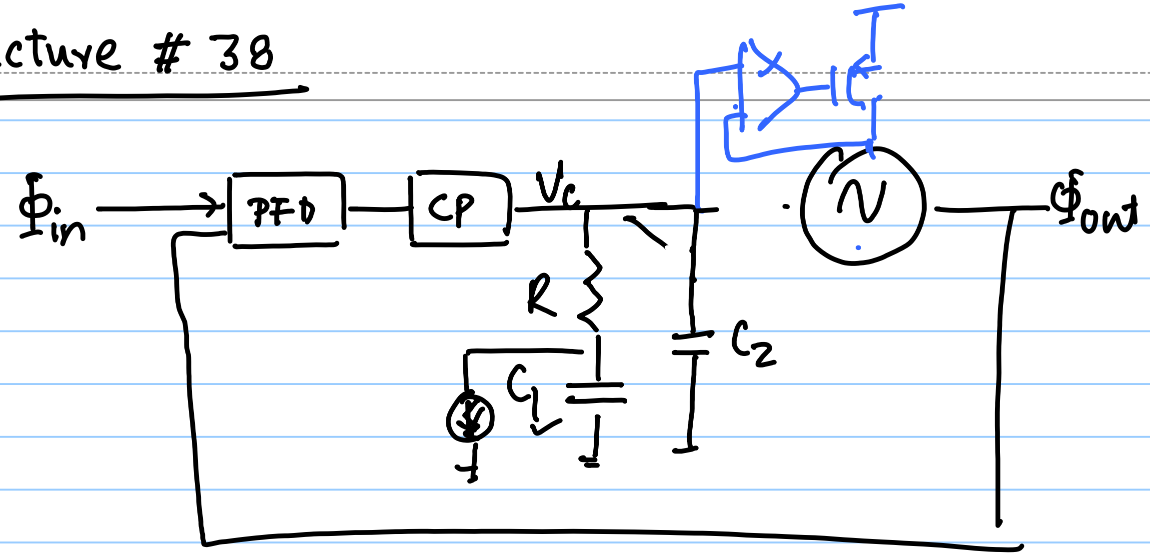
Note Title 22-10-2018

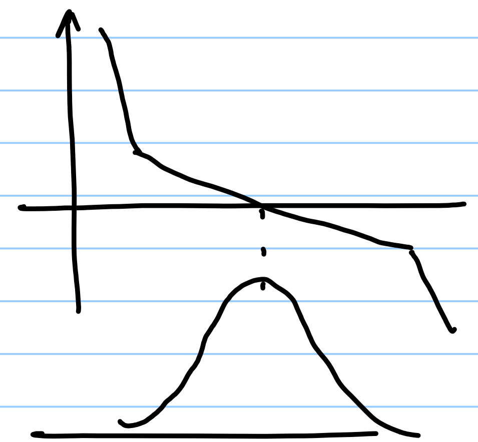
Lecture # 38



$$LG(s) = \frac{1}{2\pi} I_{cp} \left((R + 1/sC_1) \parallel 1/sC_2 \right) \frac{2\pi K_{vco}}{s}$$

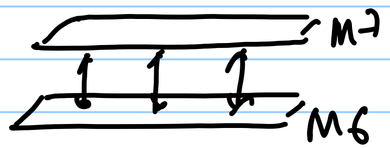
$$= \frac{I_{cp} R K_{vco}}{s^2 (C_2 + C_1)} \cdot \frac{(1 + sRC_1)}{\left(1 + sR\frac{C_1 C_2}{C_1 + C_2}\right)}$$

