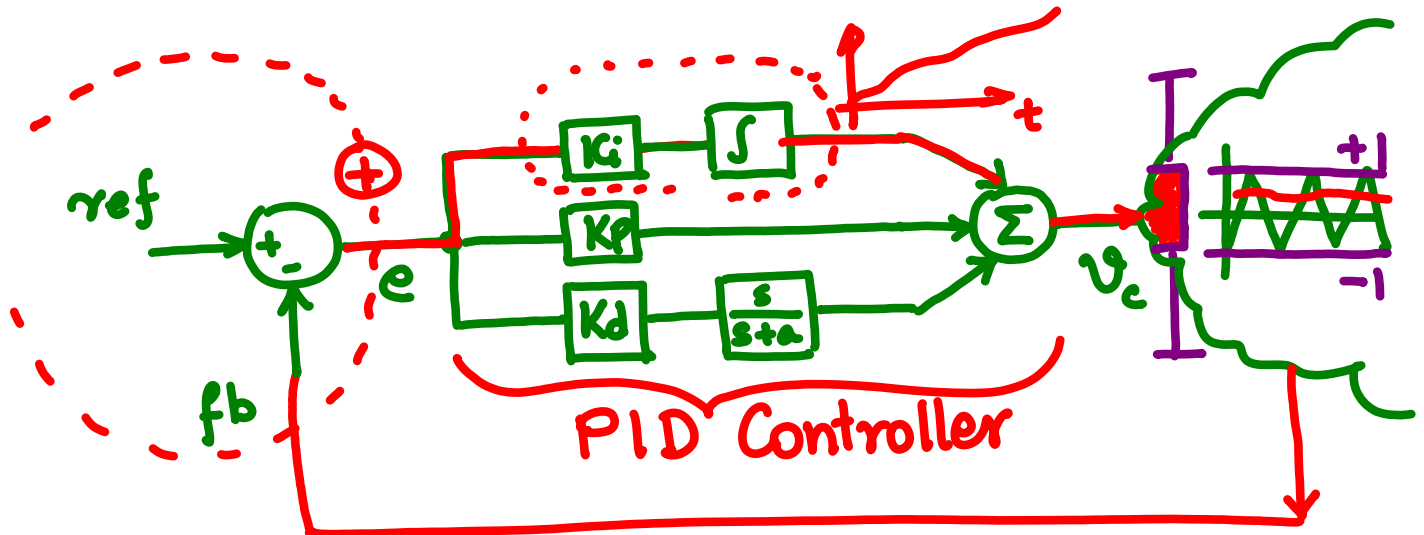


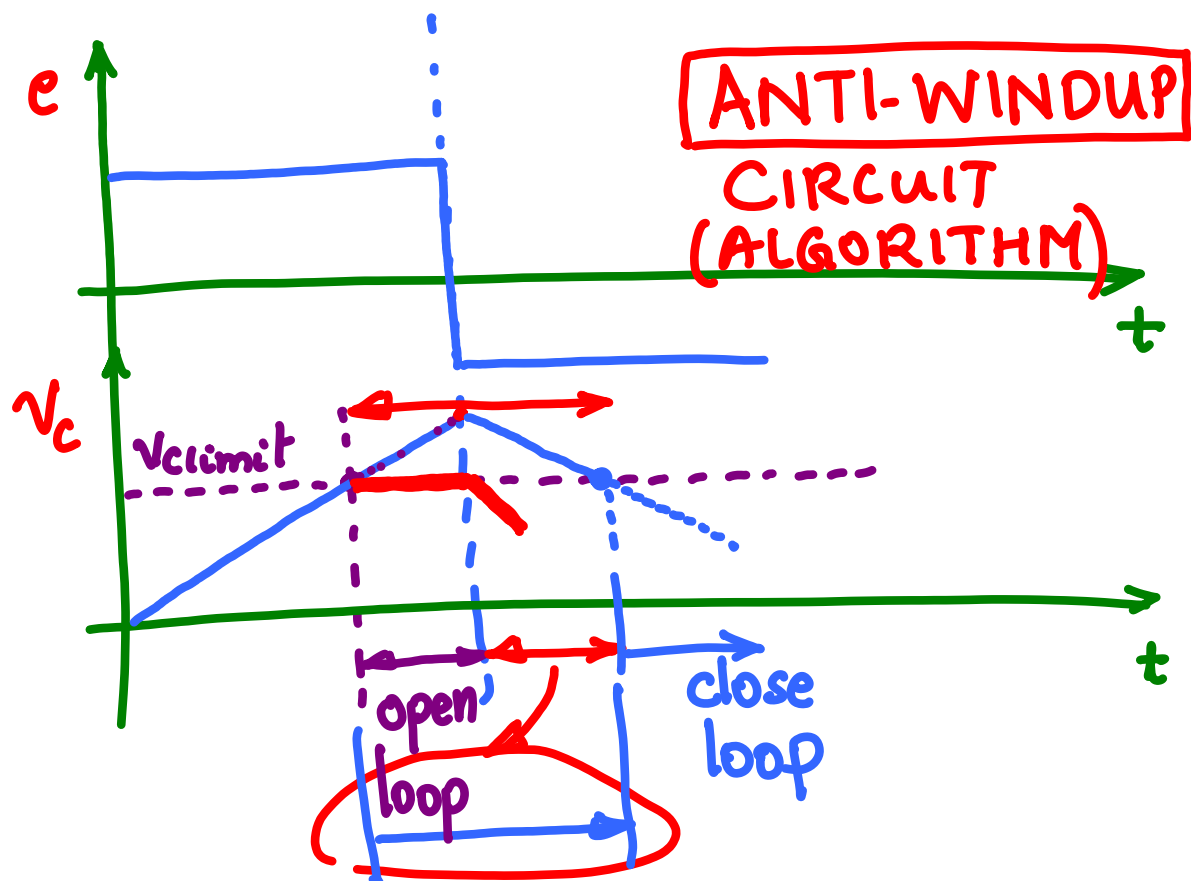
$$G_c = \frac{K_i}{s} + K_p + K_d \frac{s}{s+a}$$

