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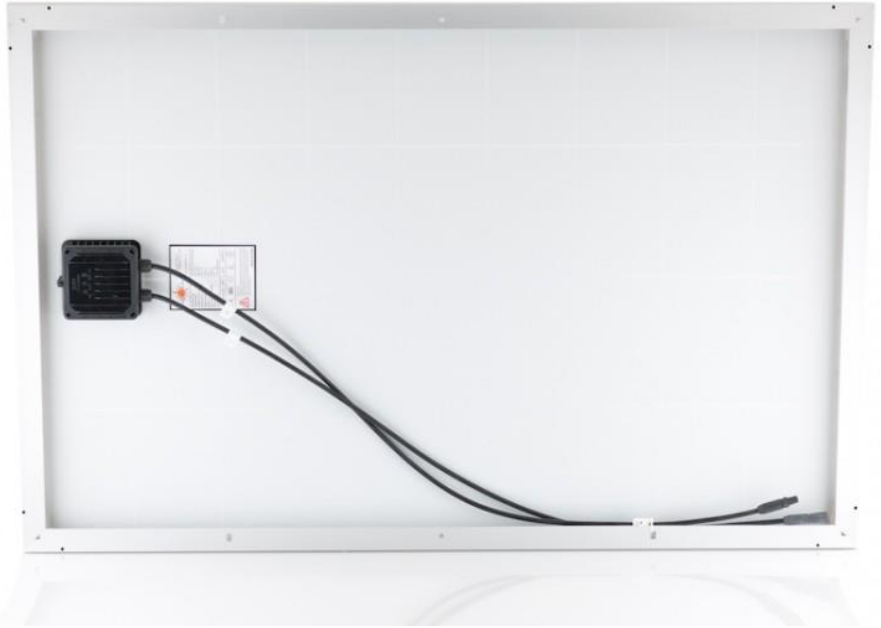
PV 101

- PV Module Basics

PV Modules (Solar Panels)



Learning Objectives

- Describe the photovoltaic effect
- Explain differences in monocrystalline and polycrystalline cells
- Identify the five electrical parameters of PV modules

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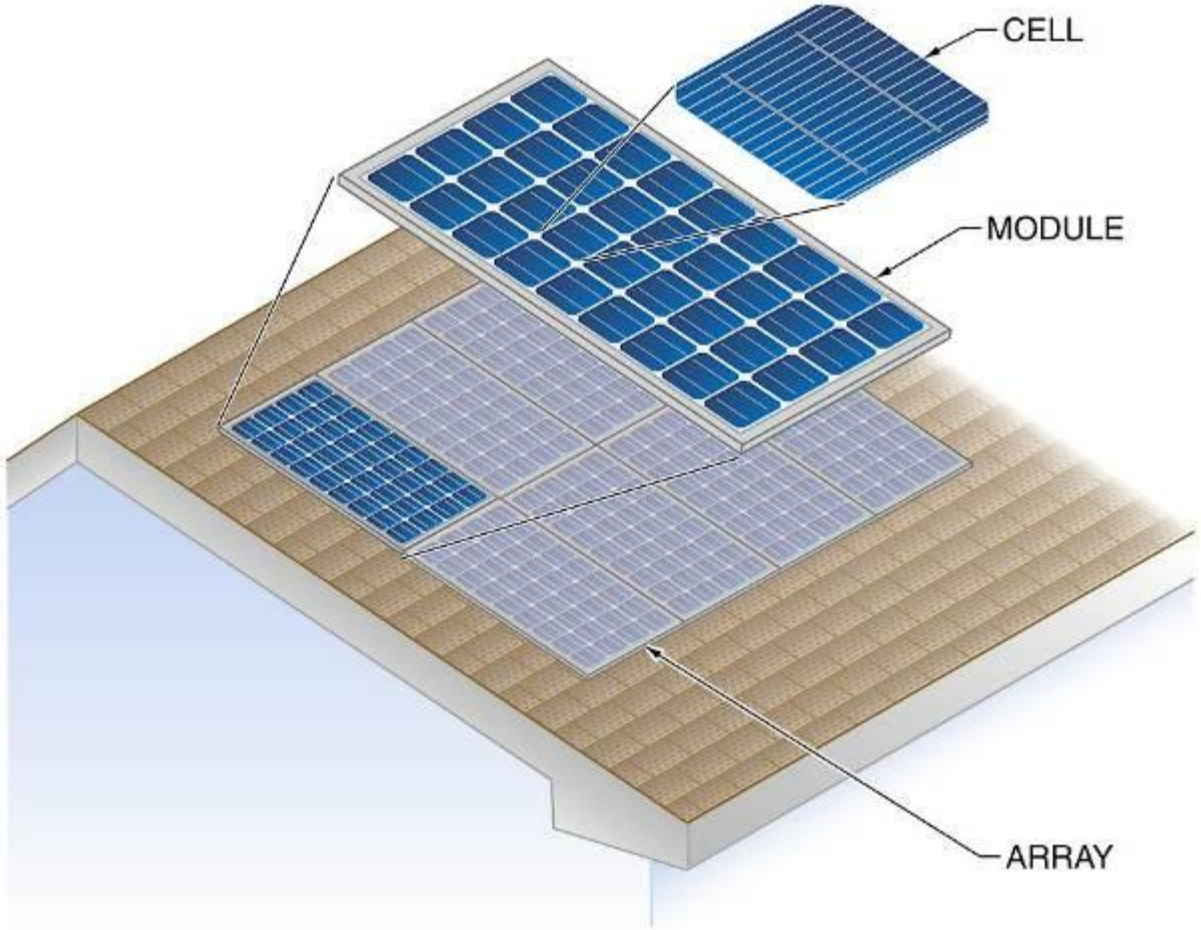
PV Module Basics



