2024-25

PHYSICS INVESTIGATORY PROJECT

Topic: Rectification Techniques: Full-Wave Rectifiers

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Roll no.:

CERTIFICATE

This is to certify that Aditya Raj of Class XII - Science has completed the project “Rectification Techniques: Full-Wave Rectifiers”.

The project is the result of their Efforts and Endeavor. The project is found worthy of acceptance as the final project for the subject of Physics of class XII.

Internal Examiner **External Examiner**

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to my Physics teacher, Mr. hata diya bhadwe, for his exceptional guidance, unwavering support, and extensive knowledge throughout the completion of my physics investigatory project on Rectification Techniques: Full-Wave Rectifiers.

I would also like to thank my parents for their unwavering support and encouragement throughout this project. Their guidance and motivation were invaluable in helping me complete this project.

Finally, I would like to thank my classmates for their support and encouragement throughout this project. Their feedback and suggestions helped me improve the quality of my work.

AIM

To construct a Full Wave Bridge rectifier and show that the (AC) alternating current is rectified into a direct current (DC).

The aim is to-

1. Understand Rectification
2. Explain Bridge Full Wave Rectification

CONTENTS

INTRODUCTION

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification. Rectification produces a type of DC that encompasses active voltages and currents, which are then adjusted into a form of constant voltage DC, although this varies depending on the current's end-use. The current is allowed to flow uninterrupted in one direction, and no current is allowed to flow in the opposite direction.

Physically, rectifiers take a number of forms, including vacuum tube diodes, mercury-arc valves, copper and selenium oxide rectifiers, semiconductor diodes, silicon-controlled rectifiers, and other silicon-based semiconductor switches.

Rectifier circuits may be single-phase or multi-phase. Most low-power rectifiers for domestic equipment are single-phase, but three-phase rectification is very important for the transmission of energy as DC.

THEORY

In half-wave rectification, either the positive or negative half of the AC wave is passed, while the other half is blocked. Because only one half of the input waveform reaches the output, it is very inefficient if used for power transfer.

A full-wave rectifier is similar to the half-wave, but allows unidirectional current through the load during the entire sinusoidal cycle (as opposed to only half the cycle in the half-wave). A full-wave rectifier converts the whole of the input waveform to one of constant polarity (positive or negative) at its output.

In this project, the aim is to construct a Full Wave Bridge rectifier and demonstrate that alternating current (AC) is rectified into direct current (DC).

The objectives are to:

- Understand rectification.
- Explain bridge full-wave rectification.

Full Wave Bridge Rectification

A bridge rectifier is a type of full-wave rectifier that uses four diodes arranged in a bridge configuration. During each half-cycle of the AC input, two of the diodes conduct, allowing current to flow through the load in the same direction. This design enables the conversion of both halves of the AC waveform into a unidirectional current, thus increasing the efficiency of power transfer compared to a half-wave rectifier.

Working Principle

In the positive half of the AC input, two of the diodes conduct to allow the current to flow through the load. During the negative half-cycle, the other two diodes conduct, maintaining the same direction of current through the load. As a result, the output is a pulsating DC voltage, which can be smoothed using a capacitor to obtain a nearly constant DC output.

