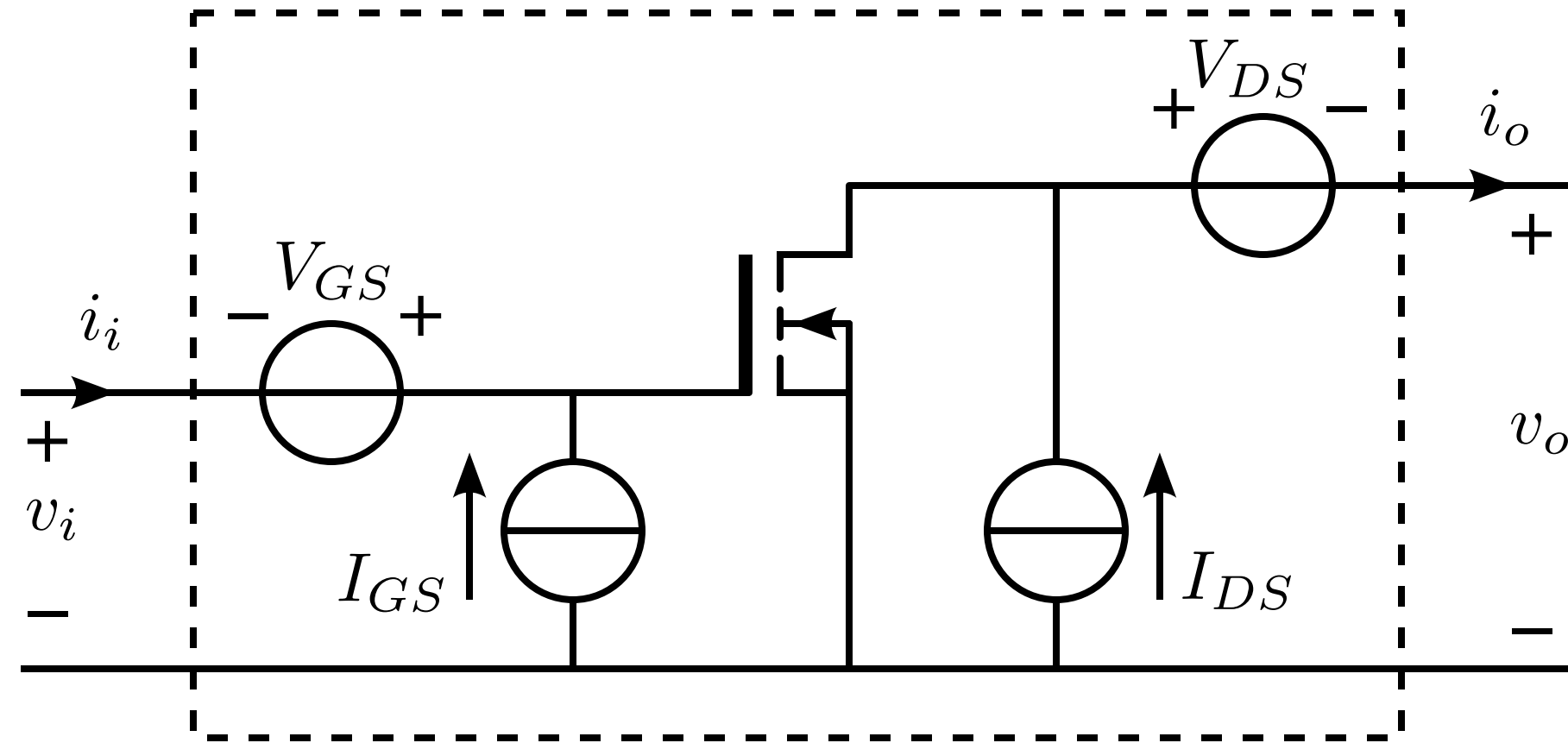


Structured Electronic Design

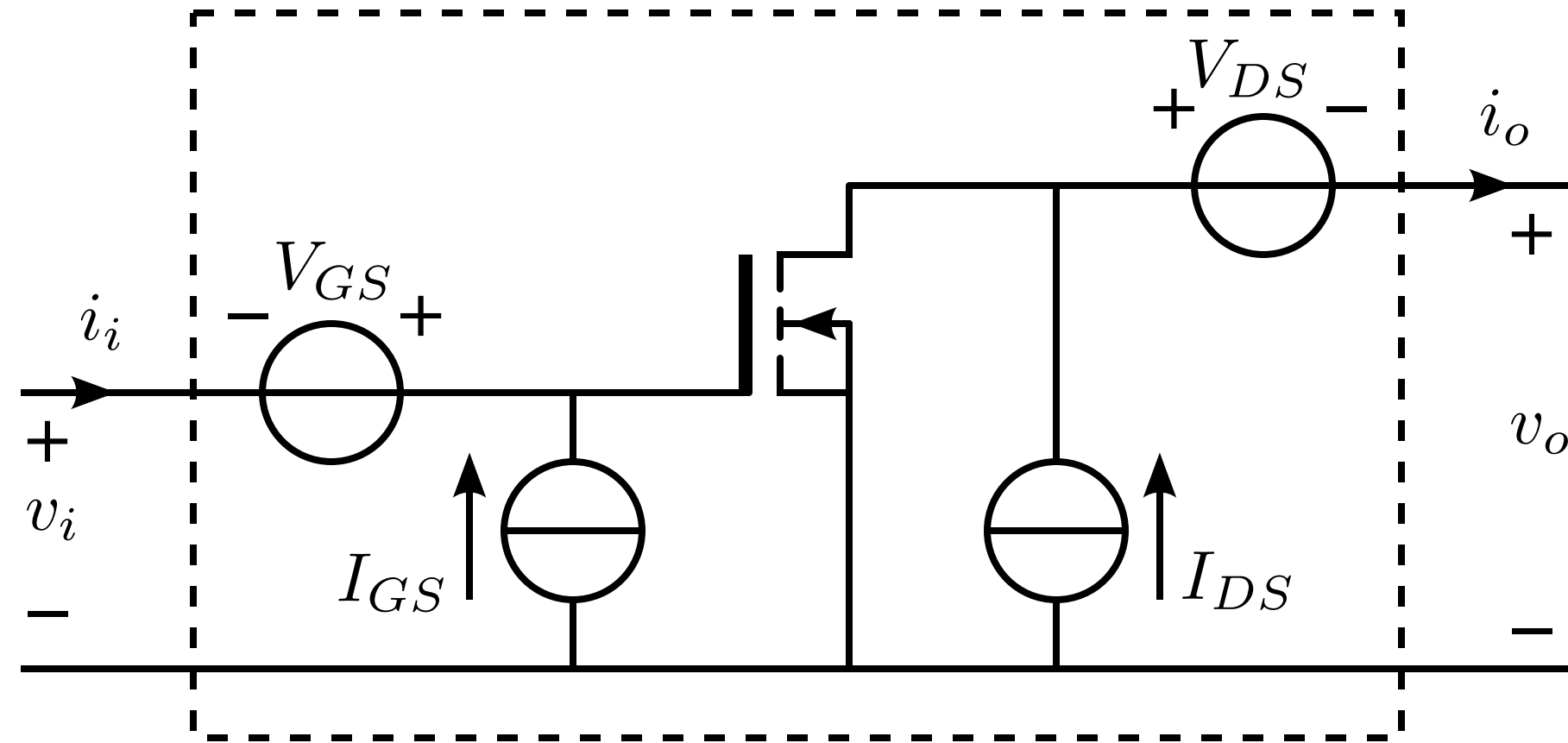
Implementation of biasing

Anton J.M. Montagne

Implementation of biasing

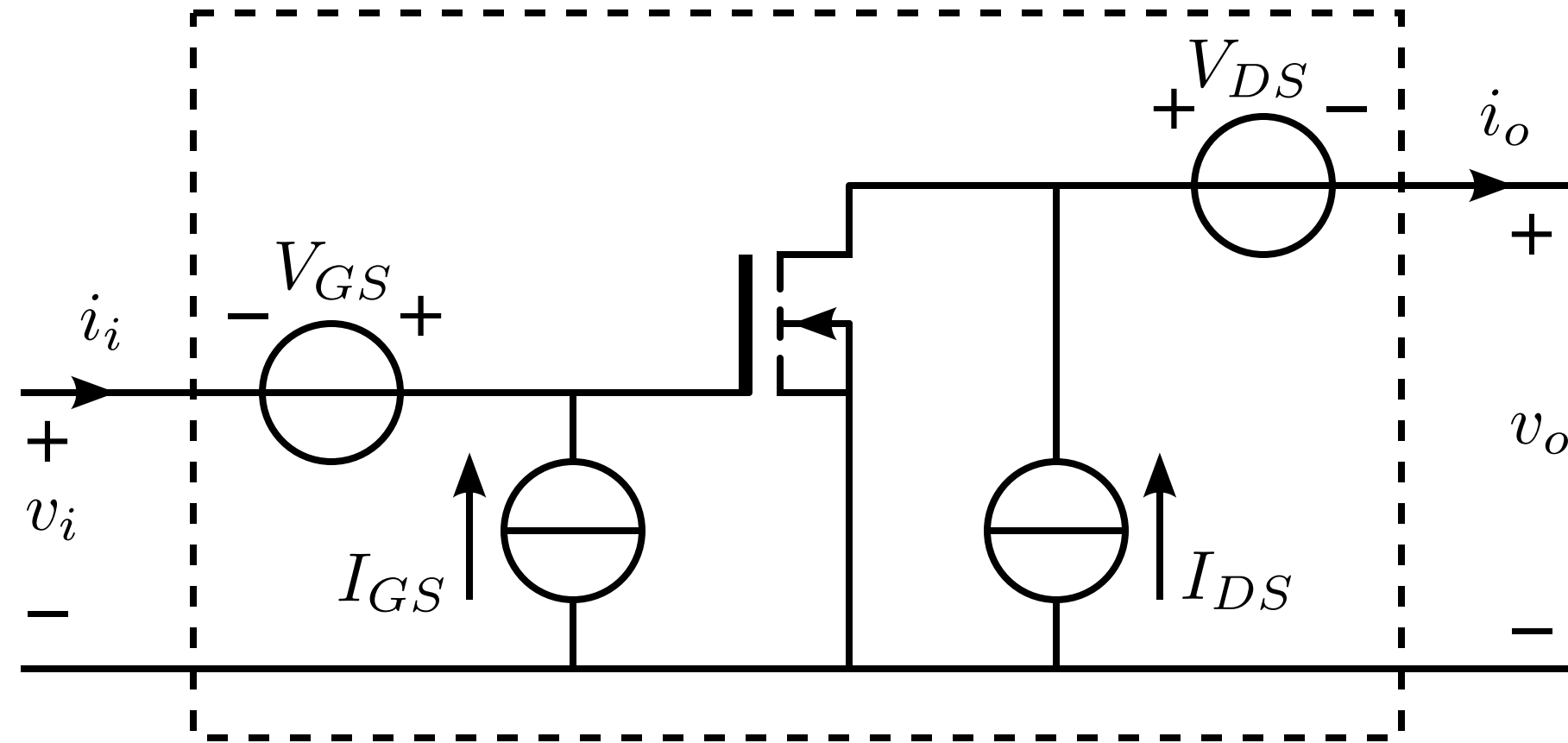


Implementation of biasing



Biased amplifier stage

