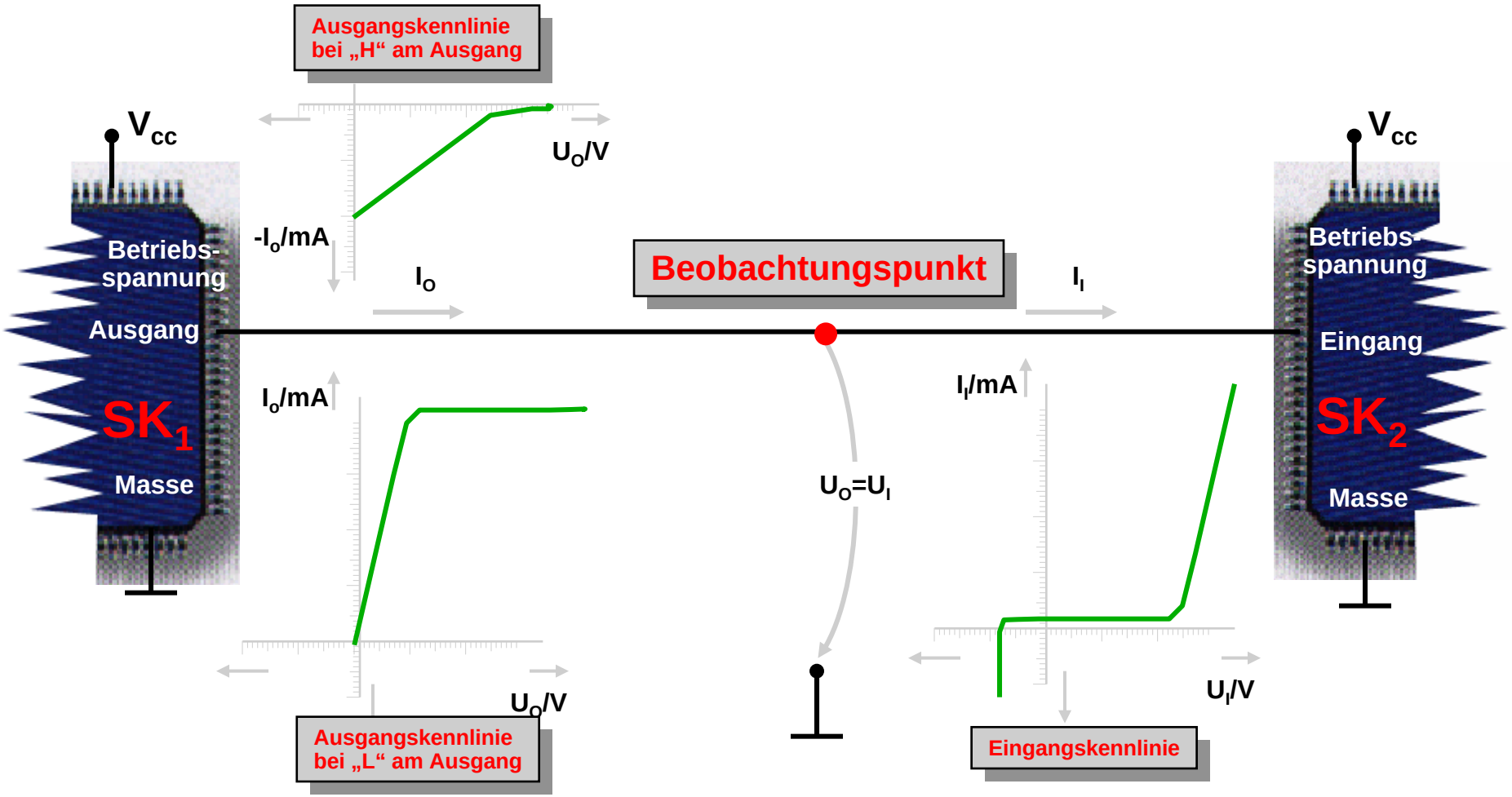
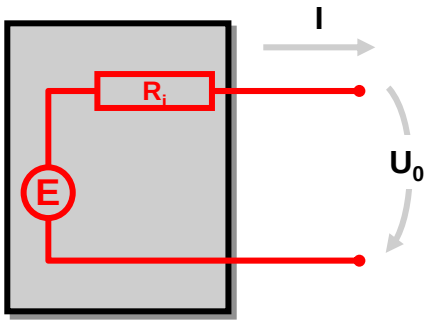
Beobachtung der Verbindung SK_1 und SK_2

