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# IMPROVEMENT OF DC OUTPUT VOLTAGE IN ELECTRIC VEHICLES BY USING ULTRA-LIFT LUO CONVERTER

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**ABSTRACT:**

*This paper proposed that by using the Ultra-lift luo converter.we can reduce the voltage ripple and get better DC output. We know that the output provided by the conventional converter which contains high voltage ripples and does not have constant voltage. So to reduce high voltage ripple we are using ultra-lift luo converter. For Electric Vehicle application the existing buck converter contains more ripples in the output voltage and parasitic effects and also does not meet the load requirements. As we seen in the voltage lift techinque the voltage transfer gain is increased in arithematic progression and in the super lift technique with four stage series gives the increases in voltage transfer gain in geometric progression but the proposed novel technique in this paper ultra-lift luo converter with single stage gives the increase in voltage transfer gain same as that of four series super lift technique. This ultra-lift luo converter gives better output as it also gives low voltage ripples, hgh efficiency than the super lift technique and voltage lift technique. The closed loop control of PI and PWM control capable of providing good static and dynamic performance characteristic in order to reduce the ripple in this ultra-lift luo converter and it can be used for electric motor drive from the MATLAB/SIMULINK output. So we are going to observe the output by using MATLAB/SIMULINK.*

## 1. INTRODUCTION

The higher growth rate in the DC-DC converter market is undergoing dramatic changes as a result of two major trends in the electronic industry. Low voltage and high power density, the production of DC-DC converter in the world market is much higher than that of AC-DC converter. The DC-DC conversion technique was established in 1920's.

The DC-DC conversion technique is developed very quickly. To meet the AC-DC power supply market, which will have a certain growth of only about 7.5% during the same period. The voltage lift technique has been widely applied in the electronic circuit design.

Using the voltage lift technique to obtain the converter's voltage transfer gain stage by stage in arithmetical series, which is higher than the buck converter, boost converter. The double output from the voltage lifts technique by using transformer less DC-DC converter.

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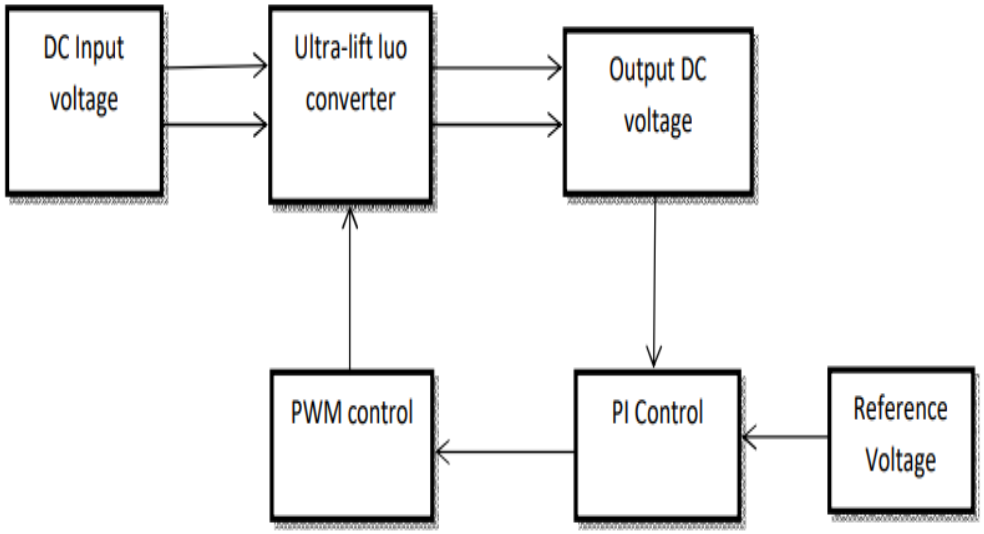
The DC-DC converter are widely used in computer hardware and industrial application such as computer periphery power supplies, car auxiliary power supplies, servo motor drives, medical application, cellular phones and laptop.The classical topologies, SEPIC and CUK converter have many industrial application like the CUK converter for electric vehicle which is combination of buck and boost converter, on the low voltage side DC supply electric vehicle together with the battery and also the development of luo converter for EV application to reduce the output ripples using additional filter elements with the converter.

## 2. BLOCK DIAGRAM




The DC input voltage is the power system voltage that uses only one polarity of voltage or current and have the constant, zero frequency which is applied to the Ultra-lift luo converter. Ultra-left luo converter is a type of converter which boost up the voltage level by reducing the ripple content from the DC voltage.

