1 Bauteile

Strom $\boxed{I = \dot{Q} = \frac{\mathrm{d}Q}{\mathrm{d}t}}$

Spannung $\boxed{U = \frac{W_{ab}}{Q}}$

Knotensatz $\boxed{\sum I_{\text{in}} = \sum I_{\text{out}}}$

1.1 Widerstand

Widerstand $\boxed{R = \frac{U}{I} = \rho \frac{l}{A}}$

Leitwert $\boxed{G = \frac{1}{R}}$

dyn. Widerstand $\boxed{r = \frac{\mathrm{d}U}{\mathrm{d}I}}$

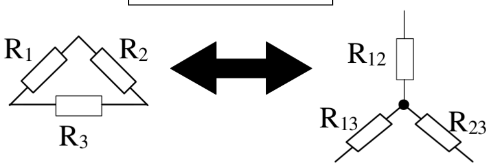
Reihens. $\boxed{R_{\text{ges}} = \sum R_i}$

Parallels. $\boxed{\frac{1}{R_{\text{ges}}} = \sum \frac{1}{R_i}}$

bei 2 $\boxed{R_{\text{ges}} = R_1 \parallel R_2 = \frac{R_1 R_2}{R_1 + R_2}}$

Spannungsteiler $\boxed{U_{R_1} = U_0 \frac{R_1}{R_1 + R_2}}$

Stromteiler $\boxed{I_{R_1} = I_0 \frac{R_2}{R_1 + R_2}}$



Stern $\rightarrow$ Dreieck: $G_1 = \frac{G_{12} G_{13}}{\sum G_i}$

Dreick $\rightarrow$ Stern: $R_{12} = \frac{R_1 R_2}{\sum R_i}$

1.2 Leistung

Leistung $\boxed{P = UI = \frac{U^2}{R} = RI^2}$

Wirkungsgrad $\boxed{\eta = \frac{P_a}{P_{\text{ges}}}}$

1.3 Elektrisches Feld und Kondensator

Feldstärke $\boxed{E = \frac{U}{d}}$

Flußdichte $\boxed{D = \epsilon E}$

Kapzität $\boxed{C = \frac{Q}{U}}$ bzw. $u = \frac{1}{C} \int i \mathrm{d}t$

Energie $\boxed{W = \frac{1}{2} C U^2 = \frac{1}{2} Q U}$

Reihens. $\boxed{\frac{1}{C_{\text{ges}}} = \sum \frac{1}{C_i}}$

Parallels. $\boxed{C_{\text{ges}} = \sum C_i}$

Differentialgleichung $\boxed{U(t) = k_1 + k_2 e^{-\frac{t}{\tau}}}$

$k_1 = U(t = \infty)$, $k_2 = U(t = 0) - k_1$

Zeitverhalten 50% $t \approx 0.7\tau$, 95% $t \approx 3\tau$

Plattenkond. $\boxed{C = \frac{\epsilon_r \epsilon_0 A}{d}}$

1.4 Magnetisches Feld und Spule

Fluß $\boxed{\Phi = BA}$

Flußdichte $\boxed{B = \mu H}$

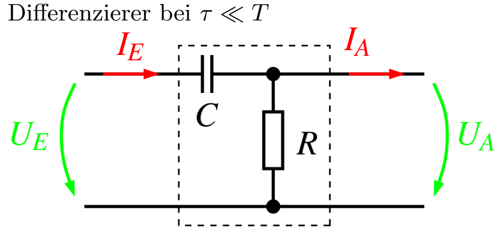
Feldstärke H

Induktionsgesetz $\boxed{U_{\text{ind}} = -N \frac{\mathrm{d}\Phi}{\mathrm{d}t}}$

