

Cours du 21 octobre 2022

Electrotechnique : alimentation et machines

Partie 2. Convertisseurs

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CPGE PSI / L3 GECCLEERE



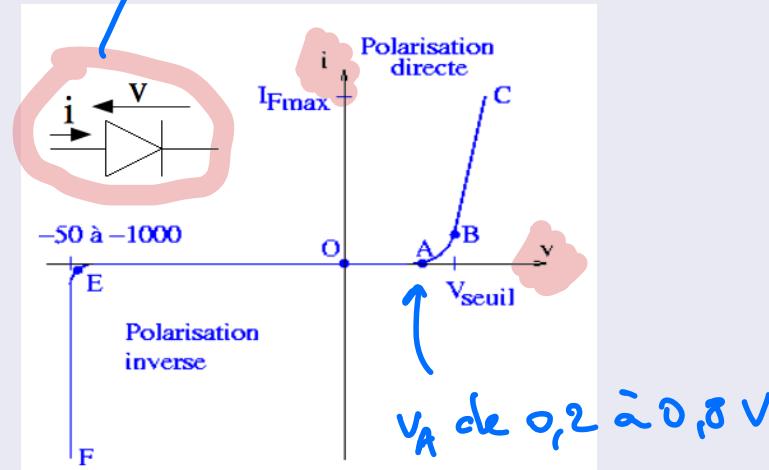
2.A Redressement de tensions sinusoïdales

2.1 diode

On va utiliser beaucoup de circuits comportant des diodes \rightarrow convention "récepteur" (vers i opposé),

Caractéristique

Trace de $i = f(v)$

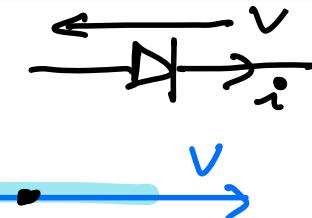
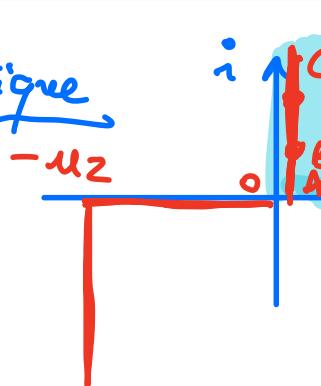


V_A de 0,2 à 0,8 V

d'où schématisation de la caractéristique

U_Z : tension ZENER

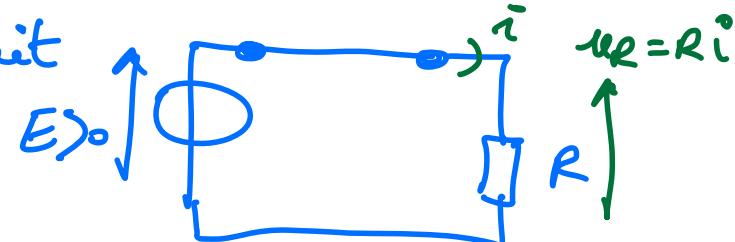
↳ diode Zener



si l'on essaie d'imposer $v > 0$, $v = 0$, $i \neq 0$ (et $i > 0$)
 \Rightarrow Eq. à un fil ($R = 0$)

example :

si $u_d > 0$ (faible) \Rightarrow diode est "passant" ($i \neq 0$)
et on dit $u_d \approx 0 \Rightarrow$ fil

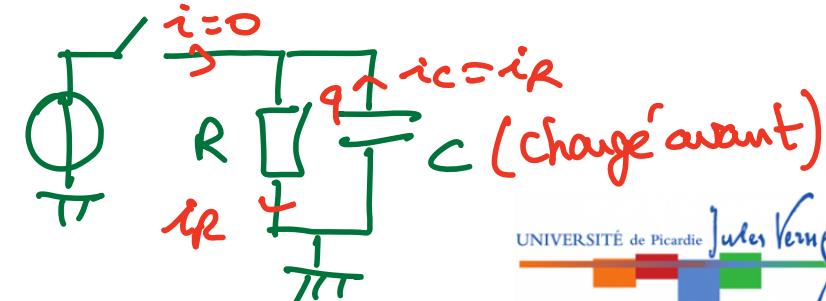


$$V_E < V < 0 \Rightarrow i = 0$$

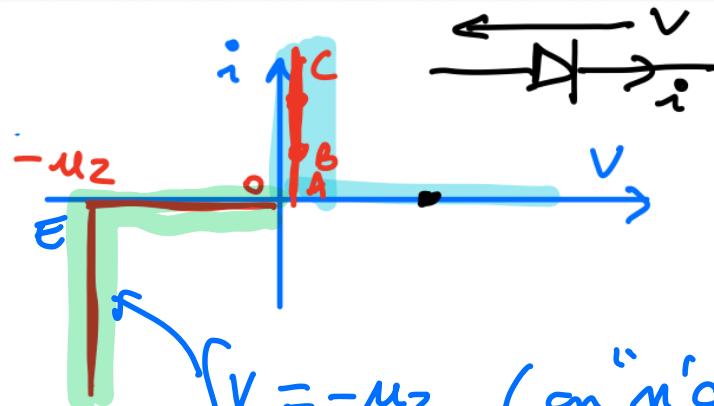
la diode s'oppose au passage du courant. \Rightarrow  interrupteur de veille.

A hand-drawn circuit diagram illustrating an ELO (Electrolytic Load Optimizer) example. The circuit consists of a voltage source labeled U_d , a diode D connected to ground, and a load branch. The load branch contains a resistor R and an inductor i_L in series, followed by a capacitor C . A switch S is shown in the middle of the load branch. To the left of the circuit, there is a pink shaded circle containing the text "ELO". Above the circuit, the word "example" is written in blue cursive.

Dans le cas $V_F < \mu d < 0$



Réu



$V = -u_z$ (on "n'arrive pas" à avoir V plus basse que $-u_z$).
 $i \neq 0$
 $i < 0$

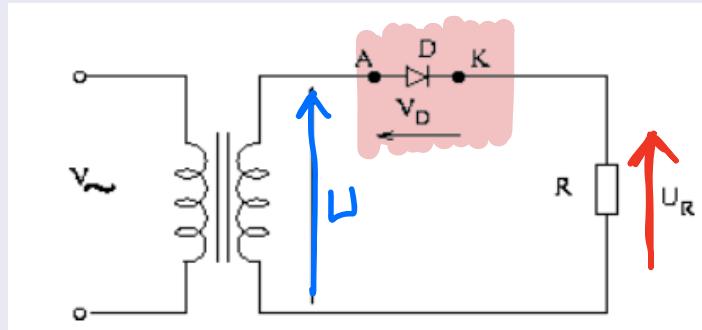
$\xrightarrow{i > 0}$ $\xleftarrow{i < 0}$ bloqué par |
sens partant (sens bloqué)

sauf "avalanche"
du sens bloqué (E.g.
à un éclair dans l'air).

