PROTECTION CIRCUIT FOR LI-ION BATTERIES

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Abstract

In this era reversible batteries plays major role. A complication with the employment of this reversible battery is their overcharging and over discharging. In our paper, we have a tendency to design a zener diode based circuit to shield lithium ion batteries from over discharging. Once a battery is charged, its terminal voltage i.e. voltage between the anode and cathode of the battery will increase. On full charging, the terminal voltage reaches a peak value that is a sign of hundred percent charging. Once this totally charged battery is hooked up to load it starts discharging, its terminal voltage starts dropping. The level of charging of a battery is so calculable by its terminal voltage. Therefore, there is a need for protection circuit. This protection circuit will monitor the battery charging level and protect the battery from over discharging.

Keywords: Lithium ion batteries, Protection circuit, Over discharge, Terminal voltage, Zener diode, Battery charging level.

I. INTRODUCTION

In this paper, batteries with a cut-off limit of 3.7 V area unit used for power offer. So, exploitation 2 batteries serial set the cut-off limit to 6.9V. So, a zener diode of 6.9 V reverse peak voltage is employed to discover the cutoff limit within the design of the circuit. The diode are used to drive shift transistors which can operate the relay. As the terminal voltage of the battery can go below 6.9V, the diode can enter the conductivity state, triggering the shift transistors and dynamical the relay state to chop off the availability of the load device. Once understanding the functioning of this paper, protection circuits for alternative cut-off limits may also be designed by correct choice of the zener diode and relay with an equivalent circuit.

II. LITERATURE REVIEW

In this paper they outlined about the protection IC for 1 cell lithium ion batteries with integrated power MOSFET. This IC integrates circuits to prevent batteries from

overcharging and over discharging. If cell voltage get lower than over discharge detection voltage, discharging will be shut off, because internal power is turned off. This is the over discharging mode. [1]

Commercial lithium ion phosphate batteries were tested to investigate their responses to overcharge and over discharge conditions. This paper connects the symptoms, effects and consequences of overcharge and over discharge phenomen and tries to establish the early precaution approach for battery failures to guarantee the safety of battery applications. [2]

This paper mainly represents a design of constant current chargers with overcharge and over discharge protection for lithium ion batteries. Analysis of different battery chemistries was carried out. The objective was to design an inexpensive and efficient lithium ion battery charger which will charge the battery to full capacity while minimizing the overcharging and over discharging. [3]

In this paper the over discharge tests were performed in an explosion-proof chamber using a battery test bench manufactured by Digatron. In the test, a fully discharged battery was connected in series with 4 auxiliary batteries and the voltages were monitored. Experiments were performed to investigate the overall voltage variation of the battery during over discharge. [4]

In this study, two lithium ion batteries are adopted to explore the effects of different thermal conditions on battery's performance. The experimental results explains the charging and discharging capabilities of lithium ion batteries under different thermal conditions. [5]

Lithium ion batteries have been widely applied in many electronics as a power source. Hence it is essential to analyze the failure of lithium ion batteries and to improve the reliability of lithium ion batteries. Herein, they report on the investigation of over discharge failure phenomenon of lithium ion battery and its internal short circuit mechanism. [6]

The purpose of this study is to diagnose and analyze the overcharge and over discharge fault of lithium ion battery. Compared with other power batteries, lithium ion battery is one of the high tech batteries. It has high reliability and power. With rapid research of electric vehicle, lithium ion battery technology is also constantly developing. So, it may have large safety problems in its application. Therefore, in this paper, the common overcharge and over discharge fault was taken as the example for fault diagnosis analysis. [7]

Technological improvements in rechargeable solid state batteries are being driven demand for portable electronic devices. This paper presents a brief review of the

development of lithium based rechargeable batteries and highlight ongoing research strategies. [8]

III. EXISTING SYSTEM

Lithium batteries are fully empty once discharged to 2.5 V/cell. Discharging a metallic element cell this low is disagreeable to the cell and reduces cell lifespan. A good battery protection circuit will give over discharge protection.

IV. PROPOSED SYSTEM

In the proposed methodology of our paper, a protection circuit is designed which will detect the lower threshold limit of the terminal voltage by the use of a suitable zener diode and will cut off the battery connection with the load by the use of relay.The circuit includes an LED indicator section also which will light up as the battery discharge below the limit.

