

EE 452 – Power Electronics Design, Fall 2021

Homework 4

Due Date: Wednesday November 3rd 2021 at 11:59 pm Pacific Time

Instructions. You must scan your completed homework assignment into a pdf file, and upload your file to the Canvas Assignment page by the due date/time above. All pages must be gathered into a single file of moderate size, with the pages in the correct order. Set your phone or scanner for basic black and white scanning. You should obtain a file size of hundreds of kB, rather than tens of MB. I recommend using the "Tiny Scanner" app. Please note that the grader will not be obligated to grade your assignment if the file is unreadable or very large.

Problem 1: An IGBT and a silicon diode operate in a buck converter, with the IGBT waveforms illustrated in Fig. 1. The converter operates with input voltage $V_g = 400\text{ V}$, output voltage $V = 200\text{ V}$, and load current $I = 10\text{ A}$.

- (a) Estimate the total energy lost during the switching transitions.
- (b) The forward voltage drop of the IGBT is 2.5 V , and the diode has forward voltage drop 1.5 V . All other sources of conduction loss and fixed loss can be neglected. Estimate the semiconductor conduction loss.
- (c) Sketch the converter efficiency over the range of switching frequencies $1\text{ kHz} \leq f_s \leq 100\text{ kHz}$ and label numerical values.

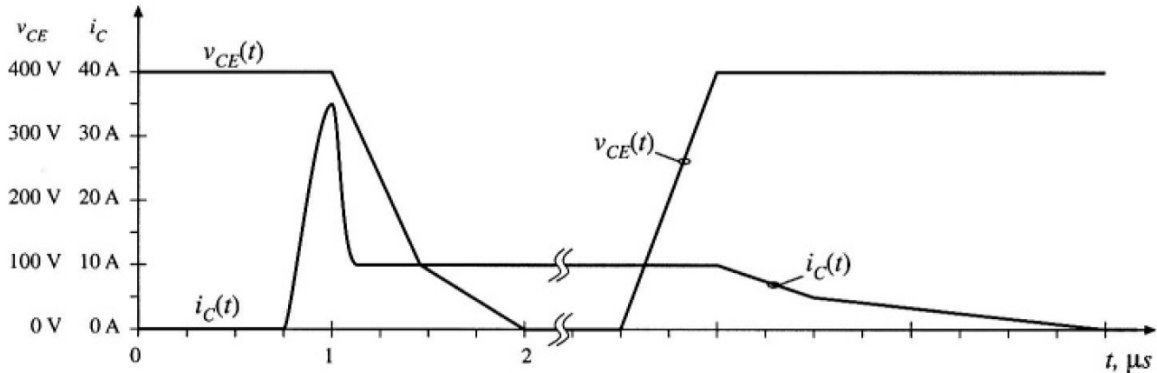


Figure 1: IGBT voltage and current waveforms for Problem 1.