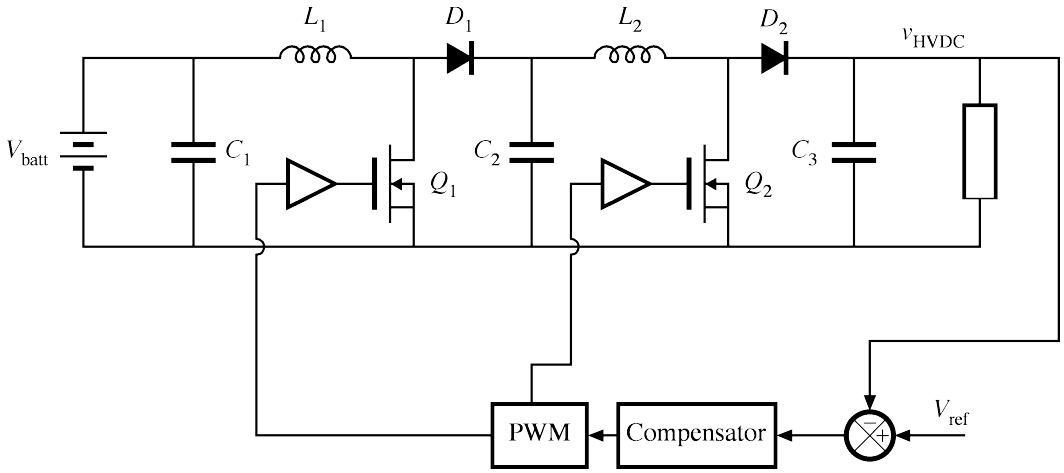
In Experiment 4, you will design, construct, test, and demonstrate the cascaded boost converter power stage discussed in Lecture 7 and illustrated below.



You may choose any value for the converter switching frequency. The converter will interface the 12-V battery to a high-voltage (120 V – 200 V) dc bus that is the input of the dc–ac inverter. You should design the best converter system you can for this application, using the parts in your kit, which results in a good engineering tradeoff between efficiency and maximum output power.

1. Converter design (50 Points)

Select initial values for the switching frequency and duty cycles. For the two cases:

a) Converter output voltage equal to 120 V, and
b) Converter output voltage equal to 200 V,

compute the following quantities:

- Duty cycle of each MOSFET.
- The dc output power P_{max} that causes the intermediate-voltage filter capacitor C_2 RMS current to be at its maximum rated value (i.e., how much power can you get out of your converter before the C_2 rating is exceeded).
- MOSFET conduction losses when $P = P_{max}$.

Your design should be capable of producing up to the PV panel rated power of 85 W at output voltages of 120 Vdc and 200 Vdc. Note that producing even more that 85 W is useful since additional power can be supplied by the battery.

2. Inductor design (50 Points)

Design the inductors L_1 and L_2 for your converter design above. For your designs, specify the core size, the value of the air gap length, the number of turns, and the wire gauge. Keep a copy of your work for use during the lab experiment.

3. Loss budget [Only for ECEN 5517 groups] (50 Points)

As discussed in class, develop a preliminary loss budget for your design. You should calculate the conduction loss of every MOSFET and diode, the switching losses, and the magnetics losses. These calculations should be based on the available datasheet specifications. Show your work.

Provide a list summarizing these losses, along with the total loss and the predicted efficiency. In your final report, you will refine these calculations based on measured data.