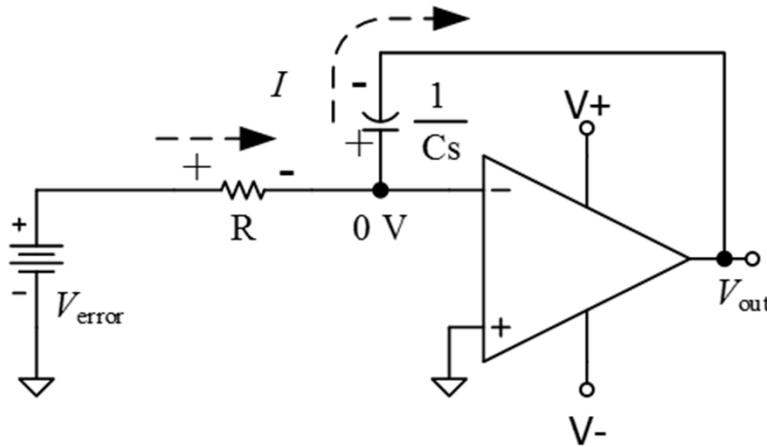


Simple Integrator



$$I = \frac{V_{\text{error}}}{R}$$

$$V_C = I \times \frac{1}{C_s}$$

$$V_{\text{out}} = -V_C = -\frac{I}{C_s}$$

This current is created by V_{error} across the input resistor, R

$$V_{\text{out}} = -\frac{I}{C_s} = -\frac{\frac{V_{\text{error}}}{R}}{C_s}$$

$$V_{\text{out}} = -\frac{V_{\text{error}}}{RC_s}$$

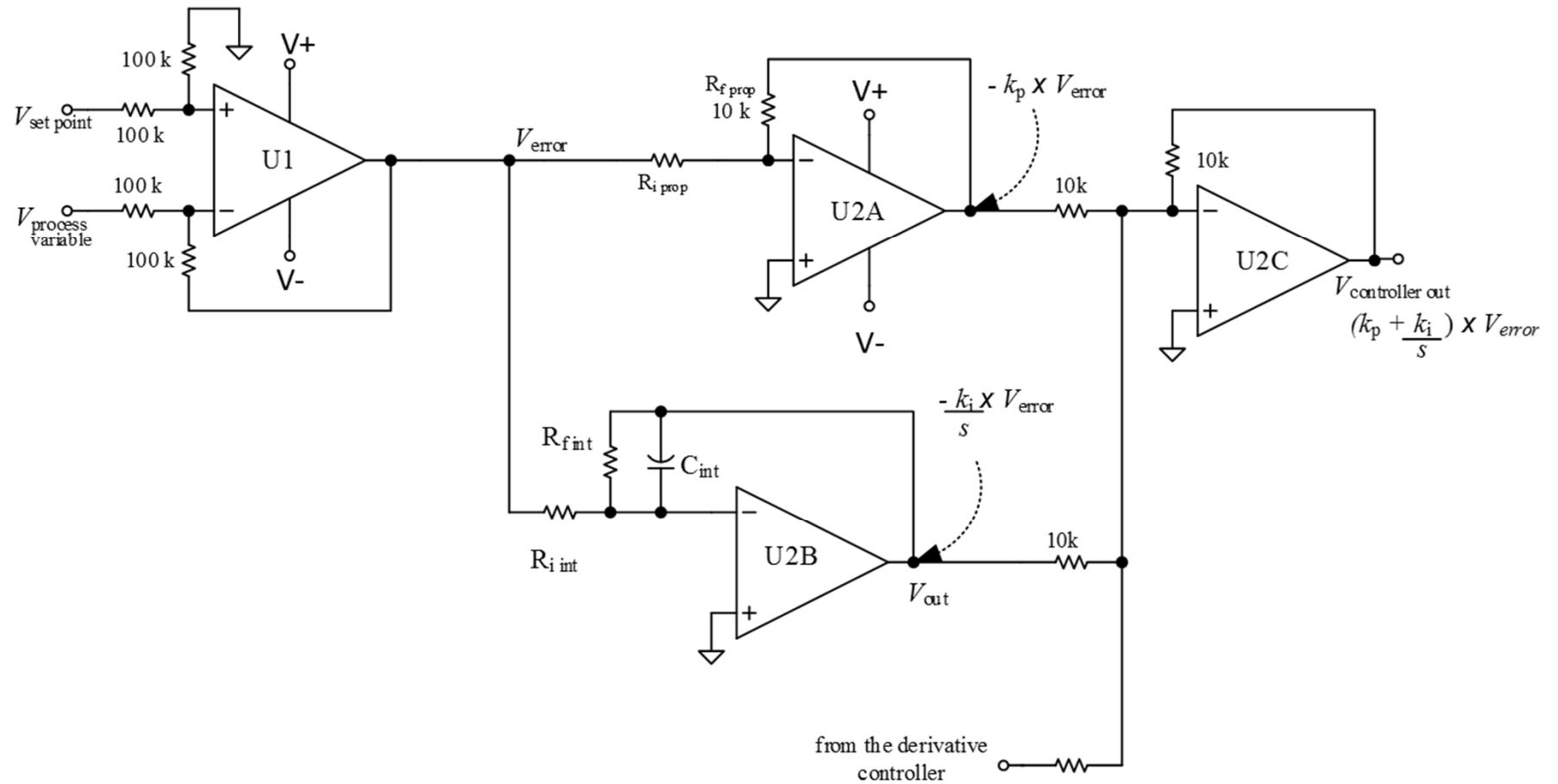
$$\frac{V_{\text{out}}}{V_{\text{error}}} = -\frac{1}{RC_s}$$

