Frequency Response of Common Source Amplifier:

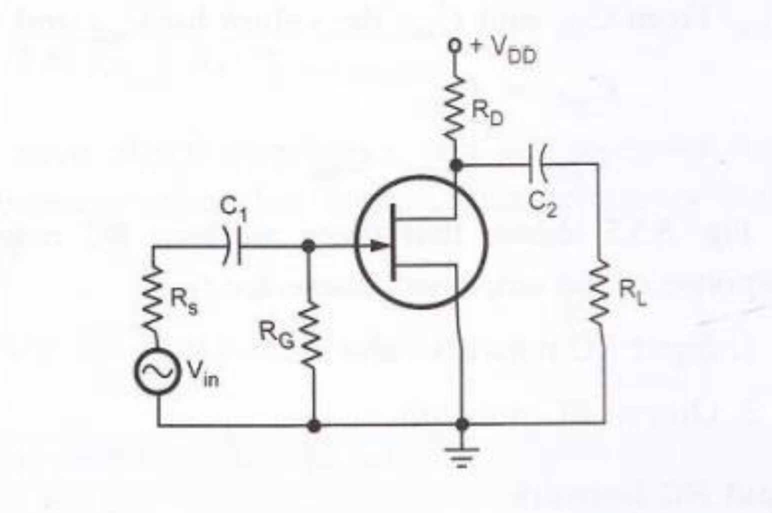

Fig. Typical RC coupled common source amplifier

Let us consider a typical common source amplifier as shown in the above figure.

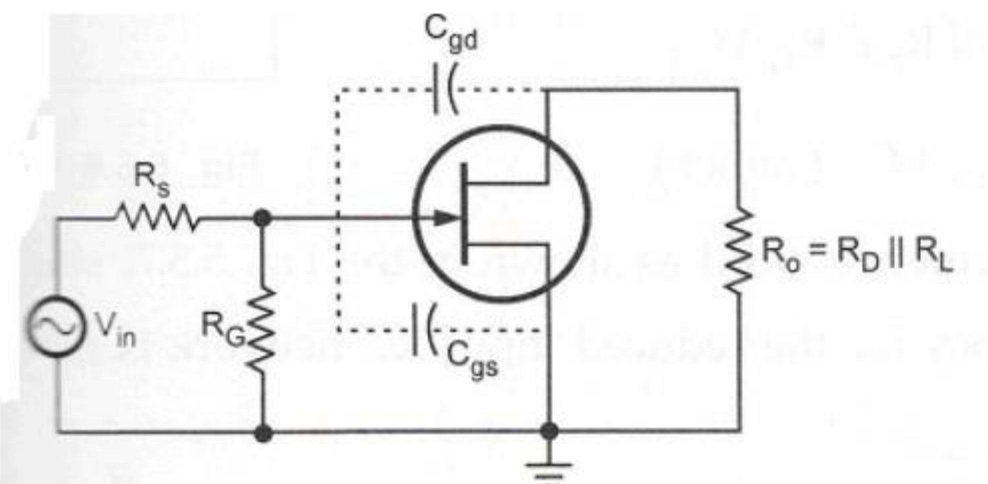

Fig. High frequency equivalent circuit

From above figure, it shows the high frequency equivalent circuit for the given amplifier circuit. It shows that at high frequencies coupling and bypass capacitors act as short circuits and do not affect the amplifier high frequency response. The equivalent circuit shows internal capacitances which affect the high frequency response.

Using Miller theorem, this high frequency equivalent circuit can be further simplified as follows:

The internal capacitance C_{gd} can be splitted into $C_{in(miller)}$ and $C_{out(miller)}$ as shown in the following figure.

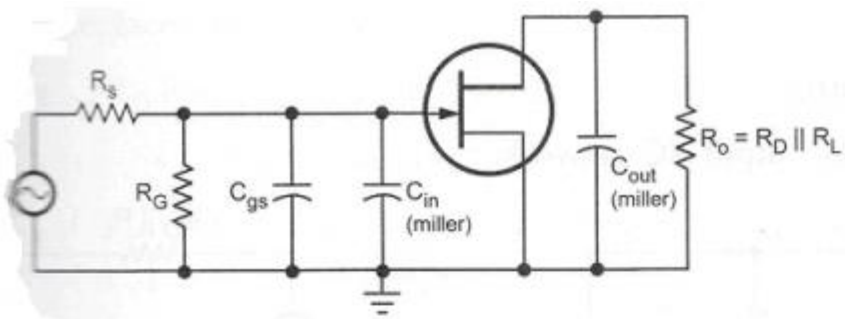

Fig. **Simplified high frequency equivalent circuit**

$$C_{in\,(miller)} = C_{gd}\,(A_v + 1)$$

$$C_{out\,(miller)} = C_{gd}\,\frac{(A_v + 1)}{(A_v)}$$

Where

$$C_{gd} = C_{rss}$$

$$C_{gs} = C_{iss} - C_{rss}$$

From simplified high frequency equivalent circuit, it has two RC networks which affect the high frequency response of the amplifier. These are,

