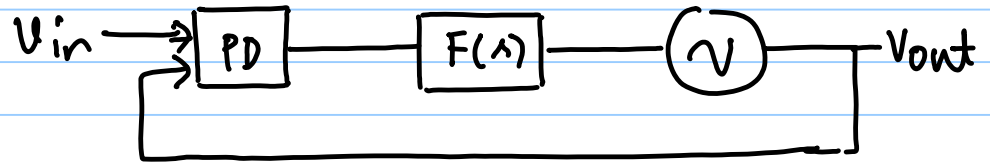
Lecture #7

Note Title 13-08-2018



	Type	Order
Case 1: $F(s) = \frac{1}{1+s/\omega_p}$	1	2
Case 2: $F(s) = \frac{\tau_p}{\tau_i} + \frac{1}{\tau_i s}$	2	2.

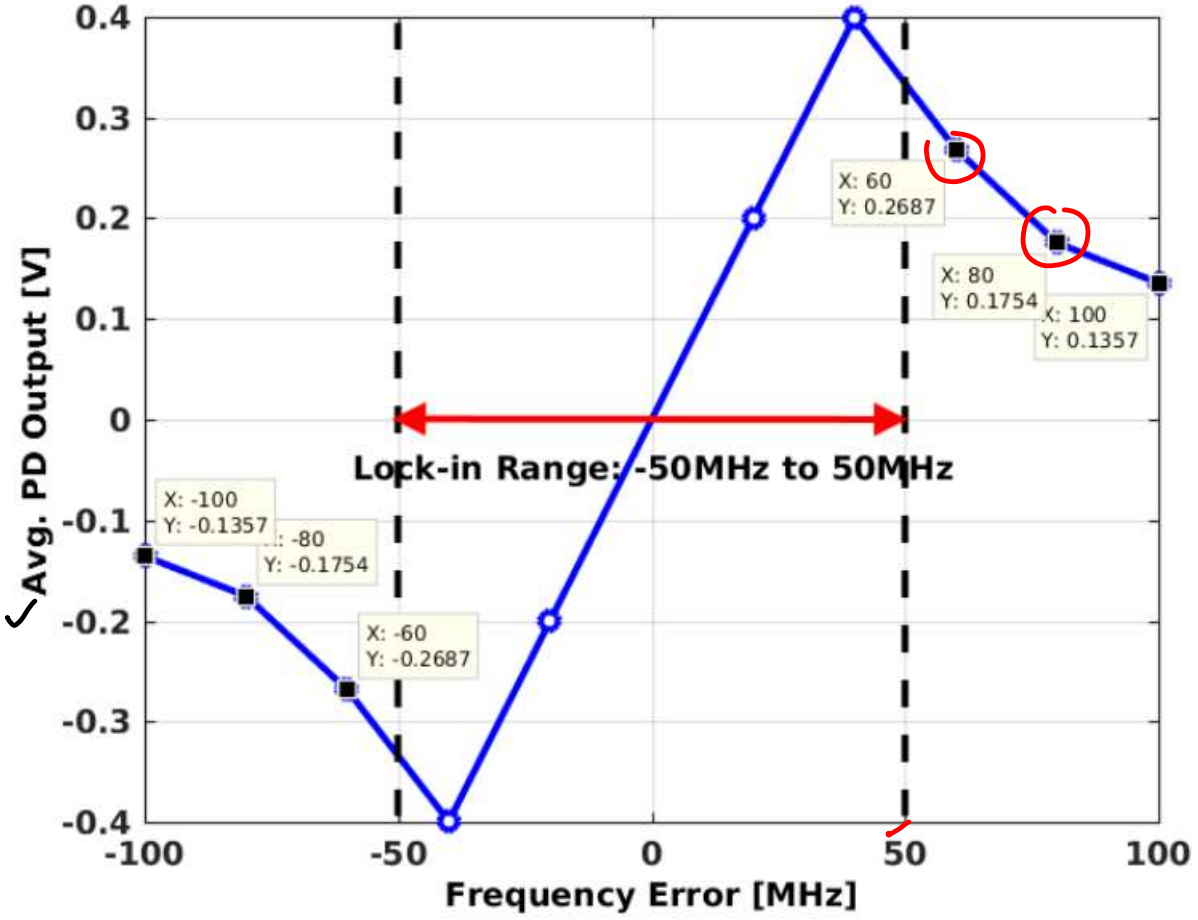
Open loop gain = $LG = K_{pd}\, F(s)\, \frac{2\pi K_{vco}}{s}$

