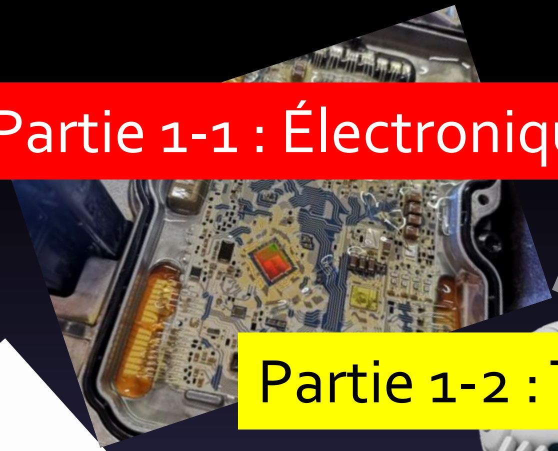
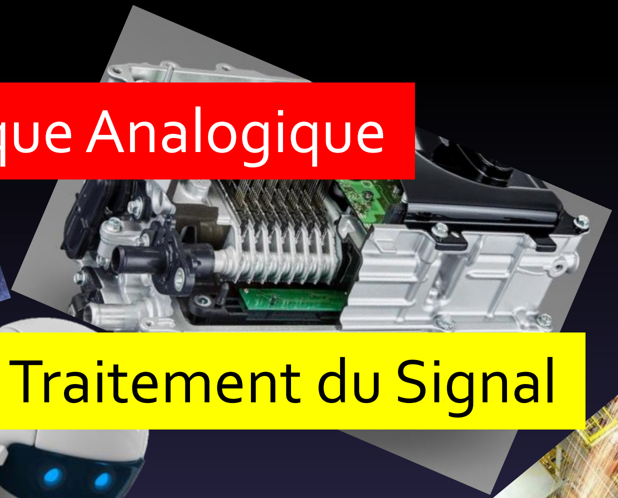
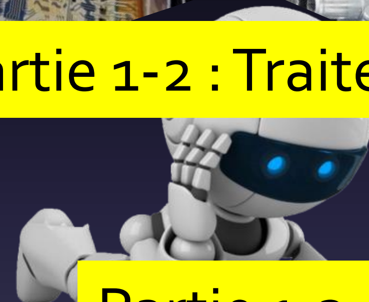
Partie 1 : Aspect électronique et traitement du signal

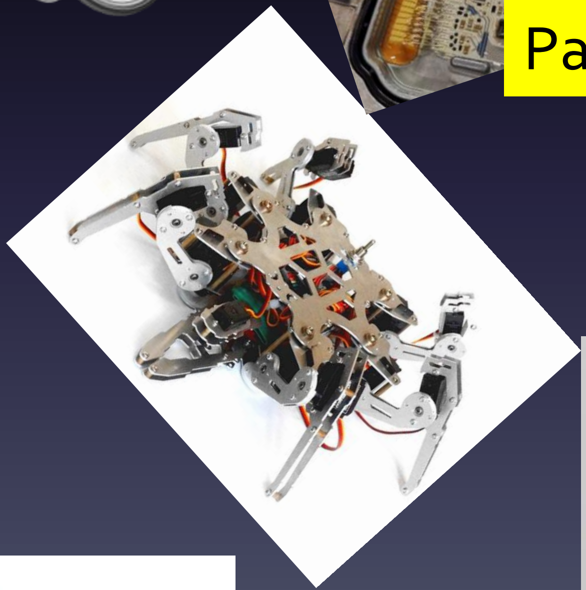




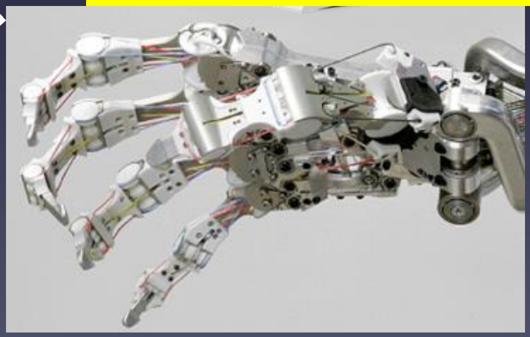
Partie 1-1 : Électronique Analogique



Partie 1-2 : Traitement du Signal



Partie 1-3 :Électronique Numérique



UNIVERSITÉ DE LORRAINE

Etienne BERNARD - 2020

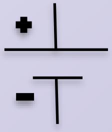
POLYTECH NANCY

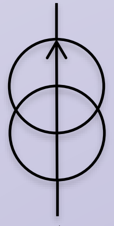
Partie 1 – 1 : L'Électronique analogique

<u>Rappels</u> :

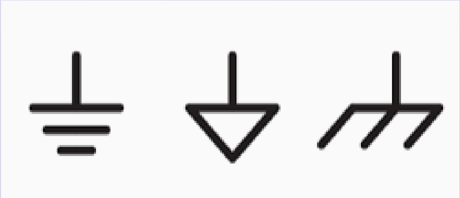
1. - Courant électrique $$i = \frac{dq}{dt}$$

2. - Sources électriques

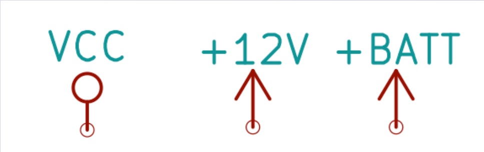




3. - Référence d'une source = masse (GND)

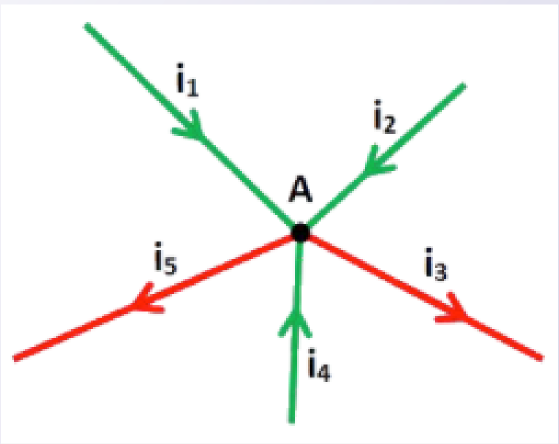


4. - Représentation symbolique d'une tension



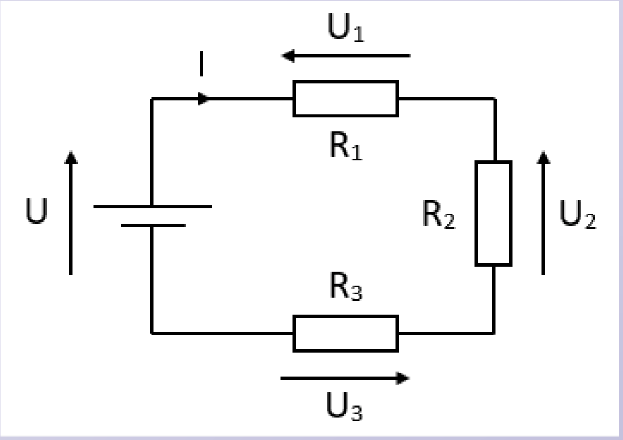
Lois de Kirchhoff

Lois des nœuds



$$\sum_{k}^{n} I_k = 0$$

- Lois des mailles



$$\sum_{k}^{n} V_k = 0$$

Autres méthodes d'analyse d'un circuit :

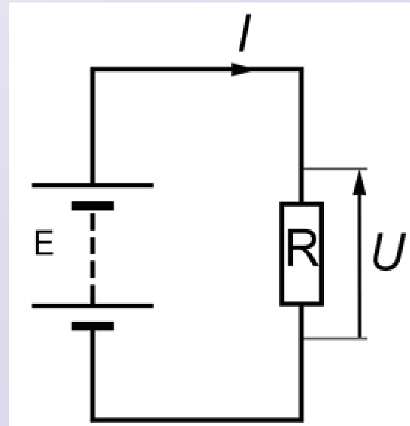
- Théorème de Thévenin
- Théorème de Norton

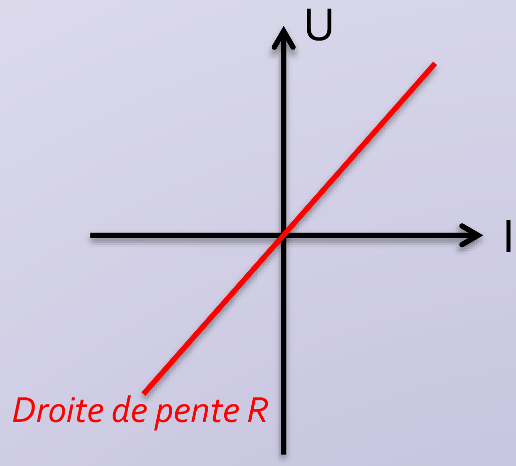
Les composants « classiques »

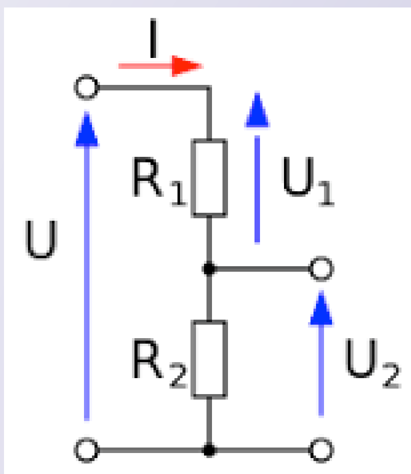
La résistance :

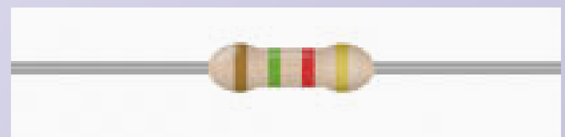
U = R . I

R en ohm (Ω)





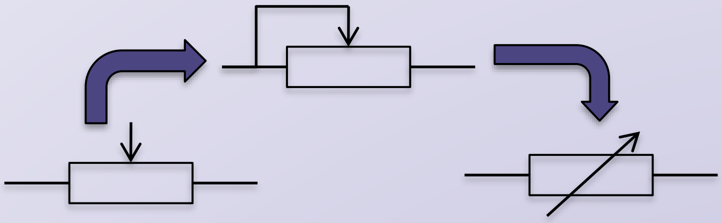




$$U_2 = U * \frac{R_2}{R_1 + R_2} \text{ et } U_1 = U * \frac{R_1}{R_1 + R_2}$$

Les composants « classiques »