- Process variation decides LG, BW
- Area
- leakage current.
-



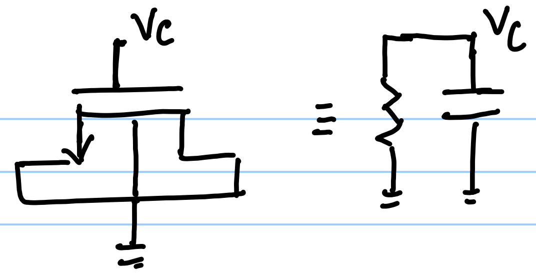
R, C : ±20%

Capacitor: Mim-cap / MOS cap

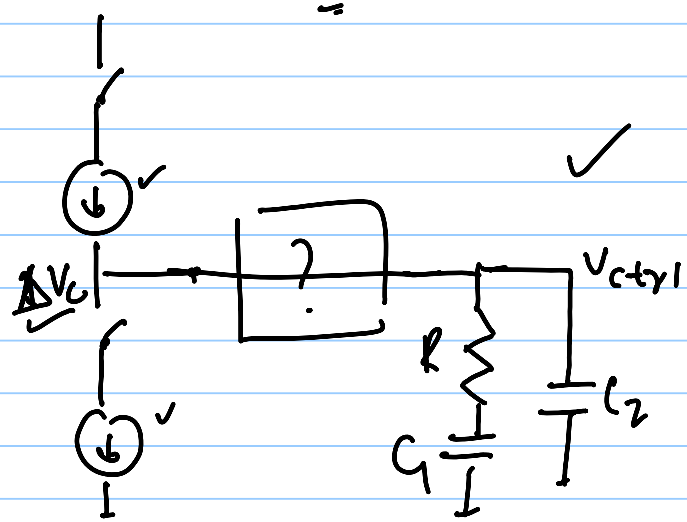


2 fF/μm², VC₁ is quite low

$\frac{dC}{dV}$

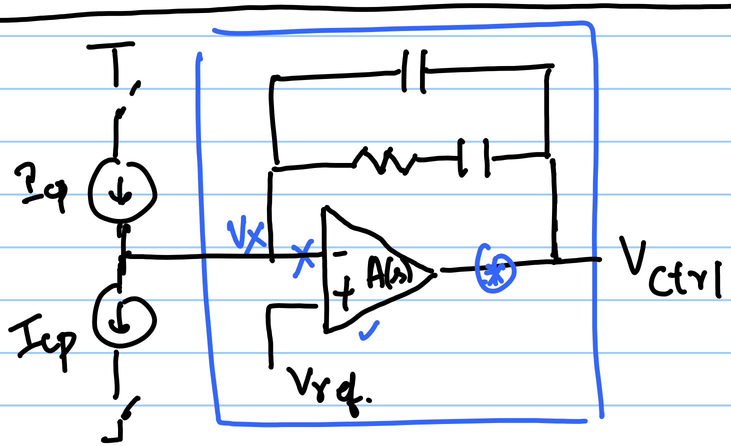


$4\,fF/\mu m^2$ — $12\,fF/\mu m^2$ ✓

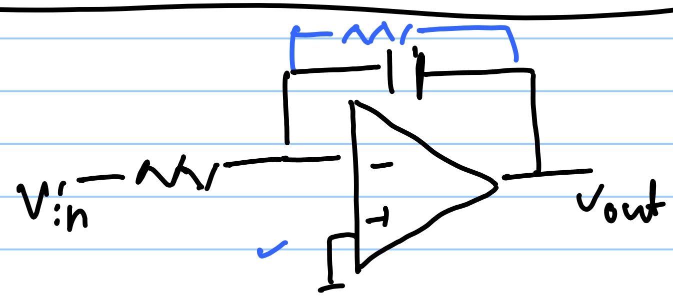


$$\frac{C_1}{C_2} = f(\Phi_m)$$

$$\frac{V_{ctrl}}{I_{cp}} = \left(R + \frac{1}{sC_1}\right) \parallel \frac{1}{sC_2} = F(s)$$

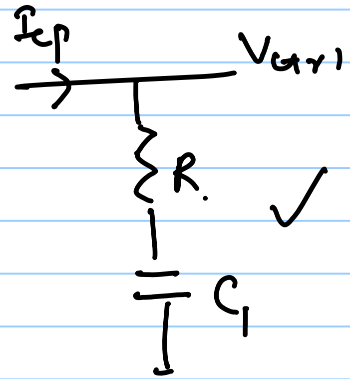


$$A(s) = \frac{A_0}{(1 + s/\omega_p)}$$



$$\frac{V_{ctrl}}{I_{cp}} = -F(s) \quad f(A(s))$$

$$(V_{ref} - V_x)\,A(s) = V_{ctrl}$$



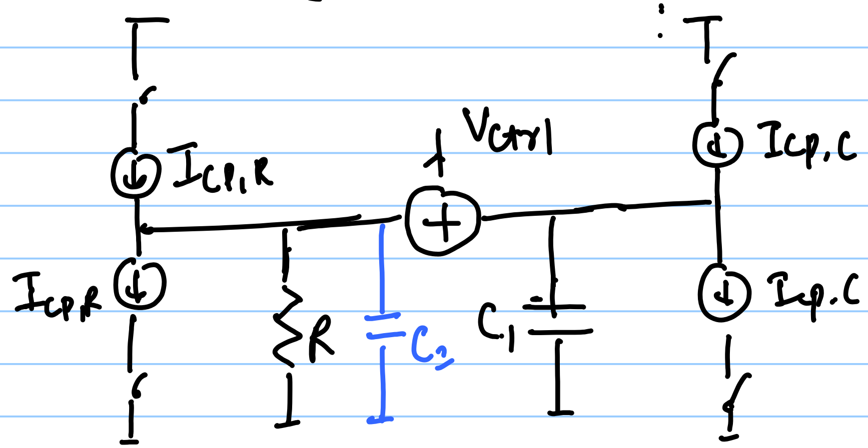
$$\frac{V_{ctrl}}{I_{cp}} = R + \frac{1}{sC_1}$$

