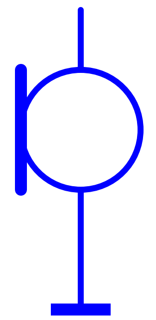
Structured Electronic Design

Amplifier Biasing Example

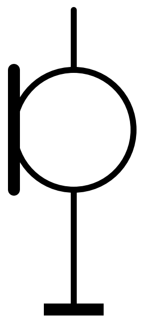
Anton J.M. Montagne

Biasing Example



Microphone:

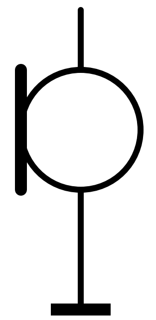
Biasing Example



Microphone:

- one-sided connected to ground

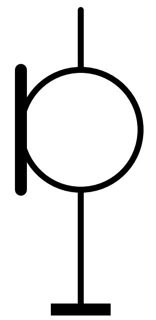
Biasing Example



Microphone:

- one-sided connected to ground
- open-circuit output voltage is related to sound pressure

Biasing Example



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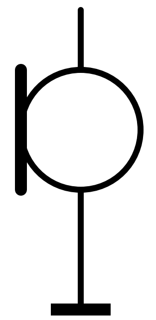

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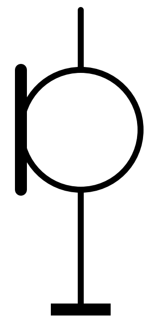

Microphone:

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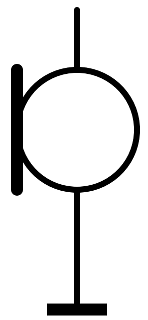
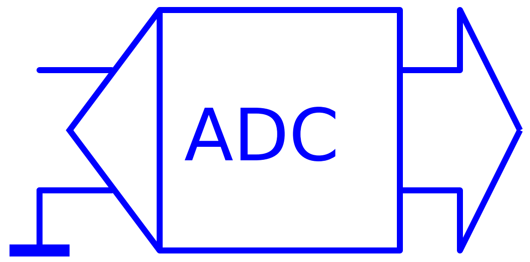
- signal frequency components 20Hz ... 20kHz

Biasing Example



ADC:



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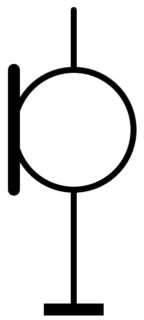

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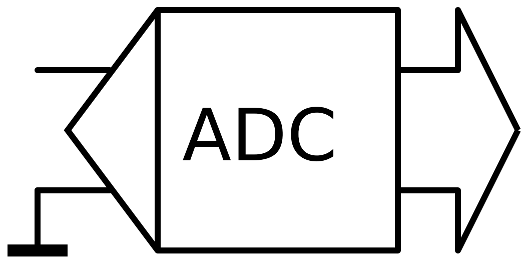

- grounded input

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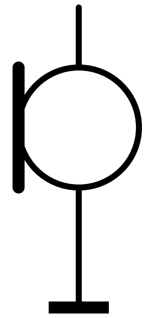

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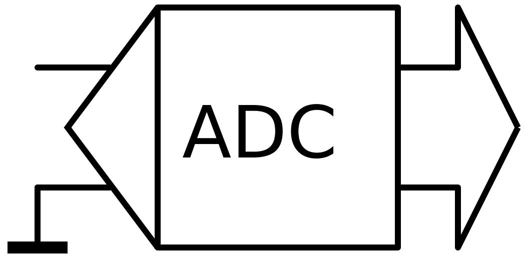
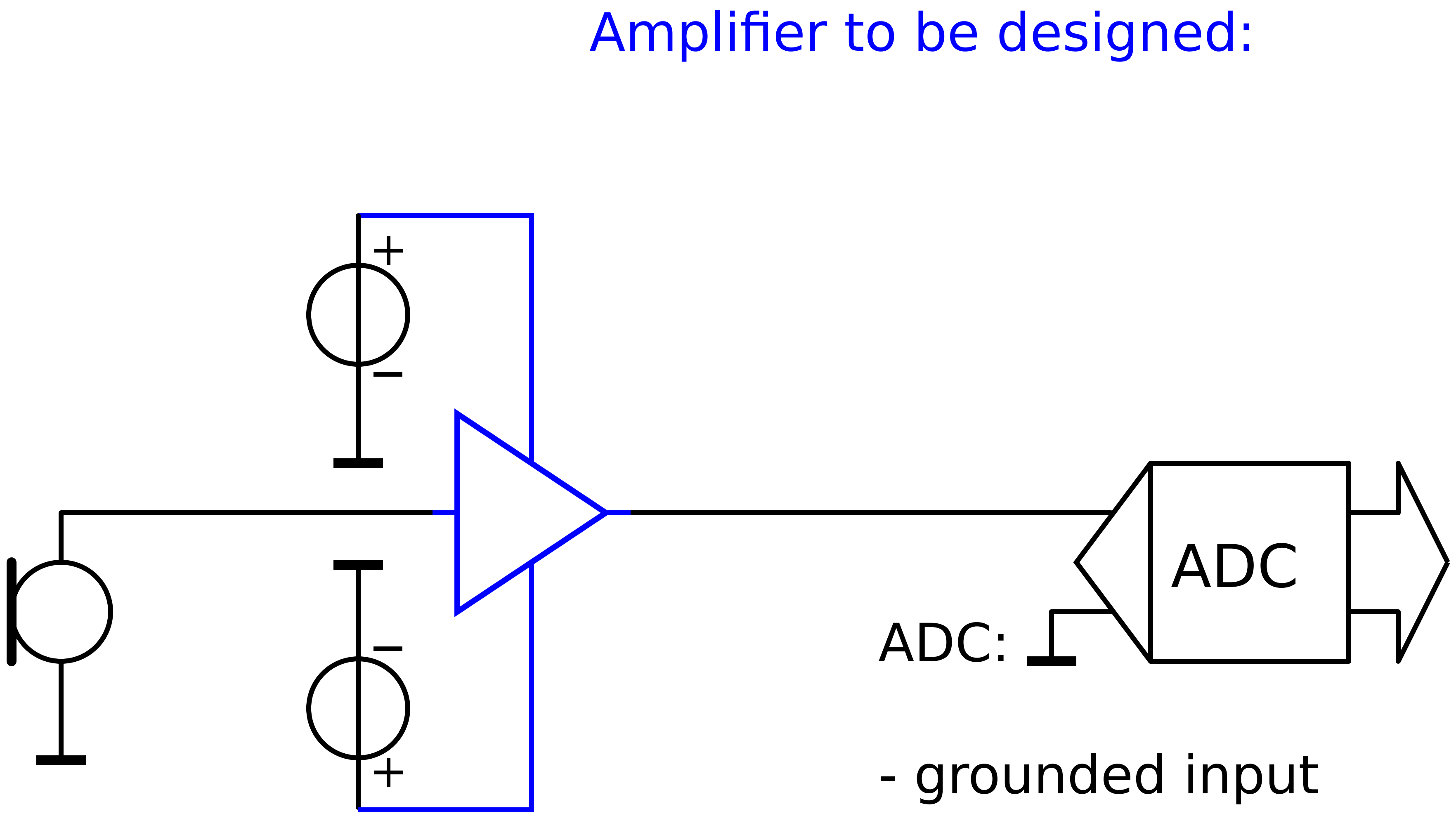


- grounded input
- input voltage range 0...4V

Biasing Example



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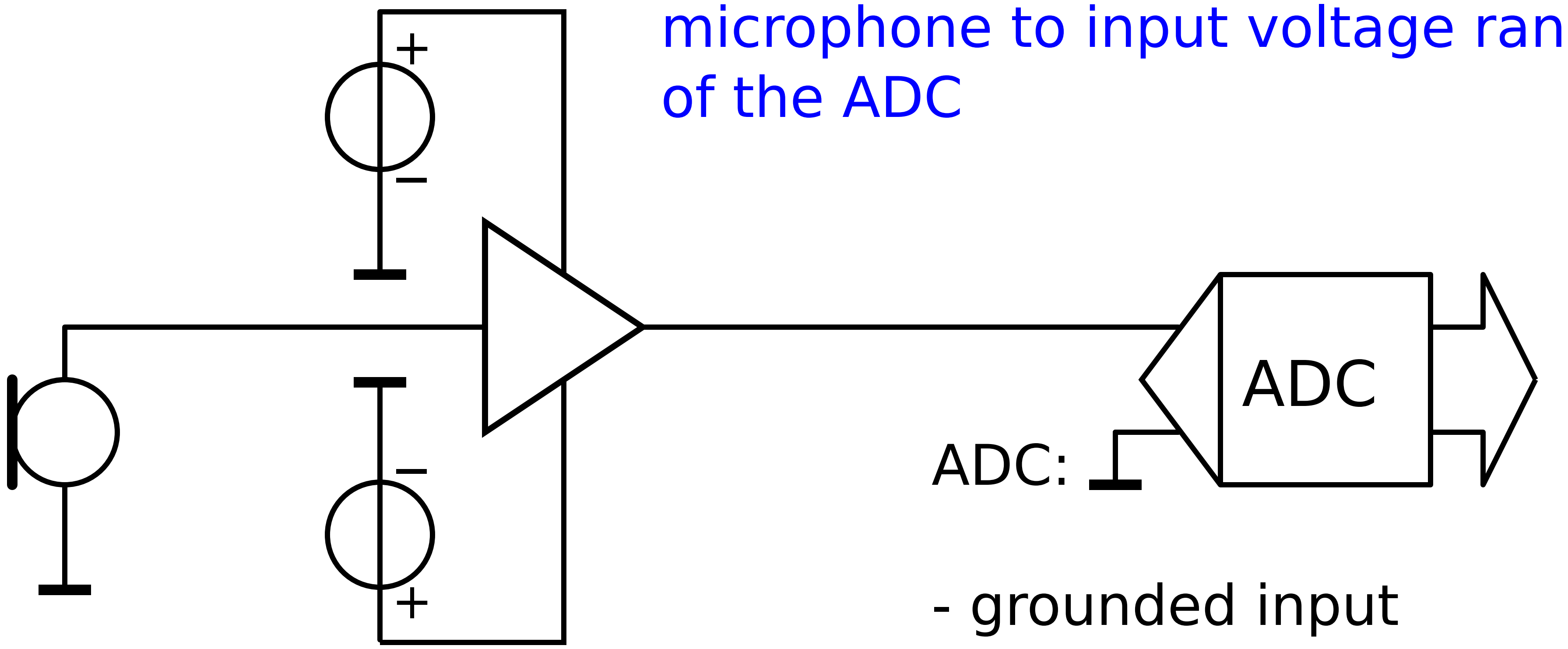
Biasing Example

Amplifier to be designed:

- Adapts output voltage range of the microphone to input voltage range of the ADC



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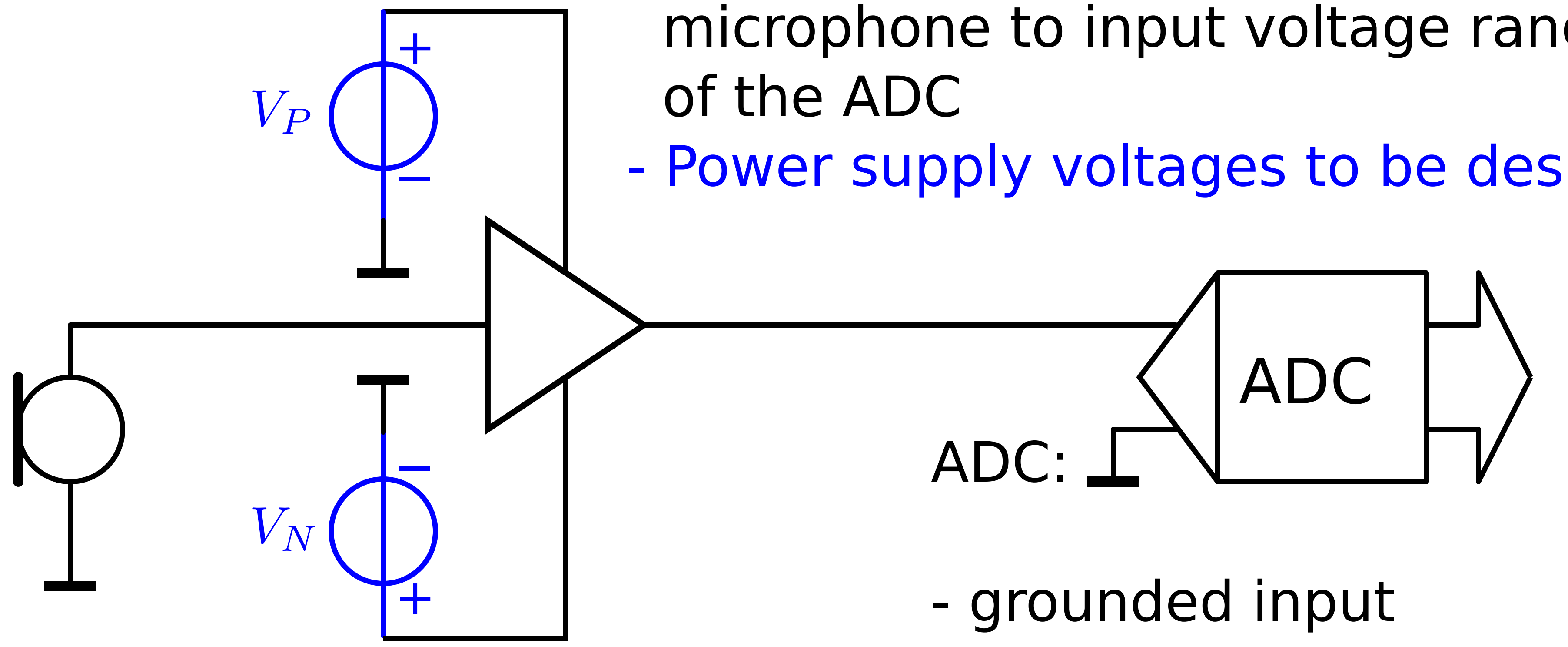

Amplifier to be designed:

- Adapts output voltage range of the microphone to input voltage range of the ADC
- Power supply voltages to be designed

