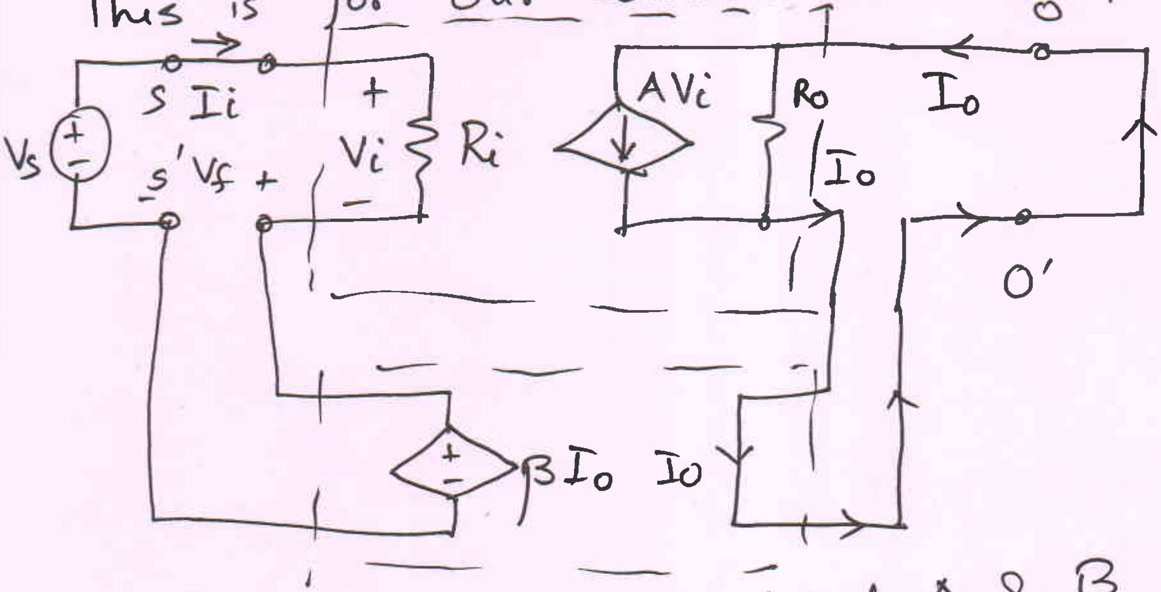
SERIES – SERIES F/B Amplifier.

Ideal Case:

This topology uses a Voltage-Controlled (V_s) Current Source (I_o) and stabilizes Transconductance.

$A = I_o/V_o$ and β is ~~I_o~~ I_o/V_f or trans-resistance.

This is for our Common Emitter Amplifier.



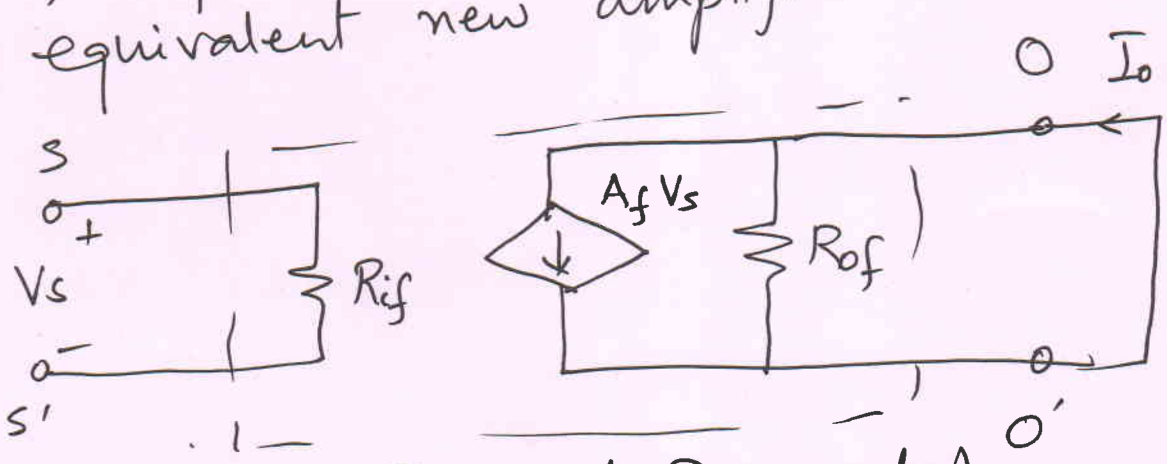
A = unit of transcond.

shorting here since R_L is included

A & β networks.

Above block shows idealised A & β networks.

