Elektronik II

Feedback: General Structure, Voltage and Current Amplifiers

Original notes: Ders11.pdf

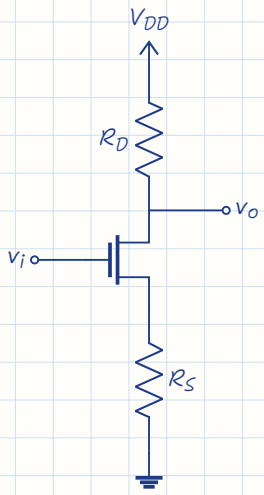
UYARI Bu belge, el yazısı ders notlarından Claude (Anthropic) yardımıyla dijitale aktarılmıştır. Yardımcı kaynak olarak hazırlanmıştır; hata veya eksik içerebilir. Lütfen orijinal notları ve ders kaynaklarını esas alın.

NOTICE *This document was transcribed from handwritten lecture notes with the help of Claude (Anthropic). It is meant as a supplementary resource and may contain errors or omissions. Always check against the original notes and official course material.*

Not: Orijinal dosyadaki basılı sayfalar (s. 2–5) dijitalleştirilmedi; yalnızca el yazısı sayfalar aktarıldı.

orig. p. 1

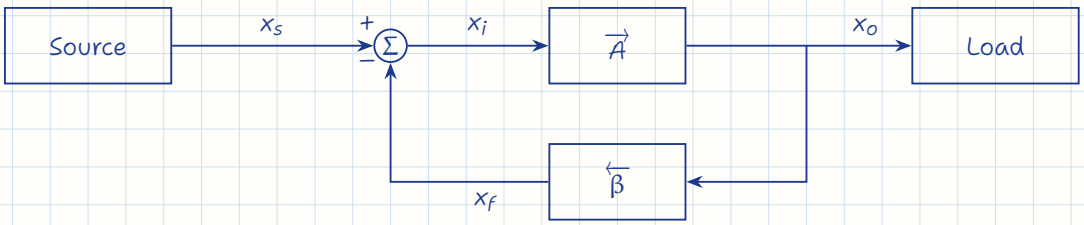
Feedback



Common source amplifier

$$\frac{v_o}{v_i} \approx \frac{R_D}{R_S}$$

The general feedback structure



A = open loop gain

β = feedback factor

x_i = Input signal

x_s = signal source

x_o = output signal

x_f = sampled output by fbn (feedback network)

