Cell Balancing Algorithm

Cells have different initial state of charge and different capacities. Therefore, when we charge the battery pack, not all cells are going to be at 100%. Therefore, we need a cell balancing algorithm so that all the cells are around 100% when charging completes so that we can get more energy out of the battery pack.

Algorithm

The algorithm is simple. First,

a) Charging completes when a cell reaches 3.65V as any higher than that may harm the cell.
b) Discharging ‘complete’s when a cell reaches 2.5V as any lower than that may harm the cell.

The cells also have bypassess. If a cell has bypass on, it will charge 0.8 times as fast as a cell with bypass off.

Therefore, the algorithm is such that

a) if a cell is charging faster than other cells, turn on the bypass for the cell.
b) For the fast cell, lower the bypass threshold for next cycle for that cell.
c) For slower cells, higher the bypass threshold for next cycle for those cells.

Assume that all cells have the same bypass threshold of around 3.585 V. (Cells will turn on bypass at this point).

Different initial SOC

If cell A has higher initial SOC, it will reach the bypass threshold faster than other cells. Then it will start charging at 0.8 rate as the bypass will be turned on. This will allow cells with lower initial SOC to start catching up to it and closes the different initial SOC gap.

Different Capacity

If cell A has lower capacity, it will charge to complete faster. Therefore, it will complete charging faster than other cells every charge cycle. Therefore, we need to lower the bypass threshold so that it turns on the bypass ahead of other cells and slows down its charging. For slower cells, we should increase the bypass threshold.

Summary

In short, this algorithm will balance the cells over some charge cycles. The algorithm manipulates the bypass thresholds for each cell to determine which cell should charge faster and which cell should charge slower. An upper and lower limit is in place so that the bypass thresholds are not low enough to turn on the bypass as soon as it charges and not high enough so that it never turns on the bypass.