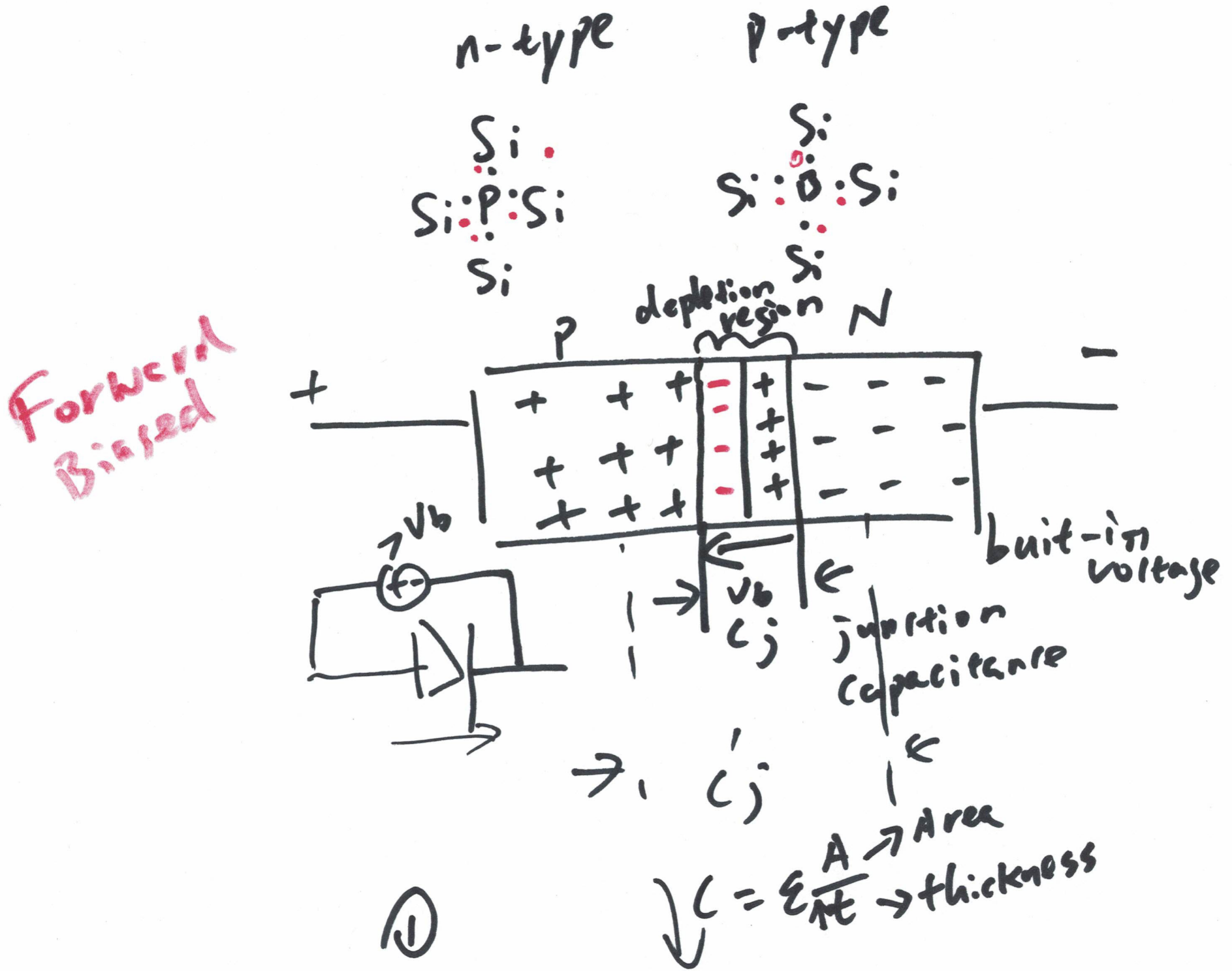
