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技术及应用

数字电源控制模块的设计

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摘要 为加速器高精度磁铁稳流电源设计了数字电源控制模块DPSCM，以硬开关拓扑结构的磁铁电源作为被控对象，实现电源的全数字化控制。DPSCM以现场可编程门阵列FPGA为控制部件，实现对高精度ADC和DAC的控制，由数字调节器产生高精度数字脉宽调制信号，并实现电源的逻辑控制和联锁保护功能。通过模拟负载测试了DPSCM的基本功能，并在数字电源样机上测试了DPSCM长期运行的可靠性及稳定性，样机电源连续运行72 h，电流稳定度优于5×10^{-5}。

关键词 数字电源控制模块 现场可编程门阵列 数字调节器 高精度数字脉宽调制信号 模拟负载

分类号

Design of Digital Power Supply Control Module

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Abstract The digital power supply control module (DPSCM) was designed for accelerator high precision current stabilized magnet power supplies. Based on the topology of the switching mode, the power supply embedding the DPSCM fulfilled all-digital control and regulation. The field programmable gate array (FPGA) was chosen as the control component for the DPSCM. The control of high precision ADC and DAC, the digital regulating loop, and the logic control and interlock protection were implemented in the FPGA. The high precision pulse width modulation (PWM) signals were produced by the DPSCM. After testing on the load simulator and the digital power supply prototype, it is proved that the DPSCM can meet requirements for most accelerator magnet power supplies. The current stability of the prototype is better than 5×10^{-5} after 72 h test.

Key words digital power supply control module _ field programmable gate array _ digital regulating loop _ digital high precision PWM signal _ load simulator

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