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Implementation of Full Wave Bridge Rectifier Using Diodes

B. karthik, UG Student, Dept. of ECE, GIET University, 23ece023.budumurukarthik@giet.edu,
B. Harshavardhan, UG Student, Dept. of ECE, GIET University, 23ece048.bewaraharshavardhan@giet.edu,
CH. Eswar Rao, UG Student, Dept. of ECE, GIET University, 23ece003.cherukurueswarrao@giet.edu,
CH. Vivek Santho, UG Student, Dept. of ECE, GIET University,
23ece072.chandravamsamviveksantho@giet.edu

Abstract: The objective of the project "Full Wave Rectifier Bridge Type Using Diodes" is the design and development of a full-wave rectification circuit that takes AC and converts it to DC. A widely used configuration in bridge rectifiers employs four diodes arranged in a bridge topology for efficient rectification. The main difference of half-wave rectifiers using only one half of the AC waveform against the full-wave rectifier using the both sides results in smoother output DCs. This project is going to demonstrate the working principle of the bridge rectifier, how it performs the AC to DC conversion operation, and some applications of this device in electronic circuits. The major components of the circuit would be four diodes, with a step-down transformer for decreasing the level of the AC input voltage, and a filtering capacitor for smoothing the waveform at the output. In a bridge rectifier, power can be more efficiently converted with little ripple compared to half-wave rectification. The expected outcomes include successful AC rectification into DC, ripple effect analysis, and understanding of how filtering improves the output. Another aspect highlighted is the importance of full-wave rectification in practical applications such as the power supply of electronic devices, charging of batteries, and other applications that have DC.

Keywords: **AC Source; Bridge Diode; Cathode Ray Oscilloscope; LED; Connecting Wires; Resistor.**

INTRODUCTION

The conversion of alternating current (AC) to direct current (DC) is a vital process in modern electronics, enabling the operation of a wide array of devices from household appliances to complex electronic systems. The project titled "Full Wave Rectifier Bridge Type Using Diodes" focuses on the design and development of a full-wave rectification circuit that effectively transforms AC into DC using a bridge configuration of diodes. This method employs four diodes arranged in a bridge topology, allowing for the utilization of both halves of the AC waveform. As a result, it delivers a smoother and more stable DC output compared to traditional half-wave rectifiers, which only use one half of the waveform.

The primary components of this circuit include four diodes, a step-down transformer to reduce the AC input voltage, and a filtering capacitor that smooths the output waveform. The step-down transformer decreases the voltage to a manageable level, ensuring the safety and efficiency of the circuit. The filtering capacitor plays a crucial role in minimizing ripple in the output, enhancing the quality of the DC signal.

This project aims to demonstrate the working principles of the bridge rectifier, illustrating how it performs the AC to DC conversion operation. Additionally, we will analyze the ripple effect and the importance of filtering in improving output quality. The expected outcomes include successful rectification, a thorough understanding of ripple analysis, and insights into the practical applications of full-wave rectification in electronic circuits. These applications encompass power supplies for various devices and battery charging systems, highlighting the significance of efficient rectification in contemporary technology. Through this project, we will underscore the essential role of full-wave rectification in delivering reliable power for

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everyday electronic needs.

1. DESIGN:

This is the full-wave rectifier setup that would turn AC into DC by utilizing a bridge-type rectifier, BR1, comprising four diodes configured such that both halves of the AC waveform pass through but the current direction remains the same. An AC voltage source, V1, supplies an input signal that is transformed by the rectifier into a pulsating DC output. Points A, B, C, and D are monitoring points in various stages of the waveform: pure AC A, pulsating DC D. LED D1 connected with 100-ohm resistor R1 will light up if DC current flows; hence it acts like an indicator for the output of rectifier. If a smoothing capacitor is added, some of the ripples would be smoothed out.

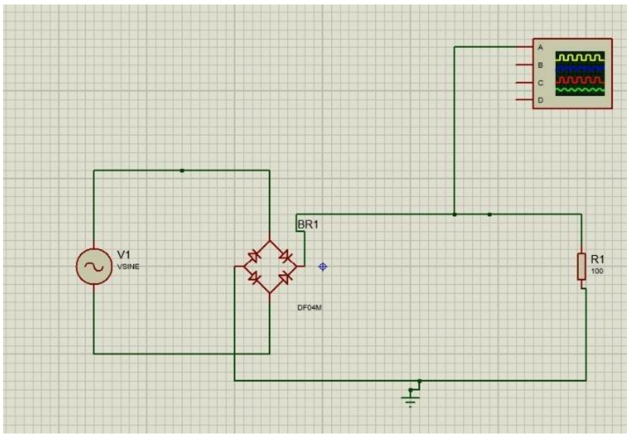

Figure 1: Design of Full Wave Rectifier

2. SIMULATION:

Proteus software version 8.11 was used to simulate the full wave rectifier. All the components are placed perfectly in the Porteous software. Then, all components are connected as per requirement**.**