Let

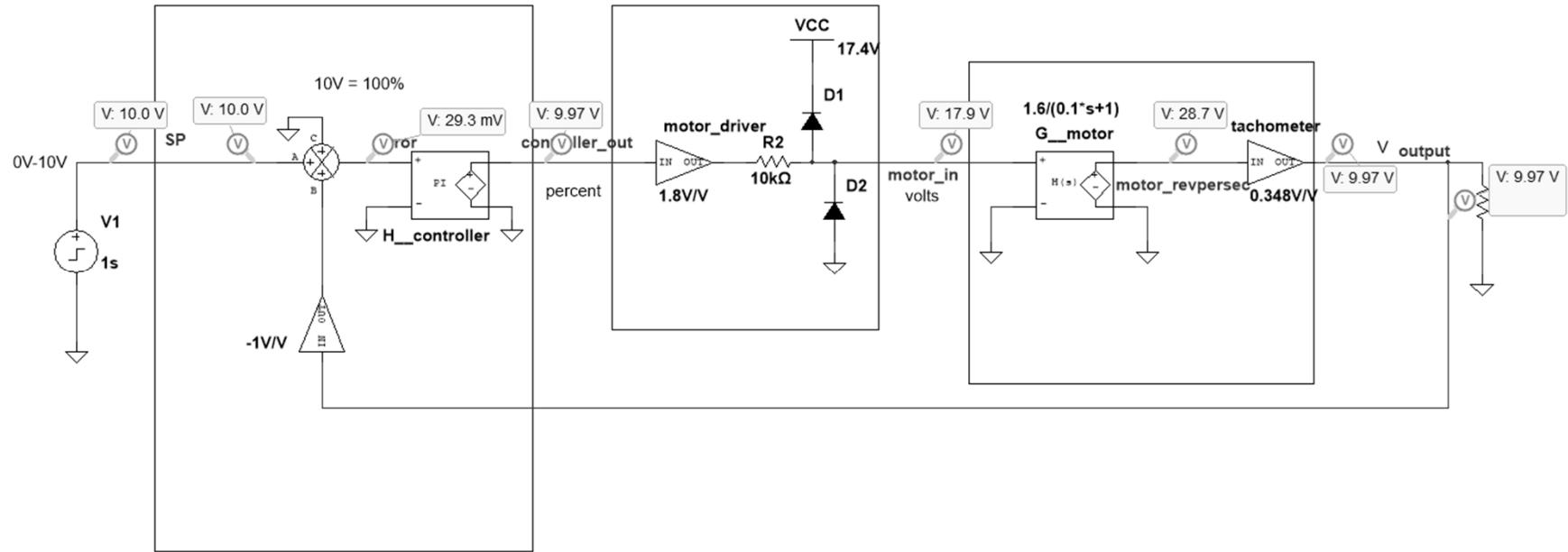
$$k_i = \frac{1}{RC}$$

$$\frac{V_{\text{out}}}{V_{\text{error}}} = -\frac{k_i}{s}$$

PI Controller



