Hybrid Cars with UltraCapacitor Augmentation

- Toyota Prius
Introduction

More efficient hybrid vehicles

Researched:

- Ultra-Capacitors
- Batteries
Overview

- Problems with regular battery life
- Benefits of Lithium Ion Batteries
- Benefits of Ultra-Capacitors
- Combination of batteries and Ultra-Capacitors
Circuit Design

Various circuits developed for model

Figure 1

Figure 2

Figure 3
DC Converters
## Specifications of DC to DC Converter

### DC-100-2 converter specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage range</td>
<td>0.5 – 1.6 V</td>
</tr>
<tr>
<td>Working input voltage</td>
<td>1.2 V</td>
</tr>
<tr>
<td>Output voltage range</td>
<td>9 – 24 V</td>
</tr>
<tr>
<td>Average working output voltage</td>
<td>12 V</td>
</tr>
<tr>
<td>Maximum Input Power</td>
<td>12 W</td>
</tr>
<tr>
<td>Average efficiency</td>
<td>90%</td>
</tr>
<tr>
<td>Acceptable ambient temperature</td>
<td>-30 to +50 °C</td>
</tr>
<tr>
<td>Dimensions</td>
<td>12 x 7 x 3.5 cm or 4.7 x 2.8 x 1.4 in</td>
</tr>
</tbody>
</table>

### DC-100 basic unit specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage range</td>
<td>0.3 – 0.9 V</td>
</tr>
<tr>
<td>Working input voltage</td>
<td>0.5 V</td>
</tr>
<tr>
<td>Output voltage range</td>
<td>3 – 18 V</td>
</tr>
<tr>
<td>Average working output voltage</td>
<td>6 V</td>
</tr>
<tr>
<td>Maximum Input Power</td>
<td>5 W</td>
</tr>
<tr>
<td>Average efficiency</td>
<td>85%</td>
</tr>
<tr>
<td>Acceptable ambient temperature</td>
<td>-30 to +50 °C</td>
</tr>
<tr>
<td>Dimensions</td>
<td>12 x 7 x 3.5 cm or 4.7 x 2.8 x 1.4 in</td>
</tr>
</tbody>
</table>
Specifications of Relays

Physical specifications

Size: 1.75” x 2.50” x 1.25”
Weight: 4 oz.
Supply voltage: 4.1 – 5.5 Vdc.
Supply current: 20ma stand-by, 220ma when relay energized.
Load rating: relay is rated for non-welding contact up to 24 amps at 30 volts DC.
Switching time: 8.0 milliseconds typical.
Simplorer

- **Simplorer Goals**
- **Brief overview of the circuit simulations**
Simplorer

- Simplorer Problems

DC Motor Model

Automotive Library

Error - Cannot load compiled model from file (C:\\Simul85\Examples\AddOns\Automotive\example dc motor.mdl)

Initialize
Simplorer

- **Benefits**

- The future of Simplorer
Powered by Matlab and Simulink, Designed for simulation of:

- Fuel economy-  
  - Conventional cars  
  - Electrical cars  
  - Hybrid cars  

- Drivetrain components  

- Vehicle data and algorithms
Ultracapacitor Simulation

Results figure

- Fuel Economy (mpg): 32.7
- Gasoline Equivalent: 32.7
- Distance (miles): 7.5
- Emissions (grams/mile):
  - HC: 0.618
  - CO: 2.612
  - NOx: 0.52
  - PM: 0
- Acceleration Test:
  - 0-60 mph: 15.7
  - Max. Accel: 16.2
  - 40-60 mph: 3.3
  - Distance in 5s (ft): n/a
  - 0-85 mph: 42.2
  - Time in 0.25mi (s): n/a
  - Max. Speed (mph): 96.7
- Gradeability: n/a %

Warnings/Messages:
- none

Replay| Back Two | Help
Back | Exit
**Advisor Model**

- Correct model which connects the lead acid battery to the ultra-capacitor

**Problems**

Unable to implement correct model
Updated weekly with current progress and information

Visit us at http://www.iit.edu/~ipro314s/
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Summary and Q/A

Any questions?