SOLAR CHARGE CONTROLLER WITH MOBILE CHARGER

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ABSTRACT

The demand of renewable energy (alternative energy sources) is increasing day by day as our non renewable sources have started depleting. The other reason for increased demand is that it has a cleaner, easy setup and has a very low cost of maintenance during its operation. Due to which, solar powered equipments and appliances are making its way into various sectors of our day to day life. This project deals with the scenario that a storage or battery is needed in order to harness the solar energy when the sunlight is available and supply it in vice versa conditions. For this, a cost effective system is built which charges a battery with the help of solar panel and protection is given to the battery in case of overcharge, deep discharge and under voltage condition. The block diagram, circuit diagram, hardware design are discussed in the project.

INTRODUCTION

Solar Power Charge Controller can be used in various sectors. For instance, it can be used in solar home system, Hybrid systems, solar water pump system etc. In this, the solar panel converts sunlight energy into electrical energy through an electrochemical process also known as photovoltaic process. Energy is stored in the battery with the help of solar panel through a diode and a fuse. Energy stored in the battery can be used when there is no sunlight as during discharge, chemical energy is converted into electrical energy which in turn illuminates electrical appliances or helps in pumping water from the ground. Hence, it is needed to protect battery form overcharge, deep discharging mode while dc loads are used or in under voltage as it is the main component in a solar power charge controller.

In this project, indications are provided by a red LED for fully charged battery while a green LED indicates that battery is charging. White LED is provided in order to indicate overcharge, deep discharge or under voltage condition. Charge controller also uses MOSFET as power semiconductor switch to ensure cut off the load in low battery or overload condition. When the battery gets fully charged, a transistor is used in order to bypass the solar energy to a dummy load which protects the battery from getting over charged.

A solar charge controller or regulator is a small box placed between a solar panel and a battery consisting of solid state circuits PCB. They are used to regulate the amount of charge coming from the solar panel in order to protect the battery from getting overcharged. Adding to this, it can also be used to allow different dc loads and supply appropriate voltage.

BLOCK DIAGRAM

In figure 1, the basic arrangement of the implemented project can be found.

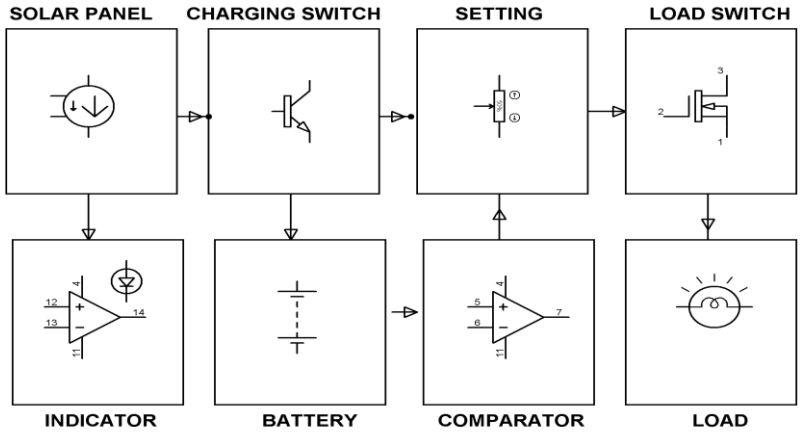

Figure 1: Block Diagram Arrangement of the Project

The main components used in order to establish the project are Photovoltaic Cells and Solar panel, battery, LM 324, Transistors and 34063A IC.

1. PHOTOVOLTAIC CELLS AND SOLAR PANEL

Photovoltaic (PV) cells are the one which are made from special materials called semiconductors like Silicon. They are used for conversion of light into electricity using semiconductor materials that exhibit the photovoltaic effect. When the light strikes the cell, certain amount of light gets absorbed into the semiconductor material which triggers the flow of electrons. This causes current to flow. We can place metal contacts on top and bottom of the cell, from which we can draw current externally. Solar panel is a panel designed to absorb sun's rays In order to generate electricity or heat. A PV module is a packaged consisting of Solar cells. Solar panels constitute the solar array of a PV system that helps in generating and supplying electricity to commercial and residential sectors.

