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Closed Loop Controlled ZV ZCS Interleaved Boost Converter System

M.L.Bharathi, and Dr.D.Kirubakaran

***Abstract*—**This paper deals with modeling and simulation of closed loop controlled interleaved boost converter. The low voltage DC is boosted to high voltage DC using interleaved boost converter. The ripple in the output is reduced by using ILBC and 'Pi' filter .This work proposes'Pi' filter at the output to reduce the ripple.ILBC with 'c' filter and 'Pi' filter is simulated and the results are presented with R load .. The simulation results are compared with the theoretical results.

***Keywords*—**Boost converter, Closed loop control, interleaved, ripple reductions.

I. INTRODUCTION

THE Renewable energy being the best solution and employed all over the world to satisfy the energy shortage existing without environmental contamination [1]-[3].Among the renewable energies available the most promising energy is Photovoltaic (PV) energy. Though PV system installation cost is high, it has lots of pros, as the system is long lasting and maintenance free [5]. Now-a-days, PV system has grasped the attention of the researchers, but high installation cost and low conversion efficiency are the major drawbacks.

To extract maximum power from the PV system MPPT technique can be implemented to the boost converters. By adjusting the duty ratio of the converter, maximum power delivered can be tracked by the PV panel. As the energy generated by the PV system is not sufficient (i.e.) very low voltage. IN order to overcome, the aforementioned cons in the PV system. The DC/DC boost converter is employed in between the power generation stage and the load shown in the Fig.1. The voltage is boosted and high voltage is achieved.

But, our conventional power converters has low efficiency due to the poor conversion ratio. The semiconductor devices are used as the switch in the converter. Since, these switches suffers with voltage stress, the switching losses increases and efficiency is decreased [15]. To increase the conversion efficiency Zero voltage switching (ZVS) and Zero current switching (ZCS) technique can be employed. In addition to this, the interleaving of converter doubles the voltage gain so that the efficiency can be increased further. Moreover, closed loop control provides better dynamic response and voltage regulation [11].

M. L. Bharathi, Research Scholar in Sathyabama University, Chennai, India. (bharathiml15@gmail.com)

Dr. D. Kirubakaran, Professor, St. Joseph Institute of Technology, Chennai, India. (kirubad@gmail.com)

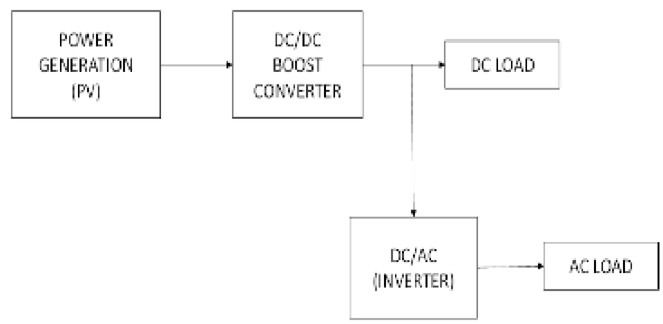

Fig. 1 Block diagram

This paper deals with closed loop control of interleaved boost converter with both the characteristic of zero-voltage turn-on and zero current turn-off for the main switches to improve the efficiency with wide range of load. Moreover, by establishing the common soft switching module, soft-switching interleaved converter can further reduce the size and cost. The above literature does not deal with closed loop controlled ILBC system. This work proposes simulation and model for closed loop control system.

II. SIMULATION RESULTS

Digital simulation is done by using the elements of MATLAB Simulink and the results are presented here.

A. ILBC with R-Load

The Simulink diagram of interleaved boost converter with R-Load is shown in Fig 2.