The output current ~~R~~ I_o passes through β network and produces proportional feedback voltage $V_f = \beta I_o$. Above can be reduced to equivalent new amplifier.



Calculate R_{if} and R_{of} and A_f.

$$A_f = \frac{I_o}{V_s} = \frac{A}{1 + A\beta}$$

where A = Transconductance of Original Amplifier with loading of β taken into account but no feedback is applied.

$$R_{if} = \frac{V_s}{I_i} = \frac{V_s}{V_i / R_i} = R_i \frac{V_s}{V_i}$$

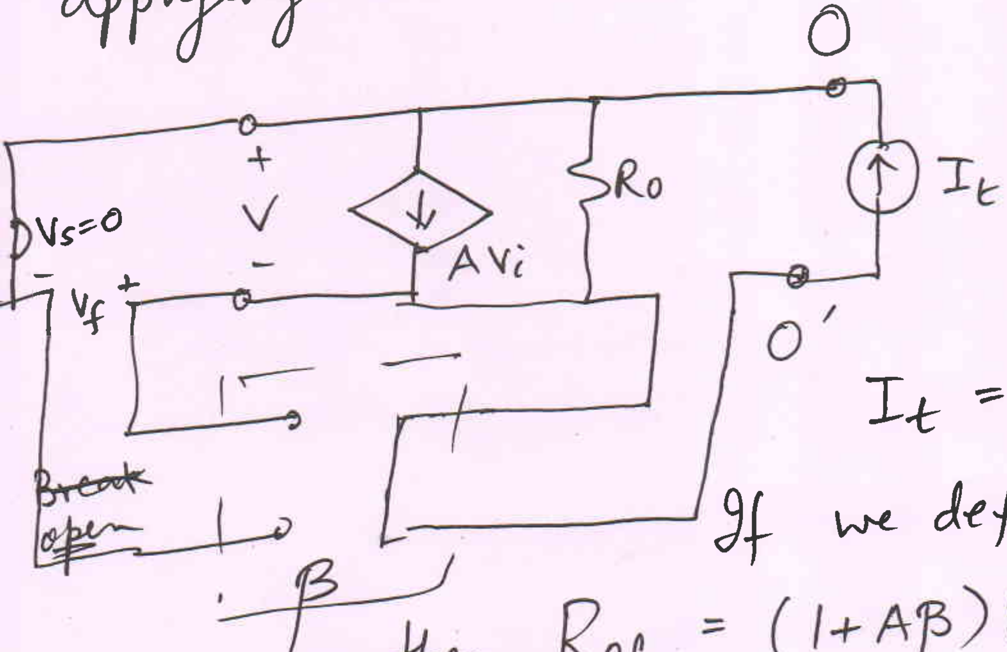
$$V_s = V_i + V_f = V_i + \beta A V_i$$

$$\therefore R_{if} = R_i \frac{(V_i + \beta A V_i)}{V_i}$$

$$= R_i (1 + A\beta) = R_i \cdot D$$

Input resistance R_{if} increases from R_i D times.

Now measure the output resistance by applying a current source I_t from output.



Reduce $V_s = 0$

$$\therefore V_i = -V_f = -\beta I_t \quad \text{--- (1)}$$

$$I_t = A V_i + \frac{V}{R_o} \quad \text{--- (2)}$$

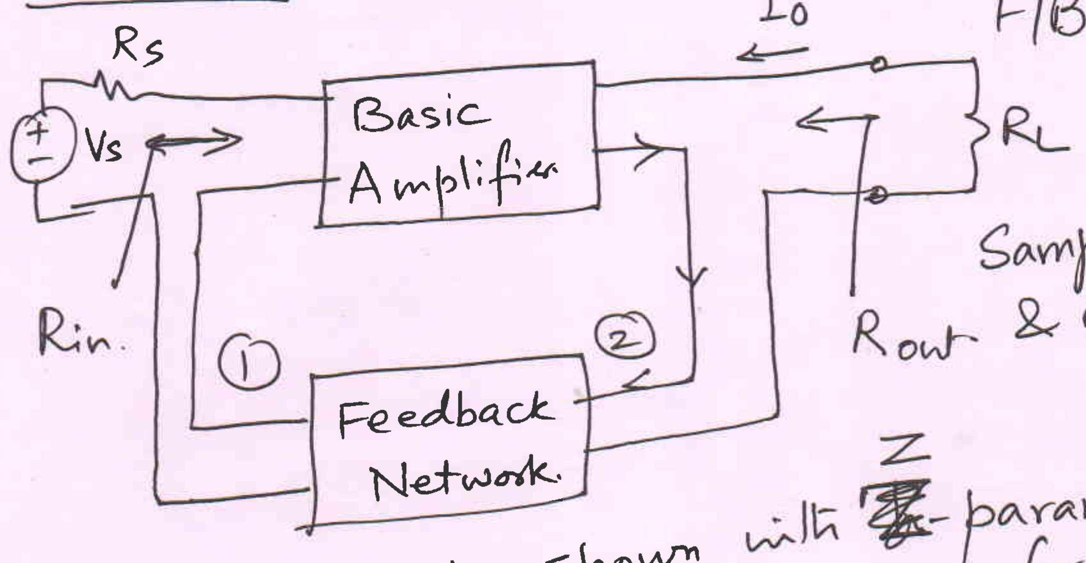
If we define $R_{of} \equiv \frac{V}{I_t}$