Simulation Setup

Sl. No.	**Parameters Name**	**Specifications**
1	AC Source	50 Hz, 10 V
2	Diodes	DF04M
3	Resistor	10 Ω

3. RESULT ANALYSIS:

The main application of a full-wave rectifier circuit is to take an AC input signal and turn it into a smooth DC output. However, the resulting DC output usually contains some amount of ac ripple superimposed over the base DC level of the output. There are several approaches to improving the performance of the circuit mainly targeted towards: First, reduction of ripple can be achieved − by placing a smoothing capacitor of larger value across the output terminals which charges on the spikes of the rectified output and discharges in the troughs helping to cut

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down the ripple. Bigger capacitors may mean better smoothing but the usage of exceptionally bigger capacitors may bring problems of inrush currents and long periods of charging time. Diodes having low junction capacitances can also come in handy, especially, in high ends in reducing noise due to switching operations. To minimize the DC offset, it is possible to use Schottky diodes with very low forward bias voltage drop as this leads conduction at lower voltage closer to clean DC. When diode characteristics are well matched, each half of the cycle conducts uniformly and thus there is no asymmetry and offset in the output. Also, selected component ratings are important, for example, when a transformer is used it has to be rated correctly for the load voltage and current so that it does not overheat, and the diodes have to be rated for not less than peak AC voltage and current to be able to withstand the conditions. Performance is also influenced by the load resistance since low resistance creeps in excess current (probably ripple too), high resistance curtails ripple but some loads may not be able to draw that current. Employing other auxiliary means, for example inductive filtering, which is accomplished by mounting an inductor in series with the load where it is assisted by a capacitor as this forms an LC filter, helps in smoothing the output also by opposing change in the rate of current. Voltage regulators can also be included to control the output voltage concerning the load and the ripple factor required for such applications are very low.

I. Peak Output Voltage (Vo, peak) = $Vs, peak - 2Vf$

II. RMS Output Voltage (Vo, rms) = $\frac{Vs,peak}{\sqrt{2}} - Vf$

III. Average DC Output Voltage (Vo, avg) = $\frac{2Vs,peak-2Vf}{\pi}$

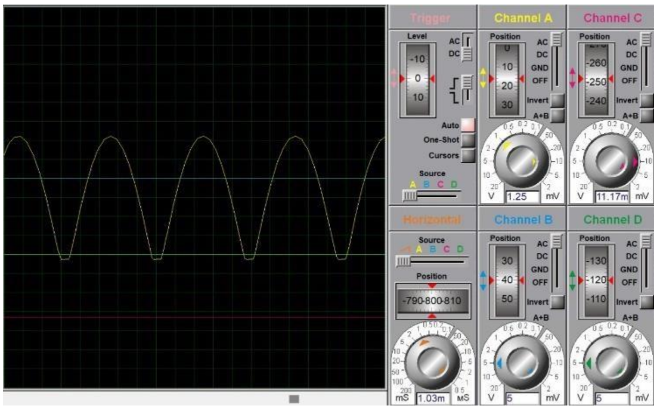

Figure 2: Output waveform

Reduction in ripple factor in addition to increasing the former. Thus it can offer good DC output using a correct smoothing capacitor to go on with. Further, as the supply fluctuation increases, this gives a DC load an increase in improved stability of supplies and diminishes fluctuations in the form of spikes affecting sensitive units. While four diodes raise a very small forward-voltage drop across each resulting in slightly reduced output overall, using low-forward voltage- drop diodes such as Schottky diodes may offset this loss in addition to the fact that this bridge rectifier form gives more stability and may have more power-handling ability compared to a one-diode half-wave due to distributing the current to each of the four. In case the application demands even lesser ripple, an LC or RC filter can be tacked to the output for further smoothing of the output, or a voltage regulator can be added to the circuit to stabilize the voltage against input fluctuations. Altogether, a full-wave bridge rectifier gives

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efficient, stable, and smooth DC supply for many applications with all these advantages packaged into a compact circuit.

4. CONCLUSION

A full-wave bridge rectifier is one of the most widely used and efficient converting circuits for alternating current into direct current. It contains four diodes in bridge configuration, making it a circuit where both halves of the AC input cycle could contribute to the output current, thus resulting in more average DC output than if it were a half-wave rectifier, and then it is used in specific applications that require a stabilized.

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