$$\left(\frac{x_o}{x_s}\right)_{CL} = ?$$

$$x_o = A x_i$$

$$x_f = \beta \cdot x_o$$

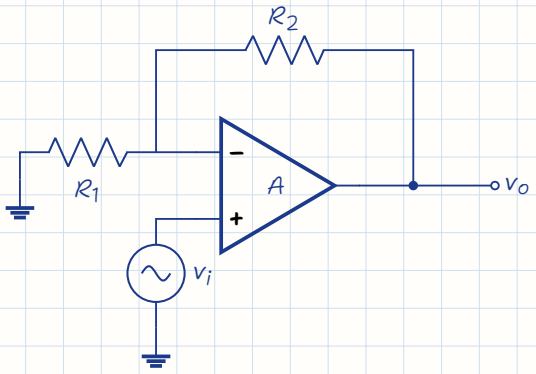
$$x_i = x_s - x_f$$

$$x_i = x_s - \beta x_o$$

$$x_i = x_s - A\beta \cdot x_i$$

$$x_s = x_i (1 + A\beta)$$

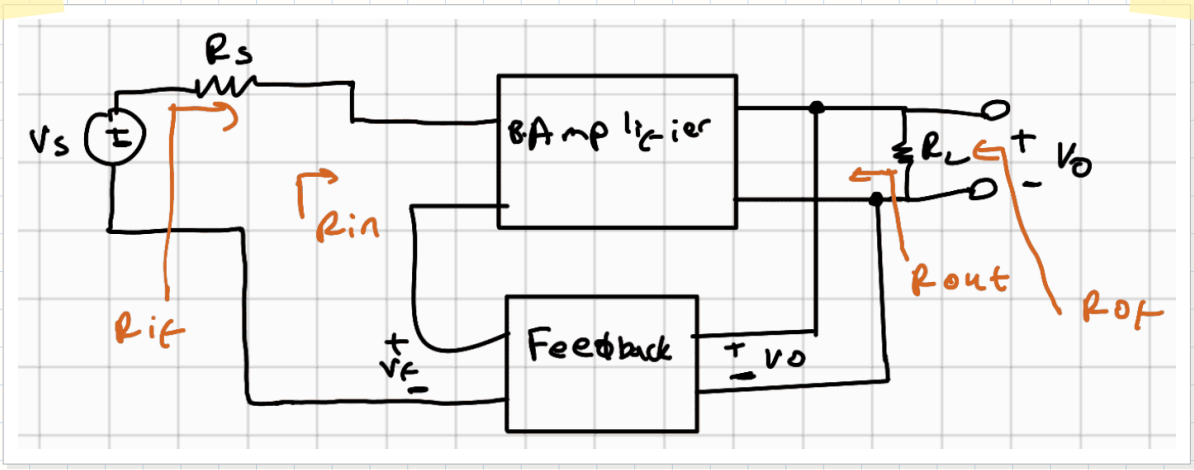
$$\left(\frac{x_o}{x_s}\right) = \frac{A x_i}{x_i (1 + A\beta)} = \frac{A}{1 + A\beta}$$



$$\frac{v_o}{v_i} = \left(1 + \frac{R_2}{R_1}\right) = \frac{1}{\beta}$$

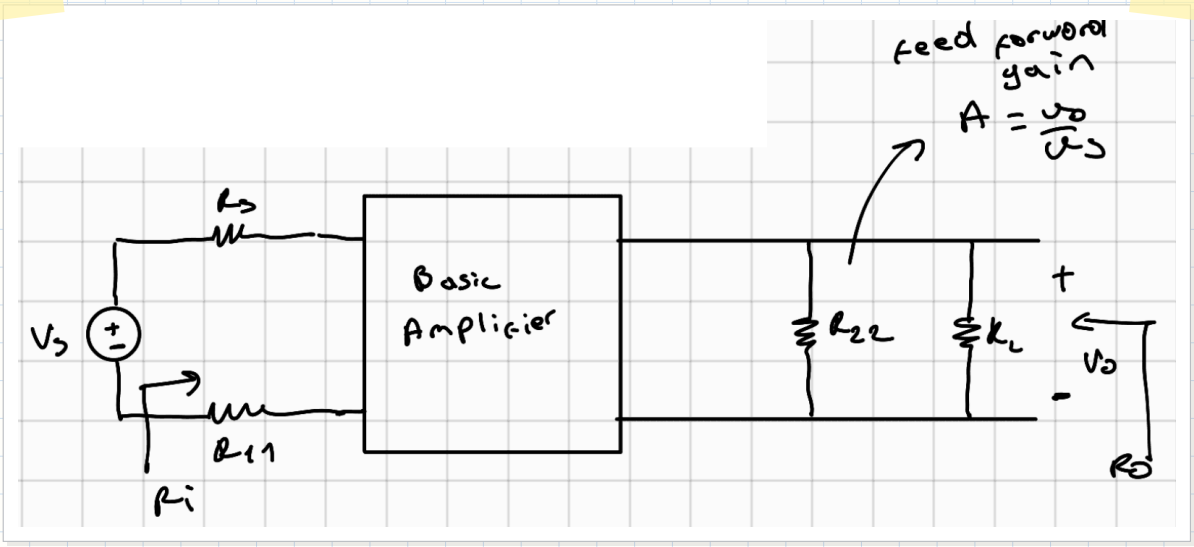
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1- Voltage Amplifiers (Shunt (o) – Series (I))

