BIDIRECTIONAL DC- DC CONVERTER FOR ENERGY STORAGE SYSTEM

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***Abstract**-Soft-switching bidirectional dc–dc converter (BDC) with a coupled-inductor and a voltage doubler cell is proposed for high step-up/step-down voltage conversion applications. A dual-active half-bridge (DAHB) converter is integrated into a conventional buck- boost BDC to extend the voltage gain dramatically and decrease switch voltage stresses effectively. The coupled inductor operates not only as a filter inductor of the buck-boost BDC, but also as a transformer of the DAHB converter. The input voltage of the DAHB converter is shared with the output of the buck-boost BDC. So, PWM control can be adopted to the buck-boost BDC to ensure that the voltage on the two sides of the DAHB converter is always matched. As a result, the circulating current and conduction losses can be lowered to improve efficiency. Phase-shift control is adopted to the DAHB converter to regulate the power flows of the proposed BDC. Moreover, zero-voltage switching (ZVS) is achieved for all the active switches to reduce the switching losses.*

***Keywords:** Bidirectional dc–dc converter(BDC),Dual active half-bridge(DAHB), Zero voltage switching.*

I. INTRODUCTION

Energy storage systems have been widely used in numerous applications, such as renewable power systems, electric vehicles, uninterrupted power supplies, and micro-grids to compensate the power mismatch between the power generations and power consumptions. Bidirectional dc–dc converters (BDCs), which have bidirectional power converting and transferring capabilities, are the key components for interfacing energy storage elements, such as batteries and super capacitors, with various power systems. One side of a BDC is connected to a storage battery, whose voltage is usually low and typically in the range 12–48 V, while the other side of the BDC is connected to a high voltage bus up to 400 V or higher to satisfy the requirement of inverter and ac grid. Therefore,a BDC with high step-up/step-down voltage conversion ratio is desired for energy storage systems to connect the low-voltage battery with high-voltage dc bus.

II. DC-DC CONVERTER

A **DC-to-DC converter** is an electronic circuit or electromechanical device that converts a source of direct current (DC) from one voltage level to another. It is a type of Transmission)

Most DC-DC convertors are designed to move power only in one direction,from dedicated input to output. However,all switching regulator topologies can be made bidirectional and able to move power in either direction by replacing all diodes with independently controlled active rectification. A bidirectional converter is useful, for example, in applications requiring regenerative braking of vehicles, where power is supplied to the wheels while driving, but supplied by the wheels when braking.

III. EXISTING SYSTEM

Soft-switching technique can be achieved with the help of conventional DC-DC converter. Existed system converter is the single-phase dc–dc single-switch boost converter. The converter is operated with a constant duty cycle throughout the line cycle and is designed so that its input capacitors operate in the discontinuous voltage which results in naturally sinusoidal input currents.

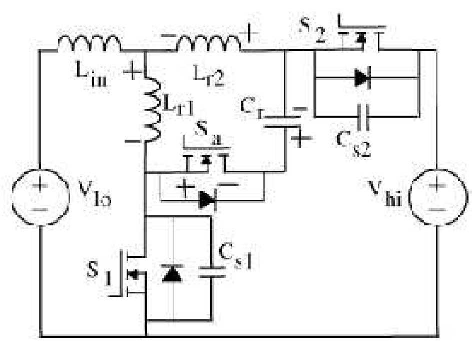
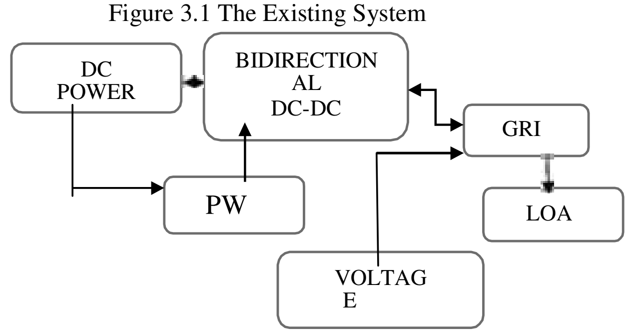


Figure 3.1 The Existing System



DC power supply either from solar or battery is given to bidirectional dc to dc converter. A part of dc supply is taken for triggering the pulse by PWM technique .The output of BDC converter which is boosted and the voltage source is given to grid and then to the load.

