ELE 613

SWITCH MODE POWER SUPPLIES

HOMEWORK 2

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1 Introduction

This report shows the simulation results of a Forward Converter with the specs in Table 1.

Vin= 48V	Vo=5V	n1/n2=4
n1/n3=1	fs=100 kHz	Lm=200uH
Lr=40 uH	Cf=100uF	Rl=0.5 ohm

Table 1: Forward Converters Specs

The simulations are done in Matlab SIMULINK environment. The simulation model is in Fig 1

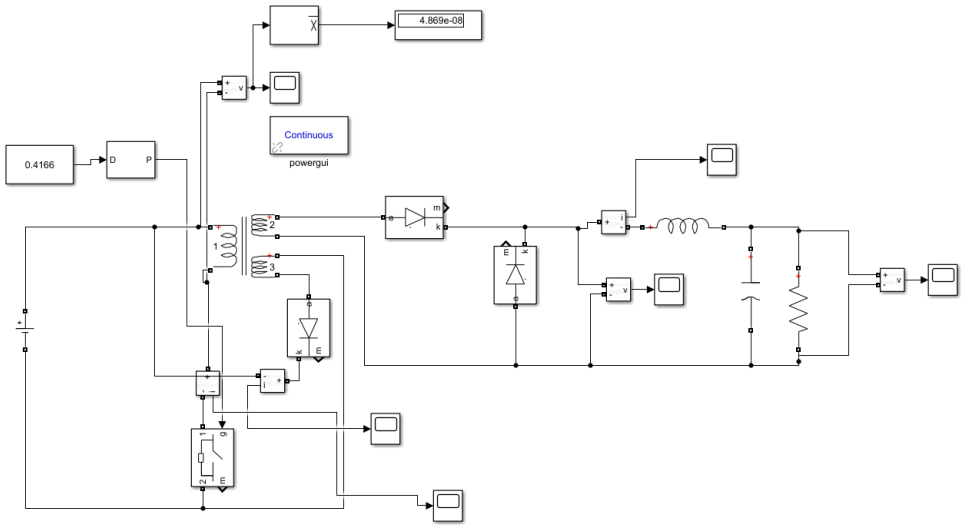

Figure 1: Simulink model of forward converter

2 Question 1

According to the specs given the duty cycle $D = 0.4166$ for a 5V DC at the output. However this formula holds for the ideal, continious case which means no bias voltage of the diode. The simulations are done according to $D = 0.4166$ and hence the output voltage is 4.2 V with a 0.8V diode on voltage. The inductor current is in Figure 2 and the voltage input to the output stage (i.e voltage across D2) is in Figure 3

