UESTC 3003: Electronic System Design
Static Errors

Lecture 2.4: Bias Current Blues(2)

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Thanks to Prof. Duncan Bremner

WORLD CHANGING GLASGOW

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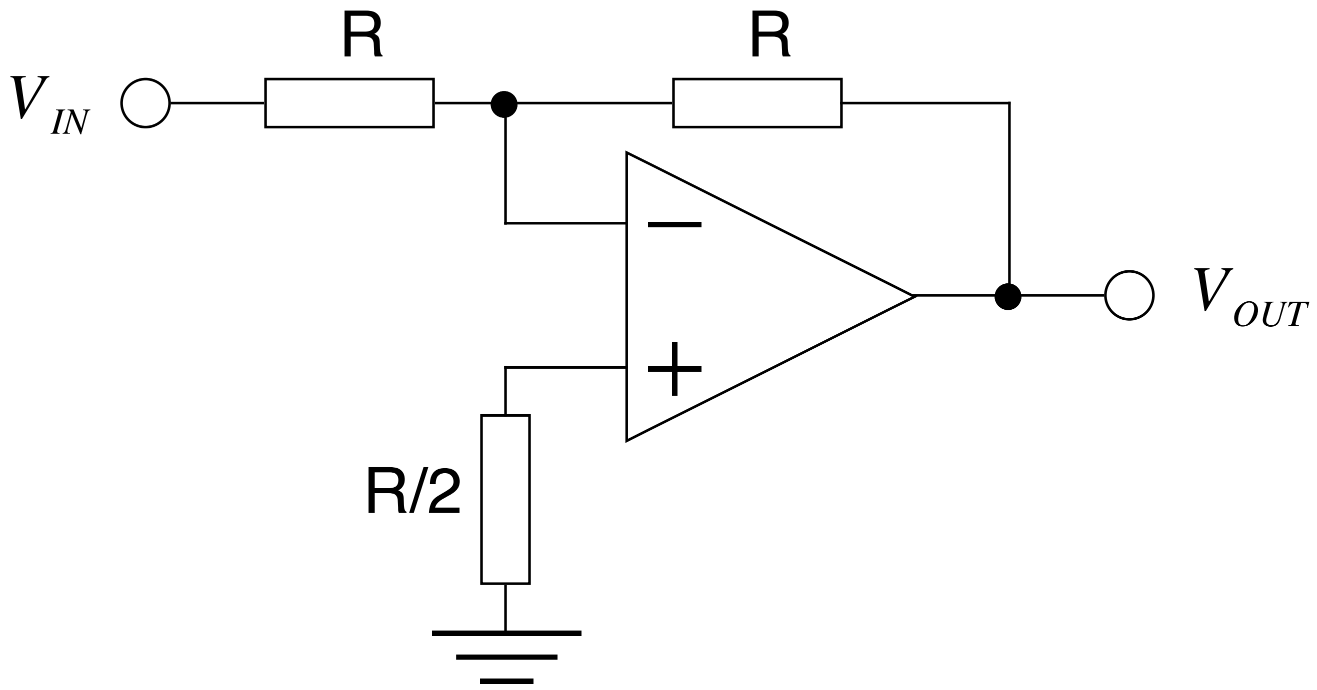
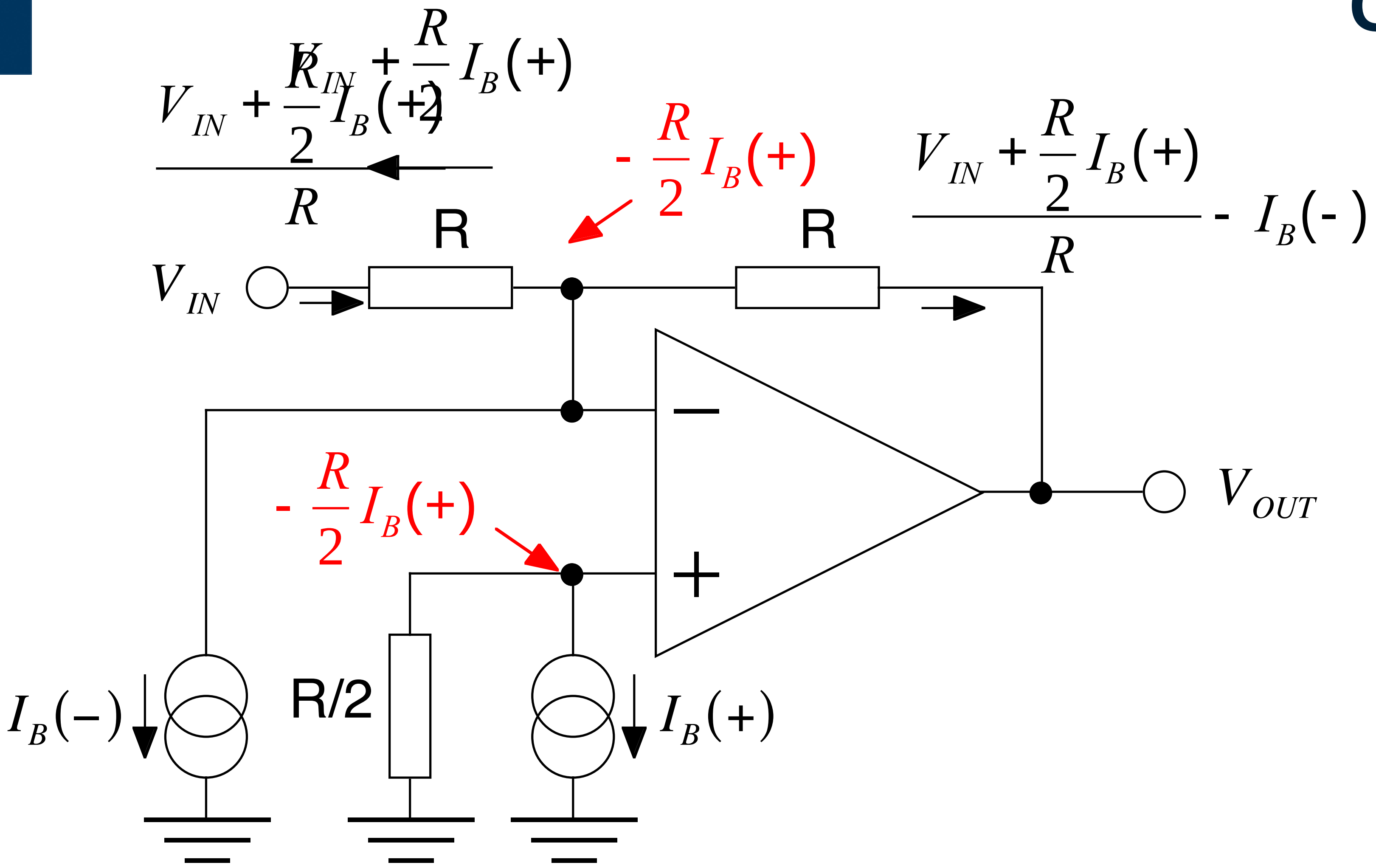
A Cool Fix (If currents are Equal)