- The basic building blocks for PV systems include cells, modules, and arrays.

Image from Photovoltaic Systems 2nd Edition, by James Dunlop

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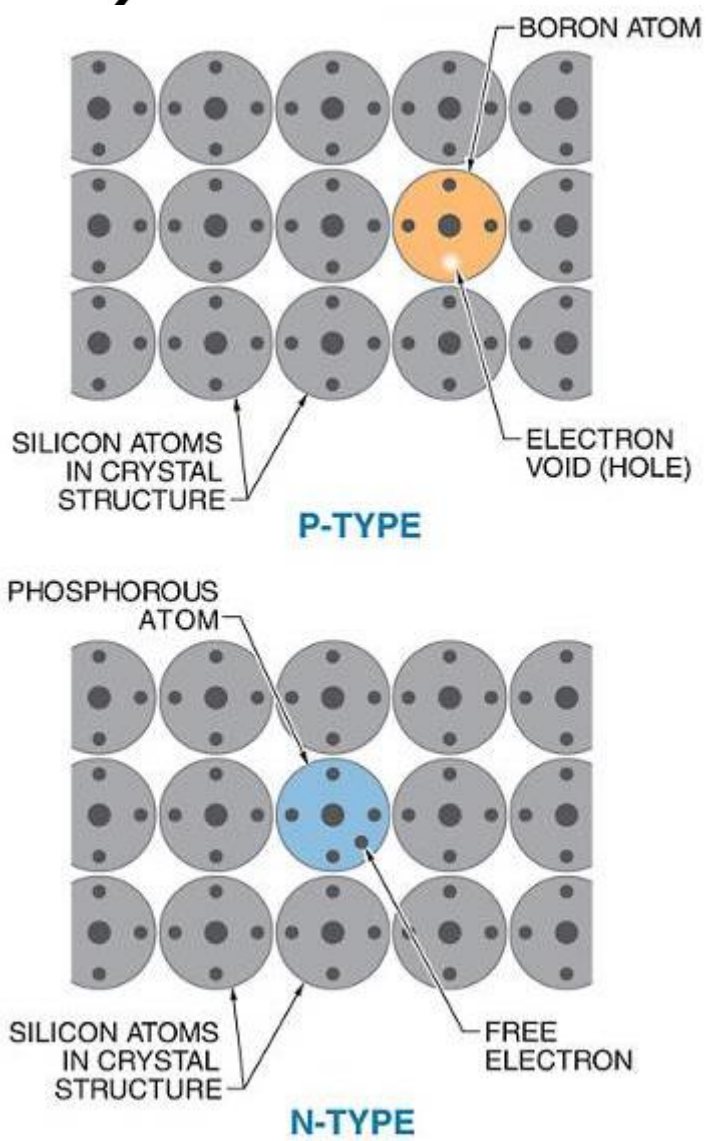

- Semiconductor materials with special electrical properties can be made by adding small amounts of other elements to silicon crystals.

