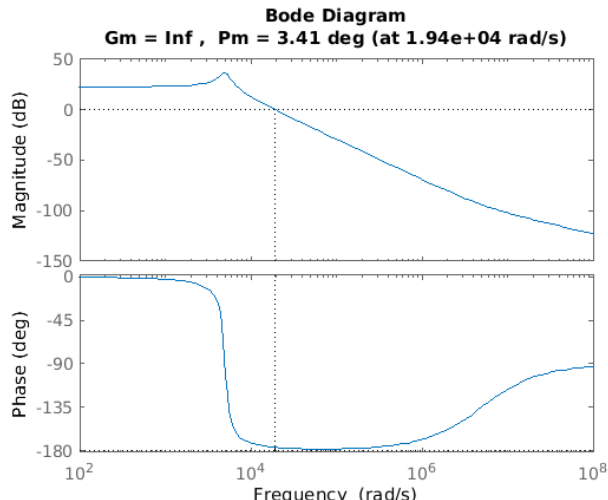# ECEN 405
Lab 6: Power converters (feedback) Submission

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1 Buck Converter

MATLAB *Bode plot of Buck-converter, w/ displayed Phase Margin*

```
Vo = 5;
Vin = 14;
L = 4e-3;
C = 10e-6;
r = 0.02;
R = 100;
f_s = 30e3;

s = tf('s');
buck = (Vin/(L*C)) * ((1 + s*r*C) / (s^2 + s*(1/(R*C) + r/L) + 1/(L*C)));
margin(buck);
```
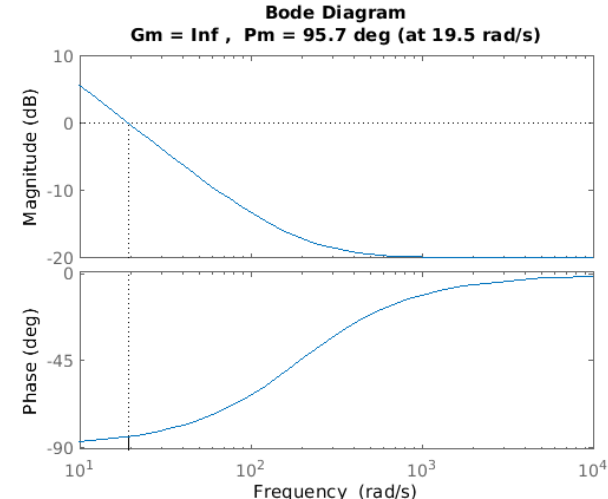
2 Controller

$$R_i = 10K, K_p = 0.1$$

$$R_f = K_p * R_i = 1K$$

Phase Margin(from `margin`), $Pm = 1.9351e4\ rad/S$

Now choosing a C_f value to maintain phase at unity gain, a pole is placed 2 decades before the phase margin computed by MATLAB .

$$C_f = \frac{1}{R_f * Pm * 1e - 2} = 5.1677uF$$

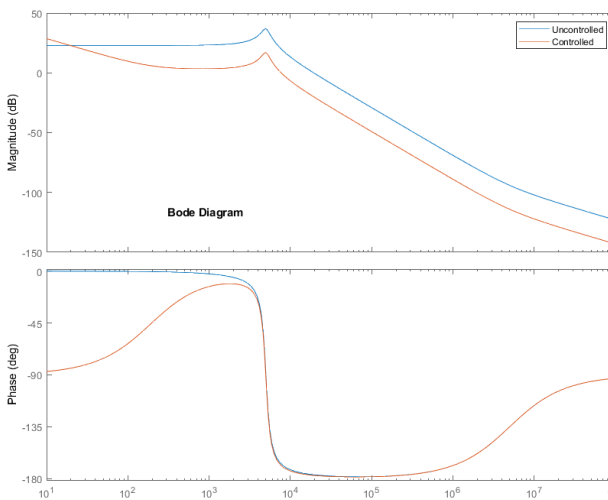$$\therefore\ K_i = \frac{1}{R_i * C_f} = 19.3510$$

