Self Project

Output Voltage Regulation of Buck Converter using Type-2 Compensator

Name- Vikas pal

Roll No: 244102114

july 2025

- **Objective:**

The objective of this experiment is to design a Type2 compensator for a buck converter to regulate its output voltage.

- **Parameters:**

Parameter	Value
Input Voltage	24
Inductor	50µH
Capacitor	100µF
Load resistance	2Ω
Switching frequency	100kHz
Desired gain crossover frequency of compensated system	90 to 120 degrees

- **Compensator Design(K factor Method):**
  For type2 compensator we have the Transfer function given by

$$G_{c2} = \frac{\boldsymbol{G_{MB}}(\mathbf{1}+\frac{\boldsymbol{w_z}}{\boldsymbol{s}})}{(\mathbf{1}+\frac{\boldsymbol{s}}{\boldsymbol{w_p}})} \quad ....(1)$$

where $G_{MB} = \frac{1}{Plant\ gain\ at\ w_c}$;Absolute gain

$w_z = \frac{w_c}{k}$

$w_p = kw_c$

k=tan(45+boost/2)

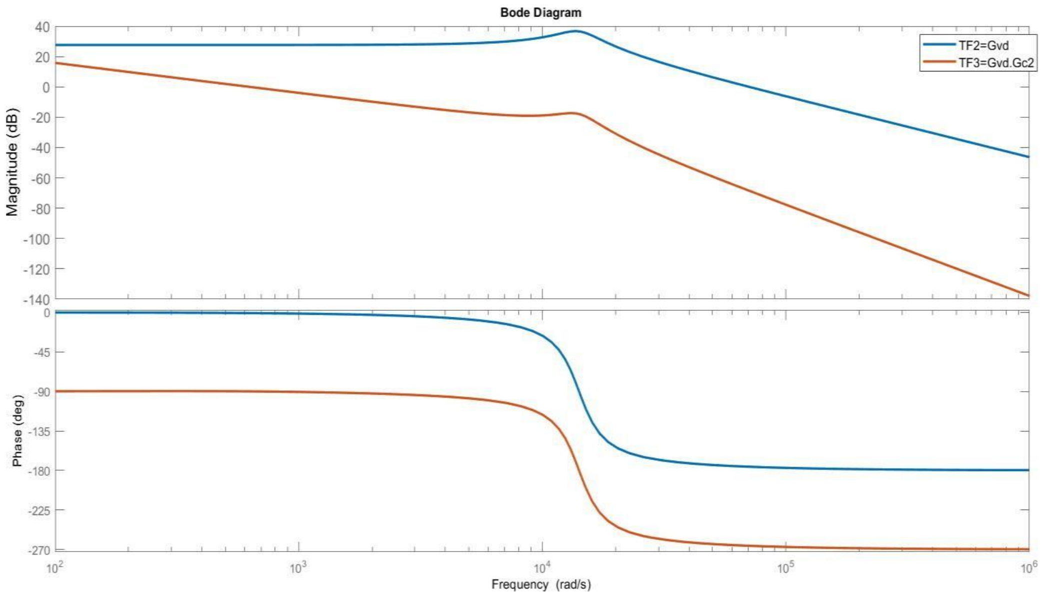
$$G_{vd} = \frac{V_{in}}{s^2 LC + \frac{sL}{R} + 1}$$

After substituting the values we got the following Transfer function

$$G_{c2} = \frac{26.54\, s + 16401}{s^2 + 638\, s}$$

$$G_{vd} = \frac{24}{5e^{-9}s^2 + 25e^{-6}s + 1}$$

- **Bode Plot**



- **Stability Margins:**

a) Gvd

GainMargin: Inf

GMFrequency: Inf

PhaseMargin: 4.2185

PMFrequency: 7.0620e+04

DelayMargin: 1.0426e-06

DMFrequency: 7.0620e+04

P1 =1.0e+04 *(-0.2500 +i1.3919)

