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Design of Charge Controller for Photovoltaic System

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ABSTRACT

The aim of this paper is to design and construct a charge controller using OP-AMP as comparator for solar system. The charge controller varies its output to a step of 12V; for a battery of 10Ah rating. This paper deals with the scenario that a battery is needed in order to harness the solar energy when the sunlight is available and supply it in vice versa condition . The designed system is very functional, durable, economical and locally sourced and most cost effective. Due to this reason, a charge controller 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.

Keywords: Metal oxide semiconductor field effect transistor (MOSFET),Operational Amplifier(OP-AMP), Optocoupler.

I. 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, a solar panel converts sunlight energy into electrical energy through an electrochemical process also know 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 . 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 paper, indications are provided by a green LED for fully charged battery while a red LED indicates that battery is charging, 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 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. In this circuit ,the main component use is an OP-AMP which is LM324 IC and used as a comparator.

II. CIRCUIT DIAGRAM

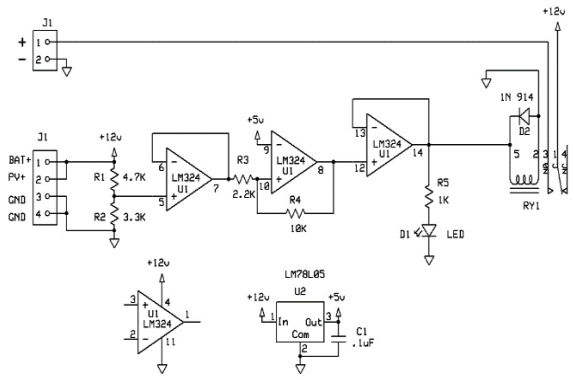

Figure 1. Circuit Diagram

III. COMPONENTS USED IN CIRCUIT

1. Operational Amplifier(LM324) – It is a 14 pin IC consisting of four independent operational amplifier compensated in a single package. They can be used as amplifiers, comparators, oscillators and rectifiers.
2. Relay (JQC-3FC(T73)) - Relay an electrically operated switch. It can be operated by a small electric current that turns a larger current ON or OFF by either releasing or retracting the armature contact,their by completing or cutting the circuit.
3. Transistor(BC547,431L) - It is the device that regulate current or voltage flow and acts as a switch or gate for electronic signal.
4. Capacitor(10uf,100uf,2A103K) - It is a passive two terminal electrical component that stores potential energy in an electric field.
5. Resistance(2.7k , 1k, 4.7k,3.3k,10k) - It is the opposition that a substance offers to the flow of electric current.
6. Optocoupler(4N35 IC) - It is an integrated circuit in which an infrared emitter diode rives a phototransistor.It is also called as optoisolator since they separate two circuits optically
7. Diode- A diode is a two terminal electronic component that conducts current primarily in one direction.
8. Inductor- It is a passive two terminal electrical component that stores electrical energy in a magnetic field when electric currnt flow through it.
9. Fuse- It is a device used in electrical systems to protect agains excessive current.
10. Mosfet(IRFZ44N)-It is a switch to control relays , motors and other high current electrical loads.
11. Heatsink- It is a passive heat exchanger that transfers the heat to a fluid medium , often air or a liquid coolant.

IV. WORKING

Charge Controller save battery if PV panels are used. The input of charge controller is 12V which is coming from solar panel. In this circuit OP-AMP (LM324 IC) is used as a comparator to compare the voltage and current . It read the voltage and current of the solar panel through the optocoupler and calculates the output power. It is a 14 pin IC and consists of four different amplifiers. Only three amplifiers are in use.Pin no. 1, 2, 3, 11 i.e first operational amplifier which is not connected(11 pin is grounded). The input which is coming from solar panel is connected to pin no. 5 and output. The analog charge controller resistor must be carefully chosen to keep the battery voltage between 10.5 volts and 14.5 volts. We used the simple voltage divider of 4.7K and 3.3K to sample the battery voltage and bring it close to the 5 volt reference. This voltage is then buffered with a voltage follower and placed on the left side of the 2.2K resistor. The voltage that appears on OP-Amp pin 10 is the voltage that is compared to the 5 volt reference. If this voltage is higher than 5V the charge controller relay is activated. Is this voltage is lower than 5 volts the charge controller relay is deactivated. As long as the voltage on pin 10 remains higher than 5 volts the relay remains activated, but if the battery voltage continues to drop the battery load will be disconnected.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. LED is connected between relay and fourth Op-amp(14 pin and 5)through diode. When the battery is fully charged, LED will glow. Green LED indicated for fully charged battery while a Red LED indicates that battery is charging, deep discharge or under voltage condition. The charger charges battery upto 12.9volt and then it charges very slowly. If the battery is fully charged the optocoupler senses , it and cut off the supply. Input voltage and battery voltage are compared by comparators.

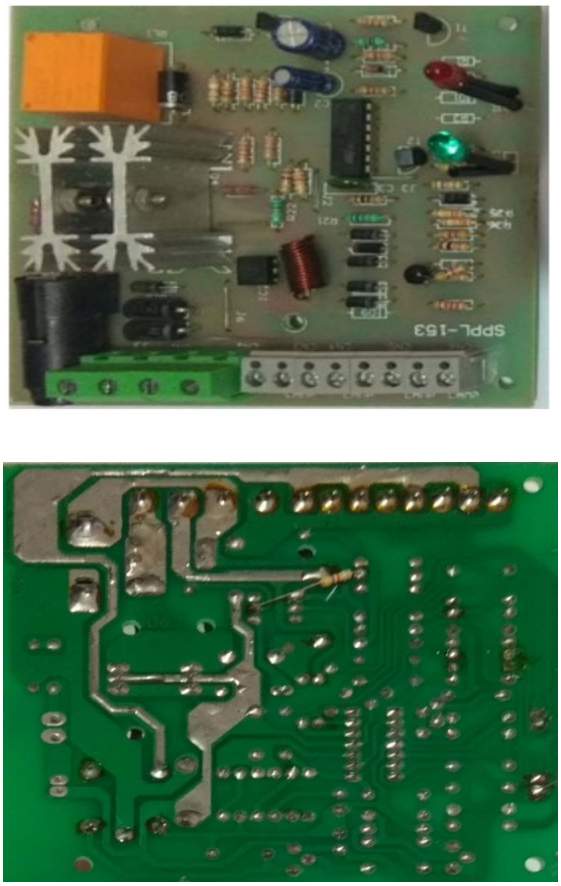

Figure 2. Circuits

V. CONCLUSION

In this paper, a photovoltaic charge controller using LM324 IC is use to protect better battery protection from overvoltage using optocoupler and mosfets.It also includes protection methods for the battery in order to curb problems like overcharging, deep discharge or under voltage which harm the life of the battery.

VI. REFERENCES

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