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Analysis and Simulation of High Voltage Gain of Modified Sepic Converter

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***Abstract*—In this work, converter investigation takes place to achieve high voltage gain. In recent times, high step up boost converter is engaged to perk up the voltage gain with Sepic converter by diminish the number of components. The existing work deals with the boost converter to achieve the high voltage gain but it leads to the drawback due to the high switching losses and high switching stresses. So the proposed topology work deals with the combination of boost converter and sepic converter, i.e., modified sepic converter it takes place in the single switch device and with a coupled inductor so it is easy to achieve a high gain voltage. The proposed structure is modular and it also limited to the duty range value 0.8. The performance parameters ripple techniques is find out for the proposed converter. The proposed work deals with continuous mode operation. Simulation results are carried out in MATLAB/SIMULINK.**

Keywords: Boost Converter, Sepic Converter, Boost Converter, High Voltage Gain, Efficiency, MATLAB/SIMULINK.

I. INTRODUCTION

As a result, many research mechanism address the expansion of converter system in recent years with improved concert. Power electronics plays a major role in development area because it converts the electrical energy from one form to another and it also achieves a high conversion efficiency of the converter system [1] [2]. Most of the researchers start using the converter operation for the research work, it start ahead high fame for the today's scenario.

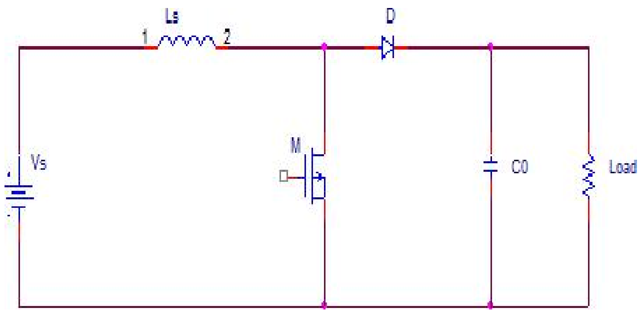
Sepic Converter results in higher output voltage greater or lesser than the input voltage but its operation are very simple. Sepic converter found in particular application in which the batter voltage can be regulated upper or lower than that of the source voltage and it is applicable in such UPS, DC motors, etc [1].

In this paper modified sepic converter deals with the proposed work. The operation and analysis of modified sepic converter is discussed in sector IV.

Section I deals with the introduction of converter. Section II presents the boost converter operation. Division III performs the Sepic Converter analysis operation. In Sector IV modified sepic converter (combination of boost and sepic converter) analysis takes place. Division V performs the simulation results of proposed work. Division VI initiates the termination of the work. Portion VII concludes the potential of the work.

II. BOOST CONVERTER

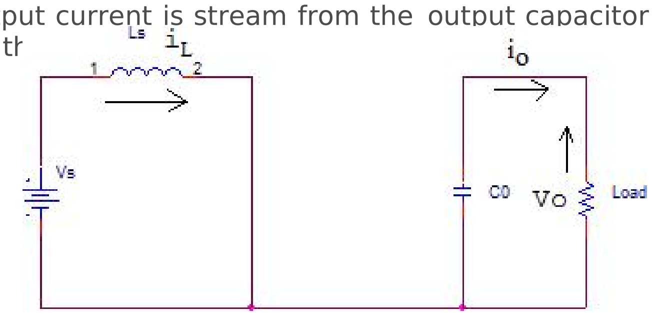
A boost converter afford a yield voltage superior when evaluate with other converters. Pic. 1 proves the plan map of Boost converter. The diverse modes of operation of boost converter, design equations of the boost converter are discussed. The converter maneuvers in different methods of operation. Pic. 2 specify method 1operation of boost converter and Pic. 3 specify the method 2 operations of boost converter [2].



