Power Upgradation of Renewable Energy Sources by using Interleaved Boost Converter

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Abstract— As the time is passing out our demand of energy is rising irrespective of the time. In this case the best option to go toward the renewable power generating sources. Among the all power generating sources the solar power generating sources are top on the list. For increasing the output of this sources we need a suitable boost converter. Interleaved boost converter is one of such convertor which consist of several identical boost convertor connected in parallel and controlled by interleaved method, which has some switching frequency and phase shift. The advantages of using IBC over conventional boost converter are increased efficiency, improved reliability, reduced current peak value and these converter cells have good current sharing characteristics. The proposed method provides the increased output voltage along with efficiency.

Keywords: Interleaved Boost Converter, Power Upgradation

I. INTRODUCTION

The global electrical energy consumption is steadily rising and consequently there is a demand to increase the power generation capacity without harming the environment .In order to achieve this renewable energy source are the best option. Among all the renewable energy source, solar power generation system tops of the list. For increasing the output of this sources we need a suitable boost converter .But it is unpleasant that only partial amount of energy can be boosted by the conventional boost converter so for increasing the output of these source IBC is use in which two or more converter will be connected in parallel which can extract maximum amount of energy from the solar panel to give better output and efficiency.

As the output current is divided by the number of phases, the current stress on each MOSFET's reduced .Each MOSFET is switched at the same frequency but at a phase difference of 180 degree .the desire output voltage for given input voltage is 15 volts and the desire output 100 volts then we have to keep the duty cycle at 0.88 since we are using two similar inductor in the circuit this will lead to equal sharing of the input current.

II. Operation of IBC

Since we are using two phases the convertor is driven 180 degree out of phase ,this is because the phase shift is given by 360/n. where n stands for number of phases. Hence its clear that the phase shift is depends the number of phases used.

When gate pulse is given to the first for time t1 the current across the inductor rises and energy is stored in the inductor. When the switch s1 in the first phase turned off the energy stored is transferred to the load through the output diode SD1. The inductor and the capacitor serve as voltage sources to extend the voltage and to reduce the voltage stress on the switch. The increasing current rate across the output diode is controlled by inductances the phases. Now the gate pulse is given to the second phase during the period t1 when the switch in the first phase is turned off. When the switch in the second phase turned ON the inductor charges for the same time and transfer energy to the load in the similar way as in the first phase. Therefore two phases feed the load continuously. Thus the proposed converter operates in continuous conduction.

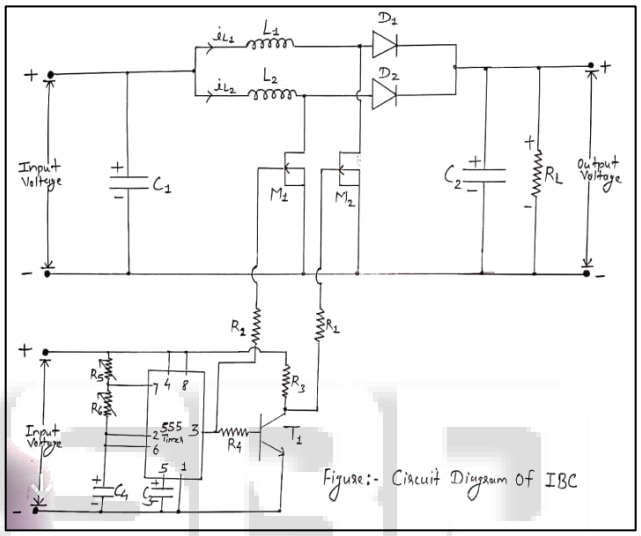

Fig. 1: Circuit Diagram of IBC

In the above figure there are two circuit diagram are shown. One is the circuit of the interleaved boost converter and other is gate driver circuit the gate driver circuit produce the gate pulse for the MOSFET. In the gate driver circuit 555 timer IC is use for generating the gate pulse here one pulse is directly given to the MOSFET M1 and the other gate pulse is given to the MOSFET M2 by the BC 547 transistor .the gate pulse which is coming by the transistor here transistor act as a NOT gate which gives the inverse of the gate pulse provided to the M2 that's how it give the 180 degree of phase shift in the circuit by which the voltage is boosted by the interleaved boost converter.

