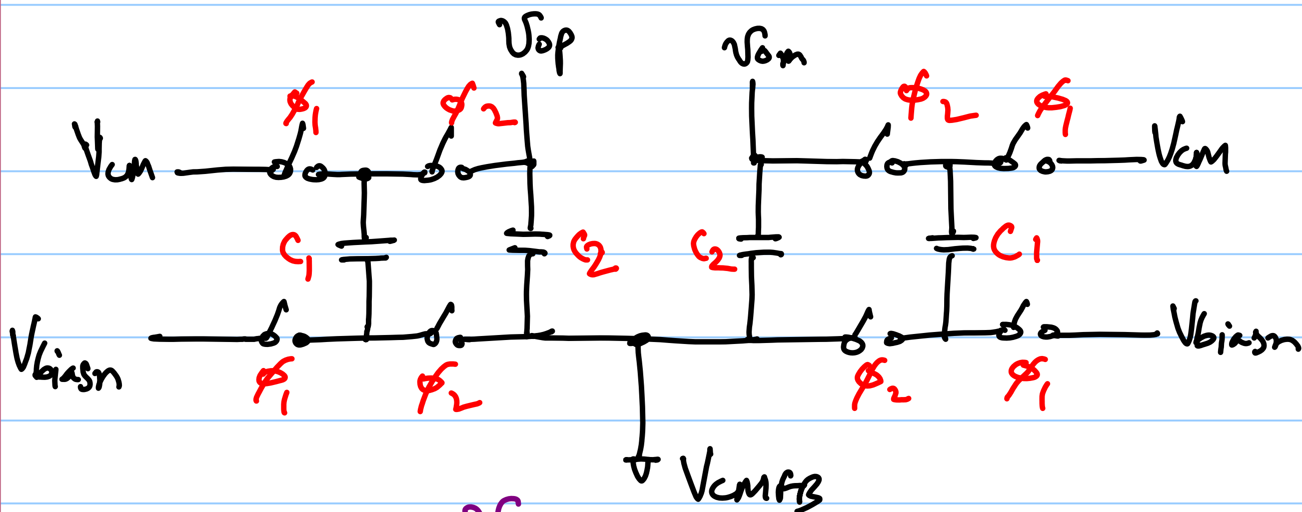
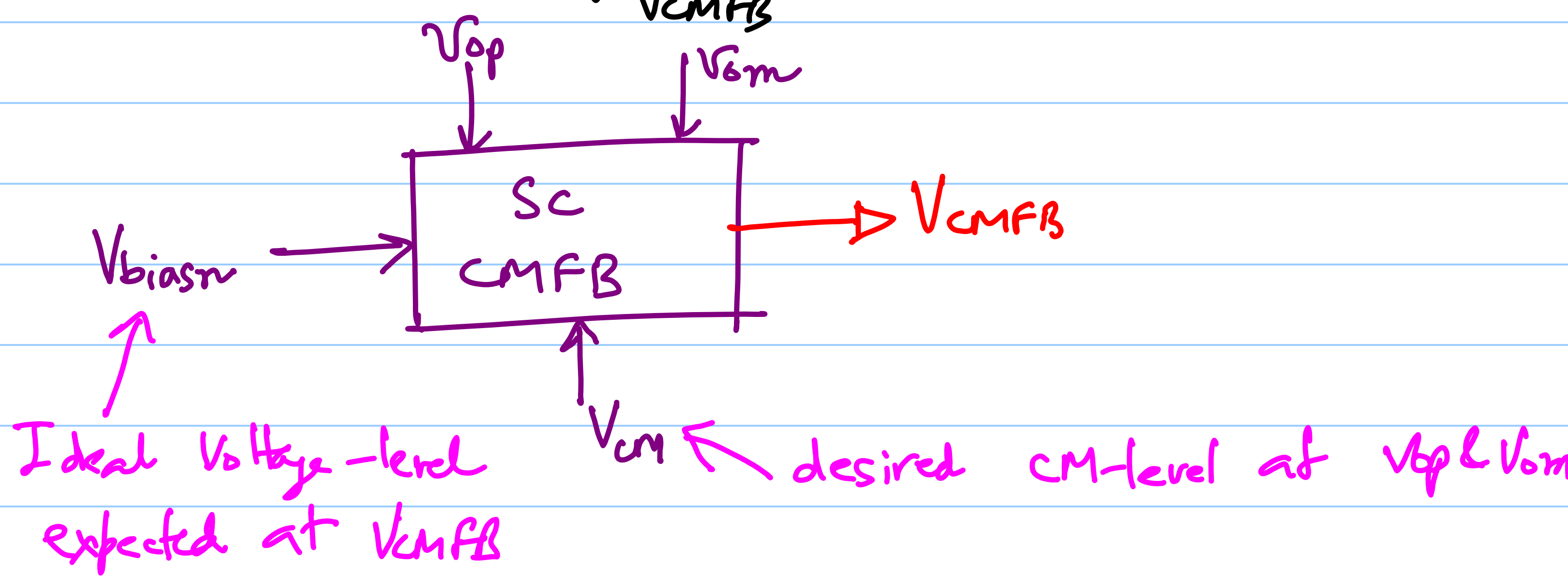
ECE 614 – Lecture 8

