Homework Assignment No. 3

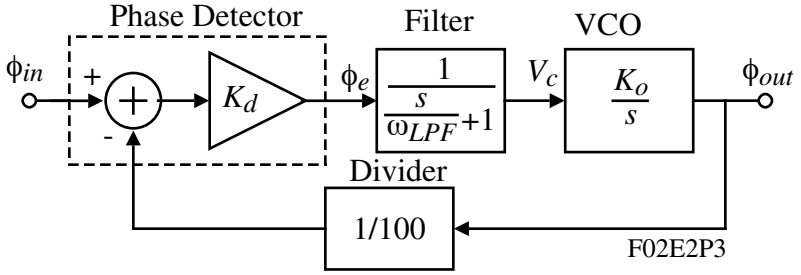
This homework assignment is due in class on Wednesday, June 4, 2003.

Problem 1 - (10 points)

Assume an LPLL has $F(s)$ =1 and the PLL parameters are K_d = 0.8V/radians, K_o = 100 MHz/V, and the oscillation frequency, f_{osc} = 500MHz. Sketch the control voltage at the output of the phase detector if the input frequency jumps from 500MHz to 650MHz.

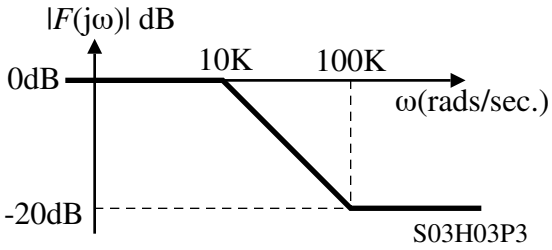
Problem 2 – (10 points)

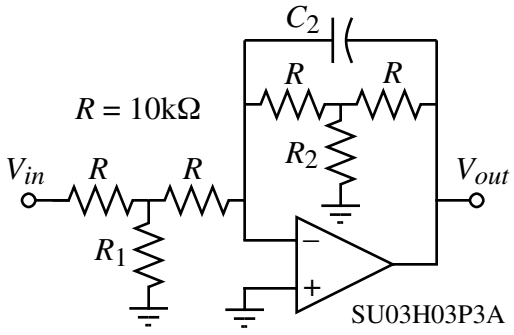
A Type I PLL incorporates a VCO with K_o = 100MHz/V, a phase detector with K_d = 1V/rad, and a first-order, lowpass filter with $\omega_{LPF} = 2\pi \times 10^6$ radians/s shown below. A divider of 100 has been placed in the feedback path to implement a frequency synthesizer. (a.) Find the value of the natural damping frequency, ω_n, and the damping factor, ζ, for the transfer function $\phi_{out}(s)/\phi_{in}(s)$, for this PLL. (b.) If a step input of $\Delta\phi_{in}$ is applied at t = 0, what is the steady-state phase error at the output of the phase detector, ϕ_e? The steady-state error is evaluated by multiplying the desired phase by s and letting $s \rightarrow 0$.



Problem 3 – (10 points)

Modify the active filter shown of Problem 4 of Homework 2 to design the lag-lead loop filter shown below. The capacitors can be no larger than 10pF. Give the values of R_1, R_2, C_1 and C_2.





Problem 4 – (10 points)

Using the filter of Problem 3, find the value of ω_n and ζ of the PLL if K_d = 1V/radians, K_o = 2Mradians/V·sec. What is the steady state phase error in degrees if a frequency ramp of 10^8 radians/sec.^{2} is applied to the PLL?

Problem 5 – (10 points)

Solve for the crossover frequency of the PLL of Problems 3 and 4 and find the phase margin. Use SPICE to find the open-loop frequency response of the PLL and from your plot determine the crossover frequency and phase margin and compare with your calculated values.