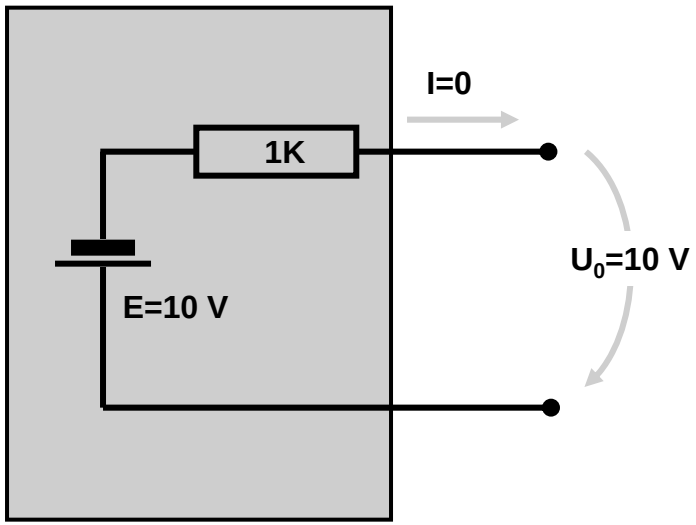


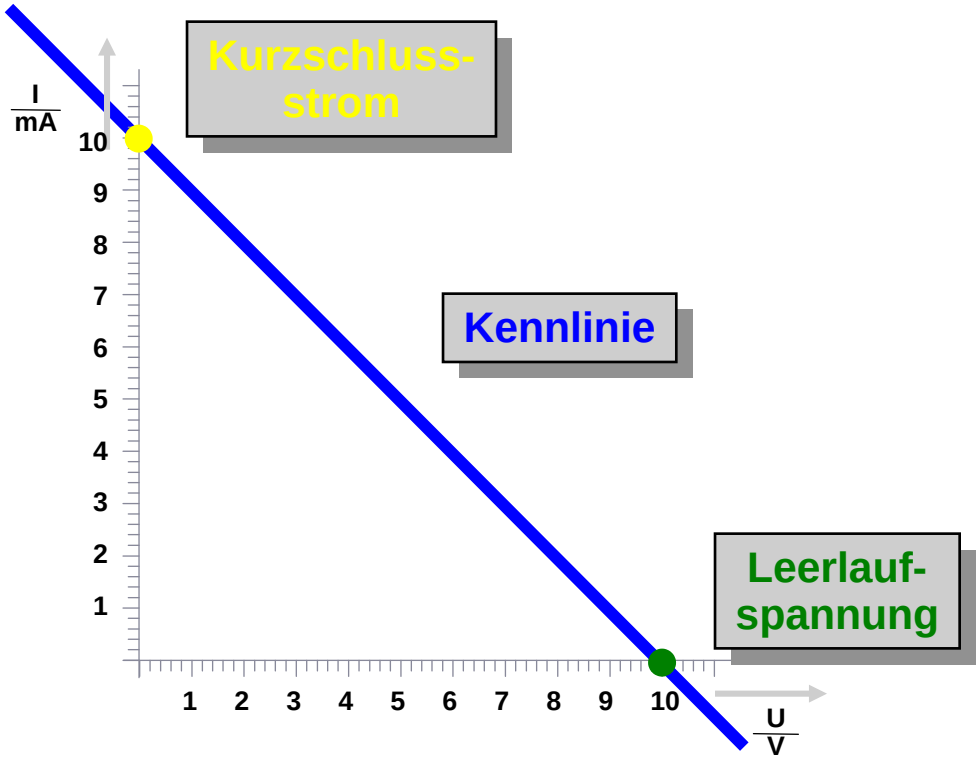
Grundlagen der Zweipoltheorie

Zweipol

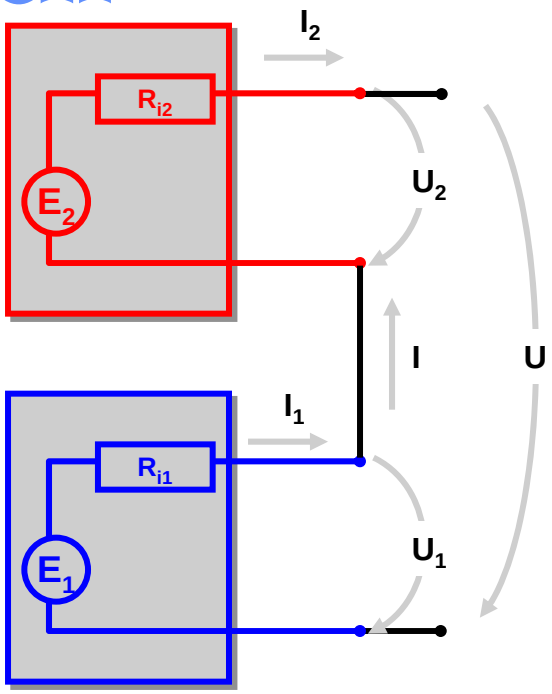


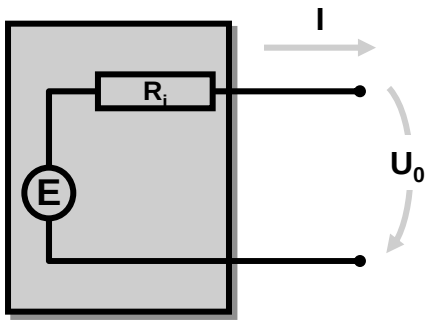
Ein Zweipol wird durch die „ideale“ Urspannung E und den Innenwiderstand R_i beschrieben!

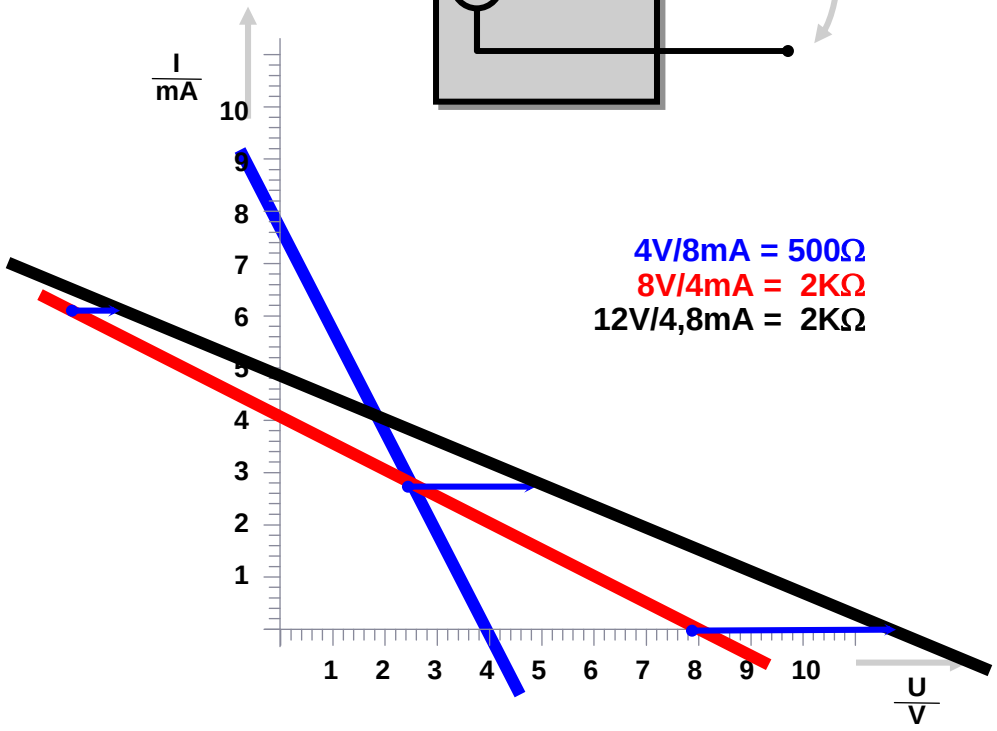




Reihenschaltung von Zweipolen







Berechnung

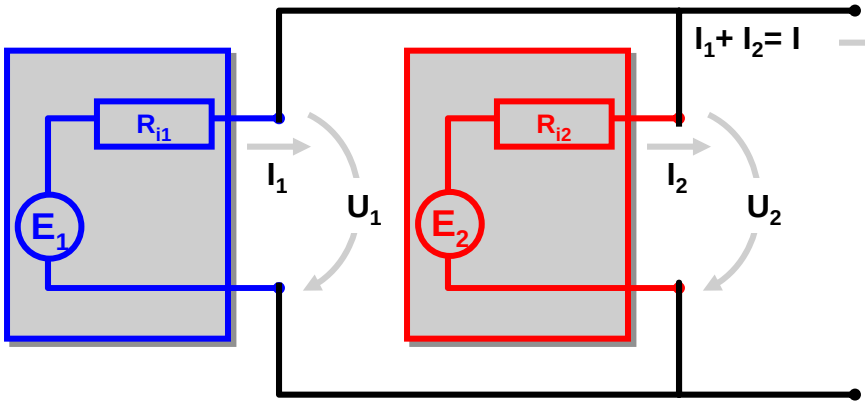
$$I = I_1 = I_2$$

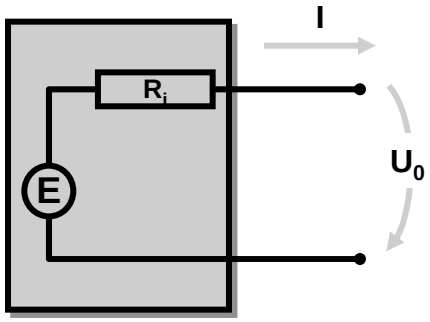
$$U = U_1 + U_2$$

$$R_i = R_{i1} + R_{i2}$$

Man addiert die Spannungen bei gleichem Strom !