1. Input RC network
2. Output RC network

Input RC network:

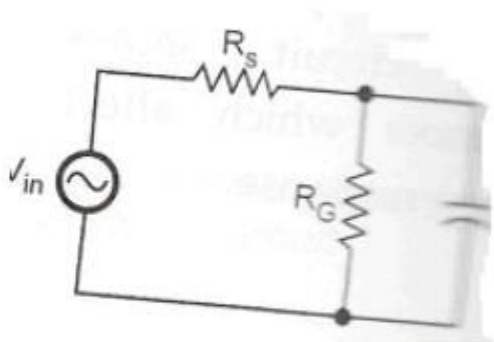

Fig. Input RC network

From above figure,

$$f_{c(input)} = \frac{1}{2\pi(R_S \,||\, R_G)C_T}$$

where $C_T = C_{gs} + C_{in(miller)}$

This network is further reduced as follows since $R_s << R_G$

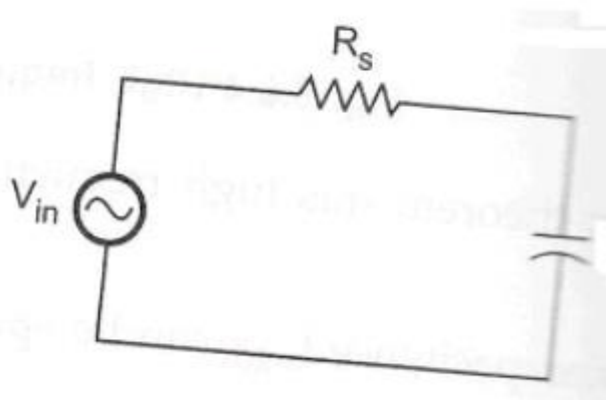

Fig. Reduced input RC network

The critical frequency for the reduced input RC network is,

$$f_{c\,(input)} = \frac{1}{2\pi R_s\, C_T}$$

or $$f_c = \frac{1}{2\pi R_s\,[C_{gs} + C_{in\,(miller)}]}$$

The phase shift in high frequency RC network is $\theta = \tan^{-1}\left(\frac{R_s}{X_{C_T}}\right)$

Output RC network:

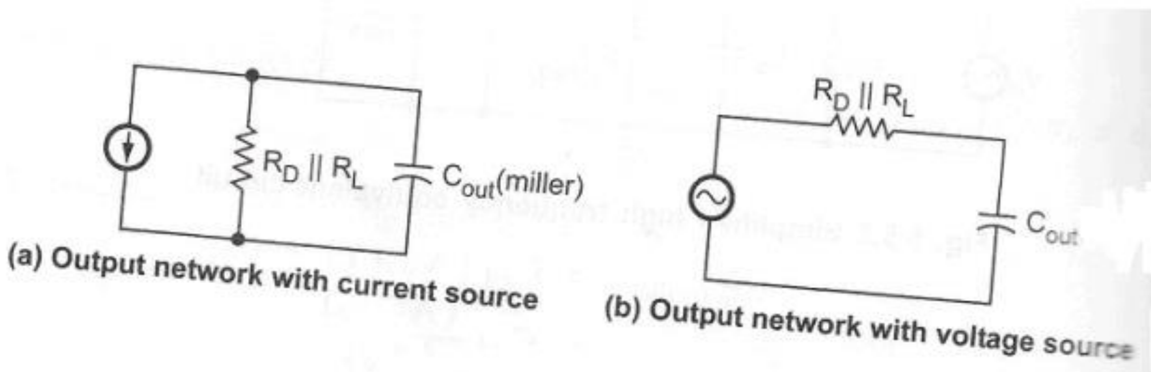

Fig. Output RC network

The critical frequency for the above circuit is,

$$f_c = \frac{1}{2\pi R_o\, C_{out\,(miller)}} = \frac{1}{2\pi(R_D \parallel R_L)\, C_{out\,(miller)}}$$

It is not necessary that these frequencies should be equal. The network which has lower critical frequency than other network is called dominant network.

The phase shift in high frequency is

$$\theta = \tan^{-1}\left(\frac{R_o}{X_{C_{out\,(Miller)}}}\right)$$