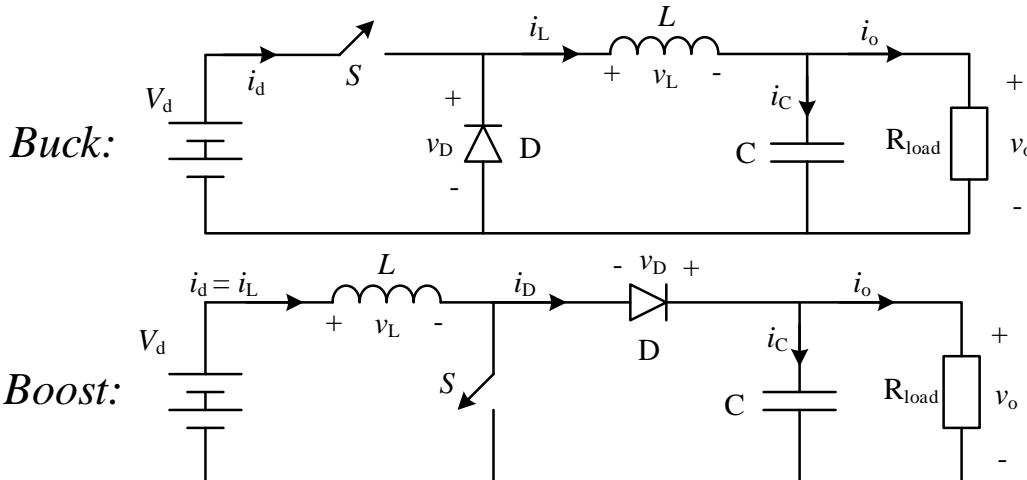


# Assignment 2

## Step-down and Step-up DC/DC Converter

The questions marked HA are home assignments to be completed before the laboratory starts.



Nominal values	Step-down converter	Step-up converter
Source voltage ( $V_d$ )	15V	6V
Filter Inductance ( $L$ )	$20\mu\text{H}$	$20\mu\text{H}$
Filter Capacitance ( $C$ )	$63\mu\text{F}$	$63\mu\text{F}$
Load Resistance ( $R_{load}$ )	$2\Omega$	$2\Omega$
Switching frequency ( $f_{sw}$ )	100kHz	100kHz
Duty ratio ( $D$ )	0.667	0.4

Source files: *assignment\_2.opj*

### Task/Questions for the buck and boost converters:

**HA 1:** Is it CCM or DCM mode of operation? Sketch the diode, load, inductor and capacitor currents as well as the inductor and load voltages. Calculate the average and ripple value of the output voltage.

1. Plot the current and voltage waveforms. Measure the average and ripple value of the output voltage. Do the results agree with the theoretical results in the home assignment HA 1?
2. Determine the harmonic components of the output voltages using the FFT button and comment on the results.

**HA 2:** What is the impact of  $L$ ,  $C$  and  $R_{load}$  in the operation of the converters?

3. Change  $R_{ESR}$  to  $500\text{m}\Omega$  for the buck converter and  $50\text{m}\Omega$  for the boost converter. How does this affect the output voltage?
4. Change  $R_{ESR}$  back to  $1\text{m}\Omega$  and adjust the duty ratio to 0.95 and 0.3 by changing the control voltage of the PWM-modulator and measure the output DC-voltage. For the Boost converter, also test with a duty ratio of 0.999. Compare the results with the theoretical output voltages and explain the difference.