1.5 Hoch-/Tiefpas

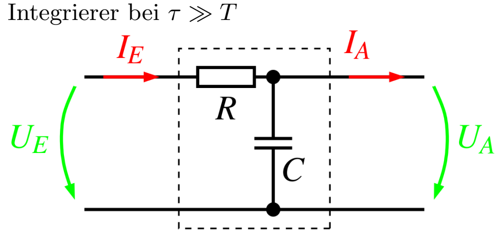
Hochpass

Differenzierer bei $\tau \ll T$



Tiefpass

Integrierer bei $\tau \gg T$



1.6 Diode

$I_D = I_S(e^{\frac{U_D}{mU_T}} - 1)$

Durchlaßbereich

$U_D \geq U_F$, $I_D \geq 0$

Durchlaßb. mit r_D

$U_D \geq U_F$, $I_D = \frac{U_D - U_F}{r_D}$

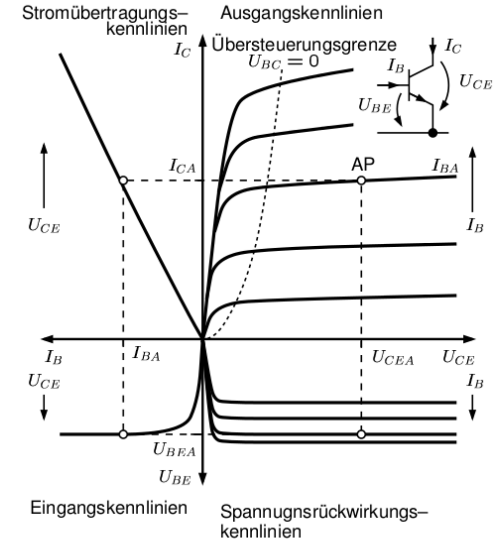
Sperrbereich

$U_D < U_F \wedge U_D > -U_{BR}$

Durchbruchbereich

$U_D \leq -U_{BR}$, $I_D \leq 0$

1.7 Bipolartransistor (BJT)



Sperrbereich

$U_{BE} < U_{BEF} \wedge U_{BC} < U_{BCF}$

$I_B = I_E = I_C = 0$

Normalbereich

$U_{BE} = U_{BEF} \wedge U_{BC} < U_{BCF}$

$I_E = \frac{I_C}{A_N}$, $\quad I_B > 0$, $\quad I_C = B_N I_B$

Inverser Bereich

$U_{BE} < U_{BEF} \wedge U_{BC} = U_{BCF}$

$I_E = \frac{I_C}{A_I}$, $\quad I_B > 0$, $\quad I_C = -B_I I_B$

Übersteuerungsbereich

$U_{BE} = U_{BEF} \wedge U_{BC} = U_{BCF}$

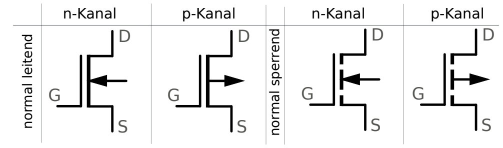
$I_E > 0$, $\quad I_B > 0$, $\quad I_C > 0$

