

**PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA  
MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH**

**MOHAMED BOUDIAF UNIVERSITY - M'SILA**



**FACULTY OF SCIENCE  
PHYSICS DEPARTMENT  
OPTION: Energy Physics and  
Renewable Energies**

**DOMAIN: Material Sciences  
FIELD: Physics**

**1<sup>st</sup> Year Master  
Energy Physics and Renewable Energies**

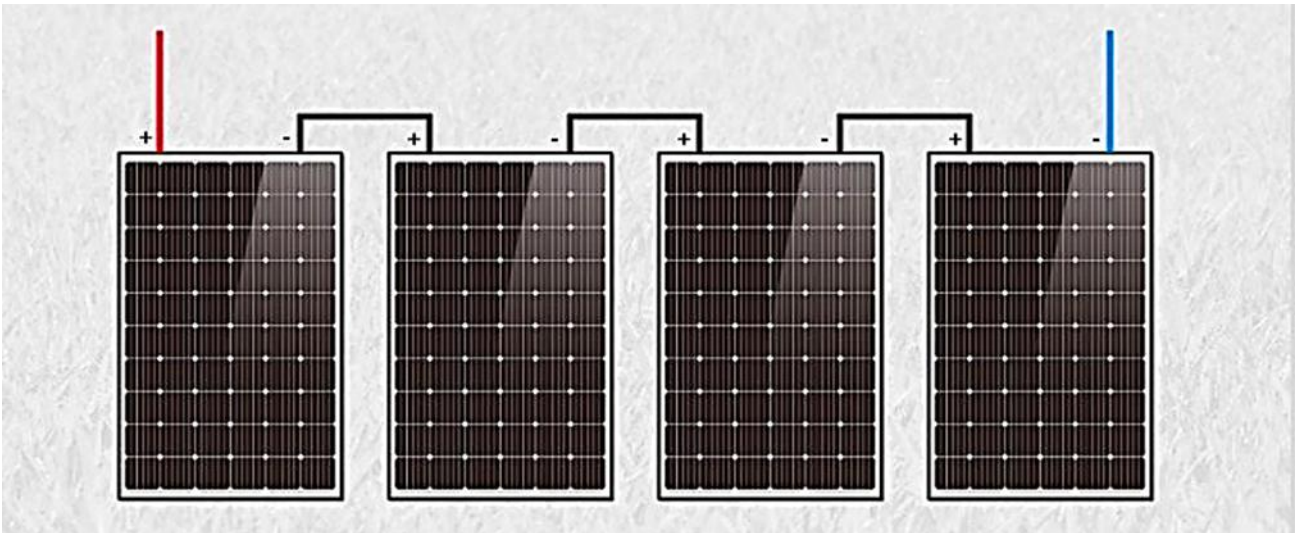
**Practical Work N°: 02  
Installation of Photovoltaic Panels in Series**

**Academic year : 2023/2024**

## 1-What is series connection of panels?

Series connection means that you connect the solar panels one after the other, so that the electrical current flows from one panel to the next. The current is therefore the same in all the panels. The total voltage of the system is the sum of the voltages of each panel. For example, if you connect three 12-volt panels in series, you will get a total voltage of 36 volts.

To connect in series, connect the positive poles of one module to the negative poles of another.



**Figure 1.** Connecting panels in series

## 2- Advantages and disadvantages of series connection

### 2-1. Advantages

- Higher voltage: Series connection gives a higher total voltage, which is ideal for systems requiring higher voltage.
- Easier to install: Series connection is easier to install than parallel connection, as less wiring is required.
- Less wiring loss: With series connection, there is less wiring loss because less wiring is required.

### 2-2. Disadvantages

- More sensitive to shadows: With series connection, if a panel is shaded, this can reduce the energy output of the whole system.
- Limited current: Connection in series can limit the total current that the system can produce.

## 3- How do I choose between series or parallel connection?

- The choice between series or parallel connection will depend on your needs and your solar system.

Here are a few things to consider to help you decide:

- Voltage required if your system requires a higher voltage, series connection may be the most appropriate choice. If you need a lower voltage, parallel connection may be more suitable.
- Available space: If you have limited space, parallel connection may be the best option, as it requires less space than series connection.
- Shading: If your installation is likely to be partially shaded, parallel connection may be preferable to avoid shading affecting the whole system.

#### 4- Electrical measurements

Measurement is playing an increasingly important role in the electrical and electronic sectors. Measurement is used for the following purposes

- experimental verification of a circuit
- Modelling, fine-tuning or troubleshooting an assembly;
- Certification of a process or product, in the industrial sector;
- maintenance or repair of an electrical or electronic device.

In the electrical and electronic field, several types of measuring equipment are used, such as:

- The voltmeter (analogue and digital) to measure voltages;
- Ammeters, to measure current;
- The wattmeter, to measure power;
- Ohmmeters for measuring resistance, etc.

The voltmeter, ammeter and ohmmeter are often combined in a single device called a multimeter. Most multimeters also have a component tester (diodes and transistors). Some models are equipped with a capacitance meter (for measuring capacitance), a frequency meter, etc...



**Figure 1.** Measuring instruments

Given the specific difficulties involved in measuring the current in a circuit, as soon as the amperage exceeds a few tens of amperes, the current clamp is used. Other measuring devices commonly used by electricians and electronics engineers include oscilloscopes, which can be used to display the shape of a wave and obtain a wide range of information (amplitude, period, etc.).

Draw a diagram of the 2 voltaic panels in series with the ammeter and voltmeter and fill in the following tables

<b>Times</b>	<b>Voltage (V)</b>	<b>Intensity (A)</b>	<b>Power (W)</b>
t = .....mn			
t = .....mn			
t = .....mn			
t = .....mn			
t = .....mn			
t = .....mn			
t = .....mn			
t = .....mn			
t = .....mn			

### Questions

- 1- Draw the current curve as a function of time.
- 2- Plot the voltage versus time curve.
- 3- Plot the current versus voltage curve.
- 4- Plot the power versus voltage curve.
- 5- Interpret these curves.
- 6- Is a series or parallel connection more efficient?
- 7- Is series or parallel connection easier to install?
- 8- Is series or parallel connection more suitable for large solar systems?
- 9- Can series connection be used with solar panels of different sizes?
- 10- Give a conclusion
- 11- Is series or parallel connection more efficient?
- 12- Is series or parallel connection easier to install?
- 13- Is series or parallel connection more suitable for large solar systems?
- 14- Can series connection be used with solar panels of different sizes?