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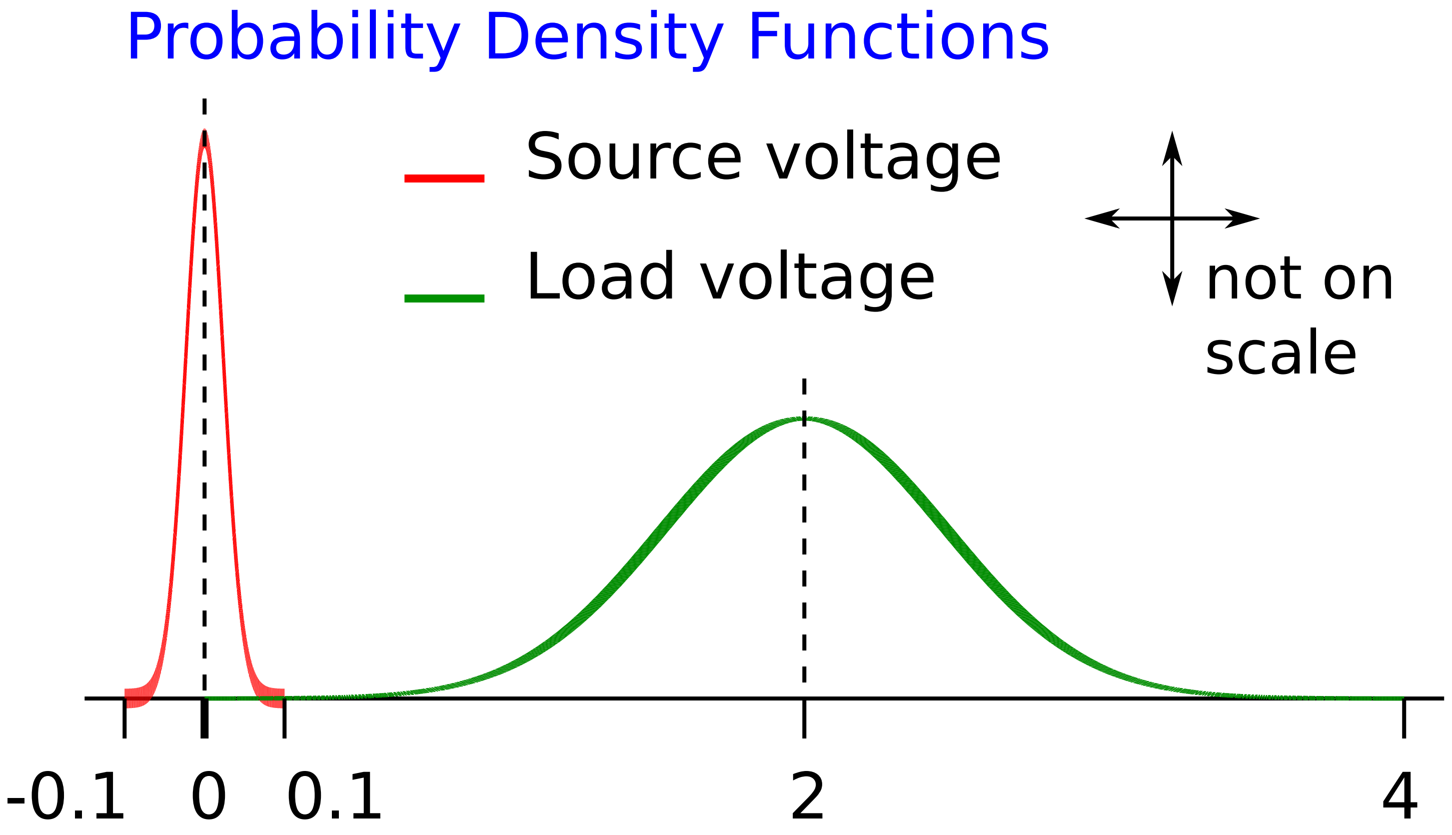

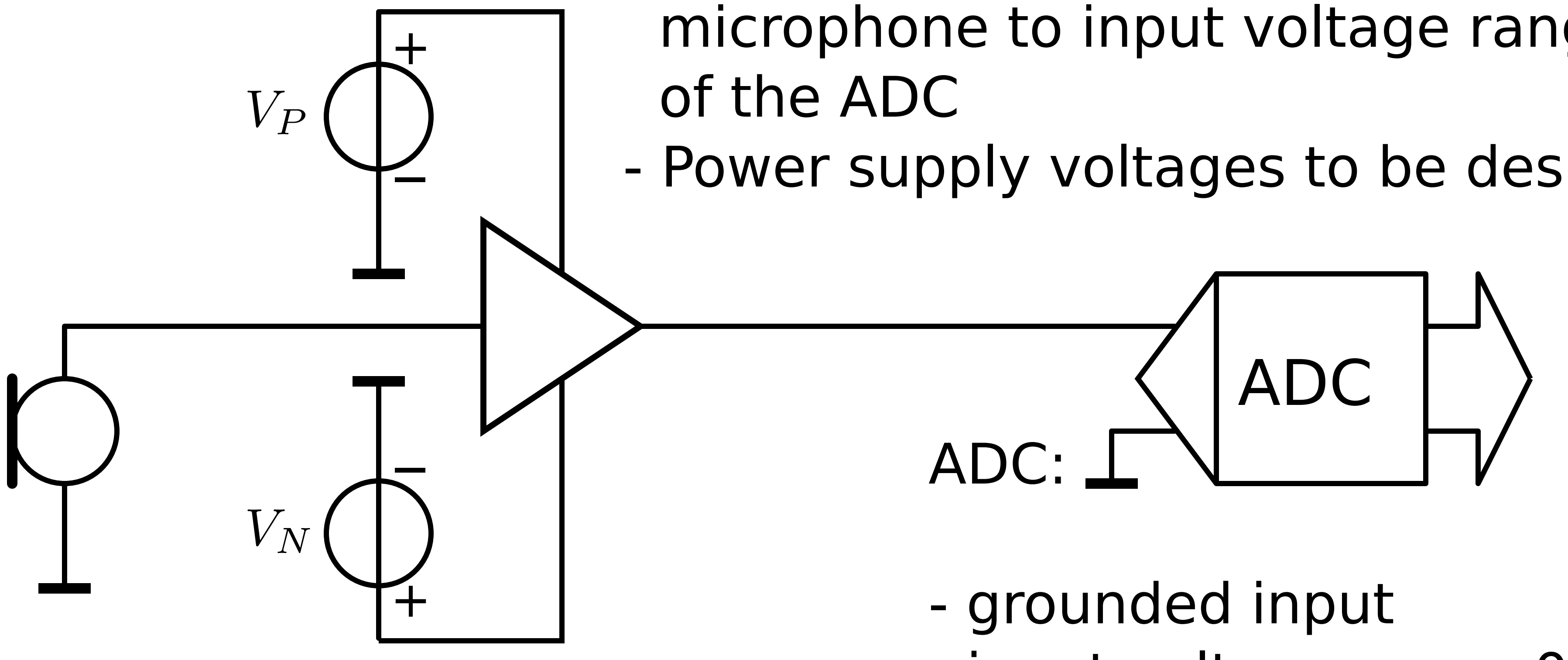

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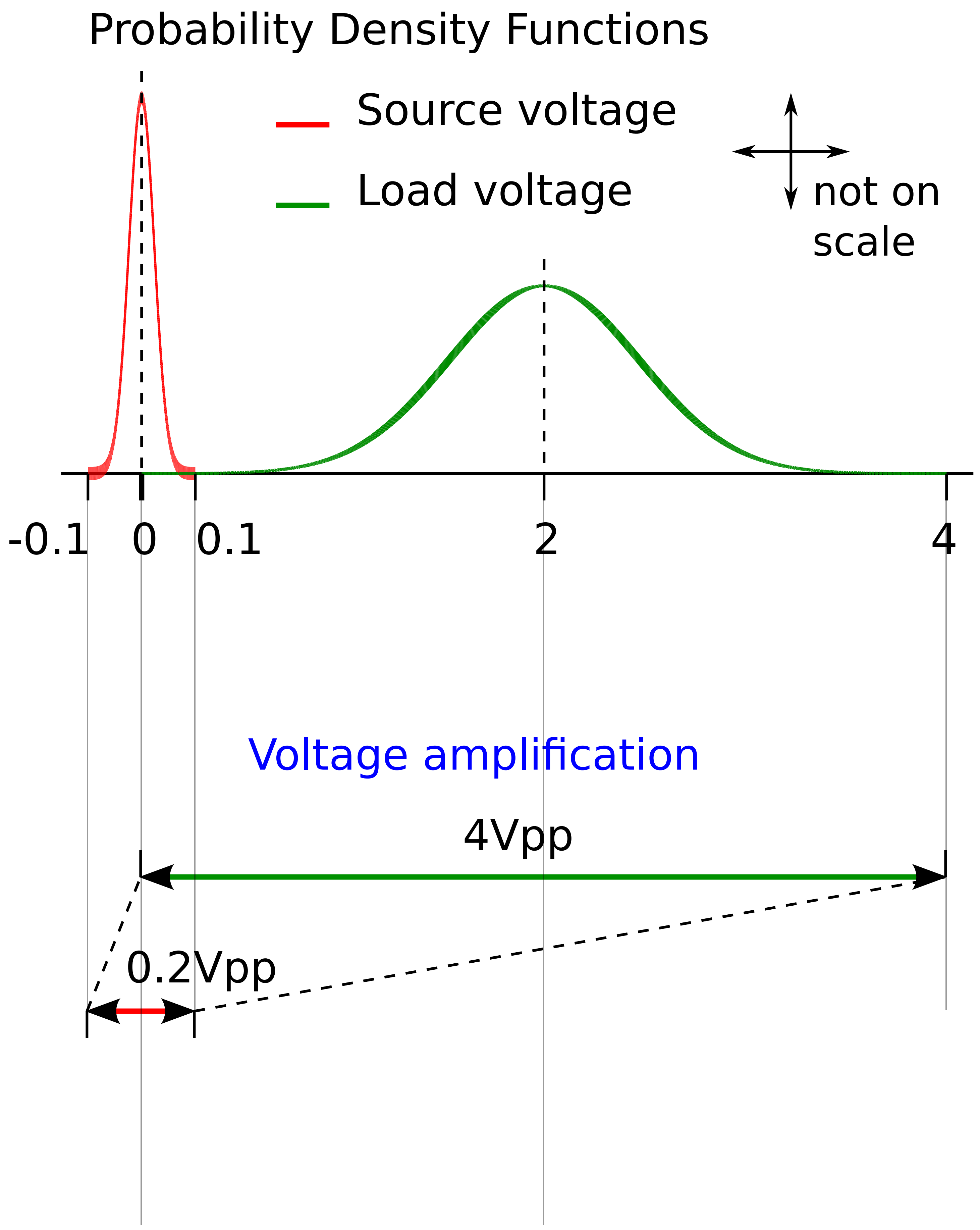

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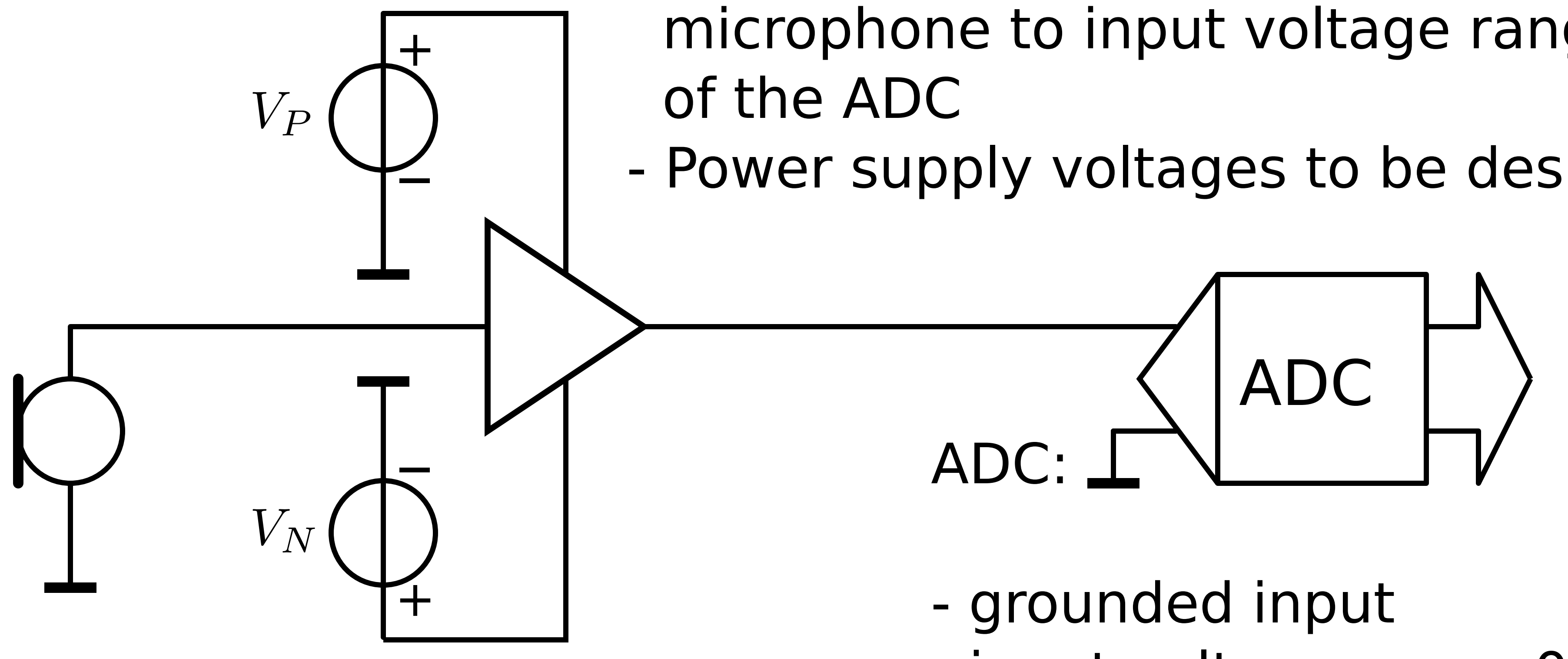