then $R_{of} = (1 + A\beta) R_o$

Negative F/B increases output resistance.

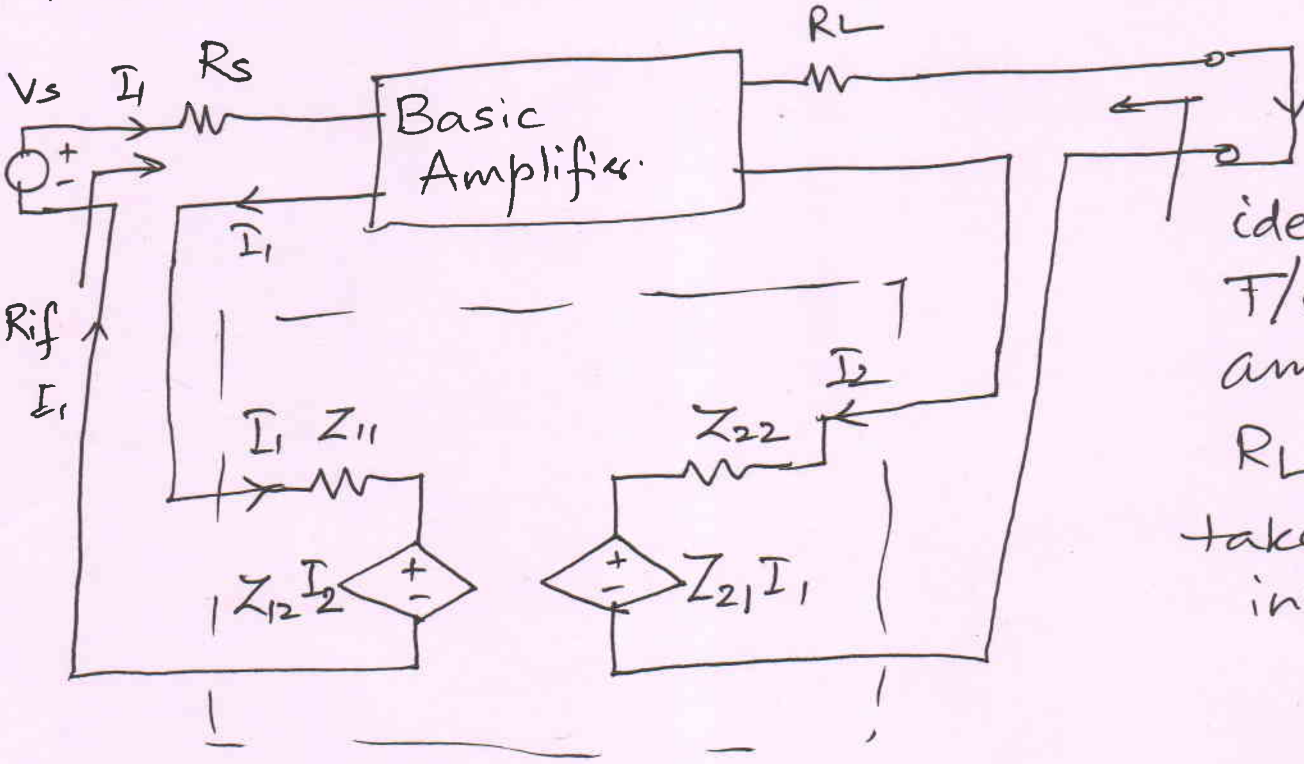
Practical Case : See Series-Series Topology. (3)

F/B amplifier.



Samples output I & creates V_f.

Above circuit is shown with ~~Z~~ Z-parameter model for β network.



SC for ideal F/C amplifier. R_L taken inside.

Z_{11} and Z_{22} have units of resistance.

Z_{11} = input resistance $= \left.\dfrac{V_1}{I_1}\right|_{I_2=0}$ output open circuited.