Make DC resistances equal at both inputs

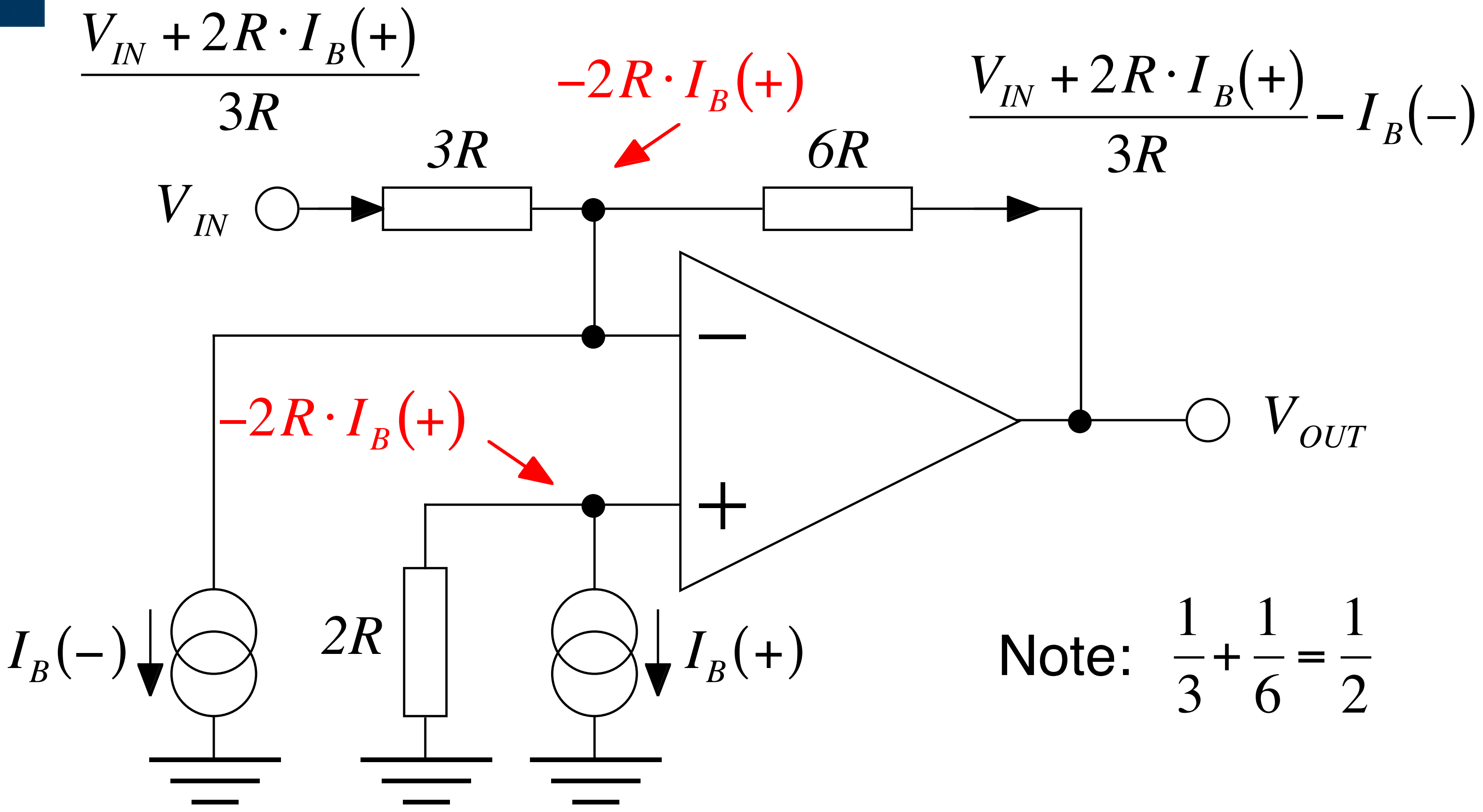
(NOTE: Take care if there are inductors or capacitors about!)

Compensating for Equal Bias Currents



$$V_{OUT} = -\frac{R}{2} I_B(+) - V_{IN} - \frac{R}{2} I_B(+) + R I_B(-) \quad = -V_{IN} + R\left(I_B(-) - I_B(+)\right)$$

Equal Bias Currents and Gain



Note: $\frac{1}{3} + \frac{1}{6} = \frac{1}{2}$

$$V_{OUT} = -2R \cdot I_B(+) - \frac{6RV_{IN}}{3R} - \frac{6R \cdot 2R \cdot I_B(+)}{3R} + 6R \cdot I_B(-)$$

$$= -2V_{IN} - 6R \cdot I_B(+) + 6R \cdot I_B(-) = -2V_{IN} + 6R\left(I_B(-) - I_B(+)\right)$$

