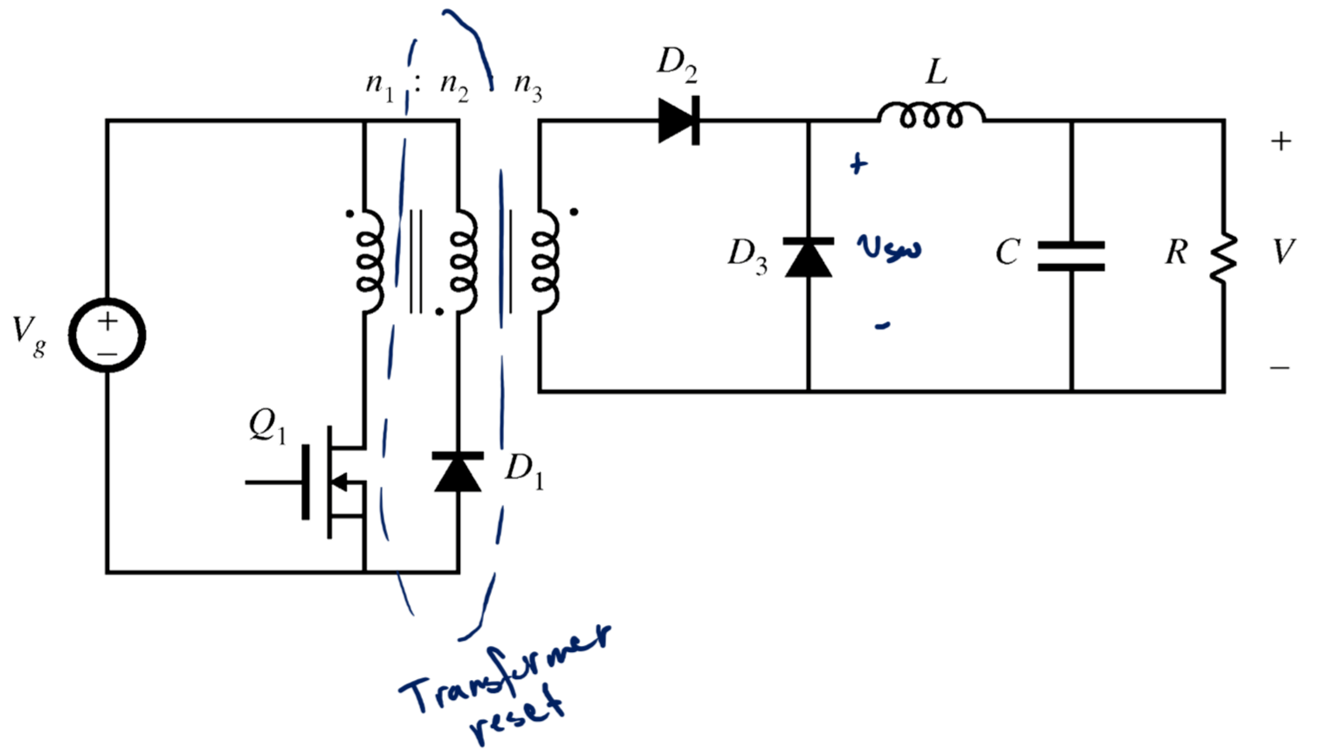
