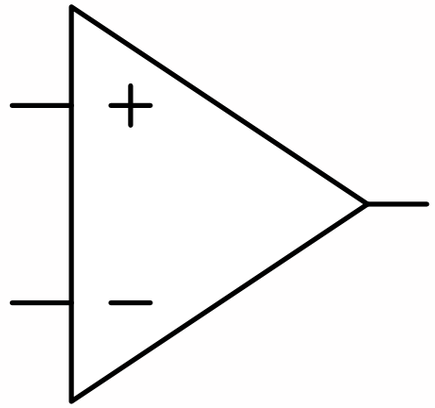
Der Operationsverstärker



Michael Bunk
11.11.2014

PROJEKT LABOR

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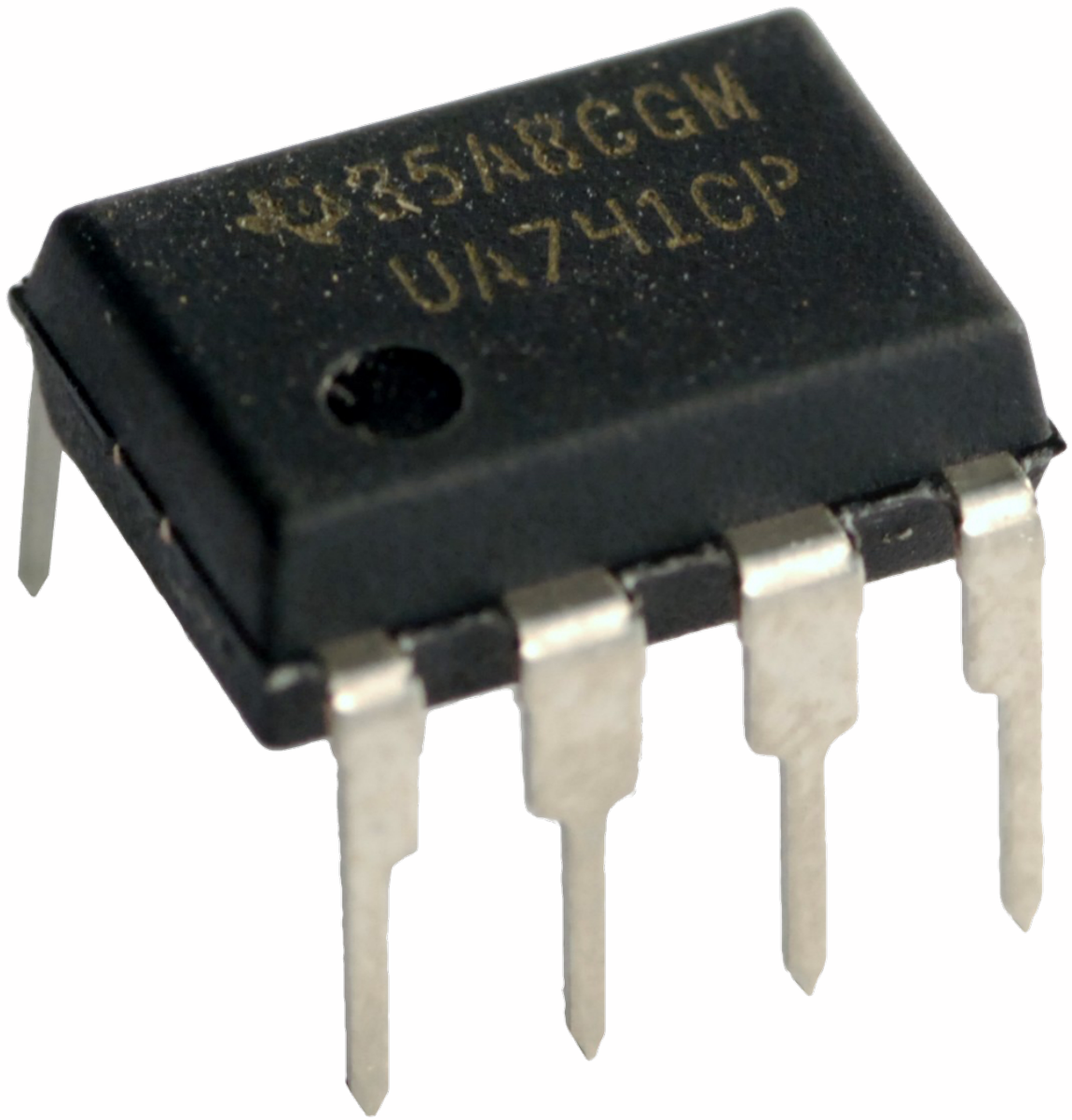