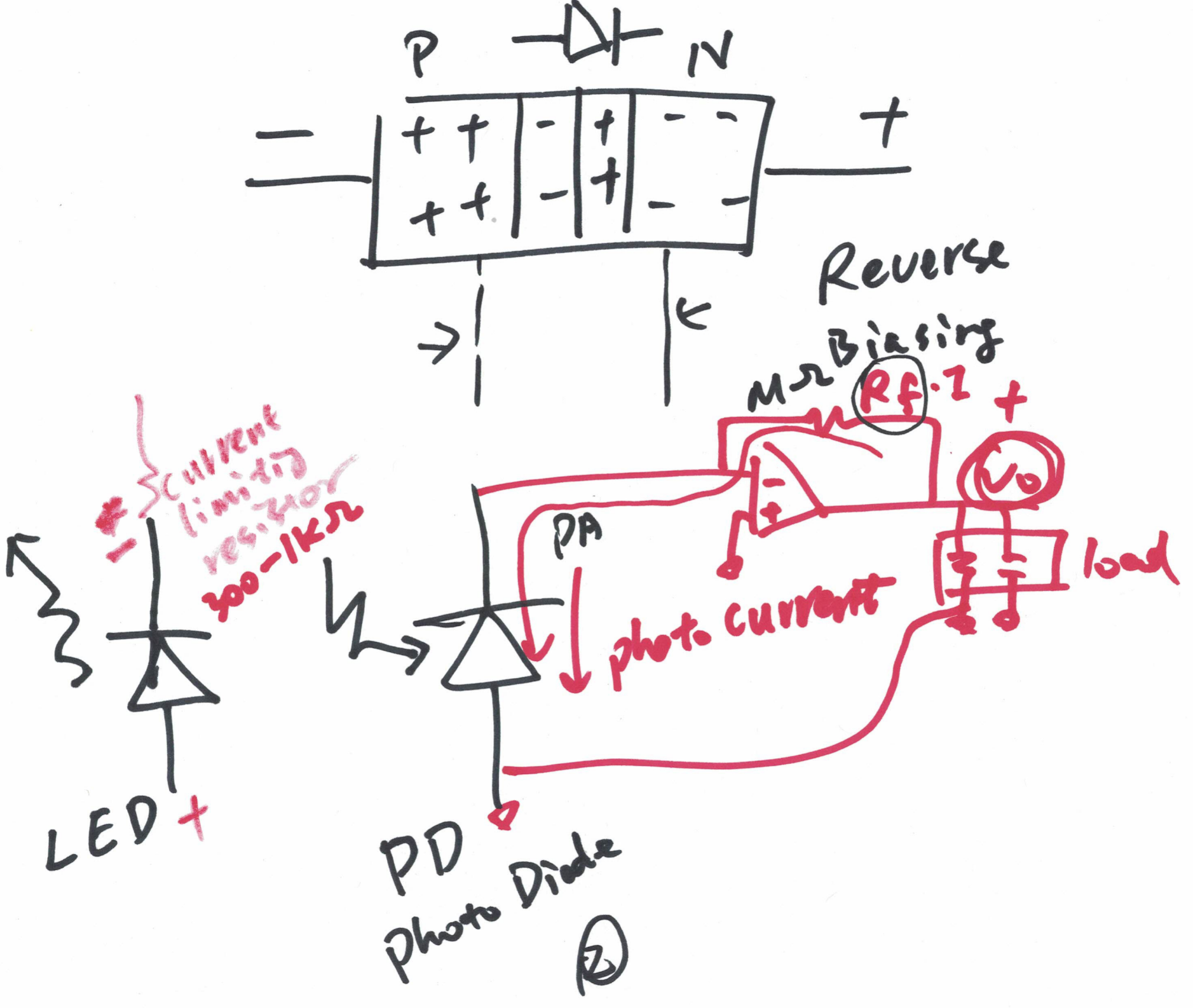