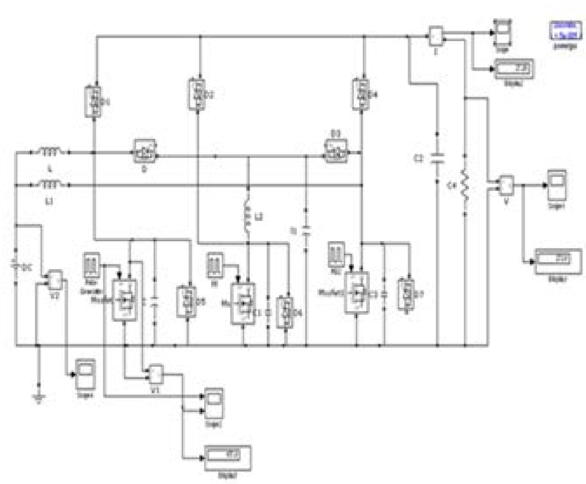

Fig. 2 Circuit Diagram of ILBC with R-load

The voltage and current measurement blocks are connected to measure the output voltage and output current. The scopes are connected to measure the driving pulse and voltage across the switch. DC input voltage is shown in the Fig .3.The gating pulse and voltage across the switch is shown in Fig .4.The output current and output voltage is shown in the Fig. 5 & Fig. 6 respectively. The output voltage is 370 V. The ripple voltage is shown in Fig. 7.

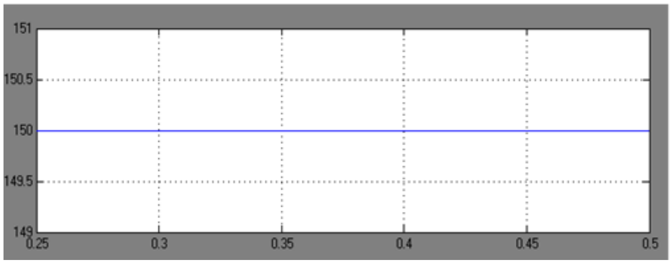

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Fig. 3 Input Voltage

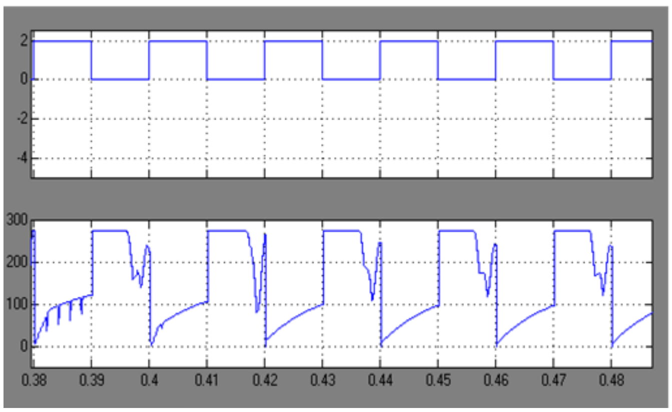

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Fig. 4 Switching Pulse and V_{DS}

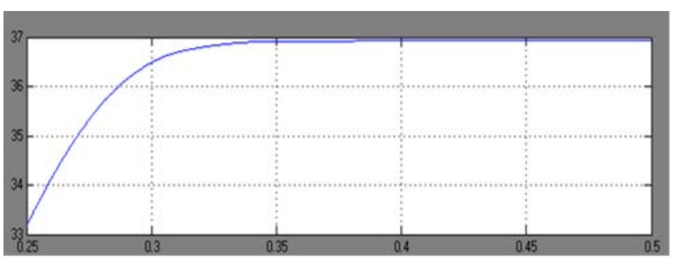

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Fig. 5 Output Current

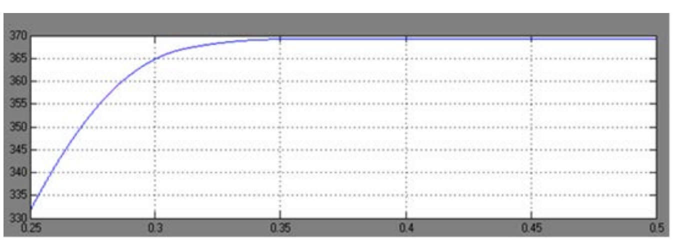

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Fig. 6 Output Voltage

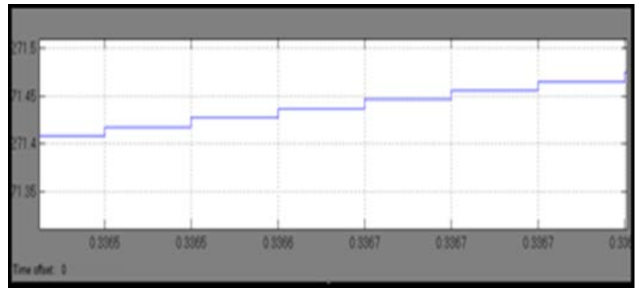

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Fig. 7 Ripple in the Output Voltage