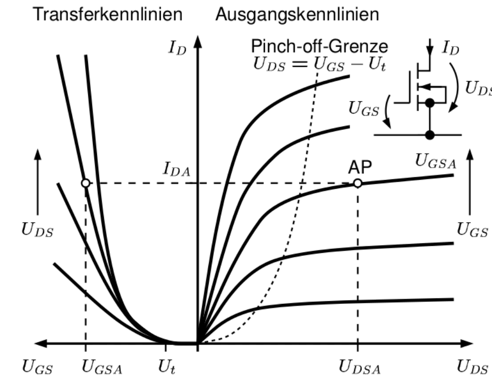
$U_{CE} = U_{CEX} = U_{BEF} - U_{BCF}$

$B_N = \frac{A_N}{1 - A_N}$, $B_I = \frac{A_I}{1 - A_I}$

$0 < A_N < 1$, $0 < A_I < 1$

1.8 MOSFET





$\beta = \frac{b}{l} \frac{\epsilon_{\text{Ox}} \mu_{\text{Hl}}}{d_{\text{Ox}}}$

Sperrbereich

$U_{GS} < U_t$, $I_D = 0$

Aktiv-/Normalbereich

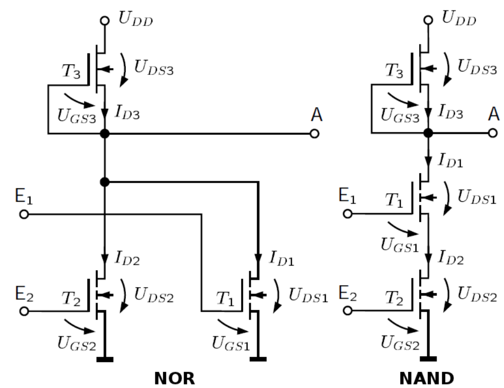
$U_{DS} \leq U_{GS} - U_t$

$I_D = \beta \left((U_{GS} - U_t) U_{DS} - \frac{1}{2} U_{DS}^2 \right)$

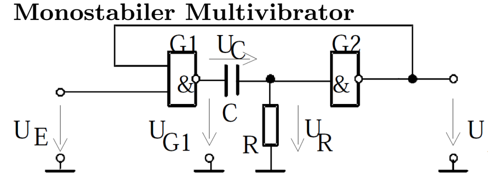
Pinch-off

$U_{DS} > U_{GS} - U_t$

$I_D = \frac{1}{2} \beta (U_{GS} - U_t)^2$



Monostabiler Multivibrator



Haltezeit $t_{\text{Halt.}} = \ln 2\tau \approx 0.7RC$ für $U_{\text{SP}} = \frac{U_0}{2}$

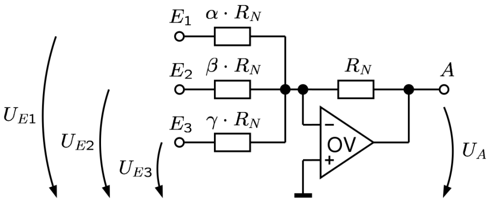
Erholzeit $t_{\text{Erhol.}} \approx 3\tau = 3RC$

1.9 Operationsverstärker

$U_D = U_P - U_N$

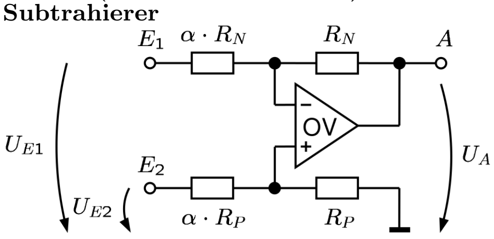
$U_A = V_D U_D$

Addierer



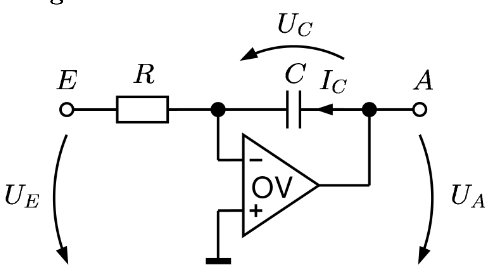
$U_A = -\left(\frac{1}{\alpha}U_{E1} + \frac{1}{\beta}U_{E2} + \frac{1}{\gamma}U_{E3}\right)$

Subtrahierer



$U_A = \frac{1}{\alpha}\left(U_{E1} - U_{E2}\right)$

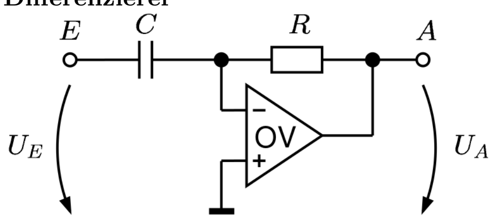
Integrierer



$I_C(t) = C\frac{\mathrm{d}U_C(t)}{\mathrm{d}t}$

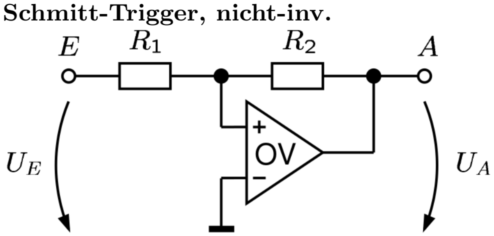
$U_A(t) = U_A t_0 - \frac{1}{RC}\int_{t_0}^{t} U_E(\tau)\mathrm{d}\tau$

Differenzierer



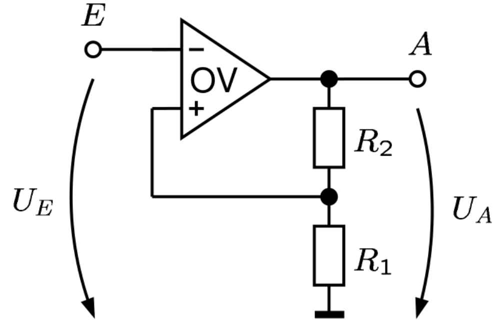
$U_A(t) = -RC\frac{\mathrm{d}U_E(t)}{\mathrm{d}t}$

Schmitt-Trigger, nicht-inv.



