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DESIGN OUT-TURN ASSESSMENT ON PERFORMANCE OF ISOLATED NON-ISOLATED CONVERTERS WITH HIGH VOLTAGE GAIN FOR PV REQUISITION

AnuThilak.S[1], Narmadha.P[2], Marimuthu.M[3]

[1,2]M.E, Saranathan College of Engineering, Trichy, (India)
[3]Assistant Professor, EEE, Saranathan College of Engineering Trichy, (India)

ABSTRACT

The yield from the most renewable source like PV module and energy component will undoubtedly be at low voltage level. This is to be enlarged significantly for exact usage or grid pertinence and these exigent affairs lead the researchers to focus on renewable energy to impose the electric power, converters are embrace at the foremost stage to increase the power conversion efficiency. This paper holds on performance assessment of converters (such as boost, cascaded boost, multilevel boost, flyback, forward) for high gain Application. Based on the output result, the performance were evaluated and used to predict the converters with the suitable appraisal of power for high gain entreaty.

Index Terms — converters, cascaded boost converter, multilevel boost converter, fly back converter, forward converter, soft switching bidirectional converter.

I.INTRODUCTION

Automobiles and sustainable power source frameworks need advance up converters for their energy transformation. We get less dc voltage level from sun oriented and energy units henceforth specialists are researching new topologies for collecting the low voltage accessible from sustainable sources, for example, photovoltaic framework and power module [1,4]. Multilevel boost converter is fit for giving high increase expansive no of parts and with expanded no of levels [8]. Despite the fact that fell lift converter is fit for accomplishing required voltage pick up yet its fundamental disservice is high stress in the switch [2,9]. Isolated converters utilize transformer to give required increase offer high voltage pick up proportion however has low proficiency. The benefit of this topology is it gives high voltage increase less exchanging pressure and with less no of segments when contrasted and multilevel boost converter.

The fundamental merit position of the isolated converter is that it will secures stack touchy, the yield of the converter is portrayed by either positive or negative extremity, and If there should be an occurrence of non-isolated converter, electrical hindrance is truant in it. When contrasting isolated converters and non-isolated converters.

Fig 1. Block diagram of high gain converters for high gain application.

Fig 1 shows the block diagram of high gain converter and this type of converter is simple in outline and it is of ease. Converter topologies are produced concerning with great productivity, exchanging control is dependable, and marshalling adaptation to internal failure doubtlessly on sustainable power source. This paper basically concentrates on execution investigation of various converter topology has its own exceptional qualities [3]. These types of converters are utilized in different supplication, for example, footing, vehicles, machine devices, dispersed DC control framework, stockpiling framework in energy component, PV module based requisition.

II. PERFORMANCE AND CIRCUIT PARAMETERS DESIGN OF HIGH GAIN NON-ISOLATED CONVERTERS

Nonisolated DC-DC converters are normal and of lower cost, they are utilized as a part of most negative ground application in vehicles for different DC controlled apparatuses and hardware [5]. Nonetheless they have one major drawback in the electrical connection between the input and yield which offers next to zero security to the heap for any high electrical voltage, current and so forth happens on the input side and have less noise separating blockage.

A. Cascaded boost converter (CBC)

The ability of a boost converter to advance up the input voltage (Vout = 1/(1-D)*Vin) is constrained by the degradation of the productivity and the impact of the parasitic protections everywhere estimations of Duty cycle D.Fig 2 demonstrates the displaying and control of cascaded boost converter and Fig 2a and 2b predicts on and off modes of CBC and simulated output voltage waveform of cascaded boost converter is shown in fig.3. If the application requires a bigger voltage transformation proportion and the least difficult arrangement is to utilize the two kinds of converters in course [10]. In any case, it is simple yet it isn't worth in light of the fact that the dynamic and detached component check is multiplied which prompts high cost and complexity..

