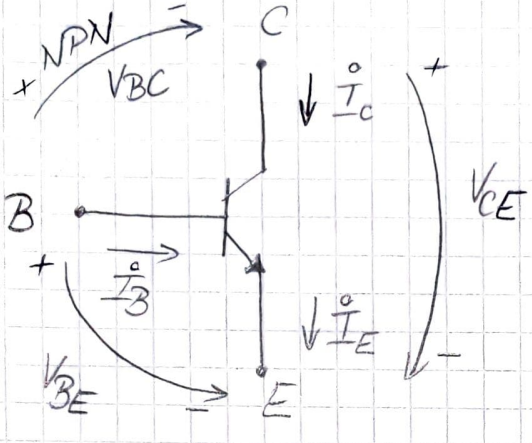
CD - CURS 4

$\underline{I}_C = \alpha \cdot \underline{I}_E + \underline{I}_{C0}$

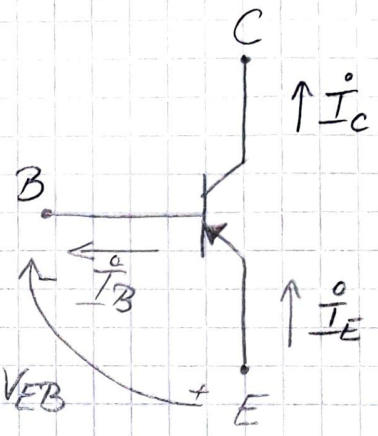
Bipolar

Param. tr. bipolar — statici / dinamici $\quad \underline{I}_E = \underline{I}_B + \underline{I}_C$

