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Design a flyback converter in LT spice of 100 watts. The output voltage should be (+ 15, -15, and 5) volt current ripple and the voltage ripple should be less than 2%. The input of the flyback converter comes from the AC main. calculate the losses and efficiency.

CALCULATIONS:

$$\frac{V_{out}}{V_{in}} = \frac{D}{(1-D)} * \frac{N2}{N1}$$

For primary winding-

$$L_p = \frac{(V_{in}(\min) * D_{max})^2}{2 * P_{in} * F_s}$$

For Secondary Winding-

$$\frac{N2}{N1} = \frac{V_{out}}{V_{in}(\min)} * \frac{(1-D_{max})}{D_{max}}$$

$$L_s = \left(\frac{N2}{N1}\right)^2 * L_p$$

$$C = \frac{I_o * D}{\Delta V_o * F_s}$$

SYSTEM PARAMETERS

$$F_{sw} = 100 \text{ KHz}$$

$$\text{Time Period} = 10 \text{ msec.}$$

$$D_{max} = 0.5$$

$$V_{in} = 230 \text{ V (RMS)}$$

$$(I_{in})_{max} = \frac{100 \text{ (W)}}{230 \times \sqrt{2} \text{ (V)}} = 0.307 \text{ Amp.}$$

$$I = \frac{\Delta Q}{\Delta T}$$

$$Q = I \times \frac{T}{2} = 3.07 \text{ mC.}$$

$$\text{Ripple} = 1\%$$

$$\Delta V = \frac{325 \times 1}{100} = 3.25$$

$$C = \frac{Q}{V} = \frac{3.07}{3.25} = 944 \text{ nF} \approx 1000 \text{ nF.}$$

$$L_p = \frac{(325 \times 0.5)^2}{2 \times 10^5 \times 100} = 1.32 \text{ mH.}$$

For ± 15 volts output.

$$\frac{V_o}{V_{in}} = \left(\frac{D}{1-D} \right) \frac{N_2}{N_1} \quad (D=0.5).$$

$$\frac{15}{325} = (1) \frac{N_2}{N_1}$$

$$\frac{L_p}{(L_1)_s} = \left(\frac{N_1}{N_2} \right)^2.$$

$$(L_1)_s = \left(\frac{15}{325} \right)^2 \times 1.32 = 2.811 \text{ mH.} = (L_2)_s$$

