

It's not your Father's Aluminum Electrolytic

CAPACITOR INNOVATIONS. THE NEW BENCHMARK FOR PERFORMANCE.

ALUMINUM ELECTROLYTIC TECHNOLOGY FOR THE MOST CHALLENGING ENVIRONMENTS



CDE CORNELL
DUBILIER
ENERGIZING IDEAS



HVMLSG



MLSH

World's toughest
80G vibration



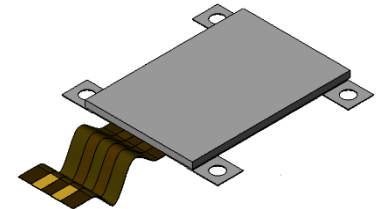
THA/THAS

World's best energy density
1.1 Joules/cc



HHT

World's hottest
175 °C



POUCH CAP

World's thinnest
3 mm



CORNELL
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ENERGIZING IDEAS

Hermetically Sealed Aluminum Electrolytic Capacitors



Hermetically Sealed Aluminum Electrolytic Capacitors – Standard (non-hermetic) Flatpack® Capacitors

- Standard (non-hermetic) Flatpack capacitors, types MLP (85°C) and MLS (125°C) have been used extensively in military/aerospace applications for more than 20 years.
 - Radar
 - Cockpit Communications
 - Aircraft Power Supplies
 - Programs:
 - KC135
 - F16
 - F18
 - F22
 - X33 Space Shuttle
 - JSF Joint Strike Fighter
 - E2C
 - Osprey

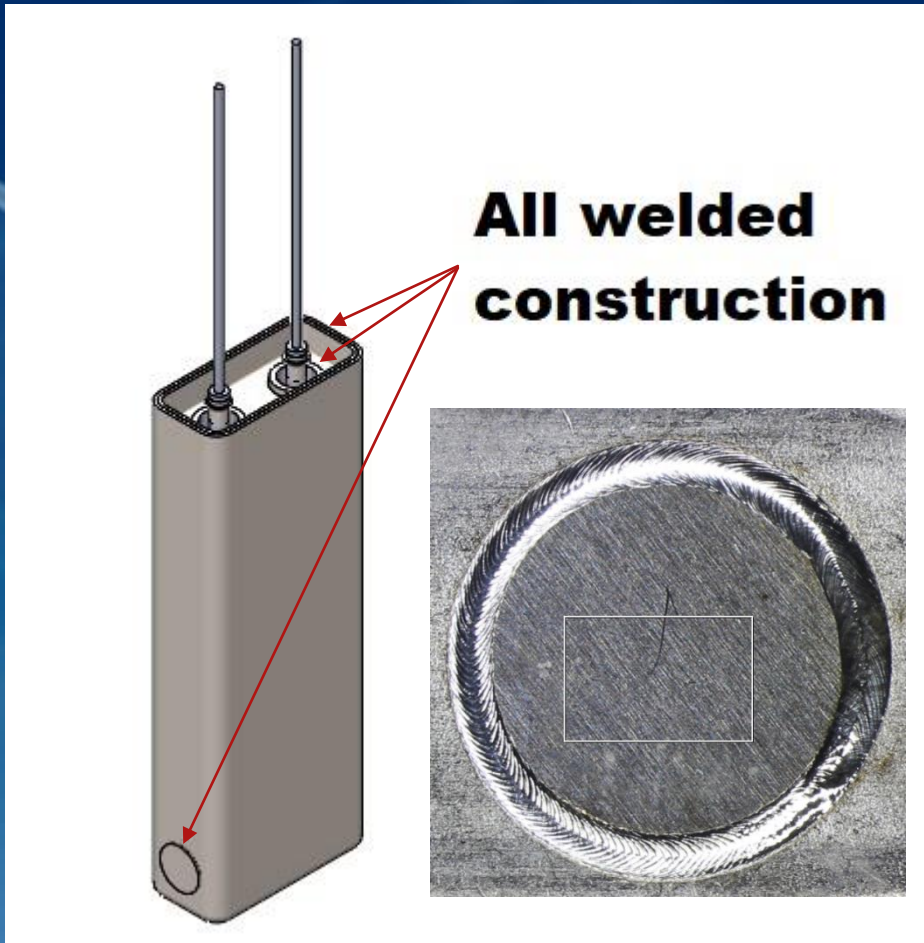


MLP, Aluminum Case (85°C)