Pic.1 Plan Diagram of Boost Converter

Method -1:

In Pic 2, the method 1 proves the map diagram boost converter operation. Foremost operation starts when the knob (S_1) is turned on at $t = t_{on}$. When the device is in on spot, the inductor current starts increasing and the current rises increases upward [3] [4]. During this function, the output current is stream from the output capacitor for th



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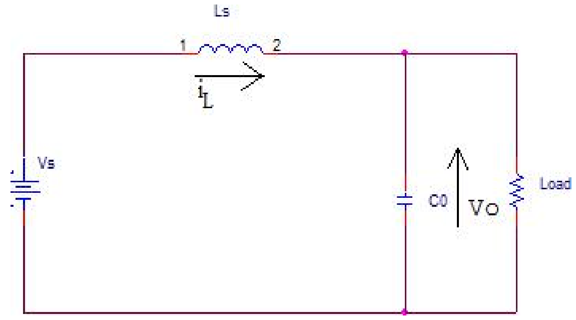
Pic. 2 Method 1 Plan Operation of Boost Converter

Method -2:

The method 2 circuit function is shown in Pic. 3. Second operation starts when the device is turned off. When the device comes to off operation, the inductor current starts decreasing hastily and therefore the current circulates through R, L and C. In this operation, the inductor conveys the accumulate energy to the load [3] [4].



Pic. 3 Method I1 Plan Operation of Boost Converter

Pic. 3 Method 2 Plan Operation of Boost Converter

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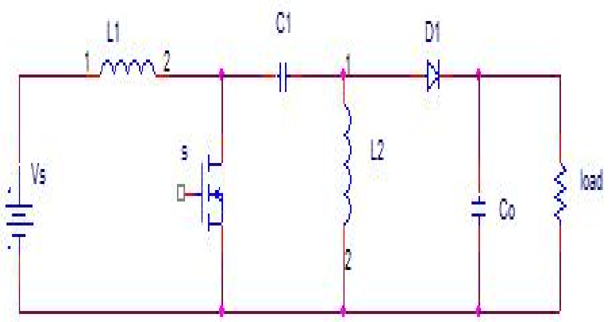
III. SEPIC CONVERTER

This converter will provide yield voltage will is less than or greater than the source voltage but the operation of the system is alike to the buck boost converter, it has advantages of having non-inverted output, by means of pairing energy from the input to the output is via a series capacitor. During steady state operation, the average voltage across capacitor Cs (Vcs) is identical to the input voltage (Vin). Because capacitor Cs wedge the direct current, but the average current across Ics is zero, making the inductor L2 the only source of load current. Hence the average current through the inductor L2 is same as the middling load current but independent of the input voltage [3] [4]. Pic .4 shows the Sepic Converter Plan Diagram. It operates in double divergent technique operation.

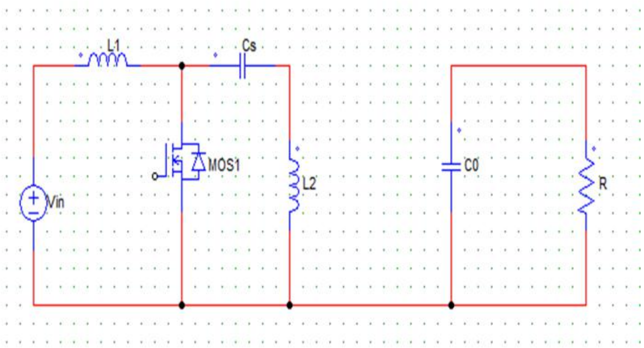


Pic. 4 Plan Diagram of Sepic Converter

Divergent Operations of Sepic Converter:

Method 1:

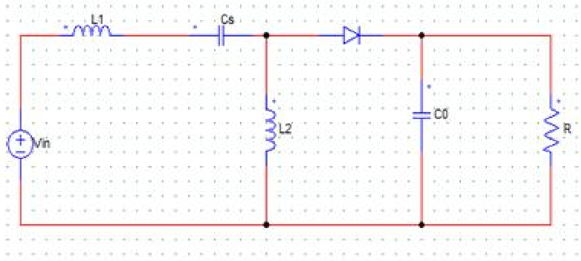
When the regulator device operation takes place, the first inductor operation takes place and it starts increasing atonce the second inductor decreases. For some timing, when the regulator is in off condition, ciupling capacitor transfer the energy to the second inductor. Pic.5 decribes the mode 1 operation of Sepic Converter [4] [5].