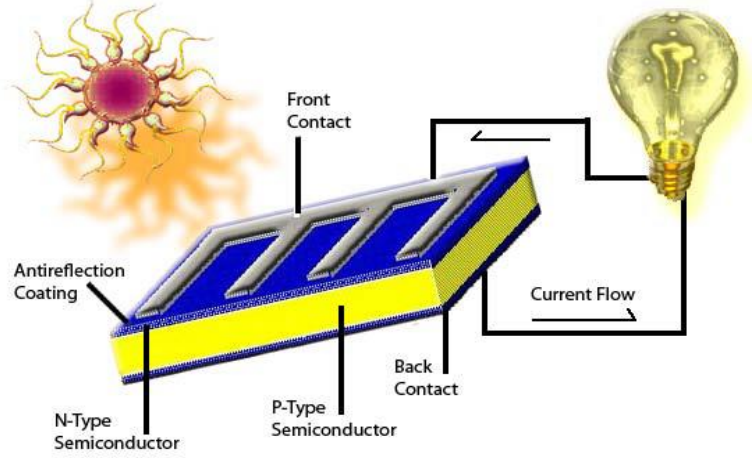

Figure 2 Solar panel

2. BATTERY

In this project a Sealed Rechargeable Battery (6V 7.5AH/20HR) is used in order to store energy. An Electrical battery converts chemical energy directly into electrical energy comprising of one or more electro chemical cells. The battery comes in all shapes and sizes and can be used for household, robotics, industrial applications etc. For example, miniature (small) cells can be used to power devices such as hearing aids, wristwatches etc. whereas as large batteries can be used telephone exchanges, computer data centres, power substations etc. A 12V, lead-acid battery has 6 cells. The range is 0.1C rate, where C is the battery capacity in Ah in order to charge lead acid batteries safely. The major disadvantage of overcharging a battery is that it can cause reduction in its life span.

3. LM 324

It is a general purpose op-amp consisting of four independent, high-gain, internally compensated operational amplifiers designed to operate from a single power supply over wide range of voltages. It has a wide range of applications such as in transducer amplifiers, C gain Blocks and Conventional op-amp circuits. Opamps in LM 324 are used as comparators in this project.

