TSTE05 Elektronik & mätteknik

Föreläsning 12

Dioder

Bipolartransistorer - Inledning

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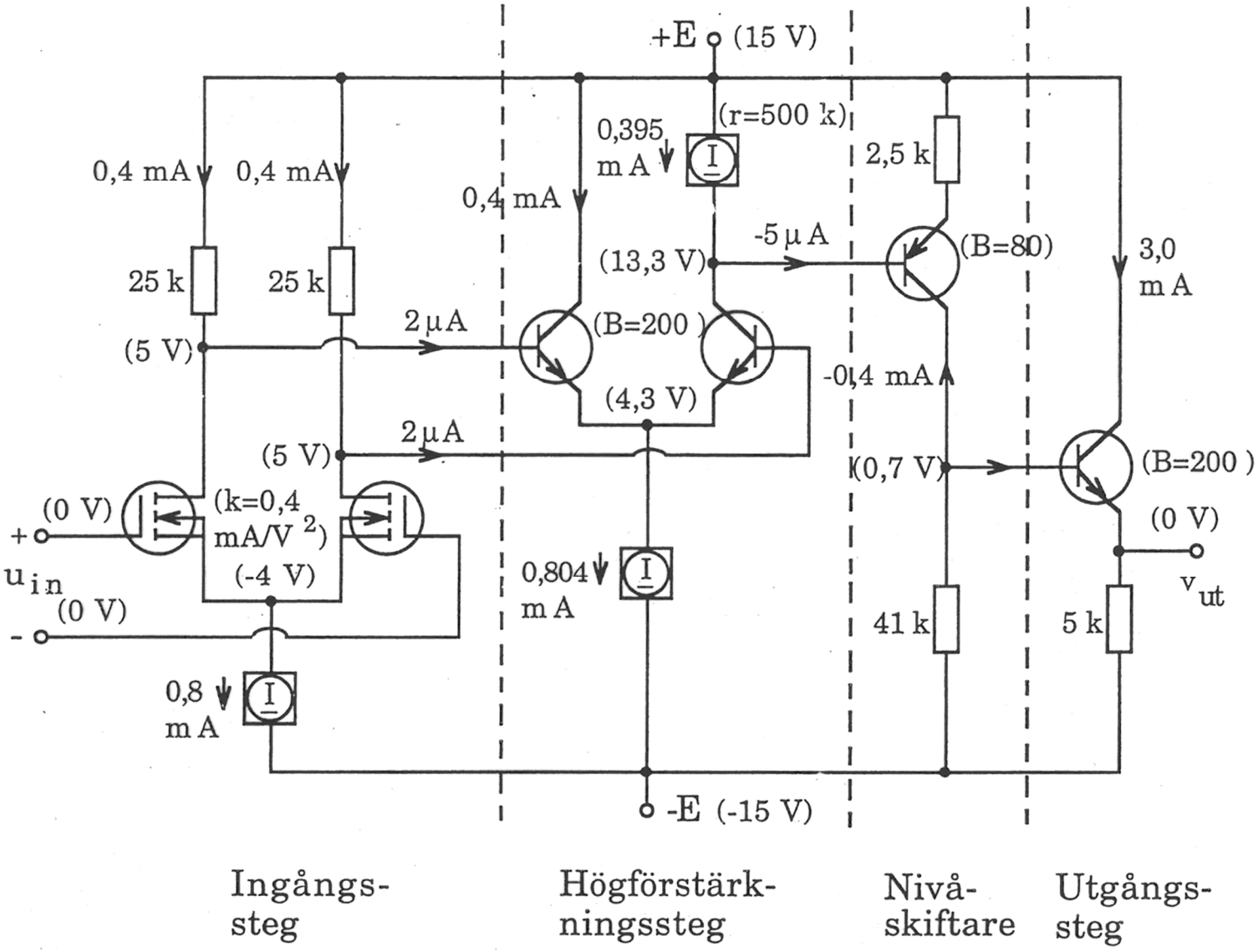
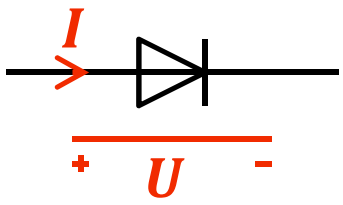
Ämnesområdet Elektroniska kretsar och system