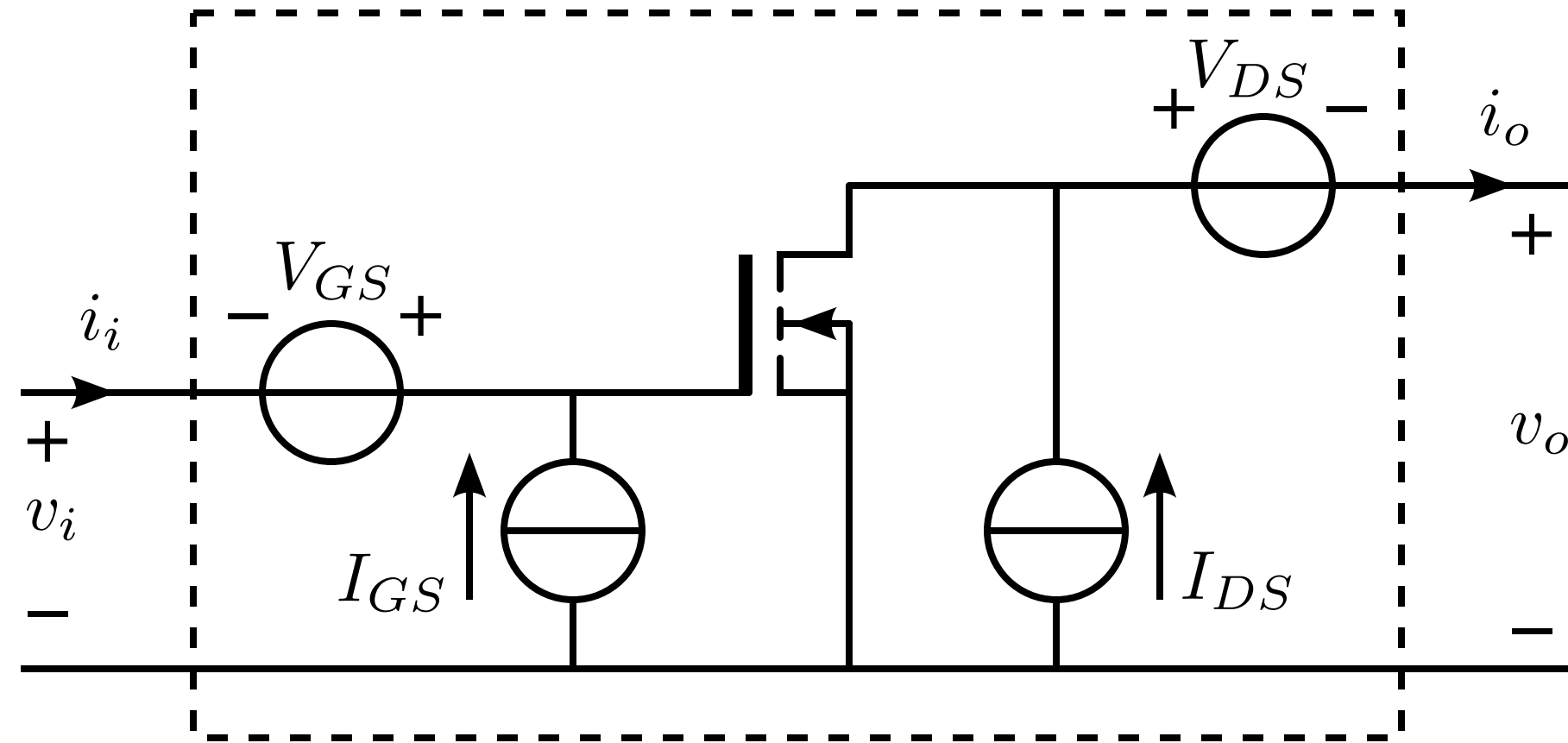
Implementation of biasing



Biased amplifier stage

Bias power delivered by I_{GS} and I_{DS}

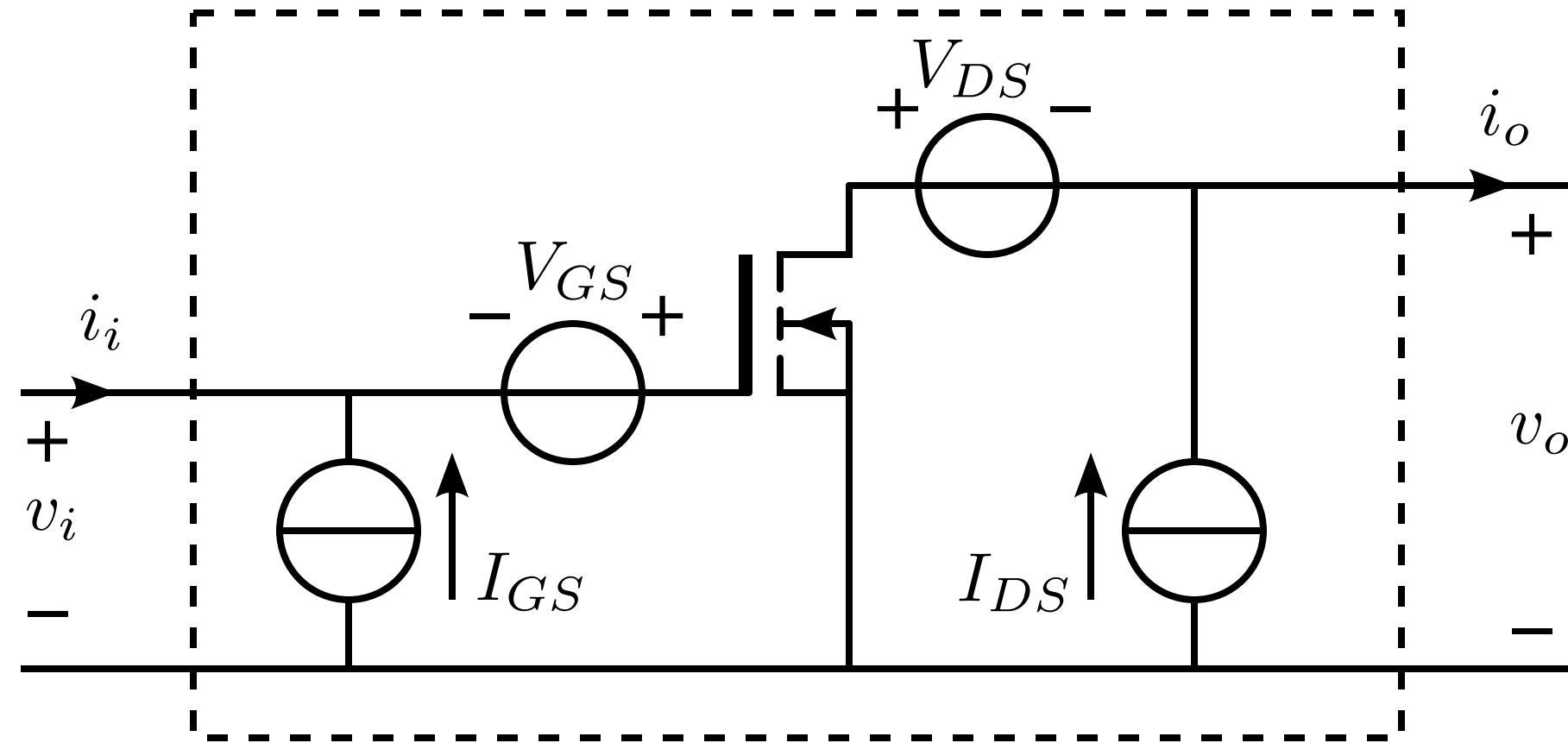
Implementation of biasing



Biased amplifier stage

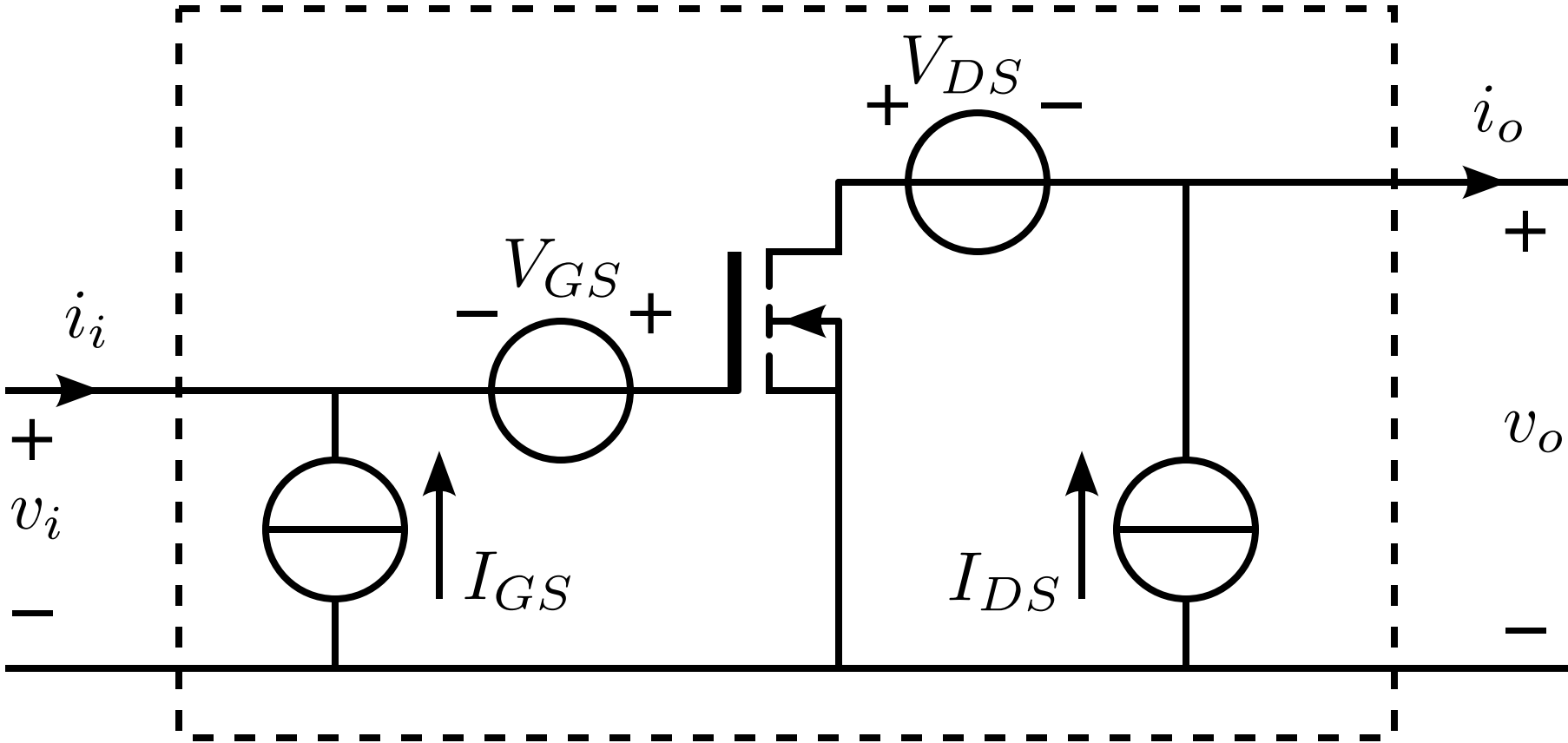
Bias power delivered by I_{GS} and I_{DS}

