

DESIGN AND ANALYSIS OF VOLTAGE REGULATOR USING OPAMP

Theory

A series voltage regulator controls the output voltage by series current away from the load. Current flows through the load from the unregulated input voltage. To keep the regulated output voltage across the load constant, the control element draws some current away. The sampling circuit sends a feedback signal to a comparator in case the load voltage tries to change as a result of a change in the load. The comparator then sends a control signal to adjust how much current is diverted away from the load. The sampling circuit sends a feedback signal to the comparator as the output voltage tries to increase, increasing the series current and decreasing the load current in order to prevent the regulated voltage from increasing.

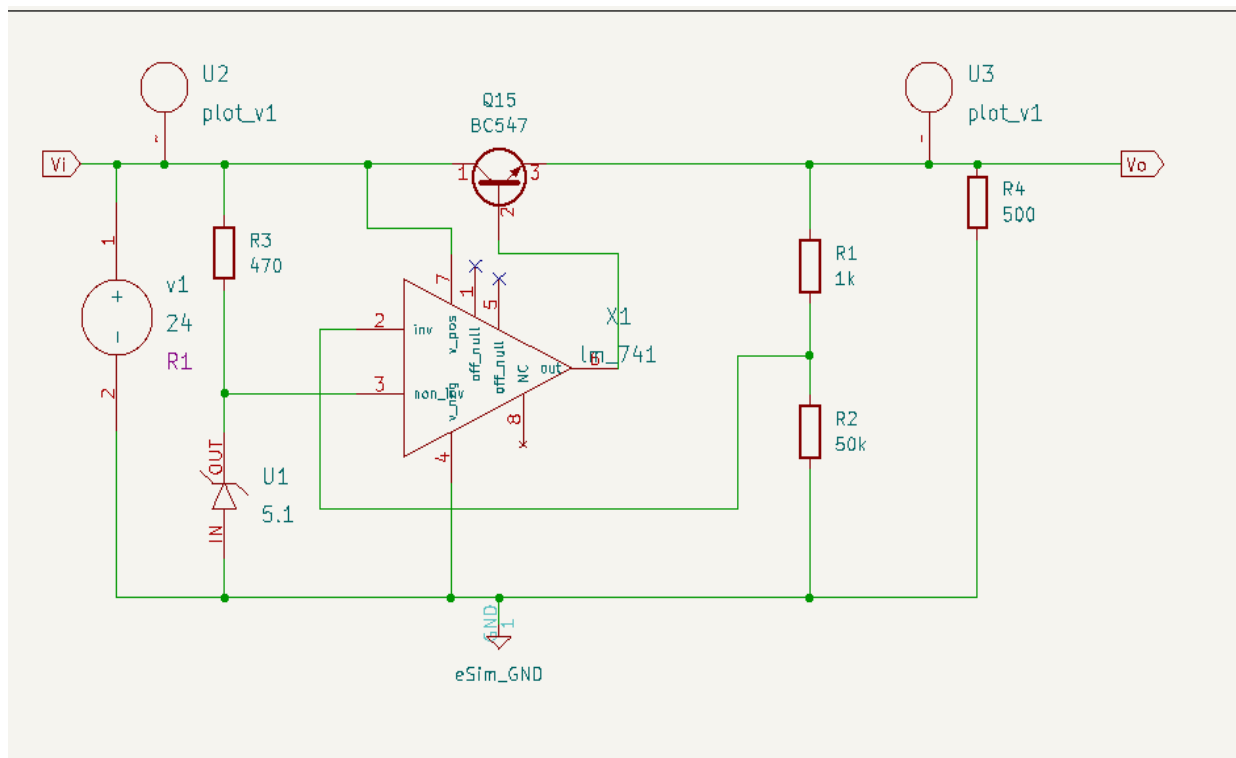


Figure 1 : Schematics of series voltage regulator using Op-Amp

Opamp Acts as an **error amplifier**. The non-inverting input receives the reference voltage from the zener diode. The inverting input receives a feedback voltage from the voltage divider ($R1$ and $R2$), proportional to the output voltage (V_o). The op-amp compares the two inputs and adjusts its output to control the transistor. NPN Transistor Serves as the **series pass element**. It adjusts the current flow to the load depending on the control signal from the op-amp.

