Performance Analysis of Dc-Dc Converters and Comparative Study of Buck -Boost with SLLB Converter by Using SPV Based INC MPPT Technique

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Abstract - *This paper present the design and analysis of dc-dc converters for PV applications. In the recent years lack of conventional energy sources (fossils.) Alike coal, petrol's, diesel and so on, demand of electricity is rising time by time. To achieve the demand of electrical energy alternate methods are important the researchers stand motivating in solar energy generation, dc-dc converters, .In this paper Performance analysis of dc/dc converters and comparative study of buck -boost with super lift luo converter by using SPV based INC MPPT technique is focused. All converters will works in Continuous conduction mode, To get maximum output power INC MPPT algorithm is also employed. The performance analysis of converters (Buck, Boost, Buck Boost, CUK and SEPIC) and comparison of the SPV fed Buck Boost with Super Lift Luo Boost Converter (SLLBC) simulation results discussed using MATLAB/SIMULINK 2014b.*

Key Words: SPV Array, INC MPPT, Buck-Boost Converter, Super lift luo Boost Converter

1. INTRODUCTION

In dc-dc conversion it is used in dc-dc converters for switch mode controllers to change over a dc voltage, typically unregulated, to controlled dc output voltage. The direction is commonly accomplished by PWM by a switching frequency and the switch over the driver is generally BJT, MOSFET, or IGBT. The power controller can be inductor based, switch-mode power converter switch capacitor charge a through linear controller. Every controller has its own merits and drawbacks, Depend upon the specific applications, requirements, which kind of power controller [1] is most suitable. The conversion of power from one form to another is essential and the switching frequency of the power devices permit these transformations. The power conversions is Done with static power switched converters [2]. A converter might stand considered as a switching conditions. As the power semiconductor industry progressed over the years , each converter is designing such that have higher efficiency ,ripple free operation ,boosted voltage, good v-I characteristics. Smooth operation in conversion. But conventional converters are have some disadvantage like

ripple content to solve this issue proposed the SLLBC converter.

A continually increasing energy demand now concentrating in the solar Pv for different application like solar air conditioning, solar refrigeration, electrical vehicles , industrial, commercial application, SPV converts light energy to electrical energy (dc power) to get [3] maximum power MPPT technique is used in this proposed paper INC MPPT method is preferred because it having many advantages as compared to P&O method, An classic SPV converting only 25 - 30 % of the occurrence solar PV radiations in to electrical energy. MPPT Method be there used to boosting the SPV modules effectiveness. From Power Transfer theorem , the power output of a circuits is maximum while the source impedances of the circuits matched with the load impedances. The maximum power point reduces to an impedance matching problem. Boosting convertor is coupled to solar PV panel to obtain the solar MPP output voltages so that it can be used for different dc motor drive applications. Through varying the duty cycle of the dc-dc converter to matches the source impedances with that of the load impedances. The block diagram of the proposed converter is as shown in the section 2, dc-dc converters in section in section 3, Performance analysis of dc-dc converters in section 4. comparison of the converter In section 6 and 7 the proposed paper simulations, 6[c] ,7[c] and 6[d],7[d]. in section 8 simulations and results discussed, In section 8 results analyzed as ashown and Finally in section 9 Conclusion of the proposed work is stated.

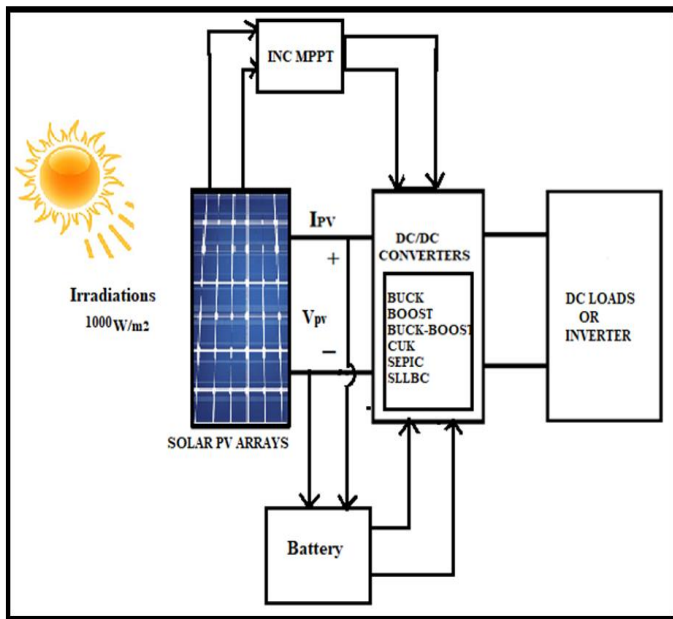## 2. PROPOSED SPV FED SLLBC DC-DC CONVERTER