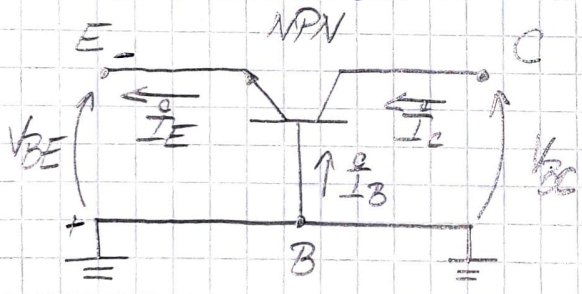
NPN

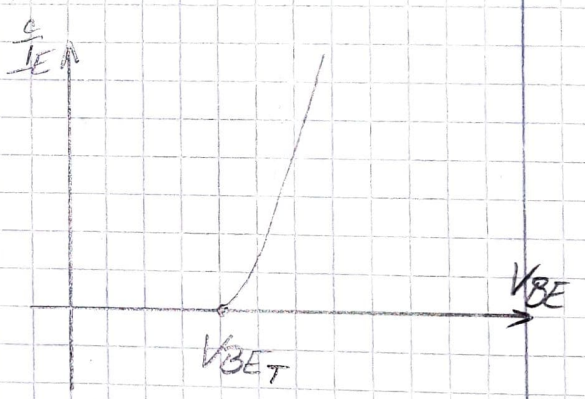


PNP



Conexiune BC

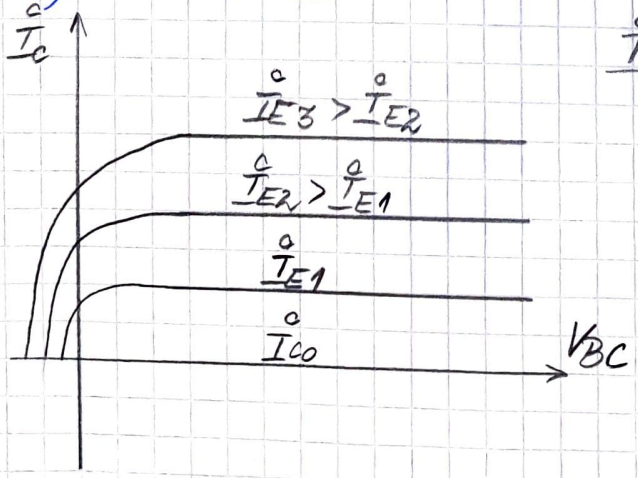




↳ Caracteristica de ieșire în conexiune BC

Intrare $\underline{I}_E, V_{BE}$

Ieșire $\underline{I}_C, V_{BC}$

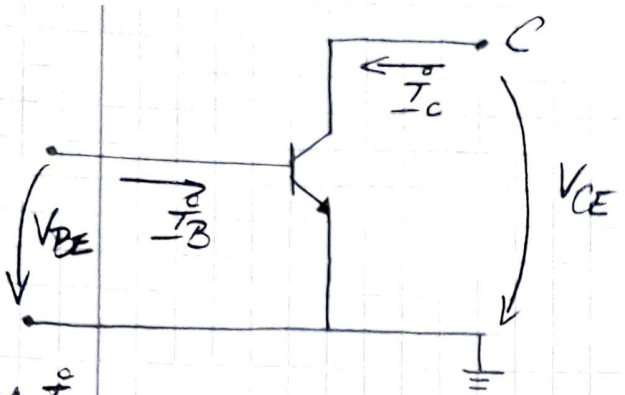


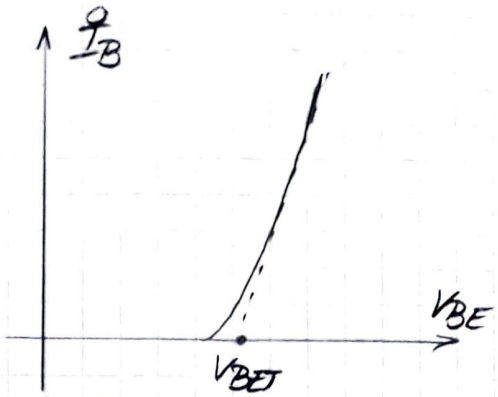
$\underline{I}_C = \alpha \cdot \underline{I}_E + \underline{I}_{CE}$

$\alpha = \frac{\underline{I}_C}{\underline{I}_E} < 1$

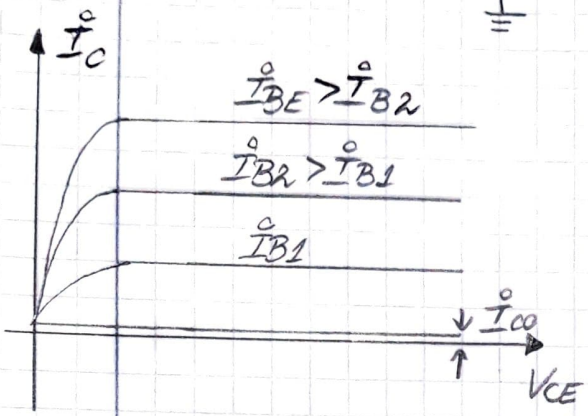
$\alpha = 0,9 \div 0,99$

↳ factor de în c.c.





↳ caracteristica de intrare pt. conexiunea în EC



↳ caracteristica de ieșire a în conex. EC

$\mathring{I}_C$ depinde comandat-consolidat

1) $\mathring{I}_B$ (EC)
2) $\mathring{I}_E$ (BC)
3) V_{BE}

$\mathring{I}_C = \beta \cdot \mathring{I}_B \quad \beta = \frac{\mathring{I}_C}{\mathring{I}_B} \gg 1$ factor de amplificare în c.c. pt. conex. EC

$\mathring{I}_E = \mathring{I}_C + \mathring{I}_B \quad / : \mathring{I}_C \quad \frac{\mathring{I}_E}{\mathring{I}_C} = 1 + \frac{\mathring{I}_B}{\mathring{I}_C} \quad \frac{1}{\alpha} = 1 + \frac{1}{\beta}$

