Single and Multi Switch Hybrid Dc/Dc Inverter for PV Systems

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Abstract- A hybrid boosting device (HBC) with combined rises of regulating ability from its boost schematic and rise improvement from its voltage booster schematic is given in this project. The novel device integrates a bipolar voltage booster, consisting of symmetrical schematic, one inductor and one switch, much rise dominance with much regulating limits, decreased elements pressure, decreased output harmonic and Adjustable expansion, which does it adaptable for photo voltaic and any other recoverable energy schemes. The working conditions, elements pressure, decreased output harmonic are discussed in this project. Working connection and operation with a many old one-switch one-inductor devices are given. The simulation analysis of given the usefulness of the studied device.

I. INTRODUCTION

In present years, the speed increment of renewable energy devices needs for novel of more rise dc-dc devices with more performance and less price [1, 2]. The “ready to use” photo voltaic scheme generally needs boost device which is potentiality of increasing the voltage from 35 to 380 V with regulating capacity because to the lesser final voltage and the need of Maximum power point tracking operation for one photo voltaic array [3].

By taking a wind field with inner standard-voltage dc (SVDC)-grid scheme, a SVDC device capable to increase the voltage from 1–6 to 15–60 kV is needed to connect the output of generator-end rectifier to the SVDC network [4].

There is an immediate need in developing and use of renewable energy schemes to fill the distance between developing world energy utilization and decreased fossil energy sources.

A few power sources need storage devices like as fuel cell energy schemes also need more- rise dc-dc device devices because of their less voltage range at storage end [5]. In need of getting increased voltage transforming ratio with increased performance, more increased rise improving schematics were discovered in the old studies. From them, switched capacitor schematic, a novel series of devices many lift pushpull switched capacitor has been successfully created [6]. Since these devices are constructed with a switched capacitor, their size is very less and power density is very more. Using this method largely increases the voltage transfer rise, and more o/p voltage is easily obtained. This series of devices is suitable and convenient to be used in industrial uses with more voltage [7]. Tapped/linked inductor-based approach, transformer-based approach, voltage booster schematic or combinations of them attracted some attentions. Every technology has its ideal advantages and disadvantages. The switched capacitor dc–dc device can get more performance but has harmonic current and less regulating ability. Introduction of resonant switched capacitor device can remove the harmonic current but not solve the regulating problem [8].

The tapped-inductor provides rise boosting operation but needs snubber circuit to tackle leakage issue. The bunch of above technologies generally gets satisfactory circuit lineaments but with more no of elements. In this study, rise improvement technology based on conversion of conventional boost device while keeping one inductor and one switch is studied, looking at easing the circuit structure, decreasing the price, pleasing the requirements of common more rise uses, and bulk manufacturing.

II. EXISTING METHOD

The existing method describes among them, switched capacitor schematic tapped or linked inductor based approach transformer based approach voltage booster schematic or combinations of them attracted some attentions. Every topology has its ideal advantages and disadvantages. The switched capacitor dc-dc device can get more performance but has harmonic current and less regulating capability. Adding of resonant switched capacitor device can reduces the harmonic current but does not provide solution to the regulating problem.

Boost Device with Voltage Booster

Boost Device with Voltage Booster given in Fig. 1. The voltage booster module, designed by the diodes DM1 DM2, the capacitors CM1 CM2 and the resonant inductor Lr, is added with a general boost device, designed by the switch S, input inductor Lin, diode Do and capacitor filter Co. When the power switch is switched off, the capacitor CM1 is charged with a voltage equal to the classical boost voltage. When the power switch is switched-on, the power saved in the capacitor CM1 is lightly shifted to the capacitor CM2 and the voltage in this capacitor is nearly same as the CM1 voltage. So, the voltage of the boost device connected with the voltage booster is double the voltage of the normal boost device. Then also, in both structures the switch voltage is same. Thus it is achievable to get better static rise without raising the switch voltage. This parameter provides to use less drain-source voltage and low RDSon MOSFETs, minimising the switch conduction losses. As in the normal voltage boosters, the no of booster phases linked in series can be improved in order to get better static rise.

