National Aeronautics and Space Administration

Power Generation and Storage

Battery Charge Equalizer System

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. NASA'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.

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BENEFITS

- Advanced equalization - charges specific individual cells
- Safe - features a fail-safe operation and built-in electrical isolation
- Fast - charges only the cells that need charging, reducing charge time
- Highly efficient - wastes no energy from discharging cells
- Extended battery life - maintains and manages battery charge state

technology solution

THE TECHNOLOGY

The 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. The innovation can charge an individual cell bank at the same time while the main battery charger is charging the high-voltage battery system.

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, this system equalizes battery strings by selectively charging cells that need it. 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 for the main charge circuit, further improving the safety of high-voltage Li-ion batteries.

The NASA developed technology has applications in both electric automotive equipment and grid energy storage.

APPLICATIONS

The technology has several potential 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

PUBLICATIONS

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More Information

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Agency Licensing Concierge

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