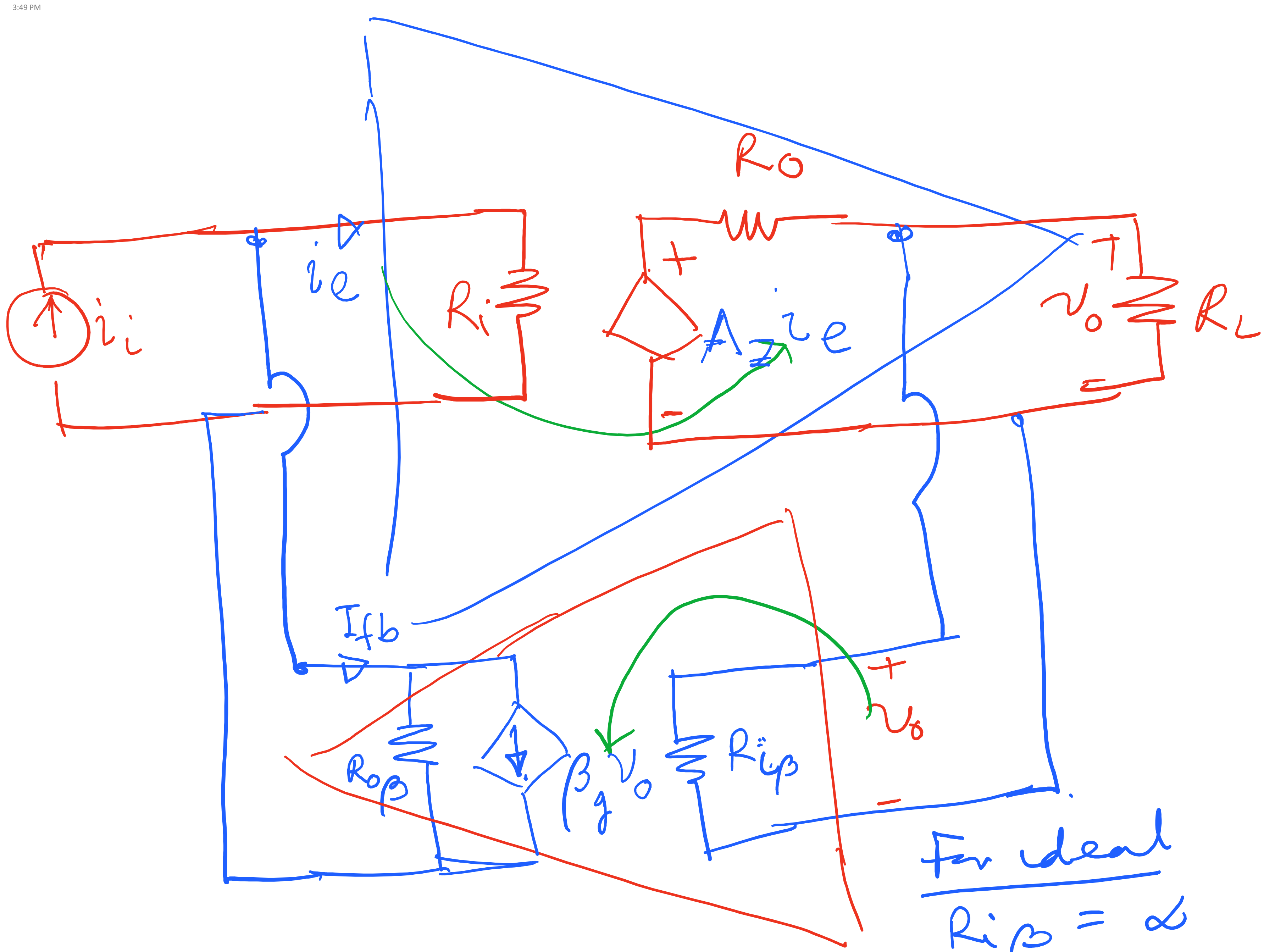
Feedback2

Wednesday, April 20, 2016 3:49 PM

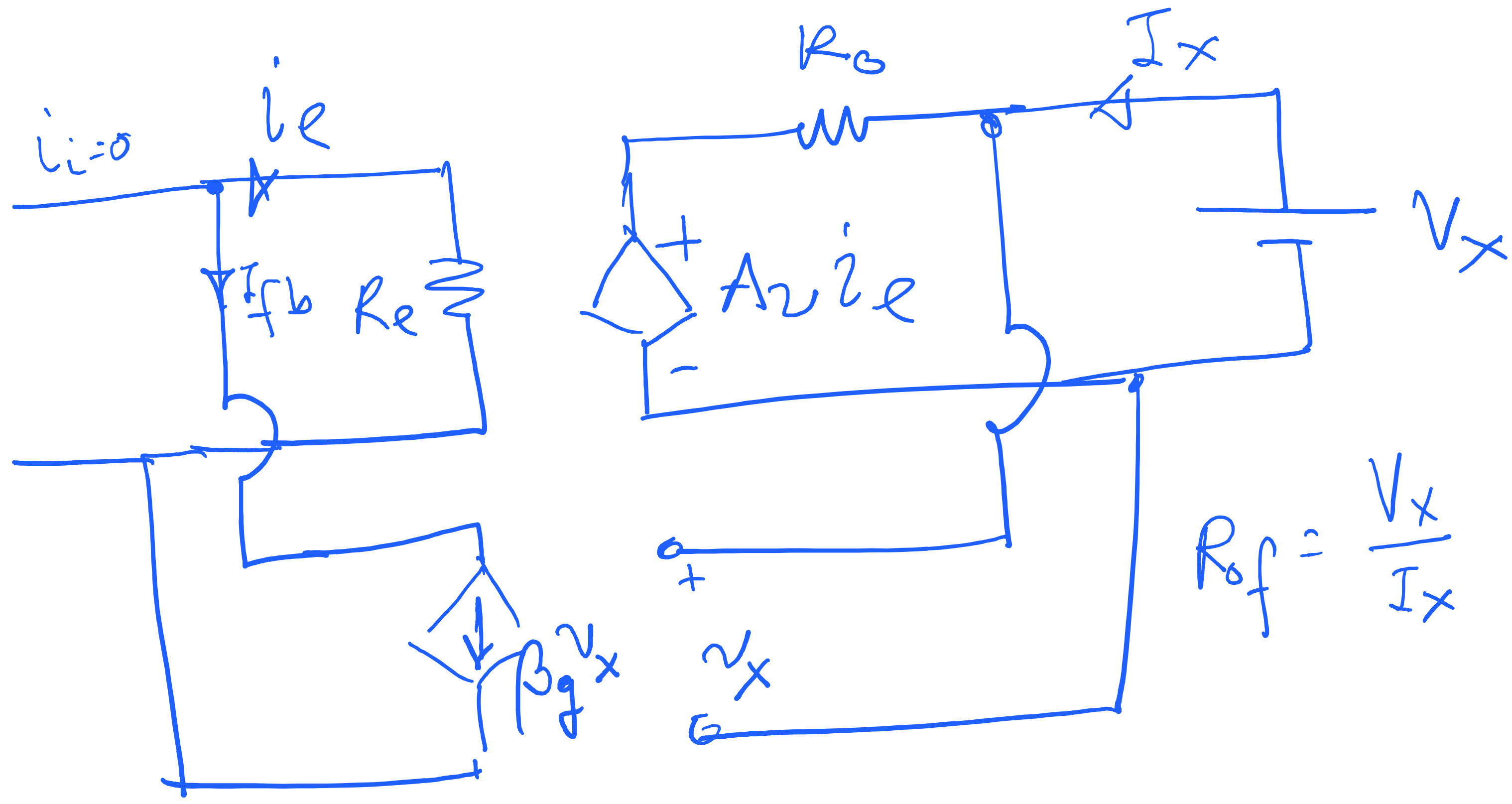


For ideal

$R_{i\beta} = \infty$

$R_{o\beta} = \infty$

$R_o = ?$



$R_{of} = \frac{V_x}{I_x}$

KNL

$$V_x = R_o I_x + A_z i_e$$

