

A Novel STATCOM Based on Diode-Clamped Modular Multilevel Converters

The project aims at developing a new static synchronous compensator (STATCOM) based on the diode-clamped modular multilevel converter (DCM2C) is proposed in this paper. In this converter topology, the capacitor voltage is clamped by using a low power rating diode in each submodule. The quantity of voltage sensors is significantly reduced and is free from the number of voltage levels. Furthermore, the voltage balancing control method becomes very simple and the capacitor voltage balance speed is fast. Based on the structure of modular multilevel converter, the DCM2C-STATCOM has the capability of Var compensation and negative-sequence current compensation. The topology characteristics and compensation control method of DCM2C-STATCOM are investigated in this paper. Experimental results obtained from a laboratory prototype validate that the capacitor voltage of the proposed DCM2C-STATCOM can be well balanced and the Var and negative-sequence current compensations are effective.

NOWADAYS, in medium-voltage distribution systems, many power quality issues, such as low power factor, harmonic distortion, and unbalanced voltage, are resulted from the unbalanced loads and nonlinear loads. To improve the power quality, the static synchronous compensators (STATCOM) are widely used on the grid side to achieve high power factor and low distortion. Recently, STATCOM based on multilevel converters are very popular in medium-voltage networks, including flying-capacitor multilevel converters (FCMC), diode-clamped multilevel converters (DCMC), and cascaded H-bridge multilevel converters (CHMC) [1]–[7]. Because there is a dc bus in the topology of the FCMC and DCMC, they have stronger capability of negative-sequence current compensation than the CHMC with star configuration and they can be used in the applications of ac/dc power conversion. However, the poor modularity and significantly increasing capacitors and power diodes restrict their applications in medium/high-voltage networks. The CHMC with star configuration has good modularity and is very popular in medium-voltage Var compensation applications [8]–[13]. In [8], a hierarchical voltage balancing control method is carried out with the phase-shifted unipolar sine PWM method. Based on the same control structure, the low-voltage ride-through issue is solved. But the CHMC with star configuration has very weak negative-sequence compensation capability. The CHMC with delta configuration can overcome that defect, but the voltage across the arm of the converter is line voltage and the number of submodules (SM) in an arm is increased a lot.

Block diagram:

**A Novel STATCOM Based on Diode-Clamped
Modular Multilevel Converters**