$U_{EHL} = -U_{A\max}\frac{R_1}{R_2}$ $U_{ELH} = -U_{A\min}\frac{R_1}{R_2}$

Schmitt-Trigger, invertierend



$U_{EHL} = U_{A\max}\frac{R_1}{R_1+R_2}$ $U_{ELH} = U_{A\min}\frac{R_1}{R_1+R_2}$

1.10 Leitungen

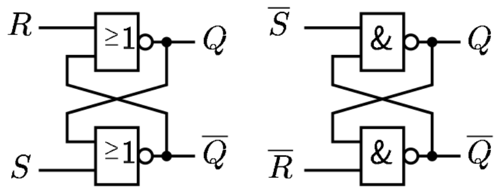
Wellenwiderstand $R_W = \sqrt{\frac{L'}{C'}}$

Phasengeschwindigkeit $c = \frac{1}{\sqrt{L'C'}} = \frac{c_0}{\sqrt{\epsilon_r \mu_r}}$

2 Digitaltechnik

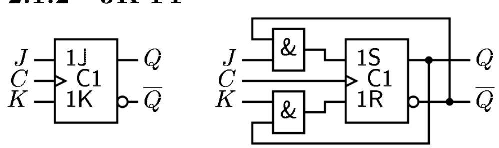
2.1 Flip-Flops

2.1.1 RS-FF

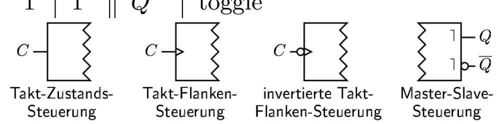


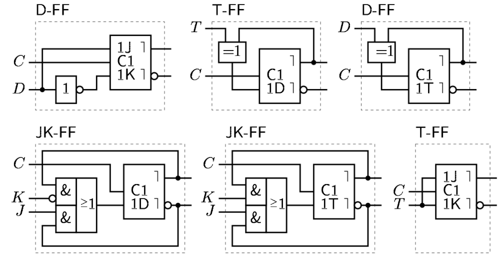
R	S	Q^+	Beschreibung
0	0	Q	save
0	1	1	set
1	0	0	reset
1	1	–	verboten

2.1.2 JK-FF



J	K	Q^+	Beschreibung
0	0	Q	save
0	1	0	kill
1	0	1	jump
1	1	$\bar{Q}$	toggle





Schaltnetz: Kombinatorische Schaltung, **Schaltwerk**: Schaltnetze + Speicherglieder (Flip-Flops) + Rückführungen **Autonomer Automat**: Hat keine Eingänge. **Moore-Ausgang**: Ausgang hängt nur vom inneren Zustand ab. **Mealy-Ausgang**: Ausgang hängt auch direkt von Eingängen ab.

2.2 KV-Diagramm

$y = f(x_3, x_2, x_1, x_0)$

y	$\bar{x_1}\bar{x_0}$	$\bar{x_1}x_0$	$x_1 x_0$	$x_1\bar{x_0}$
$\bar{x_3}\bar{x_2}$	1	2	4	3
$\bar{x_3}x_2$	5	6	8	7
$x_3 x_2$	13	14	16	15
$x_3\bar{x_2}$	9	10	12	11

Egon wünscht viel Erfolg in der Klausur.

Name	
Matrikelnummer	

z^n	Vorzustand Q_3	Q_2	Q_1	FF-Ansteuerfunk. $J_3 K_3$	$J_2 K_2$	$J_1 K_1$	Nachfolgezustand Q_3^{n+1}	Q_2^{n+1}	Q_1^{n+1}	z^{n+1}	Mealy-Ausg. A_0