# Design And Power Management of Solar Powered Electric Vehicle Charging Station with Energy Storage system

Shubham A Aher, Darshan N Borade, Gokul Y Pagar, Guide- prof. Rahul Nikam, HOD- Dr. Deepak Kadam

*Department of Electrical Engineering, MET's Institute of Engineering, Nashik-422003, India*

**Abstract-In this paper design and development of a Hybrid charging station for electric vehicles is discussed. The charging station is powered by a combination of solar power and grid power. The system works in an integrated way to optimize the energy use from the grid. The system will take the power from solar arrays and directly charge the EV when solar energy is available. When solar energy is not available the system will be powered by the grid. In addition, the system will also deliver the solar power to grid when solar power is available but there is no EV is connected to the charging system. In this mode, the charging station will work as a grid connected solar power plant. Generally, a transformer is used for feeding the low voltage solar power to the grid, whereas in this work a advance high gain boost converter is used to eliminate the transformer. This modification considerably reduces the overall system cost and size. Extensive simulation results are present in this paper to establish the effectiveness of the developed hybrid charging stations.**

## I.INTRODUCTION

Now-a-days in India, especially in public transportation systems, electric vehicles are gaining high popularity due to high cost of petroleum. Government is also encouraging the use of electric vehicle to reduce petroleum import and environmental pollution. India is trying to produce e- vehicles exclusively by 2030. In order to keep up with the government strategies of commercializing e- vehicles, one of the most important factors would be development of adequate charging infrastructure throughout the country. Charging Stations are already available in commercial market. These charging stations are mainly of three types: Level 1(120 V), Level 2 (240V), DC Fast Charging (480V) . However, all these charging stations either works completely on grid power or solar power. Both of them have certain advantages and limitations. The grid-power mechanism[4] increases the reliability of the system but at the same time, increases the energy cost. On the other side use of solar energy decreases the energy cost but system reliability is reduced. To overcome these issues, this paper proposes a hybrid charging station for Electrical Vehicle(EV). Charging station presented in this paper uses both solar energy and conventional energy. This charging station charges the EV using solar power when solar energy is available. When solar energy is not available then it uses the grid power. In addition, when solar energy is available and EV is not connected then it uses grid tie inverter technology to feed the power back to the grid. Conventionally, a grid tie inverter uses a transformer to step- up the voltage to the level where it matches the voltage of the grid . The use of a transformer makes the system costly as well as bulky. This paper gives an idea of eliminating the use of this transformer in the grid-tie inverter by using a high gain dc - dc converter . This modification considerably reduces the overall system cost and size.

BLOCK DIAGRAM

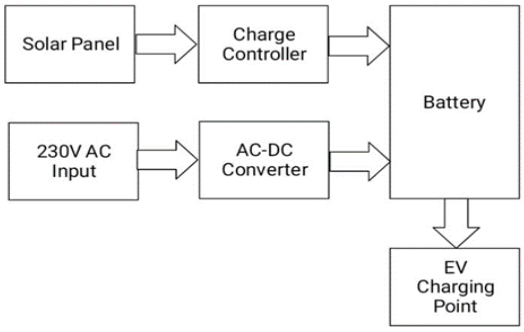



Fig. 1. Block Diagram of Charging Station

The system model consists of a PV array, Diode bridge rectifier, high gain DC-DC converter and a grid- tie inverter. The PV array converts solar power

to electrical power and feeds the power to the DC-DC converter which then charges the EV. A voltage of about 48 volts is required to charge the battery of EV. To maximize the power flow during this condition MPPT algorithm is used. The solar power is fed to the grid using a voltage source PWM inverter when EV is not available. When solar power is not available but EV is available for charging, the DC-DC converter is fed by the grid through a diode bridge rectifier. The flow of power under different cases is achieved by the selector switches. Control of these switches and converters is achieved by the controller block. Detailed working of the major electrical systems used in the design is given below.

## II.LITERATURE SURVEY

1.Electric Vehicles Charging Station In this paper design and development of a Hybrid charging station for electric vehicles is discussed. The charging station is powered by a combination of solar power and grid power. The system works in an integrated way to optimize the energy use from the grid. The system will take the power from solar arrays and directly charge the EV when solar energy is available. When solar energy is not available the system will be powered by the grid. In addition, the system will also deliver the solar power to grid when solar power is available but there is no EV is connected to the charging system. In this mode, the charging station will work as a grid connected solar power plant. Generally, a transformer I used for feeding the low voltage solar power to the grid, whereas in this work a advance high gain boost converter is used to eliminate the transformer. This modification considerably reduces the overall system cost and size. Extensive simulation results are present in this paper to establish the effectiveness of the developed hybrid charging stations.