P2=1.0e+04 *(-0.2500 -i1.3919)

b) Gc2

GainMargin: 7.8542

GMFrequency: 1.4146e+04

PhaseMargin: 90.0123

PMFrequency: 628.0470

DelayMargin: 0.0025

DMFrequency: 628.0470

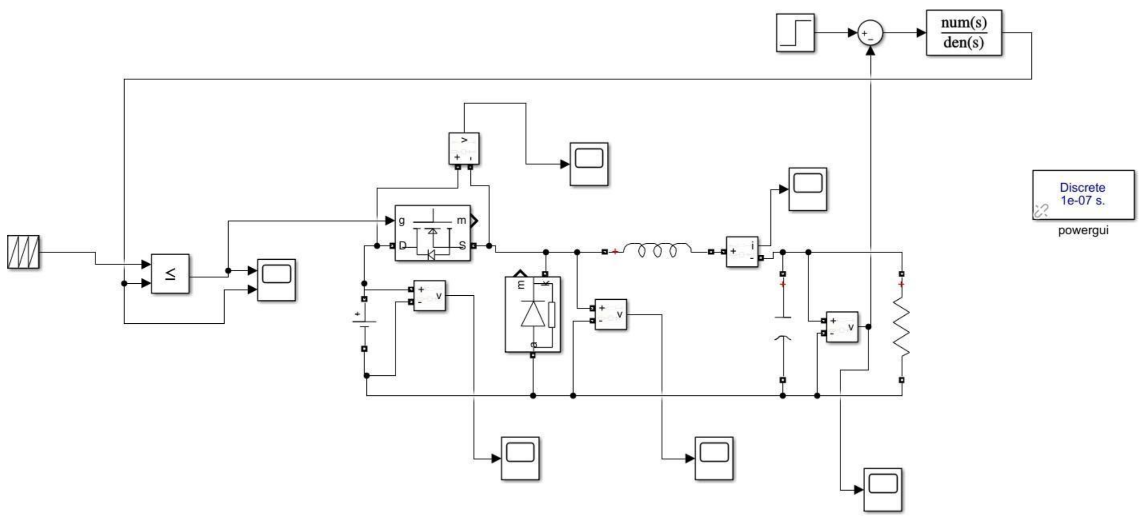
P1= 0.0000 + 0.0000i

P2=-0.2500 + 1.3919i

P3= -0.2500 - 1.3919i

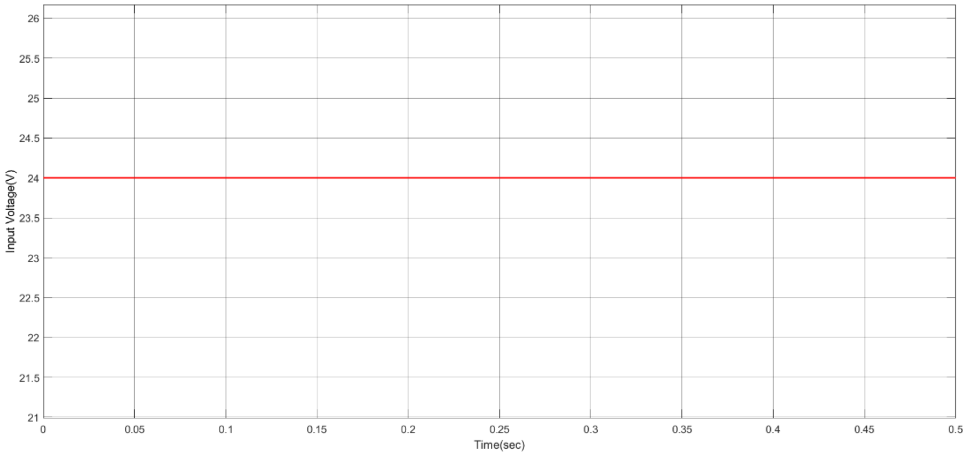
