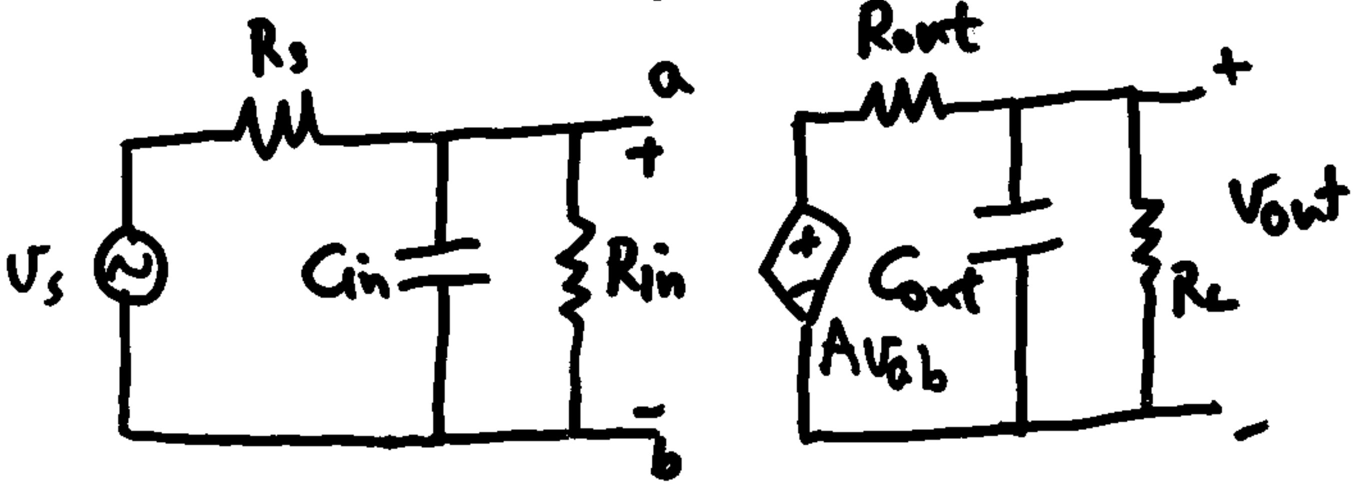
HIGH FREQUENCY MODEL



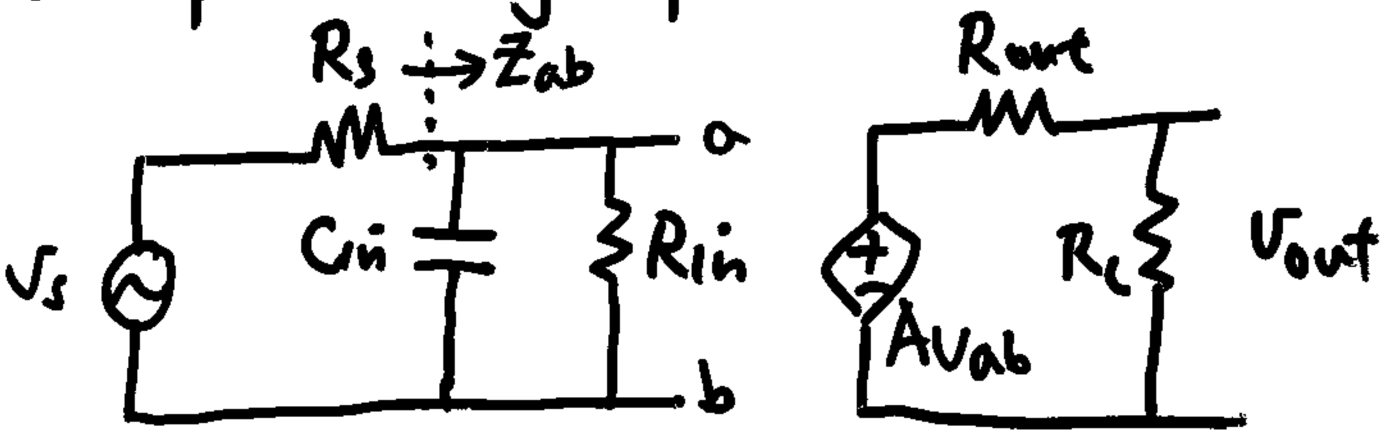
$$\omega \uparrow \Rightarrow \frac{1}{j\omega C} \downarrow$$

