SIERRA COLLEGE

Beginning Photovoltaic Systems

ESS 30

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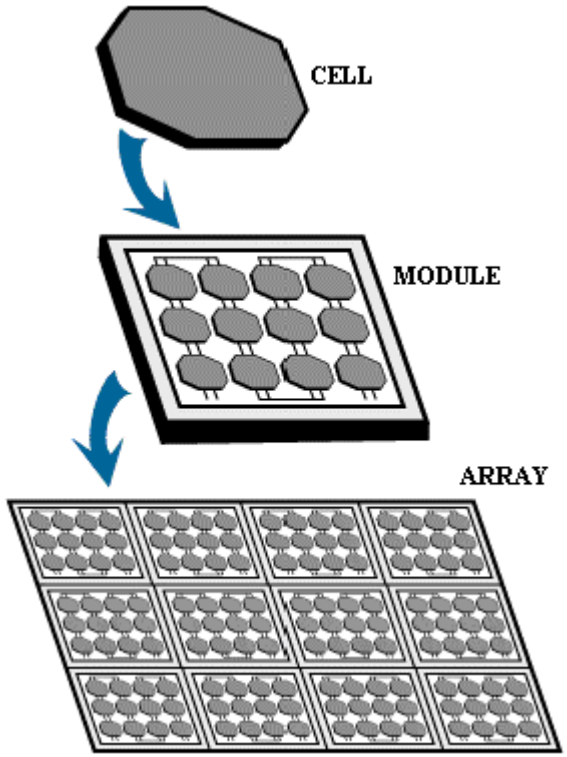
Photovoltaic Modules

Topics

- Module Basics
- The Photovoltaic Reaction
- Measuring Module Performance
- Factors that Affect Module Performance

Photovoltaic Array Structure



Module Brands

…And 70+ Others

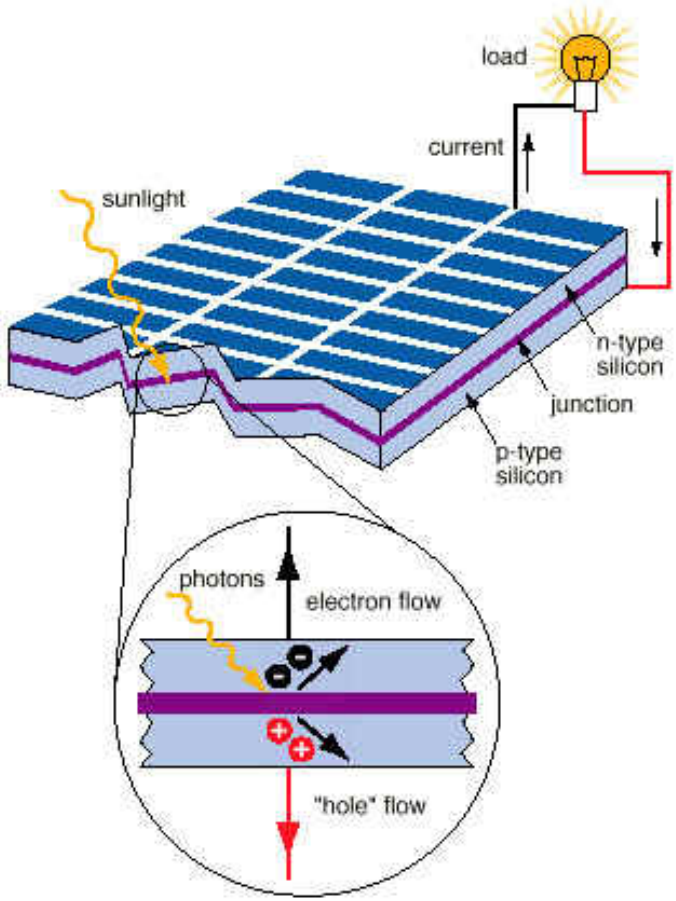
Module Types

- Mono Crystalline Silicon (most efficient)
- Poly Crystalline Silicon
- Amorphous Thin Film (least efficient – half)

Pg.51 – Photovoltaics Design and Installation Manual

The Photovoltaic Reaction

1. Sunlight will ionize the atoms (electrons) in the silicon.



2. Two layers of silicon produce a positive and negative energy flow, separated by the junction material.

p-type doped with Boron (+ side)

n-type doped with Phosphorus (- side)

3. Current flows between the positive and negative side of the cell to create electricity.

The Photovoltaic Reaction cont.

- Discovered in 1873 by British scientist Willoughby Smith (Selenium sensitive to light).
- In 1880 Charles Fritts developed the first Selenium-based solar cell.
- 1950s Bell Labs discovered that Silicon was able to create a photovoltaic reaction.

- Other materials used: Copper Indium Selenium (CIS) and Cadmium Telluride.

Measuring Module Performance

STC (Standard Test Conditions) – Common Rating

- 1000 Watts per square meter irradiance at 25°C (77°F) cell temp

PTC (Practical Test Conditions)

- 1000 Watts per square meter irradiance at 20°C (68°F) ambient temp

Measuring Module Performance cont.

- Maximum Power Point: Vmp & Imp (max output - STC)
- Open Circuit Voltage: Voc (no current drawn)
- Short Circuit Current: Isc (no resistance)

V = Volts
I = Amps
V x A = Watts

- (See Sanyo Brand PDF – I-V Curve)
- Panel Testing

Module Label / Junction Box

Factors that Affect Module Performance

- Cell Material
- Load Resistance
- Sunlight Intensity
- Cell Temperature (mounting)
- Shading (bypass diode)

Thank You