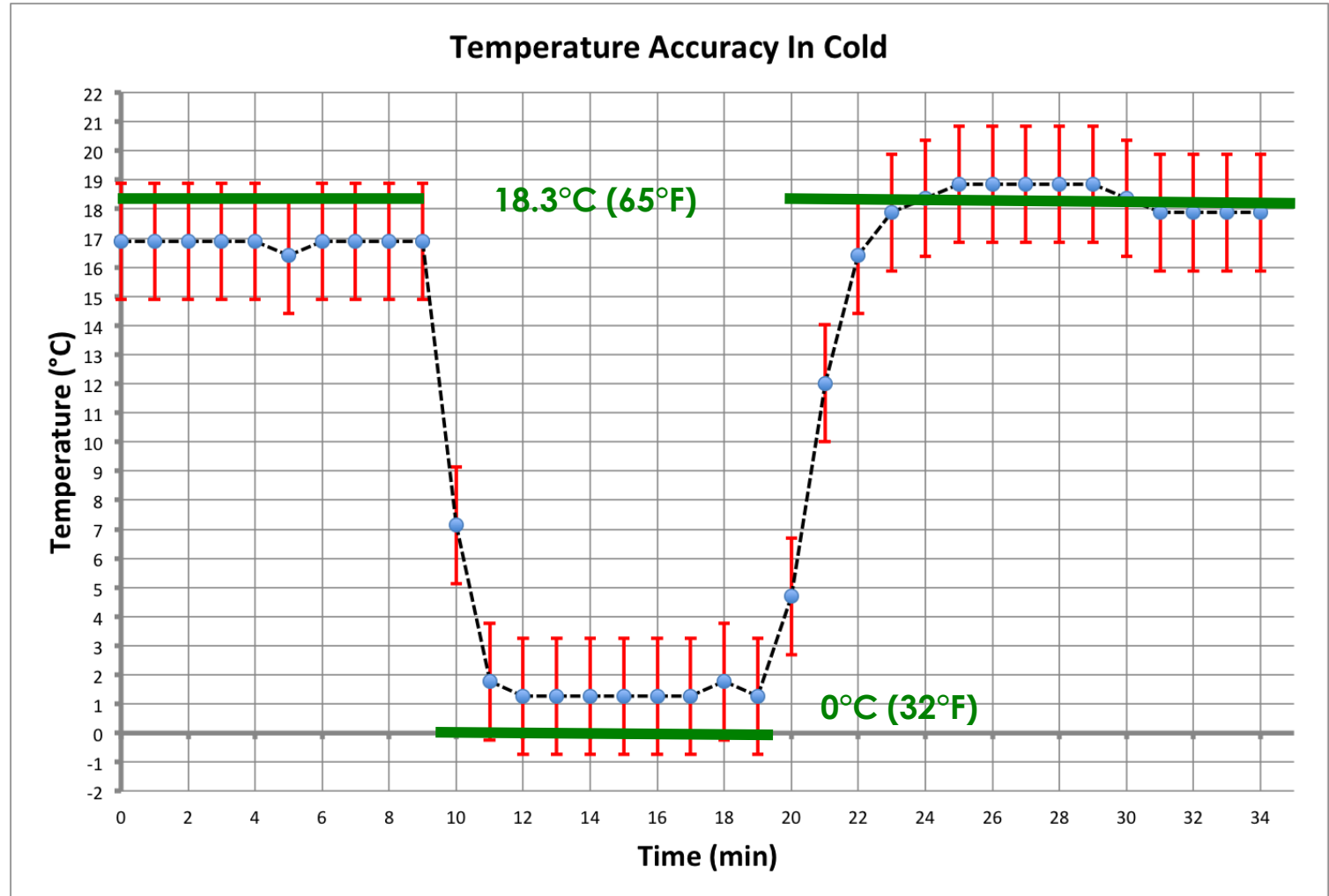


Figure X: Plot of the measured temperature when subjected to a 0°C environment. Error bars are indicated in red.

Testing Completed Temperature

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■ Temperature Monitoring

- Sensor Resolution: $\pm 2^{\circ}\text{C}$
 - Significant difference between actual and measured maximum temperature
 - Additional Testing Required
-
- This plot is temporary. I'm going to do more testing Wednesday to get a better one.

