Laboratorul 3:

Studiul porților logice cu tranzistori

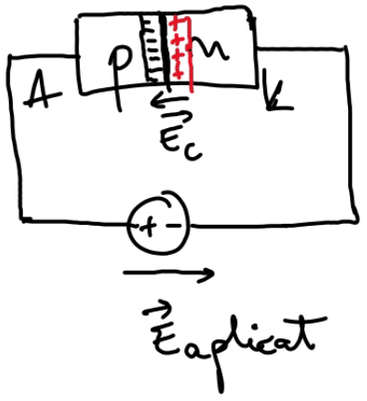
1. Porți logice cu TB (BJT)
2. Porți logice de tip CMOS
   Complementary Metal-Oxide-Semiconductor

Joncțiunea p-n (diodă).

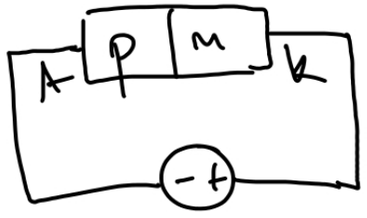
- semiconductori ($\Delta E_g \leq 3$ eV)

sc tip p - dopat cu impurități acceptoare

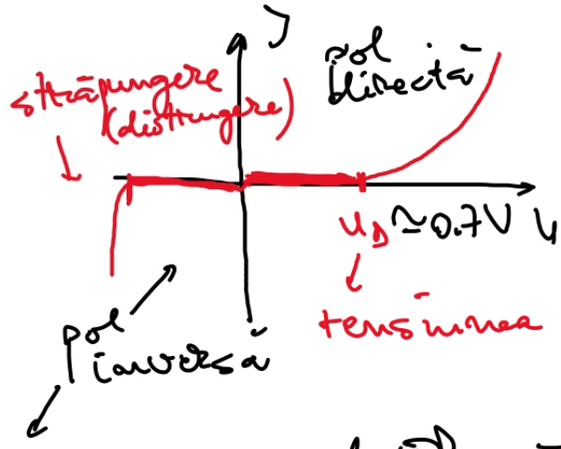
tip n - imp. donoare



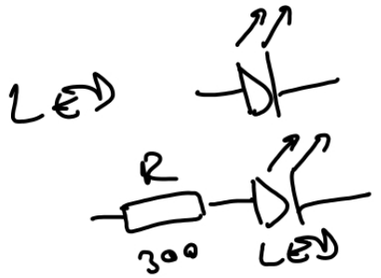
pol. directă



pol inversă

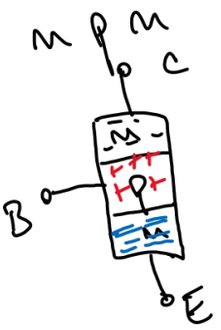


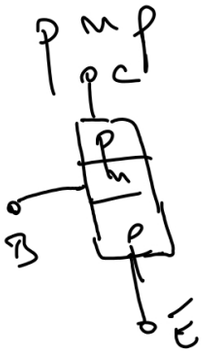
tensiunea de deschidere

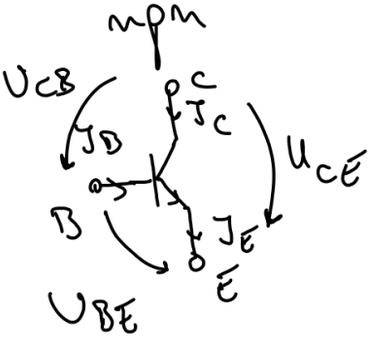


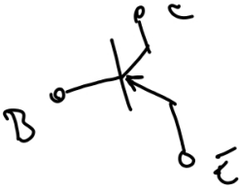
Tranzistorul bipolar:

- componentă activă
- dispozitiv comandat în curent









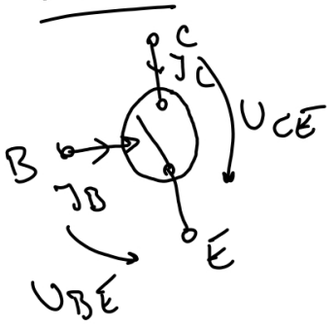
Tranzistorul
- comutator electronic (blocat/saturat)
- amplificator

BJT → $I_C \simeq \beta \cdot I_B$ (mA) (μA)

β - fact. de amp.
10 - 1000.

