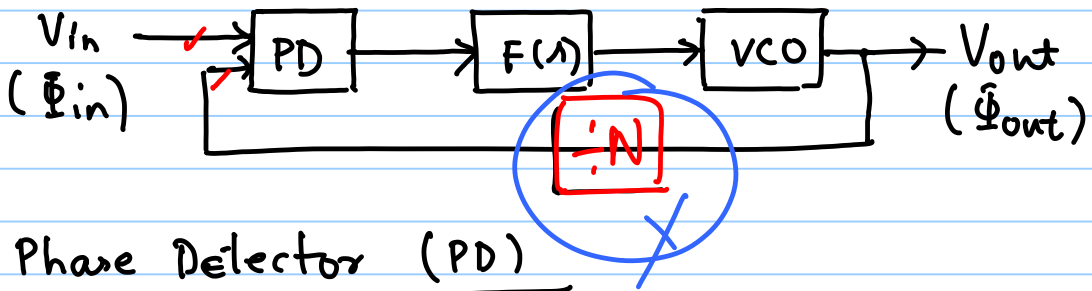
Note Title 14-08-2018

Lecture # 8



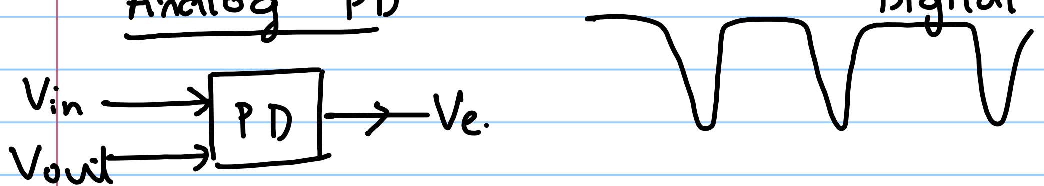
$f_{out} = N f_{in}$

$LG(s) = K_{pd} F(s) \frac{2\pi K_{vco}}{s} \times \frac{1}{N}$

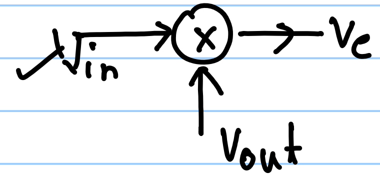
Phase Detector (PD)

Analog PD

Digital PD



1.)

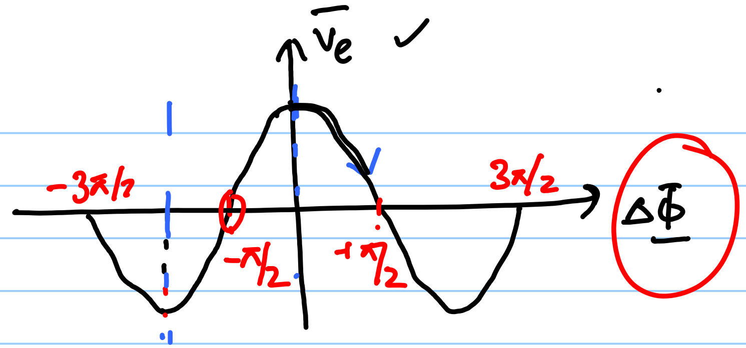


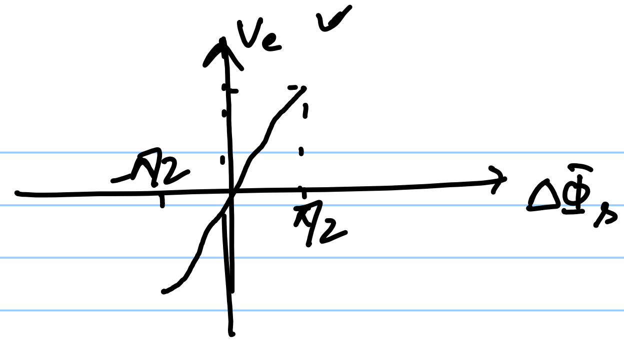
$V_{in} = A_{in} \sin(\omega_0 t)$

$V_{out} = A_{out} \sin(\omega_0 t - \Delta\phi) = A_{out} \sin(\omega_0 t - \pi/2)$

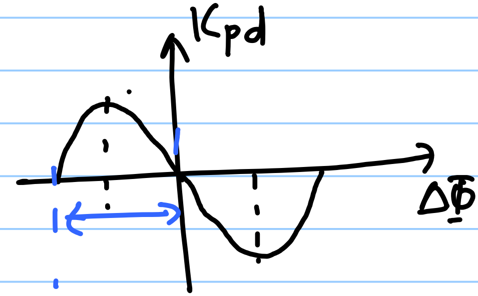
$V_e = \frac{1}{2}\left[\cos(\Delta\Phi) - \cos(2\omega_0 t - \Delta\phi)\right] = A_{out} \cos(\omega_0 t)$

