

Simulation and PCB Designing of Boost Converter

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1. Objective:

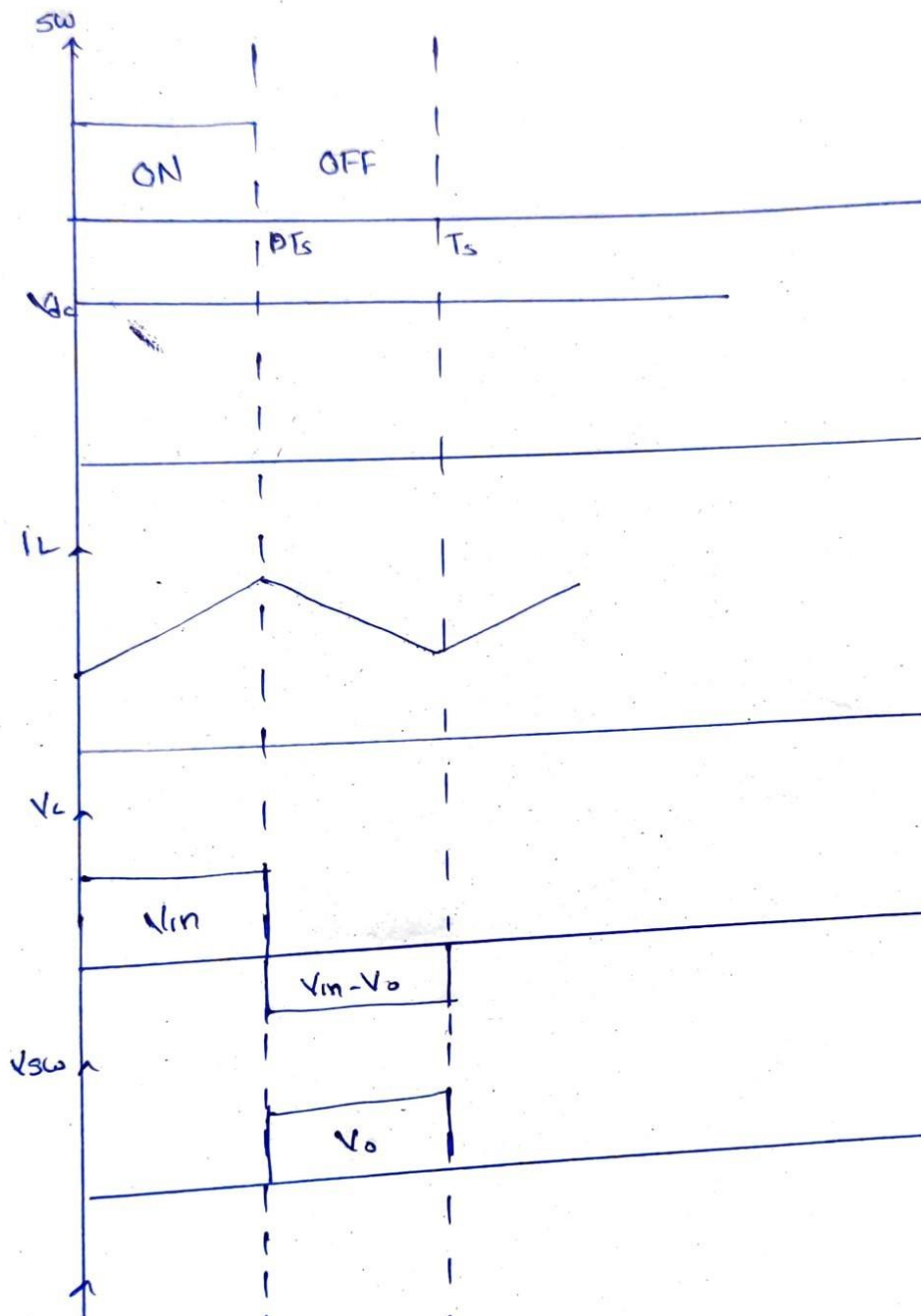
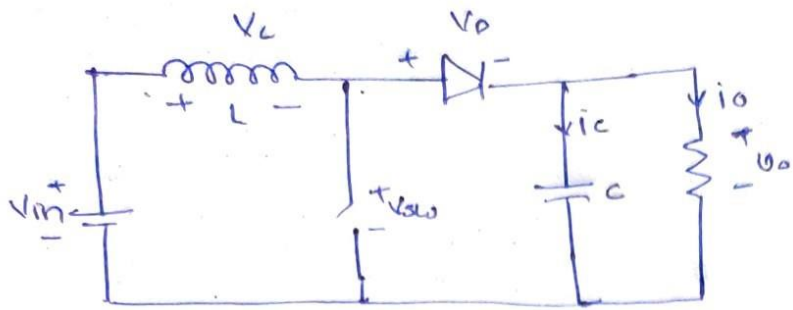
The objective of this experiment is to study the continuous conduction mode of basic Boost and Buck- Boost DC-DC converter using MATLAB/SIMULINK.