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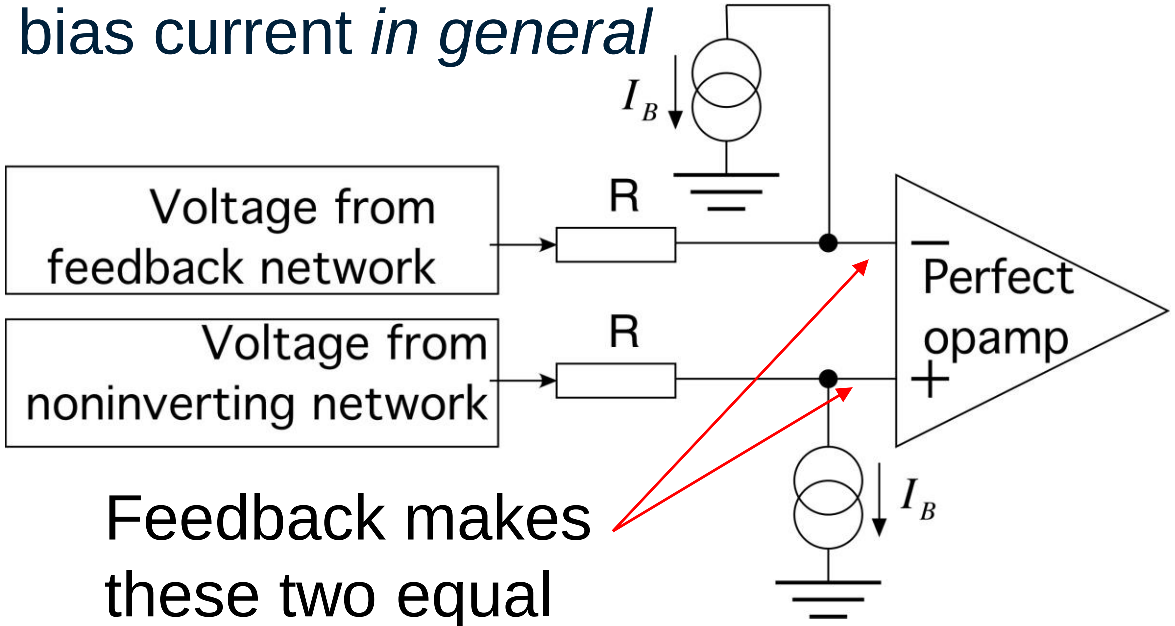
Equal Bias Currents

Equal source impedances compensate
for bias current *in general*

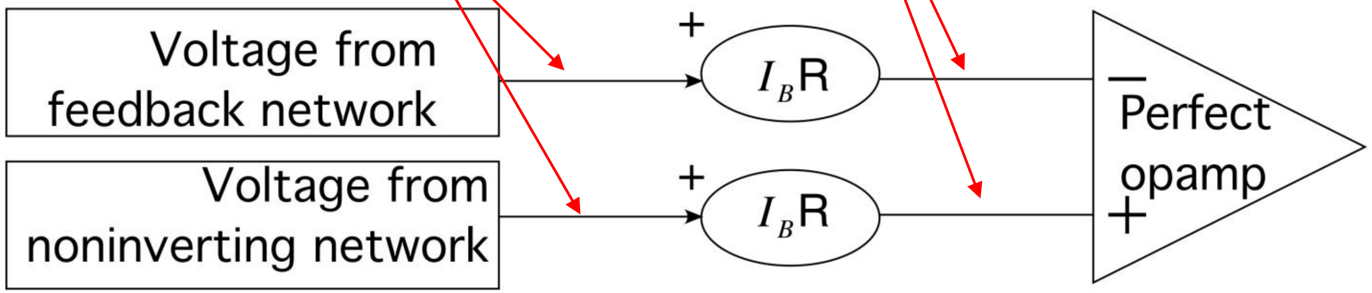
R is the Thevenin
Equivalent source
resistance of the
associated network