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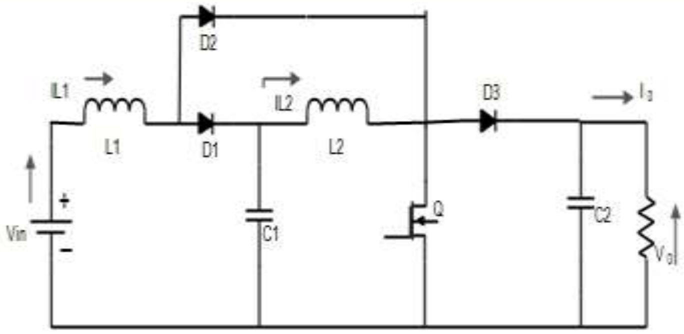

Fig 2.Cascaded Boost Converter

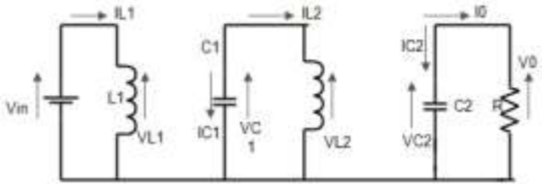

Fig 2a. On mode

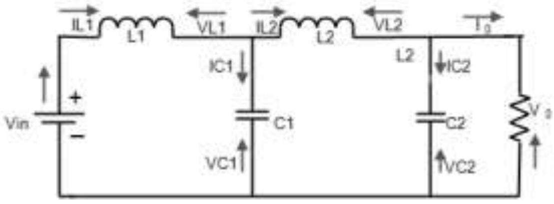

Fig 2b. Off mode

It may be extended to attain a higher boost ratio using only one switch and while comparing the cascaded boost converter and boost converter has some following features:

•Boost converter gives high present while the cascaded boost converter accomplishes high voltage.

•CBC can control the yield voltage and the decision of second inductor can give its present as positive and while for support increments in the voltage will not ready to direct the yield voltage.

•It is reasonable for high voltage battery

•Cascaded support convertor utilized as non-polluting converter gives THD under 5% in the framework side.

Cascaded boost converter used to attain a high voltage gain but here the current stress at inductor L1 will be more and by adding a another stage to boost converter , CBC is introduced and the output voltage gain will be more will compare with conventional boost converter.

Differential equations relating the state variables are when switch is ON.

$$\frac{dIL_1}{dt} = \frac{V_d}{L_1} \qquad 1$$

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$$\frac{dIL_2}{dt} = \frac{V_{C1}}{L_2} \quad 2$$

$$\frac{dV_{C1}}{dt} = \frac{IL_2}{C_1} \quad 3$$

$$\frac{dV_{C2}}{dt} = -\frac{V_0}{RC_2} \quad 4$$

Differential equations relating the state variables are when switch is OFF.

$$\frac{dIL_1}{dt} = \frac{V_d}{L_1} - \frac{V_{C1}}{L_1} \quad 5$$

$$\frac{dIL_2}{dt} = \frac{V_{C1}}{L_2} - \frac{V_0}{L_2} \quad 6$$

$$\frac{dV_{C1}}{dt} = \frac{IL_1}{C_1} - \frac{IL_2}{C_1} \quad 5$$

$$\frac{dV_{C2}}{dt} = \frac{IL_2}{C_2} - \frac{V_0}{RC_2} \quad 8$$

Average Model Equation of QBC

$$\frac{dIL_1}{dt} = \frac{V_d}{L_1} - \frac{V_{C1}}{L_1}(1-d) \quad 9$$

$$\frac{dIL_2}{dt} = \frac{V_{C1}}{L_2} - \frac{V_0}{L_2}(1-d) \quad 10$$

$$\frac{dV_{C1}}{dt} = \frac{IL_1}{C_1}(1-d) - \frac{IL_2}{C_1} \quad 11$$

$$\frac{dV_{C2}}{dt} = \frac{IL_2}{C_2}(1-d) - \frac{V_0}{RC_2} \quad 12$$

For steady state operation of an inductor in a DC-DC Converter, net inductor voltage in a switching period must be zero.