P4=-0.0638 + 0.0000i

- **MATLAB/SIMULINK SIMULATION**

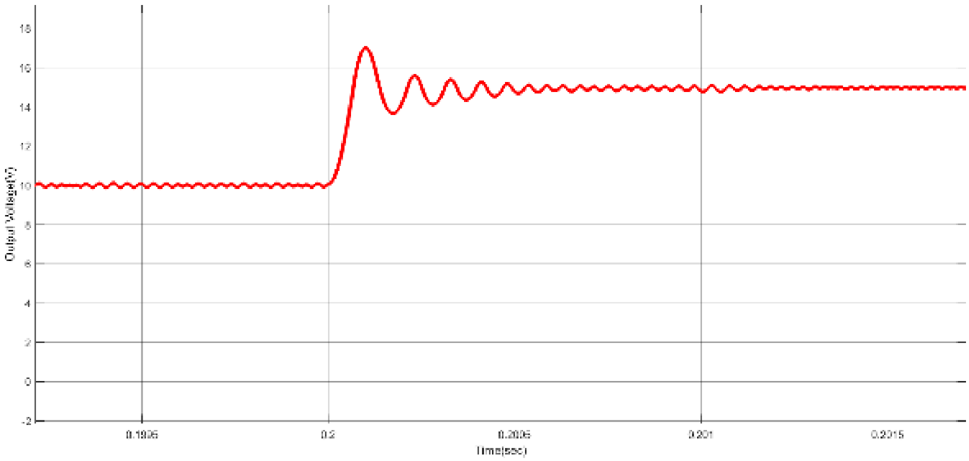


➢ SIMULATED WAVEFORMS

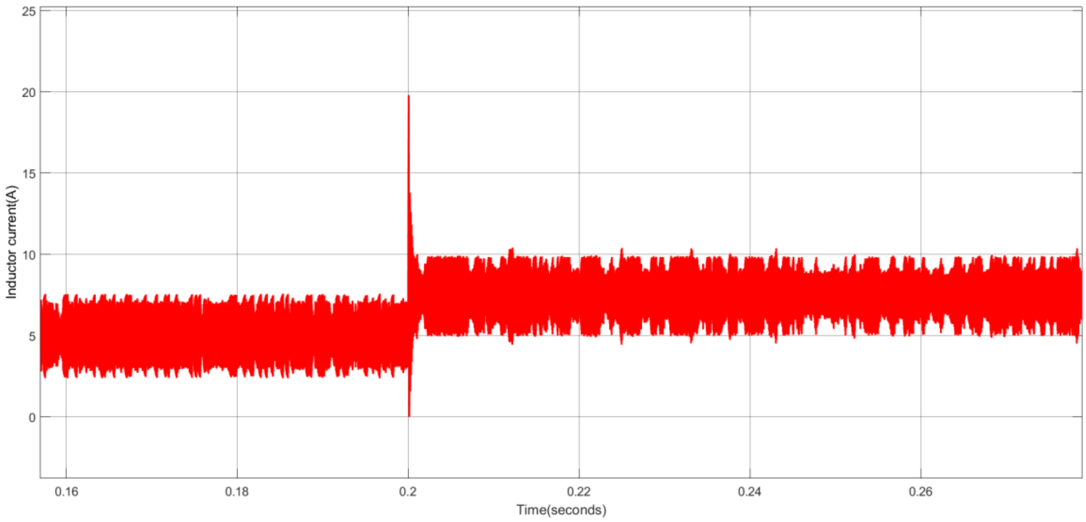
a) Input Voltage



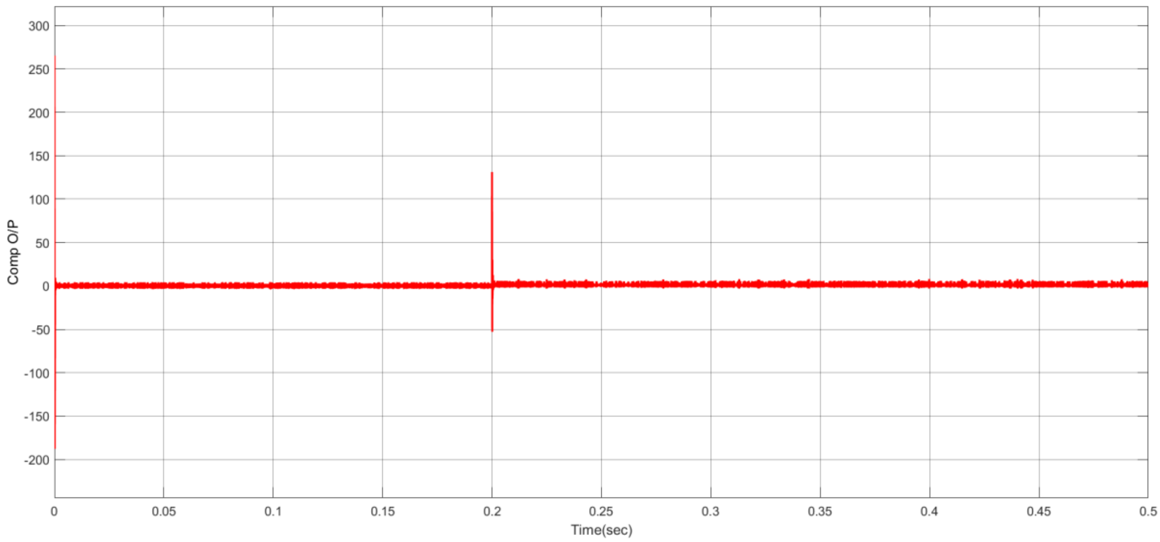
b) Output Voltage



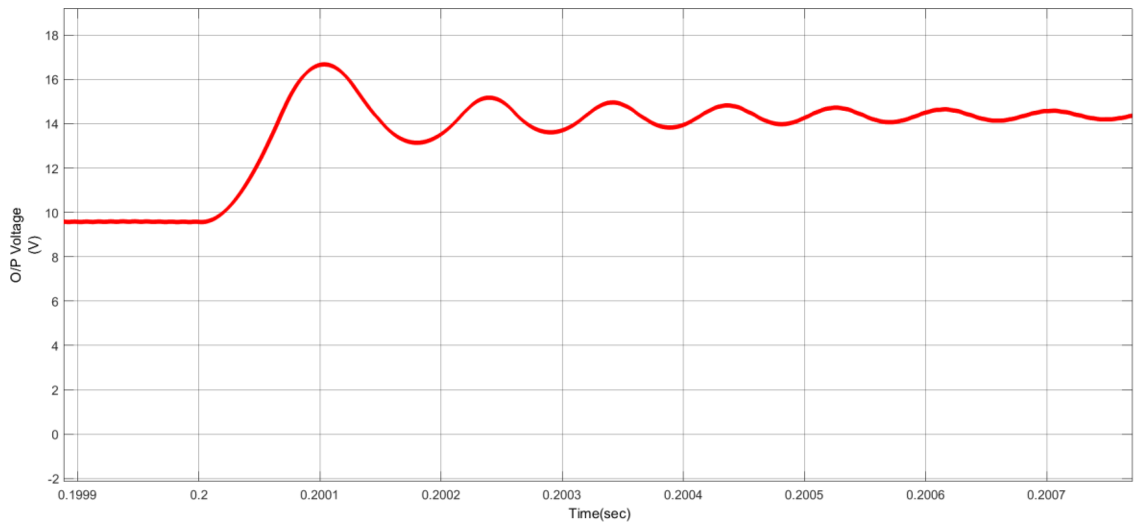
c) Inductor Current



