PW AVANCED POWER ELECTRONIC

PW N^{r}2
AC/ DC Converter
Rectifier

Objective :

Part 1 :

- Learn to know the rectification effect of an uncontrolled double-wave bridge.

- Recognize that a smoothing coil has the effect of direct current no longer running in a sinusoidal manner.

-Recognize that the mains current is distorted in a rectangular manner in the event of strong smoothing. -Recognize that the dewatted control power is zero.

Part 2:

-Learn to know the rectifying property of fully controlled full-wave rectifiers.

-Recognize that negative voltage-time surfaces appear in case of inductive ohmic load -Recognize that the ability to control the voltage depends on the load.

-Recognize that the sector current is rectangular in the event of strong smoothing.

- Recognize that the dewatted power is linked to the control of the thyristors.

1- Reminder:

1.1- Uncontrolled double-wave rectifier:

It is a symmetrical assembly in which two diodes conduct at the same time each half period. The operation of the diagram is illustrated by diagrams of input AC voltage, output DC voltage and ohmic load current, given in the following figure:

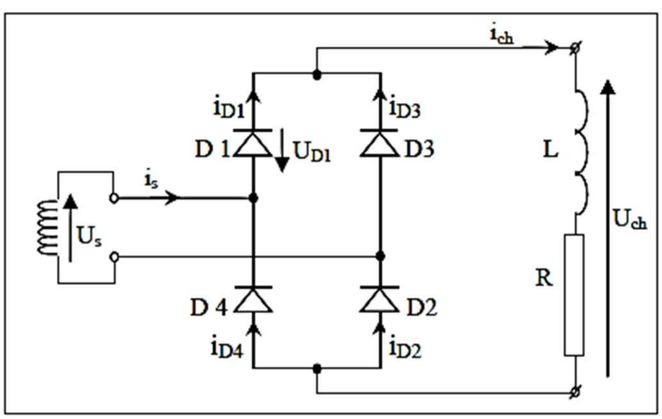

Figure 1. uncontrolled double-wave rectifier.

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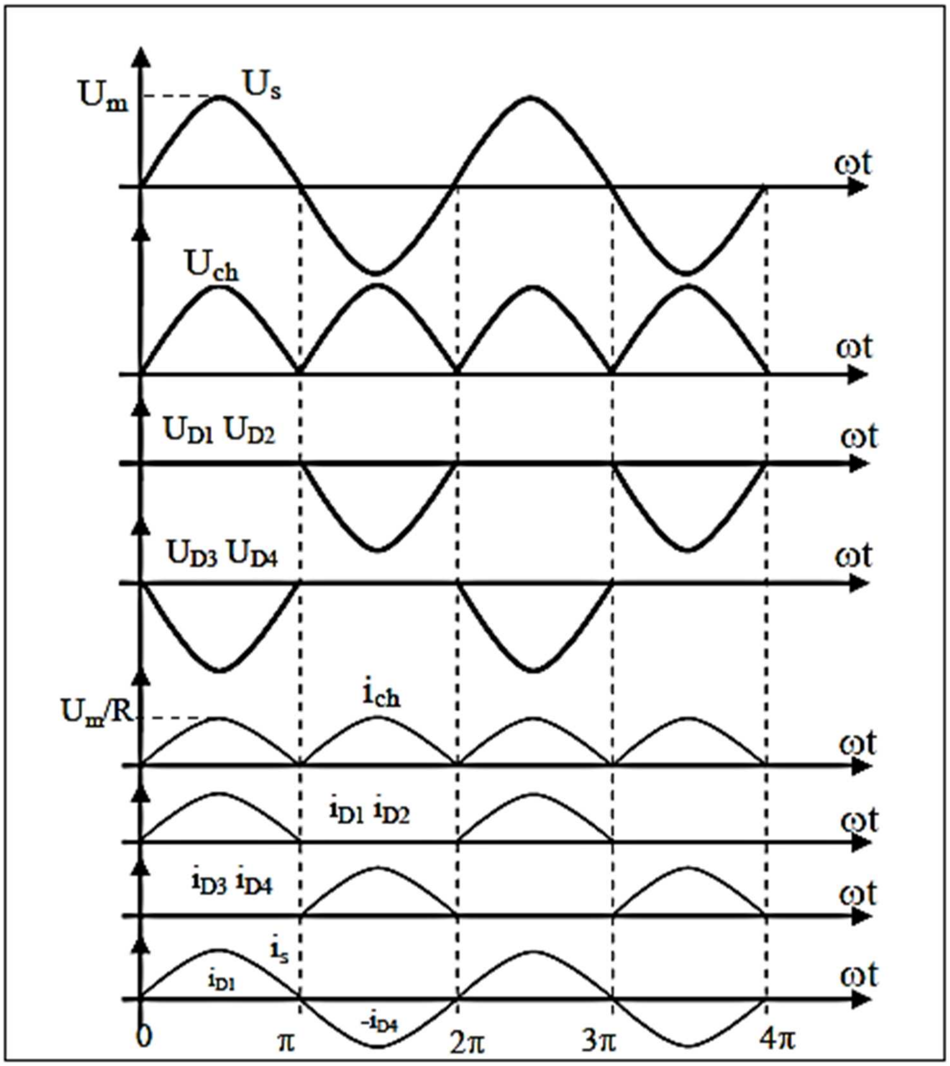
The single-phase bridge rectifier assembly includes four diodes, which work in pairs, D1, D2 and D3, D4. During the positive half-wave ($0<\omega t<\pi$) of the input voltage U1, diodes D1-D2 conduct. Conversely, the other pair D3-D4 is conductive during the negative half-wave ($\pi<\omega t<2\pi$). The waveforms of the parameters describing the operation of the assembly with a purely resistive load are represented in the figure below, the output voltage Uch copies the input voltage.