2. Parameters of the DC-DC Converter:

Parameters	Boost	Buck - Boost
Input Voltage	24 V	24 V
Duty Ratio	0.5	Buck Mode = 0.35 Boost Mode = 0.75
Switching Frequency	100kHz	100kHz
Output Power	100 W	100 W
Ripple in Inductor Current	25%	25%
Ripple in Output Voltage	0.1%	0.1%

3. Boost Converter :

3.1 Circuit Diagram and Theoretical waveforms of boost converter:



3.2 Design procedure and final design parameter obtained:

- ❖ The value of inductance can be calculated by below expression

$$L = \frac{DV_{in}}{\Delta I_L f_{sw}}$$

The inductance value comes out to be 115.2 μH .

- ❖ The value of capacitance can be calculated by

$$C = \frac{DI_o}{f_{sw}\Delta V_c}$$

The value of capacitance comes out to be 217 μF .

- ❖ For continuous conduction mode output voltage can be found out by

$$V_o = \frac{DV_{in}}{1 - D}$$

$$R = \frac{V_o}{I_o}$$

The value of output voltage and load resistance comes out to be 48 V and 23.04 Ω respectively.

- ❖ Using blocks from simscape/electrical/specialized power system/power electronics Boost converter is simulated with a discrete solver setting.

3.3 MatLab/Simulink Simulation:

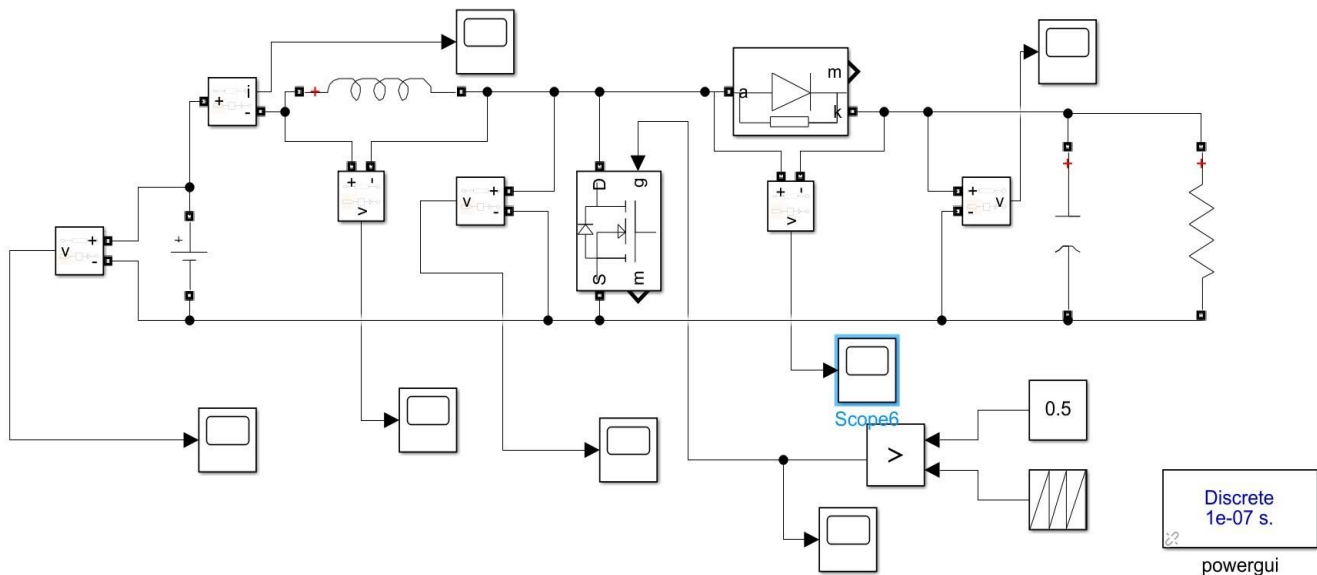
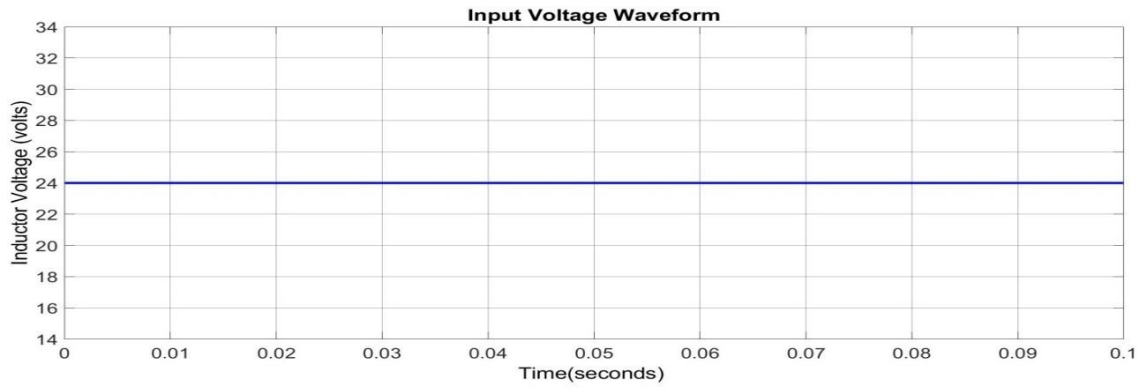


