Structured Electronic Design

Operational Amplifiers: modeling

Anton J.M. Montagne

Modeling techniques

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Macro models

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Suppliers provide Spice simulation models for operational amplifiers

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Placement:

Subcircuit call →

Modeling techniques

Spice nullor model

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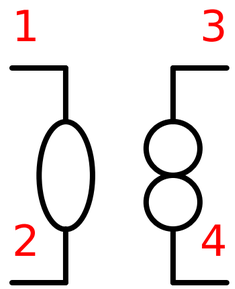
Subcircuit call → `x1 out+ out- in+ in- nullor`



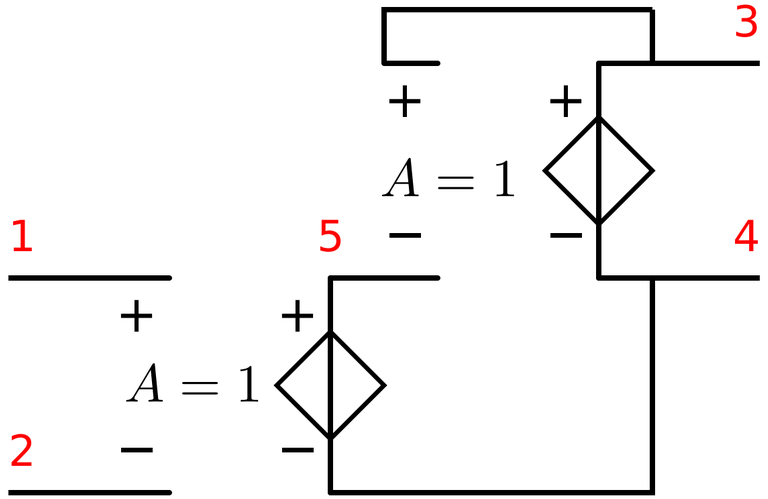
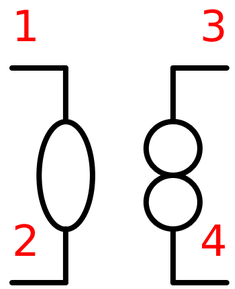


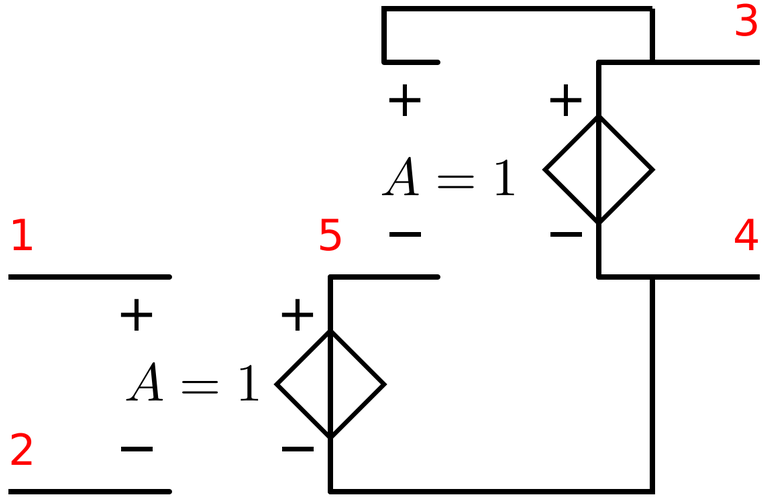
Figure 18.21

Spice nullor model

Placement:

Subcircuit call → `x1 out+ out- in+ in- nullor`





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Modeling techniques

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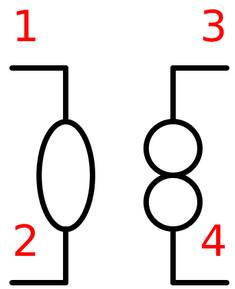

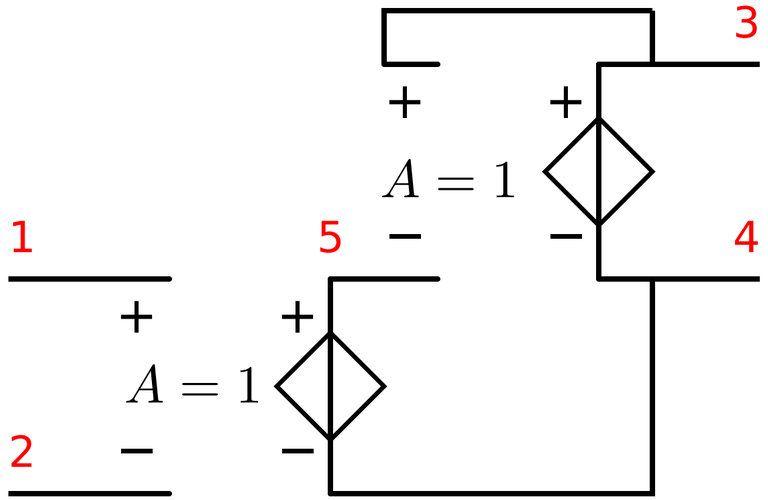

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Definition:

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VCVS →

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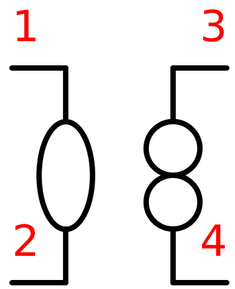

