Simulation and PCB Designing of Boost Converter

Name: Paturi Venkatadri
Roll No. : 234102111

1. Objective:

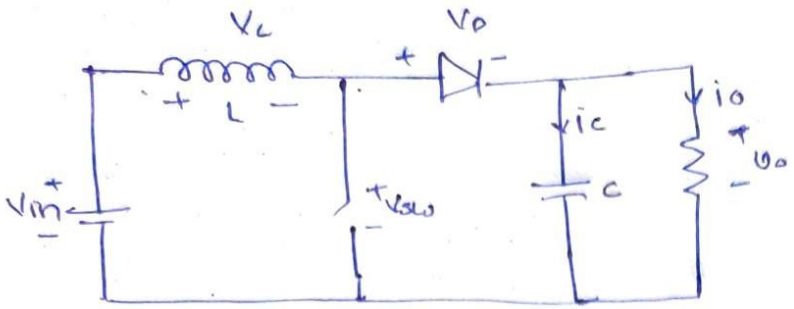
The objective of this experiment is to study the continuous conduction mode of basic Boost and Buck- Boost DC-DC converter using MATLAB/SIMULINK.

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:


VL
VD
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L
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+
Vin
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+ VSW −
ic
C
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Vo
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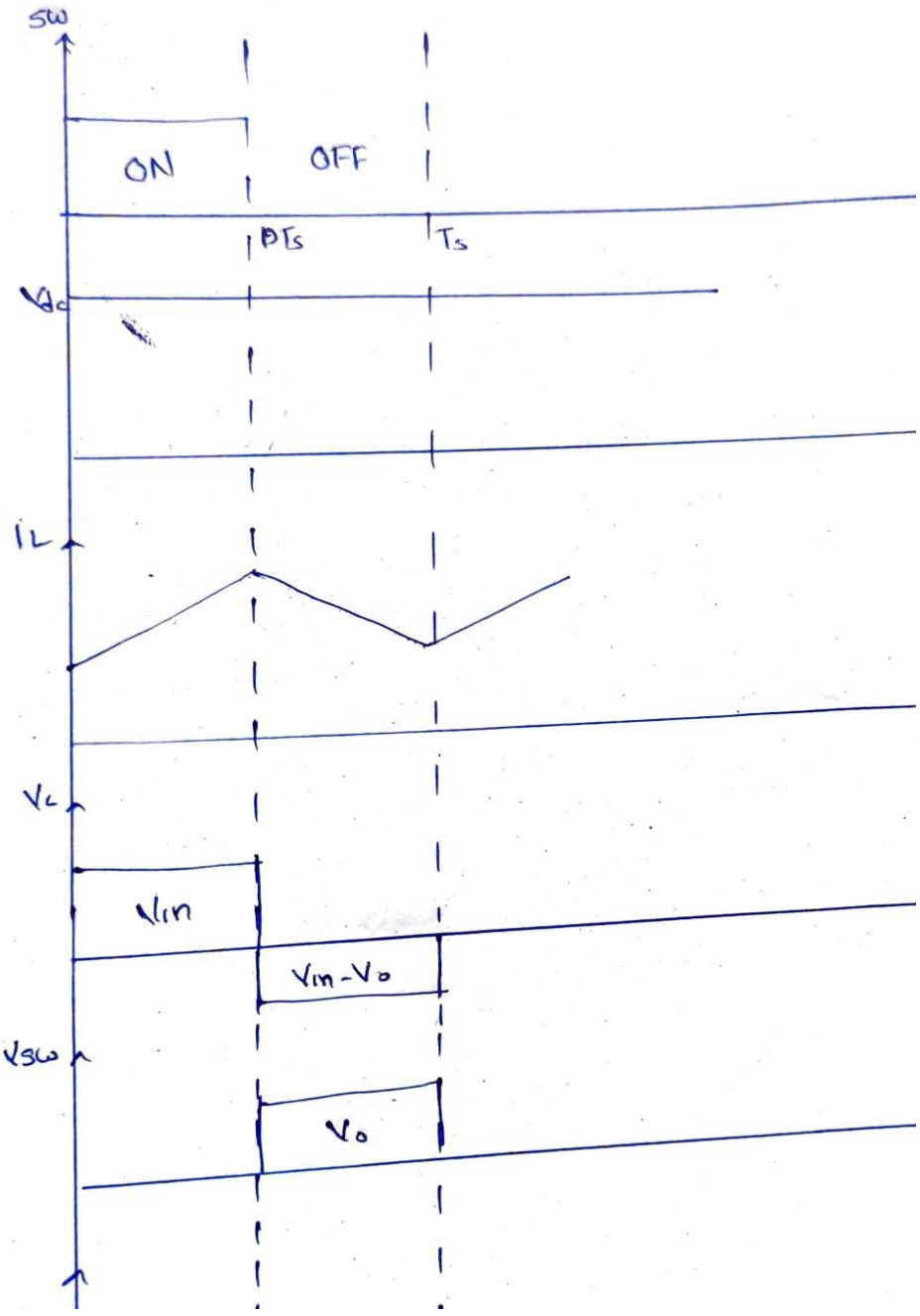