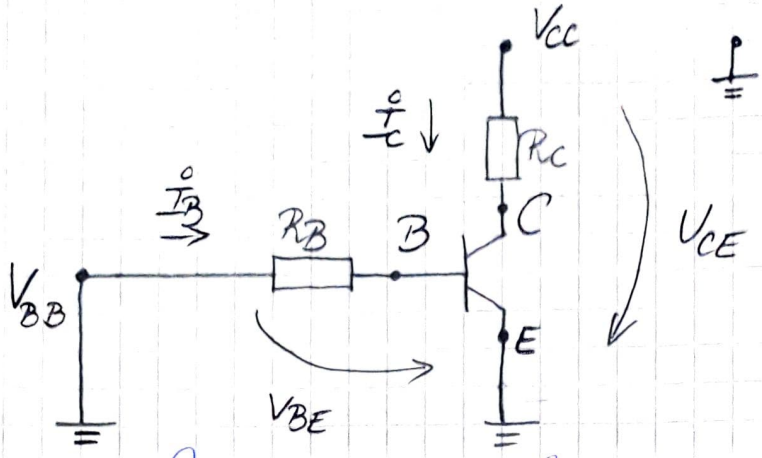
$\beta = \frac{\alpha}{1 - \frac{\alpha}{\beta}} \qquad \alpha = 1 + \beta$

ex: $\alpha = 0{,}98 \quad \beta = \frac{0{,}98}{1 - 0{,}98} \approx 50$

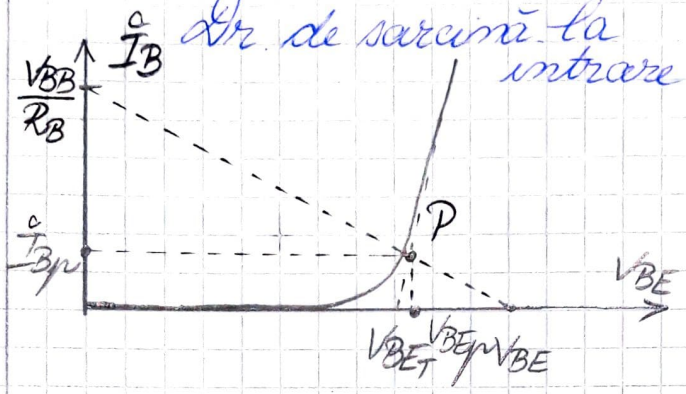
Conexiuni: (BC) (EC)

Indiferent de conexiune tranzistorul e un generator de $\mathring{I}_C$

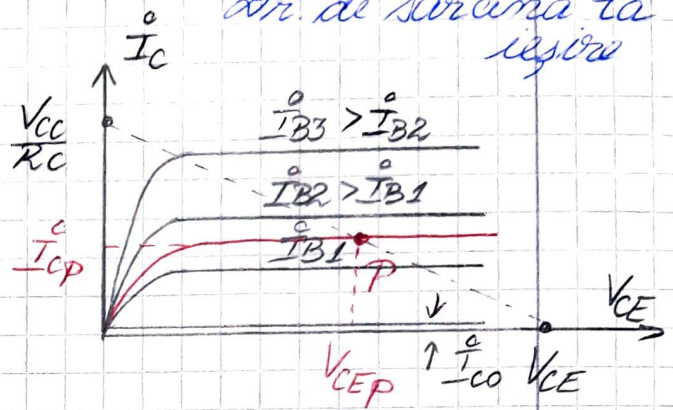
1) $\mathring{I}_B$ (EC) și V_{BE}
2) $\mathring{I}_E$ (BC) și V_{BE}



Dr. de sarcină la intrare



Dr. de sarcină la ieșire



$$V_{BB} = \mathring{I}_B \cdot R_B + V_{BE} \qquad \begin{cases} V_{BE} = 0 \rightarrow \mathring{I}_B = \frac{V_{BB}}{R_B} \\ \mathring{I}_B = 0 \rightarrow V_{BE} = V_{BB} \end{cases}$$

$$V_{CC} = \mathring{I}_C \cdot R_C + V_{CE} \qquad \begin{cases} V_{CE} = 0 \rightarrow \mathring{I}_C = \frac{V_{CC}}{R_C} \\ \mathring{I}_C = 0 \rightarrow V_{CE} = V_{CC} \end{cases}$$

Regimurile de funcționare a tranzistorului bipolar

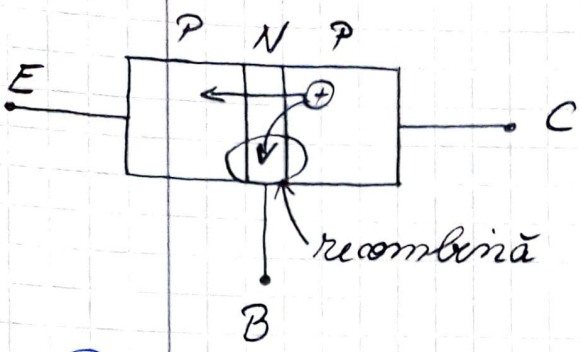
Tranzistorul are două joncțiuni (NPN)

