# DESIGN AND DEVELOPMENT OF POWER CONTROL FOR OPITIMSATION OF SOLAR BASED POWER CONTROL UNIT FORELETRICAL VEHICAL DRIVE UNIT

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**Abstract -** This paper described a novel idea implementation for development of power control unit including solar controller system for electric vehicle and its drive unit. The first part of the paper presents a concept of solar vehicle development. The second part of paper describes the design & implementation of solar based converter circuit. The third part of the paper presents testing, analysis and validation of the control unit.

***Key Words*:** DC motor, Solar panel, Battery, Wheels, MPPT, Controller.

## 1. INTRODUCTION

The sizable portion stored in the nature is in the form of chemical compounds (fossile etc), the atoms, and nuclear of substances (such as nuclear etc), the flow of rivers, the tides of sea (potential), the wind & heavy solar radiations. These are not in electrical form but needs to convert in the suitable electric form. In brief the, electricity neither occurs in natural form which can be further stored & utilized as per the requirement. Such form of electricity can be generated, stored and utilized for electric vehicles. The development of electric vehicles is based on the basis of major components such as electric motors, drive units etc. and for the same there is need to use S R motors or BLDC or Induction motors for power saving. Such electric motor analysis is present in thepaper [1] for novel approach of spice integration for modeling and utilization in the electric drive system. The power optimization is possible if the vehicle's dynamic system studied well and utilized. Hence the paper [2], reviews the dynamic equivalent circuit for better power optimization study. The motor component is well studied and described using software is well studied and described using software presented in research paper [3] . In the literature [4], described about the steps involved in the clean energy technology and innovation in it . In the research paper [5], A global policy network that is utilized in a forum for international leadership on renewable energy with ideas are shared and action is encouraged to promote renewable energy worldwide.