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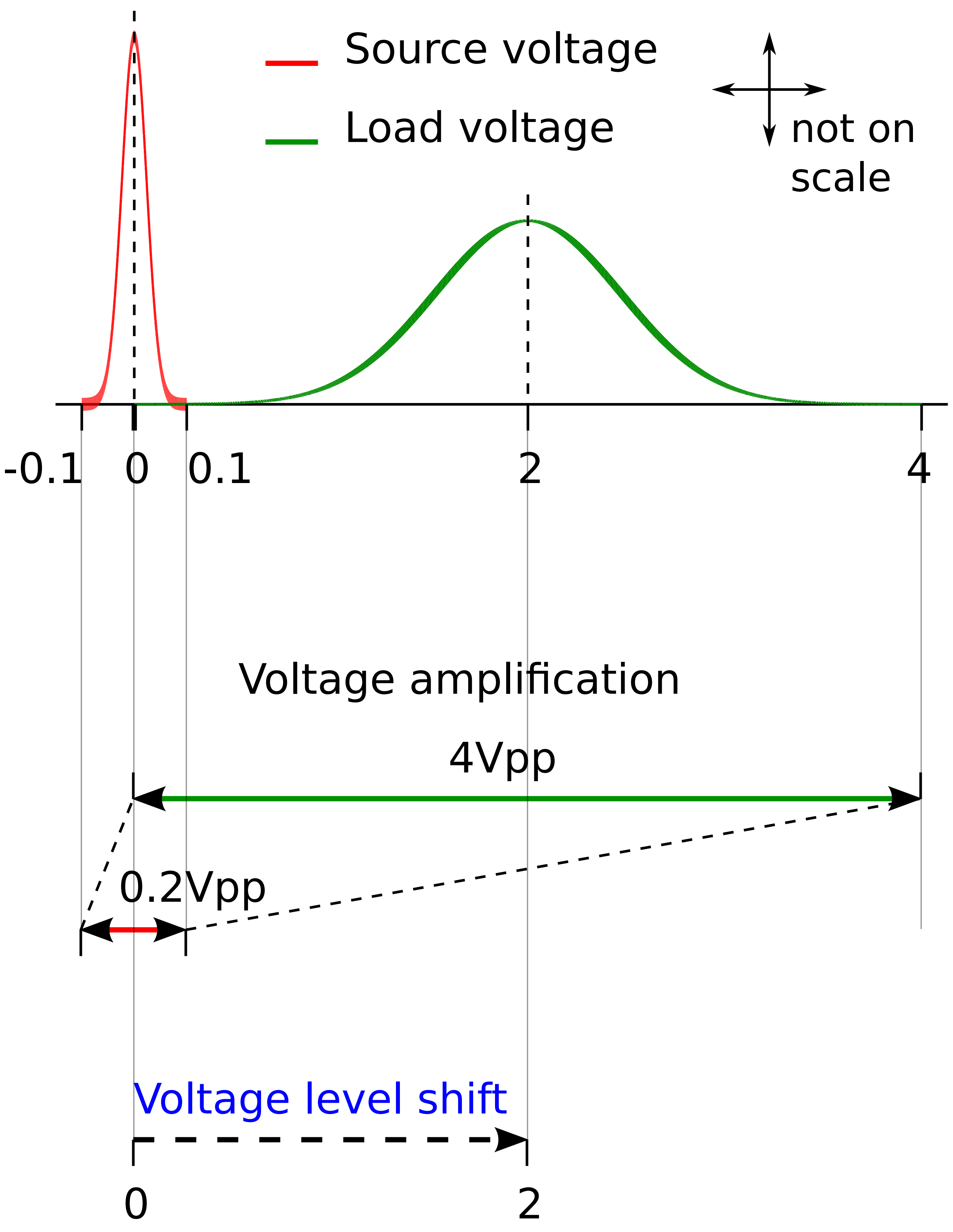
Biasing Example

Probability Density Functions



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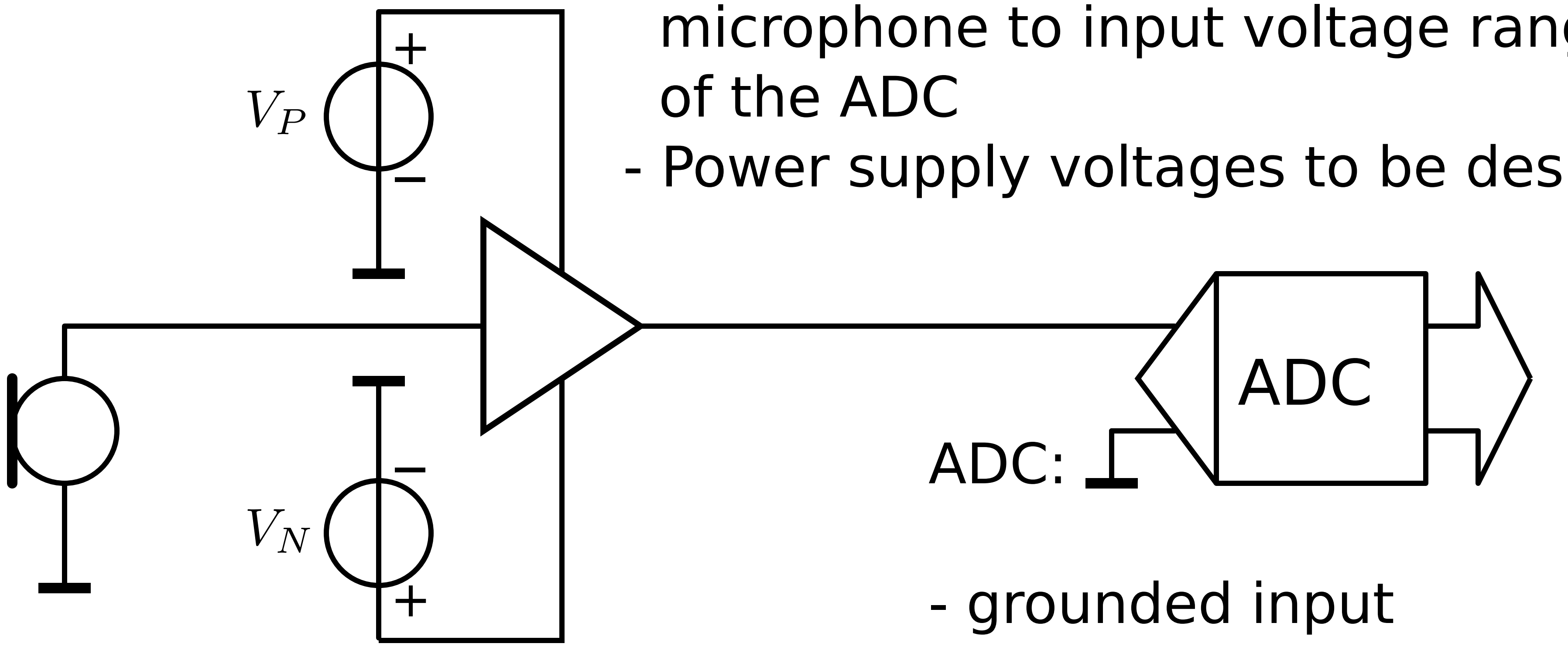

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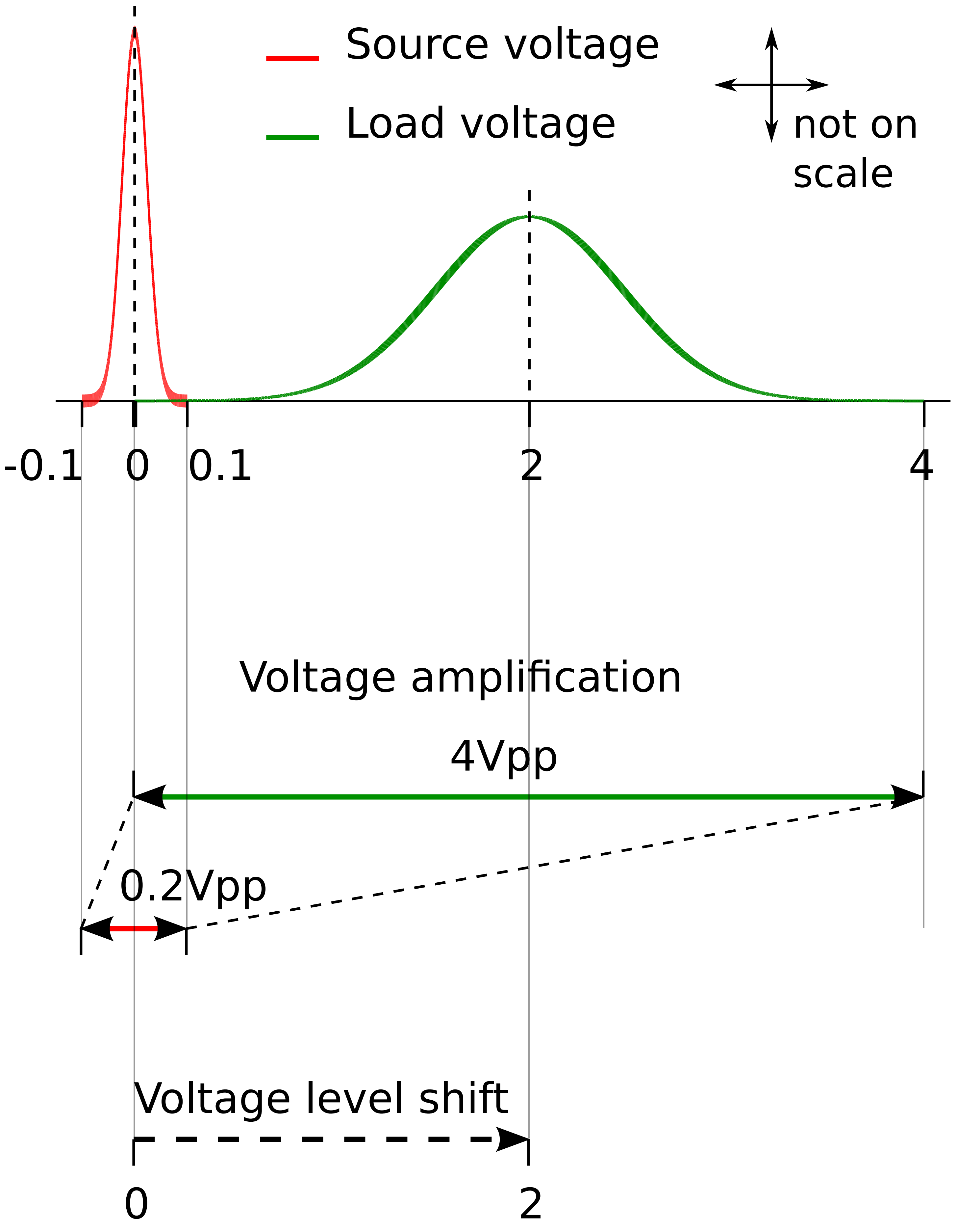

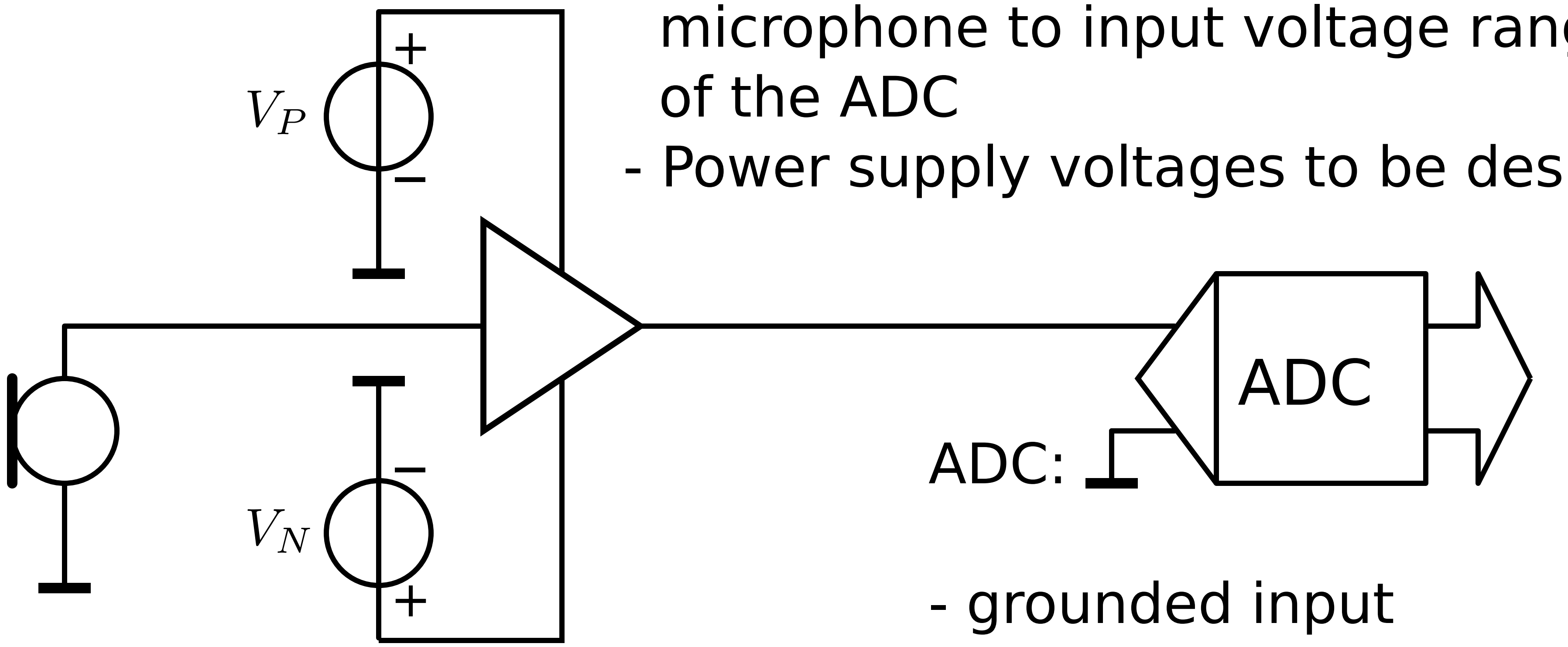

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Initial Bias

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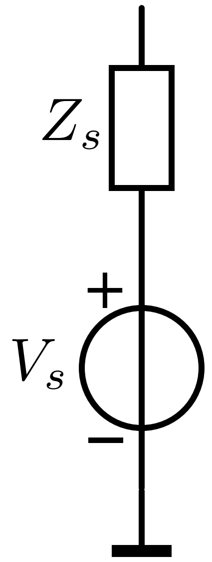
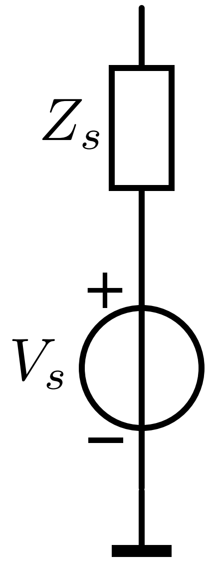