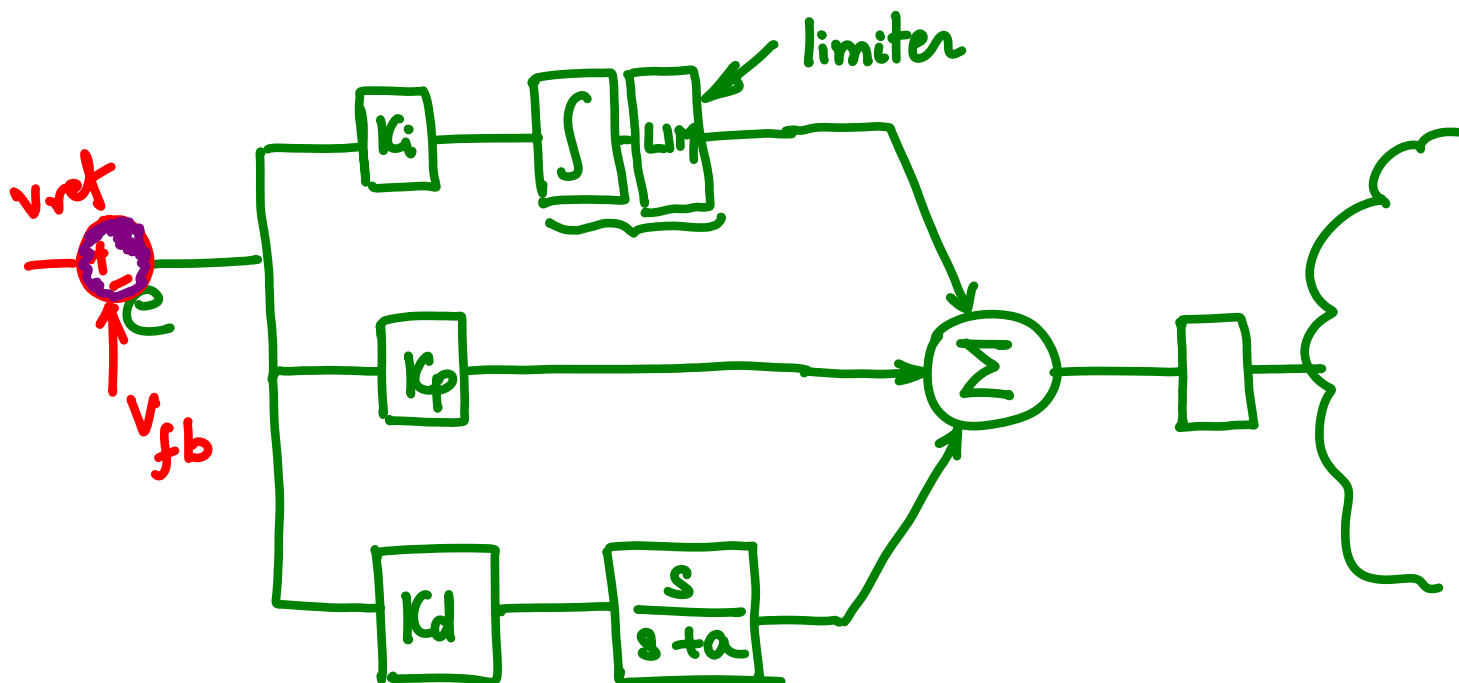
$$\frac{\overbrace{K_i(s+a)} + \overbrace{K_p s(s+a)} + K_d s^2}{s(s+a)}$$