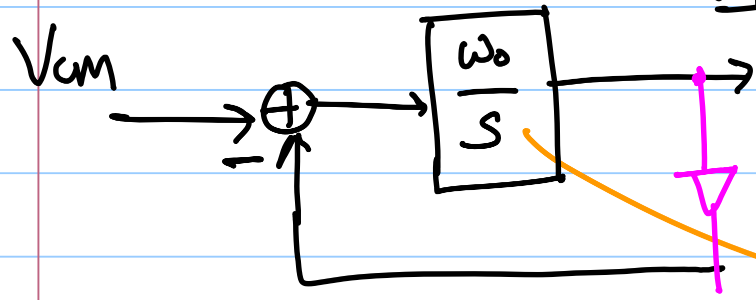
Note Title 9/18/2014

SC CMFB Circuit



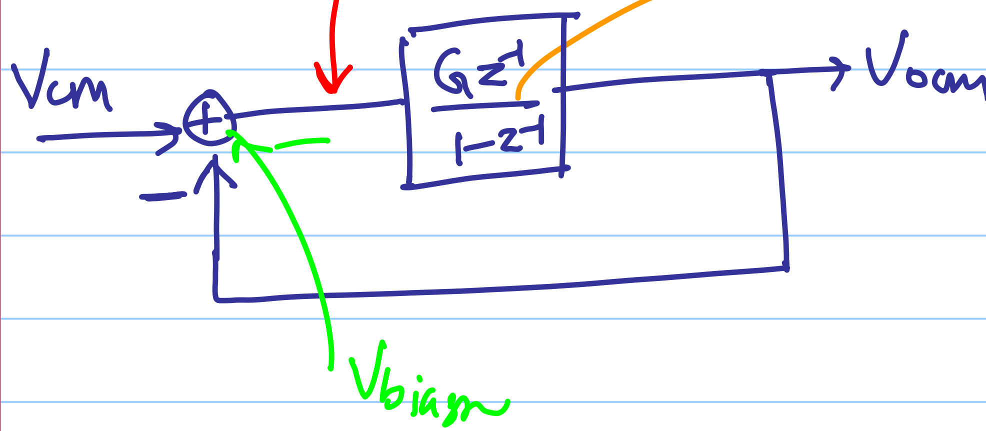


$\frac{V_{op}+V_{om}}{2} = V_{ocm}$



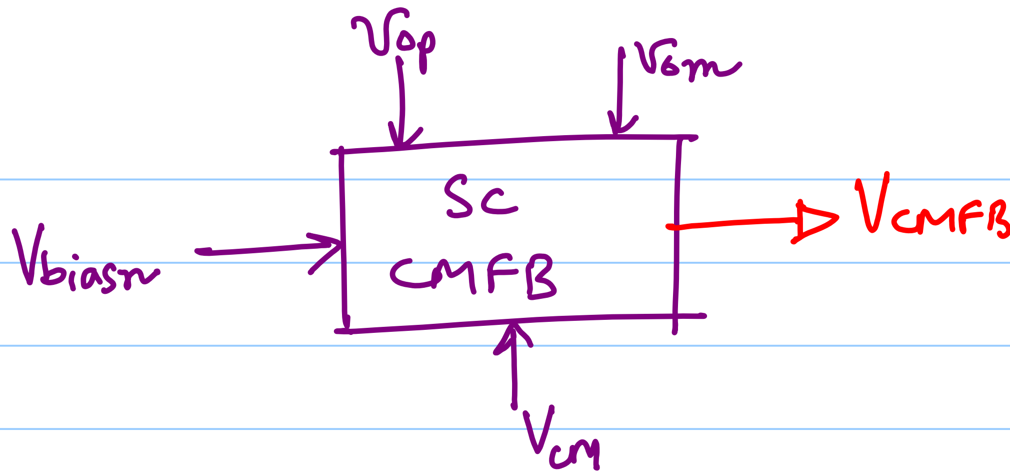
$V_{ocm} \rightarrow V_{cm}$

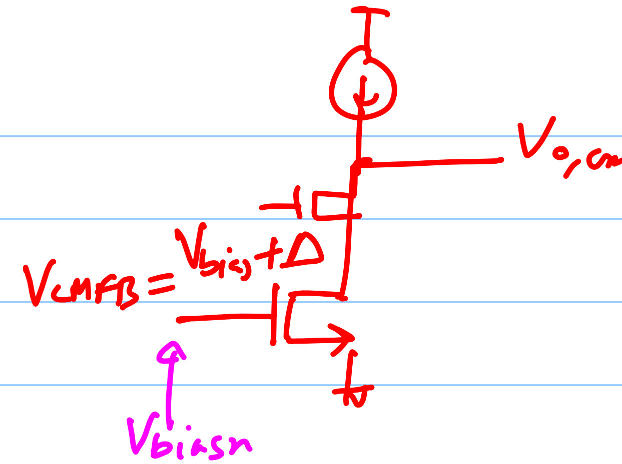
Integrating controller



-ve feedback loop that drives

$\frac{V_{op}+V_{om}}{2} \rightarrow V_{cm}$



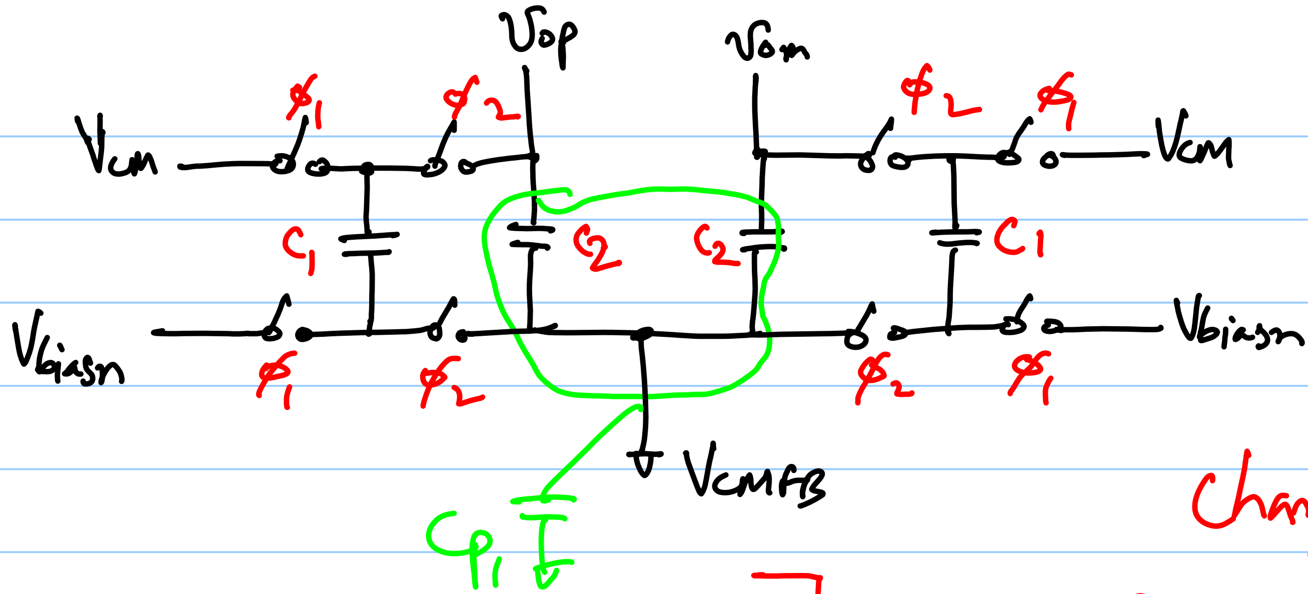


$$V_{error} = V_{CM} - V_{o,cm} = V_{biasn} - V_{CMFB} \Rightarrow 0$$

$$V_{o,cm} \leftarrow \left(\frac{V_{op}+V_{om}}{2}\right) \qquad V_{biasn} - V_{CMFB} = \Delta$$