$$\omega_z = \frac{1}{RC_1'} = \frac{1}{R\cdot(KC_1)}$$

$$V_{ctrl} = I_{cp}\cdot R + I_{cp}\cdot\frac{1}{sC_1}$$

$$\omega_z = \frac{1}{RC_1} = \frac{1}{KR \times \frac{C_1}{K}}$$

=



$$V_{ctrl}(s) = I_{cp,R}\cdot R + I_{cp,C} \times \frac{1}{sC_1}$$

$$= I_{cp,C}\left(\frac{I_{cp,R}}{I_{cp,C}}\cdot R + \frac{1}{sC_1}\right)$$

$$= I_{cp}\left(K\cdot R + 1/sC_1\right)$$

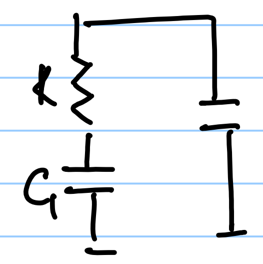
$$\omega_z = \frac{1}{K \cdot R C_1} \checkmark$$

$$V_{ctrl}(s) = K \cdot I_{cp} \left(R \parallel 1/sC_2 \right) + I_{cp} \cdot \frac{1}{sC_1}$$

$$= I_{cp} \left[\frac{K \cdot R}{1 + sC_2 R} + \frac{1}{sC_1} \right]$$

$$= I_{cp} \left[\frac{1 + sR\,(C_2 + KC_1)}{sC_1\,(1 + sC_2 R)} \right]$$

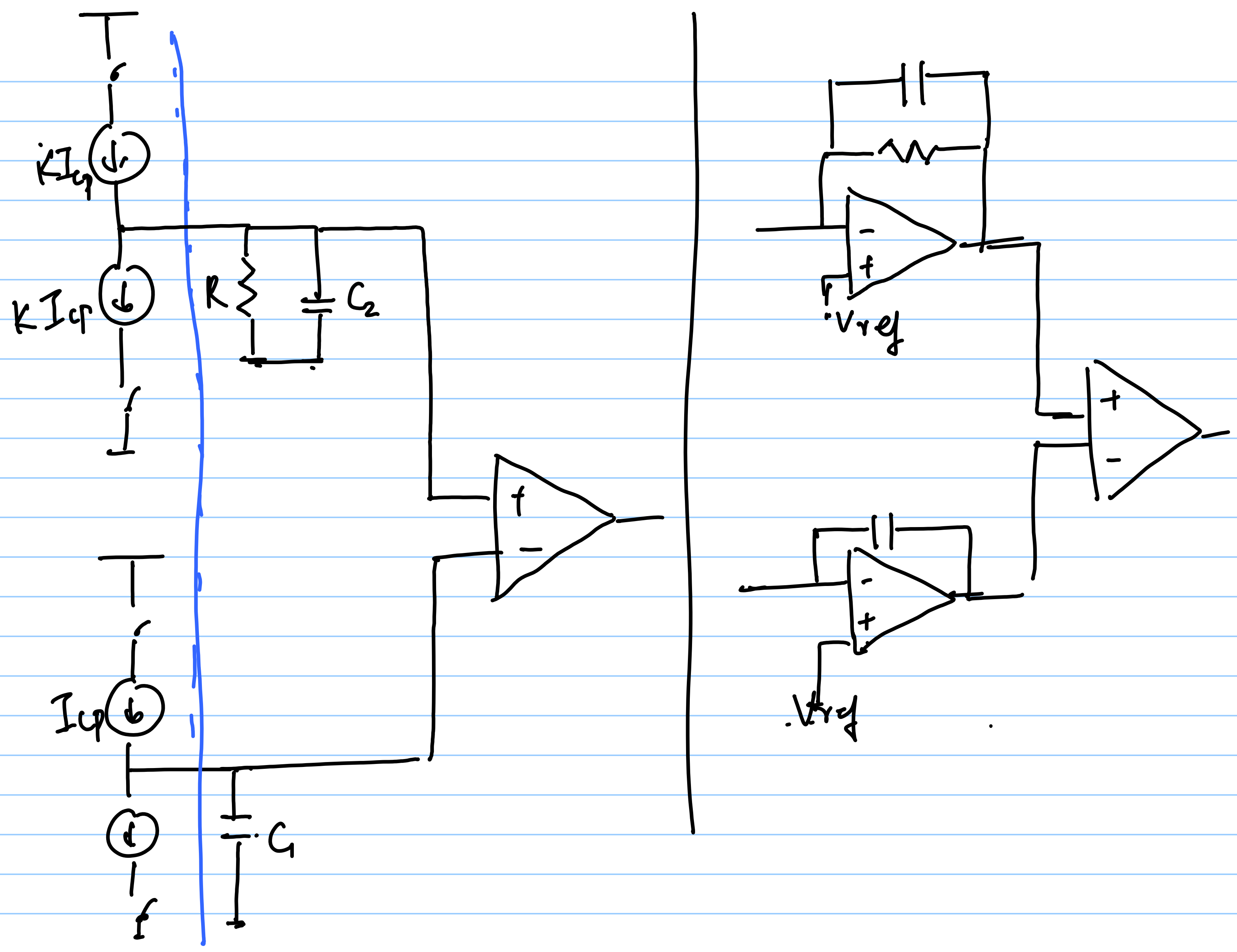
$$\Rightarrow \omega_z = \frac{1}{R(C_2 + KC_1)}, \quad \omega_{p1} = 0, \quad \omega_{p2} = \frac{1}{RC_2}.$$