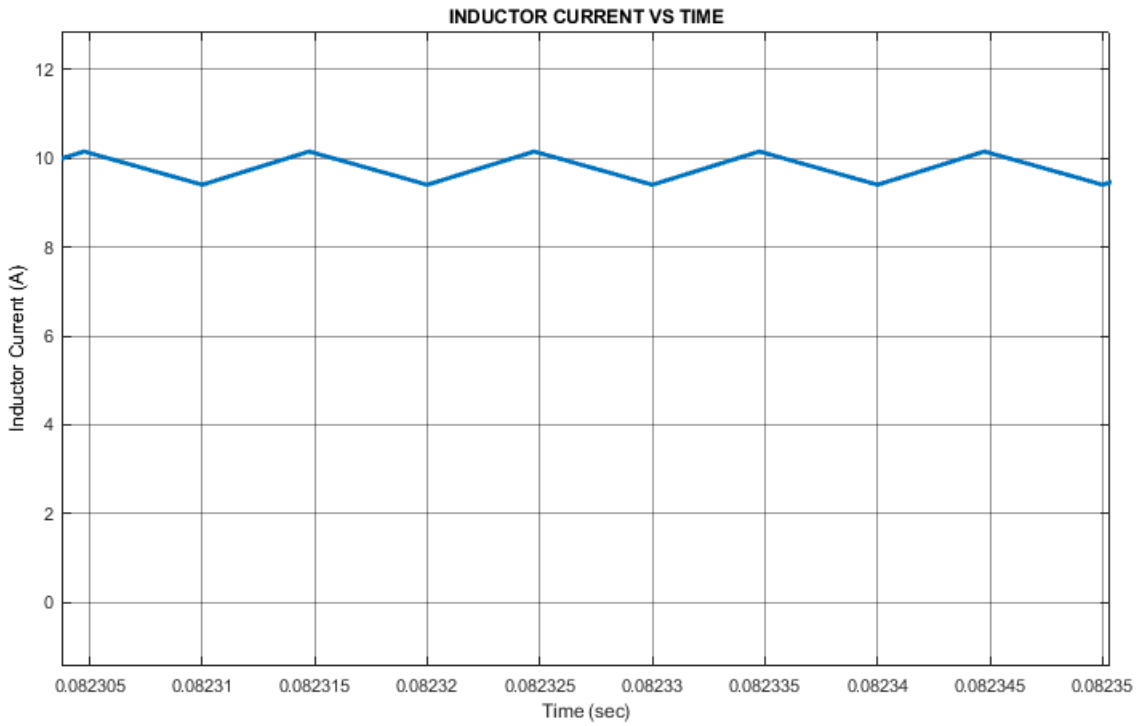

Figure 2: Inductor Current

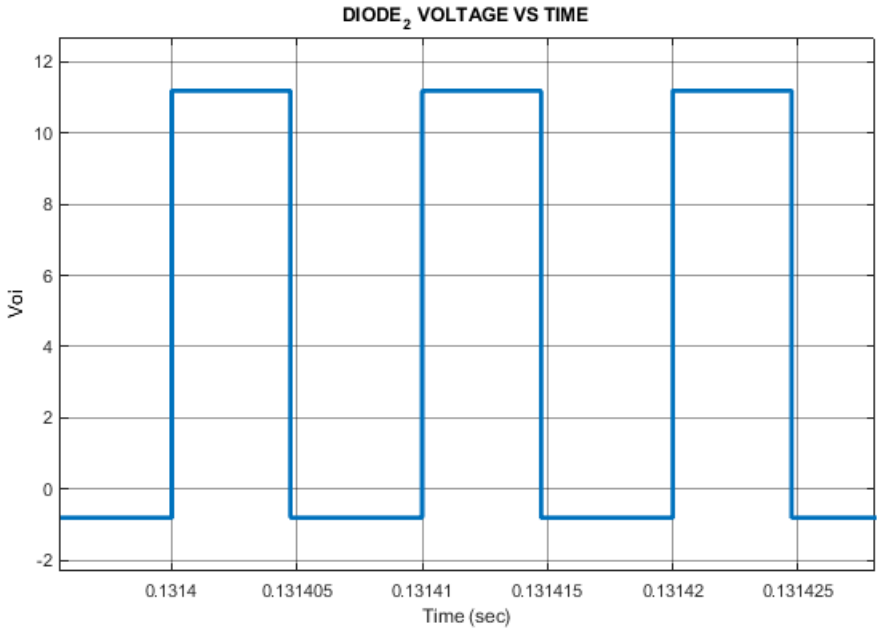

Figure 3: V_{oi} voltage

3 Question 2

The V1 voltage is in Figure 4, the D3 current is in Figure 5 and the switch current is in Figure 6.

