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A Novel SEPIC Converter With valley-fill circuit for Ripple reduction in PV electric vehicle charger

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***Abstract*—**To reduce the ripple in the DC-DC converter and to energize the electric vehicle with the alternative energy source such as sunlight by using the photo-voltaic panel.The SEPIC (Single-Ended Primary Inductance Converter) is meant for both the step-up and step down the output voltage as it's derived from the Buck-Boost converter. The SEPIC converter has a electrolytic capacitors which will increase the electric stress in the components and that can be reduced in the following task and the lifetime of the components used in the converter can be improved and reverse recovery can be eliminated . This will perform well to drive vehicles in urban conditions and in highways at reasonable speeds.

***Index Terms*—Electrolytic Capacitor, light-emitting diode(LED), Power factor correction(PFC), single switch.**

I.INTRODUCTION

The Conventional sources of energy are rapidly depleting. Moreover the cost of energy is rising and therefore photovoltaic system is a promising alternative. They are abundant, pollution free, distributed throughout the earth and recyclable. The hindrance factor is its high installation cost and low conversion efficiency. Therefore our aim is to increase the efficiency and power output of the system. It is also required that constant voltage is supplied to the load irrespective of the variation in solar irradiance and temperature. PV arrays consist of parallel and series combination of PV cells that are used to generate electrical power depending upon the atmospheric conditions. So it is necessary to couple the PV array with a boost converter. Moreover our system is designed in such a way that with variation in load, the change in input voltage and power fed into the converter follows the open circuit characteristics of the PV array.

The system can be used to supply constant stepped up voltage to dc loads using DC-DC converter. In a sepic converter, the average voltage is greater than the input voltage. A sepic converter can minimize switching loss by adopting a resonant soft-switching method. Since, the method distributes the input current according to each phase; it can decrease the current rating of the switching device. Also, it can reduce the input current ripple, output voltage, and size of the passive components.

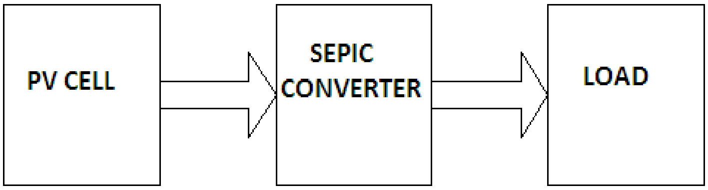

Fig 1 BLOCK DIAGRAM

Photovoltaic cell is a solid state electrical device that converts the energy of light directly into electricity by the photovoltaic effect. Thus the output voltage will be very low and not much efficient. A sepic converter is a power converter with an output DC voltage greater than its input DC voltage. Load may be battery or any DC supply unit. Even AC supply unit can be used with inverter (DC to AC) block should be used.

II.CONVENTIONAL SYSTEM

A SEPIC converter is a DC-DC converter with a buck-boost So, power converter has an output DC voltage greater than or lesser than when compared to its input DC voltage. The circuit consists of only one switch and the control action is by its duty cycle. In SEPIC converter a coupledinductor is used to reduce ripple and limit inductance requirement. Here a tightly coupled inductor is used.

The existing consists of a electrolytic capacitor in the SEPIC converter.For driving multiple lighting LED lamps is to employ the single-stage PFC circuit to eliminate the additional dc–dcstage. State-of-the-art LED drivers using the single-stage PFC topology have been published in. The circuit choices involved fly-back, single-ended primary inductance converter (SEPIC), buck-fly back , boost fly back, resonance-assisted buck , buck-boost,etc. In compared several offline PFC topologies for driving LEDs, including boost, SEPIC, forward, fly back, and half-bridge. These topologies are suitable for different power level and customer requirements.

