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High Power Application Modular Multilevel Converter (20130335, Dr. Ned Mohan)

Technology ID
20130335a

Category
Engineering & Physical Sciences/Design Specifications
Engineering & Physical Sciences/Sustainable Technology

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High voltage levels, reduced voltage stress and lower semiconductor losses

A new modular multilevel converter (MMC) can reach twice the voltage levels as conventional electrical energy transmission topologies. The modular structure of this MMC enables it to reach three voltage levels by adding a bidirectional switch with half the voltage stress, resulting in low switching frequency and near sinusoidal voltage waveforms. Benefits of these submodule topologies include reduced voltage stress, considerably lower semiconductor losses, and a compact size (and therefore a smaller footprint). These attributes translate into lower operation costs for high voltage power applications like High Voltage Direct Current (HVDC) transmission and distribution systems.

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More Reliable Power Electronic Transformer

The new MMC can be used to generate high-frequency near sinusoidal voltages across a high-frequency transformer (HFT) to reduce its size and weight. The approach is unique as it provides the ability to scale to high voltages and make these power electronic transformers (PET) more reliable. Small scale for PET application has been tested with HFT voltages nearly sinusoidal.

Voltage Balance Over Entire Modulation Range

A proposed hybrid modulation technique combines both phase shifted and level shifted carriers, while a proposed simple voltage balancing algorithm based on unequal capacitor sharing may result in proper balanced capacitor voltages over entire modulation range and output power factor. These results are shown by MATLAB/Simulink simulations.

BENEFITS AND FEATURES:

- Size and cost halved: requires half the number of submodules to reach the same number of output voltage levels
- Reduced conduction (33%) and switching losses (75%) relative to standard submodules
- Improves efficiencies, reduces losses, increases system reliabilities
- Robust value proposition
- Reduces complexities in gate drive circuitry

APPLICATIONS:

- Alternative energy in distributed systems taking and delivering energy from multiple sources
- High voltage, high power applications (e.g., high voltage direct current (HVDC) transmission and distribution, static compensator (STATCOM), multi-megawatt industrial drives)
- Potential applications in MV drives or wind turbines

Phase of Development - Proof of Concept

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