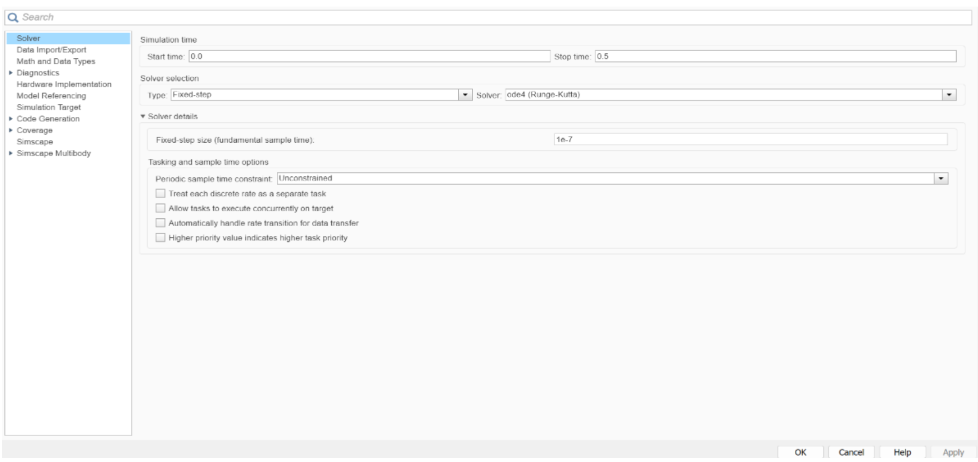
d) Compensator Output



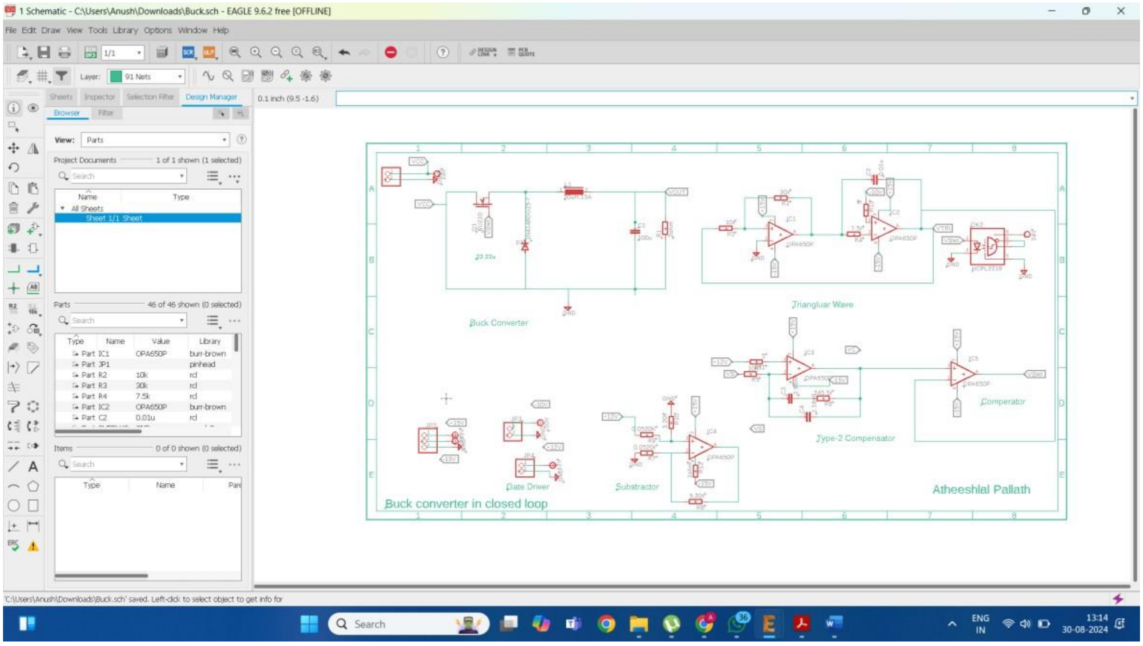
e) Output Voltage without Compensator



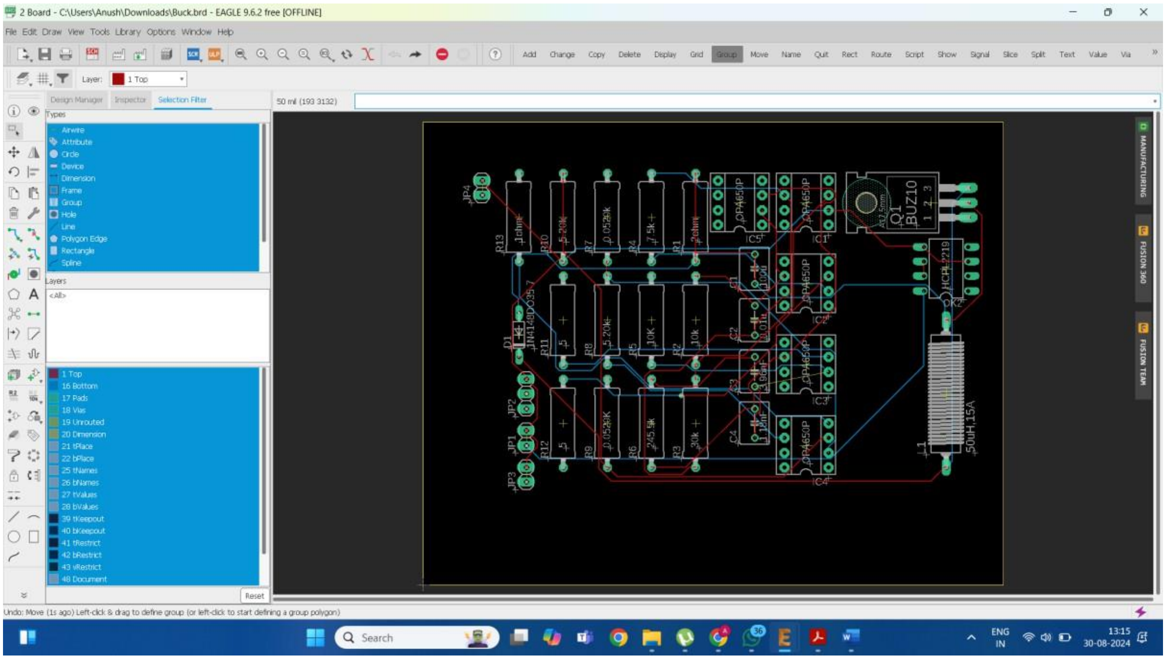
➢ **Simulation configuration parameters**



Eagle Schematic:



PCB Design:



- **Conclusion**

In this experiment we designed a type 2 compensator for regulating the output voltage of a buck converter.We used a type 2compensator to improve the transient response along with stability margins.We cam observe that the peak overshoot has also been reduced by using a compensator.

Then the PCB design of the whole system was implemented with the help of Eagle Software.