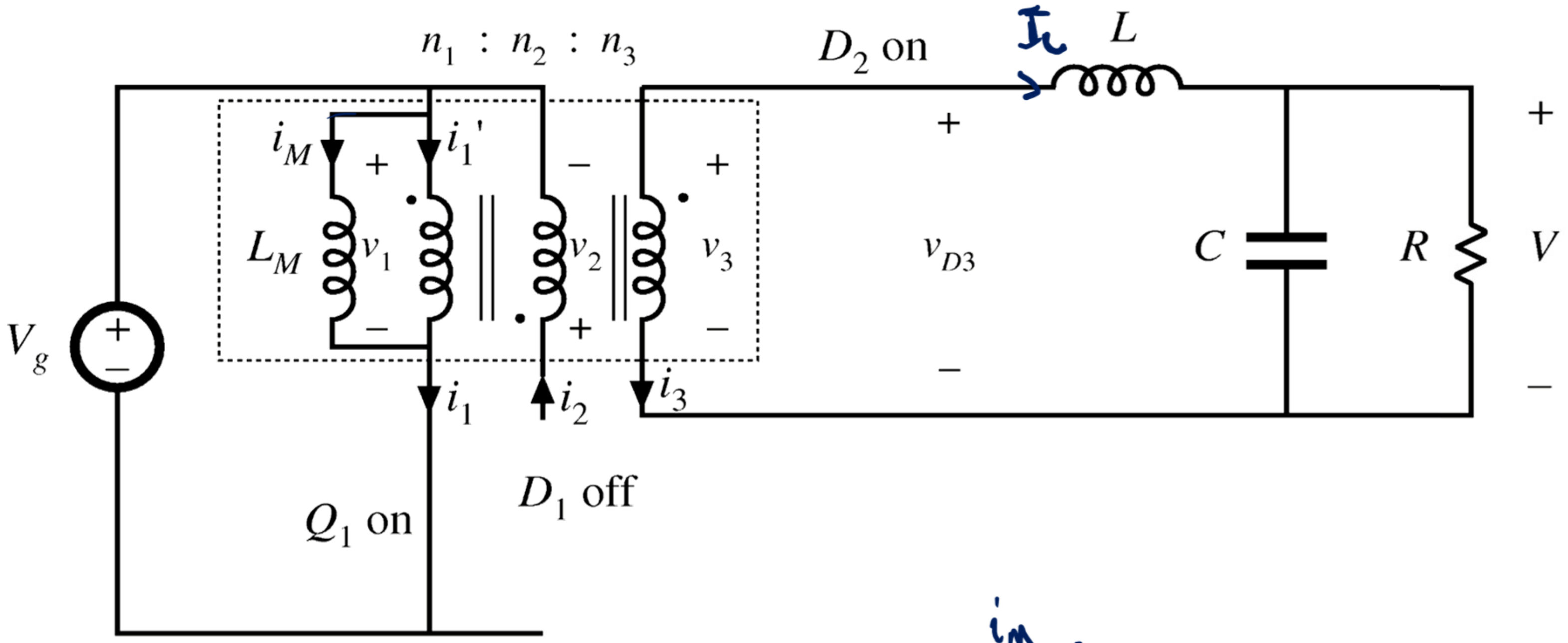
6.3.2 Forward Converter