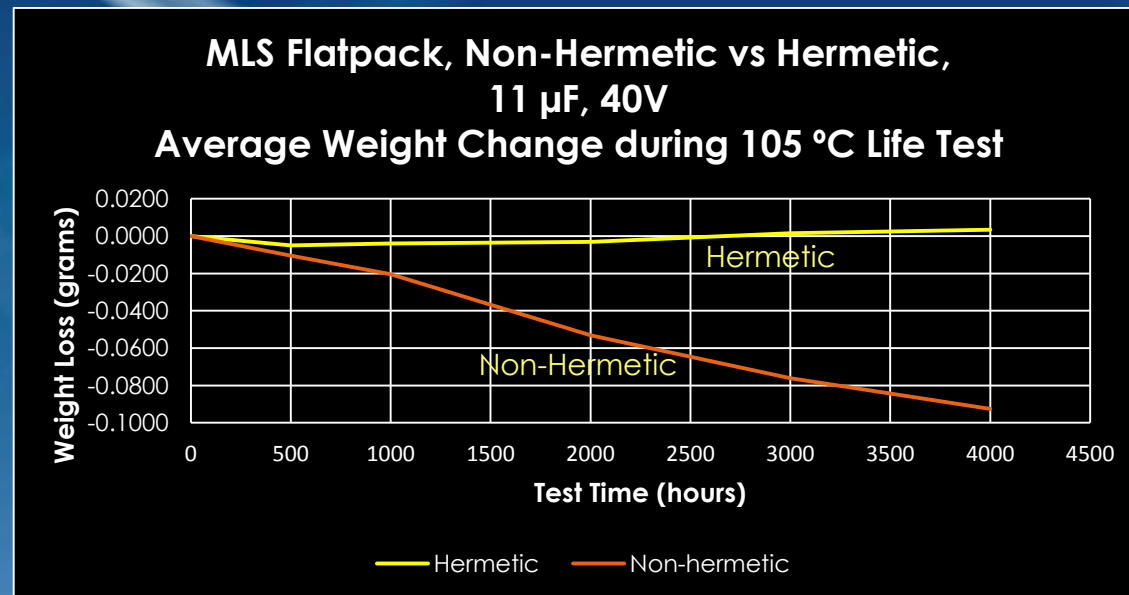
MLS, Stainless Steel Case (125°C)

Hermetically Sealed Aluminum Electrolytic Capacitors - **MLSH**



Hermetically Sealed Aluminum Electrolytic Capacitors – *No Electrolyte Loss!*

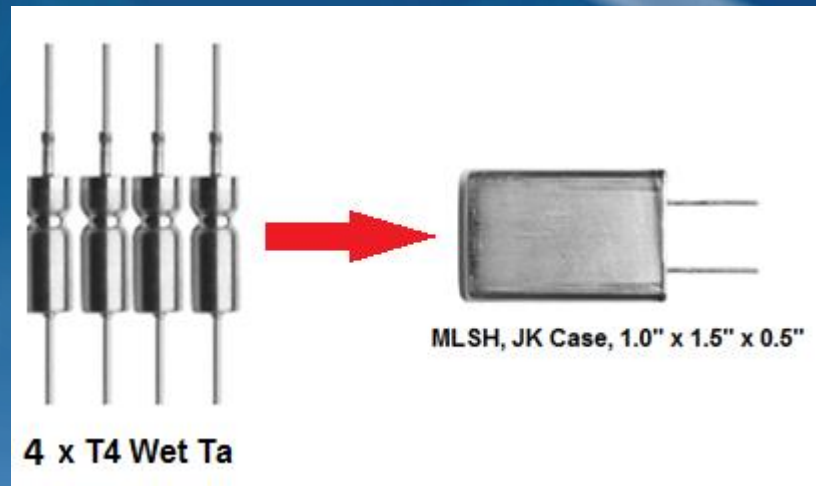
- Conventional aluminum electrolytic capacitors (e.g. snap-ins, axial, radial) lose electrolyte over time.
- Out-gassing of electrolyte results in cap loss and increased ESR.
- Standard MLP and MLS Flatpacks have a welded case and lose very little electrolyte over their life.
- Hermetic Slimpack capacitors, with a glass-to-metal seal, lose no electrolyte.



