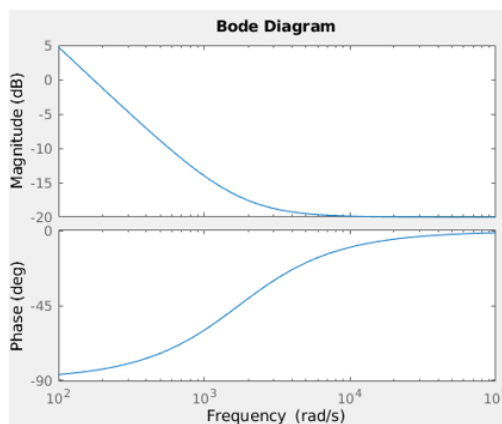


- 1.
2. It is ideal to have a zero that will cancel out the integrator (pole) a decade before dB = 0. As a result will remove steady state error as it reduces the system type. As can be seen in the bode plot when the 2 systems are connected.
 - $R_f = 1\text{k}\Omega$
 - $R_i = 10\text{k}\Omega$
 - $C = 580\text{nF}$

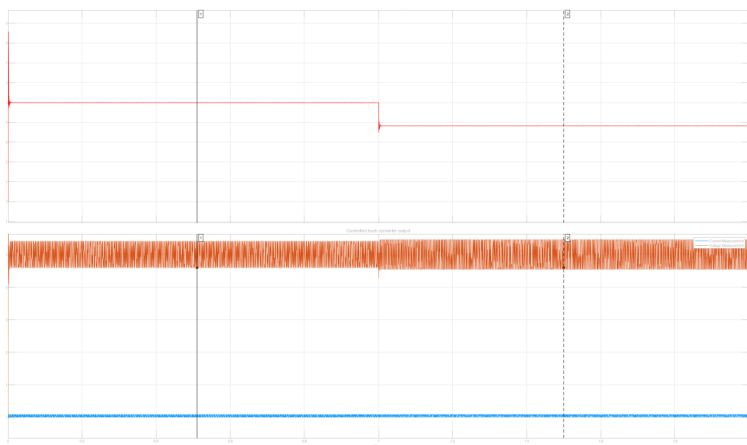
These are the components needed to create this PI controller.