2. Implementation of Solar PV-Battery and Diesel Generator Based Electric Vehicle Charging Station The proposed charging station is primarily designed to use the solar photovoltaic (PV) array and a storage battery energy to charge the electric vehicle (EV) battery. However, in case of exhaust of storage battery and unavailable solar PV generation, the charging station intelligently takes power from the grid and DG (Diesel Generator) set. However, the power from DG set is drawn in a manner that, it always operates at 80-85% loading to achieve maximum fuel efficiency under all loading conditions. However, in coordination with the storage battery, the charging station regulates the generator voltage and frequency without a mechanical speed governor. It also ensures that the power drawn from the grid or the DG set is at unity power factor (UPF) even at nonlinear loading.

3 Design and Power Management of Solar Powered Electric Vehicle Charging Station with Energy Storage System [3]An electric vehicle charging station integrating solar power and a Battery Energy Storage System (BESS) is designed for the current scenario. For uninterrupted power in the charging station an additional grid support is also considered without becoming an extra burden to the grid.

SOFTWARE DEVELOPMENT

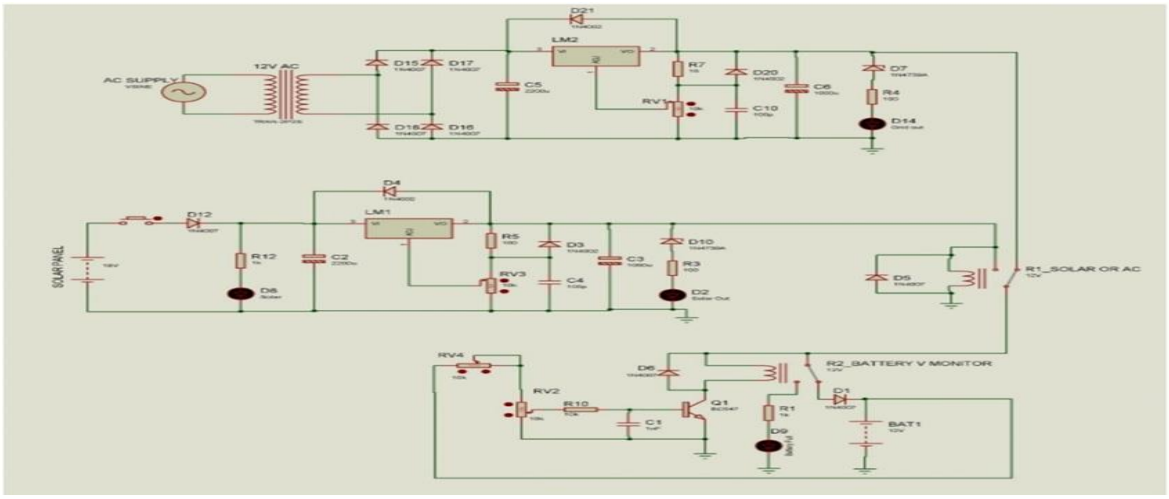



Fig. circuit diagram of charging station

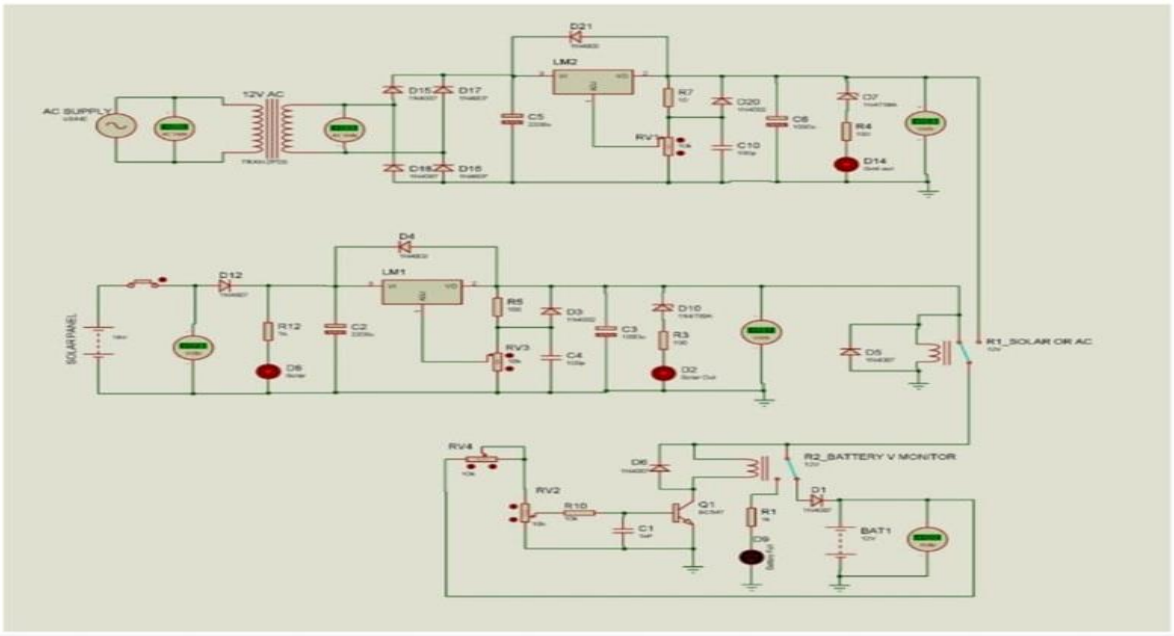



Fig. simulation result of charging station

## III.HARDWARE DESCRIPTION

| | COMPONENT | NOBs |
|---|---|---|
| 1 | Sealed lead acid battery 12v, 1.3Ahr | 1 |
| 2 | Relay 12V SPDT | 2 |
| 3 | voltage regulator LM317 | 2 |
| 4 | Solar panel 12V, 5W | 1 |
| 5 | Ac supply wire | 1 |
| 6 | Step Down transformer 12V, 1Amp | 1 |
| 7 | LEDs | 4 |
| 8 | On off switch | 2 |
| 9 | Multistrand wire | 2m |
| 10 | Variable resistor | 4 |
| 11 | Resistor | 8 |
| 12 | Capacitor ceramic disc | 6 |
| 13 | Diode | 8 |
| 14 | Capacitors | 4 |
| 15 | Coper Clad | 1 |
| 16 | Hardware material & Other | _ |

1.Sealed Lead Acid Battery-

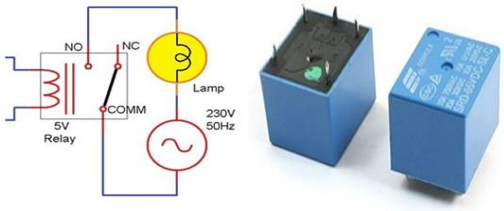
- Maintenance Free.
- Can be mounted in any orientation.
- Suitable for rough use