Le potentiomètre :



Les séries de valeurs normalisées pour les résistances

1,0 – 1,2 – 1,5 – 1,8 – 2,2 – 2,7 – 3,3 – 3,9 – 4,7 – 5,6 – 6,8 – 8,2

Série : E12 - E24 – E48 – E96

12 valeurs/décade

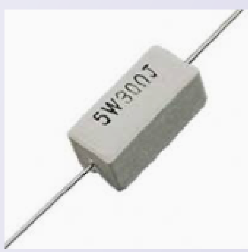
24 valeurs/décade

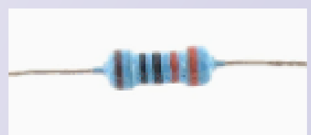
48 valeurs/décade

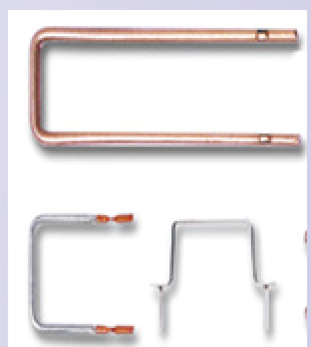
96 valeurs/décade

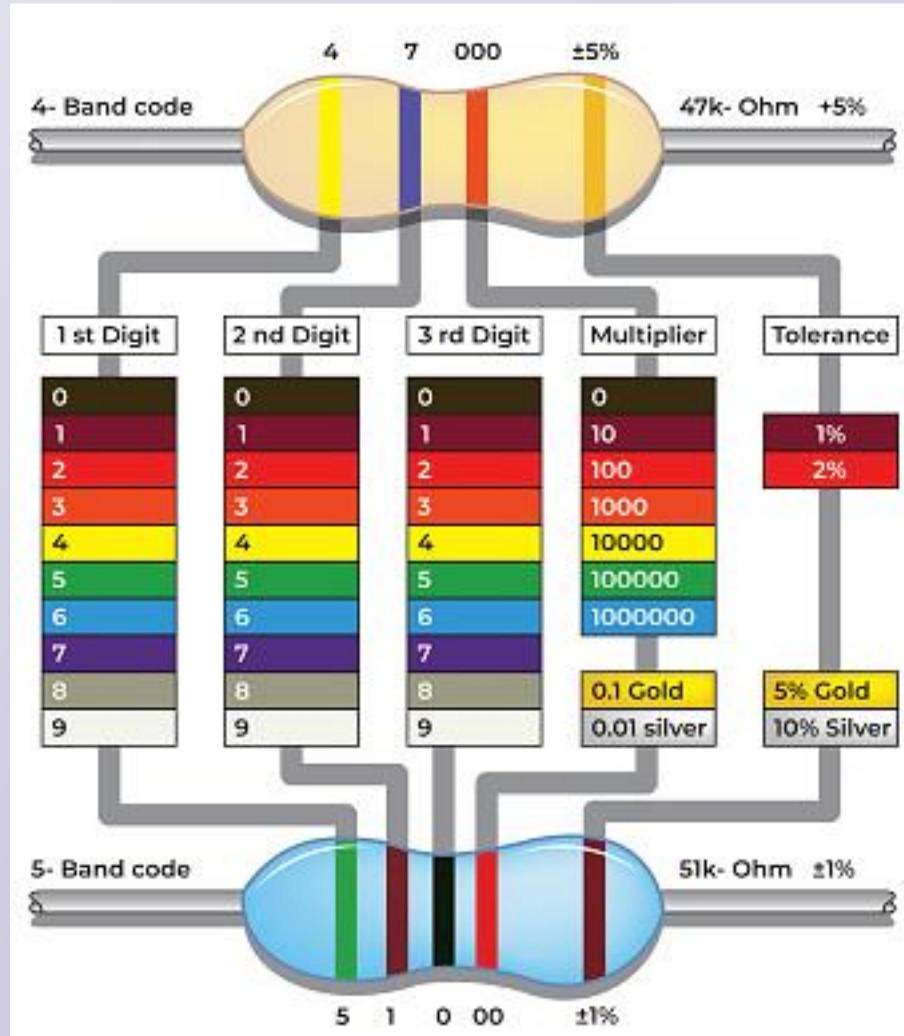
Les composants « classiques »

Marquage









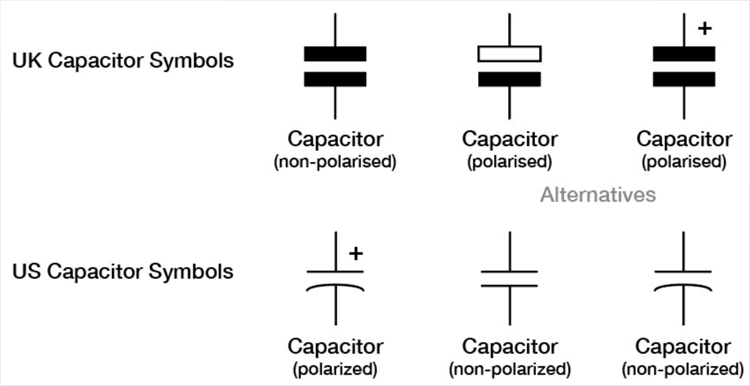
Puissance

$$P = R \cdot I^2$$

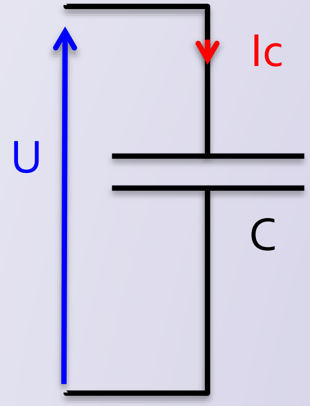
Les composants « classiques »

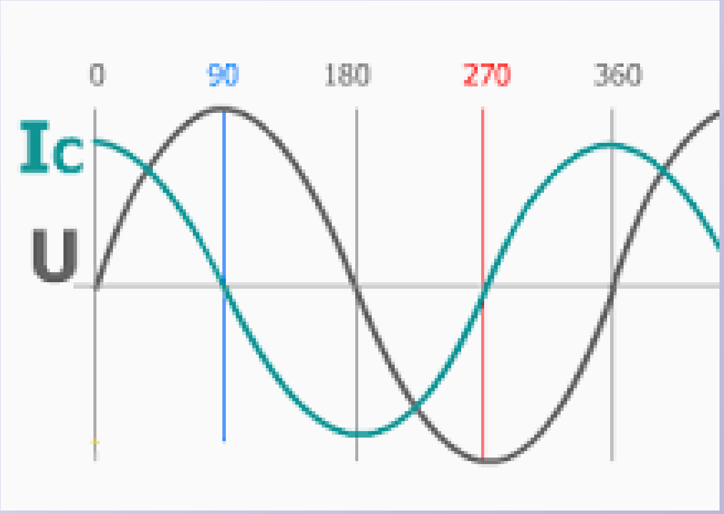
Le condensateur

$$I = C \cdot \frac{dV}{dt} \quad (1)$$



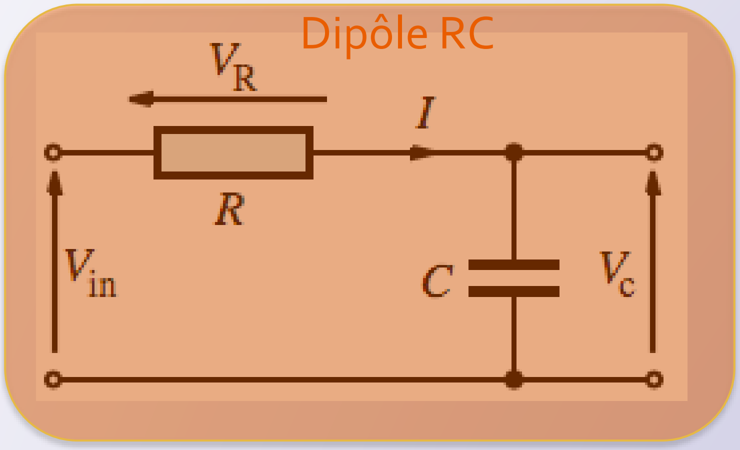
Condensateur → Elément de stockage d'énergie

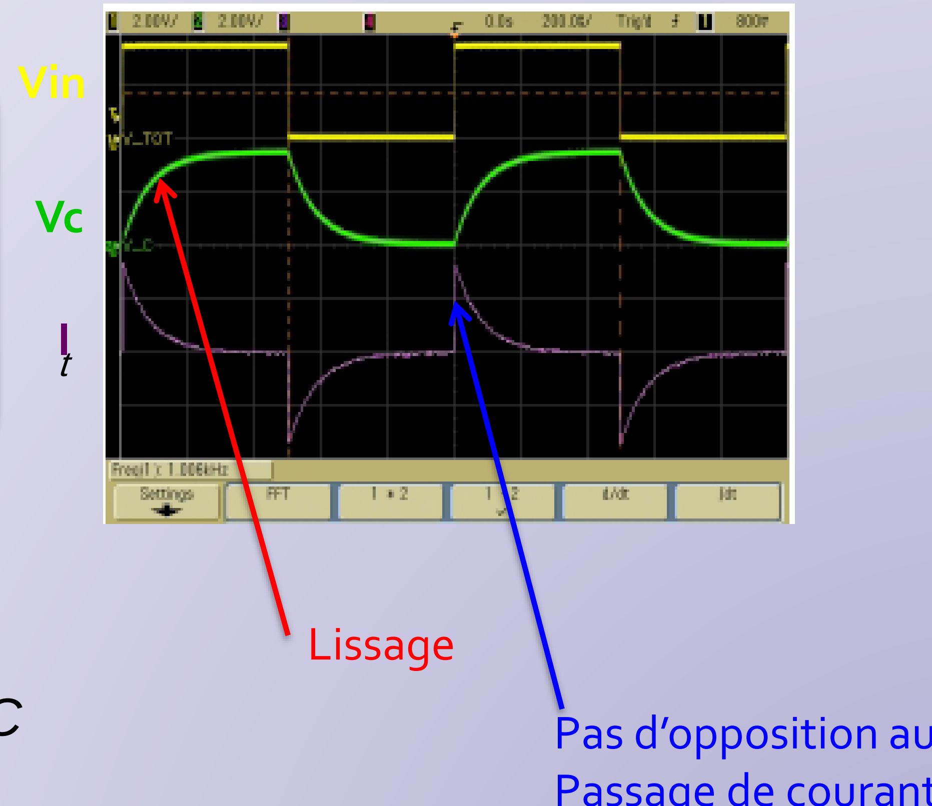




Les composants « classiques »