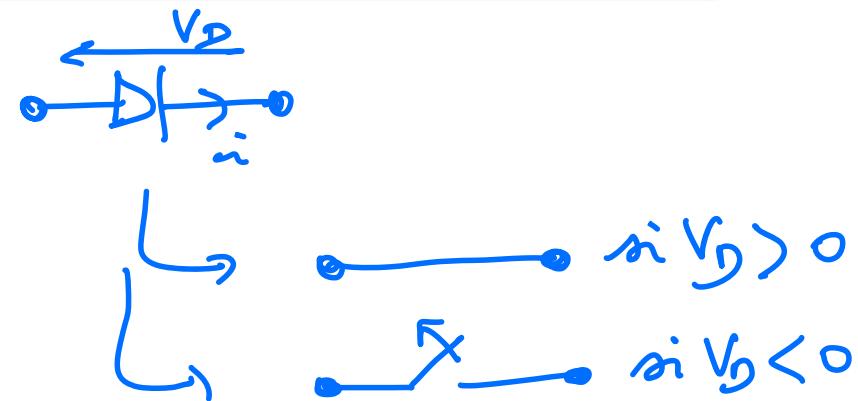
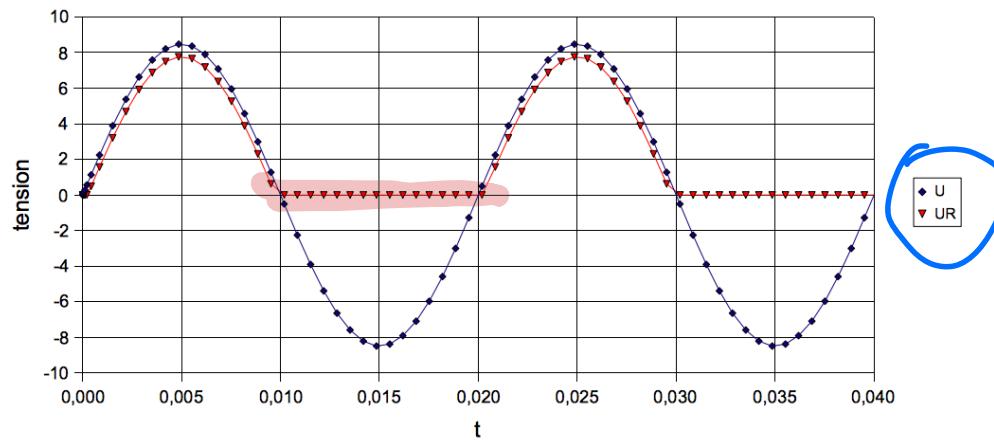
2.A Redressement de tensions sinusoïdales

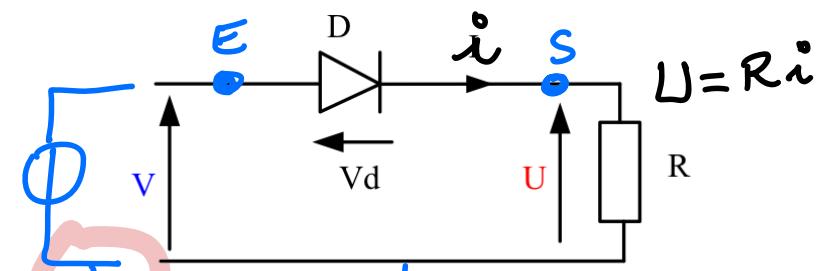
2.2 redressement monoalternance

Montage



Redressement simple alternance

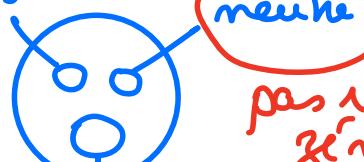




$$V_d = V_E - V_S \quad \text{avec} \quad \left\{ \begin{array}{l} U = V_E - 0 \\ U = V_S - 0 \end{array} \right.$$

$$= V - U$$

phase



souvent la masse
neutre
pas un vrai
zéro.

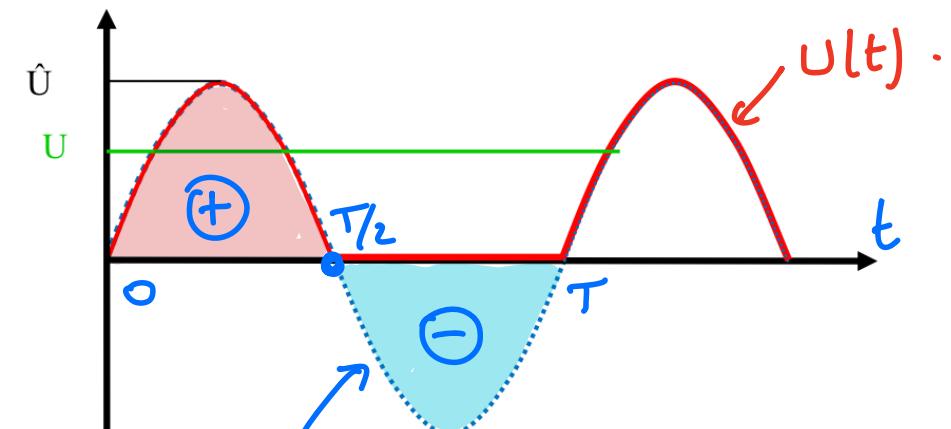
Terre
zéro volt

$$t = \frac{T}{2} \Rightarrow V = 0$$

$$\text{de } 0 \text{ à } \frac{T}{2} \Rightarrow U = V \quad (\text{diode passante})$$