LINKÖPINGS UNIVERSITET

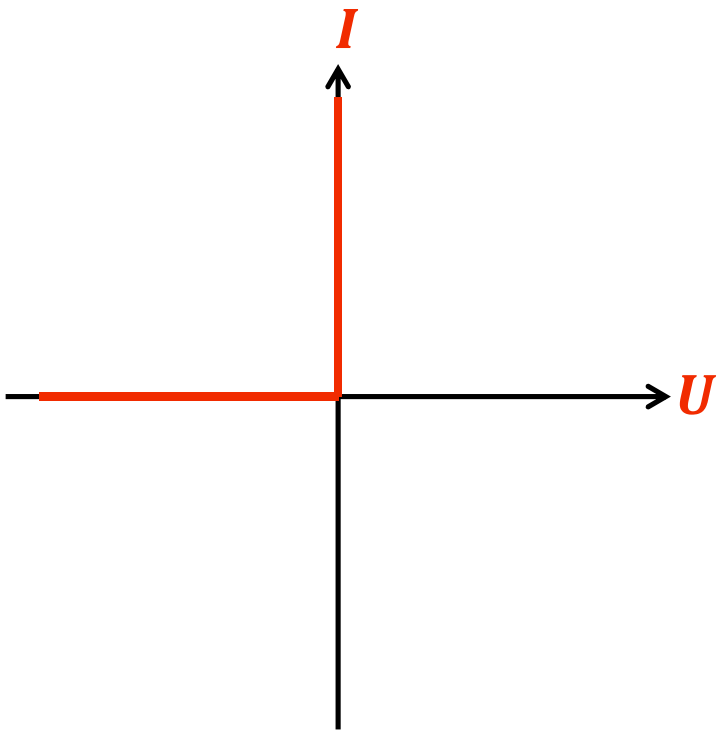
Operationsförstärkare



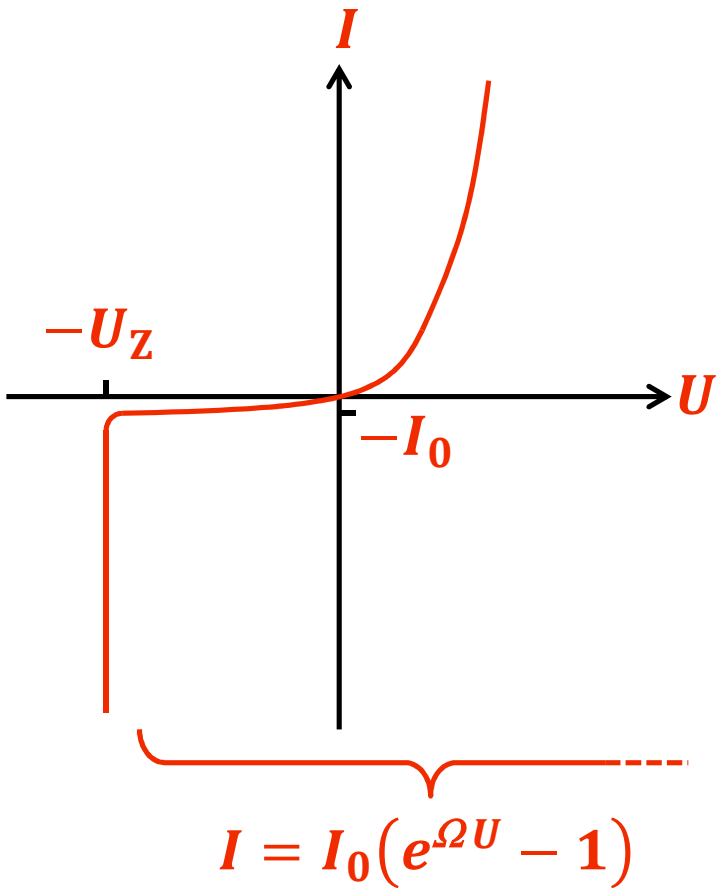
Dioder



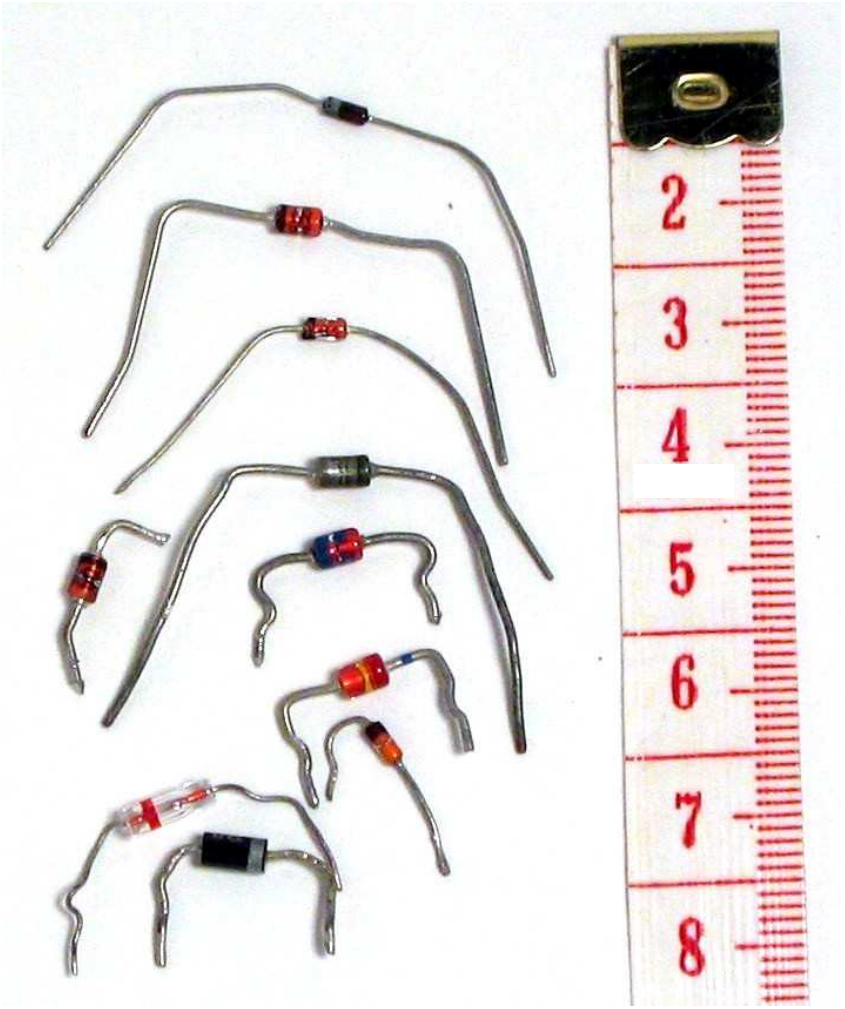
Ideal diod

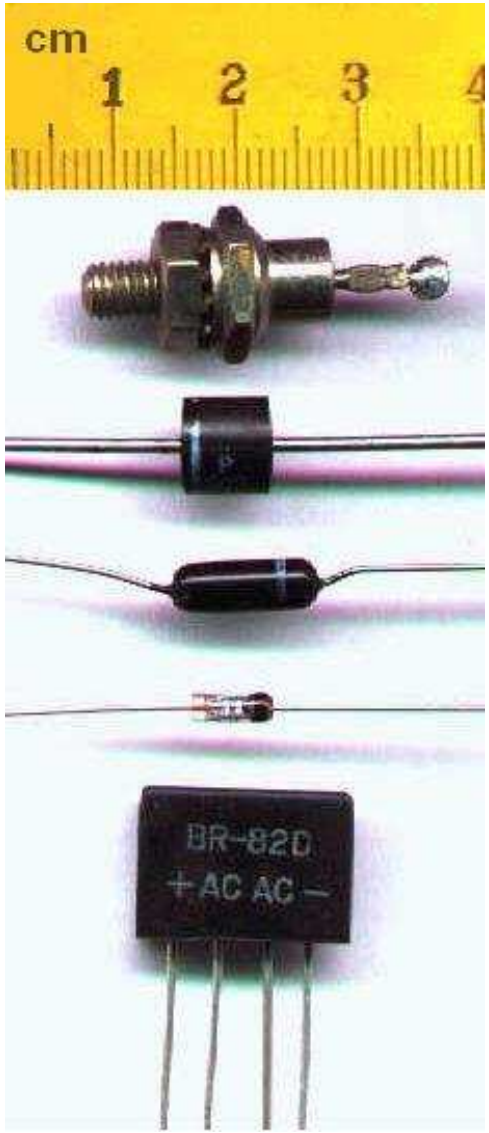


Verklig diod



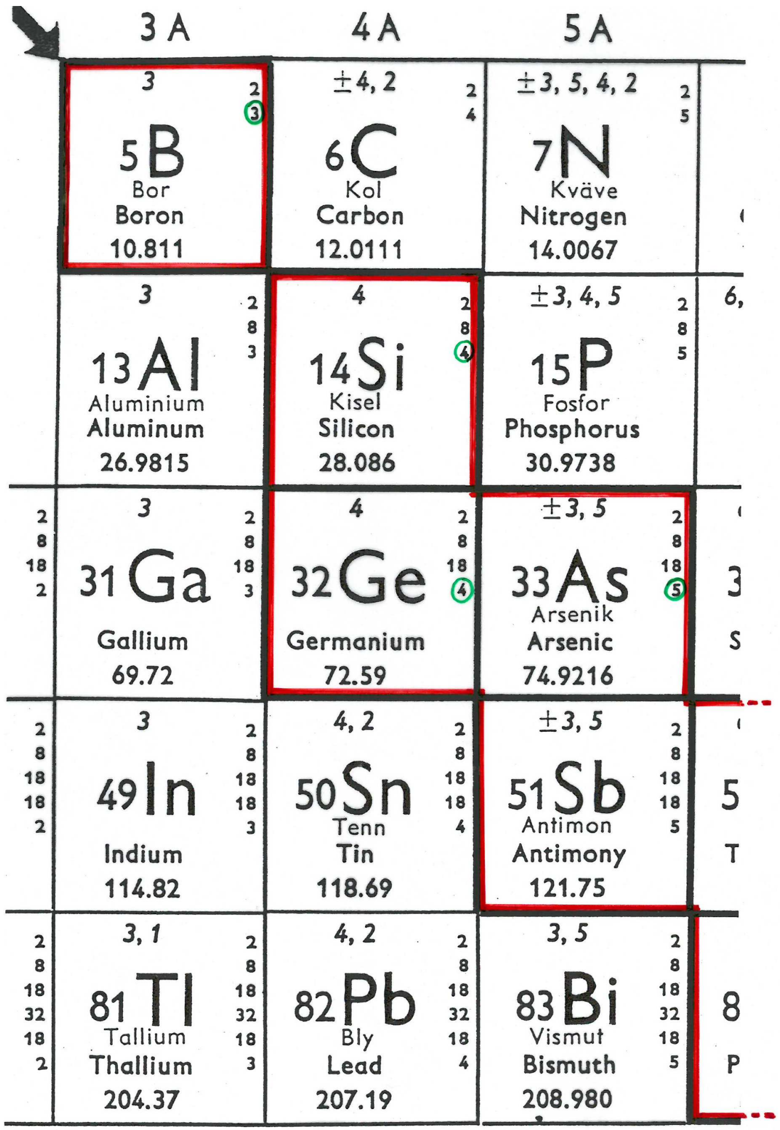
Dioder – Exempel

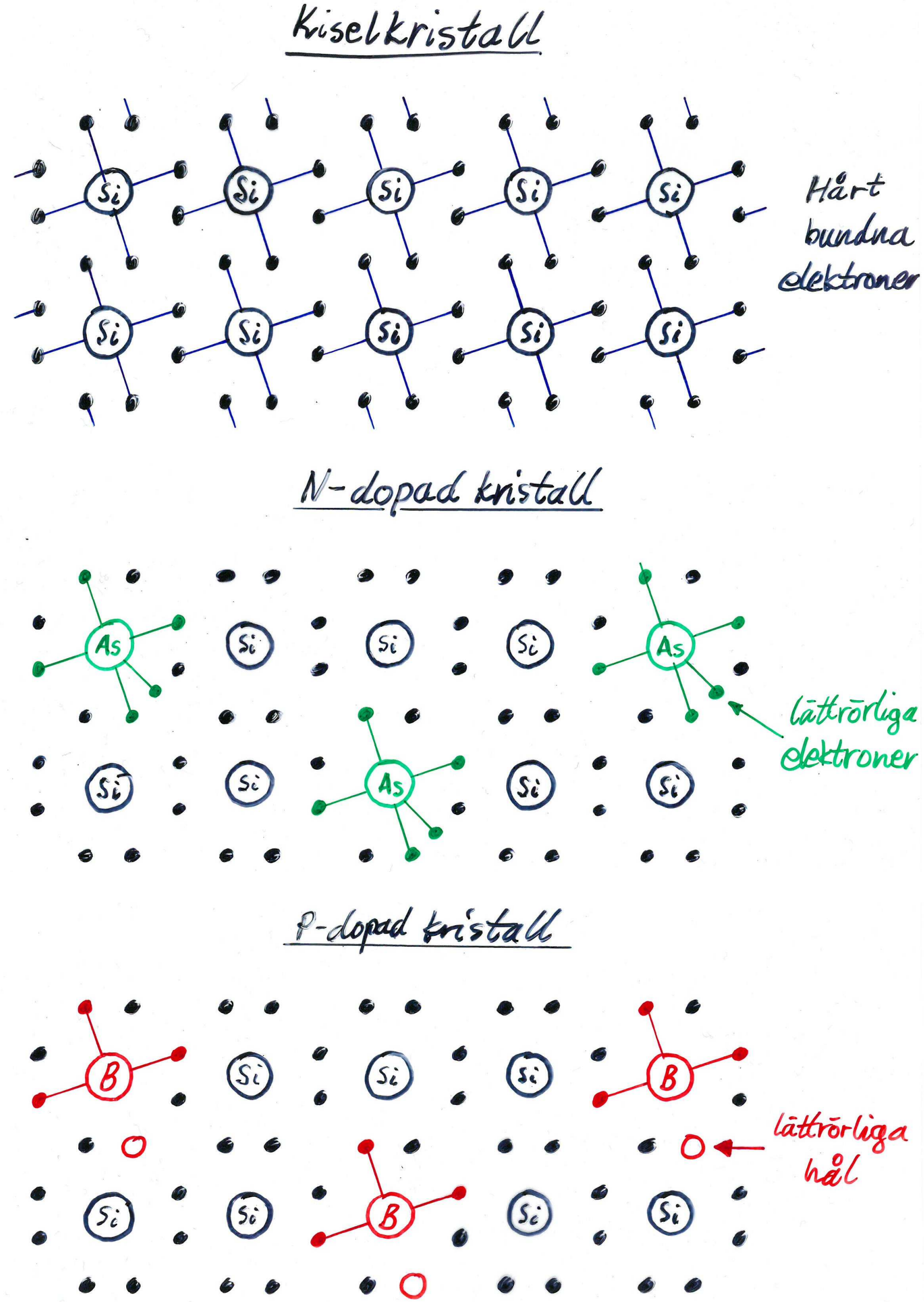




Källa: Wikipedia

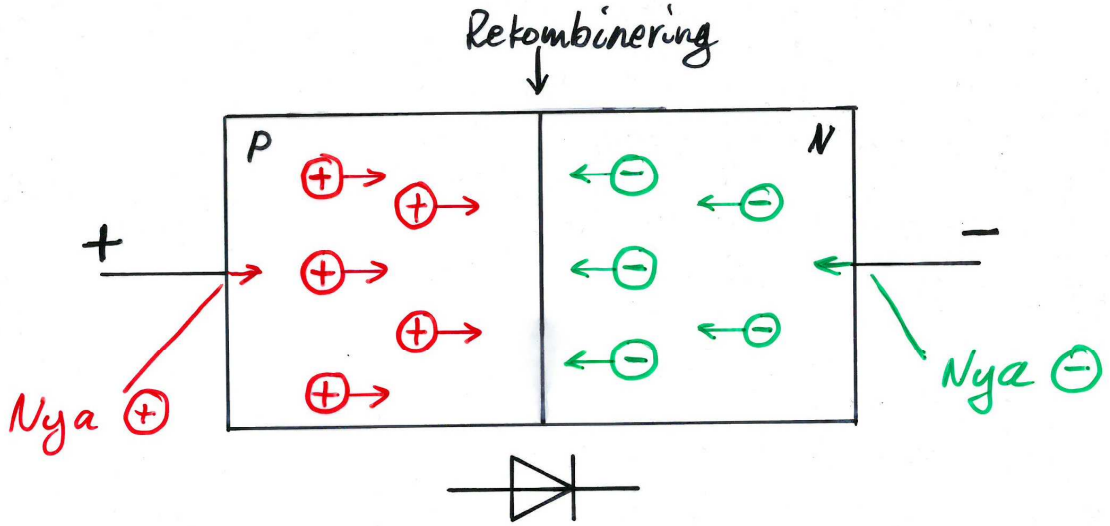
Halvledare


3 A
4 A
5 A
5 B Bor Boron 10.811
6 C Kol Carbon 12.0111
7 N Kväve Nitrogen 14.0067
13 Al Aluminium Aluminum 26.9815
14 Si Kisel Silicon 28.086
15 P Fosfor Phosphorus 30.9738
31 Ga Gallium 69.72
32 Ge Germanium 72.59
33 As Arsenik Arsenic 74.9216
49 In Indium 114.82
50 Sn Tenn Tin 118.69
51 Sb Antimon Antimony 121.75
81 Tl Tallium Thallium 204.37
82 Pb Bly Lead 207.19
83 Bi Vismut Bismuth 208.980

