

Heaven's Light is Our Guide
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Lab Report 3:
Study of 3- Φ Star Rectifier using Diode with R, RL Load

Submitted to
Md. Faysal Ahamed
Lecturer
Dept of ECE, Ruet

Submitted by
Md. Tajim An Noor
Roll: 2010025

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Study of 3- Φ Star Rectifier using Diode with R, RL Load

Theory

A three-phase star rectifier is a type of rectifier circuit that converts three-phase AC (Alternating Current) input into DC (Direct Current) output. This type of rectifier is commonly used in industrial applications due to its efficiency and ability to handle high power levels [1].

In a three-phase star rectifier, diodes are arranged in a star configuration. Each phase of the AC supply is connected to a diode, and the other ends of the diodes are connected together to form the DC output. The rectifier can be used with different types of loads, such as resistive (R) and inductive-resistive (RL) loads [2].

When a resistive load is used, the current through the load is in phase with the voltage, resulting in a purely resistive circuit. However, when an inductive-resistive load is used, the current lags behind the voltage due to the inductance, creating a more complex circuit behavior [3].

MATLAB/Simulink is a powerful tool for simulating and analyzing the performance of such rectifier circuits. By using MATLAB/Simulink, we can model the three-phase star rectifier and observe the output waveforms for different load conditions. This helps in understanding the behavior of the rectifier and optimizing its performance for various industrial applications [4].

Required Equipments/Software

- MATLAB/Simulink
- Oscilloscope
- AC Voltage Source

- Thyristor
- Series RLC Branch
- Pulse Generator
- Measurement Tools

Circuit Diagrams

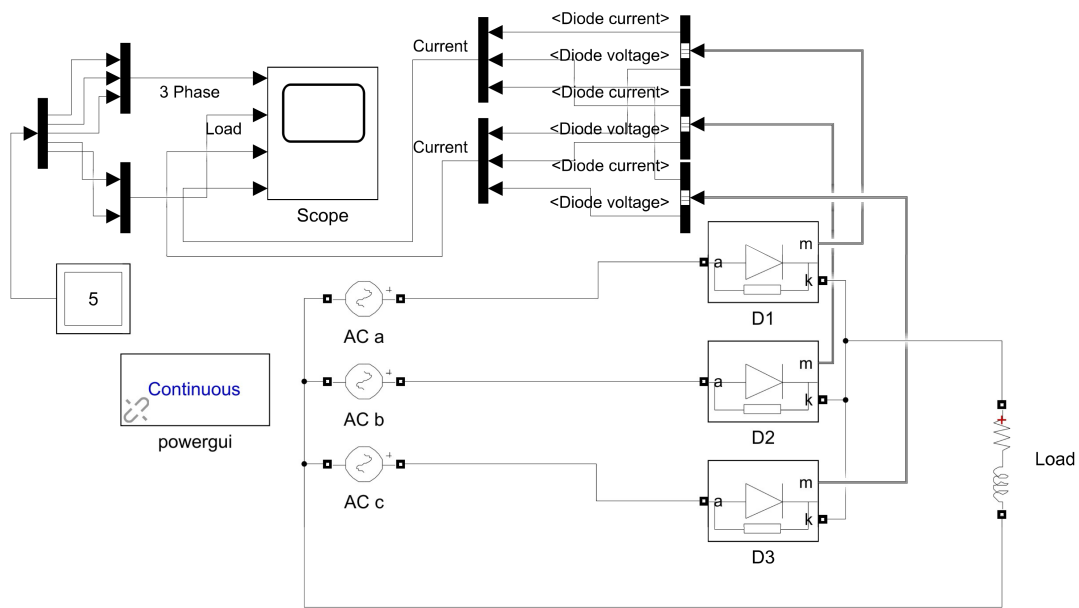


Figure 1: Diode with Resistive Load

Observations

- The output voltage for the R load is a pulsating DC with a frequency 6 times the input AC.
- With gate voltage delay for the thyristor and R load, the output voltage shows a delayed conduction angle, reducing the average output.
- For the RL load, the output voltage is pulsating DC, with the current lagging due to inductance.
- Gate voltage delay for the thyristor with RL load results in a delayed conduction angle and a more pronounced current lag.
- MATLAB/Simulink aids in analyzing and visualizing the rectifier's performance under different loads.