Type — # of integrators

Order — # of poles

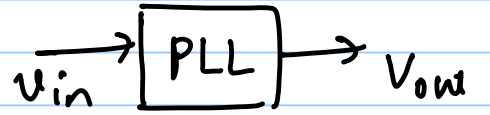
Freq. acquisition ranges

1. Lock-in range
2. Pull-in range
3. Hold-in range



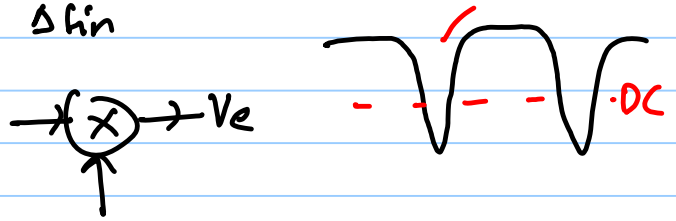
Type-I Order-2 PLL

$K_{VCO} = 100\ MHz/V$

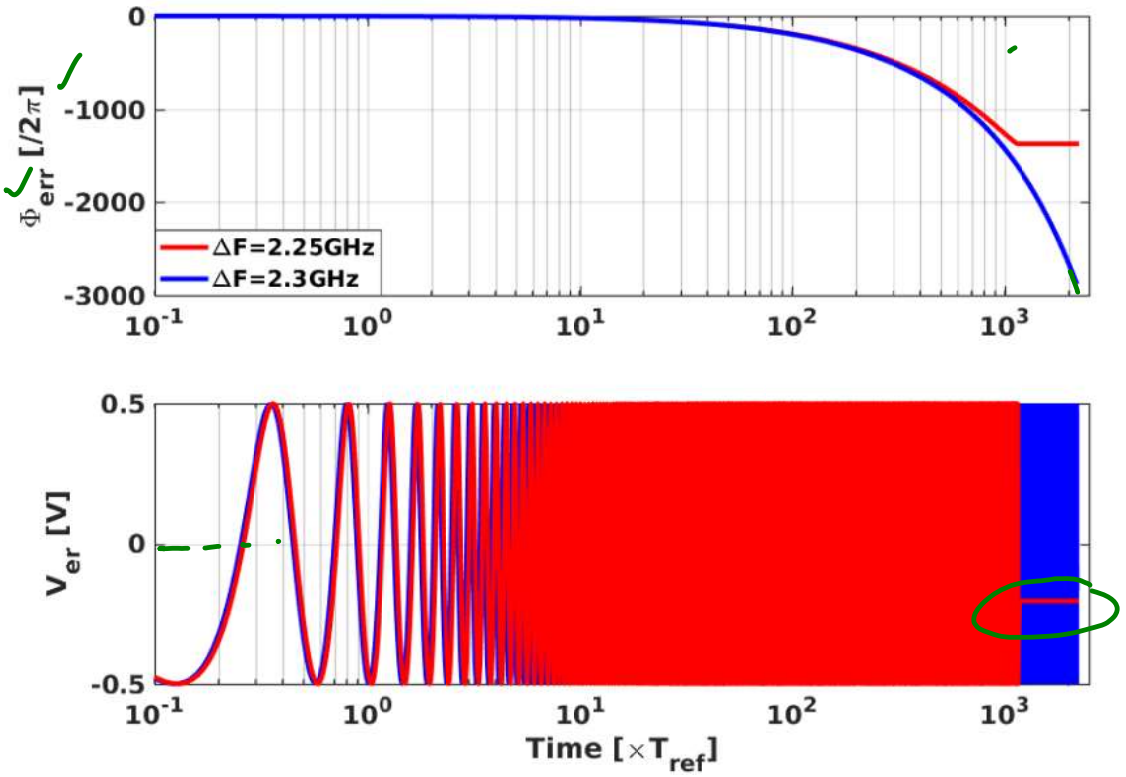


$f_{in} = 1\ GHz$, $f_{out} = 1\ GHz$

Δf_{in}



$$\frac{\Delta\omega}{2\pi K_{pd} K_{VCO}} \leq 1$$



$V_{er} = \frac{1}{2}\sin(\Phi_{er})$

Type-II Order-2

$\Delta f_1 = 2.25\ GHz$