Hermetically Sealed Aluminum Electrolytic Capacitors

Hermetic Aluminum vs. Wet Tantalum:

- Replaces 3 or more D-sized (a.k.a.T4) wet tantalum caps.
- Wet tantalums have poor capacitance retention at low temperature.
- Almost all MIL/Aero applications specify parts using the full temp range of -55 °C to 125 °C.
- A single hermetically sealed aluminum electrolytic capacitor saves weight, size and cost when compared to banks of wet tantalum capacitors.



	MLSH, 2200μF, 40 Vdc @ 125 °C	4 x T4 Wet Ta 1000μF, 40 Vdc @ 125 °C
Capacitance @ 125 °C, 120 Hz	2100 μ F	4910 μ F
Cap Change at -55 °C, 120 Hz	-20%	-68%
Capacitance @ -55 °C, 120 Hz	1675 μ F	1580 μ F
Weight (g)	32	59
Cost	1X	2X

Hermetically Sealed Aluminum Electrolytic Capacitors - **MLSH**



Type	Capacitance	Tolerance	Rated Voltage	Case Code	Insulation	Mounting Style
MLSH	322 = 3200 μ F 222 = 2200 μ F 172 = 1700 μ F	M = \pm 20%	030 = 30 Vdc 075 = 75 Vdc 150 = 150 Vdc 200 = 200 Vdc	JK, L=1.5 in.	0 = bare can 1 = polyester	C = two leads/no tabs

Voltage	Cap (μ F)	Catalog Part Number	Length	ESR max 25 °C (Ω)		Ripple (A) Case @ 85°C	
				120 Hz	10 kHz	120 Hz	10 kHz
30 Vdc @ 125 °C	3200	MLSH322M030JK0C	1.5	0.103	0.098	6.6	6.8
40 Vdc @ 125 °C	2200	MLSH222M040JK0C	1.5	0.105	0.1	6.6	6.8
50 Vdc @ 125 °C	1700	MLSH172M050JK0C	1.5	0.108	0.101	6.6	6.8
60 Vdc @ 125 °C	1100	MLSH112M060JK0C	1.5	0.109	0.103	6.5	6.8
75 Vdc @ 125 °C	700	MLSH701M075JK0C	1.5	0.246	0.234	4.0	4.2
100 Vdc @ 125 °C	400	MLSH401M100JK0C	1.5	0.960	0.768	2.1	6.5
150 Vdc @ 125 °C	210	MLSH211M150JK0C	1.5	1.019	0.815	2.2	2.4
200 Vdc @ 125 °C	160	MLSH161M200JK0C	1.5	1.274	1.019	1.9	2.1
250 Vdc @ 125 °C	120	MLSH121M250JK0C	1.5	1.200	0.96	1.9	2.2

CDE HHT Series Axial-Leaded Aluminum Electrolytic Capacitors

175 °C, Ruggedized Design for Mission
Critical Applications



CDE HHT Series Ruggedized Axial-Leaded Aluminum Electrolytic Capacitors

The HHT is the only axial-lead electrolytic featuring a glass-to-metal seal to prevent dry-out of the capacitor electrolyte.