For inductor L1 the INDUCTOR VOLT-SECONDBALANCE

$$\Delta i_{L1(\text{Closed})} + \Delta i_{L1(\text{open})} = 0 \quad 13$$

$$\frac{V_1}{L_2}dT + \frac{V_{in}}{L_1}(1-d)T = 0$$

$$V_{C1} = \frac{V_{in}}{(1-d)} \quad 14$$

For inductor L2 the INDUCTOR VOLT-SECONDBALANCE

$$\Delta i_{L2(\text{Closed})} + \Delta i_{L2(\text{open})} = 0 \quad 15$$

$$\frac{V_1}{L_2}dT + \frac{V_{in}}{L_1}(1-d)T = 0$$

$$V_0 = \frac{V_{in}}{(1-d)^2} \quad 16$$

From equation 1, and substitute the equation for Vc1 and Vo

$$L_1 = \frac{V_{in} D}{\Delta I L_1 f} \tag{15}$$

From equation 2, and substitute the equation for Vc1 and Vo

$$L_2 = \frac{V_{in} D}{(1-D)\Delta I_2 f} \tag{18}$$

For steady state operation of a capacitor in a DC-DC Converter, net capacitor current in a switching period must be zero

$$Ic1_{(Closed)} + Ic1_{(open)} = 0 \tag{19}$$

$$C_1 = \frac{I_0 * D}{f(1-D)\Delta Vc_1} \tag{20}$$

$$C_2 = \frac{D I_0}{f \Delta Vc_2} \tag{21}$$

A boost converter and a fly back converter are effectively joined as a quadratic boost converter driven by a solitary switch and accomplished high advance up voltage pick up, the voltage pick up will be up to 20 times than input. The vitality of spillage inductor of the coupled-inductor can be reused, which is adequately obliged the voltage stress of the main switch S and advantages the low on-state protection can be decided for high pick up application.

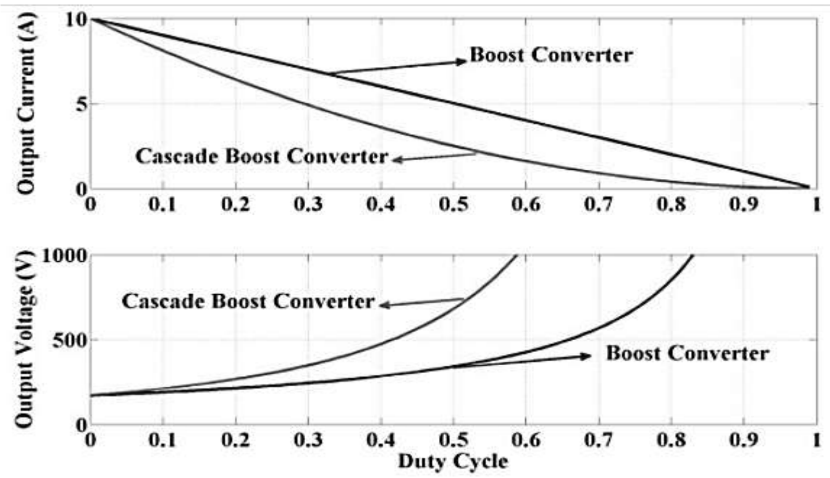


Fig 3. Characteristic of Quadratic boost converter and boost Converter.

B. Multilevel Boost Converter.

The Multilevel Boost Converter topology comprises of the ordinary boost converter and voltage doubler stages to give a high voltage pick up. The topology which utilizes single switch with just a single inductor, (2N-1) diodes and (2N-1) capacitors and fig 4 shows the three level multilevel boost converter. In this topology, every device blocks just a single voltage level. The principle point of this topology is continuous input current, extensive pick up without high obligation cycle or transformer, measured quality and utilization of devices with low voltage rating.

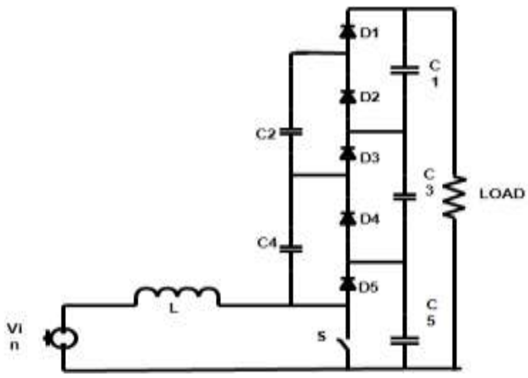
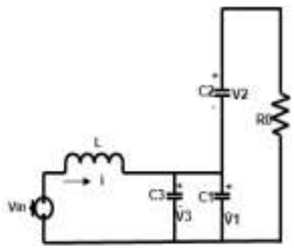


Fig 4. Multilevel boost converter for 3 level

This is used as a DC link in application required with the unidirectional current flow and self-balancing such as PV or fuel cell generation system with multilevel boost converter and fig 4a and 4b shows the operating modes of MBC.