No matter what kind of PFC converter, to balance the difference between instantaneous input power and output power, the intermediate capacitor has to be large enough to absorb the energy difference. Therefore, the electrolytic capacitor with large capacitance is usually used as the energy buffer. Unfortunately, the lifetime of the electrolytic capacitor is limited to several thousand hours under rated operating conditions, which is much shorter than the lifetime of LEDs that is generally higherthan 50 000 h. In several lighting management institutionshave expressed their needs to have LED drivers with lifetimeover 10 years. In order to prolong the overall lifetime of LED lighting products, it is necessary to reduce the storage capacitance so thatnon-electrolytic capacitors can be adopted. A third harmonicinjection into the input current to reduce the storage capacitanceof continuous conduction mode (CCM) boost PFC andthe corresponding implementation circuit is presented in.The major shortcoming with the third harmonic injection is thatthe current ripple flowing into the LEDs is too large, reducingluminous efficacy of the LEDs. This approach is also used toreduce the peak-average ratio of LED current, but the LED currentis controlled as rectified sinusoidal type with zero valleyvalue and 120-Hz frequency, which may also cause noticeableluminous variation and color variation to human eyes . Anapproach based on load modularization is reported for removingthe electrolytic capacitor . The efficiency with this approachis too low, and also the performance depends on the count ofthe LED load strings.. However, this proposalhas two major drawbacks: 1) dimming cannot be achieved withthe pulse width modulation (PWM)current control and 2) excessivelylarge secondary capacitance (6.9 mF), requiring parallel of a large amount of capacitors.

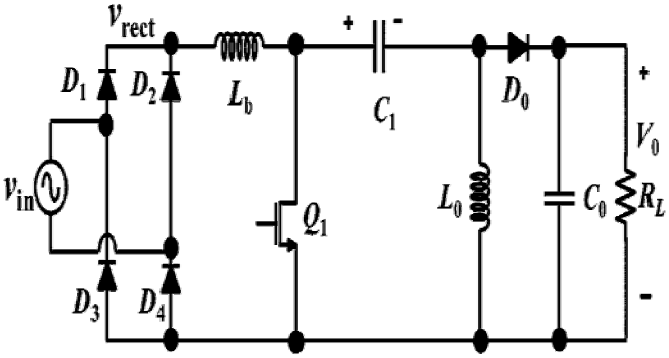

Fig 2. SEPIC Converter

The voltage across the switch is very high during the resonancemode. The efficiency and output power of renewable resource is low. There may be input current ripple and output voltage ripple in this system.Switching losses is high in the boost converter.

III.PROPOSED SYSTEM AND OPERATION

The SEPIC converter provides a positive output voltage froman input voltage that varies above and below the output voltage. The SEPIC converter also needs two inductors and a series capacitor, sometimes called a flying capacitor. The SEPIC converter is another option for regulating an unregulated input-power supply, like a low-cost wall wart. To minimize board space, a coupled inductor can be used. The SEPIC converter provide a regulated output voltage from an input voltage that varies above and below the output voltage. The advantages of SEPIC Converter include Achieve high step up voltage gain, The energy of the leakage inductor of the coupled inductor is recycled, Efficiency is improved, Low output voltage and current ripple.

The key principle that drives the boost converter is the tendency of an inductor to resist changes in current. When the capacitor being charged, it acts as a load and observes energy, when being discharged it acts as an energy source. The voltage produced during the discharge phase is related to the rate of change of current, and not to the original charging voltage, thus allowing different input and output voltages. There are many versions of SEPIC converter, here a coupled inductor version is taken and advantage being single magnetic component. In the conventional circuit a tightly coupled inductor is used with additional inductor.