# Mathematical Model of the System

## 2. BLOCK DIAGRAM

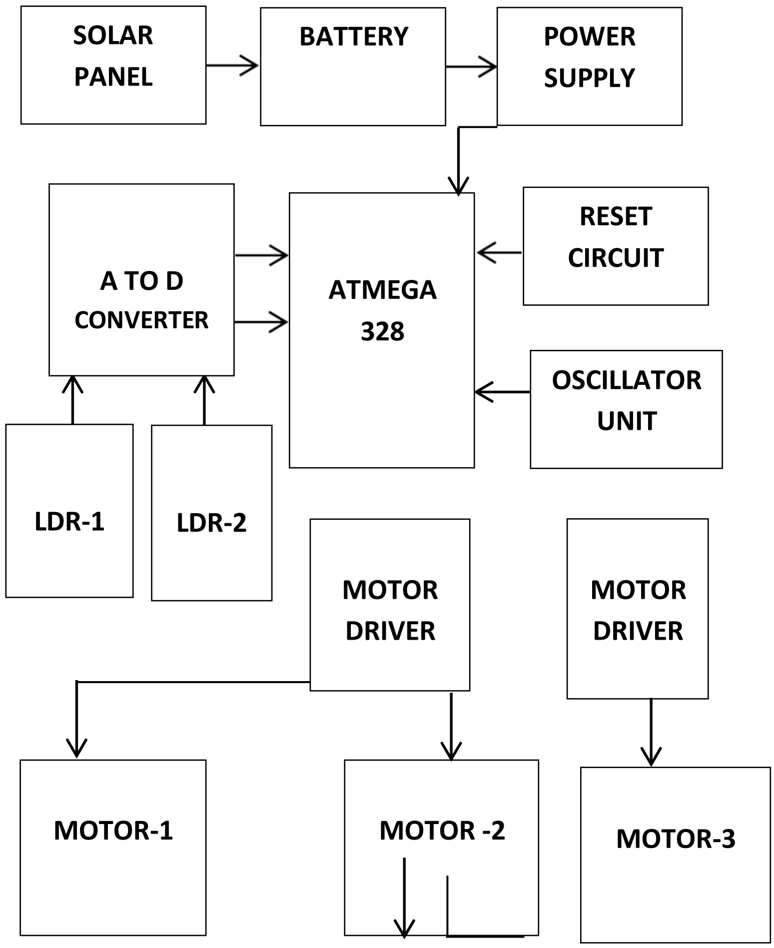


Fig.1: Block Diagram

**List of different circuit diagrams**

**1. Circuit Diagram**

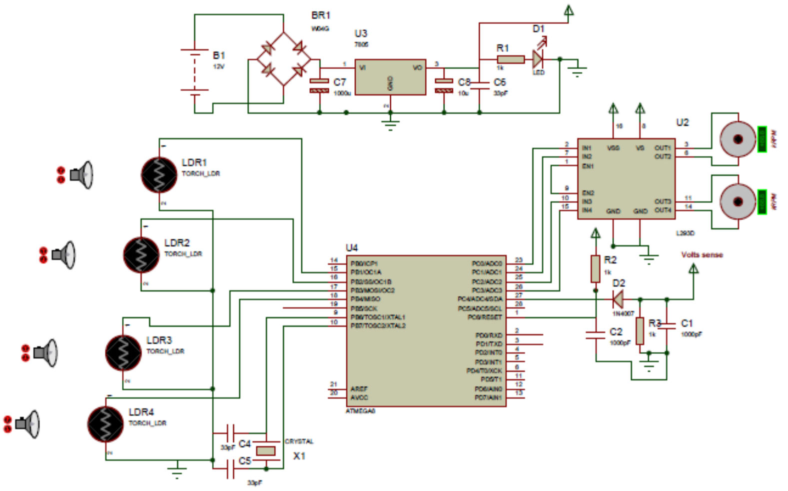


Fig.2: Circuit Diagram

Battery is connected to the bridge rectifier. Bridge rectifier is used for maintain polarity and capacitor is connected to the bridge rectifier for filter the supply. After that voltage regulator is connected to the capacitor. 1 k resistor and led for indicating thesupply. Atmega 328p is main microcontroller of the circuit. It required basic three things. Power supply, reset circuit, oscillator unit.

Light Dependent Resistors or LDRs are the resistors whose resistance values depend on intensity of the light. As the intensity of light falling on the LDR increases, resistance value decreases. In dark, LDR will have maximum resistance. LDR will output an analog value which should be converted to digital. This can be done using analog to digital converter.

ATmega328 has analog to digital converter internally. It has six ADC channels from ADC0 to ADC5 (Pins 23 – 28). The two LDRs are connected to ADC pins i.e. 27 and 28 in a voltage divider fashion with the help of individual 10KΩ Resistors. ADC conversion is done using successive approximation method.

An alternative source of energy is rapidly gaining importance as there is shortage of electrical power generated in India. At the educational level, it is therefore important for the engineering students to understand the technologies involved with the alternative source of energy. One of the most popular alternative sources is SOLAR ENERGY. This project has been designed for the electrical/electronic engineering students, to built a solar panel tracker system, or you can call sun tracking solar panel. Solar tracking enables more energy to be generated because the solar panel is able to maintain a perpendicular profile to the sun at all the time. This project module has been designed for the classroom demonstration, where a torch is used to point to the sensor to show the operation. So the student can show the working demonstration. But based on the same model, any size of tracker could be designed based on the individual requirement. There are three ways to improve the efficiency of the photovoltaic (PV)

- First is to increase the efficiency of the solar cell.
- Second is to maximize the energy conversion from the solar panel. This can be explained this way, at no load solar panel develop maximum voltage with no current, while under the short circuit condition, it supplies maximum current with no voltage. In both cases power generated is V x I which is zero. We must develop is system which can supply maximum power demand.
- Third method to increase the efficiency of a pv system is to employ a solar panel tracking system. As the sun moves across the sky during the day, it is advantageous to have the solar panel to track the location of the sun. This will tend to maximize the amount of power radiated by the sun. With the use of tracking system, we can increase the power out put by over 30% to 60%. When tracking the sun, it is noted that the direction of the sun, as seen from the solar panel will vary in two direction the azimuth angle is the horizontal direction from the observer to the sun. There is also an altitude angle, representing the vertical directing from the observer to the sun. More effective solar panel should have two axis of rotation. Here in this project we are focused on one axis solar tracking system
- This system will track the sun during day light hours
- It is done with the active control not with timed out movements.
- Every night, the tracker comes back to the start position and waits for the sunrise
- the tracker used dc motor for the movement and not the stepper motor as many people use.
- Control system is operated by ATmega8 microcontroller.

