Project 01

Design of Series and Shunt Voltage Regulator Circuit Using Basic Electronic Devices

Objectives

The aim of this project is to design, construct, and analyze **series and shunt voltage regulator circuits** utilizing **Zener diodes** and **Bipolar Junction Transistors (BJTs)**. The objective is to achieve a **stable DC output voltage in the range of 6V to 9V**, irrespective of variations in input supply or load conditions. Additionally, the project focuses on evaluating the **line regulation** and **load regulation** characteristics of both circuit configurations under dynamic operating conditions.

Theory

Voltage regulators are essential components in electronic circuits that provide a stable output voltage despite variations in input voltage and load current. The two primary types of voltage regulators explored in this experiment are:

Series Voltage Regulator

A series voltage regulator uses a pass transistor Zener in series with the load to maintain a constant output voltage. Here, The transistor operates in the active region, controlling the voltage drop across it to regulate the output. The output voltage is typically determined using a reference voltage and a feedback mechanism.

Shunt Voltage Regulator

A shunt voltage regulator works by connecting a regulating device Zener in parallel with the load. It maintains a constant output voltage by varying the current flowing through the shunt element, thereby controlling the voltage drop across the load.

Line and Load Regulation

Line Regulation: The ability of a regulator to maintain a constant output voltage despite variations in the input voltage**.**

Load Regulation: The ability of a regulator to maintain a constant output voltage despite changes in the load current by varying the load resistance.

Mathematically:

Line Regulation (%) = (ΔVout / ΔVin) * 100

Load Regulation (%) = ((Vno-load - Vfull-load) / Vfull-load) * 100

Materials Required

Bipolar Junction Transistors (BJT - 2N2222)

Zener Diodes (6V, 9V)

Resistors (1kΩ 100Ω)

Capacitors (1µF)

DC Power Supply (6-15V)

Load Resistors (Variable)