Source
model

Initial Bias



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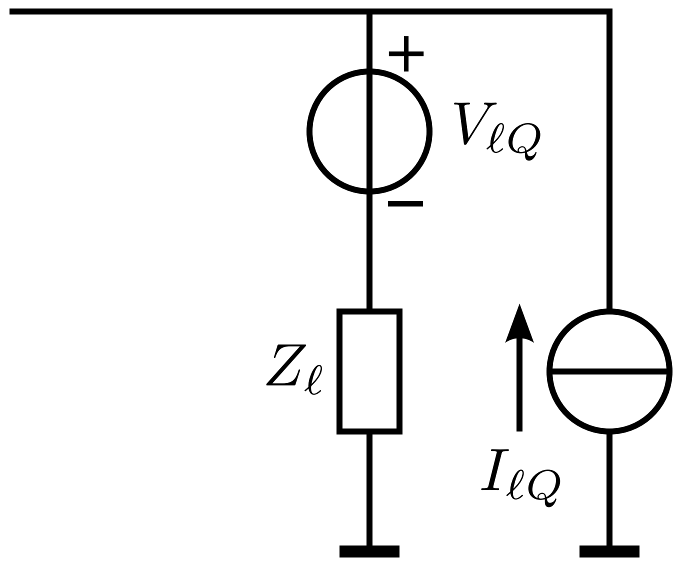
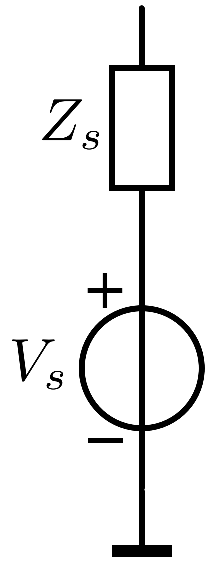
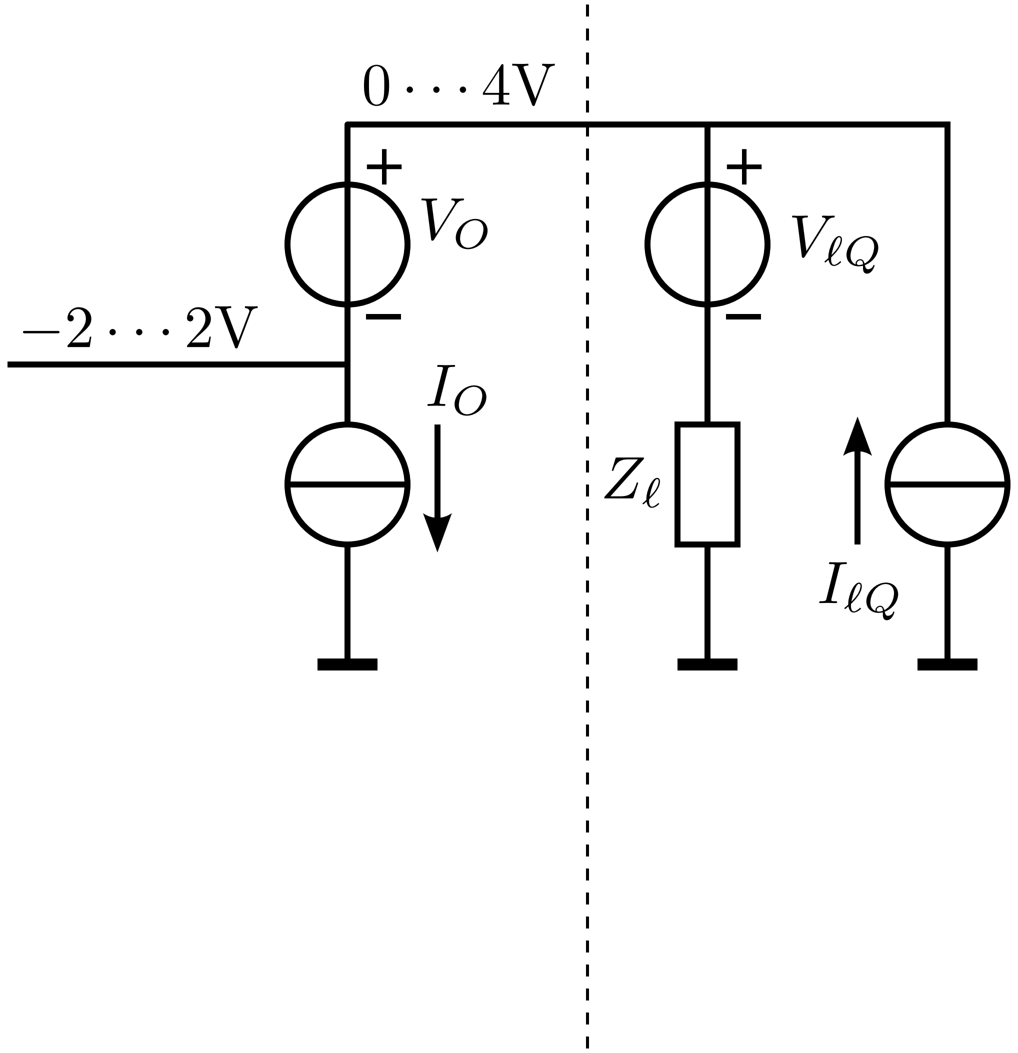


ADC input
model

Initial Bias



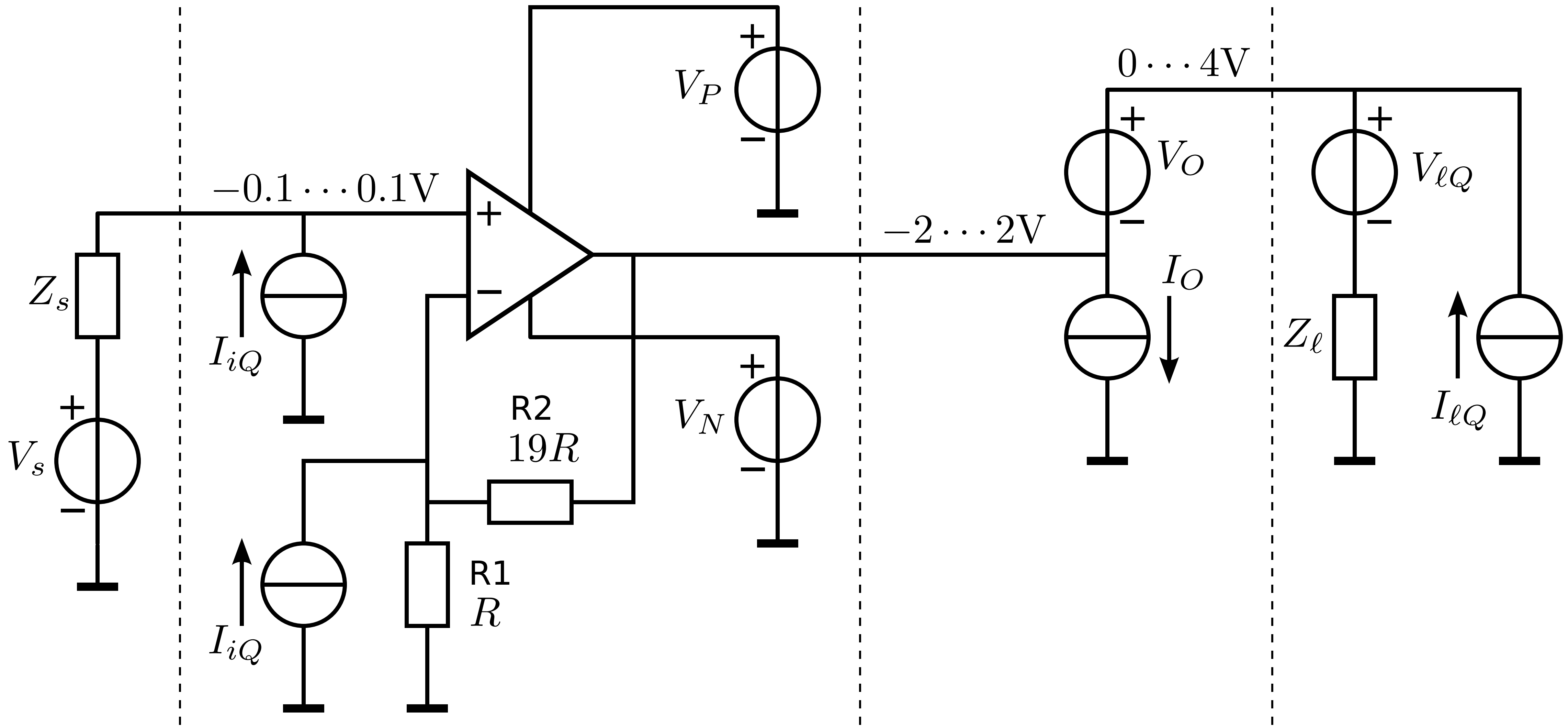


Source model

ADC bias compensation

ADC input model

Initial Bias



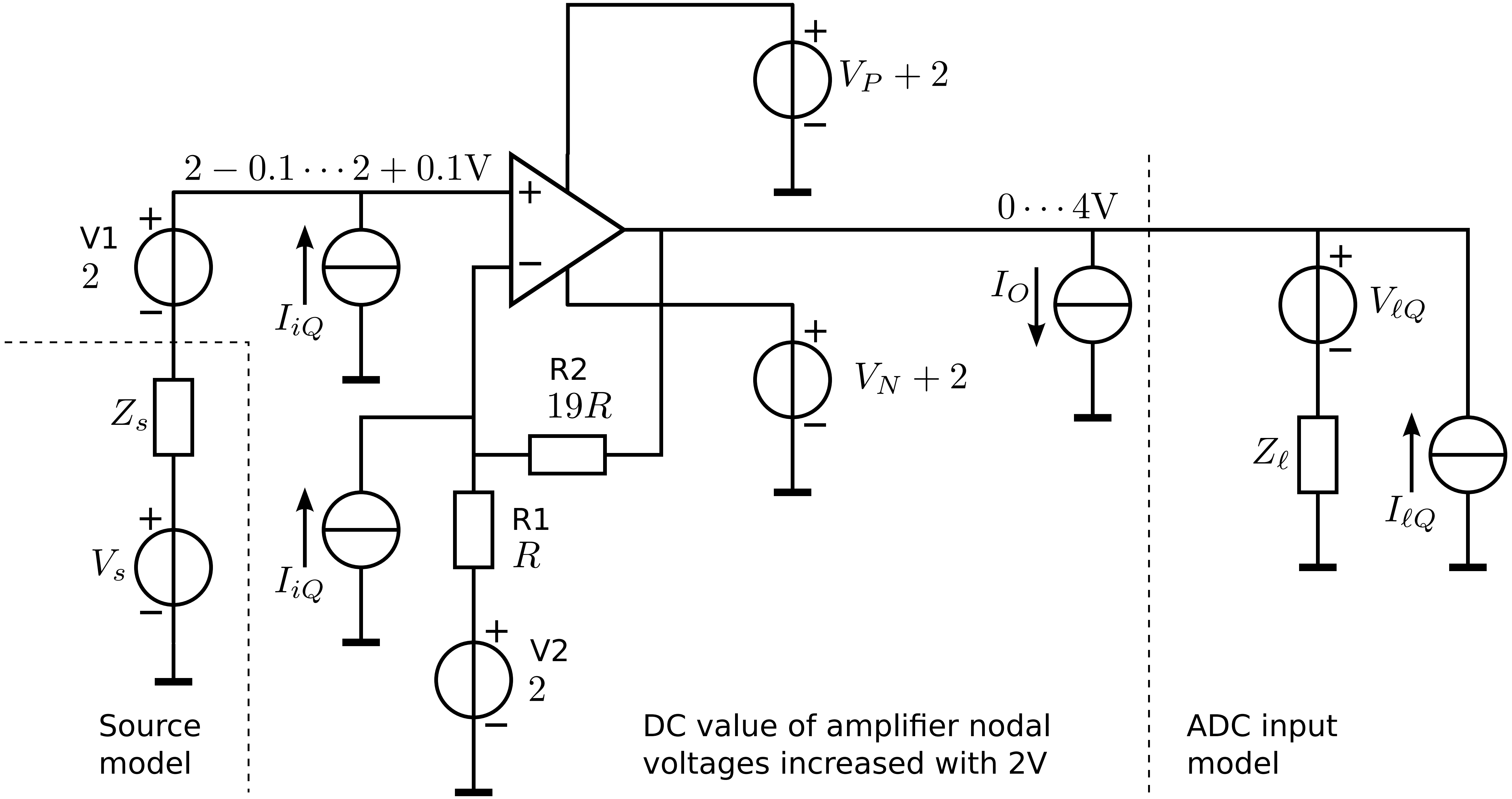
Source model

Amplifier with power supplies and bias current compensation

ADC bias compensation

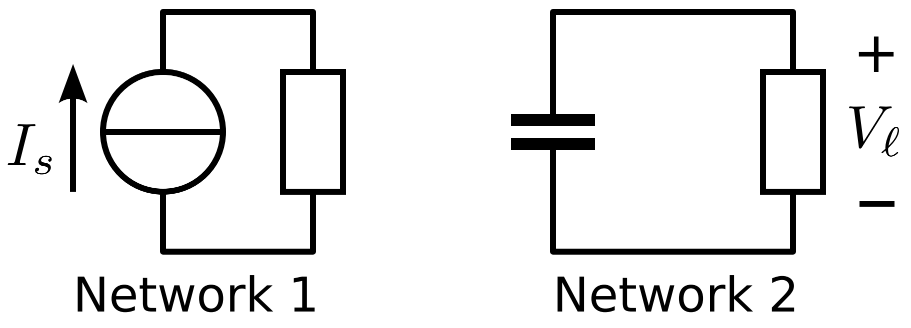
ADC input model

Add level shift



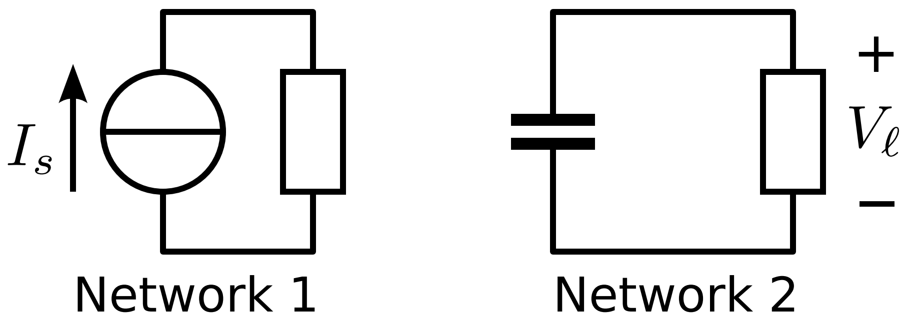
AC coupling

AC coupling



Disconnected
no coupling

AC coupling



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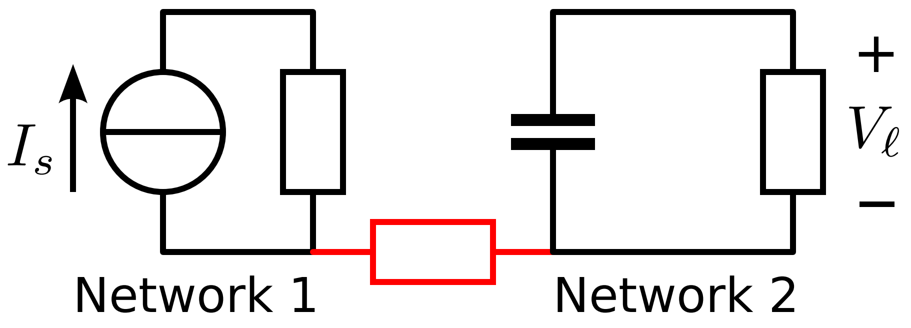

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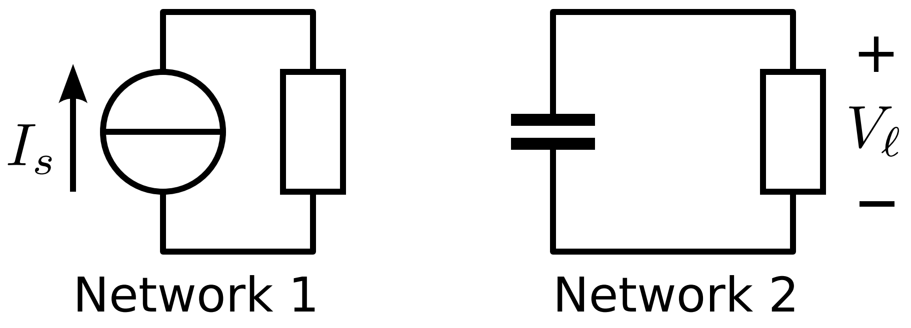