SW
ON
OFF
DTs
Ts
Vo
iL
VL
Vin
Vin-Vo
VSW
Vo

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

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

$$R = \frac{Vo}{Io}$$

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:

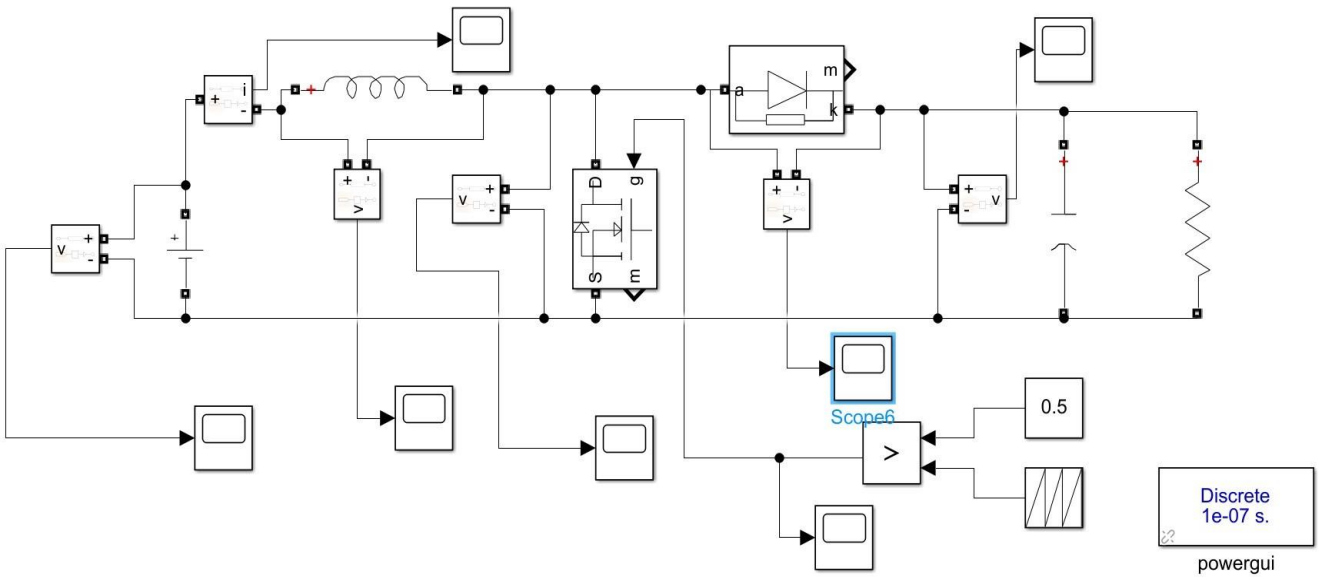
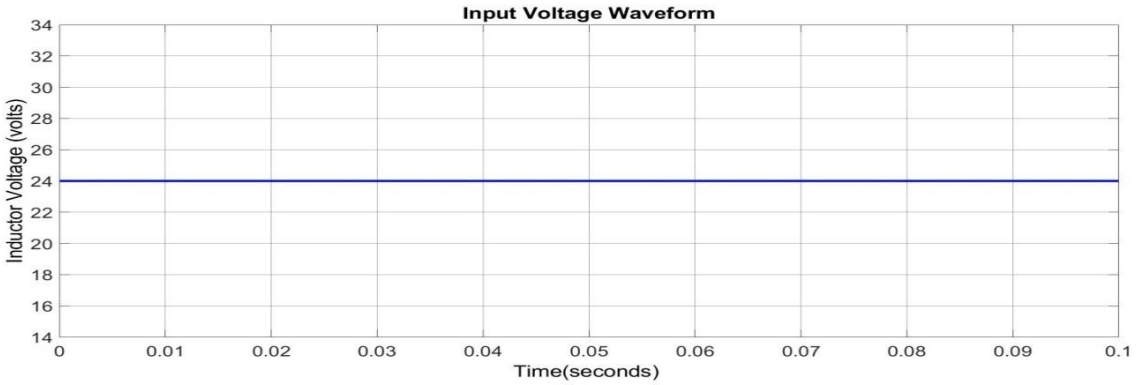


