Laborator nr 3:

Tranzistorul bipolar:

TB / TEC.

- tranzistorul → permite controlul unui curent (I_C, I_E) folosind un curent (I_B) sau o tensiune (V_G)

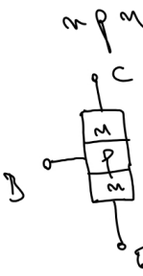
- tranzistorul ≡ cel mai simplu amplificator

tranzistori ↗ TB, BJT ("Bipolar Junction Transistor")
↘ TEC, FET ("Field-Effect Transistor")

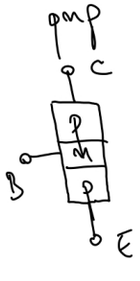
BJT: (TB) - switch controlabil electronic (blocat/saturat)
- sursă de curent controlabilă (activă)

tipuri BJT:

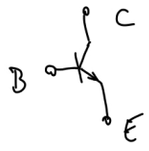
npn

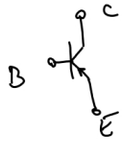


pnp

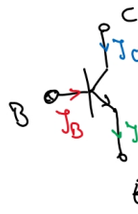


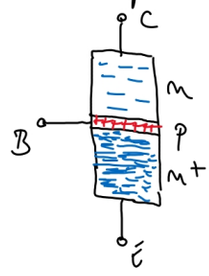
simboluri





Exemplu tranzistor npn





$I_C \cong \beta I_B$

β - factorul de amplificare

$I_E = I_B + I_C \cong I_C$

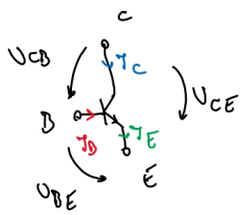
Regimuri de funcționare: (npn)

•) blocat
$U_{BE} < 0.7V$ (joncțiune BE blocată)
$I_B = 0$
$U_{CE} \geq 0$; $I_C = 0$

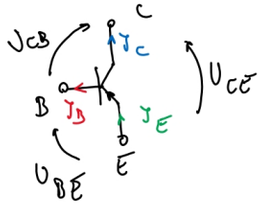
•) activ
$U_{BE} \cong 0.7V$; $I_B \neq 0$
$I_C = \beta I_B$
$U_{CE} > 0$

•) saturație
$U_{BE} \cong 0.7V$; $I_B \neq 0$
$I_C < I_B \beta$
$U_{CE} \cong 0 - 0.2V$

npn

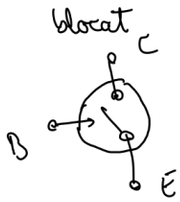


pnp

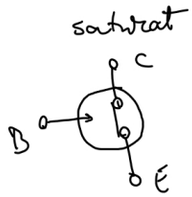


Modelarea BJT:

blocat



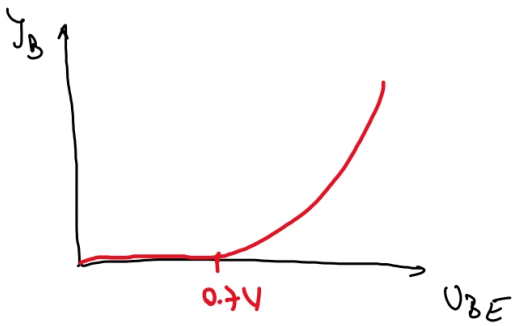
saturat



activ

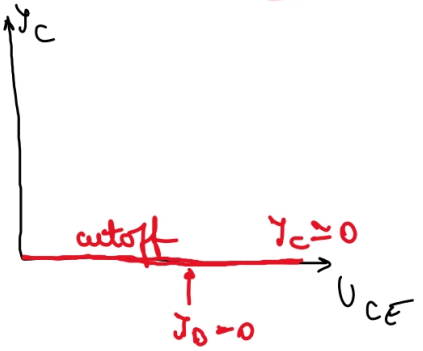
Caracteristica joncțiunii BE:

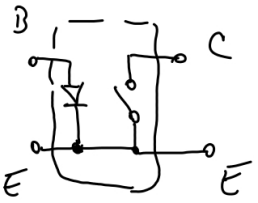
BE → diodă (joncțiune pn)



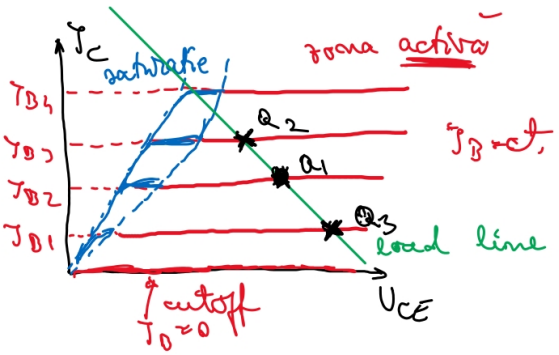
Caracteristicile colectorului:

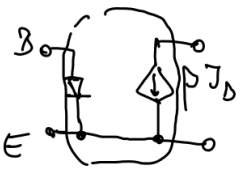
mod blocat $I_B = 0$



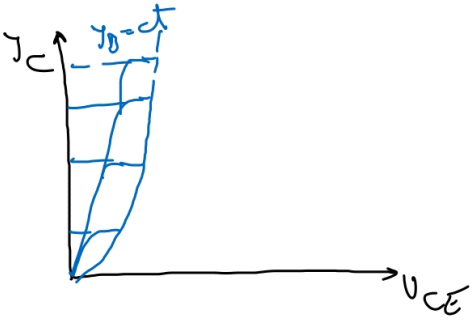


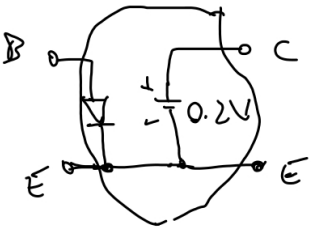
mod activ





zona de saturație





Matrices híbridas:

$$\begin{pmatrix} V_1 \\ I_2 \end{pmatrix} = \begin{pmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{pmatrix} \begin{pmatrix} I_1 \\ V_2 \end{pmatrix}$$

$$V_1 = h_{11} I_1 + h_{12} V_2$$
$$I_2 = h_{21} I_1 + h_{22} I_2$$

Definición:

$$h_{11} = \left.\frac{V_1}{I_1}\right|_{V_2=0} = Z_{in}\ (\Omega) = h_{ie}$$

$$h_{12} = \left.\frac{V_1}{V_2}\right|_{I_1=0} \text{ - adim.} = h_{re}$$

$$h_{21} = \left.\frac{I_2}{I_1}\right|_{V_2=0} = \beta\ (\text{adim}) = h_{fe}$$

$$h_{22} = \left.\frac{I_2}{V_2}\right|_{I_1=0} = Y_{out} = \frac{1}{Z_{out}} = \Omega^{-1}\ (S) = h_{oe}$$

V_{CE} (V)	V_{BE} (V)	I_B (μA)	I_C (mA)
5	0	0	0
5	0.05	0	0
⋮	⋮	⋮	⋮
5.005	0.571	0.488	0.065
⋮	⋮	⋮	⋮
4.998	0.630	3.898	0.662