Le condensateur soumis à une tension constante





$$Vc = Vin.\left(1 - e^{-\frac{t}{t}}\right) \text{ avec } t = R \cdot C$$

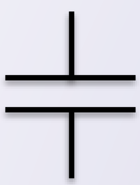
Les composants « classiques »

Les types de condensateurs

$$W = \frac{1}{2} \times C \times U^2$$

Non polarisés

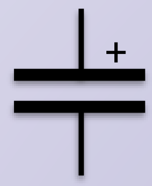
Symbole



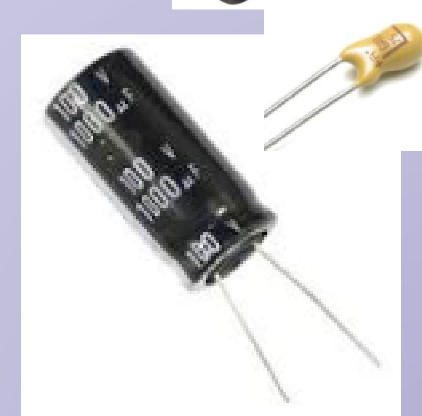
Aspect physique

Polarisés

Symbole



Aspect physique

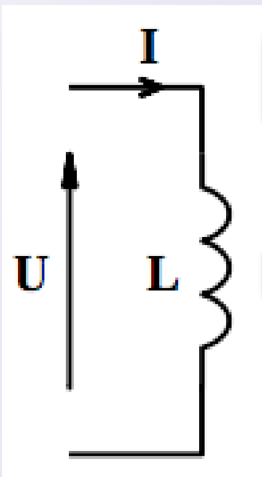


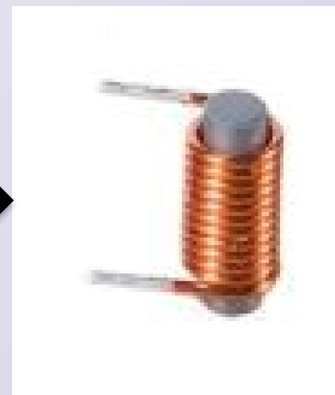
UNIVERSITÉ DE LORRAINE

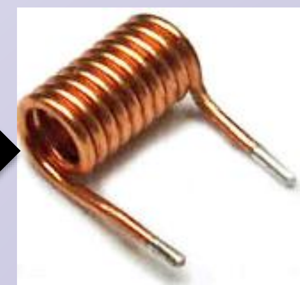
POLYTECH NANCY

Les composants « classiques »

La self (ou bobine)



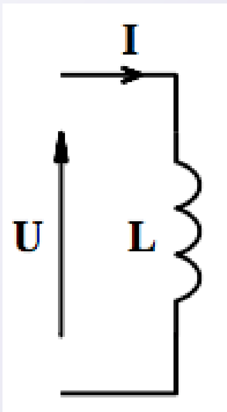




Version CMS
1,8mm x 0,8mm

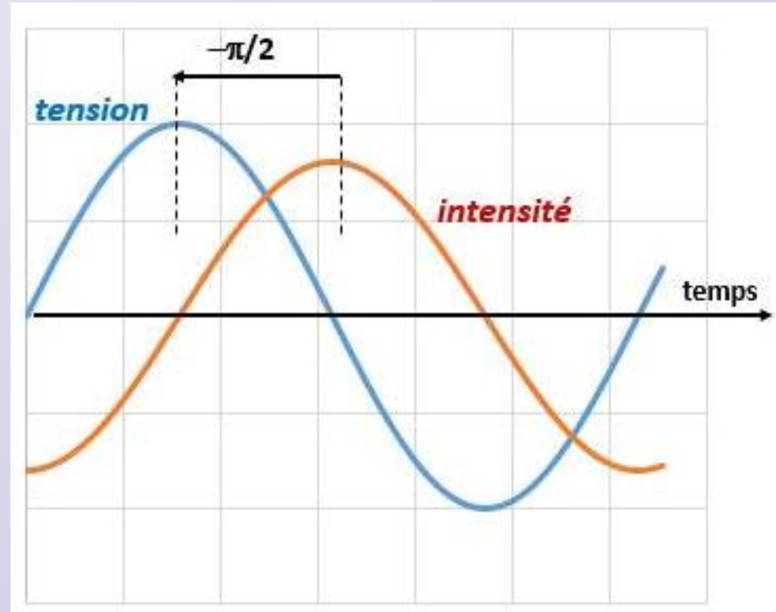
Les composants « classiques »

La self (ou bobine)



$$U = L.\frac{dI}{dt}$$

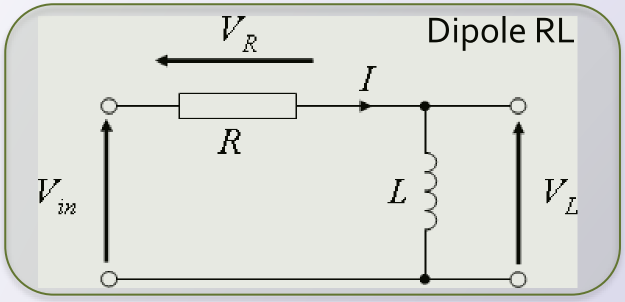
(L en H)



$$U = L \times \frac{dI}{dt} + r \times I$$ avec r (résistance série du fil)

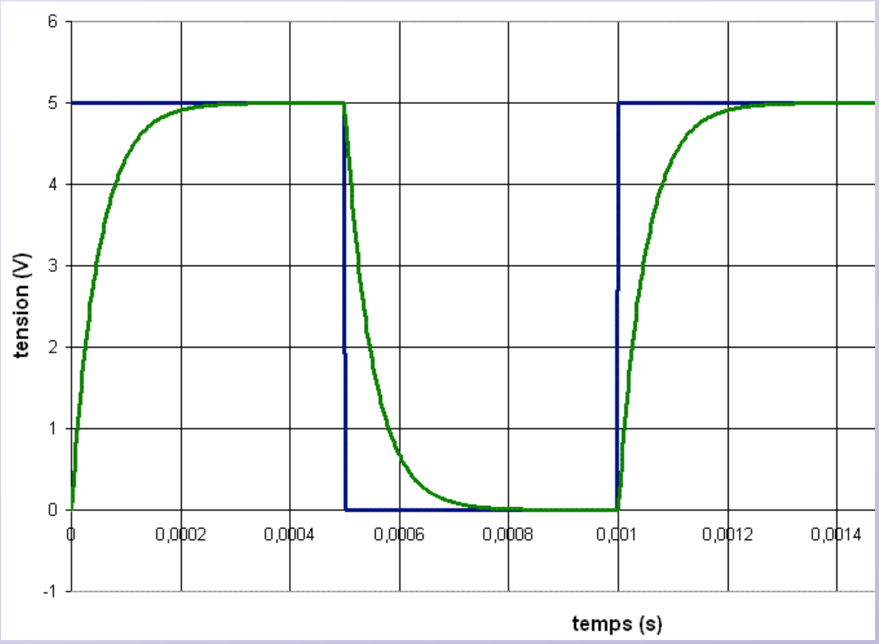
Les composants « classiques »

La self soumise à une tension constante



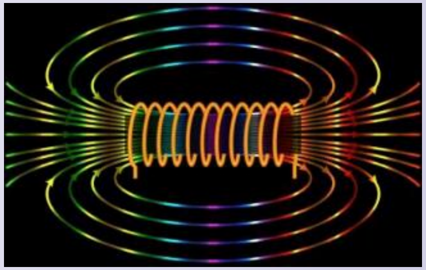
Vin

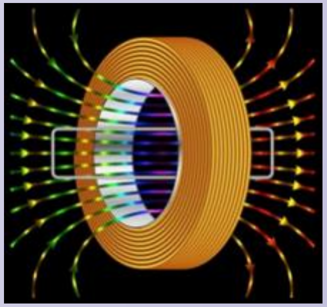
Image de I



$$I_L = \frac{Vin}{R} \cdot \left(1 - e^{-\frac{t}{t}}\right) \quad \text{avec } t = \frac{L}{R}$$

