



THE LEADING MANUFACTURER OF ULTRACAPACITORS AND LITHIUM-ION CAPACITORS

LICAP Technologies Application Note

Module Active Cell Balancing

With the lower operating voltage range of ultracapacitor cells, it is common that some number of them are connected in series to reach the desired working voltage for a given application. Ultracapacitors inherently have a high impedance internal current path between anode and cathode requiring a small current flow to maintain constant voltage across the cell. This is known as leakage current and when this current flow is turned off, the related phenomenon known as self-discharge occurs. Capacitance values also vary from cell to cell and combined with leakage current variations, the cells act as a voltage divider resulting in cell to cell voltage imbalances. Individual cell voltage should never exceed the specified voltage rating as this can shorten cell life through capacitance loss, increasing equivalent series resistance (ESR), and heat generation.

LICAP Technologies active balancing circuits apply to each individual cell within the module to mitigate the voltage imbalance condition. Low quiescent current draw of the circuitry reduces energy bleed off when there is no charge current flowing. The balancing circuit threshold is set at 2.75V. Whenever a cell voltage exceeds the threshold, the balancing circuit will activate to bring down the cell voltage.

Referring to Figure 1, V_{in} is proportional to the cell voltage and enables U1, a three-terminal voltage level translator to change V_{out} to a low condition when cell voltage is above 2.75V. This turns on Q1, and in turn Q2. With this action, the cell energy dissipates through R2 and R3 and the cell voltage decreases. When the cell voltage drops below the set point, V_{out} returns to a high output condition, Q1 and Q2 turn off and the reduction of cell voltage terminates.

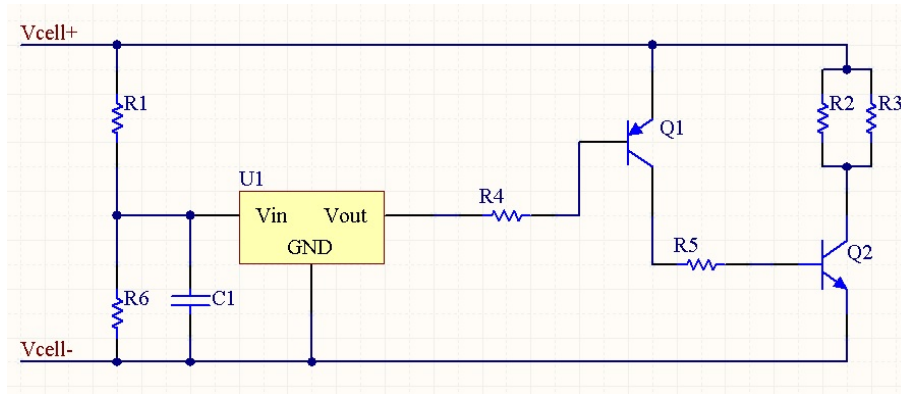


Figure 1 - Schematic representation of the active balancing circuit

With this active balancing circuit, cells maintain a voltage balance amongst themselves to ensure similar cell to cell performance towards achieving a long module lifespan. The active balancing circuit is currently implemented in LICAP modules such as the 16V/500F and 48V/165F.



Figure 2 - PCBA for 16V/500F Module

The Figure 2 photo of the PCBA shows the balancing circuit laid out six times for each of the cells in our 16V/500F module.

Our Story

LICAP Technologies, established in 2016, is a manufacturer of innovative ultracapacitor electrode material, high quality ultracapacitor cells and ultracapacitor modules. Our patented LICAP Activated Dry Electrode manufacturing process was developed in our California R&D laboratories. Dr. Linda Zhong, the leader in modern ultracapacitor electrode design with over forty patents in the US and abroad, is our company President. LICAP Technologies leads the way in ultracapacitor performance.

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