4.1 Circuit Diagram

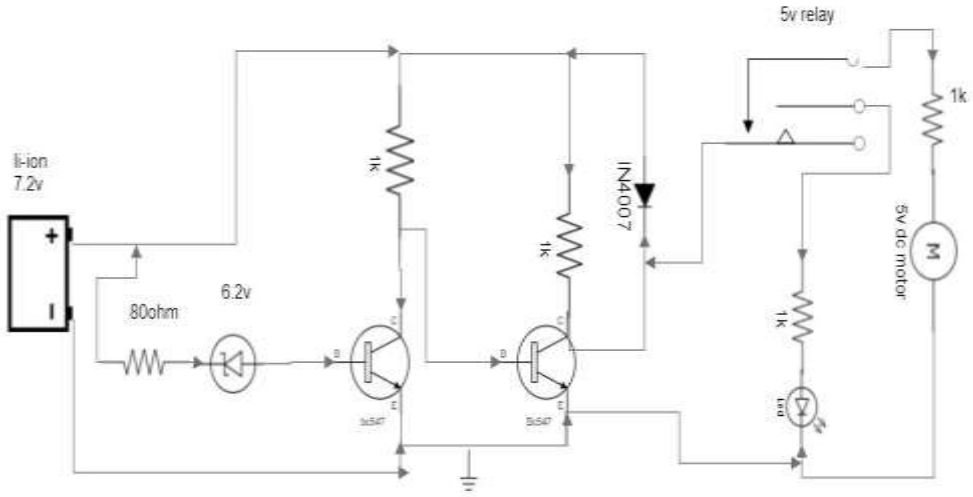


Fig 1-Circuit diagram

4.2 Circuit Explanation

The battery and the zener diode are connected in series. The negative terminal of the zener diode is connected to the positive terminal of the battery, whereas the positive terminal of the zener diode is connected to the base of the switching transistor. The intention of connecting the zener diode in this way is to operate it in reverse biased condition. The zener diode will be in conduction state till the terminal voltage of the battery is above the cutoff limit and the peak reverse voltage of the zener diode. But when the terminal voltage drop below the cutoff and peak reverse voltage, the zener will remain in off state. Initially the anode of zener diode is connected to the base of the switching transistor T1, the emitter of the switching transistor is grounded and it's collector is connected to the anode of the battery. Now, the base of the transistor T2 is connected to the collector of transistor T1.Here the collector voltage of T1 switch the transistor T2. The emitter of the transistor T2 is connected the ground and it's collector is connected to the relay coil. The supply to the load is controlled by relay coil. For protecting back current from load, a diode circuit is connected in parallel to the relay coil. The load which draw high current produces back current, this can damage the battery permanently. Hence the diode circuit is used to protect back current.

V. COMPONENTS DESCRIPTION

5.1 Lithium-Ion Battery

A Lithium ion battery is a type of rechargeable battery. This battery is commonly used for portable electronics and Electrical vehicles and are growing in popularity for military and aerospace application. It has three functional components, namely the positive and negative electrodes and electrolytes. These batteries has high energy density.

5.2 Zener Diode

The normal diodes can conduct current only in one direction, whereas zener diode allow conduction in both direction. A normal diode will be permanently damaged for a large reverse current, but a zener diode will not get damaged. Zener diodes are used as voltage regulators. Zener diodes are highly doped diodes. These are also used in switching application. Here we are using the zener diode of range 6.9v.

5.2 Transistor

In our concept, we are using BC547 transistor. It is a NPN Bipolar JunctionTransistor. It is a widely used transistor. It can be used in many electronic circuit, for example switch small load on very low input voltage and current It is also used in amplification.

5.4 Diode

Here we are using 1N4007 diode.1N4007 is a PN junction rectifier diode. This diode allows current to flow in one direction only. It has two pins in total, they are anode and cathode. There are opposite charges in both the pins. This diode's maximum current carrying capacity is 1A it withstand peaks up to 30A. The reverse current negligible. The power dissipation of this diode is 3W.

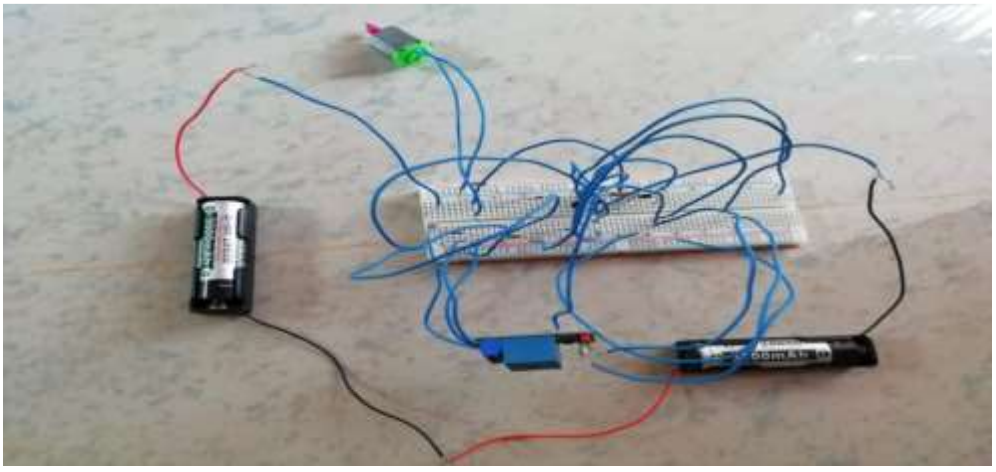
5.5 Relay

A relay is an electromagnetic switch that is used to turn on and turn off a circuit by allow low power signal. It has two basic contacts i.e. NO (Normally Open) and NC (Normally Closed). When input voltage is applied across its coil, NC changes to NO and NO changes to NC. When input voltage is supplied, we say that the relay is energized. It has several features e.g. it can be used for switching smaller voltage to higher. But it cannot be used in power consuming devices. It has a wide range of applications. It can be used in home appliances, electronic circuits where there is a need of protection, robotics for controlling its motors for the proper motion and many more.