Implementation of biasing



Biased amplifier stage, alternative arrangement

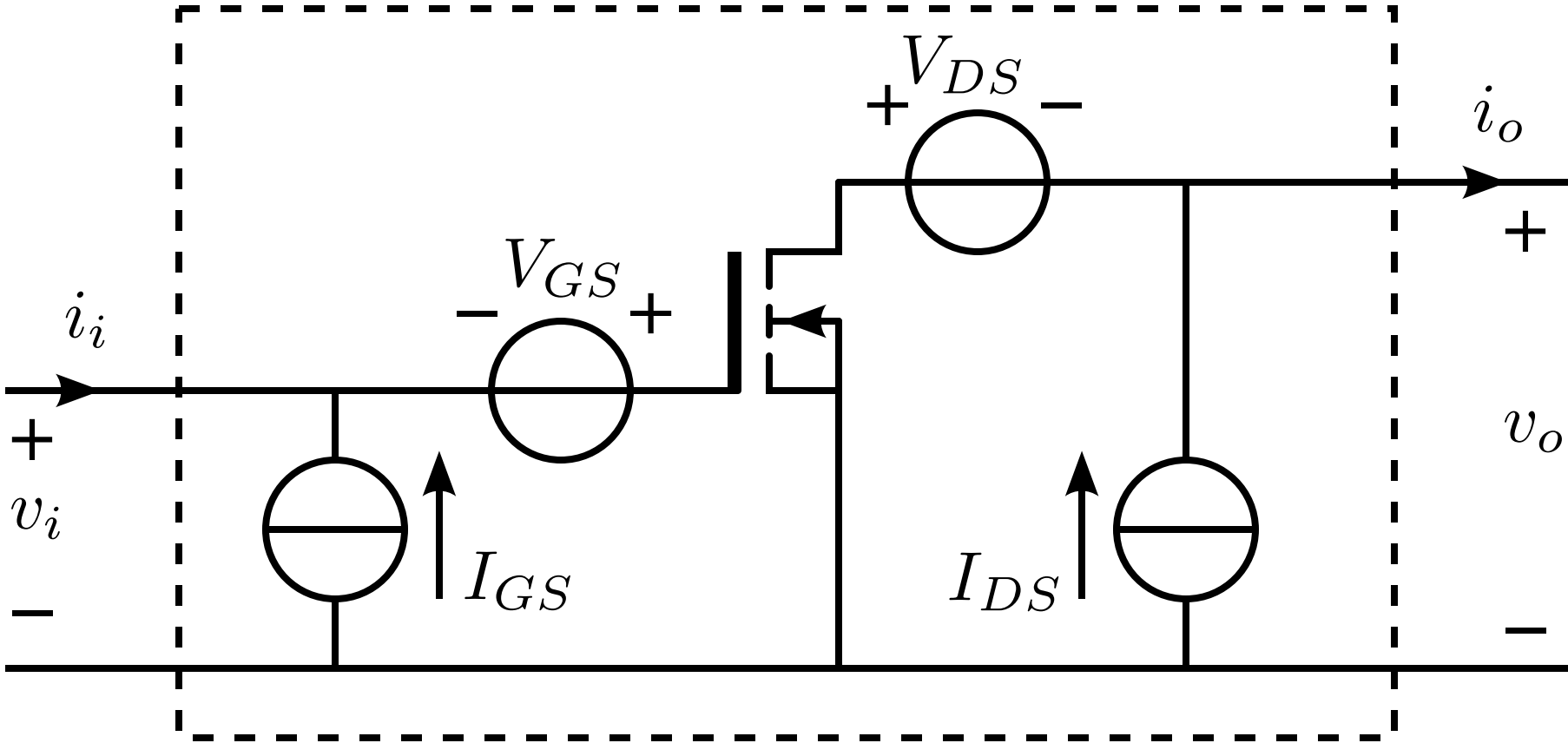
Implementation of biasing



Biased amplifier stage, alternative arrangement

Bias power delivered by V_{GS} and V_{DS}

Implementation of biasing

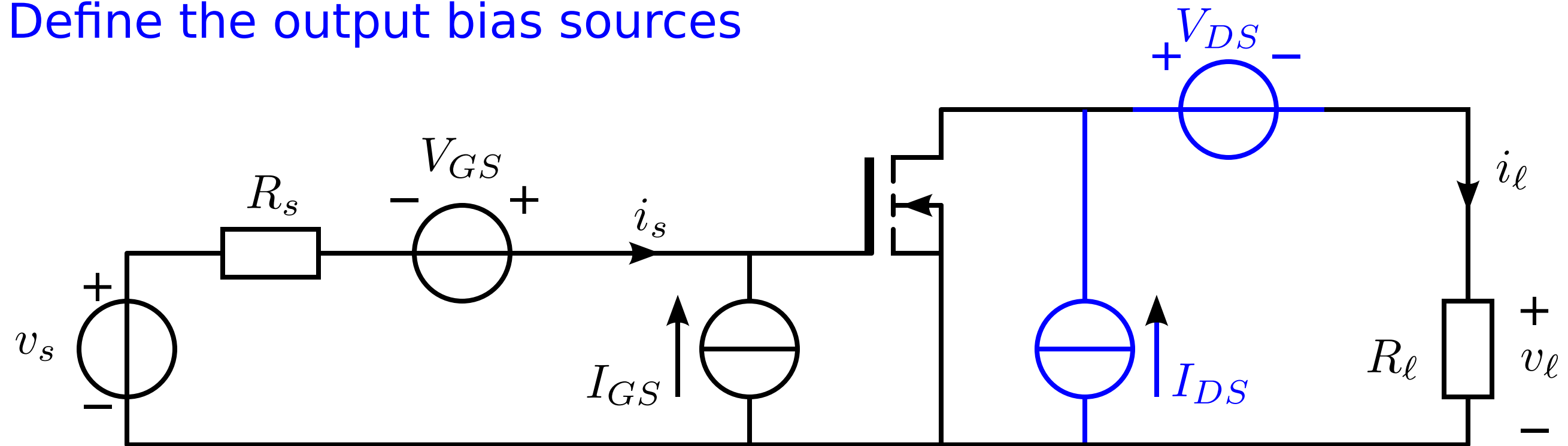


Biased amplifier stage, alternative arrangement

Bias power delivered by V_{GS} and V_{DS}

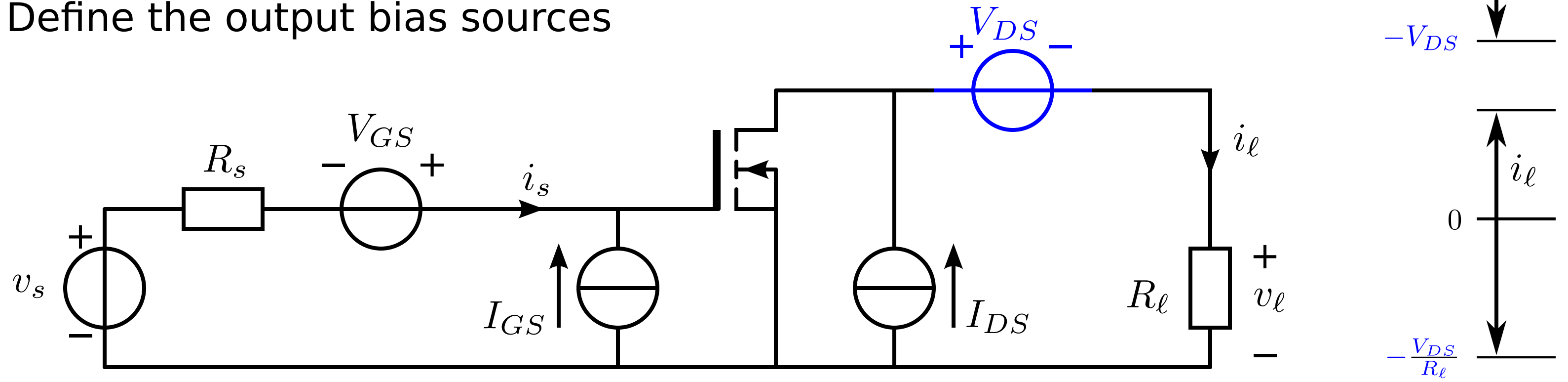
Values of bias sources

Define the output bias sources



Values of bias sources

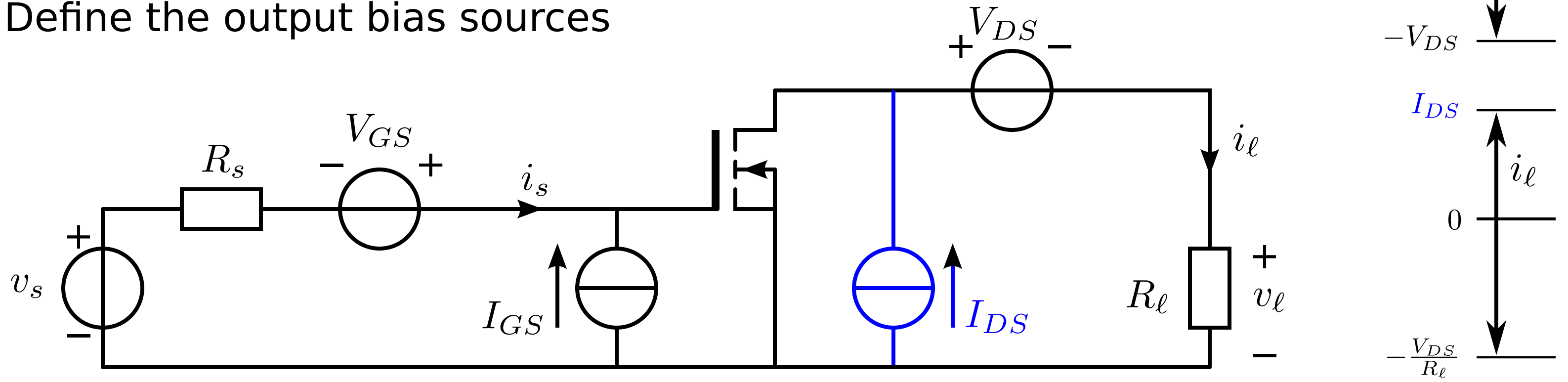
Define the output bias sources



Negative output voltage excursion from operating current limited to $-V_{DS}$

Values of bias sources

Define the output bias sources

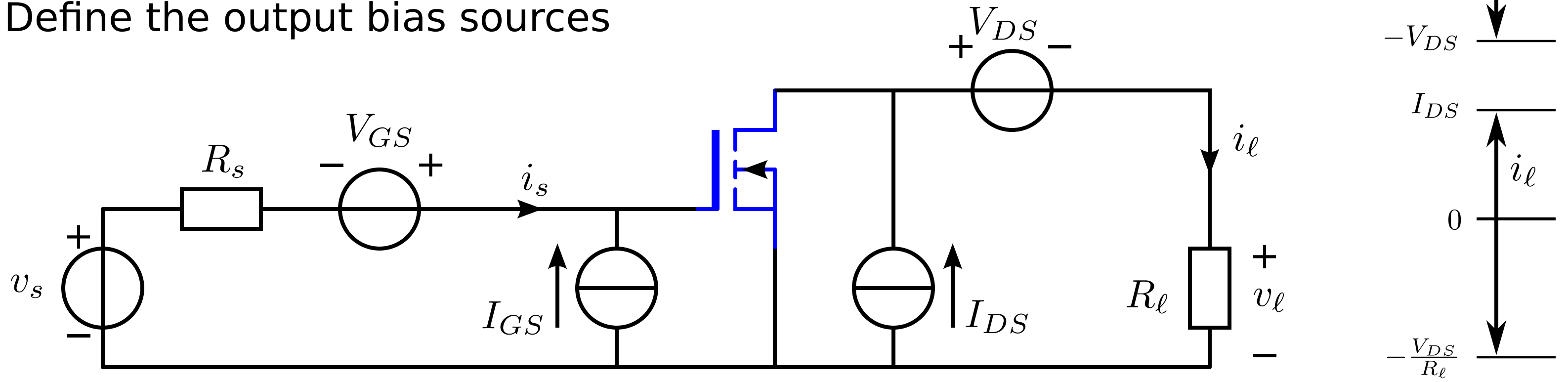


Negative output voltage excursion from operating current limited to $-V_{DS}$

Positive output current excursion from operating current limited to I_{DS}

Values of bias sources

Define the output bias sources



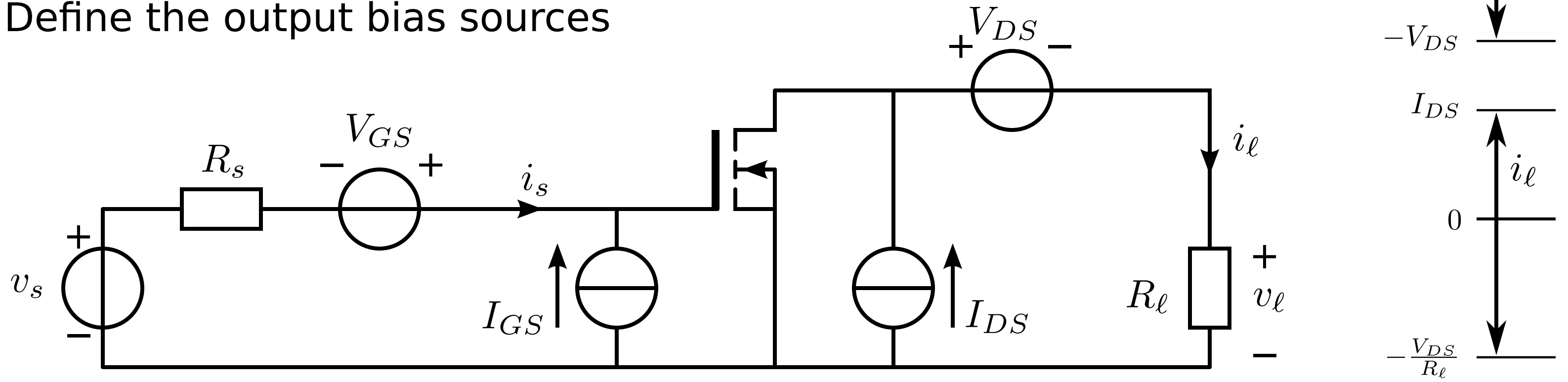
Negative output voltage excursion from operating current limited to $-V_{DS}$

Positive output current excursion from operating current limited to I_{DS}

Later: performance parameters of biased MOS strongly depend on I_{DS}

Values of bias sources

Define the output bias sources



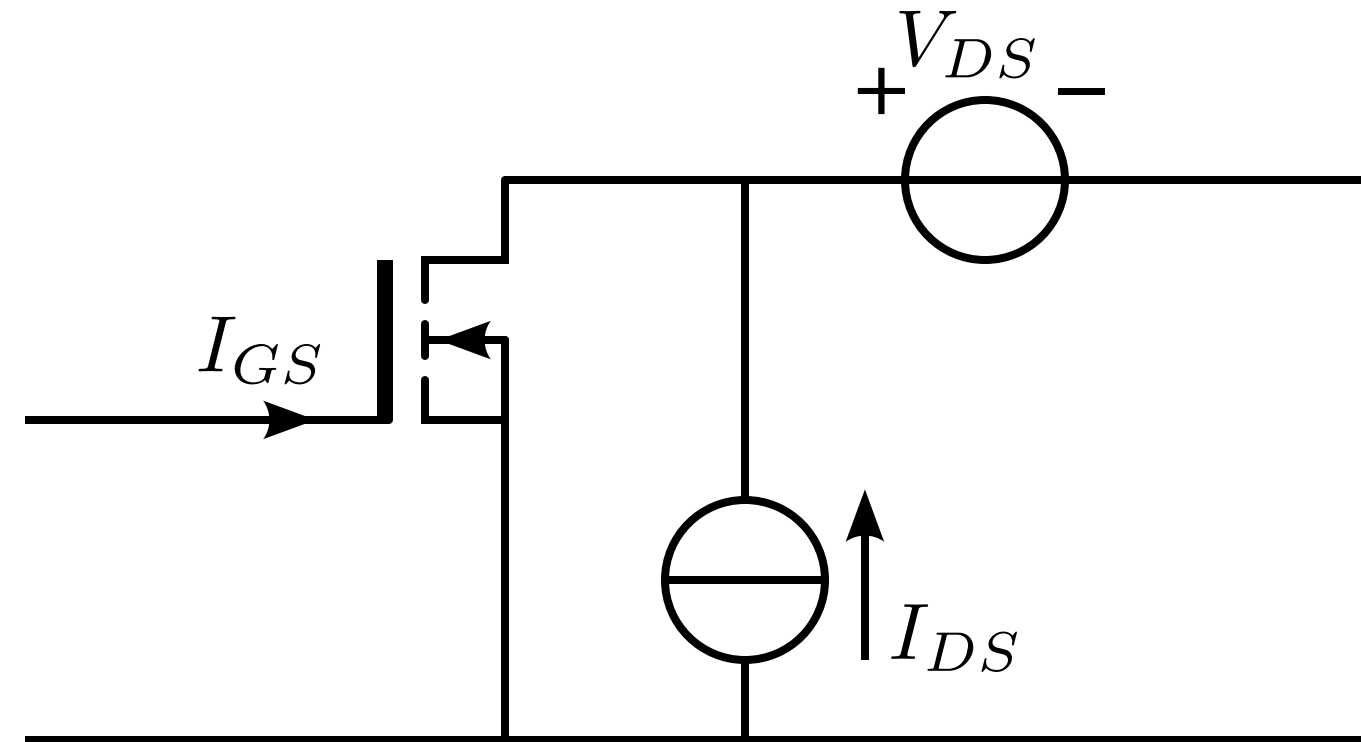
Negative output voltage excursion from operating current limited to $-V_{DS}$