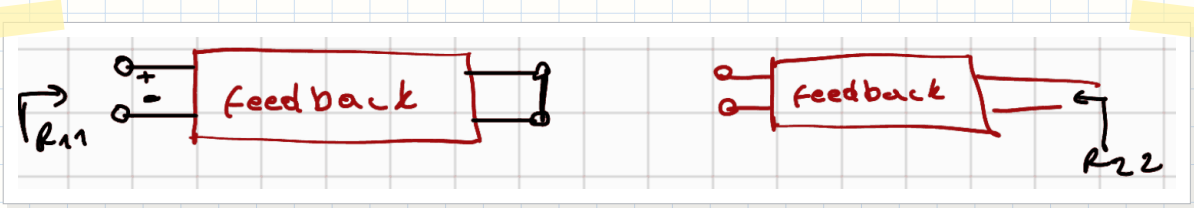


original drawing, p. 6

Two port network equivalent

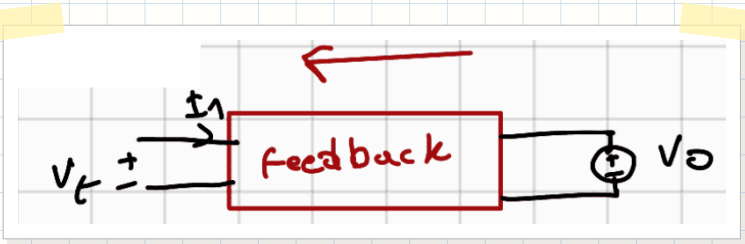


original drawing, p. 6



original drawing, p. 6

To find β

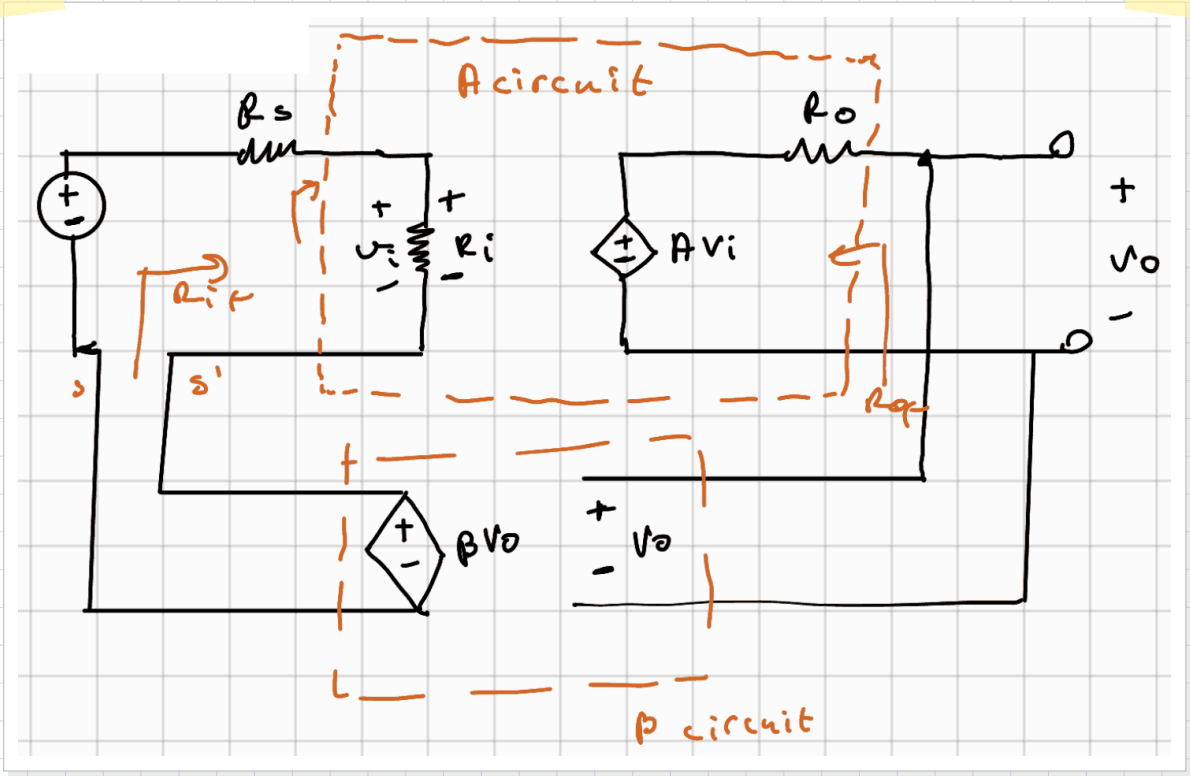


original drawing, p. 6

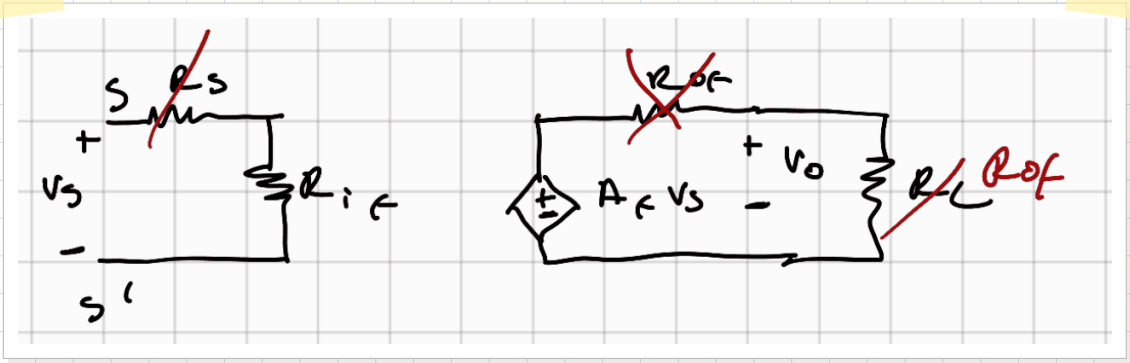
$$\beta = \left.\frac{V_f}{V_o}\right|_{I_1=0}$$

