

Analysis of a Photovoltaic (PV) JV Curve Under Varying Light Intensities

ELEC0148 – 14/11/2025

Objective

To analyze the current-voltage (JV) characteristics of a photovoltaic (PV) cell under different light intensities, extract key performance parameters, and interpret their significance in relation to real-world solar cell efficiency.

Tasks

1. Introduction (15%)

- Briefly explain what a photovoltaic cell is and its function.
- The data you are analyzing today comes from a perovskite solar cell, what is a perovskite solar cell and how do they differ from organic solar cells? (discuss the key differences)
- Define the JV curve and its significance in characterizing PV performance.
- Explain the key parameters derived from the JV curve:
 - **Open-circuit voltage (V_{OC})**
 - **Short-circuit current (I_{SC})**
 - **Maximum power point (V_{MP} , I_{MP})**
 - **Fill factor (FF)**
 - **Efficiency (η)**

2. Data Analysis (35%)

- Plot all the given JV curves using appropriate software (Excel, Python, MATLAB). The area of the solar cells is 0.045 cm^2 . The common units are mA/cm^2 for current density, convert accordingly.
- For intensities 100%, 50%, and 10%: Identify V_{OC} (voltage where current is zero) and I_{SC}/J_{SC} (current where voltage is zero).
- For intensities 100%, 50%, and 10%: Determine V_{MP} and I_{MP} from the peak power point.
- For intensities 100%, 50%, and 10%: Calculate the **fill factor (FF)** using the formula:

$$FF = \frac{V_{MP} \cdot I_{MP}}{V_{OC} \cdot I_{SC}}$$

- For intensities 100%, 50%, and 10%: Compute the **efficiency (η)** given the incident power P_{in} using:

$$\eta = \frac{V_{OC} I_{SC} FF}{P_{in}}$$

3. Discussion & Interpretation (30%)

- Why does I_{SC} increase linearly with intensity?
- Why does V_{OC} increase logarithmically rather than linearly?
- How do resistive effects impact FF and efficiency at different light intensities?
- From your results, discuss how perovskite solar cells perform under low light intensities.
- Why do solar panels perform differently under cloudy vs sunny conditions?

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4. Conclusion (10%)

- Summarize key findings and their significance.
- Reflect on the broader implications for solar technology development.

5. Presentation & Clarity (10%)

- Proper structure, grammar, citations (if external sources used).
- Clear, well-labelled graphs and calculations.

Submission Requirements

- A **concise report** (3-5 pages maximum) with figures, calculations, and discussions.
- Code or spreadsheet used for analysis (if applicable).
- Due date: 28/11/2025