ECE 320 / ECE 329 NAME _____
Quiz 9 23 April 2012
Power Electronics
Flyback Converter

1. (4 points) A flyback converter in continuous conduction mode takes 160V DC and converts to 3.3V DC. If the duty cycle is 0.40, calculate the turns ratio of the transformer. Assume an ideal switch and diode.

$V_d := 160 \cdot V \quad V_o := 3.3 \cdot V \quad D := 0.4$

Calculate the ratio of output to input DC voltage. This is the voltage gain.

$$A_v := \frac{3.3 \cdot V}{160 \cdot V} = 0.021$$

Use the voltage gain formula, rearranging it, to find the turns ratio.

$$A_v = \frac{D}{1 - D} \cdot N_{12} \qquad N_{12} := A_v \cdot \frac{(1 - D)}{D} = 0.031 \qquad \frac{1}{N_{12}} = 32.323$$

2. (3 points) The same flyback converter has a transformer magnetizing inductance of 40µH. It switches at 1.0 MHz. For continuous conduction mode, calculate the change in input current, as the text handout calls Δi_{Lm}.

$L_m := 50 \cdot \mu H \qquad f_s := 1.0 \cdot MHz \qquad T_s := \frac{1}{f_s} = 1 \times 10^{-6} s$

$$\Delta i_{Lm} := \frac{1}{L_m} \cdot (160 \cdot V) \cdot (D \cdot T_s) = 1.28 A$$

3. (3 points) Calculate and plot the transistor switch voltage of the same flyback converter in continuous conduction mode.

While the switch conducts, its voltage is zero.

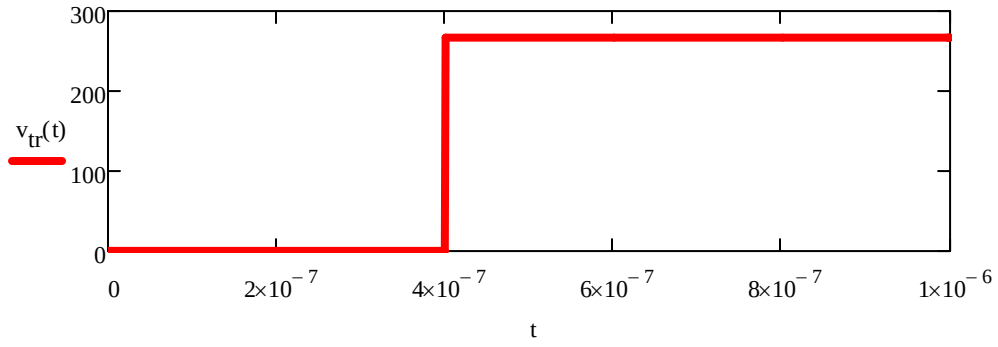
Using a loop equation, we find that, when the switch blocks, its voltage is the sum of the input voltage V_d and the reflected output voltage, which we will call V_{N1}.

$V_d = 160 V$ We already found N_{12}: $N_{12} = 0.031$

$$V_{N1} := \frac{V_o}{N_{12}} = 106.667 V$$

Plot the result: One cycle

$$v_{tr}(t) := \begin{cases} 0 \cdot V & \text{if } 0 \le t \le D \cdot T_s \\ \left(V_d + V_{N1}\right) & \text{if } D \cdot T_s < t \le T_s \end{cases}$$



Plot the result: Two cycles

$$v_{tr}(t) := \begin{cases} 0 \cdot V & \text{if } 0 \le t \le D \cdot T_s \\ \left(V_d + V_{N1}\right) & \text{if } D \cdot T_s < t \le T_s \\ 0 \cdot V & \text{if } T_s \le t \le T_s + D \cdot T_s \\ \left(V_d + V_{N1}\right) & \text{if } T_s + D \cdot T_s < t \le 2 \cdot T_s \end{cases}$$