orig. p. 7

Complete model



original drawing, p. 7



original drawing, p. 7

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

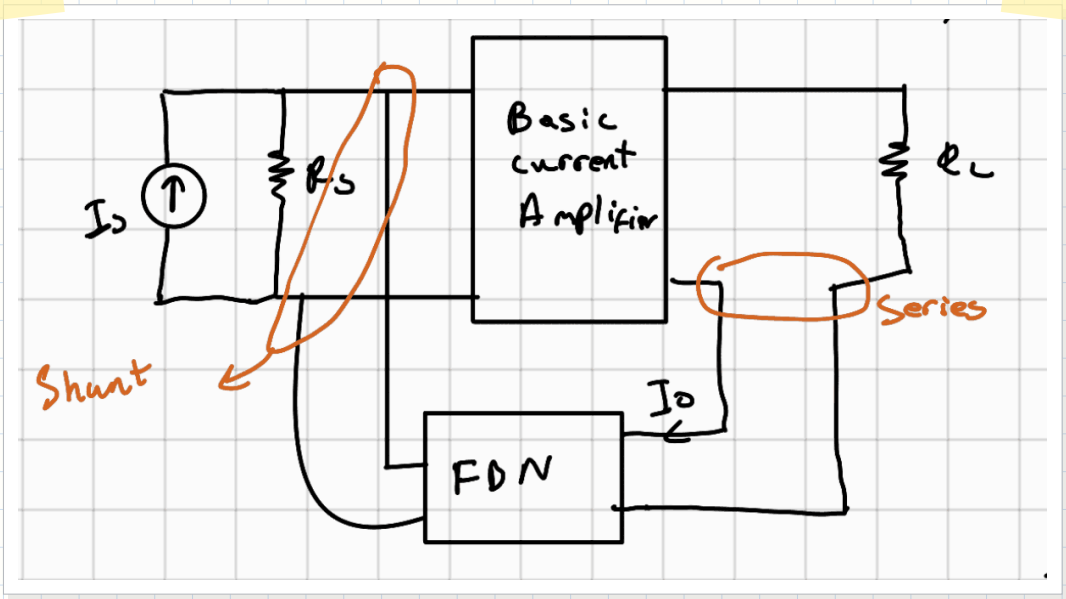
$$R_{if} = (1 + A\beta) R_i$$

$$R_{of} = \frac{R_o}{1 + A\beta}$$

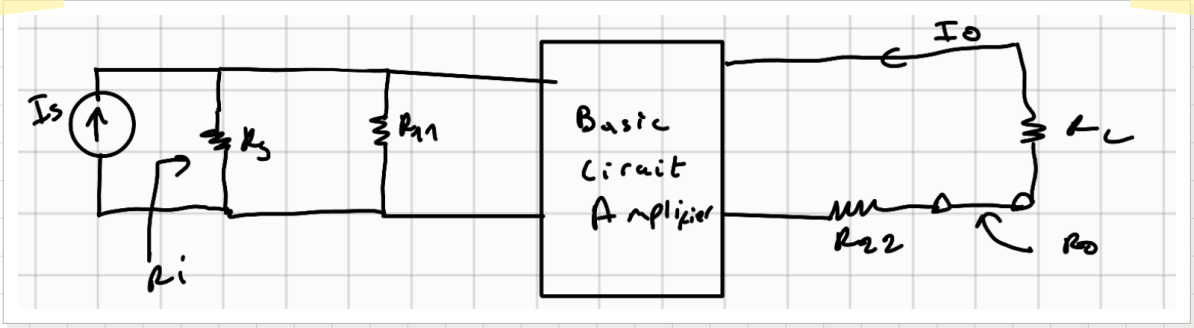
orig. p. 8

2- Current Amplifiers (Series (o) – Shunt (I))

