



# Charging Dock & Power Control

## Sustainable Energy Systems for Education

### P12402



### Mission Statement

The mission of the Charging Dock & Power Control project is to design, build, test and deliver a charging station that controls the charging of the portable power source.

### Background

- The Portable High-Power Density Energy System project (P11401), which preceded this project, charged only one (1) AA battery using a wind turbine
- P11401 was split into two projects, P12401 and P12402, for AY 2011-2012; P12401 focused on developing a more efficient wind turbine
- P12402 (this project) focused on creating a station that could recharge eight (8) NiMH battery packs utilizing the wind turbine or standard AC wall power
- Both projects will be utilized by the Freshmen class entering the Mechanical Engineering program in Fall 2013

### Concept Selection & Final Concept

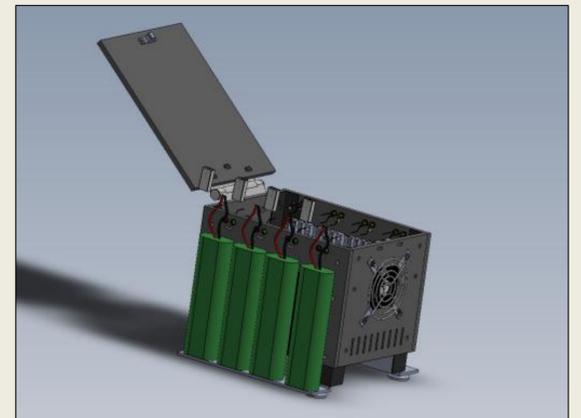
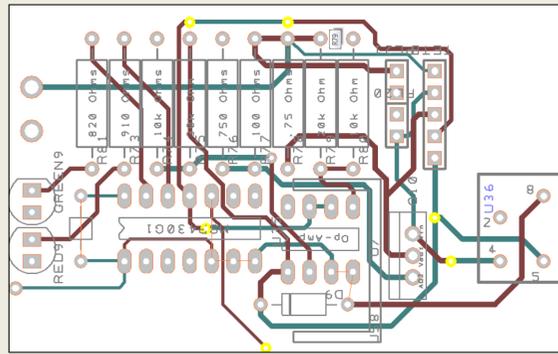
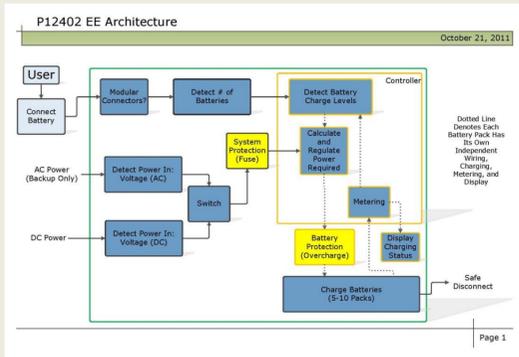
- Brainstormed several design concepts for the dock housing and the charging circuit
- Selected dock housing design is more compact and allowed for easier manufacturability
- Selected charging circuit layout is simpler while still meeting the requirements

### Motivation

- It is hard to find a charging station that will charge eight (8) NiMH batteries at once
- The station will be a tool for advancing the knowledge of future RIT students while representing RIT's commitment to the environment

### Customer Needs & Specifications

- Need: Able to charge multiple NiMH battery packs
  - Specification: Able to charge 8 7.2V NiMH battery packs
- Need: Operational inside the facility and outside the facility
  - Specification: Operational from -20°C to 32°C and up to relative humidity of 100%
- Charge all battery packs in one night
  - Specification: Maximum recharge time of 8 hours for all battery packs



### Thermal Analysis

- Due to the amount of power being delivered in such a confined space, heat would be an issue
- The critical temperature for the components is 125°C
- With only vents on the housing, the temperature was calculated to rise to 232°C
- Installation of a fan would reduce the temperature to 78.8°C

### Testing

- Electrical operation was fully tested and all 8 batteries were charged in 8 hours as specified
- The dock housing sustained three drops from a height of 3 feet
- The maximum operating temperature recorded was 54°C

### Results & Conclusions

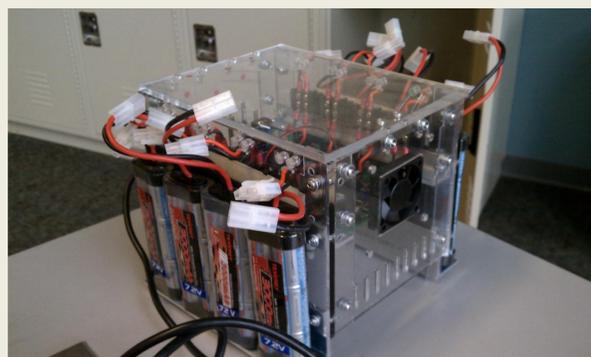
- The final product satisfies the customer's requirements under the given budget
- An ideal product would be a station that can connect to a variety of power sources and convert that power for charging multiple battery types
- Package could be more compact with only one microcontroller
- Reducing charging time and increasing power efficiencies would be feasible with more time
- Exploring different material options to improve manufacturability is necessary for future iterations



### Final Features & Specifications

- Smart Charger for 7.2V NiMH battery packs
- Charges 8 battery packs simultaneously
- Able to auto distinguish bad battery and indicate malfunction
- Automatically stop when battery pack is fully charged
- Status of charge indicated with LEDs

Rated Input Voltage	12VDC
Rated Input Current	6.3A
Input Power	<76W
Input Voltage Range	10-15V
Output Voltage Range	6VDC~8.7VDC
Charge Current Per Battery Pack	300-750mA
Max Output Power	36W
Operating Temperature	-20~32 °C
Charging Temperature	<70 °C
Operating Humidity	0-100% RH
Charging Time (Fully Discharged)	8 Hours



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