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P2.086 A novel series switch module in high-voltage applications

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Due to safety and reliability concerns, high voltage fast switch is required for Tokamak power system. It can cut off the high voltage power supply within a little time usually in microsecond, when fault occurs, system tests and load switches. IGBT is an ideal choice as the basic component of the switch to satisfy the fast response requirement. Obviously, connecting multiple IGBTs in series directly is an essential approach in high-voltage applications. But voltage balance between IGBTs connected in series is a very complex and difficult problem, and there is no satisfactory method so far. This paper presents a novel switch circuit module, which can operate easily as a modular-connecting high-voltage switch. Based on the improved MMC topology, its switch time and voltage adjustment ability are advanced and more. When module turns off, it inhibits overvoltage by a high capacity capacitor after voltage rises to rated voltage. In order to balance the voltage when switch is in conducting state, two IGBTs in overvoltage-module turn on. In the meantime, this operated mode increases current carrying capacity. The test prototype is a 10000V/100 A switch with 4 modules in series. The simulation and experimental results show that this switch can effectively improve the dynamic-voltage balance and shorten switch time. All in all, the work presented in this paper has a significant reference value for practical engineering applications.

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