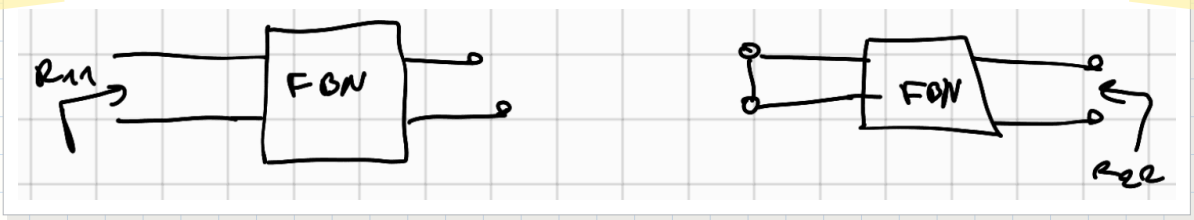
$$A = \frac{I_o}{I_i}$$



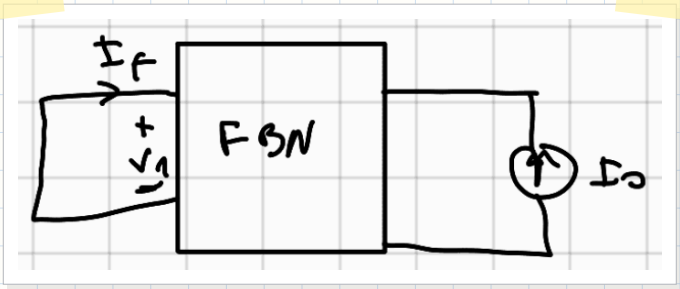
original drawing, p. 8



original drawing, p. 8

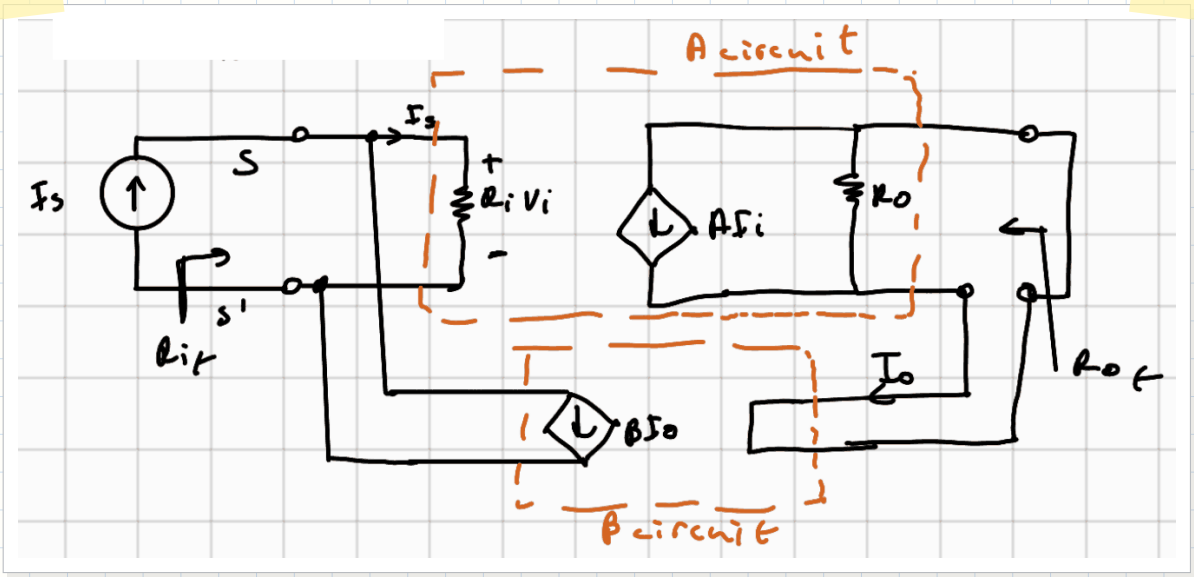


original drawing, p. 8



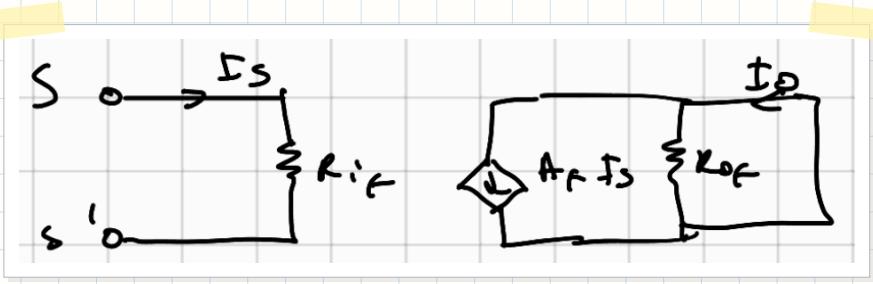
original drawing, p. 8

$$\beta = \left.\frac{I_f}{I_o}\right|_{V_1=0}$$



original drawing, p. 8

orig. p. 9



original drawing, p. 9

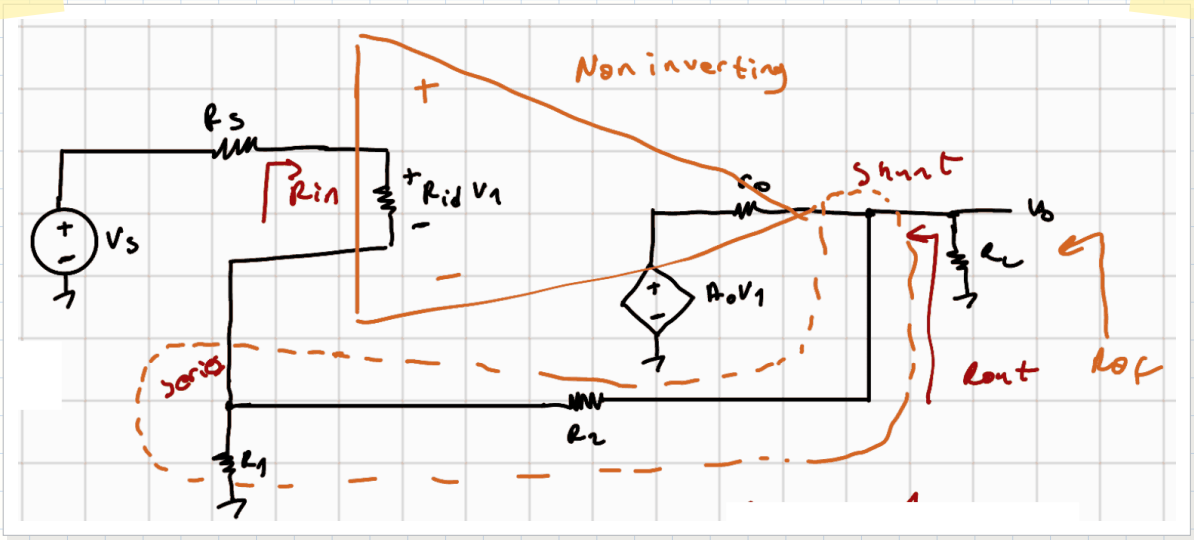
$$A_f = \frac{A}{1 + A\beta}$$

$$R_{if} = \frac{R_i}{1 + A\beta}$$

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

$$1 + \frac{R_2}{R_1} = 1001$$

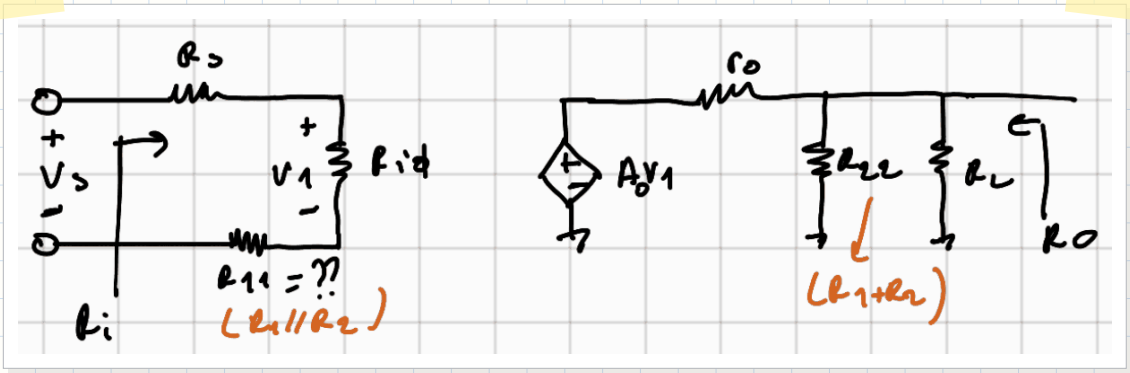