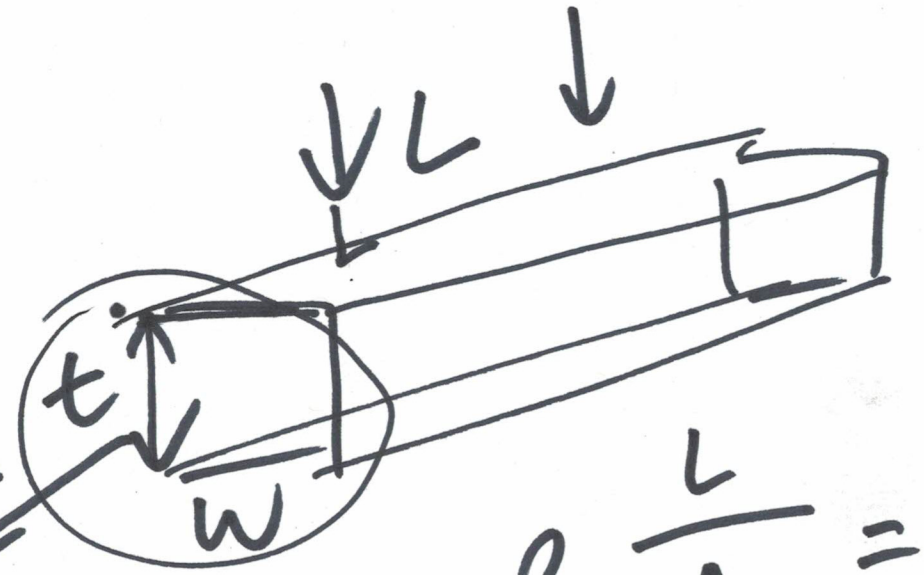

