Electricity

Voltage Equalizer between Two Battery Modules without Control

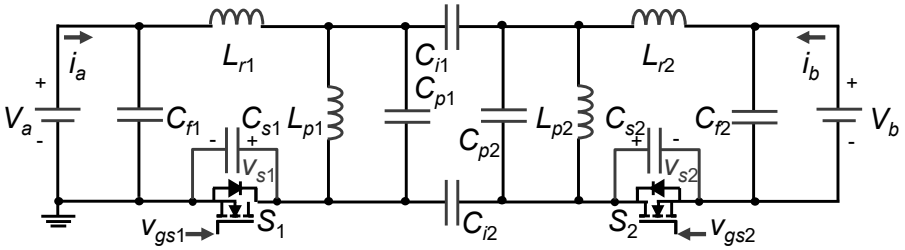
Hirotaka Koizumi
Professor, Dept. of Electrical Engineering, Tokyo University of Science

Purpose of Research

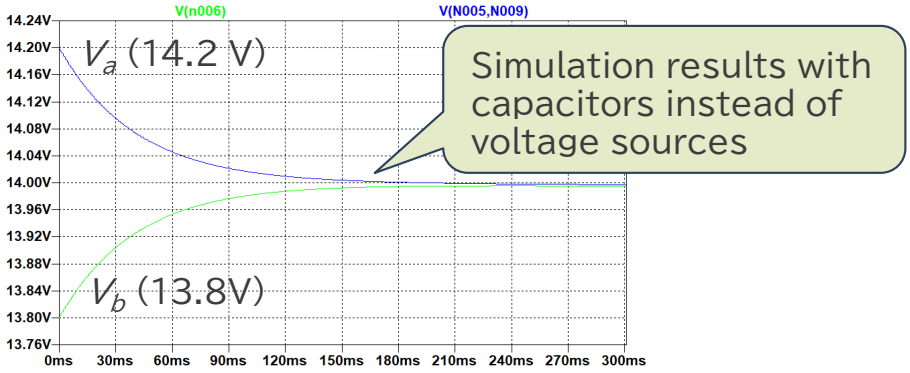
We have proposed a high-frequency resonant power converter named 'load-independent class E² parallel resonant DC-DC converter.' At the high-frequency stage, a capacitor coupler is also able to be installed for insulation. This converter naturally flows its current from the higher-voltage DC side to the lower-voltage DC side. Potential applications include, but are not limited to, voltage equalizer and wireless power transfer systems.

Summary of Research

The proposed converter is composed of two Load-independent class E parallel resonant inverters, which output a constant amplitude of AC current without any control even when the load resistance is changed. Connecting the AC output ports of the two inverters and driving them with reverse phase driving signals, they operate as a DC-DC converter. One unique characteristic is that this converter naturally flows its current from the higher-voltage side to the lower-voltage side, which can be used as a non-control voltage equalizer between two battery modules.



Load-independent class E² parallel resonant DC-DC converter (with capacitor coupler)



POINT

- Voltage equalizer WITHOUT control
- Only TWO active devices
- High-frequency operation by ZVS
- Capacitor coupler insulation

Comparison with Conventional or Competitive Technologies

【Conventional】
- Resistive consumption
→Energy loss, thermal ejection
- Switched-capacitor equalizer
→Complex switch array
- One on one converter connection
→Complex circuit with sensors

【Proposed】
- No resistive consumption
- Only two active devices
- Bidirectional (higher to lower)
- Capacitor coupler insulation

Expected Applications

- Voltage equalizer for battery
- Bi-directional DC-DC converter

Challenges in Implementation

- Experiment with real batteries (currently with electronic load)

What We Expect from Companies

- Collaborative research with battery manufacturers

Future Developments

2026 To be applied to capacitive power transfer systems

■Intellectual Property:
Japanese Patent Application No. 2023-195500
■Prototype: Laboratory trial model

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TOKYO UNIVERSITY OF SCIENCE Organization for Innovation and Social Collaboration
1-3, Kagurazaka, Shinjuku-ku, Tokyo, 162-8601, Japan E-MAIL: ura@admin.tus.ac.jp