The forward converter in the figure shown below has the following parameters. Vs = 100v ,$N1/N2$ =1/1,Lm =1mH,Lx =1mH,R=20Ω,C=33μF, f =150kHz and D = 0.35. Determine the following:

- a) The output voltage and the output voltage ripple.
- b) The average, minimum and maximum L_x current values.
- c) The peak current in L_m and in the switch.
- d) Simulate the forward converter in a software simulation program.

$$I_{Lm\,avg} = \frac{I_{in}}{D} = \frac{V_{in}}{R} D \left(\frac{N_2}{N_1}\right)^2 = 1.75.$$

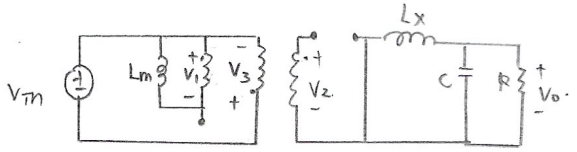
$$I_{Lm\,max} = I_{Lmavg} + \frac{1}{2}\Delta i_{LM} = 1.75 + 0.1165 = \underline{1.8665\ A}.$$

$$\Delta i_{LM} = \frac{V_{in}\, D}{L_M f_s} = 0.233$$

$$I_{SW\,avg} = I_{in} \cdot D = \frac{V_o}{R} D^2 \left(\frac{N_2}{N_1}\right) = 0.214$$

$$\Delta i_{SW} = \Delta i_{LM} = 0.233$$

$$I_{SW\,Max} = I_{SW\,avg} + \frac{1}{2}\Delta i_{SW} = 0.214 + 0.1165 = \underline{0.3305\ A}.$$



$$V_1 = V_3\left(\frac{N_1}{N_3}\right) = -V_{in}\left(\frac{N_1}{N_3}\right)$$

$$V_2 = V_3\left(\frac{N_2}{N_3}\right) = -V_{in}\left(\frac{N_2}{N_3}\right)$$

$$V_{LM} = V_1 = -V_{in}\left(\frac{N_1}{N_3}\right)$$

$$V_{Lx} = -V_o.$$

$$\Rightarrow \frac{V_o}{V_{in}} = D\,\frac{N_2}{N_1}$$

$$I_{in} = I_{LM} \cdot D \;;\; I_{LM} = \frac{I_{in}}{D} = \frac{I_o \cdot D \cdot \frac{N_2}{N_1}}{D} = \frac{V_o}{R}\cdot\frac{N_2}{N_1} = \frac{V_{in}}{R} D \left(\frac{N_2}{N_1}\right)^2$$

$$\Delta i_{LM} = \frac{V_{in}\, D}{L_M \cdot f_s}$$

$$\Delta i_{Lx} = \frac{V_o\,(1-D)}{L_x\, f_s}$$

$$I_{Lx} = I_o = \frac{V_o}{R} = \frac{V_{in}}{R} D\left(\frac{N_2}{N_1}\right)$$

