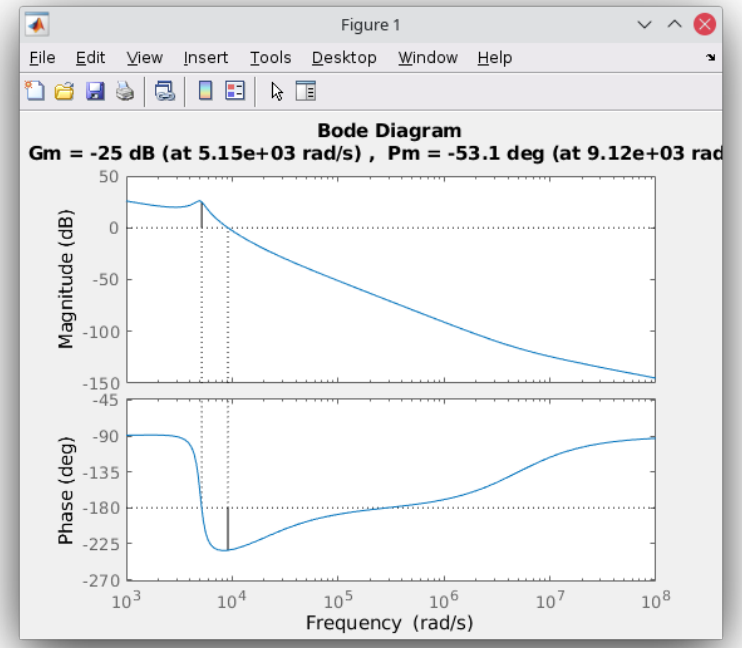
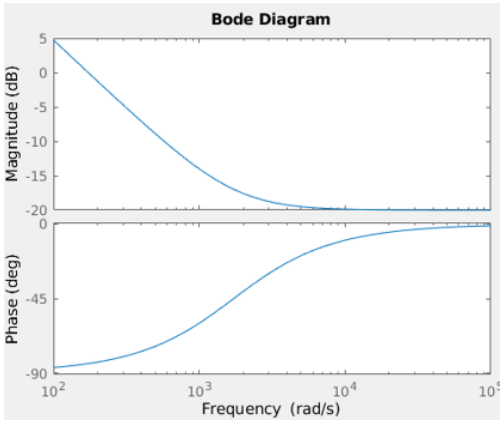
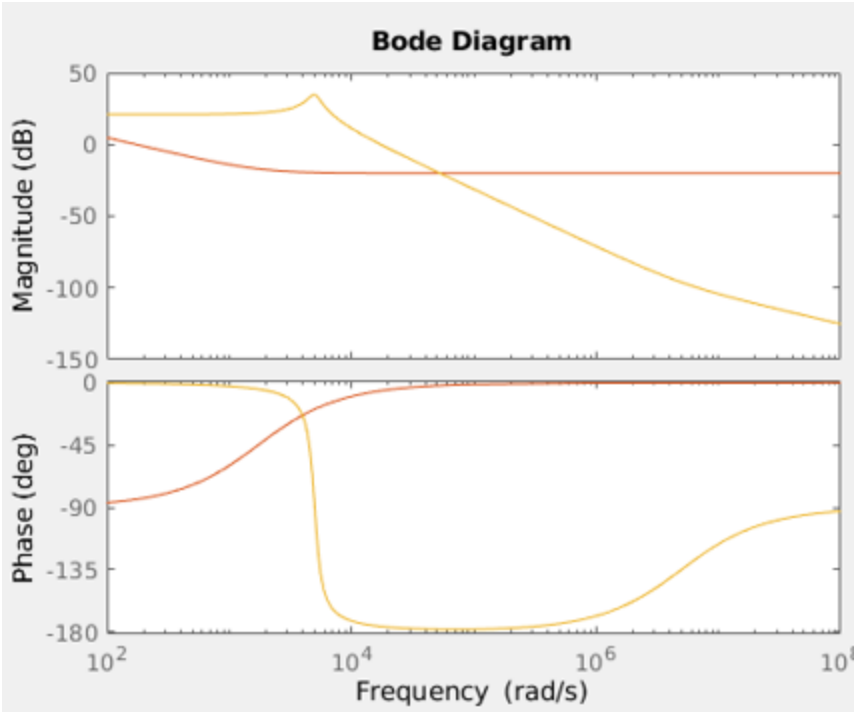


1.

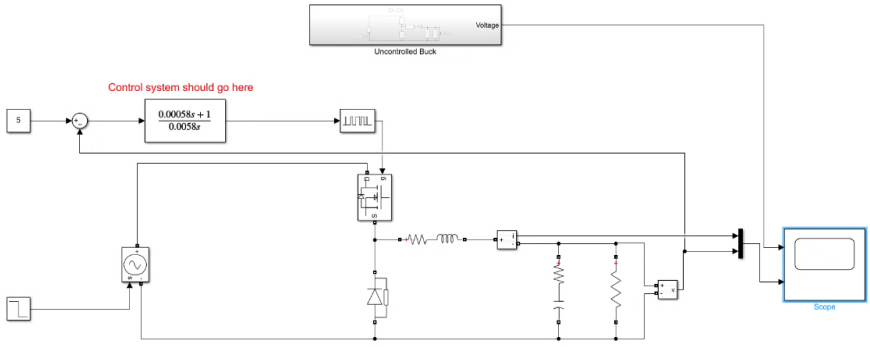
2. It is ideal to have a zero that will cancel out the integrator (pole) a decade before dB = 0. As a result will remove steady state error as it reduces the system type. As can be seen in the bode plot when the 2 systems are connected.
   - Rf = 1kΩ
   - Ri = 10kΩ
   - C = 580nF

