Ohmscher Widerstand $R = \frac{U}{I} \Leftrightarrow I = \frac{U}{R} \Leftrightarrow U = R \cdot I$ $\quad R = \rho \cdot \frac{l}{A} = \frac{l}{\sigma \cdot A}$

Dreieck-Stern

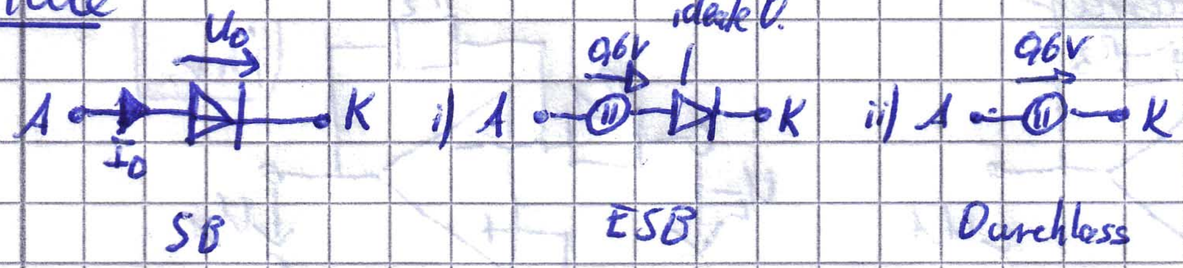
$$\text{Sternwiderstand} = \frac{\text{Produkte der Anliegerwiderstände des Dreiecks } (\cdot)}{\text{Umfangswiderstand des Dreiecks } (+)}$$

$$\text{Dreiecksleitwert} = \frac{\text{Produkt der Anliegerleitwerte des Sterns } (\cdot)}{\text{Knotenleitwerte des Stroms } (+)}$$

Leistungen $P = U \cdot I = \frac{U^2}{R} = I^2 \cdot R$ $\quad$ **Leistungsanpassung** $R_i = R_L$

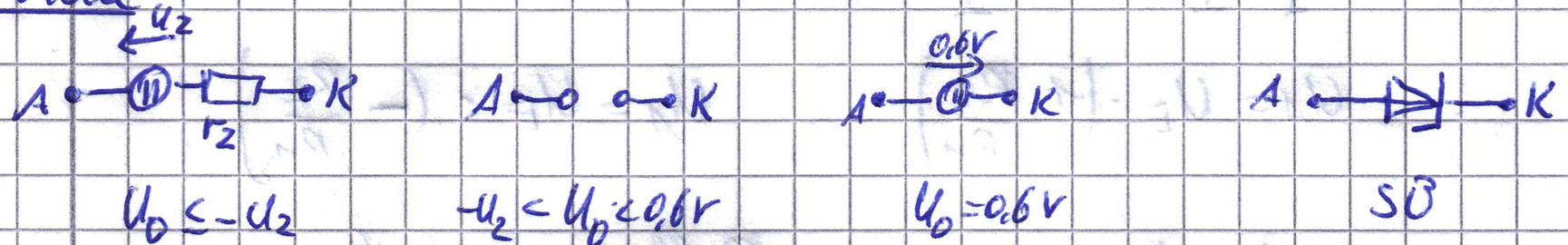
Verl. Transistor $P = U_{CE} \cdot I_C + U_{BE} \cdot I_B$ $\quad$ **Wirkungsgrad:** $\eta = \frac{P_{Nutz}}{P_{Erzeugt}}$

Dioden

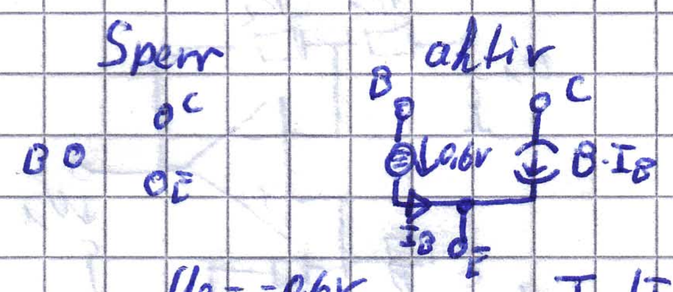


$\Delta P(U_0, I)$

Z-Diode

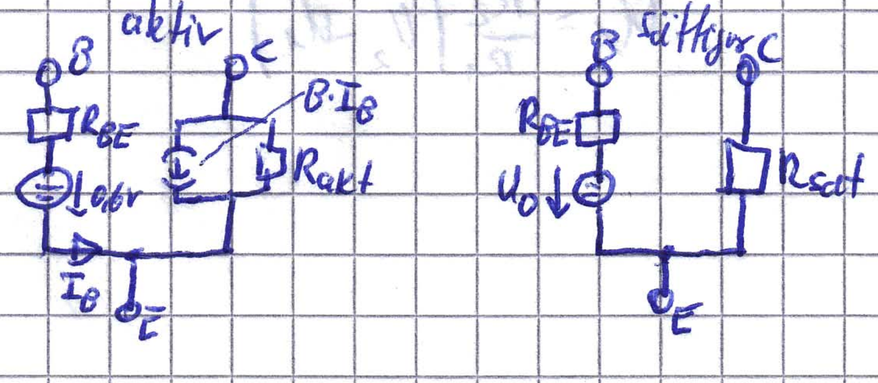


Transistor



$\Delta P(U_{CE}, I_C)$

erweitert



Kondensatoren $C = \frac{Q}{U} = \frac{\varepsilon_0 \cdot \varepsilon \cdot A}{d}$ $\quad$ Parallel: $U_1 = U_2 = \ldots = U_n$ $\quad Q_g = Q_1 + Q_2 + \ldots + Q_n$