The output obtained is then given to the PI control. The main function of the controller is as a regulator of electrical energy from batteries and inverters that will be distributed to electric motors. Which the controller itself gets the main input from the car pedal (which is set by driver) this pedal setting will determine the frequency variation or voltage variation that will enter the motor and the same time determine the car speed Pulse width modulation is a powerful technique for controlling with a analog circuits with a microcontroller's digital output's.

## 3.ULTRA-LIFT LUO CONVERTER

Luo converters are the first generation of dc-dc converters. They have advantages such as high VTG and low ripple components both in current and voltage waveforms. Super-lift converters can be easily cascaded to gain even higher VTG, which increases in the power rate. Currently, the research work of Luo converters is limited

to their basic operations. For example, the authors have analyzed the filling efficiency of Luo converters. However the analysis given in these references is not of high accuracy. Further study is thus needed for industry applications.

The core ideas of lifting voltage in series Luo converters are VL technique and SL technique. Among them, VLC is the main approach. Basic VLC includes a passive switch realized with a diode and a capacitor. For example, if a VLC including a diode and a capacitor is added to the POEL converter, the POSLL converter can be obtained. The VLC increases its VTG from $dV_{in}/(\tilde{1}d)$to$V_{in}/(\tilde{1}d)$. However, in the pioneer analysis of these circuits, it is assumed that the capacitance is sufficiently large and the voltage variation of VLC capacitor can be ignored. Considering the capacitance in the analysis, it can be found that the VLC has various influences on the converter performance. It makes the VTG a function of the load resistance and the switching frequency. The boundary between CCM and DCM is also influenced by the VLC parameters. The circuit performance in DCM have been analyzed here in a different way from, more accurate prediction can be obtained using the proposed approach.

## 4. LITERATURE SURVEY

| SL .NO | PAPER TITLE | VOLUME | DESCRIPTION |
|---|---|---|---|
| 01) | ELECTRIC Vehical by Manikandan N.vadivel | IJETT-Volume 4, issue 10-oct 2013 | In this paper we have discussed design and about implementation of luo converter for electric vehicle application |
| 02) | Nammalvar and Annapurna International Journal of engineering science and technology | Volume 4, issue-4, 2012 | In this paper we have discussed about Three Phase High power quality two stage Boost rectifier |
| 03) | Nammmalvar and Balaji international Journal of advanced research in electrical and electronics instrumentation engineering | Volume 4, issue 3 Pg-1821-1830 2015 | In this it is discussed about high performance soft switched DC-DC Boost converter suitable for PV application |

| | | | |
|---|---|---|---|
| **04)** | **Mia zhu, Fang lin luo IEEE transaction on power electronics** | **Volume-25, No-9, sep 2010** | **In this paper we have discussed about enhanced self lift cuk converter for negative to positive voltage converssion** |
| **05)** | **Sarul selvi, J, uma International Journal of electronics,Taylor and Francis** | **Volume 9 2007, no 1-2 2007, p.55-73** | **In this paper we have discussed about Deign and implementation of CF-ZVS-QRC using analog resonant controller UC38160** |

## 5.SIMULATION MODEL

A proportional integral-derivative is control loop feedback mechanism used in industrial control system. In industrial process a PI controller attempts to correct the error between a measured process variable and desired set point by calculating and then giving corrective action that can adjust the process accordingly. The PI controller calculation involves two separate modes the proportional mode and integral mode. The proportional mode determine the reaction to the current error, integral mode determines the reaction based recent error. The weighted sum of the two modes output as corrective action to the control element. PI controller is widely used in industry due to its ease in design and simple structure. PI controller algorithm can be implemented as

$$output(t) = K_p e(t) + K_I \int_0^t e(\tau) d\tau$$

Where e(t) = set reference value – actual calculated

The drive consists of speed controller, reference current generator, PWM current controller, position Sensor, the motor and MOSFETs based current controlled voltage source inverter (CC-VSI). The speed of the motor is compared with its reference value and the speed error is processed in proportional- integral (PI) speed controller.

$$e(t) = \omega ref - \omega m(t) \omega m(t)$$

is compared with the reference speed ωref and the resulting error is estimated at the nth sampling instant as.