- Low cost
- High power density.
- Long service life, float or cyclic
- Low self-discharge. 12V, 1.3Ahr


2. Solar Panel

- Maximum Power Watt 5
- Production Tolerance ±10%
- Maximum Power voltage V 18V
- Maximum Power current A 0.56
- Open circuit voltage V 21.6
- Short circuit current A 0.59 12V, 5W

3. Relay

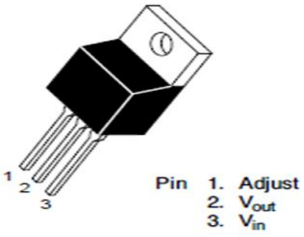
- Works on 12V
- Used as switch
- Can switch AC/DC
- Can switching large currents
- Can switch high voltages




Relay as switch

4. Voltage Regulator-

- Adjustable voltage regulator
- Output Adjustable between 1.2 V and 37 V
- Output Current upto 1.5 A
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting




## IV.SYSTEM SCOPE

Advantages-

- Provides uninterrupted supply 24x7
- Select solar power source on priority
- No pollution, no by-product for energy generation
- Energy will be stored & will be utilize on need.

## V.APPLICATION

- Electric vehicle charging
- Emergency power failure stations

## VI.RESULT

Output Of AC-DC converter is adjusted to 12.9v. output of solar charge controller is adjusted to 12.9v. output of solar charge controller will be passed to battery when its available. When power from solar panel is not available, selector relay select power from AC-DC converter and feed to battery. when battery voltage goes above 12.8v, battery protection relay disconnects battery from charging supply to avoid over charging ultimately power from solar or AC source or from battery is fed to load.

## VII.CONCLUSION

From this model development. It is concluded that. The idea of Evs will be genuinely sustainable only if they are charged using renewable energy. In this project design of a solar-powered EV charging station with combination of AC energy source is designed successfully. An DC-to-DC converter is used for utilizing the solar energy & AC-DC converter is used to utilize the AC energy. In this phase of project, we studied the ground situation and understood the importance of EV and its relation with renewable energy. On the bases of this specifications of system are decided.

## VIII.ACKNOWLEDGMENT

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