**MIDDLE EAST TECHNICAL UNIVERSITY**

**ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT**



**EE462 UTILIZATION OF ELECTRICAL ENERGY**

**EE464 STATIC POWER CONVERSION – II**

**SOFTWARE PROJECT**

**REPORT**

**Design of a SM-PMSM Variable Frequency Drive with Matlab/Simulink**

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# INTRODUCTION

# PART A: Pre-design Stage

1. Rated torque of the motor is Tnominal , 300Nm. Rated speed of the motor is found by (1) and (2).
2. The maximum applied electrical frequency is found by (3).

In LV applications where the inverter output is in between 380-460Vrms, IGBT voltage class in tow-level inverter topology is 1200V. In Figure A.1, total semiconductor losses as a function of carrier frequency can be seen. [1]. Choosing FF200R12KS4 as our IGBT and 2000W as a reasonable loss we decided to use 5000Hz. In this case mf is given by (4). Since we are operating below mf =21, mf should be an odd integer. To have mf approximately equal to 11, we chose fs as **5130Hz.**

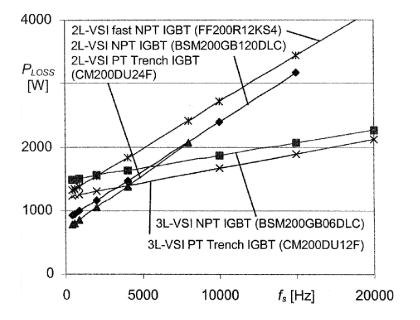


Figure A.1: Total semiconductor loss as a function of carrier frequency

1. In this part we are required to find the suitable DC link capacitor for the rectifier output so that the DC input of the inverter will be 540V. Equivalent resistance at the rated current is 2.16Ω. The rectifying circuit and voltage output waveform can be seen in Figure A.2 and 3, respectively. DC link capacitor is 1mF as it can be seen output voltage is oscillating around 540V. However, 1mF is already is a big value.

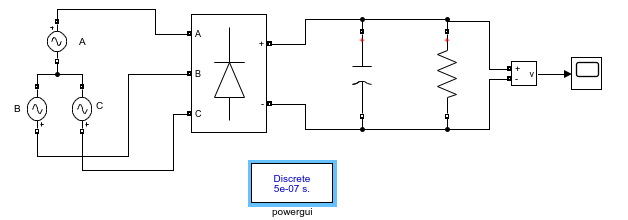


Figure A2: Simulink circuit of the rectifier

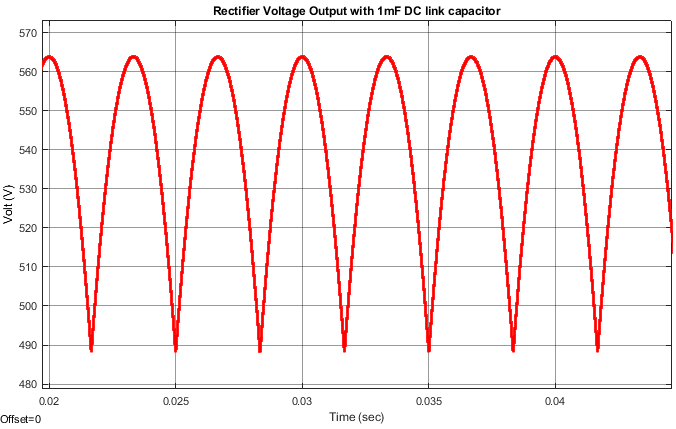


Figure A.3: Output voltage of the rectifying unit

# PART B: Sinusoidal PWM

In this part, we are asked to implement a SMPMSM motor drive using sinusoidal PWM scheme. The controller must adjust the rotor speed according to the reference value and set a current limit to the nominal value using id, iq parameters. This motor drive can be seen in Figure B.1. Subsystem details in the given Simulink model can be observed in the slx. files uploaded to Odtuclass.

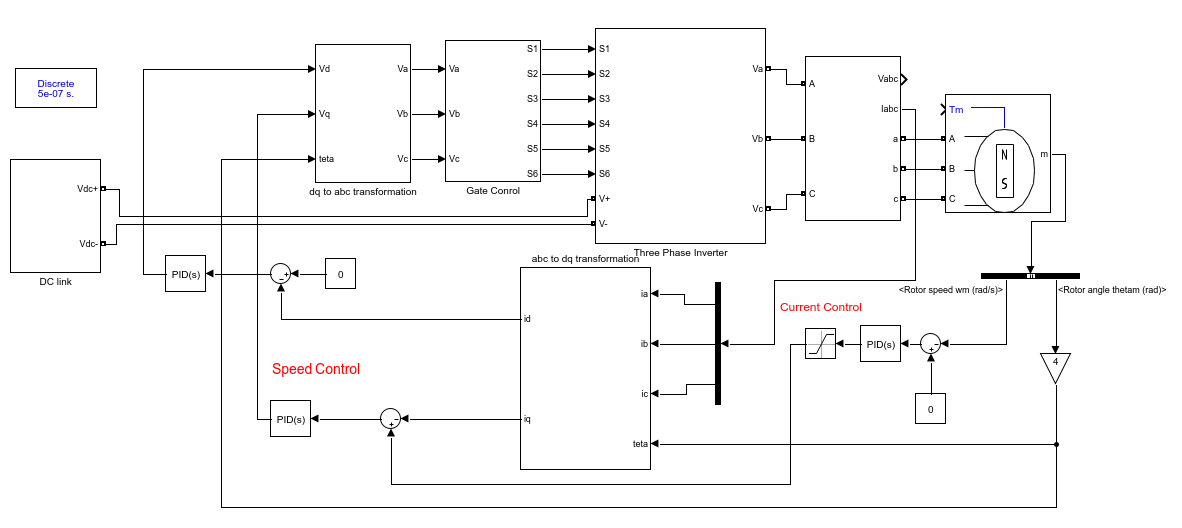


Figure B1: Simulink model of the SPWM motor drive

# PART C: Space Vector PWM (SVPWM)

# PART D: Component selection and verification

# CONCLUSION

# References