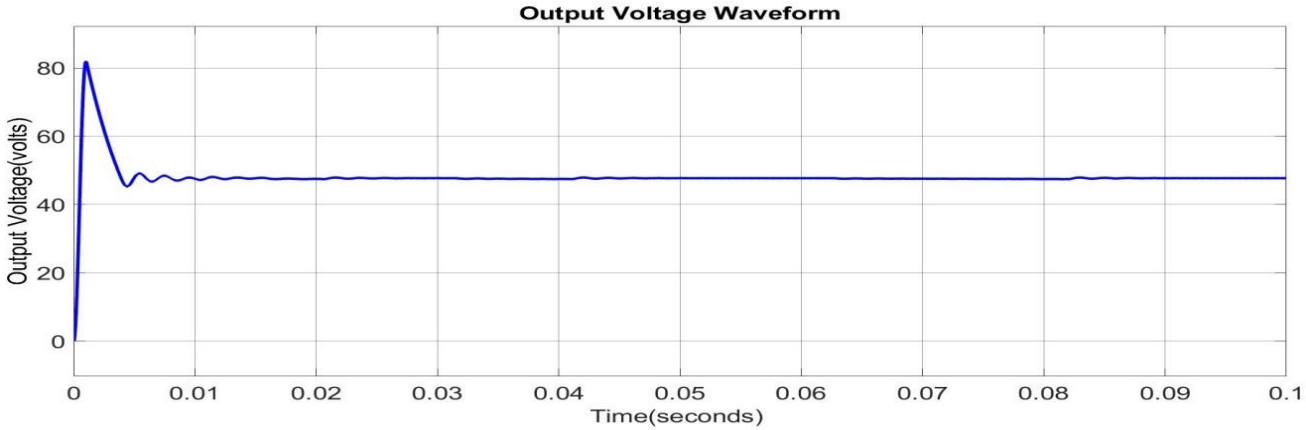
Fig. Boost Converter

3.4 Simulated Waveforms:

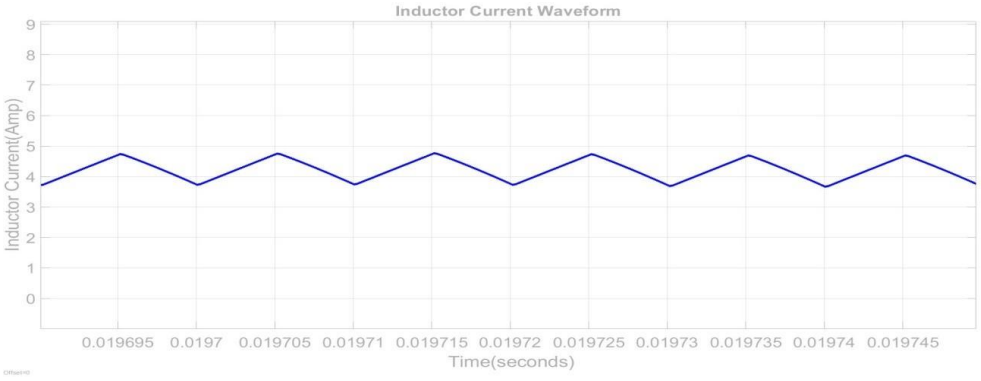
I. Input Voltage :



