



SIMULATION AND MODELING OF SOFT SWITCHING SEPIC CONVERTER FOR SOLAR PV APPLICATIONS

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Abstract

This paper covenants with replication and representation of a soft switching SEPIC (single-ended primary inductor converter) for photovoltaic purpose. A source is provided by solar panel. A clamp capacitor and an auxiliary switch are coupled. An auxiliary inductors and paired inductors are second-hand to attain ripple-less input current then ZVS procedure of the auxiliary switches with main switch. The active clamp method and voltage multiplier method are functional to the conformist converter of SEPIC to boost the gain of voltage, trim down the stresses of voltage of the diode and supremacy switches. Furthermore, with

using significance among the inductors booming and voltage multiplier circuits capacitor, output diodes ZCS procedure is attained and its opposite-recovery trouncing be extensively condensed. Due to the power semiconductor devices soft switching communication the proposed system has improved performance. The obtainable hypothetical examination has been confirmed through a sample of 80W and 100KHz converter. And calculated competence of projected converter has been achieved a cost of 94.8% at the highest output power.

Key Words: Voltage Multiplier, SEPIC Converter, ZVS, ZCS.

1 INTRODUCTION

Power factor correction, photovoltaic system and LED lighting are the few of the application where SEPIC converters have been utilized. Yet, converter has a number of drawbacks. The two main drawbacks are less performance because of hard switching operation of power switches and power semiconductors high voltage stress. Specially, higher rated voltage power semiconductor is used in high voltage application. The R_{ds} power of MOSFET is peak when the voltage range is peak. In the similar scale current, this situation creates a peak conduction loss, and then on the whole competence container is enhanced. Voltage multiplier has been introduced in order to decrease the voltage stress and boost the voltage gain.

To decrease the weight and volume of the converter, soft-switching techniques are necessary. The few of the soft switching techniques are ZCS and ZVS. DC-DC converters are the peak frequency operation which allows drop of the weight and volume of their magnetic workings. Though, electromagnetic interference noises and switching victims are important in high-frequency action. Consequently, different soft-switching methods have been performed. In the middle of them, the vigorous clamp method is repeatedly worn to bound the voltage spear efficiently, accomplish soft-switching action, and boost the system competence.

The major advantage of the SEPIC converter is, it preserve a less current ripple. Conversely, a mass inductor must be worn to curtail the current ripple. Appropriate to the ample utilize of low voltage

sources (batteries, fuel cells and super capacitors) input current ripple becomes a necessary requirement. It happens because of huge ripple current could cut down the lifetimes of those key sources.

SEPIC is proposed in Zero-current-switching PWM. 2 switches can work among soft switching. Still, 3 power diodes and 3 split inductors are used. Switchs voltage stress is the addition of a output voltage and input voltage which is identical to the conformist SEPIC Converter. In ringing pace up/down converter has been proposed. Sort-switching process is performed. 2 power switches and 2 magnetic apparatus are necessary. On the other hand, it has vivacious input current and a supplementary filter phase is obligatory in the input phase to restrain the input current ripple. Consequently, count of magnetic apparatus can be enlarged.

In bidirectional zero-voltage-switching PWM SEPIC Converter has been proposed. main switches of count two can able to function among soft switching. Conversely, a bidirectional switch needs 2 power MOSFETs. Numerous switches are necessary and compound lashing circuits for them are compulsory. In addition, switchs voltage stress is identical to the conformist convertor SEPIC. In count, S-nubber circuit is compulsory toward restrain freeloading voltage humming crosswise the bidirectional switches.

A soft-switching single-ended primary inductor converter among ripple-less input current has been introduced. A clamp capacitor and an auxiliary switch are additional to the conformist single-ended primary inductor converter. An auxiliary inductor an a united inductors has been used to gain ripple-less input current and achieve ZVS process of an auxiliary and main switches. Power switchs voltage stresses and diode are condensed by $1/2$ using the voltage multiplier procedure. Furthermore, in the multiplier circuit the annul recovery defeat of output diode is appreciably condensed due to significance among the capacitor and the resonant inductor. The introduced converter attains elevated effectiveness due to soft switching uniqueness of power semiconductor campaign. Academic examination is confirmed with an 80W investigational model with 48-200V adaptation.