$$W = \frac{1}{2} \times L \times I^2$$

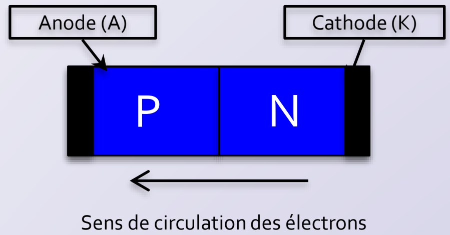


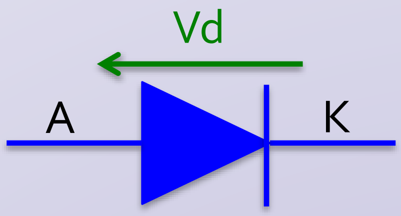


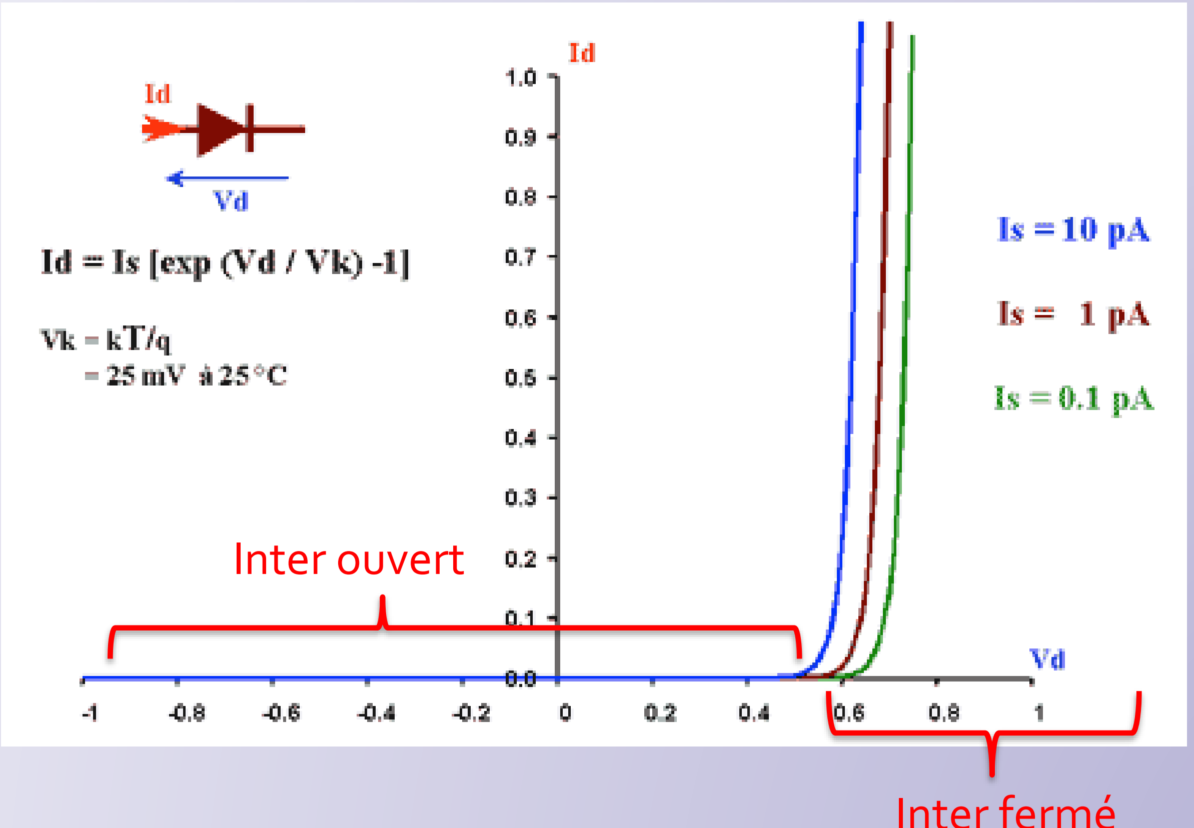
$$L = \frac{m_0 \times m_r \times N^2 \times S}{l}$$

Les composants « classiques »

La diode

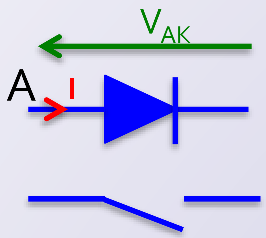


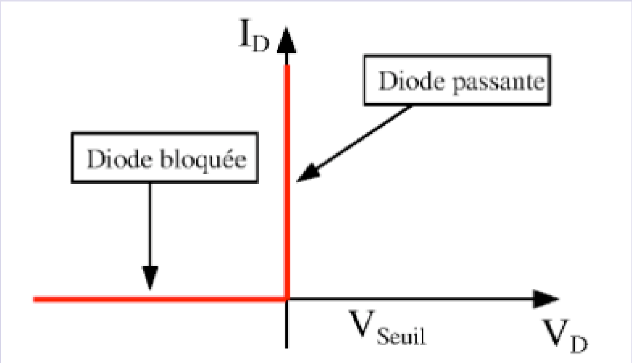




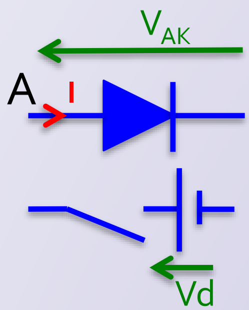
Les composants « classiques »

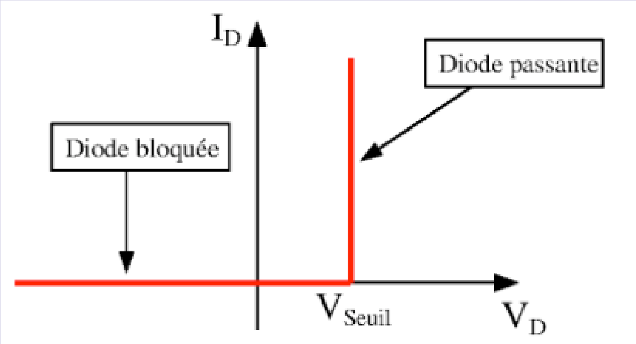
La diode



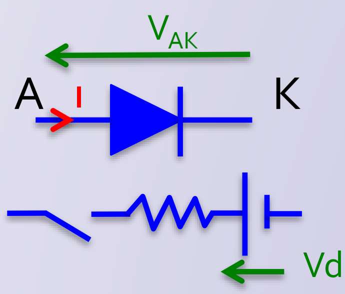


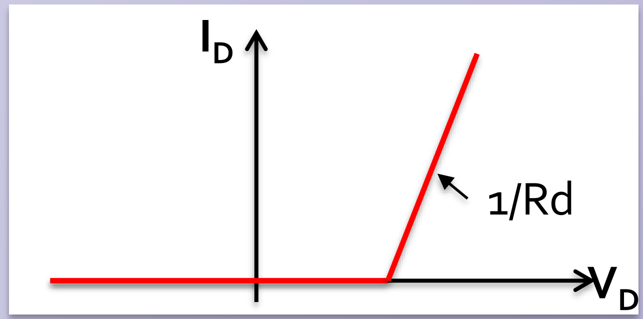
« Caractéristique idéale »





« Caractéristique semi- idéale »





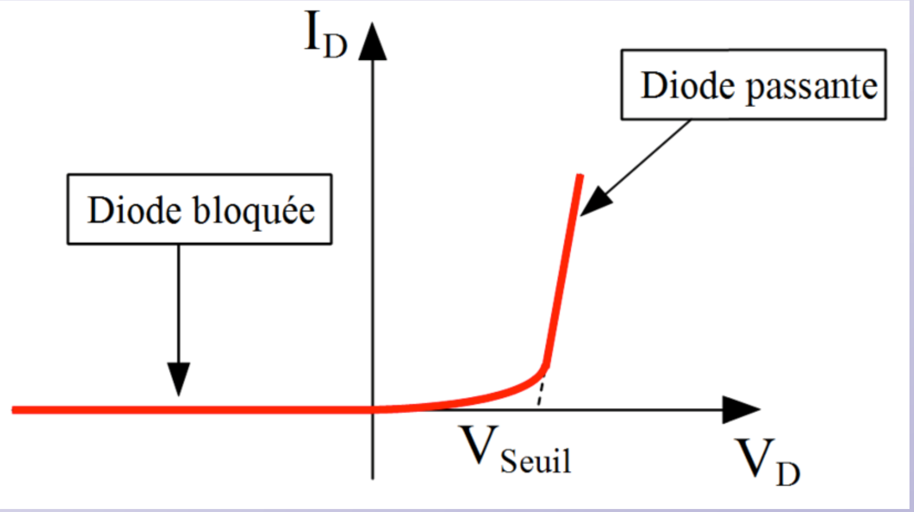
« Caractéristique quasi-réelle »

$$Si\ I_D > 0 \text{ alors } V_{AK} = V_D + R_D \times I_D$$

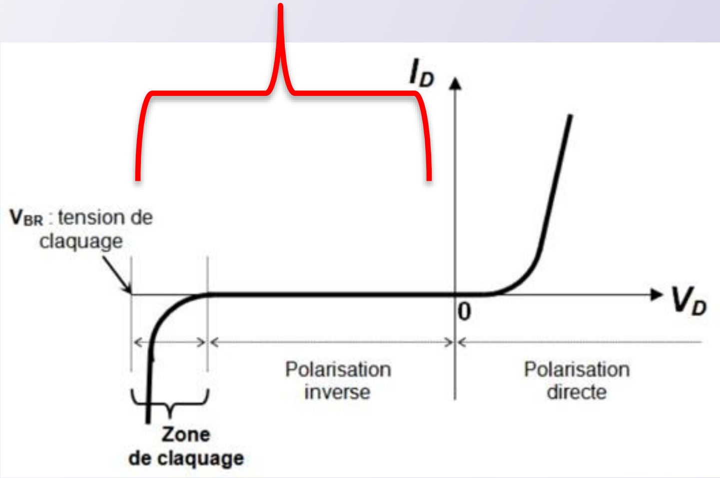
Les composants « classiques »

La diode réelle

$$I_D = I_S\left(e^{\left(\frac{Vd}{Vk}\right)} - 1\right) \text{ avec } Vk = \frac{k \cdot T}{q} = 25mV \text{ à } 25°C$$



Zone de tension inverse



Les composants « classiques »

Modèles de diode

CMS : Composant Monté en Surface

Version axiale

Version CMS

1N4148
Traitement du signal

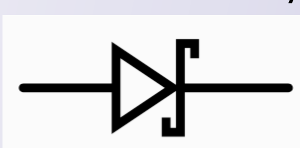
Diode de redressement

1N4007

1N4007

DO214

Diode Schottky

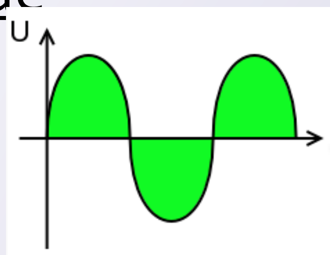


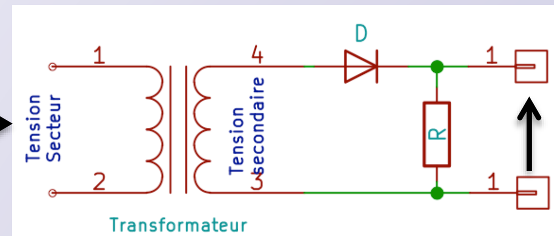
Signal

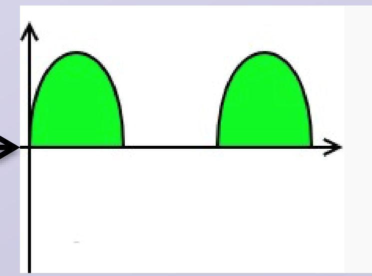
Les composants « classiques »