Positive output current excursion from operating current limited to I_{DS}

Later: performance parameters of biased MOS strongly depend on I_{DS}

Values of bias sources

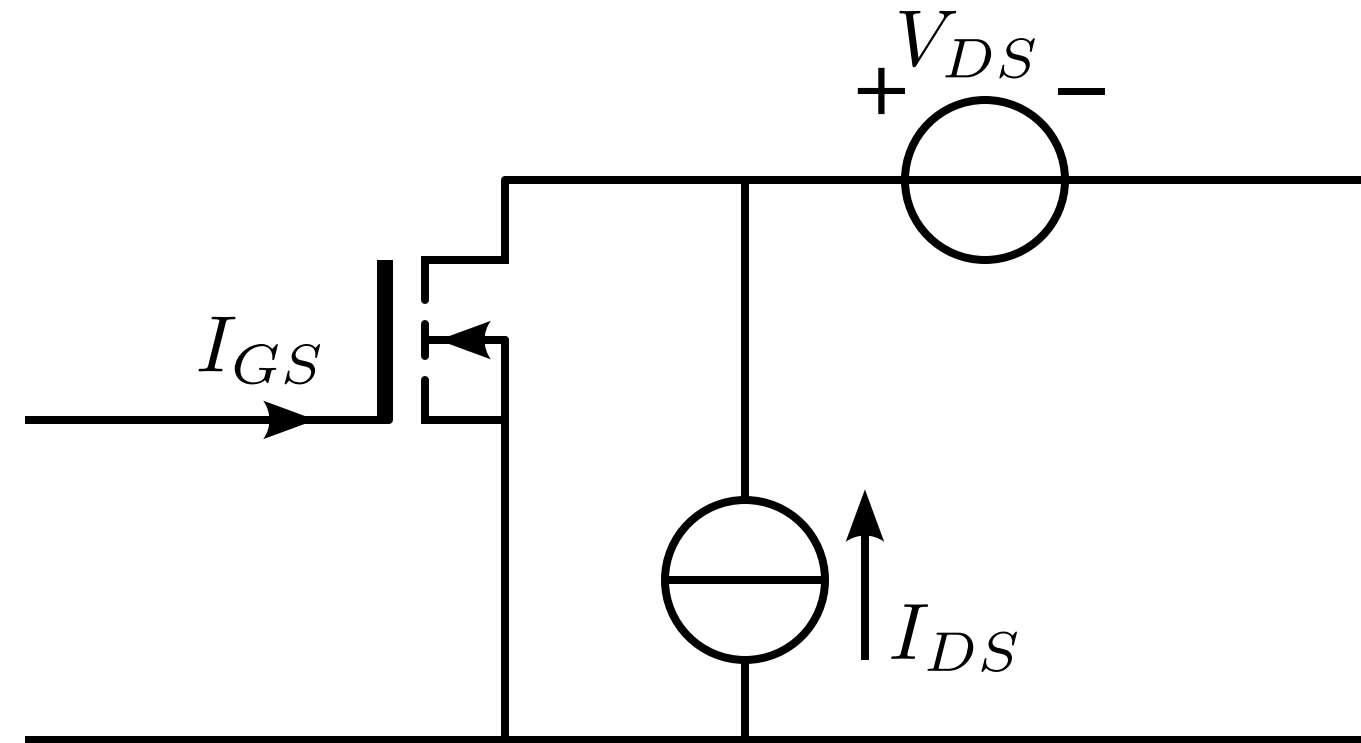
Circuit for determination of the values of the input bias sources



Define output bias quantities such as to obtain:

Values of bias sources

Circuit for determination of the values of the input bias sources

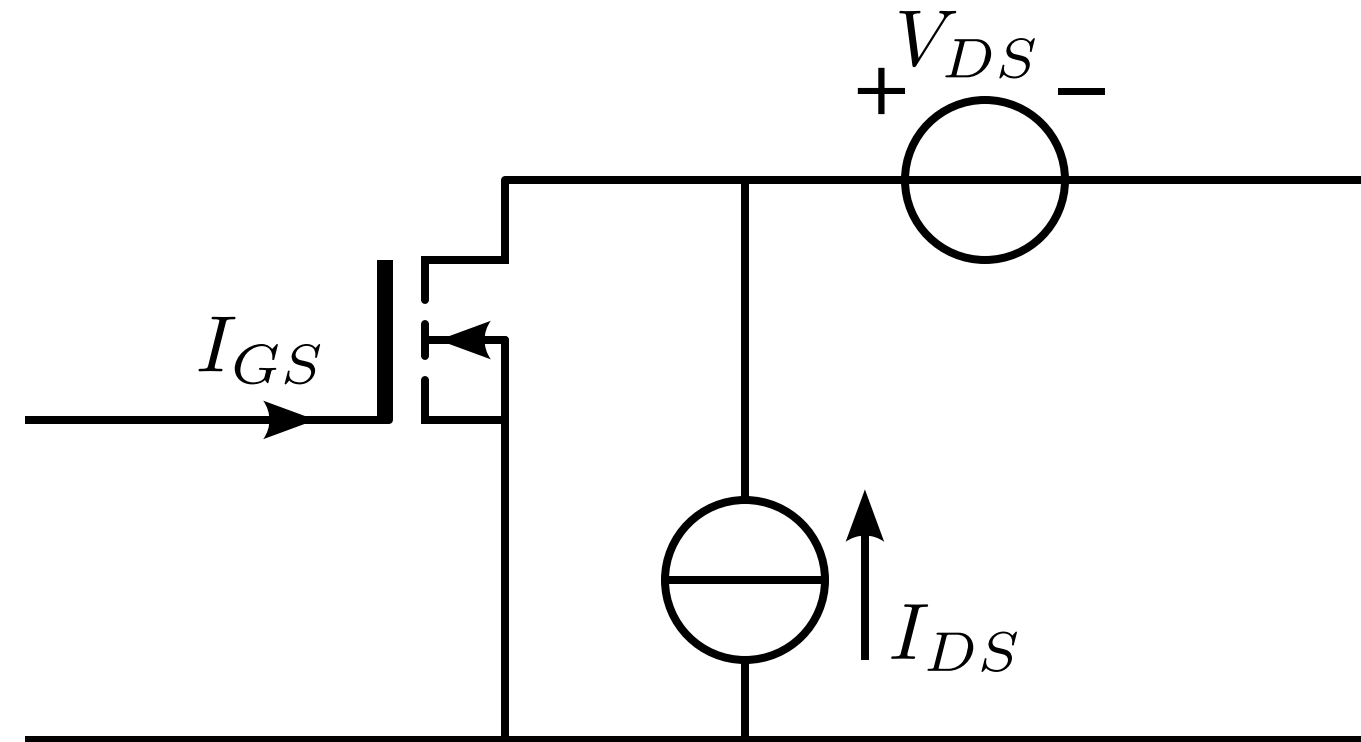


Define output bias quantities such as to obtain:

Adequate voltage and current drive capability

Values of bias sources

Circuit for determination of the values of the input bias sources



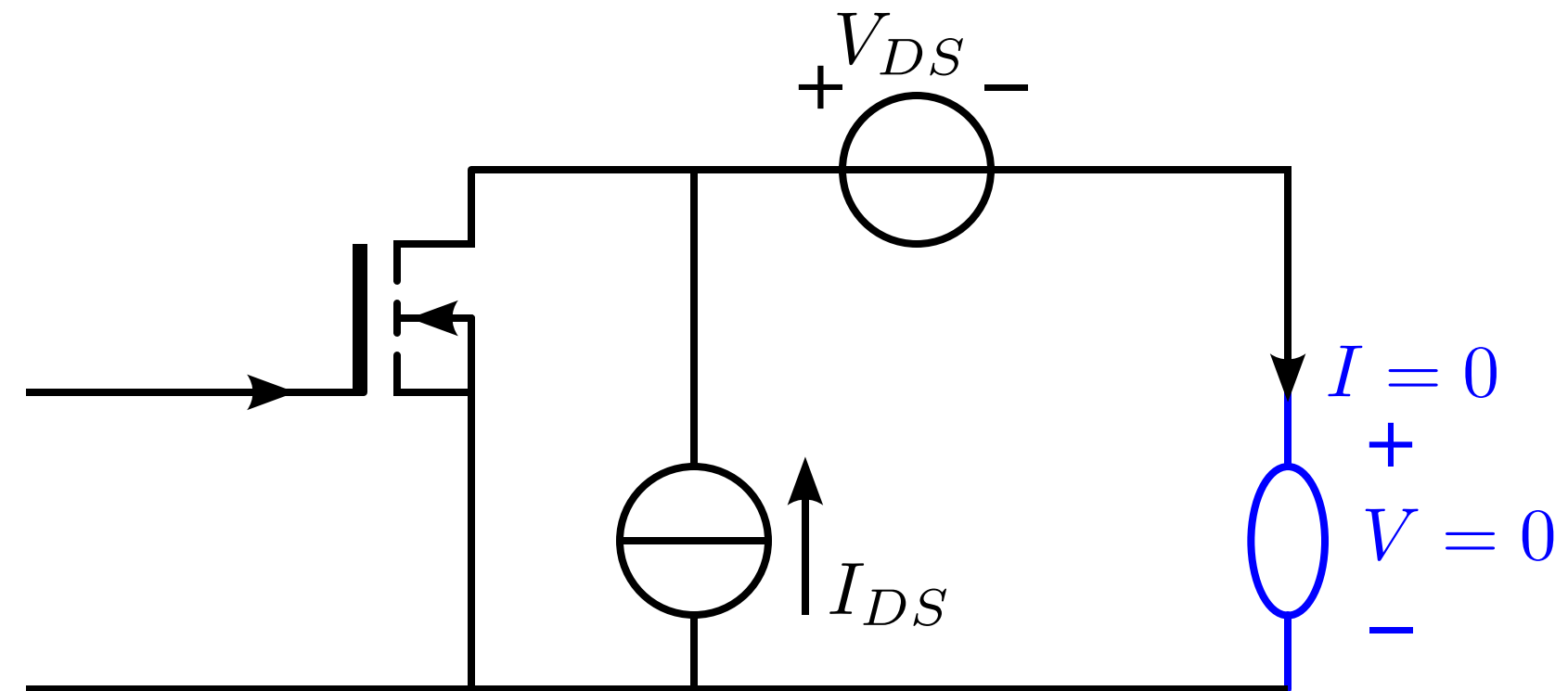
Define output bias quantities such as to obtain:

Adequate voltage and current drive capability

Desired performance parameters (will be discussed later)

Values of bias sources

Circuit for determination of the values of the input bias sources



Define output bias quantities such as to obtain:

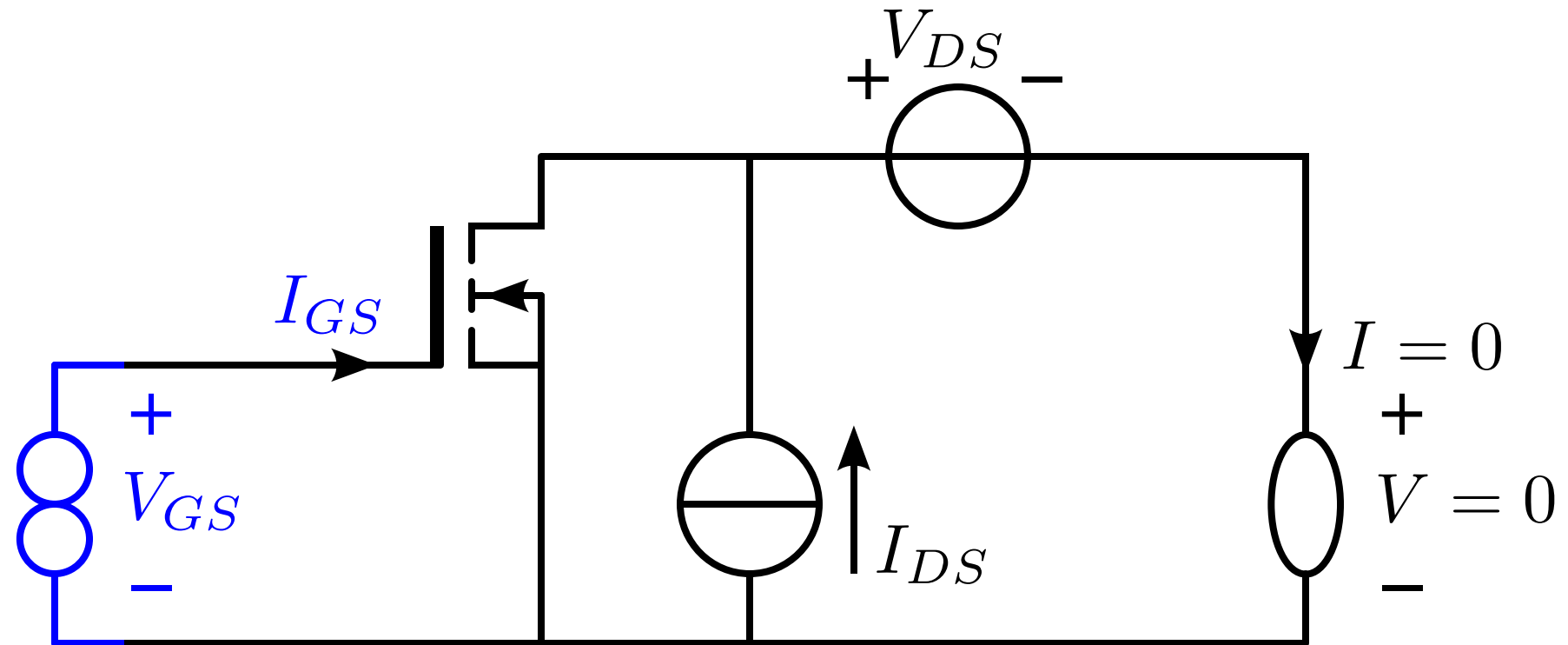
Adequate voltage and current drive capability