$\overline{V_e} = \frac{1}{2}\cos(\Delta\Phi)$

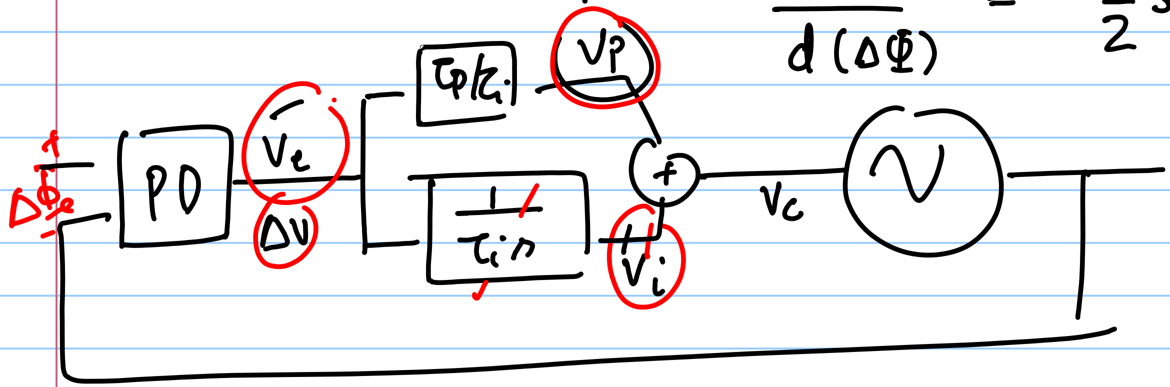




Montonous range: $[-\pi, 0]$ or $[-\pi/2, \pi/2]$ $\Delta\Phi_s = \Delta\Phi + \pi/2$



Gain of PD, $K_{pd} = \dfrac{d(\bar{V_e})}{d(\Delta\Phi)} = -\dfrac{1}{2}\sin(\Delta\Phi)$



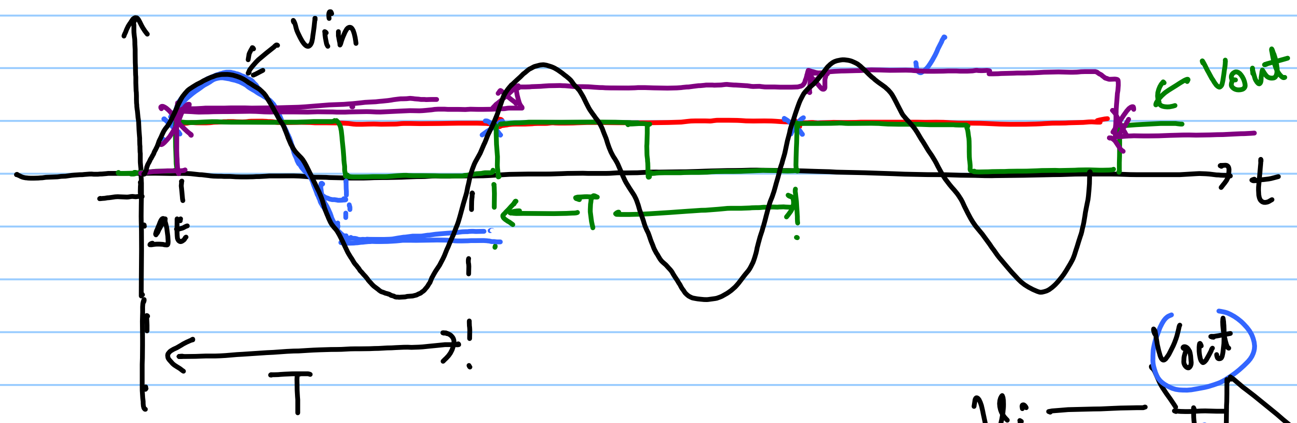
$\omega_{out} = \omega_{in}$ | $V_c = 0$

