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IMPLEMENTATION OF SEPIC CONVERTER

[1]Jaipriya. P, [2] Dr. V. Geetha
1Department of Electrical and Electronics Engg,
Government college of Engineering, Salem,

2 Proffesor and Head of the Department,
Department of Electrical and Electronics Engineering,
Government college of Engineering, Salem.

***Abstract*—This topic presents a SEPIC (Single-Ended Primary Inductor Converter) Converter and Control method suitable for dc-dc Power Conversion. SEPIC is chosen since it has positive voltage gain and higher characteristics than any other converter. The proposed design provides high efficiency over a wide range of input and output voltage ranges, up & down voltage conversion, small size and excellent transient performance. The Converter regulates the output using an ON-OFF control scheme modulating at a fixed frequency and duty ratio operation. This control method enables a fast transient response.**

***Keywords*—: DC-DC Converter, Synchronous SEPIC Converter**

1. INTRODUCTION

Transformations of a DC voltage to some other DC voltage level giving a regulated output are called choppers. In chopper circuits switch operates as an electronic switch i e; by completely ON or completely OFF. The DC component of the output voltage can be unflappable by adjusting the duty ratio D. First basic converter is the buck converter. It always brings down (bucks) the input voltage. Boost converter is the next basic converter. It boosts the input voltage . Suppose if I have an application where I need both bucking and boosting operation. When these two converters are connected in series the above need can be fulfilled. For this, two separate controllers and switches are required. The single converters which gives both buck and boost operations is SEPIC (Single ended primary inductance converter) . It is greatly used in switching circuits and PFC (Power Factor Correction) circuits because it has:

1) Input and output voltage polarities are identical.
2) Inductor ripple current is less.
3) Bucking and Boosting operation.
4) Many outputs can be taken.

Power electronic circuits have more nonlinear characteristics. Operation of the circuits is mostly by on-off switch control. This report introduces a single-ended primary inductor conventional (SEPIC) converter, its open loop simulation results (5MHz), simulation of SEPIC converter with PID controller, its simulation result.

2. LITERATURE SURVEY

In their work, Jaw-Kuen Shiau [1] and operation cause large amounts of electrical stress on the team had focused on the development of a circuit components, this can result in device failure or simulation model for maximum power point tracking overheating. SEPIC converters solve both of these (MPPT) evaluation of solar power that involves using problems. The single-ended primary-inductor converter different buck-boost power converter topologies; (SEPIC) is a type of DC/DC converter allowing the including SEPIC, Zeta, and four-switch type buck-boost electrical potential (voltage) at its output to be greater DC/DC converters. Reeto Jose [2] and their than, less than, or equal to that at its input. The output of coworkers, had presented their work on DC-DC the SEPIC is controlled by the duty cycle. The SEPIC Converter Topologies. They had mentioned that conventional power converter such as buck, boost and the conventional SEPIC converter needs capacitance buck-boost converters cannot maintain a wide operation with high value and high current handling capacity. The range with high efficiency, especially if up-and-down bulk inductor has been used in conventional SEPIC voltage conversion has to be achieved. These converter, so it is increases the component size and characteristics can be obtained in a Single Ended Primary reduces the response speed. These characteristics Inductor Converter (SEPIC). Also, the SEPIC converter reduces passive component size, improves response provides positive regulated output voltage for the given speed. Also, Soft switching can be achieved for a wide input voltage unlike the buck-boost converter which input and output voltage ranges. They had simulated the provides negative regulated output voltage. Isolation is new resonant SEPIC converter using MATLAB/Simulink provided by series coupling capacitor which protects the for 3.6V.

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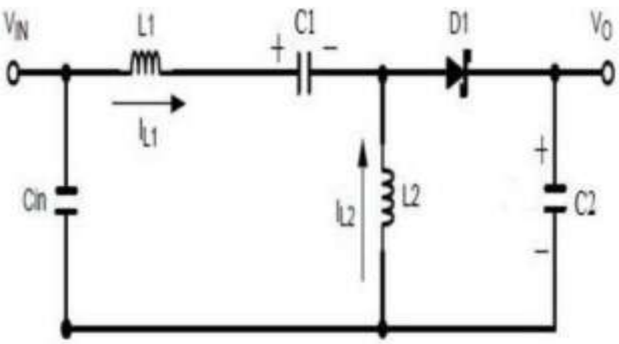
3. BLOCK DIAGRAM

