

INTISARI

Electric Vehicle Charging System (EVCS) 3,3 kW yang beroperasi di ruang terbuka menerima beban panas dari komponen elektronika daya dan radiasi matahari, sehingga diperlukan sistem pendinginan udara paksa yang mampu menjaga temperatur komponen tetap berada dalam batas aman. Penelitian ini bertujuan menghitung total beban panas pada sistem, menentukan kebutuhan aliran udara, memilih spesifikasi kipas pendingin, serta mengevaluasi pengaruh tata letak kipas terhadap kinerja pendinginan. Perhitungan dilakukan berdasarkan neraca energi untuk memperoleh kebutuhan aliran udara minimum, kemudian ditentukan kebutuhan aliran udara desain dengan margin keamanan 1,5 sebagai dasar pemilihan spesifikasi kipas. Simulasi *Computational Fluid Dynamics* (CFD) dilakukan menggunakan tiga variasi tata letak kipas. Hasil perhitungan menunjukkan total beban panas sistem sebesar 1.510 W, kebutuhan aliran udara minimum sebesar 282,5 CFM, dan kebutuhan aliran udara desain sebesar 423,8 CFM. Berdasarkan kebutuhan tersebut dipilih kipas SUNON seri EEC0251B3-0000-A99 dengan kapasitas maksimum 75 CFM. Hasil simulasi CFD menunjukkan bahwa seluruh variasi tata letak kipas mampu menjaga temperatur *power module* di bawah 85 °C, namun variasi B menghasilkan temperatur *power module* paling rendah dan distribusi temperatur yang lebih merata dibandingkan variasi A dan variasi C. Dengan demikian, variasi B merupakan konfigurasi kipas yang paling sesuai untuk sistem pendinginan EVCS 3,3 kW pada penelitian ini.

Kata kunci: EVCS, pendinginan udara paksa, CFD, kebutuhan aliran udara

ABSTRACT

A 3.3 kW Electric Vehicle Charging System (EVCS) operating in an outdoor environment receives heat loads from power electronic components and solar radiation, thus a forced-air cooling system is required to keep component temperatures within safe operating limits. This study aimed to calculate the total heat load of the system, determine the minimum airflow requirement, choose an appropriate cooling fan specification, and evaluate the effect of fan placement on cooling performance. The calculation was based on an energy balance to obtain the minimum airflow requirement, followed by the determination of the design airflow requirement using a safety factor of 1.5 as the basis for fan selection. Computational Fluid Dynamics (CFD) simulations were conducted for three fan-layout variations. The results show that the total heat load of the system was 1,510 W, the minimum airflow requirement was 282.5 CFM, and the design airflow requirement was 423.8 CFM. Based on these requirements, the SUNON EEC0251B3-0000-A99 fan was selected, with a maximum airflow capacity of 75 CFM. The CFD results indicate that all fan-layout variations were able to maintain the power module temperature below 85 °C, however, variation B produced the lowest power module temperature and more uniform temperature distribution than variation A and variation C. Therefore, variation B was determined to be the most suitable configuration for the cooling system of the 3.3 kW EVCS in this study.

Keywords: *EVCS, forced-air cooling, CFD, airflow requirement*