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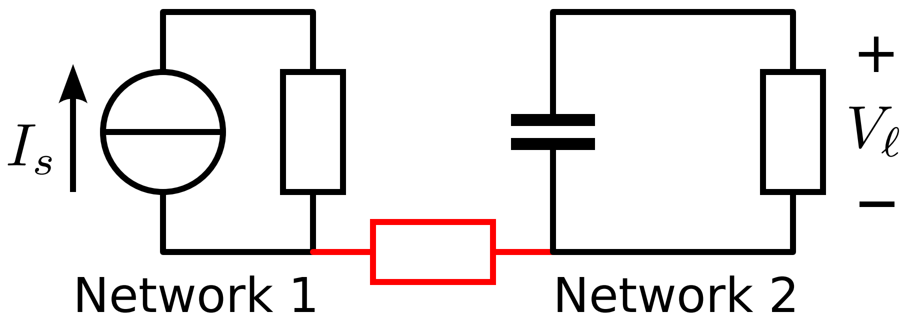

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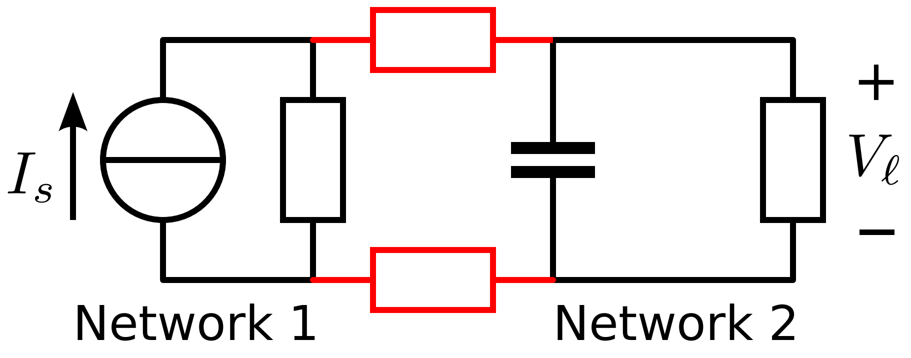
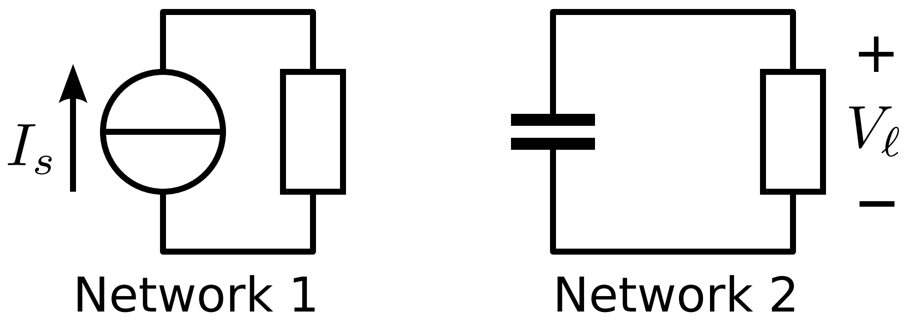


Connected
DC coupling

AC coupling



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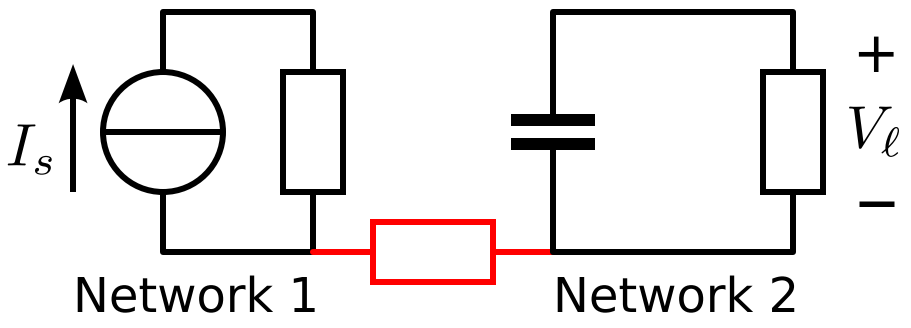

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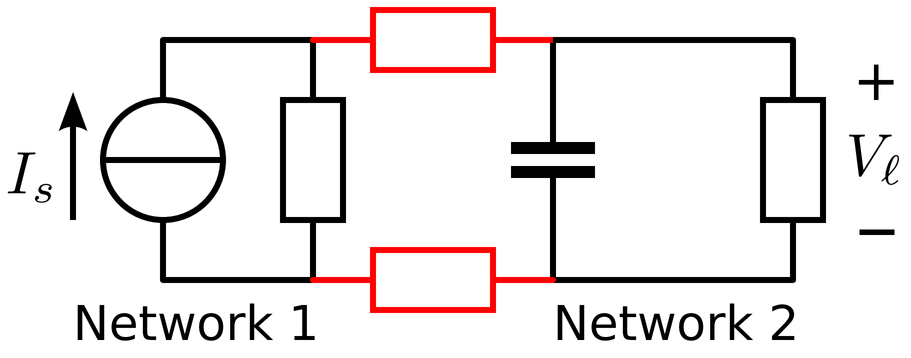

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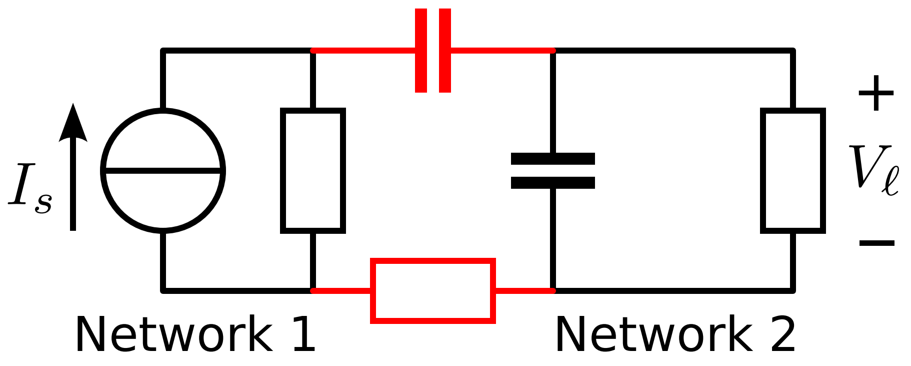

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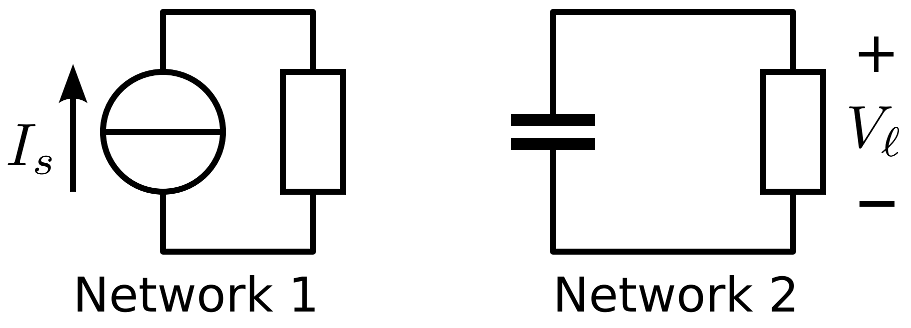

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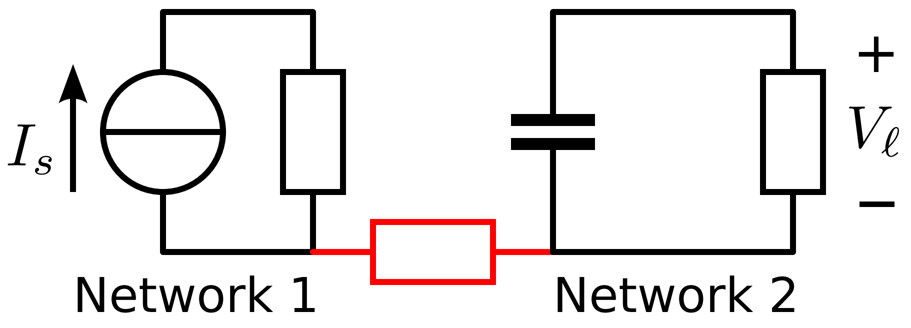

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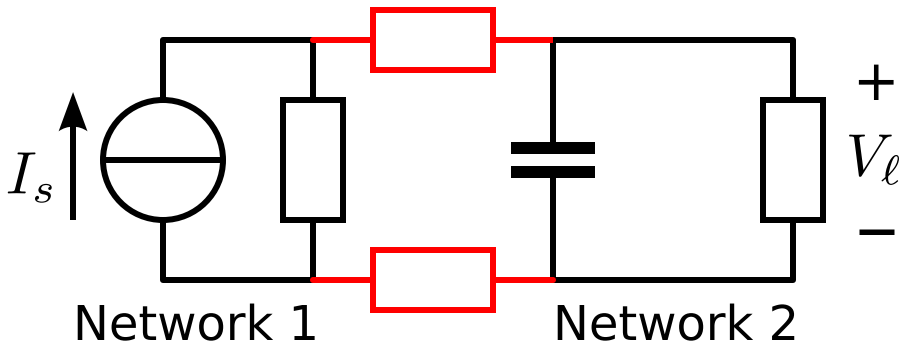

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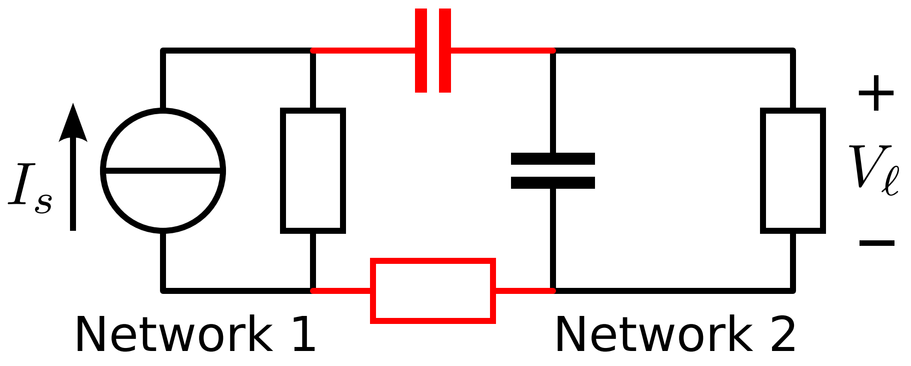

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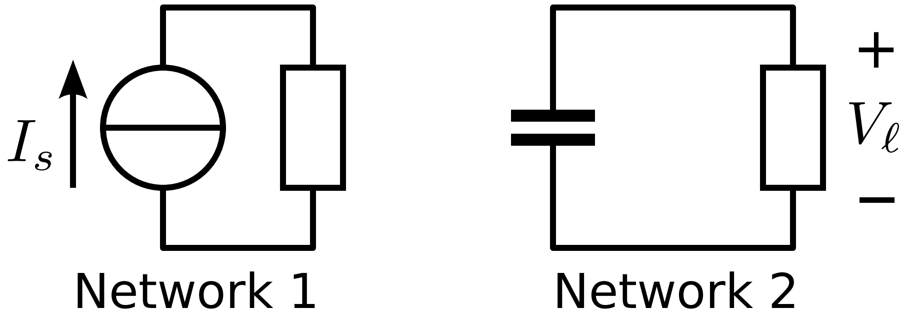
AC coupling

AC coupling:

Possible:
If signal components with very low frequencies are not of interest

AC coupling



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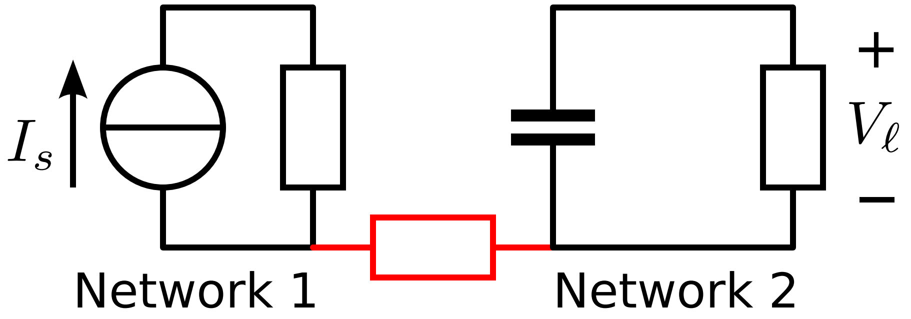

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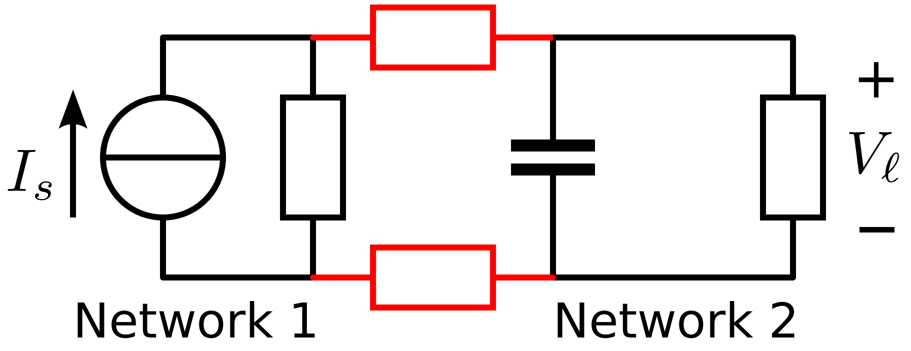

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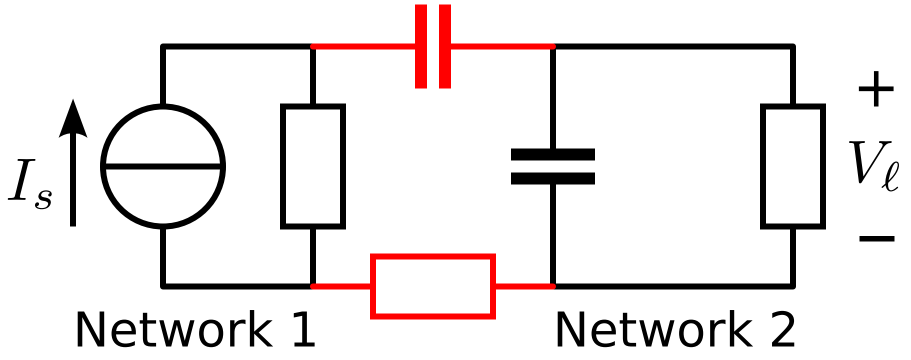

