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Design and Implementation of Buck Boost² Converter with Closed Loop Control System

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ABSTRACT

A design and implementation of buck boost² converter with closed loop control system is proposed in this paper. At the correct duty cycles, the buck boost² converter realizes high in gain. It uses MOSFET as switching device without body of diode conducting. The employment of MOSFET contributes to the reduction of modification and physical phenomenon losses. Also, the proposed system will be operated with unipolar PWM management and can be designed at higher switch frequency to reduce the amount of passive parts. The buck boost² converter are used in the some application of switch mode power supply, dc-dc converter, battery charging, E- vehicle charging station and renewable energy. Operational principles and corresponding comparisons of the on high of mentioned buck boost² converter are unit measures deeply studied and analysed. As a results of the buck boost² converter is simulated in step down/up modes for verifying the buck boost² converter.

KEYWORDS: *Buck-boost converters, inverting output voltage, single switch converters.*

I. Introduction

The Buck boost² converter are used in the some application of switched mode power supply, dc-dc converter, battery charging, E vehicle charging station and renewable energy [1]. The step-up or step-down input voltages of the one switch buck boost converter is set by the duty ratio of the switch [2-6]. Fuel cells represent one of the most economical and effective different renewable energy sources for several applications, like hybrid electric vehicles, uninterruptible power supplies, telecom back-up facilities, and portable electronics [7].The voltage stresses of components of an single switch buck boost converter are the sum of the input voltage and outputvoltage.The step-up or step-down of an single switch buck boost converter is verify by the duty ratio of the switch.If the duty ratio is larger than 0.5, for the boost converter is operated within the increase mode [8].Uptonow,severalspeciesofbuck-boostconvertershave already studied andapplied.

The conventional buck-boost, Cuk, Sepic and Zetaconverters can effectuate simple form. The present applications, their limited conversion ratios make significant challenges for the improvement ofefficiency and switching frequency, and also the realization of control circuit. By adjustingthe turn ratio, coupled-inductor converters will understand wide conversion ratio in isolated or non -isolated things. By combining thequality buck-boost device with the coupled-inductor, the extraordinary diode reverse recovery development is reliverd. Switched network cells may be designed and applied to improve the performance of the standard converters. In inserting the cells which are formed by capacitors and semiconductors within the standard converters, some new buck-boost converters area unit created. Combiningthestandard converterswiththeswitched-network cells that area unit composed of inductors and diodes, several forms of changed converters are presented. In hybrid switched-network cell is embedded at intervals the standard Sepic and Cuk for constructing new converters. The buck-boost operation of the higher efficiency than the step down operation and the step up operation due to the switch loss [9]. However, the same combinedconverters haveadvancedstructuresandso the desire willincreasesoftheirconversion ratios are not obvious. The step-up or step-down input voltages of the single switch buck boost converter is determined by the duty ratio of the switch [10]. Converters for purpose of load applications square measures being developed by the designers with special stress ordered on achieving higher conversion efficiency at full-load, increased power density, and lower radiation [11]. In three entirely totally different varieties of buck-boost converters that or composed of identical range of semiconductors and energy storage components or given. In distinction associate in nursing single switch buck boost converter entirely operates in buck–boost mode. To realize wide conversion ratio by only just switch, further capacitors and inductors area unit applied then a series of buck-boost converters are analysed.The extra energy storage components make their converter structures difficult and increase the problem of modelling. In many types of buck-boost converters and their isolated versions area unit conferred. The conversion magnitude relation second is realized by combining the synchronously corrected buck converter and also the Kentucky converter. In a very positive output polarity buck boost² converter that applies the interleaved strategy is conferred. By cascading the changed versions of typical converters, the topology of latest buck-boost converter is analysed. In combining the standard converter, a quadratic buck-boost converter is presented. Therefore, constructing powerful DC-DC converters, particularly the buck-boost converters that understand the bucking/boosting voltage, is incredibly necessary to broaden the family of buck-boost converters in addition on give additional prospects for the commercial applications. Here, so as to understand higher performances, a series of implementation buck-boost converters area unit made during this paper. While not electrical device or coupled electrical device and at the correct duty cycles, the implementation buck-boost² converter accomplish high step-up gains, respectively. Besides, these two converters posses fourth-order easy ground structures to extend the ability density and operability, low parts stress to decrease the corresponding losses then to boost the system efficiency, no sudden changings on capacitors voltage to prevent the instant overcurrent development. The set output voltage is associated with PI controller for pwm generator to buck boost converter to the load. Owing to the special structures of the implementation of buck boost² converter are constructed and analysed, severally.

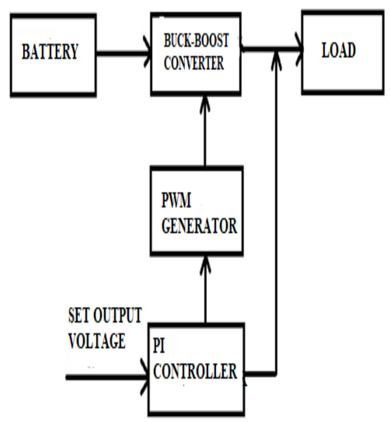

Figure: 1 Block diagram

The article organization is that the implementation of buck boost² converter are analyzed in section II. In section III, simulation parameters are constructed and studied. The section IV, are simulation results are verified. Section V is that the conclusions.

