Design and Construction of a Scalable Active Battery Management System for Electric and Hybrid Electric Vehicles

Prevost, Drew

As battery cells age, their capacities diverge, which causes problems in large series connected packs such as those found in electric vehicles. Cells that develop larger or smaller capacities compared to other cells in the pack are subject to greater stress upon charge and discharge, which further accelerates the problem. Because of this, a method of balancing the cell voltages is needed. The problem solved by this phase of the project is that the electronics industry lacks a scalable solution to active battery management. This makes it more difficult and more expensive to develop electric vehicles. The two major types of cell balancing methods are passive (exporting energy from higher cells as heat, which is inefficient but simple), and active (moving charge from higher cells to lower cells). With the recent trend towards efficiency, active cell balancing is becoming more popular. However, current methods do not scale easily, require a large number of cell tap wires, and most are incapable of directly moving a charge from a higher cell to a lower cell. The cell balancing method developed in this project solves these problems through the use of an isolated AC balance bus. The basic circuit is a multi node bidirectional isolated DC / DC voltage controlled current source. This allows the net energy transfer between cells to function as if the cells are in parallel, while they are electrically connected in series. The project was a success, because current battery balancing problems were solved and a scalable solution developed.

Awards Won:

Second Award of $2,000