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**2. Motor driver**

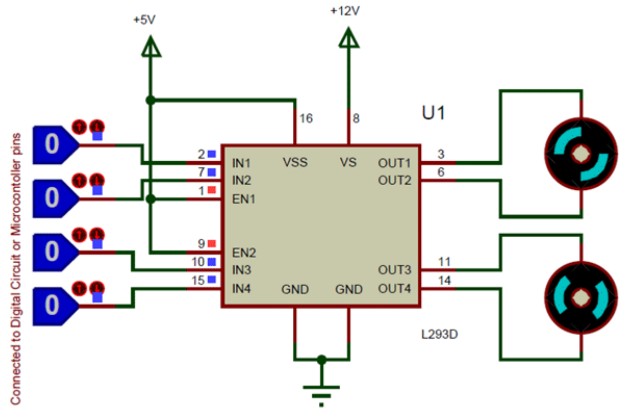



Fig.3: Motor Driver

The L293D is a popular 16-Pin Motor Driver IC. As the name suggests it is mainly used to drive motors. A single L293D IC is capable of running two DC motors at the same time; also the direction of these two motors can be controlled independently. So if you have motors which has operating voltage less than 36V and operating current less than 600mA, which are to be controlled by digital circuits like Op-Amp, 555 timers, digital gates or even Microcontrollers like Arduino, PIC, ARM etc.. this IC will be the right choice for you.

**3. H-bridge**

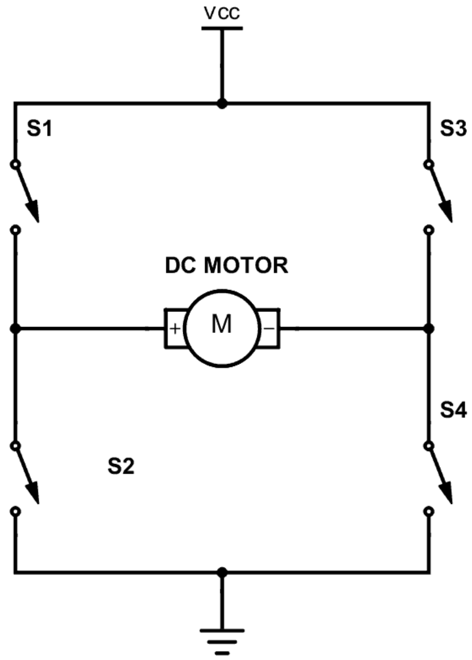



Fig.4: H-bridge

A H-bridge is fabricated with four switches like S1, S2, S3 and S4. When the S1 and S4 switches are closed, then a +ve voltage will be applied across the motor. By opening the switches S1 and S4 and closing the switches S2 and S3, this voltage is inverted, allowing invert operation of the motor.

An H bridge is an electronic circuit that allows a voltage to be applied across a load in any direction. H-bridge circuits are frequently used in robotics and many other applications to allow DC motors to run forward & backward. An H-bridge is fabricated with four switches like S1, S2, S3 and S4. When the S1 and S4 switches are closed, then a +ve voltage will be applied across the motor. By opening the switches S1 and S4 and closing the switches S2 and S3, this voltage is inverted, allowing invert operation of the motor.

**4. LDR sensor**

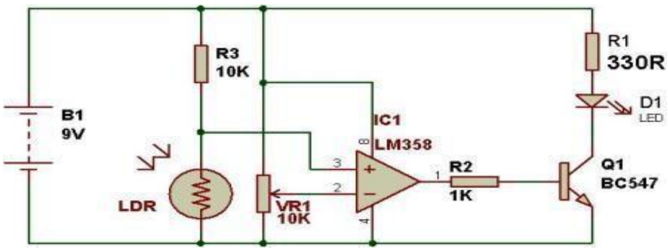



Fig.5: LDR circuit diagram

The LM358 datasheet specifies that it consists of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

This dark sensor IC LM358 circuit is used to test a light dependent resistor, a photo diode and a photo transistor. But, you need to change a photo diode and the photo transistor in place of LDR. The dark sensor circuit using LDR and LM358 IC is shown below. The required components to build the following circuit is LDR, LM358 IC, 9V battery, resistors R1-330R, R2-1K, R3-10K, variable resistor VR1-10K, transistor Q1-C547.

**5. Battery Charger Circuit**

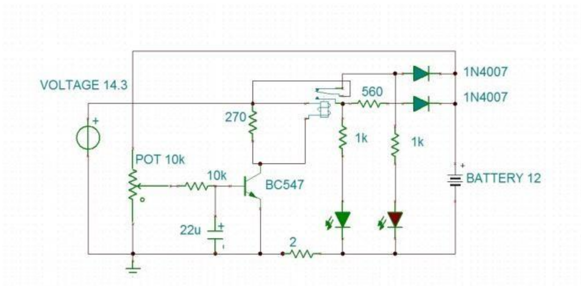
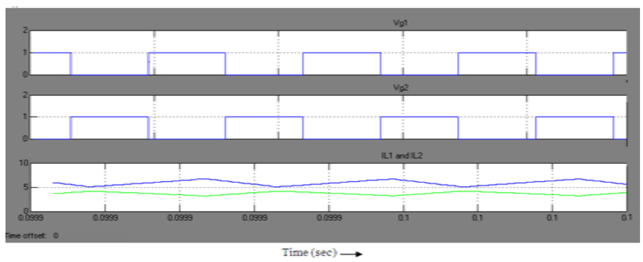



