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SYNTHESIS AND ANALYSIS OF A DUAL-INPUT PARALLEL DC-DC CONVERTER DESIGNED BY USING SWITCHED CAPACITOR TECHNIQUES

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Abstract. *As a building block of mobile equipments, single-input switched-capacitor (SC) power converters have been used. However, the single-input converter is difficult to improve battery runtime by adjusting a voltage conversion ratio, because the ratio of the voltage conversion is predetermined by circuit structure. To solve this problem, a dual-input parallel-connected converter designed by the SC technique is proposed in this paper. Although the conventional single-input converter uses a lithium battery as an input energy source, the proposed dual-input converter uses not only a lithium battery but also solar cells. For the conventional SC converters, the energy conversion of clean energy is difficult, because the voltage of clean energy sources such as solar cells is sensitive to weather condition. To adopt the change in the voltage of clean energy input, the proposed converter provides the multi-state step-up conversion. By converting clean energy, the proposed converter realizes long battery runtime. Moreover, to design the multiple-input converter, the theoretical analysis to clarify circuit characteristics is required, because detailed analyses concerning multiple-input SC DC-DC converters have not been performed yet. Therefore, concerning circuit characteristics of the proposed dual-input converter, handy theoretical formulas are given in this paper. Through SPICE simulations, theoretical analyses and experiments, the validity of the proposed converter is confirmed. The theoretical results correspond well with SPICE simulation results. Therefore, the proposed analysis technique can be extended to the circuit design of other multiple-input SC DC-DC converters. Furthermore, the experimental results show that the proposed converter can generate the stepped-up voltage in spite of the change in the voltage of solar cells. Therefore, the proposed converter can realize long battery runtime.*

Keywords: Power converters, Parallel converters, Switched-capacitor circuits, Charge-pump circuits, Multiple input circuits, Clean energy