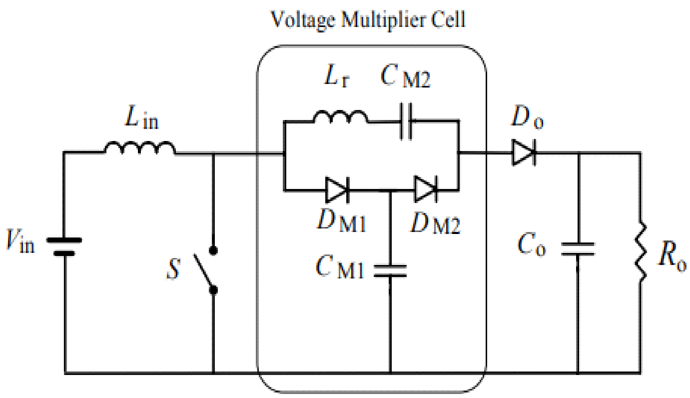

Fig.1. Boost device integrated with a voltage booster

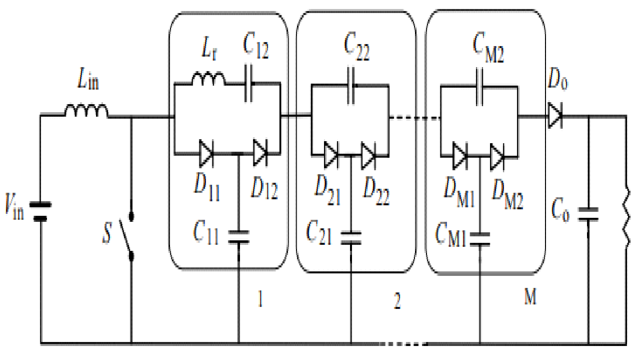

Fig. 2. Boost device with "M" voltage booster cells

The schematic with M booster phases is given in Fig.2. In this operation, only one resonant inductor in the initial booster phase is compulsory to make the reasonable function performances. The voltage booster module improves the static rise of the general boost by a times of (M+1), where M is the no of booster modules. Therefore, the o/p voltage is (M+1) times higher than the peak switch voltage. The voltage booster module also can work without the resonant inductor Lr. Then also, the adding of this less inductance provides to get zero current-commutating (ZCS) turn on and the -ve impacts of the opposite recovery current of all diodes is reduced. Thus the current flowing in all elements happens in a resonant manner, with less di/dt. This characteristic minimises the device commutating losses, making the operation with better commutating frequency, balancing more performance. The booster capacitors linked with the node of the voltage can be also added with the capacitance, as given in Fig. 3. With this schematic, the voltage in all o/p capacitor is ½ times of the o/p voltage. A voltage can get even for similar loads, by taking the reference in the capacitor middle node. The voltage booster module is interlinked with the others nornal Dc Dc devices, as given in Fig.4. Even also, as the boost device gives the more static rise of the normal schematics, only the study of the boost device connected with the voltage booster is observed in this study. But the function performances given for the boost device is same for the different topologies.

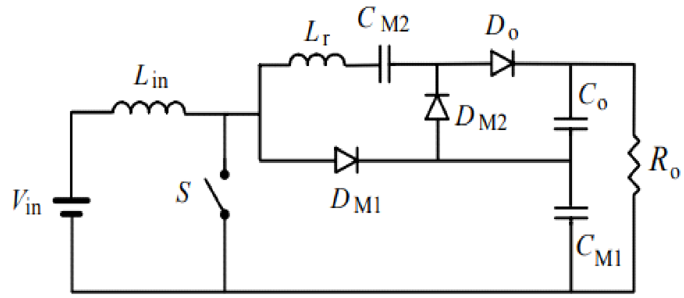

Fig. 3. Interconnection of the voltage booster capacitor with the output

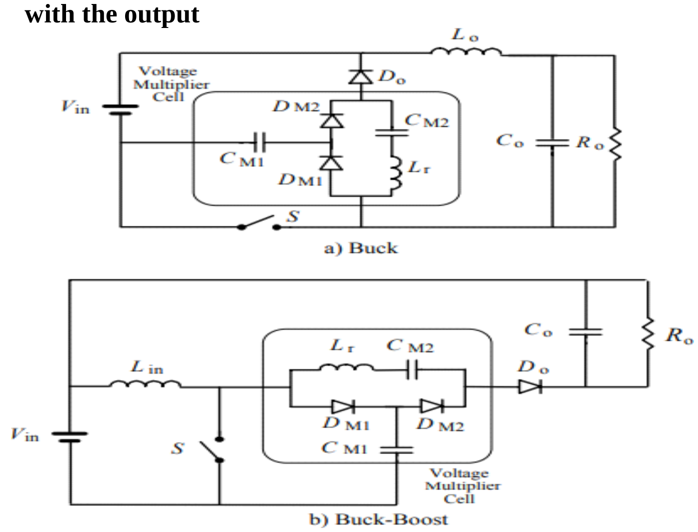

Fig. 4. Voltage Booster module connected with different conventional Dc-Dc devices