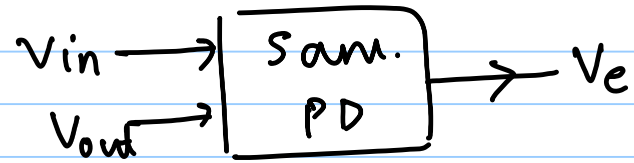
$V_c = V_p + V_i$ $V_i = \Delta V_i$

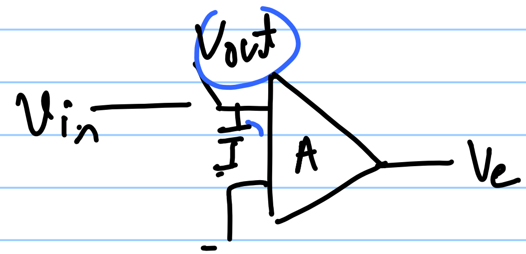
$0 = V_p + \Delta V_i$

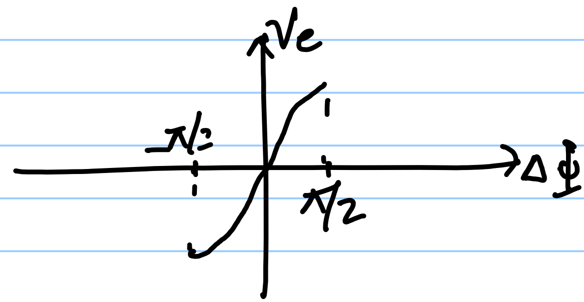
$V_p = -\Delta V_i$

2. Sampler PD









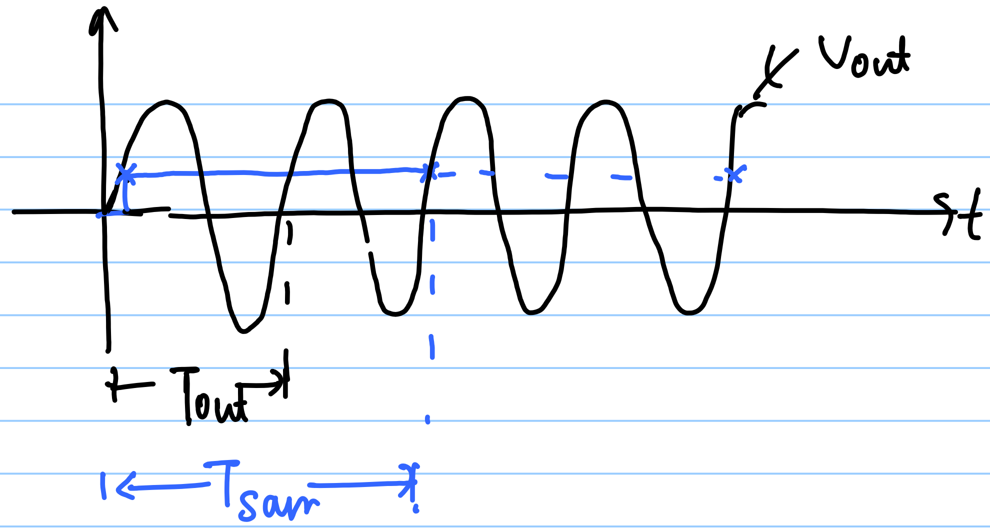
$V_{in} = A_{in} \sin(\omega_{in} \cdot t)$

$V_e = A_{in} \sin(\omega_{in}(nT + \Delta t))$

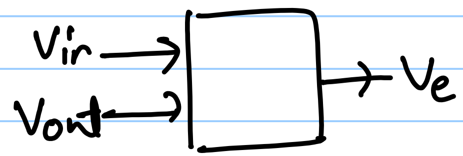
$= A_{in} \sin(n\omega_{in} T + \omega_{in} \cdot \Delta t)$

$V_e = A_{in} \sin\left(\frac{2\pi \cdot \Delta t}{T}\right) = A_{in} \sin(\Delta\Phi)$

Gain, $K_{pd} = \frac{d(V_e)}{d(\Delta\Phi)} = A_{in} \cos(\Delta\Phi)$



$= 2T_{out}$ $\Rightarrow$ $f_{out} = 2 f_{sam}$



$$V_e = A_{out} \sin(\omega_{out}(nT_{sam} + \Delta t))$$

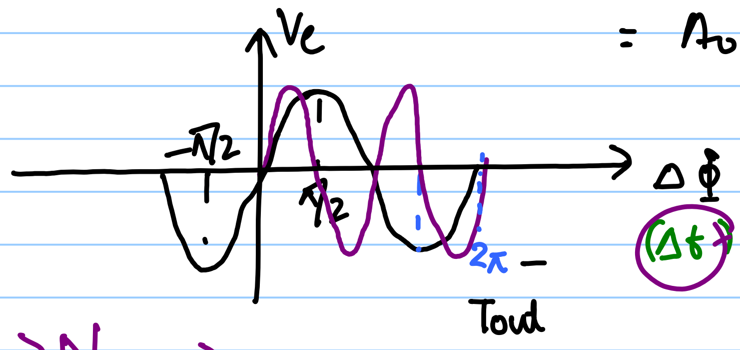
$$= A_{out} \sin\left(n\, 2\pi \cdot \frac{T_{sam}}{T_{out}} + \omega_{out} \cdot \Delta t\right)$$