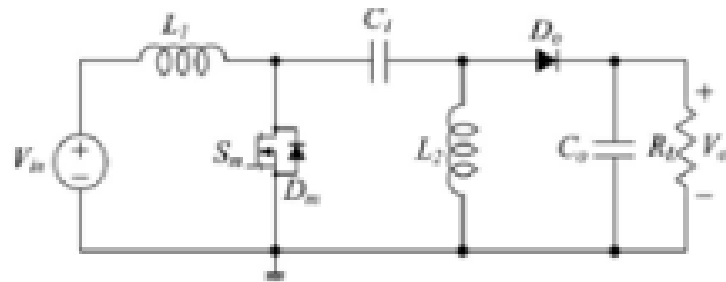


Figure 1(a) Conventional single-ended primary inductor converter

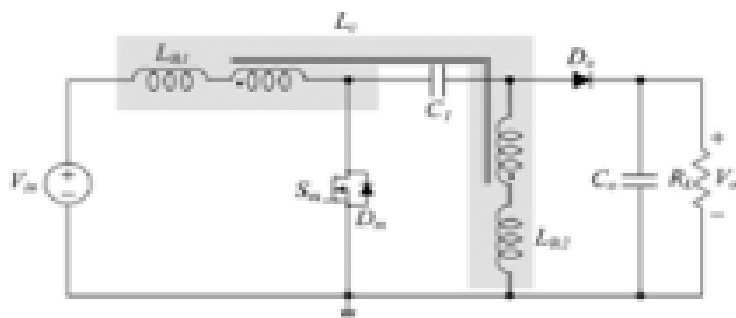


Figure 1(b) Ripple-less single ended primary inductor converter with a loosely coupled inductor

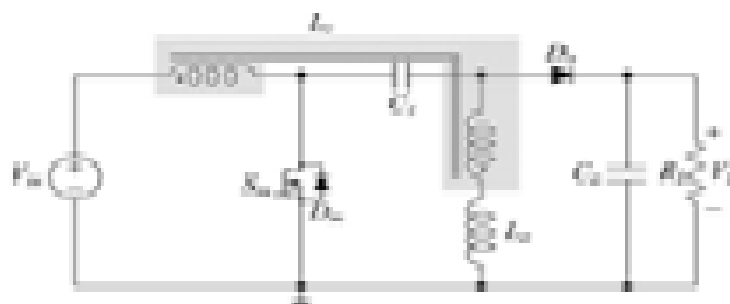


Figure 1(c) Ripple-less single-ended primary inductor converter with a tightly coupled inductor

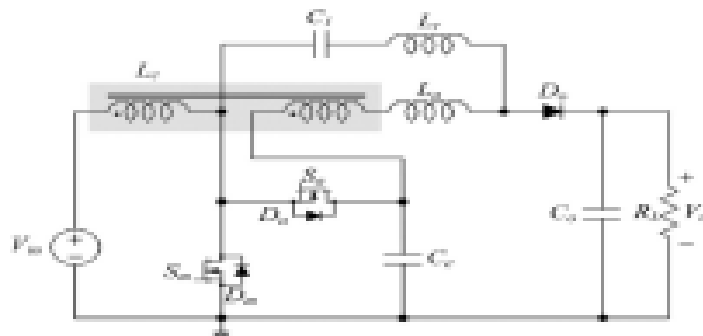


Figure 1(d) Planned soft switching ripple free single-ended primary inductor converter

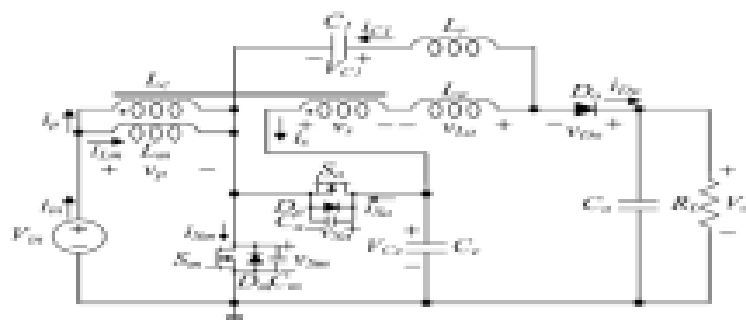


Figure 1(e) correspondent circuit of the projected converter

2 REVIEW OF THE PROPOSED CONVERTER

The conformist single-ended primary inductor converter are given away in fig(a). The disconnect inductor description is given away in fig(b). In the attached inductor description, a droopily joined inductor L_C is worn in its place of 2 disconnect inductors L_1 and L_2 .