$$\Rightarrow v_{ab} \downarrow$$

$$\Rightarrow v_{out} \downarrow$$

High-frequency fall of voltage gain
Low-pass filter

Example : Single-pole circuit



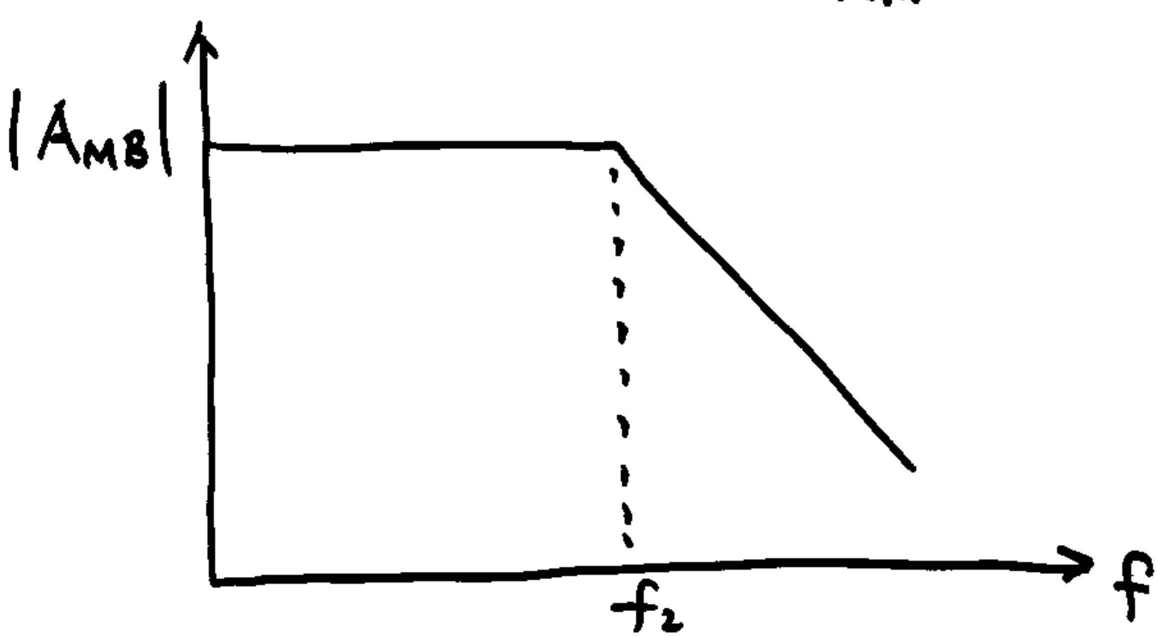
Single-pole circuit (High Freq.)

$$A_{v_s} = \frac{Z_{ab}}{Z_{ab} + R_S} A \frac{R_L}{R_L + R_{out}}$$

$$Z_{ab} = \frac{R_{in}}{1 + j\omega C_{in} R_{in}}$$

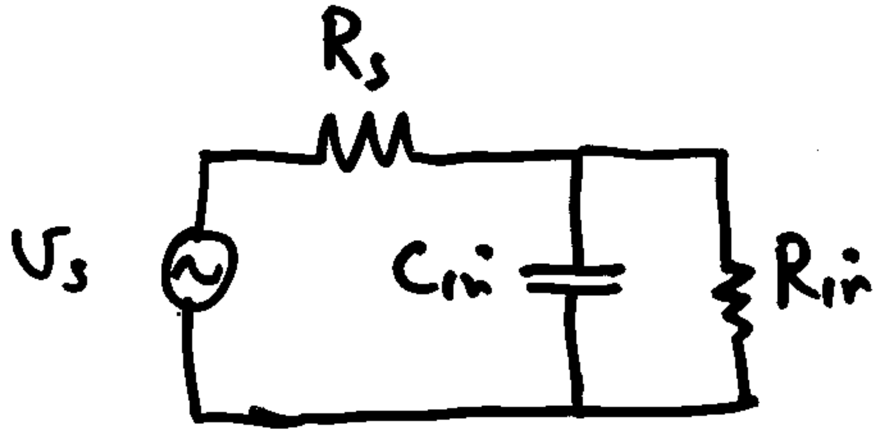
$$A_{v_s} = \frac{R_{in}}{R_{in} + R_s} A \frac{R_L}{R_L + R_{out}} \times \frac{1}{1 + j\omega C_{in} \frac{R_{in} R_s}{R_{in} + R_s}}$$

$$\text{Let } f_2 = \frac{1}{2\pi C_{in} \frac{R_{in} R_s}{R_{in} + R_s}}$$



$$\tau_p = C_{in}\left(\frac{R_{in}R_s}{R_{in}+R_s}\right)$$: short-circuit time constant

C_{C1} is shorted



Thevenin equi. impedance seen by C_{in} is $\left(\frac{R_{in}R_s}{R_{in}+R_s}\right)$

$$\omega_2 = 2\pi f_2 = \frac{1}{\tau_p} = \frac{1}{C_{in}\left(\frac{R_{in}R_s}{R_{in}+R_s}\right)}$$

Double-pole circuit

$$\tau_{p1} = C_{in}\left(\frac{R_{in} R_s}{R_{in} + R_s}\right)$$

$$\tau_{p2} = C_{out}\left(\frac{R_{out} R_L}{R_{out} + R_L}\right)$$

$$A_{vs} = \frac{R_{in}}{R_{in} + R_s} A \frac{R_L}{R_L + R_{out}} \times$$

$$\frac{1}{1 + \dfrac{jf}{\frac{1}{2\pi\tau_{p1}}}} \cdot \frac{1}{1 + \dfrac{jf}{\frac{1}{2\pi\tau_{p2}}}}$$

$$f_2 = \frac{1}{2\pi\tau_{p1}}, \quad f_2' = \frac{1}{2\pi\tau_{p2}}$$

Overall higher corner frequency

$$\left[1 + \left(\frac{f_H}{f_2}\right)^2\right]\left[1 + \left(\frac{f_H}{f_2'}\right)^2\right] = 2$$

$$f_H^4 + (f_2^2 + f_2'^2) f_H^2 - f_2^2 f_2'^2 = 0$$

Approximation for f_H

1. For each internal parasitic capacitors C_i,

   Determine R_{eff} seen by C_i assuming that other int. parasitic capacitors are open

   Calculate $\tau_i = R_{eff} \cdot C_i$

2. Approximate $\omega_H = \dfrac{1}{\tau_1 + \tau_2 + \ldots}$

   < true higher corner freq.

Approximation for A_{vs}

$$A_{vs} = A_{MB} \cdot \frac{1}{1 - j\frac{f_L}{f}} \cdot \frac{1}{1 + j\frac{f}{f_H}}$$