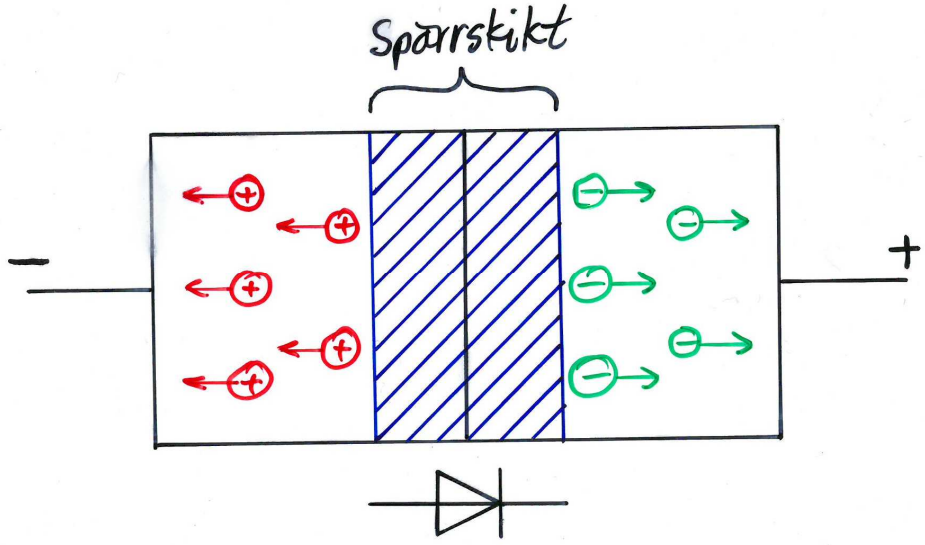

Kiselkristall
Hårt bundna elektroner
N-dopad kristall
lättrörliga elektroner
P-dopad kristall
lättrörliga hål

Diodens funktion

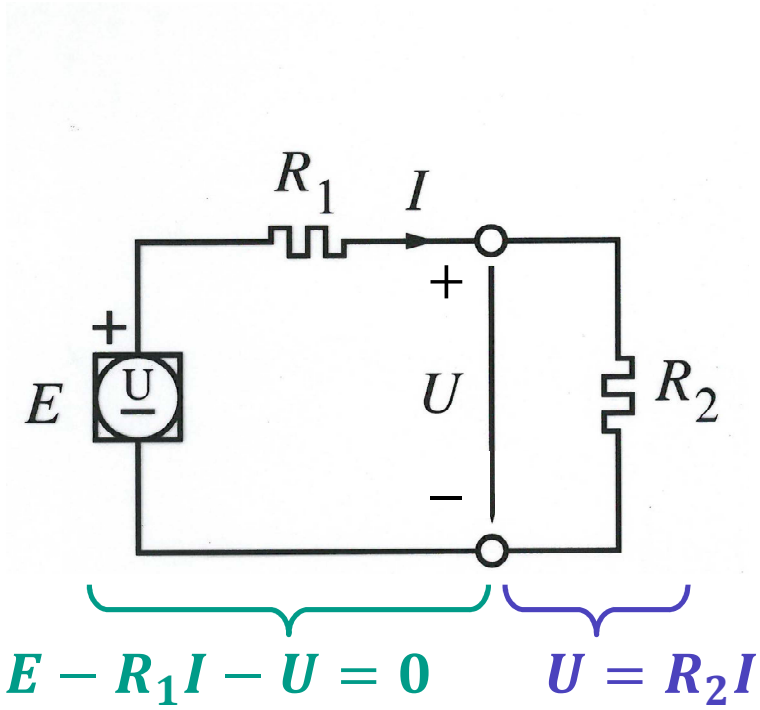
Framspänd diod:

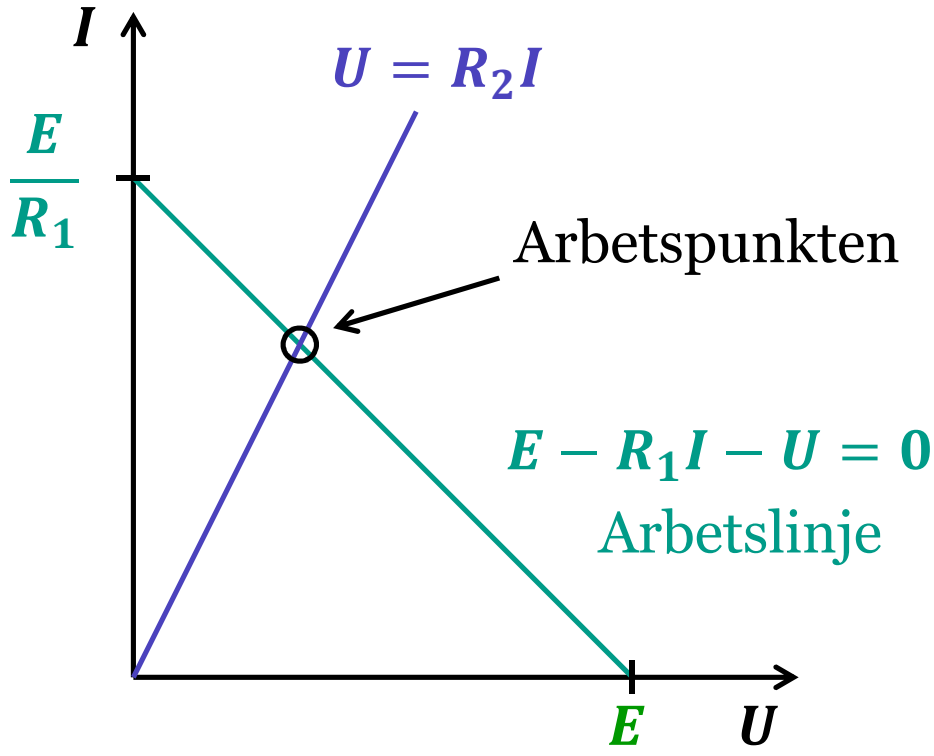


Backspänd diod:



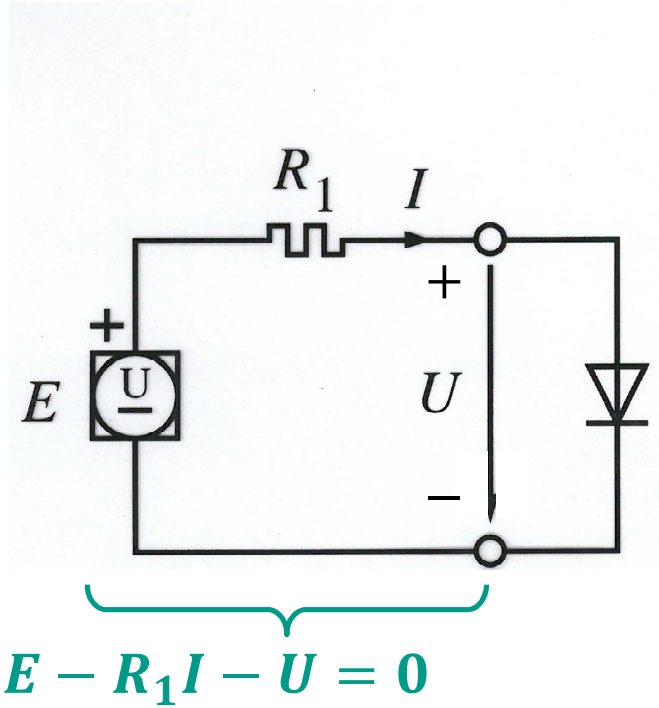
Arbetspunktsbestämning – Introduktion

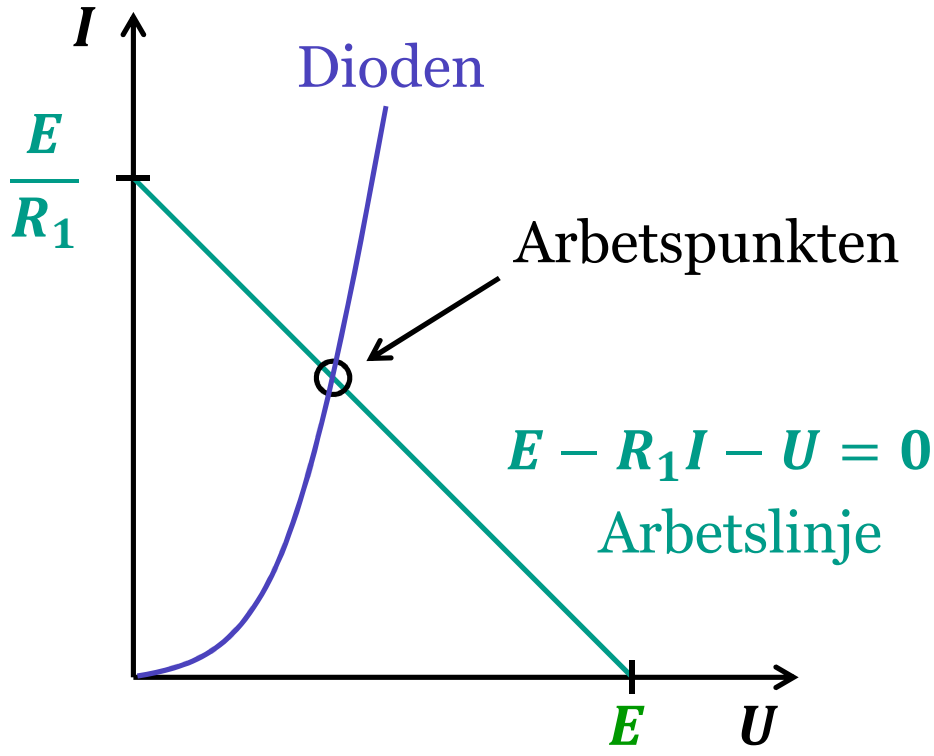




$$I = \frac{E}{R_1 + R_2} \qquad U = \frac{R_2}{R_1 + R_2} E$$

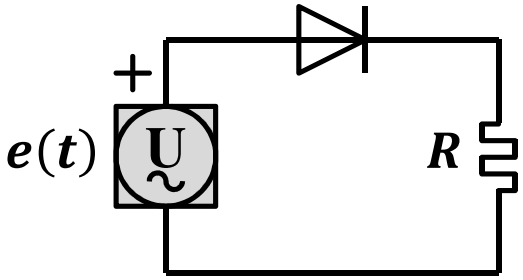
Arbetspunktsbestämning för diod

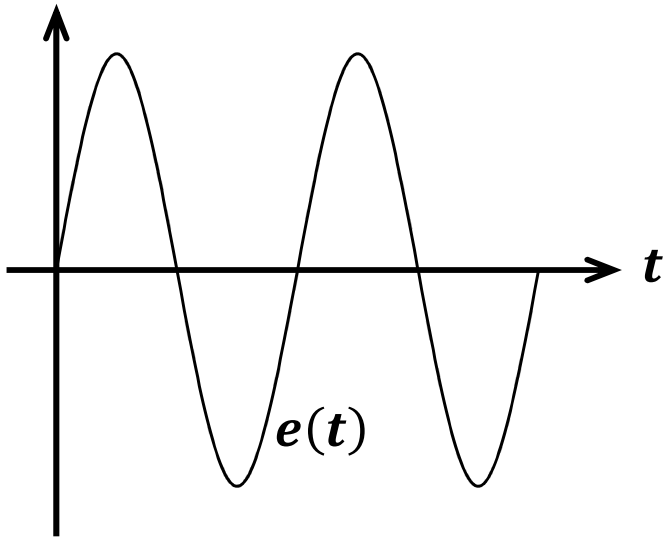




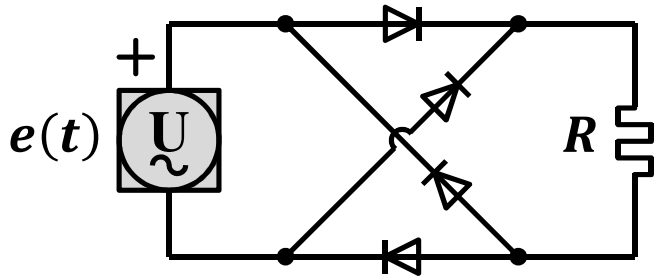
Likriktning med diod 1(3)