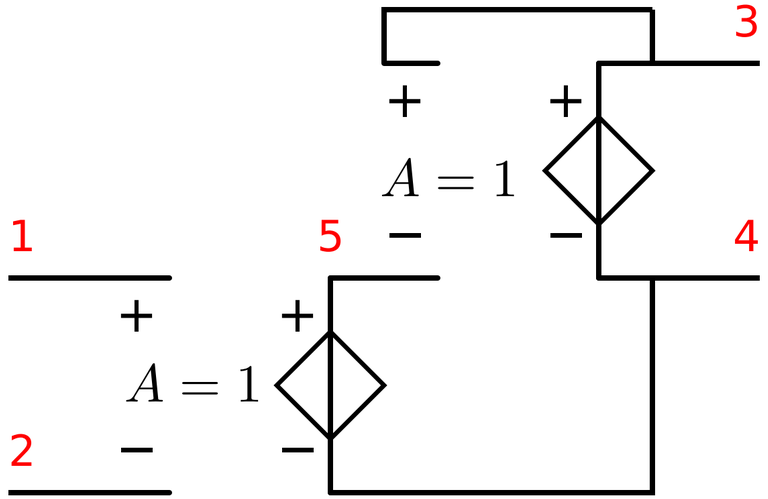

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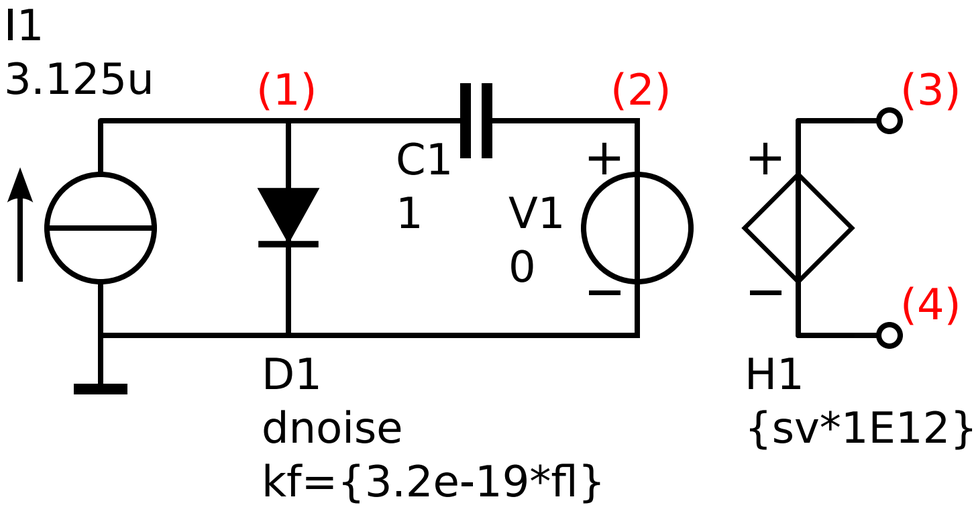

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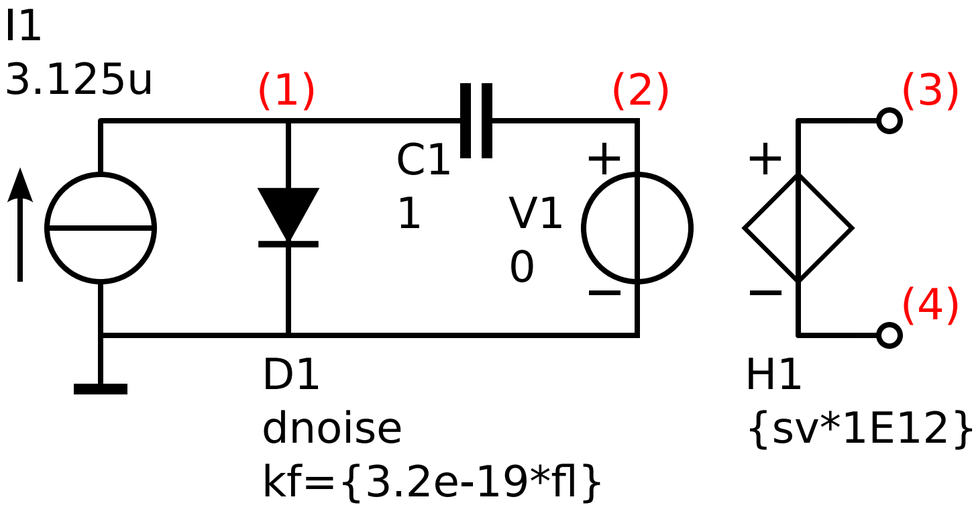

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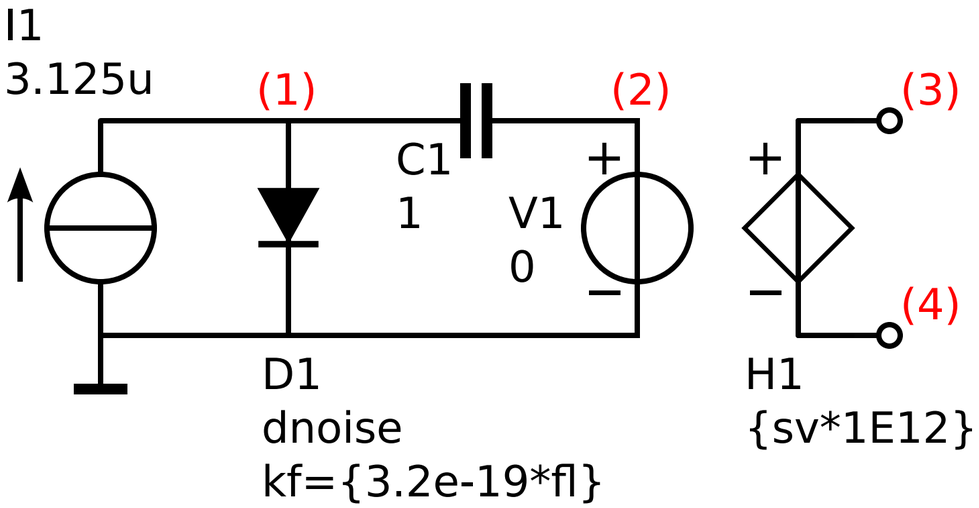