à partir de $\frac{T}{2}$, $V(t) < 0$

$$\hookrightarrow V_d = +V - 0 < 0$$

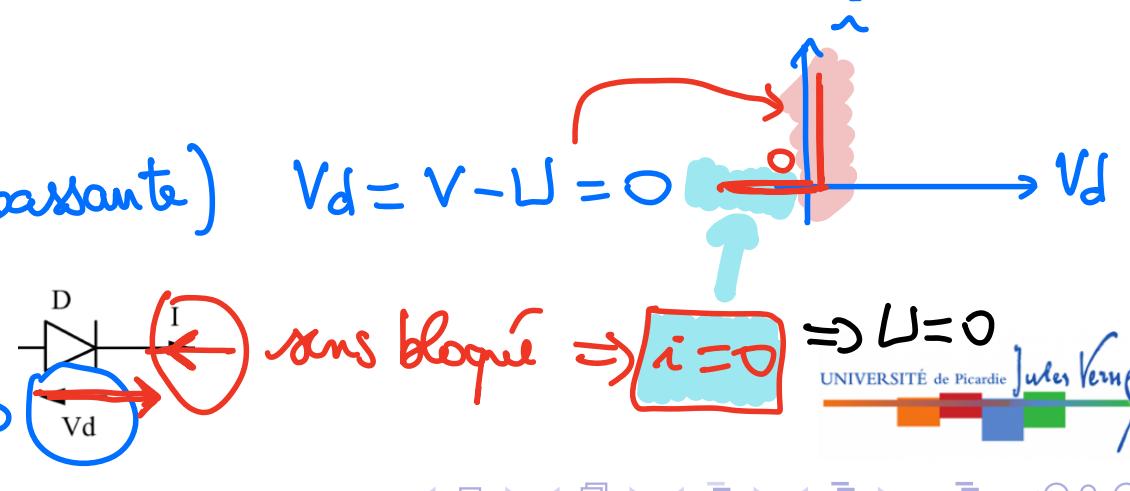


$v(t)$: aire = -aire

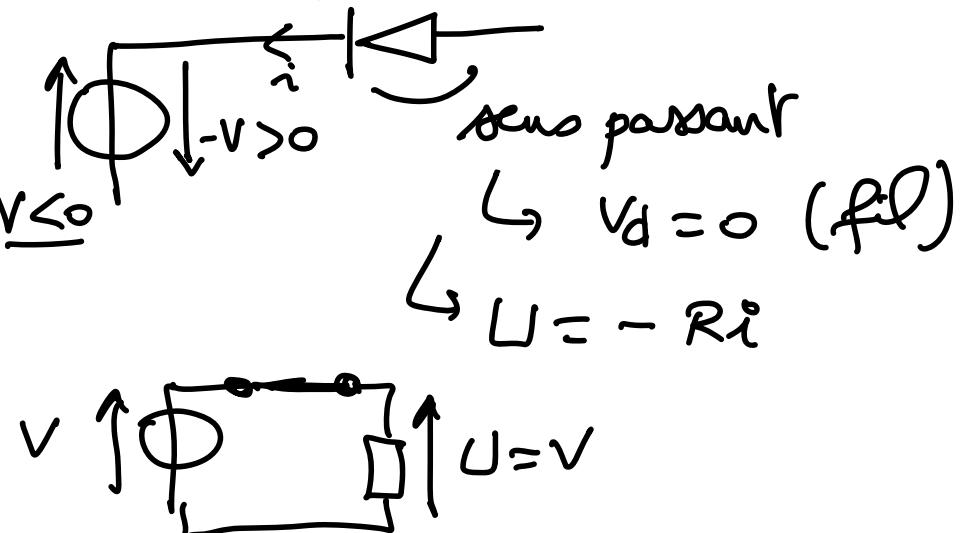
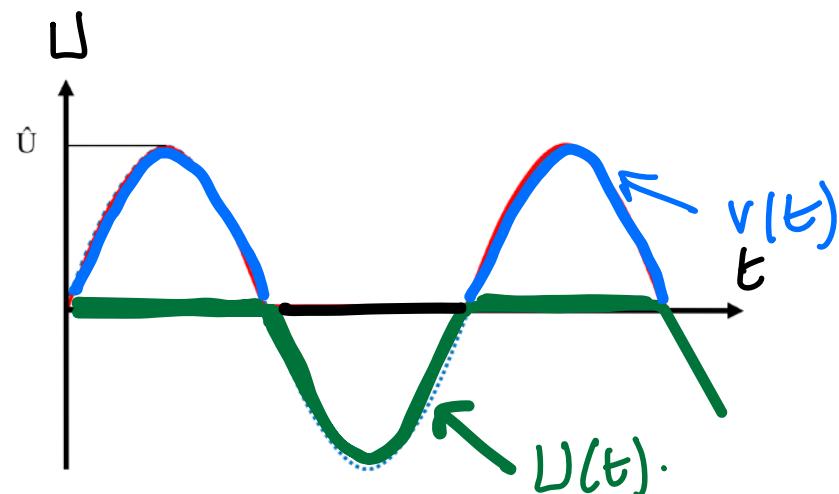
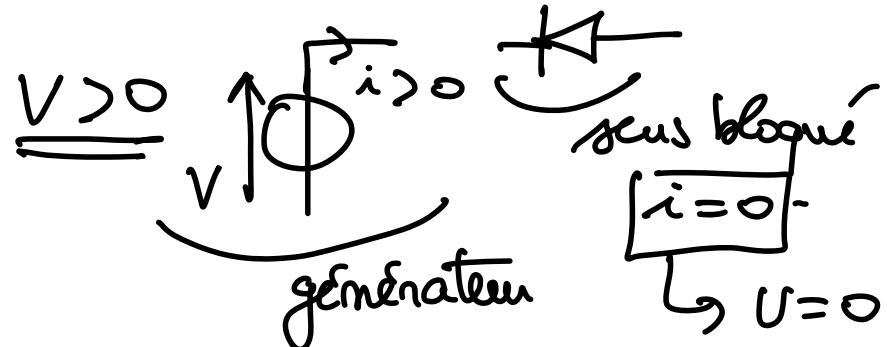
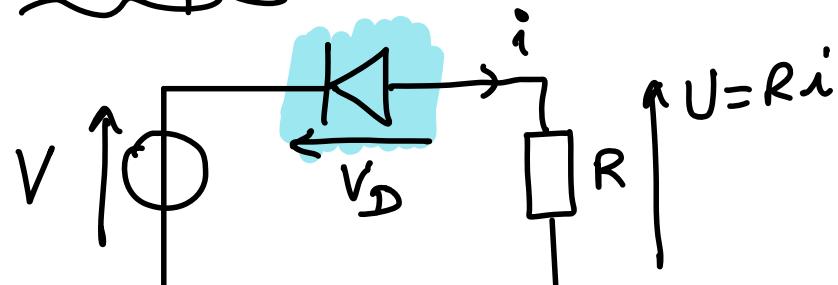
↪ somme nulle

$$\Rightarrow \bar{V} = 0 \quad (\text{moyenne})$$

$$(\text{car } \bar{V} = \frac{1}{T} \int_0^T v(t) dt)$$

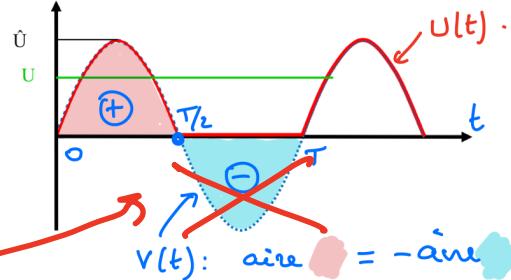


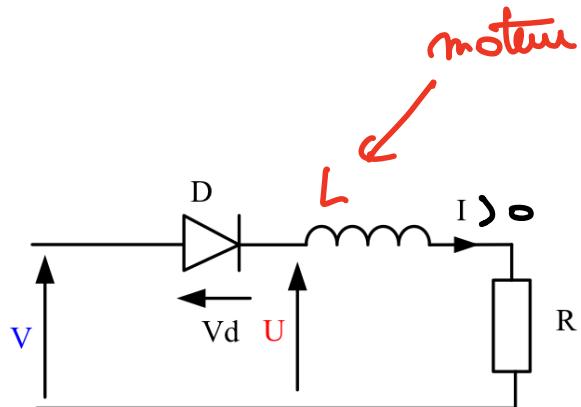
Exemple



"redressement" monoalimentation.

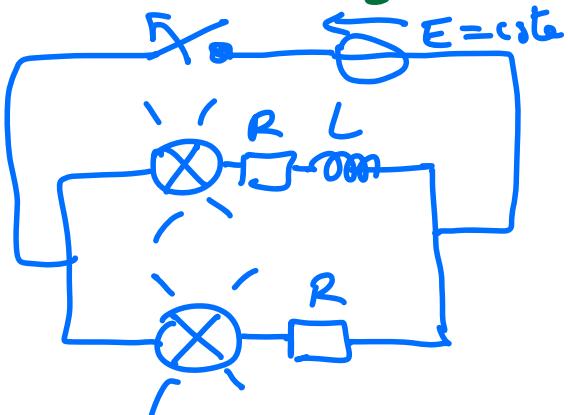
on perd une alternance





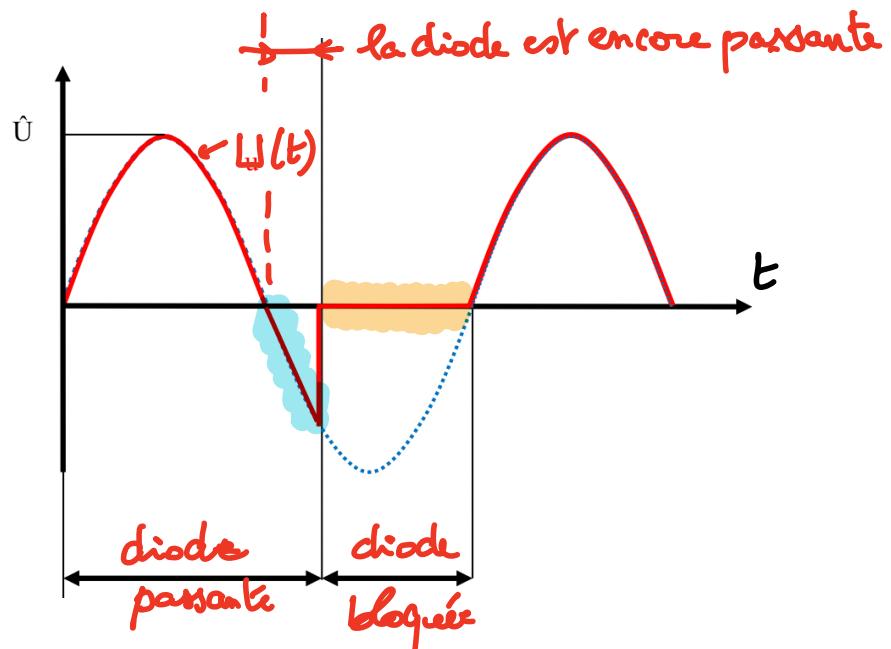
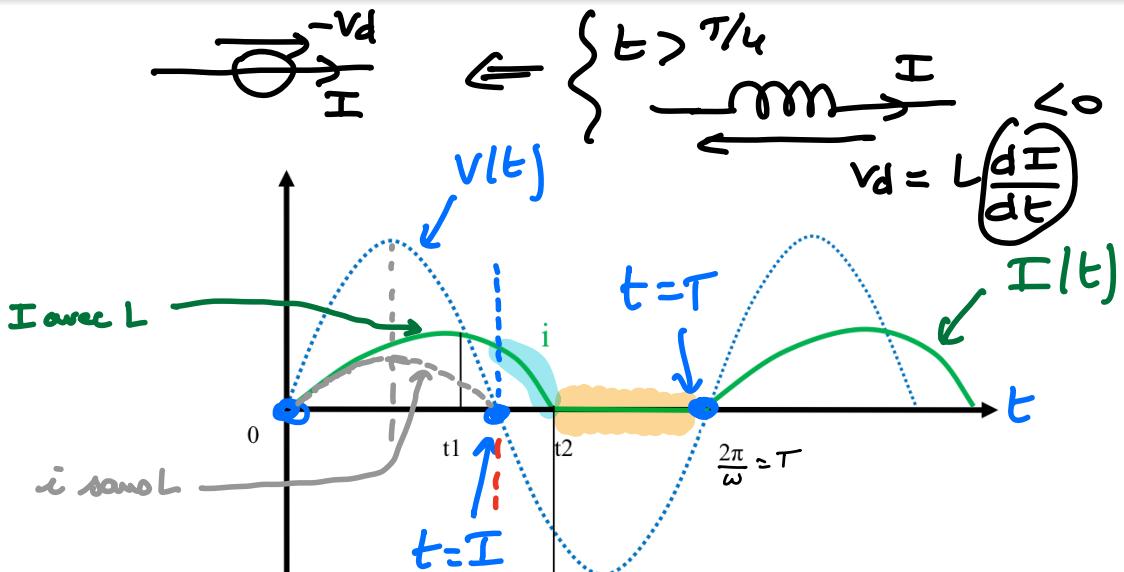
$$\text{énergie stockée } \Sigma = \frac{1}{2} L I^2$$