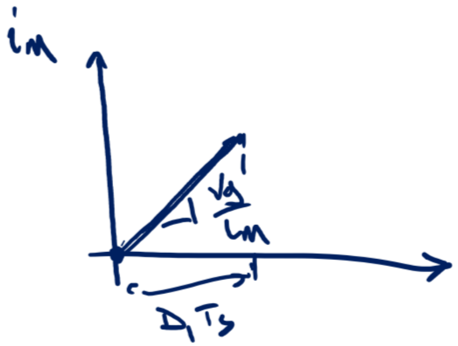
Subinterval 1



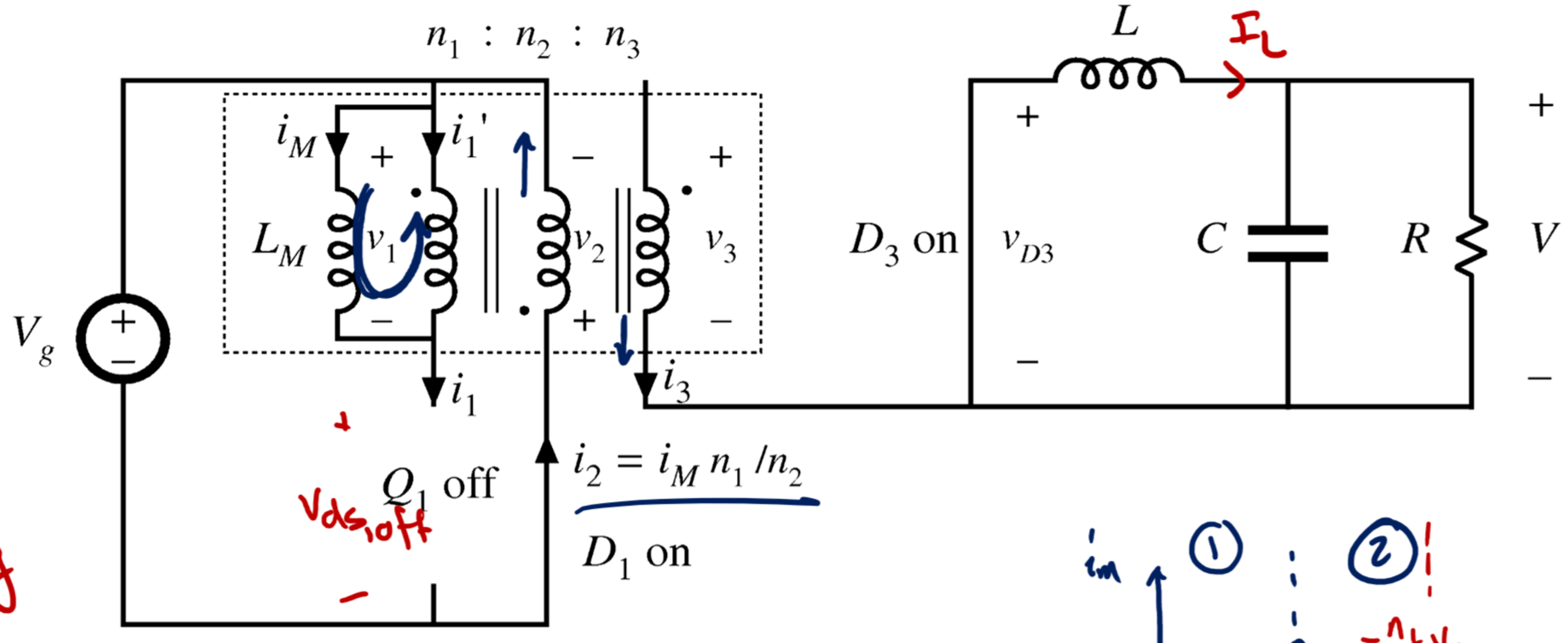
$$v_1 = V_g$$

$$v_3 = V_g \frac{n_3}{n_1}$$

$$v_2 = V_g \frac{n_2}{n_1}$$



Subinterval 2



Q_1: Blocking

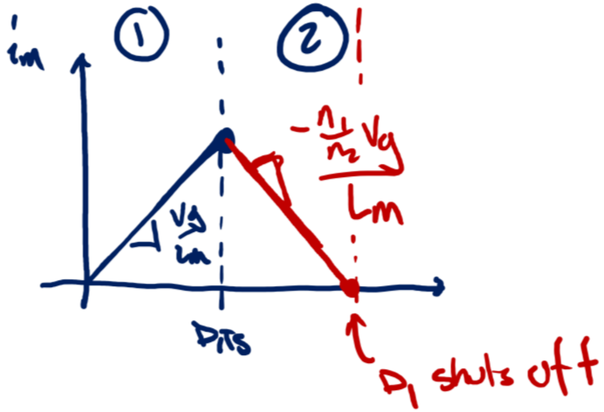
$V_{ds,off} = V_g + \frac{n_1}{n_2} V_g$