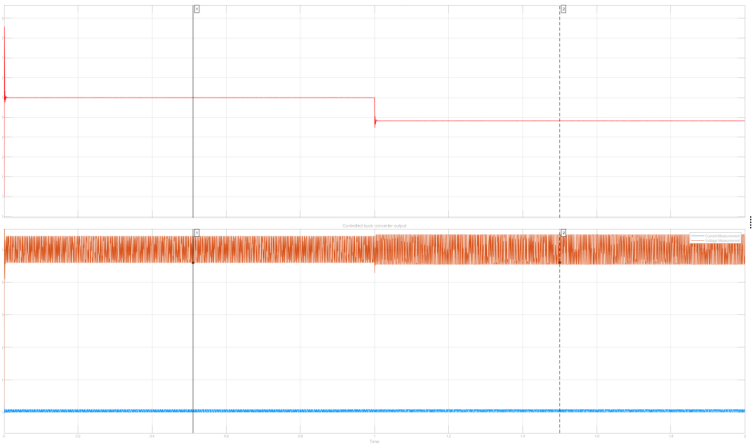
   These are the components needed to create this PI controller.

3. 

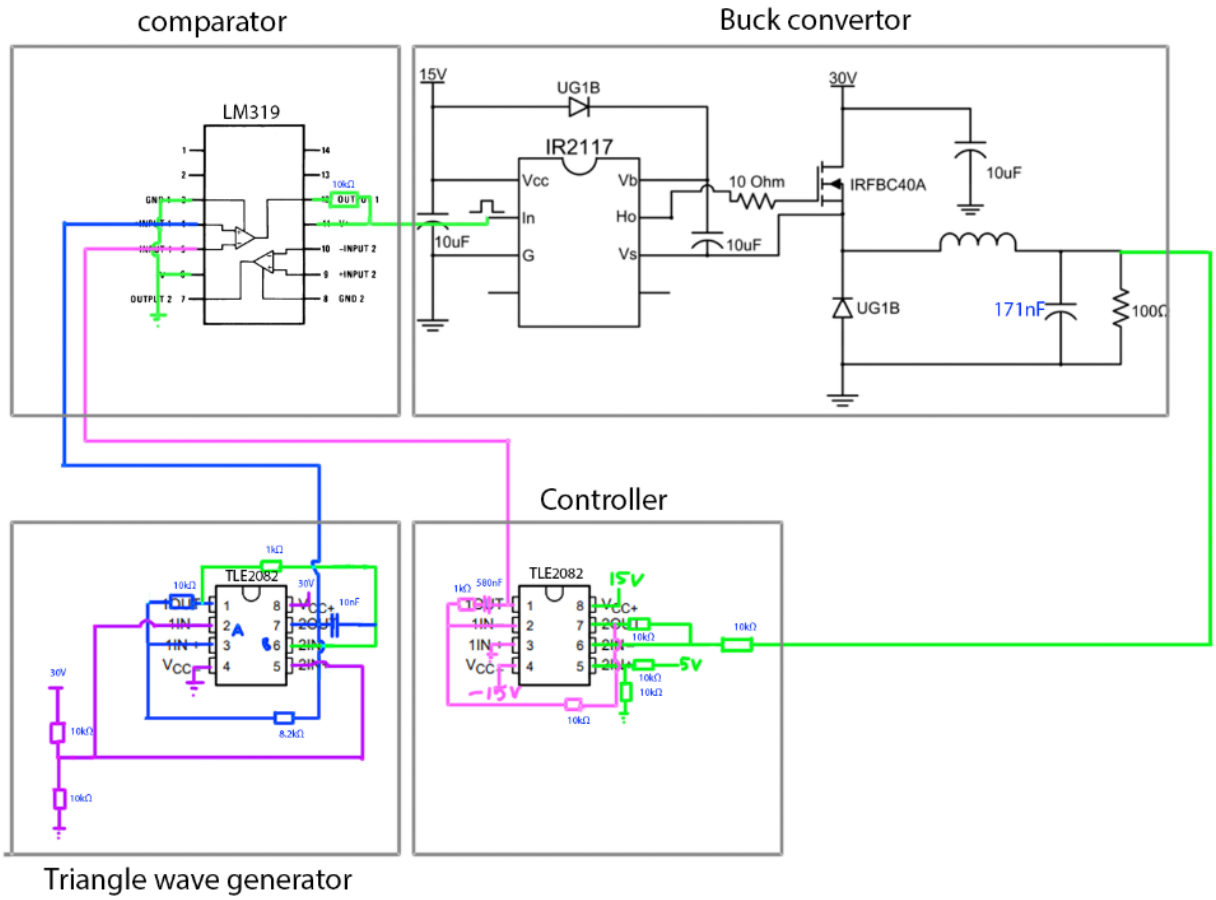
4. 

   a. Yellow = original system
   b. Orange = PI controller

5. 



6.



Appendix

1.)

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

2.)

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

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

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

3.)

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

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;

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



bode(PIcontroller)

figure(1)
hold on
bode(plant)
bode(PIcontroller)
hold off

sys = 1/(1)
sys = feedback(plant * PIcontroller,1)

bode(sys)
```