Fig.6: Battery charger

A battery charger, or recharger, is a device that stores energy in a battery by running an electric current through it. The charging protocol (how much voltage or current for how long, and what to do when charging is complete) depends on the size and type of the battery being charged.

## Resul



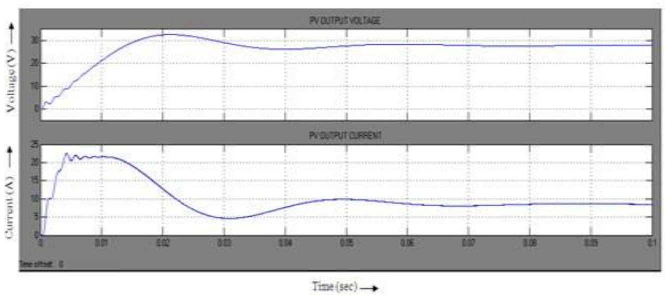




Fig.7: Waveforms of PV panel output voltage and current without MPPT.

Fig.8: Gate pulse of switches and input current of inductor without.

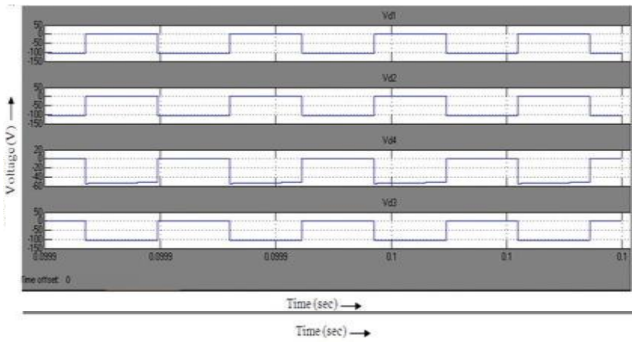



Fig.9: Voltage stress waveform of switch without MPPT.

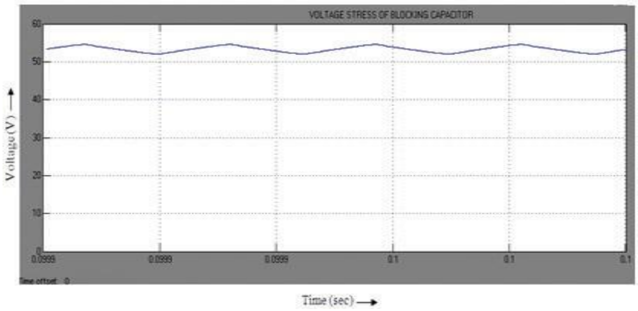



Fig.10. Diode voltage stress waveform without MPPT.

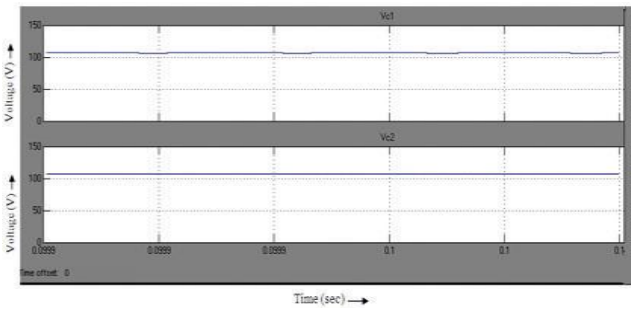



Fig.11: Blocking capacitor voltage stress waveform without MPPT

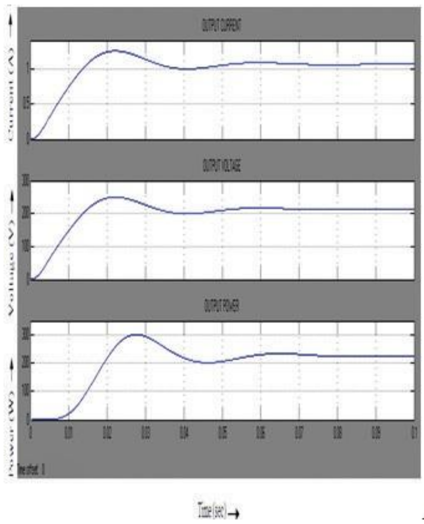


Fig.12: Waveform of output current, voltage and power of transformerless interleaved converter withoutMPPT algorithm