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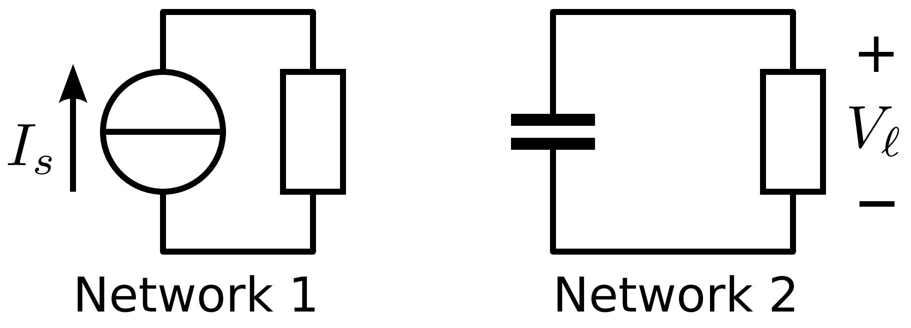
AC coupling:

Possible:
If signal components with very low frequencies are not of interest

Required:
If port bias voltages and/or currents are not allowed at the source or at the load

AC coupling



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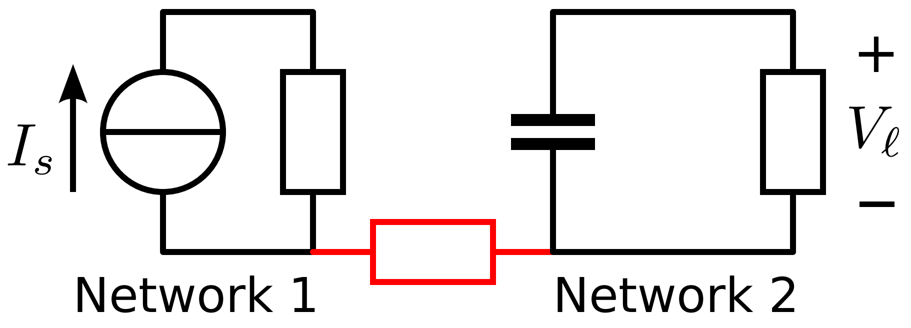

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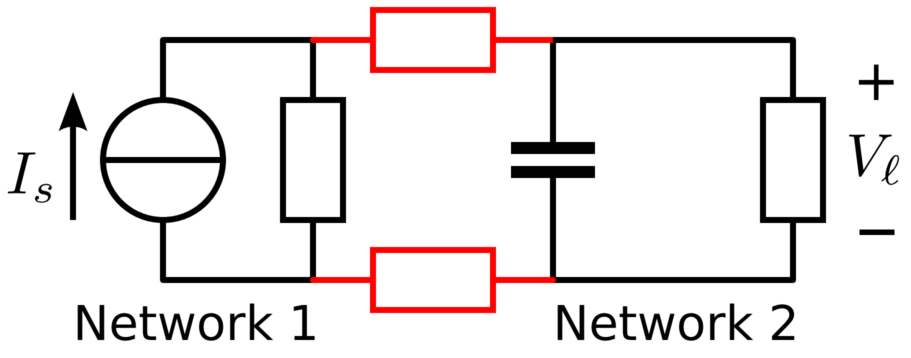

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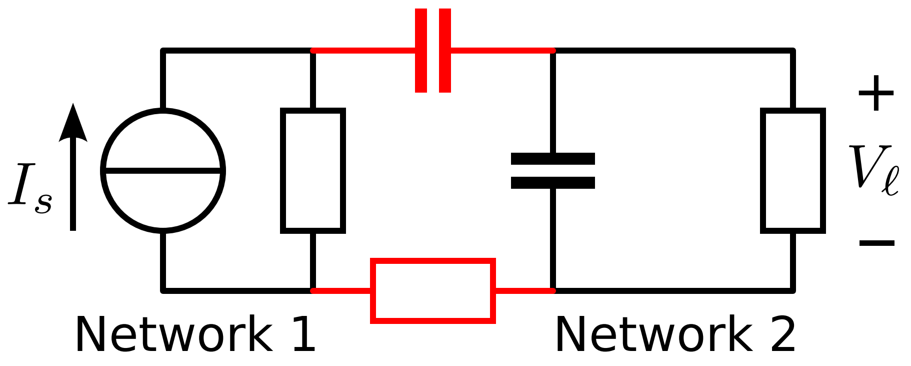

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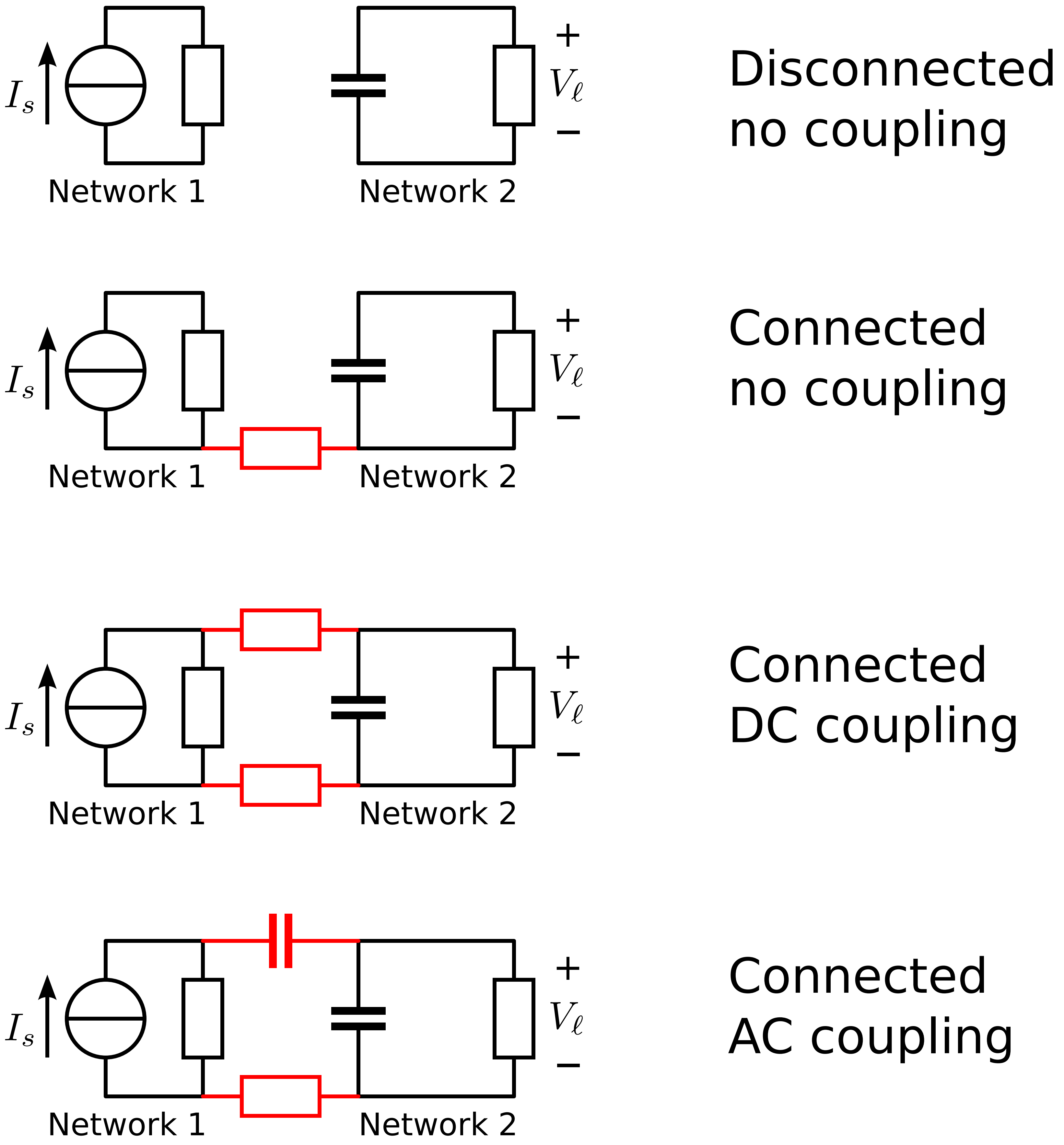
Method:
High-pass transfer

AC coupling



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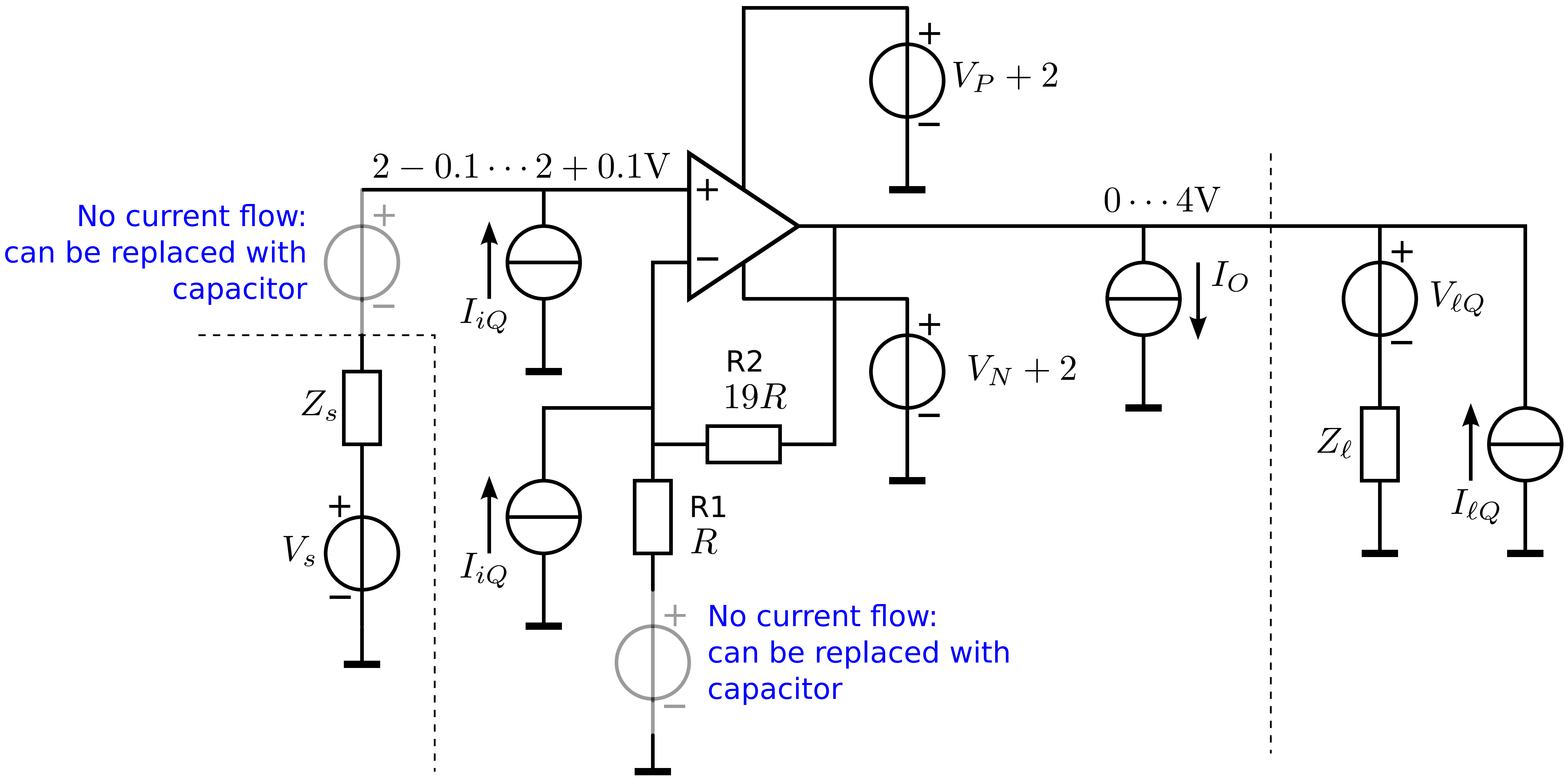
AC coupled amplifier