L_{lk2} and L_{lk1} involve the escape inductances of the joined inductor. The joined inductor description has benefit such as lone magnetic module and a ripple-less situation is linked among the magnetizing inductance, the rotate percentage, and the seepage inductance L_{k2} of the joined inductor. Still, the seepage inductance is rigid to organize in through production. Providentially, the seepage inductance L_{k1} is not associated among the ripple-less situation. Consequently, a securely attached inductor could be utilized among an supplementary inductor L_a as a substitute of L_{k2} as shown in fig(c).

The diagram of the projected soft switching single-ended primary inductor converter by way of a ripple-less input current is given away in fig(d). In the projected converter, the ringing inductor L_r and the vigorous secure cell hold the S_a and the secure capacitor C_c are further to the conformist SEPIC converter given away in fig(c). The correspondent circuit of the projected converter is given away in fig(e). The joined inductor L_c is reproduction as the magnetizing inductance L_m and an model transformer with a spin fraction 1:n. The diodes D_m and D_a are the intrinsic remains diodes of the S_m and S_a are activate inequitably and the duty fraction D is stand on the S_m . The procedure of the projected converter is one changing phase T_s canister be separated into 5 method as given away in fig(2). To abridge the fixed state investigation, it is understood that folks capacitor C_1 , C_o and C_c have hefty ethics and the voltage ripples athwart thrm canister be overlooked.

Former to method 1, the S_a is performing. The exert a pull on inductance current I_{lm} is forthcoming to its least value i_{lm2} and the I_{la} is draw near to its least value I_{la1} and the output diode is not performing.

MODE 1[t_0, t_1]: Next to to, the auxiliary switch S_a is spined OFF. Afterward, the power hoard in the magnetic machinery such as L_r , L_a and L_m begins to arraign C_a and liberation C_m . Consequently, the V_{sa} crosswise S_a begins to mount from 0 and the V_{sm} crosswise S_m begins to reduce from V_{cc} . While the capacitors C_m and C_a are dreadfully little, the shift time space T_{t14} is especially little. While the shift space T_{t1} is especially little, every current sinuous during the magnetic machinery are measured stable through this method. MODE 2 [t_1, t_2] : Next to t_1 , the V_{sm} appears at 0. Afterward, the carcass diode D_m is crooked ON. Behind to the gate indicator is functional to the S_m and the waterway of S_m acquires above the

current sinuous from first to last D_m . Because the V_{sm} is secured as 0 among twist lying on of D_m ahead of S_m is crooked ON, 0 voltage spin on of S_m is attained. In this method, the input V_{in} is functional to L_m and the current I_{lm} enlarges frequently from its least value I_{Lm2} .

