Design Efficient Mechanism for Soft Switching Boost Converter

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ABSTRACT

A new soft switching boost converter is proposed in this paper. The conventional boost converter generates switching losses at turn ON and turns OFF, and this causes a reduction in the whole system's efficiency. The proposed boost converter utilizes a soft switching method using an auxiliary circuit with a resonant inductor and capacitor, auxiliary switch and diodes.

Therefore, the proposed soft switching boost converter reduces switching losses more than the conventional hard switching converter. The efficiency which is about 91% in hard switching increases to about 97% in the proposed soft switching converter using proposed method work on efficiency and switching speed for different solar applications.

Keywords :- *soft switching boost converter , efficiency*

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1. INTRODUCTION:

Boost converter is a DC to DC power converter. This converter is Capable of giving higher voltages at the load than the input voltage, so Boost converter is called Step up chopper**.** Boost converter contains at least two semiconductors (a diode and a transistor) and at least one energy storage element (a capacitor , inductor or the two in combination). Filters mostly made of capacitors are normally added to this converter's output (load side filter) and input (supply side filter) to reduce voltage ripples**.** Power for the converter can be applied from suitable DC sources like batteries, solar panels, rectifiers and DC generators.

The average voltage output (Vo) in a step up chopper is greater than the voltage input (Vs). By law of conservation of energy the input power has to be equal to the output power (assuming no losses)

Input power (Pin) = output power (Pout)

Since Vin < Vout in a boost converter, it follows then that the output current is less than the input current. Therefore in boost converter

Vin < Vout

Iin > Iout

The main working principle of boost converter is that the inductor in the input circuit resists sudden variations in input current. When switch is OFF the inductor stores energy in the form of magnetic energy and discharges it when switch is closed. The capacitor in the output circuit is assumed large enough that the time constant of RC circuit in the output stage is high. The large time constant compared to switching period ensures a constant output

voltage Vo(t) = Vo(constant).

Soft switching method

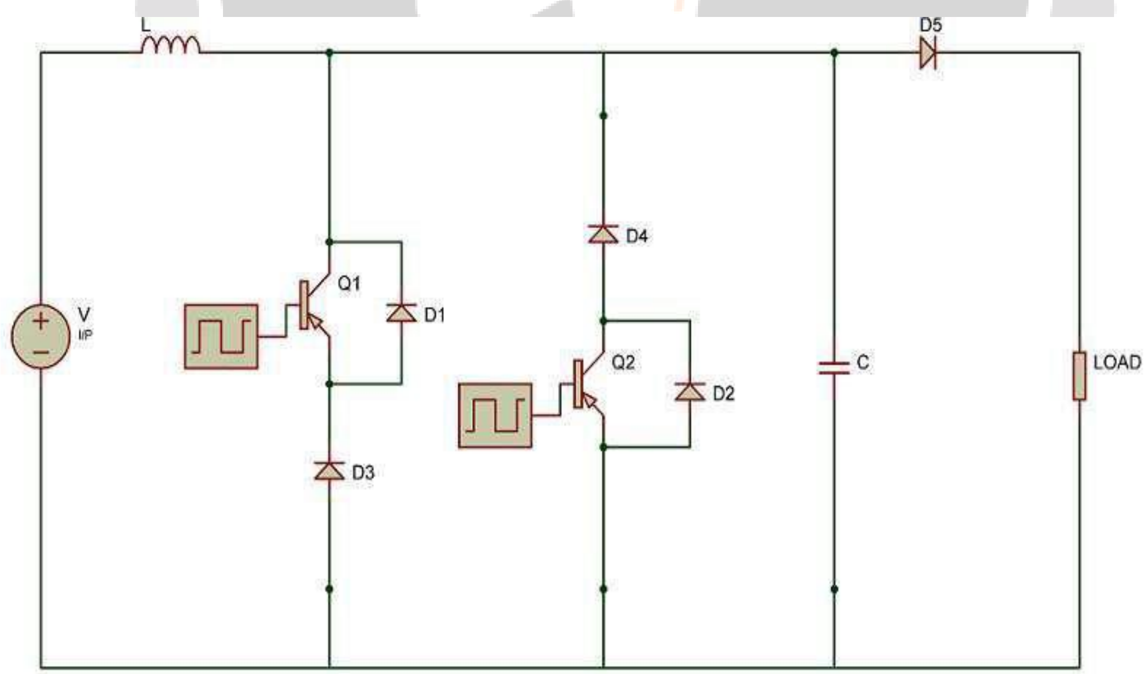
The term “soft switching” is actually defined as “The operation of power electronic switches as Zero voltage switches (ZVS) or Zero current switches (ZCS). Soft switching is a convenient alternative of reducing losses in switches of Power electronics. We can get reduced switching losses and stress occurred in switch. The thermal operation gets easy and possibly low values of EMI can be achieved.
It is done by two methods:

- Zero Voltage Switching (ZVS)
- Zero Current Switching (ZCS)

Advantages of soft switching

- Lower losses (may be!)
- Allows high frequency operation
- Low EMI (may be!)

2. PROPOSED CIRCUIT DIAGRAM OF A SOFT SWITCHING BOOST CONVERTER



Basics

- The inductor is connected in series with the dc voltage source
- There are 2 transistors which will work as a switch (Q1 & Q2)and each transistor is having freewheeling diode in parallel
- Two bidirectional diodes D3 and D4 are connected in series with the Switches (Q1 & Q2) respectively
- Capacitor is connected in parallel in the circuit to work as a Filter
- The load connected in output will be mostly a resistive load Page

3. LITERATURE REVIEW

Now-a-days using increased switching frequencies are a better way to get efficient output in DC-DC converters. The advancements in technology of semiconductor fabrication is the reason behind the significant improvement in not only the capabilities of voltage and current but also the switching speeds.

The faster semiconductors working at high frequencies result in the passive components of converters like capacitors, inductors and transformers becoming smaller thereby reducing the total size and weight of the equipment and hence to increase power density[1].

The dynamic performance is also improved by using faster semiconductors at high frequencies. Another important trend resides in reduction of voltage and current stresses on the semiconductors and limitation of the conducted and radiated noise generated by the converters due to large di/dt and du/dt [3]. By soft switching technique in each switch of converter, both the requirements size and noise are minimized [2]. Due to wider band gap of Silicon Carbide (SiC) compared to Silicon (Si), MOSFET made in SiC has considerably lower drift region resistance, which is a significant resistive component in high-voltage power devices [4].

Sr. No.	Author/s , Title , Publication	Conclusion
1.	K.R.Reshma, G.Rengini Soft switching SEPIC boost converter with high voltage gain IEEE journal, 2016	High gain DC-DC is derived from SEPIC converter. Input current is continuous.
2.	Kasunaidu Vechalapu, Subhashish Bhattacharya, Edward Van Brunt, Sei-Hyung Ryu, Dave Grider Comparative evaluation of 15 kV SiC MOSFET and 15 kV SiC IGBT for Medium Voltage converter under same dv/dt conditions IEEE journal of emerging and selected topics in power electronics 2016	Detailed hard switching characteristics of 15kV SiC and compared with 15 kV SiC IGBT
3.	Mohsen Ghaffarpour Jahromi, Galina Mirzaeva, Steven D. MItchell Design and control of a high power low losses DC-DC for MW range converter for mining applications IEEE Journal , 2016	An improved design procedure based on imposing conditions of zero reactive and active power for an LCL DC-DC Converters
4.	Yue Cao, Yutian Lei, Philip T. Krein, Pilawa-Podgurski Moular switched capacitor dc-c converter tied with lithium ion batteries for use in battery electric vehicles IEEE Journal , 2015	Modeling of A battery electric system vehicle traction system using Li-Ion Batteries, switched capacitor converters , an inverter and an ac induction machine
5.	Samir Hazra , Ankan De, Lin Cheng, John Palmour, scott Allen, Brett A. Hull , Subhashish Bhattacharya High switching performance of 1700 V,50 A SiC Power MOSFET over Si IGBT/Bi MOSFET for advanced power conversion applications IEEE Journal , 2015	By using SiC MOSFET the switching frequency of converter can be increased 10-15 times as compared to Si IGBT. Use of SiC MOSFET is better in high power soft switched converters.

4. Conclusion

From this analysis it is concluded that the efficiency of boost converter can be improved using soft switching technique. The overall performance of boost converter can be improved by reducing switching losses and conduction losses by operating the power semiconductor switches at zero Voltage Switching (ZVS) or Zero Current Switching (ZCS). Based on this analysis we can do further work on simulation analysis in detail.

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