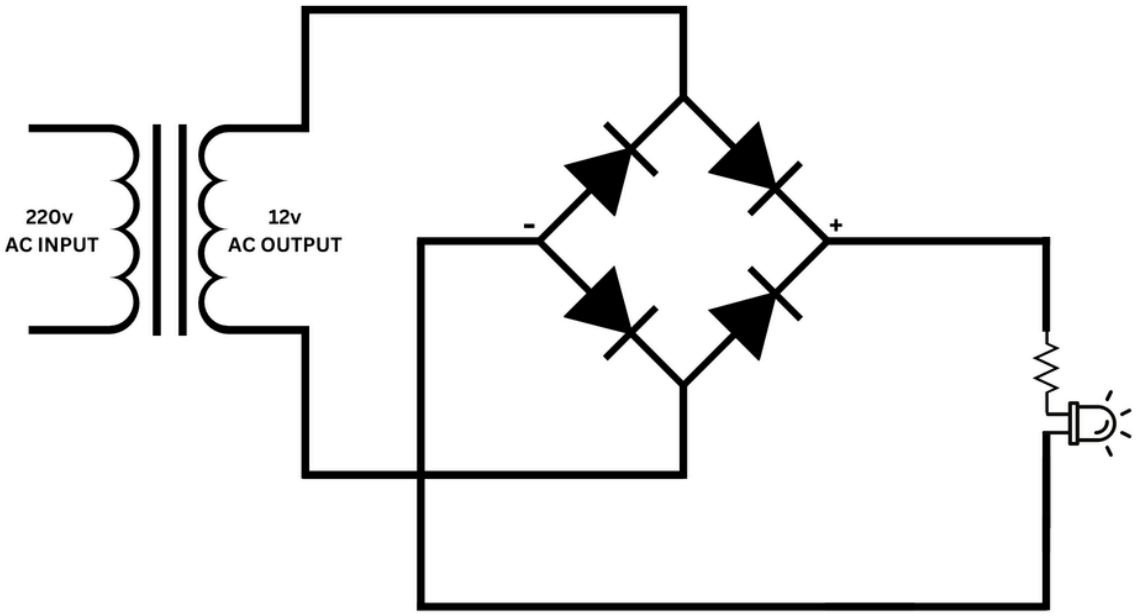
By constructing and analyzing a Full Wave Bridge rectifier, the process of rectifying AC to DC and understanding the components involved in bridge rectification can be effectively demonstrated.

MATERIALS REQUIRED

- Connecting Wires
- A Plug
- A transformer (12v, 500mA)
- A resistor 820Ω
- p-n junction diodes 1N4007 (4 nos)
- A LED
- Insulation Tape
- Soldering Iron
- Solder wire

CIRCUIT DIAGRAM

Circuit diagram of a full wave rectifier:



PROCEDURE

Set Up the Transformer:

- Connect the primary winding of the transformer to the 220V AC power supply. This will step down the voltage to 12V AC on the secondary side.

Connect the Diodes:

- Arrange four diodes (D1, D2, D3, and D4) in the configuration of a bridge rectifier.
- Connect the anode of D1 and the cathode of D3 together, and the anode of D2 and the cathode of D4 together. These two junctions will be connected to the secondary terminals of the transformer.
- The cathodes of D1 and D2 should be connected together to form the positive output terminal.
- The anodes of D3 and D4 should be connected together to form the negative output terminal.

Connect the Load:

- Connect the load resistor across the output terminals of the bridge rectifier. The positive end of the load should be connected to the common cathode of D1 and D2, while the negative end should be connected to the common anode of D3 and D4.

Power Up the Circuit:

- Once all connections are in place, turn on the AC power supply to allow a 220V AC to flow into the transformer. The transformer will step down this voltage to 12V AC.

Observe the Rectification:

- The AC voltage from the transformer's secondary winding will be converted to pulsating DC voltage by the bridge rectifier.
- During the positive half-cycle of the AC input, diodes D1 and D2 will conduct, allowing current to flow through the load in one direction.
- During the negative half-cycle, diodes D3 and D4 will conduct, allowing current to flow through the load in the same direction as the positive half-cycle.
- The output voltage across the load will be a full-wave rectified DC signal.

