

3.7 Photovoltaic cell concepts:

3.7.1 SOLAR CELL, MODULE, PANEL AND ARRAY:

Solar Cell

The solar cell consists of

- (i) p-type silicon material layer,
- (ii) n-type silicon material layer,
- (iii) front metallic grid and
- (iv) opaque back metal contact as shown in Figure 3.24

The bulk material consists of p-type silicon having thickness about 100 – 350 μ m. A thin layer of n-type silicon having thickness of about 2 μ m is diffused on this bulk material, providing p-n junction. A metallic grid at top with n-type material and an opaque back metal contact at the bottom of p-type material are provided which also act as negative and positive terminals

Solar PV Module

A Single solar cell cannot be used as such as it has

- (1) A very small output
- (2) No protection against dust moisture , mechanical impacts and atmospheric harsh condition

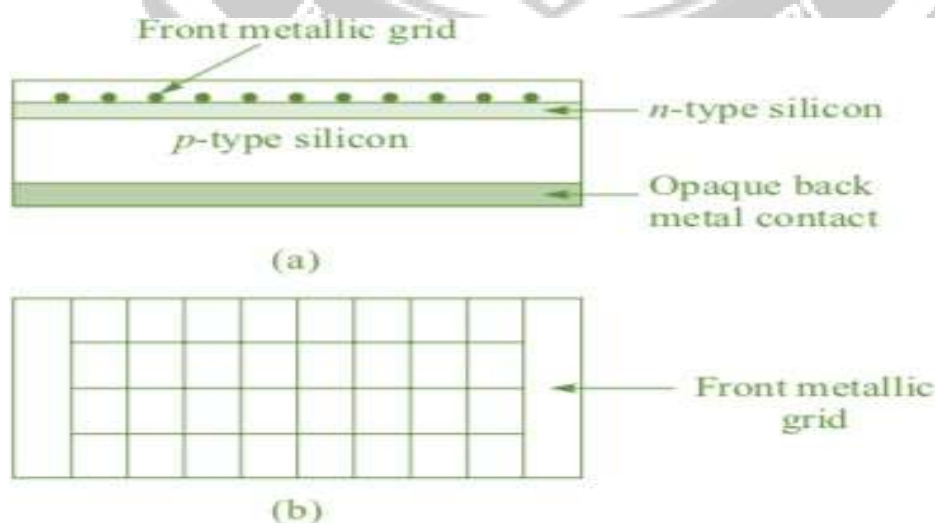


Figure 3.7.1 Construction of a solar cell. (a) Side view of the solar cell. (b) Topview of the solar cell.

[Source: “Solar Photovoltaics: Fundamentals, Technologies and Applications” by Chetan Singh Solanki, Page: 266]

Solar PV Module

Suitable voltage and adequate power can be obtained by suitably interconnecting a number of solar cells. This assembly of solar cell is called solar module. Solar cells are provided with transparent cover and these are hermetically sealed for assembly into solar module.

It is necessary that all solar cells should match as closely as possible with each other so that peak power of the module is the algebraic sum of the peak power of individual solar cells. A typical module is shown in Figure 3.25.

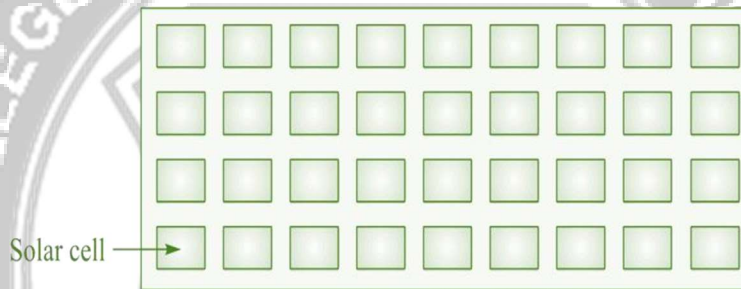


Figure 3.7.2 Solar PV modules with 36 solar cells.

[Source: "Solar Photovoltaics: Fundamentals, Technologies and Applications" by ChetanSingh Solanki, Page: 267]

The construction of a solar PV panel

Solar PV panel consists of a number of solar PV modules connected in series and parallel to obtain the power of desired voltage and current. When modules are connected in series, it is desirable that each module should produce maximum power at the same current. When solar PV modules are connected in parallel, it is desirable that each module should produce maximum power at the same voltage. A frame is used to mount several modules to form a solar PV panel as shown in Figure 3.26.

