

**THE DESIGN OF EMERGENCY LIGHT AND ALARM SYSTEM**

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**REPORT OF PSM  
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**DESIGN OF EMERGENCY LIGHT AND ALARM SYSTEM**

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

In the name of Allah, The Beneficent, The Merciful.

Alhamdulillah, all praise is to Allah that I have been able to complete my progress report for my Final Year Project that is The Design of Emergency Light and Alarm System.

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## ABSTRACT

This project is to design an emergency light and alarm system when there is blackout. This is to avoid total darkness or to give alarm when there is power outage. This project gives two choices to the user that is to illuminate lamp or an alarm sounder. It runs automatically when power outage occurs. As we know, blackout happens when there is power outage, to operate in this condition, the circuit uses dc voltage from batteries thus the circuit does not only depend on ac power. But the batteries themselves depend on the ac power. The circuit is permanently plugged into a mains socket to charge the batteries. The project is powered by two AA NI-CD batteries with four switchable options. This report is part of the FYP. This report is submitted for FYP 2. The report includes introduction, literature review, theory in the project, preliminary experiment result, discussion, recommendations and conclusion.

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## CHAPTER I

### INTRODUCTION

#### 1.1 Project Overview

This project is to develop an emergency light and alarm system. As mentioned earlier, the emergency light and alarm system are already commercially available; it is the wiring system which constitutes the actual invention. This project comprises of two mains part that is the power supply circuit and the purposely-designed control circuit that includes two systems that is emergency light and alarm system. Although the project seems easy or simple, it will bring a great beneficial to human as a user. The product is developed to help humans' life to be more safe and easy. This product is small and light weight compare than available in market. In can easily be assemble and installed anywhere such as toilet, hallway and house because the cost of the product is considerable and affordable.

About the project, the lighting and alarm system is designed for connection to the mains power supply in a building. During normal operation of the mains power, the lights are inoperative and a built-in rechargeable battery is maintained at full capacity from the mains power supply. However, should the mains supply be cut off – as in the case of a blackout, the emergency lights or alarm system will automatically come on and provide lighting or sound for several hours from its battery power. The alternating current (AC) voltage is converted to direct current (DC) voltage and the AC 240Volt is step down to About 9Volt. Rather than using a transformer, the product used a more



simple way to step down the voltage as we will discuss further on other chapter. As mentioned before, when a power outage occurs, the lamp automatically illuminates. Instead of illuminating a lamp, an alarm sounder can be chosen. When power supply is restored, the lamp or the alarm is switched-off. A switch provides a "latch-up" function, in order to extend lamp or alarm operation even when power is restored.

## **1.2 Objective Project**

There are many main objective of doing this project. The main purpose of this project is to design and develop emergency light and alarm system that combines the knowledge of electrical and electronic. The main objectives of this project are:

- To design the bridge diode circuit.
- To understand the basic operation of circuit
- To design the circuit and make the circuit operational.
- Full circuit of emergency light and alarm system will be developed.

## **1.3 Problem Statement**

The inspiration behind the invention of this emergency light and alarm system being made aware of situations where blackouts and power outage have caused death. This is because power outage happen under many causes such as fire or short circuit. Some cases those deaths may have been prevented if the building occupants had had an emergency light or an alarm system to make it easier to evacuate the building.

A power outage can happen anywhere and anytime. It means that at home, office or factory at daylight or night. Blackouts are very dangerous at those places because in the dark, humans have very limited eyesight and at some place no eyesight at all and sudden blackout will drive some people to panic.

This emergency light and alarm system is designed to avoid problems such as blackout. It will give some eyesight for the people to go to exit door in case of emergency or to avoid mishap like crashing with thing on floor. An alarm sounder can be chosen to tell someone power outage situation. Moreover, the emergency light system is a bit expensive for ordinary use such as for home use and does not included and alarm system.

#### **1.4 Scope of the Project**

- To design the circuit and combine multiple theory to create an Emergency light and alarm system:
  - ✓ Fullwave bridge diode
  - ✓ Smoothing capacitor
  - ✓ Forward and reverse bias of bipolar Junction Transistor
- To do analysis and experiment on the circuit with multisim or other software
- To make a full report.

## CHAPTER II

### LITERATURE REVIEW

This chapter will discuss the literature review according to the Electrical circuit and electronic devices that are usually studied by UTeM students. It will also include all the knowledge and information while developing this project. The information is from websites, books, journals and articles. It also includes the differences between other emergency light projects.

#### 2.1 Rectifier

There are 2 types of circuit that will produce full-wave rectification:

- Full-wave Rectifier
- Bridge Rectifier.

In this project, bridge rectifier is chosen as part of the circuit. The explanation of full-wave rectifier and bridge rectifier will be discussed in this chapter.