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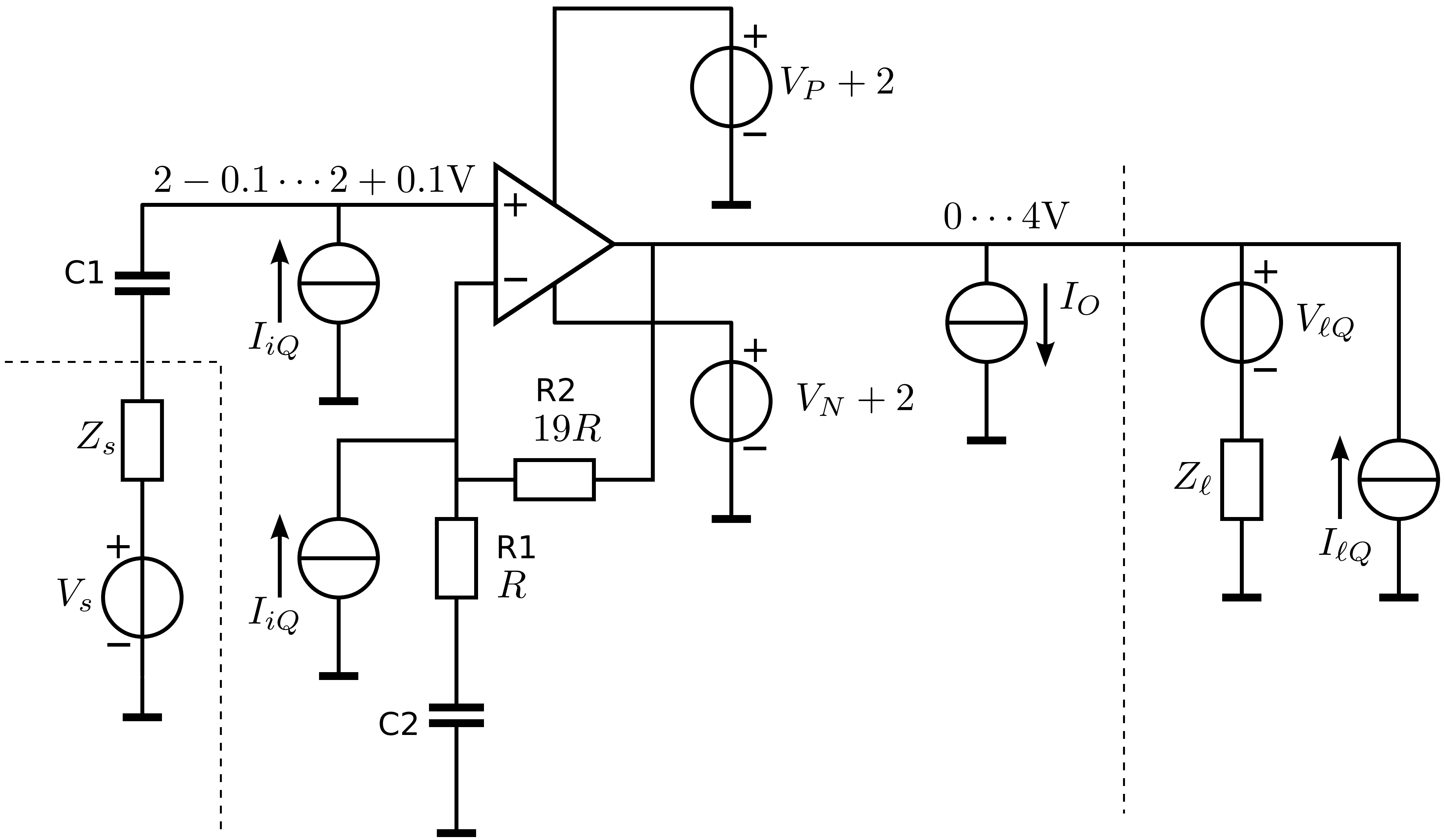
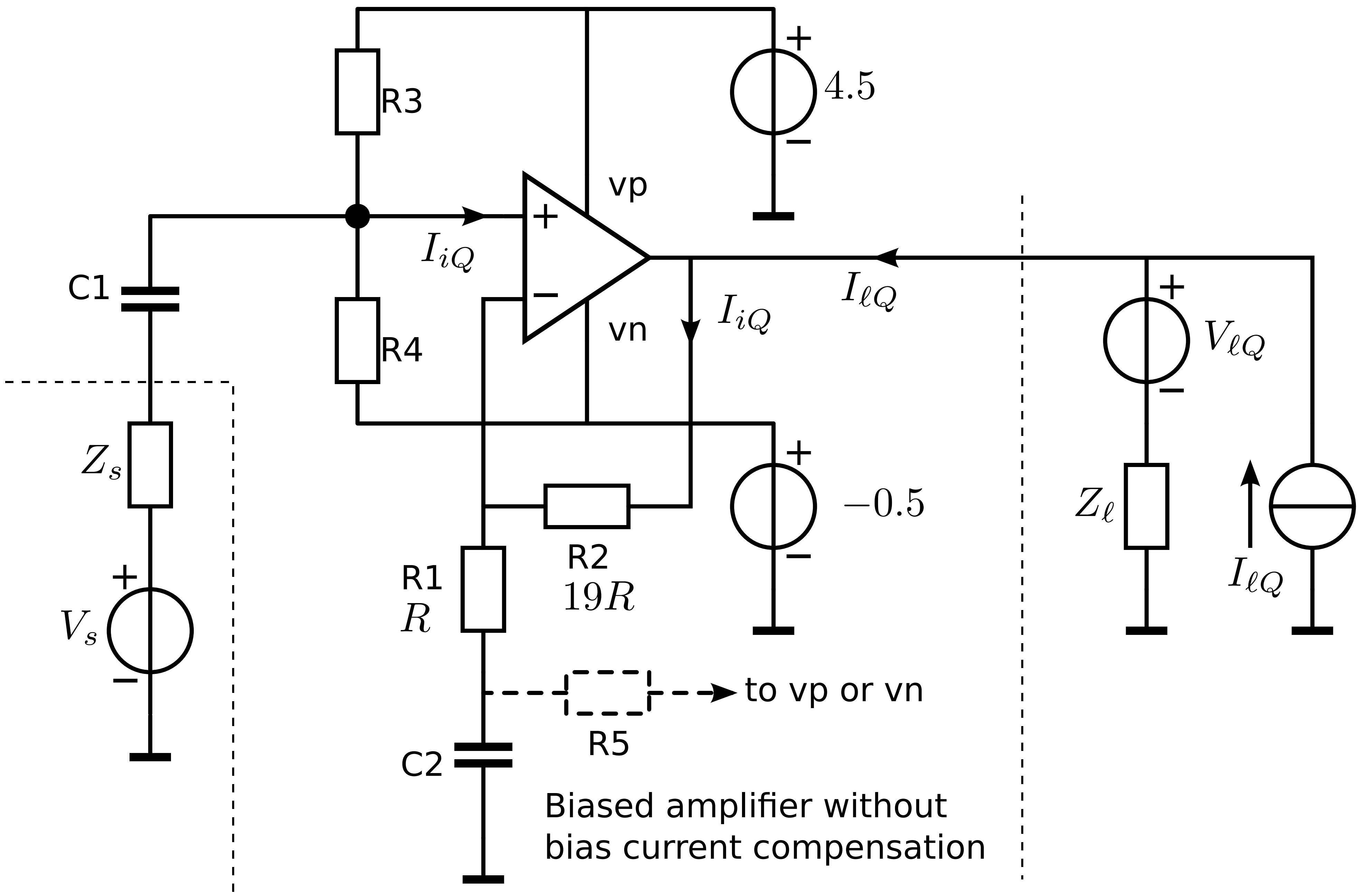
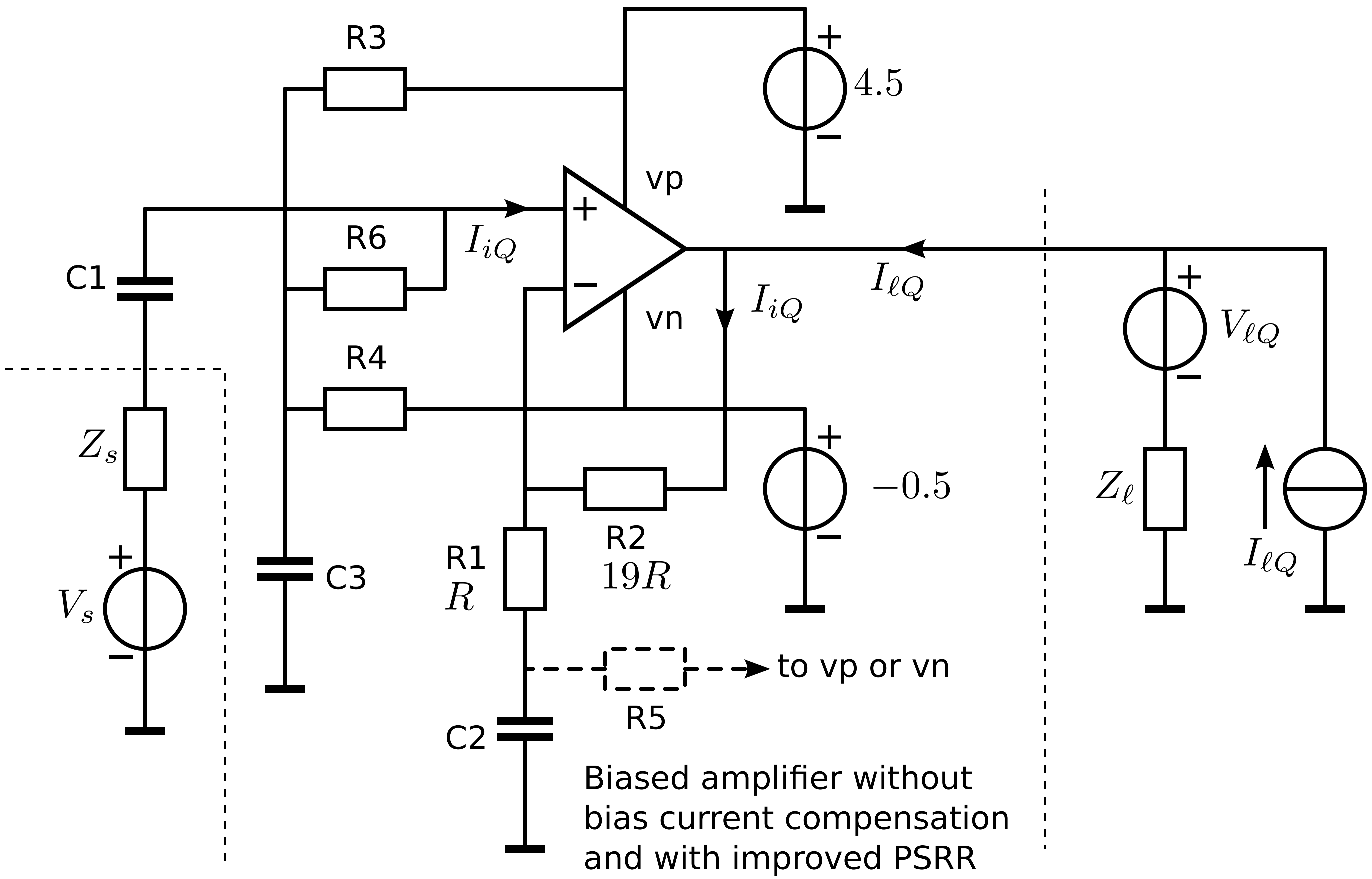


Biased amplifier



Improved biasing



Bias design equations

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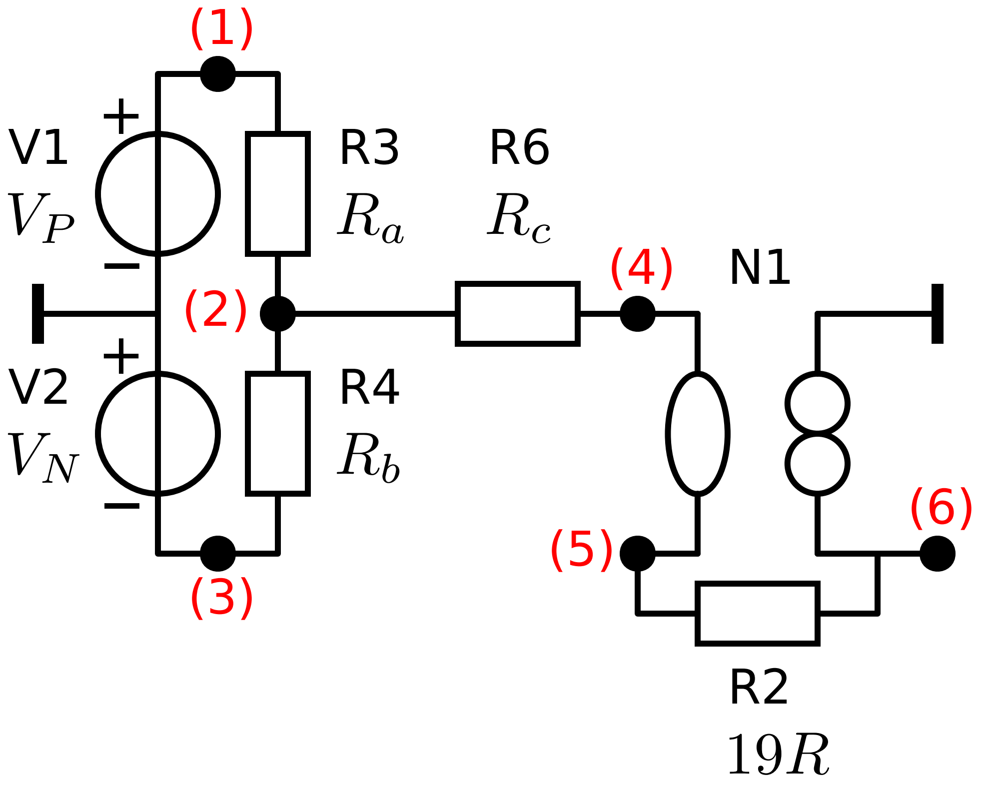

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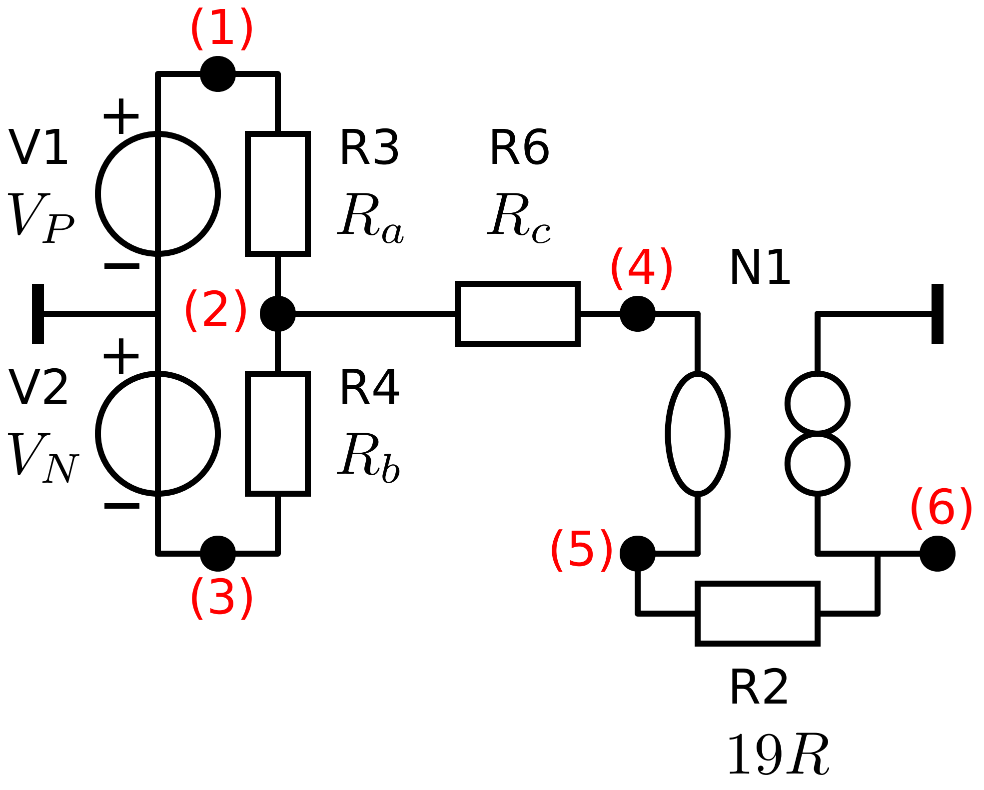
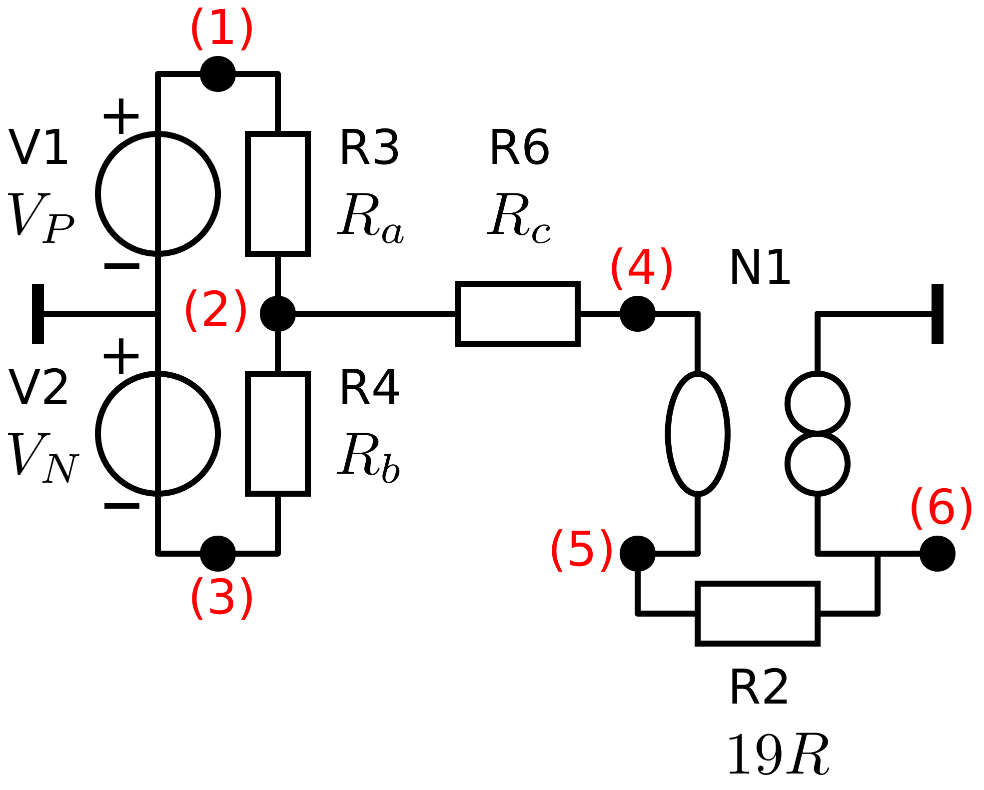