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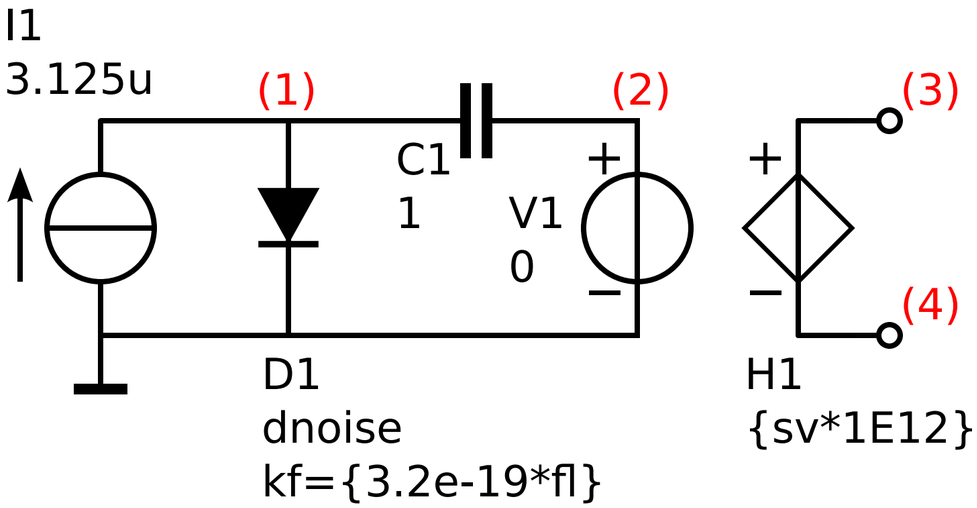

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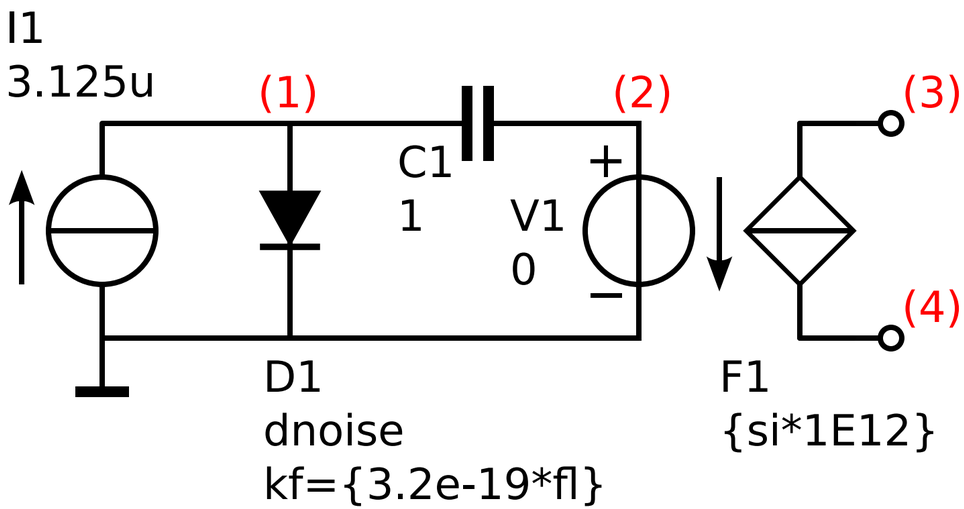

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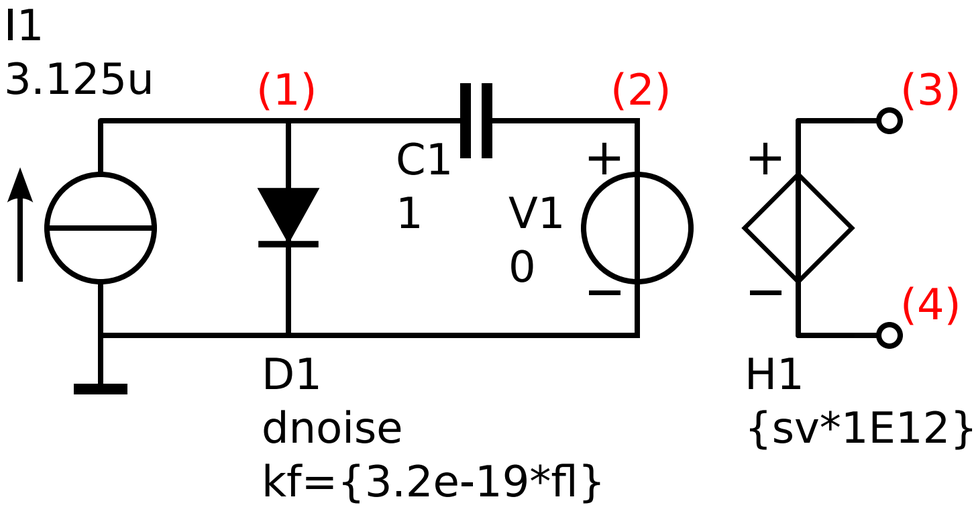

