

Acquisition Range

1. Lock-in range ($\Delta\omega_L$): $\pm K_{vco} \cdot K_{pd}$

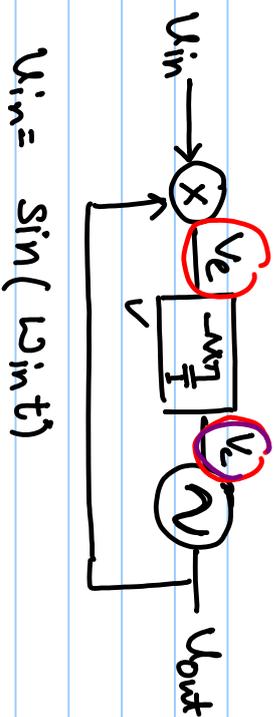
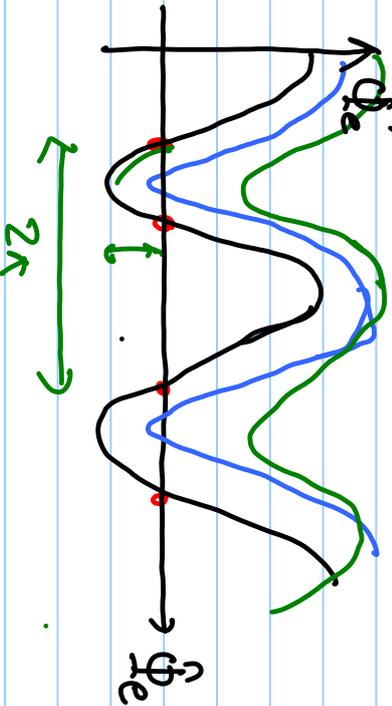
ω_{in} : input freq.

$$\omega_{out} = \omega_{free} + K_{vco} \cdot V_e$$

$$\Delta\omega(0) = \omega_{in} - \omega_{free} \checkmark$$

$$\Delta\omega(t) = (\omega_{in} - \omega_{free}) - K_{vco} \cdot V_e$$

$$\Delta\omega_{st} = \Delta\omega(0) - K_{vco} \cdot K_{pd} \cos(\dot{\phi}_e) = 0 \checkmark$$



$$U_{in} = \sin(\omega_{in} t)$$

$$V_{out} = \sin(\omega_{out} t + \phi_{os})$$

$$\bar{V}_e = \frac{1}{2} \cos(\phi_{err}) \checkmark$$

$$L_G(\lambda) = K_{pd} \times \frac{1}{1 + sRC} \times \frac{K_{vco}}{s}$$

$$K_{vco} = 100 \text{ Mrad/s/V}$$

$$\Delta\omega \leq K_{pd} K_{vco} = \underline{50 \text{ Mrad/s}}$$

$$\underline{\Delta\omega = 60 \text{ Mrad/s}}, \quad V_e = 0.6 \text{ V}, \quad V_e = 0.6 \text{ V}$$

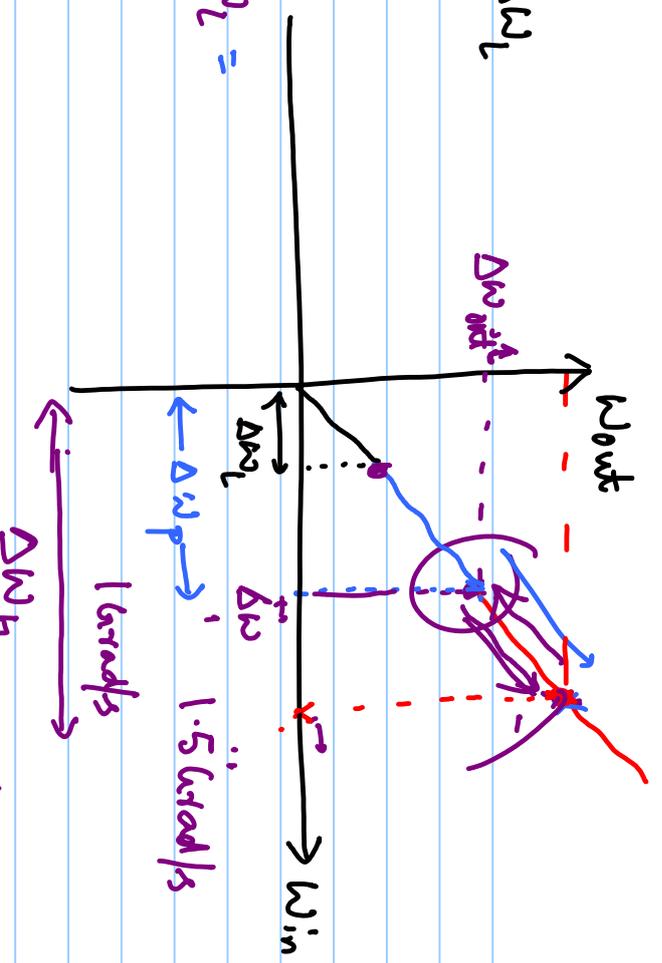
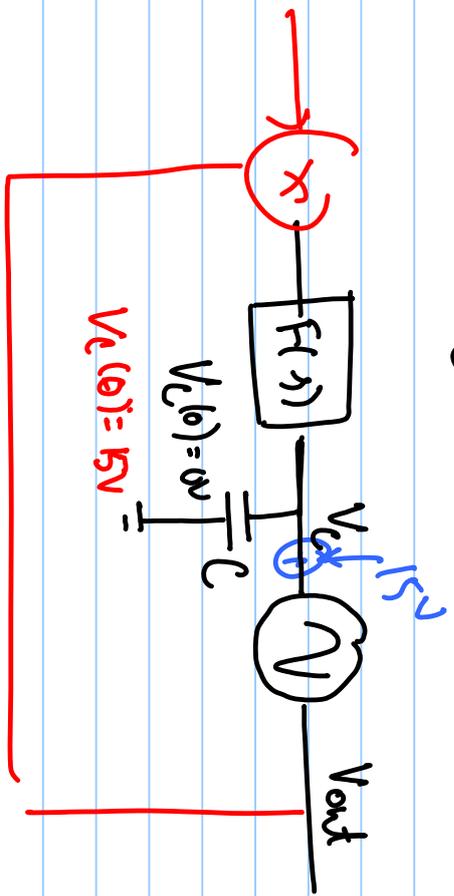
Hold-in range (ΔW_P) = $K_{VCO} \cdot K_{PD} \geq \Delta W_L$