$$i_i \;..\; i_e + i_{fb} = 0 \Rightarrow i_e = -i_{fb}$$

$i_i = i_e + i_{fb} = 0 \Rightarrow$

$$V_x = R_o I_x - A_z i_{fb}$$

$$= R_o I_x - A_z \beta_g V_x$$

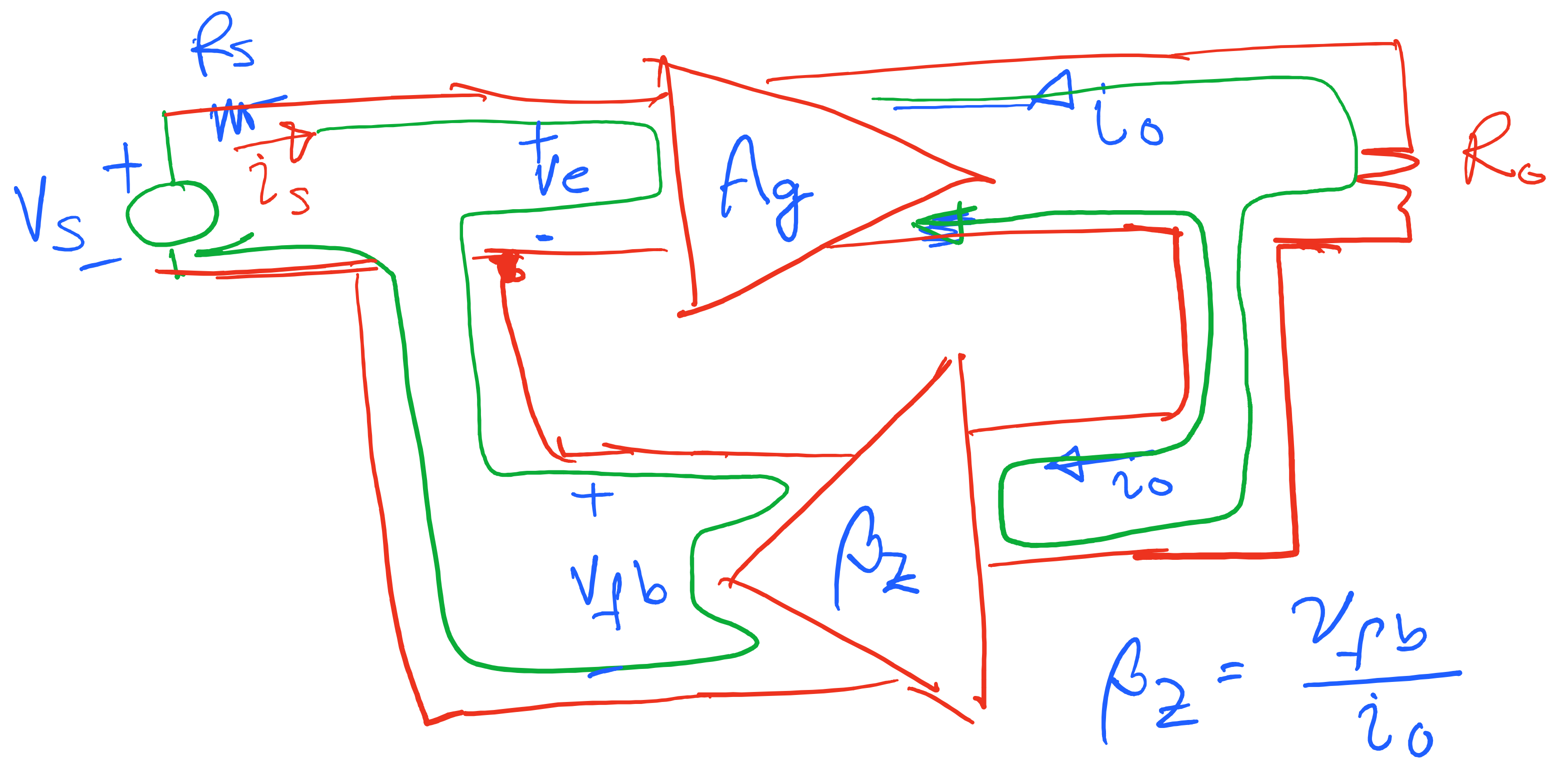
$$V_x + A_z \beta_g V_x = R_o I_x$$

$$V_x \left[1 + A_z \beta_g \right] = R_o I_x$$

$$\boxed{\therefore R_{of} = \frac{V_x}{I_x} = \frac{R_o}{1 + A_z \beta_g}}$$

Series Series

$$A_g = \frac{i_o}{v_e}$$



$$\beta_z = \frac{v_{fb}}{i_o}$$

[if $R_s = 0$]

$A_{gf} = ?\ \frac{i_o}{v_s}$

$R_{if} = ?$

$$v_s = v_e + v_{fb}$$

output parameter (i_o)