$= V_g \left(1 + \frac{n_1}{n_2}\right)$

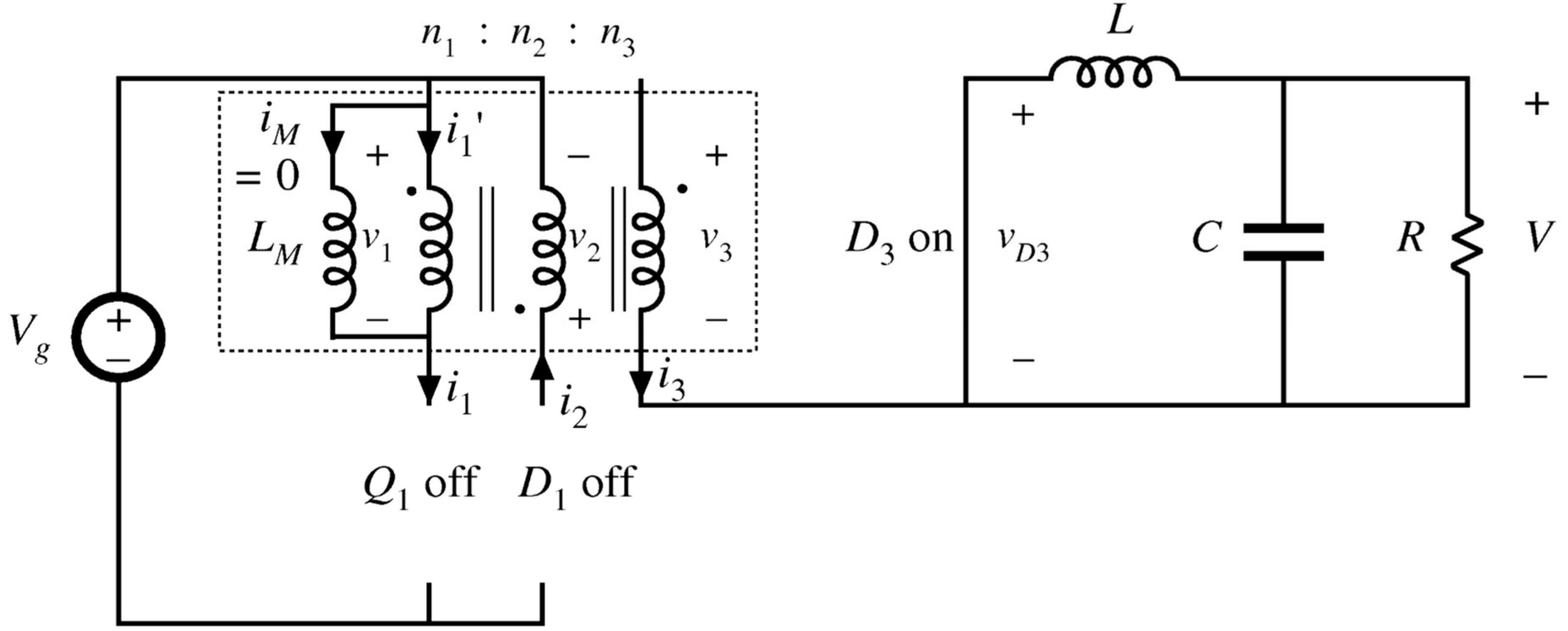
$V_2 = -V_g$

$V_1 = -\frac{n_1}{n_2} V_g$

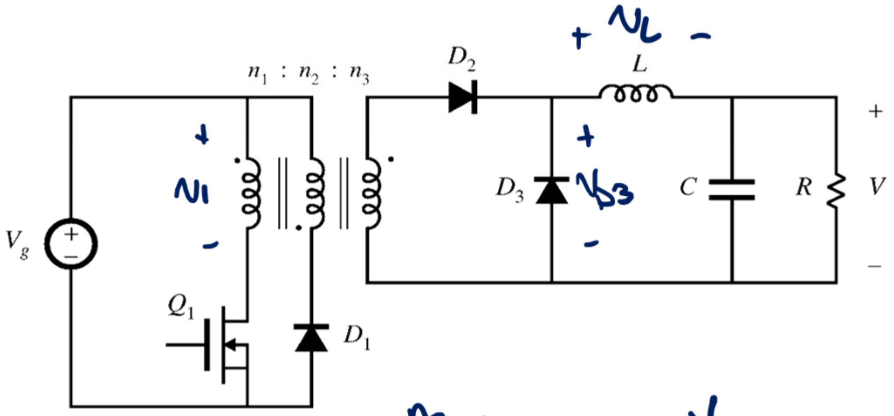
$V_3 = -\frac{n_3}{n_2} V_g$

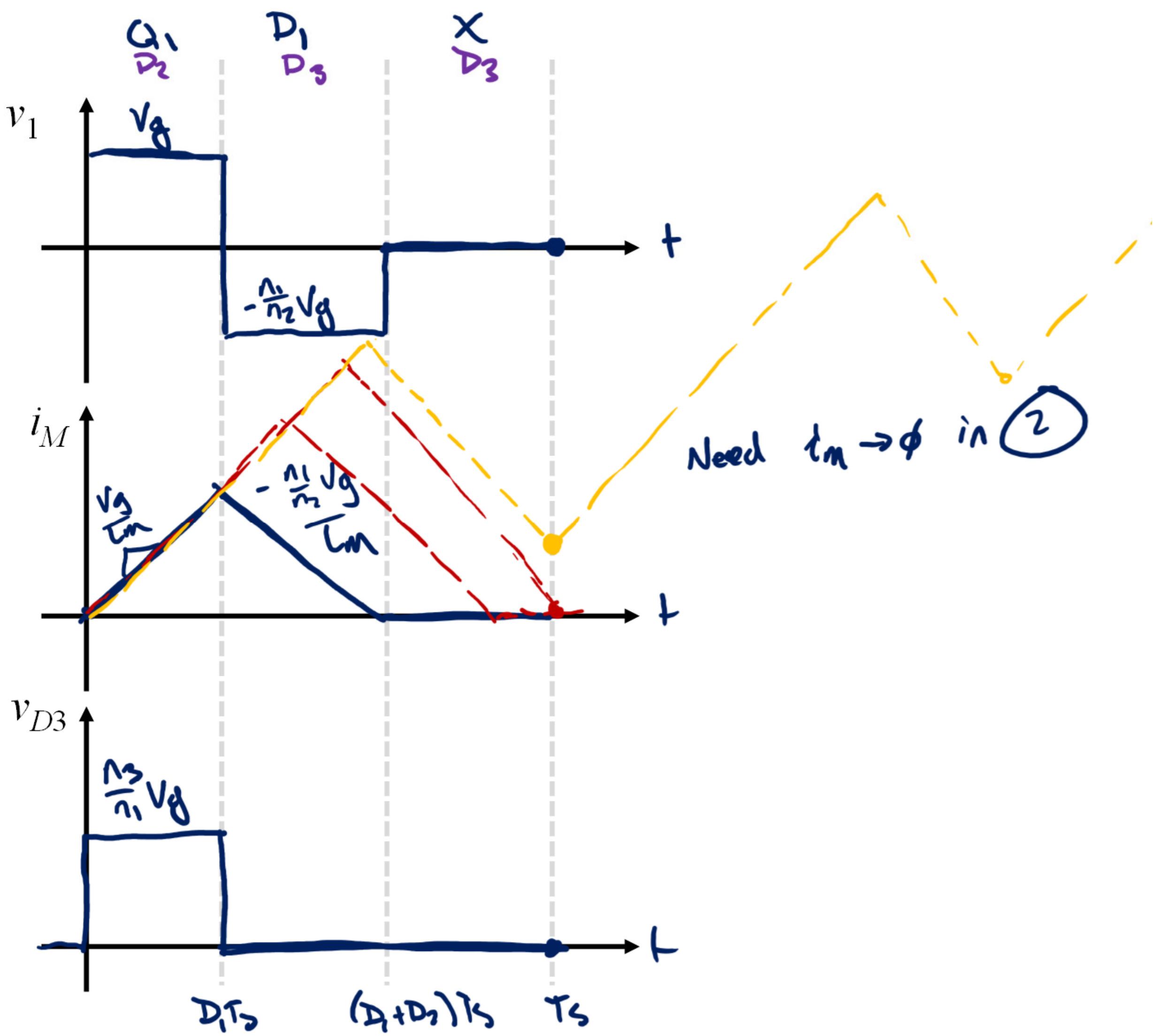


Subinterval 3



Forward Waveforms





$$\langle v_L \rangle = \phi = \frac{n_3}{n_1} V_g D_1 - V$$

$$M = \frac{V}{V_g} = \frac{n_3}{n_1} D_1$$

