

# Welcome

**APEC 2018 Industry Session  
Cornell Dubilier Electronics**

**Presented by Scott Franco**

*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 → Higher CV per unit size
- New electrolyte systems and lead attachment technology:
  - Lower ESR (Equivalent Series Resistance) → reduced power loss for the same amount of ripple current → smaller components can be used without overheating.

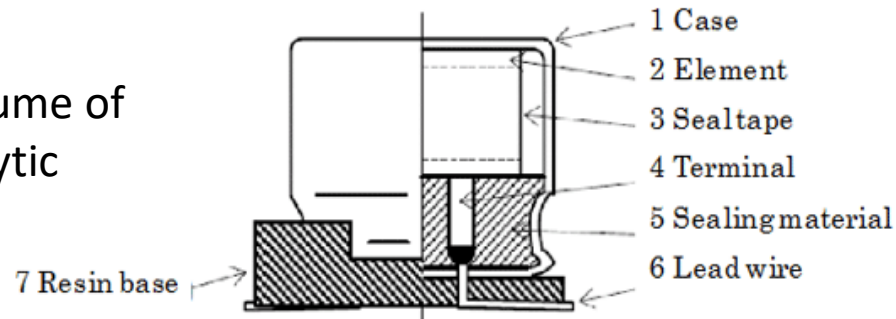
# Energy Density of Cylindrical Aluminum Electrolytic Capacitors

	TYPE	Smallest Diameter (mm)	Shortest Height (mm)	J/cc (In smallest size @ 50 Vdc)
	Snap-In	20	20	0.247
	Radial	5	11	0.191
	SMT	4	5.5	0.06