Pic. 5 Method 1 Plan Operation of Sepic Converter

Method-2:

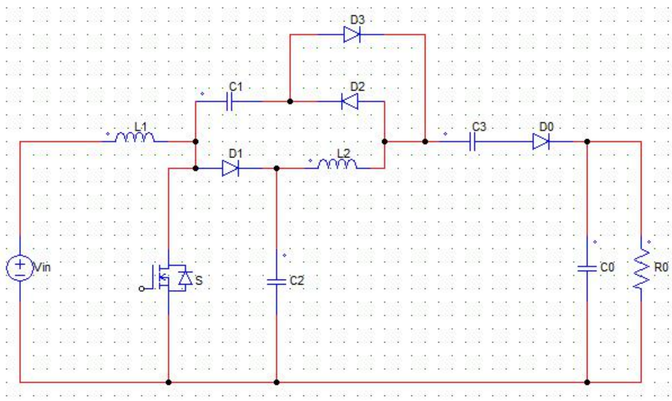
Pic.6 shows the method 2 equivalent circuit for Sepic Converter. When device gets bowed off, the current value I_{cs} becomes the same the current value I_{L1}, as the inductors will not allow instant changes in current. Current I_{L2} will continue in the pessimistic direction [6].



Pic. 6 Method 2 Plan Operation of Sepic Converter

IV. MODIFIED SEPIC CONVERTER

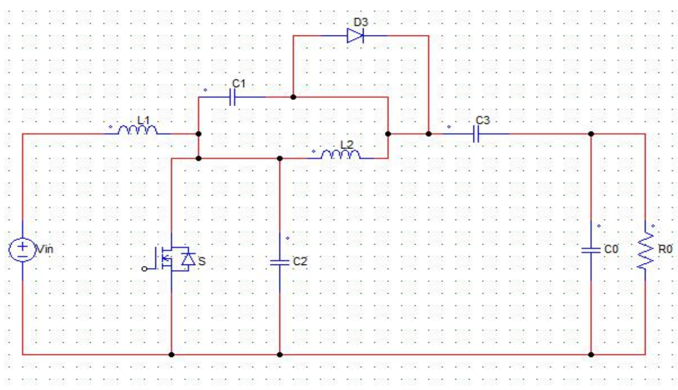
In this present sector, the proposed converter is explain with divergent stages of operation. In Pic. 7 modified plan sepic converter diagram displays which show that the static gain of modified sepic converter is step up or step down voltage. The amount of source and yield voltage is like to the regulator voltage and the gain voltage will be higher in the proposed work. The gain voltage of the modified sepic converter will be higher when compared to the normal boost converter. The divergent operations of modified sepic converter are discuss below [1] [7].



Pic.7 displays the plan of modified sepic converter

Method-1 [1]:

Pic.8 performs the method 1 plan of modified sepic converter. In this first method device will be on operation and diode D_1 and D_2 becomes forward bias. The energy hoard in the inductor L1 will be transfer to the resistive load.



Pic.8 Method 1 Plan Operation of Modified Sepic Converter

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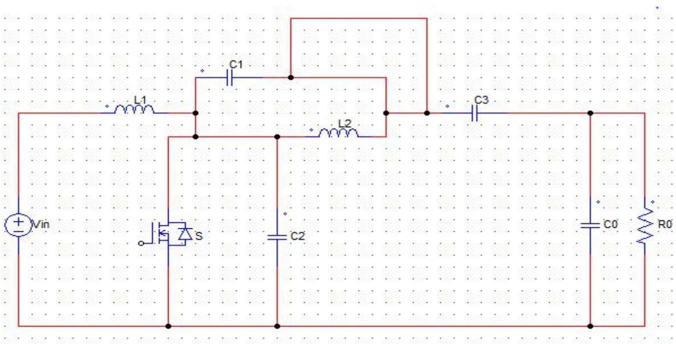
Method-2:

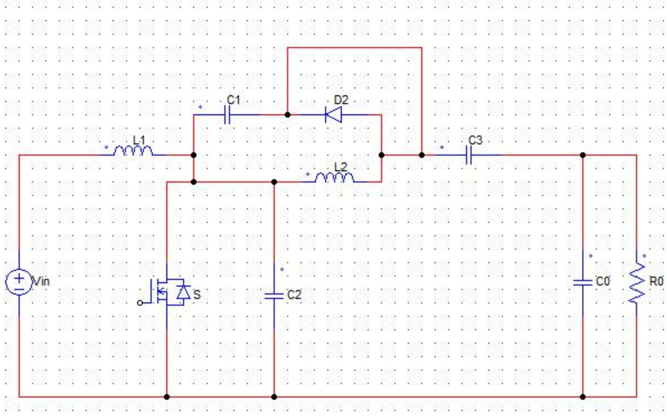


Pic.9 Method 2 Plan Operation of Modified Sepic Converter

In this method when the device operation seize the diode D_1 and D_2 gets block the energy accumulate in the inductor get charge to the supply voltage. Pic.9 performs the method 2 plan of modified sepic converter [1] [7] [8].