Check L_m saturation:

$$\langle v_1 \rangle = \phi = D_1 V_g - \frac{n_1}{n_2} D_2 V_g$$

$$D_1 = \frac{n_1}{n_2} D_2$$

We know $D_1 + D_2 + D_3 = 1, \quad D_3 \geq \phi$

$$D_1 + D_2 \leq 1$$

Limit $1 - D_1 - D_2 = \phi = 1 - D_1 - \frac{n_2}{n_1} D_1 = \phi$

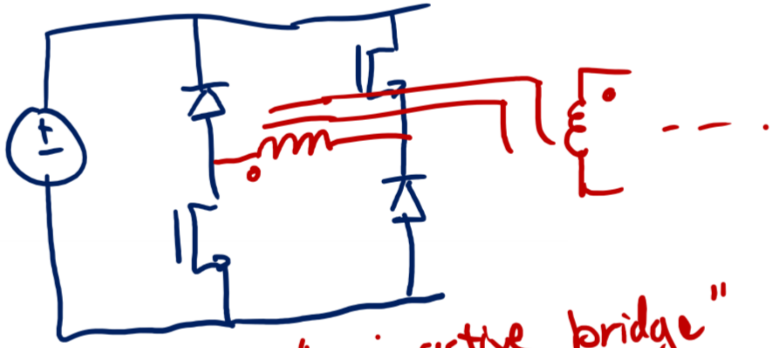
$$D_1 \left(1 + \frac{n_2}{n_1}\right) = 1$$