For 5 volts output

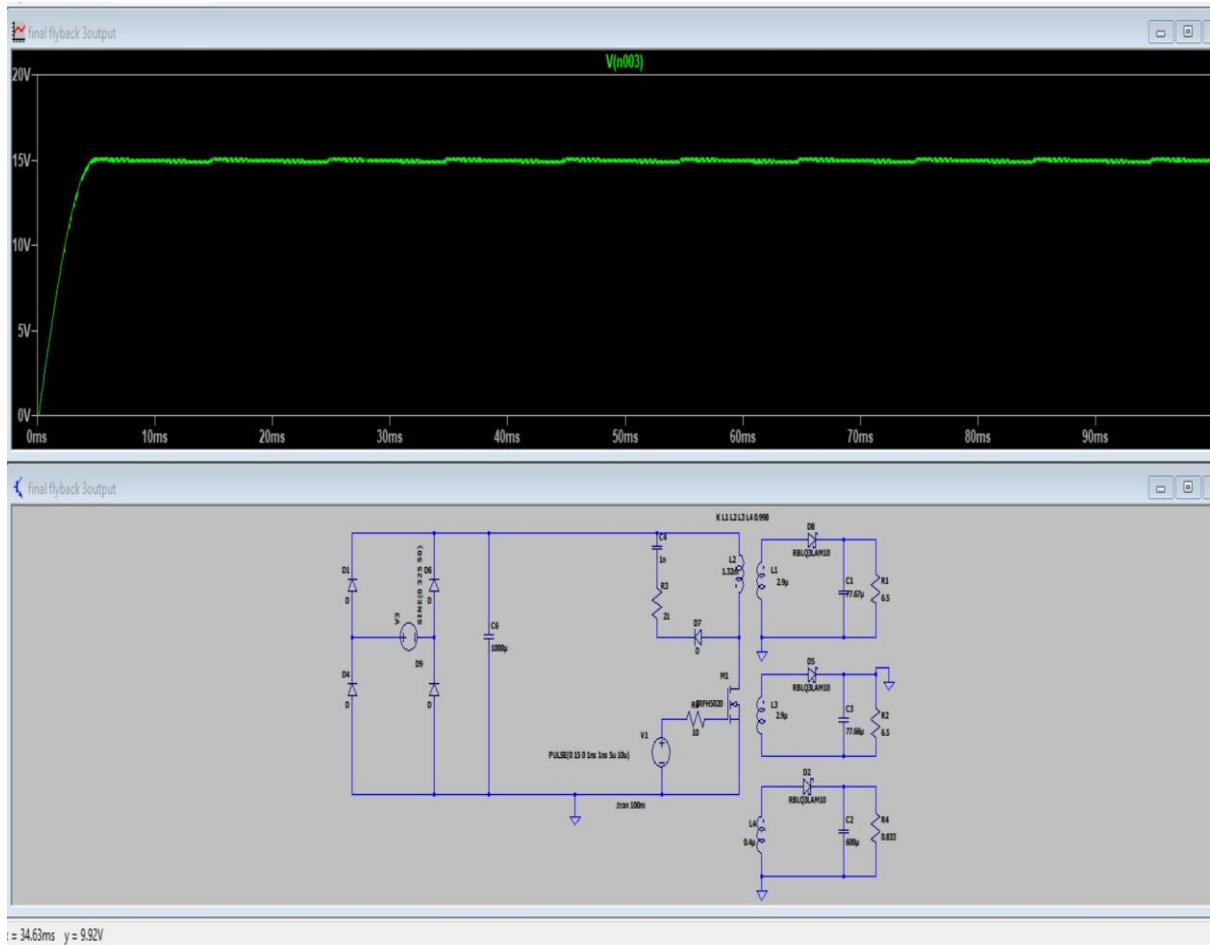
$$\frac{5}{325} = \frac{N_2}{N_1}$$

$$\frac{L_p}{(L_3)_s} = \left(\frac{N_1}{N_2} \right)^2$$

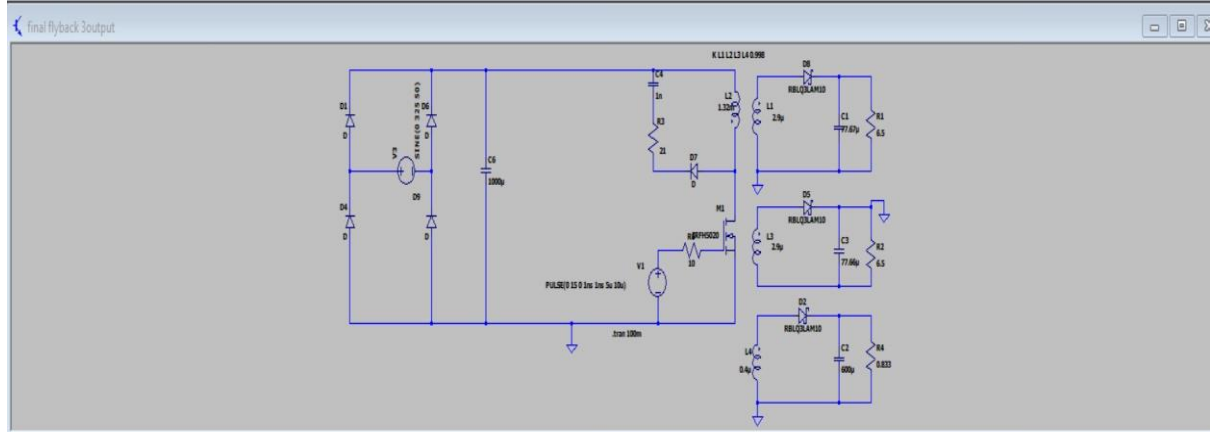
$$(L_3)_s = 1.32 \times \left(\frac{5}{325} \right)^2 = 0.312 \text{ mH.}$$

Voltage.	15 V	15 V	5 V
Power.	35 W	35 W	30 W
Current = $\frac{P}{V}$	2.33 A	2.33 A	6 A.
Resistance = $\frac{V^2}{P}$	6.428 Ω	6.428 Ω	0.833 Ω
Capacitor = $\frac{ID}{\Delta V_o f_s}$	77.66 mF	77.66 mF	600 mF.

