Structured Electronic Design

Introduction to feedback stages

Anton J.M. Montagne

Feedback

Feedback

Method to establish an accurate transfer

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Generate a copy of the source signal from the load signal with a feedback network

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Input signal of the feedback network = load quantity of interest (current or voltage)

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- Transfer of feedback network equals the required value of the corresponding T1 parameter

	Source voltage	Source current	Load voltage	Load current
T1 parameters				
Feedback type				

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	Source voltage	Source current	Load voltage	Load current
T1 parameters	A, B			
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Controller (error amplifier) generates the load quantity and nullifies comparison result

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Feedback stages

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Single-stage controllers

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Single-stage controllers

Three-terminal controllers

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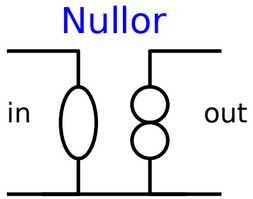
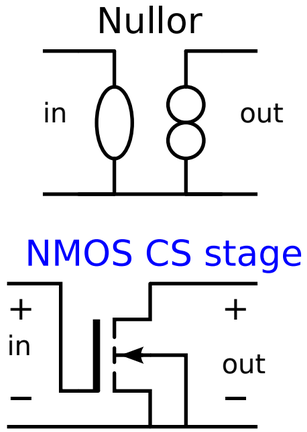
Three-terminal controllers



Feedback stages

Single-stage controllers

Three-terminal controllers

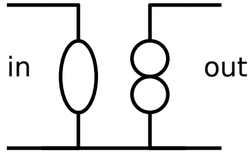


Feedback stages

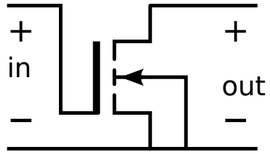
Single-stage controllers

Three-terminal controllers

Nullor



NMOS CS stage



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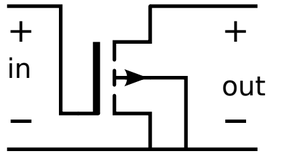

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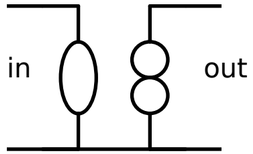

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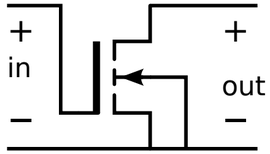

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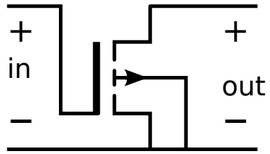
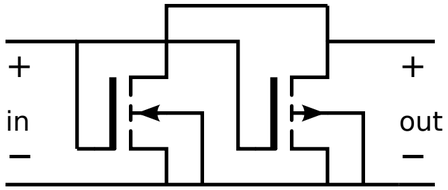


Complementary parallel CS stage



Feedback stages

Single-stage controllers

Three-terminal controllers

Four-terminal controllers

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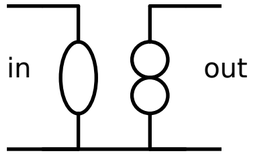

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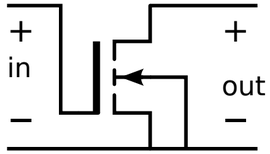

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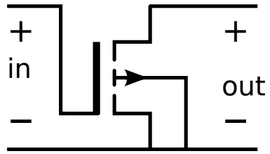

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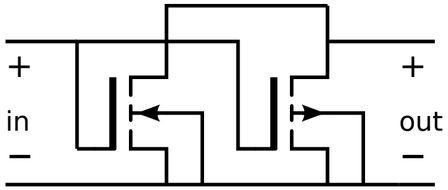

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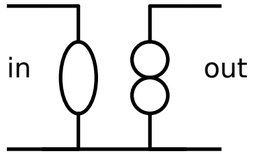

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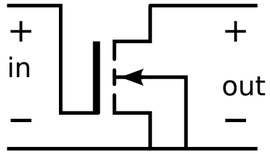

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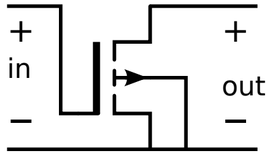

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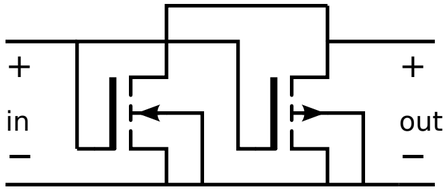

Four-terminal controllers

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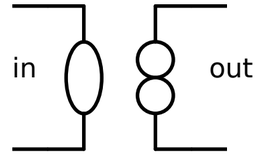

Feedback stages

Single-stage controllers

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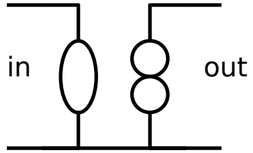

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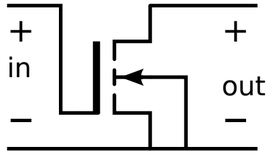

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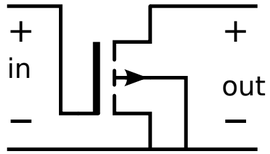

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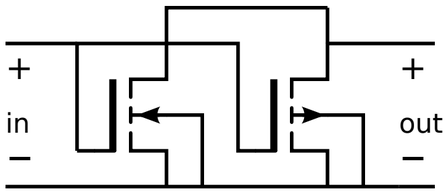

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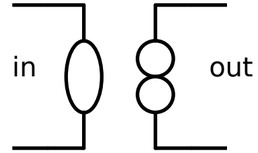
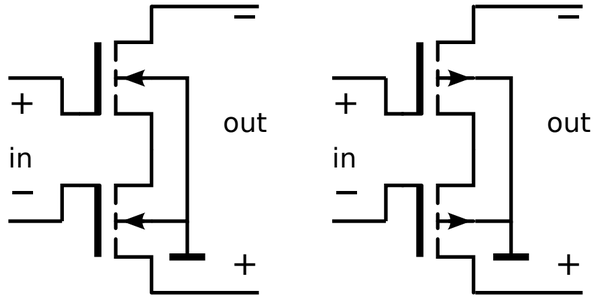


anti-series CS stages



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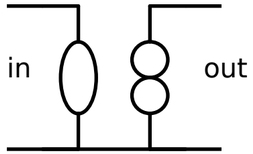

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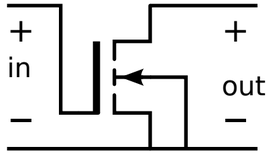

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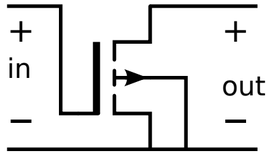

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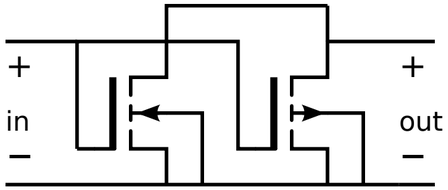

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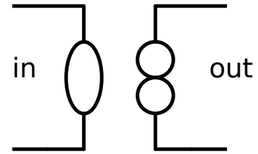

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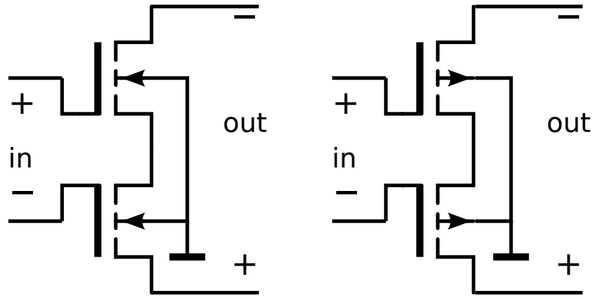

Types of feedback

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Direct feedback:

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Direct feedback:

Sensing of the load quantity of interest

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Direct feedback:

- Sensing of the load quantity of interest
- Comparison with the source quantity of interest

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- No power dissipation or energy storage in the feedback network(s)

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Passive feedback:

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  Can be kept acceptably low if feedback impedances in series with the signal path and feedback admittances in parallel with the signal path are relatively small

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Examples nonenergic feedback stages