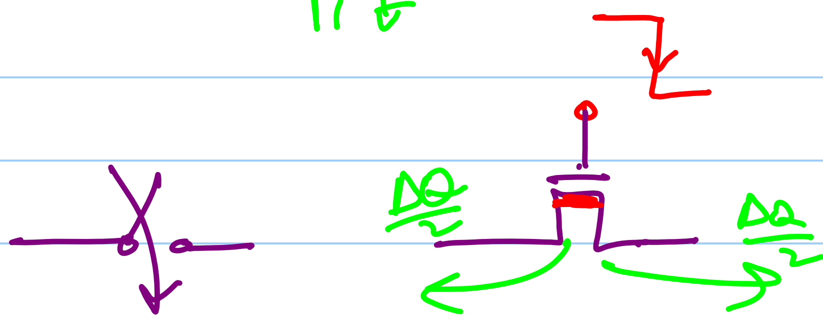
$$V_{ocm} \simeq V_{cm} - \Delta$$

Advantages: o/p swing is not limited by the CM-detector & no resistive loading



Charge-injection

$\Delta Q_I = WLC'_{ox}$



⇒ switches ϕ_1 inject charge into C_1 ⇒ ΔQ

In steady-state

$$C_1 (V_{CM} - V_{biasn}) = C_1 (V_{o,cm} - V_{CMFB}) + \Delta Q$$

$$V_{cm} - V_{o,cm} = V_{biasn} - V_{CMFB} + \frac{\Delta Q}{C_1}$$

Induces an offset into $V_{o,cm}$

$V_{o,cm}$ is away from V_{cm} by $\frac{\Delta Q}{C_1}$