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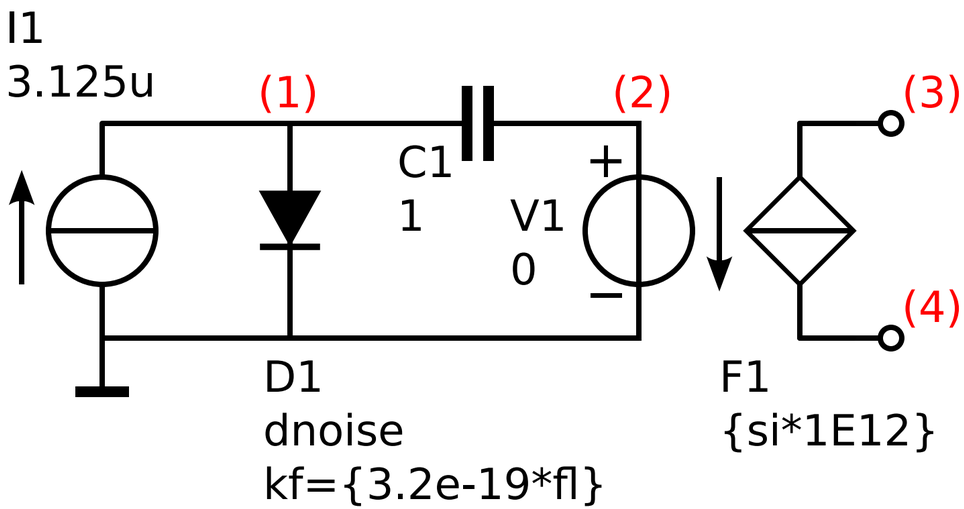

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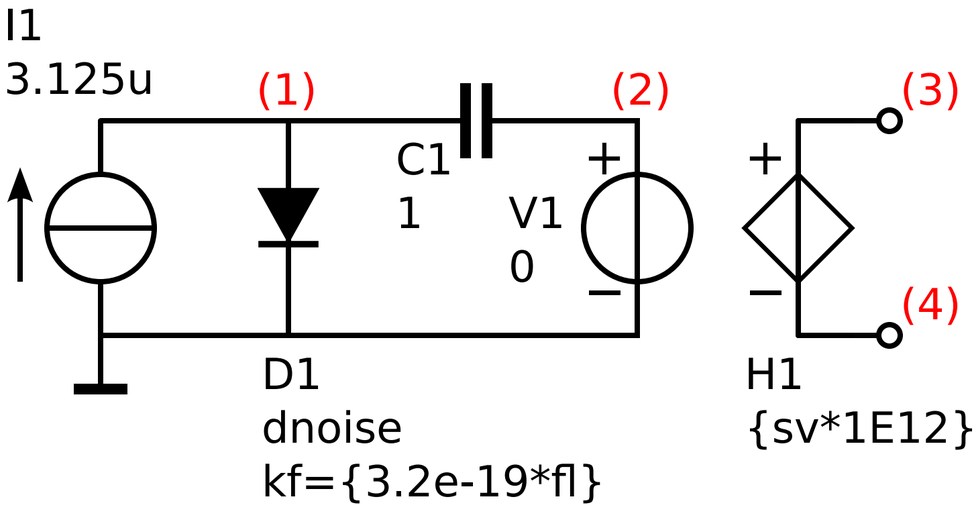

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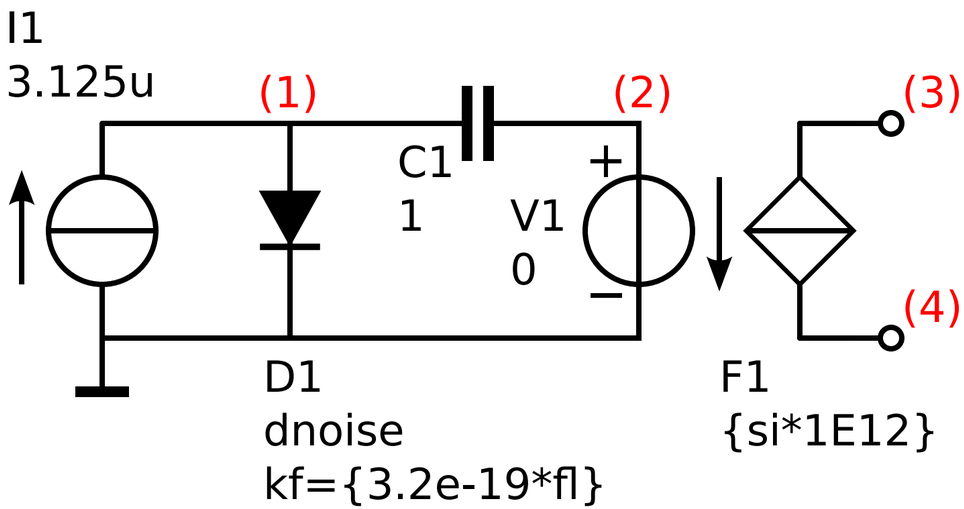

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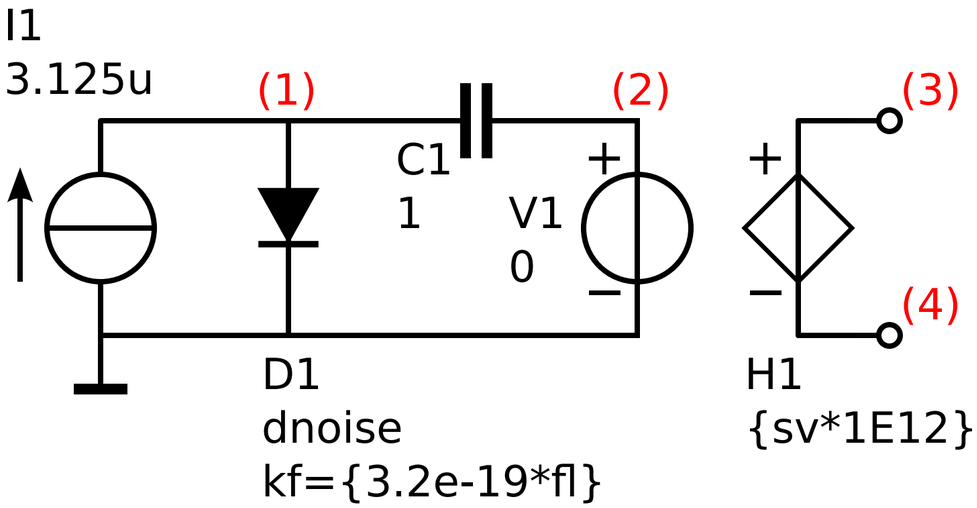

