Fractional Charging Converter with High Efficiency and Low Cost for Electrochemical Energy Storage Devices

High efficiency and low cost power converters for interfacing energy storage have become critical in renewable energy systems. In this paper a fractional charging converter (FCC) is proposed to reduce power rating as well as cost of the dc-dc converter for hydrogen production by alkaline electrolyzer cells. The FCC configuration only processes the partial power resulting from the voltage difference between the source and the energy storage element. Moreover, the converter employed in such configuration can be either isolated or non-isolated, which simplifies topology selection. An analysis and comparison of two dc-dc topologies using a high-frequency transformer based on component stress factor (CSF) is performed to determine the optimal solution for the evaluated application. Based on the results of the CSF analysis, and due to its capability of handling wide input voltage, the isolated full-bridge boost (IFBB) converter is designed, built and tested. Experimental results prove the feasibility of the fractional charging configuration with a reduction of 80% of the power rating compared to the traditional interconnection, which implies a reduction in cost, weight and an increase in efficiency. The converter’s maximum voltage gain achieved is 25 and the highest measured system efficiency is 98.2%.

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