# 벅 컨버터를 이용한 정전류 정전압 배터리 충전기

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# Constant Current & Constant Voltage Battery Charger Using Buck Converter

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## ABSTRACT

The proposed battery charger presented in this paper is suitable for Lead Acid Battery and the dc/dc buck converter topology is applied as a charger circuit. The technique adopted in this charger is constant current & constant voltage dual mode, which is decided by the value of voltage of proposed battery. Automatic mode change function is detected by the percentage value of level of battery charging. CC Mode (Constant Current Mode) is operated when charging level is below 80% of the total charging of Battery voltage and above 80% of battery voltage charging, CV Mode (Constant Voltage Mode) is automatically operated. As the charging level exceeds 120%, it automatically terminates charging. The feedback signal to the PWM generator for charging the battery is controlled by using the current and voltage measurement circuits simultaneously. This technique will degrade the damage of proposed type of battery and improve the power efficiency of charger. Finally, a prototype charger circuit designed for a 12 V 7 Ah lead acid battery is constructed and tested to confirm the theoretical predictions. Satisfactory performance is obtained from simulation and the experimental results.

## 1. Introduction

Recently, portable electronic products are rapidly proliferating. Battery is one of the most popular energy-storage devices among these products. Lead acid batteries have been employing for diverse applications. Most of the world's lead acid batteries are automobile starting, lighting and ignition (SLI) batteries. Lead acid batteries are used in emergency lighting in case of power failure as well..

In fact, there has been a great deal of research and interests in developing faster and more efficient methods for charging the batteries. Charging can be accomplished by various methods. The conventional charging methods includes constant current (CC) charging method and constant voltage (CV) charging method. Constant current charging does not change appreciably in magnitude, regardless of battery voltage or temperature. The battery is charged at the low charging rate. This charging scheme may prolong the charging time. In the constant voltage charging, the initial charging current is normally high. So the heating effect may damage the plate and shorten the life of the assembled batteries.

Therefore, constant current & constant voltage charging method is proposed for charging the lead acid batteries. The charging method comprise of two charging modes. In the initial charging mode, the battery chargers provide constant charging current until the terminal voltage increases up to a setting value. Once it reaches to the setting voltage, the charging current decreases until the battery is completely charged. Therefore, voltage regulation is an important aspect of constant voltage charging.

## 2. Contents

### 2.1 THE PROPOSED SYSTEM AND CHARGING ALGORITHM

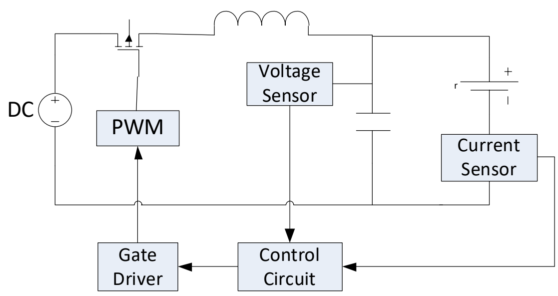


Fig. 1. Block diagram of proposed Battery Charger

#### 2.1.1 Control Method

The block diagram of the proposed charging system is shown in fig. 1.The input supply voltage of buck converter is 24V and the required maximum output voltage is 14.4 Voltage. The nominal voltage of the battery is 12V (i.e., When the charging voltage reached at 12V which is equivalent to 100% charging). The proposed battery can be charged up to 14.4V which is 120% of the nominal voltage.

During charging stage, first of all, the current and the voltage of the battery is sensed by current sensor and voltage sensor simultaneously and the PWM signal is con trolled accordingly. The current value is limited to 1.4A

### 2.1.2 CC Mode

When the battery voltage is detected less than 9.6V i.e. less than the 80% of the nominal voltage. The charger operates in the CC Mode. In CC Mode, Battery Voltge or $V_{fb}<V_{set}$, the error voltage is too large so that the voltage controller is in a disable status and therefore, the battery voltage increases linearly to the desired value. The current in the feedback is very close to setting current $I_{set}$, therefore, the error current $I_{err}$ is small, the current controller is dominant action. At the same time, the charging current is regulated to the preset value.