n-type
p-type
Si
P
B
Forward Biased
depletion region
P
N
+
−
Vb
Built-in voltage
Vb
Cj
junction capacitance
Cj
A → Area
t → thickness
C = ε A/t
①

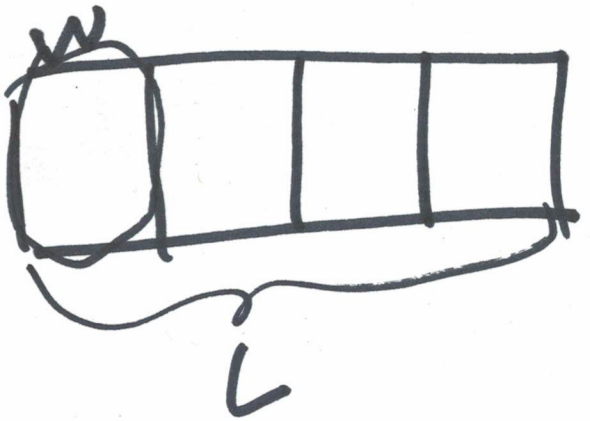

P
N
Reverse Biasing
current limiting resistor 300-1KΩ
PA
photo current
load
LED
PD
Photo Diode



not changing

$$R = \rho \cdot \frac{L}{A} = \rho \frac{L}{t \cdot w}$$

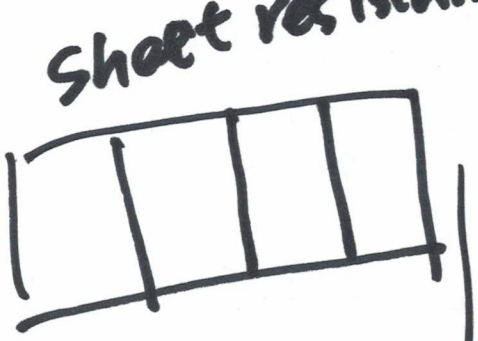
$$= \frac{\rho}{t} \cdot \frac{L}{w}$$

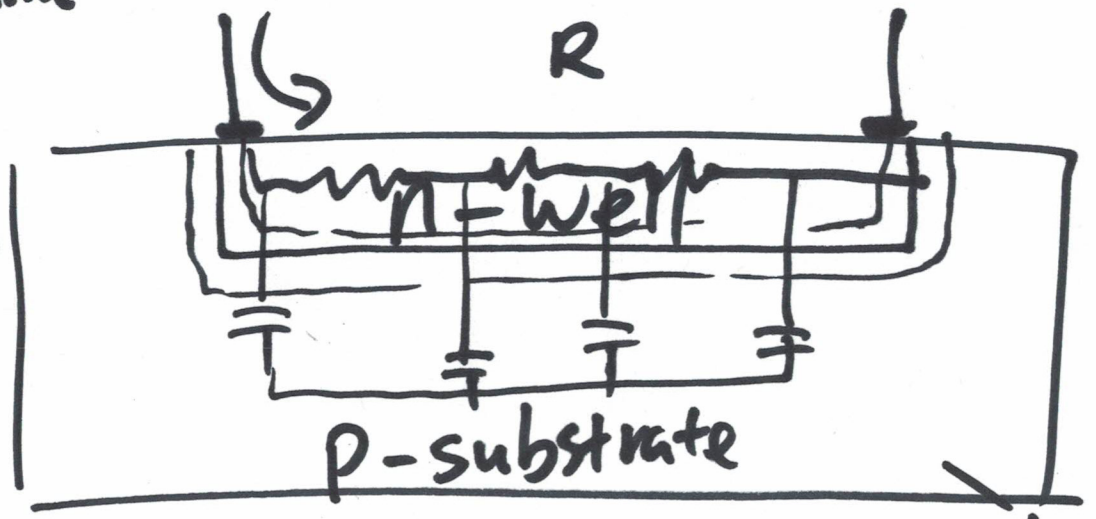


$\frac{\rho}{t}$ → sheet resistance

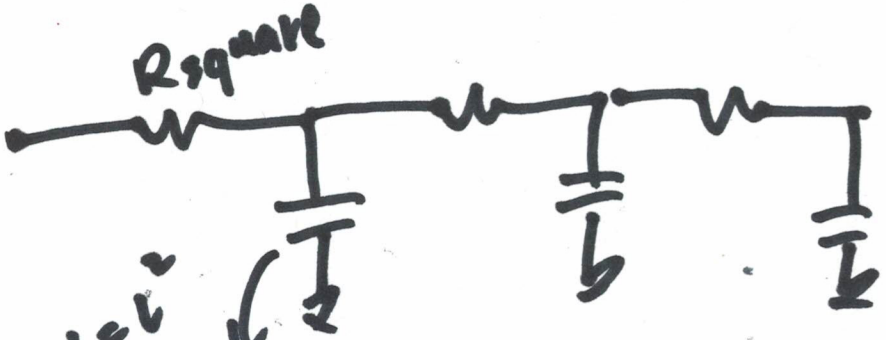
$\frac{L}{w}$ = How many squares.