Desired performance parameters (will be discussed later)

Nullify the output voltage and current

Values of bias sources

Circuit for determination of the values of the input bias sources



Define output bias quantities such as to obtain:

Adequate voltage and current drive capability

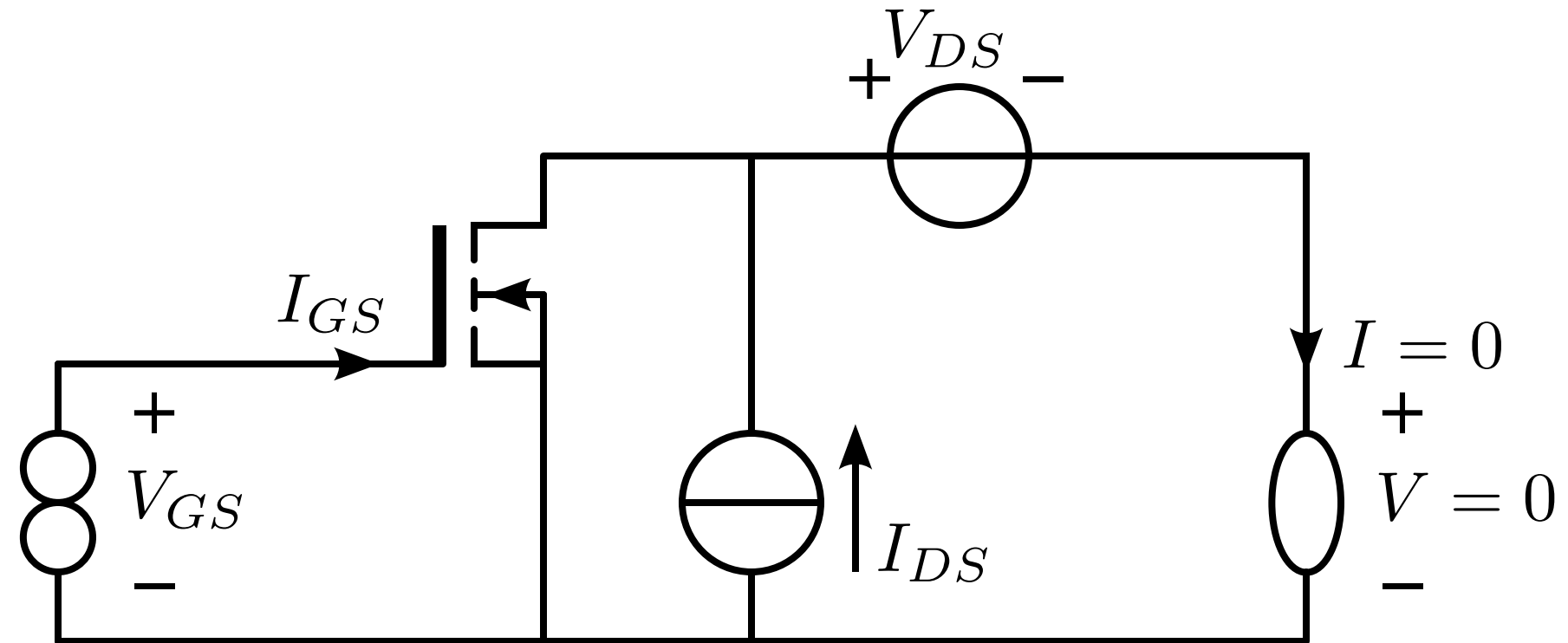
Desired performance parameters (will be discussed later)

Nullify the output voltage and current

Control the input voltage/current

Values of bias sources

Circuit for determination of the values of the input bias sources



Define output bias quantities such as to obtain:

Adequate voltage and current drive capability

Desires performance parameters (will be discussed later)

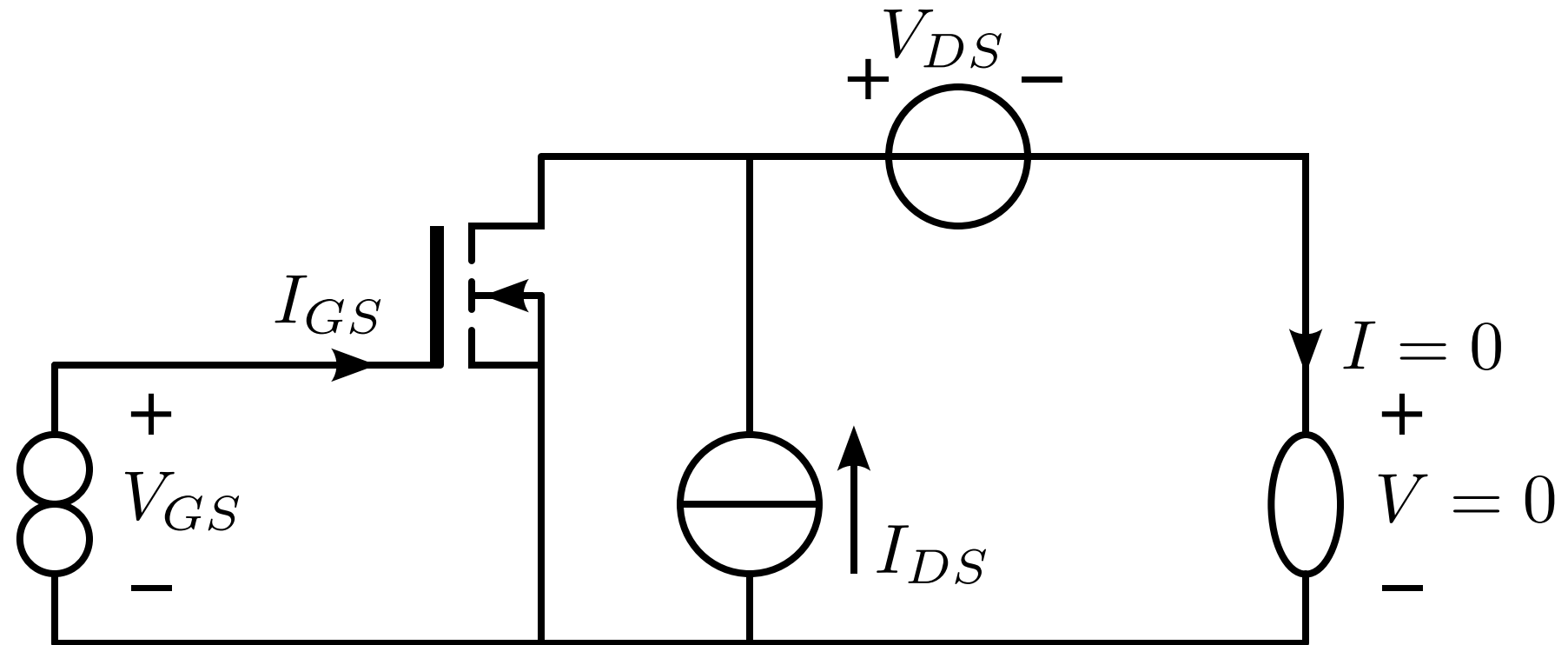
Nullify the output voltage and current

Control the input voltage/current

Obtain V_{GS} and I_{GS}

Values of bias sources

Circuit for determination of the values of the input bias sources



Define output bias quantities such as to obtain:

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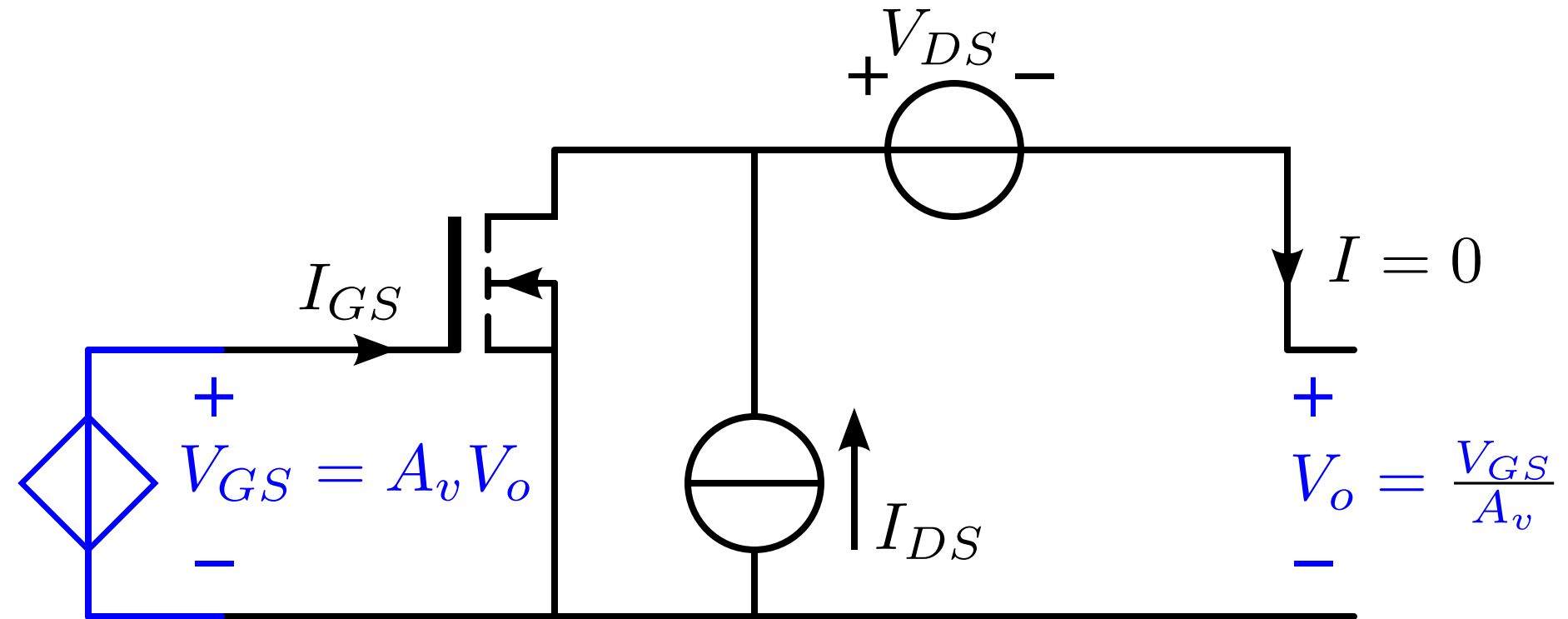
Nullify the output voltage and current

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Values of bias sources

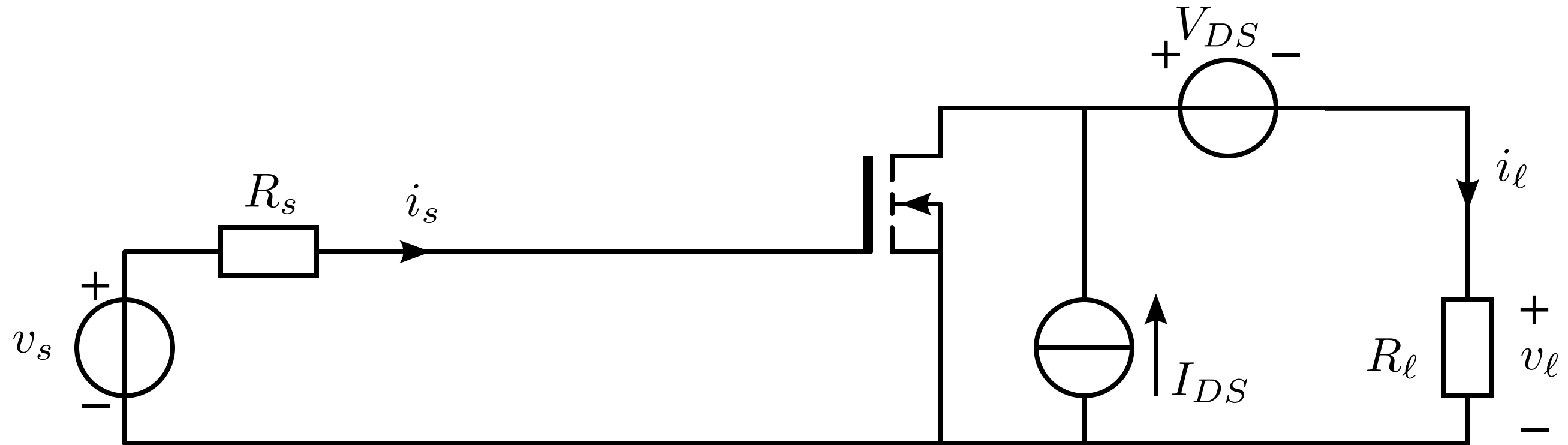
Circuit for determination of the values of the input bias sources