Fig: 2[a] PROPOSED SPV FED SLLBC DC-DC CONVERTER

The above block diagram shows the SPV fed to Dc/Dc Converter for different dc applications, To analysis the performance of dc-dc converters(Buck, Boost, Buck Boost, CUK and SEPIC, Comparison of Buck boost converter with SLL(Super-lift-luo) dc-dc converter .In this proposed paper Using SPV Based INC MPPT Techniques used to get MPP, SLLBC converter is used to get ripple free output voltage, current and boost the dc output of the solar PV array .By vary the different irradiation of solar PV different performance is obtained in simulation for SPV Fed Buck-Boost converter and proposed SPV fed SLLBC dc-dc converters. Batteries are used for power storage as shown above fig2 [a] .The output of converter are connected to the loads

3. DC/DC CONVERTERS.

This converter are used to converts fixed dc voltage to dc variable , step up , step down the dc voltages depending of the application of the system . Each converter having advantages and drawbacks few converter performance is discussed with the help of simulation as shown below. They are

- Boost Converters
- Buck Converters
- Buck Boost Converters
- CUK Converters
- SEPIC Converters

3.1Boost Converter

In this below circuit the output voltage is greater than the input voltage it consist of one switch one diode. The output voltage is 32.9 volts when input is 20 volts applied. As shown in the simulation results below fig3.6 [b] (.Vi < Vo) Duty cycle D=0.4, frequency =25 kHz. This converter is also called as "Step up converter"
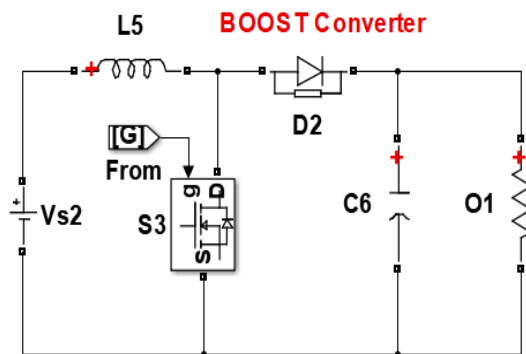

Fig: 3.1 [a] dc-dc Boosts Converter

3.2Buck Converter

In this below circuit the output voltage is lesser than the input voltage it consist of one switch, one diode. The output voltage is 8.39 volts when input is 20 volts applied. As shown in the simulation results below fig3.6 [b] (Vi>VO) Duty cycle D=0.4, frequency =25 kHz. This converter is also called as "Step down converter"
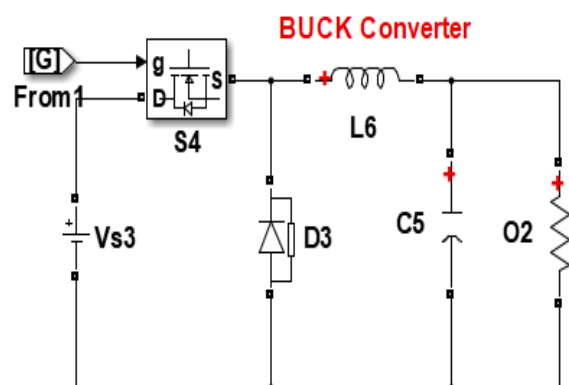

Fig: 3.2[a] dc-dc Buck Converter

3.3 Buck Boost Converter

In this below circuit the output voltage is greater than or less than the input voltage , Step up and Step down of voltage is mainly depend on the duty cycle of the converter it consist of one switch one diode. The output voltage is 12.47 volts when input is 20 volts applied. As shown in the simulation results below fig3.6 [d] Duty cycle D=0.4, frequency =25 kHz.

