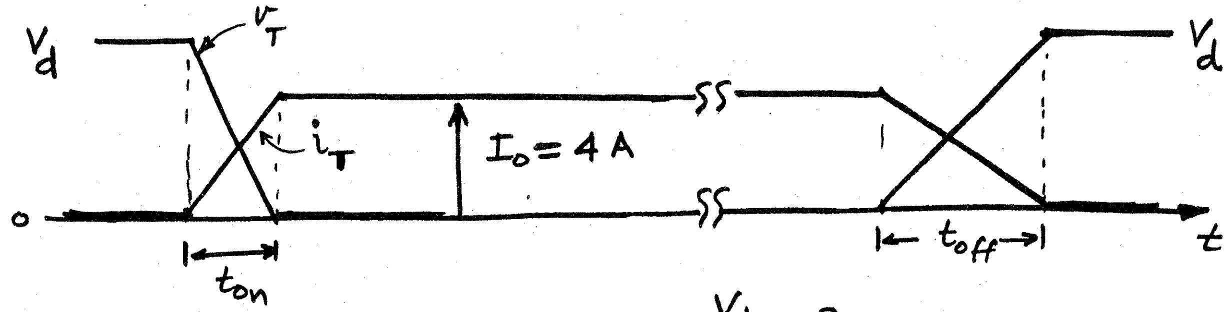
Problem 2-2



$$I_o = \frac{V_d}{R} = \frac{300}{75} = 4.0\ A$$

$$t_{on} = t_{ri} + t_{fv} = 150\ ns$$

$$t_{off} = t_{rr} + t_{fi} = 300\ ns$$

$0 < t < t_{on}$

$$i_T = I_o \frac{t}{t_{on}}$$

$$v_T = V_d\left(1 - \frac{t}{t_{on}}\right)$$

$$\therefore (p_T)_{on} = V_d \frac{I_o}{t_{on}}\left(1 - \frac{t}{t_{on}}\right)t \qquad \therefore (W_T)_{on} = \int_0^{t_{on}} (p_T)_{on}\,dt$$

$$\therefore (W_T)_{on} = \frac{V_d I_o}{t_{on}} \int_0^{t_{on}} \left(1 - \frac{t}{t_{on}}\right) t \cdot dt$$

$$= \frac{V_d I_o t_{on}}{6}$$

Similarly,

$$(W_T)_{off} = \frac{V_d I_o t_{off}}{6}$$

$$\therefore (W_T)_{switching} = (W_T)_{on} + (W_T)_{off} = \frac{V_d I_o}{6}\left[t_{on} + t_{off}\right]$$

$$P_s = f_s (W_T)_{switching} = \frac{V_d I_o}{6} f_s \left[t_{on} + t_{off}\right]$$

(P_s ← avg. switching power loss)

$$\therefore P_s = \frac{300 \times 4}{6} \times 100 \times 10^3 \left[150 + 300\right] \times 10^{-9}\ W = 9\ \text{Watts}$$

[at 100 kHz]

In this circuit, P_s is 1/3 of that in Problem 2-1.