$$Tref(t) = Tref(t-1) + Kp[e(t) - e(t-1)] + K1\ e(t)$$

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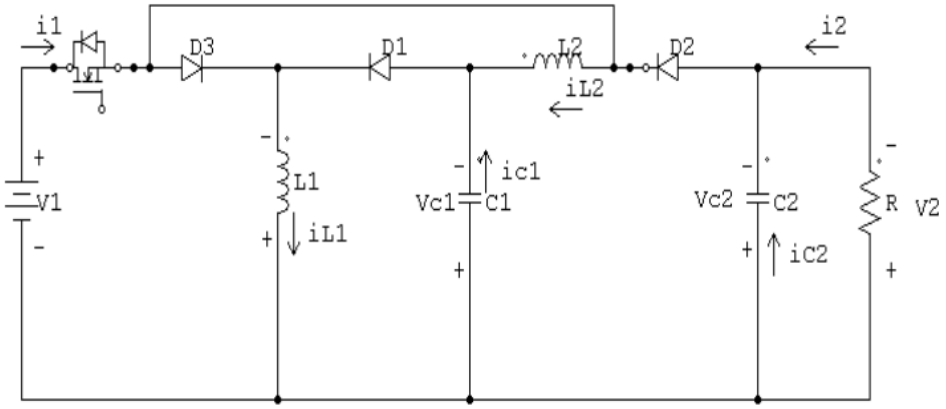


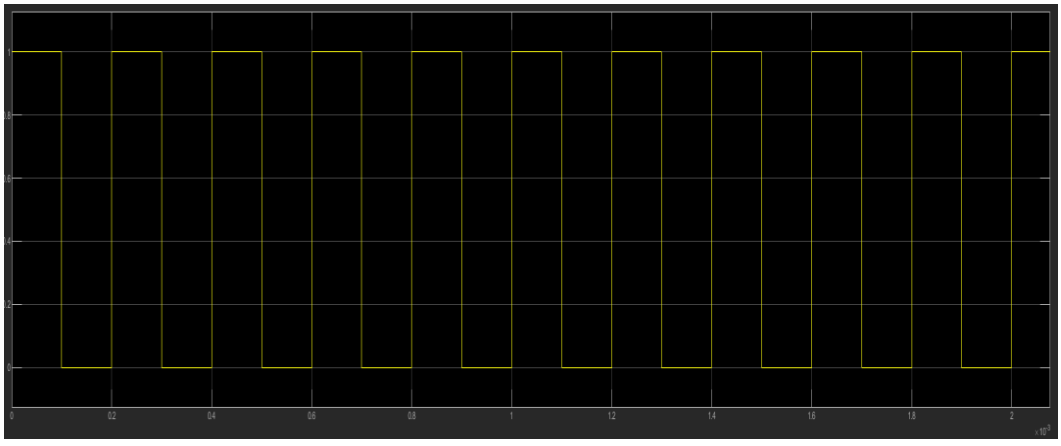

**Fig.5. Circuit Diagram OF Proposed System**

The circuit diagram of proposed system shown in Fig. 2, which consist of one switch, S, and three diodes, two inductors L1 , L2, two capacitors C1, C2, and the load R. The equivalent circuit of proposed converter when switch

ON is shown in Fig. 3,and its switch off equivalent circuit for continuous conduction mode (CCM) is shown in Fig.4, and its switch off equivalent circuit for discontinuous conduction mode (DCM) is shown in Fig.5. It is very simple structure converter compared with other converters. As before, the input voltage and current of the ultra-lift Luo converter are V1 and I1,the output voltage and current are V2 and I2, the conduction duty cycle is k and the switching frequency is f. consequently, the repeating period T=1/f, switch on period is kT and the switch off period is (1-k)T. to concentrate the load R are ideal ones. Therefore, no power losses are considered during power transformation, i.e. Pin=Po.