The following block diagram that consist of the



required components such as

1. DC voltage souce
2. SEPIC converter
3. Gating signal
4. Load

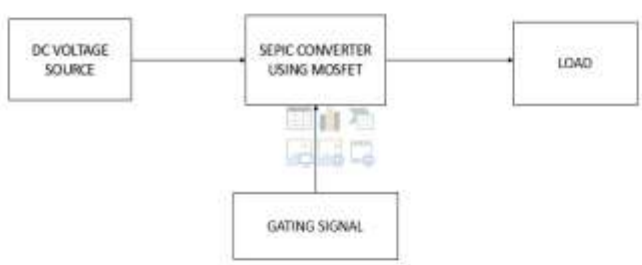
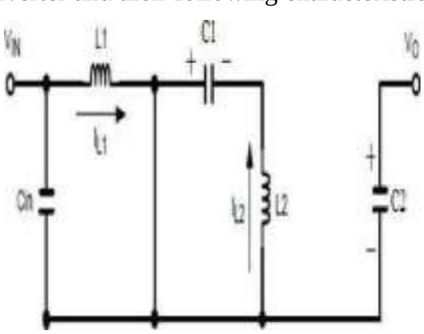


FIGURE 1 BLOCK DIAGRAM OF SEPIC CONVERTER

4 CIRCUIT OF SEPIC CONVERTER

The following figure (2) that consist of the circuit of SEPIC converter and their following characteristics are given.



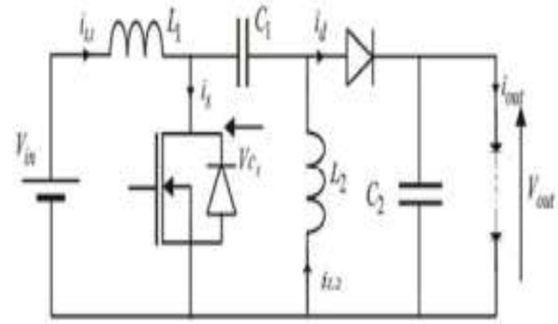


FIGURE 2 CIRCUITOF SEPIC CONVERTER

WHEN SWITCH IS CLOSED:

Figure(3) shows the circuit diagram of the SEPIC converter

FIGURE 3 WHEN SWITCH CLOSED

The inductor element L1 stores the energy in it.
During this condition the input voltage is equal to the inductor voltage.
Thus, transferring the energy stored in capacitor C1 to the other inductor element L2. The capacitor C2 supplies the energy to the load .

WHEN SWITCH IS OPEN

FIGURE 4 WHEN SWITCH CLOSED

Inductor L1 is the energy storing element which transfers the energy to the capacitance C1 during open condition. Similarly, through diode D the inductor L2 is the energy storing element which transfers its energy to capacitance C2.and supplies the require energy to Load .

5.Waveform of SEPIC in continuous mode

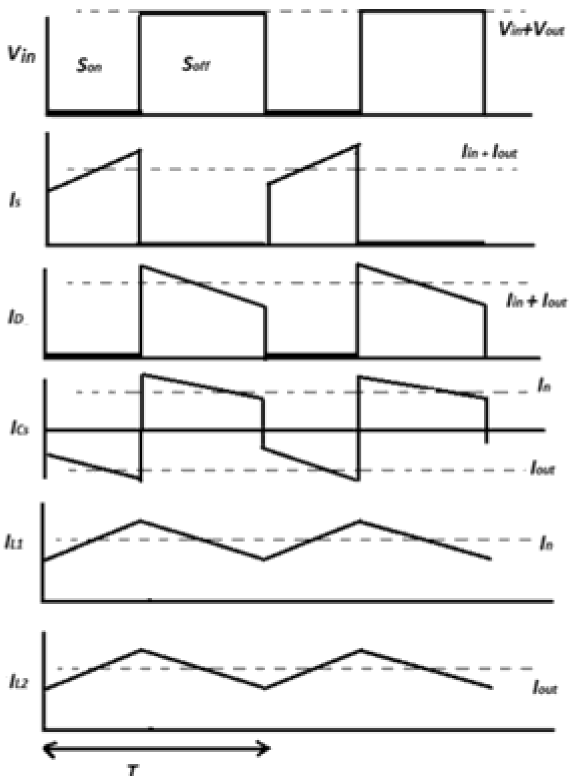


FIGURE 4 WAVEFORM OF CONTINUOUS

6. DESIGN OF SEPIC CONVERTER

DUTY CYCLE CALCULAION:

SEPIC Converters step up and down dependes on the duty ratio

$$Vo = \frac{D * V_i}{1 - D}$$

There is also an voltage drop across the diode,

$$Vo + Vd = \frac{D * Vi}{(1-D)}$$

This becomes,

$$D = \frac{Vo + Vd}{Vo + Vd + Vin}$$

Maximum duty cycle occur when input voltage is minimum,

$$D\ max = \frac{Vo + Vd}{Vo + Vd + Vmin}$$

7. **SIMULATION OF SEPIC CONVERTER**

The following simulation diagram that shows the simulation of the SEPIC converter in MATLAB/SIMULINK environment.

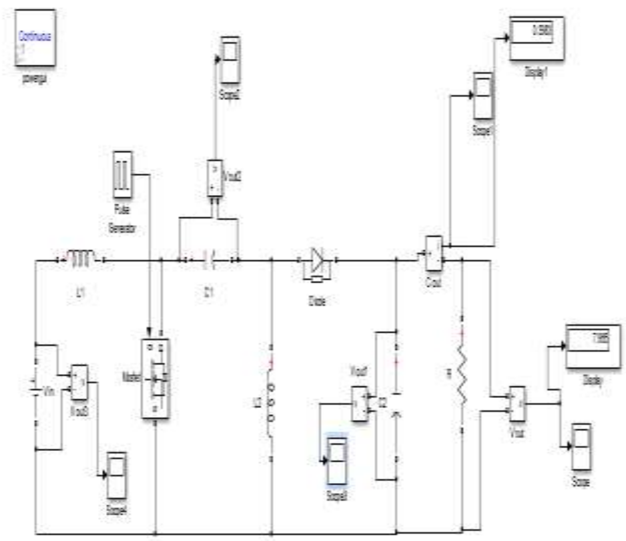


FIGURE 5 SIMULATION OF SEPIC CONVETER

SIMULATION RESULTS

The following results that are obtained from the MATLAB/SIMULINK environment.

INPUT VOLTAGE Vin

The following figure (6) shows that the input voltage waveform that are given as the input supply as Vin.

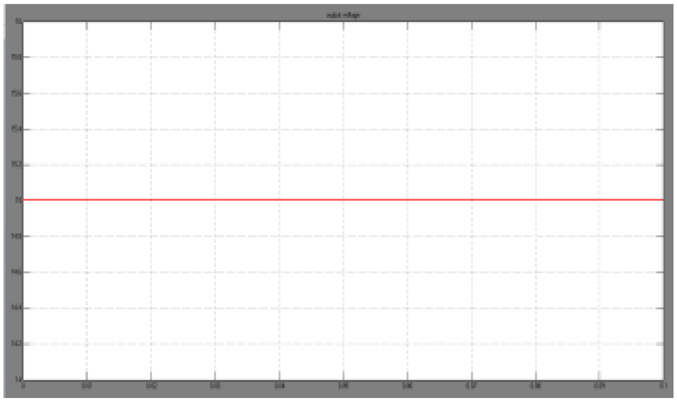


FIGURE 6. Input voltage waveform Vin

INPUT VOLTAGE ACROSS CAPACITOR C1

The following figure (7) shows that waveform of input voltage that obtained across the capacitor

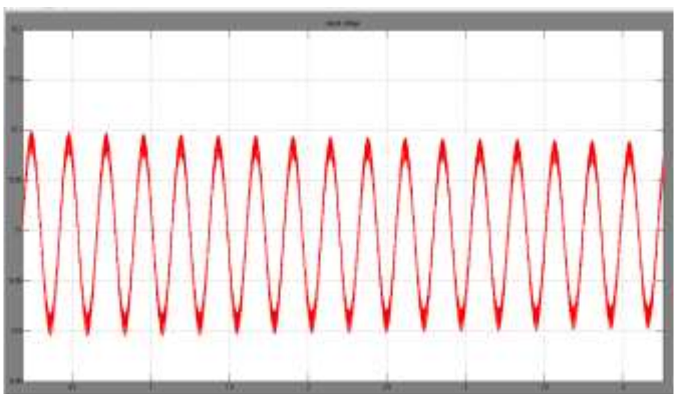


Figure 7 Input voltage waveform across capacitor C1

INPUT VOLTAGE ACROSS CAPACTIOR C2

The following figure (8) that contains the waveform that flows across the capacitor C2 and the waveform are given below