Sheet resistance



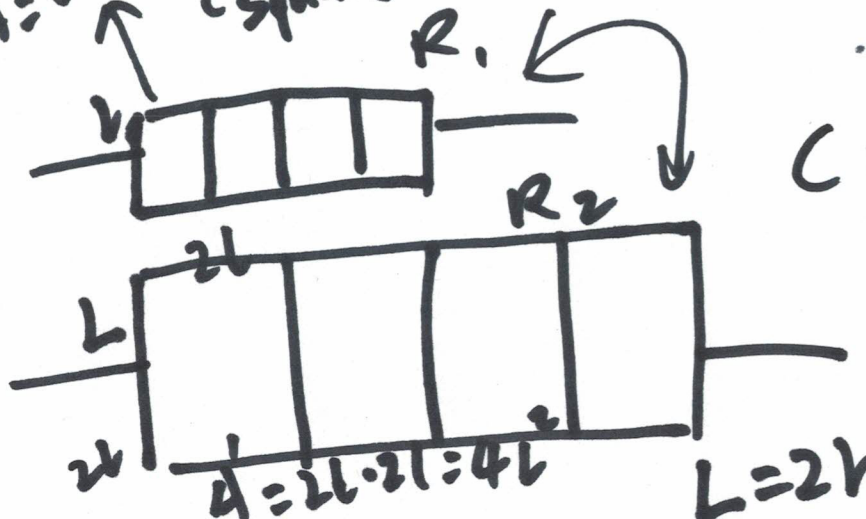


lightly doped silicon



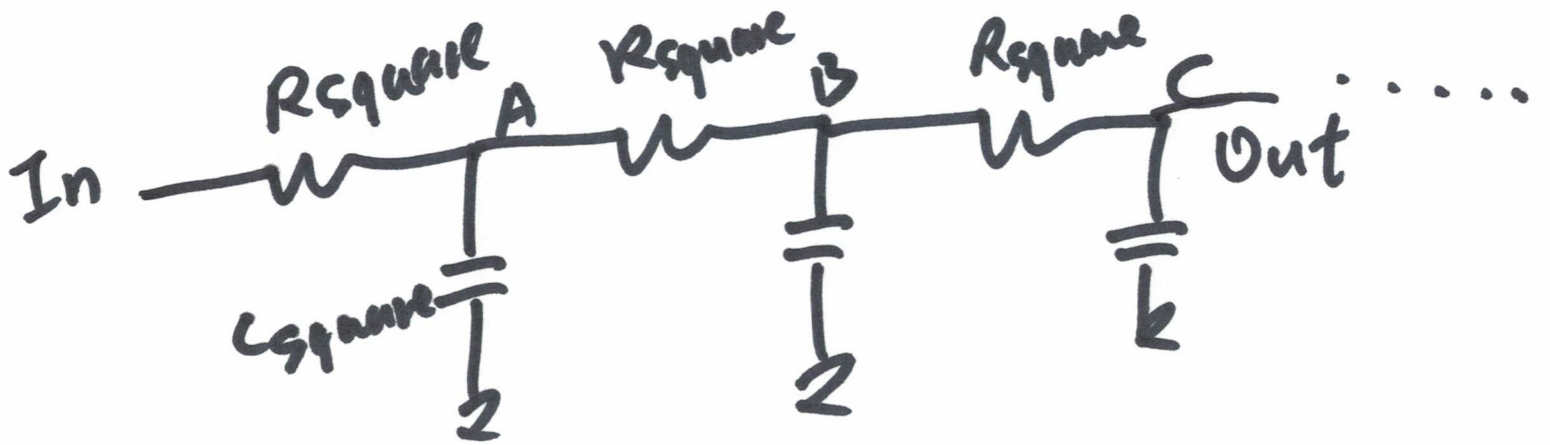
$R = \rho \frac{l}{w \cdot t}$

$A = l \cdot l = l^2$



$C = \varepsilon \frac{A}{t}$ (4)

CS process = 500 nm minimum transistor length



$$t_{dA} = 0.7 R_{square} \cdot C_{square}$$

$$t_{dB} = 0.7 \cdot 2 R_{square} \cdot C_{square}$$

$$t_{dC} = 0.7 \cdot 3 R_{square} \cdot C_{square}$$

$$t_d = t_{dA} + t_{dB} + t_{dC}$$

$$= 0.7 R_{square} \cdot C_{square} \underbrace{(1+2+3+\cdots n)}_{\frac{(1+n)n}{2}}$$

$$= 0.7 R_{square} \cdot C_{square} \cdot \frac{n^2}{2}$$

$$\approx 0.7 R_{square} \cdot C_{square} \cdot \frac{n^2}{2}$$

$$= \boxed{0.35 n^2 \cdot R_{square} \cdot C_{square}}$$

Example:

$W = 10 \quad L = 500$

$R_\square = 250K$

10x10 N-well's capacitance is 5fF.