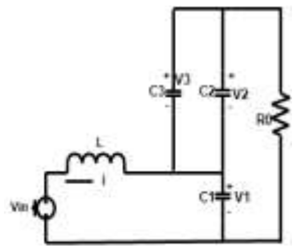


Fig.4a Mode 1(Switch On) **Fig.4b Mode 2(Switch Off)**

The main benefits of multilevel boost converter are

- Continuous input current.
- A big conversion ratio without extreme duty cycle.
- Allow high switching frequency.
- Transformer-less.
- It provides several self-balancing voltage level and only one driven switch, which makes it ideal for feeding a diode clamped multilevel inverter.
- It can be built in a module way and more level can be added without changing the main circuit.

The proposed circuit is based on the multilevel converter principle, were each device which arrests only one voltage level achieving high voltage converter with the high voltage devices in MBC and fig 5 shows the comparison of cascaded and multilevel boost converter

Differential equations relating the state variables are when switch is ON.

$$\frac{diL}{dt} = \frac{V_s}{L} \quad (22)$$

$$\frac{dV1}{dt} = -\frac{V_1}{R(C1 + C3)} - \frac{V2}{R(C1 + C3)} \quad 23$$

$$\frac{dV2}{dt} = -\frac{V_1}{RC2} - \frac{V2}{RC2} \quad 24$$

$$\frac{dV3}{dt} = -\frac{V_1}{R(C1 + C3)} - \frac{V2}{R(C1 + C3)} \quad 25$$

Differential equations relating the state variables are when switch is OFF.

$$\frac{diL}{dt} = -\frac{V_1}{L} - \frac{Vs}{L} \quad 26$$

$$\frac{dV1}{dt} = \frac{i}{C1} - \frac{V_1}{RC1} - \frac{V2}{RC1} \quad 25$$

$$\frac{dV2}{dt} = -\frac{V_1}{R(C1 + C2)} - \frac{V2}{R(C1 + C2)} \quad 28$$

$$\frac{dV_3}{dt} == -\frac{V_1}{R(C2 + C3)} - \frac{V2}{R(C2 + C3)} \quad 29$$

III.OPERATION PRINCIPLES OF ISOLATED CONVERTER TOPOLOGY

Isolated DC-DC converters have high isolation (obstruction) voltage from a few hundreds to thousand volts contingent upon the kind of standard. They can be utilized as negative grounded or positive ground or coasting ground for different hardware from information com to telecom [15]. They have solid noise and obstruction blocking ability in this manner give the heap a cleaner DC source which is required by numerous delicate burdens.

A. Flyback converter

The flyback circuit topology in which the input to the circuit might be unregulated dc voltage got from the utility air conditioning supply after rectification and some sifting. The swell in dc voltage waveform is by and large of low recurrence and the general swell voltage waveform rehashes at double the air conditioner mains recurrence [6]. Since the SMPS circuit is worked at considerably higher recurrence (in the scope of 100 kHz) the input voltage, regardless of being unregulated, might be considered to have a consistent greatness amid any high recurrence cycle.

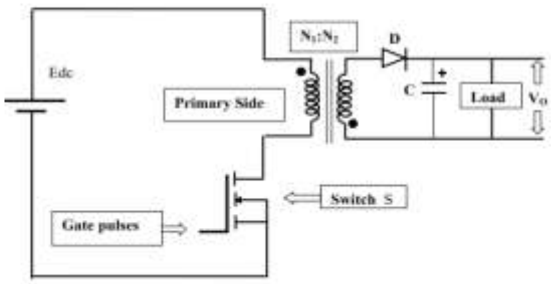


Fig.5Flyback converter

It's the most minimal cost converter among the isolated topologies it utilizes slightest number of parts. It consolidates the inductor with the transformer. In other sort of isolated topologies the inductor and the transformer are separate components. Inductor is responsible for energy storage and the transformer is in charge of energy exchange.