Parallelschaltung von Zweipolen





Berechnung

$$I = I_1 + I_2$$

$$U = U_1 = U_2$$

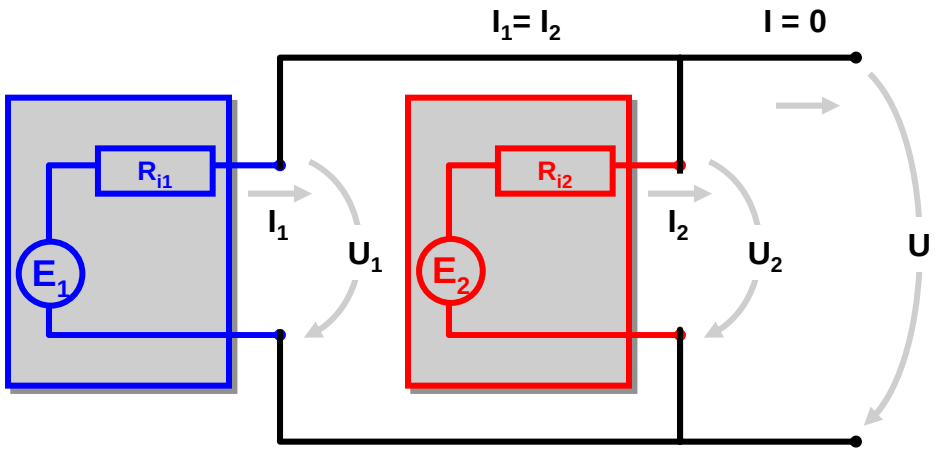
$$R = R_{i1} \parallel R_{i2}$$

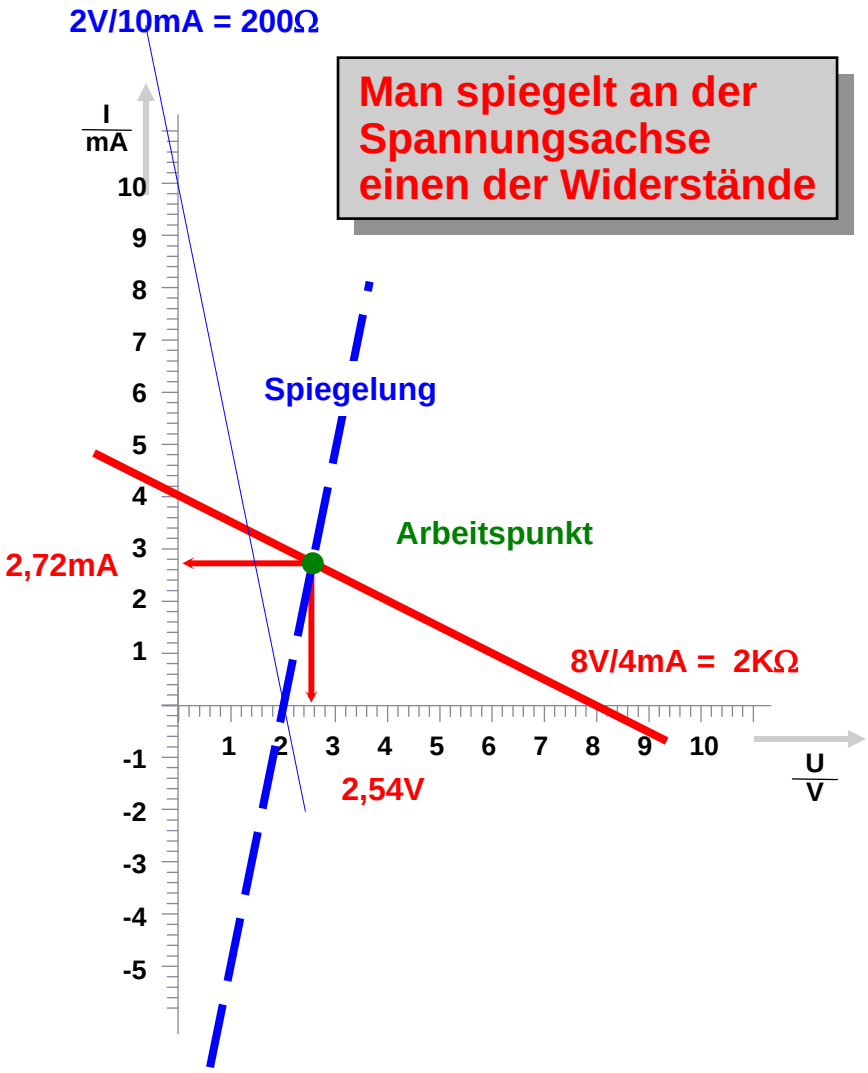
$$= \frac{R_{i1} * R_{i2}}{R_{i1} + R_{i2}}$$

$$E = E_2 + \frac{(E_1 - E_2) * R_{i2}}{R_{i1} + R_{i2}}$$

Man addiert die Ströme bei gleicher Spannung !