III. BIDIRECTIONAL DC/DC DEVICE FOR RENEWABLE ENERGY SCHEMES

Application:

The main part of the renewable energy scheme is a back-up element. The backup element takes the energy variations and switches to boost the scheme dynamic conditions. A chemical storage or super capacitors, used as a common energy back-up element, are mentioned by the less DC voltage level. To fill and drain the back-up element, the bidirectional DC-DC device is needed. The DC-DC device mainly makes an electrical separation between less voltage and more voltage elements of the scheme, and then the transformer is commissioned. In order to supply the transformer a DC power should be transformed into AC power and later converted to DC supply. To compress the transformer area, mass and cost, the frequency of the AC supply should be as more as ever. The frequency rise is controlled by the transistor flow and commutating losses. It should be observed that the primary source of the power supply is the less voltage side device because it transfers a more current. So, the main aim of the study is referred to the low voltage device operation. The first study of the bidirectional DC-DC device scheme was a DAB device. The DAB device has the 2 voltage-fed inverters at each side of the transformer. The energy transfer level and path were operated by the phase shifting angle of the each inverter. The main problem of the

DAB device is that it does not provides a more variation between voltages of less and more sides of transformer, due to the current contrast and losses created by the rotating current reaches to more. Along with this scheme does not make ZVS schemes of the transistors commutating flow in a high range of the voltages fluctuations. Other reason of the bidirectional DC-DC device scheme having a current supply (step up) inverter at a less voltage side and a voltage supply (step down) inverter at a more voltage part. The disadvantage of this scheme is the more voltage peaks made by the transformer drop inductance when the boost device is on. The transformer drop inductance can be utilized as a useful element in the resonant devices. In the study a bridge schematic class E buck resonant device is mentioned. The bridge schematic class E step up resonant device was taken in . The class E devices provides commutating operations for device transistors in the total working area and leaving that from that do not create the parasitic variations which makes the voltage peaks. Depending up on the both class E devices described above a bidirectional class E DC-DC device is studied.

Then also cascaded and parallel resonant devices have past applied in x ray, tig, and railway applications, resonant devices in more power usage require a some drawback in terms of device and element stresses. As an output, high commutating PWM dc-dc devices have been the topology of alternate in the previous. A better approach for more power levels is the bunch of resonant-transition. These devices have been described to have very less element levels and less commutating loss. The device, which is given in , has been given to be a better substitute for more power uses. The device utilizes active devices on both the sides to understand a minimal topology that has less device stresses, no more reactive elements, and utilizes the transformer drop inductance as the ideal energy transfer element. The harmonic current peaks in the filtering capacitors are also observed to be acceptable. The topology also grants more-frequency function as a aim of zero voltage commutating for all the devices over a acceptable working scope. The using of thyristors in the especially, in a complex commutating area, permits the high frequency gettable. Continuing, the requirement for transformer isolation would generate tough issues because of the energy inside in the drop inductance. In row, the schematic is used to be more acceptable, mainly where power density is compulsory.

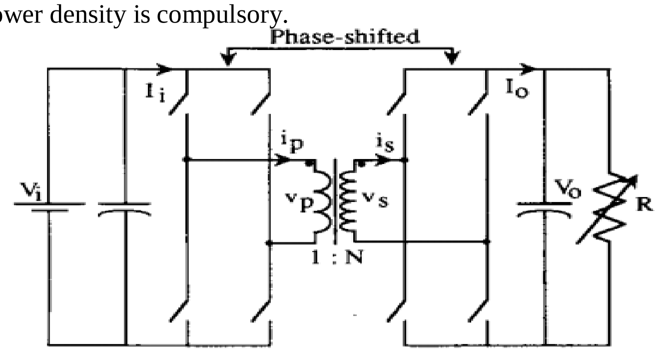

Fig: 5.Circuit schematic of one phase DAB dc-dc device

IV. TRI-MODAL HALF-BRIDGE TOPOLOGY

The general idea turning on one phase three-port linking is the making similarity between the half bridge and the active-link forward device structures. As observed in Fig.6, the half bridge and active link forward are the like as with the main source linked to various nodes. Summation of a freewheeling module around the transformer, having of a diode and a switch, generates the given tri modal half bridge schematic, as given in Fig.7. Its fundamental steady state commutating graphs are mentioned in Fig.8.