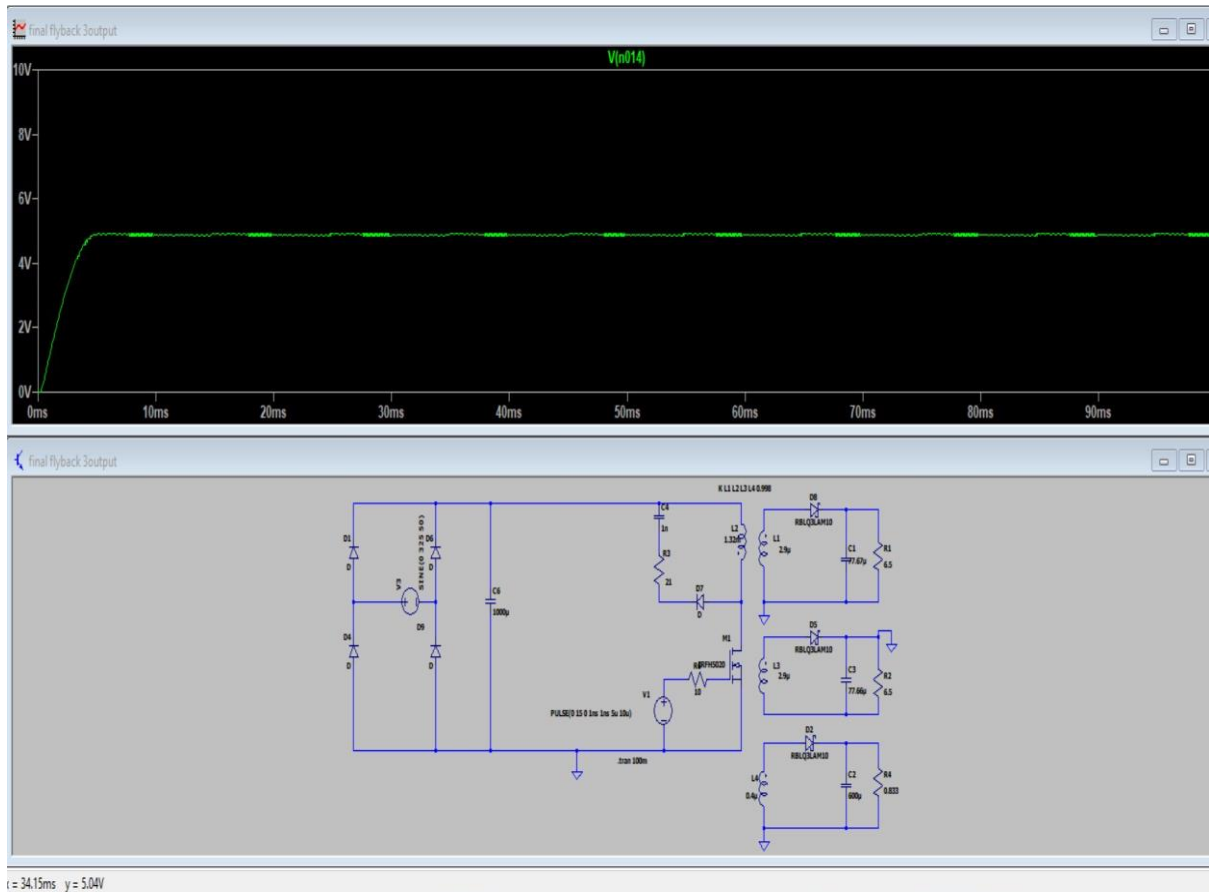
FLYBACK CONVERTER MODEL IN LT SPICE.