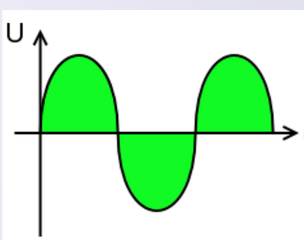
Applications de la diode

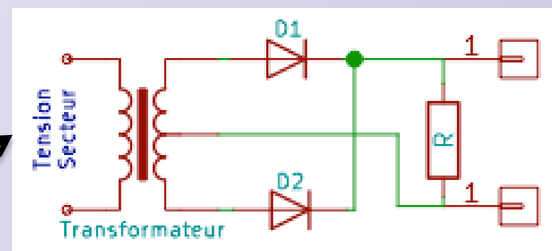
Redressement simple alternance



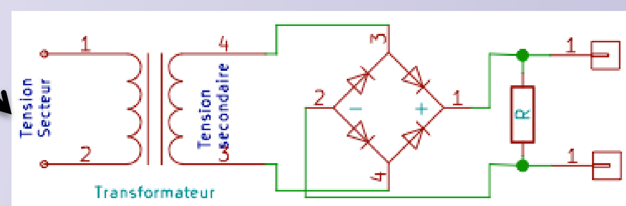


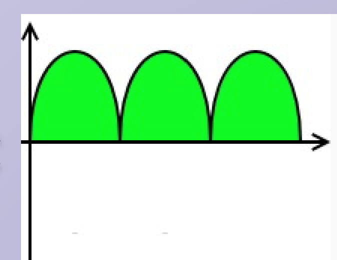






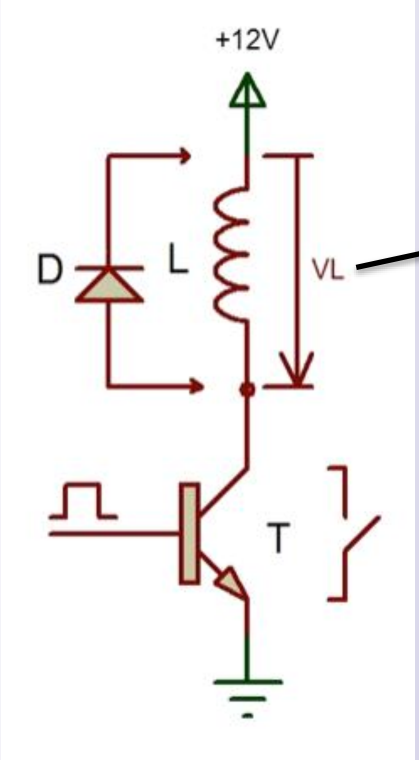
Redressement double alternance

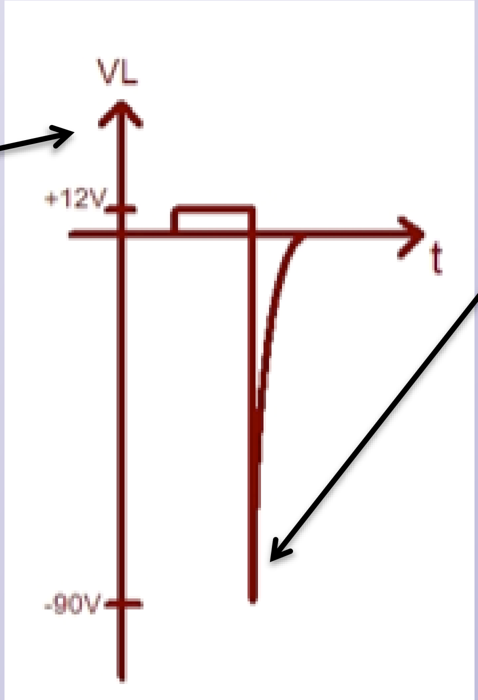




Les composants « classiques »

Autre application de la diode



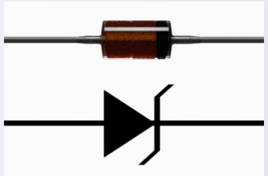


Tension aux bornes de L (sans diode)

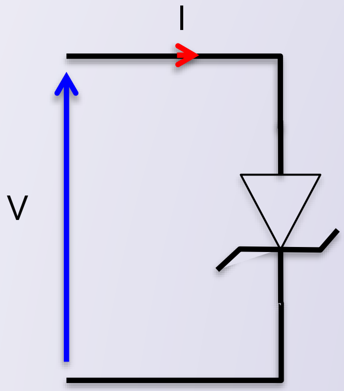
Avec la diode, $V_L = V_D = 0{,}7V$

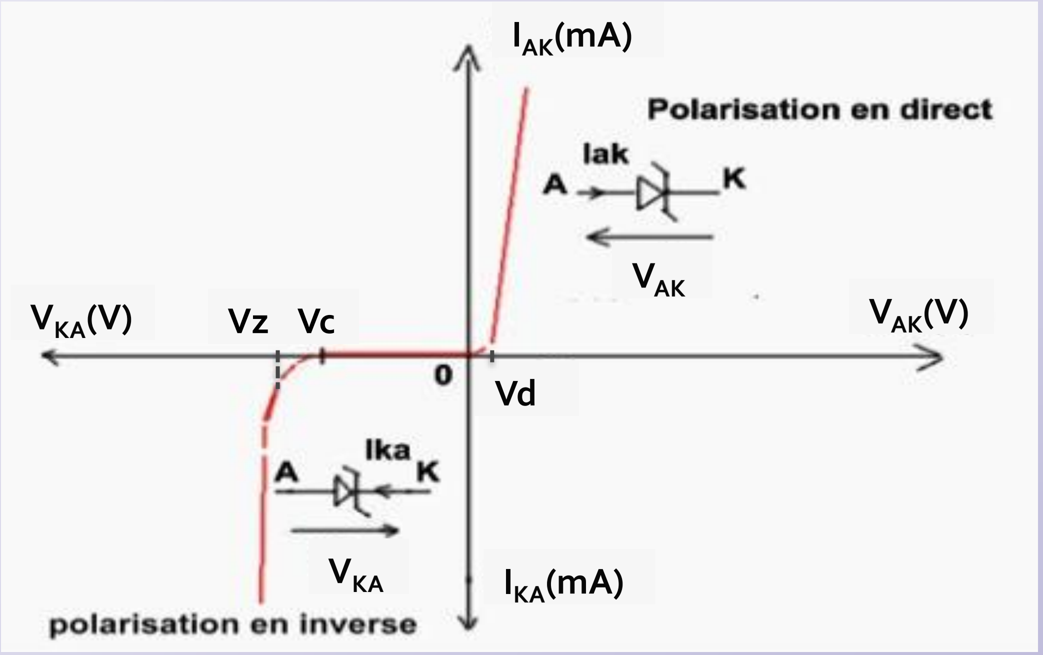
Les composants « classiques »

La diode Zener



Composant
et symbole





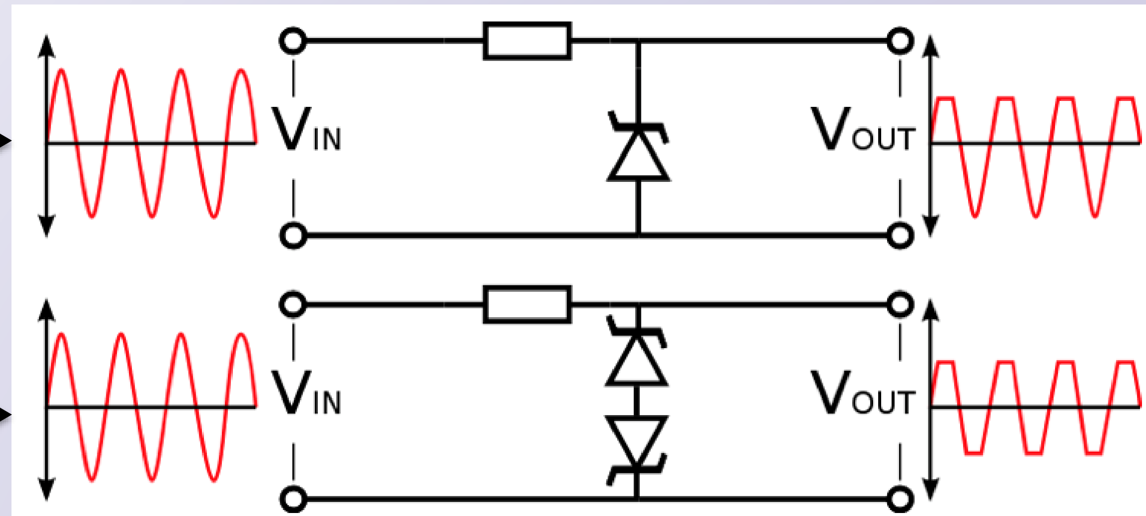
$$Vc < V < Vd \Rightarrow I = 0$$
$$V > Vd \Rightarrow I \rightarrow \infty$$
$$V < Vz \Rightarrow I \rightarrow -\infty$$

Les composants « classiques »

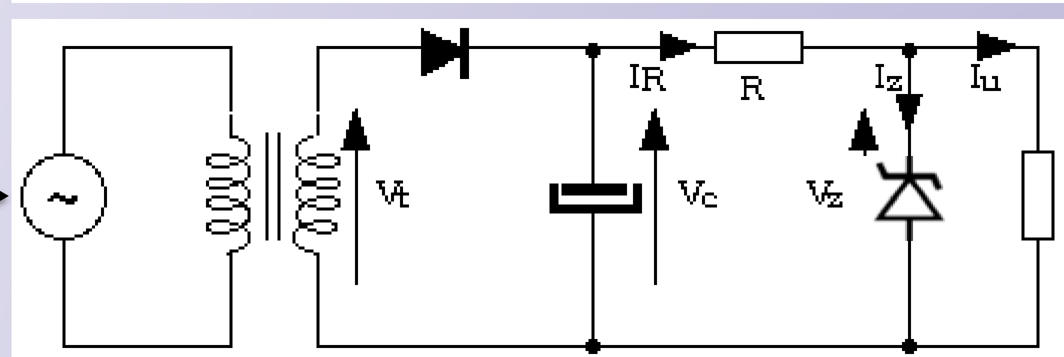
Utilisation de la diode Zener

Diode zener simple

Double diode zener montées « Tête bêche »

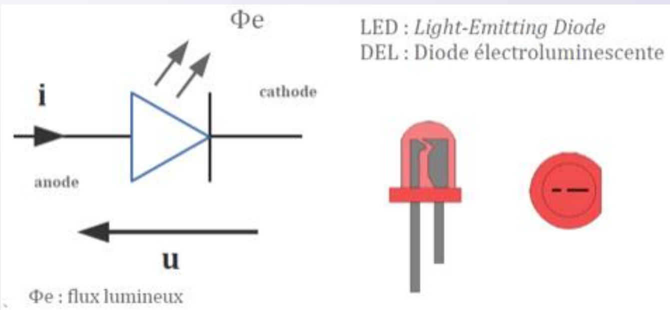


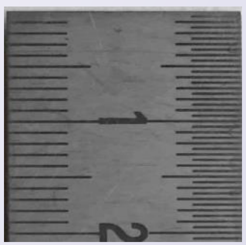
Régulation d'une tension continue. Alimentation stabilisée



