Active Cell Balancing Using Flyback Converter

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INTRRODUCTION

- With the increasing adoption of electric vehicles, the importance of cell balancing techniques for maintaining voltage uniformity among series-connected battery cells has significantly increased.
- Conventional passive cell balancing methods feature a simple structure. However, they suffer from low efficiency and slow balancing speed due to energy dissipation through resistive elements.
- To overcome these limitations, a flyback converter-based active cell balancing architecture is proposed. By utilizing a transformer, the proposed structure enables energy transfer between higher-voltage and lower-voltage cells, achieving high efficiency and fast balancing performance.

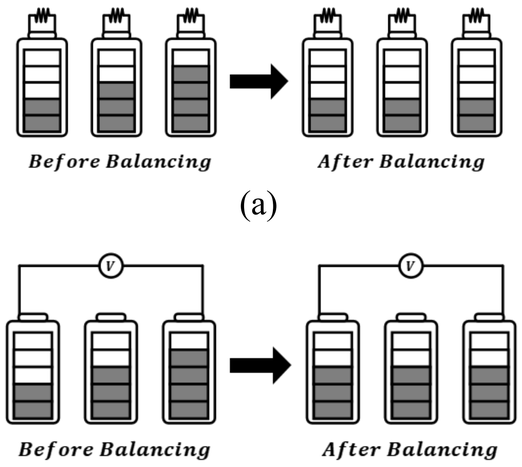

Fig. 1. Efficiency of Passive and Active Cell Balancing (a) Passive Cell Balancing (b) Active Cell balancing

PROPOSED CIRCUIT DESIGN

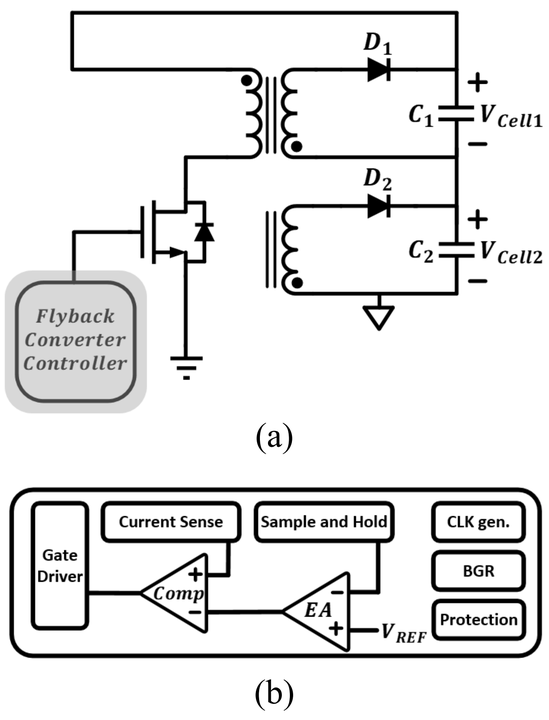

Fig. 2. (a) Proposed Active Cell Balancing System (b) Flyback Converter Controller

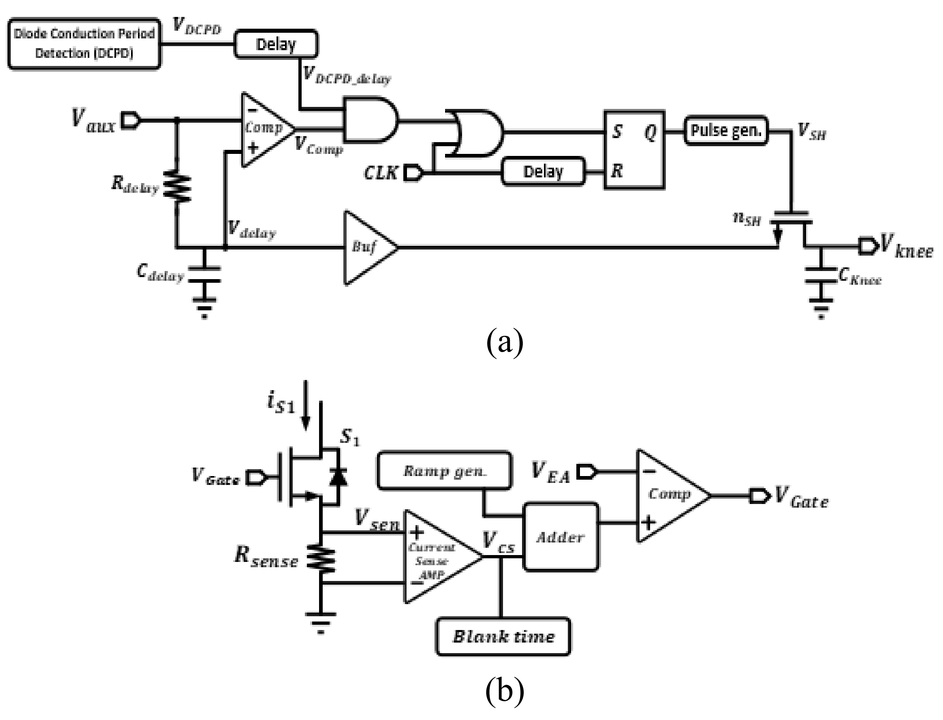

Fig. 3. Schematic of the designed Flyback Converter Controller (a) Sample and Hold (b) Current Sense