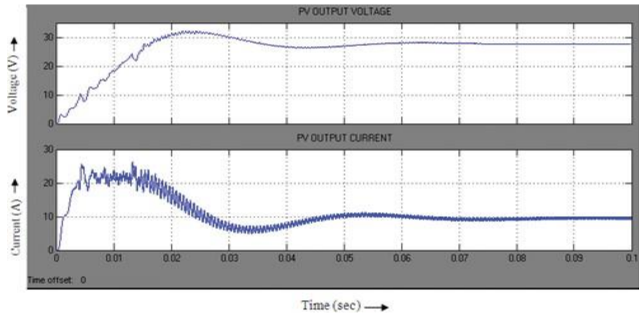



Fig.13: Waveforms of PV panel output voltage and current with MPPT

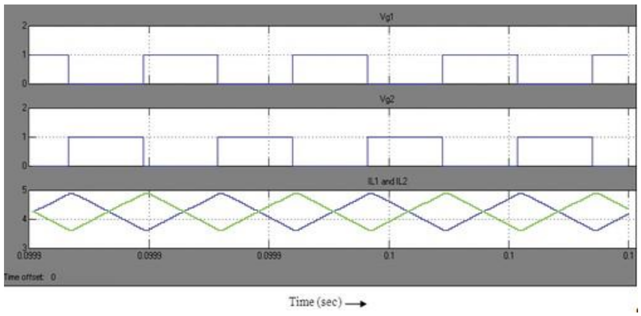



Fig.14: Gate pulse to switches and input current ofinductor with MPPT

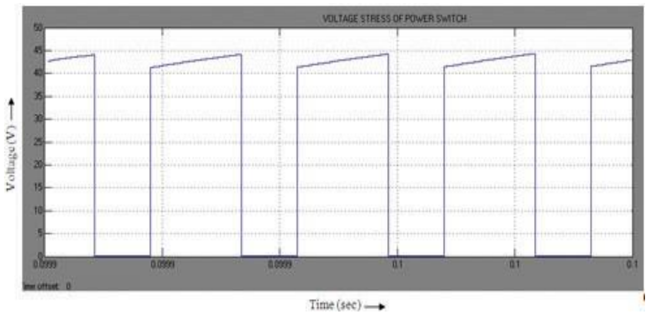



Fig.15: Voltage stress waveform of switch with MPPT.

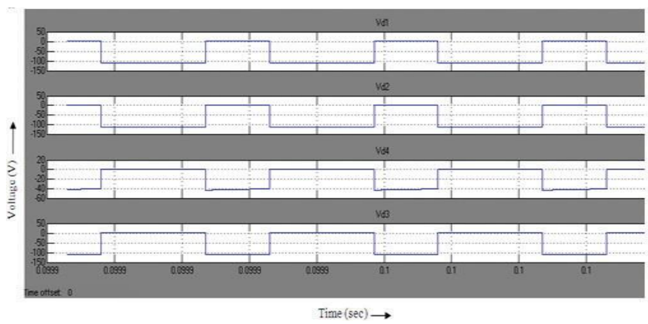



Fig.16: Diode voltage stress waveform with MPPT

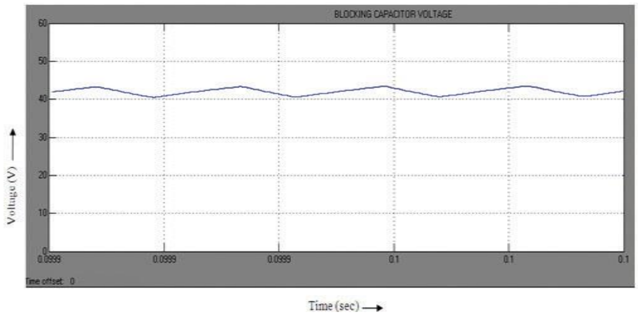



Fig.17: Blocking capacitor voltage stress waveform with MPPT.