- Rated at 175 °C, for 2,000 hours and an industry-best 5,000 hours at 150 °C with ripple current ratings up to 10 Arms
- Withstands vibrations up to 20 g's

In short, HHT capacitors go where others can't.



THA and THAS, *Thinpack*, Aluminum Electrolytic Capacitors



CDE THA and THAS Thinpack High-Energy Density Aluminum Electrolytic Capacitors.

Offers the highest energy density available in low-profile aluminum electrolytic technology.

- Ideal for the lowest-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

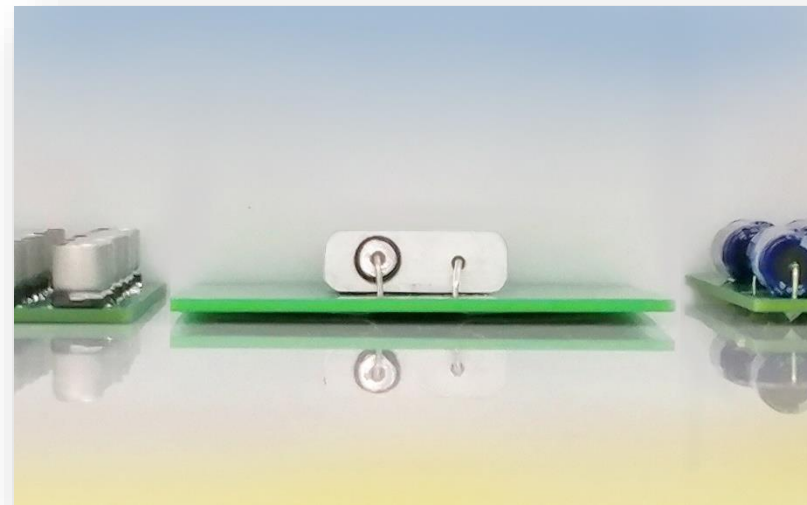


**CORNELL
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THA Thinpack Capacitors save space with high-energy density; very-low profile.

Just 8.2mm thin!

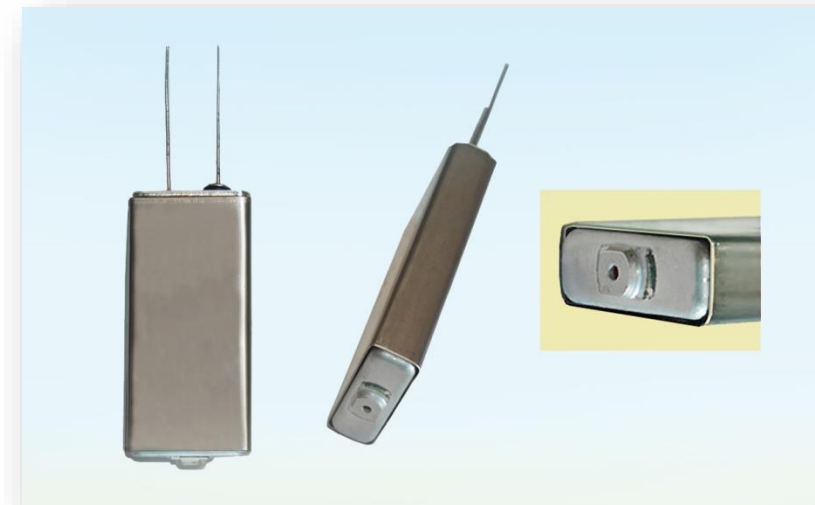
- Comparable in height to V-chip electrolytics, tantalums and board-mounted axials, but with much greater bulk storage capability and higher voltage selection.
- Simplifies assembly
- Potential cost savings when compared to the cost of bulk storage arrays



THAS Thinpack Capacitors add a stainless-steel sleeve; performs to 105 °C

Just 9mm thin!