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Concept

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Implementation
(without biasing)

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Voltage amplifier

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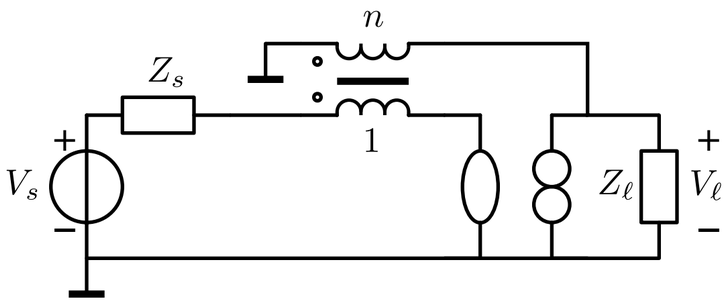
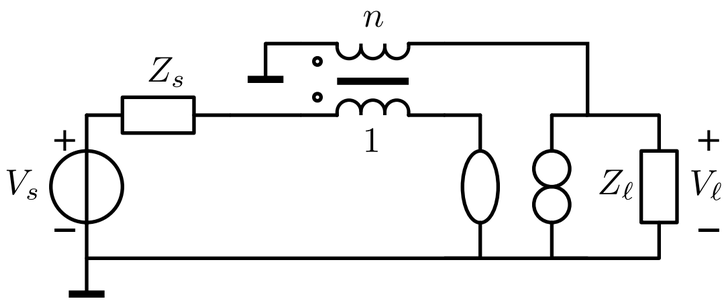
Voltage amplifier



Examples nonenergic feedback stages

Voltage amplifier

Concept



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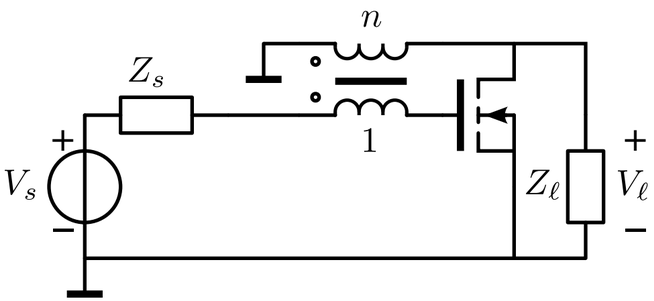

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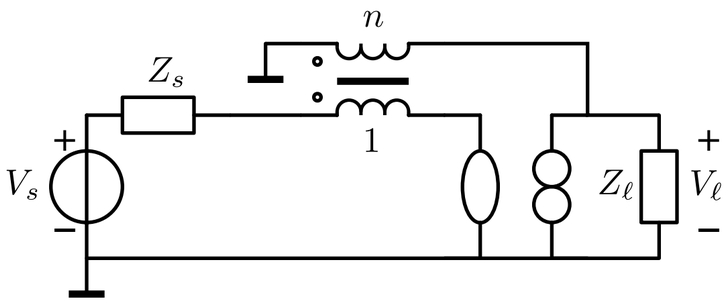
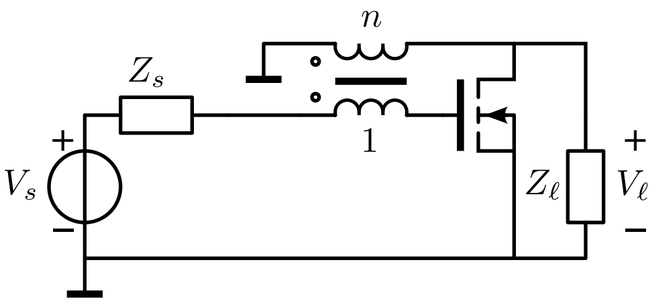




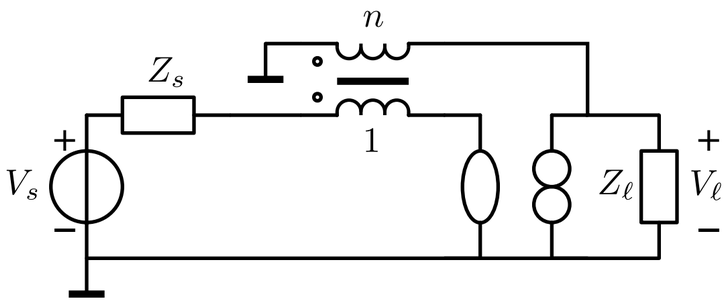
Voltage follower

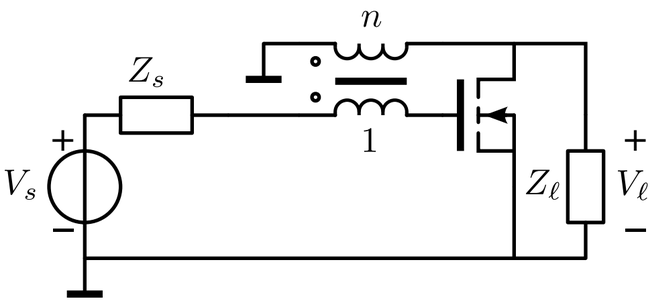
Examples nonenergic feedback stages

Concept

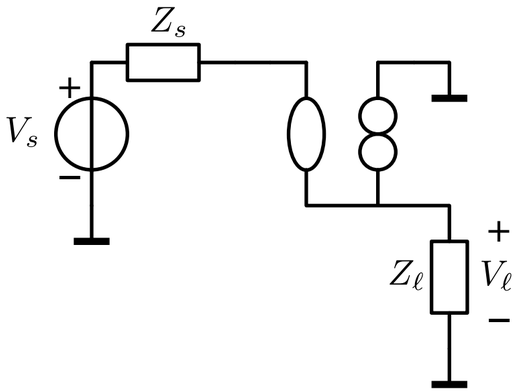
Implementation
(without biasing)

Voltage amplifier





Voltage follower

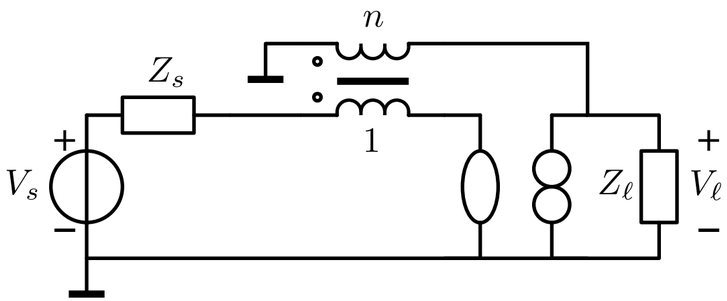


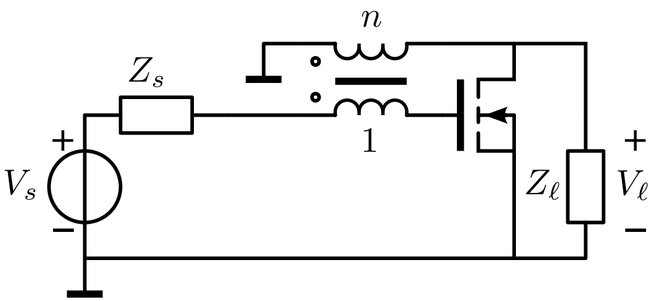
Examples nonenergic feedback stages

Concept

Implementation
(without biasing)

Voltage amplifier





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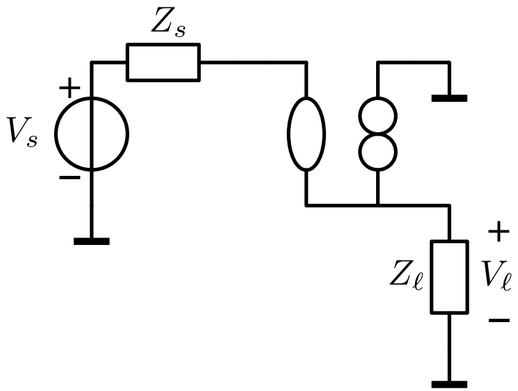
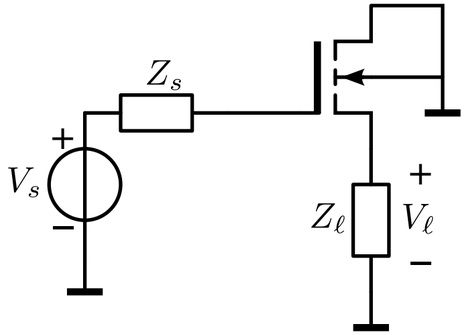