$$= A_{out} \sin\left(2n\pi\,(2) + 2\pi \cdot \frac{\Delta t}{T_{out}}\right)$$

$$= A_{out} \sin\left(2\pi \cdot \frac{\Delta t}{T_{out}}\right)$$

$$= A_{out} \sin(\Delta \Phi)$$

$$V_e = A_{out} \sin(\Delta \Phi)$$

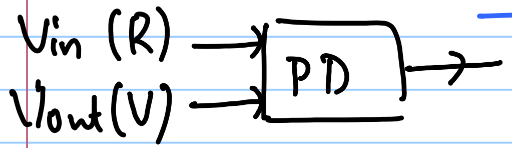


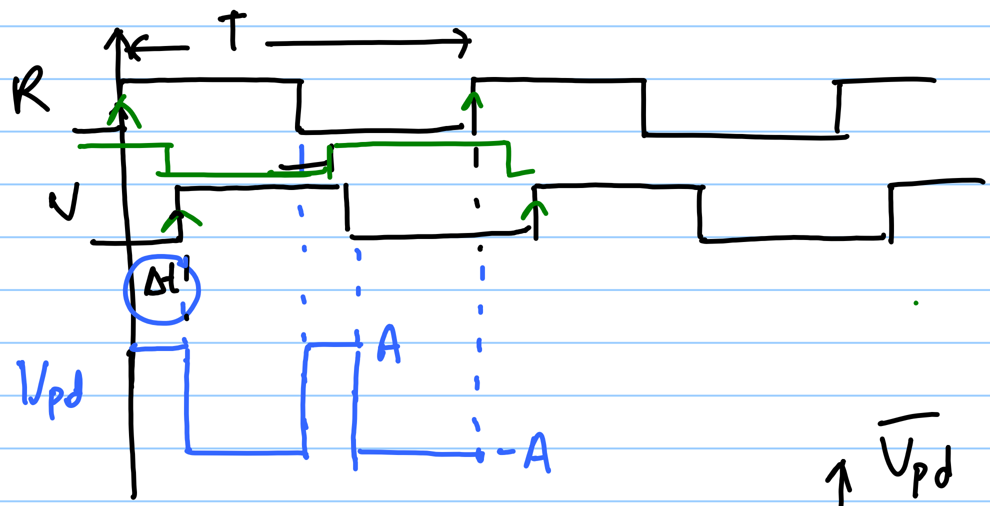
$f_{out_1} = N_1 f_{ref}$

$f_{out_2} = N_2 f_{ref}$ if $N_2 > N_1 \Rightarrow$

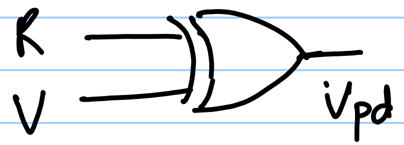
Digital (PD)

EXOR PD





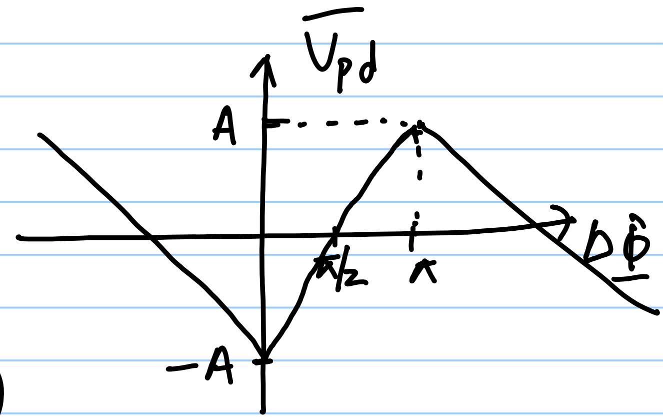
$$\Delta\Phi = 2\pi \cdot \frac{\Delta t}{T}$$



$$\overline{V_{pd}} = \frac{A \cdot \Delta t - A\left(\frac{T}{2} - \Delta t\right)}{T/2} = \frac{A}{T/2}\left(-\frac{T}{2} + 2\Delta t\right)$$

$$= A\left(4 \cdot \frac{\Delta t}{T} - 1\right) = A\left(\frac{2}{\pi} \cdot \Delta\Phi - 1\right)$$

$$\propto \Delta\Phi$$



Linear Range : $[0, \pi]$

Gain $k_{pd} = \frac{2A}{\pi}$