## 6.SIMULATION RESULTS

Fig.6.Output Voltage of Ultra-lift Luo converter in open loop Circuit



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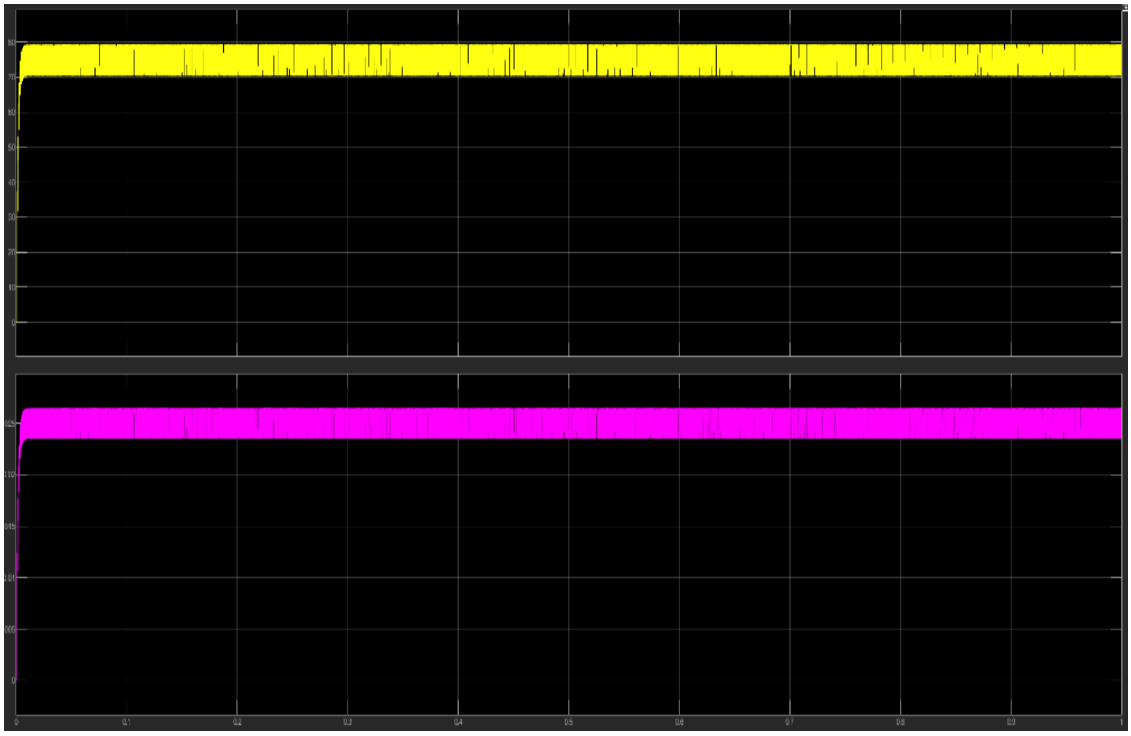

## 7.SIMULATION MODEL CLOSED LOOP

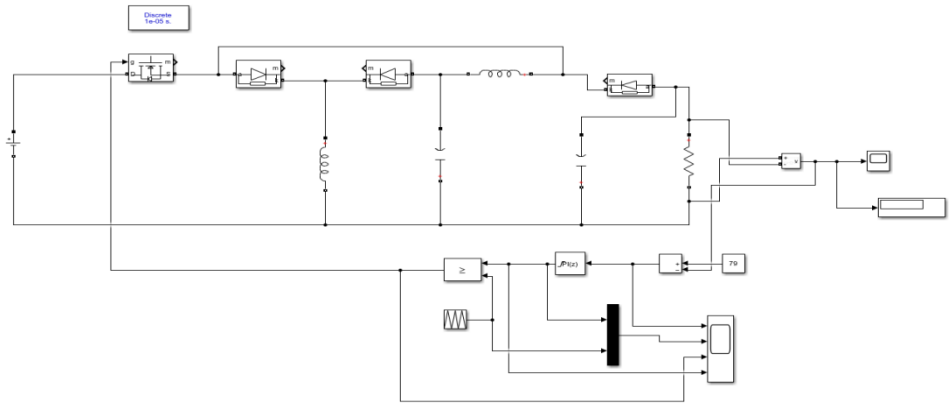

Fig.7.a.Simulation Model of PI Control of Ultra-lift Luo converter

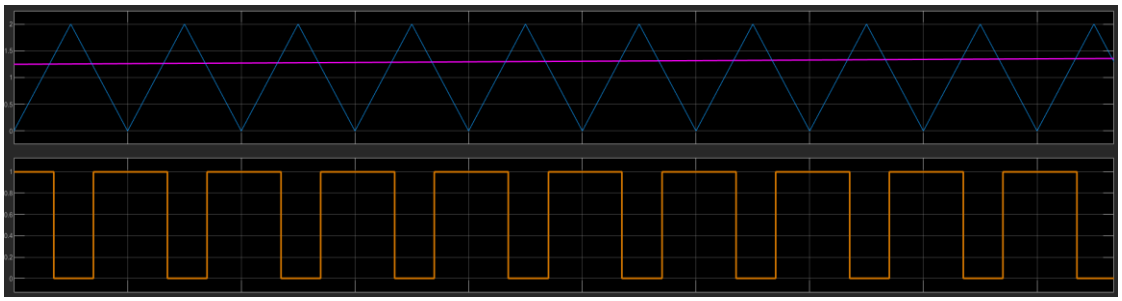

Fig.7.b.Output Voltage of Ultra-lift Luo converter in open loop Circuit

For the purpose of optimizing the stability of Ultra-lift Luo converter dynamics, while ensuring correct operation in any working condition, a PI control is a feasible approach. The PI control has been presented as a good alternative to the control of switching power converters. The advantage of PI control method is insusceptibility to system parameter variation that leads to invariant dynamics and static response in the ideal