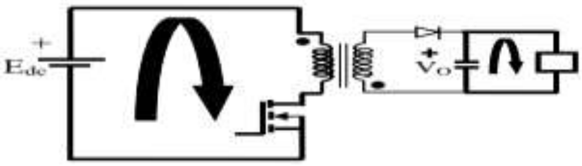


Fig.5a Mode1

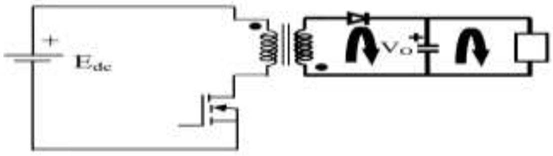


Fig.5b Mode 2`

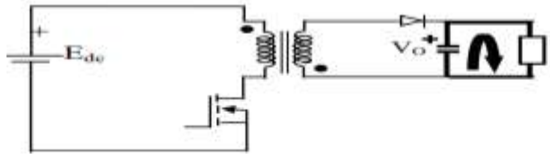


Fig.5c Mode 3

Fig 5a, 5b, 5c suggests the present way in working modes 1, 2 and 3 in this topology were difficulties of flyback converter to high power prompts the transformer with generally substantial energy storage [11] and For huge energy storage it needs vast air hole and this extensive air hole which prompts following elements appeared in Fig 6.At, discontinuous current mode the accompanying preferences and drawbacks were given underneath and fig 7 demonstrates the yield waveform for flyback converter.

Fig 6. Factors lead from large air gap

Advantages

- Very fast dynamic response-better stability.
- No reverse recovery problem.
- No turn on losses
- Easy control.
- Small size of the transformer

Disadvantages

- Higher form factor.
- More power loss.
- Current pulses-large peak, high discontinuity.

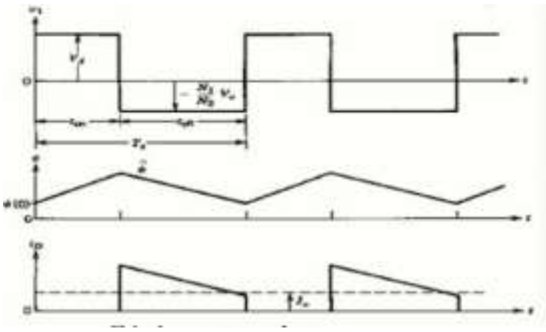


Fig.7 Output waveform for Flyback converter

B. Forward Converter

Forward converter is another prominent exchanged mode control supply (SMPS) circuit that is utilized for delivering confined and controlled dc voltage from the unregulated dc input supply is appeared in fig 8. As on account of fly-back converter, the information dc supply is regularly inferred in the wake of redressing (and small separating) of the utility air conditioning voltage [12,13]. The forward converter, when contrasted and the fly-back circuit, is by and large more vitality productive and is utilized for applications requiring minimal higher power yield (in the scope of 100 watts to 200 watts). However the circuit topology, particularly the yield sifting circuit isn't as basic as in the fly-back converter.

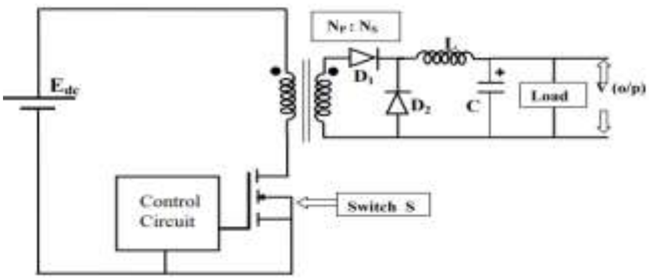


Fig.8 Forward converter

The main advantage of the forward topology is its simple and adaptability. Yield Ripple Frequency Relative Cost is Low One regular minor departure from the forward converter is the two transistors forward [7]. This setup includes another switch component the opposite side of the transformer essential and two bracing diodes, one from each side of the essential to the contrary info voltage terminal. In return for this extra multifaceted nature the two transistors forward lessens the voltage weight on the switch components and fig 8a and 8b demonstrates the method of operation in forward converter and fig 9 demonstrates the yield waveform for forward converter.

