An Asynchronous-Switched-Capacitor DC-DC Converter Based on GaN and SiC Devices

For the state-of-the-art switched-capacitor DC-DC converters at high-voltage low-power levels, switching loss becomes a major concern and challenge. Existing switching schemes operate power semiconductors at a single common frequency, which does not optimally address the switching losses, especially for a high-conversion-ratio design. This paper presents a concept of Asynchronous-Switched-Capacitor (ASC), which is applied to the GaN switches that are combined with the SiC diodes to improve the efficiency and the power density. Two stages of switched-capacitors are operating with uncorrelated frequencies, without phase and clock synchronization of the control signals. A 380 V, 6 W, 4:1 conversion ratio converter experimentally validates the concept. The efficiency is improved by 4 % and the peak-to-peak output voltage ripple is reduced by 39 %, with the proposed ASC switching compared to a synchronous operation. A peak efficiency of 95.4 % is achieved.