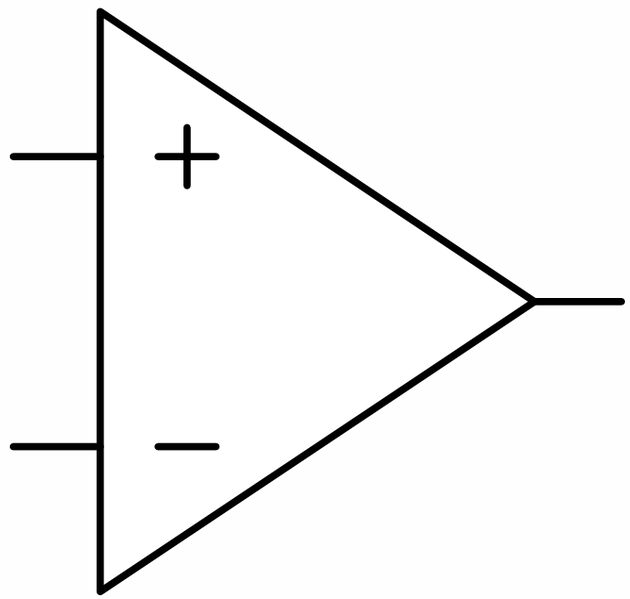
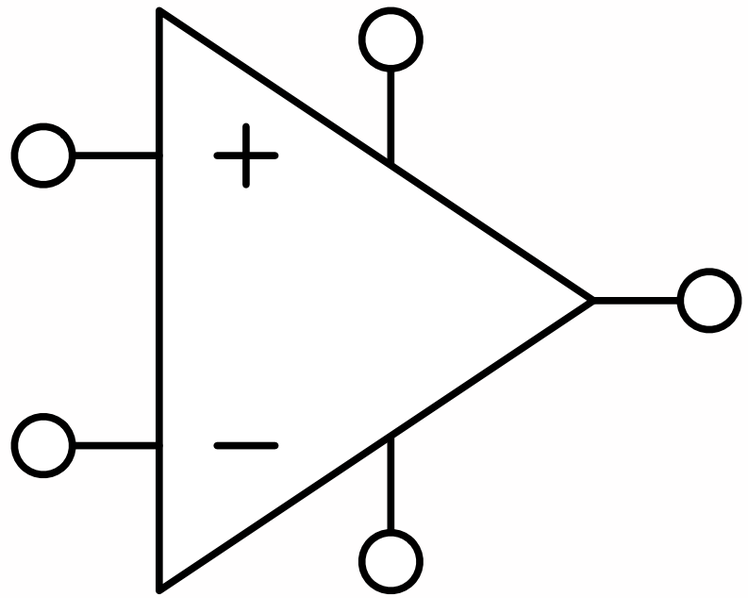
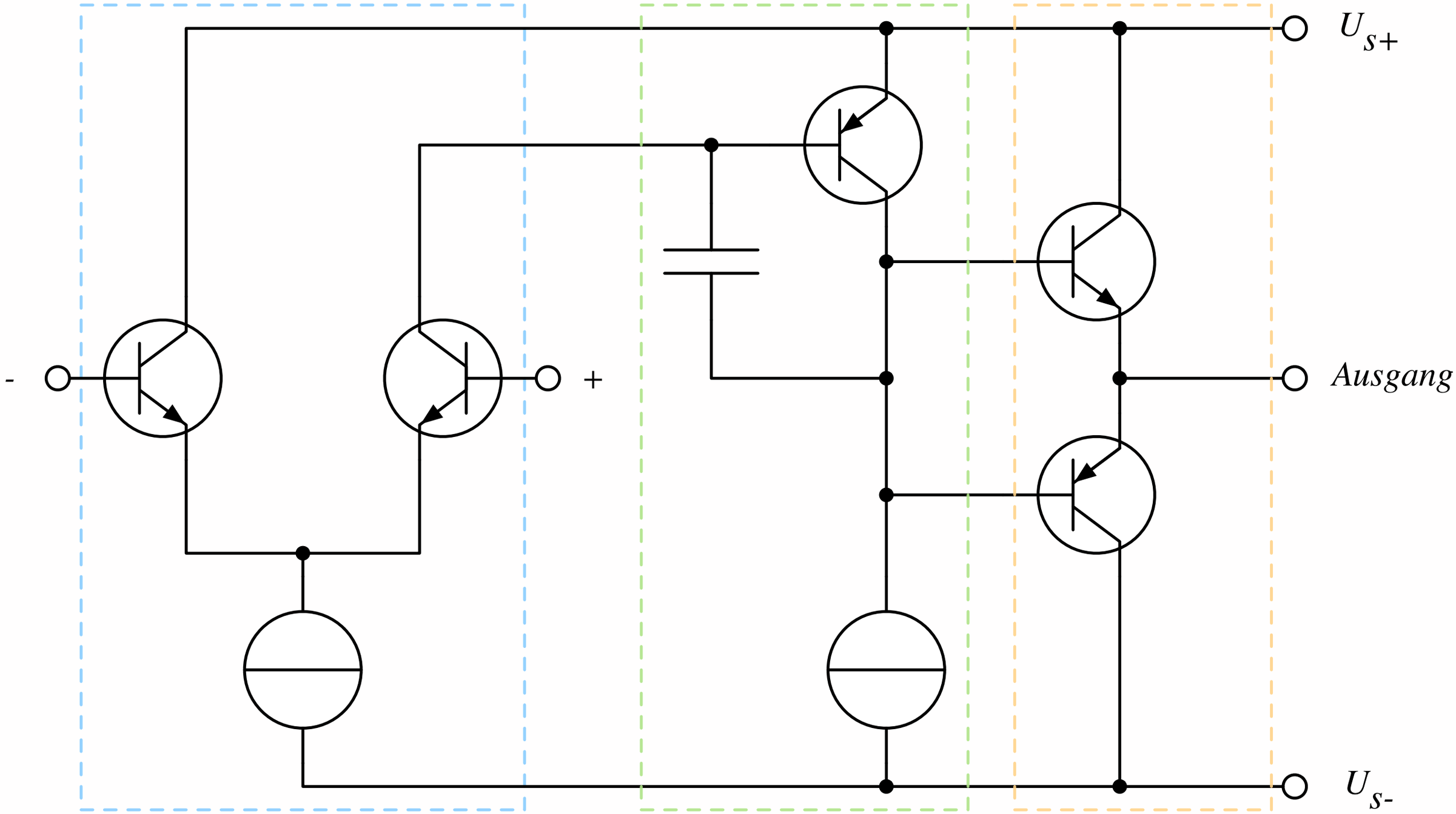
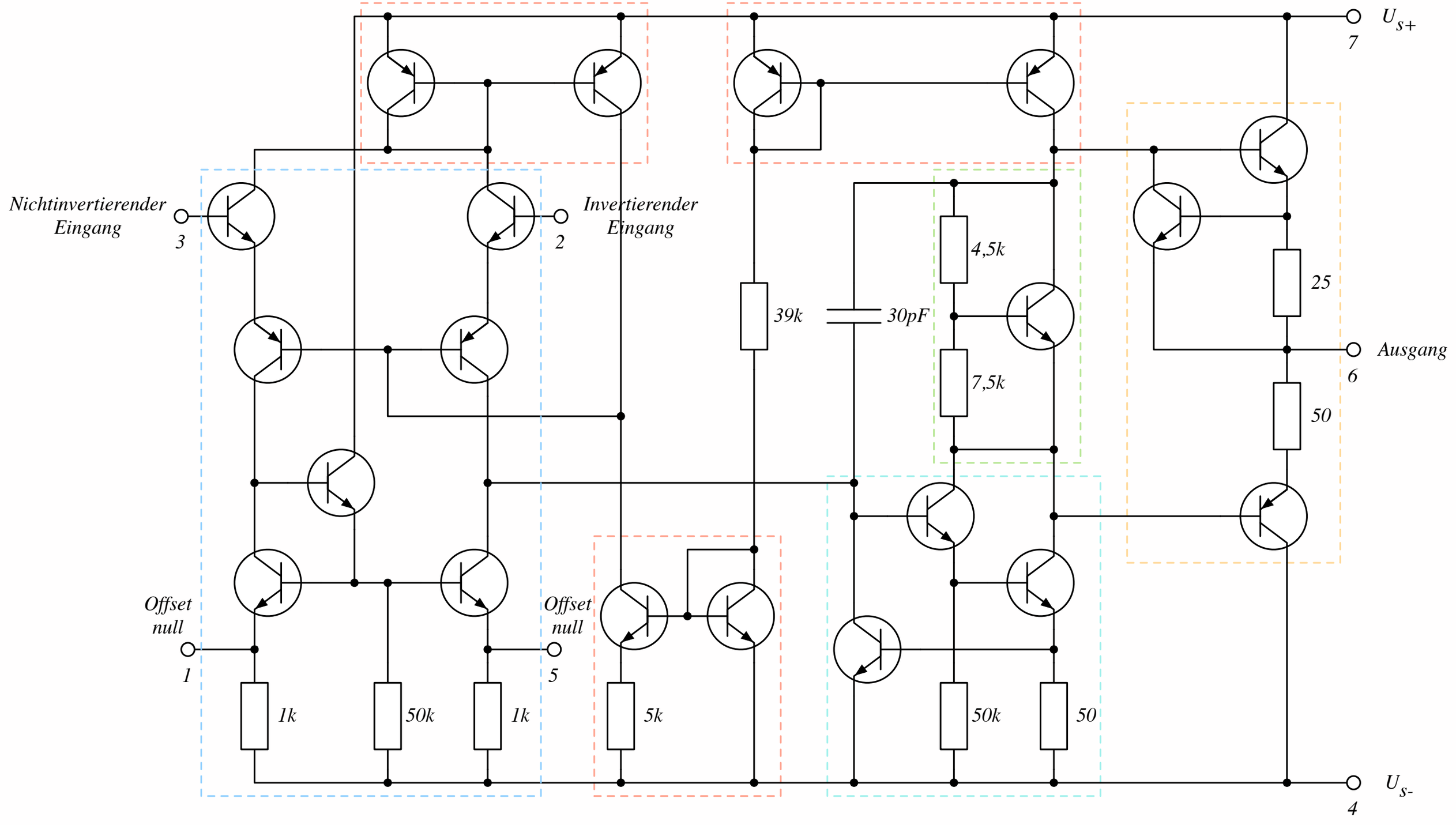
Aufbau