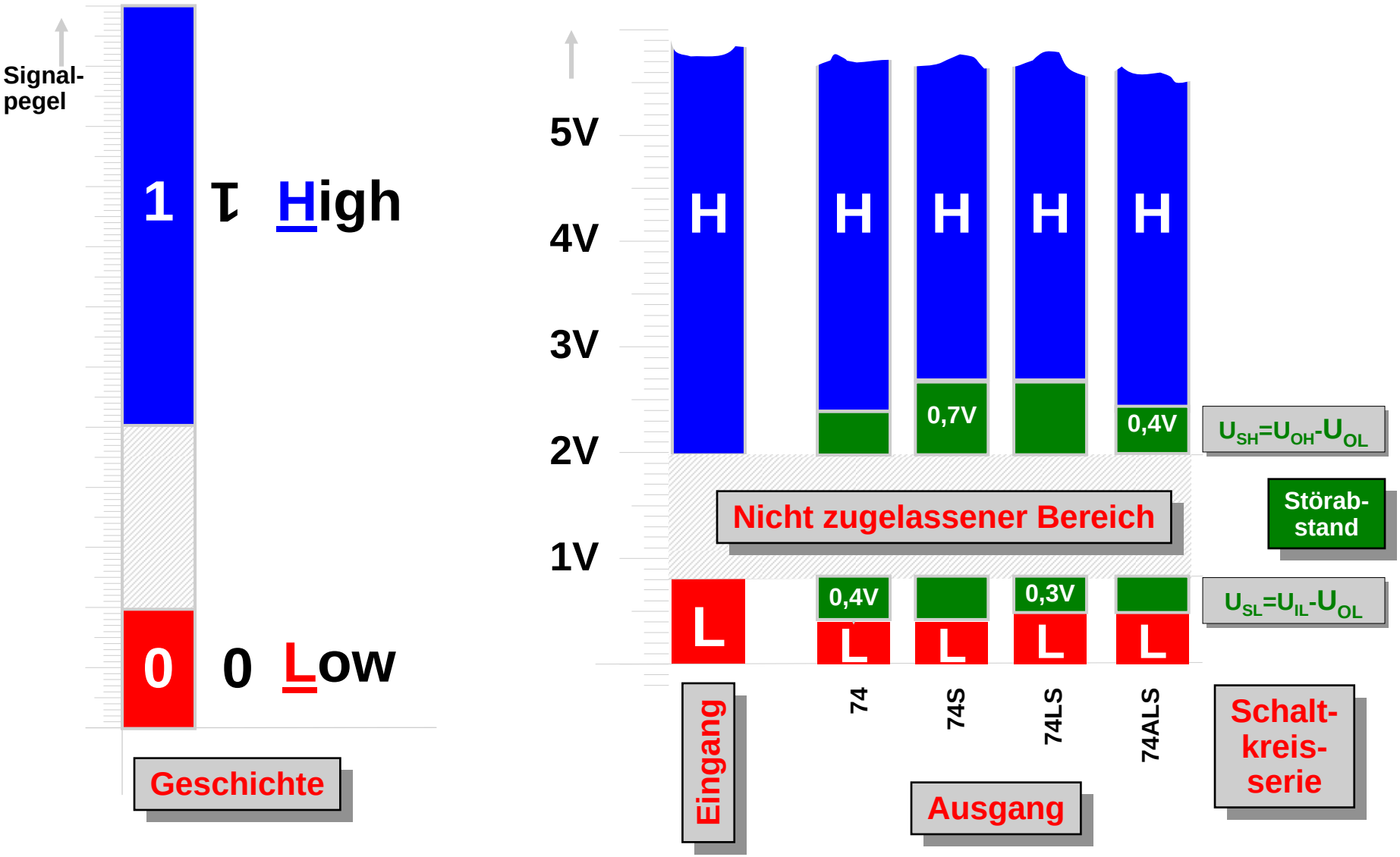
Sonderfall der Parallelschaltung I = 0





Man spiegelt an der Spannungsachse einen der Widerstände

Toleranzschemen / Störabstände

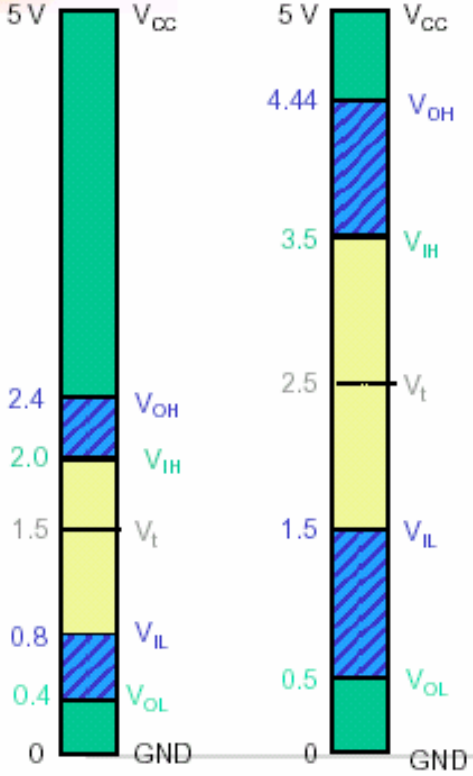


Logikpegel nach

IC Basics

Comparison of Switching Standards

TEXAS INSTRUMENTS



5-V TTL
Standard TTL: ABT, AHCT, HCT, ACT, Bipolar

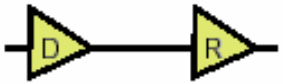
5-V CMOS
Rail-to-Rail 5 V HC, AHC, AC

3.3-V LVTTL
LVT, LVC, ALVC, LV, ALVT

2.5-V CMOS
AUC, AVC, ALVC, LVC, ALVT

1.8-V CMOS
AUC, AVC, ALVC, LVC

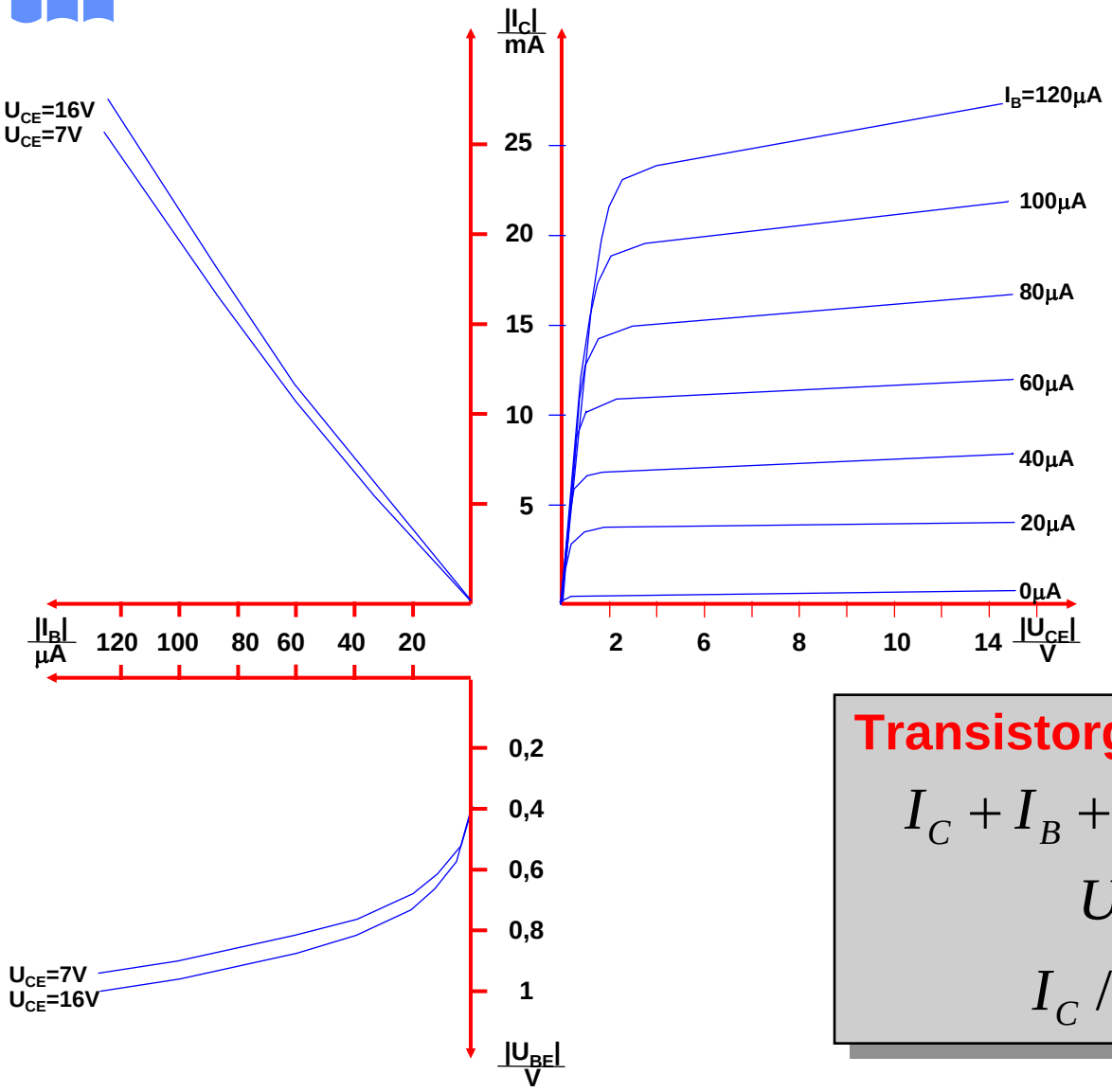
Is V_{OH} higher than V_{IH}?
Is V_{OL} less than V_{IL}?