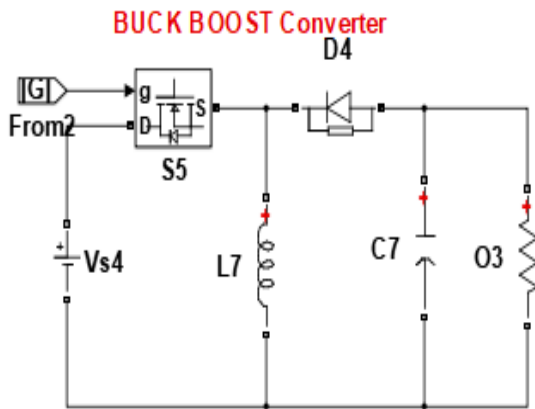This converter is also called as "Step up or Step down converter"

Fig: 3.3 [a] dc-dc Buck Boost Converter

3.4 Cuk Converter:

In this below circuit the output voltage is negative when positive voltage applied in the input side it consist of one switch, one diode. The output voltage is -15.9 volts when input is 20 volts applied. As shown in the simulation results below fig3.6 [e] Duty cycle D=0.4, frequency =25 kHz.
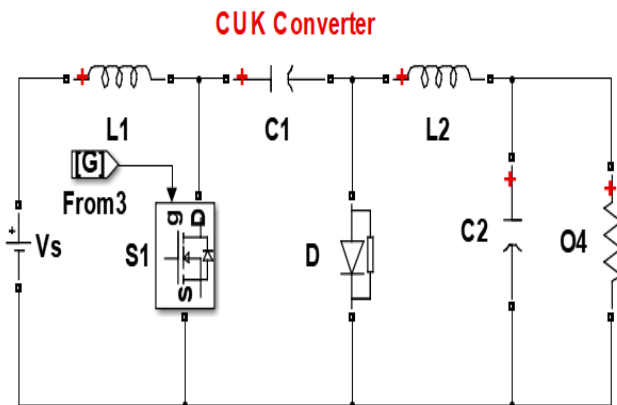
Fig: 3.4 [a] dc-dc Cuk converter

3.5 SEPIC Converter (single ended primary inductor converter):

In this below circuit the output voltage is positive but less voltage than the input voltage it consist of one switch one diode. The output voltage is 15.34 volts when input is 20 volts applied. As shown in the simulation results below fig3.6 [f] Duty cycle D=0.4, frequency =25 kHz.
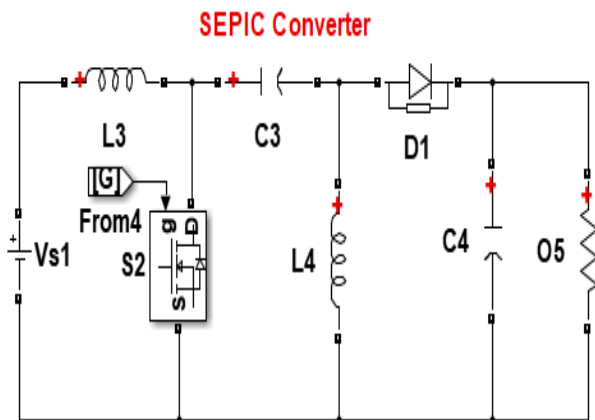
Fig: 3.5 [a] dc-dc SEPIC converter

Table -1: Design and analysis of Dc-Dc Converters

Sl.No	CONVERTERS NAME	DESIGN PARAMETERS D=40% , f= 25KHZ				
		V_{SOURCE} (volts)	$L_1=L_2=L_3$	C	R (Ohms)	V_{OUTPUT} (volts)
1	BOOST CONVERTER	20	200µH	220 µF	20	32.39
2	BUCK CONVERTER	20	200µH	220 µF	20	8.367
3	BUCK BOOST CONVERTER	20	200µH	220 µF	20	-12.47
4	CUK CONVERTER	20	200µH	220 µF	20	-15.31
5	SEPIC CONVERTER	20	200µH	220 µF	20	15.34

