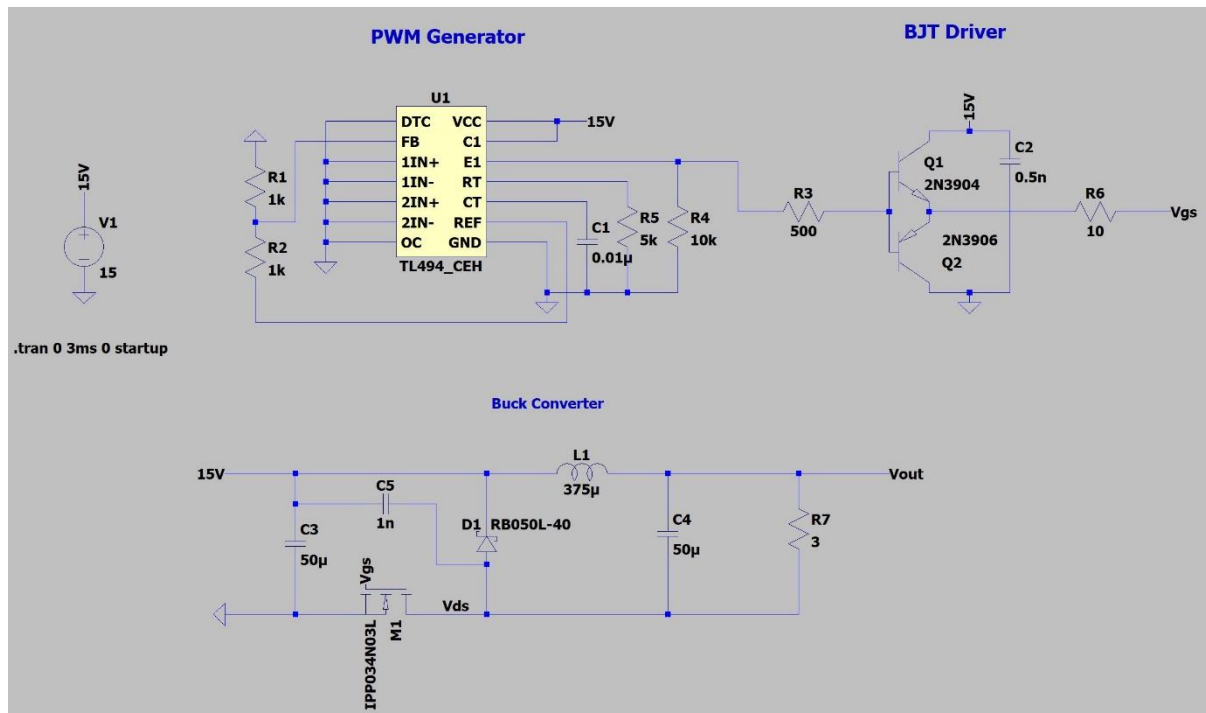


LTSpice Buck Converter Simulation

ENEL373 Power Electronics

Adam Finlayson

Simulated Circuit Diagram



Analytical Solutions for Inductor Sizing

Left: Absolute Minimum L for Continuous Conduction

Right: L for I_{p-p} of 0.5A

Minimum Inductance for Continuous Conduction:

$$v = L \frac{di}{dt} = L \frac{\Delta i}{\Delta t} \text{ Linear}$$

$$\Delta i = \frac{V \Delta t}{L} = \frac{V}{L} (1-D)T$$

$$L = \frac{V_0 (1-D)}{I_{p-p} \cdot f_s}$$

$$L_{min} = \frac{0.5 \cdot 15 \cdot (1-0.5)}{2 \cdot 0.5 \cdot 15 \cdot 20 \times 10^3} = \frac{3.75}{1 \times 10^5} = 3.75 \times 10^{-5} = 37.5 \mu H$$

Parameters:

- $D = 0.5$
- $V_0 = D \cdot V_s$
- $V_s = 15V$
- $I_{p-p} = 2 \cdot I_{avg}$
- $I_{avg} = \frac{V_0}{R_L}$
- $R_L = 3 \Omega$
- $f_s = 20 kHz$

Inductance for I_{p-p} of 0.5A

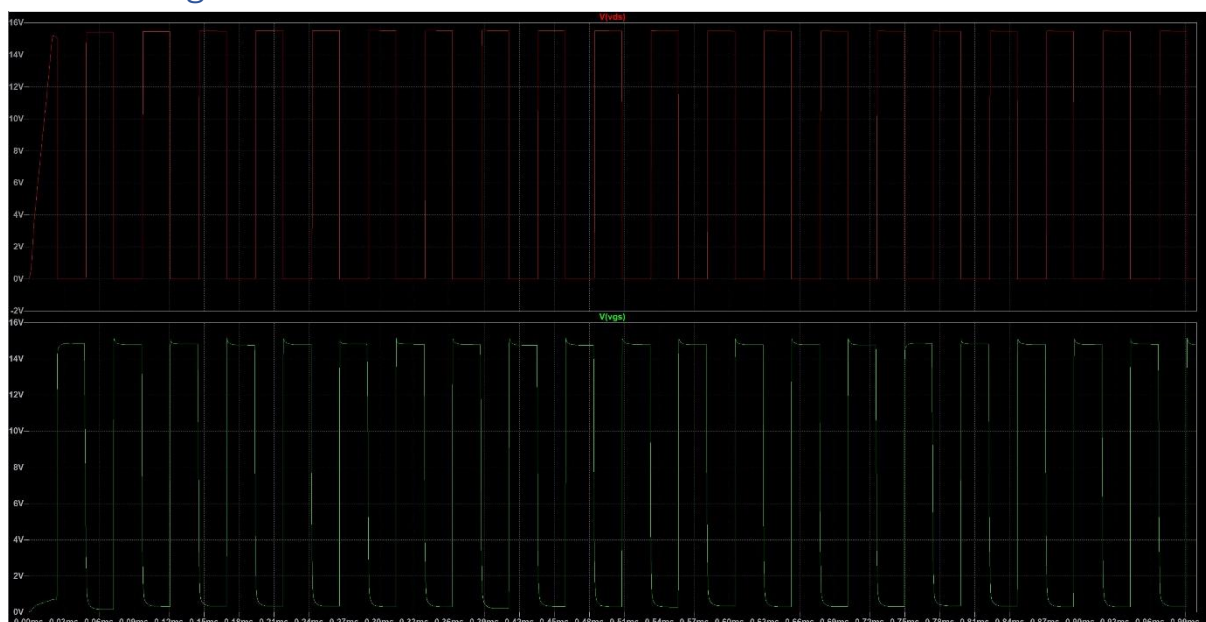
$$L = \frac{V_0 (1-D)}{I_{p-p} \cdot f_s}$$

$$L = \frac{15 \cdot 0.5 (1-0.5)}{0.5 \cdot 20,000} = \frac{3.75}{10,000} = 3.75 \times 10^{-4} = 375 \mu H$$

Parameters:

- $D = 0.5$
- $V_0 = D \cdot V_s$
- $V_s = 15V$
- $I_{p-p} = 0.5A$
- $f_s = 20,000$

MOSFET Vgs and Vds



Output Voltage