① $\because \Delta Q \propto W$, small WL $\Rightarrow$ switch resistance

↳ RC time constant

② $C_1 \uparrow$

↳ reduce the offset due to C.I.

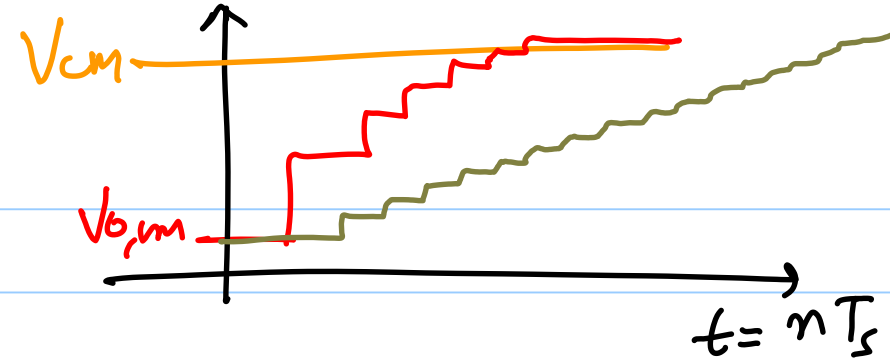
$\Rightarrow$ more loading on the outputs during ϕ_2 phase

Single-stage opamp

$$f_m = \frac{g_{m1}}{C_2}$$

Analysis:

$\frac{C_1}{C_2} \uparrow$



final value of $\frac{V_{op}+V_{om}}{2}$

$$V_{o,cm} = \frac{V_{CM} + \left[\left(1+\frac{C_{P1}}{C_1}\right)(V_{cm} - V_{biasn})\right] - \frac{\Delta Q}{C_1} + \frac{I_{Leak}\cdot T}{2C_1}}{1 + \frac{1}{A_{cm}}\cdot\left(1+\frac{C_{P1}}{C_1}\right)}$$