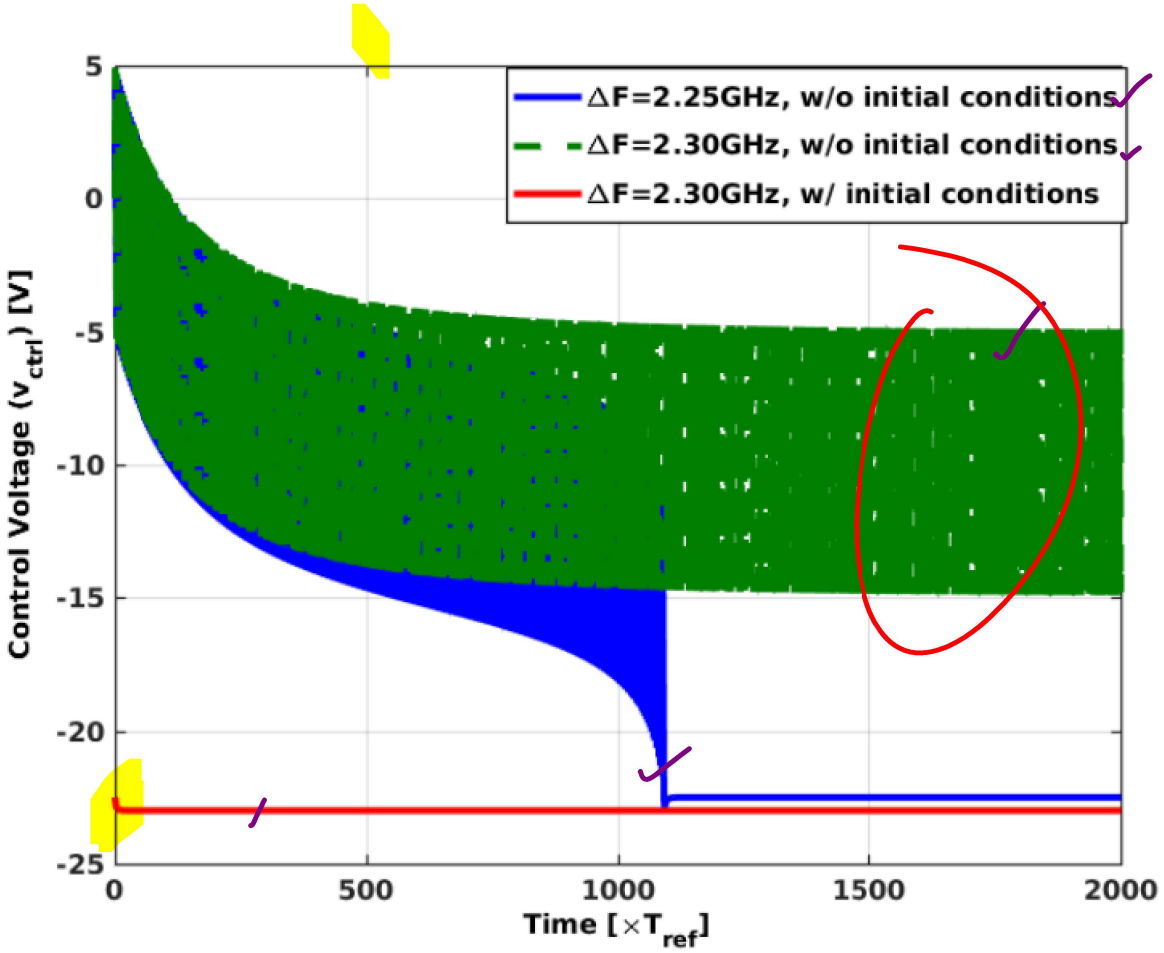
$\Delta f_2 = 2.3\ GHz$

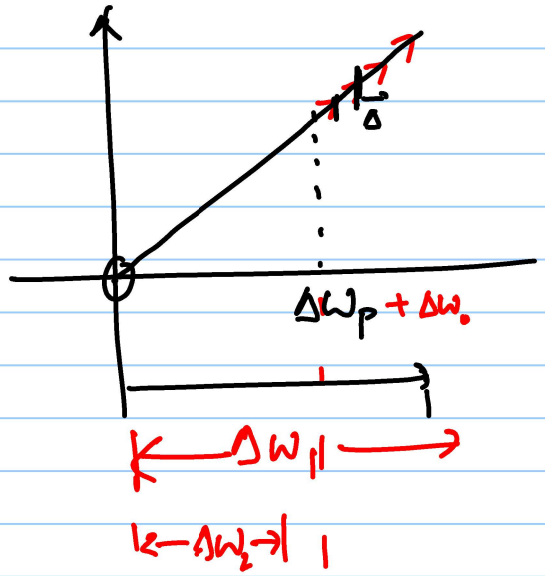
$$\Delta W \leq K\sqrt{\frac{2K_{DC}}{K} - 1}$$

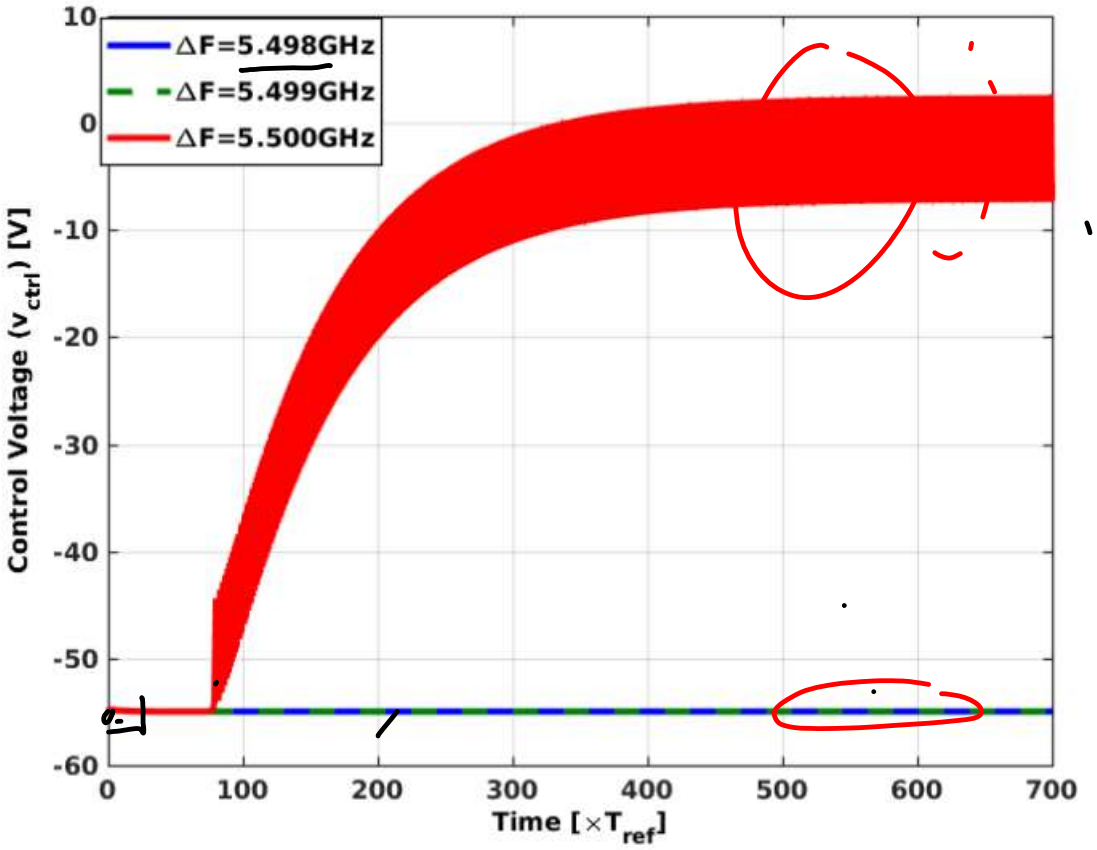
$f_{in} = 1\ GHz$, $f_{out} = f_{rec} = 1\ GHz$