- 3,000 hour life @ 105 °C without derating
- Ruggedized with a stainless-sleeve
- Up to 0.9J/cc energy density
- Like the THA...as a single device, simplifies assembly
- Also has potential cost savings in comparison with bulk storage arrays



**CORNELL
DUBILIER**

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 μ 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



ENERGIZING IDEAS

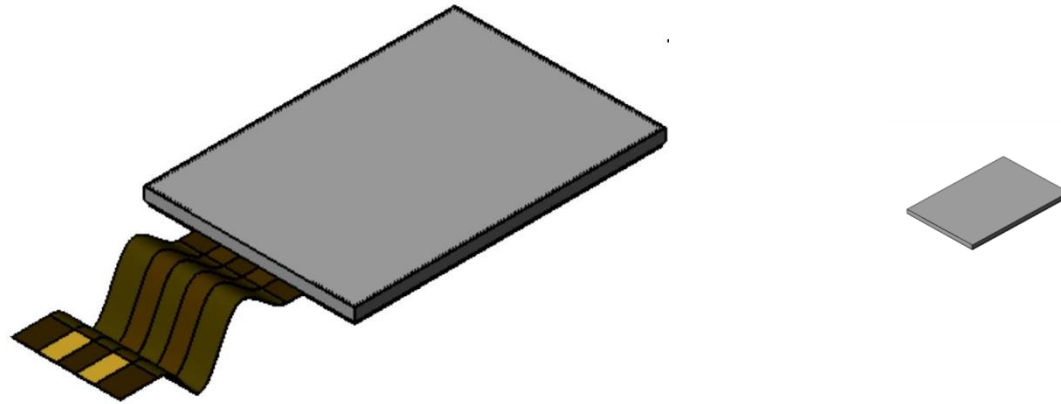
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Designed for *maximum* capacitance in the *smallest* package.

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



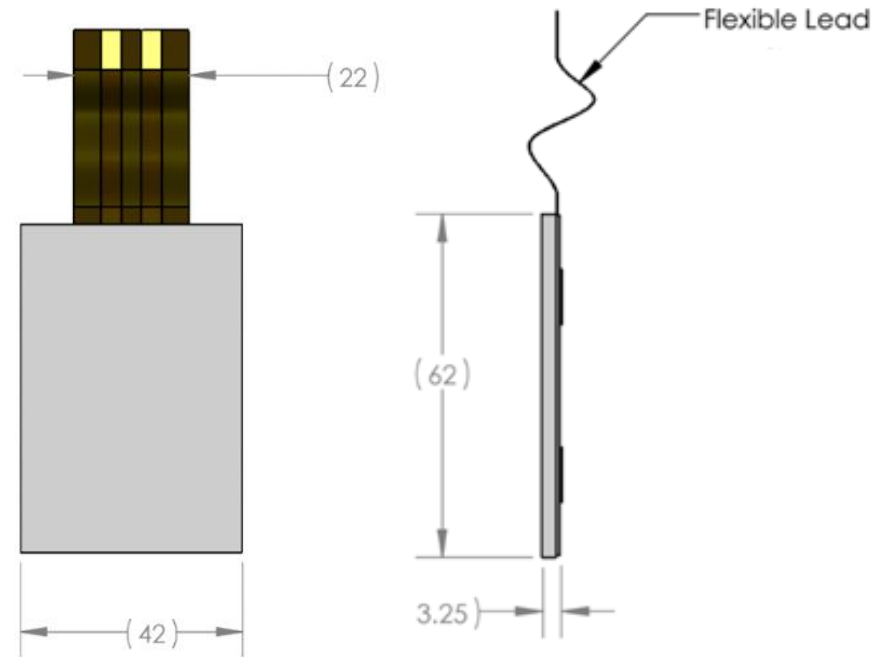
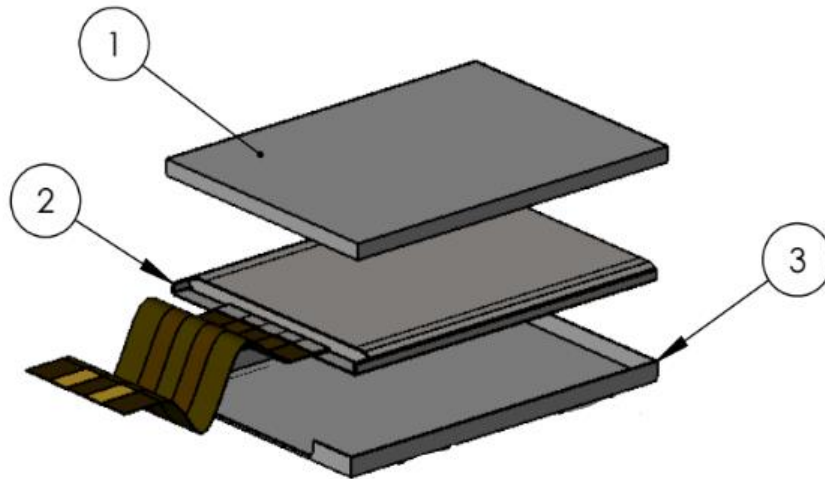


