Problem **7-8**

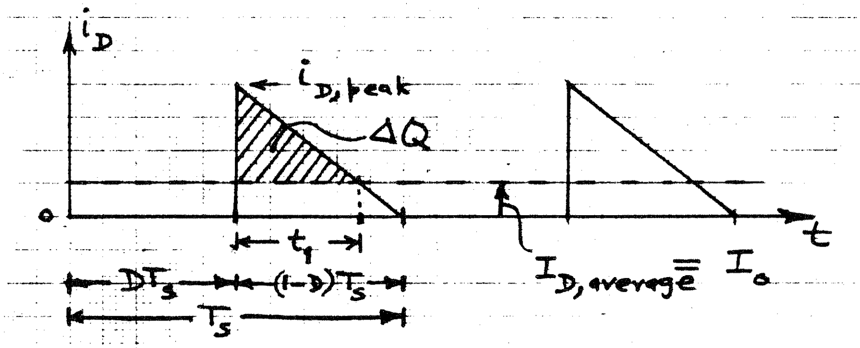
$V_d = 12V$, $V_o = 24V$, $I_o = 0.5A$, $L = 150\mu H$, $C = 470\mu F$, $f_s = 20kHz$.

Find ΔV_o.

Solution: Initially, assume that the converter is in a continuous-conduction mode.

$$\frac{24}{12} = \frac{1}{1-D} \therefore \; D = 0.5 \text{ ; From Eq. 7-29 } I_{oB} = \frac{24 \cdot 0.5 (0.5)^2}{2 \cdot 20{,}000 \cdot 150 \cdot 10^{-6}} = 0.5 \text{ A}$$

Boundary case since $I_o = I_{oB}$.



$$i_{D,peak} = i_{L,peak} = \frac{V_d}{L} DT_s = \frac{12 \cdot 0.5}{150 \times 10^{-6} \cdot 20{,}000} = 2A$$

during off time: $$\frac{di_D}{dt} = \frac{V_d - V_o}{L} = \frac{12 - 24}{150 \times 10^{-6}} = -80{,}000 \text{ A/s}$$

Therefore, $$\left(-\frac{di_D}{dt}\right) = \frac{i_{D,peak} - I_o}{t_1} = 80{,}000 \text{ ; } \therefore t_1 = \frac{2-0.5}{80{,}000} = 18.75 \times 10^{-6}$$

$$\Delta V_o = \frac{\Delta Q}{C} = \frac{1}{2} \frac{(i_{D,peak} - I_o) t_1}{C} = \frac{1}{2} \cdot \frac{(2-0.5) 18.75 \times 10^{-6}}{470 \times 10^{-6}} = \boxed{\Delta V_o = 29.92 \text{ mV}}$$

Note that the expression for ΔV_o given by Eqs. 7-39 and 7-40 is valid only if the minimum value of i_L is greater than I_o in the continuous-conduction mode of operation(as shown in Fig. 7-17a).