Image from Photovoltaic Systems 2nd Edition, by James Dunlop

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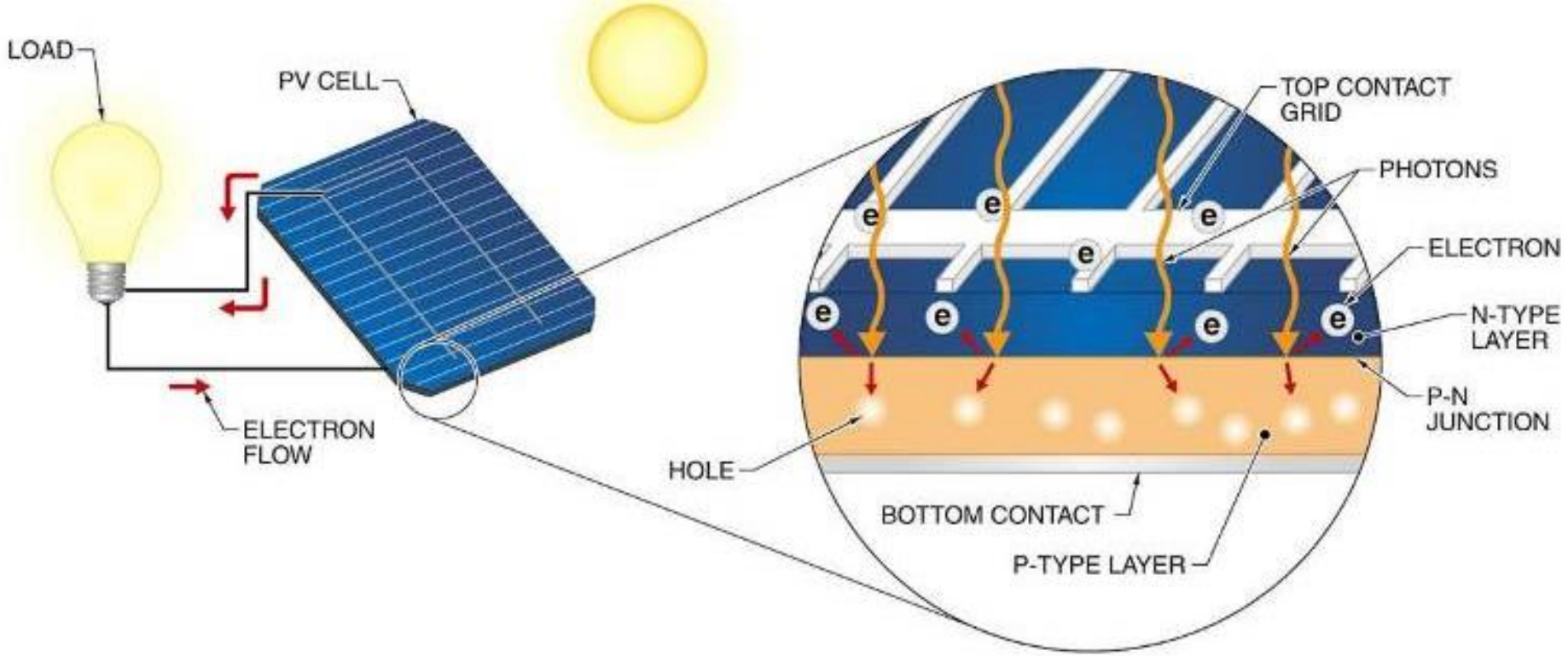

- The photovoltaic effect produces free electrons that must travel through conductors in order to recombine with electron voids, or “holes.”

Image from Photovoltaic Systems 2nd Edition, by James Dunlop

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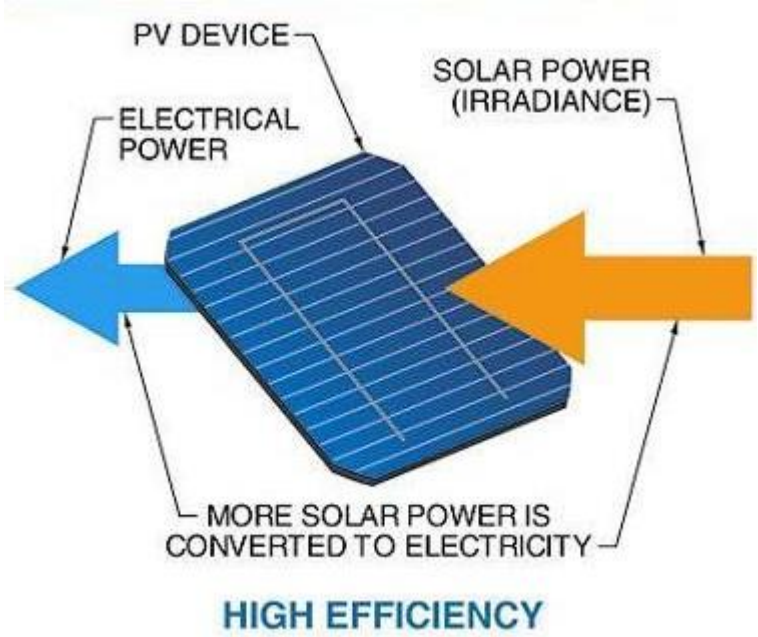