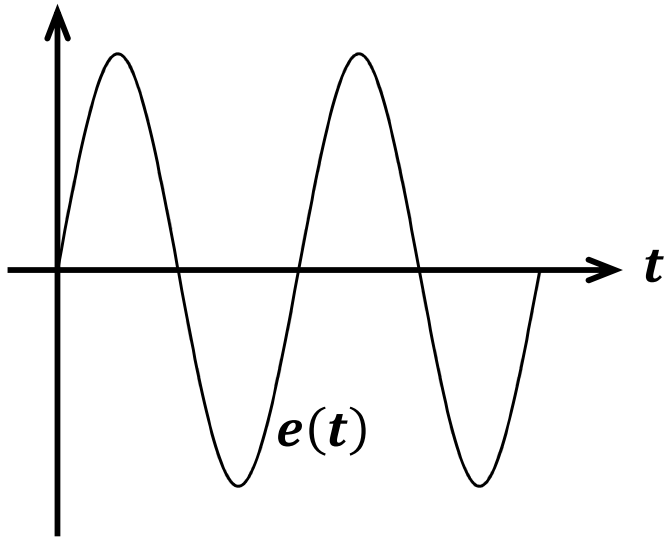
Halvvågslikriktning





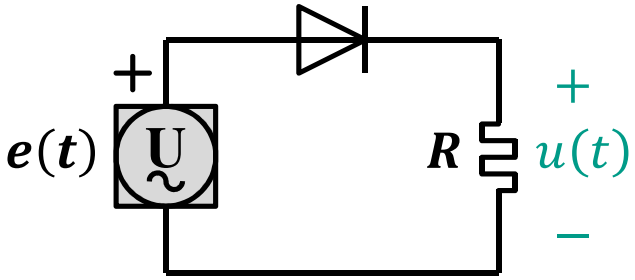
Helvågslikriktning

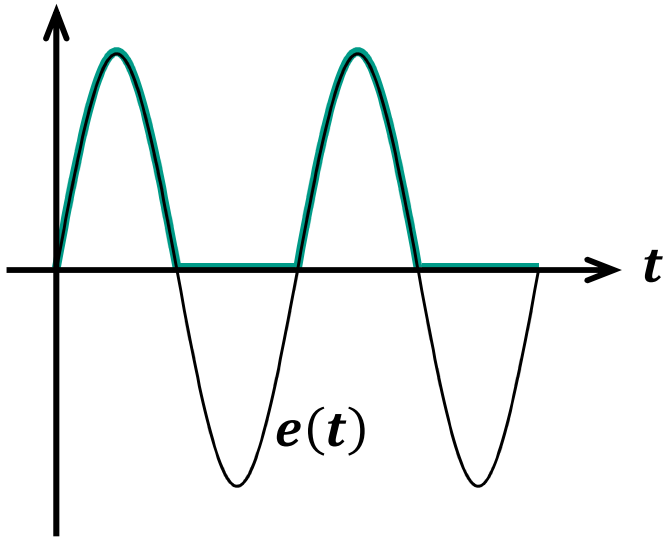




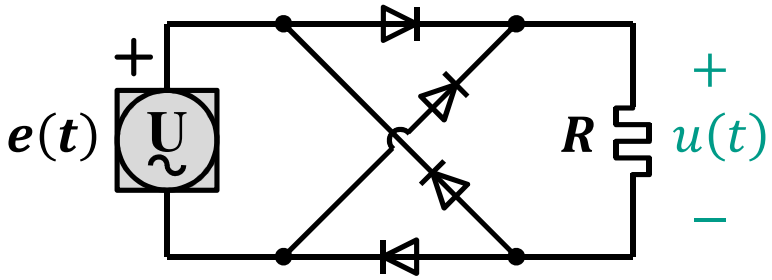
Likriktning med diod 2(3)

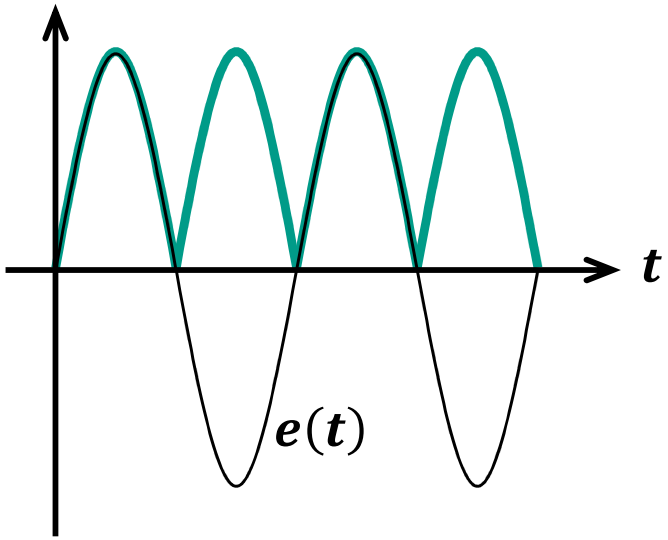
Halvvågslikriktning





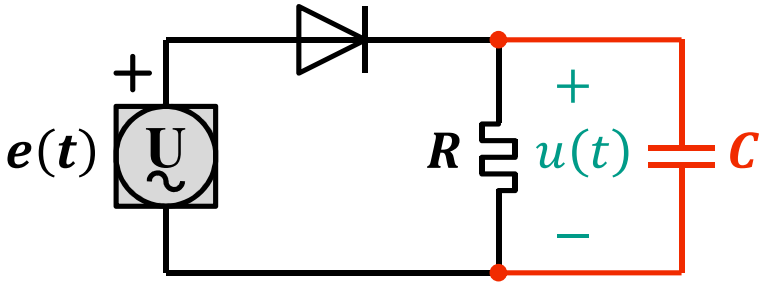
Helvågslikriktning

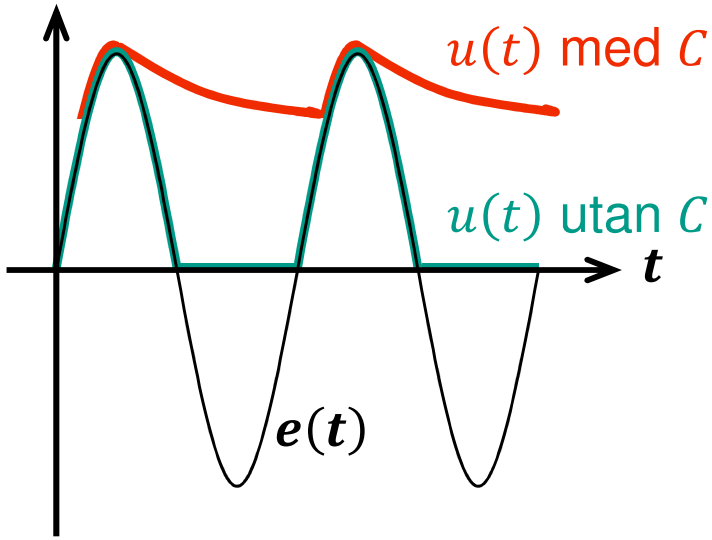




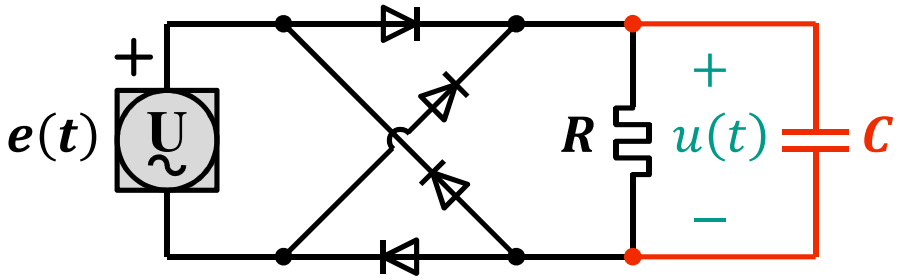
Likriktning med diod 2(3)

