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论文

中大功率单级功率因数校正变换器中的偏磁分析及其数字化抑制技术

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摘要:

单级型功率因数校正变换器(power factor corrector, PFC)由于具有功率密度高和电气隔离等特点, 在工业界某些应用场合得到应用, 然而, 用于该拓扑的变压器很容易饱和。基于隔离型全桥拓扑, 分析单级型PFC变换器中变压器偏磁产生机理, 并推导出每个工频周期内最大的理论偏磁值。对传统偏磁抑制方案进行分析, 阐述数字控制本身对偏磁抑制的原理, 提出一种能对偏磁有效抑制的数字补偿方案。新型数字控制方案能够避免传统方案所带来的诸如占空比减小和效率降低等问题, 且不会增加电路复杂度。通过额定输出功率为5.1 kW的样机验证了所提出的偏磁抑制方案的有效性和优越性。样机满载功率因数达到0.994, 效率超过92%。

关键词: 偏磁 单级 全桥 功率因数校正 数字信号处理器

Flux DC Bias and Digital Suppression Scheme for Isolated Power Factor Correction Converter

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Abstract:

Single-stage power factor corrector (PFC) AC/DC converter is preferable in some industrial applications due to its characteristic of high power density and galvanic isolation. However, the transformer used for isolation in such topologies can be easily saturated. Based on isolated full-bridge topology, the generation principle of flux DC bias for the transformer involved in the single-stage type power factor corrector converter was analyzed, and the theoretical maximum flux DC bias during every line period was deduced by recursion. Conventional suppressing strategies of flux DC bias were analyzed and bias alleviation effect by digital control method was presented. A novel digital suppressing approach was proposed. Compared with the conventional methods, the proposed scheme can solve the problem without increasing the complexity of the circuitry. A 5.1 kW PFC prototype was built and tested. The feasibility and advantage of the proposed approach was verified. The total power level is greatly increased. At full load, the power factor of the prototype is 0.994 and the total efficiency is more than 92%.

Keywords: flux DC bias single-stage full-bridge power factor correction digital signal processor

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