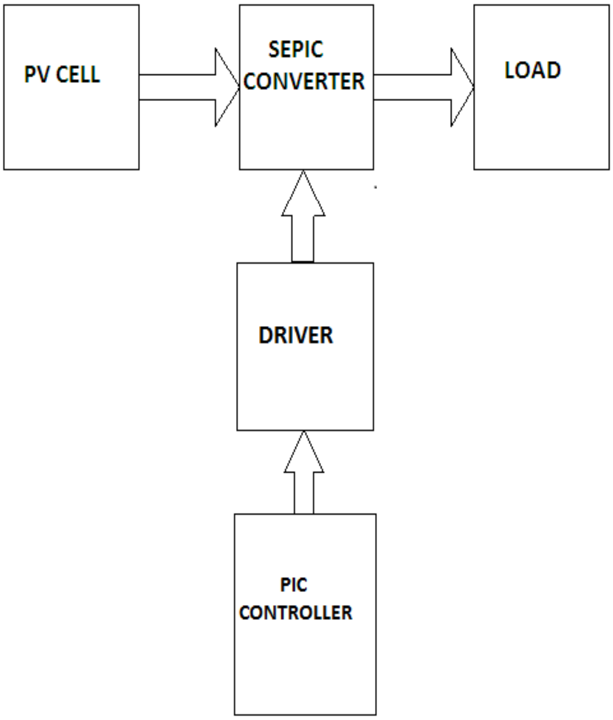

Fig 3. Block Diagram

The valley-fill circuit within the SEPIC-derived converter adopted for electrolyticcapacitor-less LED lighting applications. Unlike the previous usage of the valley-fill circuit for improving the power factor and reducing the output voltage ripple, the major function of the valley-fill circuit is to break the low frequency loop in the SEPIC converter and to reduce the voltage stress of the intermediate capacitorand output diode.

The applications of SEPIC converters include:24V DC from a truck battery must be stepped down 12V DC to operate a car radio, CB transceiver or a mobile phone,12V DC from a car battery must be stepped down to 3V DC, to run a personal CD player, Used in DC motor drive, In applications such as uninterrupted power supply (UPS) circuit and converter feed batteries, DC-DC converter forms a principle component.

The advantages of Valley-Fill circuit includes:A high efficiency dc/dc boost converter to increase the overall efficiency of PV power conditioning system (PVPCS). The single-switch type soft-switching boost converter can minimize switching loss by adopting a resonant soft-switching method. No additional switches are needed for soft switching.