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case. It ensure the specifying desired nominal operating point for Ultra-lift luo converter, then regulate the converter output, so that it stray very closer to the nominal operating point in the case of sudden disturbance, noise, modeling error and component variation.

Simulation has been performed on the novel approach of Ultra-lift Luo converter with parameter as in the table 2. The static and dynamic performance of PI control for the Ultra-lift Luo converter is evaluated in MATLAB/SIMULINK. The MATLAB/SIMULINK simulation model is depicted in Fig7. It can be seen that error in output voltage of power switch (n-MOSFET) of PI control input is obtained by the difference between feedback output voltage and feedback reference voltage and output voltage of PI control, change in duty cycle of power switch (n-MOSFET). The open loop and closed loop simulation model is depicted in Fig 6 and Fig 7. The output voltage and current waveform is shown in Fig.8. The ripple free output obtained from the proposed converter is shown in Fig. 9.

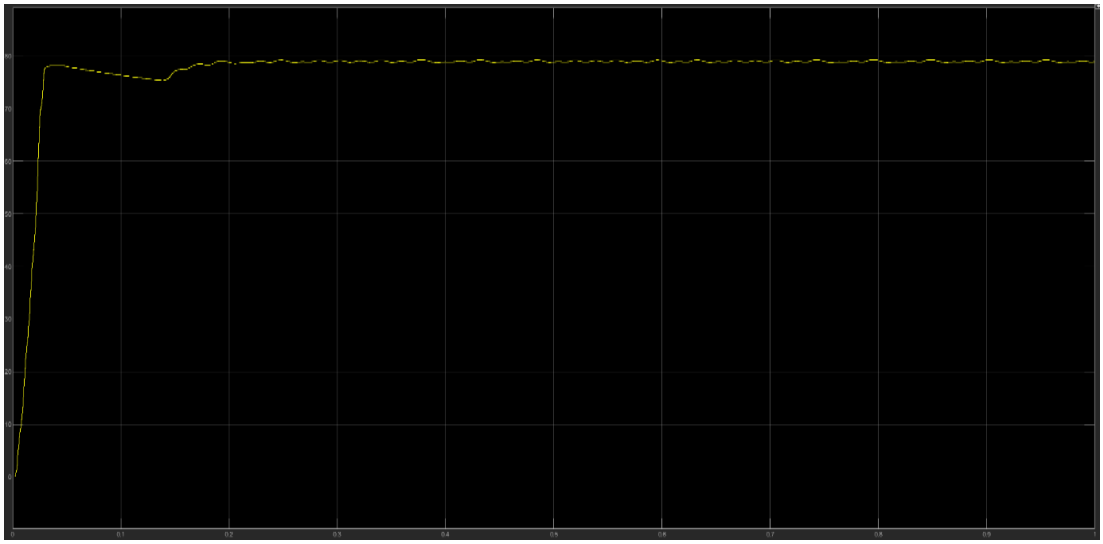

Fig 7.c .Output Voltage of Ultra-lift Luo converter in close loop circuit

## 8.STEP DOWN TRANSFORMER

When AC is applied to the primary winding of the power transformer it can either be stepped down or up depending on the value of DC needed. In our circuit the transformer of 230v/0-12v is used to perform the step down operation where a 230V AC appears as 12V AC across the secondary winding. One alteration of input causes the top of the transformer to be positive and the bottom negative. The next alteration will temporarily cause the reverse. The current rating of the transformer used in our project is 1A. Apart from stepping down AC voltages, it gives isolation between the power source and power supply circuitries.

## 9. DIODE BRIDGE RECTIFIERS

The ac input from the main supply is stepped down using a 230 /30V step down transformer. The stepped down AC voltage is converted into dc voltage using a diode bridge rectifier. The diode bridge rectifier consists of four diodes arranged in two legs. The diodes are connected to the stepped down AC voltage. For positive half cycle of the ac voltage, the diodes D1 and D4 are forward biased (ref fig). For negative half cycles

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diodes D2 and D3 are forward biased. Thus dc voltage is produced to provide input supply to the DC-DC Converter.

