2007 Future Energy Challenge

Monash University Team

Melbourne, Australia

http://fec.eng.monash.edu.au

About Monash University

- Established in 1961
- Monash University is one of the eight leading universities in Australia
- Offers a full discipline teaching program to more than 49,500 students located across eight campuses around the world
- The university has a long-standing commitment to excellence in innovative research and quality education at all levels

The Team

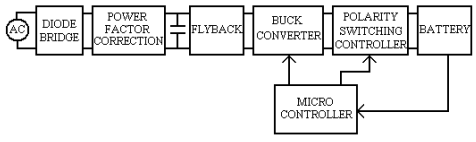
- Consists of 12 undergraduate students
- Disciplines include:
  - Electrical Engineering combined with computer science, mathematics and law
- Faculty Advisor: Professor Grahame Holmes

Team Management

- Organized into subgroups
  - Battery Management group
  - System Control group
  - Power conversion group
  - Sponsorship team
- Online Information Management
  - Website http://fec.eng.monash.edu.au
  - Team Discussion Forum

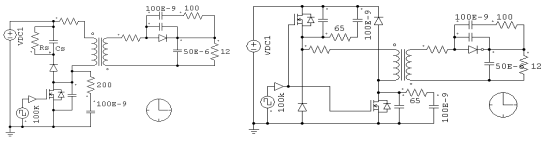
Technical Overview

- Two main power conversion stages
  - Flyback converter
  - Buck Converter
- Fully digital charge control by Micro Controller Unit (MCU)

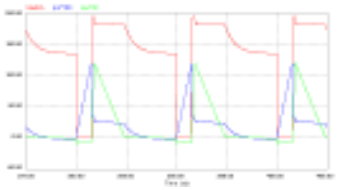


Flyback Converter

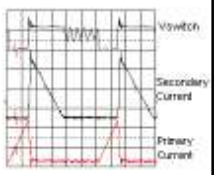
- Completed design, simulation and construction of two flyback converter topologies
- Presently evaluating which circuit is to be used



Flyback Converter



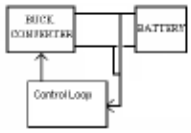
Simulation Results

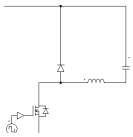


Experimental Results

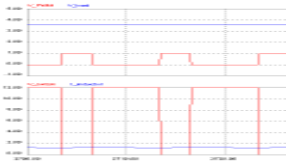
Buck Converter

- Complete the prototype for the converter
- Have successfully achieved close loop current regulation
- Ready to implement control loop in MCU

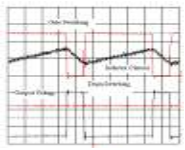




Buck Converter

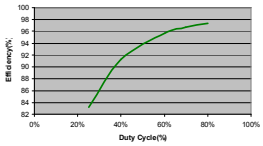


Simulation Results

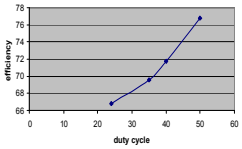


Experimental Results

Converter Efficiency



Buck Converter Efficiency



Flyback Converter Efficiency

Converter Prototypes

Buck Converter

Flyback Converter

Battery management

- Using a step load method to determine the battery chemistry
- Testing of battery profiles using LabView and NI ELVIS

Sponsorship Activities

- Generous sponsorship from Monash University
  - Allocated access to tech support service and workshop facilities
  - Initial seed fund
  - Allocated faculty and postgraduate advisors for the team
- Secured sponsorship support from Industry
  - Technical advice
  - Parts, PCB and equipment
  - Monetary

Sponsorship Obtained

MONASH University Engineering

Texas Instruments

Fastron

PCBFast

Varian

Next Phase of Work

- Integrating circuit design with proposed MCU to make full prototype charger
- 2 cycles of PCB prototype planned
- Continuous verification and improvement of battery charging algorithms

Educational Impact

- Accreditation
  - 25% of normal course loading in one semester
  - Work experience program
- Learning Experience
  - Large team-based environment
  - Gaining practical skills relating to real technical problems
- Crystallization of theoretical concepts learned in class
- Feedback towards development of undergraduate courses

Conclusion

- Substantial progress has been made – all planned initial trials and experiments have been concluded successfully
- Work is now commencing on design of first complete prototype charger
- Project is on time and following the scheduled timeline
- Team will have a leading edge product available for the competition finals in August