ABSTRAK

SYNCHRONOUS SEPIC SEBAGAI PENGISIAN BATERAI *LI-ION* MENGGUNAKAN PENGENDALI *FUZZY LOGIC*

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Ketidakstabilan tegangan *output* akibat fluktuasi tegangan *input* menjadi salah satu permasalahan utama pada sistem *converter* DC-DC, khususnya dalam aplikasi pengisian baterai. Metode pengendalian konvensional kerap kali belum mampu merespons perubahan kondisi secara cepat dan akurat. Oleh karena itu, penelitian ini merancang dan merealisasikan sistem pengisian baterai Li-Ion menggunakan *Synchronous* SEPIC berbasis pengendali *Fuzzy Logic*, yang mampu menaikkan maupun menurunkan tegangan tanpa membalik polaritas. *Fuzzy Logic* diterapkan untuk mengatur *duty cycle* berdasarkan nilai *error* dan delta *error* antara tegangan *set point* dan tegangan *output* aktual. Pengujian dilakukan dengan variasi tegangan *input* 10V dan 20V, sementara *set point* ditetapkan sebesar 13V. Hasil pengujian menunjukkan bahwa sistem mampu menjaga kestabilan tegangan *output* dengan rise time 2,75–2,76 detik, *overshoot* di bawah 0,6%, dan *settling time* kurang dari 4 detik, baik pada penaik atau penurun tegangan. Hasil ini membuktikan bahwa penerapan *Synchronous* SEPIC dengan kendali *Fuzzy Logic* efektif meningkatkan kestabilan pengisian baterai *Li-Ion* serta memiliki potensi untuk dikembangkan lebih lanjut dalam sistem berbasis energi terbarukan.

Kata kunci: SEPIC Converter, *Fuzzy Logic*, Pengisian Baterai Li-Ion, Synchronous, *Duty cycle*

ABSTRACT

DESIGN OF A SYNCHRONOUS SEPIC FOR LI-ION BATTERY CHARGING WITH *FUZZY LOGIC* CONTROL

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Output voltage instability caused by *input* voltage fluctuations is one of the main challenges in DC-DC converter systems, especially in battery charging applications. Conventional control methods often fail to respond quickly and accurately to such dynamic conditions. To address this issue, this study designs and implements a Li-Ion battery charging system using a Synchronous SEPIC Converter controlled by *Fuzzy Logic*, which can increase or decrease the voltage without inverting its polarity. *Fuzzy Logic* is applied to adjust the *duty cycle* based on the error and delta error values between the set point voltage and the actual *output* voltage. The system was tested under *input* voltage variations of 10V and 20V, with a constant set point of 13V. The test results indicate that the system successfully maintains a stable *output* voltage with a rise time of 2.75–2.76 seconds, overshoot below 0.6%, and a settling time of less than 4 seconds, operating effectively in both boost and buck modes. These findings demonstrate that implementing a Synchronous SEPIC Converter with *Fuzzy Logic* control effectively enhances the stability of Li-Ion battery charging systems and offers potential for further development in renewable energy-based applications.

Keywords: SEPIC Converter, *Fuzzy Logic*, Li-Ion Battery Charging, Synchronous, *Duty cycle*