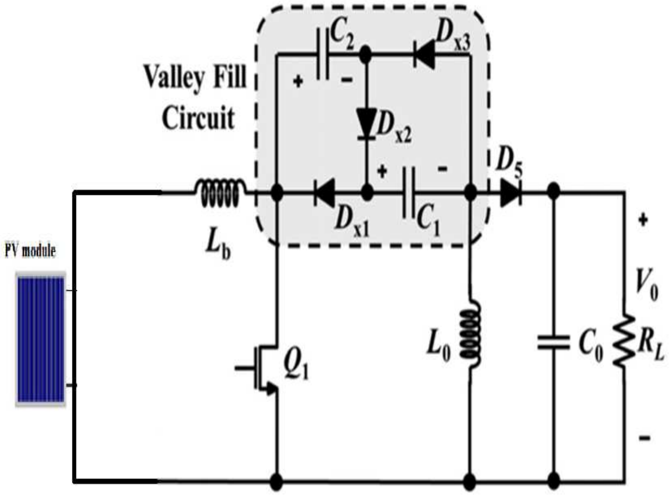

Fig 4. Valley-Fill SEPIC Converter

MODES OF OPERATION

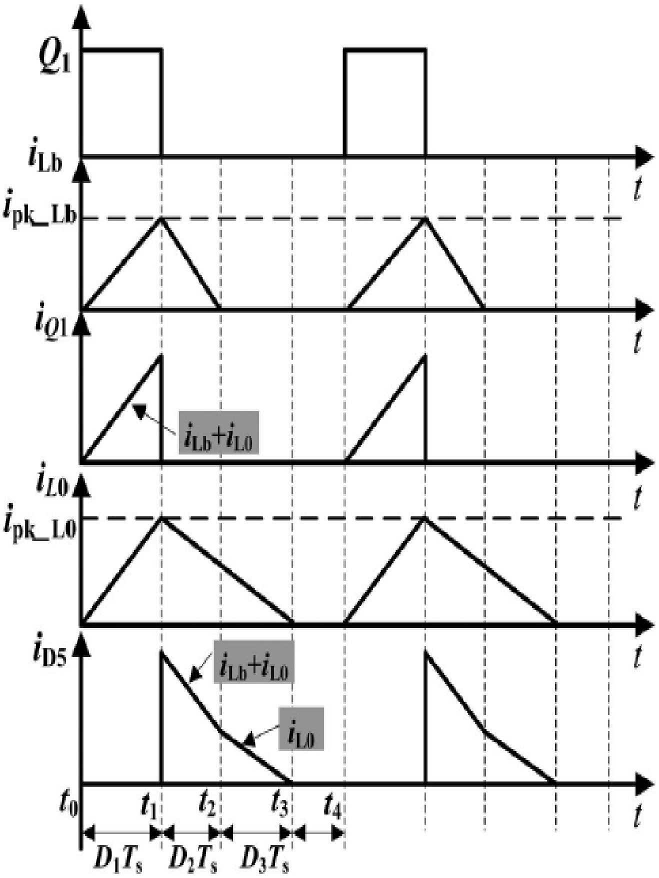

Fig 5. Modes of Operation

MODE 1

Interval [t0, t1]: Prior to this interval, the currents through *L*b and *L*0 are at zero level. When switch *Q*1 is turned ON at *t*0 , diode *D*5 is reverse biased. Diode *D*x2 of the valley-fill circuit is also reverse biased.

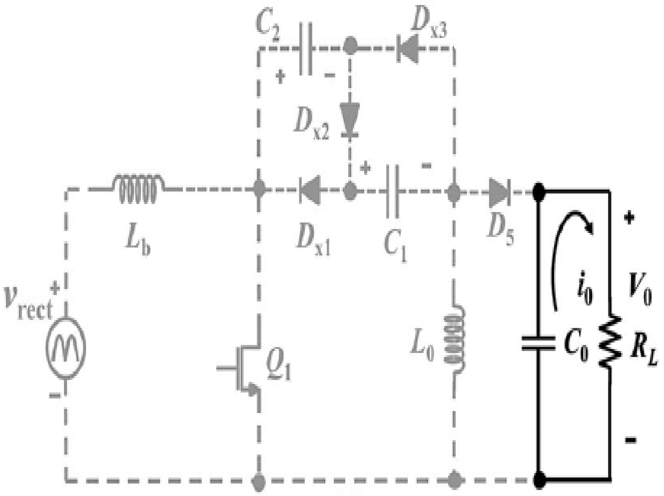

Fig 6.Mode 1

Therefore, capacitors*C*1 and *C*2 are in parallel and serve as the charging power supply of inductance *L*0. Hence, currents *i*Lb and *i*L0 begin to increase linearly.This interval ends when switch *Q*1 is turned OFF, initiating the next interval.

MODE 2

Interval [t1, t2]: When switch *Q*1 is turned OFF, diode *D*x2 of the valley-fill circuit is forward biased, and *D*x1 and *D*x3 are reverse biased. Thus, capacitors *C*1 and *C*2 are in series and absorb the discharged energy from inductor *L*b. Meanwhile, theoutput diode *D*5 becomes forward biased carrying the sum of *i*Lb and *i*L 0.

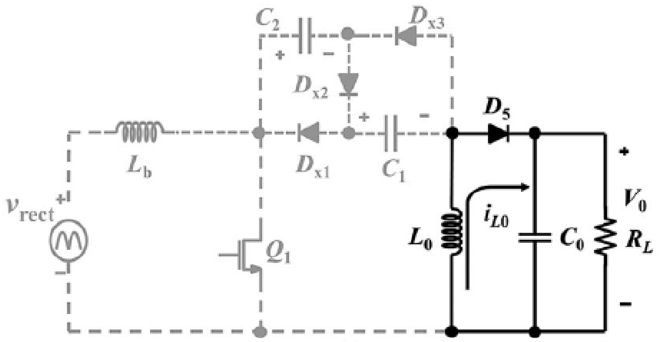

Fig 7. Mode 2

Thus, currents *i*Lb and *i*L0 decrease linearly at the rates proportional to (2*V*C1+*V*0−*v*rect) and *V*0, respectively. This interval does not end until current *i*Lb reaches zero.

MODE 3

Interval [t2, t3]: In this interval, current *i*L0 continues to decrease through the freewheeling diode *D*5. This interval ends when the current of *D*5 reaches zero.

