

Cell voltage balancing

If UltraCaps are connected in series to gain higher rated voltage, uniform voltage distribution becomes critical. Depending on the application, voltage balancing can be achieved by active or passive balancing or a combination of both.

1 Passive balancing

Recommended if:

- the closed-circuit current is of minor relevance,
- the voltage compensation can be extended to several hours, e.g. uninterruptible power supply.

Function

- Cell voltage balancing carried out via an ohmic resistor connected in parallel to the UltraCap cell terminals.
- Recommended value $R = 100000 \text{ s/C}$, tolerance $\pm 1\%$ of next standard value.

2 Active balancing

Recommended if:

- the closed-circuit current should be kept low,
- cyclic applications are concerned, e.g. electrical system applications of vehicles.

Function

- In the case of UltraCaps in series connection, it is recommended to connect a cell voltage balancing unit in parallel with each cell.
- Core of the unit is a comparator with a precise internal voltage reference and an ultra-low singlesupply operating voltage range.
- If the cell voltage U_c (calculated by the formula below) is higher than the average voltage level of the connected UltraCaps, the cell voltage balancing unit closes the switch S (Fig. 1). Cell discharging occurs with approx. 800 mA via the integrated bypass resistor R_{byp} as long as the cell voltage level becomes the average level and the switch S opens again – balanced UltraCaps.
- In a nutshell, overvoltage will be prevented by forced high selfdischarge rates.

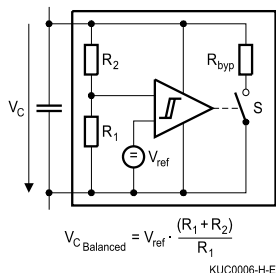


Figure 1
Schematic of active cell voltage balancing

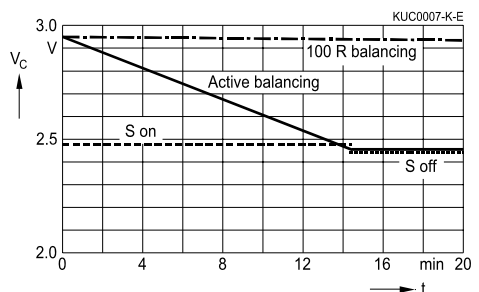


Figure 2
Diagram of balancing