- joncțiunea BE
- joncțiunea BC

$$\mathring{I}_C = \alpha \cdot \mathring{I}_E + \mathring{I}_{CO}$$

	jonc. BE	jonc. BC	
(1)	pol. inv.	pol. inv.	$\mathring{I}_C = \mathring{I}_{CO}$ (a. m. mică variază curentul de colector)
			REGIM - BLOCAT
(2)	pol. directă	pol. inv.	ACTIV
			(BC) $\mathring{I}_C = \alpha \mathring{I}_E + \mathring{I}_{CO}$ → repetor pe emitor
			(EC) $\mathring{I}_C = \beta \mathring{I}_B$ → amplificator
(3)	pol. invers	pol. direct	REGIM - INVERS

$$\mathring{I}_{Ei} = \alpha_i \cdot \mathring{I}_{Ci} + \mathring{I}_{EO}$$



slab dopat cu impurități

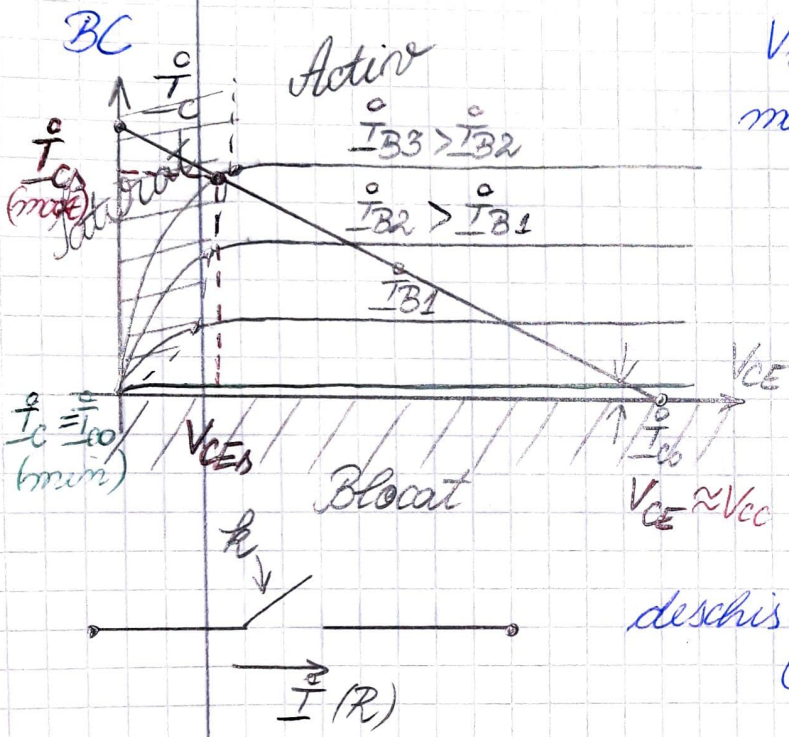
$\alpha_i = 0{,}02 \div 0{,}5$

(+) pol. direct pol. direct REGIM - SATURAT

$\overset{\circ}{I}_C$ - limitat (are valoare maximă)

$V_{BE} \approx ct.$; $V_{CE} \approx ct.$

V_{BE} ↓ max (0,75V) ↳ min (0,1 ÷ 0,2V)



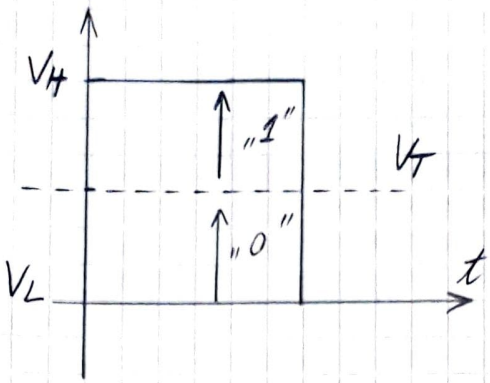
deschis $\begin{cases} \overset{\circ}{I} = 0 \\ R \to \infty \end{cases}$