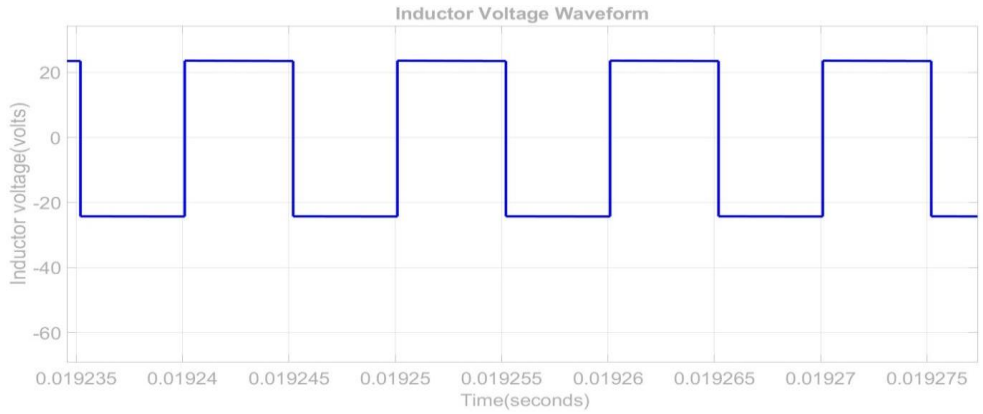
II. Output Voltage :



