Minimally Shielded Extreme Environment Power Electronic System for Flywheel Energy Storage

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ABSTRACT

Future colonization missions to the Moon and Mars will require energy storage during long periods of darkness. One option is flywheel energy storage (FES), an option only viable if its power electronic drive system can perform under extreme environments. Historically, components qualified for space missions have required thermally regulated enclosures, increasing mass and volume and utilizing significant thermal energy to heat and cool. The goal of this research is to investigate and specify a power electronic system capable of converting DC power from solar panels to store in a FES system rotating at 40,000RPMs or higher and then remove the energy to deliver to loads on demand. This power electronic system works at high frequencies while handling industrial machine level voltages and currents. It must do so in extreme environments under vacuum and wide temperature swings (-180°C to +130°C). Extreme environment devices need less shielding, reducing energy losses due to heating and cooling and requiring less costly freight to space. This reduction ultimately leads to increased energy density of flywheel energy storage solutions.