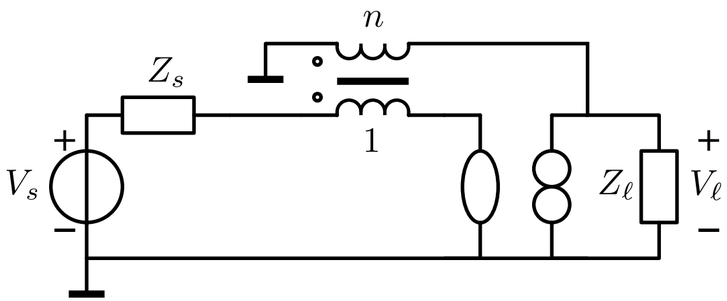


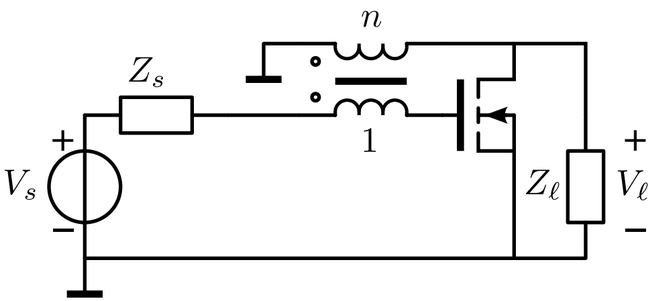
Examples nonenergic feedback stages

Concept

Implementation
(without biasing)

Voltage amplifier





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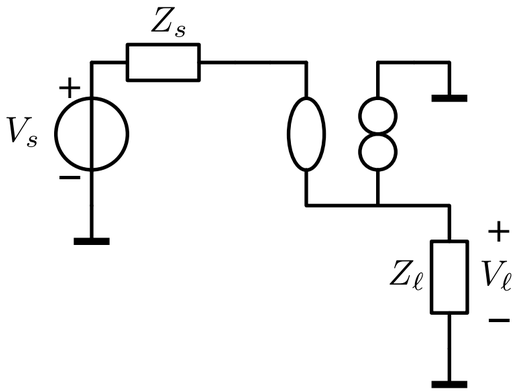
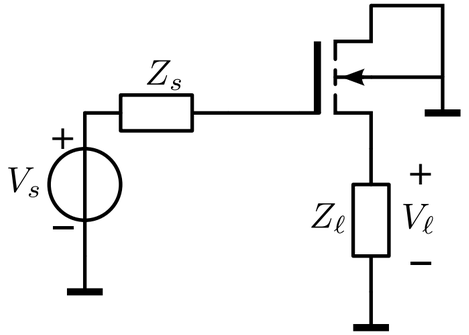




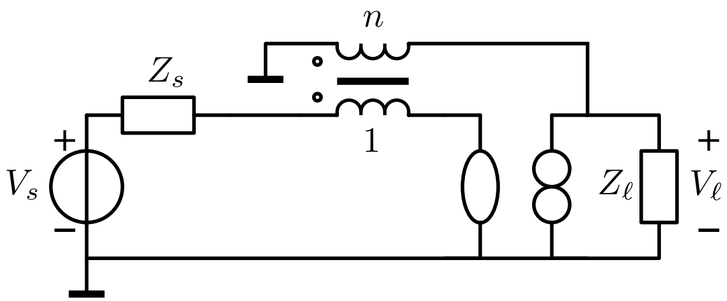
CD stage

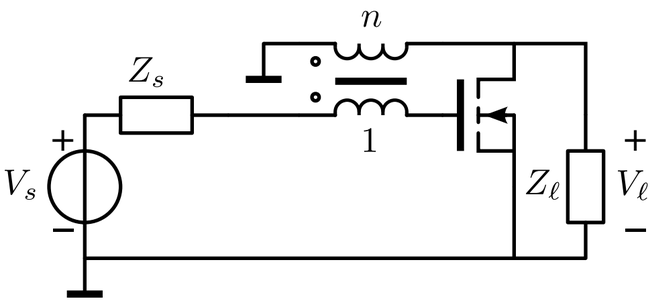
Examples nonenergic feedback stages

Concept

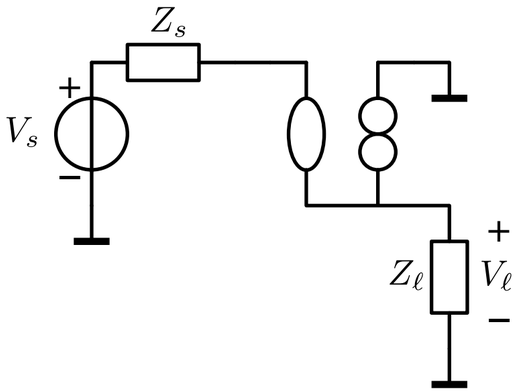
Implementation
(without biasing)

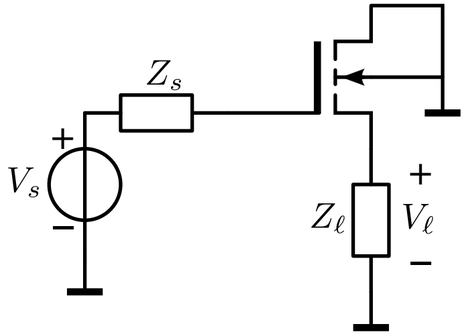
Voltage amplifier





Voltage follower





CD stage

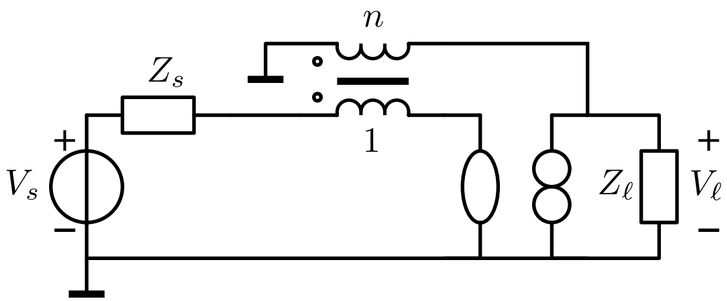
Current follower

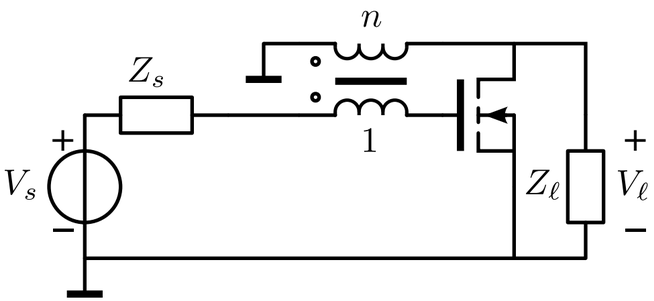
Examples nonenergic feedback stages

Concept

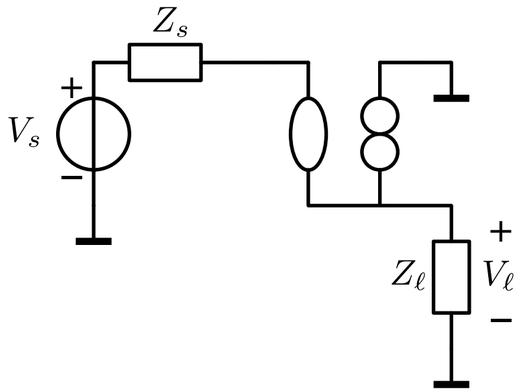
Implementation
(without biasing)

