Electric Vehicle Mobile Metering Device

Veracity: Joy Mina, David Kim, James Soukup, Leonard Brzezinski, Adviser - Prof. J. Michael McCarthy

Dean's Choice

Objectives

- To produce a highly accurate, affordable power and energy meter and data logger for use in FSAE EVs
- Satisfy the need for FSAE vehicles being able to self monitor their power and energy metrics
- Enable collegiate level teams and others to collect more data, allowing them to improve upon their designs
- Integrate our device into the UCI electric racecar

Current Design

- SD Card Shield is mounted above the Microcontroller
- Voltage divider circuitry is soldered onto the shield
- Current Sensor is isolated from the primary power supply
- Direct access to the vehicle's voltage & current through positive and negative inputs

System Overview & Changes

- Overview
  - Microprocessor Samples Sensors (voltage & current readings) at 250Hz
  - Serial transmission of data from sensors to ADCs (analog-to-digital converters)
  - Microprocessor takes these readings of voltage & current and calculates instantaneous power demand and energy
  - These calculations are transmitted to the data storage (SD card – 8 or 16 GB)
- Changes
  - No longer using current shunt
  - Still using an Arduino to simplify process & testing
  - Further implementations shall be added in future versions

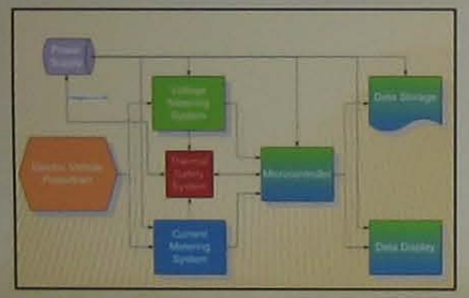
Why Our Solution?

- Substantially smaller than existing units
- Affordable relative to the hefty price-tags of commercial devices (averaging $3,000)
- Mobile – can meter on the Electric Vehicle itself, instead of on a large charging station
- High precision given the size, cost and durability
- Simple to access data & use
- Easily programmable for a technically capable user (our market)

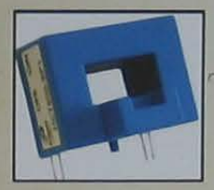
Device Subsystems

- Sensors
  - Electric Vehicle Voltage Metering System
    - Voltage Divider
    - Analog-to-Digital Convert (ADC)
  - Electric Vehicle Current Metering System
    - Hall Effect Sensor
    - Analog-to-Digital Convert (ADC)
- Data Processing
  - Microprocessor
    - Sampling sensors at 250Hz
    - Calculates the Power & Energy Metrics
    - Outputs Data to SD card
  - Data Storage
    - Sufficiently Large SD Card
    - Data stored as .csv to be used by user via software of choice (excel)

Metering Device Subsystems



Electric Vehicle Current Metering System



- Originally, the design had included a current shunt that would measure the current demand of the EV in parallel to the main power supply
- Current design incorporates a Hall Effect Sensor
  - More accurate
  - More linear over a broader range
  - Less effected by temperature
  - Higher accuracy over a broader range
  - Galvanic isolation is now allowed

Electric Vehicle Voltage Metering System

- Voltage Divider Circuit to reduce the voltage from the vehicle's primary power supply to a voltage within the range of the analog-to-digital converter
- ADC interprets the measured voltage and transmits a binary representation of the voltage value to the microcontroller

Team Organization

- EE – Leonard Brzezinski
- CSE – David Kim
- CpE- James Soukup
- EE – Joy Mina

How Are We Testing?

- Low Voltage Testing: originally we were testing the system concept by running proof of concept software off of a sample voltage varying circuit which was powered by the voltage provided by a computer
- Medium Voltage Testing includes testing by the use of battery cells, as would be used in the EV. We tested using cells that are part of the EV battery pack, averaging (this is medium voltage testing seeing that it is ~26V)
- High Voltage Testing: This is a work in progress as our design/testing is in parallel with that of the UCI car. As the car becomes available for testing, we aim to test on it, or off of a larger set of battery cells. We expect our device to monitor the EV's 70-90V operations

Testing in Progress

Future Additions & Options