Z_{22} = output " $= \left.\dfrac{V_2}{I_2}\right|_{I_1=0}$ input open circuited.

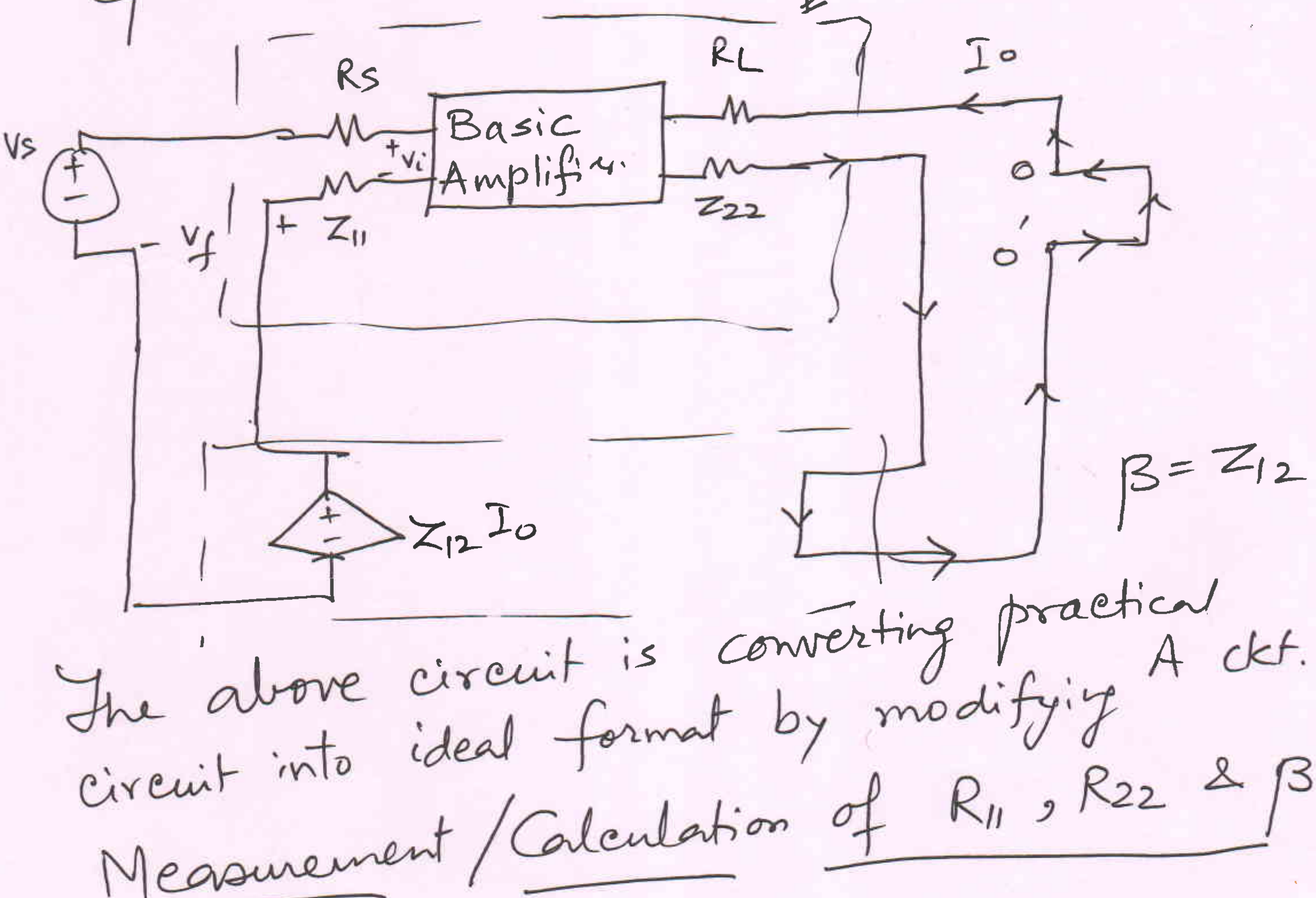
$Z_{12} = \left.\dfrac{V_1}{I_2}\right|_{I_1=0}$ forward & $Z_{21} = \left.\dfrac{V_2}{I_1}\right|_{I_2=0}$

Use I_1 or I_2 as excitation Appendix B.

Z_{11} and Z_{22} we will lump with Original Amplifier just like we will do with R_S & R_L.