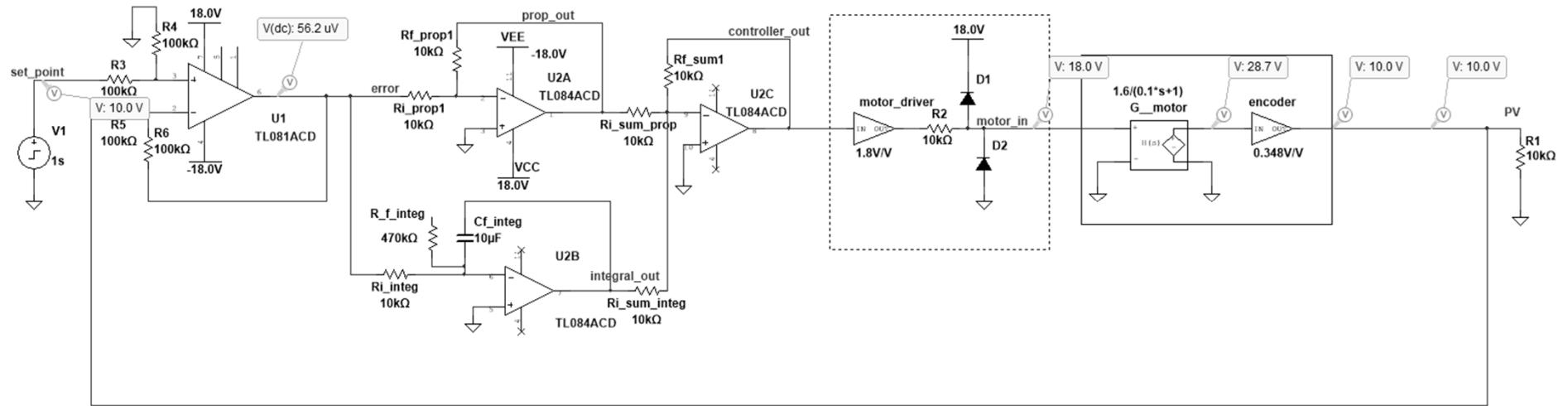
Simulation – Laplace Modules



- Rescaled 0-10V
- 10V=> 18V power

Same motor
and
Constants in
Arduino PI Control Lab

Simulation – Op Amps



