MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Electrical Engineering and Computer Science

6.622 Power Electronics — Issued: February 21, 2023
Problem Set 2 — Due: February 27, 2023

Reading: KPVS Chapter 5 through 5.7, Section 5.9

Problem 2.1

Figure 1 shows a boost converter supplying 12 V to a load of 5 Ω from a 5 V source having an internal resistance of 0.2 Ω. Determine the duty ratio D at which the converter operates. (You may neglect semiconductor device drops in your calculations and that the converter operates in continuous conduction mode with small inductor current ripple and capacitor voltage ripple.)

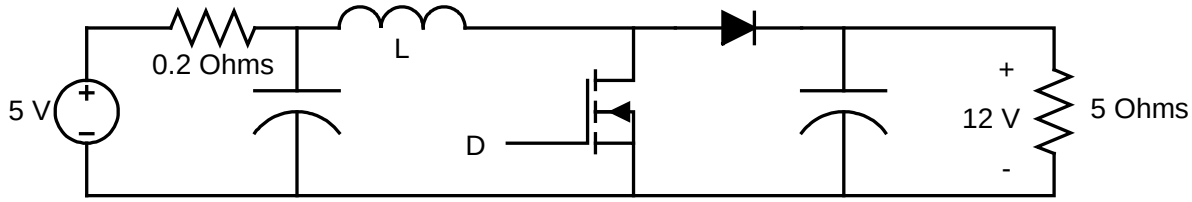

Figure 1 A boost converter operating from a source with output resistance.

Problem 2.2

Propose an implementation of the SEPIC converter in which the input voltage can have either polarity (i.e., be positive or negative).

Problem 2.3 KPVS Problem 5.18

Problem 2.4 KPVS Problem 5.22

Problem 2.5

Consider the dc-dc converter of Figure 2. The input source of this converter has its positive terminal at ground, while the output has its negative terminal at ground (so the input and output voltages are referenced differently). This configuration is sometimes used in applications where the input is a battery with its positive terminal referenced to ground to help prevent corrosion.

a. Please find the conversion ratio V_2/V_1 for operation of this converter in continuous conduction mode. What type of converter is this?

b. Find the average output current in DCM operation as a function of L, T, D, V_1, and V_2.

c. Assume the converter has the following parameters:
V_1 = 48 V, L = 9 μH, R = 8 Ω, f = 500 kHz

At what value of duty ratio D does the transition between continuous and discontinuous conduction modes occur?

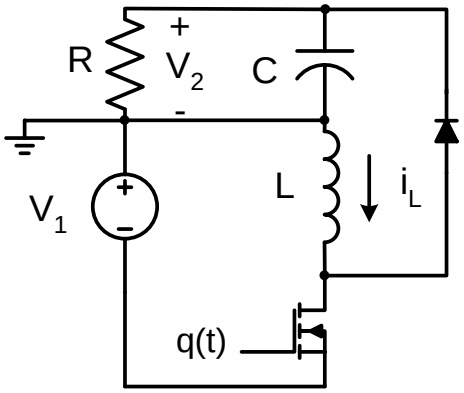

Figure 2 A dc-dc converter.

MIT OpenCourseWare
https://ocw.mit.edu

6.622 Power Electronics
Spring 2023

For information about citing these materials or our Terms of Use, visit: https://ocw.mit.edu/terms