3.6 Performance analysis of converters output voltages with source voltage
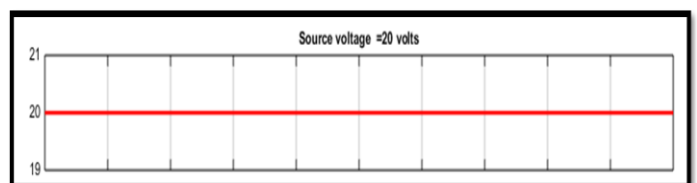

Fig: 3.6[a]Source voltage to dc-dc converter=20v
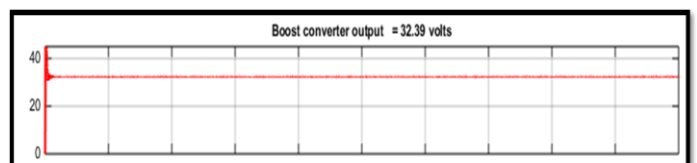

Fig: 3.6[b] output voltage of the Boost converter=32.v
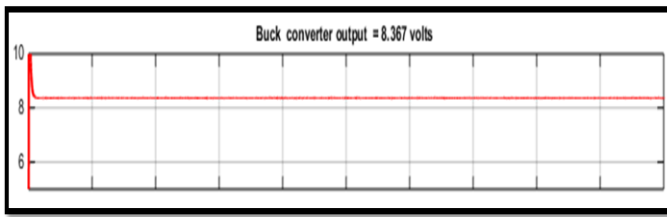
Fig: 3.6[c]output voltage of the Buck converter= 8.3v
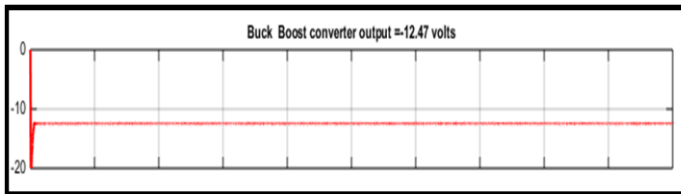
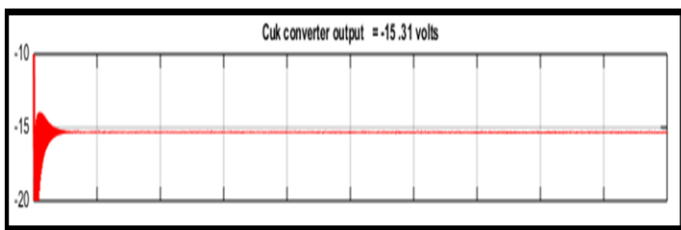**Fig:** 3.6[d]output voltage of the Buck-Boost converter=12.47v

Fig: 3.6[e] -ve output voltage of the Cuk Converter = -15.3v
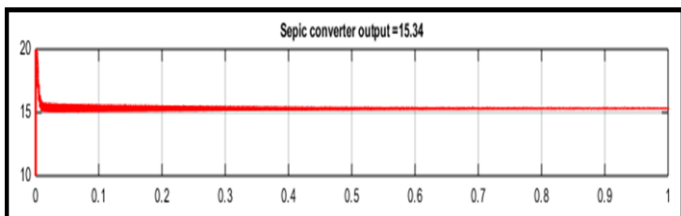
Fig: 3.6[f]Output voltage of the Cuk Converter Converter=15.3v

Performance analysis of above Converters by above Parameters with Frequency =25 kHz, Duty Ratio =0.4and source voltage =20 volts AND THE design values are tabulated in the Table.1