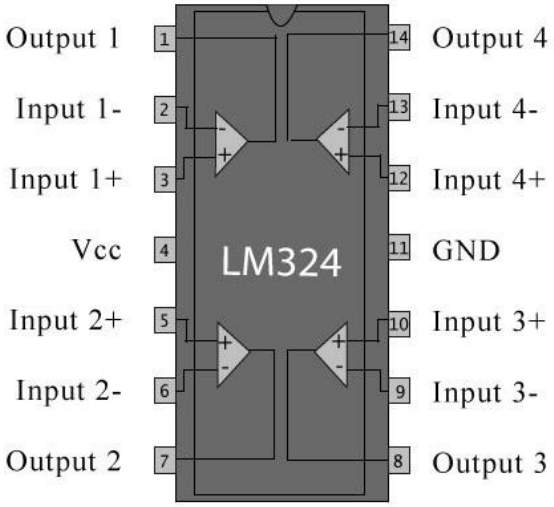

Figure 3 pin diagram of LM324

WORKING

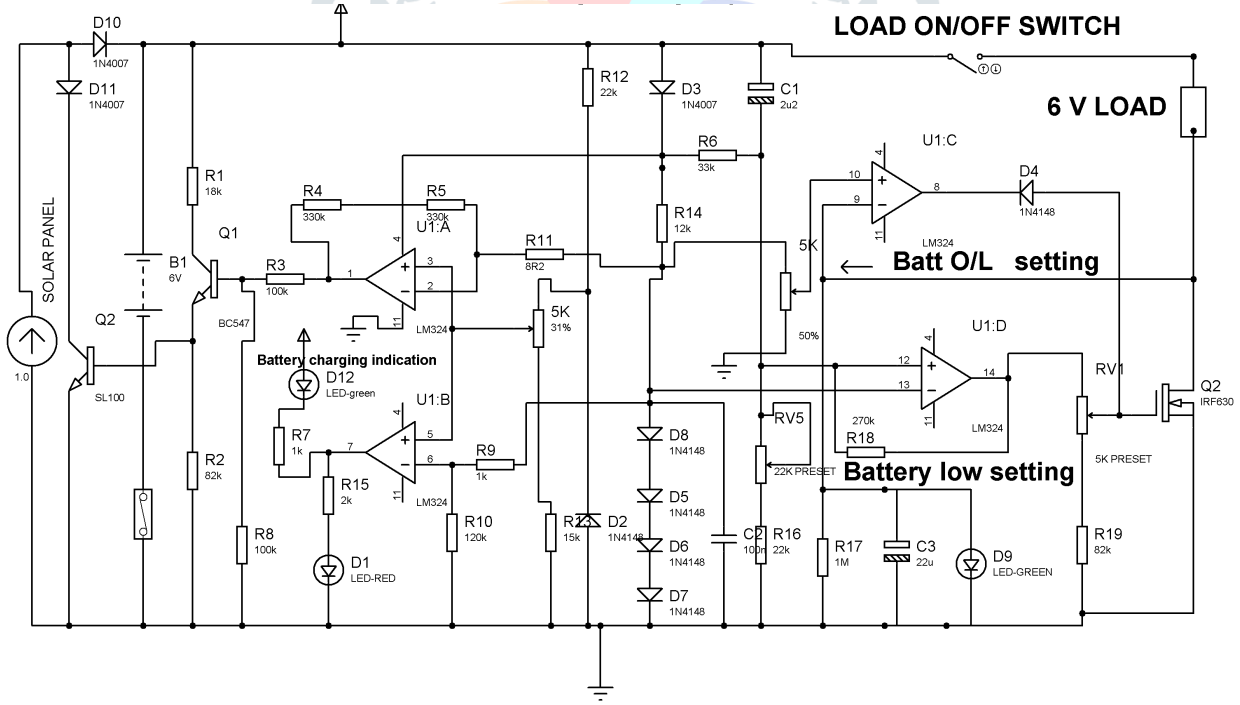

Figure 7 Schematic diagram of solar charge controller

In this, battery B1 is charged via d10 and fuse. After battery getting fully charged, Q1 conducts from output of the comparator i.e. Pin 1, resulting in Q2 to conduct and divert the solar power through D11 and Q2. In this way battery is not over charged. Pin 6 of U1: B via R9 and pin 10 of U1: C via 5K variable resistor. Solar panel being a current source is used to charge the battery B1 via D10. While the battery is fully charged, the voltage at cathode point of

D10 goes up resulting in the set point voltage at pin 3 of U1: A to go up above the reference voltage because of the potential divider formed by R12 of 22K, 5K variable resistor, R13 of 15K goes up.

This results in pin no 1 of U1: A to go high to switch 'ON' the transistor Q1 that places drive voltage to the transistor SL 100 such that the current from solar panel is bypassed via D11 and the transistor's collector and emitter. Simultaneously pin 7 of U1: B also goes high to drive a led D1 indicating battery is being fully charged. While the load is used by the switch operation Q2 usually provides a path to the (-ve) while the (+ve) is connected to the DC (+ve) via the switch in the event of over charge, the reference voltage at Pin 10 results in pin 8 of U1: C going low to remove the drive to the gate through the D4 of the MOSFET Q2 which in turn disconnects the load. In the event of over charge, Q2 voltage across drain and source goes up which results in Pin no 9 going above pin no 10 via R22. In the event of battery voltage falling below minimum voltage is duly sensed by the combination of D3, R6, RV5 and R16 in Pin 12 resulting in Pin 14 going zero to remove the drive to Q2 gate via R20 and RV1. The correct operation of the load in normal condition is indicated by D9 when the MOSFET Q2 conducts.

RESULT

With the proper working of this project, the battery gets charged with the constant voltage of 6v from the solar panel due to this the life time of battery can be increased and also protected from the damages. The charging of the battery can be indicated by glowing green led. On the other hand when a problem occurs while charging or usage of battery it is indicated by glowing red led. When the battery is charging the mobile charger also works to bypass the supply and not overload the battery. It is also indicates the red led when the load is over charged.

CONCLUSIONS

In recent days, the process of generating electricity from sunlight is having more popularity than other alternative sources and the photovoltaic panels are absolutely pollution free and they don't require high maintenance. The following are some examples where solar energy is utilizing.

- Street lights use photovoltaic cells to convert sunlight into DC electric charge. This system uses solar charge controller to store DC in the batteries and uses in many areas.
- Home systems use PV module for house-hold applications.
- Hybrid solar system uses for multiple energy sources for providing full time backup supply to other sources.

All this drawbacks are successfully eliminated by this project. This project will help every person to building their own reliable, cost efficient, small spaced mini power plant in their homes. Now every home can generate electricity for its personal use saving lots of natural resources, money which will ultimately improve our country's economy.