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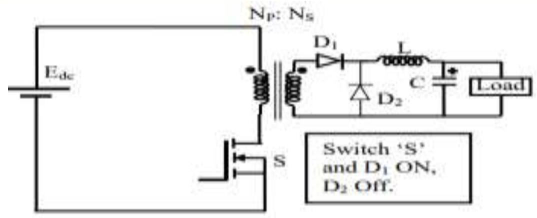

Fig.8a Mode 1

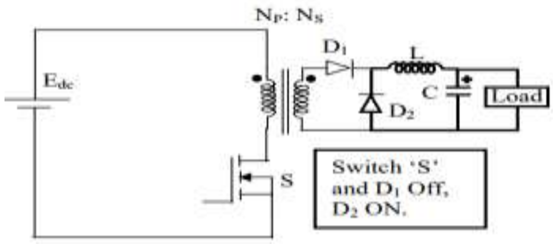

Fig.8b Mode 2

Advantages

- Drain current reduced by the ratio of Ns/Np
- Low output voltage ripple
- Supports multiple outputs
- Simple and flexible
- Cost low due to low output ripple

Disadvantages

- Poor transformer utilization and transient response
- Transformer reset limits duty ratio.
- High switch voltage and input ripple current.

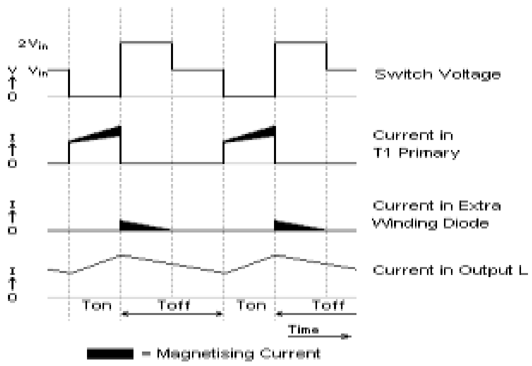

Fig.9 Output waveform for forward converter.

Comparison of Flyback and Forward Converter.

The forward converter is most appropriate for bring down power applications. While effectiveness is practically identical to the flyback, it has the detriment of having an additional inductor on the yield and isn't appropriate for high voltage yields [14]. The forward converter has the desired position over the flyback converter when high yield streams are required. Since the yield current is non-throbbing, it is appropriate for applications where the current is in overabundance of 15A. Desired position of the flyback topology over the other isolated topologies is that a considerable lot of them require a different stockpiling inductor. Since the flyback transformer is in all actuality the capacity inductor, no different inductor is required.

IV. CONCLUSION

This paper predicts about the assessment on design, operation modes and implementation of converters like cascaded boost converter, multilevel boost converter, flyback converter, forward converter has been validated through simulation design using MATLAB/SIMULINK MODEL.

From this the multilevel boost converter more effective than Cascaded boost converter achieving 240V from 24V with a voltage gain of 10. A conventional boost converter which gives low gain voltage while cascaded boost converter give high gain voltage and it is reached out to accomplish a higher boost proportion utilizing just a single switch, it gives THD under 5% in the framework side. By expanding the voltage of CBC makes it exceptionally appropriate for high battery voltage charging current and in multilevel boost converter is used to overcome the disadvantage in cascaded boost converter to reduce the current stress and extensive transformation proportion accomplish without high obligation cycle will permit to high exchanging recurrence without utilizing transformer were more levels can be included without altering the principle circuit and give consistent input current. Dissimilar to flyback and forward converter the heap yield will be generously at least level or else yield voltage will get more higher to disregard this issue, the yield terminal is associated for all time with a substantial load protection. Since, forward converter can't store the vitality in transformer for same power level yield; size of the transformer is littler contrasted with the flyback converter. The yield current is sensibly steady because of the activity of yield inductor and freewheeling diode and as an outcome, the yield channel capacitor can be influenced small and its swell current is much lower than that required for the flyback converter.

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