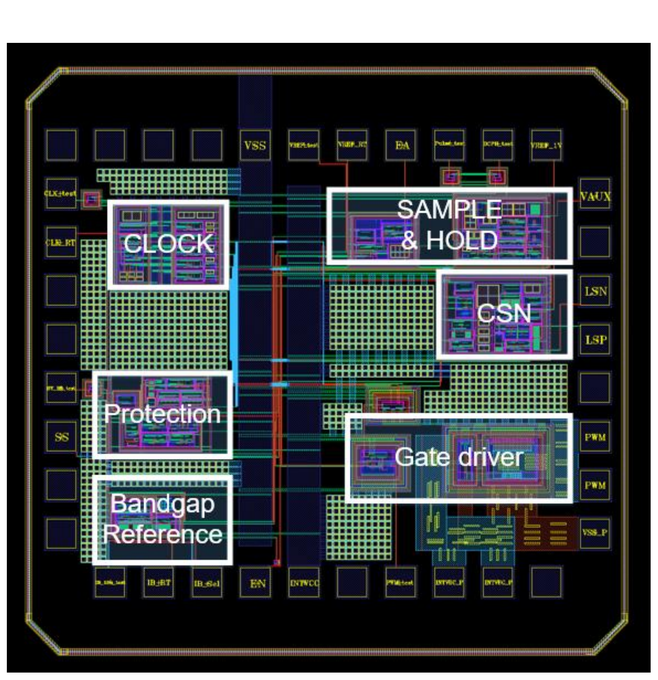

Fig. 4. Chip layout

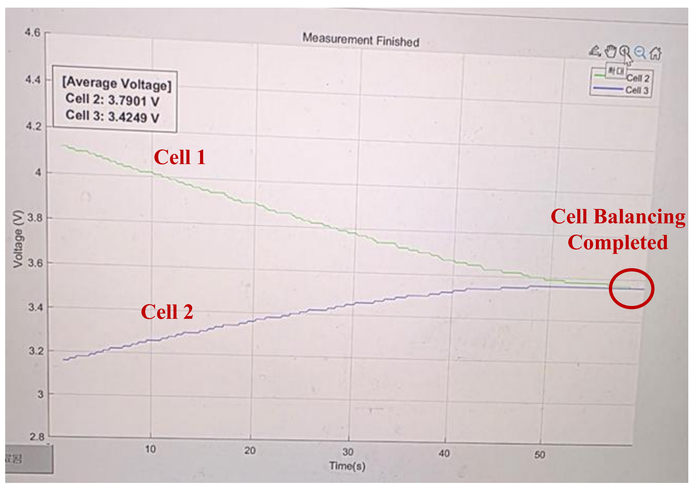

Fig. 5. Measured Cell Balancing Results

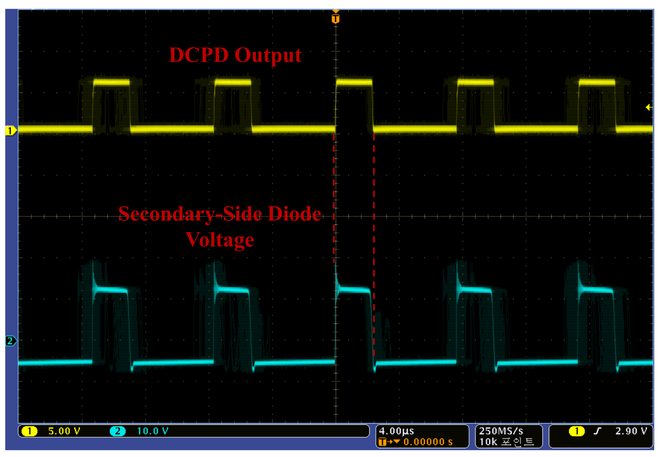

Fig. 6. Measured DCPD Output

Specifications	
Technology	DB 180nm BCD
Chip area	1.2mm * 1.2mm
Switching frequency	100KHz
Balancing Current	2.1A
Balancing Efficiency	94.8%

Table. 1. Design Results

CONCLUSION

- A flyback converter topology is employed to achieve high-efficiency, high-speed, and low-current cell balancing, thereby enabling effective energy redistribution among series-connected battery cells while minimizing power loss and improving overall system performance.
- A diode current sensing circuit on the secondary side of the transformer is designed to enable precise control of the flyback converter, and is experimentally verified to accurately monitor switching behavior and ensure stable system operation.