- Efficiency is a measure of how effectively a PV device converts solar power to electrical power.

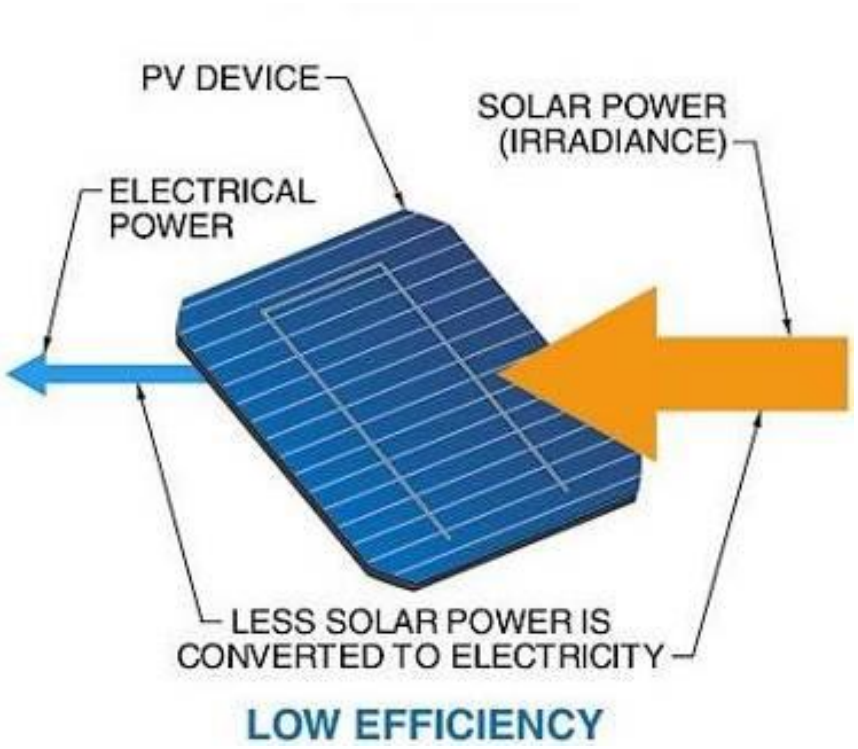

Image from Photovoltaic Systems 2nd Edition, by James Dunlop

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PV Module Basics

PV Material Efficiencies*

MATERIAL	TYPICAL EFFICIENCIES	BEST LABORATORY EFFICIENCY
Gallium arsenide (GaAs)	20	32
Monocrystalline silicon	~~14 to 17~~ 15 to 21	25
Polycrystalline silicon	~~11.5 to 14~~ 13 to 16	20
Ribbon silicon	11 to 13	16.5
Copper indium gallium selenide (CIGS)	9 to 11.5	19
Cadmium telluride (CdTe)	8 to 10	16.5
Amorphous silicon (a-Si)	5 to 9.5	13
Graetzel	4 to 5	11
Polymer	1 to 2.5	5

* in %

- Various PV materials and technologies produce different efficiencies.