$$k_p = 1$$

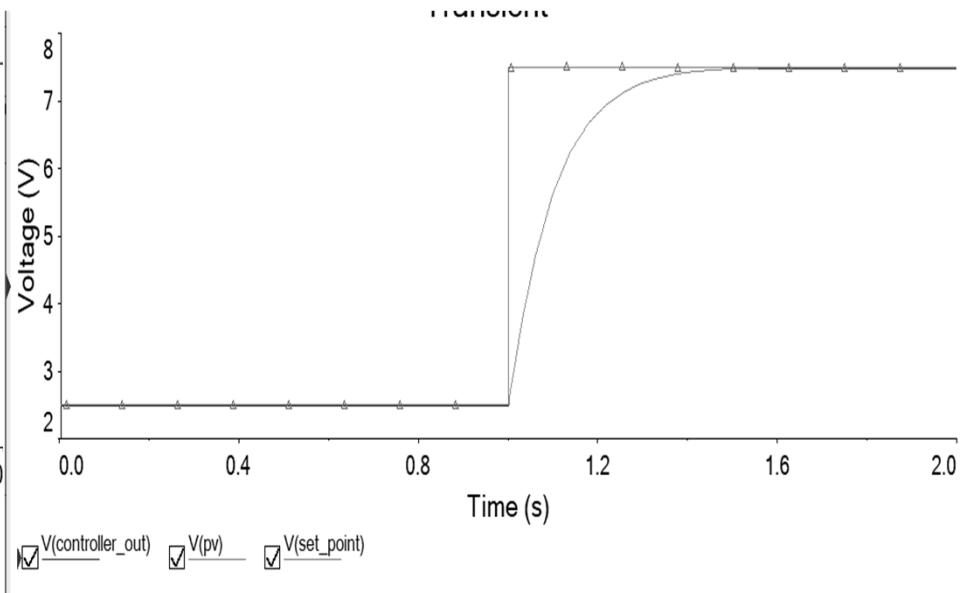
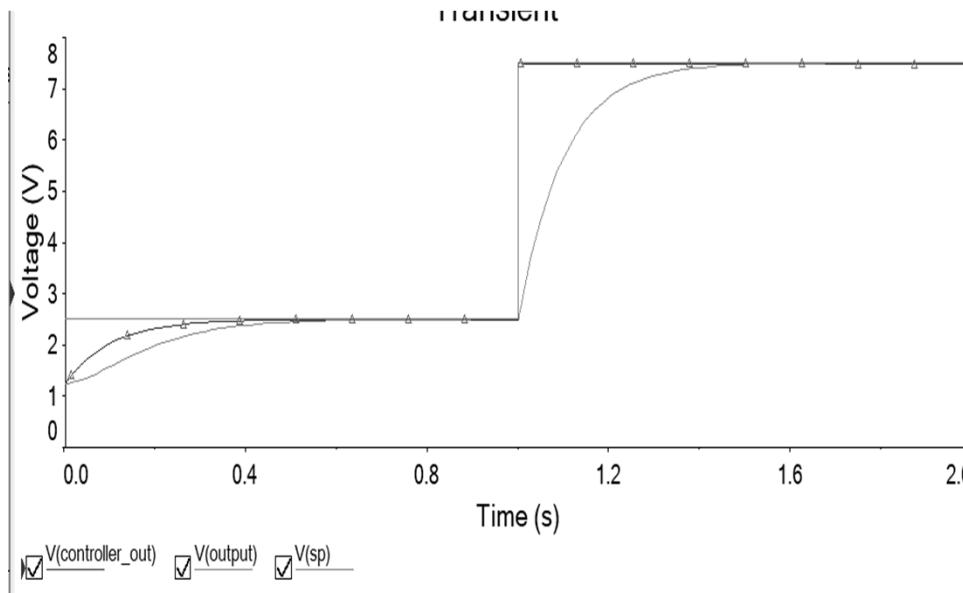
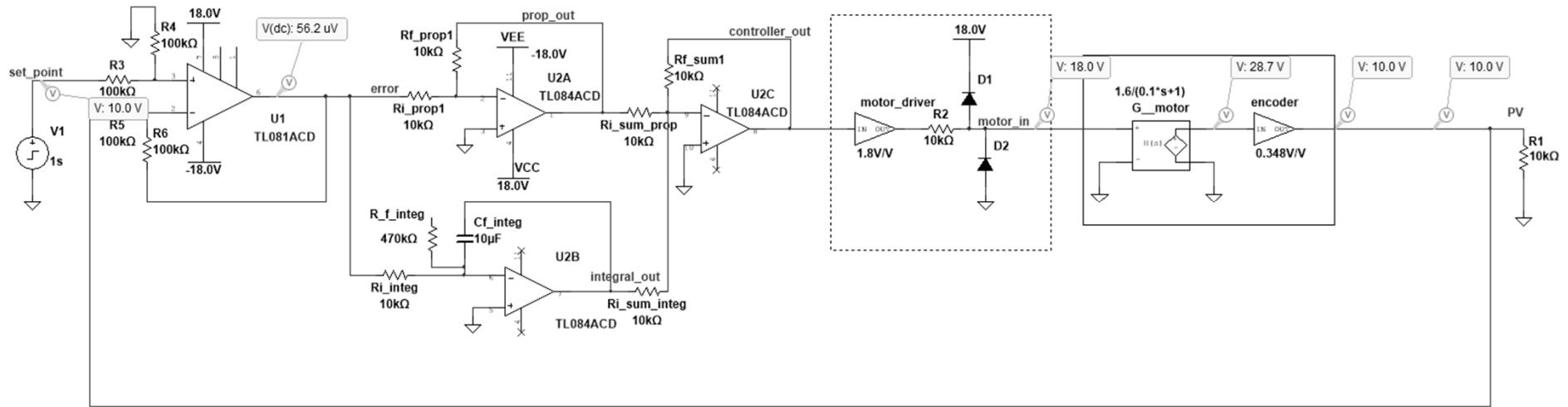
$$k_i = 10$$