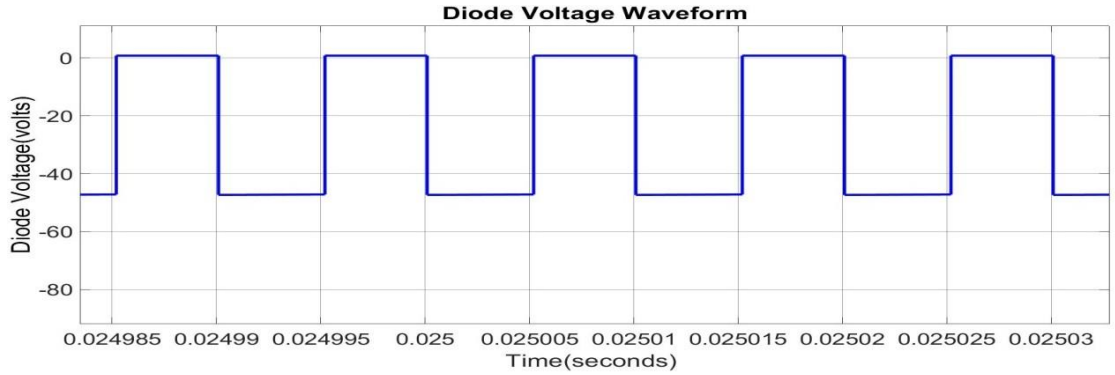
III. Inductor Current



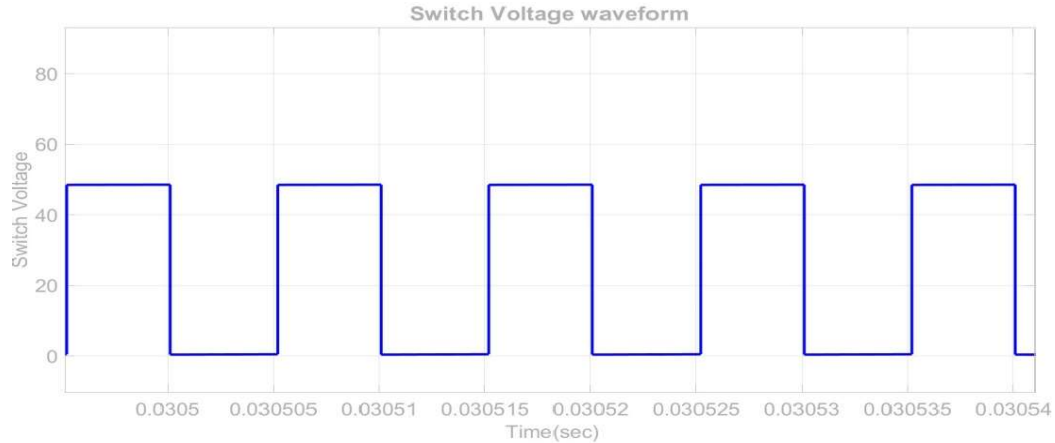
IV. Voltage across inductor



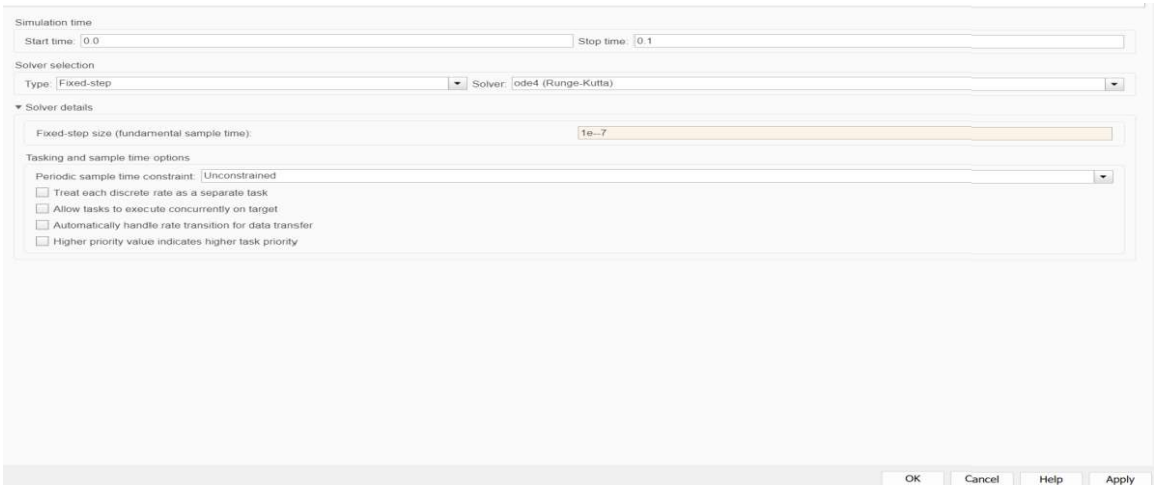
V. Voltage across Diode :



VI. Voltage across switch:



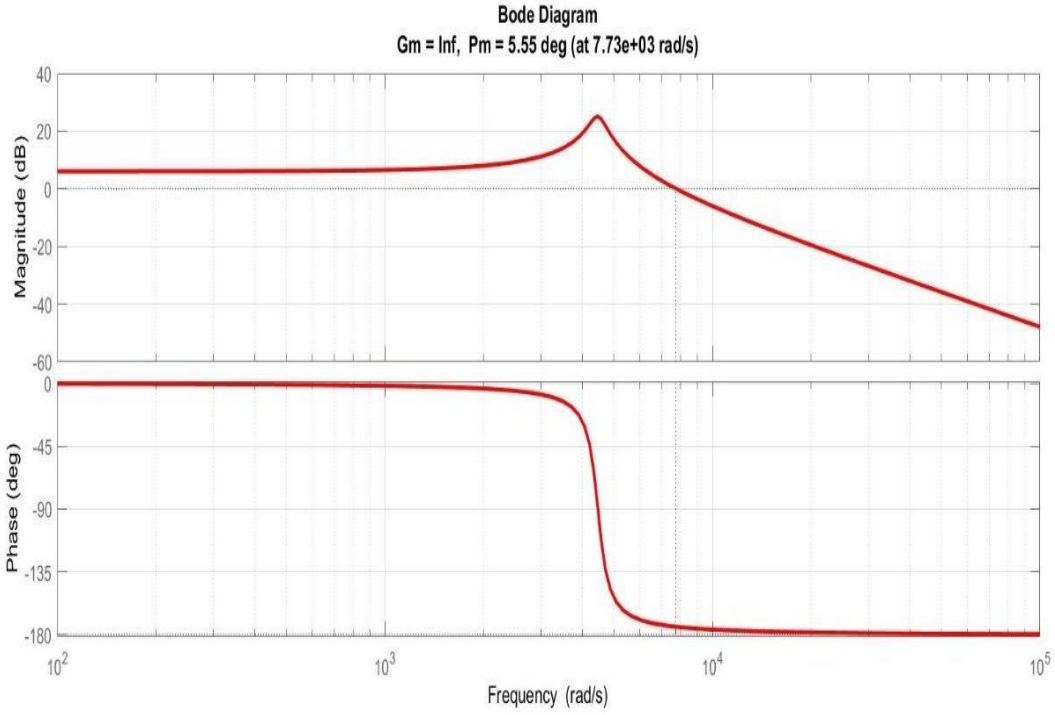
3.5 Simulation Configuration Parameters:

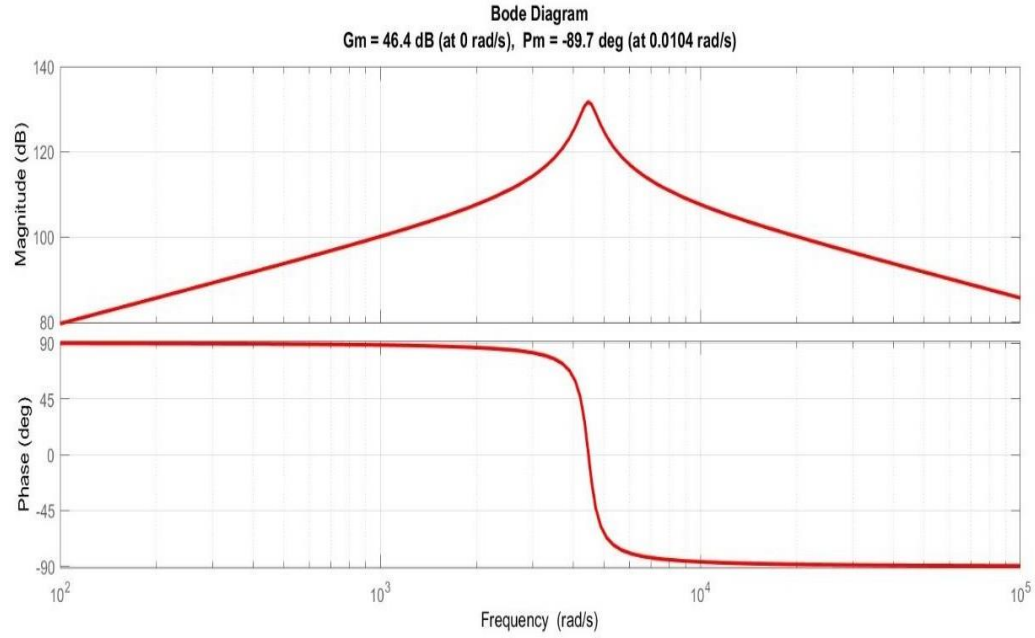


3.6 MatLab Code for Boost Converter:

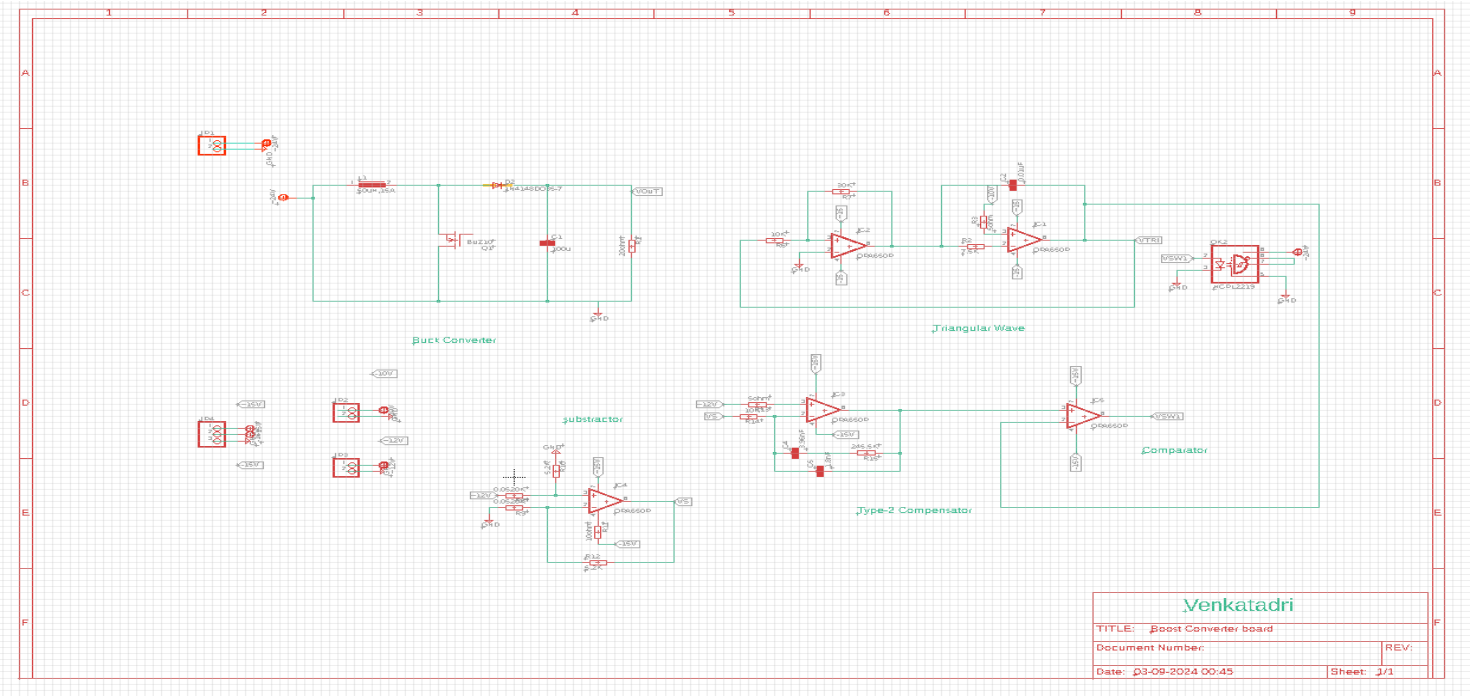
```
vin=24;
D=0.5;
d=(1-D);
Vo=vin/d
I_L=Vo/(R*d)
R=10;
fs=50e3;
C=200e-6;
L=0.0625e-3;
H=tf([d*Vo,-L*I_L],[L*C,L/R,d^2]);