Simulation Output Results Ng SPICE Plots

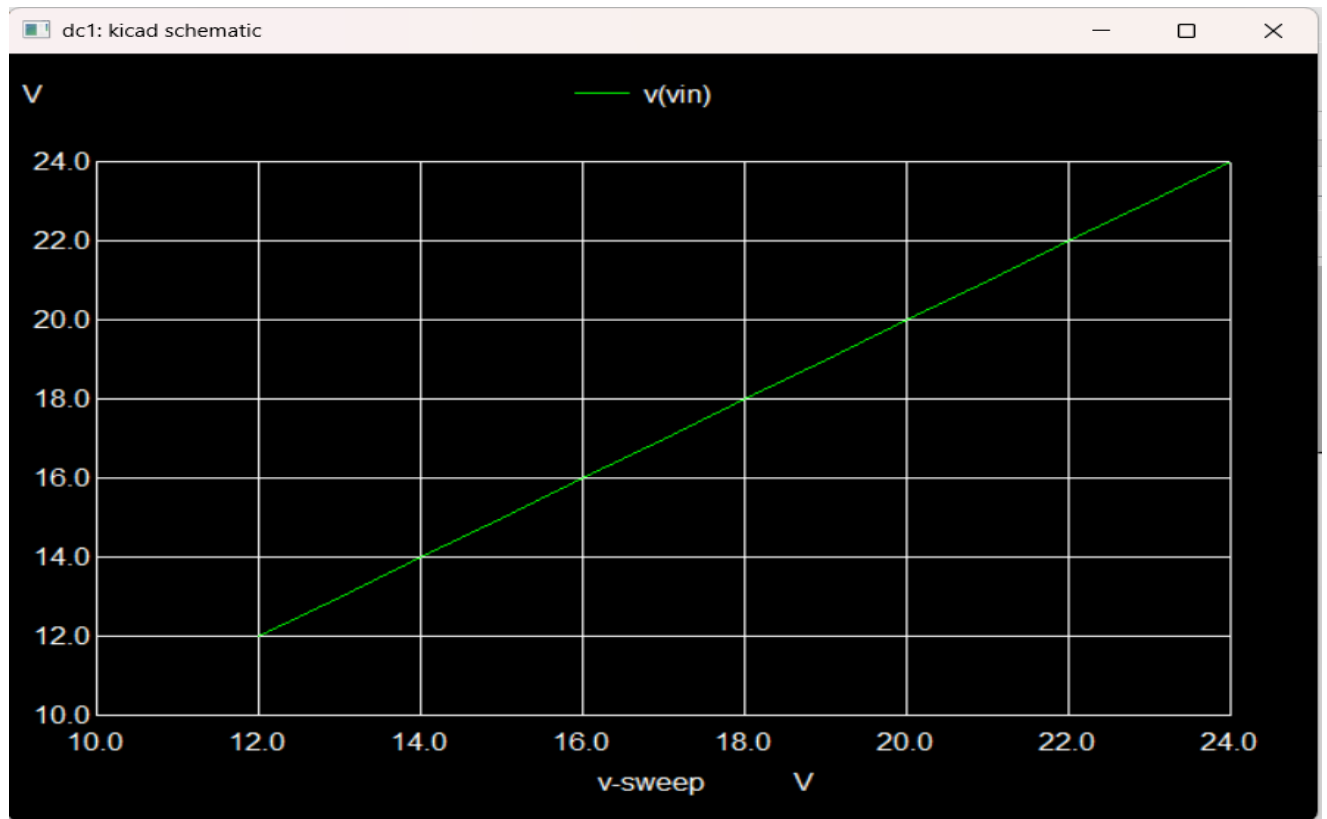


Fig 2: Unregulated Input Voltage

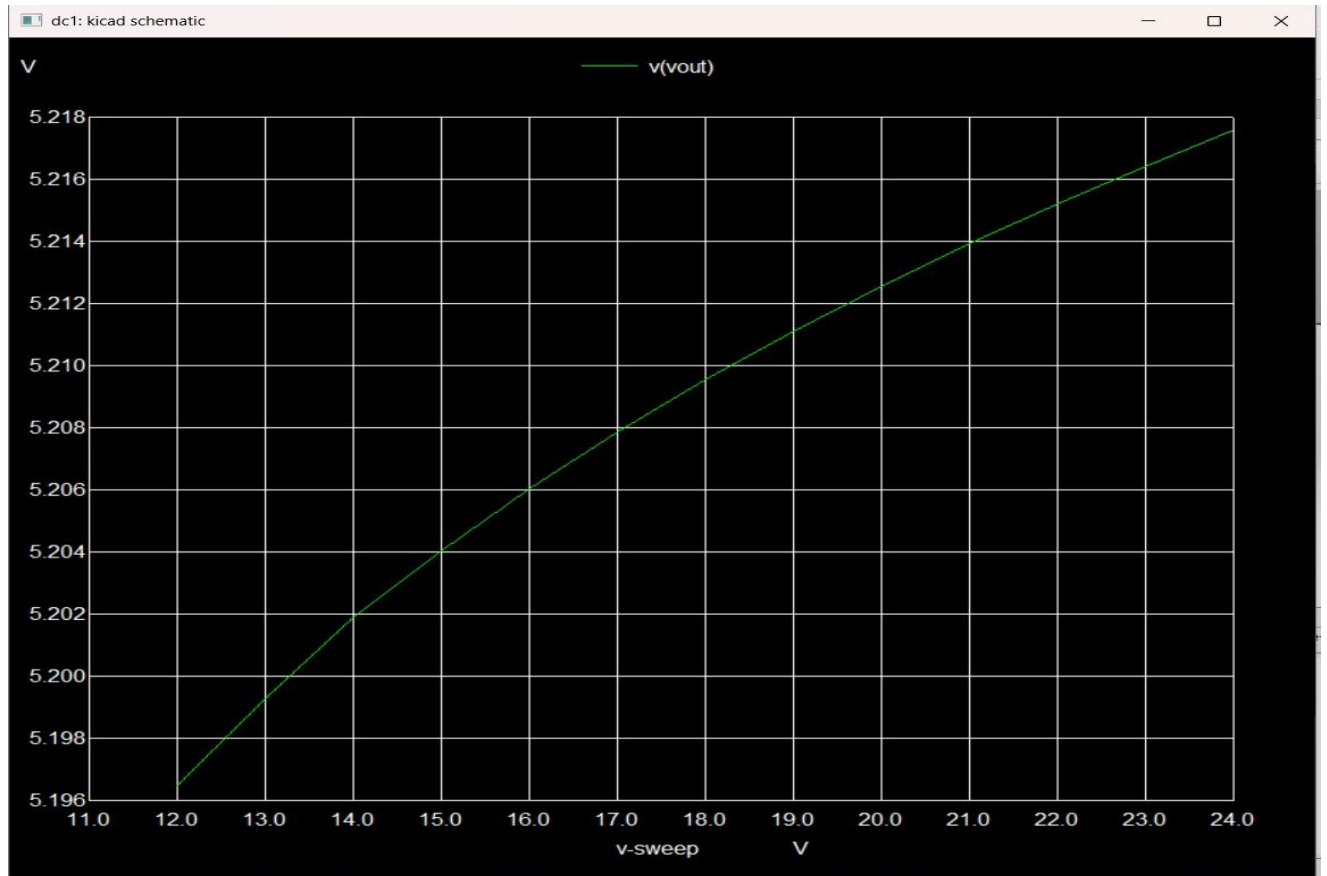


Fig 3: Regulated Output Voltage with 0.1% of line regulation

Python Plot

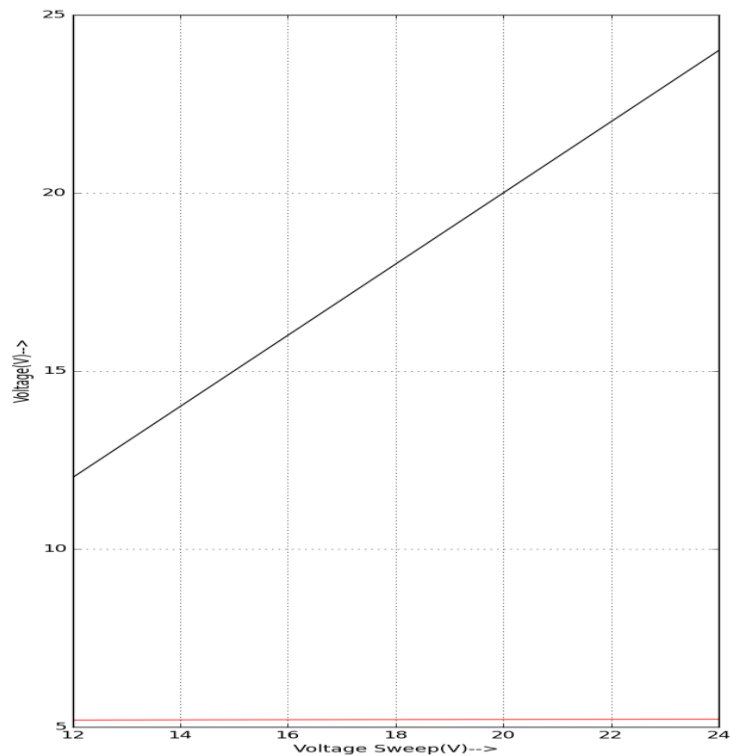


Figure 5: Both Unregulated voltage (Red) and Regulated voltage (Blue) in python plot

Conclusion

Thus, we have studied the Series Voltage Regulator Using An Op-Amp using eSim and we get the appropriate waveforms for a dc voltage sweep from 8V to 15 V in 0.5V increments and supply is regulated.

References

<https://ia802709.us.archive.org/13/items/ElectronicDevicesAndCircuitTheory/Electronic%20Devices%20and%20Circuit%20The>
<https://ieeexplore.ieee.org/document/6325338>