Step-size of settling depends on $\frac{C_1}{C_2}$

for $\frac{C_1}{C_2} >> 1 \Rightarrow$ settling is fast

Excess loading on the amplifier

$\phi_2 \Rightarrow C_1 + C_2 + C_{load}$

$\phi_1 \Rightarrow C_2 + C_{load}$

<u>Algorithm</u>: choose C_2 such that

$\omega_{u,CMFB} \simeq \omega_{u,DM}$

and choose $C_1 \Rightarrow$ 5 to 10 times of C_2

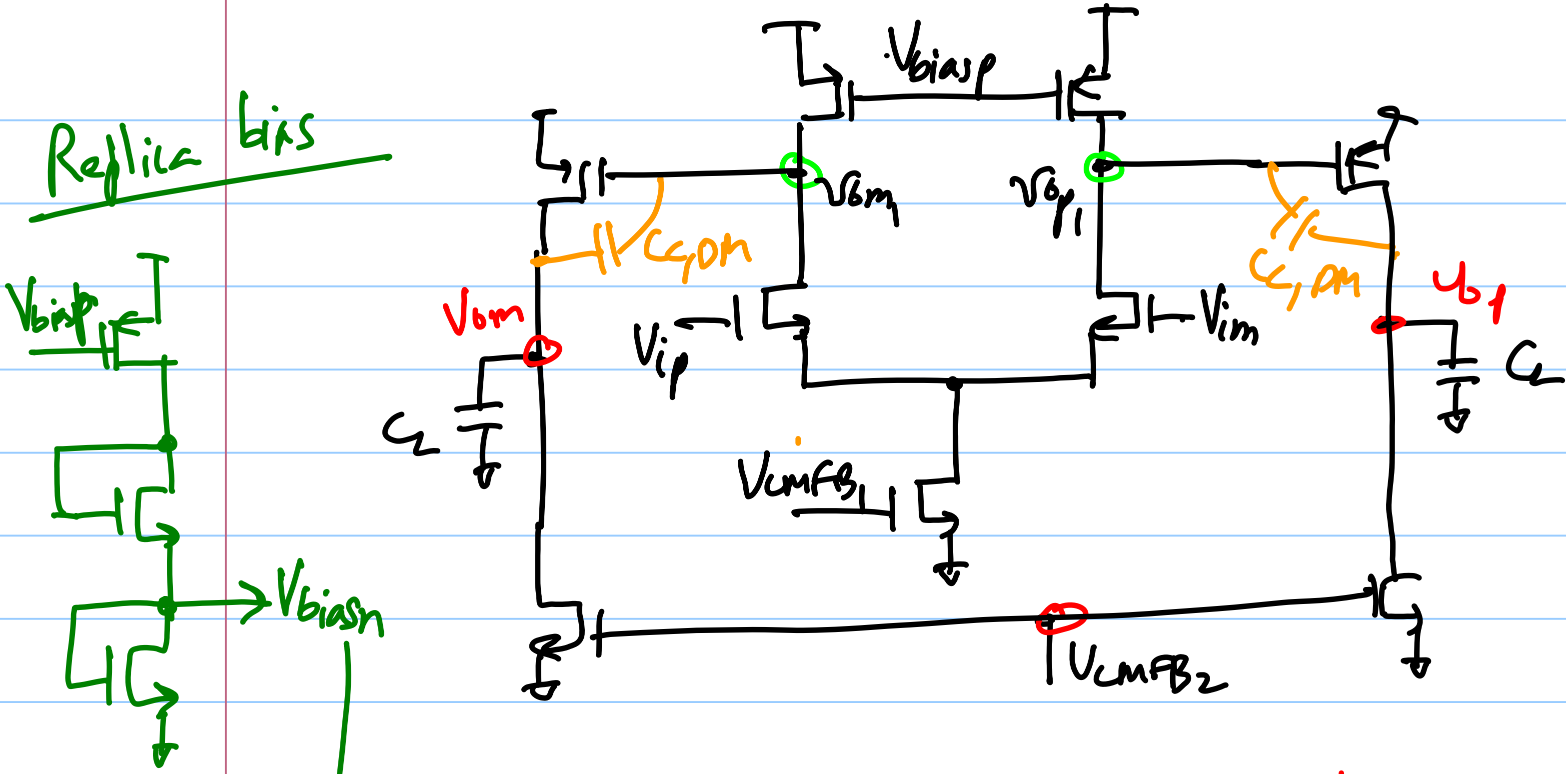
for faster settling

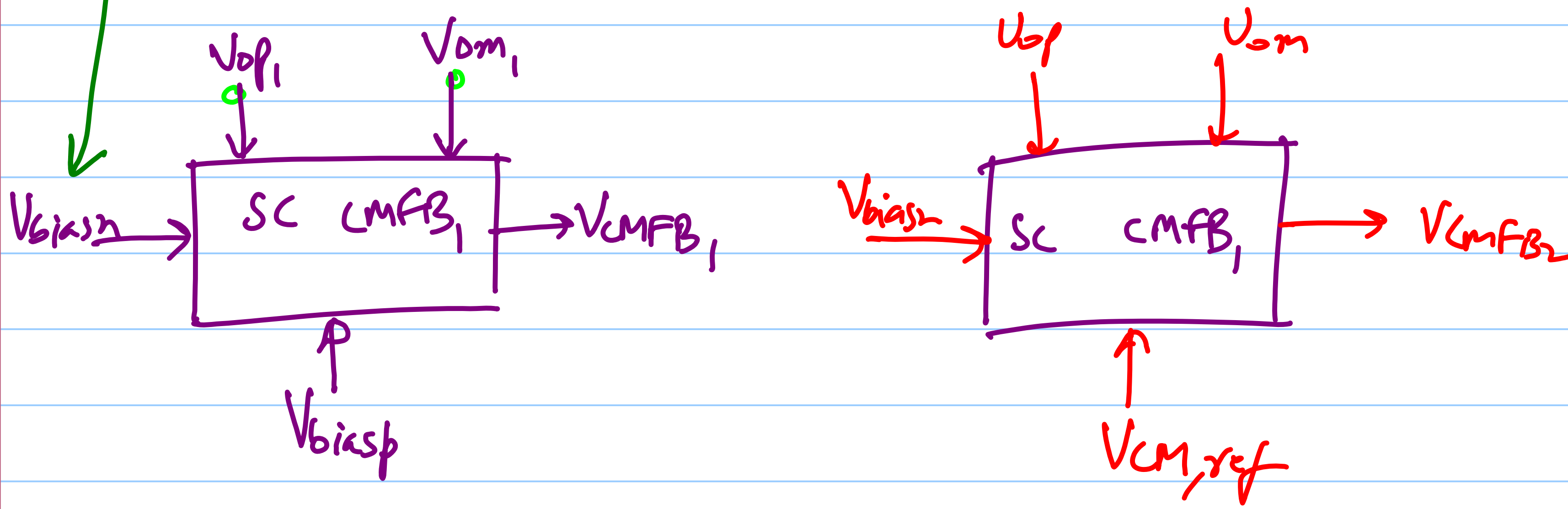
Example

$C_2 \simeq 10fF$

$C_1 = 50fF$

Replica bias





* A periodically switched system

SpectreRF