$$\Delta Q = C\,\Delta V = \Delta i\, \Delta t. \quad (\text{same as. Buck}).$$

$$\Rightarrow C = \frac{1-D}{8 f_s^2 L \left(\Delta V_o / V_o\right)}$$

$$I_{SW} = I_{in} \cdot D$$

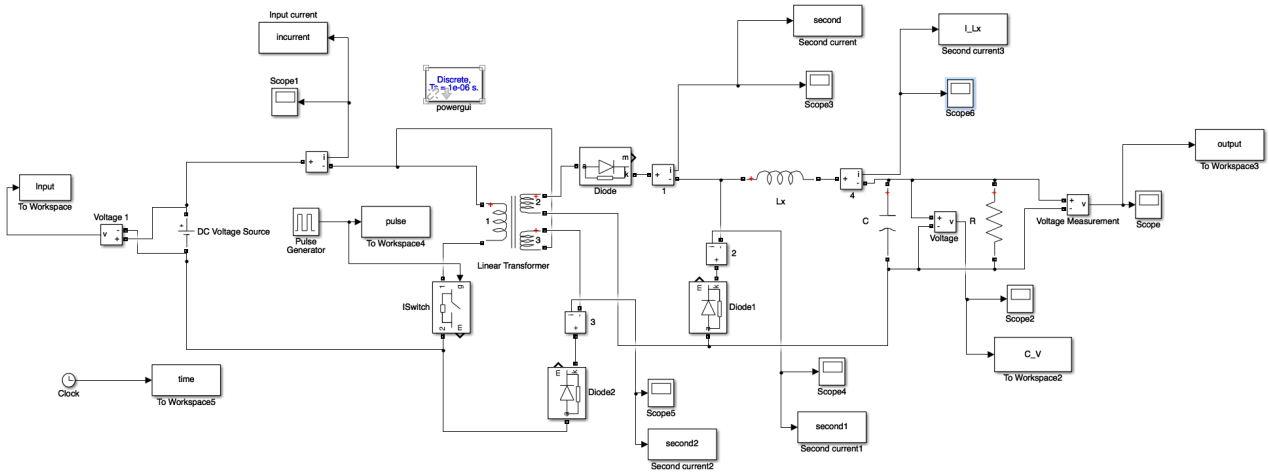