3 Controller Bode

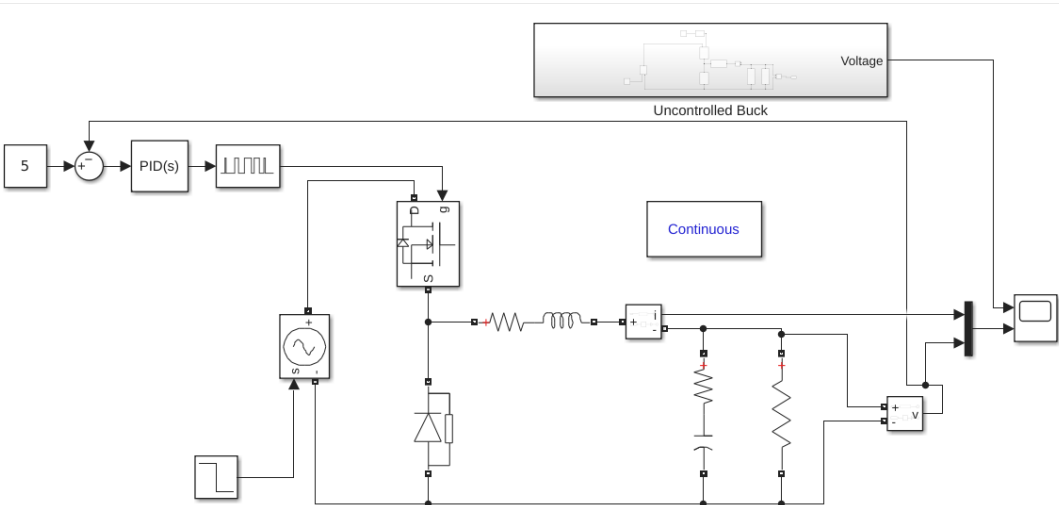*Resulting Bode plot of designed controller*

```
controller = (Rf + (1/(Cf*s)))/(Ri);
margin(controller)
```
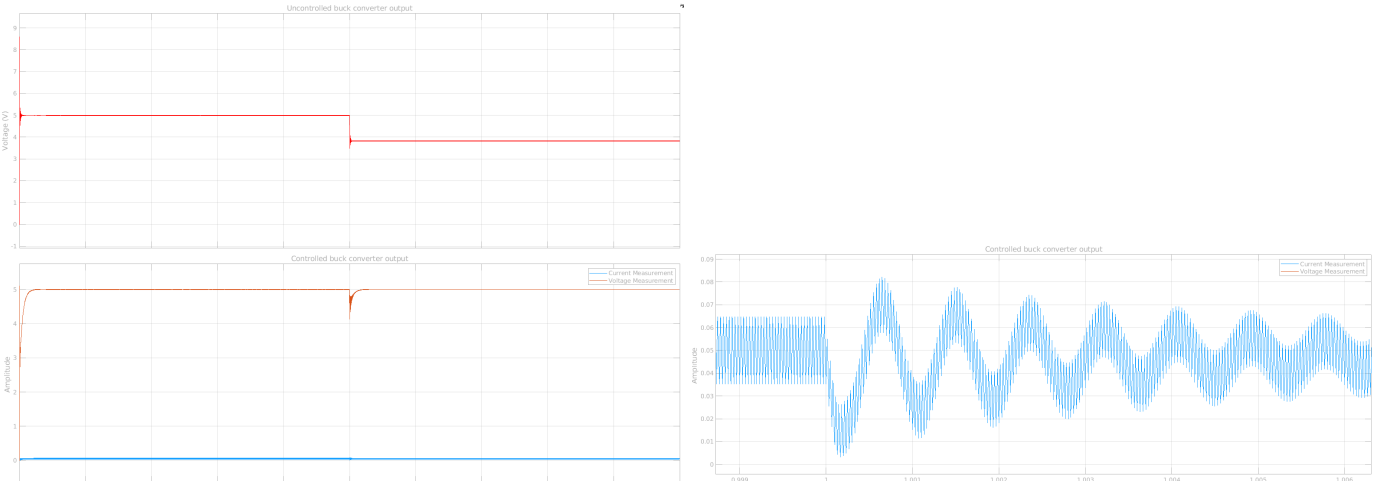
4 Uncontrolled vs Controlled

Comparison between Uncontrolled and Controlled to examine phase behaviour

5 Simulink Model

Simulink Model including controller
To implement control in the Simulink model to computed K_p and K_i from the MATLAB script at used in a PID block ($K_d = 0$) with output voltage feedback to compute error signal.

Left: Controlled vs Uncontrolled Buck converters showing the elimination of steady state error
Right: Current ripple at the step of the controlled buck

6 Schematic