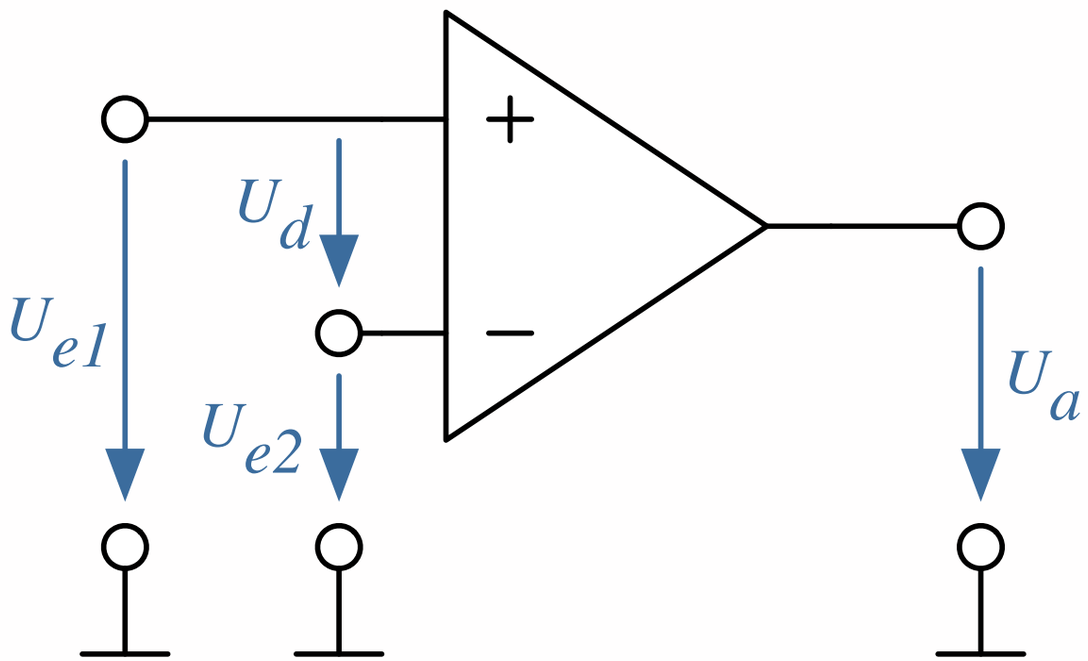


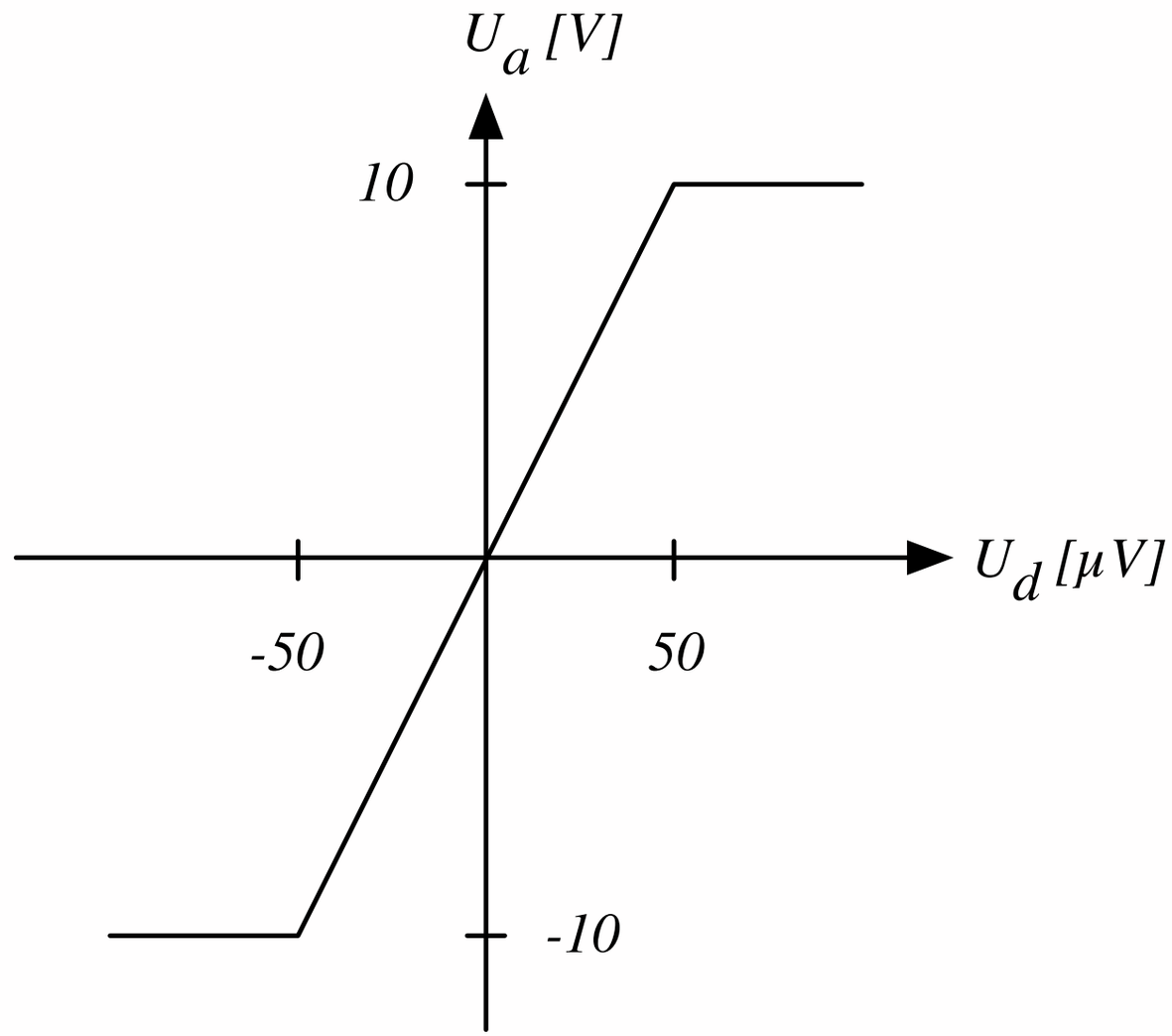



U_{s+}
-
+
Ausgang
U_{s-}
Differentieller Eingang
Verstärkerstufe
Ausgangsstufe


Nichtinvertierender Eingang
3
Invertierender Eingang
2
Offset null
1
Offset null
5
U_{s+}
7
U_{s-}
4
Ausgang
6
39k
30pF
4,5k
7,5k
25
50
1k
50k
1k
5k
50k
50

Funktionsweise



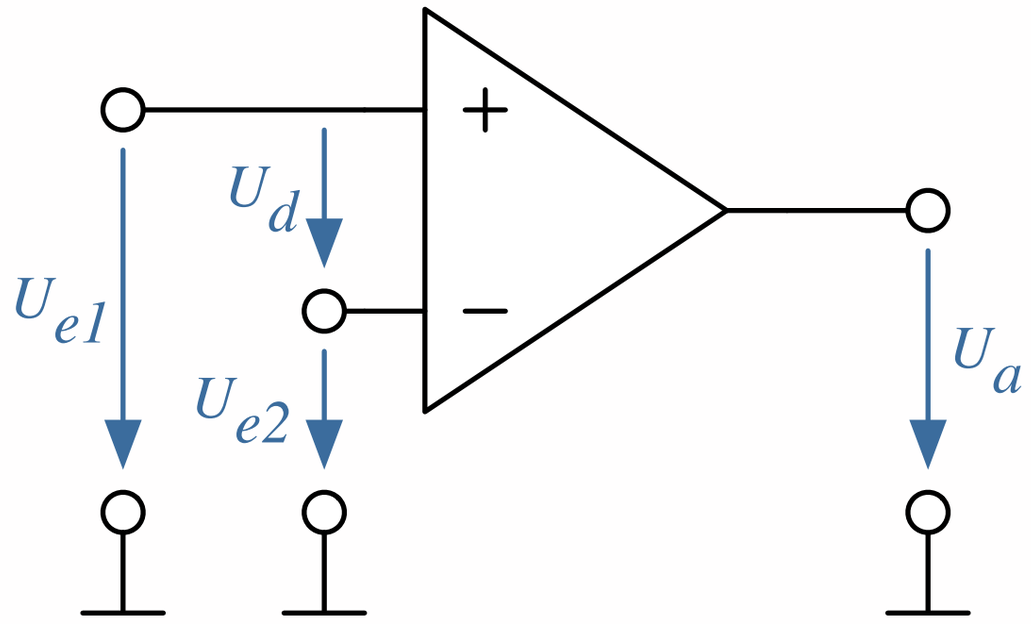


Eigenschaften

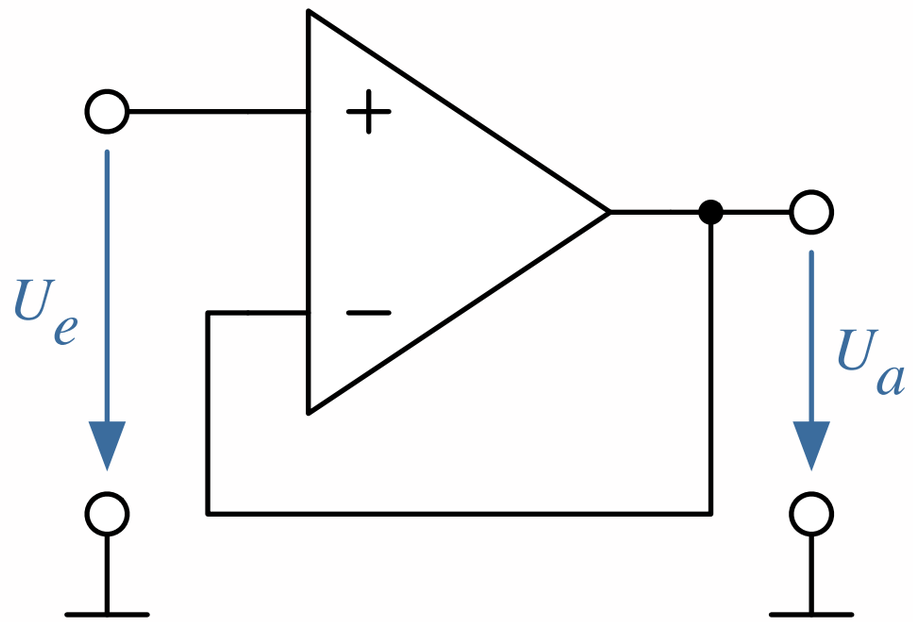
	Idealer OPV	Realer OPV
Leerlaufverstärkung $[V_0]$	∞	$10^4 - 10^5$
Gleichtaktverstärkung $[V_G]$	0	$0,2$
Gleichtaktunterdrückung $[CMRR]$	∞	$10^4 - 10^{10}$
Slew Rate $[SR]$	∞	$50V/ns - 1V/\mu s$
Eingangswiderstand $[R_e]$	∞	$1M\Omega - 100M\Omega$
Ausgangswiderstand $[R_a]$	0	$\leq 200\Omega$
Eingangsstrom $[I_{Bias}]$	0	$1pA - 100\mu A$
Aussteuerungsbereich $[U]$	$\pm U_B$	$\approx \pm U_B - 3V$
Frequenzverhalten	linear	Tiefpass