done $0 < t < \frac{I}{2}$, $I \uparrow \Rightarrow \xi \uparrow$

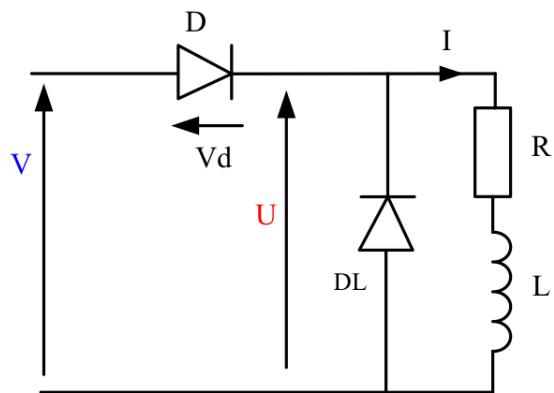


schema

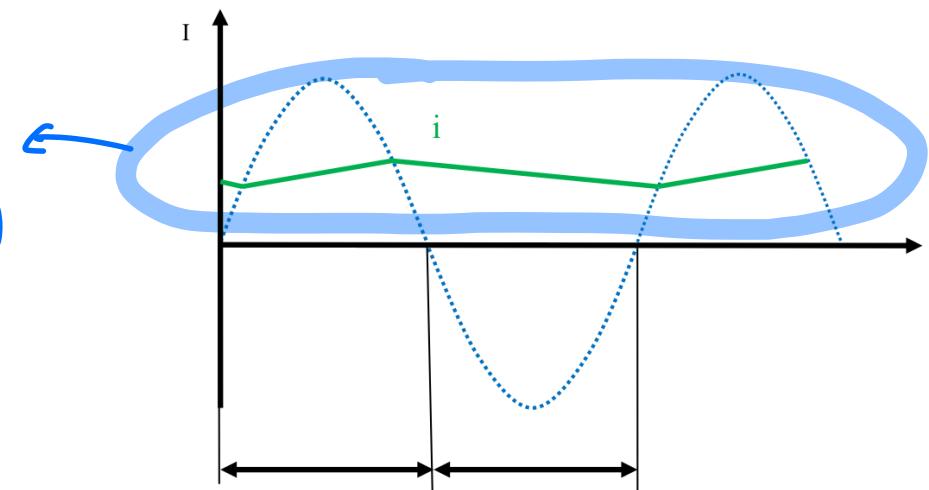
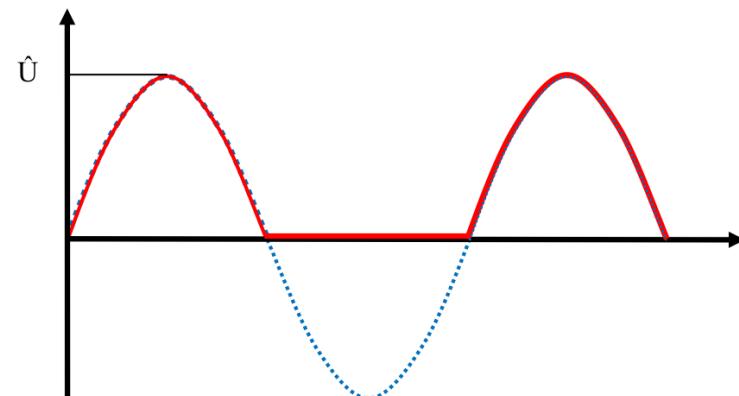
A hand-drawn blue rectangle with a vertical line through it, representing a switch or button.



Hacheurs



$I \approx \text{cst}$
pour alimenter
un moteur (L)

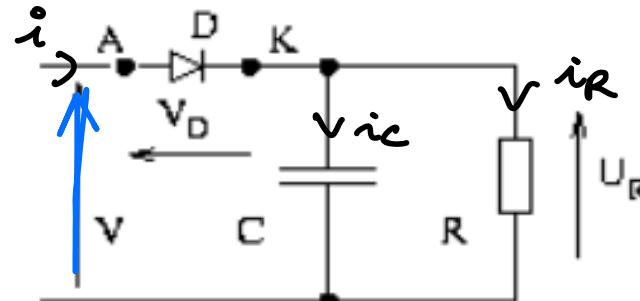


2.A Redressement de tensions sinusoïdales

2.3 redressement monoalternance : filtrage

Montage

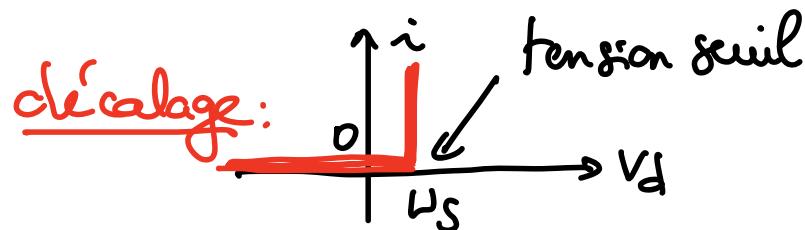
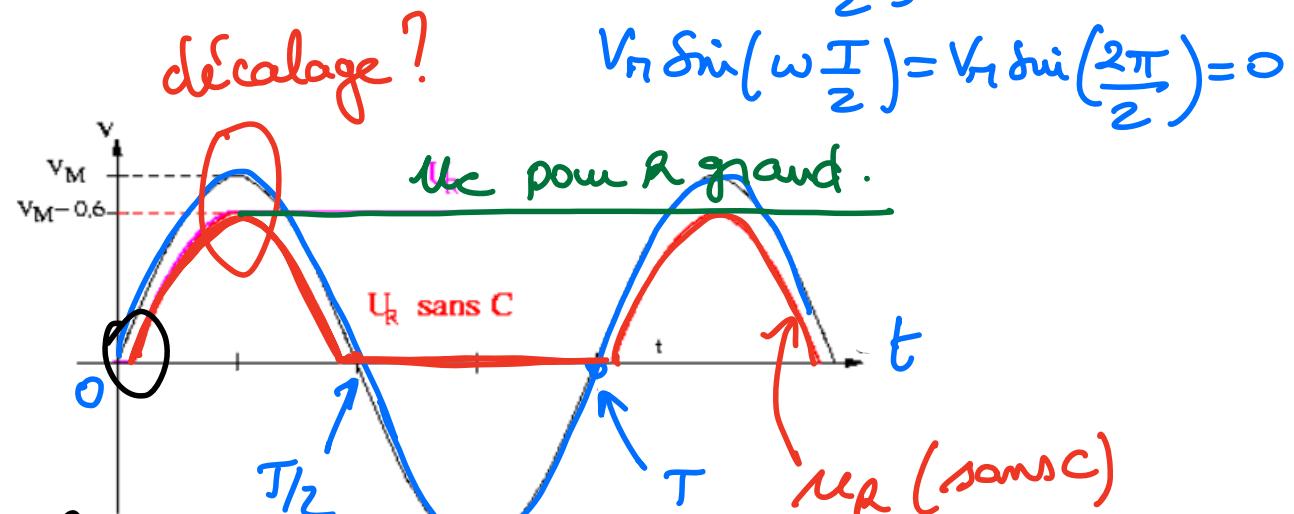
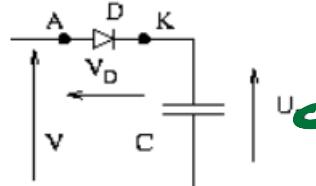
$$\begin{cases} \omega = 2\pi/T \\ v(t) = V_m \sin(\omega t) \end{cases}$$