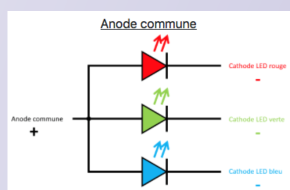
Les composants « classiques »

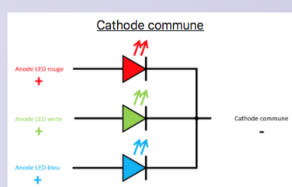
La diode électro-luminescente (LED – Light Emitting Diode)

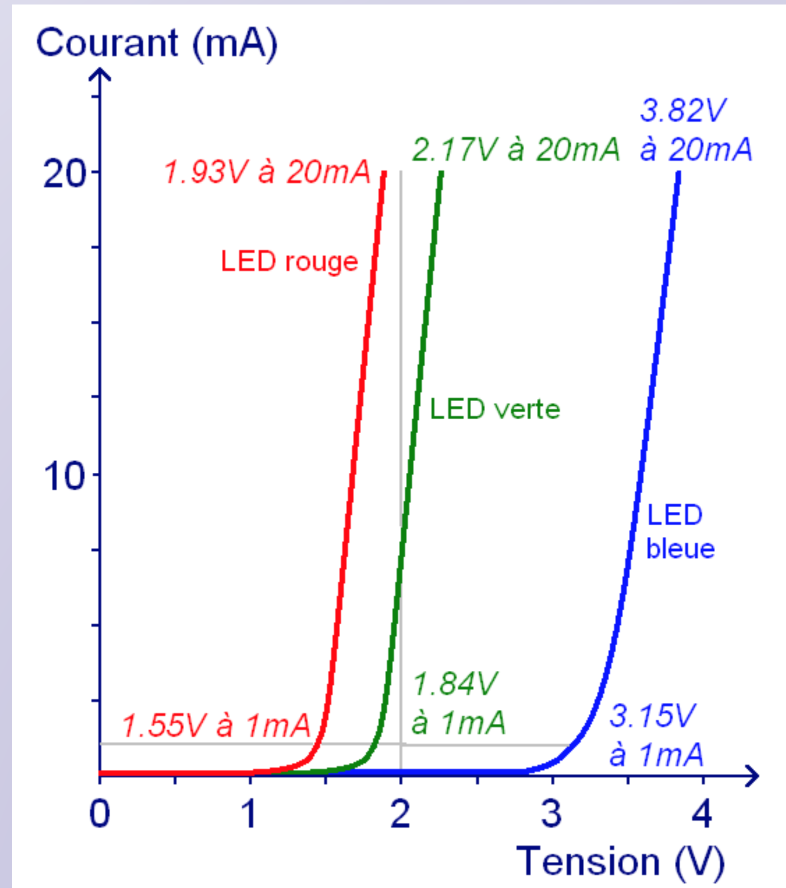




LED RGB







Les composants « classiques »

Le transistor

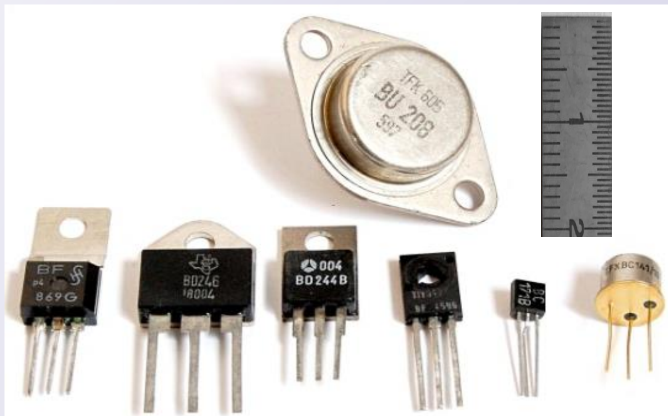
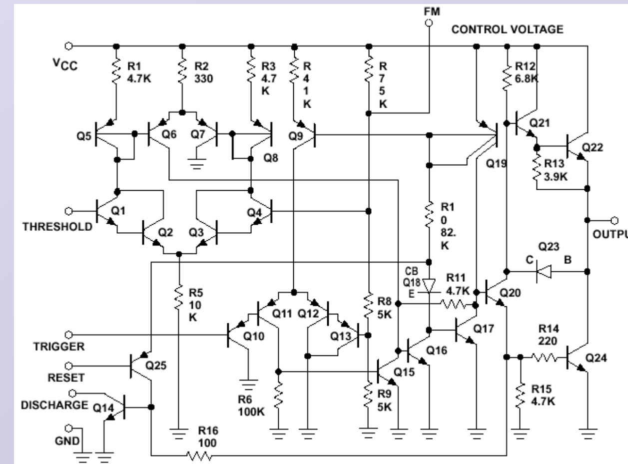
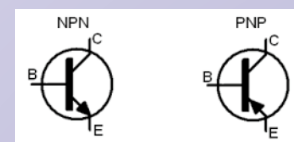


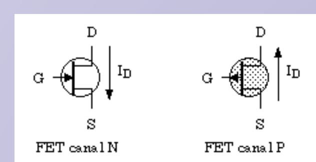
Schéma interne du NE555



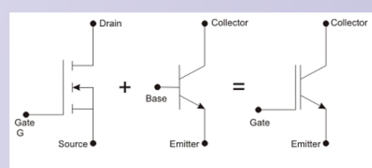
Le transistor bipolaire et ses symboles



Le transistor à effet de champ et ses symboles



Le transistor IGBT

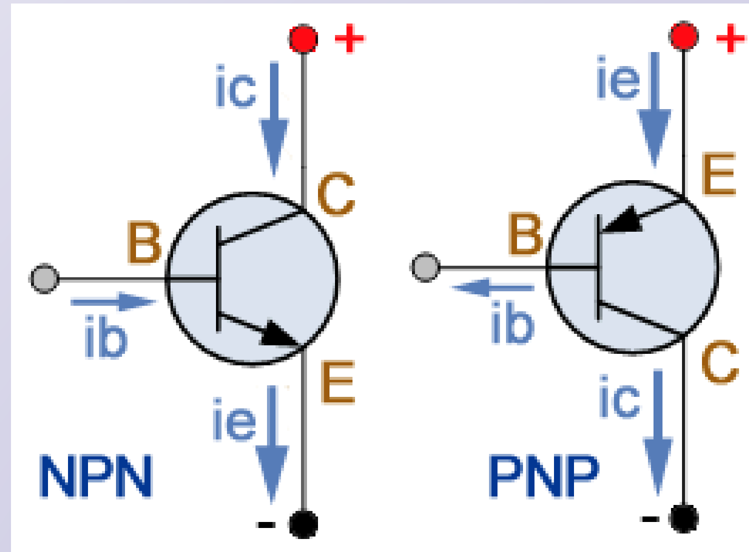


Les composants « classiques »

Le transistor bipolaire

$Ie = Ic + Ib$ avec Ic=b.Ib

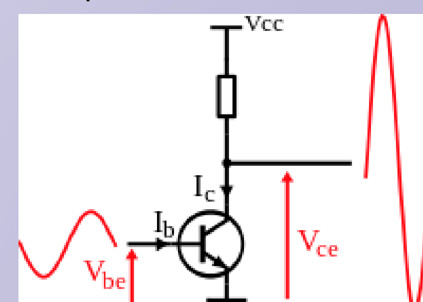
d'où $Ie = Ib \times (b+1)$



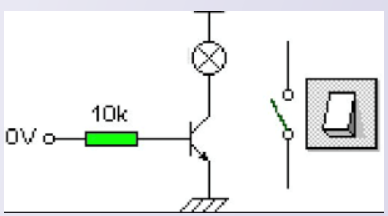
β → Gain en courant du transistor

Si β grand alors Ie ≈ Ic

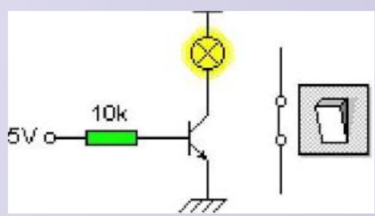
Amplificateur de courant



Transistor en interrupteur commandé



0V → Lampe éteinte

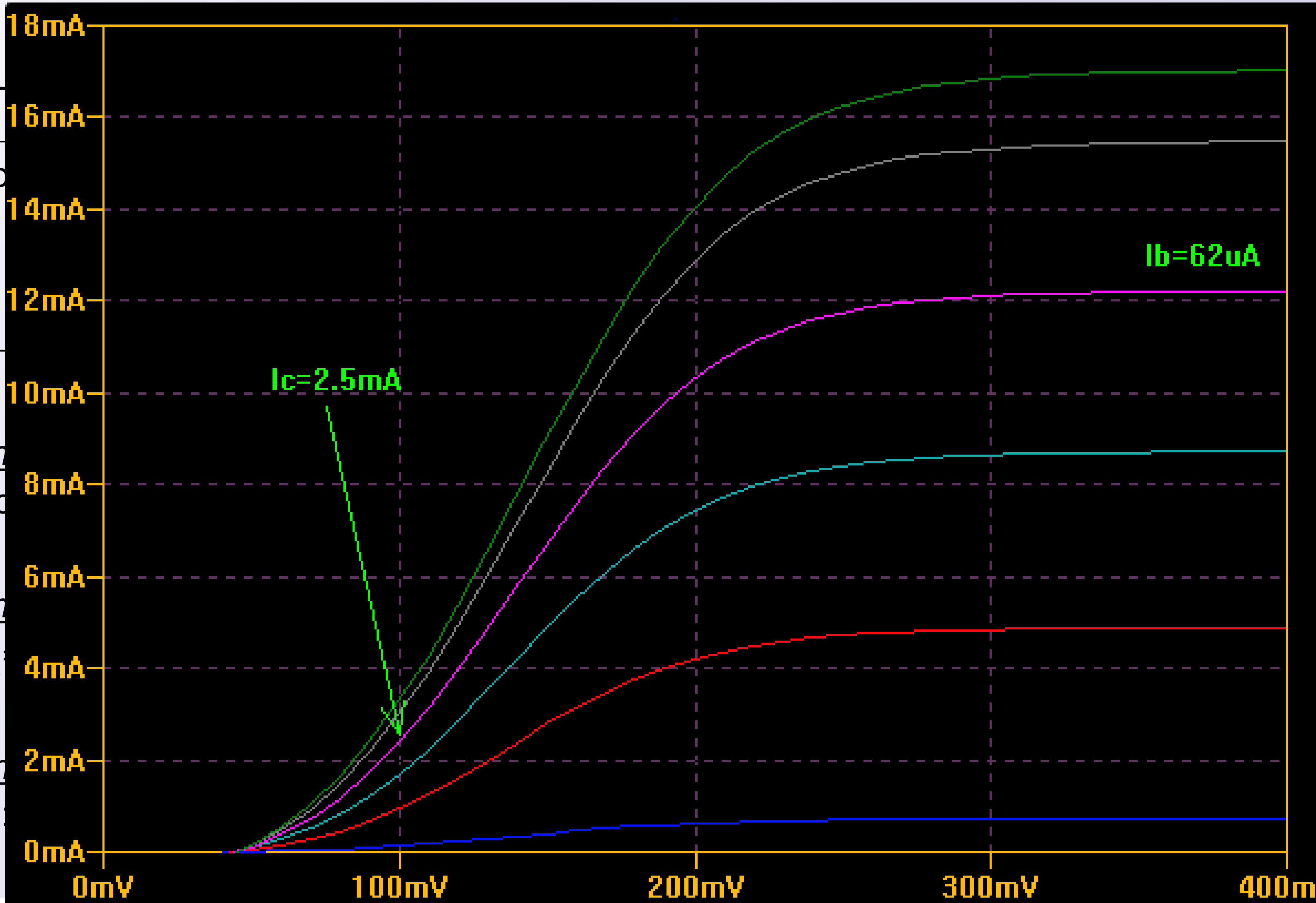


5V → Lampe allumée

Les composants « classiques »