Implementation with a high-gain VCVS

Application of the bias sources

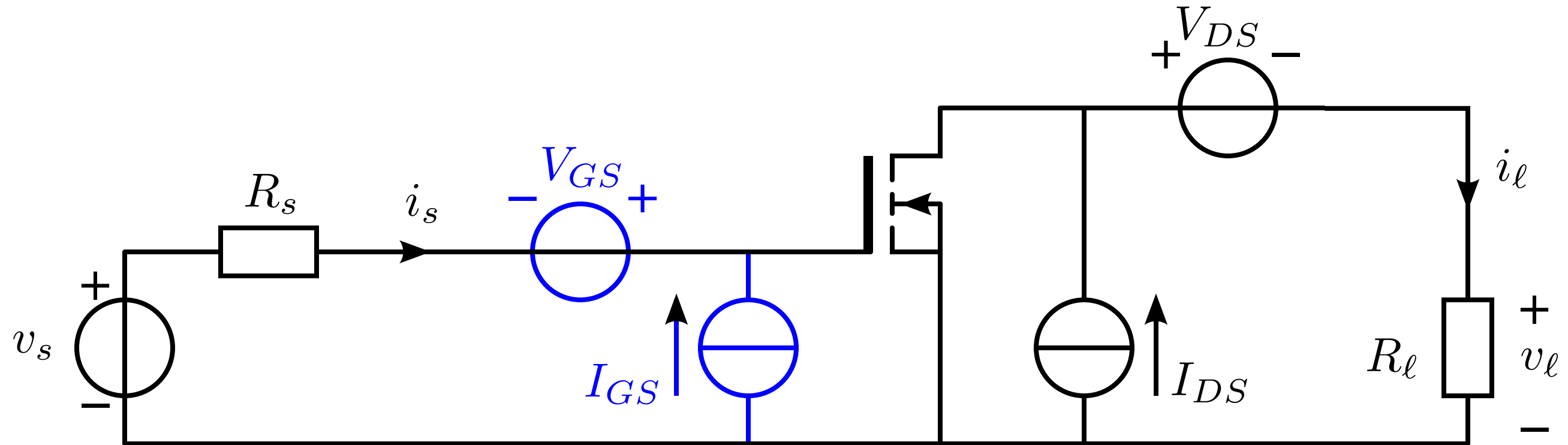
Arrangement with no bias current through voltage sources



Application of the bias sources

Arrangement with no bias current through voltage sources

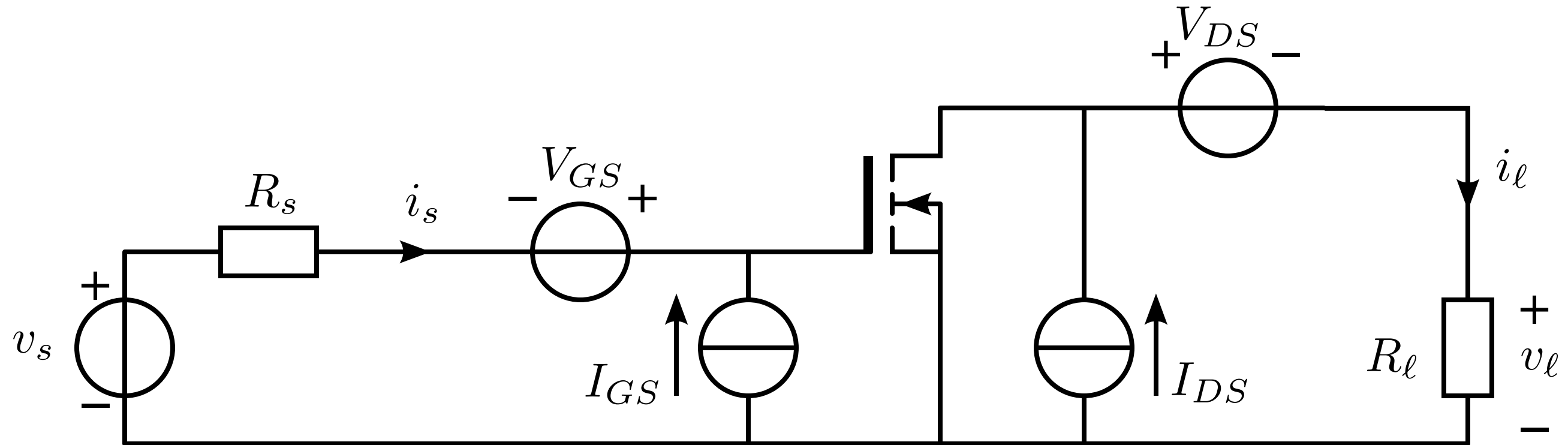
Add input bias sources



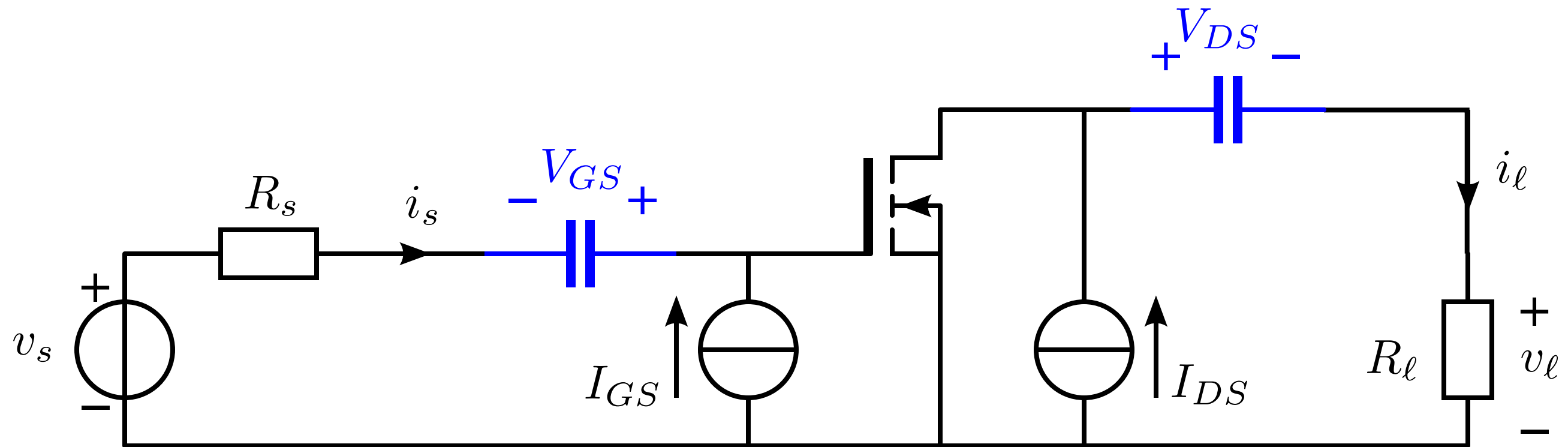
Application of the bias sources

Arrangement with no bias current through voltage sources

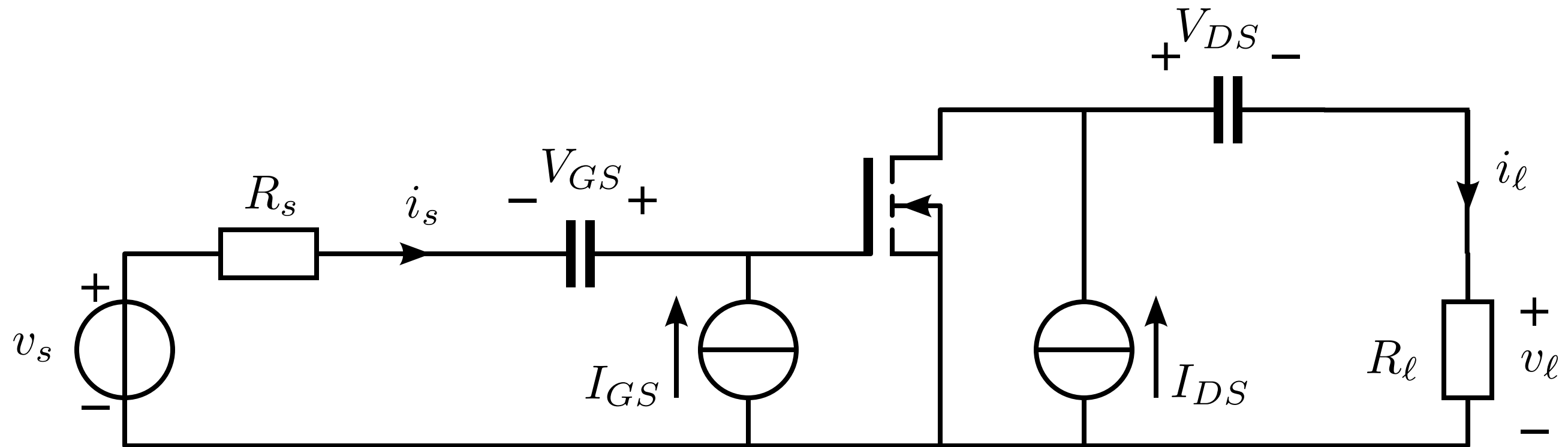
Add input bias sources



AC coupling at source and/or load

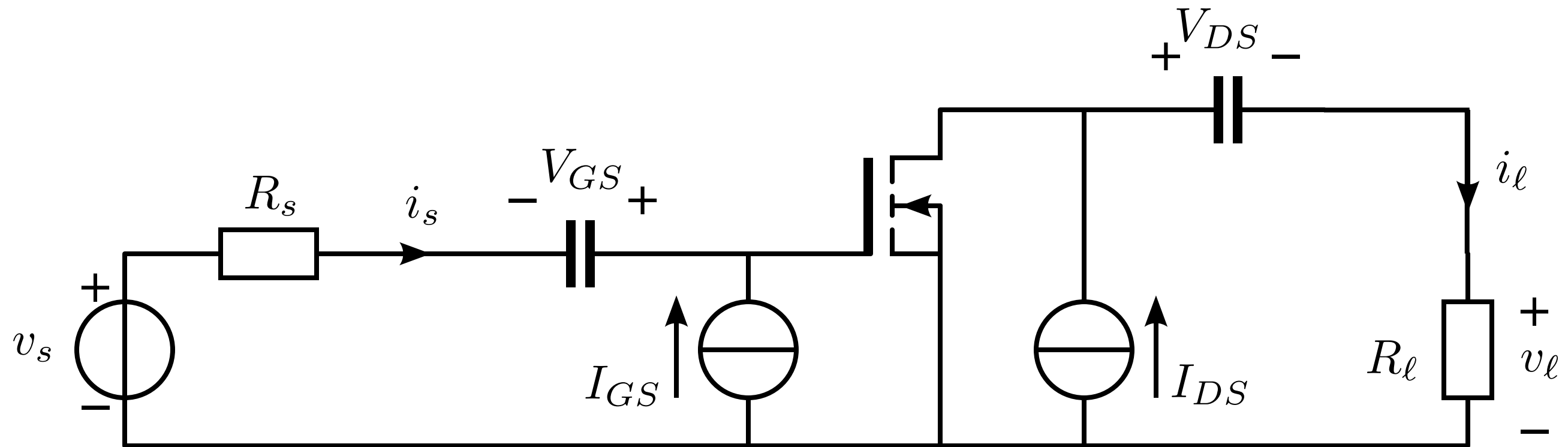


AC coupling at source and/or load



AC coupling always required if no DC current is allowed through source and/or load

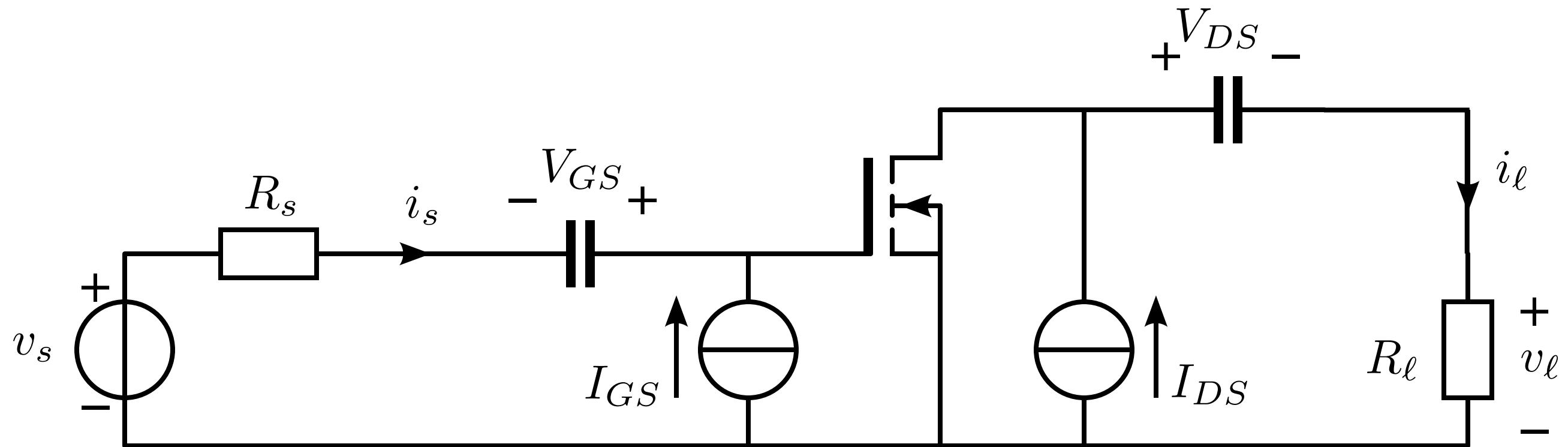
AC coupling at source and/or load



AC coupling always required if no DC current is allowed through source and/or load

