

磁集成开关电容高增益级联Boost变换器

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Magnetic Integrated Switch Capacitor High-gain Cascaded Boost Converter

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History

摘要

为进一步改善基本级联Boost变换器的电压增益等关键性能,提出了一种磁集成开关电容高增益级联Boost变换器。该变换器利用拆分开关电容的两个倍压单元,使之与级联变换器的前级储能结构重新组合,同时将磁集成技术应用其中,一方面实现高电压增益,同时减小开关管的电压应力与电感电流纹波。分析变换器的各个工作模式,推导出性能参数,给出了磁集成设计方案,最后通过仿真和实验样机实验,验证了理论分析的正确性。

Abstract

To improve the key performance of a basic cascaded Boost converter including its voltage gain, a magnetic integrated switch capacitor high-gain cascaded Boost converter is proposed. Two voltage doubling units in the switch capacitor are split and further recombined with the pre-stage energy storage structure in the cascaded converter, where the magnetic integration technology is applied simultaneously. As a result, high voltage gain is realized while reducing the voltage stress and inductance current ripple in the switch. The working modes of the converter are analyzed, the performance parameters are derived, and the magnetic integrated design scheme is given. Finally, the theoretical analysis was verified by simulations and the production of a prototype.

关键词

级联Boost变换器;高增益;磁集成;电压应力

Key words

cascaded Boost converter;high gain;magnetic integration;voltage stress

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参考文献

- [1] 文欣, 韩晓男, 孙英云. 光伏发电并网及其相关技术发展现状与展望[J]. 现代电力, 2013, 30(1):1-7. Ai Xin, Han Xiaonan, Sun Yingyun. The development status and prospect of grid-connected photovoltaic generation and its related technologies[J]. *Modern Electric Power*, 2013, 30(1):1-7(in Chinese).
- [2] 严仰光. 双向直流变换器[M]. 南京:江苏科学技术出版社, 2004.
- [3] 胡经纬, 王久和, 唐琪. 一种新型高增益Cuk变换器研究[J]. 电工技术学报, 2014, 29(S1):337-344. Hu Jingwei, Wang Jiuhe, Tang Qi. Research on a new type of high-gain Cuk converter[J]. *Transactions of China Electrotechnical Society*, 2014, 29(S1):337-344(in Chinese).
- [4] 王挺, 汤雨. 基于开关电感的有源网络升压变换器的研究[J]. 电工技术学报, 2014, 29(12):73-79. Wang Ting, Tang Yu. Study of active network DC-DC Boost converter based on switched-inductor[J]. *Transactions of China Electrotechnical Society*, 2014, 29(12):73-79(in Chinese).
- [5] Axelrod B, Berkovich Y, Ioinovici A. Switched-capacitor/switched-inductor structures for getting transformerless hybrid DC-DC PWM converters[J]. *IEEE Transactions on Circuits & Systems I:Regular Papers*, 2008, 55(2):687-696.
- [6] Luo Fanglin, Ye Hong. Positive output super-lift converters[J]. *IEEE Transactions on Power Electronics*, 2003, 18(1):105-113.
- [7] 卢志飞, 杨平, 刘雪山, 等. 单开关二次型DCM Buck变换器[J]. 电工技术学报, 2011, 26(S1):65-70. Lu Zhifei, Yang Ping, Liu Xueshan, et al. Single-switch quadratic DCM Buck converter[J]. *Transactions of China Electrotechnical Society*, 2011, 26(S1):65-70(in Chinese).
- [8] 杨平. 二次型Boost变换器研究[D]. 西南交通大学, 2013.
- [9] 杨平, 许建平, 董政, 等. 二次型Boost变换器工作模式及输出电压纹波分析[J]. 电工技术学报, 2014, 29(8):110-118. Yang Ping, Xu Jianping, Dong Zheng, et al. Output voltage ripple of quadratic Boost converter[J]. *Transactions of China Electrotechnical Society*, 2014, 29(8):110-118(in Chinese).
- [10] 张士宇, 许建平, 杨平. 新型单开关高增益Boost变换器研究[J]. 电工电能新技术, 2013, 32(3):12-15. Zhang Shiyu, Xu Jianping, Yang Ping. Research on a new single-switch high gain Boost converter[J]. *Advanced Technology of Electrical Engineering and Energy*, 2013, 32(3):12-15(in Chinese).
- [11] 李洪珠, 曹人众, 张垒, 等. 磁集成开关电感交错并联Buck/Boost变换器[J]. 电机与控制学报, 2018, 22(6):87-95. Li Hongzhu, Cao Renzhong, Zhang Lei, et al. Integrated magnetic and switch inductance staggered parallel Buck/Boost converter[J]. *Electric Machines and Control*, 2018, 22(6):87-95(in Chinese).
- [12] 赵一. 耦合电感倍压单元高增益变流器拓扑形成方法研究[D]. 杭州:浙江大学, 2012.
- [13] Yang L S, Liang T J, Chen J F. Transformerless DC-DC converters with high step-up voltage gain[J]. *IEEE Transactions on Industrial Electronics*, 2009, 56(8):3144-3152.
- [14] Hwu K I, Yau Y T. High step-up converter based on charge pump and Boost converter[J]. *IEEE Transactions on Power Electronics*, 2012, 27(5):2484-2494.

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