When the power supply is cut off the voltage source act as a main supply and given back to battery for charging through BDC converter.

IV. PROPOSED SYSTEM

Soft-switching bidirectional dc–dc converter (BDC) with a coupled- inductor and a voltage doubler cell A dual-active half-bridge (DAHB) converter is integrated into a conventional buck-boost BDC to extend the voltage gain dramatically and decrease switch voltage stresses effectively The non-isolated buck-boost BDC, which is derived by replacing the passive diode in a buck converter or a boost converter with an active switch, is the simplest bidirectional converter.

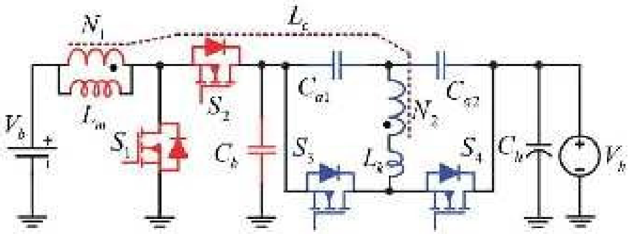
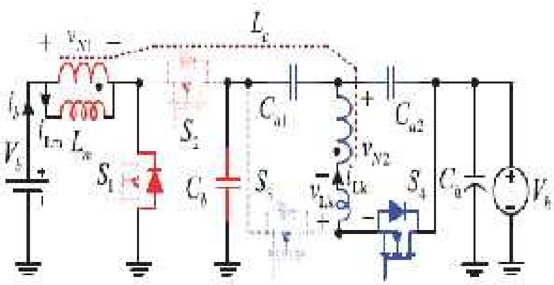


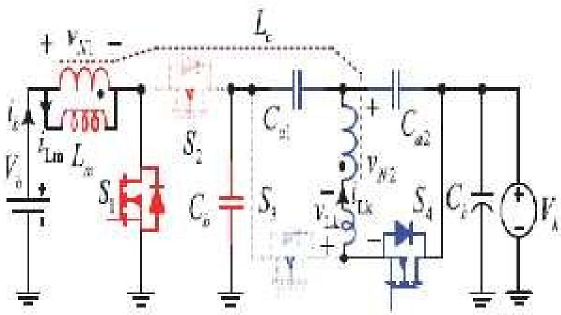
Figure 4.1 Bidirectional DC-DC converter

MODE OF OPERATION



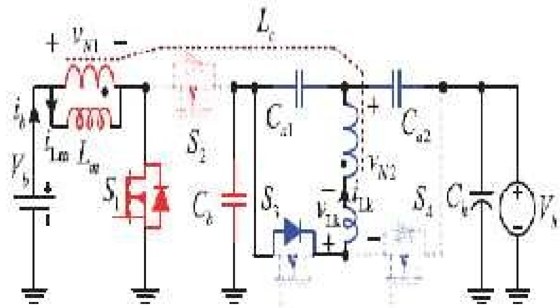
(a)

In Fig(a), the switches S2 and S4 are ON, and both the currents ib and iLk are negative. S2 is turned off. The body diode of S1 is ON due to the negative current of



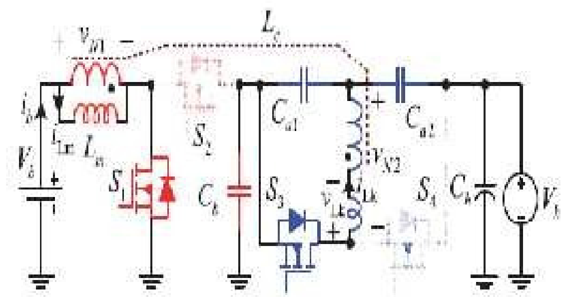
(b)

In Fig(b), S1 is turned on with ZVS. Fig (a)and Fig(b), the currents iLm and iLk increase linearly due to the positive voltage on the inductors Lm and Lk.