$\Delta f = 2.25\ GHz$

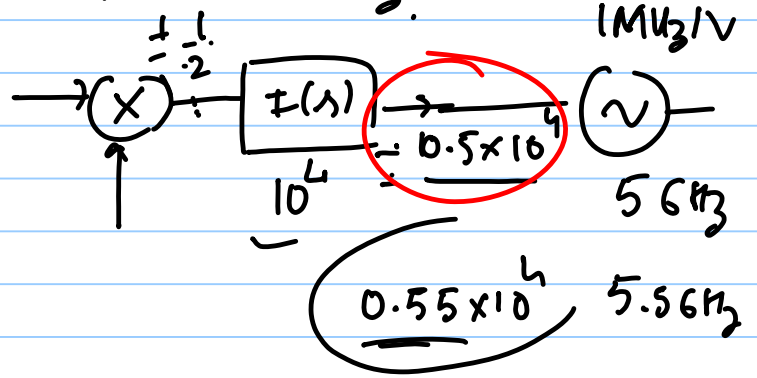
$\Phi_{er}(f) = (W_{in} - W_{rec}) \cdot t$


ΔF=2.25GHz, w/o initial conditions
ΔF=2.30GHz, w/o initial conditions
ΔF=2.30GHz, w/ initial conditions
Control Voltage (v_{ctrl}) [V]
Time [×T_{ref}]
5
0
-5
-10
-15
-20
-25
0
500
1000
1500
2000

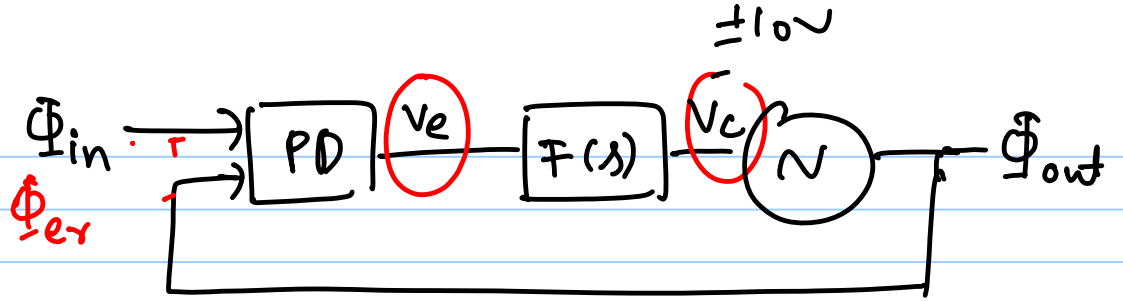

$\Delta\omega_p + \Delta\omega_0$
$\Delta\omega_{II}$
$\Delta\omega_2$



$\Delta F_H < 5.5\,GHz$.