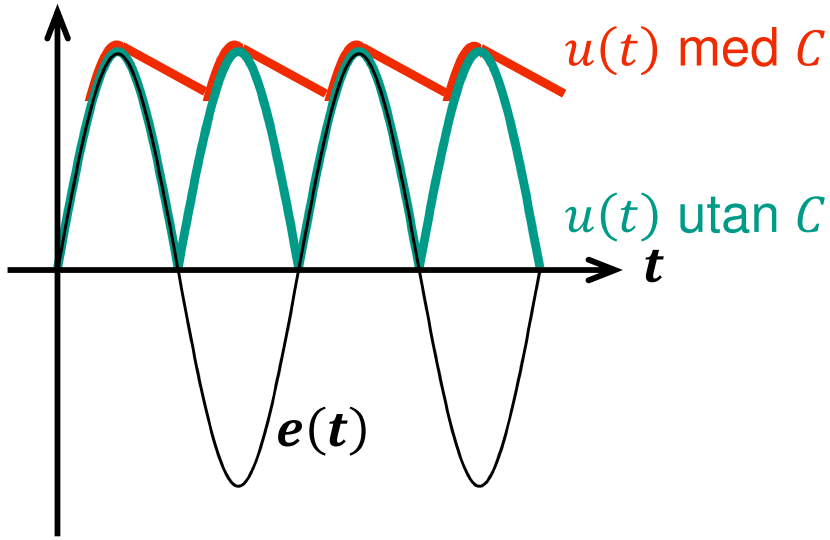
Halvvågslikriktning



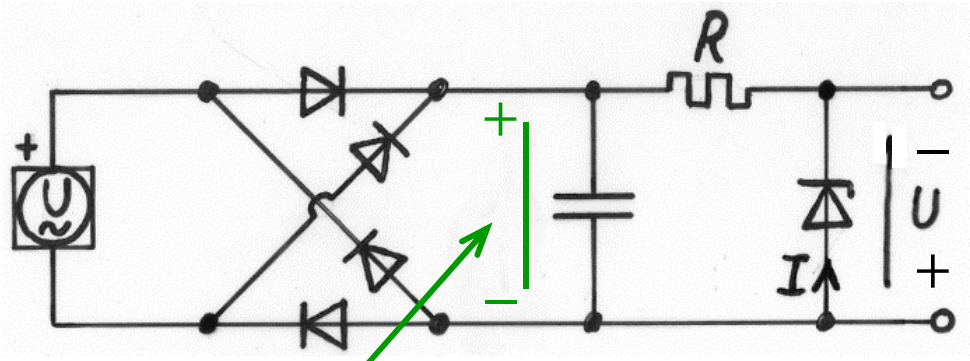


Helvågslikriktning

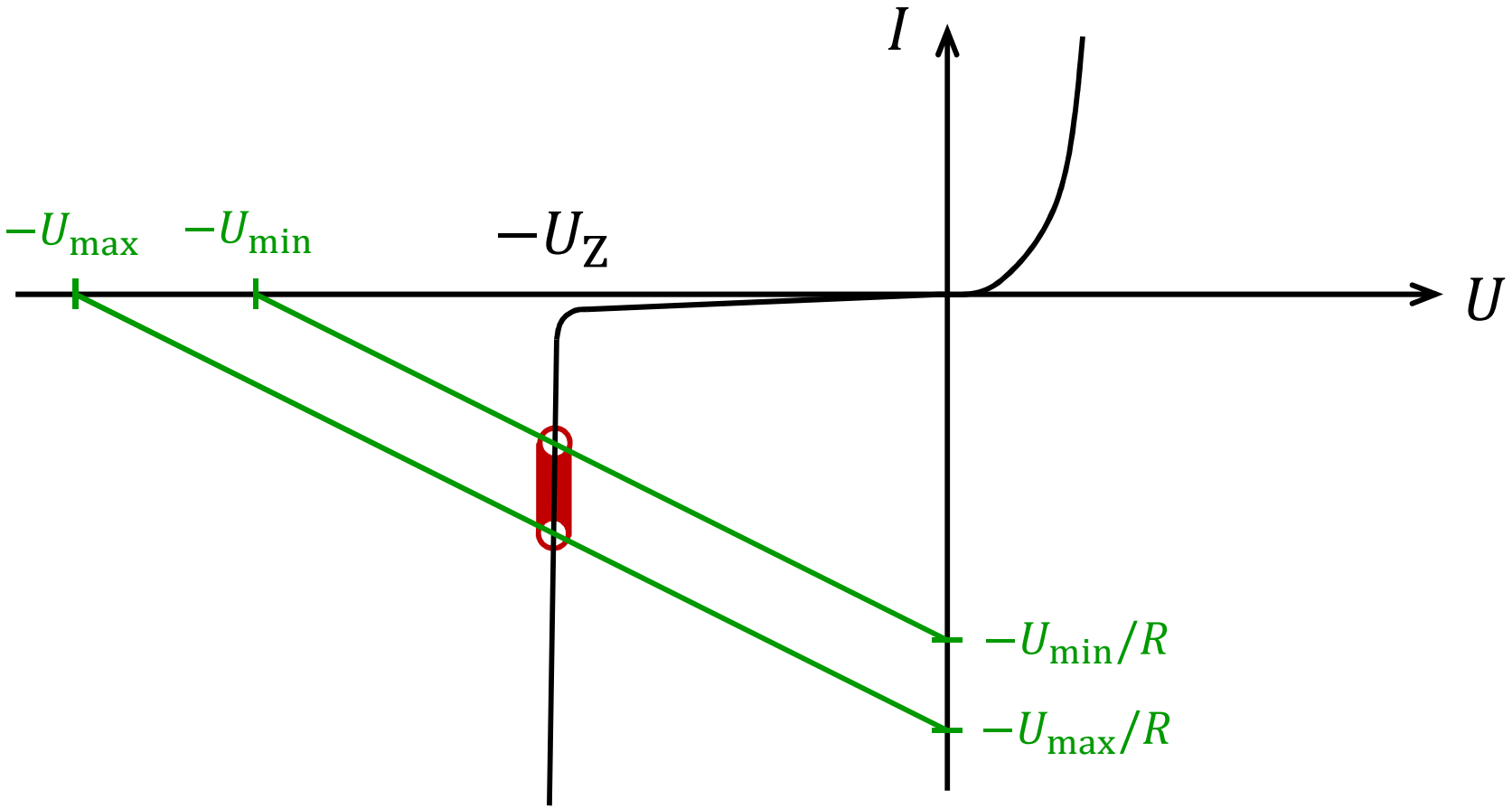




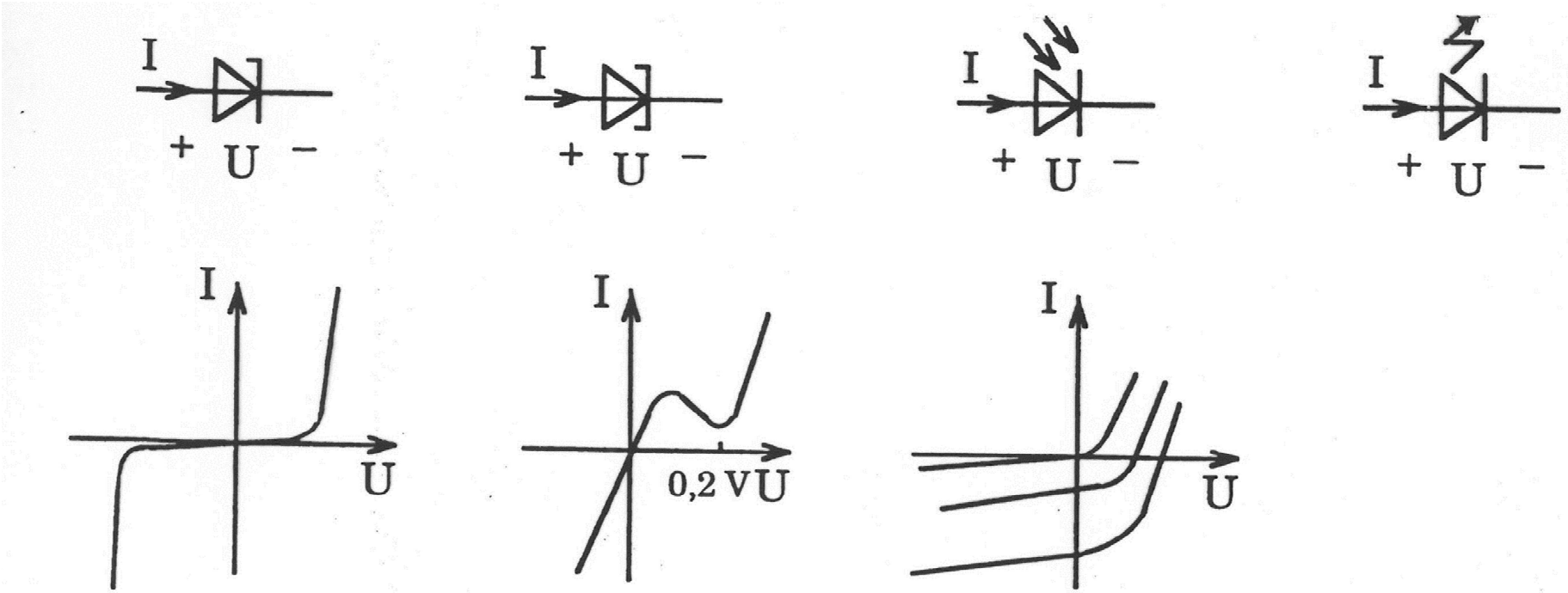
Stabilisering med zenerdiod



$U_{\min}, \ldots, U_{\max}$



Andra slags dioder

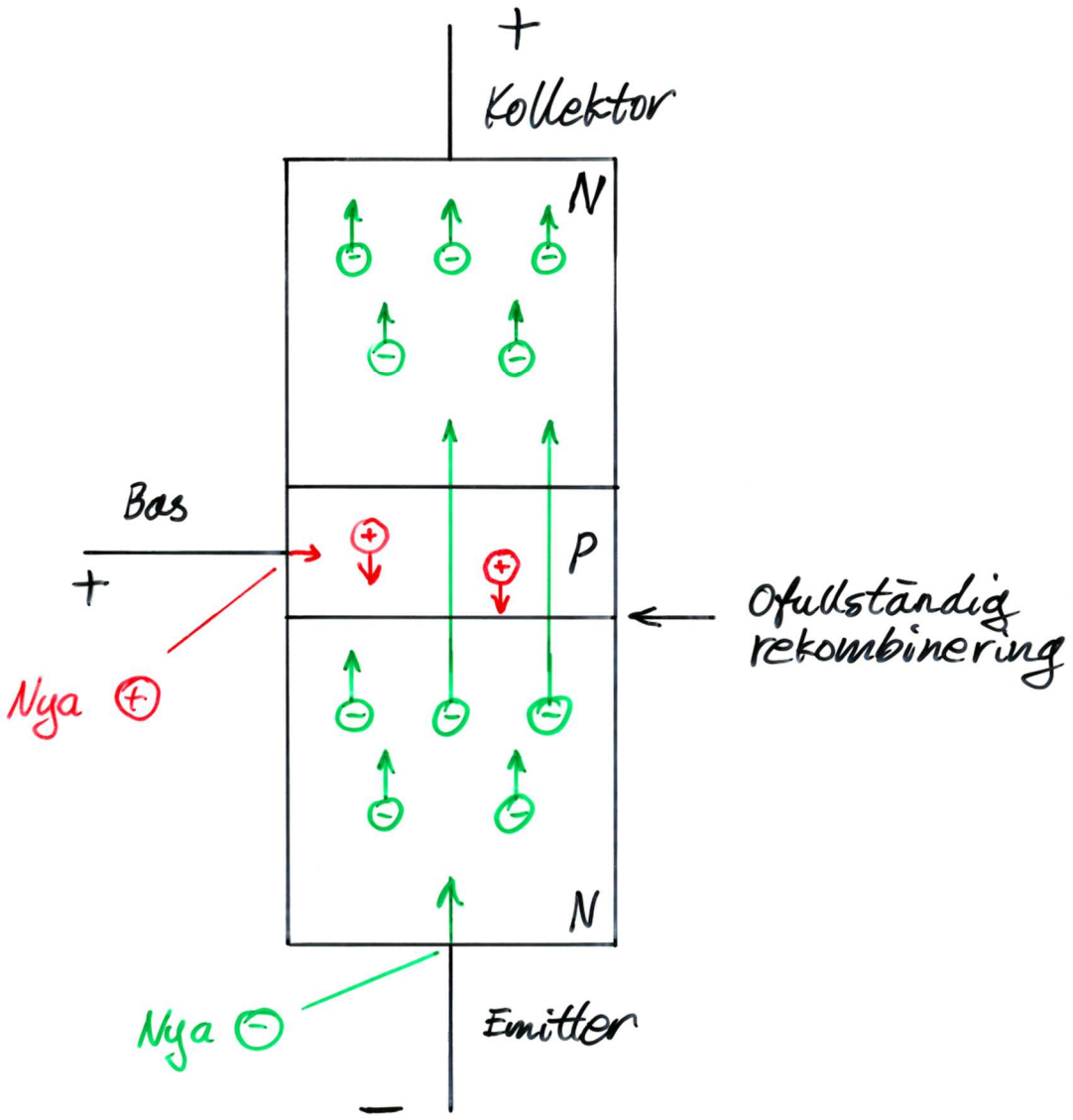


a) Zenerdiod *b) Tunneldiod* *c) Fotodiod* *d) Lysdiod*

Figur 3.72 Symbol och karaktäristik för några olika diodtyper.

