Welcome

APEC 2018 Industry Session
Cornell Dubilier Electronics

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How Advances in Flat Aluminum Electrolytic Capacitors Are Solving Today’s Power Design Problems
Board-Level Component Trends

Industrial, consumer, military and aerospace applications are trending toward smaller size

• Lower height profile
• Take up less board real estate
• Lighter
• Lower Cost

Need for smaller components without compromising system life and reliability
Is capacitor technology keeping up with these demands?

Incremental technology improvements have helped shrink component size and improve life:

Improvements in Aluminum Electrolytic Technology:

• High-gain anode foils $\rightarrow$ Higher CV per unit size
• New electrolyte systems and lead attachment technology:
  • Lower ESR (Equivalent Series Resistance) $\rightarrow$ reduced power loss for the same amount of ripple current $\rightarrow$ smaller components can be used without overheating.
Energy Density of Cylindrical Aluminum Electrolytic Capacitors

<table>
<thead>
<tr>
<th>TYPE</th>
<th>Smallest Diameter (mm)</th>
<th>Shortest Height (mm)</th>
<th>J/cc (In smallest size @ 50 Vdc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snap-In</td>
<td>20</td>
<td>20</td>
<td>0.247</td>
</tr>
<tr>
<td>Radial</td>
<td>5</td>
<td>11</td>
<td>0.191</td>
</tr>
<tr>
<td>SMT</td>
<td>4</td>
<td>5.5</td>
<td>0.06</td>
</tr>
</tbody>
</table>
Smaller Components are Less Efficient

• Smaller package sizes have lower energy density.
• At below 10mm, options are limited to small axial, radial and SMT components where energy density drops off sharply.
• Packaging takes up a high percentage of the volume.

As much as 40% of the volume of an SMT aluminum electrolytic capacitor is taken up by its packaging.
Smaller Components are Less Efficient

• Low-profile applications (< 10mm) requiring high bulk storage use banks of small capacitors in parallel. Capacitor banks take up a lot of board space.
THA and THAS, *Thinpack*, Aluminum Electrolytic Capacitors

Highest Energy-Density Electrolytic in a Low-Profile Design
CDE THA and THAS Thinpack High-Energy Density Aluminum Electrolytic Capacitors.

Offers the highest energy density available in low-profile aluminum electrolytic technology. Up to 1.1 J/cc (@ 450 Vdc)

- 30% higher energy density than comparable snap-in (@50 Vdc)
- > 5 x the energy density of SMT lytics (@50 Vdc)
CDE THA and THAS Thinpack High-Energy Density Aluminum Electrolytic Capacitors.

- Ideal for the low-profile circuits
- Designed for high capacitance bulk storage and filtering applications without derating the voltage
- Can replace arrays of SMT, radial or axial aluminum electrolytic and solid tantalum capacitors
- Increases reliability—one device vs. many; fewer PCB connection points
- THA offers 3,000 hr. life @ 85 °C
- THAS offers 3,000 hr. life @ 105 °C
THA and THAS Thinpack Capacitors save space with high-energy density; very-low profile.

THA: 8.2mm thin
THAS: 9.0 mm thin

- Comparable in height to V-chip electrolytics, tantalums and board-mounted axials, but with much greater bulk storage capability and higher voltage selection.
- Simplifies assembly
- Potential cost savings when compared to the cost of bulk storage arrays
Traditional methods of low-profile bulk storage consume too much PCB space!

Compare PCB space requirements for similar storage with axial electrolytics or v-chips...

(example shows: 5,800 µF, 35 Vdc at 85 °C)

• About 70% less board space than alternatives
• Overall size and weight of finished board is reduced
• Eliminates wasted space between components in bulk arrays
Laser-welded aluminum case

Eliminates the need for space wasting end-seal gaskets.
Designed for *maximum* capacitance in the *smallest* package.

THA and THAS Thinpack allows designers to create thinner, higher performance products...

- Tablets, laptops, specialized instruments
- LED driver modules
- Compact power supplies
- Drones and RPVs
- Set-top boxes
- Narrow, 1U rack-mounted devices
- Video monitors, displays
- Security systems
Ultra-Low Profile (ULP) Series Flat Capacitors

Cornell Dubilier’s ULP Series offers the world’s lowest-profile aluminum electrolytic at 3mm tall!
ULP Capacitor

- “Nickel-Silver” Outer Case
- Flex (FPC) Lead System
- Ultra-Thin Package
## ULP vs. Ta Chips, V-Chips & Snaps

<table>
<thead>
<tr>
<th>Capacitance (µF)</th>
<th>Rated Voltage (Vdc)</th>
<th>Solid Tantalum Equivalent *</th>
<th>V Chip Equivalent</th>
<th>Snap-in Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4X ULP</td>
<td>2X ULP</td>
<td>1X ULP</td>
</tr>
<tr>
<td>26000</td>
<td>4</td>
<td>34</td>
<td>468</td>
<td>2</td>
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<td></td>
<td>7X ULP</td>
<td>515</td>
<td>2</td>
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<tr>
<td>17000</td>
<td>10</td>
<td>64</td>
<td>545</td>
<td>1</td>
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<tr>
<td></td>
<td></td>
<td>7.5X ULP</td>
<td>760</td>
<td>2</td>
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<td>104</td>
<td>8X ULP</td>
<td>1</td>
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<td>12X ULP</td>
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<td>7600</td>
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<td>12.5X ULP</td>
<td>510</td>
<td>1</td>
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<td>22X ULP</td>
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<tr>
<td></td>
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<td>24X ULP</td>
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<tr>
<td>1700</td>
<td>63</td>
<td>--</td>
<td></td>
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</tr>
</tbody>
</table>

* Factors for derating at max rated temperature
HVMLSG
High Vibration up to 50g and 200,000 hour life @ 105 °C

MLSH
Hermetic, 80G vibration

THA/THAS
Highest energy density in low-profile, 1.1 Joules/cc

ULP
3mm Thin
Thank You!