

Problem 7-2

$$V_o = 5V, f_s = 20\text{kHz}, L = 0.001\text{H}, C = 470\mu\text{F}, V_d = 12.6V, I_o = 0.2A$$

Find ΔV_o .

Solution: Is the circuit operating in the continuous mode?

$$\text{From Eq. 7-5, } I_{oB} = \frac{D}{2f_s L} [V_d - V_o] = 0.0754 \text{ where } D = \frac{5}{12.6} = 0.397$$

$$\text{It is in the continuous mode, so from Eq. 7-24 } \Delta V_o = \frac{T_s^2 (1-D)V_o}{8LC}$$

$$\Delta V_o = \frac{[1 - (5/12.6)]5}{(20,000)^2 \cdot 8 \cdot 0.001 \cdot 470 \cdot 10^{-6}} = \boxed{\Delta V_o = 2.01 \text{ mV}}$$

A general comment about calculating the ripple voltage across the filter capacitor: in practice, the equivalent-series-resistance ESR of the filter capacitor causes a significant portion of the overall ripple voltage. Therefore, the ESR must be included in the ripple voltage calculations.