Grundschaltungen

Komparator



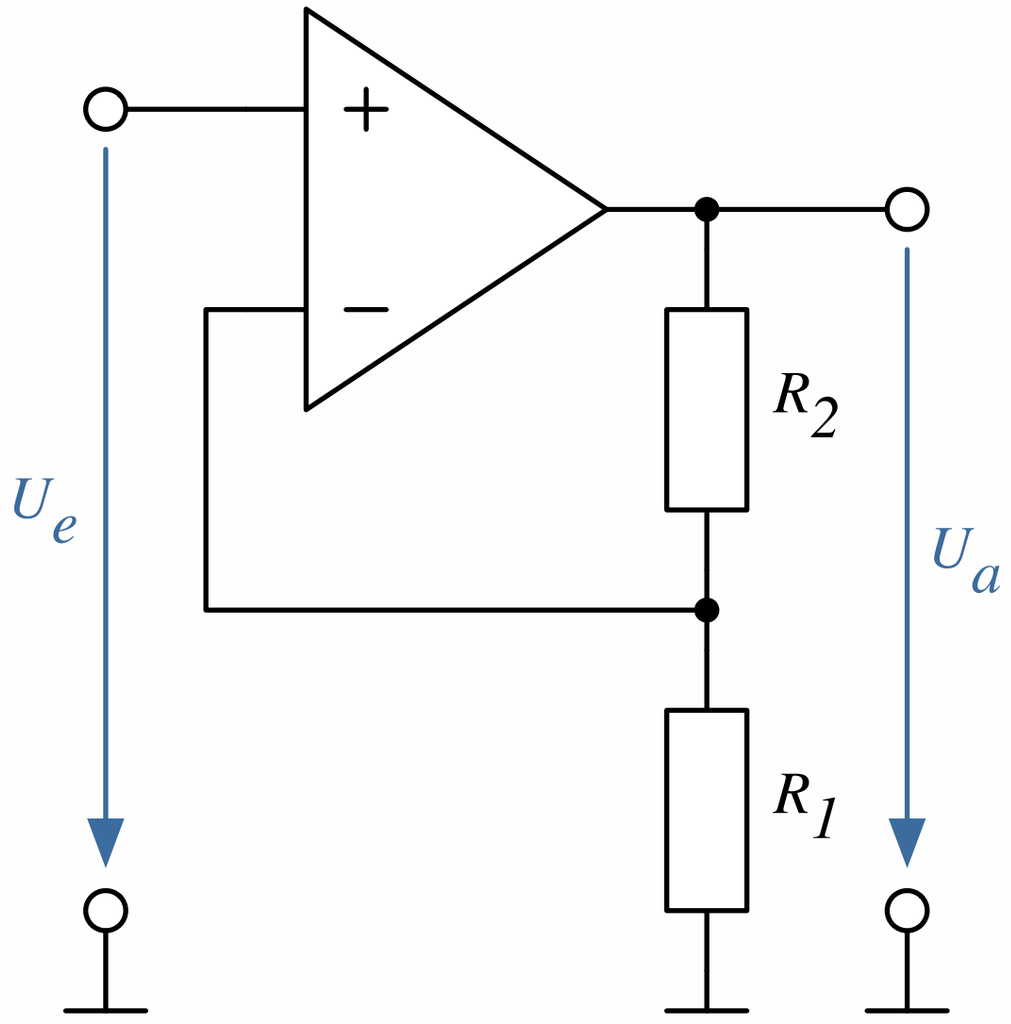
Impedanzwandler



$$V = \frac{U_a}{U_e} = 1$$

$$U_a = U_e$$

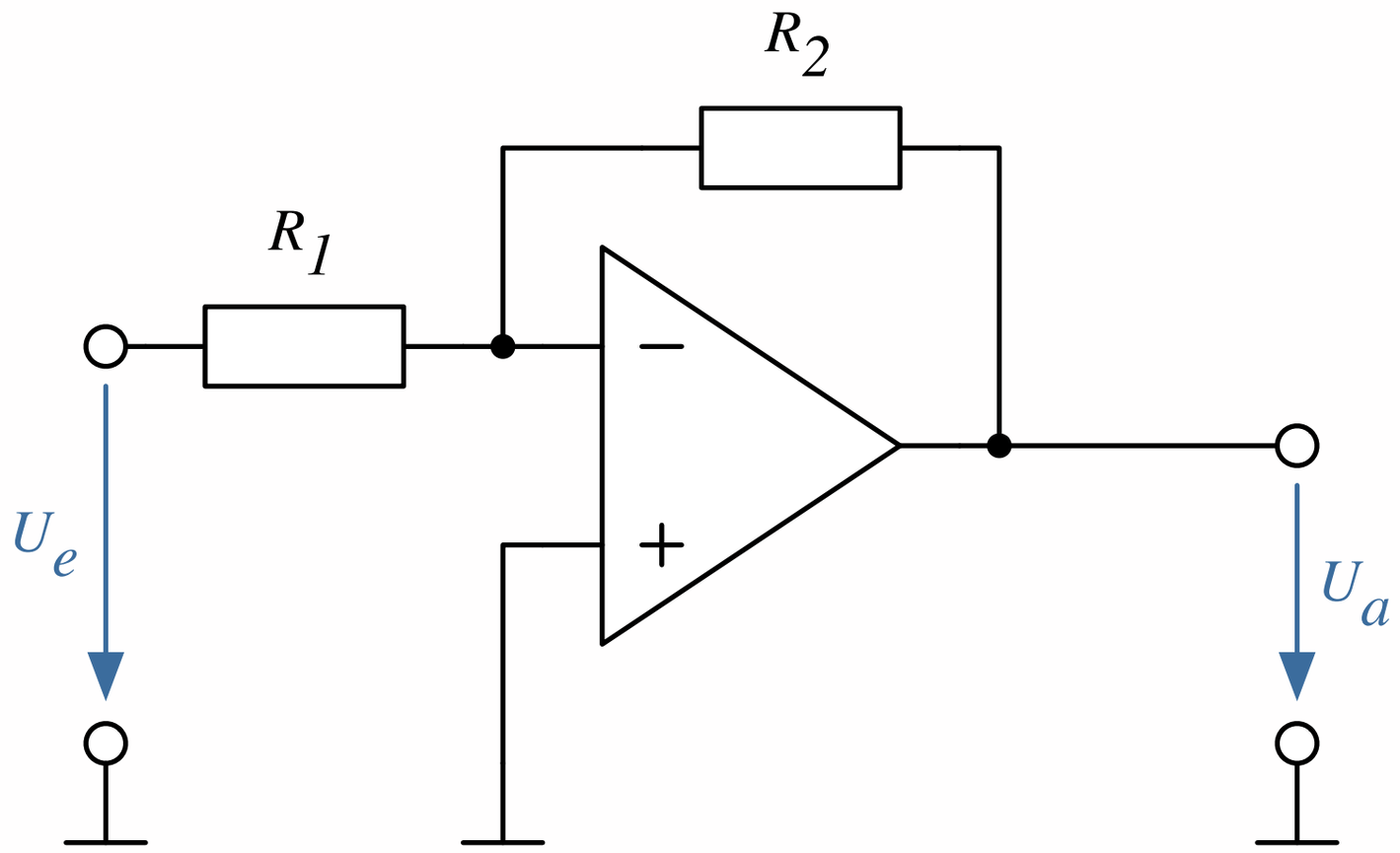