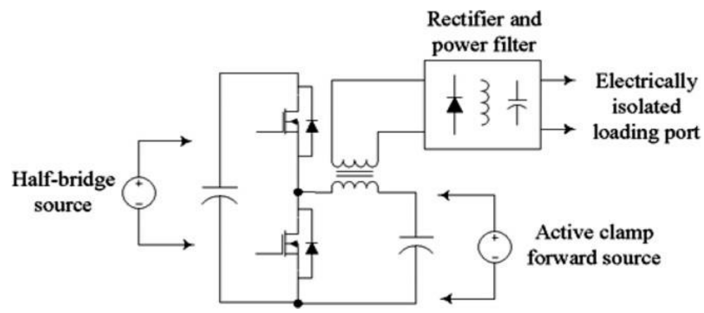

Fig.6. similar of the half bridge and active link forward device schematics.

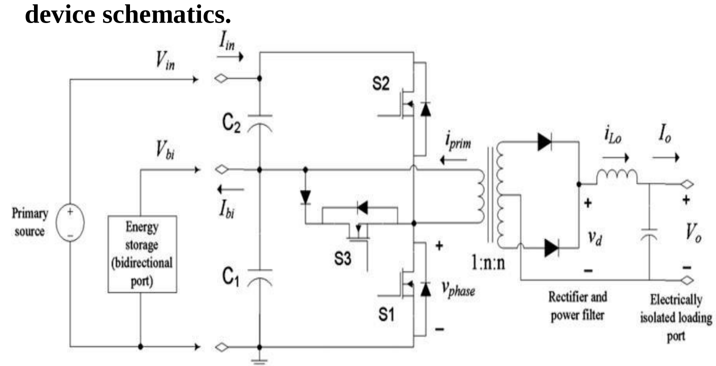

Fig. 7.tri modal half bridge schematic

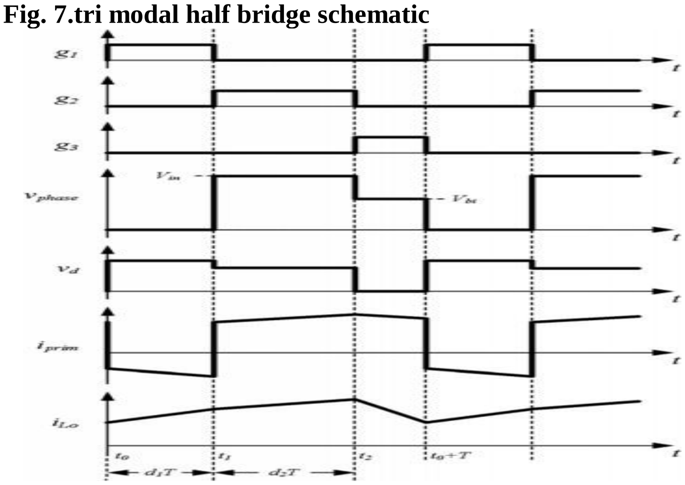

Fig.8. key operating graphs of the tri modal half bridge schematic

V. WORKING OPERATIONS

The simulation circuit design of the given device is mentioned below, which having LVS circuit and a HVS circuit interlinked by a more frequency transformer. The LVS consists of 2 terminals, an energy back up capacitor *Cs*, the primary winding of the transformer, and an *LCL* resonant circuit having a 2 inductors *Lr* and *Lp* and a capacitor *Cr*, where *Lp* includes the extra inductance *Lp*1 and the leakage inductance of the transformer *L p*. The HVS having secondary winding of the and a full-bridge rectifier connected with the diodes *Ds*1 *Ds*4.
The transformer's turn ratio is written as: $n = Np/Ns$, where *Np* and *Ns presents* the no of turns of the primary and secondary windings, continuously. From the switches, *S*1 is referred the first switch due to it not only operates the power created by the supply interlinked to node 1 (P1) but also alters the path of the current conducting to the transformer. 2 controllers are used to manage the energy in the LVS. Their aims are to control the dc node voltage to a steady level and control the power for the 2 supplies, respectively. Based on the availability of the solar energy, there are 3 working conditions of the device.