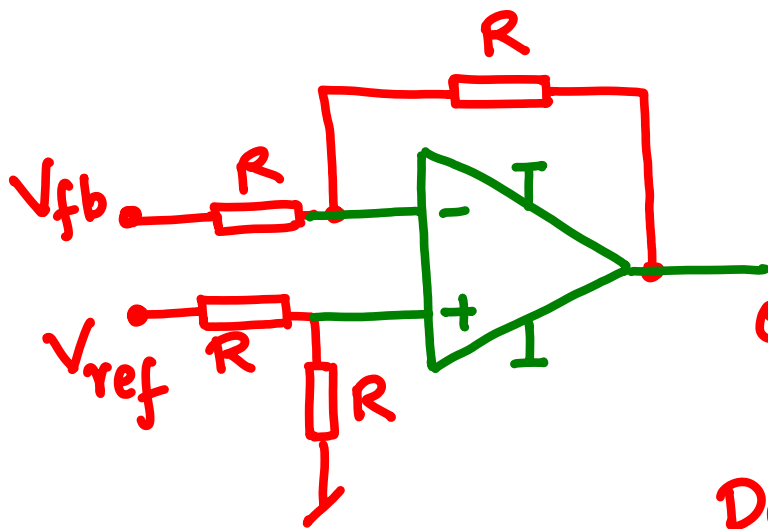
$$G_c = \frac{(K_p + K_d)s^2 + (K_i + K_p \cdot a)s + K_i \cdot a}{s^2 + a \cdot s}$$

# WINDUP PROBLEM INTEGRATOR WINDUP



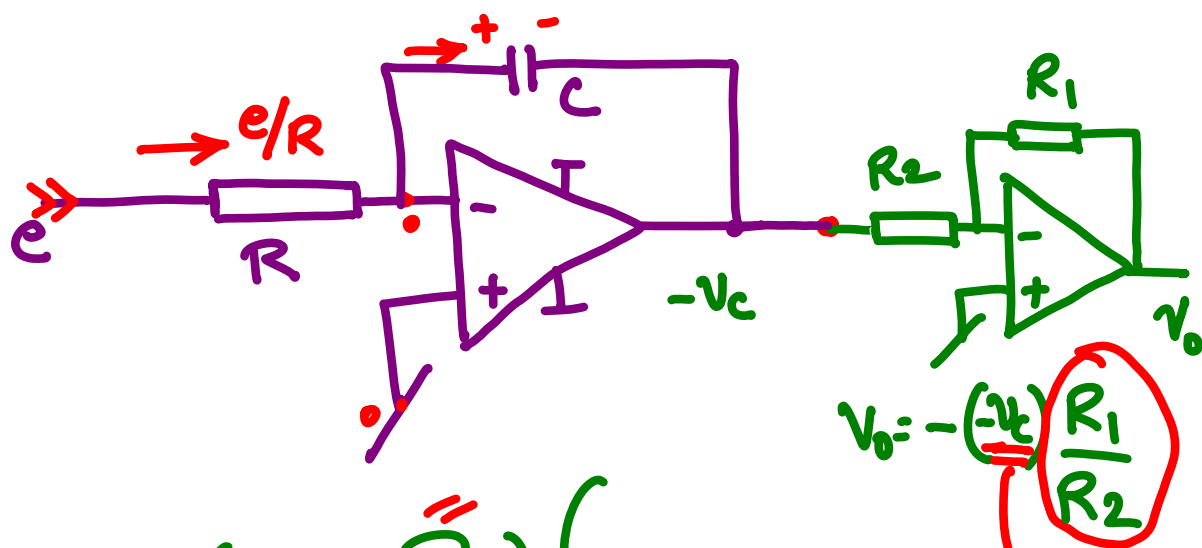






$$e = (V_{ref} - V_{fb})$$

Difference Amplifier



$$V_o = \underbrace{\left( \frac{1}{RC} \cdot \frac{R_1}{R_2} \right)}_{K_i} \int e \, dt$$

$$V_o = - \left( \frac{1}{RC} \right) \left( \frac{R_1}{R_2} \right) \int e \, dt$$