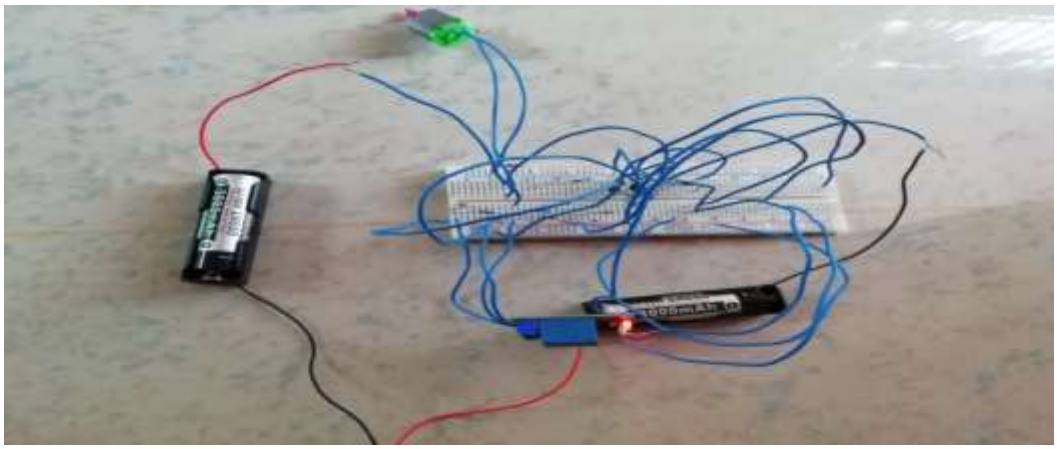
5.6 LED

LED is a PN junction diode that mainly used as a replacement of incandescent lights. It is based on the electroluminescence effect. A process where diode converts electric current to light when electrons change their state inside the LED semiconductors. Here we are using RGB LED. It is widely used in many computer applications and comes with an ability to generate three lights, as the name suggests, red, blue and green. The colour of these lights is controlled by using PWM. Both the duty cycle of PWM and frequency used for generating the signal per second, prove to be handy for controlling all three colours.

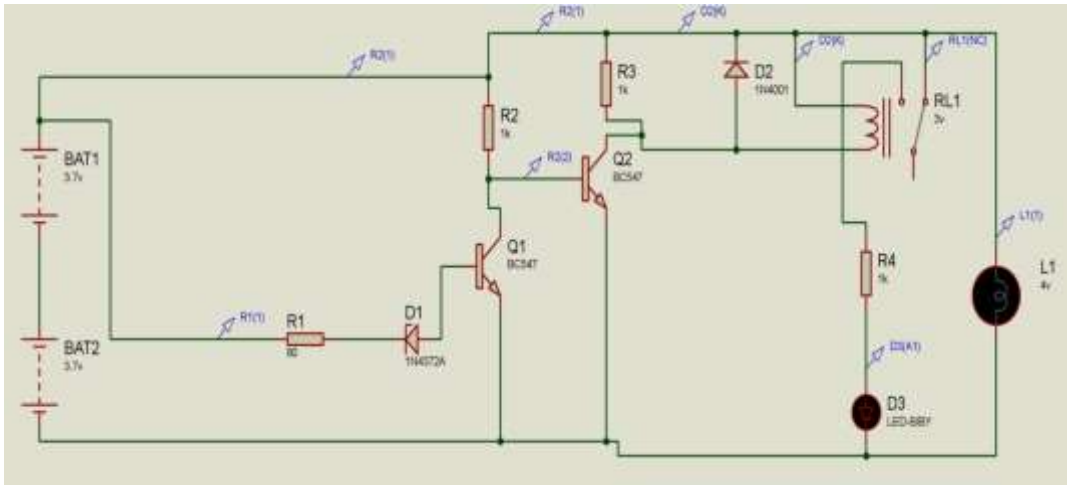
VI. EXPERIMENTAL PROTOTYPE



VII. OUTPUT



VIII. SIMULATION OUTPUT



IX. CONCLUSION

In this paper, the circuit diagram is simulated by using the proteous 8 professional. After the protection circuit is built, here we are using the zener diode to minimize the over discharging rate and protect the circuit. We can increase the time usage of load by controlling over discharge with the help of protection circuit**.**

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