4. PROPOSED SLLBC CONVERTER DESIGN:

In SLLBC (Super lift-luo Boost converter) boost up the voltage gain stage-stage in geometrical evolution. This the voltage translation from source side -load side is positive -positive voltage and thus generous amplified output voltage obtained. The simulation has been achieved on the positive Output SLLBC for SPV scheme using parameters Listed in Table 2
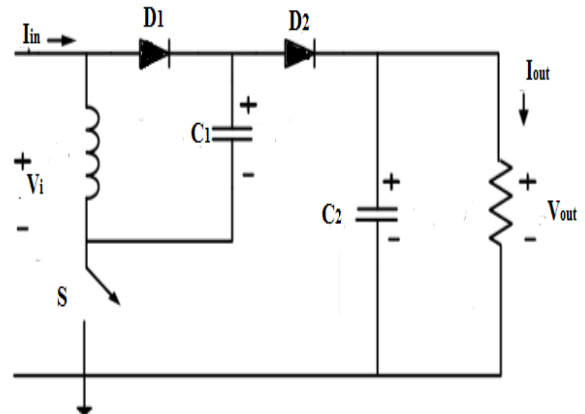
Fig: 4[a] Equivalent Circuit Super-Lift Luo Boost Converter

$$\Delta I = \frac{Vin \cdot D \cdot T}{L} = (Vin - 2Vo)\frac{(1-D)}{L}T \quad [1]$$

$$\frac{Vo}{Vin} = \frac{2-D}{1-D}\dots \quad [2]$$

$$T = \frac{L \cdot \Delta I}{Vin} - \frac{L \cdot \Delta I}{Vo - 2Vin} \quad [3]$$

$$L = \frac{Vin \cdot D}{f \cdot R \cdot \Delta Vc} \quad [4]$$

$$\Delta Vc = \int_{DT}^{t} Io\ dt\dots \quad [5]$$

$$C = \frac{V(1-D)}{f \cdot R \cdot \Delta Vc} \quad [6]$$

From the above equations Super Lift Luo Boost converter can design and for the proposed model select the parameter as shown in table.2

Table -2: Parameters to Design Elementary SLLB Converter

Parameters	Name symbols	Value
Input voltage	V_I	50 volts
Output voltage	V_O	300volts
Inductors	L_1	16.66μH
Capacitors	C_1	5mf
Capacitor	C_2	100mf
Switching frequency	fs	50kHz
Load resistance	R	100ohms

5. INC MPPT METHOD:

 INC method is preferred and used in this Proposed project For all environmental conditions to get the MPP In this proposed technique used to derivative of the current with respect to the voltage to reach the MPP. This maximum power should be equivalent. The difference in the voltage

towards biggest or smallest value it also be precious the power value. If power increase then should continue in the same way. If power decrease then should be reverse way.
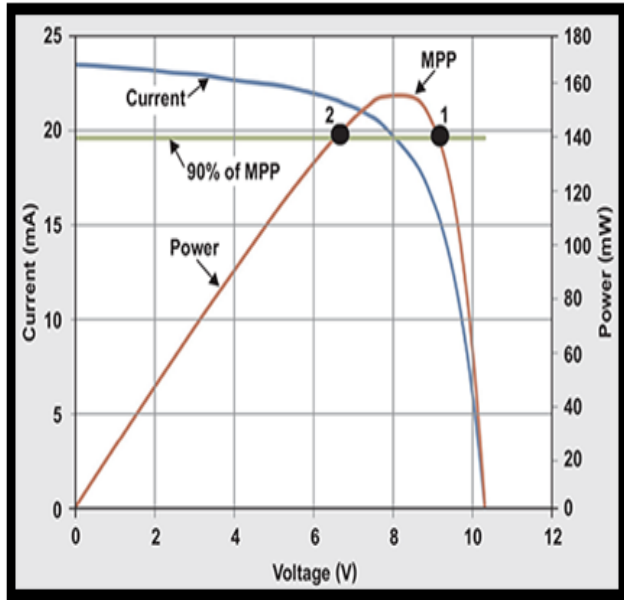

Fig: 5[a] I -V & P-V Characteristic of SPV module At 25^0C

Maximum power point is obtained when $\frac{dp}{dv} = 0$

$$\frac{d(v*i)}{dv} = i + v * \frac{di}{dt} = 0 \qquad \text{(a)}$$

Elementary equations of MPPT technique be present as follow.

$$\frac{di}{dv} = -i * V \qquad \text{(A MPP)} \qquad [7]$$
$$\frac{di}{dv} > -i * V \qquad \text{(Left Of MPP)} \qquad [8]$$
$$\frac{di}{dv} < -i * V \qquad \text{(Right of MPP)} \qquad [9]$$

From the above equation [7]-[9] MPP is obtained under different irradiation conditions and MPPT controller adjusting duty cycle such a manner to get maximum power at all time. The main advantage of this algorithm is [INC MPPT] it is suitable in all environment conditions.