$\Delta W(0) = W_{in} - W_{out}$

Hold-in range (ΔW_H) $\Rightarrow \Delta W_P \geq \Delta W_L =$

$\Delta W_H = K_{VCO} \cdot K_{PD}$

a) $W_{in} = W_{out} = W_D$



$K_{VCO} = 100 \text{ M-rads/s/V}$

$\Delta W = 1.5 \text{ Grads/s}$

$V_c = 15 \text{ V}$

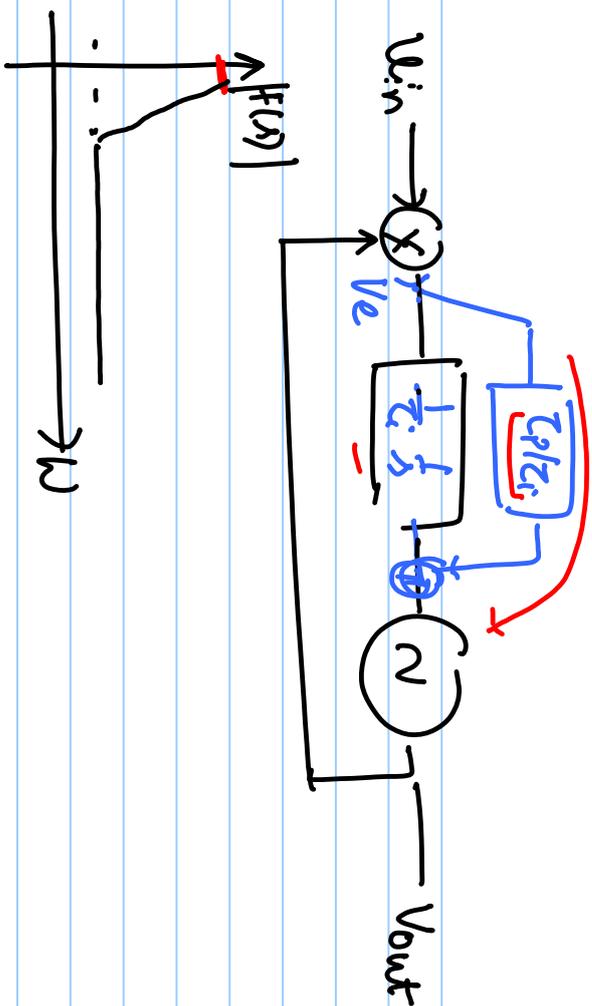
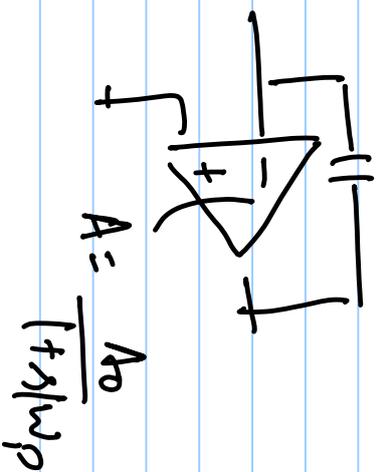
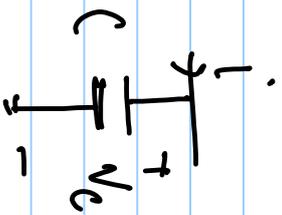
Type-II Order-2 PLL

$$F(s) = \frac{K_p}{s} + \frac{1}{s} \frac{1}{s}$$

$$\Delta \omega_L = K_{PD} F(\infty) K_{VCO}$$

$$\Delta \omega_p = \infty$$

$$\Delta k_H = \infty$$



Aeq. Summary. Type-I Type-II

$\Delta\omega_H$ Type-I $F(0) = \infty$ $F(0) < \infty$ $\frac{F(0)}{K F(0)}$ Φ_{passive} K

$\Delta\omega_L$ K $K F(\infty)$ $K F(\infty)$ $K F(\infty)$

$\Delta\omega_P$ K ∞ $K \sqrt{2 F(0) F(\infty)}$ $K \sqrt{2 F(\infty)}$

$$K = K_{PD} K_{VC0}$$