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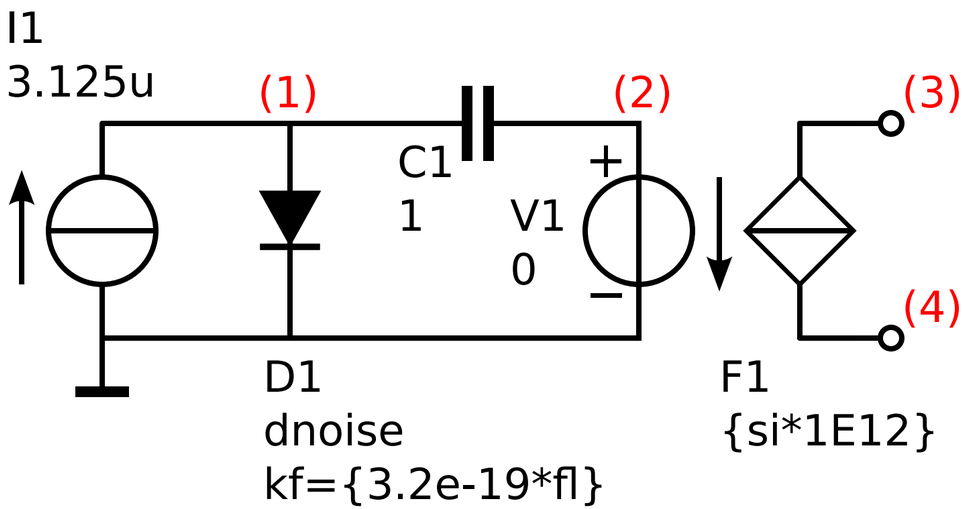

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Small-signal dynamic model voltage-feedback OpAmp

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- Use active and passive network elements or Laplace blocks

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Use active and passive network elements or Laplace blocks

- differential-mode input impedance

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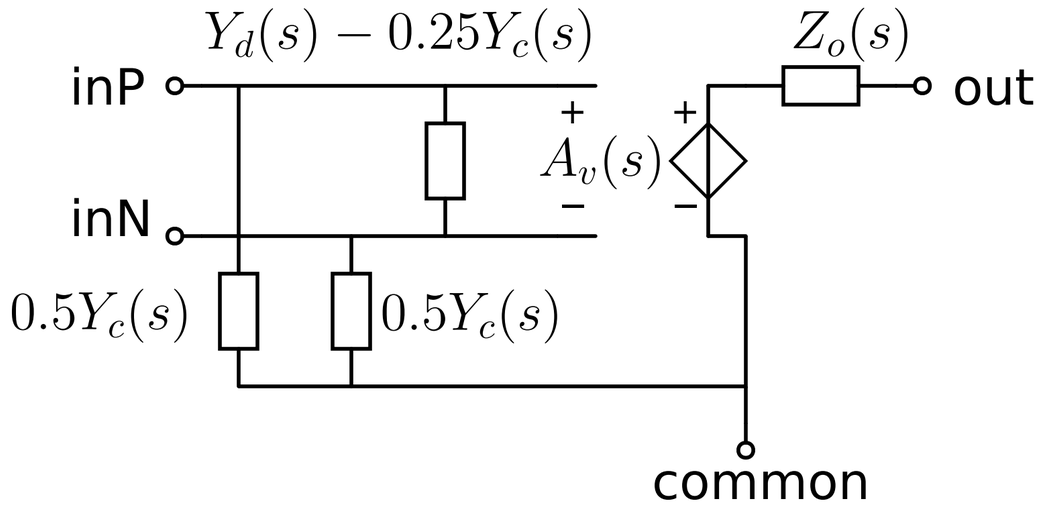

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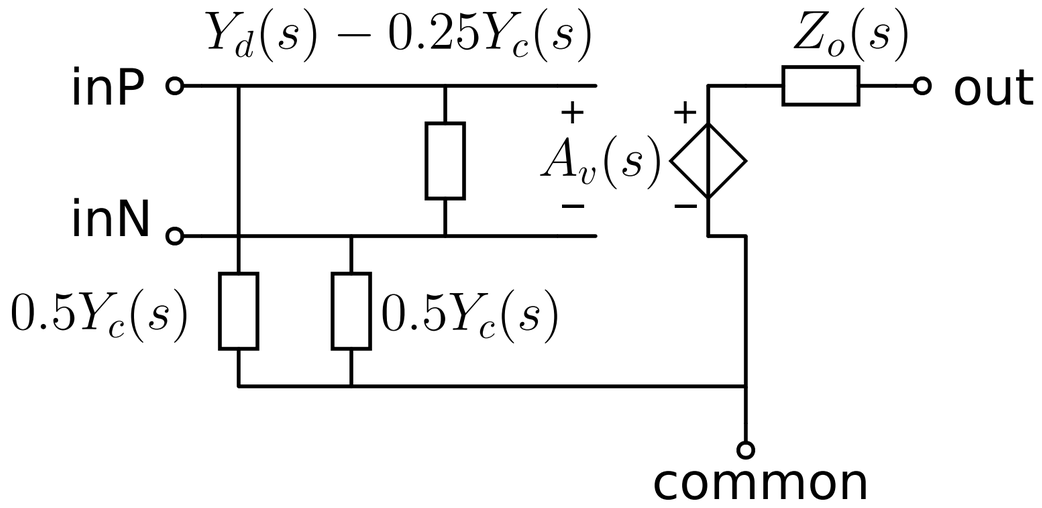