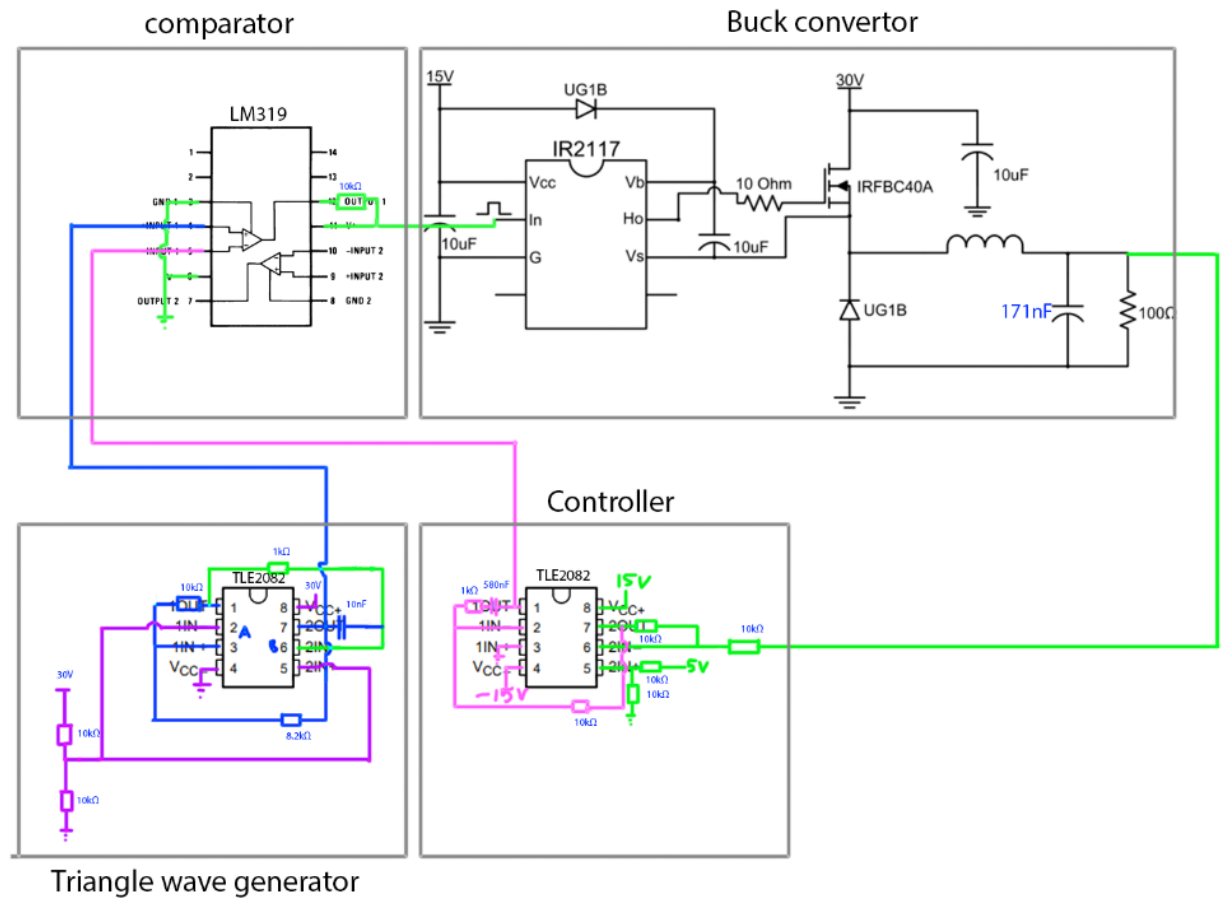


3.



-
- The diagram shows a Simulink model of a buck converter. At the top, a 'Voltage' block is connected to an 'Uncontrolled Buck' block. Below this, a control system is implemented. A red text label 'Control system should go here' points to a block containing the transfer function $\frac{0.00058s + 1}{0.0058s}$. This block is part of a feedback loop. The output of the control system is connected to a MOSFET driver block, which drives a MOSFET. The MOSFET is connected to an inductor and a capacitor, forming the power stage of the buck converter. The output voltage is measured by a scope. The model also includes a diode and a MOSFET driver block.





6.

Appendix

1.)

$$\text{Transfer function (original system)} = \frac{55s + 275000000}{s^2 + 1005s + 25000000}$$

2.)

$$K_p = \frac{R_f}{R_i} = \frac{1k\Omega}{10k\Omega} = 0.1$$

$$s = 1.73 * 10^3 (\text{decade before dB} = 0), s = \frac{-1}{R_f * C} = \frac{-1}{1k\Omega * C}, 1.73 * 10^3 = \frac{-1}{1k\Omega * C}, C = 580nF (\text{rounded})$$

$$K_i = \frac{1}{R_i * C} = \frac{1}{10k\Omega * 580nF} = 172.4$$

3.)

$$PI \text{ controller} = \frac{0.00058s+1}{0.0058s}$$

Matlab code

Clear all;

Vin = 11;

L = 0.004;

C = 10*10^-6;

r = 0.02;

R = 100;

d = 0.8;

s = tf('s');

num = Vin * (1 + s*r*C);

dem = L*C*(s^2 + s*(1/(R*C) + r/L) + 1/(L*C));

plant = tf(num/dem)

margin(plant)

RF = 1000;

C = 5.8*10^-7;

Ri = 10000;

num = RF * C;

dem = Ri * C;

Plcontroller = tf([num 1],[dem 0])

bode(Plcontroller)

figure(1)

hold on

bode(plant)

bode(Plcontroller)

hold off

sys = 1/(1)

sys = feedback(plant * Plcontroller,1)

bode(sys)