

# Prelab Assignment 2

## Experiment 4

### ECEN 4517/5517

Reading materials (on course web site)

- Notes on converter control systems
- Lecture slides, lectures 6-7
- Laboratory 4 procedure

A separate prelab assignment is required from every student. This assignment should be turned in within the first five minutes of lecture on March 4, 2008.

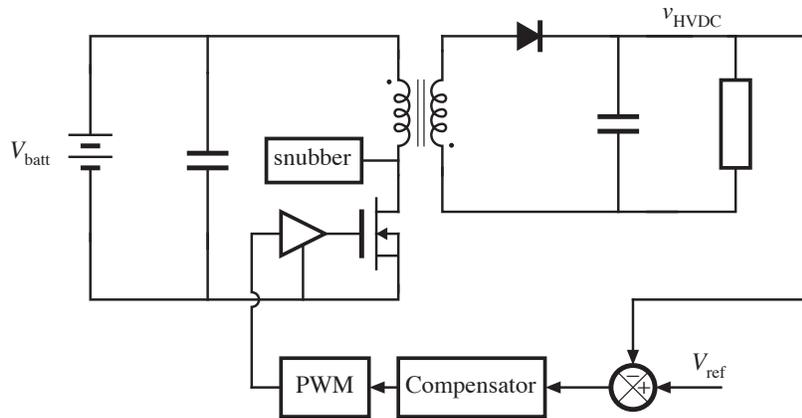


Fig. 1. Closed-loop flyback converter

After you finish construction and testing of the open-loop flyback converter, you will construct and test a feedback system that adjusts the duty cycle to regulate the flyback converter high-voltage output  $V_{HVDC}$  as illustrated in Fig. 1. In part 3 of this experiment, a microprocessor will provide a reference voltage  $V_{ref}$  that can vary over the range 0 – 2.5 V. The feedback loop should make  $V_{HVDC}$  track  $V_{re}$  and vary over the range 0 – 170 V. A compensator and summing node circuit that is capable of performing this job is illustrated in Fig. 2.

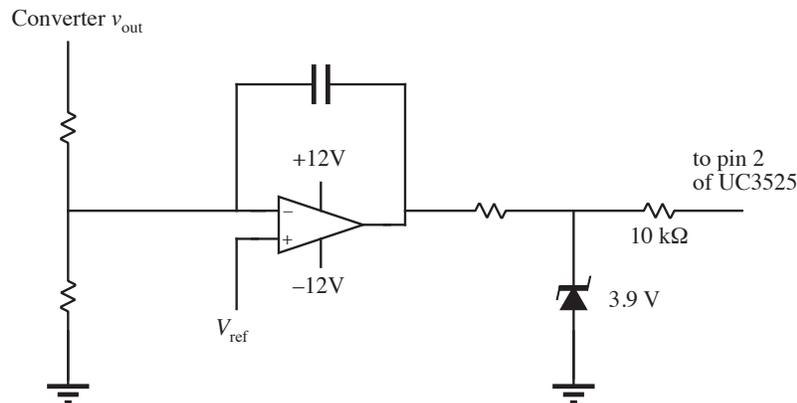


Fig. 2. Integrating compensator for closed-loop voltage regulation.

**ECEN4517 controller design.** At the operating point  $V_{\text{batt}} = 13 \text{ V}$ ,  $V_{\text{HVDC}} = 170 \text{ V}$ , and using the design values from your first prelab assignment at the maximum expected output power, compute the following:

- The dc gain  $G_{\text{d0}}$  of the control-to-output transfer function  $G_{\text{vd}}(s)$ , and
- The resonant frequency  $f_0$  of  $G_{\text{vd}}(s)$
- The gain (from the pin 2 control voltage to duty cycle) of the UC3525 pulse-width modulator

Select element values for the circuit of Fig. 2, so that your feedback loop has unity gain at a frequency substantially lower than  $f_0$ , and compute this unity gain frequency. You will use the LF356 op amp included in your lab kit.

**ECEN5517 controller design.** At the operating point  $V_{\text{batt}} = 13 \text{ V}$ ,  $V_{\text{HVDC}} = 170 \text{ V}$ , and using the design values from your first prelab assignment at the maximum expected output power, determine the numerical values of the important features of the control-to-output transfer function  $G_{\text{vd}}(s)$ . Design the best compensator circuit that you can for this feedback loop, and specify all element values. Construct the Bode diagram of the magnitude and phase of the loop gain for your design. You will use the LF356 op amp included in your lab kit.