$$LG = K_{pd}\, F(s)\, \frac{2\pi K_{VCO}}{s}$$



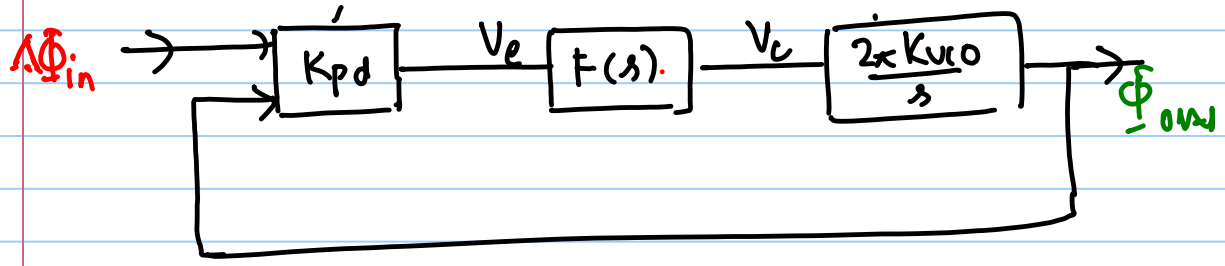
$$\lim_{t\to\infty} \Phi_e(t) = \lim_{s\to 0} s\,\Phi_e(s) = 0.6$$

$$\lim_{t\to\infty} V_e(t) =$$

$$\lim_{t\to\infty} V_c(t) = 11V$$

$$\frac{\Phi_{out}(s)}{\Phi_{in}(s)} = \frac{LG}{1+LG}$$

$$\frac{\Phi_{out}(s)}{\omega_{in}(s)} = \frac{1}{s}\,\frac{LG}{1+LG}$$

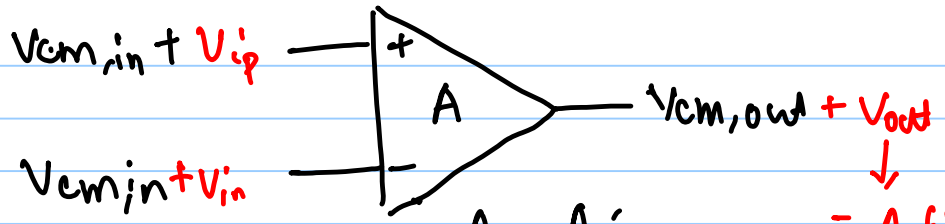


$$\Phi_e = \pi/3$$

$$V_e = \frac{\sqrt{3}}{2} \times \frac{1}{2}$$

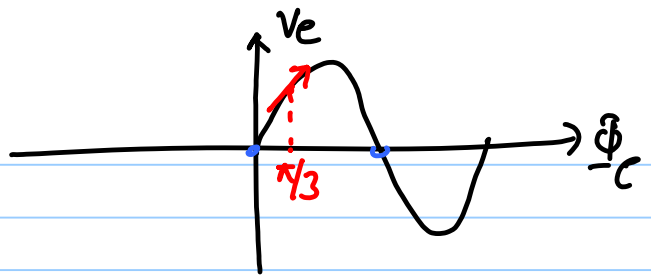
$$F(s)\Big|_{\quad} =$$

$$V_{out} = \sin\left(2\pi \quad f_{free}\, t + 2\pi K_{VCO} \int V_c\, dt\right)$$



$$A = \frac{A_0}{1 + s/\omega_p}$$

$$= A\,(V_{ip} - V_{in})$$



✓

$$\Delta V_e = K_{pd} \times \Delta\Phi_{in}$$

$$\Delta V_c = F(s) \times \Delta V_e$$

$$\Delta\omega_{out} = K_{vco} \cdot \Delta V_c$$

$$\Delta\Phi_{out} = \frac{2\pi\,\Delta\omega_{out}}{s}$$

$$V_e = \cancel{V_{est}} + K_{pd} \cdot \Delta\Phi_{in}$$