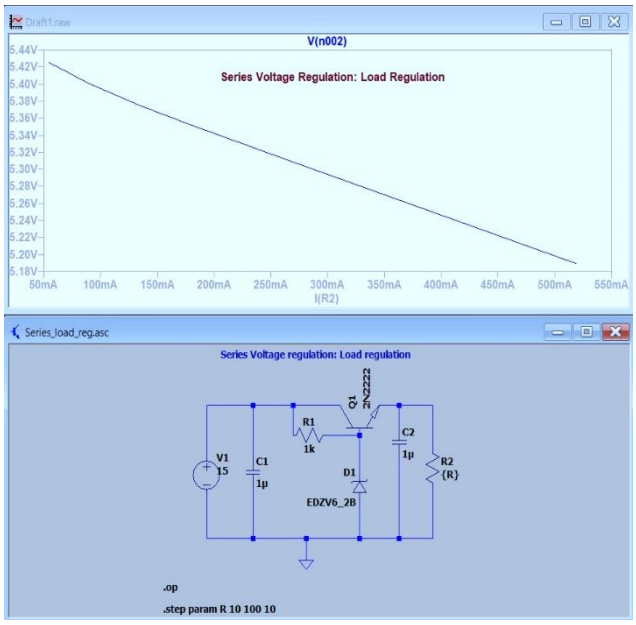
Connecting Wires

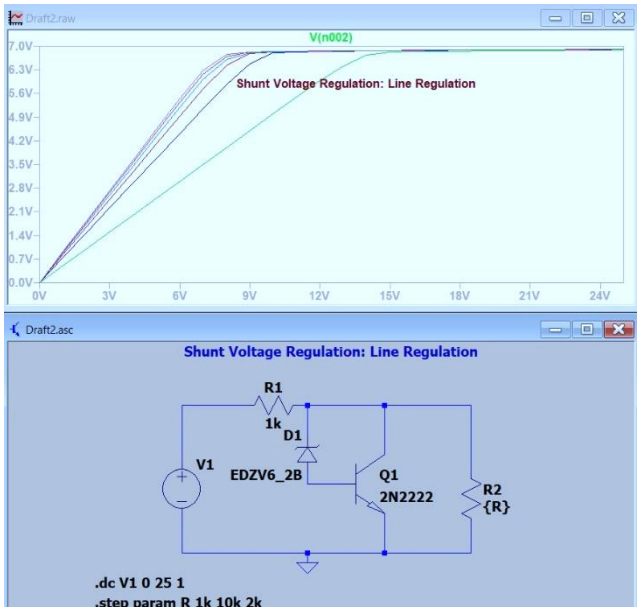
Breadboard

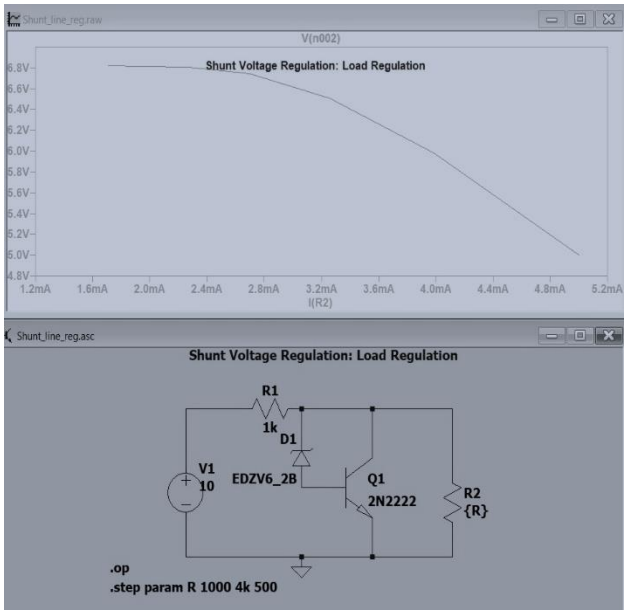
Multimeter

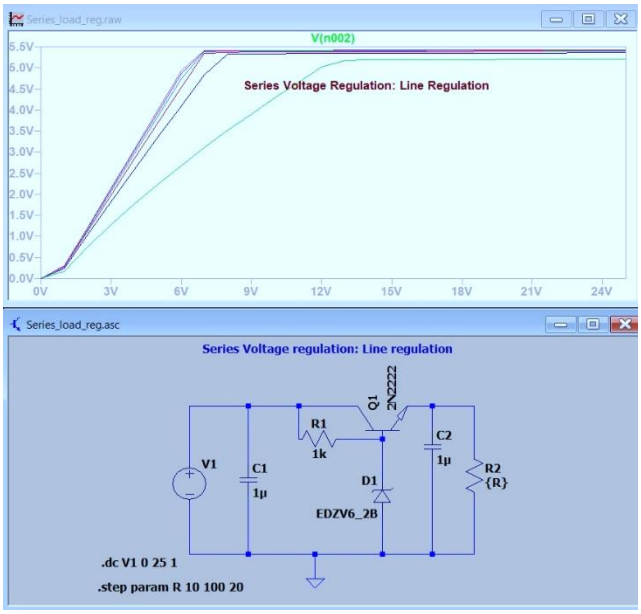
Oscilloscope

Observation









Conclusion

The experiment successfully demonstrated the working principles of series and shunt voltage regulators using Zener & BJTs. The designed circuits provided a regulated output voltage within the desired range of 6-9V. The following conclusions were drawn:

1. The series voltage regulator exhibited better load regulation due to its feedback mechanism, making it more efficient in applications requiring stable voltage supply.
2. The shunt voltage regulator provided a simple yet effective method for voltage stabilization, suitable for low-power applications.
3. The experimental results closely matched the simulated values, confirming the theoretical predictions.
4. The line and load regulation characteristics were analyzed, demonstrating the stability of the designed circuits under varying conditions.