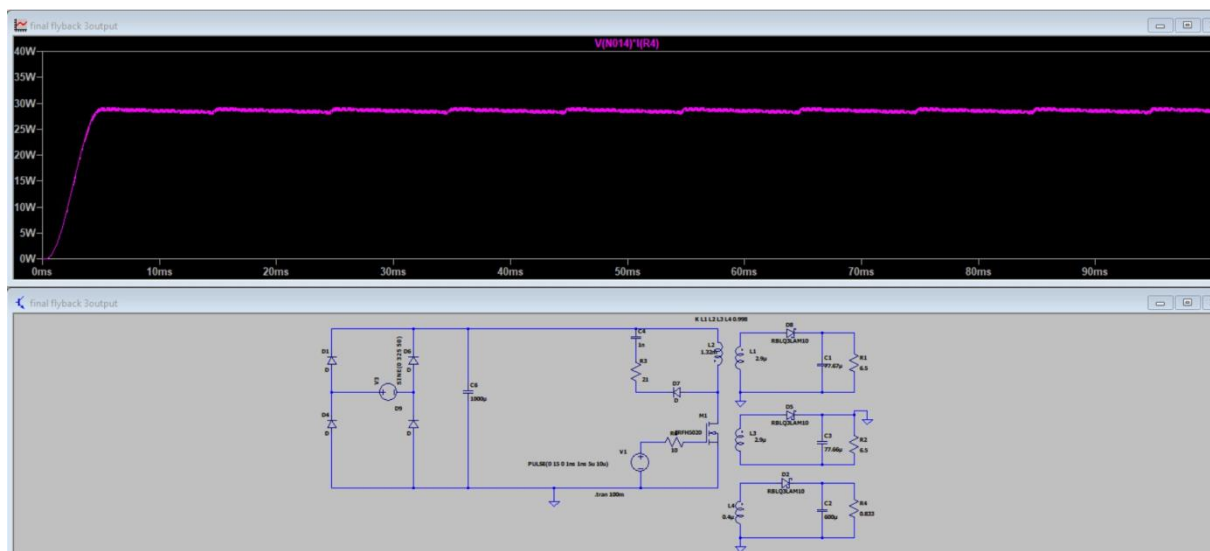
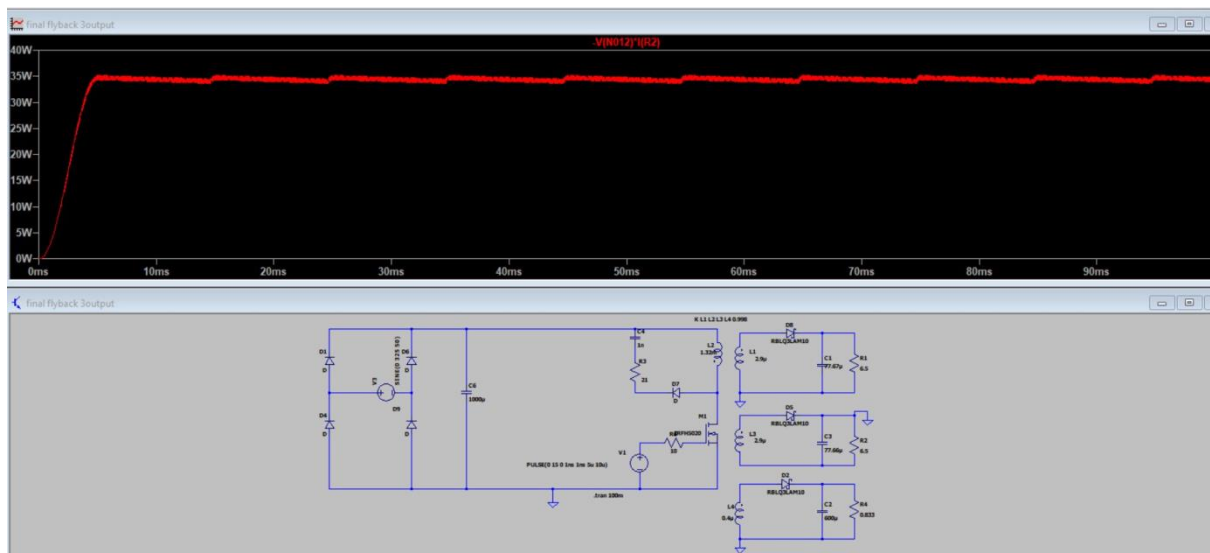
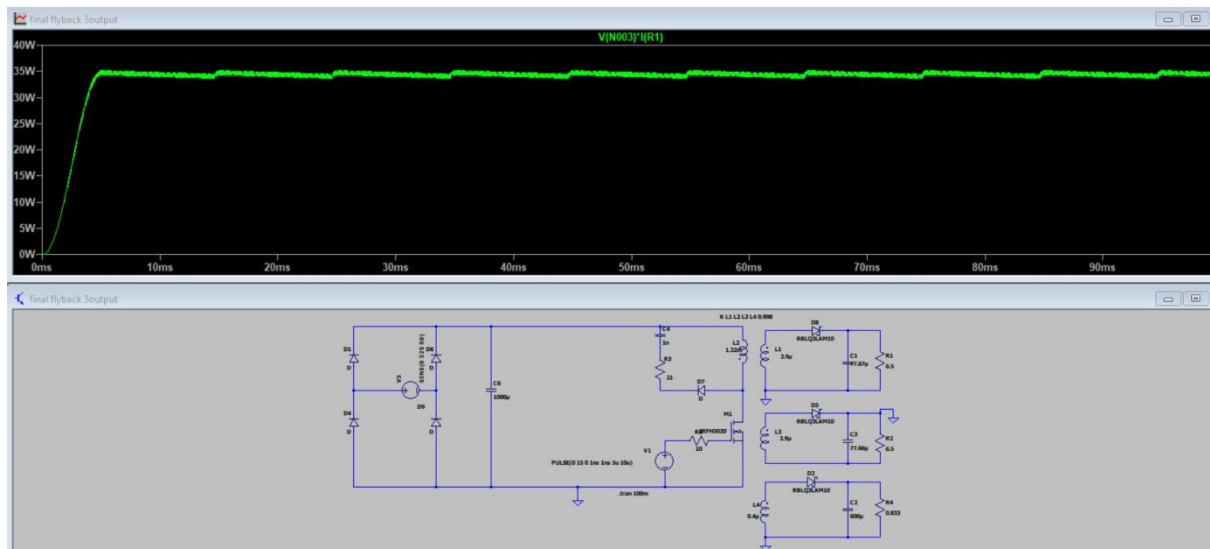
OUTPUT VOLTAGE OF -15 VOLTS AT ONE NODE.