fig1-1. simulation of forward converter

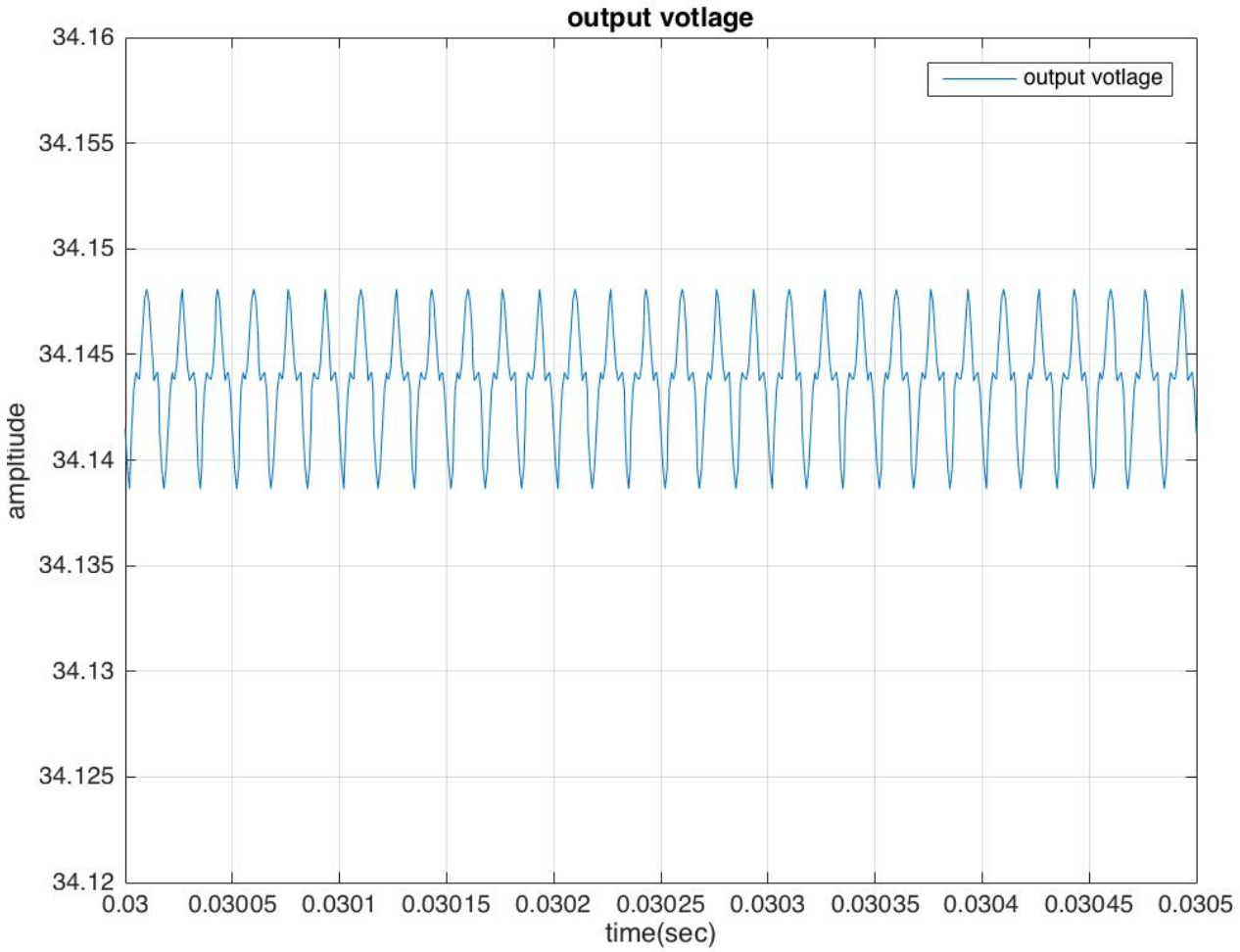


fig2. output voltage waveform.

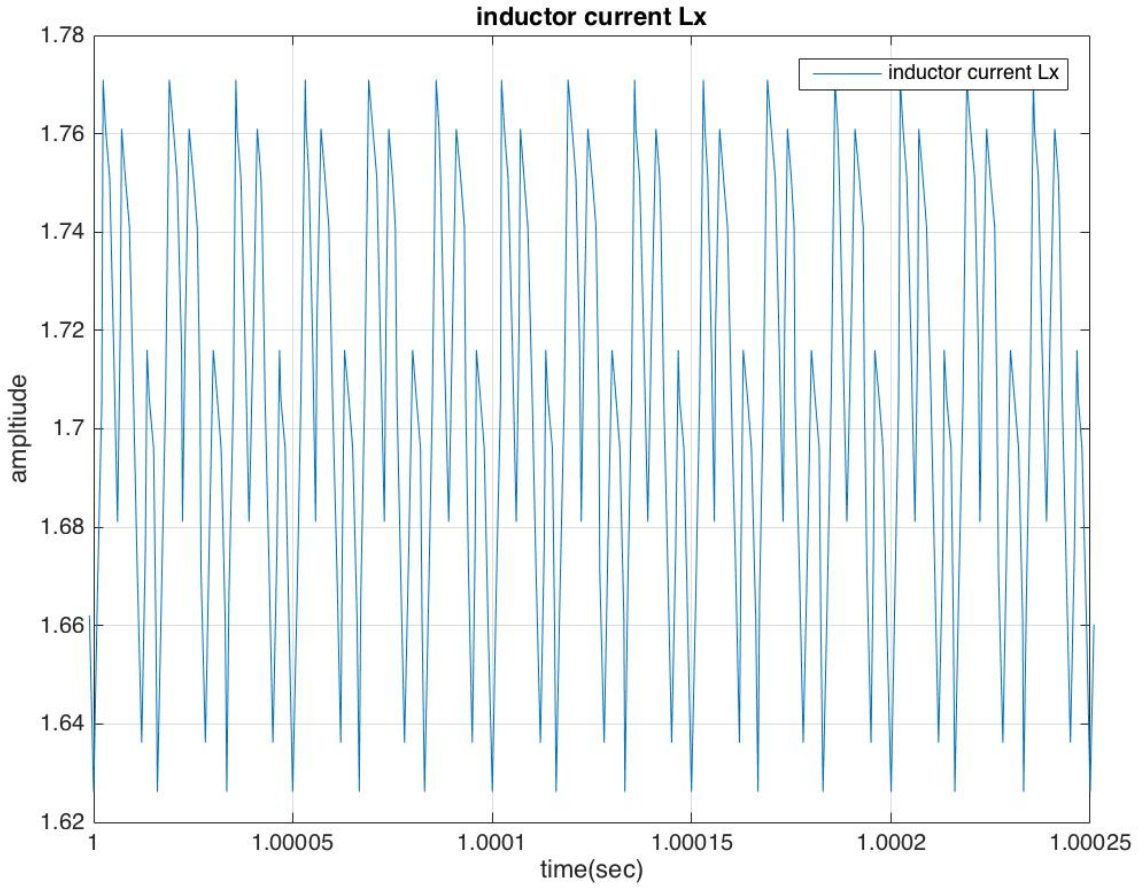


fig3. inductor (Lx) current waveform.