3 SIMULATION RESULT

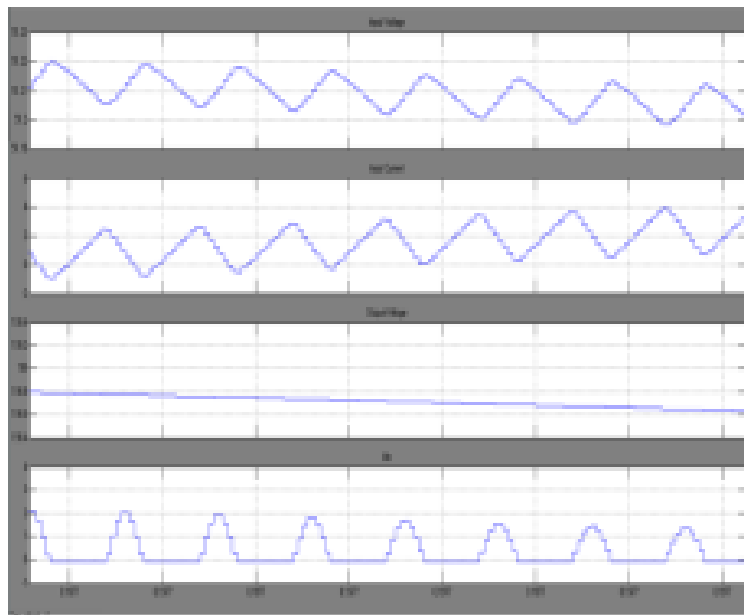


Figure 2 Output Waveform

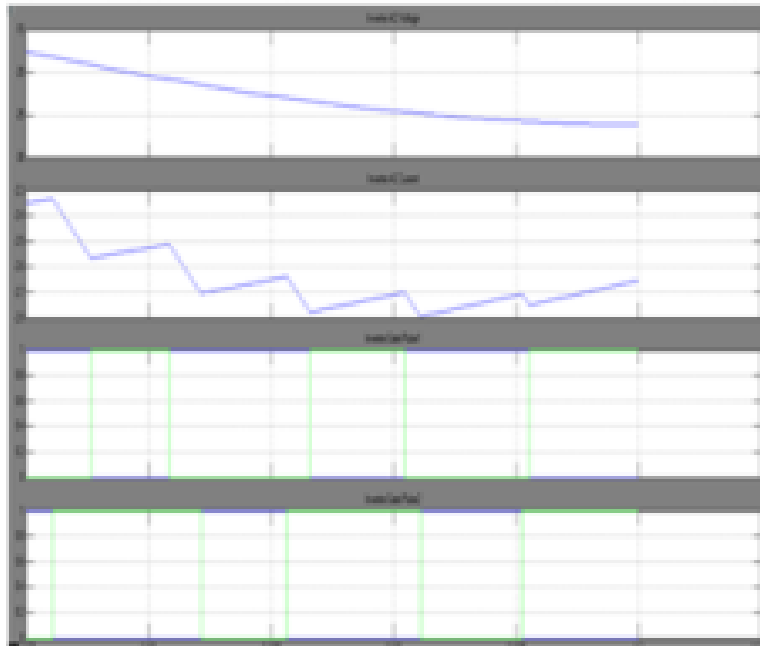


Figure 3 Inverter Waveform

While the V_s at the resulting face of the united inductor L_c is nV_{in} , the V_{la} crosswise L_a is $(V_{cc} - nV_{in} - V_{c1})L_a/(L_a + L_r)$. Consequently, the resulting current is decline frequently from its highest value I_{La1} . By the stop of this method, the current i_{Lm} appears at its highest value I_{Lm1} and the least cost I_{La2} . MODE 3 $[t_2, t_3]$: The switch S_m is crooked OFF on t_2 . Then, the voltage v_{sm} enlarges from 0 then the V_{sa} decline from V_{cc} next to the identical time unpaid to the power hoard in the magnetic machinery. Among the identical hypothesis as in method 1, the evolution time period T_{t2} canister be simplify T_{t2} is unimportant. Every part of the currents are unspoken stable throughout T_{t2} .

