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

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Abstract*:This paper describe the implementation of interleaved boost converterwhich 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 designis controlled by PID controller to regulate the speed andit 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.

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II. BLOCK DIAGRAM

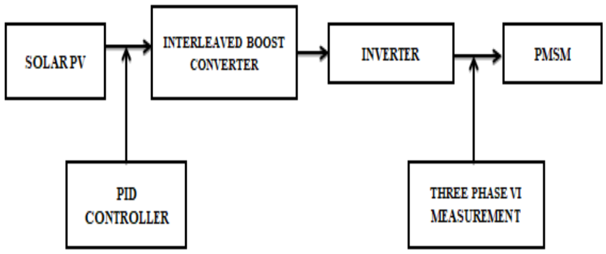

Fig 1:Block Diagram

III. OPERATION OF THE CONVERTER

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,

$$L_2^{'} = L_2 - L_m \quad ....(1)$$

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

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 .

$$\frac{diL_2}{dt} = \frac{-E_0}{L_1^{'} - L_2^{'}} \quad ....(3)$$

Rate of change of iL_1 is given by $\frac{diL_1}{dt} = \frac{E_i}{L_1}$

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

$$\frac{diL_1}{dt} = \frac{-(E_0 - E_i)}{L_1} \quad ....(4)$$

When the switch 2 is in ON condition, current in $L_2^{'}$ starts to increase. $L_1^{'}$ to discharge. Rate of change of iL_1 is

$$\frac{diL_1}{dt} = \frac{-E_0}{L_1^{'} + L_2^{'}} \quad ....(5)$$

When the inductor current iL_2 increases at the rate of

$$\frac{diL_2}{dt} = \frac{E_i}{L_2}$$

Where ,

$$L_2 = L_2^{'} + L_m \quad ....(6)$$

When the switch 2 is in OFF condition. $L_2^{'}$ discharges through the output circuit.

Rate of change of iL_2 is

$$\frac{diL_2}{dt} = \frac{-(E_0 - E_i)}{L_2} \quad ....(7)$$

The process will be repeated again.

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

$$\frac{E_0}{L_1^{'} + L_2^{'}} D_{11}T + \frac{E_i}{L_1}(D_1 - D_{11})T = \frac{E_0 - E_i}{L_1}(0.5 - D_1)T + \frac{E_0}{L_1^{'} + L_2^{'}} D_{21}T$$

$$\frac{E_0}{L_1^{'} + L_2^{'}} D_{21}T + \frac{E_i}{L_1}(D_2 - D_{21})T = \frac{E_0 - E_i}{L_1}(0.5 - D_2)T + \frac{E_0}{L_1^{'} + L_2^{'}} D_{11}T .$$

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

$$E_i(I_1 + I_2) = \frac{E_O^2}{R_L} \quad ....(8)$$

Output voltage of a interleaved boost converter is given below

$$E_O = \frac{E_i}{1-(2D+\delta D)} \quad ....(9)$$

$$E_O = \frac{E_i}{1-(D_1 + D_2)} \quad ....(10)$$

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:

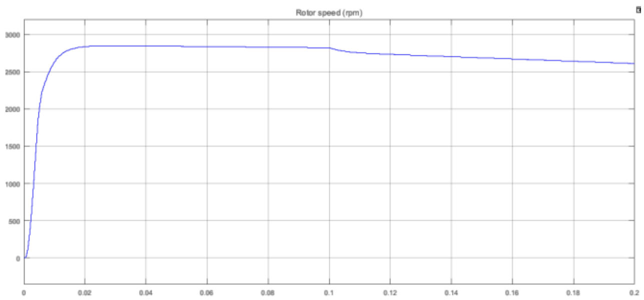

Fig 2:Waveform of rotor speed

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

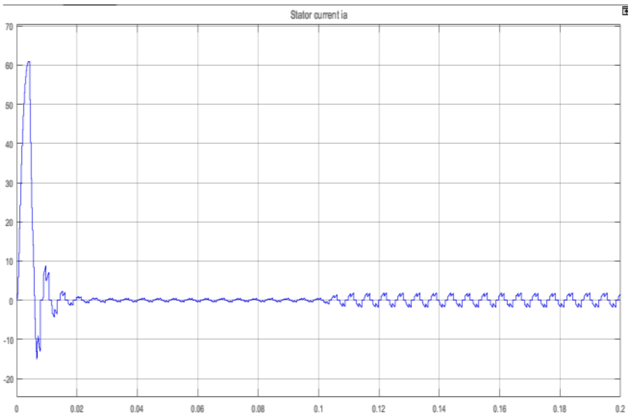

Fig 3: Waveform of stator current.

