LEAD ACID BATTERY CHARGER

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Department of Electrical and Electronic Engineering
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A project report presented to

The Academic Faculty

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ABSTRACT

With the lack of centralized power grids, lead acid batteries have taken the place of one of the main energy sources available in developing countries. With this in mind, our objective was to build a cheap, versatile and efficient lead acid car battery charger which will interest and appeal to the "cost-minded" customer. Lead-acid batteries are finding considerable use as both primary and backup power sources. For complete battery utilization, the charger circuit must charge the battery to full capacity, while minimizing over-charging for extended battery life. In our circuit we have used a voltage regulator and comparator to regulate the voltage supply to the battery for effective charging. Two LED's are used to indicate the status of battery charge. This circuit was simulated using a simulation software called proteus. Software called proteus, a product of National.

INTRODUCTION

A battery charger is a device used to put energy into a cell or (rechargeable) battery by forcing an electric current through it. Lead-acid battery chargers typically have two tasks to accomplish. The first is to restore capacity, often as quickly as practical. The second is to maintain capacity by compensating for self-discharge. In both instances optimum operation requires accurate sensing of battery voltage When a typical lead-acid cell is charged, lead sulphate is converted to lead on the battery's negative plate and lead dioxide on the positive plate. Over-charge reactions begin when the majority of lead sulphate has been converted, typically resulting in the generation of hydrogen and oxygen gas. At moderate charge rates, most of the hydrogen and oxygen will recombine in sealed batteries. In unsealed batteries however, dehydration will occur. When a typical lead-acid cell is charged, lead sulphate is converted to lead on the battery's negative plate and lead dioxide on the positive plate. Over-charge reactions begin when the majority of lead sulphate has been converted, typically resulting in the generation of hydrogen and oxygen gas. At moderate charge rates, most of the hydrogen and oxygen will recombine in sealed batteries. In unsealed batteries however, dehydration will occur.

CLASSIFICATION OF LEAD ACID BATTERY CHARGER

- Simple chargers
- Supper Fast chargers
- Dumb chargers
- smart chargers
- Solar chargers
- Usb-based chargers
- Universal battery chargers

APPLICATION OF LEAD ACID BATTERY CHARGER

1. Battery charger for vehicles:

There are two main types of chargers used for vehicles:

- To recharge a fuel vehicle's starter battery, where a modular charger is used.
- To recharge an electric vehicle (EV) battery pack.

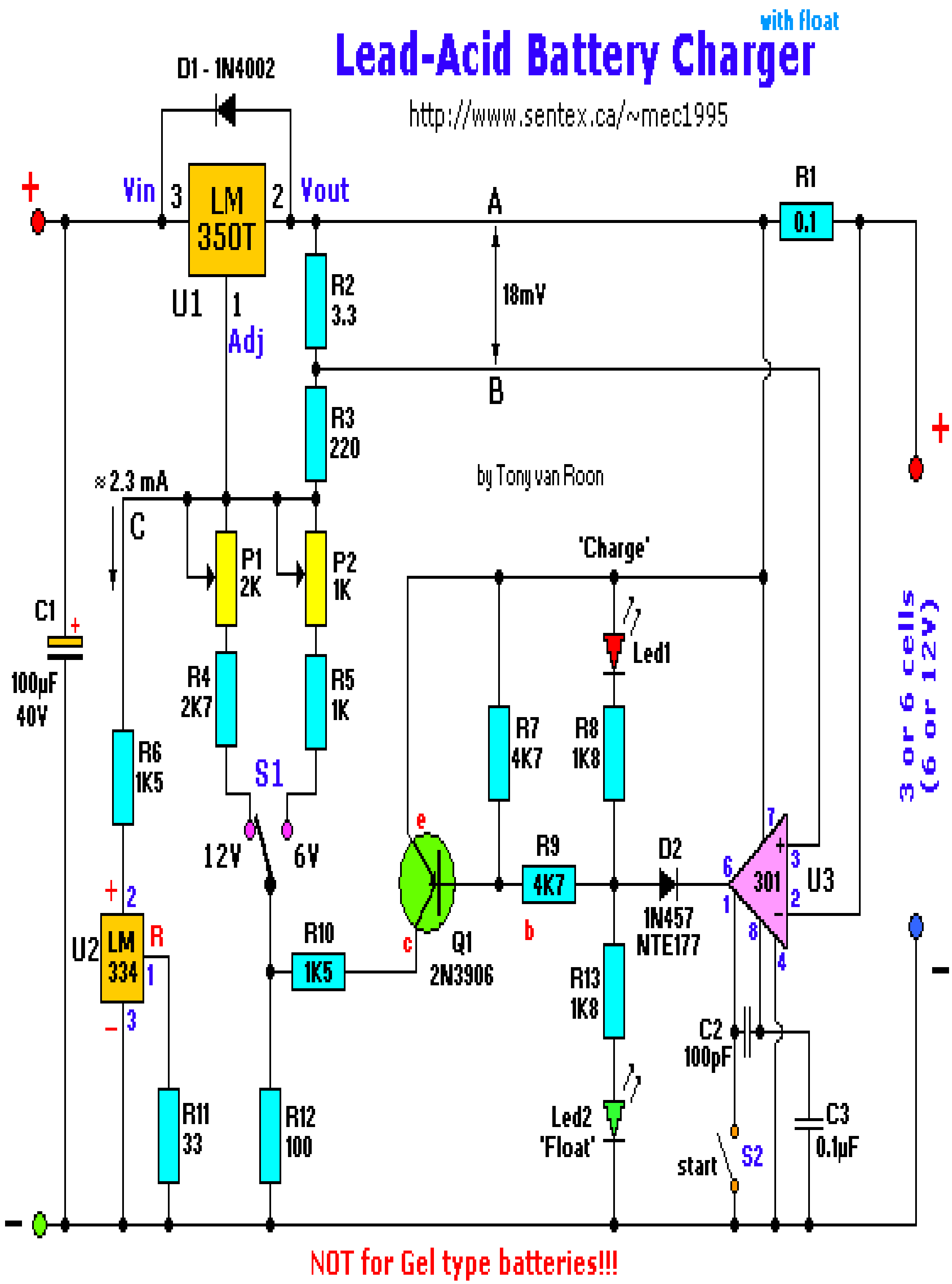
2. Electric vehicle batteries:

Some use algorithm charge curves, others use constant voltage, constant current. A 10 amp-hour battery could take 15 hours to reach a fully charged state from a fully discharged condition with a 1 amp charger as it would require roughly 1.5 times the battery's capacity. Power Factor Correction (PFC) chargers can more closely approach the maximum current the plug can deliver, shortening charging time.

3. Stationary battery plants:

Telecommunications, electric power, and computer uninterruptible power supply facilities may have very large standby battery banks (installed in battery rooms) to maintain critical loads for several hours during interruptions of primary grid power. Such chargers are permanently installed and equipped with temperature compensation, supervisory alarms for various system faults, and often redundant independent power supplies and redundant rectifier systems. Chargers for stationary battery plants may have adequate voltage regulation and filtration and sufficient current capacity to allow the battery to be disconnected for maintenance, while the charger supplies the DC system load. Capacity of the charger is specified to maintain the system load and recharge a completely discharged battery within, say, 8 hours or other interval.

CIRCUIT DIAGRAM OF LEAD ACID BATTERY CHARGER



DESCRIPTION OF THE CIRCUIT DIAGRAM

The DC voltage is connected to the VIN of the LM317 in between them the capacitor is connected and it will be opened but if it had any AC noise will remove it. The LM301A compares the voltage drop across R1 with an 18 mV reference set by R2. The comparator's output controls the voltage regulator, and produce the lower float voltage when the battery-charging current, passing through R1, drops below 180 mA. This circuit delivers an initial voltage of 2.5V per cell to rapidly charge a battery. The charging current decreases as the battery charges and when the current drops to 180 mA the charging circuit reduces the output voltage to 2.35 V per cell, leaving the battery in a fully charged state**.** The 150mV difference between the charge and float voltages is set by the ratio of R10 and R12. The red and green LED's show this state of the circuit. This lower voltage prevents the battery from over charging, which will shorten its life. At 250C and with no load, adjust R7 for a Vout of 7.35V, and adjust R8 for a Vout of 14.5V. Switch S1 is a toggle or slide (ON-ON) switch of your choice. The regular on-off type will not work. S2 is a momentary ON pushbutton switch to start the charge. VIN is at least 15-20volt max about 30V.

COMPONENTS USED IN THIS CIRCUIT

R1 = 0.1 ohm P1 = 2K

R2 = 3.3 ohm P2 = 1K

R3 = 220 ohm C1 = 100uF/40V (Electrolytic)

R4 = 2.7k ohm C2 = 100pF

R5 = 1K ohm C3 = 0.1uF (100nF)

R6, R10 = 1.5k ohm U1 = LM350

R7, R9 = 4.7k ohm U2 = LM334

R8, R13 = 1.8k ohm U3 = LM301A

R11 = 33 ohm Q1 = 2N3906

R12 = 100 ohm D1 = 1N4001

R2 = 3.3 ohm D2 = 1N457 (NTE177)

R3 = 220 ohm Led1 = Red

R4 = 2.7k ohm Led2 = Green

R5 = 1K ohm S1 = Toggle Switch, ON-ON

S2 = Pushbutton, momentary 'ON'

INTRODUCTION TO SIMULATION SOFTWARE PROTEUS

Proteus* is a software technology that allows creating clinical executable decision support guidelines with little effort**.** The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. It was developed in Yorkshire, England by Lab center Electronics. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. So if you are willing to design hardware and software this is a great tool to star with. Proteus ISIS combines ease of use with powerful editing tools as a very high degree of control over the drawing appearance, in terms of line widths, fill styles, fonts, etc. It is capable of supporting schematic capture for simulation. As for Proteus ARES is for PCB designs to make your own devices using the PCB layout tools and provides a powerful, integrated and easy to use suite of tools for professional PCB Design.