AC coupling only possible if zero (signal) frequency is not of interest

AC coupling at source and/or load

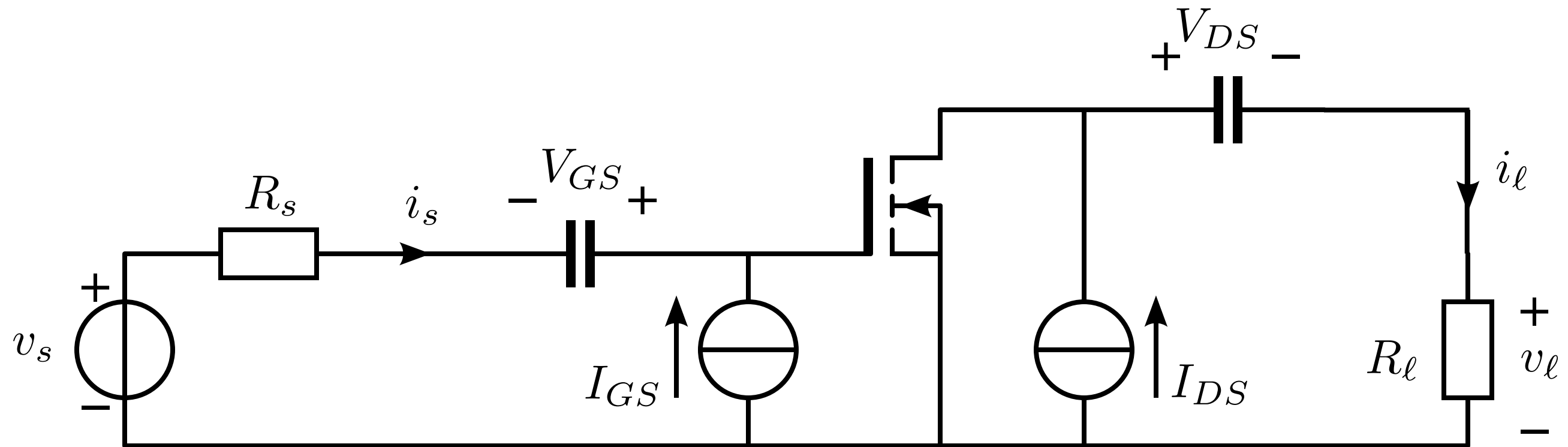


AC coupling always required if no DC current is allowed through source and/or load

AC coupling only possible if zero (signal) frequency is not of interest

Bias current sources are active elements (product V and $I < \text{negative}$)

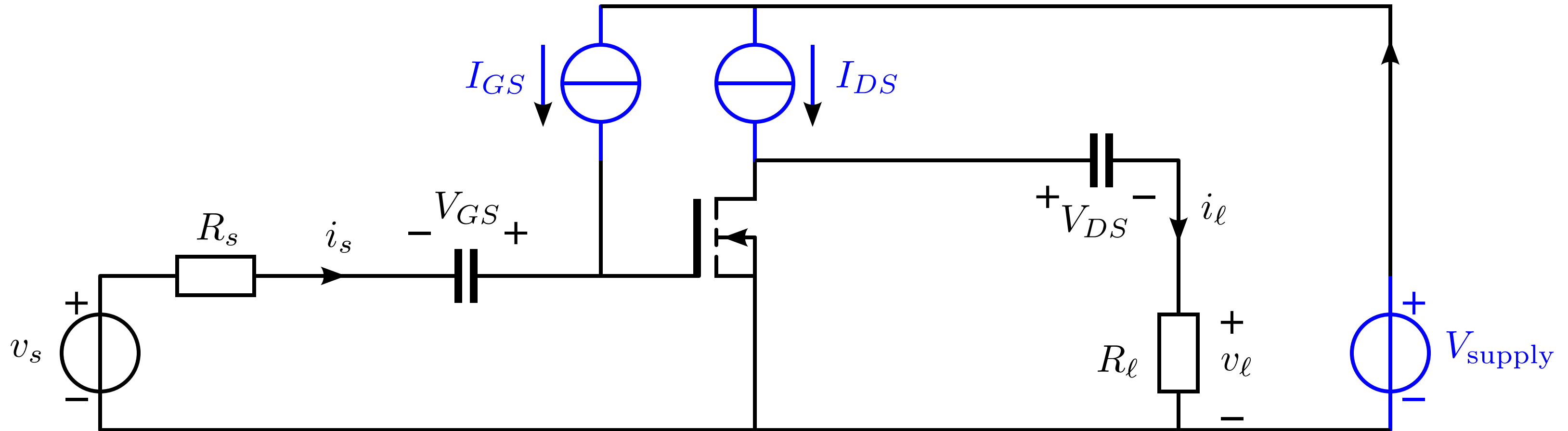
AC coupling at source and/or load



AC coupling always required if no DC current is allowed through source and/or load

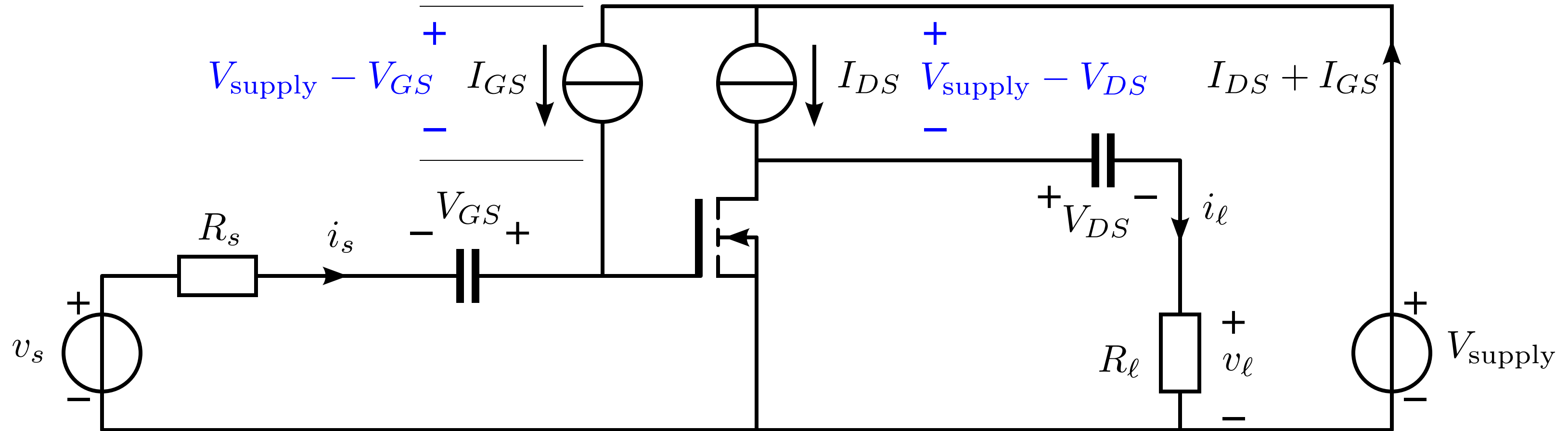
AC coupling only possible if zero (signal) frequency is not of interest

Power supply



Add a power supply voltage and redirect the current sources

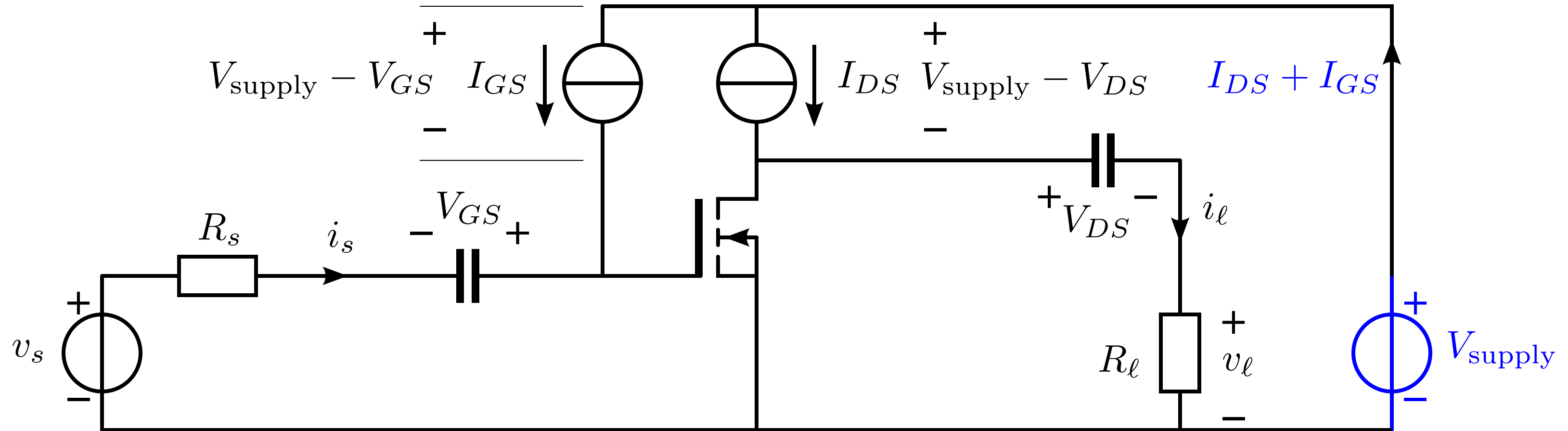
Power supply



Add a power supply voltage and redirect the current sources

Resulting current sources are passive (product V and I positive)

Power supply

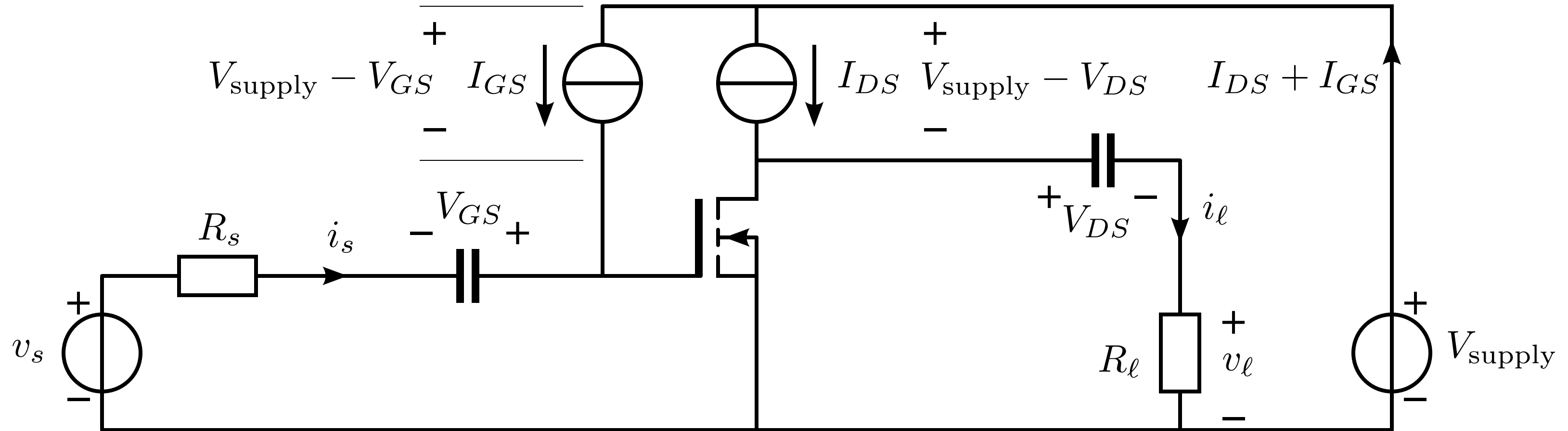


Add a power supply voltage and redirect the current sources

Resulting current sources are passive (product V and I positive)