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

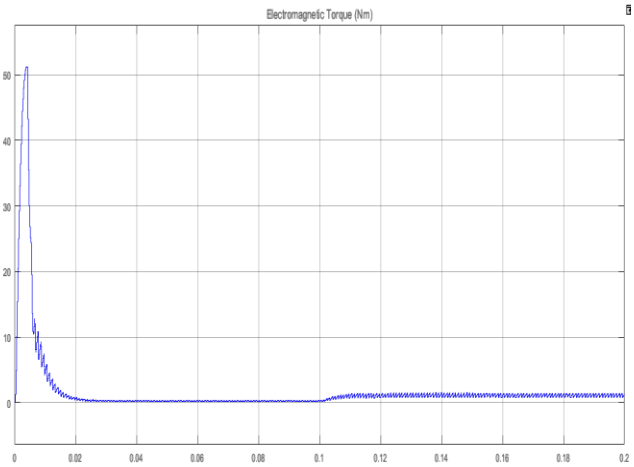

Fig 4: Waveform of electromagnetic torque

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

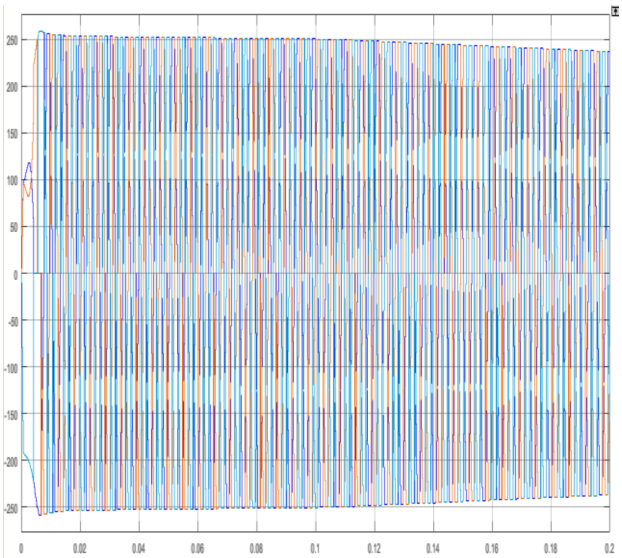

Fig 5: Waveform of motor voltage

The above figure 5 represents the motor voltage which is measured at 236.7 V

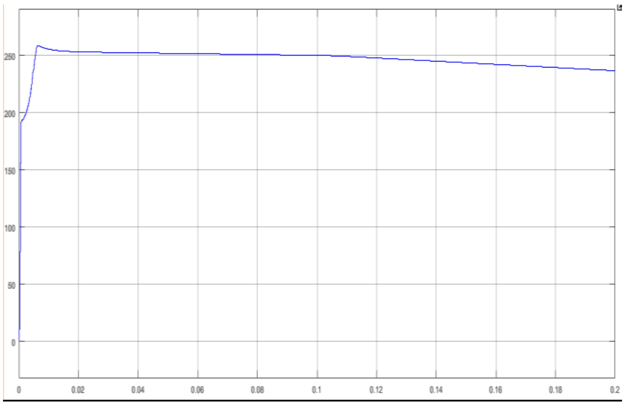

Fig 6: Waveform of converter output voltage

The above figure 6 represents the output voltage ofconverter which is measured at 236.7V

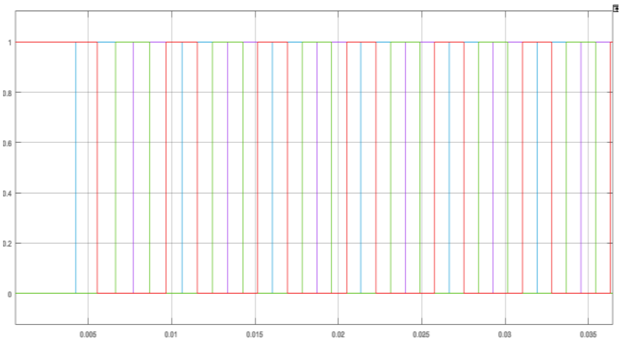

Fig 7: Waveform of gate pulse

The above figure 7 represents the gate pulse used for controlling the firing angle. Gate pulse which is fed to the inverter for controlling switching pulses.[7]

V. EXPERIMENTAL RESULT:

An experimental simulation results are shown in the above figures. According to the paper, components values are changed manually for simulation results. The sequel of the converter gives the output voltage. Output voltage is always higher than the input voltage through interleaved boost converter. From above simulation results speed of the motor will be regulated through PID controller**[5].** Regulated speed will rotate the motor. Input ripple current was reduced by using interleaved boost converter. Coupled form of inductor will reduce the switching losses of converter.**[6,14]**

VI. SPECIFICATION:

Table 1:Specification Of Components

S.NO	COMPONENTS		RATING
01	Solar PV	Output voltage	90V
02	Converter	Inductance L1,L2	10e-6 H
		Capacitance	5e-3 F
		Resistance	250e3 ohm
03	AC Induction Motor	Output voltage	236.7 V
		Input voltage	236.7 V
		Rotor speed	2600 RPM
		Torque	51 N-m
		Stator current	60 A

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.

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