III. CALCULATION OF IBC

Formula for Output voltage:

$$Vo = Vs\ \alpha / 1-\alpha$$

Suppose, $\alpha = 88\%$, $Vs = 15$ V

$$Vo = (15*0.88)/1-0.88 \quad Vo=110V$$

Here, we have supposed a firing angle of MOSFET 88 degree, and the supply voltage of renewable sources is taken as 15V, which is multiplied with the formula of the output voltage of interleaved boost converter hence the output voltage will be approximately 50 to 100 V. here above the alpha represents the firing angle of MOSFET, and the Vo is the output voltage of IBC and vs is the supply voltage consider as renewable energy source.

Duty cycle

$$Vo / Vs = 1/1-D$$

Where D is the duty cycle

Both the inductors used here are of similar rating that is both are having 1 mH of inductance. Since, we are using two similar inductors this will help us in sharing the input currents equally. And also, the inductor peak current rating is also reduced, thereby reducing the inductor rating and cost of Inductor

IV. CALCULATION OF DUTY CYCLE

Formula for duty cycle:

Vo/Vs =1/1-D

D = 1- Vs/Vo

D = 1 –15/110

D = 0.85

The calculation of the duty cycle is represented in above calculation.

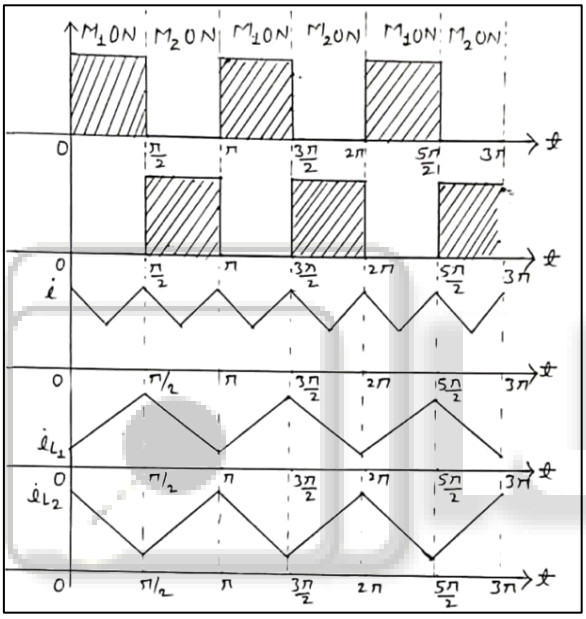

Fig. 2:

The below tabular column is prepared by taking different input power and their corresponding output power are noted down. And then the efficiency is calculated. For this obtained results the graph of efficiency versus output power is plotted. This graph clearly shows that the efficiency of the proposed converter increases with increase in output power

INPUT SIDE			OUTPUT SIDE			% η
V volts	I Amps	P watts	V volts	I amps	P watts	% η
5	1.8	9	9.2	0.91	8.372	93.02
12	4.6	55.2	22.9	2.29	52.44	95
60	24	1440	117.9	11.8	1391.22	96.6
120	48	5760	237	23.68	5612.9	97.43
200	80	16000	395	39.5	15602.5	97.8

Chart 1: Output Power & Efficient for Different Input Power

V. CONCLUSIONS

This project presents dc-dc interleaved boost converter for applying to the solar power generation system by using interleaves techniques. This converter is non –isolated boost converter, which can level up dc voltage from 15vdc to 50-100vdc output voltage at power rating of 320w. Four phase of each switching control signal are differentiate by 88 degree. However inductor currents in each phase in the experimental result are not exactly the same because of the inductor parasitic. High voltage gain interleaved dc boost converter in this paper could be applied to any renewable energy systems and some related applications.

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