Lab 3: Power converters (Part 2 - Buck converter)

In Lab 2 we used a synchronous buck converter to change a DC voltage to a lower DC voltage. During this lab, a non-synchronous buck converter will be used to achieve the same goal of stepping down a DC voltage. A comparison will be made between the two buck topologies to determine favourable characteristics.

Equipment

- Diode
- MOSFETS
- Inductor
- Capacitors
- Gate driver (IR2117)
- 100Ω load (20W) WARNING: THIS WILL GET HOT
- 10Ω gate resistor

Deliverables

1. An oscilloscope screen shot showing the waveform on the source of the MOSFET. Give a brief description of the waveform.
2. Create a graph showing the Efficiency vs output current of the converter. Comment on where the main losses are.
3. Compare the efficiency plot to that of the synchronous buck converter and comment on the comparison.
4. Comment why you may want to use a non-synchronous buck converter over a synchronous buck (an example application may help to make your point).
5. Reduce the switching frequency to 1kHz, take an oscilloscope screen shot and briefly describe the waveform. Why is the waveform like this?

Methodology

Assemble the schematic shown in figure 1 on your breadboard. Add the benchtop multimeter in series between the 30V supply and the MOSFET in current sense mode. Connect the signal generator on "pulse" mode, at a frequency of 22kHz, to the gate driver. Set the Duty cycle to 10%, the Vpp to 5V and the offset to 2.5V. Attach a

probe to the gate of the MOSFET and switch on the signal generator to ensure the gate driver is creating the PWM. Increase the duty cycle to 30% and probe the source of the MOSFET to complete deliverable 1. Next, measure the output voltage ignoring the output ripple (the DMM does this automatically). Note down the input current and output voltage for duty cycles 10% to 80% in increments of 5%. From here you should be able to calculate the input and output power to complete deliverable number 2.

Table 1: Buck converter specs

Input voltage	30V
Output voltage	20V
Output power	4W
Switching frequency	22kHz
Inductor current ripple	40%
Output voltage overshoot	5%

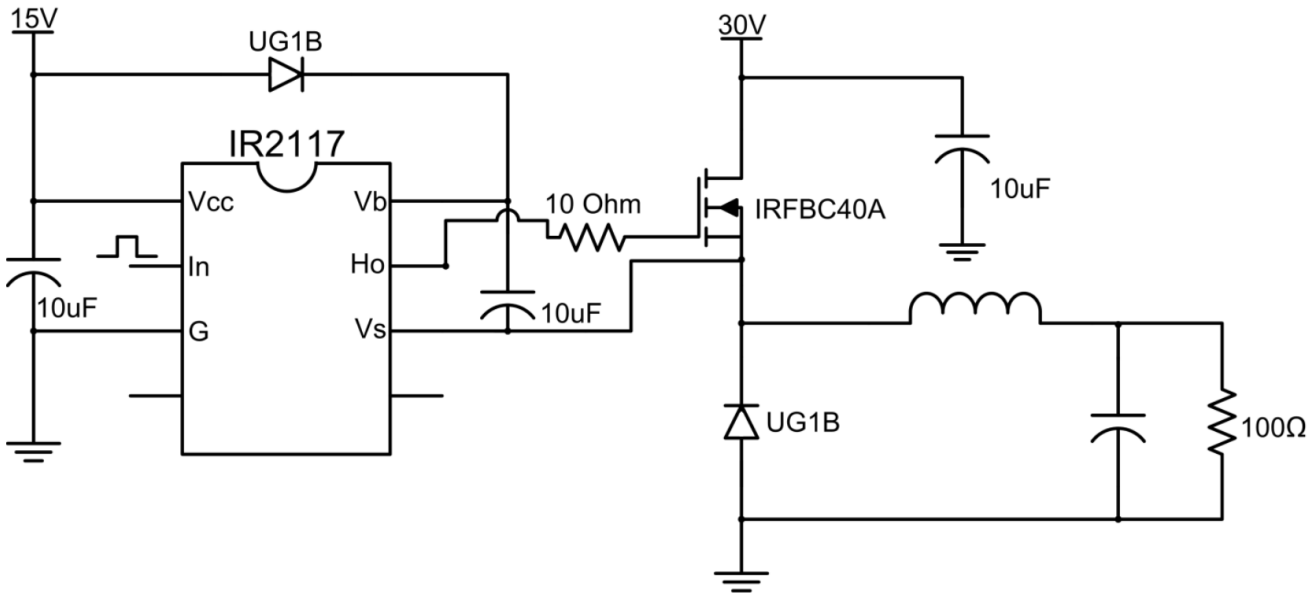

Figure 1: Buck converter schematic