Le

Co
-
-
-



Zon
I_B=c

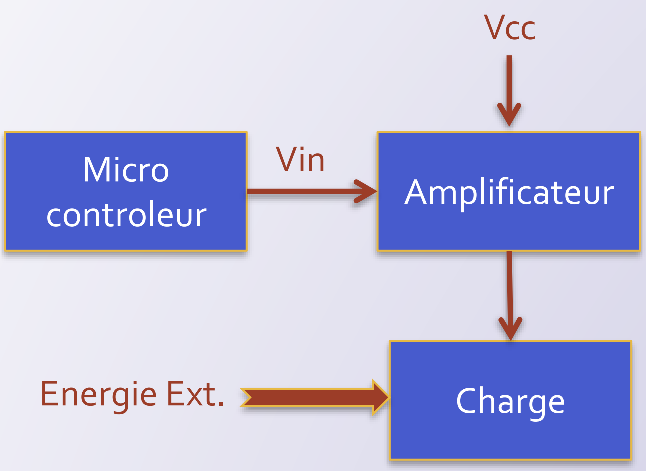
Zon
V_{BE}

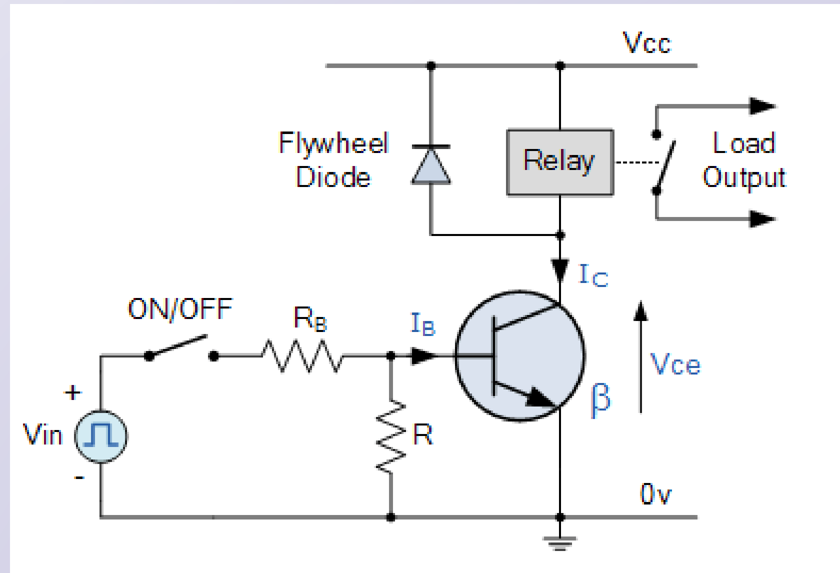
Zon
IB>

V)

Les composants « classiques »

Le transistor bipolaire





Si Vin=0V ➔ $I_B=0$ ➔ $I_C=\beta.I_B=0$ ➔ Transistor bloqué ➔ Charge déconnectée

Si Vin=3,3V ➔ $I_B>0$ ➔ $I_C=\beta.I_B$ ➔ $V_{CE}\approx 0V$ ➔ Transistor saturé ➔ Relais activé ➔ Charge connectée

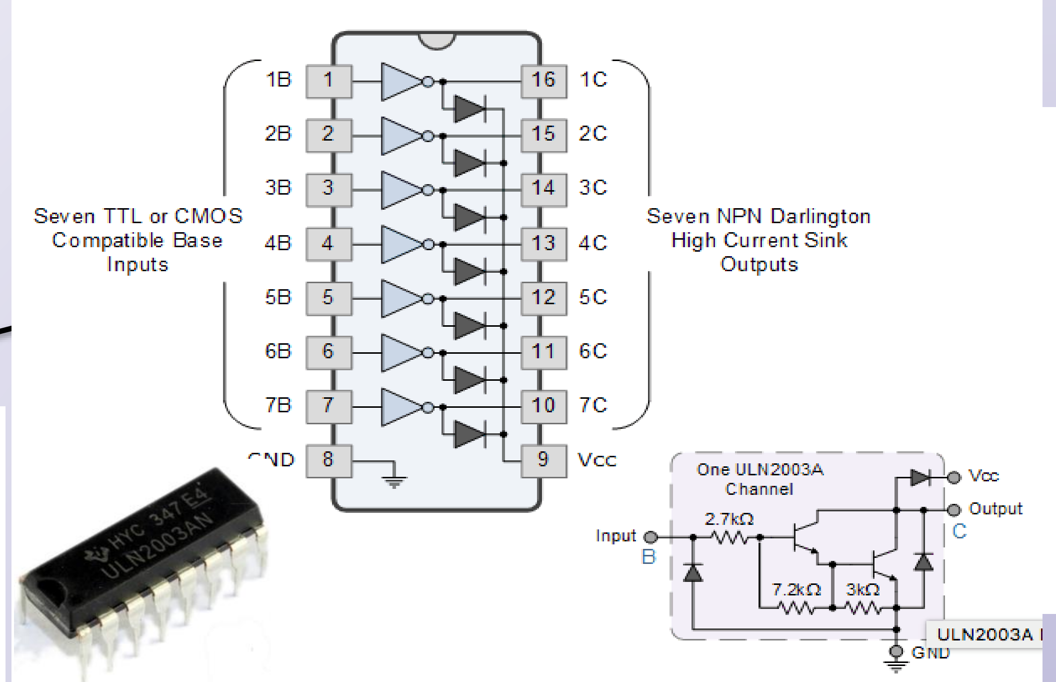
$$I_B = \frac{I_C}{b} = \frac{0,2}{200} = 1mA$$

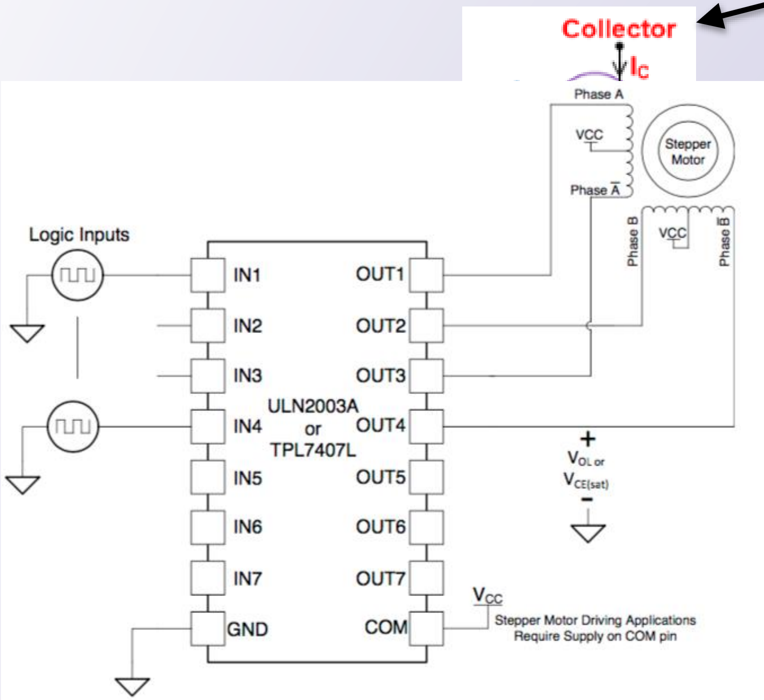
$$R_B = \frac{Vin - V_{BE}}{I_B} = \frac{3,3 - 0,7}{0,001} = 2,6KW$$

Les composants « classiques »

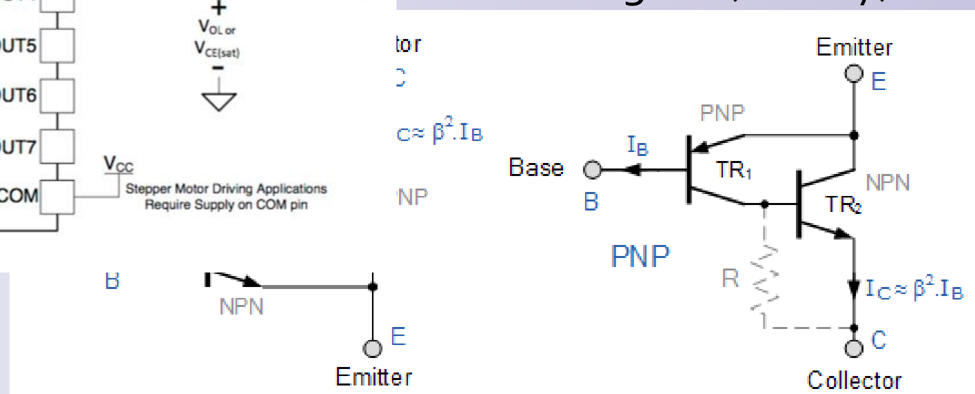
Le transistor bipolaire

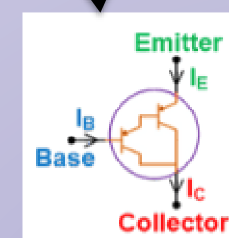
$$\beta = \beta_1 + \beta_2 + \beta_1\beta_2$$





eudo-Darlington (Sziklay)

