Reverse recovery in a two-phase buck converter

Figure 1 shows a two-phase buck converter. The output capacitance C is large enough such that negligible ripple is present during operation. The input voltage V_g is 12 V and the output voltage V is 1 V. Both converters are operated with the same duty cycle, D, and switching frequency f_s. The two MOSFETs conduct for $0 < t < DT_s$

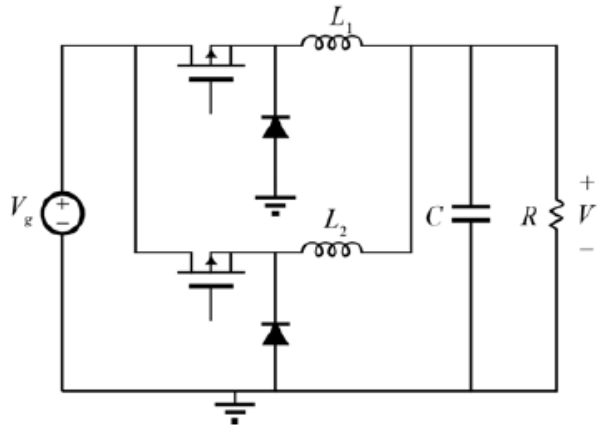

Figure 1: Two-phase buck converter

(a) Assuming L_1 and L_2 are equal in value and are large enough such that small-ripple approximations apply, solve for the duty cycle of the converters, D.

For (c-d), both converters transfer 20 W of power each to the load resistor. The diodes are identical and are ideal except for their reverse recovery characteristics, which are shown in Figure 2. During MOSFET turn-on, the ramp rate of the diode current is found to be $|di_F/dt| = 800$ A/µs.

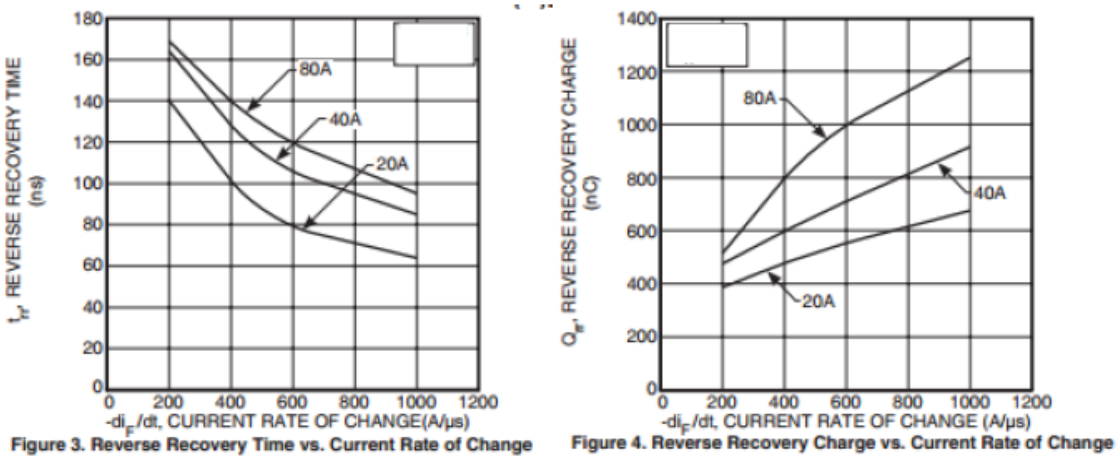

Figure 2: Diode reverse recovery characteristics

(b) Solve for energy loss of the two-phase converter during each switching period
(c) Select the maximum switching frequency of the converter f_s so that the converter efficiency is greater than 95%
(d) At the switching frequency solved in (c), find values for the inductances $L_1 = L_2$ such that each inductor has 10% current ripple.