Input parameter (v_e)

$$v_s = \frac{i_o}{A_g} + \beta_z i_o$$

$v_s = v_e + v_{fb}$

$= v_e + \beta_z i_o$

$$v_s = A_g$$

$$= \frac{i_o}{A_g}\left[1+\beta_z A_g\right]$$

$$\therefore A_{gf} = \frac{i_o}{v_s} = \frac{A_g}{1+\beta_z A_g}$$

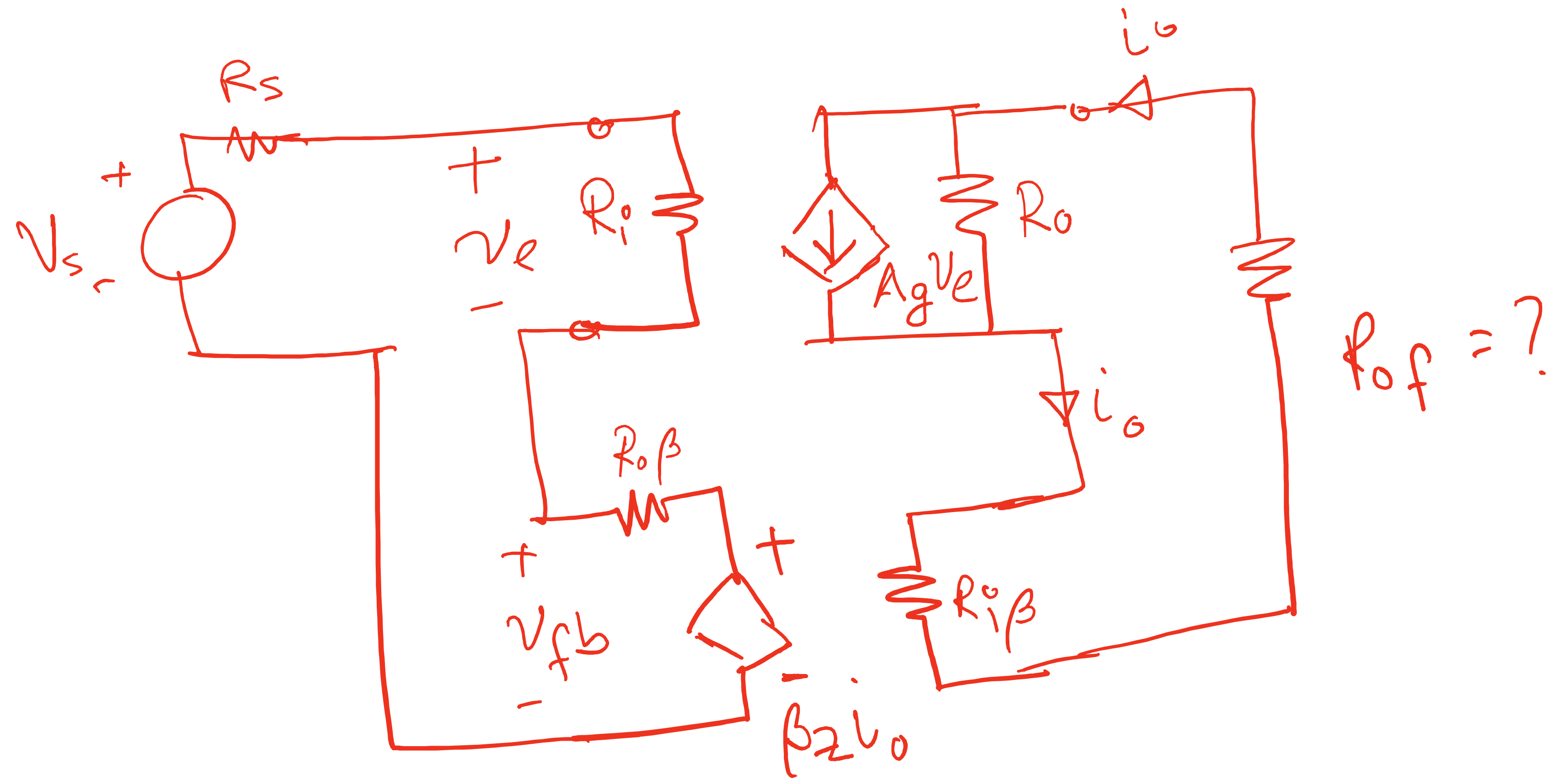
$$= v_e + \beta_z i_o$$

$$= v_e + \beta_z A_g v_e$$

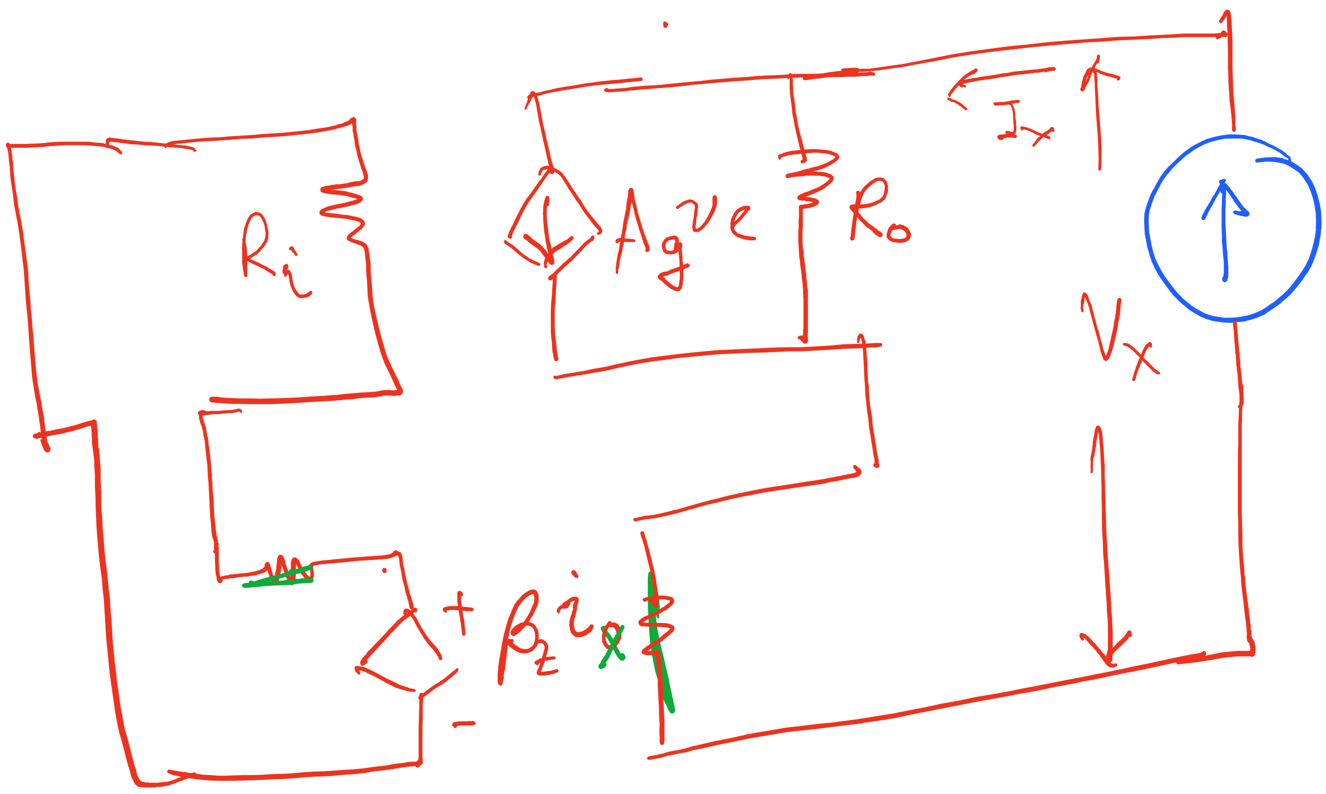
$$= v_e\left[1+\beta_z A_g\right]$$

$$R_{if} = \frac{v_s}{i_s} = \frac{v_e\left[1+\beta_z A_g\right]}{R_o\, i_s}$$

$$= R_i\left[1+\beta_z A_g\right]$$



$v_s = 0$



KCL $\quad I_x = \frac{V_x}{R_o} + A_g v_e$

$$\left[v_s = v_e + v_{fb} = 0 \right] \quad v_e = -v_{fb}$$

$$I_x = \frac{V_x}{R_o} - A_g v_{fb}$$

$$= \frac{V_x}{R_o} - A_g \beta_z I_x$$

$$I_x \left[1 + A_g \beta_z \right] = \frac{V_x}{R_o}$$

$$\therefore R_{of} = \frac{V_x}{I_x} = R_o \left[1 + A_g \beta_z \right]$$

Topology	Open loop Gain	Closed loop gain	R_{if}	R_{of}
Series-shunt (v v)	A_v	$A_{vf} = \frac{A_v}{1+\beta_v A_v}$	$R_i(1+\beta_v A_v)$	$\frac{R_o}{1+\beta_v A_v}$
Shunt-series (i i)	A_i	$A_{if} = \frac{A_i}{1+\beta_i A_i}$	$\frac{R_i}{1+\beta_i A_i}$	$R_o(1+\beta_i A_i)$
Shunt-shunt (i v)	A_z	$A_{zf} = \frac{A_z}{1+\beta_g A_z}$	$\frac{R_i}{1+\beta_g A_z}$	$\frac{R_o}{1+\beta_g A_z}$
Series-Series (v i)	A_g	$A_{gf} = \frac{A_g}{1+\beta_z A_g}$	$R_i(1+\beta_z A_g)$	$R_o(1+\beta_z A_g)$