Image from Photovoltaic Systems 2nd Edition, by James Dunlop

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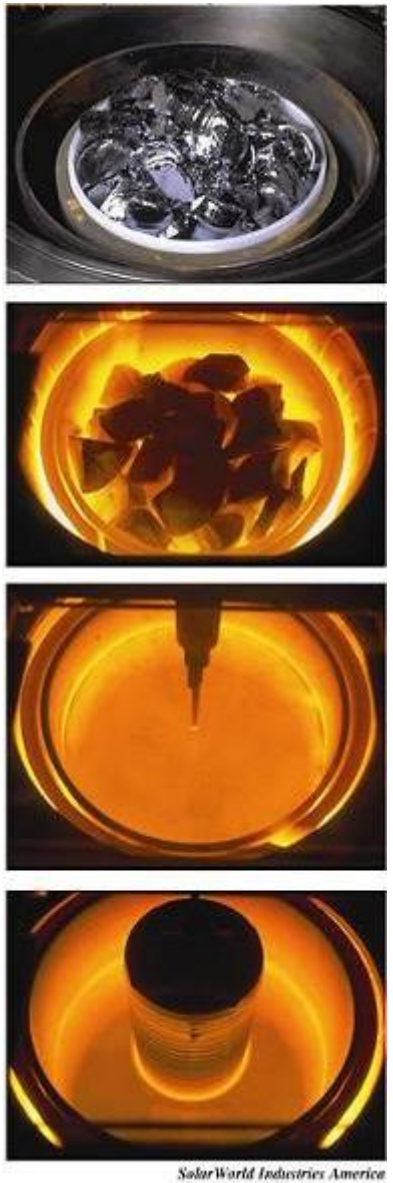

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- Monocrystalline silicon wafers are sawn from grown cylindrical ingots.
- Polycrystalline silicon wafers are sawn from cast rectangular ingots.

DOE/NREL, John Wohlgemuth—Solarex

Image from Photovoltaic Systems 2nd Edition, by James Dunlop

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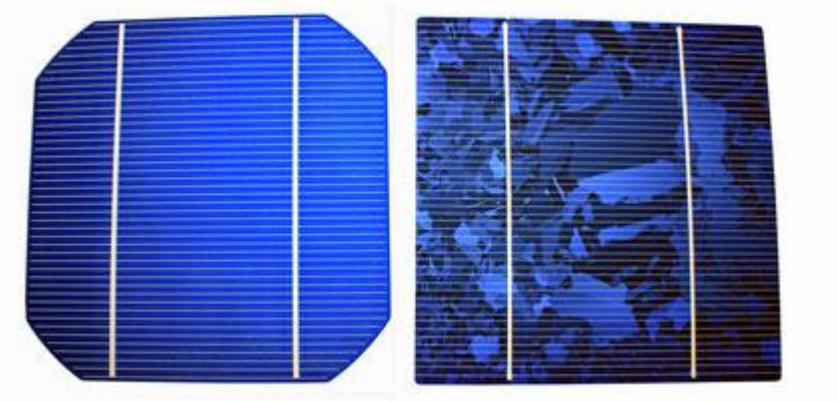