Reihe: $U_g = U_1 + \ldots + U_n$ $\quad Q_1 = Q_2 = \ldots Q_n$

- lädt und entlädt sich in einer Exponentialfunktion
- wirkt beim Einschalten wie Kurzschluss
- Ladezeit $t_L = 5 \cdot \tau = 5 \cdot R \cdot C$

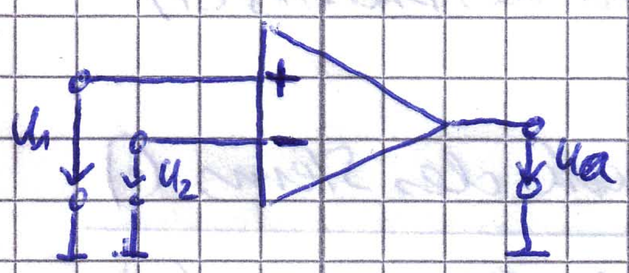
Operationsverstärker

ideal: $V_D = \infty$, $R_E = \infty$, $R_a = 0$, keine Gleichtaktverstärkung, frequenzunabhängig

Betriebsarten 1. Keine Rückkopplung 2. Mitkopplung 3. Gegenkopplung

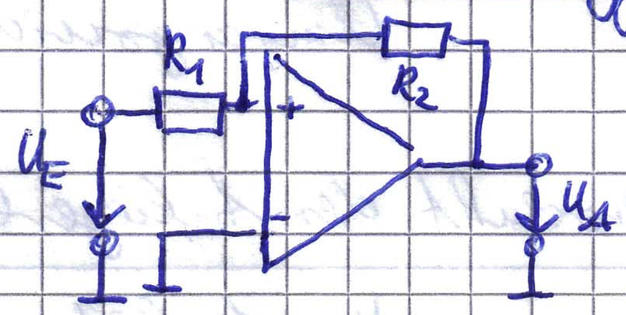
Grundschaltungen

Komparator



$$U_A = \begin{cases} U_{B+} & \text{für } U_1 > U_2 \\ U_{B-} & \text{für } U_1 < U_2 \\ 0 & \text{für } U_a = U_2 \end{cases}$$

Schmitt-Trigger

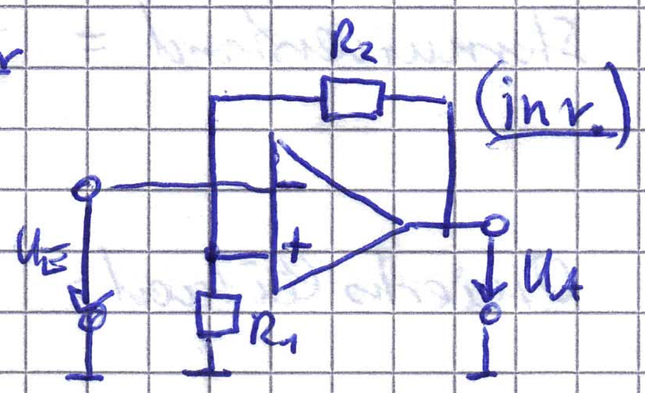


$U_A = U_{B+}$ o. $U_A = U_{B-}$

$U_{E,wechsel} = -\frac{R_1}{R_2} U_A$

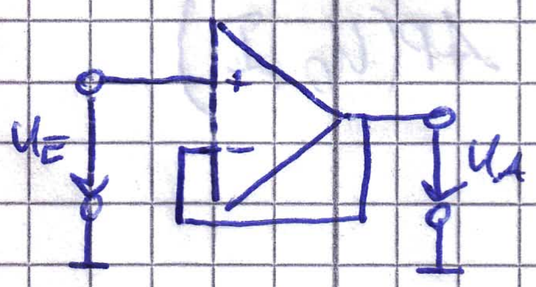
$\leftrightarrow (U_0 = 0)$

(inv.)