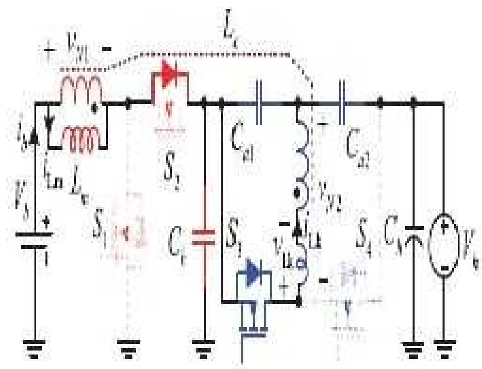
(c)

In Fig (c), S4 is turned off, the body diode of S3 is ON due to the positive value of iLk.



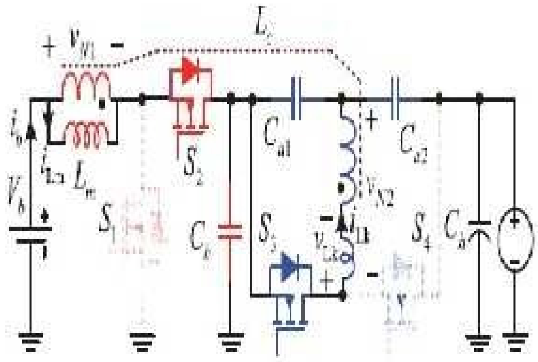
(d)

- In Fig (d) S3 is turned on with ZVS because S3 is operated as a synchronous switch in this stage. During Fig (c)and Fig (d), the battery is discharged and supplies power to the load. So, the inductor Lm is charged by Vb, and iLm keeps increasing linearly.



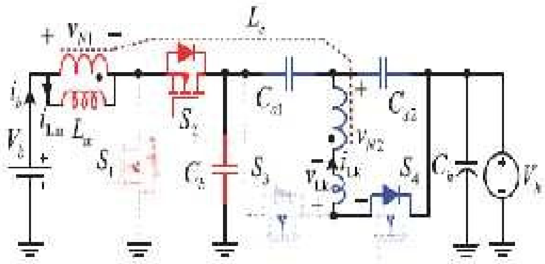
(e)

Fig (e) S1 is turned off, and the body diode of S2 is ON due to the positive values of iLm and iLk



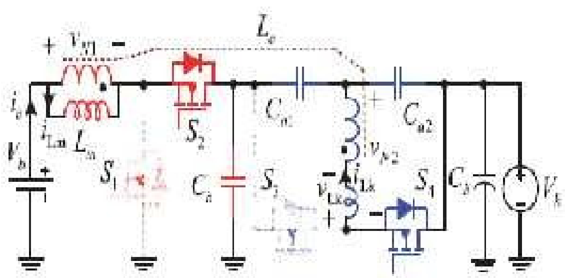
(f)

Fig (f) S2 is turned on with ZVS ZVS of S2 can always be achieved because the current in S2 is negative and S2 operates as a synchronous switch in this stage. Fig (e) and Fig(f) both iLm and iLk decrease linearly. Both the battery and the energy stored in Lm are discharged and supply power to the capacitor Cb.



(g)

Fig (g) S3 is turned off and the body diode of S4 conducts because of the negative value of iLk



(h)

In Fig (h), S4 is turned on with ZVS. During Fig(g) and Fig (h), iLk is expressed as iLk(t) = iLk(t6) is derived, which means the current of iLk keeps unchanged because the voltages on the two windings of the coupled inductor are well matched and the voltage applied on Lk is zero. In Stage 7 [t6, t7] and Stage 8 [t7, t8], the battery is discharged and supply power to the high-voltage side, and Ca1 is discharged while Ca2 is charged. At t8, the next switching periodbegins.