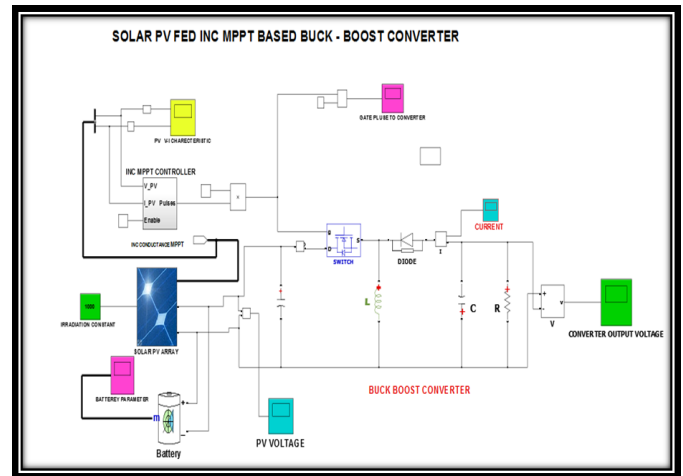## 6. SPV FED INC MPPT BASED BUCK BOOST CONVERTER FOR DC APPLICATIONS

Fig: 6.5[b] Simulation model of SPV fed INC MPPT based Buck Boost converter for dc applications
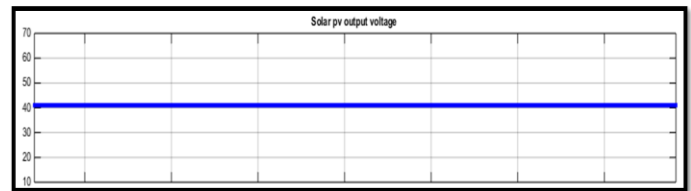
6[a].Simulation Results of SPV Fed BB Converter

Fig: 6[b] SPV output voltage= 40v to converter
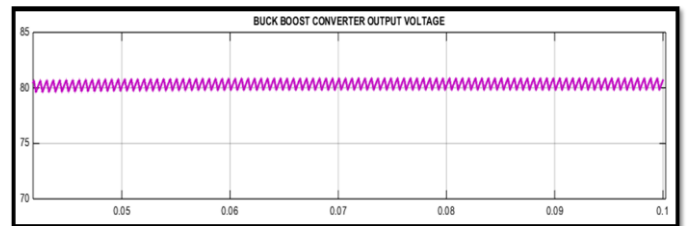

Fig: 6 [c] Buck Boost converter output voltage = 80 volts with voltage ripple
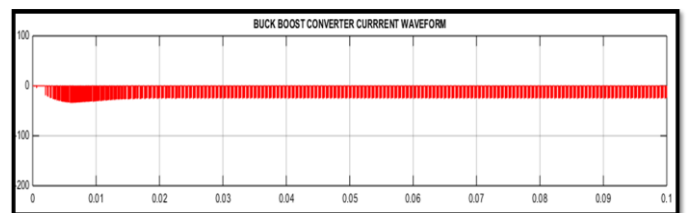