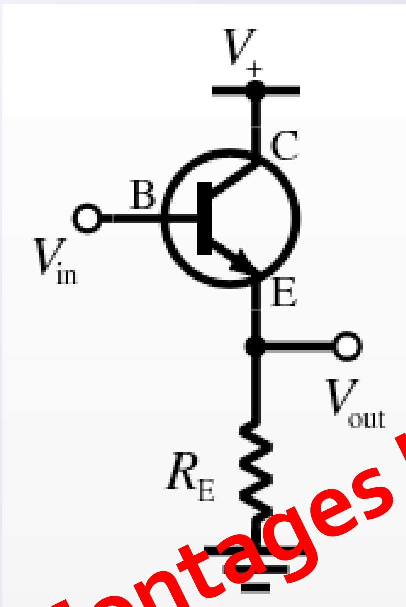


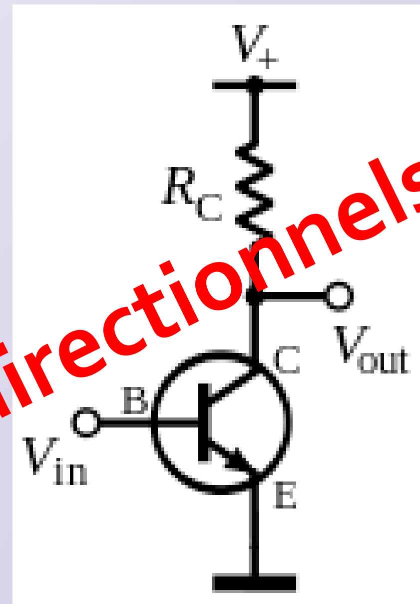


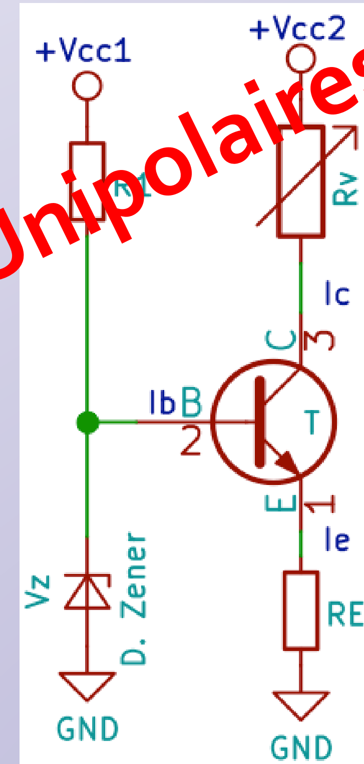
Les composants « classiques »

Le transistor bipolaire

Montages Unidirectionnels ou Unipolaires







$$I_E = \frac{V_{IN} - V_{BE}}{R_E}$$

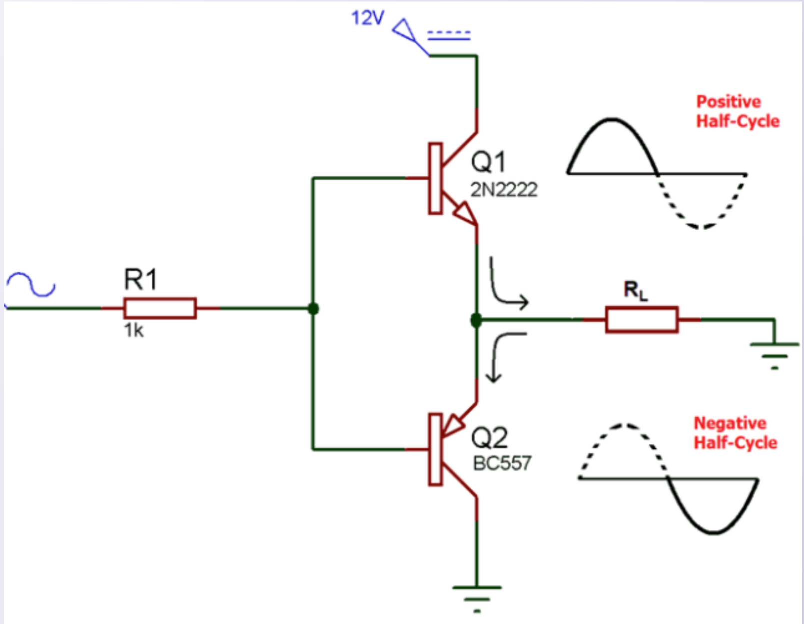
$$I_C = \frac{V^+ - V_{CE}}{R_C}$$

$$I_C = \frac{b}{b+1} \cdot \left(\frac{V_Z - V_{BE}}{R_E} \right)$$

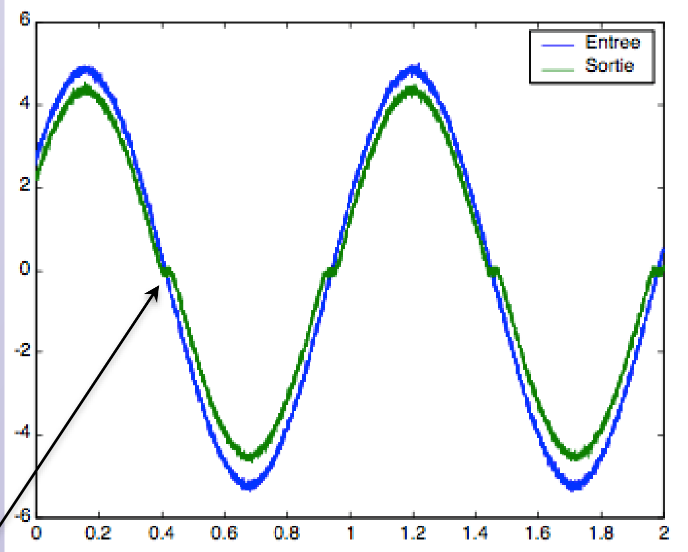
Les composants « classiques »

Le transistor bipolaire

Montage Push-Pull



En bleu le signal d'entrée
En vert le signal de sortie



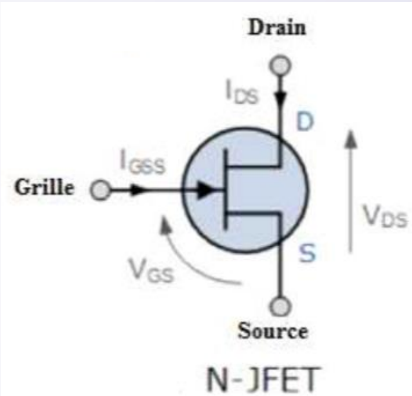
Distorsion sur Vs due au Vbe des transistors

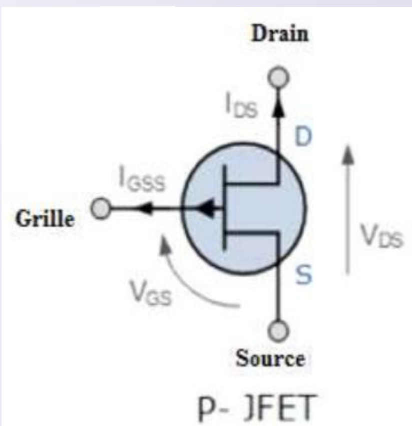
Les composants « classiques »

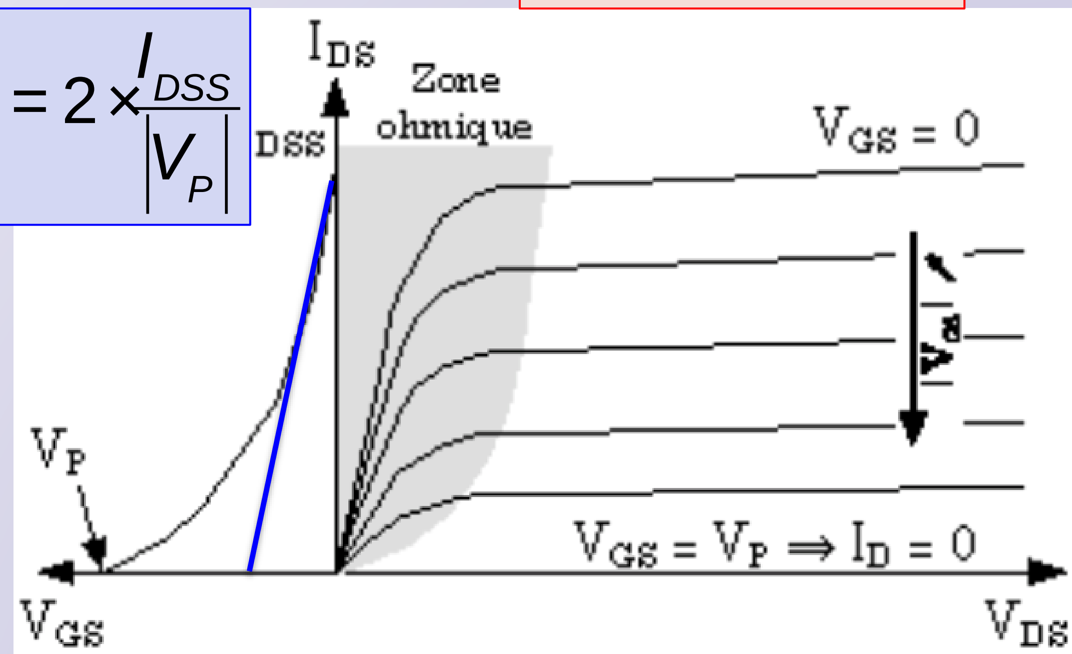
Le transistor à effet de champ (FET)

$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$$

$$g_{m0} = 2 \times \frac{I_{DSS}}{\left|V_P\right|}$$







$$g_m = \frac{dI_{DS}}{dV_{GS}} = 2\frac{I_{DSS}}{\left|V_P\right|}\left(1 - \frac{\left|V_{GS}\right|}{\left|V_P\right|}\right)$$

$$g_m = g_{m0} \cdot \left(1 - \frac{\left|V_{GS}\right|}{\left|V_P\right|}\right)$$

Les composants « classiques »

Fin de la partie 1-1 : Électronique analogique

Pour toute question, n'hésitez pas à me contacter.
Soit par mail : etienne.bernard@univ-lorraine.fr
ou de vive voix à l'école - Bât.F – Bureau 210