Reducing Energy Storage System Size & Weight in Aerospace Applications with Low Temperature Ultracapacitors

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In aerospace and defense systems, electronic components are used in a wide range of subsystems including telemetry subsystems, structural subsystems, tracking subsystems, velocity control subsystems, power distribution subsystems, and thermal control subsystems. Most of these applications subject electronic systems to large shocks, extreme vibrations, and hostile temperatures. For components that are specially engineered to operate at low temperatures, the performance characteristics are not significantly affected when they are subjected to extremely cold and harsh environments. Apart from enhancing the overall reliability of an application, employing such components eliminates the need for specialized heating systems such as radioisotope heating units and allows use of simplified thermal management systems, helping to reduce the overall cost of building and deploying systems.

Ultracapacitors are specially designed and constructed to deliver high capacitance and power density, but commercially available supercapacitors are not designed to withstand the hostile conditions that electronic systems for aerospace and defense systems are subjected to. Unlike conventional supercapacitors, FastCAP low temperature ultracapacitors and structural ultracapacitors are engineered to withstand extreme shocks, vibrations, and hostile temperatures as low as -55C. It is these characteristics that make them an ideal choice for use in modern defense and aerospace industries. The Nanoramic FastCAP Ultracapacitor cells are an ideal candidate for applications operating at high altitude, such as flight data recorders and high-altitude distributed power buffering.

In most applications, ultracapacitors are used together with traditional energy storage solutions to achieve the ideal balance of power density and energy density for the specific application. Ultracapacitors are suitable for supporting high peak power, leveling high peak loads, and providing high power backup in energy storage solutions. These components are also widely used in energy harvesting systems. The exponential growth in the applications of these components can be attributed to their impressive performance characteristics.

When applications are constrained by size, weight and power, power system selection is very critical. Nanoramic's structural ultracapacitors provide a way to marry highly energy dense modules like batteries with highly power dense ultracapacitors in a way that doesn't compromise the total mass of the system. As part of a NASA funded SBIR, Nanoramic developed structural ultracapacitors to integrate seamlessly with the 10cm by 10cm footprint of a CubeSat and provide high power pulses to a payload.