Deux cas à analyser : 1) diode passante 2) diode bloquée $v(t=\frac{T}{2})=0$?

Cas idéal : $R \rightarrow \infty$

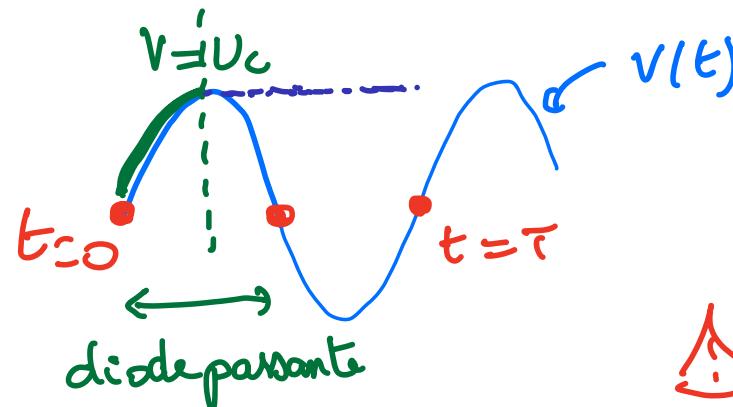
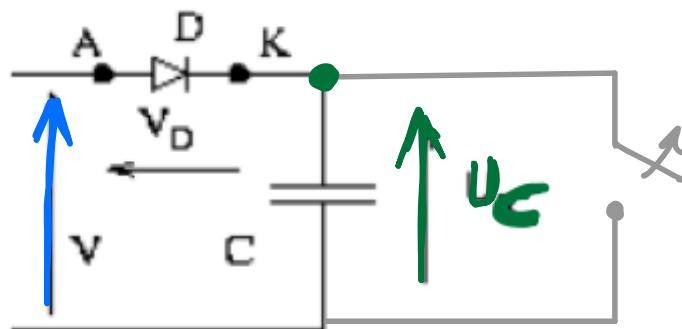
Si R est grand



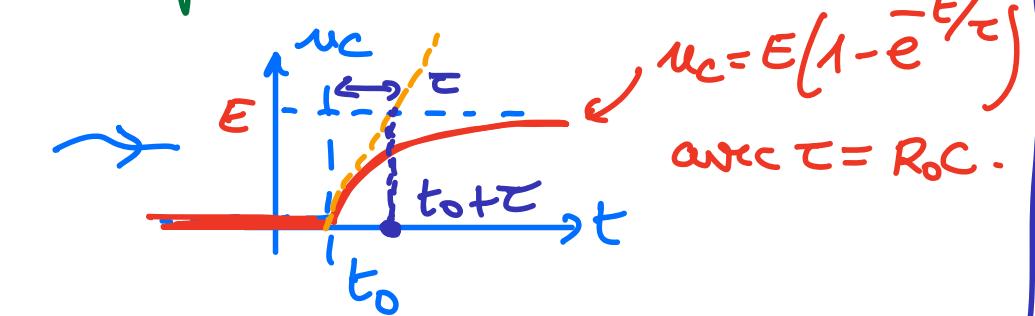
Si R est grand

$$U_R = R i_R \Rightarrow i_R = \frac{U_R}{R} \xrightarrow[R \rightarrow \infty]{} 0 \quad \text{denn}$$

A hand-drawn diagram illustrating an interrupted circuit. It features a horizontal blue line representing a wire. A vertical blue line extends upwards from the left end of the horizontal wire. From the top of this vertical line, a diagonal blue line extends downwards and to the right, forming an 'X' shape. This configuration represents a break or interruption in the electrical circuit.



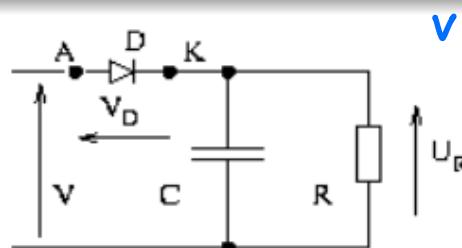
The diagram shows a circuit consisting of a battery with electromotive force $e(t)$, a resistor R_0 , and a capacitor C . The voltage across the capacitor is labeled $c(t)$. To the right, a graph plots current i against time t . The current starts at zero at time t_0 and increases linearly with time, representing exponential growth.



donc ici $R_0 = 0$ donc $\tau = 0$ donc la "charge" de C est instantanée.

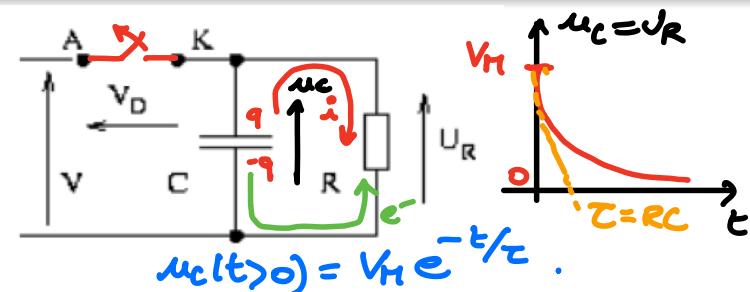
2.A Redressement de tensions sinusoïdales

2.3 redressement monoalternance : filtrage



$$v(t) = V_M \sin(\omega t)$$

$$\left\{ \begin{array}{l} R \neq 0 \\ R \neq \infty \end{array} \right.$$

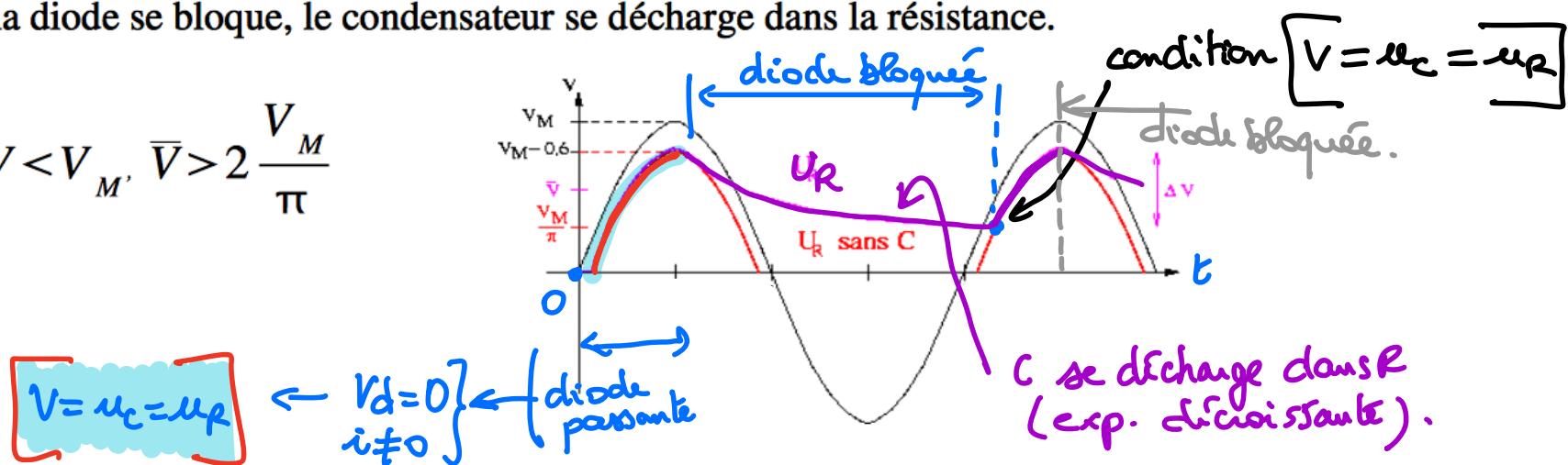


Cas d'une résistance non nulle

Quand la diode est bloquée, le condensateur se décharge dans la résistance

Dès que la diode se bloque, le condensateur se décharge dans la résistance.