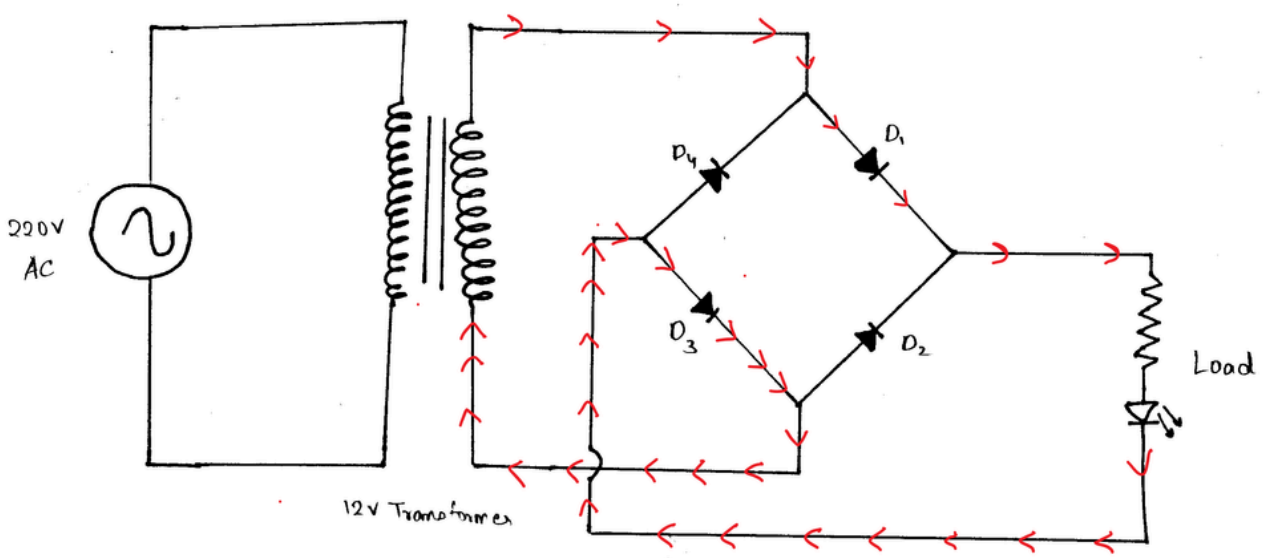
Measure the Output:

- Use a multimeter to measure the output voltage across the load. You should observe a DC voltage with ripples, which demonstrates that AC has been converted to DC.

WORKING

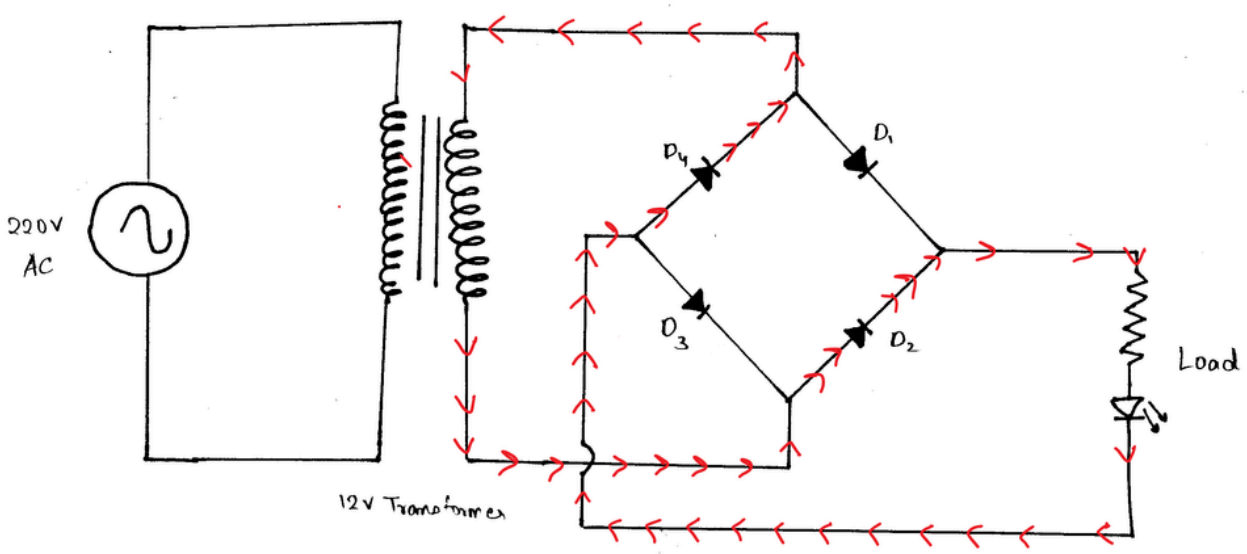
When the AC is supplied to the transformer, it step down the 220V main supply to 12V. It has a capability of delivering 500mA. The 12 volts AC appearing across the secondary is the RMS value. The four diodes labelled D1 to D4 are arranged in “series paris” with only two diodes conducting current during each half cycle. The four diodes labelled D1 to D4 are arranged in “series pairs” with only two diodes conducting current during each half cycle. During the positive half cycle of the supply, diodes D1 and D2 conduct in series while diodes D3 and D4 are reverse biased and the current flows through the load as shown below.