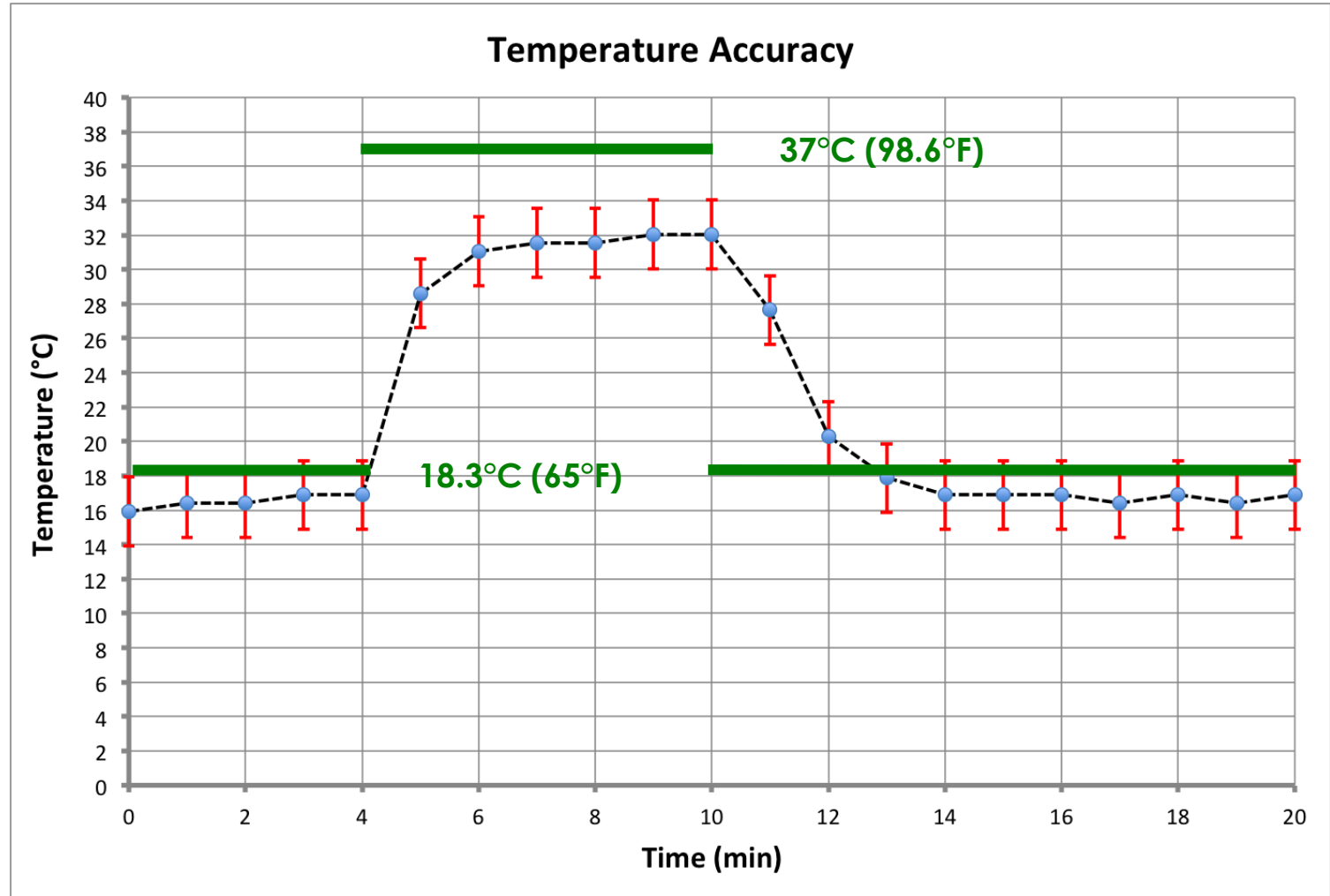


Figure X: Plot of measured temperature when placed in a 37°C environment. Error bars are indicated in red.