Ultra-Low Profile (ULP) Series Flat Capacitors

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

What is a ULP Flat Capacitor?

1. Top Case Half
2. Pouch Capacitor Assembly
3. Bottom Case Half

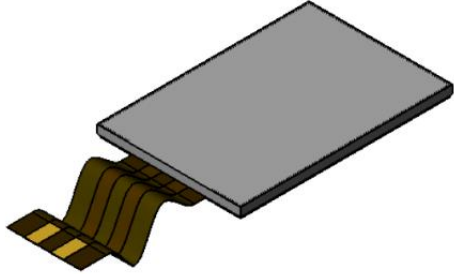


- “Nickel-Silver” Outer Case
- Flex (FPC) Lead System
- Ultra-Thin Package

What Sets the ULP Apart from Traditional Electrolytic Caps?

- **Significantly Reduced Risk of Leaks Over Traditional 'Lytics**
 - Primary seal is a heat-sealed polymer / no rubber gaskets or bungs
 - Primary seal is near-hermetic
 - Outer casing is also sealed, providing a 2nd layer of protection
- **Higher Cap Density due to High Gain Foils, Packaging & Seal System**
 - Seals & Package are < 10% of the capacitor volume (3mm wide seal)
 - Traditional small lytics sacrifice up to 40% of their volume to seals & package.
- **Rigorous In-Process Testing & Monitoring**
 - CDM tests 100% of our ULP's for Capacitance, ESR, DCL & leaks
 - 100% of parts are burned-in for 12 hours at rated temperature
 - Leakage data is monitored, collected & stored
 - Outliers are identified in-process & thrown out

ULP vs. Ta Chips, V-Chips & Snaps



ULP (62x42x3mm)				7343-31 Ta Chips			4mm x 5.8mm V-Chips		21mm x 25mm Snap-In's		
Capacitance (µF)	Rated Voltage (vdc)	Cost		Replaced	Cost	Replaced	Cost	Replaced	Cost		
26,000	4	\$ 10.00		26	\$ 20.80	---	---	---	---		
22,000	6.3	\$ 10.00		46	\$ 36.80	468	\$ 52.00	2	\$ 3.24		
17,000	10	\$ 10.00		51	\$ 40.80	515	\$ 58.42	2	\$ 8.40		
12,000	16	\$ 10.00		80	\$ 64.00	545	\$ 61.58	1	\$ 2.00		
7,600	25	\$ 10.00		111	\$ 88.80	760	\$ 85.90	2	\$ 3.40		
4,800	35	\$ 10.00		145	\$ 116.00	480	\$ 53.76	1	\$ 1.42		
2,400	50	\$ 10.00		160	\$ 128.00	510	\$ 54.57	1	\$ 1.90		
1,700	63	\$ 10.00		---	---	---	---	1	\$ 1.62		