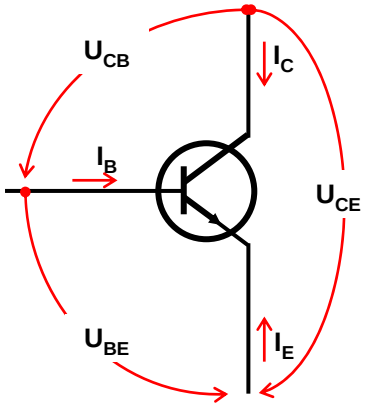


Dvr \ Rvr	5TTL	5CMOS	3LVTTL	25CMOS	18CMOS
5TTL	Yes	No	Yes *	Yes*	Yes*
5CMOS	Yes	Yes	Yes*	Yes*	Yes*
3LVTTL	Yes	No	Yes	Yes*	Yes*
25CMOS	Yes	No	Yes	Yes	Yes*
18CMOS	No	No	No	No	Yes

* Requires V_{IH} Tolerance

Kennlinienfelder eines npn - Transistors





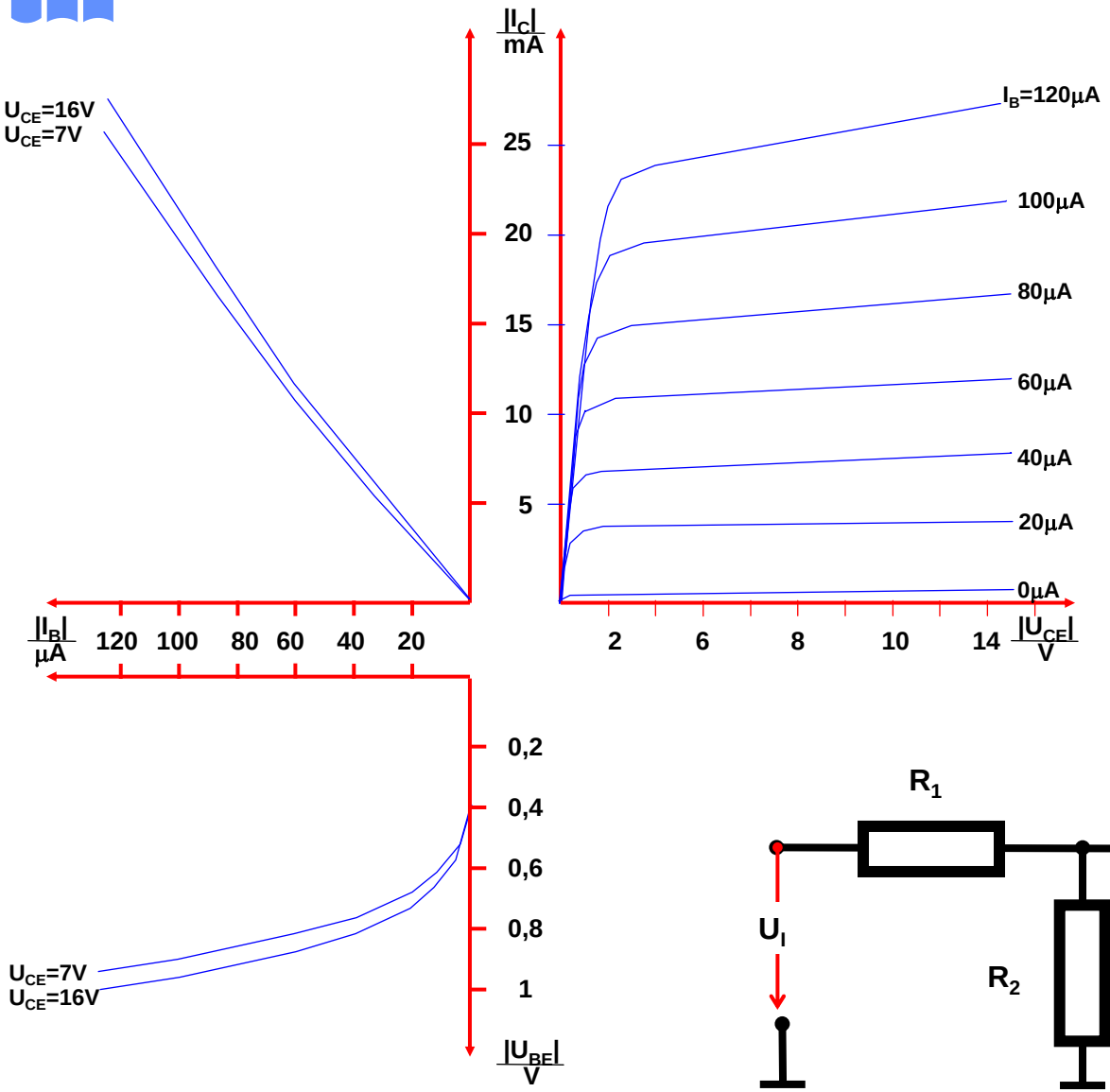
Transistorgleichungen

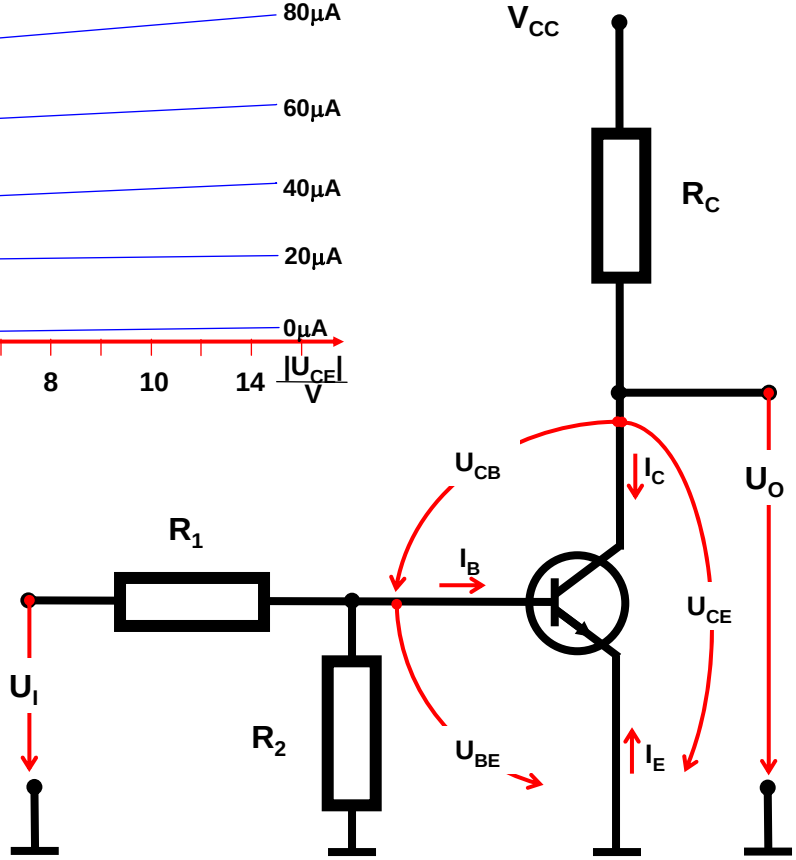
$$I_C + I_B + I_E = 0$$

$$U_{CE} = U_{CB} + U_{BE}$$

$$I_C / I_B = B_N$$

Der Transistor als Schalter

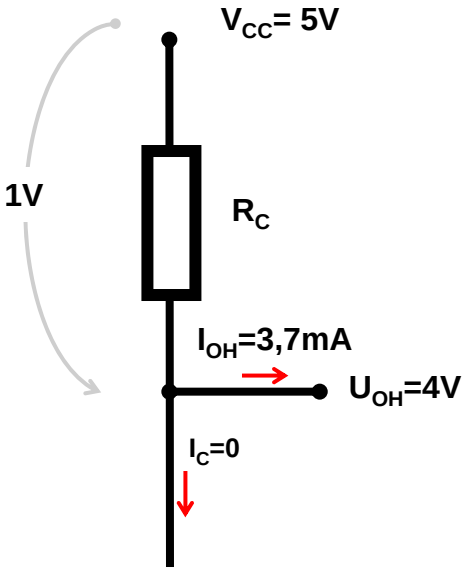