$$R_{prop1} = \underline{\hspace{2cm}}$$

$$R_{f_integ} = \underline{\hspace{2cm}}$$

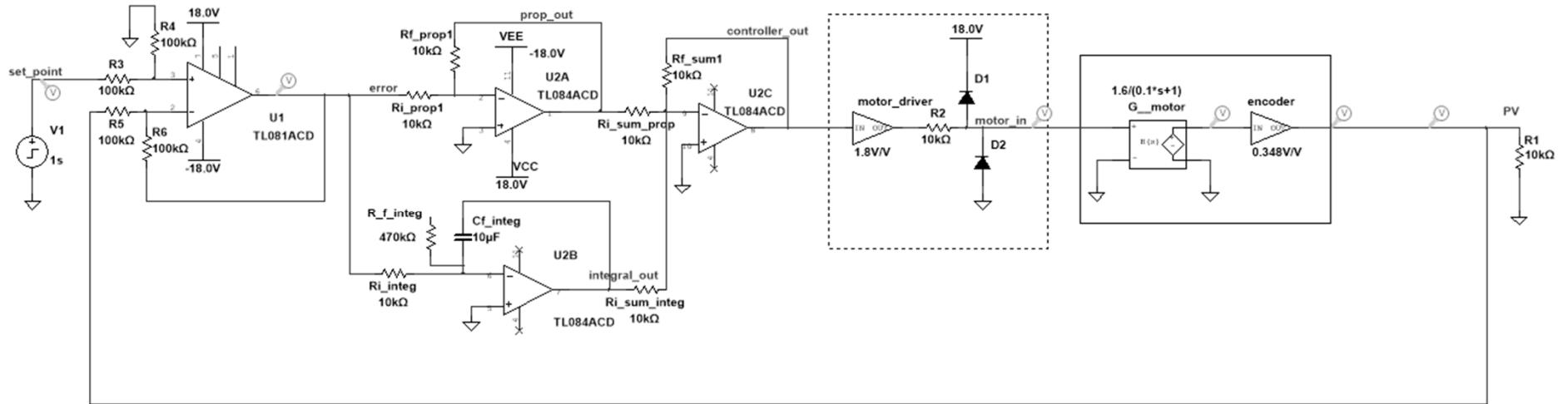
$$C_{f_integ} = \underline{\hspace{2cm}}$$

Simulation – Op Amps



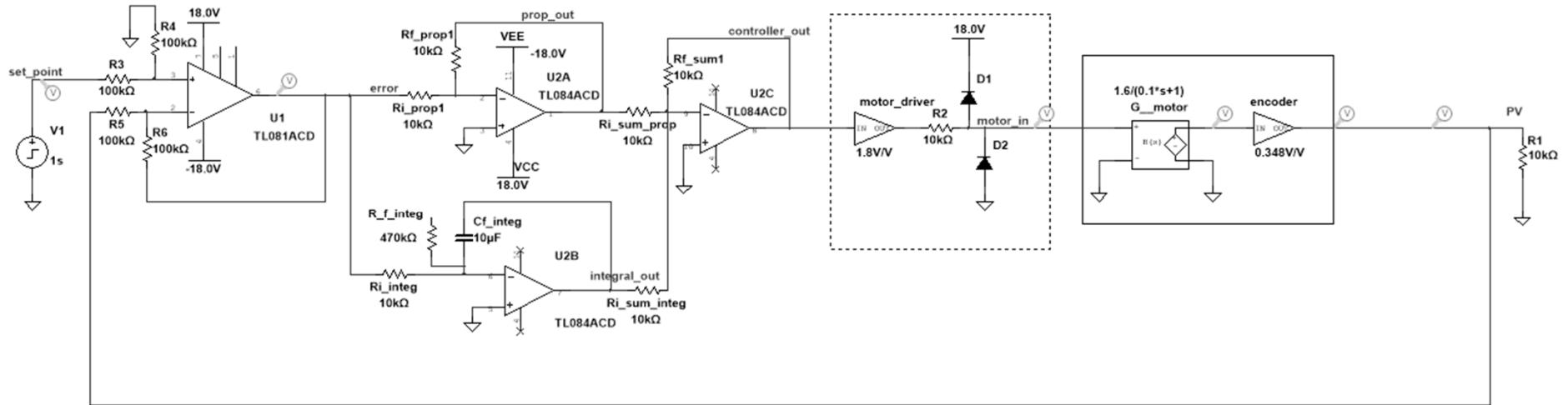
Manual Calculation

$$V_{SP} = 6 \text{ V} \quad V_{PV} = 2 \text{ V}, \quad V_{\text{integrator}} = -3 \text{ V}$$



Manual Calculation

$$V_{SP} = 6 \text{ V} \quad V_{PV} = 6 \text{ V},$$



MOS Power Amp