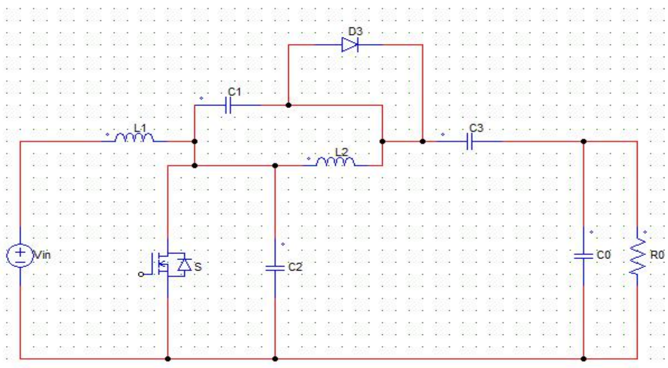
Method-3:

Pic.10 performs the method 3 plan of modified sepic converter. In this stage both the inductors operates as a freewheeling stage. The operation stage will get over once the device operation is turn on and the diode will be in reverse bias [1] [8] [9].



Pic.10 Method 3 Plan Operation of Modified Sepic Converter

Method-4



Pic.11 performs the method 4 plan of modified Sepic converter

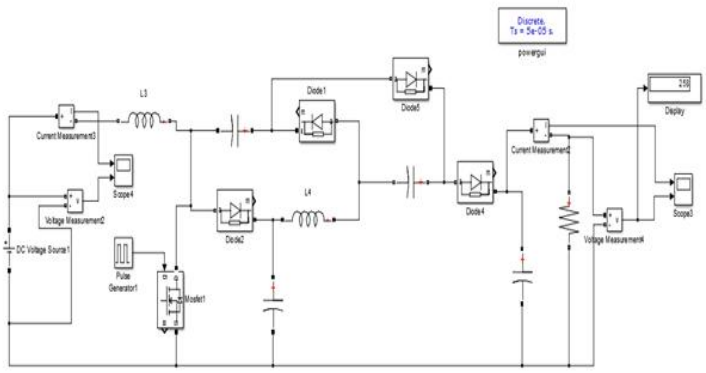
Pic.11 performs the method 4 plan of modified sepic converter. In stage 4 operation, the regulator and the diode D_2 operation takes place in OFF position. The power store in the inductor will transfer to the capacitor and the diode D_1 blocked.

V. SIMULATION RESULTS OF PROPOSED WORK

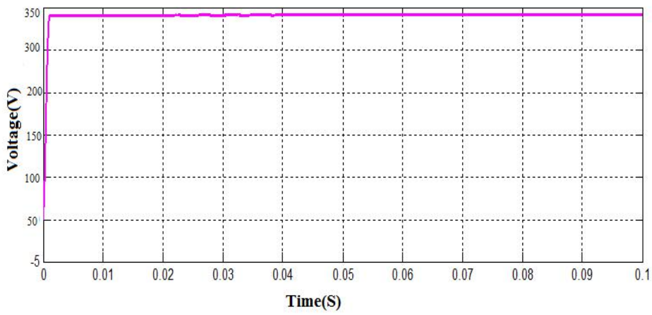
Simulation results take place in MATLAB/SIMULINK. Pic.12 displays the simulink map of modified sepic converter. Pic.13 shows the output voltage of modified sepic converter. Pic.14 shows the input current of modified sepic converter. Pic.15 shows the output voltage ripple of modified sepic converter. Pic.16 shows the input current ripple of modified sepic converter. Table I displays the parameters value of modified sepic converter.

Table I. Constraints of Modified Sepic Converter

Components	Specification
Source Voltage	30V
Switching Frequency	24kHz
Inductor	200µH and 180 µH
Input side capacitor	2.08 µF
Output capacitor	140µF



Pic.12 Simulink Diagram of Modified Sepic Converter



Pic.13 Output voltage of Modified Sepic Converter

From the Pic.13 it is confirmed that the output voltage of modified sepic converter is 280 V.