$$\Delta V < V_M, \quad \bar{V} > 2 \frac{V_M}{\pi}$$



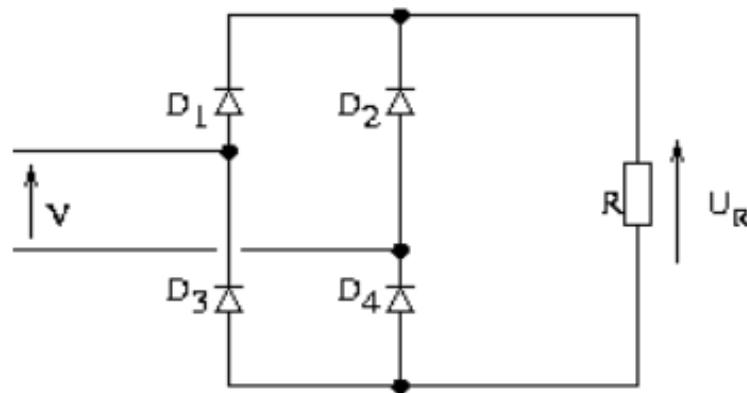
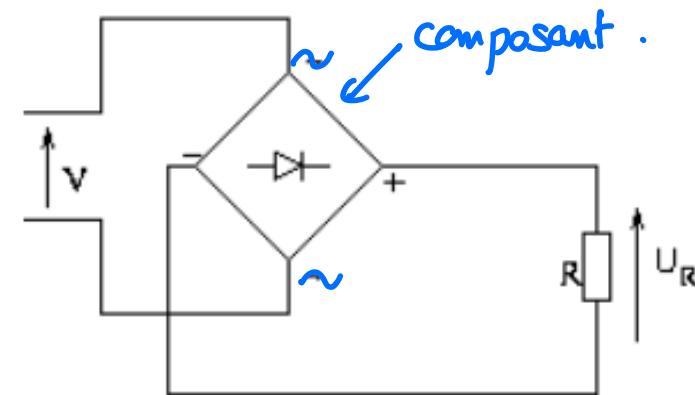
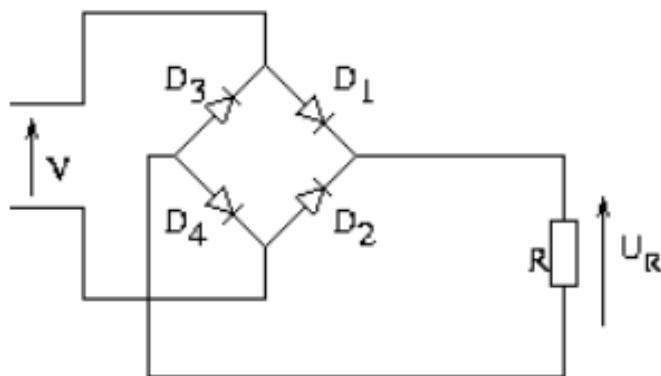
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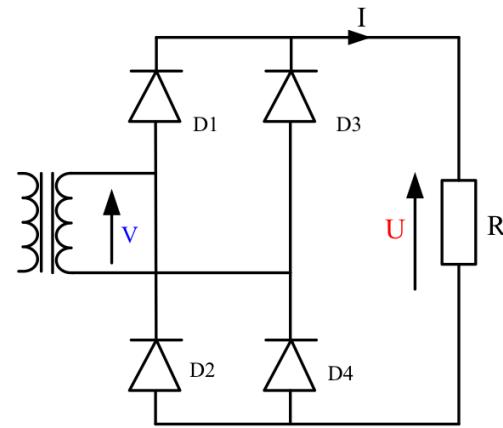
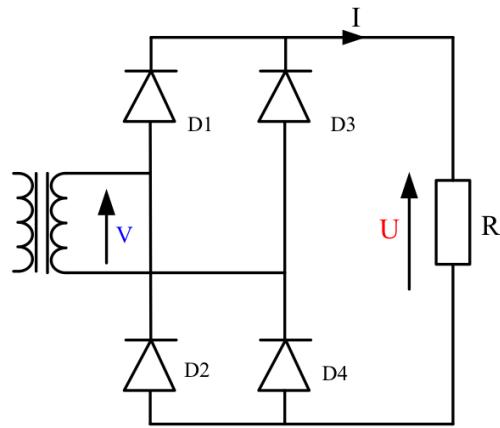
2.4 redressement bialternance : montage

Montage : utilisation de l'inversion du courant

On maintient un courant de même signe dans la résistance.

