Implementation of PV Based Interleaved Boost Converter for Ac I’m Drive

Gn. Sachinamreiss, S. Dineshkumar

Abstract: This paper describe the implementation of interleaved boost converter which is controlled by PID controller fed by inverter to run the AC Induction motor(IM). For the converter design, the converter topology used here is Interleaved boost converter which will amplify the more desirable voltage secure from the input source which is solar Photovoltaic. Solar PV is a applied science that converts solar radiation into DC supply which is fed to the interleaved boost converter. In order to drive an AC induction motor inverter design is needed. Inverter design is used to convert the DC to AC supply. By using the PID controller it can able to regulate the speed of the motor. Results from the controller are most accurate and stable. Finally, outcome of the converter is fed to the induction motor. The expected system is verified by using Simulink/MATLAB.

Index Terms: Interleaved boost converter, PID controller, PV, AC induction motor.

I. INTRODUCTION

Nowadays solar energy utilization is drastically increased for various application. By the rapid increase of solar usage it reduce the fossil fuel consumptions. Solar powered panels or PhotoVoltaic panels converts the sun’s radiation into electricity and it is given to the interleaved boost converter [1]. With effective utilization of panels by means of converter it can cultivate more amount of solar power with reliable performance in converters. Converter design include interleaved boost for high performance and inverter design which converts dc input to three phase AC output. 90V of solar input is boosted upto 236.7V by interleaved boost converter which reduce the ripple current. Converter design is controlled by PID controller to regulate the speed and it use a control feedback mechanism to control process variables and most accurate stable controller[2]. The converter output is fed to the motor by inverter for better improvements. Converter Output is given as inverter input which converts DC to three phase AC supply[3]. IM is highly used for industrial, robotic and mechatronics applications.

II. BLOCK DIAGRAM

Fig 1: Block Diagram

The proposed system consisting of interleaved boost converter. The inductor $L_1$ and $L_2$ are coupled each other. The relationship of the inductance are related by the following equations,

$$L_2 = L_0 - L_m \quad \ldots \ldots (1)$$

$$L_m = K \sqrt{L_1 L_2} \quad \ldots \ldots (2)$$

$L_1$, $L_2$ - inductances

$K$ - constant

$L_1$, $L_2$ - leakage inductances

$L_m$ - mutual inductance

When switch 1 is in ON condition, current flow through the inductor $L_1$ ready to increase and $L_2$ gets discharge:

$$\frac{di_2}{dt} = \frac{-E_0}{L_1 - L_2} \quad \ldots \ldots (3)$$

Rate of change of $i_2$ is given by

When switch 1 is in OFF condition, stored energy in the $L_1$ is transfer to the load by interleaved boost converter.

$$\frac{di_2}{dt} = \frac{-E_0 - E_i}{L_1} \quad \ldots \ldots (4)$$
When the switch 2 is in ON condition, current in $L_2$ starts to increase. $L_1$ to discharge. Rate of change of $i_{L_1}$ is

$$\frac{di_{L_1}}{dt} = -\frac{E_0}{L_1 + L_2} \quad \ldots \ldots(5)$$

When the inductor current $i_{L_2}$ increases at the rate of

$$\frac{di_{L_2}}{dt} = \frac{E_0}{L_2}$$

Where ,

$$L_2 = L_2 + L_m \quad \ldots \ldots(6)$$

When the switch 2 is in OFF condition. $L_2$ discharges through the output circuit.

Rate of change of $i_{L_2}$ is

$$\frac{di_{L_2}}{dt} = -\left(\frac{E_0 - E_1}{L_2}\right)$$

$$\ldots \ldots(7)$$

The process will be repeated again.

When current waveform reached a steady state it can be found that

$$\frac{E_0}{L_1 + L_2}D_1T + \frac{E_1}{L_1}(D_1 - D_2)T = \frac{E_0}{L_1 + L_2}D_2T$$

$$\frac{E_0}{L_1 + L_2}D_1T + \frac{E_1}{L_1}(D_2 - D_1)T = \frac{E_0}{L_1 + L_2}D_1T$$

Assume when the converter is lossless, the input power is equal to output power $P_i = P_o$.

$$E_1(I_1 + I_2) = \frac{E_o^2}{R_L} \quad \ldots \ldots(8)$$

Output voltage of a interleaved boost converter is given below

$$E_o = \frac{E_1}{1 - (2D + \delta D)} \quad \ldots \ldots(9)$$

$$E_o = \frac{E_1}{1 - (D_1 + D_2)} \quad \ldots \ldots(10)$$

The proposed system will behave like a interleaved boost converter with two active switches in parallel[4]. The simulation model of the proposed converter has been developed. Ideal switches and diodes are used in this system.[5,6]

**IV. SIMULATION RESULTS:**

The above figure 2 represents the speed of the motor which is measured at 2600 RPM.

The above figure 3 represents the stator current which is measured at 60 A.

The above figure 4 represents the motor torque which is measured at 51 N-M.

The above figure 5 represents the motor voltage which is measured at 236.7 V.
VII. VII. CONCLUSION:

The main basis behind the implementation of interleaved boost converter is that ripple is very low. Inorder to run the motor required amount of voltage is fed to the inverter by interleaved boost converter. In this converter exposure inductance is reduced and switching losses will be retain easy. The settling time to reach the motor speed is about 0.2s. The results are verified and simulated by MATLAB/simulink.

REFERENCES

1. R Karthikeyan, GN.Sachin Anreiss “PV Based Interleaved Boost Converter for Pumping Applications” 2018, International Conference on Intelligent and Advanced System (ICIAS), 1-4
2. GN.Sachinamreiss,Dineshkumar S*Eleven Level Inverter Design With DVR For Distribution Energy System” Journal of Advances in chemistry 5116 - Page 12
7. 7.A.Saranya; S.Dineshkumar, “Improving voltage stability of power system using facts device” 2017
10. 10. Esq8266 for Industries” BBRC Journal (Recent Trends in Biosignal Processing and Biomedical Instrumentation)

AUTHORS PROFILE

G.N. SACHIN AMREISS is working as an assistant professor in M.Kumarasamy College of engineering, Karur. He effectively participated in 3 conferences during the period of (2015-Tillnow). His main area of interest is Power Electronics and Renewable Energy. He published about 16 international journals in reputed publications like Control Theory and Application and Journal of Advances in Chemistry. During August 2018 participated in International Conference on Intelligent and Advanced System (ICIAS) and proceedings published in IEEE explorer.

He is pursuing Ph.d degree in Anna University,Chennai. His area of research is Power electronic converter, DC-DC converter and drives, Shunt active filter. He is an Assistant professor in M.kumarasamy college of engineering, Karur. He presented 5 international and 5 national conference in reputed institutions and also published 16 journal papers in various reputed journals like Scopus and web of science.

VI. SPECIFICATION:

Table 1: Specification Of Components

<table>
<thead>
<tr>
<th>S.NO</th>
<th>COMPONENTS</th>
<th>RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Solar PV</td>
<td>Output Voltage</td>
</tr>
<tr>
<td>02</td>
<td>Converter</td>
<td>Inductance L1 L2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Capacitance C1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Resistance R1</td>
</tr>
<tr>
<td>03</td>
<td>AC Induction Motor</td>
<td>Output Voltage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Input Voltage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rotor speed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Torque</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stator current</td>
</tr>
</tbody>
</table>