$U_{E,wechsel} = \frac{R_1}{R_1+R_2} U_A$

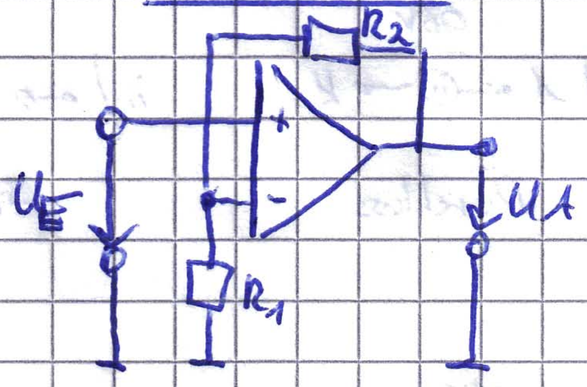
Impedanzwandler



$U_A = U_E$

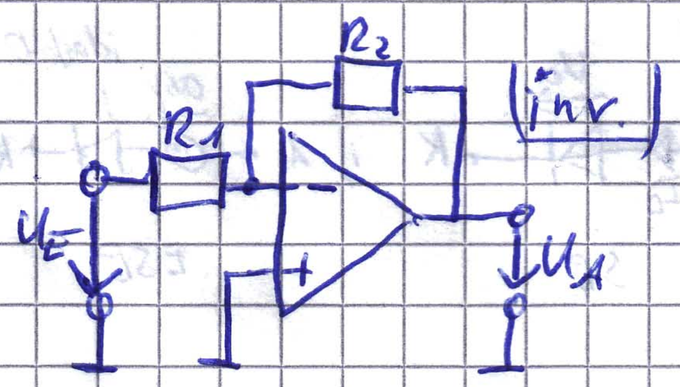
$V = 1$

Verstärker



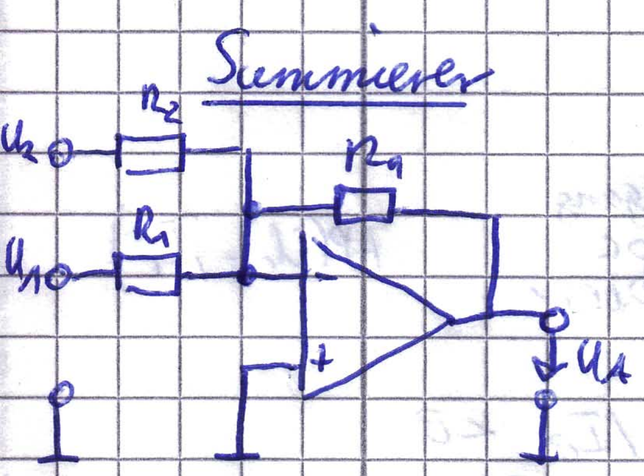
$U_A = U_E \cdot \left(1 + \frac{R_2}{R_1}\right)$

(inv.)



$U_A = U_E \cdot \left(-\frac{R_2}{R_1}\right)$

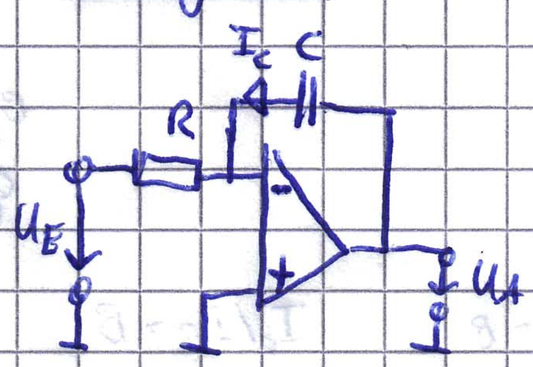
Summierer



$U_A = -R_1 \left(\frac{U_1}{R_1} + \frac{U_2}{R_2}\right)$

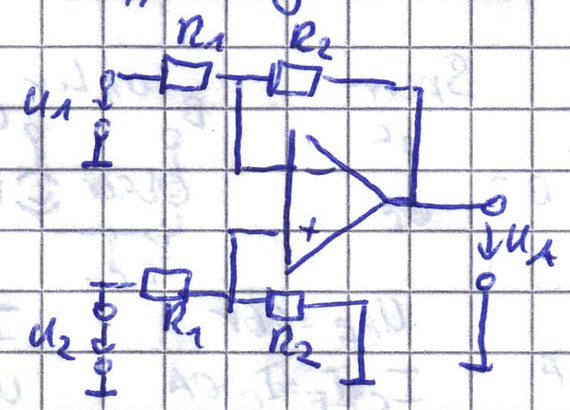
I_1 I_2

Integrator



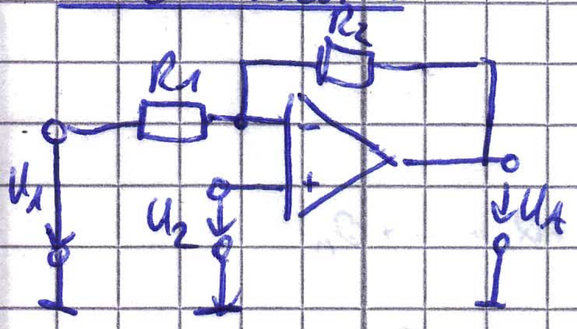
$U_A = -\frac{U_E}{R \cdot C} \cdot t$

Differenzverstärker



$U_A = \frac{R_2}{R_1}(U_2 - U_1)$

Subtrahierer



$U_A = U_2\left(1 + \frac{R_2}{R_1}\right) - U_1 \cdot \frac{R_2}{R_1}$