Pont de GRAETZ





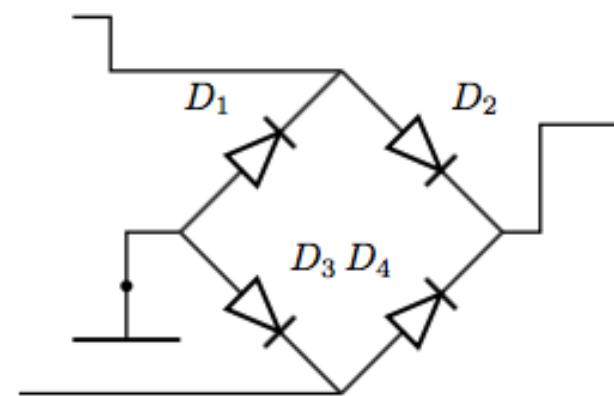
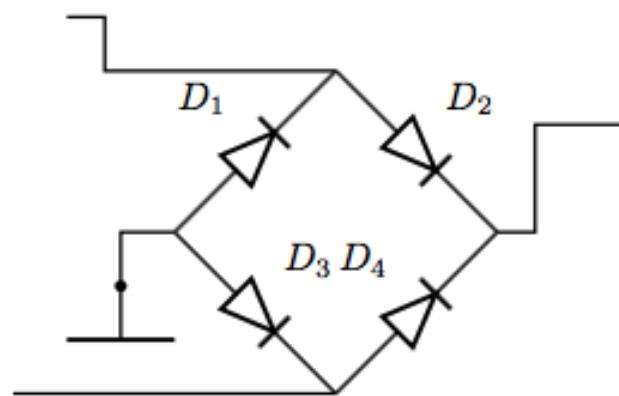
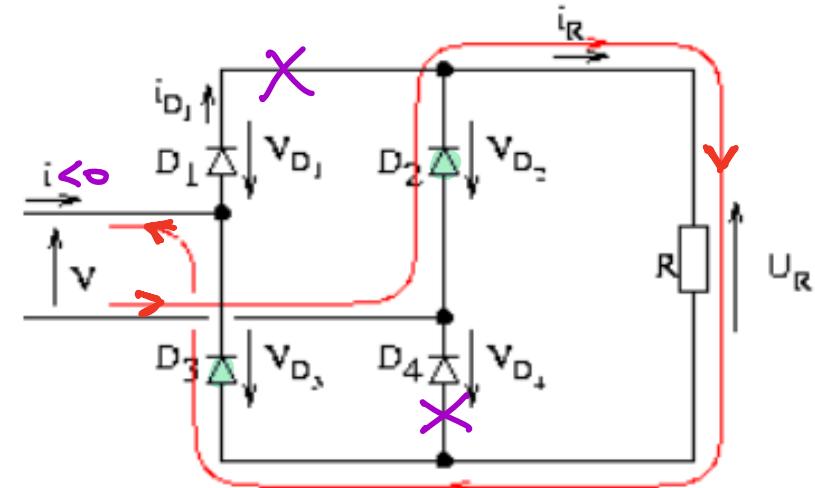
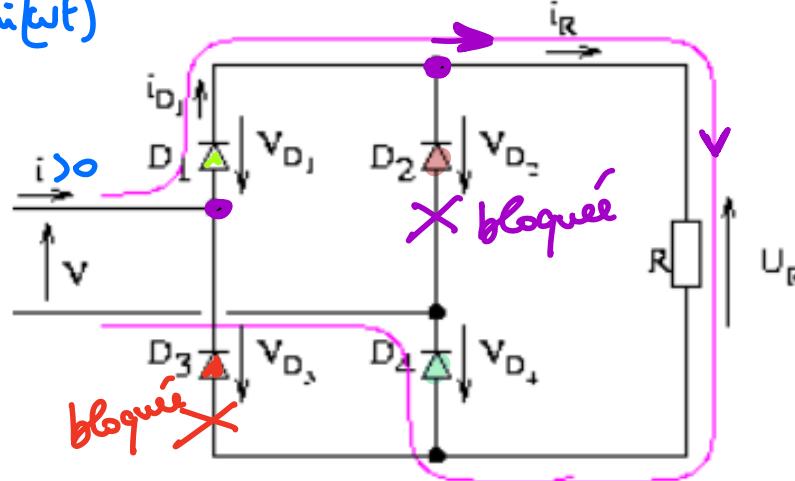
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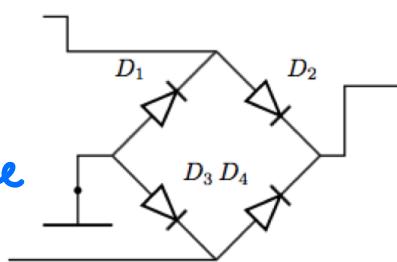
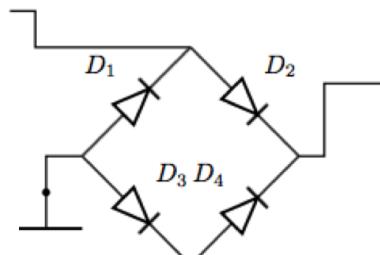
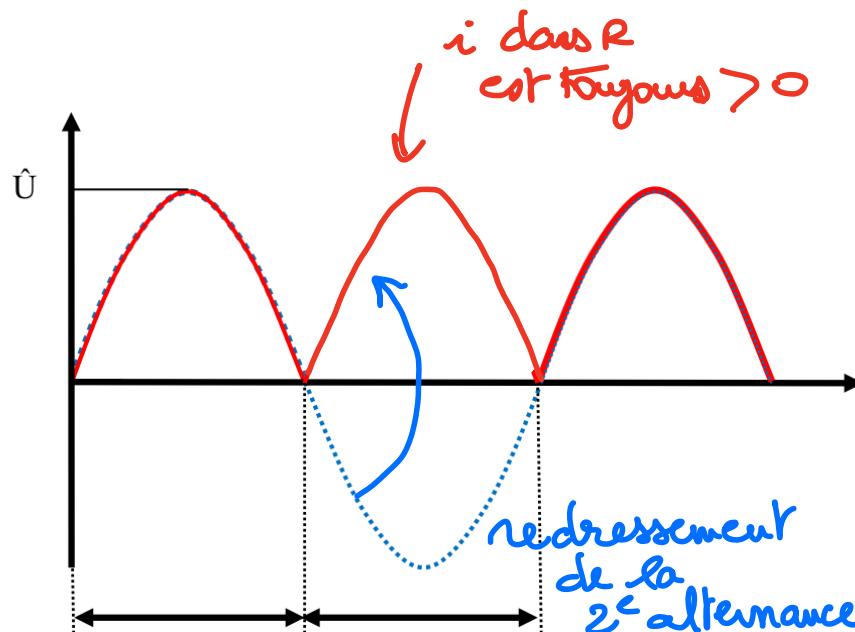
2.4 redressement bialternance : fonctionnement

Parcours du courant

On maintient un courant de même signe dans la résistance.