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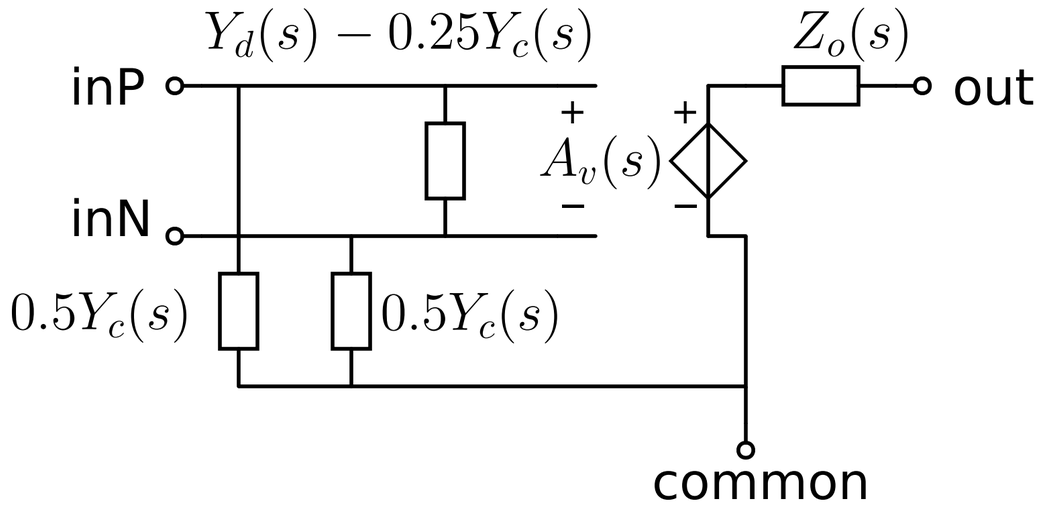

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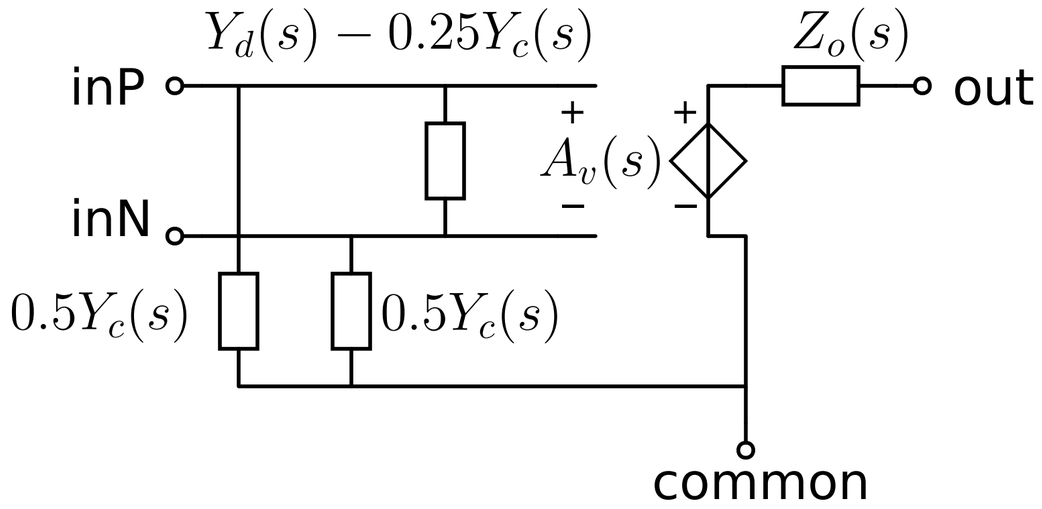
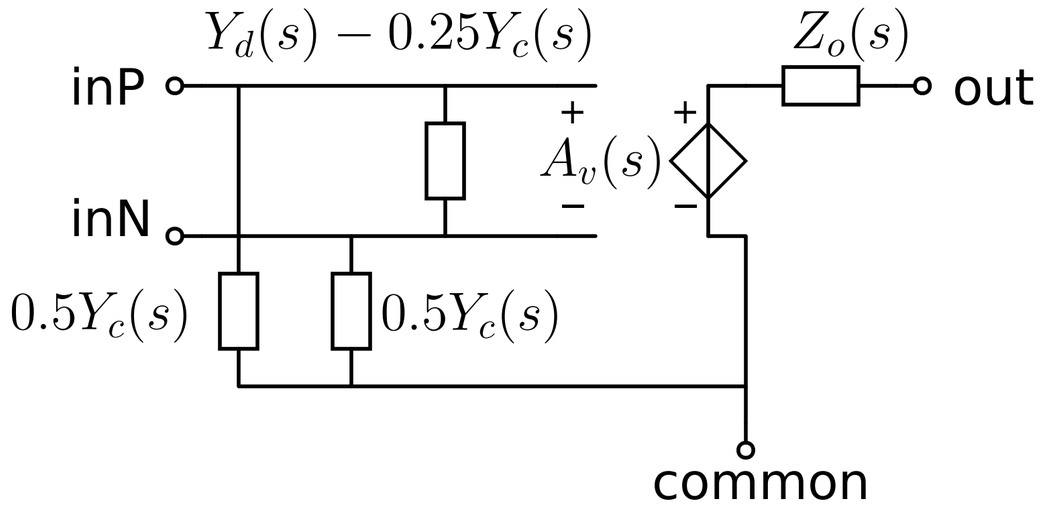