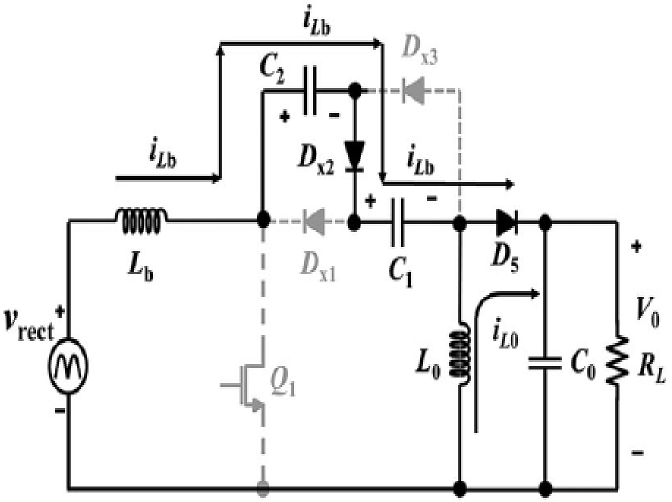

Fig 8. Mode 3

MODE 4

Interval [t3, t4]: This interval is a resting stage, where all switches and diodes are OFF and all branch currents are zero. The converter stays in this state until switch *Q*1 is turned ONagain.