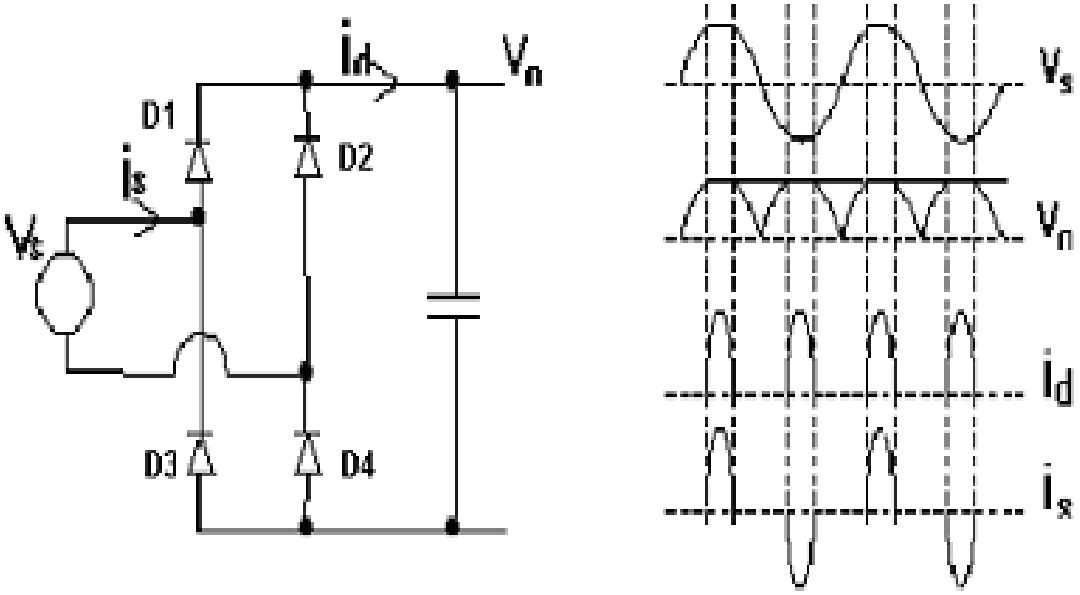


Fig.9.DIODE BRIDGE RECTIFIER

When the positive half cycle is applied to the diode bridge rectifier, the diodes D1 and D4 are forward biased. The diodes start conducting and the load current flows through the positive of the supply, diodeD1, the load, the diode D4 and the negative of the supply. The diode D2 and D3 are reverse biased and do not conduct.

During the negative half cycle, the diodes D1 and D4 are reverse biased and they stop conducting. The diodes D2 & D3 are forward biased and they start conducting. The load current flows in the same direction for both the half cycles. Thus the ac supply given to diode bridge rectifier is converted into pulsating dc.

## 10.VOLTAGE REGULATORS

The voltage regulators play an important role in any power supply unit. The primary purpose of a regulator is to aid the rectifier and filter circuit in providing a constant DC voltage to the device. Power supplies without regulators have an inherent problem of changing DC voltage values due to variations in the load or due to fluctuations in the AC liner voltage. With a regulator connected to the DC output, the voltage can be maintained within a close tolerant region of the desired output IC7805 is used in this project for providing +12v and –12v DC supply.

## 11.UITRA-LIFT LUO CONVERTER ADVANTAGES

**Advantages of Ultra-lift luo converters as follows:**

- It provides isolation in the primary and secondary circuits from each other.
- It provides a technique to extend potential (Voltage) as required.
- It is available as a hybrid circuit with all elements in a single chip.
- It simplifies the power supply systems in the circuit.
- It is also used in the regulation and control of DC voltage.
- The output is well organized as positive or negative.
- Battery space can be reduced by using a converter.

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## 12. CONCLUSION

In this we have studied about the novel approach of Ultra-lift Luo converter has been successfully developed using PI control and PWM control, which produces a high voltage transfer gain, stable and ripple free output. The output DC voltage of the Ultra-lift Luo converter is higher than that of Voltage lift technique and Super lift technique and the voltage transfer gain of Ultra-lift Luo converter is multiplied of Super-lift technique and voltage-lift technique. The Ultra-lift Luo converter has a simple construction with a single switch to produce maximum output. The switching loss comparatively lower and thus this type of converter is more suitable for Electric Vehicle and Battery Operated Vehicle. The outputs were verified using MATLAB/SIMULINK and Hardware prototype.

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