B. Interleaved Boost converter with 'Pi'Filter

The 'c' filter at the output of ILBC is replaced by 'pi' filter as shown in Fig .8.DC input voltage is shown in Fig. 9.The input voltage is 150 V. The switching pulse and voltage across the switch are shown in Fig. 10.The output current is shown in Fig. 11. The steady state value of the output current is 0.26A.The output voltage is shown in Fig .12.The voltage settles at 260 V.

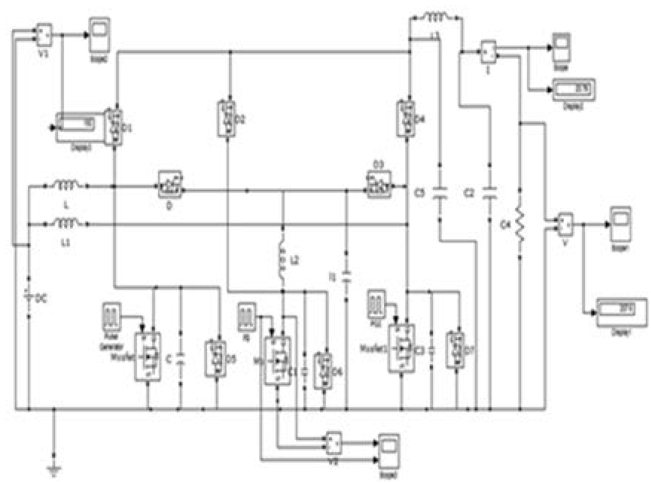

Fig. 8 ILBC with 'Pi' Filter

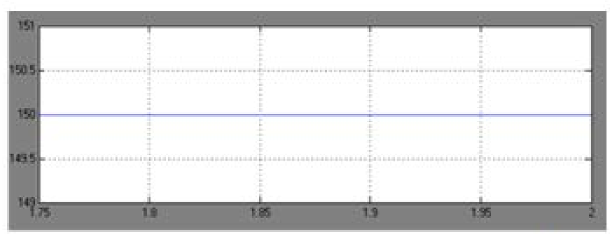

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Fig. 9 Input Voltage

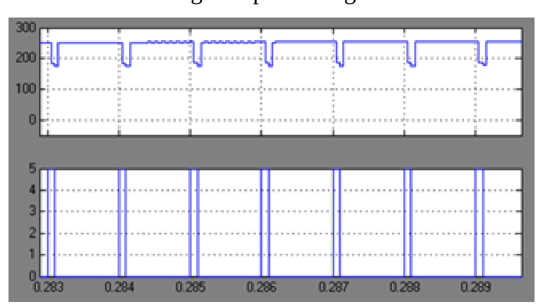

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Fig. 10 Switching Pulse and V_{DS}

