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Bidirectional onboard chargers for electric vehicles: A Comprehensive Performance and Efficiency Analysis of Future Trends (Review)

Author: Susmita Mistri, Souradip Roy and Hao-Chung Kuo

Category: Automobile Engineering

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Abstract:

The Bidirectional Onboard Chargers (BOCs) into Electric Vehicles (EVs) represents a critical advancement in the evolution of smart grid technologies, enabling two-way power flow between the vehicle and the grid or other loads. This paper presents a comprehensive review of the performance, efficiency, and future trends in BOCs, with a focus on their role in improving the sustainability and resilience of power systems. We examine the latest developments in power conversion technology, such as the application of Silicon carbide (SiC) and Gallium nitride (GaN) semiconductors and talk about how they affect charger performance and energy efficiency. Key issues like battery degradation, standardization, and regulatory obstacles are examined, along with possible fixes to improve the scalability and dependability of BOCs. We also look into future applications that have the potential to transform energy management, including vehicle-to-grid (V2G), vehicle-to-home (V2H), and vehicle-to-load (V2L). Our objective is to maximize the integration of BOCs into EVs and smart grid infrastructures by highlighting the current research progress and identifying important areas for future development.

Keywords: On – board Chargers (OBC), Unidirectional and Bidirectional Charger, AC-DC converters, DC-DC converters, Electric Vehicle (EVs), Gallium nitride, Power factor correction (PFC)

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References:

1. Zhou K, Yang H, Zhang Y, et al (2024) A review of the latest research on the topological structure and control strategies of on-board charging systems for electric vehicles. *J Energy Storage* 97
2. Khaligh A, Dantonio M (2019) Global Trends in High-Power On-Board Chargers for Electric Vehicles. *IEEE Trans Veh Technol* 68:3306–3324. <https://doi.org/10.1109/TVT.2019.2897050>
3. Sam CA, Jegathesan V Bidirectional integrated on-board chargers for electric vehicles-a review. <https://doi.org/10.1007/s12046-020-01556-2S>
4. Rana R, Saggu TS, Letha SS, Bakhsh FI (2024) V2G based bidirectional EV charger topologies and its control techniques: a review. *Discover Applied Sciences* 6
5. Wouters H, Martinez W (2024) Bidirectional Onboard Chargers for Electric Vehicles: State-of-the-Art and Future Trends. *IEEE Trans Power Electron* 39:693–716. <https://doi.org/10.1109/TPEL.2023.3319996>
6. Shahed MT, Rashid ABMH ur (2024) Battery charging technologies and standards for electric vehicles: A state-of-the-art review, challenges, and future research prospects. *Energy Reports* 11:5978–5998
7. Saraswathi VN, Ramachandran VP (2024) A comprehensive review on charger technologies, types, and charging stations models for electric vehicles. *Heliyon* 10
8. Mastoi MS, Zhuang S, Munir HM, et al (2022) An in-depth analysis of electric vehicle charging station infrastructure, policy implications, and future trends. *Energy Reports* 8:11504–11529
9. Dimitriadou K, Rigogiannis N, Fountoukidis S, et al (2023) Current Trends in Electric Vehicle Charging Infrastructure; Opportunities and Challenges in Wireless Charging Integration. *Energies (Basel)* 16
10. Oh HS, Hong SY, Lee J, Lee JB (2024) Comparison of Bi-Directional Topologies for On-Board Charger: A 10.9 kW High-Efficiency High Power Density of DC-DC Stage. *Energies (Basel)* 17. <https://doi.org/10.3390/en17215496>
11. Sethuraman R, Rudhramoorthy M (2024) Performance of bidirectional ON-Board Charger in Electric Vehicle: A review. *e-Prime - Advances in Electrical Engineering, Electronics and Energy* 8. <https://doi.org/10.1016/j.prime.2024.100613>
12. Dar AR, Haque A, Khan MA, et al (2024) On-Board Chargers for Electric Vehicles: A Comprehensive Performance and Efficiency Review. *Energies (Basel)* 17:4534. <https://doi.org/10.3390/en17184534>
13. Pradhan R, Keshmiri N, Emadi A (2023) On-Board Chargers for High-Voltage Electric Vehicle Powertrains: Future Trends and Challenges. *IEEE Open Journal of Power Electronics* 4:189–207. <https://doi.org/10.1109/OJPEL.2023.3251992>