Outputs

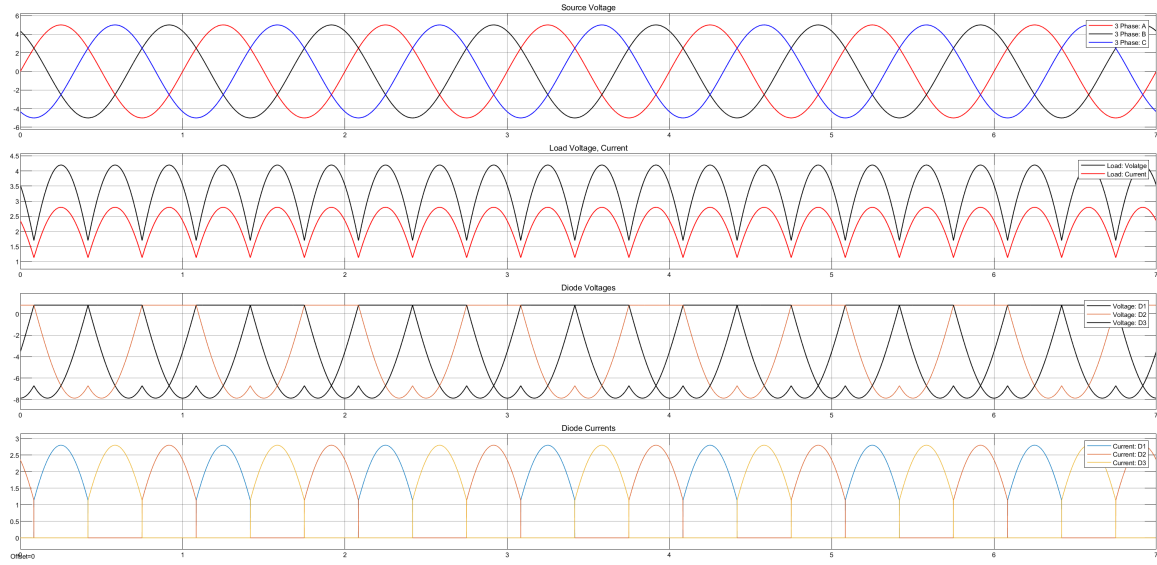


Figure 2: Simulation Output for R Load, 3 Phase Bridge Rectifier

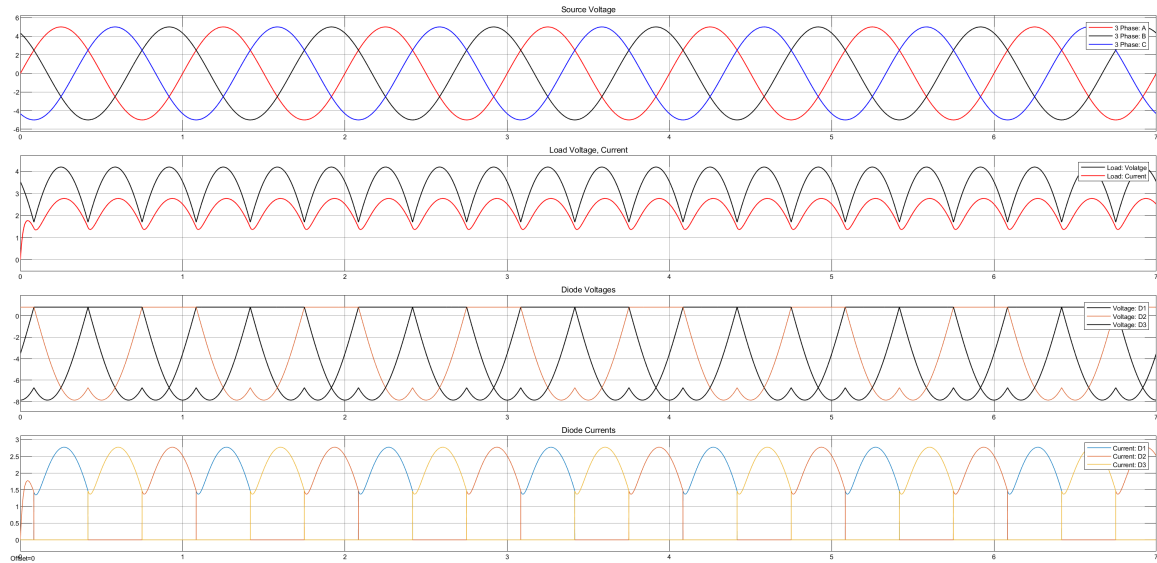


Figure 3: Simulation Output for RL Load, 3 Phase Bridge Rectifier

Discussion

The three-phase star rectifier is a versatile circuit that can be used with different types of loads to convert AC input into DC output. By using MATLAB/Simulink, we can model the rectifier and analyze its performance under various conditions. The output voltage and current waveforms can be observed to understand the rectifier's behavior and optimize its performance for different industrial applications.

Conclusion

The study of the three-phase star rectifier using diodes with R and RL loads provides valuable insights into the rectifier's behavior under different load conditions. By analyzing the output waveforms using MATLAB/Simulink, we can optimize the rectifier's performance and ensure efficient power conversion in industrial applications.

References

- [1] M. H. Rashid, *Power Electronics: Circuits, Devices, and Applications*, 4th ed. Pearson, 2013.
- [2] B. K. Bose, "Three-phase rectifier circuits: Analysis and design," *IEEE Transactions on Industrial Electronics*, vol. IE-32, no. 3, pp. 269–278, 1985.
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- [4] S. T. Karris, *Introduction to Simulink with Engineering Applications*, 2nd ed. Orchard Publications, 2006.