Nichtinvertierende Verstärker



$$V = \frac{U_a}{U_e} = \frac{R_1 + R_2}{R_1} = 1 + \frac{R_2}{R_1}$$

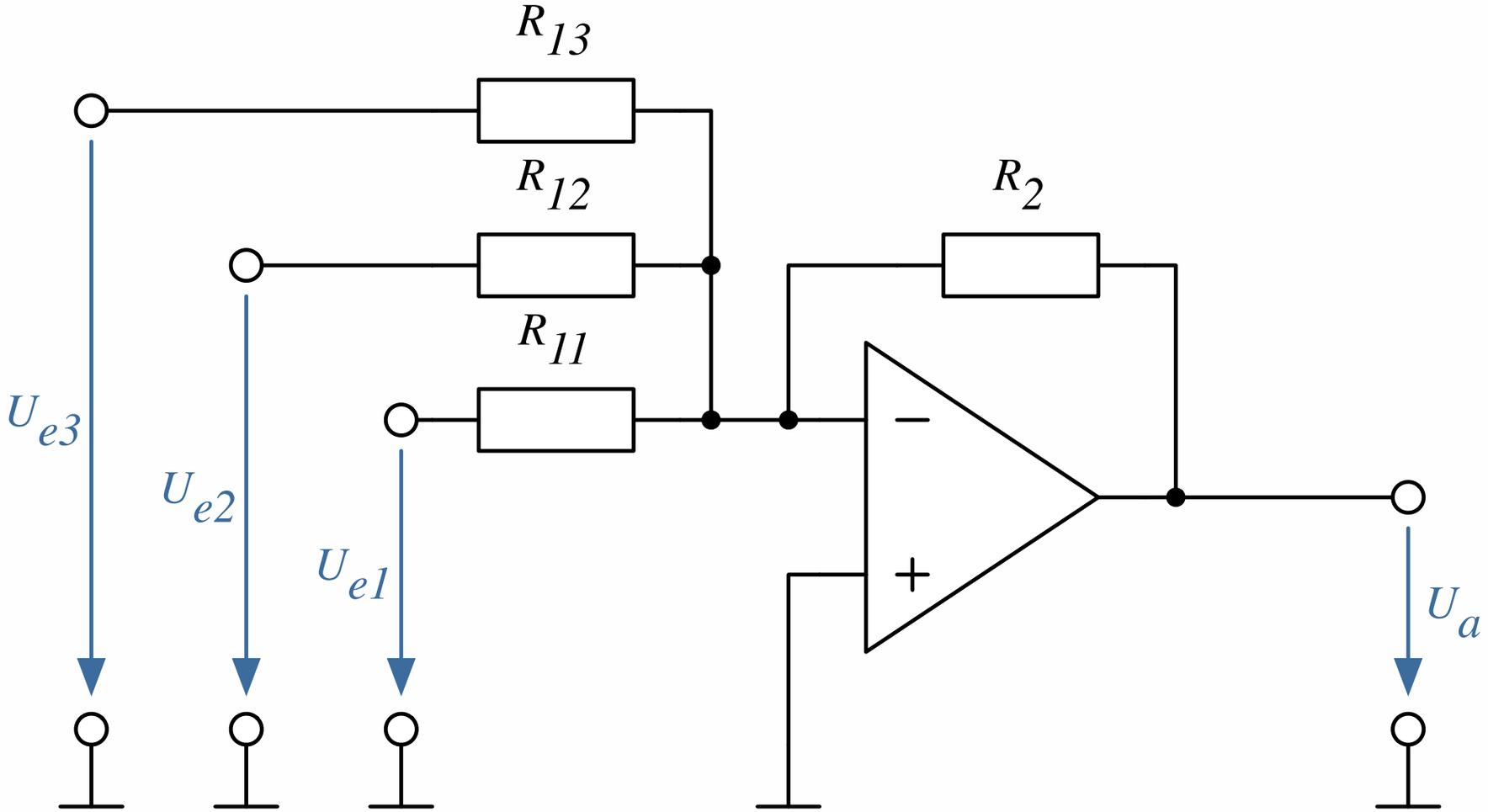
$$U_a = \left(1 + \frac{R_2}{R_1}\right) \cdot U_e$$

