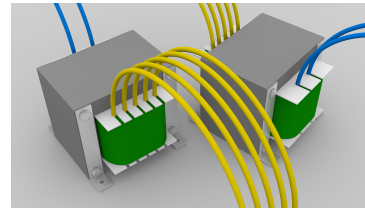




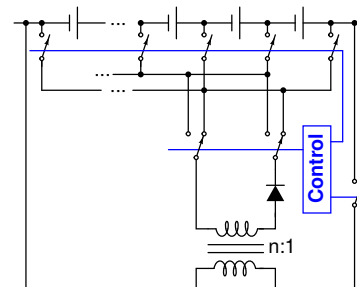
Active balancing using transformers

- Transformers are devices that convert AC electrical energy from one voltage/current level to another
- Usually constructed by winding insulated “primary” winding around a magnetic core, and also winding insulated “secondary” winding(s) around same core
- If ratio of primary : secondary winding is $n : 1$, then secondary voltage will be $1/n$ times primary voltage and secondary current will be n times primary current (ideally)
- Can be used to move charge from n cells in a battery stack to single cell



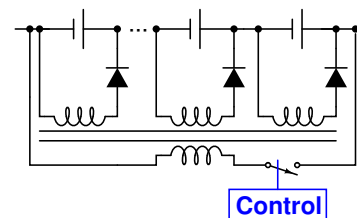
Active: Switched transformer

- Transformer-based active balancing can move charge quickly
- Rapidly switching primary creates approximate AC waveform, reproduced on secondary
 - Primary is connected across n cells
 - Transformer is wound with a $n : 1$ ratio
- Diode plus switches select cell to receive charge
- Much more efficient than passive balancing; much faster than capacitive methods; but also expensive due to transformer and electronics costs
- Presently, silicon vendors are working to create automated controls chips to make more feasible



Active: Shared transformer

- A simplified variation of the prior scheme is to use a transformer with custom winding and a diode circuit
- The control rapidly switches input to make approximate AC signal across primary
- Diodes route secondary current to low-voltage cells
 - Balancing is automatic without requiring sophisticated algorithms
 - But, need for custom transformer design makes approach quite expensive





Summary

- You have now seen two transformer-based circuit designs for cell balancing
- Much more efficient than passive balancing
- Much faster than capacitive methods
- But expensive due to transformer and electronics costs
- Presently, silicon vendors are working to create automated controls chips to make more feasible



Credits

Credits for photos in this lesson

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