In the case of the uncontrolled two-pulse rectifier with ohmic-inductive load as shown in the figure above, As the inductance value increases, the smoothing effect intensifies, and the output current becomes almost constant.

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The average value of the output voltage is:

$$U_{chmoy} = \frac{2U_{smax}}{\pi}$$

The effective value of the output voltage is:

$$U_{cheff} = \frac{U_{smax}}{\sqrt{2}}$$

1.2- Double-wave rectifier controlled:

It is a symmetrical assembly in which two thyristors conduct each half-period (T1, T2) and (T3, T4) at the same time. When the load becomes sufficiently inductive, its current is continuous and the thyristors can no longer turn off spontaneously; it is then, the priming of the opposite pair which will block them demonstrated in the figure below:

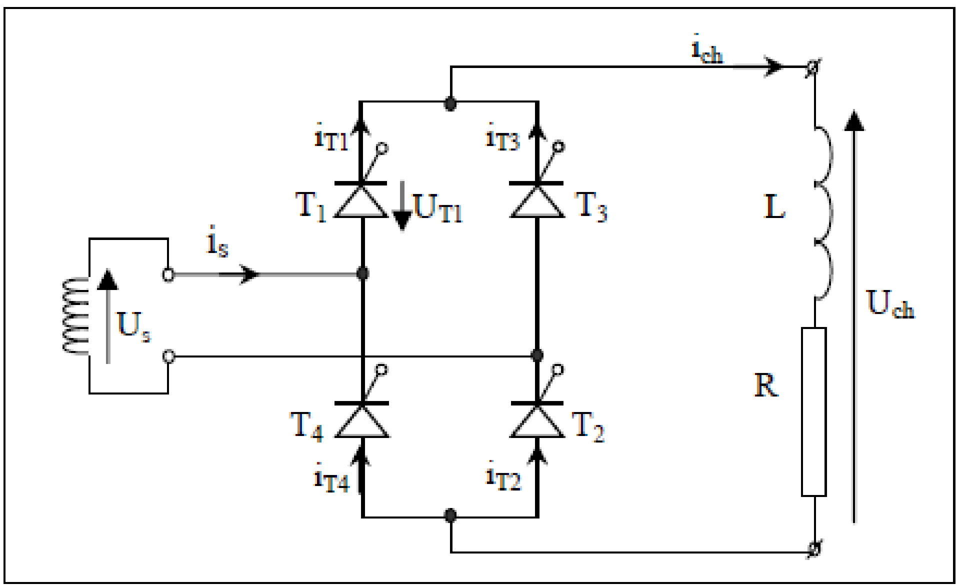

Figure 2. Controlled double-wave rectifier.

The operation of the diagram is illustrated by diagrams of alternating input voltage, direct output voltage and ohmic load current, given in the two figures below:

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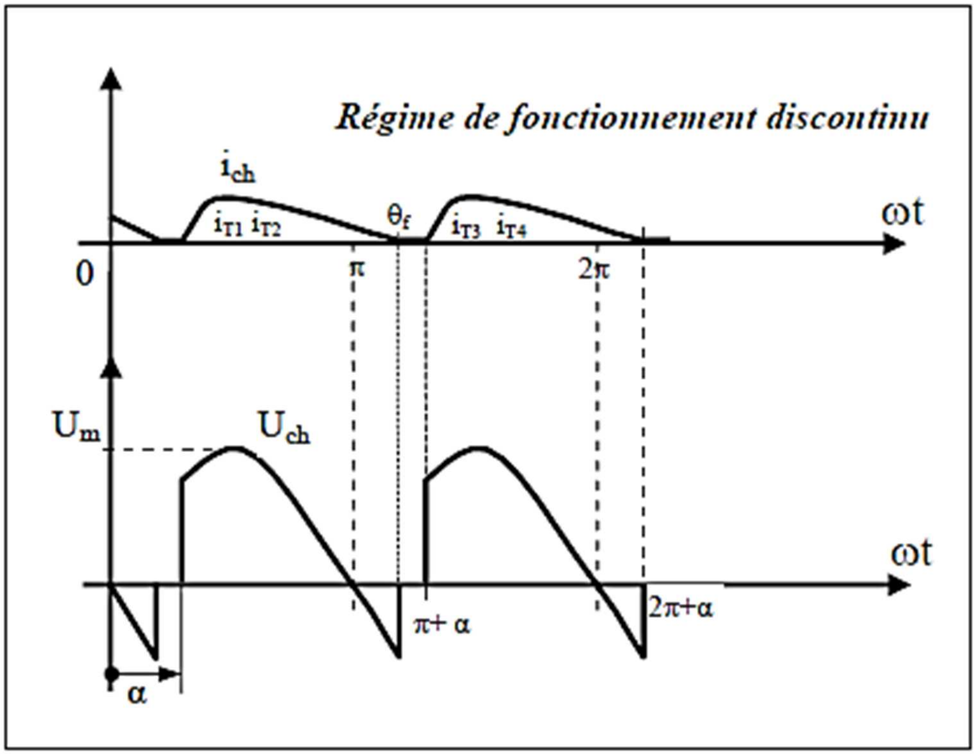

