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特种电源

应用于水处理的高频数字化电源

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High-frequency Digital Power Supply for Water Treatment

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History

摘要

高频电源可实现高频功率输出,其后再加特定装置产生磁场,用以研究高频磁场下水的特性变化。为了在宽功率范围实现移相全桥的零电压开关ZVS（zero-voltage-switching）,提高整机效率,在Boost-PWM与移相PWM双自由度控制的基础上提出一种基于模型前馈的控制方法。通过建立输出功率模型,加以模型前馈控制,结合闭环PI控制,不但可以保证输出功率满足要求和全功率范围内实现ZVS,还能够提高对于负载突变时的动态性能。首先提出该高频变换器的拓扑结构,再详细分析其工作原理和运行状态,得到精确的基于负载输出功率数学模型,给出相对应的输出功率范围和ZVS软开关范围,最终设计基于DSP和碳化硅（SiC）MOS管的电源样机。实验结果验证了所提理论的正确性,且该电源可以满足水处理实验的基本要求。

Abstract

A high-frequency power supply can achieve high-frequency power output, with which a specific device can generate a magnetic field for the study of changes in water characteristics in a high-frequency magnetic field. To achieve the zero-voltage-switching（ZVS） of phase-shifted（PS） full-bridge in a wide power range and improve the overall efficiency, a control method based on model feedforward is proposed, which is on the basis of the combination of Boost-pulse width modulation（PWM） and PS-PWM under dual-freedom control. Through the establishment of an output power model with model feedforward control, it is guaranteed that the output power can meet the requirements and ZVS can be achieved in the full power range with the combination of closed-loop PI control. In addition, the dynamic performance under sudden load changes can be also improved. First, the topological structure of a high-frequency converter is proposed. Then, its working principle and operating status are analyzed in detail, an accurate mathematical model based on the load output power is obtained, and the corresponding output power range and ZVS soft-switching range are also given. Finally, a power supply prototype based on DSP and SiC-MOS tube was designed, and experimental results verify that the theory put forward in this paper is correct and the power supply can meet the basic requirements of water treatment experiments.

关键词

高频电源 / 水处理 / 移相全桥 / 模型前馈 / 零电压开关

Key words

high-frequency power supply / water treatment / phase-shifted full bridge / model feedforward / zero-voltage-switching（ZVS）

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