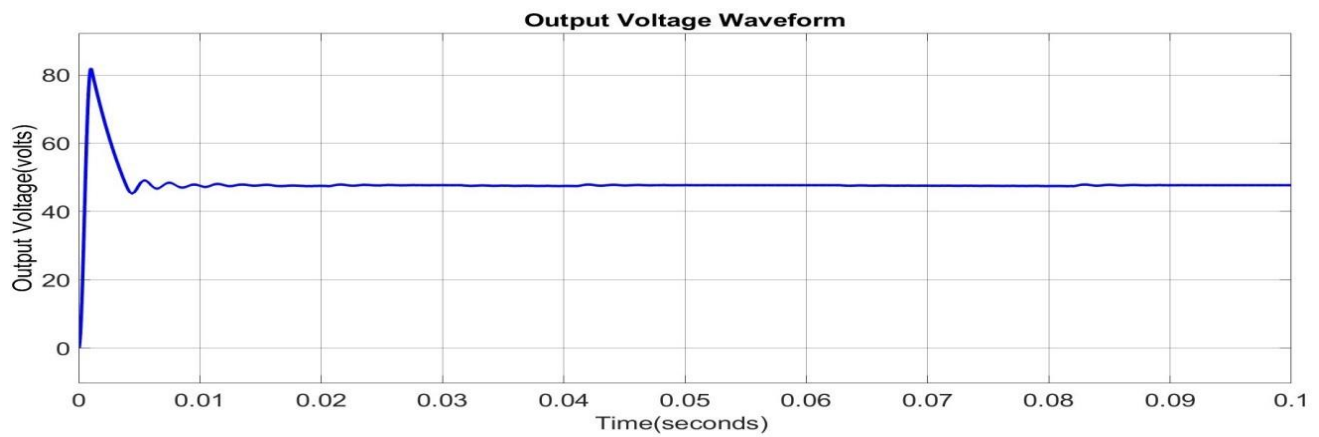
Fig. Boost Converter

3.4 Simulated Waveforms:

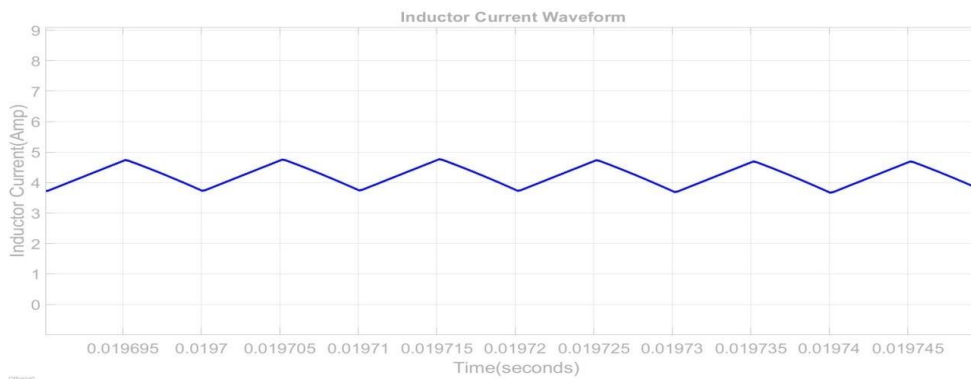
I. Input Voltage :