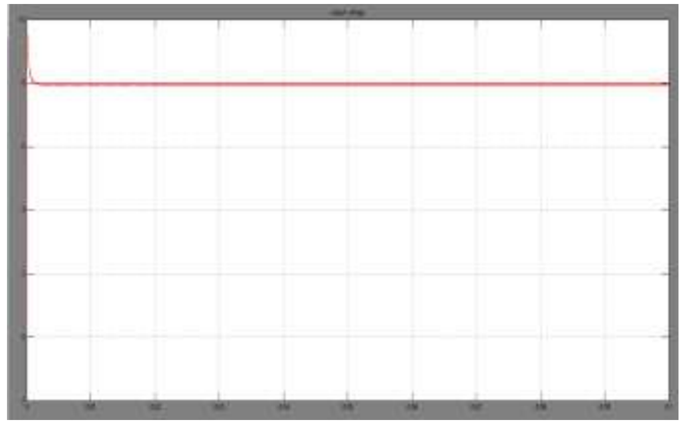


FIGURE 8 Input voltage waveform across C2

OUTPUT CURRENT WAVEFORM

The following figure (9) shows the output wavefprm of current that is obtained in the MATLAB / SIMULINK environment .

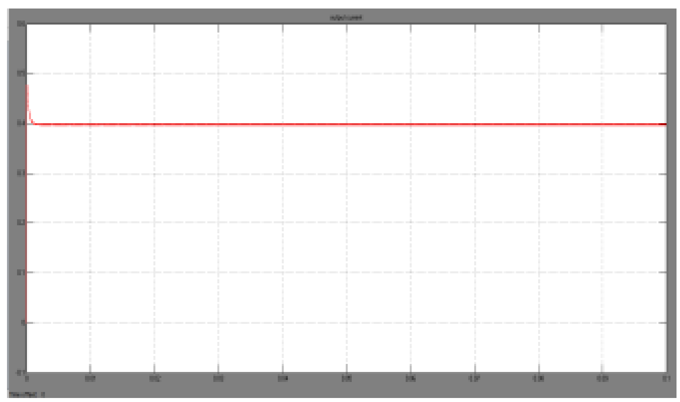


FIGURE 9. Output current waveform Cout

OUTPUT VOLTAGE Vout

The following figure (10) waveform that obtained is the output voltage Vout in the MATLAB / SIMULINK environment.

That is the output of the SEPIC converter we simulated

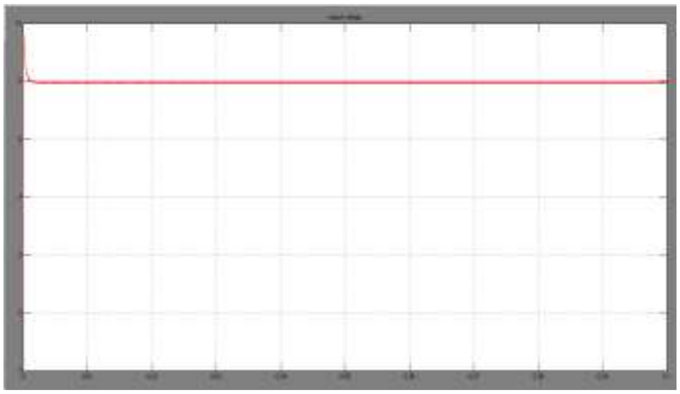


FIGURE 10 Output voltage waveform Vout

TABLE 1.1 SIMULATED VALUES

Parameters	Values
Vin	15V
LI	34.57µH
L2	14.28µH
C1	28.57µH
C2	28.57µH

8.Analysis and Simulation of Converter

The analysis and simulation of SEPIC converter is in progress using MATLAB. The circuit diagram of SEPIC converter given in FIGURE 2. All dc – dc converters turn on and off using MOSFET generally with frequency pulse, it is done by using MATLAB software. When pulse is given MOSFET is ON , inductor 1 charged by input voltage and inductor 2 charged by capacitor 1, diode is off and output is maintained by capacitor 2.

CONCLUSION

The single ended primary inductor converter (SEPIC) is able to function both buck and boost output voltage. By the switching devices present in it is controlled by the duty ratio `D` to get required output voltage. The boost operation happens if D > 0.5. The buck operation happens if D < 0. 5 and PID controller is also used. Converter is operated in two modes (switch is open & closed) only. In which it can step-up or step-down the output voltage. This converter was simulated using MATLAB or Simulink software.

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