Supply source is the only bias source that delivers power

Power supply



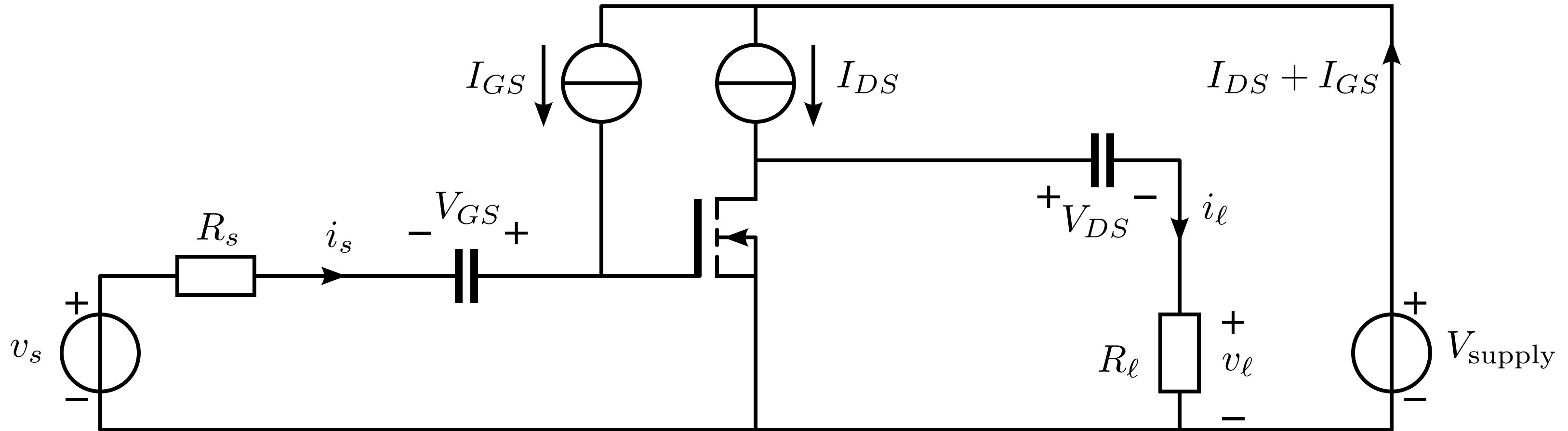
Add a power supply voltage and redirect the current sources

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Supply source is the only bias source that delivers power

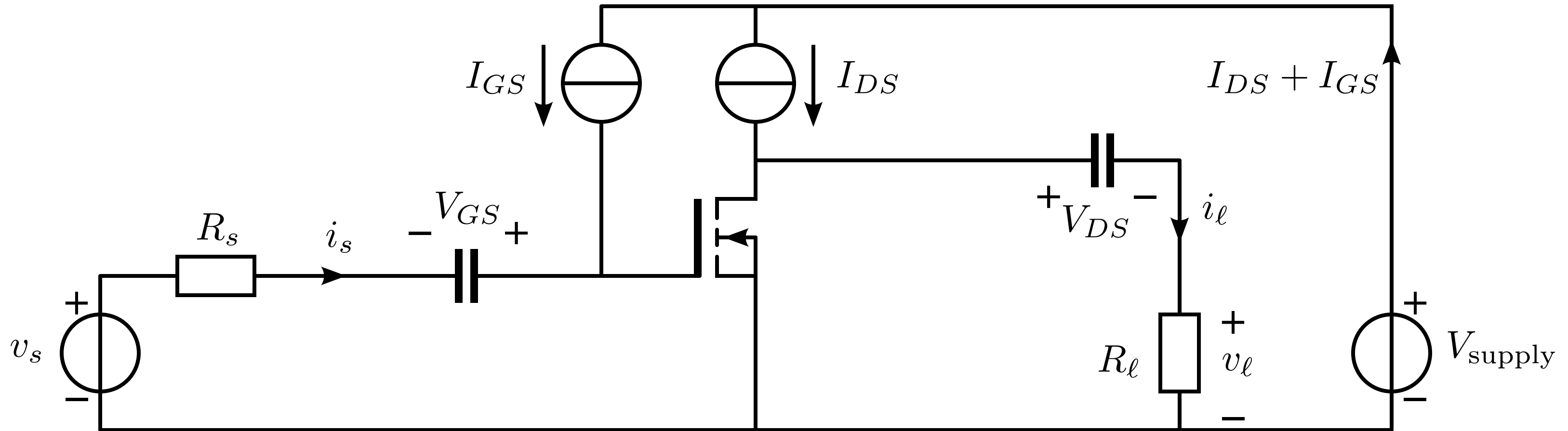
Bias error reduction

Bias solution strongly depends on device characteristics and temperature



Bias error reduction

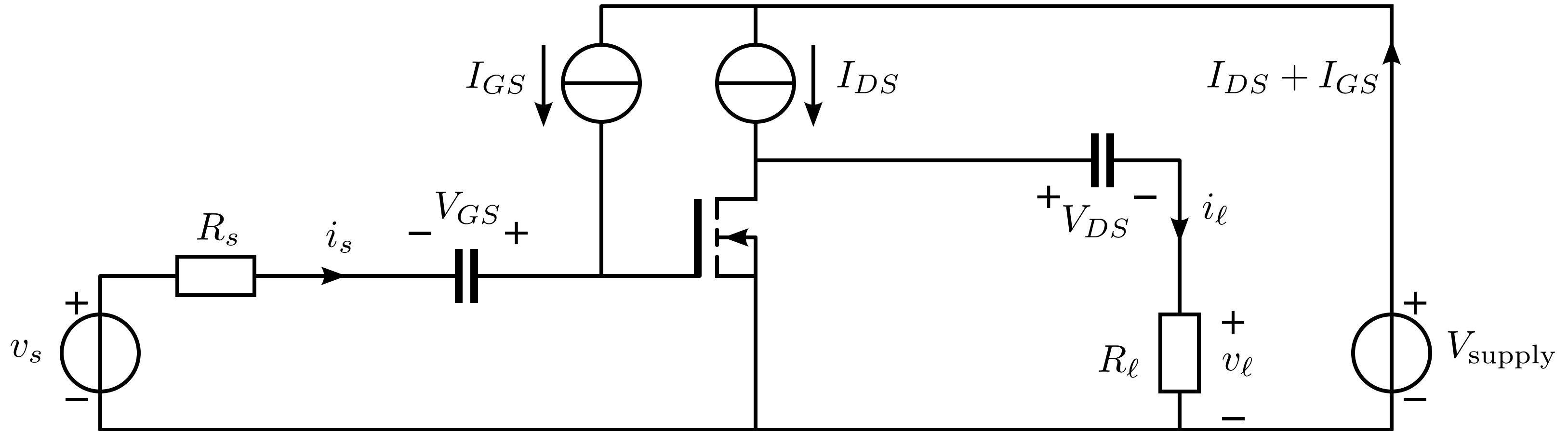
Bias solution strongly depends on device characteristics and temperature



Application of error reduction techniques required for:

Bias error reduction

Bias solution strongly depends on device characteristics and temperature

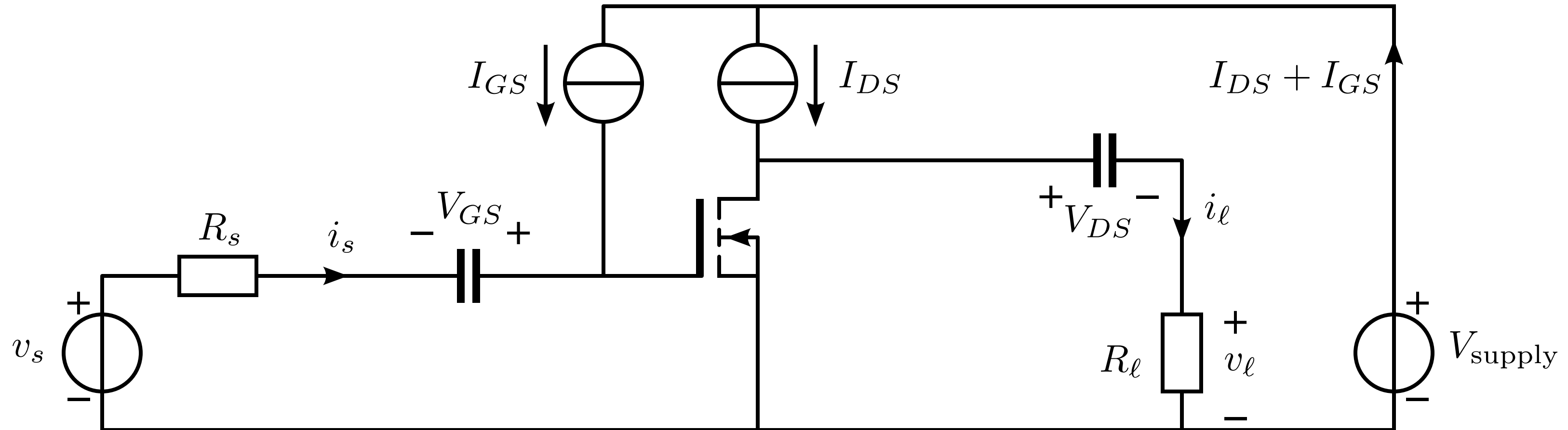


Application of error reduction techniques required for:

Reduction of sensitivity for device characteristics

Bias error reduction

Bias solution strongly depends on device characteristics and temperature



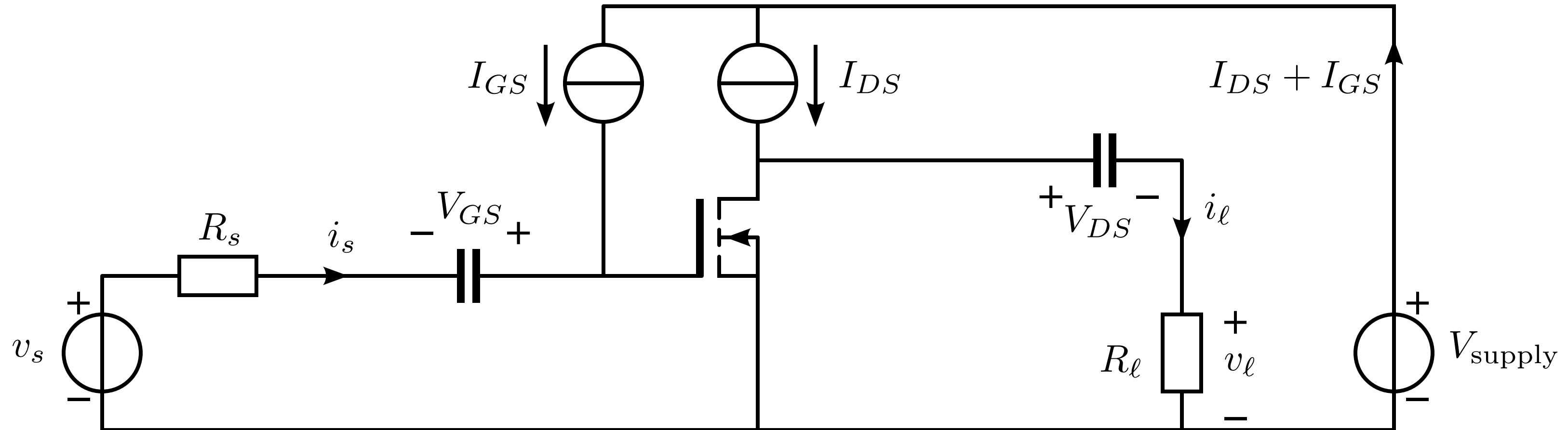
Application of error reduction techniques required for:

Reduction of sensitivity for device characteristics

Reduction of temperature sensitivity

Bias error reduction

Bias solution strongly depends on device characteristics and temperature



Application of error reduction techniques required for:

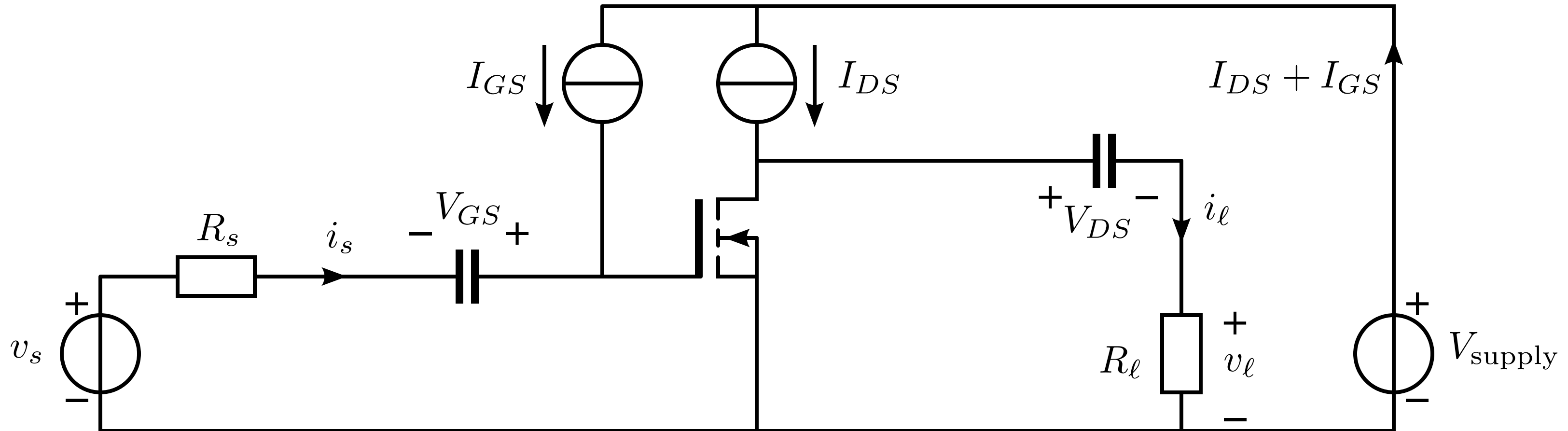
Reduction of sensitivity for device characteristics

Reduction of temperature sensitivity

[See book section 9.4](#)

Bias error reduction

Bias solution strongly depends on device characteristics and temperature



Application of error reduction techniques required for:

Reduction of sensitivity for device characteristics

Reduction of temperature sensitivity

See book section 9.4

Some examples

Applied techniques

1. compensation
2. model-based biasing
3. brute force technique
4. negative feedback biasing
5. electronic self inductance