### 2.1.3 CV Mode

When the voltage of the battery exceeds than 9.6V i.e. more than the 80% of the nominal voltage and less than 14.4V i.e., 120% of the nominal voltage. The charger operates in the CV Mode. The voltage of the battery in the feedback is very close to the setting voltage Vset and therefore, the error voltage $V_{err}$ is small. At this time, the battery voltage is constant value .The feedback current, $I_{fb}$ is smaller than the setting current $I_{set}$ and the error current $I_{err}$ is large, the charging current decreases linearly to the desired value.

### 2.1.4 Flow Chart for Charging Modes

The flow chart for the proposed strategy is shown in fig. 2. The first step for the charging control is to determine whether the charging voltage exceeds 9.6V. If the condition is false, it automatically detects the CC mode. The PWM signal is controlled continuously and again check for the voltage level 9.6. If the voltage level exceeds 9.6V then it detects CV mode until the charge voltage reached to 14.4V by the gradual control of PWM signal. If the voltage level exceeds 14.4V the charging phenomenon should be stopped automatically.

### 2.1.5 Proposed Topology & Simulation Result

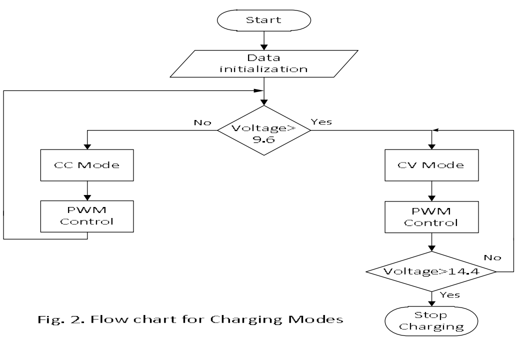


Fig. 2. Flow chart for Charging Modes

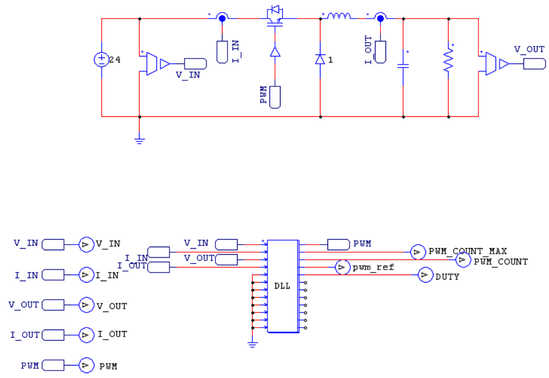


Fig. 3 Simulation circuit diagram using PSIM

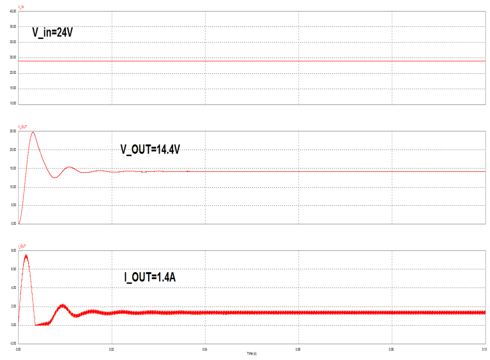


Fig. 4 Simulation wave pattern of Proposed circuit

## 3. Conclusion

DC DC buck converter topology is applied for the implementation of the proposed battery charger. Battery Charger circuit is designed in the basis of controlling the feedback current and feedback voltage signal simultaneously. The technique adopted in this charger is automtic mode detection system which will help to degrade the damage of proposed type of battery and improve the power efficiency of charger.

PWM technique has been incorporated for the precise and smooth charging of the lead acid battery which also prolongs the battery life.

## References

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