CT equivalent

periodic steady state ⇒ PSS ← operating point

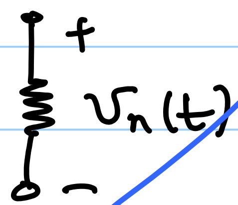
periodic stability ⇒ PSTB ← STB

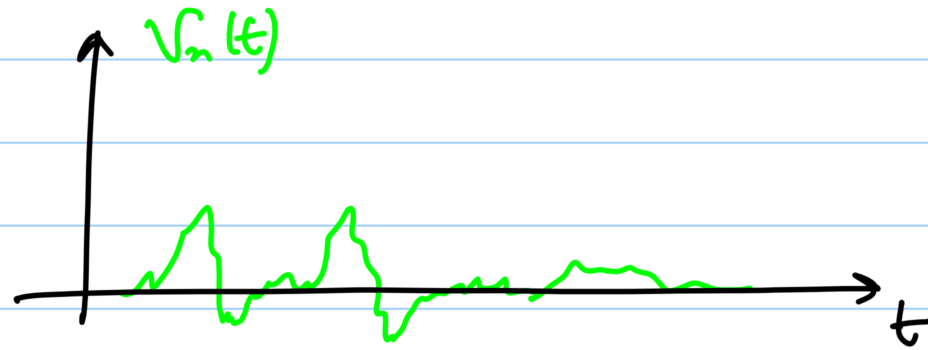
" AC response ⇒ PAC ↖ $X(e^{j\omega})$

"Transient" → Tstab parameter

Noise

Noise: random process





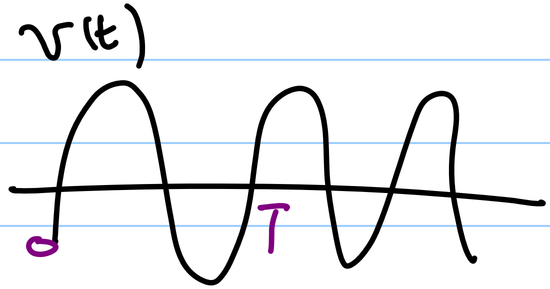
→ amplitude has a random distribution at any instance of time

↳ need to look at it statistically

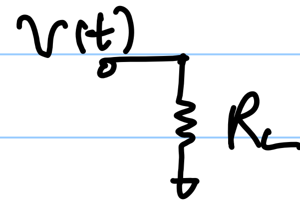
* Which properties of noise can be predicted?

⇒ In many cases, average power of noise is predictable