V. DESIGN PARAMETERS

The voltage conversion ratio of the proposed BDC can be derived as

$$G = V_h/V_b = (n + 1)/(1 - D)$$

To achieve the voltage matching, the voltage VCb is controlled by the buck-boost BDC to satisfy the following equation:

$$V_{Cb}/(V_h - V_{Cb}) = N_1/N_2 = 1/n$$

The voltages on Cb, Ca1, and Ca2 are derived as follows:

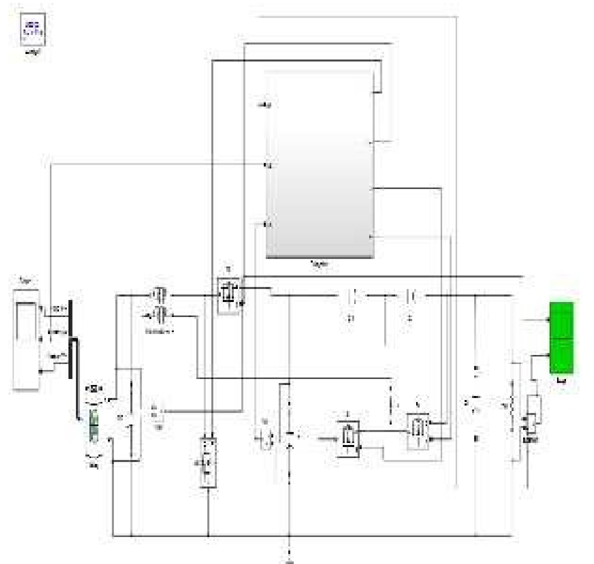
$$V_{Cb} = V_b/(1 - D)$$

$$V_{Ca1} = (1 - D)(V_h - V_{Cb}) = nV_b$$

$$V_{Ca2} = D(V_h - V_{Cb}) = D/(1 - D)nV_b.$$

VI. SIMULATION MODEL

FORWARD DIRECTION:



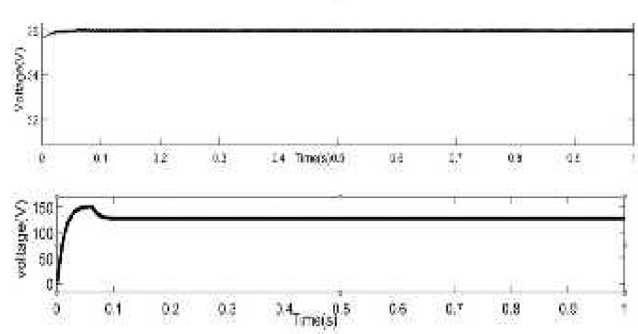


Figure 6.1 Forward Direction Input And Output Voltage

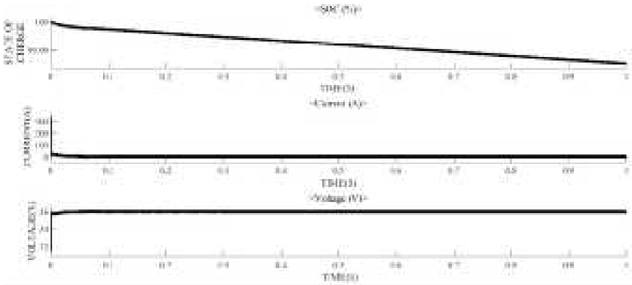


Fig. 6.2 Battery Characterstics For Forward Direction

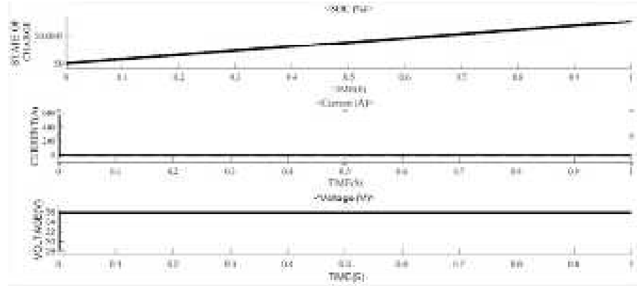
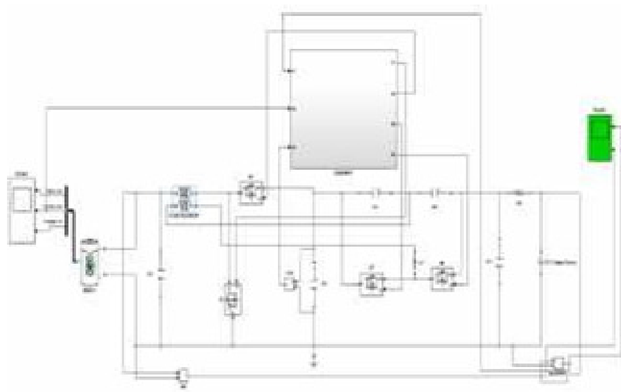
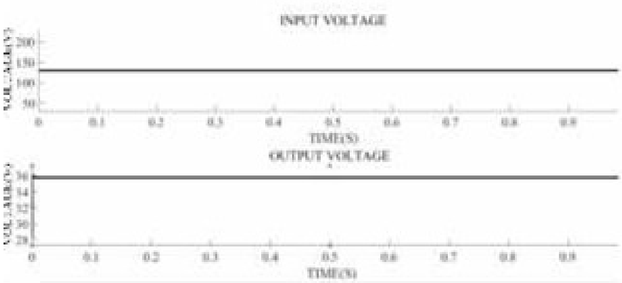


Fig.7.2 Battery Characterstics For Reverse Direction

VII. REVERSE DIRECTION

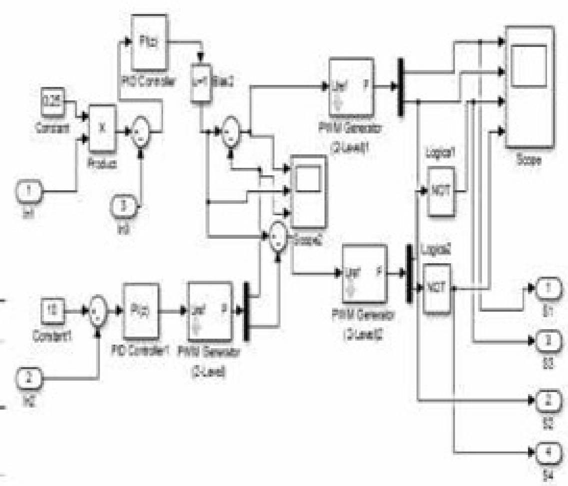




VIII. TABLE CHARACTERISTICS

Parameters name	Values
Input voltage	12-48V
Output voltage	400V
Capacitor	10e-6,470e-6
Inductor	5e-3,1000e-6,50e-6
Duty Cycle	0.4-0.6

CLOSED CONTROL LOOP USING PI



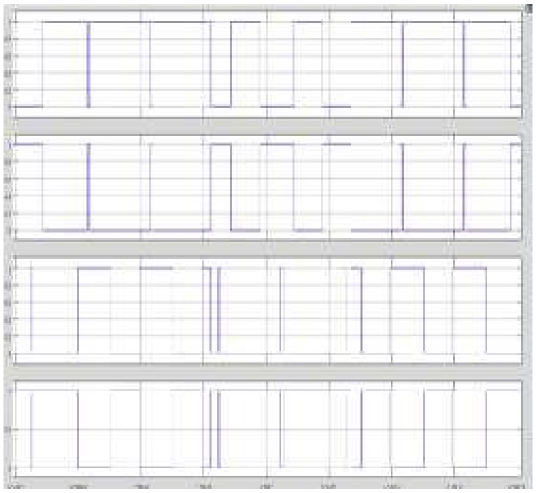


Fig : 8.2 Switching Pulses

APPLICATIONS:

D.C Motor

applications

Electrical

Vehicle

IX. CONCLUSION

It will be implemented for high power application in future. According to literature survey, the base paper will be splited into division and project will be carried out.

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