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 $V_i$ 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 $0 < t < DT$.

![Diagram of a two-phase buck converter](image)

**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 $|diF/dt| = 800$ A/µs.

(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.

![Graphs showing reverse recovery characteristics](image)

**Figure 2: Diode reverse recovery characteristics**