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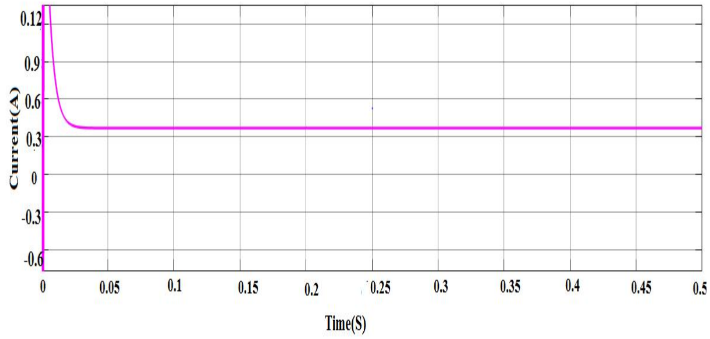
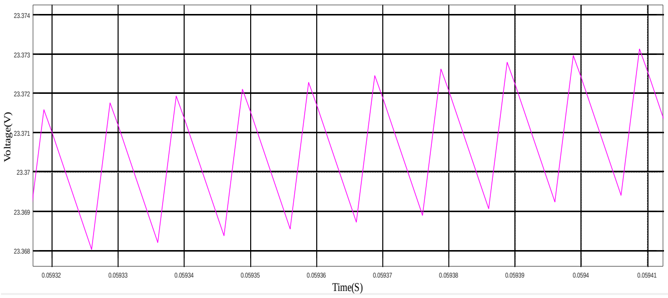


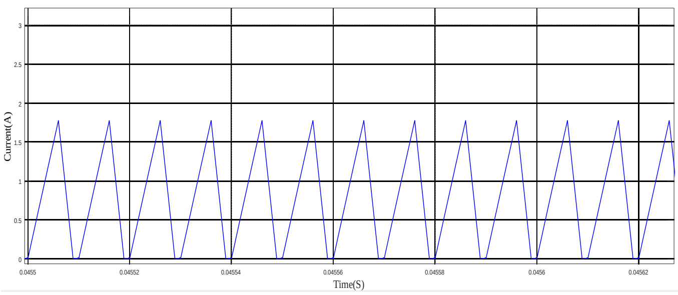
Pic.14 Input current of Modified Sepic Converter

From the Pic.14 it is confirm that the input current of modified sepic converter is 0.8 amps.



Pic.15 Output voltage ripple of Modified Sepic Converter

From the Pic.15 it is confirmed that the output voltage ripple of modified sepic converter is 0.014V.

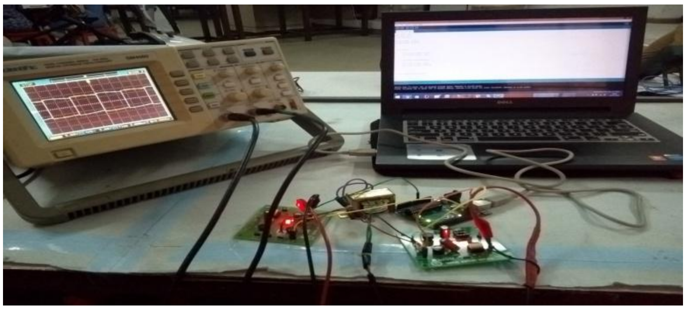


Pic.16 Input current ripple of Modified Sepic Converter

From the Pic.16 it is confirm that the input current ripple of modified sepic converter is 0.45 amps.

VI. HARDWARE RESULT

A hardware experimental set up was carried out in laboratory and successfully tested. The switching pulse waveform was carried out in Arduino UNO and the output is shown in Pic 17. Pic 18 describes the output voltage of modified sepic converter.



Pic.17 Switching pulse waveform using Arduino UNO

Pic.18 Experimental output of modified Sepic Converter

VI. CONCLUSION

From this work, it is concluded that the projected converter is simulated in MATLAB/SIMULINK. Finally the performance parameters such as ripple techniques are performed in modified sepic converter. The proposed converter achieved a high voltage gain with single switch device with the duty ratio of 0.8. Further ripple techniques were carried out in simulation results. The experimental output of modified sepic converter was carried out on laboratory and the output voltage result was verified successfully. Similarly the pulse generator waveform was tested using Arduino UNO. Finally, The proposed converter is well suited for industrial applications.

VII. WORK POTENTIAL

This work will be extended and it will interface with PV and MPPT techniques for automation applications.

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