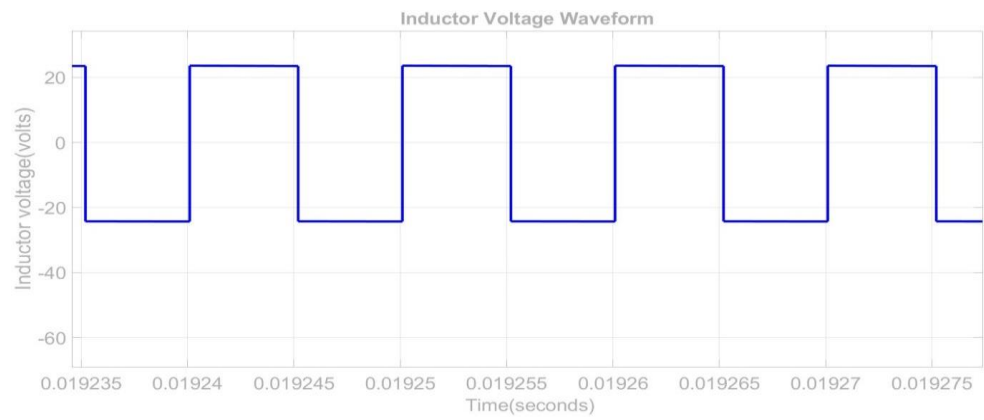
II. Output Voltage :