Modeling techniques

Small-signal dynamic model voltage-feedback OpAmp

Use active and passive network elements or Laplace blocks

- differential-mode input impedance
- common-mode input impedance
- output impedance
- voltage transfer



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First order: $A_v(s) = A_0 \frac{1}{1+s\frac{A_0}{2\pi \mathrm{GB}}}$

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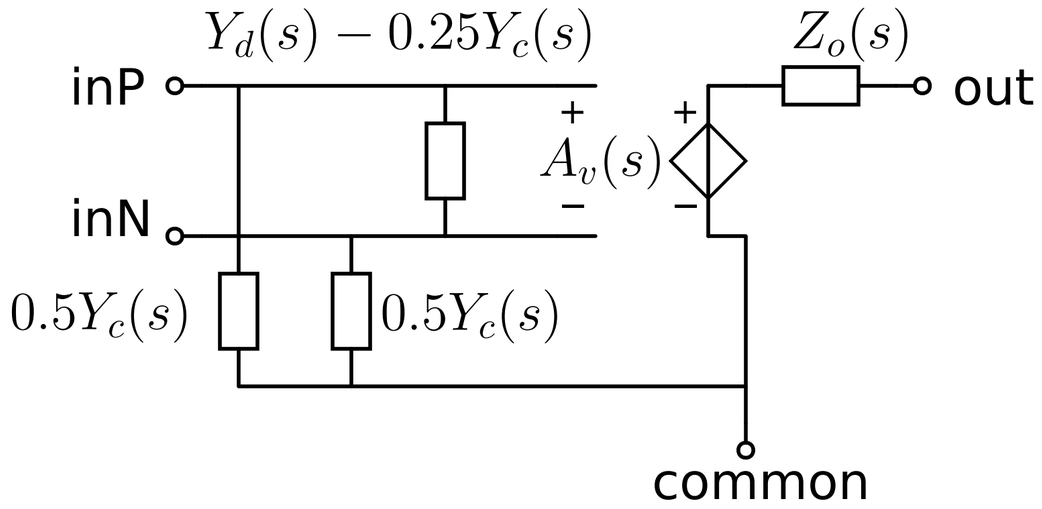

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$Z_o(s)$ complex impedance not always specified in data sheet

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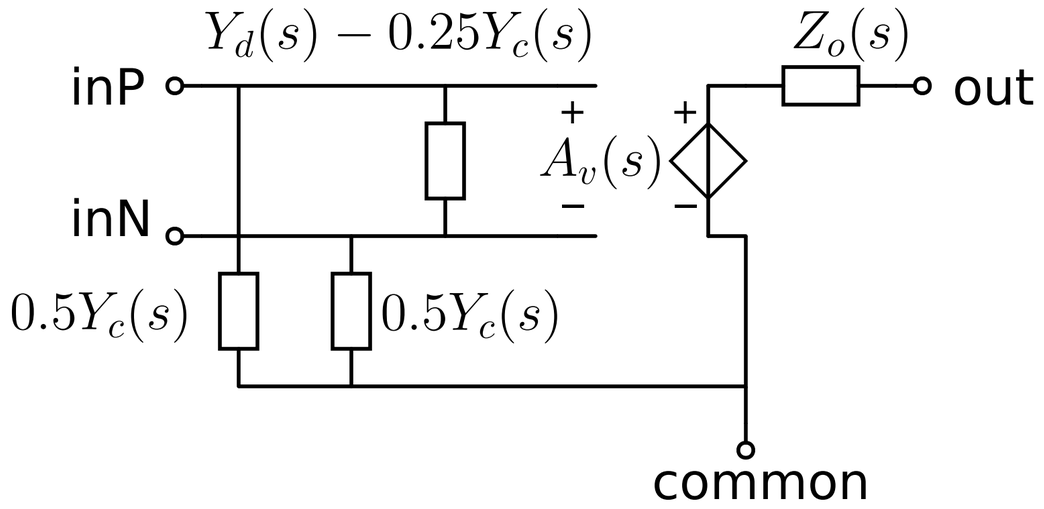

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Modeling techniques

Small-signal dynamic model current-feedback OpAmp

Modeling techniques

Small-signal dynamic model current-feedback OpAmp

Use active and passive network elements or Laplace blocks

Modeling techniques

Small-signal dynamic model current-feedback OpAmp

Use active and passive network elements or Laplace blocks

- input impedance noninverting input

Modeling techniques

Small-signal dynamic model current-feedback OpAmp

Use active and passive network elements or Laplace blocks

- input impedance noninverting input
- transconductance input stage

Modeling techniques

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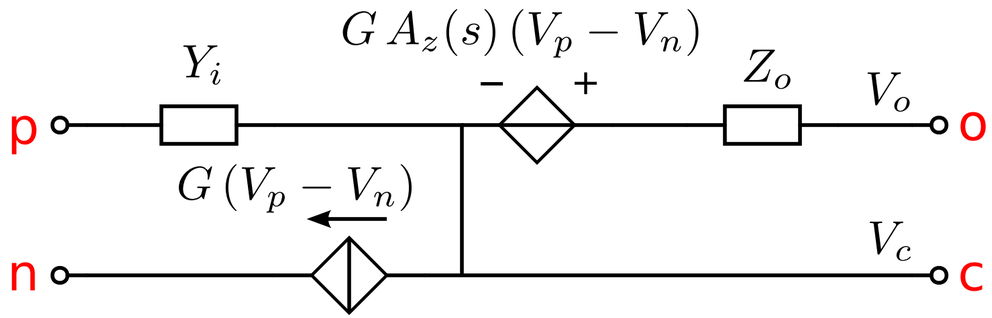