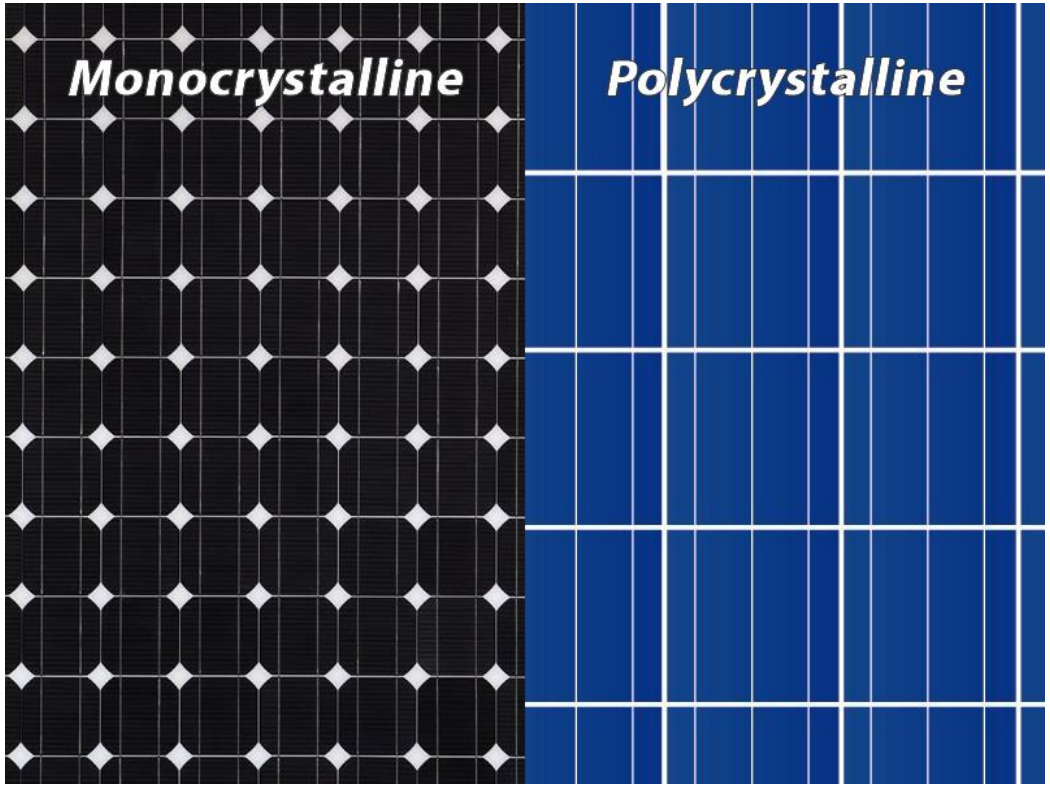

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PV Module Basics

Monocrystalline

Advantages

- Highest efficiency rating
- Space-saving
- Lifespan
- Low light conditions performance

Disadvantages

- Cost
- Silicon waste in manufacturing

Polycrystalline

Advantages

- Simpler and cheaper manufacturing process

Disadvantages

- Lower efficiency
- Less aesthetic

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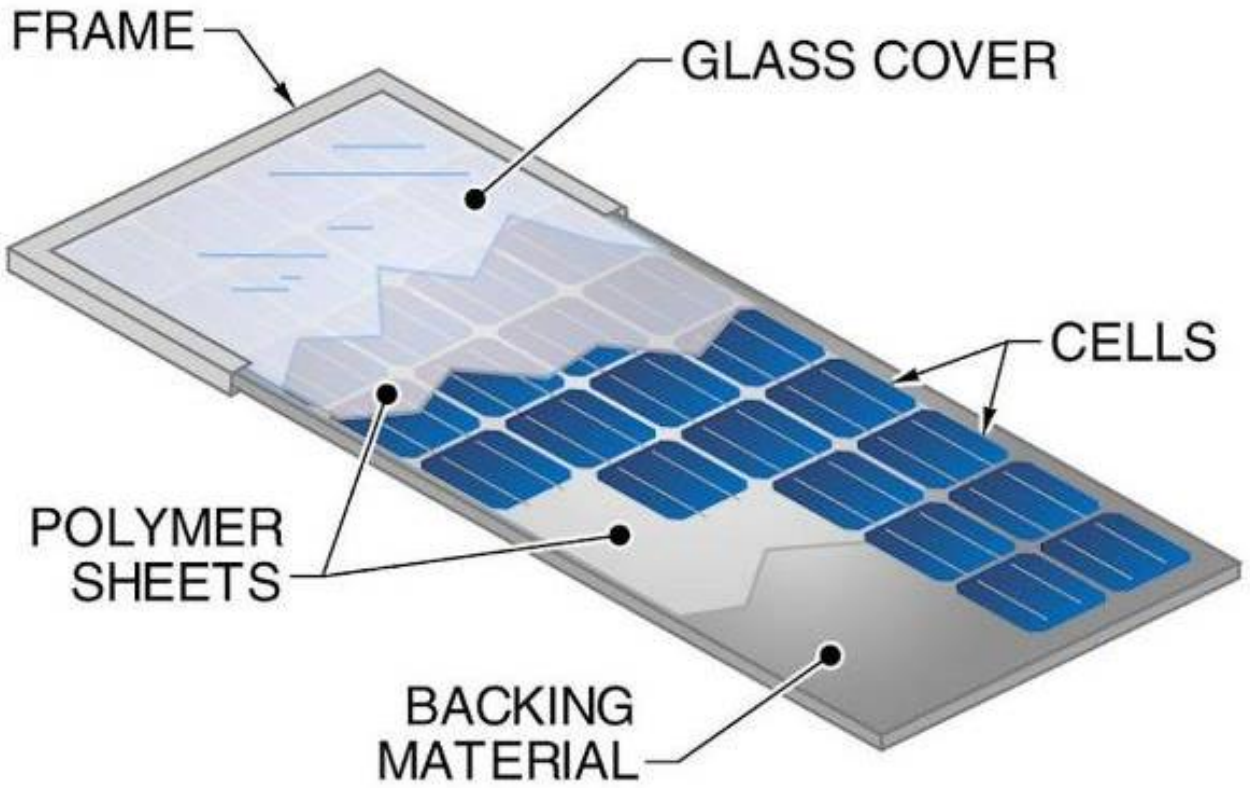

- Modules are constructed from PV cells surrounded by several layers of protective materials.