Since β network is a passive unit of type attenuator its $Z_{21} \simeq 0$ or very small as compared to A of Basic amplifier. So we neglect it and replace it with a SC. The feedback voltage $Z_{12} I_o$ is retained as the feedback voltage V_f due to load current I_o. The reduced equivalent circuit is

New A circuit

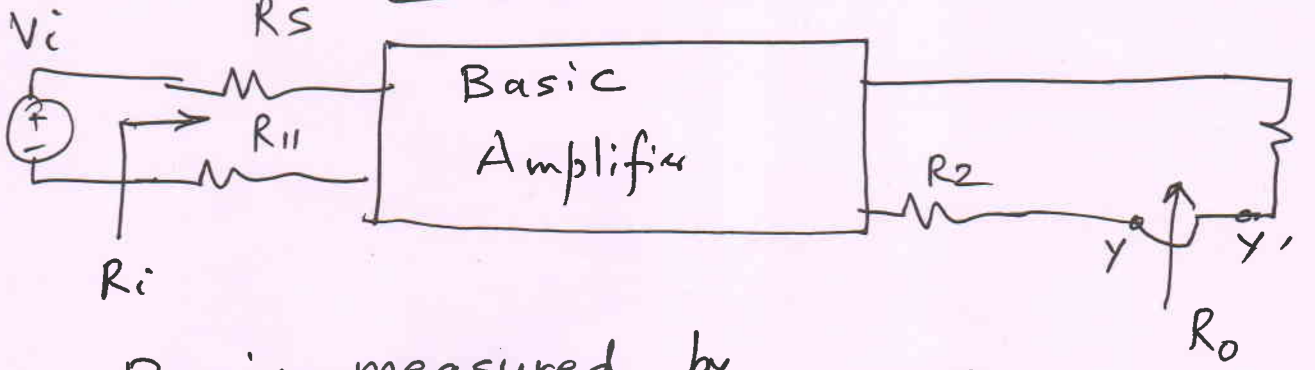


$\beta = Z_{12}$

The above circuit is converting practical A ckt. circuit into ideal format by modifying

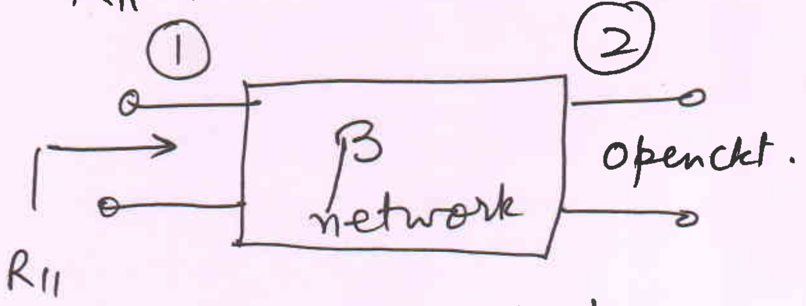
Measurement / Calculation of R_{11}, R_{22} & β

A circuit is :



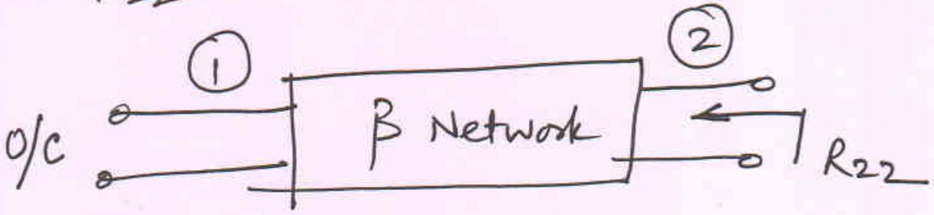
R_{11} is measured by

Gain $A = I_o / V_i$

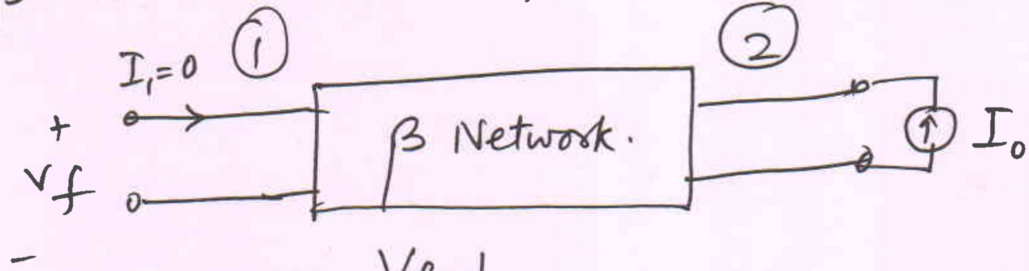


To measure R_o break Y–Y' and see inside.

R_{22} is measured by



β is obtained by



$$\beta = \left.\frac{V_f}{I_o}\right|_{\text{when } I_1 = 0}$$

or input is disconnected.