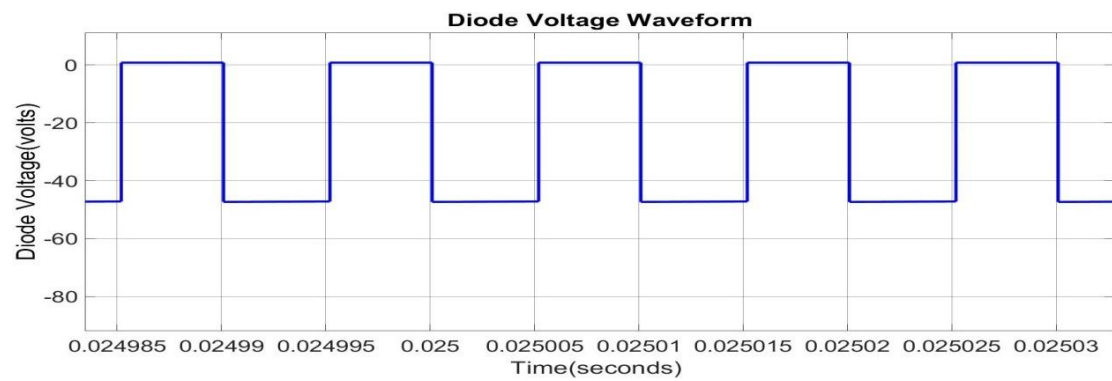
III. Inductor Current



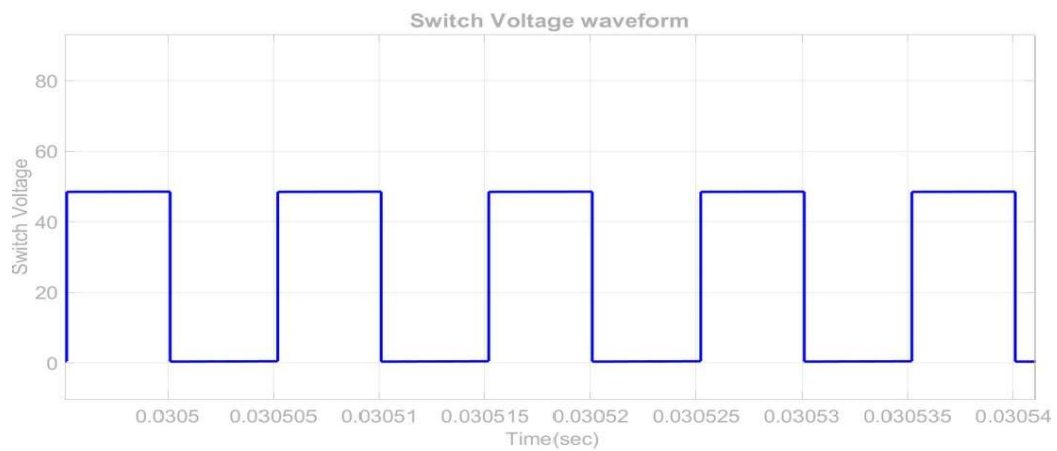
IV. Voltage across inductor



V. Voltage across Diode :



VI. Voltage across switch:



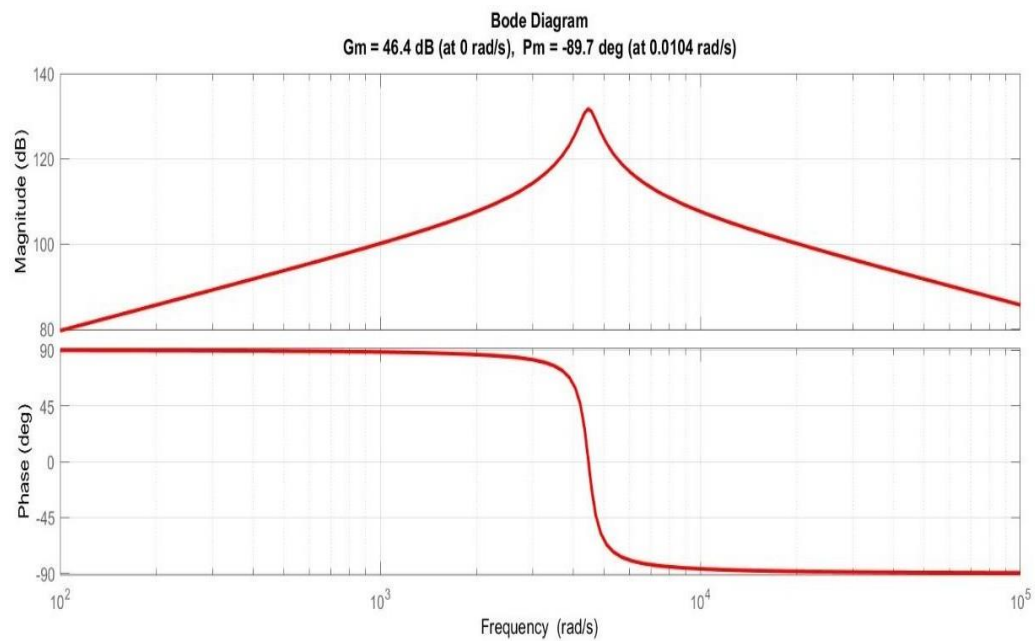
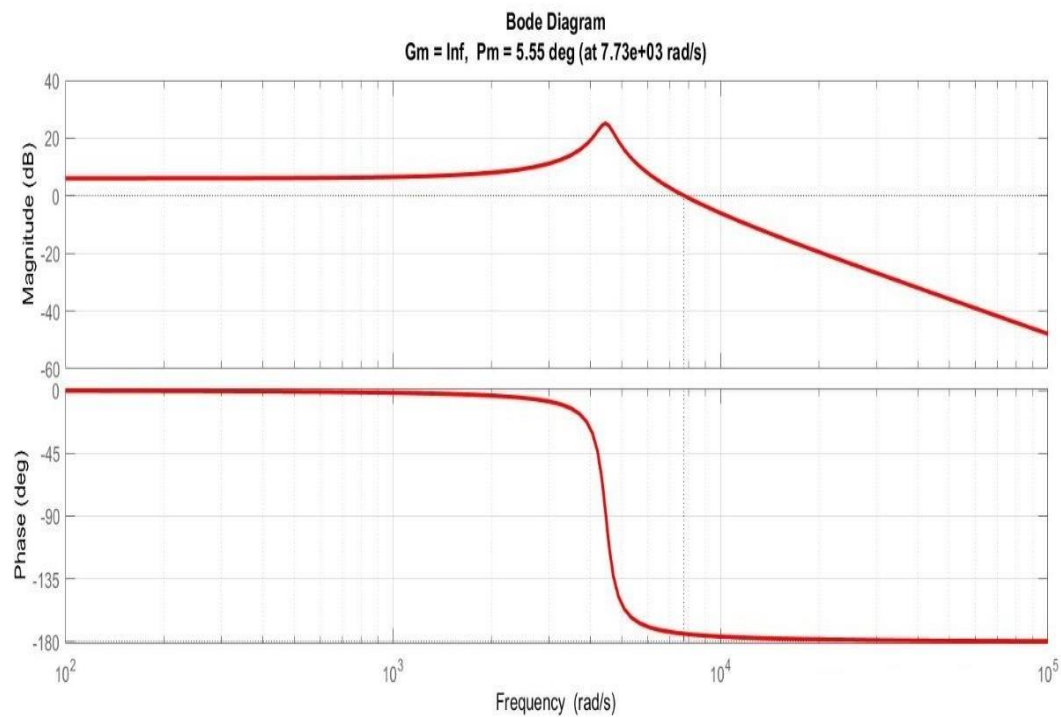
3.5 Simulation Configuration Parameters:

The screenshot shows the 'Simulation Configuration Parameters' dialog box. The 'Simulation time' section has 'Start time' set to 0.0 and 'Stop time' set to 0.1. The 'Solver selection' section shows 'Type' as 'Fixed-step' and 'Solver' as 'ode4 (Runge-Kutta)'. The 'Solver details' section is expanded, showing 'Fixed-step size (fundamental sample time)' set to 1e-7. The 'Tasking and sample time options' section is also expanded, showing 'Periodic sample time constraint' set to 'Unconstrained'. There are four checkboxes: 'Treat each discrete rate as a separate task' (unchecked), 'Allow tasks to execute concurrently on target' (unchecked), 'Automatically handle rate transition for data transfer' (unchecked), and 'Higher priority value indicates higher task priority' (unchecked). The bottom of the dialog has 'OK', 'Cancel', 'Help', and 'Apply' buttons.

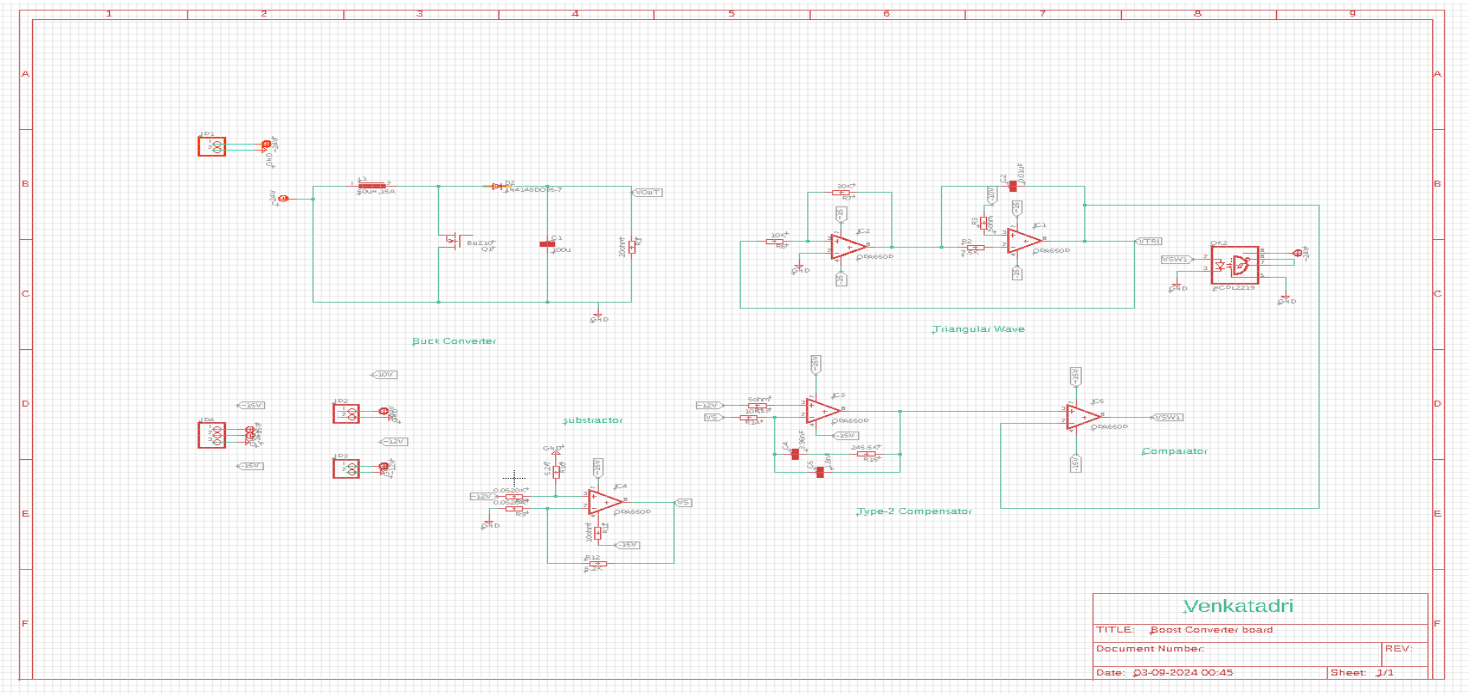
3.6 MatLab Code for Boost Converter:

```
vin=24;
D=0.5;
d=(1-D);
Vo=vin/d
I_L=Vo/(R*d)
R=10;
fs=50e3;
C=200e-6;
L=0.0625e-3;
H=tf([d*Vo,-L*I_L],[L*C,L/R,d^2]);
display(H);
[Gm,Pm,Wcg,Wcp] = margin(H)
figure(1)
bode(H)
margin(H);
[p,z] = pzmap(H);grid
G=tf(d',[L*C,L/R,d^2]);
display(G);
[Gm,Pm,Wcg,Wcp] = margin(G)
figure(2)
bode(G)
margin(G);
[p,z] = pzmap(G);grid
```