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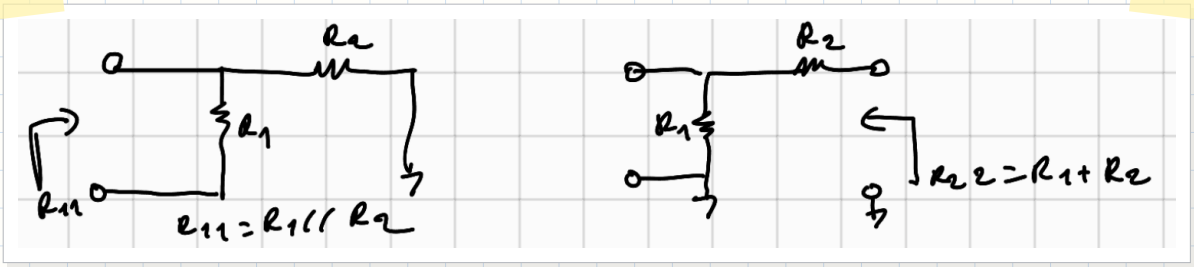
original drawing, p. 9

$$R_{in} = R_{if} - R_s \qquad R_{out} = \frac{1}{1/R_{of} - 1/R_L}$$

Find expressions for
A, β, A_f, R_i, R_{if}, R_{of}, and R_o
($A_o = 10^4$, $R_{id} = 100\,k\Omega$, $r_o = 1\,k\Omega$, $R_L = 2\,k\Omega$, $R_1 = 1\,k\Omega$, $R_2 = 1\,M\Omega$ and $R_s = 10\,k\Omega$)
Feedback-type : Shunt – Series



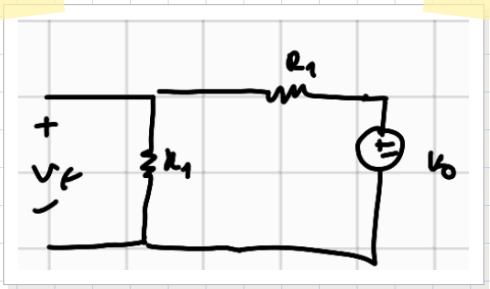
original drawing, p. 9



original drawing, p. 9

$$R_{11} = R_1 \parallel R_2 \qquad R_{22} = R_1 + R_2$$

orig. p. 10



original drawing, p. 10

$$\frac{v_f}{v_o} = \frac{R_1}{R_1 + R_2} = \beta$$

$$R_i = R_s + R_{id} + R_{11}$$
$$R_o = r_o \parallel R_{22} \parallel R_L$$

$$A = \underbrace{\frac{R_{id}}{R_i}}_{\frac{v_o}{v_s} = \frac{v_1}{v_s}} \cdot \underbrace{\frac{R_{22} \parallel R_L}{r_o + R_{22} \parallel R_L}}_{\frac{v_o}{v_1}\text{ katkıları}} \cdot A_o$$

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

$$A = \frac{100\,k\Omega}{111\,k\Omega} \cdot \frac{2\,k\Omega}{3\,k\Omega} \cdot 10^4 \approx 6000\ [V/V]$$

$R_i = 111k$
$R_o = 0{,}60k$

$$\beta = \frac{R_1}{R_1 + R_2} = 10^{-3}\ [V/V]$$
$$1 + A\beta = 1 + 6000 \cdot 10^{-3} = 7$$
$$A_f = \frac{6000}{7} = 857\ [V/V]$$

$$R_{if} = (1 + A\beta)\overset{111k}{R_i} = 777\,k\Omega$$

$$R_{of} = \frac{R_o}{(1 + A\beta)} \approx 93\,\Omega$$