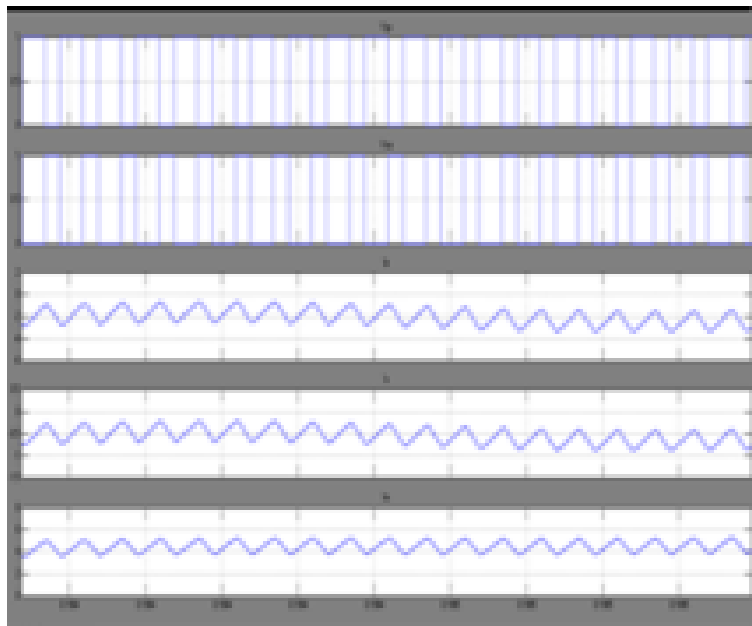
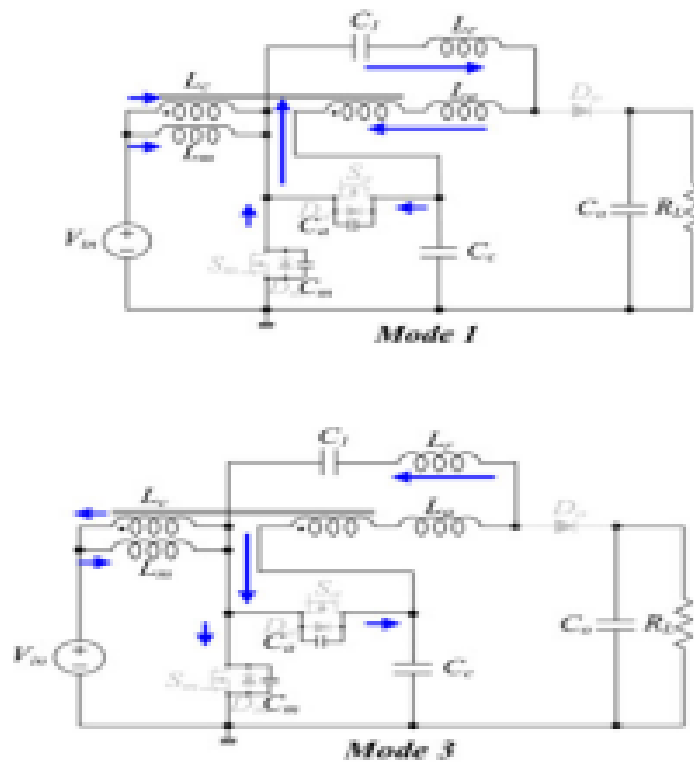
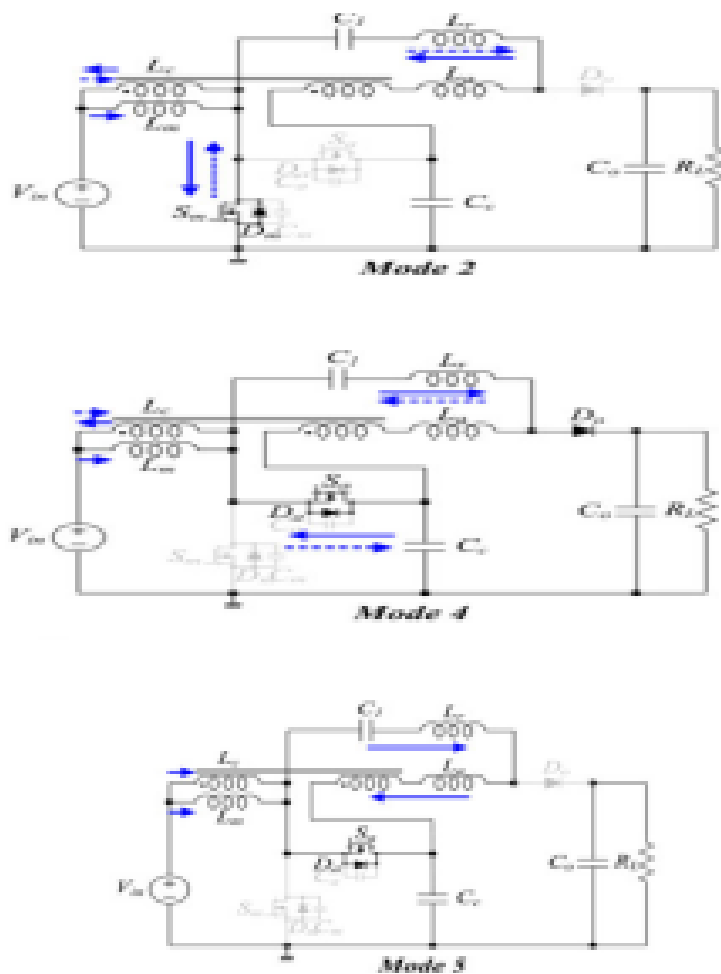


Figure 4 Gate Pulse

MODE 4 $[t_3, t_4]$: By the side of t_3 , the V_{sa} appears at 0. Then, the remains of diode D_a is crooked ON. Behind that, the gate indicator is functional to S_a and the channel of S_a acquires above the current curving during the diode D_a .



