Elektronik I

BJT – 1. ders tekrarı

Orijinal not: BJT-ders1-tekrar.pdf

UYARI Bu belge, el yazısı ders notlarından Claude (Anthropic) yardımıyla dijitale aktarılmıştır. Yardımcı kaynak olarak hazırlanmıştır; hata veya eksik içerebilir. Lütfen orijinal notları ve ders kaynaklarını esas alın.

NOTICE *This document was transcribed from handwritten lecture notes with the help of Claude (Anthropic). It is meant as a supplementary resource and may contain errors or omissions. Always check against the original notes and official course material.*

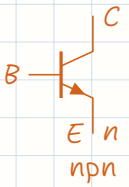
npn Junction

$$I_S = \frac{A_E q D_n n_{p0}}{W}$$

orj. s. 1

$$i_C = I_S \, e^{V_{BE}/V_T}$$

I_S ↓ saturation current

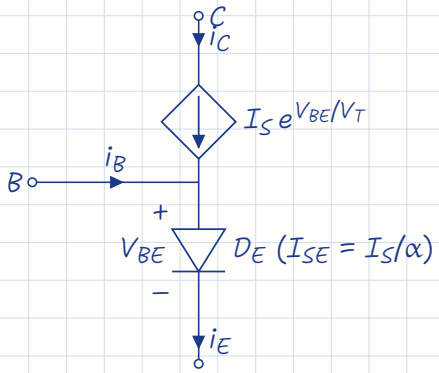


$$i_B = \frac{i_C}{\beta} \qquad \beta \rightarrow \text{(influenced by width, and doping)}$$

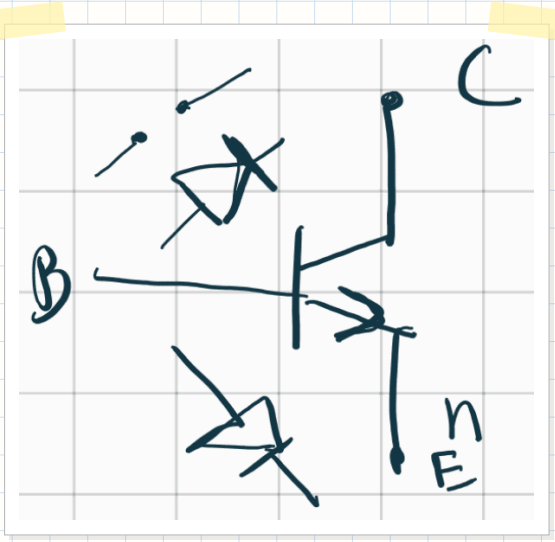
$$i_E = \frac{\beta + 1}{\beta} i_C = \frac{1}{\alpha} i_C = (\beta + 1) i_B$$

$$i_C = \alpha i_E$$

orj. s. 2



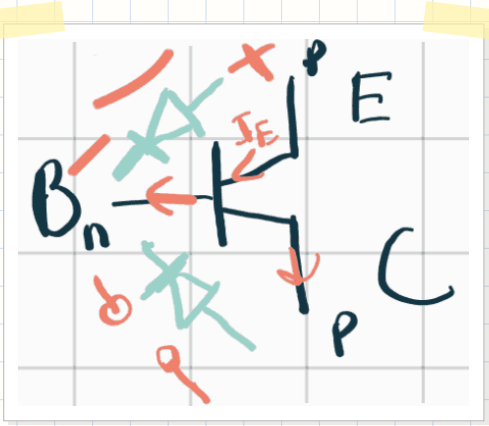
In npn



orijinal çizim, s. 2

Active:	$V_{BE} \geq 0{,}7$,	$V_{BC} \leq 0{,}4$ V
Cut off:	$V_{BE} < 0{,}7$,	$V_{BC} \leq 0{,}4$ V
Saturation:	$V_{BE} \geq 0{,}7$,	$V_{BC} > 0{,}4$

for pnp



orijinal çizim, s. 2

Active:	$V_{EB} \geq 0{,}7$ V,	$V_{CB} \leq 0{,}4$ V
Cut off:	$V_{EB} < 0{,}7$ V,	$V_{CB} \leq 0{,}4$ V
Saturation:	$V_{EB} < 0{,}7$ V [1],	$V_{CB} > 0{,}4$ V //

orj. s. 3

$2 < 4$ $\quad V_C - V_B \leq 0{,}4$ V

$-2 > -4$ $\quad V_B - V_C \geq -0{,}4$

[1] Claude notu: muhtemelen doyumda da $V_{EB} \geq 0{,}7$ V olmalı (npn'deki $V_{BE} \geq 0{,}7$ ile tutarlı).

Operation in Saturation Mode

$$i_C = I_S e^{V_{BE}/V_T} - \underbrace{I_{SC} e^{V_{BC}/V_T}}_{V_{BC}>0,4 \text{ için önem taşır}}$$

base current in sat region:

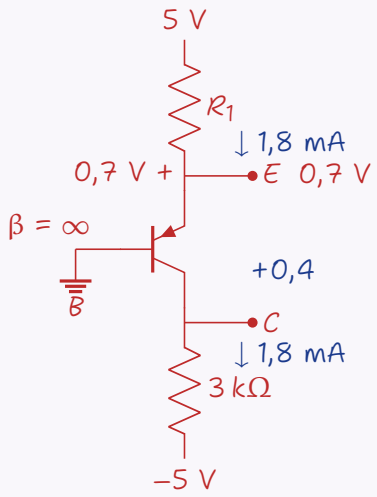
$$i_B = \frac{I_S}{\beta} e^{V_{BE}/V_T} + I_{SC} e^{V_{BC}/V_T}$$

$$\text{forced } \beta = \left.\frac{i_C}{i_B}\right|_{sat} \leq \beta$$

$V_{CB} < 0,4$ olmalı

Örnek

Determine the value of R_1 such that Q_1 operate in active mode

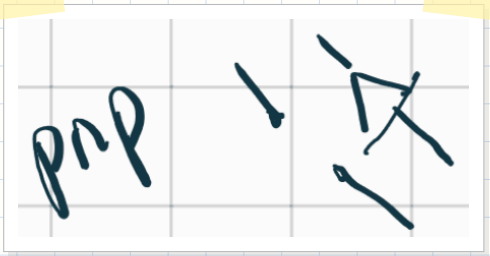


$$i_E = \frac{5 - 0,7}{R_1} = \frac{4,7}{R_1}$$ [2]

$$i_E = \frac{\beta}{\beta + 1} i_C = i_C \quad (\beta = \infty)$$

$$V_{CB} = 0,4 \text{ V}$$

$$i_C = \frac{+0,4 + 5}{3k} = \frac{5,4}{3k} = 1,8 \text{ mA}$$



orijinal çizim, s. 3

orj. s. 4

$$R_1 \geq \frac{4,7}{1,8 \text{ mA}} \geq 2,3 \text{ k}\Omega$$ [3]

çünkü

$V_{CB} < 0,4$
eğer akım artarsa
V_{CB} artar
yani direnç azalırsa

Yani direnç artarsa akım de azalır ve öylece çözmüş oluruz. //

[2] Claude notu: muhtemelen $5 - 0,7 = 4,3$ olmalı, yani $i_E = 4,3/R_1$.

[3] Claude notu: $4,7/1,8 \approx 2,6$; 2,3–2,4 kΩ sonucu $4,3/1,8$ ile tutarlı (bkz. önceki sayfadaki not).