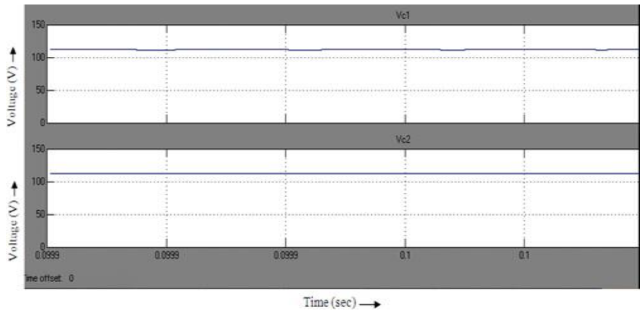



Fig.18: Output capacitor voltage stress waveform with MPPT

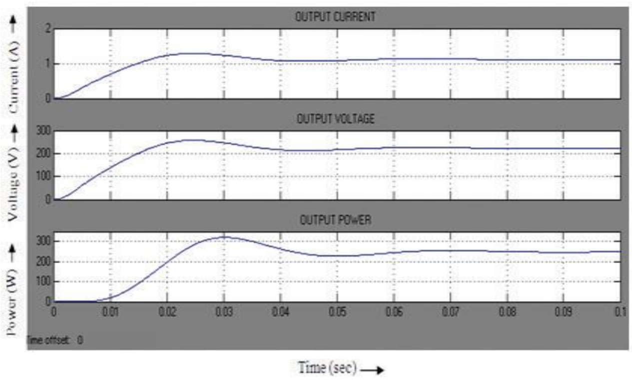



Fig.19: Waveform of output current, voltage andpower of transformerless interleaved converter withMPPT

Figure 8 shows the diode $D_1$, $D_2$, $D_3$ and $D_4$ voltage stress waveform. The voltage stress of diodes $D_1$, $D_2$ and$D_3$ is 100V and voltage stress of diode $D_4$ is 55V. Figure 9 shows the waveform of blocking capacitor voltage stress.The voltage stress of blocking capacitor is 54.5V, which is found to be one fourth of output voltage of the converter.Figure 10 shows the waveform of output capacitor voltagestress. The voltage stress $V_{c1}$ and $V_{c2}$ of the output capacitor is 106V and found to be half of the output voltage of theconverter. The input voltage 27V is step up to 213V usingconverter with the voltage gain of 8 and duty ratio 0.5. The output current and power of converter supplied to the load is 1.065A and 226.6W respectively. Figure 11 shows the waveform of output current, voltage and powerof supplied to the load.

Figure 16 shows the diode $D_1$, $D_2$, $D_3$ and $D_4$ voltage stress waveform with MPPT. The voltage stress of diodes$D_1$, $D_2$ and $D_3$ is 100V and voltage stress of diode $D_4$ is 40V. Figure 17 shows the waveform of blocking capacitor voltage stress. The voltage stress of blocking capacitor is43V. Figure 18 shows the waveform of output capacitor voltage stress with MPPT. The voltage stress of the outputcapacitor is 111.52V and found to be half of the output voltage of the converter.

The input voltage 28V is step up to a voltage of 223V using converter with MPPT. The outputcurrent and power of converter to the load is 1.11A and 248.2W respectively. The comparison of transformer- less interleaved converter with and without MPPT is tabulated in Table 1. The parameters such as voltage stress of active switches, inductor current ripples, outputpower, output voltage and output current are compared. The transformer-less interleaved converter with MPPT extracts maximum power of 248.2W. Thus, the output power of converter is 21.6W greater than that of converterwithout MPPT.

## CONCLUSION

Solar energy more specifically solar car would be a tremendous advancement in future technology. They might allow a free travel and unlimited accessibility. They'd allow a free and pollution less travel. Solar powered cars are running without burning fossil fuels makes them a possible solution to our energy crisis. Solar power is clean, renewable and free energy which will supply all the energy needs of the globe. This energy is pollutant free with no emissions of greenhouse gases released into the air whatsoever. With the rising concerns over warming and temperature change, this can be one among the foremost important reasons to pursue developing more ways to utilize alternative energy. The employment of alternative energy for private mobility seems ripe for passing from prototypical applications to commercial products. The mixing of photovoltaic panels in electric and hybrid vehicles is becoming more feasible, thanks to the increasing fleet electrification, to the rise in fuel costs, to the advances in terms of PV panel technology, and to the reduction in their cost. Of course, these vehicles cannot represent a universal solution, since the simplest balance between benefits and costs would rely upon mission profile: specifically, significant reductions in fuel consumption and emissions may be obtained during typical use in urban conditions during working days. Moreover, the mixing with solar power would also contribute to cut back battery recharging time, a critical issue for Plug-in vehicles, and to feature value for Vehicle to Grid applications.

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