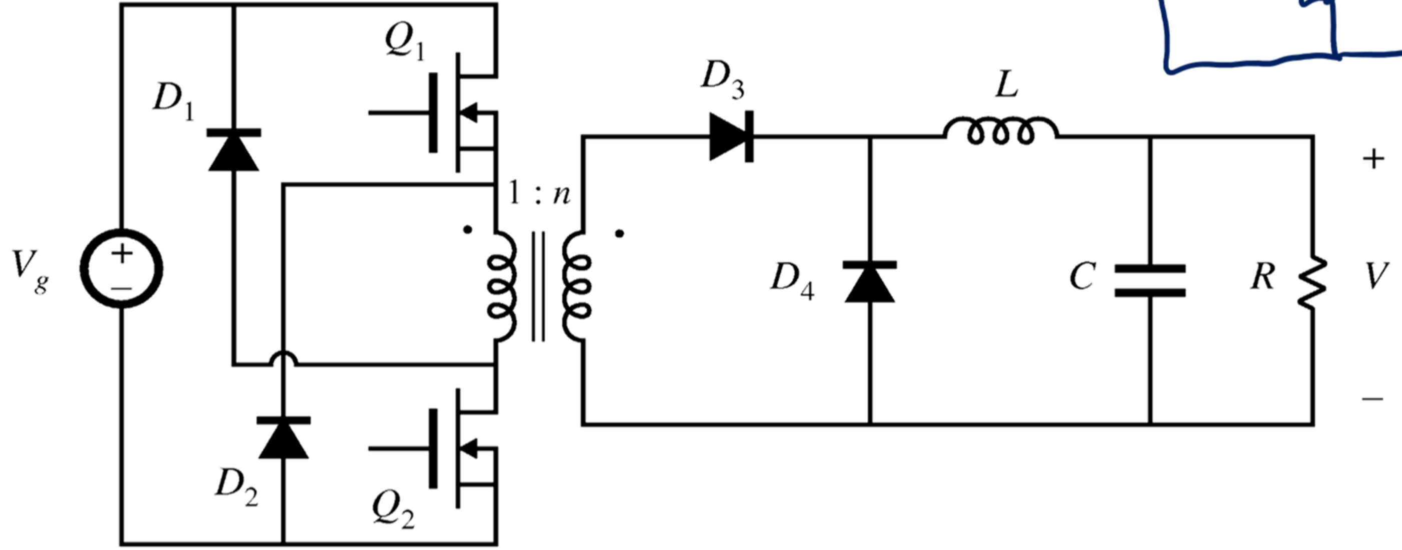
$$D_{1,max} = \frac{1}{1 + \frac{n_2}{n_1}}$$

Non-saturation limit $D_1 \le \frac{1}{1+\frac{n_2}{n_1}}$ → $\frac{n_1}{n_2}$ very large → ~full range D_1

$V_{ds,off} = V_g\left(1+\frac{n_1}{n_2}\right)$ → $\frac{n_1}{n_2}$ very small to reduce Q_1 rating

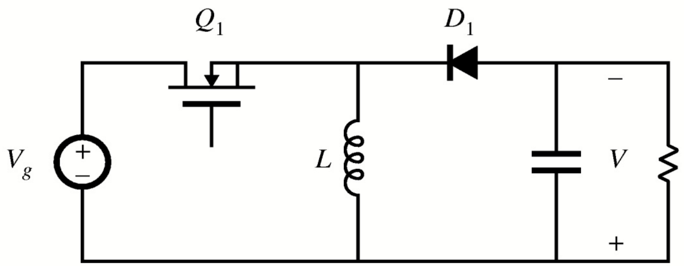
Two-Transistor Forward Converter

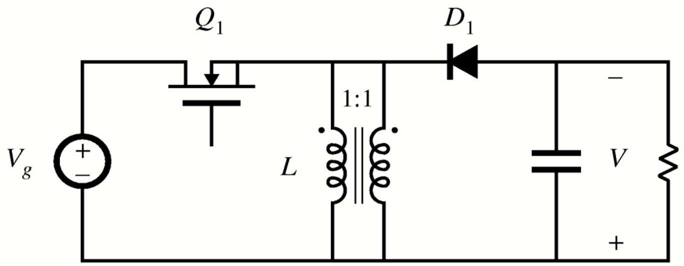


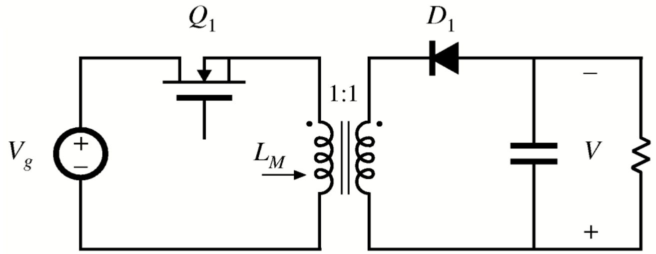


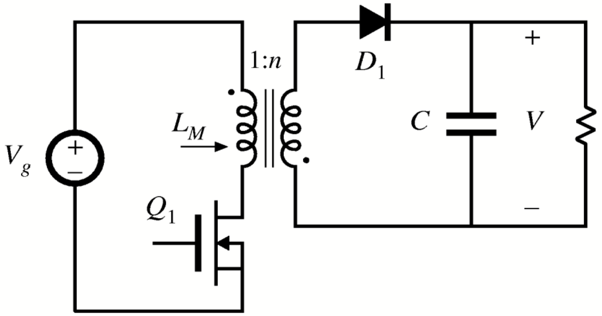
$$V = nDV_g \qquad D \le \frac{1}{2} \qquad \max(v_{Q1}) = \max(v_{Q2}) = V_g$$