Because the voltage V_{sa} is raised as 0 ahead of the switch S_a is bowed ON, 0 voltage activate of S_a is reached. In this approach, the V_p crosswise l_m is $(V_{cc} - V_{in})$ and the current i_{lm} decline frequently from its highest value i_{lm1} . Among the activate of S_a , the output diode D_o begins to perform. Then the quality among the ringing inductor L_r and the capacitor C_1 transpires. Because the voltage crosswise the inductor L_a is $V_o + nV_{in} - (1 + n)V_{cc}$, the current is boost frequently in this method .



MODE 5[t4,t5]: By the side of t4, the yield diode current i_{D_o} getting down to 0 and 0 current rotate OFF of diode D_o is attained. While the current varying pace of D_o is prohibited by a ringing method, its reverse-recovery dilemma is extensively assuaged. Because the voltage crosswise the inductor L_a is $(V_{c1} - nV_{cc} + nV_{in})L_a/(L_a + L_r)$, the current is raise in this mode.

4 CLOSED LOOP CIRCUIT DIAGRAM

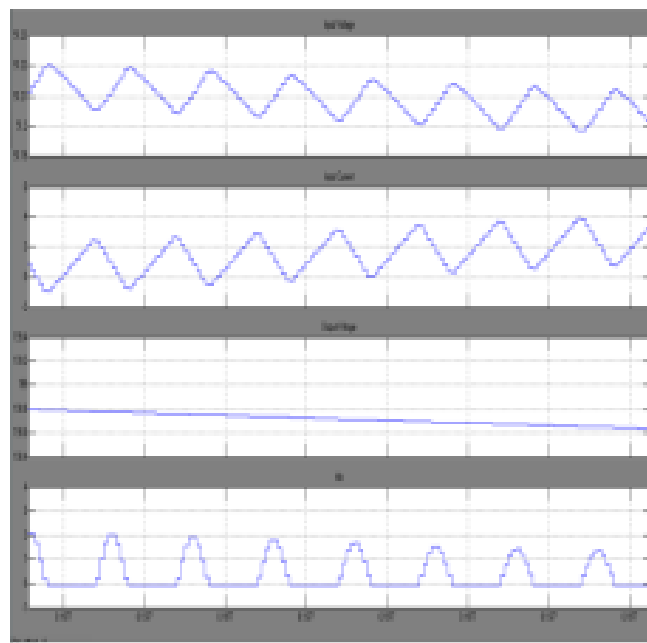
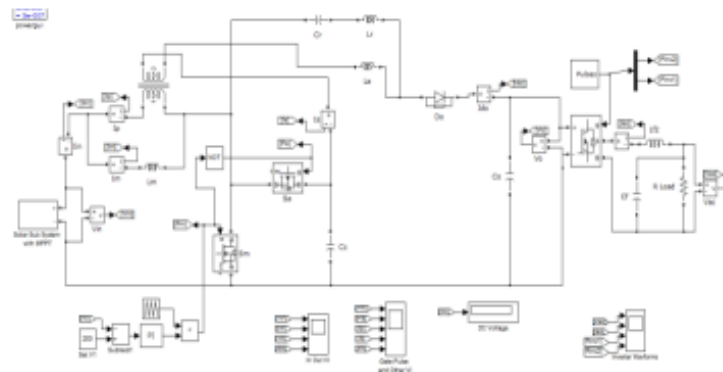


Figure 6 Output Waveform

5 EXPERIMENTAL RESULTS

Toward prove the steady-state routine and the conjectural examination of the projected soft-switching SEPIC converter for photovoltaic application, a laboratory model is developed and hardened with the input (V_{in}) and output voltage (V_o) of 50 V and 200 V respectively, switching frequency (f_s) of 100 kHz and output power (P_o) is 80W.

6 CONCLUSION

The process belief, conjectural examination, and the implementation of a soft-switching single-ended primary inductor converter for photovoltaic submission are obtainable in this article. Here the projected converter, the united with an auxiliary inductor is utilized to supply ripple-less input current and accomplish zero-voltage-switching process of auxiliary switches and the main. The reward of the projected converter are little voltage stresses, little switching losses, ripple-less input current, assuage reverse-recovery dilemma of the output diode, and soaring competence. The aim reflection of the projected converter is incorporated. The investigational outcomes based on a model are obtainable for justification.

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