display(H);
[Gm,Pm,Wcg,Wcp] = margin(H)
figure(1)
bode(H)
margin(H);
[p,z] = pzmap(H);grid
G=tf(d',[L*C,L/R,d^2]);
display(G);
[Gm,Pm,Wcg,Wcp] = margin(G)
figure(2)
bode(G)
margin(G);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

3.7 Bode Plots of Boost converter:

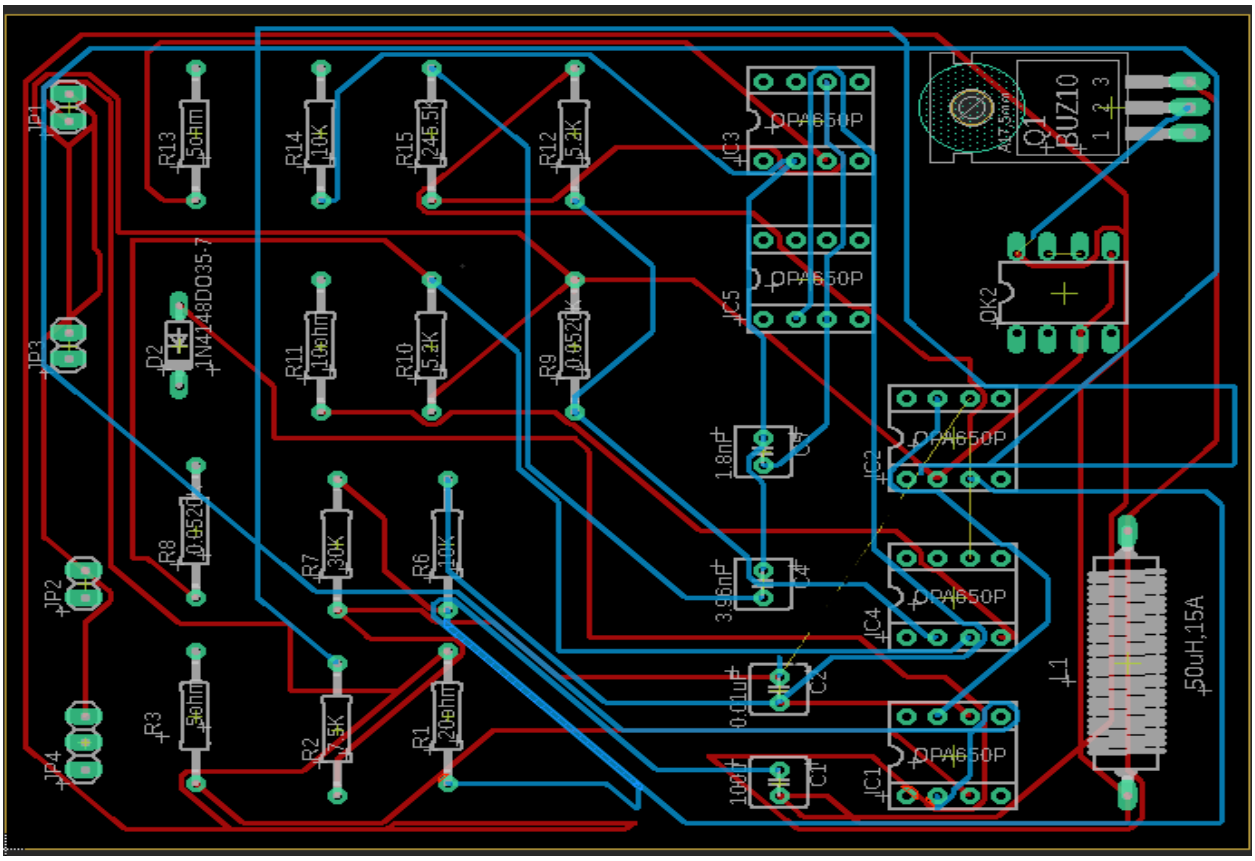




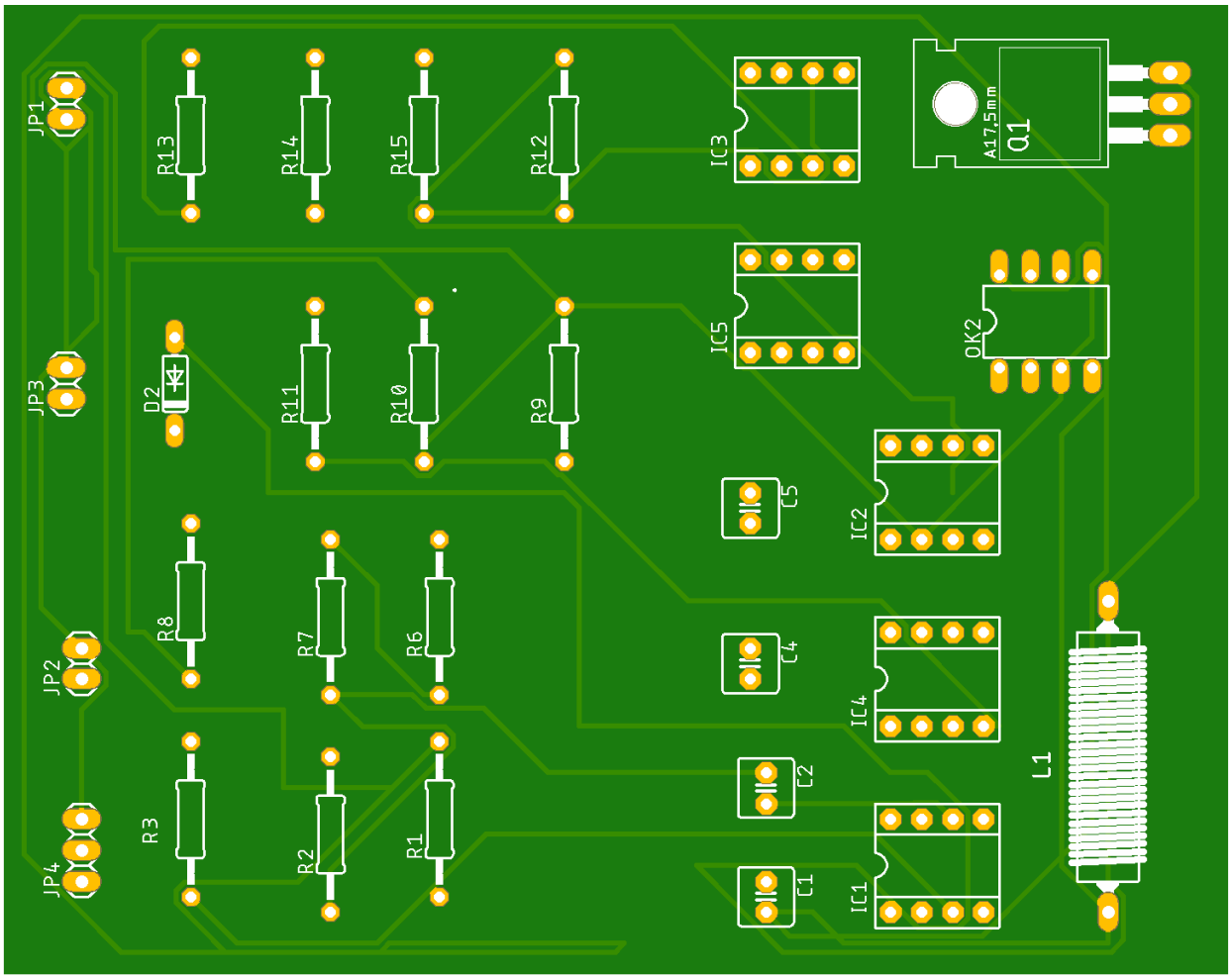
3.8 PCB Schematic:



3.9 PCB Board:



3.10: Manufacturing Board of PCB



Conclusion:

Thus the Boost converter is simulated and designed.