Flyback Converter: Isolated Buck-Boost

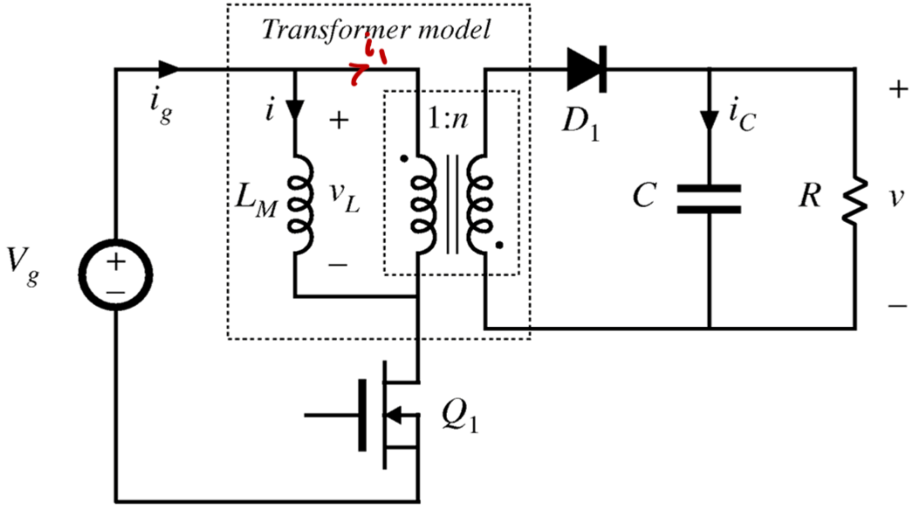








Flyback Transformer

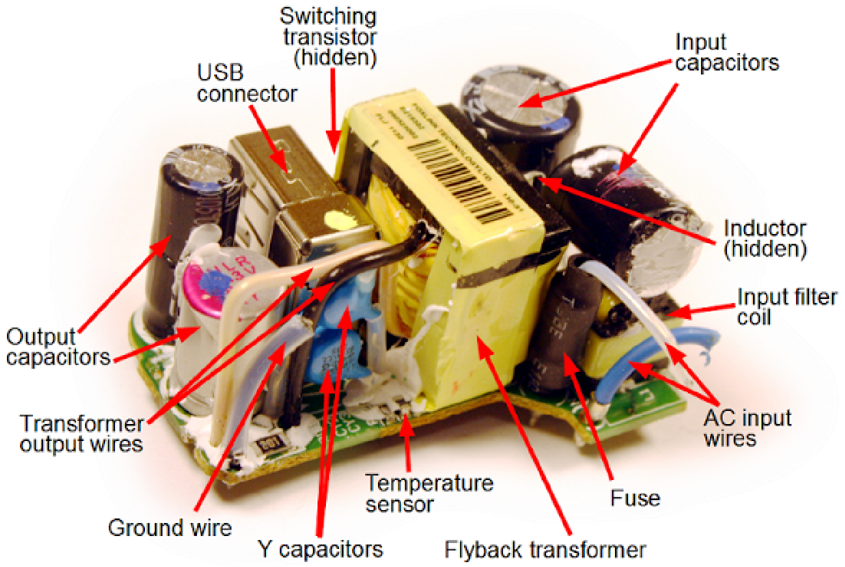


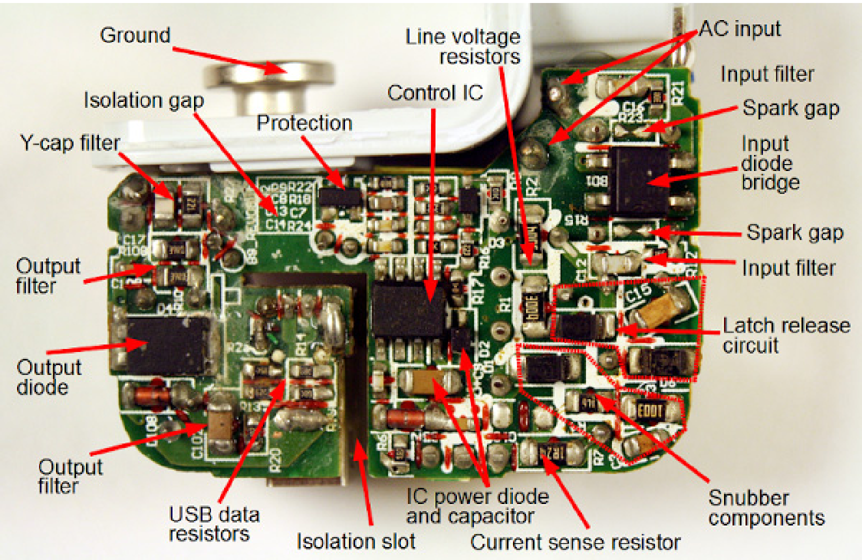
Lm is the energy conversion inductance.
it is not parasitic or "near infinite"