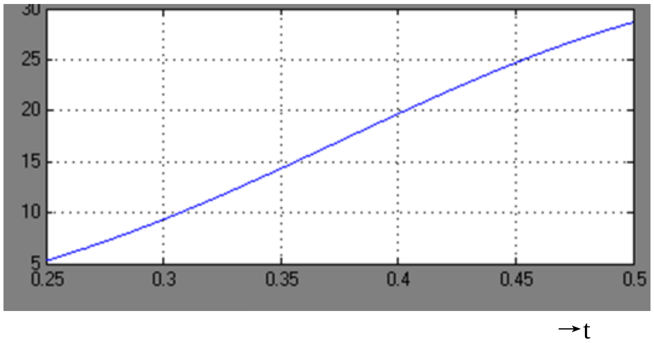

Fig. 11 Output current

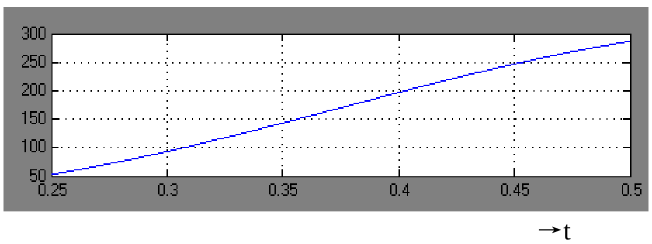

Fig. 12 Output Voltage

C. *Open loop control system*

The circuit of the open loop system with a step change in the input voltage is shown in Fig .13.The input voltage is shown in Fig 14. The output voltage is shown in Fig 15.The increase in the output voltage is due to the increase in the input voltage.

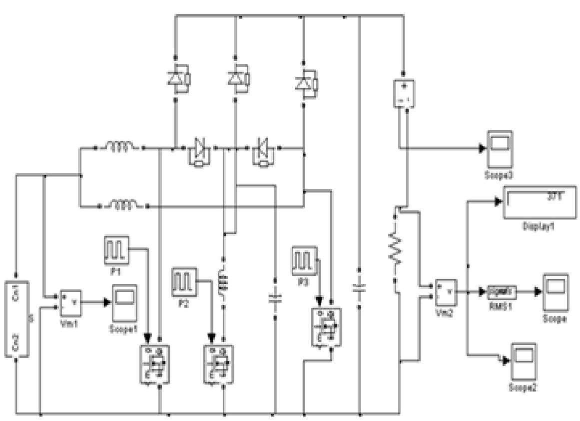

Fig. 13 Circuit for open loop control system

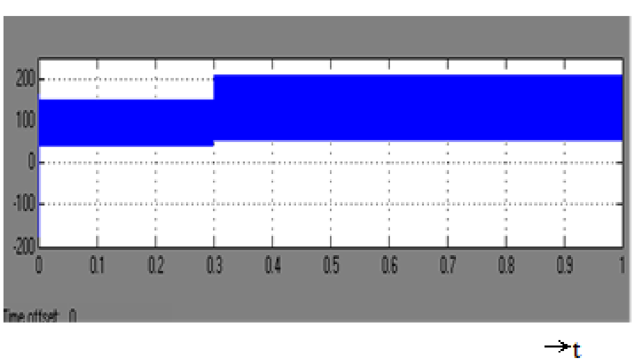

Fig. 14 Input voltage

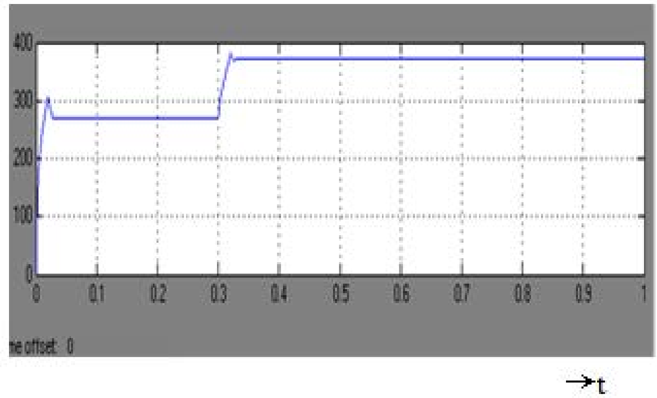

Fig. 15 Output voltage

D. *Closed loop control system*

The circuit for closed loop controlled system is shown in Fig.16. The output voltage is sensed and it is compared with the Reference voltage.

The error signal is applied to a PI controller. The output of the pulse generator adjusts the pulse width to correct the output voltage .Step change in the input voltage is shown in Fig.17.The output voltage of closed loop control system is shown in Fig.18.The output voltage increases and reduced to the normal value. Due to the closed loop system voltage has been boosted to 370 V.

