Impedance / s-Domain Examples

- Scope Probe
- ac Switching for an RL Load
- Ground Bounce
RC Circuit Revisited

Build Me\[v_t = 200\text{-Hz Square Wave, 1-V p-p}\]

\[
\tilde{v}_c = \tilde{v}_t \frac{1/Cs}{1/Cs + R} = \tilde{v}_t \frac{1/RC}{s + 1/RC}
\]

System Pole at\[s = \frac{-1}{RC}\]

\[\tau = 0.1\text{ ms} \quad C = 10\text{ nF} \quad R = 10\text{ k}\Omega\]

Measure \(\tau\)
Build Me

To Oscilloscope

Pin 7 (+15), Pin 4 (-15), Both Op-Amps
One-Pole Feedback Analysis

\[
\frac{v_c}{R} + \frac{v_t}{R} + \frac{v_o}{AR} = 0
\]

\[
v_c = v_o \frac{1/Cs}{1/Cs + R}
\]

\[
v_c = v_i \frac{-A/RC}{s + (1 + A)/RC}
\]

System Pole at \( s = \frac{-(1 + A)}{RC} \)
Modify Me

Modified RC Section
Two-Pole Feedback Analysis

\[ v_c = v_t \frac{-A/\tau^2}{s^2 + 3s/\tau + (1 + A)/\tau^2} \]

\[ \tau = RC \]

System Poles at

\[ s = \frac{-3}{2\tau} \pm \frac{3}{2\tau} \sqrt{1 - \frac{4(1 + A)}{9}} \]

Decaying Oscillations for

\[ A > \frac{5}{4} \]
Three-Pole Circuit

Modify Me

Modified RC Section
Three-Pole Feedback Analysis

Alternating Left / Right Motion
Pole Center of Gravity is Constant