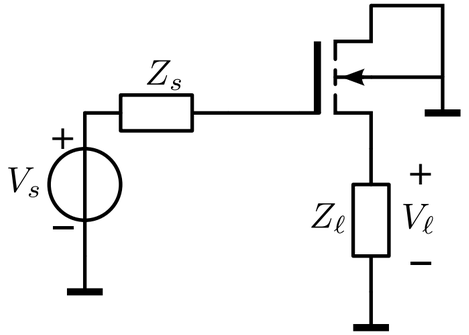
Voltage amplifier





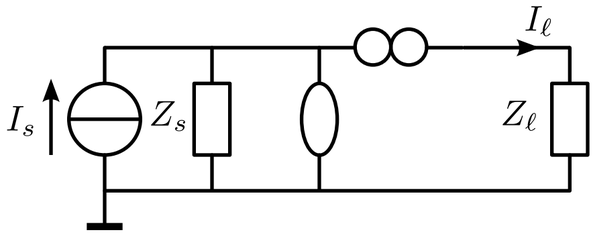
Voltage follower





CD stage

Current follower

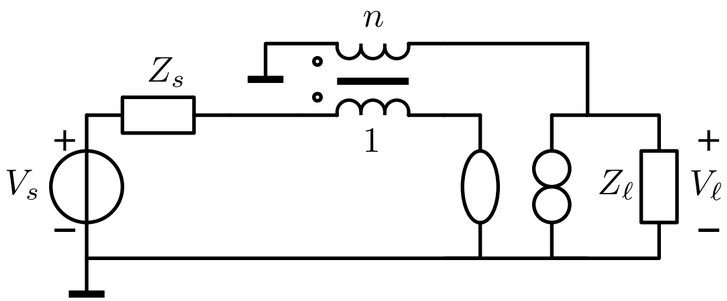


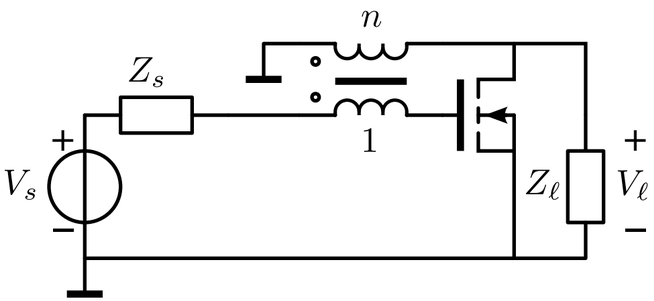
Examples nonenergic feedback stages

Concept

Implementation
(without biasing)

Voltage amplifier





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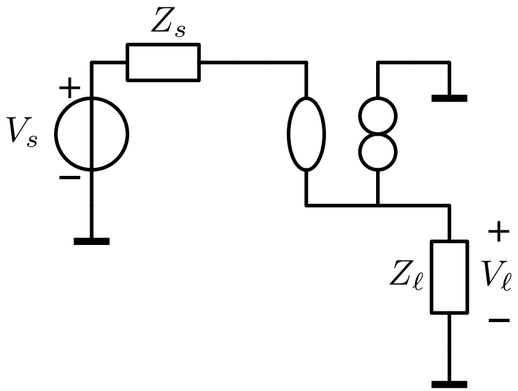
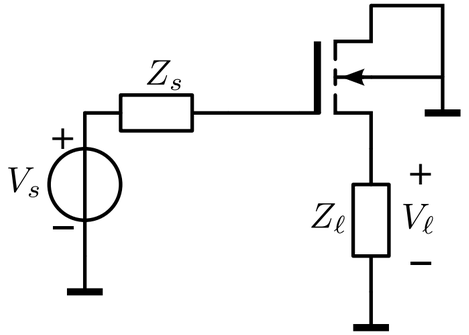
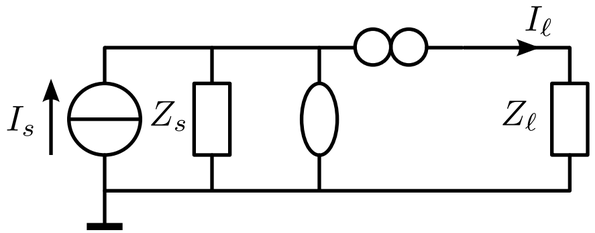
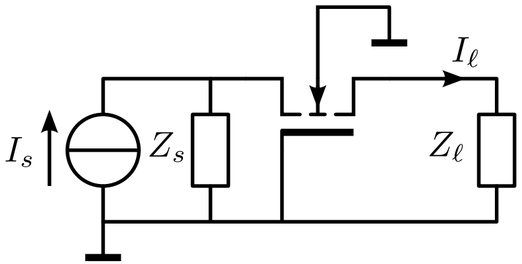




CD stage

Current follower



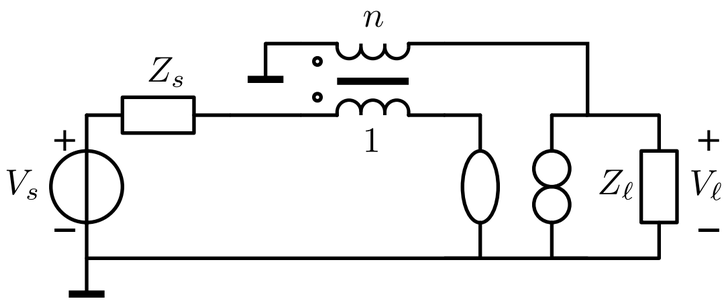


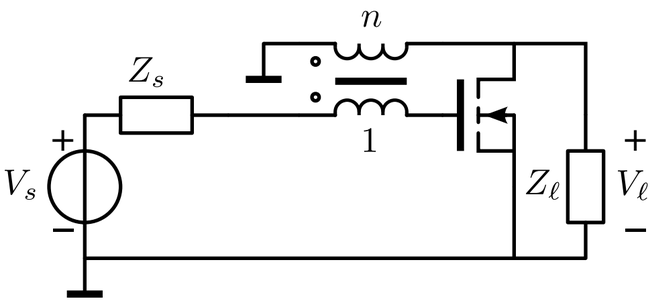
Examples nonenergic feedback stages

Concept

Implementation
(without biasing)

Voltage amplifier





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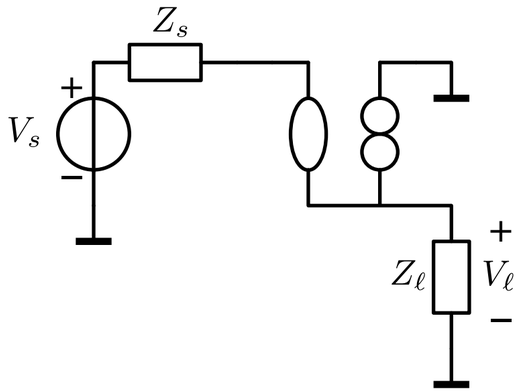
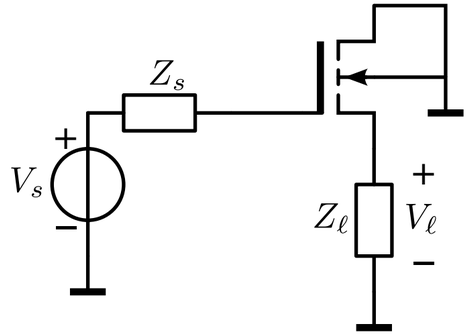
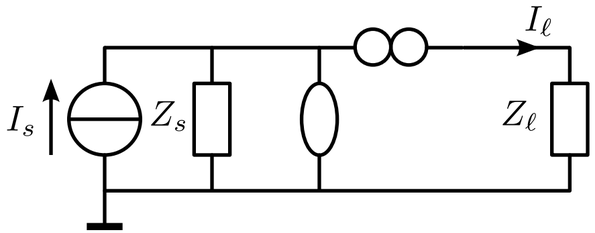
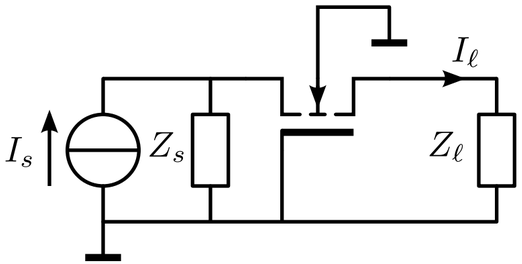