Three Working Operations

Operation 1 (p1 ≥ pout): the available solar energy is higher than the load requirement; the battery is filled so that the dc link voltage is managed at a steady level.

Operation 2 (0 < p1 < pout): there is solar energy, but the solar energy is not available to require by the load. PV array is managed in the condition by the algorithm mentioned later. On the other side, the less power is provided by the battery, which is drained by the boost device, so that the dc link voltage can be stabilized at a steady state.

Operation (p1 = 0): there is no solar energy supplied and, thus, the battery is drained to provide the load. The working switches are S1 and S3. Correct controllers are used to manage the energy of the scheme in various operations.

VI. ENHANCED SIMULATION RESULTS

Simulations are done in MATLAB Simulink to verify the given device and the controllers. The characteristics of the device are as mentioned: turn ratio n = 5: 14, Lr = 3.3 μH, Lp = 3.5 μH, and Cr = 0.22 μF. Solar array whose O.C voltage Voc and S.C current Isc are 22 V and 3.15 A continuously. The general voltage and rb of the battery are 7.5 V and 0.16 Ω,. The switching on time of S1,i.e., ton, is 3 μs, and the commutating frequency changes in a wide of 100–170 kHz. The resistive load RL = 100 Ω. The required dc-link voltage V ∗ dc and the apparent power of the load are 50 V and 25 W.

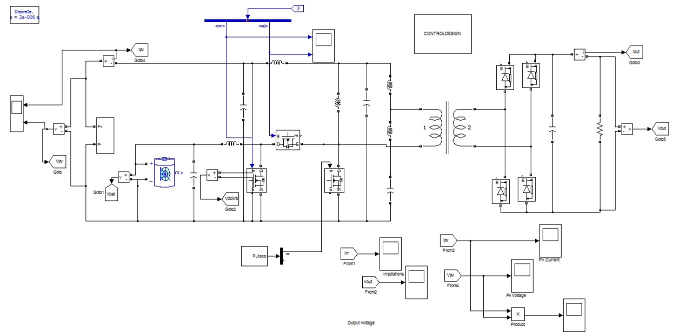

Fig: 9. simulation schematic of given three-port Dc/Dc device

To verify the dynamic operation of the control strategy, the solar radiation is step varied to check the output of the dc link voltage and o/p power of the array, as mentioned in displays that the primary solar radiation is zero and there is no power output by the array. This shows that the device operates in operation 1 and all of the power is provided by draining the battery. Fig.5.5.displays that the dc-link voltages suddenly reverse its threshold value of 50 V.

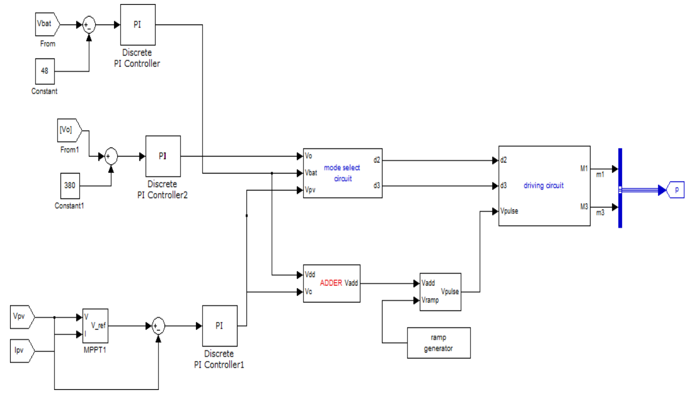

Fig: 10. simulation schematic controller

Operation 1 does not end until the solar radiation varies from zero to 400 W/m2 at the initial second. After that, the maximum power supplied by the array is 20 W, which is low required by the load 25 W. Thus, the battery still operates in the drain state to supply the required power need by the load, and the change of the dc link voltage is zero during the state shifting. From 1 to 1.5 s, the device operates in Operation 2.