Regimuri de funcționare:

blocat



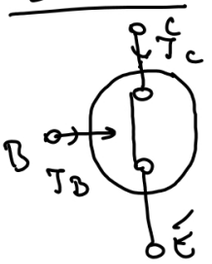
$I_B \simeq 0$

$U_{BE} < 0.7V$

$I_C = 0$

$U_{CE} \simeq V_{cc}$ (t. de alim)

saturat



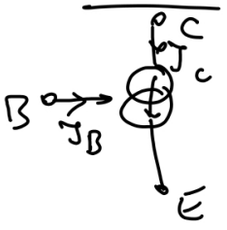
I_B - mare

$U_{BE} \simeq 0.7V$

$I_C < \beta \cdot I_B$ = max

$U_{CE} \simeq 0 - 0.2V$

activă

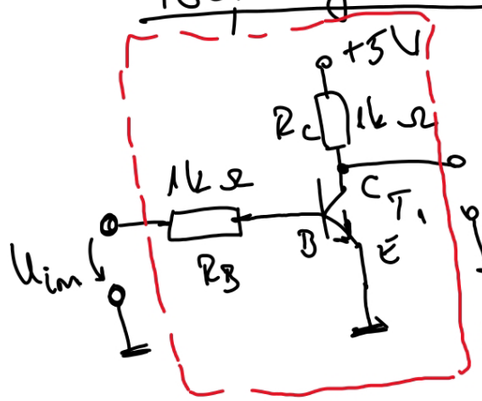


$U_{CE} > 0$

$I_C \simeq \beta \cdot I_B$

$U_{BE} \simeq 0.7V$

Porți logice cu TB:



$U_{in} = 0V \Rightarrow U_{out} = 5V$

↳ T_1 - blocat

$U_{in} = 5V \Rightarrow U_{out} = 0V$

↳ T_1 - saturat

U_{in}	U_{out}	IN	OUT
0V	5V	0	1
5V	0V	1	0

⇒ INVERSIE „NOT"

$Y = \overline{IN}$

$OUT = \overline{IN}$

Nivele logice TTL

IN: 0 (LOW): 0 – 0.8V

1 (HIGH): 2 – 5V

OUT: 0 (LOW): 0 – 0.5 V

1 (HIGH): 2.7 – 5V

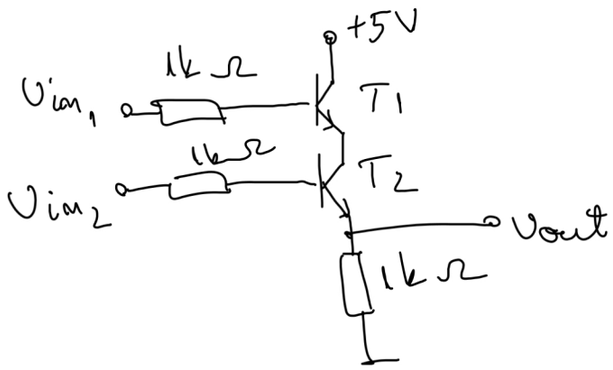
Tensiunea de alim. +5V

U_{IN} (V)	U_{out} (V)
0	5
5	0.007

IN	OUT
0	1
1	0

LED IN	LED OUT
ON	~~OFF~~
~~OFF~~	ON

Poartă AND (ȘI) cu TB



$V_{in_1} = 0 \Rightarrow T_1$ blocat
$V_{in_2} = 0 \Rightarrow T_2$ blocat
$\Rightarrow V_{out} = 0$

$V_{in_1} = 5V \Rightarrow T_1$ sat
$V_{in_2} = 0V \Rightarrow T_2$ blocat
$\Rightarrow V_{out} = 0$

$V_{in_1} = 0V \Rightarrow T_1$ blocat
$V_{in_2} = 5V \Rightarrow T_2$ sat
$\Rightarrow V_{out} = 0$

$V_{in_1} = 5V \Rightarrow T_1$ sat
$V_{in_2} = 5V \Rightarrow T_2$ sat
$\Rightarrow V_{out} = 5V$

Porți logice de tip CMOS:

Tranzistori cu efect de câmp de tip MOS. (TECMOS, MOSFET)

enhancement-type

TECMOS cu canal indus (normal - OFF)

dispozitive controlate în tensiune

Nivele logice IN:

0 (LOW) : 0 - 1.5V

1 (HIGH) : 3.5 - 5V

OUT

0 : 0 - 0.05V

1 : 4.95 - 5V