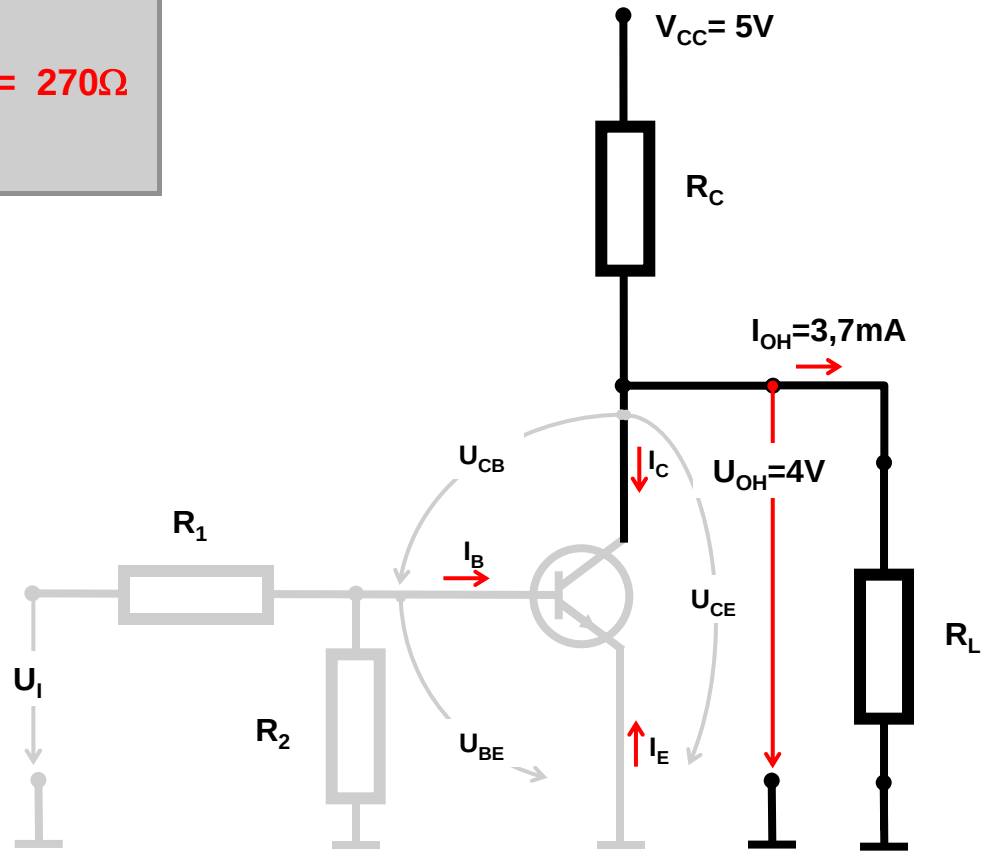
Dimensionierung des R_c

Berechnung R_C

$V_{CC} = 5V$
$U_{OH} = 4\ V$
$I_{OH} = 3{,}7mA$



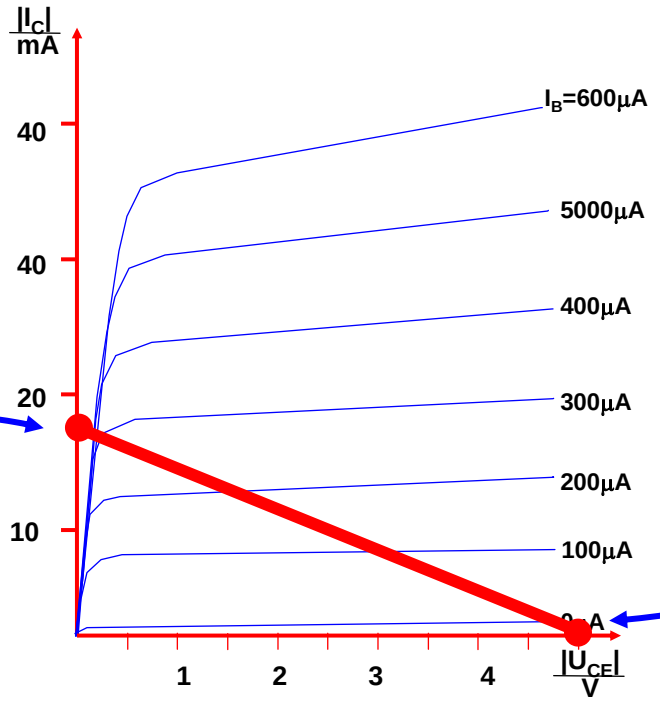
$$R_C = \frac{1V}{3.7mA} = 270\Omega$$



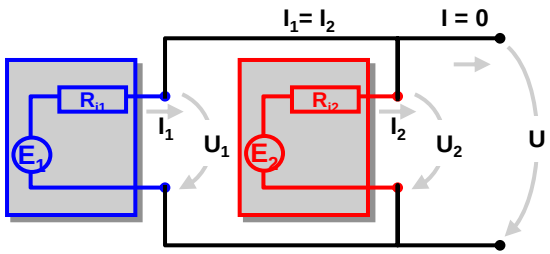
Einzeichnen des Arbeitspunktes

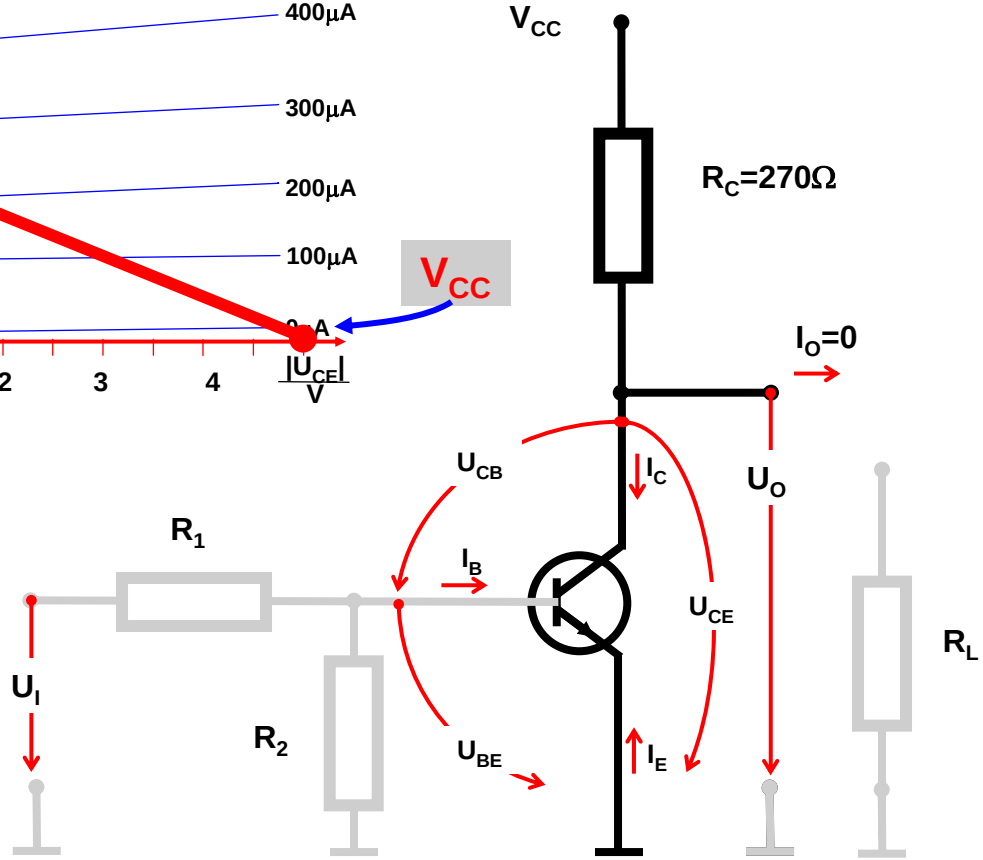
2

Einzeichnen der Arbeitsgeraden



$$i_C = \frac{5V}{270\Omega} = 18{,}5mA$$

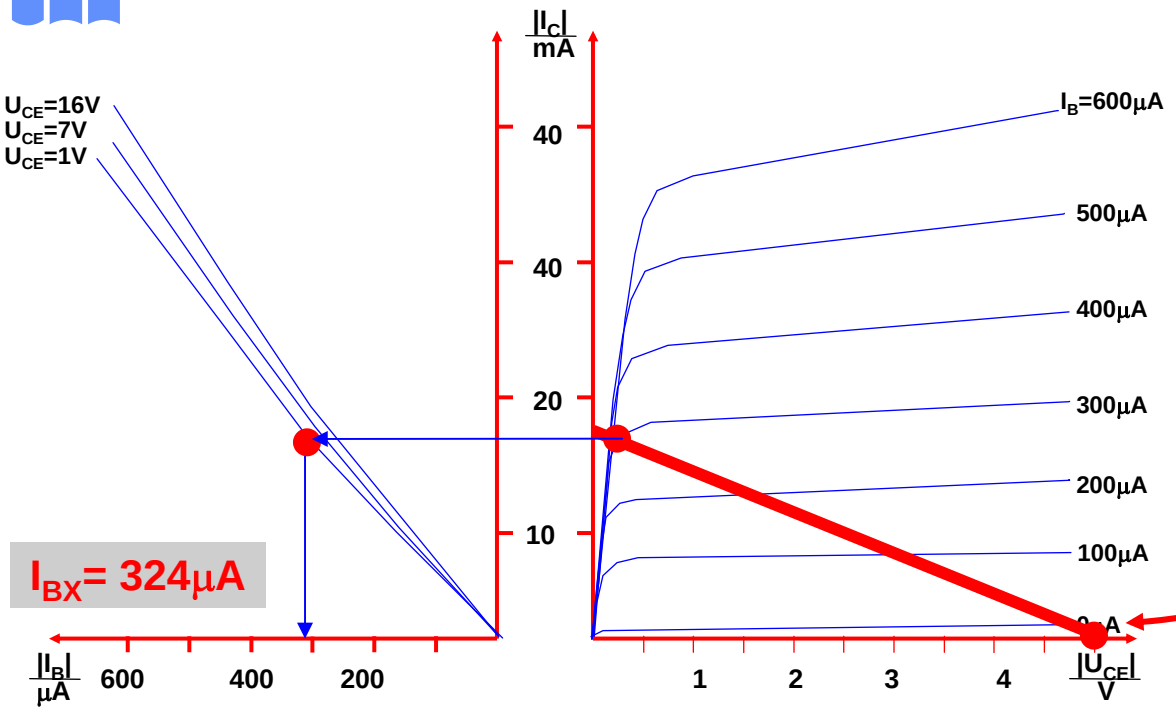




Ermittlung des Basisstromes

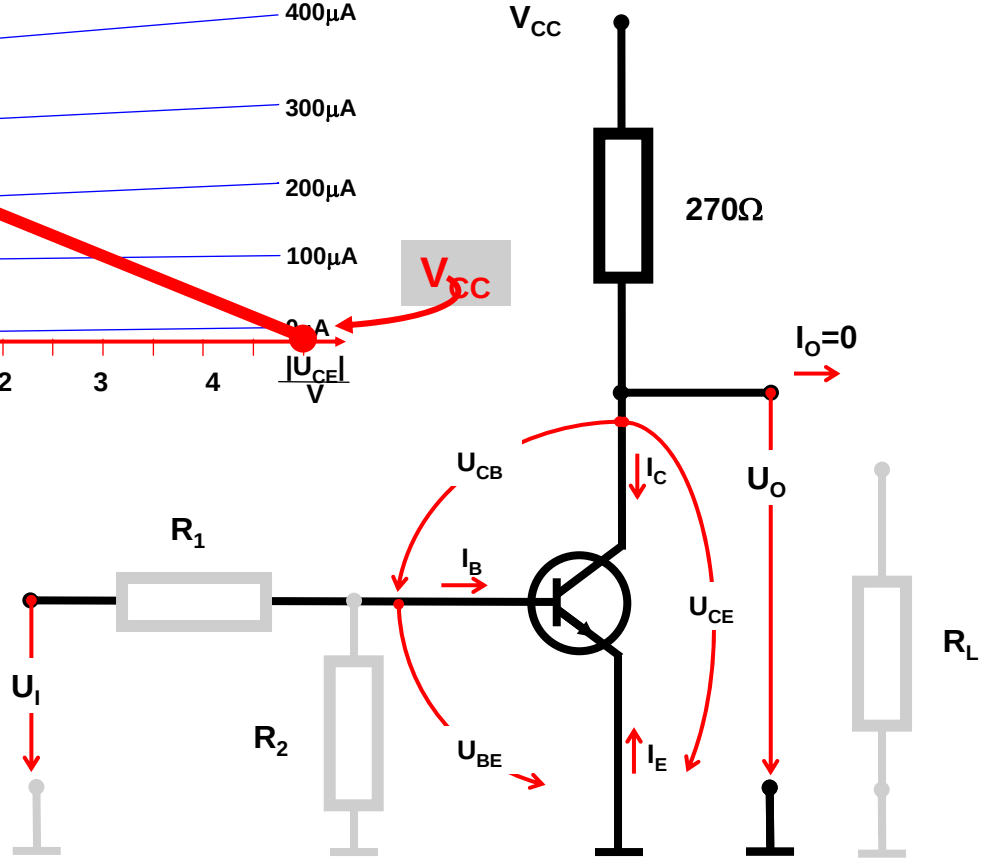
