

Disclaimer

I hereby declare that all the work presented in this thesis report of the project is my own, in accordance with the policy of university on Plagiarism.

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The rotor of the wind turbine is also connected to the output shaft of the gearbox so that the slow speed of the rotor hub can be increased to required speed of the generator rotor.

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Figure (3-6): - parts and components which are required for vertical axis wind turbine

Figure (3-6) depicts the various parts that are required in vertical axis wind turbines. It generally requires a guide wire which is used to keep the shaft of the rotor in position. It also has a provision of two hubs to which the rotor blades are attached. These rotor blades are generally a part of rotor which takes the kinetic energy of the wind and converts that to the rotation of the hub; where rotor is a heart of wind turbines, responsible for capturing the energy of the wind and transforms that energy to mechanical energy. Then the shaft is rotated with the help of the turning blades which is further connected to the generator sometimes via gearbox. The main function of the gear box is to increase the speed achieved using the shaft to further increase the speed of the generator. The last component is generator which converts the rotational speed to the electricity (Anon., 2013).

Fault Response	Slow	Slow	High
Cost	Low	Low	High
Suitability	Low power, residential applications	Small wind turbines	Direct drive small-medium wind turbines

3.2.1. Model of generator used in project

After going through all the generators and studying their advantages that they were providing, permanent magnet synchronous generator was decided to opt for this small scale wind turbine project. This was the generator which was capable of proving the benefits required for this project. Already provided model of permanent magnet synchronous generator in Matlab Simulink was used. In matlab a three phase permanent magnet synchronous machine was implemented with a sinusoidal back EMF and a rotor with round shape was selected. The selection of these configurations for permanent magnet synchronous machine is shown in figure (3-13).

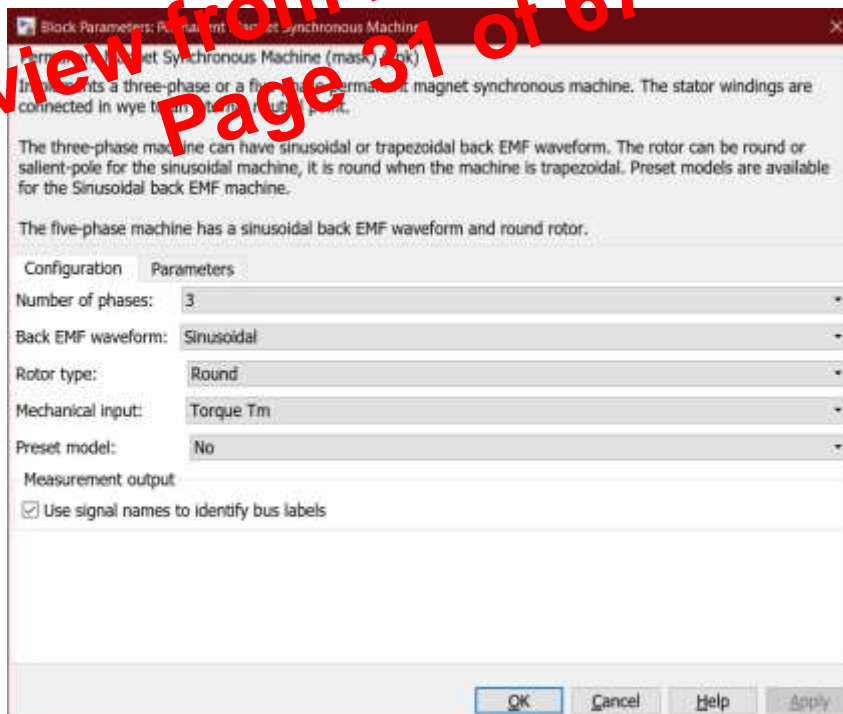


Figure (3-13): - Configuration of permanent magnet synchronous machine in Matlab for project

The parameters for this machine are shown in figure (3-14).

Configuration Parameters

Machine parameters

Compute from standard manufacturer specifications.

Stator phase resistance R_s (Ohm): 18.7

Armature inductance (H): 0.02682

Machine constant

Specify: Flux linkage established by magnets (V.s)

Flux linkage: 0.1716

Inertia, viscous damping, pole pairs, static friction [J(kg.m²) F(N.m.s) p() Tf(N.m)]: 26e-05 1.349e-05 2 0

Initial conditions [ω_m (rad/s) θ_{em} (deg) i_a, i_b (A)]: [0,0,0,0]

Rotor flux position when $\theta = 0$: 90 degrees behind phase A axis (modified Park)

OK Cancel Help Apply

Figure (3-14): - Parameters of permanent magnet synchronous machine in Matlab for project

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Where

I_o is output current

I_i is input current

V_i is input voltage

V_o is output voltage

For calculating the minimum value of the inductor following two equations were used

$$\text{-----} \tag{5-24}$$

$$\text{-----} \tag{5-25}$$

In above two equations I_{LB} is inductor boundary current and T_s is switching period

For calculating the value of the capacitor the equations (5-26) and (5-27) were used and the voltage ripple for the output of the dc - dc converter is desired to be less than 5%

$$\text{-----} \tag{5-26}$$

$$\text{-----} \tag{5-27}$$

In above equations C is the value of the capacitor required and ΔV_o is the output voltage ripple.

As the values of the capacitor and inductor are inversely proportional to switching frequency of the buck converter, so a higher frequency is required for minimizing the cost (S. Eren, 2006).

5.4. Battery Mathematical model and controller for battery charging: -

The Simulink model used for the battery in the project is of Lithium-ion type. The equations (5-28) and (5-29) are used to describe the discharge and charge voltage of the battery.

$$\text{-----} \tag{5-28}$$

$$\text{-----} \tag{5-29}$$

Where E_o is constant voltage

K is polarization constant (in V/Ah) or polarization resistance in ohms

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