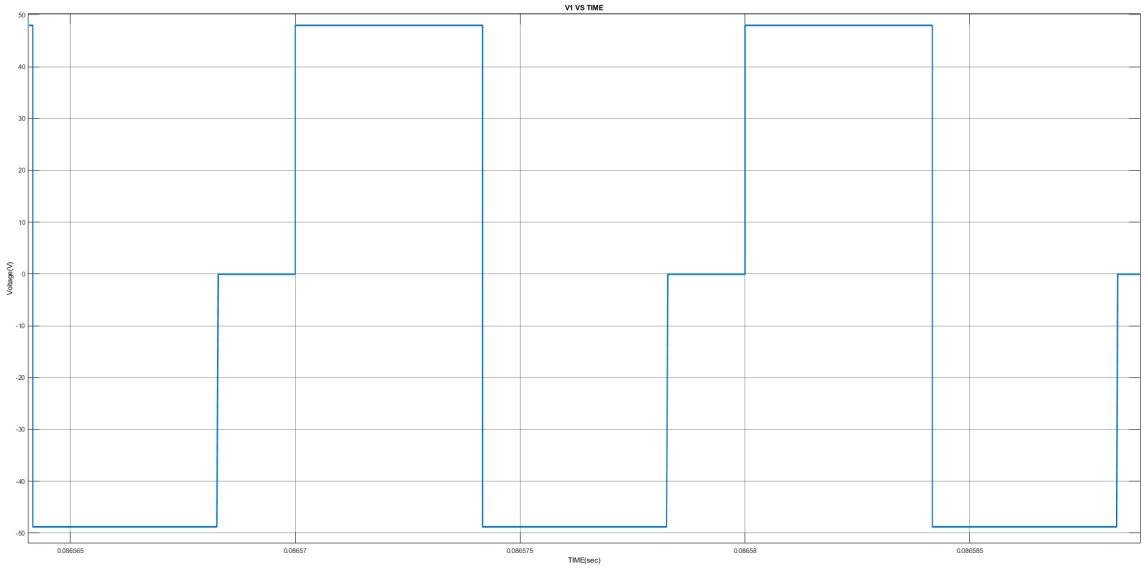

Figure 4: V1 voltage

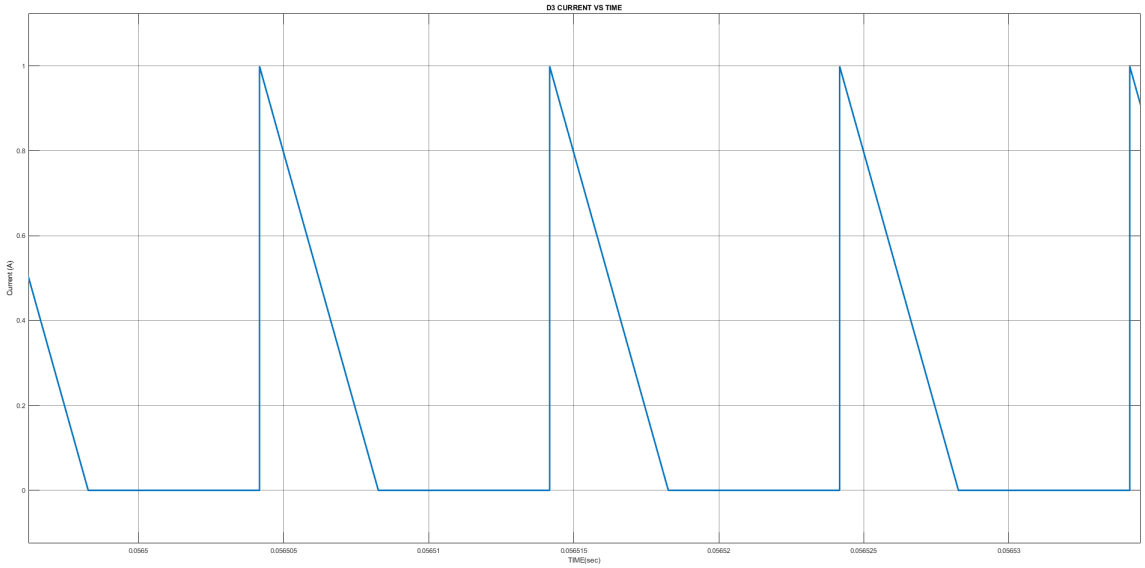

Figure 5: D3 current

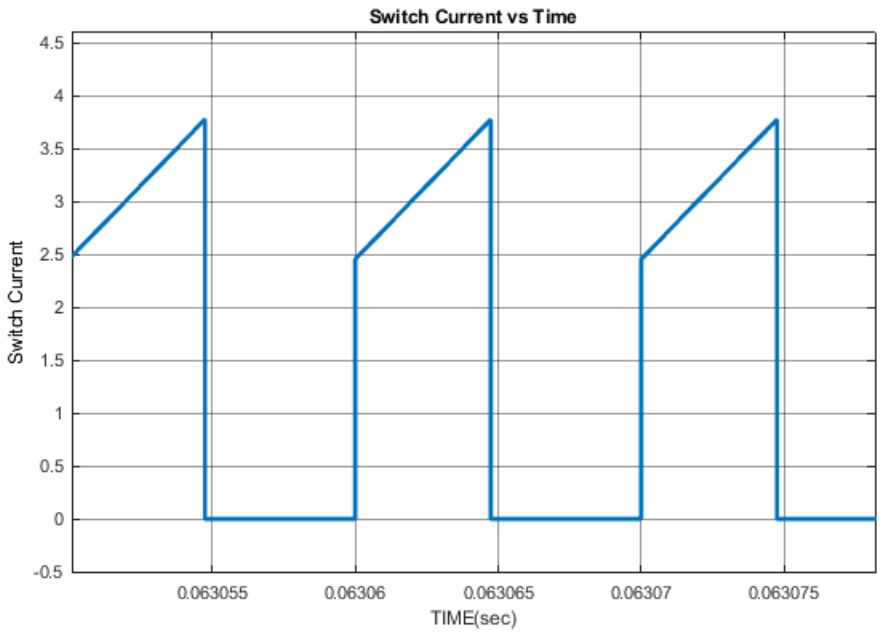

Figure 6: Switch Current

4 Question 3

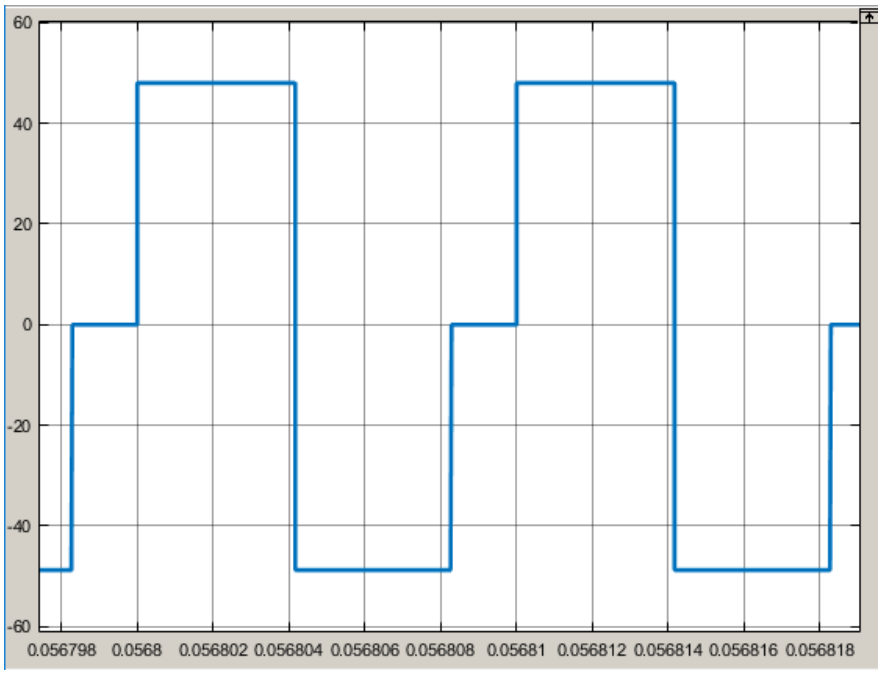

Figure 7: V1 voltage

From Figure 7, we can observe that the magnitudes of positive and negative voltages are equal. Moreover we can measure the t_1 and t_2 corresponding to positive and negative voltage times. Hence;

$$V_{1,avg} = 0V \tag{1}$$

Using the simulation it is also possible to take the mean of any waveform. From Figure 8 we can see that the V1 voltage is zero indeed expected from volt-seconds law of inductors.

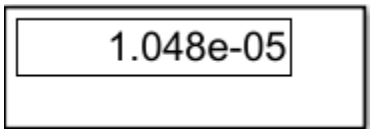

Figure 8: Average of V1 measured in simulink

5 Question 4

According to the formula since our $n1/n3 = 1$ the duty cycle and the times should hold. Our duty cycle $D = 0.4$ meaning that tm should also be 0.4Ts. From Figure 4 it is clear that this formula is true.