Topology selection:

In order to drive the given motor many different solution and topology can be used, however, in this part one explained 2 thyristors topologies and diode rectifier with buck converter and these topologies advantages and disadvantages

1)Tyhristor Topologies

Thyristors are controlled rectifiers which are used for HVDC application. By sending controlled pulses to gate terminals power output and voltage output controlled by changing firing angle. Moreover, thyristor has advantage of working two quadrants as rectifier which power flows from grid to load and as inverter (needs active source at load) which power flows from load to grid. The first thyristor topology is Single phase fully controlled rectifier.

1. Single phase fully controlled rectifier (may need isolate the firing angle from the circuit?????? )

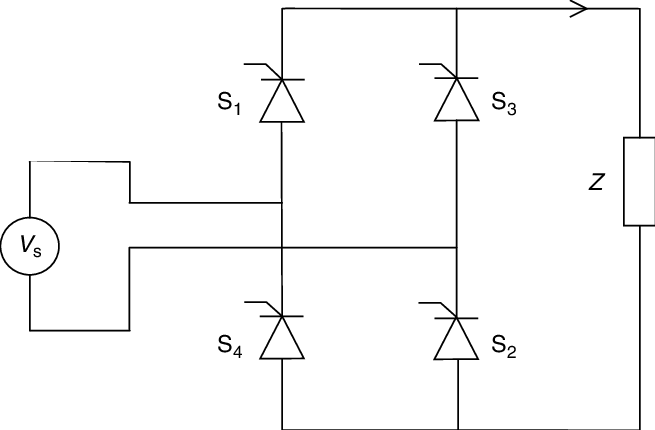


Figure . Single Phase Controlled Rectifier Schematic

The single phase fully controlled rectifier topology can be observed at figure x there are 4 thyristors work with 2 phases which need 180-degree phase difference between firing angles at the first S1 and S4 opened at second phase S3 and S2 open and conduct. The output phase voltage formula is

Due to single phase, there is high voltage ripple at the output which can be reduced by adding a high capacitor with high capacitance at the output.

Advantages:

- Two quadrant work both as inverter and rectifier.

-With another single phase-controlled rectifier connected reverse direction the rectifier can work at all four quadrants.

-It is cost friendly comparing the three-phase due to lower number of thyristor (4) used.

Disadvantages:

-High voltage ripple at the output.

- Hard to arrange firing angles simultaneously and needs for additional circuits and source to open thyristors

-Lower average output voltage comparing to three phase one.

-Large harmonics in the input current

-low power factor and dpf for smaller output voltage.

1. Three phase fully controlled rectifier

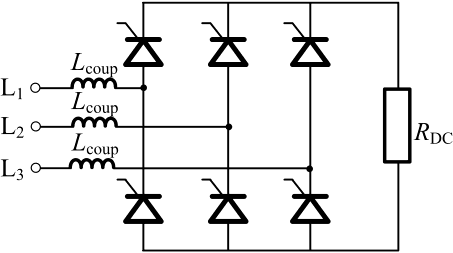


Figure . Three Phase Thyristor Rectifier Schematic

In three phase fully controlled rectifier there are 6 thyristors with 3 phases, there are 120 degrees between each phase. There is output voltage ripple, but it is less than output voltage ripple of single phase topology.

Advantages

-Two quadrant operation, with additions it can be increased to work at 4 quadrant operation

-Lower voltage ripple comparing to single phase rectifier.

-Higher average output voltage.

-Controlled output voltage and power flow

Disadvantages

-More complicated comparing to single phase due to 6 thyristors.

-Desynchronization problem since 6 thyristors gate signal must be synchronal.

-More expensive due to increasing number of thyristors.

2)Three Phase Diode rectifier with Buck Converter Topology

There are two part in this topology first one is three phase diode rectifier and second part is buck converter with control of duty cycle, schematic can be seen at the figures below.

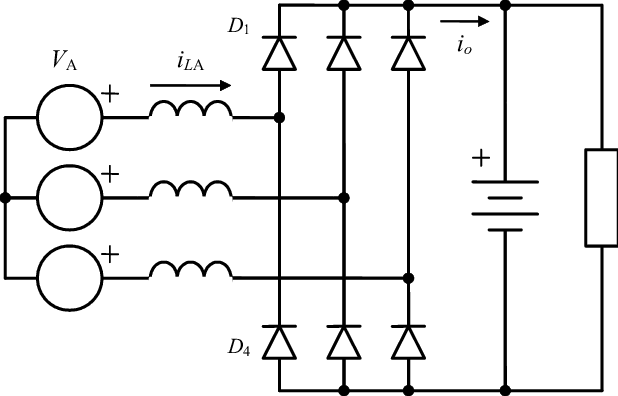


Figure . Three phase diode rectifiers schematic

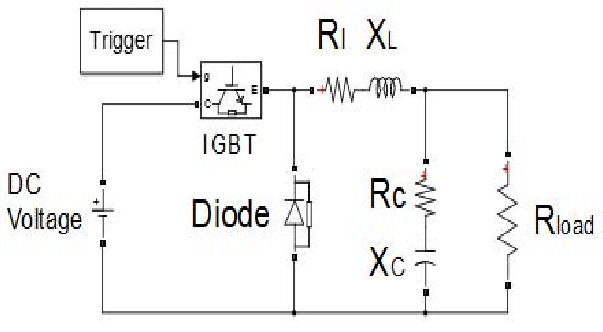


Figure . Buck converter schematic

Three phase diode rectifier contain 6 diodes, therefore, output voltage cannot be controlled like thyristor rectifiers. Moreover, diodes cannot work at two quadrant, however, due to diodes working principle no gate signal or synchronization is needed which reduces complexity of design. The average output voltage of three phase diode rectifier is :

The buck converter is used for controlling output voltage with controlled gate signal created by PWM in order to adjust duty cycle of IGBT switch to control output. The output voltage formula of buck converter is:

D is the duty cycle

Advantages:

-Low output voltage ripple.

-Motor has high inductance, therefore, no need for inductance or capacitance at the output of the buck converter.

-Easy to construct just need one timer as an extra since diodes do not require gate signal or synchronization signals.

Disadvantages:

-Four quadrant operation cannot be obtained due to diodes working principle.

-Switching losses increases with increasing switching frequency