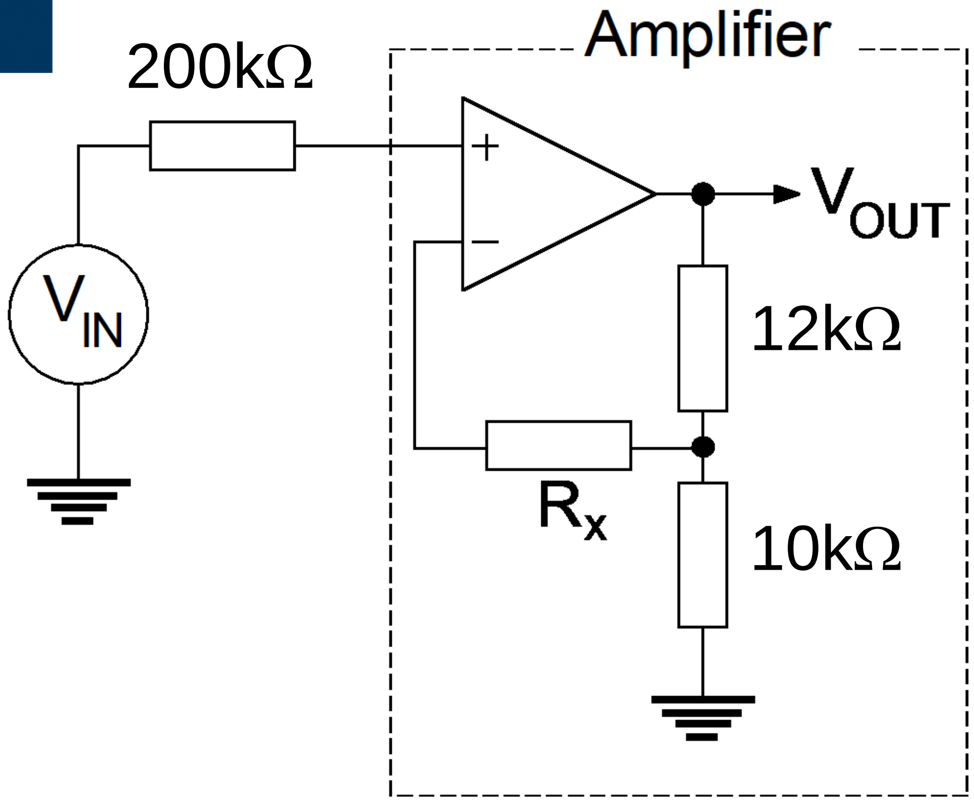
Feedback makes
these two equal

So Voltage from FB network
Still equals the voltage from
the noninverting network

Is equivalent to



Bias Current Problem



1. What is the required Value of R_x to cancel the effect of I_b at the output?

2. If I_b = 120nA and R_x = 200k, what is the Voltage error present at the output?

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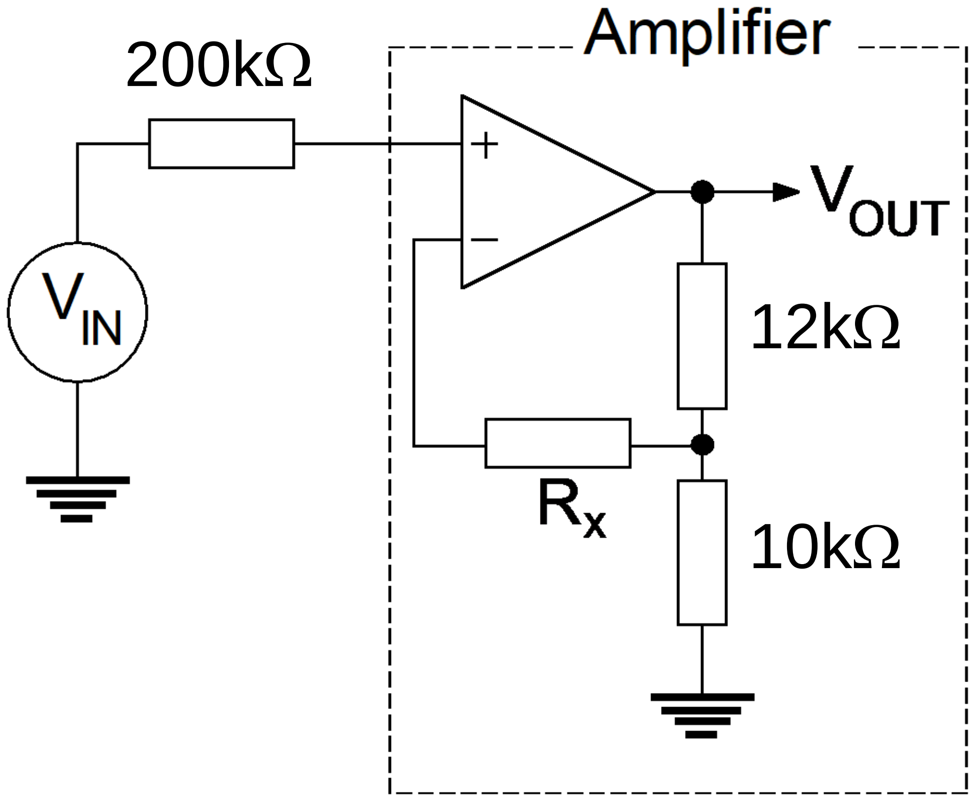