închis $\begin{cases} \overset{\circ}{I} \to \infty \\ R = 0 \end{cases}$

saturat $\begin{cases} \overset{\circ}{I}_{C\,max} = \overset{\circ}{I}_{C_S}\ (R_{CE} \Rightarrow 0) \\ V_{CE} = V_{CE_S} = 0{,}1 \div 0{,}2\,V \to \text{„0"} \end{cases}$

blocat $\begin{cases} \overset{\circ}{I}_C \Rightarrow 0 = \overset{\circ}{I}_{CO}\ (\text{f. f. mic}) \\ V_{CE\,max} = V_{CC} \to \text{„1"} \end{cases}$

$V_{CE} = V_0$ ↳ ieșire $\begin{cases} V_{CE_S\,min} \approx 0\,V \to \text{„0" logic} \\ V_{CC\,max} \to \text{„1" logic} \end{cases}$



Analiza regimului blocat

① Tranzistor e în conexiune BC

$\overset{\circ}{I}_C = \alpha \cdot \overset{\circ}{I}_E + \overset{\circ}{I}_{CO}$

$\overset{\circ}{I}_E = 0\ mA \rightarrow V_{BE} = 0$

② Tranzistorul e în conexiune EC

$\overset{\circ}{I}_C = \alpha \cdot \overset{\circ}{I}_E + \overset{\circ}{I}_{CO}$

$\overset{\circ}{I}_E = \overset{\circ}{I}_C + \overset{\circ}{I}_B$

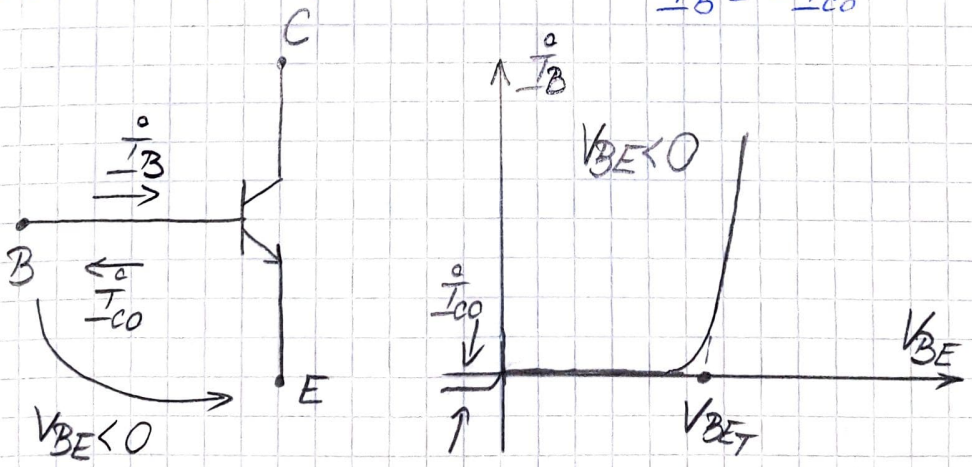
$\overset{\circ}{I}_C = \alpha (\overset{\circ}{I}_C + \overset{\circ}{I}_B) + \overset{\circ}{I}_{CO} \quad \Leftrightarrow \quad \overset{\circ}{I}_C = \frac{\alpha}{1-\alpha} \cdot \overset{\circ}{I}_B + \frac{\overset{\circ}{I}_{CO}}{1-\alpha}$

~~$\overset{\circ}{I}_B = 0$~~

$\overset{\circ}{I}_C = \frac{\overset{\circ}{I}_{CO}}{1-\alpha}$ = f.f. mare față de $\overset{\circ}{I}_{CO}$

Dar $\alpha = 0,9 \div 0,99$

Soluția are forma $\overset{\circ}{I}_B = -\overset{\circ}{I}_{CO}$



(BC) $V_{BE} = „0"$

(EC) $V_{BE} < „0"$ $\quad V_{BE} \leq 0V$

Tranzistoare de comutație $\overset{\circ}{I}_{CO} = nA$

$V_{BE_T} = 0,6 \div 0,65\ V$ (Si)