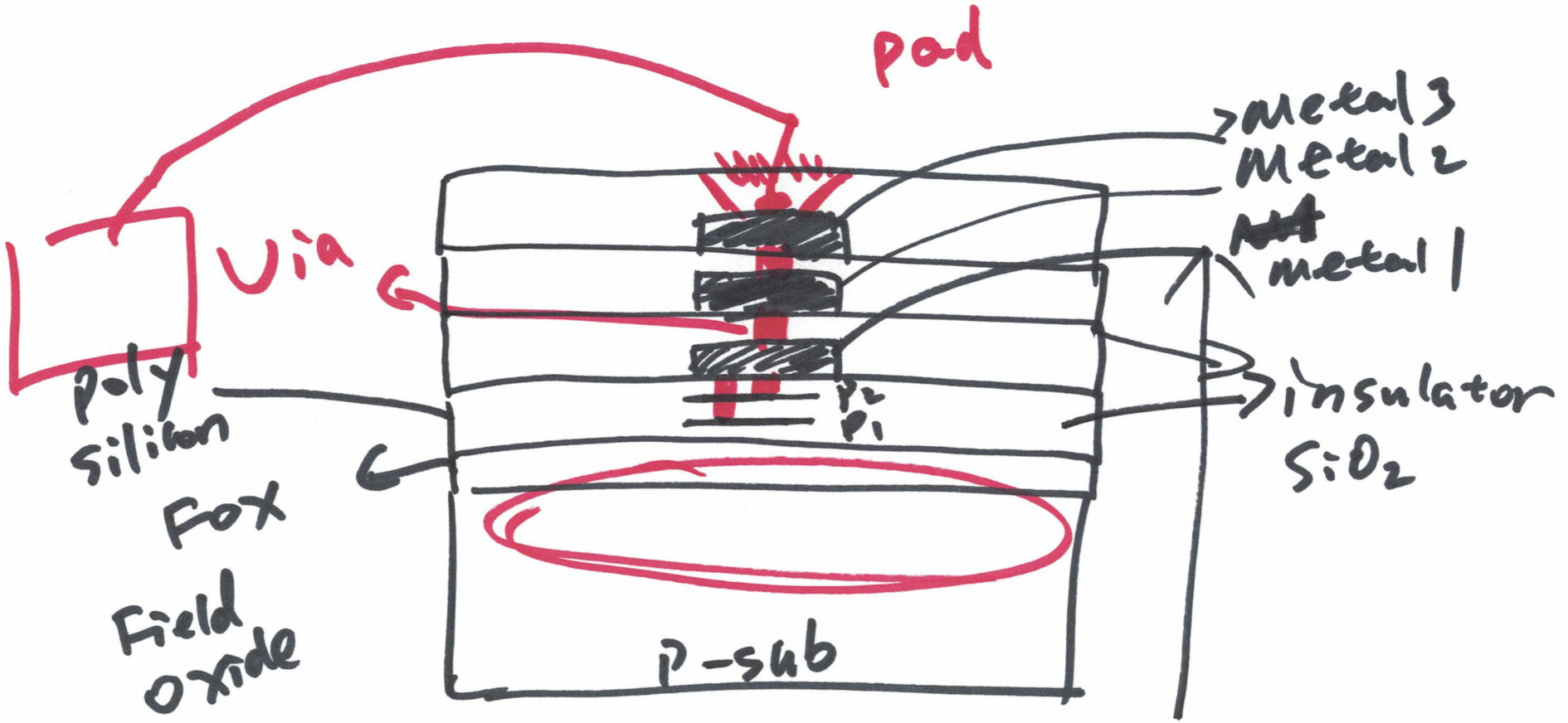
td?

$\frac{L}{W} = \frac{500}{10} = 50$ squares

$R_0 = \frac{R}{50} = \frac{250K}{50} = 5K\Omega$,

$td = 0.35 \cdot 50^2 \cdot 5K \cdot 5 \cdot 10^{-15}$

$= 21.875$ ns.



bottom-up process