Power Electronics Chapter 7 and 8 HW

1. Use LT spice to build a buck-boost converter, use the schematic in Figure 7-18

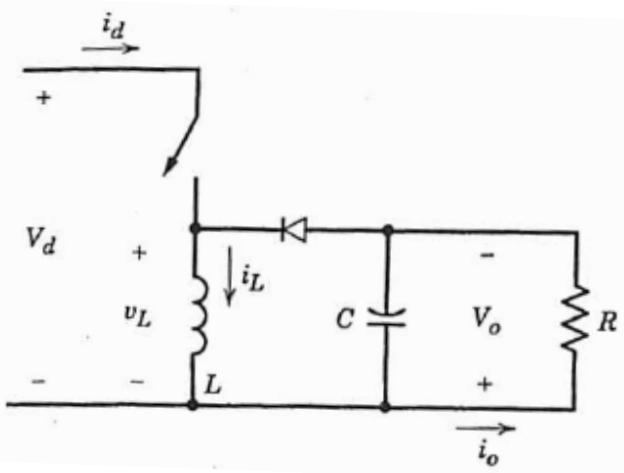

Figure 7-18 Buck–boost converter.

with the following device values:

a) C=50μF
b) R=10Ω
c) L=100μH
d) V_d=15V
e) switch=TIP32 pnp power transistor, operate the switch with a $5V_{pp}$ 25kHz square wave with a 50% duty cycle .
   - Is the converter in continuous or discontinuous mode? Justify your answer.
   - Calculate (by hand) the output voltage for this circuit.
   - Measure the average output voltage for this circuit and calculate the percent difference between the measured and predicted values.
   - Estimate the voltage ripple from your simulation.

2. Use LT spice to build a Cúk converter, use the schematic in Figure 7-25

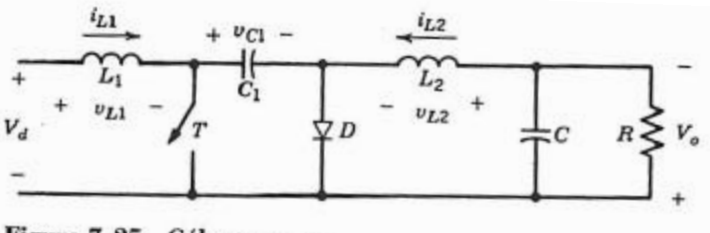

Figure 7-25 Cúk converter.

with the following device values:

a) $L_1=L_2=100\mu H$
b) $C_1=5\mu F$
c) $C=50\mu F$
d) $R=10\Omega$
e) $V_d=15V$
f) switch=TIP31 npn power transistor, operate the switch with a $5V_{pp}$ 25kHz square wave with a 50% duty cycle.
    - Is the converter in continuous or discontinuous mode? Justify your answer.
    - Calculate (by hand) the output voltage for this circuit.
    - Measure the average output voltage for this circuit and calculate the percent difference between the measured and predicted values.
    - Estimate the voltage ripple from your simulation.

3. The diode in a buck converter has a different purpose than a diode in a full bridge converter. Explain what the diode in each circuit is for.

4. For the circuit in Figure 7.27

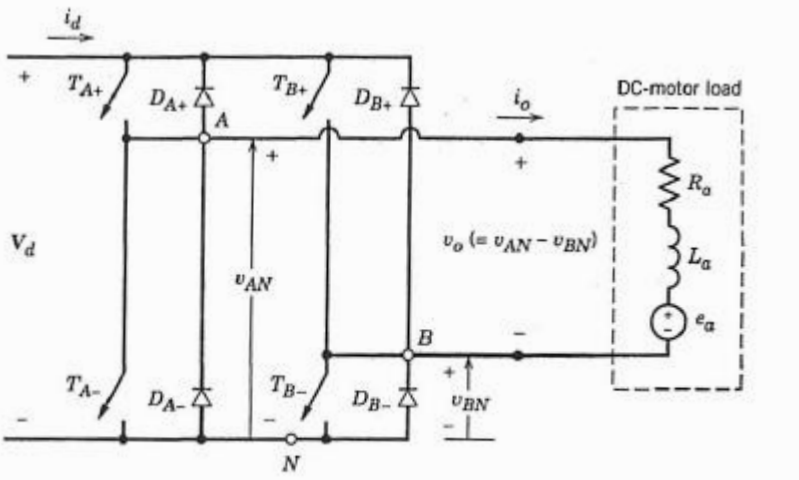

Figure 7-27 Full-bridge dc–dc converter.

explain how to

a) operate the switches to make current flow through the motor in the direction shown by the arrow i_o with a voltage V_d across the motor,
b) operate the switches to make current flow through the motor against the direction shown by the arrow i_o with a voltage V_d across the motor,
c) operate the switches to make current flow through the motor in the direction shown by the arrow i_o with a voltage V_d /3across the motor.
d) Show that you were correct in part c by building an LTspice simulation using:
   - TIP transistors
   - R_a=2Ω
   - L_a=10mH
   - e_a=10V
   - V_d=15V

5. What is the difference between a full bridge DC->DC converter and an inverter?
6. Consider a load driven by an inverter powered by a battery. If the load creates reactive power what happens to it (e.g., where does the current flow)?
7. In class we stitched together two buck converters to make an inverter. We then looked at an LTspice implementation of that circuit (attached) but didn't put in the free-wheel diodes. Explain where the free-wheel mechanism should go and what circuit element(s) you would use to make the free-wheel.