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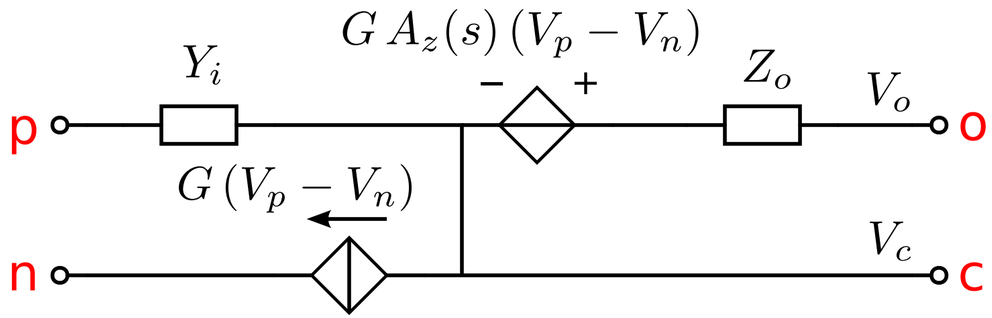

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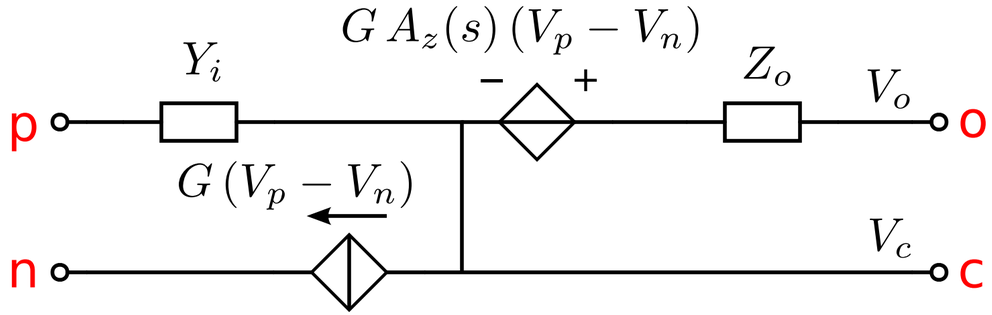

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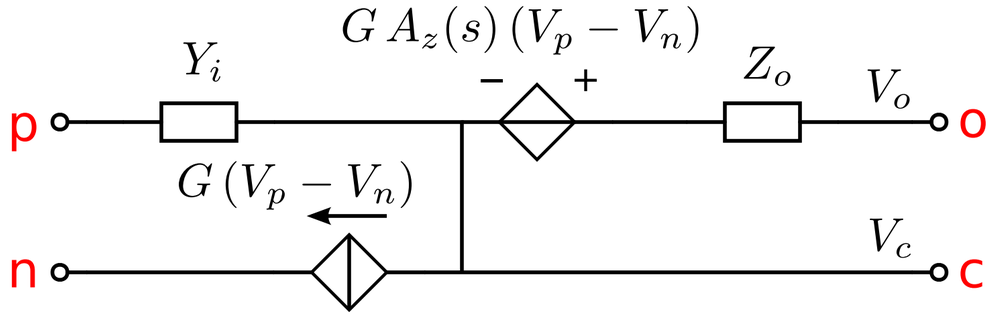

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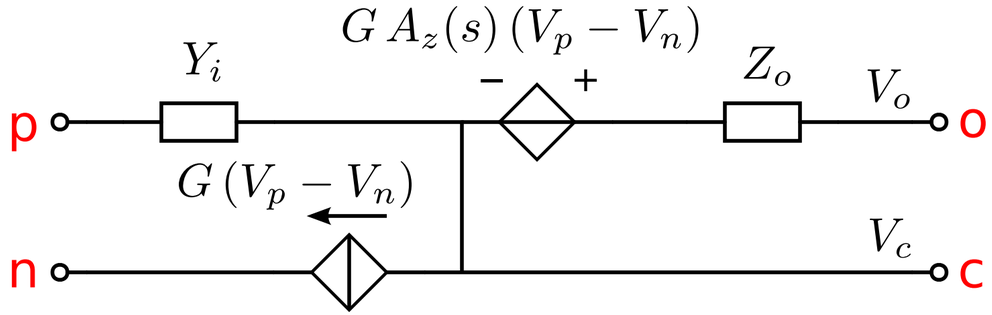

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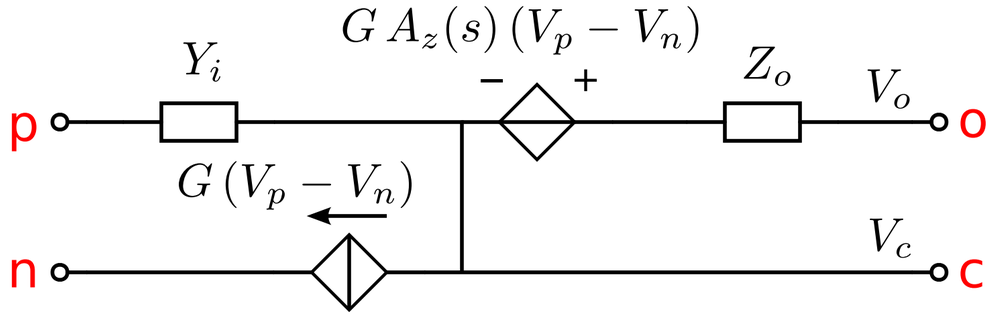

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