└→ most noises in circuits fundamentally exhibit constant average power.



periodic



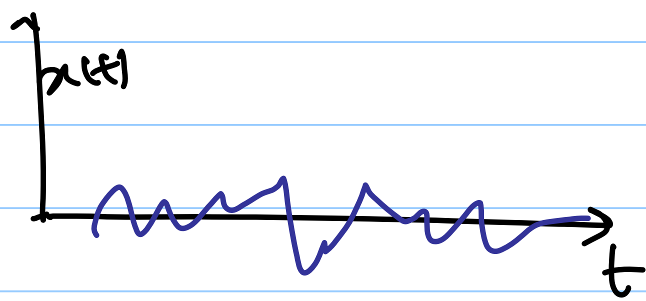
The average power delivered by a periodic voltage source v(t) to a load R_L

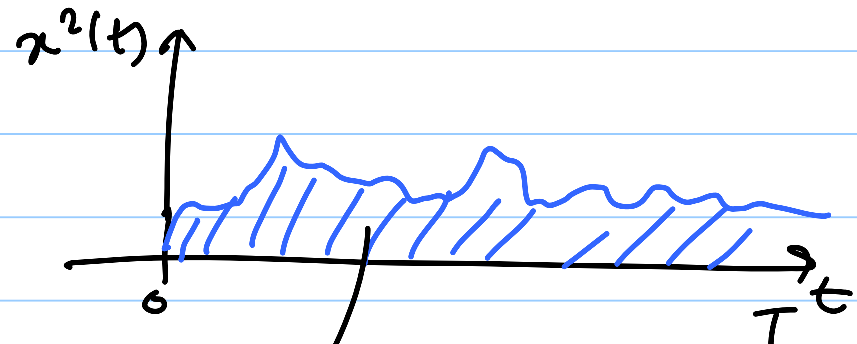
$$P_{av} = \frac{1}{T}\int_{-T/2}^{T/2} \frac{v^2(t)}{R_L}\,dt = \frac{V_p^2}{2R_L} \text{ for sine}$$

$$\frac{V_{DC}^2}{R_L} \text{ for DC}$$

for a random signal $x(t)$

$$P_{av} = \lim_{T \to \infty} \frac{1}{T} \int_{-T/2}^{T/2} \frac{x^2(t)}{R_L}\, dt$$





$$\frac{\text{Area}}{T} \Rightarrow P_{av}$$