CD stage

Current follower





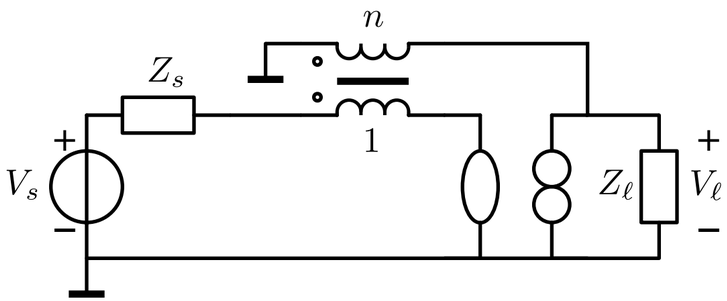
CG stage

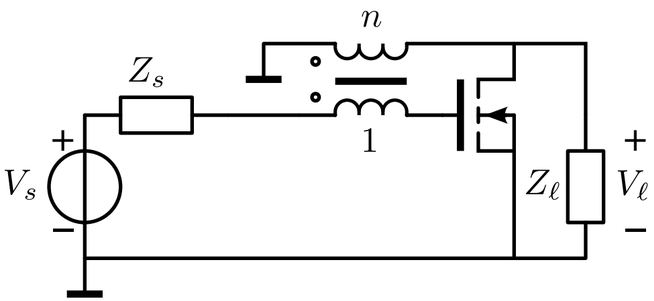
Examples nonenergic feedback stages

Concept

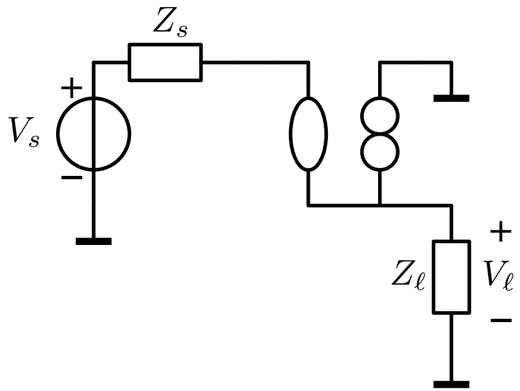
Implementation
(without biasing)

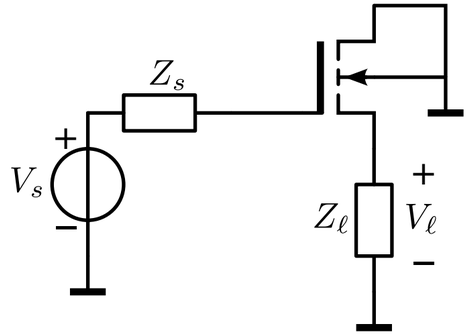
Voltage amplifier





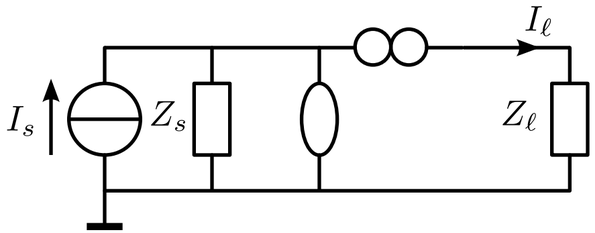
Voltage follower

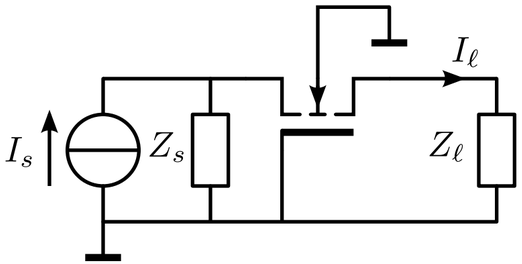




CD stage

Current follower





CG stage

Examples passive feedback stages

Examples passive feedback stages

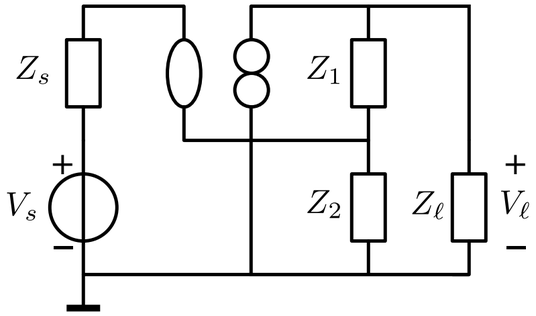
Concept A Implementation
(without biasing)

Examples passive feedback stages

Concept

A

Implementation
(without biasing)

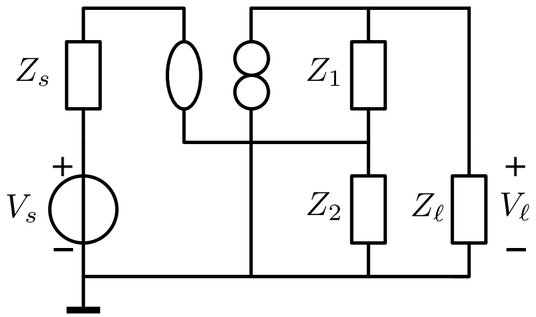


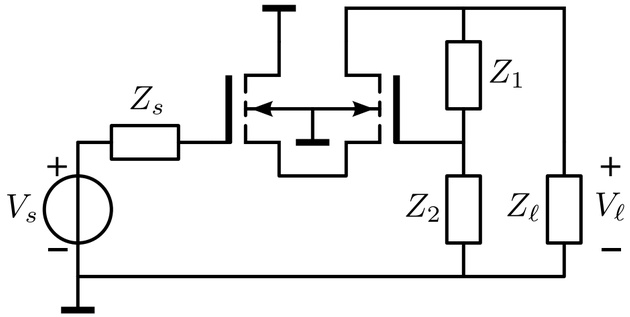
Examples passive feedback stages

Concept

A

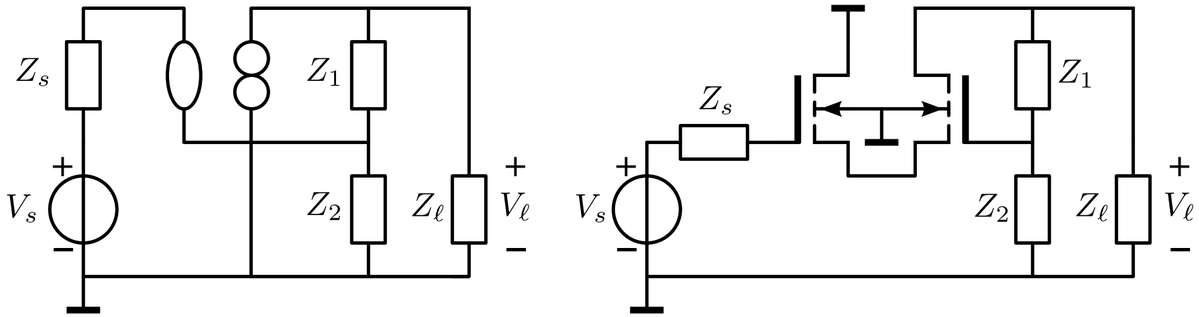
Implementation
(without biasing)





Examples passive feedback stages

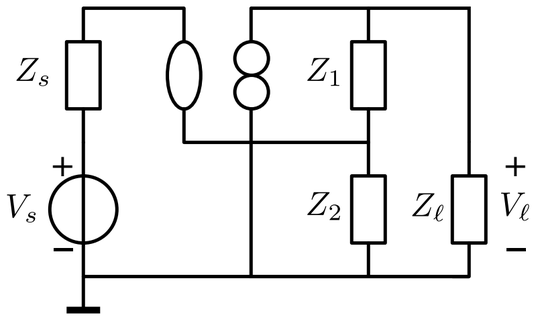
Concept A Implementation (without biasing)



Concept B Implementation (without biasing)

