

FastCAP Ultracapacitors vs. Lithium-Ion Batteries

Metric	FastCAP Ultracapacitors	Ultracapacitors	Lithium-ion Batteries
Energy Storage Mechanism	Energy is stored electrostatically on the surface of the carbon nanotube electrodes, does not involve chemical reactions	Energy is stored electrostatically on the surface of the activated carbon electrodes, does not involve chemical reactions; leakage current occurs due to the reaction of the oxygen groups of the activated carbon and the electrolyte	Energy is stored electrochemically, where chemical reactions release electrical carriers
Safety	Safe, non-volatile electrolyte Robust laser welded package No thermal management required	Volatile electrolyte Risk of venting Package is not hermetically sealed for operations in vacuum or at high temperature Thermal management required	Unsafe when used at high discharge rate Risk of fire and thermal runaway Thermal runaway can occur unexpectedly Toxic and/or deadly gases released in venting events Flammable electrolyte when in contact with oxygen or moisture Requires thermal management
Internal Architecture	FastCAP's proprietary nano-carbon based electrodes with proprietary lithium-free electrolyte	Activated carbon based electrodes with organic solvent-based electrolyte	Complex internal architecture that includes toxic/hazardous materials, such as lithium
Operational Temperature Range	-50°C to 200°C	-40°C to 65°C	-20°C to 60°C
DBR Shocks	50G peak for 500,000 shocks 250G " " 50,000 " 1000G " " 1,000 "	None reported	None reported
DBR Vibrations	60G _{rms}	None reported	None reported
Charge/Discharge Time	1ms - 60 seconds*	1 - 10 seconds	Several hours
Cycle Life	>1,000,000	500,000 - 1,000,000	300 - 500
Gravimetric Peak Power Density	Up to 50 kW/kg*	5 - 7 kW/kg	0.3 - 0.7 kW/kg
Volumetric Peak Power Density	Up to 70 kW/L*	6 - 10 kW/L	0.5 - 1 kW/L
Power Density at 90% Efficiency	3.5 kW/kg*	<1 kW/kg*	< 0.1 kW/kg*
Gravimetric Energy Density	Up to 9 Wh/kg*	1 - 4.5 Wh/kg	70- 200 Wh/kg
Volumetric Energy Density	Up to 11 Wh/L*	1.5 - 7 Wh/L	100 - 250 Wh/L
Service Life	>10 years	10 years	2 - 10 years

*Reported values vary depending on the operating temperature design and form factor of the ultracapacitor. This list of performance metrics encompasses all FastCAP product types and models, optimized for different applications. Individual product types may possess one or more of the above metrics. Comparison utilizes average performance metrics of typical commercially available lithium-ion batteries.