Buck Converter

Materials:

- 2 Series Mixed Series Oscilloscope (MSO)
- Direct current (DC) power supply: 2230 High Power Programmable Power Supply
- Arbitrary/Function Generator (AFG): AFG1000
- Resistor
- Capacitor
- Inductor
- Diode
- P Channel MOSFET
- Breadboard
- Jumper wires

Procedure:

R = 100 kΩ L = 220 uH C = 220 uF Diode PN: IN4007 MOSFET PN: CEP20P06

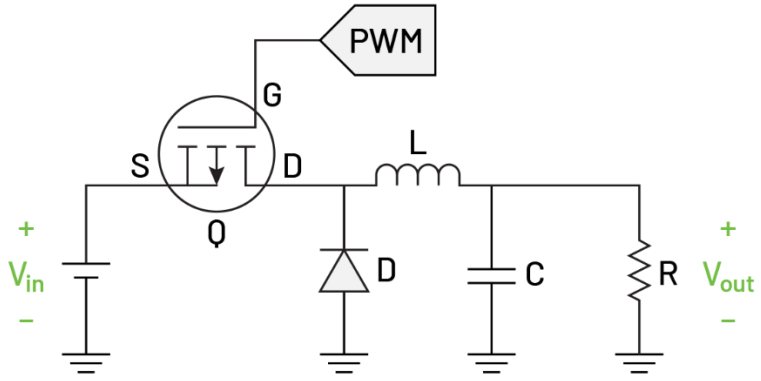

Figure 1. Buck converter circuit diagram.

1. The buck converter is designed to step down DC voltage from a DC source. It uses a switching element (in this case a P Channel MOSFET), an inductor, a diode, and a capacitor. The switching element rapidly turns on and off, controlling the flow of energy through the inductor, which smooths the current. The diode ensures current flows in the correct direction, while the capacitor filters the output to provide a stable lower voltage. Build the buck converter circuit in Figure 1. with the corresponding components. Make sure to refer to the MOSFET's schematic to connect the source, drain and gate correctly.

2. Use a DC power supply as the input (V_{in}) and set that voltage to 3 V. For the PWM signal at the gate, configure the AFG to the following settings:
    - Signal Type: "Square"
    - Amplitude: "3 Vpp"
    - Offset: "1.5 Vpp"
    - Frequency: 60 kHz

    These settings should generate a square wave that switches between 0 V and 3 V. The frequency needs to be large to switch the MOSFET on and off quickly.

3. Connect Channel 1 of the 2 Series MSO to the DC input of the converter (V_{in}), connect channel 2 to the output of the converter (V_{out}) and connect the PWM signal to channel 3. Turn all three channels on and set the display mode to "Overlay" by tapping and holding on the oscilloscope screen. Add an amplitude measurement to channel 2 to see the output voltage. Does this output look like a DC signal? Is the output amplitude lower than the input amplitude?

4. Adjust the frequency to find the lowest amplitude output with a 3 V input. Record the values in Table 1. Repeat these steps to find the lowest amplitudes for the different inputs and PWM signals.

PWM Signal	Input Voltage (V_{in})	Output Voltage (V_{out})	Frequency
Amplitude: 3V Offset: 1.5V	3 V		
	4 V		
	5 V		
Amplitude: 4 V Offset: 2 V	4 V		
	5 V		
	6 V		
Amplitude: 5 V Offset: 2.5 V	5 V		
	6 V		
	7 V		

Table 1. Frequency and voltage measurements of the buck converter for lowest output voltage.

Instructor Notes:

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