Presenter:

Budget Analysis

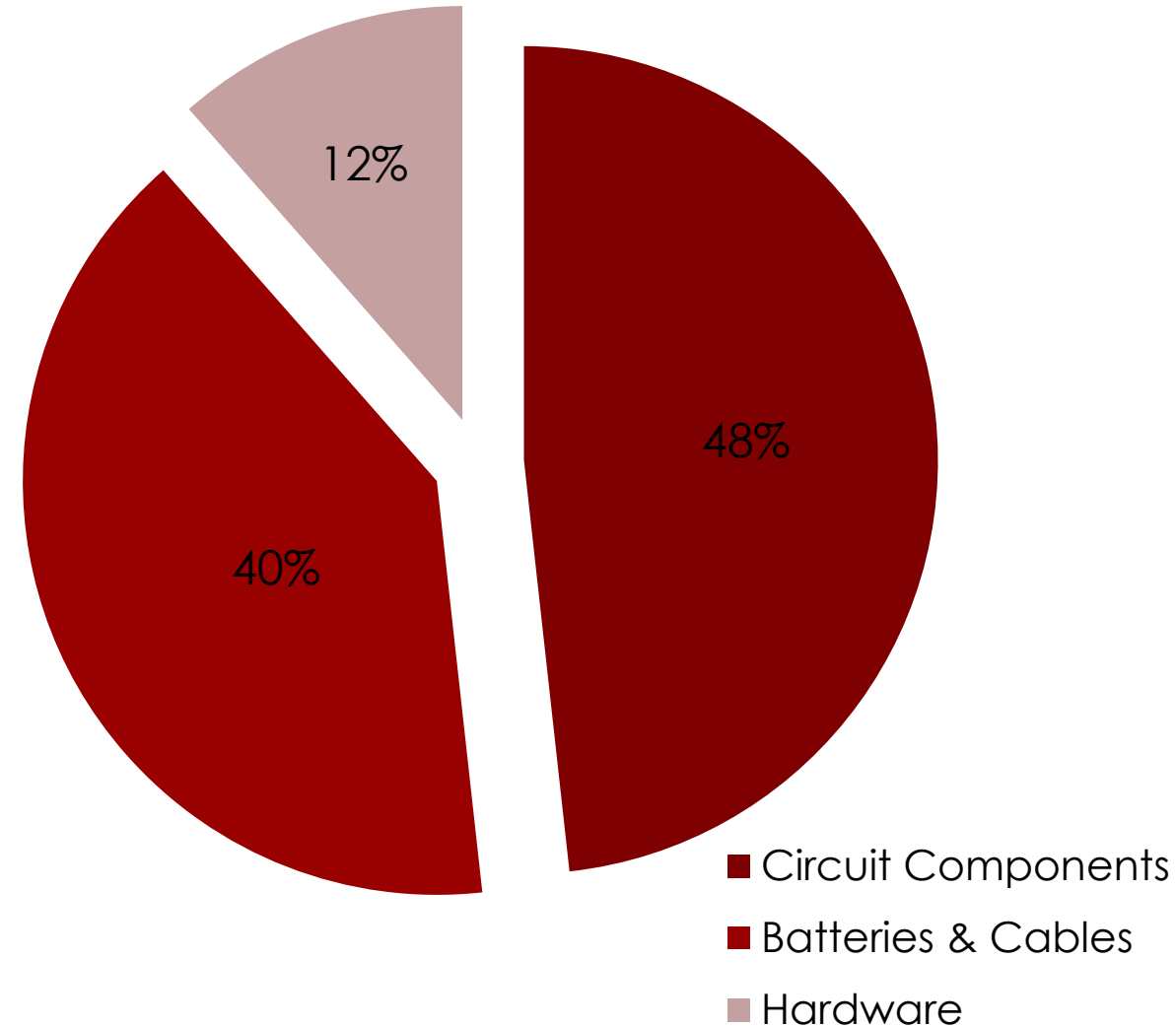
Table Y. Budget Analysis

Budget Breakdown*

Parts	Cost
Circuit Components	\$894.92
Batteries & Cables	\$747.03
Hardware	\$213
Total Used	\$1854.51
Budget Remaining	\$145.49

* This budget does not include the \$700 from the EE department

Presenter:



- Cold temperature constraint
 - Determining the voltage change respect to temperature
 - Testing entire system at cold temperatures
- Attenuating the accelerator signal so that the generator will not be overloaded.
- Eliminating noise in voltage measurements during relay activation.
 - Spikes in voltage can result in unnecessary state changes.

Conclusion & Future Work

- Fabricate propane tank mount and power supply water resistant caps
- Ensure the budget is not exceeded
- Finalize temperature testing
 - Control environment room
- Assemble entire circuit
 - Heating pads
 - Battery monitoring system
 - Generator
- Additional testing and final calibration
- Install circuit onto golf cart

Presenter:

