1 Converter Circuit Description and Specifications

The schematic of the buck converter is shown Figure 1. The PCB board has been fabricated to be used directly. The connection is described as:

- The pin-4 and Pin-5 of the terminal box J3 on the board shall connected to the PWM signals from the microcontroller that you are using.
- These PWM signals are then boosted by the MOSFET driver UCC27211 to control the gates of two MOSFETs Q1 and Q2.
- An inductor needs to be connected the terminals J1 and J2.
- The positive terminal for the DC source is P1. It is from a programmable DC power supply.
- The common ground for both the source and load is connected to P3. The testing point of ground is TP7 for the probe connection.
- The positive terminal for the load connection is P2. We use a resistive load.

The circuit specification of the buck converter is the same as the first assignment.

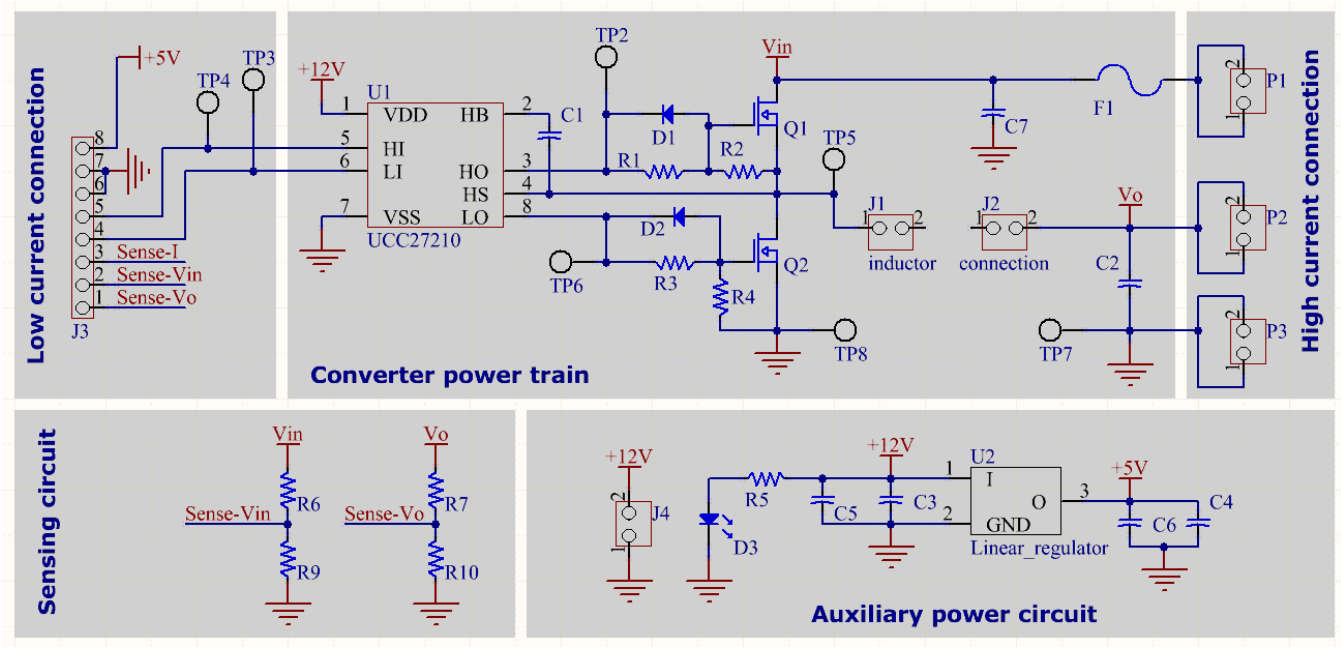

Figure 1 Circuit schematics

2 Construct DC/DC converter

1) According to the magnetic core datasheet make winding to construct one inductor to meet the inductance requirement, which is determined by the concept design.
2) Use LCR meter to check and confirm the inductance value and its ESR value.
3) According to the converter schematics, as shown in Figure 1, identify the board connection of Vin+, Vin-, Vo+, and Vo-.
4) According to the converter schematics, as shown in Figure 1, identify the board connection of the auxiliary power supply for the 12V DC.
5) According to the converter schematics, as shown in Figure 1, identify the board connection of the interlinking inductor.
6) According to the converter schematics, as shown in Figure 1, identify the location and meaning of the test point.
7) According to the converter schematics, as shown in Figure 1, identify the location and meaning of the control signals.
8) Connect to the load with the rated resistance.
9) The driver IC can be either UCC27210 or UCC27211. They are the same for your application.
10) Consult with tutor for any support.

3 Power Up Procedure

3.1 Precheck

- Using the multimeter to check the input impedance and the output impedance of the converter to avoid short circuit.
- You should use it to check all connections according to the schematics before jumping into the next step.
- A common mistake is the grounding network. All ground should be connected together.

3.2 Power up gate driver circuit

- Connect J4 to the bench-top DC power supply. Be careful of the polarity marked on board.
- Gradually increase the voltage from 0 to 12V by the auxiliary power supply, which supply the FET driver.

3.3 Power up the microcontroller circuit

- Connect the converter board to the microcontroller board for the 5V, GND, and PWM signals.
- Program the microcontroller to generate the PWM signal with the specified duty cycle output.
- Review the converter schematics and the PCB board to find the assigned 4 test points on board for PWM signal detection.
- Use oscilloscope to check the PWM signals that are transmitted to the gate of both MOSFET.

3.4 Power up input voltage of converter

- The converter input port is P1 for positive and P3 for negative connection. Before powering up, consult with tutor after the connection.
- Use the Tektronix current probe and oscilloscope to monitor the inductor current, i_L and
- Connect a voltage probe to monitor the output voltage, v_o.
- Gradually increase the voltage of the DC power supply from 0 to the rated level V_{in} and observe the change of the waveforms of voltage and current. Keep the input voltage constant at the rated input voltage level, V_{in}.

4 Check and Test

4.1 At the rated power level

- Use USB flash drive to record the waveform image and dataset of the inductor current and output voltage. Ripple level of current and voltage should be clearly measured and recorded.
- Use USB flash drive to record the waveform image and dataset of the inductor current and switching node voltage, v_{sw}.
- Evaluate the conversion efficiency, P_{OUT}/P_{IN} , based on the rated load resistor.

4.2 At reduced power level

- Change the load resistor to 20 ohm. It can be done by series connecting two 10-ohm resistors. Make sure the connection is solid, not loose!

- Repeat the same for the waveforms and efficiency evaluation.
- Attention: stop the power supply of Vin for any change in circuit.

4.3 At increased power level

- Change the load resistor to 5 ohm. It can be done by paralleling two 10-ohm resistors.
- Repeat the same for the waveforms and efficiency evaluation.
- Attention: stop the power supply of Vin for any change in circuit.

5 Demonstration and Finish

- Demonstrate the testing process to one of the tutors.
- The tutor should prove your achievement of all required testing and evaluation.
- Dissemble the circuit and return the DC/DC converter board to tutor.

6 Final Report

The report should include the recorded information, comparisons of measurements, comments, and conclusions. The following is essential in the report.

- A description of the objective, experimental setup, and your expectation.
- A picture of the prototype board and the experimental setup.
- Clearly illustrate the recorded waveforms, the pulsating signals, i_L, and v_o.
- Compare the experimental results with the theoretical analysis and simulation results. Comment on the difference and agreement among them.
- Use a table to show the efficiency values of the three load conditions.
- Evaluate and check if the recorded waveforms meet your expectation and defend your judgment in the conclusion.