Discontinuous conduction operation is characterized by the spontaneous extinction of the current in the load before the next pair of thyristors becomes conductive. This results in a zero crossing of the current from an instant θf, which depends on the load.

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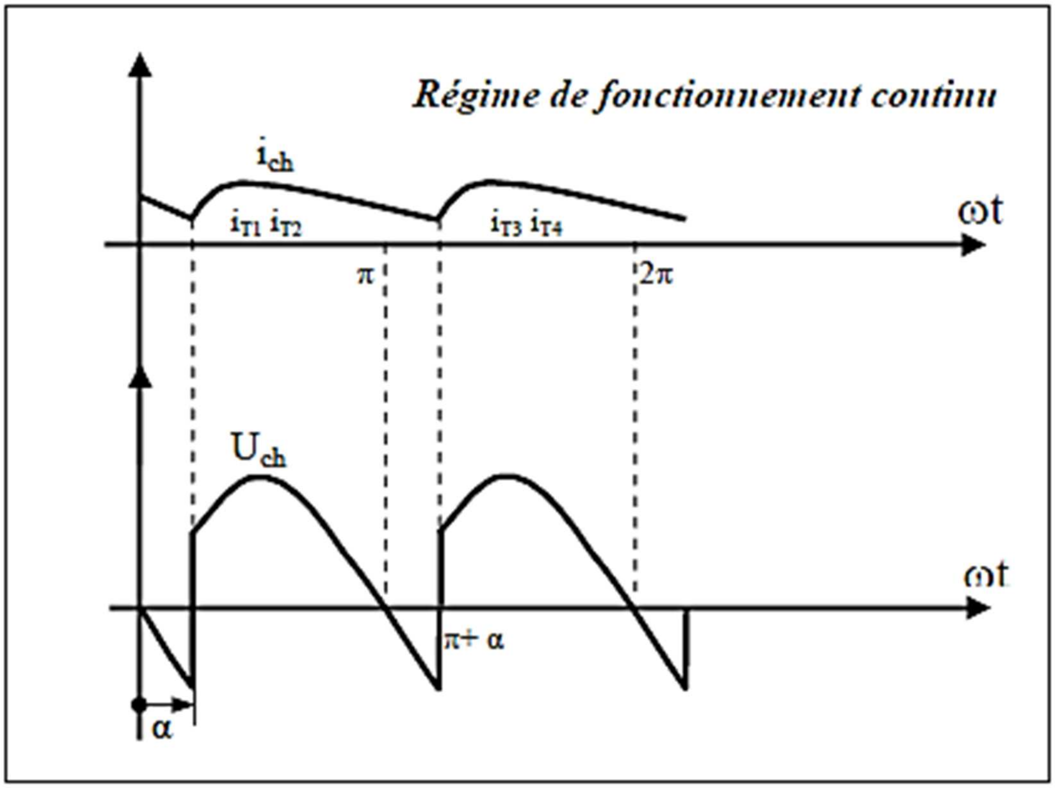

During the positive half cycle, the thyristors T1 and T2 are direct biased; they are triggered simultaneously at ωt=α and the input voltage appears across the load. Because of the inductance of the load, the thyristors T1 and T2 continue to conduct beyond the instant ωt=π. During the negative half-cycle of the input voltage, thyristors T3 and T4 are forward biased. When T3 and T4 turn on at ωt=π+α, the forward voltages of thyristors T1 and T2 reverse. T1 and T2 block and the load current ich is transferred from T1 and T2 to T3 and T4.

For a continuous operating regime:

The average value of the output voltage is:

$$U_{chmoy} = \frac{2U_{smax}}{\pi} \times cos\alpha$$

The rectified load voltage can vary from 2Um/π to zero (0) by varying the firing angle α from zero (0) to π.

The effective value of output voltage:

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$$U_{cheff} = \frac{U_{smax}}{\sqrt{2}}$$

2- Handling:

2-1- Carry out the assembly of Figure 1 on a PC with Matlab/Simulink.

2-2- Carry out the assembly of Figure 2 on PC with Matlab/Simulink.

Deduce for the two assemblies:

The Usmax value. The value of Us, Usmoy, Useff.

The values of the currents iD1, iD2.

The values of the currents iD3, iD4.

The values of the current iT1, iT2.

The values of the current iT3, iT4.

The current value ich.

Data :

Input voltage Us=325V.

R= 10Ω.

L= 0.1 H.

Frequency f= 50Hz.