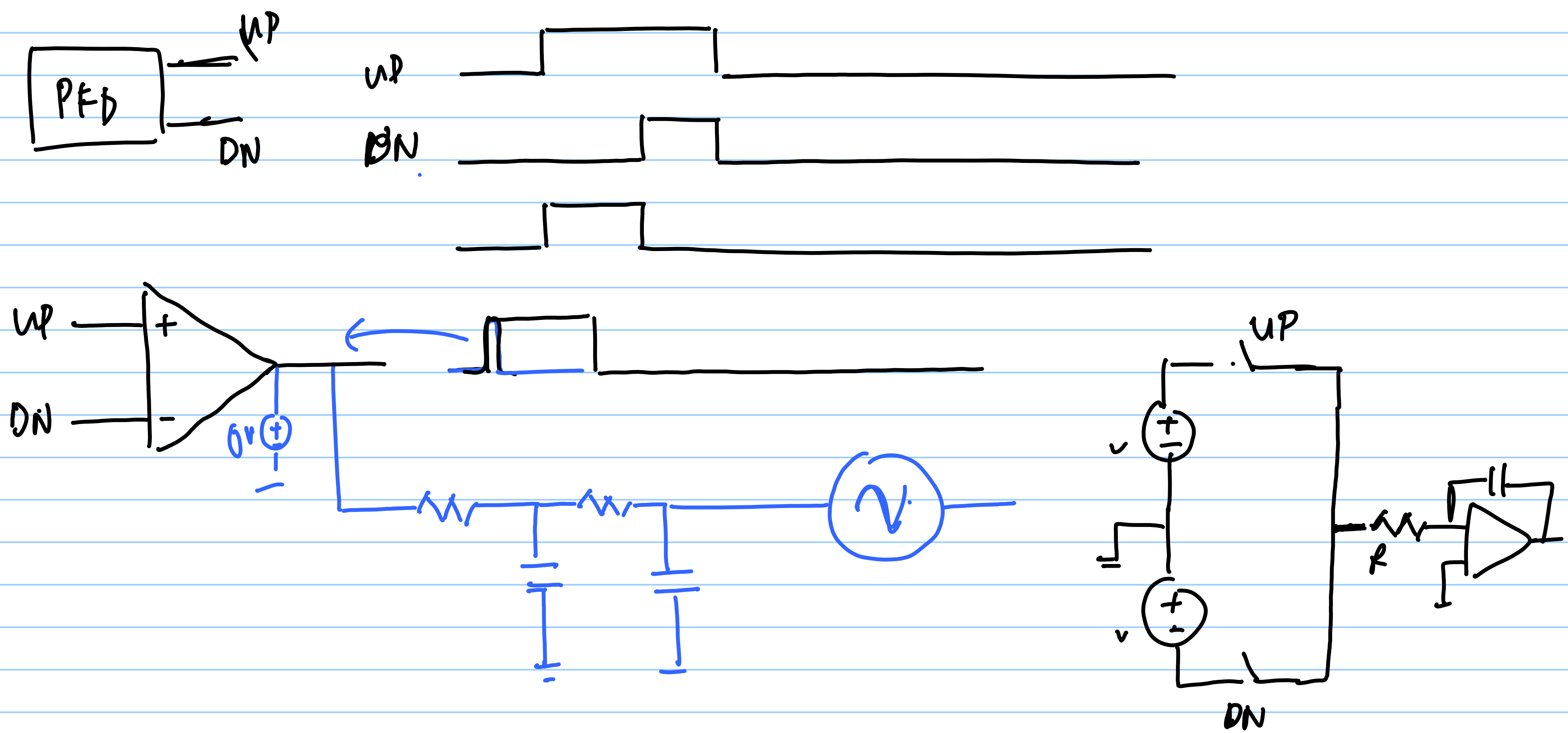


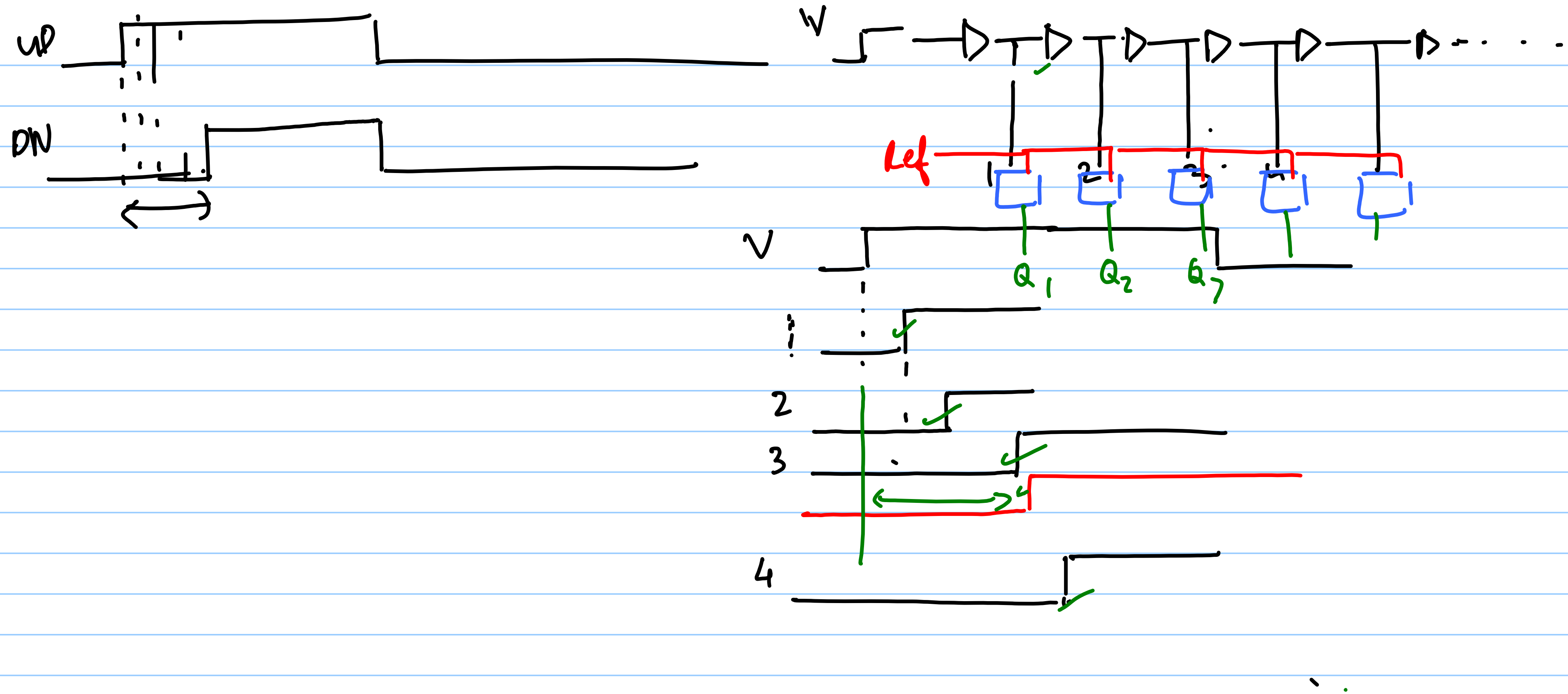
$$\omega_z = \frac{1}{KC_1}$$

$$\omega_{p2} = \frac{1}{R \frac{C_1 C_2}{C_1 + C_2}}$$

$$\omega_{p1} = 0$$


KIcp
KIcp
R
C2
Icp
C1
+
-
Vref
Vref


PFD
UP
DN
UP
DN
UP
DN
0V
v
v
UP
DN
R



UP
DN
V
Ref
Q1
Q2
Q3
V
1
2
3
4