II. PROPOSED MODEL

The implementation of buck boost² converter method the special structures that their synchronously controlled switches have a typical node. By the be a part of plot they will be converted to the one switch structures. Of the converter S operate synchronously L_1 and L_2 are magnetized whereas C_1 and C_0 are discharged once the switches on.

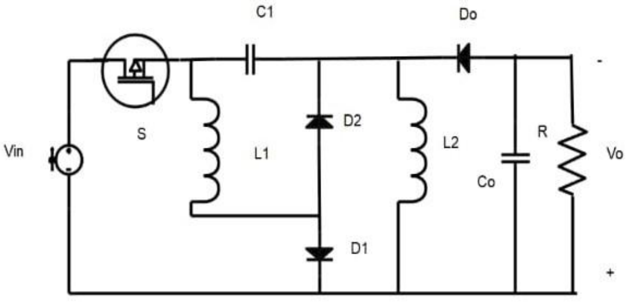

Figure: 2 Proposed model

MODES OF OPERATION

The same circuits of the Implementation of buck boost² converter in Continuous Conduction Mode (CCM) and the detailed analyses are introduced as follows.

MODE 1: The switch is on condition in this state and the diode D_1 in forwardbiasedmode.ThediodesD₂andD₀inreversebiased states,asshowninFig.3.L_1ismagnetizedfrom V_{in}through S and D_1, L_2 is magnetized form $V_{in}$and C_1 through S, C_0 releases energy to$R$.

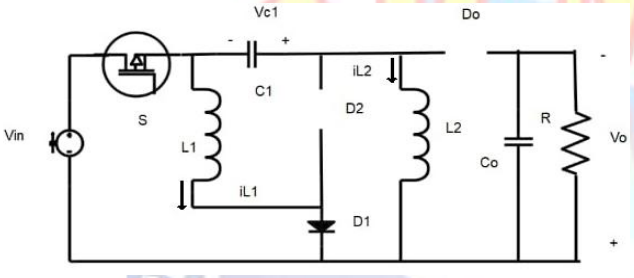

Figure: 3 Mode I

ODE 2:Withinthistimeinterval,theswitchis off condition,thediode D_1 in reverse biased state,the diodes D_2 and D_0 in forward biased states, as shown in Fig.4. L_1discharges energy to C_1 through D_2, L_2 discharges energy to C_0 and R throughD_0

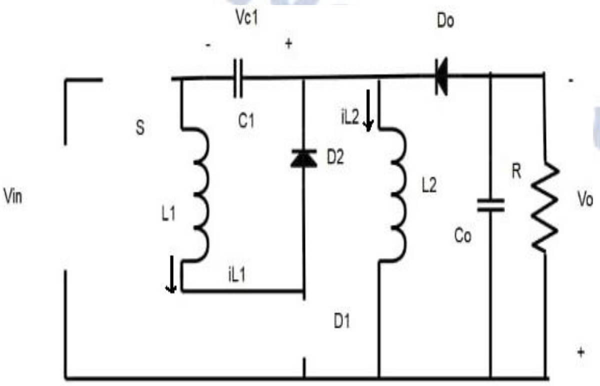

Figure: 4 Mode II

Therefore, the conversion ratio of the implementation of buck boost² converter can be obtained as

$$M = \frac{V_O}{V_{in}} = \frac{D}{(1-D)^2}$$

It is finished that M= 1 when D= 0.74.

The voltage stress on S, D1, D2, D0 when they are off also the current stress through S, D1, D2,Do once they are on.

Table 1: Equations of the IBB²C in mode I and mode II

Parameters	Mode I	Mode II
V_{L1}	V_{in}	$-V_{c1}$
V_{L2}	$V_{in}+V_{c1}$	$-V$
I	$-I_{L2}$	I_{L1}
I_{co}	$-I_O$	$I_{L2}-I_o$

Table 2: Dc values of the IBB²C

Parameters	Values
V_{C1}	$\frac{D}{1-D}V_{in}$
V_{Co}	$\frac{D}{(1-D)^2}V_{in}$
I_{L1}	$\frac{D}{(1-D)^2}I_O$
I_{L2}	$\frac{1}{1-D}I_O$

Table 3: Related stress of the IBB²C

Parameters	Voltage Stress	Current Stress
S	$V_s=\frac{1}{(1-D)^2}V_{in}$	$I_s = \frac{D}{(1-D)^2}I_o$
D_1	$V_{D1}=\frac{D}{(1-D)^2}V_{in}$	$I_{D1}=\frac{D^2}{(1-D)^2}I_o$
D_2	$V_{D2}=\frac{1}{1-D}V_{in}$	$I_{D2}=\frac{D}{1-D}I_o$
D_o	$V_{Do}=\frac{1}{(1-D)^2}V_{in}$	$I_{Do}=I_o$

III. SIMULATION PARAMETERS

The simulation parameters are used in the proposed system with its specifications, input range, output ranges are represented in the following table 4.

