Hardware elements of the battery cycler:

Hardware requirements

-defined to compete with commercial equpt

-show table

-Needs to be able to implement CC CV CP, also kept 1kHz sine wave for ESR in mind

Micro, + breakout

-Why Arduino

-Needed much more than what was available on the micro.

Data Acquisition

-TLE chip

-Current sensing IC’s

-Inst amp IC’s

-4 wire monitoring

-Temperature monitoring

-Needs to be able to accurately report cell voltage, current, cumulative energy, and temps

Cell control / Power board

* Mosfets, did we choose because of low cost?
* Positive temp coed
* De-rating and operating in the linear region.
* Current shunt IC’s, integrated diff amp, integrates all external parts, cheaper than inst amp.

Fault analysis and Safety

* Fused battery connections
* Watch dog switches main power to charge PSU and Therm chamber output

Thermal chamber

* integrated PID controller
* TRIAC for switching heating element

So why not just use NI and labview like sensible people? Well again this comes back to the whole cost and scalability. Even if a NI hardware were to be used to form the control end of the system and be used for data acquisition and load control, custom load banks, charge banks, and safety mechanisms still need to be built into hardware. From a cost perspective we can emulate the hardware in an NI DAQ box for a fraction of the cost, Analog Devies AD8221 is a complete instrument amplifier in an IC costing $5.24 in low volume, NI’s cheapest DAQ system offers 4 differential channels and cost $280/4=70 per diff channel.

Why Arduino? The Arduino platform has been taking the beginner embedded world by storm. Although it is not the most true representation of a bare embedded IDE Arduino is an ideal learning platform Students new to working with microcontrollers that do not need the overhead of working with a full C programming language. The functionality of the Arduino is still more than adequate for a relatively simple system such as the battery cycler. The

The Arduino has set the standard for open hardware, taking the success of open software and bringing it to the hardware world. The idea of most open hardware is to give everyone access to the tools that they need and allow them to improve on it. Arduino has done this by building on the wiring and processing platforms allowing people who do not necessarily understand how computers and microcontrollers work to use them. We look to emulate this sort of

Open hardware allows anyone even those without a in depth understanding of computers or microcontrollers to make use of these technologies for there own purposes.

We see this to be a great benefit in an environment such as those developing newer battery technology that have backgrounds focused in material sciences or chemical engineering.

For an open platform to be truly successful it needs to be allow its users to make improvements and share those improvements with the rest of the open source community. We believe that by using an embedded platform like Arduino can help us achieve this.

Talk about the arduinos openness

Talk about how SVN has us set up to collaborate, even though Word docs and binary files cannot be merged it has provided us with a free and published repository and version history. The modern world is setup to embrace the incredible power of collaborative design in unimaginable ways.

What does the battery cyclers hardware provide, talk about configurability, and flexability for the user to build a system as powerful as they need.

Talk about power board and controls problems that are integrated into making everything work.

Explain how we are providing a solution to a “lack of affordable electronic load banks, chargers, data acquisition systems, and software.

The capital equipment cost for commercialized battery testing equipment is significant.

We have developed an integrated solution by way of a multidisciplinary project that has allowed the students that need the hardware to develop it themselves. The most exciting part is the infinite scalability of the solution because of the systems open nature, the changes can always be made to accommodate a users requirements.

Our solution integrates all four elements of the system as a commercial solution would in dedicated custom hardware that is vastly scalable depending on what type and how much testing the user plans on conducting. Each system as currently designed provides two channels per system with that have configurable charge and load bank power and power supply configuration that makes system cost even easier to control for system that do no demand as much power for testing full size cells. In the even that more power is required both channels of a system can be used in parallel on a single cell.

Performing accelerated life cycle testing requires stressing the cells beyond the manner that they would during a normal cycle life to accelerate degradation mechanisms. This is done not only electrically but also environmentally, thus making environmental control an additional system that needed to be integrated into the battery cycler platform. While environmental testing equipment is not nearly as rare to find in most institutions as battery-testing equipment is, it can also relatively easily be integrated into the project. The battery cycler platform includes a PID controller along with temperature feedback and a Triac for switching a 120V heating element. From this an environmental chamber can be constructed and tuned to be controlled by the battery cycler hardware and make use of the integrated environmental controls of the battery cyclers software.

Cell characterization,

1Khz testing, trip efficiency, calculating cumulative energy,