Invertierende Verstärker



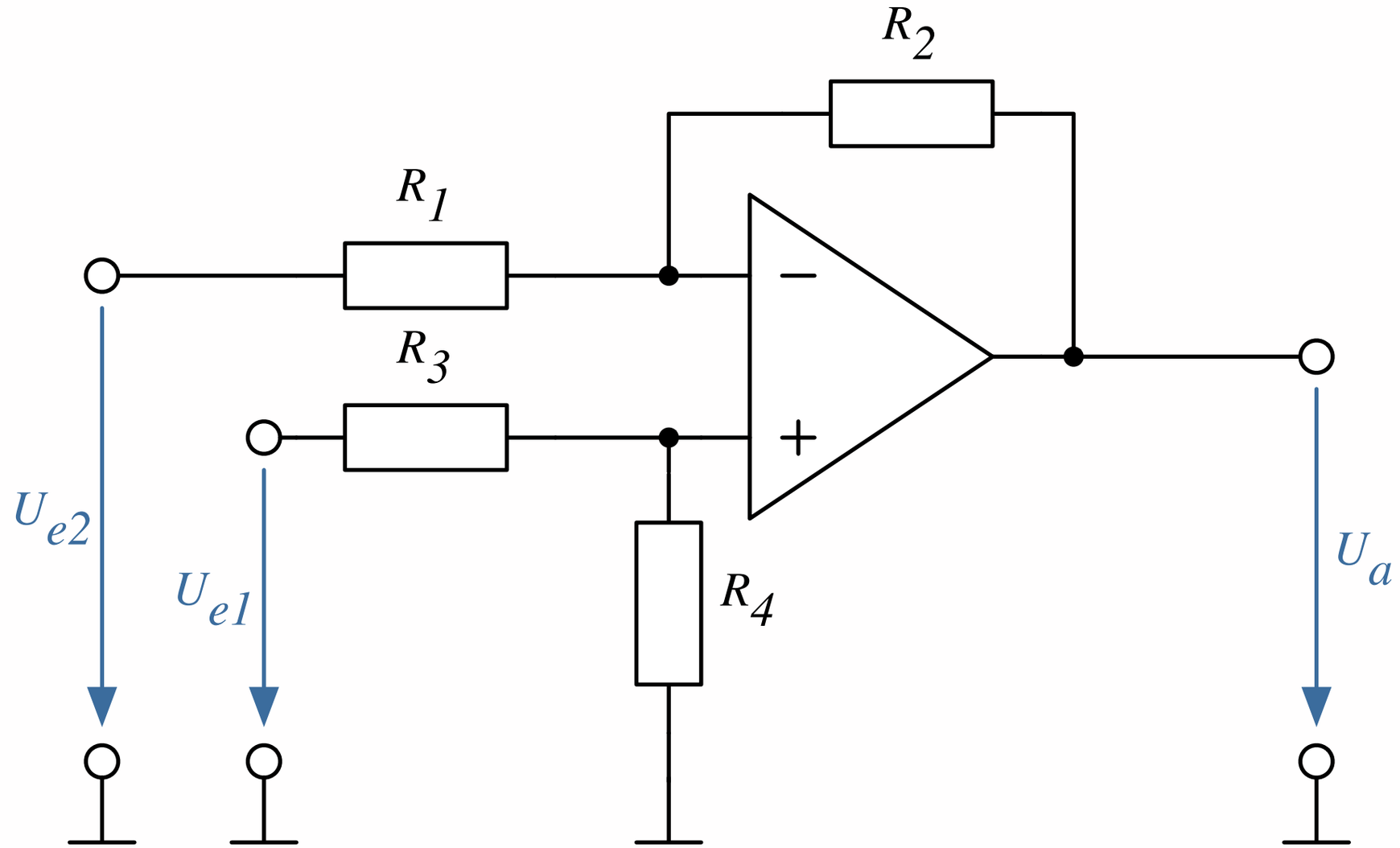
$$V = \frac{U_a}{U_e} = -\frac{R_2}{R_1} \qquad U_a = -\frac{R_2}{R_1} \cdot U_e$$