##### 2.1.1 Full-wave Rectifier

In a full-wave rectifier circuit, two diodes are now used together with a transformer whose secondary winding is split equally into two and has a center tapped connection **C**. Each diode conducts in turn when its anode terminal is positive with respect to the center point **C** as shown below.

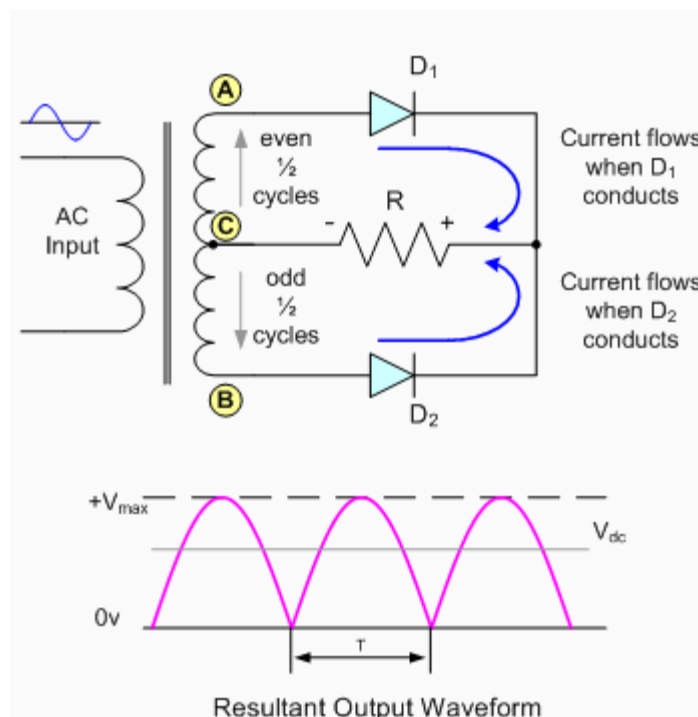


Figure 2.1 : Full-wave rectifier circuit and waveform

The circuit consists of two Half-wave rectifiers connected to a single load resistance with each diode taking it in turn to supply current to the load. When point **A** is positive with respect to point **B**, diode D<sub>1</sub> conducts in the forward direction as indicated by the arrows. When point **B** is positive (in the negative half of the cycle) with respect to point **A**, diode D<sub>2</sub> conducts in the forward direction and the current flowing through resistor R is in the same direction for both circuits. As the output voltage across the resistor R is the sum of the two waveforms, this type of circuit is also known as a "bi-phase" circuit.

As the spaces between each half-wave developed by each diode is now being filled in by the other diode the average DC output voltage across the load resistor is now double that of the single half-wave rectifier circuit and is about  $0.637V_{\max}$  of the peak voltage, assuming no losses.

$$V_{d.c} = \frac{2V_{max}}{\pi} = 0.637V_{max} = 0.9V_s$$

The peak voltage of the output waveform is the same as before for the half-wave rectifier provided each half of the transformer windings have the same root mean square (RMS) voltage value. To obtain a different DC voltage output different transformer ratios can be used, but one main disadvantage of this type of rectifier is that having a larger transformer for a given power output with two separate windings makes this type of circuit costly compared to a "Bridge Rectifier" circuit equivalent.[1][5]

### 2.1.2 The Bridge Rectifier

This type of single phase rectifier uses 4 individual rectifying diodes connected in a "bridged" configuration to produce the desired output but does not require a special center tapped transformer, thereby reducing its size and cost. The single secondary winding is connected to one side of the diode bridge network and the load to the other side as shown in figure 2.2

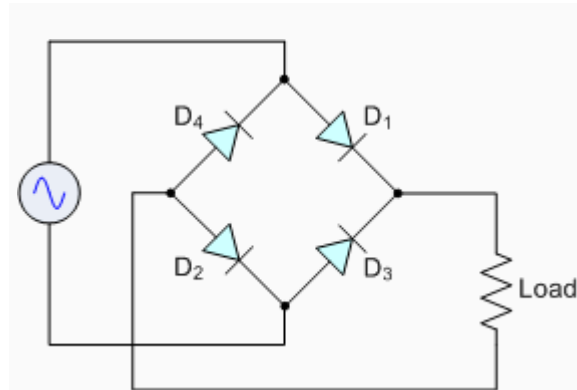


Figure 2.2: Diode Bridge Circuit

The 4 diodes labeled  $D_1$  to  $D_4$  are arranged in "series pairs" with only two diodes conducting current during each half cycle. During the positive half cycle of the supply, diodes  $D_1$  and  $D_2$  conduct in series while diodes  $D_3$  and  $D_4$  are reverse biased and the current flows through the load as shown below.