# 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



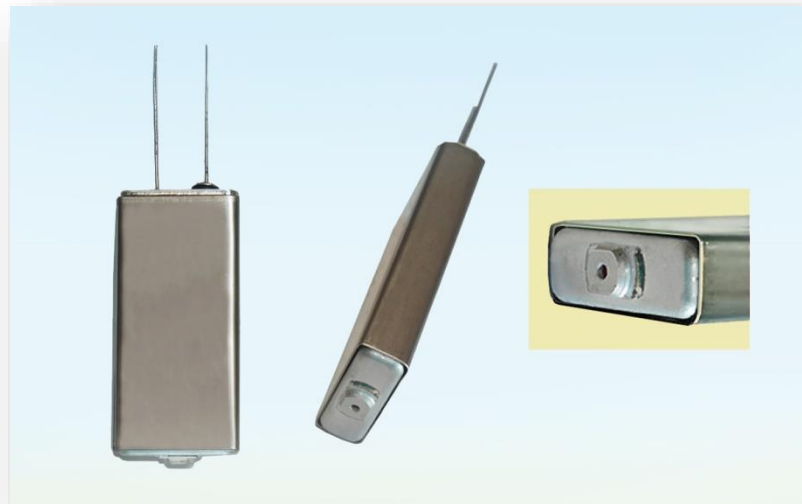
# Smaller Components are Less Efficient

- 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

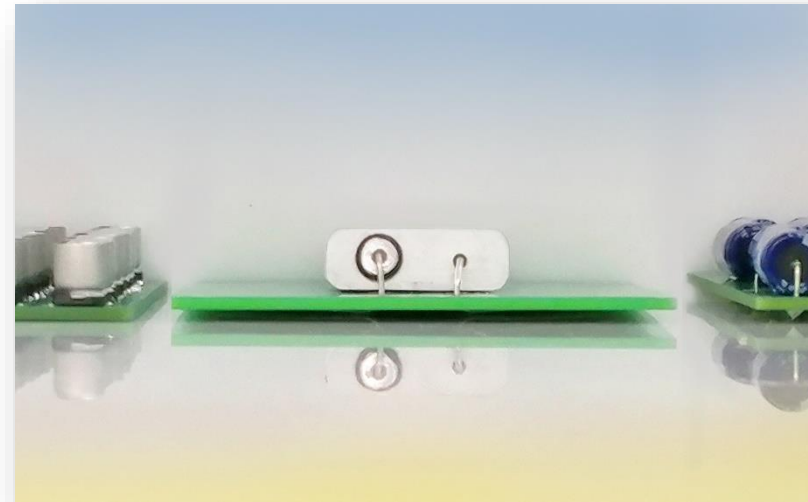


# THA and THAS Thinpack Capacitors save space with high-energy density; very-low profile.

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



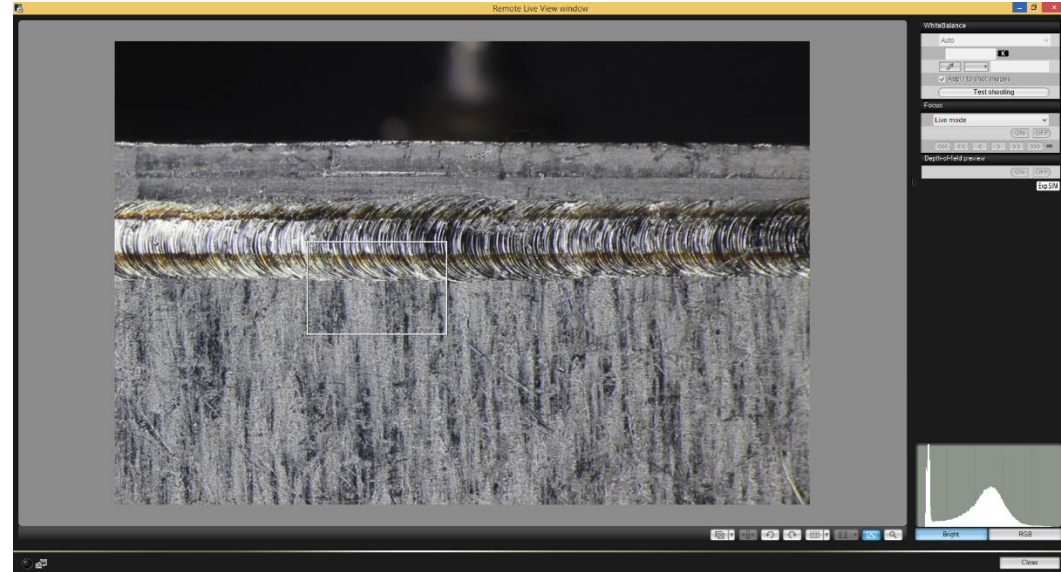
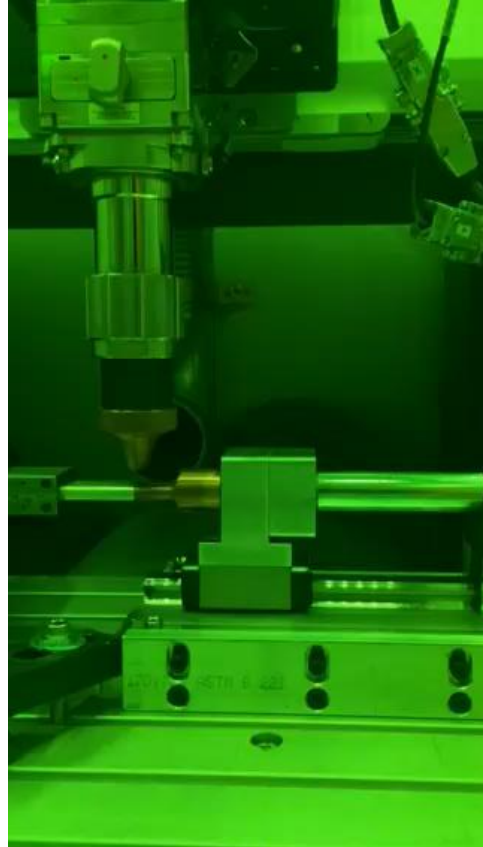
# Traditional methods of low-profile bulk storage consume too much PCB space!

Compare PCB space requirements for similar storage with axial electrolytics or v-chips...  
*(example shows: 5,800  $\mu$ F, 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