 $t = 33.36 \text{ ms}$ $v = -10.93 \text{ V}$

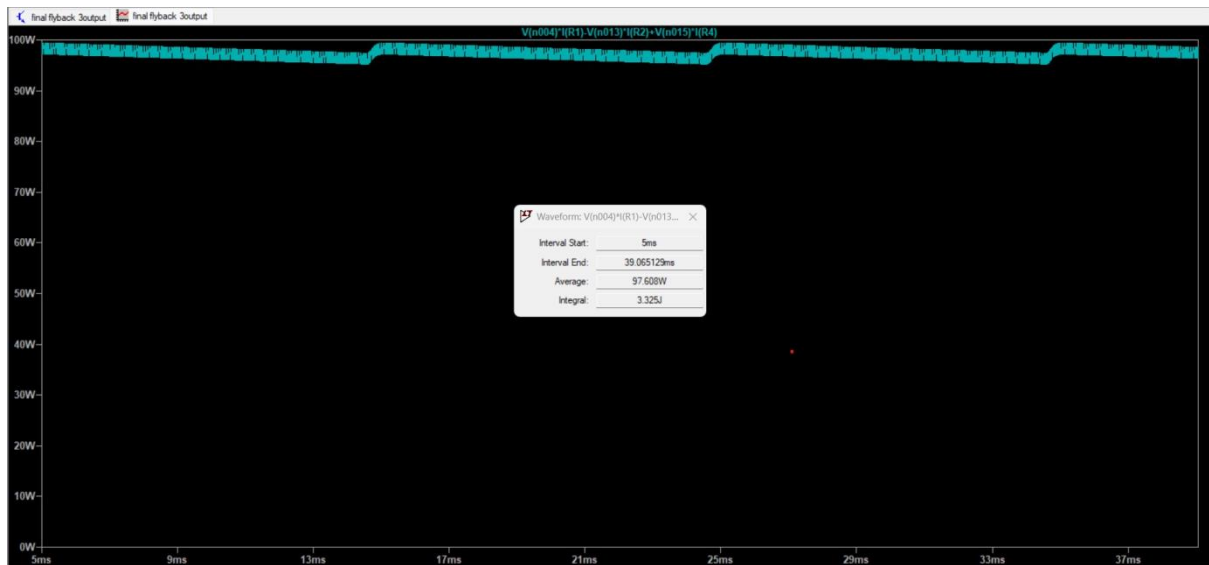
OUTPUT VOLTAGE OF +5 VOLTS AT ONE NODE.



