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高压大功率三电平逆变器的SPWM数字化技术研究

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摘要: 数字化的正弦脉宽调制(digital sinusoidal pulse width modulation, SPWM), 能够提高脉宽控制信号输出精度, 缩短控制响应时间, 增加系统安全稳定性。结合高压大功率中性点箝位(neutral point clamped, NPC)三电平逆变电路的特点, 对其SPWM数字化过程中三角载波形成、正弦调制波发生、器件开关时间计算、开关状态组合配置以及脉宽信号故障诊断的数字化原理进行了研究。提出了简化的开关时间计算方法、完善的死区设置、通用的超调制原则以及故障信号高速闭锁的实现方法。最后利用DSP+FPGA+CPLD的新型结构实现了三电平逆变器的高性能数字化控制, 仿真和试验结果证明了该文数字化构想的正确性和可行性。

关键词: 中性点箝位三电平逆变器 正弦脉宽调制 不对称规则采样 数字化控制理论

Study of SPWM Digital Technologies for High-voltage High-power Three-level NPC Inverter

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Abstract: With the application of digital sinusoidal pulse width modulation(SPWM)control technologies, the precision, responding time, security and stability of the pulse width gating signals can be improved conspicuously. In this paper, the digital theory of triangular carrier and sinusoidal modulation wave generation, PWM duty cycle calculation, switching states configuration and gating signals fault diagnosis were studied with the combination of characteristics of high-voltage high-power three-level neutral point clamped (NPC) inverter. At the same time, the simplified calculation method, all round dead state configuration, universal over-modulation principle and fast output block technology of fault PWM signals have been put forward. At last, the DSP+FPGA+CPLD based new digital implementation circuit of the control system is presented. The simulation and experimental results are given to verify the correctness, feasibility of the digitization assumption.

Keywords: three-level neutral-point-clamped inverter sinusoidal pulse width modulation asymmetrical regular sampling digital control theory

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