We want substantially non-zero current

Behaves more like a coupled inductor than a XF

Flyback Application: iPad Charger





http://www.righto.com/2014/05/a-look-inside-ipad-chargers-pricey.html

Flyback Off-Line Charger Application Circuit

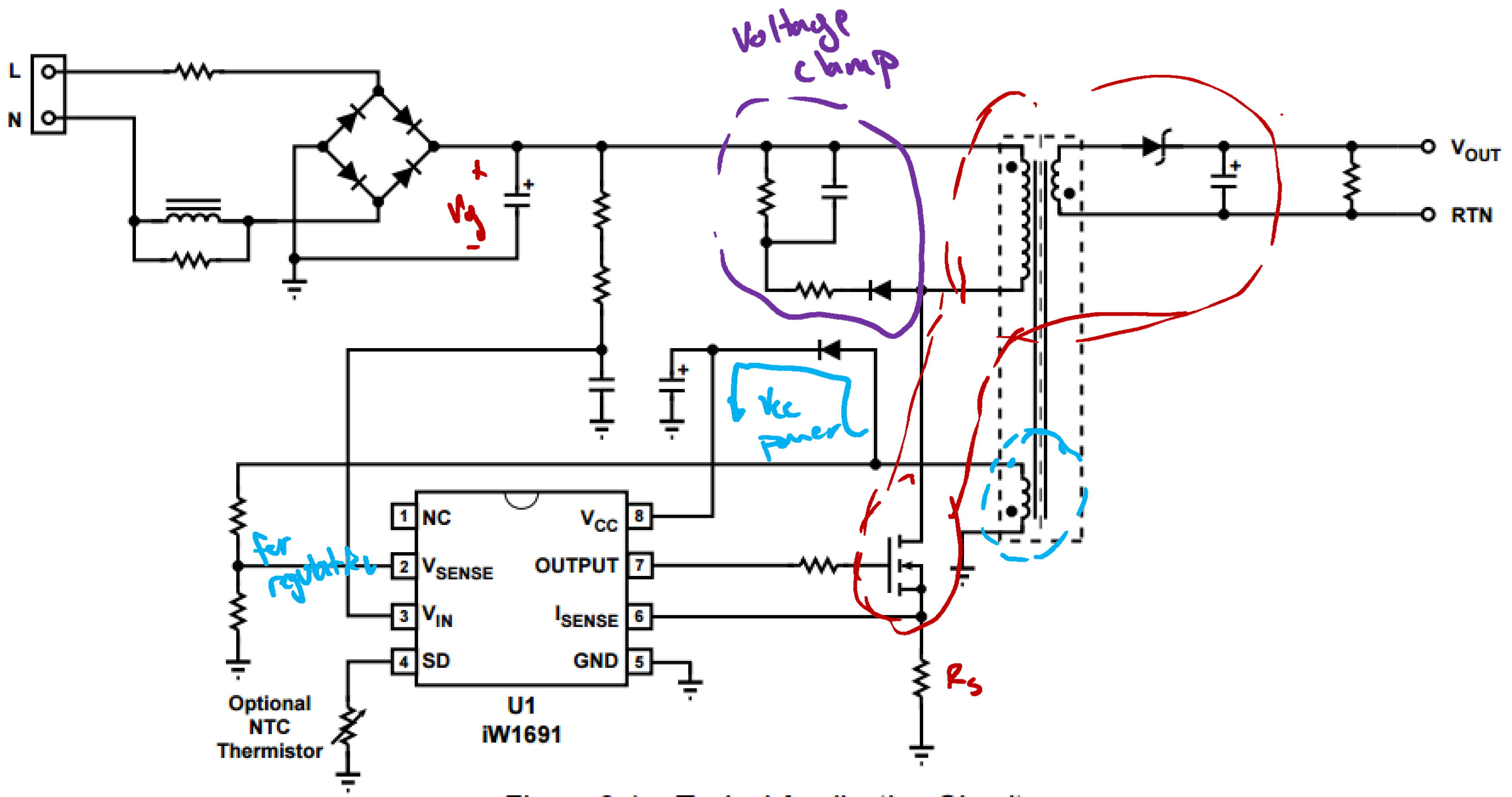


Figure 3.1 : Typical Application Circuit