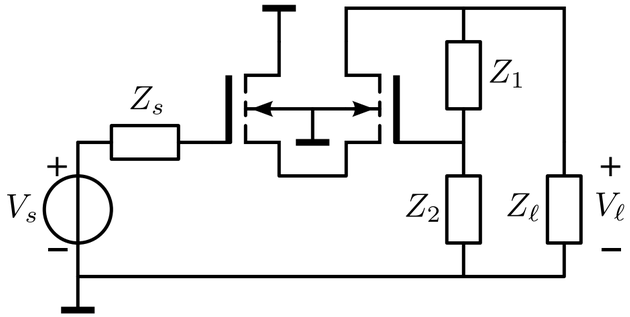
Examples passive feedback stages

Concept



A

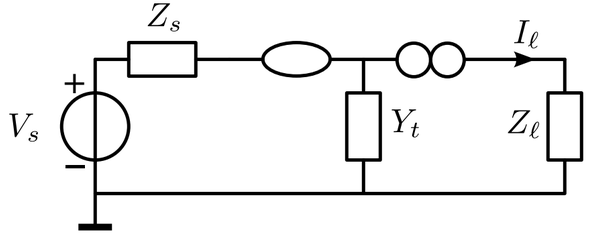
Implementation
(without biasing)



Concept

B

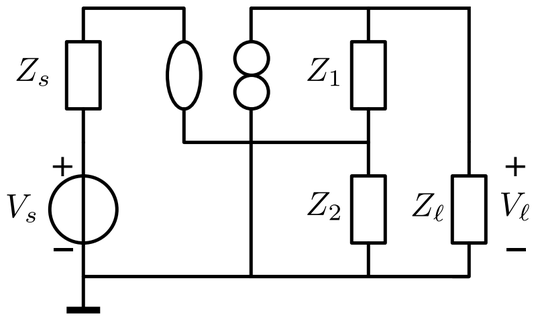
Implementation
(without biasing)



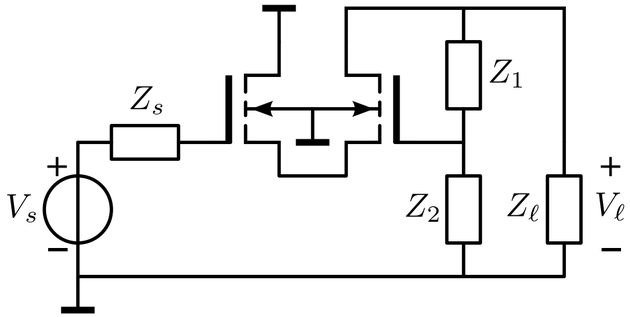
Examples passive feedback stages

A

Concept

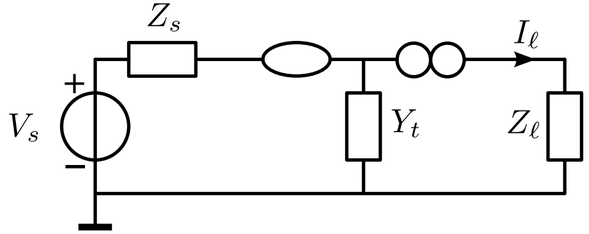


Implementation (without biasing)

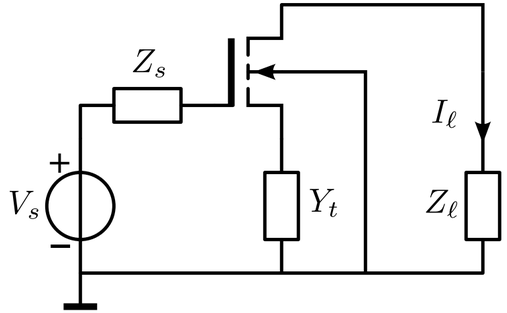


B

Concept



Implementation (without biasing)

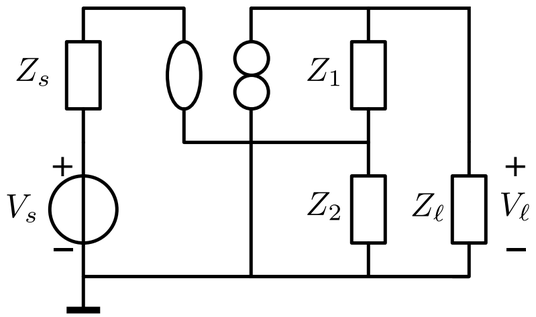


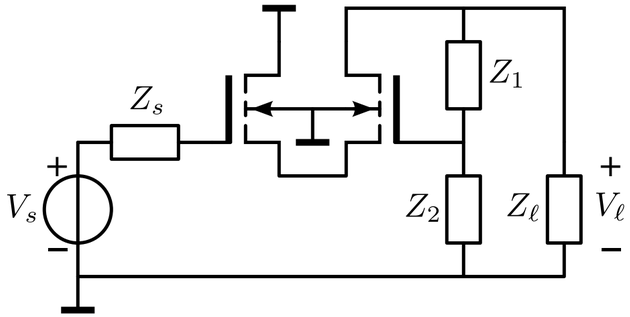
Examples passive feedback stages

Concept

A

Implementation
(without biasing)

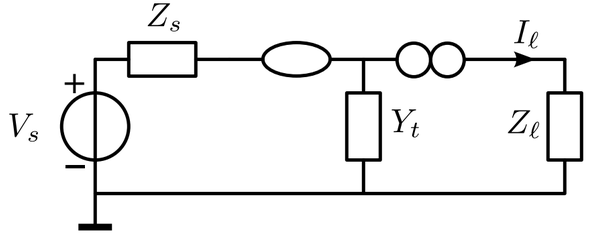


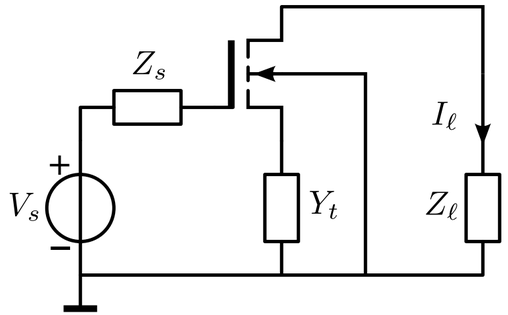


Concept

B

Implementation
(without biasing)





Concept

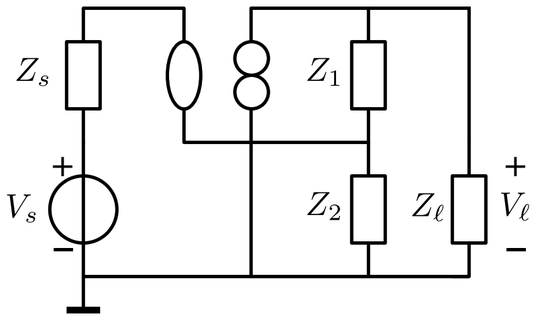
C

Implementation
(without biasing)

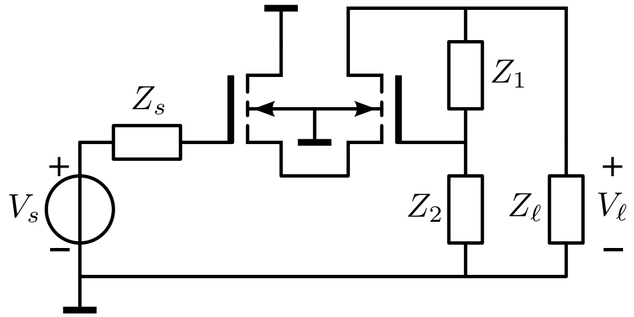
Examples passive feedback stages

A

Concept

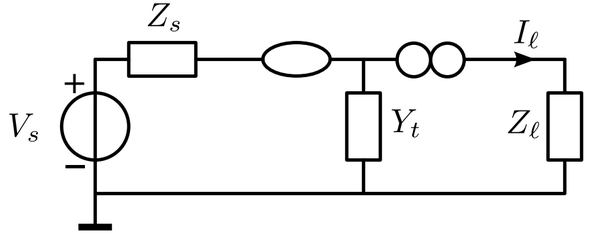


Implementation (without biasing)