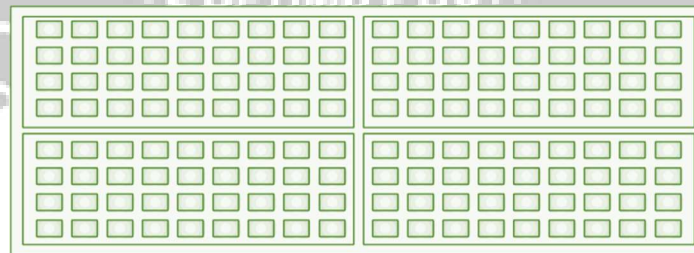


Figure 3.7.3 A solar PV panel of four modules.

[Source: "Solar Photovoltaics: Fundamentals, Technologies and Applications" by ChetanSingh Solanki, Page: 267]

In the panel, bypass diodes are installed across each module so that any defective module can be bypassed by the output of remaining modules.

The blocking diodes are connected in series with each series string of modules which enable the output of the remaining series strings should not be absorbed by the failed string. A typical panel with the series and the parallel connections is shown in Figure 3.27.

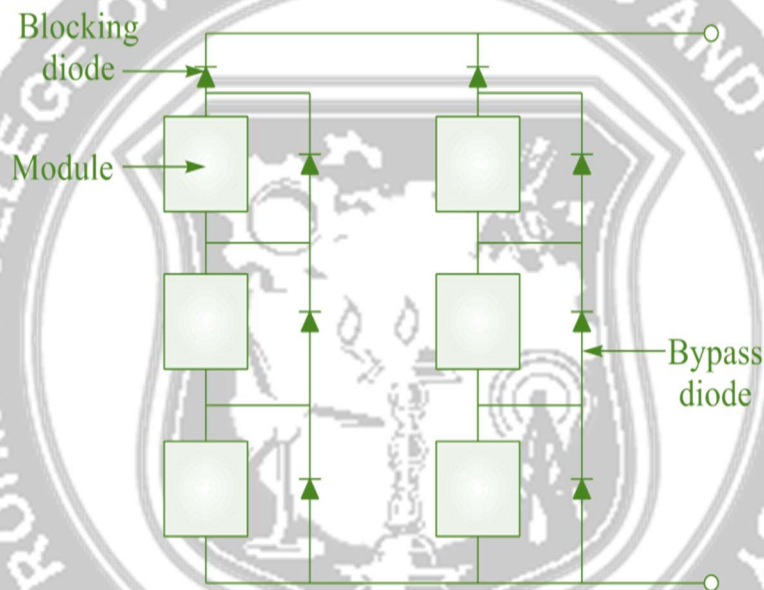


Figure 3.7.4 A typical panel with the series and the parallel connection.

[Source: "Solar Photovoltaics: Fundamentals, Technologies and Applications" by ChetanSingh Solanki, Page: 268]

Solar PV Array

A PV array consists of a number of solar panels which are installed in an array field. The solar panels may be installed as stationary facing the sun or installed with some tracking mechanism. The installation should ensure that no panel should cast shadow on any of the neighboring panels and those panels can be easily maintained.

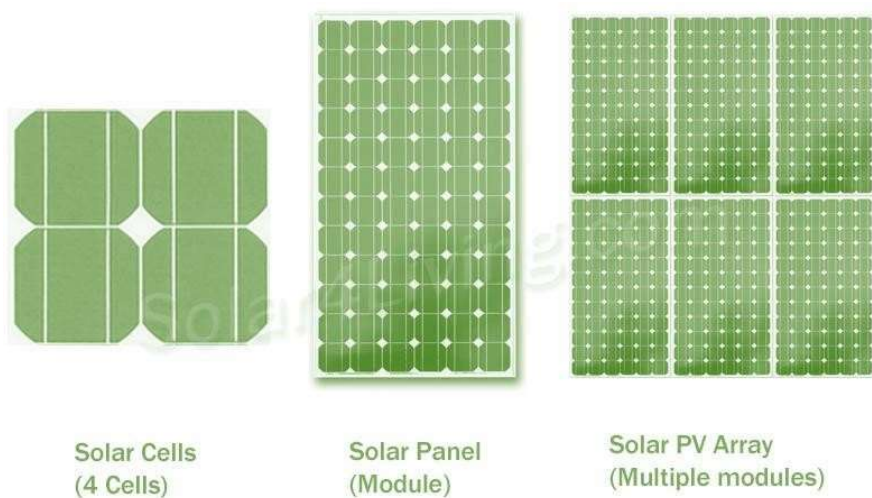


Figure 3.7.5

[Source: “Solar Photovoltaics: Fundamentals, Technologies and Applications” by ChetanSingh Solanki, Page: 269]