1. 10kΩ // 12kΩ = 5.5 kΩ

Rx+5.5kΩ = 200kΩ, Rx = 194.5kΩ

2. V(+) = 120nA × 200kΩ = 24mV

Equivalent feedback R_f = 200kΩ + 5.5kΩ =205.5kΩ

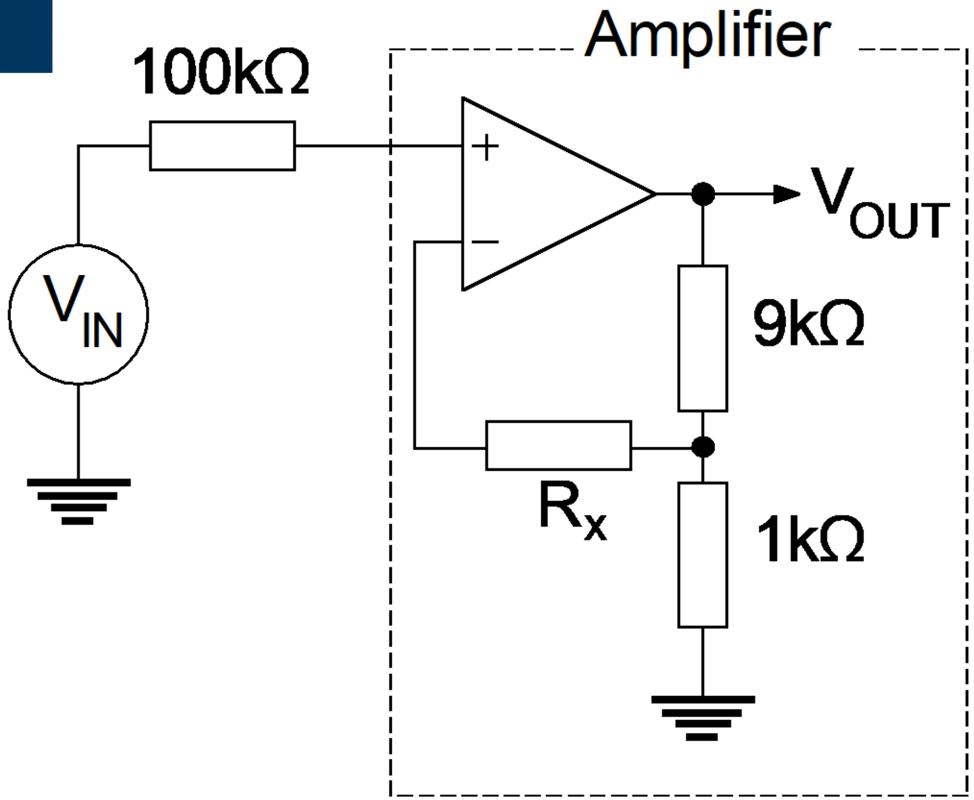
V(-) = 205.5kΩ × 120nA = 24.66mV

ΔV = 0.66mV

$$\text{Gain} = \left(\frac{10}{10+12}\right)^{-1} = 2.2$$

V_{out} error = 2.2 × 0.66 = 1.452mV

Noninverting



What is the required Value of R_x?

Need 1k // 9k + R_x = 100kΩ R_x = 100kΩ – 0.9kΩ = 99.1kΩ

Exercise: Show that this works! [Use Ib(+) = Ib(-) = 150nA]

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Thank you

谢谢

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