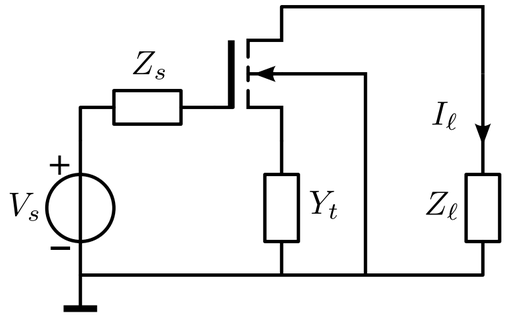


B

Concept

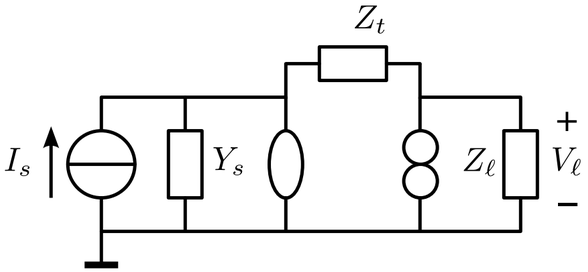


Implementation (without biasing)



C

Concept

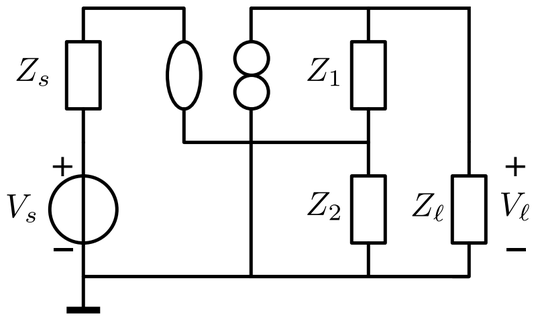


Implementation (without biasing)

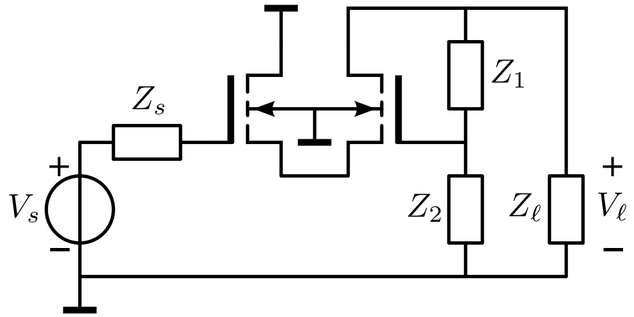
Examples passive feedback stages

A

Concept

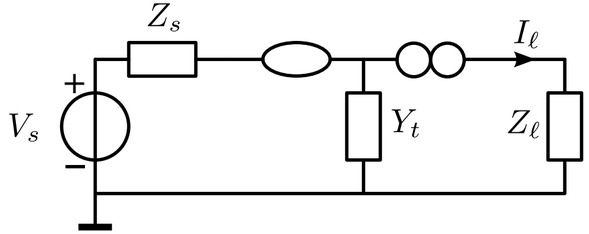


Implementation (without biasing)



B

Concept



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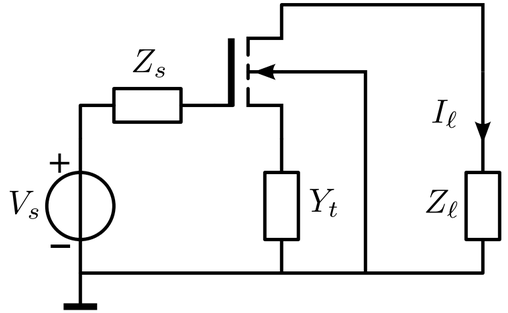
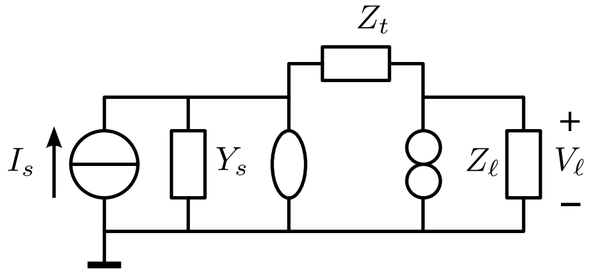
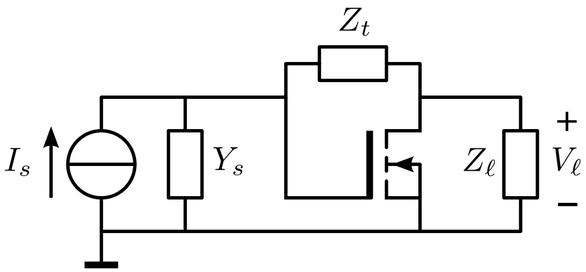


C

Concept



Implementation (without biasing)

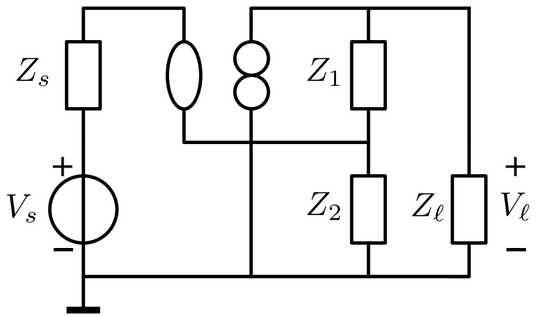


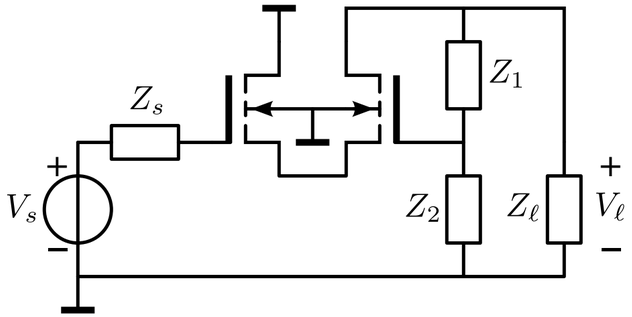
Examples passive feedback stages

Concept

A

Implementation
(without biasing)

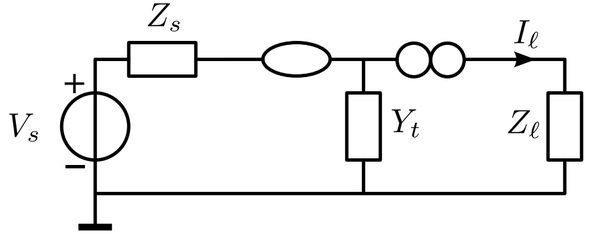


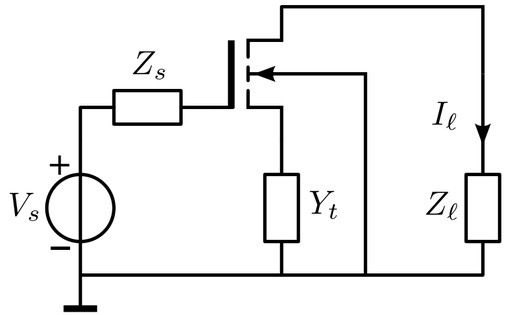


Concept

B

Implementation
(without biasing)

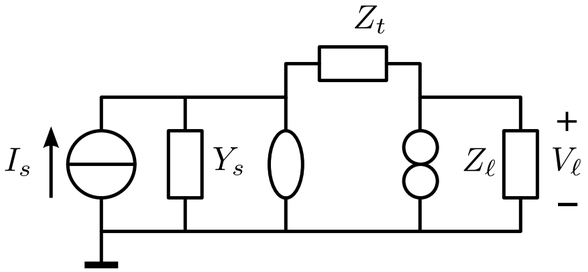


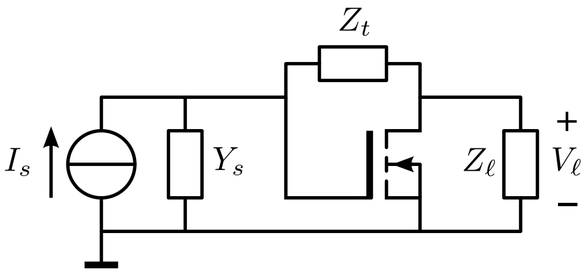


Concept

C

Implementation
(without biasing)





