EE155/255 F17 Homework 5
Flyback Converter

Assigned 10/23/17
Due 10/30/17

Problem 1

Consider the flyback converter shown in Figure 10.3 of the class notes with an input voltage of 100V, an output voltage of 10V, an input-referenced magnetizing inductance L_M of 100µH, and an input-referenced leakage inductance L_L of 5µH. The transformer has a 10:1 winding ratio. Assume the FET and diode are ideal, and that the FET has an avalanche breakdown voltage of 300V.

(a) If the converter is operating in discontinuous conduction mode (current in L_M starts at 0A at the start of each cycle) with a PWM frequency of 100kHz, what duty factor is required to provide an output current of 5A?

(b) Under the conditions from part (a), how much energy is lost each cycle due to the leakage inductance? If this were the only loss, what would the efficiency of the converter be?

(c) Under the conditions from part (a), what is the commutation time? That is, what is the time from the FET turning off until the current in the secondary reaches its peak value?

(d) Now consider the same converter with L_M=1mH and L_L=0µH operating in continuous conduction mode (current is always flowing in LM) at 200kHz with a 5A output current. In steady state, what is the duty factor of the FET gate drive? (Hint: the volt-seconds across the magnetizing inductance must sum to zero over the cycle.)

(e) [Extra Credit] What is the duty factor of the FET gate drive under the conditions of part (d) if L_L = 50µH. Make sure to consider commutation time. (Hint1: The diode clamps the magnetizing inductance to the reflected secondary voltage as long as any current is flowing in the diode. Hint2: During the drive phase, L_L and L_M form an inductive voltage divider. Hint3: The charge delivered through the diode each cycle must be 5A x 5µs =25µC.)