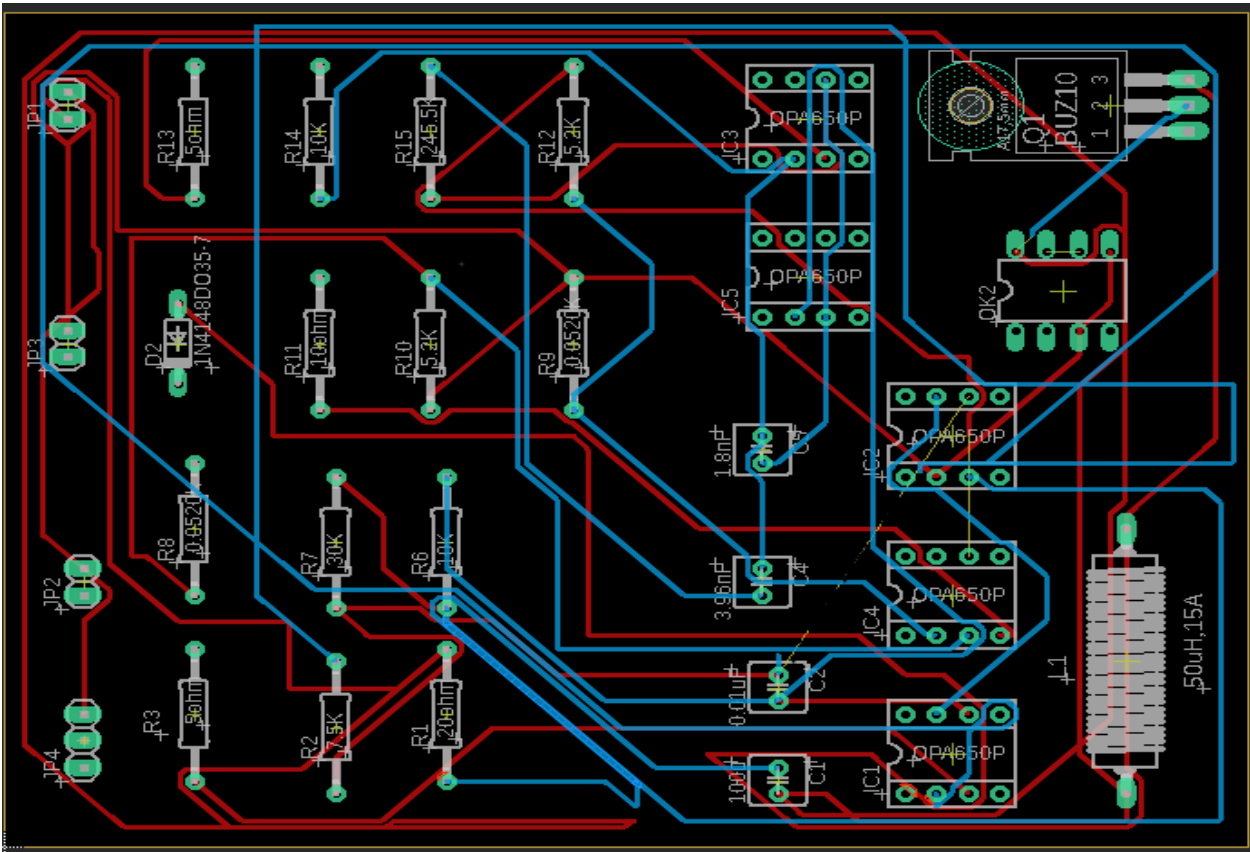
3.7 Bode Plots of Boost converter:



