What’s so Exciting About Supercapacitor Modules?
A look at some of the latest applications.
Introduction

Supercacitors are different!

• Whether you call them “supercapacitors,” “ultra-capacitors,” or “EDLC” caps, these devices have max capacities well into the thousands of Farads.

• No dielectric! Supercaps are based on a carbon (nanotube) technology which creates a very large double-layer surface area (as thin as a molecule!) with an extremely small separation between layers.

• When an electrical charge is applied to the nanotube material, a double electric field is generated which acts like a giant dielectric.

• While individual supercaps can have very high capacitance, max voltage ratings are low. This is why there is a need for supercapactor modules.
Quick Look at Supercapacitors
More than a capacitor...different than a battery

• Used with or as alternative to batteries
• Not as volumetrically efficient and more expensive than batteries, but have advantages in specific applications (Costs are coming down)
• Can be very quickly charged/discharged many thousands of times
• Used in applications where short bursts of energy are needed
• Capacitances from 1 Farad to hundreds of Farads...or even thousands
• Voltage range: 2.3 to 2.7 for a single cell package
Quick Look at Supercap Modules

- Modules are primarily intended to provide very high capacity with voltage ratings higher than individual components.
- May contain anywhere from two to many identical supercaps.
- While standard modules are available, most production applications require some level of customization.
- Modules are typically encased in a plastic or metal package, but may sometimes be contained in customer packaging.
- Capacitors are configured in active or passive balanced arrays.
Illinois Capacitor
Supercap Modules

• Virtually *any* capacitance and voltage
• Built to meet customer’s space and shape limits
• 500,000 charge/discharge cycles or more!
• Durable modular construction
• Open or closed style modules
• Ready-to-go solution...saves design time, cost
• Provide new design options for engineers
Where are modules being used?

For a growing number of applications, supercap modules are the technology of choice!

- Wind Turbine
- Solar Turbine
- Solar Panels
- Military, Medical, Smart Grid, More!
- Industrial
- Transportation (Virtually anything Motorized)
Application Overview

It’s easy to remember major application categories. Just think I-T-E-M

INDUSTRIAL
TRANSPORTATION
ENERGY
MORE
Industrial

• Automation – Including robotics and other factory automation, providing power boosts and backup
• Fork lifts, cranes, electric carts – providing power boosts and backup
• Fuel cell systems
• Regenerative breaking captures energy
• UPS Systems – Faster than conventional UPS
Example...

Industrial Generator Starting

- Multiple modules are used to start large commercial diesel powered generator
- 12 volt modules

**Basic Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Range</td>
<td>448V~672V</td>
</tr>
<tr>
<td>Working Current</td>
<td>298A~447A</td>
</tr>
<tr>
<td>Power</td>
<td>200KW; 15s</td>
</tr>
<tr>
<td>Capacitance</td>
<td>27.7F</td>
</tr>
<tr>
<td>Dimensions</td>
<td>2.02x1.96x1m</td>
</tr>
</tbody>
</table>
Transportation

- Battery propelled electric vehicles (BEVs)
- Hybrid electric vehicles (HEVs)
- Engine starting – auto, truck, train
- Regenerative breaking/energy capture – trucks, busses, trains
- Fuel cell vehicle support – electric power output smoothing
- Trains – electric power grid stabilization
**Transportation Can Take Many Forms**

- 48V Systems for Electric Vehicles
- For fork lift trucks, in plant vehicles, golf carts, etc.
- Provides extra boost of energy to support batteries or fuel cell
- May be used for regenerative braking to capture energy otherwise lost

**Basic Specifications**

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Voltage</strong></td>
<td>48V</td>
</tr>
<tr>
<td><strong>Surge Voltage</strong></td>
<td>50.4V</td>
</tr>
<tr>
<td><strong>Max Charge / Discharge Current</strong></td>
<td>810A</td>
</tr>
<tr>
<td><strong>Standard Charge / Discharge Current</strong></td>
<td>32.4A</td>
</tr>
<tr>
<td><strong>Capacitance</strong></td>
<td>166F</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>416x212x226mm</td>
</tr>
</tbody>
</table>
Green Energy

- Wind turbine – Prop pitch
- Solar turbines – Mirror power
- Solar Panels – Storage, smoothing
- Wave energy converters – Smoothing, turbine startup power (initiates startup and minimizes starting surge, regenerative breaking of turbines)
Example...

Wind Turbine Energy Storage Application

- 500,000 charge/discharge cycles
- Overvoltage monitoring
- Ultra low ESR
- High power
- Dual-fan air cooled
- RS or CAN output interface
- Integrated supercapacitor management system

52 F, 129 WVDC, -40 to +60C, Charge/Discharge current 674 A
Weight: 110 lb.
More Applications!

• Military – similar needs to those found in other markets, plus any military equipment that is motorized

• Medical – Non-life critical applications, such as support for motor driven diagnostic and patient mobility equipment

• Smart Grid – Power smoothing, backup, energy storage

• Commercial Cooking Equipment
Examples of Custom Modules

• Complete flexibility over electrical and mechanical specifications.
Options

- Overvoltage protection
- Over temperature protection – user defined
- Active or passive voltage balancing
- Voltage level indication
- Safety circuits - relays/fuses
- Charging circuit – limits current
- Power booster – very custom
- DC-DC converter (bidirectional)
- Cooling and more!
Connector Examples

Many more types are available
• Website featuring catalog pages in PDF format and individual product specifications
• Technical assistance
• Gateway to Quote & Samples
• Net Components System- inventory locator
• Glossary
IC Supercap Modules Solve Engineering Problems!
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