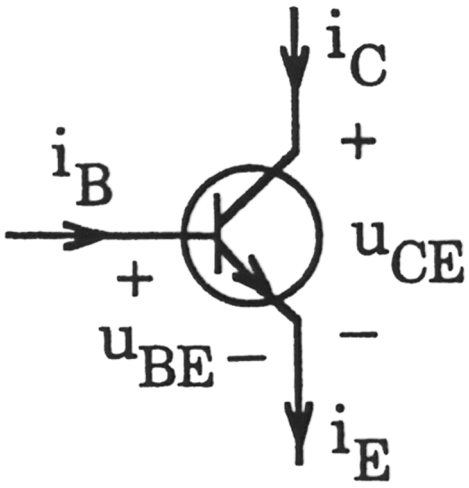
Figur 3.72 ur Söderkvist

Bipolartransistorn - NPN



Bipolartransistorer – Variabler och referensriktningar

NPN-transistor



<u>Krav</u>

Positiva strömmar och spänningar

Grundekvationer

Strömförstärkning

$$i_C = B i_B$$

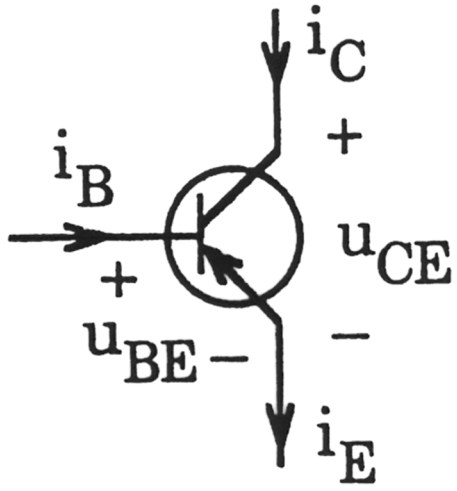
Strömförstärkningsfaktor

$$5 < B < 1000$$

Kirchhoffs strömlag

$$i_E = i_C + i_B$$

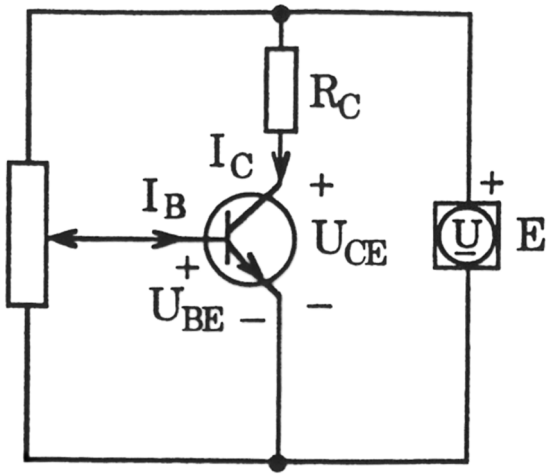
PNP-transistor



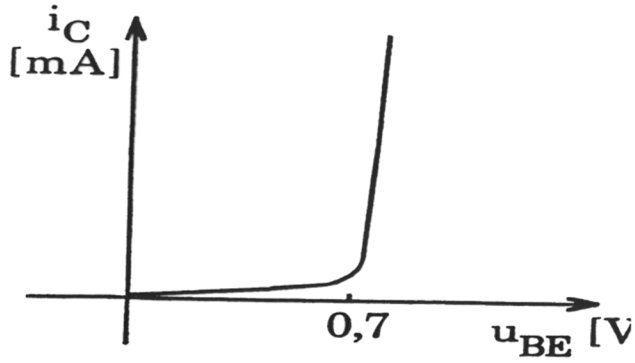
<u>Krav</u>

Negativa strömmar och spänningar

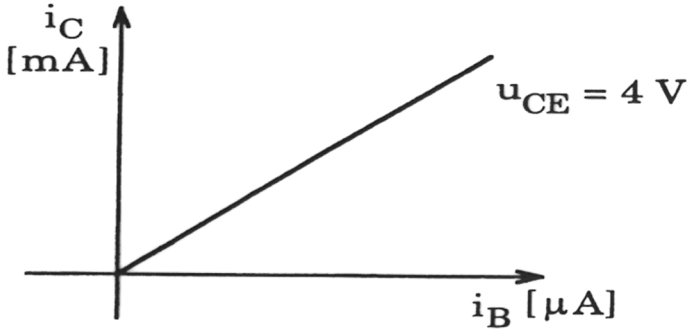
Bipolartransistorer – Några samband



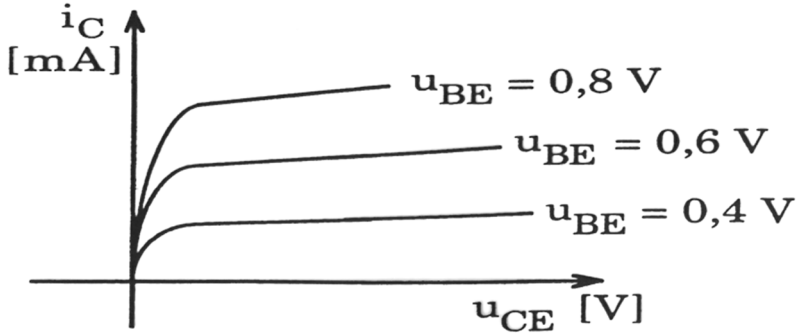
Kollektorström som funktion av bas-emitter-spänning