Concept

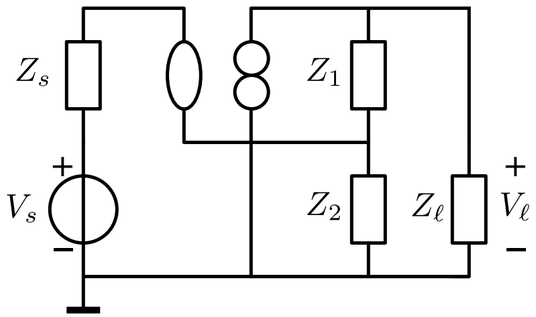
D

Implementation
(without biasing)

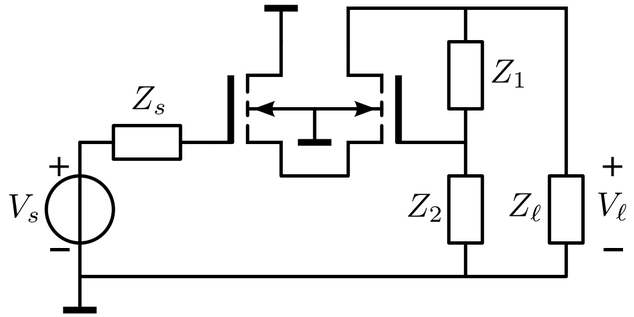
Examples passive feedback stages

A

Concept

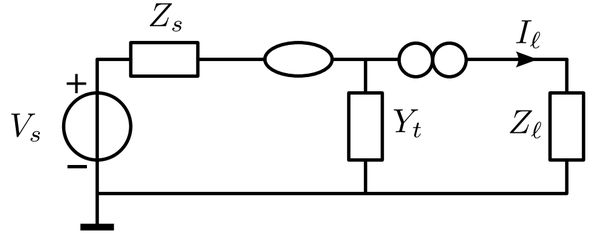


Implementation (without biasing)



B

Concept



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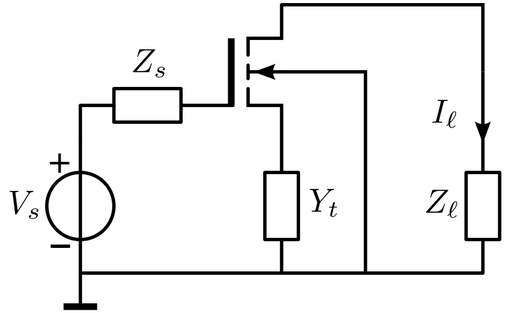
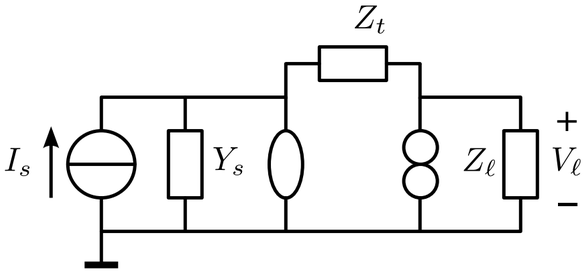


C

Concept



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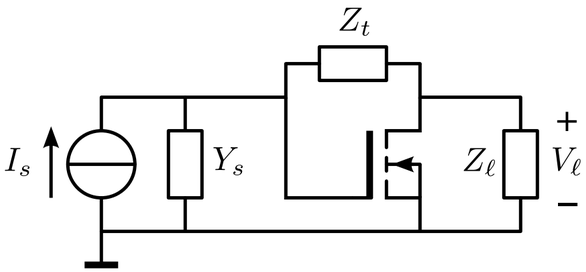
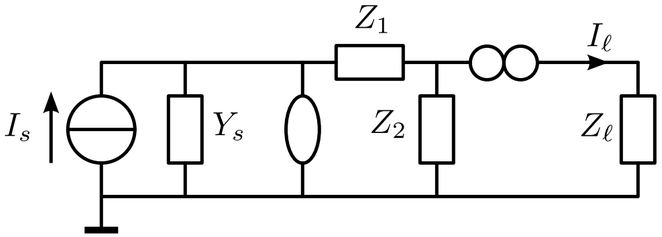


D

Concept

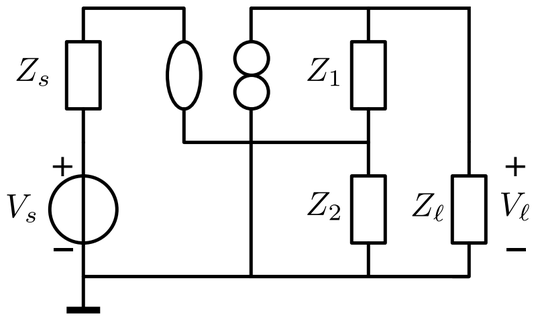


Implementation (without biasing)

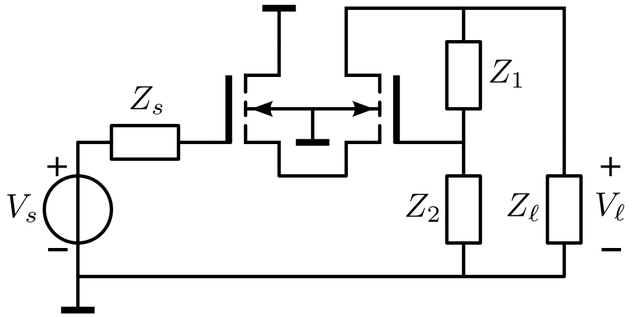
Examples passive feedback stages

A

Concept

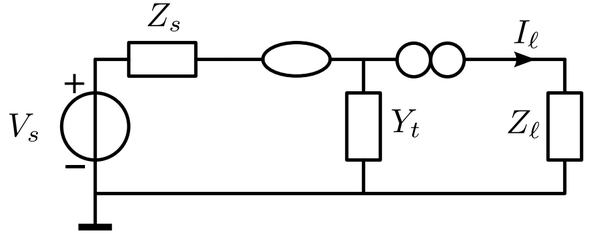


Implementation (without biasing)



B

Concept



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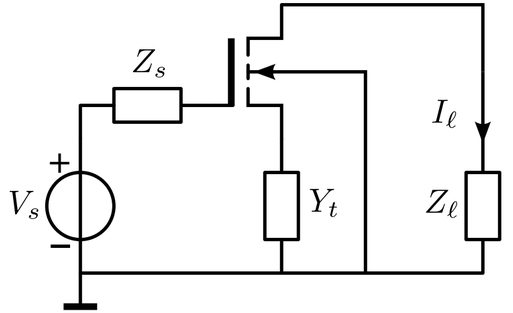
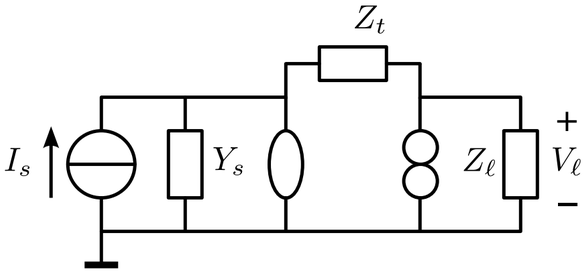
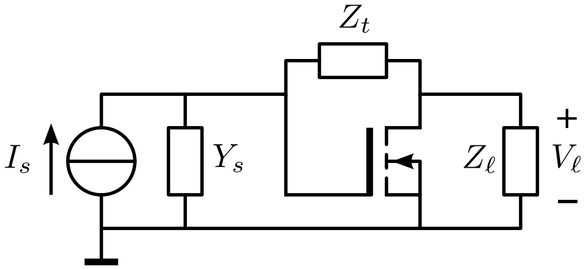


C

Concept

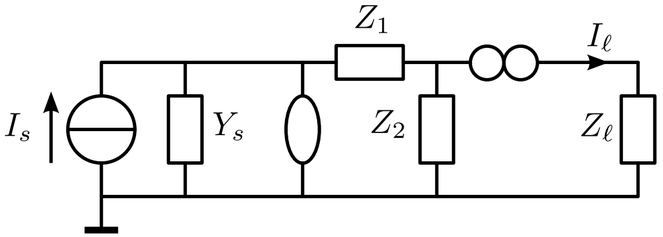


Implementation (without biasing)



D

Concept



Implementation (without biasing)