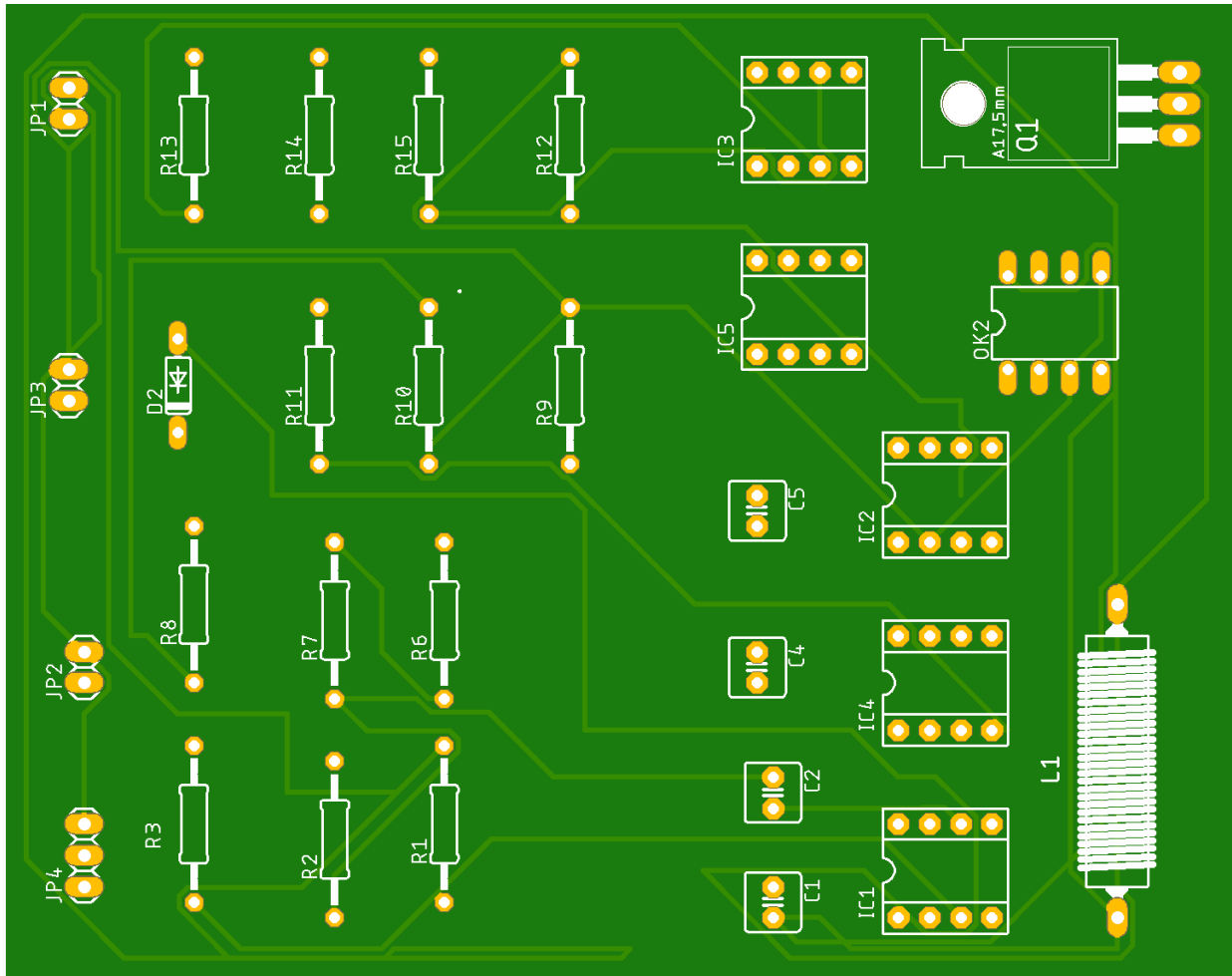
3.8 PCB Schematic:



3.9 PCB Board:



3.10: Manufacturing Board of PCB



Conclusion:

Thus the Boost converter is simulated and designed.