3

Ermittlung des Basisstroms



I_{BX}= 324µA

V_{CC}



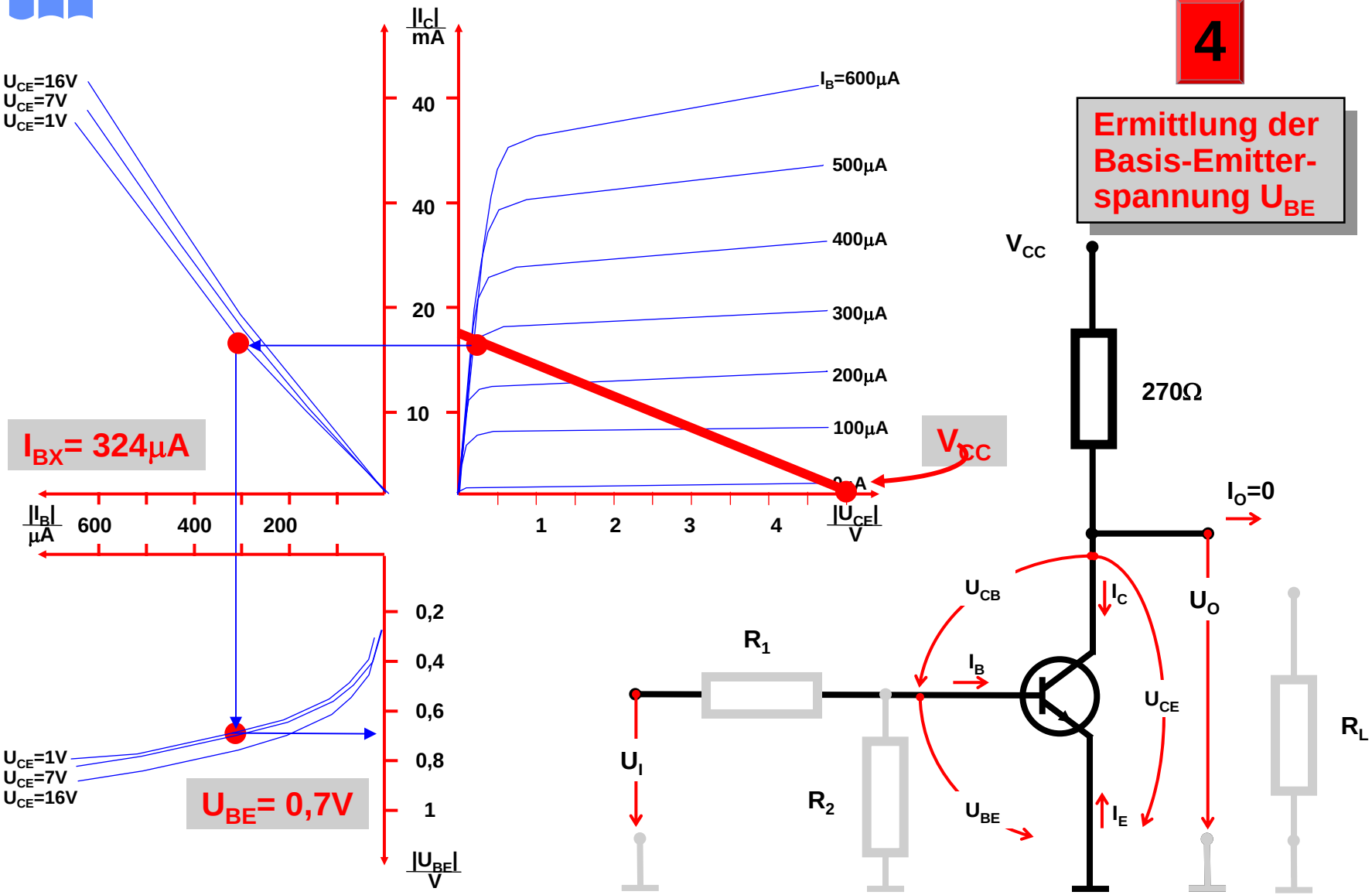
$$I_{BX} = \frac{I_{Cx}}{B_N}$$

B_N = Großsignalsttromverstärkung

Ermittlung der Basisspannung

4

Ermittlung der Basis-Emitter-spannung U_{BE}



Dimensionierungsgleichungen

Zur Verbesserung des Störabstandes und der dynamischen Eigenschaften werden die Transistoren „über-und untersteuert“ !

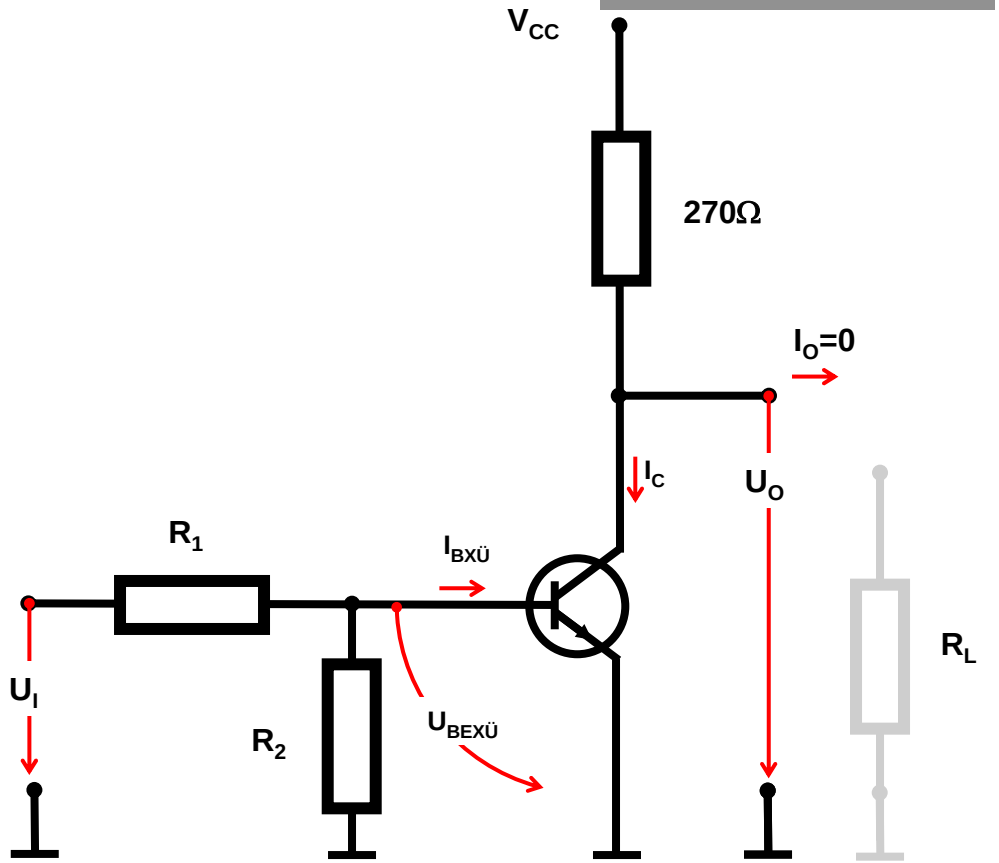
m --> Übersteuerungsfaktor
n --> Stromteilfaktor

$$I_{BxÜ} = m * I_{Bx}$$

$$R_1 = \frac{U_{IH} - U_{BEX}}{(n+1) * I_{BXÜ}}$$

$$R_2 = \frac{U_{BEX}}{n * I_{BXÜ}}$$

Dimensionierung des Basisspannungsteilers



Berechnung des Basisspannungsteilers

U_{IH}	--> min.“H“ am Eingang	= 3V
m	--> Übersteuerungsfaktor	= 5
n	--> Stromteilfaktor	= 0,5

$I_{BXÜ} = 5 * 324\mu A = 1{,}62mA$

$$R_1 = \frac{U_{IH} - U_{BEXÜ}}{(n+1) * I_{BXÜ}} = \frac{3V - 0{,}7V}{(0{,}5+1) * 1{,}62mA} = 946\ \Omega$$

$$R_2 = \frac{U_{BEXÜ}}{n * I_{BXÜ}} = \frac{0{,}7V}{0{,}5 * 1{,}62mA} = 820\ \Omega$$

Dimensionierung des Basis-spannungsteilers