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An ingenious MMC topology appropriate for motor drives across their entire frequency spectrum

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ABSTRACT

Modular multilevel converter (MMC) modules have popped up as among the best choices for medium and high-powered uses. This paper proposes a control scheme for the entire frequency range of operation for the MMC, focusing on supplying a three-phase machine. The machine is required to be controlled in the outer as well as the inner loop. Standard field oriented control (FOC) manages the three-phase machine in the outer closed loop while the inner control has to come up against the problem of energy balancing. That is unevenly distributed and stored in the capacitance of the upper and lower arms of the converter. There are two operating methods used in the inner control loop: a low-frequency method is used for start-up and low-speed operation, and a high-frequency method is for higher speed. In low-frequency mode (LF-mode), a special control strategy has to be implemented to minimize the energy oscillation in the capacitances of the converter arms. It makes utilization of the 3-phase machine's common mode voltage (Vc) as well as internal circulatory currents to verify a symmetrical energy distribution inside this MMC arms and also to avert whatever AC currents inside the DC source.

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1. INTRODUCTION

The process and control of electrical energy is an essential aspect of power transmission. This task was contented by the conception of power converters such as various levels of multilevel inverters like three-level inverters [1] and five-level inverters [2]. Modular multilevel converter (MMC) has been receiving a lot of attention and advancement ever since its inception because of its numerous advantages such as outstanding performance, high modularity, easy quantification, as well as low voltage and current rating request for switching devices [3], [4]. These would be big benefits of the MMC over conventional two-level as well as configuration converter topologies [5]. The initiation of MMC took place in 2002 for the employment of high-voltage direct current (HVDC) systems in high-voltage transmission implementations [6]. In 2003, Marquardt was the first to present MMC and it turned out to be progressively appealing owing to modularity, high efficiency, excellent V_{out} waveform, redundancy, and avoiding separate dc sources [7]. The first papers