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电源的数字控制

提高LLC谐振变换器轻载效率的改进型间歇控制

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Improved Burst Control for Improving Light-load Efficiency of LLC Resonant Converter

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History

摘要

间歇控制可提高LLC谐振变换器的轻载效率，但存在效率提升效果有限和输出电压纹波大的问题。为解决此问题，提出了一种改进型间歇控制方法。该控制方法在工作时间内将驱动脉冲数固定为3个以获得最优运行轨迹，而关断时间的长短则通过电压环自动调节。所提方法使得变换器在能量传输阶段始终运行在最佳运行轨迹上，从而进一步提高了轻载效率，减少工作脉冲数，有效降低输出电压纹波。对改进型间歇控制方法的原理分析、参数设计及具体实现方式进行介绍，并研制了一台300 W样机。实验结果表明，样机在间歇模式运行段内效率平均提升5.2%。

Abstract

Burst control has been widely applied to improve the light-load efficiency of LLC resonant converters. However, there exist problems such as limited efficiency improvement and large output voltage ripple. To solve this problem, an improved burst control method is proposed, which can make the converter run in an optimal trajectory during the burst-on duration using three constant driving pulses. Meanwhile, the burst-off duration is automatically regulated by a voltage loop. The proposed control method can further improve the light-load efficiency because the trajectory is always at the optimal level at the stage of energy transfer, and the output voltage ripple can be effectively reduced owing to the reduced number of driving pulses. Theoretical analysis, parameter design and the detailed implementation method are given. Finally, a 300 W prototype was built, and it achieved an average efficiency improvement of 5.2% during the operation in burst mode.

关键词

LLC谐振变换器;轻载效率;间歇控制;三脉冲;最优轨迹

Key words

LLC resonant converter;light-load efficiency;burst control;three pulses;optimal trajectory

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