Invertierender Summierverstärker



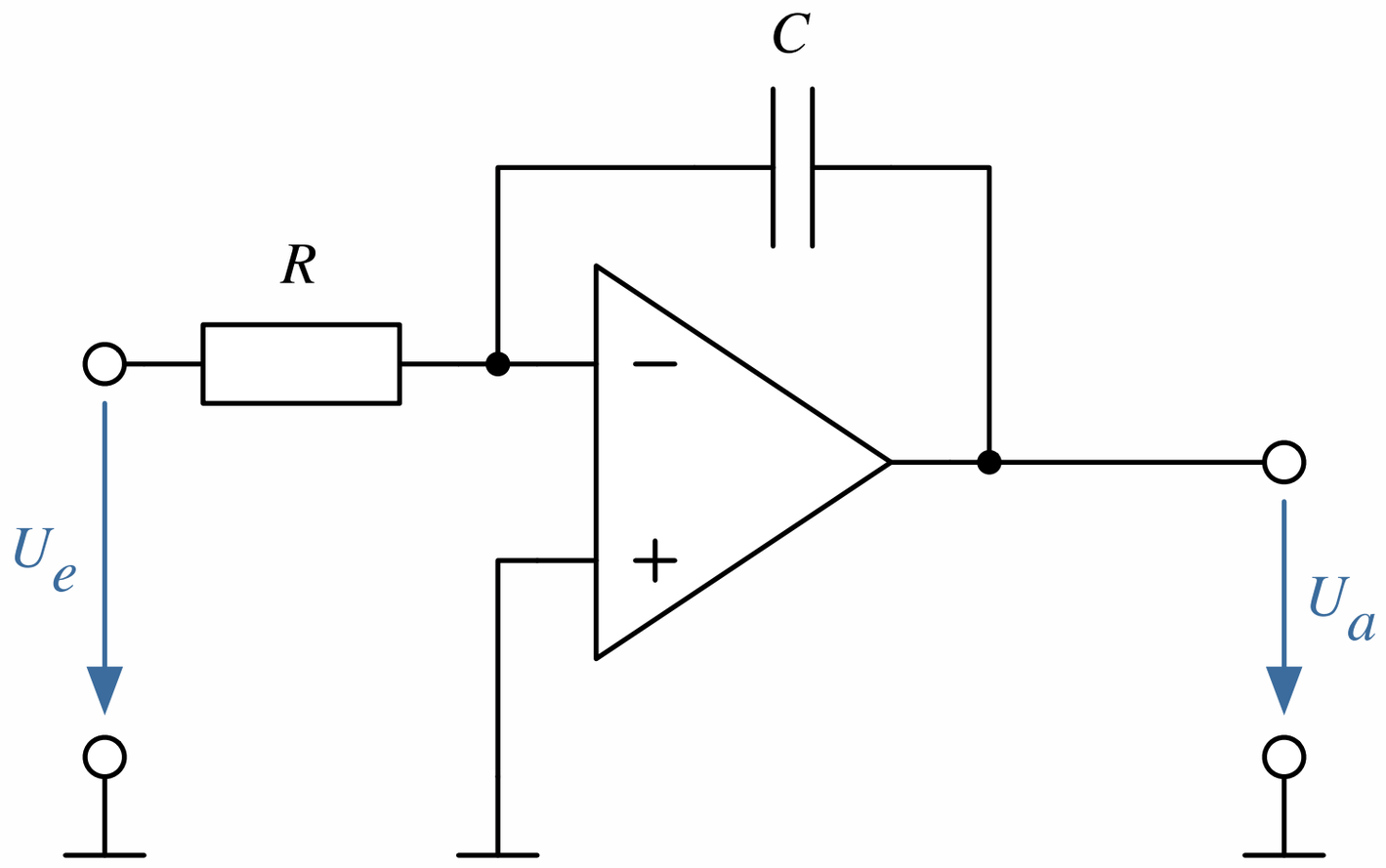
$$U_a = -R_2 \cdot \left(\frac{U_{e1}}{R_{11}} + \frac{U_{e2}}{R_{12}} + \frac{U_{e3}}{R_{13}} \right)$$

Differenzierverstärker



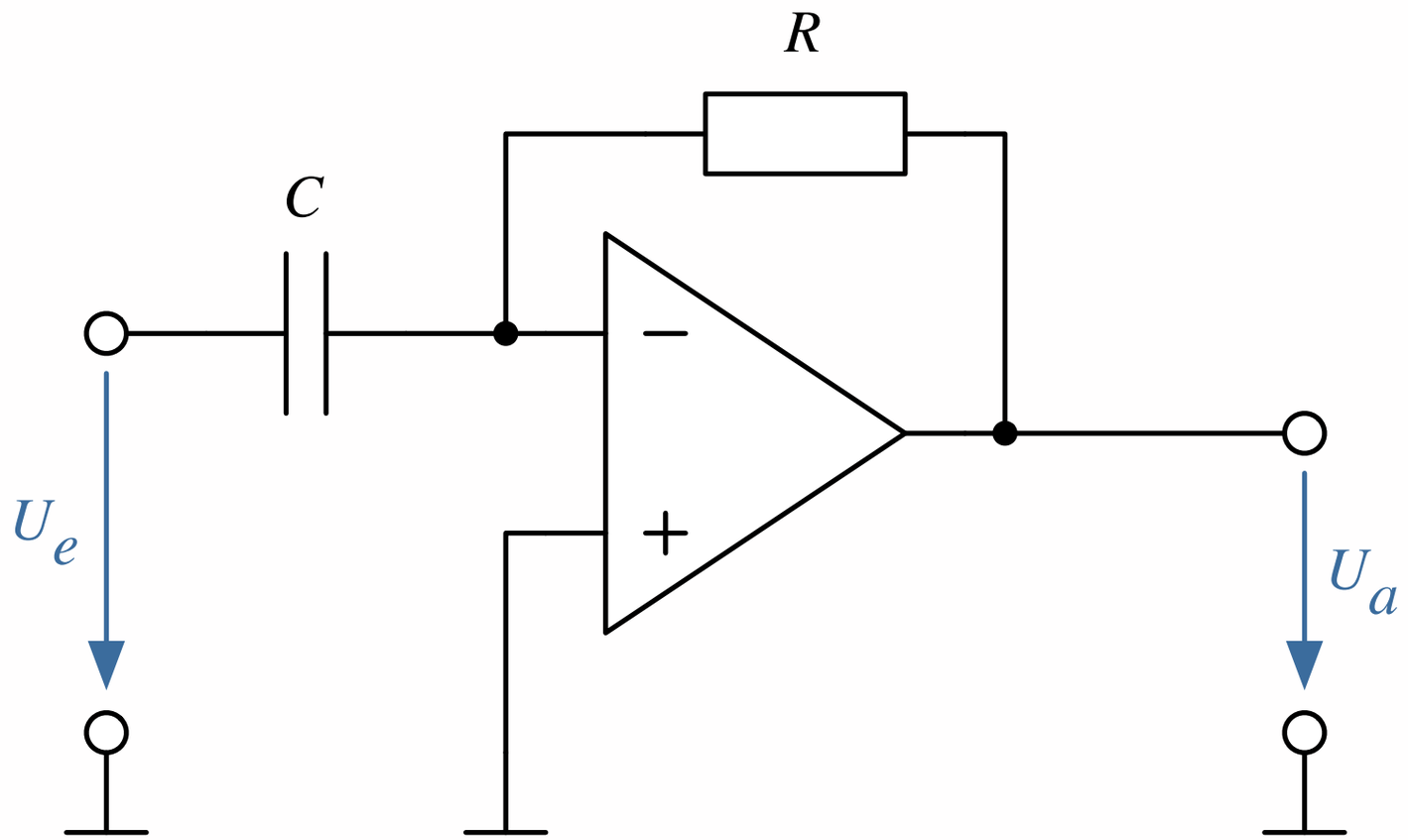
$$U_a = \frac{\left(R_1 + R_2\right)R_4}{\left(R_3 + R_4\right)R_1} \cdot U_{e1} - \frac{R_2}{R_1} \cdot U_{e2}$$

Integrierer



$$U_a = -\frac{1}{RC} \cdot \int_0^t U_e(\tau)\, d\tau + U_a(0)$$

Differenzierer



$$u_a = -RC \cdot \frac{d}{dt} u_e$$

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