Power at individual output.

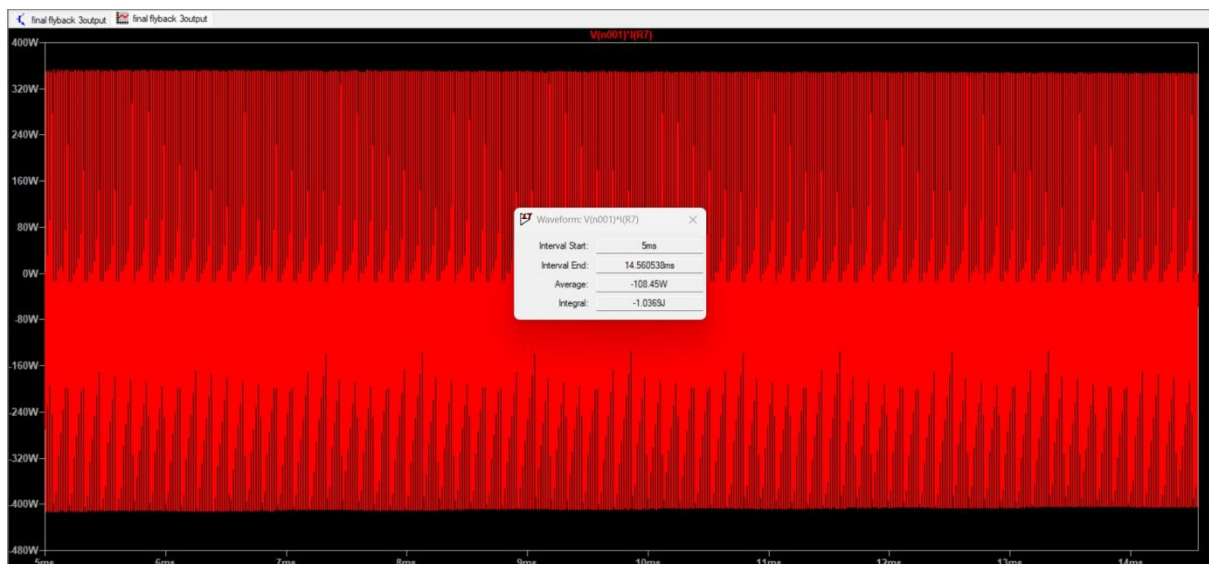


POWER MEASUREMENTS AT OUTPUT.



$P_{out\ avg} = 97.608W$

Power Measurement at Input.



$P_{in\ avg} = 108.45w$

LOSSES:

$$P_{\text{loss}} = P_{\text{in}} - P_{\text{out}}$$

$$= 108.45 - 97.608 = 10.842 \text{ W}$$

Efficiency:

$$\eta = \frac{P_{\text{out}}}{P_{\text{in}}} * 100 \%$$

$$= \frac{97.608}{108.45} * 100\%$$

$$= 90.0027\%.$$

THANK YOU !