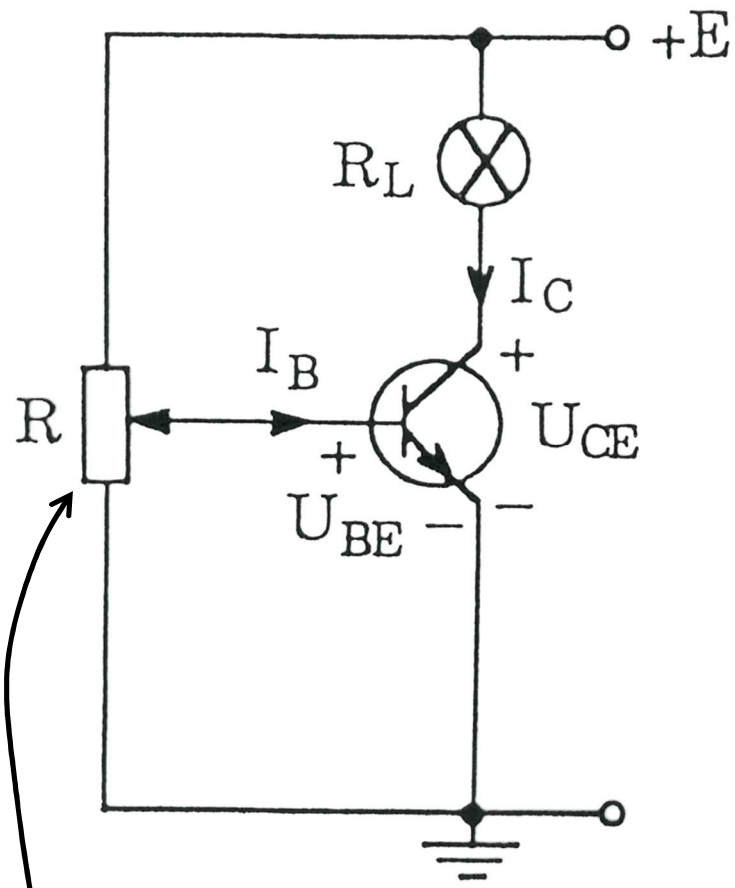
Kollektorström som funktion av basström

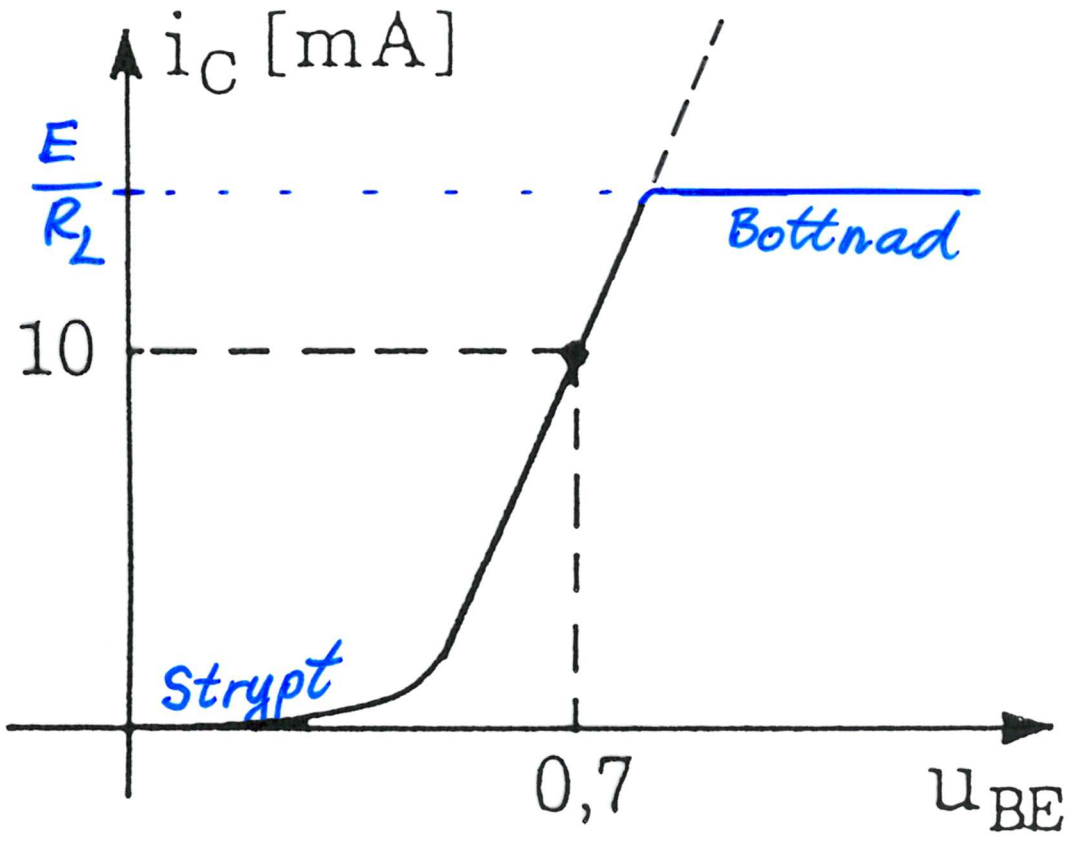


Kollektorström som funktion av kollektor-emitter-spänning



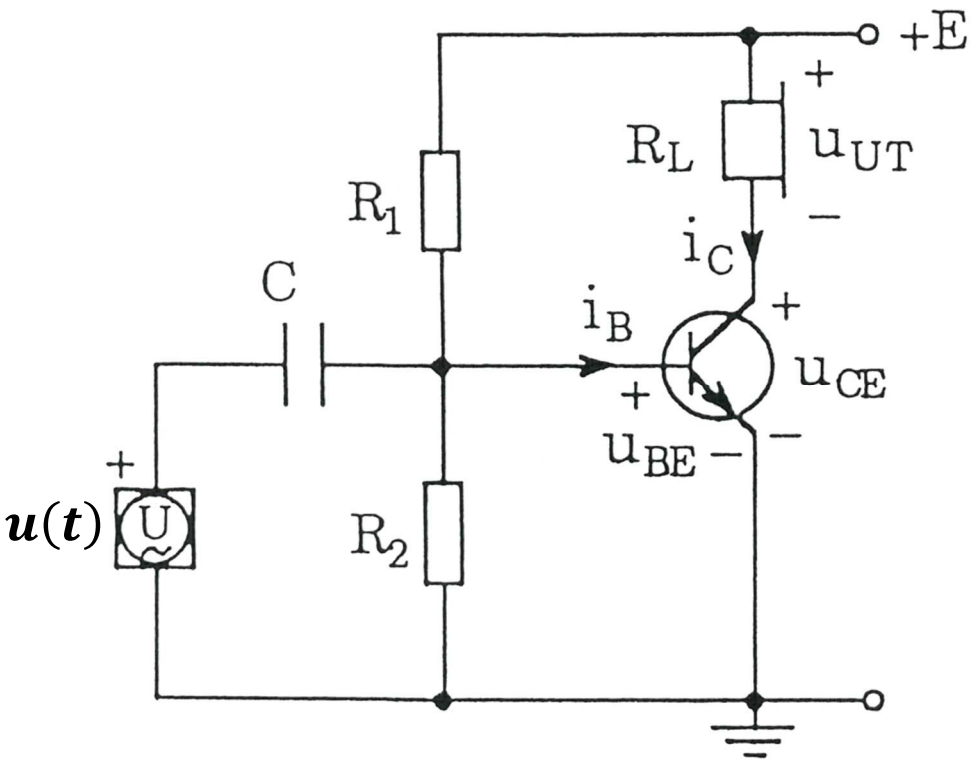
Strömstyrning med NPN-transistor

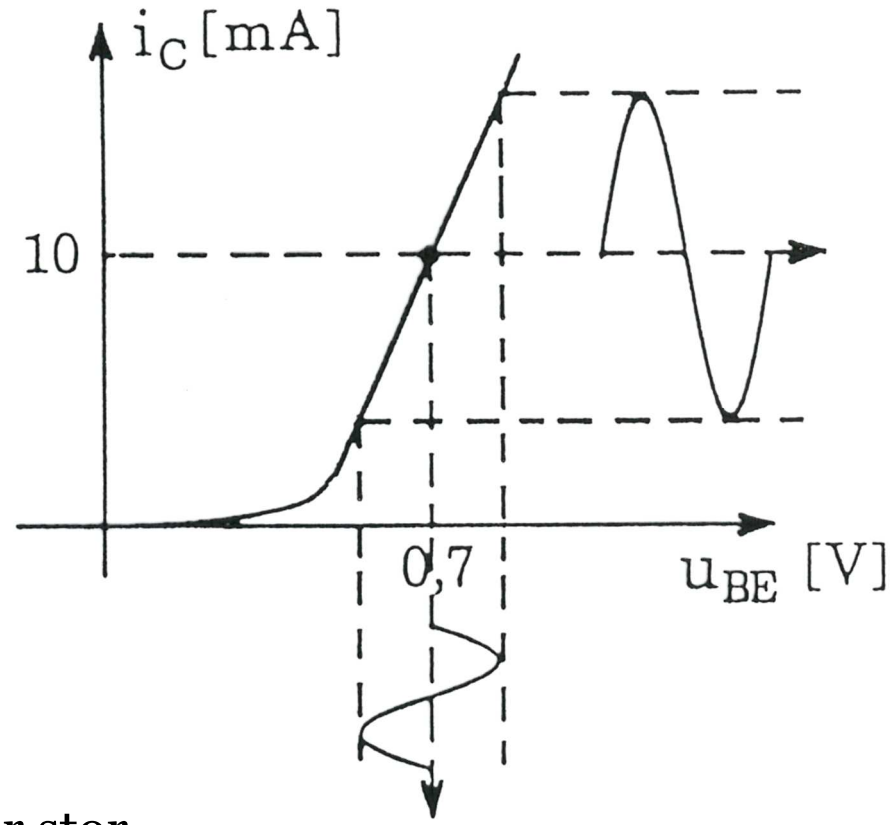




Potentiometer (vridmotstånd)

Förstärkning av signalspänning



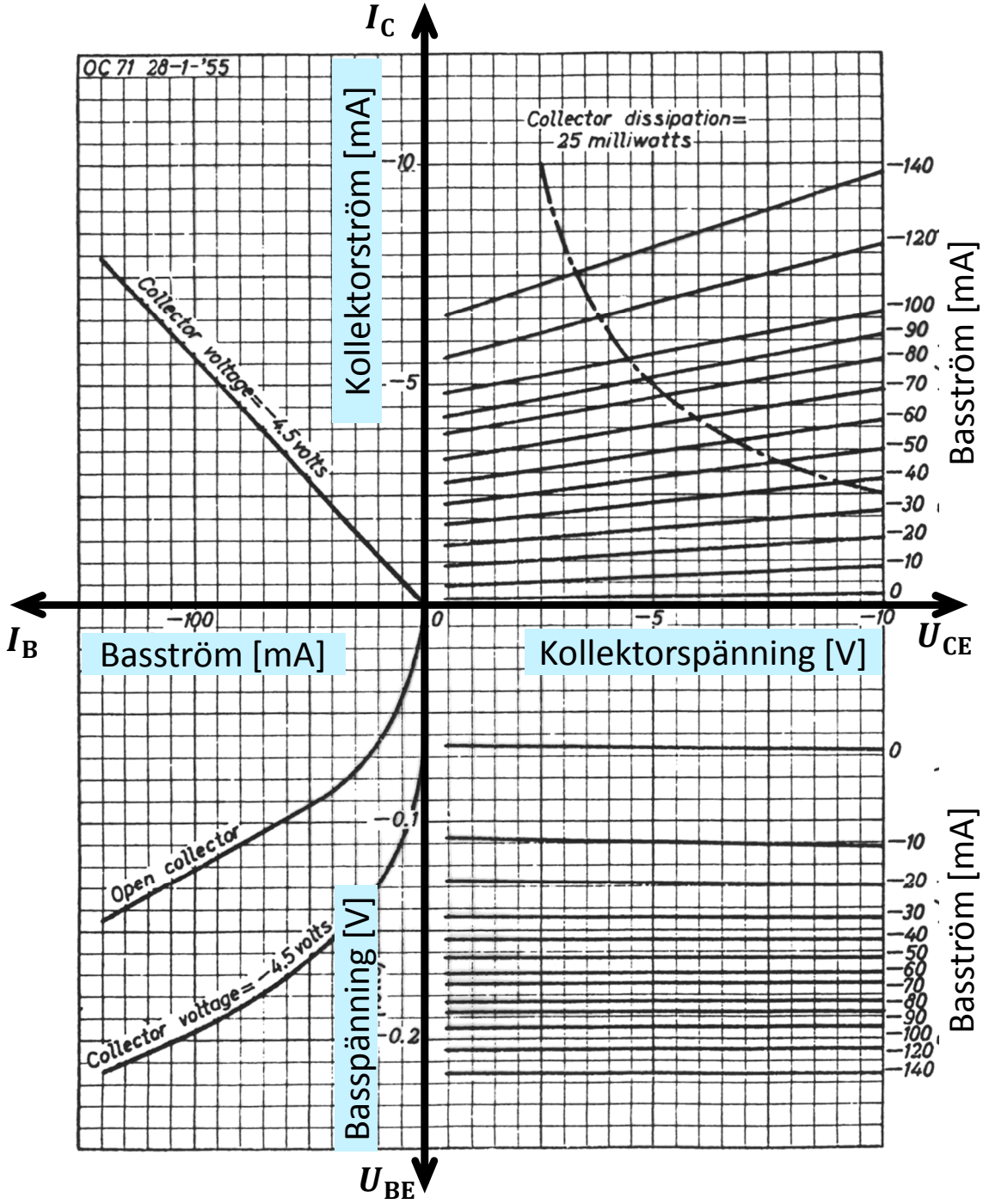


Obs! Signalspänningen $\boldsymbol{u_{be}(t) = u(t)}$ om C är stor.

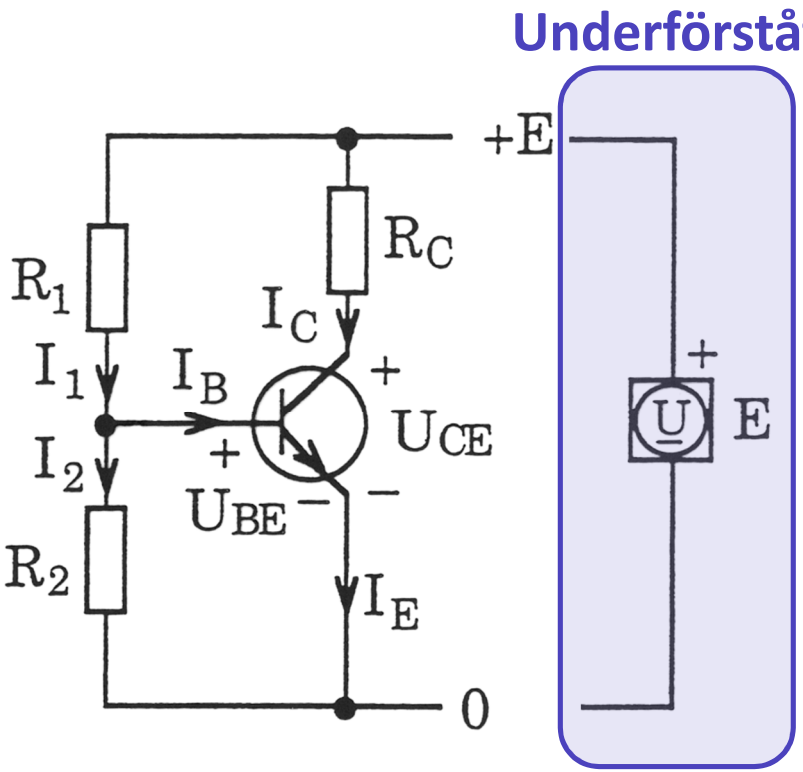
$$\boldsymbol{u_{BE}(t) = U_{BEQ} + u_{be}(t)} \qquad \boldsymbol{i_C(t) = I_{CQ} + i_c\,(t)} \qquad \boldsymbol{u_{UT}(t) = R_L i_C(t)}$$