Fig: 6[d] Buck Boost converter current with ripple =12amps

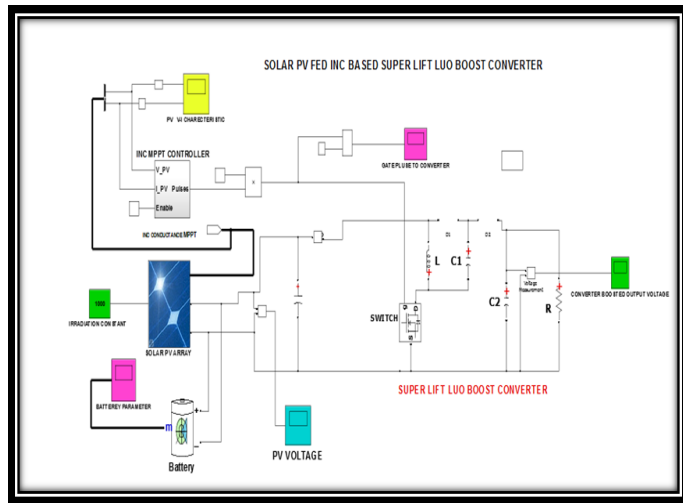## 7. SPV FED INC MPPT BASED SLLB CONVERTER FOR DC APPLICATIONS

Fig: 6.7 [b] Simulation model of SPV fed INC MPPT based SLLB converter for dc applications

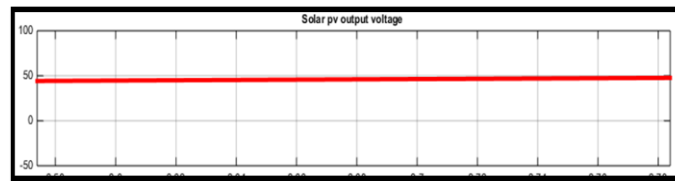## 7[a].Simulation Results of SPV fed SLLB converter

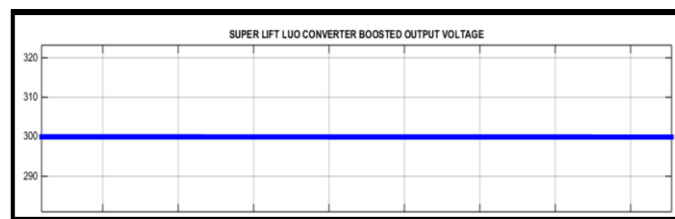**Fig:** 7[b]input to the SLLB converter =50v

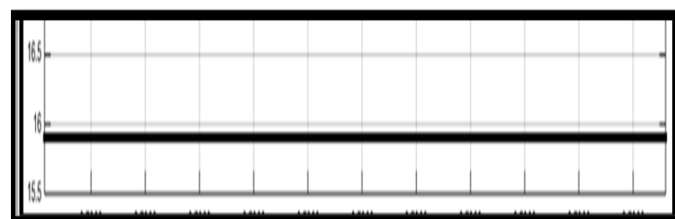**Fig:** 7[c] SLLB converter Boosted output voltage = 300 volts without ripple

Fig: 7[d] SLLBC Output current Ripple free = 16amps

8. SIMULATION RESULTS DISCUSSIONS

Design and Performance analysis of above Buck, Boost, Buck Boost, CUK and SEPIC converters discussed in section [3.1]-[3.5] and design parameters are tabulated in Table.1. The Frequency =25 kHz, Duty Ratio =0.4 are selected considered as common , all the convertes are working in continuous conduction mode (Inductor current never goes to zero) for source voltage =20volts.

In section [6[and [7] compared the performance of SPV fed Buck Boost converter with SPV fed Super lift luo converters and simulations results analyzed as ashown in 6[c] ,7[c] and 6[d],7[d]. From this conclude that proposed converter is suitable, good performance, and efficient method in the dc-dc conversion.

9. CONCLUSIONS

In this Proposed paper dc-dc converters are designed and simulated using MATLAB/Simulink, Performance of the Buck, Boost, Buck Boost, CUK and SEPIC converters are discussed and compared the Performance with each converter topology. From that conclude that dc-dc converters having its own advantages and disadvantages but all the above converter having ripple in the output voltage and current.In this paper SPV fed INC MPPT SSBLC converter is preferred as compared to the Buck-Boost converter ripple in output voltage and current is less and this converters are designed and simulated . The voltage gain of SLLBC converter obtained more, Efficient, and it is proved with the help of simulations .This type of the converter can used in the dc applications.

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