WHY WE USE PROTEUS IN THIS PROJECT

We used this software to implement and test design before a physical prototype is constructed. It is integrated with real time simulation of the electronic circuit and test whether your designed circuit is working properly or not. If you have previously worked on basic and easy tools to design circuit, this software will also look more easy to use for your analysis work at next level. It reduces the time on creating hardware and testing your errors directly on hardware. You can analyze your circuit and code both on Proteus and find the errors encountering before implementing on hardware.

THE PROCEDURE OF HOW WE USE IT TO STIMULATE

Step 1: We open ISIS software and select new design in File menu.

Step 2: A dialogue box appears to save the current design. However, we are creating a new design file so you can click Yes or No depending on the content of the present file. Then a Pop-Up appears asking to select the template.

Step 3: An untitled design sheet will be opened, save it according to your wish, it is better to create a new folder for every layout as it generates other files supporting your design. However, it is not mandatory.

Step 4: To select components, Click on the component mode button.

Step 5: Click on (p) Pick from Libraries. It shows the categories of components available and a search option to enter the part name.

Step 6: Select the components from categories or type the part name in Keywords text box.

Step 7: The selected components will appear in the devices list. Select the component and place it in the design sheet by leftclick. Place all the required components and route the wires. Double click on the component to edit the properties of the components and click on Ok.

Step 8: After connecting the circuit, click on the play button to run the simulation.

THE RESULT OF THE OUTPUT VALUES

Transistor state	R4IIR5 ohm	VR4 volt	VOUT
OFF	730	6.21	13.2
ON	450	2.3	6.7

CONCLUSION

A simple lead acid battery charger system was implemented successfully. The proposed charger can work in constant voltage or constant current mode although constant Voltage mode is the most preferred. The battery charger has many advantages like Successful 3-stage charging, over charge protection, battery discharge protection and a simple design. However the battery charger would be difficult to operate in hotter Temperatures. Further we can improve the heat sink to dissipate the heat better and also indicators can be designed to indicate bulk charge and float charge states.

DISCUSSION

A good battery charger provides the base for batteries that are durable and perform well. In a price-sensitive market, chargers often receive low priority and get the “after-thought” status. Battery and charger must go together like a horse and carriage. Prudent planning gives the power source top priority by placing it at the beginning of the project rather than after the hardware is completed, as is a common practice. Chargers are commonly identified by their charging speed. Consumer products come with a low-cost personal charger that performs well when used as directed. Lead-acid and nickel-based batteries accept charge when cold but at a lower rate. A sleep condition can occur when storing the battery in a discharged state in which self-discharge brings the voltage to the cut-off point. A regular charger treats such a battery as unserviceable and the pack is often discarded. The charge current is constant and the voltage is capped when it reaches a set limit. Reaching the voltage limit, the battery saturates; the current drops until the battery can no longer accept further charge and the fast charge terminates. Each battery has its own low-current threshold. Most lead acid chargers charge the battery in 14–16 hours; anything slower is a compromise. Lead acid can be charged to 70 percent in about 8 hours; the all-important saturation charge takes up the remaining time. Check battery temperature when using a low-cost charger. Remove battery when warm. Charge at room.

FUTURE WORKS

For recommendation in the future, the input current of our charger should be higher in order to minimize the time for charging the rechargeable batteries. Besides, the charger should come with smaller size so that the users can freely use anywhere. A battery indicator should be installed on the lead acid charger circuit to overcome the Efficiency loss on the rechargeable batteries. Therefore, a constant charge rate current will be flowing so that the result of time for charging the lead acid battery will be more accurate and shorter. We feel this project has taught us the value of planning ahead, the value of a finding (and using) an industry mentor, and the difficulties unique to multidisciplinary embedded system designs (utilizes power, software, hardware, large signal, small signal). We have learned that the most influence you can have in your project is at the very beginning, so a strong understanding of your design goals and a pathway to success are vital to project completion. Although we had met over the summer and established a general understanding of how lead acid battery charger should work. To sum up, the progress we made on the project this year, though considerable, was ultimately hampered by scope broadening, time scheduling, and insufficient tools/knowledge for (recommending breadboard). Hopefully, next semester's students will benefit from our extensive documentation and make some research on how to improve and develop the circuit to work automatically.

REFERENCE

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