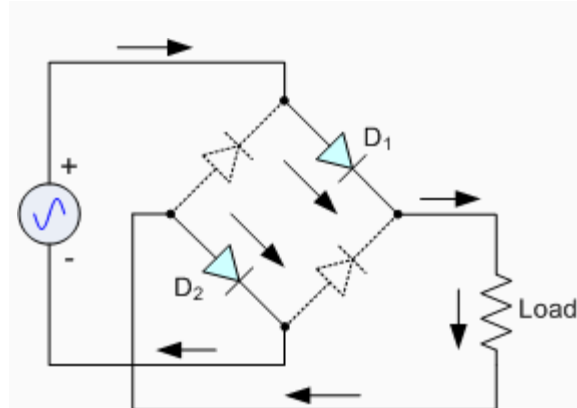


Figure 2.3: The positive cycle flow

During the negative half cycle of the supply, diodes  $D_3$  and  $D_4$  conduct in series, but diodes  $D_1$  and  $D_2$  switch off as they are now reverse biased. The current flowing through the load is the same direction as before.

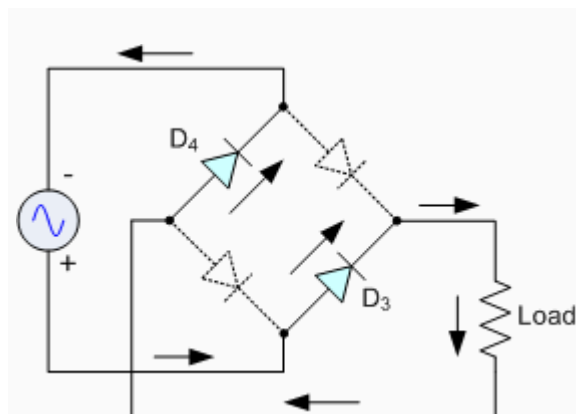


Figure 2.4: The negative half-cycle flow

As the current flowing through the load is unidirectional, so the voltage developed across the load is also unidirectional the same as for the previous two diode full-wave rectifier, therefore the average DC voltage across the load is  $0.637V_{\max}$  and the ripple frequency is now twice the supply frequency (e.g. 100Hz for a 50Hz supply).[1]

## 2.2 Basic Theory for capacitor as a filter

In order to understand how the filter capacitor works, consider the simple capacitor. It consists of two conductive plates, separated by an air space. A wire is attached to each plate. There is no connection between the two plates. This explanation uses electron flow, not conventional flow. In Figure 2.5, connected capacitor to a power supply and inserted a current limiting resistor. With the switch open and the capacitor discharged, the electrons in the conductive plates are evenly spread throughout the plates and there is the same number of electrons in each plate. Electrons repel each other, and this is why they spread evenly. Electron flow in Figure 2.5, we close the switch. Suddenly, there is a voltage pressure across the two plates. Electrons rush off the upper

plate and gather on the lower plate. This creates a sudden high current as the electrons rush through the power supply to change plates. Remember that electrons repel each other. As more and more electrons collect on the lower plate, they are forced closer together. This causes a reverse pressure to build as more and more electrons are forced into the plate. As the reverse pressure builds, the current flows slow down and stops when the reverse pressure is equal to the power supply voltage. Now the upper plate is positive and is deficient in electrons and the lower plate is negative and has an excess in electrons.

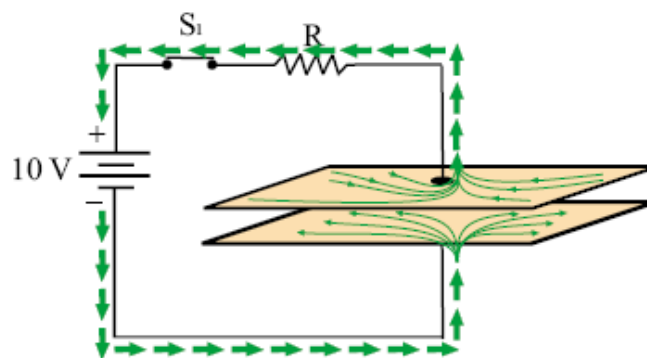


Figure 2.5: The capacitors theory

In Fig. 2.6, the switch is now opened. Even though the power supply is disconnected from the capacitor, the voltage across the capacitor remains at 10 V. The top plate is still positive and is deficient in electrons; and the bottom plate is still negative and has an excess of electrons. The capacitor is in a charged state and will remain there as long as there is no leakage path for the electrons to escape from the bottom plate and return to the top plate. Between the plates, there exists an electrostatic field of attraction, since one plate is positive and the other negative. If we were to increase the supply voltage to 20 V and then closed the switch again, a current would flow again from the positive to the negative plate. More electrons would be forced into the negative plate and the same number of electrons would be forcibly removed from the positive plate. The process would continue and the reverse pressure would increase until it matched the supply pressure. As the pressures become equal, the current will trickle down and stop. The voltage pressure between the plates is now 20V, double what it was before we increased the supply voltage.