## 2.5 Cell Balancing (CB)

**2.5.1 Feature Objective:**

When battery is charged or discharged in hybrid or pure electric vehicles, the SOC of one cell can diverge from that of others. For example, different cells can have different Coulombic efficiency that attributes to the SOC difference among them although they are charged or discharged with the same net current. Moreover, some factors including different leakage current and rate of cell discharge may introduce different net current at each cell such that their SOC values would deviate with each other. The objective of cell balancing is to balance the SOC of all cells to approximately the same lowest level such that the high SOC based aging on some cells is minimized.

**2.5.2 Functional Description:**

Battery balancing process should be enabled only during charging process and only when the minimum cell SOC is greater than a certain threshold.

The minimum cell SoC and minimum cell voltage is first determined. We then check if any cell has its SOC greater than the minimum cell SOC for a given threshold or its voltage is greater than the minimum cell voltage for a second threshold. If any of the above two conditions is true, the cell balancing command for that cell is on and current will bypass this cell. The difference between each cell voltage and the weakest cell voltage is calculated. If the difference is greater than a threshold then cell balancing is triggered for that cell. If any of the above two conditions is not true, then cell balancing command for that cell is off.

*Enable the following logic only if battery is in charging mode and SOC is greater than a threshold*

*If (cell voltage – min cell voltage > threshold1) or (cell SOC – min cell SOC) > (threshold2)*

*Cell balancing command (Cell Index) = 1*

*Else*

*Cell balancing command (Cell Index) = 0*

The cell balancing status is also determined based on cell balancing status of all cells.

*If sum (Cell balancing command) >= 1*

*Cell balancing status = 1*

*Else*

*Cell balancing status = 0*

**2.5.3 I/O description:**

The Cell Balancing module requires the dynamic I/O shown in the following table

|  |  |  |  |
| --- | --- | --- | --- |
| **Signal(s)** | **I/O** | **Description** | **Units/comments** |
| CB\_Input\_CellV | Input | cell voltage | V |
| CB\_Input\_CellSOC | Input | cell SOC | unitless |
| CB\_Input\_BattMode | Input | battery mode state | unitless |
| CB\_balancing\_cmd | output | cell balancing command | unitless |
| CB\_balancing\_status | output | cell balancing status | unitless |