



Final Project Outline:

Diode Clamped Converter for Vehicle AC machine Drive

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Aim

To simulate a Diode Clamped Converter (DCC) as a battery connected permanent magnet Synchronous machine (PMSM) drive and prove control operation using a designed PCB and experimental machine/RL load.

Introduction

Diode clamped converters (figure 1) are commonly used as drives for high frequency motors as a result of their superior waveform quality [1]. This enables the production of high frequency AC voltages for the machine with lower harmonic distortion, thus minimising filter requirements and pulsations caused by these harmonics. This project will consider their use as part of a simulation PMSM motor drive [2]. Furthermore, a PCB will be developed and sent for production which will implement a low power version of this type of converter which will be experimentally tested.

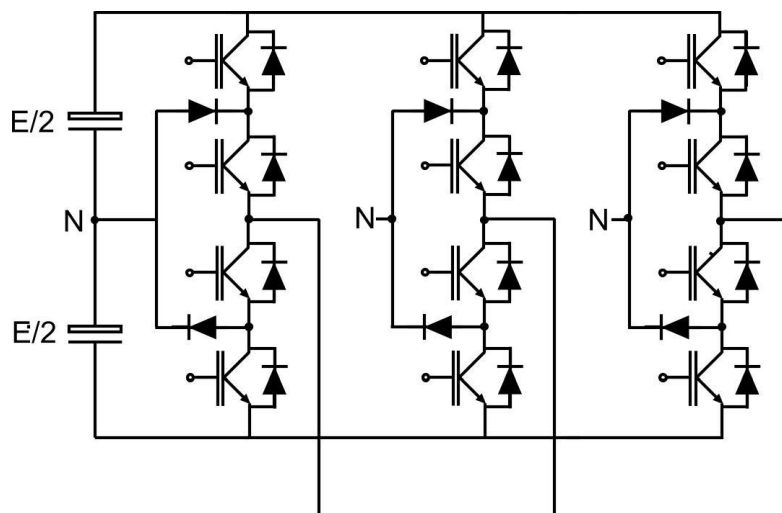


Figure 1: 3 Phase Diode Clamped Converter with split load

Control will be implemented using a F28379D micro-controller and therefore the C language based control will first be tested using the C-Script functionality in PLECS. The use of Field Oriented Control will provide a method of controlling the AC quantities (voltage, current) for this converter but using controller structures more commonly applied to DC systems such as PI controllers, simplifying design [3,4].

Tasks

The following broadly defined tasks should be arranged into a work plan. These tasks are not necessarily consecutive and are by no means exhaustive but should give the general framework of the project.

1. Familiarisation with Diode Clamped Converters and PMSM drives.
2. Development of a PCB, early in project, for implementing a low power (2kW) DCC.
3. Whilst PCB is being manufactured/populated implement in PLECS a DCC and PMSM drive with control.
4. Complete construction of converter and implementation of control on microcontroller to validate simulation work with the converter connected to an RL load.
5. Stretch target: Use PCB based DCC to drive a low power machine with full FOC.

References and Background Reading

Papers about DCC based drives and their control can be found via a combination of the internet, IEEEExplore, IET and the library. The following references will provide a solid foundation for this work.

- [1] B. Wu, "High Power Converters and AC Drives", Wiley IEEE, 2nd Edition, 2016
- [2] A. Hughes "Electric Motors and Drives: Fundamentals, types, and applications", 5th Edition, Elsevier, 2019
- [3] S. N. Vukosavic, "Electrical Machines", Springer, 2012
- [4] G. Abad, "Power Electronics and Electric Drives for Traction Applications", Wiley, 2016