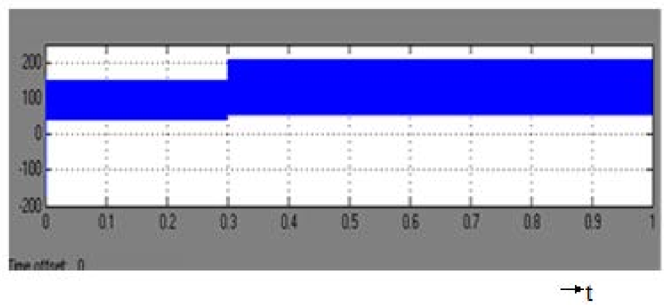

Fig. 17 Step change in input voltage

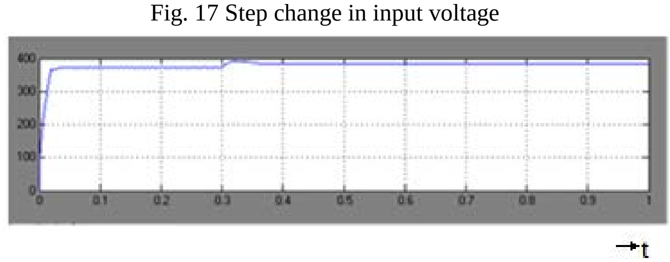

Fig. 18 Output voltage of closed loop control system

III. Conclusion

ZV- ZCS ILBC closed loop controlled converter is successfully modelled and simulated with R load. The simulation results are in line with predictions. The scope of this work is designing, modeling and simulation of closed loop controlled ILBC. The hardware is yet to be implemented. By adjusting the duty ratio by introducing MPPT technique to the converter, further improves the work quality. Which is left as the future scope of this project. The closed loop model is developed using the blocks of Simulink. Closed loop system is capable of reducing steady state error.

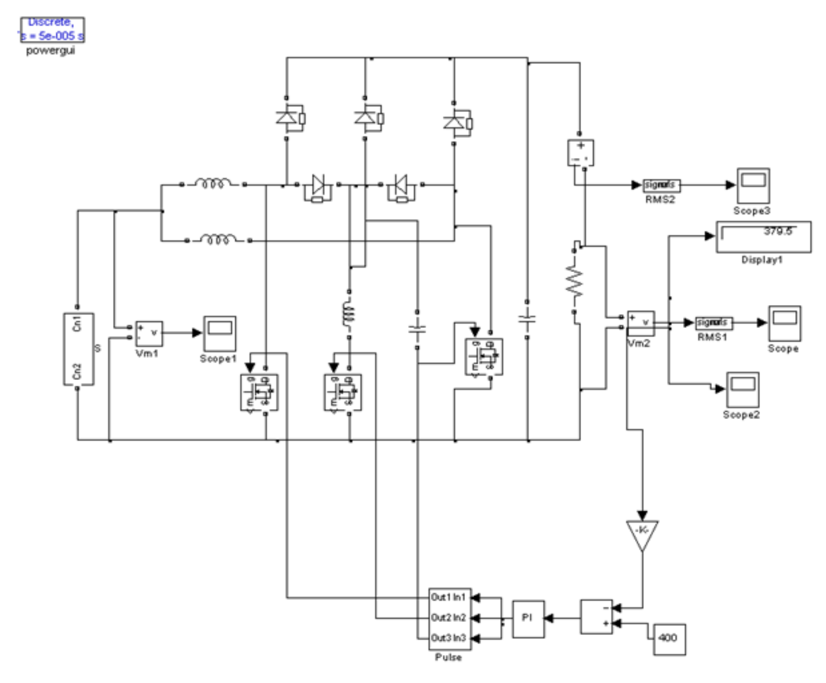

Fig. 16 Circuit for closed loop control system

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Bharathi.M.L has obtained M.E degreee form Sathyabama University in the year 2004 and obtained her B.E degree from Madras University in the year 2001 .She is currently a research scholar in Sathyabama University .Her research area is on interleaved boost converter fed drives.

Dr.D.Kirubakaran has obtained M.E. degree from Bharathidasan University, Trichy in the year 2000 and Ph.D. degree from Anna University, Chennai in the year 2010.His area of interest is Induction Heating and Renewable Energy System. He has published several research papers in the area of Induction Heating. He has more than a decade of teaching experience. He is a life member of ISTE and IET. He is currently working as a Professor and Head in the Department of Electrical and Electronics Engineering, St. Joseph's Institute of Technology, Chennai, India