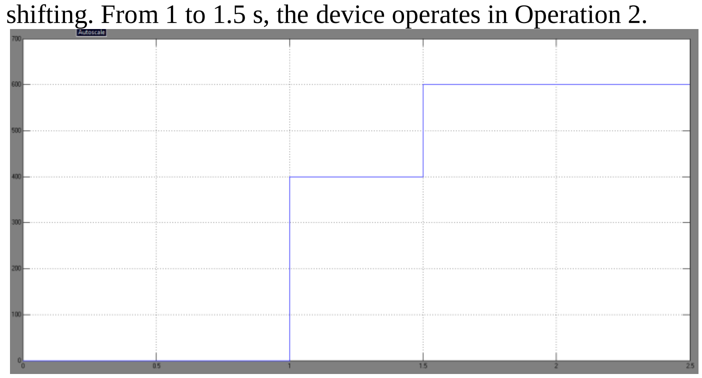

Fig.11. Dynamic responses: (a) graph of solar radiation

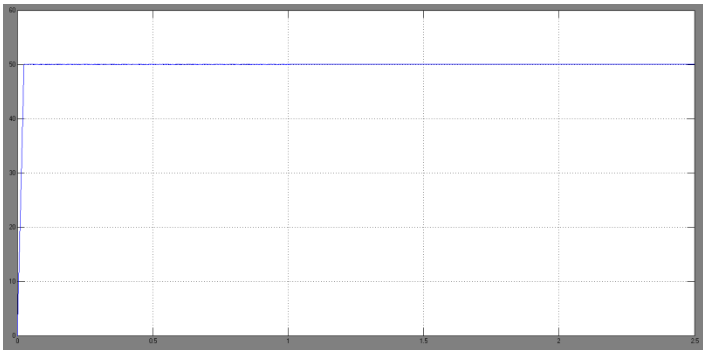

Fig. 12: dynamic responses :(b) dc-link voltage

At 1.5 s, the solar radiation is altered from 400 to600 W/m2, which makes 32-W max power. Then, the battery ends draining and initiates to take the extra power supplied by the PV array.

It takes some time to shift the path of the battery current, which not only outputs in an nearly 2 V peak in the dc-link voltage but also increases to the PV power supplied less than the ideal max power at the time of shifting time. Later 0.3 s, each of the dc link voltage and energy the required point and the ideal MPP.

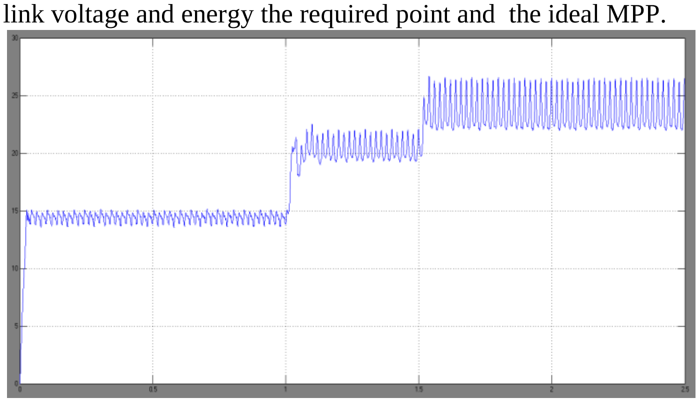

Fig. 13: dynamic responses: PV power response

Fig. 13 displays the simulation results of the PV energy and the dc link voltage. As given in Fig. 5.7, the energy taken from the PV array nearly becomes the ideal MPP by taking the given device and MPPT control chart. The dc link voltage is better managed at its described level of 50 V. The peak voltage error is nearly 1.2%, as given in Fig. 5.7.(b), which happens nearly 10:10 A.M. when the MPP betterment to 25 W. At that period, the battery turn on from the draining state to the charge state.

VII. CONCLUSION

A novel HBC designed of an inductive commutating core and is studied in this project. The proposed device has the combined advantages of the rise boosting approach from voltage booster and voltage controlling ability from boost device, containing in interlinked condition, better controlling area, low element stresses, less harmonic, flexible rise scope, and better performance. The mentioned topology has reduced the complexity which is adaptable for bulk manufacturing. Analyzed with other one switch and one inductor dc-dc devices, it has a good element usage rate, low harmonic and lower element stress. This project gives working scenario, designing feasibility, and overall comparison with many other same topologies. This device is adaptable for different renewable energy uses such as the front end of Photo voltaic scheme.

VIII. REFERENCES

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