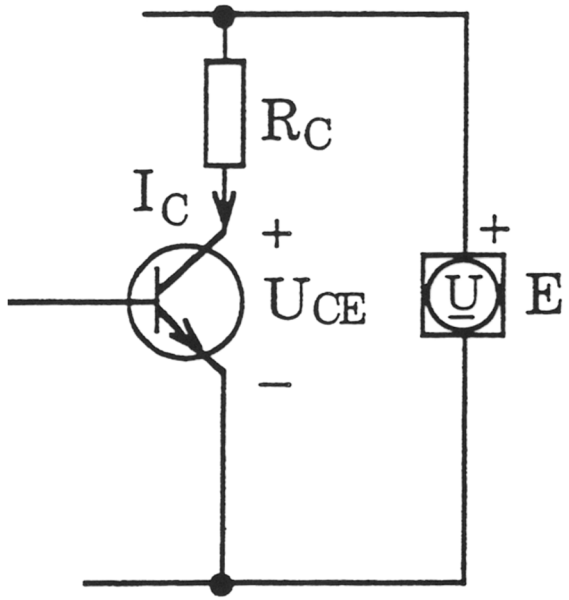
Fullständigt kurvblad för PNP-transistor

Observera: Fyra diagram i ett. Varje kvadrant är ett separat diagram



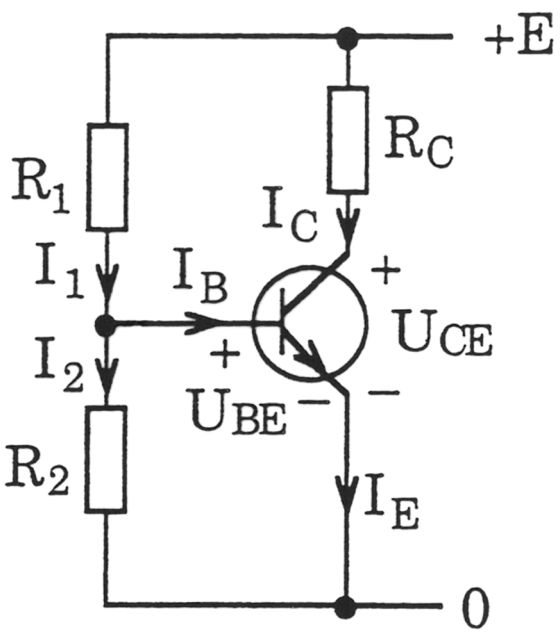
Enkel transistorkoppling – Arbetslinje



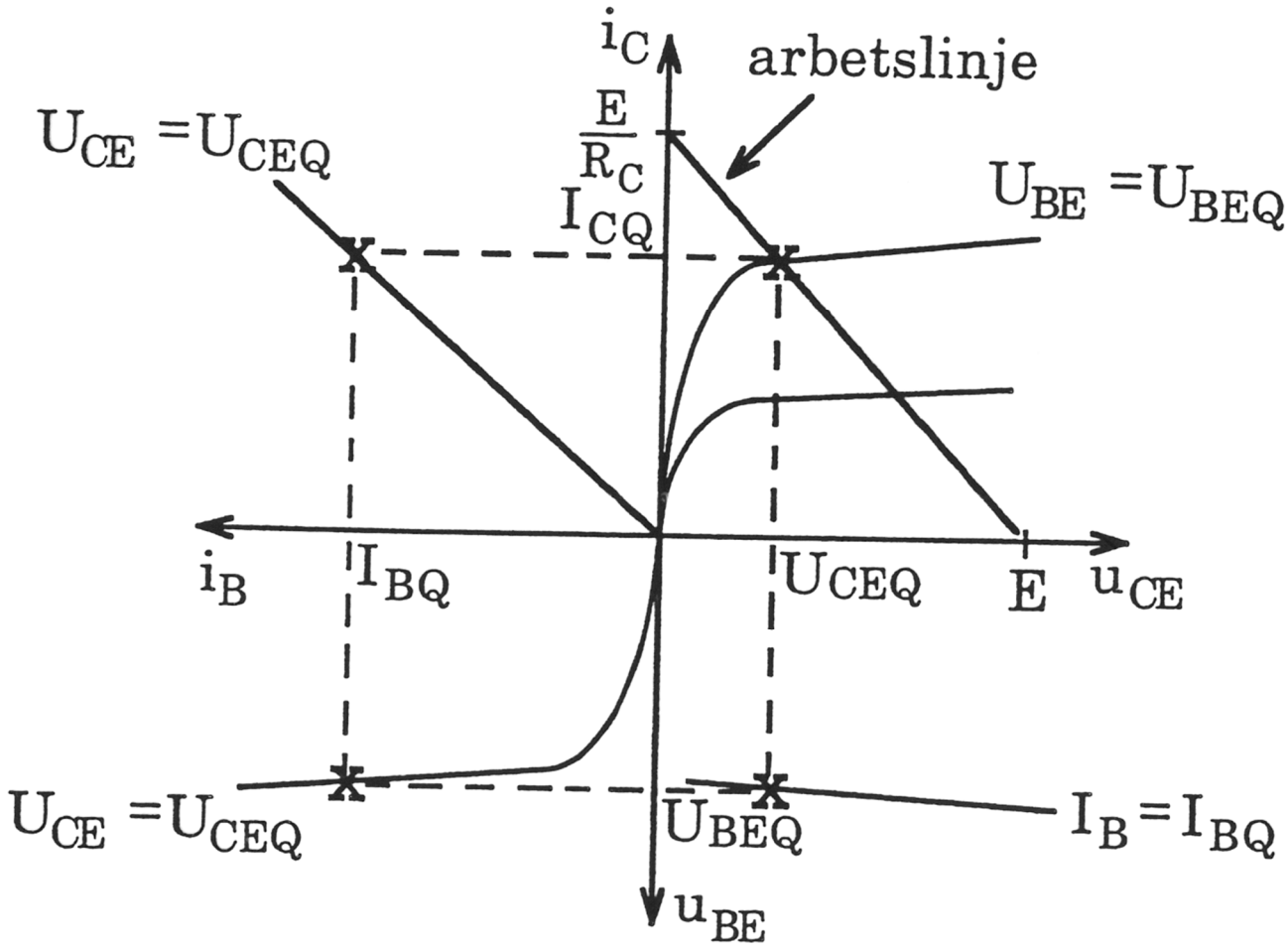


KVL: $\boldsymbol{E - R_C I_C - U_{CE} = 0}$

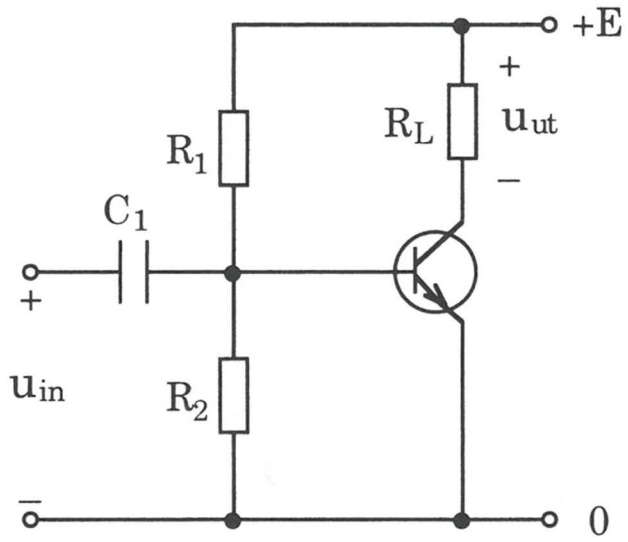
Enkel transistorkoppling – Arbetspunkt

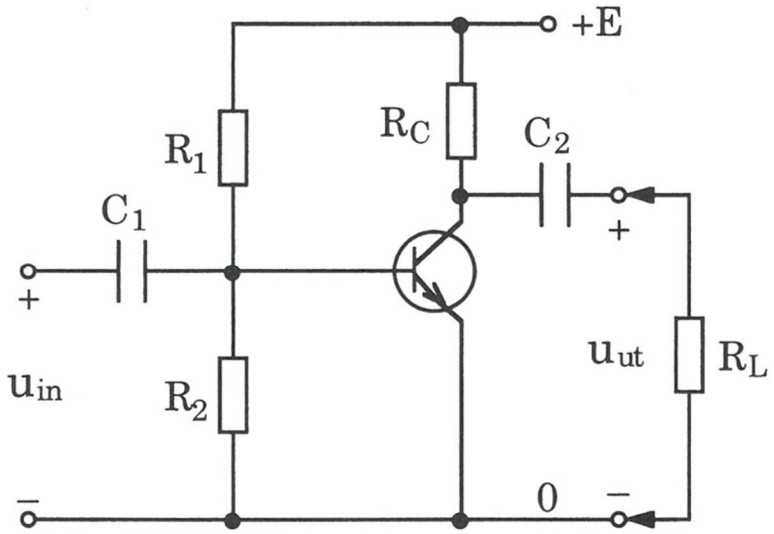


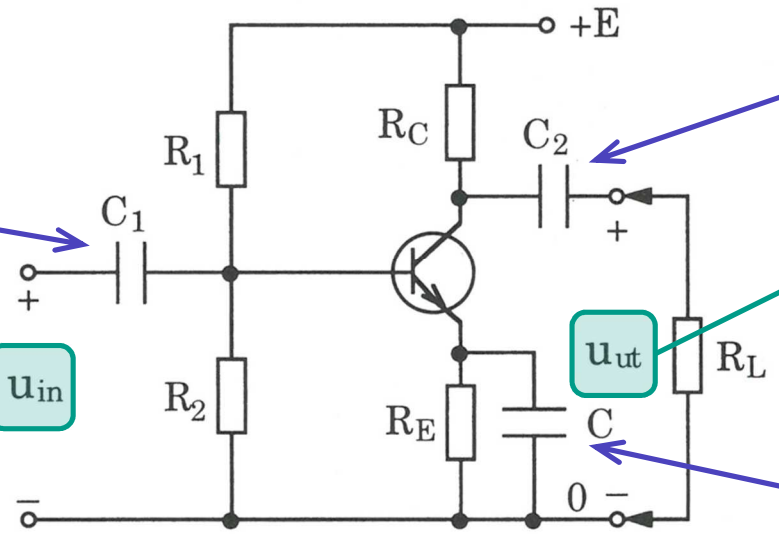
$$E - R_C I_C - U_{CE} = 0$$



GE-steg – Gemensam emitter







Kopplingskondensator

Kopplingskondensator

Utsignal

Insignal

u_{in}

Avkopplingskondensator

Mikael Olofsson
ISY/EKS

www.liu.se

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