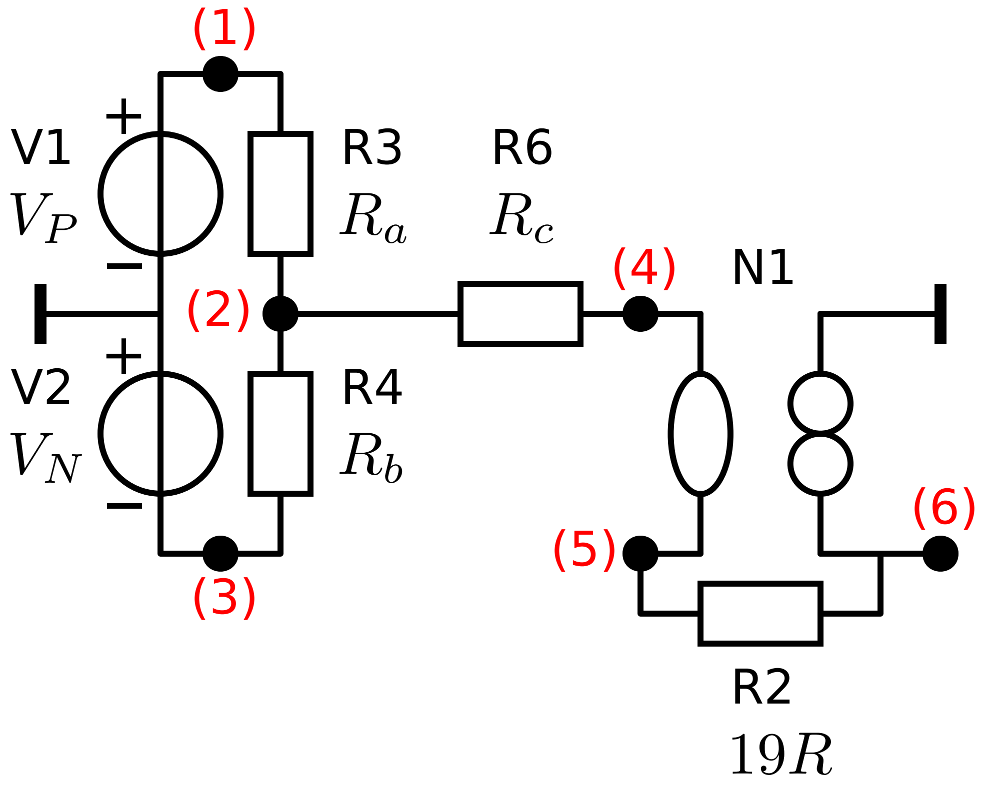
1. DC ouput voltage at node (6) should be 2V

Bias design equations



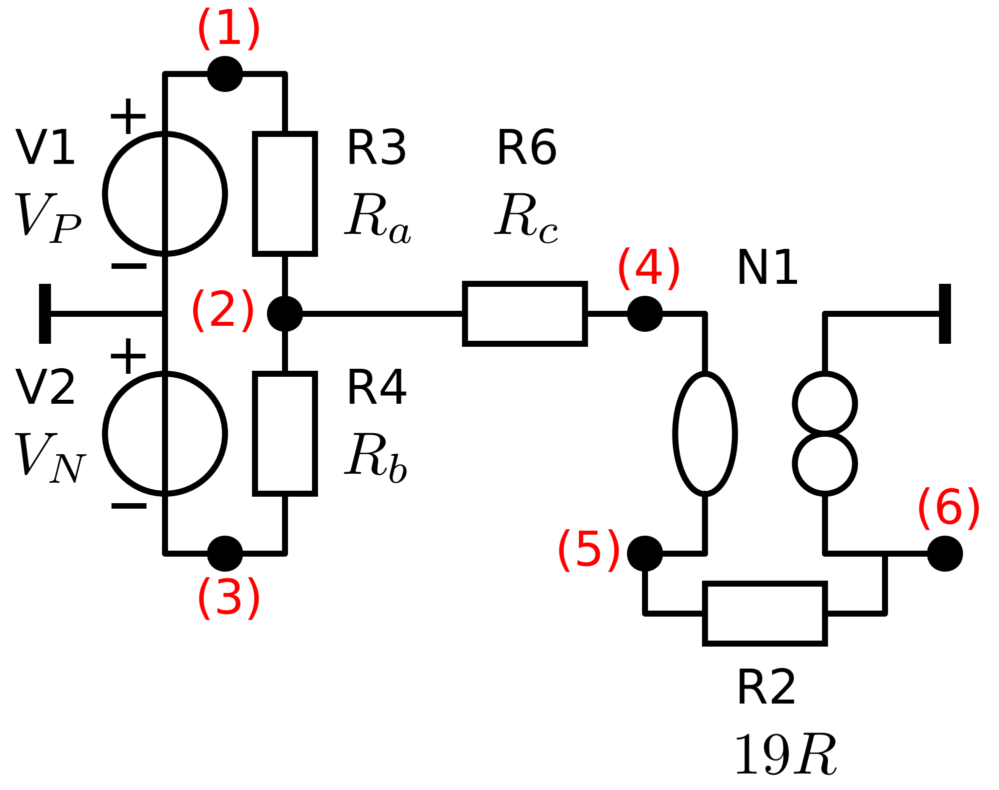
1. DC ouput voltage at node (6) should be 2V
2. Supply voltages determined by:

Bias design equations



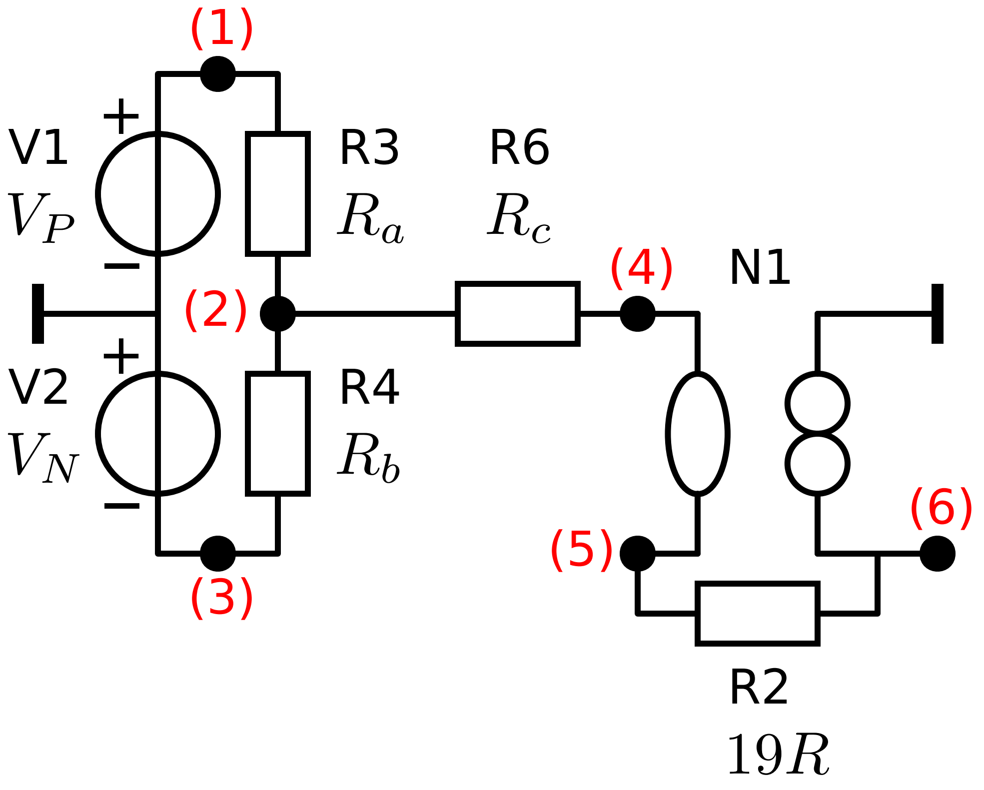
1. DC ouput voltage at node (6) should be 2V
2. Supply voltages determined by:
   - Output voltage range

Bias design equations



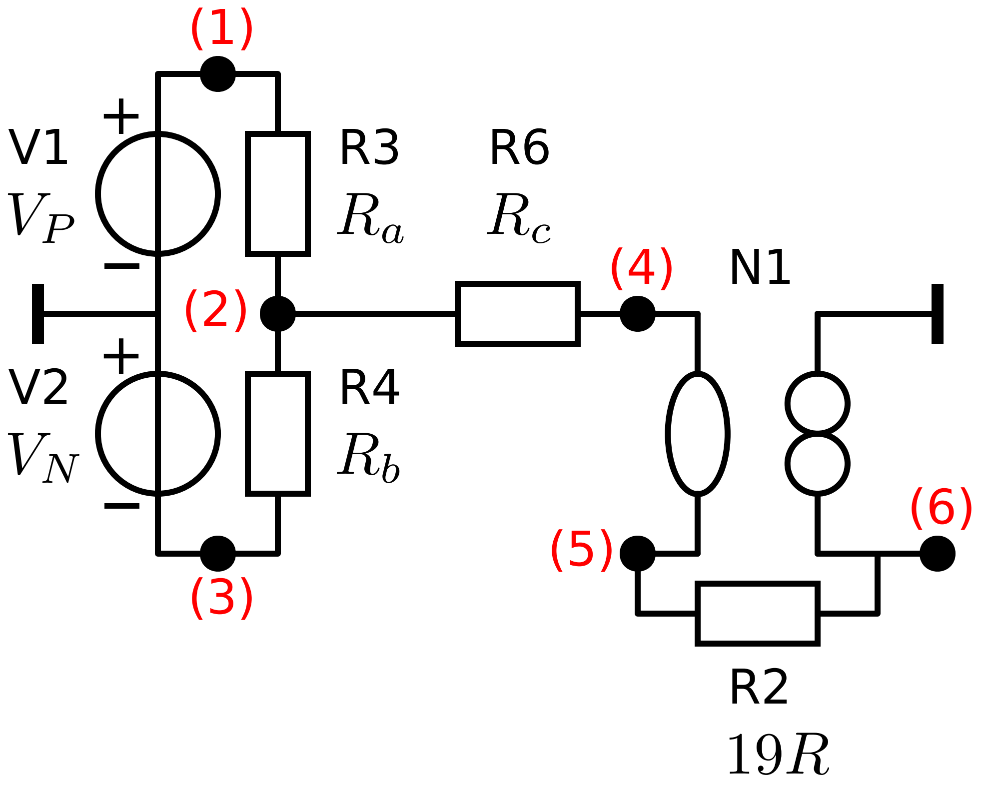
1. DC ouput voltage at node (6) should be 2V
2. Supply voltages determined by:
   - Output voltage range
   - Positive saturation voltage

Bias design equations



1. DC ouput voltage at node (6) should be 2V
2. Supply voltages determined by:
   - Output voltage range
   - Positive saturation voltage
   - Negative saturation voltage

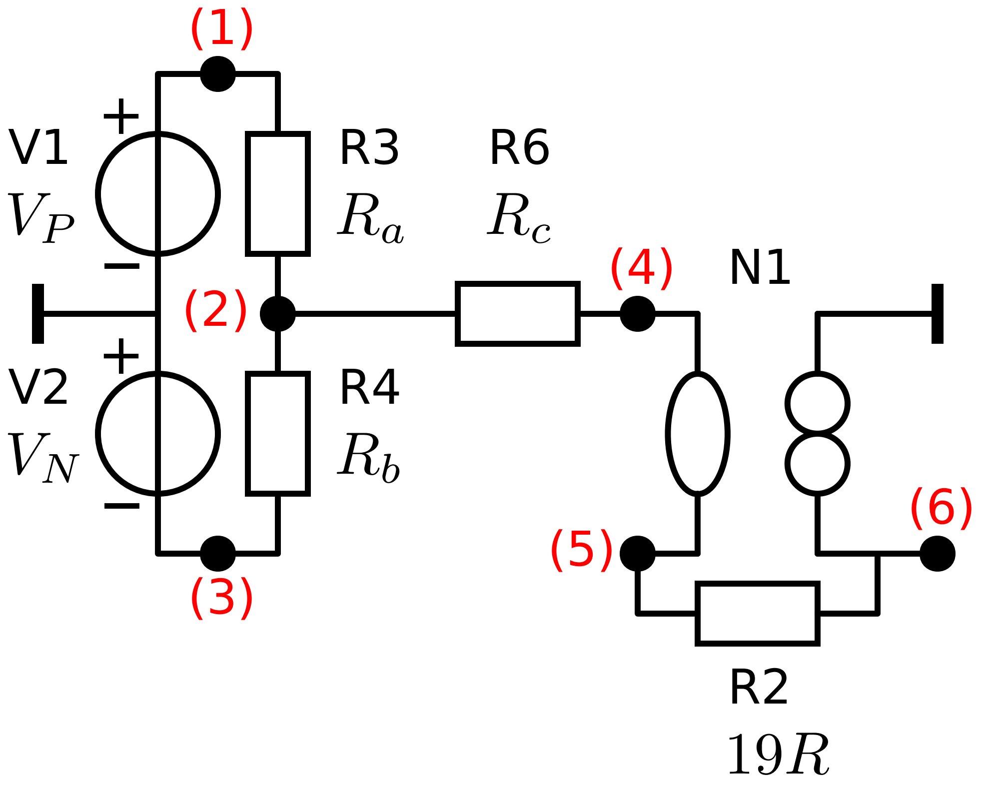
Bias design equations



1. DC ouput voltage at node (6) should be 2V
2. Supply voltages determined by:
   - Output voltage range
   - Positive saturation voltage
   - Negative saturation voltage

$$\frac{R_b}{R_a} = \frac{V_N + V_6}{V_P - V_6}$$

Bias design equations



1. DC ouput voltage at node (6) should be 2V
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