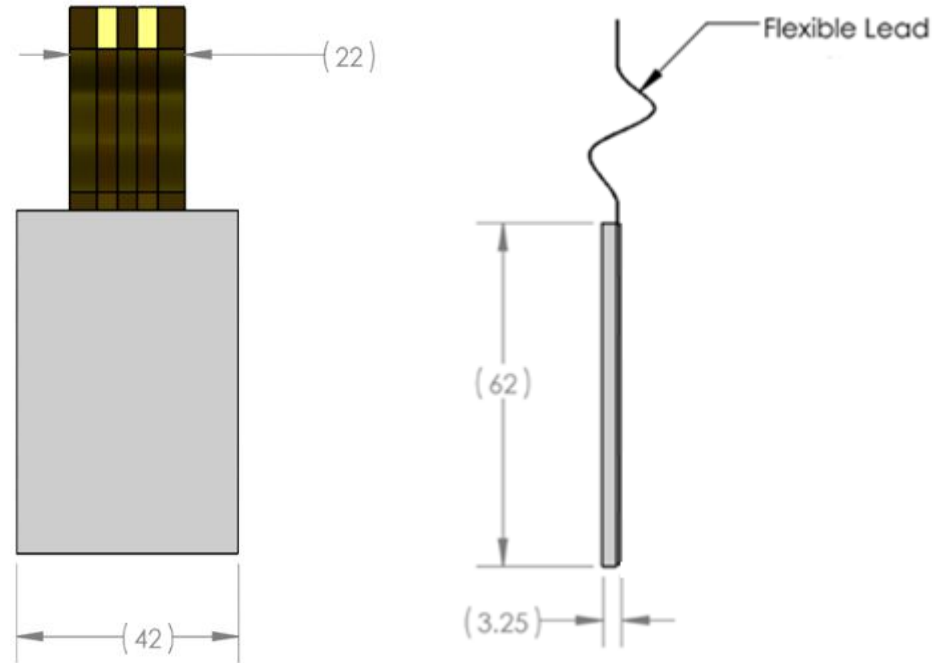




# Ultra-Low Profile (ULP) Series Flat Capacitors

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

# ULP Capacitor



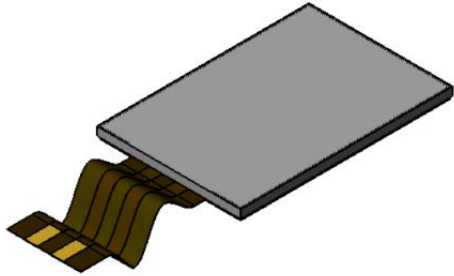
- “Nickel-Silver” Outer Case
- Flex (FPC) Lead System
- Ultra-Thin Package



ENERGIZING IDEAS

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# ULP vs. Ta Chips, V-Chips & Snaps



ULP (62 x 42 x 3.25)		Solid Tantalum Equivalent *		V Chip Equivalent		Snap-in Equivalent	
Capacitance ( $\mu$ F)	Rated Voltage (Vdc)	# Solid Ta Chips	Cost Factor	# of 4 x 5.8 V-Chips	Cost Factor	# of 21 x 25 Snap-ins	Cost Factor
26000	4	34	4X ULP	--		--	
22000	6.3	60	7X ULP	468	7.5X ULP	2	0.5X ULP
17000	10	64	7.5X ULP	515	8.5X ULP	2	1.2X ULP
12000	16	104	12X ULP	545	9X ULP	1	0.3X ULP
7600	25	145	16X ULP	760	12.5X ULP	2	0.5X ULP
4800	35	186	22X ULP	480	8X ULP	1	0.2X ULP
2400	50	208	24X ULP	510	8X ULP	1	0.3X ULP
1700	63	--		--		1	0.25X ULP

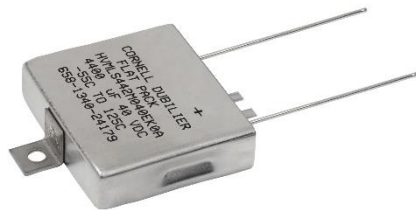
\* Factors for derating at max rated temperature

# CAPACITOR INNOVATIONS. THE NEW BENCHMARK FOR PERFORMANCE.

ALUMINUM ELECTROLYTIC TECHNOLOGY FOR THE MOST CHALLENGING ENVIRONMENTS



**CDE** CORNELL  
DUBILIER  
ENERGIZING IDEAS



## HVMLSG

High Vibration up to 50g and  
200,000 hour life @ 105 °C



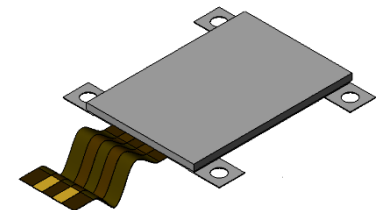
## MLSH

Hermetic,  
80G vibration



## THA/THAS

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



## ULP

3mm Thin

Thank You!