$$v(t) = V_m \sin(\omega t)$$



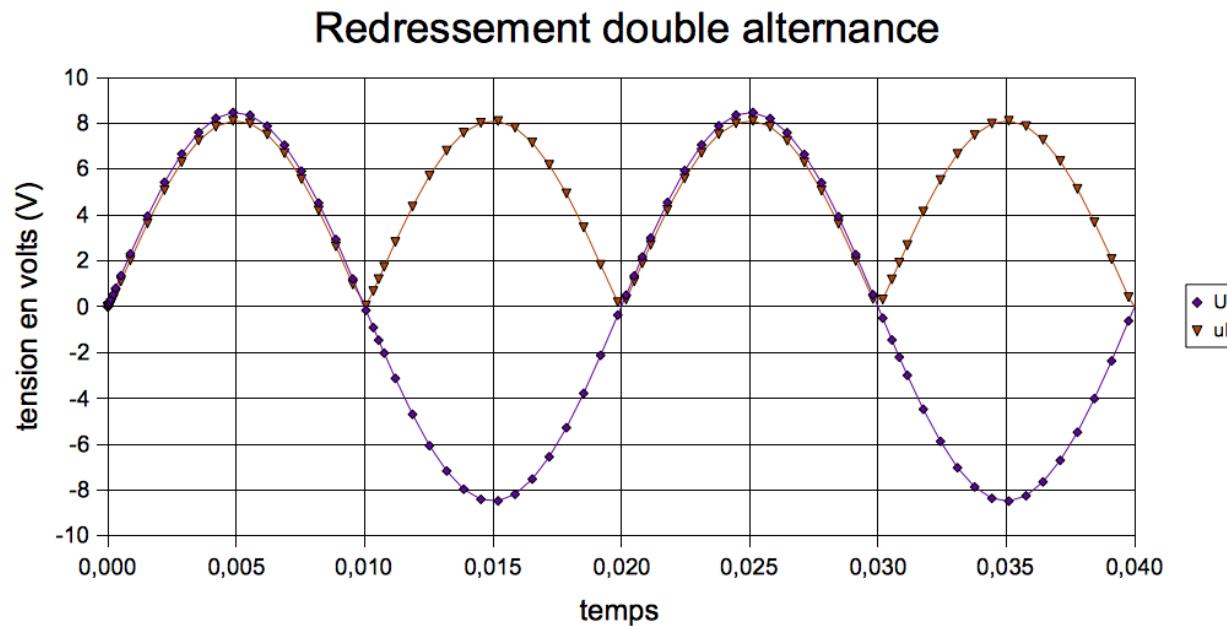


2.A Redressement de tensions sinusoïdales

2.5 redressement bialternance : signaux

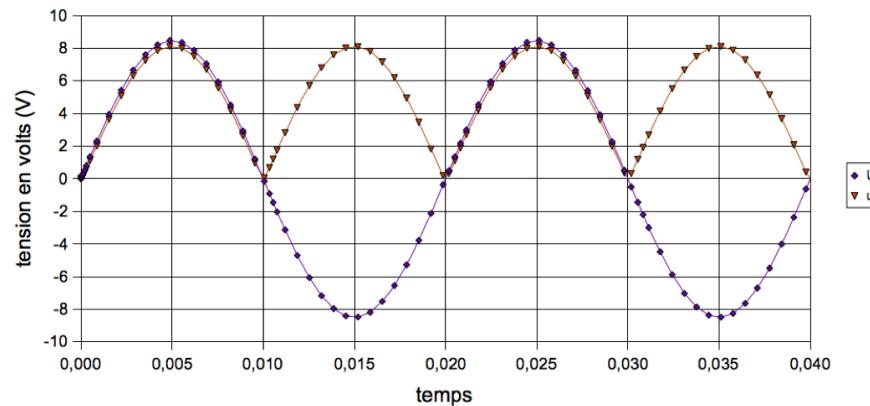
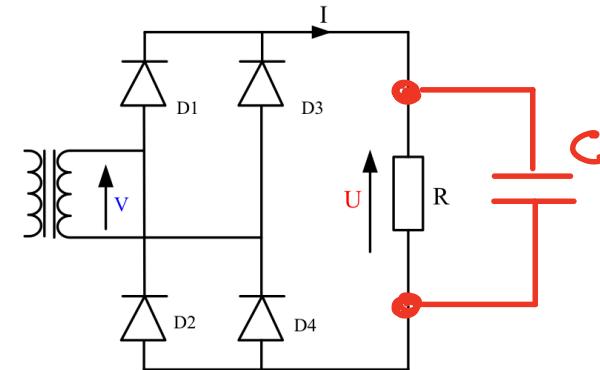
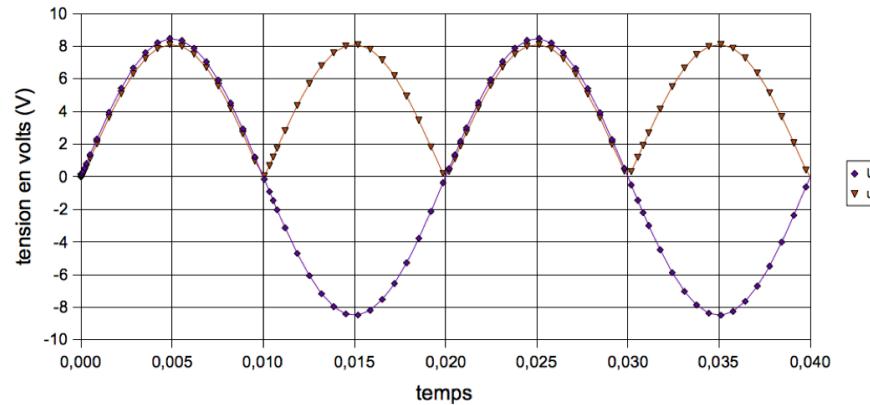
forme du signal bialternance

Pour un signal d'entrée $v_e(t) = V_m \sin(\omega t)$, on obtient la valeur absolue si les tensions seuils des diodes sont négligeables



Intérêt : la valeur moyenne est non nulle.

But ultérieur : lissage de cette tension.

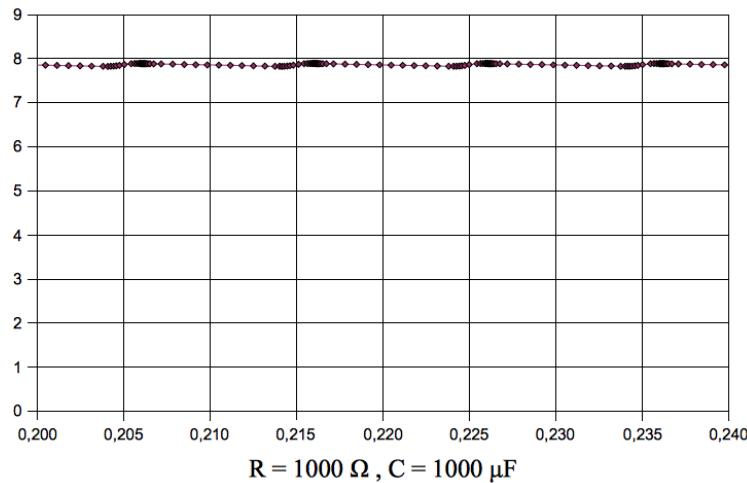
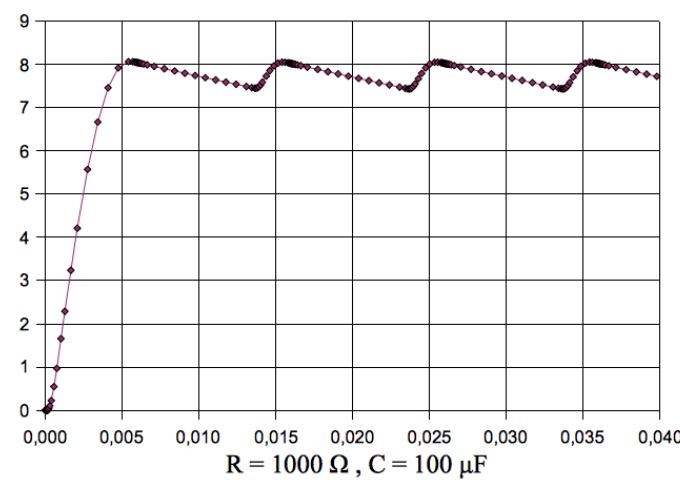
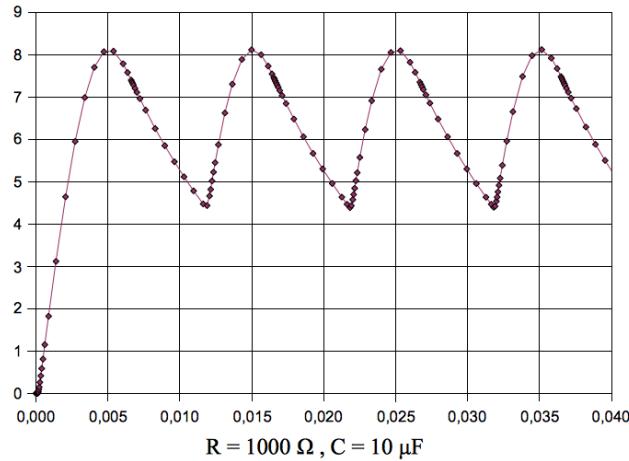


2.A Redressement de tensions sinusoïdales

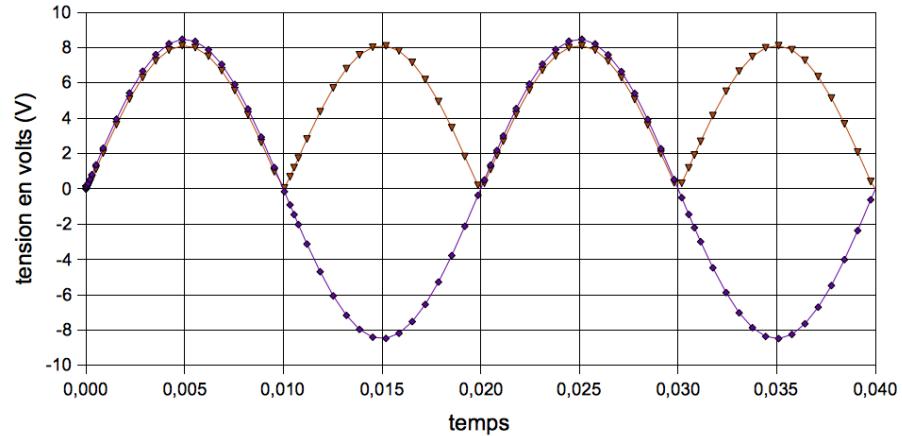
2.6 redressement bialternance : lissage

forme du signal bialternance

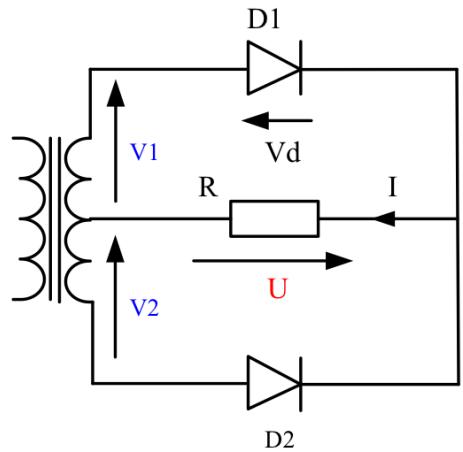
On utilise un condensateur en parallèle avec la charge R



Redressement double alternance



Autre redressement :



redressement triphasé simple alternance (P3)