Image from Photovoltaic Systems 2nd Edition, by James Dunlop

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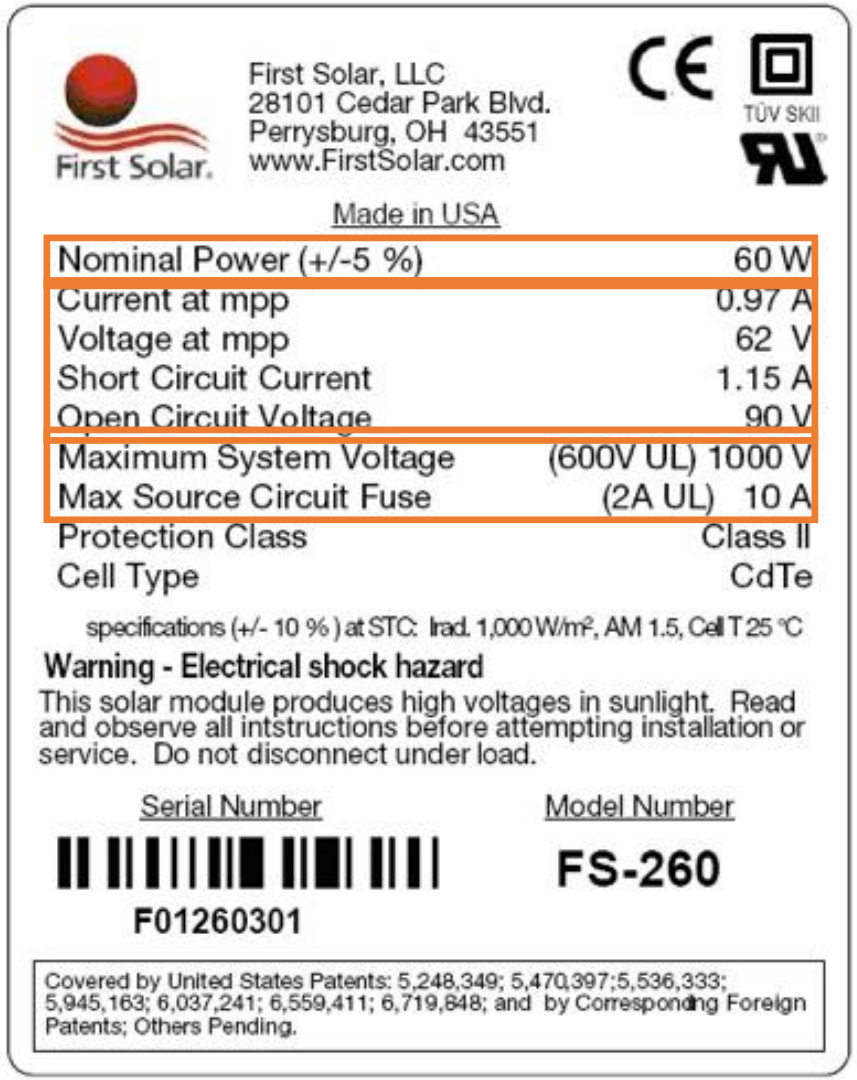

First Solar, LLC
28101 Cedar Park Blvd.
Perrysburg, OH 43551
www.FirstSolar.com

Made in USA

Nominal Power (+/-5 %)	60 W
Current at mpp	0.97 A
Voltage at mpp	62 V
Short Circuit Current	1.15 A
Open Circuit Voltage	90 V
Maximum System Voltage	(600V UL) 1000 V
Max Source Circuit Fuse	(2A UL) 10 A
Protection Class	Class II
Cell Type	CdTe

specifications (+/- 10 %) at STC: Irad. 1,000 W/m², AM 1.5, Cell T 25 °C

Warning - Electrical shock hazard

This solar module produces high voltages in sunlight. Read and observe all intstructions before attempting installation or service. Do not disconnect under load.

Serial Number: F01260301

Model Number: FS-260

Covered by United States Patents: 5,248,349; 5,470,397;5,536,333; 5,945,163; 6,037,241; 6,559,411; 6,719,848; and by Corresponding Foreign Patents; Others Pending.

- Module nameplates must include performance ratings for the module and may include other information used to design a PV system.

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Thank You

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