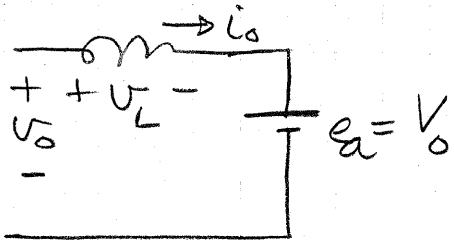
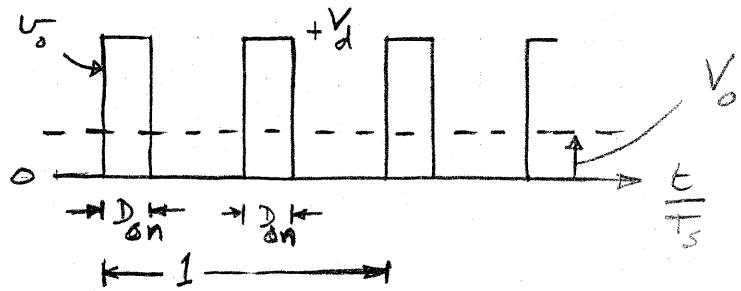
Problem 7-23

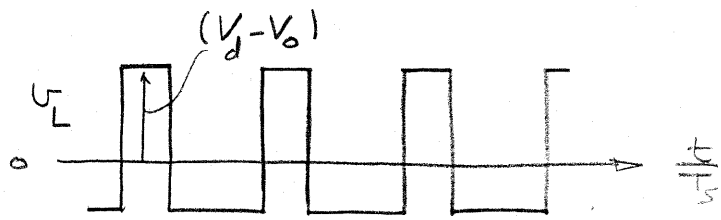
In the circuit of Fig 7-27, $R_a \simeq 0$. Consider the waveforms in Fig. 7-29 under steady state.





during D_{on}: T_A+, T_B- ON

$$\Delta I_L = \frac{V_d - V_o}{L_a} D_{on} T_s$$



From the waveform of v_o:

$$2 V_d D_{on} = V_o$$

$$\therefore D_{on} = \frac{1}{2}\frac{V_o}{V_d}$$

$$\therefore \Delta I_L = \frac{T_s V_d \left(1 - \frac{V_o}{V_d}\right)}{2 L_a} \frac{V_o}{V_d}$$

$$\frac{\partial(\Delta I_L)}{\partial\left(\frac{V_o}{V_d}\right)} = \frac{T_s V_d}{2 L_a}\left[-\frac{V_o}{V_d} + \left(1 - \frac{V_o}{V_d}\right)\right] \underset{\text{(set to)}}{=} 0$$

$\therefore$ maximum occurs at $\frac{V_o}{V_d} = \frac{1}{2}$.

Using $\frac{V_o}{V_d} = \frac{1}{2}$ in the equation for ΔI_L,

$$(\Delta I_L)_{\text{maximum}} = \frac{T_s V_d}{2 L_a}\left(\frac{1}{2}\right)\left(\frac{1}{2}\right) = \frac{T_s V_d}{8 L_a}$$

$$= \frac{V_d}{8 L_a f_s}.$$