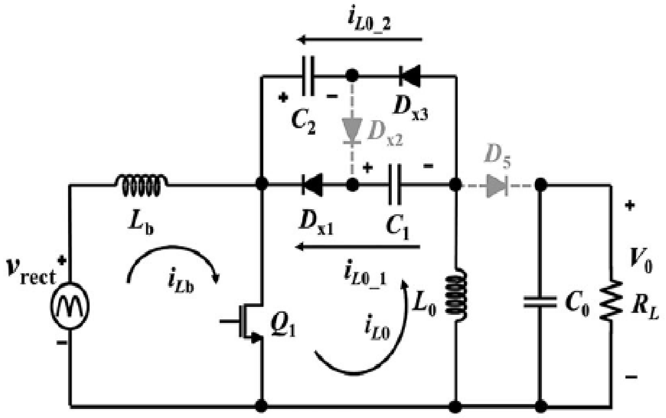

Fig 9.Mode 4

=26.8

Lb=350µH

L0=218.75µH

SIMULATION OF CONVENTIONAL CIRCUIT

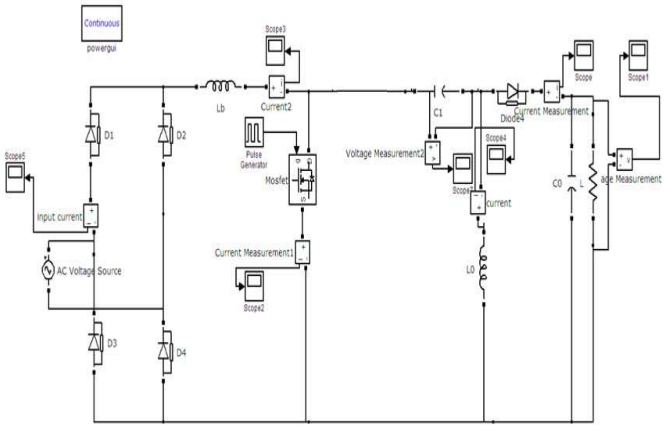

Fig 10. Simulation of Conventional circuit

SIMULATION OF PROPOSED CIRCUIT

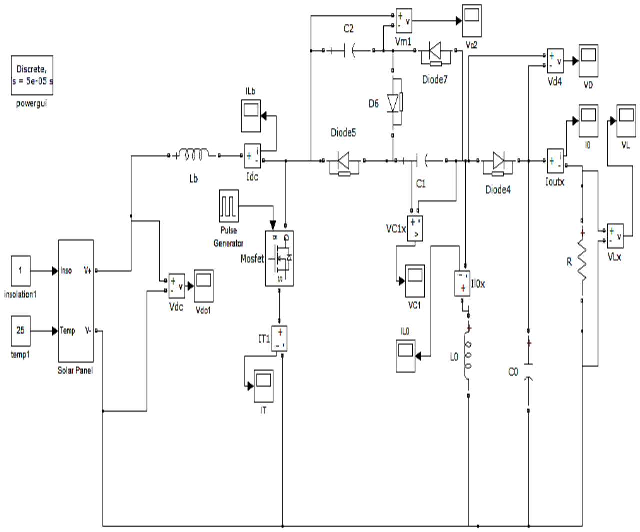

Fig 11.Simulation of proposed circuit

CONVENTIONAL OUTPUT VOLTAGE

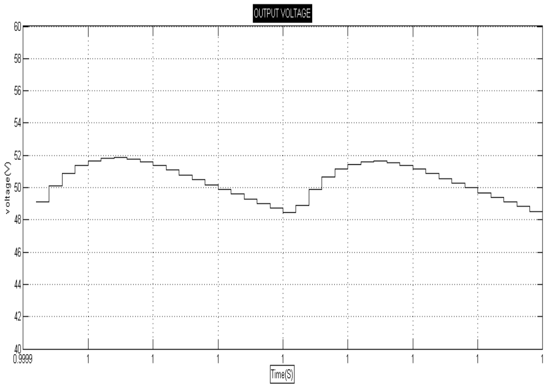

Fig 12. Conventional output Voltage

PROPOSED OUTPUT VOLTAGE

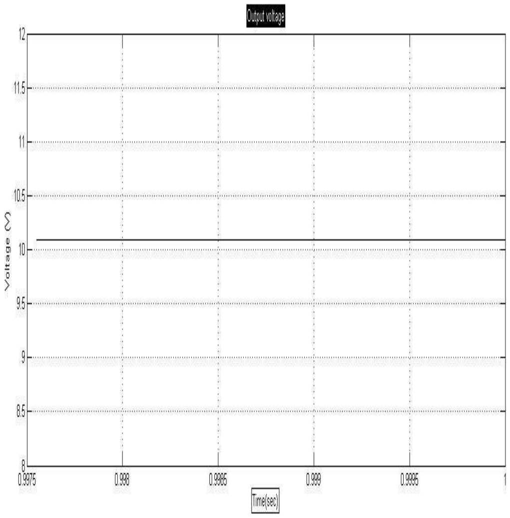

Fig 13. Proposed Output voltage

PROPOSED OUTPUT CURRENT

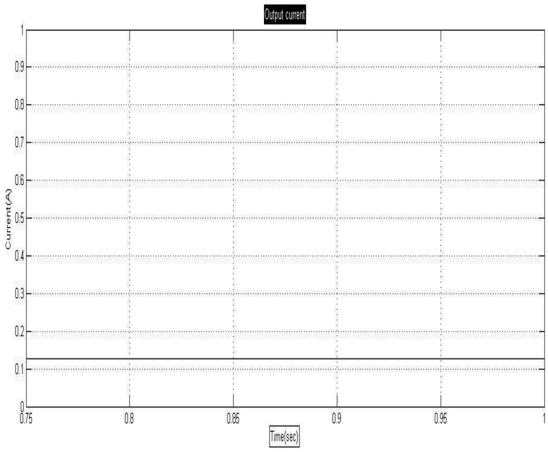

Fig 14. Proposed Output current

COMPARISON TABLE

	Conventional	**Proposed**
% of Voltage Ripple	**6.68%**	**0.000124%**
% of CurrentRipple	**6.31%**	**0.0012%**

Fig 15. Table of Comparison

IV.CONCLUSION

This paper has presented a battery for supplying high-power to electric vehicles based upon a SEPIC converter. It can be concluded that the SEPIC converter is a very interesting option for high power and low power applications due to its inherent output Low ripple current source. Low ripple in the output voltage and current. In summary, it can be concluded that this paper has presented a complete analysis of the proposal, low reverse recovery loss, for a high-power electric vehicles, with its most important parts being described in detail. The electrolytic capacitor's poor performance due to injection third harmonics in the circuit. Valley-fill circuit will provide best replacement for the huge electrolytic capacitor the boost and buck operation of the SEPIC Converter will improve the performance of the vehicle based on photo voltaic panel.

IV.REFERENCES

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