



technology opportunity

Novel Controller Selectively Charges Individual Cells in a Battery Pack

Extending battery life and performance in large battery arrays



A battery charge equalizer developed at NASA's Johnson Space Center provides individual cell charging in multi-cell battery strings using a minimum number of transformers. By effectively keeping all the cells in a multi-cell string at the same charge state, this technology maximizes the battery's life and performance. Designed to augment a simple high-current charger that supplies overall battery system energy, the innovation achieves equalization without wasting energy or creating excess heat. Johnson's battery charge equalizer complements existing high-voltage chargers and instrumentation systems and offers safe and low-cost management for lithium-ion (Li-ion) batteries used in electric vehicles and other next-generation renewable energy applications.

Benefits

- **Advanced equalization:** Charges specific individual cells, compared to traditional methods that charge the entire string then balance the charge by discharging a subset of the string
- **Safe:** Features a fail-safe operation and built-in electrical isolation from the main charge circuit
- **Fast:** Identifies and charges only the cells that need charging, greatly reducing charge time
- **High efficiency:** Wastes no energy from discharging cells through resistors and other regulators
- **Extends battery life:** Maintains and manages battery charge state, increasing individual battery life and total battery pack system life

Applications

- Electric vehicles (EVs), hybrid electric vehicles (HEVs), and plug-in hybrid electric vehicles (PHEVs)
- Stationary power systems
- Space mission critical battery systems
- Grid energy storage
- Uninterruptible power supply (UPS) systems
- Electric utility storage for renewable energy systems

Technology Details

High-power batteries generally consist of a series connection of many cells or cell banks. Cell equalization is essential to keep all the cells in a multi-cell string at the same charge level, preventing under-charging and/or over-charging while maximizing the battery's capacity and efficiency. NASA Johnson's innovation can identify a single cell or cell bank that needs a charge, then charge that individual cell within a battery pack of hundreds of cells, extending battery system life.

How It Works

The NASA Johnson innovation consists of a transformer array connected to a battery array through rectification and filtering circuits. The transformer array is connected to a drive circuit and a timing and control circuit, which enables individual battery cells or cell banks to be charged. The timing and control circuit connects to a charge controller that uses battery instrumentation to determine which battery bank to charge.

The system is ultra lightweight because it uses much fewer than one transformer per battery cell. For instance, 40 battery cells can be balanced with an array of just five transformers. NASA Johnson's innovation can charge an individual cell bank at the same time that the main battery charger is charging the high-voltage battery system.

Why It Is Better

Conventional equalization techniques require complex and costly electrical circuitry to achieve cell monitoring and balancing. Further, such techniques waste the energy from the most charged cells through a dummy resistive load (regulator), which is inefficient and generates excess heat.

In contrast, NASA Johnson's innovation equalizes battery strings by selectively charging only those cells that need it rather than discharging the entire multi-cell string into heat-generating regulators. The technology maintains battery state-of-charge to improve battery life and performance. In addition, the technology provides a fail-safe operation and a novel built-in electrical isolation from the main charge circuit, further improving the safety of high-voltage Li-ion batteries.

Patents

NASA's Johnson Space Center is seeking patent protection for this technology.

Licensing and Partnering Opportunities

This technology is part of NASA's Technology Transfer Program, which ensures that technologies developed for missions in exploration and discovery are broadly available to the public, maximizing the benefit to the Nation. NASA invites companies to consider licensing the Battery Charge Equalizer with Transformer Array (MSC-25026-1) for commercial applications.

For More Information

If you would like more information or want to pursue transfer of this technology, please contact:

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