The positive Half-cycle:



During the negative half cycle of the supply, diodes D3 and D4 conduct in series, but diodes D1 and D2 swtich “OFF” as they are reverse biased. The current flowing through the load is the same direction as before.

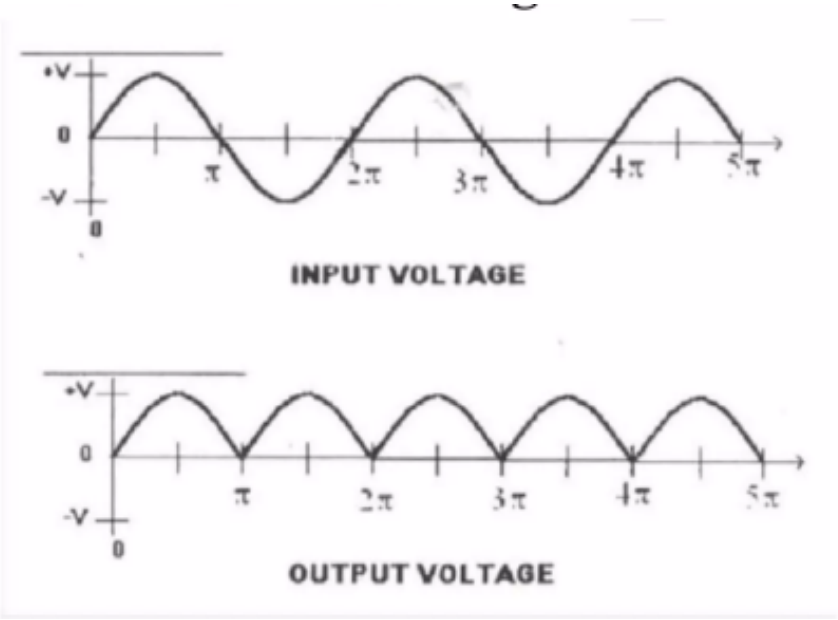
The Negative Half-cycle:

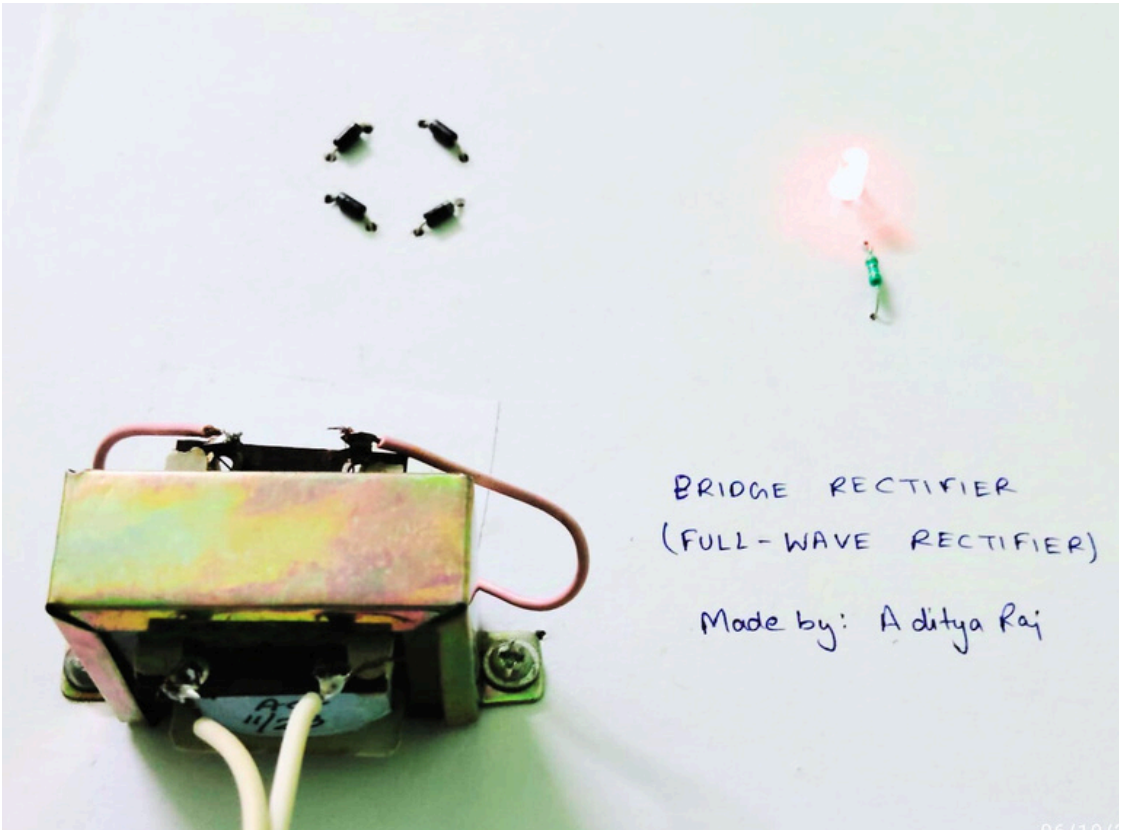


In subsequent Half cycles of the AC Current the above process are repeated. In both the half cycles it is clear that current flows through the resistor in only one direction. Even though the voltage across the load is unidirectional. A resistor is used to adjust the output voltage for the LED. The output Direct Current and voltage light up the LED and other source connected with it.

OBSERVATION AND RESULT

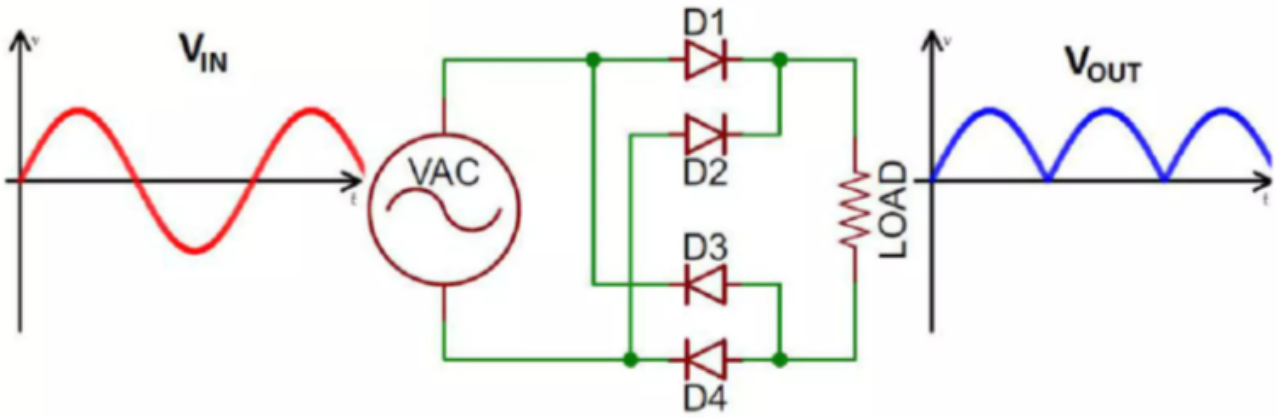
The measured output of the rectifier circuit is 6.51V, while the theoretical value should be 12V DC. This discrepancy is due to transformer voltage variations and the voltage drop across the diodes.





CONCLUSION

Rectifiers are found in all power supplies that operate from an AC voltage source. Also the rectifier is used as a power supply unit. The rectifer converts the AC input voltage to a DC voltage.



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