Table: 4 PROPOSED VALUE

PARAMETERS	STEP-UP MODE
INPUT VOLTAGE	48V
DUTY CYCLE	0.74
SWITCHING FREQUENCY	25kHz
EFFICIENCY	92%
INDUCTOR L1, L2	260µH,300mH
CAPACITOR C1,C0	90µF,800µF
RESISTOR	50Ω

Design parameters

Duty cycle, D= 0.74

Boost operation, $V_O = V_{in}\frac{D}{1-D}$

Buck Boost , $\frac{V_O}{V_{in}} = \frac{-D}{1-D}$

Where, Vo = Output voltage

Vin = Input voltage

D = Duty cycle

Fs = Switching frequency

Simulation diagram

The Simulink model for design and implementation of buck boost² converter with closed loop control system is shown in figure 5.

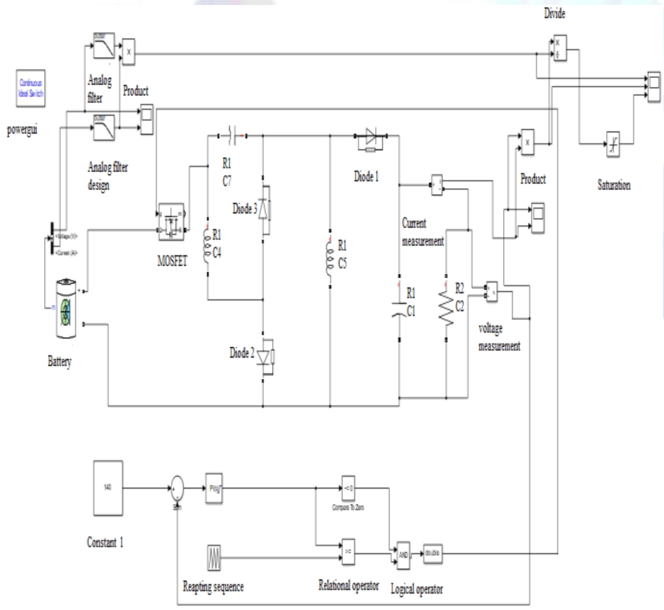

Figure 5: Simulation of design and implementation of buck boost² converter with closed loop control system for proposed system

IV.SIMULATION RESULTS

A design and implementation of buck boost² converter with closed loop control system.

Output voltage :

The simulated output voltage is represented in the fig.6, here we have set input voltage value as 48V, and the resulted output voltage is obtained as -136V.

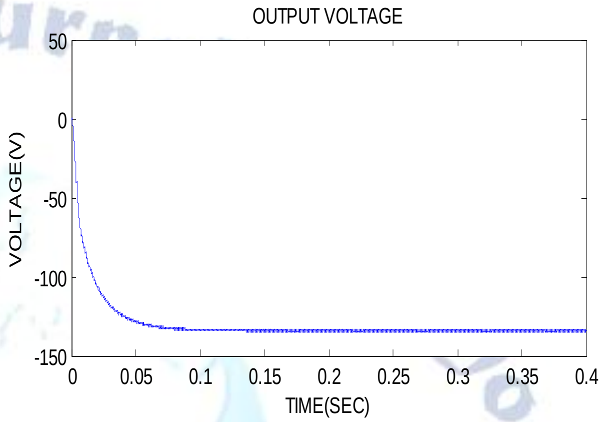

Figure 6 : Output voltage waveform

Output current:

The simulated output current is represented in the fig.7, when the DC source input voltage is fed, after simulating it will provide the output value which will be boosted while comparing with the input value of the voltage.

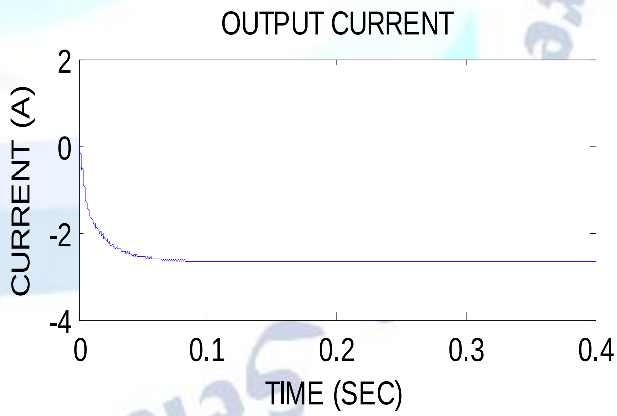

Figure 7: Output current waveform

V. CONCLUSION

A design and implementation of Buck Boost² converter with closed loop control system was proposed. Using a single switch, non-inverting output and high gain of voltage are the advantages of the proposed converter. Thus, the higher voltage rating of capacitor can be used. The

Implementation of buck boost² converter obtains high step up gain. The proposed converter helps much to achieve better high efficiency. Moreover, the topology is able to obtained high output voltage without high step up gain. Applications of switched more power supply, dc-dc converter, battery charging, E-vehicle charging station and renewable energy.

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